4.8 Soil Conditions

4.8.1 Soil Strata in Chan May Area

Soil boring investigations conducted by TEDI or other organizations in Chan May Area revealed the following major facts. The top soil near the shore line consists of fine sand, the layer of which is rather thin. Toward offshore area, a soft clayey sand layer prevails as the top layer instead of the fine sand. Under the fine sand or soft clayey sand layer, there exists thick clay or clayey sand layers which are stiffer than the top soil. Reliable fine sand as the bearing stratum can be found at -20~35m level. The top level of the bearing stratum seems to appear more deeper towards offshore direction.

Figure 4.8.1 shows the locations of boring holes and Figure 4.8.2 shows estimated typical soil profile.

4.8.2 Classification of Soils at Chan May Area

In classifying soils, coarse grained soils can be classified by grain size and fine grained soils as well as by consistency. By the Japanese Unified Soil Classification Standard ,the soil with a grain size of more than 74 μ to 2.0mm is defined as sand and under 74 μ to 5 μ as silt, then under 5 μ as clay.

Table 4.8.1 shows a typical composition ratio of soft soils classified by grain size at Chan May planning areas.

Table4.8.1 Composition Ratio of Soft Soil Classified by Grain Size

	Gravel %	Sand %	Silt %	Clay %	Total %
Chan-No.2Layer	0.00	36.04	40.48	23.48	100
Chan-No.3Layer	0.43	20.48	40.89	38.20	100
Chan-No.6Layer	0.00	23.80	40.77	35.43	100

Source: JICA Team' calculation based on the data from TEDI

According to this figure soft layers are composed of 70～80% silt and clay under 50 μ particle size(above and under 74 μ particle size % is not measured, so instead of 74 μ ,50 μ is adopted as a classifying boundary of sand and silt). These soils' natural moisture content is 35～50%,which means low plastic soil.

The consistency is a qualitative description of engineering potential of a cohesive soil, and closely related to its mechanical properties. The consistency is expressed by the liquid limit and plastic limit. Figure 4.8.3 shows the relationship between the liquid limit and plasticity index obtained by soil test using boring samples of the planning site in Chan May.

According to this figure, we can understand that the soils are mostly classified into cohesive soils such as sandy clay, silt and clay, which have low plastic property.(cf. Figure 4.8.4 :dots are in the CL area) This means ,if the layers consist of these soils are loaded by the weight of structures, the subsidence of under-foundation will not occur so much quantitatively. However careful examination based on such soil tests as consolidation or stress and strain etc. should be needed for accurate conclusion.

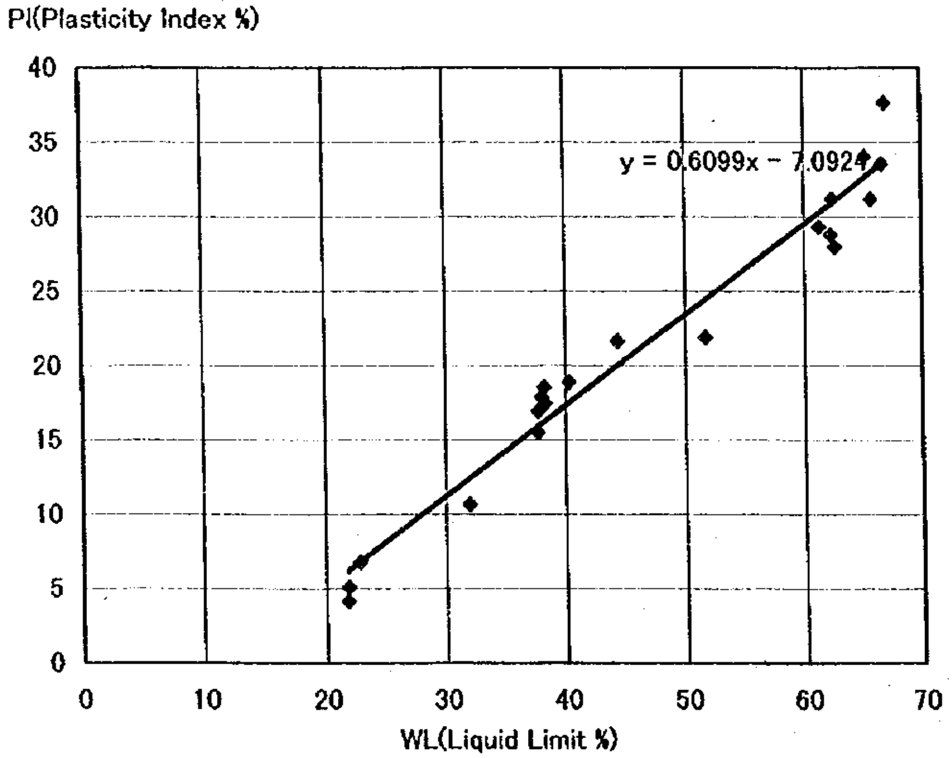


Figure 4.8.3 Relation between Plasticity Index and Liquid Limit in Chan May

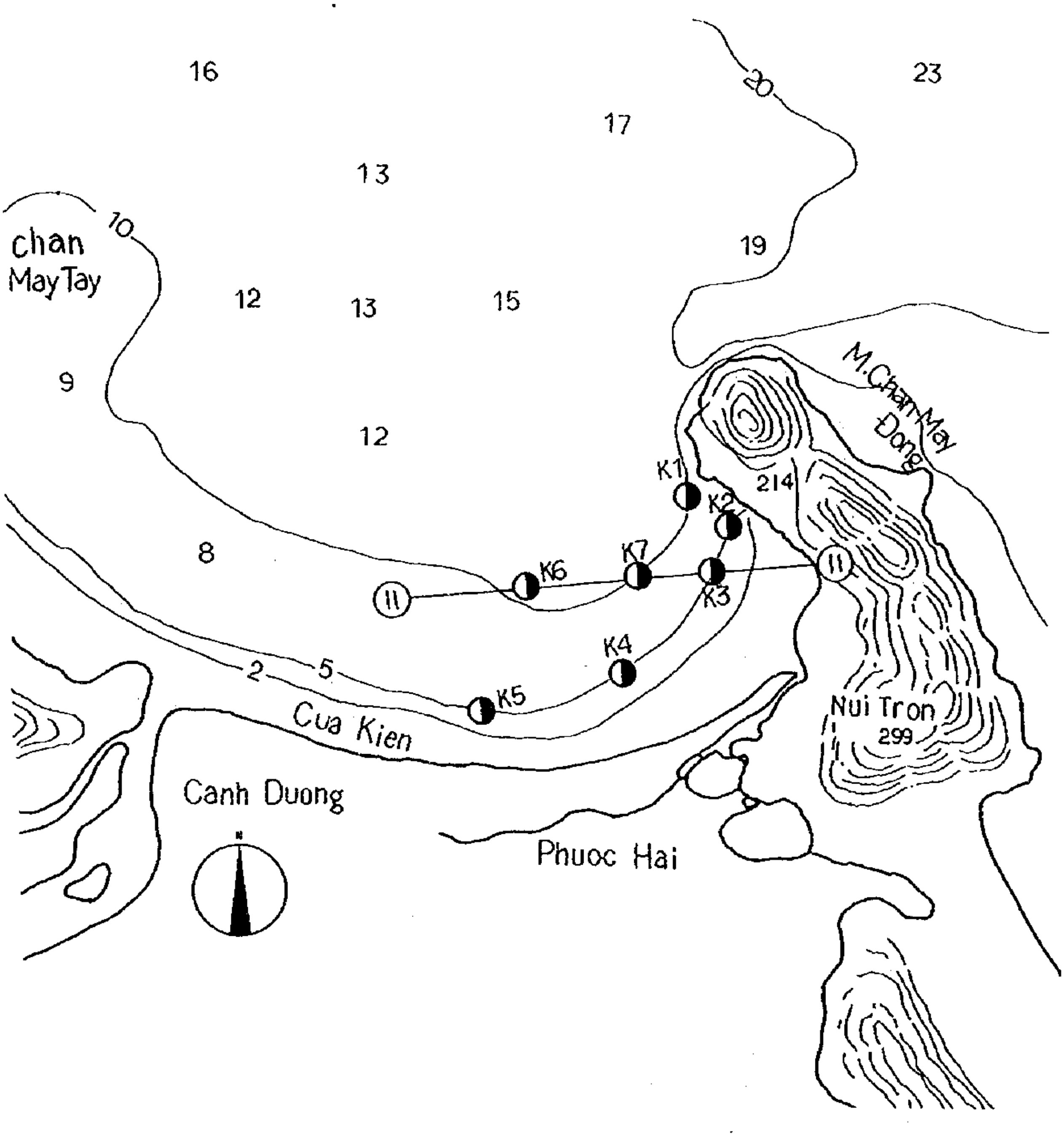


Figure 4.8.1 Location Map of Bore Hole at Chan May

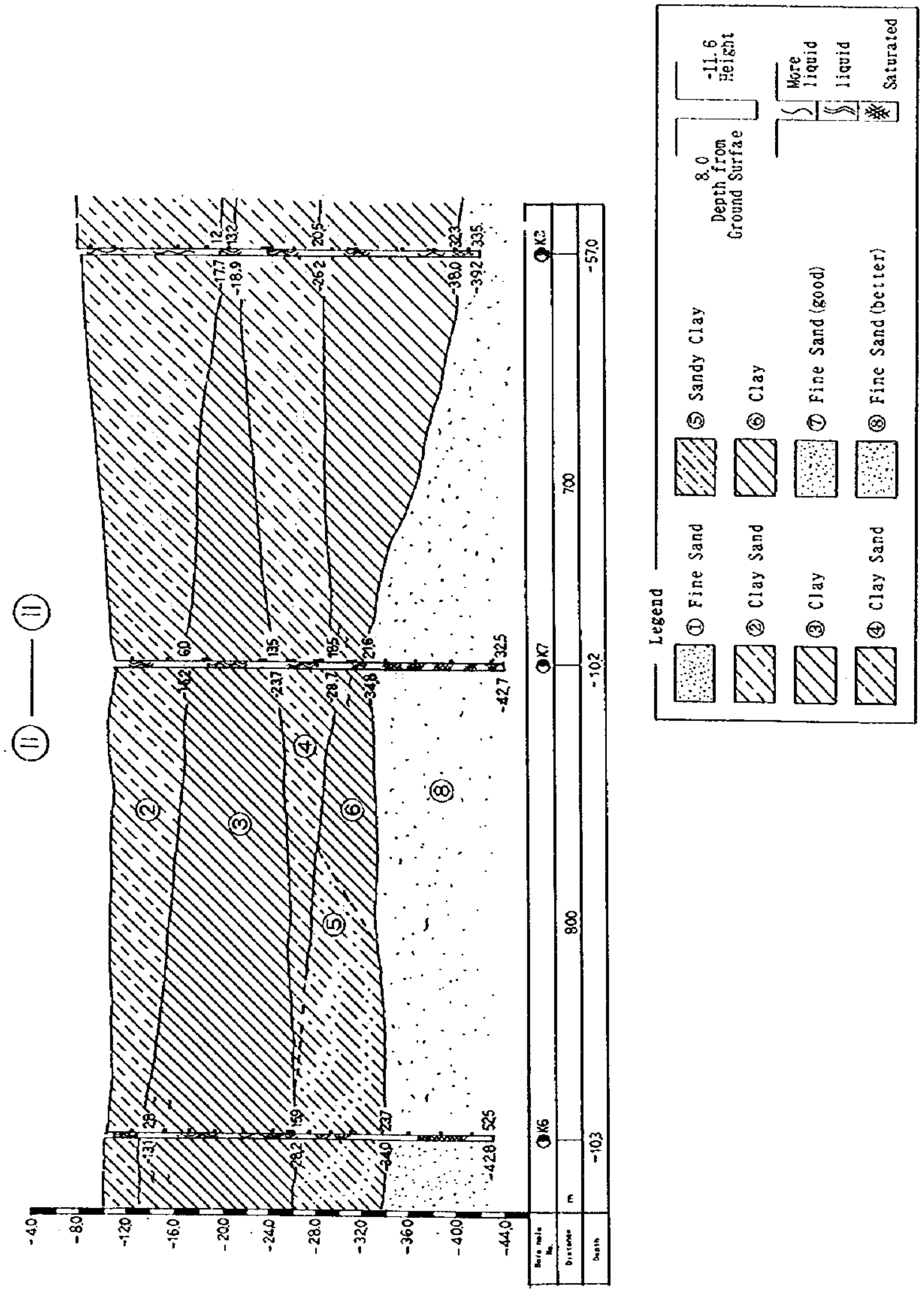


Figure 4.8.2 Typical Soil Profile of Chan May

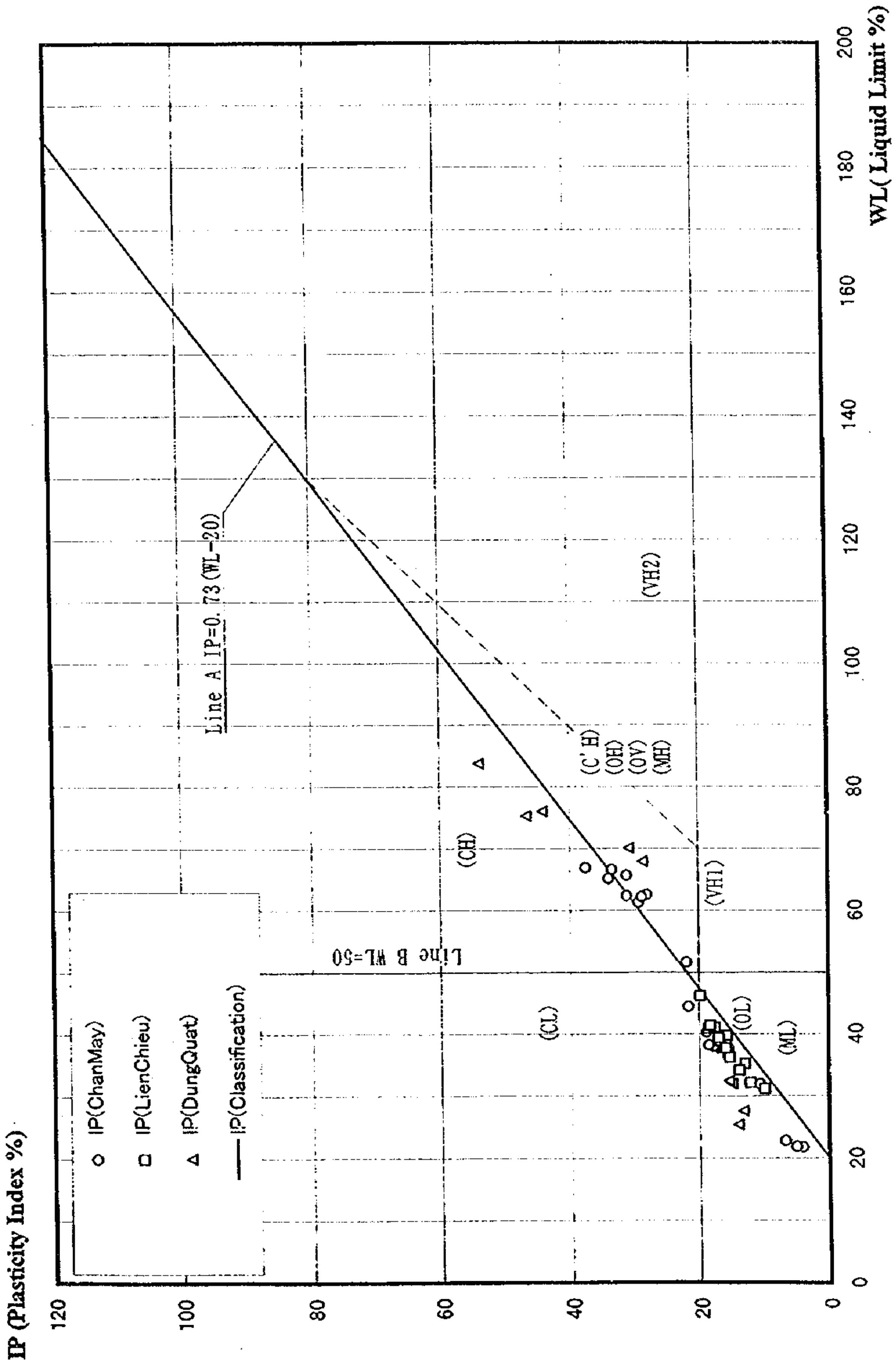


Figure 4.8.4 Plasticity Classification Chart by Japanese Standard

4.8.3 Result of Soil Investigation

(1) Soil Boring

To make supplement and confirm the existing soil data for planning and designing port facilities, soil investigations in Chan May have been carried out from the end of August to the early November. The numbers of boring are four of which locations with before-executed bore holes are shown in Figure 4.8.5.

The drilling work was carried out by XY-1B rotary boring machine made in PRC(Peoples Republic of China) which was set on the pontoon fabricated by two wooden boats with each loading capacity of 40 ton.

Figure 4.8.6(1)~4.8.6(4) show soil profiles and the results of standard penetration test (SPT) of each bore holes. The elevations of bores in Chan May are from –0.1m to –12.3m and bearing layers appear -20m~-28m.

The upper layers of each bore are mostly cohesive soils, however we could conduct SPT through all bore length. N-value of upper cohesive soil is mostly under 5.

(2) Result of Soil Test

To evaluate soil characteristics 54 soil samples of four sites in number were taken and various soil test were executed. Results of these soil tests are tabulated in Table A4.8.2. These results shall be analyzed for useful data.

Particle size analysis shows that soils classified as clay contain 15 to 40 % of clay and 40 to 60% of silt, and 10 to 20% of sand(c.f. Figure4.8.7)

Using one of these testing results, unconfined compression tests, strength of soft layers can be estimated. Figure 4.8.8 shows the relation between cohesion of a soft soil layer and its elevation. In these figures values of cohesion obtained by triaxial compression test before executed by TEDI are also doted as a reference.

The values of cohesion in Chan May are distributed between 0.1~0.3 kgf/cm^2.The values of lower layer showing over 0.85 kgf/cm^2 in 2 points and over 0.95 kgf/cm^2 in 1 point are those of just under silty sand layers which have 10m thick with 6~21 N-value and 6.6m thick with 6~20 N-value respectively.(cf. Figure 4.8.6(2), Figure 4.8.6(4))

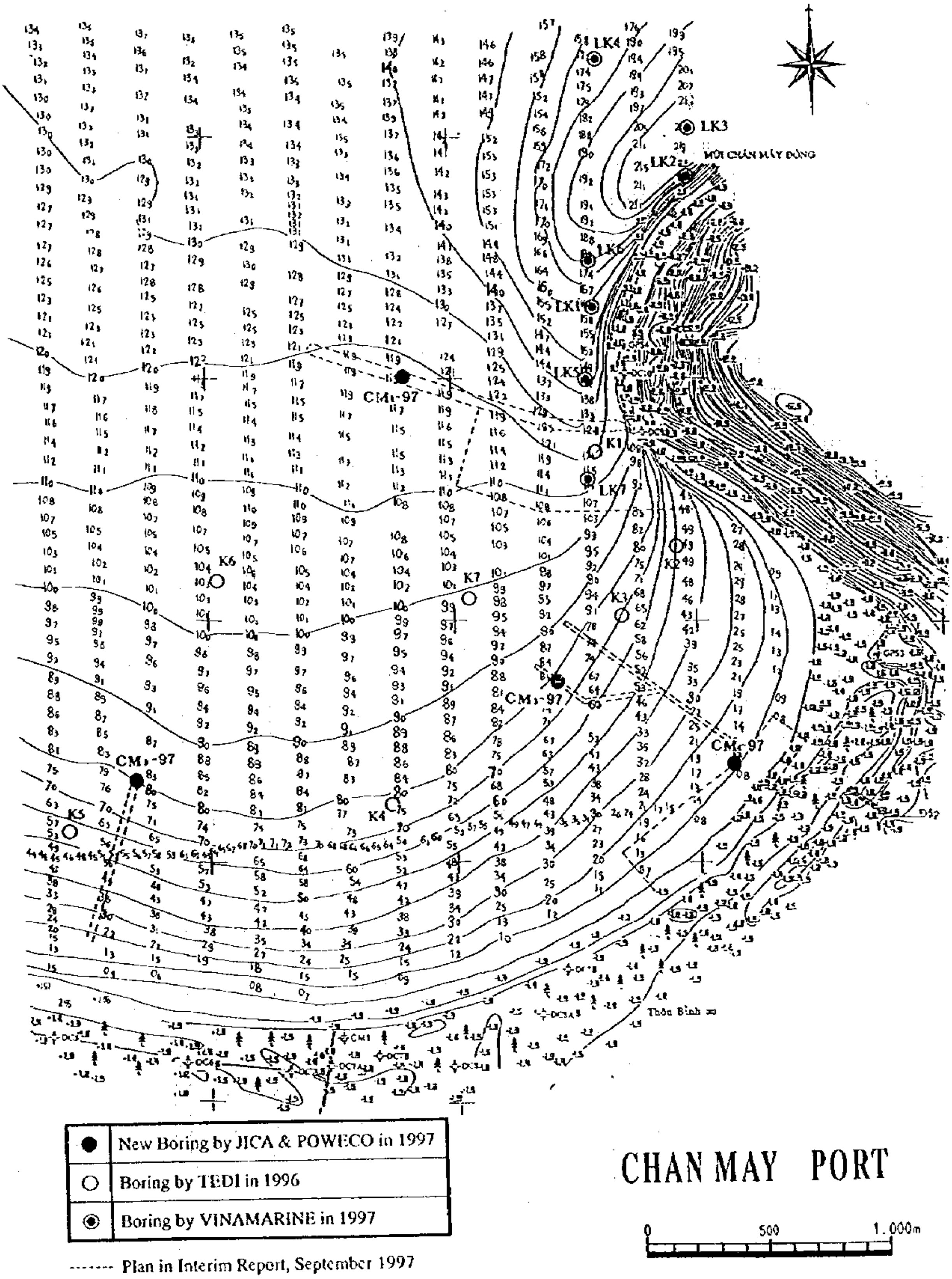


Figure 4.8.5 Location of Boring in Chan May

BOREHOLE No: CM$_{1-97}$

Depth (m): 20.90

Coordinate (m): N = 1807110

E = 500830

Elevation (m): -12.30

Location: Loc Vinh - Phu Loc - Thua Thien Hue

Date commenced: 09-09-1997

Date completed: 10-09-1997

Layer	Elevation (m)	Depth (m)	Thickness (m)	Symbol	SOIL AND ROCK DESCRIPTION	SPT Test Depth (m)	Blows/15cm N_0	Blows/10cm N_1	N_2	N_3	N	Sample No Depth of sample (m)
1			4.60	⁘	Silty sand with shells, loose, grey.	1.50	1	1	2	2	4	1 1.50-1.95
	-16.90	4.60				3.20	1	1	2	2	5	2 3.20-3.65
2			7.80	▨	Sandy Clay, brownish grey, very soft to soft.	4.60	0	1	1	1	3	
						6.10	0	1	1	1	3	3 5.50-6.10
						8.00	0	0	1	1	2	4 7.40-8.00
						9.30	1	1	1	1	3	
						10.50	0	1	1	1	3	5 9.90-10.50
	-24.70	12.40				12.00	1	1	1	2	4	6 11.40-12.00
3b			7.43	⁘	Well graded sand with clay, rounded gravel and shells, grey, medium to very dense.	13.10	7	6	7	9	22	7 13.10-13.55
						14.70	9	9	10	12	31	8 14.70-15.15
						16.20	8	10	13	13	36	9 16.20-16.65
						17.80	14	13	14	15	42	10 17.80-18.25
	-33.20	20.90				19.20	17	15	17	19	51	11 19.20-19.65

SPT chart

Sand(fine to medium)	⁘	Disturbed Sample	•
Sandy Clay	▨	Undisturbed Sample	▮
Clay	▨		
Mud	～		
Shell	○		

Figure 4.8.6(1) Soil Profile and Standard Penetration Test CM$_1$-97

BOREHOLE No: CM$_{2-97}$

Depth (m): 31.80

Coordinote (m): N = 1805650

E = 501495

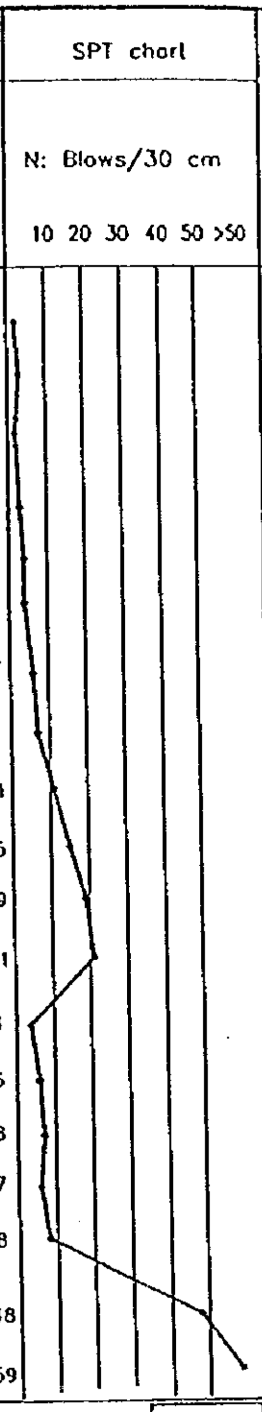
Elevotion (m): -7.00

Locotion: Loc Vinh - Phu Loc - Thuo Thien Hue

Dote commenced: 12-09-1997

Dote completed: 13-09-1997

Loyer	Elevotion (m)	Depth (m)	Thickness (m)	Symbol	SOIL AND ROCK DESCRIPTION	SPT Test Depth (m)	Blows/15cm N_0	Blows/10cm N_1	N_2	N_3	N	Somple No Depth of somple (m)
1	-9.90	2.90	2.90	~	Sondy silty mud, brownish grey	1.50	1	0	1	1	2	1 1.50-1.95
						2.90	1	1	1	1	3	
2	-17.40	10.40	7.50	▨	Leon cloy, soft, brownish grey.	4.50	1	0	1	1	2	2 3.90-4.50
						6.50	0	1	1	1	3	3 5.90-6.50
						7.90	1	1	1	2	4	
						9.10	1	1	2	1	4	4 8.50-9.10
												5 9.80-10.40
3o	-27.50	20.50	10.10	⁘	Silty sond, loose to medium dense, grey.	11.00	2	1	2	3	6	6 11.00-11.45
						12.60	1	1	2	4	7	7 12.60-13.05
						14.10	4	3	3	5	11	8 14.10-14.55
						15.70	3	3	5	7	15	9 15.70-16.15
						17.10	4	3	7	9	19	9 17.10-17.55
						18.70	7	6	6	9	21	11 18.70-19.15
4o	-35.40	28.40	7.90	▨	Leon cloy,medium stiff brownish grey.	20.50	0	1	1	2	4	
						22.00	3	2	2	2	6	12 21.40-22.00
						23.50	2	2	3	3	8	
						24.90	2	2	2	3	7	13 24.30-24.90
						26.30	3	2	3	3	8	14 25.70-26.30
4b	-38.80	31.80	3.40	▨	Leon cloy, motley (reddish brown, light grey), very stiff to hord.	28.40	14	12	15	21	48	
						29.90	18	15	19	25	59	15 29.30-29.90
												16 31.20-31.80



				Shell	⁘
Sand(fine to medium)	⁘	Disturbed Sample	•	Clay	▨
Sandy Clay	▨	Undisturbed Sample	▮	Mud	~

Figure 4.8.6(2) Soil Profile and Standard Penetration Test CM$_2$-97

BOREHOLE No: CM_{3-97}

Depth (m): 17.40

Coordinate (m): N = 1805590

E = 499540

Elevation (m): -9.00

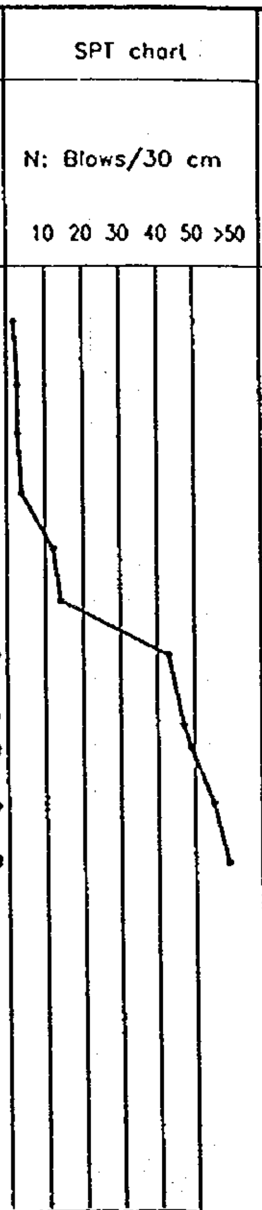
Location: Loc Vinh - Phu Loc - Thua Thien Hue

Date commenced: 11-09-1997

Date completed: 11-09-1997

Layer	Elevation (m)	Depth (m)	Thickness (m)	Symbol	SOIL AND ROCK DESCRIPTION
1	-13.20	4.20	4.20	⁘	Silty sand with shells, grey, very loose.
2	-15.70	6.70	2.50	▨	Sandy Clayey mud with shells, dark grey.
3a	-20.20	11.20	4.50	⁘	Silty sand with shells, grey, medium dense.
3b	-26.40	17.40	6.20	⁘	Well graded sand with clay mixed shells, yellowish grey, dense to very dense.

SPT Test						Sample No.
Depth (m)	Blows/15cm	Blows/10cm			N	Depth of sample (m)
	N_0	N_1	N_2	N_3		
1.50	0	0	1	1	2	1 1.50-1.95
3.20	1	1	1	1	3	2 3.20-3.65
4.50	1	1	1	1	3	3 4.50-4.95
6.10	1	1	1	2	4	4 6.10-6.55
7.60	4	3	4	5	12	5 7.60-8.05
9.00	5	4	4	6	14	6 9.00-9.45
10.50	15	12	15	16	43	7 10.50-10.95
12.40	17	13	16	18	47	8 12.40-12.85
13.00	19	14	16	19	49	9 13.00-13.45
14.50	23	16	17	22	55	10 14.50-14.95
16.10	24	17	18	24	59	11 16.10-16.55



Sand(fine to medium)	⁘	Disturbed Sample	•
Sandy Clay	▨	Undisturbed Sample	▮
Clay	▨		
Mud	～		
Shell	°		

Figure 4.8.6(3) Soil Profile and Standard Penetration Test CM_3-97

BOREHOLE No: CM_{4-97}

Depth (m): 30.45

Coordinate (m): N = 1805235

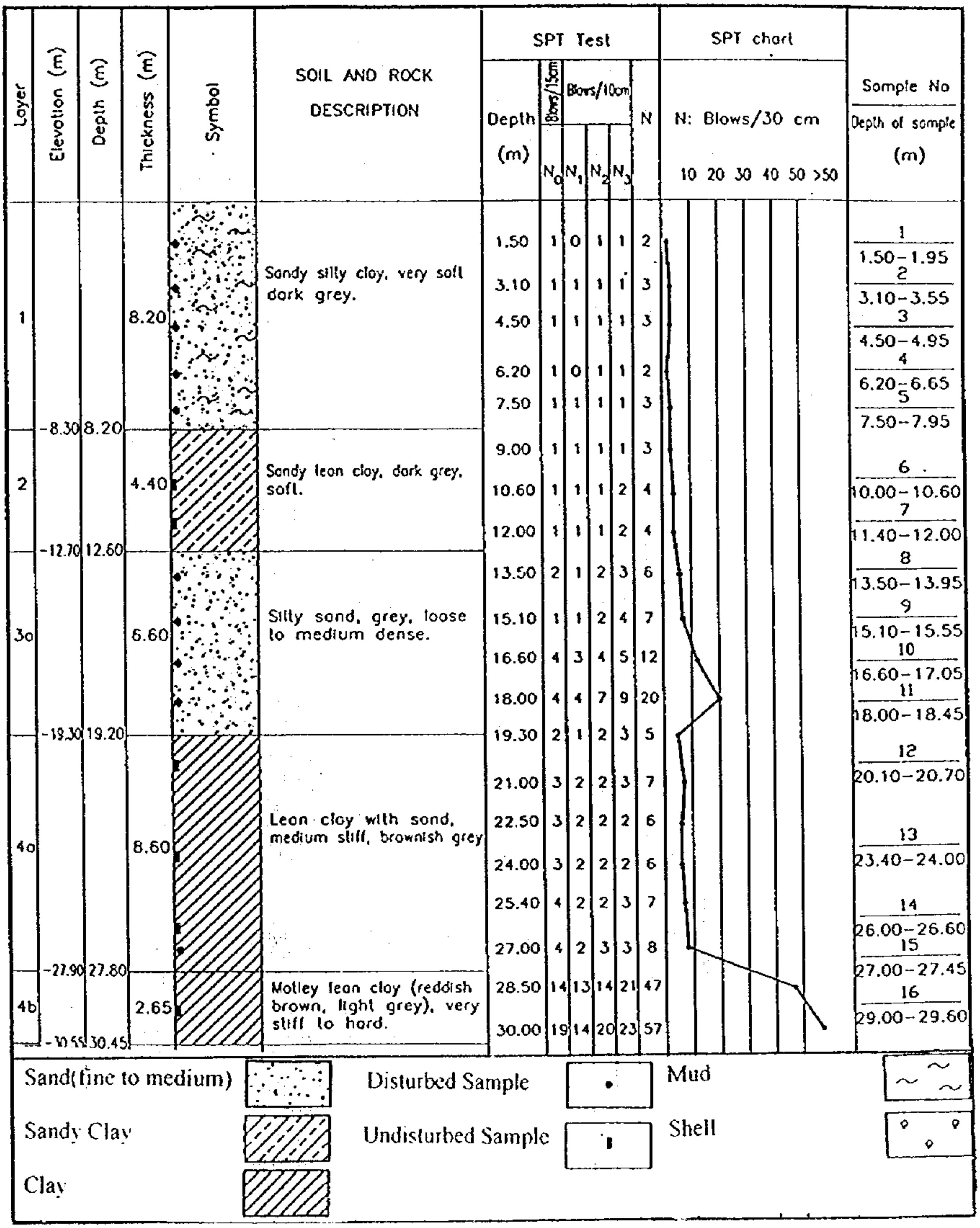
E = 502130

Elevation (m): -0.10

Location: Loc Vinh - Phu Loc - Thua Thien Hue

Date commenced: 14-09-1997

Date completed: 16-09-1997



Layer	Elevation (m)	Depth (m)	Thickness (m)	Symbol	SOIL AND ROCK DESCRIPTION
1	-8.30	8.20	8.20	Sand(fine to medium), Mud	Sandy silty clay, very soft dark grey.
2	-12.70	12.60	4.40	Sandy Clay	Sandy lean clay, dark grey, soft.
3a	-19.30	19.20	6.60	Sand(fine to medium)	Silty sand, grey, loose to medium dense.
4a	-27.90	27.80	8.60	Clay	Lean clay with sand, medium stiff, brownish grey
4b	-30.55	30.45	2.65	Clay	Motley lean clay (reddish brown, light grey), very stiff to hard.

SPT Test Depth (m)	N_0 (Blows/15cm)	N_1 (Blows/10cm)	N_2 (Blows/10cm)	N_3 (Blows/10cm)	N
1.50	1	0	1	1	2
3.10	1	1	1	1	3
4.50	1	1	1	1	3
6.20	1	0	1	1	2
7.50	1	1	1	1	3
9.00	1	1	1	1	3
10.60	1	1	1	2	4
12.00	1	1	1	2	4
13.50	2	1	2	3	6
15.10	1	1	2	4	7
16.60	4	3	4	5	12
18.00	4	4	7	9	20
19.30	2	1	2	3	5
21.00	3	2	2	3	7
22.50	3	2	2	2	6
24.00	3	2	2	2	6
25.40	4	2	2	3	7
27.00	4	2	3	3	8
28.50	14	13	14	21	47
30.00	19	14	20	23	57

Sample No	Depth of sample (m)
1	1.50-1.95
2	3.10-3.55
3	4.50-4.95
4	6.20-6.65
5	7.50-7.95
6	10.00-10.60
7	11.40-12.00
8	13.50-13.95
9	15.10-15.55
10	16.60-17.05
11	18.00-18.45
12	20.10-20.70
13	23.40-24.00
14	26.00-26.60
15	27.00-27.45
16	29.00-29.60

Figure 4.8.6(4) Soil Profile and Standard Penetration Test CM_4-97

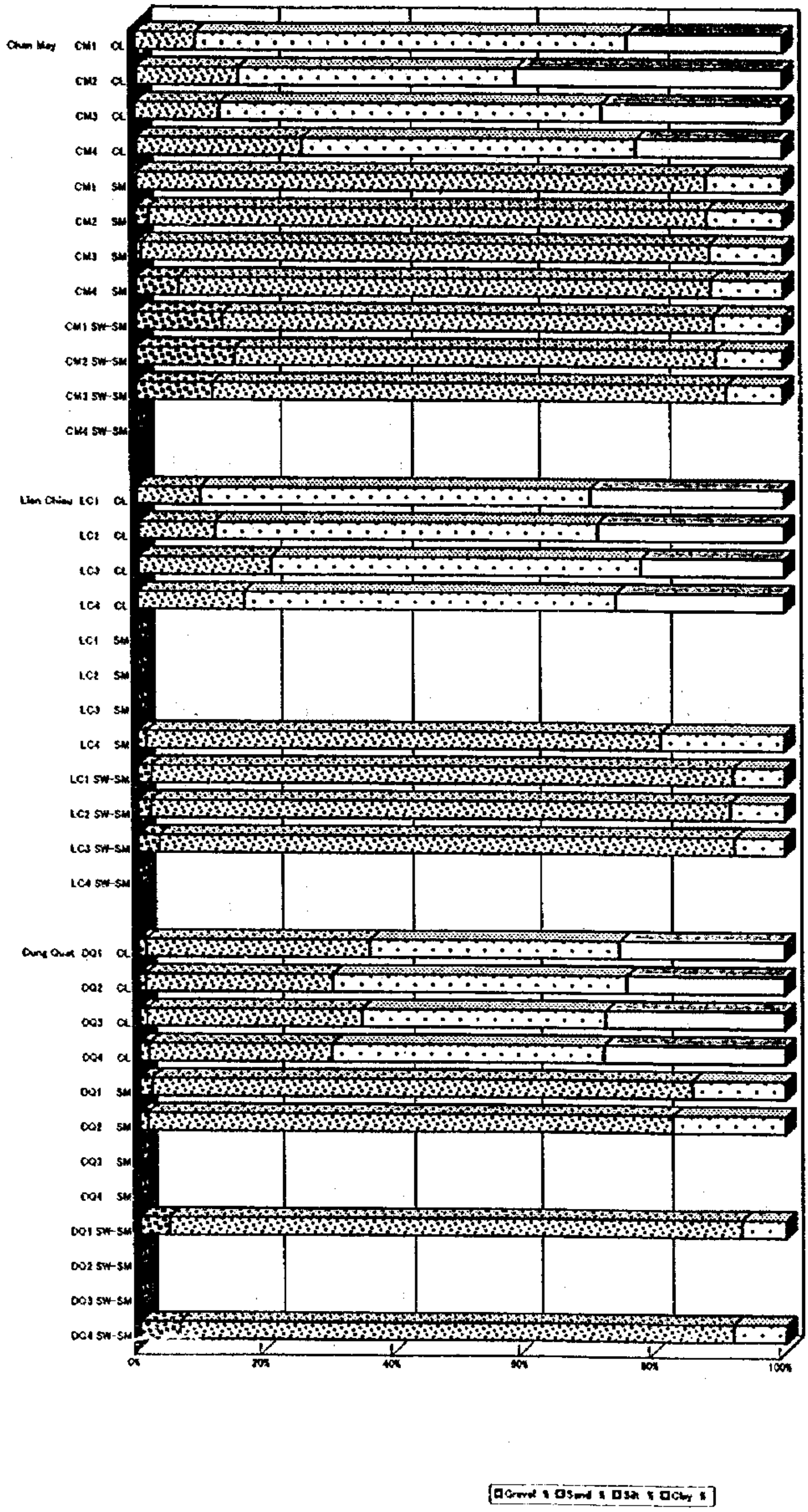


Figure 4.8.7 Result of Particle Size Analysis

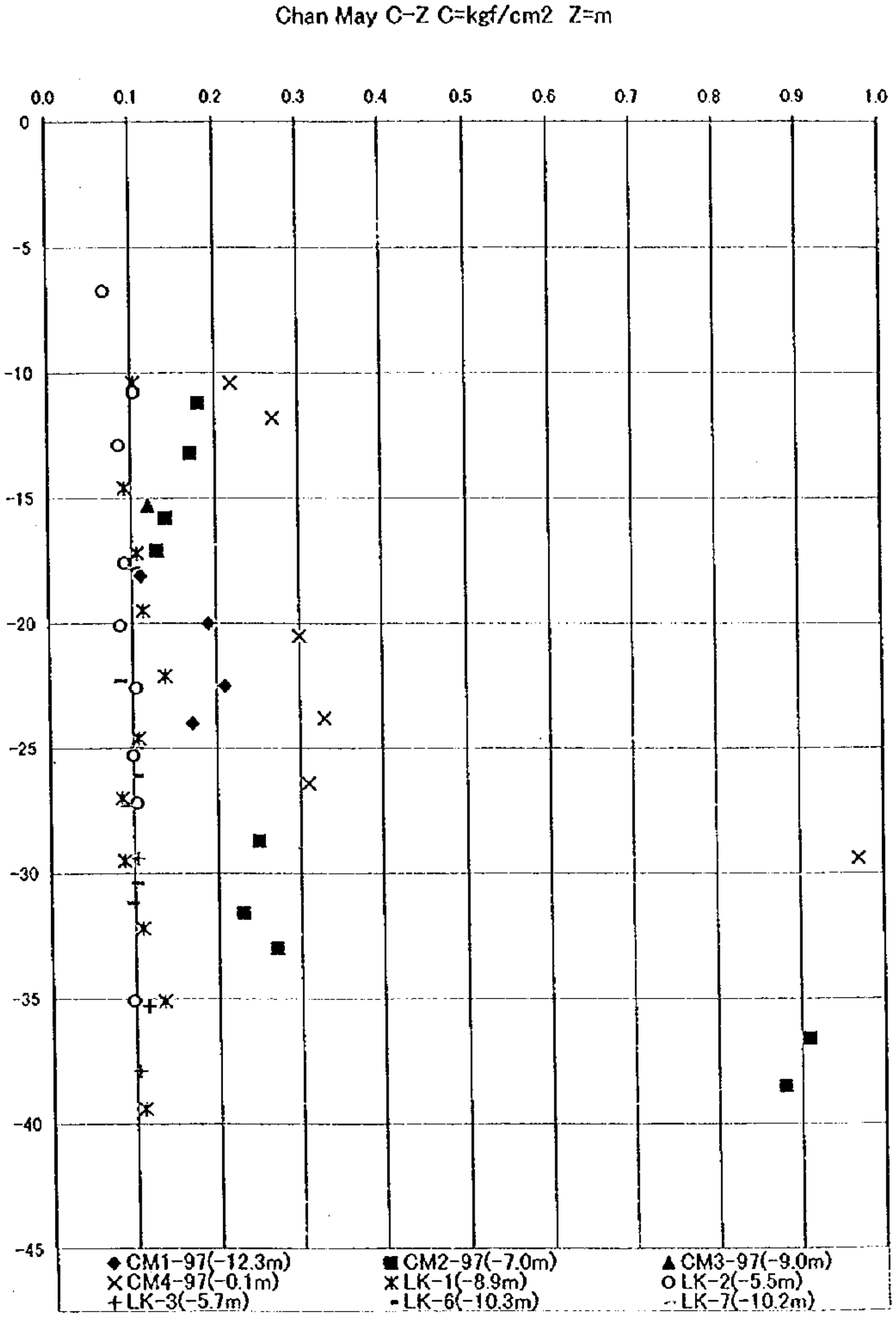


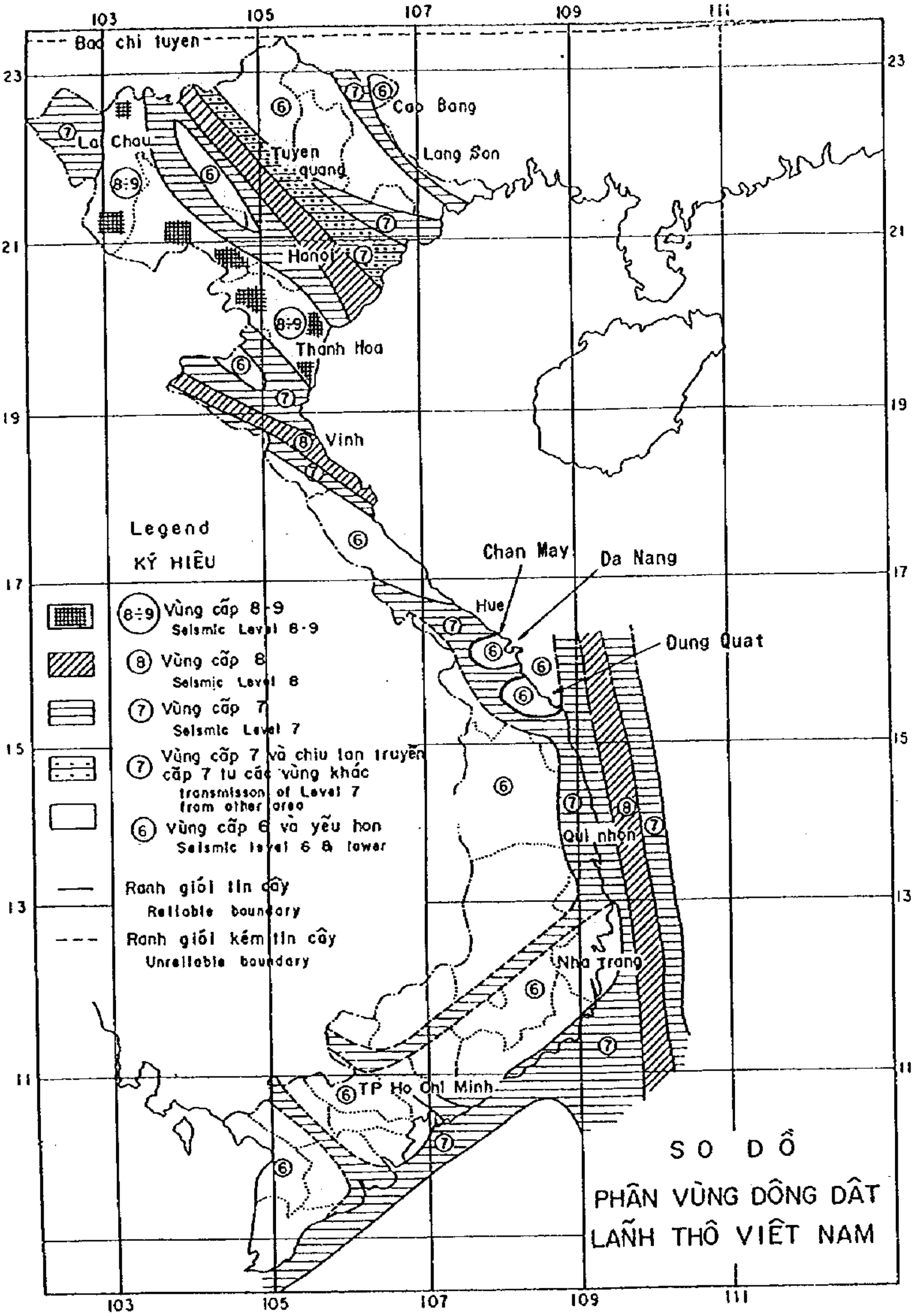
Figure 4.8.8 Relation between Cohesion and Depth in Chan May

4.9 Seismic Conditions

Earthquake intensity is an important factor for designing port facilities. Internationally, the level of earthquake intensity is divided 12 degrees for easy judging of earthquake intensity just after suffering an earthquake. Therefore this intensity level can be decided by man-feeling of shaking degree of ground and movement of furniture or extent of damage to buildings etc.

While for engineering purposes, we have to decide seismic force in compliance with seismic acceleration on the ground surface when an earthquake attack and the seismic coefficient method is prevailing to be used for determination of seismic force. Now, in Japan, the accelerations at ground surface in case of strong earthquake can be observed by measuring instrument installed at fixed points. Analyzing the data obtained from these observation points network and damage of quaywalls or structure, the relation between seismic coefficient and seismic acceleration on the ground surface gradually becomes clear.

Figure 4.9.1 shows the zoning map of seismic level in Vietnamese territory and it is used to determine the coefficient on materials and subsoil conditions. Concerning with port facilities, TCCV 4116-85 (Vietnamese technical standard for port construction promulgated by Ministry of transport in 1985) regulates a procedure how to calculate seismic force. According to this zoning map, seismic intensity in central region is classified as 6 to 7 degree which correspond to seismic coefficient of 0.05.



Source: TEDI

Figure 4.9.1 Zoning Map of Seismic Intensity Level

5. National and Regional Development Plan

5.1 National Development Plan

5.1.1 National Economic Development Plan

During the early 1990s,Vietnam experienced a rapid change in the transitional process to a market economy. An important policy issue in the late 1990s will be how to accelerate industrialization of the country.

The following two documents which have been recently published by the government address the main tasks and targets of socio-economic development to the year 2000.

- "Orientations and Tasks of the 1996-2000 Five Year Plan for socio-economic Development" (Report to the 8th National Congress of the Communist Party of Vietnam, June 1996)
- "Socio-economic Development and Investment Requirements for the Five Years 1996-2000" (Government Report to the Consultative Group Meeting, December 1995)

The main tasks and targets of the Socio-economic Development and Investment Requirements for the Five Years 1996-2000 are as follows.

1) Achieving an economic growth rate that exceeds that of the previous 5 years. GDP is projected to grow at an average annual rate of 9-10 %, with the agriculture sector (including forestry and fishing) projected to increase by 4.5 to 5 %, industry by 13-14 %, and the service sector by 11-12 % per year. By the year 2000, the share of industry in GDP is projected to be about 34-35 %, agriculture about 19-20 %, and the service sector about 45-46 % of GDP.

2) Improve national fiscal performance. Increased national income, and a rapid increase in state tax revenue collection to about 21-22 % of GDP, will contribute to the target of reducing the fiscal deficit and ensuring that it remains under 5 % of GDP, and will increase Government capacity to control inflation to an annual rate of less than 10 %. other important goals are: improving our international balance of payments and meeting foreign debt servicing obligations; developing the financial market, especially for

medium and long term finance; increasing total investment capital by 2.2 times compared with the previous 5 years; and maximizing mobilized domestic savings to reach a target level equivalent to 15 % of GDP.

3) Develop and increase the effectiveness of external economic relations and expand import and export markets. Export earnings are projected to increase at an annual rate of about 24 to 28 %, while import costs are projected to increase at an annual rate of 22-24 %. This requires measures to increase the competitiveness of goods and services, and to satisfy the necessary conditions for participation in regional free trade agreements. Efforts will continue to improve the investment environment, to increase domestic capability to absorb foreign investment and technology, to facilitate implementation of ODA financed projects, and to attract more external resources to develop socio-economic infrastructure.

4) Solve critical social issues. Promote implementation of population and family planning strategies; implement job creation programs; increase capability in science and technology; develop education and training, culture, information, and health care; gradually improve the living standard of the people; and create distinct changes in society to bring into play the domestic resources needed to promote and sustain the development process.

5) Create the necessary prerequisites, in terms of human resources, infrastructure, capital, technology, and institutional policies needed to achieve faster growth during the early part of the next century.

6) Continue strengthening economic reforms, closely linking this with administrative reform, to establish a comprehensive market mechanism, and ensure more effective implementation of law and order in society. Maintain social stability and national security.

On the other hand, Orientations and Tasks of the 1996-2000 Five Year Plan for socio-economic Development includes the following infrastructure development programme related to ports.

Consolidate and expand the capacity of existing seaports, and gradually build the ports of Cai Lan, Chan May, Lien Chieu, Dung Quat, Ben Dinh-Sao Mai and Vung Tau. To build the Can Tho port into the central port of the Mekong delta, raising its capacity to 0.5 million tonnes in 2000. To dredge and redirect riverflows, upgrade the main riverports, ensure smooth river navigation for up-to-1000-tonnes capacity barges in the Northern Delta and for 2000-tonnes capacity vessels into the hinterland in the Southern Delta.

Concerning investment, Socio-economic Development and Investment Requirements for the Five Years 1996-2000 stated the followings.

1) In recent years, Vietnam has achieved a high economic growth rate with very modest investment (the Incremental Capital Output Ratio (ICOR) is only about 2.0-2.5) because Vietnam is still at a low level of development.

2) During the next few years the ICOR is expected to increase, because more investment should be made in creating new capacity, and to promote the construction of new infrastructure. Given the emphasis on laying the foundations for development during the 21st century, ICOR during the period 1996-2000 is projected to increase from 3.0 to 3.3. Thus, the investment requirement needs for the five years 1996-2000 is estimated at USD 41-42 billion (1995 prices), a 2.2 fold increase compared with that of the previous five years 1991-1995.

3) Vietnam aims to mobilize domestic resources amounting to 15 % GDP for investment in development. This is equivalent to more than half of the total projected social investment.

4) Together with economic growth, economic policies and institutions will continue to be reformed in order to strengthen their capacity, and parallel efforts will be made to encourage savings and investment by enterprises and households along with increased levels of government savings, in order to achieve resource mobilization targets.

5)Together with domestic resources, external funds will continue to be mobilized mainly in the form of ODA and FDI, in order to achieve the total target for investing in development, during the period 1996-2000, of 30 % of GDP. Development resources are projected as follows.

Investment	Billion USD
Domestic	21
Foreign	20～22
- ODA	7～8
- FDI	13～14

Source: Ministry of Planning and Investment

5.1.2 National Port Development Master Plan

Vietnam National Maritime Bureau (Vinamarine) prepared a master plan entitled "Development Plan for Seaports in Vietnam" in June, 1995, and revised the master plan in early 1997. The master plan suggests that the major direction of development is to invest in building big port groups with a view to accommodate container ships of 50,000 DWT, dry bulk cargo ships of 70,000-80,000 DWT and oil tankers of 50,000-200,000 DWT. Pointing out that handling productivity is low compared with regional countries, it also proposes that modern handling technology be introduced in the existing ports to meet the current trend of containerization.

Regarding port planning and management, the master plan emphasized that the development plan and scale of ports should be defined in line with the socio-economic demand of each specific region and balanced development of the economic regions of the country.

Cargo throughput in the year 2000 is estimated at 106,500,000 tons and in the year 2010 at 267,000,000 tons. While cargo growth rate is not indicated, it is approximately 20% for the period of 1995-2000 and 10% for the period of 2001-2010. There is also an other forecast in the masterplan which estimates the cargo throughput in the year 2000 at 80 million tons, of which international cargo is 62 million tons, and in the year 2010 at 216 million tons, of which international cargo is 159 million tons.

Communist Party of Vietnam released a report entitled "Orientations and Tasks of the 1996-2000 Five Year Plan for Socio-economic Development" in June 1996. A chapter of the report assigned to infrastructure development programme mentioned that the ports of Cai Lan, Chan May, Lien Chieu, Dung Quat, Ben Dinh-Sao Mai and Vung Tau shall be built gradually to consolidate and expand the capacity of existing seaports. Can Tho Port will be built as the central port of the Mekong Delta, raising its capacity to 0.5 million tons in 2000. Main river ports shall be upgraded to ensure smooth river navigation for up to1000-ton capacity barges in the Northern Delta and for 2000-ton capacity vessels into the hinterland in the Southern Delta.

Cargo throughput projection taken from the above two reports is as follows:

1) Developments in Dredging and Port Construction in Vietnam[1]
Estimated Cargo Volume throughout Vietnam Seaport System 2000-2010:

Year 2000: 106,500,000 tons/year
Inclusive of a) Vietnam oriented Cargo: 93,500,000 tons/year;
b) Crude oil 20,000,000 tons/y and General dry cargo 73,500,000 tons/y;
c)Transit cargo from Lao PDR, Thailand, Cambodia, China: 3,500,000 tons/y;
d) International transhipment: 9,500,000 tons/year

Year 2010: 267,000,000 tons/year
Inclusive of a) Vietnam oriented cargo: 209,500,000 tons/year;
b) Crude oil 40,000,000 tons/y and General dry cargo 169,500,000 tons/y;
c) Transit cargo from Lao PDR, Thailand, Cambodia, China: 9,500,000 tons/y;
d) International Transhipment: 49,000,000 tons/year

Estimated Cargo Volume by Port Complexes:

Year 2000: 106,500,000 tons/year
Breakdowns:
Haiphong-Cailan 15 ports: 20,000,000-22,000,000 tons/y
Thanh Hoa-Nghe Tinh Area 7 ports: 3,000,000-4,000,000 tons/y
Quang Binh-Quang Ngai 8 ports: 18,500,000-20,000,000 tons/y
Binh Dinh-Binh Thuan 8 ports: 3,000,000 tons/y
Hochiminh-Vung Tau: 39,000,000-44,000,000 tons/y
Cuu Long Delta 11 ports: 4,400,000-4,800,000 tons/y

Year 2010: 267,000,000 tons/year
Breakdowns:
Haiphong-Cailan 15 ports: 44,000,000-47,000,000 tons/y
Thanh Hoa-Nghe Tinh Area 7 ports: 17,000,000-18,000,000 tons/y
Quang Binh-Quang Ngai 8 ports: 42,000,000-43,000,000 tons/y
Binh Dinh-Binh Thuan 8 ports: 5,000,000-6,000,000 tons/y
Hochiminh-Vung Tau: 78,000,000-86,000,000 tons/y
Cuu Long Delta 11 ports: 7,800,000-8,700,000 tons/y

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[1] Summary of Vimnamarine's Development Plan for Seaports in Vietnam, 2nd Asian and Australasian Ports and Harbour Conference, April 1997, Hochiminh City, Vietnam National Maritime Bureau

2) Orientations and Tasks of the 1996-2000 Five Year Plan[2]

Development policy of seaports:

- To consolidate and expand the capacity of existing seaports
- To gradually build the ports of Cai Lan, Chan May, Lien Chieu, Dung Quat, Ben Dinh-Sao Mai and Vung Tau.
- To build the Can Tho port into the central port of the Mekong Delta

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[2] Five Year Plan for Socio-economic Development, June 1996, Vietnam, Chapter II Programmes and Areas of Development, 3. Infrastructure development programme

5.2 Regional Development Studies

5.2.1 JICA Central Region Integrated Development Study

"The Study on the Integrated Regional Socio-economic Development Master Plan for the Key Area of the Central Region of the Socialist Republic of Viet Nam" with target year of 2010 was implemented from November 1995 to January 1997. The study area includes Quang Tri, Thua-Tthien Hue, Quang Nam-Danang and Quang Ngai province. Industrial development zones surveyed by the study are summarized in Table 5.2.1 and Figure 5.2.1.

Table 5.2.1 Industrial Development plan of the Study Are

Province	Name of IE, EPZ and FTZ	Land Area Gross (ha)	Net (ha)	(%)	Number of Companies	Number of Employees (person)	Industrial Output (Mil.US$)
Thua Thien Hue	Chan May Port FTZ	1,200	200	75	87	17,400	3,000
	Phu Bai Airport Industrial Complex	400	300	75	150	25,000	5,000
	Van Xa IE	200	150	75	60	7,600	1,900
Quang Nam Danang	Danang EPZ	63	47	75	25	6,000	1,800
	Lien Chieu-Hoa Khanh IE	800	600	75	170	40,000	7,000
	Dien Nam - Dien Ngoc IE	418	314	75	180	30,000	2,300
Quang Ngai	Dung Quat Port IE	1,800	735	41	29	9,700	15,000
	Tinh Phong IE	200	140	70	40	6,000	580
	Quang Ngai Town IE	100	75	75	20	3,600	970
	Pho Phong IE	300	180	60	60	12,000	3,500

Source: JICA Central Region Integrated Development Study 1997

5.2.2 Master Plan Study on Coastal Shipping Rehabilitation and Development Project (JICA 1997)

Although Vietnam has experienced rapid economic growth over the past few years, transport infrastructure development cannot keep pace with such growth due to inadequate finance, insufficient technology and inexperienced management. This study was carried out to improve the coastal shipping system.

1) Objectives of the Study

- To formulate a master plan on coastal shipping development and its related subsector up to the year 2010;
- To prepare a short-term implementation plan consisting of priority projects to be incorporated into the aforementioned master plan; and
- To facilitate technology transfer to counterpart officials within the study scope by means of workshops and discussions.

2) Conclusions

Table 5.2.2 Traffic Demand Forecast 2000 - 2010

	Unit	Year 2000	Year 2010
Total Freight Volume	mil. tons	121.5-140.1	388-576
Sea Transport	mil. tons	50.2-60.4	167-258
Sea Foreign Trade	mil. tons	36.0-46.0	135-223
Sea Domestic Trade	mil. tons	14.2-14.4	32-35
Total Passenger Volume	mil. passenger	1,084-1,258	4,978-5,827
Sea Transport	mil. passenger	1.7	3.7

Coastal shipping in Vietnam has great development potential. There is a growing demand which can be economically and effectively handled by coastal shipping as planned industrial developments are implemented and regional economies in the north and south become more integrated. The economic benefits of coastal shipping development are significant as indicated by the estimated EIRR of 34%.

While the development potential of coastal shipping is significant, there are a number of conditions to be met to realize the expected effects of coastal shipping improvement. They include the following:

-Incorporation of coastal shipping into the overall transportation policy framework:

- Improvement of relevant infrastructures:
- Improvement of management of shipping operators:

- Improvement of relevant infrastructures:
- Improvement of management of shipping operators:
- Improvement of regulatory environment.

3) Recommendations

Since the proposed development of coastal shipping system covers the whole country, it is recommended that three specific areas selected for short-term priority projects shall be implemented at the earliest possible time. They are:

- Program on north-south coastal shipping trunk route development;
- Program to meet international requirements; and
- Program on maritime human resources development.

In addition, to provide an appropriate policy environment for development of coastal shipping, the following recommendations are made for the government:

- For MOT to provide a clear policy statement and introduce more transparent regulations for coastal shipping which provide a level playing field for competing shipping operators;

- For the government to implement a program of equity and privatization of state and provincial-owned ship operators;

- For VINAMARINE to allow the autonomous management of ports with delegated responsibilities for finance and meeting performance targets, and the power to sub-contract various port services;

- For VINAMARINE to improve pricing of ports and waterways to encourage efficiency and adequate cost recovery;

- For MOT to strengthen VINAMARINE as the key regulatory organization for coastal shipping by ensuring adequate finance and removal of its remaining commercial functions, as well as resolving the overlapping responsibilities of VINAMARINE and IWA(Inland Waterway Administration); and

- For MOT to implement the required legal changes to introduce the improved regulatory framework regarding import and registration of ships, inspection standards of ships, quality standards for shipbuilding and repair, etc.

5.2.3 The East-West Transport Corridor Study
(ADB-Maunsell, December 1996)

The East-West Transport Corridor Study has been prepared for the Asian Development Bank under the Terms of Reference for Technical Assistance. The national executing agencies are: Ministry of Communication, Transport, Post and Construction in Lao PDR, the Ministry of Transport and Communications in Vietnam and The Department of Highways in Thailand. The Mekong River Commission Secretariat acted as co-ordinating Agency.

The study is part of the development of the transport sector in the Greater Mekong Subregion. It was commissioned to investigate the feasibility of developing transport corridors extending from the ports in central Vietnam, through central Laos to northeastern Thailand. This included consideration of possible new bridges across the Mekong River, and options for port improvement.

Three corridors were nominated for investigation: The northern corridor using Road 8 and leading to the port of Cua Lo near Vinh, the central corridor using Road 9 leading to Danang, and two alternative new routes for the southern corridor from Pakse, south Laos, to the port of either Danang or Quy Nhon.

1) Road

The two existing roads, Routes 8 and 9, provide the only recognized crossing points along the more than 500km length of the Animate Range forming the Lao/Vietnam border in the study area. Traffic volumes across the Lao/Vietnamese border, at about 200 vehicles/day for both roads combined, indicate the low level of east-west movement at present. Movements at the three Thai/Lao border crossing points are greater, but still very low compared to the projected volume if no national borders existed.

Review of the transport economic evaluation concluded that projects, if carried out in isolation, are economically worthwhile. The high values for IRR and benefit cost ratio for the projects are estimated for the Southern Corridor A (R-18) due to the relatively high volume of local traffic using the roads on the Vietnam sides. Upgrading of the existing Northern and Central corridors show lower returns on economic grounds.

Table 5.2.3 (1) Economic Appraisal of Road Projects

Route		Project cost (mUS$)	NPV (mUS$)	BCR	EIRR (%)
Northern R-8	Lao	20.3	8.6	1.6	17.4
	Vietnam	7.8	10.2	2.5	24.6
Central R-9	Lao	40.5	12.1	1.5	16.1
	Vietnam	22.6	4.3	1.3	14.7
Southern-B R-16	Lao	50.4	19.7	1.7	18.3
	Vietnam(new)	40.6	11.0	1.5	16.4
	Vietnam(14B)	30.0	32.9	2.9	29.3
Southern-A R-18	Lao	40.7	20.1	2.3	22.8
	Vietnam1	6.4	13.8	4.4	39.5
	Vietnam2	3.2	20.3	8.5	55.7

Source: The East-West Transport Corridor Study-ADB

Traffic volume on the EW Transport Corridor is estimated by two major growth scenarios, namely, the Base Case Scenario and the Dynamic Case Scenario. The estimated traffic forecast is shown in the following Table.

Table 5.2.3 (2) Estimated International Truck Flows

	1995	2000	2010	2019
Basic Case Scenario	131,700	212,200	396,600	744,000
Dynamic Growth Scenario	n.a.	23,600	138,100	492,000
Total (high case)	131,700	235,800	534,700	1,236,000

Source: The East-West Transport Corridor Study-ADB

Mekong River Bridges

Three bridges are examined in the Study as follows;

Project B1 : Pakse Bridge
Project B2 : Mukdahan - Savannakhet Bridge
Project B3 : Nakhon Phanom - Thakhek Bridge

Table 5.2.3 (3) Economic Appraisal of Bridge Projects

Bridge	Project cost (mUS$)	NPV (mUS$)	BCR	EIRR (%p.a.)
Mukdahan-Savannakhet	49.2	-10.5	0.66	7.5
NakhonPhanom-Thakhek	45.1	-8.3	0.61	8.1

Source: The East-West Transport Corridor Study-ADB

2) Ports

The investment needs of the following three ports are estimated at about US$ 559 million over a 25 year period.

Cua Lo Port: Approximately 33 % of its trade is related to international movements to /from Lao.

Danang Port: The major part of the growth is forecast as container movements. The present port at Tiensa is indicated to have an insufficient capacity for growth and the proposed new port site at Lienchieu is recommended to be built for the container trade. It is estimated that three new berths are required by 2005.

Quy Nhon Port: Quy Nhon Port is recommended to be expanded, but with a lower priority than Danang or Cua Lo in relation to the East-West Corridor Movements.

Table 5.2.3 (4) Economic and financial evaluation of port development projects

Port	Investments(1997-2019) (mUS$)	Internal rate of return (%)	
		Economic	Financial
Cualo	107	34 %	4 %
Danang	408	71 %	-ve
Quynhon	44	12 %	12 %

Source: The East-West Transport Corridor Study-ADB

5.2.4 The Master Plan Study on the Development of Steel Industry (JICA 1997)

1) Outline

The steel mill study in Vietnam commenced in September, 1996 and the final report of the study will be submitted in December, 1997. This study includes the master plan of the steel industry up to the year 2010 and the pre-feasibility study of the new plant.

Three alternative sites of the steel mill are proposed at Mui Ron near Vung Ang, Cua Sot near Thach Khe Mine and Dung Quat.

Major items to be studied are selection of the most feasible site, evaluation of domestic raw materials and designing process of the new plant.

2) Demand forecast in the master plan stage

Annual domestic consumption is projected at 6.4 million tons in 2010. New steel plant will provide 3 million tons of flat products and 1 million tons of billet annually. The rest will be provided by existing steel works and imports.

3) Evaluation of domestic raw material

The largest deposit of Thach Khe iron mine located in Ha Tinh province is classified as magnetic ore with zinc. This type of iron ore is not preferred for new plant compared with other foreign ones. Therefore, only a small volume of Thach Khe iron ore will be purchased.

Hongai coal field in Quang Ninh basin is most attractive but this coal is anthracite which is not suitable for producing coke. There is no plan to purchase domestic coal.

4) Site selection

Mui Ron and Dung Quat have similar possibility for establishing of steel mill at master plan level. Differences of two sites are small as following:

- The initial investment cost of infrastructure of Mui Ron site is 18 million US$ cheaper than that of Dung Quat site.
- Dung Quat site can save 5 million US$/year of product transportation cost to the market than Mui Ron site.
- FIRR of Mui Ron is 6.67% and that of Dung Quat is 6.71%.

5.3 Road Development Plan

5.3.1 Haivan Pass Tunnel Project

Haivan Pass is located at the border spread over Thua Thien-Hue and Danang city. Above the pass on the mountain, many vehicles were caught in engine/mechanical troubles because of the steep slope and sharp turns. Falling rocks and landslides frequently occur and sometimes fall on vehicles with great force. This pass is the most dangerous point along Highway Route 1 and road improvement is of urgent necessity. The current length of this pass is about 20 km.

The World Bank conducted the pre-feasibility study on this pass up to June 1996. Three alternatives are considered in the report. But two routes are finally adopted. One route passes along the coast side with three tunnels. Three tunnels have lengths of 1.8 km, 2.5 km and 1.6 km respectively. The other route passes one long tunnel with a length of 5 km along the mountain side.

OECF contracted loan agreement of 5.5 billion Yen with the Government of Vietnam on this project. The completion of the project is expected in the year 2004 .

5.3.2 North South Highway

North South Highway will run along the western longitudinal axis and will be the second trans-Vietnam Highway, with Route 1 being the first.

1) Purpose of the Project

Tha main purpose is to develop the socioeconomic structures of west Thanh Hoa and Nghe An, linking all northern central provinces (to Danang) and to promote the strategic development of the Central highlands.

2) Outline of the Project

The highway will stretch over 1,710 km in length, about the same length as the existing Route 1. The road, 23 meters in width, will have four principal lanes for motorized vehicles and two escape lanes.

3) Schedule of the Project

The highway will be built in two phases depending on the actual socio-economic conditions.

Phase 1 (1998-2005) : Build and upgrade the road over its length (1,710 km) with two lanes.

Phase 2 (2005-2010) : Widen the road and build it into a four-lane highway.

5.4 Industrial Zone Development Plan

5.4.1 Thua Thien Hue Province Overall Masterplan

Overall masterplan of the Chan May new city was approved by the government in December 1996 upon the proposal of the Chairman of Thua Thien Hue Province. The masterplan is entitled "General Masterplan of the Deep Seaport and Industrial-Commercial-Tourist-Service Zone of Chan May".

Following objectives are listed for the development of Chan May new city.

- To be a port city, lying on the important hub of transportation in the area and the region;
- To be an international commercial area;
- To be a city for Tourist - Service - Training; and
- To be a city of clean industries.

The first phase of the development is planned for the year 2005 and the second phase is for the year 2020. Designed population of the new city is 40,000-45,000 in 2005 and 120,000-150,000 in 2020. Land use for the first phase is 1,160 ha, of which 300 ha for industries and trading activities, 350 ha for wharves, yards and warehouses, 180 ha for residential area, 100 ha for infrastructure, 110 ha for green area and 120 ha for tourist area.

The long-term development up to 2020 encompasses a total of 4,090 ha, of which 1,600 ha is for industries and trading area, 660 ha for port area, 1,200 ha for residential area and so forth.

The concentrated industrial area of 1,600 ha will be located on the western side of the international trading area from the port to the National Highway 1A. This area will be retained for clean industries out of which, a hi-tech sub-area will be established adjacent to Chan May bay.

The Industrial Area is 5 km from the National Highway No.1 and the national railroad, and 7 km from the high voltage electricity grid (500kV).

5.4.2 JICA Central Region Development Study

According to the "Study on the Integrated Regional Socio-Economic Development Master Plan for the Key Area of the Central Region of the Socialist Republic of Vietnam", the preliminary development plan for the Chan May Area consists of the following zone:

- Port zone,
- Free trade zone (FTZ),
- Commercial and residential zone,
- Park and recreation zone,
- Residential zone,
- Conservation zone,
- Natural preservation zone,
- Natural conservation and tourism development area, and
- Tourism promotion zone.

In Chan May FTZ the development concept is to create a new urban center to form urban agglomeration in the Central Corridor subject to environmental considerations on types of industrial location.

Chan May FTZ will include assembling and/or processing by distributor's type of industries, such as construction material, chemical, wood processing, textile, garment, foodstuff, electric and electronics, and handicraft. And semi-processed and intermediate products coming in and going out will be stored, assembled, processed, packed, labeled, and distributed for trade under a "bonded" condition with one-step export/import formalities. Industrial types are summarized Table 5.4.1.

In 2010, about 50,000 people are expected to live in the Chan may Area (including Lang Co Area). The following items shall be planned taking into consideration the probable future demand.

- Roads are to be networked with the Hue-Danang New Inter-city Highway as an arterial road and grid feeders in the project area.

- Domestic and industrial water demand will be estimated at 23 million m^3 in 2005, 44 million m^3 in 2010 per annum respectively. Although a detailed survey has not been done yet, Thuy Cam and Thuy Yen reservoirs would be available for supplying 10 million m^3 of water to the area. Deficient water volume will be supplemented by diverting Truoi reservoir water to the Chan May area or exploiting groundwater.

- For Electricity, Gas, Sanitation, and Solid waste disposal and treatment, the detailed development plan needs further study.

Table 5.4.1 Future Priority Industries in Thua Thien - Hue Province

Name of Industrial Estate	Name of Industrial Sector	Main Proposed Industries in Future
Chan May Port FTZ (Assembler or processing by distributors are mainly applied)	Construction material	Cement and its products Clay refractories Aggregate and stone products Other ceramic stone and clay products
	Chemical	Petrochemical products
	Wood processing and forestry	Plywood and prefab-wood products Furniture Miscellaneous furniture and fixtures
	Glass and pottery	Glass products
	Textile	Ropes and netting Lace and other textile goods Miscellaneous textile mills products
	Garment	Outer garments White shirts and underwear Miscellaneous fabricated textile products
	Electric and electronic	Household electric appliances Communication equipment and related products Computer equipment and accessories Electronic equipment Other electrical machinery Various electronic parts
	Foodstuff	Frozen seafood Beer, salt, soft drinks, cigarettes
	Other	Handicrafts

Note: Assembling and/or processing to be carried out by distributors

Source : JICA Central Region Development Study Team

5.4.3 Industrial Development Plan of Thua Thien Hue Province

According to People's Committee of Thua Thien Hue Province, Chan May Centralized Industrial Zone, Phu Bai Centralized Industrial Zone, Dong Lam Industrial Zone, Tu Ha Industrial Zone are planned in Thua Thien Hue Province (See Table 5.4.2).

Above all, the development concept of Chan May Centralized Industrial Zone is to create a new urban center to form urban agglomeration in the Central Corridor subject to environmental considerations on types of industrial location. Chan May Centralized IZ will include assembling and/or processing by distributor's type of industries.

Table 5.4.2 Outline of Industrial Development Plan in Thua Thien - Hue Province

Name	Chan May Centralized Industrial Zone	Phu Bai Centralized Industrial zone	Dong Lam Industrial Zone	Tu Ha Industrial Zone
Area	700 ha	300 ha	300 ha	300 ha
Number of Project	25	32	7	9
Main Products	Construction material Glass and pottery Plastic products Chemical products Machine equipment Electric and Electronic Automobile Textile and Garment Foodstuff Wood processing	Construction material Glass products Ceramic products Plastic products Porcelain insulator Machinery Electrical parts Electronic bulb Communication equip Fabric shoe Beverage Wooden furniture Plywood	Const. Material Cement Sugar Confectionary Turpentine Fertilizer	Const. Material Cement Foodstuff Chemical product Candle Fodder

Source : Thua Thien Hue Province

5.5 Review of Chan May Port Development Plan

Overall masterplan of the Chan May new city entitled "General Masterplan of the Deep Seaport and Industrial-Commercial-Tourist-Service Zone of Chan May" was approved by the government in December 1996. Objectives for the development of a new port are defined as follows:

- To be one of the international commercial seaport in the Central region;

- To be one of the port complexes serving the industrial development and commodity transportation for the key economic zone of the Central region, Lao PDR, Northeast Thailand and Myanmar as the gateway to the East Sea via Route No.9; and

- To be the tourist port for the area of Hue, Thuan An, Canh Duong, Lang Co, Danang, Hoi An and the surroundings

Previous studies and proposals made on the development of Chan May Port are summarized as follows and in Table 5.5.1

(1) Study and Investigation for Establishment of Chan May Deep Sea Port and Industrial Zone in Thua Thien-Hue Province[1]

Cargo forecast through Chan May Port:
    Capacity: 40,000,000 tons/year (Target year is not indicated)
Port Facilities Proposed
    Total length of wharves: 10,000 m
    Inclusive of
        General cargo wharves: 5,100 m
        Container terminal: 1,250 m
        Berths for cement and construction materials: 1,700 m
        Berth for petroleum: 250 m
        Berth for repair ships: 600 m
        Port for tourism cruiser: 500 m
        Fishing port: 600 m
        Base for port fleet, pilotage, customs office, etc.: 300 m

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[1] December 1995, Institute of Physics-Hochiminh City Branch, Vietnam National Center for Natural Science & Technology

(2) JICA Study on the Integrated Regional Socio-economic Development Master Plan for the Key Area of the Central Region[2]

Cargo throughput forecast at the Central Region:

- Year 2000: 3,500,000 tons
- Year 2005: 22,400,000 tons
- Breakdowns:
  - Cua Viet: 200,000 tons
  - Danang: 3,300,000 tons
  - Chan May/New Danang: 3,000,000 tons
  - Dung Quat: 15,900,000 tons

- Year 2010: 42,800,000 tons
- Breakdowns:
  - Cua Viet: 200,000 tons
  - Danang: 3,300,000 tons
  - Chan May/New Danang: 8,100,000 tons
  - Dung Quat: 31,200,000 tons

(3) Proposal for Chan May Container Port[3]

Container port development in Chan May:

- Size of terminal:
  - 350 m long main berth for 5,000-6,000 TEU ships drafting -14 m
  - 250 m long feeder berth
  - Total 21.6 ha (9.6 ha on-site and 12 ha inland)

- Capacity:
  - 500,000 TEUs/year (7,000,000 tons/year)

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[2] JICA Study Report , November 1996

[3] Vietnam's 3rd Maritime & Inland Shipping Exhibition, April 16-18, 1997, Hochiminh City, by Bouygues Offshore, Vietnam

TABLE 5.5.1 Review of Previous Cargo Forecast

Chan May Port

Studies	Year 2000	Year 2010	Future
Master Plan of Industrial and Infrastructure Development 1996-2010, August 1996, Prime Minister Decision		Thanh-Hoa-Khanh Hoa area: 50 mil.	Thanh-Hoa-Khanh Hoa area: 200 mil.
Chan May Deep Seaport and Industrial Zone Study, December 1995, Institute of Physics	n.a	n.a	Capacity: 40 mil
Central Vietnam Development Masterplan, November 1996, JICA	Central Region: 6.8 mil Tien Sa: 3.3 mil	Central Region: 42.8 mil (Oil Ref. 21.8 mil) Tien Sa: 3.3 mil Chan May/New Danang: 8.1 mil Dung Quat: 31.2 mil	
Proposal for Chan May Container Port, April 1997, Bougues Offshore, Vietnam			Capacity: 500,000 TEUs (7 mil tons)

Total Cargo Throughput in all Vietnam Ports

Studies	Year 2000	Year 2010
Vinamarine's Development Plan for Seaports in Vietnam, April 1997	Total: 106 mil Im/Ex 62 mil	Total: 267 mil Im/Ex 159 mil
Prefeasibility Study in Construction of Lien Chieu-Nam O Port, May 1995, MOT	60-70 mil	150-200 mil
Port Traffic Demand Survey for Masterplan Study on Coastal Shipping, May 1996, JICA Study Team and TESI	Ttl: 55-56 mil (Transit:2-3) (Tranship:5-10)	Ttl: 149-164 mil (Transit: 9) (Tranship: 20-30)

6. Demand Forecast

6.1 Methodology for Demand Forecast

6.1.1 Methodology

Two methods, a macro forecast and a micro forecast are generally used to forecast the future cargo volume. The macro forecast is based on the assumption that the cargo volume handled by the port reflects the economic activity in the port's hinterland. The total cargo volume is estimated using the historical relation between the cargo volume and macro economic indices. The other is a micro forecast which estimates the cargo volume of each commodity individually based on related indices, the forecast demand and supply situation and the development plans. The flow chart of the forecast method is shown in Figure 6.1.1 (1) and Figure 6.1.1 (2)

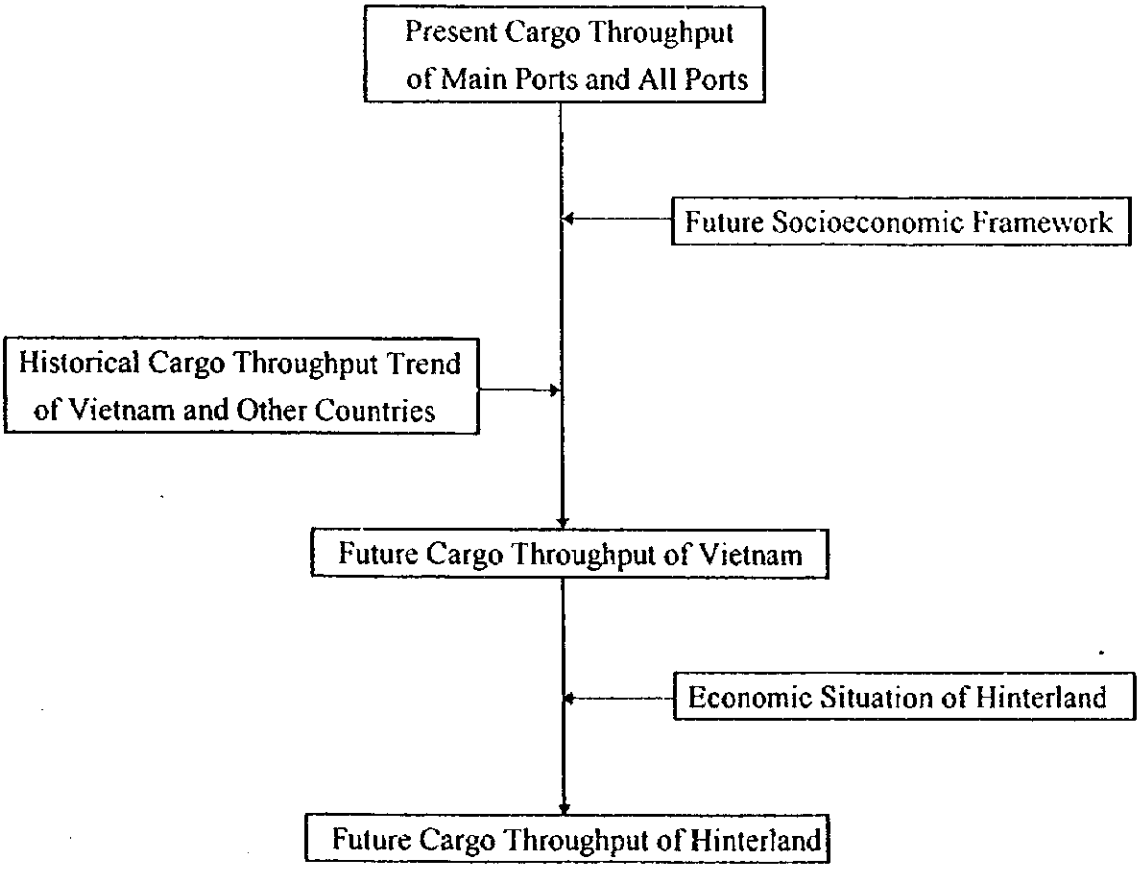


Figure 6.1.1 (1) Flow Chart of Macro Forecast

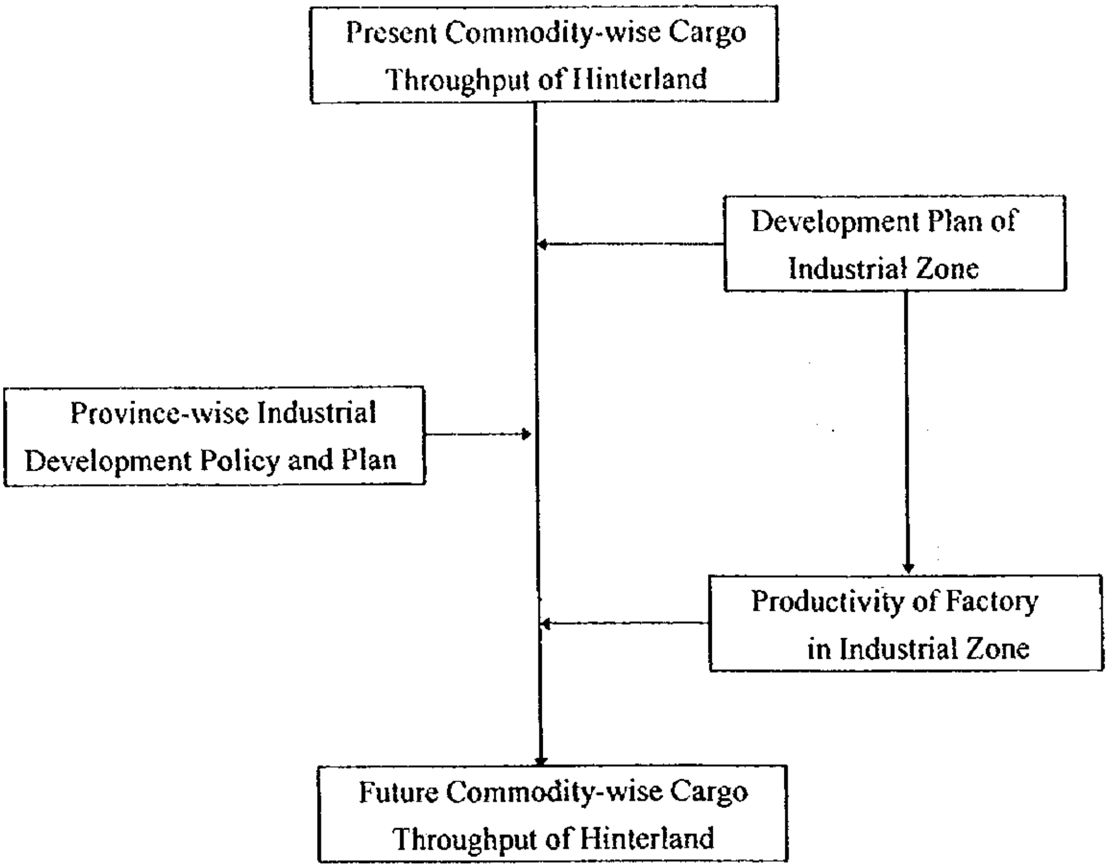


Figure 6.1.1 (2) Flow Chart of Micro Forecast

6.1.2 Hinterland

In order to forecast the future cargo volume of the Ports of Chan May, Lien Chieu and Dung Quat located in the study area, the hinterland should be defined. Danang port is located 54km away from Chan May port, 24km from Lien Chieu Port, 129km from Dung Quat port. Presently the national road No.1 is the main artery of distribution. Improvement of bridges and the main roads such as the national road No.1 and the opening of Hai Van Tunnel will improve traffic and distribution efficiency. Therefore, the hinterland of three ports could be regarded as a coincident area.

Taking into consideration the present hinterland of Danang port, future sea-lane and road network, geographical conditions, location and functional roles of ports around the study area, industrial policy including agricultural and industrial production planning and transport planning in the study area and surrounding provinces, the hinterland of three ports is assumed to be the following five provinces and one city.

- Quang Tri Province
- Thua Thien Hue Province
- Danang City
- Quang Nam Province
- Quang Ngai Province
- Kon Tum Province

6.2 Socio-economic Framework

6.2.1 Population

Population of Vietnam in 1995 is 73,959,000 while that of the study hinterland is 4,972,000, or 6.72% of the total. The breakdown in the study hinterland is as follows: 541,000 in Quang Tri Province, 1,003,000 in Thua Thien Hue province, 1,948,000 in Danang city and Quang Nam province, 1,184,000 in Quang Nagi Province, 260,000 in Kon Tum Province.

Future population of all Vietnam and the study hinterland in 2010 and 2020 is estimated in Table 6.2.1(2) based on the growth rate forecast by Ministry of Planning and Investment-Development Strategy Institute (PIM-DSI) and Transport Development and Strategy Institute (TDSI) shown in Table 6.2.1(1). The ratio of the population to the study hinterland of the national population in 2010 and 2020 is estimated at 6.73%, almost the same as that in 1995. Forecast population growth of the study hinterland is shown in Figure 6.2.1.

Table 6.2.1 (1) Population Growth Rate

Unit: %

Area	-2000	2000-2010	2010-2020
Quang Tri	2.6	1.9	1.3
Thua Thien Hue	2.3	1.6	1.1
Danang & Quang Nam	2.0	1.4	1.0
Quang Ngai	2.2	1.6	1.1
Kon Tum	2.5	1.8	1.2
All Vietnam	2.1	1.6	1.1

Table 6.2.1(2) Population Forecast

(Unit: Person)

Area	2010	2020
Quang Tri	742,000	845,000
Thua Thien Hue	1,317,000	1,469,000
Danang & Quang Nam	2,517,000	2,782,000
Quang Ngai	1,547,000	1,726,000
Kon Tum	352,000	396,000
Hinterland Total	6,476,000	7,217,000
All Vietnam	96,174,000	107,292,000

6.2.2 GDP

GDP at current prices in 1994 is US$ 21.021 billion of which US$ 1.040 billion or 4.95% is derived from the hinterland. Province-wise GDP at current prices in the study hinterland is as follows: US$81.8mill. for Quang Tri Province, US$253.0mill. for Thua Thien Hue Province, US$482.2mill. for Danang City and Quang Nam Province, US$176.2mill. for Quang Ngai Province, US$46.4mill. for Kon Tum province.

Future GDP of all Vietnam and hinterland in 2010 and 2020 is estimated in Table 6.2.2(2) based on growth rate forecast by MPI-DSI and TDSI shown in Table 6.2.1(1). GDP of the study hinterland and its ratio in the nation's GDP are predicted to increase every year reaching 6.57% in 2010 and to 8.03% in 2020 (See Figure 6.2.2(1) and 6.2.2(2)).

Table 6.2.2(1) GDP Growth Rate

Unit: %

Area	-2000	2000-2010	2010-2020
Quang Tri	7.0	8.5	6.5
Thua Thien Hue	12.0	15.0	11.0
Danang & Quang Nam	11.0	13.0	9.9
Quang Ngai	8.0	13.0	9.9
Kon Tum	7.0	8.0	6.1
All Vietnam	9.5	10.5	8.0

Table 6.2.2(2) GDP Forecast

Unit: Mill.US$

Area	2010	2020
Quang Tri	277.6	521.0
Thua Thien Hue	2,020.3	5,946.5
Danang & Quang Nam	3,061.6	7,869.1
Quang Ngai	949.1	2,439.6
Kon Tum	150.3	271.8
Hinterland Total	6,458.9	17,047.9
All Vietnam	98,346.9	212,323.7

6.2.3 GDP per Capita

GDP per capita in 1995 based on Population and GDP is US$ 311, while that of the hinterland in 2010 and 2020 is estimated at US$ 231. Province-wise GDP per capita is as follows: US$162 for Quang Tri Province, US$283 for Thua Thien Hue Province, US$270 for Danang City and Quang Ngai Province, US$161 for Quang Ngai Province, US$191 for Kon Tum Province.

Future GDP per capita of all Vietnam and the hinterland is summarized in Table 6.2.3. Forecast GDP per capita growth of all of Vietnam and the study hinterland are shown in Figure 6.2.3. GDP per Capita of the study hinterland is projected to exceed that of the nation in 2020 on the strength of large scale industrial development plans of Thua Thien Hue Province, Danang City, Quang Nam Province and Quang Ngai Province which are expected to bring substantial benefits to regional economies.

The difference in GDP per capita among provinces is pronounced. For example, in the study hinterland, GDP of Thua Thien Hue Province which has the largest GDP per capita in 2020 is forecasted to be approximately 6.6 times greater than that of Quang Tri Province of which GDP per capita is the smallest. At the national level in 1995, GDP per capita of Ba Ria-Vung Tau Province, which has the largest GDP per capita is approximately twenty times greater than that of Cao Bang Province while GDP per capita of Ho Chi Minh city is approximately six times greater than that of Cao Bang Province.

Generally, in the course of development, the economic gap between developed areas and less developed areas tends to expand, since investments concentrated in commercial and industrial sector in developed areas. Once initial investment boom has subsided, however, economic growth in developed areas tends to slow down and the gap among the regions or provinces is often eliminated or begins to shrink through expansion of economic activities which induces capital flow into less developed areas and measures such as policies to promote industry in less developed areas.

Table 6.2.3 GDP per Capita Forecast

Unit: US$

Area	2010	2020
Quang Tri	374	617
Thua Thien Hue	1,534	4,047
Danang & Quang Nam	1,216	2,830
Quang Ngai	613	1,413
Kon Tum	428	686
Hinterland Total	997	2,362
All Vietnam	1,023	1,979

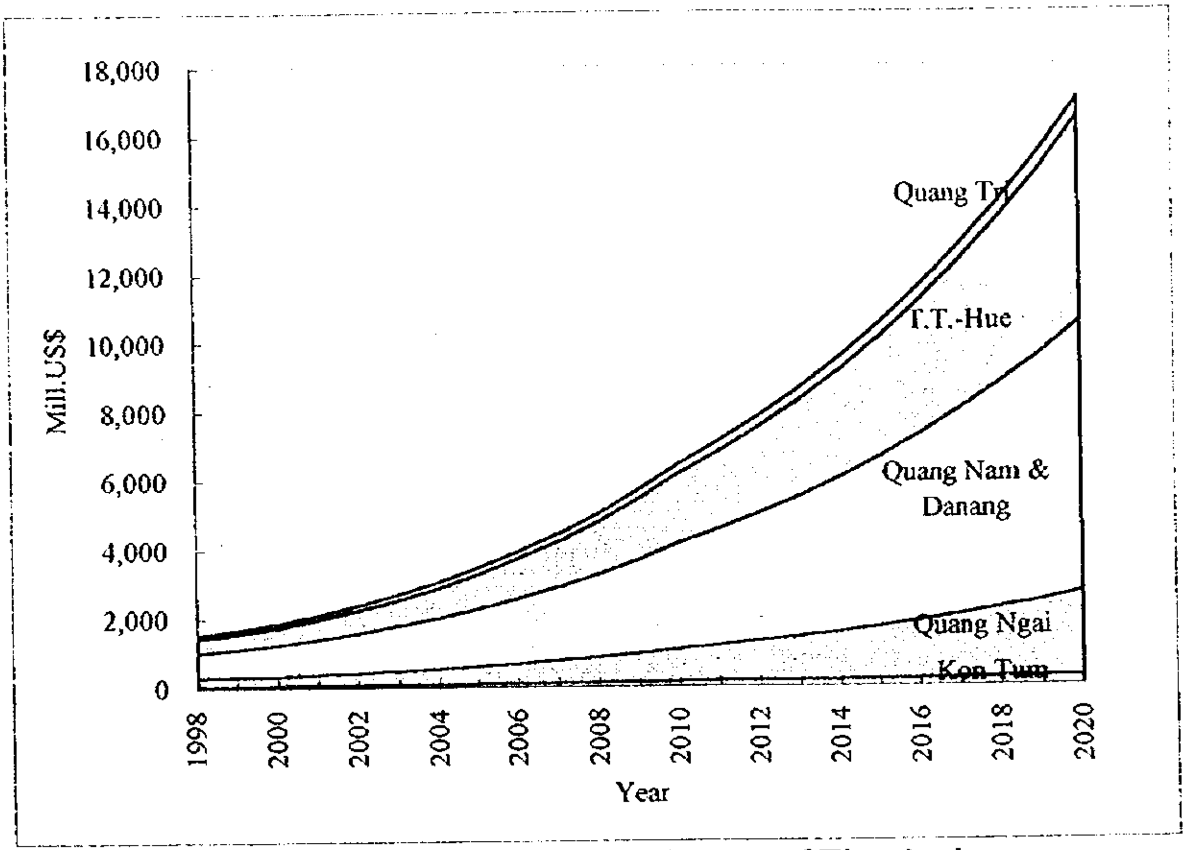


Figure 6.2.1 Province-wise GDP Forecast of Hinterland

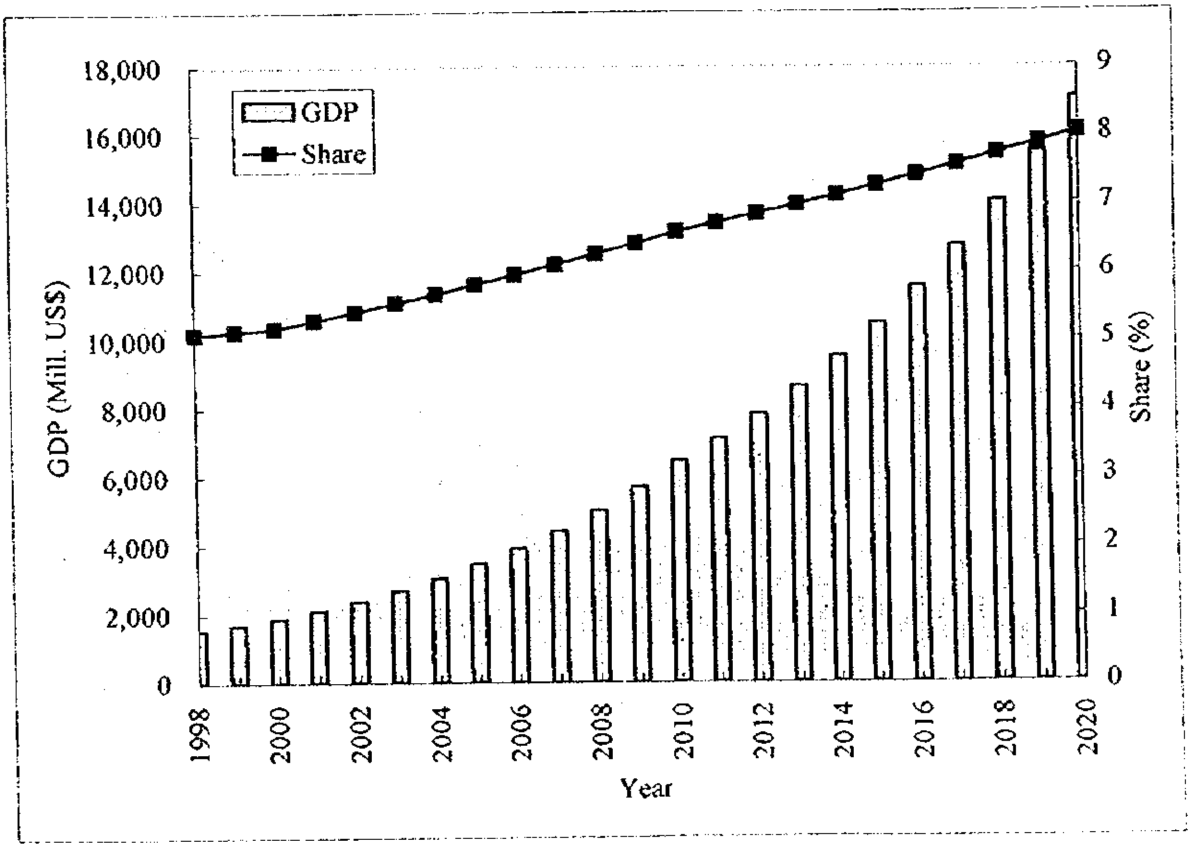


Figure 6.2.2(1) GDP Forecast and Share of Hinterland

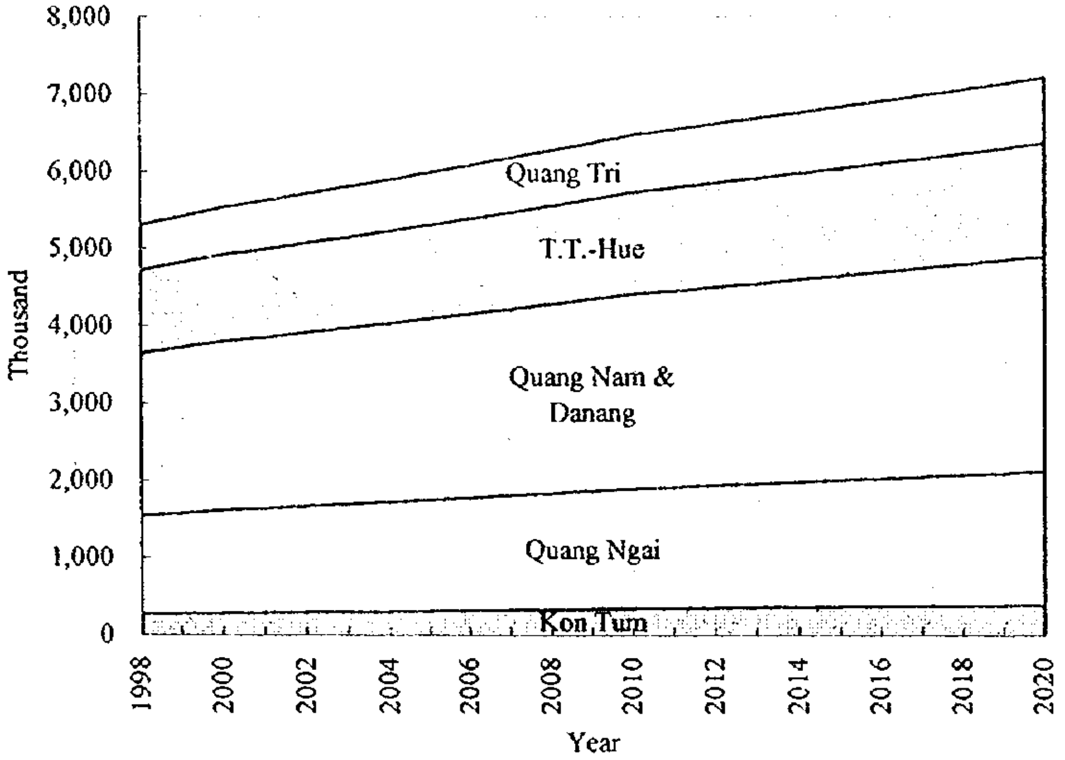


Figure 6.2.2(2) Province-wise Population Forecast of Hinterland

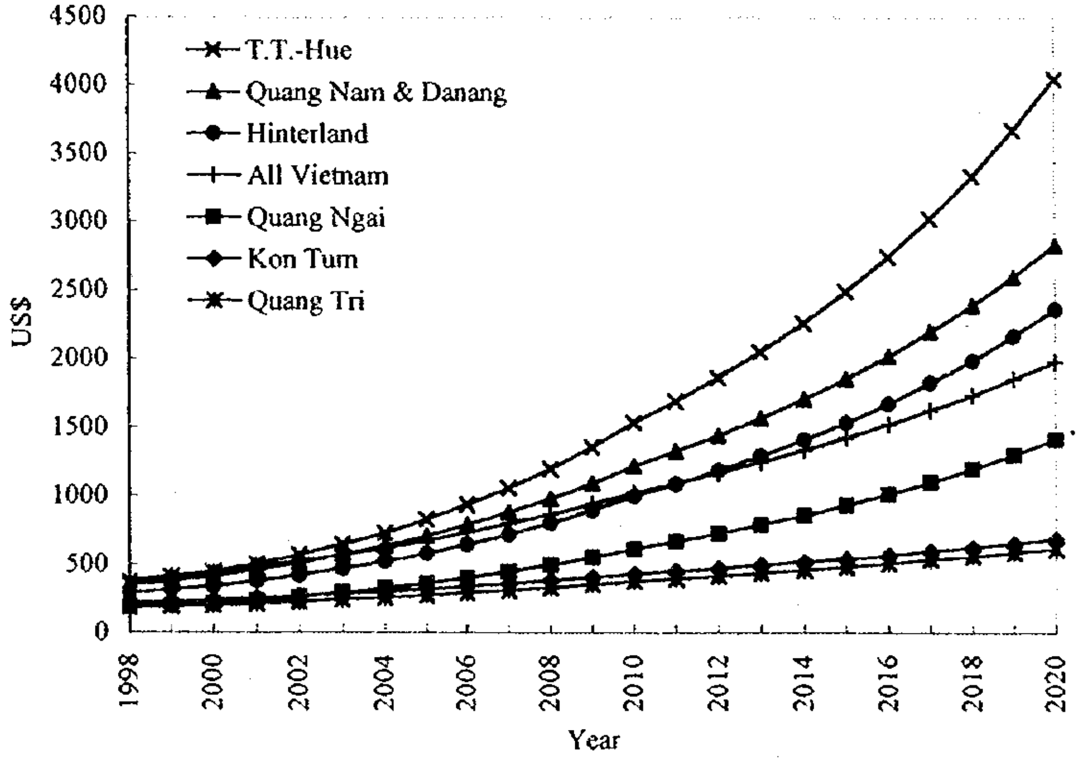


Figure 6.2.3 Province-wise GDP per Capita Forecast of Hinterland

6.3 Macro Forecast

6.3.1 Dry Cargo

(1) Scenario I

Total dry cargo handling volume of main ports (Hai Phong, Danang, Saigon, Quang Ninh, Nghe Tinh, Qui Nhon, Nha Trang, Can Tho) as shown in Table A6.3.1 has a close relation with GDP. Thus, total dry cargo handling volume of the study hinterland can be forecast the following equation based on correlation of above two historical trends.

Concerning GDP growth rate, Scenario I adopts growth rates from the MPI forecast 〔9.5% (1995-2000), 10.5%(2000-2010), 8.0%(2010-2020)〕.

$$Y = (0.46280X - 4384.5) \times S$$

Y : Total cargo volume (Thousand Ton)
X : GDP (Million US$), modified 1987 constant price
S : GDP share of the study hinterland
Correlation coefficient: r = 0.972037

Forecast results in 2010 and 2020 are as follows and cargo volume growth since 2000 projected to 2020 is shown in Figure 6.3.1(1)

Scenario I

Unit: ton

	2010	2020
Total Dry Cargo	7,496,000	20,194,000

(2) Scenario II

Scenario II is almost the same as the scenario I except GDP growth rate which is assumed at 8.2%, the average GDP growth rate from 1991 to 1995.

Forecast results in 2010 and 2020 are as follows and cargo volume growth since 2000 projected to 2020 is shown in Figure 6.3.1(1)

Scenario II

Unit: ton

	2010	2020
Total Dry Cargo	5,654,000	15,624,000

(3) Scenario III

The import dry cargo volume per capita tends to increase as GDP per capita increase as shown in Figure 6.3.1(2) and correlation coefficient is 0.881158. Vietnam's current cargo situation is found on the upper line in Figure 6.3.1(2). Thus, import dry cargo volume of the study hinterland can be estimated by the following equation based on upper case of correlation between above two factors.

$$Y = (0.31374X - 0.49909) \times S$$

Y : Total cargo volume (Thousand Ton)
X : GDP per capita (Thousand US$), modified 1989 constant price
S : Population of the study hinterland (Thousand)

The export dry cargo volume of main ports has a close relation with GDP. Thus, export dry cargo volume of the study hinterland can be forecast by the following equation based on correlation of above two historical trends and GDP growth rate forecast by MPI..

$$Y = (0.12635X - 82.97) \times S$$

Y : Total cargo volume (Thousand Ton)
X : GDP (Million US$), modified 1987 constant price
S : Population share of the study hinterland
Correlation coefficient: r = 0.85408

Domestic cargo volume is forecasted to increase in accordance with economic growth as well as foreign trade. Thus, domestic cargo volume of the study hinterland can be estimated by actual domestic share of total cargo handling volume of all Vietnam in 1995 shown in Figure 6.3.1(3).

Forecast results in 2010 and 2020 according to above method are as follows and cargo volume growth since 2000 projected to 2020 is shown in Figure 6.3.1(1).

Scenario III

Unit: ton

	2010	2020
Import Dry Cargo	2,003,000	3,989,000
Export Dry Cargo	2,173000	4,693,000
Domestic Dry Cargo	785,000	1,632,000
Total Dry Cargo	4,961,000	10,314,000

6.3.2 Liquid Cargo (Petroleum Product)

(1) Scenario I

Total petroleum product demand has a close relation with GDP. Thus, total petroleum product demand of the study hinterland can be forecast using the following equation based on correlation of above two historical trends and average GDP growth rate from 1991 to 1995.

$$Y = (0.099156X - 1148.0) \times S$$

Y : Total cargo volume (Thousand Ton)
X : GDP (Million US$), modified 1987 constant price
S : GDP share of the study hinterland
Correlation coefficient: $r = 0.960919$

Forecast results in 2010 and 2020 are as follows and demand growth since 2000 projected to 2020 is shown in Figure 6.3.2.

Scenario I

Unit: ton

	2010	2020
Total Petroleum Product	1,198,000	3,331,000

(2) Scenario II

Total petroleum product demand is estimated by analyzing "The Report of the Study on the Development Plans of Petroleum and Petrochemical Industries for the Central Part of Vietnam" by Japan Construction Institute. Average annual demand growth rates of petroleum products either in Vietnam in 1992-1994 or in the ASEAN countries in 1971-1993 are used for the forecast.

Forecast results in 2010 and 2020 are as follows and demand growth since 2000 projected to 2020 is shown in Figure 6.3.2.

Scenario II

Unit: ton

	2010	2020
Total Petroleum Product	1,148,000	2,351,000

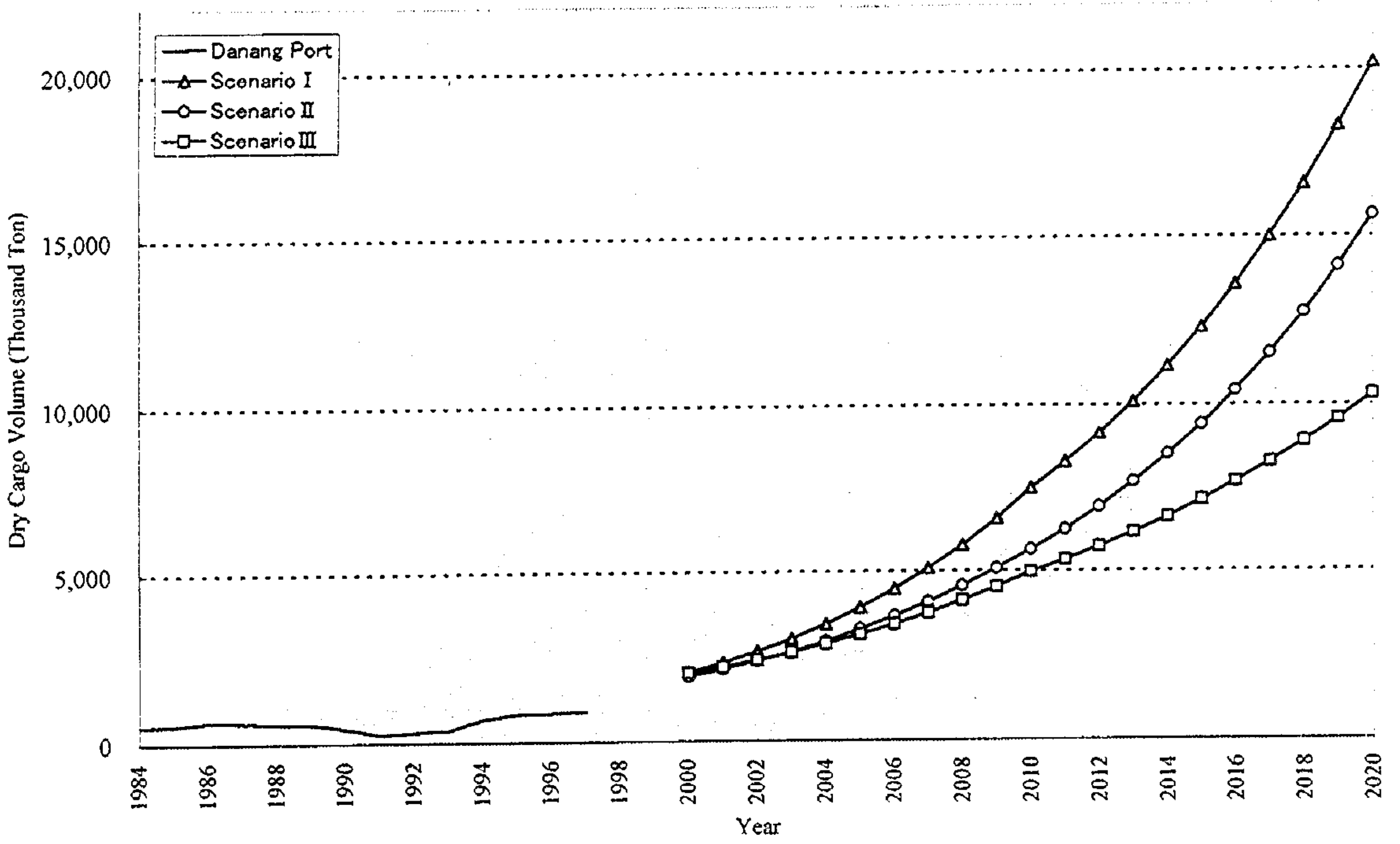
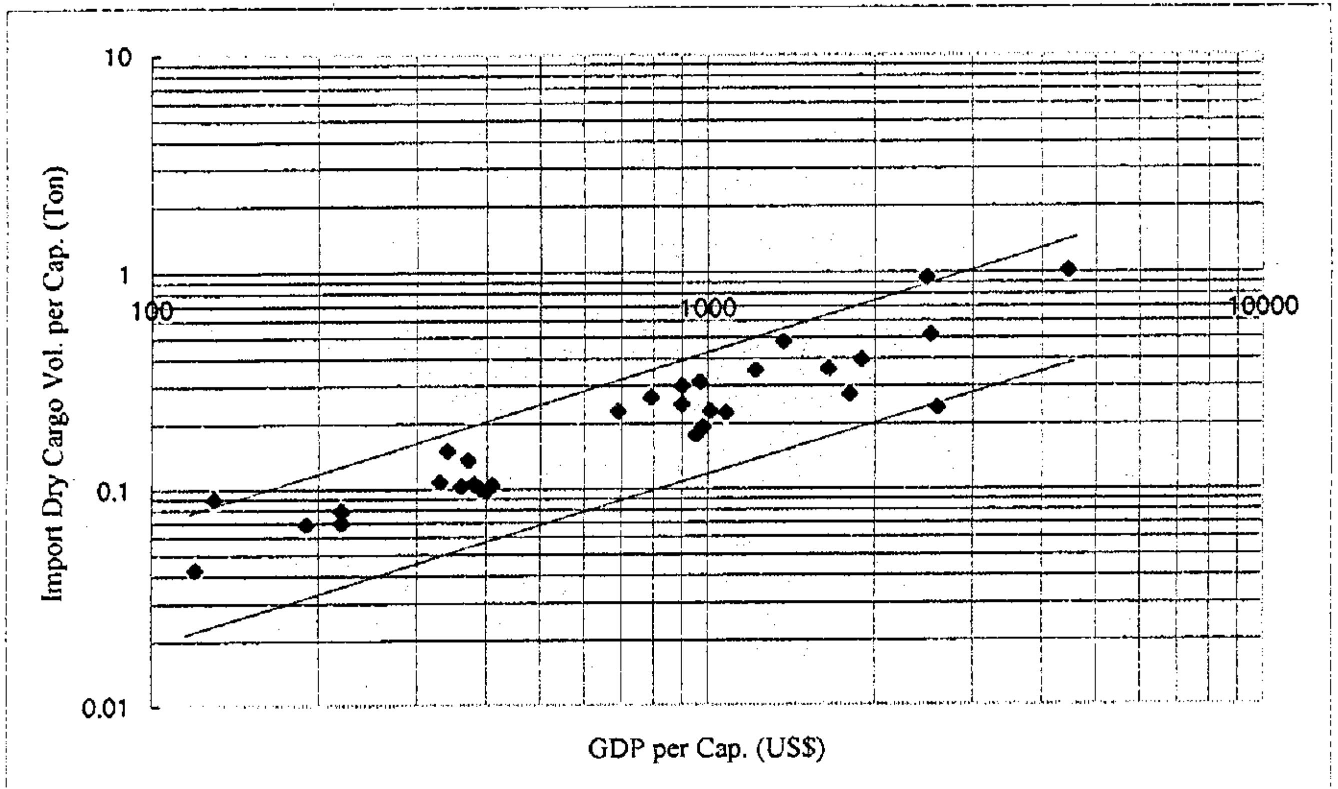


Figure 6.3.1(1) Cargo Throughput Forecast and Cargo Throughput Trend of Danang Port



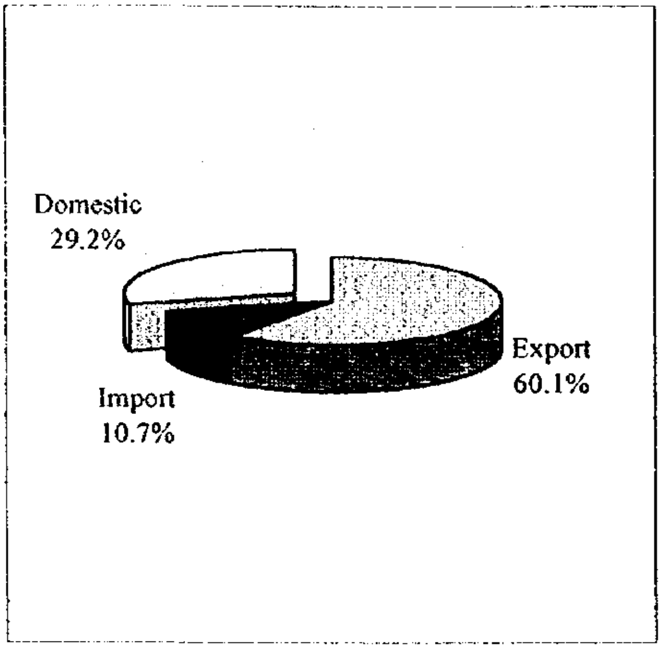
The following countries are included:
- Countries having population larger than one million
- Countries having GDP per Cap. less than US$ 5,000

The following countries are excluded:
- Countries where large volume of transship and transit cargoes are handled
- Countries which import large volume of cargoes overland
- Countries which are selfsufficient in grains and manufacturing products

Country	GDP/Cap. (US$)	Cargo Vol. /Cap (Ton)
Portugal	4,460	1.022
Iran	2,590	0.238
Algeria	2,520	0.518
Venezuela	2,480	0.949
Poland	1,890	0.395
Panama	1,800	0.274
Costa Rica	1,650	0.359
Turkey	1,370	0.479
Thailand	1,220	0.355
Peru	1,080	0.225
Cameroon	1,010	0.229
Ecuador	980	0.193
Congo	970	0.313
El Salvador	950	0.177
P. New Guine	900	0.246
Morocco	900	0.300
Dominica R.	790	0.265
Philippines	690	0.230
Guinea	410	0.104
Togo	400	0.098
Pakistan	390	0.100
Ghana	380	0.105
Kenya	370	0.136
Haiti	360	0.102
Benin	340	0.150
Nigeria	330	0.108
Madagascar	220	0.070
Sierra Leone	220	0.079
Bangladesh	190	0.069
Somalia	130	0.090
Ethiopia	120	0.043

Statistics in1989

Figure 6.3.1(2) Correlation between Import Dry Cargo Vol. per Cap. and GDP per Cap.



Classification	Volume (Ton)	Share (%)
Export	9,757,000	60.1
Import	1,742,000	10.7
Domestic	4,745,000	29.2
Total	16,244,000	100.0

Source: Coastal Shipping Study (JICA)

Figure 6.3.1(3) Cargo Classification of Vietnam in 1995

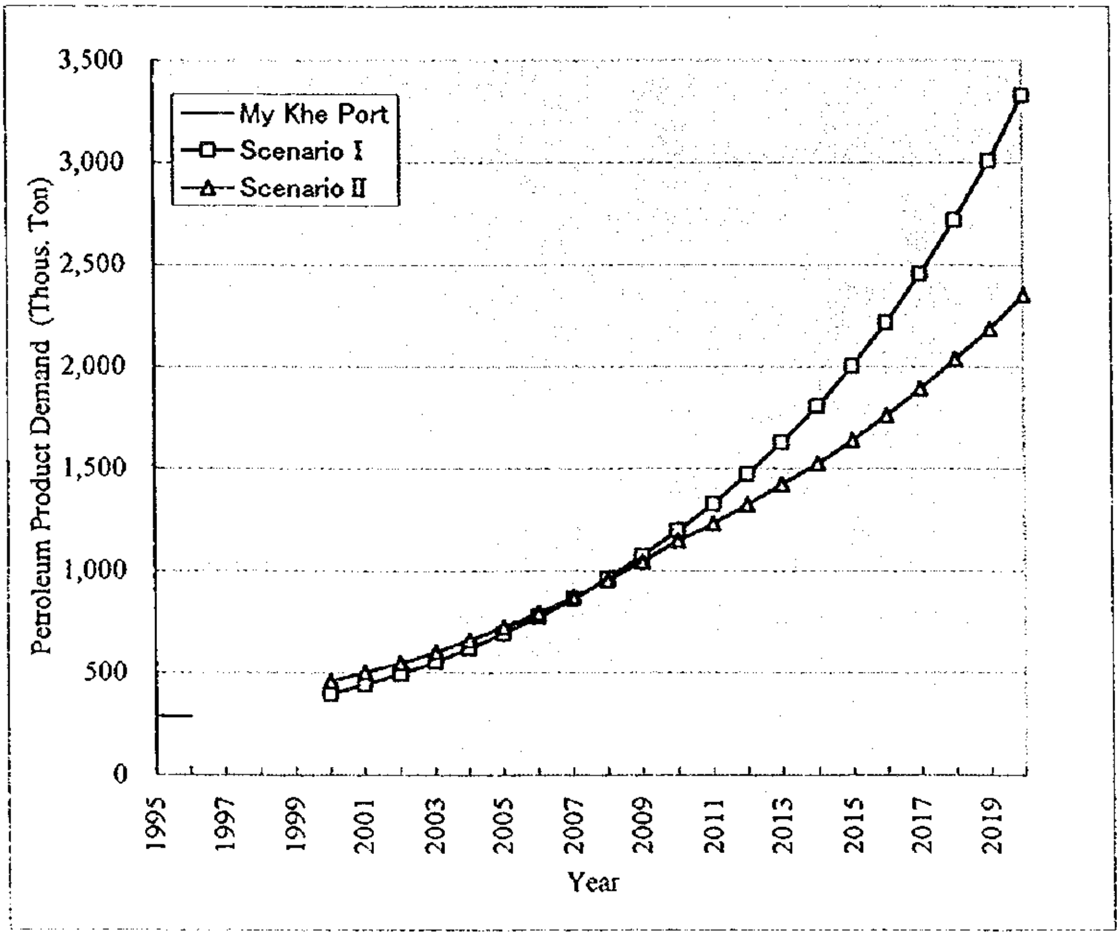


Figure 6.3.2 Petroleum Product Demand Forecast
and Cargo Throughput (except for Transit) of My Khe Port

6.4 Commodity-wise Forecast

Considering the present and future cargoes produced in Thua Thien Hue Province and the development plans of 4 Industrial Zone, the major commodities to be handled at Chan May Port are classified into the following groups (detailed data is shown in Table A6.4.1).

(1) Agricultural Products

Export : Sugar, Vegetables and Fruits, Marine products, Meat
Import : Textile, Cotton, Wheat

The throughput of agricultural products in 2000 and 2010 is estimated by Thua Thien Hue Province. As the volume of agricultural products will be expected to continue increasing, the cargo volume of agricultural products in 2020 is estimated by the time trend analysis.

In the case of sugar products, the correlation between the cargo volume and year is as follows.

$Y = 10{,}661X - 21{,}257{,}942$ ($r = 0.99$)
Where Y : Total sugar products (ton)
X : Year
r : Correlation coefficient

Furthermore, export of sugar products is calculated by multiplying the share of the export volume. The other commodities of agricultural products are calculated in the same way. The results of the calculation are summarized below.

Export

Unit : tons

year	2010	2020
Sugar	152,000	236,000
Vegetables and Fruits	85,000	135,000
Marine products	9,900	14,100
Others	60,100	97,700

Import

Unit : tons

year	2010	2020
Cotton, textile and others	29,100	34,700

(2) Mining, Clinker and Break Bulk Cargo

Export : Kaolin, Glass, Ceramic Tile, Stone, Brick
Import : Clinker, Gypsum
Domestic : Coal

The throughput of mining products, clinker and break bulk cargo in 2000 and 2010 is estimated by Thua Thien Hue Province.

Taking it into consideration, export and import cargo volume of mining products through Chan May Port is calculated at 259,800 tons in 2010 and 676,700 tons in 2020. Considering each transport mode and consumption of the province, domestic cargo volume is estimated at 200,000 tons in 2010 and at 450,000 tons in 2020. The foreign and domestic volume of mining and bulk cargo is summarized as follows.

Export Unit : tons

year	2010	2020
Kaolin	40,700	151,000
Glass	25,000	115,000
Ceramic Tile	10,200	20,700
Others	24,900	77,000

Import Unit : tons

year	2010	2020
Clinker and others	159,000	313,000

Domestic Unit : tons

year	2010	2020
Coal	200,000	450,000

(3) Oil and Oil Products

Import : Oil products

The cargo throughput of oil and oil products in 2000 and 2010 is estimated by Thua Thien Hue Province. Taking it into consideration, import cargo volume of oil products through Chan May Port is calculated at 610,000 tons in 2010 and 1,416,000 tons in 2020.

(4) Fertilizer and Break Bulk Cargo

Export : Chip, Furniture, Plywood
Import : Fertilizer, Insecticide
Domestic : Iron and steel

The cargo throughput of fertilizer and break bulk cargo in 2000 and 2010 is estimated by Thua Thien Hue Province. Taking it into consideration, export and import cargo volume through Chan May Port is calculated at 126,700 tons in 2010 and 217,000 tons in 2020. Furthermore, considering each transport mode and consumption of the province, domestic cargo volume is estimated at 33,000 tons in 2010 and 86,000 tons in 2020. The foreign and domestic volume of break bulk cargo is summarized as follows.

Export Unit : tons

year	2010	2020
Chip	35,000	45,000
Plywood	12,000	36,000
Other break bulk cargo	49,700	96,000

Import Unit : tons

year	2010	2020
Fertilizer and Insecticide	30,000	40,000

Domestic Unit : tons

year	2010	2020
Iron and steel	33,000	86,000

(5) Cement

Export : Cement
Domestic Cargo : Cement

The cargo throughput of cement products in 2000 and 2010 is estimated by Thua Thien Hue Province. Taking it into consideration, export cargo volume through Chan May Port is calculated at 200,000 tons in 2010 and 830,000 tons in 2020. Furthermore, considering each transport mode and production of the province, domestic cargo volume is estimated at 450,000 tons in 2010 and 450,000 tons in 2020. The foreign and domestic volume of cement products is summarized as follows.

Export Unit : tons

year	2010	2020
Cement	200,000	830,000

Domestic Unit : tons

year	2010	2020
Cement	450,000	400,000

(6) Manufacturing Cargo

Export : Textile and Garment, Processed Food, Mechanical, Electrical and Chemical products
Import : Mechanical and Electrical parts
Domestic Cargo : Chemical product materials

The cargo throughput of manufacturing cargo in 2000 and 2010 is estimated by Thua Thien Hue Province. Taking it into consideration, export and import cargo volume through Chan May Port is calculated at 363,200 tons in 2010 and 647,000 tons in 2020. Furthermore, considering each transport mode and consumption of the province, domestic cargo volume is estimated at 15,000 tons in 2010 and 71,500 tons in 2020. The foreign and domestic volume of manufacturing cargo is summarized below.

Export Unit : tons

year	2010	2020
Textile and Garment	28,600	39,800
Processed Food	45,500	56,500
Mechanical and chemical products	95,600	228,100

Import Unit : tons

year	2010	2020
Mechanical parts and others	53,600	90,100
Electrical parts and materials	82,500	171,00
Chemical materials	57,400	61,500

Domestic Unit : tons

year	2010	2020
Chemical materials	0	51,500

(7) Cross Check with the Result of Macro Forecast

Commodity-wise forecast (micro forecast) of dry cargo in 2010 and in 2020 of the port for cargo handling located in the study hinterland is summarized in the Table6.4.2.

Table 6.4.2 Cargo Throughput by Micro Forecast

Unit: Ton

Province	Port	2010	2020
Quang Tri	Cua Viet Port	71,000	93,000
Thua Thien Hue	Chan May Port※	1,985,000	3,947,000
	Thuan An Port	80,000	90,000
Danang City	Danang Port and Lien Chieu Port※	5,173,000	8,636,000
Quang Ngai	Dung Quat Port※	750,000	6,077,000
	Sa Ky Port	42,000	92,000
(Total)		8,101,000	18,935,000

※under planning

On the other hand, macro forecast of dry cargo in the study hinterland is summarized in the Table6.4.3. Two forecasts present similar figures as seen in the Figure 6.4.1 and yet the micro forecast exceeds Scenario I of the macro forecast by 603,800tons in 2010, while Scenario I of the macro forecast exceeds the micro forecast by 1,257,900tons in 2020.

Table 6.4.3 Cargo Throughput by Macro Forecast

Unit: Ton

Scenario	2010	2020
I	7,496,000	20,194,000
II	5,654,000	15,624,000
III	4,961,000	10,314,000

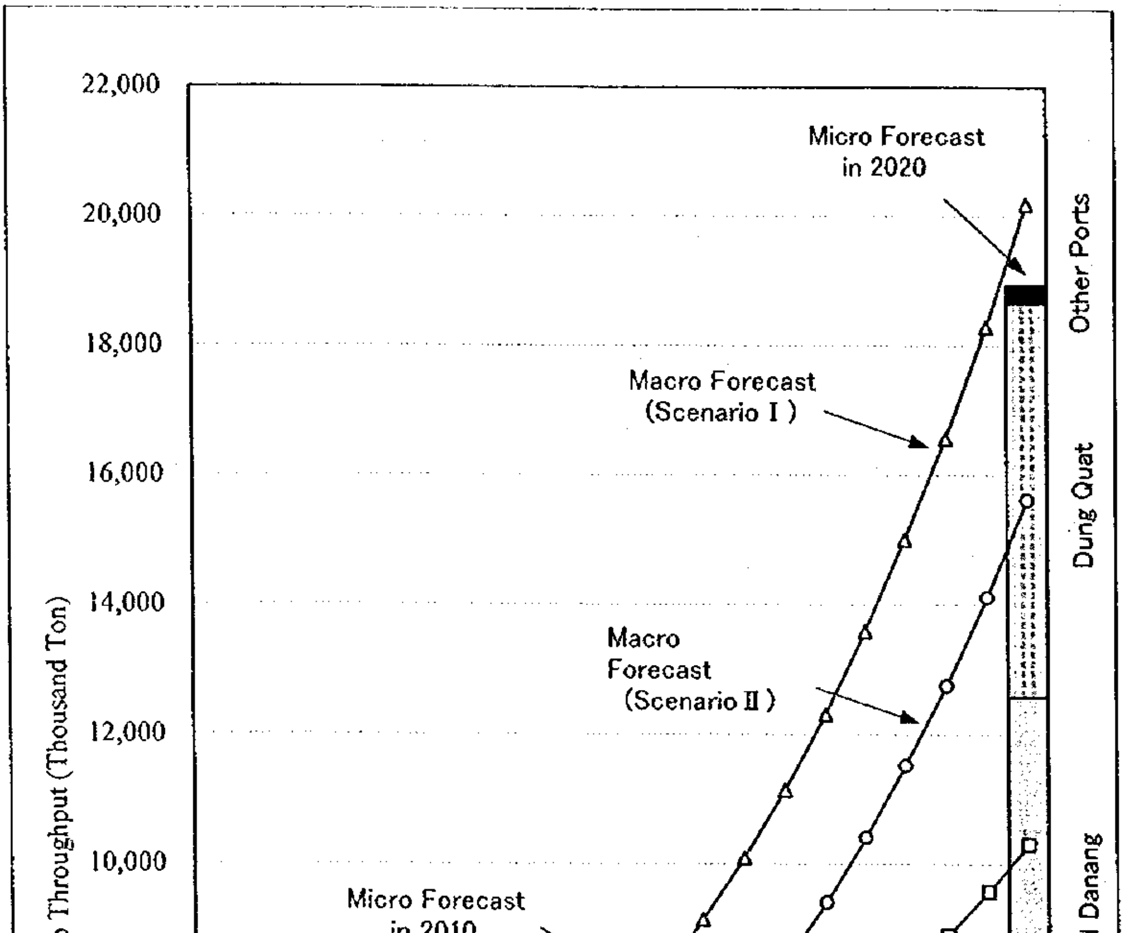


Figure 6.4.1 Comparison between Macro Forecast and Micro Forecast (Dry Cargo)

6.5 International Transit Cargo

The majority of Laotian trade is conducted via Bangkok port. According to the long-term forecast up to 2020, this situation is thought to change only slightly. Once Lao and Vietnam join ASEAN, trade and commerce between Thailand and Vietnam will be energized, and the flow of capital, skilled workers and goods will greatly increase. It is possible that the volume of foreign trade will be expanded if transport infrastructure in Lao, which is situated between the two countries, is improved. Though cargo has been transported via Bangkok port up to now, traded goods may use Vietnamese ports, especially those of Northeast Asia.

In order to realize the shift from the current trade route via Bangkok port to Vietnamese ports, certain preconditions must be met. But while the share in the flow of goods to both parties can be expected to greatly increase, transit cargo is excluded. In other words, after manufacturing and production in Thailand, goods can be assembled and finished in Vietnamese factories and then exported. In that case, this cargo would be treated as cargo originating from Vietnamese factories. In the meantime, conditions which must be satisfied for the change to occur are listed below.

1) Cargo of Thailand is subject to customs inspection within the ASEAN region at the first point of origin and free pass charge shall be paid. But there will be no special taxation on goods passing through Lao and Vietnam, which means that border clearance shall be very quick.
2) Transport vehicles within the ASEAN region require a transit permit, but transport activities can be performed freely in Thailand, Lao and Vietnam.
3) Road conditions in Lao and Vietnam must be improved through paving and increasing lane width so that vehicles can run at the same speed as on roads in Thailand.
4) The service level of Vietnamese ports in terms of cost, security and vessel allocation must be equal to that of Bangkok port.

If these conditions are not met, it will not be possible to demonstrate the short distance merit of Vietnamese ports and there will be no change in the transport route of cargoes traded with Northeast Asia. It may take a number of years before all conditions are satisfied. It will take many years before the road system is completed and it will take at least as many years to establish the necessary rules and regulations. In this study, it is thought that most conditions can be met by 2010.

On the assumption that the transport conditions can be satisfied, it is necessary to identify what types of cargoes will be transported via Vietnamese ports.

1) Cargoes originating in areas in close proximity to Vietnamese ports
2) Cargoes from areas east of Vietnam
3) Types of cargo which can be bagged or directly stocked in container box and transported by land

Two common methods, a macro and a micro forecast, were used to forecast the volume of trade. In the macro forecast, the trade volume was forecast up the year 2010 and again to 2020 based on various economic indices related to import and export trends. The micro forecast estimated the volume of each commodity individually up to 2020 based on reports such as the national development plan. Conventional cargo was forecast based on future economic indices and currents trends.

Lumbering is prohibited in principal but some lumber is being exported nonetheless. And the development of the many new hydro-electric power plants which are planned will be accompanied by the felling of trees. Therefore, it is thought that lumber exports will continue at their present level. However, as the majority of the demand will come from Thailand and Vietnam, the export volume to Northeast Asia is not expected to be large. With the development of Bolovens Plateau in Lao, there will likely be an increase in coffee exports. And fertilizer imports will increase as part of the plan to increase rice production in the whole country without using the traditional slash-and-burn method.

The type of oil to be imported will be mainly light fuel. The consumption volume is forecast to be only about 10 % of that of Vietnam and Thailand, or 2-3 million tons. Therefore, rather than construction of an oil refinery in Lao, the best approach is to import oil after it is refined in Thailand and Vietnam.

6.5.1 Socioeconomic condition of Lao PDR and Thailand

(1) Lao PDR

Based on the National Development Plans in Lao PDR, namely 1996-2000 SOCIO-ECONOMIC DEVELOPMENT PLANS, the national economic growth target is to achieve an average growth of 8-8.5% per year, of which:

1) Average annual increase of gross agriculture-forestry product is approximately 5%
2) Annual increase of gross industry and handicraft product is 12% approximately
3) Annual increase of gross service product is 10-11%

1. By the year 2000, the population is expected to grow to 5.2 million with an average GDP per capita of approximately US$500.
2. Endeavors must be exerted to attain the following structural composition : Agriculture-forestry 48%, industry-handicraft 22% and services 30% of the GDP.

Table 6.5.1 Growth Rates of Indicators of Lao PDR

	Growth Rate				
Year	Population	GDP	Agriculture-GDP	Industry-GDP	Service-GDP
1995-2000	2.83	8.0	5.0	12.0	10.5
2001-2010	2.66	8.3	5.0	11.5	10.0
2011-2020	2.36	8.6	5.0	11.0	9.5

Source :World Population Projection 1995 by World Bank
1996-2000 Socio-Economic Development Plans, October 1996, by Government of Lao

(2) Thailand

According to the national development plan, "The Eighth National Economic and Social Development Plan (1997-2001), Government of Thailand", the long term vision is planned as follows : by the year (2020) the Thai economy will be the eighth largest in the world, with an average per capita income of not less than 300,000 baht or about US$12,000 at 1993 constant prices. Average annual growth rate of GDP of Thailand from 1971-1995 is computed at 7.5%. If growth rates of GDP are set at 8.4, 7.7, 6.9% for 1996-2000, 2001-2010, 2011-2020 respectively, GDP per capita in 2020 can clear the target value.

By the year 2020 targeting areas are thought to be developing each sector corresponding to the increased border trade with Lao PDR and Vietnam and agricultural development. Growth rate of agriculture GDP of target areas is set 0.5% higher than that of Thailand because of high agricultural contribution of these areas. Growth rates of service sector are projected slightly higher than the national average and those of the industrial sector are thought to be at the same level as the national average. Specifically, growth rates of agricultural GDP, industrial GDP and service GDP are assumed at 4.0, 9.0 and 8.0 % respectively. Growth rates of Regional GDP from 1996-2000, 2001-2010 and 2011-2010 are computed at 7.2, 7.4 and 7.6% for R-9 hinterland and 7.3, 7.5 and 7.7 % for R-16/18 hinterland. Average growth rates from 1996-2020 of the two areas are the same at 7.5 %, which corresponds with the national target.

6.5.2 Macro Forecast of Transit Cargoes

International transit cargo from/to Northeast Thailand and Lao PDR is estimated based on the assumption that imports of the two countries will increase to the level of 0.12 tons per capita in Lao and 0.23 tons per capita in Thailand. These figures are obtained from the correlation between import volume and GDP per capita of more than 30 countries in the world. Correlation equation is as follows:

$$\text{Import dry cargo} = 0.1011 * (\text{GDP/capita})^{0.7131} \qquad (\text{ton})$$

where, GDP/capita : US$ in 1989 constant price

Of the hinterland's export and import cargo volumes, it is assumed that 50% of Laotian cargo will be transported via Vietnamese ports and 25% of Northeast Thai cargo will be transported via Vietnamese ports. Transit cargo projection is summarized in Table 6.5.2 (1).

Table 6.5.2 (1) Projection of Import (Dry Cargo)

Area Year	GDP per capita (US$ in 1989)	Population (000)	Cargo Volume per capita (ton)	Cargo Volume (000 ton)	Vietnamese Transit (000 ton)
Lao R-9					
2010	830	1,243	0.076	95	47.4
2020	1500	1,570	0.116	183	91.3
Lao R-16/18					
2010	830	1,118	0.076	85	42.6
2020	1500	1,413	0.116	164	82.1
Thailand R-9					
2010	1950	3,739	0.140	524	131.0
2020	3890	3,921	0.229	899	224.9
Thailand R-16/18					
2010	1940	4,357	0.140	609	152.1
2020	3880	4,569	0.229	1,046	261.6

Export dry cargo is assumed at 92% of import dry cargo based on trends of Thai trade.

Table 6.5.2 (2) International Transit Cargo by Macroscopic Forecast

(unit : ton)

	Year 2010			Year 2020		
Hinterland	Export	Import	Total	Export	Import	Total
Lao R-9	43,600	47,400	91,000	84,000	91,300	175,200
Lao R-16/18	39,200	42,600	81,800	75,600	82,100	157,700
Thai R-9	120,600	131,000	251,600	206,900	224,900	431,800
Thai R-16/18	140,000	152,100	292,126	240,600	261,600	502,200
Total R-9	164,200	178,400	342,600	290,900	316,100	607,000
Total R-16/18	179,200	194,800	374,000	316,200	343,700	659,900

6.5.3 Microscopic Cargo Forecast

Available trade volume at the site is expected as follows.

(1) Bolovens Plateau development project (Lao PDR)

Bolovens Plateau spreads over Champasack, Saravane and Sekhong provinces in Lao PDR. In the year 2010, the volume of coffee exports is expected to be 60,000 tons from the harvest area of 59,000 hectares. In the year 2020, export volume is estimated at 70,000 tons due to the expanded irrigation area.

Table 6.5.3 (1) Bolovens Plateau Development Project

year	Harvest Area (ha)	Annual Production (ton)	Export (ton)
1985	12,452	6,068	2,900
1994	19,190	8,270	4,324
1995	20,155	8,575	3,949
2010	59,000	65,000	60,000
2020	59,000	78,000	70,000

(2) Forest products (Lao PDR)

Export of log is not allowed in Lao PDR. It is possible only from the waterflooded area of dam site. Lak Sao located on the Route 8 is the major forest business center and around 10,000 cubic meters of log are exported to Japan from Lak Sao via Vinh. In case of Southern Lao, the same type of wood as in Malaysia is available. But the transportation cost from Malaysia to Northeast Asia is lower than from Lao because of the lower land transportation cost. Therefore, major exporting markets of Southern Laotian log are assumed to be Thailand and Vietnam.

Some timber factories in Savannakhet and Pakse can be assumed to produce exporting goods to Northeast Asia. Exporting volumes from Savannakhet and Pakse are assumed at 9% and 11% of Lao projected forest factory products corresponding to ratio of plantation area. Actual export volume from southern Lao to Northeast Asia is thought to be small. From interviews with Japanese investors, 3,000 tons of finished wood products were exported from Vientiane via Bangkok. Considering other forest statistics, 150,000 tons of forest products is assumed as the export volume in 2010 and 2020. As the export volume to Northeast Asia, only 15,000 tons of processed wood are projected by each respective target area assuming a factory similar to the one established in Vientiane.

Table 6.5.3 (2) Export of Forest Products

Total exporting forest products in 2020	150,000 ton	
R-9 Hinterland	15,000 ton	(10%)
R-16/18 Hinterland	15,000 ton	(10%)

(3) Forest Products (Northeast Thailand)

From the distribution of wood shops in the two study areas, exporting capacity by area is thought to be around 2 % of Thai forest products by each hinterland (see Table A 6.5.3 (4)).

Since 26,000 tons of sawn timber and 805,000 tons of rubber products are forecast to be exported to Northeast Asia in 2010 and 2020, 16,000 tons of this total are estimated to pass through the ports of central Vietnam.

Table 6.5.3 (3) Export of sawn timber

	Volume & share in 1990	Estimated export volume To Northeast Economies in 1994
Japan	23,852 cu.m. 48 %	26,900 cu.m. 48 %
Singapore	7,812 cu.m. 16 %	-
USA	4,570 cu.m. 9 %	-
Italy	4,196 cu.m. 8 %	-
Denmark	1,984 cu.m. 4 %	-
Hong Kong	1,873 cu.m. 4 %	2,240 cu.m. 4 %
Northeast Asia Total	25,725	29,140
Total	49,459 cu.m. 100 %	56,000 cu.m. 100 %

Source :Forestry Statistics 1990 , Statistical Yearbook Thailand 1995

Table 6.5.3 (4) Export of natural rubber by country 1993-1994

	in 1993	In 1994
Japan	480,652 ton	559,007 ton
China	233,076	237,115
USA	194,526	227,131
South Korea	90,910	108,167
Malaysia	71,764	113,045
Northeast Asia Total	804,638 (54%)	904,289 (37%)
Total	1,492,794	2,424,373

Source :Statistical Yearbook Thailand 1995

(4) Rice (Northeast Thailand)

Thailand is the biggest exporting country of rice in the world. Japan imported an average of 392,000 tons /year of rice from Thailand in 1993 and 1994(see Table A 6.5.3 (5)). Northeast Thailand is a major production area of rice; export volume is estimated at 210,000 tons through R-9 and 270,000 tons through R-16/18.

Table 6.5.3 (5) Estimated Export of Rice (Unit : ton)

Hinterland	Production in 1993	Consumption annum 300kg/capita	Available Export Volume	Assumed Export Volume
R-9 Mukdahan	1,384,000	1,170,000	214,000	210,000
R-16/18 Ubon Ratchathani	1,660,000	1,380,000	280,000	270,000

(5) Fertilizer (Lao PDR)

Lao government established an agricultural development plan for rice production. The target production volume is 2 million tons, which is equivalent to providing 400 kg/year of rice to 5 million people. The study team estimated that rice consumption will be 300 kg/year and wheat consumption will be 100kg/year in 2020.

In order to increase rice production, fertilizer is a useful means. To meet the increasing demand for wheat, wheat imports will gradually increase through current trading route.

Table 6.5.3 (6) Consumption and Import of Fertilizer in Lao

	Harvest Area	Fertilizer Consumption	Fertilizer Import
Lao R-9	120,000 ha	12,000 ton	12,000 ton
Lao R-16/18	111,000 ha	11,100 ton	11,000 ton

(6) Fertilizer (Northeast Thailand)

According to annual statistics of Thailand in 1994 and 1995, 1 million tons of fertilizer are imported from the Republic of Korea while total imported volume was 3.5 million tons. Consumption volume of fertilizer in 2020 is projected at 101,000 ton/year for R-9 hinterland and 143,500 ton/year for R-16/18 hinterland respectively.

Production of fertilizer is expected in 2020 by the chemical industry in Thailand, but the study area in the Northeast Region will purchase around half of its annual consumption fertilizer by import via central Vietnamese ports.

Table 6.5.3 (7) Consumption and Import of Fertilizer in Northeast Thailand

	Harvest Area	Fertilizer Consumption	Fertilizer Import
Thailand R-9	1,010,000 ha	101,000 ton	51,000 ton
Thailand R-16/18	1,435,000 ha	143,500 ton	71,000 ton

(7) Daily Goods (Lao PDR and Thailand)

Daily goods imports are estimated by unit volume in correspondence with GDP per capita as shown in Table 6.5.3 (8).

Table 6.5.3 (8) Daily Goods Imports in 2020

	GDP per capita (US$)	Assumed Daily Goods per capita (kg/person)	Population (person)	Estimated Import Volume (ton)
Lao R-9	1,500	30	1,570,000	47,000
Lao R-16/18	1,500	30	1,413,000	42,000
Thailand R-9	3,890	50	3,921,000	196,000
Thailand R-16/18	3,880	50	4,569,000	228,000

Table 6.5.3 (9) Daily Goods Imports in 2010

	GDP per capita (US$)	Assumed Daily Goods per capita (kg/person)	Population (person)	Estimated Import Volume (ton)
Lao R-9	830	30	1,243,000	37,000
Lao R-16/18	850	30	1,118,000	34,000
Thailand R-9	1,950	30	3,739,000	112,000
Thailand R-16/18	1,940	30	4,357,000	131,000

(8) Other Miscellaneous Cargo (Lao PDR)

Other exporting goods will be raw materials and finished products. Major commodities to be considered are garment, manufactured products, mineral (gypsum), food etc.

Other importing goods will be finished products or intermediate products. Major commodities considered are car, cement, electric product, factory machine, steel etc.

(9) Other Miscellaneous Cargo (Northeast Thailand)

Agricultural products other than rice and manufactured products are estimated to be exported to Northeast Asia via Vietnamese ports. Other imports are construction materials, factory machines and intermediate products from Northeast Asian countries.

(10) Trading Cargo Volume

Trading cargo volumes of hinterland in 2020 and in 2010 are estimated by totaling above volumes. But those include both cargoes through Bangkok and Vietnamese ports.

Table 6.5.3 (10) Trading Cargo Volume in 2020 (Unit : ton)

Export	Agri-Product	Forest Product	Other	Total
Lao				
R-9	0	15,000	10,000	25,000
R-16/18	70,000	15,000	10,000	95,000
Thailand				
R-9	210,000	16,000	10,000	236,000
R-16/18	270,000	16,000	10,000	296,000
Total				
R-9	210,000	31,000	20,000	261,000
R-16/18	340,000	31,000	20,000	391,000
Grand Total	550,000	62,000	40,000	652,000

Import	Fertilizer	Daily Goods	Other	Total
Lao				
R-9	12,000	47,000	40,000	99,000
R-16/18	11,000	42,000	40,000	93,000
Thailand				
R-9	51,000	196,000	40,000	287,000
R-16/18	71,000	228,000	40,000	339,000
Total				
R-9	63,000	243,000	80,000	386,000
R-16/18	82,000	270,000	80,000	432,000
Grand Total	145,000	513,000	160,000	817,000

Table 6.5.3 (11) Trading Cargo Volume at Site in 2010

(Unit : ton)

Export	Agri-Product	Forest Product	Other	Total
Lao				
R-9	0	15,000	10,000	25,000
R-16/18	60,000	15,000	10,000	85,000
Thailand				
R-9	210,000	16,000	10,000	236,000
R-16/18	270,000	16,000	10,000	296,000
Total				
R-9	210,000	31,000	20,000	261,000
R-16/18	330,000	31,000	20,000	381,000
Grand Total	540,000	62,000	40,000	642,000

Import	Fertilizer	Daily Goods	Other	Total
Lao				
R-9	12,000	37,000	40,000	89,000
R-16/18	11,000	34,000	40,000	85,000
Thailand				
R-9	50,000	112,000	40,000	202,000
R-16/18	70,000	131,000	40,000	241,000
Total				
R-9	62,000	149,000	80,000	291,000
R-16/18	81,000	165,000	80,000	326,000
Grand Total	143,000	314,000	160,000	617,000

6.5.4 High Case and Low Case

(1) Schedule of Relevant Projects

In 6.5.3, available volume as international transit cargo is estimated, and this is thought to be maximum. Actual trade volume through Vietnamese ports is determined by the transport condition. This is decided by completion of 4 projects of road improvements, 2 projects of bridge construction and 1 tunnel project. Starting of AFTA in the study area is also important. Favorable project schedule is assumed as high case and delayed schedule as low case. Favorable schedule is assumed as follows:

AFTA	- Vietnam and Lao are expected to enter AFTA in 2006 after first official start in 2001 by the first group.
Road 9	- Estimated construction period (2000 – 2003)
Mukdahan Bridge	- Estimated construction period (2000 – 2003)
Haivan Tunnel	- Completed up to 2004
Road 14, 14B	- Completed up to 2004
Road 16	- Estimated construction period (2010 – 2013)
Road 18	- Estimated construction period (2004 – 2007)
Pakse Bridge	- Estimated construction period (1997 – 2000)

Table 6.5.4(1) Estimated Completion Schedule of Relevant Projects

◎:High Case ○:Low Case

Project	2000	-	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	--	2018	-	2020
AFTA						◎			○								
Road 9			◎			○											
Mukdahan Br.			◎			○											
Haivan Tunnel				◎													
Road 14/14B							◎				○						
Road 16													◎		○		
Road 18							◎				○						
Pakse Br.	◎																

(2) High Case and Low Case

In the high case, international transit cargo will start to be handled at central

Vietnamese port from the year 2003 for Route 9 and 2007 for Route 16/18; after 13 years all available cargo will be shifted to the routes completely. In the low case, this shift will be delayed 3 years for Route 9 and 4 years for Route 16/18. Also, the shifting interval is estimated as 16 years. Available cargo at site is transported to/from Vietnamese ports by rate which is estimated based on condition of transport routes. Above rate is set for high and low cases as in Tables 6.5.4 (2) and (3).

Table 6.5.4(2) Ratio of Cargo Flow to Vietnam (High Case)

	2003	2004	2005	2006	2007	--	2010	----	2015	2016	---	2020
R-9	0.20	0.30	0.40	0.50	0.55	--	0.70	----	0.95	1.00	---	1.00
R-16/18	0.00	0.00	0.00	0.00	0.20	--	0.50	----	0.75	0.80	---	1.00

Table 6.5.4(3) Ratio of Cargo Flow to Vietnam (Low Case)

	2006	2007	--	2010	2011	2012	--	2015	---	2019	2020
R-9	0.20	0.30	--	0.55	0.60	0.65	--	0.80	---	1.00	1.00
R-16/18	0.00	0.00	--	0.00	0.20	0.30	--	0.55	---	0.75	0.80

(3) Style of Cargo

Containerized rate of cargo depends on two factors: the characteristics of the commodity and the land transport condition such as free pass cargo. In other words, the containerized rate of international transit cargo is set higher than non-transit cargo.

For exports, containerized rates of coffee and rice are set at 100 % and forest products and other miscellaneous at 50 %. For imports, containerized rate of daily goods is set at 100 % and fertilizer and other miscellaneous at 50 %.

(4) Transit Cargo Volume

Transit cargo volume by style is calculated by using above two coefficients. Transit cargo volumes in 2005, 2010, 2015 and 2020 are estimated by road route(see Tables 6.5.4 (4) and (5)).

Table 6.5.4 (4) Transit Cargo through Route-9 (Unit : ton)

Cargo Case	Direction	Year 2005	Year 2010	Year 2015	Year 2020
High Case	Import	75,000	154,000	248,000	314,000
Container	Export	93,000	163,000	223,000	236,000
	Total	168,000	317,000	471,000	550,000
High Case	Import	29,000	50,000	68,000	71,000
BreakBulk	Export	9,000	17,000	23,000	26,000
	Total	38,000	67,000	91,000	97,000
High Case	Import	104,000	204,000	316,000	385,000
Total	Export	102,000	180,000	246,000	262,000
	Total	206,000	384,000	562,000	647,000
Low Case	Import	0	121,000	209,000	314,000
Container	Export	0	128,000	187,000	236,000
	Total	0	249,000	396,000	550,000
Low Case	Import	0	39,000	57,000	71,000
BreakBulk	Export	0	13,000	20,000	26,000
	Total	0	52,000	77,000	97,000
Low Case	Import	0	160,000	266,000	385,000
Total	Export	0	141,000	207,000	262,000
	Total	0	301,000	473,000	647,000

Table 6.5.4 (5) Transit Cargo through Route-16/18 (Unit : ton)

Cargo Case	Direction	Year 2005	Year 2010	Year 2015	Year 2020
High Case	Import	0	123,000	218,000	351,000
Container	Export	0	177,000	269,000	366,000
	Total	0	300,000	487,000	717,000
High Case	Import	0	40,000	60,000	80,000
BreakBulk	Export	0	11,000	18,000	26,000
	Total	0	51,000	78,000	106,000
High Case	Import	0	163,000	278,000	431,000
Total	Export	0	188,000	287,000	392,000
	Total	0	351,000	565,000	823,000
Low Case	Import	0	0	160,000	280,000
Container	Export	0	0	198,000	292,000
	Total	0	0	358,000	572,000
Low Case	Import	0	0	44,000	64,000
BreakBulk	Export	0	0	13,000	20,000
	Total	0	0	57,000	84,000
Low Case	Import	0	0	204,000	344,000
Total	Export	0	0	211,000	312,000
	Total	0	0	415,000	656,000

Table 6.5.4 (6) Summary of International Transit Cargo

Year	2010	2020
Case	High	High
R-9	384,000	647,000
R-16/18	351,000	823,000
Grand Total	735,000	1,470,000

Table 6.5.4 (7) Transit Cargo of High Case in Chan May

		Year 2005	Year 2010	Year 2015	Year 2020
Import	BreakBulk	26,000	45,000	61,000	64,000
Export	BreakBulk	8,000	15,000	21,000	23,000
Total	BreakBulk	34,000	60,000	82,000	87,000

Table 6.5.4 (8) Transit Cargo of Low Case in Chan May

		Year 2005	Year 2010	Year 2015	Year 2020
Import	BreakBulk	0	35,000	51,000	64,000
Export	BreakBulk	0	12,000	18,000	23,000
Total	BreakBulk	0	47,000	69,000	87,000

6.5.5 Land Transport Cost

In terms of land transport cost, unit cost per kilometer reflect the condition of road. In other words, a flat is easier to pass than a mountainous one and pavement is faster than gravel. Cost comparison table indicates estimated land transportation cost based on the modified Thailand regulations. If toll of bridge is assumed at 150 Thai Baht and free pass charge in other countries is assumed at 1,000 Thai Baht, not only southern Lao but also Mukdahan is inside the hinterland of the Port of Chan May.

Table 6.5.5. Land Transport Cost by Truck per 20' Container

(unit : US$/TEU, US$1=30THB)

Origin & Destination	Chan May	Bangkok
Savannakhet(R-9)	405	589
Pakse(R-16)	392	672
Pakse(R-18)	509	672
Mukdahan(R-9)	427	534
UbonRatchathani(R-16)	508	522
UbonRatchathani(R-18)	626	522

6.5.6 Sea Transportation Cost

Table 6.5.6 shows a comparison of freight rates of container handling in following cases: from the ports of Vietnam to Kaohsiung Port, Yokohama Port and Los Angeles Port, from the ports of surrounding ports to Kaohsiung Port, Yokohama Port and Los Angeles Port. The freight rates on containers transported from Bangkok and Singapore to Kaohsiung and Yokohama is quite low.

Table 6.5.6 Comparison of Freight Rates (Unit: US$ / 20feet)

From / To	Kaohsiung Port	Yokohama Port	Los Angeles Port
Hai Phong Port	750 (Direct)	1,200 (Via Hong Kong)	2,750 (Via Singapore)
Danang Port	850 (Direct)	1,300 (Via Kaohsiung)	2,750 (Via Singapore)
Saigon Port	600 (Direct)	1,100 (Via Kaohsinug)	2,520 (Via Singapore)
Bangkok Port	-	700 (Direct)	1,240 -
Singapore Port	350 (Commercial FDR)	450 (Direct)	-

Note : freight rates include surcharge

6.6 Cargo Throughput in 2010 and 2020

(1) Total Cargo Throughput

Table 6.6.1 shows a summary of the commodity-wise cargo and the international cargo from/to Lao PDR and Thailand forecast. The cargo volume through Chan May Port is estimated at about 2.6 million tons in 2010 and at about 5.4 million tons in 2020.

Table 6.6.1 Cargo Throughput in 2010 and 2020

Commodities	Foreign		Domestic		Total
	Export	Import	Loaded	Unloaded	
Year 2010					
Agricultural Products	307,000	29,000	0	0	336,000
Mining, Clinker and Bulk	101,000	159,000	0	200,000	460,000
Oil and Oil Products	0	610,000	0	0	610,000
Fertilizer and Break Bulk	112,000	75,000	0	33,000	220,000
Cement	200,000	0	450,000	0	650,000
Manufacturing Goods	155,000	149,000	15,000	0	319,000
International Transit Cargo	15,000	45,000	-	-	60,000
Total	890,000	1,067,000	465,000	233,000	2,655,000
Year 2020					
Agricultural Products	483,000	35,000	0	0	518,000
Mining, Clinker and Bulk	364,000	313,000	0	450,000	1,127,000
Oil and Oil Products	0	1,416,000	0	0	1,416,000
Fertilizer and Break Bulk	200,000	104,000	0	86,000	390,000
Cement	830,000	0	450,000	0	1,280,000
Manufacturing Goods	301,000	259,000	20,000	52,000	560,000
International Transit Cargo	23,000	64,000	-	-	87,000
Total	2,201,000	2,191,000	470,000	588,000	5,450,000

Note : Including of the international transit cargo from/to Lao PDR and Thailand

(2) Container cargo

The container volume is estimated from future containerization ratio. The manufacturing goods are suitable for containerization and the ratio of containerization is estimated by using the actual data of Hai Phong Port. The ratio of containerization during the planning period is calculated by the following equations.

(Export) $$Y = \frac{0.80}{1 + 0.6522^{t-3.268}}$$

(Import) $$Y = \frac{0.80}{1 + 0.7010^{t-5.344}}$$

Y : Ratio of containerization

t : Number of years from 1990

(Ratio of Containerization)

		2010	2020
Foreign	Export	80.0%	80.0%
	Import	79.7%	80.0%

Tonnage is converted into TEU assuming a unit weight per TEU. The assumed unit weight per TEU is 14.6 ton/TEU for export, and 12.0 ton/TEU for import respectively. The export and import volume of containerizable cargo is summarized as follows.

(Container cargo volume) Unit : TEU

Year	Export	Import	Empty	Total
2010	18,920	14,250	4,670	37,840
2020	33,520	22,400	11,120	67,040

7. Master Plan for Port Development

7.1 Port Development Policy

7.1.1. Basic Concept of Port Development of the Key Area in the Central Region

(1) The final goal of the port development of the region is to realize a well balanced national development by creating the third core of social and economic activity of the country following the other two advanced areas, namely Hanoi and Ho Chi Minh.

(2) In order to achieve the above objective, an effective port development strategy that leads to the promotion of regional development through the various port activities should be designed.

(3) The functional allotment among the ports in the three sites designated by the Scope of the Study should be clearly identified considering the geographical, social, political and economic conditions of each site, which means that unreasonable duplication of the port functions among these ports should be avoided.

(4) By building up a well conceived functional network, the three ports could function as one port which would contribute greatly to the expected regional development.

(5) Improvement of the port related infrastructures such as road, railway, power/water supply, industrial estate and so on should be planned and executed in principle according to the scale and function of the port development and construction planning/schedule of each target port. In actual planning works on the target ports of the Study, however, the existing plans or concepts on the development of port related infrastructures announced officially by the Vietnamese authorities shall be recognized as the status quo.

(6) Careful attention shall be paid to reasonable conservation of social and natural conditions.

(7) The full-scale development of the port function for the cargo traffic from/to the neighboring countries including Laos, Cambodia and Thailand needs to be planned generally from a medium/long term point of view, considering the uncertain situations of the countries in terms of economic and transport policies, or perspectives of future improvement of road / rail systems and cross border facilities.

(8) The actual construction of the required port facilities should be commenced only after relevant conditions such as industrial location, improvement of related infrastructures, social/

economic situations, official decision on each target site of the region and so on, are satisfied and confirmed.

(9) Considering the scale of economy and financial capability of Vietnam, the initial scale of port development needs to be planned and adjusted accordingly.

7.1.2 Functions of Chan May Port

After the completion of Hai Van Tunnel, expected in the year 2004, the distance between Chan May Port and Lien Chieu Port becomes 28 km. Both ports will play a complementary role if functions of both ports are well demarcated, however, both ports will be in cutthroat competition if the demarcation of functions is not taken into consideration.

Requirements for a commercial hub port are to accommodate post Panamax container ships and to have a large volume of cargo to enable shipping lines to make frequent calls at the port. It is therefore important that the Key Area of the Central region should have a large port complex to attract shipping lines and consequently cargoes from a wider hinterland. It should also be noted that maritime freight rate between large ports remains at a low level due to competition between shipping lines. However, maritime freight rates between small ports or between a large port and a small port are kept at a high level due to less competition between shipping lines. Shippers and consignees are therefore liable to choose a large port for their imports and exports.

Furthermore, port needs the accumulation of maritime services supporting trade and port activities. Since Danang Port is recognized as a commercial hub in the Central region, new commercial port in the Key Area should be built in close connection with Danang Port and should form a port complex in the area.

In terms of commercial port function, Chan May can form a port complex in the area after the completion of Hai Van Tunnel. First stage of the port development shall be part of the industrial park development planned behind the Chan May Bay. In the long-term, Chan May will form a port complex with ports in the Danang Bay. Summarizing the above mentioned idea, following core functions will be required for Chan May Port.

1) Chan May Port will play a role of commercial port as a port of Danang Bay port complex. At the first stage, Chan May will be developed as a gateway to the industrial park in the hinterland.

2) The Port will be required to accommodate international and domestic passenger cruisers for tourism promotion in Thua Thien-Hue Province.

3) The Port has to cater to fishing boats in the vicinity of Chan May Bay.

7.2 Requirements for New Port

7.2.1 Commercial Port

Seeking economies of scale, shipping lines deploy larger vessels and form groups for utilizing their capacities. In particular, container carriers introduced new alliances in 1996 and will bring larger vessels into operation in major shipping services, which will result in the reduction of calling ports of mother vessels. Consequently, ports are requested to cope with deep draft vessels or to remain as small feeder ports. In this regard, efforts should be made to attract shipping lines through economies of scale of port.

A new commercial port development should comply with the following requirements with a view to expanding the capacity of existing port and meeting the demand for economic development in the Central Region of Vietnam.

- To enable the port to accommodate post Panamax container ships on a long-term basis and to cope with urgent demand for feeder container services on a short-term basis.
- To ensure the calmness of the port waters;
- To upgrade and modernize cargo handling equipment so as to improve the cargo handling productivity, and to comply with an urgent need for increasing the capacity of container handling;
- To be flexible enough to cope with unforeseen changes in future demand;
- To improve the situation of present ports and to utilize the capacity of the present ports;
- To be competitive with ports in Thailand, namely Bangkok Port and Laem Chabang Port so as to attract export and import from/to Lao PDR and Northwest Thailand;
- To have a certain amount of cargo throughput (containers) to attract shipping lines and to enable liner vessels to serve frequently, at least one service a week, on a short-term basis;
- To encourage the participation of shipping companies in the development of port;
- To ensure easy access from the hinterland.

7.2.2 Industrial Port

Providing the region with a maritime transportation means, port plays a key role in encouraging investors to select the area for the development of their manufacturing factories, warehouse, cargo distribution center and other transportation facilities. However, the development of a new port requires a large amount of investment and a long period of construction. Hence, strategic development of ports is required from the viewpoint of early completion of facilities to cater to industries planned in the hinterland.

A new industrial port should fulfill the following requirements in compliance with the development of hinterland.

- To mitigate adverse effects on the environment caused by industries;
- To provide factories and importers & exporters in the hinterland with easy access to the waterfront;
- To minimize the cost and period of breakwater construction so as to encourage private investors to establish their facilities in the hinterland.

7.2.3 Target Ship Size

(1) Possible Size of Mother Container Vessels

The largest container ship in operation has dimensions of 318 m in length, 14 m in draft and 42 m in width, with a capacity of more than 6,200 TEUs. With the formation of new alliances, such as Global Alliance and Grand Alliance, shipping lines are deploying 5,000-6,000 TEU vessels on the trunk liner services. While only a few ports can accommodate this class vessel, hub ports are requested to cater to this class.

On a long-term basis, hub ports in Vietnam may be required to accommodate this class so that a container berth should have an alongside length of 330 m or more. It will therefore be necessary to design the container berths with this length or more, however, it will not be necessary to cater to this class on a short-term basis as the container throughput is limited. Taking into account container vessels seldom have full draft in actual operation, it will be adequate to deepen the basin if it becomes necessary. Port development plan should be flexible enough to cope with this demand.

(2) Dry Bulk Carriers and Tankers

Maximum DWT of ore/coal carries, oil tankers, and other bulk carriers are much bigger than container vessels, however, these are used only for low material transportation for heavy industries. Since Chan May is planned as a gateway port to the industrial parks in their hinterland, it will be adequate to cope with the cargoes originated from or destined to light industries.

In accordance with industrial development plans in Chan May, design ship size will be 40,000 DWT for dry bulk carriers, 20,000 DWT for break bulk carriers, and 12,000 DWT for cement ships.

(3) Coastal Ships

Conventional coastal ships will be gradually replaced by Ro/Ro and ferry boats on a long-term basis. Car carriers and other specialized vessels will be introduced in the near future. Sizes of typical coastal ships are listed in Table 7.2.1 and, therefore, deep berths for coastal ships are designed at a depth of 8 meters.

(4) Passenger Ships

Hue City, located 60 km northwest of Chan May, is a famous tourist destination in central Vietnam and Chan May Port will be required to serve for international cruisers. Ocean going cruisers are usually 15,000-80,000 GT and have a draft of 6-8 meters. The deepest draft cruiser, Queen Elizabeth II, has a draft of about 11 meters. Chan May Port is requested to accommodate such ocean going cruisers to promote tourism in the central region.

TABLE 7.2.1 Dimensions of Possible Calling Vessels

Vessel Type		L	B	d	
Container Vessel		m	m	m	Container
	50,000 GT (58,000 DWT)	280	32	13.0	3,600-4,000 TEUs
	48,000 GT (47,000 DWT)	275	32	12.0	3,200-3,700 TEUs
	43,000 GT (38,000 DWT)	250	32	11.5	2,400-2,800 TEUs
	37,000 GT (30,000 DWT)	216	32	11.5	1,600-2,000 TEUs
	32,000 GT (29,000 DWT)	222	32	11.3	1,500-1,800 TEUs
Car Carrier					
	42,000 GT (17,000 DWT)	185	29	9.0	
	32,000 GT (15,000 DWT)	180	32	9.8	
	31,000 GT (16,000 DWT)	190	32	8.2	
	31,000 GT (27,000 DWT)	196	32	8.5	
Bulk Carrier					
	60,000 DWT	220	32	12.4	
	40,000 DWT	201	29	11.7	
	36,000 DWT	183	29	10.9	
Ro/Ro					
	7,000 DWT	140		7.5	
	6,000 DWT	150		7.0	
	5,700 DWT	140		6.9	
Product Oil Carrier					
	6,000 DWT	106	16	6.9	
	5,000 DWT	104	16	6.5	
	3,000 DWT	92	14	5.7	
Cement Carrier					
	12,000 DWT	135		8.0	
	9,000 DWT	123		7.3	
General Cargo Ship					
	10,000 DWT	140	20	8.4	
	7,000 DWT	129	18	7.5	
	5,000 DWT	103	15	6.8	
	3,000 DWT	86	13	5.9	
	2,000 DWT	74	12	4.9	
Passenger Ship (Ocean Going)					Passengers
	77,000 GT	261	32	7.9	1,950
	49,000 GT	241	30	7.5	960
	29,000 GT	193	25	6.6	600
Ferry Boat (Long Distance)					
	20,000 GT	200	30	6.8	
	15,000 GT	190	29	6.8	
	12,000 GT	185	24	6.5	
	9,500 GT	160	22	6.2	

Note 1/ GT: Gross Tonnage
2/ DWT: Deadweight Tonnage
3/ L:Length over all, B:Moulded breadth; d:Moulded draft

7.3 Port Facilities

As shown in Chapter 6, the cargo transportation demand through Chan May Port is estimated at about 5.5 million tons in the year 2020 inclusive of container throughput of 67,000 TEUs.

Coping with these cargo throughputs, requirements for new berths in Chan May are estimated at one multi-purpose berth for container cargo vessels and general cargo trampers; one deep draft conventional berth for car carriers, passenger ships and general cargo trampers; three conventional berths for general cargo and bulk cargo; and 2 berths for product oil tankers. Small craft basin is also necessary for tug boats, pilot boats and other port service ships. Basin for fishing boats is also required in Chan May Port, which can be developed in the river mouth if the main breakwater is developed. All requirements for the new port of Chan May are summarized in Table 7.3.1.

TABLE 7.3.1 Requirement for New Berths (in 2020)

Location	Berth	Length (m)	Alongside depth (m)	Target Ship Size
W1	General cargo	150	8	7,000 DWT class Ro/Ro vessels; 7,000 DWT class conventional vessels
W2	Passenger and Conventional cargo	330	-13	80,000 GT class passenger ships; 40,000 GT class car carriers; 20,000DWT class general trampers
W-3	Multipurpose	330	-13	47,000 DWT class container vessel; 20,000 DWT class container feeder vessel
E1-3	General cargo/Liquid	450	-8	7,000 DWT class Ro/Ro vessels; 7,000 DWT class conventional vessels; 5,000 DWT class product oil tankers
E4	Breakbulk/Liquid	100	-5.5	2,000 DWT class conventional vessels
W1 side and E1 side	Small crafts	280	-4	Tug boats, Pilot boats, Customs' ships, others

Cargo handing capacity of a berth is estimated by the standard performance of cargo handling operations at each berth, i.e. 3,000 tons/year per one meter of 2,000 DWT class conventional berths, 3,750 tons/year per one meter of 5,000-10,000 DWT class conventional berths, and 4,500 tons/year per one meter of deep water berths for general trampers. Container handling capacity of a full size container terminal is estimated at 150,000-200,000 TEUs per year. Because the transhipment from a mother vessel to a feeder vessel does not offen in the Danang area, container handling performance cannot be so high as that of a transhipment port.

Although Berth W3 is planned as a multi purpose berth with two container cranes, container cargo in Chan May will be mostly feeder containers. Size of multi-purpose berth is planned to have an alongside length of 330 meters, an area of 10.5 ha for container yard and open shed for general cargo. A deep water berth can also accommodate ocean going cruisers and therefore passenger terminal will be necessary in the back yard.

Conventional cargo berths are planned to have an alongside depth of 5.5-8.0 meters and a total length of 700 meters. Back yard has a total area of 49 ha for open yard, transit sheds, warehouses, truck pools and other port related land use. Four lane road will be necessary for port access form the hinterland. Chan May industrial park will provide enough area for port related industries.

Here, to determined the scale of berth, vessel type and sizes will first be explained. Cargo forecast is carried out by commodity basis, and as a result the vessel type can be specified for each cargo, for example a container vessel, a bulk carrier, and so on. Once the vessel type is specified, the alternative dimensions of each type of vessels can easily be found. These are general dimensions of each type and not necessarily applicable to the vessels which will possibly call the studied ports. The sizes of the possible vessels calling the specific port are to be examined. The most desirable and probable vessel sizes are examined taking into account the following issues;

- status of the port , that is, distinction between a mother port and a feeder port etc.
- cargo volume, that is, large vessels cannot call for a small amount of cargo and on the other hand small vessels are inadequate and inefficient for a large amount of cargo.
- calling conditions, that is, loading factors of vessels depend on their sea route.
- natural conditions, that is, the depth of berthing facilities largely depends on the natural conditions in the actual planning.

In the next step, the scale of berth, such as length and depth is determined according to the standard size of ships shown in Table A 7.3.1 as to add some allowance depending on ship size.

Four lane road will be necessary for port access from the hinterland. Dredging of the access channel is not necessary as the port entrance has a depth of -13 m, however the turning basin requires the dredging of about 4.0 million m^3. (see Table 7.3.2)

TABLE 7.3.2 Port Facilities in Master Plan

Facilities	Quantity	Remarks
Main Breakwater	1,290 m	Depth at the top: -13.5 m
Berths	1,360 m (-5.5 to -13 m)	See Table 7.3.1 for details
Land Reclamation	492,000 m^2	East & west wharves
Dredging	3,960,000 m^3	Channel depth: -13 m
Groin (West breakwater)	720 m	

7.4 Port Development Options

7.4.1 Characteristics of Development Site

Chan May is located 60 km from Hue City and 45 km from Danang City. Port development site is 7 km north from Road No.1 and the water area is sheltered by East Chan May Cape. South west coast of the East Chan May Cape will be favorable for the first berth. The water area is sheltered from NE waves by a 1,800 m long headland, however, it is exposed to N and NW waves and the construction of a breakwater is necessary for port development.

Soft clay layer is located in the bay area and the depth of foundation layer is about minus 20-35 m with an average of minus 30 m. Hinterland of more than 4,000 ha is available for the development of manufacturing factories, warehouses, port facilities and other transportation facilities. A large lagoon, Dam Cau Hai Lagoon, is located 10 km north of the development site, the adverse effects of which shall be avoided.

The completion of Hai Van Tunnel, expected by the year 2004, will considerably reduce the difficulties in Hai Van Pass and make it possible to form a port complex of Danang and Chan May. Distance from Savannakhet to Chan May is 450 km through Route No.9 and Route No.1, and therefore, the provincial government plans the new port as a possible gateway to the East West Transport Corridor.

7.4.2 Alternatives to Master Plan

Several cases of the layout of breakwaters and berths are designed for comparison. Option 1 (see Figure A7.4.1) has a breakwater along the contour line of minus 13 meters and a deep water wharf behind the breakwater.

Option 2 (Figure A7.4.2) has a breakwater in deeper water than Option 1 and a turning basin located behind the breakwater. Advantages in Option 2 are less volume of dredging and a calm basin behind the breakwater, which ensures not only safe mooring but also reduces the water spray on the wharf. However, disadvantages of Option 2 are the depth of the breakwater construction site, which is more than minus 17 meters at the deepest point, and the cost and period of construction, which will exceed those of the Option 1.

Option 3 (see Figure A7.4.3) has a breakwater located on the contour line of minus 12 meters and a wharf along the second breakwater, which is designed to prevent sand drift into port waters. The depth of the main breakwater is shallower than Option 1, and the location of the second breakwater is 1,000 meters east of that of Option 1. Advantages in Option 3 are the construction cost of the main breakwater and less impact on the surroundings due to limited port waters, but the latter is a disadvantage for ship maneuvering in the port. Disadvantages are the volume of dredging and the period required for the completion of the first stage of the development.

Option 4 (see Figure A7.4.4) is designed to minimize the area in the bay waters and to utilize the hinterland by excavating the channel. Advantages of Option 4 are less occupancy in the bay waters and less cost for the main breakwaters. However, disadvantages are the volume of dredging, which is quite large compared with other options, and the time required for the first stage of the development, which consists of the main and the second breakwater, quaywalls and channel dredging.

Comparative evaluation of the alternatives is shown in Table 7.4.1, and Option 1 is proposed as the Master Plan for Chan May Port Development.

TABLE 7.4.1 Comparative Evaluation of Alternatives

Items	Option 1	Option 2	Option 3	Option 4
Calmness of harbor waters	○ Fair	○ Fair	◎ Good	◎ Good
Period required for the first stage of the development	◎ Short	△ long	○ Medium	△ Long
Depth of the main breakwater	○ Fair -13m	△ Very Deep -14~17m	○ Fair -12m	○ Fair -11~12m
Volume of dredging	○ Fair	◎ Small	△ Large	△△ Very Large
Construction cost	○ Medium	△ Large	○ Fairly Small	△ Large
Possibility for future development	◎ Good	○ Fair	○ Fair	◎ Good
Impacts on sand drift and other surrounding environment	○ Fair	○ Fair	○ Fair	○△ Land Excavation
Overall Evaluation	◎ Good	○ Fair	○ Fairly Good	△ Fairly Poor

Note:

◎ Good, Reasonable

○ Fair, Medium

△ Poor

7.5 Port Development Master Plan

7.5.1 Port Layout Plan

Maximum size of calling vessels at Chan May is deemed to be 40,000-50,000 DWT container vessels, whose length and draft are 270 m and 12 m respectively. Some ocean going passenger ships and handy type bulk carriers will call at Chan May. The port is designed to have a deep sea multipurpose berth with a length of 330 meters and a depth of 13 meters and a deep sea general tramper berth with the same dimensions. To cater to conventional ocean-going vessels, Ro/Ro vessels, container feeder vessels, product oil carriers and other coastal vessels, five alongside berths are designed with a total length of 700 meters and a depth of 5.5-8.0meters.

Although the east end of Chan May Bay is sheltered from NE monsoon waves, breakwater is planned to shelter harbor waters from NE, NNE and N waves. Once the breakwater is built from the East Chan May Cape, sand drift would occur from the unsheltered coast to the sheltered coast by long shore currents. To prevent beach erosion in the unsheltered area and sand accumulation in the sheltered area, the west breakwater will be necessary to stop sand drift into harbor waters. Length and location of the west breakwater shall be carefully examined and determined at the detailed design stage.

Access channel has a width of 300 m, which is 1L of the largest calling vessel. Turing basin has a diameter of 2L of the largest calling vessel at each berth. Port facilities layout of Master Plan is shown in Figure 7.5.1. Location of the new port in Chan May Bay is shown in Figure A7.5.1 (Appendix) and Port Development Master Plan of Chan May area is shown in Figure A.7.5.2 and (Appendix).

7.5.2 Calmness of Harbor Waters

(Offshore Waves)

Direction-wise wave height occurrences are estimated from wind data obtained by European Center for Medium Range Weather Forecast, which covers all the sea by every 2.5 degrees. Offshore wave heights at N17.5° E107.5° (Quang Tri offshore) and N15° E110° (Quang Ngai offshore) are estimated as shown in Table A7.5.1 and A7.5.2 in Appendix. Since Chan May is located in the middle of two provinces, wave heights at Chan May offshore are deemed to be the middle of the two estimates, which indicates that more than 60 percent of the waves height occurrences are from NE, ENE and E.

(Wave Refraction and Shoaling)

Energy of offshore waves decreases in approaching the shoreline due to refraction, shoaling and diffraction. Reduction ratio of offshore waves is estimated by means of computer simulation. At the mouth of the planned new port, offshore waves are estimated to decrease to 88% in Chan May Bay. Wave refraction diagram from offshore to the development site is shown in Figure A7.5.3 - A7.5.8 (Appendix).

Maximum wave height during a period of two years[1] are assessed at 3.2 m from ENE and at 3.1 m from N, NNE and NE at the planned entrance of Chan May Port. Offshore waves change their directions to NNE when approaching the development site of Chan May (see Table 7.5.2).

(Wave Diffraction in Harbor Waters)

Wave disturbance to berths are checked by calculating wave diffraction in the harbor waters. Reflection factor used in the simulation is 0.9 at upright quaywalls or seawalls, 0.5 at low reflection structures and 0.1 at natural beach.

Wave height in front of the planned deep sea multipurpose berth (W3) is estimated at about 0.5 m against the above mentioned maximum offshore wave. (see Table 7.5.3.) A large ship could safely receive waves up to 1 m from the bow or astern and waves up to 0.7 m from the side. For cargo handling operations, wave disturbance should be less than 0.5 m and this level will be assured in Chan May Port. Wind speed is also requested to be less than 10 m for cargo operations. Details of wave diffraction are shown in Figures A7.5.9-A7.5.11.

TABLE 7.5.3 Wave Heights[1] in Harbor

(meters)

Wave Direction Area	NNW	N	NNE
Off Breakwater	1.3	3.1	3.1
Berth W3	0.5	0.5	0.3
Berth E4	0.3	0.3	0.2

Note 1/ High wave height which may occur once every two years

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[1]/ From 1 January 1993 to 31 December 1994, Swells are estimated based on Pierson and Moskowitz Spectrum and wind waves are based on Wilson's Equation

7.5.3 Ship Maneuvering

Approach channel is designed to have a width of 300 meters, approximately 1L of the maximum calling vessel. Turning basin is also designed to have a diameter of 600 meters, approximately 2L of the maximum calling vessel, assuming tug boat services. Figure A7.5.12 illustrates ship maneuvering for port entry and berthing.

7.5.4 Port Access Road

Port related traffic is estimated at about 2,250 per day in the year 2020 if Master Plan is completed and the port is utilized. Breakdowns are 1,500 per hour of trucks and 750 of passenger cars. As the traffic capacity is 650 per hour for two lane road and 2,400 per hour for four lane road, port access road is designed to have 4 lanes with a width of 22 meters or more.

TABLE 7.5.2 Maximum Significant Wave Height and Direction During a Period of Two Years

Chan May Offshore

Direction	Height (m)	Frequency (sec)
NNW	1.9	5.6
N	3.9	7.8
NNE	3.5	7.6
NE	3.6	8.0
ENE	3.8	8.5
E	3.2	7.9

Chan May Port Entrance

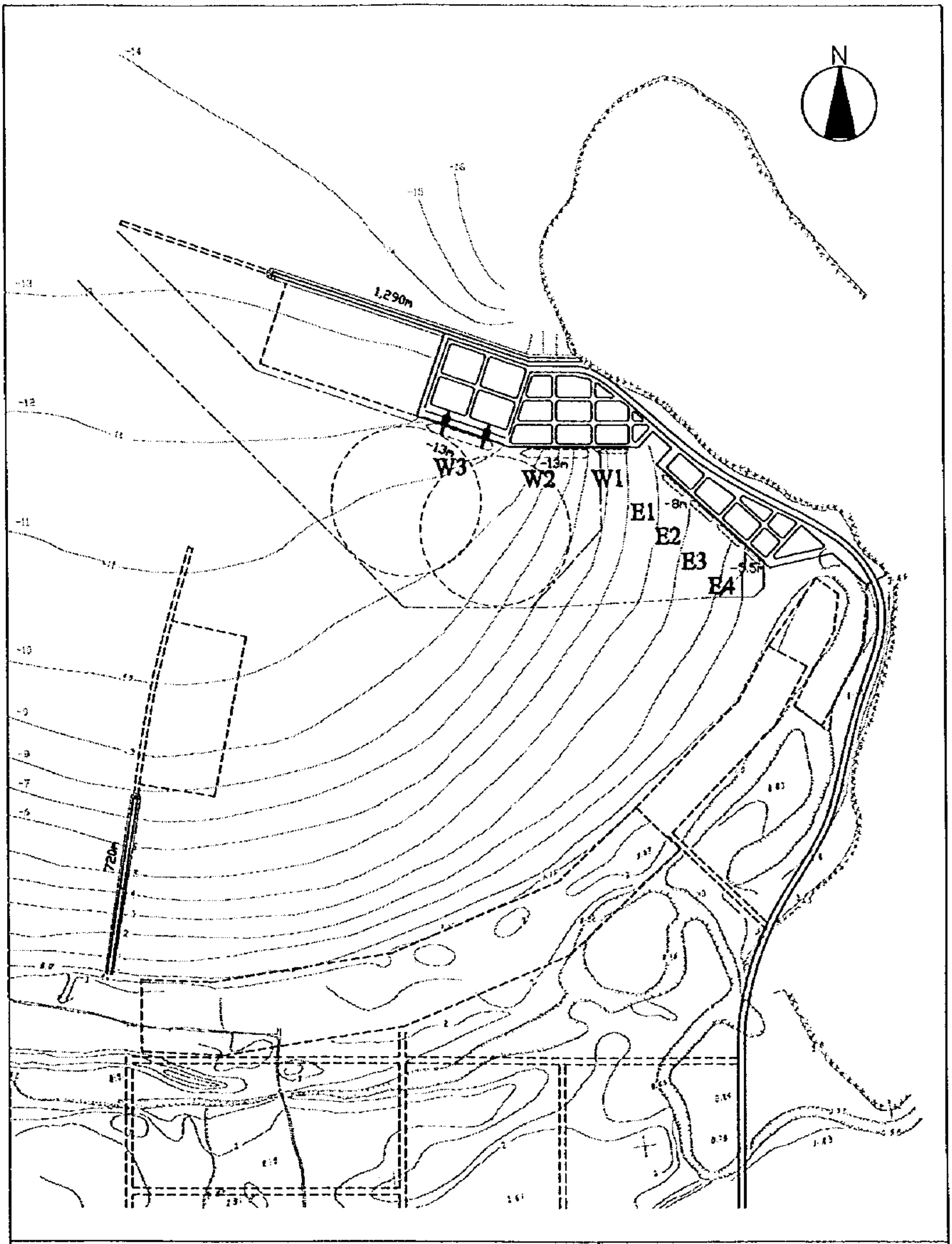
Direction	Height	Frequency	Change in the WaveDirection
	(m)	(sec)	(dgree)
NNW	1.3	5.5	△ 6
N	3.1	7.7	△12
NNE	3.1	7.4	0
NE	3.1	7.8	▲ 6
ENE	3.2	8.4	▲12
E	2.5	7.8	▲18

△ Clock-wise
▲ Anti Clock-wise

Shoaling Coefficient

Direction	Height	Frequency	Change in the WaveDirection
			(degree)
NNW	0.70	0.99	△ 6
N	0.80	0.99	△12
NNE	0.88	0.98	0
NE	0.86	0.98	▲ 6
ENE	0.85	0.99	▲12
E	0.78	0.99	▲18

△ Clock-wise
▲ Anti Clock-wise



JICA Port Development Study in Central Region	**Figure 7.5.1**
Chan May Port Development Masterplan	0 200 400 600 800 1,000 m
Final Report 1998	**FILE CM-DF-MP-A4**