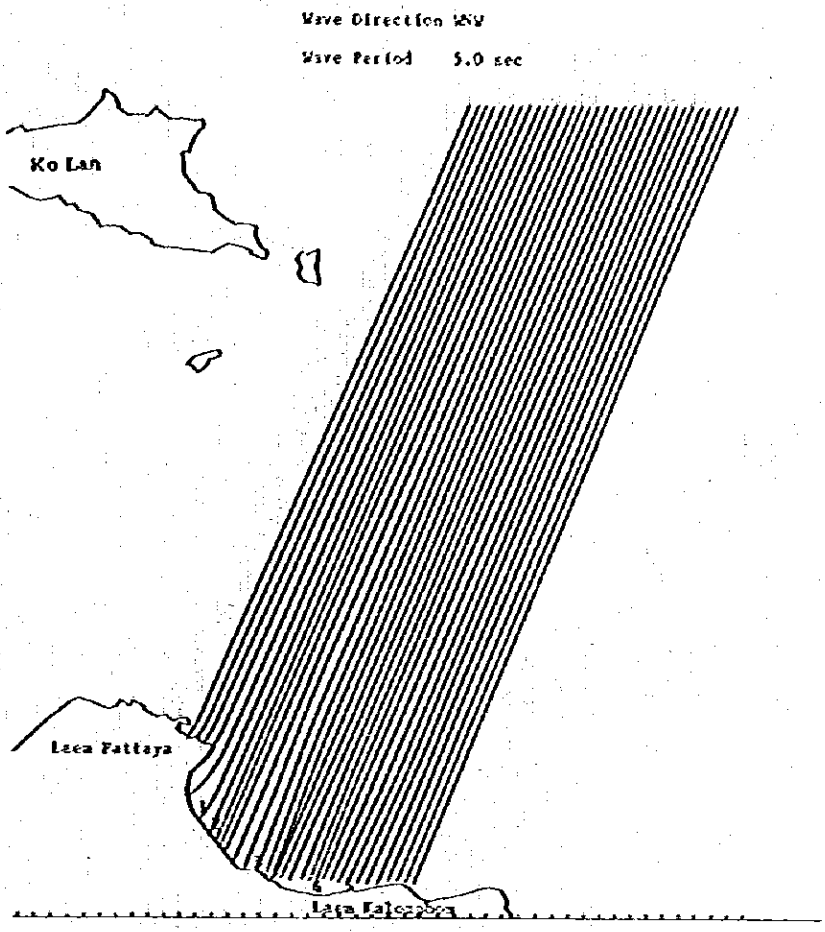


Fig. 6.2.10 Wave Refraction Diagram

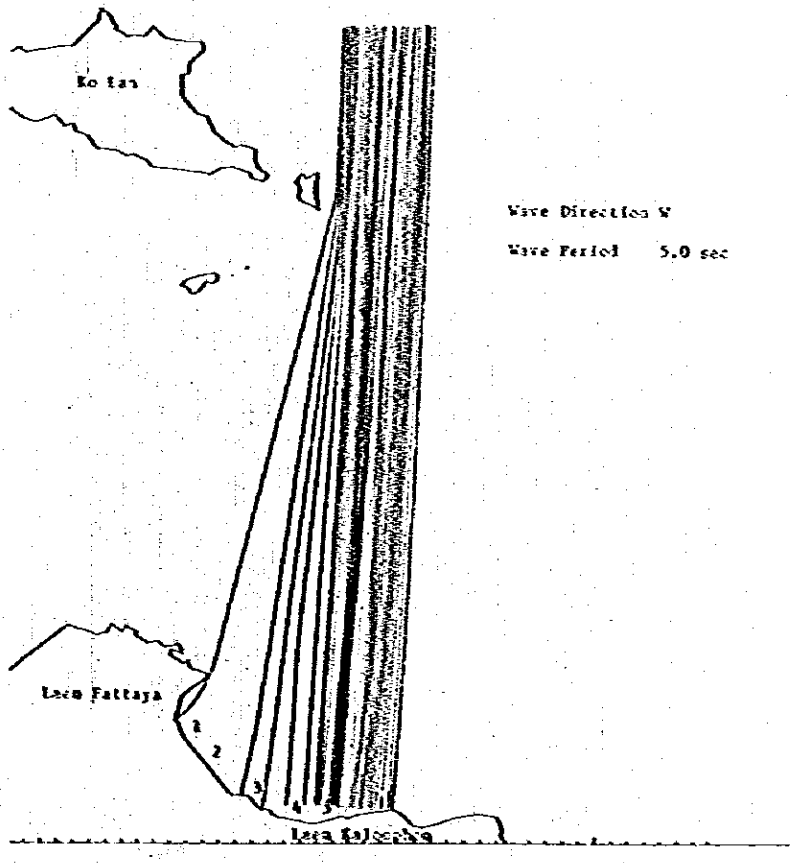


Fig. 6.2.11 Wave Refraction Diagram

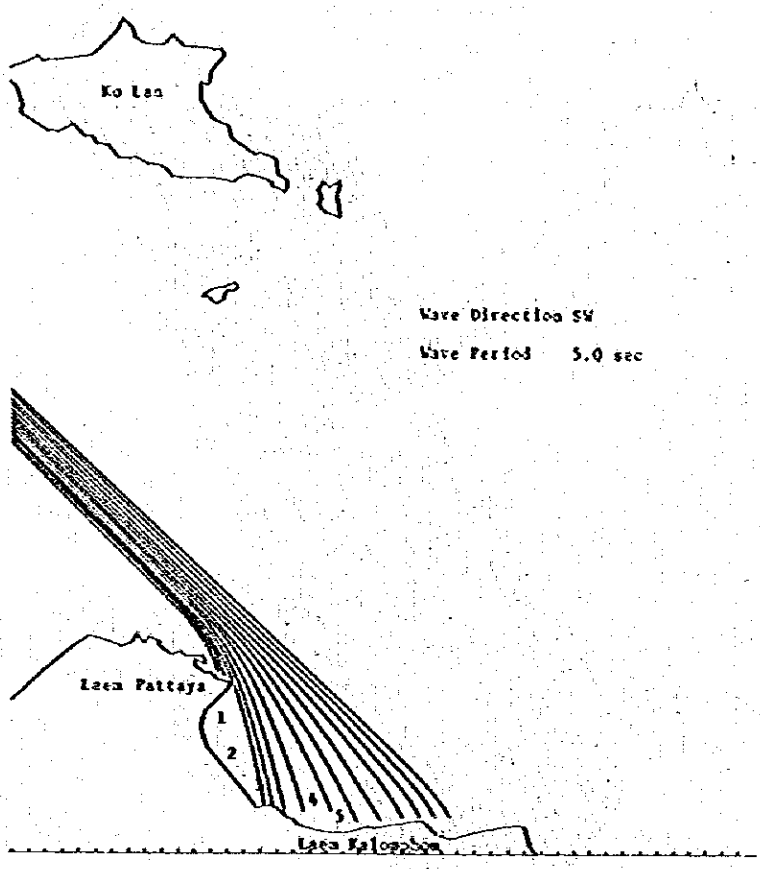


Fig. 6.2.12 Wave Refraction Diagram

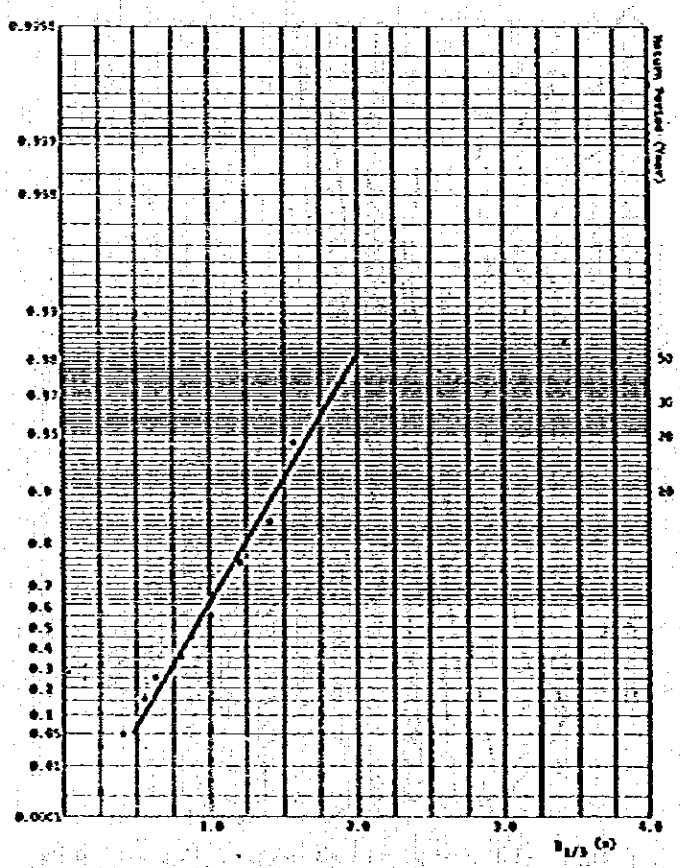


Fig. 6.2.13. Probable Deep Water Wave Height
(Wave Direction : NW - N)

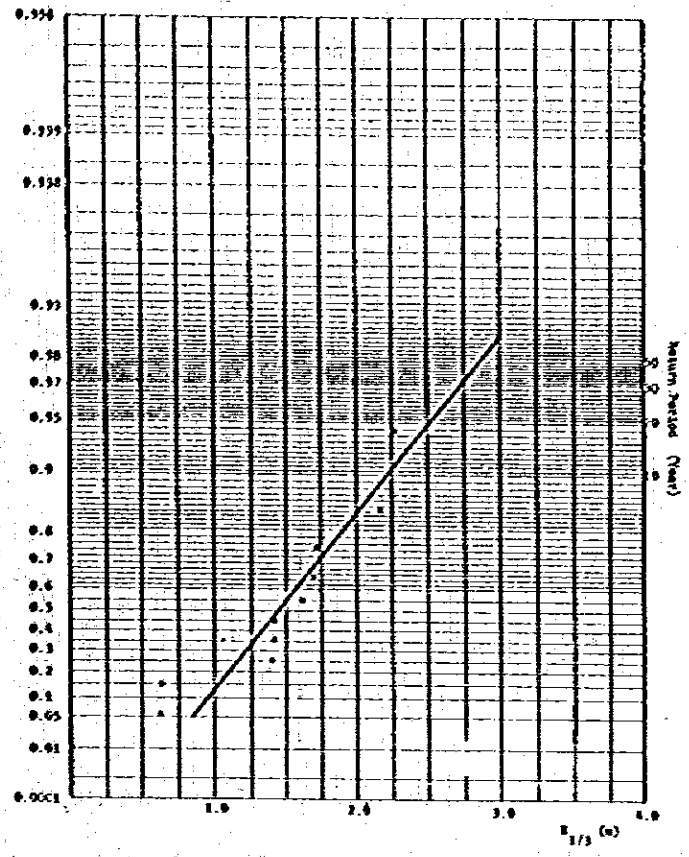


Fig. 6.2.14 Probable Deep Water Wave Height
(Wave Direction : S - SW)

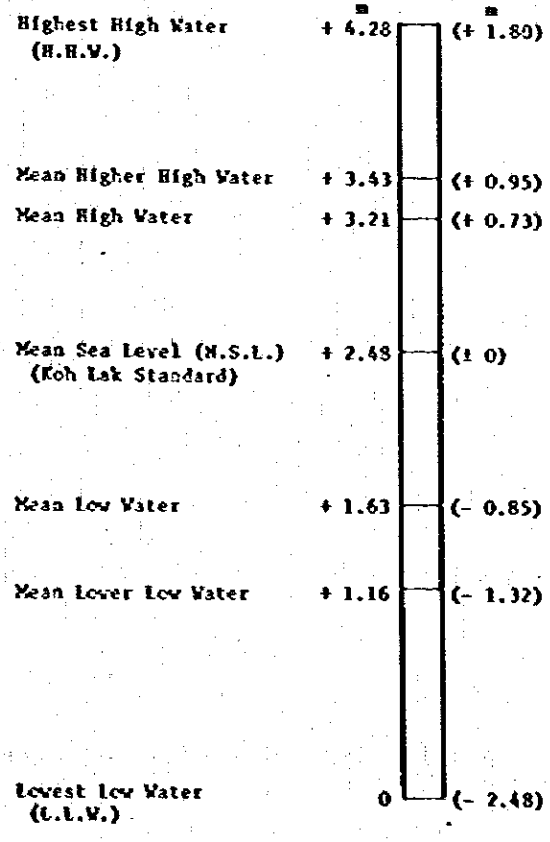


Fig. 6.2.15 Tidal Data of Ko Si Chang

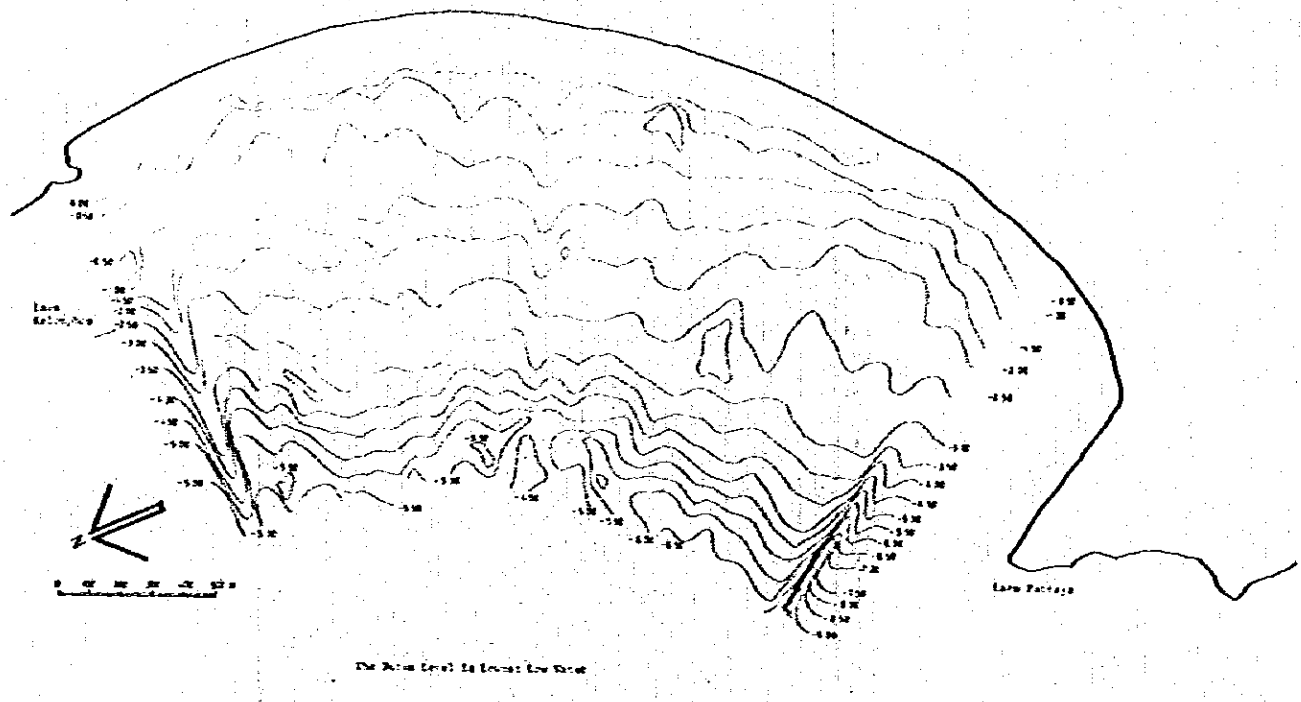


Fig. 6.2.16 Sounding Map

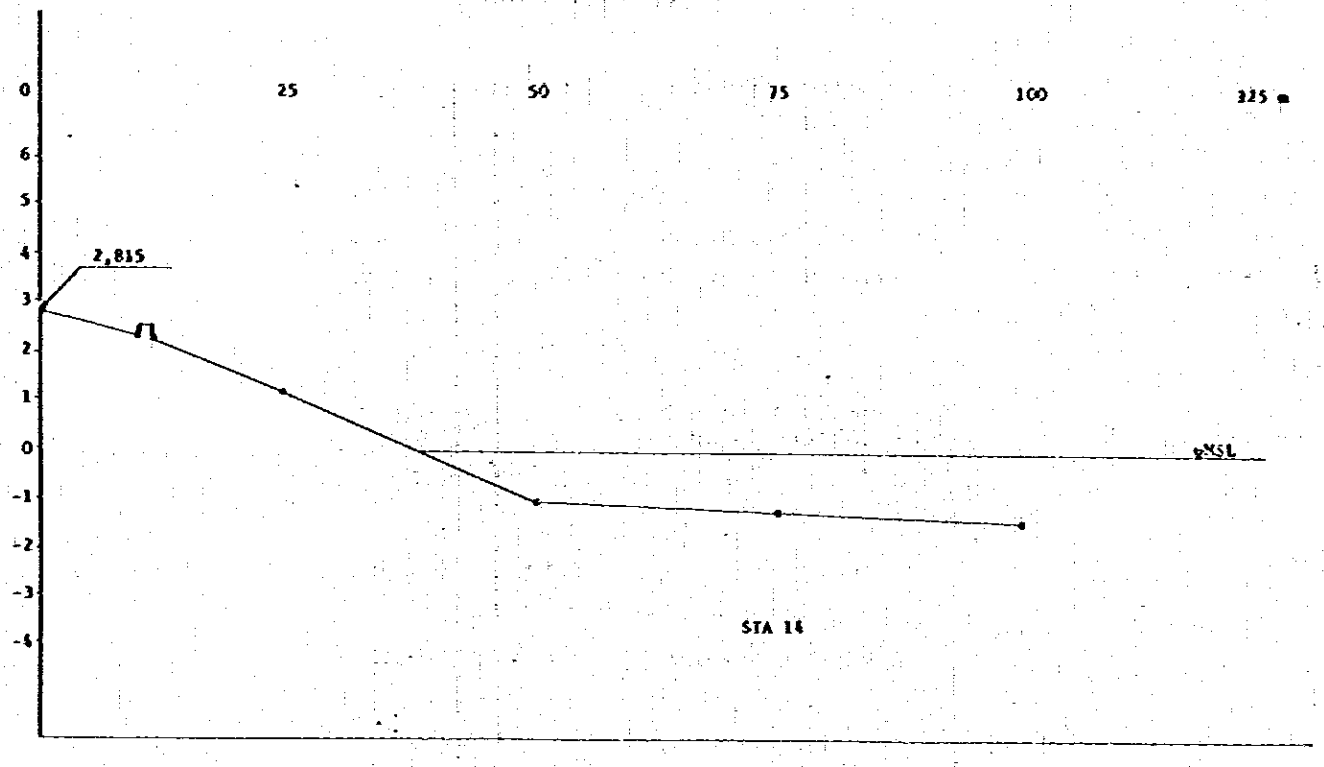


Fig. 6.2.17 Typical Profile of Pattaya Beach

Table 6.2.2 Summary of Soil Engineering Properties

Project : Pattaya Tourism Development
Location: Pattaya, Chonburi

Date: June 12, 1978

Bore Hole No.	Depth m	Water Content %	Liquid Limit %	Plastic Limit %	Wet Unit Wt. t/m³	Dry Unit Wt. t/m³	Specific Gravity	Standard Penetration Resistance blows/ft
BP 1	3.0-3.5	16.5	-	-	2.02	1.77	2.63	53
	6.0-6.5	35.6	62.6	24.6	2.04	1.50	2.61	85
	7.0-7.5	16.6	-	-	2.03	1.73	2.66	133
BP 2	1.0-1.5	17.5	-	-	2.09	1.77	2.66	39
	6.0-6.5	14.1	49.1	22.9	1.96	1.72	2.69	35
	7.0-7.5	11.4	-	-	1.92	1.71	2.65	42
	10.0-10.5	13.6	-	-	2.02	1.79	2.63	170
BP 3	6.5-7.0	13.5	49.0	27.1	2.01	1.77	2.67	87
	8.0-8.5	-	-	-	-	-	2.65	118/11"
	7.5-8.0	6.5	-	-	2.03	1.90	2.66	147/11"
	10.5-11.0	23.5	45.5	22.3	2.00	1.65	2.65	69
BP 4	1.5-2.0	14.5	-	-	2.09	1.83	2.66	39
	6.5-7.0	22.0	39.4	26.3	1.94	1.59	2.62	56
	7.5-8.0	22.8	-	-	1.94	1.58	2.65	28
	10.5-11.0	17.5	43.5	27.6	2.09	1.78	2.64	33
	13.5-14.0	7.6	-	-	2.07	1.83	2.65	100/5"
BP 5	3.0-3.5	19.2	-	-	2.06	1.73	2.63	47
	6.0-6.5	10.4	-	-	2.00	1.81	2.65	55
	7.0-7.5	13.6	-	-	1.93	1.75	2.65	47
	10.0-10.5	18.5	41.2	27.5	2.19	1.77	2.65	55

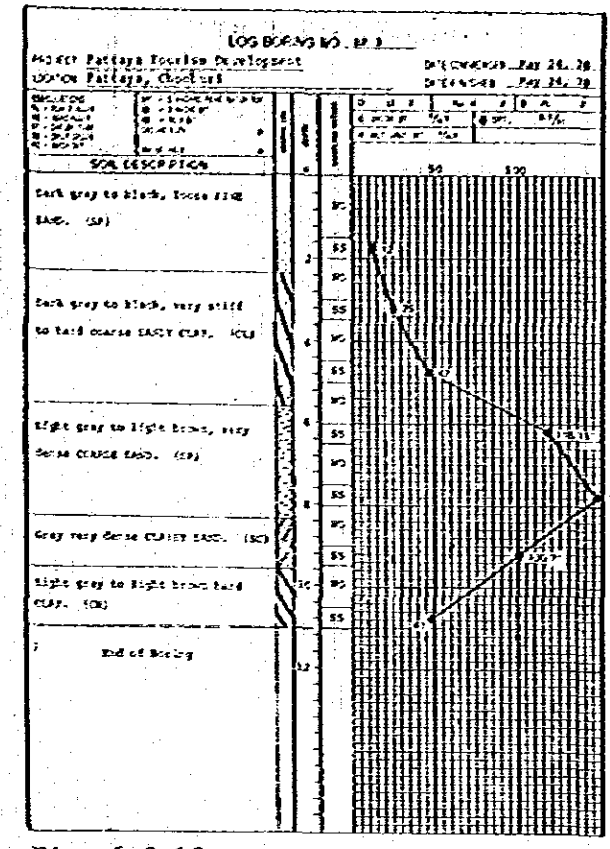


Fig. 6.2.18 Example of Soil Profile

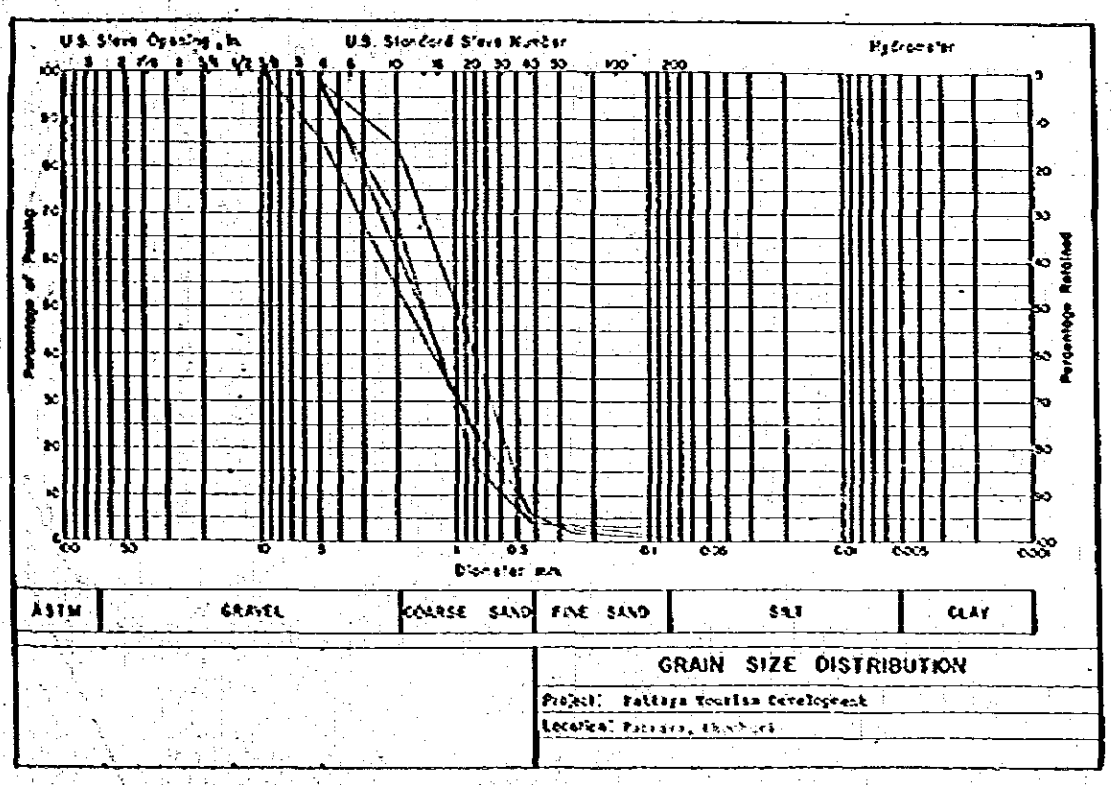


Fig. 6.2.19 Grain Size Distributions of Beach Materials at Pattaya

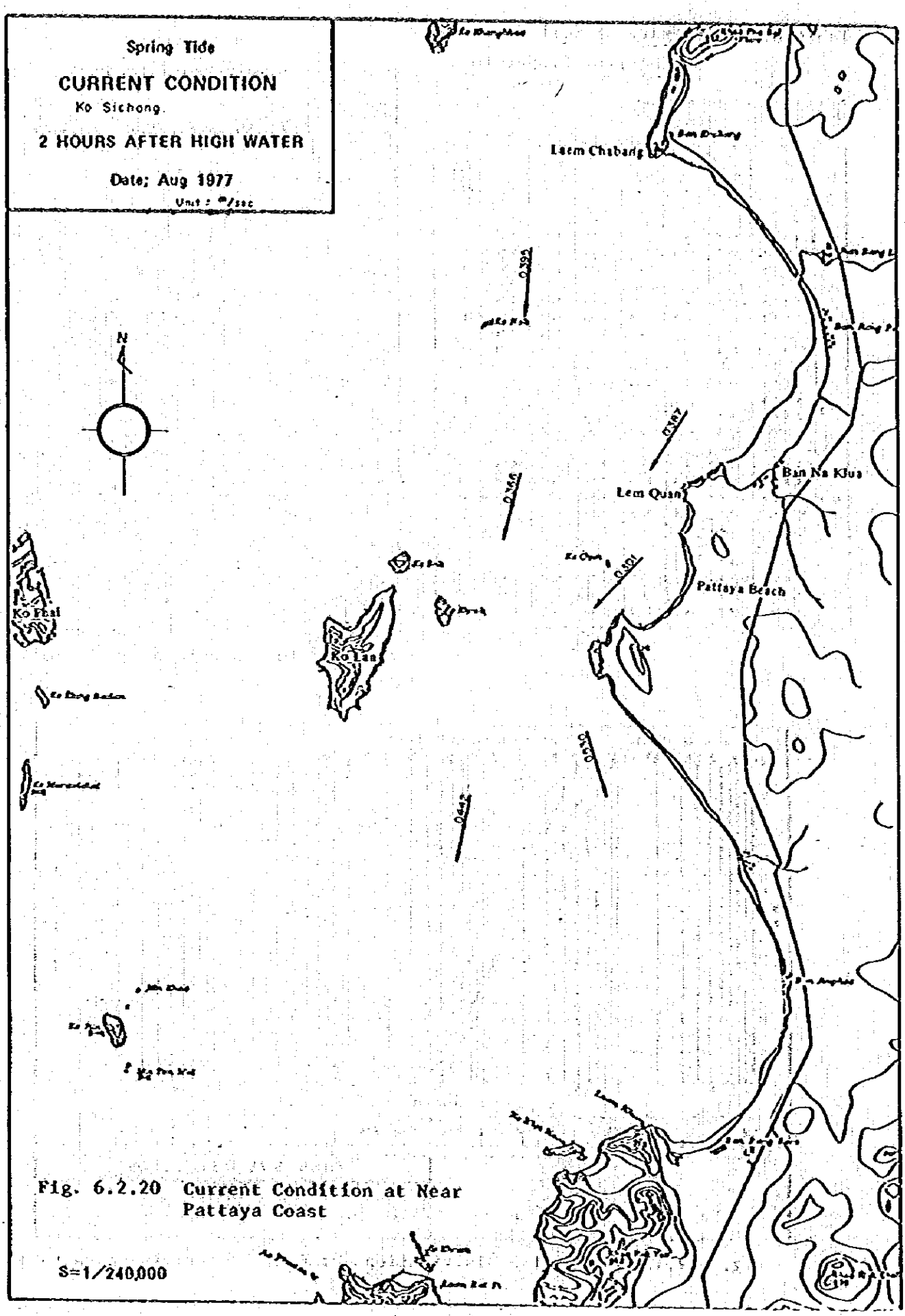


Fig. 6.2.20 Current Condition at Near Pattaya Coast

6.3 Actual Conditions in Sea Area Utilization

6.3.1 Outline of the Field Survey

For the purpose of understanding the actual utilization of the sea areas more fully, the following on-site investigations were conducted. Because of the limited time allowed for the investigations, the conclusions drawn are necessarily limited. More comprehensive investigation of the tourist activity is recommended.

(a) Counting the number of boats

Tourist boats have no mooring facilities of their own and serve the tourists directly off the beach, which extends for about 4 km. In order to correctly assess the number of boats actually working in Pattaya, the area was divided into 4 blocks, each block extending for 1 km and 4 observers assigned to count the boats anchored there. The work continued for 5 days from 7 in the morning to 6 in the evening at hourly intervals. By evaluating the increase and decrease of the number of ships anchored, the number of boats staying in the port and their characterization behaviour may be assumed in the port plan. As the present investigation was made during the off-season, it will be necessary to conduct another investigation during the peak season.

(b) Investigation of small boats by type

Separate survey was conducted for 2 days to see the types of small boats which were classified under "Others" in the above survey; these small boats were motor boats, scooter boats, pedal boats, wind surfing boards, etc.

(c) Direct interview

In order to assess the activities of the boats, the actual conditions and the use of the existing facilities, direct interviews were conducted among those concerned. Poor recovery of questionnaire sheets resulted in failure to assess the situation otherwise.

a: Owners of excursion boats and passengers
b: Owners and crews of fishing boats
c: Owners of piers (all existing facilities are privately owned)
d: Fish dealers

(d) Investigation of existing facilities

Direct interviews were conducted among persons concerned and investigations of existing facilities including partial measurements were conducted.

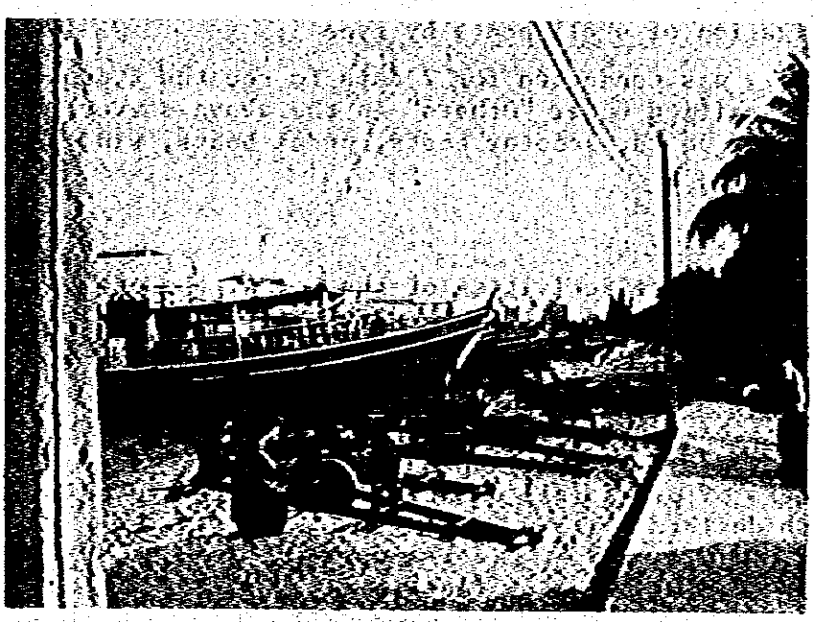
6.3.2 Situation of Sea Area Utilization

Pattaya has rapidly grown and become an international beach resort in the these 10 years. The most remarkable feature is the beautiful beach extending for about 4 km. The area is excellent for boating and swiming. In recent years, sightseeing boats have increased rapidly in number and variety, including all types of boats such as motorboats, scooter boats, yachts, wind surfing boards, etc. Most of these boats serve their passengers directly off the sandy beaches and concentrate their activities in the foreshores of Pattaya Beach. The swimming zone and boating zone

are completely competitive; and securing safety in the swimming zone is a very important subject when considering the expected increase of sightseeing boats. Last year (1977) Harbour Department designated a swimming zone to secure safety for the bathers and provided buoys. However, these are hardly utilized today. It will be necessary to establish an observation system and control the reckless boating in the future. In addition to the sightseeing boats, there are about 100 fishing boats based at Pattaya. Fishing-related activities in Pattaya may pose problems as the demand for recreation increases and the competition with the sightseeing boats will become more marked, particularly where the fishing-related facilities are adjacent to the swimming zone. The following problems are considered in view of the present utilization of Pattaya Beach.

(a) The beach is public property and should be used as such.

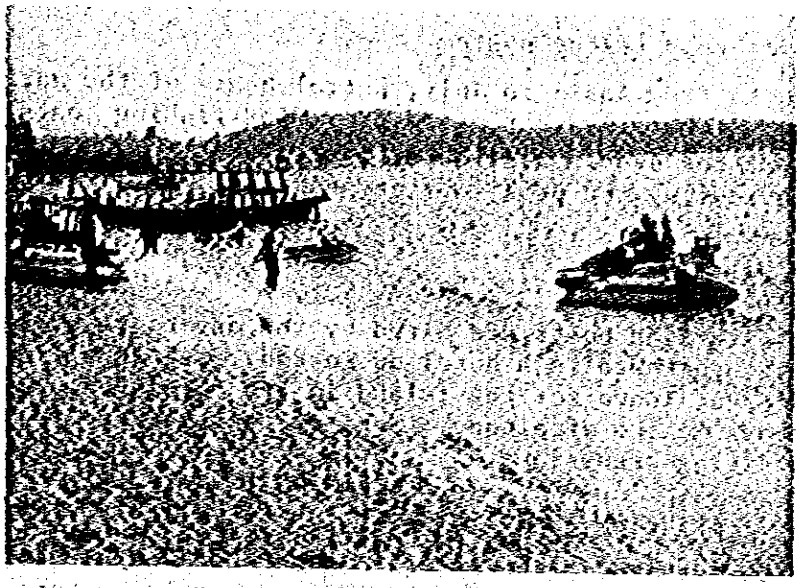
However, the beach in front of the downtown area which takes up about 1/4 of the whole beach is occupied by private organizations such as restaurants, souvenir shops, snack bars, hotel swimming pools, privately owned piers (for fishing boats and sightseeing boats) and related facilities. A privately owned launching ramp also contributes to the disorder of the many vessels occupying the beach. Control should be exercised to allow the use of beach as a public place. (Photo. 4)



(Photo. 4)

(b) Disorder in using the sea

Various boating activities at Pattaya Beach completely overlap areawise with the swimming activities. Harbour Department has designated a swimming zone in order to protect the swimmers, but the designation is not enforced effectively. Boating activities within the swimming zone are most hazardous particularly in view of the recent increase of scooter boats and motor boats. Special types of boating, such as water skiing and parasailing now conducted in the same water should also be banned and placed in separate waters. (Photo. 5)



(Photo. 5)

(c) Lag in measures for preserving the coastal environment

At Pattaya, no sewage and storm water drainage system is operative, and some waste water is directly discharged into the sea. In the foreshore of the downtown area, the waste water from restaurants, souvenir shops and from the fishing boats where people live daily is discharged into the sea without any treatment and the quality of the water and the soil in front of the downtown is visibly deteriorating. Even in the swimming zone several sewage discharge outlets can be seen. Thorough measures are recommended for maintaining water quality in the area, including the swimming zone. (Photo. 6)

(Photo. 6)

(d) Lack of safe embarkation and disembarkation facilities

Almost all the sightseeing boats use the beach as their landing place with the help of ladders, subjecting their passengers to considerable danger when the waves are high. It is urgently recommended that safe boarding facilities be provided.

(e) Unsatisfactory rescue system

For four months from April to July, patrol boats of the marine police are stationed along the privately owned pier (for fishing boats) at Pattaya. There is no rescue system available, including life guards for the bathers at the beach, during the peak tourist season.

6.3.3 Activities of Excursion Boats

Most of the excursion boats are hired by the day to take the tourists to Ko Lan. Although there is a hotel on Ko Lan, most tourists spend the night in Pattaya, leave for the island in the morning, lunch there and go back to Pattaya in the afternoon. Some of these boats are for hire for fishing and diving excursions.

(a) Number of existing excursion boats

A registration system for the excursion boats was enforced in 1977. About 167 boats are presently registered under this system. A survey count confirmed a maximum of 178 excursion boats on a Sunday, the actual number exceeds the registrations. Therefore, the number of excursion boats as of 1978 was 167 registered boats and 180 active working boats.

Most of the excursion boats now working in Pattaya have been converted from fishing boats. It would be safe to say that the potential supply for such purposes is not small. Usually an excursion boat is owned by an individual and they are allowed complete freedom in finding their customers on the beach.

Conversion of fishing to sightseeing boats is very easy. Table 6.3.1 shows the results of the survey count of the boats anchored.

(b) Excursion boat business

About 180 excursion boats are in business as of 1978. Most of them are owned by individuals except for a few which are owned by travel agencies. The business is conducted by soliciting the customers on the beach except in the case of the travel agencies. These individual owners are divided roughly into two groups; one of Ko Lan and the other of Pattaya and Na Klua. The business is also zoned into two; the southern and nothern beaches of Pattaya. There is no organized owners union. All excursion boats are anchored off the Pattaya Beach and some excursion boats of Ko Lan and Na Klua will back to their home port once in several days.

Tourists get on and off boats directly from and to the shore. When the water is low tide, they use the longtail boat to transfer to the excursion boats. Charge for one trip by longtail boat is 30 Baht which will be a standard for setting the pier charge.

(c) Actual conditions of excursion boats

1) Business conditions

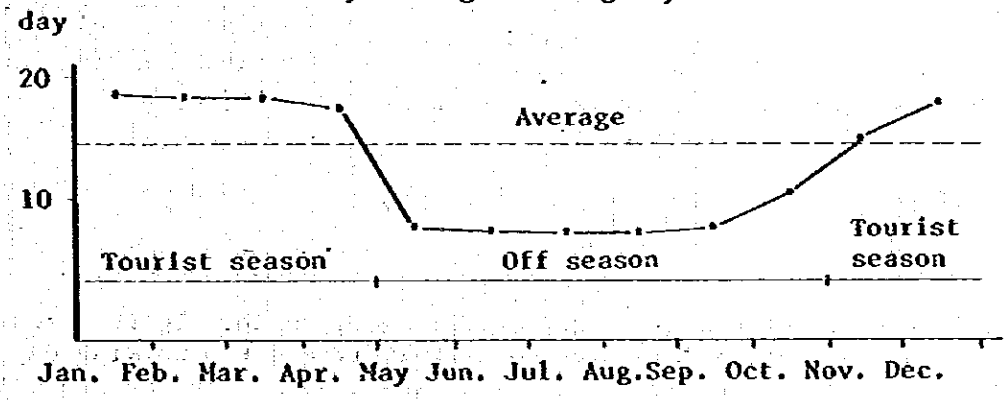
As regards the working conditions of excursion boats, the following results were obtained by random sampling and direct interviews with 24 boats.

Annual average working days: 14.2 Days/Month
Monthly average working days:
Tourist-season: 17.8 Days/Month
Off-season: 9.3 Days/Month

Table 6.3.1 Number of Anchored Boats

Date	Item \ Time	7:00 -8:00	8:00 -9:00	9:00 -10:00	10:00 -11:00	11:00 -12:00	12:00 -13:00	13:00 -14:00	14:00 -15:00	15:00 -16:00	16:00 -17:00	17:00 -18:00
2/June (Fri.)	1) Boat for tourist use											
	Excursion Boat		136	149	137	115	130	132	144	165	165	176
	Others		89	98	113	96	116	116	117	112	89	70
	Sub total		225	247	250	211	246	248	261	277	254	246
	2) Fishing Boat		15	13	8	8	7	9	10	17	16	19
	Total		240	260	258	219	253	257	271	294	270	265
27/May (Sat.)	1) Boat for tourist use											
	Excursion Boat	144	158	138	121	102	97	107	121	149	161	162
	Others	78	128	140	126	109	111	124	125	160	107	92
	Sub total	222	286	278	247	211	208	231	246	309	268	254
	2) Fishing Boat	31	35	13	30	30	30	30	29	30	30	30
	Total	253	321	291	277	241	238	261	275	339	298	284
28/May (Sun.)	1) Boat for tourist use											
	Excursion Boat	161	178	128	95	89	79	84	103	133	161	153
	Others	77	121	93	97	107	110	113	115	144	118	97
	Sub total	238	299	221	192	196	189	197	218	247	279	250
	2) Fishing Boat	36	34	32	32	32	28	30	30	30	30	30
	Total	274	333	253	224	228	217	227	248	277	309	280
29/May (Mon.)	1) Boat for tourist use											
	Excursion Boat	150	141	137	98	92	82	77	75	76	79	93
	Others	35	34	54	52	46	55	48	48	48	25	28
	Sub total	185	175	191	150	138	137	125	123	124	104	121
	2) Fishing Boat	35	36	39	36	34	34	54	36	36	38	38
	Total	220	211	230	186	172	171	179	159	160	142	159
7/June (Wed.)	1) Boat for tourist use											
	Excursion Boat	124	107	92	86	76	73	75	81	88	105	121
	Others	48	75	74	73	70	79	84	91	73	61	57
	Sub total	172	182	166	159	146	152	159	172	161	166	138
	2) Fishing Boat	16	16	14	14	11	11	14	15	16	16	20
	Total	186	198	180	173	57	163	173	187	177	182	193

Monthly Average Working Days



In this connection, the working day means days of business with passengers per month. As shown in the figure, the tourist season is six months from November to April and the off-season is six months from May to October. The working days in tourist season is about two times of working days in off season. Most of the excursion boats are hired by one-day charter system. The standard charge is based on one round trip for Ko Lan and additional charge is applied according to destination. The charge per one trip is as follows:

Charge/Boat/One round trip
371 ฿/Boat to 218 ฿/Boat
Average 300 ฿/Boat

The number of passengers is 8.9 persons/boat on average and 23.3 persons/boat max. For reference, the expenses necessary for the excursion boat business are as follows:

Salaries for employees:

Monthly salary
450 to 900 ฿ / person
(Crews: 2 to 3 persons)

Repair cost: 7,400 ฿ / year

Fuel cost: 54 ฿ / one trip

A monthly average sales amount of 4,300 ฿/boat was obtained from the direct interview. When the number of working boat is 180, the scale of excursion boat business is 4,300 ฿/boat x 180 boats = 774,000 ฿/month. According to the monthly average of working days and average charge, the average sales amount is 14.2 days/month x 300 ฿/day = 4,260 ฿/month. However, it is questionable whether the sales amount obtained during direct interview is accurate because understatement by the interviewers is suspected.

2) Seasonal changes and hourly rates of concentration of boat utilization

As mentioned above, tourist season utilization of excursion boats is twice off-season utilization.

Table 6.3.2. Seasonal Working Days

	Period		Working days of excursion boats
Tourist-season	November to April	6 months	18 days
Off-season	May to October	6 months	9 days

The number of tourists changes considerably every month. In the present investigation, the seasons are divided definitely and the working days of excursion boats are nearly constant in each season. In the present statistical investigation, the following average numbers of working boats were roughly determined to obtain the rate of concentration in the week.

	Mon. - Fri.	Sat. & Sun.
Max. anchored boats	130 Boats/Day	170 Boats/Day
Working boats	50 Boats/Day	80 Boats/Day

Since the number of working boats is evenly less before noon and increases in the afternoon, and most tourists follow the pattern of leaving the port in the morning, returning to port in the afternoon as shown in Fig. 6.3.1, only a few tourists return to Pattaya before noon. Therefore, the reduced number of anchored boats is taken to be the working boats.

On weekdays, however, only a small number of boats are seen at Pattaya, because some crew take days off and return to their homes. This trend is evident on Mondays and Fridays. Therefore, it was decided that the data on Wednesday be taken as the number of weekday working boats. As a result, the calculated number of tourists concentrated on Saturday and Sunday will be about 40% of the total weekly number of tourists.

Further, the ratio of concentration of out-going boats during the peak hours on Saturday and Sunday is determined as an average of the ratio to the total number of out-going boats on Saturday and Sunday. The result is shown in Table 6.3.3.

Table 6.3.3. Hourly Rate of Concentration

	1 hr.	2 hrs.	3 hrs.
Ratio of concentration	40%	70%	83%

The abovementioned seasonal change and hourly ratios of the concentration of boat utilization are used as a basis for calculating when the number of annual tourists is distributed and the number of out-going boats during peak hours for future facility planning.

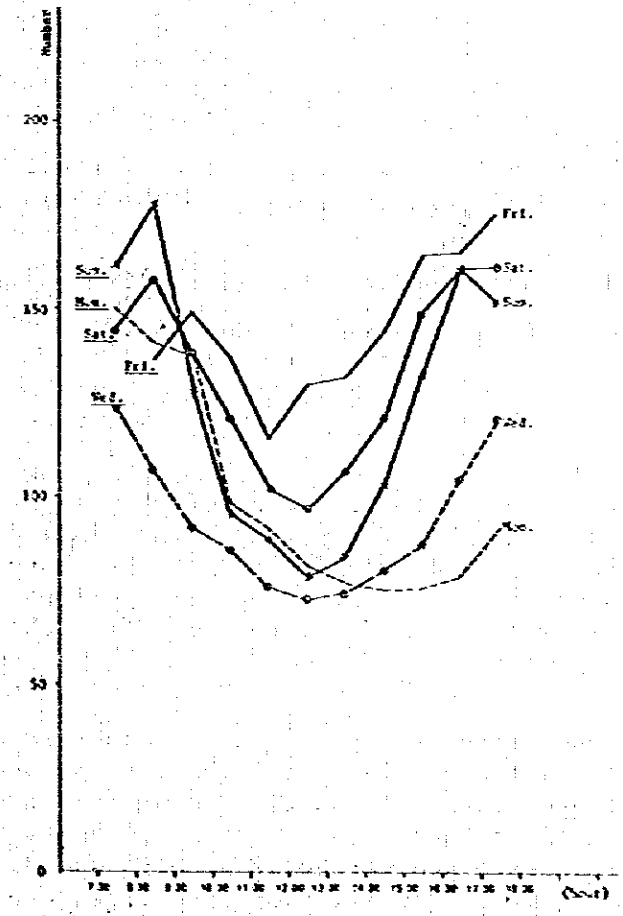


Fig. 6.3.1 Number of Anchored Excursion Boats

6.3.4 Actual Conditions of Other Tourist Boats

(a) Number of boats

Table 6.3.4 shows the number of registrations and the number obtained through interview of tourist boats smaller than excursion boats.

Table 6.3.4. Number of Small Boats (Registered)

	Register Number	Hearing Number
Motorboat	88	70 - 80
Scooter Boat	97	120
Longtail Boat	47	-

On the other hand, the actual number of operation boats was studied for two days, i.e. Saturday and Sunday.

The result is shown in Table 6.3.5.

Table 6.3.5. Number of Small Boats (counted in 1978)

	Saturday	Sunday	Average
Longtail Boat	7	8	8
Sailing Boat	28	31	30
Motorboat	66	33	50
Scooter Boat	83	76	80
Pedal Boat	44	23	34
Others	41	38	40
Total	269	209	242

Note: 1) For motorboats and pedal boats, the difference between Saturday and Sunday is too large and the reliability of the figures comes into question.

2) Wind surfing boards are counted as sailing boats.

3) Others, small fishing boats without engine.

(b) Actual activities

1) Motorboats

Three companies are carrying on the business of motorboats for water skiing, parasailing and sightseeing. Repair shops (including hull manufacturing) and boat houses are provided along the beach road. Two of them own a private launching ramp. Since no sea moorings are provided for motor boats, tourists get on and off the boat from the sandy beach.

2) Scooter boats

The scooter boat business is shared privately by about 30 owners. In addition to the above-mentioned private launching ramp, one public launching ramp is used for outgoing boats. The public launching ramp is utilized by about half of the owners, i.e. about 50 boats. Since tourists are allowed to drive scooter boats at high speed, and enter Harbour Dept.'s swimming areas freely, proper controls are

necessary for the prevention of accidents in the future.

6.3.5 Current Conditions of the Fisheries

The beaches in Chonburi province, where Pattaya is also located, have shoals and there are few places suitable for fishing ports. Pattaya is favored with comparatively deep water and is suitable as a fishing base as well as tourist base. Presently, the fishing business is actively followed and the results of direct interview show that about 100 boats are based at Pattaya. About 35 fishing boats were counted during the daytime survey count. As the same number of boats are considered to be on the night shift, it is assumed that about 70 boats utilize these piers. While no statistics are available for the catch at Pattaya, it is estimated to be 10-15 tons/day according to the direct interview. The catch is transported by dealers to the market at Chonburi, leaving practically nothing for local consumption.

The direct interview showed that the unloaded catch from the fishing boat was 50,000 ฿/boat/month on the average. Consequently, the scale of catch is 3.5 to 5.0 million baht based on the number of active fishing boats of from 70 to 100.

6.3.6 Actual Conditions of Facilities

In Pattaya, excursion boats utilize the sandy beach and almost no facilities are available. First of all, the excursion boats were converted from fishing boats and the living conditions are the same as that of fishing boats. Except the owners who reside at Pattaya, owners residing at Ko Lan and Na Klua commute to Pattaya Beach and carry on their business while anchored offshore. Therefore no special moorings are provided at Pattaya beach.

At present, some piers are provided along Pattaya Beach as shown in Fig. 6.3.2. All of these piers are owned privately and were constructed while Pattaya was a small fishing village before the tourist industry was developed. Two long center piers are mainly used by fishing boats. Pier owners keep their business going by supplying oil, water, foods, fittings, etc. to the fishing boats and collect no charges from pier users. Other piers are used for ferryboats between Pattaya and Ko Lan or for combined utilization of fishing and excursion boats.

It seems that the existing fueling facilities installed near the supply shops and wooden piers are not safe from the view point of fire protection. Qualities of the equipment for fuel handling should be examined by conforming to the laws, regulations and standards of practice set up by industrial and governmental organizations.

The launching and landing of small tourist boats such as motorboats, scooter boats, etc. other than excursion boats are carried out using the launching ramp as shown in Fig. 6.3.3.

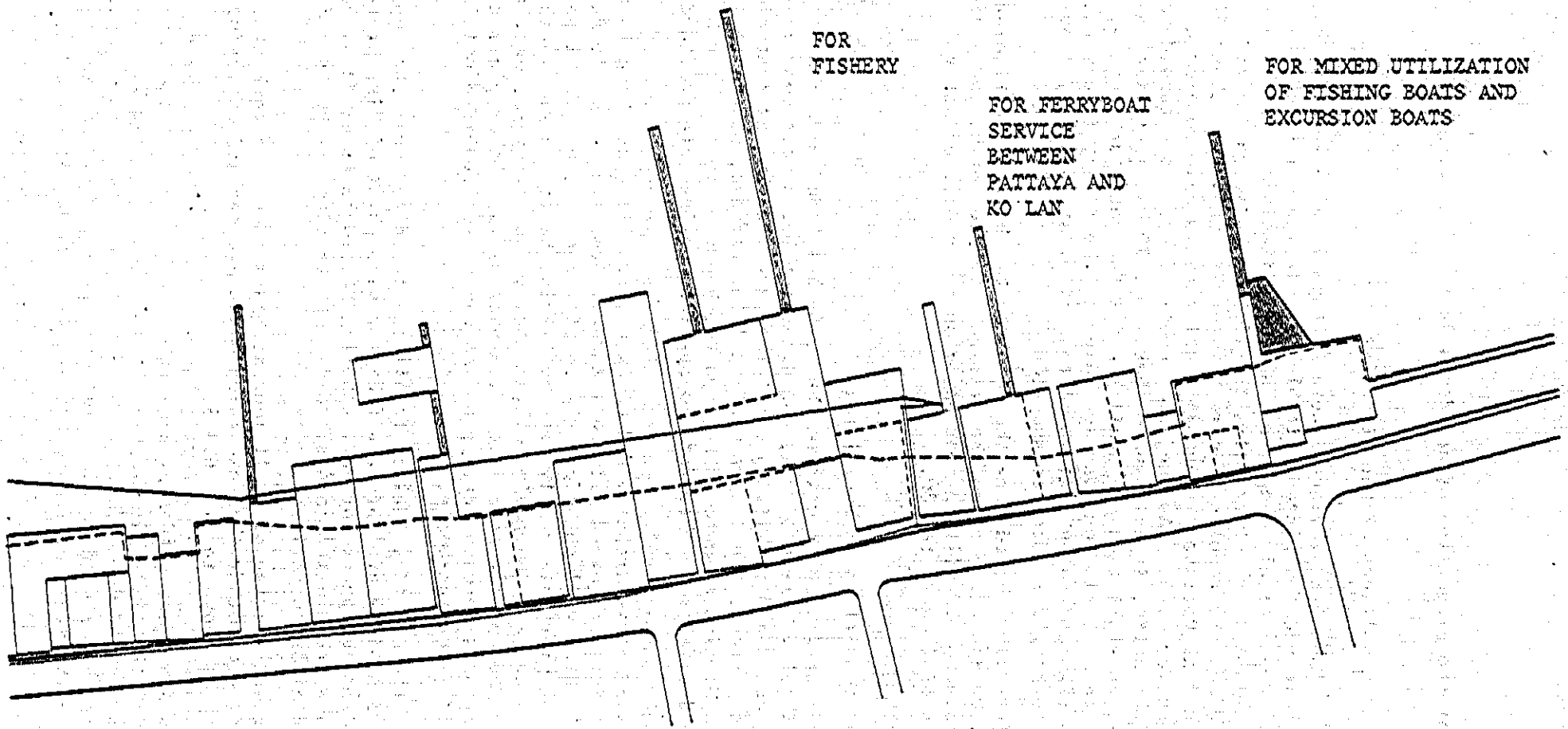


Fig. 6.3.2 Actual Condition of Piers

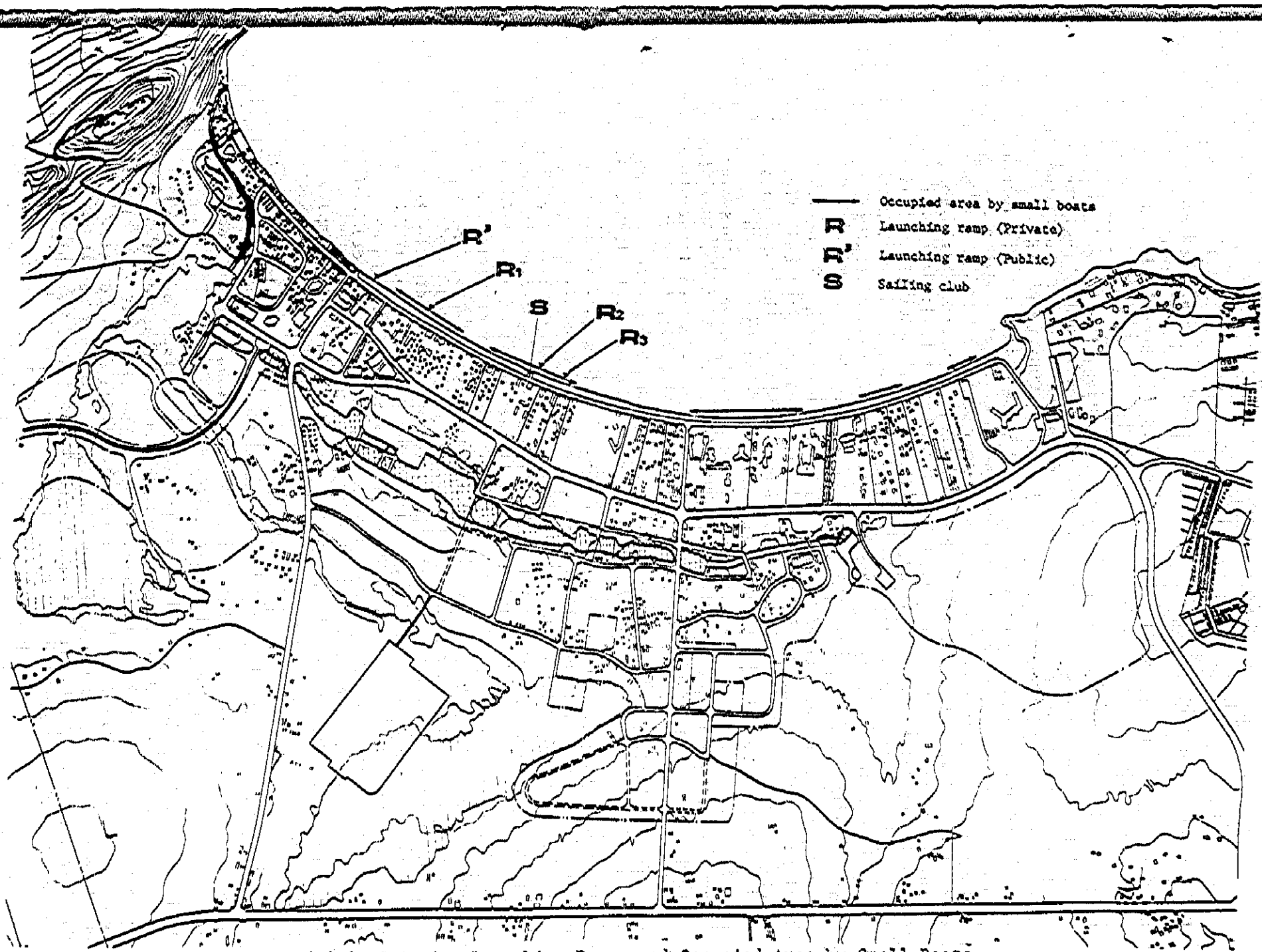


Fig. 6.3.3 Existing Launching Ramps and Occupied Area by Small Boats

6.4 Plan and Environment

6.4.1 Harmonization of Tourism and other Development at Pattaya and its Environs

Most of the coastline of Chonburi, where Pattaya lies, is utilized for fisheries and recreation together with some cities and towns. The land is mainly utilized for agriculture and for the production and processing of tapioca, which has become a large industry. Noteworthy future plans are the industrial base construction plan and industrial port construction plan at Laem Chabang. There are controvesies in connection with the Laem Chabang development project and it is not known whether the plan will be realized. Nevertheless, the area between Bangkok and Sattachip is geographically favorable and will occupy a most important position in the future industrialzation of Thailand. As regards utilization of the coast line, future development still lies within the realm of inference, but the above-mentioned area between Bangkok and Sattahip will have the highest utility value in Thailand.

Surveying the actual conditions of coastal utilization from the tourism development point of view, recreation is very active along the beautiful coastal line, with its calm sea, gentle sandy beaches and the large city of Bangkok behind. Pattaya beach, a well-known international beach resort, will continue to develop as one of the most important sightseeing places for attracting foreign tourists to Thailand. In addition, Bang Saen beach nearer to Bangkok will become more important as a recreational place for the local inhabitants. Moreover, the coastal zone from Pattaya through Bang Sarey to Sattahip has sufficient potential for tourism development and is significant in the expansion of the development of Pattaya.

As discussed above, it is expected that foreign tourists as well as people of Thailand will actively utilize the coast of Chonburi for recreational purposes. Since the development of fisheries as well as of industries and urbanization are fully expected, it will become necessary to have an overall utilization plan to control the varieties of demand for the entire development. Since a major part of the supply of recreation depends on natural resources, the plans for other developments require thorough attention. In the case of Pattaya, there is already an oil refinery complex near Laem Chabang and plans for an industrial complex centering around the deep sea port, even though the chances for realizing these plans are not yet definite. When the importance of Pattaya as a tourist center is considered, it is important that the construction of the port and the industrial complex should proceed with sufficient attention being given to environmental aspect.

6.4.2 Fisheries and Tourism at Pattaya

As mentioned in Paragraph 6.3.5 "The current conditions of the fisheries", the fishing boats based at Pattaya are quite active.

It is expected, on the other hand, that the waters in front of Pattaya Beach will become more and more congested because of the anticipated increase in swimming and boating activities. If possible, it is desirable to adopt fishing activity as a sightseeing attraction so as to allow its coexistence with the tourism activity. For future coexistence, there are the following problems in view of the current condition of coastal utilization and fishing activity.

- Most of the fishing boats are owned by seasonal users and control is difficult.

- Crews living on the boats will be a source of environmental contamination by discharging waste water and oil from the boats.

- In Pattaya, fishing-related facilities are located adjacent to the swimming area. There are bound to be conflicts between the fishing and tourism, as well as the issue of environmental pollution.

6.4.3 Preservation and Conservation of the Marine Environment

(a) Prevention of Excessive Development by Designating Preservation and Conservation Areas

Unlawful buildings and structures on the beach should be removed and preservation and conservation of the marine environment should be maintaind by designating preservation and conservation areas. Since the NEB[2] Report recommended designating a general conservation area, including the land area and preservation of the sandy beaches and coral reef, it is considered advisable that with the efforts of the Thai Government these recommendations are realized at an early date.

(b) Measures against Marine Contamination

1) Improving the infrastructure

The contamination caused by the direct discharge of waste into Pattaya Beach will be alleviated when the sewage plant and the waste processing plant are improved as a result of the present feasibility study.

2) Contamination by discharge from the boats

The following two factors are considered to be the cause of contamination from the boats:

- Oil leakage from motorboats and scooter boats;

- Excreta, waste oil, waste water, etc. discharged from the excursion boats and fishing boats.

As regards the former, there are signs of a rapid increase in the number of motorboats and scooter boats at present, which might pose serious problems in future. The inspection system for the water quality should be improved.

As regards the latter, crews live on almost all the fishing boats and on some of the excursion boats, as mentioned above. Contamination will be a serious problem especially in the case of fishing boats, because about 100 boats are moored at the existing private piers.

With the new pier for excursion boats, there will be about 200 boats concentrated in this area. It will be necessary to have controlling regulations prohibiting the waste discharge from these boats. Generally speaking, control of this problem may be difficult in the face of realities in Thailand. Still, efforts for realizing such control are urged, at least in this very limited sea area in front of Pattaya Beach as suggested in Fig. 6.4.1 The timing of implimentation would depend on the monitoring survey of sea water quality and bed sediments.

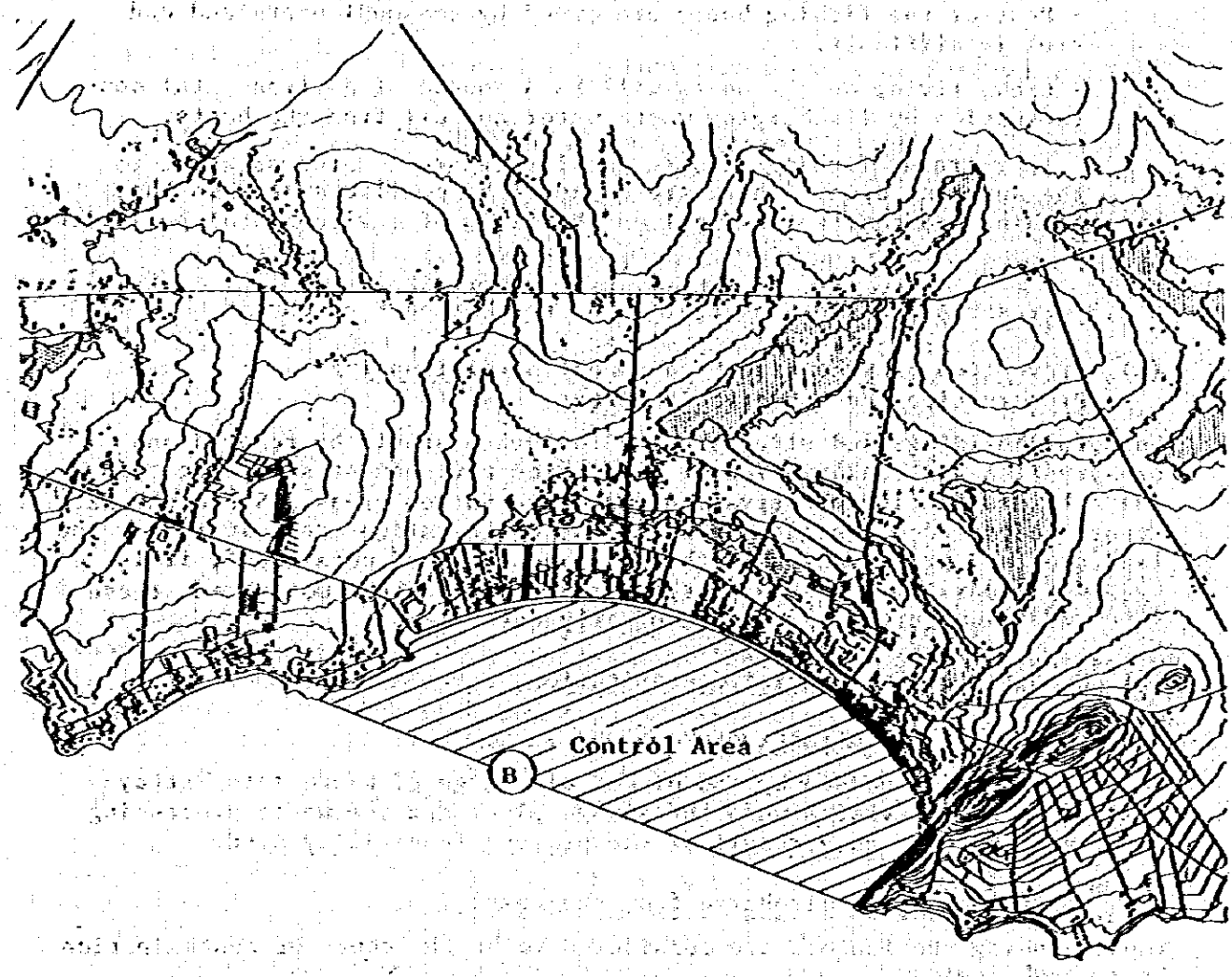


Fig. 6.4.1 Control District for Dirt Discharge from Boats

6.4.4 Basic Guideline for Pattaya Water Area Utilization

In utilizing the Pattaya sea area, the major premise is that the sea be comfortable for swimming. Marine facilities should be planned based on the said premise. That is, the basic requirements are the safety of the swimming area, prevention of water contamination, orderly boating activity, maintenance of an attractive beach environment, etc. Therefore, the basic guidline for the sea area of utilization were established as follows:

- Priority should be given to the swimming area (Fig. 6.4.2)

  Priority should be given to securing safe swimming areas and to controlling boating activities within the designated area.

- Orderly boating activity

  Control of the present unlimited landing of boats on the beach and the designation of mooring areas and landing places for safe and orderly utilization of the sea area.

- Prevention of water contamination

  Possible measures should be taken against waste discharge from the boats.

- Maintenance of an attractive beach environment

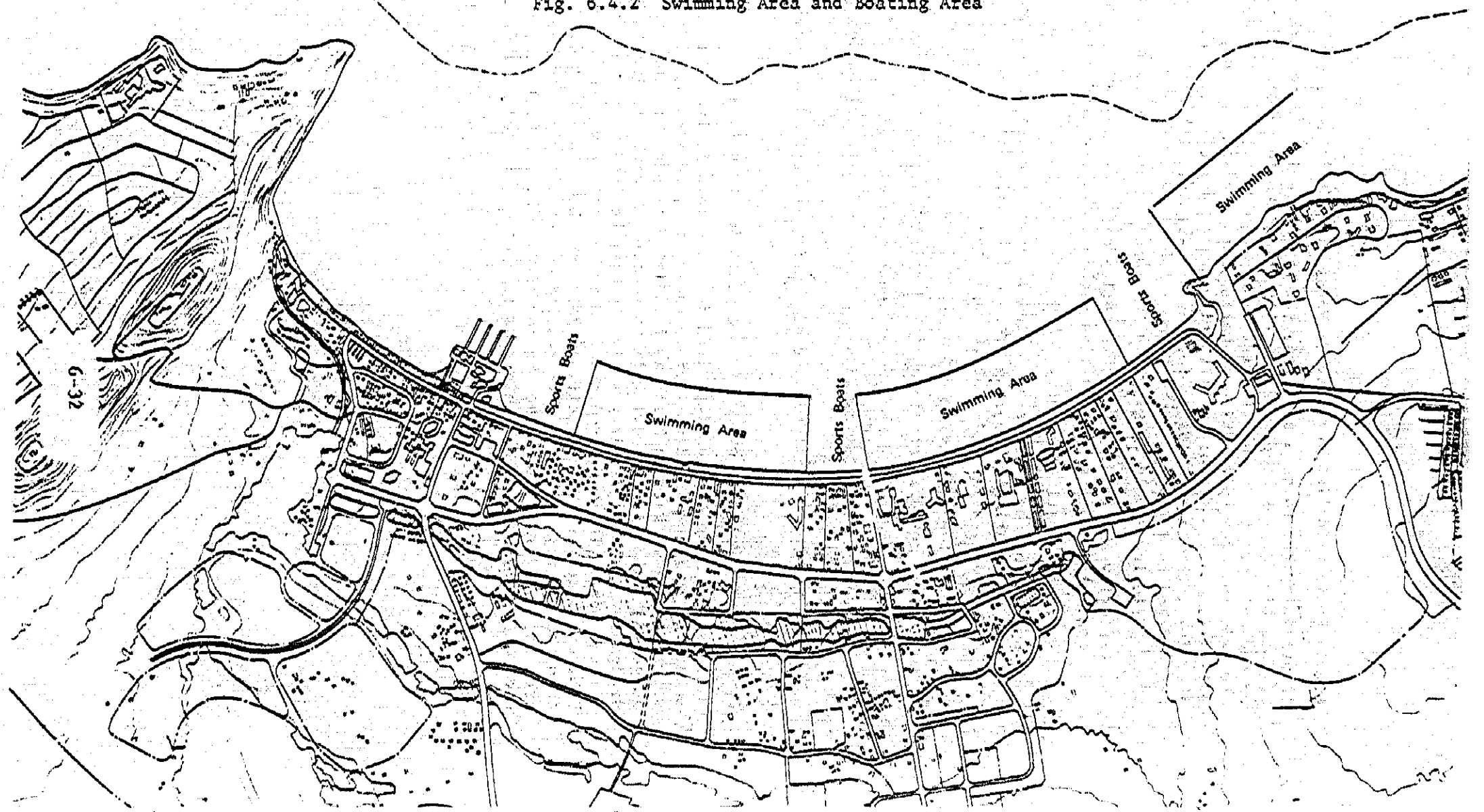
  Control of privately owned sandy beach and unlawful buildings and constructions.

- Protection and maintenance of tourism assets and the environment.

6.4.5 Measures to improve dirty sediments in the waters

Dirty sediments have been deposited in the waters in front of Pattaya down town. It is recommended to improve these dirty sediments, because the swimming area of Pattaya beach is immediatly adjacent to this area. The suggested method for improving is to remove out dirty sediments by dredging. The dredged dirty sediments will be used to reclaim the land for the port. The suggested method here was actually carried out at Ushibuse beach near Numazu city of Japan as shown in Fig. 6.4.3. In this case, dirty sediments were removed out by a dredger in the offshore area and by a dragline in the shallow area. (Fig. 6.4.4) The dredged area was $900^{m} \times 150^{m}$ and the thickness removed out is about 50^{cm}.

Fig. 6.4.2 Swimming Area and Boating Area



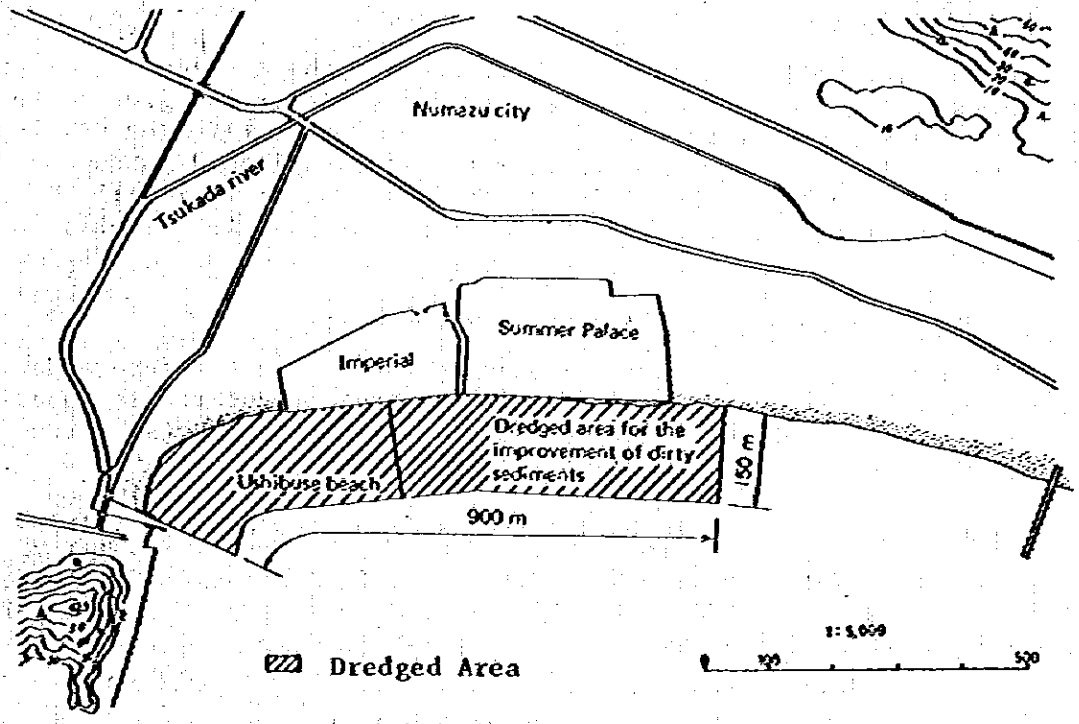


Fig. 6.4.3 Ushibuse Beach

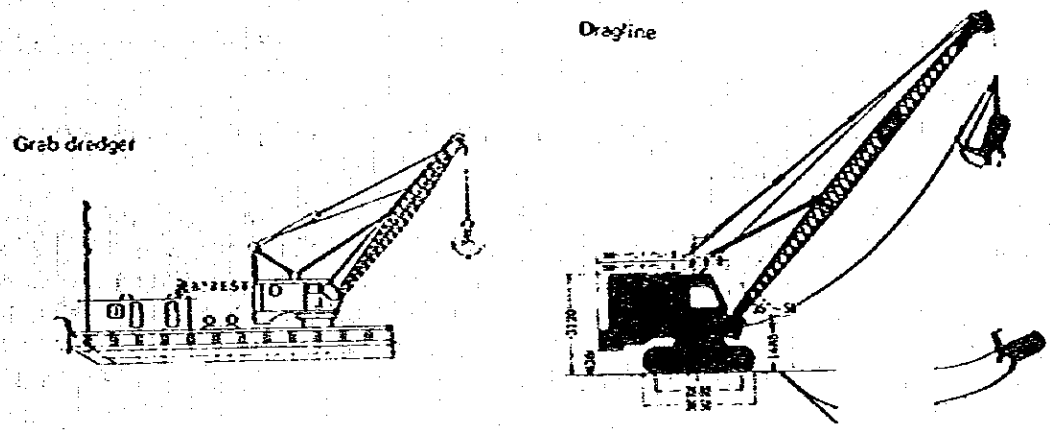


Fig. 6.4.4 Dredging Method

6.5 Demand Analyses

The master plan divided the development into two phases; Phase I (up to 1986) and Phase II.

The present feasibility study was conducted for the development of Phase I and does not include the development for Phase II for the area south of Pattaya Hill. The port facilities plan also concern with the development of Phase I. Accordingly, the scope of facilities planned is supposed to meet demand up to 1986. The increase in demand after 1987 will be met by the development of the areas south of Pattaya Hill as in Phase II.

6.5.1 Estimated Future Demand for Excursion Boats

The following two methods were followed in estimating the future demand for excursion boats. Extreme difficulties were encountered in assessing the current situation involving tourists and excursion boats, although we did our best to collect as much data as possible.

(a) Estimations based on investigation of excursion boat activities

A number of excursion boat owners as well as their passengers were questioned in on-site investigations for information on the activities of such boats. The results are summarized as follows:

- Average days worked ..... 14.2 days/month
- Average number of passengers ..... 9.0 persons/boat
- Number of registered boats ..... 167 boats

An estimate of sightseeing boat passengers during 1978 on the basis of the above figures is formed as follows:

167 (boats) x 14.2 (days/month) x 12 (months) x 9 (persons/boat)
= 256,100 (persons)

According to the master plan, the study area is to have 846,000 tourists staying overnight or longer and 384,560 one-day trippers during 1978. This leads to the estimate that about 21% of the yearly total utilize excursion boats. Supposing the above percentage of excursion boat passengers to the yearly total of tourists holds true and remains applicable in the years to follow, the expected numbers of such passengers would be as follows:

Year	1976	1978	1981	1986
No. of passengers in thousands	221.7	256.1	322.9	551.3

(b) Estimation based on the rate of participation in sightseeing activities

1) Estimate of the number of participants in ocean activities

Future demand for ocean activities is going to be estimated as follows on the basis of the method that was set forward in the master plan.

Table 6.5.1 gives the estimate of the number of tourists Pattaya is expected to have respectively in 1976, 1981, and 1986, under the two categories:

A; tourists staying overnight or longer,
B; one-day trippers.

The numbers of tourists on peak days and average days were calculated using the method described in the master plan.

Table 6.5.1 Tourists to Visit Pattaya Area

(unit; persons)

Year / No. of Tourists	1976		1981		1986	
	A	B	A	B	A	B
Yearly total	720,000	335,600	1,080,000	458,000	2,000,000	625,000
Peak day	3,096	4,027	4,644	5,496	8,600	7,500
Average day	1,980	913	2,970	1,246	5,500	1,700

Note: As for A, overnight or staying tourists, the average length of the stay was calculated at 1.8 days, 1976 to 1981, and 2.5 days, 1981 to 1986.

Based on the above table, the number of visitors broken down by the types of ocean recreation activities is shown in the next table. This table, assuming that 70% of the visitors staying overnight or longer and 60% of the one day trippers would participate in the activities, was made by the following formula.

(the number of participants in respective activities) = (number of tourists) x (0.7) or (0.6) x (participation ratio of respective activities).

Table 6.5.2 Number of Tourists in Each Activity (Unit: persons)

	%		1976		1981		1986	
	A	B	A	B	A	B	A	B
Swimming (sea)	30.0	50.0	416 650	274 1208	624 975	374 1649	1155 1806	510 2250
Sightseeing (sea)	2.0	1.0	28 43	5 24	42 65	7 33	77 120	11 45
Day-Camping	6.0	7.0	83 130	38 169	125 195	52 231	231 361	72 315
Boat-riding	1.0	0.1	14 22	4 17	21 33	5 23	39 60	8 32
Water-skiing	1.0	0.6	14 22	3 14	21 33	4 20	39 60	7 27
Diving	0.5	0.2	7 11	1 5	10 16	1 7	20 30	2 9
Yachting	0.4	0.3	6 9	2 7	8 13	2 10	16 24	4 14
Fishing	3.0	2.0	42 65	11 48	62 98	15 66	116 181	21 90
Total	43.9	61.8	610 952	338 1492	913 1428	460 2039	1693 2642	635 2782

Upper figures: Average days
Lower figures: Peak days

2) Demand for excursion boats

The demand for excursion boats was estimated based on the number of participants in ocean recreation activities as outlined above. Then, the demand for each activity was obtained using some results from the direct interview of tourists in the study area that were compiled for the purpose here.

Tourists Utilizing Sightseeing Boats

Swimming (sea)	- 60% of tourists staying overnight or longer 50% of one-day tourists
Sightseeing (sea)	- 50% of all the tourists
Day-camping	- all the tourists

The results of the above estimation are given in Table 6.5.3.

From this, the yearly total of excursion boat passengers was obtained as follows.

Year	1976	1981	1986
Yearly passengers	(person) 151,475	(person) 223,745	(person) 398,580

The number of passengers for each year represents about 14% of the yearly total of sightseers.

Table 6.5.3 Excursion Boat Users (Unit: persons)

Activity \ Year		1976		1981		1986	
		P	A	P	A	P	A
Swimming	N	390	250	585	374	1084	693
	D	121	27	165	37	225	51
Sightseeing	N	22	14	33	21	60	39
	D	12	3	17	4	23	6
Day-Camping	N	130	83	195	125	361	231
	D	169	38	231	52	315	72
Sub Total	N	542	347	813	520	1505	963
	D	302	68	413	93	563	129
Total		844	415	1226	613	2068	1092

Note: P = Peak day N = Tourists staying overnight or longer
A = Average day D = One-day visitors

6.5.2 Examination of Estimation

Figs. 6.5.1 and 6.5.2 show the yearly and daily numbers of passengers on excursion boats as estimated through the two approaches as described above. A point to be noted is that the estimate based on the operational state of excursion boats is higher by 50% than that based on the assumption of the participation rate in various sightseeing and recreational activities.

These estimates were further used for determining the scale of the planned facilities, allowing for various factors discussed below.

- Judging from scenic and sightseeing resources and the related facilities that the Pattaya area has at present, Ko Lan and Pattaya Beach are considered to have a very high attraction compared with other places. Supposing that the said sightseeing and recreational facilities are updated and/or installed anew thus increasing the attraction, sightseeing activities will be so diversified that excursion boats will not have so many passengers as now.
- For this reason, the estimate obtained by increasing the present number of tourists using the sightseeing boats in proportion to the increase of incoming tourists would give somewhat excessive figure.
- References were made to the results of the surveys conducted in some other seaside resorts in forming the latter estimates. In the case of Pattaya Beach, it is considered that the locational advantage of having Ko Lan in the vicinity assists in attracting a good many tourists to use excursion boats in comparison with other resorts. In view of this, the estimates will probably be the lowest minimum.

From these discussions, the port plan is based on the average value of the estimated number of passengers. Table 6.5.4 shows the estimated values taking account of the seasonal characteristics obtained through the on-site survey.

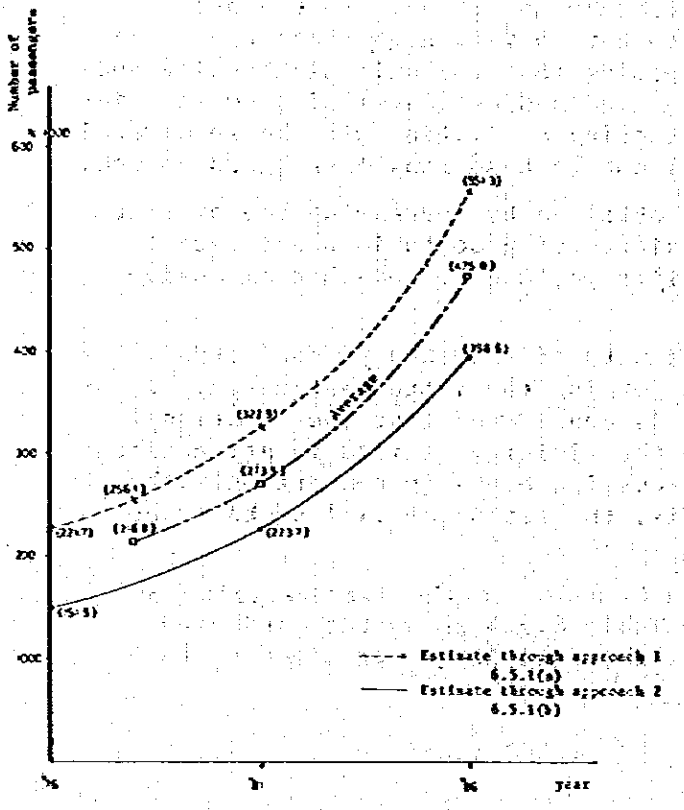


Fig. 6.5.1 Yearly Passengers on Excursion Boats

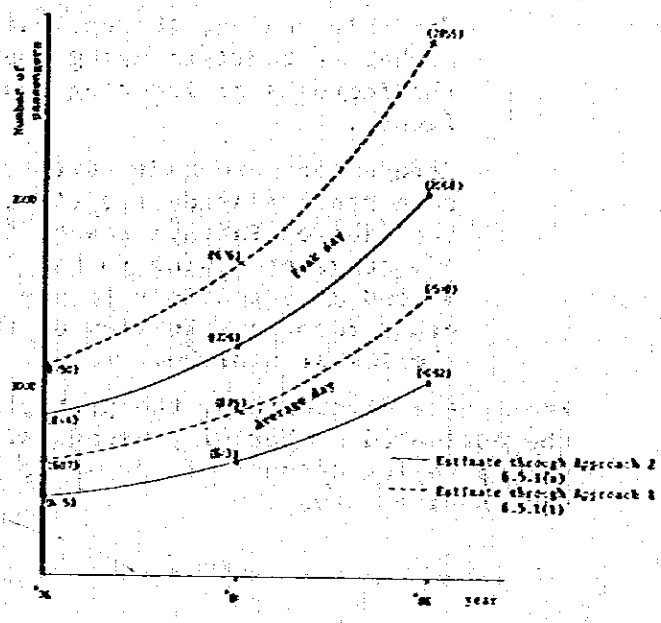


Fig. 6.5.2 Daily Passengers on Excursion Boats

Table 6.5.4 Seasonal Variation in Number of Excursion Boat Passengers

(unit: person)

Year	Yearly total		Tourist-season passengers					Off-season passengers				
			Weekday		Weekend		Weekly total	Weekday		Weekend		Weekly total
			Daily	Total of 5 days	Daily	Total of 2 days		Daily	Total of 5 days	Daily	Total of 2 days	
1976	MAX.	221,700	682	3,411	1,137	2,274	5,685	341	1,705	569	1,137	2,842
	AVE.	---	--	--	--	--	--	--	--	--	--	--
1978	MAX.	256,100	788	3,940	1,313	2,626	6,566	395	1,970	657	1,313	3,283
	AVE.	216,000	665	3,323	1,058	2,115	5,538	332	1,661	554	1,108	2,769
1981	MAX.	322,900	994	4,968	1,656	3,312	8,280	499	2,484	828	1,656	4,140
	AVE.	273,500	806	4,028	1,403	2,805	7,013	421	2,105	701	1,402	3,506
1986	MAX.	551,300	1,696	8,482	2,827	5,654	14,136	848	4,241	1,414	2,827	7,068
	AVE.	475.000	1,461	7,307	2,436	4,872	12,179	731	3,654	1,218	2,436	6,090

6.6 Port Planning

6.6.1 Planning Concepts

A great number of excursion boats are actively engaged in business at Pattaya beach, and most of them use the beach for embarking and disembarking the passengers and berth at whatever points which they consider advantageous for finding customers. Except for the safety factor, this is quite convenient both for the business and for those participating in boating activities. It is also the least costly as no facilities are required. This leads to apprehension that the piers to be constructed for them will not be popular and may not be frequently used. It will be important in this context to make the facilities as attractive as possible and to set the pier charge at a very low price by reducing the construction cost, thereby decreasing whatever financial burden there may be on the users. The master plan proposed completing both the north and the main ports within Phase I (by 1986) having considered such factors as easy control of the use of the waters, convenience to the tourists and sightseeing boats, and the future tourism development plans for the hinterland. Providing the north port would be most helpful in the smooth utilization of the piers since the excursion boats are roughly divided into the two groups of Ko Lan and Pattaya-Na Klua, each group serving respectively the northern and the southern portions of Pattaya Beach.

However, there arose a need to reconsider the construction of the north port as a result of the sounding and underwater soil surveys. It was realized that the construction cost for the north port would far exceed the estimated amount. For this reason, the two plans 1) to construct both the north port and the main port, and 2) to construct only the main port were reviewed in respect of such factors as coast-line utilization, natural conditions, port operations and management, mooring systems and anchoring areas, and construction costs. This led to the conclusion that the north port construction should be delayed as much as possible while the main port should be constructed and completed by 1986 within Phase I. The need for constructing the north port will be reviewed after the data on water area utilization and port operation becomes available.

When only the main port is built, all the excursion boats will be serviced by the main port, contrary to the master plan. It will become necessary to exercise administrative guidance in optimumly utilizing the water areas and the port. The master plan considered a facility for serving all the boats, but it is proposed that piers mainly for the embarkation and disembarkation passengers should be built and the rest of the boats be anchored offshore. It will become necessary to build only the number of berths required to serve the maximum number of passengers at a peak time so long as the rotation of boats utilizing the berths is carried out smoothly. It is noted, however, that a great number of boats will be using one pier. If very rigid control of the smooth rotation of the berths can be exercised by those individually owned excursion boats, it will be ideal.

However, under the present circumstances this is practically impossible. Thus, it was decided to build more than the minimum number of berths so that several boats can be assigned to one berth exclusively. Even in this case, it will be necessary to work out a control system for the joint users.

6.6.2 Required Scale of Facilities

(a) Discussion of the Port Capacity Plan

As for planning the capacity of the port, a fairly large number of boats must be anticipated if the increase in the number of excursion and other boats is to be left to take its own course in the future without any control measures as today. By way of reference, Fig. 6.6.1 shows the expected increase in the number of excursion boats up to 1986 estimated on the assumption that the increase is in proportion to the increase in the number of tourists. The figure also incorporates a table showing the estimated number of boats in operation respectively on weekdays and at weekends, supposing that a boat has nine passengers on average, from the estimate of total excursion boat passengers in the foregoing section, and that such a boat is chartered once a day. Assuming a normal rate of increment in the present mode of operations is maintained, the number of boats will be a little more than double the present number in 1986. It may safely be said that Pattaya Beach will be monopolized by these boats as it substantially has only a 3-km length available for embarkation and disembarkation. From the viewpoint of coastline utilization as well as the sightseeing boat business itself, it would be necessary to control by some means or other the disorderly increase of "private-business" boats. For doing this, several means are possible; establishing a boat registration system including the obligation of obtaining a business licence, or a licence system for using the pier accompanied by the obligation to use the pier. It would be necessary to examine from an all-around viewpoint what measures of control to take up with due regard to the orderly excursion boat business in the future.

In this study, the port capacity was designed on the assumption that the above-mentioned control is possible and that regular services to and from Ko Lan are to be enforced.

There are many unknown factors to decide the optimum scale of the regular service operation and the adequate range of the number of individually-operated boats. However, the present plan assumes that the increase in the individually owned excursion boats would be curbed in 1981 when the pier facilities would be open to the public, any increase in the number of passengers after 1981 to be met by the enforced regular services and the increased rate of operation for private-business boats.

(b) Introduction of the Regular Public Service

It is suggested that a regular line should be opened under public management to check the disorderly increase of private-business excursion boats and maintain the charter fare at an adequate level. The shuttling times of this public line was calculated as follows to obtain a value required to meet the surplus demand that can not be taken care of by private-business boats based on the assumption that the number of such boats is fixed at 200 after 1981 and their yearly rate of operation reaches about 60% by 1986.

The rate of operation of such private boats in 1981 (assuming that there are 200 such boats) is estimated using the mean value of passengers as shown in Fig. 6.5.1.

$$\frac{273{,}500}{200(\text{boats}) \times 9(\text{persons}) \times 365(\text{days})} = 0.42$$

Year		Tourist Season			
		Per weekday		Per weekend day	
		No. of passengers	No. of boats	No. of passengers	No. of boats
1976	Max.	682	76	1,137	127
	Ave.	—	—	—	—
1978	Max.	788	88	1,313	146
	Ave.	665	74	1,058	118
1981	Max.	994	111	1,656	184
	Ave.	806	90	1,403	156
1986	Max.	1,696	189	2,827	315
	Ave.	1,461	163	2,435	271

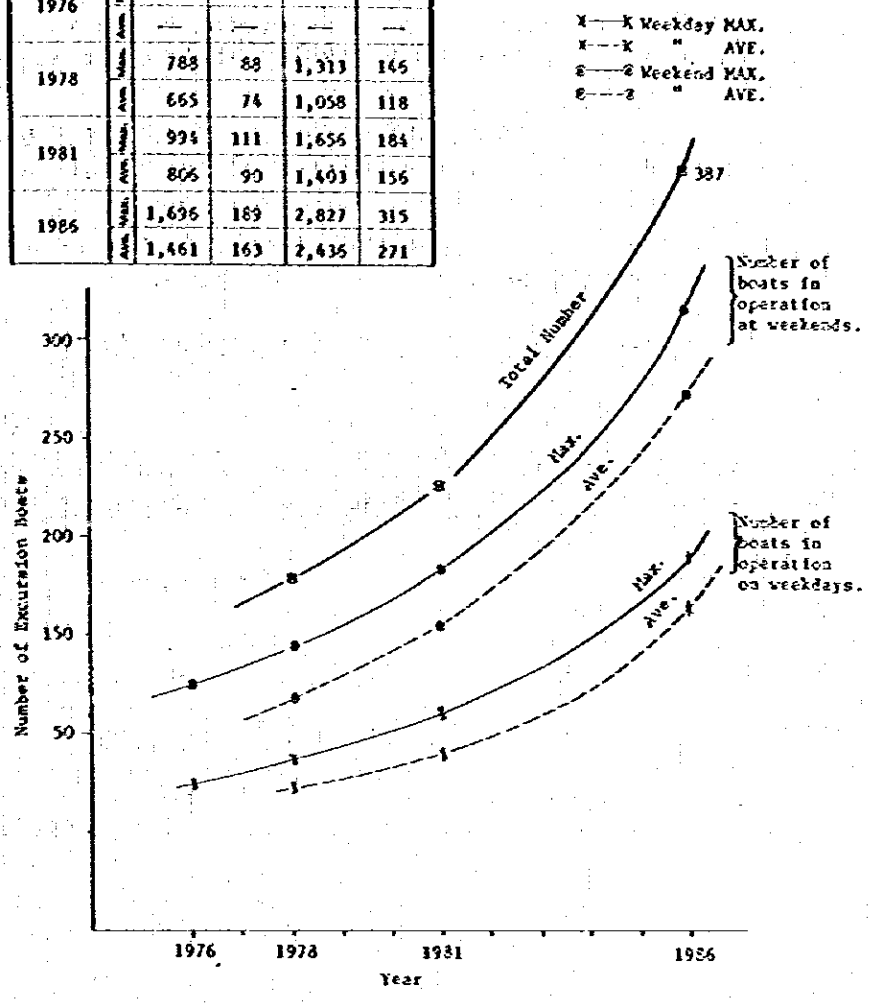


Fig. 6.6.1 Required Number of Private-Business Excursion Boats - without regular service

Supposing the rate of operation reaches 0.6 in 1986, the number of passengers on private boats will be:

200 (boats) x 9 (persons) x 365 (days) x 0.6
= 394,200 (persons)

Since the total number of passengers amounts to 475,000 for 1986, the passengers of the regular service line can be determined to be 81,000 persons as follows.

475,000 - 394,000 = 81,000 (persons)

This represents about 17% of the total of passengers.

(c) Establishing the Planned Number of Excursion Boat Passengers

After various considerations, it was decided to base the establishing of the planned number of excursion boat passengers on the following conditions:

i) The number of private-business excursion boats is to be 180 in 1978 and to increase to 200 by 1981. The number is to be fixed at 200 after 1981.

ii) On some date after 1982, the regular service line boats are to be introduced to take over a portion of the total passengers, 10% from 1982 and 20% from 1984.

Table 6.6.1 and Fig. 6.6.2 show the planned number of excursion boat passengers established as mentioned above.

Table 6.6.1 Planned Number of Excursion Boats

(Unit: person)

Year	Yearly Total of Passengers	Passenger on Peak days	Private Boat Passengers	Regular Line Passengers	Rate of Private Boat Operation(%)
1978	216,000	1,108			
1981	273,500	1,403			
1982	303,000	1,554	273,000	30,000	41
1984	376,000	1,928	300,000	80,000	45
1986	475,000	2,438	380,000	90,000	57

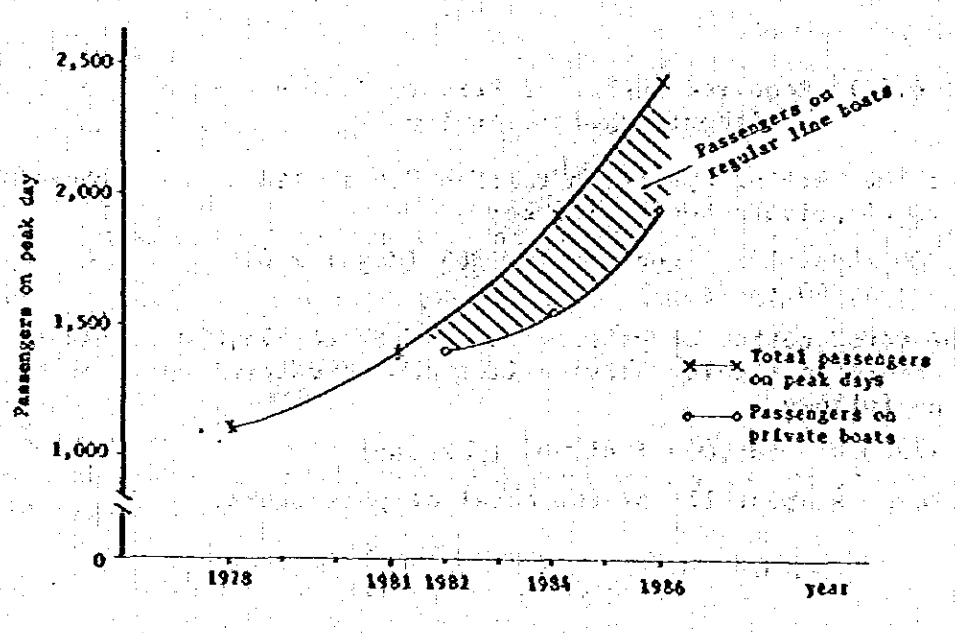
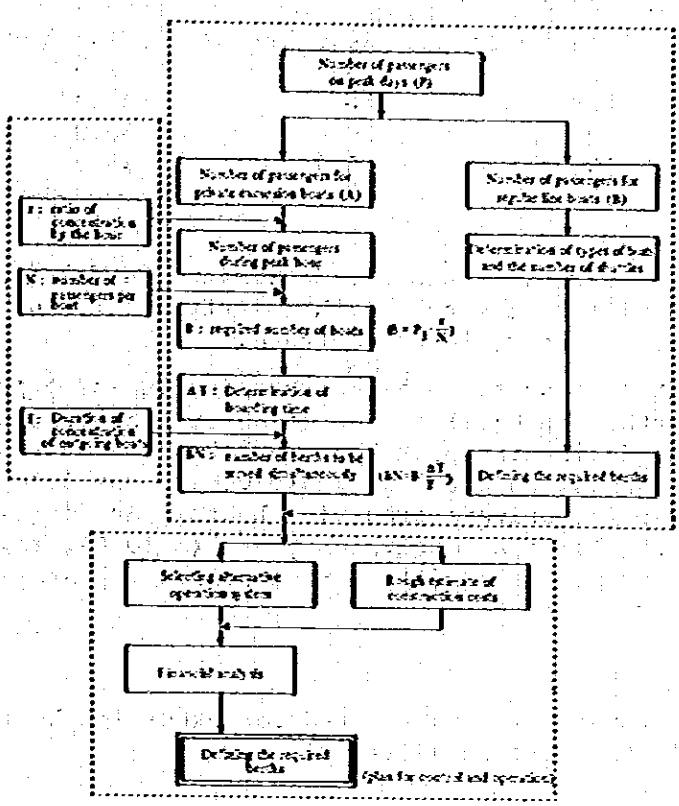


Fig. 6.6.2 Number of Passengers

(d) Required Number of Berths

i) Method of estimating the required number of berths

Following method was used in estimating the required number of berths.



ii) The number of boats to use the pier at the same time and the minimum number of berths required

For obtaining the necessary data as to the minimum scale of the embarkation and disembarkation pier, the number of boats to use the pier at the same time was calculated as shown in Table 6.6.2.

The minimum number of berths required will be as follows assuming that a boat requires 20 or 30 minutes for embarkation and disembarkation. (Table 6.6.3)

Table 6.6.2 Number of Passengers in Peak Hours

Year \ Number of Passengers	Passengers in Peak Day (Total)	Ratio of Concentration: 1 hour	2 hours	3 hours	Number of Passengers in Priority Operated Boats: Number of Passengers	1 hour	2 hours	3 hours
1978	1,158	443	776	942	1,138	443 (55)	776 (87)	942 (105)
1981	1,693	561	952	1,193	1,693	561 (63)	952 (110)	1,193 (133)
1992	1,553	621	1,087	1,320	1,338	559 (63)	977 (109)	1,158 (132)
1996	1,938	771	1,359	1,639	1,542	617 (69)	1,076 (120)	1,311 (147)
1996	2,438	975	1,707	2,072	1,950	780 (87)	1,365 (152)	1,658 (184)

Note: Ratio of concentration
1 hour : 40%
2 hours: 70%
3 hours: 85%

( ) shows number of boats

Table 6.6.3 Minimum Number of Berths

Year	Number of Boats (2 hours)	ΔT=20 mins.	ΔT=30 mins.
1978	87 boats	14.5 berths	21.8 berths
1981	110	18.3	27.5
1982	109	18.2	27.3
1984	120	20.0	30.0
1986	152	25.3	38.0

Thus, the design number of berths was determined as follows on the premise that 5 to 6 boats will occupy one berth jointly and taking account of the hours when the passengers would concentrate.

Supposing the number of boats to be berthed is 200 and 5 to 6 boats are to moor at one berth, the total number of berths required will be 33 to 40. On the other hand, during the peak hours - 2 hours - there will be required 25 to 38 berths as shown in Table 6.6.3. At least about 33 berths are required for private excursion boats. An additional 10 berths are proposed for regular line excursion boats (3 to 4), regular line boats for local transportation (1), marine police (1) and fishing boats (several).

(e) Particulars of Berth

The registration system has been started for excursion boats and 167 boats were registered in the Pattaya district.

The types of boats have been determined for the said 167 registered boats. Fig. 6.6.3 plots the relationship between the length and the width of them. A quadratic correlation is represented by a curve in the figure. The correlation formula is;

$$y = -0.006x^2 + 0.42x - 1.26$$

where, y: width
x: length

In the data, the maximum length (L max) is 19.50M, the minimum length is 7.00M, the maximum width is 6.00M and the minimum width is 1.50M.

Boats included within 50% ∿ 90% of all types are determined based on Poisson's distribution formula and the results are shown in the table below and Fig. 6.6.4.

Probability of Occurrence	Length	Width
90%	17.0M	4.5M
80%	15.0M	3.8M
70%	14.0M	3.5M
60%	13.0M	3.2M
50%	12.0M	3.0M

Fig. 6.6.3

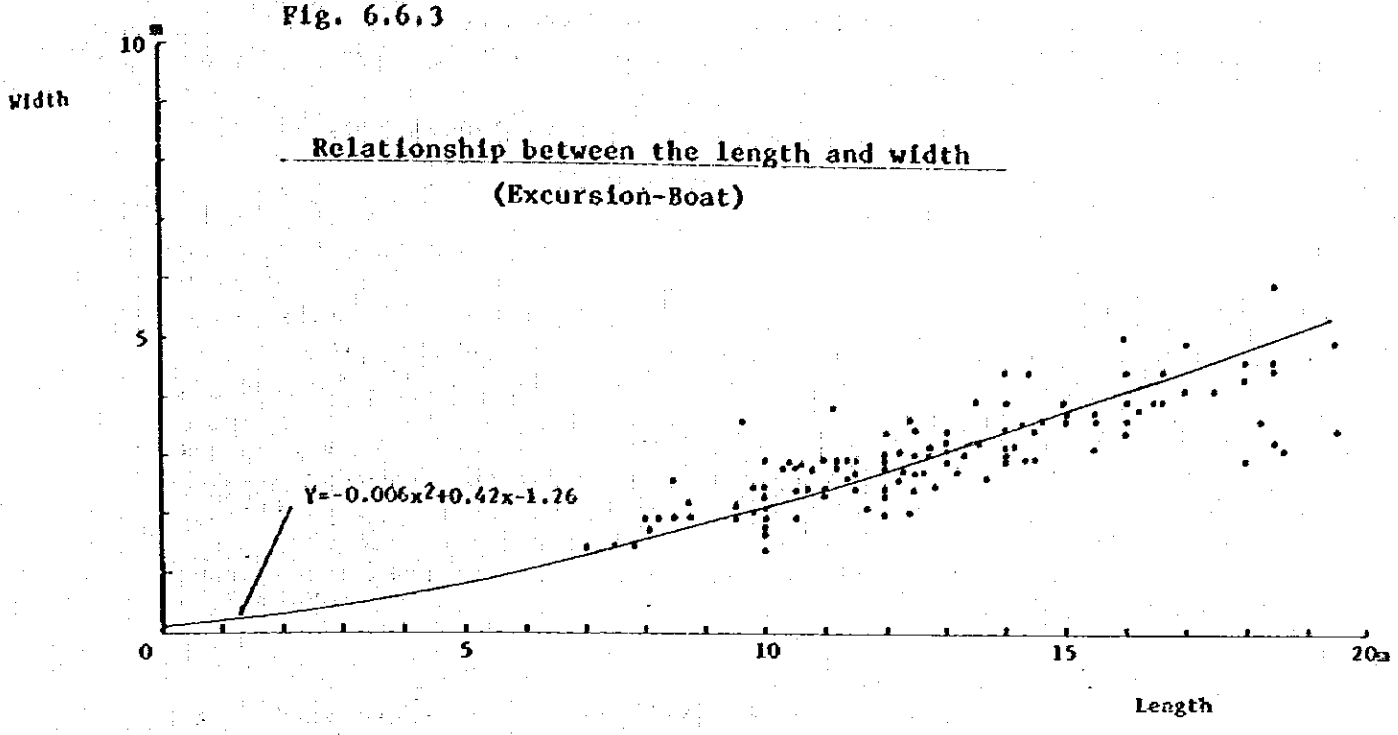
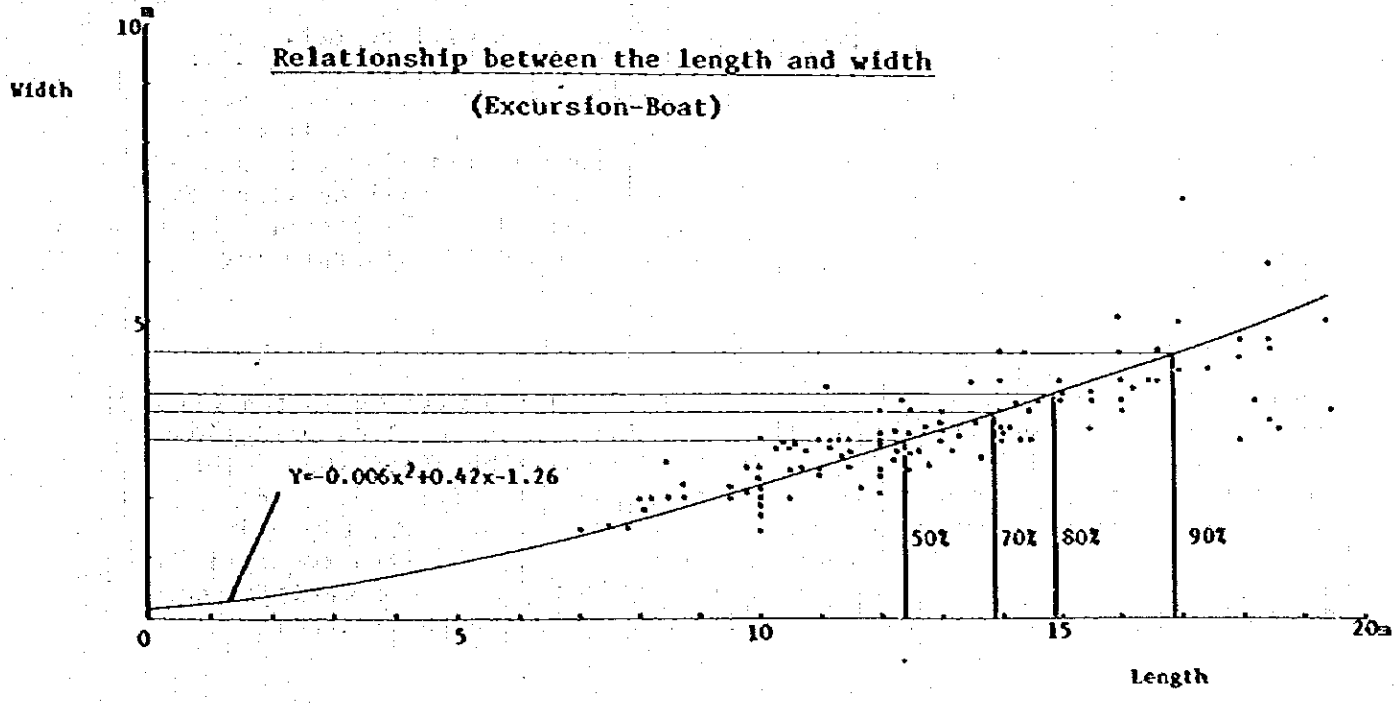


Fig. 6.6.4



As to the design-types of the boats, the boats are divided into two groups; those grouped under 60% and those over 60%. Bigger boats will use berth located at the tip of the piers.

6.6.3 Layout for Port

(a) Main Port

1) Port location

There are wooden piers, shops operating piers and supplying goods for the boats, various stores and restaurants. The planned site for the port facilities is the same as that where the piers are located. The site was selected because of its ideal natural conditions and also because it will be integrated in the redevelopment project for the downtown area. In order to smoothly carry out the construction of the port facilities, it is desirable that the redevelopment project for the downtown area be reviewed. The amenity core will be the point where the main access route to the piers coincide.

2) Need for protective facilities

Analyses of the natural conditions revealed the wave characteristics at the planned site for the main port. More than 95% of waves are less than 50 cm in height, and the design waves are about 1.0 m. As there has been no report of damage to piers in Pattaya by wave turbulence, it is assumed that breakwaters will not be necessary to protect the piers from such small waves. However, if pontoons are to be used for embarking and disembarking purposes, then calmness of a higher degree will be required and the breakwaters will be necessary.

Because of the high construction cost for breakwaters and possible damage to the scenic beauty, fixed piers were selected in lieu of pontoons.

3) Access channel and anchorage area

In order to optimumly use the waters, access channel will be set. The main route for the excursion boats is from Pattaya to Ko Lan; thus a straight channel from the main port to a point offshore of Pattaya Beach will be used as the Ko Lan course. The width of the channel will be as wide as possible (about 200m) to allow two-way navigation for the excursion boats. The calm area on both sides of the channel will be reserved for anchoring boats waiting for passengers and spending the night. The area required will be about 220,000m^2 allowing a single anchorage for the boats.

4) Mooring facilities

Mooring facilities for embarkation and disembarkation will be on the fixed type piers. The piers will be the parallel mooring system to allow variations in future utilization. The length of the pier will be about 100m. The berthing arrangements for a pier will be as shown in Fig. 6.6.5; and about 11 berths per 1 pier will be provided by arranging the big and small ships. Thus, four piers will be sufficient to meet the required number of berths, i.e. 40. The intervals between piers were selected to be 38m each, the width of the slip being twice the length of a boat.

5) Utilization of port site

Basically, the present port facilities will be built where the tourists taking the excursion boats will be concentrated. Thus, it is desirable that the port itself will be one of the sightseeing resources for Pattaya. In the present plan, the port will have the functions of serving the passengers and it is also intended that the port will take the position of a sub-core where the sea plays the major role and also the port will be an integral part of the main amenity core. There will be built a marine museum with a seaside park as its main part in addition to the facilities for boating activities. Thus, all the facilities will feature their direct contact with the sea.

The area required for the port will be about 4,000 to 5,000m^2 if it is to serve only the function of embarkation and disembarkation of the excursion boats provided that the number of passengers per hour during the peak hours is about 1,000. The areas required for administrative facilities, service facilities and for the park and marine museum as its sub-core will be as follows. (Table 6.6.4)

Table 6.6.4 Land-Use

1.	Administrative and service facilities	2,000 m^2
2.	Ocean Musium	5,000 m2
3.	Commercial area	5,000 m2
4.	Park	7,000 m2
5.	Road	6,000 m2
	Total	25,000 m2

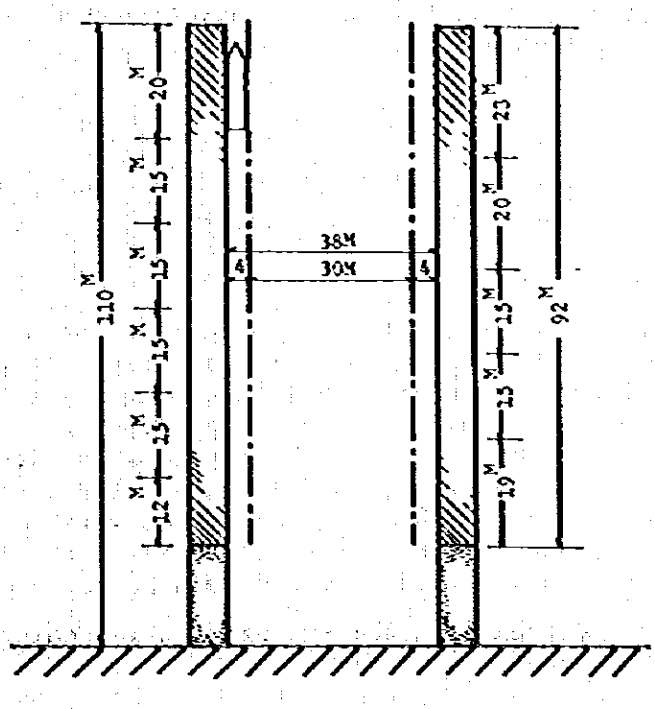


Fig. 6.6.5 Berthing System

6) Construction of Port Site

Two plans of 1) man-made island and 2) extension by reclamation proposed by the master plan were reviewed and the following conclusions were reached.

(1) The construction cost for the plan 1) will be about 30% higher, thus increasing the pier charge proportionately. If the pier charge is high, the owners of excursion boats who are using the beach freely today would be reluctant to use the piers and the piers would not be fully utilized. The pier charge computed based on the plan 2) extension by reclamation is as high as 1,390 ฿/boat per month. When the monthly turnover of 4,300 ฿ per boat (the figure was obtained by interviews) is considered, this will be an extremely heavy burden. For the tourists who might otherwise use the longtail boat, the amount is not beyond their means. However, for boat owners, the amount is a considerable burden as compared with their monthly turnover even if half the amount is the fee for their exclusive use of the pier.

(2) The result of the feasibility study revealed that an island built in the sea would have to be located quite far offshore if the channel between the island and the beach were to be submerged in the water during low tide.

The sight of the bare bottom and the 4 to 5 m height of the revetment for the island being wholly visible is not desirable, especially because the place is noted for its scenic beauty. In this case, a connecting walk between the island and the beach should be built and the walk should be covered by beautiful sand or made into a promenade. If the channel was made very wide, there would be fewer problems of contamination of the water or impairment of the scenic beauty as the pretty sandy beach will join the island to the main land during low tide. However, the wider the channel, the farther the island will have to be built offshore and the higher the construction cost will be.

7) Layout

The proposed layout for all the facilities is shown in Fig. 6.6.6. Fig. 6.6.7 is a plan for an access channel and anchorage area.

(b) Launching Ramp Plan

Most of motorboats and scooter boats are kept in the boat houses and these boats depart from the launching ramps daily. At present there are one public and three private (R_1 - R_3) launching ramps at Pattaya as shown in Fig. 6.3.3. The private launching ramps are used mainly by motorboats, and the boat houses and the repair shops are located on the inland side of the seaside walk. R_1 and R_3 are frequently used by motorboats and scooter boats. If boating activities were to expand proportionate to the increase in the number of tourists, the coastal line and the sea around the launching ramps would soon be occupied by these boats.

Therefore, it is proposed that the two private launching ramps at the center of Pattaya beach be disused in the future. The time of disuse would naturally depend on agreement with the owners, but it is hoped that the time will coincide with the completion of port facilities and

the launching ramps to be built anew (1981).

Two launching ramps will be built in the north and the south as proposed in the master plan and these points will be designated for lifting the boats ashore. The location of launching ramps is shown in Fig. 6.6.7.

(c) Ko Lan Plan

At Ko Lan four beaches, namely Ta Van beach, Tien beach, Sa Mae beach and Ko Lan Vac Beach, are utilized for tourism while the tourist season is restricted by monsoons. Among the said four beaches, Ko Lan Vac beach is exclusively used by a private tourist company which owns the southern part of the island and where the only hotel on Ko Lan is provided. In the present plan, the private Ko Lan Vac beach is excluded and the other three beaches are considered.

To utilize the Ko Lan beaches, the tourist boats are chartered for a day from Pattaya Beach, tourists get on and off the boats directly from and to the sandy beach or are relayed by the longtail boats. On the beaches of Ko Lan, the swimming areas have been designated by the Harbour Dept., in the same manner as on Pattaya Beach, and prohibition of boating activity is not observed in the swimming areas. It is necessary to construct a complete landing facility and to control boating activity at least in the swimming area.

As for the landing facility plan based on the Ko Lan utilization plan and island traffic network plan, piers for excursion boats are provided at two places, i.e., Ta Van beach and Tien beach, and moreover, an additional pier is to be provided for materials transportation (including construction materials for other infrastructural facilities) and water supply on the east side of Ko Lan, where there is a fishing village at present.

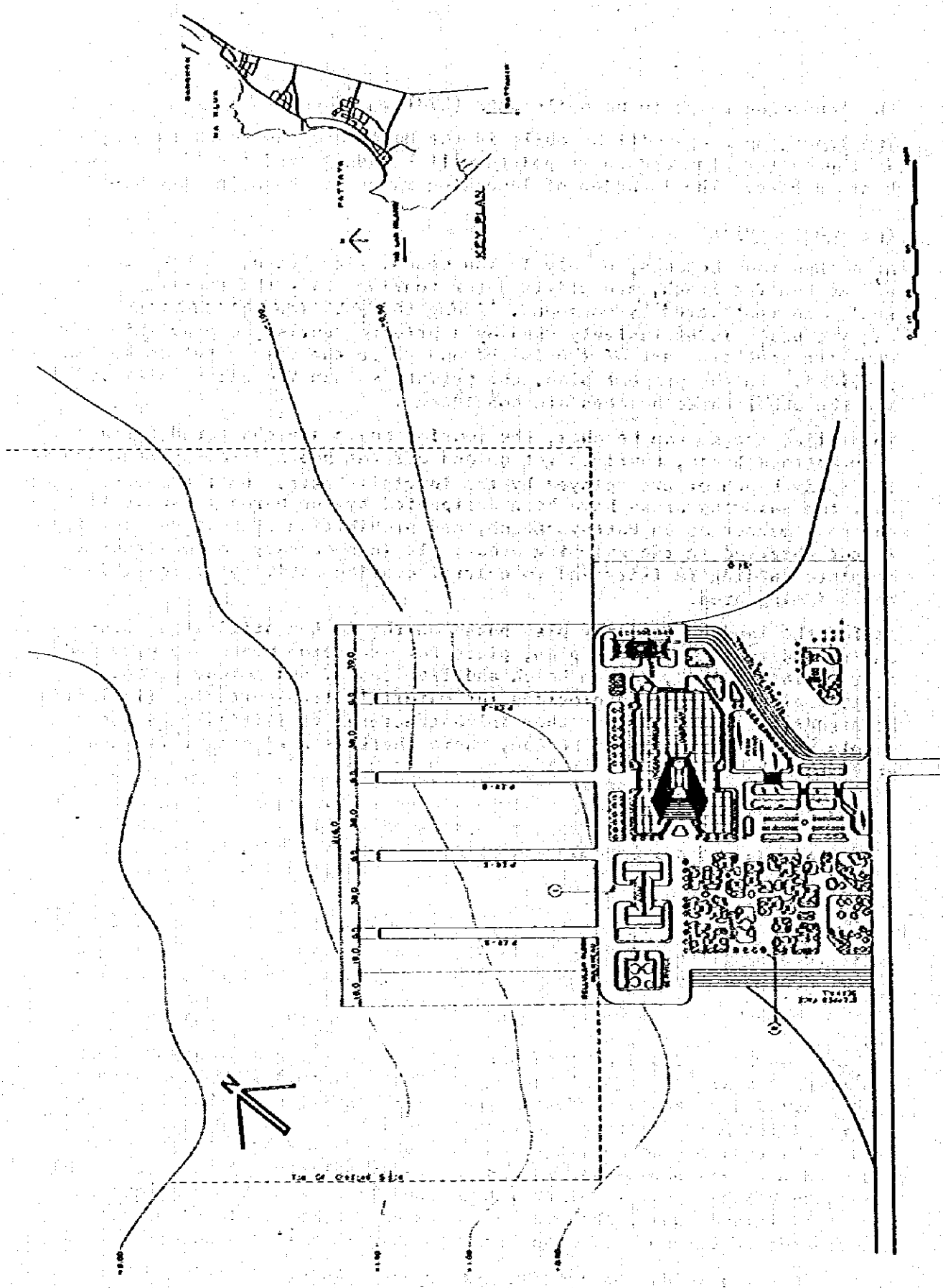
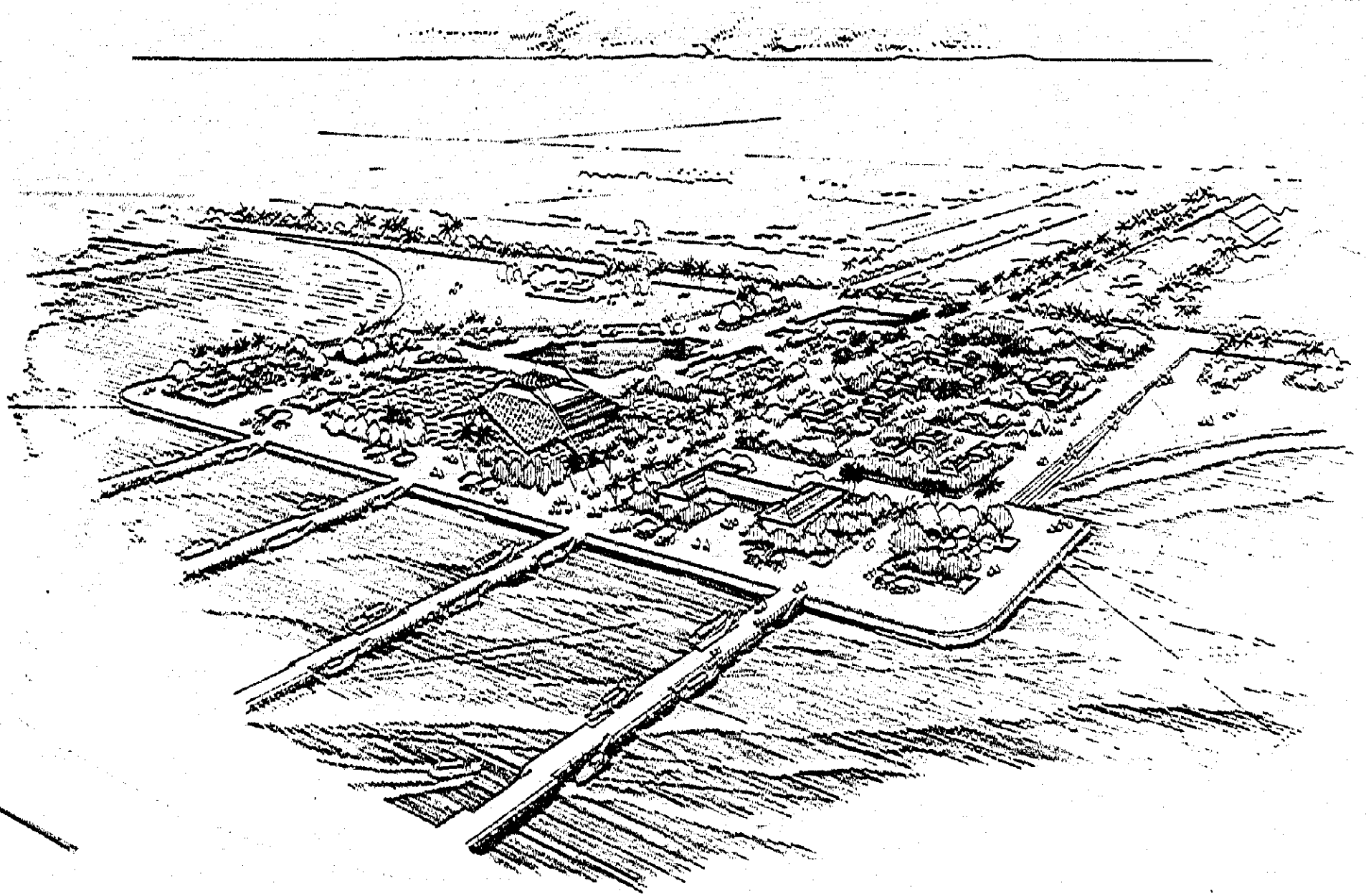


Fig. 6.6.6 General Plan (Pattaya Main Port)



Pattaya Main Port

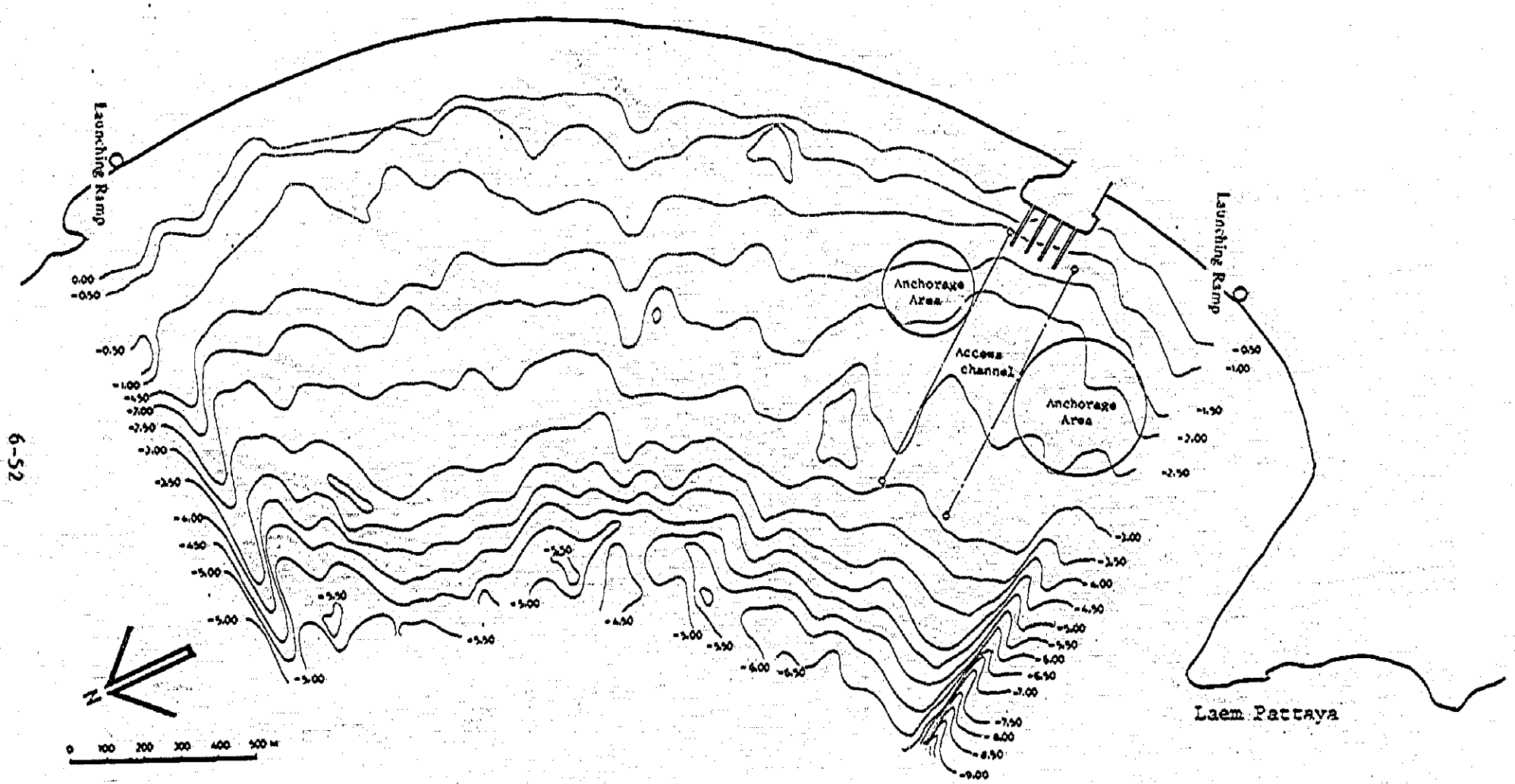
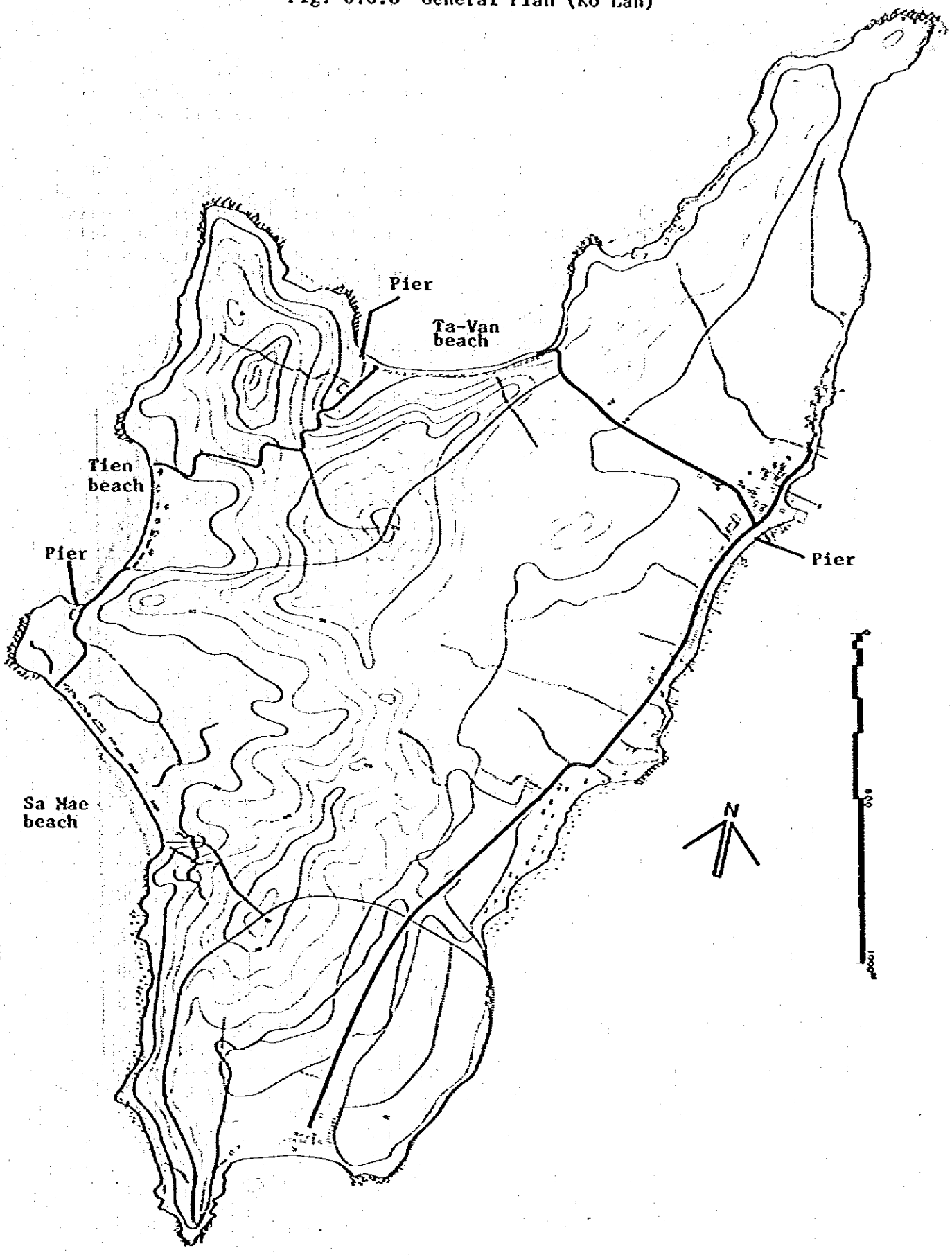


Fig. 6.6.7 Navigational Channel and Anchorage Area

Fig. 6.6.8 General Plan (Ko Lan)



(d) North Port Plan (Alternative)

According to the result obtained from more detailed studies concerning natural conditions, the north port proposed in the Master plan was re-examined and modified as shown in Fig. 6.6.9. Table 6.6.5 shows the estimated construction costs for civil works.

As the construction of the north port is very costly compared with the main port, the accommodation plan for excursion boats was reviewed and it was finally decided to accommodated all excurision boats in the main port. In Phase I (up to 1986), only main port will be constructed and the necessity of the north port should be re-examined observing an actual condition in management and operation of the main port.

Table 6.6.5 Cost Estimation (North Port)

Discription	Quantity	Unit	Unit Cost (₱)	Cost (₱)
1. Pier				
R.C. Piling	131	PCS	20,296	2,658,776
R.C. Beam & Slab	2,267	m^2	2,230	5,055,410
Tax.				201,000
2. Revetment				3,028,110
Revetment	330	m	8,967	2,959,110
Tax.				69,000
3. Dredging				8,800,000
Dredging	114,000	m^3	70	7,980,000
Tax.				820,000
4. Land Reclamation				2,959,000
Land Reclamation	70,800	m^3	40	2,832,000
Tax.				127,000
5. Breakwater				16,378,000
Breakwater	650	m	25,000	16,250,000
Tax.				128,000
Total				39,080,290

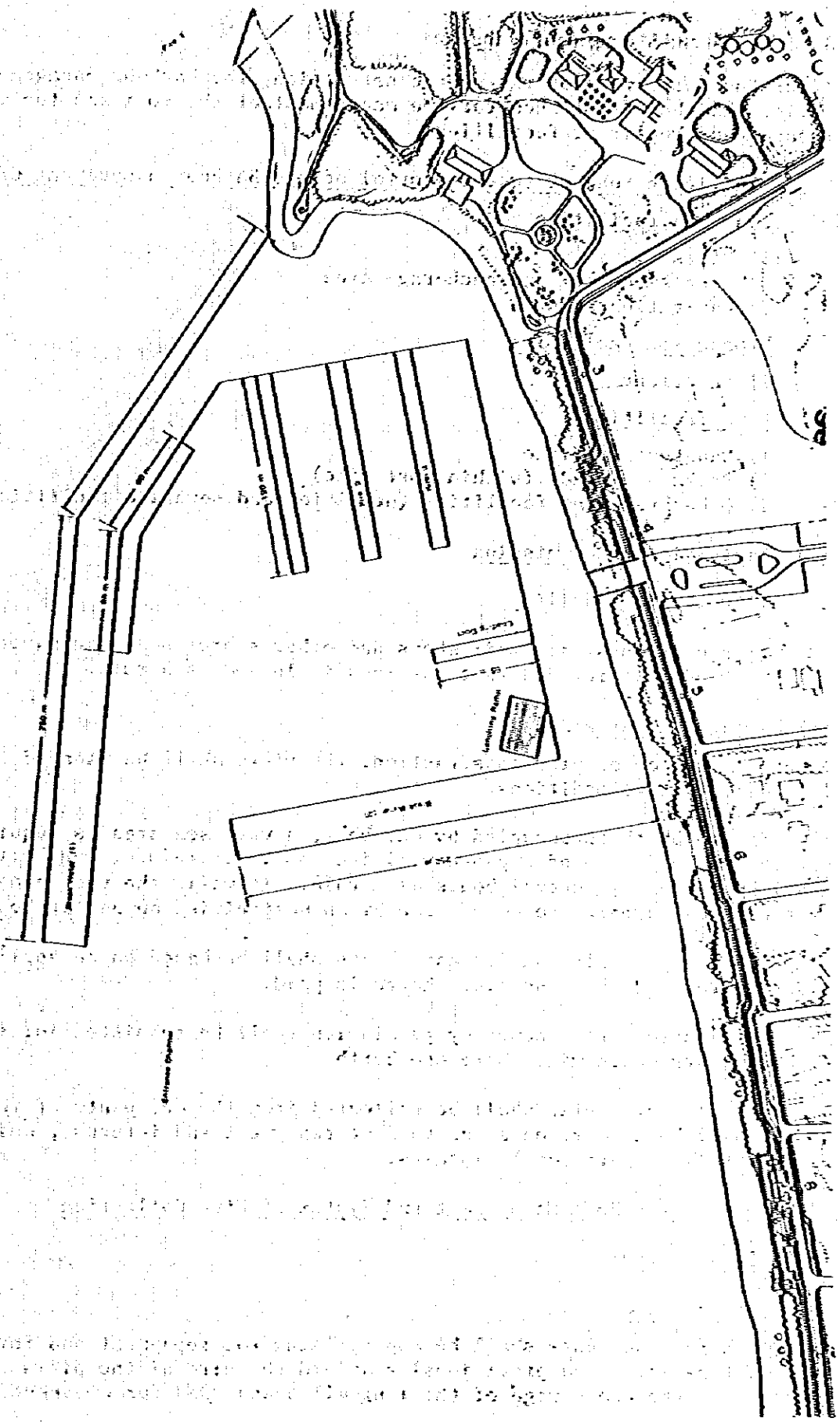


Fig. 6.6.9 North Port Plan

6.7 Control and Management of the Port

After the completion of the port construction, the harbour management office will be established for the management of the port and for maintenance and repair of facilities.

(a) Facilities Subject to the Control of the Harbour Management Office

Sea area facilities

1) Piers
2) Access channel and anchorage area
3) Navigation aids

Protection facilities

1) Revetment

Land facilities

1) Management office
2) Parks and roads (within port site)
3) Other relevant facilities (utilities and severage facilities)

(b) Facilities on Commission

1) Refueling facility

2) Restaurants, souvenir shops and other stores shall be owned by traders, provided that the land is leased as a rule.

(c) Management of Piers

After completion of pier construction, the piers shall be managed under the following preconditions.

1) If one berth is occupied by one boat, a vast sea area is required and the user's share of expense will increase. Therefore, one berth shall be shared by several boats as a rule. It will make pier management easy as compared to common use by an unspecified number of boats.

2) Occupancy permission for each berth shall be based on an application system, provided that the pier charge is paid.

3) Applications for occupancy permission shall be submitted jointly by several boats which will share one berth.

4) The rent of a pier shall be collected from the occupants of the pier and it will be determined so as to meet repayment and interest, maintenance cost and operational expenses.

(d) Revenue for Boat Management and System of Hire Collection

1) Hire of piers

2) Rent of land

Hiring charge and rents shall be appropriated for repayment and interest on a cost basis. As a provisional standard the hire of the piers shall be based on the charterage of the longtail boats used for embarkation and

disembarkation the boats at present, and the rents shall be based on the land value of the downtown area. In regard to the collection system, it will require a careful review of how to collect the hireing charges for the piers. Since the sandy beach is used freely for embarkation and disembarkation of the boats at present. There will be quite a lot of resistance if the new port must be used by paying hire charge and rents. On the other hand, if the hire charges are collected from tourists but not from the owners of the excursion boats, it is expected that some owners might register their boats irrespective of their intended use or disuse. Therefore, these charges should be shared half and half by owners and tourists. Details of the rent determination and collecting system shall be examined later.

(e) Personnel Required for Harbor Management Office

Harbour master	1 person
Engineer for facility maintenance	1 "
Accountant	2 persons
General affairs	1 person
Miscellaneous affairs and cleaning	2 persons
Pier charge collector	4 persons
Total	11 persons

(f) Calculation of Maintenance and Operation Costs

1) Maintenance costs

Facilities maintenance costs (1% of total construction cost) 55,000,000/100 = 550,000 ฿/yr

2) Operation costs

Personnel expenses 11 persons x 2,000 ฿/month x 12 months = 264,000 ฿/yr

Miscellaneous (Ratio of personnel costs in operation costs: 50%) 264,000 ฿/yr

3) Total maintenance and operation costs

550,000 + 264,000 + 264,000 = 1,078,000 ฿/yr

(g) Marine Police

Expenses for the rescue boat and marine police shall be paid from the general account of Central Government.

There will be a berth for use by the marine police and the principle will be a 24-hr/day watch system.

Many of the established harbors and marinas have combined fire protection, police protection, search and rescue and enforcement of safety rules under an agency usually called a harbor patrol.[8][9] In the case of Pattaya port, Marine police would be better to take responsibilities for such services in cooperation with the local police department and fire department. In taking this approach, Marine police must provide for recruitment and selection of personnel well suited for a wide variety of tasks and responsibilities. It is recommended that Pattaya port be

provided with a patrol boat operated by Marine police as shown in the following Photograph.

(h) Determination of Pier Charge and Land Rents

The pier charge and land rents will be based on cost, and the cost for facilities will be borne by the users of the piers (boat owners) and the land. The computation results are shown in Table 6.7.1. As for the pier charge, if the boat owners and the tourists are to divide the cost among themselves, then 1/2 of the amounts shown in the table will be their respective costs. Fig. 6.7.1 shows the computation results where the whole cost is to be paid by the passengers of the boats; the amount will be about 8 ฿ per person. This amount was computed including the pier cost at Ko Lan and is considered to be reasonable for the tourists as they will not have to pay for the hire of the longtail boats.

The other costs such as engineering fee for designs and construction supervision and the cost assigned from the administration cost will be included in the annual charge of hotel rooms.

Table 6.7.1 Calculation for hire of pier and rent of land

	Pattaya												Ko Lan			
	1 Pier	2 Revetment (1)	3 Revetment (2)	4 Artificial beach	5 Breakwater	6 Land reclamation	7 Navigation aids	8 Office	9 Park	10 Road	11 Flood control	12 Landscaping, etc.	1 Pier (1)	2 Pier (2)	3 Pier (3)	Total
1. Construction costs	11,711 x 1,000 ฿	5,299	2,338	612	4,337	3,353	1,335	1,009	771	674	543	116	3,335	8,226	3,335	53,654,000
2. Service life	30 Year	30	30	30	50	*	10	60	30	30	20	30	30	30	30	
3. Repayments	393 x 1,000 ฿	176	78	21	100	-	135	50	25	16	43	6	135	308	135	1,557,000
4. Interest	442 x 1,000 ฿	198	87	23	134	220	69	113	29	18	36	7	149	233	149	2,069,000
3 + 4	835 x 1,000 ฿	374	165	34	234	220	204	163	55	34	14	93	265	441	265	3,564,000
Ratio of pier's each charge	1	1/2	1/2	1/2	1	-	1	1	0	-	1/2	-	1	1	1	
Pier's charge	835 x 1,000 ฿	187	83	17	234	0	204	163	0	0	42	0	265	441	265	2,834,000
* Determination of hire of pier = 12,834,000 ÷ 536,000x220 hours = 16,683 ฿/pier/hour Maintenance and operation costs = 1,399 ฿/month/boat = 99 ฿/day/boat																
Charge of rent of land		1/2	1/2	1/2	-	1/2	-	-	1	1	1/2	-	-	-	-	368,000
	0	187	83	17	0	220	0	0	55	34	43	0	0	0	0	

* Determination of rent of land = 736,000 ÷ 333,000x1,000 = 114 ฿/m²

Year	1981	1982	1984	1986	1981~1986 Total
Annual number of users	266,000	273,500	376,000	475,500	2,087,500
Total of charges assigned to use of pier	2,836,000	2,836,000	2,836,000	2,836,000	17,016,000
Individual charges assigned to use of pier	13¥	10	8	6	
Average annual number of users, 1981 to 1986	2,087,500person / 6year = 347,917				
Average individual charges assigned to use of pier, 1981 to 1986	2,836,000¥ / 347,917person = 8¥/person				

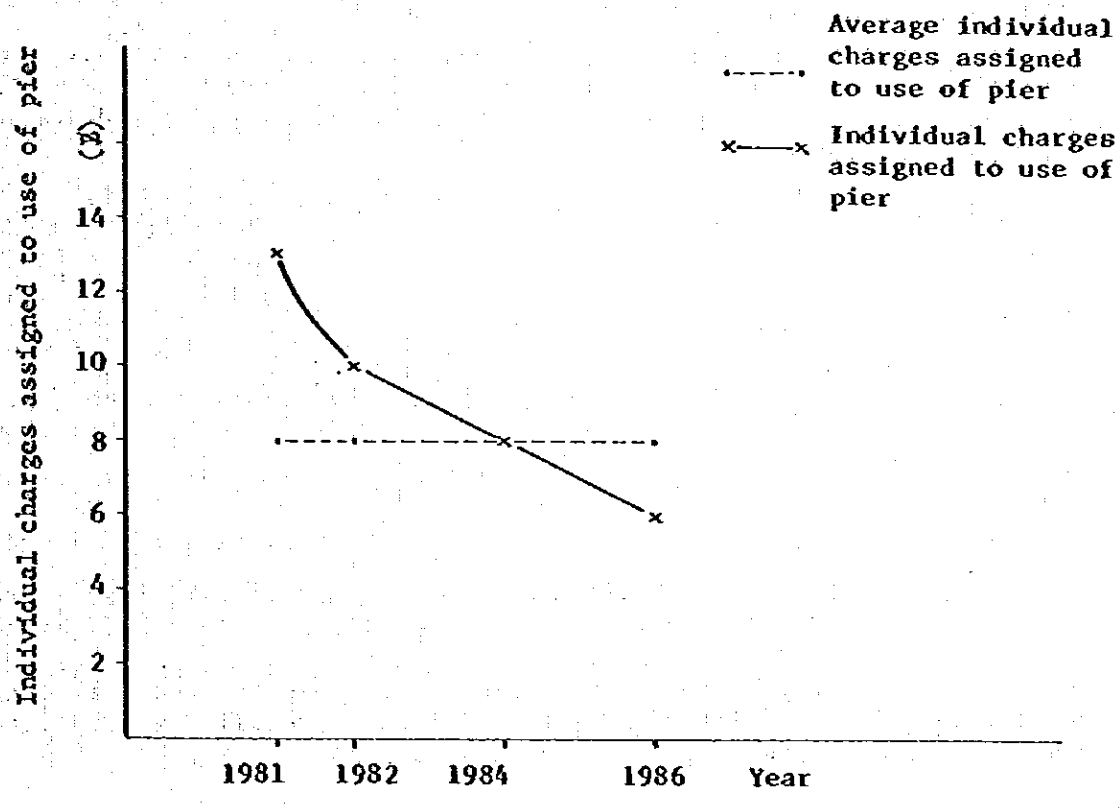


Fig. 6.7.1 Charges assigned individually to passengers

6.8 Facility Design, Construction Plan and Construction Costs

6.8.1 Design Conditions

(a) Design Wave Height

As shown in Figs. 6.2.7 to 6.2.12, waves of south to southwest direction are very refracted and waves of west-northwest to north-northwest direction enter directly to the point where main port is planned.

The annual maximum wave heights of west-northwest to north-northwest direction during 1965 to 1974 are shown in Fig. 6.2.13. The maximum wave heights as shown in the figure were determined by the winds every 3 hrs. at Sattahip and the duration of the winds showed a somewhat larger value. Therefore, probable wave height at return period of 30 years, takes somewhat smaller value, i.e. H=1.70m and T=5.0sec. The refraction coefficient and shoaling coefficient of waves are determined by use of the said deep water waves, and wave height in front of the structure is determined and is taken as the design wave height.

Formerly, the refraction coefficient had used a single wave direction and a single wave period as regular wave. However, the design wave is calculated allowing for the irregularity of wave direction which has especially large effect because actual waves are irregular one which have certain range for period and direction. Therefore, the calculated result by regular wave is weighed and analysed by the irregularity of the wave direction according to the superposition method.

In calculation by means of irregular wave, the deep water wave spectrum should be given. Now, the Bletschneider·Mitsuyasu type is used. This is the spectrum which is expressed for period by equation (1) and for wave direction by equation (2):

$$S(f) = 0.257H_{1/3}^2 \cdot T_{1/3}(T_{1/3}\cdot f)^{-5} \exp\left[-1.03(T_{1/3}\cdot f)^{-4}\right] \quad \cdots\cdots(1)$$

$$G(f\cdot\theta) = G_0\cos^{2s}\left(\frac{\theta}{2}\right) \qquad G_0=\left[\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \cos^{2s}\left(\frac{\theta}{2}\right) d\theta\right]^{-1} \quad \cdots\cdots(2)$$

$$S = \begin{cases} S_{max}(f/f_p)^5 & f \le f_p \\ S_{max}(f/f_p)^{-2.5} & f > f_p \end{cases} \qquad f_p = 1/(1.05T_{1/3})$$

where, θ: Angle from main wave direction

f: Frequency

S_{max}: Parameter by which the concentration of the wave direction is represented. For wind waves, Smax=10

For weight in superposition of the calculation results, the following values, which are the integral calculus of the wave direction spectrum expressed by equation (2), are used.

Table 6.8.1 Weight With Wave Direction

Angle from main wave direction	-67.5°	-45°	-22.5°	0°	22.5°	45°	67.5°
Weight (D_j)	0.05	0.11	0.21	0.26	0.21	0.11	0.05

The refraction coefficient $(Kr)_{eff}$ to irregular waves is determined by the following equation:

$$(Kr)_{eff} = \sqrt{\sum_{j=1}^{7} (Kr)_j^2 \cdot D_j}$$

From the refraction diagram as shown in Figs. 6.2.7 to 6.2.12 the refraction coefficient at the planned main port location (Station 2) on Pattaya coast is determined as follows:

Table 6.8.2 Refraction Coefficient for Regular Waves

Wave direction of offshore wave	N	NNW	NW	WNW	W	SW
Refraction coefficient (Kr)	0.34	0.82	0.93	0.86	0.24	0.13

By using the value in Table 6.8.2, the following refraction coefficient for irregular waves is determined for the main wave direction northwest and west-northwest:

Main wave direction	NW	WNW
Refraction coefficient $(Kr)_{eff}$	0.74	0.68

Therefore, when the wave direction of the design wave is west-northwest direction which gives maximum fetch, the design wave height at the planned main port of Pattaya is:

$$H = H_0 \cdot (Kr)_{eff} \cdot K_S$$

$$H = 1.70 \times 0.68 \times 0.913 = 1.05 \text{ (m)}$$

Where, K_S is a value for wave period of 5.0 sec. in 5.88m of a water depth at high tide.

Therefore, the design wave height is T = 5.0 and H = 1.05m.

(b) Design Water Level

From the tidal data as shown in Fig. 6.2.15, design high water level and design low water level are:

Design high water level = H.H.W. (1.80m above M.S.L.)

Design low water level = L.L.W. (2.48m below M.S.L.)
Mean Sea Level is Koh Lak Standard.

(c) Soil

Based on the soil data as shown in Table 6.2.2 and Fig. 6.2.18, design soil conditions at the planned main port location are the soil profile at Point B_p3 for revetment, etc. and the soil profile at Point B_p4 for pier.

The soil is extremely good alternate layers of fine sand and hard clay, and the N value is 30 to 50.

6.8.2 Facility Design

(a) Basic Lines of Design

1) Revetment

At the planned main port location, the subsurface condition is good and the design wave height is small. Therefore, rubble available near Pattaya can be used for construction. A rubble mound type revetment was not considered appropriate because of the long face of the slope required to cope with a large tidal range, because of difficulties in connecting the piers and because of the possible damage to the scenic beauty of the area. A cellular block type revetment with a vertical structure on the top is proposed. There will be stepped face revetment constructed on the both sides of the reclamation for direct access by the tourists to the beach.

2) Piers

The tidal range is large at Pattaya. Therefore, pontoons are suitable for the kinds of mooring facilities which are intended mainly for embarkation and disembarkation the boats. However, there are difficulties with pontoons in their maintenance and their use at places where waves are high and tidal current is large. They are usually used for places where the design wave height is up to 1.0m. If pontoons are to be used at the planned main port location where the design wave height is about 1.0m, there should be measures provided against winds waves. Although fixed piers are inconvenient for embarkation and disembarkation the passengers, they are stable against the waves and easy to maintain. Therefore, the piers should be of the fixed type with pile foundations.

(b) Facility Design

The general designs of the structures shown in the port plan drawings and land use plan drawings are as follows:

1) Reclaimed revetment

(i) Cellular block type reclaimed revetment (Fig. 6.8.1 (A))

For connection with the pier, the front side of the reclamation should be of the cellular block-type vertical revetment as shown in Fig. 6.8.1 (A). However, it is desirable to use a vertical wave dissipating block type revetment (such as the Igloo)[17] because the generated reflected waves adversely affect the utilization of the pier constructed in front. (Fig. 6.8.1 (C))

. Crown height of the revetment

The crown height of the revetment is determined by the height of wave run up and allowable quantity of wave overtopping.
(ref: Port construction design standards, etc.)
The allowable limit of quantity of wave overtopping is

$q = 0.01\ m^3/m\text{-sec}$. When $q = 0.01 \sim 0.001\ m^3/m\text{-sec}$., the crown height of the revetment is as follows:

H = 1.05m T = 5.0 sec. $H'/L_0 = 0.028$

H.H.W.L. + 1.80m (above M.S.L.)

Installed depth of water - 2.5m (below M.S.L.)

h = 4.30m h/H = 4.3

Crown height of revetment = Design water level + (1.0 ~ 1.25)H

= (+1.80) + (1.0 ~ 1.25) x 1.05

= + 2.8 ~ + 3.0m (above M.S.L.)

The crown height of the revetment should be as low as possible in view of the landuse and facility utilization as a sightseeing place. If the vertical wave dissipating type revetment is used, the height of wave run up is low and the crown height of the revetment can be lowered.

. Stability of the rubble mound

Various experimental formulae have been proposed to calculate the stable weight of armour stones of breakwaters against the waves. Generally, Brebner-Donnellys experimental formula is used for calculating stability of armour materials for foot protection mounds. Therefore, the minimum weight of armour stone would be 150 to 200kg under the following conditions.

Unit weight of armour stone = $2.65\ t/m^3$

Wave height = 1.05m

Water level neally coincides with the top of rubble mound.

. Stability of cellular blocks

The safety factor of cellular blocks, as shown in the figure, is F = 2.0 or more to prevent their overturning landward and sliding out, and it is fairly stable against wave force. For superstructure work, however, a reinforcement connection with substructure is required.

(ii) Stepped face revetment (Fig. 6.8.1)

. Crown height of revetment

The stepped face revetments on both sides of the reclamation are not affected by waves. Therefore, the crown height of the reclamation should be made equal to the ground height of the reclamation (2.5m above M.S.L.), which will provide easy access to the beach.

. Step work

The steps should be as wide as possible (0.7m) for the convenience of tourists, but they should be somewhat high (20cm).

2) Pier (Fig. 6.8.2)

. Crown height of pier

For convenience in embarkation and disembarkation of the boats, it is desirable to reduce the crown height of the pier as much as possible. The pier should not be submerged at high tide nor should the difference in height as compared with the decks of the boats be large. As shown in Table 6.8.3 tidal level of +1.50m or over occurs five times per year and at that time, the difference in height would not be larger as compared with the decks of the boats. Since the deck height of

the present excursion boat is 0.5 to 1.0m from the still water level, crown height of pier should be +2.0m or less.

On the other hand, a low tide level of -2.0m or less occurs five times per year. If approx. 1.0m is allowed for the difference with the decks of the boats, the height of the pier steps should be M.L.W.L. -0.97m for embarkation and disembarkation of the boats.

Table 6.8.3 Tidal Conditions at Pattaya

Higher High Water		Lower Low Water	
Level above MSL	Number of HHW per year higher than indicated	Level below MSL	Number of LLW per year lower than indicated
2.00m	0.01	-1.25m	150
1.75	0.2	-1.50	75
1.50	5	-1.75	30
1.25	40	-2.00	5
1.00	150	-2.25	1
		-2.50	0.1
		-2.75	0.01

from Ref. 4

° Pier width

Steps are provided on both sides of the piers for the use of getting on and off boats, while a sufficient width is required for the center passages. This width is related to the length of the piers. For example, the overall width of a pier is approx. 6.5m if the width of the center passage is 3.0m.

° Step work

Three wide steps are provided for easy and safe embarkation and disembarkation of boats. While the length of step work is varied depending on the length of boats, the standard length is one half of the boat length, i.e. 6.5m, and the standard width is 1.75m.

° Pier foundation work

The substructure of pier is pile foundation with concrete pile or steel pipe pile. As shown in Fig. 6.8.2, the transverse spacing is 3.0m and the longitudinal spacing is 6.5m.

Pile dia.	0.50m
Pile length	15.0m
Depth of pile penetration	-13.3m (below M.S.L.)
Length of penetration	8.8m

For subsurface, the N value is 30, the live load is 1.0 t/m^2 and the design boat weights 20 Gt.

3) Beach nourishment work

Beach nourishment is executed to the front of the stepped face revetment on both sides of the reclamation in order that the structure may blend harmoniously with Pattaya Beach. As shown in Fig. 6.2.17, Pattaya Beach forms a steep slope of approx. 1/10 to a point 1.0m below M.W.L. at present.

The grain diameter of the sand comprising the foreshore is rather coarse, the median diameter (d_{50}) being about 1.0 ∿ 2.0mm as shown in Fig. 6.2.19. If the width of the offshore slope and the conditions of the waves are unchanged, the same shape as the existing beach can be maintained by beach nourishment with similar coarse sand. Sand of about 1.0 ∿ 2.0mm grain diameter is usually preferred by bathers.

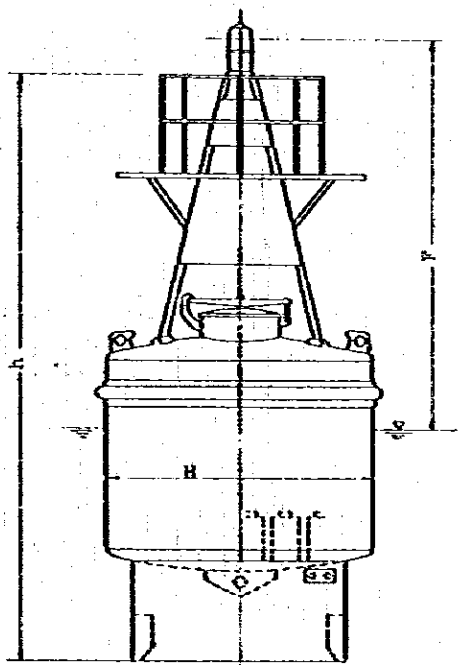
4) Navigation aids

In order to define the access channel, light buoys and beacon lights will be provided respectively at the entrance of access channel and at the head of piers.

i) Light buoy

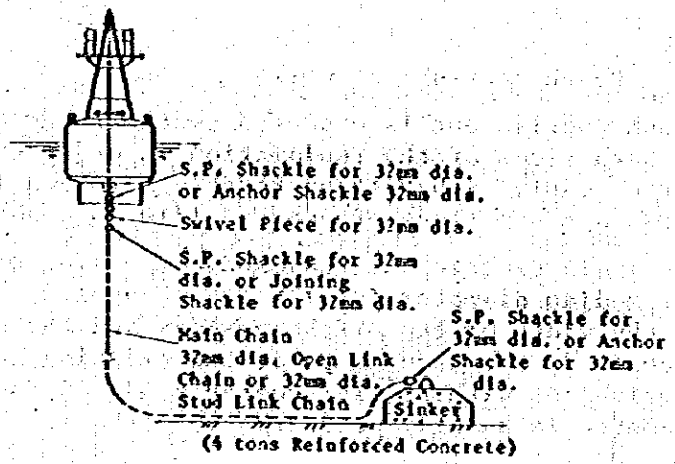
- Buoy

The dimension of buoy body is as follows:



	Type I	Type II
Diameter of Buoy Body H (m)	2.1	2.4
Total Weight (ton)	3.6	4.6
Total Buoyancy (ton)	8.3	9.0
Focal Plate Height (m) F	3.2	3.9
Allowable Current Velocity (knot)	3	4
Installable Water Depth (m)	3∿	3∿
Main Material	Steel(JIS SS41)	

• Mooring system



• Light

Battery ; 12V, 1.15A

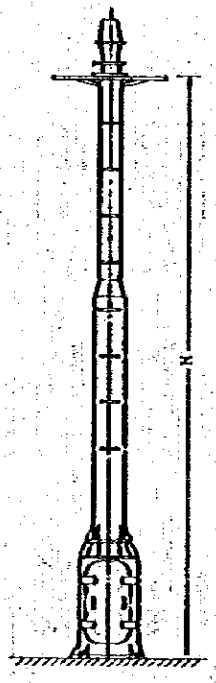
Flash interval ; 1F/4 seconds

Effective range ; Green 6.5 miles
Red 5.7 miles

ii) Beacon light

• Body

The dimension of Beacon body is as follows:



Height Over All(H:cm)	5,000
Weight (Body only) kg	390
Main Material	Rolled Steel for General Structure (JIS SS41) or Anti-corrosive Aluminum (JIS A5052)
Installation Method	By anchor bolt

• Light

Power source ; A.C. or D.C.

Flash interval ; 1F/2 seconds

6.8.3 Construction Plan

(a) Execution of Work

1) Reclaimed revetment

Preparation of the rubble-mound precedes the reclaimed revetment. The depth of the water is shallow at the rubble-mound on both sides of the stepped face revetment work and the subsurface becomes dried up at low tide, this allowing spreading work from the shore. The rubble-mound with the front cellular block shall be thrown down from small floating crane, or barge mounted with crawler crane (lifting capacity: approx. 5t), a tug boat, etc. on the sea.

Cellular blocks are transported from the manufacturing yard on the land and carried by barge (50t), then installed by 15t floating crane. Divers are necessary for installation of the cellular block and the levelling of the mound.

2) Dredging and reclamation

The volume of sediment in dredging and reclamation is only approx. 150,000m^3. Thus, dredging is carried out by non-propelled 3m^3 grab dredger. Sediment is transported by two non-propelled barges (capacity: 120m^3) and one tug boat. Reclamation is carried out by crawler crane with bucket and levelled by bulldozer.

3) Pile foundation

Concrete and steel pipe piles are transported by 50t barge and tug boat, and driven by pile-driving boat (ram weight: 1,200 to 2,200kg). The standard daily progress of work depends on the soil condition and approx. 6 piles/day. A diver's boat is necessary for pile-driving.

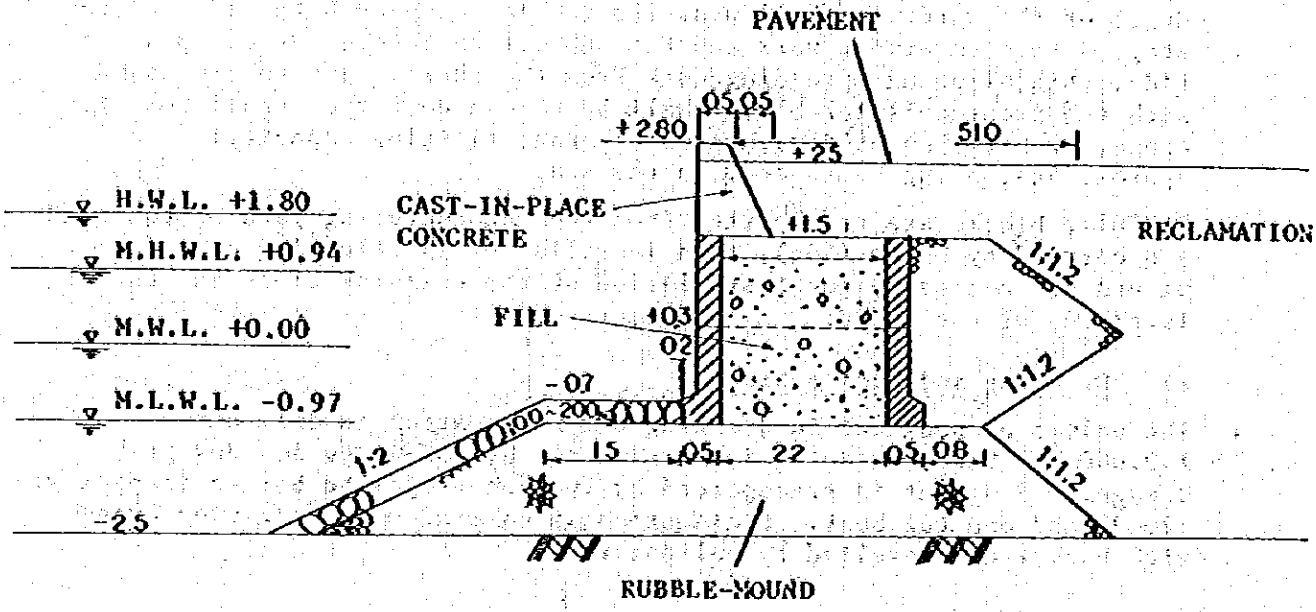
(b) Construction Schedule

The schedule of work is shown in Table 6.8.4. The order of progress is revetment work, dredging/reclamation and pier work. Pier work at Ko Lan can be executed simultaneously with revetment and dredging/reclamation work at Pattaya.

6.8.4 Construction Cost

The construction cost is shown in Table 6.8.5. Refer to Appendix for the detailed bases of the calculation.

(A) CELLULAR BLOCK REVETMENT S=1/100



(B) STEPPED FACE REVETMENT S=1/100

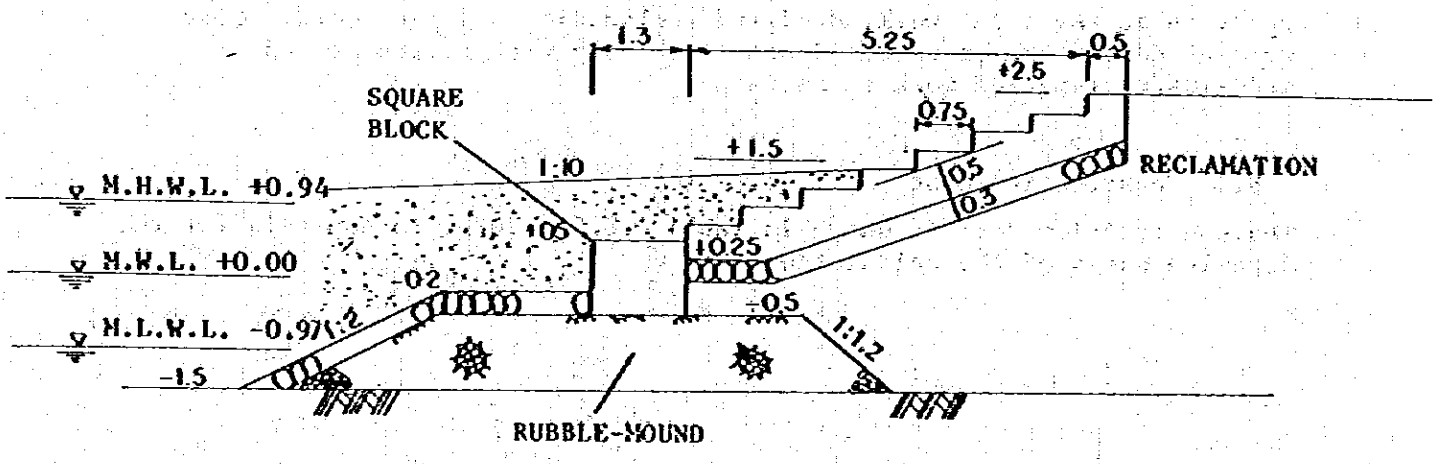
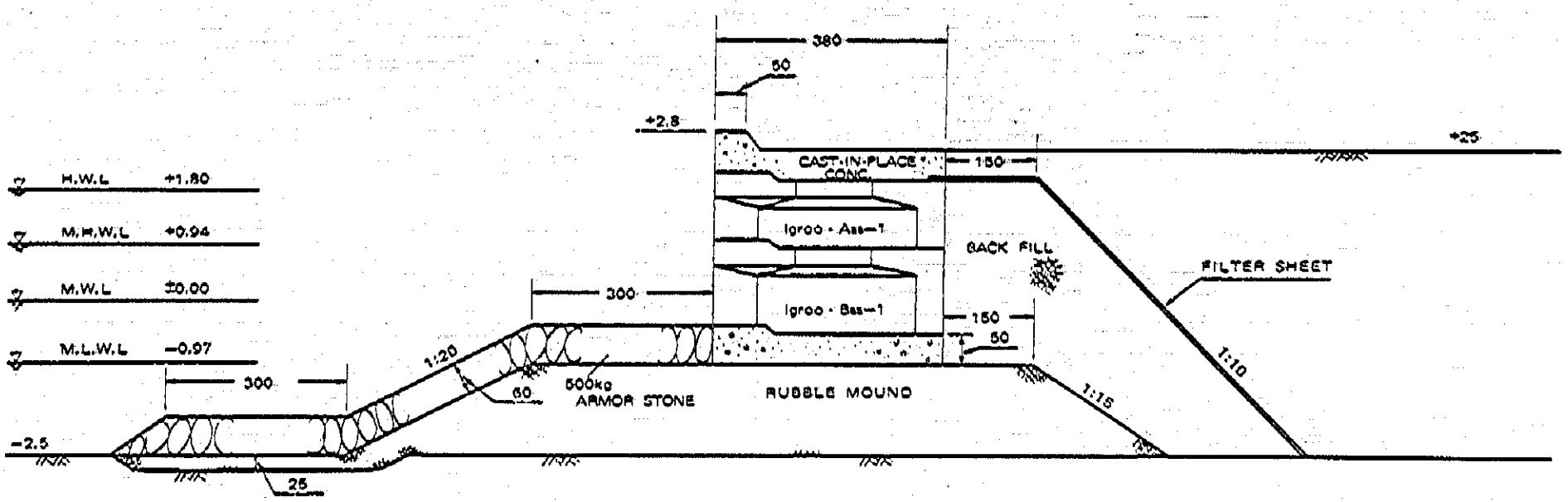


Fig. 6.8.1 Standard Cross Sections of Reclaimed Revetment

(C) Igloo Wave Absorber type Revetment (Alternative)



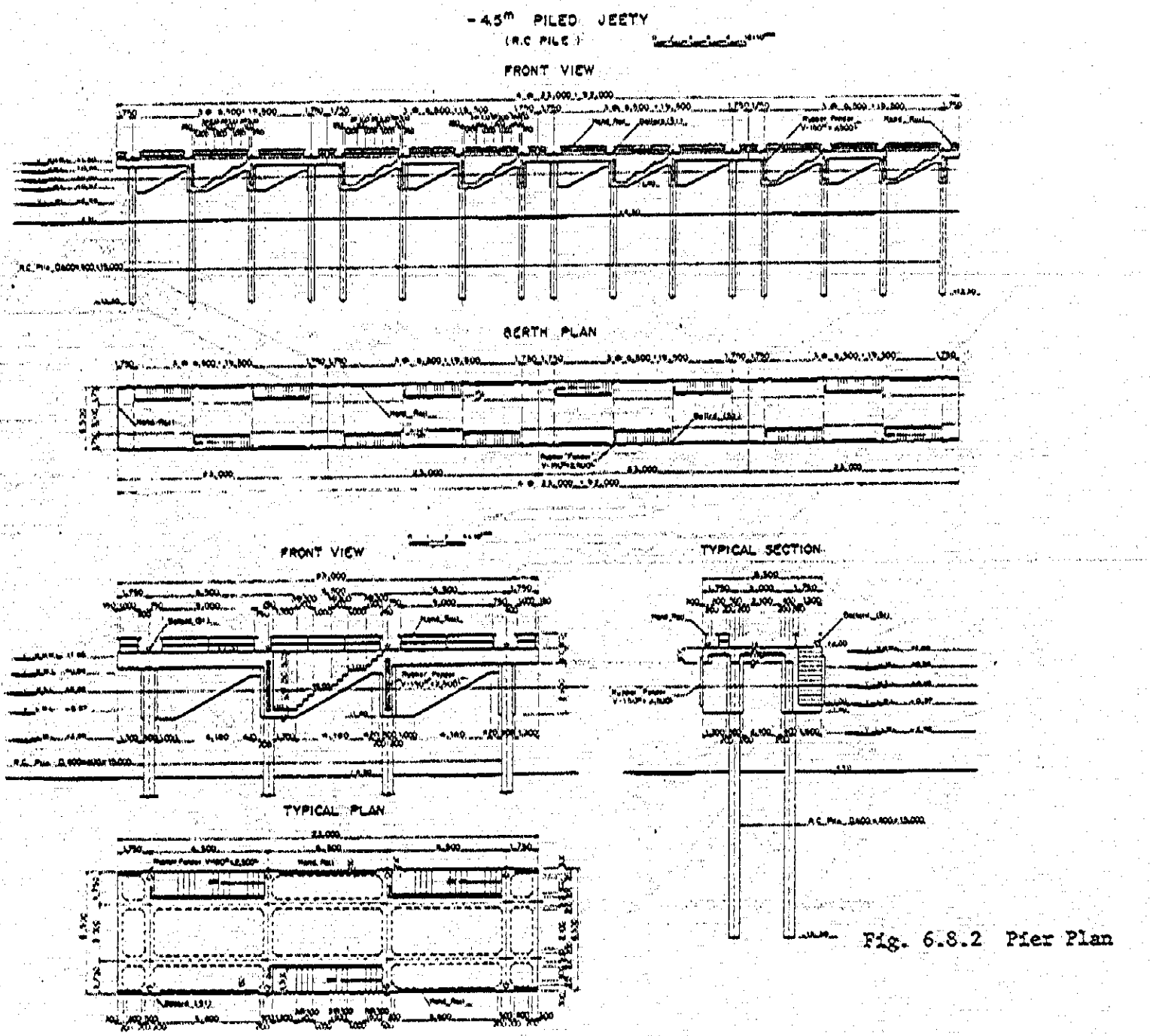
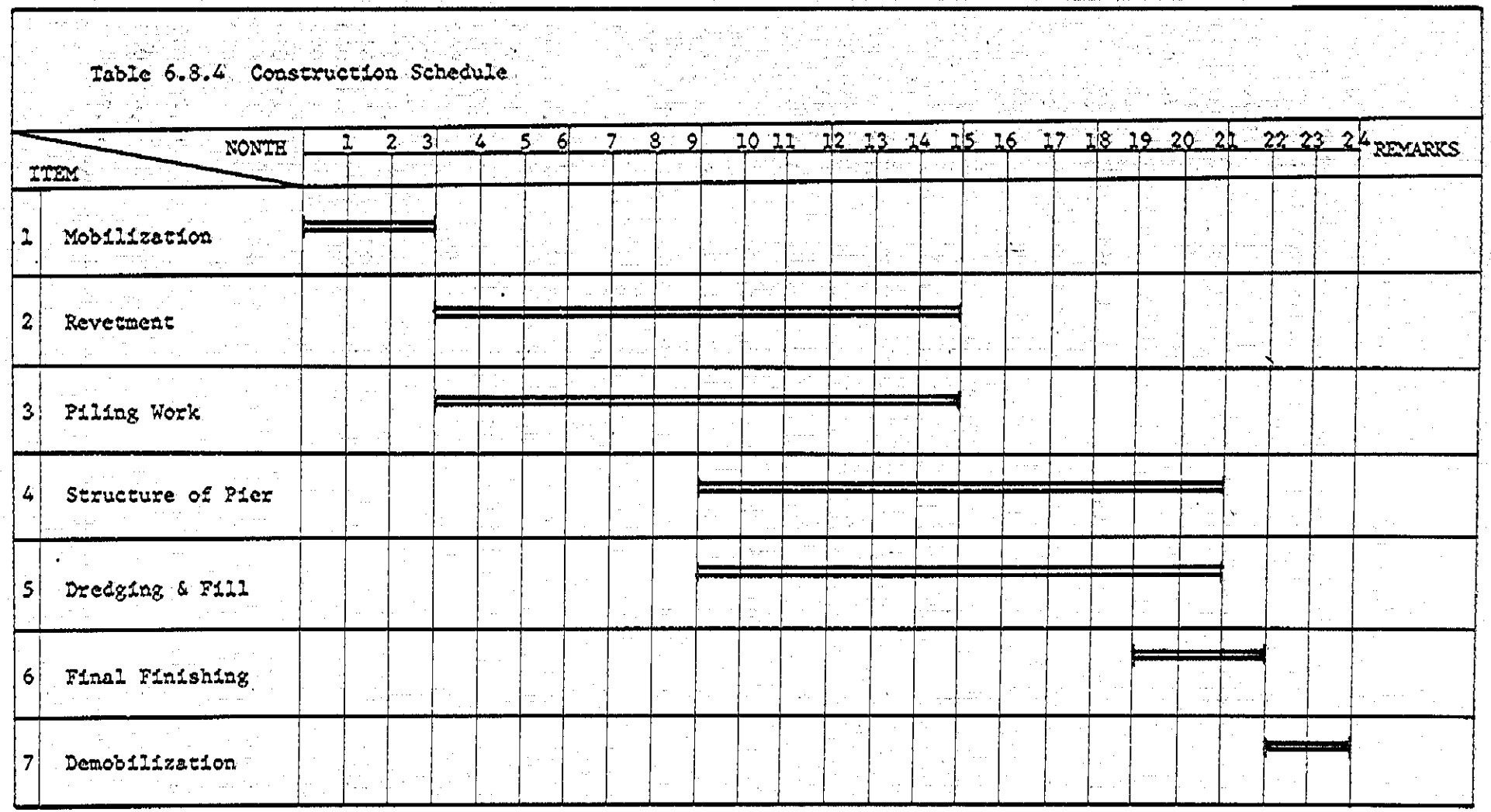


Fig. 6.8.2 Pier Plan

Table 6.8.4 Construction Schedule



(Including Ko Lan Pier)

Table 6.8.5 Cost Estimation

Pattaya

Description	Quantity	Unit	Unit Cost (฿)	Cost (฿)
1. Pier				11,781,092
R.C. Piling	168	PCS	14,127.5	2,373,420
R.C. Beam & Slab				9,125,672
Tax				282,000
2. Revetment (1)				5,290,220
Revetment	290	m	17,818	5,167,220
Tax				123,000
3. Revetment (2)				2,338,140
Revetment	260	m	8,789	2,285,140
Tax				53,000
4. Artificial Beach				622,000
Artificial Beach	6,400	m^3	95	608,000
Tax				14,000
5. Dredging				4,897,000
Dredging	148,000	m^3	30	4,440,000
Tax				457,000
6. Land Reclamation				7,733,000
Land Reclamation	148,000	m^3	50	7,400,000
Tax				333,000
7. Navigation Aids				1,845,000
Navigation Aids				1,644,000
Tax				201,000
8. Administration Office				3,008,512
Administration Office	872	m^2	3,371	2,939,510
Tax				69,000
9. Park				770,840
Park	12,564	m^2	60	753,840
Tax				17,000
10. Road & Illumination				1,435,840
Road	6,220	m^2	72	447,840
Illumination	1.2	km	715,000	858,000
Tax				130,000
11. Launching Ramp				185,640
Launching Ramp	2	PCS	90,820	181,640
Tax				4,000
Total Construction Cost				38,225,000
Tax				1,683,000
Total				39,908,000

Cost Estimation

Ko Lan

Description	Quantity	Unit	Unit Cost (฿)	Cost (฿)
1. East Pier				3,735,050
East Pier	150	m	24,307	3,646,050
Tax				89,000
2. North Pier				6,225,750
North Pier	250	m	24,307	6,076,750
Tax				149,000
3. West Pier				3,735,050
West Pier	150	m	24,307	3,646,050
Tax				89,000
Total Construction Cost				13,369,000
Tax				327,000
Total				13,696,000