No.

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR CONSTRUCTION OF MARINE CULTURE RESEARCH AND DEVELOPMENT CENTER IN NHA TRANG
IN
SOCIALIST REPUBLIC OF VIET NAM

NOVEMBER 2002

JAPAN INTERNATIONAL COOPERATION AGENCY

OVERSEAS AGRO-FISHERIES CONSULTANTS CO., LTD.

NIPPON KOEI CO., LTD

GR4
CR(1)
02-159

PREFACE

In response to a request from the Government of the Socialist Republic of Viet Nam, the Government of Japan decided to conduct a basic design study on the Project for Construction of Marine Culture Research and Development Center in Nha Trang. and entrusted the study to the Japan International Cooperation Agency(JICA).

JICA sent to the Viet Nam a study team from 15th day of May to 19th day of June, 2002.

The team held discussions with the officials concerned of the Government of the Viet Nam, and conducted a field study at the study area. After the team returned to Japan, further studies were made. then, a mission was sent to the Viet Nam in order to discuss a draft basic design, and as this result , the present report was finalized

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Socialist Republic of Viet Nam for their close cooperation extended to the teams

November, 2002

Takao Kawakami
President
Japan International Cooperation Agency

November, 2002

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Construction of Marine Culture Research and Development Center in Nha Trang in the Socialist Republic of Viet Nam.

This study was conducted by Overseas Agro-Fisheries Consultants Co.,Ltd., and Nippon Koei Co.,Ltd under a contract to JICA, during the period from May, 2002 to November, 2002. in conducting the study, we have examined the feasibility and rationale of the project with due to consideration to the present situation of Viet Nam and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

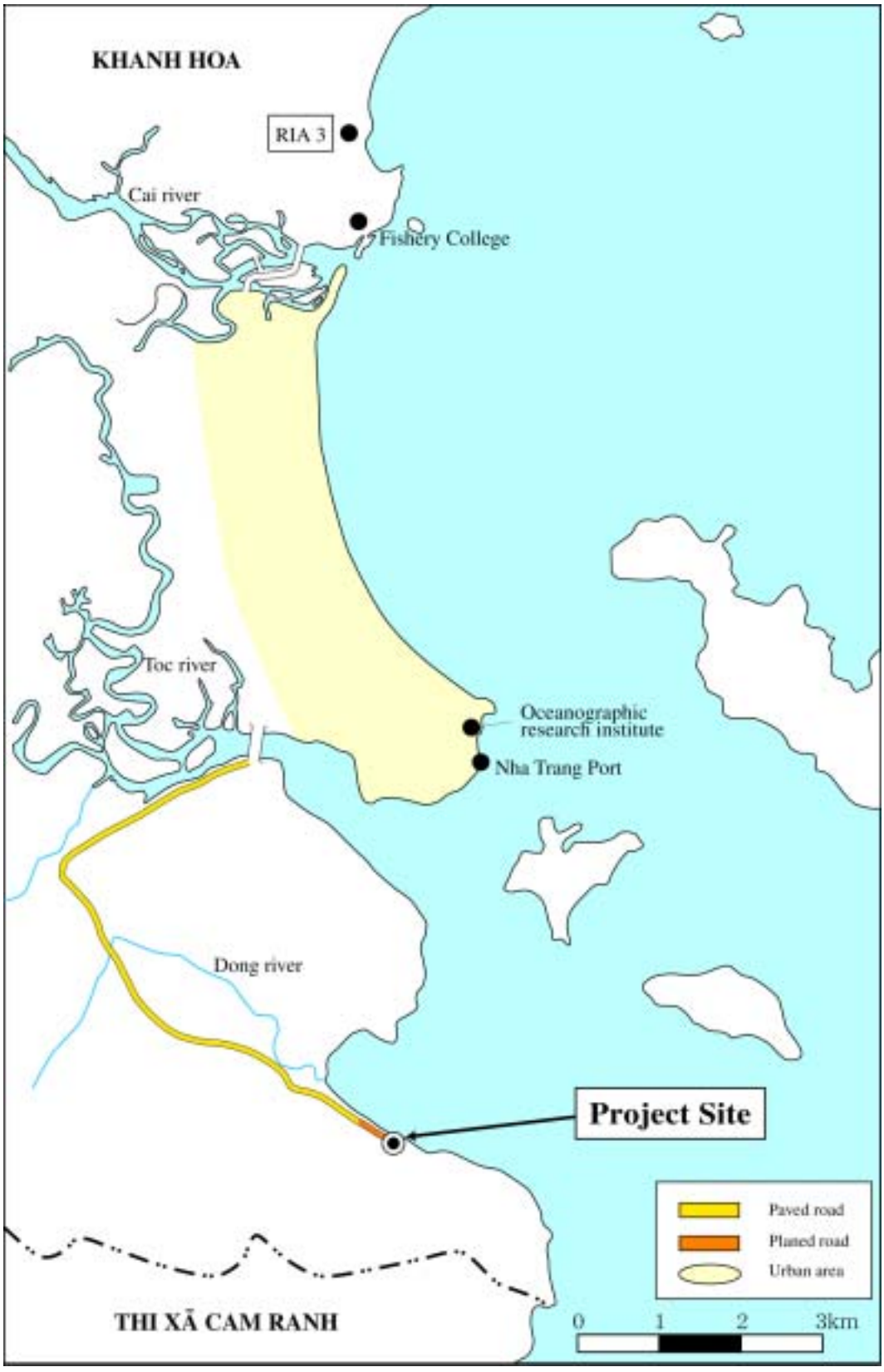
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours.

Toru Fujiki
Project Manager,
Basic design study team on the Project for
Construction of Marine Culture Research and
Development Center in Nha Trang.
Overseas Agro-Fisheries Consultants Co.,Ltd.
Nippon Koei Co.,Ltd

MAP OF THE SOCIALIST REPUBLIC OF VIET NAM

LOCATION MAP



List of Figures & Tables

Figures

Tables

Abbreviations

BOD	Biological Oxygen Demand
DANIDA	Danish International Development Association
DO	Dissolved Oxygen
FAO	Food and Agriculture Organization
FRP	Fiber Reinforced Plastic
ICLARM	International Center for Living Aquatic Resources Management
JIS	Japan Industrial Standard
NACA	Network of Aquaculture Centres in Asia-Pacific
PCR	Polymelase Chain Reaction
PIT Tag	Passive Integrated Transponder Tag
PL	Post Larva
PVC	Polyvinyl Chloride Pipe
RIA3	Research Institute for Aquaculture NO3
SEAFDEC	South East Asia Fisheries Development Center
SGP	Carbon steel Pipes for Ordinary Piping(JIS)
STPG	Carbon steel Pipes for Pressure Piping(JIS)
VND	Viet Nam Dong

Summary

The Socialist Republic of Viet Nam, located on the east coast of the Indo China Peninsula, faces onto the Gulf of Tong King in the northeast of the country, the East China Sea in the east, and the Siam Sea in the southwest. The country is bordered by China in the north, and Laos and Cambodia in the west. Viet Nam is a long thin country shaped like an 'S' and measuring approximately 1,650 km from north to south. It has a coastline of around 3,260 km and its 200 nautical mile exclusive fishing zone covers approximately 1,000,000 km^2. The national land area is approximately 330,000 km^2, which is equivalent to the size of Japan not including Kyushu, and roughly three-quarters of this is covered with mountains and plateaus. The south of the country has a tropical climate, while the north belongs to the subtropical zone. Based on the policy of Doi Moi (renewal) that was adopted from 1986, the country is aiming to introduce the market economy, become more open to the international community and promote economic growth. In line with this policy, efforts are underway to move away from the conventional heavy industry-oriented economy and more towards light and manual industries; furthermore, emphasis is being placed on modernization of agriculture, 'high-tech' industries and high added value import and export industries.

As a result of Doi Moi and a succession of private investment and ODA from foreign countries, Viet Nam achieved major economic growth of between 1991 and 1997 when the average annual rate of growth in the GDP was 8.5% per year; however, following the Asian economic crisis, the GDP growth rate fell to 5.8% in 1998 and 4.8% in 1999. However, the Vietnamese economy seems to have turned the corner with the GDP once more rising to 6.7% in 2000 and expected to reach 7% in 2001. In line with the continuing economic growth, the ratio of people living in poverty fell from 30% in 1990 to 11% in 2000, however, income differentials between urban and rural areas and the disparity between rich and poor have been growing in recent years.

Fisheries in Viet Nam are an important primary industry for supplying animal protein to citizens, creating employment and acquiring foreign currency. Particularly in terms of foreign currency acquisition, fisheries products are the third most important export item behind petroleum and rice. The value of fisheries products exports in 2000 was US $ 1.48 billion, accounting for 17.4% of the total export value. The fisheries working population is approximately 3,350,000 and has almost doubled over the past 10 years. Fish catches have also doubled and reached 1,830,000 tons in 1999. Coastal fisheries largely dominate the fisheries sector, and 90% of all artisanal fishermen are engaged in this. According to FAO estimates, whereas the peak sustainable production volume on coastal marine resources is somewhere between 1,100,000~1,500,000 tons, since actual production was 1,210,000 tons in 1999, the sustained utilization of coastal marine resources is almost at its limit. Since the targeted fishing grounds of coastal fisheries in Viet Nam are spawning grounds and larvae maturation grounds, there is a risk that indiscriminate catching in coastal areas will destroy the natural renewal of

resources. Therefore, it is becoming necessary to utilize and develop fishing grounds and waters outside of coastal areas by carrying out management of coastal fisheries resources and encouraging fishermen to shift to offshore fishing and aquaculture activities. Meanwhile, aquaculture is mainly dominated by brackish water aquaculture centering on freshwater culture and shrimp culture, which accounted for 303,000 tons or 99% of all aquaculture production in 1999.

The higher plan to the Project is the National Programme for Aquaculture Development Period 1999-2010, which was compiled and is being implemented by the Ministry of Fisheries of Viet Nam. In order to achieve the objectives of the Programme, establishment of a nationwide setup for researching nursery production of marine fish and supplying nursery stock is regarded as an urgent requirement. It is planned to construct three national aquaculture research centers in the north, center and south of the country for carrying out test and research activities into large-scale mariculture production processes ranging from selection of target species and research on maturation of broodstock through to transfer of technology. The Center targeted in the Project is the National Mariculture Research Center, which is charged with serving the central part of the country.

Viet Nam has short history of mariculturem, sea shrimp farming from artificial seed production through to high-density cultivation is carried out, however, marine fish cultivation from artificial nurseries is still an uncharted area and its supply of fry is depend of nature. In order to realize development of mariculture, since it is important to have stable supply of nurseries for species other than shrimp, it is necessary to establish technology for the mass production of marine fish nursery stock at once; however, the problem is that the research setup needed for this is not yet fully in place. However, the Research Institute for Aquaculture NO3 has responsibility for covering the central part of the country, existing facilities are currently used to research aquaculture of shellfish, echinoderms, and mollusks. Because this Center is cramped and has no space for expansion, it has no facilities or apparatus for conducting other mariculture research and development. As a result, research activities at the Center are not adequate with respect to needs.

It was in these circumstances that the Government of Viet Nam compiled, and requested Japanese grant aid for the Project for Construction of Nha Trang Mariculture Research and Development Center. The objective of the Project is, through preparing facilities and equipment for mariculture research and technical development in the Song Lo Area of Nha-Trang City in Khanh Hoa Province, to promote mariculture research and technical development.

In response, the Government of Japan decided to implement the basic design study and dispatched the study team to Viet Nam according to the following schedule;
Basic design study : May 15, 2002 to June 19, 2002

Draft Basic design explanatory : September 2, 2002 to September 7, 2002

Through the field study and examination in Japan, the background and contents of the project, natural conditions, operation and maintenance setup, infrastructure in the surrounding area, building conditions, and so forth. As a result, the importance of securing large-scale and stable supply of nursery stock in order to promote mariculture was confirmed together with the need to establish technology for the mass production of artificial stock through mariculture research. As research areas for realizing these goals, it was determined that the following six items are required: ①Research on maturation of broodstock, ②Research on nursery production technology, ③Research on live food, ④Research on rearing technology, ⑤Research on nutrition, and ⑥Research on fish diseases and environment.

It was determined that construction and provision of the following facilities and equipment is appropriate as the scope of cooperation by the Japanese Government: broodstock rearing facility, larvae breeding and spawning facility, administration and research building, machinery building, seawater intake facility, seawater receiving tanks, net reserve, microscopes, spectrophotometer, dispersion electric migration device, water quality measurement device, service vessel, truck fitted with crane, and so forth. Basic design indicating the general outline of the equipment and facilities is given below.

1)Facilities

Facility	Contents and Scale
Broodstock rearing block	180 ton broodstock tanks x 2, 200 ton broodstock tank x 1, Building area : approximately 672 m^2, Total floor area : approximately 672 m^2, reinforced concrete single story structure, steel truss and steel plate roof
Larvae breeding and spawning facility	Larvae breeding tank room, spawning tank room, plankton cultivation room, multipurpose water tank room, Building area : approximately 1,512 m^2, total floor area: approximately 1,512 m^2, reinforced concrete single story structure, steel truss and steel plate roof, brick masonry walls
Outdoor plankton cultivation ponds	Chlorella cultivation tank (50 ton) x 3, rotifer cultivation tank (50 ton) x 2, reinforced concrete structure
Administration and research building	Ground floor : fish disease and environmental laboratory, chemical laboratory, live food research room, library, etc. First floor : director's room, vice director's room, general affairs department room, etc. Building area : approximately 631 m^2, Total floor area : approximately 1,202 m^2, reinforced concrete two-story structure, RC roof with local tiles, reinforced concrete walls
Machinery building	Power receiving room, generator room, pump room, blower room, etc. Elevated seawater tank (35 ton) x 2, elevated freshwater tank (8 ton) x 1 Building area : approximately 242 m^2, Total floor area : approximately 374 m^2, reinforced concrete two-story structure, waterproof coated roof, brick masonry walls
Seawater intake pipes	Underground installation of seawater intake pipes (435 m, 2 pipes) Main intake pipe (pipe diameter 400 mm), emergency subsidiary intake pipe (pipe diameter 250 mm)
Seawater receiving tanks	Seawater receiving tank (400 ton) x 2 Building area : approximately 320 m^2, reinforced concrete structure, steel truss and steel plate roof,
Pump room	Incoming water well, pump room, Building area : 64 m^2, Floor area : 64 m^2, reinforced concrete single story structure, waterproof coated roof, brick masonry walls
Wastewater treatment facility	Approximately 20 m x 5 m, approximately 2 m deep, brick masonry structure, interior waterproof coating
Wastewater monitoring pond	Approximately 2 m x 2 m, approximately 1 m deep, brick masonry structure, interior waterproof coating
Facility	Rapid filter : multi-layer pressure filtration unit x 6 (0.38 m^3/minute x 2, 0.40 m^3/minute x 2, 0.91 m^3/minute x 2) Power supply equipment : emergency generator x 1 (160 kVA) Drainage equipment : wastewater treatment facility (200 m^3) Sea water supply and drainage facility: elevated tanks (35 m^3 x 2), UV seawater sterilization device (0.75 m^3/minute), and internal plumbing facility
Landscaping	Premises paving: concrete paving 1,600 m^2, asphalt paving 160 m^2, Septic tanks, Infiltration drain: site-assembly type, Storm water drainage conduits : open channel L = 136 m, BOX L = 60 m

2)Equipment

Purpose of Use	Equipment	Quantity	Specifications
Broodstock rearing research	Equipment for fish cage net	3 sets	Size: 6 m x 6 m x 5 m, Net materialtetron knotless, mesh, 8 knots, 14 knots
	Fish tagging system	1 set	Fish tagging system, with reader, detection distance:10 cm, transmitting tag:φ2.1 x 11 mm (1000 pieces)
	Liquid nitrogen jar	1	Liquid nitrogen capacity:30 L, Dimensions:667 x 441 mm, Diameter :φ63.5 mm, 6 casters, with caster base
Larvae rearing research	Stereomicroscope	2	Overall magnification::40・45 times
	Universal projector	1 set	Screen diameter:φ250 mm, Projection lens:10 times, 20 times, 50 times, Measurement scope :50 x 50 (mm)
Live food research	Illuminated incubator for microscopic algae	1 set	Dimensions:W 500 x D 500 x H 1,100 (mm), Capacity :approximately 250 L, Luminance:20,000 lux, digital temperature control
	Spectrophoto-meter (ultraviolet)	1 set	Wavelength range:190・1100 (nm), Bandwidth:3 nm, software, PC
Nutrition research	Spectrophoto-meter (fluorescent)	1 set	Wavelength scan range:220・900 (nm), measurement wavelength range:220・750 (nm), software, PC
	Autoclave	1	Effective dimensions:φ300 x 650 D (nm), Temperature:120 ℃, microcomputer control, with drying functions
	Ultrasonic cleaner	1	Washing tank capacity:8 L
	Distilled water and pure water plant	1 set	Distilled water manufacturing capacity :approximately 1.5 L/hour, Storage capacity:20 L, cartridge filter
Fish disease and environment research	Clean bench	2 sets	Electronic flow control, outer dimensions :W 1,200 x D 700 (mm), with ultraviolet lamp
	Thermal cycler	1 set	Block:for 96 wells x 0.2 ml tube or 96 wells, temperature range: 4--99.9 (℃)
	Dispersed electric migration device	1 set	Horizontal electric migration system, gel size :15 x 7 and 15 x 10, PFC agarose 3 sets, gel dye 2 sets
	Fluorescent microscope (with photograph projector)	1 set	Overall magnification:40・400 times, Eye lens :10 times, Object lens:4 times, 10 times, 20 times, 100 times, camera and projector
	Frozen microthome	1 set	Graduation range: 0.5-12 (μm), Dimensions:W 300 x D 420 x H 310 (mm), electro-freeze
	Water quality monitoring device	1 set	Water temperature, PH, salt content, dissolved oxygen, ammonia, nitrate ion, depth 20 m or more
	BODmeasuremen t device	1 set	5-day method, 6 bottle type
	Sludge sampler	1 set	Smith-McIntyre sludge sampler, sampling area 22 x 22 (cm)
	Water sampler	1 set	Bandoon water sampler, capacity 3 L
Work equipment	Work vessel	1	Length 7 m, outboard motor 40Hp
	Truck with crane	1	Maximum load: 2.5 tons, crane lifting capacity:maximum 2 tons, vehicle dimensions (mm): 6,000 (L) x 2,000 (W) x 2,000 (H), diesel drive, left-hand steering wheel

To implement the Project under the Grant Aid Scheme of the Government of Japan, detail design will require 4 months, and the overall implementation schedule will be 16 months breaking down as 4 month for detail design, 11.5 months for construction works, and 5 months for equipment and materials procurement. The rough project cost is estimated as 891 million yen (873 million yen furnished by the Japan side and 18 million yen by the Viet Nam side).

Operation and maintenance costs arising from the Project are estimated as 682.9 million Vietnamese Dong per year. The total budget for the Research Institute for Aquaculture NO3 in 2000 and 2001 was 4,810 million Dong and 5,217 million Dong respectively, and it is expected that the same amount will be allocated to the Center. Since the above operation and maintenance costs account for around 13~14% of this budget, there is thought to be no problem concerning operation and maintenance of the Project facilities and equipment.

In view of the expected effects of the Project as indicated below, the Project is deemed to be appropriate and meaningful as an undertaking for implementation under the Grant Aid Scheme of the Government of Japan.

Implementing the Project will lead to the construction and establishment of research and experimental facilities required for researching and testing large-scale nursery stock production for marine fish. This will make it possible to realize the following research and testing on: ①Maturation of broodstock, ②Nursery production technology, ③Live food, ④Rearing technology, ⑤Nutrition, and ⑥Fish diseases and environment. Through promoting development of mariculture research and technical development, the Project will lead to the establishment of large-scale nursery production technology for groupers, milkfish and other marine fish species.

Furthermore, the following indirect effects can also be anticipated from Project implementation.

①Securing of grouper nursery stock
In all Khanh Hoa Province, approximately 200,000 grouper nursery stock are fished from the natural habitat every year. By producing and supplying artificial nursery stock through disseminating and utilizing the mass production technology established in the Project, it will be possible to secure the necessary stock while at the same time relieving this pressure on the natural stock.

②Sustainable shrimp cultivation
In order to prevent reduction of production capacity in shrimp ponds as a result of mixed cultivation and continuous cultivation of milkfish with shrimp, milkfish nursery stock will be utilized for extensive cultivation during idle times in shrimp ponds. Since extensive cultivation will contribute to improving sediment soil and the cultivation environment in shrimp ponds, it is anticipated that this will aid the sustained development of shrimp cultivation.

③Supply of cheap protein
By establishing mass production technology for milkfish nursery stock, extensive cultivation of milkfish will take place during idle periods in shrimp ponds, and this will make it possible to provide a cheap supply of protein to citizens.

The following recommendations are made to ensure the smooth and effective implementation of the Project.

①Conservation of the water environment
Nha Trang is a well-know marine resort, however, it is desirable that infrastructure such as sewage and wastewater treatment facilities, etc. be prepared to ensure that water quality around the water inlet of the facilities does not deteriorate due to larger flows of domestic wastewater from local tourism development.

②Stable budget allocation
Since the Center is a research and development facility, it is basically not intended to make a profit. Accordingly, in order for the Center to be properly run and maintained, the Government of Viet Nam will need to take solid budget steps.

③Maintenance and inspection of machine equipment
Development of the maintenance setup, including training and recruitment of pump and electrical maintenance staff, etc., is an important element in ensuring the smooth operation of facilities. Particularly concerning seawater intake, since this is key to facility activities, it is necessary to secure facility functions by compiling and executing an appropriate maintenance plan.

④Researchers
Exchange of human resources between the Center and the Research Institutes for Aquaculture NO1 and NO2, Institute of Oceanography, Fisheries Universities and fisheries laboratories should be actively encouraged because this will boost the effectiveness of research activities. Moreover, it is anticipated that absorbing the results of aquaculture research and technology through exchange with the Southeast Asia Fisheries Development Center and other international agencies will lead to greater efficiency in research.

Contents

CHAPTER 1

BACKGROUND OF THE PROJECT

Chapter 1 Background of the Project

Fisheries in Viet Nam is an important primary industry for supplying animal protein to the nation, creating employment and acquiring foreign currency. Particularly in terms of foreign currency acquisition, fisheries products are the third most important export item behind petroleum and rice. The value of fisheries products exports in 2000 was US $ 1.48 billion, accounting for 17.4% of the total export value. The fisheries working population is approximately 3,350,000 and has almost doubled over the past 10 years. Fish catches have also doubled and reached 1,830,000 tons in 1999. Coastal fisheries largely dominate the fisheries sector, and 90% of all artisanal fishermen are engaged in this. According to FAO estimates, whereas the peak sustainable production volume on coastal marine resources is somewhere between 1,100,000~1,500,000 tons, since actual production was 1,210,000 tons in 1999, the sustained utilization of coastal marine resources is almost at its limit. Meanwhile, aquaculture is mainly dominated by brackish water aquaculture centering on freshwater culture and shrimp culture, which accounted for 303,000 tons or 99% of all aquaculture production in 1999. From this it can be inferred that mariculture is still a largely undeveloped area.

The superior plan to the Project is the National Programme for Aquaculture Development Period 1999-2010, which was compiled and is being implemented by the Ministry of Fisheries of Viet Nam. This Programme calls for the development of sustained aquaculture activities and the effective utilization of so-far unused water bodies. Mariculture has a short history even for the limited aquaculture experience of Viet Nam. Cultivation of shrimp and grouper has been carried out for some time now, however, aquaculture for cultivating nursery stock to commodity sizes has only just begun in earnest in recent years. In order to achieve the objectives of the Programme, establishment of a nationwide setup for researching nursery production of marine fish and supplying nursery stock is regarded as an urgent requirement. In an effort to promote mariculture, the Ministry of Fisheries of Viet Nam plans to construct three national aquaculture research centers in the north, center and south of the country for carrying out test and research activities into large-scale mariculture production processes ranging from selection of target species and research on maturation of broodstock through to transfer of technology.

Since the targeted fishing grounds of coastal fisheries in Viet Nam are spawning grounds and larvae maturation grounds, there is a risk that indiscriminate catching in coastal areas will destroy the natural renewal of resources. Therefore, it is becoming necessary to utilize and develop fishing grounds and waters outside of coastal areas by carrying out management of coastal fisheries resources and encouraging fishermen to shift to offshore fishing and aquaculture activities. In the area of mariculture, shrimp farming from nursery production through to high-density cultivation is carried out, however, fish cultivation from artificial nurseries is still an uncharted area. In order to realize development of mariculture, since it is important to have stable supply of nurseries for species other than shrimp, it is necessary to establish technology for the mass production of marine fish nursery stock at once; however, the problem is that the research setup needed for this is not yet fully in place. In the northern and southern parts

of Viet Nam, the mariculture research setup is currently in place with the reorganization of existing national aquaculture research facilities. However, at the Research Institute for Aqualculture NO3 responsible for covering the central part of the country, existing facilities are cramped and there are no facilities or apparatus for conducting mariculture research and development. As a result, the facility is unable to carry out sufficient mariculture research.

The Government of Viet Nam compiled the Project for Construction of Nha Trang Mariculture Research and Development Center. This Project aims to construct facilities and equipment for mariculture research and technical development in the Song Lo Area of Nha Trang City in Khanh Hoa Province, in order to promote mariculture research and technical development. The request made by the Government of Viet Nam to the Government of Japan concerns the provision of grant aid for the construction of facilities and supply of materials in the Project, and the contents of the request are outlined in Table 1-1.

Table 1-1 Outline of the Request

1. Facilities		
(1) Buildings		
Administration and research building	:	two-story
	Ground floor :	office, manager's room, conference room, library, toilets, etc.
	First floor :	chemical laboratory, biology laboratory, dark room, specimen room, etc.
Spawning block	:	60-ton tank x 4, 10-ton tank x 8
Larvae breeding block	:	600 m^2, 5-ton x 40
Live food biological cultivation block	:	750 m^2, preparation room (temperature and illumination control), artemia cultivation FRP tanks (1-ton x 10), saltwater rotifer cultivation tanks (50-ton x 4), zooplankton cultivation tanks (10-ton x 10), chlorella cultivation tanks (50-ton x 4)
Live food block	:	food mixture production and test plant 100 m^2
Machinery room	:	50 m^2
Generator room	:	30 m^2
Pump room	:	30 m^2
Accommodation facilities		
(2) Outdoor rearing ponds		
Broodstock rearing ponds	:	400 m^2 x 4 (stone masonry)
Intermediate rearing ponds	:	50 m^2 x 20 (stone masonry)
2. Equipment		
(1) Seawater supply system		
Main pumps	:	15 kw x 3
Filtration system	:	50 t/hr
Seawater supply tower	:	50 ton, H 10 m
Water storage tank	:	1,200 ton
Water supply channel	:	L 200 m x D 1 m
(2) Freshwater supply system	:	gravity flow
(3) Aeration system Blowers	:	7.5 kw x 2
(4) Emergency generator Capacity	:	50 KVA , 15 KVA
(5) Wastewater treatment system		
3. Equipment		
(1) Experimental and research equipment		
Live feed production, broodstock rearing, mariculture environment, molecular biology and standard equipment for mariculture experiments and research		
(2) Incubation equipment		
Portable submersible pumps, plankton nets, young fish sampling nets, pan lights, etc.		
(3) Net preserves:	:10 m x 10 m x 3 m, 10 sets	
(4) Refrigerator truck	:	1 truck
(5) Workboat		
L 7 m, outboard motor 40 hp		
(6) Office equipment		
Data analysis equipment, copier		
(7) Educational equipment		
OHP, projector, video deck, etc.		
(8) Workshop equipment		

CHAPTER 2

CONTENTS OF THE PROJECT

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

(1) Higher Objective and Project Goals

The superior plan to the Project is the National Programme for Aquaculture Development Period 1999-2010, which was compiled and is being implemented by the Ministry of Fisheries of Vietnam. This Programme calls for the development of sustained aquaculture activities and the effective utilization of so-far unused water bodies. Mariculture has a short history even for the limited mariculture experience of Vietnam; indeed, mariculture from seedlings to commodity sizes has only just begun in earnest in recent years. The Ministry of Fisheries has raised the following as short-term goals for the Project Center:

①Application of the results of basic research on marine fish (biological and ecological research findings) to mariculture research,
②Development of technology for the maturation, spawning, incubation, larvae rearing and nursery production of marine fish via practical testing,
③Development of appropriate mariculture technology that can be disseminated to artisanal fishermen, etc., and
④Bolstering of mariculture training, education and dissemination activities.

Moreover, the Ministry has raised the following as medium to long-term goals of the Center:

①Establishment of a stable system for supply of marine fish seedlings,
②Appropriate management of coastal fisheries resources through shifting of artisanal fishermen to mariculture and creation of subsidiary income sources,
③Supply of protein to citizens through increased mariculture production,
④Acquisition of foreign currency through consumption of marine fish by the local tourist industry and export of fish to overseas destinations.

The objective of the Project is, through preparing facilities and equipment for mariculture research and technical development in the Song Lo Area of Nha Trang City in Khanh Hoa Province, to carry out mariculture testing and research based mainly on research and technical development aimed at establishing large-scale mariculture production technology.

(2) The Requested Project

1) Purpose of the Requested Project

The objective of the Project is, through construct facilities and equipment for mariculture research and technical development in the Song Lo Area of Nha Trang City in Khanh Hoa Province, to establish technology for carrying out the stable production of marine fish seedlings and to promote research and development for this goal.

In order to achieve the above objective of the requested project, it is necessary to carry out research and development in the following areas:

①Research concerning maturation of broodstock

In order to obtain healthy seedlings, it is first necessary to secure good quality eggs and sperm. This research item intends to accurately gauge the degree of maturation of broodstock and to carry out technical and test research on natural spawning and artificial spawning using hormones, etc.

②Research concerning nursery production technology

This research is intended to efficiently incubate spawned fertile eggs and to carry out technical and test research concerning initial rearing to ensure that high survival rates are secured.

③Research on live food

In order to rear larvae and young fish, it is important to secure production and stable supply of zooplankton and photo plankton for feed. Therefore, it is necessary to carry out testing and research on methods for preserving and safely and efficiently cultivating seedlings for production.

④Research on rearing technology

Research shall be carried out from various viewpoints concerning improvement of survival rates in interim rearing.

⑤Research on nutrition

Test research and development shall mainly be carried out on artificial food during transition from natural to artificial feeding.

⑥Research on fish disease and environment

In addition to inspection of brood stock and larvae disease histories and research on prevention of diseases, testing and research shall be carried out on indicators of water quality environment, which is an important factor in fish rearing. Also, testing and research shall be carried out in order to achieve sustained mariculture.

2) Research Plan for Mariculture

The concept of research for mariculture is shown Fig.2-1. This chart shows that procedure of mariculture research and it is planed to establish the mass seed production technology takes 5 to 6 years. The research for immunology, selection, vaccine are planed to be started 5 to 8 years ahead.

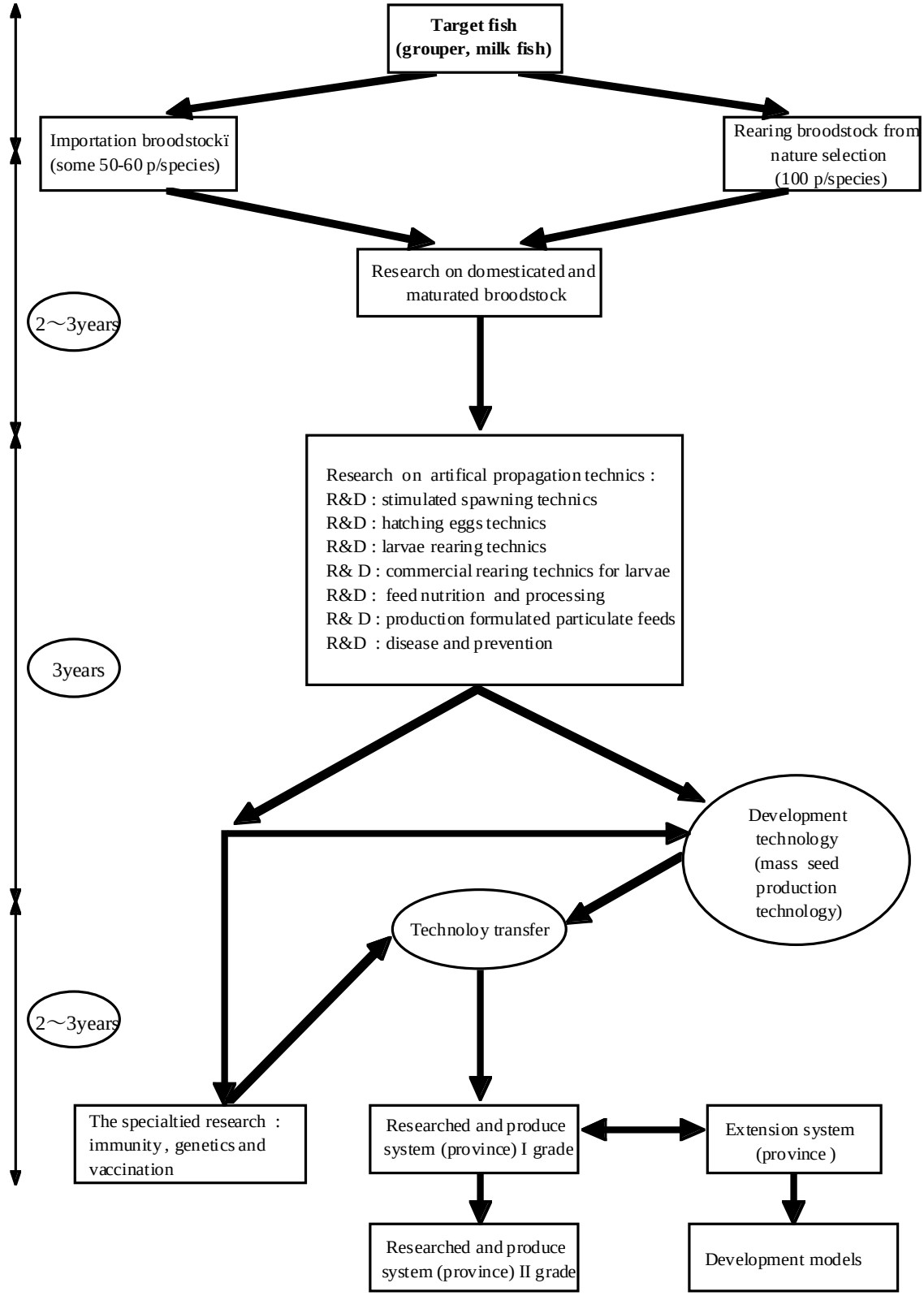


Fig.2-1 Research And Development Plan For Mariculture

3) Scope of the Requested Project

The Vietnam side plans the organization of the Project facilities in the manner shown in Table 2-1. This shows that the Center will consist of three research and technical development departments, namely the Department of Culture Technology, the Department of Biological Technology, and the Department of Environmental & Fish Disease.

The scope of the requested project in the Project shall be examined with consideration given to phased development upon taking into account the local technical level, order of priority of research and schedule for research. Concerning technology transfer plans for applying the developed technology to the provincial and prefectural level, and research plans concerning genetic breeding and vaccine production, etc. as performed by the Genetics & Selection Section and Immunology Section of the Department of Biological Technology, the Center will carry out research not only on nursery production but all important areas for the medium and long-term development of mariculture in Vietnam. Accordingly, although this is considered to be an important area of research for the medium to long-term development of mariculture in Vietnam, it is thought appropriate to only supply equipment after the basic technology for nursery production has first been established and to omit this research from the scope of the initial Project works. Therefore, the scope of cooperation shall be limited to supporting areas worthy of priority handling in the short term, i.e. those research and development areas that are directly linked to establishing technology for carrying out stable mass production of seedlings. In specific terms, this refers to research and development activities that will be conducted by the four sections of the Department of Culture Technology (Brood stock Handling Section, Live Food Section, Breeding, Incubation & Larvae Rearing Section, and On-growing Section), the Feeds Nutrition & Processing Section of the Department of Biological Technology, and the two sections of the Department of Environmental & Fish Disease (Environmental Section, Fish Disease Section).

Table 2-1 Organization Chart of the Center

Department		Number of Staff	Number of Workers	Main Jobs
Administration				
	Director	1		Overall management of the Center
	Vice Director	1		
Administration	Chief	1		Administration on general
& Management	International affairs section	1		International communication
	Information & library section	2		Librarian, information management
	Administration & service section			
	+ Document	1		Documentation
	+ Engineer		1	Maintenance of machine equipment
	+ Driver	2		Operate the vehicle
	+ Security	2		Patrol in the Center
Planing	Chief	1		Administration on planing, finance
& Finance	Staff	3		Account and Financial affairs
Research Departments				
Culture	Chief	1		Management of this section
Technology	Broodstock handling section	4	4	Brood stock rearing
	Live feed section	2	1	Live feed research and experiment
	Breeding,larvae rearing section	5	3	Larvae rearing experiment
	On growing sction	5	2	Culture technology
Biological	Chief	1		Management of this section
Technology	Nutrition section	3	2	
	Genetics & Selection	2		
	Immuniology Section	2		
Environmental	Chief	1		Management of this section
&Fish Disease	Fish disease section	2		Pathological research
	Environmental section	2		Environmental research

4) Contents of the Requested project

The Project intends to construct a new center for carrying out various basic and applied testing, research and development concerning mariculture and marine fish. The specific contents of the construction work are as follows: brood stock rearing facility, larvae breeding facility, live food nurturing facility, seawater intake facility, seawater and freshwater supply facility, seawater filtration system, research administration block including biological and chemical laboratories, etc., machinery building, and wastewater treatment system. The necessary facility and equipment are shown in Table 2-2. The contents of the requested project are as indicated Table 2-3.

Table 2-2 The necessary facility and equipment(1/3)

①Broodstock Handling Section		
Facility	Brood stock tank Research room	Common Sea water intake facility, receiving tank UV sterilizer Machine room Generator room Pump room Sea water supply system Airation system Stand by generator Outlet water Treatment system Night duty room
Equipment	Nets for cage culture PIT Scale Deep freezer（-80℃） Liquid Nitrogen Thermos	Common Truck with crane
②Breeding, Incubation & Larvae Rearing Section		
Facility	Breeding Area Facility for hatching out Photo plankton mass culture tank Zoo plankton mass culture tank Artemia hatching out tank Tanks for breeding Research room	Common Sea water intake facility, receiving tank UV sterilizer Machine room Generator room Pump room Sea water supply system Airation system Stand by generator Outlet water Treatment system
Equipment	Study material for hatching out material（Handy submerged pump、plankton nets, etc）	

Table 2-2　The necessary facility and equipment(2/3)

③Live Food Section		
Facility	Live Food area 　Live Food Room 　　Photo plankton culture 　　Zoo plankton culture 　Work room in the breeding building Study room Biological experiment room	Common Sea water intake facility, receiving tank Machine room Generator room Pump room Sea water supply system Airation system Stand by generator
Equipment	Microscope Microscope（Stereoscopic） Multi projector CO2 diffuser Micro algae incubator Precise balance Shaker Refrigerator	
④On-growing Section		
Facility	Broodstock tank Breeding tank Research room	Common Machine room Generator room Pump room Sea water supply system Airation system Stand by generator
Equipment	Nets for cage culture PIT	Truck with crane Work boat Scale

Table 2-2　The necessary facility and equipment(3/3)

⑤Feeds Nutrition & Processing Section		
Facility	Chemical Experiment room Research room	Common Machine room Generator room Pump room Water supply system Airation system Stand by generator Outlet water Treatment system
Equipment	Homogeniser/Detachable, Spectrophotometer（UV/VIS）	
⑥Fish Disease Section,　Environmental Section		
Facility	Chemical experiment room Research room	Common Machine room Generator room Pump room Water supply system Stand by generator Outlet water Treatment system
Equipment	Cooling Chamber Clean Bench Analytical Balance Portable Dry Ice Making Machine Changeable Digital Pipette Thermal Cycler（DNA PCR） Electrophoresis System Ultrasonic Washer Fluorescent Microscope with Photography System Chemical Oxygen Demand (COD) Meter Water Sampler Bottom Sampler	

Table 2-3 Outline of the Requested Project

Facilities Area	Functions	Contents
Civil engineering facilities	Water intake	Laying of intake pipes（435m 2lines） Main pipe (diameter 400mm） Sub pipe for emergency（diameter 250mm）
	Land reclamation and slope protection	Slope protection works（A1,200m2） Soil works（A12,000m3）
	Storm water drainage facilities	Open channels（L=135m）、utility chnnel L=60m、water drainage
	Road paving and incidental works	Paving works（A=3,100m2）
Construction facilities	Seawater supply	Storage pumps（2sets）
		Receiving tank（800m3）
		Filtration equipment（6set）
		Seawater disinfection unit （UV）
		Elevated tank（35m3：2tanks）
	Freshwater supply	Elevated tank（8m3）
	Wastewater treatment	Wastewater treatment pond（200m3）
	Broodstock rearing	Broodstock block (672m2） Broodstock tank（180m3：2tanks、200 m3：1tank）
	Breeding and incubation	Breeding and incubation block（1512m2） Incubation tanks（500L:11sets） Breefing tanks（15m3：6tanks、7m3：12tanks、5m3：5tanks） Photo plankton cultivation room（49m2） Zooplankton cultivation room（61m2）
	Common tank	Multi-purpose water tank 100m3：1tank、25m3：2tanks
	Live food cultivation	Plankton mass cultivation Chlorella cultivation tank（50m3：3tanks） Rotifer cultivation tank（50m3：2tanks）
	Research	Main building 1F：684m2、2F：574m2
	Machine block	Emergency generator room（24m2） Receiving and transformer room（84m2） Pump room（70m2） Blower room（40m2）
Equipment	Research	Broodstock rearing research equipment（PIT、liquid nitrogen pot）
		Larvae cultivation research equipment（under water pomp）
		Live food research equipment（light incubator）
		Diet research equipment（homozinyser、spectrophotometer）
		Fish disease and environmental research equipment（PCR、water quality monitor equipment etc.）
		Dissemination and education equipment（OHP etc.）
		Work equipment, work vessel, crane-fitted truck

2-2 Basic Design of the Requested Project

2-2-1 Design Policy

(1) Basic Policy

The requested facilities and equipment shall be examined to ensure that they are in accordance with the mariculture research and development plans of the Viet Nam side and conform with the framework of Japan's Grant Aid Scheme. The Center is designed by the concept to begine the study for Grouper and Milk fish, but off course this facility and equipment are contribute for the study on the coastal bottom fish and migration specices. The facility design and equipment sellection are concerned to be easy maintenance and high reliability, especially on the sea water intake function.

(2) Policy Regarding Socioeconomy

There are plans to construct resort hotels and amusement park facilities close to the Project site, and these construction works are currently in progress. Nha Trang is one of the top coastal resorts in Viet Nam and is visited by many local and foreign tourists. Since there is a strong possibility that large numbers of people will pass by the Project facilities following completion of the road in front of the site, care shall be taken to select materials that do not harm the landscape and add to the appearance of facilities.

(3) Policy Regarding Natural Conditions

1) On-shore facilities and buildings will be so designed as to be effectively protected from direct exposure to sun and well-ventilated taking the climatic condition of the site that is hot and highly humid into consideration. As the site is located close to seashore being affected by sea breeze, effective measures against corrosion will also be considered such as increased cover thickness of concrete structures or selection of anti-corrosion materials and so on.

2) Waste waters from the planned facilities will be well-treated providing an appropriate treatment facility in order to satisfy the environmental standards on waste water discharge in force in Viet Nam.

3) The layout plan of each facility will be determined considering the most effective flow/ movement of the activities on research/experiments.

4) The land formation which is to be formed at two-levels according to the site slope.

5) The design of off-shore facilities such as seawater pipes will be made taking into consideration the affects of oceanographic conditions such as waves or littoral drift. Any adverse effects to the environment such as breaking corals will be avoided.

6) The location of seawater in-take will be determined so as to obtain high-quality

seawater through a total evaluation on the influence of fresh water, temperature of seawater, salt contents, characteristics of sediment, etc.

(4) Policy Regarding Civil Engineering Design

1) Land leveling, Retaining wall and Slope protection
①Land leveling works
In order to implement and complete smoothly and effectively the planned project components, the land leveling work is to be divided into two stages. The first stage leveling, which is to be carried out by Viet Nam side prior to the project implementation, will be so designed as to ease the earthworks required in the project provided that such work be completed within the allocated time schedule for Viet Nam side.

In consideration with the above basic policy for the land leveling work, the following conditions will be applied;
-Along the hill side boundary of the site, 1.5m to 3.0m wide back roads be provided in order to ease the access to the boundary area and the construction of perimeter fence to be provided by Viet Nam side.
-The slope of the hill side boundary be so designed as to be stable without any provision of retaining walls or slope protection.
-The elevations and slopes of the project site be so designed that will fit to the planned land formation and will have a smooth surface flow of rain water. It is also planned that a filling work of the lower land
area be minimized in order to avoid any double-handling of earthworks which may be caused from found excavation for the facility foundations.

The subsequent land leveling work therefore be completed in line with the planned facilities constructions.

②Retaining walls
Retaining wall will be provided where, as a rule, a gap of the elevations between adjacent areas exceeds 0.5 m to protect the leveled areas. The structural type of the retaining walls be selected considering the advantages/disadvantages of respective types in various aspects based on the utilization purpose, degree of gaps, area availability and so on. It is intended to pay an special attention to an effective use of rock material which is produced abundantly near the site.

③Slope protection
A slope protection will be provided along the hill side boundary areas for the protection of the cut slopes to be made for the effective use of the limited land area. As a several methods for the slope protection are adopted, a comparable study will be carried out for the selection of the best method among the applicable alternatives in the project.

2)Storm Water Drainage System
①Measures against Storm Water In-flow from the Hinterland
The project site is located at a foot of the mountainous area being feared from a

considerable storm water in-flow may be caused by strong rains in and around the area. Judging from the site topography, the rain water should be flowing in mostly through a sort of valley found almost the center of the site.

To cope with this issue, an appropriate drainage system will be provided along the foot of the eastern side slopes. The drainage for this purpose will be an open channel type so as to work as a buffer when a stone falling occurs in future.

The design of the drainage will be made in accordance basically with the technical standards used in Viet Nam and/or a code of practice applied in Japan will also be used when deemed necessary. The return period for rainfall intensity to be considered in the design will be 50 years.

②Drainage system within the project site
The drainage system in the project site is to be designed taking the final configurations of the site, land use plan and the requirements of the technical standards in force in Viet Nam into consideration. The drainage will basically composed of L-type or U-type ditches depending on the estimated run-off quantity and discharge capacity of ditches. An appropriate culvert system will also be considered where run-off of rain water exceeds the capacity of ditches or deemed necessary for the effective drainage system. 10 return-year will be considered for the estimation of run-off water.

The inside drainage system will finally be connected to the main drainage system (open channel) and discharged to the sea area through a box culvert across the outside road area.

3)Road and Paving

Based on the importance, frequency of usage of the inside road, width, gradations and structural type of road and paving will be properly determined. The gradations of the road will be, as a rule, not more than 8% longitudinally and between 1.5% and 2.0% sectionally.

Since the area is subjected to seawater from the activities of the facilities, a concrete paving could be a most advantageous option which is deemed durable against seawater and hot weather. Where deemed less importance or low usage, simple paving methods will be applied such as a macadam paving and so on.

Notwithstanding the above, the access road connecting to the front public road (it is expected that the road in front of the project site will be completed before the project implementation) will be designed to be same asphalt paving with the public road.

(5) Policy for condition of construction

Regarding the design of architectural work, Architect regulations 1996, are effective in Viet Nam. According to these regulations, the structural design is basically respected. On the structure calculation for earth quick, a half index of the Japanese

standards which means design seismic coefficient 1.0 for earth quick shall be applied. In Viet Nam, the typhoon arrive one or two times per year, and the regulation for winds is not same in the provinces. In this study, the Khanh Hoa province regulation is applied to the facilities's design of the Project.

(6) Policy Regarding Utilization of Local Operators

Due to the effects of Doi Moi in recent years, the technical levels of local operators are increasing as they accumulate experience working as subcontractors for overseas construction companies. Therefore, there is no problem concerning execution capacity, including civil and architectural work, with respect to the Project facilities. However, concerning quality control aspects such as adherence to schedules and technical specifications, etc., it will be important to receive guidance and supervision by Japanese engineers.

(7) Policy in relation with the capabilities of operation and management by the implementation body

The Project facilities will fall under the control of the Research Institute for Aquaculture NO3. Concerning the method and mode of facilities operation, no problems can be identified in particular. The Research Institute for Aquaculture NO3 plans to carry out smooth and efficient test and research activities at the Center by setting up an operating committee. However, since experience of handling such a large-scale rearing facility is limited, and in order to make the technical running of facilities more certain, it is considered necessary to support technical training on operation and maintenance activities for water intake pumps, intake pipes, filtration equipment and drainage units, etc. Moreover, concerning mariculture experimentation and research activities, since experience is again limited, so it is expected that some expert for mariculture shall be dispatched for the Project.

(8) Policy Regarding Scale and Grade Setting of Facilities and Equipment, etc.

1) Basic Criteria for Scale Setting

It is planned that three broodstock tanks, namely two 180m3 tank (broodstock tankA.B) and one 200m3 tank (broodstock tankC). It is planned that twenty three rearing tanks, namely six 15m3 tank (rearing tankA) , twelve7m3 tank (rearing tankB) and five 5m3 tank (rearing tankC). The basic criteria concerning setting of scale of Project facilities are as follows.

①Broodstock tankA.B

When carrying out spawning experiment with groupers and other coastal bottom type fishes, as was also indicated in the case study mentioned earlier, it is normal for at least 20 broodstock to be reared. In the Project facilities, it is planned to have a tank big enough to rear 10 male broodstock and 20 female broodstock. Care shall be taken to make the rearing density 1.5 kg/m3, the water exchange rate 10-7.5 times/day, and to prevent outbreak of parasitic diseases such as white spot disease. In cases where a

higher water exchange rate is required, peak water exchange of 15 times per day can be attained by limiting the rate in the backup water tank; moreover, it shall also be possible to take operating steps such as adjusting water level and reviewing rearing density, etc.

Broodstock rearing

Broodstock tank A.B Sex ratio (number of fish) ♂:♀ = 10 :20 Average weight (kg) ♂:♀ = 12 : 7 Rearing density (kg/m3) 1.5 Tank size 10 fish x 12 kg + 20 fish x 7 kg = 260 kg/1.5 kg/m3 → 173 m3 → 180 ton tank (wet depth 3 m x diameter 8.8 m) Maximum used water: 180 tons x 10 revolutions/day = 1,800 tons/day Backup tank: 1 more tank of the same size Used water: 180 tons x 7.5 revolutions/day = 1,350 tons/day

②Broodstock tankC

When carrying out spawning tests with milkfish and other migrate type fishes, it is planned to have a tank big enough to rear 10 male broodstock and 20 female broodstock. Care shall be taken to make the rearing density 3.0 kg/m3, the water exchange rate 3 times/day, and to maintain water flow. In cases where a higher water exchange rate is required, peak water exchange of 5 times per day can be attained by limiting the rate in the grouper backup water tank; moreover, it shall also be possible to take operating steps such as reviewing rearing density, and so on.

Broodstock rearing

Broodstock rearing tank C Sex ratio (number of fish) ♂:♀ = 10 :20 Average weight (kg) ♂:♀ = 15 : 15 Rearing density (kg/m3) 3.0 Tank size 10 fish x 15 kg + 20 fish x 15 kg = 450 kg → 150 m3 → 200 ton tank Maximum used water: 150 tons x 3 revolutions/day = 450 tons/day Depth: 2 m, diameter 11 m

③Breeding tank A.B

The breeding tank is planned to have a capacity big enough to enable 20 spawning broodstock to spawn 3,000,000 eggs on average (60,000,000 in total), and 1,500,000 of these to be reared to fry of 25 mm (aggregate survival rate 15%) or 1,000,000 to be reared to fry of 50 mm (aggregate survival rate 10%).
As for Breeding tanks, it is planned to have six 15-m3 tanks and twelve 7-m3 tanks.

Tanks Required for One Spawning Cycle

Stage	Work Plan	Necessary Facility
Spawning	Assume that 10,000,000 eggs are spawned. Store 2,000,000 eggs each in 500 l incubation tanks, and separate eggs that sink or form an intermediate layer.	6 FRP tanks of 500 L(including backup tank)
Incubation	Assuming an egg flotation rate of 1/3, set the incubation rate at 50%. The number of incubated larvae will be 1,660,000.	
Start of larvae rearing (3 days until mouth opening)	Start the rearing with a rearing density of 70 fish/l. Required tank capacity is 25 m3 with respect to 1,660,000 larvae, however, in consideration of screening and bottom cleaning work, one 15-m3 tank and two 7-m3 tanks shall be planned. Since larvae do not open their mouths for three days after incubation, they cannot eat food.	15-m3 tank: 1 7-m3 tank: 2
3-10 days after hatch out	Assuming a survival rate of 50% during the period from the third to the 10^{th} day after hatching, the number of fish still alive on the tenth day will be 830,000/25 m3. Fish will measure 4 mm by this time. (Start adding live food from the third day after incubation).	
10-50 days after hatch out	Assuming a survival rate of 30% during the period from the 10^{th} to the 50^{th} day after hatching, the number of fish still alive on the 50^{th} day will be 280,000/25 m3. Fish will measure 25 mm by this time and will start changing shape. (25 mm length – start of shape change), start of screening	
50-80 days after hatch out	Assuming a survival rate of 60% during the period from the 50^{th} to the 80^{th} day after hatching, the number of fish still alive on the tenth day will be 168,000/25 m3. Fish will measure 50 mm by this time.	

*above calculation are based on the references from some Japanese mariculture experiment center.

④Breeding tank C

The Breeding tank is planned to have a capacity big enough to enable 20 spawning broodstock spawn 1,500,000 eggs in total, and 144,000 of these to be reared to fry of 10 mm (aggregate survival rate 20%) or 29,000 to be reared to fry of 25 mm (aggregate survival rate 4%).

Spawning, incubation and larvae rearing

Natural spawning

Spawning: 5 times/year

Spawned eggs: 300,000/time → total 1,500,000 in 5 times

Assuming a fertilization rate of 60%, 900,000 normal eggs will be obtained.

Hatching out

Assuming an incubation rate of 80%, the number of incubated larvae will be 900,000 x 80% = 720,000.

Assuming a rearing density of 300 fish/l immediately following incubation, tank capacity of 24 tons is needed in order to rear 720,000 larvae. Therefore, five tanks of 5 tons each shall be planned.

Breeding

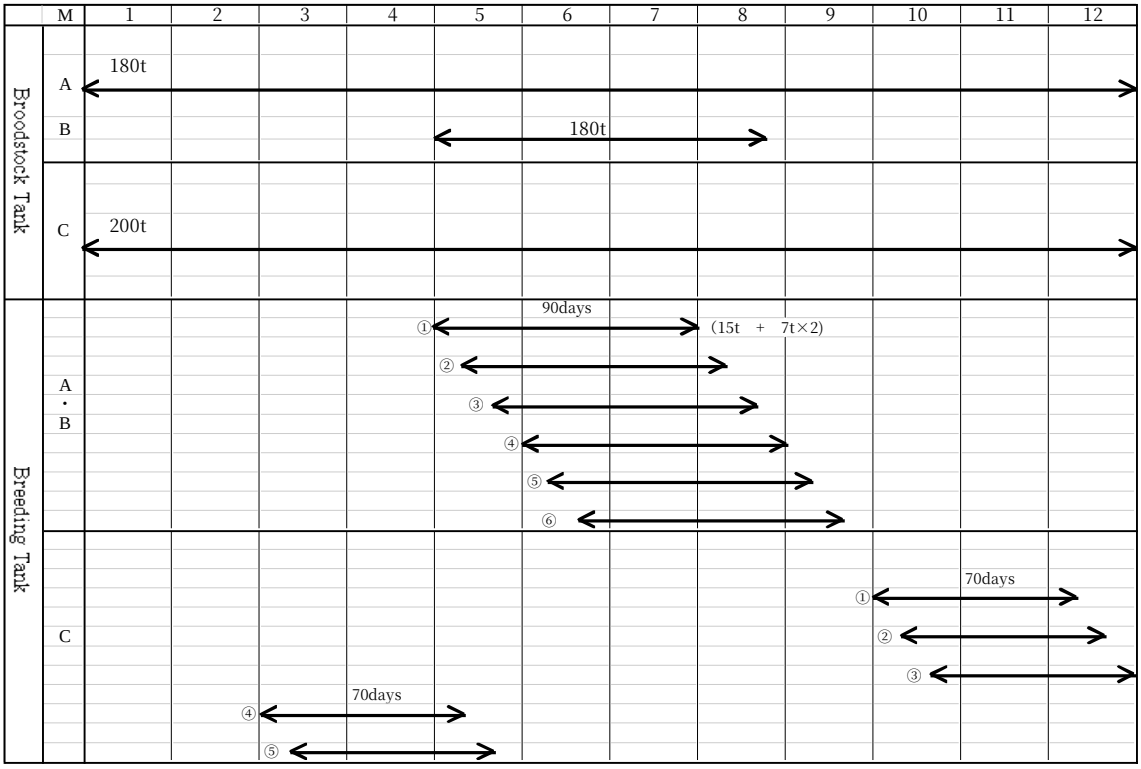
Round tanks measuring 1.2 m deep and 2.5 m in diameter shall be adopted to prevent occurrence of dead water and to enable excreta, etc. to be easily collected and removed. Assuming a survival rate of 20% after 25 days (10 mm length), the surviving number of fish will be 144,000. Moreover, assuming a survival rate of 20% after 40 days (20-25 mm), the number of surviving fish at this time will be 29,000.

⑤Hatching out tank

It shall be assumed that spawning of Grouper takes place six times with 10,000,000 eggs spawned on each occasion. Incubation tanks shall consist of six FRP tanks of 500 L each.

It shall be assumed that spawning of milk fish takes place five times with 300,000 eggs spawned on each occasion, thereby producing 1,500,000 eggs in total. Incubation tanks shall consist of five FRP tanks of 500 L each. As for larvae rearing tanks, it is planned to have five 5-m3 tanks.

Table 2-4 Tank Use Plan



2) Setting of Scale and Grade in Each Component

A. Seawater Intake

① Intake pipes

(Design policy)

Since water intake is the key to the Project facilities, a reliable intake method that enables water to be obtained with safety and certainty shall be adopted. The sub-intake line will be installed for the emergency situation, to maintain the necessary water volume. The sub-intake line will be closed on normal term to keep clean of inside of the pipe, and only be opened on emergency situation.

(Examination of scale and grade)

Distance from the intake mouth to the receiving tanks shall be approximately 435 m, and pipe diameter shall be set at 400 mm in consideration of peak intake flow of 200 tons/hour, flow resistance and the necessary shellfish. The sub-intake emergency pipe has 250mm diameter. Pipe materials that offer sufficient performance in terms of corrosion resistance and durability shall be selected.

② Pit

(Design policy)

In order to respond to incoming water flow of 200 tons/hour, the pit water holding capacity at lowest tide shall be set at 6 minutes (65 m3, 5 m x 7 m, depth WL-3.18). In consideration of the storage pump suction head, a storage pump house shall be installed over the pit. Pumps shall be efficiently arranged over 65 m2.

③ Storage pumps

(Design policy)

Two storage pumps are planned for lifting up raw seawater. From the pit, two lines are planned to supply filtered seawater to the broodstock tanks, and another line is intended to supply filtered seawater to the larvae rearing tanks (three lines in total). For each supply line, two seawater filtration pumps are planned. Since the filtered seawater for larvae rearing will be distributed to each rearing tank after first being held in overhead tanks, pump operation shall be linked by relay to water level inside the receiving tanks.

(Examination of scale and grade)

Pumps shall be ordinary centrifugal types with plastic casing to prevent electric corrosion. The capacity of each pump is 3.35 m3/min to maintain 4,800 m3/day for the center maximum day demand of seawater.

B. Filtration and Water Distribution

① Receiving tanks

(Design policy)

The purpose of receiving tanks is to maintain a set quantity of water. Here, the capacity of receiving tanks shall be set at 800 m3 to enable the water requirement for one day or four hours to be stored. Two receiving tanks(400m3 x 2) are planned at a height 2 m from the ground, and with water depth of 3 m and dimensions of 5 m x 27 m. In order to

prevent dilution of salt concentration by rainwater, roofs shall be constructed over the tanks. The tank building area of 320 m2. Also, pressure filtration load shall be mitigated by installing sand separators.

② Filtration
(Design policy)
In order to filter large amounts of seawater, six rapid filtration units shall be installed.
No special materials shall be used for the filtration agent, but multiple layers shall be adopted in order to reduce the backwashing time.

(Examination of scale and grade)
In order to sustain filtration functions, the filtration unit shall undergo periodic sand washing and a backwashing pump shall be installed. the filter capacity is 0.91 m3/min ×2 for Brood stock tank A and B, 0.40 m3/min ×2 for Brood stock tank C, and 0.38 m3/min ×2 for Breeding building.

③ Disinfection unit
(Design policy)
Equipment shall be installed to disinfect rearing seawater and thus ensure the healthy rearing of larvae. There are three types of seawater disinfection units, i.e. UV, ozone, and electrolysis units. Of these, since the UV unit is the easiest to maintain, this shall be installed.

(Examination of scale and grade)
The disinfection unit shall be capable of treating 0.75 m3/min of water.

④ Overhead tanks
(Design policy)
Filtered seawater for use in larvae rearing shall be pumped to overhead tanks installed above the machinery house, and from there it shall be distributed to each tank by gravity.

(Examination of scale and grade)
Assuming enough capacity to satisfy the water requirement for 20 minutes, two tanks of 35 m3 each shall be planned. Tanks shall be made from FRP.

C. Freshwater Supply
① Overhead tanks
(Design policy)
The freshwater requirement is 59 personnel x 100 L = 5.9 tons, however, in consideration of visitors to the Center and so forth, tank capacity shall be set at 8 tons. As with the seawater overhead tanks, the freshwater tanks shall be installed over the machinery house in order to raise the efficiency of facilities.

D. Wastewater treatment facilities
(Design policy)

Concerning treatment of rearing wastewater, after solids are removed, supernatant shall be fed to the purification tank, where BOD shall be reduced before being discharged.

E. Broodstock tanks
①Broodstock tankA.B
(Design policy)
Tanks shall be assembled close together as much as possible in order to reduce costs and make work easier. Concrete tanks shall be adopted. Service stairs shall be provided on the inner walls of tanks, and tanks shall be designed to make the handling of large broodstock as easy as possible. Work stages shall be provided around tanks, and the height of tank edges shall be set at 80 cm to ensure that test and research work is not obstructed. Also, space shall be secured under stages for storing materials.

(Examination of scale and grade)
Two octagonal tanks of 3 m depth and 180 ton capacity each shall be installed. Water shall be supplied from two places in the tank sides, and a vertical drainage pipe shall be installed in the middle of tanks to drain water by overflow. The inside color of tanks shall be decided after checking the wishes of the Viet Nam side. The inner walls of tanks shall be painted with flexible epoxy resin coating.

②Broodstock tanks C
The tank shall be designed with emphasis placed on large surface area rather than depth for high swimming fish.

(Examination of scale and grade)
One octagonal tank of 2 m depth and 200 ton capacity shall be installed. Water shall be supplied from two places in the tank sides, and a vertical drainage pipe shall be installed in the middle of tanks to drain water by overflow. The inside color of tanks shall be decided after checking the wishes of the Viet Nam side. The inner walls of tanks shall be painted with flexible epoxy resin coating.

F. Breeding and Incubation Block
① Incubation tanks for groupers
(Design policy)
500 L pan-light or FRP tanks shall be used. The tank bottom shall be a gentle rote shape to make it easy to remove dead eggs and rubbish, etc. Assuming six spawning cycles, six tanks shall be installed.

(Examination of scale and grade)
In order to secure ease of work in FRP tanks, piping space, room between each tank, and space to install additional tanks in future, the tank room dimensions shall be planned as 7 m x 10.5 m.

② Incubation tanks for milkfish
(Design policy)
500 L pan-light tanks shall be used. The tank bottom shall be a gentle rote shape to

make it easy to remove dead eggs and rubbish, etc. Five tanks shall be installed to accommodate 1,500,000 anticipated spawned eggs.

(Examination of scale and grade)
In order to secure ease of work in FRP tanks, piping space, room between each tank, and space to install additional tanks in future, the tank room dimensions shall be planned as 7 m x 10.5 m.

③Breeding tank A.B
(Design policy)
In order to adjust rearing density in accordance with the survival rates and different growth stages of fry, two 7-ton tanks and one 15-ton tank shall be designed as a single unit. In consideration of screening and observation activities, intervals of approximately 1.5 m shall be adopted between each tank, and the upper edge of tanks shall be set at a height of 80 cm above the floor.

(Examination of scale and grade)
Concrete tanks shall be adopted and air and water supply shall be carried out from above. As with broodstock tanks, drainage shall be carried out by overflow from vertical pipes located in the center of tanks. Since six sets consisting of two 7-ton tanks and one 15-ton tank are required, units shall be alternately crossed in order to achieve a compact layout. Space for young grouper tanks shall be 28 m x 24 m.

④Breeding tank C
(Design policy)
Five 5-ton tanks shall be installed. In consideration of screening and observation activities, intervals of approximately 1.5m shall be adopted between each tank, and the upper edge of tanks shall be set at a height of 80 cm above the floor.

(Examination of scale and grade)
Concrete tanks shall be adopted and air and water supply shall be carried out from above. As with broodstock tanks, drainage shall be carried out by overflow from vertical pipes located in the center of tanks. Drainage channels shall be provided at the front of grouped tanks, and tank space of 14 m x 10.5 m shall be secured to provide for walkways and working space.

⑤ Phyto plankton cultivation room
(Design policy)
The Phyto plankton cultivation room shall be designed with sufficient space to concentrate large quantities of cultivated plankton and with consideration given to the ease of work.

(Examination of scale and grade)
Room size shall be 7 m x 6 m assuming the above working space.

⑥ Zooplankton cultivation room (artemia cultivator)

(Design policy)
The artemia cultivation room shall be designed with sufficient space to store the artemia cultivator and with consideration given to the ease of work (artemia is an important early feed for fry).

(Examination of scale and grade)
Room size shall be 7 m x 6 m assuming the above installation and working space.

⑦ Multipurpose tanks
(Design policy)
As tanks for multipurpose uses limited not only to nursery production research but also test research on mariculture environment, training of new broodstock to the artificial environment at the Center, artificial spawning using hormones, etc., rearing until disease diagnosis results are ready, and so forth, two 25 ton tanks shall be installed for groupers and other demersal fish that are not so mobile, and one 100 ton tank shall be installed for milkfish and other species with high mobility.

(Examination of scale and grade)
The 25 ton tanks shall be round with diameter of 4 m and wet depth of 2 m. Height from the floor to the top edge of the tank shall be 80 cm. The 100-ton tank shall be octagonal with diameter of 8 m and wet depth of 2 m. This tank shall also measure 80 cm from the floor to the top edge. Water and air shall be supplied from the top of tanks. As with broodstock tanks, drainage shall be carried out by overflow from vertical pipes located in the center of tanks. Accordingly, easy working shall be ensured in the 100-ton tank and sufficient workspace shall be secured.

G. Outdoor Tanks
① Chlorella tanks
(Design policy)
Tanks shall be installed for cultivating marine chlorella as feed for rotifer. Tanks shall be concrete and three tanks of the same size shall be installed to ensure safe and steady supply.

(Examination of scale and grade)
Each tank shall have capacity of 50 tons and water depth of 1.2 m, and tank design shall be such that it is possible to mix water and carry out uniform photosynthesis by setting air stones at the rate of one per square meter. Tank bottoms shall be inclined to make drainage easier.

② Rotifer cultivation tanks
(Design policy)
Tanks shall be installed for cultivating rotifer as feed for larvae. Tanks shall be concrete and two tanks of the same size shall be installed to ensure safe and steady supply.

(Examination of scale and grade)
Each tank shall have capacity of 50 tons and water depth of 1.2 m, and tank design shall

be such that it is possible to mix water and carry out uniform photosynthesis by setting air stones at the rate of one per square meter. Tank bottoms shall be inclined to make drainage easier.

I. Administration and Research Block
Ground Floor
① Live food research room
(Design policy)
Upon referring to the manner in which local laboratories are used in general and the size of laboratories at the existing Research Institute for Aquaculture NO3 (6 m2/person), the research room shall be planned with the necessary office equipment and furniture layout.

(Examination of scale and grade)
Space for the Chief of the Department of Culture Technology shall be based on the manner in which local offices (department manager class) are used in general and the size of department manager offices at the existing Research Institute for Aquaculture NO3 (4 m x 6 m = 24 m2). Since space for meeting with visitors will be secured next to the Live Food Section, 6 m2 of office space and 6 m2 of visitor meeting space shall be secured. Concerning the area occupied per person in laboratories, no standard figures exist because this is largely dictated by the layout of research apparatus and furniture;
6 m2 x 2 people = 12 m2 + 6 m2 + 6 m2 = 24 m2

② Live food laboratory
(Design policy)
The live food laboratory is the room where seeds for cultivating Phyto plankton and zooplankton are stored, and where initial and intermediary cultivation ahead of mass production is carried out. Therefore, this room shall be designed as a wet laboratory fitted with incubators with temperature and light control, cultivation flasks and other equipment needed for seawater and air supply.

(Examination of scale and grade)
One illuminated incubator each shall be installed for Phyto plankton (marine and freshwater chlorella) and zooplankton (rotifer, etc.). Concerning incubator size, it should be sufficient to install micro algae illuminated incubators with capacity of 200 L. In this case, it will be possible to install eight flasks (four on each level) when using 5-liter flasks, and 24 flasks (12 on each level) when using 1-liter flasks. For detailed observation and counting of Phyto plankton and zooplankton, one standard size biological microscope and universal projector shall be installed in each incubator. In order to investigate the propagation rate of Phyto plankton and zooplankton over time, it is necessary to measure absorbance (wavelength 675 nm) by spectrophotometer, but this equipment shall be shared with the disease research laboratory. Also, chemical shelves will be needed for storing culture solution chemicals and flasks and other glass utensils.
Since the bread yeast used as nutrients for rotifer is fragile in high temperatures, a refrigerator will be needed for storage. Since approximately 90 kg/month (1 billion rotifer/day x 300 g/100 million x 30 days) will be required when the Center is operating

at full capacity, a refrigerator of around 300 l capacity shall be installed for storage. Room size of 48 m2 is planned to accommodate the said equipment.

③ Fish disease and Environmental laboratory
(Design policy)
Upon referring to the manner in which local laboratories are used in general and the size of laboratories at the existing Research Institute for Aquaculture NO3, the laboratory shall be planned with the necessary office equipment and furniture layout.

(Examination of scale and grade)
Space for the Chief of the Department shall be based on the manner in which local offices (department manager class) are used in general and the size of department manager offices at the existing Research Institute for Aquaculture NO3 (4 m x 6 m = 24 m2). 6 m2 of office space and 6 m2 of visitor meeting space are planned.
Laboratory dimensions shall be 6 m2 x 4 persons = 24 m2 + 6 m2 + 6 m2 = 36 m2 → 40.5 m2.

④ Chemical laboratory
(Design policy)
This laboratory, mainly used for conducting fish disease experiments, shall be fitted with PCR and electric migration unit. In consideration of the necessary equipment and workbenches to be installed, room area shall be 60.75 m2.

⑤ Microscope and culture room
(Design policy)
This room, used for cultivating and observing pathogenic organisms, shall consist of two parts including two independent bioclean room(5 m2×2) fitted with ventilation fan and UV sterilization tube. The reason for having two separate rooms is that one room will be used for operating on pathogenic organisms and the other will be for preventing contamination by culture medium meristems, etc. The bioclean room shall be provided with a pre-clean room for changing clothes, a pass box for passing in equipment, and a clean bench, and its total shall have space of 48m2 for conducting clean operations.

⑥ Washing and sterilization room
(Design policy)
This room will be used for washing glass wears and metal utensils and for disinfecting metal utensils and culture mediums. A room area of 36 m2 is planned for to be installed Autoclave, Ultra Sonic Washer, Dryer etc..

⑦ Nutrition research room
(Design policy)
Upon referring to the manner in which local laboratories are used in general and the size of laboratories at the existing Research Institute for Aquaculture NO3, the nutrition research room shall be planned with the necessary office equipment and furniture layout.

Space for the Chief of the Department shall be based on the manner in which local offices (department manager class) are used in general and the size of department manager offices at the existing Research Institute for Aquaculture NO3 (4 m x 6 m = 24 m2). 6 m2 of office space and 6 m2 of visitor meeting space are planned.
Room dimensions shall be 6 m2 x 3 persons = 18 m2 + 6 m2 + 6 m2 = 30 m2

⑧ Nutrition laboratory
This laboratory shall be used for performing experimental research on nutritional analysis and mix feed design. Gas chromatograph, liquid chromatograph, amino acid analyzer, and other apparatus shall be installed. In consideration of the installed equipment and necessary workbenches, room size of 24.75 m2 shall be planned.

⑨Library
(Design policy)
Library size shall be designed so that one-third of the 28 resident researchers including department chiefs can use it at any one time. Nine reading desks shall be furnished.

(Examination of scale and grade)
Scale shall be computed upon referring to building design data.
Assuming that 5,000 volumes are stored in elevated shelves and that nine people use four-seat reading desks with an allowance of 1.5:
5000 volumes/220 volumes/m2 + 9 people/0.55 people/m2 = 60 m2

⑩Toilets
(Design policy)
Appropriate scale and specifications shall be designed based on the number of persons using the toilets.

(Examination of scale and grade)
Estimated number of users: 28 (male-female ratio 1 : 1)
Men's: 1 closet, 2urinals, 2 sinks
Women's: 2closets, 2 sinks
The total room shall be planned 36m2.

⑪Bed room for Night Research
(Design policy)
Appropriate scale and specifications shall be designed based on the 4 persons use.
It shall be designed two 10m2 size rooms.

First Floor
① Director's room
(Design policy)
Upon referring to the manner in which local offices (director class) are used in general and the size of the director's office at the existing Research Institute for Aquaculture NO3 (4 m x 6 m = 24 m2), the Director's room shall be planned with the necessary office equipment and furniture layout as 36.75 m2.

②Vice Director's room
(Design policy)
Upon referring to the manner in which local offices (sub-director class) are used in general and the size of the vice director's office at the existing Research Institute for Aquaculture NO3 (4 m x 6 m = 24 m2), the Vice Director's room shall be planned with the necessary office equipment and furniture layout as 30 m2.

③Administration and management room
(Design policy)
Upon referring to the manner in which local offices are used in general and the size of offices at the existing Research Institute for Aquaculture NO3, the administration and management room shall be planned with the necessary office equipment and furniture layout. Moreover, in the Compendium of Building Design Data, necessary office area is given as 5 m2/person.

(Examination of scale and grade)
Work space: 5 m2 x 5 people = 25 m2
Space for Director: 6 m2
Space for Guest meeting: 6 m2
Others: 10 m2
Therefore, room size will be approximately 47 m2 → 48.75 m2

④ Planning and finance department room
(Design policy)
Upon referring to the manner in which local offices are used in general and the size of offices at the existing Research Institute for Aquaculture NO3, the planning and finance room shall be planned with the necessary office equipment and furniture layout. Moreover, in the Compendium of Building Design Data, office area is given as follows:

(Examination of scale and grade)
Work space: 5 m2 x 5 people = 25 m2
Shelves and office equipment (facsimile, copier, etc.): 3 m x 2 m = 6 m2
Corridor: 30% = 6 m2
Moreover, as space for the department chief, referring to the manner in which local offices (department chief class) are used in general and the size of executive offices at the existing Research Institute for Aquaculture NO3 (4 m x 6 m = 24 m2), working space of 6 m2 and visitor meeting space of 6 m2 shall be planned:
15 m2 + 6 m2 + 6 m2 + 6 m2 + 6 m2 = 39 m2 → 36 m2

⑤Broodstock rearing research room, Larvae rearing research room, and Culture technology research room;
(Design policy)
Upon referring to the manner in which local laboratories are used in general and the size of laboratories at the existing Research Institute for Aquaculture NO3, these rooms shall be planned with the necessary office equipment and furniture layout.

(Examination of scale and grade)
Space for the Chief of the Department of Culture Technology shall be based on the manner in which local offices (department manager class) are used in general and the size of department manager offices at the existing Research Institute for Aquaculture NO3 (4 m x 6 m = 24 m2). 6 m2 of office space and 6 m2 of visitor meeting space are planned. Concerning the area occupied per person in research rooms, no standard figures exist because this is largely dictated by the layout of research apparatus and furniture；
Broodstock rearing research room: 6 m2 x 4 people = 24 m2
Larvae rearing research room: 6 m2 x 5 people = 30 m2 = 30.75 m2
Culture technology research room: 6 m2 x 5 people = 30 m2

⑥Conference room
(Design policy)
A large conference room shall be provided. This shall be big enough to accommodate all 28 of the resident researchers.

(Examination of scale and grade)
Large conference room: (Data) 2.5 m2/person x 28 people = 70 m2 → 72 m2
Also, the large conference room shall be used to conduct training and seminars, etc. In this case, if three-seat desks are used, it should be possible to accommodate 70 m2 x (Data) 1.5 people/m = 50 people.

⑦Hot water service room
(Design policy)
A hot water service room containing sink, water boiler, refrigerator and shelves and consisting of appropriate size shall be provided. Design shall take conditions of use in Viet Nam into account.

(Examination of scale and grade)
Sink, water boiler, refrigerator, shelves: 3 m x 4 m = 12 m2

⑧Toilets
(Design policy)
Appropriate scale and specifications shall be designed based on the number of persons using the toilets.

(Examination of scale and grade)
Estimated number of users: 31 + 50 during training (male-female ratio 2 : 1)
Men’s: 2 closets, 3 urinals, 3 sinks
Women’s: 2 closets, 2 sinks
Total room shall be planed 36m2.

J. Machinery Block
①Power receiving and distribution room

Electric poles, transmission lines needed for new extensions, and wiring and meter installation up to the power receiving equipment shall be included in the Viet Nam side scope of works, whereas equipment from the receiving and transformer panel onwards shall be covered by the aid. This room is planed 84 m2

②Emergency generator
For any fish rearing facility, the stable operation of pumps for lifting and distributing water and air pumps for conducting aeration is vital. Therefore, it is necessary to install an emergency generator. In accordance with pump load etc., 100KVA capacity emergency generator shall be planned. This room is planned 24 m2

③Pump room
The pump room shall contain six seawater filtration pumps and planned 70 m2

④Air blower room
Air flow shall be set at 0.5 L/ton/min for rearing seawater fish. Three air supply lines are planned: one (5.5 kw) for the larvae rearing and live food section, multipurpose water tanks and research block, one (3.75 kw) for grouper broodstock tanks, and one (2.2 kw) for milkfish broodstock tanks. This room is planed 40 m2.

L. Landscaping
①Parking area
Most workers in Viet Nam commute by motorbike. Parking space shall also be secured for private cars and mini buses.

M. Equipment
①Crane-fitted truck
(Design policy)
When carrying out nursery production of marine fish, it is first essential to secure broodstock. In the Project, broodstock shall be procured from the wild, cultured broodstock and foreign imports. Accordingly, broodstock must be carried to the Center from nearby waters and fishing ports, however, the Research Institute for Aquaculture NO3 does not currently own a truck. Moreover, from the viewpoint of preventing fish diseases, it is vital for the Center to use its own vehicle when transporting live fish. Furthermore, this truck will be used to carry live food for broodstock. It shall be designed for use with other work such as attach&detatch the pig, launcher, high pressure pomp for cleaning the sea water intake pipe. Therefore, it is necessary to supply a crane-fitted truck with live fish tank that can be removed and attached according to the above purposes of use.

(Examination of scale and grade)
Concerning the amount of live food, at peak times it will be necessary to carry on average 400 kg of live food for net cages (1 kg/fish x 5000 fish x yield 80% x feed rate 10%) and 45 kg/day for broodstock in ponds on land (250 kg/pond x 3 ponds x feed rate 6%). Therefore, it will be necessary to carry 450 kg/day of live food. The amount of live fish carried in as spawning broodstock will initially be 950 kg (groupers 250 kg x 2,

milkfish 450 kg x 1). The amount of live fish transported as fry in the intermediate nursery stage (offshore bearing) will be 150 kg (5000 groupers x 30 g). Assuming that a maximum of 100 kg of live fish can be transported at any one time, the live fish tank will need water capacity 10 times this (1 ton) plus around twice as much allowance for handling accidents during transportation. Therefore, a 2.5-ton crane-fitted truck (with live fish tank) shall be supplied.

② PIT Tag System
(Design policy)
The PIT tag system is a device for identifying small fish: a transmitting tag is embedded in the body of the research fish so that it is possible to identify each fish by reader from a remote location without killing or harming the fish.

(Examination of scale and grade)
Broodstock inspection frequency
Groupers: once per month at normal times + three times/month during spawning, approximately 16 times/year/fish x 30 fish x 2 = total 960 times/year
Milkfish: once per month at normal times + two times/month during spawning, approximately 16 times/year/fish x 30 fish x 1 = total 480 times/year

Fry inspection frequency
Groupers: once per month, approximately 12 times/year/fish x 30 fish x 2 = total 720 times/year
Milkfish: once per month, approximately 12 times/year/fish x 30 fish x 1 = total 360 times/year
It works out that 2,520 inspections will be made per year. If inspections are carried out once per month, the number of fish handled per inspection will be 210. In the case where work is implemented using one PIT tag system machine, assuming that one minute is required to measure each fish (including preparation time), the inspection work should be completed in around 4 hours. Therefore, although the request was for five such machines, one should be sufficient.

③Cage culture equipment
(Design policy)
The intention of this equipment is to mitigate the risk involved in cultivating intermediate nursery stock and candidate broodstock in ponds on land only. This will make it possible to cultivate fast-developing promising candidates for broodstock. It will be possible to mass-produce intermediate nursery stock and thus supply hatchery fish to fishermen.
(Examination of scale and grade)
Concerning scale of the ocean net cages, four net cage sets of 6 m x 6 m x 5 m will be required.
5000 fish (accommodated fish) x 50% (yield) x 1 kg (weight/fish) /4 kg (density) /5 m (cage depth) /36 m (cage area) = 3.5 cages

Therefore, four net cage sets shall be provided.

Concerning the cage frames and other equipment, the method currently used in grouper farming in the Nha Trang area shall be adopted. In other words, wooden frames and vinyl resin floats shall be adopted for the cage frames, and a guardhouse shall be provided over the cage to enable surveillance to be carried out around the clock. These cage frames, floats, guardhouse and other incidental equipment can all be handled with existing technical levels in Viet Nam; moreover, since all equipment can be procured in Viet Nam, the local side shall be responsible for incidental equipment.

④Work boat
(Design policy)
A work boat is required in order to secure spawning brood stock and to take fry out to sea. This boat is also needed for feeding intermediate nursery fish and candidate brood stock in ocean cages and performing routine management (net changing, observation, etc.).

(Examination of scale and grade)
Concerning loading capacity, the workboat will carry around 1,000 kg in total including a maximum of 500 kg live food. Moreover, since the boat will need to pull up and load nets when renewing cages and one net is 6 m long, a vessel of 7 m with flat deck for easy working has been selected. A flat-bottom workboat equipped with 40 HP outboard motor and having a maximum load capacity of 1,200 kg shall be procured.

⑤PCR
(Design policy)
In recent years, as aquaculture has become more and more intensive, the incidence of fish diseases has increased dramatically; in particular, viral diseases are causing major harm to the sector.

(Examination of scale and grade)
Since the PCR method has been developed and compiled in manual form, anybody can easily conduct genetic research and perform early diagnosis of fish diseases, etc. This system can also be used for identifying types of fish, distinguishing sex, and determining clones.

⑥ Clean benches
(Examination of scale and grade)
A laminar flow cabinet is a clean bench, which is needed in order to carry out experiments on microorganisms, etc. in a clean state. Clean benches shall be installed in each bioclean room and mainly divided according to use for disease research and other research uses. Clean benches shall be equipped with disinfecting lamps and flame disinfecting gas burners, and standard size benches of around 1,200 mm in width shall be adopted.

⑦ Incubator
(Examination of scale and grade)
The incubator will mainly be used for culturing pathogenic organisms in research of fish

diseases. Since the appropriate temperature for organisms varies from low to high temperatures (0~40 ℃), a temperature controller shall be installed. An incubator of approximately 300 L, which can also be used for measuring BOD in water environmental research, has been selected.

⑧ Autoclave
(Examination of scale and grade)
The autoclave is used to disinfect utensils and culture mediums used in experiments using steam under conditions of high temperature and high pressure. This is the most common, certain, economic and practical method of sterilisation. In consideration of the size of the facilities, one small autoclave of around 25 L capacity shall be supplied.

⑨ Ultrasonic cleaner
The ultrasonic cleaner is used to clean experimental utensils, etc. One small cleaner of around 3 L capacity shall be supplied.

⑩ Water quality measurer etc.
(Examination of scale and grade)
As water quality monitoring instruments for measuring environmental factors in mariculture and rearing water, two portable water quality measurers (one for inside use, one for surrounding seawater use) shall be supplied. These measurers shall be capable of measuring 15 items (temperature, salt content, pH, DO, ammonia, ion nitrate, etc.) continuously for one month and be suited to both indoor and outdoor use. Moreover, in order to study and monitor water indicators in surrounding seawater and avoid wastewater containing environmentally harmful substances, In specific terms, such equipment shall consist of spectrophotometer, BOD measurer, water sampler, sediment sampler.

2-2-2 Basic Plan

2-2-2-1 Facility Layout Plan

The planned construction site for the Centre is located in the Song Lo area, in turn situated some 10 km south of Nha Trang City in Khanh Hoa Province. The site is sloping land facing north and is located some 70 m inland from the coastline. It faces an estuary of Don River and boasts an excellent view to the north. For the planning of the facility layout, the site will be largely prepared on two levels to match the slope.

The seawater intake facility is planned to the south east area in the site. The machine building incorporating the substation, pump room and blower room, etc. will be introduced in the middle position of the site in view of efficient energy supply to the Centre's various facilities. The building holding the blood stock water tanks and the breeding and rearing building will be located on flat land near the planned road on the lower level because of their large size. The research building will be located on upper level. The laboratory and study room shall be planed ground floor and administration room, conference room will be on first floor. The flat area between research building and breeding building is able to be a extension area for the future.

2-2-2-2 Seawater Intake Plan

1) Seawater Intake volume

The total required volume of filtered seawater for the planned facilities is about 4,600m^3/day as shown in the Table 2-5. Considering the use of prefabricated temporary water tanks, small tanks of various sizes (30 litres and 100 litres), water for miscellaneous use and long-term decline of the pumping capacity, a surplus capacity is provided, resulting in a planned daily seawater intake volume of 4,800 m^3/day. This means that a pumping capacity of 200 m^3/hour will be required.

Table 2-5 Seawater Intake Volume (Maximum Volume per Day)

Type of Tank	Daily Number of Water Turnover	Filtered Seawater (tons)	Total (tons)
Broodstock tankA	180 tons x 10 times	1,800	3,600
Broodstock tankB	180 tons x 7.5 times	1,350	
Broodstock tankC	150 tons x 3 times	450	
Breeding tank A.B	25 tons x 6 x 3 times	450	450
Breeding tank C	5 tons x 5 x 3 times	(75)	
Rotifers	50 tons x 2 x 0.5	50	95
Green	50 tons x 3 x 0.3	45	
Artemia	12.5 tons x 0.5	6.25	6.25
Multi-Purpose Tank	100 tons x 3 times	300	450
Multi-Purpose Tank	25 tons x 2 x 3 times	150	
Total			4,601.25 (make4,800 t) 200 tons/hour

2) Seawater Intake method

The three kind methods(gravity methods, siphon method, submerged pomp methods) for intake the seawater are considered with the natural condition as shallow water, and necessary of big amount of water intake volume. The evaluation among these three methods is done by the criteria shown in the table 2-6. The result is gravity methods is the most suitable way to take seawater at this site area.

3) Seawater Intake point

The seawater for culture and seed production of marine fin fish should be taken from clean water mass as much as possible and the effect of heavy rain and strong sun shine should be avoided. The deeper water is generally better cause the water quality is stable. Sea water must be taken from the shore as much as possible to avoid the fresh water flow form the mountain side in this site area. So, the water should be from under 4m depth.

4) Maintenance

It is very difficult that making forecast the biological attached amount on the inner wall of sea water intake pipe. During the Basic Design Study no biological attachment to disturb the water intake function seriously were observed. The maintenance plan/schedule of water intake pipe should be made after half or one year water intake operation. Sea water intake function is the most important key of this facility, so the scheduled maintenance /cleaning of inner wall of sea water intake pipe is indispensable. The Peg cleaning method is appropriate way to keep clean the inner of the pipe.

5) Seawater Intake Pipe

The selected Peg cleaning method need the strong pipe material, PVC is not enough to accept the Peg cleaning method. Steel pipe or High density polyethylene pipe is available for this cleaning method. Nylon coating to the inside of the pipe is recommended, this coating makes difficult to invade of shell fish.

Table2-6 Evaluation Of Seawater Intake Methods

	Natural introduction method Gravity method	Natural introduction method Siphon method	Direc intakemethos Sub merge pump method
Water Quality	・ Possible to take clean and no drifting, no suspending water with enough depth ・ Possible to screening of big contamination and sand iin the pit 3	・ Ditto to left 3	・ Possible to take clean and no drifting, no suspending water with enough depth ・ Drifting things are filterd at the strainer, but easy become blocked 3
Hydrogy	・ Should think about head loss by attached organisum ・ No effect by wave to the water lifting pump ・ Easy to check the head loss at pit during operating the lift pump ・ Pipe diameter is bigger than sub merge pump type 3	・ Ditto to left 3	・ Pipe diameter is smaller than sub merge pump type 3
Oceano Condition	・ Basically the sand is very difficult draw into the pipe although the intake mouth should be located in low sand movent 2	・ Possible to be broken the sealed water by the wave action depend on the water depth 1	・ Submerged pump should be located at the low wave effect 1
Outer Element	・ Consider to the boat vessel running cause the mouth is up light standing, in this case needs the mark or buoy 2	・ Ditto to left 2	・ Needs to construct the structeron the water, consider the social terms and scenery 1
Maintenance	［Daily］ ・ Require the scheduled cleaning inside the pipe ・ Easy to check the head loss by attached organism at pit during operating the lift pump ・ Even in the case of much drifting things, the maintenance of lift pump is easy 3	・ Ditto to left 3	［Daily］ ・ Submerged pump is not easy to maintain daily ・ Containation and driftings thins easy to make pump sucowork and trouble ・ life of submeeged pump is 4-7years only 1

	Natural introduction method Gravity method	Natural introduction method Siphon method	Direc intakemethos Sub merge pump method
Maintenance	［Emergeny］ ・ The pipe is under the water or bottom, partial change of pipe is not easy work 1	 1	［Emergeny］ ・ The pipe is not under the water or bottom,partial change of pipe is easier than left two methods 3
Construction	・ Scale of construction work is more cause of pit ・ There are plenty case of construction by small scale to big scale 2	・ Scale of construction work is more cause of pit ・ Needs vaccum pump and sealed water destroied detection system makes operaion difficult 1	・ Difficulty of construction on the water and shoul be careful on weather and wave condition ・ needs power line to the submerged pump 2
Reliability of safty water intake	・ It is very sure to take water cause the water level differences brings the water to the shore side. This method is most reliable to take water safely 3	・ using the siphon system makes the reliablity less than the gravity method 2	・ Intake water is easy but reliability si not high 1
Fail safe	・ Possibility of trouble of water intake is lower than Siphone and Submerged pump ・ Required sub intake pipe for the emergency ・ To change the waer intake pipe needs 1-3 month 2	・ Possibility of trouble of water intake is lower than Submerged pump method ・ To change the waer intake pipe needs 1-3 month 1	・ The risk of water intake stop is higher than Gravity and siphon methos by cut of power line, trouble of submerged ・ first recover by spare pump ・ Changing and the maintemance of the pipe is easier than other methos, simple water pump can be adopted for enerency 2
Overall evaluation	This method is simple and sure to take water on the shore side. So the risk of this methods is the lowest. It makes long life stable water intake that the scheduled maintenance plan must be executed 24	This method basically takes same evaluation but maintenance and reliability is less than gravity method. 19	This method is easy to take water, but low reliability than Gravity and Siphon method for long term operation and trouble of submerged pump. 18

Table 2-7 Comparison on Seawater Pipe Material

Item	PVC Pipe	High-density Polyethylene Pipe	Nylon-coated Steel Pipe
Characteristics	Easy to procure with low cost.	-Mainly used for deep seawater in-take pipes. High durability, but need some time for procurement due to order-base production	-Typically used for similar purposes.
Maintenance	Difficult to use Pig for pipe cleaning.	-Possible to use Pig for maintenance. -Normally less joints thus a pipe length is longer than other types.	-Possible to use Pig for maintenance. -Possible to replace only damaged pipe.
Construction Aspect	-Weak against heavy load or impact. -Replacement of damaged pipe is not easy under water.	-Workability is good. -Need special machine for pipes jointing.	- Joint is normally every 5 m thus require to check pressure leak when Pig is used
Evaluation	Not recommended	Not recommended	*Recommended*

Table 2-8 Seawater Intake Flow Volume by Pipe Diameter

Diameter of Pipe	Calculation of flow Volume					
	Flow Q (m^3/h)		200.0			
	Flow Coefficint C		90			
	Pipe Lengh L(m)		435			
	Inner Diameter D (mm)	Attached Organism (mm)	Diameter D (mm)	Flow Velocity V (m/sec)	Head loss	
					Unit S (mAq/m)	Total (mAq)
W100	105.8	10.60	84.60	9.88	2.0350	814.0
W130	135.4	13.50	108.40	6.02	0.6085	243.4
W150	152.3	15.20	121.90	4.76	0.3435	137.4
W200	210.8	21.10	168.60	2.49	0.0708	28.3
W250	265.5	26.60	212.30	1.57	0.0230	9.2
W300	299.2	29.90	239.40	1.23	0.0128	5.1
W350	337.2	33.70	269.80	0.97	0.0072	2.9
W400	379.3	37.90	303.50	0.77	0.0040	1.6
W500	471.9	47.20	377.50	0.50	0.0014	0.6

6) Fail safe

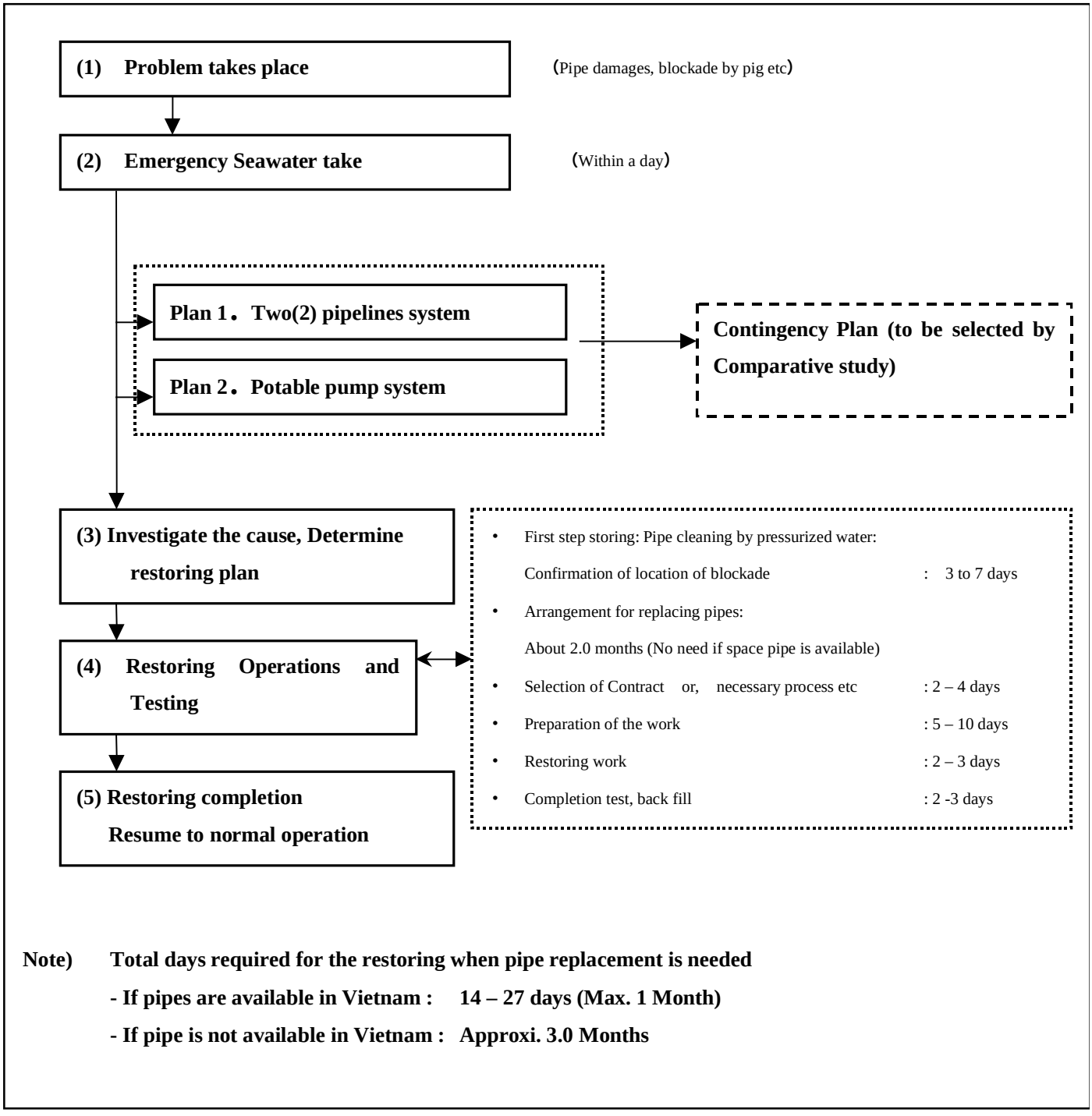
Sea water intake is just key of this facility, so we have to prepare for the accident and crisis which makes no water situation. The facility should be designed to be able to keep the basic function even face to the water intake trouble. The trouble analysis of sea water intake are described in the table2-9.

As shown in table 2-9, the most serious and dangerous trouble is Peg stacked in the pipe during cleaning. And if it happen, you have to dig and take out a part of pipe to collect the Peg. Its procedure are shown in fig.2-2, it takes three or ten days to identify the position of stuffed Peg, two weeks for repare and prepare material(spare pipe, working vessel, diver etc.), a few days for test run, total takes almost one month, if the spare pipe were not available in Viet Nam, ask for foreign market takes a few month.

Table 2-9 Trouble of Sea Water Intake Pipe

Trouble	Cause	Measures	Preventive Measures
Decrease the intake volume	Attached organism or heaped shell etc.	Cleaning with Peg	Establish the cleaning plan and schedule
	Stuffed on mouth	Cleaning the mouth mesh, filter	Establish the cleaning plan and schedule of mouth mesh, filter
	Damage by dropped heavy things	Change the damaged part or install new line	・ Select the strong enough material for pipe. ・ Put the pipe under the sea bottom to avoid the shock
Impossible to intake water by stuffed Peg in side	Too much friction → too much organism → too long cleaning interval	Push back the Peg adding pressure from the opposite side of the pipe	・ Reconsider the cleaning plan and schedule ・ Step cleaning with different diameter Peg
	Pressure leak from some part of pipe	・ Push back the Peg adding pressure from the opposite side of the pipe ・ Dig out the part of pipe to collect the Peg	・ Execute the presser test of he pipe before use peg to check the presser leak ・ Reduce the presser leak risk using the seamless pipe

There are four way to keep the water as, ①Construct big water reserve tank, ②Prepare sub water intake line for emergency, ③Prepare hose and submerged pump, ④Transfer the sea water from RIA3 by tank lorry.



Note) **Total days required for the restoring when pipe replacement is needed**

- If pipes are available in Vietnam : 14 – 27 days (Max. 1 Month)

- If pipe is not available in Vietnam : Approxi. 3.0 Months

Fig.2-2 Contingency Plan Work Flow

The best way among these four way is ②prepare sub water intake line for emergency, because ①Construct big water reserve tank and ④transfer the sea water from RIA3 by tank lorry is very costly and ③prepare hose and submerged pump has limitation depend on the weather condition on the sea. To make sub water intake line is the quick solution for emergency, it bring easy water intake just open the both side of pipe and water flow into the pit without any power.

The water reserve tank of this facility has 4 hours capacity, so during normal inspection work for main sea water intake pipe, it is no need to open sub sea water pipe. When the pipe cleaning with Peg takes 5hours, usually the times of cleaning by peg is one per year. In January or February is good chance to do maintenance the pipe. Sub sea water intake pipe is designed just for emergency situation and the capacity is more than 90% of average water consumption. The average daily water consumption of month is 3,371m3/day from table 2-10. Regarding to the Hezen-William's formula, the water intake capacity is introduced as 0.6m3/min(pipe diameter:150mm), 1.3m3/min(pipe diameter:200mm), 2.2m3/min(pipe diameter:250mm). So the diameter of sub water intake pipe for emergency should be more than 250mm and it is available to take 3,168 m3/day. This figure (3,168 m3/day) is equivalent for 94% of average daily water consumption(3,371 m3/day). However, the capacity of sub pipe for emergency will be decrease by time passing with increasing organism attachment, so the water intake capacity of this sub pipe is just for emergency use only. The main sea water intake pipe must be cleaned by scheduled maintenance.

Table 2-10 Planed daily sea water consumption (m3/day)

Month	1	2	3	4	5	6	7	8	9	10	11	12
Brood Stock Tank A	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800
Brood Stock Tank B					1,350	1,350	1,350	1,350				
Brood Stock Tank C	450	450	450	450	450	450	450	450	450	450	450	450
Breeding Tank A . B					225	450	450	375	150			
Breeding Tank C			30	30	30					45	45	45
Multi Purpose Tank A	300	300	300	300	300	300	300	300	300	300	300	300
Multi Purpose Tank B	150	150	150	150	150	150	150	150	150	150	150	150
Biological Feed			55	55	101	101	101	101	101	55	55	55
Total	2,700	2,700	2,785	2,785	4,406	4,601	4,601	4,526	2,951	2,800	2,800	2,800
Average	3,371											

2-2-2-3 Civil Engineering Plan

1) Design Criteria and Conditions

① Codes and Standards applied in the Design
The following technical standard, guidelines and design manuals are used in the Design;

-Design Guidelines for Sewerage Facilities in Japan, 1994 : Japan Sewerage Association
-Roadway Earthworks, Design Guidelines for Retaining Walls; 1999 : Japan Road Association
-Roadway Earthworks, Design Guidelines for Slope Protection; 1999 : Japan Road Association
-Design manual for Concrete Pavement; 1996 : Japan Road Association
-TCXD 51; 1984 Design Standard, Drainage, External networks and facilities : MOC, Vietnam

② Design loads
The following loads are applied;

-Surcharge	Roads, working areas		PL =`T-20, UDL =10.0KN/m^2
	Living areas, other areas		UDL. =5.0 KN/m^2
-Dead loads	Concrete	Reinforced concrete	24.5 KN/m^3
		Mass concrete	23.0 KN/m^3
	Asphalt paving		23.0 Kn/m^3
	Rocks, sand	Rock materials	20.0 KN/m^3
		Back-fill materials	18.0 KN/m^3

③ Safety factors

Analysis Item	Description	Normal condition	Seismic condition
-Stability of retaining wall	For sliding	Not less than 1.5	Not less than 1.2
	For overturning	Not less than 1.5	Not less than 1.2
-Slope stability	Circular slip	Not less than 1.2	-

2) Land Leveling, Retaining Wall and Slope Protection

① Land leveling
As stated in " Design Concept", the first stage leveling work, which is to be carried out by Vietnam Side, has been designed considering an achievable earthwork volume expected within the limited time allocation, and the following arrangement is also considered;

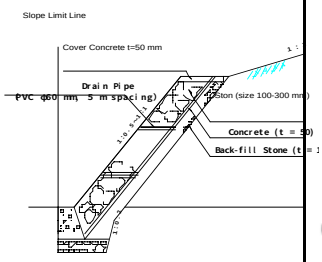
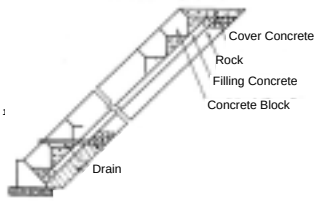
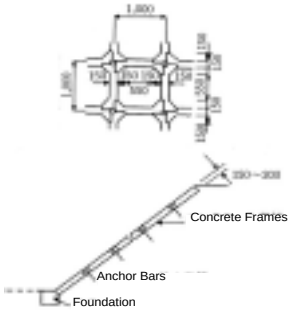
-The hill side boundary be provided with an proper bench since cutting height is considerably large (max. 9.0m).
-The cutting slope of the site boundary areas at 1:2 to 1:3 has been applied to ease a use of construction equipment in the subsequent earthworks for the project.

In the project, the 1:2 to 1:3 slopes will be further excavated at a gradient between 1:0.5 and 1:1 to form the required land areas for the planned facilities with adequate slope protection. And the slopes left as it was are to be protected with vegetation of trees/plants by Vietnam Side.

② Slope protection
Slope protections are provided to the areas where the slope is steeper than 1:1.

(Alternatives for slope protection method)
There are several methods applicable for the slope protection depending on the site conditions. In the design, the following 3 alternatives have been compared as typical and applicable to the project as shown in the following Table2-11.

Table 2-11 Comparison of Slope Protection Alternatives

Item	A. Rock armoring	B. Con. block armoring	C. Precast frames
Typical section			
Method description	-Applicable as protection for weathering/ scouring of slope -Generally used for slopes gentler than 1:1, weak soil or mad stones -Possible to apply to slopes steeper than specified also -Generally applied to slopes lower than 5m or less than 7m in height -drain pipes are required	-Similar applications with Rock armoring is possible -Advantageous to steeper slopes as uniformly constructed concrete blocks are used	-Adopted together with trees vegetation planned onto weak soil/ rock slopes to protect from any surface sliding -Generally slope is gentler than 1:1 -Materials for Frame are concrete, steel or plastic -Typical size of Frame is 1m grid and member size is 15 to 20 cm
Construction aspect	-After placing foundation base rocks placing, backfill concrete/ gravel to follow without any adverse void -Construction is generally easy as typically used	-Almost similar with Rock armoring method -Yard area for fabrication of many numbers of concrete blocks is required and some time for fabrication/ curing is necessary	-After grading slope surface, frames be carefully placed and fixed with steel bars etc. -Difficult to adopt to slopes having irregular surface -Where vegetation of trees is difficult, not applicable
Economical aspect	-Advantageous when abundant rock production is expected	-Generally less economical than rock used type	-If no problem is seen in construction aspect, normally most economical
Evaluation	Most advantageous	Not recommendable	Not recommendable as less reliability for application

(Selection of Slope protection method)
From the above evaluation result, the rock armoring method has been selected as most advantageous in the project.

③ Retaining wall
Where the leveled elevation differs more than 0.5m with adjacent area, a retaining wall is provided for the protection of the leveled land. Along the leveled land limit in front of sedimentation pond, a concrete retaining wall is provided in order to protect the area from possible run-up by strong stream of storm water. Besides the above, a stone masonry type retaining wall is provided since this type is simple and economical than concrete walls.

(Design of concrete retaining wall)
The concrete retaining wall can be divided into two typical types, i.e. rigid gravity type and semi-gravity type. In general, gravity types are advantageous for relatively low height walls, whilst semi-gravity types (L-shaped, reversed T-shaped, etc.) are often applied to high walls as less concrete volume is required than gravity types thus in general more economical.

In this design, L-shaped concrete block type is selected in consideration that an immediate completion of the construction is important after land leveling work.

3) Storm Water Drainage Facility

Storm Water Drainage Facility which is composed of Open Channel, Inside Storm Water Drainage and Storm Water Discharge Culvert has been designed as under-mentioned;

① Open Channel for In-flowing storm water
In order to smoothly discharge in-flowing storm water of outside catchment areas, an open ditch type stone-masonry channel of 5.0 m wide has been provided at total length of about 135m along the bottom edge of the eastern boundary slopes.

a. Run-off volume estimation
The following equation (rational formula) has been used for the estimation;

$Q = 1/360 \cdot C \cdot I \cdot A$ where, Q: run-off volume (m^3/sec.)
C: run-off coefficient
I: design rainfall intensity (mm/hr.)
A: catchment area (ha)

- Catchment Area: From the available topographic map around the site, about 42 ha of the catchment area is estimated.
- Design Rainfall Intensity: Based on the Vietnam Standards on Rainfalls and expected time to reach the site, 113.35 mm/hr is estimated as 10 minutes raining intensity in 50 return years.
- Run-off Coefficient: 0.65 is applied as average value of typically used values under similar natures which is between 0.50 and 0.80.

Therefore, the estimated run-off volume is as follows;
$Q = 1/360 \times 0.65 \times 113.35 \times 42.0 = 8.60\ m^3$/sec.

b. Estimation of Open channel flow capacity
- Channel dimensions: Top width : 4.0 m
Bottom width :1.0 ~2.0 m

Depth : 1.0 ~1.5 m
Side slope : 1:1

- Hydraulic gradient : Upper stream portion : average. 1.10 %
Down stream portion : average. 0.87 %

- Capacity estimation :

Manning's formula is used for the estimation;

$Q = 1/N \cdot R2/3 \cdot I1/2 \cdot A$ where, Q : Flow capacity of channel (m^3/sec.)
N: Manning's roughness coefficient , R = A/S
I : Hydraulic gradient
A : Sectional area of channel (m^2)
S : Area contacting with water (m^2/m)

The estimation results are as follows;

Location	Flow capacity	Max. velocity
Upper stream portion	9.55 m^3/sec.	3.41 m/sec.
Down stream portion	9.92 m^3/sec.	3.18 m/sec.

② Inside Area Storm water Drainage

Storm water drainage facilities for inside project area have been designed adopting 10 year return period rainfall intensity of 98.54 mm/hr.(corresponding to 10minutes continued rainfall intensity) in accordance with Vietnam Standards. Along the inside roads, L-type and U-type concrete ditches are provided with sufficient flow capacity according to the estimated run-off volume. And around the building areas, U-type ditch is used to collect rainfalls anywhere around buildings.

Where the estimated run-off volume exceeds the flow capacity of ditches, a pipe culvert has been introduced. A minimum size of 600 mm diameter for pipe culvert has been applied to ease maintenance of the drainage.

③ Storm Water Discharge Culvert

A box culvert for storm water discharge is provided from the discharge pit to the out-fall at total length approximately 60 m. The location of the out-fall has been determined considering a possible future widening of the planned front road, and the bottom elevation of the culvert is set at +0.60m based on the high tide level (HWLS +0.78) of the site.

The box culvert section has been determined based on the estimated total storm water caught at the discharge pit and design loads imposed to the culvert.

(Discharge capacity estimation of box culvert)

- Dimensions of box culvert used in the design: 1.40 m wide x 1.00 m high x 2 lines
- Hydraulic gradient : I = 0.60 %, Roughness coefficient : 0.012
- Total volume to be discharged Q= 9.41 m^3/sec.

Using the same Manning's formula, the following two cases are estimated and the results are as follows;

Case-1	Normal condition	Q max.= 9.31 m^3/sec.	V max.= 3.50 m/sec.
Case-2	Pressurized condition	Q max. = 10.82 m^3/sec.	V max. = 4.43 m/sec.

4) Road and Paving

The main road and paving within the project land area are designed with concrete paving as is durable under such conditions that seawater is used in the activities and climate is quite hot. The required thickness of the concrete paving is 15 cm considering that design CBR of sub-grade is expected to be more than 8. The sub-roads and other areas to be paved but of less importance are paved with a macadam paving.

5) Sea water Pipe Installation

Seawater pipelines (main pipe dia.400mm, sub pipe dia.250mm) are installed extending up-to －5.0m water depth area from the seawater catchment's pit.
In order to protect the pipes from any accidental damages, the pipes are to be buried with at least 1.0m soil cover, and the elevations of the main pipe center are maintained at －2.2 m at highest.

The water intake facilities are designed so as to be stable against wave/ current actions providing steel-frame structure. A proper navigation light as a warning for passing by boats is also provided at the water intake location.

①Protective Coating

It is anticipated that excessively rust-contaminated water may cause adverse effects to Larvae Rearing. Especially for just incubated larvae that have undeveloped immune system yet, it is still unknown about the influences to the larvae rearing by any alteration of ion balance in seawater, thus it is likely that the outputs of the research may be adversely affected from this alteration.

In addition, the broodstock in spawning season is quite nervous against any alteration of water quality or rearing environment, and it has been proved that such alteration influences to the balance of hormones. It is therefore anticipated that an increase of iron or iron-ion contents may cause adverse effects to spermatozoon, egg-quality, spawning rate or incubating rate.

From the above, an appropriate protective coating for inside pipes against corrosion has to be considered in order to maintain supplying seawater of good quality, since in this project the effective and stable larvae rearing and broodstock rearing are the most important themes.

A comparative study for the selection of an adequate coating has been carried out. And from the study result, Polyethylene coating for pipe insides are selected as most recommendable as shown in the following Table 2-12 .

It is however proposed that for outside surfaces of seawater pipes are to be provided with anti-corrosion painting only from an economical view point as the pipes are buried under seabed where the corrosion rate is relatively low.

Table 2-12 Comparison of Coating Methods

Coating Materials	Tar epoxy	Polyethylene	Nylon	Notes
Corrosion	△	◎ (Rate of water absorption<0.01 %)	○ (Rate of water absorption<0.4 %)	Since steel materials are used, some corrosion will be unavoidable due to damages by dynamic impact, cracks, etc. With tar epoxy, rust is generated in the period of three (3) to five (5) years.
Durability and damage by peg use	– (more than t=0.3mm)	◎ (more than t=1.0mm)	○ (more than t=0.3mm)	Since the thickness of polyethylene coating is thicker, it is more elastic and advantageous for peg use.
Foreign substance adhesion in pipe	–	◎ (Contact angle of water is 81°)	○ (Contact angle of water is 54°)	When the contact angle of water is large, non-adhesiveness is high thus less possibility of foreign substance adherence.
Foreign substance adhesion in pipe	–	○ (Friction coefficient is 0.12)	◎ (Friction coefficient is 0.10)	Smaller the friction coefficient is, less possibility of foreign substance to adhere.
Economical view point	◎	○	–	
Evaluation	It is not used typically recently due that corrosion and foreign substance adhesion are the largest.	Since coating thickness is thicker than nylon, any damage or cracks occur with relatively low possibilities even in use of peg.	There are some examples that nylon coating was changed into polyethylene coating recently due to problem of damages.	
Adoption	-	◎	-	

②Determination Method of Seawater Pipe Section

Though inside pipes is provided with anti-corrosion coating, it cannot be said that such coating is perfectly reliable against corrosion. Furthermore, any damage during peg-used cleaning operation, wearing by sand contained in seawater, excessive corrosion rates than the designed, deterioration of the coating and concentration of corrosion at pin-holed area are all possible causes of pipe corrosion.

To this end, the following methods are generally used to determine the thickness of seawater pipes in due consideration with its importance, application conditions, environmental conditions and economical aspects, as no standardized design method is available;

a) To deign without consideration of the effect of coating. (Corrosion starts immediately)
b) To design with a certain period of coating effect (in year).
c) To design with consideration of a certain corrosion loss of thickness.

As no specific base of the calculation on the above methods has been established yet, Method a) is often used for seawater pipes considering safer design. Therefore, it is intended to adopt this method in this Basic Design.

③Corrosion Rates of Steel Materials

The general design method for corrosion protection for marine structures is explained showing design corrosion rates to be applied in "Technical Standards and Commentaries for Port and Harbour Facilities in Japan". And "Technical Standards for Fishery Ports in Japan", descried that the corrosion loss should be estimated considering for 30 years and corrosion rates of steel should be conformed with the "Technical Standards and Commentaries for Port and Harbour Facilities in Japan".

Moreover, this value has been also used in another published design manual/ recommendation of practice, "Design and Construction of Steel Pipe Piles issued by Japan Steel Pipe Associations". (However, according to some actual measurement of corrosion in Singapore for the past ten years, the highest corrosion rate of the steel observed was around 0.3mm/year to 0.51mm/year.)

In the study, the water intake facilities has been designed to be set at －5.0 m. Therefore, 0.2mm/year for inside pipes and 0.03mm/year for under seabed area are adopted based on the following Standard Values of Corrosion Rates for Steel Materials.

Table 2-13 Standard Values of Corrosion Rates for Steel Materials

Corrosion Environment		Corrosion Rate (mm/year)
Seaside	H.W.L or higher	0.3
	H.W.L～L.W.L-1.0m	0.1～0.3
	L.W.L-1.0m～seabed	0.1～0.2
	Under seabed	0.03
Source: Technical Standards and Commentaries for Port and Harbour Facilities in Japan Note1) 30 years be considered as a standard design time span. Note2) Corrosion rates in the above table are for one side.		

④Applied Code/ Standards

The following design standards are used for design of seawater pipelines.

- Displacement and Bending Stress
- Design Standard for Determining of Wall-Thickness of Buried Steel Pipes for Water Supply,

1999, Japan Association of Water Supply Steel Pipes

- Axial failure and Minimum Thickness of Steel Pipe
- Problems in Designing Steel Pipes and Rational Design Method in determining minimum thickness , 1961, Japan Water Supply Associations

- Corrosion and Protection
- Technical Standards and Commentaries for Port and Harbour Facilities in Japan, Nov, 2001, Japan Port and Harbor Association
- Technical Standards for Fishery Ports in Japan, 1999, Japan Fishery Port Association under Ministry of Fishery
- Design and Construction of Steel Pipe Piles, 1996, Japan Steel Pipe Associations

⑤Examination Conditions

The following design criteria and conditions are used in the examination;

- Diameter of Steel Pipes : D400mm、D250mm
- Material of steel pipe : SGP or STPG
- Corrosion Rate : 0.2mm/year in seawater, 0.03mm/year under seabed
- Allowable rate of displacement (%) : 4.0%
- Allowable bending Stress (kgf/cm^2)：SGP：1,000kgf/cm^2、STPG:1,250kg/cm^2
- Design loading condition：(Loading Type 1：5.9m soil overburden, Loading Type 2：2.0m soil overburden)

⑥Examination of Pipe Section

Based on the design standard, sections of seawater pipes have been examined as follows;

Deformation and Bending stress

$$\Delta x = \frac{2 \cdot K_x (W_v + W_t) R^4}{EI + 0.061 E' R^3}$$

Horizontal displacement

$$\sigma_b = \frac{2}{fZ} \times (W_v + W_t) \times \frac{K_b \cdot R^2 \cdot EI + (0.061 K_b - 0.083 K_x) E' R^5}{EI + 0.061 E' R^3}$$

σb ：Bending stress coefficient at bottom of pipe by external pressure (kgf/cm^2)
f ：Shape coefficient, 1.5
Z ：Section modules of Pipe per unit width Z=t2/6(cm^3/cm)
t ：thickness of steel pipe(cm)
Wv ：Design Vertical load of soil (kgf/cm^2)
Wt ：Design Surcharge load(kgf/cm^2)
R ：Average radius of a pipe (cm)
E ：Elastic coefficient of steel, (E=2,100,000kgf/cm^2)
I ：Moment of Inertia of unit width of pipes, I=t3/12(cm4/cm)
E’ ：Reaction coefficient of soil (kgf/cm^2)
Kb ：Bending stress coefficient at bottom of pipe
Kx ：Horizontal deformation coefficient

△X ：Horizontal displacement (cm)

Table 2-14 Result of calculation for Seawater Pipes (SGP)

Case No.	Case1-1 Loading Type 1	Case1-1 Loading Type 2	Case1-2 Loading Type 1	Case1-2 Loading Type 2	Case2-1 Loading Type 1	Case2-1 Loading Type 2	Case2-2 Loading Type 1	Case2-2 Loading Type 2
Examination years	After 5 years				After 10 years			
Pipe Type (ID)	D250mm (254.2mm)		D400mm (390.6mm)		D250mm (254.2mm)		D400mm (390.6mm)	
Thickness (mm)	6.6		7.9		6.6		7.9	
Amount of corrosion at inside face of pipe (mm)	1		1		2		2	
Amount of corrosion at outside face of pipe (mm)	0.15		0.15		0.3		0.3	
Design thickness (cm)	0.545		0.675		0.430		0.560	
Calculation radius (cm)	13.0825		19.9675		13.1250		20.0100	
Section modules (cm^3/cm)	0.0495		0.0759		0.0308		0.0523	
Moment of Inertia (cm4/cm)	0.0135		0.0256		0.0066		0.0146	
Vertical load of soil Wv (kgf/cm^2)	1.04	0.20	1.04	0.20	1.04	0.20	1.04	0.20
Design surcharge load Wt(kgf/cm^2)	0.03	0.0	0.03	0.0	0.03	0.0	0.03	0.0
Horizontal displacement Δ x(cm)	0.2	0.04	0.54	0.10	0.38	0.07	0.87	0.16
Allowable rate of deformation (%)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Rate of deformation (%)	0.76	0.15	1.35	0.25	1.45	0.27	2.17	0.40
(1-1) Examination by rate of deformation	○	○	○	○	○	○	○	○
Allowable bending stress (kgf/cm^2)	1000	1000	1000	1000	1000	1000	1000	1000
Bending stress at bottom of pipe (kgf/cm^2)	734	137	1067	199	1126	210	1456	272
(1-2) Examination by stress	○	○	×	○	×	○	×	○
Allowable Axial failure load (kgf/cm^2)	42.10	42.10	22.89	22.89	20.68	20.68	13.25	13.25
Axial failure (kgf/cm^2)	1.605	0.300	1.605	0.300	1.605	0.300	1.605	0.300
(2) Examination by Axial failure	○	○	○	○	○	○	○	○
Minimum thickness (mm)	2.6355	2.6355	2.9765	2.9765	2.6355	2.6355	2.9765	2.9765
(3) Examination by minimum thickness	○	○	○	○	○	○	○	○

Table 2-15 Result of calculation for Seawater Pipes (STPG)

Case No.	Case4-1 Loading Type 1	Case4-1 Loading Type 2	Case4-2 Loading Type 1	Case4-2 Loading Type 2	Case5-1 Loading Type 1	Case5-1 Loading Type 2	Case5-2 Loading Type 1	Case5-2 Loading Type 2
Examination years	After 15 years				After 20 years			
Pipe Type (ID)	D250mm (251.8mm)		D400mm (387.4mm)		D250mm (251.8mm)		D400mm (387.4mm)	
Thickness (mm)	7.8		9.5		7.8		9.5	
Amount of corrosion at inside face of pipe (mm)	3		3		4		4	
Amount of corrosion at outside face of pipe (mm)	0.45		0.45		0.6		0.6	
Design thickness (cm)	0.435		0.605		0.320		0.490	
Calculation radius (cm)	13.1075		19.9725		13.1500		20.0150	
Section modules (cm^3/cm)	0.0315		0.061		0.0171		0.0400	
Moment of Inertia (cm4/cm)	0.0069		0.0185		0.0027		0.0098	
Vertical load of soil Wv (kgf/cm^2)	1.04	0.20	1.04	0.20	1.04	0.20	1.04	0.20
Design surcharge load Wt(kgf/cm^2)	0.03	0.0	0.03	0.0	0.03	0.0	0.03	0.0
Horizontal displacement Δ x(cm)	0.37	0.07	0.71	0.13	0.8	0.15	1.19	0.22
Allowable rate of deformation (%)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Rate of deformation (%)	1.41	0.27	1.78	0.33	3.04	0.57	2.97	0.55
(1-1) Examination by rate of deformation	○	○	○	○	○	○	○	○
Allowable bending stress (kgf/cm^2)	1250	1250	1250	1250	1250	1250	1250	1250
Bending stress at bottom of pipe (kgf/cm^2)	1103	206	1284	240	1787	334	1780	333
(1-2) Examination by stress	○	○	×	○	×	○	×	○
Allowable Axial failure load (kgf/cm^2)	21.48	21.48	16.63	16.63	8.71	8.71	9.07	9.07
Axial failure (kgf/cm^2)	1.605	0.300	1.605	0.300	1.605	0.300	1.605	0.300
(2) Examination by Axial failure	○	○	○	○	○	○	○	○
Minimum thickness (mm)	2.6295	2.6295	2.9685	2.9685	2.6295	2.6295	2.9685	2.9685
(3) Examination by minimum thickness	○	○	○	○	○	○	○	○

From the above result, it is required that for on-shore area (Loading Type1) “STPG pipe” or “SGP with reinforcement are to be used”
Accordingly, these two (2) cases are further examined and the results are shown in the Table below.

Table 2-16 Comparison of SGP with reinforcement and STPG

Item	SGP with Reinforcement	STPG
Economical View Point	More economical than STPG	Higher cost than SGP is required
Construction	Encase with reinforcement concrete	Not reinforcement required
Repair	It is necessary to excavate and reconstruct of concrete encasement	Excavation only

Source: JICA Study

Based on the above result, the reinforced SGP pipes are adopted in the design from an economical view point, though some issue on its repair is seen.

6) Other Related Works

In addition to the above civil works, the following ancillary works are provided in the basic design;

- Guardrail; along the open channel for safety
- Safety fence; at discharge pit (net fence of 2.0 m high)

2-2-2-4 Building Plan

1)Ground Plan

The main facilities planned under the Project are described below.

①Administration and Research Building
This building will consist of five sections, i.e. administration section, three research sections (research on fish rearing, research on biotechnology and research on environment and fish-pathology) and communal section incorporating a meeting room and library, etc. The research blocks will be located on the highest place in the site.

②Broodstock Tank facility
This facility will be consist of one tank (100 m^2) and two tanks (60 m^2 each). Each tank will have an octagonal shape in view of good workability and the two tanks for grouper will be managed as a single group for a better rearing performance.

③Breeding and Rearing Building
This building will house such rooms related to the rearing of fry as the feed culture room, breeding tank room, fry tank room and multi-purpose tank room. For the locationing of each room, the optimal line of flow to the blood stock tank building will be taken into careful consideration.

④Machine Building
This building will consist of the power room, generator room, pump room, blower room and elevated water tank yard. The power room will be located adjacent to the generator room while the pump room and blower room will be placed next to each other. The elevated water tanks will be installed above the pump room to facilitate piping work and the elevation of the tank bottom will be set at +20.00 m. The floor area of each room in each planned building under the Project is listed in the Table2-17 below.

Local materials and methods will be used as much as possible for the building finishing work. The planned finishings are listed Table 2-18.

Table2-17 Floor Area

Building	Floor	Room	Floor Area (m^2)	Equation to Calculate Floor Area
Administ-ration and Research		Total	1,201.89	
	Ground	Environmental Pathology Office	42.50	8.125 x 6 – 4.125 x 2
		Nutrition and Metabolism Office	30.00	5 x 6
		Nutrition and Metabolism Laboratory	24.75	4.125 x 6
		Washing and Sterilisation Room	36.00	6 x 6
		Chemical Laboratory	60.75	10.125 x 6
		Microscope and Culture Room	38.00	6.3 x 6
		Sterilisation Room	10.00	5 x 2
		Entrance Hall and Staircases	52.87	6 x 8.81
		Library	60.00	8 x 7.50
		Live Feed Office	24.00	4 x 6
		Live Feed Laboratory	48.75	8.125 x 6
		Men's Toilet	18.00	6 x 3
		Women's Toilet	18.00	6 x 3
		Night Shift Room	10.00	4 x 2.5
		Night Shift Room	9.10	2.6 x 3.5
		Corridors, etc.	152.84	
		Sub-Total	631.50	
	First	Director's Office	36.75	6 x 6.125
		Assistant Director's Office	30.00	5 x 6
		Planning and Accounting Office	36.00	6 x 6
		General Affairs Office	48.75	8.125 x 6
		Kitchenette	12.00	4 x 3
		Meeting Room	72.00	12 x 6
		Storage Room	12.00	2 x 6
		Specimen Room	18.00	3 x 6
		Men's Toilet	18.00	6 x 3
		Women's Toilet	18.00	6 x 3
		Blood stock Rearing Office	24.75	4.125 x 6
		Culture Technology Office	30.00	5 x 6
		Fry Rearing Office	30.75	5.125 x 6
		Night Duty Room	10.00	4 x 2.5
		Night Duty Room	9.10	2.6 x 3.5
		Storage Room	12.00	2 x 6
		Corridors, etc.	170.32	
Broodstock Tank		Total	570.39	
	Ground	Blood stock Tank Room	570.39	

Building	Floor	Room	Floor Area (m^2)	Equation to Calculate Floor Area
Breeding and Rearing		Total	1,512.00	
	Ground	Fry Rearing Tank Room	909.75	42 x 24,14 x 6,3 x 4.75
		Multi-Purpose Tank Room	336.00	14 x 24
		FRP Tank Room A	70.25	7 x 10.75 – 2 x 2.5
		FRP Tank Room B	70.25	7 x 10.75 – 2 x 2.5
		Records Room	14.25	3 x 4.75
		Zooplankton Culture Room	42.00	7 x 6
		Phytoplankton Culture Room	42.00	7 x 6
		Toilet	5.00	2 x 2.5
		Corridors, etc.	22.50	
Machine		Total	374.00	
	Ground	Power Room	84.00	12 x 7
		Emergency Generator Room	24.00	6 x 7
		Pump Room	70.00	10 x 7
		Air Blower Room	40.00	10 x 4
		Storage Room	10.20	6 x 1.7
		Staircase	13.80	6 x 2.3
		Sub-Total	242.00	
	First	Staircase, etc.	132.00	12 x 11
	Rooftop	Elevated Water Tank Yard	0.00	
Seawater Tank		Total	377.00	
	Ground	Seawater Tank	377.00	20 x 16 ＋ 57
Pump Room		Total	64.25	
	Ground	Pump Room	64.25	7 x 9.5 – 1.5 x 1.5
Guard Room		Total	4.00	
		Guard Room	4.00	2 x 2
Gross Floor Area of the Centre			4,205.14	

Table 2-18 Finishing Plan (External)

BUILDING	FINISHING
BUIL.MANEGEMENT&RESERCH	ROOF ： CONCRETE MONOPOLITHIC SURFASE FINISH,CLAY TILE ROOFING ON THE SPOT CANOPY: CONCRETE MONOPOLITHIC SURFASE FINISH,COVER MORTAR EXTERNAL WALL：BRICK WALL,MORTAR BRUSH FINISH ACRYLIC RESIN PAINTING BASEBOARD：PITCHING GRANITE ON THA SPOT(AT RANDOM) COLUMN&BEEM：CONCRETE,MORTAR BRUSH FINISH ACRYLIC RESIN PAINTING FITTINGS：ALMINUM SASH PORCH：PITCHING GRANITE ON THA SPOT(AT RANDOM)
HATCHERY&BREEDING TANK HOUSE	ROOF:FORMED STEEL SHEET(CORRGATED FLUOROPOLYMER COATED),FORMED POLYCARBONATE SHEET TOPLIGHT EXTERNAL WALL：BRICK WALL,MORTAR BRUSH FINISH ACRYLIC RESIN PAINTING BASEBOARD：MORTAR BRUSH FINISH ACRYLIC RESIN PAINTING COLUMN&BEEM:ANTI-CORROSIVE PAINT,POLYURETHANE RESIN FINISH FITTINGS：ALMINUM SASH
MATURAITION TANK HOUSE BROODSTOK SEA WATER RESERVIOR TANK	ROOF:FORMED STEEL SHEET(CORRGATED FLUOROPOLYMER COATED),FORMED POLYCARBONATE SHEET TOPLIGHT COLUMN&BEEM:ANTI-CORROSIVE PAINT,MARINPAINT
MACHINE HOUSE SUCTION PUMP HOUSE GUARDSMAN HOUSE	ROOF：CONCRETE MONOPOLITHIC SURFASE FINISH,COVER MORTAR EXTERNAL WALL：BRICK WALL,MORTAR BRUSH FINISH ACRYLIC RESIN PAINTING BERM:MORTAR BRUSH FINISH

Finishing Plan (Internal)

BUILDING · ROOM		FINISHING		
		FLOOR	WALL	CEILING
BUIL.MANEGEMENT& RESERCH	LABORATRY CHEMICAL LABORATORY ENVIROMENT&FISH DIS -EASE STAFFS'R. SPECIMEN ROOM	FLOOR:EPOXY RESINE BASEBOARD:HARDWOOD	MORTAR EP	PB t 12 EP
	WASHING&STERILIZATION ROOM	FLOOR:EPOXY RESINE BASEBOARD:HARDWOOD	MORTAR EP	FIBRECEMENT BOARD t 6 EP
	STAFFS'ROOM LIBRARY DIRECTOR'S ROOM VICE DIRETOR'SROOM DEPERTMENTOF GENERAL AFFAIRS CONFERENCE ROOM NIGHT DUTY ROOM	FLOOR:PVC TILE BASEBOARD:HARDWOOD	MORTAR EP	PB t12 EP
	ENTRANCE HALL CORRIDOR	FLOOR:PITCHING GRANITE ON THE SPOT BASEBOARD:HARDWOOD	MORTAR EP	PB t12 EP
	TOILET	FLOOR:PORCELAIN TILE	PORCELAIN TILE	
HATCHERY&BREEDI-NG TANK HOUSE	HATCHERY TANK ROOM PROPAGATION TANK R. BREEDING TANK ROOM MULTIPURPOSE TANK R.	FLOOR:FLOORHARDNER BASEBOARD:MORTAR	MORTAR EP	ROOFING RESERVE SIDE
	RECORDING ROOM CORRIDOR			FIBRECEMENTBOARDt6 EP
	TOILET	FLOOR:PORCELAIN TILE	PORCELAIN TILE	FIBRECEMENTBOARD t6 EP
MATURAITION TANK HOUSE BROODSTOK	MATURATION TANK R.	FLOOR:FLOORHARDNER	NIL	ROOFING RESERVE SIDE
	STORAGE	FLOOR:FLOORHARDNER	MORTARSTEELTROWEL	CEMENT TOUCH-UP
MACHINE HOUSE	TRANSFORMER ROOM GENERATOR ROOM BROWERSMACHINE ROOM PUMP ROOM STORAGE	FLOOR:FLOORHARDNER BASEBOARD:MORTAR	MORTARSTEELTROWEL	HEAT INSULATION BOARD
SUCTION PUMP HOUSE	PUMP ROOM	FLOOR:FLOORHARDNER BASEBOARD:MORTAR	MORTARSTEELTROWEL	HEAT INSULATION BOARD
GUARDSMAN HOUSE	ROOM	FLOOR:PVC TILE	MORTAR STEELTROWEL EP	PB t12 EP

2)Section Plan

For the planning of the cross-section of each building, emphasis is placed on (i) skilful integration to the land which is prepared to suit the sloping site, (ii) due consideration of the rational as well as economical supply and drainage of fresh seawater which is the life-source of the Centre and (iii) proper consideration of strong sunshine, high temperature and intensive rain during the rainy season.

①Administration and Research Building
For this central building of the Centre, sufficient air space per person is planned for the offices and other rooms for the purposes of containing the rise of the room temperature and facilitating ventilation. The ceiling of the corridors, offices and laboratories, etc. will be sufficiently high to provide a large air space per person to reduce the air-conditioning load. For the exterior, deep eaves are planned to obstruct direct sunshine.

②Blood stock Building
The sloping land will be skilfully used to make a shallow drainage channel and vehicle approach from the south to the tanks is planned. A storage area for the storage of outdoor equipment is planned in a space under the floor which will be created through the skilful manipulation of the sloping land.

③Breeding and Rearing Building
The sloping land will be skilfully used to make a shallow drainage channel. Ground-level approach to the building from the south is planned.

④Machine Building
The floor height is determined by the height of the high voltage incoming panel to be installed in the power room. The height of the elevated water tanks is determined to create the required water pressure to supply seawater and fresh water to the administration and research building.

⑤Pump Room
As the water level of the water intake basin at the lower section of the building will fluctuate in accordance with the tide, the elevation of the pump room is determined by the pumping capacity at the lowest water level during low tide.

3)Structural Plan

The structure of the planned buildings will be a RC rigid structure with brickwork walls which is the most popular construction method in Viet Nam. However, the administration and research building will have brick-faced RC walls. A rigid structure with steel bracing will be adopted for both the blood stock tank building and the breeding and rearing building because of their large span. The Structure Plan is shown in able 2-19.

Table 2-19 Structure Plan

Building	Total Floor Area (m^2)	Building Area (m^2)	Storys Above Ground	Type of Structure	Framework	Type of Foundations
1 Administration and Research Building	1,201.89	631	2	RC	Rigid frame	Spread
2 Blood stock Tank Building	672	672	1	Steel-frame	Rigid with bracing	Spread
3 Breeding and Rearing Building	1,512	1,512	1	Steel-frame	Rigid with bracing	Spread
4 Machine Building	374	242	2	RC	Rigid frame	Spread
5 Pump Building	64	64	1	RC	Rigid frame	Spread
6 Seawater Tank	377	377	1	Steel-frame		Spread
7 Guard Room	4	4	1	Brick masonry		Spread

4) System plan

Sea water Supply System Plan

The Sea water Supply System Plan is shown as follows chart.

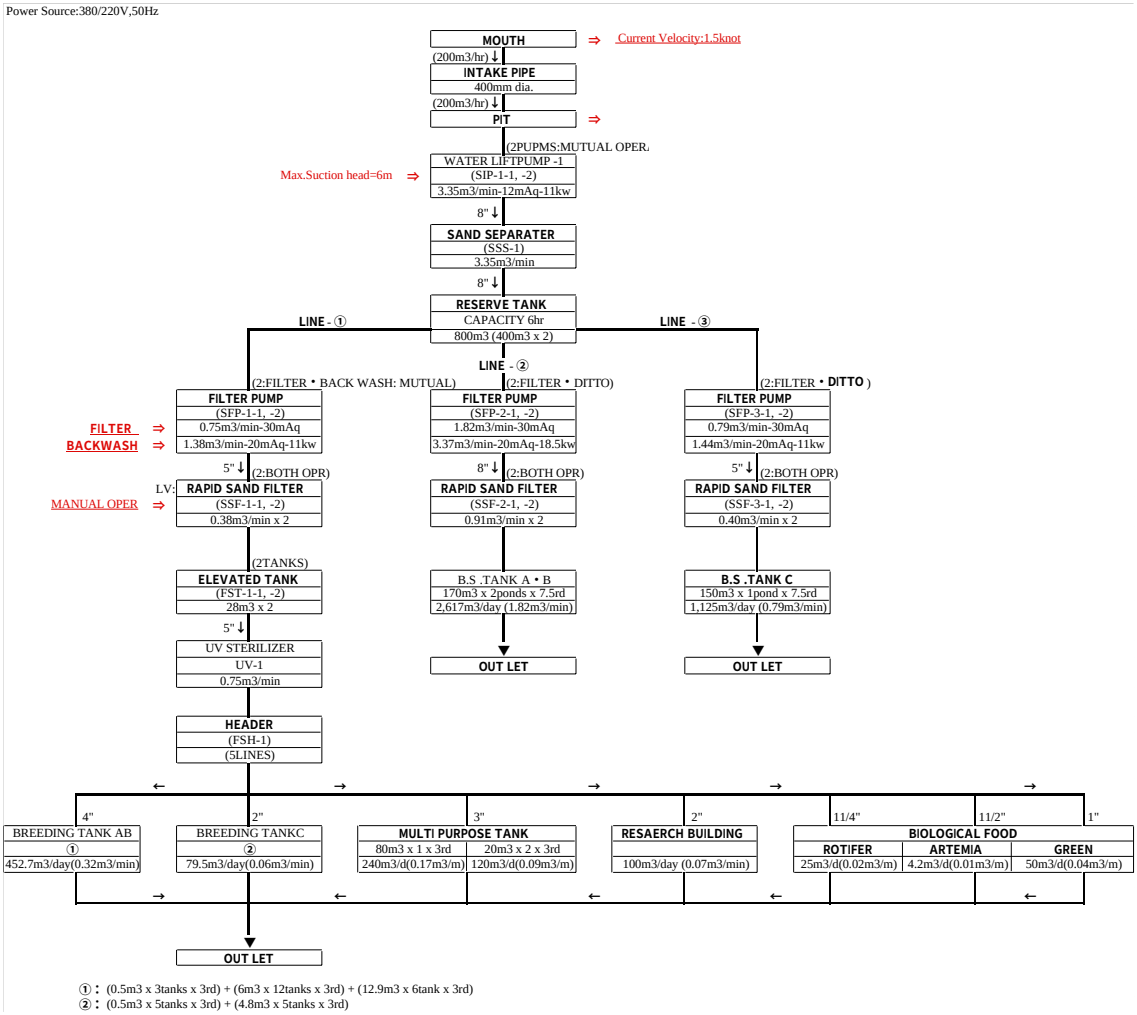


Fig. 2-3 Sea Water Supply Flow

Drainage System Plan

As there is no public sewer channel serving the site, water drainage and treatment will be conducted on the site. Foul water and miscellaneous waste water from the Centre's facilities will be treated in accordance with WHO standards and supernatant will be discharge while deposited solid matter will be collected. Waste water from the breeding facilities will be guided into a sedimentation tank for the purpose of removing deposited fish excrement and other solid matter and the supernatant will be discharged. In the case of predacious marine fish, since 6.67% of live feed is converted into BOD (Fish Nutrition and Feed: Koseisha Koseikaku), and 15 kg/day of feed will be given to groupers (assuming provision of the saturation amount once every two days) and 15 kg/day to milkfish, making 30 kg of feed per day, the resulting BOD will be as follows: 30 kg/4600 m^3 = 6.5 ppm. Concerning domestic wastewater, assuming the target personnel to be 109, design sanitary sewage flow to be 60 L/person (60 L x 109 = 6540 L), and BOD load to be 5 g/person (5 g x 109 = 545 kg/day), BOD will be as follows: 545 g/day ÷ 6540 L = 84.5 mg/L.

If supernatant from domestic wastewater is discharged into the ocean together with rearing wastewater, total BOD will be (30 kg + 545 kg)/4600 m^3 = 6.6 ppm. This clears the Viet Nam's environmental standard of 50 ppm. Therefore, supernatant liquid from toilet wastewater shall be discharged following removal of settled night soil and solids.

Aeration Equipment Plan

The standard aeration flow, based on the reference flow of 0.5 L/min/m^3 for freshwater and taking into account seawater oxygen saturation (12.5% increase) and the freshwater/seawater ratio (12.5% increase), will be as follows:

0.5 L/min/m^3 x 1.25 x 1.25 = 0.78 L/min/m^3

Since 1,992 m^3 of water will be held in the Project facilities, the hourly air requirement will be as follows:

0.78 L/min/m^3 x 1992 m^3 = 1.6 L/hr/m^3

Assuming the required discharge air pressure to be 0.5 kg/cm^2, total discharge will be 8.16 m^3/min. Therefore, blower capacity will be 11 kW. The aeration system drawing is shown in Figure 2-4.

Air Supply System Plan

The Air Supply System Plan is shown as follows chart.

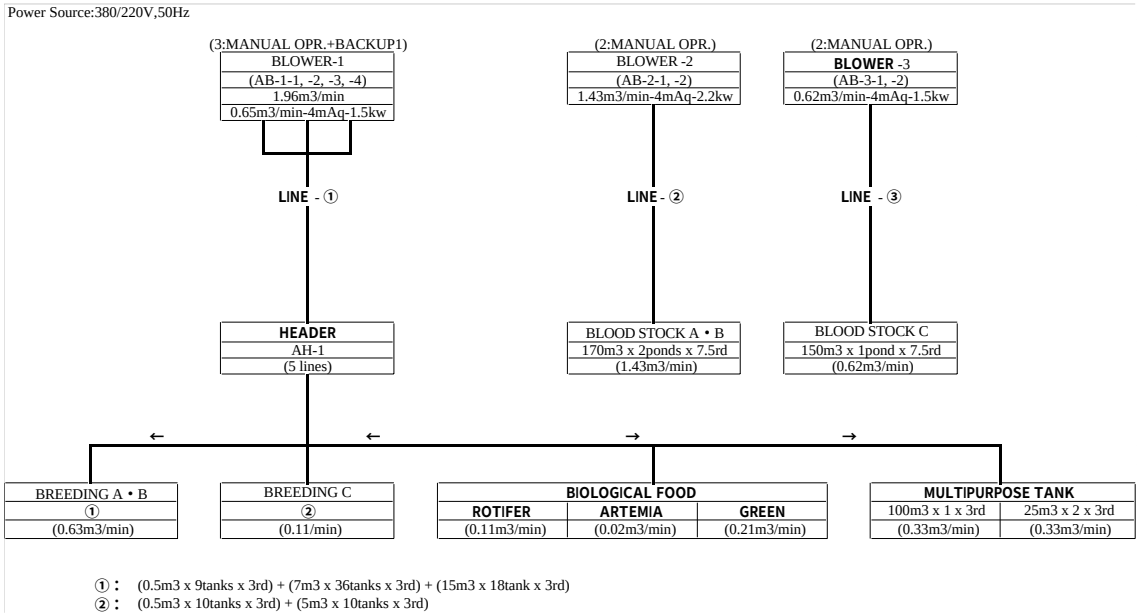


Fig.2-4 Air supply flow

Electrical Installation Plan

①Power Receiving and Transformation System

Power supply to the Centre will be made from the 35 kV overhead distribution line of the power company which runs along the road in front of the site and the supply capacity of this line is sufficient.

An overhead cable will be extended to the site (the cost of this work will be borne by the recipient country) and a 35 kV underground cable will be laid from the service connection point to a 35 kV class transformer to be installed in the power room to step down to 380/220 V. This transformer will, therefore, be the direct power source for lighting, receptacles and power equipment inside the various buildings. The estimated power load is shown in the table below.

Table 2-20 Electrical Installation Plan

Load Item	Installed Capacity (kVA)	Assumed Demand Factor	Simultaneous Operation Load (kVA)
A. Receptacles	82.8	0.75	62.10
B. Lighting	48.7	0.70	34.10
C. Air-Conditioning/Ventilation	62.9	0.80	50.37
D. Building Service Equipment	71.35	1.00	71.35
E. Equipment	24.00	1.00	24.00
F. Others	22.4	0.70	15.54
Total			257.46

257 kVA x 1.2 = 308.4 kVA

Based on the above examination, the required electric capacity is estimated to be approximately 300 kVA.

②Generator

Given the unreliable power supply situation and frequent occurrence of power cuts, a diesel generator with an automatic start-stop function will be installed to ensure the continual operation of the Centre. The required generator capacity is estimated as follows.

A. Receptacle load	:	3 kVA (part of the administration and research building)
B. Lighting load	:	1.8 kVA (as above)
C. Building service systems load	:	70.11 kVA
D. Equipment load	:	4 kVA
E. Other load	:	5.24 kVA
Total	:	84.15 kVA

Based on the above examination, the required generator capacity is estimated to be approximately 100 kVA.

③Trunk Power Lines

Electricity supply to the distribution panels, power panels and equipment switches will be made from a low voltage main distribution panel to be installed inside the power room in the machine building. Trunk power lines will be rationally planned to avoid any adverse impacts of an electrical accident in one zone on other areas. In principle, wires will be buried underground and cross-linked polyethylene-insulated wire will be protected by conduit piping.

④Power Plants

Electricity supply to such power plants as pumps, air blowers, filtering system, sterilisation system and air-conditioners, etc. will be made from the distribution panel or power panel. In principle, cross-linked polyethylene-insulated wires protected by conduit piping will be used for wiring.

⑤Receptacles

Two types of receptacles will be provided, i.e. general-purpose receptacles to be provided in various offices and rooms and exclusive receptacles for rearing equipment, etc. The shape will be European-style round pins (13 A). Electricity supply will be made via PVC wire protected by conduit piping to each receptacle which is placed in a housing created in a concrete body or brick wall.

⑥Lighting

Lighting will mainly be provided by fluorescent lamps. V-shape type light will be used for the various types of offices while waterproof light fittings with an acrylic cover will be used for the rearing rooms. Fittings which are easy to maintain and replace will be considered for other rooms. Given the proximity of the sea, the salt resistance performance of these fittings will be taken into careful consideration. Electricity supply will be made via PVC wires protected by conduit piping, in turn placed in concrete slabs. The illuminance standards listed below will be adopted.

Rearing room	:300 lux (floor surface)
Office (research)	:500 lux (table top)
Office (administration)	:400 lux (desk top)
Auxiliary room	:200 lux (floor surface)
Toilet and storage room	:150 lux (floor surface)
Corridor	:150lux (floor surface)

2-2-2-5 Equipment Plan

1) Basic Concept

The basic concept for the equipment plan is as follows:

① Since the main objective of the Project is to research and develop technology for mass-producing marine fish nursery stock, top priority shall be given to supplying equipment needed for establishing the said mass production technology.

② The scale and specifications of equipment shall be matched with existing technical levels in Viet Nam; equipment that can be shared between different departments shall be jointly used; and maximum care shall be taken to avoid redundancy of equipment.

③ Equipment that is easy to operate and maintain and poses no problems in terms of maintenance and parts supply shall be selected.

④ Ample consideration shall be given to environmental impact. Wastewater from the research block shall undergo sedimentation treatment before final discharge.

2) Basic Equipment Plan by Field of Research

The following equipment shall be supplied to each field of research.

① Research on maturation of broodstock
Equipment that is indispensable for research from the securing of superior broodstock to maturation and spawning shall be supplied. The following equipment shall be supplied: live fish transportation truck for carrying and securing broodstock to the facilities; small fish PIT tag system for measuring body size of spawning broodstock and reproduction broodstock, checking for fish diseases, and observing rate of growth, etc.; liquid nitrogen jar for storing broodstock sperm; net preserve equipment for rearing candidate broodstock fish in sea net preserves; and a small workboat for feeding fish and performing net replacement work. These items shall be shared with all the other fields of research.

② Research on nursery stock production technology
Equipment that is indispensable for research of nursery stock production from incubation to young fish rearing shall be supplied. Incubation tanks (500 L) for spawned eggs, and a universal projector for observing young fish shall be supplied. Also, as common equipment for use with other fields, a biological microscope and stereomicroscope for observing zooplankton and photo plankton in spawning and rearing tanks, and a refrigerator for storing egg and young fish specimens shall be supplied.

③ Research on live food
Equipment shall be supplied for carrying out mass cultivation of initial live food for the

young fish that are essential for nursery stock production. As equipment for cultivating and storing large quantities of seeds for initial live food, an illuminated incubator for viewing microscopic algae, and a biological microscope and universal projector for observing the culture status of zooplankton and photo plankton shall be installed. Furthermore, as common equipment for use with other fields, a spectrophotometer and colony counter for measuring and counting the photo plankton propagation rate, and a CO_2 incubator for conducting fast photo plankton cultivation shall be supplied.

④Research on intermediate nursery stock rearing technology
Equipment that is indispensable for carrying out intermediate nursery stock production from young fish to fry shall be supplied. As equipment for measuring environmental factors in rearing ponds, water quality monitoring equipment, BOD measuring device, COD meter shall be supplied. Also, as common equipment for use with other fields, net preserves for carrying out surface rearing of fry, truck, workboat, PIT tag system for observing growth, etc., stereomicroscope, and a portable dry ice plant for storing and carrying specimens of sick fish, etc. shall be supplied.

⑤ Research on nutrition
As equipment for improving nutrition of spawning broodstock and performing research and development on food mix proportions in each stage from young fish to adult fish, a spectrophotometer shall be supplied for analyzing the composition of raw materials and products.

⑥ Research on fish diseases and environment
As the minimum required equipment for preventing diseases in broodstock and young fish and conducting research into fish diseases, a set of PCR equipment for conducting rapid diagnosis of diseases shall be supplied. Concerning environmental research, equipment that is indispensable for measuring, studying and researching the rearing environment and indicators of water quality and environment in surrounding seawaters shall be supplied. For measurement of rearing environment water and general water in surrounding sea, a water quality monitoring device, sampling devices, sediment samplers, BOD monitor, and COD monitor, etc. shall be supplied.

3) List of Equipment and Materials

The list of equipment and materials is indicated in Table 2-21, and the list of related expendables is given in Table 2-22.

Table 2-21 Equipment List

	Item	Q'ty	Specification
1	VTR ・ Monitor	1 Set	VTR and 21 inch monitor TV
2	Overhead Projector with Screen	1 Unit	Lamp:36V400W Halogen, with screen
3	Slide Projector	1 Unit	Lamp:24V250W, Slide tray:80 slide
4	Refrigerator	3 Unit	Capacity:Approx.300L(Cooling:240L, Freezing:60L)
5	Automatic Scale	1 Set	Capacity：30kg、Graduation：100g
6	Electric Scale (2000g/100mg)	1 Set	Capacity：2,000g、Graduation：10mg
7	Electric Scale (300g/0.1g)	1 Set	Capacity:310g, Graduation:0.1g
8	Analytical Balance (300g/0.1mg)	2 Set	Capacity:310g, Reading limit:0.1mg
9	Truck with Crane	1 Unit	Capacity：Approx. 2.5ton、Crane Hanging capacity：Max. Approx.2ton、
10	Microscope (Bright field observation)	2 Set	Tri-nocular biological microscope for research, magnification:40x～1000x, Fungicide-proof
11	Microscope （Stereoscopic）	2 Set	Stereoscopic Microscope for research、 Magnification：more than 45times、
12	Fluorescent Microscope with Photography System	1 Set	Incident -light fluorescent observation, objective:4x,10x,20x,100x, including camera and photography system
13	Profile Projector	1 Unit	Dia. screen：250mm、Lens：10x、20x、50x、Digital Micrometer Head、Measuring range：50x50mm
14	Incubator	1 Unit	Temperature range: Ambient temp.～60℃, Capacity: Approx.150L, Digital PID control
15	Incubator with Illuminator for fine plankton	2 Unit	Effective dimension：Approx. W500×D500×H1,100mm、Capacity：Approx.250L、illuminance：20,000lux or more、Digital control
16	CO2 Incubator	1 Unit	Capacity:120L or more, digital PID control, Temperature range:5-50℃,Carbon dioxide range:0-20%
17	Cooling Chamber	1 Unit	Temperature range:-10～+45℃, Capacity:400L or more, Digital PID control
18	Shaker	2 Unit	Table Dimension:Approx.300x250mm,Shaking speed:20-200rpm, Shaking range:10-40mm, digital display, Bottle holder: Spring net/stick sheet shaking table
19	Wave Motion Type Shaker	1 Unit	Movement: Horizontal, vertical, Swivel, shaking speed:20-120rpm, Angle of gradient:1-10, Culture tube, Micro tube, rack for petri dish
20	Platform Shaker	1 Unit	Swivel ・ shaking type, Spring net, Shaking table:400x300mm
21	Quick Loader （Seesaw Shaker）	1 Unit	Horizontal rotary seesaw type, with pump, Shaking speed:20～60 rpm, Angle of gradient:10℃, Shaking table:300x200mm
22	Low Temperature Refrigerator（-80℃）	1 Unit	Temperature:-80℃,Capacity:300L,
23	Plankton Net	2 Set	For phytoplankton, for zooplankton
24	Brood stock culture cages（6mx6mx5m）	4 Set	Net type : Tetron knotless, Mesh:8knots/6 inch, 14 knots/6 inch

NO	Item	Q'ty	Specification
25	Vessel	1 Unit	Length:7m, Ouboardengine:40Hp
26	PIT Tag System	1 Set	Fish identifying system, reader, Reading speed:120mm/s, Detecting distance:10cm, Display:LCD16 digit, Tag:Dia.2.1x11mm, 1000pcs
27	Water Monitoring Apparatus	2 Unit	WT, PH, Salinity, DO, SS, ORP, Ammonia, Nitrate ion, Depth of water:20m or more
28	Biological Oxygen Demand (BOD)Meter	1 Unit	Test method : 5 days, 6 bottle type
29	Chemical Oxygen Demand (COD) Meter	1 Unit	Dichromate process, 0-1000mg/l
30	Water Sampler	1 Unit	Van Dorn water sampler, Capacity:3L
31	Bottom Sampler	1 Unit	Smith-McIntyre bottom sampler, Area Collected Sample:22x22cm
32	Submersible Pump	1 Unit	Dia. 25mm, discharge capacity:100liter/min., Pump head:6m, 220V/50Hz
33	Artemia hatchery Water tank	25 Set	Capacity:500L, Made of polycarbonate
34	Hatchery Tank	11 Set	Capacity:500L, Made of polycarbonate
35	Blower	1 Set	Output:2HP, Wind capacity:300L/min. Pressure:0.02Mpa, 3phase 380V/50Hz
36	Portable Dry Ice Making Machine	1 Set	Portable dry ice making machine, Capcity:1kg/6 block/1operation. Gas: Liquid CO2
37	Liquid Nitrogen Storage	1 Unit	LN2 capacity:30L, Dimension:660x440mm, Dia.63.5mm, No. of canister:6, with caster LN2 capacity:30L, Dimension:660x440mm, Dia.63.5mm, canister:6, with caster
38	Water Bath	1 Unit	Temperature: Ambient temperature～70℃, tank capacity:26L or more, with cover
39	Clean Bench	2 Unit	Automatic flow control, outer dimension:Approx.W1200xD700mm, with ultraviolet lamp
40	Changeable Digital Pipette （0.5-10μl）	3 pcs	Capacity:0.5-10ul
41	Changeable Digital Pipette （2-20μl）	3 pcs	Capacity : 2-20ul
42	Changeable Digital Pipette （10-100μl）	3 pcs	Capacity : 10-100ul
43	Changeable Digital Pipette （20-200μl）	3 pcs	Capacity : 20-200ul
44	Changeable Digital Pipette （100-1000μl）	3 pcs	Capacity : 100-1000ul
45	Changeable Digital Pipette（1000-5000μl）	3 pcs	Capacity : 1000-5000ul
46	Chip for Pipette	25 Set	Each 1000pcs/bag
47	Changeable Multi Channel Pipette (8 channel) （5-50μl）	1 pcs	8 channel, 5-50ul
48	Changeable Multi Channel Pipette (8 channel) （50-250μl）	1 pcs	8 channel, 50-250ul

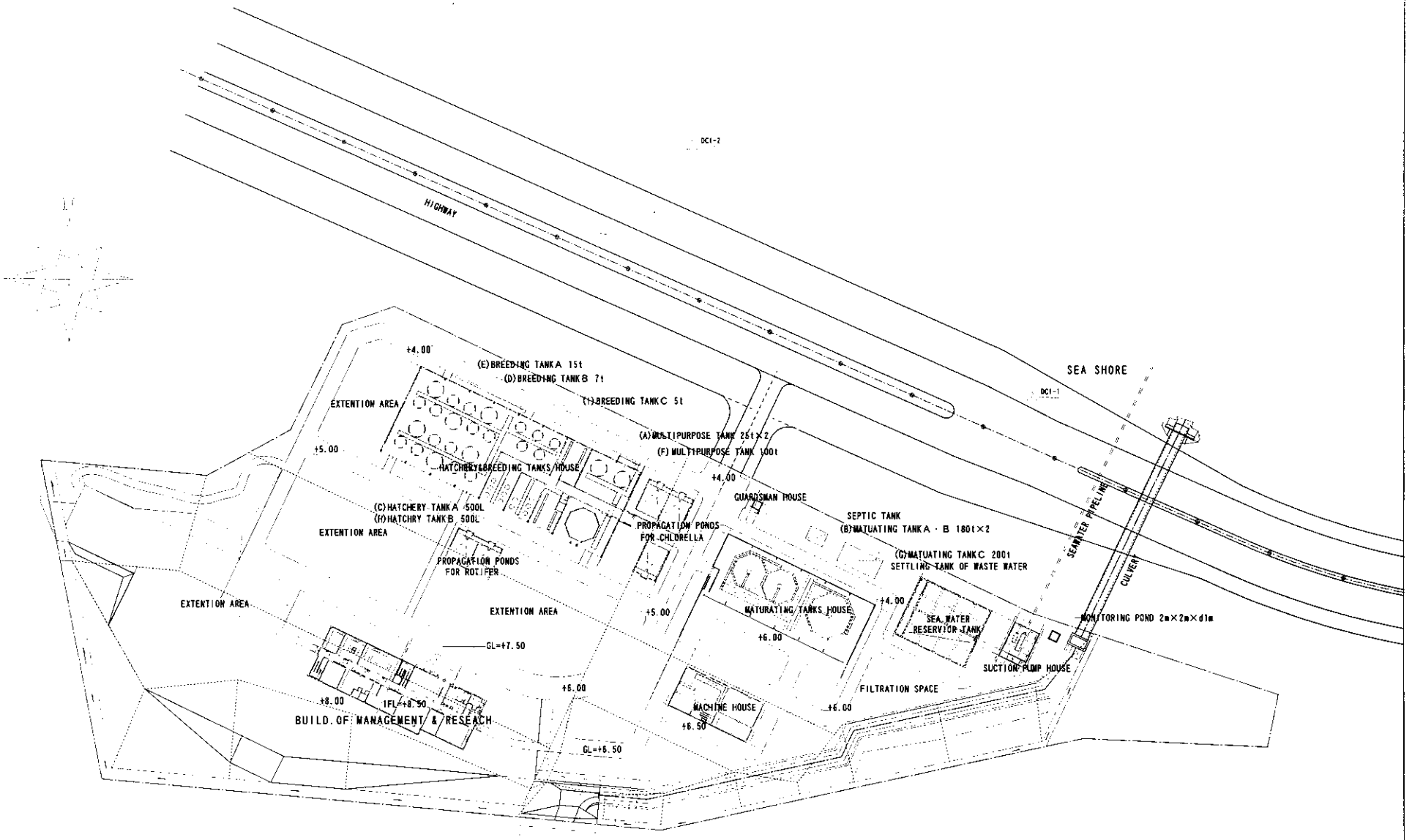
NO	Item	Q'ty	Specification
49	Changeable Multi Channel Pipette (12 channel) （5-50μl）	1 pcs	12 channel, 5-50ul
50	Changeable Multi Channel Pipette (12 channel) （50-250μl）	1 pcs	12 channel, 50-250ul
51	Homogeniser/Detachable	1 Set	Rotary speed:8000～20000rpm,Shaft dia.:8～10mm, with stand
52	Vacuum Constant Temperature Dryer	1 Unit	Inner dimension:W300xD300xH300mm, Temperature control:50～200℃,Digital display ・ setting
53	Vacuum Pump	1 Unit	Air displacement:50 litre/min. or more
54	Vortex Mixer	1 Unit	Mixer of small capacity, plate dimension:Approx.70mm, rotary speed:Approx.3000rpm
55	Stirrer	1 Unit	Rotary speed:100-1200r/min, Temperature: Ambient temperature+5℃+150℃,Outer Dimension:310x210x180H mm
56	Spectrophotometer （UV/VIS）	1 Set	Wavelength range:190～1100nm, Width of band: 3nm
57	Spectrophotometer （Fluorescent）	1 Set	Wavelength scan range:220～900nm, Measuring wavelength range: 220～750nm
58	Ultrasonic Homogeniser	1 Set	Output:50W or more, Frequency:20KHz, with Intermittent oscillation ・ timer
59	Hotplate	1 Set	Temperature range:50～+250℃, with Over current breaker, plate dimension:W550xD350
60	Refrigerated microtome	1 Set	Slide way length：400mm、Specimen opening object clamp : 41x43mm、Slice Thickness：0.5～12μm Dimension：W300xD420xH310mm、with freezer
61	Micro centrifuge （Micro High peed）	1 Set	Max. rotary speed:12000rpm or more、centrifuge:11000xg or more, tube:1.5ml or 2.0ml, with timer
62	Refrigerated Micro centrifuge（Micro Refrigerated）	1 Set	Max .rotor speed:13000rpm or more、centrifuge:16000xg or more, Digital control, Rotor:0.5ml or 2.0ml
63	Centrifugal concentrator （Centrifugal Evaporator）	1 Set	Depression centrifugal concentrator, Purpose: Concentration of DNA/RNA ・ Nucleic acid etc., temperature changeable, Rotary speed : Approx. 1400 rpm, with angle rotor
64	Refrigerated Centrifuge （Cooling）	1 Set	Max. rotary speed:21000rpm or more、centrifuge:40000xg or more, Analogue or digital control panel, Rotor:15ml～500ml
65	Tube for Microcentrifuge / Polyplopylene	30 Set	Polypropylene, each size
66	PH Meter	1 Unit	Table-top type, Parameter: pH, ORP(mV), temperature (℃), digital display
67	Colony Counter	1 Unit	Display: 3 digit digital, lens magnification:2x, stage size:dia.100mm
68	Water Bath	1 Set	Temperature range: 4-70℃,cooler and heater PID control, rotary/vertical switch type, shaker table size:400x300mm
69	Thermal Cycler（DNA PCR）	1 Set	Block: for 96x0.2ml tube or 96 holes, Temperature range:4-99.9℃
70	Protein Electrophoresis System	1 Set	Stand, frame, comb, guide, glass plate, module, Buffer dam, electrode, clamping frame, electrophoresis reservoir, power device
71	Nucleic Acid Electrophoresis System	1 Set	Horizontal electrophoresis system, electrophoresis reservoir, cable, gate, tray15x10cm, valve, comb, gel size:15x7 and15x10

NO	Item	Q'ty	Specification
72	Algarose Electrophoresis System	1 Set	Algarose electrophoresis system, electrophoresis reservoir, UV gel tray, casting, comb, gel size:150W x200Dmm, electrode, cable, power device
73	Incident-light fluorescence Reader for Electrophoresis	1 Set	Power of light : Incident-light UV, UV wavelength:312nm, UV strength : Approx. 3mW/cm2, Sample size: 210Wx150Dmm
74	Baffaly Circulator	1 Set	Buffer circulation mini pump, Max.discharge:400ml/min. Tube size: inner dia.7mm, outside dia. 11mm
75	Gel Dryer	1 Set	Capacity:6 gels or more, effective gel size:Approx.200x200mm, with timer
76	Autoclave	1 Set	Effective dimension: Approx.300 dia. X 650Dmm, temperature:120℃, microcomputer control, with dryer
77	Ultrasonic Washer	1 Set	Capacity:2.8L or more
78	Timer	1 Set	Digital display, 2 channel+time display, power: cell
79	Distilled Water ・ Water Purifier	1 Set	Distilled water making capacity: Approx.1.5L/hour, storage capacity:20L, cartridge filter, Activated carbon→Ion exchange →Distil→tank

Table 2-22　Expendable List of Equipment

A. Water Monitoring Apparatus
pH Solution（pH4/500ml）
pH Solution（pH7/500ml）
pH Reference Internal Solution（250ml）
ORP Powder（10pack/set）
Ion one-point Calibration Solution（250ml）
Nitric Acid Ion Sensor Internal Solution（50ml）
Ammonia Acid Ion Sensor Internal Solution（250ml）
B. Biological Oxygen Demand（BOD）Meter
BOD Solution（16pcs/set）
C. Chemical Oxygen Demand（COD）Meter
Reagent（500ml）
Emery Sand
Printer Paper（10rolls/set）
D. PCR ・ Pathology Section
Fluorescent Microscope with Microphotography ・ Immersion Oil
pH Meter
Solution（pH4.01/500ml）
KCL Solution（3.3mol/100ml）
Thermal Cycler（DNA PCR）
PCR tube
DNA Purification ・ Isolation Kit
DNA PCR Kit
Protein Electrophoresis System
Agarose Gel　Kit、PFC Agarose（100g）（50 times test）
Gel Dying (Ethidium Bromide)(11mg/10 tablets)（50 times test）
E. Common Section
Microscope （Bright Field Observation）・ Immersion Oil
Ultrasonic Washer ・ Detergent

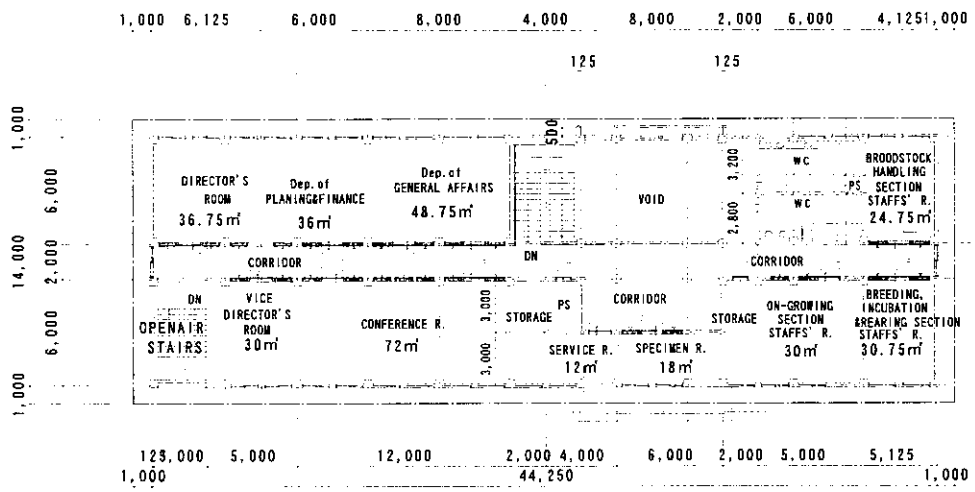
2-2-3 Basic Design Drawings



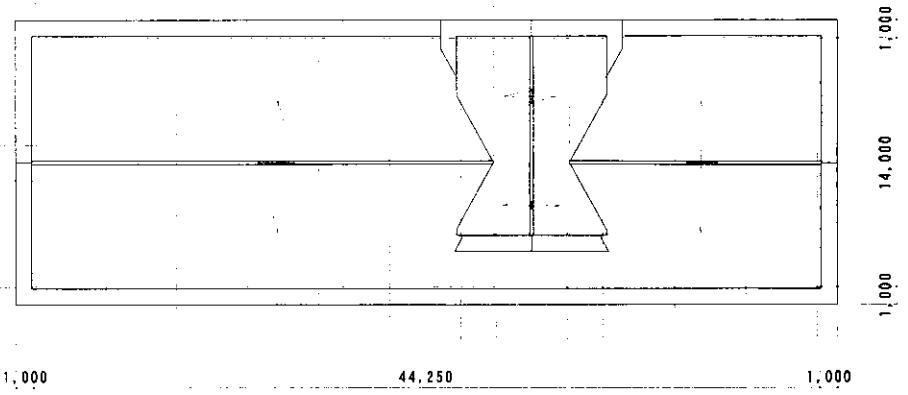
SITE PLAN S:1/1000

0m 10m 25m 50m 100m 200m

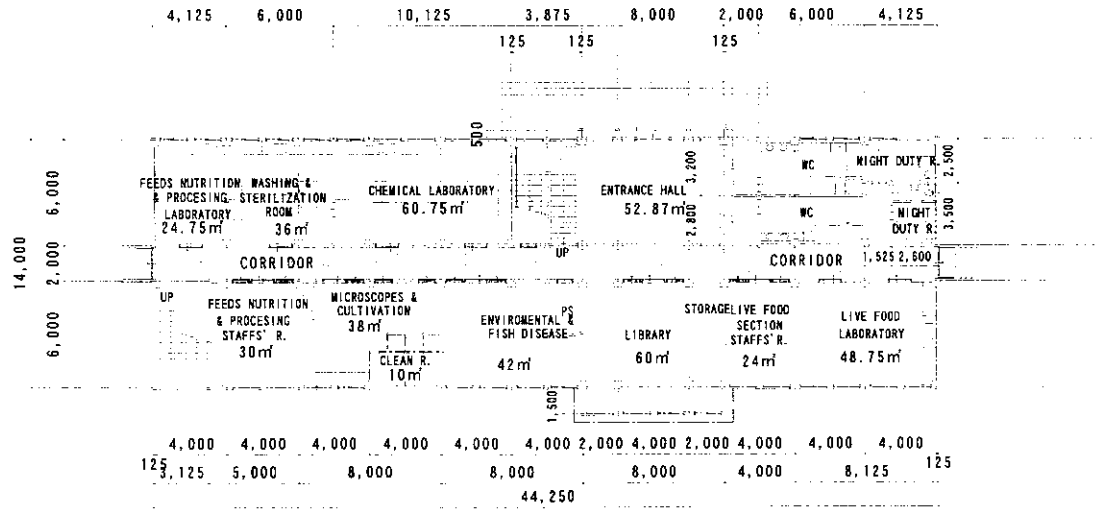
THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEACH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL COOPERATION AGENCY OVERSEAS AGRO-FISHERIES CONSULTANTS CO., LTD. NIPPON KOEI CO., LTD.	DRAWING TITLE SITE PLAN	SCALE 1/1000	DRAWING NO. A 0 1



2ND FLOOR PLAN S:1/300



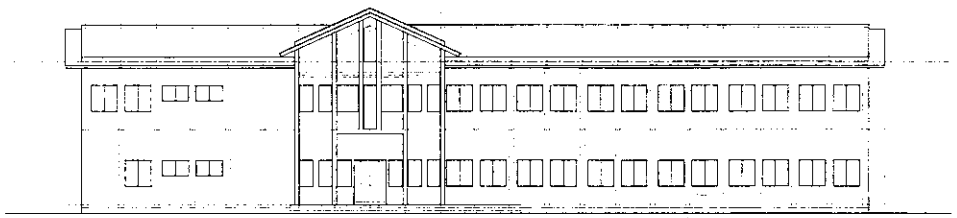
ROOF PLAN S:1/300



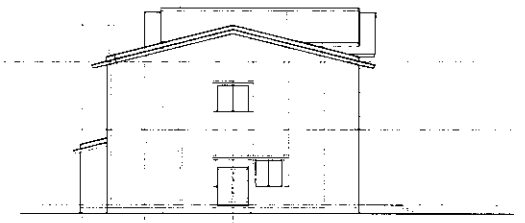
GROUND FLOOR PLAN S:1/300

GROUND FLOOR AREA: 631.50㎡
1ST FLOOR AREA : 570.39㎡
TOTAL :1,201.89㎡ (EAVES AREA:120.50㎡)

THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEACH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL COOPERATION AGENCY OVERSEAS AGRO-FISHERIES CONSULTANTS CO.,LTD. NIPPON KOEI CO.,LTD.	DRAWING TITLE BUILDING of MANAGEMENT & RESEARCH GROUND FLOOR PLAN, 1ST FLOOR PLAN	SCALE 1/300	DRAWING NO. A 0 2

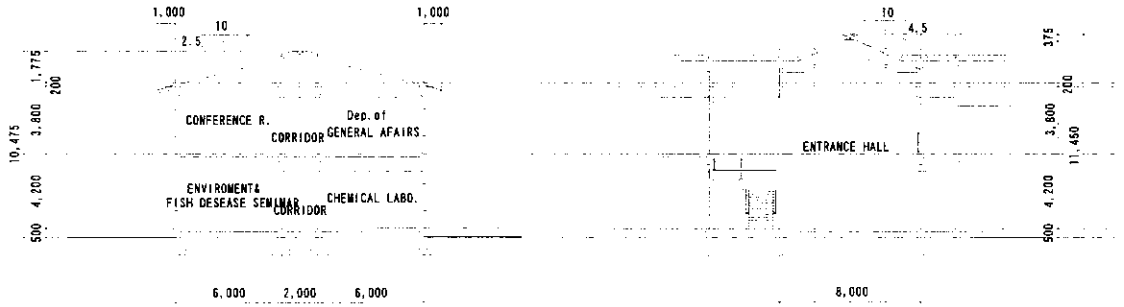


NORTH ELEVATION S:1/300



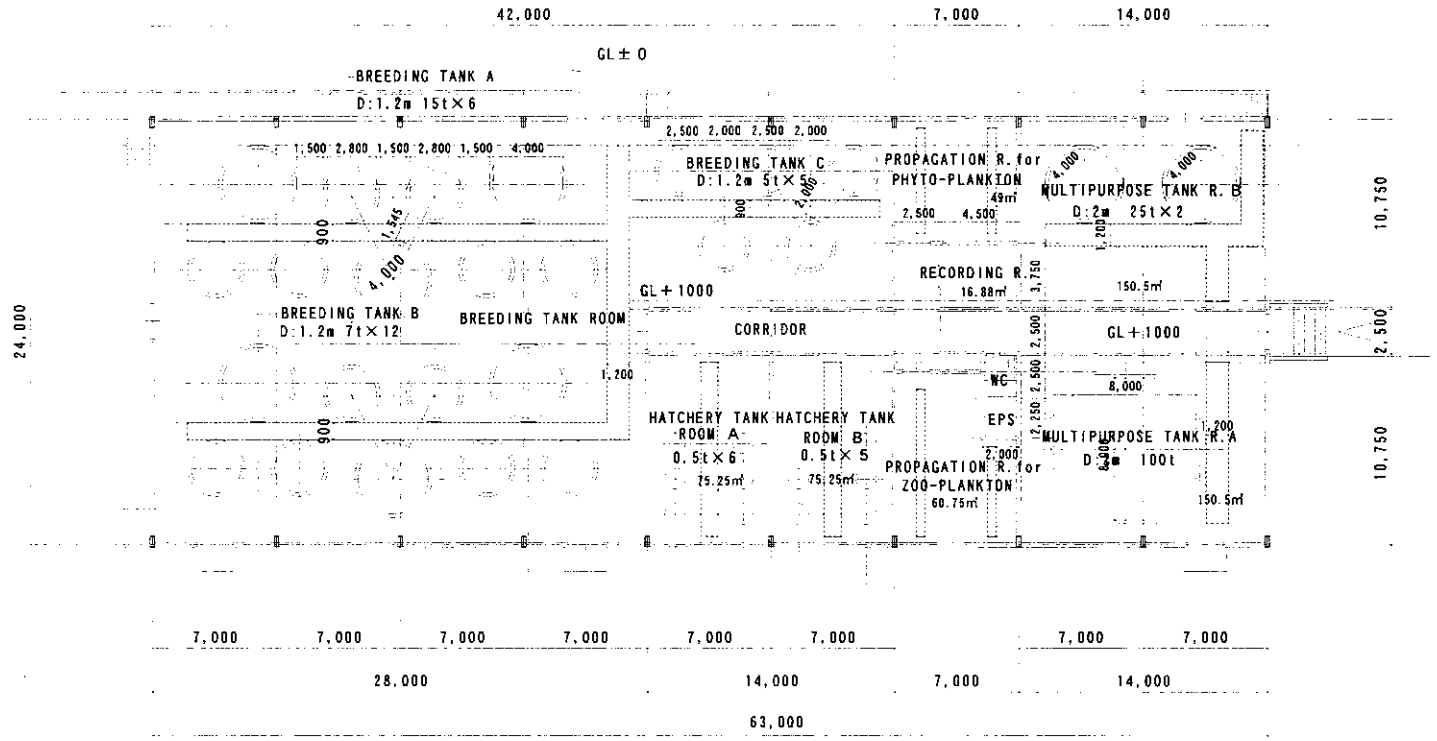
EAST ELEVATION S:1/300

SOUTH ELEVATION S:1/300



SECTION S:1/300

THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEACH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL COOPERATION AGENCY OVERSEAS AGRO-FISHERIES CONSULTANTS CO., LTD. NIPPON KOEI CO., LTD.	DRAWING TITLE BUILDING of MANAGEMENT & RESEARCH ELEVATION SECTION	SCALE 1/300	DRAWING NO. A 0 3

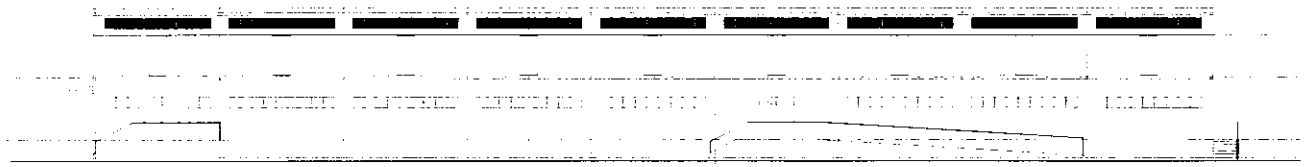


PLAN S:1/300

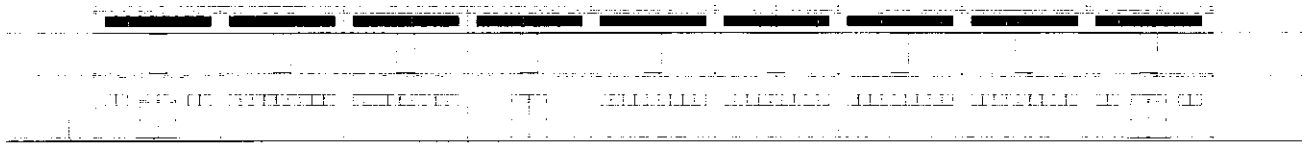
FLOOR AREA:1,512㎡

BRREDING TANK R. AREA:822.5㎡

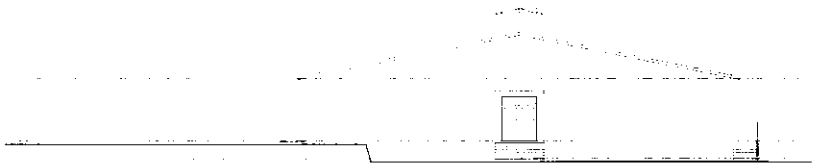
THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEACH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL COOPERATION AGENCY OVERSEAS AGRO-FISHERIES CONSULTANTS CO.,LTD. NIPPON KOEI CO.,LTD.	DRAWING TITLE HATCHERY & BREEDING TANK HOUSE FLOOR PLAN	SCALE 1/300	DRAWING NO. A 0 4



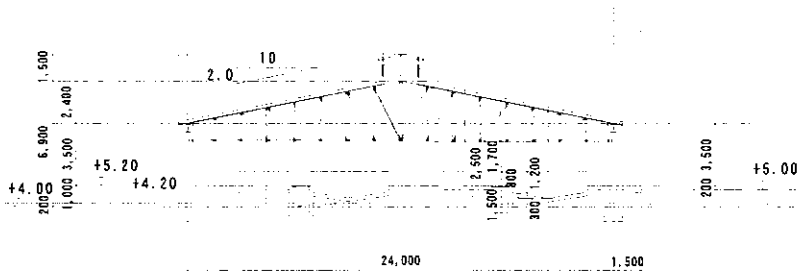
NORTH ELEVATION S:1/300



SOUTH ELEVATION S:1/300

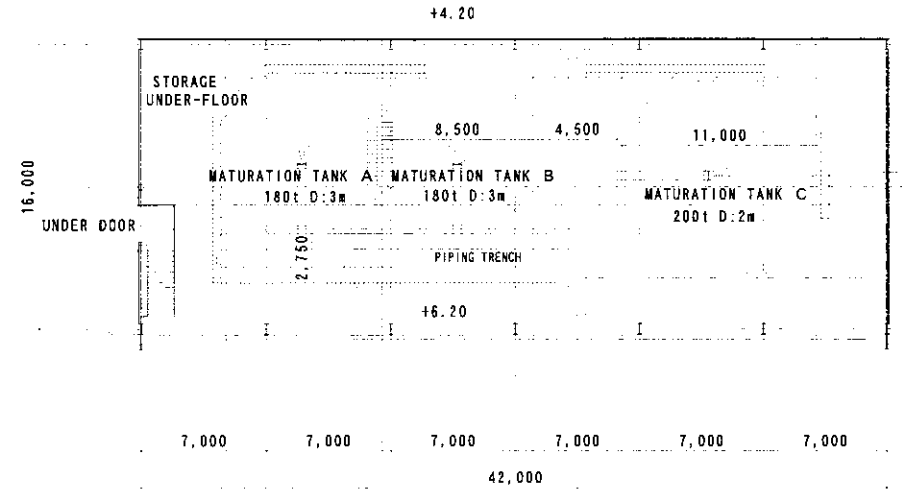


EAST ELEVATION S:1/300

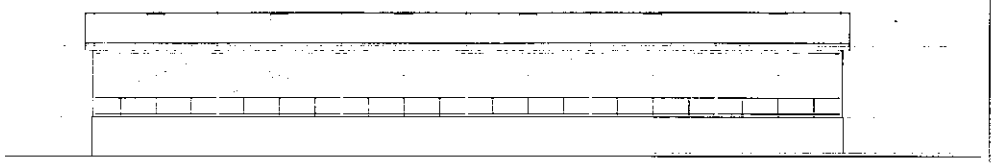


SECTION S:1/300

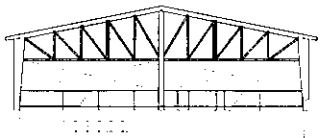
THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEACH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL COOPERATION AGENCY OVERSEAS AGRO-FISHERIES CONSULTANTS CO.,LTD. NIPPON KOEI CO.,LTD.	DRAWING TITLE HATCHERY & BREEDING TANK HOUSE ELEVATION, SECTION	SCALE 1/300	DRAWING NO. A 0 5



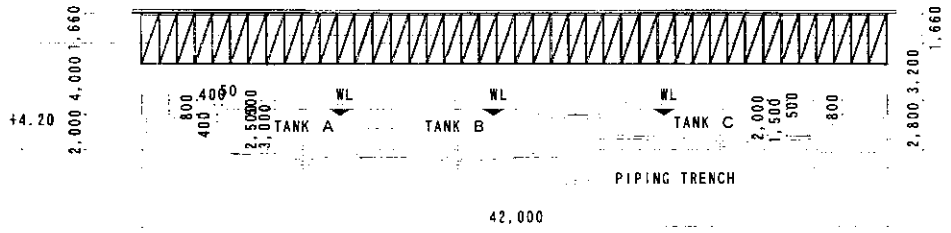
BROODSTOCK MATURATION TANK HOUSE S:1/300 FLOOR AREA:672㎡



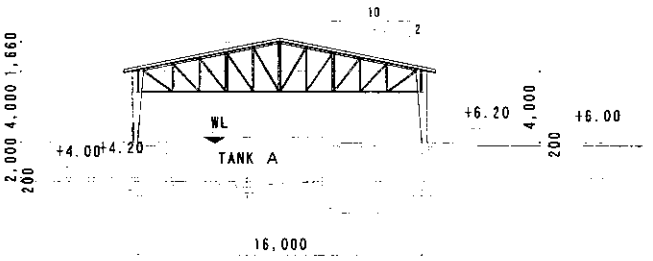
NORTH ELEVATION S:1/300



WEST ELEVATION S:1/300



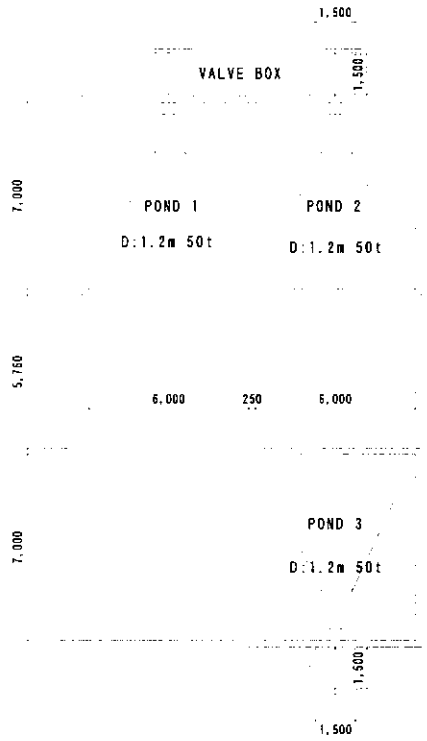
EAST-WEST SECTION S:1/300



NORTH-SOUTH ELEVATION S:1/300

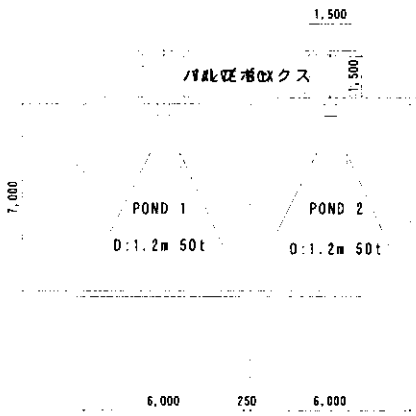
THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEACH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL COOPERATION AGENCY OVERSEAS AGRO-FISHERIES CONSULTANTS CO.,LTD. NIPPON KOEI CO.,LTD.	DRAWING TITLE BROODSTOCK MATURATION TANK HOUSE FLOOR PLAN, ELEVATION, SECTION	SCALE 1/300	DRAWING NO. A 0 6

CHLORELLA POND

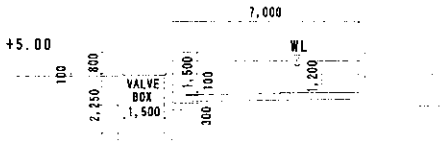


PLAN S:1/200

ROTIFER POND

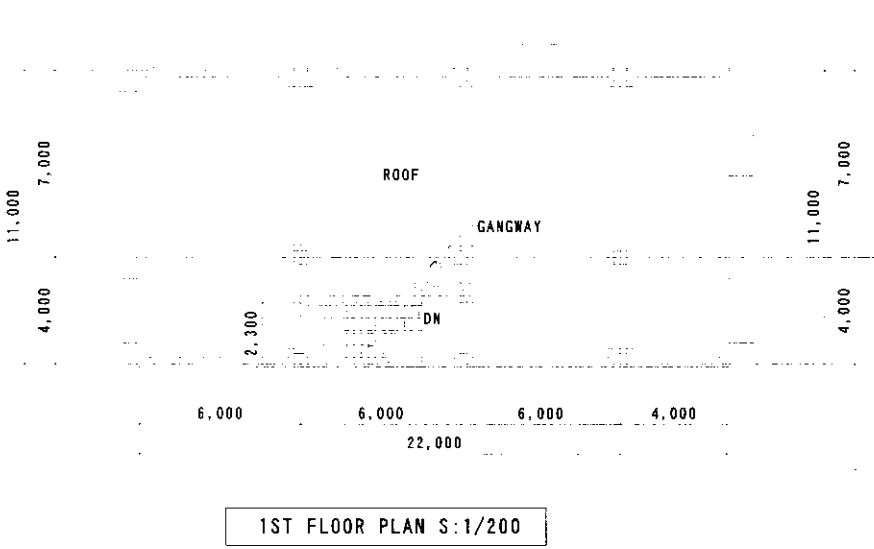


PLAN S:1/200

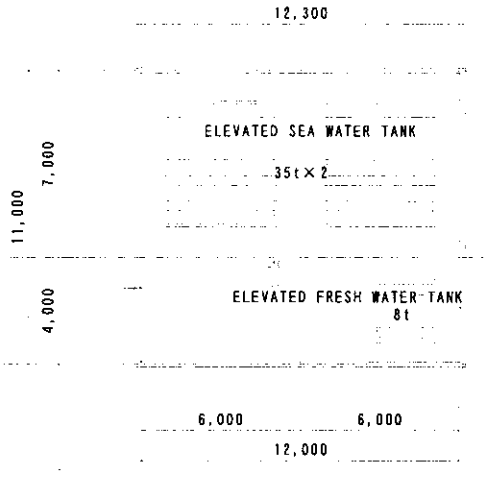


SECTION S:1/200

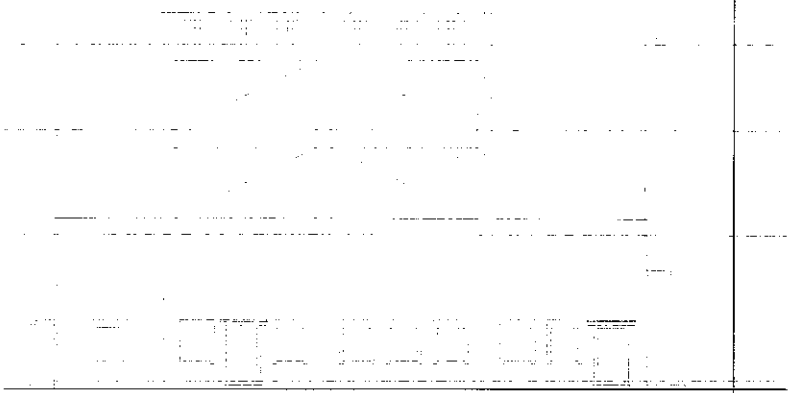
THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEACH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL COOPERATION AGENCY OVERSEAS AGRO-FISHERIES CONSULTANTS CO.,LTD. NIPPON KOEI CO.,LTD.	DRAWING TITLE PROPAGATION PONDS for CHLORELLA, ROTIFER FLOOR PLAN, SECTION	SCALE 1/200	DRAWING NO. A 0 7



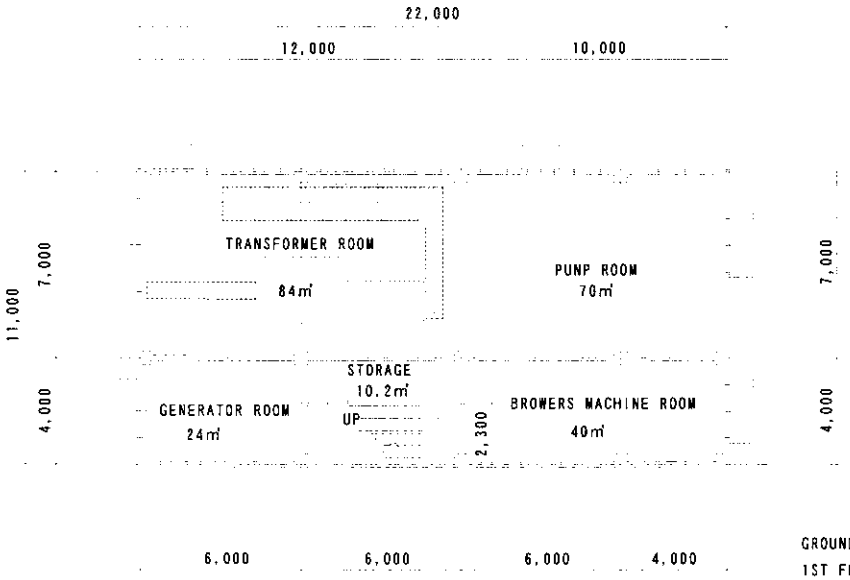
1ST FLOOR PLAN S:1/200



2ND FLOOR PLAN S:1/200

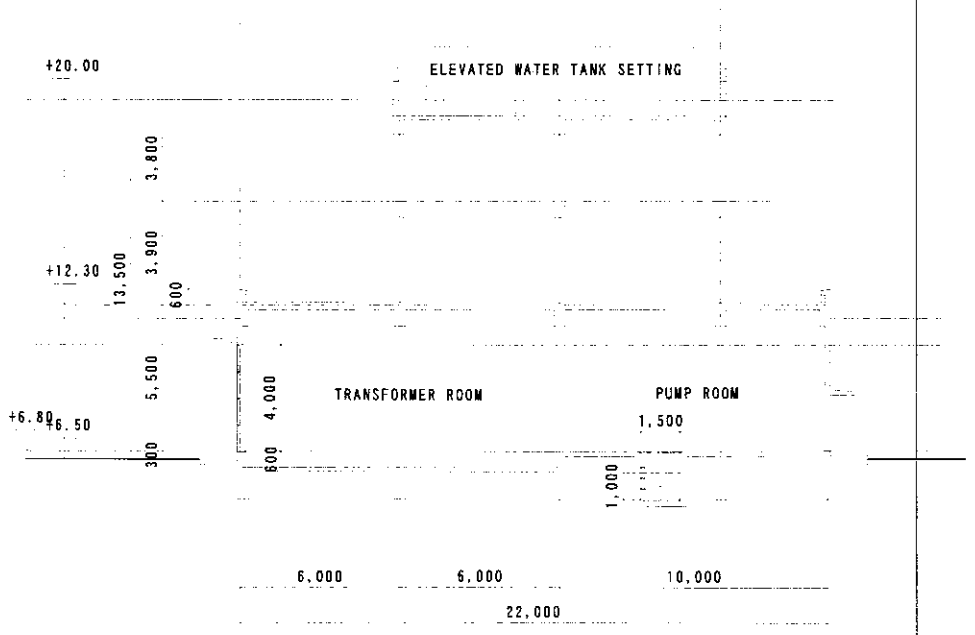


NORTH ELEVATION S:1/200



GROUND FLOOR PLAN S:1/200

GROUND FLOOR AREA:	242㎡
1ST FLOOR AREA:	132㎡
TOTAL:	374㎡



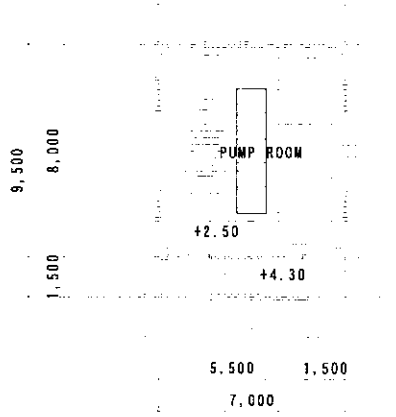
SECTION S:1/200

THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEACH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL COOPERATION AGENCY OVERSEAS AGRO-FISHERIES CONSULTANTS CO.,LTD. NIPPON KOEI CO.,LTD.	DRAWING TITLE MACHINE HOUSE FLOOR PLAN, ELEVATION, SECTION	SCALE 1/200
			DRAWING NO. A 0 8

ROOF PLAN S:1/200

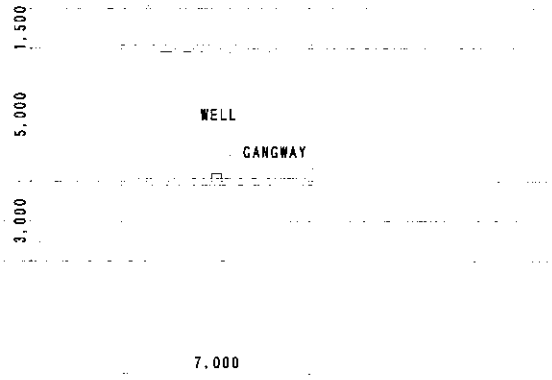
SOUTH ELEVATION S:1/200

WEST ELEVATION S:1/200

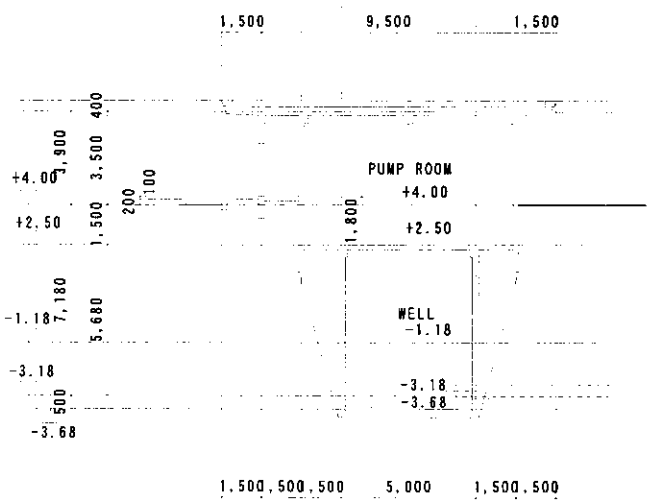


PUMP ROOM PLAN S:1/200

FLOOR AREA:64.25㎡

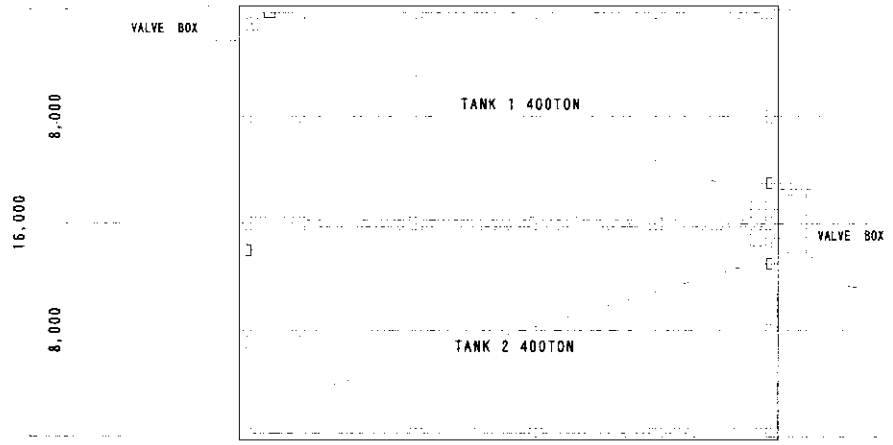


SEA WATER WELL PLAN S:1/200

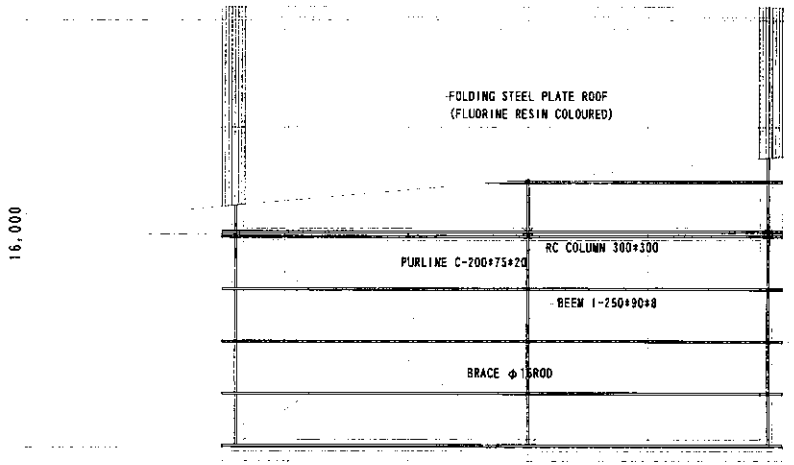


SECTION S:1/200

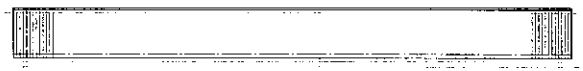
THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEACH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL COOPERATION AGENCY OVERSEAS AGRO-FISHERIES CONSULTANTS CO.,LTD. NIPPON KOEI CO.,LTD.	DRAWING TITLE SUCTION PUMP HOUSE FLOOR PLAN,ELEVATION,SECTION	SCALE 1/200	DRAWING NO. A 0 9



FLOOR PLAN S:1/200

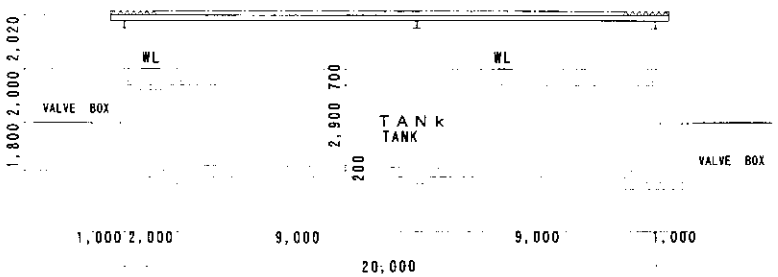


ROOF PLAN S:1/200

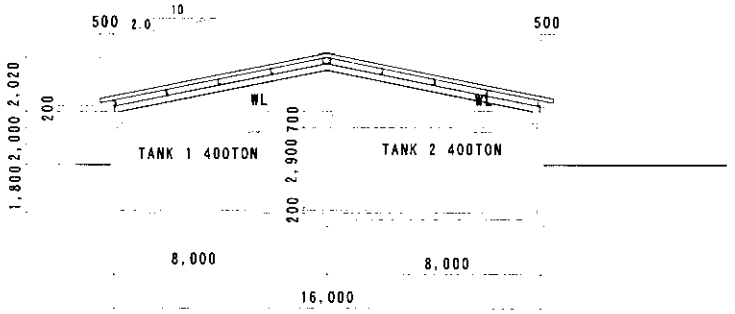


SOUTH ELEVATION S:1/200

WEST.EAST ELEVATION S:1/200



SECTION 1 S:1/200



SECTION 2 S:1/200

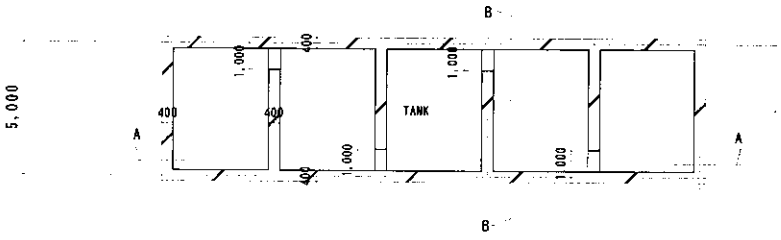
THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEACH AND DEVELOPMENT CENTER IN NHA TRANG

JAPAN INTERNATIONAL COOPERATION AGENCY
OVERSEAS AGRO-FISHERIES CONSULTANTS CO.,LTD.
NIPPON KOEI CO.,LTD.

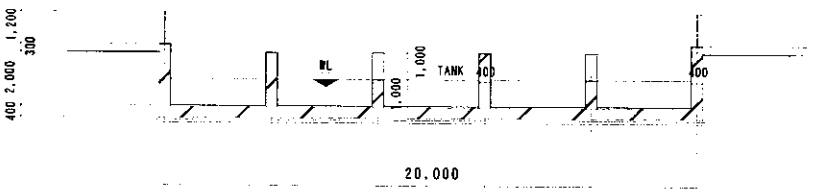
DRAWING TITLE
SEA WATER RESERVOIR PLAN, SECTION

SCALE	DRAWING NO.
1/200	A 1 0

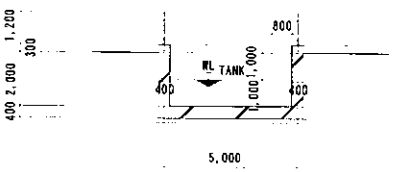
SETTLING TANK OF WASTE WATER



PLAN S:1/200

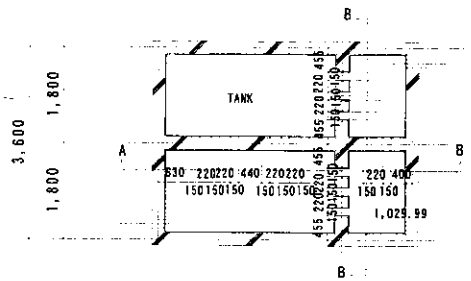


SECTION A-A S:1/200

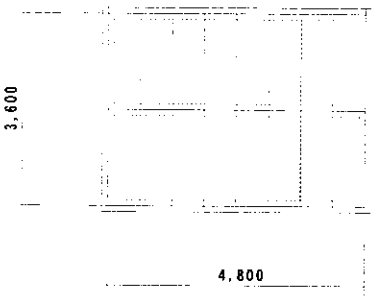


SECTION B-B S:1/200

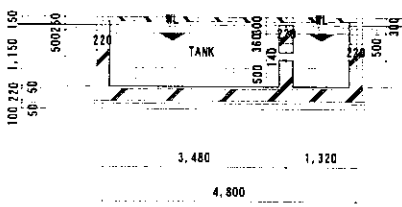
SEPTIC TANK



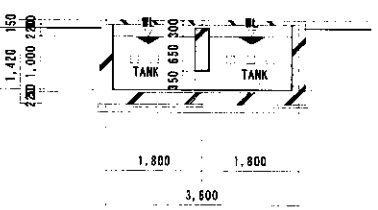
PLAN S:1/100



ROOF PLAN S:1/200

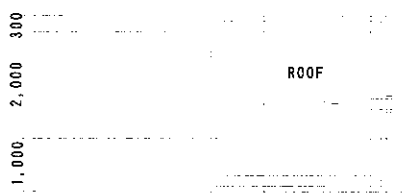


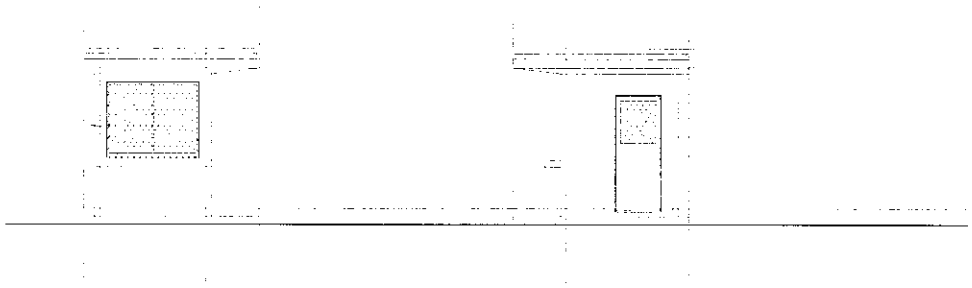
SECTION A-A S:1/100



SECTION B-B S:1/100

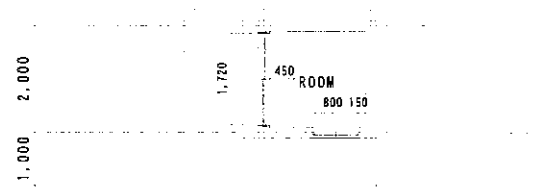
THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEACH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL COOPERATION AGENCY OVERSEAS AGRO-FISHERIES CONSULTANTS CO.,LTD. NIPPON KOEI CO.,LTD.	DRAWING TITLE SETTLING TANK OF WAST WATER SEPTIC TANK	SCALE 1/200,1/100	DRAWING NO. A 1 1

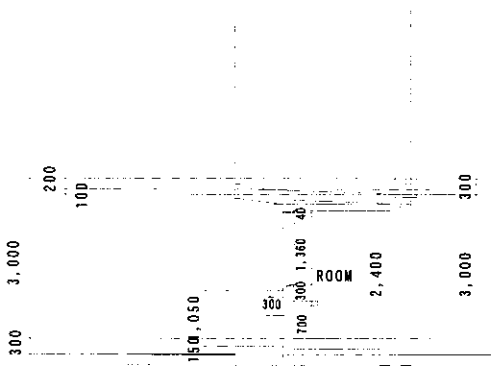




WEST ELEVATION S:1/100

SOUTH ELEVATION S:1/100





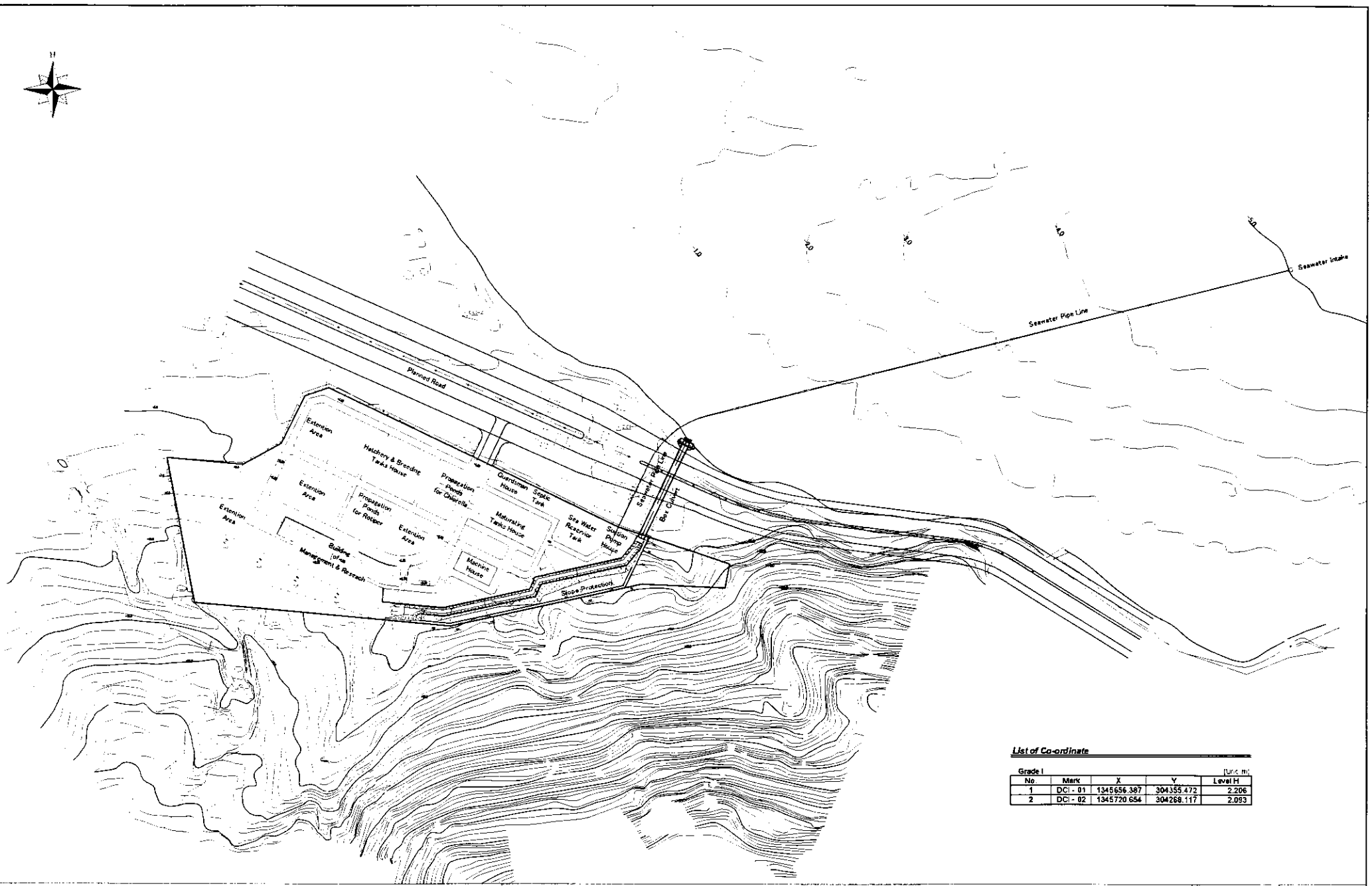
1,500 2,000

FLOOR PLAN S:1/100 FLOOR AREA:12㎡

1,000 2,000 300

SECTION S:1/100

THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEACH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL COOPERATION AGENCY OVERSEAS AGRO-FISHERIES CONSULTANTS CO.,LTD. NIPPON KOEI CO.,LTD.	DRAWING TITLE GUARDSMAN HOUSE FLOOR PLAN,ELEVATION,SECTION	SCALE 1/100	DRAWING NO. A 1 2



List of Co-ordinate

Grade I [unit: m]

No.	Mark	X	Y	Level H
1	DCI - 01	1345656.387	304355.472	2.206
2	DCI - 02	1345720.654	304268.117	2.093

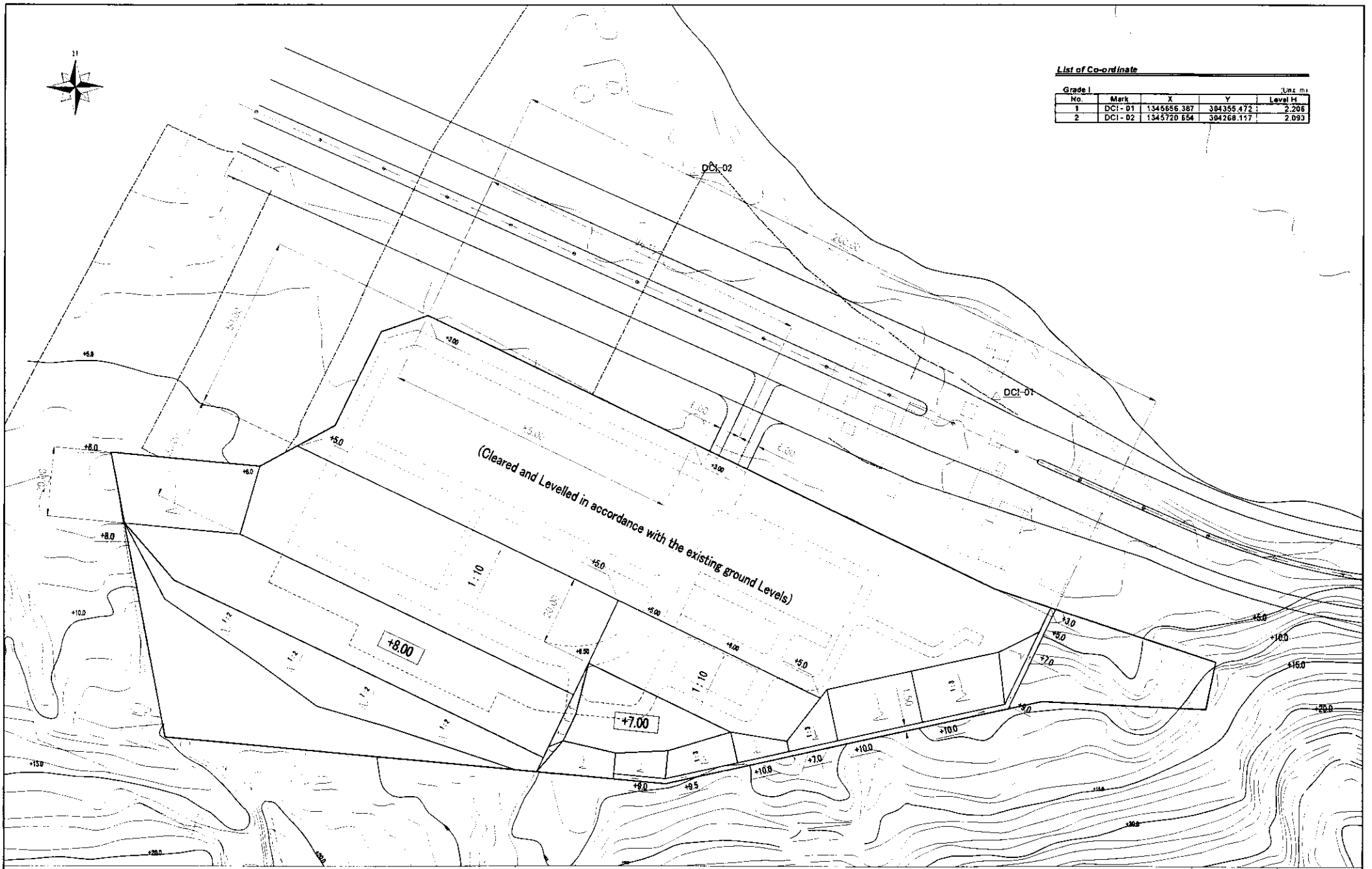
THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEARCH AND DEVELOPMENT CENTER IN NHA TRANG

JAPAN INTERNATIONAL CO-OPERATION AGENCY
OVERSEAS AGRO-FISHIRIES CONSULTANTS CO., LTD.
NIPPON KOEI CO., LTD.

DRAWING TITLE

SITE PLAN

SCALE	DRAWING No.
1 : 2000	C-01

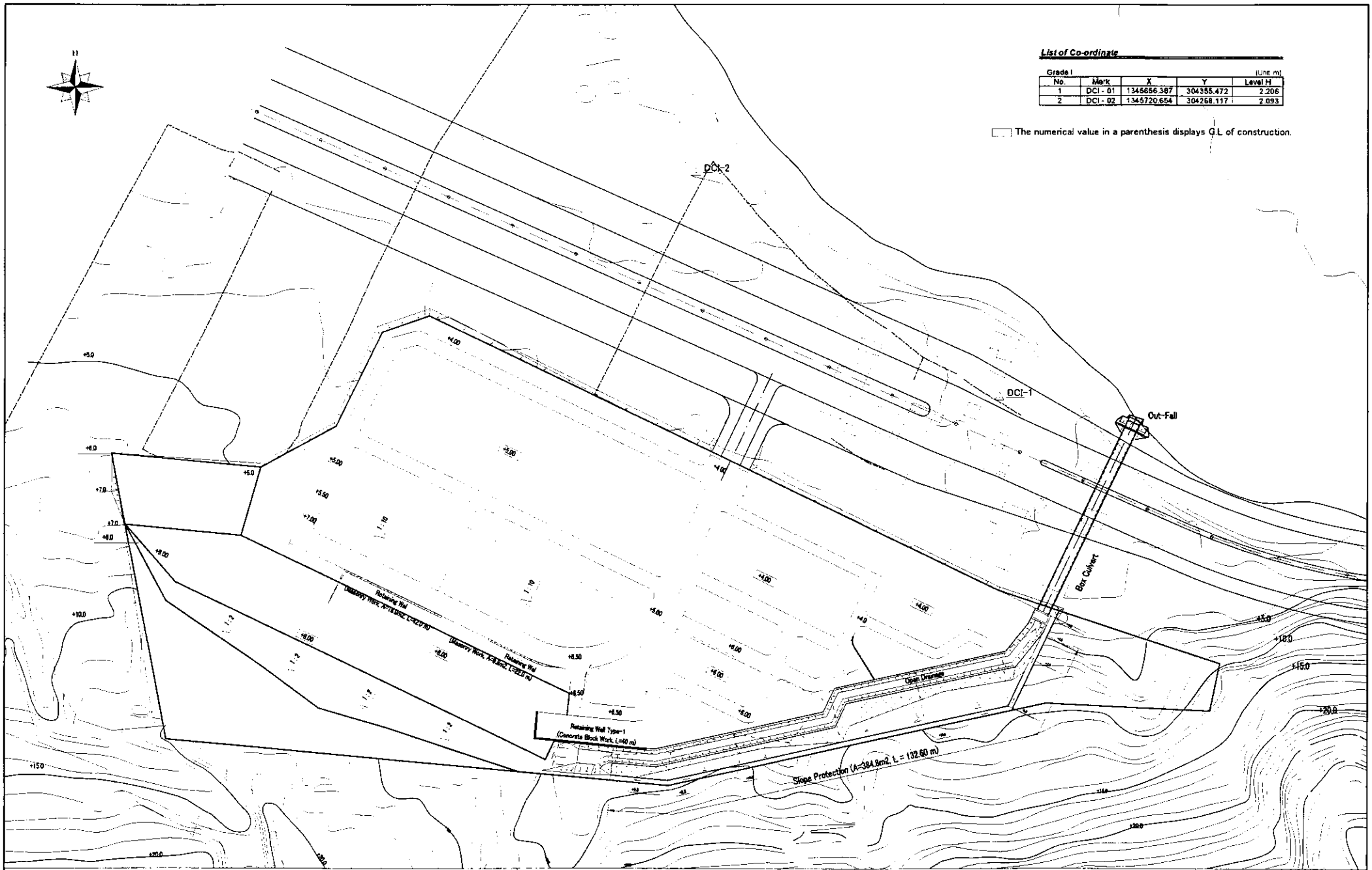


THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEARCH AND DEVELOPMENT CENTER IN NHA TRANG

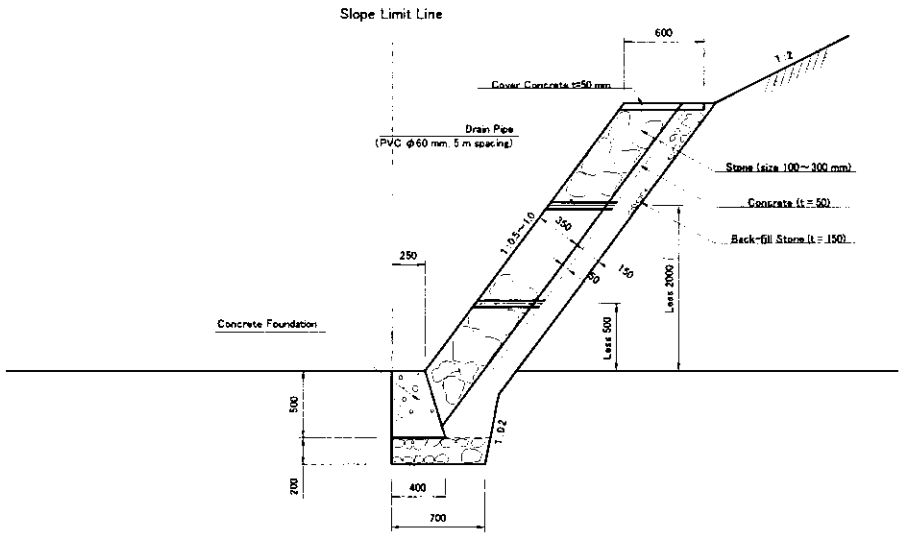
JAPAN INTERNATIONAL CO-OPERATION AGENCY
OVERSEAS AGRO-FISHRIES CONSULTANTS CO., LTD.
NIPPON KOEI CO., LTD.

DRAWING TITLE
LAND LEVELLING PLAN
FIRST STAGE LEVELLING WORK

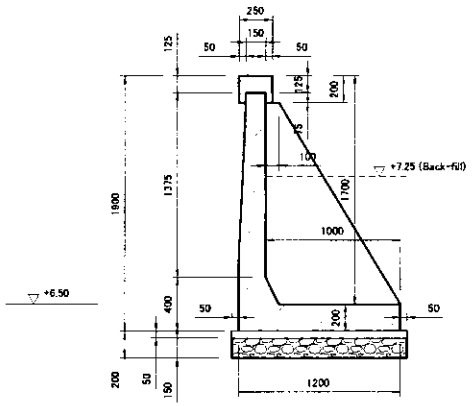
SCALE	DRAWING No.
1 : 1000	C-02



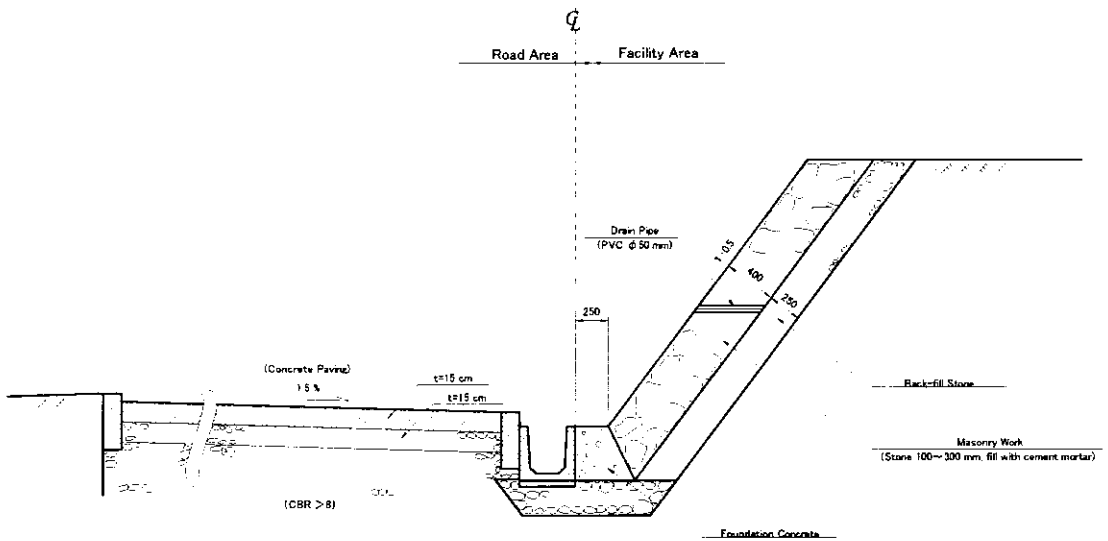
THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEARCH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL CO-OPERATION AGENCY OVERSEAS AGRO-FISHRIES CONSULTANTS CO., LTD. NIPPON KOEI CO., LTD.	DRAWING TITLE LAND LEVELLING / SLOPE PROTECTION GENERAL PLAN	SCALE: 1 : 1000 DRAWING No.: C-03



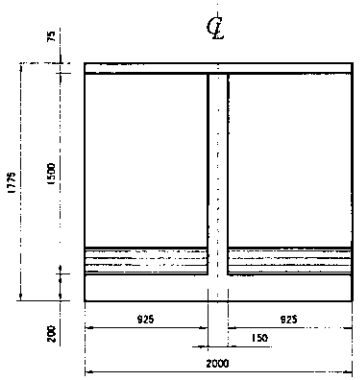
Typical Section of Slope Protection



Typical Section of Concrete Retaining Wall

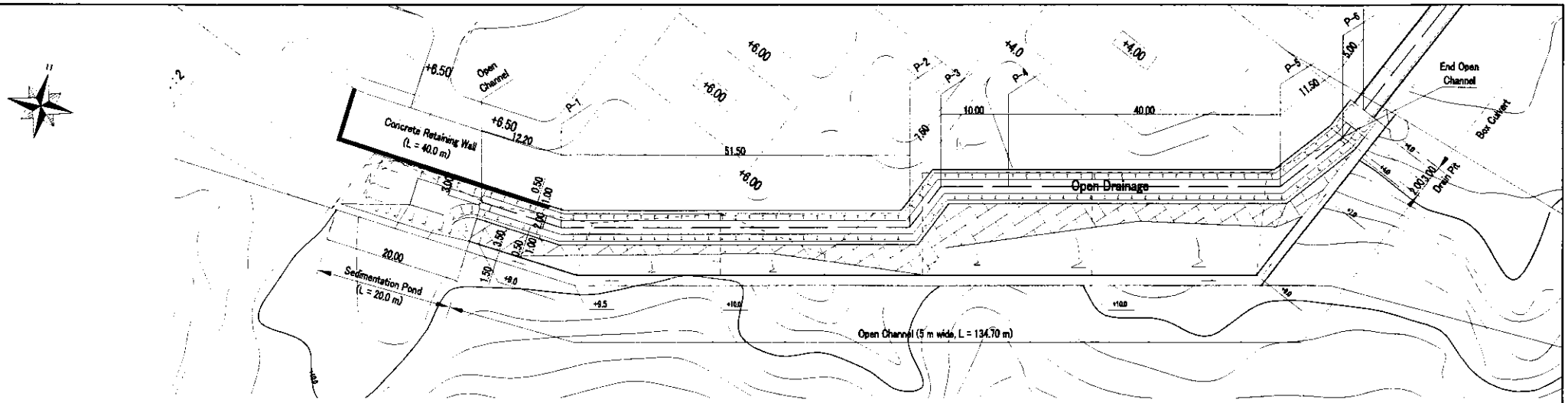


Typical Section of Retaining Wall (Masonry Work)

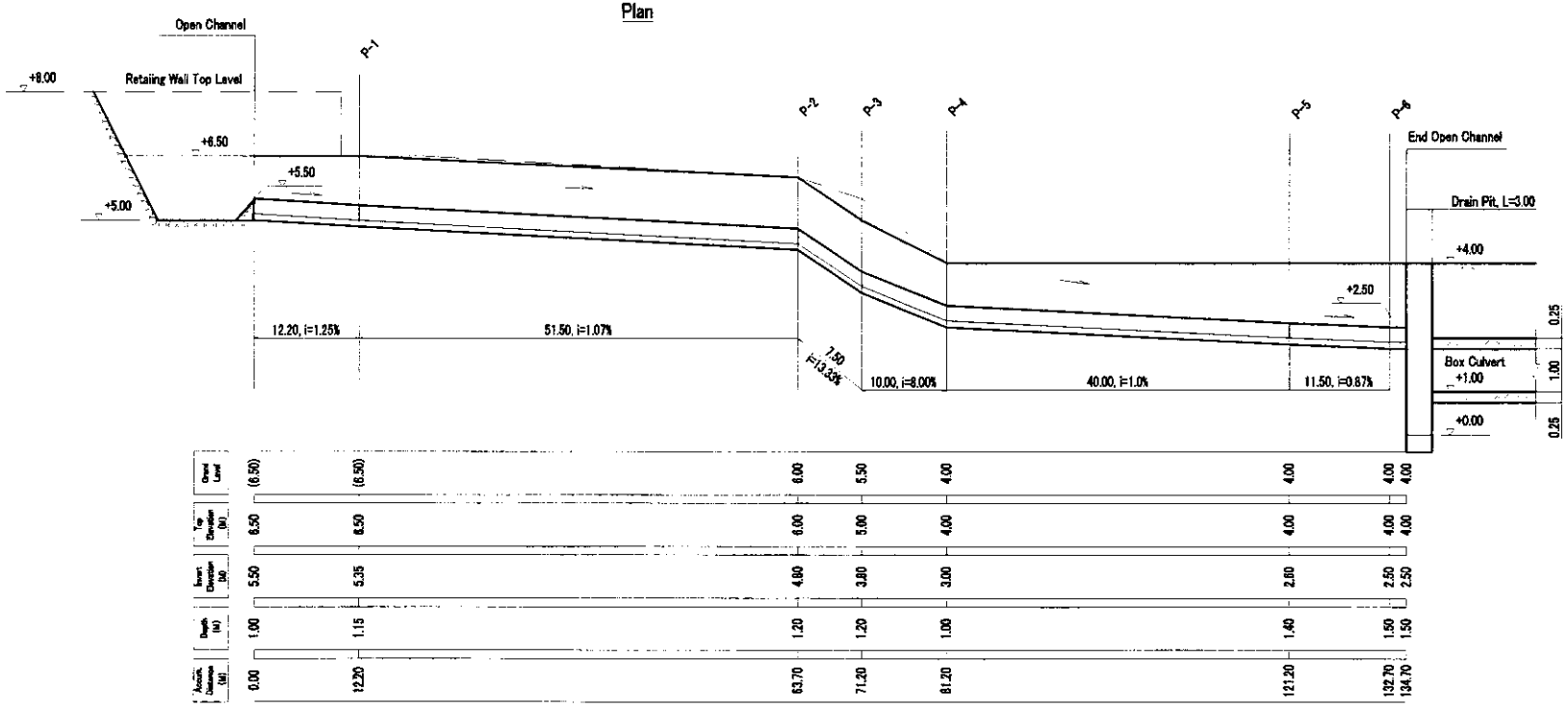


Front View L Type Precast Concrete Block

THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEARCH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL CO-OPERATION AGENCY OVERSEAS AGRO-FISHRIES CONSULTANTS CO., LTD. NIPPON KOEI CO., LTD.	DRAWING TITLE LAND LEVELLING / SLOPE PROTECTION TYPICAL SECTIONS FOR MASONRY WORK AND SLOPE PROTECTION	SCALE: 1 : 40 DRAWING No.: C-04

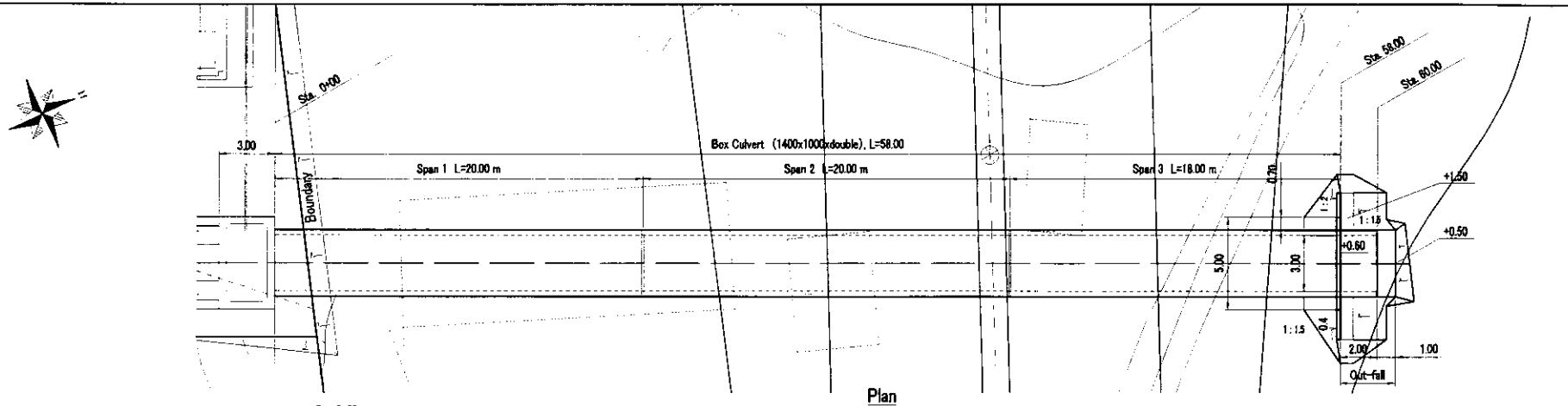


Plan

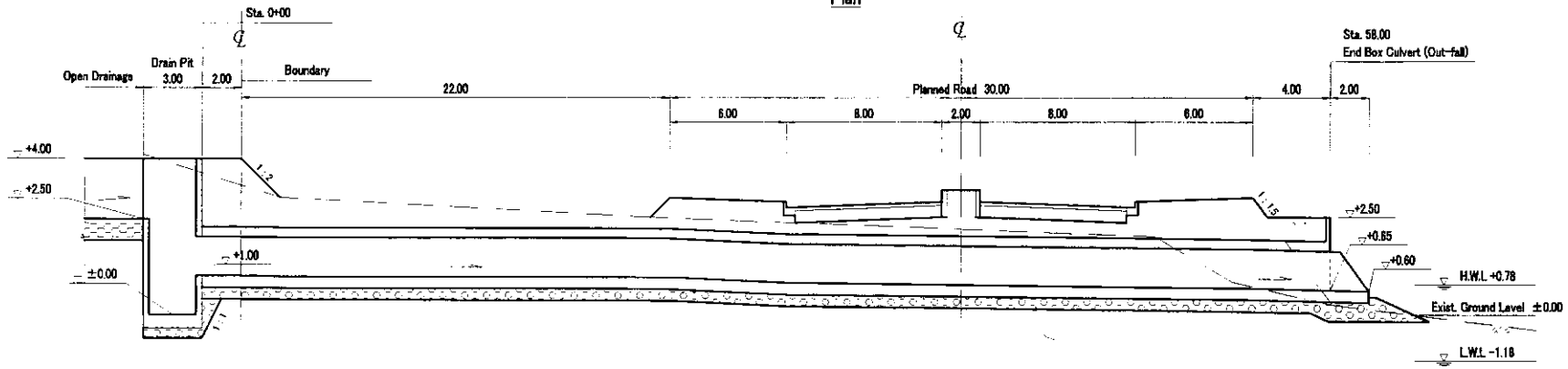


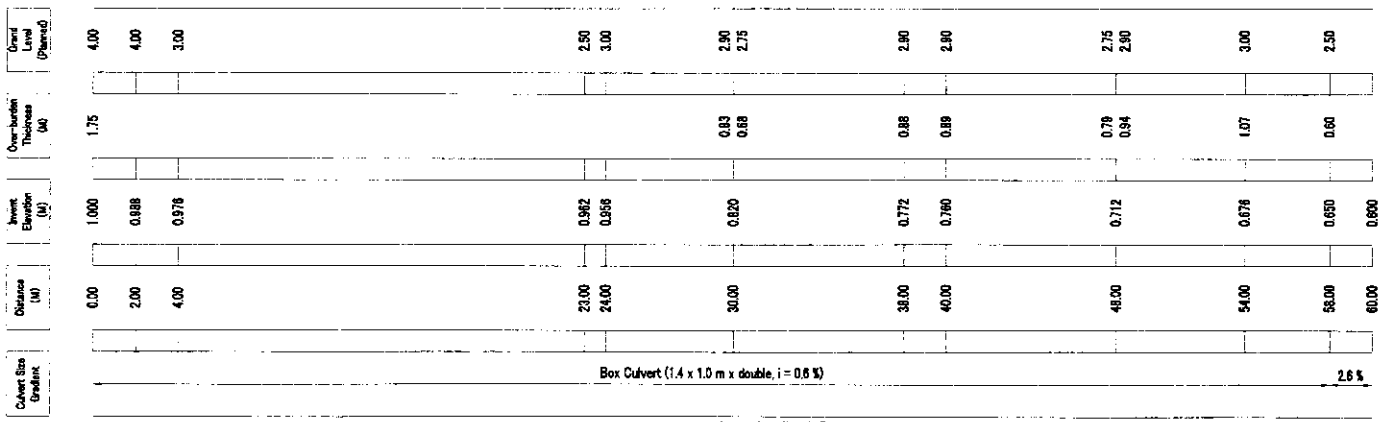
Longitudinal Section

THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEARCH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL CO-OPERATION AGENCY OVERSEAS AGRO-FISHRIES CONSULTANTS CO., LTD. NIPPON KOEI CO., LTD.	DRAWING TITLE STORM WATER DRAINAGE OPEN CHANNEL	SCALE: 1 : 600 DRAWING No.: C-05



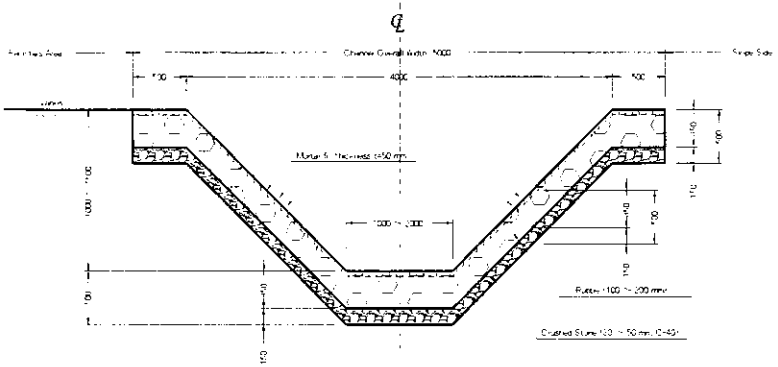
Plan



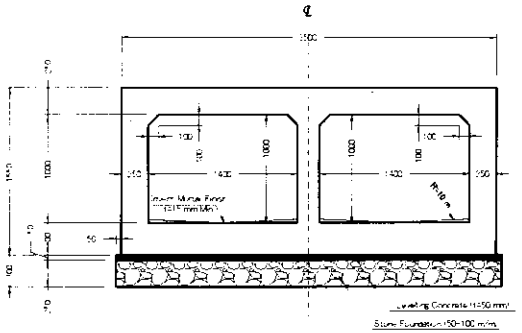


Longitudinal Section

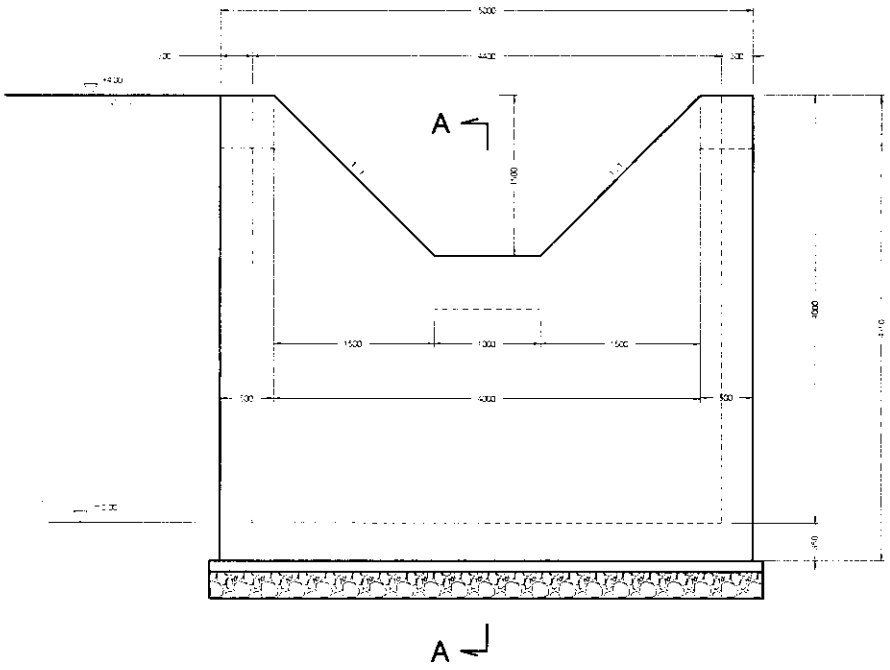
THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEARCH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL CO-OPERATION AGENCY OVERSEAS AGRO-FISHERIES CONSULTANTS CO., LTD. NIPPON KOEI CO., LTD.	DRAWING TITLE STORM WATER DRAINAGE BOX CULVERT	SCALE: 1 : 250 DRAWING No.: C-06



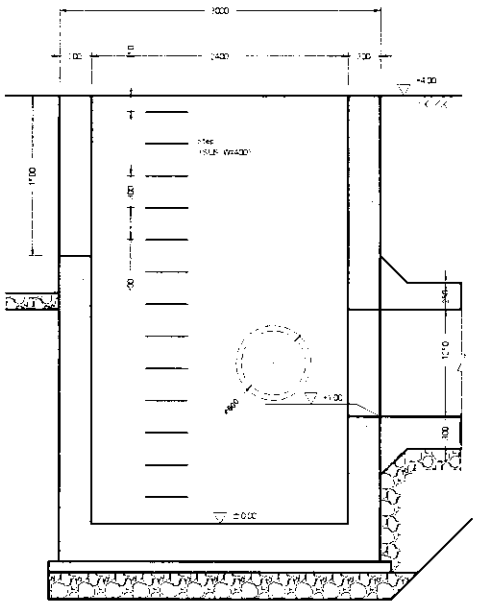
Typical Section of Open Channel



Typical Section of Box Culvert



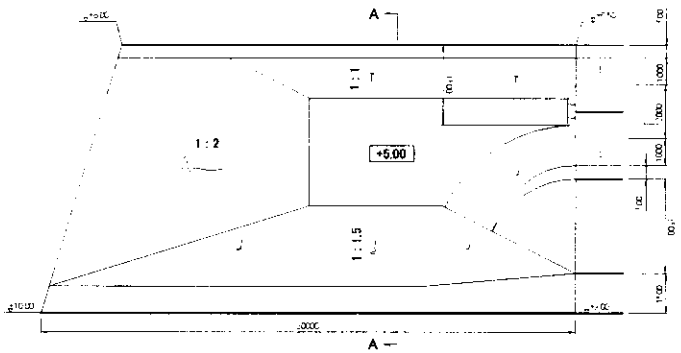
Front View



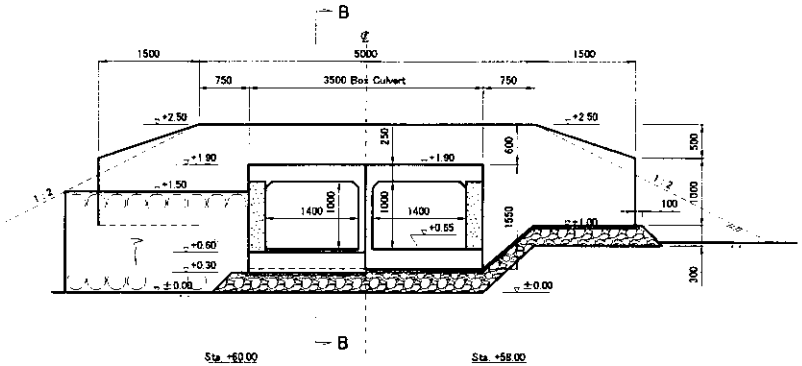
A-A Section

Drain Pit

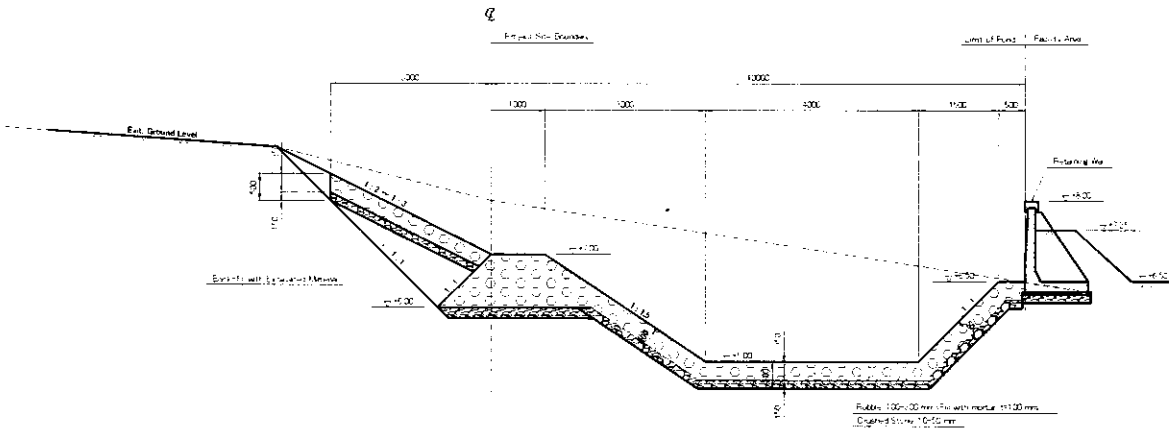
THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEARCH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL CO-OPERATION AGENCY OVERSEAS AGRO-FISHRIES CONSULTANTS CO., LTD. NIPPON KOEI CO., LTD.	DRAWING TITLE STORM WATER DRAINAGE DRAIN PIT AND TYICAL SECTIONS	SCALE 1 : 50	DRAWING No. C-07



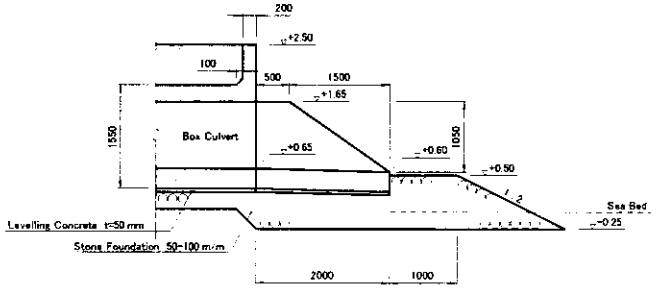
Seamentation Pond (S=1 : 200)



Out-fall Front View (S=1 : 80)

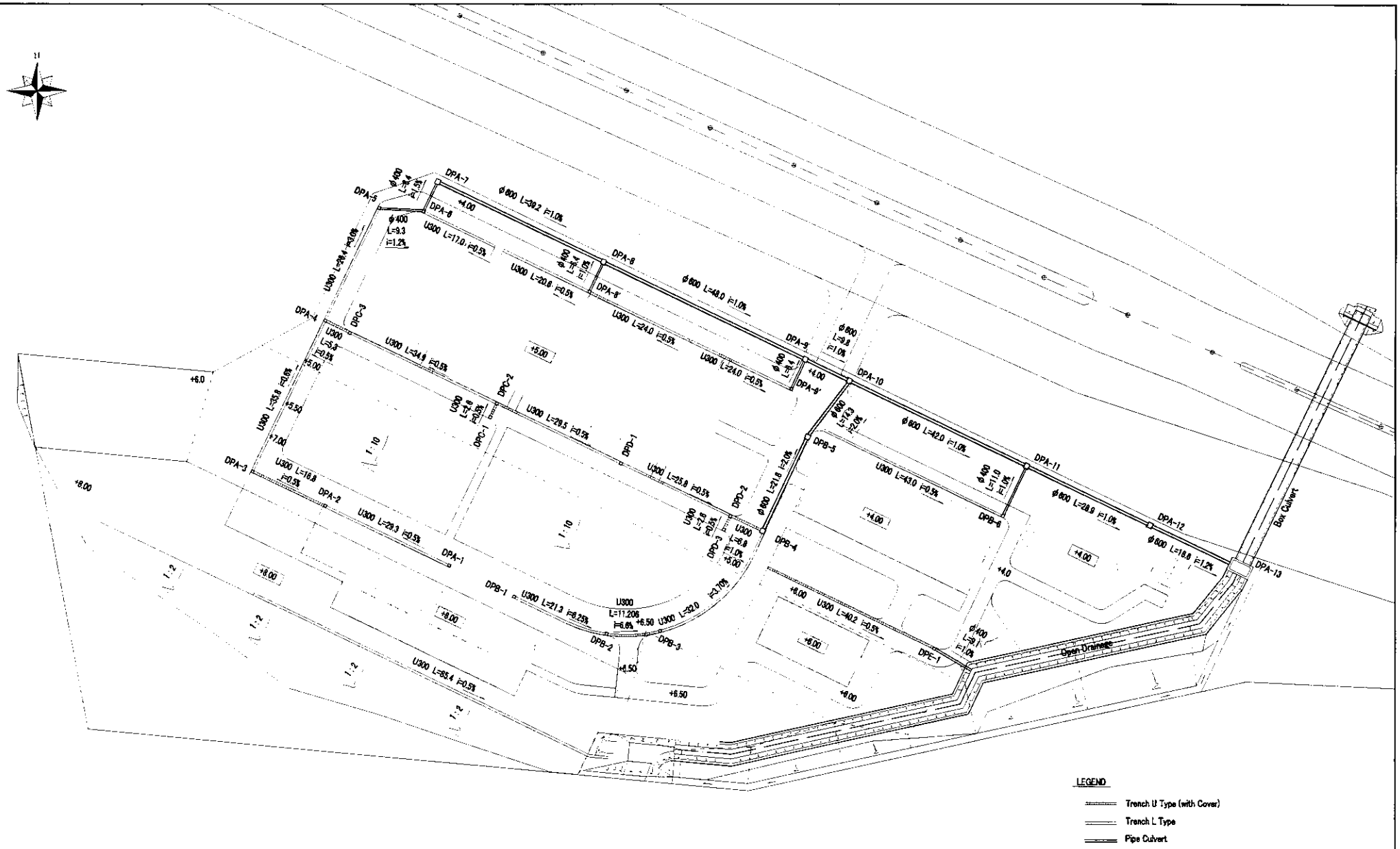


A-A Section (S=1 : 100)



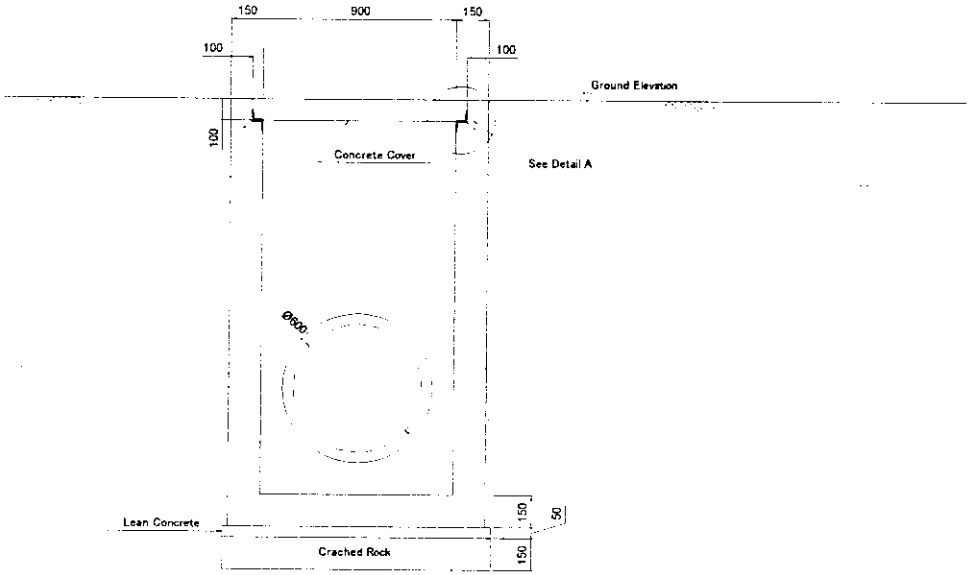
B-B Section (S=1 : 80)

THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEARCH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL CO-OPERATION AGENCY OVERSEAS AGRO-FISHRIES CONSULTANTS CO., LTD. NIPPON KOEI CO., LTD.	DRAWING TITLE STORM WATER DRAINAGE SEDIMENTATION POND / OUT-FALL DETAILS	SCALE As Shown	DRAWING No. C-08

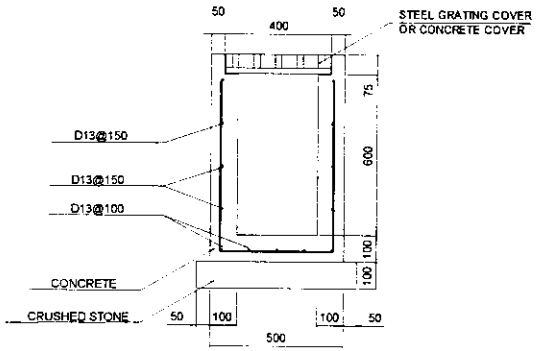


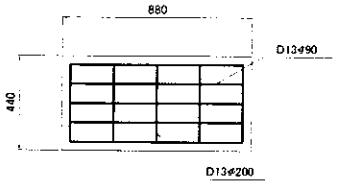
THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEARCH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL CO-OPERATION AGENCY OVERSEAS AGRO-FISHRIES CONSULTANTS CO., LTD. NIPPON KOEI CO., LTD.	DRAWING TITLE STORM WATER DRAINAGE GENERAL PLAN OF SITE DRAINAGE SYSTEM	SCALE 1 : 800	DRAWING No. C-09

CONCRETE (S=1:25)

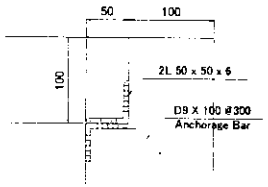


SECTION OF TRENCH WITH COVER (300)
S=1:200

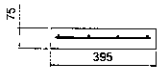




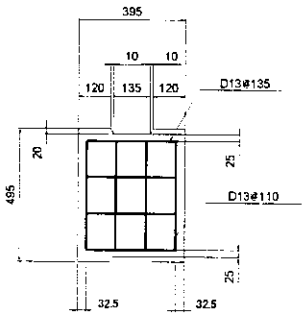
REINFORCEMENT (S=1:25)



DETAIL-A (S=1:10)



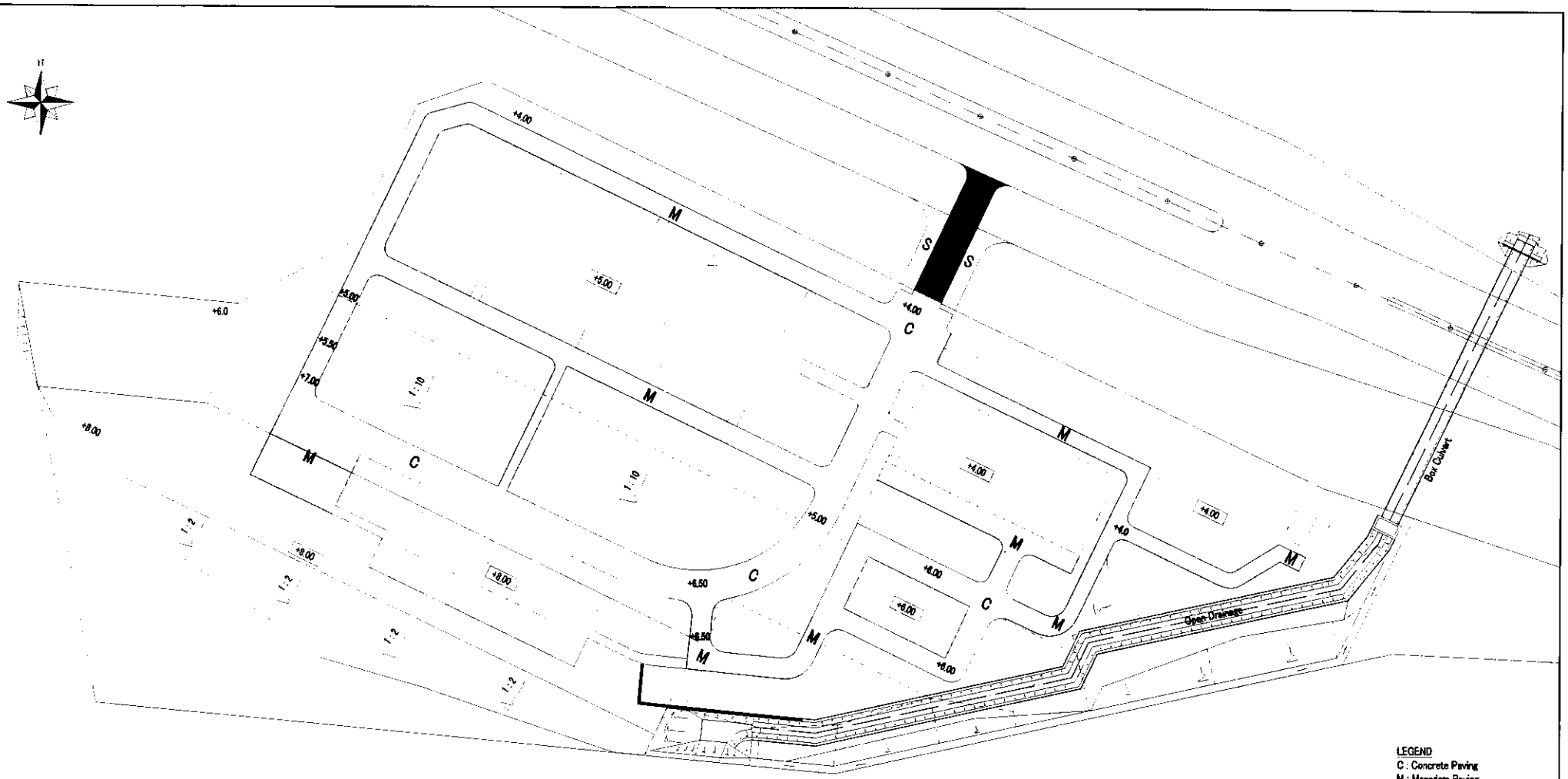
SIDE VIEW
S=1:200



PLAN

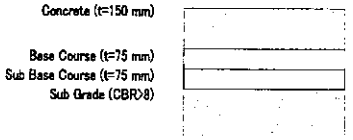
DETAILS OF CONCRETE COVER (300)
S=1:200

THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEARCH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL CO-OPERATION AGENCY OVERSEAS AGRO-FISHRIES CONSULTANTS CO., LTD. NIPPON KOEI CO., LTD.	DRAWING TITLE STORM DRAINAGE DETAIL OF MANHOLE	SCALE As Shown	DRAWING No. C-10

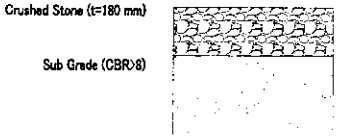


LEGEND
C : Concrete Paving
M : Macadam Paving
A : Asphalt Paving
S : Shoulder

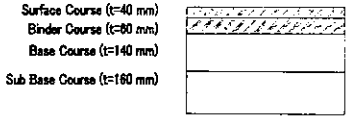
Concrete Paving Structure



Macadam Paving Structure



Asphalt Paving Structure

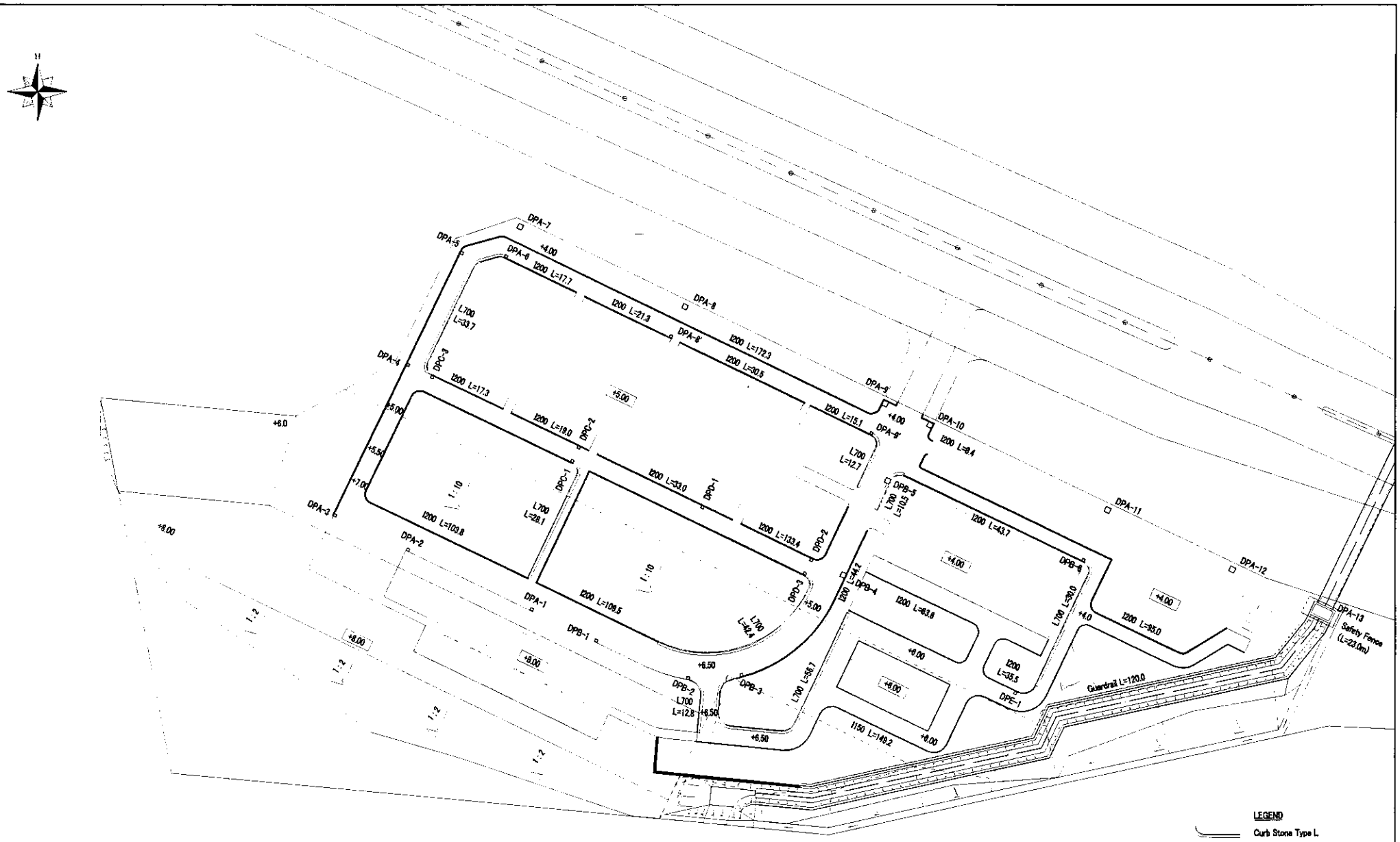


THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEARCH AND DEVELOPMENT CENTER IN NHA TRANG

JAPAN INTERNATIONAL CO-OPERATION AGENCY
OVERSEAS AGRO-FISHRIES CONSULTANTS CO., LTD.
NIPPON KOEI CO., LTD.

DRAWING TITLE
ROAD AND PAVING WORK
GENERAL PLAN AND DETAILS OF PAVEMENT

SCALE	DRAWING No.
1 : 800	C-11

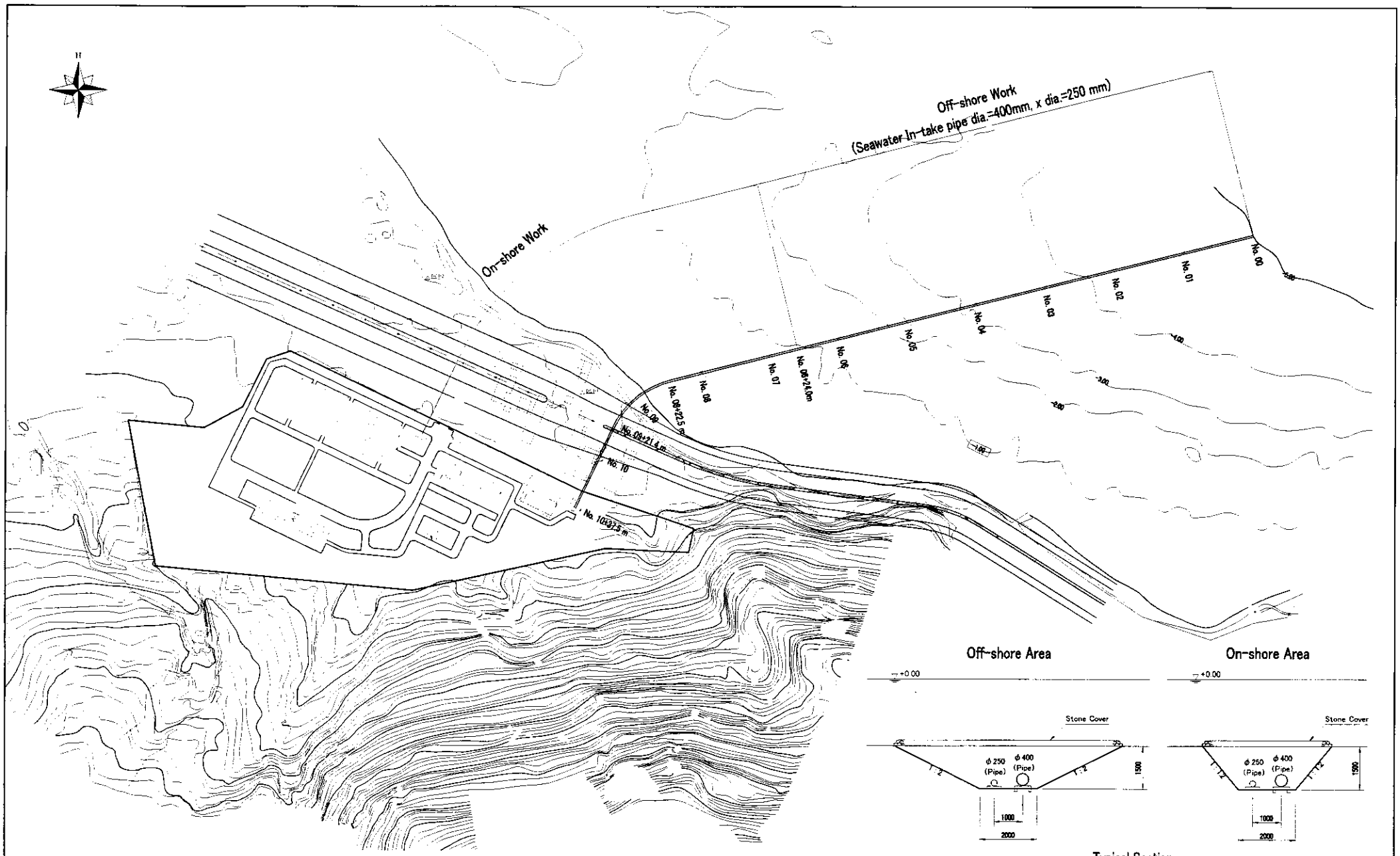


LEGEND

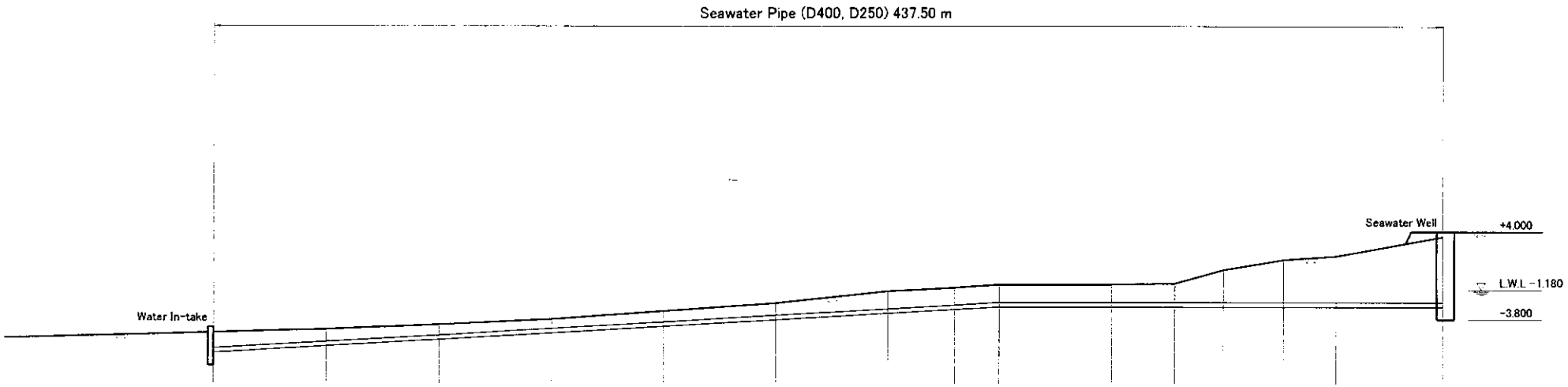
Curb Stone Type L

Curb Stone Type I

THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEARCH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL CO-OPERATION AGENCY OVERSEAS AGRO-FISHRIES CONSULTANTS CO., LTD. NIPPON KOEI CO., LTD.	DRAWING TITLE ROAD AND PAVING WORK CONCRETE KERB ARRANGEMENT PLAN	SCALE: 1 : 800 DRAWING No.: C-12



THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEARCH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL CO-OPERATION AGENCY OVERSEAS AGRO-FISHRIES CONSULTANTS CO., LTD. NIPPON KOEI CO., LTD.	DRAWING TITLE SEAWAER PIPE WORKS GENERAL PLAN	SCALE 1 : 2000	DRAWING No. C-13



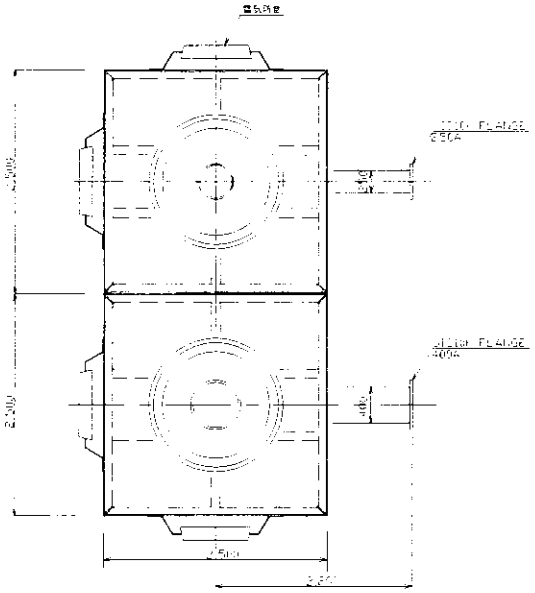
Sta. No.	No. 00	No. 01	No. 02	No. 03	No. 04	No. 05	No. 06	No. 06 +24.0 m	No. 07	No. 08	No. 08 +22.5 m	No. 09	No. 09 +21.4 m	No. 10	No. 10 +37.5 m
Ground Level	-5.00	-4.70	-4.30	-3.80	-3.10	-2.40	-1.30	-1.00	-0.70	-0.70	-0.60	+0.60	+1.50	+1.80	+3.52
Pipe Center Elevation	-6.60	-6.01	-5.43	-4.84	-4.26	-3.67	-3.09	-2.73	-2.50	-2.50	-2.50	-2.50	-2.50	-2.50	-2.50
Excavation Depth	-7.00	-6.31	-5.73	-5.14	-4.56	-3.97	-3.39	-3.03	-2.80	-2.80	-2.80	-2.80	-2.80	-2.80	-2.80
Distance	0.00	40.00	40.00	40.00	40.00	40.00	40.00	24.00	16.00	40.00	22.50	17.50	21.40	18.60	37.50
Accumated Distance	0.00	40.00	80.00	120.00	160.00	200.00	240.00	264.00	280.00	320.00	342.50	360.00	381.40	400.00	437.50

THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEARCH AND DEVELOPMENT CENTER IN NHA TRANG

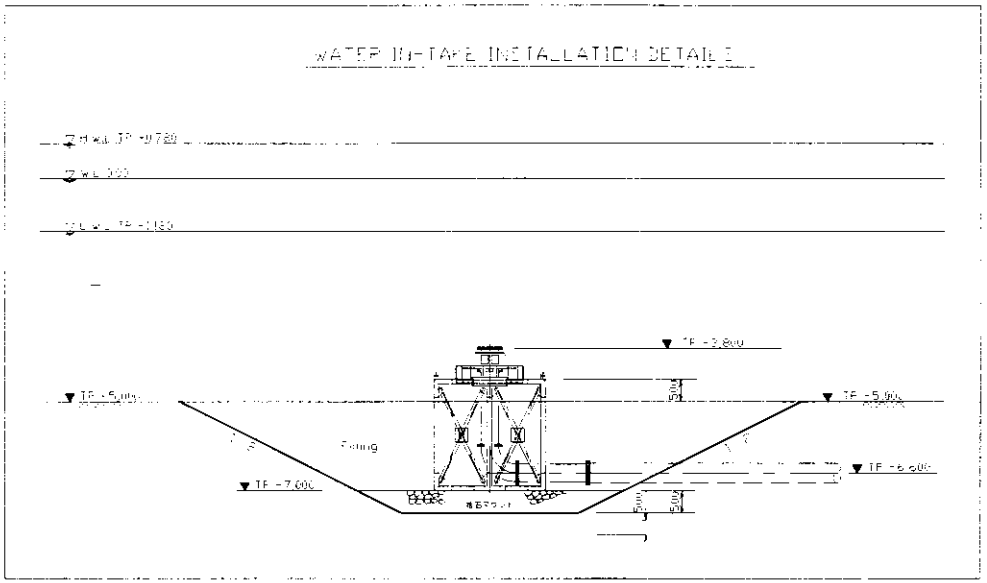
JAPAN INTERNATIONAL CO-OPERATION AGENCY
OVERSEAS AGRO-FISHRIES CONSULTANTS CO., LTD.
NIPPON KOEI CO., LTD.

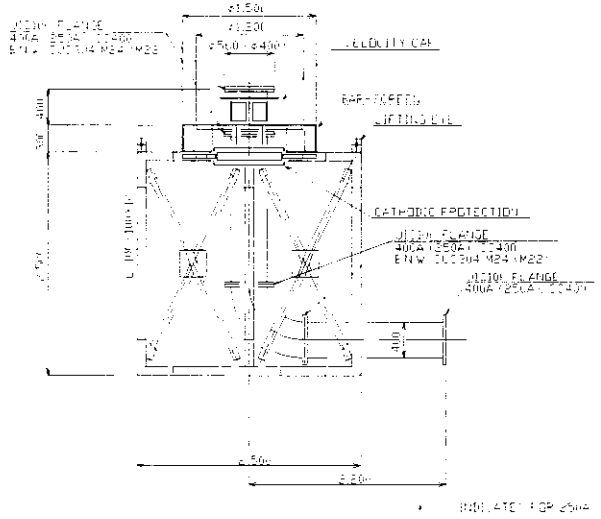
DRAWING TITLE
SEAWATER PIPE WORK
LONGITUDINAL SECTION

SCALE	DRAWING No.
1 : 1500	C-14

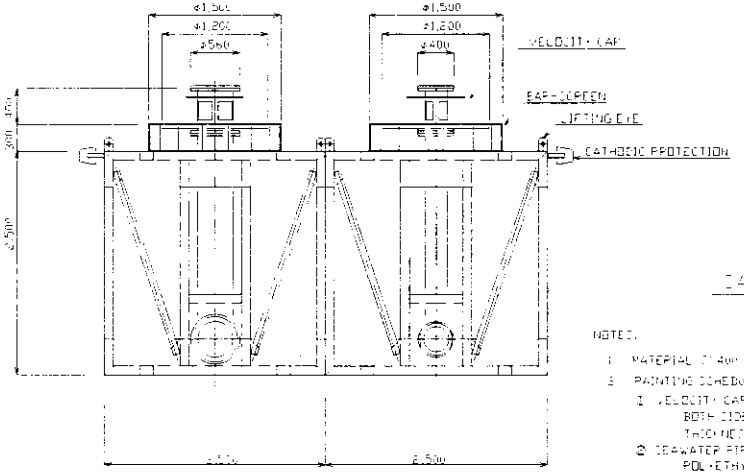


PLAN

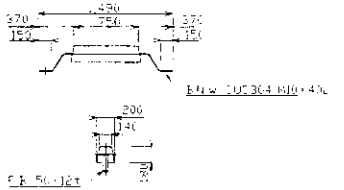




SIDE VIEW



FRONT VIEW



CATHODIC PROTECTION DETAILS

NOTES:
1. MATERIAL : SEAWATER PIPE STPG370 SCH30 400A 16KA
2. PAINTING SCHEDULE
   ① VELOCITY CAP, EAR-SCREEN, FRAME
   BOTH SIDES (OUTER/INNER SURFACE) TAR-EPOXY COATING
   THICKNESS NOT LESS THAN 0.3 MM
   ② SEAWATER PIPES INNER SURFACE
   POLYETHYLENE COATING THICKNESS 2.0 MM
   OUTER SURFACE TAR-EPOXY COATING THICKNESS 0.3 MM
3. OTHERS CATHODIC PROTECTION DESIGNED FOR 25 YEARS

THE BASIC DESIGN STUDY ON THE PROJECT FOR CONSTRUCTION OF MARICULTURE RESEARCH AND DEVELOPMENT CENTER IN NHA TRANG	JAPAN INTERNATIONAL CO-OPERATION AGENCY OVERSEAS AGRO-FISHRIES CONSULTANTS CO., LTD. NIPPON KOEI CO., LTD.	DRAWING TITLE SEAWATER PIPE WORKS WATER IN-TAKE DETAILS	SCALE: 1 : 60 DRAWING No.: C-15

2-2-4 Implmentation Plan

2-2-4-1 Implmentation Policy

The Project will be implemented under the grant aid scheme of the Government of Japan. As it is essential for the Project to be completed within a specified period of time, the preparation of an appropriate construction plan, procurement plan, schedule plan and quality control plan is necessary so that the construction work can be conducted under an appropriate management regime to a suitable standard. The construction work will be carried out in accordance with the following basic principles.

①Close relation with the related government officials in the recipient country should be maintained at each stage to ensure smooth communication to prevent any procedural irregularities.
②The procurement of Japanese products should be considered if those available in Viet Nam are not the best option in terms of quality and quantity.
③The technical level of local construction companies has already achieved a certain level. Local construction companies should, therefore, be used as subcontractors as much as possible although careful checking of their technical capability is still required.
④The equipment to be selected should be easy to obtain spare parts and easy to maintain.
⑤The customs, traditions and culture of Viet Nam should be taken into careful consideration in the planning of the construction work and labor management.

2-2-4-2 Implementation Conditions

Work safety should be given the highest priority and the introduction of certain measures, including prohibition of the entry of unrelated persons to the construction site, will be necessary.

In regard to equipment to be procured locally, any mistake in procurement could cause a significant delay of the construction work. Detailed delivery planning and detailed discussions with the supplier are, therefore, essential.

2-2-4-3 Scope of Works

The Project will be implemented under the grant aid scheme of the Government of Japan and both the Japanese side and the Viet Namese side will be responsible for certain work at their own expense.

(1) Scope of Work for the Japan Side

①Consultancy work, including detailed design, assistance for tender and design supervision
②Provision of all construction materials and labor required for the construction work

for which the Japanese side is responsible under the Project
③Maritime and inland transportation of equipment and materials to be imported for the construction work for which the Japanese side is responsible under the Project, such transportation of equipment to be imported as part of the equipment procurement plan and payment of the transportation and insurance costs
④Quality inspection required for the construction work and equipment procurement for which the Japanese side is responsible under the Project

(2) Scope of Work for the Viet Nam Side

①Provision of the planned construction site for the Project, primary land preparation, demolition and removal of existing buildings and structures on the planned construction site and disposal of waste materials from the project site
②Construction of a well on the project site to supply fresh water
③Construction of fencing and gates, etc. which are required at the project site
④Extension of telephone lines to the project site
⑤Extension of electricity supply to the service point on the project site
⑥Procurement of office equipment, telephone sets and furniture, etc. which are required by the administration and research building and other buildings of the Center

2-2-4-4 Consultant Supervision

The Consultant will carefully examine the planned construction work, schedule and quality control plan, etc. in accordance with the project design and will establish an appropriate work supervision system. In regard to work supervision, the Consultant will establish a system to the project-related organizations in Viet Nam, Embassy of Japan in Hanoi the JICA and the Constructor and will formulate appropriate plans for the equipment and office facilities, etc. required for work supervision and the procedure, timing and method of quality control. The Consultant will also carefully examine the technological level, strength and distribution of the personnel required for work supervision to ensure the proper implementation of such supervision.

2-2-4-5 Quality Control Plan

Based on the following policy quality control for construction work will be supervised for the project.

1) To instruct the standards and specific values for quality control clearly in design specifications, etc.

2) To make a quality control plan which instruct method, order, frequency, etc. of control activities, according to each item to be controlled and to utilize the plan to examine causes of malfunctions and ways of treatment during construction in order to assure the designed quality.

3) To confirm each data of quality control quantitatively to satisfy the standard of the

quality, by using satatistical methods such as check sheet, control chart, histogram, etc., depending on feature of quality.

4) To pursue the causes by means of methods such as analysis chart of characteristic factors, and to take a treatment to prevent recurrence, when data of quality contro; are within the control limit of quality but indicate abnormal signs.

5) For the quality control of concrete, to measure slump, temperature, air contents, etc., upon every test if sample, and to conduct experiments for compression strength on one week and four weeks curing. As for concrete strengths, to assure the design quality, by making the control chart based on the data from the experimental results and implementing the quality control as aforementioned.

2-2-4-6 Procurement Plan

(1) Building Equipment and Materials

Most common construction materials are readily available in Viet Nam except for special finishing materials and building service equipment, etc. Those items which are available in Viet Nam and of which the specifications are suitable for the Project will be procured in Viet Nam. Meanwhile, items of which the procurement in Viet Nam is difficult, of which the delivery may be unreliable because of uncertainty associated with its import or of which the quality is questionable will be procured in Japan.

(2) Equipment

1)Procurement

The sources for equipment supply will be widely sought, including Japan and third countries, to check the prospects of after-care and parts supply so that equipment of reliable quality can be procured at a favourable cost.

2) Quality Control and Performance Check

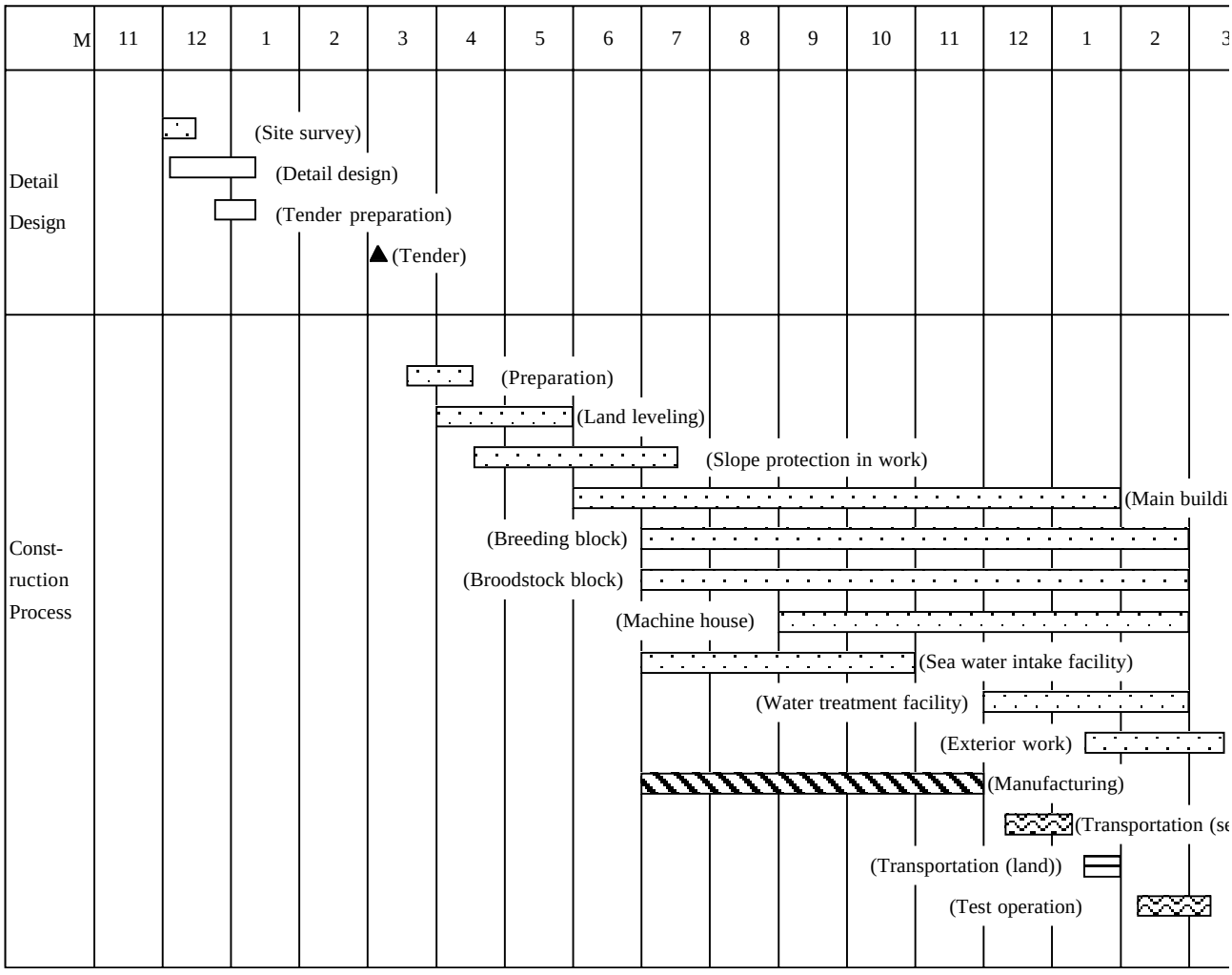
Factory checking of the equipment and operation checking of the equipment after its installation will be conducted. The installation of the equipment at the project site will be witnessed by the equipment supervisor and specialist engineers will conduct the completion checking and performance checking of each installed equipment prior to the handing over of the equipment to the Viet Namese side. The same engineers will convey important points for equipment operation and maintenance to the Viet Namese engineers.

2-2-4-7 Implementation Schedule

For the implementation of the Project, it is assumed that four months will be required to complete the detailed design for the buildings and tender, 12 months for the approval of

the completion drawings, construction work and completion inspection, etc. after the conclusion of the construction agreement, five months for the preparation and approval of the work drawings after the tender, one month for transportation and one month for product inspection and handing over. The project implementation schedule is shown in Fig.2-5.

Fig 2-5 Project Implementation Schedule



2-3 Obligations of Recipient Country

(1) Obligations of Recipient Country

The obligations of Viet Nam side are as follow;

① Securing of the scheduled construction site for the Project, primary land leveling of site land, dismantling and removal of existing facilities and obstructions on the site, and disposal of solid waste
② Acquisition of all authorizations required in Viet Nam with respect to Project implementation and construction works
③ Signing of the banking agreement required for Project implementation and the prompt issue of the authorization to pay
④ The prompt securing of tariff-free customs clearance in Viet Nam as required for Project implementation and construction works
⑤ Exemption of all taxes and surcharges that may otherwise be imposed on Japanese nationals and corporate persons in Viet Nam during the course of construction works, procurement of equipment and materials and provision of services
⑥ Permission for entry to Viet Nam and stay therein of Japanese persons as required for implementation of the Project
⑦ Securing of a works temporary yard, site office and other site space necessary for the Project construction works
⑧ Implementation of steps to prohibit unauthorized persons from entering the Project site during the construction works
⑨ Construction of necessary fences and gates, etc. around the scheduled Project construction site
⑩ Procurement of office equipment, telephones and furniture required inside the Project research and administration building and facilities
⑪ Digging of a well for supplying freshwater inside the Project construction site
⑫ Extension of telephone and power lines up to the scheduled Project construction site
⑬ Bearing of all other necessary expenses not covered by the Japanese grant aid in the Project
⑭ Implementation of steps to avoid the uncomfortable vibration and noise to research activity and fish breeding from the planed road in front of site

(2) Bearing of necessary expenses of Recipient Country

① Extension of telephone and power lines, etc	7,700US$ (Apppox.1mil .JY)
② Freshwater well works	8,000US$ (Apppox.1.05mil .JY)
③ Project site initial reclamation and disposal of boulders on and outside the Project sit	90,000US$ (Apppox.11.7mil .JY)
④ Fences, gates, plantation, etc.	33,000 US$ (Apppox.4.31mil .JY)
	138,700 US$ (Apppox.18.06mil .JY)

2-4 Project Operation Plan

(1) Project Operation Plan

At the Research Institute for Aquaculture NO3, it is planned to implement the following personnel arrangement in the Project facilities. Basically speaking, human resources will be shifted from the Research Institute for AquacultureNO3, however, it is also planned to recruit staff from Nha-Trang University of Fisheries and general universities. Concerning Project operation, it is planned to establish a Science Council consisting of the Center Director, Vice Director and three department chiefs in the Center, and to hold three or four meetings per year in order to hear reports and hold discussions on the state of progress of research work and contents and results of research plans.

Table 2-23 Personnel Plan

Position	Number of Staff	Number of Workers
LEADERS		
- Director	1	
- Vice Director	1	
FUNTIONAL DEPARTMENTS		
Dept. of Administration & Management		
- Chief A&M	1	
- International affairs Section	1	
- Administration & Service Section, including:		
+ Document	1	
+ Equipment		1
+ Driver	2	
+ Security	2	
- Information & Library Section	2	
Dept. of Planing & Finance		
- Chief	1	
- Staff	3	
Research Departments		
Dept. of Culture Technology		
- Chief	1	
- Broodstock Handling Section		
+ Staff	4	
+ Worker		4
- Breeding, Incubation & Larvae Rearing Section		
+ Staff	5	
+ Worker		3
+ Staff	5	
+ Worker(algae, rotifer…)		2
+ Staff	2	
+ Worker		1
Dept. of Environmental &Fish Disease		
- Chief	1	
- Environmental Section	2	
- Fish Disease Section	2	

Dept. of Biological Technology		
- Chief	1	
+ Staff	3	
+ Worker		2
- Genetics & Selection Section		
+ Staff	2	
- Immunology Section		
+ Staff	2	
Total	45	13

(2) Operation and Maintenance Cost

The Nha-Trang Mariculture Research and Development Center will carry out operation and maintenance of Project facilities, however, since this Center is under the existing Research Institute for Aqualculture NO3., budget shall be appropriated as that of a subordinate agency of the Research Institute for Aqualculture NO3 when making the budget application to the Ministry of Fisheries. Here, in order to offer a guide for future budget measures by the Ministry of Fisheries, the operation and maintenance cost of Project facilities was examined. Since personnel expenses and miscellaneous research costs in the Project facilities can be calculated on the Ministry side, trial calculation here is limited to power charges and maintenance costs.

1)Power Charges

It is forecast that power charges will account for a major chare of necessary operating expenses. Concerning setting of the power tariff unit rate, since the Project facilities belong to the government of Viet Nam, it is possible to set the power tariff rate at the minimum level of 1,000 VND/KWH. Operating costs surrounding water intake and air supply are estimated in the manner shown in Table 2-24.

Table 2-24 Estimation of Operating Expenses

	Power Consumption (KW/h) (A)	Capacity (m3/min)	Annual Operating Time (hrs) (B)		Annual Power Cost (VND) A x B x @ (power unit rate) @: 1,000 VND/KWh
Seawater intake pumps	11	3.35	4,800m3/3.35/60*0.8*365	6,973	76,703,000
Seawater filtration pumps	11	0.75	1,058m3/0.75/60*0.7*365	6,007	66,077,000
	18.5	1.82	2,617m3/1.82/60*0.7*365	6,123	113,257,000
	11	0.79	1,125m3/0.79/60*0.1*365	8,662	95,282,000
UV disinfect. unit	1.32	0.75	24*365	8,760	11,563,000
Blowers	1.5×3	0.65	24*0.7*365	6,132	27,594,000
	2.2	1.43	24*365	8,760	19,272,000
	1.5	0.62	34*365	8,760	13,140,000
Total					422,888,000

* Since the water requirement falls following production of seeds and seedlings, the average operating rate of the nursery tank pumps and broodstock pumps was assumed as 70%.

2) Fuel Cost

The emergency generator consumes around 20 liters of diesel oil per hour. Assuming the generator operates for 24 hours per month, diesel oil consumption will be 20 L x 24 hrs = 480 L/month, and the fuel cost will be 480 L x 5,000 VND = 2,400,000 VND. Therefore, the annual fuel cost will be 2,400,000 VND x 12 months = 28,800,000 VND.

Incidentally, during power cuts, normal power charges do not arise. The ordinary power charge according to (1) above is 422,888,000 VND/year, which works out as 1,158,000 VND per day. During power cuts, a cost difference with this of 29,160,000 VND per year is generated.

Cost difference: 2,400,000 VND – 1,158,000 VND = 1,242,000 VND/24 hrs → 14,904,000 VND/year

3) Maintenance

The maintenance cost for sea water pipe cleaning, pit, filter etc will be born. The maintenance work for sea water pipe cleaning, pit needs under water activity, so the cost for scuba equipment rental shall be born. The fee for scuba equipment rental with two air tanks is estimated as 750,000VND for one day. The maintenance times is one per month, it is estimated 900mil.VND per year. The coral sand shall be used for filter material. It will be estimated 0.5% of total machine price for maintenance.
118.20mil JY × 0.5%=591,000JY→67.83mil VND
Adding common maintenance cost ie. Paint is estimated 7.5milVND.

4) Running cost for equipment

The running cost for equipment is shown in table 2-25. According to this table, its cost is calculated 9,667USD equal to 14.5milVND. And running cost for Liquid Nitrogen pot is 1.62milVND per year.

Consumption of Liquid Nitrogen	15L / 5month →36L / year
Unit price of Liquid Nitrogen	3USD / L
Annual cost for Liquid Nitrogen	36L / year x 3USD / L = 108 USD / year =1.62milVND per year

Table 2-25 Annual Consumable Cost of the Equipment

Name of Consumables	Unit Price US$	frequency in use	Q'ty of annual necessity for 1	Q'ty of equipment	Total Q'ty for 1 year	Total cost for 1year US$
1. Environmental Section						
Water Monitoring Apparatus						
(1) pH Solution (pH4/500ml)	15	Using for all the year round. 50ml for 1 week.The Q'ty of annual necessity =2600ml(50ml/week x 52weeks).Total pcs for 1 year=6 pcs (2600ml ÷ 500ml=5.2)	6	2	12	174
(2) pH Solution (pH7/500ml)	15	Using for all the year round. 50ml for 1 week.The Q'ty of annual necessity =2600ml(50ml/week x 52weeks).Total pcs for 1 year=6 pcs (2600ml ÷ 500ml=5.2)	6	2	12	174
(3) pH Reference Internal Solution (250ml)	23	Using for all the year round. 25ml for 1 week.The Q'ty of annual necessity =1300ml(25ml/week x 52weeks).Total pcs for 1 year=6 pcs (1300ml ÷ 250ml=5.2)	6	2	12	275
(4) ORP Powder (10pack/set)	31	Using for all the year round. 1 pack for 1 week.The Q'ty of annual necessity =52 packs(1 pack/week x 52weeks).Total pcs for 1 year=6 sets(52 packs÷10 pack=5.2)	6	2	12	367
(5) Ion one-point Calibration Solution (250ml)	27	Using for all the year round. 25ml for 1 week.The Q'ty of annual necessity =1300ml(25ml/week x 52weeks).Total pcs for 1 year=6 pcs (1300ml ÷ 250ml=5.2)	6	2	12	321
(6) Nitric Acid Ion Sensor Internal Solution (50ml)	27	Using for all the year round. 5ml for 1 week.The Q'ty of annual necessity =260ml(5ml/week x 52weeks).Total pcs for 1 year=6 pcs (260ml ÷ 50ml	6	2	12	321
(7) Ammonia Acid Ion Sensor Internal Solution (250ml)	27	Using for all the year round. 25ml for 1 week.The Q'ty of annual necessity =1300ml(25ml/week x 52weeks).Total pcs for 1 year=6 pcs (1300ml ÷ 250ml=5.2)	6	2	12	321
Sub Total						1,956
Biological Oxygen Demand (BOD) Meter						
(1) BOD Solution (16pcs/set)	77	1pcs for 1 week. The Q'ty of annual necessity =52 pcs (1 pcs/week x 52weeks). Total set for 1 year=4 sets(52pcs÷16pcs=3.3)	4	1	4	306
Sub Total						306
Chemical Oxygen Demand (COD) Meter						
(1) Reagent (500ml)	46	10ml for 1 week. The Q'ty of annual necessity =520ml(10ml/week x 52weeks) Total pcs for 1 year=1 pcs(520ml÷500ml=1.04)	1	1	1	46
(2) Emery Sand	12	1 set for 1 year	1	1	1	12
(3) Printer Paper(10rolls/set)	99	1 set for 1 year	1	1	1	99
Sub Total						158
Environmental Section Total						2,420
2. PCR・Pathology Section						
Fluorescent Microscope with Microphotography						
(1) Immersion Oil (50cc)	31	1 pcs for 1 year	1	1	1	31
Sub Total						31
pH Meter						
(1) Solution (pH4.01/500ml)	15	Using for all the year round. 50ml for 1 week.The Q'ty of annual necessity =2600ml(50ml/week x 52weeks).Total pcs for 1 year=6 pcs (2600ml ÷ 500ml=5.2)	6	1	6	92
(2) Solution (pH6.86/500ml)	15	Using for all the year round. 50ml for 1 week.The Q'ty of annual necessity =2600ml(50ml/week x 52weeks).Total pcs for 1 year=6 pcs (2600ml ÷ 500ml=5.2)	6	1	6	92
(3) KCL Solution (3.3mol/100ml)	11	Using for all the year round. 50ml for 3 months.The Q'ty of annual necessity =200ml(50ml/3 months x 12months).Total pcs for 1 year=2 pcs (200ml ÷ 100ml=2)	2	1	2	23
Sub Total						207
Thermal Cycler (DNA PCR)						
(1) PCR tube (1000 pcs/set)	130	PCR experiment is done 128 times in 1 year. 1 set Total 100 times.1 year=2 sets(128 times ÷ 100 times=1.28)	2	1	2	260
(2) DNA Purification・Isolation Kit	199	PCR experiment is done 128 times in 1 year. 1 set Total 100 times.1 year=2 sets(128 times ÷ 100 times=1.28)	2	1	2	398
(3) DNA PCR Kit	1,025	PCR experiment is done 128 times in 1 year. 1 set Total 100 times.1 year=2 sets(128 times ÷ 100 times=1.28)	2	1	2	2,051
Sub Total						2,709
Protein Electrophoresis System						
(1) PAGE Reagent Kit(50 times tests)	253	PCR experiment is done 128 times in 1 year. 1 set Total 50 times.1 year=3 sets(128 times ÷ 50 times=2.56)	3	1	3	758
(2) Gel Dying Kit (10g)	57	PCR experiment is done 128 times in 1 year. 1 set Total 50 times.1 year=3 sets(128 times ÷ 50 times=2.56)	3	1	3	172
Sub Total						930
Nucleic Acid Electrophoresis System						
(1) Agarose Gel Kit, PFC Agarose (100g) (50 times test)	184	PCR experiment is done 128 times in 1 year. 1 set Total 50 times.1 year=3 sets(128 times ÷ 50 times=2.56)	3	1	3	551
(2) Gel Dying Kit(Ethidium Bromide)(11mg/10 Tablets) (50 times test)	103	PCR experiment is done 128 times in 1 year. 1 set Total 50 times.1 year=3 sets(128 times ÷ 50 times=2.56)	3	1	3	310
Sub Total						861
Agarose Electrophoresis Apparatus						
(1) Agarose Gel Reagent, PCR Agarose (125g) (50times test)	681	PCR experiment is done 128 times in 1 year. 1 set Total 50 times.1 year=3 sets(128 times ÷ 50 times=2.56)	3	1	3	2,043
(2) Gel Dying Kit(Ethidium Bromide)(11mg/10 tablets) (50 times test)	119	PCR experiment is done 128 times in 1 year. 1 set Total 50 times.1 year=3 sets(128 times ÷ 50 times=2.56)	3	1	3	356
Sub Total						2,399
PCR・Pathology Total						7,136
3. Common Section						
Microscope (Light Field Observation)						
(1) Immersion Oil (50cc)	31	1 pcs for 1 year	1	2	2	61
Ultrasonic Washer						
(1) Detergent (1kg)	25	PCR experiment is done 64 days in 1 year, Adding this solution works an Total experiment is done 180 days in 1 year.one day for one time.1kg .The Q'ty of annual necessity =1.8kg(10g/day x 180 days=1.8) for 1 year=2 sets(1.8kg ÷ 1kg=1.8)	2	1	2	51
Sub Total						51
Common Section Total						112
Total						9,668

The total Operation and Maintenance Cost is estimated 682.902milVND. The total Operation and Maintenance Cost of this project is shown Table 2-26

Table 2-26 Operation and Maintenance Cost

title		Mil.VND
Power Charges	Above mentioned	422.888
Fuel Cost	Above mentioned	14.904
Maintenance	9milVND+67.83milVND	76.83
Expendables	Above mentioned	161.20
Others		7.08
Total		682.902

CHAPTER 3

PROJECT EVALUATION AND RECOMMENDATIONS

Chapter 3 Project Evaluation and Recommendations

3-1 Project Effect

The following effects can be anticipated from implementation of the Project.

Current Conditions and Problems	Project Countermeasures (grant aid activities)	Project Effect and Improvements
Facilities at the Research Institute for Aquaculture NO3, which is responsible for serving the central part of Viet Nam, are currently used to research aquaculture of shellfish, echinoderms, and mollusks. Because this Center is cramped and has no room for expansion, it has no facilities or apparatus for conducting other mariculture research and development. As a result, research activities at the Center are not adequate with respect to needs.	Construction of research facilities and supply of research equipment necessary for conducting research, in particular research and testing on large-scale nursery stock production. (Buildings: broodstock block, larvae breeding block, administration and research block, seawater intake facilities, live feed biological cultivation tanks (outdoor), etc. Equipment: net preserves, microscopes, spectrophotometers, dispersed electric migration device, water quality measurement device, workboat, truck with crane, etc.)	If research and test facilities for conducting research and testing for large-scale production of marine fish nursery stock are completed, mariculture research and technical development will be promoted and technology for the mass production of marine fish nursery stock will be established. (As the immediate goal, it will be possible to mass-produce Groupers and Milkfish nursery stock).

Furthermore, by improving and overcoming the above current conditions and problems, the Project can be expected to impart the following effects.

1) Securing of Grouper nursery stock

In all Khanh Hoa Province, approximately 200,000 Grouper nursery stock are fished from the natural habitat every year. By producing and supplying artificial nursery stock through disseminating and utilizing the mass production technology established in the Project, it will be possible to secure the necessary stock while at the same time relieving this pressure on the natural stock.

2) Sustained shrimp cultivation

In order to prevent reduction of production capacity in shrimp ponds as a result of mixed cultivation and continuous cultivation of Milkfish with shrimp, Milkfish nursery stock will be utilized for extensive cultivation during idle times in shrimp ponds. Since

extensive cultivation will contribute to improving sediment soil and the cultivation environment in shrimp ponds, it is anticipated that this will aid the sustained development of shrimp cultivation.

3) Supply of low cost protein

By establishing mass production technology for Milkfish nursery stock, extensive cultivation of Milkfish will take place during idle periods in shrimp ponds, and this will make it possible to provide supply of low cost protein to the nation. Incidentally, the final survival rate of Grouper nursery stock and final survival rate of Milkfish nursery stock are considered to be appropriate indicators of the Project effectiveness. Moreover, when using these indicators to carry out intermediate assessment of the Project, it is desirable that the number of spawned eggs, fertilized eggs, normal hatching rate, intermediate survival rate, and final survival rate at the point where nursery stock reaches commodity size be measured for each fish species when measuring the indicator effect, and that the Project outputs be assessed at each stage of research.

3-2 Recommendations

The following recommendations are made to ensure the smooth and effective implementation of the Project.

Conservation of the hydrosphere environment

Since Nha-Trang is a well-know marine resort, the Government of Viet Nam and Khanh Hoa Province consider it necessary to pay attention to preservation of the hydrosphere environment to ensure that the natural coastal environment is not harmed. In particular, it is desirable that increased flow of domestic wastewater from local tourism development around the Center does not deteriorate local seawater quality.

Stable budget allocation

Since the Center is a research and development facility, it is basically not intended to make a profit. Accordingly, in order for the Center to be properly run and maintained, the Government of Viet Nam will need to take solid budget steps.

Maintenance and inspection of machine equipment

Development of the maintenance setup, including training and recruitment of pump and electrical maintenance staff, etc., is an important element in ensuring the smooth operation of facilities. Particularly concerning seawater intake, since this is key to facility activities, it is necessary to secure facility functions by compiling and executing an appropriate maintenance plan.

Researchers

Exchange of human resources between the Center and the Research Institutes for Aquaculture NO1 and NO2, Marine Research Institute, fisheries universities and fisheries laboratories should be actively encouraged because this will boost the effectiveness of research activities. Moreover, it is anticipated that absorbing the results

of aquaculture research and technology through exchange with the Southeast Asia Fisheries Development Center and other international agencies will lead to greater efficiency in research.

Economic support for mariculture fishermen

The technology that is developed at the Center should eventually be returned to mariculture fishermen. Accordingly, it is desirable that economic support be provided for fishermen and fishing households to ensure that these technologies are effectively used and make a contribution to the promotion of mariculture.

Monitoring and preservation of the mariculture environment

At the same time, steps shall be taken to prevent reduction in mariculture production via implementation of mariculture environmental monitoring and appropriate mariculture management.

Development of the mariculture dissemination setup

It is desirable that systems and institutions be established to ensure that the mariculture technologies developed at the Center are properly disseminated.

Quality control of fishery products

It will also be necessary to practice thorough quality control of fishery products and be careful to avert any situations that may tarnish the image of the sector and dampen consumer enthusiasm for products. Decline in consumption will eventually be translated into lower production.