4.8 Soil Conditions

4.8.1 Soil Strata in Lien Chieu Area

According to the soil boring investigations conducted by TEDI or other organizations in Lien Chieu Area, the top soil near the shore line consists of fine sand, the layer of which is not located widely. Toward offshore area, the upper layer of the soft clayey sand partially mixed with mud is likely prevailing. Under this 6 to 8m thick-soft clayey sand, very thick fine and coarse sand layers appear at the level of -12~20m. The existing deepest boring was driven into -38.3m, however there is no rock stratum but fine and coarse sand layers continue. These sand layers have enough strength for bearing upper structures.

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 Lien Chieu 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 Lien Chieu planning areas.

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

	Gravel %	Sand %	Silt %	Clay %	Total %
Lien-N0.2layer	9.4	63.9	13.2	13.5	100
Lien-N0.4-1layer	7.2	42.3	18.6	31.9	100
Lien-N0.2layer	2.5	9.7	70.0	17.8	100

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

According to this figure softer layers are composed of 70% silt 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) and 20% clay under 5 μ particle size . These soils' natural moisture content is 30~50%,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 Lien Chieu.

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 further examination should be needed to evaluate subsidence of under-foundation using the results of such soil tests as consolidation, stress and strain etc.

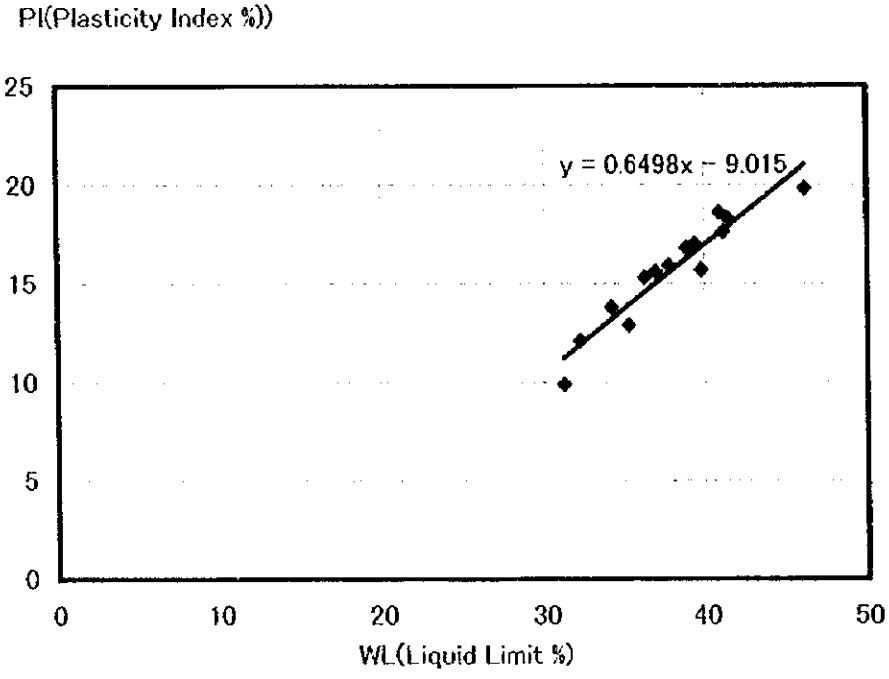


Figure4.8.3 Relation between Plasticity Index and Liquid Limit in Lien Chieu

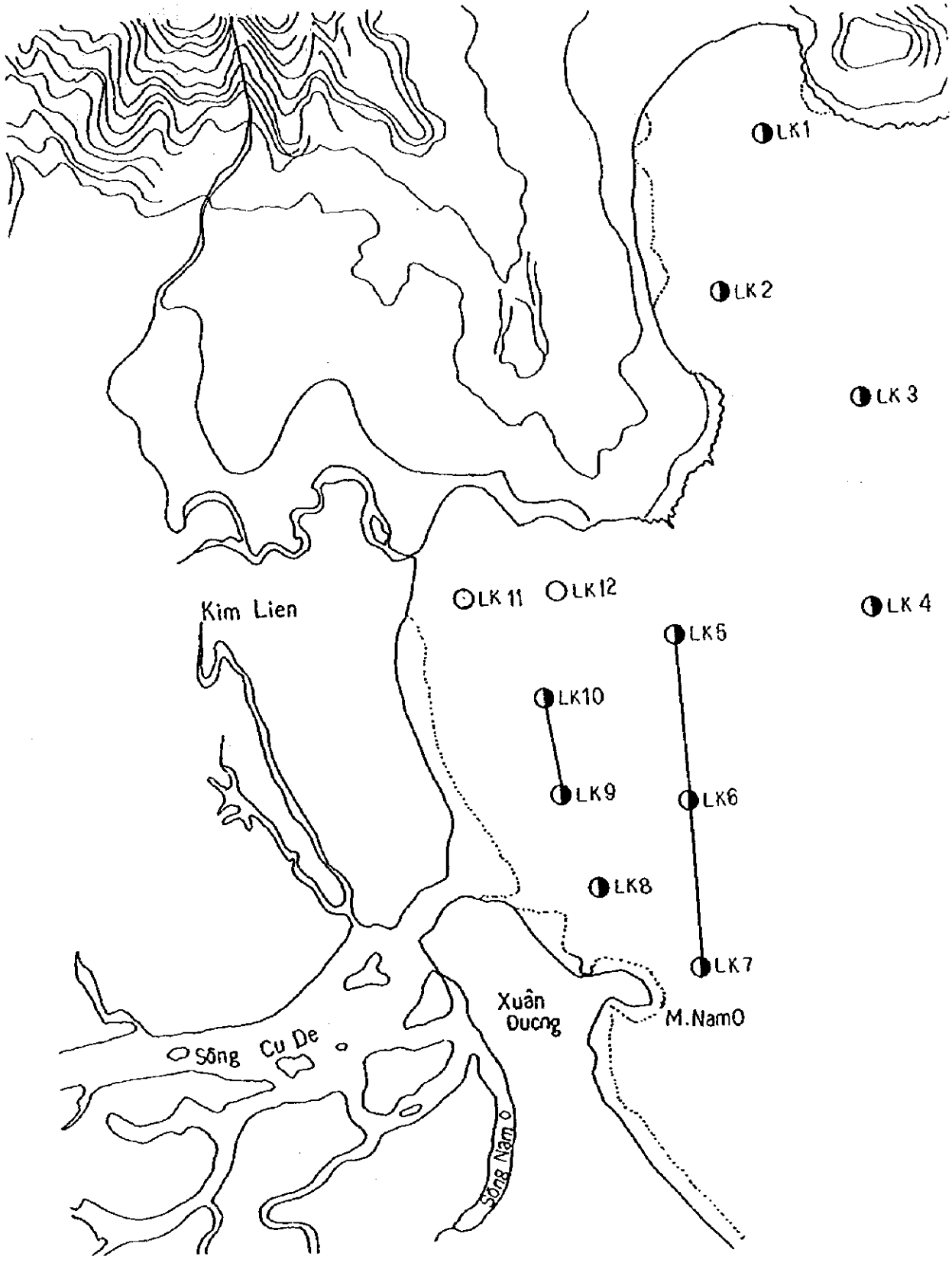


Figure 4.8.1 Location Map of Bore Hole at Da Nang (Lien Chieu)

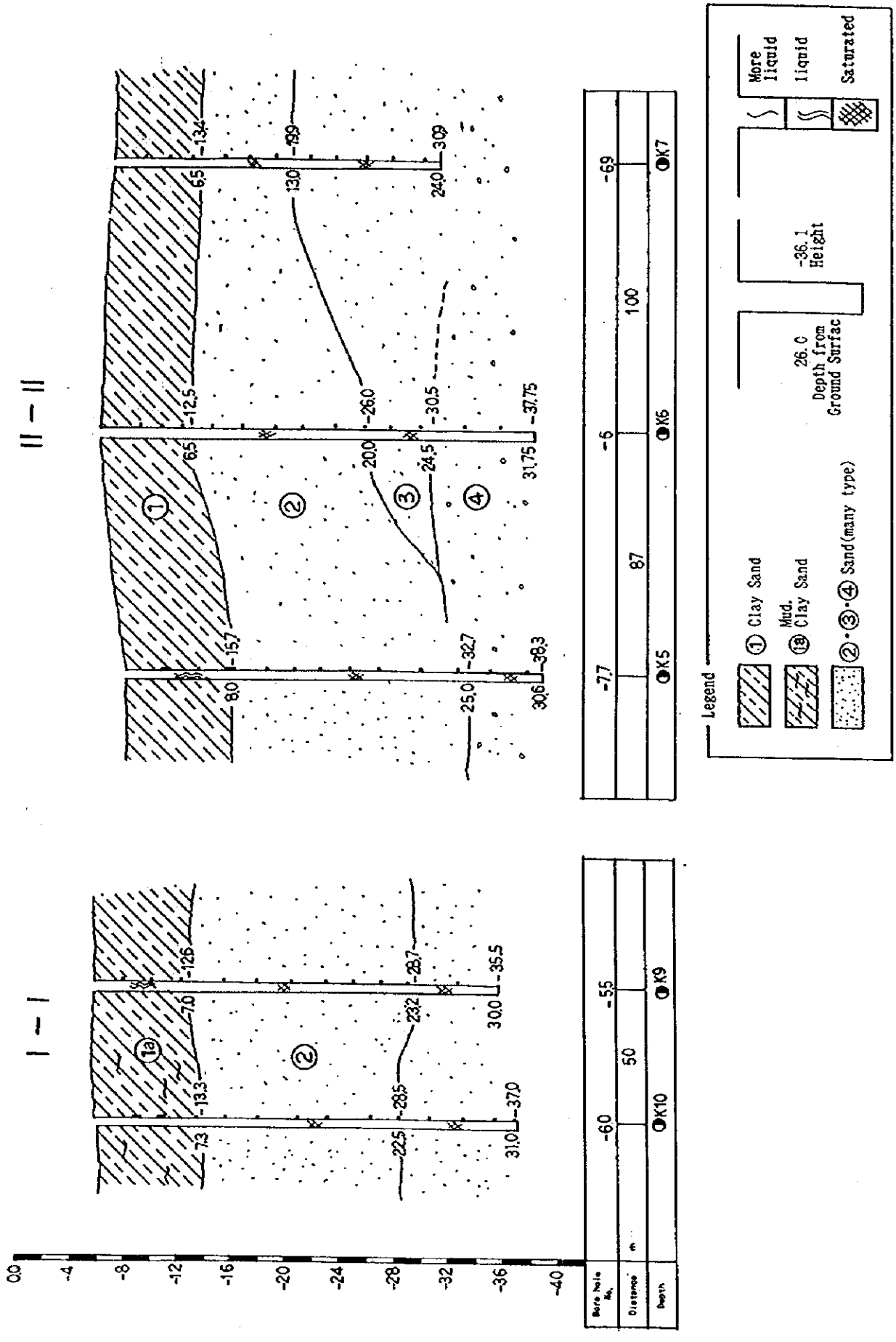


Figure 4.8.2 Typical Soil Profile of Da Nang(Lien Chieu)

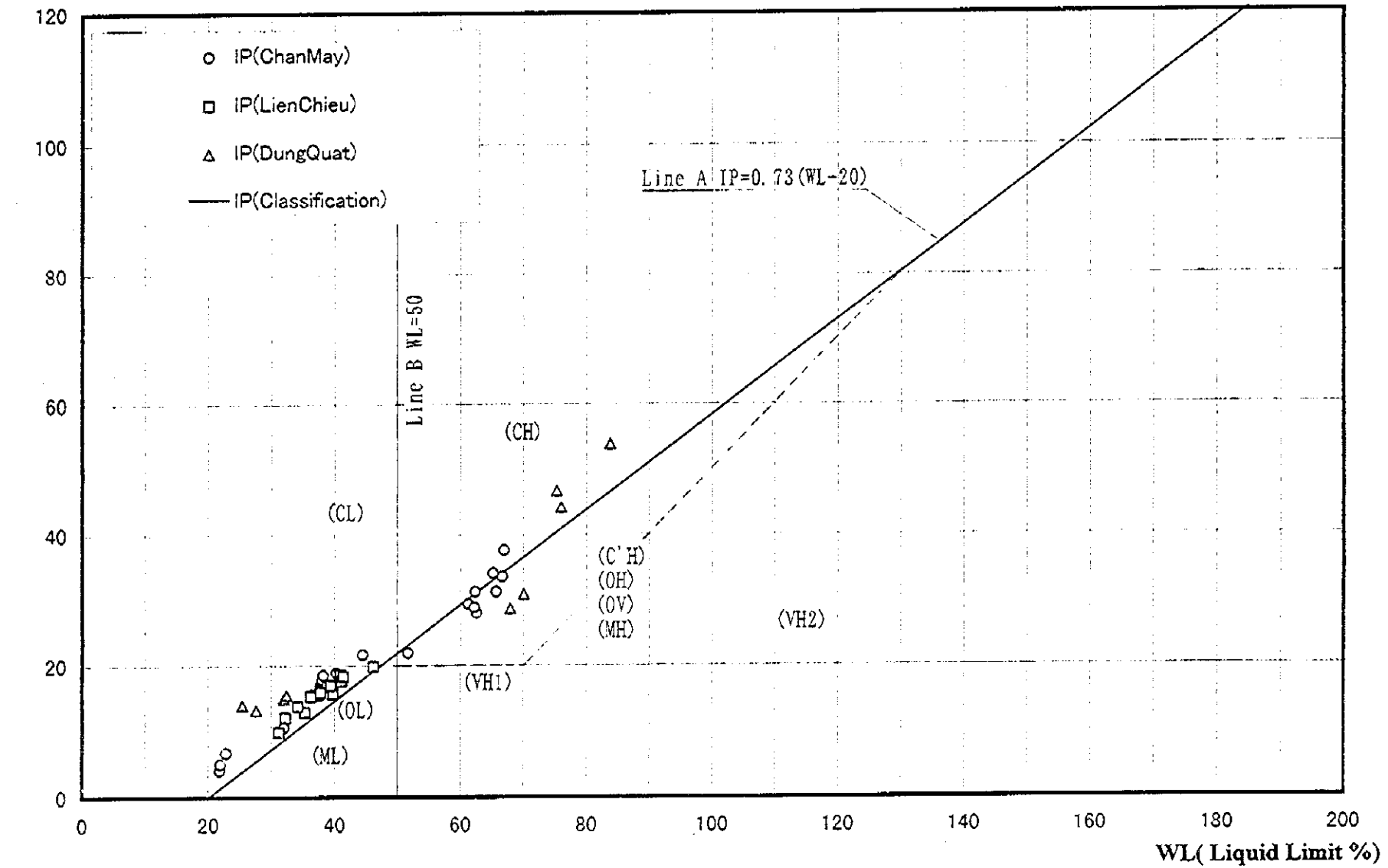


Figure 4.8.4 Plasticity Classification Chart by Japanese Standard

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 Lien Chieu 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. In Lien Chieu the elevations of bores are from –7.7m to –9.9m while bearing layers appear –16m~-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 48 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 25 to 30 % of clay and 55 to 60% of silt, and 10 to 20% of sand(c.f. Figure 4.8.7)

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 Lien Chieu are distributed between 0.1~0.25 kgf/cm^2. It seems that strength of upper soft layers is as same as in Chan May, however thickness of soft layers in Lien Chieu is less than in Chan May and it likely appear more stiff silty sand layer in the area within –5.0m deep. (c.f. Figure 4.8.7(3): LC_3-97)

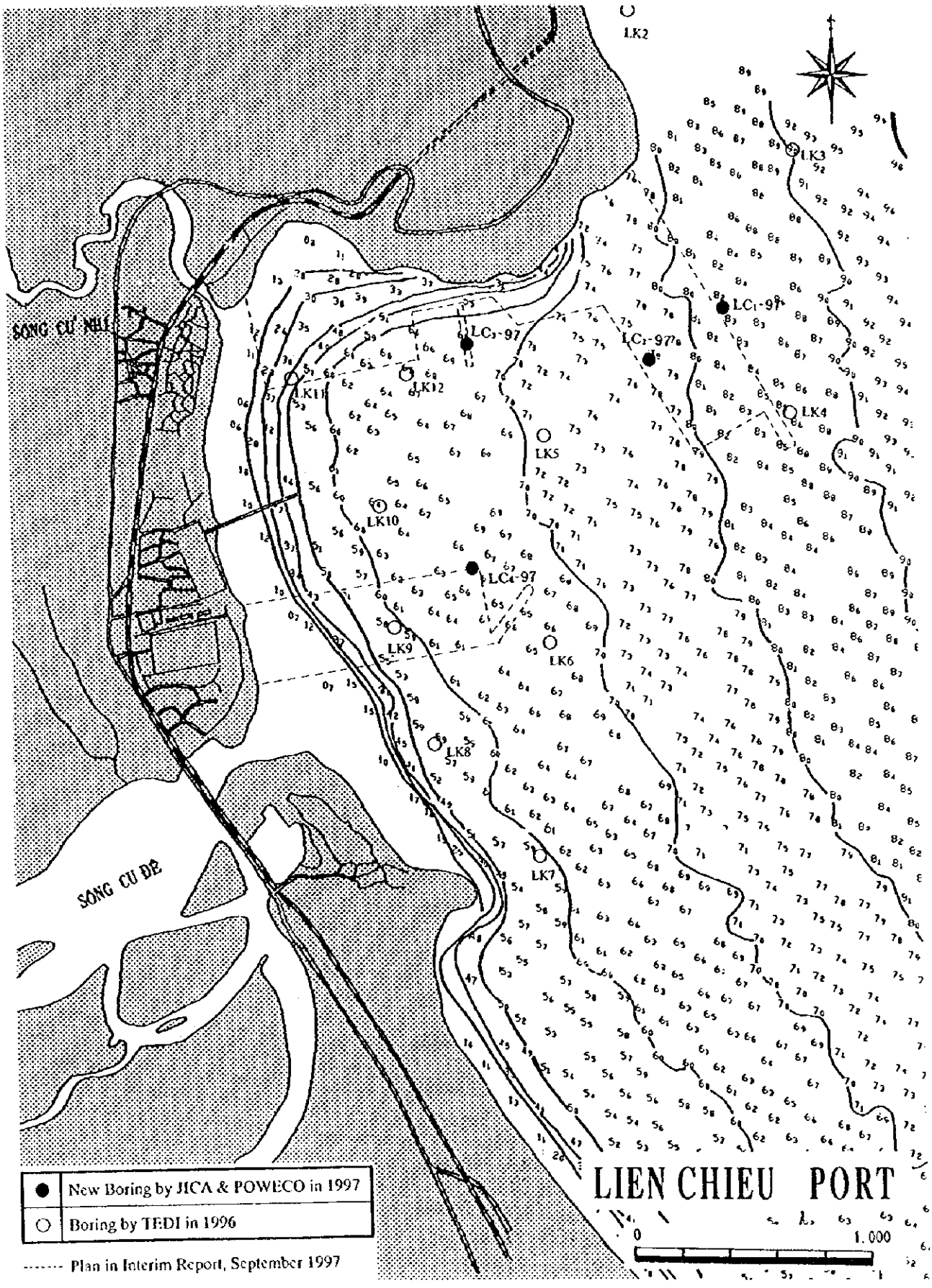


Figure 4.8.5 Location of Boring in Lien Chieu

BOREHOLE No: LC_{1-97}

Depth (m): 25.20

Coordinate (m): N = 1785120
E = 515420

Elevation (m): -9.90

Location: Kim Lien – Hoo Hiep – Lien Chieu

Date commenced: 04-10-1997

Date completed: 04-10-1997

Layer	Elevation (m)	Depth (m)	Thickness (m)	Symbol	SOIL AND ROCK DESCRIPTION	SPT Test: Depth (m)	N_0 (Blows/15cm)	N_1 (Blows/10cm)	N_2 (Blows/10cm)	N_3 (Blows/10cm)	N	SPT chart: N: Blows/30 cm (10 20 30 40 50 >50)	Sample No / Depth of sample (m)
			10.80		Clayey mud, grey.	1.50	0	0	0	1	1		1 / 2.00-2.60
						3.10	0	0	1	01	1		2 / 3.90-4.50
						4.50	0	1	0	0	1		3 / 5.50-6.10
						6.10	0	0	1	1	2		4 / 7.90-8.50
						7.30	1	0	0	1	1		5 / 9.60-10.20
						8.50	0	0	0	1	1		6 / 11.10-11.50
	-20.70	10.80				10.20	0	0	1	1	2		7 / 12.60-13.05
			4.20		Medium sand with shells, loose to medium dense, grey.	11.10	2	1	2	2	5		8 / 14.10-14.55
						12.60	2	1	2	3	6		9 / 15.10-15.70
						14.10	4	3	3	5	11		10 / 16.60-17.20
	-24.90	15.00				15.70	1	0	1	2	3		11 / 19.20-19.65
			3.90		Soft clay, grey.	17.20	1	1	1	2	4		12 / 20.70-21.15
	-28.80	18.90				19.20	6	5	6	7	18		13 / 22.50-22.95
						20.70	8	7	8	8	23		14 / 24.10-24.55
			6.30		Medium sand, yellowish grey, dense to very dense.	22.50	11	9	13	14	36		
						24.10	16	13	17	21	51		
	-35.10	25.20											

Sand(fine to medium)

Sandy Clay

Clay

Mud

Shell

Disturbed Sample

Undisturbed Sample

Figure 4.8.6(1) Soil Profile and Standard Penetration Test LC_1-97

BOREHOLE No: LC_{2-97}

Depth (m): 24.90

Coordinate (m): N = 1784900
E = 515120

Elevation (m): -9.10

Location: Kim Lien - Hoa Hiep - Lien Chieu

Date commenced: 03-10-1997

Date completed: 03-10-1997

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	SPT chart: N: Blows/30 cm (10 20 30 40 50 >50)	Sample No / Depth of sample (m)
						1.50	0	0	0	1	1		1 / 1.50-1.95
						3.10	0	0	0	1	1		2 / 3.10-3.55
			9.80		Clayey mud, grey.	4.60	0	0	1	1	2		3 / 4.00-4.60
						6.00	0	0	1	0	1		
						7.70	0	0	1	1	2		4 / 7.10-7.70
						9.10	0	0	1	2	3		5 / 9.10-9.55
	-18.90	9.80											
			4.40		Medium sand with shells, grey, loose to medium dense.	11.50	3	2	2	5	9		6 / 11.50-11.95
						13.00	3	2	3	5	9		7 / 13.00-13.45
	-23.30	14.20											
			3.40		Soft cloy, grey.	15.40	2	0	1	2	3		8 / 15.40-15.85
						17.00	2	1	1	2	4		9 / 16.40-17.00
	-26.70	17.60											
						18.50	11	8	9	13	30		10 / 18.50-18.95
						20.10	12	8	10	14	32		11 / 20.10-20.55
			7.30		Medium sand, yellowish grey, dense to very dense.	21.50	14	11	12	16	39		12 / 21.50-21.95
						23.00	16	13	14	19	46		13 / 23.00-23.45
						24.40	19	15	17	20	52		14 / 24.40-24.85
	-34.00	24.90											

Sand(fine to medium)
Sandy Clay
Clay
Mud
Shell

Disturbed Sample
Undisturbed Sample

Figure 4.8.6(2) Soil Profile and Standard Penetration Test LC_2-97

BOREHOLE No: LC_{3-97}

Depth (m): 20.60

Coordinate (m): N = 1784960

E = 514330

Elevation (m): -7.90

Location: Kim Lien - Hoo Hiep - Lien Chieu

Date commenced: 27-10-1997

Date completed: 27-10-1997

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	SPT chart: N: Blows/30 cm (10 20 30 40 50 >50)	Sample No / Depth of sample (m)
			1.40		Sandy mud, greu.								1 / 0.00-1.40
	-9.30	1.40				1.50	2	1	1	2	4		2 / 1.50-1.95
			4.10		Medium sand with shells, grey, dense.	3.30	3	2	2	3	7		3 / 3.30-3.75
						4.60	4	2	3	3	8		4 / 4.60-5.05
	-13.40	5.50	0.90		Soft cloy, grey.	5.80	2	1	1	1	3		5 / 5.80-6.25
	-14.30	6.40	1.60		Medium sand with shells, grey, loose.	7.50	2	1	2	3	6		6 / 7.50-7.95
	-15.90	8.00				9.00	12	8	10	12	30		7 / 9.00-9.45
						10.40	13	8	11	13	32		8 / 10.40-10.85
						12.00	12	9	11	13	34		9 / 12.00-12.45
			12.60		Medium sand, yellowish grey, dense to very dense.	13.60	12	9	12	16	38		10 / 13.60-14.05
						15.00	14	10	12	16	38		11 / 15.00-15.45
						16.60	17	13	14	19	46		12 / 16.60-17.05
						18.00	19	15	16	22	53		13 / 18.00-18.45
						19.50	20	17	18	22	57		14 / 19.50-19.95
	-28.50	20.60											

Sand(fine to medium)

Sandy Clay

Clay

Mud

Shell

Disturbed Sample

Undisturbed Sample

Figure 4.8.6(3) Soil Profile and Standard Penetration Test LC_3-97

BOREHOLE No: LC_{4-97}

Depth (m): 12.60

Coordinate (m): N = 1783980

E = 514300

Elevation (m): -7.70

Location: Kim Lien – Hoo Hiep – Lien Chieu

Date commenced: 02-10-1997

Date completed: 02-10-1997

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	SPT chart: N: Blows/30 cm (10 20 30 40 50 >50)	Sample No / Depth of sample (m)
			3.00		Clayey sandy mud, dark grey.	2.10	0	0	1	1	2		1 / 1.50–2.10
	-10.70	3.00				3.00	1	1	1	1	3		
			5.70		Sandy clay, blackish grey, soft.	4.60	1	1	1	1	3		2 / 4.00–4.60
						6.00	1	1	1	1	3		3 / 5.40–6.00
						7.90	2	1	1	2	4		4 / 7.30–7.90
	-16.40	8.70											
			2.20		Medium sand, grey, loose to medium dense.	10.25	7	6	7	8	21		5 / 10.25–10.70
	-18.60	10.90				10.90	18	14	22	29	65		6 / 12.00–12.60
			1.70		Rounded gravel with sand, grey.								
	-20.30	12.60											

Sand(fine to medium)

Sandy Clay

Clay

Mud

Shell

Disturbed Sample

Undisturbed Sample

Figure 4.8.6(4) Soil Profile and Standard Penetration Test LC_4-97

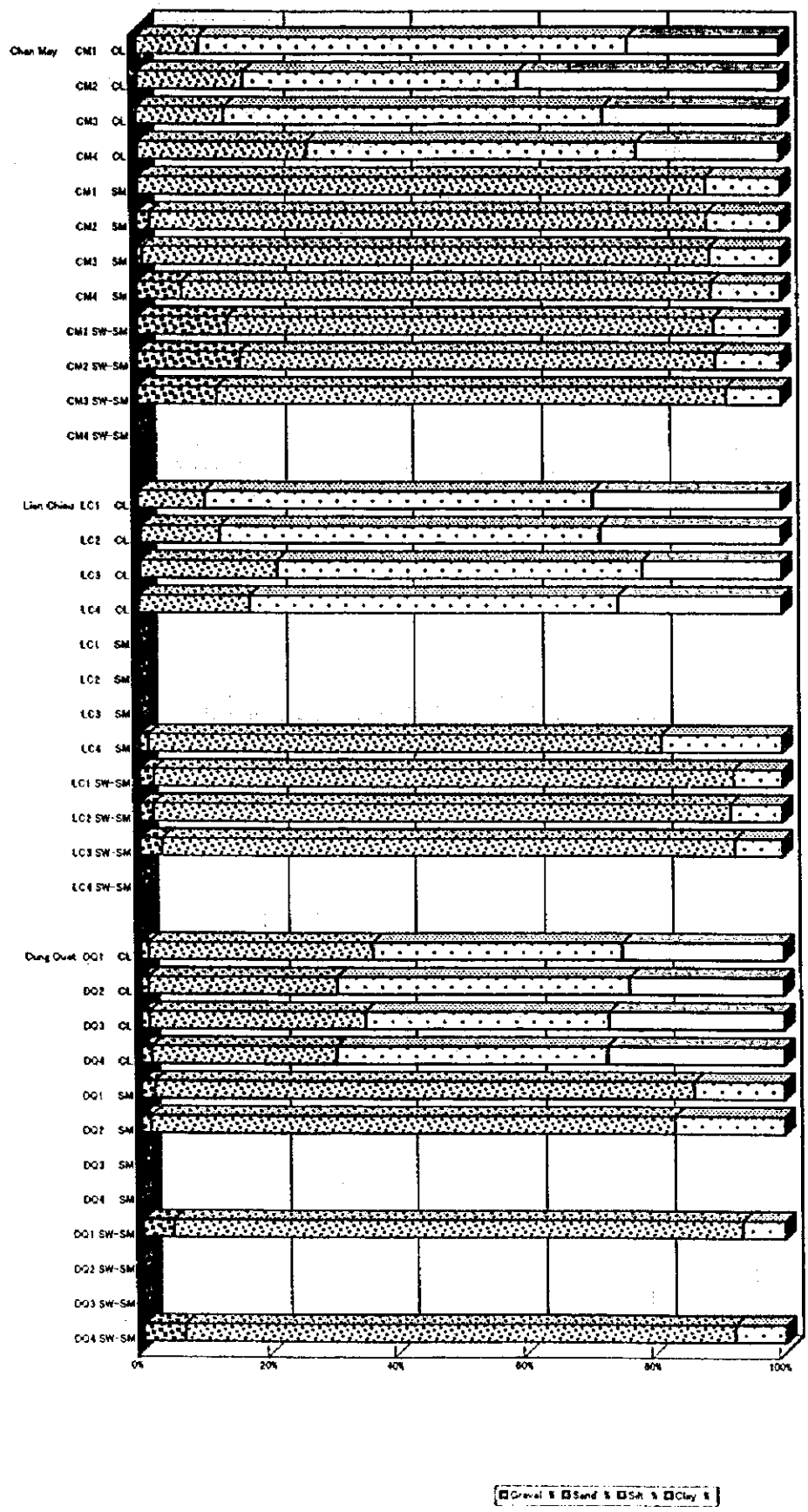


Figure 4.8.7 Result of Particle Size Analysis

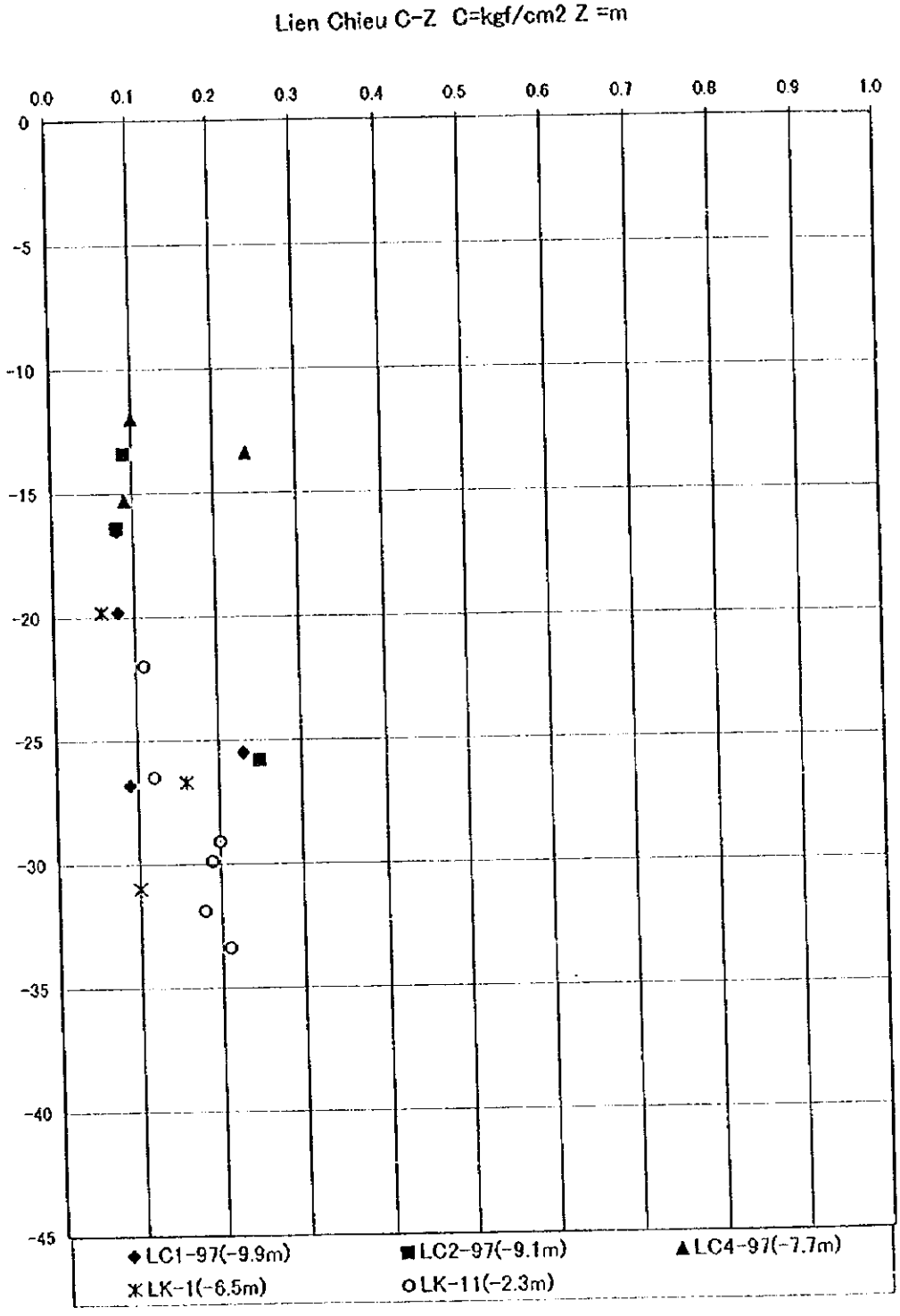


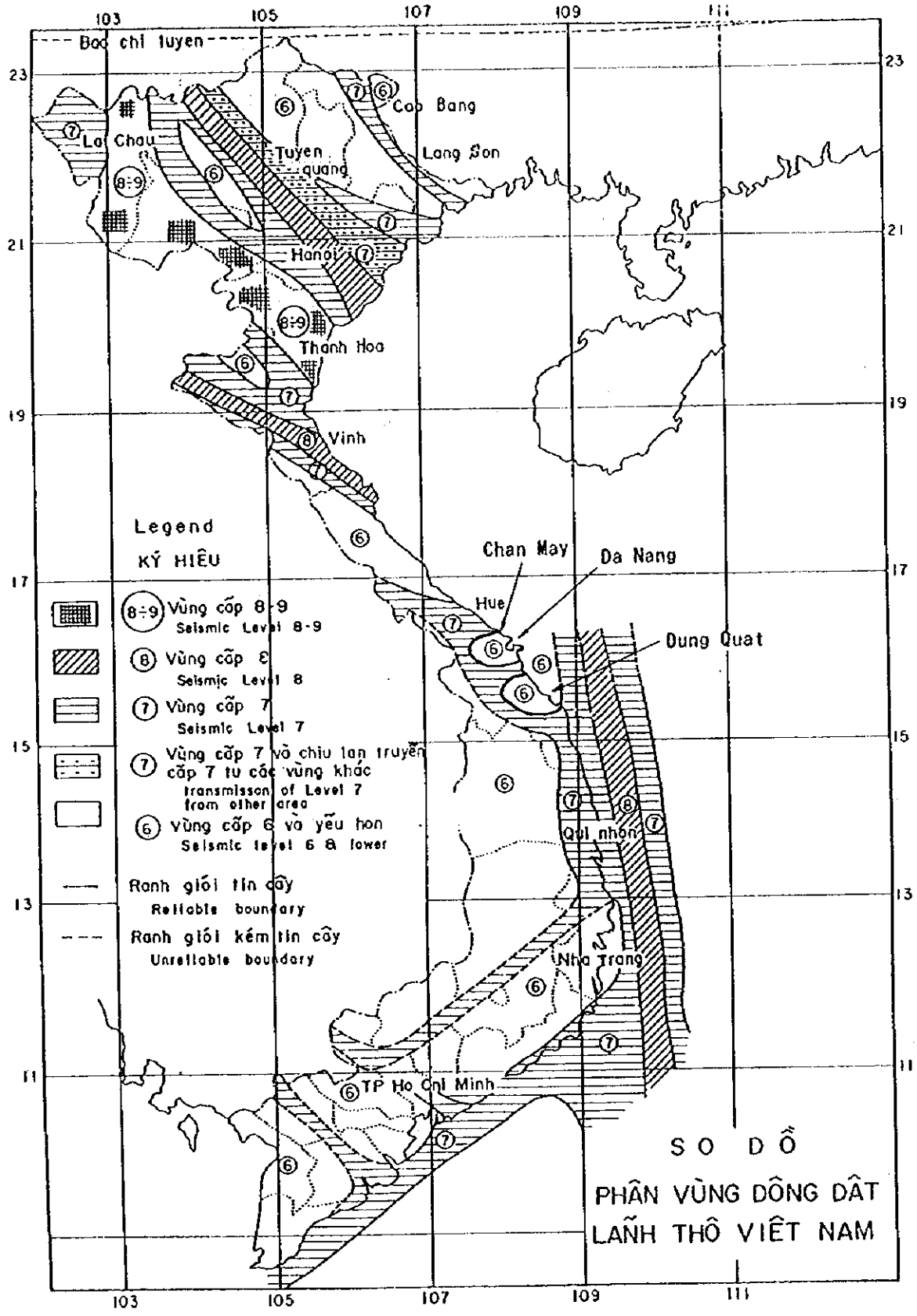
Figure 4.8.8 Relation between Cohesion and Depth in Lien Chieu

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 Vinnamarine'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

[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)	Land Area Net (ha)	Land Area (%)	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 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 Lien Chieu and Hoa Khanh Industrial Zone

(1) Location

Two Industrial Zones are located at Hoa Khanh-Hoa Hiep Communes, Hoa Vang District, Danang City, 10km from the center of the city, 2km from Lien Chieu Port, 20km from Tien Sa Port, near railways and National Highway No.1A.

(2) Land Use

Total land area of Lien Chieu IZ is 373.5ha, while that of Hoa Khanh IZ is 423.5ha. Detailed planned land use is shown in Table 5.4.1.

Table 5.4.1 Planned Land Use

Unit: ha

Land Use	Lien Chieu IZ	Hoa Khanh IZ
Factory land	174.0	293.5
Warehouse land	41.0	10.0
Public land	12.5	19.5
Technique land	11.5	6.5
Transportation land	54.0	55.0
Greenery	50.0	30.0
Water surface	23.5	38.5
Servicing IZ	7.0	24.5
(Total)	373.5	423.5

Source: Summary of Content Project of Hoa Khanh Industrial Area
Lien Chieu, Hoa Khanh Industrial Zone (Danang City)

(3) Main Products and Services

Main products are machinery, steel, chemicals, automobile assembly, construction materials, plastics of all kind, glass containers, construction glass. Services to be provided are goods delivery, warehousing and others.

(4) Drainage

Rain and wastewater drainage systems are planned in the zone. The length of rain drainage of Lien Chieu IZ is 25km, while that of Hoa Khanh IZ is 34.4 km. As for wastewater, 12.5km round sewage, 5 pumping stations and 1 treatment wastewater station are planned at Lien Chieu IZ, while 20km round sewage, 8 pumping stations and 1 treatment wastewater station are planned at Hoa Khanh IZ.

(5) Water Supply

Common water demand is 100,000m^3/day of which 40% is utilized by Lien Chieu IZ and 60% by Hoa Khanh IZ. In the first phase, the capacity of the water station at Ram river is planned as 20,000m^3/day. In the second phase, the capacity of the water station at Cu De is also planned as 80,000m^3/day.

(6) Electricity

Total demand for electricity is 145MW of which 54% is used by Lien Chieu IZ and 46% by Hoa Khanh IZ. Being built at Thanh Vinh village, Hoa Khanh Commune transfer station (outside of IZ) includes two transformers, each with a capacity of 125 MVA, to supply electricity to the above two IZ and the northwest area of the new city. From center station, electric line directs to transformer station which installed at each IZ to supply electricity to factories. Electricity resource takes from station of 500KV/220KV Red river.

5.4.2 Dien Nam and Dien Ngoc Industrial Zone

(1) Location

Two Industrial Zones are located at Dien Nam and Dien Ngoc Communes, Dien Ban District, Danang City, 20km south-east of the city and Danang International Airpot, 29km north of Tien Sa Port.

(2) Land Use

Total land area is 418ha of which 260ha is used as the industrial area for factory and warehouse. Detailed land use of the entire area and industrial area is shown in Table 5.4.2.

Table 5.4.2 Land Use of All Area and Industrial Area

Unit: ha

Land use of the Entire Area		Land Use of Industrial Area	
Classification	Area	Classification	Area
Factory and warehouse land	260.0	Electronic	70.5
Land for construction managing, technology, transferring center	20.5	Agriculture and sea product processing	48.2
Technical land	20.7	Textile and garment	45.4
Green land	40.8	Decorative product	48.9
Tree and gully	30.6	Transportation and engineering	47.0
Transportation	45.4		
(Total)	418.0	(Total)	260.0

Source: Summary of Dien Nam Dien Ngoc Industrial Zone (Danang City)

(3) Main Products

Main products are motorcycle, electronics assembly, refrigeration appliances, agro-forestry processing, sea products, garment, textiles, fishing net, leather products, footwear, cosmetics and stationary.

(4) Drainage

Waste water of IZ is completely treated following Vietnamese Standard 5945 of the Ministry of Science, Technology and Environment before discharging out of the factory. Volumes of waste water are follows.

-Industrial waste water:25,290m^3/day

-Domestic waste water: 3,000m^3/day

-Domestic waste water of residential area: 22,500m^3/day

(5) Water Supply

Common water demand is 40,200m^3/day for industry and 22,500m^3/day for civil use. Water is taken from Thanh Quyt dam and from Yen river.

(6) Electricity

Electricity supply is planned to be supplied from Hoa Cam transformer station. A 110KV line is set from the transformer station along National Highway No.1A to Dien Ngoc commune and this line runs from the eastern gully to the transformer station of IZ. Electricity consumption is as follows.

-Industrial use: 75,000 KVA

-Civil use: 40,000 KVA

5.4.3 Danang Export Processing Zone

(1) Location

Danang EPZ is located on An Don District along Ngo Quyen Street, north-east of Danang City, 6km from the city center and Danang International Airport, 6km north of Tien Sa Port.

(2) Land Scale

Land area is 63ha and divided into 58 blocks for factory use.

(3) Main Products and Services

Main products and services are textile, garment, leather products, footwear, microelectronics, electrical appliances, beverage, foodstuff processing, packing, jewelry,

handicrafts, plastics, trading services, assembly of generators and scientific equipment.

(4) Water Supply

Site is linked to the province's Son Tra and Cam Le water supply station, with treated water of up to 20,000m^3/day.

(5) Electricity

The recent commissioning of a 500KV transmission line through Danang city ensures that An Don will receive a regular supply of electricity.

5.5 Review of Lien Chieu/Danang Port Development Plans

Ministry of Transport, Post and Telecommunications (now Ministry of Transport) released the Programme for the Roads, Bridges and Ports Construction to the Year 2005 in August 1994, which indicated that many of the larger vessels exceeding 5,000 DWT anchor offshore and the berths are in poor condition in Danang Port. Urgent rehabilitation and strengthening is requested as many of their piles are broken and their decks are cracked. Handling equipment is inadequate and in poor condition. The condition of the sheds is also poor.

Danang City has a masterplan to develop Lien Chieu area for a new port in connection with Tien Sa Port and Song Han Port. Both ports foresee the saturation in their capacity and need rehabilitation of their wharves in the near future. The masterplan calls for the construction of a breakwater and two new wharves so as to increase the port capacity up to 2.5 million tons. Song Han Port will be used for passenger boats and tourist servicing. The masterplan also proposed that a general study be carried out from the viewpoint of economic development of ports in the Central Region, where many deep wide bays favorable for forming large seaports are located.

In Lien Chieu area, the construction of a jetty was started in April 1996 by Hai Van Cement Co. and its completion is expected by September 1997. The jetty is designed to accommodate 5,000-6,000 DWT vessels with a length of 590 m at the first stage. Future extension is planned to cope with 30,000 DWT. Cement production in the year 2000 is estimated at about 1,200,000 tons, of which 300,000 tons will be exported.

Brief summary of the above mentioned development studies is as follows (see Table 5.5.1 for details):

(1) Prefeasibility Study on Construction of Lien Chieu - Nam O Ports[1]

Cargo throughput forecast

Vietnam total:

Year 2000: 60-70 million tons (0.6-0.7 to per capita)

Year 2010: 150-200 million tons (1.6-2.16 ton per capita)

Danang Port:

Year 2000: 2,384,000 tons/year

Year 2010: 8,152,000 tons/year

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[1] Quang Nam Da Nang Province, May 1995, by Transport Science and Technology Department, Ministry of Transport

Lien Chieu Port:

Phase I: 6,000,000 tons/year (Year 2000)

Separated goods: 1,000,000 tons/year

General cargo: 2,000,000 tons/year

Container: 3,000,000 tons/year (237,000 TEUs)

Phase II: 20,000,000 tons/year (Year 2010)

General cargo: 2,000,000 tons/year

Container: 12,000,000 tons/year (1,090,910 TEUs)

(2) Project on Construction of Lien Chieu Port[2]

Total cargo volume through Danang Port system is estimated as follows based on socio-economic development in the Central Key Economic Area and in Quang Nam-Da Nang Province.

Total Danang Port Complex:

Year 2000: 4,500,000 tons/year

Year 2010: 12,000,000 tons/year

Inclusive of general cargo, specialized cargo of steel plant, cement plant.

Exclusive of petroleum, tourism, services, oil & gas, ship building etc.

Tien Sa port:

Existing capacity: 1,500,000 tons/year

Year 2010: no indication

Song Han Port:

Capacity: 200,000 tons/year

Lien Chieu Port:

Year 2000: 2,500,000 tons/year

Year 2010: 8,900,000 tons/year

Year 2020: 20,000,000 tons/year

[2] Summary Report, Prefeasibility, 96-522 NCa, 1996, by Port & Waterway Engineering Consultant

(3) Danang City Lien Chieu Port Project[3]

Cargo throughput forecast:

Danang Port Complex:

Year 2000: 4,500,000 tons/year

Year 2005: 8,000,000 tons/year

Year 2000: 12,000,000 tons/year

Tien Sa port:

Year 2000: 1,500,000 tons/year

Year 2010: 2,500,000 tons/year

Song Han Port:

Capacity: 200,000 tons/year

(4) Development of a jetty by Hai Van Cement Co.

Cargo forecast in 2000 is as follows:

Export: Cement 300,000 tons

Import: Clinker 600,000 tons

Coal 300,000 tons

Cement productions in 1996 was 200,000 tons. 5,000 tons of clinker is transported from Tien Sa Port to Hai Van Cement factory every month, which costs US$100,000 a month. Some other companies in the hinterland request Hai Van Cement for the use of the jetty for import of coal, plaster (gypsum), flour (wheat) and gas. Belt conveyor is planned on the jetty in three stories to cope with this demand.

[3]/ Quang Nam Danang Export Processing and Industrial Zone Authority, 1996

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)

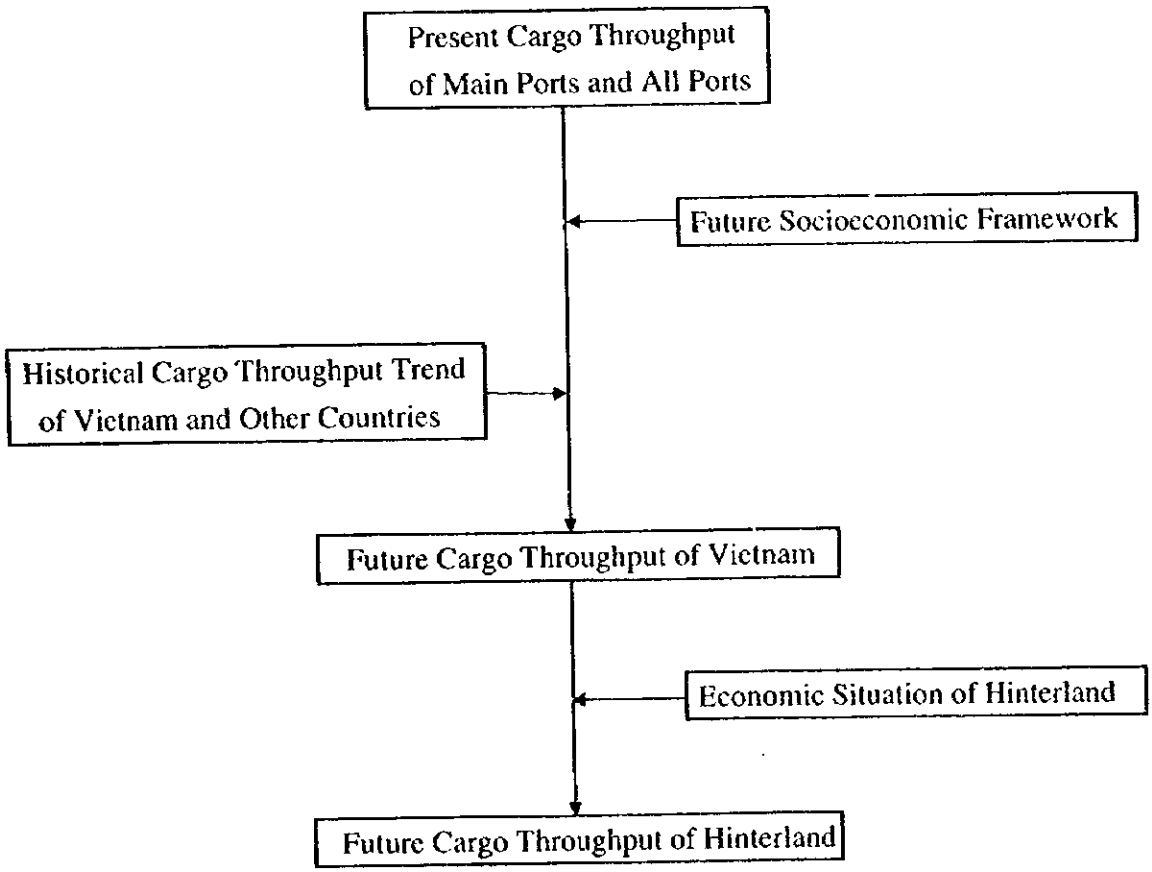


Figure 6.1.1 (1) Flow Chart of Macro Forecast

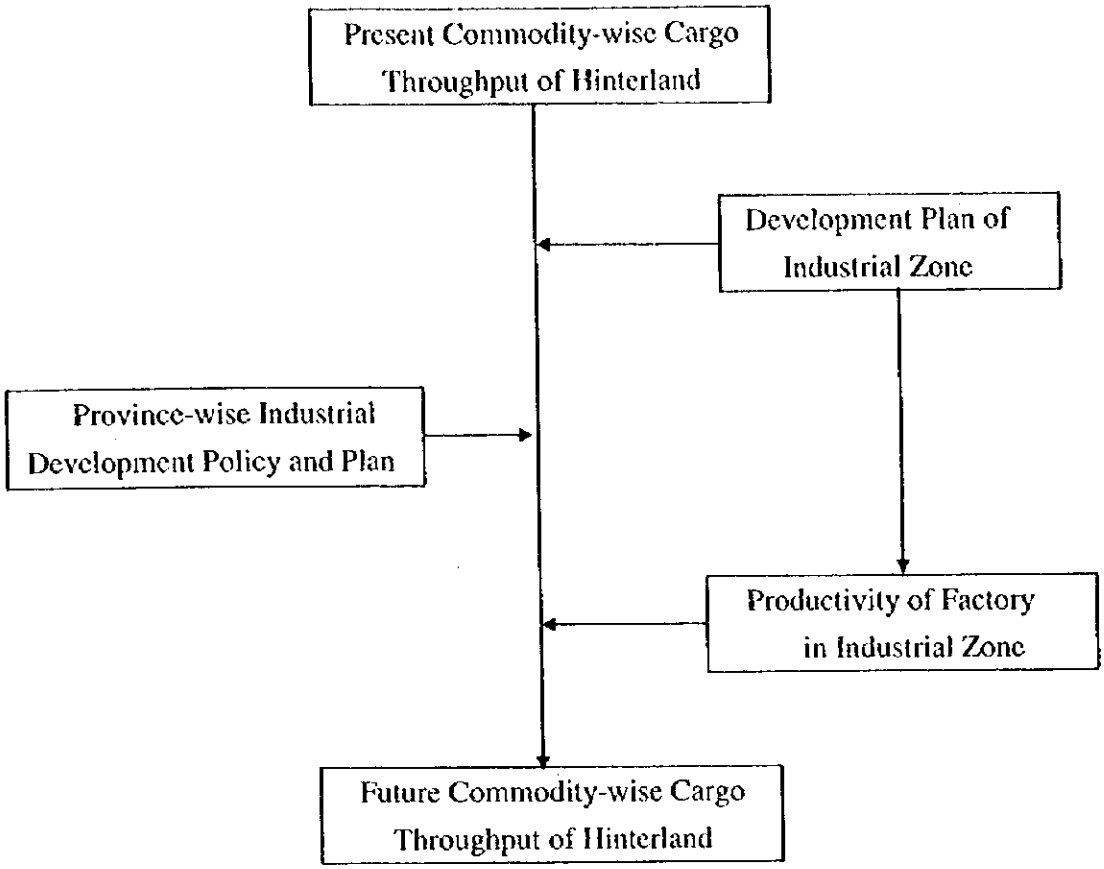


Figure 6.1.1 (2) Flow Chart of Micro Forecast

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

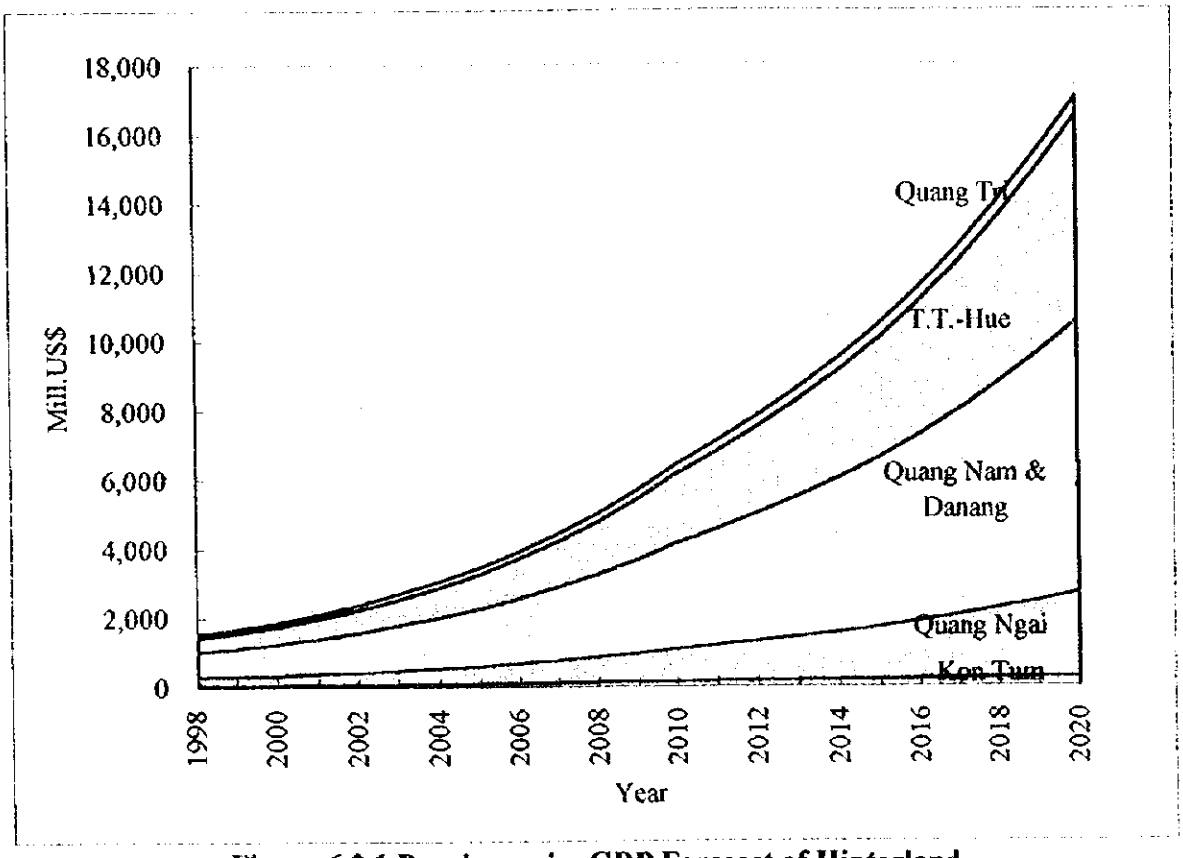


Figure 6.2.1 Province-wise GDP Forecast of Hinterland

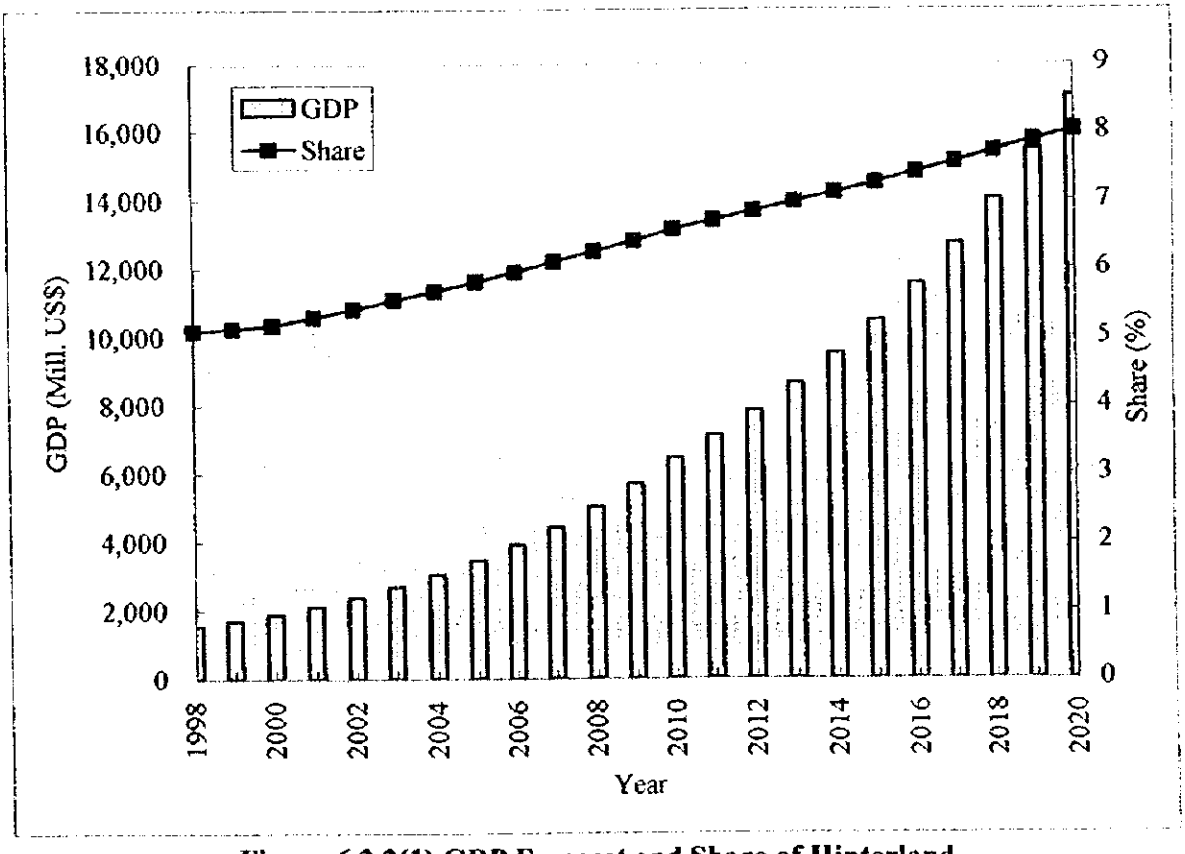


Figure 6.2.2(1) GDP Forecast and Share of Hinterland

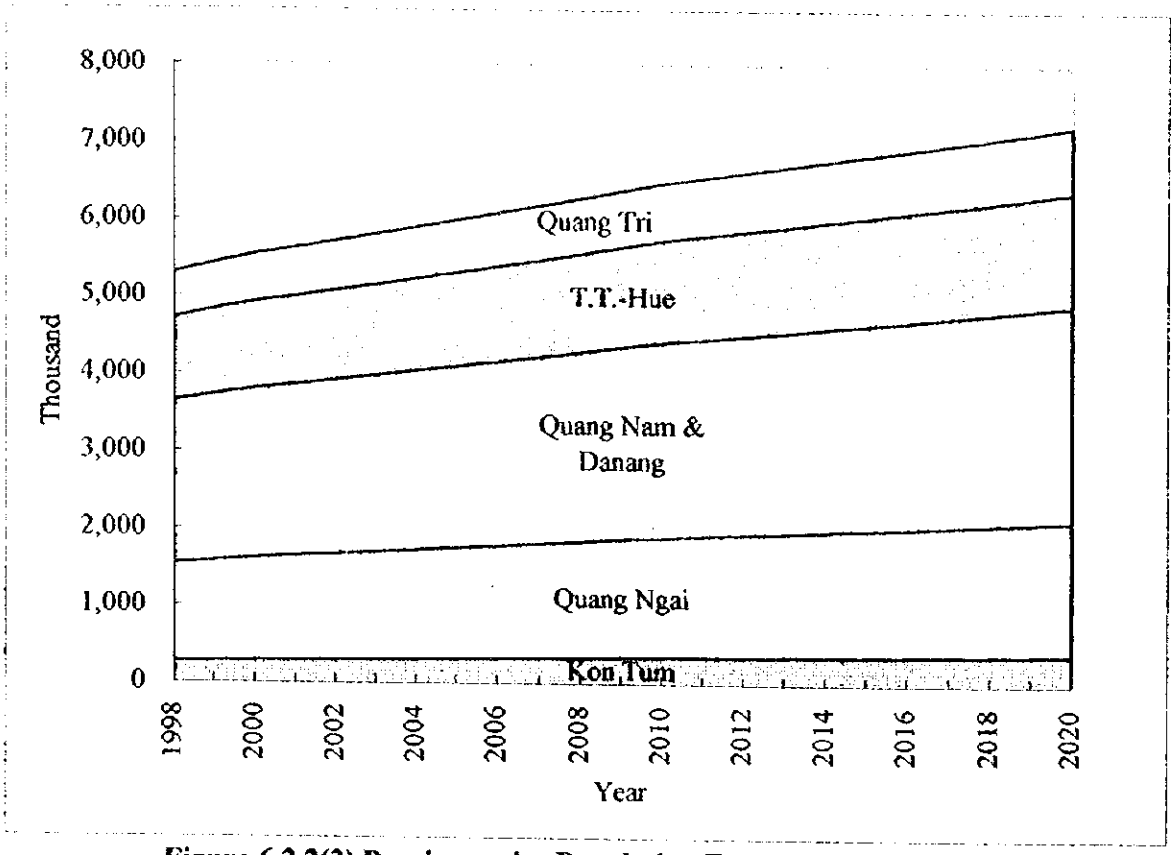


Figure 6.2.2(2) Province-wise Population Forecast of Hinterland

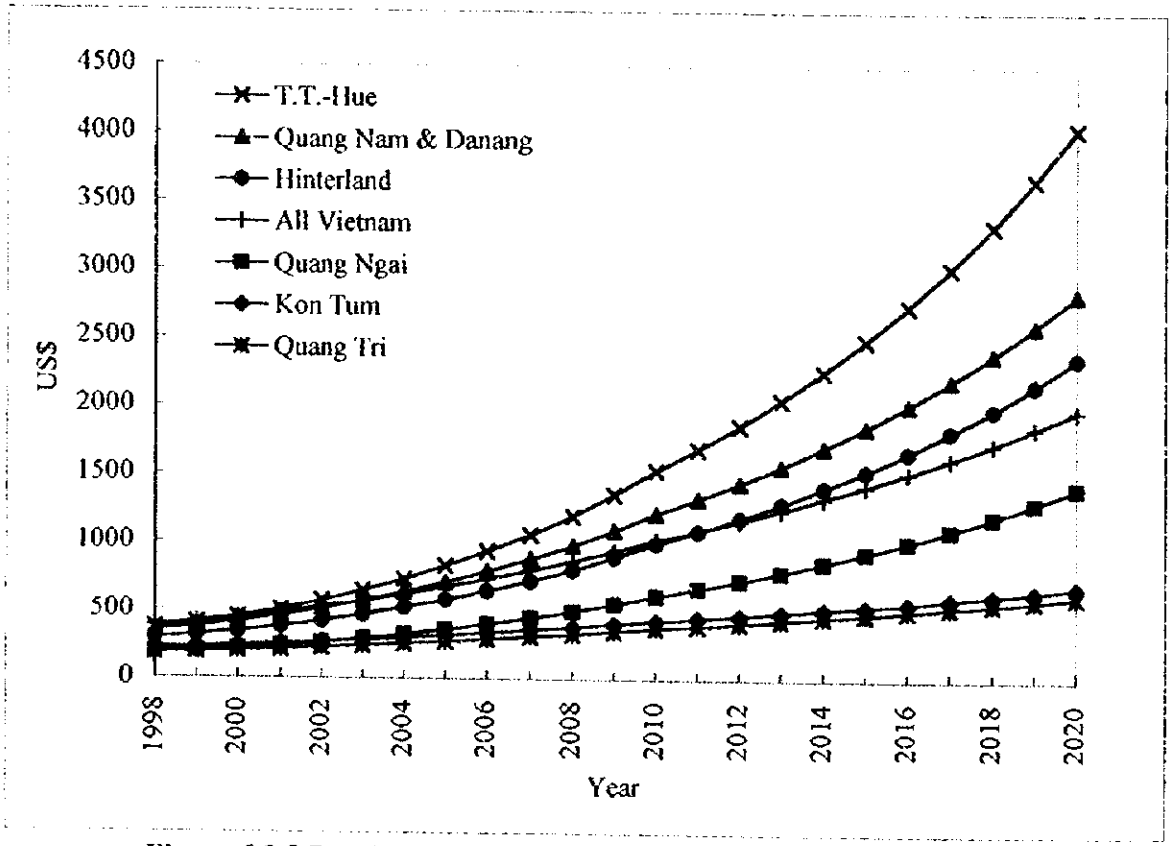


Figure 6.2.3 Province-wise GDP per Capita Forecast of Hinterland

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

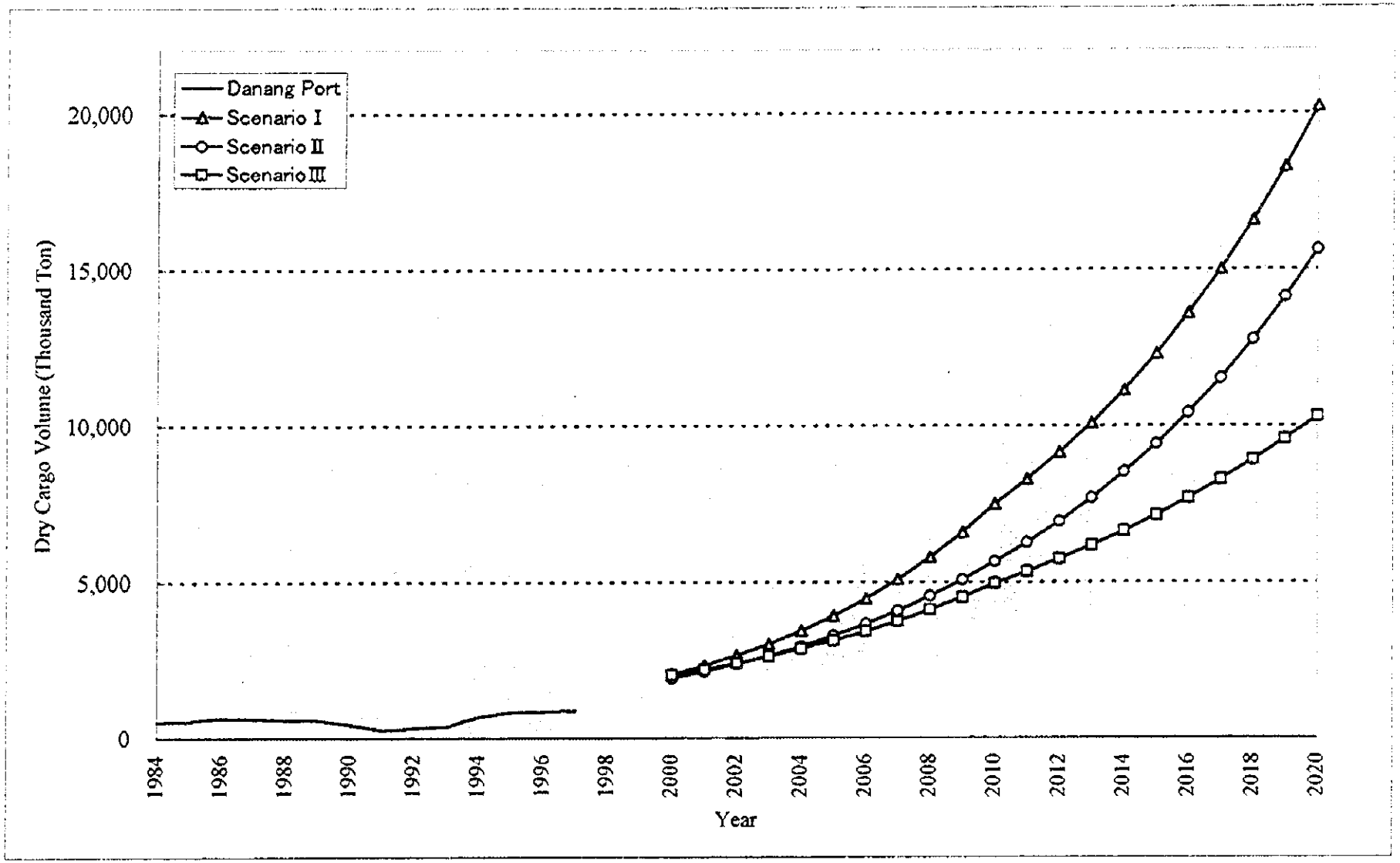
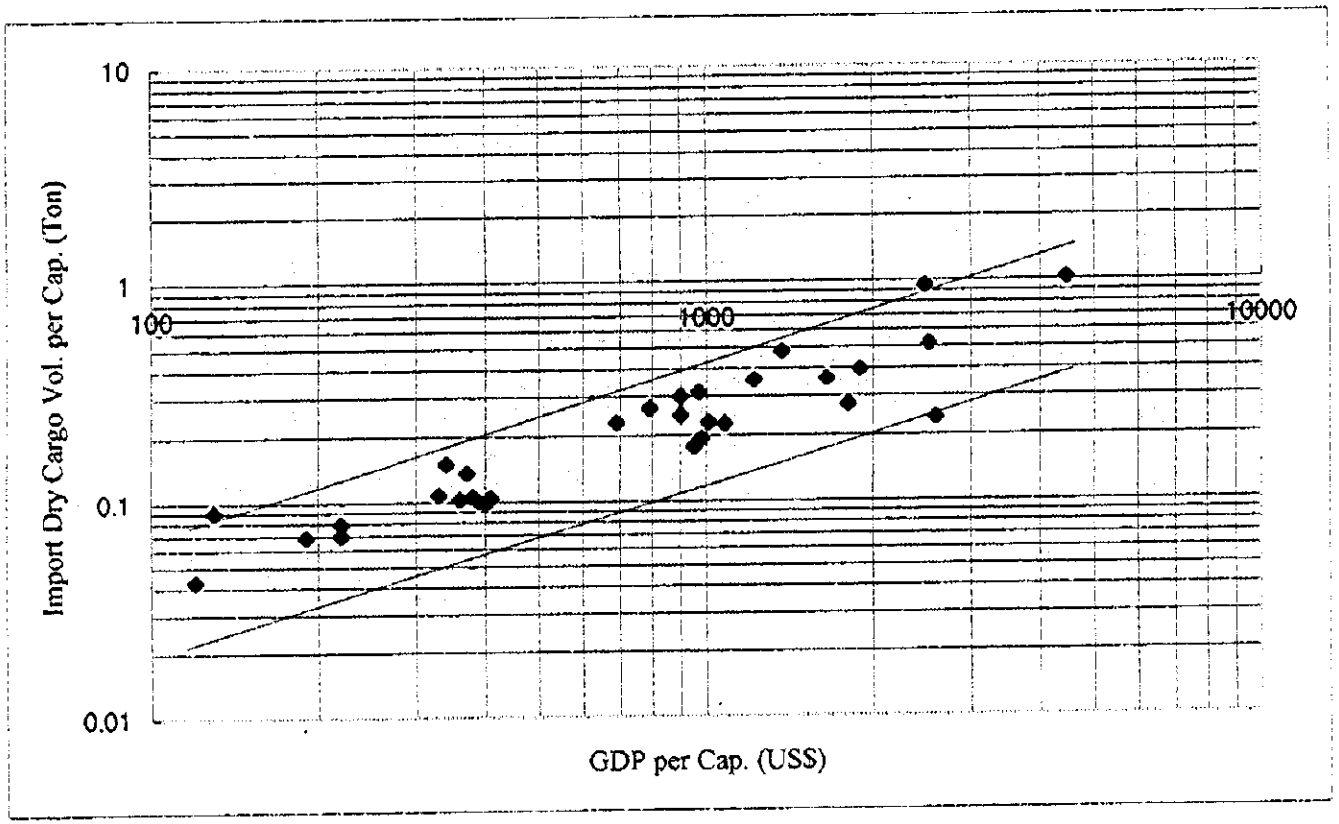


Figure 6.3.1(1) Cargo Throughput Forecast and Cargo Throughput Trend of Danang Port

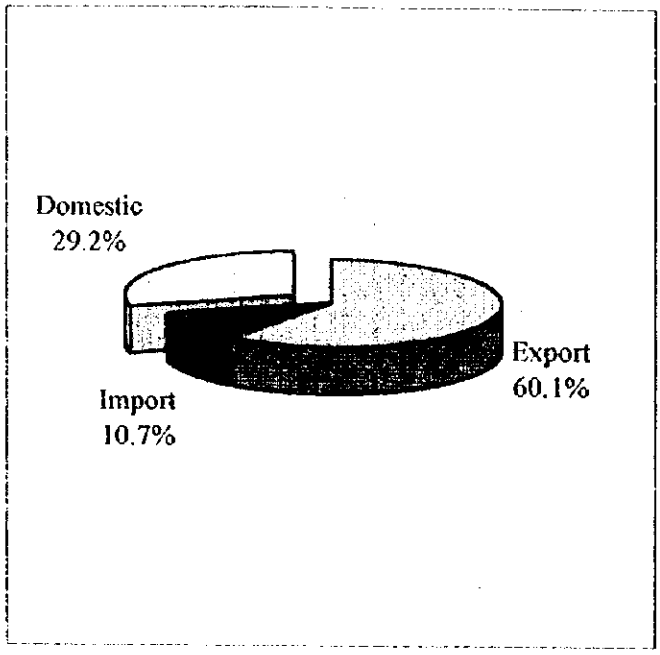


Country	GDP/Cap. (US$)	Cargo Vol. /Cap (Ton)
Portugal	4,460	1.022
Iran	2,590	0.238
Algeria	2,520	0.518
Venezuela	2,480	0.949
Poland	1,890	0.395
Panama	1,800	0.274
Costa Rica	1,650	0.359
Turkey	1,370	0.479
Thailand	1,220	0.355
Peru	1,080	0.225
Cameroon	1,010	0.229
Ecuador	980	0.193
Congo	970	0.313
El 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

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

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

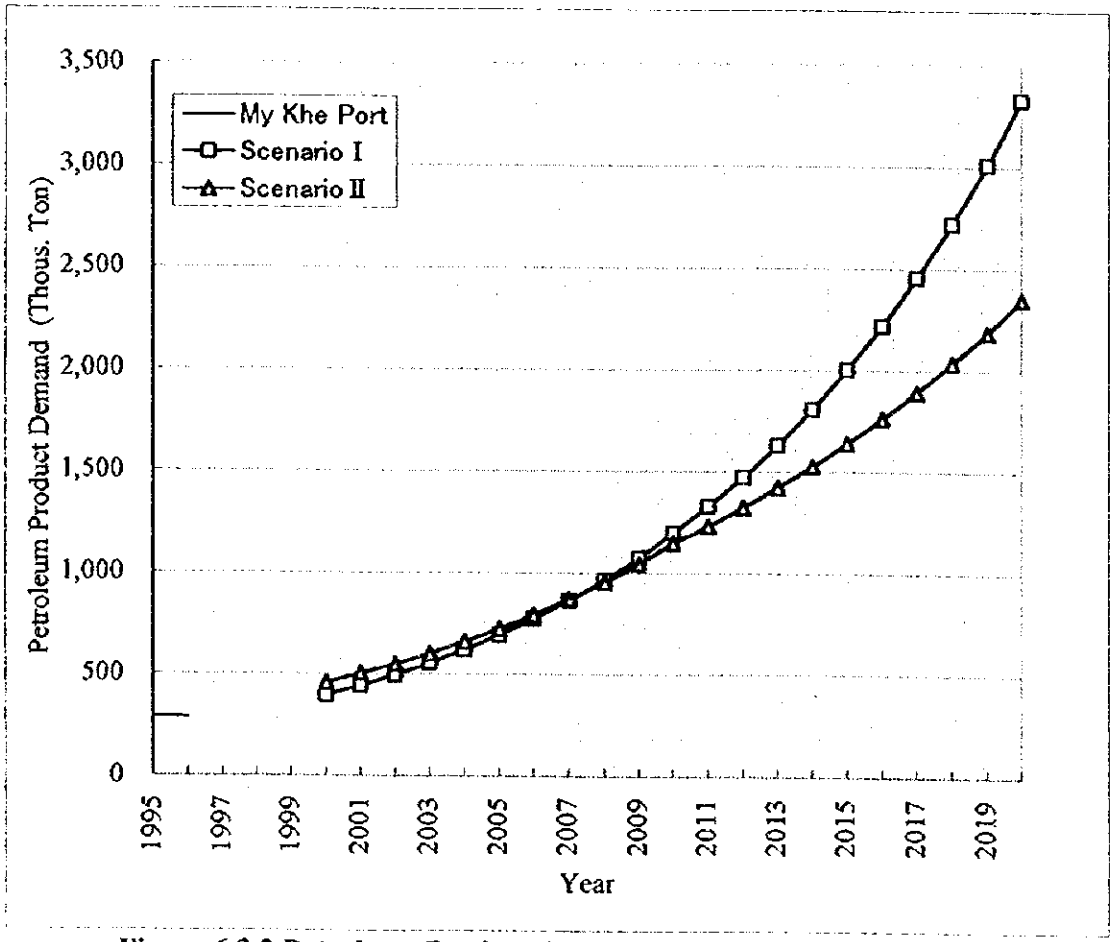


Figure 6.3.2 Petroleum Product Demand Forecast and Cargo Throughput (except for Transit) of My Khe Port

6.4 Commodity-wise Forecast

Currently there are two ports in Danang Bay, namely, Danang Port (Tien Sa Area and Song Han Area) and My Khe Port. In order to forecast demand, commodity demand in the whole Danang Bay area including that in Lien Chieu port which is under planning is estimated. Commodity-wise demand forecast is made considering present situation and historical trade trends of Danang Port, economic development plan and industrial policies in the study hinterland, scale and productivity of factory in industrial zone and supply-demand balance.

6.4.1 Oil Products

All the oil products are currently imported since there is no oil refinery in Vietnam. In the central region, oil products are landed at a specialized port of My Kke port in Danang City as shown in the Table 6.4.1, and are transported to the study hinterland and surrounding cities overland or by sea.

Table 6.4.1 Cargo Throughput of My Khe Port Unit:Ton

Year	Import Sea Transportation	Domestic Loading Sea Transportation	Domestic Loading Land Transportation
1995	463,082	174,280	288,802
1996	567,255	278,864	288,391

Source: Petrolimex Danang

In 1995, Vietnam imported 5,033,000ton of oil products while per capita consumption of oil products is 68kg/cap. Future oil products demand per capita is estimated at 185/kg/cap. in 2010 and 278kg/cap. in 2020 based on "The Report of the Study on the Development Plans of Petroleum and Petrochemical Industries for the Central Part of Vietnam" by Japan Construction Institute.

In the future, handling volume at My Kke Port is forecasted to decrease with the opening of Dung Quat oil refinery and planned import of oil products at Chan May Port under planning. Then the port will handle only a part of Domestic Loading which is currently transported to surrounding Provinces and imports to meet the demand of Danang City. Oil products demand can be forecast using the following equation.

〔Domestic Loading by Land Transportation〕 =
〔Demand per Capita〕 × 〔Population of Danang City〕

〔Domestic Loading by Sea Transportation〕 =
〔Present Domestic Loading by Sea Transportation〕
× 〔1－Yield Rate(80%) 〕 × 〔 Growth Rate (7%)〕

〔Import〕 = 〔Domestic Loading by Land Transportation〕
+ 〔Domestic Loading by Sea Transportation〕

There is a plan to move My Khe Port to Lien Chieu Area or Thanh Khe Area. This study is conducted on the assumption that imported products are unloaded at the offshore mooring facility at Thank Khe and Domestic Loading is done at the Berth at Lien Chieu Port. The result of estimation is as follows.

(Oil Products) Unit: ton

		2010	2020
Foreign	Import	295,500	534,700
Domestic	Loading	143,800	282,900

6.4.2 Agricultural, Fishery and Forestry Products

(1) Fishery Processing Products

Combined export volume of frozen fishery products including shrimps, cuttle fishes and processed products including Dry cuttlefishes is 5,915 ton in 1996 and is estimated at 5,914 ton in 1997. With advances in fishery technique and planned construction of additional prawn firms and new processing plants, growth rate is estimated at 4.94%, which is similar to past records.

(Fishery Processing Products) Unit: ton

		2010	2020
Foreign	Export	11,100	17,900

(2) Coffee

Kon Tum Province plans to make a coffee plantation and its harvest area in 2020 is 15,000ha. All production will be exported as follows.

(Coffee) Unit: ton

		2010	2020
Foreign	Export	7,500	15,000

(3) Rubber

Kon Tum Province plans to make a rubber plantation and its harvest area in 2020 is 15,000ha. All production will be exported as follows.

(Rubber) Unit: ton

		2010	2020
Foreign	Export	12,500	25,000

6.4.3 Mining

(1) Silica Sand

Silica sand is found in Danang City and Quang Nam Province. Total mining capacity per year of silica sand is 1,400,000tons. Based on above capacities, present handling volume at Danang Port and GDP growth rate of industry [14.5%(1995-2000), 12%(2000-2020)] , future cargo throughput is forecast as follows.

(Silica Sand) Unit: ton

		2010	2020
Foreign	Export	103,300	320,900

(2) Coal

Although Coal is used by both households and factories, it mostly serves as factory fuel. Coal demand has a close relation with GDP of industry. Therefore, based on GDP growth rate of industry [14.5% (1995-2000), 12% (2000-2020)] and present handling volume at Danang Port, future demand is forecast as follows.

(Coal) Unit: ton

		2010	2020
Domestic	Unloading	174,400	541,700

6.4.4 Break Bulk

(1) Fertilizer

Fertilizer demand has a close relation with agriculture production. Thus, fertilizer demand can be estimated based on present handling volume at Danang Port and GDP growth rate forecast of agriculture [5%(1995-2000), 4%(2000-2020)] as follows.

(Fertilizer) Unit: ton

		2010	2020
Foreign	Import	378,300	559,900

(2) Tar and Asphalt

Road conditions are poor in the central region of Vietnam, in which Danang city forms the nucleus. The lack of a sufficient road network, it is a bottleneck to economic development. In response, the government has proposed construction projects for road No.14, 24 and a rehabilitation/expansion projects for road No.1,9 some of which are already underway.

Tar and asphalt demand grows in relation to road construction, it can be estimated based on GDP growth rate of industry [14.5% (1995-2000), 12%(2000-2020)] and present handling volume at Danang Port as follows.

(Tar and Asphalt) Unit: ton

		2010	2020
Foreign	Import	63,700	198,000

(3) Wood Chip

There is a wood chip producing factory, namely "VIJACHIP" which has been already producing and exporting woodchip at Tien Sa District. While Kon Tum Province plans to build a woodchip factory in an industrial park in the northern part of the province. Future production planning of these two factory is shown as follows. All the products will be exported by ship.

(Wood Chip) Unit: ton

			2010	2020
VIJACHIP	Foreign	Export	187,000	200,000
Kon Tom Prov.	Foreign	Export	60,000	100,000
(Total)	Foreign	Export	247,000	300,000

6.4.5 Steel and Scrap

Consumption volume per capita of Vietnam is approximately 15kg/cap. in 1995. It is estimated at 67kg/cap. in 2010 and 150kg/cap. in 2020 based on historical trends of ASEAN nations and projected growth in GDP per capita of Vietnam.

Demand and supply volume of 5 provinces and 1 city in the study hinterland is shown in Table6.4.5(1),(2). Since supply volume outvalues demand volume, surplus is transported to the outside of the study hinterland.

Table 6.4.5(1) Steel Demand Forecast of the Hinterland

Year	Demand per Cap. (kg/cap.)	Population (persons)	Demand (Ton)
2010	67	6,476,000	433,900
2020	150	7,217,000	1,082,600

Source: JICA Steel Industry Development Study

Table 6.4.5(2) Steel Production Plans of the Hinterland

Unit: ton

	Hoa Khan IZ	Lien Chieu IZ	Dung Quat Recycle	Danang Shipbreaking	(Total)
2010	40,000	300,000	0	100,000	440,000
2020	40,000	360,000	1000,000	100,000	1,500,000

Source: VSC

At the moment, there is a steel mill factory run by Vietnam Steel Corporation in Hoa Khanh Industrial Zone. Its annual output is 9,000ton in 1997. There is a plan to improve and expand facilities to increase production capacity. Scrap as raw material will be transported by truck from surrounding areas and will be also imported from abroad. All the products will be transported to the northern and the southern part of Vietnam by ship.

Vietnam Steel Corporation plans to construct a new steel mill factory in Lien Chieu Industrial Zone in which all the scrap will be imported from abroad while one thirds of the products will be transported to the central region by truck and two thirds will be transported to the northern and the southern region by sea. Seaborne cargo throughput of these two factory is as follows.

(Steel) Unit: ton

			2010	2020
Hoa Khanh IZ	Domestic	Loading	40,000	40,000
Lien Chieu IZ	Domestic	Loading	200,000	240,000
(Total)	Domestic	Loading	240,000	280,000

(Scrap) Unit: ton

			2010	2020
Hoa Khanh IZ	Foreign	Import	35,000	35,000
Lien Chieu IZ	Foreign	Import	450,000	540,000
(Total)	Foreign	Import	485,000	575,000

6.4.6 Cement and Clinker

Demand per capita in 1996 of ASEAN nations and other countries is shown in Table6.4.6(1). Demand per capita of Vietnam in 1996 is 106kg/cap. Since demand per capita has a close relation with GDP per capita, demand per capita of Vietnam will increase as the nation's economy grows. GDP per capita of Vietnam in 2020 is estimated at around US$2,000 as shown in Table 4.4.2(5), almost the same level as that of Thailand in 1996. Thus, demand per capita of Vietnam in 2020 could be estimated at 620kg/cap.(Demand per capita of Thailand in 1996).

Table 6.4.6(1) Cement Demand per Capita of ASEAN Countries in 1996

Country	Demand (Thous.Ton)	Population (Thous.)	Demand per cap. (kg/cap.)
Vietnam	8,000※	75,355	106
Indonesia	25,711	198,808	129
Malaysia	14,850	20,396	728
Philippines	12,750	70,020	182
Singapore	4,500	3,048	1,476
Thailand	37,980	61,071	620

※Estimated

Source: VNCC

Regarding demand supply balance of five provinces and one city in the study hinterland, Quang Tri Province and Thua Thien Hue Province have plans to build several cement factories. Supply volume is expected to exceed demand volume. Surplus will be directly transported to other provinces by truck or by ship from nearby ports.

As for Danang City, Quang Nam Province Quang Ngai Province and Kon Tum Province, there is a plan to build clinker grind station and kiln factory in Danang City and surrounding areas as shown in Table6.4.6(2). Since supply volume is expected to exceed demand volume as shown in Table 6.4.6(3), surplus will be directly transported from the factories to other provinces by truck or through Lien Chieu Port to other countries by ship.

Table 6.4.6(2) Cement Production Plans of Danang City and Quang Nam Province

Factory Name or Location	Sort of Factory	Production Vol. (Tous.Ton) 2010	2020
Hai Van Cement	Clinker Grind Station	780	1,000
Ky Ha	Clinker Grind Station	780	780+ α
A So	Kiln Factory		
Thanh My	Kiln Factory	1,400	1,400+ α
(Total)		2,960	3,180+ α

Source: Panorama of Da Nang city's Fishery-Forestry-Agriculture

Table 6.4.6(3) Cement Demand Forecast of Danang City and Quang Nam, Quang Ngai, Kon Tum Province

Year	Province	Population (Thous.)	Demand per Cap. (kg/cap.)	Demand (Thous.Ton)
2010	Danang, Quang Nam	2,517	436	1,096
	Quang Ngai	1,547	222	344
	Kon Tum	352	134	47
	(Total)	4,416		1,487
2020	Danang, Quang Nam	2,781	620	1,724
	Quang Ngai	1,726	307	530
	Kon Tum	396	149	59
	(Total)	4,903		2,313

In Lien Chieu area, Hai Van Cement Company is building a clinker grind station which has a plan to transport materials and products. Since supply volume exceeds demand volume in the surrounding areas of Danang City as explained above, 80% of products is transported to northern and southern part of Vietnam or is exported abroad. Future cargo throughput of cement and clinker as material is forecast as follows.

(Cement) Unit: ton

		2010	2020
Foreign	Export	187,200	240,000
Domestic	Loading	436,800	560,000

(Clinker) Unit: ton

		2010	2020
Foreign	Import	780,000	1,00,000

6.4.7 Manufacturing Products and Consumer Goods

The import dry cargo volume per capita has a close relation with GDP per capita as explained in 6.3 Macro Forecast. Thus, import dry cargo volume of the study hinterland can be estimated by the following equation and forecast results in 2010 and 2020 are as follows

$$Y = (0.31374X - 0.49909) \times S_1 \times S_2$$

Y : Total cargo volume (Thousand ton)

X : GDP per capita (Thousand US$), modified 1989 constant price

S_1: GDP of the study hinterland (Thousand)

S_2: Manufacturing products and consumer goods share of total import volume of Vietnam in 1995; 51.0%

Source: Coastal Shipping Study

(Manufacturing Products and Consumer Goods Import)

Unit: ton

		2010	2020
Foreign	Import	1,021,500	2,034,200

In Danang Export Processing Zone, Lien Chieu Industrial Zone, Hoa Khanh Industrial Zone and around the Industrial Zones, there are factories which manufacture consumer goods such as textile, garment, shoes, washing, powder and the like. Combined export volume from Danang Port in 1995 was 29,740tons.

Cargo demand of industry generally grows at the same rate as that of GDP of industry, however, in this case, it is expected to be suppressed due to limitations of production capacity and site area of factories. Thus, cargo demand growth rate of manufacturing industry is estimated at 12.0% [- 2000], 11.0% [2001-2010], 10.0% [2011-2020] which is the middle rate between GDP of industry and that of all sectors.

(Consumer Goods Export) Unit: ton

		2010	2020
Foreign	Export	148,800	386,000

There are 4 industrial area plans around Danang Port, namely, Danang export processing zone (Danang EPZ), Lien Chieu industrial zone, Hoa Khanh industrial zone and Dien Nam-Dien Ngoc industrial zone.

Cargo demand for vacant plots of industrial zone was forecast based on zoning plans by industry, unit productivity of each factory and share of sea transportation using the following equation.

〔Cargo Demand〕 = 〔Net area of each factory〕
× 〔Unit productivity〕 × 〔Share of sea transportation〕

Future, production plans of enterprises which will be located in the industrial zone were also utilized for forecast. Forecast result of cargo throughput of industrial zone is as follows and result of commodity-wise forecast (micro forecast) is summarized in Table 6.4.7(1),(2).

(Foodstuff) Unit: ton

			2010	2020
Products	Foreign	Export	9,400	17,700
Raw Materials	Domestic	Unloading	37,700	70,900
(Total)			47,100	88,600

(Construction Materials) Unit: ton

			2010	2020
Products	Foreign	Export	120,100	212,400
Products	Domestic	Loading	120,100	212,400
(Total)			240,200	424,800

(Textiles and Garment) Unit: ton

			2010	2020
Products	Foreign	Export	9,600	18,000
Products	Domestic	Loading	2,400	4,500
Raw Materials	Domestic	Unloading	21,000	39,400
(Total)			33,000	61,900

(Electronics Industries) Unit: ton

			2010	2020
Products	Foreign	Export	61,300	115,500
Products	Domestic	Loading	26,400	49,500
Raw Materials	Foreign	Import	50,800	95,500
Raw Materials	Domestic	Unloading	50,800	95,500
(Total)			189,300	356,000

(Handicrafts and Decorative Products) Unit: ton

			2010	2020
Products	Foreign	Export	4,800	7,300
Raw Materials	Foreign	Import	2,000	2,000
Raw Materials	Domestic	Unloading	14,000	26,500
(Total)			20,800	35,800

(Plastics) Unit: ton

			2010	2020
Products	Foreign	Export	16,000	28,400
Products	Domestic	Loading	7,000	12,200
Raw Materials	Foreign	Import	34,500	61,000
Raw Materials	Domestic	Unloading	34,500	61,000
(Total)			92,000	162,600

(Mechanical Products) Unit: ton

			2010	2020
Products	Foreign	Export	7,400	13,100
Products	Domestic	Loading	3,200	5,600
Raw Materials	Foreign	Import	12,300	21,800
Raw Materials	Domestic	Unloading	12,300	21,800
(Total)			35,200	62,300

(Chemical Products) Unit: ton

			2010	2020
Products	Foreign	Export	11,000	18,900
Products	Domestic	Loading	4,800	9,200
Raw Materials	Foreign	Import	9,400	19,000
Raw Materials	Domestic	Unloading	38,100	65,000
(Total)			63,300	112,100

(Automobile Assembly) Unit: ton

			2010	2020
Products	Foreign	Export	8,400	14,900
Products	Domestic	Loading	19,700	34,900
Raw Materials	Foreign	Import	56,300	99,600
(Total)			84,400	149,400

(Glass Products) Unit: ton

			2010	2020
Products	Foreign	Export	21,800	38,700
Products	Domestic	Loading	7,400	12,900
(Total)			29,200	51,600

(Construct Machinery) Unit: ton

			2010	2020
Products	Foreign	Export	10,300	19,700
Products	Domestic	Loading	4,400	8,400
Raw Materials	Foreign	Import	16,200	31,000
Raw Materials	Domestic	Unloading	10,800	20,600
(Total)			41,700	79,700

6.4.8 Container Cargo

The agriculture, fishery and forestry Products, the manufacturing products except for construction materials and consumer goods of foreign trade are suitable for containerization. The container volume can be forecast by future containerization ratio and unit weight per TEU. Then, containerization ratio can be estimated by using theoretical logistic curve on the past throughput of Hai Phong Port. Unit weight per TEU calculated by cargo statistics in 1995 of Danang port is 14.6 ton/TEU for export, 12.0 ton/TEU for import. The equation for containerization ratio forecast, result of containerization forecast and container volume forecast in target year is as follows.

(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%
Foreign	Import	79.7%	80.0%

(Container Volume) Unit: TEU

		2010	2020
Foreign	Export	18,600	40,300
Foreign	Import	79,900	157,600

6.4.9 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 Table6.4.9(1).

Table 6.4.9(1) 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

※new port

On the other hand, macro forecast of dry cargo in the study hinterland is summarized in the Table6.4.9(2). Two forecasts present similar figures as seen in the Figure 6.4.9 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 6.4.9(2) 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

Table 6.4.7(1) Summary of Commodity-wise Forecast in 2010

(Unit: ton)

Commodities	Foreign		Domestic	
	Export	Import	Loading	Unloading
Oil Products		295,500	143,800	
Fishery, Processing	11,100			
Coffee	7,500			
Rubber	12,500			
Silica Sand	103,300			
Coal				174,400
Fertilizer		378,300		
Tar and Asphalt		63,700		
Wood Chip	247,000			
Steel			240,000	
Scrap		485,000		
Cement	187,200		436,800	
Clinker		780,000		
Manufacturing Products				
and Consumer Goods for Import		1,021,500		
Consumer Goods for Export	148,800			
Foodstuff	9,400			37,700
Construction Materials	120,100		120,100	
Textiles and Garment	9,600		2,400	21,000
Electronics Industries	61,300	50,800	26,400	50,800
Handicraft and Decorative Products	4,800	2,000		14,000
Plastics	16,000	34,500	7,000	34,500
Mechanical Products	7,400	12,300	3,200	12,300
Chemical Products	11,000	9,400	4,800	38,100
Automobile Assembly	8,400	56,300	19,700	
Glass Products	21,800		7,400	
Construct Machinery	10,300	16,200	4,400	10,800
(Total)	997,500	3,205,500	1,016,000	393,600
	4,203,000		1,409,600	
	5,612,600			

Table 6.4.7(2) Summary of Commodity-wise Forecast in 2020

(Unit: ton)

Commodities	Foreign		Domestic	
	Export	Import	Loading	Unloading
Oil Products		534,700	282,900	
Fishery, Processing	17,900			
Coffee	15,000			
Rubber	25,000			
Silica Sand	320,900			
Coal				541,700
Fertilizer		559,900		
Tar and Asphalt		198,000		
Wood Chip	300,000			
Steel			280,000	
Scrap		575,000		
Cement	240,000		560,000	
Clinker		1,000,000		
Manufacturing Products				
and Consumer Goods for Import		2,034,200		
Consumer Goods for Export	386,000			
Foodstuff	17,700			70,900
Construction Materials	212,400		212,400	
Textiles and Garment	18,000		4,500	39,400
Electronics Industries	115,500	95,500	49,500	95,500
Handicraft and Decorative Products	7,300	2,000		26,500
Plastics	28,400	61,000	12,200	61,000
Mechanical Products	13,100	21,800	5,600	21,800
Chemical Products	18,900	19,000	9,200	65,000
Automobile Assembly	14,900	99,600	34,900	
Glass Products	38,700		12,900	
Construct Machinery	19,700	31,000	8,400	20,600
(Total)	1,809,400	5,231,700	1,472,500	942,400
	7,041,100		2,414,900	
	9,456,000			

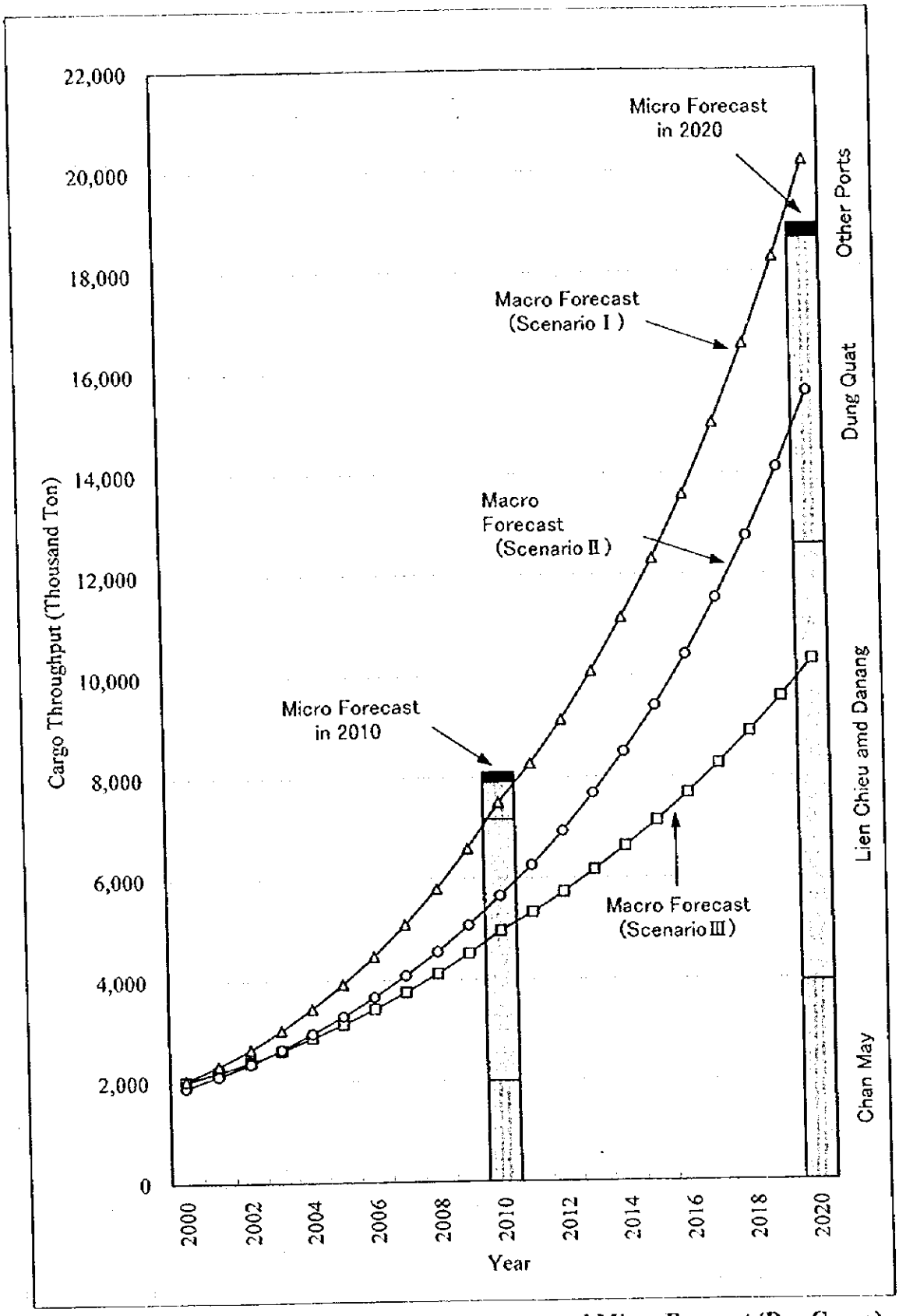


Figure 6.4.9 Comparison between Macro Forecast and Micro Forecast (Dry Cargo)

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 (Unit : %)

Year	Growth Rate (%)				
	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:

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

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 Thailnd

	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	818,000

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 Lien Chieu

Lien Chieu	Year	2005	2010	2015	2020
Import	Container	75,000	277,000	466,000	665,000
Export	Container	93,000	340,000	492,000	602,000
Total	Container	168,000	617,000	958,000	1,267,000
Import	BreakBulk	3,000	9,000	13,000	15,000
Import	BreakBulk	1,000	3,000	4,000	6,000
Total	BreakBulk	4,000	12,000	17,000	21,000

Table 6.5.4 (8) Transit Cargo of Low Case in Lien Chieu

Lien Chieu	Year	2005	2010	2015	2020
Import	Container	0	121,000	369,000	594,000
Export	Container	0	128,000	385,000	528,000
Total	Container	0	249,000	754,000	1,122,000
Imporrt	BreakBulk	0	4,000	10,000	13,000
Export	BreakBulk	0	1,000	3,000	5,000
Total	BreakBulk	0	5,000	13,000	18,000

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 Lien Chieu. And Ubon Ratchathani is recognized as a hinterland of the Port of Lien Chieu after completion of Route 16 or if total transportation cost is cheaper than the Bangkok route.

Table 6.5.5 Land Transport Cost by Truck per 20' Container

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

Origin & Destination	Lien Chieu	Bangkok
Savannakhet(R-9)	432	589
Pakse(R-16)	364	672
Pakse(R-18)	482	672
Mukdahan(R-9)	454	534
UbonRatchathni(R-16)	481	522
UbonRatchathani(R-18)	599	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