irrespective of temporary use or permanent use. The service line laying charge for the digital systems is more expensive than that one for analog systems. Wiring and installation of the telephone set and other related matters are done by the T & T Board.

(6) Gas

Natural gas supplied by BGS Ltd. is available all over the country in Bangladesh, and it is being used as the main heat. Gas mains are available in the area of the project site. The mains are 1-inch of steel pipes and natural gas is being supplied with 60 psi pressure. Gas appliances are sold in shops in the city. The service pipe is laid up to the meter, regulator and check valve.

5-2 Determination of the Scale of the Facilities and Equipment

5-2-1 Basic Policy for Determining the Scale

1) To determine the scale of the facilities to cope with the fish landing and distribution demand in the project target year.

2) To determine the scale of the facilities on the premise that the improvements in the fish landing and distribution method currently in practice will be carried out as proposed in this project.

5-2-2 Fish Landing Facilities

(1) Basic Policy

1) To forecast the number of mechanized fishing boats that will land their catches in the project target year.

2) To take steps for utilizing the facilities by turns, by taking into consideration improvements in the landing time and the berthing method of the mechanized fishing boats expected to use the facilities.

3) To make shared use of the facilities by assuming that there is no coincidence in the hours when the landing of the catch and the loading of fishery ice. Since the work consists of loading and unloading relatively heavy cargo, a floating pontoon, that is not too affected by tide fluctuation, should be taken into consideration in the project.

4) To have the refueling, the loading of water, food, etc., in preparation for sailing done at the landing apron because these works coincide with the hours when fishery ice is to be loaded and because these can be done even when there is some effects of tide fluctuation.

(2) Forecast of the Number of Mechanized Fishing Boats

1) Basis for the Calculations

a) Quantity of fish to be landed by the mechanized fishing boats at the project site in the project target year : 30,475 tonnes/year

b) Annual number of operating days of the landing facilities : 360 days/year

c) Average landing quantity of each mechanized fishing boat : 1.76 tonnes/boat (Refer to Table 2-4)

2) Calculation of the Number of Fishing Boats

As can be seen from data shown below, a daily average of 48 mechanized fishing boats are expected to carry out the fish landing and the preparations for sailing.

30,475 tonnes/year ÷ 360 days/year ÷ 1.76 tonnes/boat
= 48.1 boats/day

(3) Determination of the Scale of the Floating Pontoon

1) Basis for the Calculations

a) Landing hours : 4-hour period from 1:30 AM to 7:30 AM

b) Average landing quantity per fishing boat : 1,760 kg/boat

c) Landing rate : 30 kg in 2 minutes (one fish box/2 min.) (It is assumed that 30 kg of fish can be loaded in a 50-liter fish box by assuming a volume ratio of 0.6)

d) Fishery ice loading hours : 8-hour period from 9:00 AM to 5:00 PM

e) Quantity of fishery ice to be loaded in each mechanized fishing boat : 3,520 kg/boat (about 26 ice block ices of 135 kg each)

f) Ice loading rate : Each ice block takes approximately 4 minutes to load.

g) Specifications of the mechanized fishing boat :
- overall length : 11.5 to 14.5 m
- Overall width : 3.2 to 4.3 m
- Draft : 1 to 2 m

2) Determination of the Scale

a) Occupying time of the facilities during the fish landing work of each mechanized boat :
As the landing work itself of each mechanized fishing boat takes about 117 minutes as follows, the overall occupying time of the facilities is predicted to be

2.1 hours by taking into consideration the time of 10 minutes required to moor the fishing boat.

1,760 kg/boat ÷ 30 kg/2 min.= 117.3 minutes

b) Occupying time of the facilities during the ice loading work of each mechanized fishing boat :
The ice loading work itself of each mechanized fishing boat takes about 104 minutes as follows, but the overall occupying time of the facilities is predicted to be 1.9 hours by taking into consideration the time of 10 minutes to moor the fishing boat.

26 ice blocks/boat x 4 minutes/block = 104 minutes

c) Daily rotation rate of the use of the floating pontoon
The floating pontoon will be used 3.0 turns a day by the fishing boats as follows.

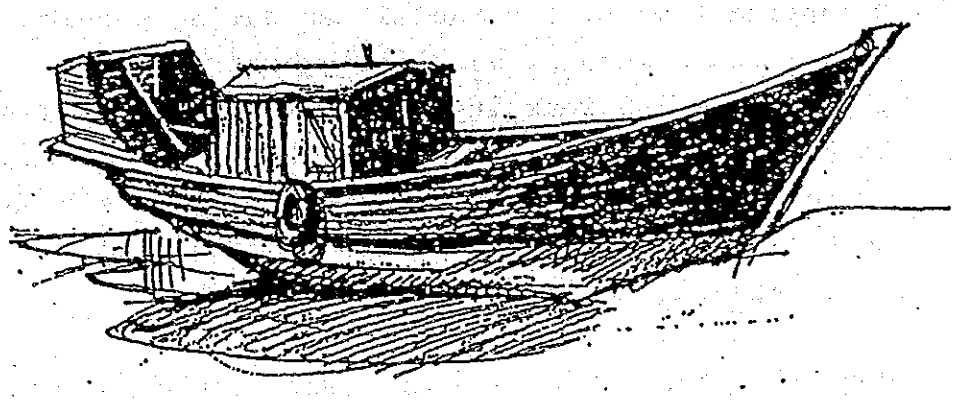
(Number of hours the floating pontoon is available for use) ÷ (Occupying time by fishing boat) =
4 hours + 8 hours) ÷ (2.1 hour + 1.9 hour) =
3.0 turns

d) Number of fishing boats berthing during each turn of use of the facilities :
As can be seen below, 16 mechanized fishing boats will be berthing during each turn of use of the facilities.
48 boats/day ÷ 3 turns/day = 16.0 boats/turn

e) Berthing plan

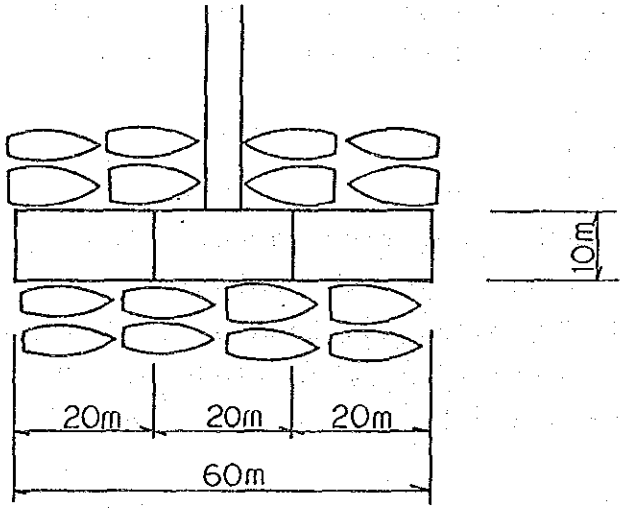
Since the mechanized fishing boats have bow sections with pointed shape and the toilet is located astern, landing of the catch and loading of ice from the bow and stern sections is impracticable. The fishing boats must be put alongside the pontoon for the

sake of landing and loading. The fishing boats should be put alongside the pontoon in rows to effectively utilize the facilities, and the work should be carried out with using small landing bridges.



f) Scale of the floating pontoon

Since the floating pontoon requires such maintenance as painting, scaling, etc., once in two years, floating pontoons must be provided to prevent interruption of landing and loading during the maintenance.
Three floating pontoons of 20 m in length and 10 m in width should be used coupled with each other in conformity with the fishing boat berthing plan shown in the figure below.



(4) Determination of the Length of the Landing Apron

1) Basis for the calculations

a) Loading hours of water, fuel, food, etc. : 8-hour period from 9:00 AM to 5:00 PM

b) Duration of the berthing hours of each mechanized fishing boat : 1.5 hours (30 minutes each for loading water, fuel oil and food, respectively)

c) Berth length required by each fishing boat : 15.5 m
(Average length of each fishing boat : 13 m + Margin of safety : 2.5 m)
(Since the mechanized fishing boats for this project are from 11.5 m to 14.5 m in length, they are assumed to have an average size of 13 m.)

2) Calculation of the Required Berth Length

The required berth length is calculated by the following expression.

$$\frac{\text{(Number of mechanized fishing boats of this project)} \times \text{(Berth length required by each boat)}}{\text{(Rotation rate of the berth)}}$$

Since the mechanized fishing boats will be put alongside the berth, the berth will be used 10.7 turns a day.

(Hours available for utilization of the facilities) ÷ (Berthing hours of each fishing boat) x (Number of boats that can be berthing in each berth) = 8 hours ÷ 1.5 hours/boat x 2 boats/time = 10.7

Therefore, the required berth length will be 70 meters.

48 boats/day x 15.5 m/boat ÷ 10.7 = 69.5

5-2-3 Fish Distribution Facilities

(1) Basic Policy

1) To forecast the quantity of fish to be distributed at the project site in the project target year.

2) To determine the scale of the wholesale market by taking into consideration the work efficiency based on improvements in the current fish distribution procedures and the utilization of the facilities by shifts in correspondence to the volume of fish expected to be handled and distributed.

3) To determine the plan layout of the fish loading lot and the parking lot by taking into consideration the quantity of vehicles engaged in the delivery of the fish to be distributed, the waiting spaces and the traffic lines of the delivery vehicles.

4) To determine the required space of the wholesale market by using the following expressions by referring to the "Standards for Calculation of the Scale of Wholesale Market Facilities (7th March 1986, '61 Food Distribution, No.819) of Japan. These standards are used because there are no indigenous standards of Bangladesh applicable to the matter.

(Formula)

$$S_1 = \frac{qt \times f_1}{\mu_1} + R_1$$

(where) :

S_1 : Scale of the wholesale floor required in the project target year.

qt : Daily distribution volume in the project target year.

f_1 : Proportion of distribution through the wholesale floor.

μ_1 : Standard quantity to be handled on the wholesale floor.

R_1 : Passageway area of the wholesale floor.

(Remarks)

a) f_1

The value of f_1 should be calculated by considering the improvement and rationalization process of the transactions through such measures as using storage outside the market, systematic introduction of low-temperature distribution, expansion of sample transaction and brand transaction, etc., and by taking into consideration the promotion of effective utilization of the wholesale floor.

b) R_1

The value of R_1 should be calculated by taking into consideration smooth ways to take the commodities in and out in the construction of the market and with other relevant factors, and to aim at securing at least one-third of the required size of the wholesale floor as passageway area.

(2) Determination of the Scale of the Wholesale Market

1) Basis for the Calculations

a) Annual quantity of the fish to be distributed at the project site during the target year of the project : 39,690 tonnes/year.

b) Annual number of days the wholesale market is open : 360 days/year

c) Wholesale market hours : 4-hour period from 5:00 AM to 9:00 AM.

d) Number of shifts for the wholesale market : Three will be 2 shifts a day. (One turn every 2 hours)

e) Proportion of distribution through the wholesale floor (f_1) : 1.0
(It is presumed that in Bangladesh there will be no forms of outside-market distribution such as utilization of extra-market storage, systematic introduction of low-temperature distribution, sample transaction, etc., during the implementation of the project).

f) Standard quantity to be handled on the wholesale floor (μ_1) : 55 kg/m^2 (Refer to the Remarks below).

g) Area of passageways of the wholesale floor (R_1) : The area of the passageways is one-third of the required wholesale floor.

(Remarks)

a) 55 kg/m^2 is realized when current fish handling (35 kg/m^2) and the planned fish handling with fish boxes (70 kg/m^2) are done concurrently.

b) Fish distribution method to realize 70 kg/m^2 ;
Fish should be handled by piling up 50-liter fish boxes.
The 50-liter fish boxes are sized 80 cm x 55 cm x 18 cm(H) (floor area : 0.44 m^2), and since the packing rate per fish box is 0.6, the quantity of fish to be handled by each fish box is 30 kg. Thus, the quantity of fish to be handled on the wholesale floor is calculated by : 30 kg ÷ 0.44 m^2 ≅ 70 kg/m^2.

2) Determination of the Scale

a) Daily distribution volume in the project target year (q_t) ;
The daily distribution volume of 110 tonnes/day is calculated by the following expression.

q_t = (Annual fish handling volume at the project site in the project target year) ÷ (Annual days the market is open) = 39,690 tonnes/year ÷ 360 days/year = 110.3 tonnes/day.

b) Required scale of the wholesale floor ;
The effective area of the wholesale floor (1,000 m^2) is calculated by the following expression, by taking into consideration the use of the facilities by shifts.

$(q_t \cdot f_1)/\mu_1$ = (110 tonnes/day x 1.0 ÷ 2 turns <rotation rate>)/55 kg/m^2 = 1,000 m^2

Thus, the required space of the wholesale floor (S_1) taking into consideration the passageway space calculated by the following expression is 1,330 m^2.

S_1 = 1,000 + (1,000 x 0.33) = 1,330 m^2

(2) Space of the Auctioneer's Room

There are 30 auctioneers in the Monoharkhali landing place and 40 auctioneers in the Fisheries Ghat landing place, respectively, and the number of auctioneers of supporting the wholesale activities is 70 persons in total.

Auctioneers play an extremely important role in wholesale markets, and they are the decisive factor which determines whether the market is given full play to its functions. Since the attractiveness of the market to the auctioneer is a very

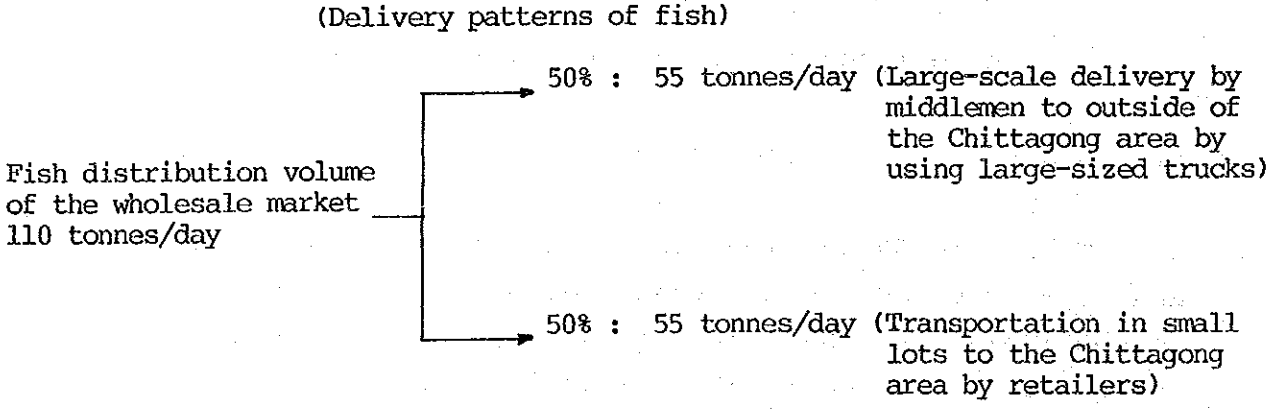
important factor for the sake of proper operation of the market, the auctioneer's rooms must be located at places allowing easy access to the auction floor.

The number of auctioneer's rooms to be provided within the context of this project should be 42 rooms in total. That accounts for barely 60% of the auctioneers that are working at the vicinities of the project site, but the idea is to select only good auctioneers when they register with the BFDC when the operation of the facilities of the project will be opened, thereby contributing for sound operation of the wholesale market in question.

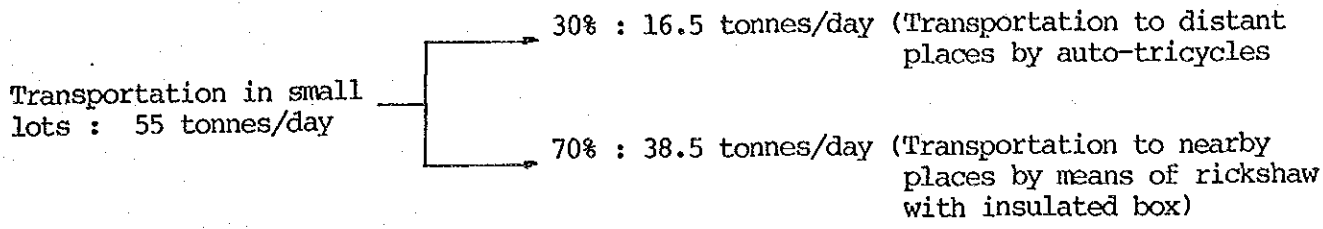
Each auctioneer's room will be 10 m^2, by taking into consideration the sizes of the auctioneer's room of the Khulna wholesale market (13 m^2) and the Barisal wholesale market (10 m^2).

(3) Determination of the Space of the Fish Loading Lot and Parking Lot

1) Flow of the Stacking and Delivery Operations



The flow of the transportation in small lots to the Chittagong area carried out by retailers is shown in the below.



2) Required Scale of the Facilities Related to Large-sized Truck Transportation

a) Specifications of the truck : 6-ton load capacity truck (loading 4 tonnes of fishes and 2 tonnes of ice), size of 7.9 m(L) x 2.6 m(W).

b) Loading time of each truck : 2.2 hours (4,000 kg ÷ 30 kg/minute)

c) Loading and delivery hours : 4-hour period from 6:00 AM to 10:00 AM.

d) Daily number of trucks accessing the wholesale market : 14 trucks (55 tonnes/day ÷ 4 tonnes/truck).

e) Number of trucks parked at the loading lot during each turn : 8 trucks {14 trucks ÷ (4 hours ÷ 2.2 hours)}

f) Length of the fish loading platform required to serve the trucks : 29 m (8 trucks x 3.6 m/truck)

g) Number of trucks waiting for the departure of the previous truck : Maximum 8 trucks.

3) Required Scale of the Facilities Related to the Deliveries Using Auto-Tricycles

a) Quantity of fishes to be loaded in each tricycle : Fish 500 kg/tricycle

b) Loading time of each tricycle : 0.3 hour (500 kg ÷ 30 kg/minute)

c) Delivery hours of the tricycles : 4-hour period from 6:00 AM to 10:00 AM

d) Daily number of auto-tricycles accessing the wholesale market : 33 tricycles (16.5 tonnes ÷ 500 kg/tricycle)

e) Dimensions of the auto-tricycles : 3 m(L) x 1.5 m(W)

f) Number of auto-tricycles to be parked at the loading yard during each turn : 3 tricycles {33 tricycles ÷ (4 hours ÷ 0.3 hour)}

g) Number of auto-tricycles waiting for the departure of the previous ones : Maximum 3 tricycles

4) Required Scale of the Facilities Related to Deliveries using Rickshaws with/without Insulated Box

a) Quantity of fish to be loaded in each rickshaw : Fish 300 kg/rickshaw

b) Loading time of each rickshaw : 0.3 hour (300 kg ÷ 30 kg/2 minutes)

c) Loading and delivery hours of the rickshaw : 3-hour period from 7:00 AM to 10:00 AM.
(Since the deliveries are for nearby places, it is presumed that there will be no early morning delivery)

d) Daily number of rickshaws accessing the market : 128 rickshaws (38.5 tonnes ÷ 300 kg/rickshaw)

e) Size of the rickshaw : 2.5 m(L) x 1.3 m(W)

f) Number of rickshaws accessing the market per turn : 13 rickshaws (128 rickshaws ÷ (3 hours ÷ 0.3 hour))

5-2-4 Fish Preservation Facilities

(1) Basic Policy

1) Since ice-making is business with a relatively high profitability, it is highly probable that there will be investment of private capital in new ice-making plants near the project site when new market opens. Such being the case, the ice-making plant to be introduced in this project will be limited to make up for the shortage of ice at the present state of things.

2) Temporary ice storage space required to cope with the daily ice-making capacity of the plant and ice storage space for coping with the increase of the fish landing quantity during the peak fishing season will be introduced in this project.

(2) Determination of the Capacity of the Ice-Making Facilities

1) Current Demand of Ice

- For fishery
  72 tonnes (fish landing quantity) x 2 (ice/fish ratio) = 144 tonnes

- For Distribution
  94 tonnes (fish distribution quantity) x 1 (ice/fish ratio) = 94 tonnes

- Total : 238 tonnes

(Remarks)

a) According to the Table of Fisheries Production Forecast in the Chittagong area given in section 4-3-2(2) of this report, the quantity of fish which is being landed currently by mechanized fishing boats is 51,980 tonnes (144 tonnes/day with the market operating 360 days per year). Since 50% of the landing in the Chittagong area is carried out at the project site, it is concluded that 72 tonnes/day are being landed there. The volume of fish being distributed at the project site is 94 tonnes/day in total, which consists of the landed fishes, the annual quantity of 2,068 tonnes (5 tonnes/day) which corresponds to a one-half of the production at the Kaptai lake and 10% of the production of other inland-water fisheries which corresponds to 6,252 tonnes/year (17 tonnes/day).

b) Twice as much ice as the weight of the landed fish and the same quantity of ice as the weight of fish distributed at the market are currently required.

2) Ice Supply Capacity at the Project Site

a) Supply capacity from the existing ice-making plants : 190 tonnes/day (Refer to Table 4-2)

b) Supply capacity from the Chittagong Fish Harbor Complex : 16 tonnes/day
(This ice-making plant has nominal production capacity of 25 tonnes/day of ice blocks, but the actual production record was 5,910 tonnes/year as of 1988 and 5,768 tonnes/year as of 1989, averaging approximately 16 tonnes/day with an operating rate of 365 days per year).

3) Required Scale

A daily production capacity of 32 tonnes (238 - 190 - 16 = 32) will be required.

(3) Determination of the Capacity of the Ice Storage Facilities

1) Capacity of the Temporary Ice Storage

This ice-making plant manufactures 135-kg ice blocks that take 48 hours to manufacture. The ice blocks are made in succession with the plant operating round the clock. But since they are sold only during the daytime, they must be temporarily stored for sale.

a) Ice Block Selling Hours ; 9-hour period from 8:00 AM to 5:00 PM

b) Quantity to be Stored Temporarily ; The production of ice out of the selling hours will be 20 tonnes/day. {32 x (24 - 9) ÷ 24 = 20}

c) Size of the Ice Blocks ; 135 kg/block, 1.1 m(H) x 0.57 m(W) x 0.29 m(T)

d) Quantity of Ice to be Stored Temporarily per Unit Area ; 423 kg/m^2 {135 kg ÷ (1.1 m x 0.29 m) = 423.1 kg/m^2}

e) Required Area of the Temporary Storage Room ; 57 m^2 (The required space of the temporary ice block storage room is calculated by taking into consideration 20% of additional work space. 20 tonnes/day ÷ 423 kg/m^2 x 1.2 = 56.7)

2) Scale of the Ice Storage Room

The daily production capacity of this ice-making plant is determined on the basis of the demand of ice corresponding to the average fish distribution quantity. It must be remembered,

however, that the actual demand of ice and the quantity of fish to be handled are variable depending on such factors as abundant catch, poor catch, etc. Generally speaking, the capacity of the ice storage facilities is of the order of 3 to 5 days of the production of the ice-making plant (96 to 160 tonnes for these facilities). In this project the ice storage facilities will have a capacity to cope with 2 days of demand of ice during the peak fishing season.

a) Demand of Ice during the Peak of the Fishing Season : Double the Average Demand
(Basis for the Estimation)

According to the monthly operation record of gill-net fishing boats during the 1988/89 (Table 2-4), the monthly average catch on annual basis was to 9,932 tonnes/month, but the average monthly catch during the peak period of the fishing season, September, October and November, increased to 20,035 tonnes/month. {(22,225 + 18,521 + 19,360) ÷ 3)}. Thus, the catch during the peak period of the fishing season is approximately twice as large (20,035 ÷ 9.932 = 2.02) as the average catch. The demand for ice increases accordingly.

b) Quantity of ice to be stored : 96 tonnes (The daily production is subtracted from the demand of 2 days during the peak period of the fishing season)
(32 tonnes/day x 2 (double) x 2 days - 32 tonnes/day)

c) Quantity of ice to be stored per unit area : 1,260 kg/m^2 (432 kg/m^2 x 3 layers)
(It is planned that the ice blocks will be stacked in 3 layers by using mechanical ice lifts)

d) Required area of the ice storage room : 76 m^2 (96 tonnes ÷ 1,269 kg/m^2)

5-2-5 Equipment

(1) Fish Boxes

Fish boxes must be introduced to improve the fish landing and distribution to be carried out within the context of this project.

a) Daily volume of fish to be handled in the target year of the project : 110 tonnes/day

b) Number of shifts for handling fish : 2 shifts

c) Size of the fish box : 50-liter fish box containing 30 kg of fish

d) Required quantity of fish boxes : 1,830 fish boxes (110 tonnes/day ÷ 2 turns ÷ 30kg/fish-box = 1,883.3)

(2) Hand Cart

Hand carts must be introduced to improve the fish landing to be carried out within the context of the project.

a) Number of fishing boats to be berthed per turn in the target year of the project : 16 boats/turn

b) Landing quantity per fishing boat : 1.76 tonnes/boat

c) Transportation capacity per hand cart : 60 kg/cart (carrying 2 fish boxes)

d) Trip rate of each hand cart : 1 trip/10 minutes

e) Average landing time : 117 minutes

f) Required quantity of hand carts : 40 carts
(1,760 kg/boat ÷ 60 kg/cart) x (10 minutes/117 minutes) x 16 fishing boats = 40.1

5-3 Basic Design

5-3-1 Site and Layout Plan

The lot secured by the BFDC for the project is divided in two parts by the canal located at its center. Its overall area is barely 6,000 square meters and is not necessarily large for this kind of application. Such being the case, the facilities of the project are arranged as shown in Figure 3 by taking into consideration the following points to effectively utilize the available lot. Recommended flow of fish landing and distribution in the project site is shown in Figure 4.

a) The facilities of the project will be arranged in the wider side of the two available parts of the lot, and the narrower side will be reserved for future expansion of the facilities and other applications.

b) A bridge will be constructed over the canal for access to the facilities.

c) A floating pontoon will be set at the offing of the project site, which has larger water depth, to make the main landing facility of the project.

d) The fish landing apron will be used as a preparation for fishing operation.

e) The water area located between the landing apron and the floating pontoon will be used as anchorage for mooring the fishing boats.

5-3-2 Design of the Engineering Facilities

The civil engineering facilities required for this project are mentioned in the followings.

FIG. 3 SITE ALLOCATION PLAN

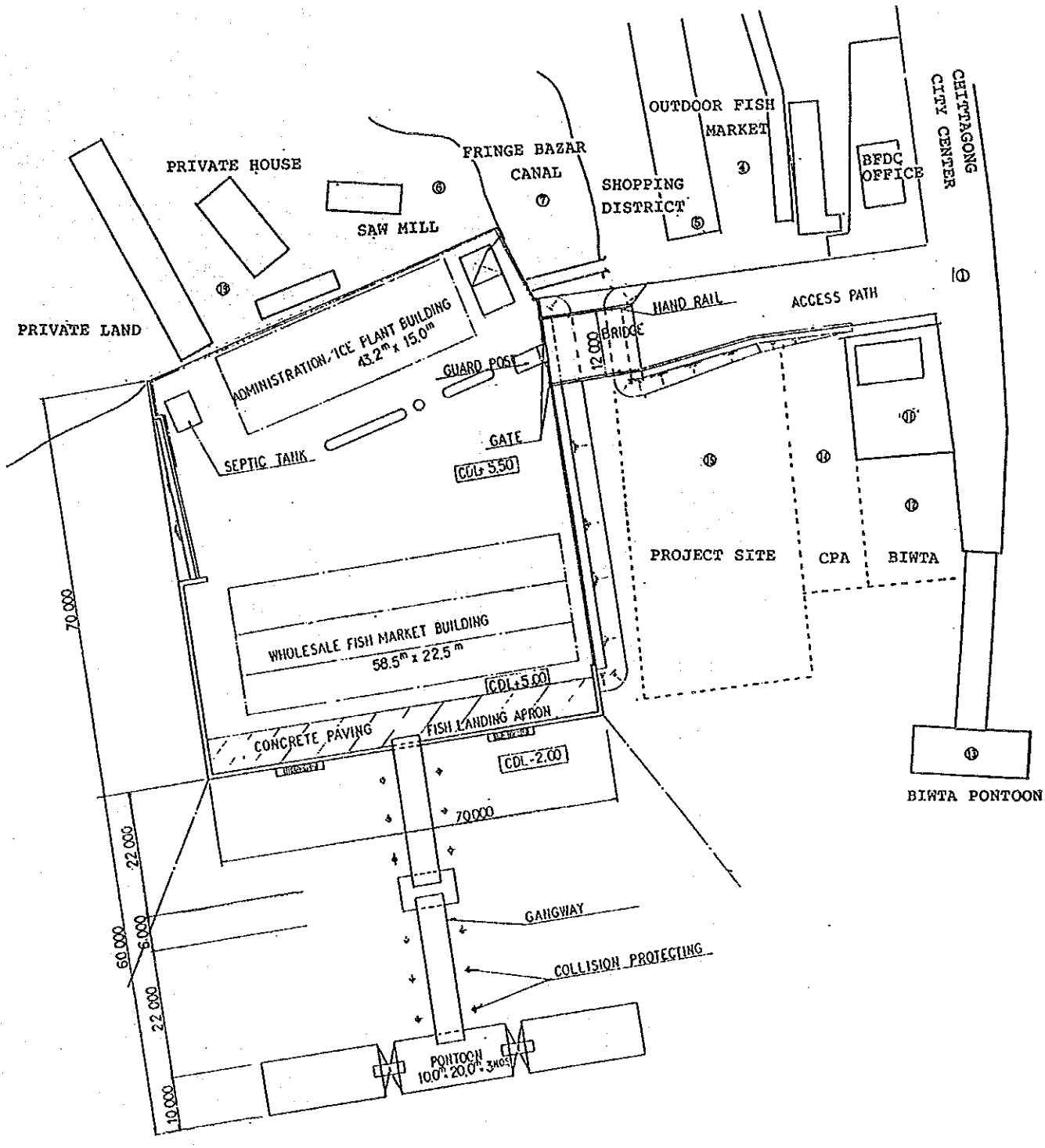
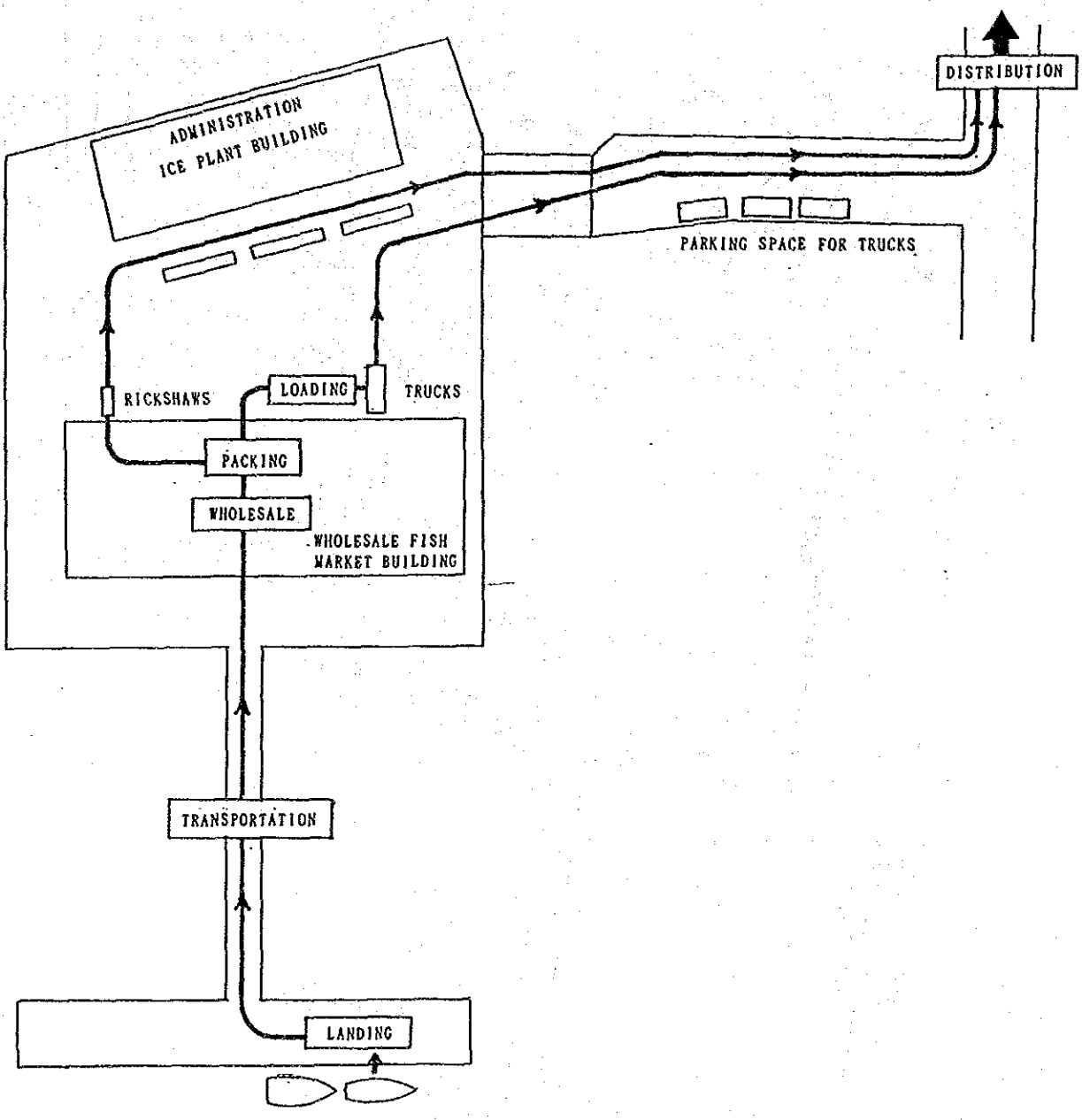


FIG. 4 FLOW OF FISH LANDING AND DISTRIBUTION



1) Fences, gates
2) Access roads, internal traffic roads, fish loading lot
3) Fish landing apron
4) Revetments, retaining walls
5) Canal bridge
6) Gangway, floating pontoon
7) Collision protector

(1) Fences and Gates

Since the project site is adjacent to private houses and private facilities, fences will be built on the edge of the project site, and pole gate and guard house will be provided at the gateway for security.

In Japan, wire net and similar fences are inexpensive and popularly used in this type of facilities, however, it is an imported product in Bangladesh, it is not necessarily inexpensive. Brick walls with RC (reinforced concrete) poles can be built at a cost comparable to that one of wire mesh fence in Bangladesh. They are durable and resistance to damage, in addition to a vast record of use in Bangladesh. Thus, fence will be designed with a brick wall.

(2) Entrance Road, Internal Traffic Road, Fish Loading Lot

Most of the streets of the urban area and arterial roads are paved with asphalt, and part of the traffic roads in the lots of the facilities of various kinds are paved with bricks.

Fish landing and distribution are carried out in the site of this project, it is frequently accessed by trucks for transportation (6-tonne vehicles) and moreover it is also used for fueling to fishing boats. Therefore brick pavement is not durable enough and asphalt pavement is not appropriate because of melting caused by fuel oil leakage. The ground of the project site will be made of embankment soil, it is feared that surface cracking will occur as a result of uneven ground

settlement if concrete pavement is used. In view of these problems, concrete block pavement will be adopted in the design of this project in view of its advantages of durability and easy maintenance.

(3) Fish Landing Apron

There are two alternatives applicable to the type of structure to be adopted in the landing apron of this project, elevated platform and reclamation. There are various types of retaining wall structures that can be adopted in the reclamation method. Generally speaking, slope retaining methods cost less than the upright walls, but slope retaining systems are not appropriate for this project because the retaining wall section will be used for fishing operation. Thus, it was decided to adopt the upright wall type structure in the design, and a comparative study was done on three alternatives, 1) steel sheet-pile method, 2) steel pipe sheet-pile method, and 3) stepped block method. Table 2 and Table 3 show the results of the study on convenience for use, ease of the construction, construction costs and construction time.

The results of comparative study between the elevated platform method and the reclamation method indicate that the the former method is more costly, has lower rate of local procurement, and, although the construction time is shorter, there is no major difference in the overall construction time when the time needed to procure materials is taken into consideration.

Of the various alternatives of the reclamation method, the steel pipe sheet-pile method is expensive and the pile driving must be made very deep. Although the stepped block type retaining wall is convenient for berthing by mechanized fishing boats from the ebb tide (CDL ± 0.7 m) to normal tide (CDL ± 1.5 m), it takes a long time for construction up to 7 months.

TABLE 2 Comparison of the landing apron construction methods

	Elevated platform	Reclamation method
1) Component elements of the facilities	1. Master pile (steel) 2. Beam and girder (steel) 3. Deck plate laying work 4. RC slab	1. Steel sheet-pile 2. Soil reclamation/ compaction 3. RC slab (partial)
2) Component materials and quantities (for 3,200 m)	Steel : 1,186 tonnes Reinforced concrete : 640 m^3 (Thickness : 20 cm)	Steel : 465 tonnes Reinforced concrete : 160 m^3
3) Comparison of the construction costs		
Construction cost index	100	70
Local procurement rate	14%	30%
Transportation cost rate	37%	30%
4) Characteristics of the use	-No water flow trouble -Need to prevent the access of small boats -Risk of vibration	-Minor water flow trouble -No need to prevent small boat access -Minor risk of vibration
5) Characteristics of the construction method		
Contents of the work	-This method is not popular in Bangladesh and civil engineer must be sent from Japan	-This method is popularly used in Bangladesh
Safety	-High degree of risk because of need to work at elevated places during the election of the structures	-Since most of the work is carried out on the ground, the degree of safety is high
Delivery time of the materials	-The manufacture of the steel pipes and section steel takes 4 months	-The manufacture of the steel sheet-piles takes 3 months
Work time at the project site	-4 months	-5 months

TABLE 3 Comparison of the construction methods of the landing apron (Upright retaining wall method)

	Steel sheet-pile method (strut sheet pile)	Steel pipe sheet-pile method	Stepped block method
1. Component elements	-Steel Sheet-pile method (strut sheet pile) -Brick chip, soil backfilling, compaction -RC slab	-Self-sustained type steel pipe sheet-pile -Backfilling of light weight material -RC slab	-Gravity type concrete block -RC step -RC slab
2. Component materials (Corresponding to retaining wall length of 110 meters and water depth of 2.0 meters)	-Steel sheet-pile (Type V) : 380 tonnes -Steel sheet-pile (Type III) : 289 tonnes -Steel material -Tie-rod :16 tonnes -Concrete : 230 m^3 -Reinforcing bars : 5 tonnes -Brick chips : 3,630 m^3 -Soil backfilling : 14,000 m^3	-Steel sheet-pile : 680 tonnes -Joint pipes : 67 tonnes -Concrete : 350 m^3 -Reinforcing bars : 11 tonnes -Light weight backfilling materials : 4,780 m^3 -Soil backfilling : 14,000 m^3	-Concrete : 1,880 m^3 -Reinforcing bars : 63 tonnes -Armor stones : 3,400 m^3 -Brick chips : 2,439 m^3 -Soil backfilling : 14,000 m^3
3. Comparative construction cost -Construction cost index -Local procurement rate	100 30%	140 30%	120 80%
4. Construction time	150 days	160 days	210 days
5. Characteristics of the construction method	-Dry work (Sheet-pile driving work) -Tie-rods are due under water	-Dry work (pile driving work) -The pile driving length is large -Use of light weight backfilling materials	-Marine work -Precasting yard is required -Most of the work is executed under the water
6. Characteristics of the use	-Construction of stairways is required	-Construction of stairways is required	-Stairways are included in the structure -No maintenance is required and the degree of durability is high

Since it requires such steps as dredging, rubble-mounding, levelling-off and block masonry work under muddy water, it is difficult to obtain sufficient accuracy. In this regard it was decided to adopt the steel sheet-pile method in this project.

(4) Retaining Walls and Revetments

Retaining walls and revetment will be made on the borderlines with the adjacent lots and on the sides of the canal to prevent the shoulder the borderline from retreating and to secure the safety of the structures to be built on the project site. The same sheet-pile as the waterfront retaining wall will be used on at the parts with large water depth adjacent to the waterfront retaining wall.

Comparative examination of the two possible alternatives for the retaining wall, upright and sloped, was carried out and the results are summarized in Table 4. The slope revetment is less expensive for construction and it presents less problems in the construction method. It is decided to use sloped revetments where there are no problems with the layout of the facilities, and the upright revetment will be used where unavoidable for the utilization of the project site.

(5) Canal Bridge

Since the canal at the project site is being used for such purposes as drainage of the rainfall in areas behind the site, transportation of bamboo and logs, it is recommended to leave its current cross section basically unchanged.

Table 5 summarizes the results of the comparative study of the two alternatives for the canal bridge, the box culvert method and the slab bridge method. As can be seen, the box culvert method is less expensive from the standpoint of the direct construction cost. However, the overall cost of box culvert will catch up the one of the slab bridge cast-in-place

TABLE 4 Comparison of the construction method of the retaining wall and revetment

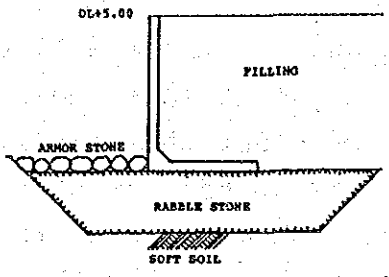
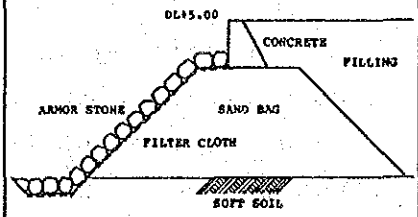
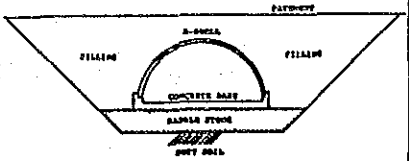
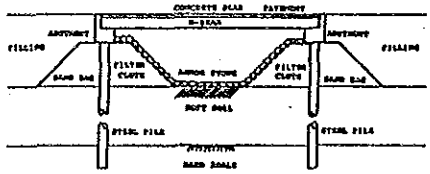
	Upright type		Sloped type
1) Component elements of the facilities			
2) Quantities of the materials (Quantities per meter expressed in cubic meters when the height is 5 m)	Excavation	12.8	1.0
	Rubble-mound	30.1	Not required
	Backfilling	Crushed stone/brick	Crushed stone
	Armor stone	2.0	3.5
	Concrete	2.6 (RC)	1.0
3) Comparative construction costs Construction cost index Local procurement rate	100 50%		50 85%
4) Characteristics of use	The available area of the lot is not reduced. The building can be arranged close to the retaining wall. There is no risk of uneven sttlement and inclination.		The available area of the lot is reduced. The buildings must be arranged at places retracted from the slope shoulder. The maintenance is easy in the case of any damage.
5) Characteristics related to the construction method	The excavation work and the rubble-mound work must be carried out under the water. Heavy machinery is required when using precast concrete. Part of the concreting work must be done under water.		Armor stone and other kinds of work must be done under water.

TABLE 5 Comparison of the canal bridge construction methods

	BOX CULVERT METHOD		SLAB BRIDGE METHOD	
1) Component elements of the facilities			RC pile 	Steel pile
2) Quantities of materials (per meter)	Excavation	32 m^3	2 m^3	
	Rubble-mound	20 m^3(crushed stone)	9.5 m^3	
	Backfiling	26 m^3(bricks and crushed stone)	Not required	
	Armor stone	Not required	9.5 m^3	
	Cast-in-place concrete RC	26.9 m^3 (Reinforcing bars : 100 kg/m^3)	2.6 m^3(Abutment)	
	Piles	Required depending on the case	RC/o500 x 2 piles/m	Steel pile/o500 x 10 m x 0.5 piles/m
	Girder	Not required	H-700x300(4T/m)	H65-(11T/0.7 m)
	Slab	Not required	Thickness :20 cm (3.12 m)	Thickness :10 cm (1.6 m)
3) Comparative construction cost Construction cost index Local procurement rate	100 (150 when pile driving is required) 100%		150 33%	160 14%
4) Characteristics of use	There is risk of uneven settlement due to differences in the thickness of the soft stratum. The intermediate wall obstructs the canal.		There is no trouble related to the use of the canal.	
5) Characteristics of construction method	Most of the works is done under water. Underwater concreting work is required. Temporary cofferdam is required when doing work on land.		Heavy machinery (cranes, pile driving hammers) must be brought into the work site. H-shape steel, PC beams and piles must be imported.	

RC piles are required and piles sized ø500 x 7 m x 15 (20.6 m^3) are arranged at a 1 m pitch. In spite of the lower local procurement rate comparing with the culvert method, it is decided to adopt the floor slab method making use of RC piles because it has such advantages as less trouble to the canal traffic and easier construction.

(6) Gangway & Floating Pontoon

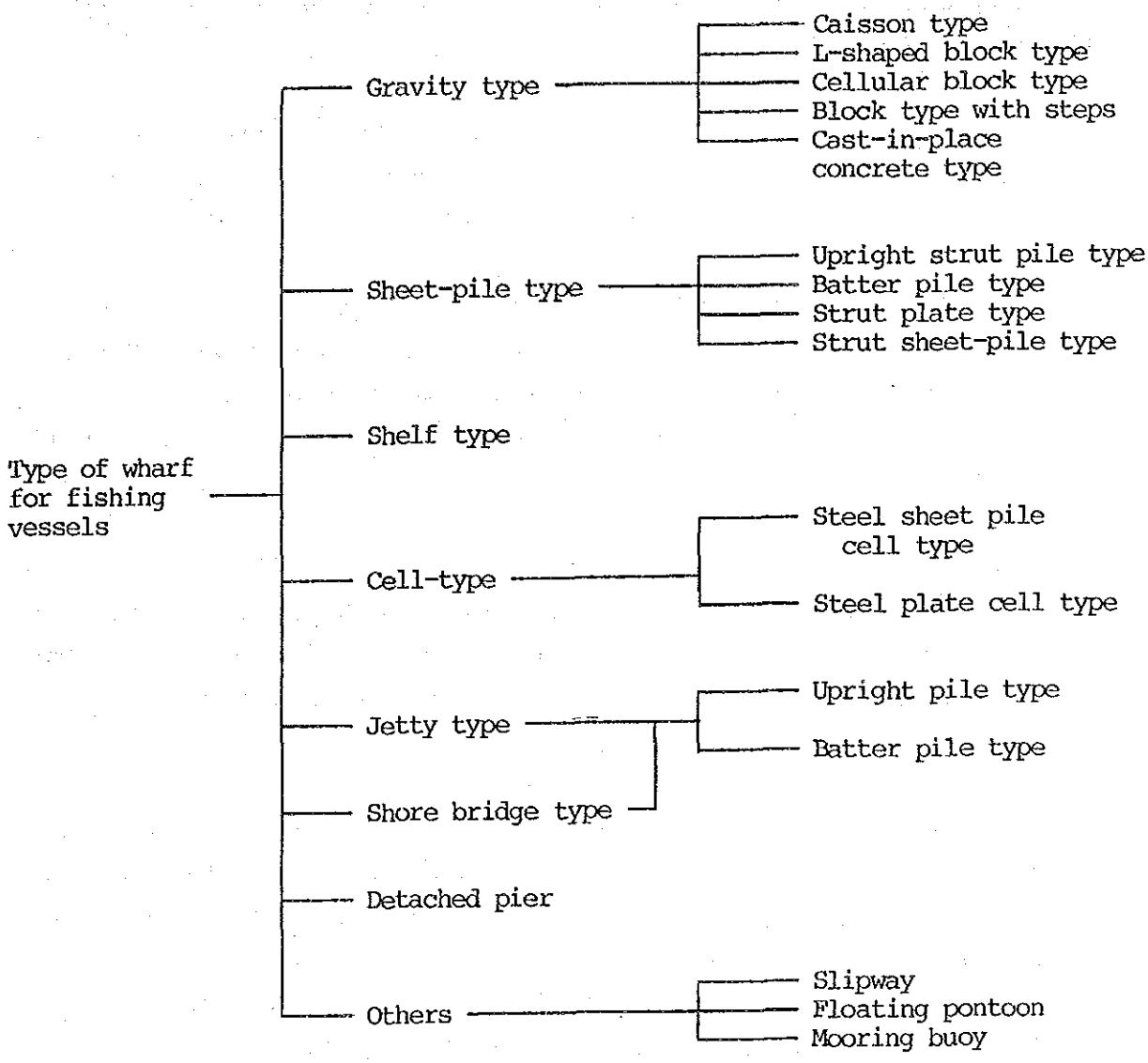
1) Selection of the type of structure of the mooring facilities

Figure 5 shows the various types of mooring facility structures. Since the facilities of this project are aimed at serving small-sized mechanized fishing boats, detached piers, dolphins and cell-type wharves for deep water mooring of large-sized vessels, such as tankers, are not appropriate for this project.

Although shelf and jetty mooring facilities are suited for places with poor subsoil because the supported load is born by pile structures, these fixed mooring wharves are very inconvenient for mooring small-sized boats. The efficiency of use is very low at the project site where the daily fluctuation in the tide level reaches a maximum of 4.2 m, and the maximum water level vises over 5 m higher than the lowest water level (CDL) during flood period of the rainy season.

Floating pontoons are suitable for mooring facilities of small-sized boats in basin with large fluctuation of water level and small waves, and they have long record of use in harbors serving small-sized fishing boats. Such aspects as the mooring method of the floating pontoon itself and the durability/maintenance of the movable gangway

FIGURE 5 Mooring facilities of various kinds



interconnecting the floating pontoon with the land are matters to be examined with further care. However, in this project, it is regarded as the most appropriate structure to be adopted in the landing facilities, because water of the Karnaphuli river has low salinity level and there is not so much concern about the maintenance.

It was decided to install the floating pontoon at a place located 50 meters off the waterfront revetment of the landing apron in view of the following reasons.

a) Since fishing boat will also be moored at the land side of the floating pontoon and at the waterfront of the landing apron it is necessary to keep a distance at least 3 times (approximately 39 meters) as large as the length of the fishing boats.

b) The slope of the gangway must be kept within a maximum value of about 10 degrees for smooth landing work. The maximum slope is 11 degrees when the distance from the waterfront is 50 meters, and this is regarded as an appropriate slope angle.

The floating pontoon and the water area in front of the landing apron will be used as anchorage for the fishing boats, and an anchorage depth of CDL -2.0 m will be required because of the draft of the fishing boats in use. Therefore, it will be necessary to dredge part of the water area in front of the landing apron which has a shallow water depth.

As this project site is located 16 km inland from the estuary of the Karnaphuli river, at a place where the river is bent, it is possible to obtain the calmness making it possible to "anchor the ships safely more than 90% to 95% of the days of the year".

2) Design of the Gangway

Since the dead weight of the bridge becomes excessive if a 50 m gangway is designed as a one-span structure, it will to present a large deflect and a part of the gangway permanently submerged. In order to prevent this problem it was decided to divide the gangway into 2 spans with a float arranged at an intermediate position. It was also decided to install a height adjustment stand on the intermediate float for the float to be able to support the gangway at a position halfway between the crest elevation of the landing apron (CDL + 5.0 m) and the crest elevation of the floating pontoon at the lowermost tide level (CDL + 1.0 m). When the floating pontoon, the gangway and the landing apron are arranged as described above, the gangway will have a slope of about 1:9 in the direction of the jetty during the lowermost tide level. During the highest tide level the intermediate float will be located at the highest point, with a descending slope to the floating pontoon and to the landing apron.

The gangway will be fabricated as a steel-truss structure of a 1-m tall girder consisted of the combination of steel shapes, to make a light weight structure with minimum of deflection. The support system of the gangway will have a hinged mechanism at one side and a sliding mechanism at the other side, in such a way to allow a given extent of horizontal displacement in two directions.

3) Design of the floating pontoon

There are three alternatives regarding the material for the floating pontoon construction, concrete, FRP and steel. Table 6 compares the advantages and disadvantages of each type.

Small-sized FRP floating pontoons for small-sized fishing boats and marinas have a long record of use in Japan, but this

TABLE 6 Comparison of the floating pontoon alternatives

	CONCRETE		FRP	STEEL
1) Characteristics	Heavy structure with superior stability. Large draft is possible. There may be structure cracks. There is risk of infiltration of water.		Light weight structure with remarkable oscillation. The draft is too small. Ballast is required. Superior durability.	This structure has ordinary stability. The draft is appropriate. This structure is corroded when exposed to sea water, but there is no problem in this project.
2) Construction cost	When built in Bangladesh	200	—	100
	When built in Japan	500	200	—
3) Characteristics of the construction method	It is difficult to construct concrete structures on the slipway. Dry dock or cofferdam is required. It is difficult to obtain concrete with high degree of watertightness and high strength (compressive strength <300 kg /cm)		The hand lay-up method is adopted to build the FRP structure, but it has a small experience in large sized floating pontoon	The steel structure can be built with ease on the slipway. There is vast experience of construction and use of steel structure floating pontoons in Bangladesh.

kind of material has not been used much in large sized floating pontoons such as the one of this project. Even when the hand lay-up method is used, it will be necessary to carry out detailed studies about adopting the one-body molded structure or the module structure and other relevant aspects. Moreover, since it is very light weight, such problems as tilting, oscillation, etc., are expected. Although FRP is the most durable material, it is regarded as inadequate for this project in view of the said demerits.

As for floating pontoons made of concrete structure, it is quite difficult to secure an appropriate flat, dry yard for building the concrete structure, and good quality cement and aggregate are difficult to obtain in Bangladesh. This would make it difficult to make concrete structures with high density and high strength. Also, a temporary manufacturing yard (e.g. sheet pile cofferdam, construction of temporary dock by dry land work, etc.) would be required when manufacturing them in Bangladesh and that involves considerable cost.

In view of these facts, it is decided to construct steel structure floating pontoons which have a long record of construction and use in Bangladesh.

The corrosion protection method is particularly important in a marine environment. Although this project site is located in a tidal river, the salinity level in the water is low, and only negligible corrosion is observed for use of more than 10-year of old steel structures (sheet-piles, floating pontoons) in the area. Such being the case, the corrosion protection method to be adopted in this project consists of a) corrosion margin of 1 millimeter and b) corrosion protection painting (marine paint). (Refer to Table 7).

The construction of the floating units, the positions of

TABLE 7 Corrosion protection specifications of steel structures (Fishing port standards)

Floating unit section	Corrosion protection specifications
Splashing zone	Painting : 3 years + Corrosion margin (0.3mm/side/year) : 27 years
Submerged section	Electric corrosion protection : 15 years (Corrosion margin : 0.02mm/side/year) + Corrosion margin (0.01mm/side/year) : 15 years
Inside the float	No corrosion margin (painting) or corrosion margin of 0.05mm/year (No painting)

(Remarks)

(1) The specification of the coating to be carried out on the splashing zone must have durability of 3 or more years.

(2) The anode of the electric corrosion protection should be properly designed to secure maintenance corrosion protection current density of 50 mA/m or more.

(3) The durability of electric corrosion protection is improving in recent years, and there are cases with 3-year durability in practical use. The specifications of the submerged part shown in the table above are applicable to the float and other major structural elements. Electric corrosion protection with 3-year durability can be used at the other parts after a careful study about the matter.

the bearings of the gangway and the fabrication of the mooring apparatus must be properly selected so as to secure sufficient overall strength of the floating unit to cope with the design external forces as well as the strength and the stability of the various individual parts of the floating unit both for the floating pontoon and for the intermediate float. The floating units must satisfy the requirements of sufficient longitudinal bending strength, horizontal bending strength and other aspects of the overall strength during the fabrication, towing and installation.

The stability and the freeboard of the floating units must be examined in connection with the following ;

a) Stability and required freeboard when fully loaded
b) Stability and minimum freeboard when flooded
c) Inclination and minimum freeboard when unevenly loaded

The specifications of the floating pontoon obtained as a result of the study are given below ;

a) Freeboard when unloaded : 1.0 m : Draft when unloaded : 0.2 m : Inclination angle (short side) : Under 1/10
b) Freeboard when fully loaded : 0.8 m : Draft when fully loaded : 0.4 m : Inclination angle (short side) : Under 1/10
c) Bulkheads will be provided in the longitudinal and transversal directions inside the floating pontoon, thereby dividing it in small watertight compartments to cope with flooding.
d) Since even the shorter side of the floating pontoon is 10 m, there is no problem of inclination (under 1/10) and stability for 1/2 one-sided loading.
e) Rubber-based anti-slip pavement was selected for the top surface.

f) The mooring posts are 1-ton bits arranged at 5-m spacing for the moorings the fishing boats.
g) Watertight manholes will be provided on the top slab for maintenance.
h) Lighting equipment will be provided on the floating pontoon to provide safety for work during the night and to function as beacon lights to prevent ships from colliding.
i) Used tires will be used as fenders.
j) Cap/stans will be provided to adjust the tension of the mooring chains.

4) Mooring system

There are two types of mooring systems applicable to floating pontoons, chain mooring and pole mooring. In Japan, pole mooring is used in small-sized floating pontoons of marinas, but the chain mooring system is used in most of the large-sized floating pontoons. In Bangladesh, the pole mooring is used in some cases such as the floating pontoon (8 m x 35 m) for ferry boats of the bank of the Karnaphuli river, but chain mooring is used in most of the cases.

In this project, the pole mooring was regarded as better functionally because it restricts horizontal displacements due to large external forces such as tidal currents. However, it was decided to use chain mooring because of such factors as limitations in the construction method, construction costs and aesthetics. Of the various types of chain mooring systems, it was decided to use a sinker fixing system (concrete block) because of the larger resistance to external forces, in spite of its rather expensive cost. Table 8 shows the comparison of the various methods.

(7) Structure to prevent the gangway from Collisions

TABLE 8 Comparison of the mooring systems

	Pole mooring system		Chain/anchor mooring system	
	Sliding type	Rope mooring	See anchor type	Sinker type
1) Component elements	Pole	Pole	See anchor	Sinker
2) Quantity of materials	Sliding device : o600xl0m/4 units Sliding unit /4 sets	Rope/fixing equipment : o600xl0m/4 units TP-32xl0m ropes/4units	Chain anchor 1 ton/4units; Chain o34mm x 85.5mm/4units	(Short pole) chain, concrete Block/10m/4 units;Chain : o34mmx82.5m /4 units
3) Construction cost index (Per ship)	140	100	70	70
4) Characteristics of using	No horizontal displacement. Maintenance of the sliding unit is required. The outer appearance is bad. This kind of mooring facility is difficult to move.	There is some horizontal displacement. Corrosion protection of the wire rope is required. The outer appearance is bad. This kind of mooring facility is rather difficult to move.	There is large horizontal displacement. The outer appearance is good. It is easy to move the floating pontoon.	

The gangway is slender steel truss structure designed to cope with a live of 250 kg/m^2. Moreover, its bearings use such component parts as pins, rollers and chains to cope with the up/down movements (0 to 5.5 m) as well as the horizontal displacements in 2 directions (±2.0 m in each direction) of the intermediate float and the floating pontoon, so that they are prone to be damaged. In particular, the main structures of both gangway and its bearing devices are not built to cope with collisions of ships coming from the transversal direction.

There will be many fishing boats anchoring and landing in the anchor basin of the project site, and it is presumed that there is considerable risk of damage to the gangway from collisions of fishing boats in anchorage. Thus, it was decided to provide structures to prevent collisions.

Two possible alternatives for the anticollision structure were examined : (1) a rigid steel frame structure built by fastening a submerged steel frame with concrete base, and (2) a flexible structure made by connecting mooring buoys with chains. Table 9 compares the two alternatives. As can be seen, the rigid steel structure has many demerits in its use and construction and is expensive. Thus, it was decided to use the flexible anti-collision structure in this project.

Collision prevention buoys with the same construction as ordinary mooring buoys (1-m diameter, 70-cm height) will be used in this project. Steel rings will be arranged instead rubber fenders at the periphery of the buoys, and used tires will be wound around the steel rings as fenders.

In rubber fenders for ordinary wharves type the reaction (collision force) to the effective wharfing energy of 0.402 ton of 10-tonne fishing boat is approximately 15 tonnes. However, in chain mooring buoys, because of the displacement of the buoy and the tension of the chain, the reaction force is of the order of 2.0 tons even in L.L.W.L.

TABLE 9 Comparison of the collision prevention structures

	RIGID STRUCTURE	FLEXIBLE STRUCTURE
1) Component elements of the facilities	1) Steel structure 2) Submerged concrete 3) Cutting or stone mound	1) Buoy/fender 2) Mooring device Chain Sinker/anchor, etc.
2) Quantities of materials (Water depth : -2.5m) (Quantities per set)	1) Steel : 18 tonnes 2) Underwater concrete : 120 cubic meters 3) Excavation : 560 cubic meters 4) Rubble-mound : 440 cubic meters	1) Buoy/6 units (1.68 tonne) 2) Chain/6x175m (11.13 tonnes) 3) Sinker/18x2m (36 cubic meters)
3) Direct construction cost index Local procurement rate	270 85%	100 95%
4) Characteristics of use	1) Possible to be used for mooring ships 2) Serious damage in the gangway in abnormal situations and when colliding with the gangway. 3) It is difficult to be installed and removed.	1) It can be used also for mooring. 2) The damage in the gangway minor even when there is collision. 3) It is easy to install and to remove the facility.
5) Characteristics of the construction method	1) Floating crane is required. 2) Dredger bridge is required. 3) Underwater concrete is required.	1) No floating crane is required. (Required when using sinker and precast concrete)

The horizontal displacement of the buoy is 1.25 m at most in the case of double mooring, and 72 cm at most in the case of triple mooring. It is presumed that two units sized ø22 mm x 55 is sufficient.

5-3-3 Architectural Plan

(1) Basic Policy of the Design of the Facilities

1) The annual rainfall of Bangladesh is not extremely large, but it is concentrated in the monsoon period. Since this project site is located close to the river estuary, it is influenced by the volume of water of the river as well as the ebb and flood tides, and the land at the periphery of the project site may be submerged. Appropriate measures must be taken for the floor surfaces of the major facilities not be flooded and losing their functions.

2) The dwelling spaces of the facilities will have relatively high ceiling by taking into consideration the high temperature and humidity climate, and the buildings will be of open and provided with eaves for shade and ventilation.

3) Since the buildings will be erected on embankment ground, it is recommended to use a light-weight structure. Steel structure is a appropriate type of building frame for this project, but it is not used because it relies on imports for most of the components, and it is not a familiar type of structure in Bangladesh.

4) The major structures are reinforced concrete columns, walls and floors. Bricks, abundant in Bangladesh, will be used in the walls. Procurement of local materials and employment of local work force will be possible because of the types of structures used. Since there is risk of considerably strong winds from cyclones, the roofing must be light-weight, be strong, and have sufficient durability to cope with the high temperatures and high humidities. Materials that can be

procured locally in Bangladesh will be used as much as possible in the fittings and equipment to facilitate the maintenance and the control of the facilities.

5) The fish distribution process from landing to delivery will be considered in designing the traffic flow and ground plans of the facilities, with special considerations taken for the auction hall to face as widely as possible the landing apron, and to allow the loading of large trucks adjacent to the auction hall.

6) The administrative office and the ice-making plant will be arranged at the inner part of the lot because of the limit of space. The administrative section will be put on the second floor because of such factors as the necessity of monitoring the activities in the market and to prevent pilferage.

7) Lighting equipment will be provided outdoors to make it possible to work during the nighttime in the parking lot, in the fish loading lot and in the landing apron.

8) Local procurement and adoption of local construction methods will be considered for selecting most of the construction materials. That will make it possible to cope with such problems as difficulty in obtaining heavy construction machinery and custom clearance. The employment of the local work force will contribute to stabilizing the establishment of the construction schedule.

(2) Construction Plan of the Facilities

1) The wholesale market will be an one-storied (part of it two floors) reinforced concrete building. The auction hall will be on the first floor and the auctioneer's rooms will be on the second floor. The auction hall will be 7.5 m x 3-span deep and 7.5 m x 7-span wide, with two stairways arranged in the midway through the ridge direction span. The first floor will

have an area of 1,316 square meters, with the space for fish handling being properly secured. The height of the building will be determined a minimum of 3 m of effective height in the space under the auctioneer's rooms, a ceiling height of 2.5 m in the auctioneer's rooms, and a minimum height of 4 m in the space for fish loading. Heat prevention and ventilation required to cope with the high temperature and high humidity climate of Bangladesh are the other factors to be taken into consideration when determining the ceiling heights. Movement of people and commodities in the buildings will be arranged in such a way to demarcate the auction hall and the passageways in conformity with the location of the columns and the marking of the floor. The auctioneer's rooms located in the mezzanine will be accessed through the two stairways located in the auction hall. There will be 42 auctioneer's rooms sized 2.5 m x 4.0 m that will be used for office work and for napping.

2) The administrative office and the ice-making plant will be located in a two-story (partially well hole) reinforced concrete building. The ice-making room, the ice storage, and the machine room are on in the first floor and the office is on the part of the second floor. This building will be 5.4 m x 9-span deep and 15.0 m x single-span wide. The ice-making room and the machine room of the first floor will be closed with external walls, the ice storage will be open. The ice-making room will have an inner height of 7.4 m to facilitate the ice-lifting crane. The machine room will contain the compressor in addition to the small diesel engine generator for emergency use. The administrative office, located in the second floor of this building, will be occupied by the superintendent plus 12 to 15 senior clerks and will be 100 square meters (8.3 to 6.7 square meters each). A rest room approximately 15 square meters will be provided for the approximately 10 ordinary workers of the ice-making room and the market floor (approximately 1.5 square meters each). The outer walls of the office will be recessed into the column faces to make decks. The berthings and landings of the fishing

boats will be visible from these decks, and they will help improve the shading and ventilation as well. There will also be a counter for payment for ice and the charge for market use in the office.

3) Guard Post

There will be a guard post at the gateway of the lot to separate the truck and light weight vehicle traffic as well as to prevent vehicles from coming into the market, thereby preventing confusion at the gateway.

4) Feature of the Buildings

The features of the buildings and rooms are summarized here.

a) Wholesale market building : single-storied with mezzanine reinforced concrete structure

Construction area : 1,316 square meters, overall floor area : 1,925 square meters
First floor : Auction hall 1,316 square meters
Mezzanine : Auctioneer's rooms 609 square meters

b) Two-storied building for administrative and ice-making plant : reinforced concrete structure

Construction area : 648 square meters, overall construction area : 816 square meters

First floor :
- Ice-making room and machine room : 446 square meters
- Ice storage and anteroom : 202 square meters

Second floor :
- Administrative office : 119 square meters
- Rest rooms, etc. : 49 square meters

c) Guard post

Single-storied brick structure
Construction area : 10 square meters : overall floor area : 10 square meters

5) Finishing

Generally, the buildings will be given the following finishing.
Roof : Wooden backing, single layer asphalt
Columns and girders : Mortar backing and painted finish
Floor : Mortar backing and painted finish
Ceiling : Waterproof plywood, painted finish

Wooden fitting will be used to facilitate the maintenance and control. The roofing will be wooden backing and single to reduce the weight of the building.

(3) Structural design of the facilities

1) The basic column arrangement of the wholesale market building will be 7.5 m x 7.5 m. There are columns exposed in the auction hall, but it is not a wide-open space. The columns are arranged properly in order to utilize the available space in blocks, as well as for the safety and the economical efficiency of the reinforced concrete construction frame. Ordinary direct foundations will be used for the market building. The building will be 52.5 m long and expansion joints will be required.

2) Spans of 15.0 m, which is long in a reinforced concrete structure, will be required in the administrative office and ice-making plant building. The columns must be arranged with a spacing of 5.4 m in the longitudinal direction of the building for durability. Since this building has a complicated shape and large weight comparing with the market building, there is risk of uneven soil settlement. Thus, it will be designed with pile-born foundations.

3) The guard post will be a local brick structure.

4) The specifications of the structural materials. Cement made in Bangladesh meets appropriate quality control is used. It is recommended to use crushed rubble stone as coarse aggregate and river sand as fine aggregate. Reinforcing bars equivalent to SD35 (JIS standards) will be used. The piles to be used will be RC type.

5) Design strength

Concrete : FC 210 (3,000 psi)
Reinforcing steel : SD 35 or SD 40 (60 kips)
Piles : pile diameter and bearing power : 500ø Ra=75 ton
Pile length : L = 12 meters

6) Structural design standards

Although the AIJ standards of Japan are applicable to this project, the design is carried out in conformity with the standards of the United States of America (UBC, ACI, AISC) that are in general use with the authorities of Bangladesh that will take charge of the examination of the documents related to this project. The applied load will be in conformity with the UBC, but the values referring to the seismical intensity and the velocity pressure will be those ones mentioned before.

(4) Design of the Mechanical Equipment of the Facilities

1) The water service piping will be laid from the road in front of the project site, and water will be stored in the water receiving tank after the water meter. The water will then be pumped up to the elevated tank and will be distributed to each building. Water will be distributed to the ice-making room, to the ice storage, to the auction hall and to the administrative office. Water taps will be provided at the required places of the various rooms, and will be used for ice-making, washing, drinking, drainage, etc.

Ice-making room : 100,000 Liters/day
Auction hall (washing twice/day) : 15,000 Liters
Ice storage : 1,000 Liters
Administrative office : 15 persons x 50 liters = 750 liters
Administrative office : 20 persons x 10 liters = 200 liters

116,950 liters/day ⟶ Approximately 120 m^3/day

2) Drainage

Rain water will be discharged from the periphery of the lot to the river by the slope of the pavement. Washing water used in the administrative building and in the ice-making building will be handled in the same way as rain water. Sewage and raw waste water will be collected in the catch basins located outdoors, and will be soaked into the ground infiltration, after being carried to the septic tank by means of the collecting pipe. Since fish processing will not be carried out in the auction hall of the market building, contamination of washing water by fish guts is presumed to be negligible. Washing water will flow to the drainage ditches located at the jetty side from a drain of the auction hall floor, and will be discharged directly in the river after being collected in a few catch basins. Fish meat chips, bones and other fish wastes will be filtered and eliminated at the catch basins.

3) Sanitary facilities

Sanitary facilities such as lavatory bowls, urinal, wash basins, sinks, etc., will be required in the administrative building. Attention must be paid so that the lavatory bowls and the urinals not to face the E-W directions due to religious reason.

4) Ventilation facilities

No heating, cooling and air-conditioning facilities will be provided, and ventilation will be carried out by natural means. A ceiling fan will be provided in the administrative building.

5) Kitchen equipment

Natural gas will be piped to the kitchen, and will be available for connection with gas appliances. A small sink and cooking space will be provided, and piping will be laid for supply and drainage of water to and from the sink.

6) Handling of waste water

Contact aeration type septic tank will be installed in the lot to handle sewage and raw waste water. The volume of waste water and sewage to be processed will 1 m^3/day, and the quality of the discharged water will have concentration under 60 ppm.

7) Fire Prevention

Fire extinguishers will be provided in conformity with the fire law of Japan. In particular, since ammonia will be used as a refrigerant in the ice-making room, the outer walls will be made of bricks and the roofing will be a light weight one with wooden backing and asphalt finish.

(5) Design of the electric system of the facilities

1) Power receiving equipment

Overhead power line of 11 KV is available up to the project site. A power-receiving transformer will be installed in the project site, and one circuit of 3-phase 4-line 415 V. 50 Hz power will be received. The electric system will have 250 KVA capacity. The outdoor conduits will be vinyl pipes.

2) Wiring

The wiring will be in conformity with the IEC standards. A low-voltage switchboard will be installed in the electric room to be built in the guardhouse, and cables will be laid from the switchboard to each building. The wiring systems to be used will be a 3-phase 4-line 415V and a single-phase 2-wire 240 V 50 Hz system. The outdoor conduits will be vinyl pipes.

3) Lighting and power outlets

With exception of the ice-making plant, which will use 415 V power, the voltage to be used in the whole electric system of the project will be 240 V, and the lead wires will be vinyl-insulated or cables. The lighting equipment will mostly be fluorescent lamps manufactured in Bangladesh. The illuminance standards and the number of power outlets of the major parts are given here.

Name of the Building	Name of the Room	Illuminance (Lux)	Number of Power Outlets
Wholesale Market Building	Auction hall	400 Lux	0
	Auctioneer's rooms (per room)	300	1
	Corridors and stairways	50	0
Administrative Office and Ice-making Plant Building	Ice-making room	200	2 (waterproof type)
	Machine room	300	4
	Ice storage	100	3 (waterproof type)
	Ice handling space	100	1 (waterproof type)
	General Manager's room	300	2
	Meeting room	300	5
	Lavatory and kitchen	100	2
	Corridors and stairways	50	0
	Guard post	100	0
	Electric room	100	0
Pontoon	Deck	400	2 (waterproof type)

4) Telephone and Interphone

Wiring and piping for telephones and interphones will be taken charge by the Bangladesh side.

5-3-4 Design of the ice-making plant

(1) Basic policy

1) Design standards

a) Currently, there are no Bangladesh regulations and laws for refrigeration facilities, and moreover there are no standards referring to the design of machinery and refrigerant systems related to this matter.

b) The standards established by the International Standards Organization (ISO) are internationally applicable to refrigeration facilities, but it must be remembered that they provide mostly for the inspection methods referring to refrigeration equipment and facilities. On the other hand, the "HIGH-PRESSURE GAS CONTROL LAW" of Japan provides not only for the inspection methods but also for the construction and component materials of the equipment as well as welded structures and other relevant details.

c) The facilities of this project will be designed in conformity with the "HIGH-PRESSURE GAS CONTROL LAW" of Japan, and the standards of the ISO will be used only for the sake of reference.

2) Basic specifications of the equipment

a) The basic specifications of the equipment will be

determined by taking into consideration the technical level of Bangladesh related to the matter, for smooth operation, maintenance and control of the equipment in question.

b) The refrigerant will be ammonia, which is popularly used in Bangladesh and is inexpensive.

c) The compressor will be an open and reciprocating type is the most popular type used in Bangladesh.

d) The condenser will be an evaporation type, popularly used in Bangladesh, and is appropriate for operating environment with relatively poor water quality.

c) The ice-making plant will be equipped with two compressors to make it possible to adjust the production by controlling the number of units in operation.

f) The quantity of spare parts of the equipment regarded as sufficient for a minimum of 2 years of maintenance and control will be provided.

(2) Equipment for common use

a) Evaporation type condenser : 2 units
Capacity : 50 JRT ton
Blower : 1.5 KW x 2 units
Cooling water pump : 1.5 KW x 1 unit

b) Receiver : 1 unit
Type : Horizontal type
Dimensions : Outer diameter 750 mm, Length 3,000 mm

c) Oil separator : 2 units
Type : Vertical type

Dimensions : Outer diameter 350 mm, Length 1,000 mm

d) Oil purge drum : 1 unit
Type : Horizontal type
Dimensions : Outer diameter 300 mm, Length 800 m

e) Cooling water pump : 1 unit
Capacity : 200 Liters/minute, Head 19 m
Motor : 0.75 KW x 1 unit

f) Refrigerant piping materials : 1 set

g) Cooling water piping materials : 1 set

(3) Ice-making plant

a) Conditions related to the ice-making plant
Production capacity : Daily ice-making capacity of 32 tonnes of 135 kg ice blocks
Ice-making cycle : Ice-making cycle with 48-hour duration

b) Compressor : 2 units
Type : Open reciprocating compressor
Capacity : Minimum 114,000 Kcal/h
Motor : 44 KW, 4P

c) Accumulator : 2 units
Type : Vertical type
Capacity : Outer diameter 600 mm, Height 3,000 mm

d) Ice-making tank : 1 unit
Type : Welded steel plate tank type
Capacity : Length 12 m, Width 10.5 m, Height 1,220 mm
Insulating specifications : 125 mm thickness polystyrene plate

e) Evaporator : 1 unit
System : Herring bone coil system

Dimensions : 32 A steel pipe, 860 m

f) Brine agitator : 1 unit
Propeller diameter : 406 mm
Motor : 7.5 KW

g) Ice cans : 476 cans
Type : For 135 kg ice blocks

h) Can grids : 34 sets
Type : For 14 cans
Specifications : Hot dip zinc coating

i) Water filling tank, dissolved water tank, ice extractor : 1 unit each
Type : For 14 cans

j) Ice hoisting crane : 1 unit
Capacity : 2.5-tonne hoisting capacity
Motor : 3 KW
Span length : 11 m, including rail and supporting beam

k) Ice lift : 1 unit
Capacity : 300 kg x 1.2 m
Motor : 1.5 KW

l) Water piping materials : 1 set

(4) Ice storage

a) Technical conditions
(Ice storage)
Capacity : Storage capacity of 96 tonnes (135 kg ice blocks)
Storage room temperature : -5°C
Dimensions : Floor area 76 m^2, internal height 3.5 m
(Temporary storage room)

Capacity : Storage capacity of 20 tonnes (135 kg ice blocks)
Temporary storage room temperature : -5°C
Dimensions : Floor area 57 m^2, internal height 3.5 m

b) Compressor : 1 unit
Type : Open reciprocating compressor
Capacity : Minimum 22,900 Kcal/hour
Motor : 15 KW, 4 P

c) Accumulator : 1 unit
Type : Vertical accumulator
Capacity : Outer diameter 300 mm, height 900 mm

d) Evaporator : 2 units
(For ice storage room)
Type : Suspended one-body type evaporator
Heat transmission area : 40 square meters
Fan : 0.4 KW x 3 units
(For temporary storage room) : 1 unit
Type : Suspended one-body type evaporator
Heat transmission area : 70 square meters
Fan : 0.4 KW x 3 units

e) Floor surface finishing : 1 set
Type : Lined with wooden draining boards

(5) Control facilities

a) Power control board : 1 unit
Power supply : 440 V, 50 Hz, 3-phase

b) Starting board for compressor : 3 units
Starting system : Star-delta system

c) Lighting equipment : 1 unit
Ice-making room : Fluorescent lamps

d) Wiring materials for power, lighting and control : 1 set

(6) Power generation equipment for emergency use

a) Alternating current generator : 1 unit
Output : 50 KVA
Rating : Continuous
Engine specifications : 4-cycle water-cooled engine

b) Power feed and power supply switchover equipment, etc.
: 1 set

(7) Equipment and materials related to the plant

a) Ice crusher : 1 unit
Capacity : Ice crushing capacity of 7 tonnes/hour
Motor : 1.5 KW, 3-phase

b) Equipment and materials
Ammonia refrigerant contained in 45-liter cylinders :
40 cylinders
Refrigeration oil contained in 200-liter drums : 4 drums
Brine : 20 tonnes
Refrigerant filling equipment : 2 sets
Thermometer : 10 units
Densimeter : 10 units
Materials for repair (welding rods, paint, etc.) : 1 set
Special tools for maintenance : 1 set

c) Spare parts
Ice cans : 16 cans
Can grid : 1 unit
Spare parts for compressor, motor, generator : For 2 years of operation
Spare control switches, etc. : For 2 years of operation

5-3-3 Design of the Equipment

(1) Fish boxes : 1,830 units
Capacity : 50 liters
Material : Polypropylene
Dimensions :
- (Overall dimensions) : 800 x 550 x 185 (Height) mm
- (Effective inner dimensions) : 700 x 460 x 165 (Height) mm

Type : Fish boxes suited for piling-up storage and for storage

(2) Hand carts : 40 units
Loading capacity : 150 kg
Material : Steel
Load platform dimensions : 1,100 x 500 mm
Overall length : 1,250 mm
Wheel : Two rubber wheels

5-3-6 Basic Design Drawings

1. Layout Plan

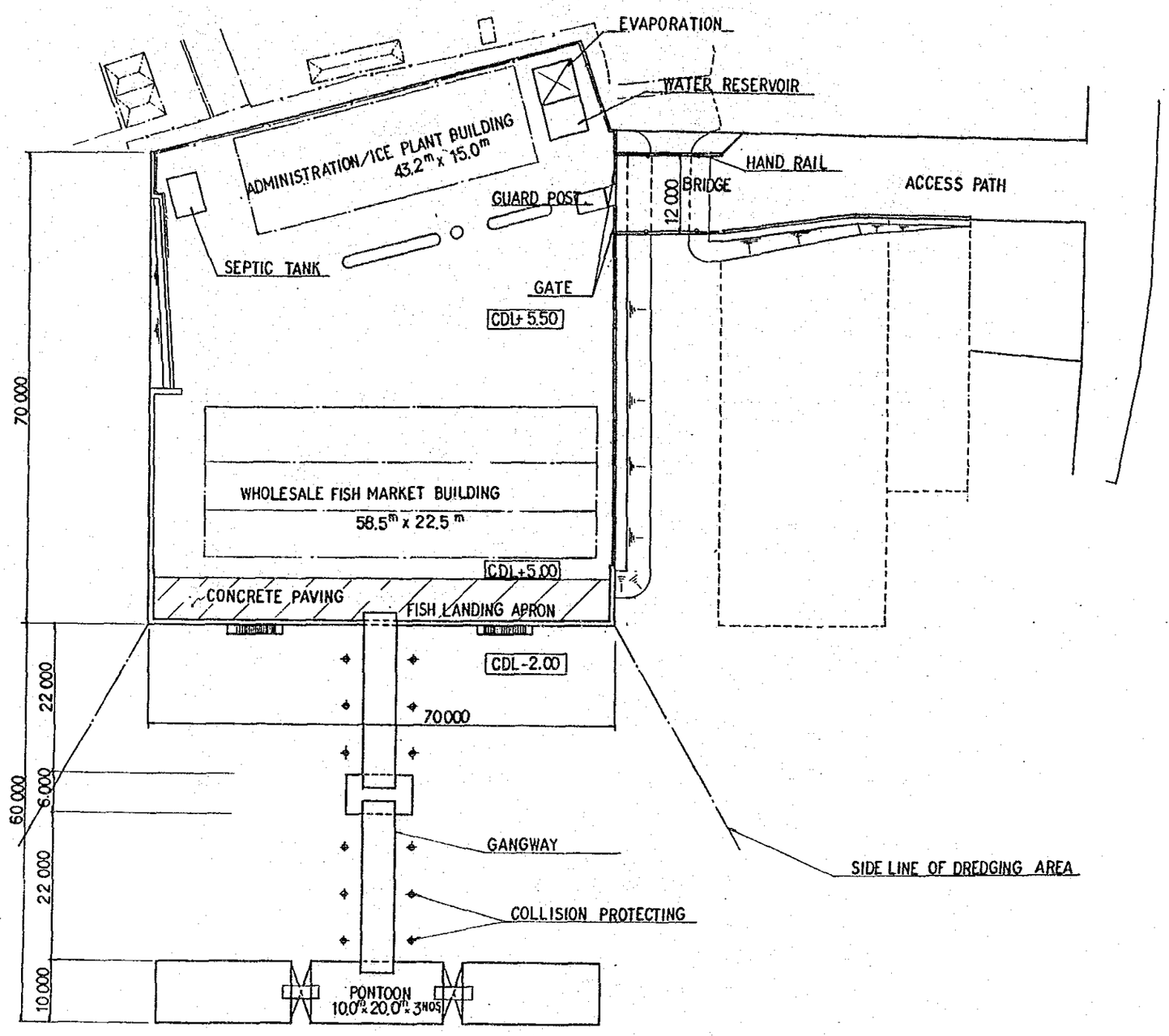
2. Fish Wholesale Market Floor Plan

3. Fish Wholesale Market Section & Elevation

4. Ice Plant & Administration Building Floor Plan

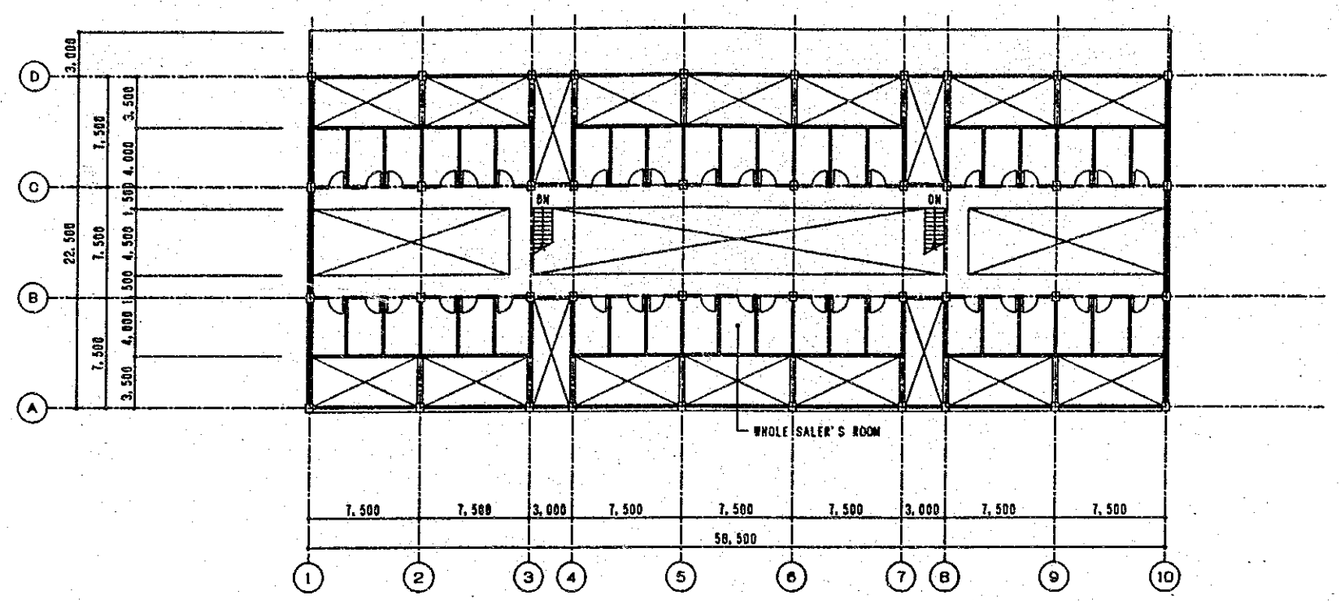
5. Ice Plant & Administration Building Section & Elevaton

6. Fish Landing Apron & Canal Bridge Typical Section



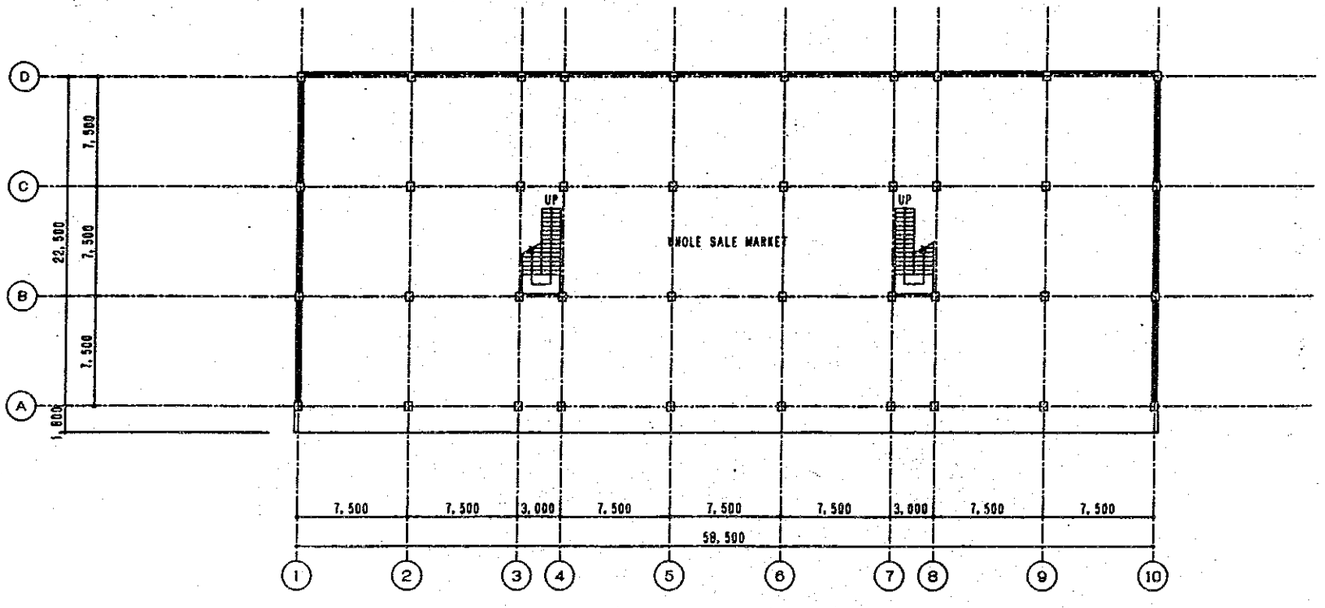
GENERAL PLAN S=1:500

1. LAYOUT PLAN



FIRST FLOOR PLAN

S=1:200

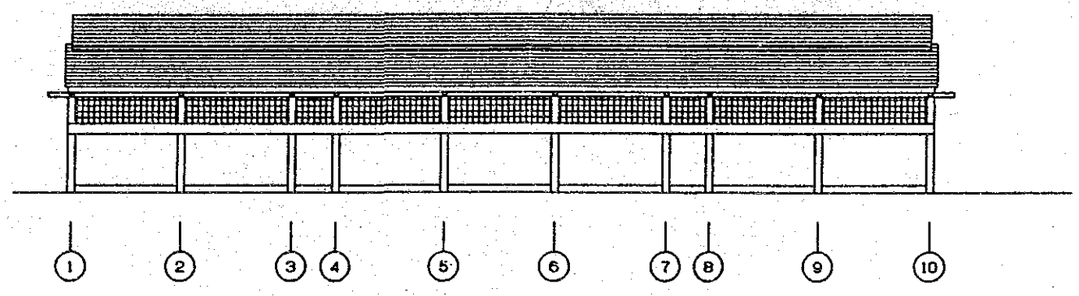


GROUND FLOOR PLAN

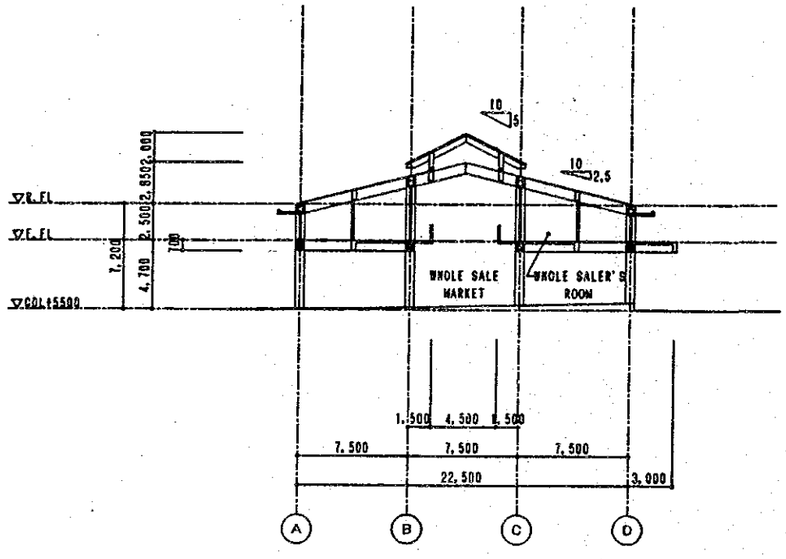
S=1:200

2. FISH WHOLESALE MARKET

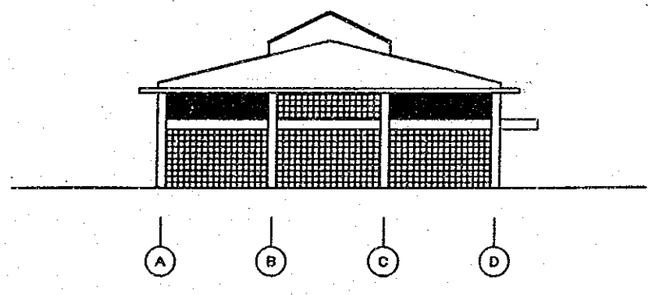
FLOOR PLAN



SOUTH ELEVATION
S=1:200

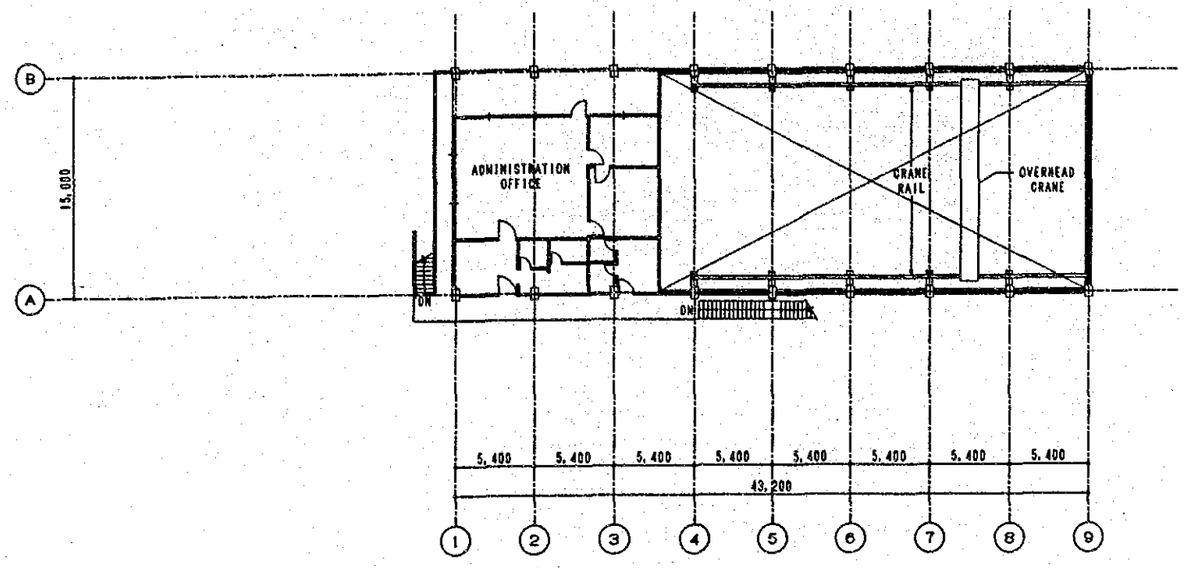


SECTION
S=1:200

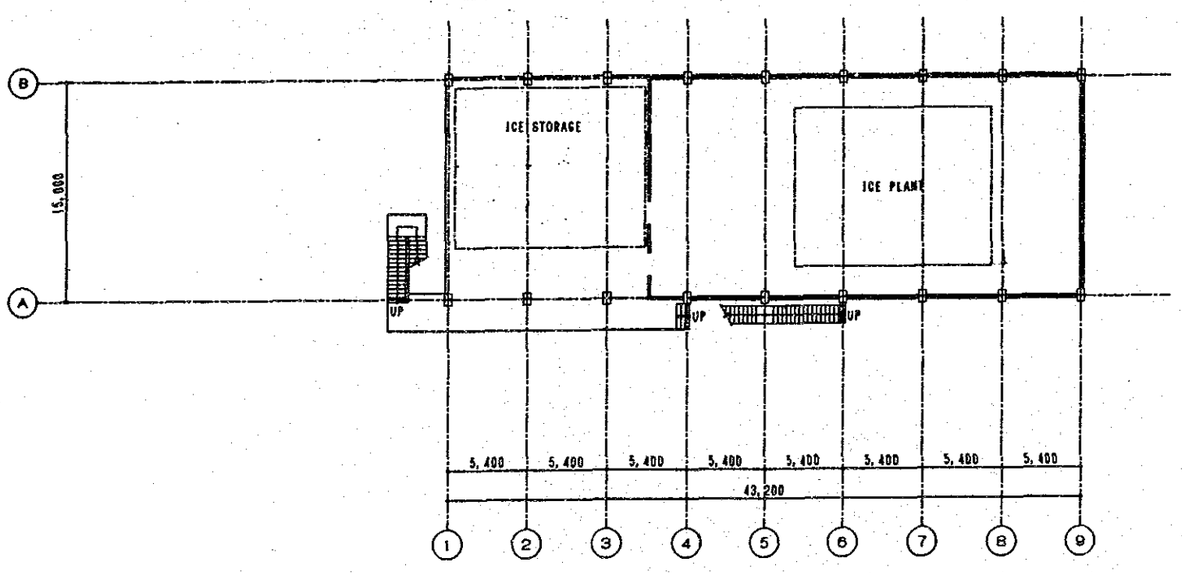


EAST ELEVATION
S=1:200

3. FISH WHOLESALE MARKET
SECTION & ELEVATION



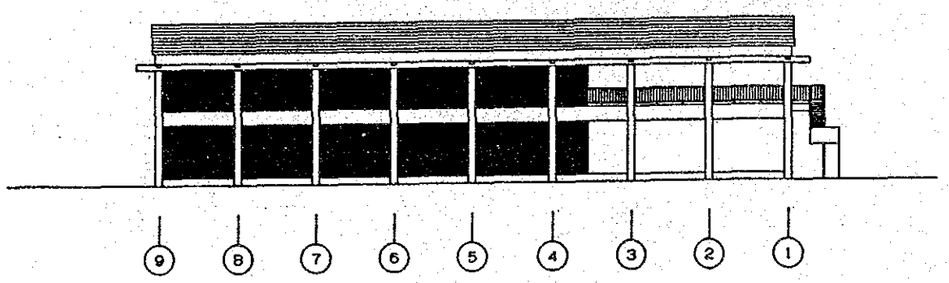
FIRST FLOOR PLAN
S=1:200



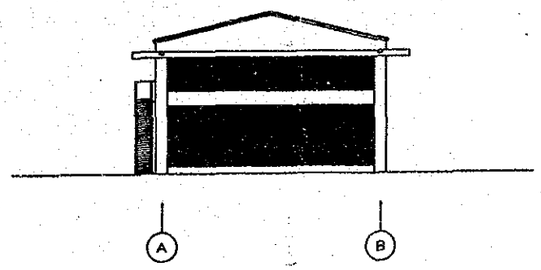
GROUND FLOOR PLAN
S=1:200

4. ICE PLANT & ADMINISTRATION BUILDING

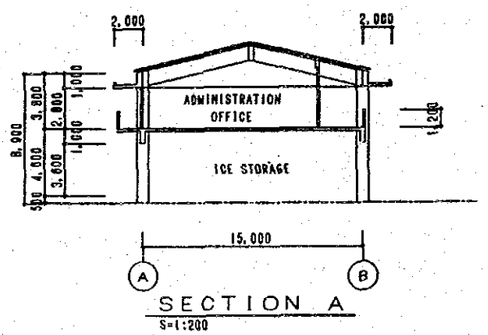
FLOOR PLAN



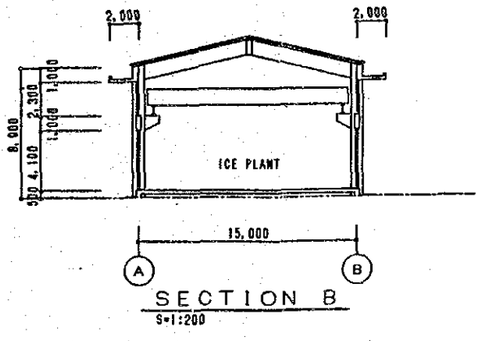
NORTH ELEVATION
S=1:200



EAST ELEVATION
S=1:200

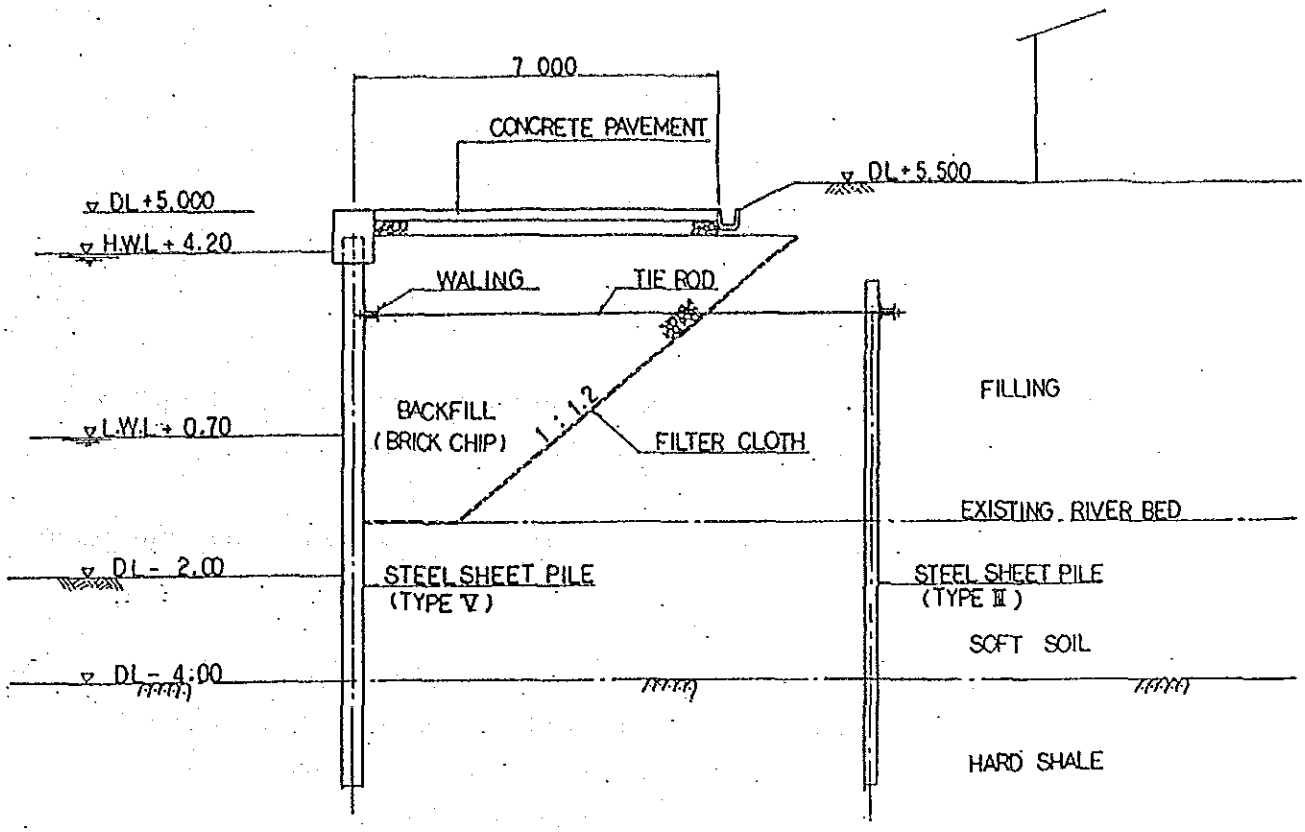


SECTION A
S=1:200

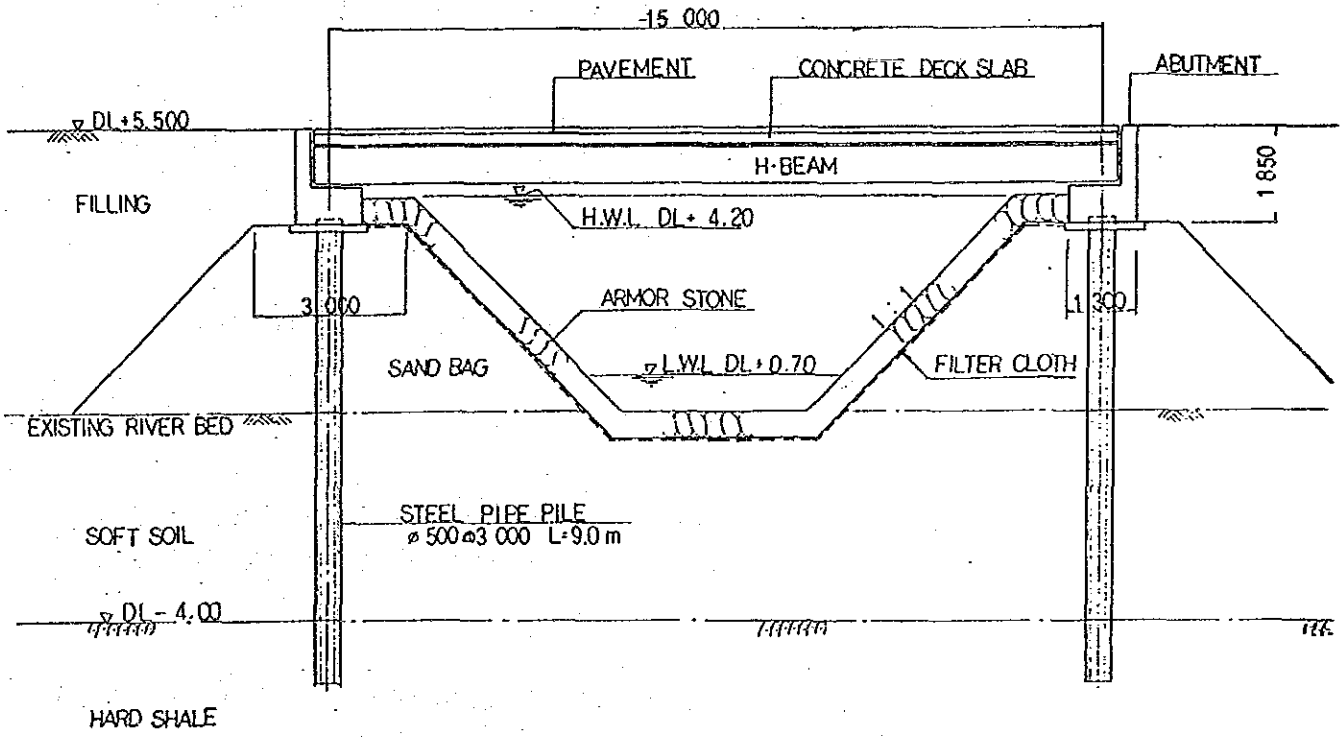


SECTION B
S=1:200

5. ICE PLANT & ADMINISTRATION BUILDING
SECTION &ELEVATION



FISH LANDING APRON TYPICAL SECTION Scale 1:100



CANAL BRIDGE TYPICAL SECTION Scale 1:100

6. FISH LANDING APRON & CANAL BRIDGE TYPICAL SECTION

5-4 Implementation Plan

(1) Implementation policy

1) Implementation policy

Implementation of the construction for this project will be executed in conformity with the following policy.

a) To use local work force, local materials and equipment as much as possible.

b) To determine the period for execution of the construction works with attention paid to avoid the rain season as much as possible to improve the operation rate of the construction work.

c) To pay special attention to the conservation of the environment.

d) To keep close contact with the local community to prevent trouble.

e) To respect the culture and the tradition of Bangladesh.

2) Scope of the works

The scope of the works of this project is as follows.

a) To secure the lot for the project.

b) To construct the fish landing facilities, the fish distribution facilities and the fish preservation facilities.

c) To procure equipment for fish landing and distribution.

d) To execute the work and to provide the services accompanying the supervision of the work.

e) To carry out the formalities and to obtain permission to execute the previously-mentioned steps of work.

3) Responsibilities of the governments of Japan and Bangladesh

The governments of the two countries in connection with the execution of this project are as follows.

{Responsibilities of the government of Bangladesh}

a) To secure the construction lot and to remove all obstacles existing in the lot, those ones in the water areas concerned.

b) To secure the required source of water.

c) To take the steps required to exempt the custom clearance formalities and the custom duties for import the equipment and materials to be used.

d) To take the steps required to exempt the taxes and other charges applicable to Japanese citizens in Bangladesh in connection with the provision of construction equipment as well as services involved in the execution of the project.

e) To exempt the Japanese parties concerned from the permits and the like required to execute the project, and to give and grant them other required rights.

f) To carry effective operation and maintenance of the facilities constructed under the auspices of the grant-in-aid.

{Responsibilities of the government of Japan}

a) To procure all equipment, materials and work force required for the construction works.

b) To secure the sea and land transportation of the imported equipment and materials required for the construction works and to bear the cost of the export insurance.

c) To provide consulting services related to the executive plan, to the execution of the tender, to the supervision of the construction works, etc.

(2) Execution of the works and matters of consideration.

The method of to secure the safety of the barge on the floating pontoon during strong wind and flood must be planned in advance when executing the work on the water. Since the risk of having waves with significant height exceeding 1 m is small even during the periods with strong wind and waves (mainly in May and October), it is presumably sufficient to interrupt the work and to take appropriate measures to moor the barge.

Since the daily fluctuations in the river water level is large (1.2 to 4.2 m), the schedule and the method of the construction must be properly planned, by taking into consideration the tide level forecast table, to minimize the masonry and the concrete works of the bottom of the revetment under the water to do the work in dry.

Since the air temperature and the rainfall exert remarkable influence on the quality of the concrete, the following measures must be taken to prevent the concrete temperature from exceeding a given value (35°C) right after casting the concrete.

a) Temperature control of the raw materials (cement, sand, gravel, water)

b) Temperature control of the set concrete.

c) Temperature control and prevention of drying (water sprinkling) during the curing period.

Appropriate measures must be taken to prevent the infiltration of rain water when working with concrete outdoors.

A large yard will be required to stock the construction materials, to place and to repair the heavy machinery, to work the reinforcing bars and to carry out the concrete work. Since it is difficult to make the required space in the project site, it will be necessary to rent a nearby lot for this purpose.

(3) Plan for supervision of the construction work

After the signature of the design and supervision contract with the Government of Bangladesh, the consultant will carry out the field survey and the final discussions with the local authorities in charge, and after that, the consultant will prepare such materials as the detailed plans, the structural calculation documents, the bill of materials, the work specifications and other documents required for bids. After the completion of the tender documents, the contractor, that will be in charge of the construction, will be selected through such steps as the approval of the plan, prequalification, tendering and evaluation of the bids.

After the signature of the construction work contract, the consultant will carry out such steps as checking the working diagrams to be submitted by the contractor, supervision of the manufacture of the processed component parts, witnessing of the quality inspection of the exported products and materials, and inspection of the shipment. When the construction works starts

in Bangladesh, the consultant will dispatch a supervising engineer who will be in charge of such matters as coordination of the reception of the shipped items by the contractor, control of the construction work, the execution of the quality control tests, the inspection of the work progress, etc., and will submit the relevant reports.

(4) Procurement of equipment and materials

The construction materials required to execute the construction works of this project are soil, cement, bricks, rubble stones, concrete, steel (reinforcing bars, shapes, sheet piles) and construction materials (roof materials, blocks, bricks, paint, glass, sanitary facilities, ping). These materials can be procured in Bangladesh, with exception of some special items (sheet piles, materials to equip the floating jetty, roofing materials, etc.). Detail on their quality is summarized in Appendix VII-5. With exception of some special products, it is regarded as recommended to procure them in Bangladesh, with special attention paid to quality assurance.

Heavy construction machinery will have to be transported from Japan because the models and the quantities available in Bangladesh are very limited. Part of the construction machinery will be procured in Bangladesh only when there is no other alternative. The materials and heavy machinery required to carry out the construction works will be transported by sea from Japan to Chittagong and by land from Chittagong to the project site, and the plans for their procurement and transportation will be formulated with utmost care.

(5) Execution schedule

This project will be implemented in two phases. In the first phase, it will take about 2.5 months for detail design and 11.5 months for construction. In the second phase, it will take 2.5 months for detail design and 11.5 months for construction.

Details of each phase construction are as follows.

- Phase I
  Civil engineering works (floating pontoon/gangway, canal bridge, etc.) : Realization of the fish landing functions

- Phase II
  Construction works (wholesale market, ice-making plant, etc.) : Realization of the fish distribution and preservation functions.

Implementation schedule

Type of work			Month 1	2	3	4	5	6	7	8	9	10	11	12
Phase I	Detail Design	Local survey												
		Domestic work												
	Construction	Preparatory work												
		Temporary work												
	Procurement	Reclamation												
		Fish landing apron												
		Floating pontoon												
		Canal bridge												
		Collision protect												
Phase II	Detail Design	Local survey												
		Domestic work												
	Construction	Preparatory work												
		Temporary work												
	Procurement	Office/Ice making building												
		Wholesale market building												
		Ice making machine												
		Pavement work												

CHAPTER 6
PROJECT EVALUATION AND CONCLUSION

CHAPTER 6 CONCLUSIONS AND RECOMMENDATIONS

6-1 Impact of the Project

This project is aimed at improving fish landing and distribution through the construction of fish landing and distribution facilities for artisanal fishery in Chittagong, the center of marine fishery in Bangladesh. The following impacts are expected as a result of the implementation of this project.

1) In the fish landing and distribution facilities existing in the project area, the fish, precious source of animal protein in Bangladesh, suffer a remarkable loss of quality and value during the waiting for landing, the landing itself and the distribution process. Deterioration of the quality and decline of the value of the fish are expected to be prevented as a result of the improvements through the implementation of this project, thereby making substantial contributions to the economy of Bangladesh.

2) One of the disadvantages of fishery products comparing with other sources of animal protein is the high degree of degradability of their quality due to the surrounding environment. However, since the facilities of this project have an appropriate level of environment sanitation, it will be possible to supply further hygienic animal protein sources to the consumers.

3) The mechanized artisanal fishing boats, the major objects of this project, are currently forced to reserve 3 days for landing their catch and to make preparations for sailing, while the actual fishing period of each trip is just an average of 7 days. Improper equipment of the landing and preparation facilities is the major cause of this situation. If the improvements planned in this project are implemented, it would be possible to shorten the period required for the fishing

boats to land their catch and to make preparations for the next sailing down to a maximum of one day. In that case, it would be possible to increase the fishery production by increasing frequency of fishing trips even when the existing fishing boat fleet is not increased.

4) It is presumed that within the context of the operation of this project, to be taken charge by the BFDC, improvement will be possible not only in the fish landing and distribution process, but also in some aspects related to the form of distribution (e.g. control over the fishermen by the distribution business, unreasonably low fish prices, etc.) that have ample room for improvement. The establishment of fair distribution practice through the market will make ample contributions to the benefit of the population in general.

5) Improvements in the fish landing and distribution activities that are expected to be realized within the context of this project will play the role of a model case for Bangladesh, and the achievements of this project will bring about strong impact to stimulate the development of the fishery and the distribution of fishery products in Bangladesh.

6-2 Conclusions and Recommendations

It is recommendable that the Government of Bangladesh pay special attention to the following points of the facilities for effective operation.

1) The facilities of this project will be operated under the jurisdiction of the BFDC, but since these are facilities for the fish landing and distribution, they are related to the livelihood of many people such as fishermen, distributors, consumers, etc. Thus, these facilities are of a strong public nature, and they will be closely related to the administration of the Municipality of Chittagong. The access roads to these

facilities are not necessarily wide, and they will tend to cause traffic congestion. Moreover, the smell of fish may bother for the people living in nearby areas. It is also presumed that trades related to this project such as fishing gear shops, fish processing industries, transportation companies, food shops, restaurants, etc., will flourish around the project area once the operation of this project is started. From the standpoint of city planning, BFDC is recommended to start discussions as soon as possible with the Chittagong municipal authorities about these influences for the smooth operation of the facilities. Especially, remarkable traffic congestion on the access road to the project site is predicted after opening of the facilities. In this connection, the proper measures are necessary to be arranged. For example, one-way traffic regulations on the branched of the access road and disposition of traffic controlers.

2) The Government of Bangladesh does not currently impose no restriction on the number of fishing vessels, fishing methods, sailing frequencies, etc., of wooden mechanized fishing boats. When these facilities are completed, it will be possible to increase the volume of catch through increasing the fishing efforts such as increase of fishing fleet and the efficient operation of the fishing boats. It must be remembered, however, that since the demersal fish resources of the Bay of Bengal is being already exploited in intensively, special attention must be taken not to dry up these resources through overcatching. The administrative authorities in charge of the matter will be required to take appropriate measures so as to divert the efforts to increase the volume of catch to other kinds of fishery resources such as pelagic fish and migratory fish.

3) Since most of the artisanal fishermen of Bangladesh are in independent "cellular" business units with a few fishermen that crew fishing boats, their business is fragile, and in most of the cases they are under the control of the middle man. business. As it happens everywhere else, the fish price falls when the catch is abundant, and it rises when the catch is scarce, but either, the profit that goes to the producer is not very large. BFDC should promote the organization of the fishermen through the utilization of the facilities of this project and take measures that would contribute to increase the income of the fishermen.

4) The introduction of the facilities of this project will make it possible to deliver fish with high degree of freshness. It must be remembered, however, that retail shops are not properly equipped in Chittagong, the major consumption center, and there are no proper facilities such as cold storage and ice-making plants in the provincial district and of the distribution. The fish risk losing their quality before reaching the consumers. Hereinafter it will be necessary to improve the equipment and the installations in the provinces to make it possible to realize low-temperature distribution networks through the final outlets of the distribution system.

5) In principle, the self-sustained accounting system will be adopted in the operation of the facilities of this project, but too much importance is attached to the profitability of the project and such revenue as ice sales, berthing charges, market utilization charges, etc., are made too expensive, they would be added directly to the price of the fish, thereby resulting in a negative effect. In Bangladesh, the price of the fish is an important factor of public nature since fish is a major source of animal protein and a kind of food closely related to the daily lives of the people. The prices and charges of the various kinds mentioned above must be set at appropriate levels to secure the financial resources required to carry out the maintenance of the facilities for a long period.

6) The current facilities for mooring, anchorage, fish landing, distribution, etc., of mechanized wooden fishing boats are poorly equipped. The boats are also being operated arbitrarily by their owners, causing the waiting time of the boats to become long, the rotation of the boats become slow, and adding to the time for the boats returning later to the harbor to be able to land their catch. In order to have smooth operation of the project facilities it will be necessary to establish regulations covering the operation of fishing boats in the inner waters of the facilities and to have these regulations strictly observed by their captains and owners.

The BFDC, which will have jurisdiction over the water areas, will have to post personnel in charge of the traffic control of the fishing boats to maintain orderly arriving and sailing.

7) The project facilities are modern, with special attention paid to such aspects as drainage, ventilation, etc., and proper measures are taken for sanitary handling of the fish. The sense of hygiene of the personnel handling the fishes must be improved in order to maintain the hygienic state of the fish to the consumer. The BFDC must establish work regulations referring to hygienic matters for all people with access to the market, and to have these regulations strictly observed.

8) The project facilities are designed to meet the current demands at the time of opening of the facilities. However, it is possible to utilize the facilities to meet the demands in near future by realizing improvement of fish landing and distribution procedures recommended in this report. Though the facilities will meet the demands in the year of 2,000 as shown in Appendix VI-2, BFDC should promote properly improvement of the fish landing and distribution procedures. As software aspects play a key role in this improvement, role of technical assistance remarked in this report is recognized significant.

APPENDIX

List of Appendix

Appendix I Member List of Study Team

I-1 Basic Design Study

NAME	ASSIGNMENT	BELONGING
Mr. Akiyoshi NAKAYAMA	Team Leader	Deputy Director, Fishing Port Planning Division, Fishing Port Department Fisheries Agency
Mr. Katsuhiro SASAKI	Project Coordination	Second Basic Design Study Division, Grant Aid Study and Design Department, Japan International Cooperation Agency (JICA)
Mr. Yasuo ISHIMOTO	Fishing Port Planning	Overseas Agro-Fisheries Consultants Co., Ltd.
Mr. Mamoru NAMIKI	Port Structure Design	Overseas Agro-Fisheries Consultants Co., Ltd.
Mr. Munehiro SHIMADA	Fisheries	Overseas Agro-Fisheries Consultants Co., Ltd.
Mr. Masato ARAYA	Facilities Design	Overseas Agro-Fisheries Consultants Co., Ltd.
Mr. Akiyoshi TAKAHASHI	Topographic/ Hydrographic Survey	Overseas Agro-Fisheries Consultants Co., Ltd.
Mr. Masami TSUCHIYA	Cost Estimation	Overseas Agro-Fisheries Consultants Co., Ltd.

I-2 Draft Report Explanation Mission

NAME	ASSIGNMENT	BELONGING
Mr. Akiyoshi NAKAYAMA	Team Leader	Senior Researcher, Aquaculture & Fishing Port Engineering Division, National Research Institute of Fisheries Engineering, Fisheries Agency
Mr. Akihiro KAWADA	Project coordination	Fisheries Technical Cooperation Division, Japan International Cooperation Agency
Mr. Yasuo ISHIMOTO	Fishing Port Planning	Overseas Agro-Fisheries Consultants Co., Ltd.
Mr. Mamoru NAMIKI	Port Structure Design	Overseas Agro-Fisheries Consultants Co., Ltd.

Appendix II Study Schedule

II-1 Basic Design Study

Order	Date	Place	Activity
1.	Jan.26(Sat)	NARITA-BANGKOK	Travel (Mr. NAKAYAMA, SASAKI, ISHIMOTO NAMIKI, SHIMADA AND TAKAHASHI)
2.	Jan.27(Sun)	BANGKOK-DHAKA	Travel, Courtesy call to JICA office
3.	Jan.28(Mon)	DHAKA	Courtesy call to Japan Embassy
4.	Jan.29(Tue)	DHAKA	Courtesy call and discussion with BIWTA (Bangladesh Inland Water Transportation Authority) Courtesy call and discussion with BFDC (Bangladesh Fisheries Development Corporation)
5.	Jan.30(Wed)	DHAKA-CHITTAGONG	Courtesy call and discussion with BFDC Chittagong branch Observation of project site
6.	Jan.31(Thu)	CHITTAGONG	Observation of artisanal fish landing place, existing market
7.	Feb. 1(Fri)	CHITTAGONG-DHAKA	Travel
8.	Feb. 2(Sat)	DHAKA	Discussion with BFDC Courtesy call and discussion with Ministry of Fishery and Livestock
		BANGKOK-DHAKA	Joint of a member in charge of facilities design, Mr. ARAYA, to survey team
9.	Feb. 3(Sun)	DHAKA	Discussion with BFDC about contents of Minutes. Observation of BFDC Pagla Center
		CHITTAGONG	Start Boring survey
10.	Feb. 4(Mon)	DHAKA	Courtesy call and discussion with Ministry of Finance Signing of Minutes

Order	Date	Place	Activity
11.	Feb. 5(Tue)	DHAKA-BANGKOK	Departure of Bangladesh of official members (Mr. NAKAYAMA and SASAKI)
		DHAKA	Discussion with BFDC Observation of High Speed Ship yard Discussion with the Meteorological Agency
12.	Feb. 6(Wed)	DHAKA-CHITTAGONG	Travel. Discussion with BFDC Chittagong branch
		CHITTAGONG	Setting of tidal current meter and flow meter. Start survey
13.	Feb. 7(Thu)	CHITTAGONG	Discussion with Department of Fishery, Chittagong branch. Discussion with CPA (Chittagong Port Authority)
14.	Feb. 8(Fri)	CHITTAGONG	Depth measurement by echo-sounding
15.	Feb. 9(Sat)	CHITTAGONG	Start fish landing and marketing survey at Monoharkhali and Fisheries Ghat Survey on ice making facilities around Monoharkhali
16.	Feb.10(Sun)	CHITTAGONG	Discussion with BFDC Chittagong branch Observation of neighboring civil work site
17.	Feb.11(Mon)	CHITTAGONG-COX'S BAZAR	Travel. Discussion with BFDC. Observation of wholesale market, fish landing facilities and fish processing facilities
18.	Feb.12(Tue)	CHITTAGONG-COX'S BAZAR	Travel. Discussion with BFDC Chittagong branch
19.	Feb.13(Wed)	DHAKA	Discussion with BFDC Discussion with statistic division of Department of Fishery
20.	Feb.14(Thu)	DHAKA-JESSOR	Travel to Khulna by air and car Observation of BFDC wholesale market and fish landing facilities Observation of Government ship yard
		CHITTAGONG	Completion of boring survey and withdrawal

Order	Date	Place	Activity
21.	Feb.15(Fri)	JESSOR-DHAKA	Travel from Khulna.
		CHITTAGONG-DHAKA	Travel.
22.	Feb.16(Sat)	DHAKA	Final discussion with BFDC
23.	Feb.17(Sun)	DHAKA	Reporting to JICA office
		DHAKA-BANGKOK	Departure of Bangladesh (Mr. ISHIMOTO, NAMIKI, SHIMADA and ARAYA)
24.	Feb.18(Mon)	DHAKA	Data compilation
25.	Feb.19(Tue)	DHAKA	Data compilation
26.	Feb.20(Wed)	DHAKA-BARISAL	Travel by ship.
27.	Feb.21(Thu)	BARISAL	Observation of BFDC fish landing center and fish processing factory
28.	Feb.22(Fri)	BARISAL-DHAKA	Travel
29.	Feb.23(Sat)	DHAKA-BANGKOK	Departure of Bangladesh
30.	Feb.24(Sun)	BANGKOK-NARITA	Arrival (Mr. TAKAHASHI)

II-2 Draft Report Explanation Mission

Order	Date	Place	Activity
1.	Jul. 1(Mon)	NARITA-BANGKOK	Travel
2.	Jul. 2(Tue)	BANGKOK-DHAKA	Travel, Courtesy call to JICA office
3.	Jul. 3(Wed)	DHAKA	Courtesy calls and discussions with the Ministry of Fishery and Livestock, the Ministry of Finance and BFDC
4.	Jul. 4(Thr)	DHAKA-CHITTAGONG	Discussions with CPA and BFDC's Chittagong branch
5.	Jul. 5(Fri)	DHAKA-CHITTAGONG	Inspection on the project site and damage caused by the cyclone along Karnaphuli river
6.	Jul. 6(Sat)	DHAKA	Discussions with BFDC
7.	Jul. 7(Sun)	DHAKA	Discussions with BFDC on contents of the Minutes
8.	Jul. 8(Mon)	DHAKA	Signature on the Minutes Courtesy call and reporting to the Embassy of Japan and JICA office Visitation to DHAKA fish market
9.	Jul. 9(Tue)	DHAKA-BANGKOK	Travel
10.	Jul.10(Wed)	BANGKOK-NARITA	Travel

Appendix Ⅲ Member list of concerning parties in Bangladesh

Ⅲ-1 In the Basic Design Survey

1. Ministry of Fisheries & Livestock

Mr. Muhammad Lutfullahi Majid	Secretary
Mr. Luqueman Ahmad	Joint Chief (Planning cell)

2. Bangladesh Fisheries Development Corporation

1) Dhaka head office

Brigadier Chowdhury K. Laman	Chairman
Mr. M. Muzaffar Hussain	Director, Purchase & Marketing
Mr. A. K. M. Shanidul Islam	Manager, Planning Division
Mr. S. M. Yashin	Manager, Implementation
Ms. Kha Lutfunnessa	Stasistical Analyst

2) Chittagong branch

Mr. Khwaja M. Hassan	General Manager, Fish Harbour Complex
Mr. M. A. Hye	Manager, Trawler Fleet
Mr. Matiur Rahman Sarker	Manager (Administration)
Mr. Kazi Nurun Nabi	Project Manager
Mr. Zakaria Mamoon	Senior Stores Officer
Mr. Rowshon Ali	Refrigeration Engineer
Mr. Harun-or Rashid	Electrical Engineer
Mr. Habibur Rahman	Executive Engineer
Mr. Mohamed Islaque	Senior Purshase Officer
Mr. Mozammel Hussain	Assistant Manager (Administration)
Mr. Abdul Halim Sarkin	Stores Officer

3) Cox's Bazar branch

Mr. Golah Murtaza	Manager, Wholesale Fish Market

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Mr. Nuran Nabi	Manager, Fish Processing Unit

4) Khulna branch

Mr. Mesbahul Islam	Manager, Wholesale Fish Market
Mr. M. A. Momen	Manager, Fish Net Factory

3. Department of Fisheries

1) Dhaka head office

Mr. Nazrul Islam	Deputy Chief, Planning
Mr. Kasha Banik	Senior Scientific Officer, Resource Survey

2) Chittagong branch

Md. Harun-or Rashid	Deputy Director, Marine Fisheries Department
Mr. S. M. Shamsul Huda	Inspector, Marine Fisheries Department

3) Chittagong quality control laboratory

Md. Akhtar Ali	Deputy Director, Fish Inspection and Quality Control
Md. Abdul Khaleque	Fish Inspection and Quality Control Officer

4) Khulna quality control laboratory

Md. Kelal Uddin	Deputy Director, Fish Inspection and Quality Control

4. Chittagong Port Authority

Capt. M. Zakaria	Chairman, Chittagon Port Authority
Md. Jahirul Hoque	Member (Engineering & Dev.)
Dr. Shafaat Hossain Khan	Deputy Chief Engineer

5. Bangladesh Inland Water Transport Authority

Md. Salehuddin	Member (Engineer)

6. Ministry of Finance

Md. Nasim	Deputy Secretary, Economic Relations Division
Md. Rafiqul Islam	Assistant Chief, Economic Relations Division

7. Embassy of Japan

Mr. Ito	Minister
Mr. Takeshi Ota	First Secretary

8. JICA Dhaka office

Mr. Norio Matsuzawa	President
Mr.Naitoh	Vice-president
Mr. Takeshi Naruse	Deputy Resident Representative
Mr. Kenichirou Tominaga	Assistant Resident Representative

Ⅲ-2 In the Draft Report Explanation Mission

1. Ministry of Fisheries & Livestock

Mr. A. Z. M. Nasiruddin	Secretary
Mr. M. N. Shah Noor	Deputy Chief
Mr. Sirajal Islam Khan	Joint Secretary

2. Bangladesh Fisheries Development Corporation

1) Dhaka head office

Brigadier Chowdhury K. Laman	Chairman
Mr. A. K. M. Shanidul Islam	Manager, Planning Division
Mr. S. M. Yashin	Manager, Implementation
Mr. M. D. Fakhrul Alam	Executive Engineer

2) Chittagong branch

Mr. Khwaja M. Hassan	General Manager, Fish Harbour Complex
Mr. Kazi Nurun Nabi	Senior Marketing Officer
Mr. Abdul Hannan	Executive Engineer
Mr. Purna Chandra Sarker	Assistant Civil Engineer

3. Chittagong Port Authority

Capt. Lahiruddin Mahmood	Chairman
Md. Jahirul Hoque	Member (Engineer & Dev.)

4. Ministry of Finance

Mr. Ahmed Shanar Chowdhury	Deputy secretary, Economic Relations Devision (ERD)
Mr. Rafiqul Islam	Senior Assistant Secretary, ERD

5. Embassy of Japan

Mr. Ito	Minister
Mr. Takeshi Ota	First Secretary

6. JICA Dhaka office

Mr. Takeshi Imazu	President
Mr. Takeshi Naruse	Deputy Resident Representative
Mr. Kenichirou Tominaga	Assistant Resident Representative

Appendix IV Minutes of Discussions

1. Baic Design Study

MINUTES OF DISCUSSIONS
OF
THE BASIC DESIGN STUDY
ON
THE PROJECT FOR ESTABLISHMENT OF FISH LANDING, PRESERVATION AND DISTRIBUTION FACILITIES AT MONOHARKHALI IN THE PEOPLE'S REPUBLIC OF BANGLADESH

In response to the request of the Government of the People's Republic of Bangladesh (Bangladesh), the Government of Japan decided to conduct a basic design study (the Study) on the Project for Establishment of Fish Landing, Preservation and Distribution Facilities at Monoharkhali (the Project) and entrusted the Study to the Japan International Cooperation Agency (JICA). JICA sent to Bangladesh the Study Team headed by Mr. Akiyoshi NAKAYAMA, Deputy Director, Fishing Port Planning Division, Fishing Port Department, Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries, from January 26 to February 24, 1991. The Team had a series of discussions on the Project with the officials concerned of the Government of Bangladesh headed by Brig.Chowdhury Khalequzzaman (Retd.) Chairman, BFDC. and conducted field surveys.

As a result of the discussions, both parties agreed the fundamental factors for conducting the Study as attached herewith.

Dhaka, February 04, 1991

中山哲嚴

Akiyoshi NAKAYAMA
Team Leader,
Basic Design Study Team,
Japan International Cooperation Agency (JICA)
JAPAN

Brig.Chowdhury Khalequzzaman (Retd.)
Chairman
Bangladesh Fisheries Dev.Corporation,
Dhaka, Bangladesh.

ATTACHMENT

1. Objectives of the Project
   The objective of the Project is to improve fish landing operation, preservation and distribution of fishes caught by mechanized and local fishing boats for supply of fishes to Chittagong, Dhaka and other areas through establishment of the most appropriate fish landing, preservation and distribution facilities to be recommended by the Study.

2. Organization
   Executing and Implementing Agency : Bangladesh Fisheries Development Corporation, the Ministry of Fisheries and Livestock

3. Project site
   The site of the Project is located at Monoharkhali in Chittagong, Bangladesh as shown in ANNEX - 1.

4. Major items requested by the Government of Bangladesh for the Project
   The outline of the facilities and major equipment is shown in the ANNEX - 2.

5. Japan's Grant Aid Program
   The Government of Bangladesh has understood the system of Japan's Grant Aid Program explained by the Team, which includes a principle and the role of the Japanese consultants and Japanese firms for the implementation of the Project.

6. Provision of Necessary Budget and Personnel
   The Government of Bangladesh will assure the necessary budget and personnel for the operation and maintenance of the facilities and equipment provided, on condition that

the Grant Aid by the Government of Japan is extended to the Project.

7. Measures to be taken by the Government of Bangladesh
The Government of Bangladesh will take necessary measures as listed in ANNEX - 3, on condition that the Grant Aid by the Government of Japan would be extended to the Project.

8. The Bangladesh side requested for outline Draft study by end of March, 1991.

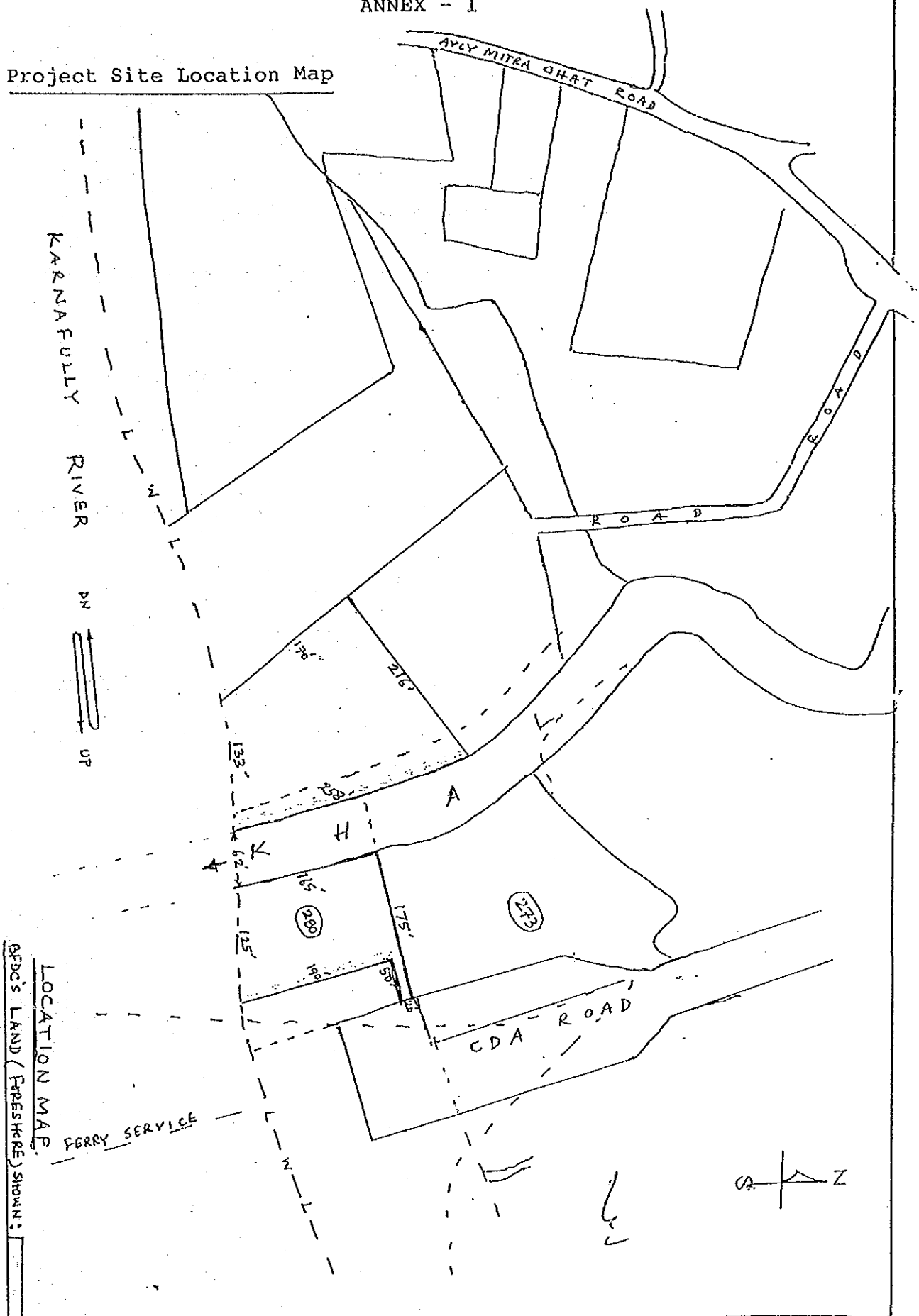
9. The Bangladesh side suggested that the design of the project be done in such a manner that land reclamation cost is not incurred.

10. Both side agreed to observe financial clauses as mentioned, subject to the approval of both the Govt.

中山

ANNEX - 1

Project Site Location Map



LOCATION MAP.

BFDC's LAND (FORESHORE) SHOWN:

MOUZA: FERINGIBAZAR,

DIST. CHITTAGONG.

SCALE NOT TO BE SHOWN.

ANNEX - 2

Request made by the Government of Bangladesh

1) Facility for fish landing of mechanized and local fishing boats; wharf, pontoon, gangway

2) Facility for preservation of fish ; ice plant, cold storage

3) Facility for distribution of fish ; fish market

4) Administration facility

5) Fisheries equipment for fish handling and distribution

6) Others

The Bangladesh side requested that appropriate minimum required facilities only may be studied/ incorporated in order to minimize the project cost.

ANNEX - 3

Necessary measures to be taken by the Government of Bangladesh are as follows ;

1. To secure the ownership and/or the right to use the Project site.
2. To clear, level and reclaim the Project site, when needed, prior to the commencement of the Project.
3. To construct wall and fences around the Project site.
4. To improve the access road to the Project site.
5. To provide facilities for the distribution of the electricity, water supply, drainage, telephone line and other incidental facilities.
6. To bear advising commission of the Authorization to Pay (A/P) and payment commission to the Japanese foreign exchange bank for banking services based upon the Banking Arrangement (B/A).
7. To ensure prompt unloading, tax exemption, and custom clearance of the goods for the Project at port of disembarkation.
8. To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the verified contract such facilities as may be necessary for their entry into Bangladesh and stay therein for the performance of their work.
9. To exempt Japanese national from customs duties, internal taxes to other fiscal levies which may be imposed in Bangladesh with respect to the supply of the products and services under the verified contracts.
10. To maintain and use properly and effectively the facilities constructed and equipment under the verified contracts.
11. To bear all the expenses other than those to be borne by the Grant, necessary for construction of the facilities as well as for the transportation and installation of the equipment.

12. To coordinate and solve any matters related which may arise with third party and inhabitants living in the Project area during implementation of the Project.

2. Draft Report Explanation Mission

MINUTES OF DISCUSSIONS

BASIC DESIGN STUDY

ON

THE PROJECT FOR ESTABLISHMENT OF FISH LANDING, PRESERVATION AND DISTRIBUTION FACILITIES AT MONOHARKHALI IN THE PEOPLE'S REPUBLIC OF BANGLADESH

(CONSULTATION ON DRAFT REPORT)

In July 1991, the Japan International Cooperation Agency (JICA) dispatched the Basic Design team on the Project for Establishment of Fish Landing, Preservation and Distribution Facilities at Monoharkhali (hereinafter reffered to as "the Project") to the People's Republic of Bangladesh, and through discussions, field survey and technical examination of the results in Japan, has prepared the draft report of the study.

In order to explain and to consult the Bangladesh side on the components of the draft report, JICA sent to Bangladesh a study team, which is headed by Mr. Akiyoshi Nakayama, Senior Researcher, Aquaculture and Fishing Port Engineering Division, National Institute of Fisheries Engineering, Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries and is scheduled to stay in the country from July 2 to 9, 1991.

As a result of discussions, both side confirmed the main items described on the attached sheets.

Dhaka, July 08,1991

中山哲巖

Akiyoshi Nakayama
Leader
Draft Report Explanation Team
JICA

Brig. Chowdhury Khalequzzaman (Retd.)
Chairman
Bangladesh Fisheries Dev. Corp.
Dhaka, Bangladesh.

ATTACHMENT

1. Components of Draft Report

The Government of Bangladesh agreed and accepted in principle the component of the Draft Report proposed by the team.

2. Japan's Grant Aid Program

(1) The Government of Bangladesh has understood the system of Japanese Grant Aid explained by the team.

(2) The Government of Bangladesh will take necessary measures, described in ANNEX I, for smooth implementation of the Project on condition that the Grant Aid Assistance by the Government of Japan is extended to the Project.

3. Products required for the project and available in Bangladesh shall not be exported from Japan.

4. Further Schedule

(1) The team will make the Final Report in accordance with the confirmed items, and send it to the Government of Bangladesh by the middle of September 1991.

Annex-I: Necessary measures to be taken by the Government of Bangladesh in case Japan's Grant Aid is extended.

1. To secure the site for the Project.

2. To clear the debris and wrecked ships brought by the cyclone on the site, prior to the commencement of the Project.

3. To undertake incidental outdoor works such as gardening, fencing, gates and exterior lighting in and around the site, when needed.

4. To take necessary control measure or make arrangement to alleviate traffic condition during construction period.

5. To provide facilities for the distribution of the electricity, water supply, drainage, telephone line and other incidental facilities to the Project site.

   1) Electricity distributing line to the site.
   2) City water distribution main to the site.
   3) Drainage city main to the site.
   4) Telephone trunk line to the main distribution panel of building.
   5) General furniture such as carpets, curtains, tables, chairs and others.

6. To bear commissions to the Japanese foreign exchange bank for the banking services based upon the Banking Arrangement as per prevailing rule of the Govt. of Bangladesh.

7. To exempt taxes and to take necessary measures for customs clearance of the materials and equipment brought for the project at port of disembarkation as per prevailing rule of the Govt. of Bangladesh.

8. To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the verified contract such facilities as may be necessary for their entry into Bangladesh and stay therein for the performance of their work as per prevailing rule of the Govt. of Bangladesh.

9. To maintain and use properly and effectively the facilities constructed and equipment purchased under the Grant.

10. To bear all the expenses other than those to be borne by the Grant, necessary for construction of the facilities as well as for the transportation and installation of the equipment.

Appendix V Tables and Figures

Table 2-1 Fishery Production

(Unit : tonnes/year)

	1983/84	1987/88
1. Inland capture	471,595	423,598
2. Inland culture	117,025	175,925
3. Marine industrial fishery	14,500	10,395
4. Marine artisanal fishery	150,382	217,187
TOTAL	753,502	827,105

(Source : DOF ; Department of Fisheries, Ministry of Fisheries and Livestock)

Table 2-2 Marine artisanal Fishery Production by Fishing Method (1987/88)

(tonnes/year)

Fishing method	production
1. Gill net	(132,890)
Mechanized fishing boat	118,276
Non-mechanized fishing boat	14,614
2. Set bag net	(63,464)
Seasonal type	45,000
Round-the-year type	18,464
3. Long line	(6,118)
Mechanized fishing boat	4,817
Others	1,301
4. Others	(14,715)
TOTAL	217,187

(Source : DOF)

Table 2-3 Number of artisanal fishing boat by area

Area	mechanized (no.)	non-mechanized (no.)
1. Cox's Bazar	1,822	2,089
2. Chittagong	1,128	5,272
3. Noakhali	179	1,860
4. Barisal	81	1,852
5. Patuakhali	98	2,044
6. Khulna	9	897
	3,317	14,014

(Source : DOF, 1984/84 survey of fishermen households)

Table 2-4 Operation records of gill net mechanized fishing boats (1988/89)

	number of boats of operation	monthly average fishing trips	average catch per fishing trip	monthly production
Jul.1988	570	3	453	775
Aug.1988	1,680	3	1,862	9,386
Sep.1988	2,692	3	2,752	22,225
Oct.1988	2,810	3	2,197	18,521
Nov.1988	2,570	3	2,511	19,360
Dec.1988	1,952	3	1,865	10,921
Jan.1989	1,750	3	1,910	10,028
Feb.1989	1,430	3	1,423	6,104
Mar.1989	1,305	3	1,327	5,196
Apr.1989	1,398	3	1,892	7,935
May 1989	1,145	3	1,815	6,236
Jun.1989	715	3	1,164	2,497
Annual total	20,017		21,171	119,184
Monthly average	1,668		1,764	

(Source : DOF)

Table 2-5 Annual fish handling volume at BFDC Cox's Bazar wholesale market

Year	1985/86	1986/87	1987/88	1988/89	1989/90
Annual handling volume (tonnes)	2,115	4,832	5,062	7,136	6,581

(Source : BFDC)

Table 2-6 Monthly fish handling volume at BFDC Cox's Bazar wholesale market

(Unit : tonnes)

Month	1989/90	1990/91
7	83	12
8	368	404
9	1,140	829
10	789	612
11	534	335
12	682	535
1	569	362
2	469	---
3	491	---
4	655	---
5	592	---
6	209	---

(Source : BFDC)

Table 2-7 Annual fish handling volume at BFDC Khulna Wholesale Market

Year	1985/86	1986/87	1987/88	1988/89	1989/90
Annual handling volume (tonnes)	3,294	2,858	2,495	2,866	1,933

(Source : BFDC)

Table 2-8 Monthly fish handling volume at BFDC Khulna wholesale market

(Unit : tonnes)

Month	1989/90
7	211
8	484
9	982
10	283
11	206
12	190
1	174
2	99
3	26
4	14
5	36
6	161

(Source : BFDC)

Table 3-1 Results of Water Analysis

BANGLADESH UNIVERSITY OF ENGINEERING & TECHNOLOGY, DHAKA
DEPARTMENT OF CIVIL ENGINEERING
ENVIRONMENTAL ENGINEERING LABORATORY

ANALYSIS OF WATER SAMPLE

Our Ref.No. : BRTC - 1920/90-91 Dated: 16/02/91

Your Ref.No.: TC/06/91 Dated: 16/02/91

Sent by : Tecnocosult International Ltd.
Sena Kalyan Bhaban 7th floor 195, Motijheel C/A, Dhaka

Location BFDC office, Bridge Ghat, Chittagong

Date of Test: 17th & 18th February, 1991

TEST RESULTS

Sl. No.	Water quality parameters	Unit	Concentration present	Drinnking water standards	
				WHO guide line values (1984)	Tentative Bangladesh standards
1.	Total Dissolved Solids	mg/l	136	1000	1500
2.	Turbidity	NTU	2.5	5	25
3.	Colour	mg/l	5	15	30
4.	pH	-	6.80	6.5-8.5	6.5-9.2
5.	Total Hardness as $CaCO_3$	mg/l	55	500	250(Max.400)
6.	Calcium, Ca	mg/l	7		
7.	Magnesium, Mg	mg/l	9		
8.	Chloride, Cl	mg/l	23	250	600(Max.1000)
9.	Fluoride, Fl	mg/l	0.15	1.5	1(Max. 2)
10.	Iron, Fe	mg/l	0.10	0.3	1(Max. 5)
11.	Manganese, Mn	mg/l	Nil	0.1	0.5
12.	Nitrate, Nitrogen, NO_3	mg/l	6	10	45(Max. 50)
13.	Carbondioxide, CO_2	mg/l	17		
14.	Alkalinity	mg/l	67		

Note: The maximum value in Bangladesh standard is for small diameter handpump tubewell water in absence of a better source.

Countersigned by:

Test performed by: 20/2/91

PROFESSOR
Department of Civil Engineering
Bangladesh University of
Engineering & Technology, Dhaka

(Source : by analysis in the field survey)

Table 3-2 Ice plants located within 2km from Monoharkhali

District	No of plants	Actual ice production capacity
1. Monoharkhali area	6 plants	40 ton
2. Fisheries Ghat area	10 plants	100 ton
3. Other area	7 plants	50 ton
Total	23 plants	190 ton

(Source : BFDC)

Table 4-1 Fisheries facilities of BFDC

	No of facilities	Capacity
1. Fishing harbor	1	--
2. Fish landing center	9	--
3. Fish wholesale market	7	--
4. Ice plant	13	225 ton/day production
5. Chilled storage	11	665 ton storage
6. Freezer	5	64 ton/day freezing
7. Cold storage	5	1,410 ton storage
8. Fishmeal plant	4	8 ton/day production
9. Trawl fishing vessel	8	--
10. Fishing net factory	3	0.42 million pounds/year production
11. Marine workshop	1	--
12. Slipway/dockyard	2	--
13. Mini-dock	3	--

(Source : BFDC)

Table 4-2 BFDC's Commercial Projects

Location	Project Name
1. Chittagong	Fish harbor complex
2. Chittagong	Trawler project
3. Rangamati	Kaptai lake fisheries development and marketing project
4. Mongla	Fish processing and preservation plant
5. Cox's Bazar	Fish and Fish by products processing plant
6. Narayanganj	Marketing and distribution project
7. Cox's Bazar	Wholesale fish market
8. Khulna	Wholesale fish market
9. Rajshahi	Wholesale fish market
10. Barisal	Fish landing and preservation facilities
11. Khepupara	Fish landing center
12. Patharghata	Fish landing center
13. Daborghat	Wholesale fish market and fish landing center
14. Comilla	Fish net factory
15. Chittagong	Fish net factory
16. Mongla	Fish net factory

(Source : BFDC)

Table 5-1 Results of water quality analysis around project site

central part

		PH	E.C.	CL	S.S	TALKALI	T.S	BOD	COD
89	JAN	7.25	95	1.0	0.1	52.0	73.0	2.1	42.0
	FEB	7.20	140	2.0	1.0	46.0	74.0	2.8	40.0
	MAR	7.00	100	1.5	0.8	64.0	69.0	2.2	40.0
	APR	7.20	110	0.5	0.4	68.0	71.0	0.4	36.0
	MAY	7.80	95	2.5	0.2	96.0	79.0	1.8	42.0
	JUN	7.80	140	2.5	0.4	96.0	22.0	0.9	45.0
	JUL	7.40	130	4.0	1.0	70.0	102.0	0.7	35.0
	AUG	7.20	90	2.0	1.1	56.0	100.0	0.4	20.0
88	DEC	6.20	80	1.5	0.1	44.0	65.0	2.2	
	OCT	7.60	178	2.2	0.1		80.0	0.3	
	APR								

peripheral part

		PH	E.C.	CL	S.S	TALKALI	T.S	BOD	COD
89	JAN	7.40	100	2.5	0.4	60.0	79.0	3.8	48.0
	FEB	7.20	145	7.5	0.1	48.0	129.0	2.6	62.0
	MAR	7.30	135	4.0	1.2	64.0	108.0	2.1	58.0
	APR	7.40	130	2.0	1.2	64.0	112.0		64.0
	MAY	7.60	120	4.0	1.1		98.0	2.9	70.0
	JUN	7.60	160	6.5	0.9	92.0	187.0	2.5	50.0
	JUL	7.70	140	3.0	1.1	76.0	121.0	0.6	45.0
	AUG	7.40	120	1.5	1.8	68.0	128.0	0.4	30.0
88	DEC	6.10	110	6.5	0.1	47.0	28.0	2.0	
	OCT	7.50	181	25.5	0.1		85.0	3.8	
	APR	6.40	180	2.0		6.0		1.2	

NOTE : KARNAPHLI RIVER WATER
SS : SETTING SOLID (ml/l)
T.ALKALI : TOTAL (mg/l)
BOD/COD : PPM
EC : (μs/cms)
CL : Chlorine (mg/l)

(Source : by analysis in the field survey)

Figure 2-1 Organization chart of the Department of Fishery

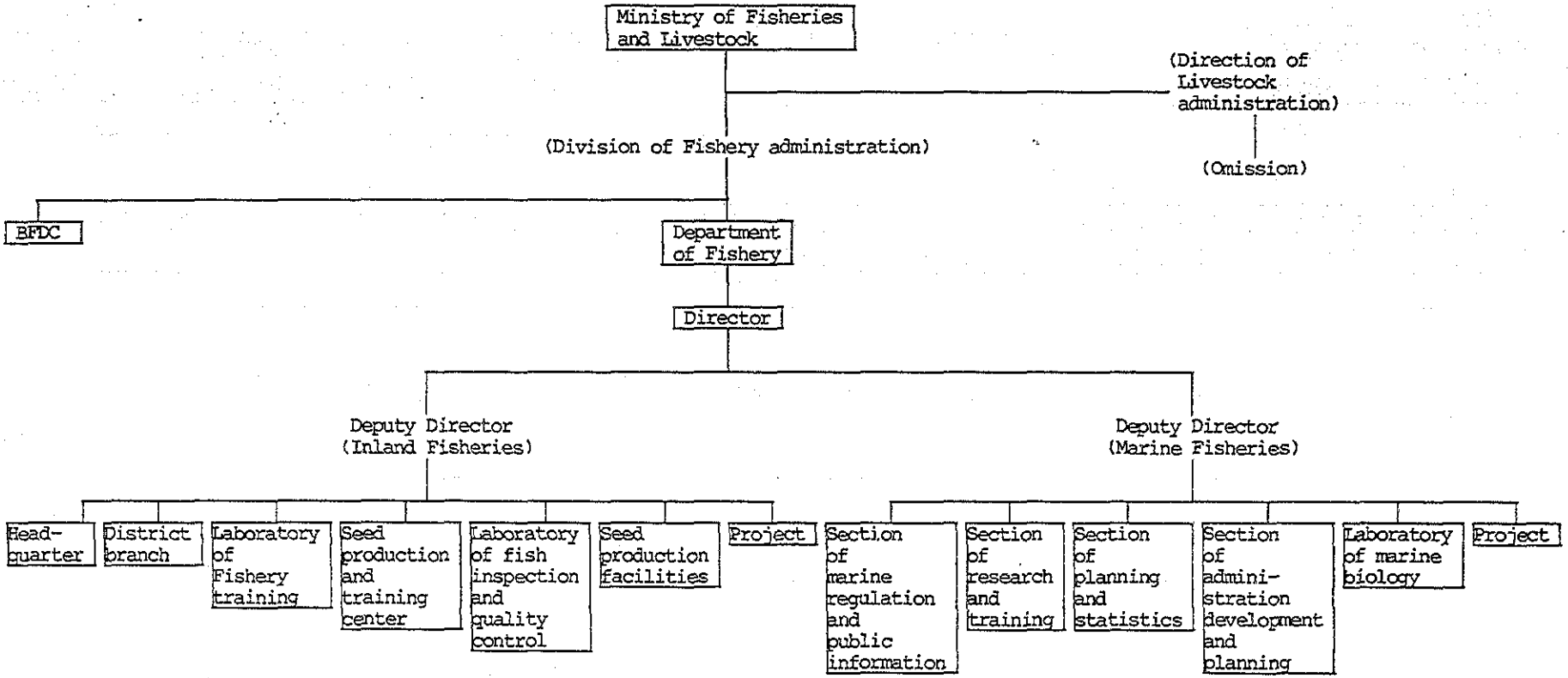


Figure 2-2 Organization chart of Bangalesh Fisheries Development Corporation (BFDC)

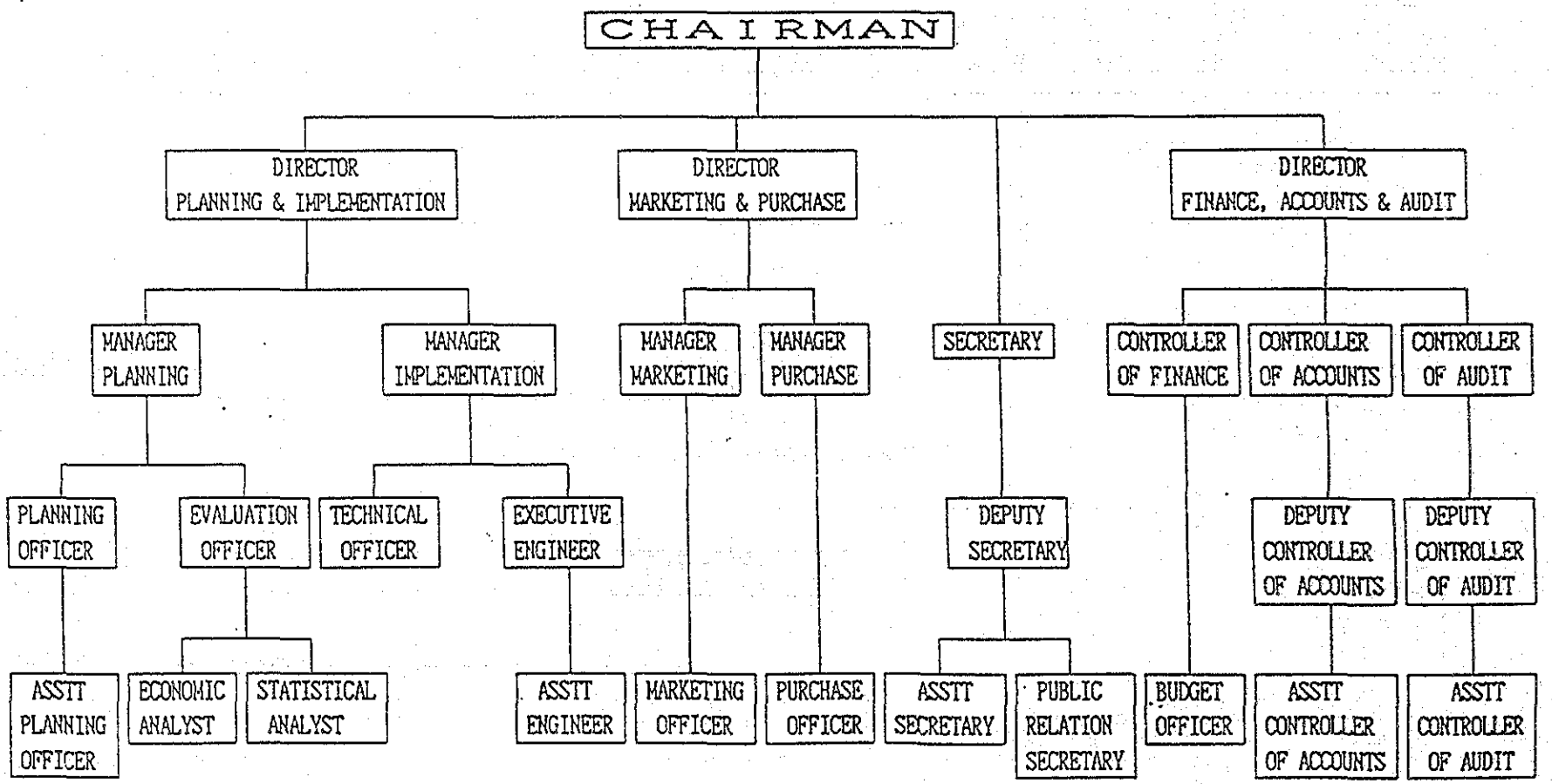
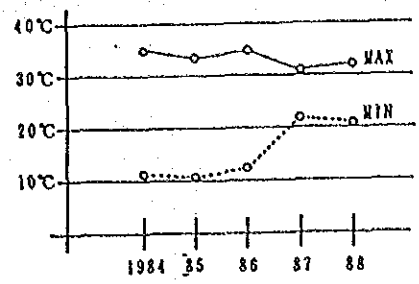
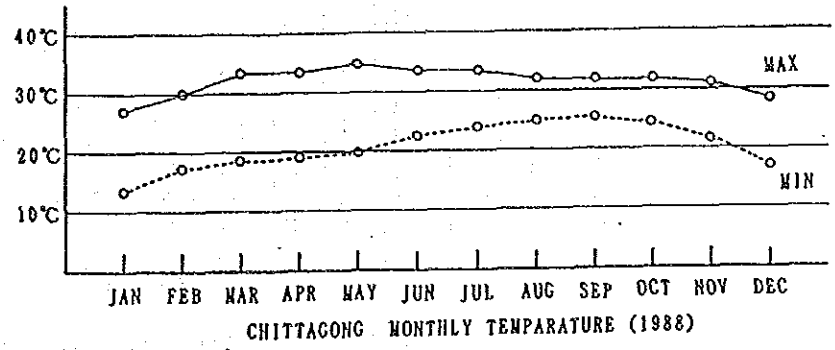


Fig. 3-1 Annual temparature fluctuation in Chittagong



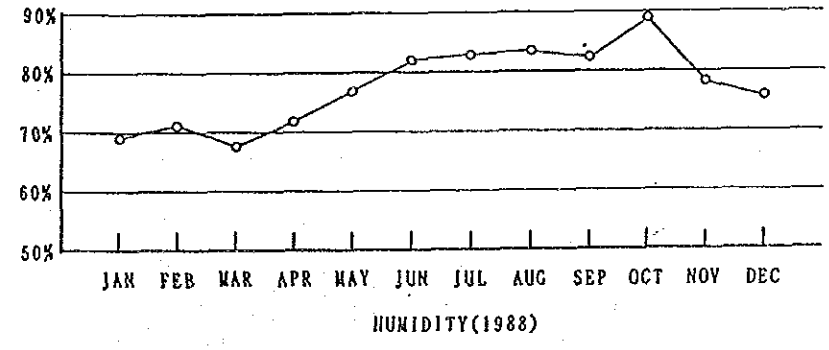
(Source : Statistical Year Book of Bangladesh)

Fig. 3-2 Monthly temparature fluctuation in Chittagong



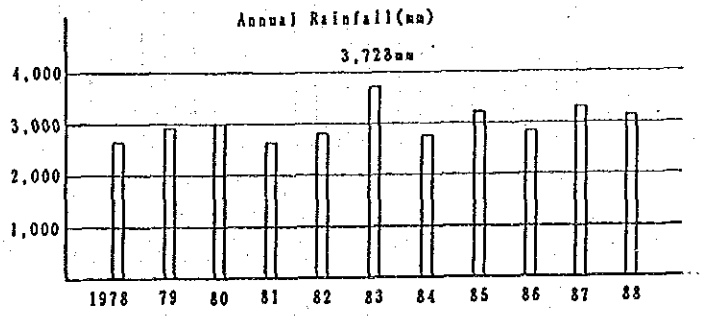
(Source : Statistical Year Book of Bangladesh)

Feg. 3-3 Monthly moisture fluctuation in Chittagong (1988)



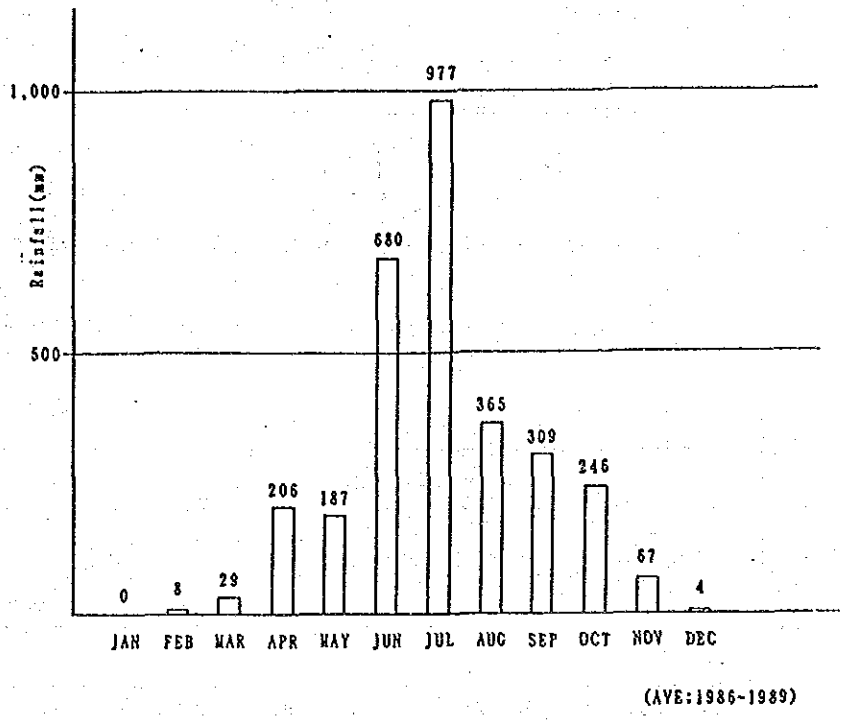
(Source : Statistical Year Book of Bangladesh)

Fig. 3-4 Annual fluctuation of rainfall in Chittagong



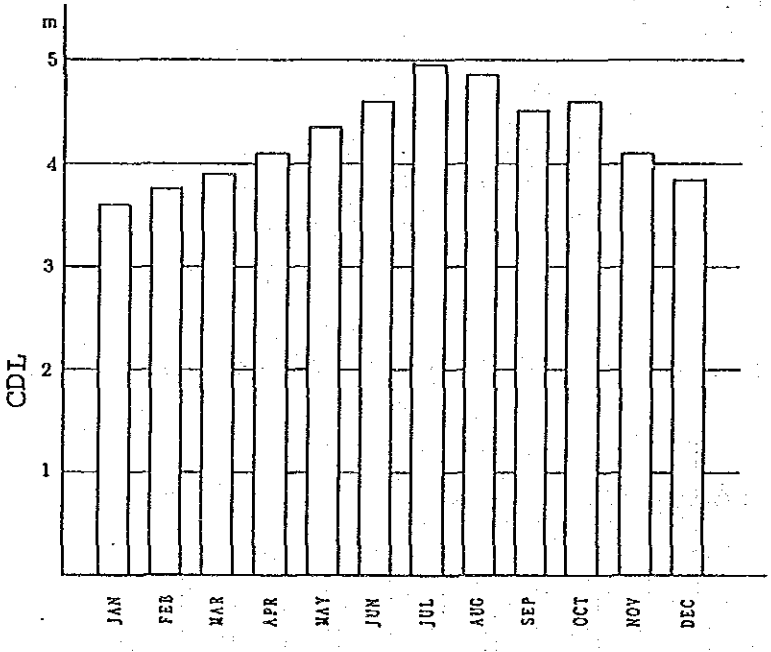
(Source : Statistical Year Book of Bangladesh)

Fig. 3-5 Monthly fluctuation of rainfall in Chittagong
(average between 1981 and 1989)



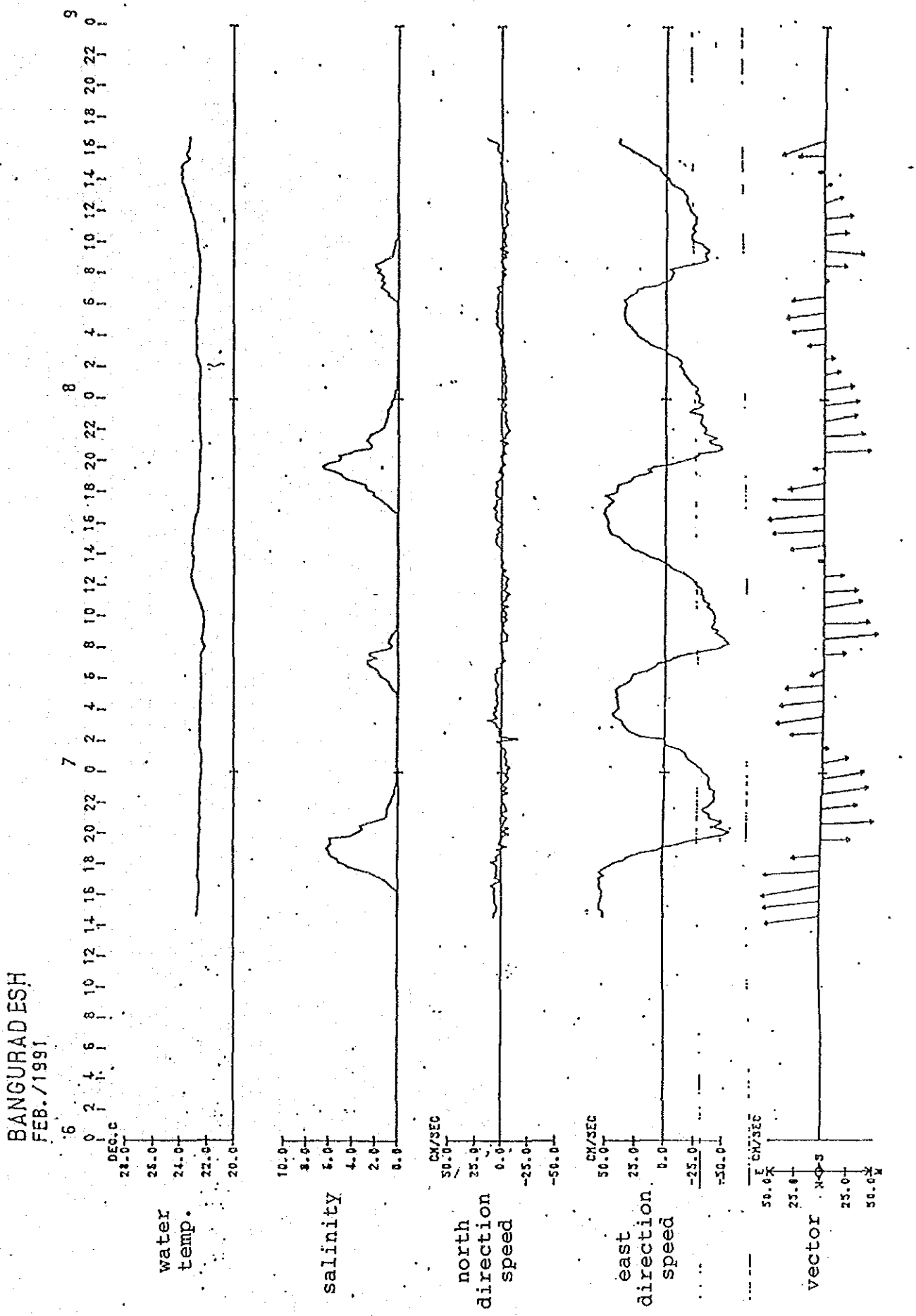
(Source : Statistical Year Book of Bangladesh)

Fig. 3-6 Monthly fluctuation of water level in Chittagong
(average between 1985 and 1989)



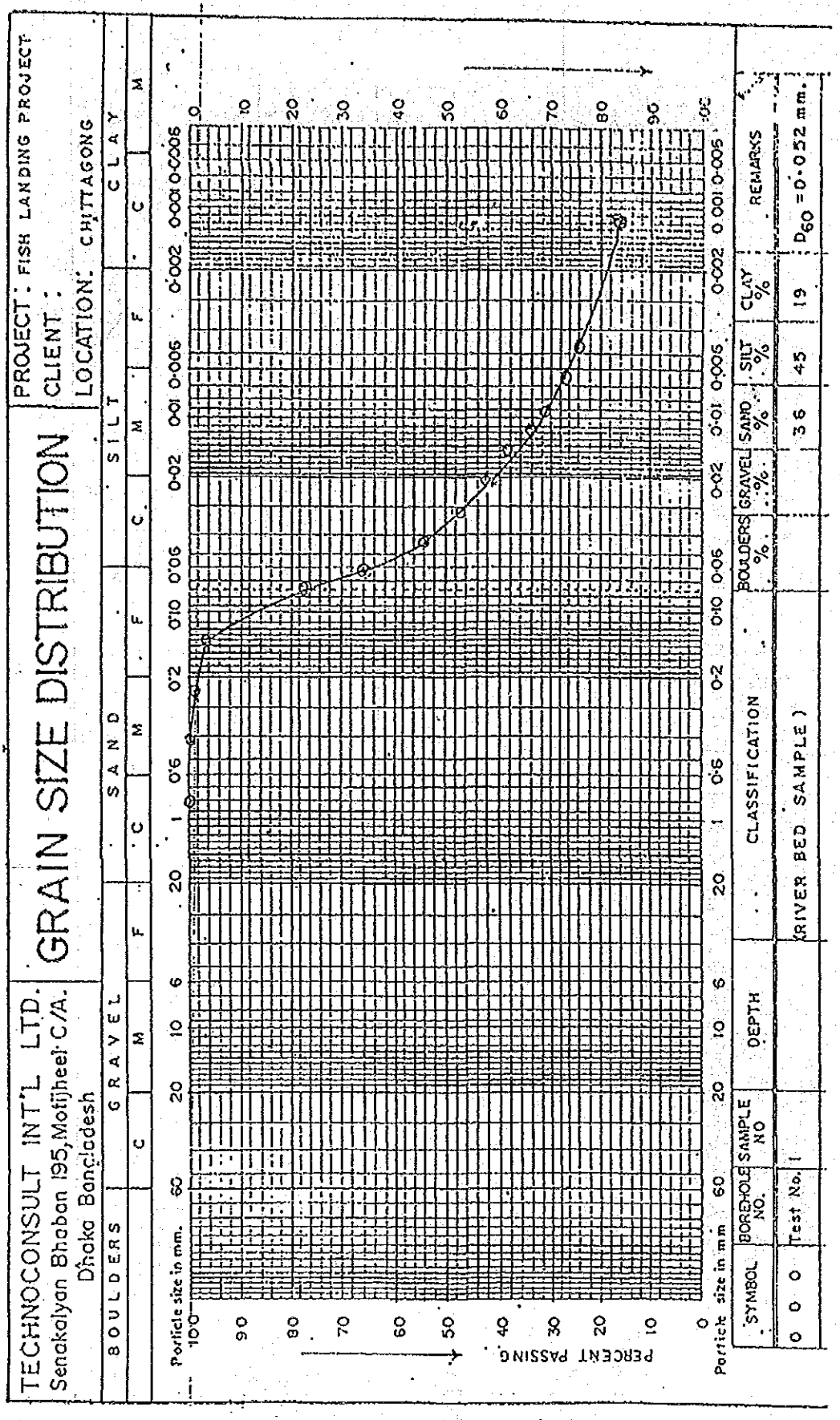
(Source : Statistical Year Book of Bangladesh)

Fig. 3-7 Water quality, etc. of river water nearby the project site



(Source : by analysis in the field survey)

Fig. 3-8 Contents of soil of river bottom nearby the project site



(Source : by analysis in the field survey)

Fig. 3-9 Monthly frequency of cyclones attacking Chittagong
(total frequency in recent 42 years)

(Source : by analysis in the field survey)