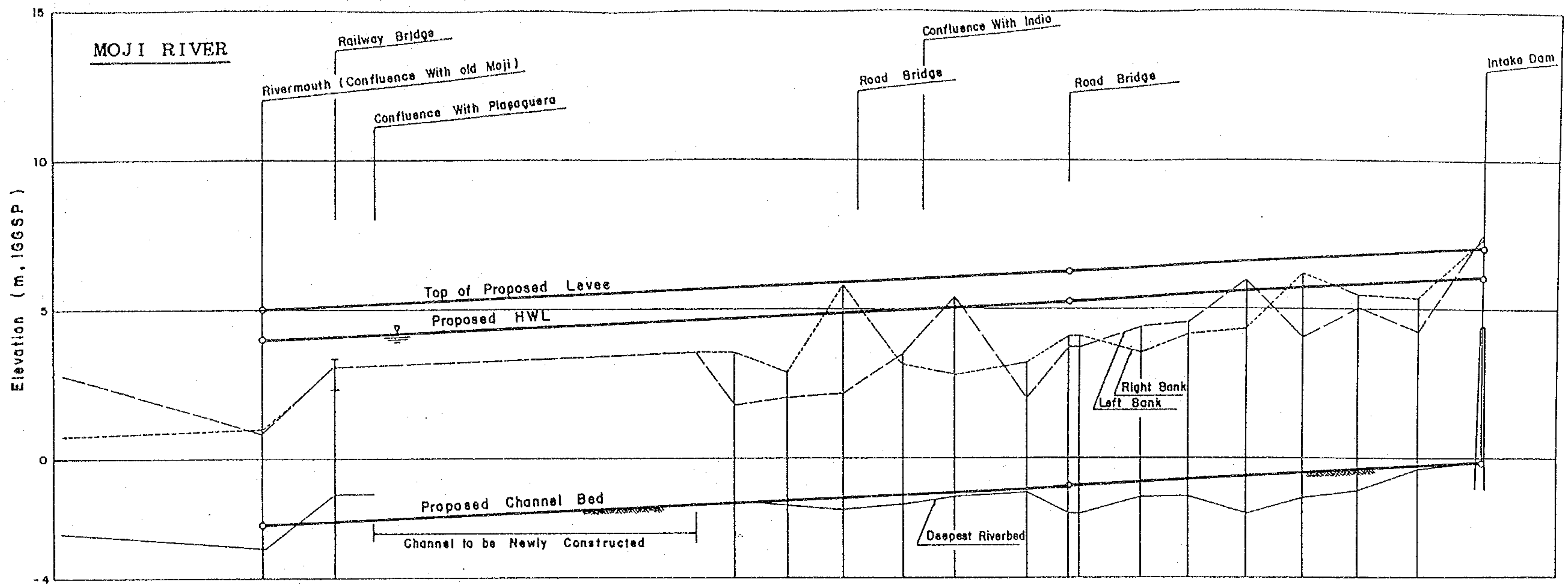


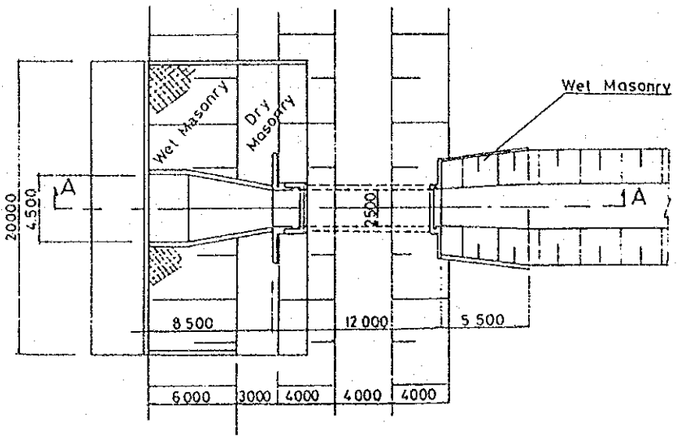
Section Nº	M.3	P.O	Rail Bridge	Conf.	Bifur	M-12	M-13	M.14	M.15	M.16	M.17	Bridge	M.18	M.19	M.20	M.21	M.22	M.23	M.24	M.25
Design Flood Discharge (m³/s)		1000 m³/s																		
Gradient of HWL		1/2340											1/1850							
Gradient of Channel Bed		1/2340											1/1850							
Top of Proposed Levee (m, IGGSP)		5.00	5.11	5.16	5.64	5.70	5.77	5.86	5.95	6.02	6.14	6.20	6.22	6.34	6.43	6.54	6.65	6.76	6.88	7.00
Proposed HWL (m, IGGSP)		4.00	4.11	4.16	4.64	4.70	4.77	4.86	4.95	5.02	5.14	5.20	5.22	5.34	5.43	5.54	5.65	5.76	5.88	6.00
Proposed Channel Bed (m, IGGSP)		-2.20	-2.09	-2.04	-1.56	-1.50	-1.43	-1.34	-1.25	-1.18	-1.06	-1.00	-0.98	-0.86	-0.77	-0.66	-0.55	-0.44	-0.32	-0.20
Distance (m)	0	690	940	1070	2195	2320	2500	2700	2910	3090	3350	3500	3540	3760	3925	4135	4335	4535	4755	4985

FIG. L.16
PRELIMINARY DESIGN
OF RIVER PROFILE

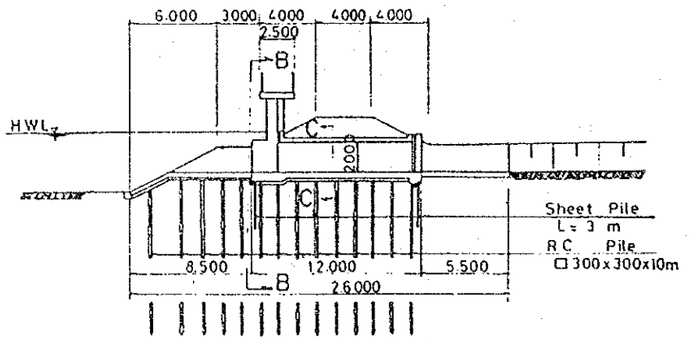
GOVERNMENT OF FEDERATIVE REPUBLIC OF BRAZIL
THE STUDY ON THE DISASTER PREVENTION AND RESTORATION PROJECT IN SERRA DO MAR, CUBATÃO REGION, STATE OF SÃO PAULO

JAPAN INTERNATIONAL COOPERATION AGENCY

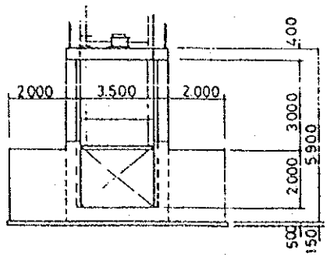
DRAINAGE CULVERT (2.0 m x 2.5 m)



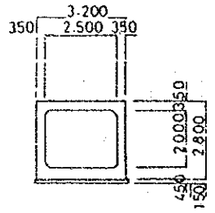
PLAN SCALE A



A – A SCALE A

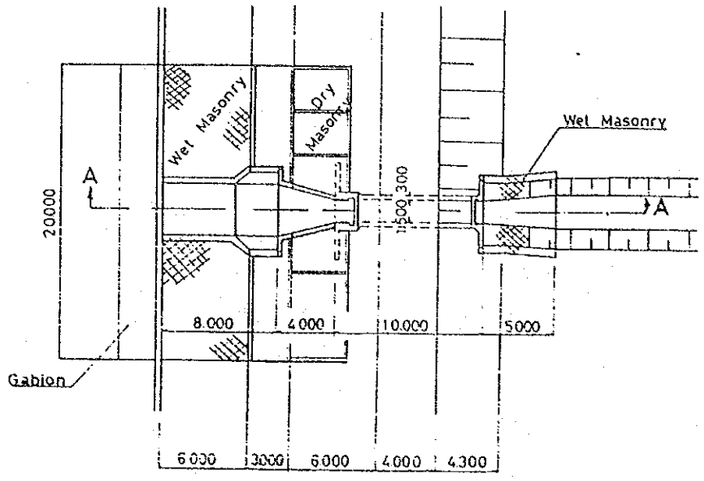


B – B SCALE B

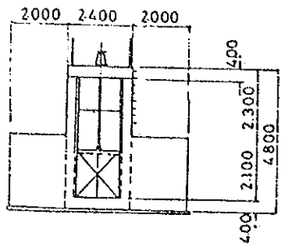


C – C SCALE B

DRAINAGE CULVERT (1.5 m x 1.5 m)



PLAN SCALE A



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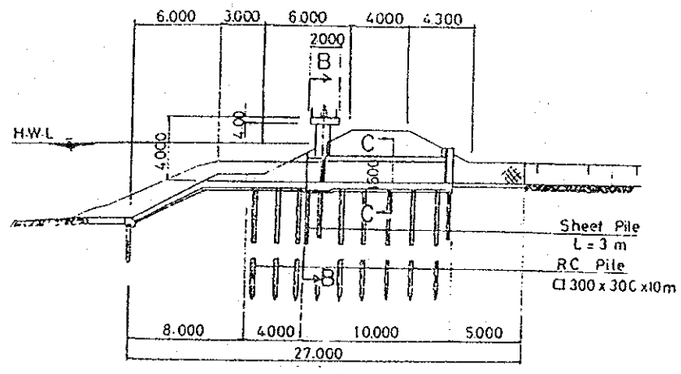
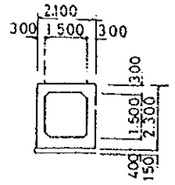


A – A SCALE A



C – C SCALE B

0 SCALE A 20m

0 SCALE B 10m

FIG. L.17
PRELIMINARY DESIGN
OF CULVERT

GOVERNMENT OF FEDERATIVE
REPUBLIC OF BRAZIL
THE STUDY ON THE DISASTER PREVENTION AND
RESTORATION PROJECT IN SERRA DO MAR,
CUBATÃO REGION, STATE OF SÃO PAULO

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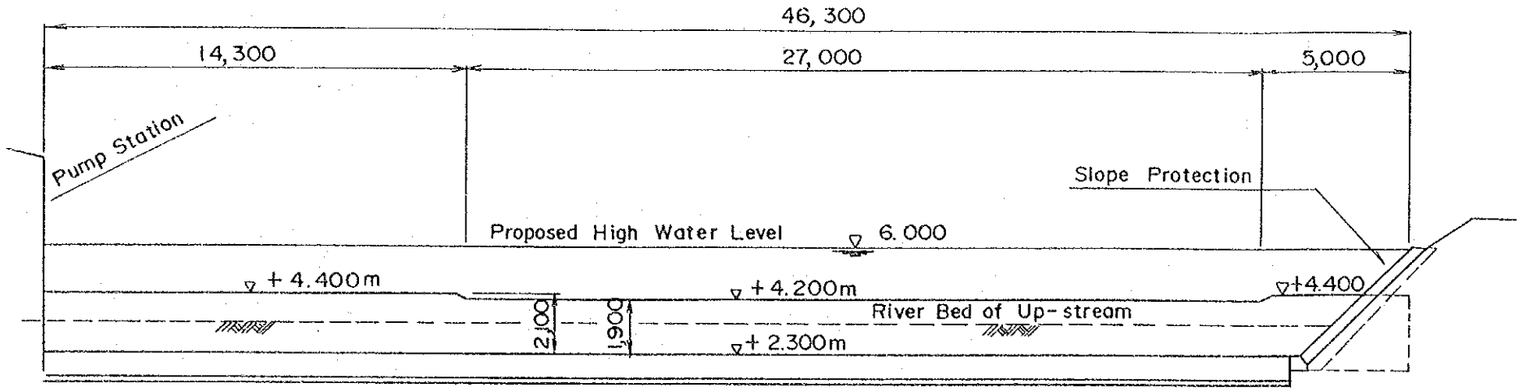
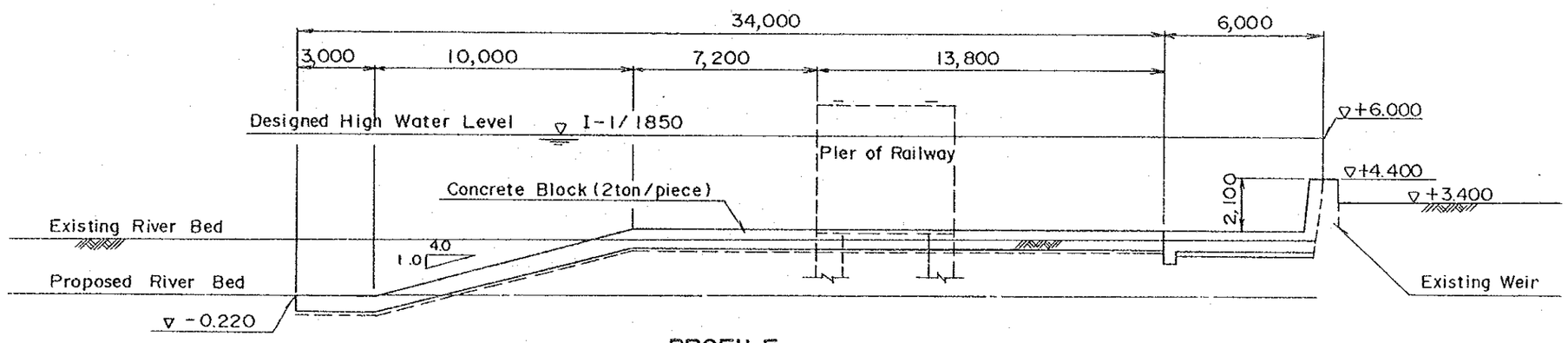
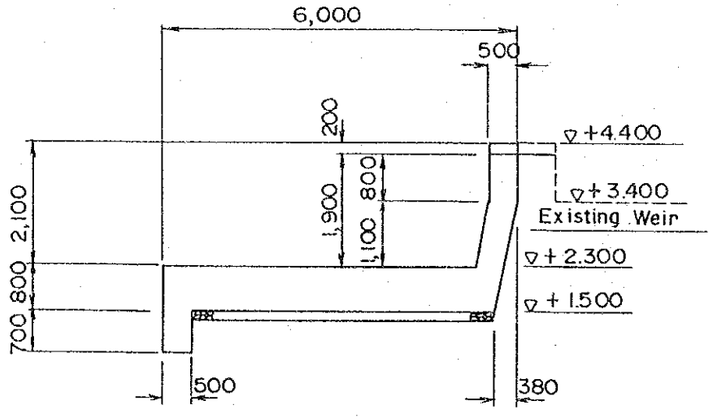


FRONT VIEW SCALE A



PROFILE SCALE A



PROFILE OF INTAKE WEIR SCALE B

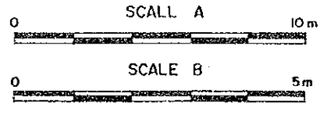
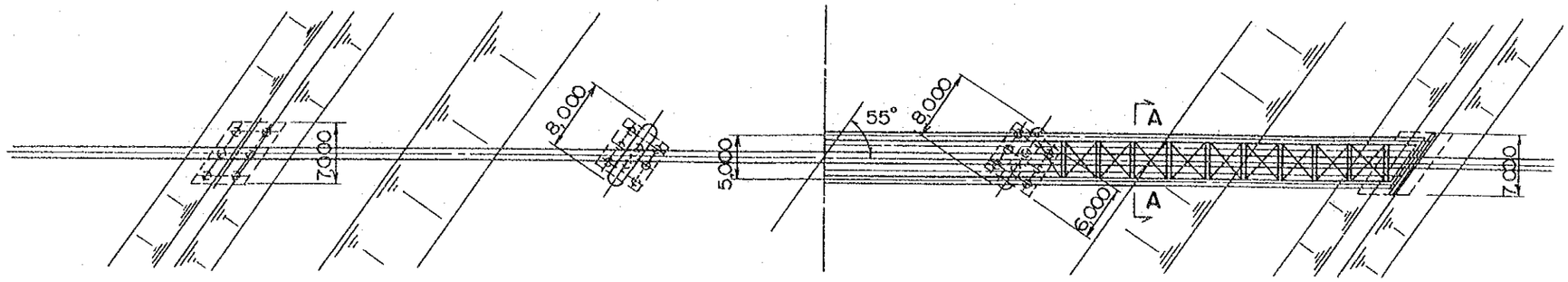
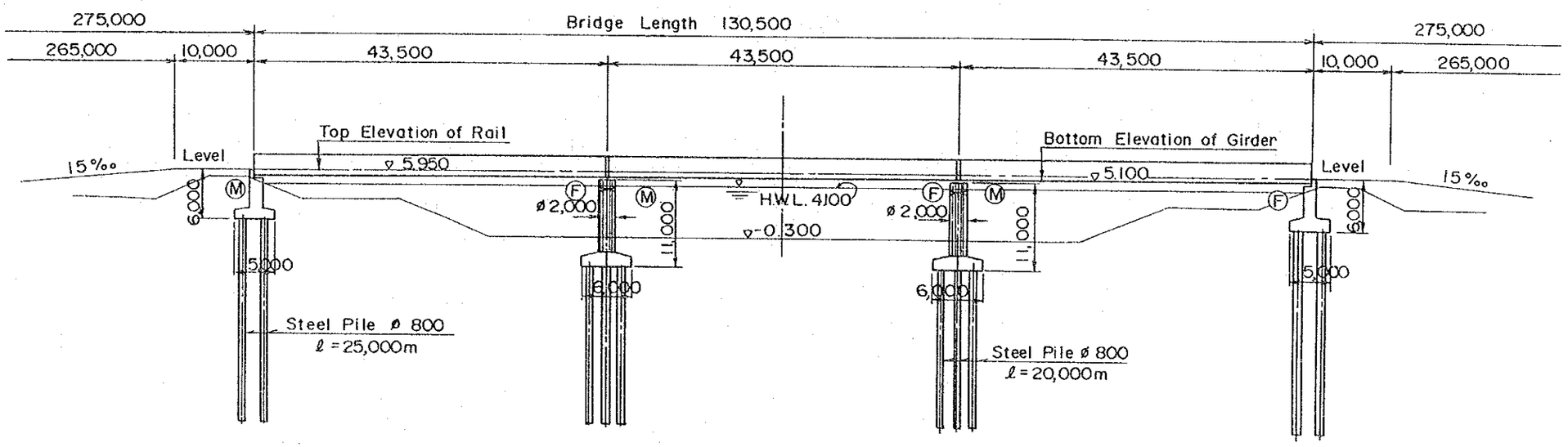


FIG. L.18
PRELIMINARY DESIGN
OF ULTRAFERTIL INTAKE WEIR

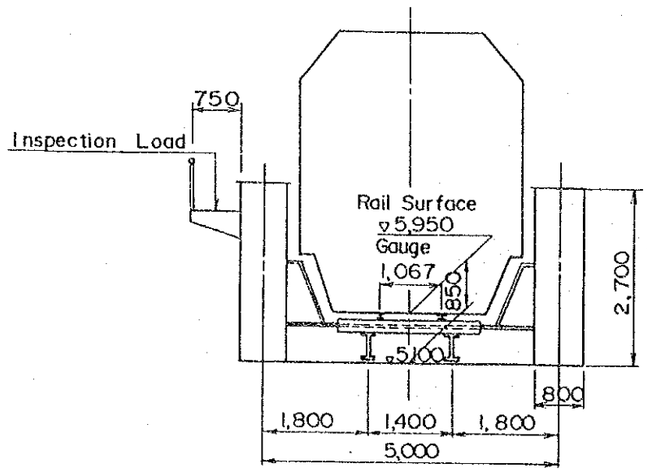
GOVERNMENT OF FEDERATIVE REPUBLIC OF BRAZIL
THE STUDY ON THE DISASTER PREVENTION AND RESTORATION PROJECT IN SERRA DO MAR, CUBATÃO REGION, STATE OF SÃO PAULO
JAPAN INTERNATIONAL COOPERATION AGENCY



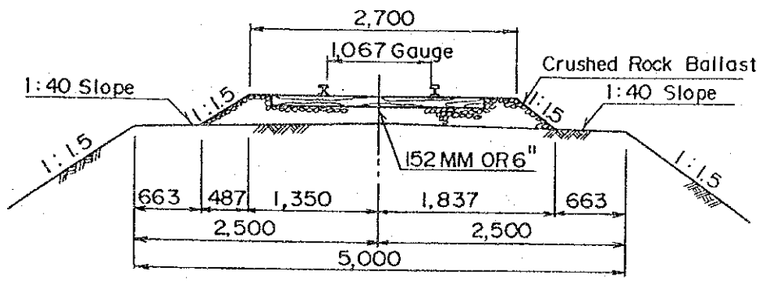
PLAN SCALE A



PROFILE SCALE A



SECTION A-A SCALE B



SECTIONAL COMPOSITION OF TRACK SCALE C

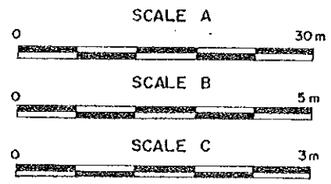
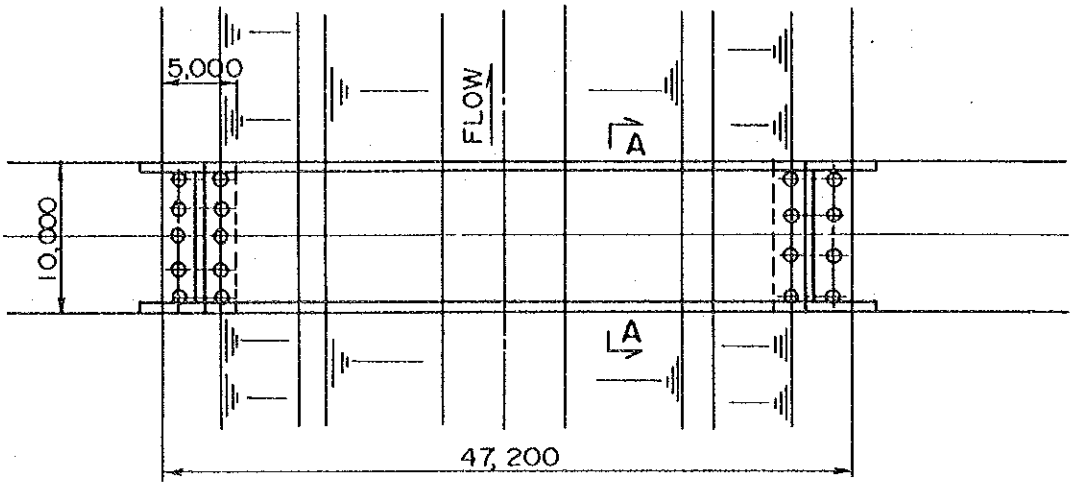
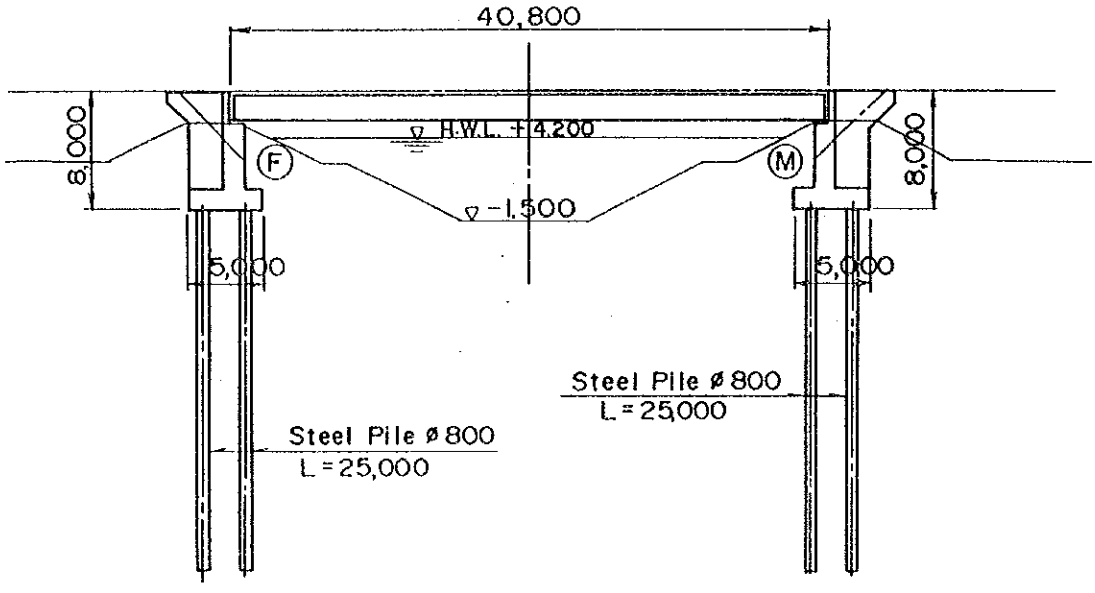


FIG. L.19
PRELIMINARY DESIGN
OF RAILWAY BRIDGE

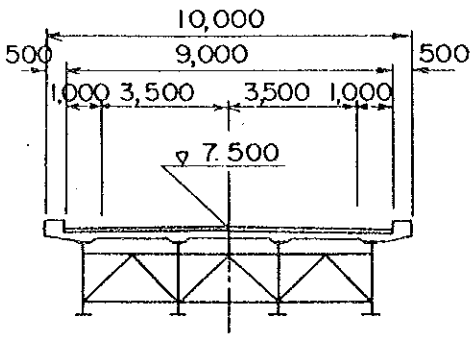
GOVERNMENT OF FEDERATIVE REPUBLIC OF BRAZIL
THE STUDY ON THE DISASTER PREVENTION AND RESTORATION PROJECT IN SERRA DO MAR, CUBATÃO REGION, STATE OF SÃO PAULO
JAPAN INTERNATIONAL COOPERATION AGENCY



PLAN SCALE A



PROFILE SCALE A



SECTION A-A SCALE B

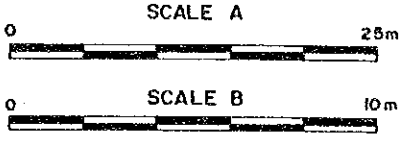


FIG. L.20
PRELIMINARY DESIGN
OF ROAD BRIDGE

GOVERNMENT OF FEDERATIVE REPUBLIC OF BRAZIL
THE STUDY ON THE DISASTER PREVENTION AND RESTORATION PROJECT IN SERRA DO MAR, CUBATÃO REGION, STATE OF SÃO PAULO

JAPAN INTERNATIONAL COOPERATION AGENCY

ANNEX M

CONSTRUCTION PLAN AND COST ESTIMATE

TABLE OF CONTENTES

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

The study was carried out in the two(2) phases. Of these, the objectives of the study in the Phase-1 stage are to outline the construction plan and to estimate the construction cost for the master plans taken up in the sediment run-off and flood disaster prevention studies(Refer to ANNEX-H and ANNEX-I). Sabo dam, groundsill and channel works are major countermeasures for sediment run-off disaster prevention works, and flood protection dike, enlargement works of river course by excavation and dredging, revetment, riverbed protection works and diversion works of flood flow by tunnel are for flood disaster prevention works.

The objectives of the study in the Phase-2 stage are to formulate the construction plan and to re-estimate the construction cost for the priority projects selected among the master plans mentioned above. Topo-maps with a scale of 1 to 500 and river cross section data were used for sediment run-off disaster prevention works, and topo-maps with a scale of 1 to 5,000 and river cross section data were for flood disaster prevention works.

This ANNEX-M describes the following five(5) studies carried out from the beginning of February upto the end of October in 1990. General workflow of the study on construction plan and cost estimate is presented on Fig M.1.

(1) To conduct data collection
(2) To undertake field investigation
(3) To prepare methodology of the study
(4) To outline construction plan and to estimate construction cost for master plan
(5) To formulate construction plan and to re-estimate construction cost for priority project

2. DATA COLLECTION

Data collection was conducted related to the data on construction plan and cost estimate from DAEE, publications and other sources concerned. Data collected is listed in Table M.1.

3. FIELD INVESTIGATION

Field investigations were undertaken in order to grasp the construction conditions such as site conditions (topography, geology, meteo-hydrology, access to the site, power supply, communication, construction materials and labor source), preparatory works needed, and contract system and administration.

4. METHODOLOGY

4.1 Methodology for Construction Plan

The following four(4) items are mainly worked out to formulate the construction plan in this study.

(1) To clarify construction conditions
(2) To arrange major work quantities of construction
(3) To determine basic consideration for planning
(4) To prepare construction plan

Firstly, the construction conditions such as site conditions, preparatory works ,and contract system and administration affecting the execution of construction works are clarified as a basic data to the plan.

Secondly, the major work quantities of construction are arranged by the layout in the master plan or preliminary design in the feasibility study stage.

Thirdly, the basic consideration for planning applied from the conditions of topography, meteo-hydrology and geology in the study area are determined.

Finally, the construction plan is prepared based on the conditions mentioned above.

4.2 Methodology for Cost Estimate

Construction cost consists of the two(2) main items that are direct cost and indirect cost. Direct cost is mainly categolized into

the three(3) sub-items such as main works, preparatory works and miscellaneous works.

Cost of main works which generally covers around seventy percent of the total direct cost, is estimated based on the work items and quantities derived from the layout and/or preliminary design, which includes the equipment, labor and material cost and contractor's indirect cost. Costs of preparatory works and miscellaneous works are estimated with a certain percentage of main works for minor work items.

Indirect cost includes the compensation cost, government administration cost and engineering services.

Constitution of construction cost is illustrated on Fig M.2. Cost estimated is divided into foreign and local currency components according to their sources.

5. CONSTRUCTION PLAN

5.1 Construction Conditions

5.1.1 Site conditions

The site conditions affecting the execution of construction works in the study area are as follows:

(1) Topography and geology

The study area is located in the coastal mountain and a small plain area, 60 km south-east from São Paulo city in the state of São Paulo. The Moji and Cubatão rivers originate from the north-east and south-west of mountain slopes of Serra do Mar in the area.

The study area is generally identified as an eastern edge of Brazilian plateau. The geology in the study area is mainly characterized by the massive, sound and well jointed migmatites in the mountain area and schists in the downstream plain area.

(2) Meteo-hydrology

The study area belongs to a tropical zone and climatically, there is a rainy season from November to April and dry season from May to October. Annual mean rainfall in the area is around 3,000 mm. Annual mean temperature is fluctuated from 20°C to 25°C through the year.

Average rainfall days in the recent ten years (1980 to 1989) at E3-038R station located in the center part of the study area are presented in the following table(For locations see ANNEX-F).

(E3-038R station) (Unit : days)

Rainfall	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3-10mm	4.0	1.6	2.5	3.0	2.9	1.1	1.7	2.8	3.0	3.4	4.6	4.0
10-15mm	1.6	1.2	1.2	1.1	0.8	1.0	1.0	1.1	0.9	1.3	1.1	2.3
15-20mm	0.8	1.2	0.5	1.0	0.5	1.1	0.3	0.7	1.3	0.8	0.8	1.2
20-30mm	1.5	1.6	1.0	0.9	1.1	0.7	0.4	0.6	0.7	1.2	0.7	0.8
30-50mm	1.4	1.0	2.1	1.4	0.4	0.9	0.7	0.2	0.5	1.0	1.0	1.5
over 50mm	1.4	2.1	1.3	1.6	0.8	0.2	0.3	0.2	0.6	0.6	0.3	1.6

(3) Access to the site

There are four(4) existing state highways in the study area. They are Rodovia dos Imigrantes(Route No.160), Via Anchieta(Route No.150), Caminho do Mar(Route No.148) and Rodovia Cubatão-Guarujá (Route No.55).

Among them, highways(Route No.160, No.150, No.148) are major trunk route for an inland transportation between the north and south regions of Brazil, the other(Route No.55) is situated between south-west and north-east. These major road networks are constructed and maintained by Desenvolvimento Estadual Rodoviário Sociedade Anômima (DERSA) and Departamento de Estradas de Rodagem(DER). The maintenance conditions of these roads seems to be fair with paving.

There is a Federal railway line crossing the area between north (Jundiai) and south(Santos) served by Rede Ferroviária Federal Sociedade Anômima(RFFSA). Besides, there is a state railway managed by Ferrovia

Paulista Sociedade Anômima(FEPASA) which connects the several branch lines from the factories to the state line.

(4) Power supply

In and around the study area, Eletricidade de São Paulo (ELETROPAULO) supplies the electric power. The conditions of the electric power supply seems to be fair.

(5) Communication

TELESP(Telecomunicações de São Paulo) operates the modern telephone service in the state, connecting all districts including the study area. Majority of them also have telex and international dialling services by the post office.

(6) Construction material

The major construction materials required for the construction works are cement, steel bar, formed steel, earth, gravel, rock, wooden material, explosives and fuel. The sufficient quantity and quality of these materials can be obtained from the domestic market in Brazil.

The concrete aggregate and rock materials for stone works such as channel, revetment and gravel pavement are available from the upstream of Cubatão and Moji River deposit. The soil materials for the dike embankment will be available from the riverbed.

(7) Labor source

The sufficient number of unskilled and skilled labor is available in and around the study area. Daily working hours are set at eight(8) hours from Monday to Friday, which is equivalent that the total working hours per week is fixed to 48 hours.

5.1.2 Preparatory works

Since the study area is located in the urban area, there are many public utilities available for the project implementation. Those are existing roads, transportation and so on. Therefore, the preparatory

works required for this project are planned to be construction of access road, temporary buildings, communication system, power supply and arrangement of spoil bank.

5.1.3 Contract system and administration

The contract system considering the participation of foreign contractors associated with Brazilian contractors will be adopted.

The bill of quantities contract system will be applied based on the open competitive bid accompanied with the prequalification of bidders. The fund required for the implementation of project will be allocated by the national budget and supporting loan from an international financing agency. Throughout the implementation period, the project will be substantially managed and administrated by DAEE headquarters and its branch offices in association with other state agencies and engineering consulting firms.

5.2 Construction Plan for Master Plan

5.2.1 Project components

The major components of the master plans for sediment run-off and flood disaster prevention works are tabulated as follows:

(1) Sediment disaster prevention works

Component	Type of Structure	Quantity
32 Sabo dams	Concrete	180,000 m^3
11 Channel works	Wet masonry	5.7 km
2 Groundsills	Concrete	1,700 m^3

(2) Flood disaster prevention works

	Component	Type of Structure	Quantity
(Cubatão Basin)	Dike		157,000 m^3
	Excavation		256,000 m^3
	Dredging		256,000 m^3
	Revetment	Wet masonry	6,700 m^2
	Riverbed protection	Concrete	1 No.
	Diversion tunnel	Concrete	600m X 2 Nos.
(Moji Basin)	Dike		250,000 m^3
	Excavation		846,000 m^3
	Dredging		584,000 m^3
	Revetment	Wet masonry	24,800 m^2
	Riverbed protection	Concrete	3 Nos.

5.2.2 Implementation schedule

The master plan consisting of the plans for sediment run-off disaster prevention works and for flood disaster prevention works will be implemented upto the target year 2000.

In compliance with the prioritization of construction of proposed facilities, the implementation schedule shown on Fig. M.3 was prepared taking into account the construction conditions. Total project period was set at 10 years, in which the project period was divided into two(2) stages.

In consideration of a loan application procedure, first five(5) years (from 1991 to 1995) includes a preparation of implementation program (I/P), project appraisal by the international financing agency, exchange of note (E/N), detailed design (D/D), tendering and construction of the structures which have rather high priority in the first stage.

The construction of the other facilities in the second stage will be started at the beginning of construction in the first stage due to limited period.

5.2.3 Plan for sediment disaster prevention

(1) Sabo dam

The total volume of Sabo dams was estimated at around 180,000 m^3. The volume of each Sabo dam is presented in Table L.2.

For the purpose of dam construction, diversion is handled in two(2) stages. Firstly, a cofferdam enclosing a portion of the water channel at the left or right bank is constructed. Next, the area enclosed by cofferdam is unwatered and the unwatered dam foundation area is excavated. Then, concrete is poured in the dam monoliths until they reach an elevation that will be above the impounded water surface. Second-stage diversion starts at the beginning of dry season. The order of pouring concrete is planned to be always higher in both bank portions in order to minimize a damage caused by an expected flood flow. The major equipments required to the works are as follows:

Equipment	Activity
(1) Excavation	
Bakhoe (0.6 m^3)	Excavation
Dump Truck (8 t)	Hauling
Bulldozer (21 t)	Spoilbanking
(2) Concrete	
Concrete plant (0.5 m^3)	Mixing
Truck mixer (3.2 m^3)	Hauling
Concrete bucket	Pouring
Vibrator (45 mm)	Compacting
Air compressor (10.5 m^3)	Clearing
Diesel generator (50 kVA)	Power source

(2) Channel works

The channel works are constructed in the lower reach of Sabo dams located at the downstream of each basin. It was judged that the channel works in the downstream of basin No.10 is not needed because of an adequate existing channel. Total length of channel works was estimated at about 5.7 km.

Firstly, a channel is excavated in order that the design flood peak can be flowed down safely. Secondly, backfilling by gravels, installing of concrete blocks and construction of wet masonry are executed. Lastly, installing of gabion mattress and filling by cobblestone are made. The major equipments required to the works are as follows:

Equipment	Activity
(1) Excavation	
Backhoe (0.6 m^3)	Excavation
Dump truck (8 t)	Hauling
Bulldozer (21 t)	Spoilbanking
(2) Revetment	
Wheel loader (2.1 m^3)	Loading
Dump truck (8 t)	Hauling
Cargo truck (6 t)	Hauling
Truck crane (4.9 t)	Installation

(3) Groundsill

The groundsill are constructed in the lower channels of basin No.4 and No.12. The concrete volume of two(2) groundsills were estimated at about 1,000 m^3 and 700 m^3, respectively. The major equipments required to the works are as follows:

Equipment	Activity
Backhoe (0.6 m^3)	Excavation
Dump truck (8 t)	Hauling
Bulldozer (21 t)	Spoilbanking
Concrete Plant (0.5 m^3)	Mixing
Truck Mixer (3.2 m^3)	Hauling
Concrete Pump (30 m^3/hr)	Pouring

5.2.4 Plan for flood disaster prevention

(1) Dike

The total embankment volume of dike in the Cubatão and Moji river basins were estimated at around 157,000 m^3 and 250,000 m^3. Embankment materials will be hauled from river water course for the purpose of increase of flow capacity. Embankment is executed by using bulldozer for dozing, tamping roller for compaction and sprinkler truck for sprinkling water to control moisture contents of material. The major equipments required to the works are as follows:

Equipment	Activity
Bulldozer (21 t)	Dozing
Tractor shovel (3.2 m^3)	Loading
Dump truck (11 t)	Hauling
Motor grader (3.1 m)	Spreading
Tamping roller (5 t)	Compacting
Sprinkler truck (8 kl)	Moisture control

(2) Excavation and dredging

The work for enlargement of river course is executed by excavation and dredging and proceeded from the downstream toward the upstream. The excavation above water level is performed by using backhoe and bulldozer. Total volume of excavation for the Cubatão and Moji rivers were estimated at 256,000 m^3 and 846,000 m^3. The dredging work is mainly applied to the excavation in water by using pump suction dredger. Total volume of dredging for the Cubatão and Moji rivers were estimated at 256,000 m^3 and 584,000 m^3. The major equipments required to the works are almost same as that of channel works.

Equipment	Activity
Bakhoe (0.6 m^3)	Excavation
Dredger	Dredging
Dump Truck (8 t)	Hauling
Bulldozer (21 t)	Spoilbanking

(3) Revetment

The revetment works will be planned in order to protect river channel from an attack of unexpected flow. The total area to be protected by the revetment in the Cubatão and Moji rivers were estimated at 6,700 m^2 and 24,800 m^2. The major equipments required to the works are generally same as that of channel works.

(4) Riverbed Protection

The riverbed protection works will be executed at just downstream of Imigrantes road bridge in the Cubatão river basin to protect the bridge piers from scouring by flood flow and at the upstream of Moji river to replace damaged existing facilities. The major equipments required to the works are generally same as that of groundsill.

(5) Diversion works of flood flow by tunnel

Diversion works of flood flow by two(2) tunnels having a flow capacity of 900 m^3/s (600 m length with a diameter of 10m each) in the

Cubatão river basin is constructed. Total volume of excavation and concrete for two(2) tunnels were estimated at 150,000 m^3 and 34,000 m^3. The major equipments required to the works are as follows:

Equipment	Activity
(1) Excavation	
Drill Jumbo (2-boom)	Excavation
Muck loader (5.4 m^3)	Loading
Wheel loader (2.1 m^3)	Loading
Dump truck (11 t)	Hauling
Bulldozer (21 t)	Spoilbanking
(2) Concrete	
Concrete plant (0.5 m^3)	Mixing
Truck mixer (3.2 m^3)	Hauling
Concrete pump (45 m^3/hr)	Pouring
Concrete vibrator (45 mm)	Compacting
Air compressor (10.5 m^3)	Clearing
Diesel generator (100 kVA)	Power source

5.3 Construction Plan for Priority Project

5.3.1 Basic consideration for planning

(1) Contract system and administration

The contract system considering the participation of foreign contractors associated with Brazilian contractors are proposed to execute the project works.

The bill of quantities contract system will be applied based on the open competitive bid accompanied with the prequalification of bidders. The fund required for the implementation of project will be allocated by the national budget and supporting loan from an international financing agency. Throughout the implementation period, the project will be substantially managed and administrated by DAEE headquarters and its branch offices in association with other state agencies and engineering consulting firms. The projects will be proposed to be executed with the several packages taking into account the project scale, amount of construction costs and secure implementation, as follows:

Package A --- Sediment run-off disaster prevention works for basin No.2 and No.3

Package B --- Sediment run-off disaster prevention works for basin No.7 and No.8

Package C --- Sediment run-off disaster prevention works for basin No.10, No.11 and No.12

Package D --- Flood disaster prevention works in the Moji river

(2) Workable days

Number of annual workable day for the proposed mechanized construction was estimated by applying the following equations.

$$N = \sum_{i=1}^{12} (Ni - (NSi + NHi))$$

$$NSi = \sum_{j=i}^{6} (Rji \times NRji)$$

N : number of annual workable day
Ni : number of day in each month
NSi : number of suspended day in each month
NHi : number of holiday, Saturday and Sunday in each month
Rji : suspended ratio in each month with class j (j=1,6)
NRji: number of rainy day in each month with class j (j=1,6)
(Refer to table on page M.4)

Class	3-10mm	10-15mm	15-20mm	20-30mm	30-50mm	50mm-
Earth works	0.5	1.0	1.0	1.5	2.5	3.0
Rock works	0.0	0.0	0.5	1.0	1.5	1.5
Concrete works	0.0	0.0	0.0	1.0	1.0	1.0

Based on the number of suspended day computed by the suspended ratio and the rainfall data for the recent 10 years from 1980 to 1989, number of workable day for the construction planning were calculated as follows:

Work Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Earth works	6	8	9	7	14	15	17	17	14	11	12	6	136
Rock works	14	16	16	14	18	18	20	21	18	17	17	16	205
Concrete works	16	18	18	16	19	20	21	21	20	19	18	17	223

(3) Mix proportion of concrete

Three(3) kinds of mix proportion for concrete structure were designed. Type A concrete is generally adopted for structures with reinforcement such as culvert, parapet wall and so on. Type B concrete is used for structures without reinforcement such as base concrete and concrete block for stone masonry. Type C concrete is taken for structures by mass concrete such as Sabo dam. The designed mix proportions were assumed as follows:

Type	G max (mm)	Air (%)	W/c (%)	S/a (%)	Unit Weight (kg/m^3) W	C	S	G	A	Design Strength (kg/cm^2)
A	40	4.5	52	38	156	300	705	1,150	0.750	240
B	40	4.5	55	36	148	270	685	1,215	0.675	210
C	40	4.5	60	34	126	210	670	1,300	0.525	160

Note; W : Water, G : Gravel
C : Cement, A : Water reducing agent
S : Sand

Water reducing agent was designed to be mixed to all types of concrete to save cement content. It is one of the most effective method to prevent from any cracks in hardening at hot temperature.

(4) Construction plant

(a) Concrete plant

The portable concrete plant was designed to be installed at the upstream of the Moji river. The required plant capacity is generally calculated as follows:

$$Cr1 = Vc / (T * D) * F$$

where, Cr1 : required capacity (m^3/day)
Vc : total concrete volume (m^3)
T : construction period (= 1.5 year)
D : workable days per year (= 223 days)
F : operation factor (= 1.2)

Two (2) concrete plants with a capacity of 0.5m^3 (= 45m^3/day) will be needed in case of basin No.2.

(b) Aggregate plant

The portable aggregate crushing plant will be installed beside the concrete plant. The required capacity of the plant is calculated by the following equation.

Cr2 = Cr1 * (S + G) / 1,000 * F / H

where, Cr2 : required capacity of aggregate plant (ton/hr)
Cr1 : required capacity of concrete plant (m^3/day)
H : working hour (8 hrs/day)
F : operation factor (= 1.2)
S : unit weight of sand (670 kg/m^3)
G : unit weight of gravel (1,300 kg/m^3)

In case of basin No.2, the plant capacity of about 25 ton/hr will be required.

(5) Volume change factor of earth materials

In view of the characteristics of soil materials in the study area, the volume change factor of the earth materials were assumed as follows:

Material	Loose/Bank	Compaction/Bank
Earth	1.20	0.90
Gravel	1.15	0.95
Soft rock	1.45	1.20

5.3.2 Plan for sediment disaster prevention

The construction works for sediment run-off disaster prevention works comprise three (3) categories; Sabo dam construction, channel works and groundsill works. The construction plan for the above major works is as follows:

(1) Sabo dam

Major work items and quantities of Sabo dams are tabulated below.

Contract Package	Sabo Basin No.	Work Quantity (m^3)	
		Excavation	Concrete
Package-A	2	35,200	22,000
	3	8,500	9,800
	Subtotal	43,700	31,800
Package-B	7	13,900	9,400
	8	6,400	3,700
	subtotal	20,300	13,100
Package-C	10	600	1,100
	11	4,400	7,300
	12	3,900	4,900
	subtotal	8,900	13,300
	Total	72,900	58,200

The total work quantity of excavation was estimated at around 72,900 m^3, distributed as follows: 43,700 m^3 for Package-A, 20,300 m^3 for Package-B, and 8,900 m^3 for Package-C. Meanwhile, the total work quantity of concrete was approximately estimated at 58,200 m^3, distributed as follows: 31,800 m^3 for Package-A, 13,100 m^3 for Package-B and 13,300 m^3 for Package-C.

Excavation was planned to be carried out by medium class construction equipment owing to limited site conditions. The excavated materials were to be transported to spoil banks which were basically planned in the vicinity of each dam. Hauling distance from dam site to the spoil banks was approximately 1 km on average.

Following the excavation of dam foundation, Sabo dam construction was planned with due consideration for foundation treatment and against expected flood during construction. Temporary construction plant was exclusively designed in each Package for secure concrete supply, which meets design mix proportion.

(2) Channel works

Major work items and quantities of channel works are tabulated below.

Contract Package	Sabo Basin No.	Work Quantity	
		Length (m)	Excavation (m^3)
Package-A	2	530	70,800
	3	490	31,200
	subtotal	1,020	102,000
Package-B	7	250	39,400
	8	440	23,200
	subtotal	690	62,600
Package-C	10	-	-
	11	410	12,300
	12	750	64,000
	subtotal	1,160	76,300
	Total	2,870	240,900

The total channel length was estimated at around 2,870 m, distributed as follows: 1,020 m for Package-A, 690 m for Package-B, and 1,160 m for Package-C. Meanwhile, the total work quantity of excavation was approximately estimated at 240,900 m^3, distributed as follows: 102,000 m^3 for Package-A, 62,600 m^3 for Package-B, and 76,300 m^3 for Package-C.

The channel works, which were designed at the downstream of each Sabo dam except for basin No. 10, comprise channel excavation, gravel backsill, concrete block installation, wet masonry and gabion mattress.

(3) Groundsill

Major work items and quantities of groundsill works are tabulated below.

Contract Package	Sabo Basin No.	Work Quantity Nos.	Excavation (m^3)	Concrete (m^3)
Package-A	2	4	15,700	1,200
	3	1	120	200
	subtotal	5	15,200	1,400
Package-B	7	5	10,500	1,000
	8	4	4,000	400
	subtotal	9	14,500	1,400
Package-C	10	-	-	-
	11	11	15,700	1,100
	12	9	19,000	900
	subtotal	20	34,700	2,000
	Total	34	65,020	4,800

The total groundsills amount to 34 numbers; 5 nos. for Package-A, 9 nos. for Package-B, and 20 nos. for Package-C. The total work quantity of excavation was estimated at around 65,020 m^3, distributed as follows: 15,820 m^3 for Package-A, 14,500 m^3 for Package-B, and 34,700 m^3 for Package-C. The total work quantity of concrete was approximately estimated at 4,850 m^3, distributed as follows: 1,440 m^3 for Package-A, 1,410 m^3 for Package-B, and 2,000 m^3 for Package-C.

Construction of groundsill with maximum height of 5 m, arranged in each river channel, was planned to be executed together with channel works. Construction works were to be carried out, taking into full account sequence of the works, restricted site conditions, and combination of the equipment.

(4) Preparation of spoil bank

Spoil bank will be prepared for excavation volume in each Sabo basin as shown as follows:

Unit : m^3

Basin No.	Dam No.	Dam	Channel Works	Groundsill	Total
2	2-1	35,200	70,800	15,700	121,700
3	3-1	8,500	31,200	120	39,800
Sub-total					161,500
7	7-1	10,300	39,400	10,500	60,200
	7-3	2,400	-	-	2,400
	7-4	1,200	-	-	1,200
Sub-total					63,800
8	8-1	6,400	23,200	4,000	33,600
10	10-1	600	-	-	600
11	11-1	4,400	12,300	15,700	32,400
12	12-1	3,900	64,000	19,000	86,900
Total					378,800

Spoil bank (450m x 400m x 1m) will be needed for total volume of 161,500 m^3 excavated from basin No.2 and basin No.3, which was designed at the left side of downstream reaches, about 1 km south-east from Dam No.2-1.

Spoil bank (350m x 200m x 1m) will be needed for total volume of 63,800 m^3 excavated from basin No.7, which was designed at the left side of two-level crossing point between Rodovia Piaçaguera and local road, about 1.5 km south-east from Dam No.7-1.

Spoil bank (150m x 100m x 2.5m) will be needed for total volume of 33,600 m^3 excavated from basin No.8, which was designed at the right hilly area, about 0.1 km south-east from Dam No.8-1.

Spoil bank (150m x 100m x 2.5m) will be needed for total volume of 33,000 m^3 excavated from basin No.10 and No.11, which was designed at the right hilly area, about 0.4 km south-east from Dam No.11-1.

Spoil bank (300m x 150m x 2.2m) will be needed for total volume of 86,900 m^3 excavated from basin No.12, which was designed near the confluence of Cubatão river and outlet channel of Henry Borden, about 1.3 km east from Dam No.12-1.

(5) Safety control

The following safety control will be needed for the purpose of safety of labor's life and work efficiency.

- training program for labor newly engaged
- safety instruments such as helmet and life vest
- traffic sign board and miller
- security system
- medical clinic
- safety patrol
- safety meeting

5.3.3 Plan for flood disaster prevention

The construction works for flood disaster prevention works comprise dike construction, new channel excavation of around 1 km, dredging, and relocation works of road and railway bridges.

The general feature of the priority project of flood disaster prevention works are summarized below:

Component	Type of Structure	Quantity
Dike		265,000 m^3
Excavation		334,000 m^3
Dredging		141,000 m^3
Revetment	Wet masonry	9,800 m^2
Culvert		1.5m x 1.5m (6 sites)
		2.0m x 2.5 m(1 site)
Intake Weir	Concrete	
Parapet Wall	Concrete	
Road Bridge		40.8 m
Railway Bridge		130.5 m

The construction plan for the major works is as follows:

(1) Dike

The dike construction of 265,000 m^3 was planned to be carried out in parallel with a new channel excavation and dredging works.

Approximately one-third of embankment volume was to be directly hauled from excavation site, whereas around 60% was transported from stock yard where excavated materials were to be treated. Remaining embankment material was planned from borrow pit in the upstream of the Moji river.

(2) Channel excavation

The new channel excavation of the Moji river amounting to 334,000 m^3 was planned by combination of conventional excavation and dredging method. The excavation above water level was basically to be performed by medium class construction equipment. Meanwhile, dredging was also planned for excavation below water level and where applicable, to save excavation cost.

Excavation volume of around 100,000 m^3 was planned to be directly hauled for dike embankment. Another 100,000 m^3 was to be transported to stock yard for material treatment and remaining 134,000 m^3 was envisaged to spoil bank.

(3) Dredging

Around 141,000 m^3 of channel dredging was basically planned to be carried out using pump suction dredger. The dredged material obtained from the upper sediment of riverbed material was designed to be hauled to stock yard to exert material treatment for dike embankment. On the other hand, the sediment material mainly consisting of silty deposits from the lower portion of the riverbed was planned to spoil bank for future land reclamation.

(4) Relocation of existing bridge construction

The existing road bridges and Federal railway (RFFSA) were planned to be relocated in the early stage of construction works. Both relocation works were designed with due care for local traffic and consideration during construction and for future permanent use.

6. COST ESTIMATE

6.1 Basic Assumptions

The construction cost for the master plan was estimated on the basis of preliminary design layout and construction plan. The following basic assumptions and conditions were adopted for cost estimate in this study.

(1) Price level

The cost was estimated at the price level in the end of June 1990 for all of the project works.

(2) Official exchange rate

The official exchange rates of one(1) United States dollar(US$) applied in the conversion into Brazilian Cruzeiro dollar(Cr$) and Japanese Yen(¥) were set at Cr$ 60 and ¥ 150, respectively.

(3) Currency of cost estimate

The construction cost was estimated for the foreign and local currency components in accordance with the origin of materials. The currency for the cost estimate was expressed in United States dollar (US$) for the foreign and local currency components which include the following items.

(a) Foreign currency component

- cost of plant and equipment
- cost of foreign portion of local materials
- cost of engineering service for consultant

(b) Local currency component

- labor cost
- cost of local materials
- land compensation cost
- administration cost
- local portion of engineering service
- cost of spare parts

(4) Labor wages, materials and equipment cost

The direct construction cost for civil works was estimated on the unit cost multiplied by the corresponding work quantity. The unit cost of each work item based on the construction plan consists of the costs of labor, material and equipment as shown in Table M.2 to Table M.4.

The labor cost was generally considered as a part of local currency component for cost estimate and was calculated based on the minimum wage and the social charges.

The cost of material available in the local markets was principally counted into the local currency component. However, their certain proportions were considered into foreign currency component according to their usage of imported raw material and production facilities which is called as an indirect foreign currency portion.

The cost of equipment were counted based on the current cost in Japan. The equipment cost consists of the depreciation cost, repairing cost and administration cost.

(5) Constitution of capital cost

The construction cost was estimated in accordance with the direct construction cost, costs for compensation, administration, engineering service, and physical and price contigency. Physical contigency is provided for the physical changes of work conditions.

(a) direct construction cost

- preparatory works (five(5) to 15 percent of construction cost)
- construction cost

(b) Compensation cost

- residence
- factory
- residential area
- non-residential area
- factory area

(c) administration cost --- five(5) percent of direct cost (for local currency portion)

(d) engineering service --- 10 percent of direct cost

(e) physical contingency --- 15 percent of total cost

(f) price contingency --- three(3) percent for foreign and local currency portion

6.2 Construction Cost for Master Plan

6.2.1 Unit costs for major works

The unit costs for major works were estimated based on the data for labor wage, material and equipment cost as shown in Table M.5. These figures were determined through the discussions between the study team and the agency concerned (DAEE), and were judged to be reasonable in comparison with the unit costs of similar projects in this country.

6.2.2 Construction cost for master plan

The construction costs for the master plans in the financial basis were estimated for the sediment run-off and flood disaster prevention works.

The financial cost for the sediment run-off disaster prevention works was estimated at US$ 75.0 million as presented in Table M.6. The direct and indirect costs were estimated at US$ 45.9 million and US$ 29.1 million, respectively. The summary of financial cost excluding price contingency for the sediment run-off disaster prevention works in each Sabo basin is shown in Table M.7.

The financial costs for the flood disaster prevention works in the Cubatão and Moji river basins were estimated at US$ 43.2 million and US$ 22.7 million as presented in Table M.8. The direct and indirect costs were estimated at US$ 25.5 million and US$ 17.7 million for the plan in the Cubatão river basin and at US$ 13.9 million and US$ 8.8 million for the plan in the Moji river basin, respectively. The summary

of financial cost excluding price contingency for the alternative plans of flood disaster prevention works is shown in Table M.9.

The financial cost for master plan formulated is tabulated in Table M.10. Total financial cost for the sediment run-off and flood disaster prevention works was estimated at US$ 140.9 million.

6.3 Construction Cost for Priority Projects

6.3.1 Unit costs revised

The unit costs for major works were revised based on the basic data such as labor wage, material and equipment cost. These figures were obtained with a little difference from unit costs estimated in the master plan stage. The unit costs revised are indicated in Table M.11.

6.3.2 Construction cost for priority projects

The construction cost for the priority project was estimated based on the preliminary design and construction plan. The basic assumptions and conditions adopted for the cost estimate are basically the same as that of master plan stage as follows:

a) price level --- the end of June 1990
b) official exchange rate --- US$ 1.0 = Cr$ 60 = ¥ 150
c) currency of cost estimate --- foreign and local currency
d) labor wage, materials and equipment cost
e) constitution of capital cost

The construction costs for the priority projects in the financial basis were estimated for the sediment run-off and flood disaster prevention works. The summary of financial cost for the sediment run-off disaster prevention works was estimated at US$ 25.7 million as presented in Table M.12. The direct and indirect costs were estimated at US$ 17.0 million and US$ 8.7 million, respectively. The financial cost for sediment run-off disaster prevention works in each Sabo basin is shown in Table M.13.

The financial cost for the flood disaster prevention works in the Moji river basin was estimated at US$ 11.4 million as shown in Table

M.14. The direct and indirect costs were estimated at US$ 7.4 million and US$ 4.0 million, respectively.

Total construction cost for the sediment run-off and flood disaster prevention works, therefore, was estimated to amount to US$ 37.1 million; direct cost of US$ 24,4 million and indirect cost of US$ 12.7 million.

Construction Cost for Priority Project

(Unit : million US$)

Works	Construction Cost		
	Direct	Indirect	Total
(1) Sediment run-off disaster prevention works	17.0	8.7	25.7
Basin 2	6.0	3.0	9.0
" 3	2.7	1.3	4.0
" 7	2.7	1.4	4.1
" 8	1.1	0.8	1.9
" 10	0.3	0.1	0.4
" 11	2.2	1.1	3.3
" 12	2.0	1.0	3.0
(2) Flood desaster prevention works	7.4	4.0	11.4
Total	24.4	12.7	37.1

TABLES

TABLE M.1 LIST OF DATA COLLECTED

No.	TITLE	SOURCE
1	Non Title (Facilities of Cement, Concrete and Block in the Cubatão River Basin)	DAEE/Cubatão City
2	Energia supletiva - Distribuição de Energia (Power Supply and Distribution)	DAEE/ELETROPAULO
3	LINHA DE TRANSMISSÃO 88 KV) (Transmission Line, 88 KV)	DAEE/ELETROPAULO
4	LINHAS DE TRANSMISSÃO (230-345KV) (Transmission Line, 230-345KV)	DAEE/ELETROPAULO
5	Diário Oficial (June 1990) (Daily Official)	São Paulo State
6	Construção (Construction; Weekly Magazine; Jan.'90)	Editora PINI Ltda, São Paulo
7	Construção (Construction; Weekly Magazine)	
8	Non Title (Index of Updating Unit Price)	São Paulo State
9	Conjuntura Economia (Economy Context; Monthly Data)	Instituto Brasileiro de Economia-Fundação Getúlio Vargas
10	OBRA-Planejamento & Construção (Planning and Construction; For Building; Monthly Data)	Publicação Mensal de Construção, Planejamento e Desenvolvimento Urbano
11	Dirigente Construtor (Construction Manager; Monthly Data)	Revista Mensal Publicada pela Editora Visão Ltda
12	Informador Construção Leve e Pesada das Construções (Information for Light and Heavy Construction)	Minas

TABLE M.2 LABOR WAGE

	Item	Daily Wage	
		Foreign Portion (US$/day)	Local Portion (US$/day)
1	Foreman, local	0.00	55.00
2	Operator	0.00	18.00
3	Assis.operator	0.00	10.00
4	Driver	0.00	18.00
5	Mechanic	0.00	21.00
6	Electrician	0.00	21.00
7	Welder	0.00	18.00
8	Carpenter	0.00	13.00
9	Tunnel worker	0.00	13.00
10	Concrete worker	0.00	13.00
11	Mason	0.00	13.00
12	Steel worker	0.00	10.00
13	Pipe fitter	0.00	16.00
14	Rigger	0.00	10.00
15	Powderman	0.00	10.00
16	Skilled labor	0.00	13.00
17	Common labor	0.00	10.00
18	Foreman, foreign	150.00	40.00

Note : 1) Source of data : DAEE
2) Social charge(Encargos Sociais or Leis Sociais) of 123.7% was included in the daily wage.

TABLE M.3 UNIT COST OF MATERIALS

No.	Description	Unit	Unit Cost F/C(US$)	Unit Cost L/C(US$)
1	Portland cement	ton	69.60	46.40
2	Reinforcing bar	ton	444.00	296.00
3	Reinforcing bar	kg	0.44	0.30
4	H-shaped steel	ton	270.00	180.00
5	Round bar, 16mm	kg	0.39	0.26
6	Channel steel	kg	0.32	0.21
7	Steel angle	kg	0.28	0.19
8	Cobble & rubble	ton	4.56	10.64
9	River run(screened)	ton	4.41	10.29
10	Coarse aggregate	ton	3.63	8.47
11	Fine aggregate	ton	3.27	7.63
12	Water reducing agent	kg	0.96	0.64
13	Form oil	lit.	16.02	10.68
14	Galvanized pipe 50mm	m	5.70	3.80
15	Metal form,300x1500	no.	7.20	4.80
16	Metal form,200x1500	no.	4.80	3.20
17	Timber,plank	cu.m	122.70	286.30
18	Timber log	cu.m	39.30	91.70
19	Timber square	cu.m	122.70	286.30
20	Concrete pipe,1m dia.	m	141.60	94.40
21	PVC pipe 2in.	m	1.41	3.29
22	Light oil	lit	0.23	0.15
23	Gasoline	lit	0.40	0.27
24	Lubricant	lit	1.53	1.02
25	Grease	kg	4.68	3.12
26	Dynamite	kg	1.56	1.04
27	Detonator	pc	0.20	0.14
28	Asphalt	ton	0.12	0.08
29	Taper rod,L=1.1m	no.	23.40	15.60
30	Taper rod,L=1.8m	no.	30.00	20.00
31	Shank rod, 32R	no.	30.00	20.00
32	Sleeve, 32R	no.	30.00	20.00
33	Cross bit, 22mm	no.	35.00	15.00
34	Anchor bolt,22mm	no.	0.60	0.40

Note ; Source of data : DAEE
EXCHANGE RATE : US$ 1.0 = Cr$ 60.0 = JYE 150.0

TABLE M.4 EQUIPMENT EXPENSE

No.	Equipment	Spec.	Hr. or Day	Horse Power (HP)	Initial Cost C.I.F (1000Y)	Equipment cost F/C (US$)	L/C (US$)
1	Bulldozer	21t	hr	219	27600	52.15	20.91
2	Tractor shovel	3.2m3	hr	250	30700	55.51	21.97
3	Wheel loader	2.1m3	hr	128	15500	27.54	14.24
4	Muck loader	5.4m3	hr	415	52900	95.65	33.31
5	Backhoe	0.6m3	hr	124	16200	26.22	13.79
6	Backhoe	1.2m3	hr	200	32700	51.14	19.56
7	Dump truck	11t	hr	319	9810	14.77	9.57
8	Dump truck	8t	hr	242	6900	10.57	8.27
9	Cargo truck	6t	hr	180	3850	7.73	5.58
10	Asphalt cooker	4m3	hr	260	26300	67.60	20.37
11	Truck crane	4.9t	hr	160	9720	13.56	10.83
12	Truck crane	20t	hr	230	26800	30.28	15.10
13	Tunnel form	10m	day	0	50000	1754.98	66.23
14	Drill jumbo	2-boom	hr	60	72800	157.23	43.87
15	Motor grader	3.1m	hr	115	11900	20.50	12.47
16	Tire roller	8t	hr	39	7240	11.19	9.96
17	Macadam roller	10-12t	hr	73	9670	15.43	11.29
18	Asphalt finisher	2.4-5m	hr	48	28100	48.98	19.30
19	Tamping roller	5t	hr	0	3450	4.17	0.83
20	Vibrating roller	4t	hr	28	4810	13.50	10.09
21	Vibrating roller	0.5t	hr	5.1	1290	3.44	2.89
22	Vibrating compactor	90kg	day	5	201	5.28	14.88
23	Sprinkler truck	8kl	hr	270	8280	14.75	7.03
24	Truck mixer	3.2m3	hr	220	6890	13.41	10.75
25	Concrete plant	0.5m3	hr	0	20200	67.71	54.27
26	Asphalt plant	30t/hr	day	0	63000	130.16	67.03
27	Concrete pump	30m3/hr	hr	0	13300	30.72	5.62
28	Concrete pump	45m3/hr	hr	0	15600	36.03	6.59
29	Screening plant	30t/hr	day	0	24200	68.15	53.41
30	Crushing plant	50t/hr	day	0	60600	114.26	61.55
31	Concrete bucket	1.0m3	day	0	524	6.35	1.02
32	Concrete vibrator	45mm	day	0	145	1.88	0.22
33	Concrete mixer	0.5m3	day	0	2360	20.64	58.95
34	Seed sprayor	1.3m3	hr	10	3470	6.86	3.63
35	Volute pump	50mm	day	0	61	0.73	0.14
36	Volute pump	80mm	day	0	133	1.58	0.31
37	Volute pump	150mm	day	0	302	3.59	0.70
38	Submersible pump	2in	day	0	61	0.73	0.14
39	Water tank	5m3	day	0	350	2.60	0.40
40	Welder	300A	day	0	160	0.99	0.22
41	Diesel generator	200kvA	day	260	7500	112.50	57.01
42	Diesel generator	100kVA	day	131	3650	57.93	30.67
43	Diesel generator	50kvA	day	54	2450	30.11	16.26
44	Diesel generator	10kvA	day	16	990	14.05	8.54
45	Diesel generator	3kVA	day	5	410	4.31	5.55
46	Centrifugal pump	50 mm	day	0	110	1.04	0.22
47	Air compressor	10.5m3	day	110	5190	73.28	33.44
48	Air Fun	400m3	day	0	4370	22.38	7.90
49	Dredger		hr	75	0	0.00	0.00
50	Tower crane	90 t-m	day	0	38600	186.68	39.40

TABLE M.5 UNIT COST FOR MAJOR WORKS

Item	Unit	Unit Cost (US$) F/C	Unit Cost (US$) L/C	Total
(For Sediment Control)				
(1) Sabo Dam (Concrete Gravity)	m3	95	95	190
(2) Channel Works (Wet Masonry)	m2	15	35	50
(3) Groundsill (Concrete)	m3	90	90	180
(For Flood Control)				
(4) Embankment	m3	2.1	1.4	3.5
(5) Excavation	m3	1.8	1.2	3.0
(6) Dredging	m3	2.7	1.8	4.5
(7) Revetment (Wet Masonry)	m2	15	35	50
(8) Tunnel	m	7,800	5,200	13,000
(9) Road Bridge	m2	800	500	1,300
(10) Railway Bridge	m2	1,000	700	1,700
(For Compensation)				
(11) Residence	m2		400	400
(12) Residential Area	m2		2.5	2.5
(13) Non-Residential Area	m2		0.7	0.7
(14) Factory Area	m2		1.3	1.3

TABLE M.6 FINANCIAL COST FOR SEDIMENT DISASTER PREVENTION WORKS

Item	Unit	Quantity	Foreign Currency		Local Currency		Total
			Unit Cost	Amount (1,000US$)	Unit Cost	Amount (1,000US$)	(1,000US$)
I. Preparatory Works (15% of II)				2,879		3,102	5,980
II. Construction Cost							
II.1 Sabo dam (32 sites)	m3	179,600	95.0	17,062	95.0	17,062	34,124
II.2 Channel works (11 sites)	m2	70,800	15.0	1,062	35.0	2,478	3,540
II.3 Groundsill (2 Nos.)	m3	1,700	90.0	153	90.0	153	306
II.4 Miscellaneous (5% of Total II.1 - II.3)				914		985	1,899
Total of II				19,191		20,678	39,869
III. Compensation Cost							
III.1 Residence	Nos.	12			400	5	5
III.2 Residential Area	m2	960			2.5	2	2
III.3 Non-Residential Area	m2	11,200			0.7	8	8
III.4 Factory Area	m2	132,700			1.3	173	173
Total of III						188	188
IV. Administration Cost (5% of I + II)						2,292	2,292
V. Engineering Service (10% of I + II)				3,668		917	4,585
VI. Physical Contingency (15% of I + II + III + IV + V)				3,861		4,076	7,937
VII. Price Contingency (F/C 3%, L/C 3%)				6,901		7,289	14,190
Total				36,499		38,542	75,041

TABLE M.7 SUMMARY OF FINANCIAL COST (EXCLUDING PRICE CONTINGENCY)
FOR SEDIMENT DISASTER PREVENTION WORKS

Unit : 1,000 US$

	Item	Basin 1			Basin 2			Basin 3			Basin 4			Basin 5			Basin 6		
		F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	TOTAL
I	Preparatory Work (15% of II)	51	81	132	429	456	885	222	240	462	343	373	717	148	162	311	249	284	533
II	Construction Cost	341	542	883	2,860	3,043	5,903	1,479	1,603	3,082	2,289	2,489	4,778	989	1,083	2,072	1,661	1,894	3,555
III	Compensation Cost		28	28		11	11		10	10		47	47		15	15		35	35
IV	Administration Cost (5% of I + II)		51	51		339	339		177	177		275	275		119	119		204	204
V	Engineering Service (10% of I + II)	81	20	102	543	136	679	284	71	354	440	110	549	191	48	238	327	82	409
VI	Physical Contingency (15% of I+II+III+IV+V)	71	108	179	575	598	1,173	298	315	613	461	494	955	199	214	413	336	375	710
	Total	544	831	1,375	4,407	4,583	8,990	2,282	2,417	4,699	3,533	3,788	7,321	1,527	1,641	3,169	2,573	2,874	5,447

	Item	Basin 7			Basin 8			Basin 9			Basin 10			Basin 11			Basin 12		
		F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	TOTAL
I	Preparatory Work (15% of II)	387	400	787	129	142	271	201	215	415	81	81	162	306	321	627	325	346	670
II	Construction Cost	2,580	2,668	5,248	861	945	1,806	1,338	1,430	2,768	539	539	1,078	2,039	2,138	4,177	2,165	2,304	4,469
III	Compensation Cost		9	9		4	4		1	1		0	0		13	13		15	15
IV	Administration Cost (5% of I + II)		302	302		104	104		159	159		62	62		240	240		257	257
V	Engineering Service (10% of I + II)	483	121	604	166	42	208	255	64	318	99	25	124	384	96	480	411	103	514
VI	Physical Contingency (15% of I+II+III+IV+V)	517	525	1,042	173	185	359	269	280	549	108	106	214	409	421	831	435	454	889
	Total	3,967	4,025	7,992	1,330	1,422	2,751	2,062	2,149	4,211	827	813	1,640	3,139	3,229	6,368	3,336	3,478	6,814

TABLE M.8 FINANCIAL COST FOR FLOOD DISASTER PREVENTION WORKS(1/2)

ALTERNATIVE M-2

Item	Unit	Quantity	Foreign Currency		Local Currency		Total
			Unit Cost	Amount (1,000US$)	Unit Cost	Amount (1,000US$)	(1,000US$)
I. Preparatory Works (5% of II)				378		283	661
II. Construction Cost							
II.1 Dike	m3	250,000	2.1	525	1.4	350	875
II.2 Excavation	m3	846,000	1.8	1,523	1.2	1,015	2,538
II.3 Dredging	m3	584,000	2.7	1,577	1.8	1,051	2,628
II.4 Revetment	m2	24,800	15.0	372	35.0	868	1,240
II.5 Culvert (7 Nos.)	L.S.	1		240		160	400
II.6 Intake Weir (1 No.)	L.S.	1		72		48	120
II.7 Groundsill (4 Nos.)	L.S.	1		120		80	200
II.8 Road Bridge	L.S.	1		1,000		700	1,700
II.9 Railway Bridge	L.S.	1		1,600		1,000	2,600
II.10 Repair of Riprap Dike (4 Nos.)	L.S.	1		174		116	290
II.11 Miscellaneous (5% of Total II.1 - II.10)				360		269	630
Total of II				7,563		5,658	13,221
III. Compensation Cost							
III.1 Residence	Nos.	0			400	0	0
III.2 Factory	L.S.	1				0	0
III.3 Residential Area	m2	0			2.5	0	0
III.4 Non-Residential Area	m2	354,000			0.7	248	248
Total of III						248	248
IV. Administration Cost (5% of I + II)						694	694
V. Engineering Service (10% of I + II)				1,111		278	1,388
VI. Physical Contingency (15% of I + II + III + IV + V)				1,358		1,074	2,432
VII. Price Contingency (F/C 3%, L/C 3%)				2,299		1,801	4,100
Total				12,708		10,035	22,743

TABLE M.8 FINANCIAL COST FOR FLOOD DISASTER PREVENTION WORKS(2/2)

ALTERNATIVE C-2(2)

Item	Unit	Quantity	Foreign Currency Unit Cost	Foreign Currency Amount (1,000US$)	Local Currency Unit Cost	Local Currency Amount (1,000US$)	Total (1,000US$)
I. Preparatory Works (5% of II)				695		520	1,215
II. Construction Cost							
II.1 Dike	m3	157,000	2.1	330	1.4	220	550
II.2 Excavation	m3	256,000	1.8	461	1.2	307	768
II.3 Dredging	m3	256,000	2.7	691	1.8	461	1,152
II.4 Revetment	m2	6,700	15.0	101	35.0	235	335
II.5 Culvert (11 Nos.)	L.S.	1		384		256	640
II.6 Diversion Weir	L.S.	1		240		160	400
II.7 Overflow Weir	L.S.	1		130		90	220
II.8 Diversion Channel (Cubatao)	L.S.	1		530		850	1,380
II.9 Tunnel (2 Nos.)	m	1,200	7,800	9,360	5,200	6,240	15,600
II.10 Diversion Channel (Sao Vicente)	L.S.	1		340		640	980
II.11 Road Bridge (2 Nos.)	L.S.	1		192		120	312
II.12 Railway Bridge (1 Nos.)	L.S.	1		300		210	510
II.13 Protection Dike	L.S.	1		143		87	230
II.14 Riverbed Protection	L.S.	1		36		24	60
II.15 Miscellaneous (5% of Total II.1 - II.14)				662		495	1,157
Total of II				13,899		10,394	24,293
III. Compensation Cost							
III.1 Residence	Nos.	10			400	4	4
III.2 Factory	L.S.	1				0	0
III.3 Residential Area	m2	800			2.5	2	2
III.4 Non-Residential Area	m2	248,000			0.7	174	174
Total of III						180	180
IV. Administration Cost (5% of I + II)						1,275	1,275
V. Engineering Service (10% of I + II)				2,041		510	2,551
VI. Physical Contingency (15% of I + II + III + IV + V)				2,495		1,932	4,427
VII. Price Contingency (F/C 3%, L/C 3%)				5,242		4,058	9,300
Total				24,372		18,869	43,241

TABLE M.9 SUMMARY OF FINANCIAL COST (EXCLUDING PRICE CONTINGENCY)
FOR FLOOD DISASTER PREVENTION WORKS

Unit : 1,000 US$

Item	Alternative C - 1			Alternative C - 2 (1)			Alternative C - 2 (2)			Alternative M - 1			Alternative M - 2		
	F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	TOTAL
I Preparatory Work (5% of II)	543	399	942	951	699	1,650	695	520	1,215	450	337	788	378	283	661
II Construction Cost	10,865	7,975	18,840	19,015	13,988	33,003	13,899	10,394	24,293	9,009	6,748	15,757	7,563	5,658	13,221
III Compensation Cost		19,343	19,343		180	180		180	180		698	698		248	248
IV Administration Cost (5% of I + II)		989	989		1,733	1,733		1,275	1,275		827	827		694	694
V Engineering Service (10% of I + II)	1,583	396	1,978	2,772	693	3,465	2,041	510	2,551	1,324	331	1,654	1,111	278	1,388
VI Physical Contingency (15% of I+II+III+IV+V)	1,949	4,365	6,314	3,411	2,594	6,005	2,495	1,932	4,427	1,617	1,341	2,959	1,358	1,074	2,432
Total	14,939	33,467	48,406	26,149	19,887	46,036	19,130	14,811	33,941	12,400	10,283	22,683	10,409	8,235	18,644

TABLE M.10 FINANCIAL COST FOR MASTER PLAN

Unit : 1,000 US$

Item	Sediment Disaster Prevention Works			Flood Disaster Prevention Works									(Sediment+Flood) Disaster Prevention Works		
				Cubatao			Moji			(Cubatao + Moji)					
	F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	TOTAL
I Preparatory Work (5-15% of II)	2,879	3,102	5,980	695	520	1,215	378	283	661	1,073	803	1,876	3,952	3,904	7,856
II Construction Cost	19,191	20,678	39,869	13,899	10,394	24,293	7,563	5,658	13,221	21,462	16,052	37,514	40,653	36,730	77,383
III Compensation Cost		188	188		180	180		248	248		428	428		616	616
IV Administration Cost (5% of I + II)		2,292	2,292		1,275	1,275		694	694		1,969	1,969		4,262	4,262
V Engineering Service (10% of I + II)	3,668	917	4,585	2,041	510	2,551	1,111	278	1,388	3,151	788	3,939	6,819	1,705	8,524
VI Physical Contingency (15% of I+II+III+IV+V)	3,861	4,077	7,937	2,495	1,932	4,427	1,358	1,074	2,432	3,853	3,006	6,859	7,714	7,083	14,796
VII Price Contigentcy (F/C 3%, L/C 3%)	6,901	7,289	14,190	5,242	4,058	9,300	2,299	1,801	4,100	7,541	5,859	13,400	14,442	13,148	27,590
Total	36,499	38,543	75,042	24,372	18,869	43,241	12,708	10,036	22,744	37,080	28,905	65,985	73,579	67,448	141,027

TABLE M.11 UNIT COST REVISED

Item	Unit	Unit Cost (US$) F/C	Unit Cost (US$) L/C	Total
(For Sediment Control)				
(1) Excavation	m3	1.7	1.8	3.5
(2) Outer Concrete	m3	76.7	83.3	160.1
(3) Inner Concrete	m3	71.3	80.4	151.6
(4) Form	m2	7.7	15.4	23.1
(5) Wetstone Masonry	m2	13.6	23.4	36.9
(6) Concrete Block	m3	60.9	94.6	155.5
(7) Berm Concrete	m3	60.9	94.6	155.5
(8) Gabion	m3	18.4	30.3	48.7
(For Flood Control)				
(9) Gravel Metalling	m3	12.1	18.4	30.4
(10) Excavation	m3	2.1	1.3	3.4
(11) Dredging	m3	2.4	1.6	4.0
(12) Embankment	m3	2.2	1.4	3.6
(13) Sod Facing	m2	0.2	0.6	0.7
(14) Concrete	m3	74.0	81.8	155.8
(15) Reinforcement Bar	ton	642.2	488.2	1130.4
(16) RC Pile	m	12.0	8.0	20.0
(17) Gate	ton	3000.0	2000.0	5000.0
(18) Steel Pile	m	162.0	108.0	270.0
(19) Ballast	m3	16.2	35.7	51.8
(For Compensation)				
(20) Residence	m2		400	400
(21) Residential Area	m2		2.5	2.5
(22) Non-Residential Area	m2		0.7	0.7
(23) Factory Area	m2		1.3	1.3

TABLE M.12 SUMMARY OF FINANCIAL COST FOR SEDIMENT DISASTER PREVENTION WORKS IN EACH BASIN (FOR PRIORITY PROJECT)

Unit : 1,000 US$

	Item	Basin 2			Basin 3			Basin 7			Basin 8		
		F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	TOTAL
I	Preparatory Work (15% of II)	368	413	781	160	183	343	168	188	356	74	86	160
II	Construction Cost	2,453	2,751	5,204	1,068	1,218	2,286	1,120	1,253	2,373	495	573	1,068
III	Compensation Cost		11	11		10	10		9	9		4	4
IV	Administration Cost (5% of I + II)		299	299		131	131		136	136		61	61
V	Engineering Service (10% of I + II)	479	120	598	210	53	263	218	55	273	98	25	123
VI	Physical Contingency (15% of I+II+III+IV+V)	495	539	1,034	216	239	455	226	246	472	100	112	212
VII	Price Contingency (F/C 3%,L/C 3%)	527	574	1102	230	255	485	241	262	503	107	120	226
	Total	4,322	4,707	9,029	1,884	2,089	3,973	1,973	2,149	4,122	874	981	1,855

	Item	Basin 10			Basin 11			Basin 12			Total		
		F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	Total
I	Preparatory Work (15% of II)	15	17	32	132	150	281	122	141	263	1,039	1,177	2,216
II	Construction Cost	102	114	216	878	997	1,875	810	940	1,750	6,926	7,846	14,772
III	Compensation Cost		0	0		13	13		15	15		62	62
IV	Administration Cost (5% of I + II)		12	12		108	108		101	101		849	849
V	Engineering Service (10% of I + II)	20	5	25	173	43	216	161	40	201	1,359	340	1,699
VI	Physical Contingency (15% of I+II+III+IV+V)	21	22	43	177	197	374	164	186	349	1,399	1,541	2,940
VII	Price Contingency (F/C 3%,L/C 3%)	22	24	46	189	209	398	175	198	372	1,490	1,642	3,133
	Total	180	194	374	1,549	1,717	3,265	1,431	1,620	3,051	12,213	13,457	25,670

TABLE M.13 FINANCIAL COST FOR SEDIMENT DISASTER PREVENTION WORKS (1/7)
(FOR PRIORITY PROJECT)

(Basin No.2)

Item		Unit	Quantity	Foreign Currency		Local Currency		Total
				Unit Cost	Amount (1,000US$)	Unit Cost	Amount (1,000US$)	(1,000US$)
I. Preparatory Works (15% of II)		L.S.	1		368		413	781
II. Construction Cost								
II.1 Sabo dam (Vc=23,200m3)								
1) Care of river		L.S.	1		102		77	180
2) Excavation	(No.40)	m3	35,200	1.72	61	1.76	62	122
3) Outer concrete	(No.30-B-1)	m3	6,600	76.73	506	83.34	550	1,056
4) Inner concrete	(No.30-B-2)	m3	15,400	71.29	1,098	80.35	1,237	2,335
5) Form	(No.72-A)	m2	5,368	7.71	41	15.37	83	124
6) Miscellaneous (10% of Total 1) - 5))		10%			181		201	382
Total of II.1		m3			1,989		2,210	4,200
II.2 Channel works (L=530m)								
1) Care of river		L.S.	1		11		9	21
2) Excavation	(No.40)	m3	70,800	1.72	122	1.76	125	246
3) Wet stone masonry	(No.6)	m2	3,660	13.55	50	23.39	86	135
4) Concrete block	(No.7)	m3	64	60.94	4	94.56	6	10
5) Berm concrete	(No.7)	m3	42	60.94	3	94.56	4	7
6) Gabion	(No.9)	m3	530	18.44	10	30.26	16	26
7) Miscellaneous (10% of Total 1) - 6))					20		25	44
Total of II.2		m2			219		270	489
II.3 Groundsill (4 Sites)								
1) Excavation	(No.40)	m3	15,700	1.72	27	1.76	28	55
2) Concrete	(No.30-A-1)	m3	1,210	74.00	90	81.82	99	189
3) Miscellaneous (10% of Total 1) - 2))					12		13	24
Total of II.3		m3			128		139	267
II.4 Miscellaneous (5% of Total II.1 - II.3)					117		131	248
Total of II					2,453		2,751	5,204
III. Compensation Cost								
III.1 Residence		Nos.	0			400	0	0
III.2 Residential Area		m2	0			2.5	0	0
III.3 Non-Residential Area		m2	0			0.7	0	0
III.4 Factory Area		m2	8,400			1.3	11	11
Total of III							11	11
IV. Administration Cost (5% of I + II)							299	299
V. Engineering Service (10% of I + II)					479		120	598
VI. Physical Contingency (15% of I + II + III + IV + V)					495		539	1,034
VII. Price Contingency (F/C 3%, L/C 3%)					527		574	1,102
Total					4,322		4,706	9,029

TABLE M.13 FINANCIAL COST FOR SEDIMENT DISASTER PREVENTION WORKS (2/7)
(FOR PRIORITY PROJECT)

(Basin No.3)

Item		Unit	Quantity	Foreign Currency		Local Currency		Total
				Unit Cost	Amount (1,000US$)	Unit Cost	Amount (1,000US$)	(1,000US$)
I. Preparatory Works (15% of II)		L.S.	1		160		183	343
II. Construction Cost								
II.1 Sabo dam (Vc=9,800m3)								
1) Care of river		L.S.	1		45		34	79
2) Excavation	(No.40)	m3	8,500	1.72	15	1.76	15	30
3) Outer concrete	(No.30-B-1)	m3	2,940	76.73	226	83.34	245	471
4) Inner concrete	(No.30-B-2)	m3	6,860	71.29	489	80.35	551	1,040
5) Form	(No.72-A)	m2	2,391	7.71	18	15.37	37	55
6) Miscellaneous (10% of Total 1) - 5))		10%			79		88	167
Total of II.1		m3			872		970	1,842
II.2 Channel works (L=490m)								
1) Care of river		L.S.	1		7		6	12
2) Excavation	(No.40)	m3	31,200	1.72	54	1.76	55	109
3) Wet stone masonry	(No.6)	m2	2,940	13.55	40	23.39	69	109
4) Concrete block	(No.7)	m3	59	60.94	4	94.56	6	9
5) Berm concrete	(No.7)	m3	39	60.94	2	94.56	4	6
6) Gabion	(No.9)	m3	490	18.44	9	30.26	15	24
7) Miscellaneous (10% of Total 1) - 6))					12		15	27
Total of II.2		m2			127		169	296
II.3 Groundsill (1 Site)								
1) Excavation	(No.40)	m3	120	1.72	0	1.76	0	0
2) Concrete	(No.30-A-1)	m3	230	74.00	17	81.82	19	36
3) Miscellaneous (10% of Total 1) - 2))					2		2	4
Total of II.3		m3			19		21	40
II.4 Miscellaneous (5% of Total II.1 - II.3)					51		58	109
Total of II					1,068		1,218	2,286
III. Compensation Cost								
III.1 Residence		Nos.	0			400	0	0
III.2 Residential Area		m2	0			2.5	0	0
III.3 Non-Residential Area		m2	0			0.7	0	0
III.4 Factory Area		m2	8,000			1.3	10	10
Total of III							10	10
IV. Administration Cost (5% of I + II)							131	131
V. Engineering Service (10% of I + II)					210		53	263
VI. Physical Contingency (15% of I + II + III + IV + V)					216		239	455
VII. Price Contingency (F/C 3%, L/C 3%)					230		255	485
Total					1,884		2,089	3,974

TABLE M.13 FINANCIAL COST FOR SEDIMENT DISASTER PREVENTION WORKS (3/7)

(FOR PRIORITY PROJECT)

(Basin No.7)

Item		Unit	Quantity	Foreign Currency		Local Currency		Total
				Unit Cost	Amount (1,000US$)	Unit Cost	Amount (1,000US$)	(1,000US$)
I. Preparatory Works (15% of II)		L.S.	1		168		188	356
II. Construction Cost								
II.1 Sabo dam (Vc=9,400m3)								
1) Care of river		L.S.	1		44		33	77
2) Excavation	(No.40)	m3	13,900	1.72	24	1.76	24	48
3) Outer concrete	(No.30-B-1)	m3	2,820	76.73	216	83.34	235	451
4) Inner concrete	(No.30-B-2)	m3	6,580	71.29	469	80.35	529	998
5) Form	(No.72-A)	m2	2,294	7.71	18	15.37	35	53
6) Miscellaneous (10% of Total 1) - 5))		10%			77		86	163
Total of II.1		m3			848		942	1,790
II.2 Channel works (L=250m)								
1) Care of river		L.S.	1		6		5	11
2) Excavation	(No.40)	m3	39,400	1.72	68	1.76	69	137
3) Wet stone masonry	(No.6)	m2	1,650	13.55	22	23.39	39	61
4) Concrete block	(No.7)	m3	30	60.94	2	94.56	3	5
5) Berm concrete	(No.7)	m3	20	60.94	1	94.56	2	3
6) Gabion	(No.9)	m3	250	18.44	5	30.26	8	12
7) Miscellaneous (10% of Total 1) - 6))					10		13	23
Total of II.2		m2			114		138	252
II.3 Groundsill (5 Sites)								
1) Excavation	(No.40)	m3	10,500	1.72	18	1.76	18	37
2) Concrete	(No.30-A-1)	m3	1,040	74.00	77	81.82	85	162
3) Miscellaneous (10% of Total 1) - 2))					10		10	20
Total of II.3		m3			105		114	218
II.4 Miscellaneous (5% of Total II.1 - II.3)					53		60	113
Total of II					1,120		1,253	2,373
III. Compensation Cost								
III.1 Residence		Nos.	0			400	0	0
III.2 Residential Area		m2	0			2.5	0	0
III.3 Non-Residential Area		m2	0			0.7	0	0
III.4 Factory Area		m2	7,000			1.3	9	9
Total of III							9	9
IV. Administration Cost (5% of I + II)							136	136
V. Engineering Service (10% of I + II)					218		55	273
VI. Physical Contingency (15% of I + II + III + IV + V)					226		246	472
VII. Price Contingency (F/C 3%, L/C 3%)					241		262	503
Total					1,972		2,150	4,122

TABLE M.13 FINANCIAL COST FOR SEDIMENT DISASTER PREVENTION WORKS (4/7)
(FOR PRIORITY PROJECT)

(Basin No.8)

Item		Unit	Quantity	Foreign Currency Unit Cost	Foreign Currency Amount (1,000US$)	Local Currency Unit Cost	Local Currency Amount (1,000US$)	Total (1,000US$)
I. Preparatory Works (15% of II)		L.S.	1		74		86	160
II. Construction Cost								
II.1 Sabo dam (Vc=3,700m3)								
1) Care of river		L.S.	1		17		13	30
2) Excavation	(No.40)	m3	6,400	1.72	11	1.76	11	22
3) Outer concrete	(No.30-B-1)	m3	1,110	76.73	85	83.34	93	178
4) Inner concrete	(No.30-B-2)	m3	2,590	71.29	185	80.35	208	393
5) Form	(No.72-A)	m2	903	7.71	7	15.37	14	21
6) Miscellaneous (10% of Total 1) - 5))		10%			31		34	64
Total of II.1		m3			336		373	708
II.2 Channel works (L=440m)								
1) Care of river		L.S.	1		5		5	10
2) Excavation	(No.40)	m3	23,200	1.72	40	1.76	41	81
3) Wet stone masonry	(No.6)	m2	2,250	13.55	30	23.39	53	83
4) Concrete block	(No.7)	m3	53	60.94	3	94.56	5	8
5) Berm concrete	(No.7)	m3	35	60.94	2	94.56	3	5
6) Gabion	(No.9)	m3	440	18.44	8	30.26	13	21
7) Miscellaneous (10% of Total 1) - 6))					9		12	21
Total of II.2		m2			98		132	229
II.3 Groundsill (4 Sites)								
1) Excavation	(No.40)	m3	4,000	1.72	7	1.76	7	14
2) Concrete	(No.30-A-1)	m3	370	74.00	27	81.82	30	58
3) Miscellaneous (10% of Total 1) - 2))					3		4	7
Total of II.3		m3			38		41	79
II.4 Miscellaneous (5% of Total II.1 - II.3)					24		27	51
Total of II					495		573	1,067
III. Compensation Cost								
III.1 Residence		Nos.	0			400	0	0
III.2 Residential Area		m2	0			2.5	0	0
III.3 Non-Residential Area		m2	0			0.7	0	0
III.4 Factory Area		m2	3,000			1.3	4	4
Total of III							4	4
IV. Administration Cost (5% of I + II)							61	61
V. Engineering Service (10% of I + II)					98		25	123
VI. Physical Contingency (15% of I + II + III + IV + V)					100		112	212
VII. Price Contingency (F/C 3%, L/C 3%)					107		120	226
Total					874		980	1,854

TABLE M.13 FINANCIAL COST FOR SEDIMENT DISASTER PREVENTION WORKS (5/7)
(FOR PRIORITY PROJECT)

(Basin No.10)

Item		Unit	Quantity	Foreign Currency Unit Cost	Foreign Currency Amount (1,000US$)	Local Currency Unit Cost	Local Currency Amount (1,000US$)	Total (1,000US$)
I. Preparatory Works (15% of II)		L.S.	1		15		17	32
II. Construction Cost								
II.1 Sabo dam (Vc=1,000m3)								
1) Care of river		L.S.	1		5		4	9
2) Excavation	(No.40)	m3	600	1.72	1	1.76	1	2
3) Outer concrete	(No.30-B-1)	m3	330	76.73	25	83.34	28	53
4) Inner concrete	(No.30-B-2)	m3	770	71.29	55	80.35	62	117
5) Form	(No.72-A)	m2	268	7.71	2	15.37	4	6
6) Miscellaneous (10% of Total 1) - 5))		10%			9		10	19
Total of II.1		m3			97		108	205
II.2 Channel works (L= 0 m)								
1) Care of river		L.S.	1		0		0	0
2) Excavation	(No.40)	m3	0	1.72	0	1.76	0	0
3) Wet stone masonry	(No.6)	m2	0	13.55	0	23.39	0	0
4) Concrete block	(No.7)	m3	0	60.94	0	94.56	0	0
5) Berm concrete	(No.7)	m3	0	60.94	0	94.56	0	0
6) Gabion	(No.9)	m3	0	18.44	0	30.26	0	0
7) Miscellaneous (10% of Total 1) - 6))					0		0	0
Total of II.2		m2			0		0	0
II.3 Groundsill (0 Sites)								
1) Excavation	(No.40)	m3	0	1.72	0	1.76	0	0
2) Concrete	(No.30-A-1)	m3	0	74.00	0	81.82	0	0
3) Miscellaneous (10% of Total 1) - 2))					0		0	0
Total of II.3		m3			0		0	0
II.4 Miscellaneous (5% of Total II.1 - II.3)					5		5	10
Total of II					102		114	216
III. Compensation Cost								
III.1 Residence		Nos.	0			400	0	0
III.2 Residential Area		m2	0			2.5	0	0
III.3 Non-Residential Area		m2	0			0.7	0	0
III.4 Factory Area		m2	0			1.3	0	0
Total of III							0	0
IV. Administration Cost (5% of I + II)							12	12
V. Engineering Service (10% of I + II)					20		5	25
VI. Physical Contingency (15% of I + II + III + IV + V)					21		22	43
VII. Price Contingency (F/C 3%, L/C 3%)					22		24	46
Total					180		194	373

TABLE M.13 FINANCIAL COST FOR SEDIMENT DISASTER PREVENTION WORKS (6/7)
(FOR PRIORITY PROJECT)

(Basin No.11)

Item		Unit	Quantity	Foreign Currency		Local Currency		Total
				Unit Cost	Amount (1,000US$)	Unit Cost	Amount (1,000US$)	(1,000US$)
I. Preparatory Works (15% of II)		L.S.	1		132		150	281
II. Construction Cost								
II.1 Sabo dam (Vc=6,800m3)								
1) Care of river		L.S.	1		33		25	58
2) Excavation	(No.40)	m3	4,400	1.72	8	1.76	8	15
3) Outer concrete	(No.30-B-1)	m3	2,190	76.73	168	83.34	183	351
4) Inner concrete	(No.30-B-2)	m3	5,110	71.29	364	80.35	411	775
5) Form	(No.72-A)	m2	1,781	7.71	14	15.37	27	41
6) Miscellaneous (10% of Total 1) - 5))		10%			59		65	124
Total of II.1		m3			646		719	1,364
II.2 Channel works (L=410m)								
1) Care of river		L.S.	1		4		4	7
2) Excavation	(No.40)	m3	12,300	1.72	21	1.76	22	43
3) Wet stone masonry	(No.6)	m2	2,010	13.55	27	23.39	47	74
4) Concrete block	(No.7)	m3	49	60.94	3	94.56	5	8
5) Berm concrete	(No.7)	m3	33	60.94	2	94.56	3	5
6) Gabion	(No.9)	m3	410	18.44	8	30.26	12	20
7) Miscellaneous (10% of Total 1) - 6))					6		9	16
Total of II.2		m2			71		102	173
II.3 Groundsill (11 Sites)								
1) Excavation	(No.40)	m3	15,700	1.72	27	1.76	28	55
2) Concrete	(No.30-A-1)	m3	1,100	74.00	81	81.82	90	171
3) Miscellaneous (10% of Total 1) - 2))					11		12	23
Total of II.3		m3			119		129	249
II.4 Miscellaneous (5% of Total II.1 - II.3)					42		47	89
Total of II					878		997	1,875
III. Compensation Cost								
III.1 Residence		Nos.	0			400	0	0
III.2 Residential Area		m2	0			2.5	0	0
III.3 Non-Residential Area		m2	0			0.7	0	0
III.4 Factory Area		m2	10,000			1.3	13	13
Total of III							13	13
IV. Administration Cost (5% of I + II)							108	108
V. Engineering Service (10% of I + II)					172		43	216
VI. Physical Contingency (15% of I + II + III + IV + V)					177		197	374
VII. Price Contingency (F/C 3%, L/C 3%)					189		210	398
Total					1,548		1,717	3,265

TABLE M.13 FINANCIAL COST FOR SEDIMENT DISASTER PREVENTION WORKS (7/7)

(FOR PRIORITY PROJECT)

(Basin No.12)

Item		Unit	Quantity	Foreign Currency Unit Cost	Foreign Currency Amount (1,000US$)	Local Currency Unit Cost	Local Currency Amount (1,000US$)	Total (1,000US$)
I. Preparatory Works (15% of II)		L.S.	1		122		141	262
II. Construction Cost								
II.1 Sabo dam (Vc=4,900m3)								
1) Care of river		L.S.	1		22		17	39
2) Excavation	(No.40)	m3	3,900	1.72	7	1.76	7	14
3) Outer concrete	(No.30-B-1)	m3	1,470	76.73	113	83.34	123	235
4) Inner concrete	(No.30-B-2)	m3	3,430	71.29	245	80.35	276	520
5) Form	(No.72-A)	m2	1,196	7.71	9	15.37	18	28
6) Miscellaneous (10% of Total 1) - 5))		10%			40		44	84
Total of II.1		m3			435		484	920
II.2 Channel works (L=750m)								
1) Care of river		L.S.	1		12		10	22
2) Excavation	(No.40)	m3	64,000	1.72	110	1.76	113	223
3) Wet stone masonry	(No.6)	m2	4,550	13.55	62	23.39	106	168
4) Concrete block	(No.7)	m3	90	60.94	5	94.56	9	14
5) Berm concrete	(No.7)	m3	60	60.94	4	94.56	6	9
6) Gabion	(No.9)	m3	750	18.44	14	30.26	23	37
7) Miscellaneous (10% of Total 1) - 6))					21		27	47
Total of II.2		m2			227		293	520
II.3 Groundsill (9 Sites)								
1) Excavation	(No.40)	m3	19,000	1.72	33	1.76	33	66
2) Concrete	(No.30-A-1)	m3	900	74.00	67	81.82	74	140
3) Miscellaneous (10% of Total 1) - 2))					10		11	21
Total of II.3		m3			109		118	227
II.4 Miscellaneous (5% of Total II.1 - II.3)					39		45	83
Total of II					810		940	1,750
III. Compensation Cost								
III.1 Residence		Nos.	12			400	5	5
III.2 Residential Area		m2	960			2.5	2	2
III.3 Non-Residential Area		m2	11,200			0.7	8	8
III.4 Factory Area		m2	0			1.3	0	0
Total of III							15	15
IV. Administration Cost (5% of I + II)							101	101
V. Engineering Service (10% of I + II)					161		40	201
VI. Physical Contingency (15% of I + II + III + IV + V)					164		185	349
VII. Price Contingency (F/C 3%, L/C 3%)					175		198	372
Total					1,431		1,620	3,051

TABLE M.14 FINANCIAL COST FOR FLOOD DISASTER PREVENTION WORKS (FOR PRIORITY PROJECT)

ALTERNATIVE M-2

Item		Unit	Quantity	Foreign Currency Unit Cost	Foreign Currency Amount (1,000US$)	Local Currency Unit Cost	Local Currency Amount (1,000US$)	Total (1,000US$)
I. Preparatory Works (5% of II)		L.S.	1		198		156	354
II. Construction Cost								
II.1 Dike (L=9.3km)								
1) Gravel metalling	(No.3)	m3	6,600	12.07	80	18.36	121	201
2) Excavation	(No.1)	m3	329,000	2.14	704	1.28	421	1,125
3) Dredging		m3	141,000	2.40	338	1.60	226	564
4) Embankment	(No.2)	m3	255,000	2.20	561	1.38	352	913
5) Sod Facing	(No.4)	m2	111,600	0.17	19	0.56	62	81
6) Miscellaneous (10% of Total 1) - 5))					170		118	288
Total of II.1		m3			1,872		1,301	3,173
II.2 Revetment (L=1.45km)								
1) Wet stone masonry	(No.6)	m2	9,800	13.55	133	23.39	229	362
2) Concrete block	(No.7)	m3	170	60.94	10	94.56	16	26
3) Berm concrete	(No.7)	m3	120	60.94	7	94.56	11	19
4) Gabion	(No.9)	m3	2,900	18.44	53	30.26	88	141
5) Miscellaneous (10% of Total 1) - 4))					20		34	55
Total of II.2					224		379	603
II.3 Culvert (6 Sites)								
1) Excavation	(No.40)	m3	2,300	1.72	4	1.76	4	8
2) Concrete	(No.30-A-1)	m3	550	74.00	41	81.82	45	86
3) Reinforcement bar	(No.71)	ton	30	642.20	19	488.18	15	34
4) Form	(No.73-A)	m2	960	6.01	6	21.16	20	26
5) RC pile		m	136	12.00	2	8.00	1	3
6) Gate		ton	8	3,600.00	29	2,400.00	19	48
7) Miscellaneous (10% of Total 1) - 6))					10		10	20
Total of II.3					110		115	225
II.4 Intake Weir (1 Site)								
1) Excavation	(No.40)	m3	2,000	1.72	3	1.76	4	7
2) Concrete	(No.30-A-1)	m3	270	74.00	20	81.82	22	42
3) Wet stone masonry	(No.6)	m2	460	13.55	6	23.39	11	17
4) Concrete block	(No.7)	m3	840	60.94	51	94.56	79	131
5) Miscellaneous (10% of Total 1) - 4))					8		12	20
Total of II.4					89		127	216
II.5 Parapet wall (1 Site)								
1) Excavation	(No.40)	m3	680	1.72	1	1.76	1	2
2) Concrete	(No.30-A-1)	m3	310	74.00	23	81.82	25	48
3) Reinforcement bar	(No.71)	ton	25	642.20	16	488.18	12	28
4) Form	(No.73-A)	m2	870	6.01	5	21.16	18	24
5) Miscellaneous (10% of Total 1) - 4))					5		6	10
Total of II.5					50		63	113
II.6 Road Bridge								
1) Embankment	(No.2)	m3	5,100	2.20	11	1.38	7	18
2) Super structure (Steel)		ton	74	3,000.00	222	2,000.00	148	370
3) Sub structure (Concrete)		m3	350	74.00	26	81.82	29	55
4) Steel pile		m	450	162.00	73	108.00	49	122
5) Miscellaneous (10% of Total 1) - 4))					33		23	56
Total of II.6					365		256	621

(to be continued)

(Continuation)

Item	Unit	Quantity	Foreign Currency Unit Cost	Foreign Currency Amount (1,000US$)	Local Currency Unit Cost	Local Currency Amount (1,000US$)	Total (1,000US$)
II.7 Railway Bridge							
1) Embankment (No.2)	m3	5,240	2.20	12	1.38	7	19
2) Ballast (No.11)	m3	550	16.18	9	35.66	20	29
3) Super structure (Steel)	ton	270	3,000.00	810	2,000.00	540	1,350
4) Sub structure (Concrete)	m3	440	74.00	33	81.82	36	69
5) Steel pile	m	620	162.00	100	108.00	67	167
6) Miscellaneous (10% of Total 1) - 5))				96		67	163
Total of II.7				1,060		737	1,797
II.8 Miscellaneous (5% of Total II.1 - II.7)				189		149	337
Total of II				3,959		3,125	7,085
III. Compensation Cost							
III.1 Residence	Nos.	0			400.00	0	0
III.2 Factory	L.S.	1				0	0
III.3 Residential Area	m2	0			2.50	0	0
III.4 Non-Residential Area	m2	257,000			0.70	180	180
Total of III						180	180
IV. Administration Cost (5% of I + II)						372	372
V. Engineering Service (10% of I + II)				595		149	744
VI. Physical Contingency (15% of I + II + III + IV + V)				713		597	1,310
VII. Price Contingency (F/C 3%, L/C 3%)				760		637	1,396
Total				6,225		5,216	11,441

TABLE M.15 FINANCIAL COST FOR PRIORITY PROJECT

Unit : 1,000 US$

Item	Sediment Disaster Prevention Works			Flood Disaster Prevention Works Moji River			(Sediment+Flood) Disaster Prevention Works		
	F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	TOTAL
I Preparatory Work (5-15% of II)	1,039	1,177	2,216	198	156	354	1,237	1,333	2,570
II Construction Cost	6,926	7,846	14,772	3,959	3,125	7,084	10,885	10,971	21,856
III Compensation Cost		62	62		180	180		242	242
IV Administration Cost (5% of I + II)		849	849		372	372		1,221	1,221
V Engineering Service (10% of I + II)	1,359	340	1,699	595	149	744	1,954	489	2,443
VI Physical Contingency (15% of I+II+III+IV+V)	1,399	1,541	2,940	713	597	1,310	2,111	2,138	4,250
VII Price Contigentcy (F/C 3%, L/C 3%)	1,490	1,642	3,133	760	637	1,396	2,250	2,279	4,529
Total	12,213	13,457	25,670	6,224	5,216	11,440	18,437	18,673	37,111

FIGURES

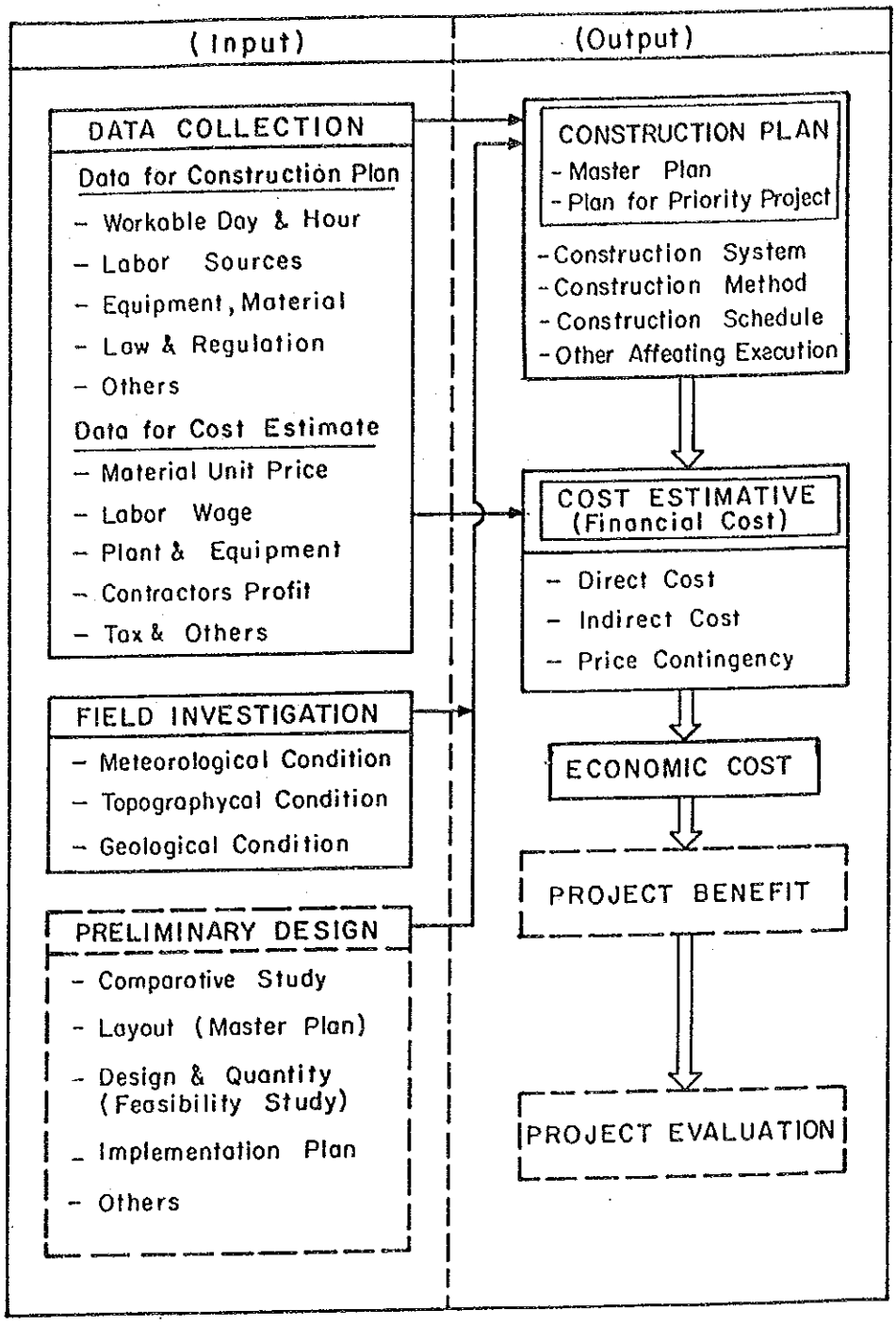


FIG M.1

FLOWCHART OF THE STUDY

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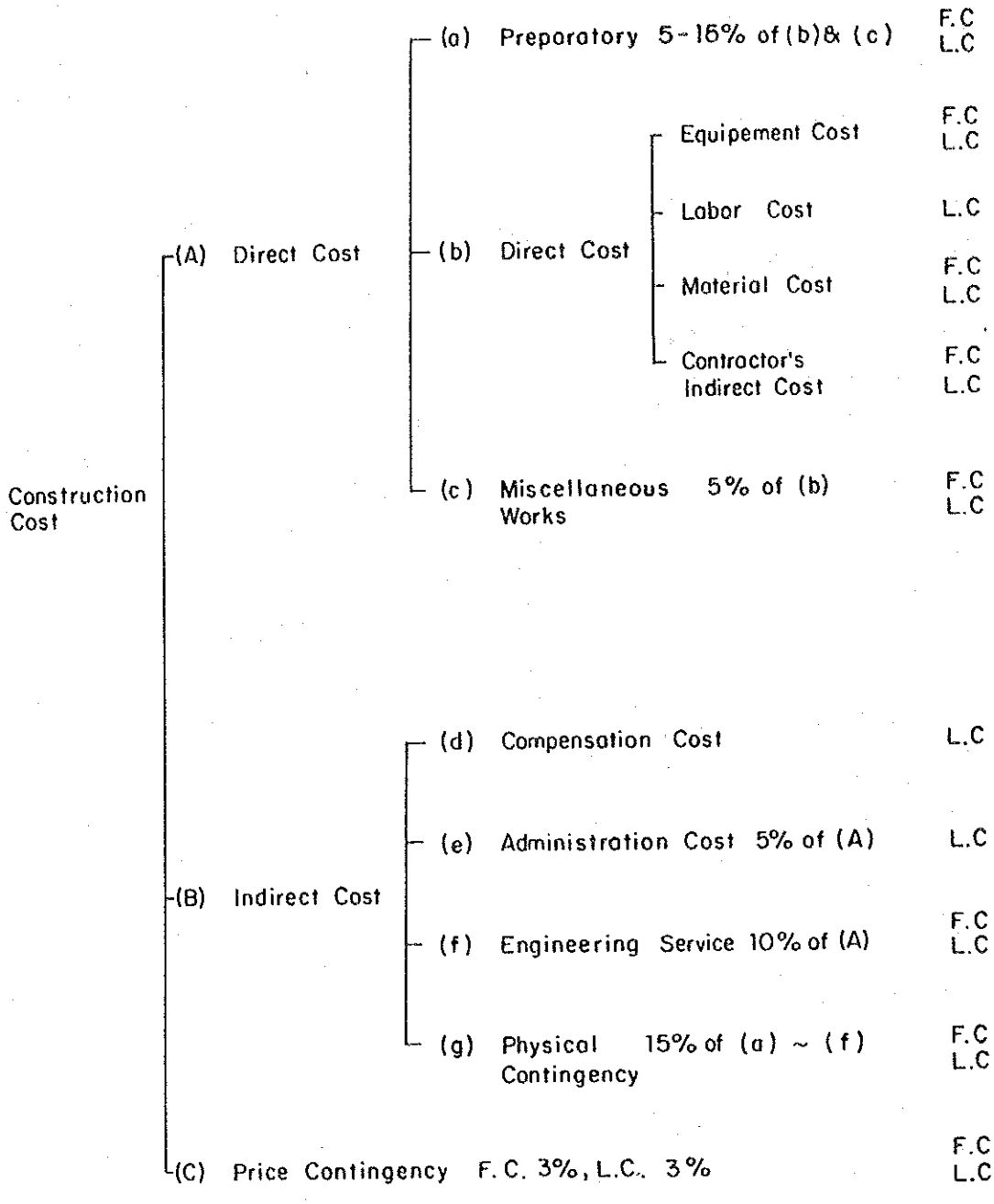

FIG M.2

CONSTITUTION OF CONSTRUCTION COST

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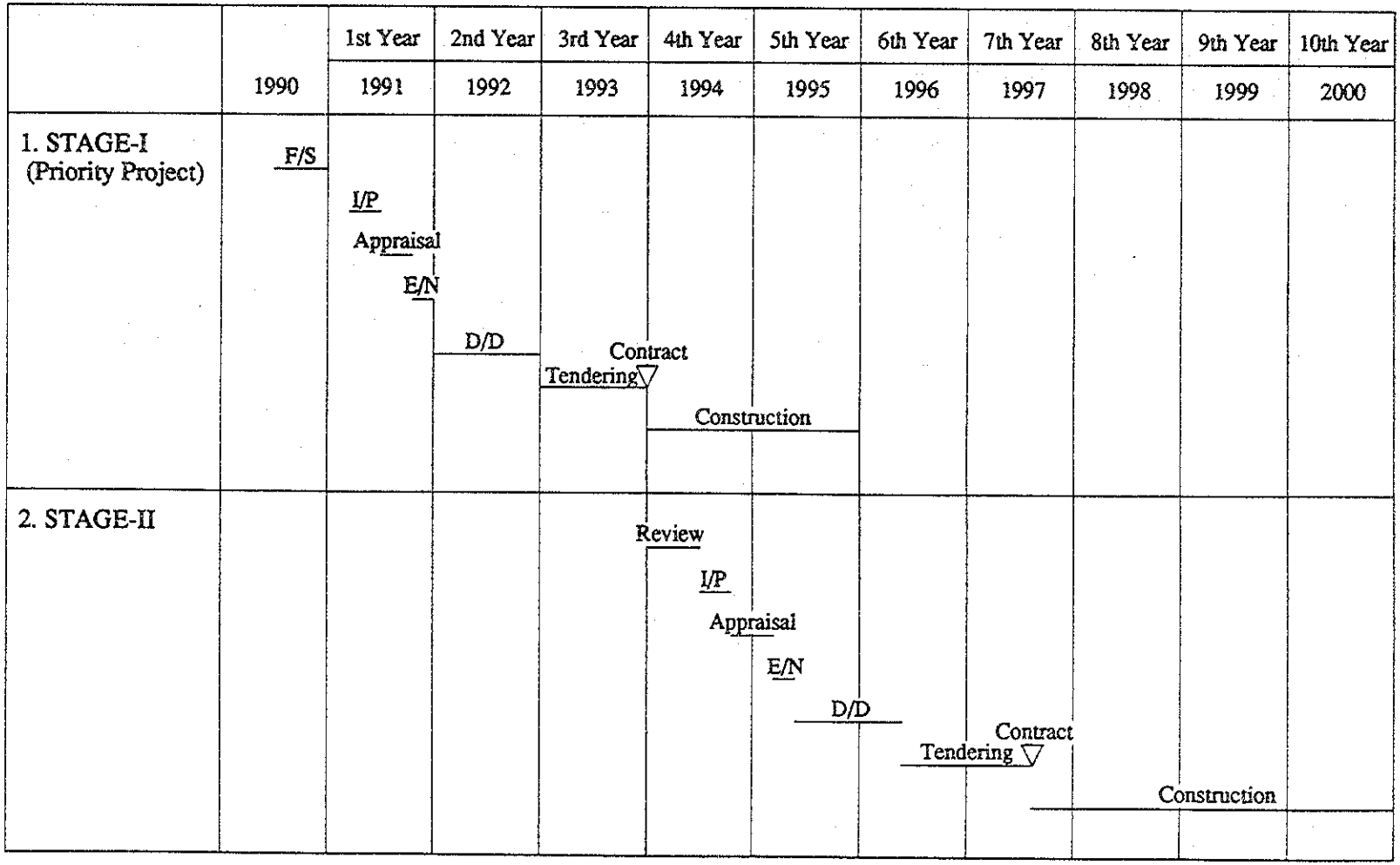
FIG M.3

IMPLEMENTATION SCHEDULE



F/S : Feasibility Study E/N : Exchange of Note

I/P : Implementation Program D/D : Detailed Design

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