5-2-6 Soil analysis and type of foundation

(1) Outline

The soil analysis is made to establish soil condition of this project site. Then the foundation structure type is examined for the major facilities such as landing pier, building, road and parking area. Soil condition of this project site is briefly as follows.

1) Very soft to soft silty CLAY layer with its thickness of 16 m from the existing ground surface (about + 1.50 ~ + 2.50) is distributed.
2) Under soft layer, stiff CLAY layer follows.

In accordance with result of this study, it is possible to construct fishing port facilities to employ pile foundation. However, piles are not used for road and parking area because of high cost. The soil conditions (cohension C of soft layer, thickness of soft layer) of this planned fishing port is similar to that of existing fishing ports such as Songkhla and Samut Prakarn.

Construction experiences of existing similar facilities in Thailand and soil analysis results lead us to a conclusion that there is no basic problem what so ever to construct this fishing port.

(2) Geotechnical investigation report and data

Soil design parameters (C, γ), thickness of soft layer elevation of supporting layer for pile which are required for designing of structure foundation, are established according to the following report and reference.

1) Nakornsrithamarat Fishing Port Project Report on Subsurface Investigation. (BY FMO January 1985)
2) Subsoil Investigation Report for Pakpanang Fishing Port (BY FMO April 1987)
3) Site Investigation Report for B.D Study. (BY JICA May 1987)

(3) Establishing soil condition along face line of landing pier

Based upon the results of the above reports, soil condition to be used for pier designing has been established as follows.

The first layer :

Very soft to soft silty CLAY layer

By the correlation chart between unconfined compression test (qu) and ground depth shown on Figure 5-13, design cohension (C) is decided as :

$C = 0.5 + 0.15\ Z(t/m^2)$

Here, Z is the depth (m) from EL ± 0.0.

The second and third layer :

Stiff to very stiff CLAY layer. As shown on Figure 5-14, using average N value, design cohension (C) is caluculated by the following Peck's formula.

$$C = \frac{\overline{N}}{1.2} \quad (t/m^2)$$

Boring logs along the face line of pier are shown on Figure 5-15, which indicate that thickness and plane distribtion of soil layer at this project site is relatively uniformal. So, soil condition for building foundation and others is the same with the above condition.

(4) Structure foundation type

1) Landing facilities

As structural types of landing facility, the followings are most commonly used; gravity type (caisson, L-shapped block etc.), sheet pile type and deck on pile type.

The structural type for this fishing port is decided as the pier type (concrete deck on piles) for the following reasons.

① Since soft layer thickness is as deep as 16 m from the ground surface, gravity type and sheet pile type require soil improvement on a large scale, it will wastefully, boost construction cost.

② In case of gravity type and sheet pile type (upright quaywall type) structures are made upto face line of quaywall. Therefore, water flow of the river and siltation will be expected to have adversary effect when face line of quaywall locating front side (Pak Panang river side) as the case of this fishing port.

③ In case of gravity type and sheet pile type, consolidation settlement will happen. It makes maintenance difficult due to the load generated from dead load of structures.

Figure 5-13 Unconfined Compression Strength (qu)-Ground Depth Curve

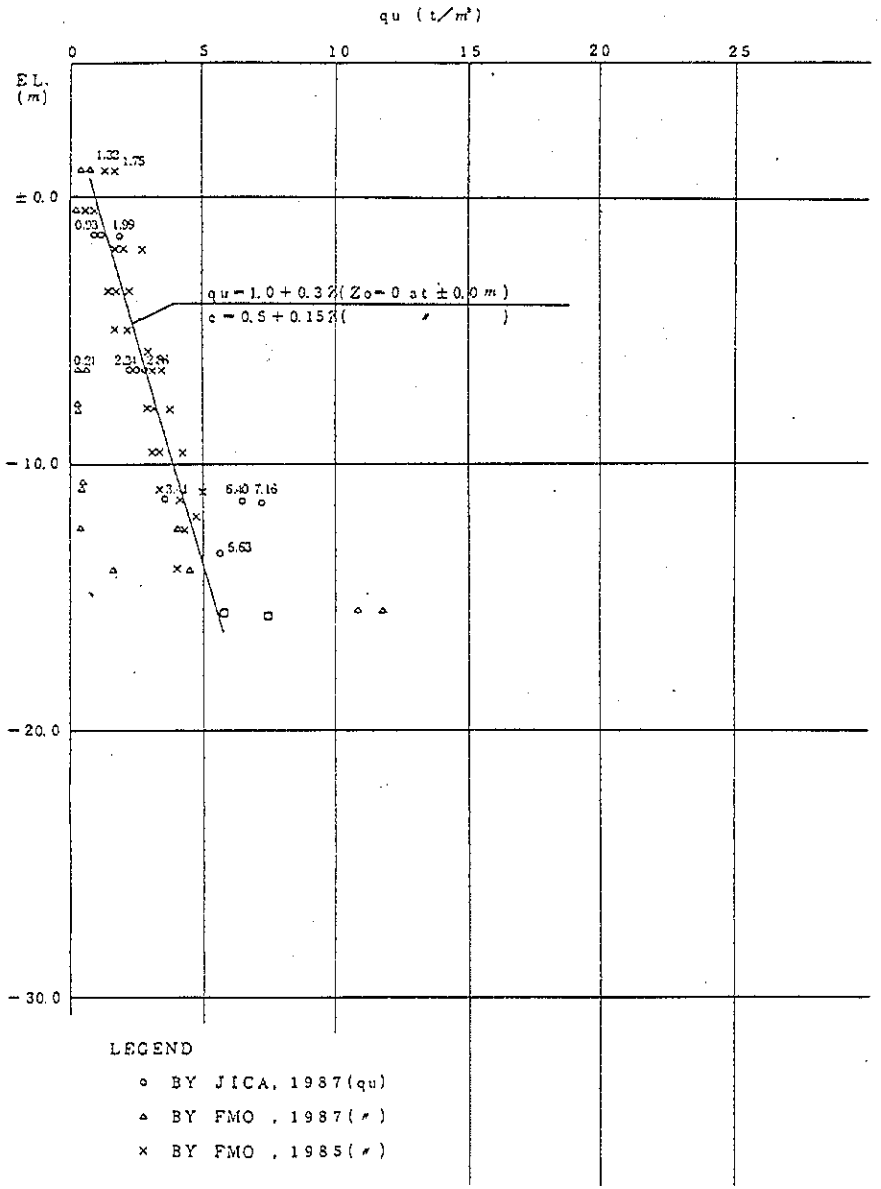


Figure 5-14 Design Soil Parameters along Landing Pier

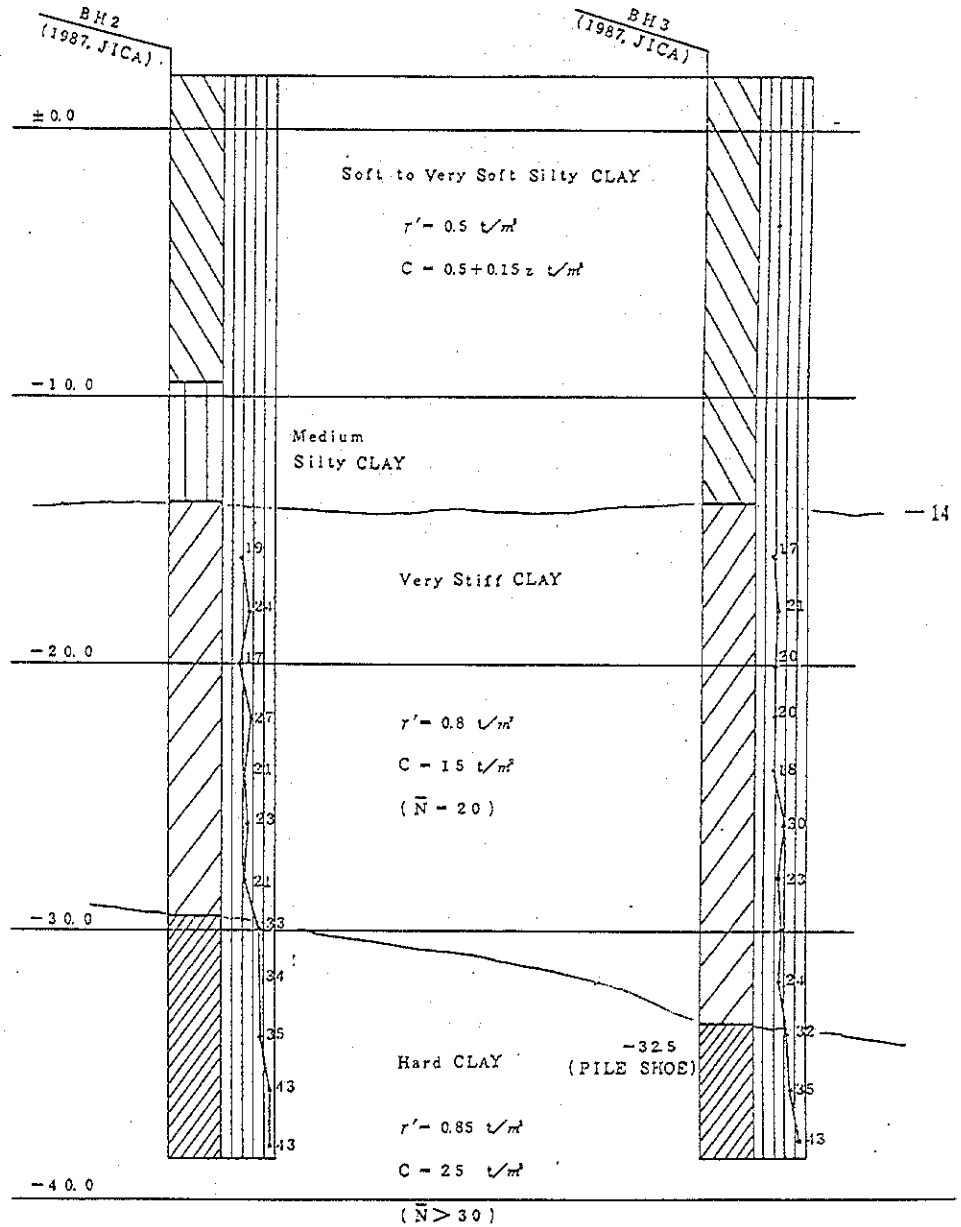
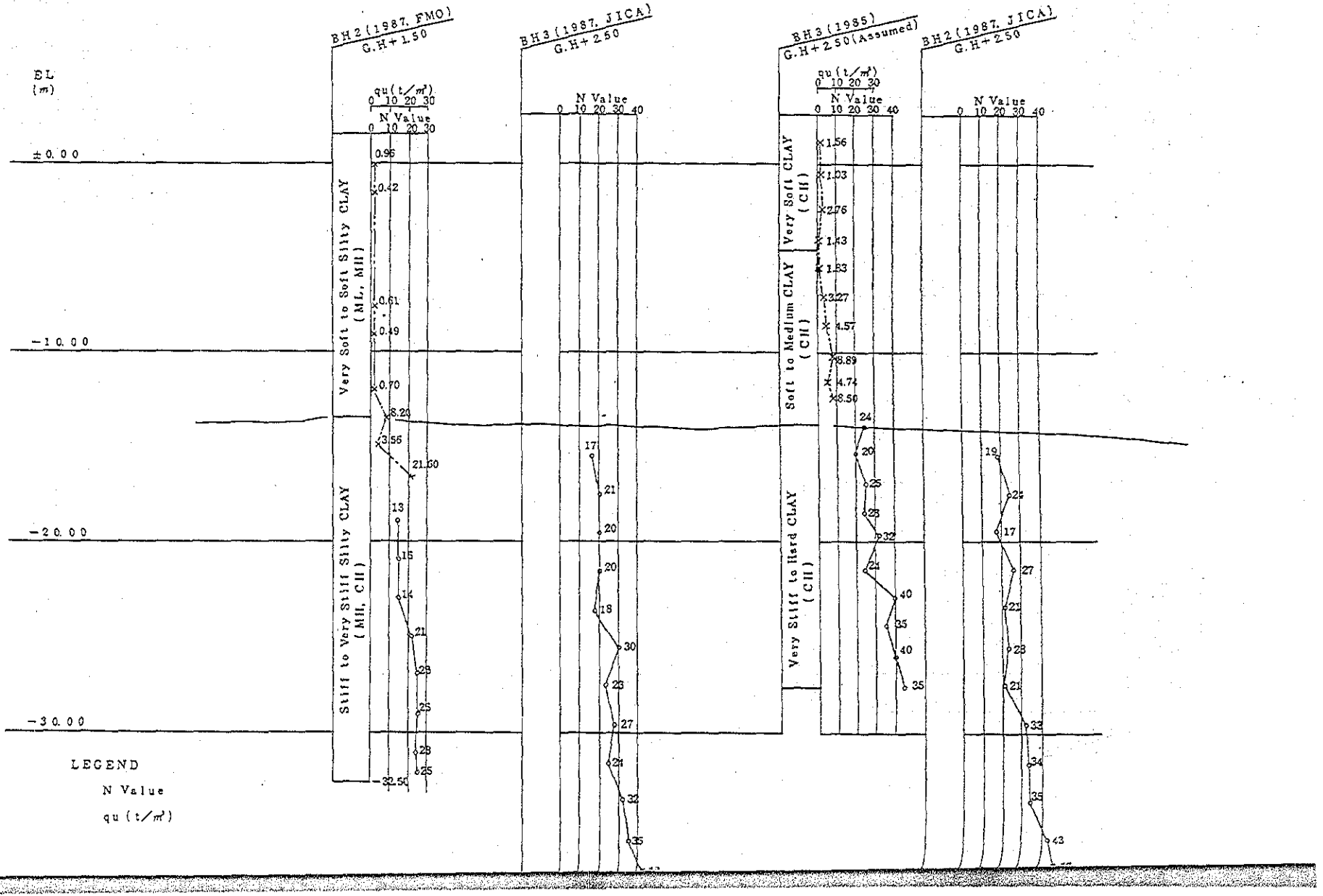


Figure 5-15 Boring Logs along Landing Pier

Scale H=1:2000 V=1:200



④ In case of pier type advanteges are;
- By means of foundation pile , load is conveyed to supporting layer. Stracturally, it is most stable.
- There is no need of improving ground on large scale. It saves construction period. So, the most economical structural type.
- This type has been most commonly used for construction of fishing ports and harbors in Thailand with a lot of satisfactory results.

In addition, comparative design of retaing structural types behind landing pier is made as detailed in section 5-1-2(1) of this Chapter.

2) Building

After reclamation work, building work is expected to start after 1.5 years of consolidation period.
Residual settlement is expected to continue for a long time , so all the structures will be supported by pile foundations.
Piles shall be treated with friction cutter by making pile diameter bigger or by coating paint to resist nagative friction.
Junction point between water conduit and sewage installed underground shall be flexible in structure to resist settlement of ground.

3) Road and parking area

Cross section of pavement of road and parking area shall be resistant against settlement of soft layer applying concrete block pavement with 0.8 m (long) ×0.8 m (wide) × 0.25 m (thick) blocks.
The reasons applying concrete block pavement are as follows.

① Structurally durable against long-term consolidation settlement of soft layer.
② Easy maintenance and repair by supplying additional base material (crushed stone) against unequal settlement.
③ Compared with asphalt pavement, longer service life and cheaper repair cost.
④ Even partial damage takes place, repairing is easy to carry out since material (concrete) is always available at site.
⑤ When long-term consoldation settlement is finalized, raising of pavement is easy to do by supplying base material to lift concrete blocks.

For further description of each detailed structure design, refer to section 5-5 Basic Design of Civil Facilities and sequent sections in this Chapter.

5-2-7 Plan of reclamation work

(1) Summary

Land reclamation work will be executed by FMO to provide a space for the fishing port facility.

The construction of access bridge with provincial road and the temporary road within site are ordered already and their construction work have commenced since this May. The construction of the access bridge was commenced this July. Then the land reclamation work will be progressed from coming July.

Designing and planning of reclamation is under way by FMO at present. However, there was no submission of planning or reference documents on method of reclamation work, location of sand borrow pit and transportation method of material.

There is soft layer up to 16m deep from the ground surface, so consotlidation settlement will happen with reclamation work. In this section, the following study has been made.

1) Study on method of reclamation work.
2) Eestimation of consolidation settlement. (Refer to Attachment 5-1)

Based on this study results detailed here-in-after, crown height is determined at +5.00 at the time of the execution of reclamation work by FMO.

(2) Method of reclamation work

Planning, designing and construction of land reclamation will be executed by FMO.

Here, preliminary study for reference to FMO is done.

1) Area of reclamation work

Land reclamation work is divided into two areas.

Area A: To be reclaimed by the end of 1987 as a space for fishing port facility.

Area B: To be reclaimed by the end of 1988 to use as material stockyard and manufacturing workshop during the construction period.

The location of temporary dike behind landing pier is examined by the slope stability based on the dredged ground condition for sand replacement. (Refer to Figure 5-16)

2) Crown height of reclaimed land

It is decided by the following procedure.

① Setting up the design crown height at the time of execution of consruction of road and parking area at the point of almost in the center of fishing port→ set up +5.00.

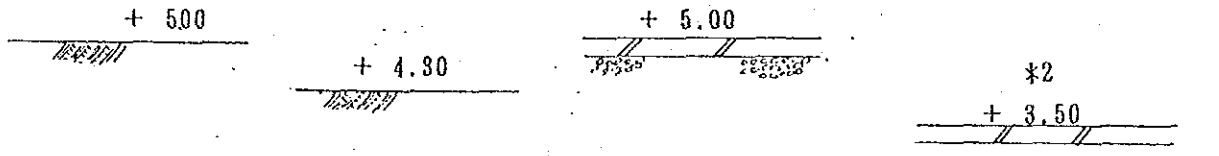
② Calculation of consolidation settlement for the 1.5 *1 years of consolidation period. → 0.7m (Refer to Attachment 5-1)

Note:*1 From the completion of reclamation work to the commencement of construction of road and parking area.

③ Designing of cross section of road and parking area → estimating pavement thickness approximately 0.7m.

④ Calculation of residual settlement after the completion of construction of pavement for road and parking area. → 1.44m (Refer to Attachment 5-1)

Illustrations below show the time series change of reclaimed crown height and pavement crown height.



Note:*2 Highest H.W.L at Nakhon Si Thamarrat port is +3.74m, therefore, in this case, water will flood in. But by raising concrete block pavement , it can be prevented.

3) Method of reclamation

Reclamation materials of sand will be dredged from borrow pit locating sea area, then transported to the to-be-reclaimed land area by dump truck through the temporary road.

Prior to spread reclamation sand, temporary dike might be constructed around the project site.

The crown height of such dike will be +3.50 and above to prevent flowoing out of sand during reclamation work.

Cross section of slope stability of temporary dike for reclamation work is designed as shown on Figure 5-17.

Figure 5-16 Slope Stability of Dike behind Landing Pier

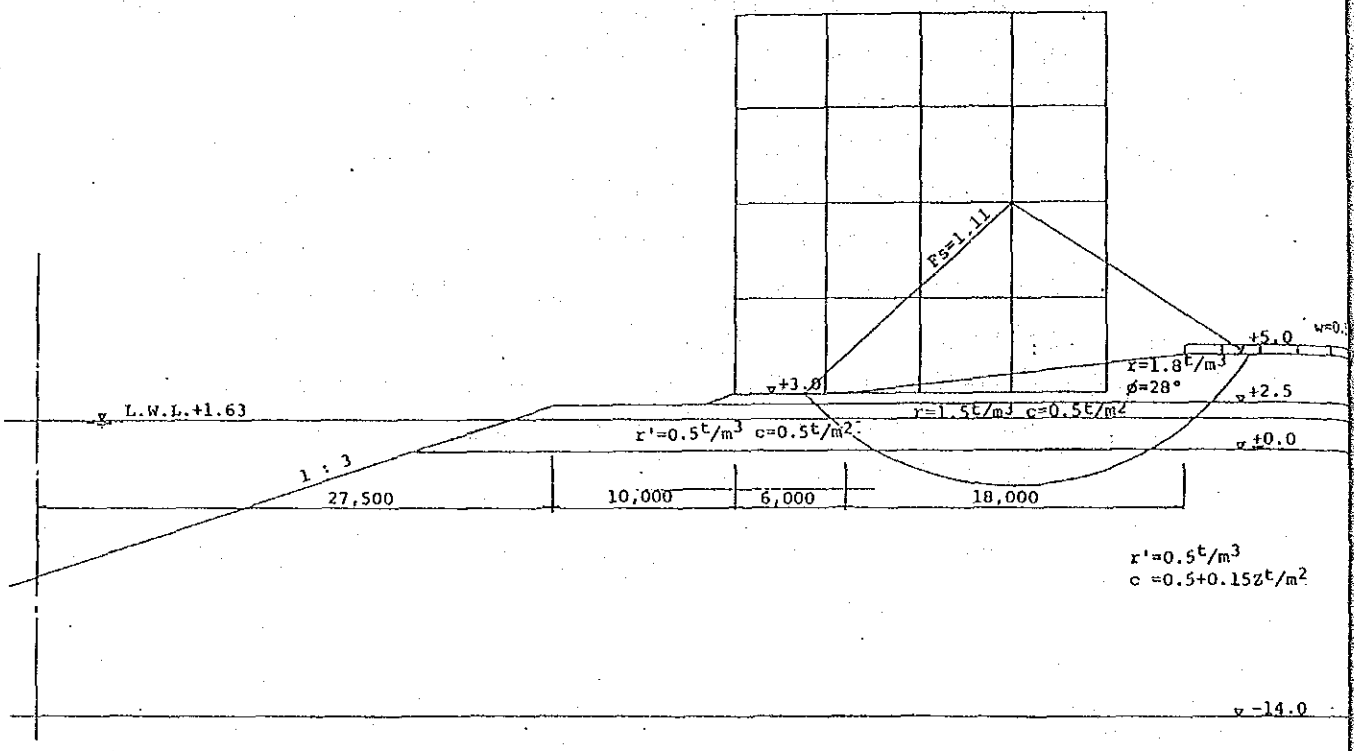
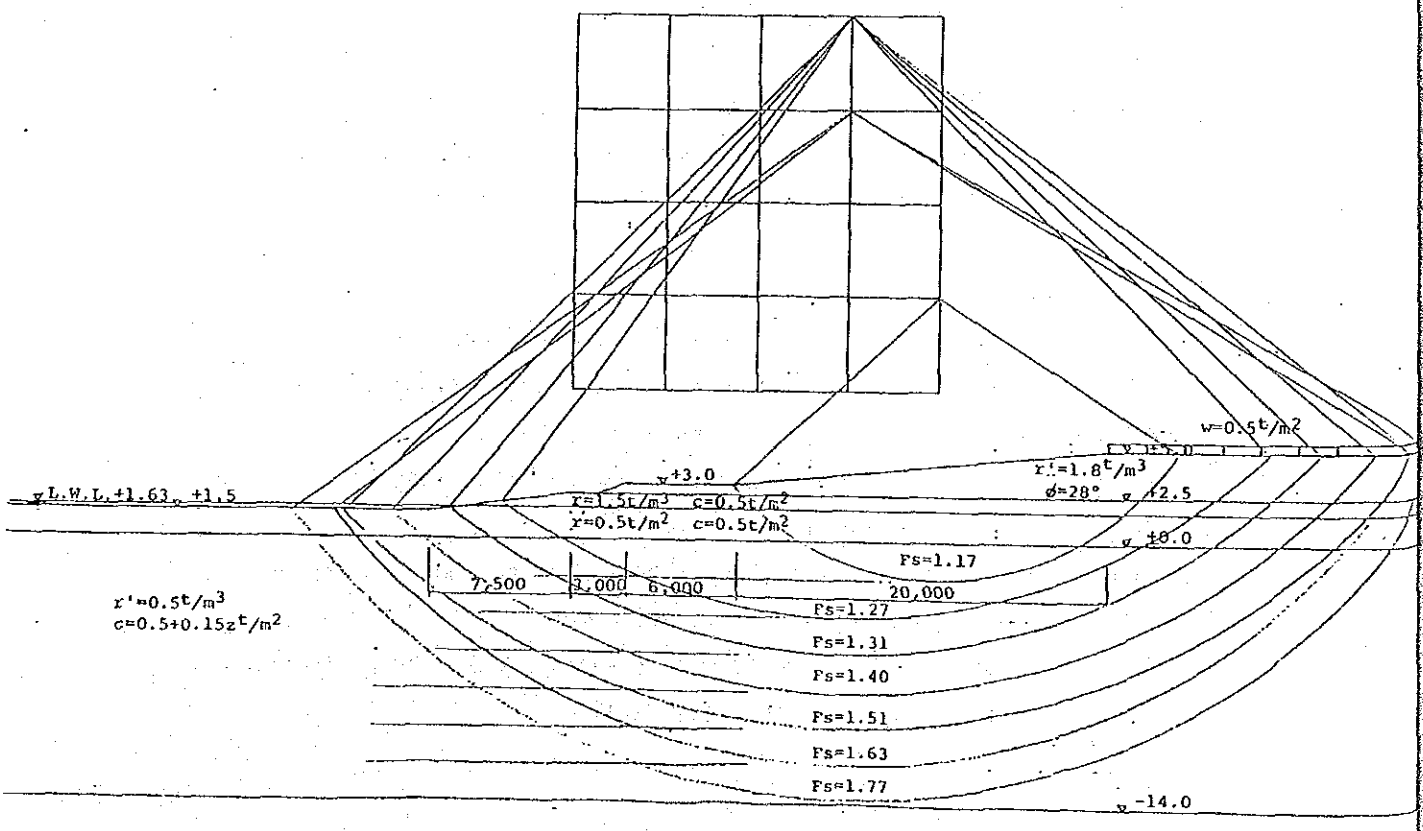


Figure 5-17 Slope Stability of Temparary Dike



The sequence of reclamation work is as follows.

① Separater temporary road *3 will be constructed prior to land reclamation work.

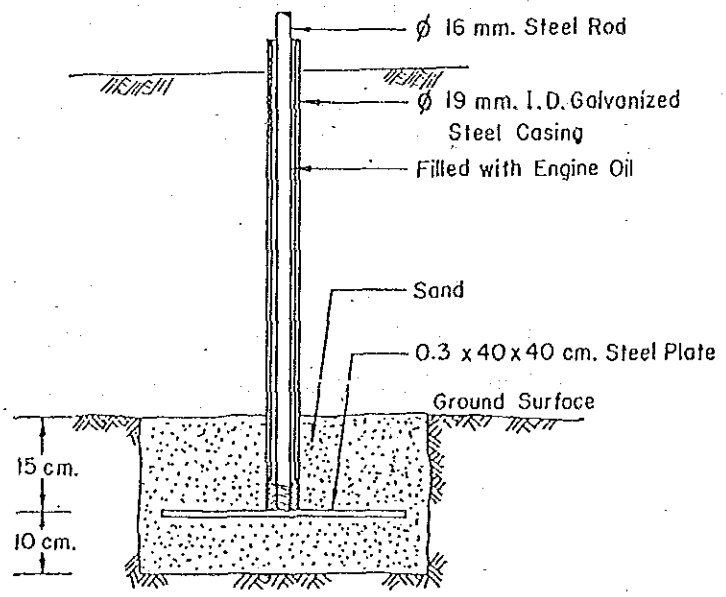
② After completion of access bridge, reclamation materials of sand are transported to the to-be-reclaimed land area by dump truck and grading the ground surface by bulldozer.

③ Spreading reclamation sand from each separater temporary road to each divided reclamation area.
Special attention shall be paid to spread sand on very soft ground.

Note *3 : Very soft soil of ground surface layer of approx 2m is expected to have forcible side flow by reclaimed sand and flow out toward spreading direction of reclaimed sand.
For this reason the to-be reclamed land area will be divided by separater temporary roads into blocks. So, soft soil can be collected and taken out separatly one by one.

4) Observation of settlement
Installing steel plate on the surface of existing ground, then settlement observation will be carried out to understand relationship betwteen consolidation settlement and time after reclamation work is completed.
The result of this observation might be used to estimate residual settlement afterwards.

Figure 5-18 Settlement Measuring Plate



5-3 Determination of Scope

5-3-1 Determination of Fishing Port Size

(1) Design policy

Thailand's fish catch has been stagnating at a level of around 2 million tons per year since 1977. This can be attributed to overfishing in the Gulf of Thailand, which has seen production decline steadily while the fish catch in the southern parts of the Gulf and in the international waters off Malaysia and Indonesia have been increasing. These trends are expected to become even more accentuated.

The present fishing ports of Songkhla and Pattani, in southern Thailand, have become congested as a result of increased activities, and other ports of the region may not be able to cope with a larger number of fishing boats in the future. To remedy this problem, the creation of a new fishing port has been considered.

The main objective behind the construction of the Project port is not to deal with increased fish landings. Rather, the mitigation of the congestion which affects the ports of Songkhla and Pattani and the desire to accelerate the economic development of Nakhon Si Thammarat Province through the return of fishing boats are the guiding principles. The need to avoid overcapacity, however, is such that an expansion of the facilities of this Project port will only be considered if this becomes necessary. Such a possibility is nevertheless considered in the layout of the planned facilities.

(2) Prospective number of boats utilizing the project port

1) Criteria

A. Those boats allowed to use the new port shall be boats belonging to Pak Phanang and of a length of over 14 m. The current number of fishing boats belonging to Pak Phanang is indicated in Attachment 3-1.

a) Reasons for excluding boats of a length of less than 14m:

- The owners of fishing boats under 14 m in length do not have relations with fish agents, so that they will continue to land fish at Pak Phanang's existing landing site after the opening of the Project port.

- The number of trawlers and push netters which operate illegally within 3 km of the coast may be declining due to tighter police control in 1986.

- The height of the landing pier is dictated by tidal levels during the rainy season, and this will preclude small boats from using it.

b) Reasons for limiting access by Pak Phanang fishing boats:

- Fishing boats from various small ports in Nakhon Si Thammarat Province excepting those from Pak Phanang, have strong connections with local fish agents, and they would continue such relationships even after completion of the project port.

- Purse-seiners whose home ports are mainly in eastern Thailand are operating off Pattani and landing fish there. Given the distance separating Pattani from the Project port, it seems unlikely that they will use the latter.

- Trawlers whose home ports are located in the inner parts of the Gulf do not currently land fish in either Songkhla or Pattani, so that they are unlikely to use the Project port.

B. According to an FMO survey of 14 m plus fishing boats, 100% of Pak Phanang boat owners currently landing their catch in Pak Phanang intend to use the Project port upon completion. 90% of Pak Phanang boat owners currently landing fish at

Songkhla, Pattani or at other ports declared the same intention.

- The FMO is encouraging fish agents having contacts with Pak Phanang fishing boats to set up businesses in the Project port. Up to now, 14 from Pak Phanang, 4 from Songkhla, 1 from Pattani and 1 from Bangkok have been contacted.

- The 14 local fish agents in Pak Phanang intend to move to the Project port.

- The existing fishmeal plants in Pak Phanang are expecting increased landings in raw materials and they do not foresee problems with regards to handling.

- Cold storages in Pak Phanang have no relationship with Pak Phanang fishermen and they obtain all their fish raw materials from other sources.

C. The number of Pak Phanang fishing boats will not change much in the future, according to an estimate of new boats built over the last 6 years and the number of disused boats.

2) Estimate of the number of boats per day that will use the Project port

A. Operational efficiency of fishing boats:

Regardless of size or type of fishing boat, the number of months of operations of Pak Phanang boats is 9 to 10 months. Two to three months are used for annual maintenance and repair work. It is in addition necessary to effect major repairs once every 10 or 15 years and these repairs last for approximately 6 months. Annual operational efficiency can thus be calculated at 0.75.

B. Operational cycle of fishing boats:

The fishing grounds of Pak Phanang boats are mainly situated

in the southwestern water region of the Gulf of Thailand. The operational cycle of fishing boats is assumed to be as following, according to data on these waters (DOF, 1984).

Type of boat	Average No. of fishing days/trip	Running time (days)	Days of rest	Total No. of days/ cycle	No. of cycles/ month
Otter trawler					
14-18 m	10	2	3	15	2.0
18-25 m	15	2	3	20	1.5
Pair trawler					
14-18 m	14	2	3	19	1.6
18-25 m	14	2	3	19	1.6
King mackerel gill netter	8	2	3	13	2.3

The operational cycle of Pak Phanang fishing boats of over 14 m in length is regular, regardless of season.

C. Number of boats entering per day

Type of boat	No. of Fishing boats	No. of boats(*) to use Project port	Annual operational efficienty	Average No. of cycles/ month	No. of operational days of port/month	No. of boats entering per day
Otter trawler						
14-18 m	173	165	0.75	2.0	30	8
18-25 m	368	351	0.75	1.5	30	13
Pair trawler						
14-18 m	32	30	0.75	1.6	30	2
18-25 m	22	21	0.75	1.6	30	(1 pair/day)
King mackerel gill netter						
14-18 m	1	1	0.75	2.3	30	0.3
18-25 m	1	4				(1 boat/3 days)

(*) The number of boats to use the new Project port is calculated according to the following formula:

(total number of boats) x [((proportion of Pak Phanang boats currently using Pak Phanang as a landing site, 53%) x (rate of return 100 %) + ((proportion of Pak Phanang boats currently using other landing sites, 47 %) x (rate of return 90 %))]

(3) Expected fish landings

1) Criteria

As data is unavailable, fish landings for 1986 at the project port are estimated by using the number of cycles, fish catch per trip and operational efficiency of Pak Phanang boats.

2) Estimated fish landings

A. Catch per trip:

The fishing grounds of Pak Phanang fishing boats are located in the southwestern water region of the Gulf of Thailand. Based on fish catch data by type of fishing in this region (DOF, 1984), catch per trip is as follows:

Type of boat	Other trawler		Pair trawler		Mackerel gill netter
Boat length	14-18m	18-25m	14-18m	18-25m	Over 14m
Catch per trip (ton/boat)	9	19	9	13	7

B. Estimated fish landings:

Average monthly and daily fish landings by type of boat are estimated as follows:

Type of boat	No. of boats to use port	Operational efficiency	Average No. of cycles /month	Catch /trip /boat (ton)	Average monthly landings (ton)	Average daily landings (ton/day)
Otter trawler						
14-18m	165	0.75	2.0	9	2,228	74.3
18-25m	351	0.75	1.5	19	7,503	250.1
Pair trawler						
14-18m	30	0.75	1.6	9	324	10.8
18-25m	21	0.75	1.6	13	328	10.9
King mackerel gill netter						
14-18m	1	0.75	2.3	7	12	0.4
18-25m	4	0.75	2.3	7	48	1.6
Total	572				10,443	348.10

Monthly fish volume fluctuations are considered to be equal to those of Songkhla fishing port, where most fishing boats are trawlers. Average fish landings in peak month are therefore equal to 1.4 times average monthly landings. Daily fish landing fluctuations are in the same proportion, since the daily entrance number of fishing boats is assumed not to change.

Consequently, annual fish landings at the Project port are estimated at 125,000 tons. Average daily landings will approximate 350 tons while those during peak month are estimated at 490 tons.

3) Estimated fish landings by species

A. Estimated catch rate of trash fish

Based on fish catch data by species in the southwestern water region of the Gulf of Thailand (DOF, 1984), the catch rate of trash fish at the Project port is estimated as follows:

(unit: ton/year)

Type of boat	Annual fish landings	Breakdown based on data		Breakdown of estimate	
		Trash	Consum-able	Trash	Consum-able
Otter trawler					
14-18m	26,736	14,785	11,951	15,451	11,285
18-25m	90,036	51,771	38,265	54,105	35,931
Pair trawler					
14-18m	3,888	2,652	1,236	2,772	1,116
18-25m	3,936	2,739	1,197	2,862	1,074
King mackerel gill netter	720	-	720	-	720
Total	125,316 (100%)	71,947 (57%)	53,369 (43%)	75,190 (60%)	50,126 (40%)

Throughout the country, 70% of fish catch from otter board trawlers and pair trawlers consists of trash fish. Pak Phanang fishing boats mostly operate in the southwestern water region of the Gulf of Thailand but some operate in other regions. It is therefore thought that the trash fish rate is 60% of total fish landing at the Project port.

B. Estimated composition of consumable fish

Based on fish catch data by species in the southwestern water region of the Gulf of Thailand (DOF, 1984), the catch composition of fishes by species and type of boat is estimated as follows:

(unit: ton/year)

Type of boat	Annual consumable fish landings	Pelagic fish	Demersal fish	Other fish	Shrimp	Crab	Squid/ cuttle fish
Otter trawler							
14-18m	11,285	2,361	11,804	7,555	9,443	944	1,509
18-25m	35,931	(5%)	(25%)	(16%)	(20%)	(2%)	(32%)
Pair trawler							
14-18m	1,116	131	416	263	22	44	1,314
18-25m	1,074	(6%)	(19%)	(12%)	(1%)	(2%)	(60%)
King mackerel gill netter	720	655 (91%)	43 (6%)	22 (3%)	-	-	-
Total	50,126	3,147	12,263	7,840	9,465	988	16,423
(Proportion)	(100%)	(6%)	(24%)	(16%)	(19%)	(2%)	(33%)

Annual fish landing by species at the Project port is summarized as follows:

Total fish landing 125,000 tons

(Breakdown)

- Consumable fish 50,000 tons
  - Pelagic fish 3,000 tons
  - Demersal fish 12,000 tons
  - Other fish 8,000 tons
    (almost all is demersal fish)
  - Shrimp 9,500 tons
  - Crab 1,000 tons
  - Squid and Cuttle fish 16,500 tons
- Trash fish 75,000 tons

(4) Prospective fish distribution system by species

Data given under section 3-1-2, "Fish Marketing" and the data given in section 5-3-1 (3) "Expected Fish Landings", enable one to draw a prospective picture of the fish distribution system of the Project port.

1) Trash fish distribution system

A. Distribution channels:

The expected fish landings of trash fish (75,000 tons) can be broken down as follows:

Present landings at Pak Phanang	42,000 tons (69,700 tons x 60%*1)
Landings by Pak Phanang boats currently using Songkhla Port	32,000 tons (59,100 tons x 90%*2 x 60%*1)
Landings by Pak Phanang boats currently using other ports	1,000 tons (2,600 tons x 90%*2 x 60%*1)

*1/ Ratio of trash fish in catch
*2/ Rate of return of Pak Phanang boats

The 7 fishmeal plants of Pak Phanang have the maximum annual handling capacity of 198,000 tons of raw materials (Nakhon Si Thammarat Industrial Office, 1986), so that there should be no problem with regards to the handling of the expected trash fish volume.

All trash fish will be sold directly to the fishmeal plants by the boat owners and transported there by trucks provided by the fishmeal plants.

B. Impact on Songkhla port

The opening of the Project port will occasion the return of 90% of Pak Phanang boat currently using Songkhla port's landing facilities. This means that about 32,000 tons of trash fish will not be landed in Songkhla port. This represents 22% of total trash fish used in Songkhla Province (143,162 tons in 1985). The average price of trash fish in

Songkhla Province (1.51 Baht/kg) is the lowest in the country, so that, even though the drop in supply will cause an increase in price, this will bring the latter closer to national levels.

On the other hand, the price of trash fish in Nakhon Si Thammarat Province is 1.92 Baht/kg in 1984. This is close to the national average of 1.97 Baht/kg. With the increase in fish supply in Pak Phanang the prices are likely to drop, but this may raise the level of competitiveness of fishmeal plants in Pak Phanang.

2) Consumable fish distribution system

The expected volume of consumable fish landings in the Project port is 50,000 tons per annum. It is broken down as follows:

Present landings at Pak Phanang	28,000 tons (69,000 tons x 40%*1)
Landings by Pak Phanang boats currently using Songkhla Port	21,000 tons (59,000 tons x 90%*2 x 40%*1)
Landings by Pak Phanang boats currently using other ports	1,000 tons (2,600 tons x 90%*2 x 40%*1)

*1/ Ratio of consumable fish in catch
*2/ Rate of return of Pak Phanang boats

A. Fish volume by destination

Calculations are made on the condition that fish volume by destination does not change after the opening of the Project port. In other words, the overall balance of existing markets will not be altered.

(a) Distribution to Malaysian markets:

Present landing site of Pak Phanang boats	Distribution ratio to Malaysia	Fish landing at the Project port (tons/year)	Volume to Malaysia from Project port (tons/year)	Major destination
Pak Phanang	20 %	28,000	5,600	Kuala Lumpur
Songkhla	50 %	21,000	10,500	ditto
Pattani	30 %	1,000	300	ditto
Total		50,000	16,400 (33%)	

(b) Distribution to processing plants:

Present landing site of Pak Phanang boats	Distribution ratio to processing plants	Fish landing at the Project port (tons/year)	Volume to processing plant from Project port (tons/year)	Major destination
Pak Phanang	30 %	28,000	8,400	Bangkok
Songkhla	25 %	21,000	5,300	Songkhla
Pattani	40 %	1,000	400	Songkhla
Total		50,000	14,100 (28%)	

(c) Distribution to domestic consumer markets:

a) To neighboring markets:

Present landing site of Pak Phanang boats	Distribution ratio to neighboring markets	Fish landing at the Project port (tons/year)	Volume to neighboring markets from Project port (tons/year)	Major destination
Pak Phanang	35 %	28,000	9,800	Nakhon Si Thammarat
Songkhla	5 %	21,000	1,000	Songkhla
Pattani	3 %	1,000	-	-
Total		50,000	10,800 (22%)	

Note: The volume to each neighboring market is calculated as follows.

National fresh fish consumption per capita: 10 kg/year
Fresh fish consumption in the province:
(10 kg/year x population)
Ratio to local markets in the province:
$$\frac{\text{(fresh fish consumption)}}{\text{(consumable fish landing)}}$$
Volume to local markets from each port:
(consumable fish landing) x (ratio to local markets)

b) To distant markets:

Present landing site of Pak Phanang boats	Distribution ratio to distant markets	Fish landing at the project port (tons/year)	Volume to distant markets from project port (tons/year)	Major destination
Pak Phanang	15 %	28,000	4,200	Bangkok
Songkhla	20 %	21,000	4,200	ditto
Pattani	27 %	1,000	300	ditto
Total		50,000	8,700 (17%)	

(d) Summary:

Destination	Volume	Ratio
Malaysia	16,400	33 %
Songkhla and Pattani	6,700	13 %
Bangkok and its vicinity	17,100	34 %
Nakhon Si Thammarat	9,800	20 %

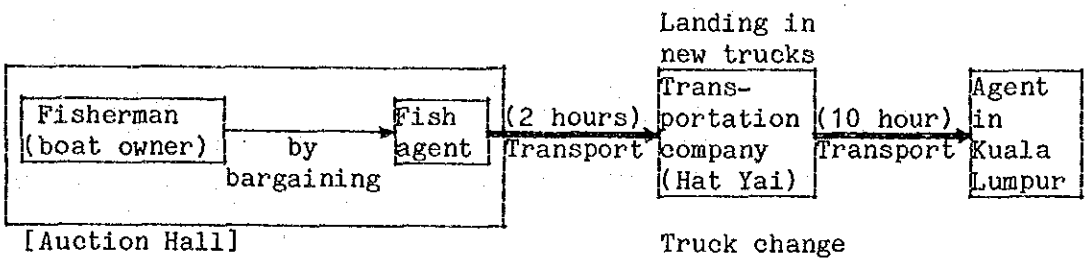
Note : The volume of fish to distant markets, such as Malaysia and Bangkok, is 33,500 tons per year (16,400 tons + 8,400 tons + 8,700 tons) which is 67 % of the total consumable fish landings (50,000 tons per year).

B. Marketing channel by destination and handling body

(a) Consumable fish to Malaysia:

All consumable fish for Malaysia is sent as fresh fish. Fish agents in Songkhla and Pattani take care of the marketing of fish to Kuala Lumpur, Malaysia. This includes packing and transportation. One cannot expect buyers from Malaysia to come to the Project port. Fresh fish to Malaysia will be directly taken care of by fish agents having dealings there.

[Marketing Channel]



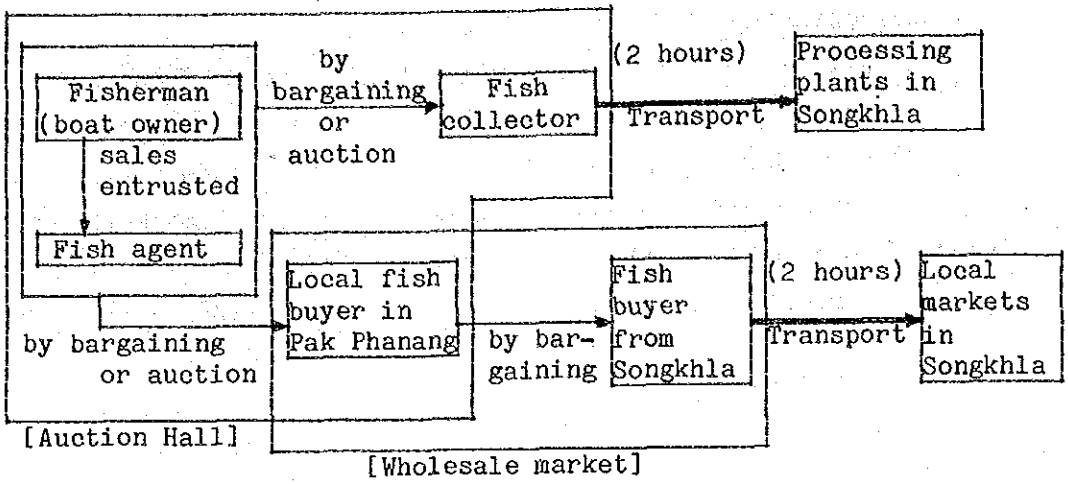
[Packing Method]

100 kg of fish is packed with an equal quantity of ice in wooden boxes with insulated styroform (inside dimensions = 500 x 800 x 500 mm = 0.2 m^3/box)

(b) Consumable fish for Songkhla:

Most consumable fish sent to Songkhla from the Project port consists of raw materials for processing plants. These are dealt with by fish collectors in Songkhla, who will be expected to fetch the raw materials at the project port. On the other hand, the volume of fresh fish for local markets in Songkhla is very small (1,000 tons annually), so that fish buyers from Songkhla province are not expected to buy fish directly from fishermen but from the wholesale market in the Project port. In the wholesale market, fish is sold by Pak Phanang local fish buyers who originally purchased fish from fishermen or fish agents.

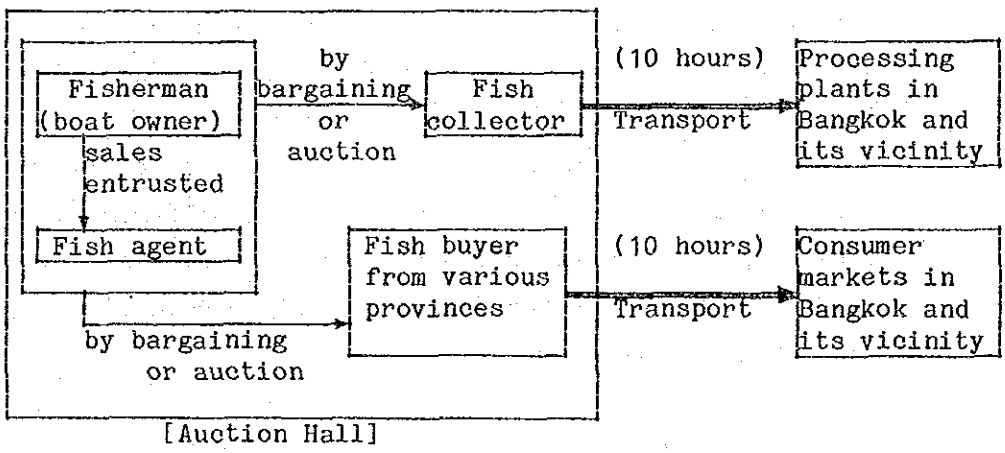
[Marketing Channel]



(c) Consumable fish for Bangkok and its vicinity:

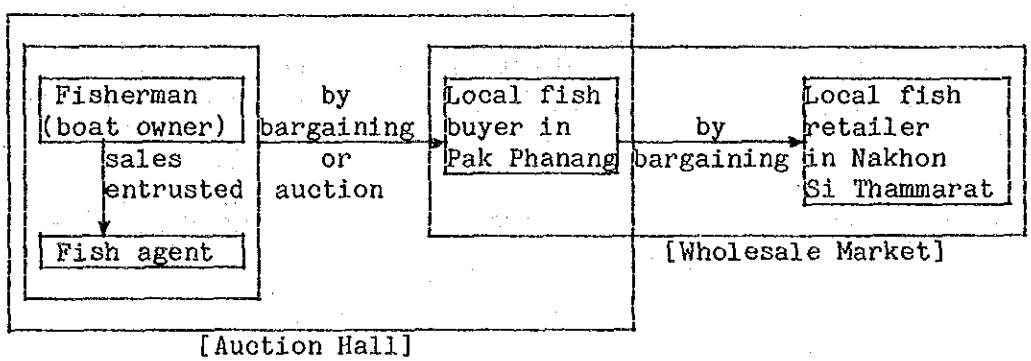
This can be divided into two categories, raw materials for processing plants and fresh fish for consumer markets. At present, although no fish collector can be found in Pak Phanang and fish agents fulfill this role with regards to raw materials for processing plants, one can expect that fish collectors will in future conduct such activities in the Project port. On the other hand, fresh fish for consumer markets in Bangkok and its vicinity will be handled by fish buyers from various provinces.

[Marketing Channel]

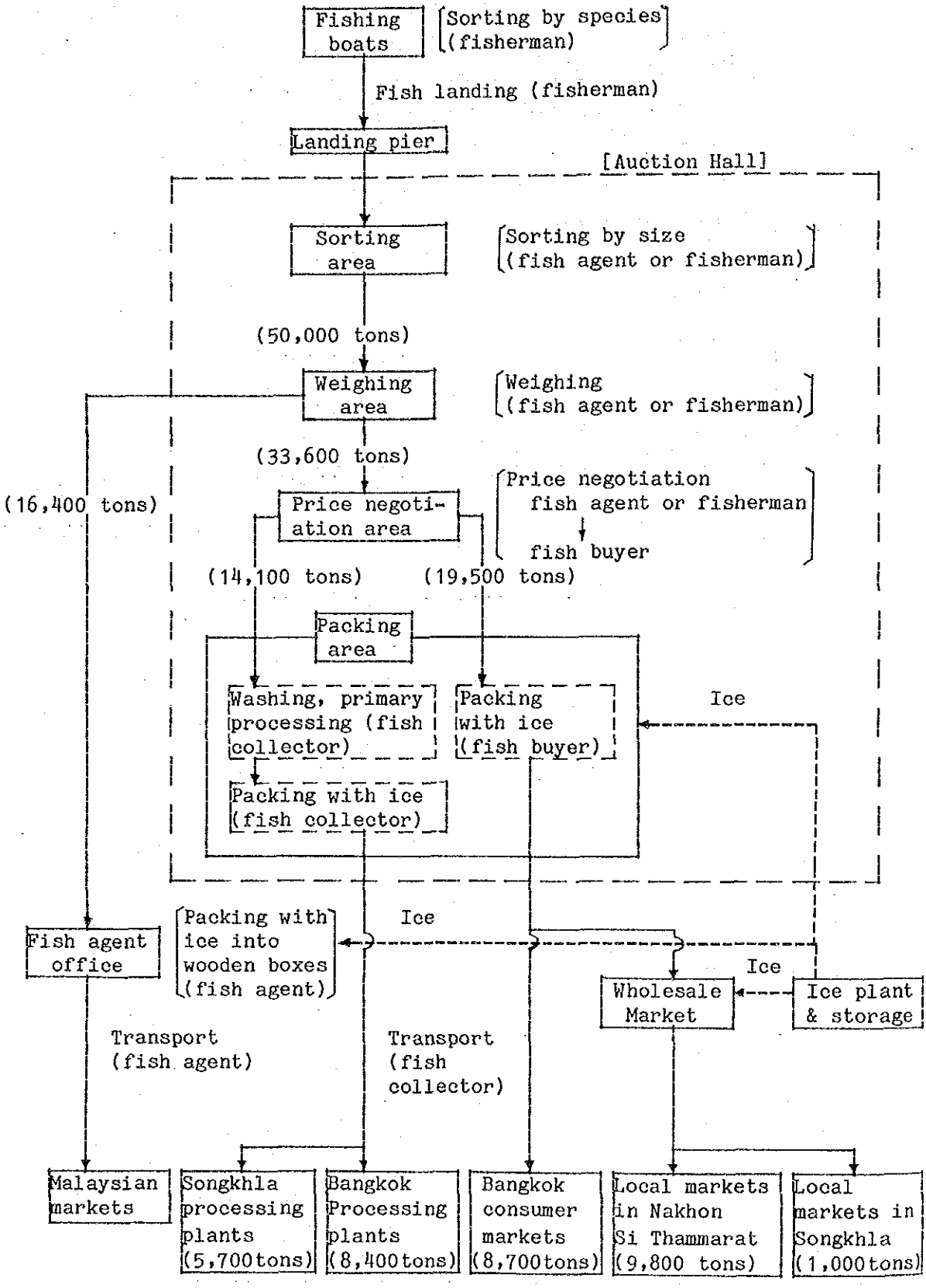


(d) Consumable fish for local markets in Nakhon Si Thammarat:
At present, local fish buyers in Pak Phanang are acting as fish venders to various districts within the province. With the establishment of the Project port, however, it is expected that fish retailers will visit the Project port. Local Pak Phanang fish buyers will buy fish at the auction hall and sell it to local retailers at the Project port's wholesale market.

[Marketing Channel]



C. Consumable fish flow at the Project facilities



(5) Determination of landing facilities capacity

1) Basic considerations:

A. Objective fishing boats:

The boats which will use Project port facilities are as follows:

Type of boat	Length	Number of calls per day
Otter trawlers	14-18 m	8
	18-25 m	13
Pair trawlers	14-18 m	2 (1 pair per day)
	18-25 m	
King mackerel gill netters	14-18 m	0.3 (1 boat every 3 days)
	18-25 m	
Total		23-24 boats per day

The number of boats calling will fluctuate in terms of months and days. However the average number of boats only shall be considered hereunder. If the number of boat calling should increase slightly, this situation will be solved by efficient control of entry into port. Fishing boats of a length under 14 m will use the existing landing site, but if they should use Project port facilities they will land fish at the embankment beside the landing pier.

B. Hours of landing pier use

In consideration of the congestion and possible inconvenience which the use of different methods for landing and handling consumable and trash fish might cause, landing times have been allocated for these two different cases. The landing time is fixed according to market destination as follows (see Attachment 5-2).

7:00	13:30	14:00	17:00
Trash fish landing	Cleaning & preparation	Consumable fish landing	

The appropriate calling pattern of fishing boats is as follows:

Otter trawler/pair trawler	6:30-10:30	port call
	7:00-13:30	landing of trash fish
	14:00-17:00	landing of consumable fish
(after completing, boats shall leave port)		
King mackerel gill netter	13:30-14:00	port call
	14:00-17:00	landing of consumable fish
(after completion, boats shall leave port)		

C. Required length of landing pier

(a) Mooring method:

In the case of the Project port, in which most boats will be trawlers, an along-side mooring (double row) system will be employed, taking into account the following local conditions:

a) An along-side mooring (double row) system is a popular method applied for Thai trawlers, and fishermen are therefore accustomed to this method.

b) A headway mooring system is incovenient for fish unloading work, and does not allow safe mooring considering the hydrological condition of river at the proposed site.

(b) Landing cycle:

The landing cycle of the project port is set at one cycle per day. Fishing boats will therefore be able to remain moored from the time of port entry to the time of completion of landing of all fishes.

(c) Length of the berth:

Required berth length per boat is calculated as at least 1.15 times average boat length.

2) Scale of landing facilities

A. Landing pier:

The required length of the landing pier is calculated by multiplying the length of the berth by the number of berths required for by the number of boats calling per day, as shown in table below:

Type of boat	Average length (m)	Berth length/ boat (m)	Number of boats/day	No. of berths required	Required length of landing pier
Otter trawler					
14-18 m	16.0	19.0	8	4	76 m
18-25 m	21.5	25.0	13	6.5	163 m
Pair trawler					
14-18 m	16.0	19.0	2	1	25 m
18-25 m	21.5	25.0			
King mackerel gill netter					
14-18 m	16.0	19.0	0.3	0.15	4 m
18-25 m	21.5	25.0			
Total			23.3	11.65	268 m

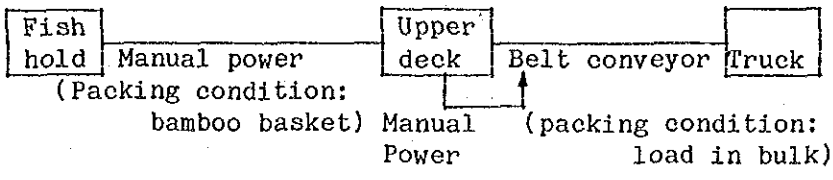
Based on the above calculation, the average length of one berth is 23 meters (268 m ÷ 11.65 berths) and the scale of the landing pier is designed as follows:

Type of boat	No. of berths	Length of pier
Otter trawler	10	230 m
Pair trawler	1	23 m
King mackerel gill netter	-	-
Total	11	253 m

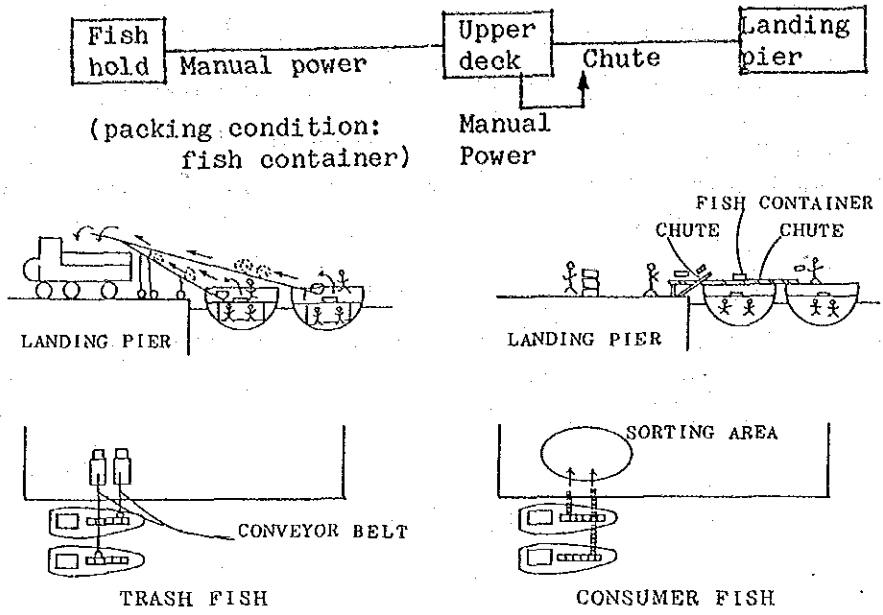
B. Landing equipment:

The following methods, to which fishermen are accustomed, shall be adopted:

[Trash fish]



[Consumable fish]



A. Landing equipment for trash fish:

Landing speed: Landing speed is considered to be equal to the speed with which fish is discharged from the hold to the upper deck. Judging from Thai practice this is 6 baskets per minute (120 kilos per minute). Each bamboo basket contains 20 kilos of fish.

Required time of landing:

Type of boat	Fish catch/ trip	Volume of trash fish	Required landing time (min.)	No. of boats calling /day	Total average landing period (min.)	Total landing period at peak (min.)
Otter trawler						
14-18 m	9	5.4	44	8	360	504
18-25 m	19	11.4	95	13	1,235	1,729
Pair trawler						
14-18 m	9	5.4	45	2	130	182
18-25 m	13	7.8	65			
Total				23	1,725	2,415

The time necessary to prepare landing is 10 minutes per boat, so that 230 minutes are required in total for such preparations. The maximum amount of time necessary to land fish is therefore 2,645 minutes.

Number of conveyors required :

The number of conveyors necessary to complete landing of all trash fish within the landing time (7:00 to 13:30) is:

2,645 min/day ÷ 390 min/day = 6.78

(approx. 7 units of conveyor belts)

There are three possibilities for the conveying of fish from the hold to the truck. In the first case, landing of fish from first and second row boats occur at the same time. In the second case, only first row boats will use the conveyor belt. In the third case, unloading will be done from second row boats. In order to meet all possibilities, the following types and numbers of conveyors are required:

a. First row boat -------- inclined conveyor belt -------- truck

b. Second row boat ---------- horizontal conveyor belt (First row boat) --------- inclined conveyor belt --------- truck

Inclined conveyor belt :	7 m long	: 7 units
Horizontal conveyor belt:	6 m long	: 7 units

B. Landing equipment for consumable fish:

The landing of consumable fish will take place from 2 PM until completion. Fish buyers will visit the port according to fish landing opening times, so that it is desirable to land all consumable fish as soon as possible. Also, since all boats will have been waiting in the port at mooring, unloading will happen at the same time. The required number of chutes for unloading fish containers is equal to the number of fishing boats.

For first row boats :	Chute	4 m long	:11 units
For second row boats:	Chute	8 m long	:11 units

(6) Design for the alignment of Landing Pier

1) Design Fishing Boats

The design fishing boat is defined from such boat that is longer than 14 m and registered at the Pak Panang Port.

The Dimensions of design boats are tabulated below, they are determined based on the Specification for newly built ships in 1980 which was investigated by The Department of Fisheries in Thailand.

Table 5-14 Dimension of Design Fishing Boats

Type of boat	Gross ton (G.T)	No. of boats (Ships)	No. of calls (ship/day)	Length of boat (m)	Width of boat (m)	Full loaded Draft (m)	Hight of bull work from water level (m)
Otter trawler							
14−18m	17− 45	165	8	16.0	3.6− 4.8	1.5− 1.7	0.9− 1.2
18−25m	45−100	351	13	21.5	4.8− 6.4	1.7− 2.2	1.2− 1.5
Pair trawler							
14−18m	17− 45	30	2	16.0	3.6− 4.8	1.5− 1.7	0.9− 1.2
18−25m	45−100	21	(1 pair/day)	21.5	4.8− 6.4	1.7− 2.2	1.2− 1.5
Gill netter							
14−18m	17− 45	1	0.3	16.0	3.6− 4.8	1.5− 1.7	0.9− 1.2
18−25m	45−100	4	(1 boat/day)	21.5	4.8− 6.4	1.7− 2.2	1.2− 1.5
Total		572	23.3	—	—	—	—

2) Water Depth of Landing Pier

The water depth of landing pier is designed by adding the additional water depth for safety shown as below to the maximum draft of the maximum design fishing boat.

a) Stiff sea bed foundation …… more than 0.5m

b) Soft sea bed foundation …… 0.5m

The river bed foundation is found as the soft silty clay at the project site, so that, 0.5m can be adopted for the additional water depth. Consequently, the water depth is designed as 3.0m as follows.

Waterdepth= Max. draft of 25 m fishing boat (100GT) + 0.5m

= 2.7m≒ 3.0m

3) Water Level

Water level is established as follows based on the investigation results of tidal level servey at the project site.

The design water level is the Highest High Water Level (+ 3.74 m) and the Datum Level for construction is the Low Water Level (+ 1.63 m).

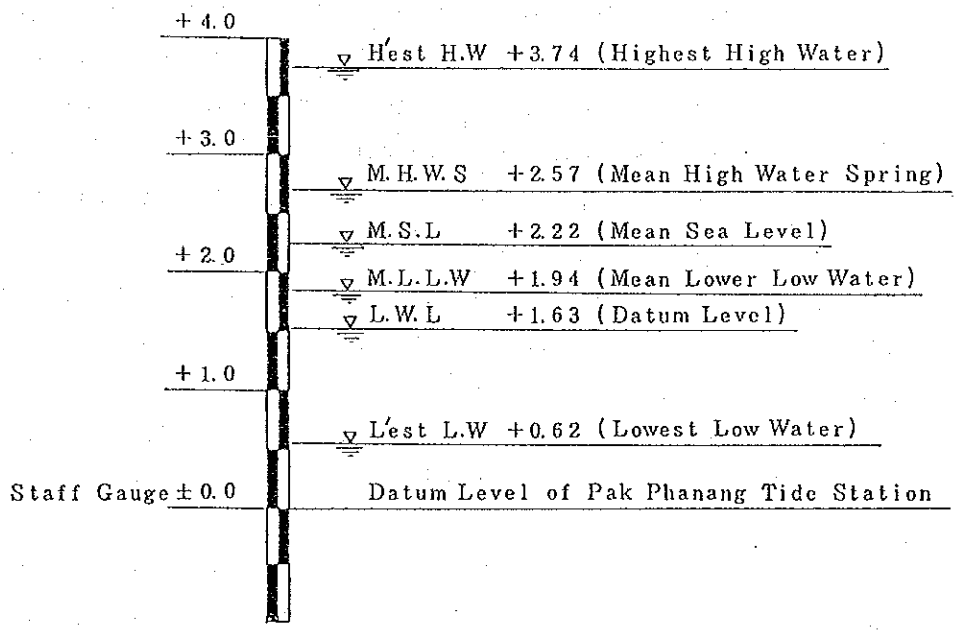


Figure 5-19 Water Level of the Project Site

4) Crown Height of Landing Pier

The Crown height of landing pier is designed from consideration of the Highest High Water Level (+ 3.74 m) and the annual highest water level for 13 years as shown in clause 5-2-4(3). These annual highest water level has been caused by composition of the flood level during the period of rainy season and the spring tide level, and usually continue around one week.

From above reason, considering the allowance of 26cm, the crown height is designed + 4.00 m as shown as below

Crown Height of Landing Pier = + 3.74 m (H'est HW) + 0.26 m

= + 4.00 m

The height of bull work of the fishing boat with length shorter than 18m is lower than the crown height of landing pier, however, fish landing may be possible using the cute at the bow of ship.
For the boat longer than 18 m, fish landing using the chute or conveyer is possible at the Mean High Water Level and fish can be landed at the bow of ship during the time of Low Water Level.

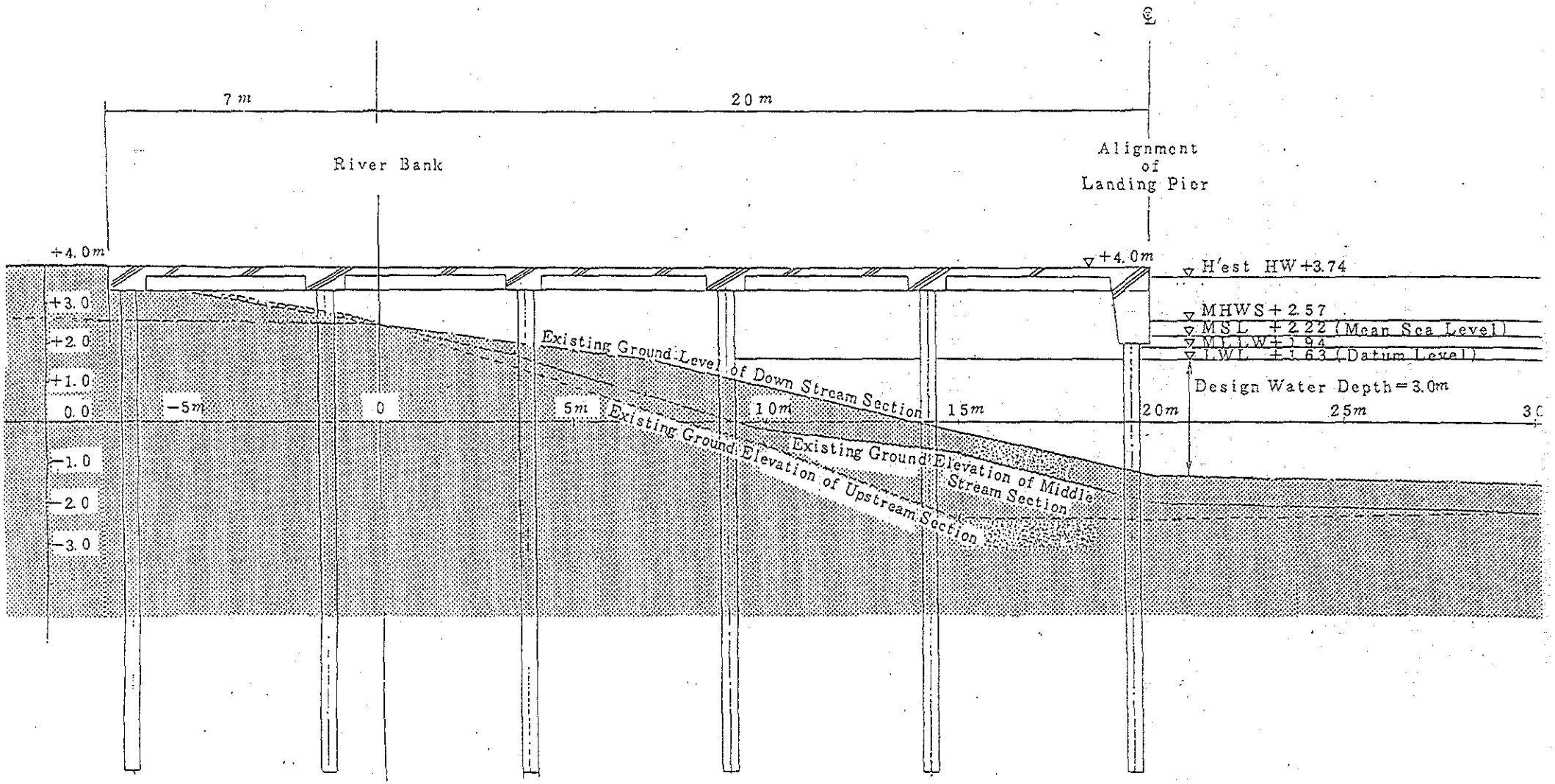
5) Design for the alignment of Landing pier

The existing ground elevation of three sections (upsteam, middle, downstream) at the proposed site of landing pier are surveyed and shown in Fig 5-20.It can be found that the ground elevation of the upstream section is the deepest, and the downstream section is the shallowest and the middle section is between above two sections. At the downstream section, the water depth is deeper than the design water depth at the distance more than 20 m away from the river bank, accordingly, the alignment of proposed landing pier is established 20m away from the river bank.

It can be thought that there is no necessary for dredging in the front area of landing pier and that the water depth will be kept for long time without maintenance dredging.

The navigation channel is established along the center line of the Pak Phanang river and the width of it is 60 m, the clearance between the alignment and navigation channel is 75m. The width of turing area for figshing boat is considered 75m (3L= 3×25m), therefre, the clearance of 75 m from navigation channel to the landing pier is required for safefty maneuvering of fishing boats. It is considered that this alignment of landing pier is the limit of extension to riverward.

Figure 5-20 Cross Section of Landing Pier and Existing River Bed



(7) Determination of auction hall scale

1) Basic considerations:

A. Volume and content of fish transactions:

196 tons out of a maximum of 490 tons which will be landed in the Project port each day will be treated in the auction hall (sorting, weighing, price negotiation and packing). The remaining 294 tons, which consist of trash fish, will be directly loaded into trucks at the landing pier, so that the auction hall will also serve as a passageway to the trucks.

B. Handling hours:

The time required for handling fish will be equal to that required for fish landing, under the assumption that smooth operations are carried out.

C. Working area:

(a) Handling agents, who are either fish agents or boat owners, usually perform services for one boat only. Individual working areas will be provided in order to avoid confusion. The length of one berth being of 23 meters and one berth accomodating two boats, one side of the working area attributed to each boat will measure 11 meters.

(b) A specific working space is attributed to each function (ice sorting, weighing, price negotiation, packing and transportation within the hall).

2) Auction hall scale:

Under the Project, 22 boats can land fish at 11 berths at any one time. The auction hall should be designed so as to enable each of the 22 handling agents to perform his functions.

A. Sorting Area:

Consumable fish landing speed is of 75 kg per minute so that sorting should ideally be conducted at the same speed.

(a) Sorting ability per capita:

Sorting speed varies according to fish species and size. Nevertheless, on-site survey allows the establishment of an average sorting speed:

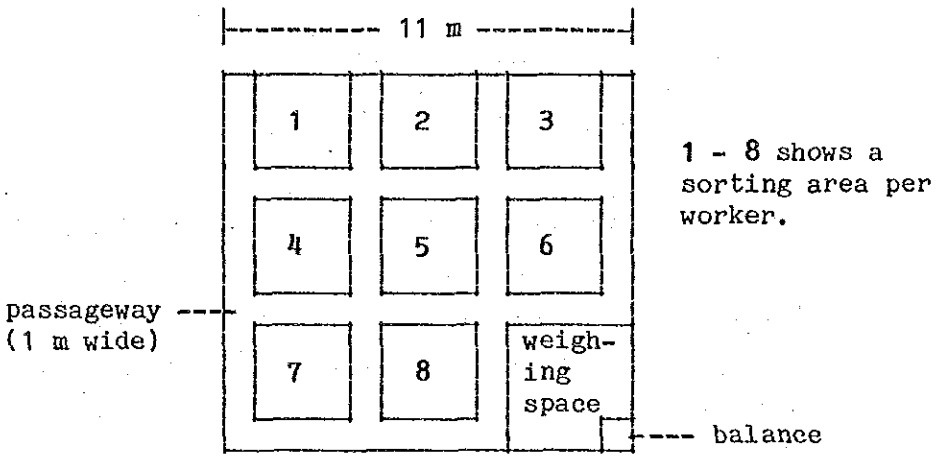
Average fish body weight : 0.5 kg/piece

Sorting volume per unit time : 20 pieces/min/person
(10 kg/min/person)

Eight persons are therefore required to sort one boat's fish landing.

(b) Space allocation in the sorting area:

In order to ensure a smooth sorting operation, the sorting area will be drawn as follows:



(c) Required area:

a) Sorting space:

Required area for one sorting worker is calculated below:

[Space for the FMO's fish containers]

Volume of fish to be sorted : 1,110 kg/person/day
(196 tons per day/22 areas/8 persons)

Required No. of fish containers : 28 boxes
(1,110 kg/40kg per box)

Number of containers within a pile : 4 boxes/pile

Required area : 1.75 m2

(28 boxes/4 boxes per m^2 /4 boxes per pile)

[Space for the fishermen's fish containers]

Required No. of containers : 89 boxes

(1,110 kg/12.5 kg per box)

Number of containers within a pile : 10 boxes

Required area : 1.49 m^2

(89 boxes/6 boxes per m^2/10 boxes per pile)

[Space for the FMO's fish containers during sorting]

Sorting method : large, medium, small, inferior

No. of fish containers : 4 boxes

Required area : 1 m^2

(4 boxes/4 boxes per m^2)

[Space for sorting worker]

Required area : 2 m^2

Total 6.24 m^2 (2.4 m x 2.6 m)/person

Therefore, the total area for 8 persons is 49.92 m^2.

b) Passageway for fish container transportation:
The width of such passageways should be of 1 m in order to transport containers freely. The figure above indicates that 58.2 m^2 are necessary.

c) Weighing space (weighing preparation area):
The above figure indicates that 12.24 m^2 are needed to weigh fish (3.4 m x 3.6 m). Fish sorted shall be gathered here and be weighed.

The total of the above items is 120.36 m^2, so that one individual area is determined as 121 m^2 (11 m x 11 m). The total area of the Sorting Area is calculated by multiplying the number of individual areas (22 areas) by 121 m^2. Thus, the total area is 2,662 m^2.

B. Price Negotiation and Packing Area:

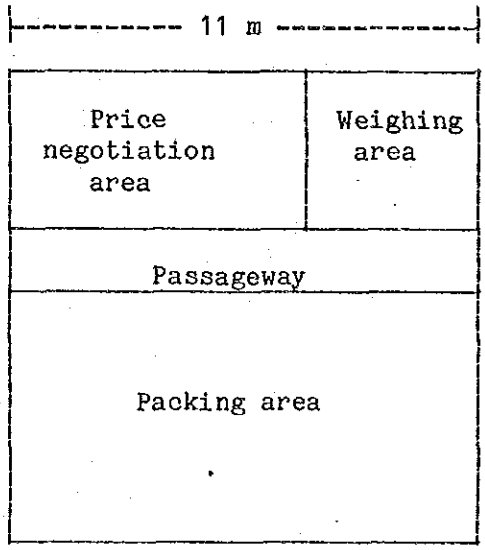
(a) Volume to be handled in the price negotiation and sorting area:

As shown in section 5-3-1 (4), the fish handled in this area does not include fish to be sent to Malaysia by fish agents.

Maximum landing of consumable fish/day	: 196 tons/day
Distribution ratio to Thailand	: 67%
Maximum volume to Thailand	: 131 tons/day
Maximum dealing volume by individual working area	: 5.9 tons/day/area (131 tons/day ÷ 22 areas)

(b) Space allocation by function

In order to ensure a smooth process after weighing, space will be allocated as follows:



The side closest to the berth shall be kept at 11 m.

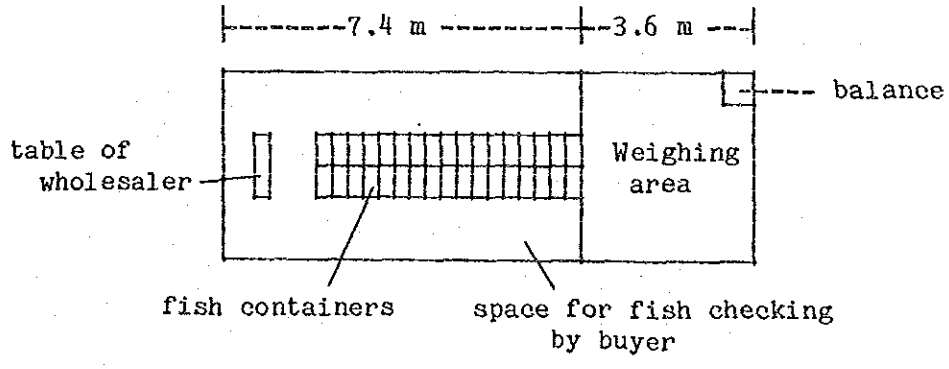
(c) Required area:

a) Weighing space (post weighing preparation area):
Space for weighing shall be identical to that for the sorting area (12.24 m^2 = 3.4 m x 3.6 m). Fish agents or boat owners will record the weight of fish in their own books and mark each fish container by means of a small paper tag that will indicate the weight.

b) Price negotiation area
Transactions are usually made by price bargaining or auction on a species by species basis. In the case of auctions, the minimum volume per transaction is at least 1 ton, while price bargaining is usually conducted over fish quantities less than 1 ton, in the Bangkok Central Fish Market. The fish shall be transferred to the price negotiation area at a rate of 75 kg per minute. After selling, fish boxes shall be transported by the fish buyers to their respective packing areas successively. The average volume of fish per transaction is assumed at 1 ton and, based on this assumption, the required area is determined.

Average number of fish containers
per transactions : 25 boxes (1,000 kg ÷ 40 kg per box)
Required area for the fish
containers : 6.25 m^2 (25 boxes ÷ 4 boxes/m^2)

The following reflects the best layout for the fish negotiation area:



The surface allocated for fish price negotiation in each individual working area is 25.16 m^2.

c) Passageway for ice transportation:
This passage is provided to allow the transportation of crushed ice with two-wheel carts from the ice plant. It shall also be used by fish buyers. The width of the passage should be at least 1.6 m to allow two carts to cross each other if necessary. The passageway area necessary in each working area is 17.6 m^2 (1.6 m x 11 m).

d) Packing area:
The fish shall be transported by fish buyers to the packing area after being bought. After packing, fish containers will be successively loaded on trucks. Raw materials for the processing plants may be washed or undergo primary processing in the packing area according to the fish collector's wishes.

[Rate of incoming fish from the price negotiation area]:
Average time necessary for one transaction can be assumed to be 5 minutes according to a field survey. The volume of fish being transfered from the weighing area to the price negotiation area is estimated at 375 kg (75 kg/min x 5 min). The average volume per transaction is 1 ton, as mentioned above, unless the fish transaction happens to take a long time. Consequently, the rate of incoming fish from the price negotiation area can be assumed to be 75 kg per minute.

[Required number of packers]:
Required packing time differs according to packing condition. The on-site survey indicates that packing conditions mainly differ according to fish destination.

For the Wholesale Market : Ice is simply added on top of the fish stored in the FMO's containers.

For Bangkok's consumer markets : Fish is stored in new containers and new ice added.

For processing plants : Ditto (in some cases, washing and primary processing are effected.)

Packing ability per worker in each of the above cases can be assumed as follows:

For the Wholesale Market : 80 kg/min (2 boxes/min)

For Bangkok's consumer markets : 40 kg/min (1 box/min)

For processing plant : Ditto (except for washing and primary processing)

In order to maintain the rate of 75 kg of fish packed per minute, the required number of workers in each case is the following:

For the Wholesale Market : 1 person

For Bangkok's consumer markets : 2 persons

For processing plants : 2 persons

If we assume fish is packed with ice and loaded onto trucks with respect to the order of destination, 2 packers, at least, shall be necessary at all times. The area necessary for these two workers is considered below:

[Volume of fish packed per worker]:

The average size of fish transactions being of 1 ton, the volume of fish packed by each worker is assumed to be the same.

[Required area]:

The space necessary for one worker is calculated as follows:

Number of fish containers	:	25 boxes (1,000 kg ÷ 40 kg/box)
Space for " "	:	6.25 m^2 (25 boxes ÷ 4 box/m^2)
Ratio of fish to ice	:	1 : 1
Space for ice containers	:	6.25 m^2
Space for the worker	:	9 m^2
Space for the fish containers after packing	:	6.25 m^2
Total:		27.75 m^2/worker (x 2 workers) 55.5 m^2/area

In addition, one must consider the area taken by fish containers not yet loaded onto the trucks. This area is estimated at 11 m^2 (11 m x 1 m) per individual area.

Therefore, a total of an individual packing area is 66.5 m^2, so as to be determined as 66 m^2 per individual area.

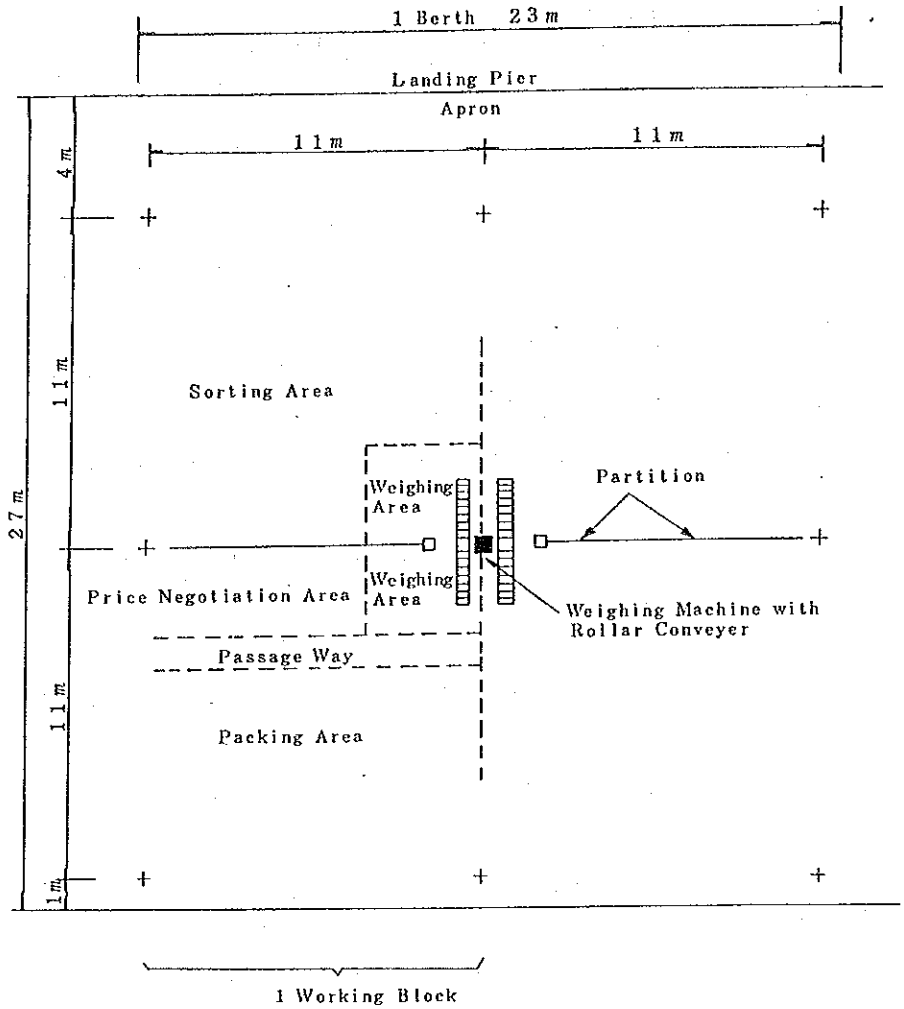
The space required for washing and primary processing shall not be considered. The space left vacant after packing can be used for washing and primary processing.

e) Total area required for Price Negotiation and Packing Area:

	(Per individual area)	(22 areas in total)
Weighing area	12.24	269.28
Price negotiation area	25.16	553.52
Passage way for ice transportation	17.60	387.20
Packing area	66.00	1,452.00
	121.00 m^2 (11m x 11m)	2,662 m^2

C. Auction hall layout:

The layout of the auction hall can be understood from the following, which indicates a typical working area:



5 - 3 - 2 Determination of Ice Making and Cold Storage Capacity

(1) Ice Making Facility

The daily capacity of existing ice factories in the Pak Phanang area totals 4,850 pieces of 150kg ice block. 3,450 of those blocks are for fishing boats.

To forecast the demand for ice after completion of this Project, it is necessary to calculate accurately the supply to fishing boats which consume 70% of total ice. The followings are considered proper procedures:

1) To estimate based on fish catch

2) To estimate based on fishing boats.

1) To estimate comparing present and expected fish catch:

Presently, the annual fish catch is 69,700 tons,and upon completion of the Project, is expected to increase to 125,000 tons as mentioned in 5-3-1 (3). Thus, the ratio of the future fish catch to the present fish catch will become 125,000 ÷ 69,700 = 1.8 times. The maximum daily catch is then expected to be 490 tons. However, the maximum daily catch is not shown in the data that has been issued. Thus, using the above ratio, the preseent maximum daily catch becomes 272 tons for which 3,450 blocks (517 tons) of ice consumption seems to be excessive. If the demand for ice is assumed to increase in relation to the fish catch, the expected ice supply to fishing boats will be 3,450 × 1.8= 6,210 blocks (932 tons) which will be enough to supply 25 fishing boats of the 25-meter class; this, also, seems to be excessive.

However, if not in relation to the present catch, but only based on the future catch, the estimation will be as follws:

The ratio of ice to fish was determined to be 1.2 to 1.5. Thus, the daily consumption of ice will be 490× 1.2~ 1.5= 588~735 tons amounting to 3,920~4,900 blocks...an average of approximately 4,373 blocks.

2) To estimate based on numbers of fishing vessels:

It was determined after interviews with fishermen that 25m class vessels required 250 blocks of ice. From this, the supply necesssary for each class of vessels was assumed to be as follows:

14 to 18m class 150 blocks (average)

18 to 25m class 215 blocks (average)

The total supply will be as follows:

Type of boat	Boat Length (m)	No. of boats entering per day	No. of ice blocks required per boat	Sub total of ice blocks required
Otter trawler	14～18	8	150	1,200
	18～25	13	215	2,795
Pair trawler	14～18	1	150	150
	18～25	1	215	215
Gill netter	18	1/3	150	50
TOTAL		23.3		4,410 pcs

4,410 blocks seems to be a proper figure refer to the 4,373 blocks in 5-3-2, (1), 1).

The demand, other than for fishing boats, will be estimated based on the actual record at the site. It is assumed that the supply to the local cold storage will be the same 800 blocks/day unless there will be an increase to the number of cold storages.

The long distance transport to Bangkok and Malaysia require ice of 1.0 ～ 1.2 times of fish and 0.2～ 0.4 for short distances near the Project site. The total quantity of ice for transportation can be estimated from the above ratio and 5-3-1 (3) as follows:

Maximum daily catch	490 ton
Consumable fish	490 ×0.4 = 196 ton
Fish for long distance transport	196 ×0.67= 131 ton
Ice for long distance transport	131 ×1.0 ～ 1.2= 131～157 ton
Fish for short distance transport	194 ×0.3 = 65 ton
Ice for short distance transport	65 ×0.2 ～ 0.4=13～26 ton
Total of ice	1,080 blocks(162 tons) (average)

It is natural that the demand for ice should increase as the size of fish catches increase. Thus, the amount shown above, in comparison to the 600 blocks of ice currently being supplied, should be sufficient to meet future transportation needs.

Then the total demand of ice will be as follows:

For fishing vessels	4,410
For cold storage	800
For transportation	1,080
Total	6,290 blocks
Existing capacity	4,805
Ice shortage in the future	1,440 block/day

This 1,440 block/day is the capacity of ice making facility to be constructed. However, the actual capacity is determined as 1,400 blocks/day for convenience in designing the ice making tank.

(2) Cold Storage Facility

The freezing and cold storage facilities were included in the Government of Thailand's request for grant aid. However, they believe that the survey should be conducted focusing on the profitability of such an operation in the event FMO intends to operate these facilities by a self-supporting system.

After completing the survey at Songkhla, Pattani, and the Project site, it was found that the amount of fish to be frozen was very low because the type of fish are not proper to be frozen. FMO planned that the facilities would be used for the benefit of the fishermen to freeze and store fish until market prices rose. However, as a matter of fact, those who can profit by such operations are not fishermen but buyers and wholesalers. If fishermen want to make a profit, they must either have their own facilities or operate independently, but this means that they can receive no income until the fish can be sold at higher prices.

FMO agreed that the freezing and cold storage facilities would not be included in this Project, but would be studied again in the future.

On the other hand, it was recommended by the team, and accepted by FMO, to install an ice storage room attached to the ice making room that has sufficient capacity to supply two fishing boats. This will be useful in supplying large quantities of ice to fishing boats within a short period of time.

Further, it was recommended that a small cold storage room (insulated but

without cooling equipment) and a small ice crusher should be installed and connected to the wholesale market. This would be extremely useful in supplying crushed ice to market users for the purpose of storing fresh fish for short periods of time.

5 - 3 - 3 Determination of Water Supply Capacity

The water supply system consists of the following two lines.

City water : For raw water used in ice making cooling water for refrigeration system, and drinking water for offices and other facilities.

River water : For washing of fish, floors of market, road, and fire hydrants.

It was strongly requested by FMO to use river water for washing fish because the daily water consumption will be more than 300 tons making it too expensive to use city water. However, river water is not recommendable from a sanitary point of view. As a conclusion, it was decided to use the river water subject to the installation of an automatic chloride feeding device sterilization.

(1) City water

Total required quantity can be calculated as follows:

Raw water for ice: 150kg×1,400blocks/day =210 tons/day

Cooling water(1% of circulating quantity):

1.8 tons/day×60min ×24hr× 4× 1%=104 tons/day

Others: Consumption in offices, buildings, and by fishing boats totals 70 tons per day.

Total : 210 +104 + 70 =384 tons/day

(2) River water

Total required quantity can be calculated as follows:

For washing of fish : 2 times more than a fish catch of 196 tons

194 ×2 =388 tons/day

Washing of market floors, fish containers and the access road will be performed within 30 minutes after the morning and afternoon fish landings. Assuming that four 50 mm pipelines are used to provide continuous water supply during those times, and that the flow rate of 50 mm pipe is 0.25 ton/min, then the required quantity will be 0.25 bon/min× 4 ×60 min=60 tons.

Then the total quantity of river water required is 388+ 60 =448 tons/day.

5 - 3 - 4 Determination of Fuel Supply Capacity

An average of 23 fishing boats will use the new facilities daily, but as some of them will continue to be supplied fuel from existing stations it can be assumed that eight vessels will use the fueling facilities at the new port. Later in this report it wil be mentioned that the same number of boats (8) will use the new port's ice supply facility. According to FMO's record, an average supply of fuel oil to a fishing boat is 4.8 tons. The total quantity of supply per day can be calculated as follows:

Number of vessels : 8 vessels

Quantity of oil : 4.8 × 8= 38 tons

And, as the capacity of one oil tank is 15 tons, the required number of tanks are as follows:

38÷15= 2.6

Considering the use of one tank as a spare, a total of four tanks are to a be provided.

5 - 3 - 5 Determination of Service Jetty Capacity

A service jetty will be located next to the north end of the landing pier for the purpose of supplying ice, fuel, water and food to the fishing boats. The scope of the jetty is as follows:

Ice Supply; The capacity of the ice making facility is 1,400 pieces per day. Some of the ice will be used in the packing of fish at the auction hall, fish agents' offices, and at the wholesale market. However, for the effectively arranging the facility and transportation, and crushing and loading the ice onto fishing boats , the total amount of ice to be loaded aboard the eight boats is set at 1,400 pieces per day, meaning that the total daily output of the ice making facility will be loaded aboard the ships.

Considering the capacity of the ice crusher (30 tons/hr) and the efficiency of transporting and handling the ice at the boat is 60%, the time taken to load the crushed ice can be assumed to consume two hours, including the time taken to berth and deberth each fishing vessel.

Fuel Supply; The average amount of fuel supply to each boat is 4.8 tons. It is assumed that eight boats will be supplied with fuel and ice .

Water Supply: The average amount of the water supply to each boat is 3.0 tons. Eight boats are to be supplied with water. Water is to be supplied while the vessel is berthing for the purpose of taking on crushed ice and fuel.

Consequently, a boat will be alongside the service jetty for about two hours, including time for berthing and deberthing, and for taking on ice, fuel and water. It is assumed that eight boats are to be supplied. Thus, it will take 16 hours to supply all eight boats at the jetty. The lengh of the jetty is to be 25 meters; this takes into consideration the size of boats having the greatest length. There will be a service control house on the jetty for controlling and measuring the supplies being issued.

5 − 3 − 6 Determination of Building and Infrastructure

(1) Building

1) Administration Office

The management and operation of the fishing port will be carried out by organizations under the control of FMO. Each section has a manager, an assistant manager and some staff members. The area of each room is indicated as follows:

Name of the room	area (m^2)
Administration office	88
Supply office	44
Meeting room	88
Manager's office	44
Office of DOF	44
Warehouse	44
Corridor, toilet and stairs	253
Total	605

2) Fish Agent Offices:

Fish agents will play an important role in handling and distributing the fish catches. They will be required to reside at the new port. There are to be twenty fish agents at the port as mentianed in 5-3-1(2).

Therefore, twenty offices are to be provided and rented out the agents. The agents will handle the fresh fish, sending 16,400 tons per year to the Malaysian market. The average daily amount of fish handled by one agent office will be about 2.3 tons (maximum amount of about 3.2 tons). The size of a fish box used for transporting fish is 500 × 800× 500mm ; it can be filled with 100 kg of fresh fish packed with crushed ice. Each agent's office will be provided with space for packing and stocking fish box containers and, also, a space for dwelling.

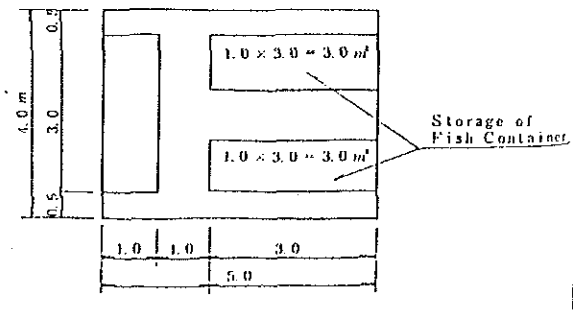
The required space for each fish agent's office was determined to be as follows:

Name of room		area (m²)
①First floor		
Stock space for fish containers, fish boxes, and so on		20
Space for fish container 2,300 kg/40kg=60 pc 60pc/4pc/sm² = 15m²		15
Working space for measurement and packing		25
Steps, toilet and other		12.5
	Sub total	72.5
②Mezzanine floor		
Office		37.5
Stairs and other		5.0
	Sub total	42.5
③Second floor(including stairs)		55.0
	Total	170.0

3) Wholesale Market:

The amount of fish to be handled at the wholesale market will be 9,800 tons for consumption in Nakhon Si Thammarat and 1,000 tons for the Songkhla market. The average daily amount of fish to be handled at the wholesale market is assumed to be 30 tons (maximum amount is 42 tons). The fish will be handled by forty retailers who have been working at exsisting facilities in the Pak Phanang district. The average amount to be handled by one retailer will be one ton.

The amount of fish that may be transported from other landing places to the new fishing port are not taken into consideration in the determination of the scale of the wholesale market. An area of about 6 sq.m is required for handling one ton of fish, assuming that four containers, each holding 40kg of fish, can be handled in a 1 sq.m area. The area required for one retailer is about twenty sq.m , which includes fish container space, and aisle and counter area for the retailer.



The wholesale market will have spaces for forty retailers of twenty sq.m each, and a space for a canteen, a kiosk for labor, and an ice storage of 16 sq. m for use at the auction hall and wholesale market.
The area required is as follows:

Name of room	area (m²)
Space for retailer 40 pc x20 sq.m	800
Passageway	384
Canteen	116
Kiosk	12
Ice storage and working space	32
Eaves	405
Total	1,749

4) Fishermen Center

At each fishing port, a fishery association and fishery cooperation have been organized for the fishermen. The purposed of these organizations are as follows :

- Fishery associations are organized in order to contribute to the improvement of the social and welfare conditions of the fishermen
- Fishery cooperations are organized to provide financial advice and assistance to fishermen that, in return, will result in smoother fishery activity operations.

FMO provides the facilities for these organizations.
At these facilities, exchanges of information between the fishermen and governmental staffs can be carried on.

At the new Fishermen Center there will be shops, offices and an auditorium. The shops will handling fishing gear and boat supplies. Offices are for use by the fishery association and fishery cooperation. The auditorium will be use for office staff meetings and will be available for use to train the fishermen in improved fishery methods, boat operations, and fish preservation methods . THe area required for the new Fishiermen Center is as follows :

Name of room	area (m²)
Auditorium	200
Cooperation shops (8 shops × 20 sq.m and passage)	200
Cooperation office	18.75
Association office (including communication room)	75
Warehouse and toilet	56.25
Total	550

5) Ice Making Building

The scale of ice making facility set forth in 5-3-2, and is as follows:

- Ice-making capacity : 1,400 blocks/ day (210 tons)
- Size of ice : 150 kg/each block
- Ice supply method : block or crished ice (crusher of 30 tons/hr for fishing vessels)
- Ice storage : 110 sq.m (100 tons)

The size of the ice making facility is as follows:

Name of room	area (m²)
Ice making and machinery	1,222
Ice storage	110
Working space for ice supply	150
Total	1,482

6) Stand-by Generator House

The stand-by generator will have a capacity of 150 KVA. The area required for the generator house is 120 sq.m, including switch-boards, cable ducts, and working space.

7) Service Control House

On the service jetty, there will be a 9 sq. m service control house for controlling and measuring fuel and ice supplies.

8) Truck Scale House

In order to measure the exact weight of fish products carried by incoming and outgoing trucks, a truck scale will be provided with the maximum capacity of 40 tons. Considering the number of trucks that will transport trash fish, the need for only one scale was based on the following information :

Amount of trash fish	: max. 300 tons/day
Loading capacity of truck	: max. 8 tons
Number of transportation	: 38 times
Operation time	: 6:30AM to 1:30PM
Frequency of measurement	: 5.5 minutes/time

There will be personnel at the Scale House to control and measure the weight of the trucks. The required area for the Scale House is as follows :

Name of room	area (m^2)
Office	16
Toilet, etc.	3
Total	19

(The truck scale itself is covered by eaves.)

9) Guard House

In order to control incoming and outgoing personnel and traffic, and for collecting charges for the utilization of the fishing port, a guard house will be provided near the access bridge; it will be staffed by one person at all times. The provision of a guard and a guard house should help in preventing nighttime thefts. The guard house will require the following area :

Name of room	area (m^2)
Guard room and others	9
Toilet, lavatory	3
Total	12

10) Public Toilet

Two toilet facilities are to be provided at the fishing port to be utilized by the fishermen, sorting and packing workers, fish buyers, etc. Each toilet facility will have an area of 23.4 sq.m and will have seperate facilities for males and females.

11) Sub Station

A Sub Station, having one section for receiving electricity and another section for distributing the power into the port area, will be provided near the guard house. The Sub Station will have an area of 156 sq.m.

12) Fish Container Storage

A fish container storage will be constructed south of the retail market for the purpose of storing the fish containers and hand carriers that are to be provided as Project equipment for use in the sorting and transporting of fish products.

The general layout of each building is shown in Attachment 5-3.

(2) Utilities

1) Electrical facilities

A. The illumination standards for buildings are as follows :

Illumination Standards

Location	Illumination Standards (Lux)
Office	300
Corridor, store	20～50
Ice making facility	20～100
Canteen	100～200

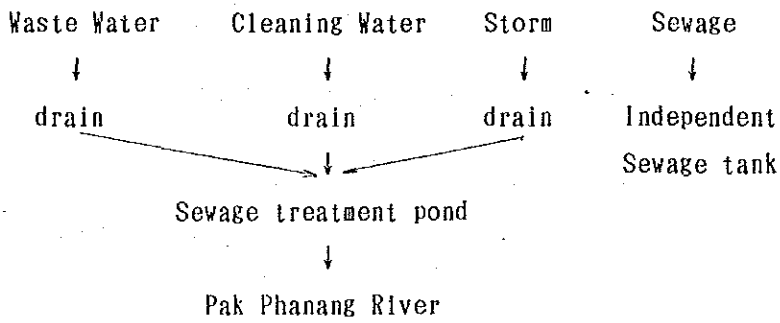
B. Electricity required by each facility is as follows :

Name of facility	Ordinary Power(kw)	Emergency Power(kw)
Auction and admin office	50	4
Fishermen's Center	7	2
Fish agent office	26	6
Wholesale market	7	2
Ice Making building	10	2
Stand-by generator house	1	1
Service control house	1	1

Truck scale house	1	1
Guard house	1	1
Public toilet	1	0
Sub station (road lighting)	14(10)	7(5)
Fish container storage	2	1
Water supply system	52	52
Fuel Supply system	1	1
Ice-making plant	870	0
Total	1,044 kw	81 kw

2) Drainage Facilities

Waste water from each building, cleaning water used on the floors at the auction hall and wholesale market, and storm water is discharged to the Pak Phanang River through a drain and sewage treatment pond. Sewage from toilets is treated by an independent sewage tank.



The sewage treatment pond is about 4,000 sq. m and is divided into three natural sedimentation ponds. After sedimenting materials the water is discharged to the river.

The quantity of cleaning water for floors of the port at the first stage of the operation will be about 450 m3 as shown in 5-3-3 and the quality will not be too much dirty providing that proper arrangement of pits to collect waste through the drain. It is, however, necessary to consider the arrangement of an artificial sewage treatment facility after construction of fishery industry at the hinterland of the port area.

3) Parking area

The road just in front of the auction hall will be crowded at the limitted fish landing time because there come so many cars for different purpose such as large cars to carry fish and other cars to supply ice and fish containers. Accordingly, providing the wide road including parking area for large cars behind auction hall is essential. And the parking area, same space as the one at the auction hall, is also provided in front of fish agent office to make possible the loading of fish product for Malaysian market. The composition of the parking area from the auction hall to fish agent office is parking area (13 m) for retreat approaching, road area (9m) to make preparation to get access to parking area and roadway and road way of 3 m wide as shown in figure 5-21. The overall road width is 50m and the length of the road is 253m.

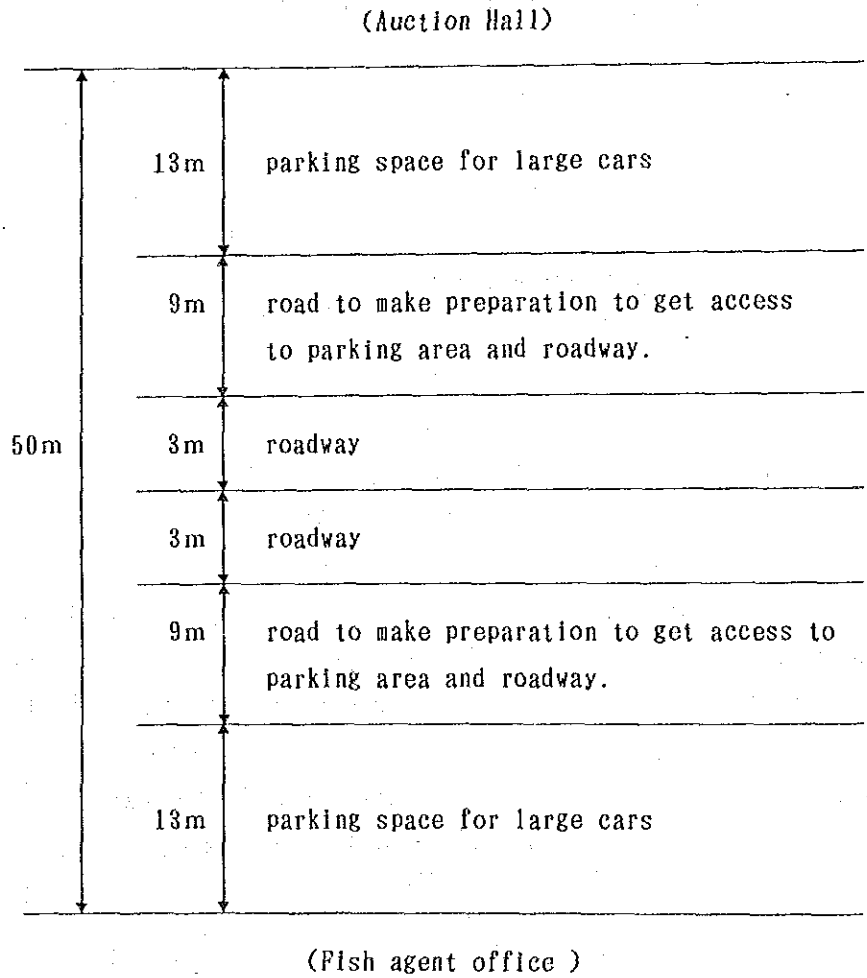


Figure 5-21 Constitution of Parking Area

(3) Equipment

The equipment necessary for fulfilling the functions of the Project port shall be selected and its quantity examined hereinafter. Plant equipment installed and lying within the scope of construction work is not included herein.

1) Selection criteria:

A. The type and quantity of equipment shall be determined with full consideration given to the functions of each Project facility.

B. Local methods shall be adopted so long as they do not create problem for performing functions. Appropriate equipment shall be selected that will meet the technical level and capability of local users.

C. Equipment not requiring advanced technology with regards to maintenance and repair should be selected.

D. Equipment resembling local equipment shall be selected as much as possible to ensure easy repair and procurement of spare parts locally.

2) Equipment to be covered by the Project:

The equipment to be covered by the Project includes the following:

A. Equipments necessary for performing FMO's existing functions:
   (a) Fish unloading equipment
   (b) Weighing machine for trash fish
   (c) Fish transportation equipment
   (d) Communication equipment
   (e) Training & extension service equipment

B. Equipment necessary for performing the functions to be newly introduced under the Project (functions lacking at the existing fishing ports):

(a) Weighing machine for consumable fish

(b) Information service equipment

3) Determination of equipment:

A. Fish unloading equipment:

Fish unloading equipment shall be determined by considering the fish landing volume, local unloading ability, possible time for unloading, specifications of Thai fishing boats, and tidal difference at the Project site. As a result of these considerations, local unloading methods shall be selected. The types and quantities of equipment are as follows (See section 5-3-1, (5)-2)-A):

For trash fish	: Incline type electric conveyor belt 7 m(L) x 0.4 m(W), 2.2kw	: 7 units
	Horizontal type electric conveyor belt 6 m(L) x 0.4 m(W), 1.5kw	: 7 units
For consumable fish	: Chute 4 m(L) x 0.4 m(W)	: 11 units
	" 8 m(L) x 0.4 m(W)	: 11 units

B. Fish weighing machine:

(a) For trash fish:

A 40-ton type truck scale of the type generally used at existing ports shall be selected (see Section 5-3-6 (1)).

(b) For consumable fish:

In order to ensure accurate weighing of consumable fish, an appropriate system of weighing shall be introduced. A total of 22 sets of electric platform weighing machines will be introduced for use by handling agents. A printer shall also be provided and connected to each weighing machine in order to check the weighing record with the weight

declared by each handling agent. In addition, a pair of conveyor roll as shall be installed in the front and rear of the weighing machine in order to protect it from rough treatment. The weighing range was determined to be 0-150 kg to ensure multi-purpose use despite the fact that the average weight of a fish container is only 40 kg.

C. Fish transportation equipment:

(a) Plastic fish container:

Plastic fish containers shall be used to handle fish being processed at the auction hall. In addition, as required, these containers will be leased to fish buyers at a charge of 0.05 Baht per container per day. The type and size of these containers shall be the same as for those introduced at the FMO's existing ports. The necessary quantity was calculated as follows:

Daily fish landings at peak	: 196 tons
Average fish weight per container	: 40 kg
Required No. of containers per day	: 4,900 each
Average leasing period	: 24 hours
No. of leasing cycles	: 2 times/day
Total No. of containers required	: 10,000 each
Size of container: inner volume	: Approx. 60 liters
inner dimension	: Approx. 560x360x320mm

(b) 2-wheeled carts:

2-wheeled carts shall be used for transporting fish and ice within the port's grounds. They shall be loaned to fish agents and fish buyers free of charge.

For fish agents:	20 agents x 1 unit/agent	20 units
For fish buyers:	22 porters x 1 unit/porter	22 units
For spare :		8 units
	Total	50 units

(c) Forklifts:

Two forklifts will be necessary: one shall be used by the FMO for lifting block ice to the truck, and the other shall be leased to fish agents for lifting up wooden fish boxes onto trucks. The capacity of each forklift is determined to be 1 ton, so as to allow 4 units of wooden fish boxes (200 kg each) or 6 units of block ice (150 kg each) to be lifted at one time. In addition, 10 pallets (approx. 1.1m x 1.1m) shall be included as accessories.

(d) Truck:

A truck shall be used for transporting ice from the ice storage to the wholesale market within the port, but it shall also be used for selling ice outside the port. The truck shall have a 6-ton payload to deal with the volume of ice to be transported to the wholesale market (approx. 15 tons per day).

D. Communication equipment:

(a) Radio transceiver:

A radio transceiver will be installed at the Project port for communicating with fishing boats. The type and quantity are to be determined based on the operating area and specifications of the fishing boats, and will be in compliance with Thai radio communication regulations.

SSB 100W, communication distances over 300 miles : 1 set
VHF 25W, " " over 20 miles : 1 set

(b) Walkie-talkie:

Walkie-talkies shall be used for communications by the FMO's field staffs at the Project port. The output will be 5 Watts, which is standard models used in Thailand. The quantity shall be determined based on the number of field staffs (1 port manager and 9 field officers). Thus, a total of 10 sets of walkie-talkies will be required.

(c) Announcing system:

The announcing system shall be used for instructing fishing boats entering and leaving the port and trucks in the parking area. The type and output shall be determined based on the range to be covered.

a) For instructing boats:

Distance from pier	Output (dB)	Quantity
200 m	85	2
160 m	85	1
140 m	85	1

b) For instructing vehicles in the Port:

Distance from pier	Output (dB)	Quantity
50 m	85	2

E. Information service equipment:

Information service equipment shall be installed at the Project port. FMO is planning to introduce this system to their ports by 1990, funding the installations through annual profits. It will be advantageous for fishermen conducting their fish dealings to be provided with current market information. Further, fishery related information, such as port utilization, fishing boat operations and fish dealing should be obtained promptly to ensure a more reliable statistical analysis for the future development of the ports.

The equipment for setting up the information service is shown below:

(a) Facsimile : 2 units
One unit to be installed at the Project port and one at the head office in Bangkok.

(b) Data analyzing apparatus (personal computer) : 1 unit
To be installed at the Project port.

F. Training and extension services equipment:

Training and extension services to fishermen are important tasks to be performed by the FMO in collaboration with the DOF and other related agencies. The training program shall be conducted once a month, two days a time, at the Fishermen's Center. The curriculum of the training programme comprises fishing gear and methods, fish resources, fisheries regulations, quality control, and cooperative activities. The majority of fishing boats in the Project port are trawlers. Therefore, in order to preserve fish resources, efforts must be taken to strengthen training programs to encourage fishermen to engage in purse seining, gill netting, and deep sea fishing rather than in trawling.

(a) Mini-bus: for 15 persons : 1 unit

The mini-bus will be used for home-to-office transportation for FMO's staff personnel during the initial stage of port operation as public transportation will be not be available at the existing town that is located some 4 km from the Project port. It will also be used for transporting lecturers to the Project port to participate in training activities. Occasionally it will be used to cover other areas in the southern part of Thailand.

(b) Station wagon: : 1 unit

The station wagon shall be used for extension services to small ports in the Project province, as well as for transportation within port grounds.

(c) Typewriters: English : 2 units
Thai : 1 unit

Typewriters are to be used for the preparation of training material and correspondence to fishermen.

(d) Copying machine : 1 unit
- ditto -

(e) Video set : 1 set

A video set will be a necessary training aid for the following subjects.

- Technology of purse seining and gill netting
- Fish marketing in urban regions

(f) White board : 1 pc.

5 － 4　Scale and Layout of Facility

5 － 4 － 1　Scale of Fishing Port Facilities and Project Equipment

The construction of the fishing port will be divided as mentioned below:

(1) Phase I Construction :

1) Basic civil facilities :

① Landing Pier (water depth-3.0m) ..... L=253m

② Service Jetty (water depth -3.0m) ..... L= 25m

(2) Phase II Construction :

1) Basic civil facilities :

① Revetment ..... L. Sum

2) Civil facilities :

① Road ..... L. Sum

② Parking area ..... 12,200㎡

③ Drainage ..... L. Sum

④ Earth work ..... L. Sum

3) Building :

① Auction hall, sorting and packing ..... 6,487㎡

(Administration office ..... 605㎡)

※② Fisherman center ..... 550㎡

③ Fish agent office ..... 3,400㎡

※④ Wholesale market ..... 1,749㎡

⑤ Ice making building ..... 1,482㎡

⑥ Stand-by generator house ..... 120㎡

⑦ Service control house ..... 9㎡

⑧ Truck scale house ..... 19㎡

⑨ Guard house ..... 12㎡

⑩ Public toilet ..... 2 ×23㎡

⑪ Sub station ..... 156㎡

⑫ Fish container storage ..... 300㎡

Note ※

As described before, it is necessary to provide a fisherman center and a wholesale market. However, a fisherman center is not cotributed directly to operate/manage the port and also some part of the port facilities may be available for the activities of fisherman center, the construction of the fisherman center is excluded from the Project. Thought, for the effective activity for the fisherman, it is recommended to construct the fisherman center in the earliest stage.

On the other hand, the scale of a wholesale market was evaluated for the forty retailers. But some part of the auction hall may be available to sell local fish as a wholesale market, the first stage of the construction of the wholesale market is planned to cope with the retailers up to 20 numbers. The wholesale market to be constructed in this project is then estimated as 1,089 m2. But the activity of the selling fish to local retailers at auction hall will disturb the work of auction/packing, it is recommened to extend the area of wholesale market up to 1,749 m2 for 40 retailers as evaluated in order to keep their activities and for port operation properly.

4) Utilities :

①	Water supply	L. sum
②	Fuel supply	L. sum
③	Electricity supply	L. sum
④	Telephone	L. sum
⑤	Sewenage	L. sum

5) Plant

①	Ice making plant	150kg× 1,400pcs/day
②	Generator	100KVA × 1set

(2) Project equipment

The project equipment to be provided to this project is as follows:

1)	Fish unloading equipment	
	Incline type electric conveyor belt	2.2KW× 7 unit
	Horizontal type electric conveyor belt	1.5KW× 7 unit
	Chute	4m(L)×11 unit
	Chute	8m(L)×11 unit
2)	Fish weighing machiue	
	Truck scale	40 t × 1 unit
	Electric platform balance	150kg×22 unit
	Conveyor roll .....1.5m(L)×44 unit	
3)	Fish transportation equipment	
	Plastic fish container	10.000 pcs
4)	Communication equipment	
	※Radio transceiver (SSB)	100W× 1 set
	※Radio transceiver (VHF)	25W× 1 set
	Walkie talkie	5W×10 set
5)	Announcing system	1 set
6)	Vehicle (transportation equipment)	
	2 - wheel carts	50 unit
	Fork lift	1ton × 2 unit
		(※ 1 unit)
	※Truck	6ton × 1 unit
	※Mimi bus	15Person× 1 unit
	Station wagon	1 unit
7)	Information service equipment	
	Facsimile	2 unit
	Data analyzing apparatus (personal computer)	1 unit
8)	Training and extension service equipment	
	Typewriter (English)	2 unit
	Typewriter (Thai)	1 unit
	Copying machine	1 unit
	Video set	1 unit
	White board	1 unit

Note ※

In order to smooth and effective operation of the port, it is required to supply the equipmet mentioned above. Though, considering the priority and the degree of requirement, the equipment marked ※

will be excluded from this project. However, for the smooth and effictive operation, it is requested to supplement these equipment in the early stage.

5 - 4 - 2 Scale of facility and Layout

The main facilities are systematically arranged for smooth fish processing and fowarding with the progress of fish flow as shown in Figure 5-22.

(1) Landing Pier, Sorting Area , Auction Hall, Packing Area

Landing Pier is arranged to be able to maintain required water depth (3 meter from LWL). The overall width of Landing Pier is 27m including apron (width=4m), sorting area (width=11m), and space for auction, packing with ice (width=11m).

The car parking lot is arranged just behind the space of packing with ice because the truck can stand by with loading deck facing to the pakcing area.Landing of trash fish can be made directly by lift from ship hold to a truck deck; therefore, the truck can make access on the Landing Pier.

(2) Fishing port administration office

Fishing port administration office is set up at the second floor of the auction hall, where it is most appropriate to control berthing and disberthing in the fishing port and landing pier.

(3) Service jetty

Service jetty is arranged at the down stream side by connecting with landing pier.

Facilities to supply oil, water and ice to fishing boats is arranged behind service jetty and service control house is set up also on the jetty.

(4) Ice making plant

Ice making plant is located behind the service jetty being connected with ice supply tower on the service jetty by slope passage.

(5) Fish agent office, wholesale market

Fish agent office is base to supply marine products that were dealt with at auction hall to Malaysia after these products were transported to fish agent office, ice-filled, and packed.

On the other hand, wholesale market services as distribution market where local buyers can transact with retailers from inside and outside of the prefecture.

Two fish agent offices, wholesale market, fish container storage are arranged parallelly with auction hall separated 50m away by parking space.

(6) Fisherman center

Fisherman center is arranged next to the zone of marine products distribution facility mentioned above.

(7) Water supply facility

Water supply facility is arranged with river water drawing pump installed at the upstream site.

Furthermore, all the pipes of potable water delivered from Pak Phanang city are connected with site from site entrance, so, facilities are arranged to provide at triangular part of site upstream side.

(8) Others

Truck scale, guard house and power receiving house are arranged at near the entrance of fishing port.

Public toilet are arranged at two spots: at the side of ice making plant and fish container storage.

The General plan of Nakhon Si Thammarat Fishing Port is shown in Figure 5-23.

Figure 5-22 Flow of marine products and port facilities

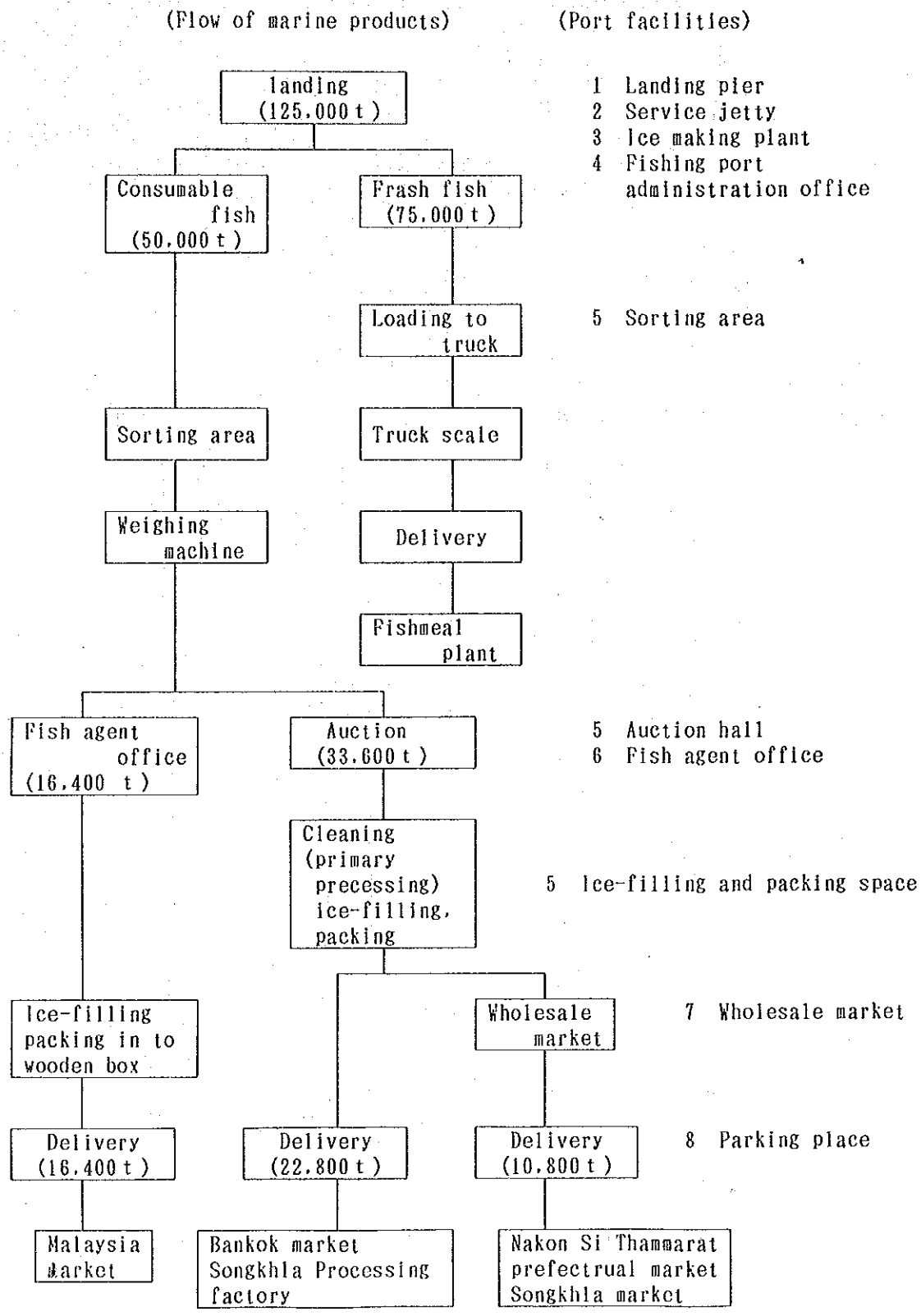
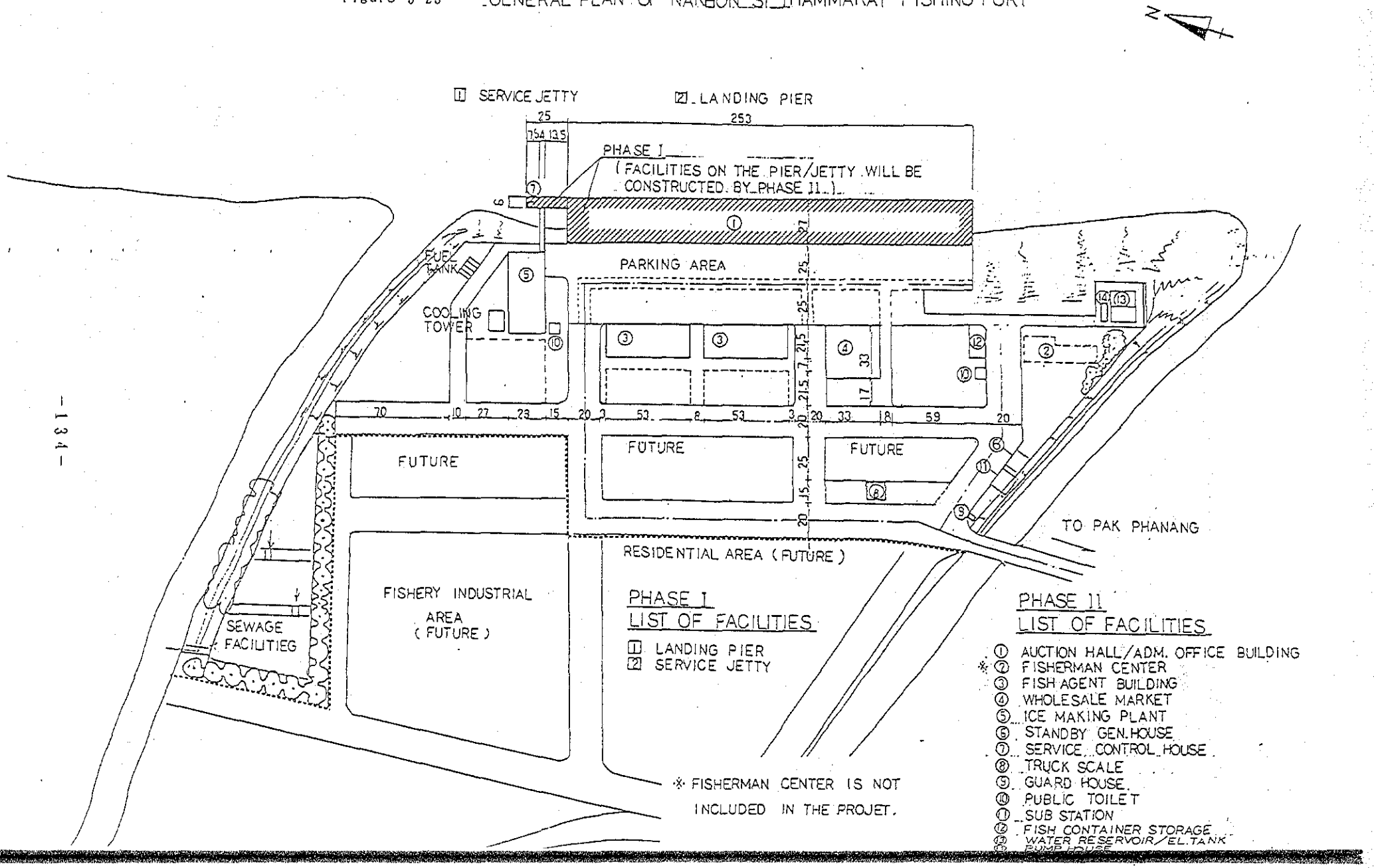


Figure 5-23 GENERAL PLAN OF NAKHON SI THAMMARAT FISHING PORT



5 － 5　Basic Design of Fishing Port Facilities

5 － 5 － 1　Design Condition

(1)　Structural Dimension of Landing Pier and Service Jetty

Structural Dimention	Landing Pier	Service Jetty
Length	253m	25m
Width	27m	6m
Crown Height	+ 4.0m	+ 4.0m
Water Depth	3.0m from L.W.L (+1.63)	

(2)　Design fishing boats

Length (m)	Depth (m)	Gross ton (GT)	Loaded Draft (m)	Height of bull work (m)
16	2.14	< 30	1.50	1.03
18	2.40	30～40	1.68	1.16
20	2.65	50～60	1.86	1.27
22	2.90	70～80	2.03	1.40
24	3.20	90～100	2.24	1.54

(3)　Oceanographic Condition

1)　Water Level

H'est HW	+3.74	(Highest High Water)
MHWS	+2.57	(Mean High Water Level)
MSL	+2.22	(Mean Sea Level)
MLLW	+1.94	(Mean Lower Low Level)
LWL	+1.63	(Low Water Level)
L'est LW	+0.62	(Lowest Low Water)

2)　Current

Max. velocity Vmax.= 0.80 m/sec

3)　Wave

The project site is located at more than 20 km away from the mouth of Ao Nakhon Bay and also 4 km upsteam from the mouth of

Pak Phanang River, therefore, there is no need to consider the wave condition for design of landing pier and service jetty.

4) Design Load

Uniform load : W = 1.0 t/m²

Mobil load : T − 20 truck load

5) Seismic Coefficient

Horizontal : Kh = 0.0

Vertical : Kv = 0.0

6) Wind Velocity

Max. Velocity : Vmax.= 28 m/sec

7) Soil Condition

Soil condition is indicated in the clause 5-2-6 (3).

8) Structural Material and Strength

a) Concrete

Normal Concrete is used.

Design Strength

Fc = 210～240 kg／cm² (28 days Compressive strength)

b) Reinforcing Bar

Re-Bar	Standard	Yield Strength
Round Bar	SR-24	2,400kg／cm²
Deformed Bar	SD-30	3,000kg／cm²
Deformed Bar	SD-35	3,500kg／cm²

c) Steel

Material	Standard	Yield Strength
Frame	SS41	2,400kg／cm²
Common	SS41	2,400kg／cm²

5 - 5 - 2 Outline of design

(1) Design of landing pier and service jetty

The structural type of landing pier and service jetty which are the main civil facilities of the port are designed considering the followings :

① There is a very soft layer of 16 m thickness.

② The required water depth is 3 m due to the small scale of design fishing boat.

③ The landing pier is planned to extend 20 m riverward in order to keep the required water depth.

④ The type of the structure must not be damaged by erosion or siltation.

The type of the structures is relieving platform-type wharf from the following reasons :

① Load will be supported by foundation pile penetrated into the bearing stratum, therefore the structual reliability is very high.

② It is very common structural type for the construction of fishing port in Thailand.

The following three structural types against the very soft sub soil are compared and evaluated

① Soil improvement (sand replacement)

② Sheet pile retaining wall

③ Pavement supported by foundation pile

As the result of the comparison Table 5-15, the soil improvement by the sand replacement was adopted. And the structural type of landing pier and service jetty is decided as the relieving platform-type wharf with sand replacement.

General plans of the structure are shown in Figure.5-24.

The arrangement of pile is 5.5 m interval of combination piles of vertical and batter which are driven upto the bearing stratum.

Mooring facility is arranged at the interval of 5.5 m along the pier with palm tree and buffer material at the connection point of pier.

Table 5-15 Comparative table of structure types at landing pier

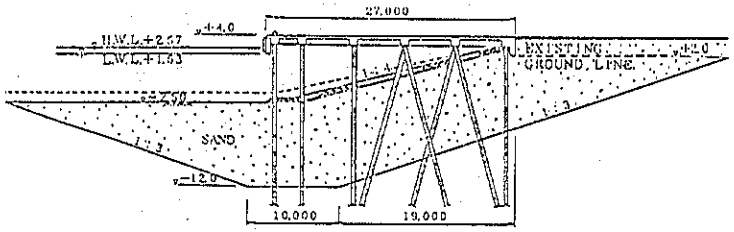
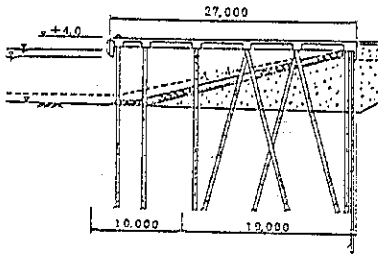
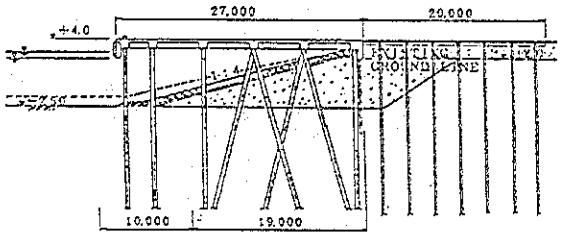
	Plan A : Soil improvement (sand replacement)	Plan B : Sheet pile retaining wall	Plan C : Pavement supported by foundation pile
General Plan			
Remark	Original ground that generates slope sliding is replaced with sand and secure the safety factor of slope stability of 1.3	Drive sheet piles up to the depth where the safety factor of slope stability of 1.3 is secured.	Paved area at the behind of pier is constructed on foundation piles to the width safety factor of slope stability 1.3 is secured.
Merit	• Highest reliability in structure is a vailable • Most economical compared with other methods	• No need of dredging work on a large scale	
Demerit	Disposal of dredged soil is required (it is planned to deposit into sea)	• Sheet pile becomes about 20 m long, so piledriving barge is necessary. Because of pile drivng barge, dredging work is required, which causes costly. • As ground is soft, structural stability is not high.	• Piles for pavement must be driven to bearing layer, so, it causes high cost • Some structual work is required at the connection between pier and pavement area, which eventually makes other working required.
Evaluation	Recommendable		

Figure 5-24 Typical Section of Landing Pier

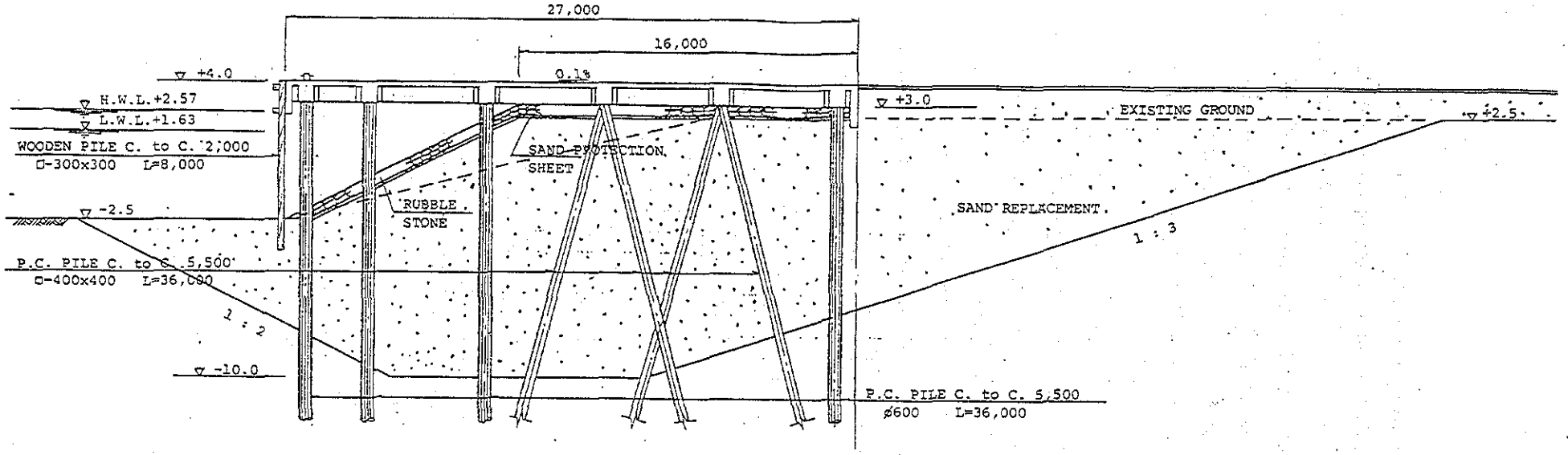
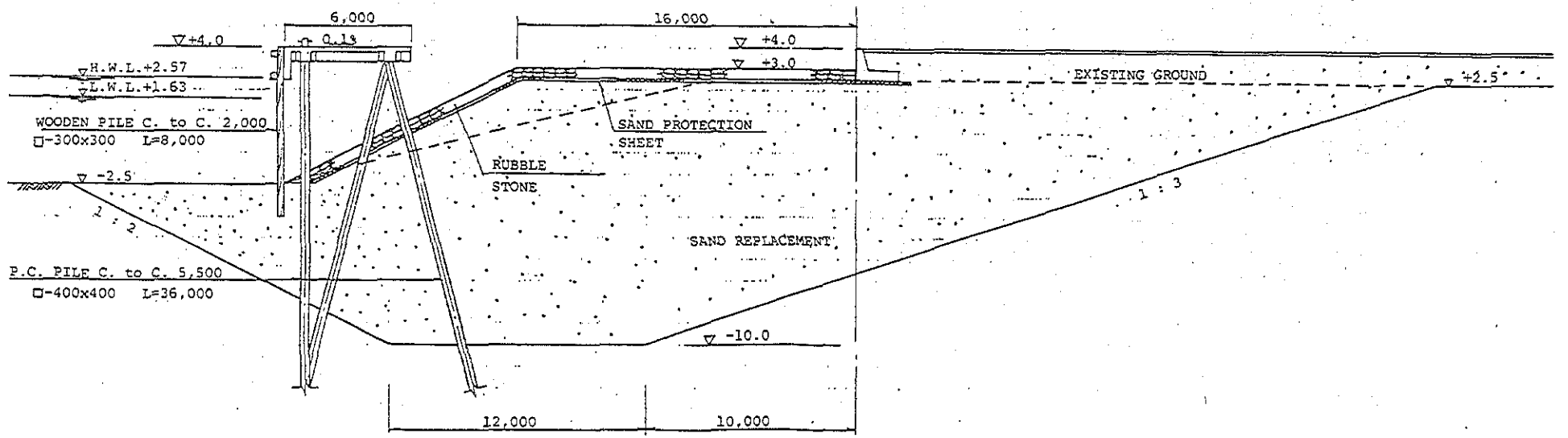


Figure 5-25 Typical Section of Service Jetty



(2) Design of road

1) Width of road

The traffic flow at the port is expected to become maximum in a very short limited hour when fish landing, market opening and departure of truck are carried at the same time. And consequently the traffic flow is apt to be one sided heavily. As the most of fish product, both consumable and trash fish, is transported by the large size cars, the width of the road within the port is decided as 3.25 m and the roadway is planned to be two lanes for both directions.

Among four lanes two of them are paved with concrete block and the outer lane for both direction are paved with rubble stone for roadway at the time of peak traffic and parking spaces. The area will be paved in future for expansion of roadway to cope with the progress of the traffic. Therefore, the width of the road is totally 19 m including the space for drainage of 0.5 m and walkway of 1.5 m as shown in Figure 5-26.

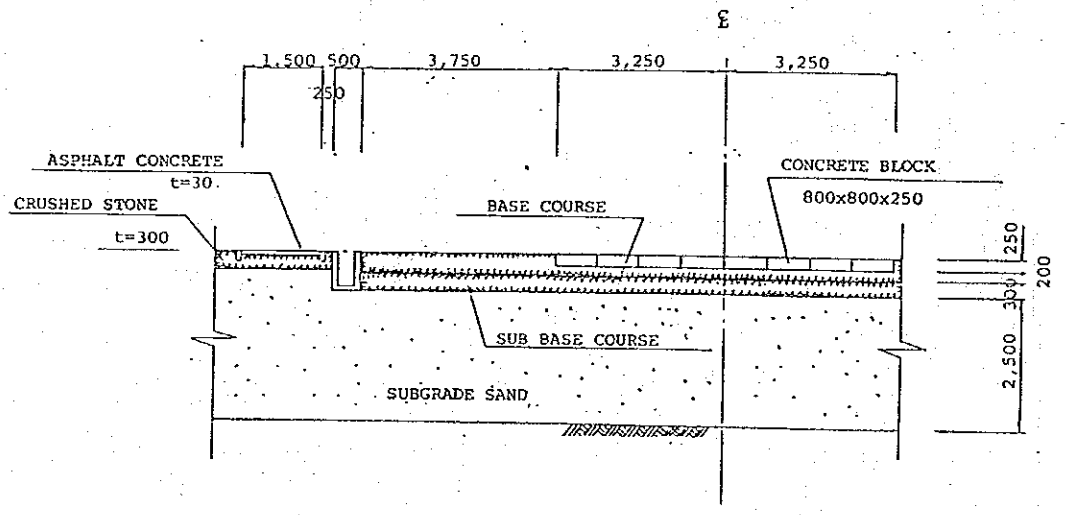


Figure 5-26 Typical Section of Road

2) Selection of pavement type

The road on the soft sub soil is likely to have consolidation settlement at the area deeper than subgrade of road. There are a lot of cases that consolidation settlement becomes major cause of pavement damage.

For this reason, pavement is planned to be carried out as late as possible after the reclamation and permanent pavement will be carried out in future by the other after the consolidation settlement becomes nearly end.

As consolidation settlement does not stop after the completion of the pavement work, it happens to generate cracks and settlement of the paved surface. These are causing traffic difficulty and it becomes necessary to repair the damaged parts or to raise the pavement.

Considering all the pavement types in terms of countermeasure against consolidation settlement and repair easiness, concrete block pavement is the most appropriate method as shown table 5-16 because concrete pavement has disadvantages on the countermeasure against consolidation settlement and repair work, and asphalt pavement generates problems on durability.

Table 5-16 Characteristics of Different Type of Pavement

Pavement	Advantage	Disadvatage
1) Concrete pavement	a) Flat surface is maintained b) Strong against big concentrated load c) Concrete slab is highly durable and service life is long.	a) Construction Joint is weak. b) Removal and repair to damaged concrete pavementl is difficult c) Easily damaged by the miner settlement when unequal settlement happens under the subgrade d) Support for Concrete slab is required against consolidation settlement of soft layer.
2) Asphalt pavement	a) Gradual construction process is available and the pavement can be made after termination of consolidation settlement and consolidation of subgrade b) It can cope with the unequal settlement that happens at the area deeper than subgrade c) Easy to repair	a) Service life is short because asphalt pavement is worn out in one year in Thailand b) Weak against big static load or repeated load that passes the same point c) Easily eroded by oil and heat
3) Concrete block pavement	a) Highly resistant against long-term consolidation settlement of the soft layer b) Easy maintenance by supplying base material against unequal settlement c) Compared to asphalt type, service life is longer and low cost d) Easy and cheap in partial maintenance against the damage by the settlement e) Raising of pavement is easy after long-term consolidation settlement	a) Joint is weak and traficability is no good c) Construction is not easy

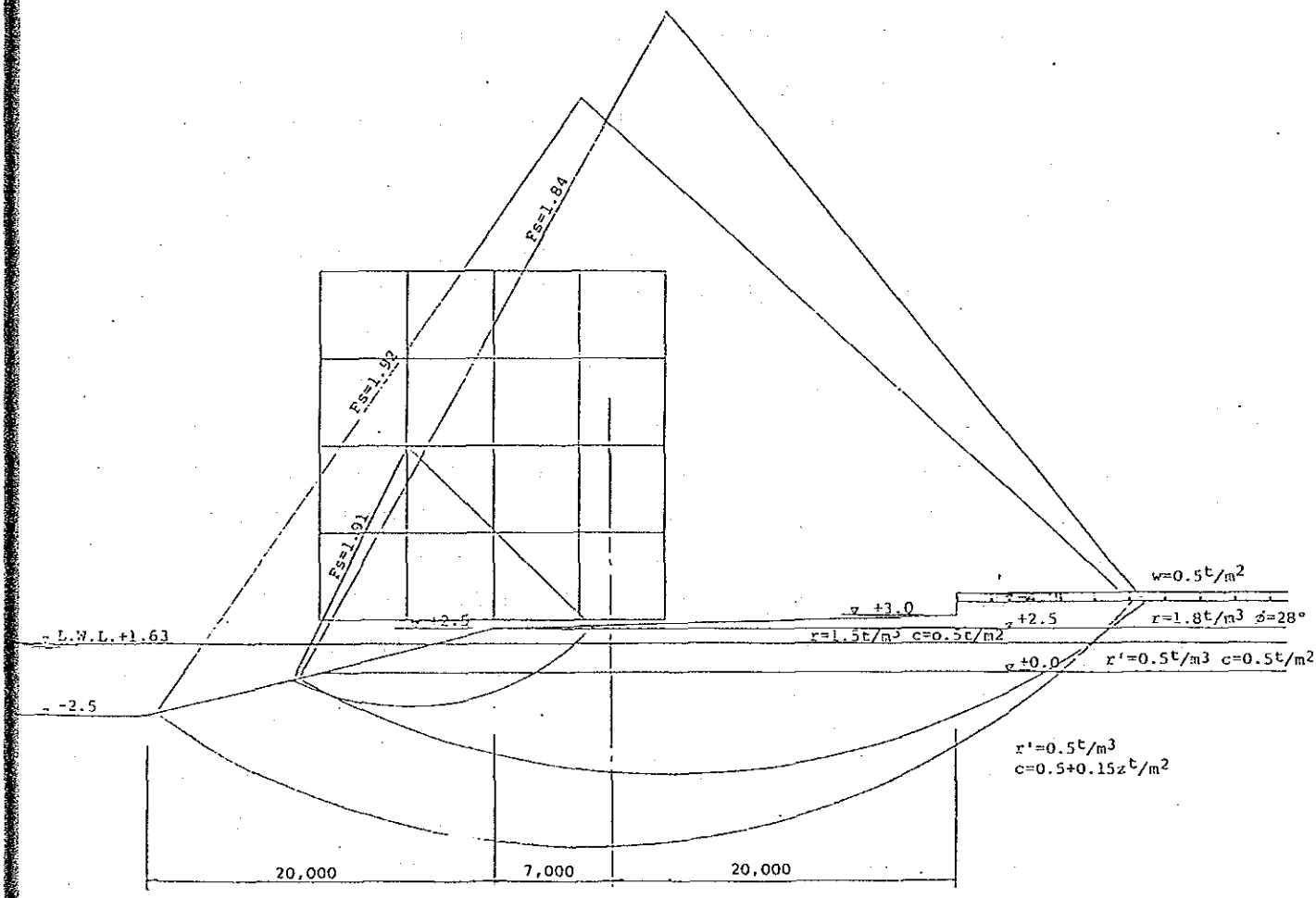
(3) Design of dike

Typical section of dike is shown in Figure 5-27. Only for banking and stone-covering work will be carried out at the surface of temporary dike executed by FMO.

There are two kind of dikes section, that is Dike-1 which is on the line extended to the landing pier and Dike-2 which is facing creek. All the dimensions such as slope and shape of dike have been determined by the examination of slope stability.

The following Figure 5-27 shows the result of slope stability of Dike-1.

Figure 5-27 Slope Stability of Dike-1.



5 - 6 Basic Design of Ice Making Facility

(1) Design Policy

There are no restrictions for designing machines and equipment for refrigeration systems in Thailand as there are no laws or regulations covering them. However, for safe operations and maintenance, the facilities should be designed and installed in accordance with the regulations of a developed country. For this facility, the High Pressure Gas Regulations of Japan was, with certain exceptions, adopted. For example, the use of ammonia as a refrigerant and the installation of non welded-type valves is unacceptable in Japan because of the occurrence of frequent earthquakes, yet , in Thailand, where there are no earthquakes, they may be used.

The facility should be designed taking into consideration the customary manners and technical standards in Thailand. Doing so will make managing the facility by personnel not having received special education or training in refrigeration systems as simple as possible.
Pressure valves, tanks, and cooling coils should be manufactured locally in order to promote employment within the area. For this purpose, customary designs will be advantageous.

Other main points concerning design are as follows :

The use of screw type ammonia compressors is recommended because they have no wearing parts, such as piston rings and valve plates, which obviously makes their maintenance a simple matter. It is said that the screw type of compressor is not recommended for use in developing countries because of the lack of contractors familiar with them. However , in Thailand, as there are experienced contractors who are able to install and overhaul them, their use presents no problem.
Air blowing and core water sucking devices will not be provided for the ice-making systems of this Project in an effort to save energy costs. A 14 -can grid system will be applied to reduce the ice harvesting cycle.
Local made beads board (expanded polystyrene) will be used for insulation in order to save on construction costs.

(2) Specifications

1) 1,400 blocks/day Ice Making with Ice Storage Facility :

- Ammonia Compressor : screw type : 4 sets
  Capacity: not less than 32,800 kcal/hr (Tc 40 ℃, Te -15℃)
  Motor: 180KW, 2P, 50Hz, 380V

- Ammonia Condenser : horizontal shell and tube type : 4 sets
  Cooling surface area : not less than 115sq.m.

- Ammonia Receiver : horizontal type : 1 set
  Size: 1,300mm OD X 5,000mm L

- Cooling Tower : #300 type : 2 sets
  Fan: 7.5KW

- Cooling Water Pump : centrifugal type : 4 sets
  Discharge dia: 150mm
  Capacity: 2.0 cub.m/min X 20m H X 11KW

- Oil Feeding Equipment : for compressor : 1 set
  Oil Tank: 250 ltr
  Oil Pump: 0.4KW gear pump

- Ammonia Piping Material : including pipes, valves, : 1 set
  joints, automatic control devices, and pipe supports

- Cooling Water Piping Material : including galvanized : 1 set
  steel pipe, valves , joints, etc.

- Ice Making Tank : for 1,400 blocks/day, 150 kg/ea ice can : 2 sets
  Size: 10,450mm X 32,200mm X 1,515mm depth,
  including wooden covers

- Ammonia Evaporator : herringbone coil type : 2 sets
  Cooling surface: not less than 400 sq.m

- Suction Trap: vertical type : 2 sets
  Size: 956mm X 1,500mm H
  with liquid leg of 350mm X 2,000mm H

- Brine Agitator : vertical type : 8 sets
  Propeller: 400mm dia.
  Vertical motor: 7.5KW, 4P, 50Hz, 380V

- Raw Water Filling Tank : : 2 sets
  Capacity: 150kgs X 14 cans

- Dip Tank : : 2 sets
  Size: 900mm X 5,200mm X 1,700mm H

- Can Dumper : : 2 sets
  Size: For 14 ice cans

- Ice Can : for 150kg block ice : 2,800 cans
  Size:approx. 280mm X 560mm X 1,700mm H

- Can Grid : hot dip galvanized : 200 sets
  Size: For 14 cans of 150kgs ice

- Overhead Travelling Crane : : 2 sets
  Hoisting: 7.5KW
  Travelling: 1.5KW
  Traverse: 1.5KW

- Raw Water Piping Material : including galvanized steel pipe, valves, joints, and pipe supports : 1 set

- Cooling Coil : for ice storage room, hair pin type : 1 set
  Length of 32mm Coil: not less than 400m

- Crushed Ice Shipping Equipment : : 1 set
  Inclined Chain Conveyor: 15m L X 7m H
  Ice Crusher: 30 tons/hr capacity
  including supporting tower and ice chute

- Ice Crusher for Truck Supply : 1 set
  Capacity: 10 ton/hr

- Anhydrous Ammonia : 12 tons

- Refrigerator Oil : 1.4 kltr

- Salt : 23.5 tons

- Thermometer : 3 ea

- Hydrometer : 2 ea

- Starter Panel for Ammonia Compressor : 4 sets

- Power Control Panel : 1 set

- Lighting Fixture : : 1 set
  Ice meking room: Fluorescent light
  Ice storage room: Waterproof type lamp

- Electric Wiring Material for Power and Lighting : 1 set

- Insulation Material : for ice-making tank, ice storage : 1 set
  room and ammonia piping including
  Beads board, 650mm X 1,300mm X 50mm thick : 1,000 sheets
  ditto but 75mm thick : 2,300 sheets
  Insulation door with door frame, fitting metal : 2 sets
  and door packing
  Pipe insulator : 1 set
  including necessary material for insulation such as
  asphalt felt, asphalt roofing, ect

- Necessary Material and Equipment : for wholesale market : 1 set
  storage room
  Insulation Material : including beads board, : 1 set
  insulation door, ect.
  Ice crusher with steel base : 1 set

5 - 7 Basic Design of Buildings

Basic Design for Buildings is as follows:

(1) Architectural Design Condition

Thailand's standards for building design are applicable, but Japanese building codes may be applied if necessary. As no earthquakes occur at the Project site, it will be unnecessary to take seismic forces into consideration for design purposes. It is planned to have technical discussions concerning building design with staff members of the City and Rural Planning Department and FMO.

(2) Structural system and Material

Taking into consideration of local conditions - climatic conditions, land situation, material procurement, and construction methods - the building materials must be carefully examined prior to selection. Furthermore, to simplify the performance of maintenance upon completion of the construction, material to be used should be readily obtainable on the local market if at all possible.

1) Exterior Finishing (Common part) :

Roof-slate :

(Partly with heat insulation material underneath)

Exterior Wall :

Post and beam : paint finish

Wall : slate, partly mortar finish

Fittings :

Windows : aluminum frame

Entrances : wooden door and aluminium doors

2) Interior Finishing (Common part) :

Floor : concrete with steel trowel finish

Skirting : plastic material

Wall : asbestos cement board

(concrete block)

Ceiling : asbestos cement board.

For washing rooms, toilet and kitchen, watertightness and fireproofness shall be taken into account in selecting materials.

3) Building Structures :

(a) Structures :

Structural design shall be based on the use of reinforced concrete, and rigid and steel frames that are common in the buildings of Thailand.

(b) Foundations :

Considering the geotechnical conditions and load intensities , the buildings will basically be designed having pile foundations.

(c) Load condition :

a) Live load :

Name of room	Live load (KN/m²)
1. Office, meeting romm	3.0
2. Fishermen's center	3.0
3. Fish agent office	3.0
4. Wholesale market	5.0
5. Ice making building	30.0
6. Generator house	10.0
7. Receiving house	10.0
8. Fish containner storage	5.0

b) Structural material and material strength

Structural design for concrete, reinforcement and steel frame is based on the standards as shown in Section 5-5-1.

5 － 8 Basic Design of Infrastructures

(1) Water Supply Equipment

－Water Reservoir for city water : 1 set
concrete made
Capacity: net 200 cub.m.

－Elevated Water Tank, steel made : 1 set
Capacity: 10 cub.m. minimum
Height: 15m minimum

－Forcing Pump for city water, 1 set for standby, : 2 sets
centrifugal type
Discharge dia.: 100mm
Capacity: 1.0 cub.m X 25m H X 7.5KW

－Forcing Pump for river water suction , 1 set for standby, : 2 sets
centrifugal type
Discharge dia.: 150mm
Capacity: 2.0 cub.m X 30m X 18.5KW

－Piping Material, including galvanized steel pipes, : 1 set
valves, joints, and fittings

－Chloride Feeding Device : 1 set
The chloride feeding device for sterilizing
shall be installed in the auction hall plumbing

－Water Faucet for Washing Fish : 10 sets
Discharge dia: 25mm

－Water Faucet for Washing Floors : 10 sets
Discharge dia: 50mm

－Hydrant : 10 sets

(2) Fuel Supply Equipment

- Fuel Oil Tank : 4 sets
  Capacity: 15 ton
  Material: steel

- Service Pump : 1 set
  Discharge dia: 40mm
  Capacity: 0.2 m^3/min×0.4KW

- Fuel Oil Piping Material, including : 1 set
  steel pipe, valves, joints, fitting
  material and measurement instrument

(3) Water Supply Equipment (to ship)

- Water Piping Material including galvanized, : 1 set
  Steel pipe, valves, joints and fitting material

(4) Electric Supply Equipment

1) Power Connections :
Electricity will be brought into the site's Power House from one overhead power line of Provincial Electricity Authority (PEA). Each line will be 33 KV., 3 phase, 50Hz.

2) Main Line System
A power supply line from the low voltage switchboard at the Power House will be connected to the low voltage switchboard located in each building.

The wiring systen is 3-phase, 4-line, 380-220V, 50 Hz, and the voltage drop is less than 5% at the end.

3) Light and Electric Sockets :

- Wiring installed according to the technical standard for electrical installation and the Thailand Industrial Standard.
- Wiring made of insulated (PVC) Polyvinyl Chloride.

(5) Telephone Line Installation

A telephone drop is to be provided up to the terminal box at the Project site. From there an underground cable connects to MDF in the Administration Office.

For each building, telephone wiring and terminal boxes are provided and connected through the underground cable from the main terminal in the Announcing Room.

(6) Stand-by Generator

At the stand-by generator house, a diesel generator (100 KVA, 3-phase, 4-line, 50 Hz) is provided for emergency use.

Chapter 6. Project Implementation Program

CHAPTER 6.
PROJECT IMPLEMENTATION PROGRAM

6 - 1 Scope of Work

Based on a study result detailed in Chapter 5 Basic Design, the project elements to be covered by Japan's grant aid program are summarized below.

1) Waterfront structures
2) Civil works
3) Buildings
4) Utilities
5) Plants
6) Project equipment (including spare parts)

A detail of the above elements is dealt with section 5-4-1 in Chapter 5.

Pursuant to Minutes of Discussion between FMO and Japanese Basic Design Study Team of JICA, the works to be born by the Kingdom of Thailand are;

1) Repair of road from Pak Phanang city to the project site
2) Construction work of access bridge, temporary road within site and land reclamation
3) Related facilities to the project site (Electricity, Water, Telephone)

A detail of the above works is dealt with section 4-3(4) in Chapter 4.

6 - 2 Construction Program

(1) Construction method

It is scheduled to complete the land reclamation including access bridge by FMO and reparing work of the provincial road upto the project site by the Nakhon Si Thammarat Provincial Government.

Therefore, there is no problem against the land-route to transport materials and construction equipment required to the project which is expected to be commenced from April, 1988.

Construction methods are established, considering the advantages in cost, time schedule and liability to work out.

Brief of construction methods with respect to the major works of the project, ie. landing/service piers and buildings are described in here-in after.

1) Landing/service piers

a) Excavation

To-be-dredged volume is estimated as about 155,000m³. It is scheduled to employ a dredger fleet because of relatively big excavation volume.

Dredger fleet :

8m³ grab dredger	(1 unit)
800 PS tugboat	(2 〃)
500m³ barge	(3 〃)

Dredged soils are planned to dispose in offshore area of Laem Talumpuk away about 20km from the project site.

b) Sand replacement

Sand will be placed using by both marine construction equipment and on-land equipment at the same time. Portion of sand replacement by on-land equipment might be limitted to avoid the slope sliding during work.

The same dredger fleet will be also employed for placing sand materials.

Sand materials will be dredged from borrow pit locating at the southern area of Laem Lalumpuk, also transported from on-land pit at the area of Ban Hua Thanon , about 15 to 20km and about 10 to 15 km of transportation distance from the project site respectively.

In addition, environmental impact during dredging is described herewith. The estimated siltation volume around the project site is 1,200,000 ton/year as described in section 5-2-5. while the dredging volume is calculated as about 230,000ton. Judging from the dredging volume (about 20% of siltation volume) and dredging period of 3.5 months (very tentative period), it can be said that environmental impact against the surrounding area of the project site is not so signficant eventhough without silt protector.

c) Piling

After completion of grading of sand replacement materials, piling work can be started.

Prestressed concrete piles will be transported from Bangkok by trucks, then such piles will be transfer to flat barge at temporary dike near the project site then tug to piling position.

A pile consists of 3 parts, ie, upper pile, middle pile and lower pile due to relatively long length of a pile.

Lower pile will be driven, then middle pile will be hung up to weld with lower pile. After welding of upper pile with middle in same manner, a pile will be finally penetrated to the hard supporting stratum.

The bearing capacity of a pile will be confirmed according to Hily's formula which has been widely used in the word.

d) Superstructure

After completion of piling and slope protection works, H-beam supporting for formwork will be installed between piles by floating crane. Concrete will be placed into formwork after reinforing have arranged.

2) Building

a) Excavation・backfill

Excavation and backfill work will be carried out by backhoe and bulldozer which are easily employed at site. The works in small quantity will be done by man power.

b) Foundation pile

About 400 PC piles manufactured by a factory Pak Panang city will be used.They will be penetrated by the on-land pile driver to be mobilized from Bangkok.

c) Structure

i) Concrete

Ready-mixed concrete will be cast into formwork by concrete pump car.

ii) Reinforcing bar

Reinforcing bar supplied from factories in Bangkok will be arranged at temporary working yard

iii) Steel strudure

Pre-fabricated steel members to be transported from factories will be built by truck crane.

d) Finishing

Materials in large quantity or heavy will be installed by truck crane. Materials in small quantity or light will be handled by man power.

(2) Temporary yard

Reclaimed land area where the construction works are not expected or suspended in near future can be provided for a space of temporary yards.

They are;

1) Engineer's site office, contractor's site office
2) Materials stock yard
3) Work yard for reinforcing and formwork
4) others

(3) Undertaking by FMO

The followings are subject to FMO's undertaking

1) To take an approval of usage of sea areas for dumping dredged materials and dredging sand borrow pit from the Government of Thailand.
2) To assist for taking custom clearance at the surrounding area of the project site (not in Bangkok) for dredger and piling barge.

6 - 3 Estimation of Project Cost

Through meetings with FMO and the related authorities, the costs amounting totally to 120 Million Yen (equivalent to about 20 Million Baht at exchange rate of 1 Baht = 5.82 Yen) are summarized below.

1) Repair of road from Pak Phanang city to the project site
   Executing body : Nakhon Si Thammarat Provincial Government
   Construction period : August~October, 1987
   Construction cost : 2.8 Million Baht
   Brief Work : Improvement of crushed stone pavement of about 6m wide, 3.5km long.

2) Construction of access bridge, temporary road within site and reclamation work
   Executing body : FMO
   Construction period : May~December, 1987
   Construction cost : 12 Million Baht
   Brief work : Access bridge over the Khlong between the project site and the provincial road, temporary road for reclamation work, and land reclamation of the project site

3) Related facilities
   Execution body : Public authorities
   Construction period : Until December, 1988
   Construction cost : Electricity 2 Million Baht,
   Water 2 Million Baht,
   Telephone 1.2 Million Baht
   Brief work : Supply of the above distribution lines to the project site.

6 - 4 Operation and Maintenance Cost

The costs are estimated as about 44 Million Yen annually (equivalent to about 7.6 Million Baht at exchange rate of 1 Baht = 5.82 Yen) on the basis of a study result of Financial Evaluation.

The costs are;

1. Remuneration cost Note 1)	1.61	Million Baht/Year
2. Welfare fee Note 1)	1.61	〃
3. Maintenance cost of facilities	4.38	〃
Total	7.60	〃

Note 1) : Remuneration cost and welfare fee include FMO staffs to be engaged in port managing division and ice making plant・service jetty division.

Chapter 7. Evaluation of the Project

CHAPTER 7 EVALUATION OF PROJECT

7 - 1 Evaluation Policty

The fishing ground in Thailand is shifting to the southern Thailand sea area, Malaysian and Indonesian off sea areas due to the reduced fish catch in the Gulf of Thailand. It is anticipated that this trend will be much greater in future. The Songkhla fishing port and the Pattani fishing port, which are the major fishing ports in southern Thailand are now landing fish by the alongside mooring (double rows) system.

These fishing ports are congested because the number of calling fishing boats exceeds the landing capacity.

The fishing boat waiting time is likly to be longer, accordingly these fishing ports are not profitable from a national economic viewpoint.

It is therefore expected that the construction of the planned Nakhon Si Thammarat fishing port will alleviate such congestion in the existing Songkhla and Pattani fishing ports and bring about the promotion of industry and increasing the economic impact in the Nakhon Si Thammarat Province.

In this Chapter, for an assessment of the project of the planned fishing port, the following study has been made.

1) Economic evaluation

With the construction of this fishing port the direct benefits derived from reduced fishing boat waiting time, and an increased frequency of fishing boat operation, and expenses consisting of investment cost and maintenance cost, etc, are calculated in order to analyze the degree of economic benefits in the light of the internal rate of return (IRR) as an index.

2) Financial evaluation

The financial profitability of FMO (managing body of this fishing port) as an independent corporation is analyzed according to the revenue and expenditure balance in the project life of 30 years.

3) Evaluation as a grant aid project

On the basis of the analytical results of the above economic and financial aspects, and the ability of FMO management and operation for this fishing port, the project is evaluated in terms of its suitability for Japan's grant aid project .

7 - 2 Economic Evaluation

(1) Costs

The following items are appropriated as costs.

1) Investment cost (construction cost)
2) Maintenance cost
3) Re-investment cost (project equipment, plants)

(2) Benefits

The economic benefits expected from the construction of this fishing port are summarized as follows :

1) Benefits produced due to the reduced fishing boat waiting time in the the planned Nakhon Si Thammarat fishing port, and the existing Songkhla fishing port
2) Benefits produced due to the increased fishing boat operations
3) Benefits produced due to an increase of the fish price while retaining the freshness of the fish by maintaining a sufficient supply of ice
4) Benefits due to a stable fish price through efficient and appropriate fish dealing by providing modern data processing and wieighing equipment
5) Benefits due to establishing the only modern large scale fishing port in the Nakhon Si Thammarat Province
6) Benefits produced due to a stable supply of inexpensive and high quality animal protein through Thailand
7) Benefits due to the acquisition of foreign currencies and increased employment through the availability of fresh fish and marine product processing industry arrangements in future

It is thus judged that the economic effect produced by implementing this project is widely impacted, and the beneficiary will cover the whole national economy as well as the persons related to fishing industry and fish comsumers.

In this analysis, as the quantitatively presumable direct benefits, only the following two items are employed :

1) Benefits due to the reduced fishing boat waiting time
2) Benefits due to the increased fishing boat operation

(3) Economic analysis

The costs and benefits in 30 years of project life being equalized the economic internal rate of return (EIRR) is computed as 14.35%.

On the basis of two conditions set in below, the sensitive analysis is made. EIRR gives more than 12%.

As to a project normally for public purposes, if EIRR is approx. 10%, the project can be said to be feasible, therefore this project is judged to be substantially high.

Sensitive Analysis

Case	Setting conditions	EIRR(%)
1	When the investment cost is 10% higher, but the benefits is the same.	12.87
2	When the benefits 10% lower, but the investment cost is the same.	12.73

7 - 3 Financial Evaluation

(1) Expenditure

The following items are appropriated as expenditures.

1) Personnel expenses
2) Welfare expenses
3) Depriciation cost

This fishing port will be constructed by grant aid program. The depriciation cost is taken into account in the case study when FHO executed the project by their own budget.

4) Maintenance cost
5) Re-investment cost
6) Ice making cost
7) Supplementary fund against Songkla fishing port

(2) Revenue

The following items are appropriated as revenues.

1) Fishing port utilization cost
2) Truck entrance fee
3) Fish agent fee
4) Service berth turnover/sales commission

(3) Financial analysis

The following case study has been made to understand the influence of the management configuration of those who bear the construction cost, and who manage the ice plant. The " with " or " without " depreciation of the construction cost for this planned fishing port and the management configuration of the ice plant (FMO managtement or manangement entrusted to a private firm) are combined with each other in order to know the revenue/expenditure balance for a project life of 30 years under three conditions set in below.

Case	Conditions	Balance (Million Baht)
1	Without depreciation and ice plant managed by FMO	130.16 Black
2	Without depriciation and ice plant managed by private firm	5.14 Red
3	With depreciation and ice plant managed by FMO	198.12 Black

(4) Analysis of FMO financial aspect

The results of the case study can be summarized as follows.

1) When the depreciation cost of the fishing port facilities is allocated in the expenditure, no FMO profitability is made.
2) FMO's financial profitability can be establish to obtain the revenue from the turnover of the ice plant.

It is apparent that " without depreciation cost "and " the ice plant managed by FMO "are absolutely essentical conditions for establishing FMO's financial profitability as an independent corporation.
With respect to the ice plant entrusting management to a private firm is not a desirable management configuration since the beneficiary is for limitted private firm.
In this project, the fundamental policy is preferable that the profit from the ice plant is maintained by FMO, then the fishing port utilization fee, etc. will be able to be minimal. This leads to reduce fish price, and its beneficiary is not only for the fishermen and the consumers but also covers the whole nation.

7 - 4 Evaluation as Grant Aid

It is apparent that economic benifits produced through the use of this planned fishing port is rather high from the economic internal rate of return (EIRR) 14.35%. This beneficiary covers the whole nation including fishermen as well as the fishing industry.
Further, indirect benefits which are not evaluated in quantitative contribute to a stable fish price, a stable supply of animal protein, a possible increased employment, an acquisition of foreign currencies, and producing a significant impact on the society.
However, it is anticipated that FMO financial status is not so high, as well as many other similar fishing port projects.
From this viewpoint, it is preferable that the construction cost for this fishing port will be covered by Japan's grant aid program.
As a result of the case study for the financial analysis, if the construction cost is covered by grant aid, FMO's financial profitability is apparently established. As discussed in section 4-3(1) of Chapter 4, FMO's operation and management ability has been satisfactorily proven.
Accordingly, it is concluded that implementation of this project with Japan's grant aid is highly recommended.

Chapter 8. Conclusion and Recommendations

CHAPTER 8.
CONCLUSION AND RECOMMENDATIONS

8 - 1 Conclusion

In order to unload fish catches brought by Pak Phanang fishing boats to Nakhon Si Thammarat Province, Thailand's requests for the construction of a new fishing port were studied. The function and scale of each facility were evaluated and a layout plan was prepared. The Project construction work that is to be borne by Thailand, such as reclamation work within the fishing port, will be carried out in 1987 and 1988.

As for the construction work to be carried out under Japan's Grant Aid Program for this Project, the landing pier and the service jetty are to be built during the first year. In the following year, various facilities, such as buildings, are to be constructed.

As shown in Chapter 7, the implementation of this Project produces a substantial benefit by reducing the waiting time of fishing vessels standing by to be unloaded, thereby increasing their operational time.

The fishing port project has high public value. Its revenue is dependent upon the quantity of fish unloaded. FMO charges utilization fees for the amount of fish handled. The fee rate is one percent for consumable fish and 0.02 baht/kg for trash fish. At this project port, the rate for consumable fish is set at 0.5 percent for the first few years, gradually inncreasing to 1 percent.

Revenue at this port will exceed expenditures, such as management and operational expenses, and within one year a financially self-sufficient management will be possible. On the other hand, the new fishing port will not be in a position to repay construction costs and depreciation costs. Yet, for the purpose of developing fishing industries in southern Thailand and to activate regional industries, implementing this Project seems to be quite essential.

Accordingly, it is highly recommended that this Project, under Japan's Grant Aid Program, should be implemented as soon as possible.

8 - 2 Recommendations

In order to have its fullest effect, the following is recommended :

(1) To complete the construction work borne by the Government of Thailand (construction of an access road, a crossing bridge and auxillary utilities up to the site) as scheduled.

(2) In the view of settlement of the ground, complete the reclamation work within the area, particularly during 1987, after a sufficient study is made to determine that stable execution can be achieved, proceed with the construction.

(3) Income from ice sales will provide the greater percentage of the new fishing port's revenue. However, since the management of ice-making facilities will be the first trial for the FMO, they should train their expert engineers and operators in order to ensure smooth operations.

(4) In order to obtain higher revenues, to provide for reliable fishing port operations, and to protect fish resources, appropriate fishing instructions should be given to reduce the ratio of trash fish to that of consumable fish.

(5) As uneven settlement of structures, other than those with pile foundations, built on soft subsoil is unavoidable, they are to be properly repaired and maintained.

(6) The basic fishing port facilities are to be arranged under this Project. However, in order to achieve more effective port operations, the following planning should be implemented : the invitation of fishing related industries and processing firms ; the arrangement of living quarters for FMO management staff ; the arrangement of freezing and refrigerating systems to handle the increased volume of consumable and high-grade fish.

(7) Invite fish agents to be prepared to handle fish catches by the opening date of the new fishing port.

(8) For the efficient utilization, management and operation of the port facilities, it is advisable for the FMO staff to investigate, review and study similar fishing ports, especially riverside ports, both locally and overseas, that have maintenance and operating experience.

Attachment

LIST OF ATTACHMENT

Attachment 1-1 : Member of Study Team

Name	Status	Present Post	Participation
Mr. Masao Kishino	Team Leader	Ministry of Agriculture, Forestry and Fishery of Japan	1st,2nd
Mr. Shigeto Hase	Coordinator	Ministry of Foreign Affairs of Japan	1st
Mr. Yoshiki Miyanishi	Coordinator	Ministry of Foreign Affairs of Japan	2nd
Mr. Eiji Kawabata	Port Planning	PCI	1st,2nd
Mr. Hiroshi Nishimaki	Plant/Facilities Planning	PCI	1st,2nd
Mr. Hiroshi Fukao	Fishery and Fish Handling/Operation	PCI	1st,2nd
Mr. Kazuhiro Goto	Port Structural Design	PCI	1st
Mr. Saburo Fujitsuka	Economic Analysis Cost Estimate	PCI	1st

1st means during April to May
2nd means during July

Attachment 1-2 : Minutes of Discussion (April, 1987)

MINUTES OF DISCUSSIONS
ON
THE PROJECT FOR CONSTRUCTING
THE NAKHON SI THAMMARAT FISHING PORT
IN
THE KINGDOM OF THAILAND

In response to the request of the Government of the Kingdom of Thailand, the Government of Japan had decided to conduct a basic design study on the Project for constructing the Nakhon Si Thammarat Fishing Port and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to the Kingdom of Thailand the Basic Design Study Team headed by Mr. Masao Kishino, Deputy Director, Disaster Prevention and Coastal Protection Division, Fishing Port Department, Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries from April 18 to May 12, 1987.

The Team had a series of discussions on the Project with the officials concerned of the Government of the Kingdom of Thailand headed by Mr. Tongbai Sirimai, Director, the Fish Marketing Organization and conducted a field survey in Nakhon Si Thammarat.

As a result of the study, both parties agreed to recommend to their respective Governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the Project.

Bangkok, April 27, 1987

岸野昭雄

Mr. Masao Kishino
Leader, Japanese Basic Design
Study Team
Japan Internation Cooperation
Agency (JICA)

Tongbai Sirimai

Mr. Tongbai Sirimai
Director
The Fish Marketing Organization
in the Kingdom of Thailand

ATTACHMENT

1. OBJECTIVE OF THE PROJECT

The objectives of the Project is to contribute to the development of fishery in Nakhon Si Thammarat Province by constructing a fishing port equipped with necessary facilities including a fish market.

2. EXECUTING BODY

The responsible and executing organization for the Project is the Fish Marketing Organization (FMO), which is an autonomous body under the supervision of the Ministry of Agriculture and Cooperatives.

3. SITE OF THE PROJECT

The proposed site of the Project is located at approximately 5 km from Pak Phanang Town to the north. And about 18 ha of a plot is permitted to be used for the Project by the National Environmental Board and the Royal Forestry Department.

4. REQUEST BY THE GOVERNMENT OF THAILAND

The Japanese Basic Design Study Team will convey the desire of the Government of the Kingdom of Thailand to the Government of Japan that the latter will take necessary measures to cooperate in implementing the Project and provide necessary facilities and equipment as listed in Annex II within the scope of the Japanese Economic Cooperation in grant form.

5. MEASURES TO BE TAKEN BY THE GOVERNMENT OF THE KINGDOM OF THAILAND

The Government of the Kingdom of Thailand will take the necessary

岸野昭雄　　Toongbai Sirisnai

measures listed in Annex III on conditions that the Grant Aid by the Government of Japan is extended to the Project.

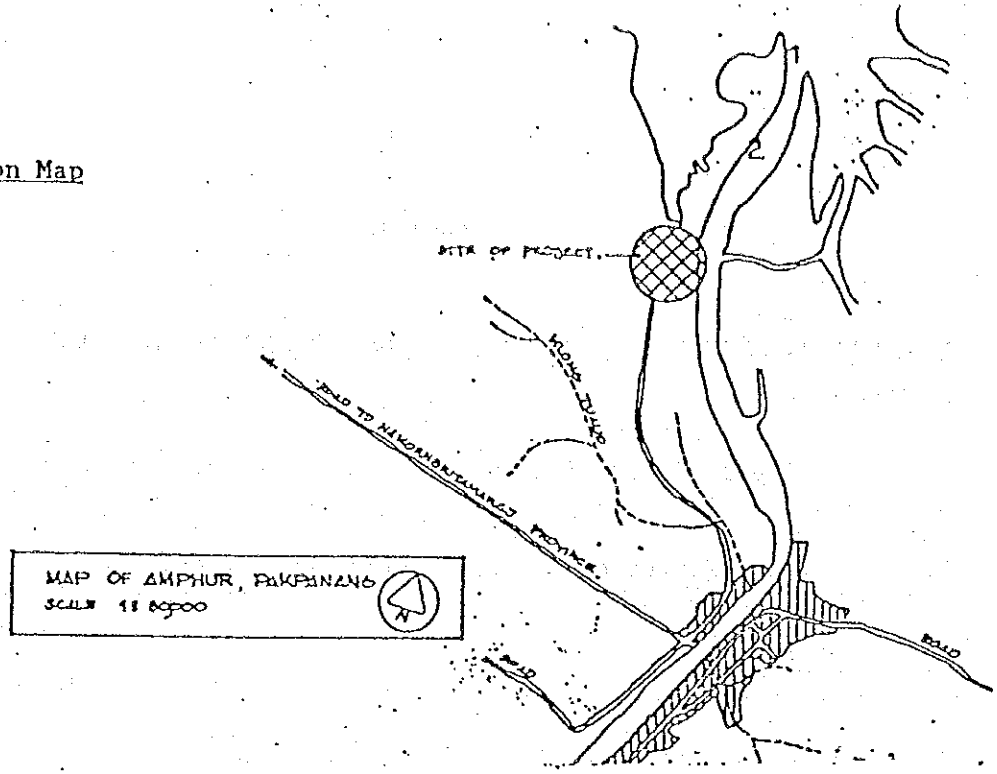
6. SYSTEM OF JAPAN'S GRANT AID

Both sides have confirmed that the Japanese Basic Design Study Team explained to the Thai side Japan's Grant Aid System and they understood it.

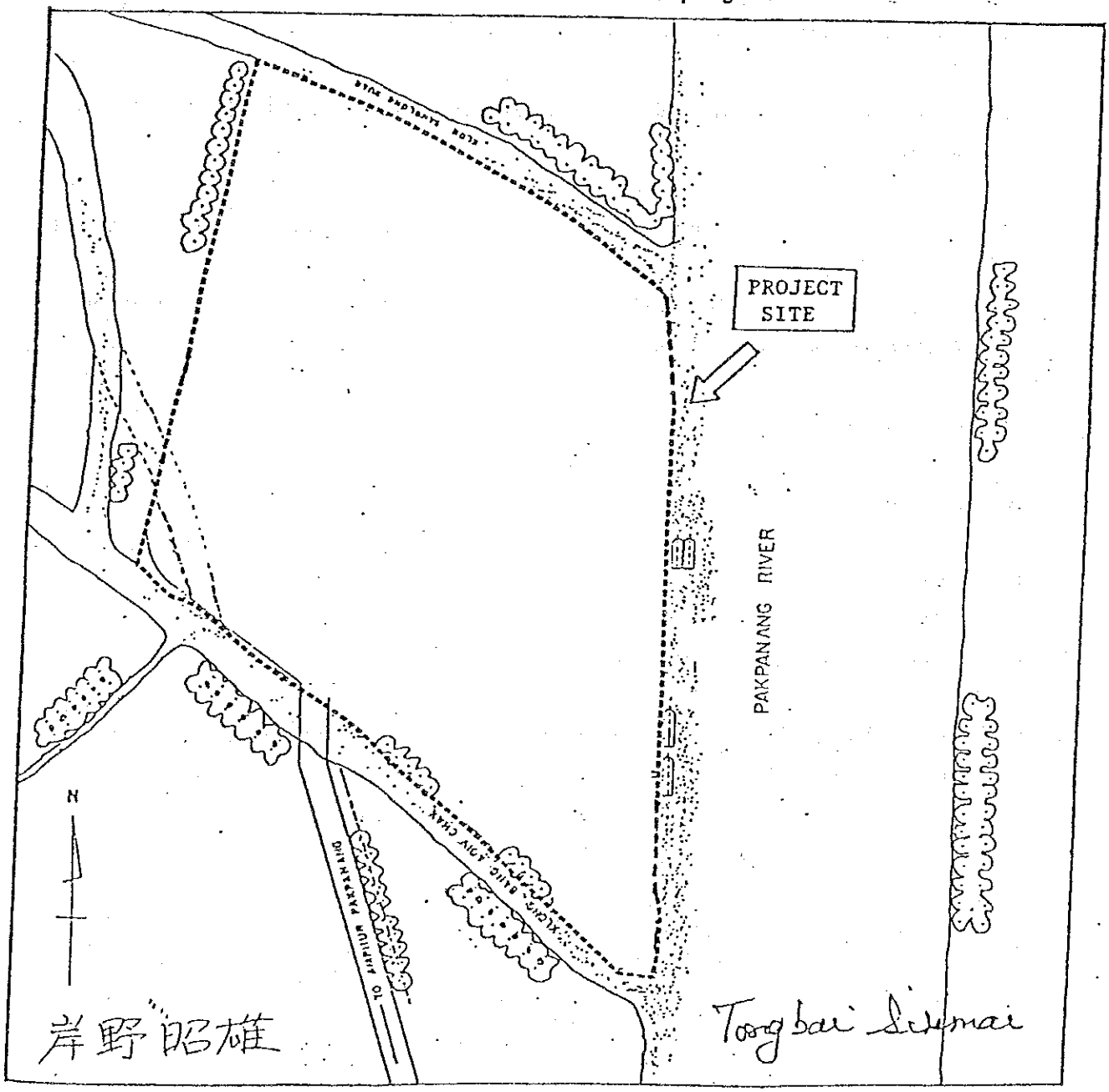
岸野昭雄

Tongbai Sisinai

Annex I. Location Map



Site of project



ANNEX II

Major facilities and structures of the Project requested by the Government of Thailand.

1. landing pier (including the area for sorting, auction and packing)
2. ice plant (including service system and ice crusher)
3. cold storage
4. storage (plastic container, carrier and etc.)
5. fuel tank (including fuel supply system)
6. water supply system (drinking and ice making; cleaning pier and fish washing)
7. fishermen centre (e.g. canteen, toilet, shower, meeting room and etc.)
8. fisheries office (for fishery department, FMO, fisherman association, fisherman cooperatives and etc.)
9. retail market hall
10. parking area
11. embankment
12. construction of the road within the site
13. electricity (drop wiring and internal wiring within the site and the main circuit breaker and transformer)

岸野昭雄　　Toongbai Sirinai

14. drainage (drainage system for toilet sewer, ordinary waste and water pollution treatment)

15 telephone (extension after panel)

16. project equipment (weighing machine for consumer fish and trash fish, market communication system (1) announcing set in the fishing port (2) communication system between the central market and local market (3) talkie-talkie, fish conveyor and etc.)

17. vehicle

18. others

岸野昭雄

Tongbai Sisinai

ANNEX III

Necessary measures to be taken by the Government of Thailand.

1. To secure land necessary for the execution of the Project and provide enough space for such construction as temporary offices, working area, stockyard and others.

   (The construction of the temporary road for the reclamation within the site and bridge across Klong Bang Aow Chak will be started in May and be completed in November 1987. Land reclamation and levelling within the site will be started in August and completed at the end of November 1987.)

2. To ensure that sea area necessary for the construction of the facilities be freely accessible.

3. To construct the roads outside the site to connect Pak Phanang town. (The construction will be completed until the end of July 1987.)

4. To provide facilities for distribution of electricity, water supply, drainage and sewage, telephone and other incidental facilities up to the Project site. (These facilities will be completed its distribution line until the end of 1988.)

5. To ensure prompt unloading, tax exemption, customs clearance at ports of disembarkation in Thailand and prompt internal transportation therein of the products purchased under the grant.

6. To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Thailand with respect to the supply of the products and services under the verified contracts.

7. To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the

岸野昭雄 Tongbai Sisinuai

the verified contract such facilities as may be necessary for their entry into Thailand and stay therein for the performance of their work.

8. To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid.

9. To bear all the expenses including the periodical dredging, which will be carried out by the Department of Harbour, other than those to be borne by the Grant Aid.

岸野昭雄　　Tongbai Sirimai

Attachment 1-3 : Minutes of Discussion (July, 1987)

MINUTES OF DISCUSSIONS
ON
THE PROJECT FOR CONSTRUCTING
THE NAKHON SI THAMMARAT FISHING PORT
IN
THE KINGDOM OF THAILAND

In response to the request of the Government of The Kingdom of Thailand for Grant Assistance for the project for Constructing the Nakhon Si Thammarat Fishing Port (hereinafter referred to as "the Project"), the Government of Japan decided to conduct a basic design study on the Project and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Thailand the team headed by Mr. Masao KISHINO, Deputy Director, Disaster Prevention and Coastal Protection Division, Fishing Port Department, Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries from April 18 to May 12, 1987.

As a result of the study, JICA prepared a draft report and dispatched a mission to explain and discuss it from July 27 to August 5, 1987.

Both parties had a series of discussions on the Report and agreed to recommend to their respective Governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the Project.

Bangkok, July 31, 1987.

岸野昭雄

Mr. Masao Kishino
Leader, Basic Design Study Team
Japan International Cooperation Agency

Tongbai Sirimai

Mr. Tongbai Sirimai
Director
The Fish Marketing Organization
in the Kingdom of Thailand

ATTACHMENT

1. The Thailand side was satisfied with the Report; principally and both parties agreed to some modifications as shown in APPENDIX-1.

2. The Thailand side understood Japan's grant aid system and confirmed that the necessary measures will be taken by the Thailand side as shown in APPENDIX-2 which are manifested in the ANNEX III of the Minutes of Discussions on the Project signed on April 27th, 1987, on condition that the grant aid by the Government of Japan would be extended to the Project.

3. The Thailand side ensured that the necessary budget for the effective operation and maintenance of the Project constructed under the Grant Aid will be provided in line with the adequate number of the Thailand personnel with sufficient knowledge and experiences.

4. The Final Report (10 copies in English) will be submitted to the Thailand side by the end of September, 1987.

岸野昭雄

T. Seimai

MEETING

Date : July 26th to 30th, 1987.

Place : Fish Marketing Organization
Head Office

Participants: FMO: Mr. Tongbai Sirimai
Mr. Shirngshy Bunyapukkana
Mr. Manus Hemnukul
Mr. Polsilp Sharupash
Mr. Pramuan Rugjai
Mr. Rachan Wongsiri
Mr. Terapong Thanabodhi
Mrs. Vipha A. tikamporn

JICA: Mr. Masao Kishino
Mr. Yoshiki Miyanishi
Mr. Eiji Kawabata
Mr. Hiroshi Nishimaki
Mr. Hiroshi Fukao

on July 28th 1987, the Team submitted ten (10) copies of draft final report of the above-mentioned project to FMO. The major modifications agreed by both parties are as follows:

1. The wholesale market will be included in the scope of this project, providing that the scale of the facility is reduced to about a half size of the scale which is mentioned in the draft final report.

2. The equipment as follows will be deleted.
   1) Mini bus : 1 unit
   2) Station wagon : 1 unit
   3) Radio transceiver (SSB) : 1 set
   4) Radio transceiver (VHF) : 1 set
   5) Fork lift : 1 unit

3. The both public toilets will be equiped with shower rooms.

岸野昭雄 T. Sirimai

4. One public toilet and a fish container storage will be relocated as shown in APPENDIX-3

The Japanese side mentioned that these modifications will be examined in Japan in consultation with the authorities concerned, and its results will be incorporated in the Final Report.

岸野昭雄 T. Seinai