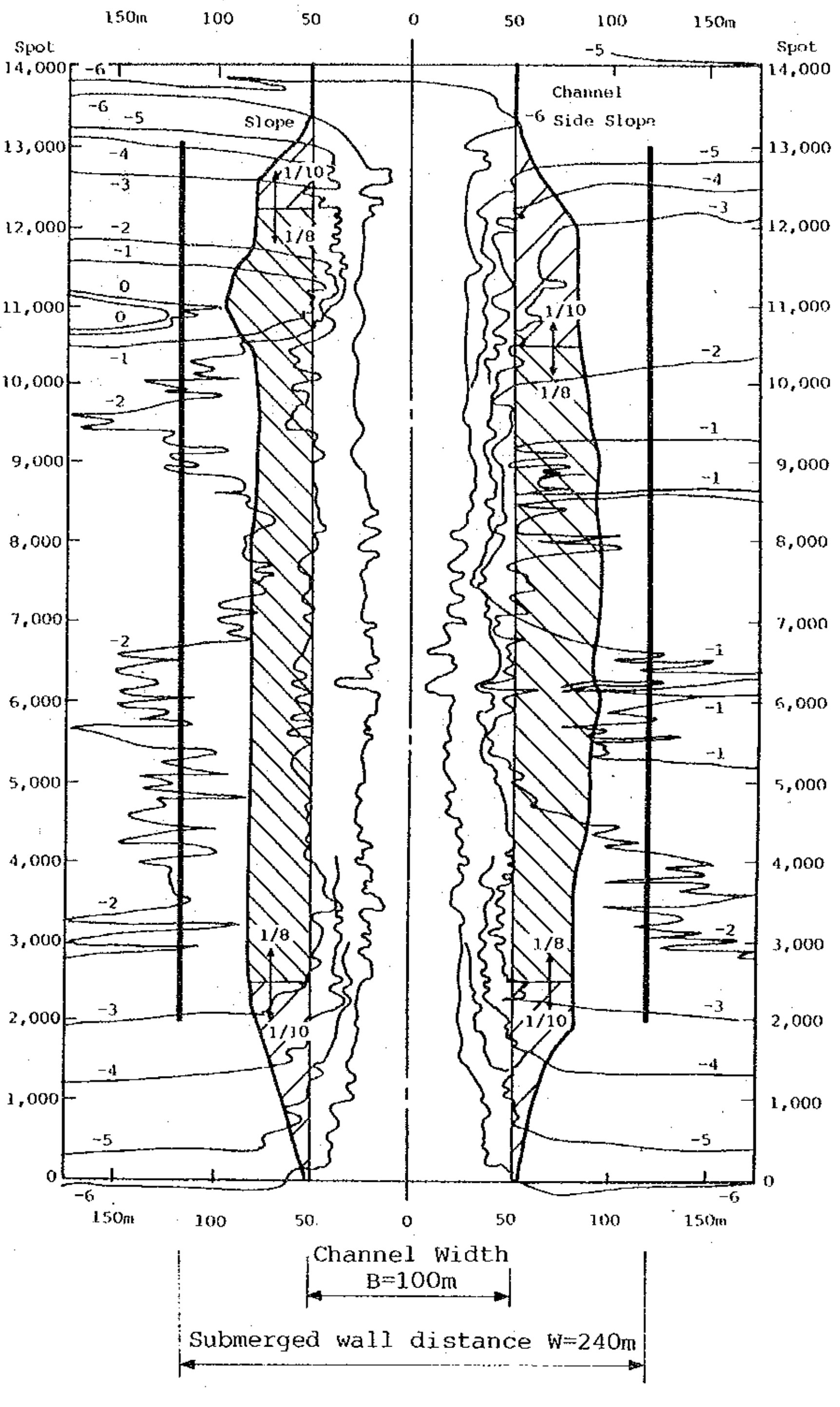


Fig. VI.1.2-1 Layout of Submerged Walls (Comprehensive Plan)

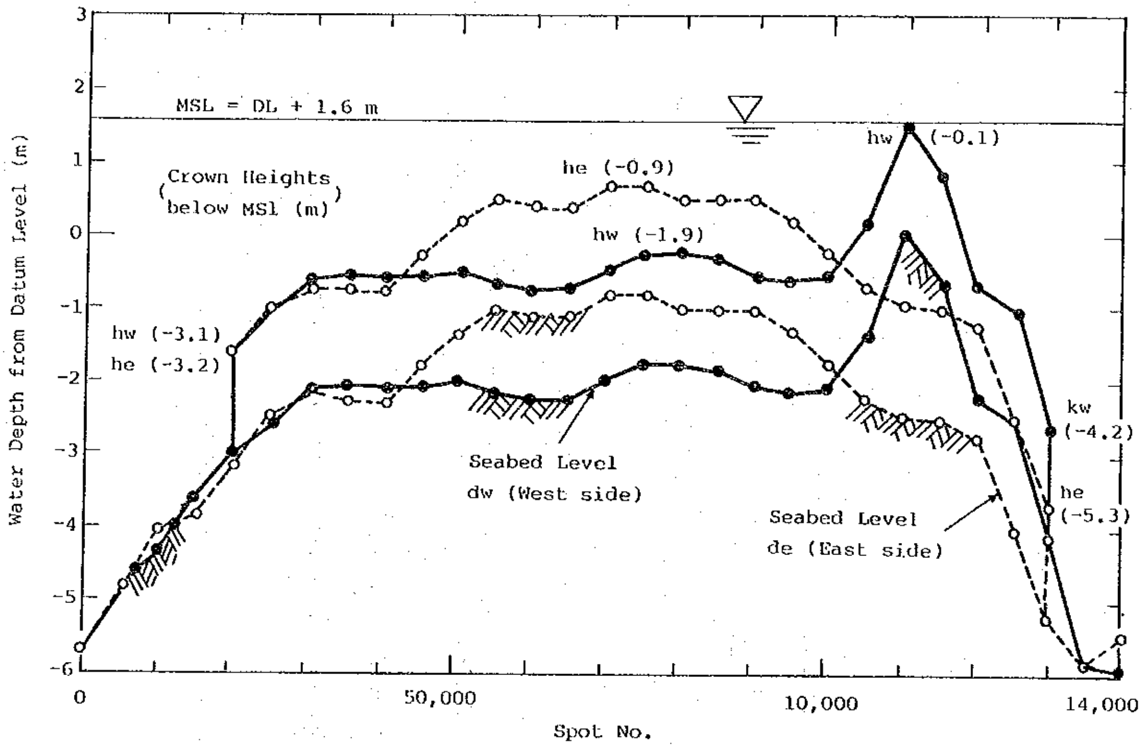


Fig. VI. 1.2-2 Longitudinal Distribution of Water Depth and Crown Height of Submerged Walls

1-2-3 Structural Plan of Siltation Reduction Facilities

The siltation reduction facilities in the Comprehensive Plan are submerged walls as described previously. The design conditions and other information on submerged walls are detailed in the First-stage Plan in Chapter 2 of PART VII. The proposed structure is H-shaped Steel Pile and Concrete Panel Type as shown in Fig. VII.2.2-1.

1-3 Navigational Safety Measures and Navigational Aids Plan

1-3-1 Navigational Safely Measures

(1) Navigation Control

The Harbour Master shall perform the following functions more strictly:

1) Enforcement of law and order in the Port and access channel
2) Matters concerning investigation of marine accidents
3) Removal of menaces to navigation
4) Matters concerning rules of sailing and signals for navigation
5) Matters concerning port regulation
6) Matters concerning patrol of port area
7) Matters concerning search for and arrest of criminals in the port area

In order to facilitate these works, a pilot boat is planned to he purchased.

(2) Other Measures

1) Communication: Equipment of VHF telephone should be compulsory for towing tugs
2) Horsepower: Strengthening of engine power of towing tugs should be compulsory
3) Preparation and supply of the harbour chart and manual useful for navigation
4) Provision of Information of matters necessary for preserving safety of navigation

(3) Channel Maintenance

Above all, dredging should be carried out to maintain sufficient depth and width, and also, sufficient and reliable navigation aids should be laid and maintained well.

1-3-2 Arrangement of Navigational Aids

Depending on changes in the navigation system and traffic conditions, navigational aids should be fully arranged and expanded, making sure that they are highly reliable and economical. On the other hand, the present navigational aids and facilities should also be renewed and upgraded by the reliable and efficient navigational aids.

The following navigational aids are planned to be installed for the objective Comprehensive Plan as shown in Fig. VI.1.3-1:

(1) Two leading lights	at Spots Nos. 17,000 (rear, visibility: 12 miles) and 15,000 (fore, 10 miles with Racon);
(2) One fairway buoy with Racon	at Spot No. -2,000 (8 miles),
(3) Five channel buoys with radar reflectors	at the east edge of Spots Nos. 2,000 and 7,000 (4 miles), and at the west edge of Spot Nos. 4,500, 11,500 (4 miles) and 14,000 (6 miles): and
(4) Eight marking lights on the submerged wall	at both sides of Spots Nos. 2,000, 6,000, 9,000 and 13,000 (visibility : 4 miles)

The visibilities of the leading lights and the fairway buoy are strengthened such that they will be more than the present ones. The submerged wall marking lights are arranged in between the channel buoys.

Presently, there are many complicated problems that should be resolved in Banjarmasin Port. It might be difficult to solve these problems altogether. After establishing order in the channel in the future, however, additional channel buoys are expected to be allotted parallel to the channel, forming pair buoys, as already shown in Fig. V.1.1-1, which will contribute to achieving the greatest degree of navigational safety.

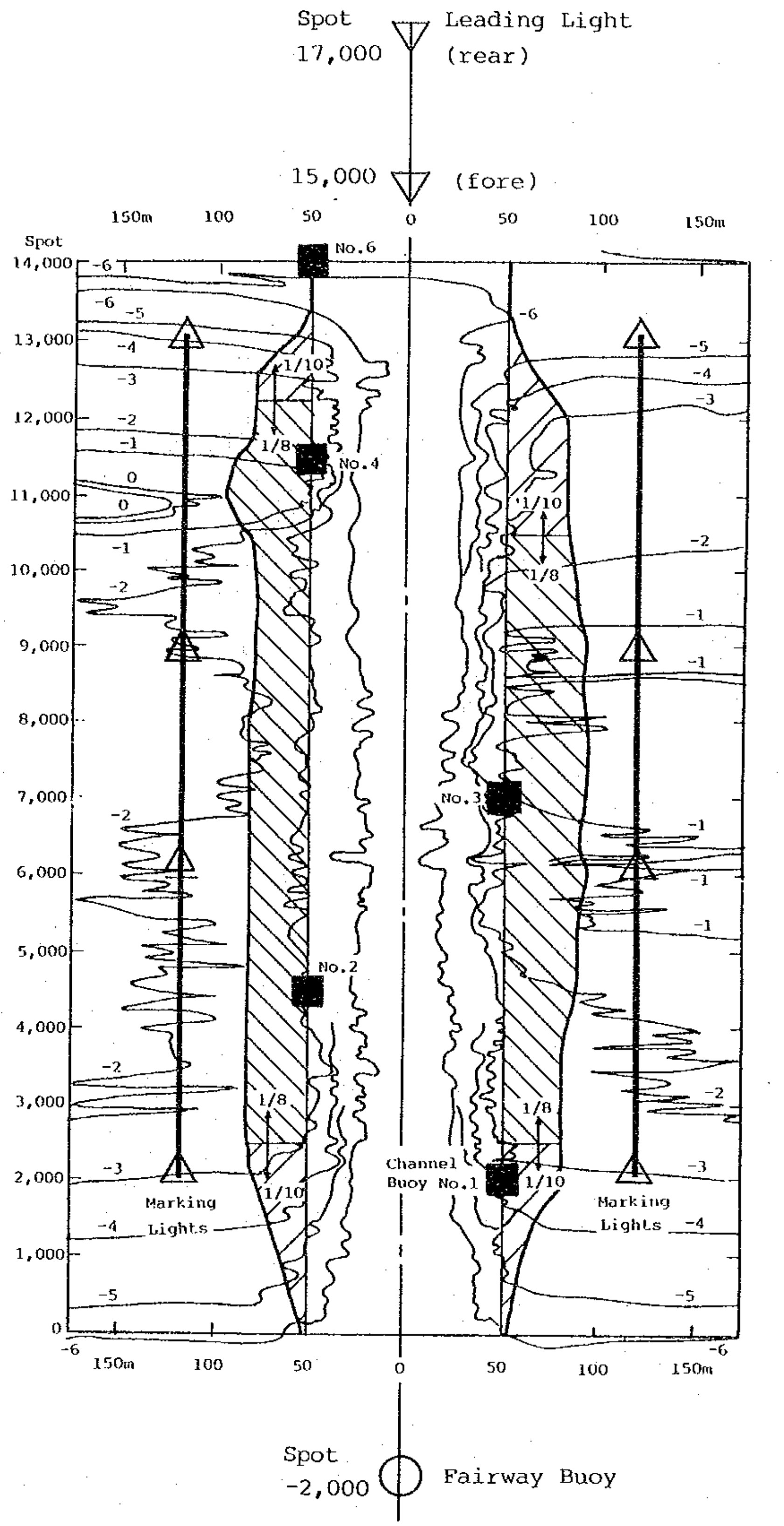


Fig. VI.1.3-1 Arrangement of Navigational Aids (Comprehensive Plan)

Chapter 2 Dredging Plan

2-1 Objectives of Dredging

Firstly, widening and deepening the channel based on the design profile by trailing suction hopper dredgers and a cutter suction dredger of Perumpen is to be executed. Secondly, the channel should be maintained by trailing suction hopper dredgers of Perumpen to meet the design profile. Dredging efficiency improvement plans stated in Section 4-3 of Chapter 4 of PART V are to be carried out.

2-2 Dredging Methods

2-2-1 Planning

Planning dredging operations is first based on dredging requirements. So, it is always necessary to carry out sounding survey by dual frequencies such as 210 kHz and 33 kHz to know the accurate depth of the sea bottom. Through a JICA field survey, it was found that the depth measured by 33 kHz is deeper than that of 210 kHz and the depth of sea bottom measure by lead was sometimes deeper than that measure by an echo-sounder at 33 kHz. The depth measure by an echo-sounder of 33 kHz is closer to the sea bottom than that of 210 kHz.

Planning for maintenance dredging by a trailing suction hopper dredger is to be made as shown in Table III.5.1-1 of Chapter 5 of PART III. A personal computer will be helpful for future planning of dredging operations. Based on various accumulated data, an appropriate dredging plan should be made.

2-2-2 Execution

(1) Major Execution Method

Trailing suction hopper dredgers are most suitable for maintenance dredging of the channel. The ideal situation is that the channel is maintained through a year by one dredger.

Three different monthly and annual dredging capacities are shown in Table VI.2.2-1. The standard capacity is used for the fixing the unit cost for the governmental dredging project and is shown in Table II.4.3-2 of Chapter 4 of PART II. The estimated dredging capacity of a dredger with a hopper capacity of 2,900 m^3 and 4,000 m^3 is based on the records of the semi-capital dredging explained in Section 6-4 of Chapter 6 of PART II. The estimated capacity for a trailing suction hopper dredger with a hopper capacity of 2,000 m^3 is calculated based on the records of the dredger FLORES in 1985 at this channel. The estimated capacity after improvement by fixing spades to dragheads, making a turning basin and applying a tugboat equipped with a blade is calculated from multiplying the improvement efficiency by the capacity based on the records of the semi-capital dredging, etc.

The estimated capacity after improvement is calculated as follows:

$$VE = VA \times a \times b \times c$$

where,

VE: estimated capacity after improvement

VA: estimated capacity based on semi-capital dredging, etc.

a: improvement of concentration ratio by spades (except for the dredger with a 4,000 m^3 hopper)

b: improvement of cycle times by a turning basin (except for the dredger with a 2,000 m^3 hopper)

c: improvement by applying a tugboat equipped with a blade

Table VI.2.2-1 Dredging Capacities

Unit: thousands of cubic meters

Classification \ Hopper Capacity \ Capacity	Monthly Capacity			Annual Capacity		
	2,000 cu.m.	2,900 cu.m.	4,000 cu.m.	2,000 cu.m.	2,900 cu.m.	4,000 cu.m.
1. Standard capacity	230	334	461	2,074	3,007	4,147
2. Estimated capacity based on Semi-capital dredging, etc.	192	232	323	1,728	2,088	2,907
3. Estimated capacity after improvement	229	323	395	2,061	2,907	3,555

For example, the estimated capacity after improvement of the dredger with a 2,900 m^3 hopper is:

$$232,000\times(47/41.3)\times[100/(100-14.2)]\times1.05=323,000 \ m^3/month$$

The number of annual working months are estimated at 9 months considering regular maintenance, etc.

The estimated annual siltation volume is around 2.9 million cubic meters. This volume is similar to the annual dredging capacity of the dredger with a 2,900 m^3 hopper. Over-depth and over-width dredging is necessary to maintain the design profile of the channel. Considering this extra volume, a dredger with a 4,000 m^3 hopper is to be used every few years. The full load draft of a dredger of a 2,900 m^3 hopper is the same as that of a dredger of a 4,000 m^3.

During the widening and deepening of the channel, a Perumpen cutter suction dredger of 3,600 Hp will also be used.

(2) Making the Turning Basin

Among the many plans for improving dredging, reduction of sailing distance by the turning basin is dominant. The estimated dredging volume for the turning basin is about 50,000 m^3. A cutter suction dredger of 3,600 Hp of Perumpen will dredge this volume within a week.

(3) Spades for Dragheads

The spade has the same function of the present edges fixed to dredgers of Perumpen, but the shape of the spade is quite different. Firstly, the same shape of spade as used in Japan will be fixed. The ideal shape will be developed during the actual dredging operation.

(4) Tugboat Equipped with a Blade

A tugboat equipped with a blade is indispensable for the dredging operation by a trailing suction hopper dredger. This tugboat will be used not only as supporting equipment but also as a survey boat.

(5) Draghead Position Indicator System

The completion of one project is accepted when the design profile is cleared in the new guidelines for dredging works by the DGSC. In order to achieve this object, a draghead position indicator is necessary.

(6) Agitation Dredging

As already mentioned, agitation dredging has been executed to secure the navigation of the dredger itself at the initial stage of each maintenance dredging operation in this channel and is sometimes carried out near the slope. It might be useful at least over a short period. A tugboat equipped with a blade can carry out similar agitation dredging. The effects of agitation dredging should be investigated.

(7) Over-depth and Over-width Dredging

Over-depth dredging and over-width dredging are indispensable in determining the design profile. The cross section of this over-dredging in a ordinary case is shown in Fig.VI.2.2-1. Using a tugboat equipped with a blade will reduce this over-depth and 30 cm over-depth is planned. The estimated volume of over-dredging is around 400,000 m^3. Especially in the area near the toe of the slope, over dredging is required to reduce dredging of the slope.

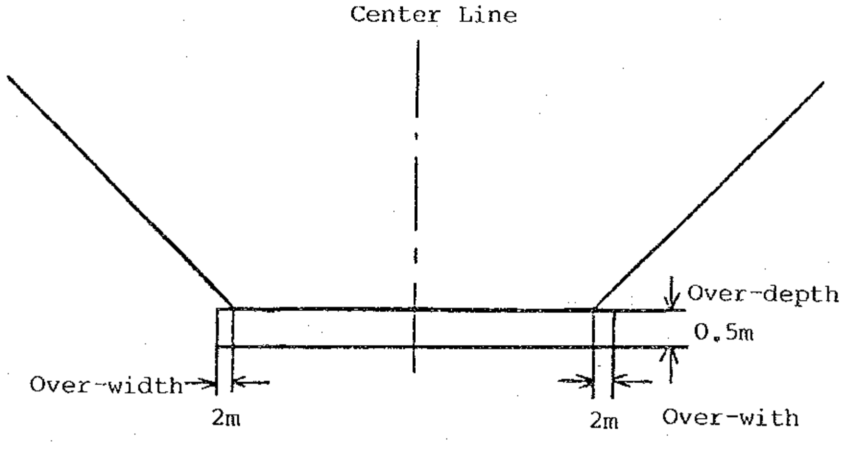


Fig. VI.2.2-1 Over-depth and Over-width Dredging

(8) Timing for Dredging

The estimated annual siltation volume is around 2.9 million cubic meters. This is equivalent to the annual estimated dredging capacity of a dredger with a 2,900 m^3 hopper. This dredger will be used during nine months covering the rainy season.

(9) Order of Dredging

It is necessary to dredge the entire length of the channel totally step by step. For example, the channel is dredged to be deepened every 50 cm.

(10) Dumping Area

The present off-shore dumping area will be used. Dumping near the river mouth in the east might be decided on after trials at the site.

(11) Side-casting

If a dredger can side-cast the dredged material beyond the submerged walls, the number of dredging hours required will be reduced to half of the number now required. However, there will be some problems regarding this method such as influence by wind, wear on the nozzle, behavior of dumped soil, etc. Application of this method might be decided on after the year 2000 after trials at the site.

2-3 Dredging Equipment

2-3-1 Spades for Dragheads

The spade for dragheads has previously been explained in paragraph 2-2-1 of Chapter 2 of PART V.

2-3-2 Tugboat Equipped with a Blade

A tugboat equipped with a blade was previously mentioned in paragraph 2-2-2 of Chapter 2 of PART V. The main engine of the tugboat comprises two sets of 350 ps.

2-3-3 Draghead Position Indicator System

The draghead position indicator system was previously mentioned in Section 2-2-3 of Chapter 2 of PART V.

2-3-4 Remodeling of the Dredger for Side-casting

Side-casting is subject to trials at the site. If this method is proved effective, side-casting operation is expected to be realized by remodeling the present suction hopper dredger. One remodeling plan of FLORES for side-casting is shown in Fig. A VI.2.3-1 of the appendices for reference. This type of dredger will be considered after the year 2000, when replacement of the present dredging fleet is planned.

2-3-5 Others

Future dragheads could be expanded outward near the sea bottom, and the total width will be two or three times the present one as shown in Fig.III.5.2-1 and Fig.III.5.2-2 of Chapter 5 of PART III. Application of these types of dragheads is subject to the future performance in other places or other countries and is planned possibly after the year 2000.

2-4 Dredging Control and Survey

2-4-1 Dredging Control

Dredging control will be carried out as stated in Section 2-3-1 of Chapter 2 of PART V.

2-4-2 Survey

Survey work shall be done as stated in Section 2-3-2 of Chapter 2 of PART V. Sounding surveys in longitudinal directions will be necessary.

2-4-3 Survey Equipment

The same survey equipment referred to in Section 2-3-3 of Chapter 2 of PART V will be necessary.

Chapter 3 Maintenance, Management and Operation Plans

3-1 Maintenance and Management of Siltation Countermeasures

There is no means other than dredging to keep the planned channel profile after siltation occurs.

As far as the siltation countermeasure facility, i.e. submerged walls, is concerned, care should be taken to maintain the function and stability of the structure. Regular surveys will be required to check up on conditions of the structure and change of the seabed in terms of accretion and erosion of the bed around the structure.

One of the most technically difficult subjects is the assessment of how long the effectiveness can be maintained against local accretion and erosion of sediments around the walls, which depends on local conditions of current, waves, sediments, etc. The example of Kumamoto Port proves that the submerged walls have been free from being buried or stripped since their construction at the end of 1986. Hence, the period is generally expected to be long. It is necessary, however, to be prepared to undertake appropriate measures such as raising the crown level, if accretion occurs, for example, at around the sand spit of the upper channel.

3-2 Maintenance and Reliability of Navigational Aids

(1) Reliability

Vessels, audible and electronic aids should be selected, built and equipped such that they will be extremely reliable in ensuring continuity of service in a very hostile environment.

Having obtained aids of the highest quality, duplication or additional equipment is still vital to obviate the risk of an accident, which the failure of an aid could cause.

Care must be taken, however, to ensure that such duplication or additional equipment does not itself lead to confusion.

In particular, the energy source for the aid itself often need to be duplicated: for example, the means of electricity supply may need to be backed up by diesel generators or batteries and gas may also be used as a reserve source.

A prerequisite for a reliable and trouble-free operation is regular preventive maintenance. Nevertheless, when an incident does occur, maintenance personnel must be available to restore normal conditions with the least possible delay and careful thought must be given to the means by which such personnel may be rapidly transported to the site of the incident.

Thorough training of service and maintenance personnel plays a vital role in ensuring regular and accident-free service from navigational aids.

Apart from basic technical training in mechanical or electrical engineering, such personnel should have specialized instruction in maintaining and repairing the relevant equipment. The manufacturers of the equipment are often able to help with this training.

An incident procedure is also important whereby the servicing organization and the navigator or pilot are quickly informed of any accident to a navigational aid.

In the case of an interruption to service due to routine maintenance, this can be accomplished in advance by means of Notice of Mariners or Port Circulars.

When the interruptions are due to an accident or equipment failure, the navigator or pilot should be informed by radio, or by Vessel Traffic Service where such a service is in operation.

(2) Maintenance and Operation

Establishment, maintenance and operation of navigational aids are the responsibility of the central government as a general rule, because navigational aids have a special role in availability, public use, and international.

So, the officials in charge of navigational aids are responsible for keeping the facilities and navigational aids in good condition through the year. In practice, it might be valuable to remember the following points,

1) Visual Aids

Generally a light-house with extinguished light and with abnormal pulse is sometimes more dangerous for a vessel. So, it is very important to observe and check the conditions of the navigational aids, and in the case of something unusual, notification and repair should be carried out as quick as possible.

Previously, lighting and unlighting have been controlled by the officials in charge. At present almost all aids are renewed by an automatic system. There are three systems:

- Automatic solar system
- Pre-arranged timer system
- Manual maintenance by officials

Confirmation of lighting conditions is carried out in the following ways:

- Direct observation by officers in charge or with observation apparatus and adjust them if necessary
- Observation by radio or wire-relayed apparatus
- Reports from users

2) Audible aids

Such aids are normally reffered to as fog signals, and operated by automatic systems.

3) Radio aids

Generally, a timer system is used in the medium wave beacon station and the other beacon stations are operated continuously through the year. And the observation of the radio aids can be done by the system itself, sometimes by cooperation with the other stations and also by reports from the users.

3-3 Maintenance and Repairs of Dredging Equipment

3-3-1 Spare Parts

The crucial item is the supply of spare parts at present. It often happens that dredgers are idling just waiting for spare parts. Without knowing the actual conditions of dredgers, proper supply of spare parts cannot be realized. Trailing suction hopper dredgers have dredging sections added to the ordinary sailing sections and maintaining and repairing them is more difficult.

3-3-2 History Sheets

Preparation of history sheets of each dredger and supporting equipment showing the past maintenance and repairing records will be carried out. Characteristics of each dredger and supporting equipment will become clear after analyzing these history sheets.

3-3-3 Maintenance and Inspection Standards

Various data will be collected to make maintenance and inspection standards for the Perumpen dredging fleet. The standards will be compared with Japanese standards stated in Section 5-3 of Chapter 5 of Part III and their own standards should be established. The maintenance and inspection standards made by Perumpen will be applied to actual operations and some items will be revised. These activities will result in preventive maintenance.

3-3-4 Home Docking System

It is not clear whether a home docking system will be realized or not. If it is realized, Perumpen will follow this system.

3-3-5 Perumpen's Plan for a New Own Shipyard

Perumpen plans to build its own shipyard in which it can maintain and repair all its own vessels in the future. This will be an ideal case.

3-4 Dredging Management and Operations

In order to effectuate the management and operation of maintenance dredging, the necessary improvements are suggested based on the following three items:

3-4-1 Organizations

As mentioned in the previous chapter, the four organizations as the DGSC, KANWIL DEPHUB, Perumpen and Perumpel play major roles in the management and operation of maintenance dredging under the control of the MOC, as shown as Table II.4.2-1.

To oversee the maintenance dredging, it is necessary to establish a "core organization" within the MOC that will be responsible for maintenance dredging planning, administration and development. The core organization would be responsible for drafting and initiating almost all maintenance dredging items with the close cooperation of these organizations.

3-4-2 Maintenance and Repair and Supply of Equipment for Dredgers

The maintenance and repair of dredgers has been increasing. However, regular maintenance docking of some hopper dredgers has not been carried out due to efforts to increase productivity. And the procurement of spare parts and materials and the execution of major repairs are often delayed due to lack of funds, a long decision-making process and other factors.

A monitoring system for maintenance and repair of dredgers including procurement of spare parts and materials should be established because Perumpen's dredgers are national property. If maintenance and repair of dredgers are not carried out systematically, the dredgers will age rapidly.

3-4-3 Personnel and Training

The number of directorates of Perumpen was reduced from four to three in March 1989. However, the total number of personnel is almost the same.

Perumpen has set a standard crew composition of dredgers. It is necessary to consider the total number of crew members during the holidays.

At present, training of the personnel "Personnel Development Program" for Perumpen is being carried out. It is necessary to proceed with such training, not only for the personnel of Perumpen, but also for the personnel of related maintenance dredging organizations.

Chapter 4 Rough Cost Estimation

4-1 Project Components

The cost of the Comprehensive Plan proposed in the previous chapters of this part will be discussed in this chapter. From the viewpoint of the capital cost, the Comprehensive Plan with the target year of 2000 can be classified as follows.

- Capital dredging to secure the channel dimensions of 100m width, DL -6m depth and slope of 1 on 8 (partially 1 on 10) including making the turning basin in the middle of the channel

- Construction of submerged walls

- Installation of navigational aids and purchase of one pilot boat

- Preparation and installation of the dredging equipment and other machinery/survey equipment

(1) Capital Dredging

The capital dredging work of the proposed comprehensive plan can be done with a combination of the existing Perumpen's dredgers. The capital dredging volume including the turning basin is totally 8.03 mill. m^3 among which 5.81 mill. m^3 will be dredged by the trailing suction hopper dredgers and 2.22 mill. m^3 by the cutter suction dredger. The original channel dimensions, the present channel dimensions in other words, is assumed to be of DL -5.5m depth, 50m width and 1 on 8 slope which is considered the average dimensions maintained by DGSC recently as discussed in sub-section 1-4-2 of PART V. The maintenance dredging is excluded from the scope of the Project, but the maintenance dredging during the period of capital dredging is covered within the scope of the Project as a part of the capital dredging.

(2) Submerged Walls

Submerged walls will be constructed from Spot.2,000 up to 13,000 on both sides of the channel. The total length of submerged walls is 22 km. The crown height of the submerged wall is 1.5m above the sea bottom and the distance between the walls is 240m. The standard cross section of submerged walls is shown in Fig. VII.2.2-1.

(3) Navigational Aids

According to section 1-3 of this part, the navigational aids proposed in the Comprehensive Plan are as listed below.

- Leading Light (Rear) ; 25m Height, 12 NM x 1 Set

- Leading Light (Front) ; 15m Height, 10 NM with Racon x 1 Set

- Fairway Buoy with Racon; 8 NM x 1 Set

- Channel Buoy with Rader Reflector ; 4 NM x 4 Sets, 6 NM x 1 Set

- Marking Light for Submerged Walls ; 4 NM x 8 Sets

- Purchase of One Pilot Boat

(4) Dredging Equipment and Other Machinery

The proposed dredging efficiency improvement plans include items related to the channel, the dredger and the other supporting equipment. The channel item, namely making the turning basin is included with the capital dredging as was discussed previously. The items for the dredging equipment and other machinery/survey equipment are listed below.

- Tugboat Equipped with a Blade and Survey Equipment x 1 Set
  - Tugboat with a Blade x 1
  - Echo Sounder (210kHz/33kHz) x 1

- Fast Survey Boat Equipped with Complete Survey Equipment x 1 Set

  Survey Boat (20 knots max.) x 1

  Positioning System x 1

  Echo Sounder (210kHz/33kHz) x 1

  Data Processing System x 1

- Spade for Draghead x 8 Sets

- Draghead Position Indicator System for Dredger x 1 Set

- New Platform in the East of the River Mouth x 1 Set

- Personal Computer on Site x 1 Set

- Tide Pole x 2 Sets
  (near Sports Nos: 5,000 and 10,000)

4-2 Cost of the Comprehensive Plan

The project cost of the proposed Comprehensive Plan is shown in Table VI.4.2-1.

The total project cost of the Comprehensive Plan is estimated at about 51 million US$ broken down into the foreign component of 37 million US$ (70% of the total) and the local component of 14 million US$ (30% of the total).

About 60% of the total is for the submerged walls, 17% for the capital dredging, 3% for the dredging equipment and 2% for the navigational aids.

Table VI.4.2-1 Project Cost of the Comprehensive Plan

Unit: thousands of US$

ITEM	UNIT	QUANTITY	UNIT COST	FOREIGN	LOCAL	TOTAL	
[COMPREHENSIVE PLAN COST]							
Capital Dredging				0.0	8,552.0	8,552.0	16.7%
Dredging by Hopper	m^3	5,810,000	0.00081	0.0	4,713.4	4,713.4	
Dredging by Cutter	m^3	2,218,000	0.00173	0.0	3,838.6	3,838.6	
Submerged Walls	m	22,000	1.4	27,593.1	2,741.9	30,335.0	59.3%
Dredging Equipment				1,696.2	2.4	1,698.6	3.3%
Tug Boat(700PS)	Nos.	1	742.6	742.6	0.0	742.6	
Survey Boat	Nos.	1	656.8	656.8	0.0	656.8	
Spade for Draghead	Nos.	8	1.7	13.7	0.0	13.7	
Draghead Pos. Indicator	Nos.	1	274.5	274.5	0.0	274.5	
Survey Platform	Nos.	1	6.9	4.5	2.4	6.9	
Personal Computer	Nos.	1	3.4	3.4	0.0	3.4	
Tide Pole	Nos.	2	0.3	0.7	0.0	0.7	
Navigational Aids				982.8	152.7	1,135.5	2.2%
Leading Light Rear	Nos.	1	171.6	102.9	68.6	171.6	
Leadign Light Front	Nos.	1	178.4	109.8	68.6	178.4	
Fair-way Buoy	Nos.	1	86.5	82.4	4.1	86.5	
Channel Buoy	Nos.	5	24.5	116.7	5.8	122.5	
Sub. Wall Marking Light	Nos.	8	3.4	22.0	5.5	27.5	
Pilot Boat	Nos.	1	549.1	549.1	0.0	549.1	
Mob./Demob.	L.S.	1		686.3	53.2	739.5	1.4%
Engineering Services				1,725.0	928.8	2,653.8	5.2%
Detailed Desing	L.S.	1		690.0	371.5	1,061.5	
Superivision & Survey	L.S.	1		1,035.0	557.3	1,592.3	
Physical Contingency	L.S.	1		4,307.2	1,704.5	6,011.7	11.8%
Total				36,990.6 72.4%	14,135.5 27.6%	51,126.1 100.0%	100.0%

Chapter 5 Examination of the Present Port Development Plan

5-1 Demand Forecasts

The present post development at Banjarmasin Port has its basis in the Master Plan Study by the JICA in 1977 and the Review Master Plan by Pacific Consultants International, P.T. Diagram and P.T. Dacrea in 1985.

The Review Master Plan contains a forecast of cargo volume in 1993 and 2000, i.e., a total of 2,589 thousand tons in 1993 and 4,214 (low) to 4,915 (high) thousand tons in 2000. Knowing the fact that the record of total cargo volume in 1989 was 3,548 thousand tons/m^3 which already exceeds the above forecast volume in 1993, it can be understood that the growth rate of the Port has been faster than that projected one in the Plan. This difference comes from an extraordinary increase in export and incoming. The forecast of our study is 6,784 and 8,861 thousand tons/m3 in 1995 and 2000, respectively, as discussed in Part III, Chapter 1. It could be accepted that the development potential of Banjarmasin Port in the future is high, provided that appropriate investments to port infrastructures are made on a timely basis.

The forecast of ship calls in the Review Master Plan is naturally of the same nature as the cargo forecast. It should be noted that the Review Master Plan did not include a study regarding the access channel and no comparison can be made with this study on channel planning.

5-2 Facility Development Plan

The Review Master Plan recommended the following development of new berths:

	Trisakti (Depth-9m)	New Martapura (-5m)
1993 (Phase-I)	320m	500m
2000 (high)	1,280m	1,755m
(low)	1,120m	1,541m

The ADB's 8th port project, which is currently being carried out and expected to be completed in 1991, covers 120m (Depth -9m) at Trisakti and 350m (-5m) at New Martapura, which is less than the above plan.

Taking into consideration the above demand forecasts, there might be a policy to exepedite the development of Banjarmasin Port. One special point to be remembered in this regard is that containerization at Banjarmasin Port has greatly increased in the past three years. It is expected that the forecast of container throughput made in the Review Master Plan, i.e. 7,433 TEU in 1989 and 8,269 TEU in 1993 (the actual record in 1989 was a throughput of 4,180 TEU and an annual growth rate of 208%), will possibly be exceeded in the near future.

With regard to channel planning, the above Plan and the development project are in agreement with this study in terms of water depth at Trisakti Terminal, i.e. -9m, and that at the access channel, i.e. -6m, taking account of the tidal level in the channel.

5-3 Planning of Basins

In the planning of Banjarmasin Port, basins for anchoring and cargo handling should be allocated in the offshore area and the river. This is not critical, however, because there is enough space in these areas except for the basins for waiting for high tide and/or for opening of the access channel at the river mouth.

5-3-1 Number of Basins at the River Mouth

According to the results of channel traffic simulations, the probability of expected number of simultaneously waiting ships at the river mouth in 2000 is as shown in Fig. VI.5.3-1. The expected maximum and average numbers are 2 and 0.6 ships, respectively, in the case of a channel maintained with a profile of -6m in depth and 100m in width. Hence the required number of basins can be set at 2.

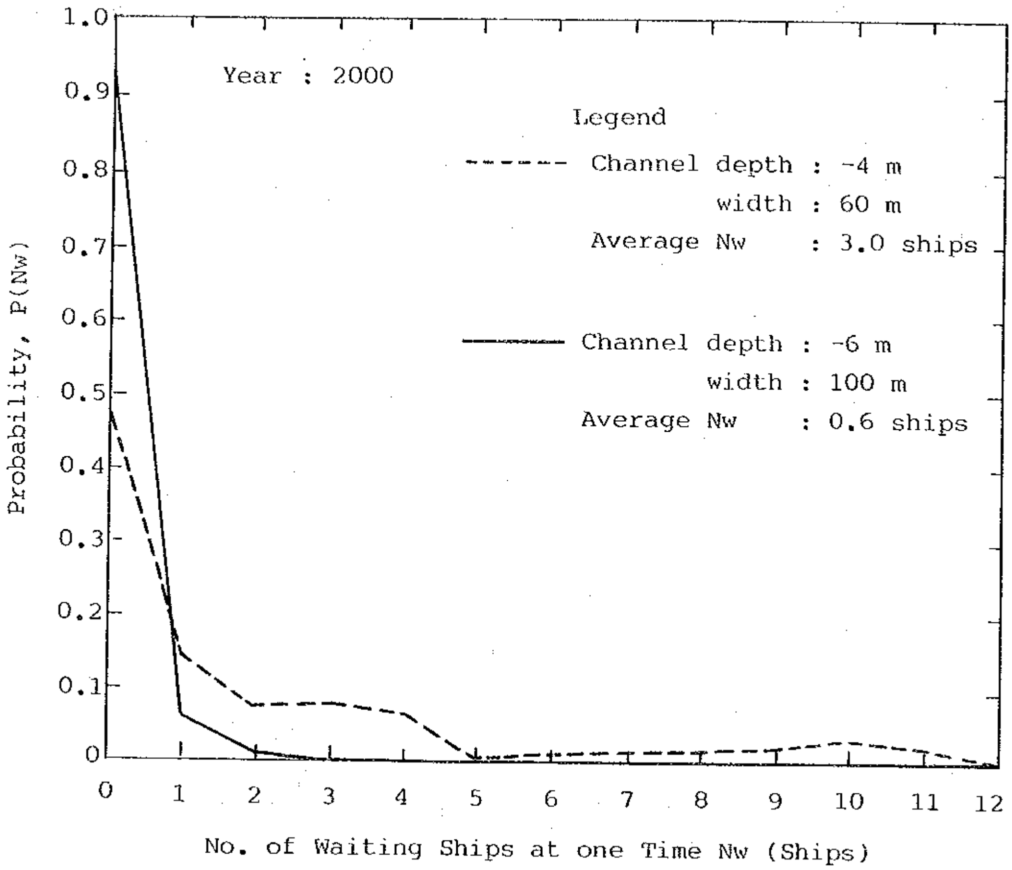


Fig. VI.5.3-1 Simulated Probability of Expected Number of Waiting Ships at the River Mouth in 2000

5-3-2 Size and Location of the River Mouth Basins

The basins are supposed to be used by ships with single anchor, each of which requires a circle with the following radius R:

$$R = L_{oa} + 6d,$$

Where L_{oa} is the overall length and d is the water depth. Substituting dimensions of the design ship (10,000 DWT), i.e. L_{oa} = 130m and d = 6m, R becomes 170m.

The most suitable location for the basins is on the west side of the river month near the Pilot Station, as shown in Fig. VI.5.3-2, taking water depth and others into account. The current in the area flows only in an up and down direction, and hence the above circle has a rather safe radius toward the center of the river.

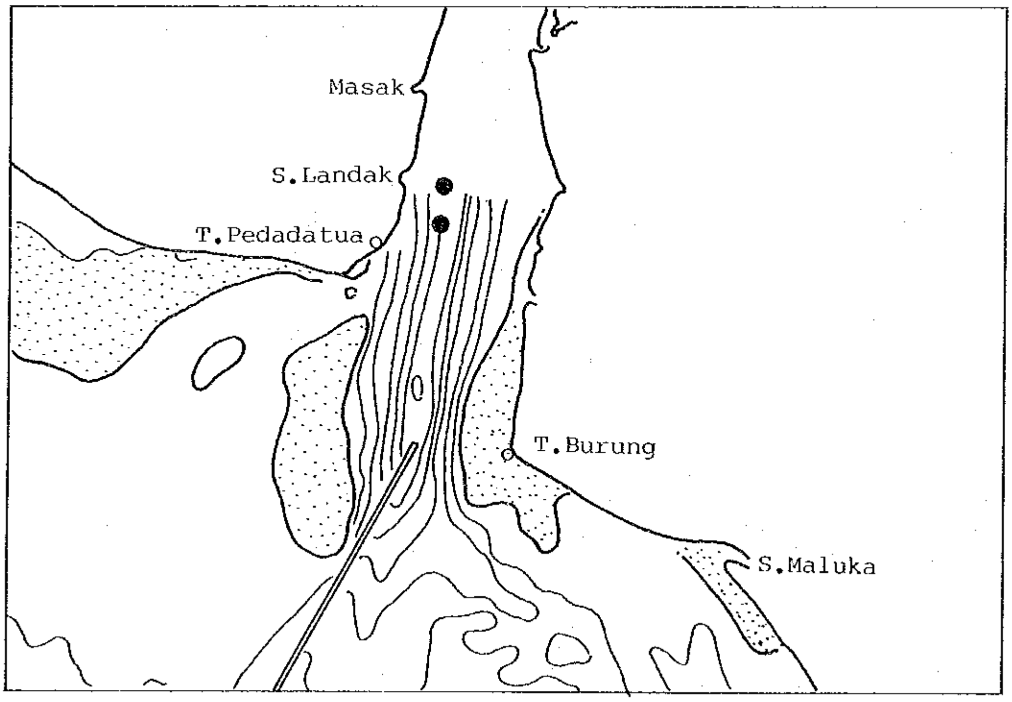


Fig. VI.5.3-2 Arrangement of Basins at the River Mouth

PART VII THE FIRST-STAGE PLAN

Chapter 1 The Plan's Stages and the First-stage Plan

1-1 Basic Principles

In dividing the Comprehensive Plan, for which the target year has been set as 2000, the most important principles to be taken into consideration in this project are:

a. Careful implementation with attention on the particular subjects involving technically difficult judgment and which may need confirmation through step-by-step execution and surveys, and

b. Steady implementation with flexibility to achieve substantial and better effects in each stage plan.

1-2 Divison of Stages and the First-stage Plan

The Comprehensive Plan consists of the four following major elements:

(1) Construction of anti-siltation facility, i,e, submerged walls from Spots Nos. 2,000 to 13,000,

(2) Undertaking of dredging efficiency improvement measures by mechanical, operational, and other means, and execution of capital dredging (maintenance dredging is excluded from the scope of the project),

(3) Undertaking of navigational safety measures and installment of navigational aids, and

(4) Engineering services for preparatory works,supervision and studies with follow-up surveys.

It would be better if the construction works of the submerged walls were not carried out all at once, but instead in the several steps with follow-up surveys. From the practical point of view, however, the principal division is to protect a certain length of the channel which will be enough to secure the siltation reduction effect at the most effective places or will have the highest cost-effectiveness. Then a reasonable basic division might be two stages separated by the non-continuous state (Case III-4) as the first stage.

Dredging efficiency improvement measures should be undertaken at the first-stage except for those that need prior experiments. The capital dredging should be included in the first-stage parallel to the completion of the non-continuous submerged walls.

The navigational safety measures and installation of navigational aids should also be undertaken from the first-stage.

The engineering services should cover the follow-up survey through and after the first-stage construction works.

The target year for the first-stage construction works can be set as 1995 taking into account the schedule.

The concrete project items are summarized as follows:

1-2-1 Siltation Reduction Facility

(1) The First-stage Plan
Construction of four submerged walls on the both side of the channel at Spots Nos. 3,000 to 7,000 and 10,000 to 13,000 with a total length of 14km. The arrangement is illustrated in Fig. VII. 1.2-1.

(2) The Second-stage Plan
Construction of four submerged walls from Spots Nos. 2,000 to 3,000 and 7,000 to 10,000 with a total length of 8km.

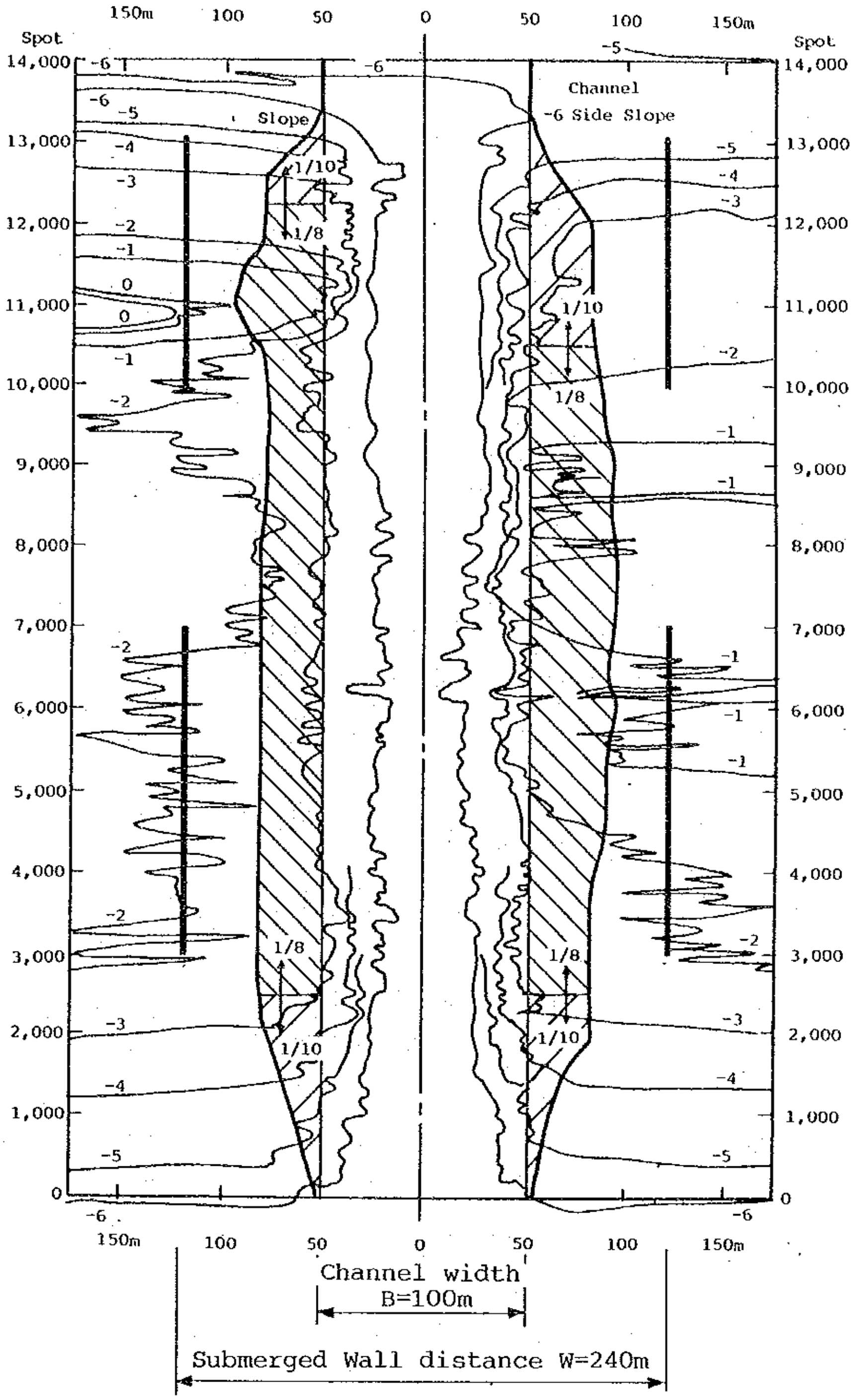


Fig. VII.1.2-1 The First-stage Plan of the Submerged Wall Arrangement

1-2-2 Dredging Plan

Based on the plan's stages, the following dredging plan will be carried out in each stage:

(1) The First-stage Plan

The dredging plan in the first stage aiming for the year 1995 is:

a. Widening and deepening the channel based on the design profile
b. Making a turning basin in the middle of the channel
c. Fixing spades to dragheads
d. Constructing a tugboat equipped with a blade and survey equipment
e. Installing a draghead position indicator in a dredger
f. Using devices such as flow, concentration and draft meters in a dredger
g. Installing a personal computer on site
h. Carrying out sounding by dual frequencies such as 210 kHz and 33 kHz with cross-checking by lead
i. Setting two tide poles along the channel near Spots Nos.5,000 and 10,000
j. Constructing a new platform for surveying in the east part of the river mouth
k. Constructing a fast survey boat equipped with complete survey instruments
l. Preparing necessary spare parts
m. Preparing history sheets of each dredger and supporting equipment showing the past maintenance and repaire records
n. Prepairing maintenance and inspection standards for the dredging fleet
o. Surveying the effects of the present agitation dredging
p. Carrying out trial dumping at the river mouth
q. Carrying out trial side-casting in which the dredged material will be dumped outside the submerged walls

(2) The Second-stage Plan

The dredging plan in the second stage aiming for the year 2000 is:

a. Maintaining the channel through the whole year based on the design profile by improved dredging efficiency.

b. Modifying the spade for dragheads and the blade for a tugboat
c. Studying a draghead expanding outward and a wide draghead
d. Using a new density meter that can continuously record the underwater density
e. Applying an accurate positioning system using satellites
f. Using maintenance and inspection standards for the dredging fleet
g. Following a home docking system, if established by the government
h. Studying Perumpen's plan for constructing its own shipyard
i. Continuing surveying the effects of the present agitation dredging
j. Continuing carrying out trial dumping at the river mouth
k. Continuing carrying out trial side-casting in which the dredged material will be dumped outside the submerged walls

1-2-3 Navigational Safety measures and Navigational Aids

(1) The First-stage Plan

a. Strengthening navigation control and other measures as described in Part VI, Chapter 1, 1-3-1.

b. Purchase and installation of the navigational aids. The arrangement of the navigation aids is presented in Fig. VII. 1.2-2, which includes two leading lights with a Racon, one fairway buoy with Racon, five channel buoys with radar reflectors (their spot numbers and visibility are the same as the Comprehensive Plan stipulated in Part VI, chapter 1, 1-3-2), and eight marking lights on the submerged walls at Spots Nos. 3,000, 7,000, 10,000, and 13,000.

c. Purchase of a pilot boat.

(2) The Second-stage Plan

Relocation of six marking lights on the submerged walls following the Comprehensive Plan.

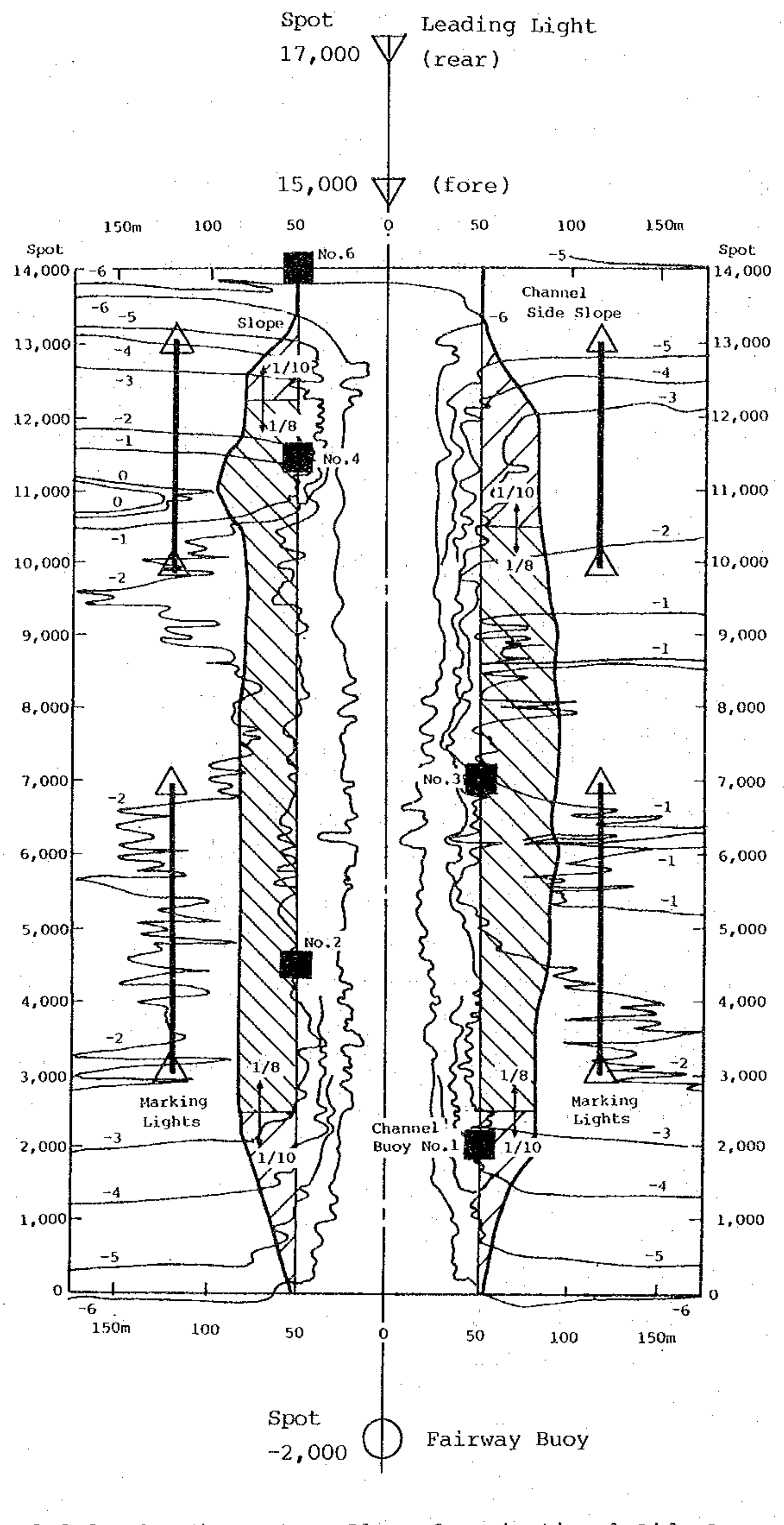


Fig. VII.1.2-2 The First stage Plan of Navigational Aids Arrangement

1-2-4 Engineering Services

(1) The First-stage Plan

a. Preparatory works including borings and other surveys; planning, and detailed design(D/D), Preparation of bidding documents;

b. Supervision of construction works, and of procurement and installation of equipment.

c. Administration of trial dredging operations, and

d. Monitoring and follow-up surveys of structures, topography and siltation.

(2) The Second-stage Plan

a. Supervision of construction works, and

b. Monitoring and follow-up surveys of structures, topography and siltation.

Chapter 2 Preliminary Design of Facilities and Equipment

2-1 Channel Arrangement and Cross Sections

The channel alignment is the present one oriented to 208.5 degrees from the north. The profile of the channel is -6m in depth, 100m in bottom width, and side slope of 1/8 and 1/10 as already shown in Fig. VII. 1.2-1.

A turning basin with a diameter of 165m is arranged roughly in the center of the channel, or at Spot No. 6,735.

The lateral cross sections are illustrated in Fig. VII.2.1-1.

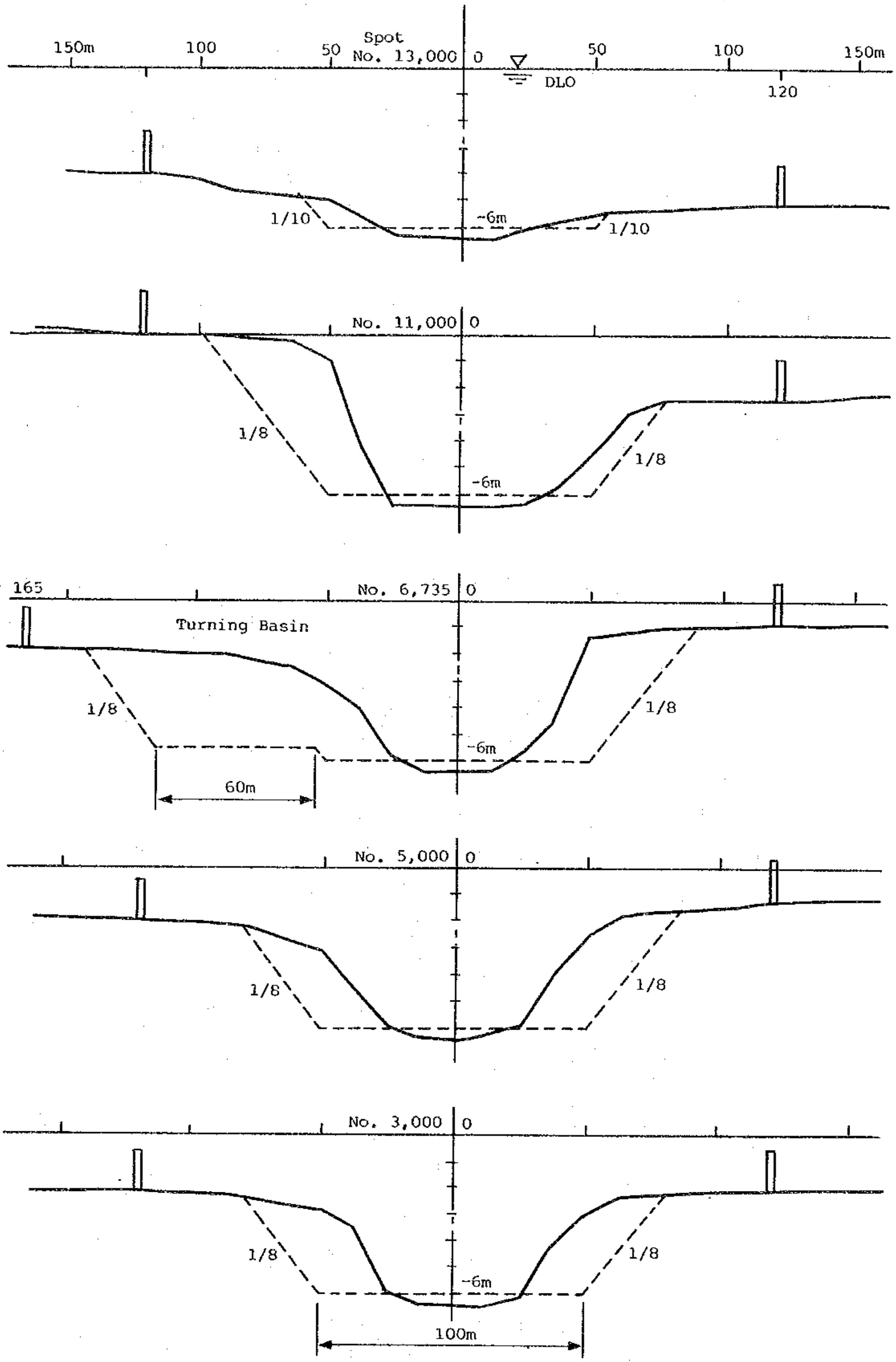


Fig. VII.2.1-1 Profiles of Channel and Location of Submerged Walls

2-2 Siltation Reduction Facilities

The siltation reduction facilities proposed in the First-stage Plan are submerged walls to be constructed along both sides of the existing channel with a 240m distance between the walls from Spot No. 3,000 to 7,000 and from Spot No. 10,000 to 13,000 as shown in Fig. VII.1.2-1.

In designing the structure of the submerged walls, the following points should be taken into account.

a. Function of Submerged Walls

- impermeability as a wall structure
- durability against erosion
- stability from the viewpoint of the crown height and
- stability against external forces, etc.

b. Construction Work

- very soft soil condition
- construction speed
- easily obtained and constant material supply
- simple procedure of construction work
- minimal influences from oceanographical conditions and
- minimal cost, etc.

c. Others

- easy maintenance or free from maintenance and
- applicability to staged plan, etc.

2-2-1 Design Conditions

(1) Crown Height : 1.5 m above sea bottom

(2) Tide

Indian Spring High Water	:	DL +2.859 m
Mean Sea Level	:	DL +1.627 m
Indian Spring Low Water	:	DL +0.396 m

(3) Soil Condition

The results of the soil survey by the Study Team are shown in the appendices, Figs. A VII.2.2-1 and -2, and summarized below.

- The top layer was composed of dark gray silty sand with organic fragments to a thickness of about 3 to 4 m.

- This top layer covers mostly soft silt and clay up to the end of bore holes of about 21 m below the seabed.

- N-value :

  Bore Hole No.1 located east of Spot No. about 4,000;

  N-value varies from 2 (3m below seabed) to 4 (21m below seabed)

  Bore Hole No.2 located west of Spot No. about 10,000;

  N-value varies from 0 (3m below seabed) to 6 (21m below seabed)

- Unconfined Compression Strength (qu)

  Bore Hole No.1;

  qu varies from 0.217 kg/cm^2 (12m below seabed) to 0.502 kg/cm^2 (20m below seabed)

  Bore Hole No.2;

  qu varies from 0.325 kg/cm^2 (6m below seabed) to 0.515 kg/cm^2 (16m below seabed) and 0.3 kg/cm^2 (20m below seabed)

(4) Design Wave

When designing the structure against wave force, the wave scale with a return period of the same duration as the lifetime of the structure is applied. In the Banjarmasin area, however, there are not enough data to be used to estimate such wave heights against the return period. According to the year long survey of around the offshore end of the existing channel (water depth : about 10 m) from September, 1988 to August, 1989 carried out by the Study Team, the largest significant wave height ($H_{1/3}$) was 1.72 m ($T_{1/3}$=5.8 sec) and the largest maximum wave height (Hmax) was 2.68 m (Tmax=6.5 sec). No wave heights ($H_{1/3}$) over 2 m has ever been recorded even based on other sources, e.g. historical data.

The wave condition to reproduce 2m of $H_{1/3}$ at the wave recording point above was therefore applied. After some calculation the following wave condition was chosen as the design offshore wave, estimated to be the worst wave condition the facility would experience.

H_o = 2.94 m, T = 6 sec and direction from SW

Once the offshore wave condition has been determined, the design wave heights for each point can be calculated by taking refraction and shoaling into account. Results of wave heights calculation with a consideration of 1m erosion are shown in the appendices, Tables A VII.2.2-1(1) and (2) and Figs. A VII.2.2-3 to 16. After an examination of wave forces against certain points along the proposed submerged walls, the following condition was taken as the representative critical case at this stage of the feasibility study.

$H_{1/3}$ = 2.4m, Hmax = 3.8m, T = 6 sec, beta = 70°, at DL -2m

where beta is the angle between the direction of wave approach and the line normal to the submerged walls

2-2-2 Comparison of Structural Types

The following three structural types can be considered as examples of the possible structural types.

- H-shaped Steel Pile and Concrete Panel
- Concrete Block and Bamboo Pile
- Gravel and Sheet Pile

The above three types were compared as shown in Table VII.2.2-1 and summarized as follows.

The Gravel and Sheet Pile Type is considered to be a gravity type structure requiring a good seabed bearing capacity. The soil survey, revealed the need for soil replacement with sand or some better material. This kind of soil replacement would be rather difficult.

This structure also requires 2 ton class stones which would be difficult to quarry locally resulting in high cost.

The Concrete Block and Bamboo Pile Type is considered to be a modification of the gravity type but this also needs soil improvement supplemented by bamboo piles for bearing capacity. This structure requires rather complicated procedures and a good supply of bamboo is critical.

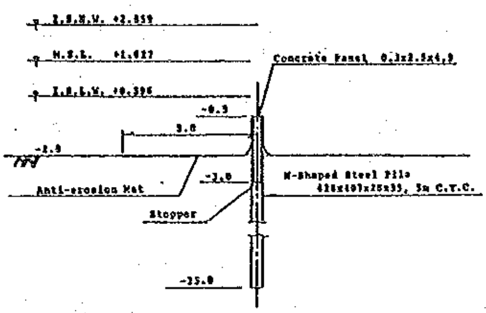
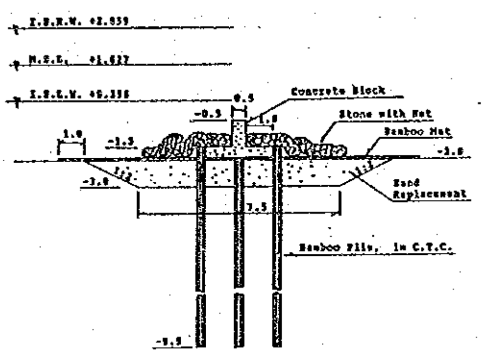
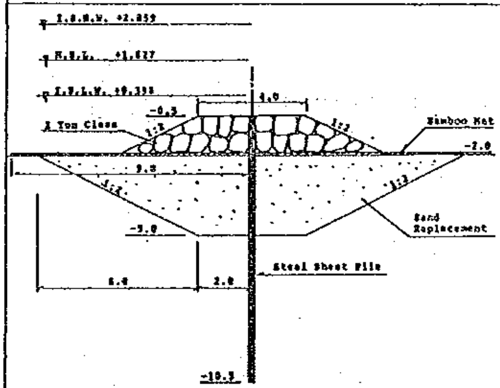
The H-shaped Steel Pile and Concrete Panel Type is a simpler construction than the others and applies mostly factory made materials which can be constantly supplied and easily controlled as far as quality is concerned, securing a constant rate of construction. This structure does need rather accurate piling work for the H-shaped steel piles.

The H-shaped Steel Pile and Concrete Panel Type is judged to be appropriate at this stage of the feasibility study. If more suitable conditions, e.g. better soil condition especially in the top layer, are specified in the detailed design stage, a simpler gravity type structure could be applied after careful consideration.

2-2-3 Structure of Submerged Walls

The standard cross section of the proposed submerged wall is shown in Fig. VII.2.2-1.

Table VII.2.2-1 Comparison of Structural Types

Structural Type	Simplicity of Work	Costruction Speed	Material Supply	Cost
 H-Shaped Steel Pile + Concrete Panel	Simple	High	○	Low
 Concrete Block + Bamboo Pile	Complicated	Low	△	Medium
 Gravel + Sheet Pile	Medium	Medium	△	High

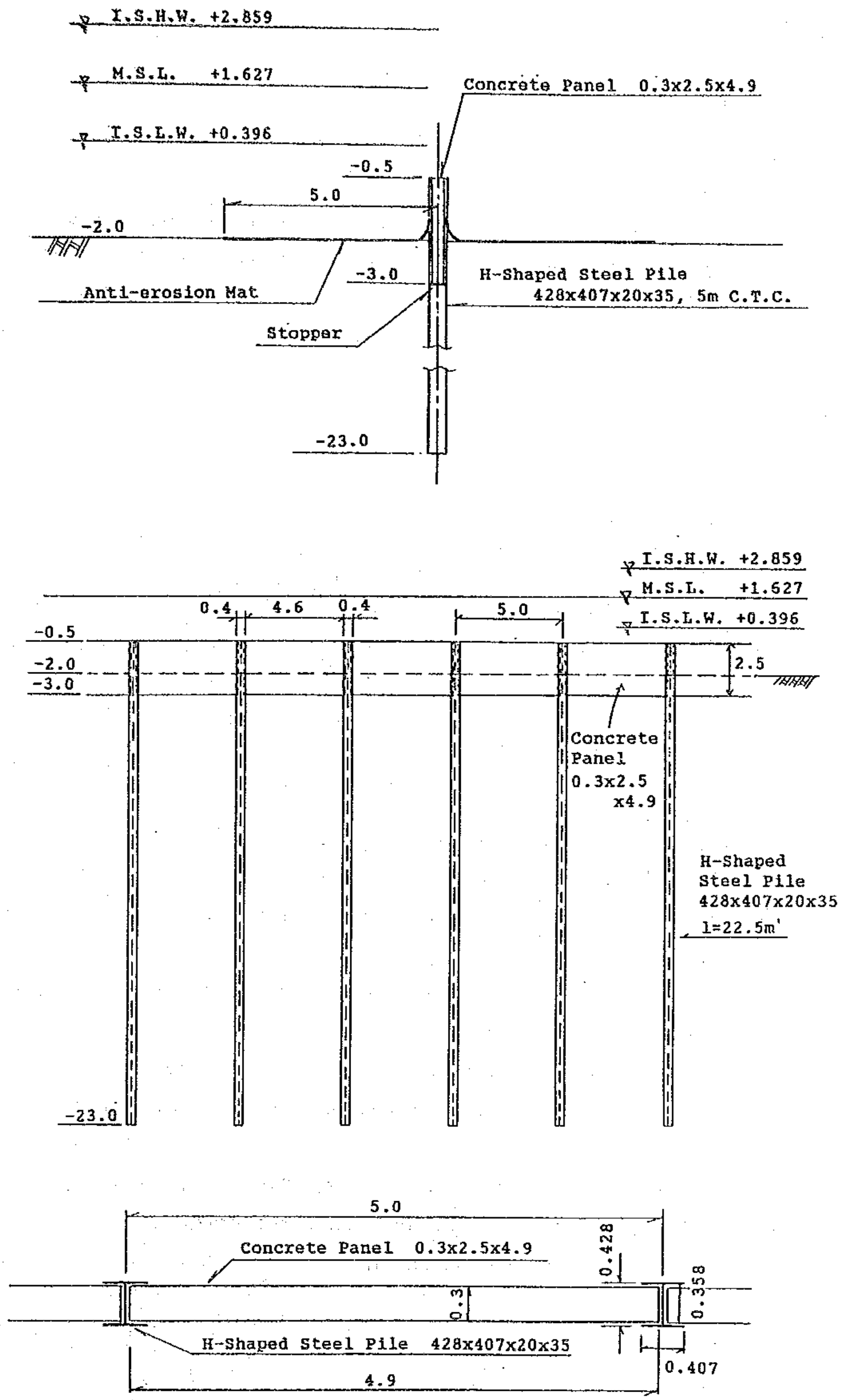


Fig. VII.2.2-1 Structural Plan of Submerged Walls

2-3 Navigational Aids

2-3-1 Design Conditions

(1) Lighted Buoys

The lighted buoys are designed under following local conditions:

Water depth : 6m (in the channel)

Tidal range : 3.35m

Wave height : 2.4m (H1/3)

Current speed : 3kt

Wind velocity : 40m/sec

Sea bed : Silt

(2) Pilot Boat

The pilot boat is designed for special coastal services which has enough sea worthiness at the site. The draft must be very shallow, e.g. around 1.5m and the speed must be high, e.g. more than 20 kt.

2-3-2 Specifications and Design

(1) Leading Lights (2 Units)

Structure : Skeleton type steel tower on pile foundation

Height : 15m (fore) and 25m (rear) above DL

Lighting Equipment :

Lantern, lamp, automatic lamp changer and flasher

Power Source :

Solar cell module, charging controller(protection against over charge), and storage batteries.

Accessories :

Synchronizer transmitter Racon (fore), synchronizer receiver (rear) and radar reflectors.

The design drawings are shown in Fig. VII.2.3-1.

(2) Fairway Buoy (1 unit)

Buoy Body :

Material : Steel float and aluminum alloy

Size : approx. diameter 1.5m x height 3.6m

Weight : approx. 1,000kg (buoyancy 1,900kg)

Daymark : Spherical type (combined use as radar reflectors)

Anode Plate :

Aluminum alloy (4 pcs)

Lighting Equipment :

Lantern, lamp, automatic lamp changer and flasher.

Range : 8NM

Power Source :

Solar cell module, charging controller, and storage batteries.

Accessories :

Racon

Mooring : 2 ton concrete sinker

The design Drawings are shown in Fig.VII.2.3-2.

(3) Channel Buoys (5 units)

Buoy Body :

Same as the fairway buoy except for the type of daymarks, i.e. can or conical type

Lighting Equipment :

Same as the fairway buoy except for the lamp, and range : 4 NM.

Power source :

Solar cell module, charging controller, and storage batteries.

Mooring : Same as the fairway buoy

The design drawings are already shown in Fig.VII.2.3-2.

(4) Marking Lights (8 units)

Body

Material : Aluminum alloy

Size : Length approx. 0.5m

Weight : approx. 4kg

Lighting Equipment :

Lantern, lamp and flasher

Range : 4 NM

Power source :

Solar cell module, charging controller, and storage batteries

The design drawings are shown in Fig. VII.2.3-3.

(5) Pilot Boat

Body

Material : FRP

Size : approx. Loa 17.5m x B_{ext}4.2m x D2.1m

Main Engine

Power : approx. 450PS x 2,000 rpm Diesel x 2 sets

Max.speed : more than 20 kt

Capacity

Passenger : 8 psn

Crew : 2 psn

Equipment

Ladder : Rigging net

Radar, Search light and Radio (VHF, SSB and MW)

An example of a bay pilot boat is shown in Fig. VII.2.3-4.

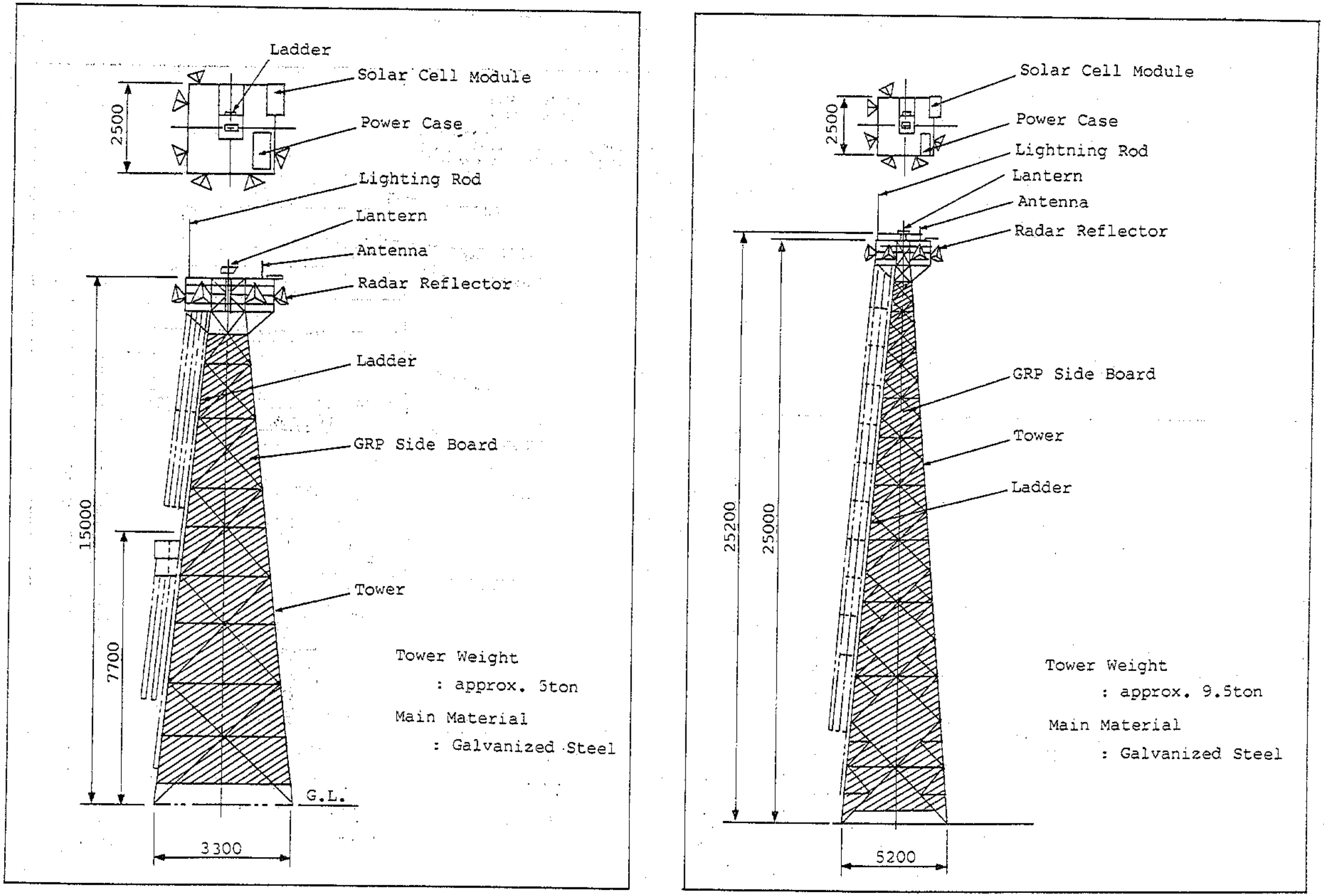


Fig. VII.2.3-1 Leading Lights Fore (left) and Rear (right)

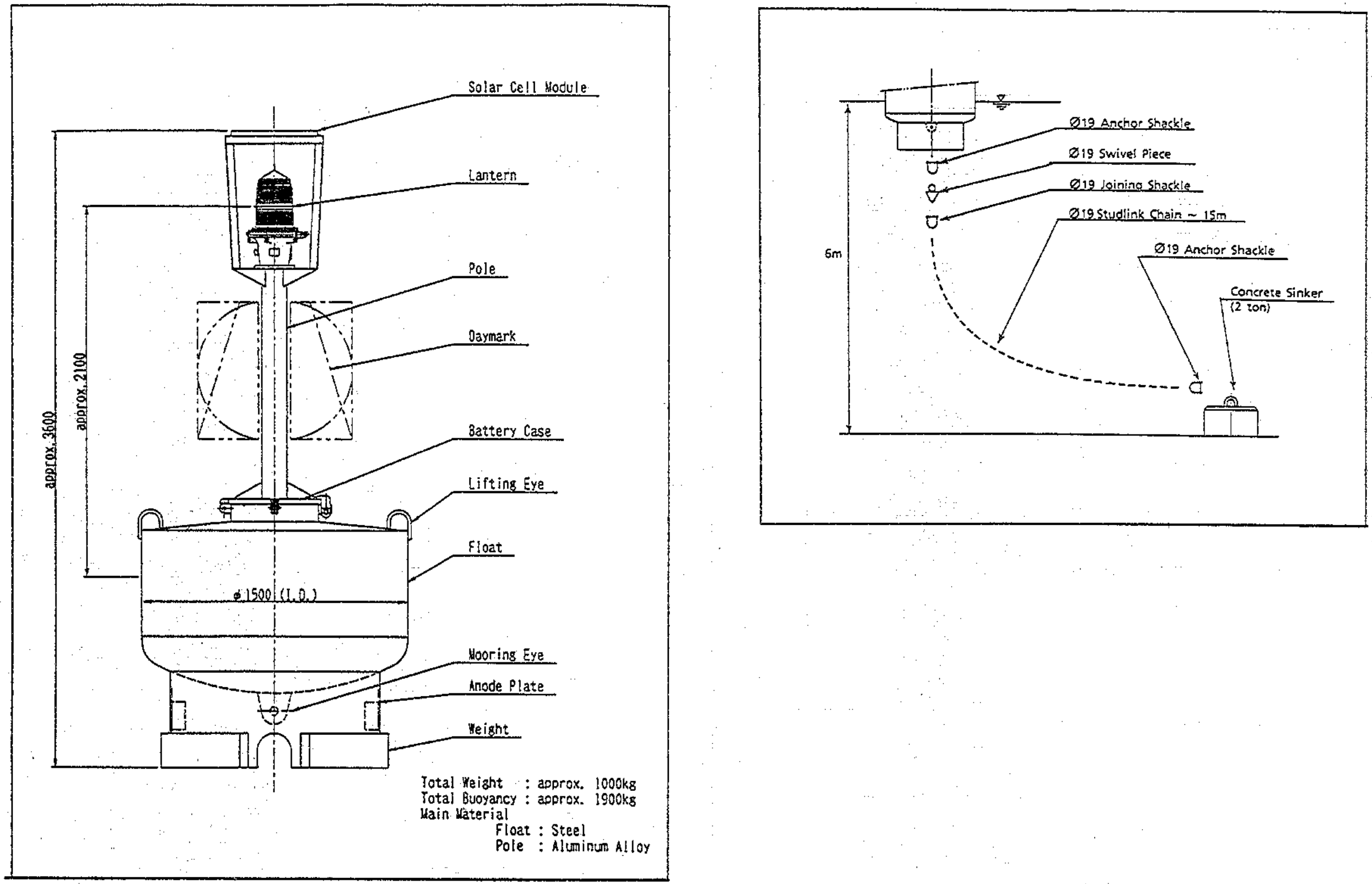


Fig. VII.2.3-2 Fairway and Channel Buoys

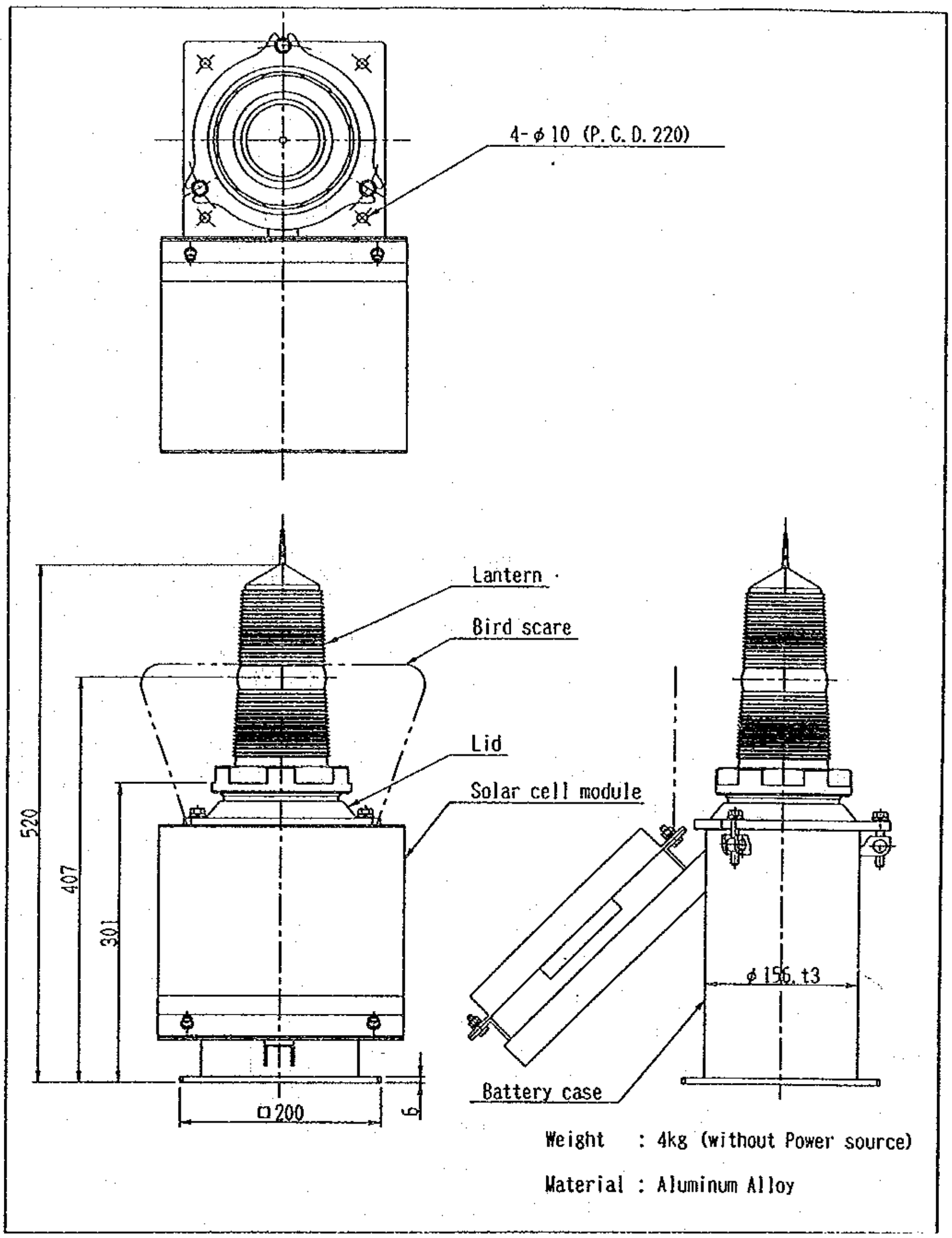


Fig. VII.2.3-3 Marking Lights on Submerged Walls

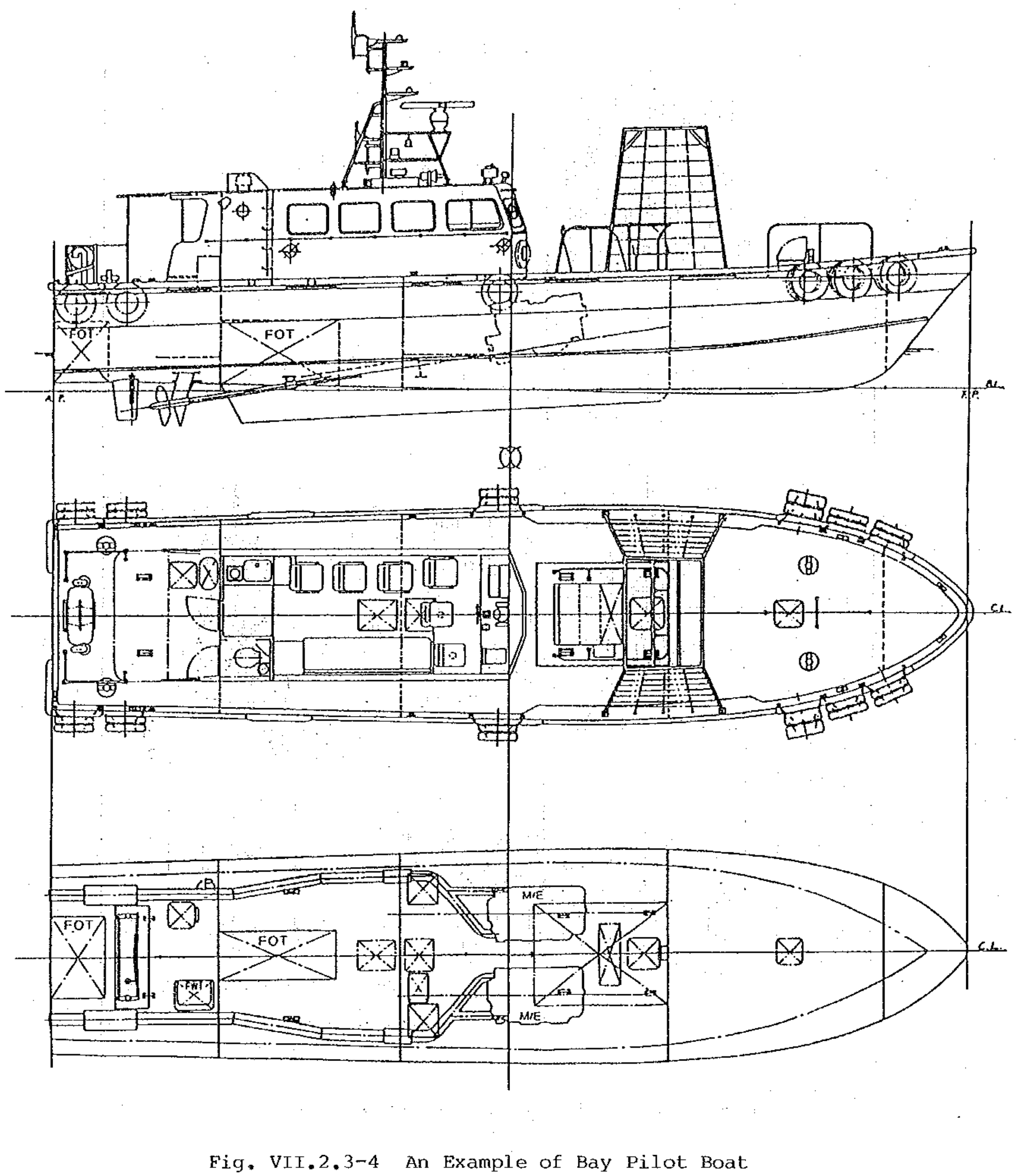


Fig. VII.2.3-4 An Example of Bay Pilot Boat

2-4 Design of Dredging Equipment

(1) Tugboat Equipped with a Blade

The general arrangement of a tugboat equipped with a blade is as shown in Fig.VII.2.4-1 and its specifications are:

Length overall	20.0 m
Breadth moulded	6.8 m
Depth moulded	2.8 m
Draught moulded	2.0 m
Speed	8.0 knots
Main engine	350 PS x 2 sets

(2) Survey Boat

General arrangement of a fast survey boat made of FRP is as shown in Fig.VII.2.4-2 and its specifications are:

Length overall	17.0 m
Breadth moulded	4.2 m
Depth moulded	2.1 m
Draught moulded	0.8 m
Speed	20.0 knots (max)
Main engine	360 PS x 2 sets

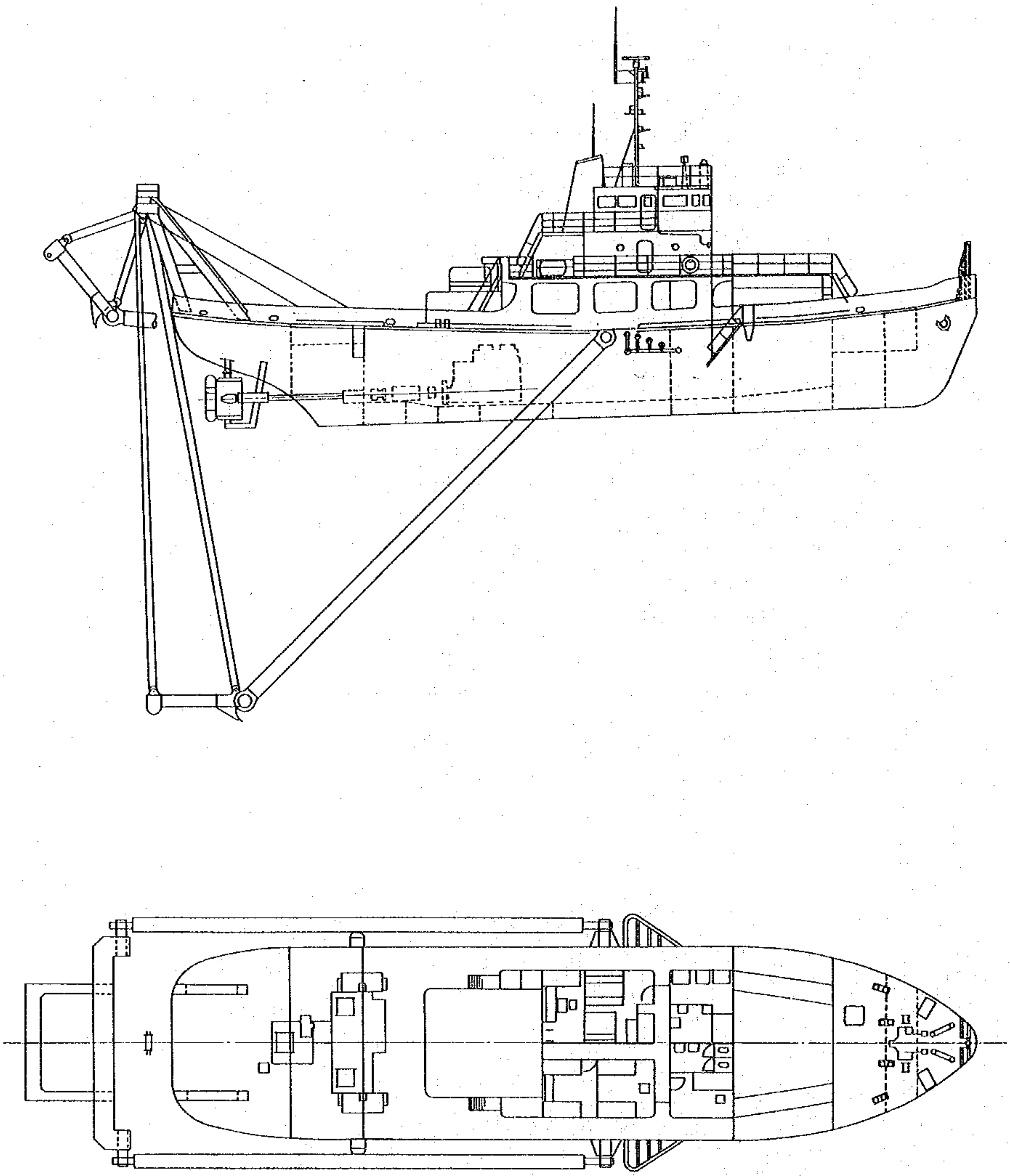


Fig. VII.2.4-1 General Arrangement of a Tugboat Equipped with a Blade

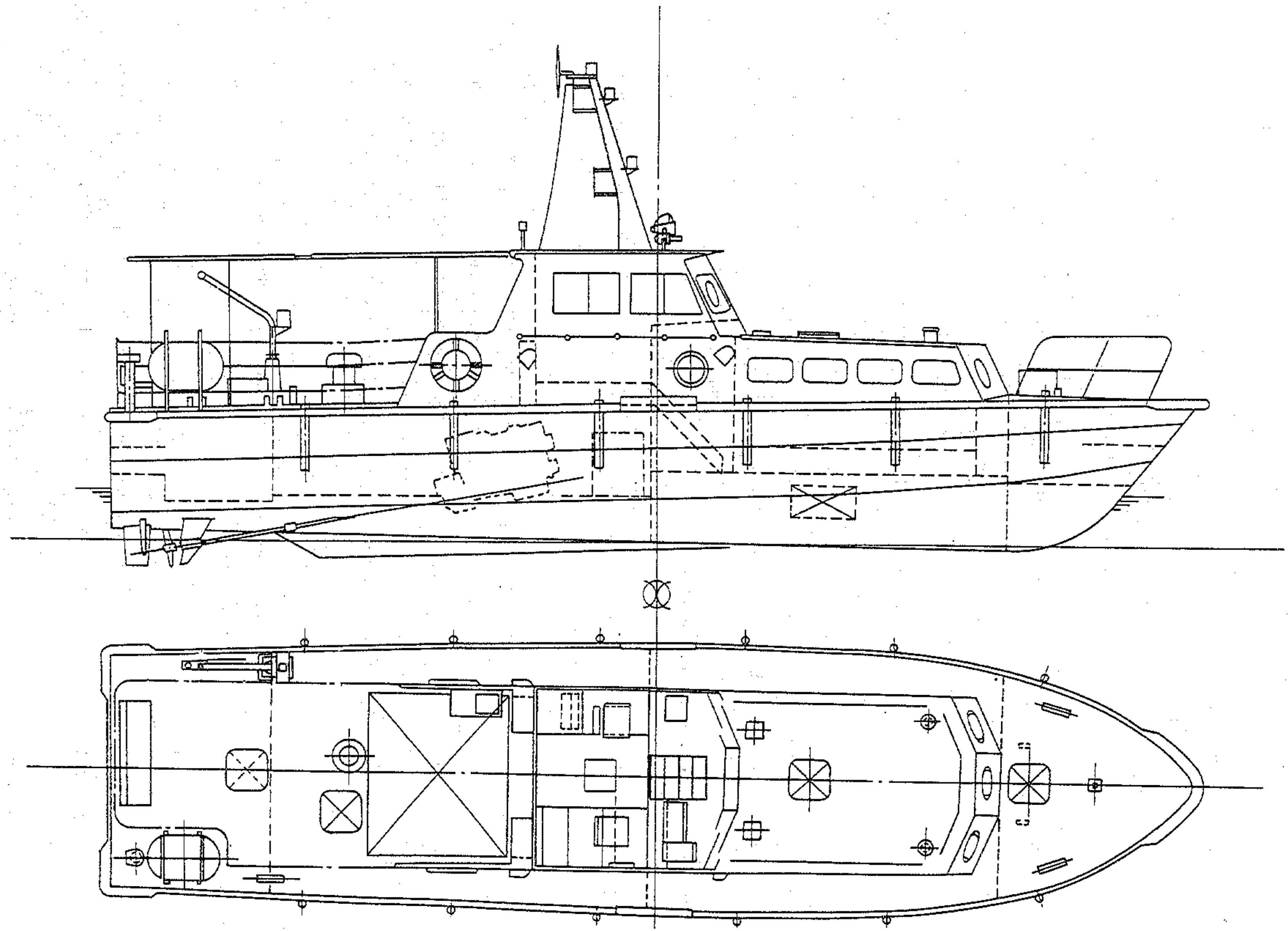


Fig. VII.2.4-2 General Arrangement of a Survey Boat

Chapter 3 Project Implementation Plan

3-1 Execution Strategy

The execution plan of the Project should be formulated by paying special attention to the following items;

- minimization of interference from the capital dredging and construction work on daily channel operation to secure efficient and safe navigation of ships

- consideration of the supply condition of the construction material and the construction speed

- completion of the Project by the end of 1995 which is set as the target year of the First-stage Plan

3-2 Project Implementation Schedule

The proposed implementation schedule of the First-stage Plan is shown in Fig. VII.3.2-1

As shown in the figure, detailed engineering services will commence in January 1993, allowing about two years after submission of the Final Report of this feasibility study for the review of the Project and the preparation of the detailed engineering services. The detailed engineering services will be completed within one year by December, 1993.

Following the detailed engineering services, the tendering stage will commence and will be completed in May, 1994.

The actual construction work will commence in June, 1994 with the mobilization and will be completed in December, 1995, leaving two months for the demobilization to be ended in February, 1996.

Each project component will be executed as follows.

(1) Mobilization

The mobilization of construction materials and construction equipment will take four months from the contract award involving the preparation and transportation. During the same period the general preparation of the Project such as establishment of the site office, preparation of the local materials and equipment and arrangement of local labor, etc. will be completed.

(2) Capital Dredging

The capital dredging work will commence in January, 1995 following the installation of the spades to the draghead and the draghead position indicator to be completed by December, 1994. The actual dredging work will be completed within one year i.e. December, 1995 including two months allowance for schedule adjustment with the construction of submerged walls.

(3) Submerged Walls

The construction period of submerged walls is estimated at 15 months including one month allowance. The construction will commence in October, 1994 and will be completed by December, 1995. To avoid any complication with the construction equipment especially in the submerged wall construction and the capital dredging by cutter suction dredger using discharging pipe, the west of offshore part of submerged walls (e.g. Spot No.3,000 to 7,000) is preferable for the commencement. Because no cutter suction dredger work will be scheduled at the west offshore part as discussed in section 1-4 of PART V.

(4) Dredging Equipment and Machinery

In the dredging equipment and machinery, the spades for the draghead and the draghead position indicator will be installed by December, 1994 prior to the actual capital dredging work to secure better efficiency in the dredging work. The other equipment and machinery such as the tugboat, survey boat and others will be prepared and shipped to the site by December, 1995.

(5) Navigational Aids

The pilot boat will be purchased and shipped to the site by December, 1995 and other items, e.g. leading lights, the fairway buoy, channel buoys, and the submerged wall marking lights will be built and installed within one year to be completed by December, 1995.

(6) Demobilization

The first two months of 1996 will be spent in the demobilization of the construction equipment and for the ancillary work.

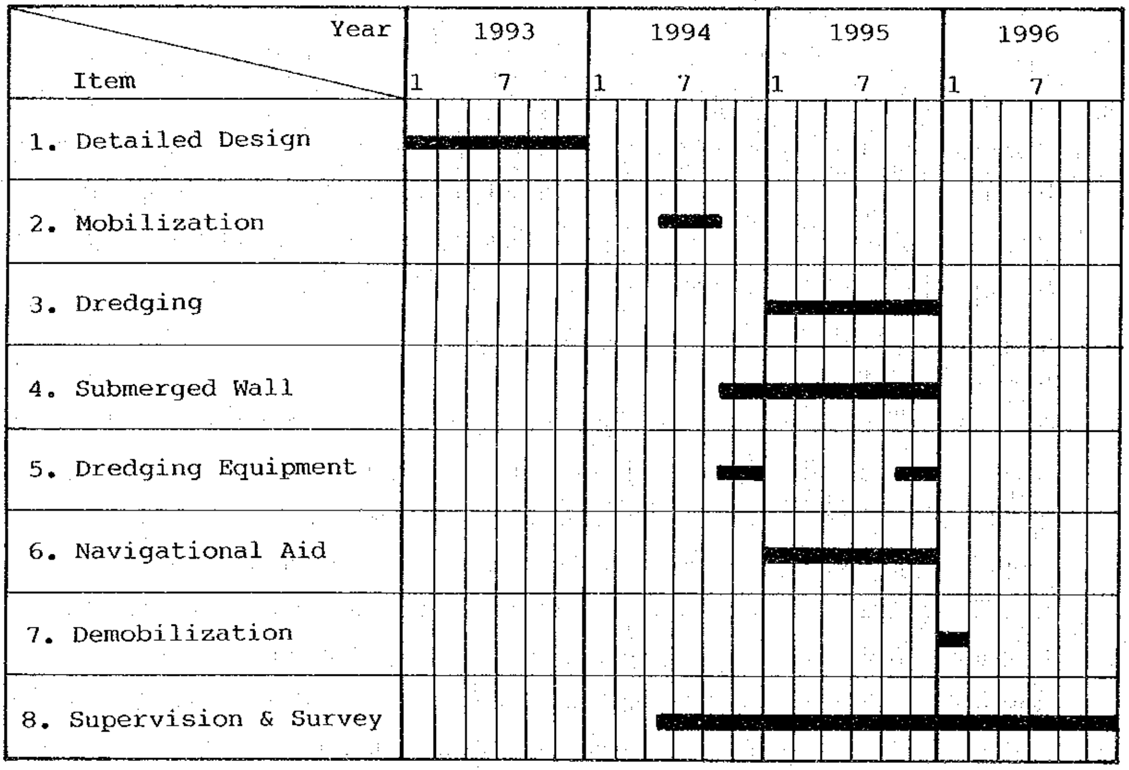


Fig. VII.3.2-1 Project Schedule of the First-stage Plan

Chapter 4 Rough Cost Estimation

4-1 Estimation Conditions

The project cost is estimated based on the following conditions.

- All prices to be used in the cost estimation will be based on the market prices.

- Exchange rates of foreign currencies are fixed at US$1.00=Rp1,849 and Yen1.00=Rp12.69 as of 1st August, 1990.

- Costs will be estimated based on the international tender basis except for the unit prices of the capital dredging work to be carried out by Perumpen's dredgers, namely 1,500 Rp/m^3 for hopper dredgers and 3,200 Rp/m^3 for non hopper dredgers as discussed in sub-section 1-4-3 of PART V.

- All the imported construction materials and equipment are assumed to be exempt from import duties and taxes.

- The physical contingency is assumed at 15% for the capital dredging and the submerged walls, 5% for the dredging equipment, the navigational aids and mobilization/demobilization and none for the engineering services.

- The maintenance dredging before and after the capital dredging is excluded from the scope of the project. However, the siltaton volume within one year of the capital dredging is considered as a part of the capital dredging volume.

- The original channel dimensions, the present channel dimensions in other words, is assumed to be of DL -5.5m depth, 50m width and 1 on 8 slope which is considered the average dimensions maintained by DGSC recently as discussed previously in sections 1-4-2 of PART V and 4-1 of PART VI.

4-2 Cost of the First-stage Plan

The cost of each project item is estimated as shown in Table VII.4.2-1. As shown in the table, the project cost of the First-stage Plan amounts to about 38 million US$ equivalent to about 70 thousand million Rp broken down into 66% for the foreign portion and 34% for the local portion.

About half of the total cost will be for the submerged walls, a quarter for the capital dredging, 5% for the dredging equipment and 3% for the navigational aids.

Table VII.4.2-1 Project Cost of the First-stage Plan

Unit: thousands of US$

ITEM	UNIT	QUANTITY	UNIT COST	FOREIGN MATERIAL	FOREIGN LABOUR	FOREIGN TOTAL	LOCAL MATERIAL	LOCAL SKILLED LABOUR	LOCAL UNSKILLED LABOUR	LOCAL TOTAL	GRAND TOTAL	
Capital Dreadging				0.0	0.0	0.0	6,166.4	2,215.0	170.6	8,552.0	8,552.0	22.6%
Dredging by Hopper	m^3	5,810,000	0.00081	-	-	0.0	3,506.2	1,117.5	89.7	4,713.4	4,713.4	
Dredging by Cutter	m^3	2,218,000	0.00173	-	-	0.0	2,660.1	1,097.5	81.0	3,838.6	3,838.6	
Submerged Walls	m	14,000	1.4	15,242.7	2,316.5	17,559.2	1,005.4	606.9	132.5	1,744.9	19,304.1	51.1%
Dredging Equipment				1,696.2	0.0	1,696.2	0.7	1.4	0.3	2.4	1,698.6	4.5%
Tug Boat(700PS)	Nos.	1	742.6	742.6	-	742.6	-	-	-	0.0	742.6	
Survey Boat	Nos.	1	656.8	656.8	-	656.8	-	-	-	0.0	656.8	
Spade for Draghead	Nos.	8	1.7	13.7	-	13.7	-	-	-	0.0	13.7	
Draghead Pos.Indicator	Nos.	1	274.5	274.5	-	274.5	-	-	-	0.0	274.5	
Survey Platform	Nos.	1	6.9	4.5	-	4.5	0.7	1.4	0.3	2.4	6.9	
Personal Computer	Nos.	1	3.4	3.4	-	3.4	-	-	-	0.0	3.4	
Tide Pole	Nos.	2	0.3	0.7	-	0.7	-	-	-	0.0	0.7	
Navigational Aids				982.8	0.0	982.8	76.4	61.1	15.3	152.7	1,135.5	3.0%
Leading Light Rear	Nos.	1	171.6	102.9	-	102.9	34.3	27.5	6.9	68.6	171.6	
Leading Light Front	Nos.	1	178.4	109.8	-	109.8	34.3	27.5	6.9	68.6	178.4	
Fair-way Buoy	Nos.	1	86.5	82.4	-	82.4	2.1	1.6	0.4	4.1	86.5	
Channel Buoy	Nos.	5	24.5	116.7	-	116.7	2.9	2.3	0.6	5.8	122.5	
Sub.Wall Marking Light	Nos.	8	3.4	22.0	-	22.0	2.7	2.2	0.5	5.5	27.5	
Pilot Boat	Nos.	1	549.1	549.1	-	549.1	-	-	-	0.0	549.1	
Mob./Demob.	L.S.	1		343.2	0.0	343.2	36.7	15.4	1.1	53.2	396.3	1.0%
Engineering Services				454.6	1,060.8	1,515.5	204.0	571.2	40.8	816.0	2,331.5	6.2%
Detailed Design	L.S.	1		159.1	371.3	530.4	71.4	199.9	14.3	285.6	816.0	
Supervision & Survey	L.S.	1		295.5	689.5	985.1	132.6	371.3	26.5	530.4	1,515.5	
Physical contingency	L.S.	1		2,437.5	347.5	2,785.0	1,081.5	427.2	46.3	1,554.9	4,339.9	11.5%
Total				21,157.1 56.0%	3,724.8 9.9%	24,881.9 65.9%	8,570.9 22.7%	3,898.2 10.3%	406.9 1.1%	12,876.1 34.1%	37,757.9 100.0%	100.0%

4-3 Annual Project Cost

The annual investment cost of the First-stage Plan is shown in Table VII.4.3-1. As shown in the table, about 80% of the investment cost is concentrated in 1995, 2% in 1993, 15% in 1994 and 1% in 1996.

Table VII.4.3-1 Annual Investment Cost of the First-stage Plan

Unit: thousands of US$

Item \ Year	1993	1994	1995	1996	Total
Capital Dredging	0.0	0.0	8,552.0	0.0	8,552.0
Dredging by Hopper	0.0	0.0	4,713.4	0.0	4,713.4
Dredging by Cutter	0.0	0.0	3,838.6	0.0	3,838.6
Submerged walls	0.0	3,860.8	15,443.3	0.0	19,304.1
Dredging Equipment	0.0	288.3	1,410.4	0.0	1,698.6
Tug Boat(700PS)	0.0	0.0	742.6	0.0	742.6
Survey Boat	0.0	0.0	656.8	0.0	656.8
Spade for Draghead	0.0	13.7	0.0	0.0	13.7
Draghead Pos. Indicator	0.0	274.5	0.0	0.0	274.5
Survey Platform	0.0	0.0	6.9	0.0	6.9
Personal Computer	0.0	0.0	3.4	0.0	3.4
Tide Pile	0.0	0.0	0.7	0.0	0.7
Navigational Aids	0.0	0.0	1,135.5	0.0	1,135.5
Leading Light Rear	0.0	0.0	171.6	0.0	171.6
Leading Light Front	0.0	0.0	178.4	0.0	178.4
Fair-way Bucy	0.0	0.0	86.5	0.0	86.5
Channel Buoy	0.0	0.0	122.5	0.0	122.5
Sub. Wall Marking Light	0.0	0.0	27.5	0.0	27.5
Pilot Boat	0.0	0.0	549.1	0.0	549.1
Mob./Demob.	0.0	264.2	0.0	132.1	396.3
Engineering Services	816.0	505.2	866.0	144.3	2,331.5
Detailed Design	816.0	0.0	0.0	0.0	816.0
Supervision & Survey	0.0	505.2	866.0	144.3	1,515.5
Physical Contingency	0.0	606.7	3,726.6	6.6	4,339.9
Total	816.0	5,525.2	31,133.7	283.0	37,757.9

The yearly maintenance and renewal costs for each project component are estimated based on the assumption described in Table VII.4.3-2 and summarized in Table VII.4.3-3. As discussed in section 4-1 of this PART VII, the maintenance dredging costs until December, 1994 and from January, 1996 are excluded from the tables. The maintenance dredging in 1995 is covered within the scope of the Project as a part of the capital dredging.

Table VII.4.3-2 Yearly Maintenance Cost and Lifetime

Item	Maintenance Cost (% of Initial Cost)	Lifetime (Years)
Submerged Walls	0.3	50
Dredging Equipment and Pilot Boat	5.0	20
Navigational Aids	3.0	30

Table VII.4.3-3 Annual Investment and Maintenance Cost of the First-stage Plan

Unit: thousands of US$

Year	Capt. Cost	Maint. Cost	Total
1993	816.0	0.0	816.0
1994	5,525.2	0.0	5,525.2
1995	31,133.7	0.0	31,133.7
1996	283.0	187.9	470.9
1997	0.0	187.9	187.9
1998	0.0	187.9	187.9
1999	0.0	187.9	187.9
2000	0.0	187.9	187.9
2001	0.0	187.9	187.9
2002	0.0	187.9	187.9
2003	0.0	187.9	187.9
2004	0.0	187.9	187.9
2005	0.0	187.9	187.9
2006	0.0	187.9	187.9
2007	0.0	187.9	187.9
2008	0.0	187.9	187.9
2009	0.0	187.9	187.9
2010	0.0	187.9	187.9
2011	0.0	187.9	187.9
2012	0.0	187.9	187.9
2013	0.0	187.9	187.9
2014	0.0	187.9	187.9
2015	2,360.1	187.9	2,548.0
2016	0.0	187.9	187.9
2017	0.0	187.9	187.9
2018	0.0	187.9	187.9
2019	0.0	187.9	187.9
2020	0.0	187.9	187.9
2021	0.0	187.9	187.9
2022	0.0	187.9	187.9
2023	0.0	187.9	187.9
2024	0.0	187.9	187.9
2025	0.0	187.9	187.9
Total	40,118.0	5,636.7	45,754.7

Chapter 5 Economic Analysis

5-1 Purpose and Method of Economic Analysis

5-1-1 Purpose

The purpose of the economic analysis in this chapter is to evaluate the economic feasibility from the national economic point of view of the First-stage Plan for the access channel of the Banjarmasin port, which deals with the non-continuous submerged walls designed to counteract siltation.

The First-stage Plan will be evaluated as feasible when the net benefits of this project exceed a reasonable level which could be obtained from other investment opportunities (the opportunity cost of capital) in Indonesia.

5-1-2 Method

The EIRR, based upon a cost-benefit analysis, is used in order to appraise the feasibility of the project. In estimating the costs and benefits of the project, "Economic Pricing" is applied. Economic pricing here means the appraisal of costs and benefits in terms of international prices (border prices).

Fig. VII.5.1-1 shows the flow chart of the economic analysis procedure.

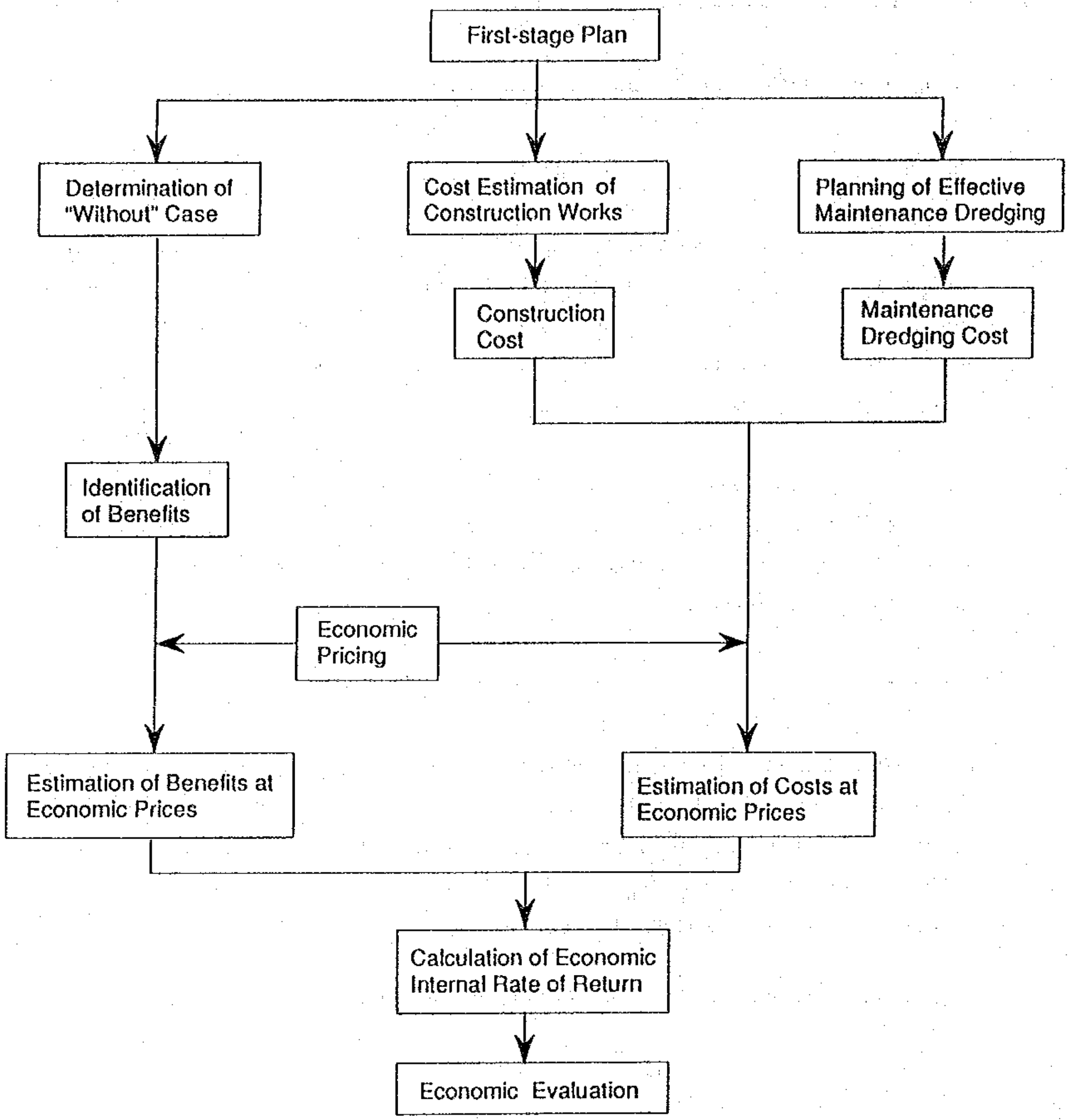


Fig. VII.5.1-1 Flow Chart of Economic Analysis Procedure

5-2 Economic Pricing

5-2-1 Method

The values of goods quoted at market price do not always represent the true value of those goods from the viewpoint of the national economy.

For example, the project cost often includes customs duties in its material costs, and its labour cost at market prices is often influenced by a minimum wage system. Prices of public utilities are sometimes subsidized by the government, and in such cases the economic price is higher than the nominal price. To examine the economic value, "Economic Pricing" should be carried out. The principal aspect of "Economic Pricing" is to revise the prices of domestic goods and services to border prices.

In general these border prices are intended to represent the international market value of these goods and services.

The market prices are changed to the border prices by various conversion factors such as the "Standard Conversion Factor (SCF)", "Conversion Factor for Consumption (CFC)" and so forth.

5-2-2 Exclusion of Transfer Items

Import duties, other taxes and subsidies shall be considered as transfer items, which do not consume national resources. Therefore, these transfer items should be excluded in the calculation of the costs and benefits of the project for the economic analysis.

5-2-3 Standard Conversion Factor (SCF)

It is not so difficult to obtain the economic prices of traded goods mentioned above; just exclude the transfer items. But the economic prices of certain domestic goods and services cannot be directly changed to border prices. There is the problem of currency. Import duties and export subsidies systems are different from country to country and they cause a price differential. If import duties are higher, the nominal prices may be higher. In other words, the value of a currency itself is influenced by the system. Therefore the nominal prices of domestic goods measured by the same currency are also influenced by the system.

The standard conversion factor (SCF) is a method of excluding such influences. It is used to determine the economic prices of certain non-traded goods and services.

The Standard Conversion Factor (SCF) is expressed by the following equation:

$$SCF = \frac{I + E}{(I + D_I) + (E + D_E)} \quad \text{------ Equation VII.5.2-1}$$

Where, I : Total Amount of Imports
E : Total Amount of Exports
D_I: Total Amount of Import Duties
D_E: Total Amount of Export Subsidies

Economic Prices of Non-Traded Goods = Nominal Price X SCF
In this Study, 0.931, the SCF in 1988, is adopted.

5-2-4 Conversion Factor for Consumption (CFC)

The CFC is used for converting the prices of consumer goods from domestic market prices to border prices. This is particularly required in converting domestic labour costs to the corresponding border prices. The CFC is usually calculated in the same manner as the SCF, only replacing total imports and total exports with consumer goods only.

In this Study, 0.960, the CFC in 1988, is adopted.

5-2-5 Shadow Wage Rate

For economic analysis, labour costs should be measured in terms of their opportunity costs, which is the value of lost marginal production that the employment of the laborers for a given project would create for other purposes.

(1) Conversion Factor for Skilled Labour

The cost of skilled labour is calculated based on actual market wages, assuming that the market mechanism is functioning properly. However, since these are domestic costs, they should be converted to border prices by multiplying the local wage by the CFC.

(2) Conversion Factor for Unskilled Labour

Generally speaking, the market wages for unskilled laborers should not be used in calculating the economic value of the unskilled labour, since these wages are usually far above the opportunity cost of the labour because of the minimum wage system and other regulations. On the other hand, it is practically impossible to figure out the opportunity cost of unskilled labour in Indonesia.

When a project is conducted, the inflow of unskilled labour to the project is mainly from the agricultural sector, which is relatively elastic in its use of labour. Therefore, in a simplified manner it is often assumed that the economic cost of unskilled labour is equal to the per capita income of the agricultural sector.

In Indonesia, the average daily salary of farm workers is available in "Statistik Indonesia" and can be considered as a proper indicator of the marginal productivity of the agricultural sector.

In this Study, the 1988 figure, 1,853 Rupiah per day is used as the opportunity cost of unskilled labour.

The conversion factor for unskilled labour is calculated as follows:

$$\boxed{\begin{array}{l}\text{Conversion Factor}\\ \text{for Unskilled Labour}\end{array}} = \frac{\boxed{\text{Opportunity Cost}}}{\boxed{\text{Nominal Wage}}} \times \text{CFC}$$

------ Equation VII.5.2-2

5-3 Prerequisites of Economic Analysis

5-3-1 Project Life

Taking into consideration the lifetime of the facilities and the construction schedule, the period of calculation in this analysis is assumed to be thirty-three years between 1993 and 2025.

5-3-2 "Without" Case

The cost-benefit analysis is conducted on the difference between the "With" and "Without" investment cases. In other words, incremental benefits and costs arising from the proposed investment are compared and whether or not the net benefits generated by the project exceed the opportunity cost of capital in Indonesia is then studied. Therefore, determining the "Without" case is one of the key points of the economic analysis.

In this study, the following conditions are adopted as the "With" and "Without" case :

(1) "With" case

1) Non-continuous submerged walls will be made for siltation countermeasures.

2) The channel dimension planned in the Comprehensive Plan (width 100m, depth -6m) will be kept by the capital and maintenance dredging.

3) The improvement plans mentioned in Chapter 2, Part VI is made for the maintenance dredging.

4) The volume of channel traffic and the navigational condition is assumed as estimated in Chapter 1, Part III for the year 2000.

(2) "Without" case

1) No investment is made for the siltation countermeasures.

2) The channel dimension is same as that assumed in the "With" case and will be kept by the capital and maintenance dredging.

3) The improvement plan mentioned in Chapter 2, Part VI is made for the maintenance dredging.

4) The volume of channel traffic and the navigational condition is the same as that assumed in the "With" case.

5-4 Benefits

Considering the "With" and "Without" situations mentioned above, the amount of savings due to the smaller annual maintenance dredging volume stemming from the reduction of siltation is identified as the annual benefits of the plan.

It should be noted that the dredging cost cannot be calculated in nominal prices, but in economic prices.

5-4-1 Savings on the maintenance dredging volume

The savings stemming from maintenance dredging volume in this case are shown as follows:

Table VII.5.4-1 Savings on Maintenance Dredging Volume

(Unit: Millions of m^3)

Savings on maintenance dredging volume	Maintenance dredging volume	
	"With" case	"Without" case
1.6	3.5	5.1

5-4-2 The Economic Price of the Costs of Dredging

The unit price of the dredging is determined between the MOC and the DGSC. The breakdown of its cost is estimated in Table A III.4.4-2. This price is a kind of official price between the Indonesian government and a Public Corporation, Perumpen. There is some difference from economic costs.

The main points are as follows:

1) Depreciation Costs

This item depends on the initial shipbuilding cost. The annual amount of the depreciation cost is expressed by the following equation:

$$\text{Annual Depreciation Cost} = \frac{\text{(Initial Shipbuilding Cost} - \text{Residual Value)}}{\text{Lifetime}}$$

Residual Value = 10% of the Initial Cost

Lifetime = 25 years

Perumpen's dredgers were built before 1985. The exchange rate between the Rupiah and foreign currency is getting lower and the book value of the dredgers measured by foreign currency, i.e., US Dollars, is decreasing year by year. The amount of depreciation is thus now not enough for replacing dredgers at present border prices.

In this analysis we should calculate this item based on the border price.

2) Payments of Interest of Loans for Shipbuilding

Perumpen's dredgers were built by the government of Indonesia financed by foreign governmental loans made on condition that the government would repay the loans, including the interest. These payments should also be considered as a part of the dredging cost from the point of view of the national economy.

3) Maintenance Costs

The reason why this item is so inexpensive is not clear. In the above breakdown the percentage of the maintenance as a percentage of the shipbuilding cost is less than 2%. It is assumed that at least 5% is necessary to maintain the ships in good condition throughout their lifetime.

4) Dredging Capacities

The dredging capacity after the improvement plans mentioned in Chapter 2, Part VI is assumed to be the capacity of each dredger in this study.

According to this assumption, the share of maintenance dredging by dredgers will be as follows:

Table VII.5.4-2 Maintenance Dredging Volume by Dredgers

(Unit: m^3)

Case	Total	2,900m^3	4,000m^3
Principal Plan	5,100,000	1,545,000	3,555,000
First-stage Plan	3,500,000	0	3,500,000

5) Economic Pricing

The costs will be changed to the border price by the conversion factors as mentioned in 5-2.

Consequently, the maintenance dredging cost based on economic prices and its breakdown are shown in Table VII.5.4-3 and the unit costs of maintenance dredging by cases at economic prices are shown in Table VII.5.4-4.

Table VII.5.4-3 Maintenance Dredging Costs at Economic Prices

(Unit:US $)

Hopper Capacity (m^3)	2,900		4,000	
Estimated Capacity after Improvement (m^3)	2,907,000		3,555,000	
	Nominal Price	Economic Price	Nominal Price	Economic Price
Crew	162,334	155,841	162,334	155,841
Material	427,304	397,820	427,304	486,499
Overhead	155,057	91,921	155,057	112,411
(Replacement Cost Base) Shipbuilding Cost	(30,070,517)		(36,550,576)	
Interest of loan	751,763	751,763	913,764	913,764
Depreciation	1,503,526	1,503,526	1,827,529	1,827,529
Maintenance Cost	1,503,526	1,399,783	1,827,529	1,701,429
Rate of Maintenance Cost /Shipbuilding Cost(%)	(5.00%)		(5.00%)	
Total	4,503,510	4,300,654	5,313,517	5,197,473
Average Cost	1.55	1.48	1.49	1.46
Survey Cost	0.02	0.02	0.02	0.02
De/mobilization	0.01	0.01	0.01	0.01
Av. Unit Cost ex. tax	1.58	1.51	1.52	1.49
Tax (ppn)	0.03	0.00	0.03	0.00
Av. Unit Cost inc.tax	1.61	1.51	1.55	1.49
Interest	0.00	0.00	0.00	0.00
Insurance	0.01	0.01	0.01	0.01
DIP Cost	1.63	1.52	1.57	1.50
Administrative Cost	0.41	0.38	0.39	0.38
Profit	0.10	0.00	0.10	0.00
Total Unit Cost	2.13	1.90	2.06	1.88

Table VII.5.4-4 Unit Costs of Maintenance Dredging at Economic Prices

(Unit: US$)

Case	Unit Cost
Principal Plan	1.89
First-stage Plan	1.88

5-4-3 Savings on Annual Maintenance Dredging Cost at Economic Price

The savings on the annual maintenance dredging cost is calculated as shown in Table VII.5.4-5.

This is the Benefit of the First-stage Plan.

Table VII.5.4-5 Savings on Maintenance Dredging Costs at Economic Prices

(Unit: Thousands of US $)

Year	Savings on Maintenance Dredging Costs	With Case			Without Case		
		Maintenance Dredging Costs	Volume (Million m³)	Unit Cost (US$)	Maintenance Dredging Costs	Volume (Million m³)	Unit Cost (US$)
1996	3,059	6,580	3.5	1.88	9,639	5.1	1.89
1997	3,059	6,580	3.5	1.88	9,639	5.1	1.89
1998	3,059	6,580	3.5	1.88	9,639	5.1	1.89
1999	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2000	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2001	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2002	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2003	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2004	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2005	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2006	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2007	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2008	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2009	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2010	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2011	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2012	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2013	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2014	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2015	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2016	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2017	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2018	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2019	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2020	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2021	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2022	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2023	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2024	3,059	6,580	3.5	1.88	9,639	5.1	1.89
2025	3,059	6,580	3.5	1.88	9,639	5.1	1.89
Total	91,770	197,400	105.0		289,170	153.0	

5-5 Costs

5-5-1 Construction Costs

The differences in the following items between the "With" and "Without" cases are considered as costs of the First-stage Plan:

(1) Capital dredging costs

(2) Construction costs of Submerged Walls

(3) Other capital investments

These costs are estimated in Chapter 4, Part VII, in nominal prices. As mentioned in 5-2, in the economic analysis, these costs have to be divided into the foreign currency portion, skilled labour, unskilled labour and other local currency portions.

Since the foreign currency portion is shown in CIF prices, it is considered as an economic price. The labour costs should be converted into economic prices by using the respective conversion factors mentioned in 5-2-5. Other local currency portions should be converted into economic prices by multiplying by the SCF. Table VII.5.5-1 shows the costs at economic prices.

Table VII.5.5-1 Construction Costs of the First-stage Plan at Economic Prices

(Unit:Thousands of US $)

Item	Case	Construction Costs at Market Price	Foreign Portion Goods	Local Portion Non-traded Labour	Local Portion Skilled Labour	Local Portion Unskilled Labour	Custom Duties	Construction Costs at Economic Prices
			1.000	0.931	0.960	0.593	0.000	
Capital Dredging by Hopper	With	4,713	0	3,506	1,118	90	0	4,390
	Without	5,301	0	3,943	1,257	101	0	4,937
	Net	-587	0	-437	-139	-11	0	-547
Capital Dredging by Cutter	With	3,839	0	2,660	1,098	81	0	3,578
	Without	4,607	0	3,193	1,317	97	0	4,294
	Net	-768	0	-533	-220	-16	0	-716
Submerged Walls	With	24,291	17,559	1,006	607	133	4,987	19,156
	Without	0	0	0	0	0	0	0
	Net	24,291	17,559	1,006	607	133	4,987	19,156
Dredging Equipment	With	2,023	1,696	1	1	0	324	1,698
	Without	2,023	1,696	1	1	0	324	1,698
	Net	0	0	0	0	0	0	0
Navigational Aids	With	1,310	983	76	61	15	175	1,122
	Without	1,476	1,124	78	62	16	196	1,265
	Net	-165	-141	-1	-1	0	-21	-144
Mob./Demob	With	396	343	37	15	1	0	393
	Without	122	69	37	15	1	0	118
	Net	275	275	0	0	0	0	275
Detailed Design	With	816	530	71	200	14	0	797
	Without	390	254	34	96	7	0	381
	Net	426	277	37	104	8	0	416
Supervision	With	1,516	985	133	371	27	0	1,481
	Without	911	592	80	223	16	0	890
	Net	605	393	53	148	11	0	591
Pysical Contengency	With	5,113	2,785	1,081	427	46	773	4,229
	Without	1,667	145	1,076	390	31	26	1,539
	Net	3,446	2,641	5	37	16	747	2,690
Grand Total	With	44,017	24,882	8,571	3,898	407	6,259	36,845
	Without	16,496	3,879	8,441	3,362	268	547	15,124
	Net	27,520	21,003	130	537	139	5,712	21,721

[ ] Conversion Factors

5-5-2 Maintenance Costs of the Facilities

It is desirable to make the facilities maintenance-free. But we cannot say that there is no possibility that they will be damaged by natural factors or by poorly controlled ships.

In this study, it is assumed that the following percentages of the construction costs in economic prices will be annual maintenance costs:

Submerged walls: 0.3%

Dredging equipment: 5.0%

Navigational aids: 3.0%

5-5-3 Lifetime

The lifetime of the facilities constructed are assumed as following after completion:

Submerged walls:	50 years
Capital dredging:	50 years
Dredging equipment:	20 years
Navigational aids:	30 years

5-5-4 Residual Value

The residual value at the end of the project life is calculated by using Equation V.3.1-2.

5-6 Evaluation

5-6-1 Calculated Results of Costs and Benefits

Table V.5.6-1 shows the calculated results of the costs and benefits of the First-stage Plan.

Table VII.5.6-1 Costs and Benefits of the First-stage Plan at Economic Prices

(Unit: Thousands of US $)

	Costs												Benefits	
	Construction Costs			Maintenance Costs for Facilities			Residual Value			Total Costs			Savings on Maintenance Dredging Costs	Benefits -Net Costs
Year	With	Without	Net	With	Without	Net	With	Without	Net	With	Without	Net		
1993	797	381	416							797	381	416		-416
1994	5,466	681	4,785							5,466	681	4,785		-4,785
1995	30,303	13,935	16,368							30,303	13,935	16,368		-16,368
1996	278	126	152	176	123	53				454	249	205	3,059	2,854
1997				176	123	53				176	123	53	3,059	3,006
1998				176	123	53				176	123	53	3,059	3,006
1999				176	123	53				176	123	53	3,059	3,006
2000				176	123	53				176	123	53	3,059	3,006
2001				176	123	53				176	123	53	3,059	3,006
2002				176	123	53				176	123	53	3,059	3,006
2003				176	123	53				176	123	53	3,059	3,006
2004				176	123	53				176	123	53	3,059	3,006
2005				176	123	53				176	123	53	3,059	3,006
2006				176	123	53				176	123	53	3,059	3,006
2007				176	123	53				176	123	53	3,059	3,006
2008				176	123	53				176	123	53	3,059	3,006
2009				176	123	53				176	123	53	3,059	3,006
2010				176	123	53				176	123	53	3,059	3,006
2011				176	123	53				176	123	53	3,059	3,006
2012				176	123	53				176	123	53	3,059	3,006
2013				176	123	53				176	123	53	3,059	3,006
2014				176	123	53				176	123	53	3,059	3,006
2015	1,698	1,698	0	176	123	53				1,875	1,821	53	3,059	3,006
2016				176	123	53				176	123	53	3,059	3,006
2017				176	123	53				176	123	53	3,059	3,006
2018				176	123	53				176	123	53	3,059	3,006
2019				176	123	53				176	123	53	3,059	3,006
2020				176	123	53				176	123	53	3,059	3,006
2021				176	123	53				176	123	53	3,059	3,006
2022				176	123	53				176	123	53	3,059	3,006
2023				176	123	53				176	123	53	3,059	3,006
2024				176	123	53				176	123	53	3,059	3,006
2025				176	123	53	-11,699	-4,542	-7,157	-11,523	-4,419	-7,104	3,059	10,163
Total	38,543	16,822	21,721	5,281	3,687	1,595	-11,699	-4,542	-7,157	32,125	15,967	16,159	91,770	75,611

5-6-2 Calculation of EIRR

The economic internal rate of return (EIRR), based upon the cost-benefit analysis above, is calculated by using Equation V.3.1-1.
The EIRR result of the comprehensive plan is calculated as 13.2%.

5-6-3 Sensitivity Analysis

In addition to the base case, the following two cases are calculated in order to examine the impact of fluctuation on construction costs (C.C.) and the benefits.

Table VII.5.6-2 Sensitivity of EIRR for the First-stage Plan

Case	EIRR
Base Case	13.2%
Increase in C.C. by 10%	11.9%
Decrease in Benefits by 10%	11.8%

5-7 Conclusion

The opportunity cost of capital in Indonesia is not known. However, it is considered to range from 8% to 15% in various countries. Taking into consideration the non-profit characteristics of this project, which is a basic public utility, the reasonable level of the economic internal rate of return (EIRR) could be much lower than that of ordinary development projects. Based on this understanding and the above analyses, this project can be regarded as feasible from the national economic point of view.

Chapter 6 Financial Analysis

6-1 Purpose and Method of Financial Analysis

6-1-1 Purpose

The purpose of the financial analysis is to appraise the financial feasibility of the First-stage Plan focusing on the viability of the project.

6-1-2 Method

Since both maintenance dredging and construction of the siltation countermeasure will be undertaken principally by the Indonesian government, a financial analysis should be carried out on the influence of the First-stage Plan to the government.

The method of this analysis is similar to that of the economic analysis mentioned in Chapter 5, except for economic pricing. It is a kind of cost-benefit analysis carried out by means of the Financial Internal Rate of Return (FIRR), which equalizes the costs and the benefits during the project life.

6-2 Prerequisites of Financial Analysis

Prerequisites of the financial analysis, i.e., the project life and assumptions of "With" and "Without" cases, are assumed to be same as that of the economic analysis, Chapter 5, Part VII.

6-3 Benefits

The benefit would be generated by savings on maintenance dredging volume and its cost per year, the same as in the economic analysis.

Concerning the volume, there is no difference between the financial and the economic analyses, 1.6 million m^3 per year.

There is a difference in the price (unit cost) of dredging. Financially, the price of dredging is determined between the MOC and the DGSC. As already mentioned in 5-4-2, Chapter 5, Part VII, this price seemed to be too low to cover the full cost. But it is very difficult to change the price drastically. Considering the recent rate of increase in the price, we assume in this analysis that it will rise 10% every three years.

Table VII6.3-1 shows the savings on annual maintenance dredging costs.

Table VII.6.3-1 Savings on Maintenance Dredging Costs

(Unit: Thousands of US $)

Year	Savings on Maintenance Dredging Costs	With Case			Without Case		
		Maintenance Dredging Costs	Volume (Million m^3)	Unit Cost (US$)	Maintenance Dredging Costs	Volume (Million m^3)	Unit Cost (US$)
1996	1,142	2,499	3.5	0.71	3,641	5.1	0.71
1997	1,256	2,749	3.5	0.79	4,005	5.1	0.79
1998	1,256	2,749	3.5	0.79	4,005	5.1	0.79
1999	1,256	2,749	3.5	0.79	4,005	5.1	0.79
2000	1,382	3,023	3.5	0.86	4,405	5.1	0.86
2001	1,382	3,023	3.5	0.86	4,405	5.1	0.86
2002	1,382	3,023	3.5	0.86	4,405	5.1	0.86
2003	1,520	3,326	3.5	0.95	4,846	5.1	0.95
2004	1,520	3,326	3.5	0.95	4,846	5.1	0.95
2005	1,520	3,326	3.5	0.95	4,846	5.1	0.95
2006	1,672	3,658	3.5	1.05	5,331	5.1	1.05
2007	1,672	3,658	3.5	1.05	5,331	5.1	1.05
2008	1,672	3,658	3.5	1.05	5,331	5.1	1.05
2009	1,840	4,024	3.5	1.15	5,864	5.1	1.15
2010	1,840	4,024	3.5	1.15	5,864	5.1	1.15
2011	1,840	4,024	3.5	1.15	5,864	5.1	1.15
2012	2,024	4,427	3.5	1.26	6,450	5.1	1.26
2013	2,024	4,427	3.5	1.26	6,450	5.1	1.26
2014	2,024	4,427	3.5	1.26	6,450	5.1	1.26
2015	2,226	4,869	3.5	1.39	7,095	5.1	1.39
2016	2,226	4,869	3.5	1.39	7,095	5.1	1.39
2017	2,226	4,869	3.5	1.39	7,095	5.1	1.39
2018	2,448	5,356	3.5	1.53	7,805	5.1	1.53
2019	2,448	5,356	3.5	1.53	7,805	5.1	1.53
2020	2,448	5,356	3.5	1.53	7,805	5.1	1.53
2021	2,693	5,892	3.5	1.68	8,585	5.1	1.68
2022	2,693	5,892	3.5	1.68	8,585	5.1	1.68
2023	2,693	5,892	3.5	1.68	8,585	5.1	1.68
2024	2,963	6,481	3.5	1.85	9,444	5.1	1.85
2025	2,963	6,481	3.5	1.85	9,444	5.1	1.85
Total	58,254	127,430	105.0		185,684	153.0	

6-4 Costs

6-4-1 Construction Costs

The difference in the following items between the "With" and "Without" cases should be considered as costs of the First-stage Plan.

(1) Capital dredging costs

(2) Construction costs of the siltation countermeasures

(3) Other capital investments

These costs are estimated in Chapter 4, Part VII.

6-4-2 Maintenance Costs of Facilities

It is assumed that the following percentages of construction costs will amount to annual maintenance costs:

Submerged Walls:	0.3%
Dredging Equipment:	5.0%
Navigational Aids:	3.0%

6-4-3 Lifetime

The lifetime of the facilities constructed are assumed as following after completion:

Submerged Walls:	50 years
Capital Dredging:	50 years
Dredging Equipment:	20 years
Navigational Aids:	30 years

6-4-4 Residual Value

The residual value at the end of the project life is calculated by using Equation V.3.1-2.

6-5 Evaluation

6-5-1 Summary of the Costs and the Benefits

Table VII.6.5-1 shows the costs and the benefits of the First-stage Plan.

6-5-2 Calculation of FIRR

FIRR is calculated by using Equation V.3.1-1. The FIRR of the First-stage Plan is calculated as 5.0%.

6-5-3 Sensitivity Analysis

In addition to the base case, the following two cases are calculated in order to examine the impact of the fluctuation in construction costs (C.C.) and the benefits.

It should be noted that the benefits are measured not by the reduced siltation volume itself but by the product of the volume and the unit cost.

Table VII.6.5-2 shows the calculation results of each case.

Table VII.6.5-2 Sensitivity of FIRR for the First-stage Plan

Case	FIRR
Base Case	5.0%
Increase in C.C. by 10%	4.4%
Decrease in Benefits by 10%	4.3%

6-5-4 Average Interest Rate for the Project Funds

An FIRR level, that determines whether a project is viable or not is commonly considered one that exceeds the average interest rate for all the project funds.

Table VII.6.5-1 Costs and Benefits of the First-stage Plan

(Unit: Thousands of US $)

Year	Costs: Construction Costs: With	Construction Costs: Without	Construction Costs: Net	Maintenance Costs for Facilities: With	Maintenance Costs for Facilities: Without	Maintenance Costs for Facilities: Net	Residual Value: With	Residual Value: Without	Residual Value: Net	Total Costs: With	Total Costs: Without	Total Costs: Net	Benefits: Savings on Maintenance Dredging Costs	Benefits -Net Costs
1993	816	390	426							816	390	426		-426
1994	6,686	747	5,939							6,686	747	5,939		-5,939
1995	36,231	15,230	21,001							36,231	15,230	21,001		-21,001
1996	284	129	155	213	145	68				498	275	223	1,142	919
1997				213	145	68				213	145	68	1,256	1,189
1998				213	145	68				213	145	68	1,256	1,189
1999				213	145	68				213	145	68	1,256	1,189
2000				213	145	68				213	145	68	1,382	1,314
2001				213	145	68				213	145	68	1,382	1,314
2002				213	145	68				213	145	68	1,382	1,314
2003				213	145	68				213	145	68	1,520	1,452
2004				213	145	68				213	145	68	1,520	1,452
2005				213	145	68				213	145	68	1,520	1,452
2006				213	145	68				213	145	68	1,672	1,604
2007				213	145	68				213	145	68	1,672	1,604
2008				213	145	68				213	145	68	1,672	1,604
2009				213	145	68				213	145	68	1,840	1,772
2010				213	145	68				213	145	68	1,840	1,772
2011				213	145	68				213	145	68	1,840	1,772
2012				213	145	68				213	145	68	2,024	1,956
2013				213	145	68				213	145	68	2,024	1,956
2014				213	145	68				213	145	68	2,024	1,956
2015	2,023	2,023	0	213	145	68				2,236	2,169	68	2,226	2,158
2016				213	145	68				213	145	68	2,226	2,158
2017				213	145	68				213	145	68	2,226	2,158
2018				213	145	68				213	145	68	2,448	2,381
2019				213	145	68				213	145	68	2,448	2,381
2020				213	145	68				213	145	68	2,448	2,381
2021				213	145	68				213	145	68	2,693	2,625
2022				213	145	68				213	145	68	2,693	2,625
2023				213	145	68				213	145	68	2,693	2,625
2024				213	145	68				213	145	68	2,963	2,895
2025				213	145	68	-14,149	-4,975	-9,174	-13,935	-4,829	-9,106	2,963	12,069
Total	46,040	18,519	27,521	6,400	4,363	2,037	-14,149	-4,975	-9,174	38,291	17,908	20,384	58,254	37,870

In the First-stage Plan, it is assumed that the project will be financed 15% by the government and 85% by foreign governmental loans. It is also assumed that no interest is to be paid on the funds loaned by the government, and the interest rate of the foreign governmental loans will be 2.5%.

The average interest rate for all the project funds is calculated as follows:

$0.15 \times 0\% + 0.85 \times 2.5\% = \text{Average Interest Rate} = 2.1\%$

6-6 Conclusion

Judging from the above analysis, this project is feasible, provided that the project is financed by low-interest funds such as government funds and foreign governmental loans.

Chapter 7 Management and Operation Plans

7-1 Management of Siltation Reduction Facility

Throughout the project implementation period, surveys and analyses on the stability of the structures, change in the bottom topography around the submerged walls and siltation in the channel should be carried out once or twice a month. Detailed and continuous observations will be required after storms.

If any problems arise, the causes should be scrutinized and appropriate countermeasures should be taken as soon as possible.

7-2 Management of Navigational Aids

For the safe navigation of ships in the channel the following steps are to be undertaken at appropriate intervals:

(1) Regular Maintenance of Navigational Aids

a. Check-up of the conditions and functions of the navigational aids at the site, and, if necessary, repair them.

b. Replacement of consumables such as batteries, lamps, and anchor chains,

c. Re-painting of the leading light tower and buoys,

d. Overhaul of equipment on land including the above c. and

e. Training of engineers in maintenance.

(2) Accident Prevention

a. Patrol of the channel area.

b. Issue of regulations, manuals and charts.

c. Education and training of crews, specifically those of small ships.

d. Provision of proper information on the current conditions of navigational aids, and

e. Guidance on improvement of small ships' equipment such as engine power and communication tools.

(3) Remedy of Accidents

a. Preparation of procedures in the event of accidents.

b. Notice of information concerning accidents and navigational aids, and

c. Repair and restoration of navigational aids,

It should be noted that during the period of submerged wall construction it will be necessary to establish special navigational safety measures to ensure safe and smooth passage of ships and operations of working vessels.

7-3 Management of Dredging Equipment

7-3-1 Dredgers

The channel is so long and narrow that good manouverability of a dredger is necessasry. When a dredger turns in the turning basin in the middle of the channel, good maneuverability is especially necessary. It is assumed that a dredger will be used in the channel through the year, so the dredger should be always kept in good condition. A trailing suction hopper dredger has the dredging part adding to the sailing part. Regular maintenance and repair and daily inspection are most important.

Measuring devices such as flow, concentration and draft meters in a dredger are sensitive and annual maintenance by the staff of the maker will be necessary.

The water in the channel is muddy and a dredger is often compelled to stop operations due to the trouble in the cooling system which uses sea water. In the worst case, the main engine suddenly stops and the dredger is grounded. Careful attention should be paid to this problem.

7-3-2 Supporting Equipment

A tugboat equipped with a blade will be used in many ways. The shape of the blade will be studied to achieve the optimum effect. This tugboat will play an important role in helping the operations of a trailing suction hopper dredger.

A personal computer on site will be used to control daily dredging operations and a laptop-type computer can be easily carried by hand. This computer can be used by the staff of Perumpen's Banjarmasin Base, surveyors and dredging crew.

7-3-3 Survey Equipment

A new survey boat will be made of FRP which is not as strong as steel. One of the merits of this boat is her fast maximum speed of 20 knots. The channel is located about 26 km downstream from Banjarmasin Port. This speed can save on sailing time. Not only fast sailing but also steady sailing is necessary. A complete array of survey equipment including a data processor will be installed in this boat. This equipment should be protected from high levels of humidity.

The new transducer should be larger and heavier than the present one to gain sounding records by both 210 kHz and 33 kHz more clearly. The sounding record measured by both 210 kHz and 33 kHz is indispensable for the maintenance dredging of this channel and careful attention should be paid to this transducer.

7-4 Dredging Management and Operations

Based on the analysis of the management and operations of maintenance dredging, the following points are recommended in order to make the maintenance dredging more effective for the First-stage Plan.

These points are advisable from the viewpoint of the maintenance dredging management and operations so as to effectuate this recommendation:

(1) to support and upgrade communications between the relevant organizations,
(2) to introduce a computer-based maintenance dredging management and operations system,
(3) to strengthen the management and operation system at Perumpen, and
(4) to continue training personnel.

7-4-1 Supporting and Upgrading Communications

Supporting and upgrading communications between the relevant organizations should be taken into consideration as follows:

1) to secure the maintenance dredging budget, and
2) to fulfill each body's responsibility for maintenance dredging.

Regarding the general concept of the maintenance dredging budget, it has basically been decided in planning by PELITA. There was a large difference in budget for and volume of maintenance dredging between the planning and execution in PELITA IV due to lack of funds in the national budget.

The navigation channels should be kept safe through continuous maintenance dredging form the viewpoint of the national economy. It is necessary to upgrade communications by increasing cooperation and coordination between the relevant organizations.

Reliable communications will enable confirmation of the fulfillment of each body's responsibility during maintenance dredging and to compensate for each other's weak points.

Increased cooperation among relevant organizations can result in a more unified, clearer appeal to the central Government for proper maintenance dredging without budgetary restraints.

7-4-2 Computer System

The Directorate of Ports and Dredging, DGSC, plays an important role in maintenance dredging and has the responsibility of supervising all dredging measures in order to guarantee the safe passage of vessels at sea and in port.

A computer-based maintenance dredging management and operation system should be introduced at the level of personal computer as soon as possible.

The purpose of this computer system is not only to make the management and operations of maintenance dredging efficient but also to meet the relevant organizations' demand that an appropriate form required for maintenance dredging should be considered in this Directorate.

The result of the introduction of a computer system will be the ability to obtain basic necessary information such as maintenance dredging reports. As well, a data communications system needed to link relevant organizations will be developed in the near future.

7-4-3 Management and Operation System

Strengthening the management and operation system at Perumpen should take the following points into consideration;

1) establishing a monitoring system for dredging operations,
2) keeping the maintenance and repair program,
3) simplifying documents for each activity, and
4) speeding up the procurement of spare parts and materials.

Regarding item 1), smooth execution of dredging operation requires the collection of correct information such as site conditions, material conditions, working conditions, etc., and records of dredging operations. Therefore, establishment of a system to monitor dredging operations is necessary. A monitoring system will enable coordinated analysis of revenues and expenditures during each project.

Regarding item 2), a schedule of regular maintenance docking and repair of dredgers has been decided upon by Perumpen. However, it is sometimes not carried out due to effort to increase productivity and lack of funds.

The maintenance and repair program should be according to the regulations and maintenance planning. As well, the execution of regular maintenance and repair of dredgers is not only beneficial in terms of effective dredging operations but will also help lengthen the dredger's lifespan.

It is important to maintain proper maintenance records and to develop a data collection and analysis system.

Regarding item 3), many documents are now needed for each activity, and almost all of them must be approved by the head office before the activity can go ahead.

Simplification of the documents for the smooth execution of each activity is needed as soon as possible.

Regarding item 4), the delay in procurement of spare parts and materials is due to lake of funds, a long decision-making process and other reasons.

It is necessary to proceed with an intentional purchase scheme base on the analyzed consumption of spare ports and materials as soon as possible. A skilled expert is necessary to carry out the analysis.

In addition to this, strengthening Perumpen's management and operation system should also be given high priority in order to achieve the attitude and skills needed to operate commercially and competitively.

7-4-4 Training of Personnel

As mentioned in the previous chapter, training of personnel under Perumpen's "Personnel Development Program" is now being carried out.

The program is aimed at establishing a systematic dredging operation, from drawing up the dredging program based on an appropriate monitoring system, priority of demand and budgeting constraints to how to execute the maintenance dredging from the highest-productivity point of view. To this end, training of personnel in all relevant organizations is required as soon as possible.

Chapter 8 Notes on the Implementation of the Project

8-1 Charateristics of this Study

The objectives of this study are to develop measures to reduce siltation and to improve dredging efficiency at the access channel of Banjarmasin Port. One of the characteristics of the study is not only that the channel length is long, i,e, 14km, but also that the area in question at Barito river mouth delta is very large, i.e. about 400 km^2. Naturally, siltation phenomena occur on a very large scale and the mechanism is complicated, which has made it difficult to clarify the causes and results of siltation.

In order to collect data concerning the site, extensive site surveys regarding natural conditions were carried out in the initial stage of this study. Then, simulations of currents and siltation were made by means of the state-of-the-art hydraulic and numerical model experiments. There are many facts revealed through these studies. The dominant causalities were explained by the numerical model taking into account suspension, diffusion and settling of sediments, which could successfully reproduce the siltation in the channel. In addition to the above model, a concept of direct flow of fluid muds on the seabed into the channel is introduced as a cause of siltation, and predictions of siltation volumes for various alternative countermeasures were carried out, although knowledge regarding the behavior of the fluid muds is still limited given the present level of technology.

Through technical and economic evaluations of alternatives, installation of submerged walls is adopted as the best countermeasure plan against siltation in the present channel, which ensures substantial reduction of siltation volume. As the siltation in the channel takes place along almost the entire channel length except for the two entrances, the submerged wall must be long enough to cover the majority of the channel.

Besides this, the submerged wall must be a large and durable structure due to the poor soil conditions of the seabed. Inevitably, the absolute value of the construction cost becomes rather high, although the economic feasibility of the plan has been confirmed.

8-2 Importance of the Project

Submerged walls can be one of the most powerful means for the reduction of siltation in a channel such as the Banjarmasin channel, as discussed in detail in PART V.

It is, however, a relatively new technology developed in the 1980s, and there are few precedents for projects of this scale in the world. In other words, this technology could be applied to many ports that have been suffering from similar siltation problems. The results of this study and the forthcoming experiences of the project at Banjarmasin will be invaluable in terms of the future development of these ports.

In addition, this study itself has revealed or achieved many useful technical results which can be applied to planning, execution, study and research works on siltation and dredging by DGSC, Perumpel, Prumpen and research institutes. They are summarized in Table VII.8. 2-1.

8-3 Technical Points of the Submerged Walls

Bearing in mind the above charateristies and their importance, construction of the submerged walls must be carefully and flexibly carried out, as previously mentioned in Chapter 1 of this Part.

Care should be taken to confirm and to develop technologies at the site connected with the submerged walls such as:

a. Structure and costs, and
b. Function.

It must be emphasized that throughout the implementation period the engineering services play more a vital role than in ordinary port construction projects in terms of the technical planning and management of the project's execution. Surveys on the above two elements and, later on, siltation reduction effect are to be carefully planned and carried out.

Above all, the preliminary aspects of the project are a matter of great importance. In this context it is recommended that the preparatory design and execution of submerged walls will be carefully done to monitor the above items, a and b, in the preliminary stage of the project.

The general order of the construction of submerged walls depends on the result of the above preliminary monitoring. At the stage of this study priority could be given first to the offshore portion and second to the nearshore western portion of the non-continuous submerged walls taking account of the local natural conditions, etc.

More sophisticated order and separation of the submerged wall construction works than the above could be devised and might be valuable to be discussed in the engineering services in view of the above items, a and b. It is step by step execution. Conditions and behavior of the structure and the surrounding seabed should be monitored throughout and after the construction of previous steps, examining local adaptability in terms of durability of the structure, possibility of cost saving, and preservation of the function against accumulation/erosion. The result of monitoring surveys could be immediately reflected on the next step construction. Improvement or modification of the design and execution, if necessary, should be done in the following steps.

Table VII.8.2-1 Application of the Major Technical Results on Siltation and Dredging

Technical Results Revealed or Achieved	Application
1. Natural Conditions	
(1) General	
a. River discharge of water and sediments, tides, currents, saline wedge, bed material, etc. for one year.	a. Planning, methods, analyses, etc. for site surveys.
b. Local change in tidal level which affects sounding accuracy.	b. Control of dredging by the installation of tide poles with about 4km interval.
(2) Fluid Muds	
a. Vertical structure in the channel and relationship with nautical depth,	a. Planning of Channel and dredging.
b. Observation of the surface by high frequency (210KHz) echo sounder of which depth changes with time.	b. Rationalization of survey for dredging by introducing low frequency (30KH) echo sounder and lead.
c. Effect of suspended particles on choking on ships' cooling water intake.	c. Measures to prevent ships' engine stop.
(3) Siltation	
a. Siltation rate during intermission of dredging and estimate for the other seasons.	a. Planning and analysis of siltation countermeasures and dredging.
b. Siltation Phenomena such as formation of submerged dam and acceleration of siltation behind it.	b. ditto
c. Annual variation of rainfall and estimated siltation.	c. ditto
2. Siltation Reduction Measures	
(1) Laboratory Tests	
Parameters of bed materials such as settlement speed.	Planning, methods, analyses, etc. for laboratory tests.
(2) Numerical Siltation Simulations	
a. Proof of applicability of "muti-layer suspension-diffusion-settlement model" by quantitively reproducing the present siltation.	a. Study and research of other similar cases.
b. Evaluation of longshore littoral drift by "one-line theory" and effect of coastal jetty.	b. ditto

Technical Results Revealed or Achieved	Application
c. Quantitative forecast of siltation for various siltation countermeasures.	c. ditto
d. Substantial effect of siltation reduction by submerged walls.	d. ditto
(3) Hydraulic Model Tests	
a. Effectiveness of the three dimensional two-layer model tests in reproducing tides, currents and saline wedge.	a. Study and research of other similar cases.
b. Forecast of current conditions of various siltation countermeasures.	b. ditto
c. Relative assessment of siltation due to high density fluid mass for various siltation countermeasures.	c. ditto (especially on methodology)
d. High prevention effect of siltation due to high density fluid mass or fluid mud by submerged walls.	d. ditto
3. Dredging Efficiency Improvement	
(1) Present COnditions	
a. Local distribution of dredging requirement.	a. Planning and control of dredging.
b. Estimation of the dredging capacities of trailing hopper suction dredgers	b. ditto
(2) Effective Operational Measures	
a. Creation of turning basin(s) for one-way long channel.	a. Planning and Control of dredging in other similar channels.
b. Initial agitation dredging of fluid muds.	b. ditto
c. Dumping at the river mouth during appropriate ebb tide subject to trials.	c. ditto (subject to trial).
d. Side casting dredging over submerged walls subject to trials.	d. ditto (subject to trial).
(3) Effective mechanical Measures	
a. Spades for dragheads.	a. Planning of dredging efficiency improvement in other similar channels.
b. Tugboat equipped with a blade.	b - e. ditto
c. Drughead position indicator system	
d. Advanced survey boat and equipment.	
e. Installation of a new survey platform.	