NO. 7

BASIC DESIGN SURVEY REPORT

ON

BIOMASS ENERGY RESEARCH AND DEVELOPMENT CENTER IN THE REPUBLIC OF INDONESIA

JULY 1981

JAPAN INTERNATIONAL COOPERATION AGENCY

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JAPAN INTERNATIONAL COOPERATION AGENCY

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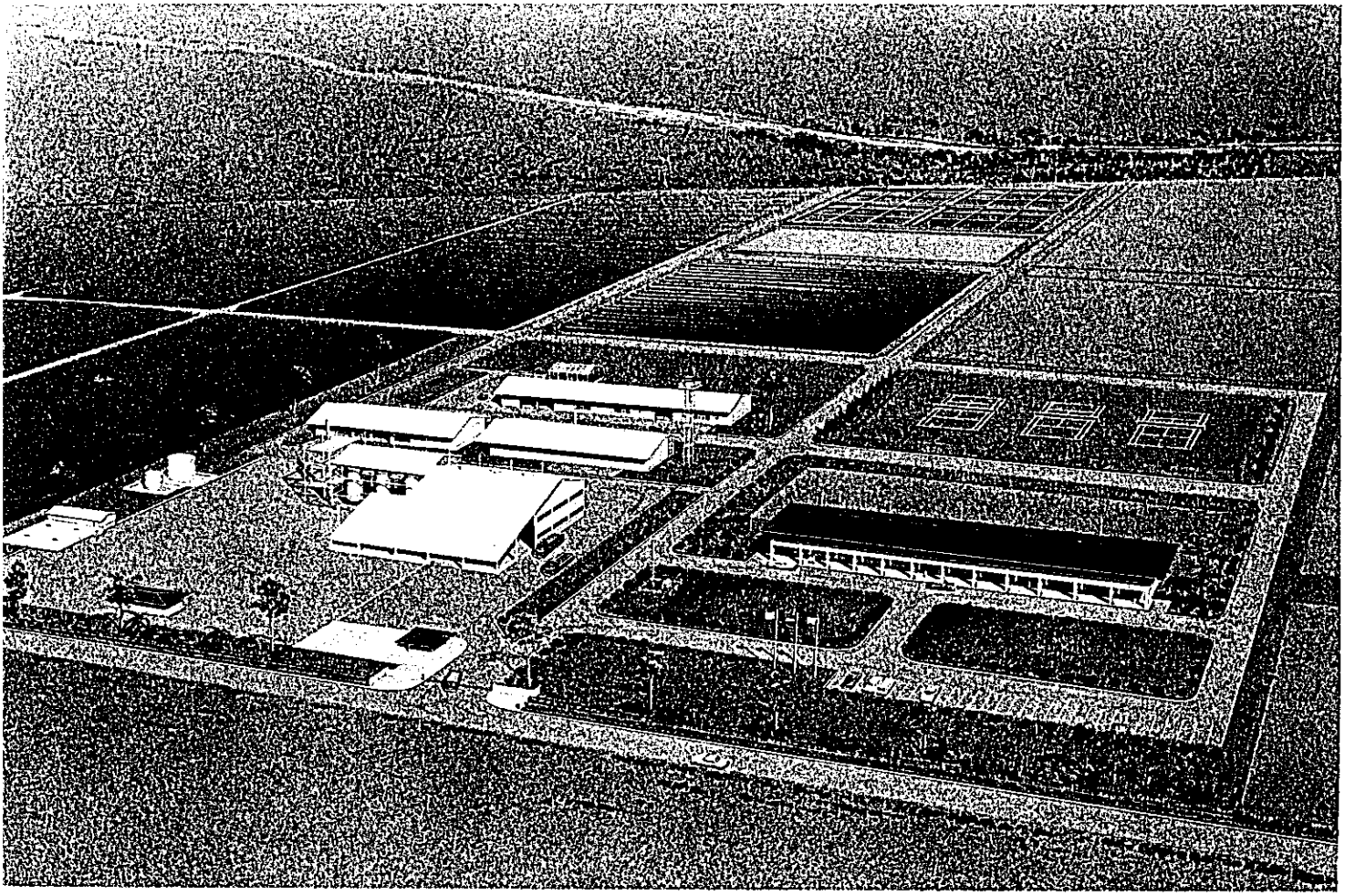


PREFACE

In response to a request of the Government of the Republic of Indonesia, the Japanese Government decided to conduct a survey on the Basic Design for Biomass Energy Research and Development Project and entrusted the survey to the Japan International Cooperation Agency (J.I.C.A.). The J.I.C.A. sent to Indonesia a survey team headed by Takaharu Kazama from March 10 to March 29, 1981.

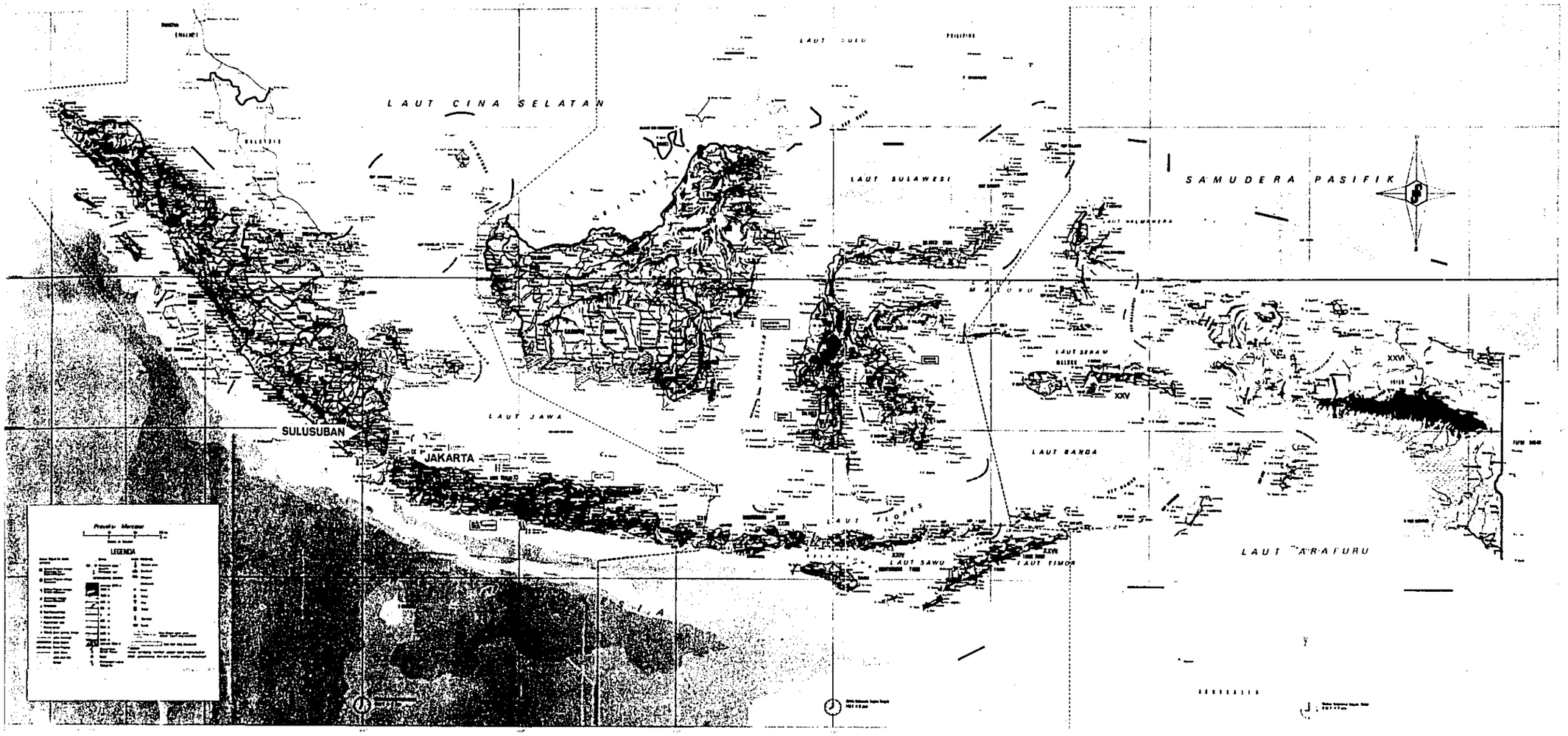
The team had discussions with the officials concerned of the Government of Indonesia and conducted a field survey in Lampung area, Sumatra. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between the two countries.

I wish to express my deep appreciation to the officials concerned of the Government of Indonesia for their close cooperation extended to the team.

July, 1981

Keisuke Arita
President
Japan International Cooperation Agency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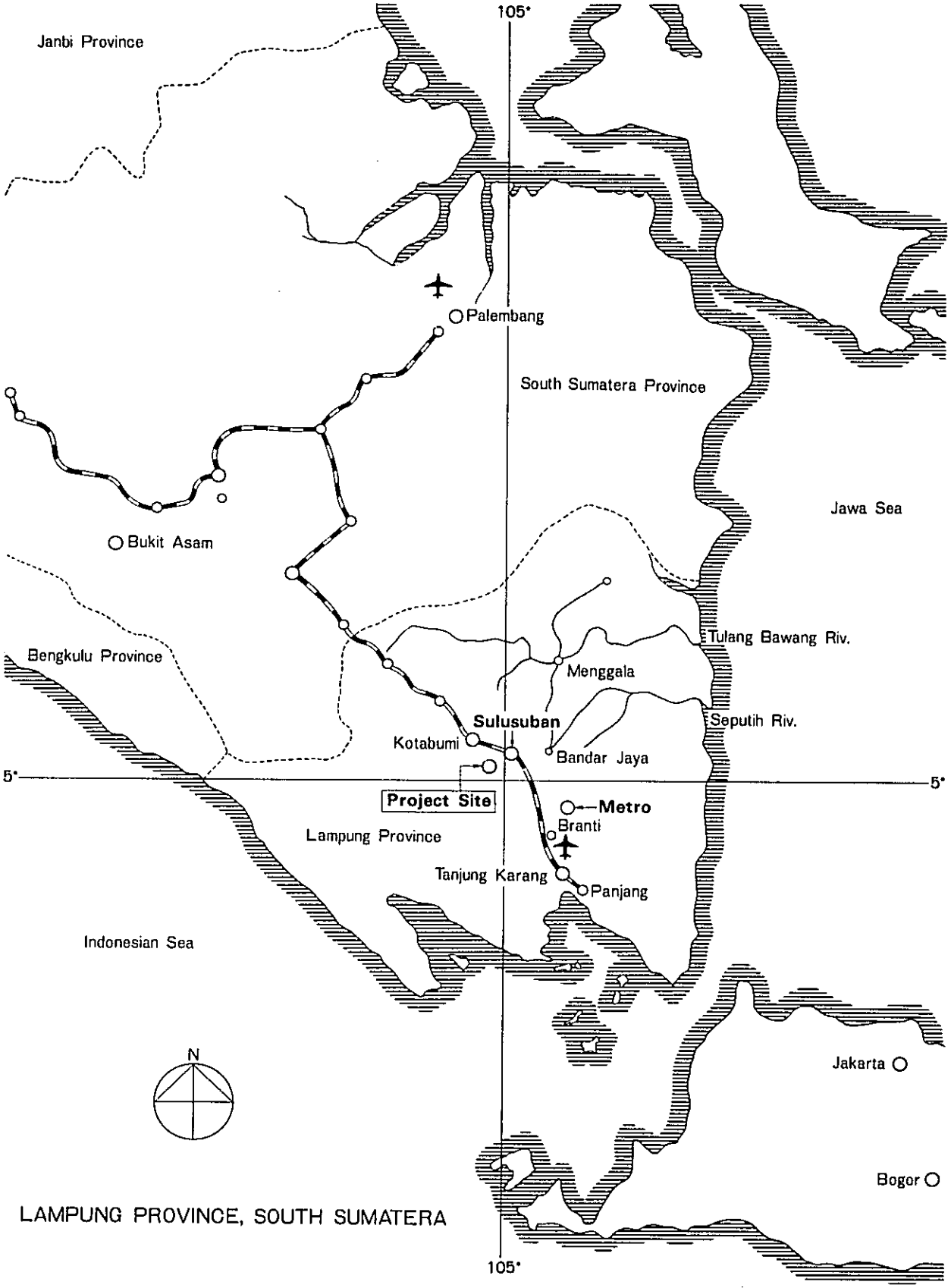

LAMPUNG PROVINCE, SOUTH SUMATERA

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CHAPTER 1: SUMMARY

1-1 OBJECTIVE AND BACKGROUND OF THE PROJECT

Based on the National Alcohol Supply Program, the Indonesian Government has a scheme to construct a fuel alcohol manufacturing plant at the transmigration area in Tulang Bawang, and this project is in progress, with the plant inauguration scheduled for October 1982. In parallel with the progress of the foregoing project, the Indonesian Government considers it necessary to acquire thorough knowledge about the social and economic aspects of the total system of fuel alcohol industry, covering all such facets as the collection of raw materials, and the manufacture, circulation and consumption of products. The Biomass Energy Research and Development Center now under consideration is intended to serve a purpose of research and development concerning fuel alcohol production and supply. The basic concept of the proposed project is that the Center should be a practical one for development of applied technology concerning fuel alcohol rather than an academic one for basic research and development of fundamental biomass energy science. Thus, the proposed Center, as such, is to include an experimental alcohol plant of a reasonable size. The Indonesian Government requested the Japanese Government to provide a grant for implementation of this project.

1-2 BASIC DESIGN SURVEY

In response to the Indonesian Government's request, the Japanese Government through the Japan International Cooperation Agency conducted the basic design survey in March 1981. The Survey Mission dispatched to Indonesia made various investigations necessary for the basic design, conferring with the representatives of the concerned Indonesian Government agencies. The findings and discussions held between the Mission and the Indonesian Government agencies were summarized in the form of the Minutes of Meeting on March 18th.

In succession, the basic design confirmation study was made in Indonesia from June 23 to June 29, 1981, the Minutes of Meeting exchanged on June 29th.

1-3 BASIC DESIGN

In accordance with the Indonesian Government's request, the basic design as outlined below was worked out. The site is to have a total area of about 50 ha of which 10 ha is to be allotted to a sweet potato experimental farm and the remainder to the sites of an alcohol experimental plant, agricultural experimental facilities, a research and development center, and reserve space.

A number of buildings will be constructed to house an alcohol experimental plant, an office and laboratory, a farming implement shop, workshop, a guardhouse, etc. The alcohol experimental plant is to have a production capacity of about 8 K liters per day. Cassava and sweet potatoes are considered for raw materials. Functionally, the research center will consist of such departments as: general administration; experimental plant operation; research sections engaged in biological studies concerning enzyme, yeast, etc. and those engaged in alcohol manufacturing process; sections conducting agricultural experiments for selection of raw materials, improvement of cultivation techniques, etc.; and a section for socioeconomic research.

The outdoor facilities to be provided will include a gate, project roads, a parking lot, a water reservoir, an elevated water tank, etc. Such equipment and apparatuses as are required for alcohol production research and agricultural research will also be furnished. The Indonesian Government wishes for a guesthouse, a staff housing, etc. which will be constructed by the Indonesian side.

1-4 BRIEF DESCRIPTION OF THE PROJECT

Title of the Project:	Biomass Energy Research and Development Center, Republic of Indonesia
Location:	Sulusuban, Terbanggi Besar, Lampung Province, Sumatera, Republic of Indonesia
Indonesian Government Agency in Charge:	Agency for Development and Application of Technology (B.P.P.T.)
Project Implementation:	To be implemented under the Japanese Government's grant
Outline of the Project:	Biomass Energy Research and Development Center comprising an experimental alcohol plant (8 kl/day), research laboratory and an experimental farm

Outline of Facilities:

Experimental Plant:

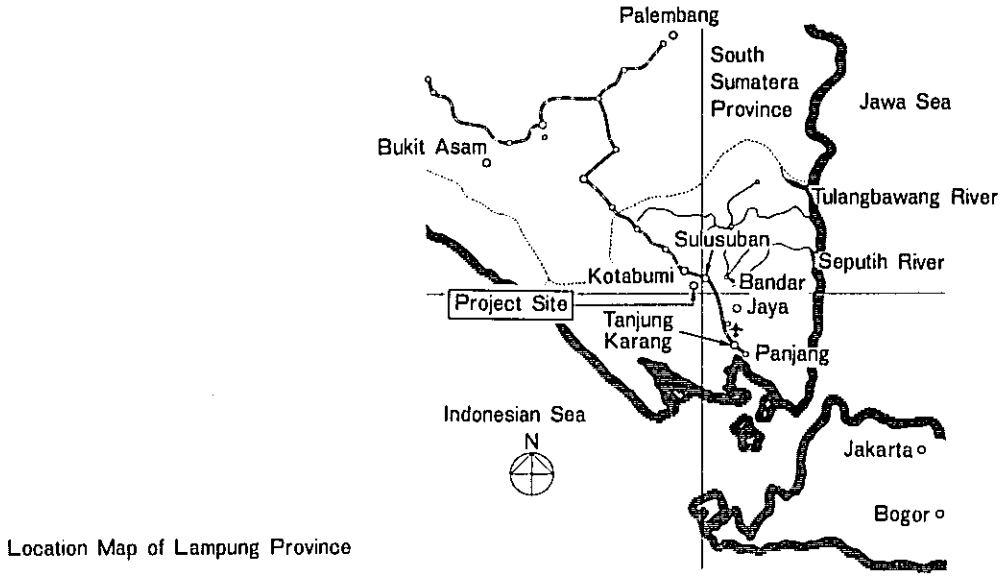
Office and Laboratory:

Experimental Farming Facilities:
Farming Implement Shop, Workshop

Appurtenant Facilities:
Power Plant, Water Reservoir, Elevated Water Tank, Guardhouse, Gate

Equipment:
Equipment items for alcohol production research, and equipment items for agricultural research

Project Site: The Indonesian Government is now negotiating with landowners for procurement of the project site of about 50 ha. Arrangement has already been made so that site preparation, approach road construction, division of farms, site grading and soil exploration can be done by the Indonesian side. Utility systems (power supply, water supply and sewerage) will also be provided by the Indonesian side.



Location Map of Lampung Province

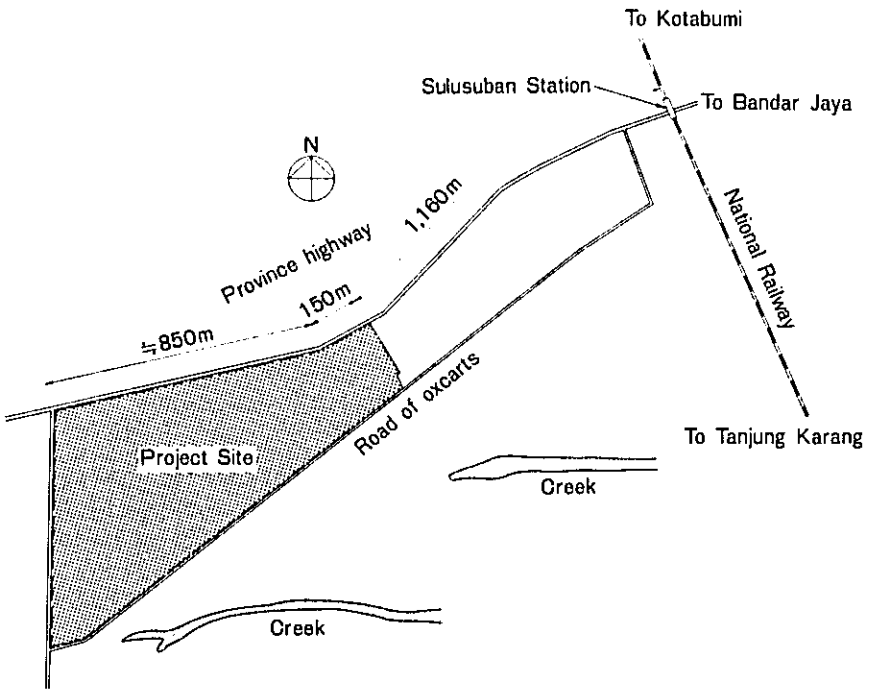


Fig. 1-1 Vicinity Map

1-5 IMPLEMENTATION OF PROJECT PROGRAM

Presently this biomass center project is to be implemented under the auspices of the Japanese Government's grant and according to the procedures established therefor. However, the electric power and water supply, lagoon, experimental farm, etc. are not encompassed in the scope of grant and, hence, must be put into construction by the Indonesian side in keeping pace with the progress of construction covered by the Japanese grant. As for the Guesthouse, Staff-housing, etc. as planned in the present layout, their design and construction will be developed by the Indonesian side in the future.

1-6 PROJECT APPRAISAL

After the completion of the present center, it will be imperative for the Indonesian side to assure adequate readiness to operate and maintain the center in line with the intended purposes.

From the following considerations, it is believed that construction of this Center will bring about far-reaching effects in many respects so that the amicable relationship between Indonesia and Japan is deepened.

(1) The Center, when completed, will become such a base of energy farms and alcohol plants in transmigration area as will redound to the National Alcohol Supply Program and make valuable contribution to the research and development of production and supply of alcohol for fuel.

(2) Experimental cultivation of raw materials as programmed in this Project will improve agricultural technology since such experiment will enable species and crop cycling appropriate to South Sumatera to be found, existing or possible insects and diseases to be ascertained, and fertilizer and exterminating chemicals, etc. to be developed.

(3) The construction of the present center will not only enable the research on experimental alcohol processes to be made but add to the research on process of various raw materials.

(4) Operation of the experimental plant will enable practical study on process engineering and energy balance to be performed, which will lead to enhancement of technology in alcohol production.

(5) The establishment of this center will enable raw materials, fuel alcohol production process, socioeconomic system, etc. to be let under integrated, systematic research. This is duly expectable to make contribution to the research and development in production of alternative energy from the biomass resources.

CHAPTER 2: DISPATCH OF BASIC DESIGN STUDY MISSION

2-1 OBJECTIVES OF DISPATCHING THE MISSION

In compliance with the Indonesian Government's request for the Japanese aid for the establishment of Biomass Energy Research and Development Center consisting of starch-based alcohol research facilities, experimental plant, experimental farm, etc., the basic design studies were conducted including the necessary investigations for determining the basic planning policy and for collecting information and data required for the basic design. The field surveys were carried out from March 10 to March 29, 1981 by the mission headed by Mr. Takaharu Kazama, Executive Director of the Japan International Cooperation Agency. The Mission had discussions with the representatives of B.P.P.T. (Agency for Development and Application of Technology), the Indonesian Government Agency taking charge of this project, and the two parties agreed on the scope and other requirements of the Project on March 18, 1981 as recorded in the Minutes of Meeting for that day.

The Mission also collected the data and information on the National Alcohol Supply Program initiated by the Indonesian Government and on the proposed Research and Development Center Project, and further conducted field reconnaissance for selection of the project site.

2-2 BACKGROUND, ETC.

The Indonesian Government already has the National Alcohol Supply Program which sets out the basic course of research and development of starch-based alcohol that is expected to become a promising substitute for petroleum-based fuel. In this National Alcohol Supply Program, the farming population is encouraged to move out of densely populated areas and engage in cultivation of cassava, sweet potatoes, etc. in thinly populated areas. It is expected that the agricultural products thus made available will provide the raw materials for

alcohol production. This will on one hand enable the farmers to secure the means for cash income thereby causing them to settle in the transmigration areas, and on the other hand enable the Government to utilize alcohol as fuel in substitution for petrol the demand for which is anticipated to keep increasing in the future.

As the first step of such National Program, the Indonesian Government decided to construct, for the purpose of disseminating fuel alcohol production technology to each transmigration area, a biomass energy center having an experimental plant, a laboratory and an experimental farm for research and development of techniques and technology concerning plant operation, raw material cultivation, fermentation, distribution of products, etc. In carrying out this program, the Indonesian Government asked the Japanese Government to give a grant.

CHAPTER 3: PRESENT STATUS OF ENERGY USE AND BIOMASS ENERGY DEVELOPMENT IN INDONESIA

In Indonesia, the government's third five-year development plan is on its course. The plan aims to give an impetus to self-sufficiency in the food supply and more reasonable income distribution by increasing the employment opportunities at reasonable wages. In the economic statistics, the exports in total for the year 1980 represent US$17.5 billions equivalent of which 66 % or 11 billions account for petroleum, natural gases, etc., with an increase of 9 % as compared with the figures for the previous year. The Indonesian national budgets for economic development are largely dependent upon the crude oil and liquefied natural gases in that two-thirds the budget amount are made up with those resources. The Indonesia has recorded about p.a. 10 % increase in the consumption of products made of petroleum and, for that reason, is supposed to fall under oil-importing countries by the end of 1990's, whereby a difficulty being imposed on the sound economic development. Therefore, it is believed most imperative to change the traditional energy use pattern.

In order to curtail the domestic consumptions of petroleum fuels, an emphasis has been given to: (1) more economical use of petroleum fuels for power sources and (2) development of energy projects, electric power stations and more comprehensively integrated energy loss-prevention programs. Indonesia is rich in such energy resources as coal, natural gases, potential water-power and terrestrial heat. In addition, there is (3) a scheme to build ethanol plants for producing alcohol from biomass as a plan for developing reclaimable energy resources. According to the present schedule, B.P.P.T. takes charge of the study and investigation into methods for producing the alcohol from vegetation.

In cooperation with other few agencies, B.P.P.T.is studying the production and utilization feasibilities of raw materials which are reclaimable for alcohol production as well as the technical aspects in material cultivation, plant construction and operation, future profitability and product

marketing. As first step in the long-range plan, an alcohol plant of 15 kilo liters in per-day production is scheduled for construction.

Since the construction site is located in the transmigration area, this pilot plant should be of simplified process and mechanical system. With regard to the assigned tasks, it has to make the wide-disciplined subjects, but in an integrated way, including (1) selection of the most suitable specie for raw materials, (2) guidance of the farming techniques for farmers, (3) advancement of alcohol production process and (4) marketing problems, such as, distribution system, promotion of the use, sales prices and method for encouraging the cultivation.

On the other hand, there are problems possibly inherent to the use of food as raw materials: any drawback might be caused to the sound food supply policy; and food is used for alcohol. Hence, due consideration should be given to prevent such drawback from being developed.

From a long-range standpoint, it will be of particular significance in Indonesia to make study on cellulose-based raw materials.

CHAPTER 4: BIOMASS ENERGY RESEARCH AND DEVELOPMENT CENTER

4-1 INDONESIAN GOVERNMENT'S REQUEST AND WHAT HAS BEEN INVESTIGATED

In compliance with the request of the Indonesian Government with respect to the proposed Biomass Energy Research and Development Center Project, the Japanese Mission conducted the field surveys from March 10 to March 29, 1981 and, in succession, the basic design confirmation study from June 23 to June 29, 1981. What has been requested and confirmed is as summarized below. The present basic plan is developed based on those confirmation results. Prior to the field surveys, Preliminary Survey Mission was dispatched to Indonesia. This mission conducted surveys from December 15 to December 24, 1980.

(1) Relationship between the National Alcohol Supply Program and Biomass Energy Research and Development Center

The concept of this Biomass Energy Research and Development Center should be considered in the context of the National Alcohol Supply Program which was formulated mainly by Agency for Development and Application of Technology (B.P.P.T.) with cooperation of the representatives of Ministry of Agriculture, Ministry of Industries, Ministry of Mines and Energy, Ministry of Public Works, Ministry of Transportation and various universities.

The Program was published in the form of a report by B.P.P.T. in July 1980. From the information contained in this report and collected by the Mission later, the basic concept of the National Alcohol Supply Program may be summarized as follows.

The Indonesian Government encourages farmers to emigrate from Java to Sumatera,Kalimantan, Sulawesi and other islands and cultivate cassava, sweet potatoes, etc. in such immigration areas. The Government, then, plans to convert these

agricultural products into alcoholic fuel. It is the belief of the Indonesian Government that this National Program will not only contribute to the promotion of the living standard of the farming population and to the improvement of the national economy as a whole but also make it possible for Indonesia to develop alternative energy from biomass resources, thereby enabling to curtail the domestic consumption of petroleum-based fuel and increase the export of petroleum to foreign countries.

The present Biomass Energy Research and Development Center should be considered an integral part of the National Alcohol Supply Program which in turn is linked with the nation's transmigration policy. Thus, the center is to have a character of a main base behind the front line to be formed by a number of alcohol plants in various emigration areas, and the center as such will be a major facility for research and development of alcohol production and supply.

(2) Functions of the Center

In consequence of the discussions, it has been known that the Indonesian side has the project requirements as summarized below.

i) Raw Materials and Research Organization

Any agricultural product is basically qualified as raw material for alcohol production as long as it is comparatively easy to cultivate and has high energy producing capacity. However, the Indonesian Government, in conjunction with its transmigration policy, is giving prime consideration to cassava for the time being and will consider sweet potatoes at the subsequent stage. Cassava is now widely cultivated throughout the Lampung Province and used for foods, starch, processed animal foods, etc. The cultivation of cassava

for the sales purpose has been sharply increasing in these recent years and there now is more supply than demand. As tropical crop, cassava has wide regional adaptability and presents few problems in cultivation.

When the foregoing factors are taken into account, it is considered reasonable to use cassava as raw material for alcohol production for the time being. If seen in a long range, cassava cultivation has some problems with respect to stability of crop level, selection of most suitable specie, etc.; however, B.P.P.T. as its policy will not include cassava as subject of research study on crop for raw materials because of their recognition that extensive studies have already been made on cassava cultivation. Guidance for the selection of cassava specie and cultivation technique in the Lampung Province is at present being given by the Central Research Institute for Agriculture in Bogor.

As for sweet potatoes, they are cultivated in farming area exceeding 300,000 ha in whole Indonesia. Particularly, in West Irian, they are used as staple food and are, therefore, counted as one of the most important crops, but they are given less attention in South Sumatera. In this area, however, people have been eating sweet potatoes between meals and also using them as material for cakes for a long time. Sweet potatoes, raised in gardens of farm houses or in farmlands, are commonly found in markets. Potatoes are available in a variety of kinds, and sometimes two or three different kinds of potatoes are raised in a same farm. However, because of the limited demand, each farm house allocates a rather small area for cultivation of sweet potatoes, and they are often raised only in a corner of a bean, corn or cassava farm. In some areas, sweet potatoes are included in a cycle of cultivations in paddy fields, but even then they are raised only at the season unfit for rice cultivation and are cultivated in small scale. The crop rate of

potatoes is generally as low as 5 to 6 tons per ha. This low crop rate is to some extent attributable to poor cultivating conditions and techniques, but is mainly accounted for by the small economic merit expected from potato cultivation. If sweet potatoes can be sold at more advantageous conditions, farmers will naturally try to improve cultivating technique and make greater efforts in raising them, and this alone will be enough to bring up the crop rate of sweet potatoes to about three times the present rate, or in other words, at least to the same rate as cassava. It follows from this that potatoes can be made a promising raw material or starch-based alcohol if proper research is made in future. However, there are six research workers who are engaged in studies of sweet potatoes at the Central Research Institute for Agriculture, and it is considered essential that two or three more researchers who can take charge of studies on breeding, cultivation, vermin extermination, etc. be trained by the time this Biomass Energy Research and Development Center is inaugurated.

ii) Confirming the Basic Project Requirements of the Indonesian Side (regarding the cultivation)

The Indonesian side also wishes to concentrate their cultivation efforts on sweet potatoes for the time being, and carry out such cultivation tests as required for selection of a suitable specie, crop cycling, insect elimination and fertilizer selection. In addition to the foregoing research studies, the Center is expected to have training and education functions which enable the research results to be disseminated and put into practical use. The items to be included in the cultivation tests will be decided by coordination with the Central Research Institute for Agriculture; however, such test items will essentially place stress on finding the cultivation method which is adaptable to the local conditions of Southern Sumatera. From what has been

described above, the Biomass Energy Research and Development Center as envisaged by the Indonesian side may be considered to consist of the following:

* Office
  (for five researchers and ten research assistants)

* Meeting Room

* Analytical Experiment Room
  (for analysis of starch, soil, etc.)

* Preparation/Control Room
  (for measurement of agricultural products, installation of drying ovens, etc.)

* Sweet Potato Storage

* Farming Implement Shop and Workshop, Etc.

iii) Alcohol Plant

In Indonesia, alcohol is mainly used as fuel for lamps, stoves and solvent of the furniture polish. No fuel alcohol is produced on a commercial basis. Almost all alcohol plants are privately owned except one public plant (PT ASEN Pabuaram). In the National Alcohol Supply Program, the fermentation technology is being taken care of by a group of technical experts whose major subjects of research are: 1) saccharification technology; 2) high temperature resistant yeast; and 3) cooling water.

For the time being, alcohol hydride (95 v % ethanol) is considered for use as fuel, and it is reported that this type of alcohol is being used on trial as fuel for automobiles. If it becomes necessary to dehydrate alcohol, dehydration will be made at a central dehydrating plant rather than at each individual alcohol plant.

iv) Experimental Plant as desired by the Indonesian Side

The experimental plant, nearly as large as practical one, is intended to serve the purpose of conducting various kinds of biomass fermentation tests. The Indonesian side desires that the experimental plant should preferably have a production capacity of 8 kl/day, or a capacity as close to that as possible within the limits of available fund. The subjects of research studies to be conducted at the experimental plant and the laboratory are as follows:

a) As for the pretreatment, three kinds of tests, i.e., those by normal cooking, extruder and supraton pump, are to be conducted.

b) Studies on enzyme (imported material will be used for the time being) are to be conducted to improve the energy balance during the saccharification process.

c) Yeast which is resistant against high temperature and usable at 35°C to 36°C is to be developed.

d) Technical problem in distilling process, particularly those concerning the location at which crude alcohol is injected, will be studied.

e) Waste disposal facility need not necessarily be provided from the outset; however, such disposal facility as will enable wastes to be converted into animal foods should preferably be provided if the budget permits.

f) Because the proposed center is to deal with biomass energy, it is strongly desired by the Indonesian side that a facility should be included in which cellulose that will possibly become a material for alcohol production can be studied. Such a facility may, at the outset, be a simple one where basic research on acid hydrolysis is conducted.

The Experimental Plant may be briefly described as follows:

a.	Production capacity	8 kl per day
b.	Raw materials	Cassava and sweet potato
c.	Production system	Batch system
d.	Product	95 v % ethyl alcohol
e.	Fuel	Heavy oil or coal

v) Research on Socioeconomic System

When the alcohol produced from biomass resources is to be used as an alternative energy source, the research on the socioeconomic system relevant to the distribution route from the alcohol production to consumption, as well as technical improvement of the production process, may play significant roles in developing such alternative source.

How newly emerging energy, such as alcohol, should be distributed to final consumers in the existing market where petroleum is predominant, is an indispensable key to the success of alternative energy development. Taking account of the discussion with the Indonesian authorities, the following may be summarized as research subjects for such socioeconomic research.

a) Shipping-Assembling and Pricing of Raw Materials

National Alcohol Supply Program being now developed chiefly by B.P.P.T. contemplates the alcohol production in each transmigration area. In this connection, problems may arise as to who buys and assembles cassava and sweet potatoes as raw materials, from what region, and at what prices. What is expected of the center is to study and develop a raw material-purchasing system which should be most rational and be applicable to the transmigration area. For instance, the pricing at the time of raw material purchase may be based on the income level required for those farmers' lives. Even in this case, however, there still remain many problems: one may be how to give an incentive to farmars who cultivate these raw materials in preference to rice and other agricultural produce.

b) Economy in Alcohol Production

The improvement of the alcohol production technology is one side of a coin, the other side being the economic aspect. In other words, such study and improvement of the economic aspect, while keeping pace with the technological development at the experimental plant, are indispensable for the success of the Project. In doing so, major study subjects may be how the economy aspect will change in consequence of improved energy balance in each phase of cooking, fermentation and distillation; how the same will change when the plant is extended in scale or when changes arise as to plant depreciation period, etc.

c) Distribution System and Its Economy

According to the present program, the product will be supplied for use in the transmigration area and nearby district at an early stage in which an alcohol output is small in volume. But in the target stage, "PERTAMINA", a national petroleum corporation, will act as an assembler-cum-distributor, undertaking the transportation and supply to larger cities, such as Jakarta. In this respect, impending task for the present center is to study and establish the distribution system applicable to the early stage of alcohol supply to the transmigration area. Here, the study subjects are, inter alia, 1) whether each alcohol plant in the area should be directly responsible for the raw material assembly and product distribution, or alternatively 2) whether any other organization, national or private, should be responsible; and, in either case, 3) what should be the optimum cost in the assembly and distribution.

d) Usage of Alcohol in Transmigration Area

For the time being, the alcohol will be used in place of automobile gasoline. For additional alternative usage, diesel fuel for buses, trucks and small diesel generators may be replaced by alcohol. Other conceivable area of use may include lighting fixtures and kitchen equipment, both now depending on kerosene, and agricultural equipment. In this regard, the present center can play a significant role in establishing: methods and basic principles for the feasibility studies on alternative use of alcohol for these varied purposes; the study on the order of priority in such replacement; and studies on the present demand and future trends for different types of fuels.

e) Regional Demand-and-Supply Plan

Since no governing economic system is developed in the new transmigration area, a regional economic development plan should first be developed to include all comprehensive economic activities ranging from the agricultural production to the alcohol demand-and-supply. For this purpose, the center should establish a development plan for the transmigration area including the pertinent surroundings to study how to attain the regional economic and social development for long term and, in addition, for intermediate term.

vi) Organization of Center

The Research and Development Center is operated through five main trunks and associated branches as shown in the family tree below.

The operating force will consist of about 70 administrative staff members/researchers; about 40 workers engaged in the experimental plant operation; and about 25 workers for the maintenance and repairs.

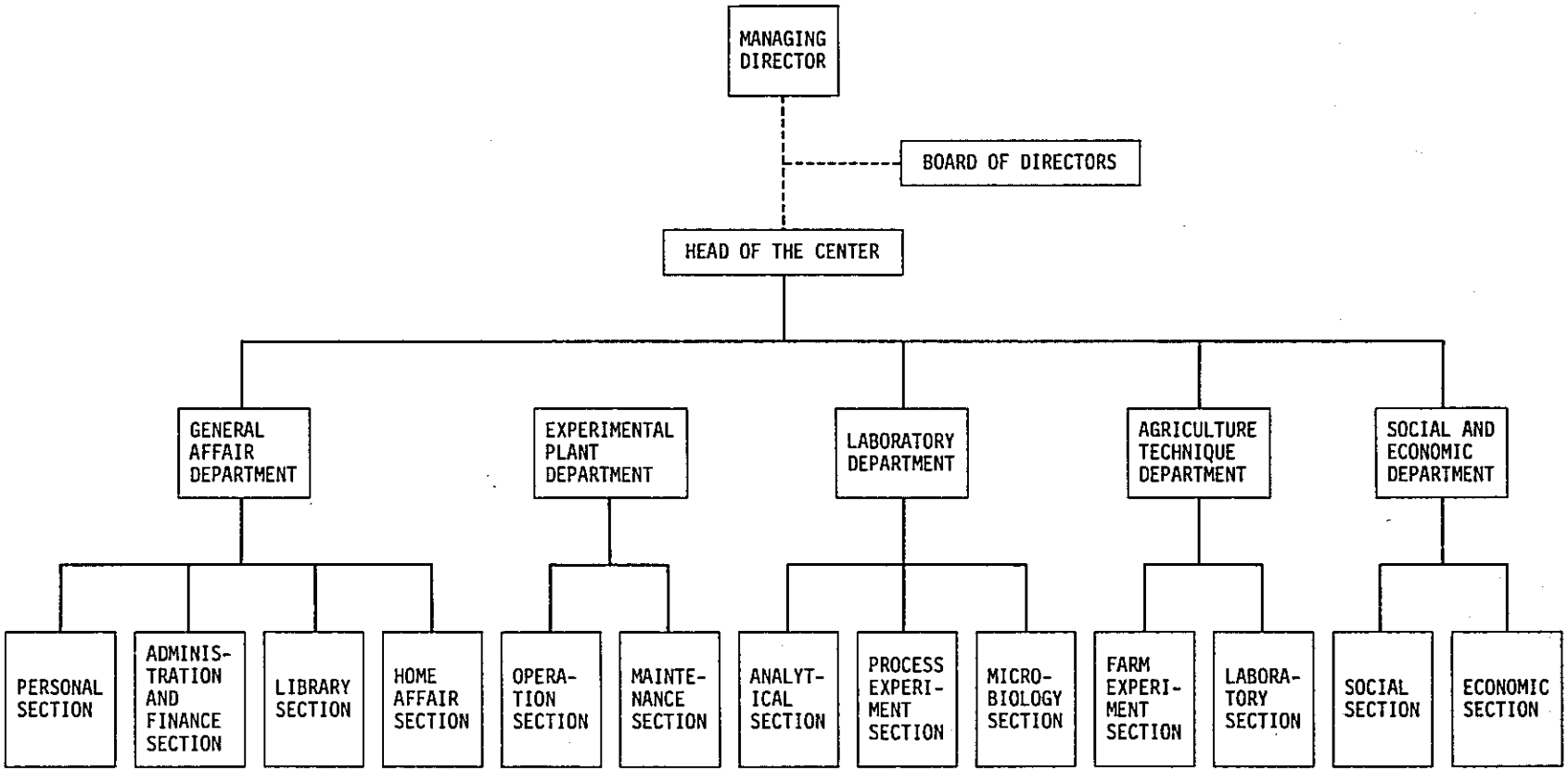


Fig. 4-1 Organization of the Center

4-2 SELECTION OF SITE

From March 13 to March 16, 1981, the Basic Design Study Mission, staying in Lampung, investigated and studied the eight candidate locations for the construction of the Project. (See Fig. 4.2.) In selecting the site, the governing factors were taken as follows.

a. Is the proposed site suitable for farming?

b. Is water of good quality available?

c. Is there a sufficient fuel source(s) near the site, and can fuel be easily transported to the site?

d. Is the site free of any problems in obtaining the raw materials?

e. Does the site face any public roadway?

f. Is the site conveniently located in the transportation of construction equipment and materials without causing a delay in the construction?

g. Is the site on a flat terrain at a level higher than the surroundings so that it will not be flooded in rainy season?

h. Is there near the site any watercourse or pond into which the drainage water can be discharged?

i. Is there any possibility that the plant operation or associated activities cause any nuisance to the neighborhood?

j. The selected site should not impose an unfavorable budgetary burden and much difficulty on the Indonesian Government either in construction or in operation of the Center.

Finally, the Basic Design Study Mission selected the proposed site B near the Sulusuban Station, which decision was reported to the Indonesian Government on March 17th as first site survey report. The Indonesian Government, consenting to the report, made detailed investigations on and around the site, on March 22nd and 23rd, in cooperation with the Indonesian counterparts and the Japanese Mission. The selected site is shown in outline on Fig. 4-3 Vicinity Map.

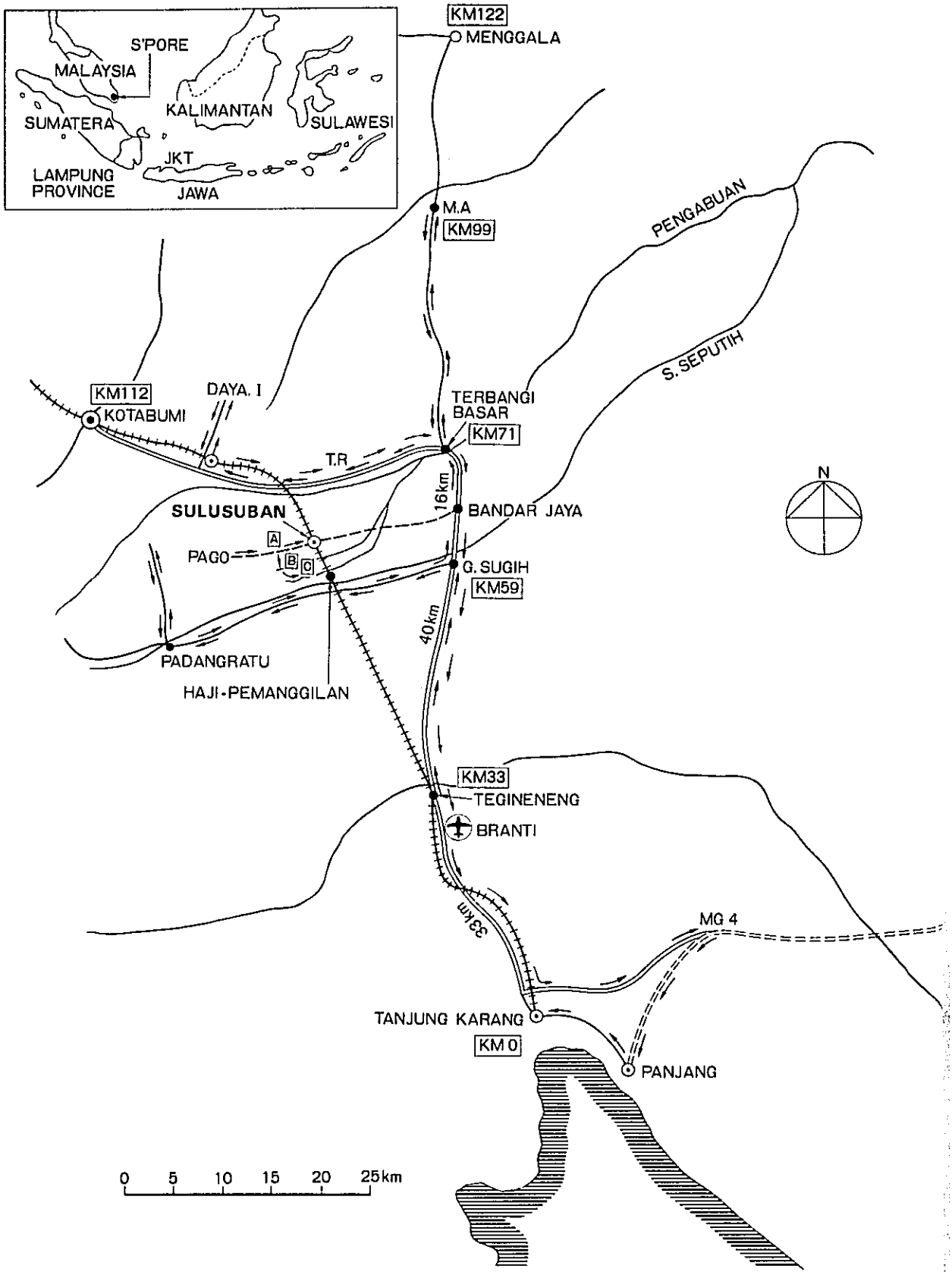


Fig. 4-2 South Lampung and Proposed Sites

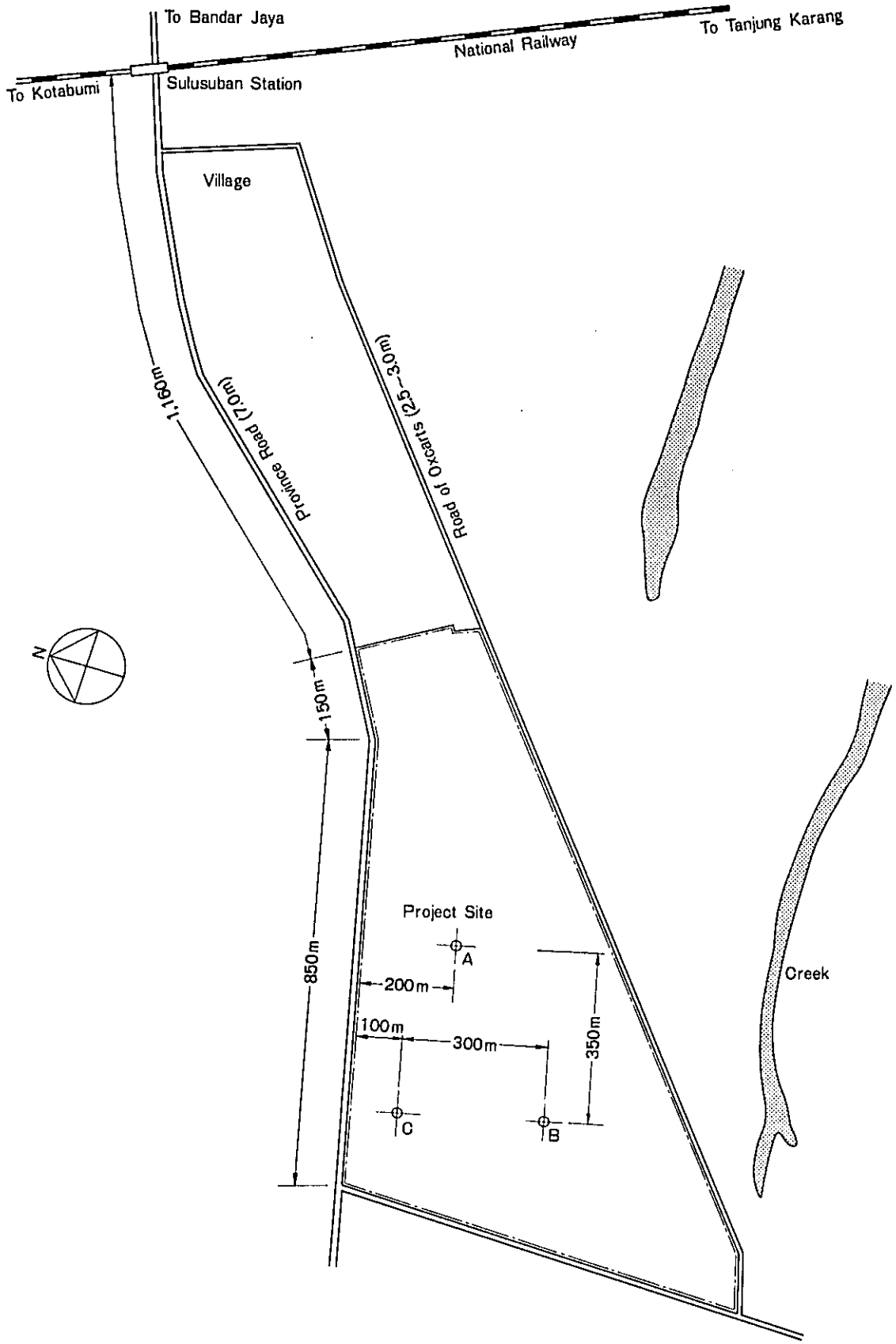
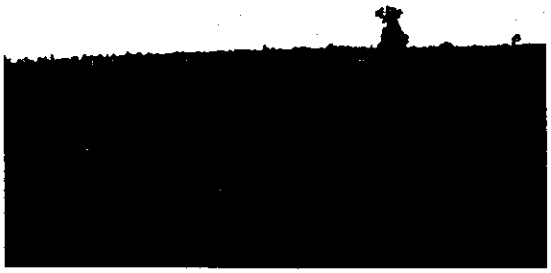


Fig. 4-3 Vicinity Map



Project Site

Province Road at the north of
the Project Site

Experimental Farm Site

4-3 ADDITIONAL REQUEST BY THE INDONESIAN GOVERNMENT

In the course of discussion with the Indonesian side, the Basic Design Study Mission was requested to work out the block plan of the center facilities including the Guesthouse, Staff Housing, etc. which will be constructed by the Indonesian side.

In addition, the Indonesian Government requested that the two years preceding the completion of the Center construction should be used to the best advantage in training and education of the staff who will work for the Center. This seems to be ascribed to the facts that fermentation-related engineers are quite limited in number and that the operation of plant and transfer of technology are important concerns to the government. The similar request was made as to cultivation of raw materials too.

CHAPTER 5: BASIC DESIGN

5-1 PRELIMINARY CONDITIONS

The basic design described here has been developed on the basis of the investigation and discussion results which were obtained by the Preliminary Survey Mission for Biomass Energy Research and Development Center (sent from December 15 to December 24, 1980), the Basic Design Study Mission (March 10 to March 29, 1981) and the Basic Design Confirmation Study Mission (June 23 to June 29, 1981).

In an effort to insure that the basic design meets the purposes of the Project, the results of the field studies conducted as above and requirements agreed upon in the discussions with the Indonesian authorities were all studied in correlative, analytical way for incorporation into the basic design.

In connection with the Project, there are some items of design/construction to be implemented by the Indonesian authorities. Where deemed necessary from a functional or constructional standpoint, requirements as to such items will be described briefly in this report.

In the field study, such local conditions as availability and costs of construction materials and labor; construction time; competence and workmanship of contractors; relative codes, regulations and engineering standards were investigated. The construction budget and period were roughly predicted based on those study results; however, the prediction at this stage inevitably involved vagueness or uncertainty; therefore, these study results should be subjected to further analysis in the subsequent stage of the Project work.

For the transportation of construction materials from Japan to Tanjung Karang, direct freight services to Port of Panjang may be available. In this regard, however, the Government of Indonesia is cordially requested to take all necessary measures to receive these materials and for land transportation (e.g. exemption from custom duties and provision of space for temporary bonded storage of the materials.)

5-2 DESIGN POLICY

(1) In view that the Project comprizes three different functions, i.e., laboratory, experimental alcohol plant and experimental farm, the whole facilities are divided into three blocks depending upon the respective functions, simultaneously these three being systematically correlated with each other. To make them readily operable, the entire project is made of simple, clearly defined composition.

(2) Since the experimental sections aim at practical research, their facilities are arranged to fit in with that purpose.

(3) The buildings are made flexible enough to cope with functional changes and expansion in the future.

(4) Efforts in design are given to let the facilities comport with the local customs, climate conditions and other relevant conditions.

(5) The design is elaborated to permit smooth construction with respect to the local construction systems, materials and trade techniques.

(6) The facilities are designed to add to the smooth use and unelaborated maintenance.

5-3 OUTLINE OF PROJECT PLAN

5-3-1 Project Site

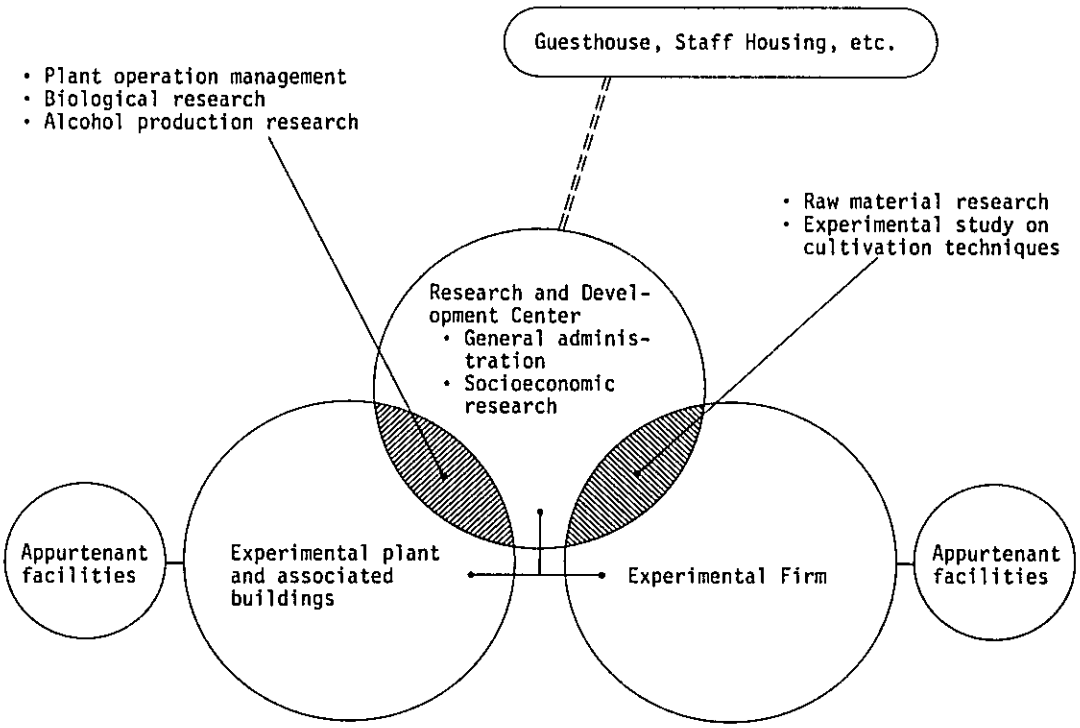
The Project will be constructed on a parcel of farmland in Sulusuban, Terbanggi Besar, Lampung, Sumatera, the Republic of Indonesia.

5-3-2 Outline of Project

On the site of about 50 ha in aggregate, the present research and development center consists of:

- Sweet potato cultivation field, 10 ha in area,
- Experimental plant, about 8 kl/day in production capacity, and associated buildings,
- Laboratory, and
- Appurtenant facilities.

The project concept can be diagramed as follows.



5-4 SITE CONDITIONS

5-4-1 Location

Sulusuban, a city in Lampung Province, Sumatera, is located about 80 km north-northwest of Port of Panjang. Middle Lumpung District is a great plain of which the west and the east are bordered by Sumatera Mountains and Java Sea respectively. Many rivers flow from the west to the east and numberless creeks (*sungai*) form swamps. The proposed site is about 17 km west of Bandar Jaya, a town beside the national road and about 1.2 km from Sulusuban Station, and is now being used as farmland where cassava, upland rice and pulse are mainly cultivated. That locality is far away from human habitations and does not benefit from such services as electricity supply, town water supply and drainage. The site is almost level except that the south side slopes down to a creek; the grading will not involve any difficulty.

Viewed from the precipitation, soil acidity, soil fertility, occurrence of blight, etc., it cannot be judged that climatic and soil conditions of this area are most appropriate for planting sweet potatoes. However, there are found no disadvantageous conditions to affect substantially operation of Experimental Farm.

5-4-2 Climatic Conditions

The location exists in the tropics. Mean temperature ranges from 25°C to 30°C throughout the year without remarkable change. Annual precipitation reaches about 2000 to 3000 mm much of which is concentrated in the rainy season from December to February, with considerable variation in individual years.

Wind does not blow in any distinct direction throughout the year. Wind velocity is at highest a few meters per second.

The following is the data obtained from the adjacent farm.

Annual precipitation:	About 2,500 mm (Considerably varying with the year)
Rainy season:	December to February (Considerably varying with the year)
Dry season:	March to November (Rainfall lightest especially in July and August)

Temperature (measured from September 1979 to November 1980)

Highest: 38°C (in Nov.) to 40°C (in Jan.)

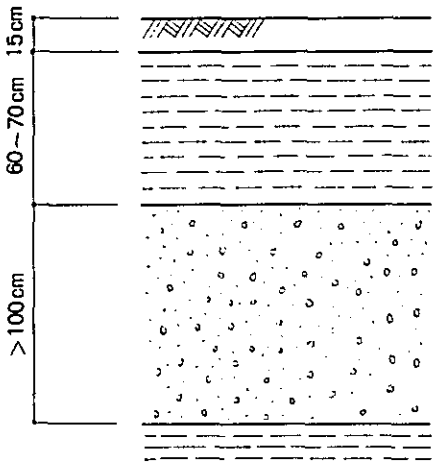
Lowest : 25°C (in Jan. and Aug.) to 29°C (in Feb. and Apr.)

Relative humidity of air:	30 % to 85 %
Soil group:	Podzol
Depth of mold:	0 to 18 cm
Specific yield:	67 % to 70 %
pH:	3.6 to 5.0

5-4-3 Soil Conditions

Three in-site boring locations were determined for soil exploration at the time the Basic Design Study Mission was in Indonesia. The following three boring logs were obtained by the Indonesian side at those points.

The preliminary boring done at the adjacent farm showed the following results.



Top soil

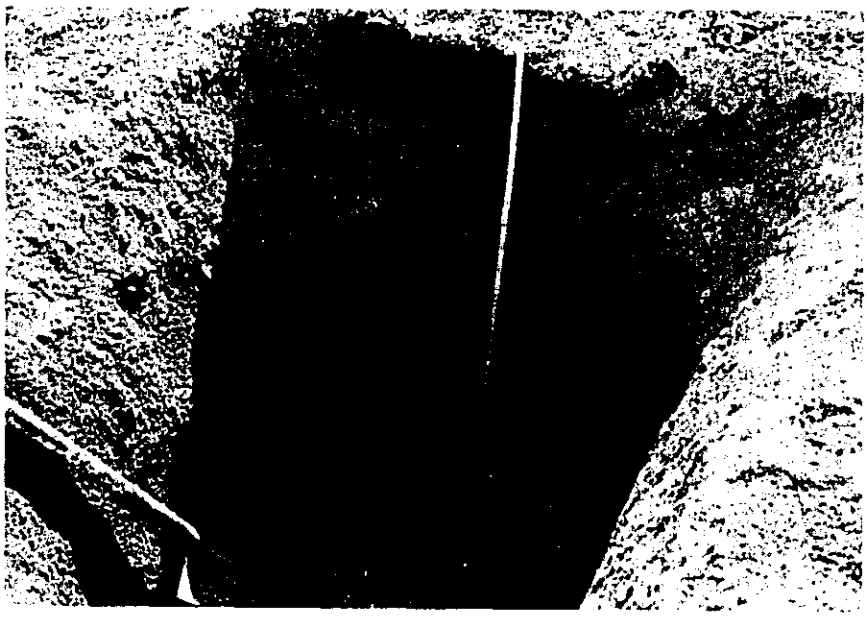
Reddish yellow cohesive soil

Cohesive soil with red ferrous grains gravel

(Mixed with quarts gravel)

White clay layer with red ferrous grains

The ground is a diluvial trapezoid.



SUBSURFACE EXPLORATION LOG

BORING NO	: A
SHEET	: 1 OF 1
TOTAL DEPTH	: 20.00M

PROJECT : PILOT PLANT ETHANOL	DATE COMMENCED : MEI 21 1981
LOCATION : SULUSUBAN CENTRE LAMPUNG	DATE COMPLETED : MEI 23 1981
FEATURE :	ANGLE : BEARING : VERTICAL
AREA DESIGNATION :	DRILLER : ULI SADELI A-KUSNAEDI
GROUND ELEVATION :	SUPERVISOR : SUPRAPTO
COORDINATES :	LOGGED : SUPRAPTO
DEPTH OF G.W.L : −2.5	DRILLING MACHINE : LONG YEAR LY 17

1	2	3	4	5	6				7	8	9	10	11	12	13		14
DATE	DEPTH IN METER	G.W.L	DRILLING RATE/10CM	DEPTH OF WATER LOSS	CORES				METHOD OF SAMPLING	SOIL DESCRIPTION OR ROCK LITHOLOGY	CORE BARREL & BIT TYPE	CASING TYPE	BLOWS/30CM CASING	S.P.T BLOWS/30CM	WATER PRESSURE TEST		REMARKS
					RUN NO	NUMBER AND SIZE OF CORE PIECES	% RECOVERY	ROD	SYMBOL						CM/SECOND	LUGEON	■ Coring by core barrel S.P.T ⊠ SHELBY TUBE
MEI/21/1981	1				1		100			Top Soil	SINGLE TUBE ϕ73 TUNGSTEN	ϕ89					SPT:1.00-1.45
	2				2		100			Clay Silt Brownish Yellow Dry, Soft, High plasticity Impervious				10			3/15;4/15;8/15
	3				3		100										SPT:2.00-2.45
	4				4		100							28			8/15;10/15;18/15
	5				5		100										SPT:3.00-3.45
	6				6		100			Clay Silt Light Grey Brownish Red Reddish Light Grey Wet, Soft High Plasticity Impervious Containing Small Amount Of Fine Sand Rock Fragment				43			13/15;18/15
	7				7		100										SPT:4.00-4.45
	8				8		100							33			9/15;14/15;19/15
	9				9		100										:5.00-5.37
	10				10		100										Shelby Tube
	11				11		100										SPT:6.00-6.45
	12				12		100							30			9/15;13/15;17/15
	13				13		100			Silty Clay Light Grey							SPT:7.00-7.45
	14				14		100			Silty Sand Light Grey				27			8/15;11/15;16/15
	15				15		100			Silty Clay, Light Grey-Reddish Light Grey. Wet. High Plasticity Impervious							SPT:8.00-8.45
	16				16		100							25			8/15;10/15;15/15
	17				17		100										SPT:9.00-9.45
	18				18		100							14			4/15;6/15;8/15
	19				19		100										:10.00-10.57
	20				20		100										Shelby Tube
MEI/22/1981											SINGLE TUBE ϕ73 TUNGSTEN BIT						SPT:11.00-11.45
														11			4/15;5/15;6/15
																	SPT:12.00-12.45
														9			4/15;4/15;5/15
																	SPT:13.00-13.45
														21			9/15;9/15;12/15
																	SPT:14.00-14.45
														21			8/15;9/15;12/15
																	Shelby
																	SPT:16.00-16.45
										Claystone Light Grey Medium Hard. Medium Compact				20			18/15;9/15;11/15
																	SPT:17.00-17.45
										Clay Sand Brownish-Reddish Grey Sand is Fine Coarse Gravely up to ϕ35cm Angular ±20%				22			7/15;11/15;11/15
																	SPT:18.00-18.45
														7			8/15;5/15;2/15
																	SPT:19.00-19.45
										09.20-19.80 Sandy Clay. 19.80-Clay Sand				5			6/15;3/15;2/15

SUBSURFACE EXPLORATION LOG

BORING NO	: B
SHEET	: 1 OF 1
TOTAL DEPTH	: 20.00M

PROJECT : PILOT PLANT ETHANOL	DATE COMMENCED : MEI 13 1981
LOCATION : SULUSUBAN CENTRE LAMPUNG	DATE COMPLETED : MEI 16 1981
FEATURE :	ANGLE : BEARING : VERTICAL
AREA DESIGNATION :	DRILLER : ULI SADELI A-KUSNAEDI
GROUND ELEVATION :	*SUPERVISOR : SUPRAPTO* A
COORDINATES :	LOGGED : SUPRAPTO A
DEPTH OF G.W.L : −1.50m	DRILLING MACHINE : LONG YEAR LY 24

1	2	3	4	5	6				7	8	9	10	11	12	13		14
DATE	DEPTH IN METER	G.W.L	DRILLING RATE/10CM	DEPTH OF WATER LOSS	CORES				METHOD OF SAMPLING	SOIL DESCRIPTION OR ROCK LITHOLOGY	CORE BARREL & BIT TYPE	CASING TYPE	BLOWS/30 CM CASING	S.P.T BLOWS/30CM	WATER PRESSURE TEST		REMARKS
					RUN NO	NUMBER AND SIZE OF CORE PIECES	% RECOVERY	ROD							CM/SECOND	LUGEON	■ Coring by core barrel □ S.P.T ▨ SHELBY TUBE
MEI 13 1981	1				1		100			Top Soil	SINGLE TUBE CORE BARREL ϕ73 TUNGSTEN BIT	ϕ89					
	2				2		100			Sandy Silt Brownish Yellow *Moist, Soft, Low Plasticity* Sand is Fine To be Medium Sand, About 10-20%				16			SPT: 1.00-1.45
	3				3		100							28			5/15;9/15;7/15
	4				4		100							29			SPT: 2.00-2.45
	5				5		100			Clay Silt Light Grey Reddish Brown Soft, Moist, High Plasticity Impervious				28			9/15;13/15;15/15
	6				6		100			Silty Clay Reddish Brown *Light Grey Yellowish Grey.* Soft, Moist, High Plasticity Impervious				25			SPT: 3.30-3.45
	7				7		100										9/15;12/15;17/15
MEI 14 1981	8				8		100			*Clay Silt* Light Grey Reddish Brown Soft, Moist, High Plasticity Impervious							SPT: 4.00-4.45
	9				9		100										9/15;12/15;16/15
	10				10		100										SPT: 5.00-5.45
	11				11		100			Sandy Silt Brownish Yellow Wet, Soft, Low Medium Plasticity							7/15;10/15;15/15
	12				12		100										Shelby Tube
	13				13		100			Sand is Fine Coarse Sand About 30%							SPT: 7.00-7.45
	14				14		100										5/15;6/15;7/15
MEI 15 1981	15				15		100			Silty Clay Sand Brownish Yellow Wet, *Loose*, Sub angular Subraunded Quartz Grains About 60%							SPT: 8.00-8.45
	16				16		100										4/15;8/15;6/15
	17				17		100			Silt Clay; Clay About 40%							SPT: 9.00-9.45
	18				18		100										3/15;5/15;6/15
	19				19		100										SPT: 10.00-10.45
	20				20		100			*Claystone Yellowish Light Grey*							3/15;3/15;9/15
																	Shelby Tube
																	SPT: 12.00-12.45
																	2/15;2/15;2/15
																	SPT: 13.00-13.45
																	2/15;3/15;3/15
																	SPT: 14.00-14.45
																	3/15;5/15;7/15
																	SPT: 15.00-15.45
																	4/15;7/15;9/15
																	SPT: 16.00-16.45
																	5/15;7/15;11/15
																	SPT: 17.00-17.45
																	2/15;16/15;21/15
																	SPT: 18.00-18.45
																	8/15;14/15;15/15
																	SPT: 19.00-19.45
																	7/15;9/15;13/15

SUBSURFACE EXPLORATION LOG

BORING NO	: C
SHEET	: 1 OF 1
TOTAL DEPTH	: 20.00M

PROJECT : PILOT PLANT ETHANOL	DATE COMMENCED : MEI 17-1981
LOCATION : SULUSUBAN CENTRE LAMPUNG	DATE COMPLETED : MEI 19 1981
FEATURE :	ANGLE : BEARING : VERTICAL
AREA DESIGNATION :	DRILLER : ULI SADELI A-KUSNAEDI
GROUND ELEVATION :	SUPERVISOR : SUPRAPTO A
COORDINATES :	LOGGED : SUPRAPTO A
DEPTH OF G.W.L : −2.5m	DRILLING MACHINE : LONG YEAR LY 24

1	2	3	4	5	6				7	8	9	10	11	12	13		14
DATE	DEPTH IN METER	G.W.L	DRILLING RATE/10CM	DEPTH OF WATER LOSS	CORES				METHOD OF SAMPLING	SOIL DESCRIPTION OR ROCK LITHOLOGY	CORE BARREL & BIT TYPE	CASING TYPE	BLOWS/30 CM CASING	S.P.T BLOWS/30CM	WATER PRESSURE TEST		REMARKS
					RUN NO	NUMBER AND SIZE OF CORE PIECES	% RECOVERY	ROD	SYMBOL						CM/SECOND	LUGEON	■ Coring by core barrel S.P.T ⊠ SHELBY TUBE
MEI 17 1981	1				1		100			Top Soil	SINGLE TUBE ϕ73 TUNGSTEN	ϕ89		10			SPT: 1.00-1.45
										Clay Silt, Yellowish Brown Dry, Soft, High Plasticity Containing Fine Sand							4/15;4/15;6/15
	2				2		100										SPT: 2.00-2.45
										Sandy Clay Silt Yellowish Grey Brownish Red				33			10/15;13/15;20/15
	3				3		100										SPT: 3.00-3.45
										Dry, Soft, Medium Plasticity Impervious				35			9/15;14/15;21/15
	4				4		100										:4.00-4.46
										Sand is Fine Medium Sand About 15%				⊠			Shelby Tube
	5				5		100										SPT: 5.00-5.45
MEI 18 1981	6				6		100			Silty/Clay/Sand Brownish Grey-Yellow, Sand is Fine To Coarse Quartz Grains Sub Angular Subrounded Silt ±40%				36			12/15;17/15;19/15
																	SPT: 6.00-6.45
	7				7		100							37			12/15;17/15;20/15
										Cley Silt, Light Grey Brownish Red Moist, Soft, High Plasticity Impervious							SPT: 7.00-7.45
	8				8		100							26			10/15;12/15;14/15
																	SPT: 8.00-8.45
	9				9		100							18			3/15;9,15;9/15
																	:9.00-9.50
	10				10		100							⊠			Shelby Tube
										Containing Small Amount of Fine Sand	BIT	ϕ89		18			SPT: 10.00-10.45
																	5/15;7/15;9/15
	11				11		100										SPT: 11.00-11.45
														13			4/15;6/15;7/15
	12				12		100			Silty Sand Yellowish Grey Sand is Fine to Medium. Quartz Grains Sub Angular Subrounded ±60% Silt ±40%							SPT: 12.00-12.45
														12			4/15;5/15;7/15
	13				13		100										SPT: 13.00-13.45
										Clay Silt, Brownish, Red, Wet, VevySoft High Plasticity	SINGLE TUBE ϕ73 TUNGSTEN			13			5/15;6/15;7/15
	14				14		100										SPT: 14.00-14.45
										Silty Sand. Light Grey Dark Grey. Sand is Fine to Coarse Sand. Quartz Grains Sub Angular Subrounded ±60%, Silt 40%				53			16/15;24/15;29/15
	15				15		100										:15.00-15.50
														⊠			Shelby Tube
MEI 19 1981	16				16		100										SPT: 16.00-16.45
														19			9/15;9/15;10/15
	17				17		100										SPT: 17.00-17.45
														13			4/15;6/15;7/15
	18				18		100										SPT: 18.00-18.45
										Organik Clay Dark Grey, Black, Wet, Very Soft, High Plasticity				11			3/15;5/15;6/15
	19				19		100										SPT: 19.00-19.45
										Clay Stone-Silt Stone, Grey Greenish Grey				71			19/15;33/15;38/15
	20				20		100										

5-4-4 Earthquake

As for earthquake, the Indonesian Islands are located in one of the most active area in the world. Many large earthquakes occured in Indonesia in the past. In Fig. 5-1, the past earthquakes in Indonesia are classified into three types depending on depths of their epicenters. The Indonesian Building Standards (Draft) provide that seismic loads for building design should be determined in accordance with the seismic risk zones as shown in Fig. 5-2. In Fig. 5-3, earthquakes which occured in the period from 1900 to 1970 are regionally classified on the basis of the MM Seismic Intensity Scale. Fig. 5-4 shows tectonical data about the Quarternary. Figs. 5-5 and 5-6 are the provisions for aseismatic design applicable to Indonesia which was cited from "Earthquake Resistant Regulations: A World List 1980" issued by International Association for Earthquake Engineering in August 1980. As understood from this data, many of the earthquakes seem to originate in the fault near Sumatera Mountains. And, it is known that Lampung Province lies just on the boundary area between Zone 3 and Zone 4 in Fig. 5-5.

Total horizontal seismic base shear V for building design is given as follows:

$$V = C \cdot I \cdot K \cdot W_t \qquad C_d = C \cdot I \cdot K$$

In which,

C : Basic seismic coefficient

I : Important factor

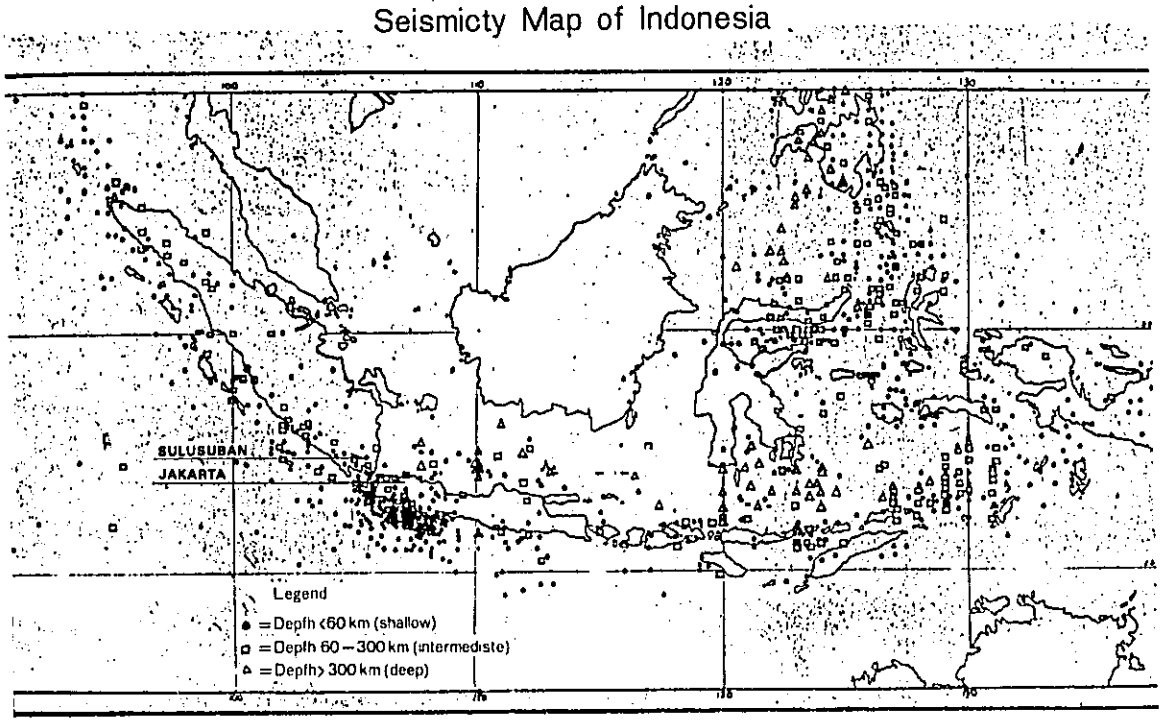
K : Structural type factor

W_t: Building load

From Figs. 5-5 and 5-6, C = 0.05 (for Zone 4), I = 2.0 and K = 1.0 (for steel structure or reinforced concrete structure). Hence, C_d applicable to facilities in the site can be taken as 0.1.

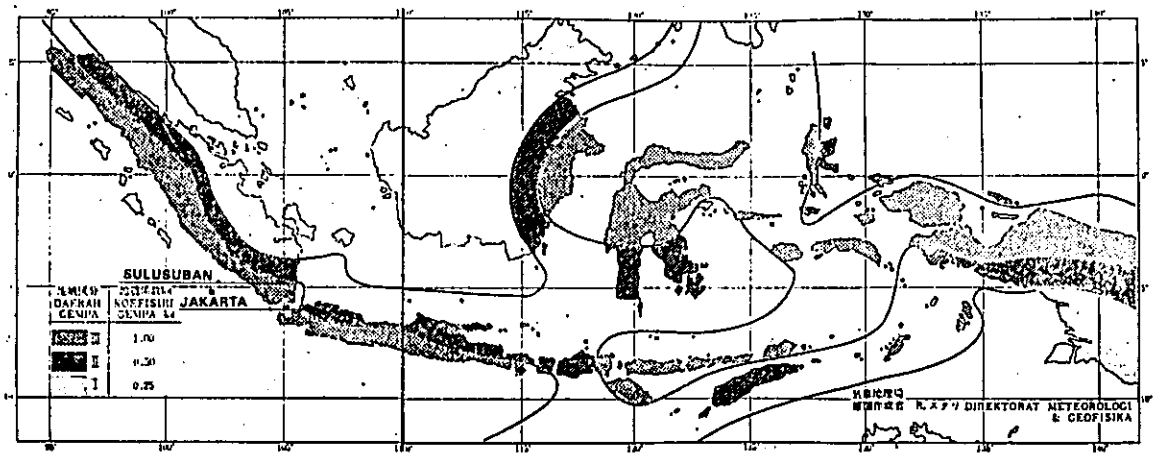
5-1

Seismicty Map of Indonesia

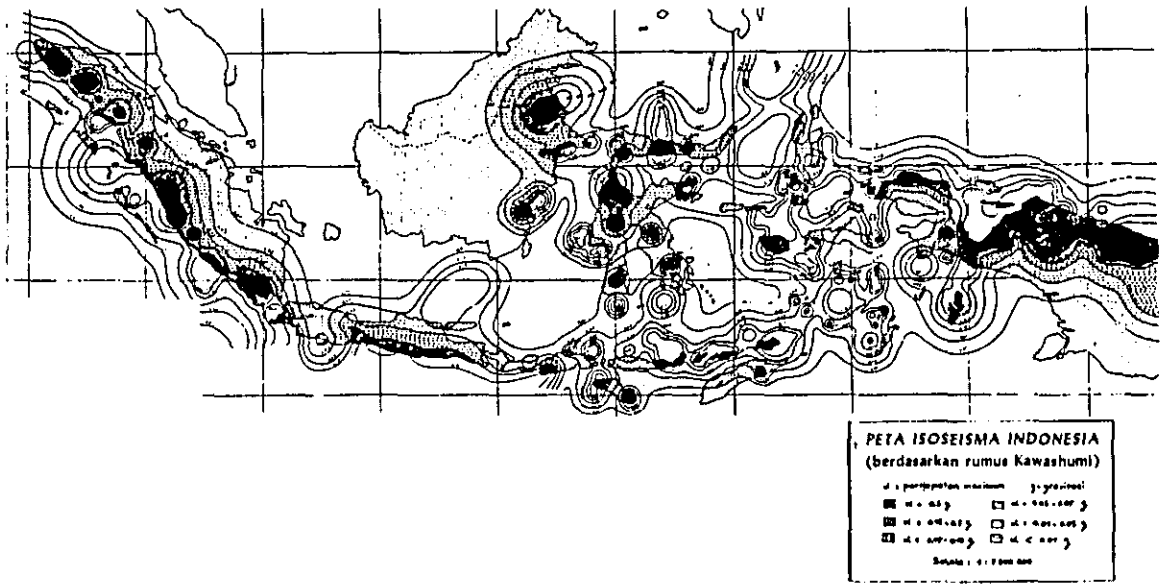


5-2

PETA DAERAH GEMPA INDONESIA



5-3



5-4

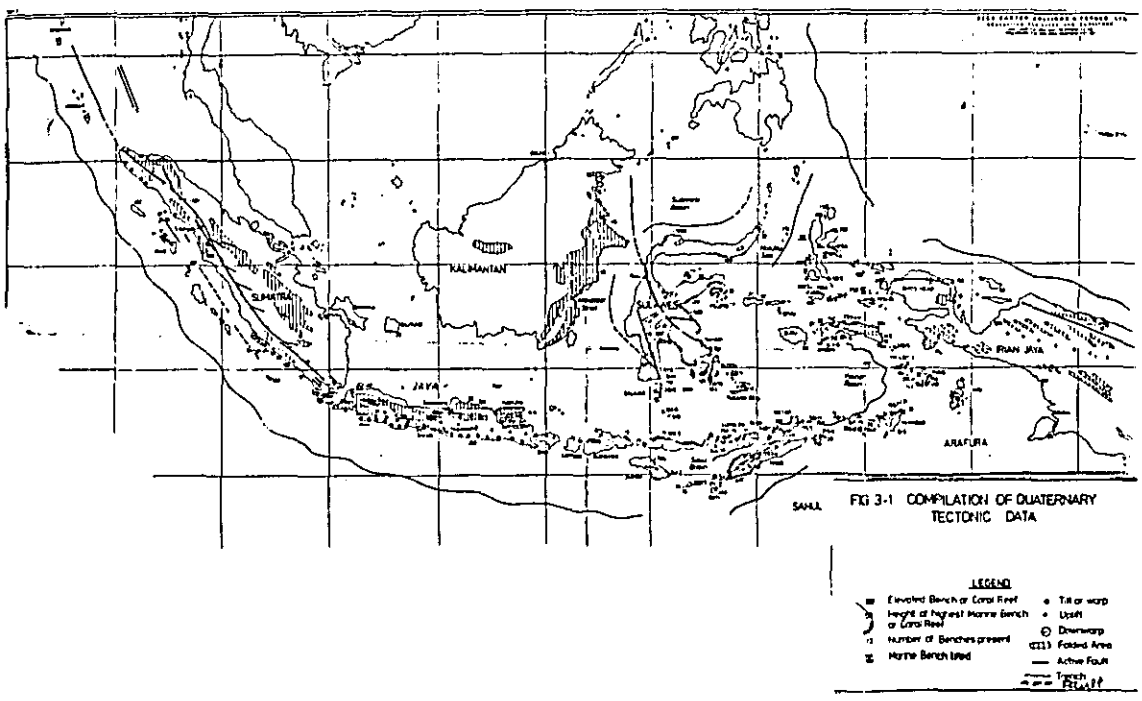
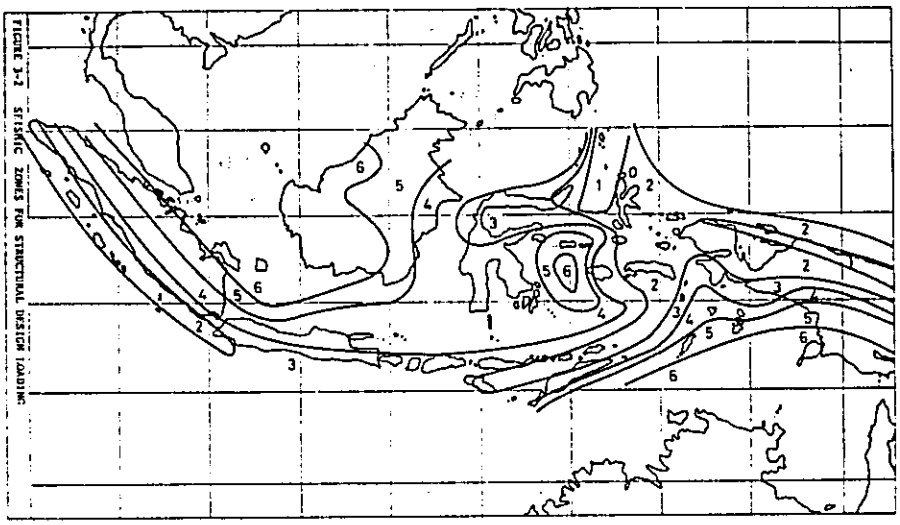


FIG 3-1 COMPILATION OF QUATERNARY TECTONIC DATA

5-5



5-6

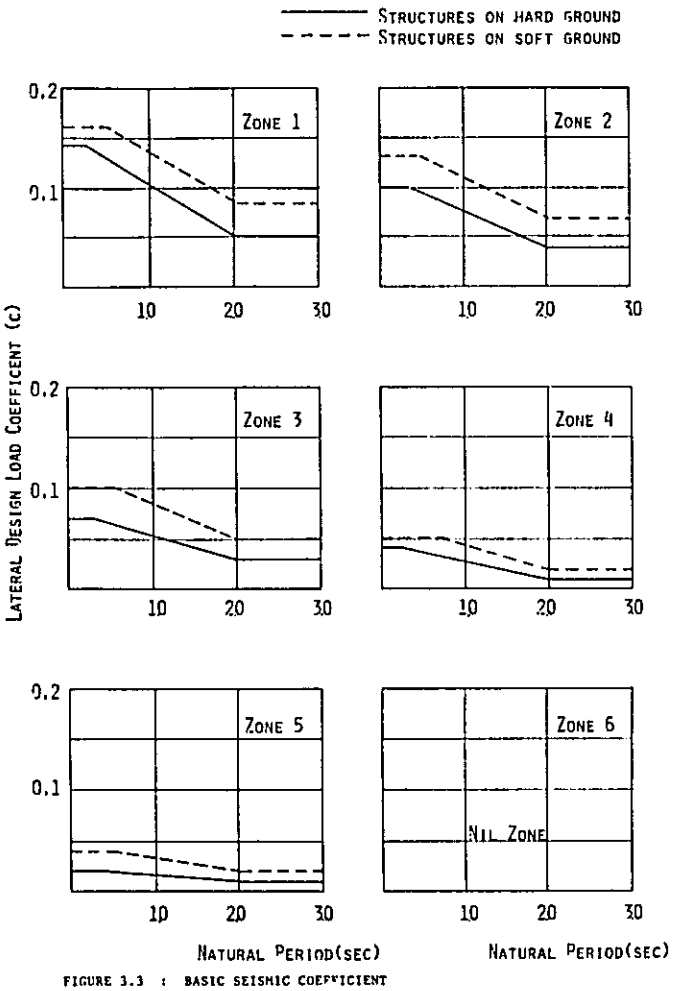


FIGURE 3.3 : BASIC SEISMIC COEFFICIENT

5-4-5 Electricity Supply and Telephone System

The site as it is now is a farmland. The neighboring villages are served with neither electricity nor telephone system. Therefore, electricity for the Center must be provided by the use of an in-house power plant until public power supply system can be utilized. As for the present communication, wireless telephone system is in operation between Jakarta and Tanjung Karang and wireless communication system, between Tanjung Karang and the adjacent farm.

5-4-6 Water Supply and Drainage Systems

No water supply and drainage systems are provided at and near the site. Water for domestic and plant use will be provided by wells to be constructed by the Indonesian side. Effluent from the plant will be discharged into the nearby creek.

5-4-7 Fuel

Generally, neighboring people are using firewood and charcoal as fuel.

5-5 LAYOUT OF PROJECT FACILITIES

The Project site is narrow and long in the east-west direction, about 1,000 m long in the east-west and about 500 m long in the north-south. In plan, it is sandwiched by about 7 m wide public roadway in the north and a pathway, serving for farmer's cart carriages, close to the property line in the south.

The main access is provided adjacent to the public roadway from which the main roads within the center premises run in the north-south direction. Those main roads are intersected at a right angle by the east-west main roads. The entrance portion of the premises is laid out with these main roads into a research and development zone, an experiment plant zone and an experimental farm zone according to their functions.

The following makes supplementary comments on the layout shown in Fig. 5-7 General Layout.

(1) The Office and Laboratory Building and the Experimental Plant are allocated near the main gate to give visitors vivid impression of the center, while these two facilities are separated by the north-south main road to have unconcerned visitors keep off the plant equipment.

(2) In an attempt to facilitate ready access from the public roadway and to avoid unnecessary complication of custodian services, the ingress and egress at the center are limited to the main entrance. To relieve traffic congestion of carts, trucks and personnel as will be caused by delivery of raw materials, the gate is enlarged to 15 m in width.

(3) Located to the east of the north-south main road is the Experimental Plant to the south of which the Workshop, Farming Implement Shop and Mechanical Equipment Building are provided, whereby

defining this area as servicing and maintenance zone common to both the experimental plant and farming.

(4) To the west of that main road is the Office and Laboratory Building to the south of which a lot for training center is reserved. By this layout, these functions are kept apart from the servicing and maintenance zone to assure purposive use and convenience in use pattern.

(5) The Guesthouse and the Staff Housing, both requiring the human amenity, are located in the north-west corner remote from the plant zone, with the access route taken along the Office and Laboratory Building.

(6) The sanitary sewage is drained by piping which runs along the north-south main road, finally flowing into the sewage basin. The industrial waste water from the plant is drained through a drainage channel, which is provided along the road running to the east of the plant, to finally run into the Lagoon. This drainage channel is to be constructed as buried type within the servicing and maintenance zone to keep odor emitted into air the least endurable and as open type in the subsequent route. The sewage basin and the lagoon are located at the south end of the site to be most convenient for letting the effluent run into the nearby creek and to prevent the neighboring facilities from being subjected to the excessive odor and contamination.

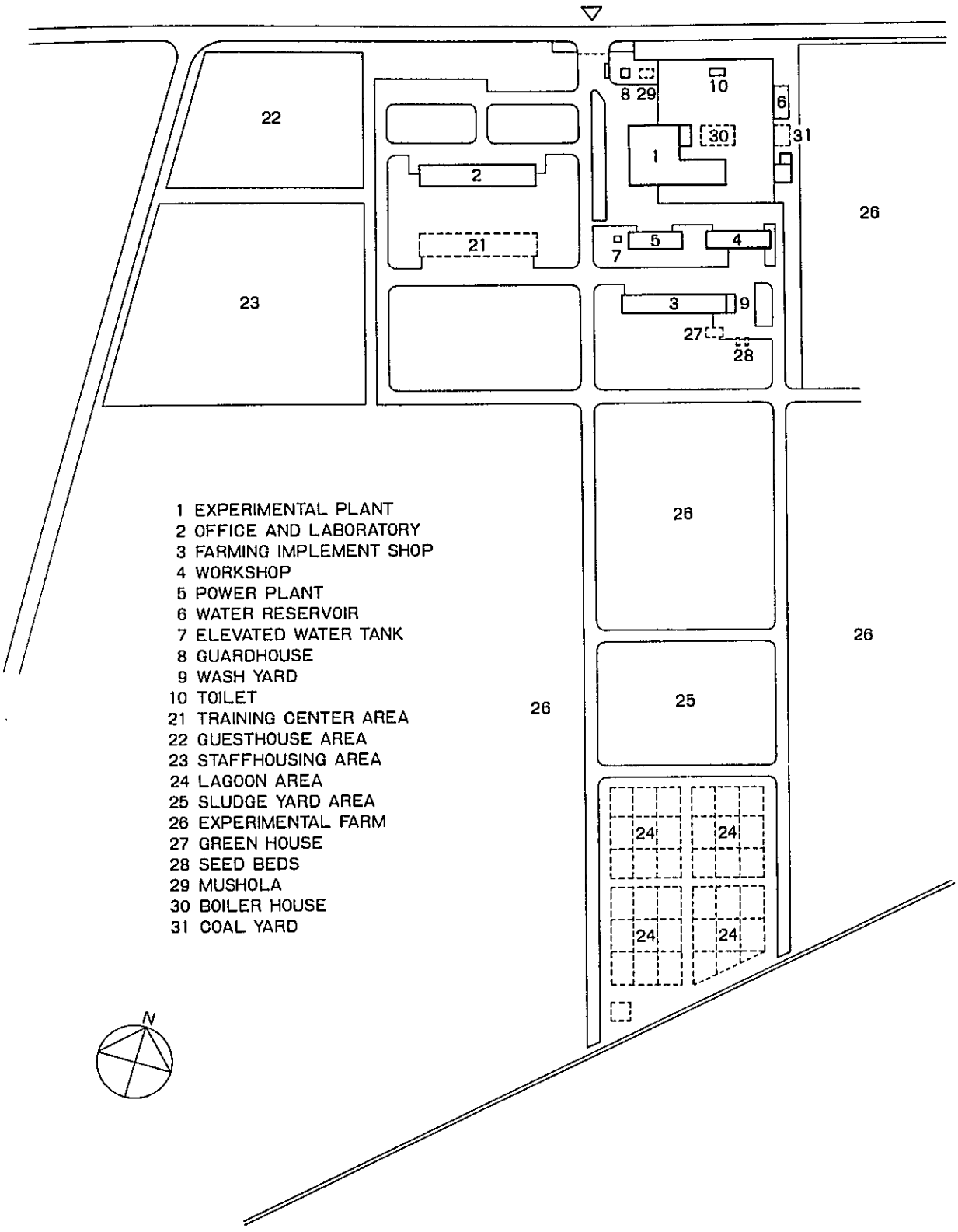


Fig. 5-7 GENERAL LAYOUT

5-6 BUILDING PLAN

(1) Experimental Plant

The plant layout having been elaborately analyzed, a grid pattern of 7 m by 7 m is taken as a basic unit to facilitate the future expansion of production equipment and associated remodeling/expansion of the building. On the first floor, two entrances are provided for delivery of raw materials, one each for personnel and for cargo trucks, and an additional opening is provided for ingress and egress of repair/maintenance equipment. The roof is sloped at 4/10, without gutters, to deal with intensive storm in this country. Inside the building, the ventilation is effected with natural air flow by providing roof fans and louvers on the walls. Without siding, the fermentation and distillation bays are built with exposed frames, maintenance deck and roof being provided as necessary.

Outline of Building

Construction and stories:	Two storied steel-framed building
Building area:	1,078 m^2 inside 392 m^2 outside
Total floor area:	1,470 m^2 inside 924 m^2 outside
Eaves height:	FL + 8,700; FL + 3,100
Outside finishes:	
Roof	Corrugated asbestos cement sheets
Siding	Corrugated asbestos cement sheets
Skirting	Bricks with pointed joints
Doors & windows	Wood frames/sashes painted

Inside finishes:

Plant Building

Ceiling	Frames exposed without ceiling
Wall	Columns and studs exposed without inside wall
Floor	Troweled concrete

Electrical Room

Ceiling	Asbestos sandwich boards painted
Wall	As above
Floor	Troweled concrete

Control Room and Experiment Room

Ceiling	Asbestos sandwich board painted
Wall	As above
Floor	Precast terrazzo blocks

(2) Office and Laboratory Building

On the basis of the design requirements for experiment room layout, the module for room space is taken as 8 m by 5.5 m. For access, the main entrance is given at the center of the building, the succeeding approach to each room being led along the corridor which is designed as open type to make it breezier in the tropical climate.

The floor-to-ceiling height is taken large to make smooth the ventilation inside each room. Eaves are projected outside sufficiently to prevent sunbeams and storm from coming inside. Taking account of possible disturbance or disorder by noise, heat, gas, soil, mold and of easiness in delivery of experiment equipment, utensils and materials, experiment rooms are grouped

on the first floor, with quiet farming experiment rooms and dynamic plant experiment rooms separated from each other group into the left side and right side of the main entrance. Adjacent to the entrance lobby, Show Room is provided to make exhibition and explanation for publisizing the role of the center.

Outline of Building

Construction and stories:	Two storied reinforced concrete-framed building
Building area:	725 m^2
Total floor area:	1,450 m^2
Eaves height:	FL + 7,200 mm
Outside finishes:	
Roof	Waterproofed with chemical agents
Exterior wall	Sprayed-on synthetic resin paint
Doors and windows	Wood or aluminum frames/sashes painted
Inside finishes:	
Experiment Rooms	
Ceiling	Exposed concrete painted
Walls	As above
Floors	Precast terrazzo blocks or chemical agent finish
Show Room	
Ceiling	Exposed concrete painted
Walls	As above
Floor	Precast terrazzo blocks

Toilet and Shower Rooms

Ceilings	Asbestos cement boards painted
Walls	Upper —— Concrete painted Lower —— Ceramic tiles
Floors	Mosaic tiles

Office

Ceiling	Asbestos boards painted
Walls	Painted concrete and asbestos boards
Floors	Precast terrazzo blocks

Library and Data Processing Room

Ceilings	Asbestos boards painted
Walls	Painted concrete and asbestos boards
Floors	Precast terrazzo blocks

Head of the Center and Conference Room

Ceiling	Plywood
Walls	Plywood
Floors	Carpet

Dinning and Resting Room

Ceiling	Exposed concrete painted
Walls	Painted concrete and asbestos boards
Floors	Precast concrete blocks

Corridors and Lobby

Ceiling	Exposed concrete painted
Walls	Painted concrete
Floors	Precast terrazzo blocks or chemical agent finish

(3) Farming Implement Shop

The building is for storing seeds, fertilizers, farming implements and equipment, and includes a starch analyzing room and a resting room, a toilet and a shower room for workers.

Outline of Building

Construction and stories:	Single storied steel-framed building
Building construction area:	600 m^2
Floor area:	600 m^2
Eaves height:	FL + 4,500 mm
Outside finishes:	
Roof	Corrugated asbestos cement sheets
Walls	As above
Skirting	Bricks with pointed joints
Doors and windows	Wood frames/sashes painted
Inside finishes:	
Farming Preparation Room	
Ceiling	Frames exposed without ceiling
Walls	Columns and studs exposed without inside wall
Floor	Abrasion-resistant hardner finish

Agricultural Product Storage

Ceiling	Frames exposed without ceiling
Walls	Columns and studs exposed
Floor	Abrasion-resistant hardner finish

Farming Implements Room

Ceiling	Frames exposed without ceiling
Walls	Columns and studs exposed
Floor	Abrasion-resistant hardner finish

Seed Storage and Fertilizer Storage

Ceiling	Frames exposed without ceiling
Walls	Columns and studs exposed
Floor	Abrasion-resistant hardner finish

Toilet, Lockers and Shower Rooms

Ceiling	Asbestos cement boards painted
Walls	Upper —— Asbestos cement boards painted
	Lower —— Ceramic tiles
Floors	Mosaic tiles

Resting Room

Ceiling	Asbestos cement boards painted
Walls	As above
Floor	Precast terrazzo blocks

(4) Workshop

Workshop for repairing equipment for farming activities and plant operation. A utensil/tool storage and a spare parts storage are provided at the both ends of the building and a one-ton hoist equipped in the center.

Outline of Building

Construction and stories:	Single-storied steel-framed building
Building construction area:	350 m^2
Floor area:	350 m^2
Eaves height:	FL + 4,500 mm
Outside finishes:	
Roof	Corrugated asbestos cement boards
Walls	As above
Skirting	Bricks with pointed joints
Doors and windows	Wood frames/sashes painted
Inside finishes: (Common to the whole inside)	
Ceiling	Frames exposed without ceiling
Walls	Columns and studs exposed
Floor	Abrasion-resistant hardner finish

(5) Guardhouse

Provided, at the Main Entrance, to check the ingress/egress, guard the Center, and scale raw materials delivered into the Center.

Outline of House

Construction and story:	Single-storied reinforced concrete construction
Construction area:	20 m^2
Floor area:	20 m^2
Eaves height:	FL + 3,100 mm
Outside finishes:	
Roof	Waterproofed with chemical agent
Walls	Bricks with pointed joints
Door and windows	Wood or aluminum frames/sashes painted
Inside finishes:	
Ceiling	Asbestos cement boards painted
Walls	Bricks with pointed joints
Floor	Precast terrazzo blocks

(6) Detached Toilet

A detached toilet is provided for use by workers at the plant, guardians and deliverers of raw materials.

Outline of Toilet

Construction and story:	Single-storied reinforced concrete construction
Construction area:	40 m^2
Floor area:	40 m^2
Eaves height:	FL + 3,100 mm
Outside finishes:	
Roof	Waterproofed with chemical agent
Walls	Bricks with pointed joints
Doors and windows	Wood frames/sashes painted
Inside finishes: (Common to the whole inside)	
Ceiling	Exposed concrete painted
Walls	Ceramic tiles and bricks with pointed joints
Floors	Mosaic tiles

(7) Power Plant

In addition to the electrical equipment room, the building incorporates a generator room and a pump room for domestic water supply.

Outline of Building

Construction and story:	Single-storied reinforced concrete building
Building construction area:	300 m^2
Floor area:	300 m^2
Eaves height:	FL + 5,000 mm
Outside finishes:	
Roof	Waterproofed with chemical agent
Wall	Bricks with pointed joints
Doors and windows	Wood frames/sashes painted
Inside finishes:	
Generator Room and Electrical Room	
Ceiling	Exposed concrete painted
Walls	Mortar painted
Floor	Troweled concrete
Pump Room	
Ceiling	Exposed concrete painted
Walls	Mortar painted
Floor	Troweled concrete

(8) Water Reservoir

Water reservoir and associated pump house for water supply to the experiment plant.

Outline of Structure

Construction:	Reinforced concrete reservoir structure, 20 m long x 15 m wide x 1.5 m high, and single-storied, steel-framed pump house
Pump House:	
Construction area	25 m^2
Eaves height	FL + 3,000 mm
Outside finishes	
Roof	Corrugated asbestos cement sheets
Walls	As above
Inside finishes	
Ceiling	Roof framing exposed without ceiling
Walls	Columns and studs exposed
Floor	Troweled concrete

(9) Elevated Water Tank

Water tank provided for domestic water supply.

Outline of Structure

Construction:	Steel framing
Highest portion:	GL + 22,000 mm
Tank:	3.0 m long x 3.0 m wide x 2.0 m deep, made of FRP

(10) Wash Yard

Provided for washing farming implements.

Outline

Construction:	Troweled concrete
Area:	10 m long x 3 m wide = 30 m^2

(11) Outdoor Works

Gate: Main gate will be constructed of reinforced concrete and be finished by bricks with pointed joints. Gate will be of a chain type made of stainless steel.

Paving: Asphaltic pavement will be provided in the premises where required. Side ditches will consist of precast concrete elements, with metal grating covers provided as required.

5-7 BASIC DESIGN OF PLANT

5-7-1 Design Principles

The plant will serve as an experimental plant for the alcohol production processes. As such, thorough consideration will be given to the following in planning.

a. The research aspect should be given a due emphasis.

b. The processing system should have a high degree of interchangeability so that components can easily be replaced with those newly developed.

c. The system should be compatible with the operation techniques prevailing in the locale.

In view that the plant will be a benchmark for development of the energy alcohol production in Indonesia, it should be such as will enable the owner to make the research activities for the practical processing techniques for the operation. With this taken into account, the plant will be planned so that it will basically consist of the systems which are technically well known and proven but have, wherever feasible, a high degree of flexibility to meet such requirements as the future study programs may require.

(1) Plant Capacity

The capacity is taken at 8 kl/day for the reasons given below.

i) The present plant should be similar to ordinary commercial plants in size and, hence, should be such a model as will allow easy scale expansion.

ii) As an experimental plant, it should be operable with ease.

iii) The plant should be serviceable for study purpose.

(2) Raw Materials

Conceivable raw materials which are available in Indonesia will be starchy materials, such as cassava and sweet potato; sugary materials, such as sugar cane; and woody cellulose-based materials. Among these kinds of materials, cassava and sweet potatoes most frequently found around the project site will be selected as predorminant raw material for the time being.

(3) Products

The plant will produce ethanol of 95 v %. In order to cope with possible need of absolute alcohol, Indonesian Government has a plan to construct a comprehensive central plant for producing the anhydride.

(4) Washing and Crushing Processes

The method as adopted in local starch production shops and similar plants will be used i.e. rotating impeller type washer and drum type washer.

(5) Liquefying Process

In the plant, the steam cooking will be used which is recognized as reliable in the engineering sense. But, a spatial reserve and prearrangement for piping installation will be maintained to allow for the future installation of a mechanical liquefying system in addition to the steam cooking.

(6) Saccharifying Process

Saccharifying enzyme, as well as liquefying enzyme and yeast, of commercial stock type will be used.

(7) Fermenting Process

An even number of fermentors will be provided, the process being of batch type.

(8) Distilling Process

Two towers distilling process will be used to avoid complication of the system.

(9) Fuel

Steam boilers for use in cooking and distilling will use heavy oil as fuel.

(10) Cooling Water

Two types of cooling water will be used: one taken from a well and the other cooled by a cooling tower.

(11) Instrumentation

To bring the pilot plant to its advantage, such instruments will be provided which will be capable of measuring the instant values in each process and, as necessary, of recording/controlling them.

5-7-2 Basics of Plant

(1)	Plant capacity:	8 kl/day
(2)	Raw material:	Cassava and sweet potatoes
(3)	Product:	Ethanol (95 v %)
(4)	Process system:	Batch type fermentation and continuous type distillation
(5)	Operation time:	24 hours/day
(6)	Operation period:	300 days/year
(7)	Fuel:	Heavy oil

5-7-3 Basic Plan of Processes

(1) Pretreatment Process

i)	Peeling:	Peeler
ii)	Washing:	Rotating impeller type washer
iii)	Crushing:	Crushing into coarse and fine particles
iv)	Liquefying:	Supplied with hot water and subsequently with α-amylase
v)	Cooking:	Steam to be blown in
vi)	Cooling:	To be water-cooled
vii)	Saccharification:	β-amylase to be added
viii)	Cooling:	To be water-cooled

(2) Fermenting Process

i)	Seed cultivation:	Flask seed is added, while air being supplied, to cultivate the seed.
ii)	Fermenting:	Cultivated seed is mixed to effect fermentation.
iii)	Filtering:	Residue is removed from the fermentation liquid.

(3) Distillating Process

i)	Mash-distilling:	To be supplied with filtered mash and, then, filled with steam from the bottom. The alcohol is extracted from the top, with the stillage taken out from the bottom.
ii)	Concentration:	From the mash column, alcohol is supplied. The alcohol is extracted from the top, and liquid drained out from the bottom is sent again to the mash column.

5-7-4 Plant Equipment and Installations

(1) Pretreatment Process

i)	Peeler	10 t/h
ii)	Washer:	Rotating impeller type, 10 t/h
iii)	Automatic scale:	Conveyer type, 10 t/h

iv) Crusher: 10 t/h x 1 unit and 5 t/h x 2 units

v) Cassava pit: 15 m^3

vi) Cooking tank: Spherical shape, 35 m^3, with agitator

vii) Saccharifying tank: 35 m^3 with agitator

(2) Fermenting Process

i) Seed tank: 6.5 m^3 x 2 units with agitator

ii) Main fermentor: 120 m^3 x 4 units

iii) Screen filter: Screen type, 30 m^3/h

iv) Mash tank: 120 m^3

(3) Distilling Process

i) Mash column: SUS 304 construction

ii) Concentration column: SUS 304 construction

iii) Condenser: SUS 304 construction x 2 units

iv) Product cooler: SUS 304 construction

v) Waste water tank: 120 m^3

(4) Appurtenant Equipment

i) Truck scale: Pendulum type, 1 to 20 tons

ii) Weigher: 200 kg

iii) Product tank: Cone roof, 100 m^3

iv) Boiler: Package type, 3 t/h (4 kg/cm^2G)

v) Air compressor: Reciprocating type, 250 Nm^3/h (5 kg/cm^2G)

vi) Cooling tower: 150 m^3/h

vii) Heavy oil tank: 50 m^3

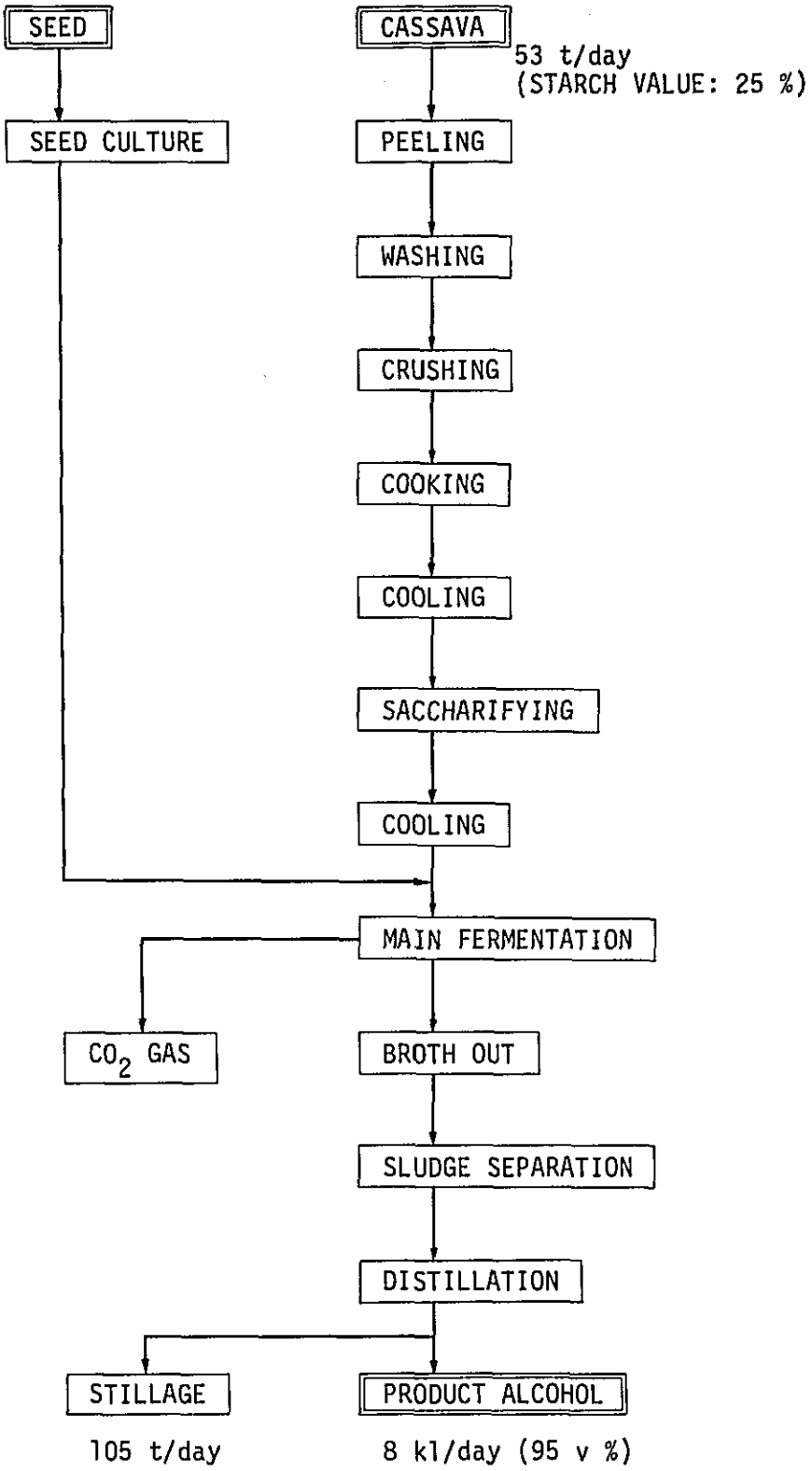
viii) Others including pumps and conveyers

(5) Instrumentation

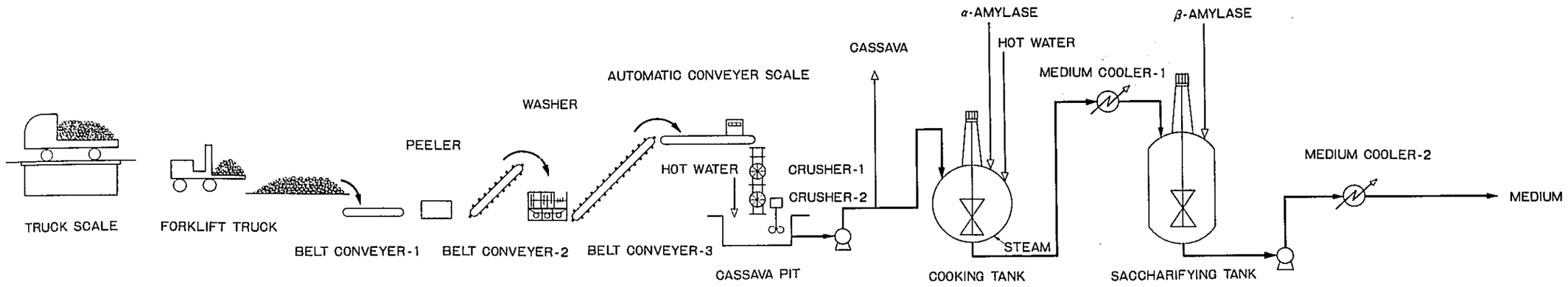
i) Instrument

ii) Instrument panel

iii) Control panel



PROCESS BLOCK DIAGRAM


TRUCK SCALE
FORKLIFT TRUCK
BELT CONVEYER-1
PEELER
WASHER
BELT CONVEYER-2
AUTOMATIC CONVEYER SCALE
BELT CONVEYER-3
HOT WATER
CRUSHER-1
CRUSHER-2
CASSAVA PIT
CASSAVA
α-AMYLASE
HOT WATER
COOKING TANK
STEAM
MEDIUM COOLER-1
β-AMYLASE
SACCHARIFYING TANK
MEDIUM COOLER-2
MEDIUM

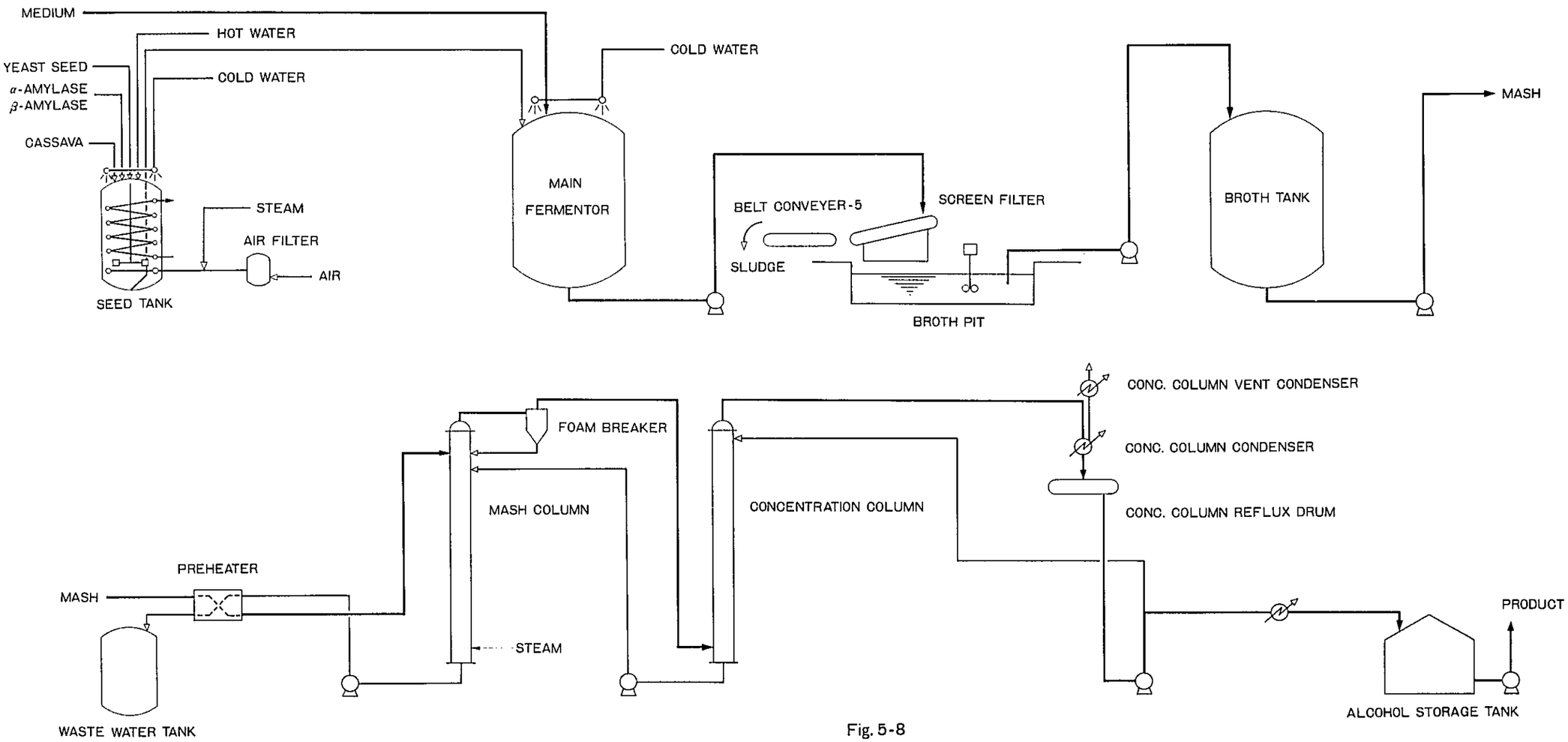

MEDIUM
HOT WATER
YEAST SEED
α-AMYLASE
β-AMYLASE
COLD WATER
CASSAVA
STEAM
AIR FILTER
AIR
SEED TANK
COLD WATER
MAIN
FERMENTOR
BELT CONVEYER-5
SLUDGE
SCREEN FILTER
BROTH PIT
BROTH TANK
MASH
FOAM BREAKER
MASH COLUMN
CONCENTRATION COLUMN
CONC. COLUMN VENT CONDENSER
CONC. COLUMN CONDENSER
CONC. COLUMN REFLUX DRUM
PREHEATER
MASH
STEAM
WASTE WATER TANK
PRODUCT
ALCOHOL STORAGE TANK

Fig. 5-8

5-8 BUILDING SERVICE SYSTEMS

5-8-1 Electrical

(1) Power Supply

Around the proposed construction site, no power supply network is now provided by any power corporation. Then, generator system will be provided. Power supply system including generator with accessories and generator board is to be procured and constructed by the Indonesian side. The loads on all the facilities, demand factor and easiness in maintenance being taken into account, two generators, each meeting the requirements above, are recommended of which one is put into full operation, the other being stood by or subjected to overhaul when so required.

As for the generators, the following specifications are recommended.

i) Engine

Diesel engine of radiator-cooling type

Capacity:	About 650 ps.
Rating:	Continuous type
Fuel:	Heavy oil or light oil

ii) Generator

Drip-proof, self-exciting type synchronous generator

Capacity:	500 KVA (400 KW)
Phase and Voltage:	3 ø, 4 W, 380/220 V

Frequency: 50 Hz

Rating: Continuous type

(2) Power Distribution

Generators and low voltage switchboards are provided in the power plant from which the power is supplied to each facility.

The supply voltage is taken as follows.

3 ø 4 W 380 V for power operation

1 ø 2 W 220 V for lighting and convenience outlets

Those equipment and tools for experiments which require 3 ø 3 W 220 V or 1 ø 100 V power are made operable by providing a small transformer at a nearby, convenient point.

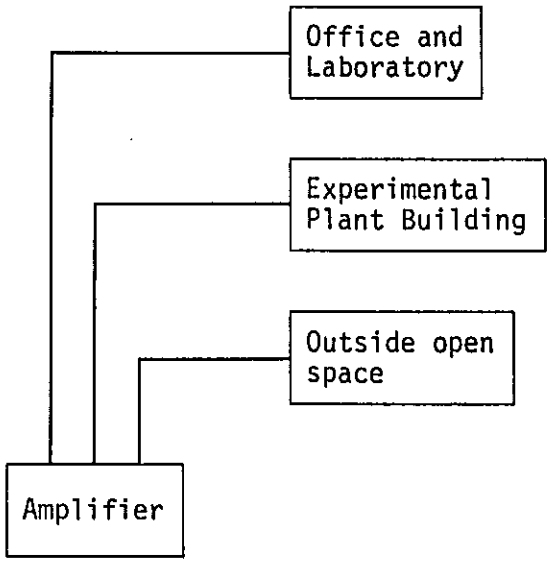
(3) Lighting and Convenience Outlets

The lighting is mainly by fluorescent lamps, partially supplemented by incandescent lamps and mercury-vapor lamps. Unless otherwise required, the fixtures are of surface-mounting type and the illumination will be taken as follows.

Head of the Center, Office	:	200 to 300 lux
Library, Conference room	:	200 to 300 lux
Experiment space, Researcher's Office	:	200 to 300 lux
Plant and mechanical equipment space	:	50 to 100 lux

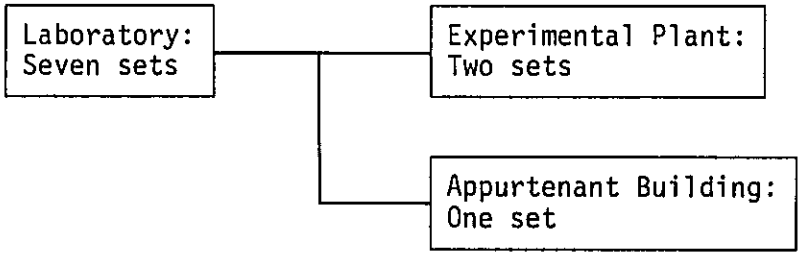
(4) Public Address System

Public address system is provided for paging and announcing. The amplifier, being provided in the office, is to incorporate a clock device to send time-check chimes within the premises.



(5) Intercom System

The intercom system is provided for in-house communication. The system is of two-way type, a total of about ten intercom sets being included.

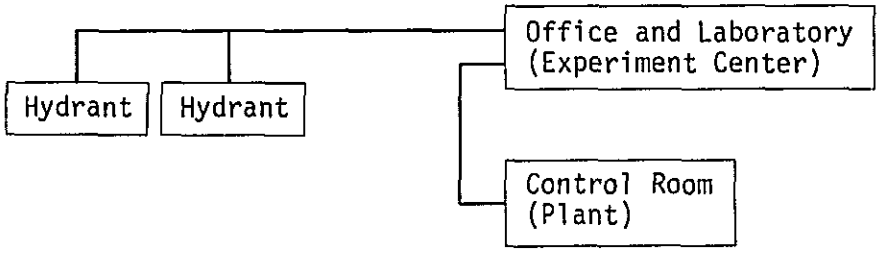


(6) Wireless Communication System

A wireless communication system will be provided by the Indonesian side for communicating with the outside.

(7) Emergency Alarm System

In order to provide against an emergency case, an emergency sound alarm system is provided, with the main equipment in the office and push-buttons/alarm bells around the hydrants. The plant operation will be let under surveillance by providing a subsidiary alarm panel in the control room of the plant.



(8) Community TV Antenna System

A community TV antenna system is provided to make television readily receivable in the spaces for Head of the Center, Dining and Resting, etc. by providing a convenience outlet in each of them.

(9) Power Supply for Experiment/Research Operation

The power sources will be supplied as required for the operation of equipment in the experiment room, data processing room, etc.

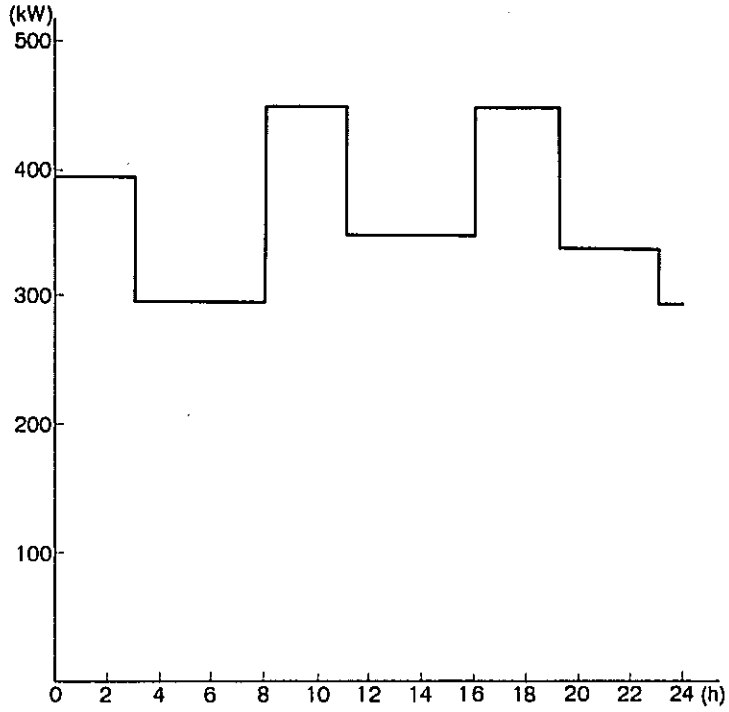


Fig. 5-9 Daily Load Fluctuation Diagram

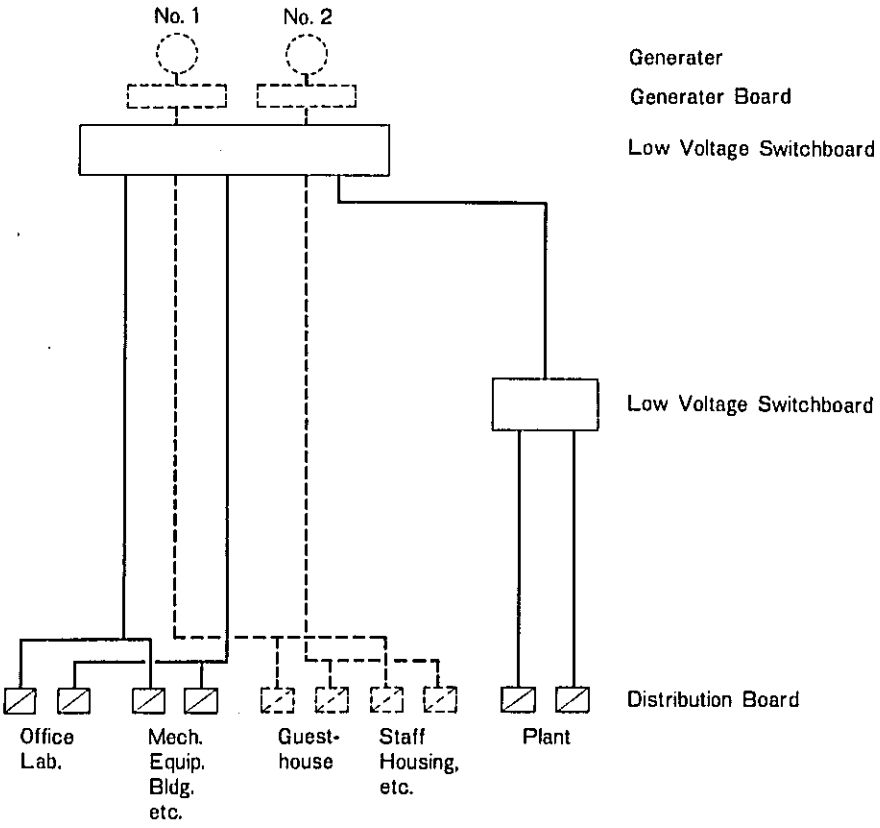


Fig. 5-10 Electrical Wiring

5-8-2 Cooling and Ventilation Systems

(1) Cooling System

The Head's room and conference room will be serviced with the cooling system of independent type window coolers. The design conditions are taken at 35°C for outside ambient temperature and 26°C inside.

(2) Ventilation System

Toilets, Kitchnet, etc. will be equipped with mechanized ventilation system using electrical ventilating fans.

5-8-3 Plumbing System

(1) Water Supply System

The water supply up to each of the following water receiving points is to be undertaken by the Indonesian side to meet the requirements given below.

i) Domestic water: 12 m^3/h (similar to potable water)
(Water Receiving Tank)

ii) Alcohol plant: 90 m^3/h
(Water Reservoir)

Dependent upon the analysis results of such well water, a settling basin or filtration system might be required which must be all studied, planned and constructed by the Indonesian side.

Based upon the estimated daily consumptions, the Water Receiving Tank and Reservoir should have the following capacities.
Water for the domestic water lines is to be put in service in

combination with the water which is stored in the fire-fighting water tank.

i) Domestic water: 50 m^3 FRP

ii) Alcohol plant: 360 m^3 Concrete

For domestic water supply, the water in the receiving tank is pumped up to the Elevated Water Tank and subsequently supplied by gravity to the required points. The water supply pipe is steel or PVC products.

(2) Hot-Water Supply

Kitchnet is to be furnished with kerosene burners for use in cooking. Hot water is made serviceable by electrical water-heater for which convenience outlets are provided, but no central hot-water supply is planned.

(3) Gas Supply

For use in experiments, gas is supplied from propane gas cylinders.

(4) Drainage Systems

All the drainage systems are planned as follows.

Sanitary sewage:	From sanitary fixtures to the point A as shown on the drawing, page 87.
Domestic waste:	From relevant plumbing fixtures to the point A
Laboratory waste:	From laboratory plumbing fixtures to the point B

Plant waste:	From plant plumbing fixtures to the point B
Plant cooling water:	From cooling tower to point A
Stormwater:	From stormwater drainage system to the point A

(5) Sanitary Fixtures

Water closets will, in principle, be of squatting style, with a few western style ones as required. Their flushing will be by flush valves. Urinals will be wall-mounted.

(6) Fire-Fighting System

There will be provided indoor hydrants and portable powder type fire-extinguishers. A fire pump, 750 l/min in capacity, is stationed near the Water Receiving Tank. It is so devised as to be operable by connecting it to the hydrants. The generator room is to be given a portable powder type fire-extinguisher.

(7) Service System for Laboratory Equipment

The water supply/drainage systems for the laboratory equipment items are to be installed up to the connection points. Likewise, the gas supply is to be installed up to and including gas cocks.

5-8-4 Lightning Protection System

Lightning protection systems having air terminals will be installed at Experimental Plant Building, Office and Laboratory Building and Elevated Water Tank.

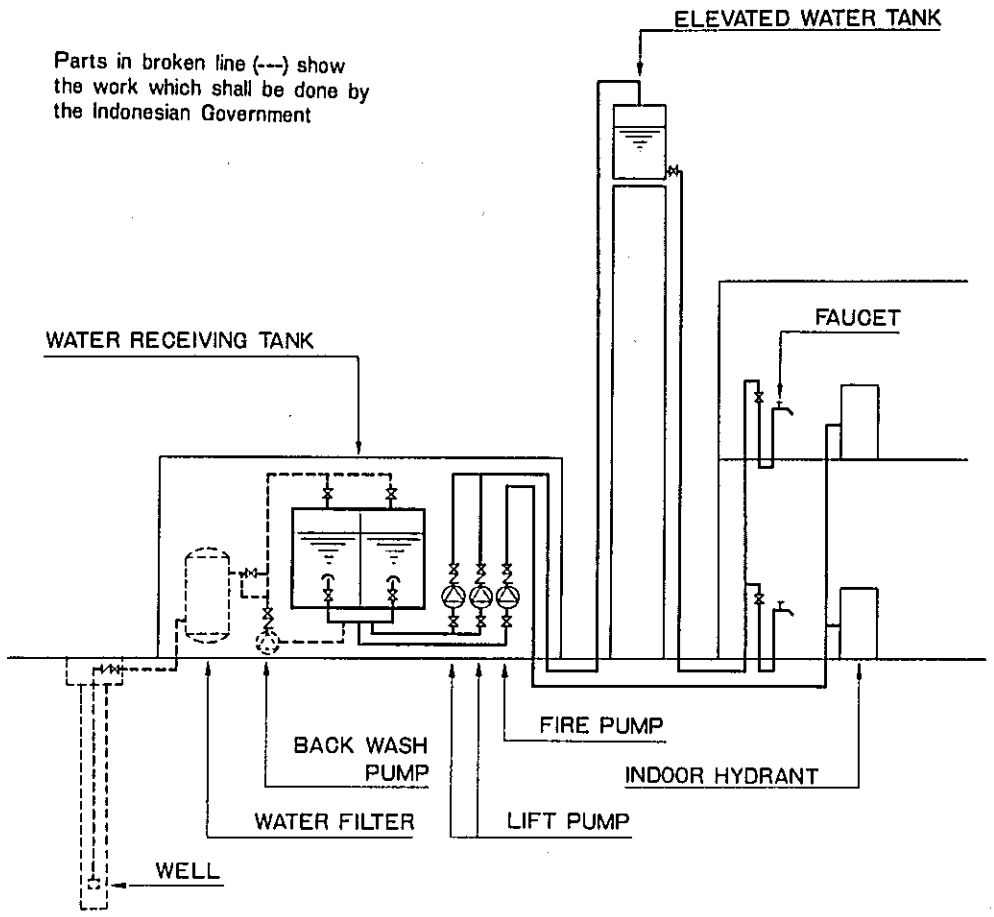


Fig. 5-11 WATER SUPPLY AND FIRE EXTIGUISHING FLOW DIAGRAM

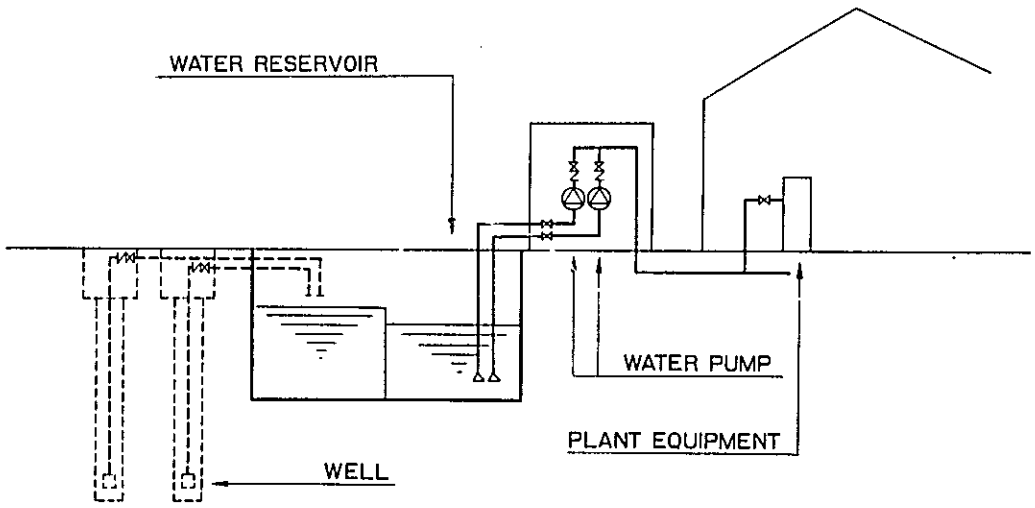


Fig. 5-12 WATER SUPPLY FOR ALCOHOL PLANT

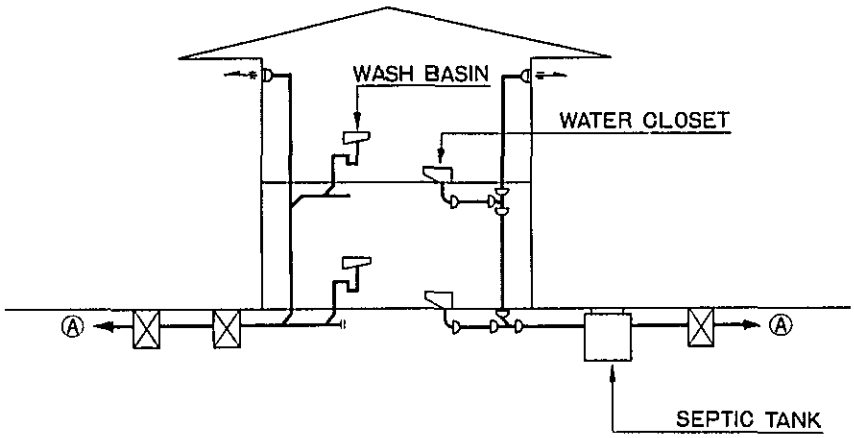


Fig. 5-13 Drainage Flow Diagram (Laboratory)

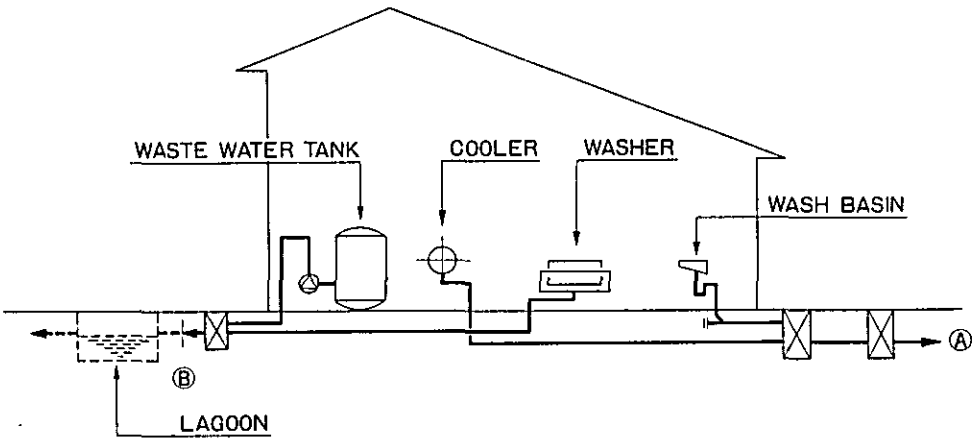


Fig. 5-14 Drainage Flow Diagram (Alcohol Plant)

5-9 STRUCTURAL DESIGN

5-9-1 General

(1) Each of the buildings in the center will be of appropriate construction depending on its own dimensions, shape and purpose. The Office and Laboratory, Mechanical Equipment Building, Guardhouse and (detached) Toilet will be constructed of reinforced concrete, and Experimental Plant, Workshop, etc. will be steel structure.

(2) Building structures will be determined with due consideration for local availability of materials, quality of available materials and labour, construction technology, etc.

5-9-2 Design Concept

(1) In Indonesia, there is enforced at present no standardized building code. So, the basic design will be conducted making reference to the executive regulations being presently used for administrative instructions.

(2) Magnitude of external forces and assumed loads will be determined with due consideraiton for the climatic conditions, soil conditions, purposes of the buildings, constructional procedures, etc., making reference to the executive regulations described in (1) above.

5-9-3 Design Loads

Design loads will be preset as follows:

(1) Dead Loads

a. Reinforced concrete 2.4 t/m^3

b. Structural steel 7.85 t/m^3

c. Brick 1.9 t/m^3

(2) Live Loads

Unit: kg/m^2

ITEMS	FOR FLOOR AND BEAM	FOR GIRDER AND COLUMN	FOR EARTH-QUAKE
Roof	90	65	30
Office; Conference Room; Researcher Room; Laboratory	300	180	80
Library; Storage	500	350	200
Plant equipment, Water Reservoir, etc.	To be separately determined		
Workroom	200	200	100

(3) Wind Loads

$q = 60\ h \quad (kg/m^2)$

In which,

q: Velocity pressure

h: Height from the ground level

(4) Seismic Force

Horizontal seismic coefficient will be taken as K = 0.1.

5-9-4 Structural Materials

Principal structural materials will be as specified below.

a.	Reinforcement	Plain bar SR24 (JIS products) or equivalent
b.	Concrete	F_c = 180 kg/cm^2 (at 28 days)
c.	Cement	Normal Portland cement
d.	Steel	SS41 (JIS products) or equivalent

5-9-5 Bearing Capacity of Soil

According to boring exploration at three points in the site, there exists a sandy silt layer with N-value of 30 or so under the 10 m deep top soil. Since the layer is considered to have sufficient bearing capacity, the basic design is developed with the foundations directly resting on soil.

5-10 EQUIPMENT AND UTENSILS

The following laboratory equipment has been considered to give a top priority as required in the Center within the budget of the Japanese grant.

LIST OF MAJOR LABORATORY EQUIPMENT

1. Analytical Section

- o Muffle furnace
- o Analytical balance
- o Gas chromatograph
- o Autoclave
- o Starch determination apparatus
- o Protein determination apparatus
- o Fat determination apparatus
- o Fiber determination apparatus

2. Process Section

- o Crusher(*)
- o Autoclave (*)
- o Jar fermentor(*)
- o Liquefaction machine
- o Distillation apparatus

Note:

Cooking, saccharification, fermentation and cellulose hydrolization tests can be executed by the apparatuses marked with (*).

3. Microbiology Section

- o Microscope
- o Incubator
- o Clean bench
- o Rotary shaker

4. Agriculture Section

- o Direct reading balance
- o Drying oven
- o Microscope
- o Meteorological survey apparatus
- o Soil investigation instruments
- o Incubator
- o Clean bench

CHAPTER 6: PROJECT IMPLEMENTATION

It is anticipated that this Project will be implemented under the Japanese Government grant program in accordance with the procedures set out by the Japanese Government. In that case, certain items of the work must be carried out by the Indonesian side in parallel with the work performed under the grant program, and the former must be integrated with the latter. The work to be done by the Indonesian side will be outlined in this report, but the details of such work must be determined through discussion as the implementation of the Project makes progress.

6-1 SCOPE OF WORK

The items of the work for the construction of Biomass Energy Research and Development Center are divided into those to be covered by the Japanese grant and those to be performed by the Indonesian side. The items of the work assigned to each side are as indicated in Table 6-1.

6-2 CONSTRUCTION SCHEDULE

If the aforesaid work is to be implemented in accordance with the procedures set out for the Japan's grant projects, the schedule as shown in Table 6-2(A) can be considered. Also, the schedule as shown in Table 6-2(B) will have to be followed if the work assigned to the Indonesian side is to be implemented in parallel with the schedule indicated in Table 6-2(A).

6-3 OPERATION AND MAINTENANCE

For the operation and maintenance of the completed center, the Indonesian side proposes the organization and staffing, as given in pp. 20 and 21, which are in substantial rapport with those established by the Study Mission and are considered reasonable.

Also, the Indonesian side wishes to utilize the center for another function in which the center serves as an institution for securing the operation staff to be stationed at future alcohol plants proposed for construction in the transmigration area. Supposedly the center will be operated to comfort with this purpose.

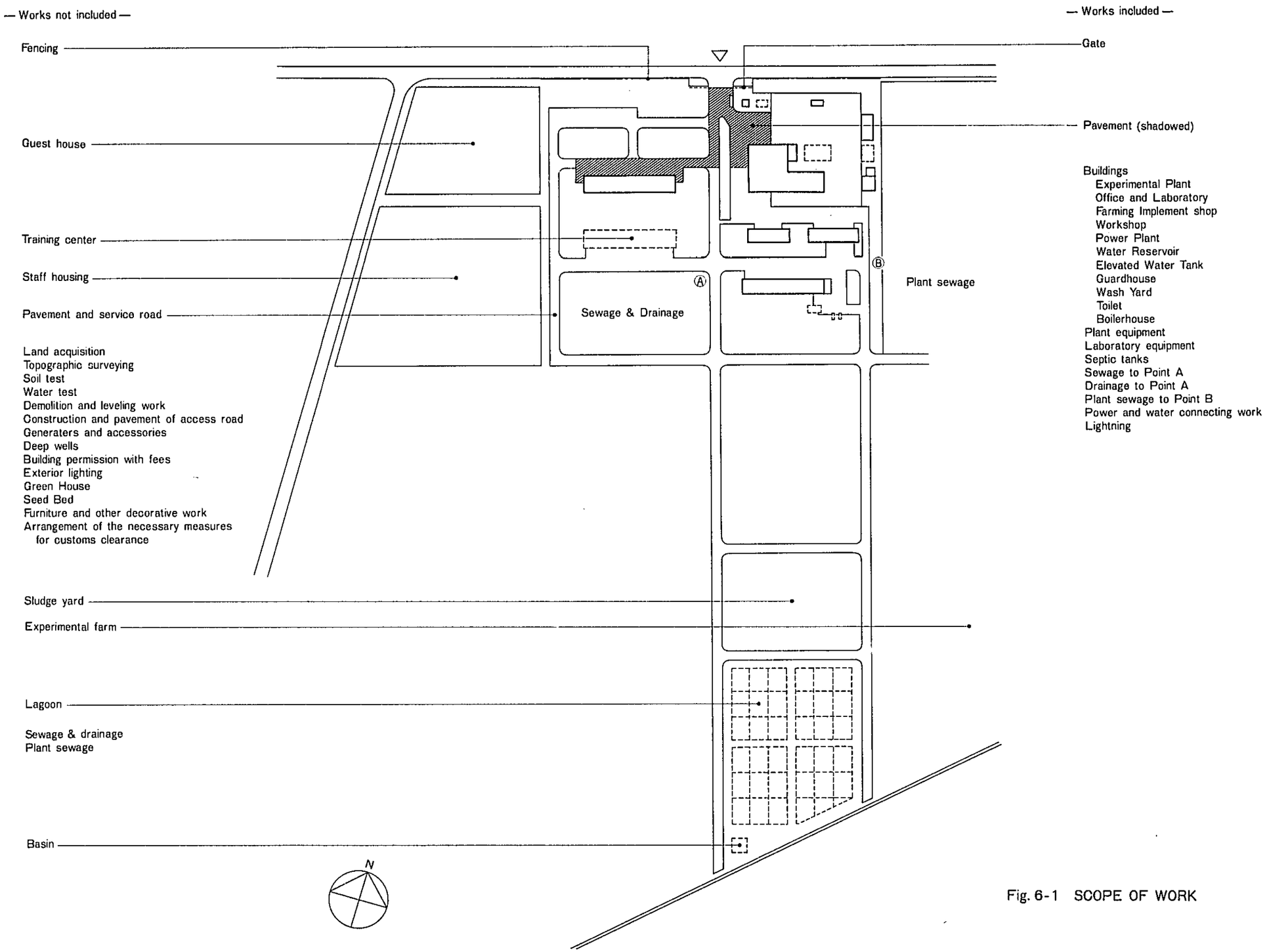


Fig. 6-1 SCOPE OF WORK

Fig. 6-2(A) PROJECT PROGRESS SCHEDULE (Tentative)

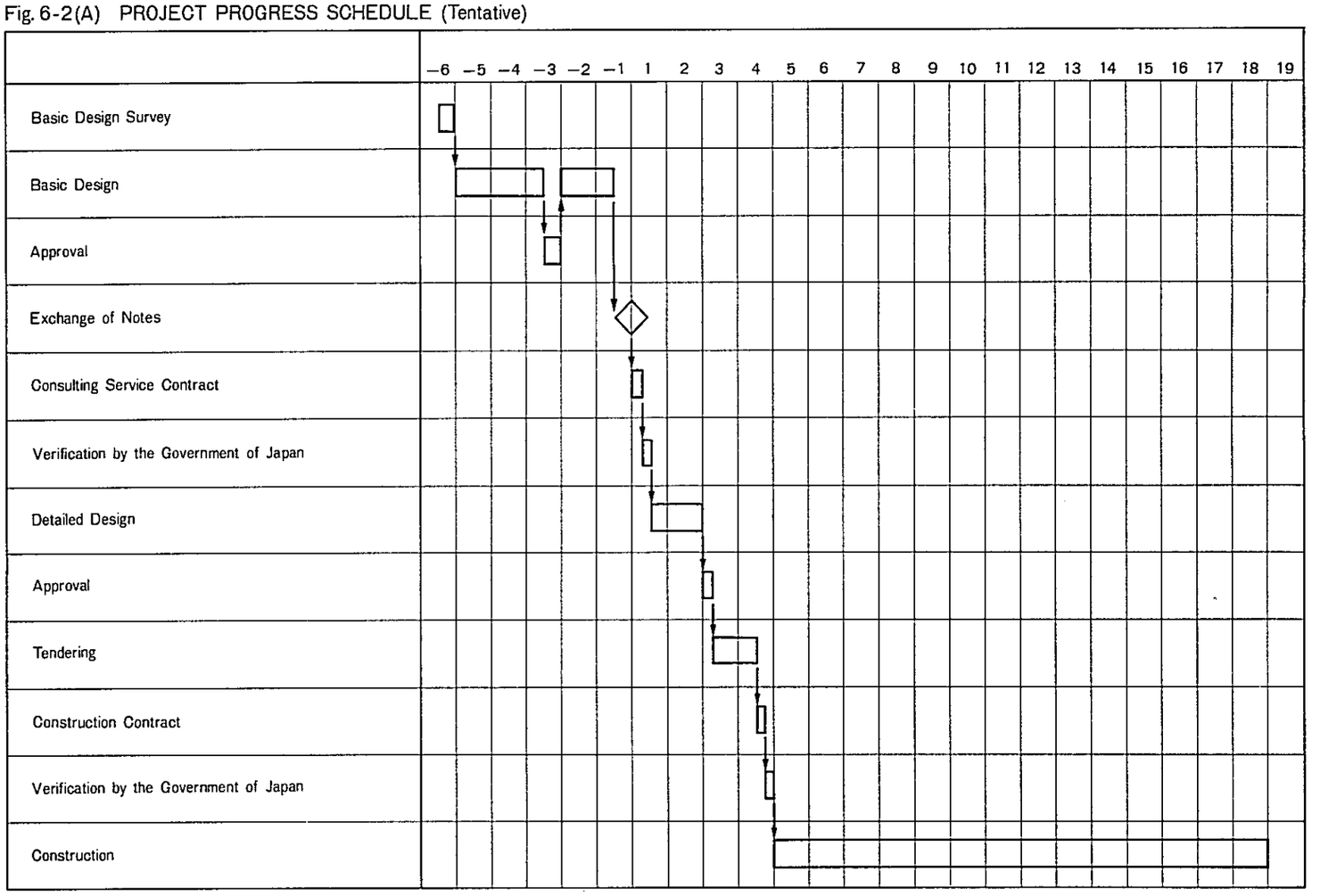
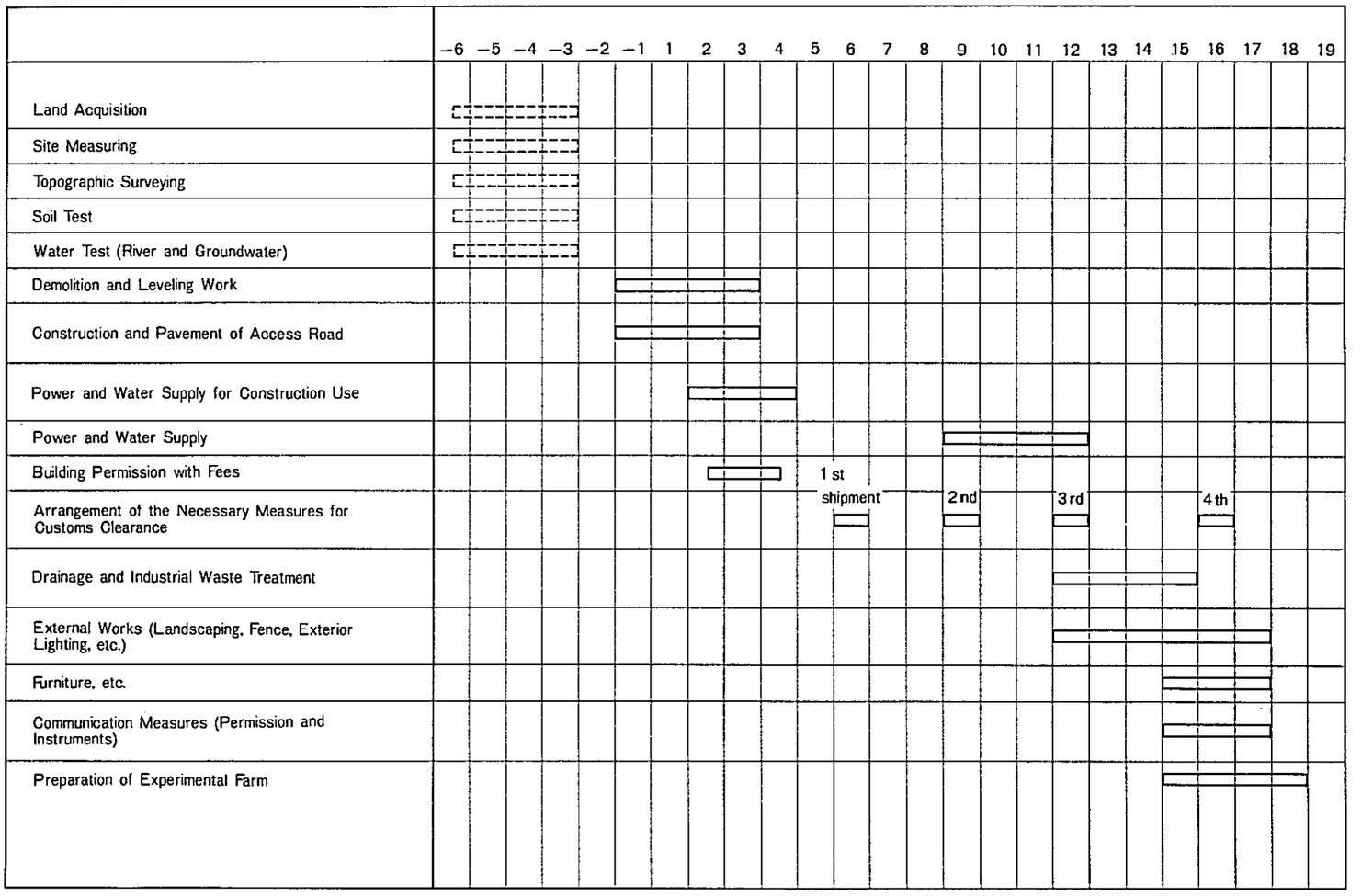
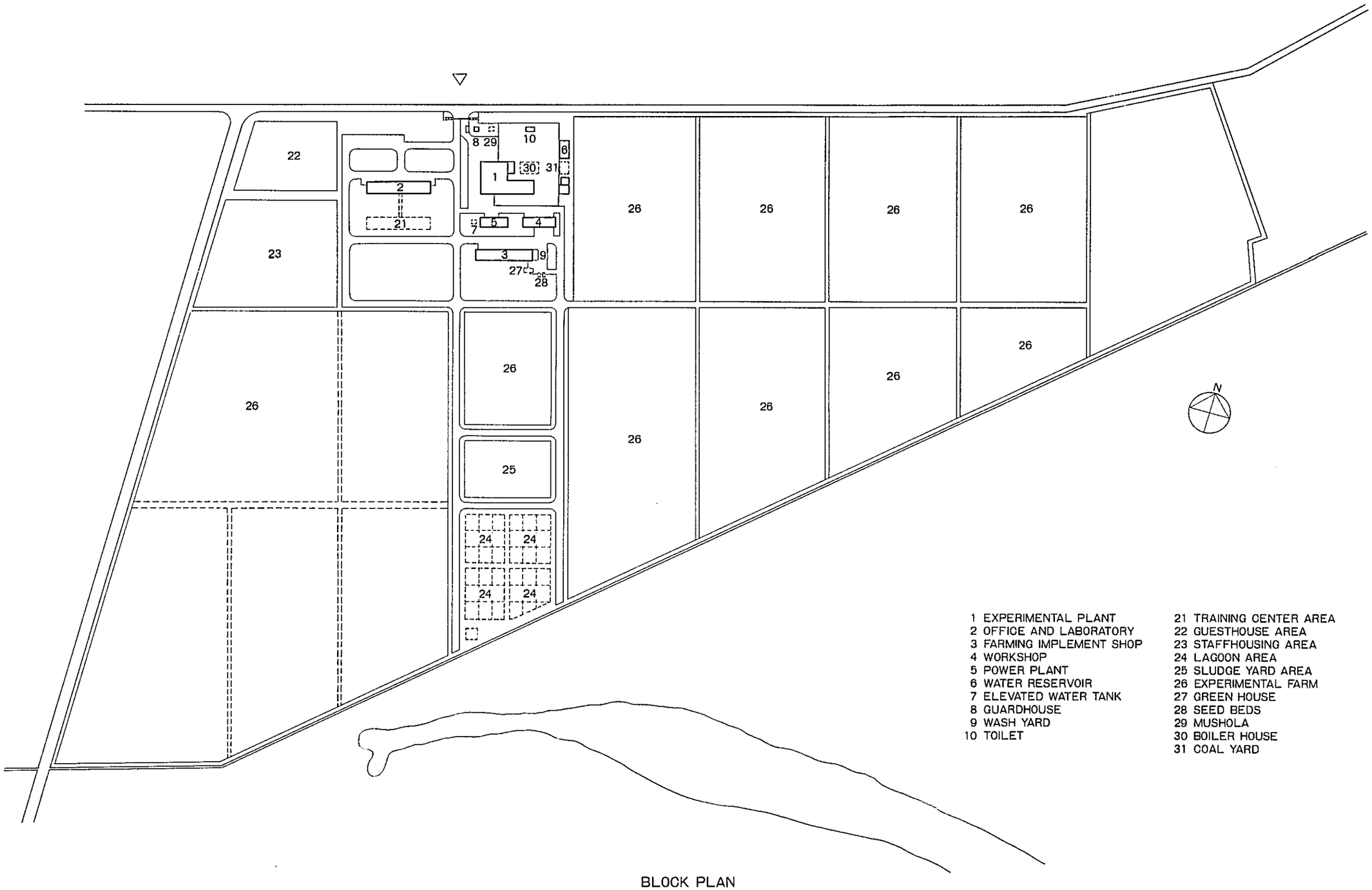


Fig. 6-2(B) SCHEDULE FOR WORKS TO BE CARRIED OUT BY THE GOVERNMENT OF INDONESIA (Tentative)



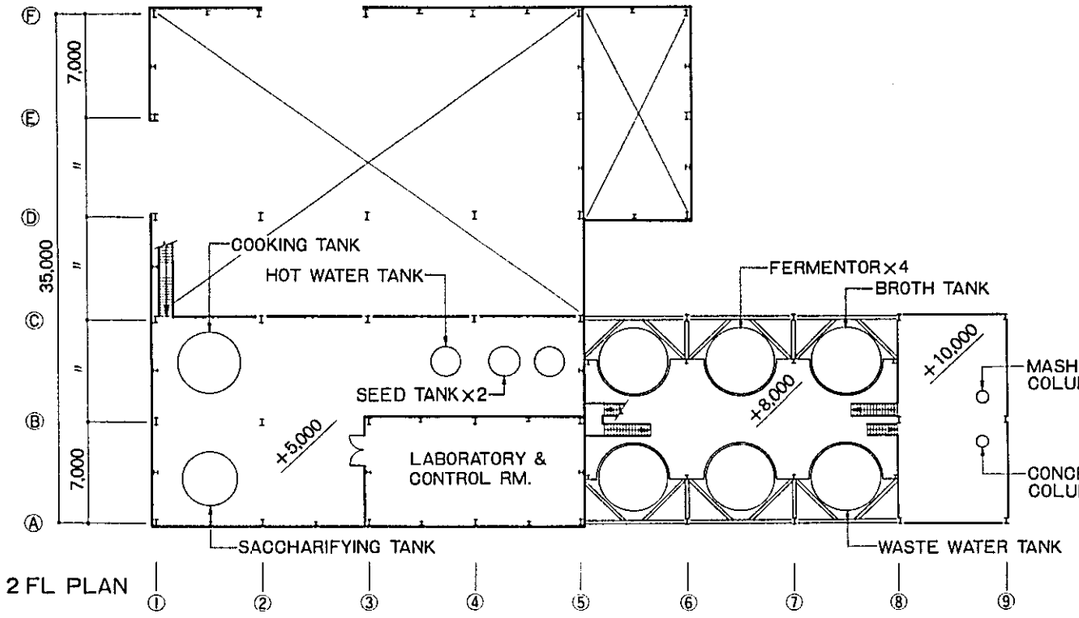
CHAPTER 7: BASIC DESIGN DRAWINGS

BLOCK PLAN
EXPERIMENTAL PLANT
OFFICE AND LABORATORY
FARMING IMPLEMENT SHOP
WORK SHOP
POWER PLANT
ELEVATED WATER TANK
GUARDHOUSE
TOILET

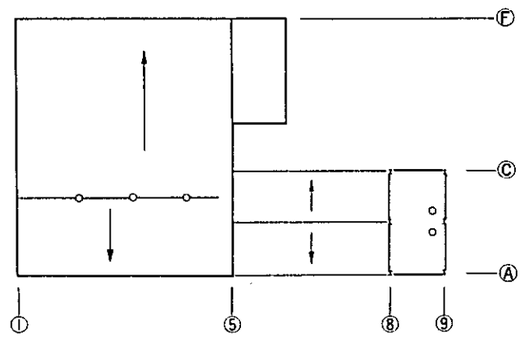


1 EXPERIMENTAL PLANT
2 OFFICE AND LABORATORY
3 FARMING IMPLEMENT SHOP
4 WORKSHOP
5 POWER PLANT
6 WATER RESERVOIR
7 ELEVATED WATER TANK
8 GUARDHOUSE
9 WASH YARD
10 TOILET
21 TRAINING CENTER AREA
22 GUESTHOUSE AREA
23 STAFFHOUSING AREA
24 LAGOON AREA
25 SLUDGE YARD AREA
26 EXPERIMENTAL FARM
27 GREEN HOUSE
28 SEED BEDS
29 MUSHOLA
30 BOILER HOUSE
31 COAL YARD

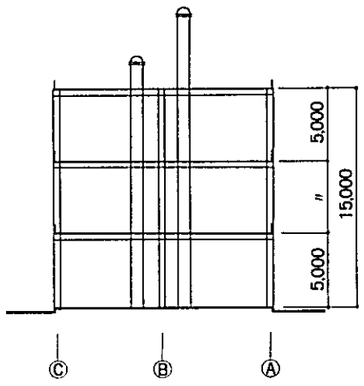
BLOCK PLAN



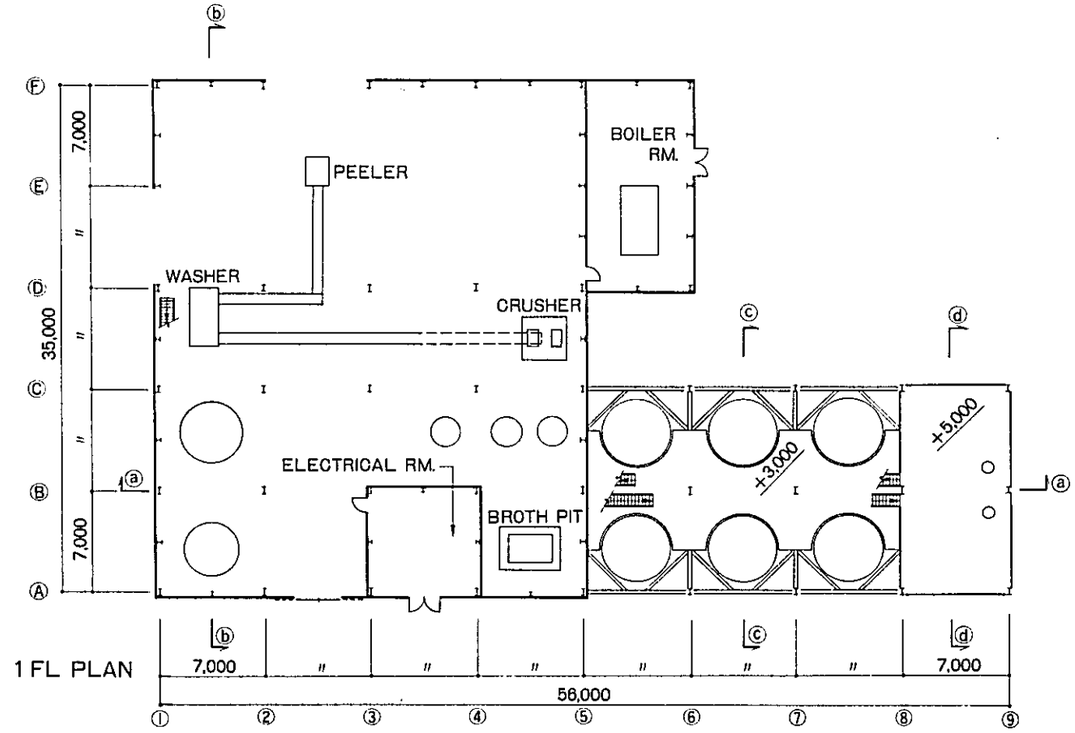
2 FL PLAN



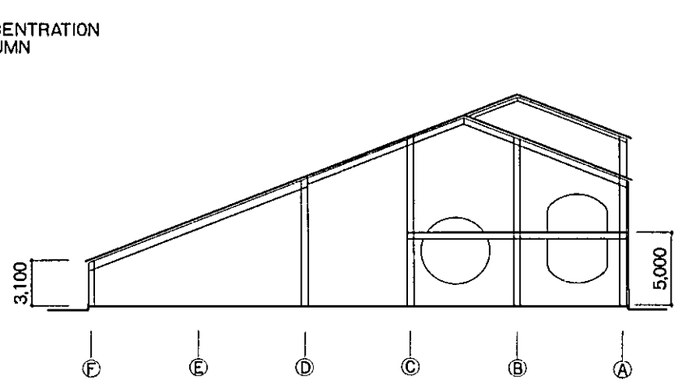
ROOF PLAN



SECTION ⓓ—ⓓ



1 FL PLAN



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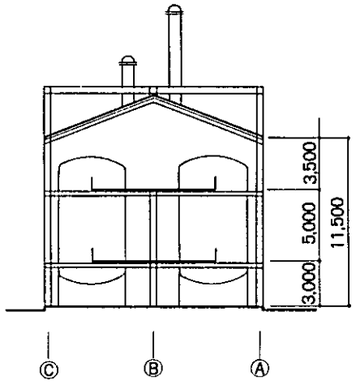

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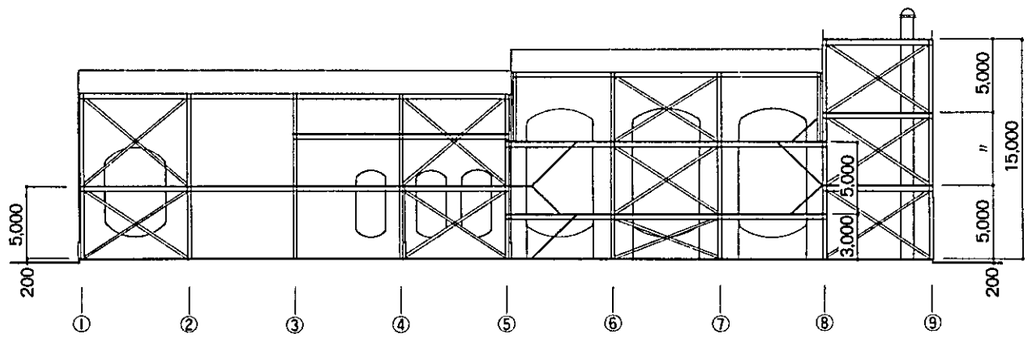
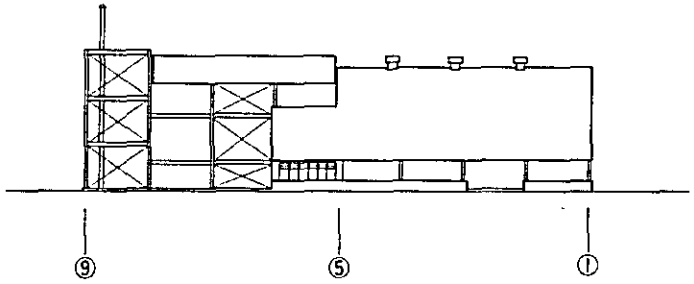
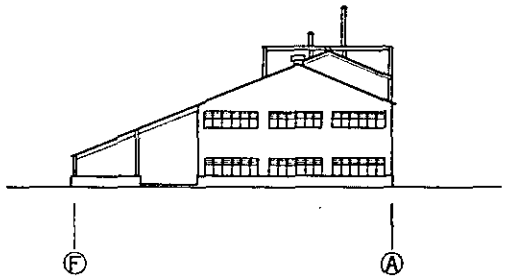


SECTION ⓐ—ⓐ

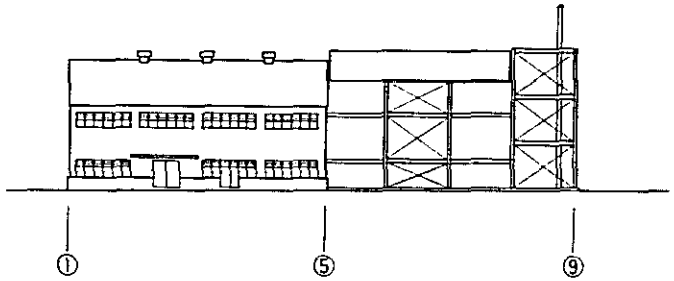
EXPERIMENTAL PLANT



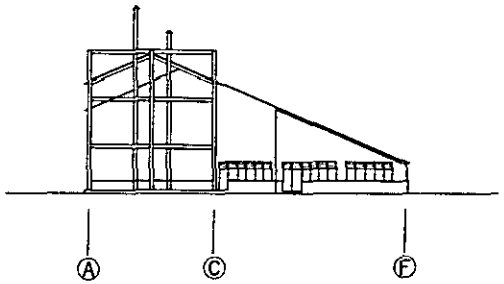
NORTH ELEV.



WEST ELEV.

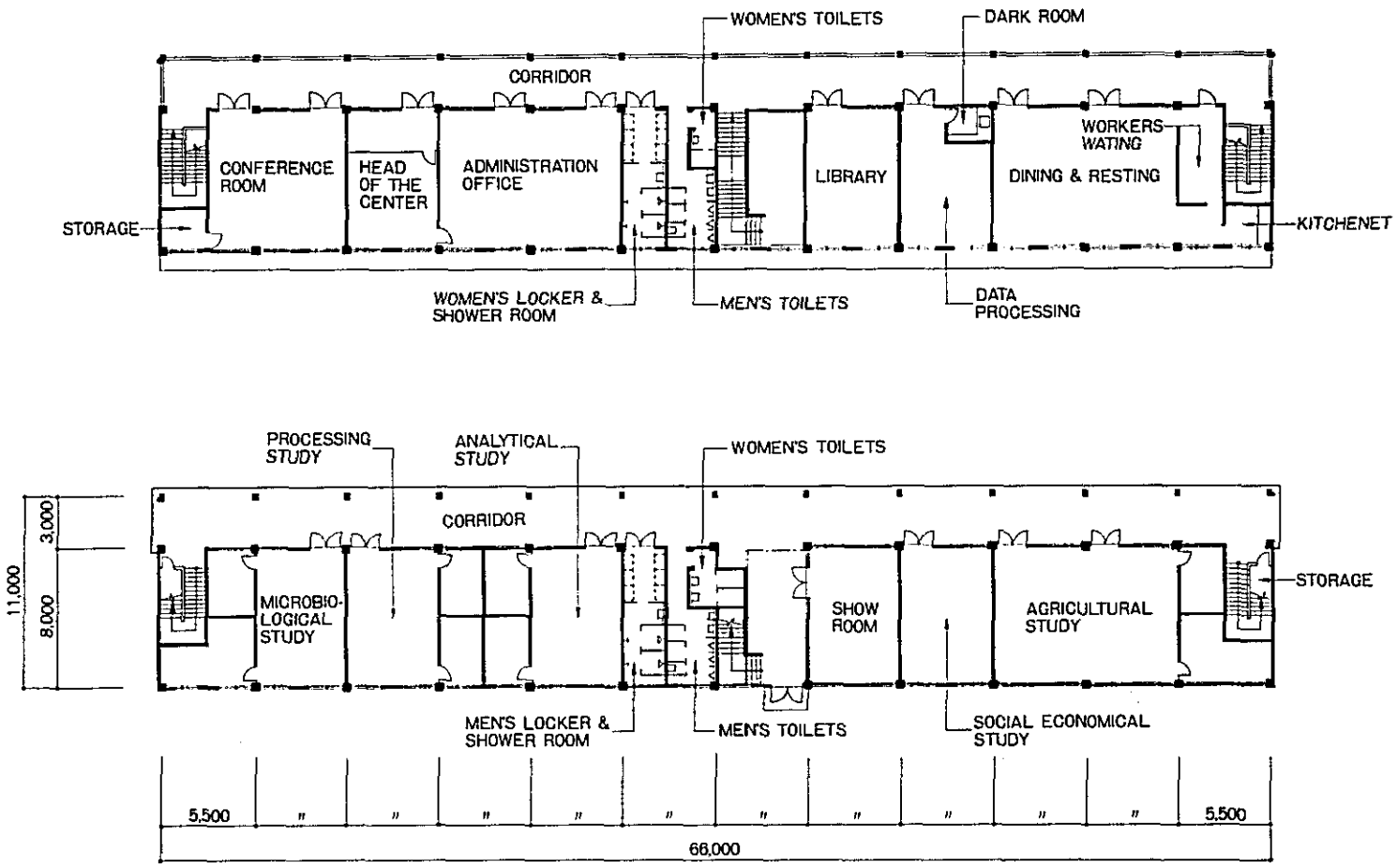


SOUTH ELEVATION

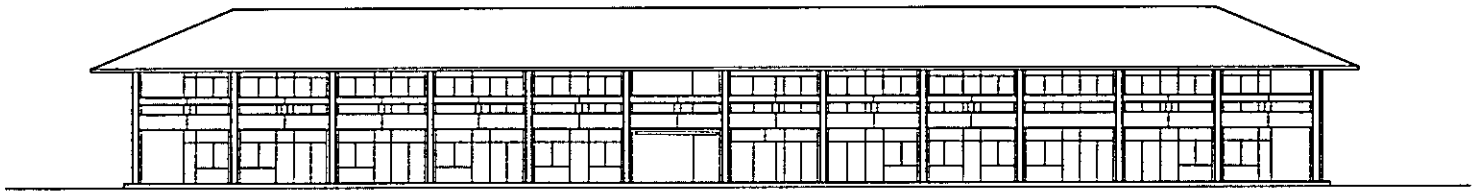


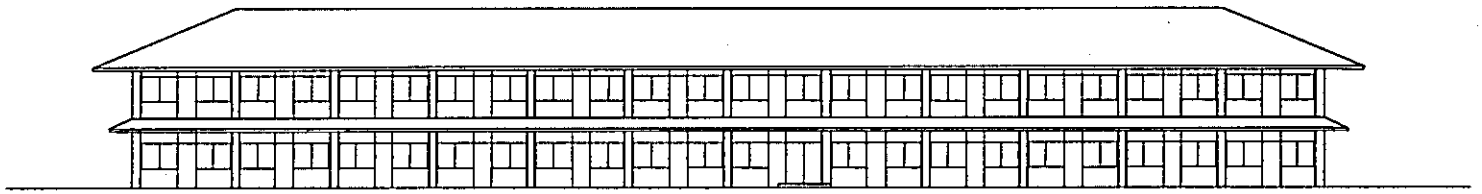
EAST ELEV.

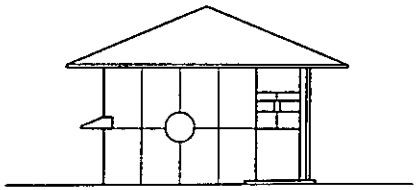
EXPERIMENTAL PLANT

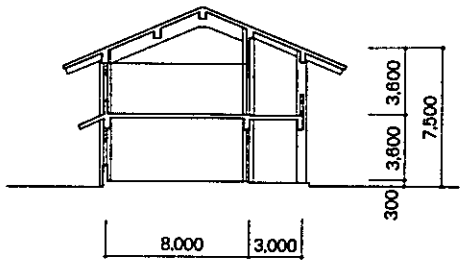


OFFICE AND LABORATORY

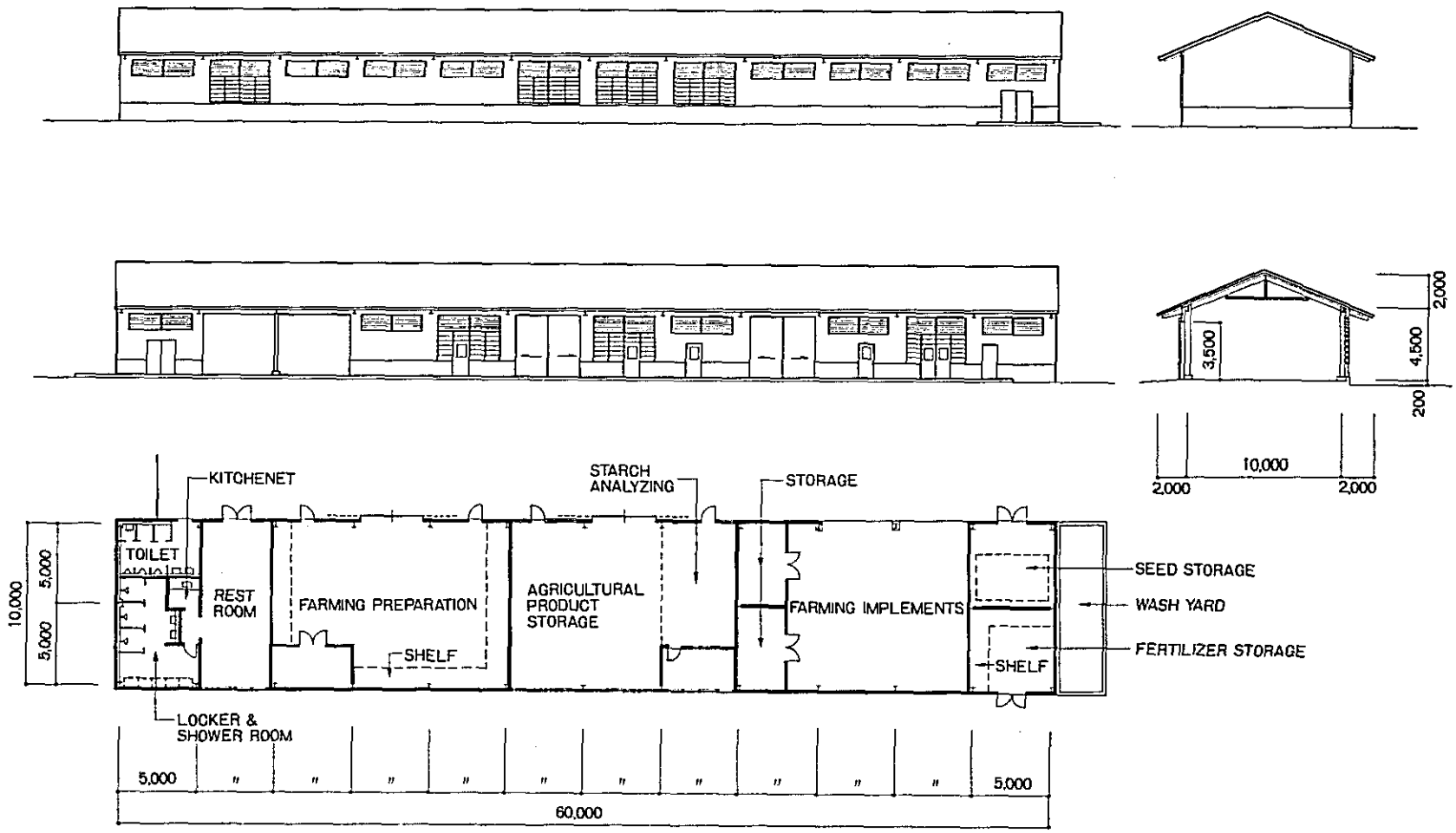




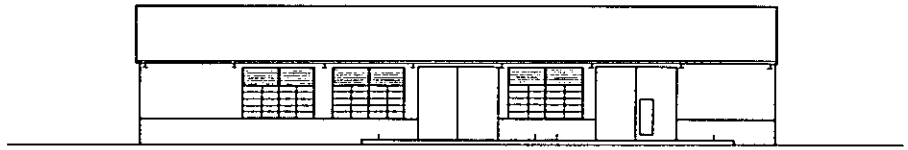


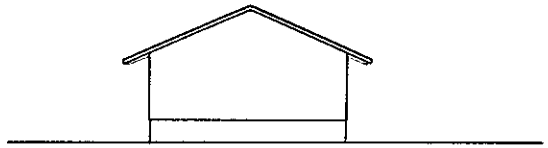


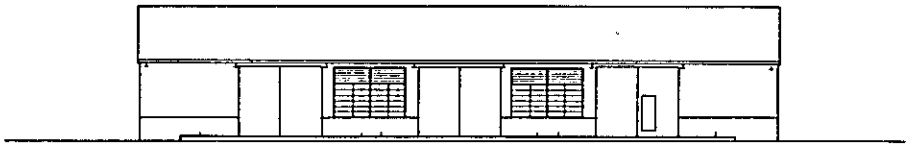
OFFICE AND LABORATORY

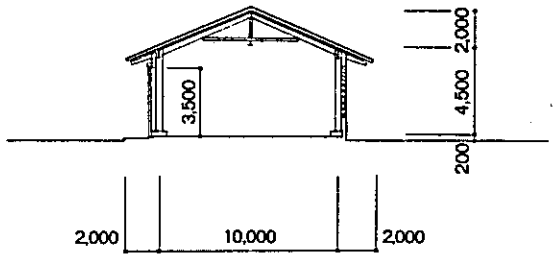


FARMING IMPLEMENT SHOP





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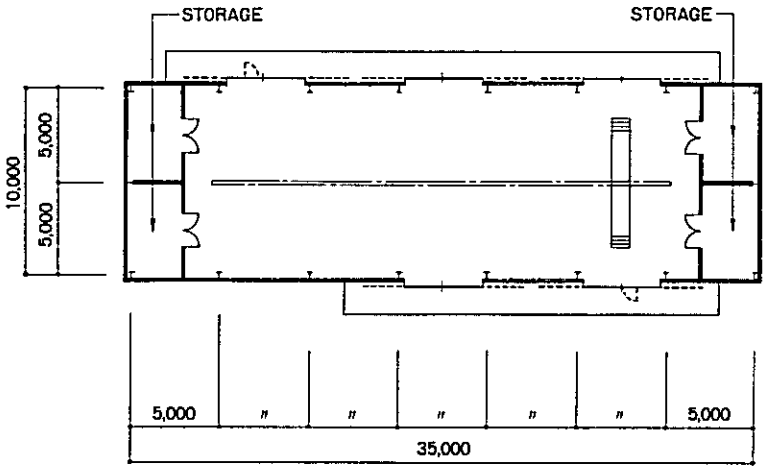
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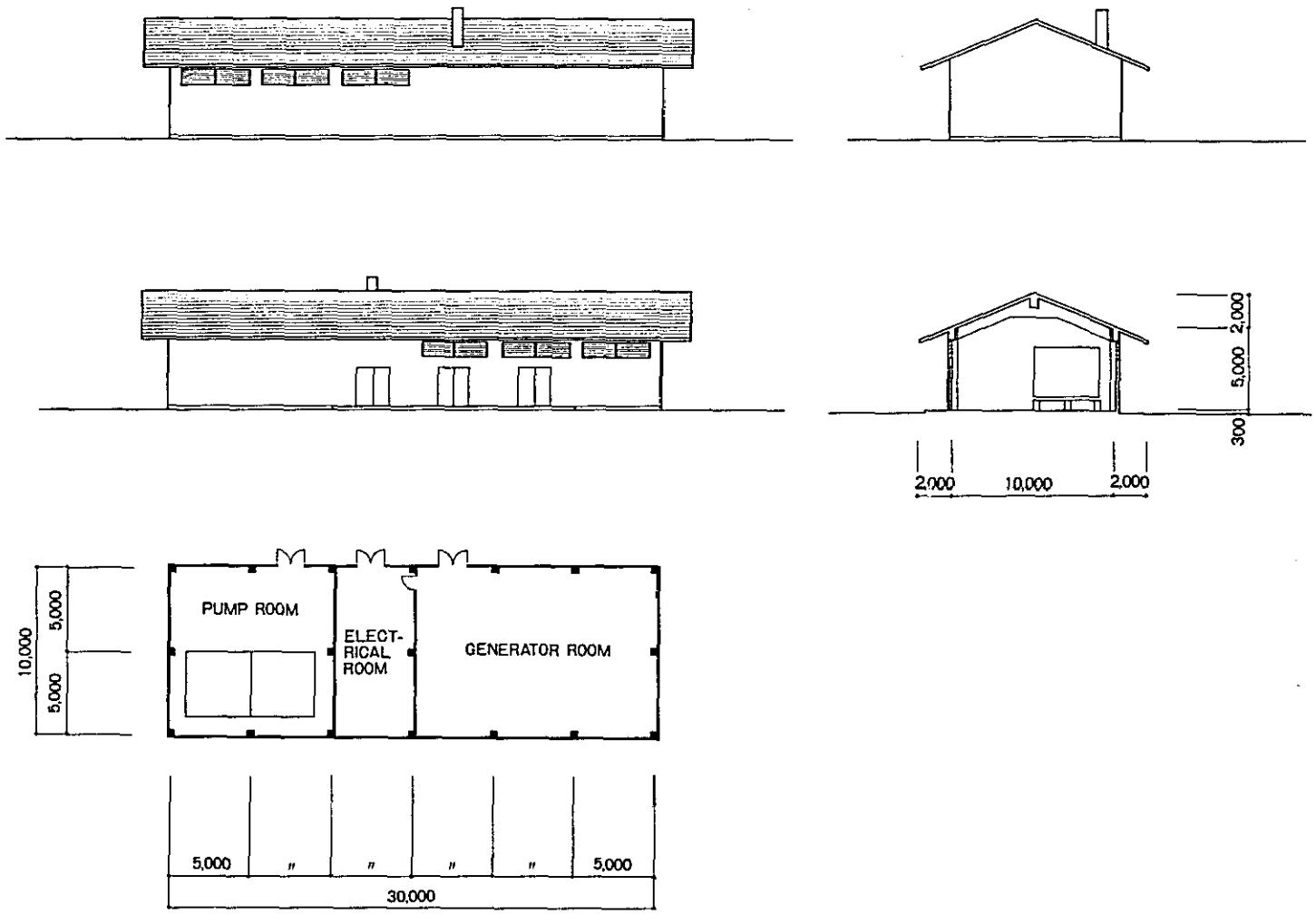
WORKSHOP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GENERATOR ROOM
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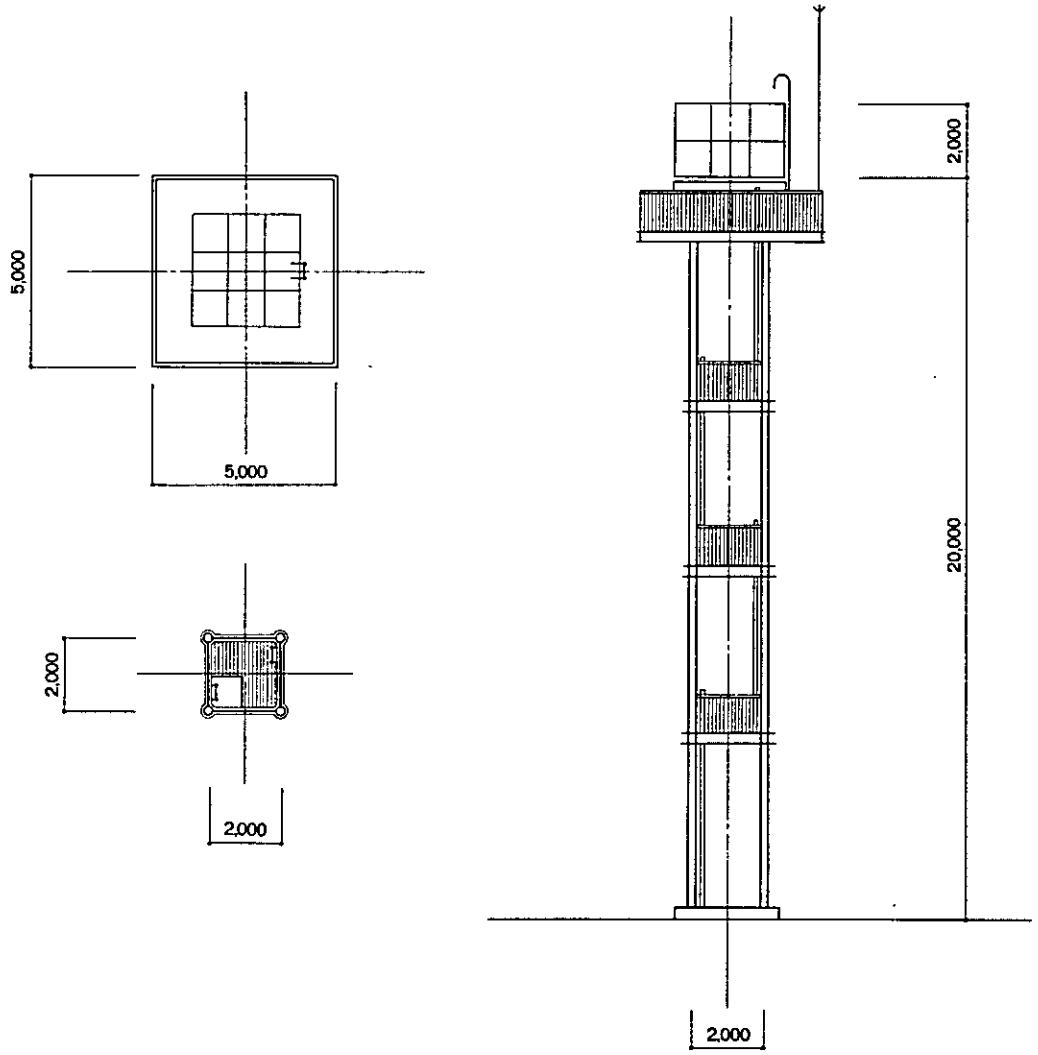
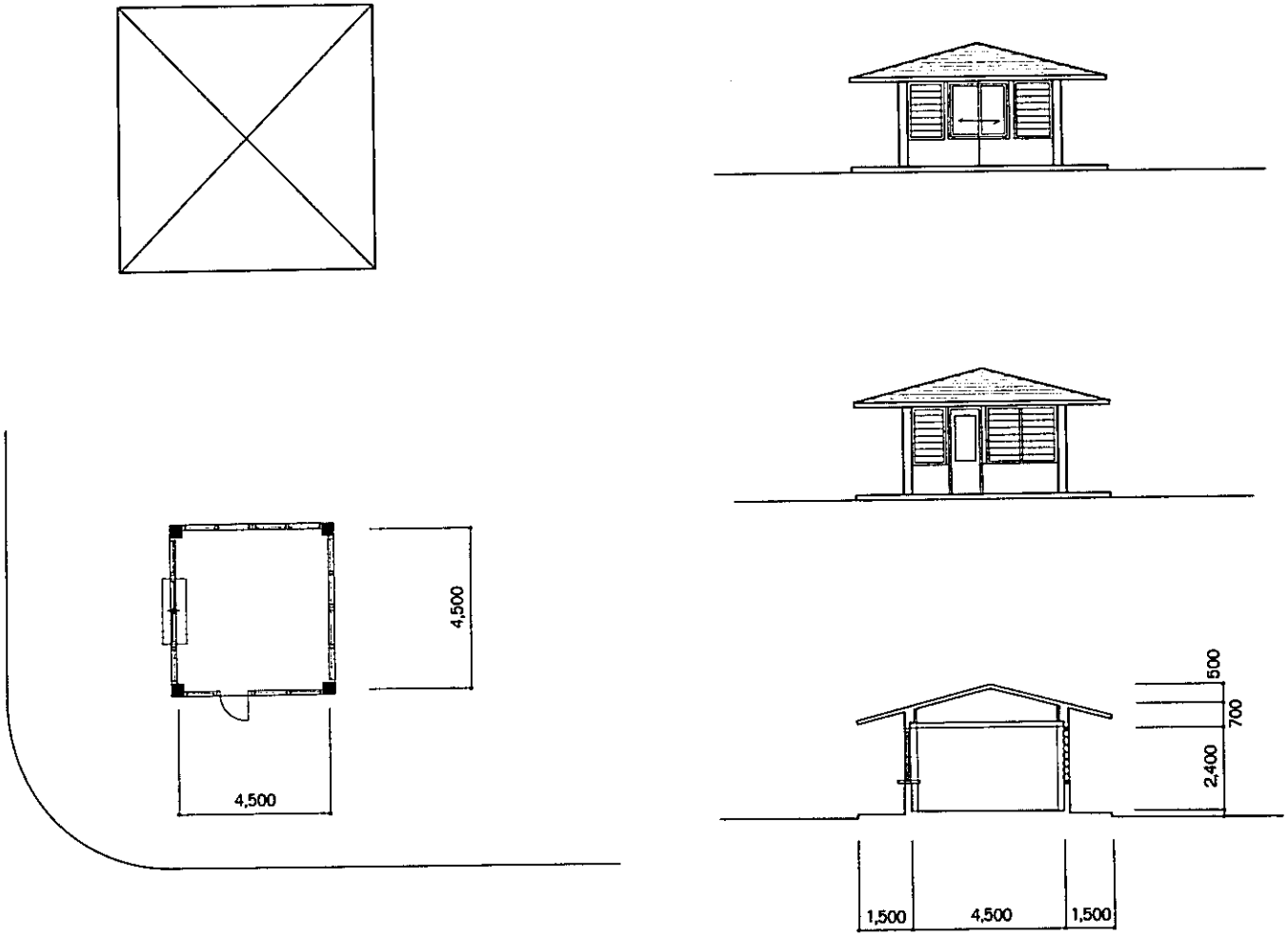
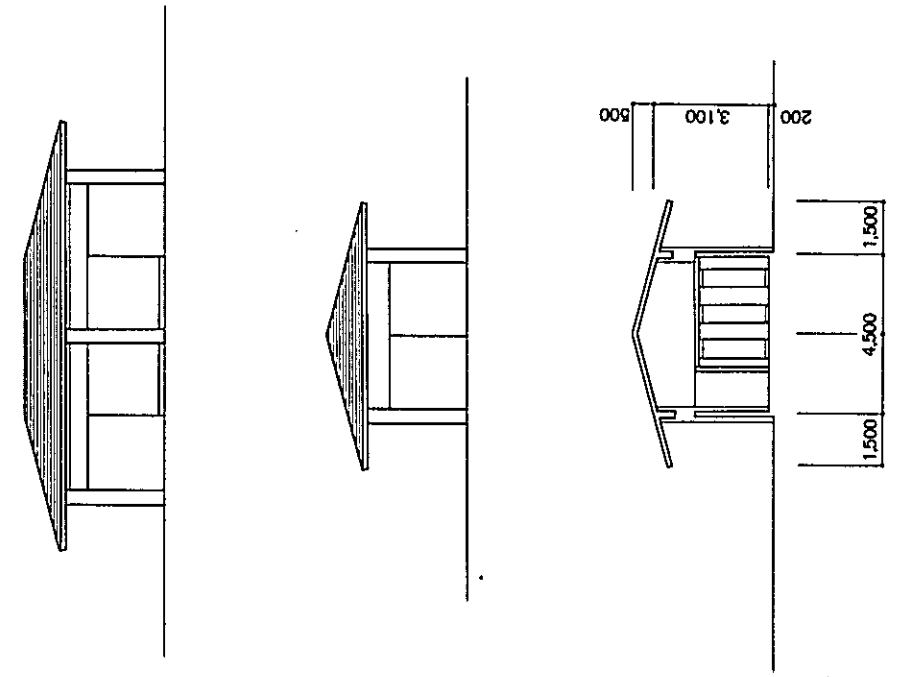
POWER PLANT



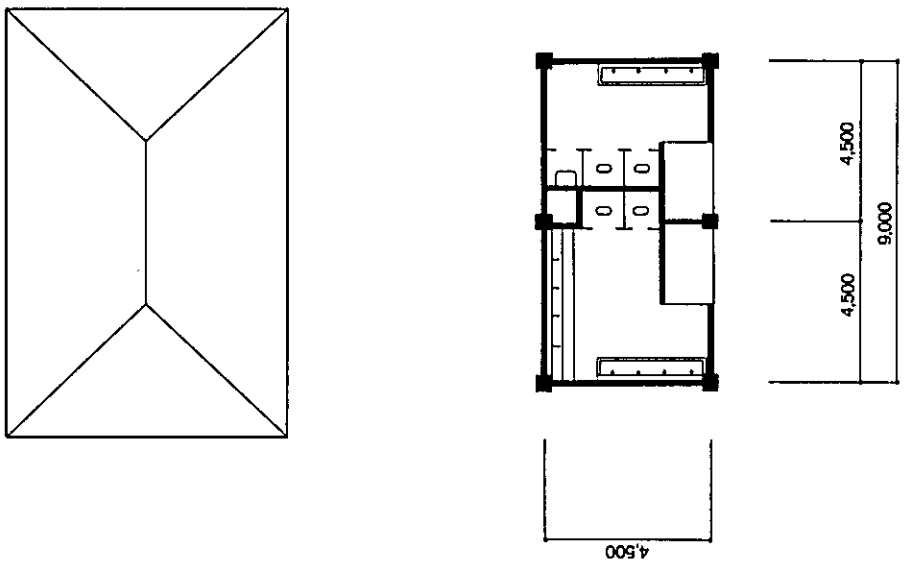
ELEVATED WATER TANK



GUARDHOUSE



TOILET



CHAPTER 8: APPRAISAL OF THE PROJECT

The direct effect of the Project implementation and the subsequent indirect effect may be evaluated as follows.

(1) In the perspective view, the Project constitutes an integral part of the National Alcohol Supply Plan which is implemented as a link in a chain of the transmigration policy, one of the most important policies of the Indonesian Government. In line with the plan, the Project will provide a "technical resource basis" serving for the future alcohol plants and energy firms in the emigration area.

When completed, the Center will, for this reason, redound not only to the improvement in the farmer's standards of living and consequently the national economy in general, but to the research and development of the fuel alcohol production and supply techniques.

(2) In the farming aspects, an eminent contribution is expectable. For the time being, the Center will use cassava and sweet potatoes as raw materials. This will increase a constant demand for cassava now cultivated around the Center and will, as a consequence, impel the farmers to improve crop cycling and select more suitable specie in order to meet the demand. As for sweet potatoes, the demand is now limited, but as the raw material farming tests make progress at the Center, their cultivation in South Sumatera will be greatly improved.

(3) In the alcohol production techniques, vital contribution will be self-evident either in plant operation or processing. The Center operates the experimental plant as large as commercial plants to enable the fermentation to be made using various biomass resources. The research subjects will include (a) pretreatment process; (b) ferment for improving energy balance; and (c) process engineering in distillation process. These subjects can be dealt with by running the experimental plant of the size described above. Thus, the

Center will evolve the substantial benefit to the research on experimental alcohol processes and on processes of various raw materials.

(4) In the socioeconomic field, the Center will make distinguished contribution. When operated, the experimental plant will produce alcohol of 8 kl/day from cassava of about 50 t. It will inevitably involve socioeconomic problems widely ranging from the alcohol production to the consumption, such as in raw material assembly and pricing, distribution of alcohol products and sharing of relevant costs. The produced alcohol will be used as a substitute for automobile gasoline and, in addition, for diesel oil, kerosene, etc. Therefore, wide-channeled problems are left to be resolved by the Center, including the investigation into the feasibilities, priority of alcohol usage and methodology of studying the current status and future trend of alcohol demand. All these will greatly contribute to the success of the National Alcohol Supply Plan.

(5) On the basis of systems technically completed and known in public, the Center contemplates developing highly flexible, practical systems in the future research and studies. Therefore, vital contribution to the transfer of technology is expectable through the design and construction of the Project.

A P P E N D I C E S

I Government Organization of the Republic of Indonesia

II Indonesian Officials Concerned

III Preliminary Survey Mission

III-1 Members

III-2 Dates and Events

IV Basic Design Study Mission

IV-1 Members

IV-2 Dates and Events

IV-3 Exchange of Minutes

V Basic Design Confirmation Study Mission

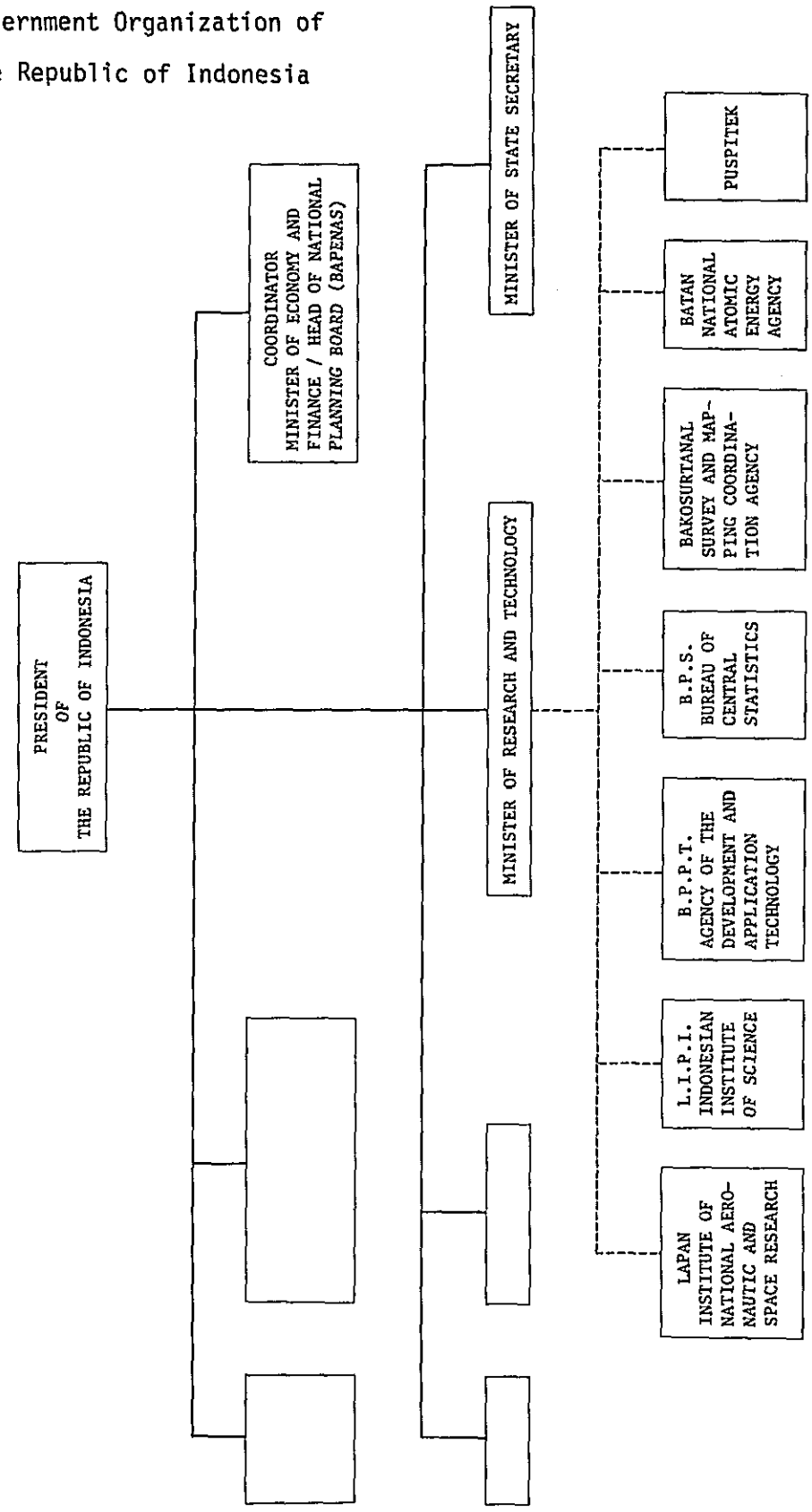
V-1 Members

V-2 Dates and Events

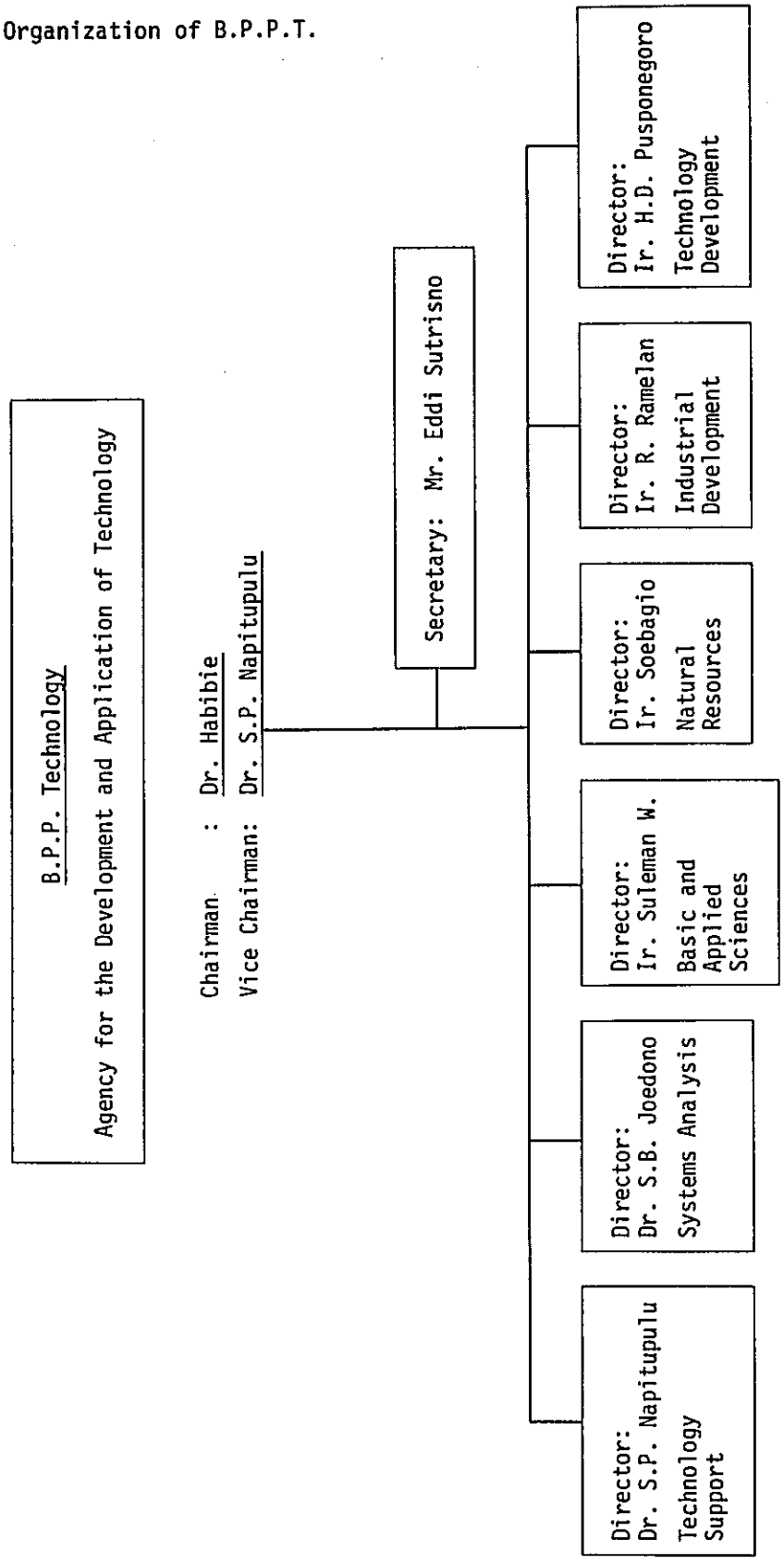
V-3 Exchange of Minutes

VI Local Climate Conditions

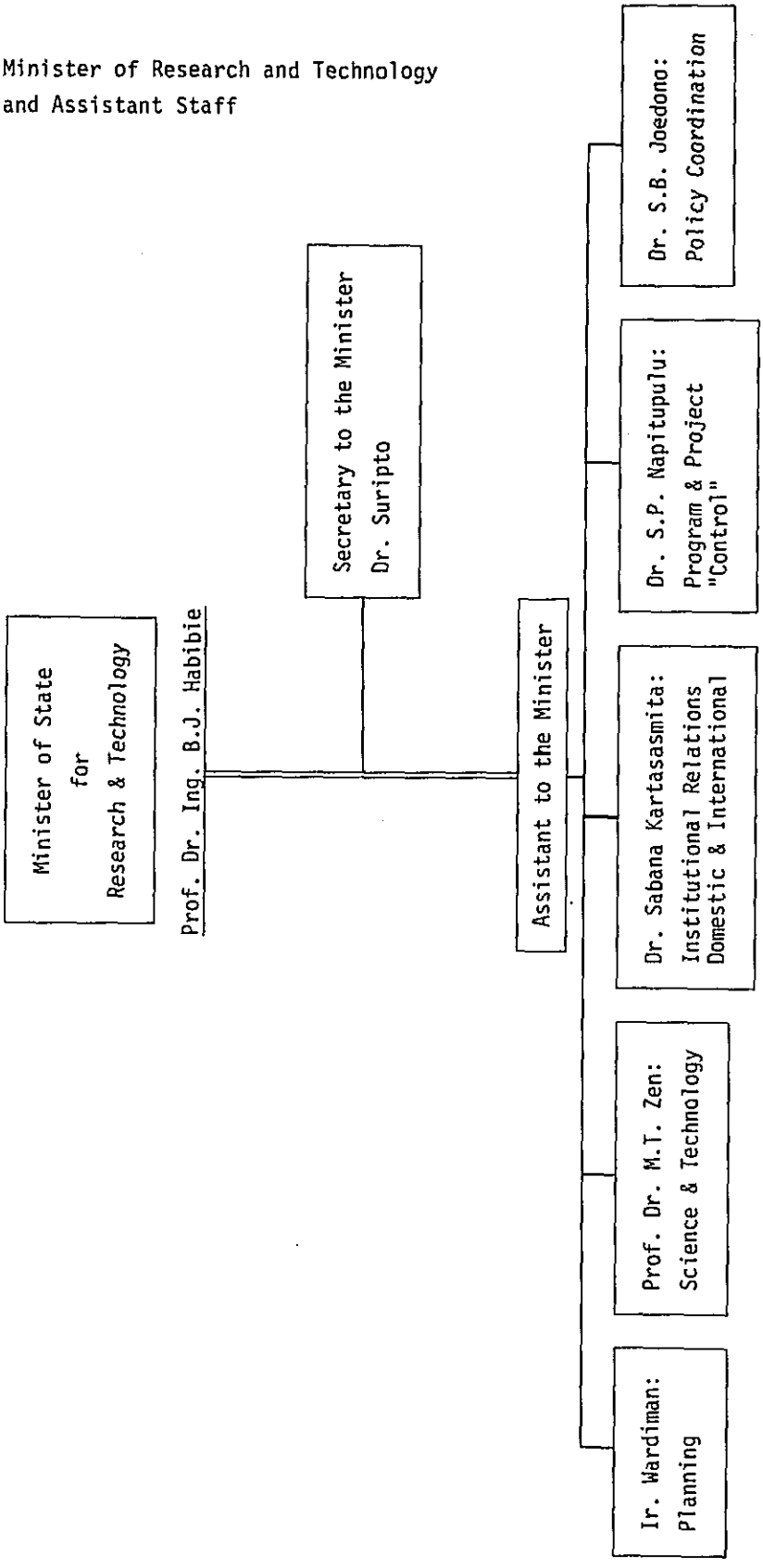
I Government Organization of the Republic of Indonesia



Organization of B.P.P.T.



Minister of Research and Technology
and Assistant Staff



II. Indonesian Officials Concerned

Ir. Wardiman DJOJONEGORO	Assistant (Planning) to the Minister of State for Research and Technology
● Ir. Koeswandi WASITO	Deputy Assistant (Planning) to the Minister of State for Research and Technology
Ir. Didie HERKAMTO	B.P.P.T. (Planning Department, Architect)
Ir. Joko PRIHASTATO	B.P.P.T. (Planning Department)
Ir. TRIHONO	B.P.P.T. (Planning Department, Mechanical Engineer)
○ Ir. Endang SUARNA	B.P.P.T. (Planning Department, Agronomist)
Ir. M. RASYID	B.P.P.T. Assistant Staff (Agronomist)
Dra. Ina MIRYANTI	B.P.P.T. (Planning Department Social Psychologist)
Dra. Sri SUSANTI	B.P.P.T.
Ir. Cecilya MALIK	B.P.P.T.
Ir. S.H. NASUTION	B.P.P.T. (Technology Development)
Dr. Suryo HARTO	B.P.P.T. (Technology Development)
● Ir. Marsal ALIMIN	B.P.P.T. (Technology Development)

	Ir. Sofyan RASYAD	B.P.P.T. (Technology Development)
	Ir. Tri Setya BUDHI	B.P.P.T.
	Ir. Osriman OESMAN	B.P.P.T. (Industrial Development)
	Ir. B. TRIADI	B.P.P.T. (Industrial Development)
	Bastaman B.E.	B.P.P.T. (Industrial Development)
○	Ir. Enang SUPENA	B.P.P.T. (Planning Department)
○	Ir. B. Triadi KASWANTO	B.P.P.T. (Mechanical Engineer)
○●	Ir. Asfian M.K.	Department of Transmigration and Worker, Transmigration Planning Staff
●	Ir. M. ISHAKS	Agronomist
	J. WARGIONO	Bogor Food Crops Research Institute, Agronomist
●	Ir. SARASWATI P.D.E.	Chemist Fakultas Teknik Kimia I.T.S.
	Ir. Dwipurwo Pangarso	Director/Factory Manager P.T. Asen Pabuaran

○: Participated in first site survey

●: Participated in second site survey

Both above in the course of Basic Design Survey.

: Participated in Basic Design Confirmation Study

III Preliminary Survey Mission

III-1 Members

Leader:	Norio Hattori	Chief Secretarial Officer, Ministry of Foreign Affairs
Member:	Yoshio Hara	Senior Researcher, Institute of Energy Economics
	Mutumi Niimi	Senior Researcher, Institute of Energy Economics
	Toshio Nakamura	JICA
	Keiichi Taniguchi	Nikken Sekkei Ltd
	Kosaku Mayekawa	Nikken Sekkei Ltd

III-2 Dates and Events

Dates		Events
Dec. 15	Mon.	Flight from Tokyo to Jakarta (Hara and Niimi)
16	Tue.	Preparatory discussion with BPPT
17	Wed.	Flight from Tokyo to Jakarta (Nakamura, Taniguchi and Mayekawa, and Leader Hattori joined these three at Manila) Visit to Bogor Food Crops Research Institute
18	Thu.	Visit to PUSPIPTEK Courtesy calls and briefing at Japanese Embassy and JICA office
19	Fri.	Discussion with BPPT

Dates		Events
Dec. 20	Sat.	Flight from Jakarta to Tokyo (Leader Hattori) Travel from Jakarta to Lambung Courtesy call at Dept. of Transmigrations and Workers, Lambung Province Observatory survey in Tulang Bawang
21	Sun.	Visit to Pago, Daya, Itoh and Mitsugoro Farms Visit to Starch plant at Bumi and Waras
22	Mon.	Survey at Panjang Port Travel Lampung to Jakarta
23	Tue.	Discussion with BPPT Courtesy call to His Excellency Minister Habibie Reporting at Japanese Embassy and JICA office
24	(Wed.)	Flight from Jakarta to Tokyo

IV Basic Design Study Mission

IV-1 Members

Leader	Takaharu KAZAMA	Executive Director, Japan International Cooperative Agency (JICA)
Co-Leader	Minoru ISHIDA	The Second South East Asian Division Asian Affairs Bureau Ministry of Foreign Affairs
Fermentation	Tetsuo NISHIDE	Chief of Planning Section Biomass Policy Office General Affairs Division Basic Industries Bureau Ministry of International Trade and Industry
Upland Crops	Masashi KOBAYASHI	Director, No.4 Genetics Research Office Division of Genetics Department of Physhiology and Genetics National Institute of Agricultural Science Ministry of Agriculture, Forestry and Fisheries
Coordinator	Yoichi SEKI	Social Development Cooperation Dept. Japan International Cooperation Agency

Training	Minori SANO	Technical Cooperation Division Mining and Industrial Development Cooperation Dept. Japan International Cooperation Agency
Civil Engineering	Minoru FUKUI	Nikken Sekkei Ltd
Plant	Shigeo KUWATA	Nikken Sekkei Ltd
Cost Estimator	Kosaku MAEKAWA	Nikken Sekkei Ltd
Energy	Yoshio HARA	Nikken Sekkei Ltd
Facilities	Hirokazu IKEZAWA	Nikken Sekkei Ltd
Planning	Hitoshi BORI	Nikken Sekkei Ltd

IV-2 Dates and Events

Dates		Events	Kazama	Ishida	Nishide	Kobayashi	Seki	Sano	Nikken Sekkei
Mar. 10	Tue.	Flight from Tokyo to Jakarta							
11	Wed.	Courtesy Call and briefing to the Japanese Embassy and JICA office Courtesy Call to the Indonesian authorities concerned							
12	Thu.	Discussion with Indonesian Counterparts at BPPT about the Draft of Minutes and others							
13	Fri.	Flight from Jakarta to Lampung Surveying at four proposed sites							
14	Sat.	Surveying at one proposed site							
15	Sun.	Surveying at three proposed sites							
16	Mon.	Courtesy Call to Lampung Province Government, Panjang Port Authority, and Department of Transmigrations and Workers							
17	Tue.	Flight from Lampung to Jakarta Detailed discussion with BPPT about the proposed site and the minutes							
18	Wed.	Signing of the minutes							

Dates		Events	Kazama	Ishida	Nishide	Kobayashi	Seki	Sano	Nikken Sekkei
Mar. 19	Thu.	Detailed discussion with BPPT							
20	Fri.	Detailed discussion with BPPT							
21	Sat.	Reconnaissance into building construction in Jakarta							
22	Sun.	Flight to Lampung Surveying of the selected site							
23	Mon.	Surveying of the selected site and neighboring area							
24	Tue.	Reconnaissance into building construction in Tanjung Karang							
25	Wed.	Flight to Jakarta							
26	Thu.	Final discussion with BPPT about the Center							
27	Fri.	Final discussion with BPPT about the Center Briefing to the Japanese Embassy							
28	Sat.	Reporting to JICA Flight from Jakarta to Tokyo							
29	Sun.	Arrival at Narita							

IV-3 Exchange of Minutes

The Basic Design Study Mission discussed, with Indonesian party, the implementation method for the Japanese Government's cooperation to be extended under the latter's grnat.

The solution agreed on by the both parties is as summarized in the Minutes of Discussions which were exchanged between Mr. T. Kazama, Executive Director of the Mission and Ir. Wardiman, Assistant (Planning) to the Minister of State for Research and Technology, on March 18, 1981.

M I N U T E S

O F

THE CONSTRUCTION PROJECT OF THE BIOMASS ENERGY RESEARCH AND DEVELOPMENT CENTER IN LAMPUNG

THE REPUBLIC OF INDONESIA

At the request of the Government of the Republic of Indonesia for assistance in establishing the Biomass Energy Research and Development Center in Lampung (hereinafter referred to as "the Center") the Government of Japan through Japan International Cooperation Agency (JICA) has sent a twenty days survey team headed by Mr. Takaharu Kazama (Executive Director, JICA) to conduct the Basic Design survey on the program from March 10 , 1981. The team held a series of discussion and exchanged views with the Badan Pengkajian dan Penerapan Teknologi (B.P.P.Teknologi) team headed by Mr. Wardiman Djojonegoro on the establishment and construction of the Center.

Draft final report will be expected to be submitted to the Indonesian Authorities in June 1981.

As a result of the survey and discussions , both parties have agreed to recommend to their respective Governments to take the necessary measures toward establishing the Center as stated in the Minutes attached herewith.

March 18 , 1981.

Jakarta , Indonesia.

Mr. Takaharu Kazama.
Head of the Japanese
Basic Design Survey Team.

Mr.Wardiman Djojonegoro.
Senior Scientist
B.P.P.Teknologi.

- MINUTES -

1. The proposed site for the Biomass Research and Development Center will be located at Selusuban , Terbanggi Besar , Lam - pung-tengah , Lampung as the first recommendation.

2. The functions of the Center are concentrated on the following:

   (a) Research in raw materials for alcohol production.

   Experimental Farm for :

   - Selection of appropriate varieties (mainly sweet - potato).
   - Improvement of cultivation (mainly sweet potato).

   (b) Research in technology for alcohol production.

   - Improvement of energy consumption at each phase of preparation , fermentation and distillation.
   - Selection and cultivation of more suitable enzyme and yeast fungi.

   (c) Research in social and economic systems for alcohol pro duction.

3. The Government of Japan will take necessary measures to pro - vide such experimental plant, buildings and equipment for the Center as listed in Annex I.

4. The Government of Indonesia will take necessary measures as follows :

   (a) To provide data and information necessary for the cons- truction , including topographic survey , soil test, wa ter test and other geological survey reports.

   (b) To obtain 30 ha land for the Center.

(c) To clear and level the site before the start of the construction.

(d) To construct and pave access road to the site before the start of the construction.

(e) To arrange the necessary measures for customs clearance in consideration of the nature of this project.

(f) To provide other items listed in Annex II.

5. The Japanese Government will study for the items requested by the Government of Indonesia as listed in Annex III.

ANNEX I

Outline description

1. Laboratories and other facilities.

2. Administration building.

3. Experimental alcohol plant.

4. Equipment for research.

ANNEX II

Items whose cost should be borne by the Government of the Republic of Indonesia.

Infrastructure.

1. Power and water supply for the plant and buildings, including services for construction use.
2. Communication measures to the Center.
3. Preparation of experimental farm land.
4. Drainage and industrial waste treatment (according to Indonesian regulations).
5. Landscaping, gateway, fence, exterior lighting and pavement.
6. Furnitures, etc.
7. Building license fees.

ANNEX III

Items to be studied

1. Capacity of experimental alcohol plant will be around 8.000 liters per day.
2. The Research on the hydrolysis of cellulosic substance will be considered.
3. The training of Indonesian experts in Japan will be considered.

V Basic Design Confirmation Study Mission

V-1 Members

Coordination	Takeshi IMAZU	Basic Design Division Grant Aid Department Japan International Cooperation Agency
Civil Engineering	Minoru FUKUI	Nikken Sekkei Ltd
Architectural Planning	Hitoshi BORI	Nikken Sekkei Ltd
Plant Engineering	Shigeo KUWATA	Nikken Sekkei Ltd (Engineering Advisor)

V-2 Dates and Events

Dates		Events	Imazu	Fukui	Bori	Kuwata
June 23	Tue.	Flight from Pakistan to Jakarta (Imazu)				
		Flight from Tokyo to Jakarta (Fukui, Bori and Kuwata)				
		Preparatory meeting at Japanese Embassy and JICA Office				
24	Wed.	Draft report submitted.				
		Discussion with B.P.P.T.				
25	Thu.	Discussion with B.P.P.T.				
26	Fri.	Discussion with B.P.P.T.				
		Preparation of a draft of Minutes				
28	Sat.	Preparation of Construction Specifications for Indonesian Work Portion				
		Observatory survey in Jakarta City				
29	Mon.	Discussion with B.P.P.T.				
		Exchange of Minutes				
30	Tue.	Flight from Jakarta to Tokyo				

V-3 Exchange of Minutes

The matters, including commitments that oil shall be used for fuel and that the water supply works shall be undertaken by the Indonesian side, as agreed upon with the Indonesian side in the Basic Design Confirmation Survey were reduced to the Minutes as signed on June 29, 1981.

MINUTES OF DISCUSSIONS
O N
THE DRAFT REPORT OF THE BASIC DESIGN
FOR THE ESTABLISHMENT PROJECT OF
BIOMASS ENERGY RESEARCH AND DEVELOPMENT CENTRE

1. The Government of Japan has sent, through Japan International Cooperation Agency (JICA), a Basic Design Confirmation Study Team from 23 to 29, June 1981 to submit the Basic Design Report (draft) on the above mentioned project.

2. The Team held meetings with the staffs concerned of B.P.P. Teknologi to explain and to discuss on the draft report. As a result of these discussions, the Indonesian side principally approved the draft report. Both sides confirmed the items, which are described in the attached sheet.

3. The Team confirmed that the Indonesian side understood the system of Japan's Grant Aid Programme to be extended by the Government of Japan, especially the arrangements to be taken by the Indonesian side (as agreed in the Minutes for this project dated on March 18, 1981).

Jakarta, June 29, 1981.

IR. WARDIMAN DJOJONEGORO
Assistant Planning to the
Minister of State for
Research and Technology/
Senior Scientist,
B.P.P. Teknologi.

for M. Fukui

MR. TAKESHI IMAZU
Leader,
Japanese Study Team.

A T T A C H M E N T.

a. As for the boiler, the Indonesian side accepted the package boiler with oil fuel proposed by the Team and wished to keep the area for coal boiler to be installed by the Indonesian side in future.

b. The necessary water for this project will be provided by the Indonesian side with an optimized system ensuring the water supply or required quantity and quality in the Report.

DEPARTMENT OF COMMUNICATIONS

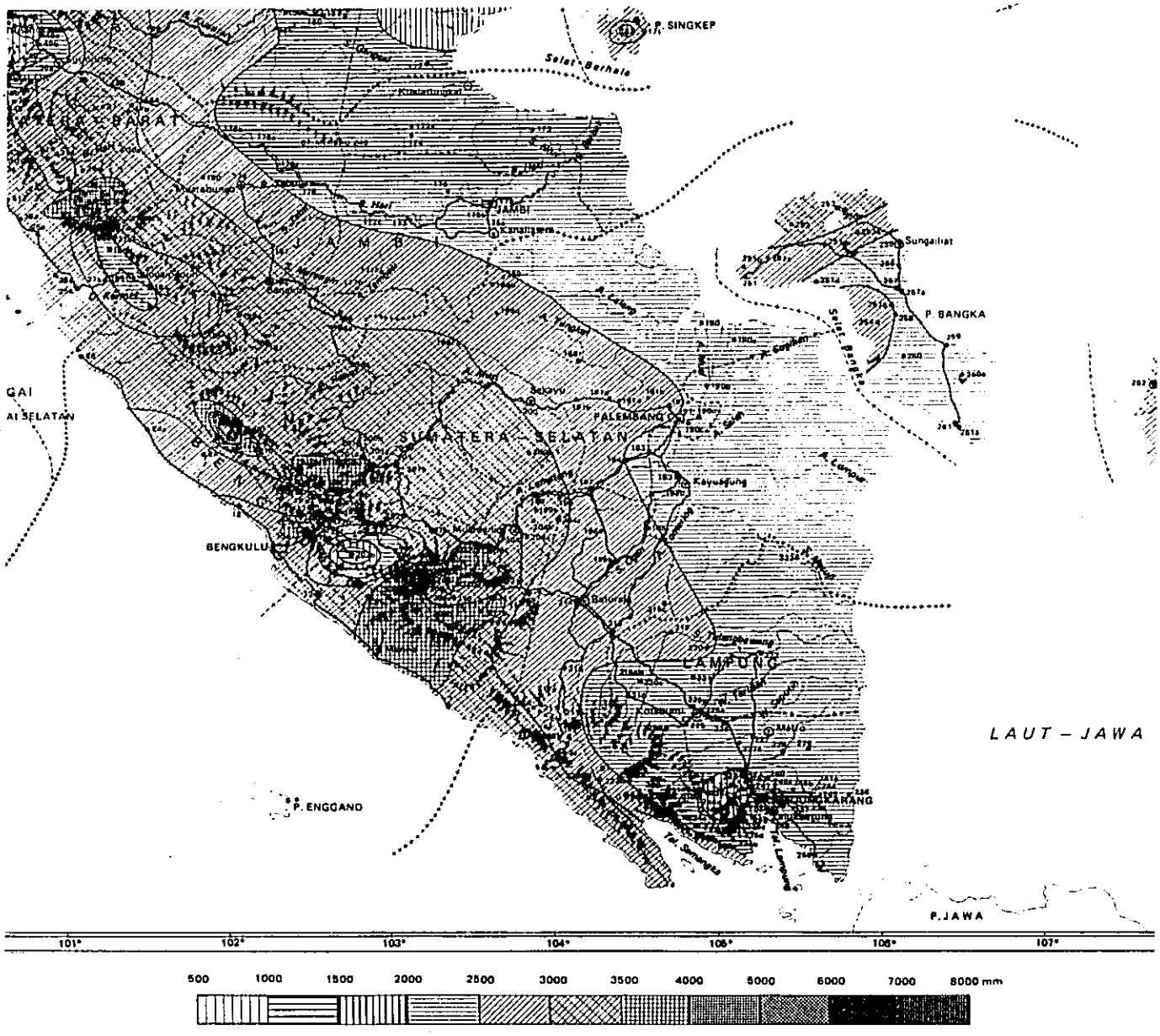
METEOROLOGICAL AND GEOPHYSICAL INSTITUTE

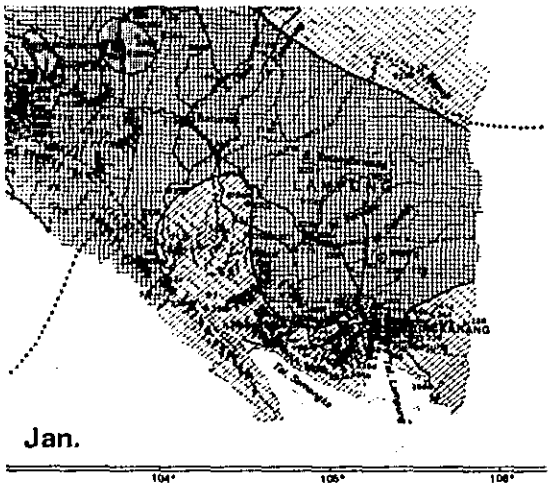
REPUBLIC OF INDONESIA

JAKARTA

1973

METEOROLOGICAL NOTE No. 9 (1911 — 1940)

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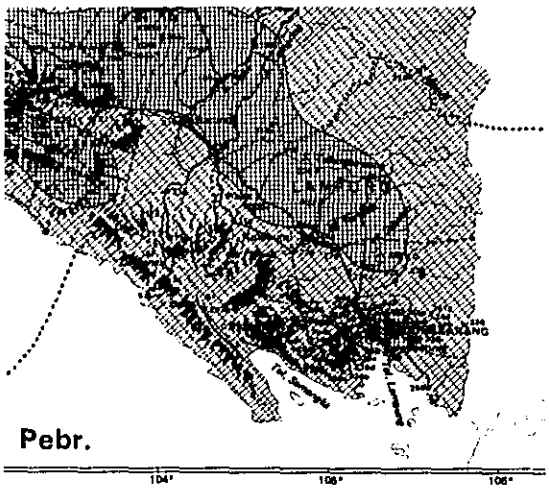
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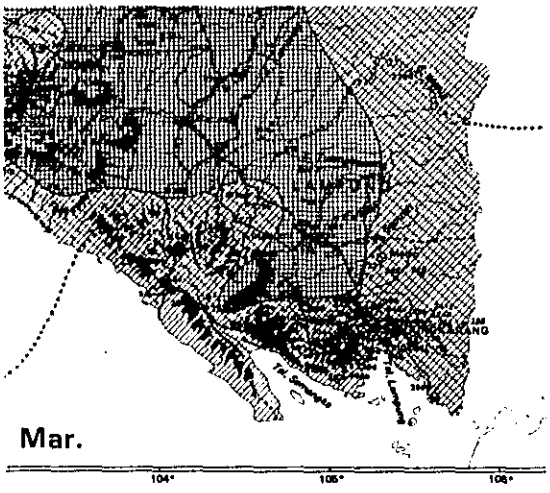
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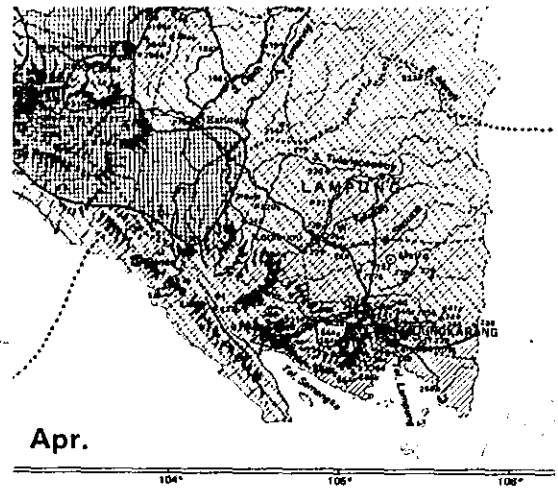
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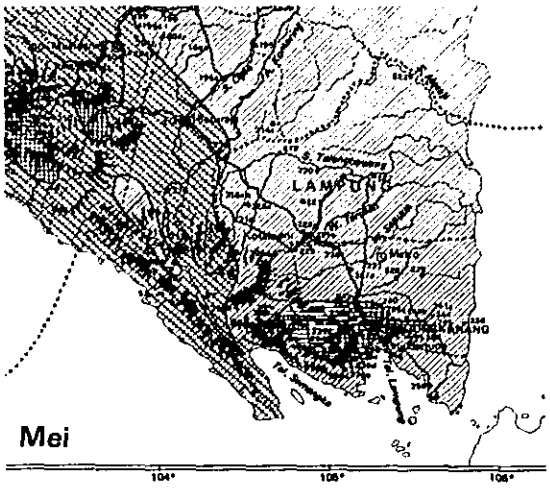
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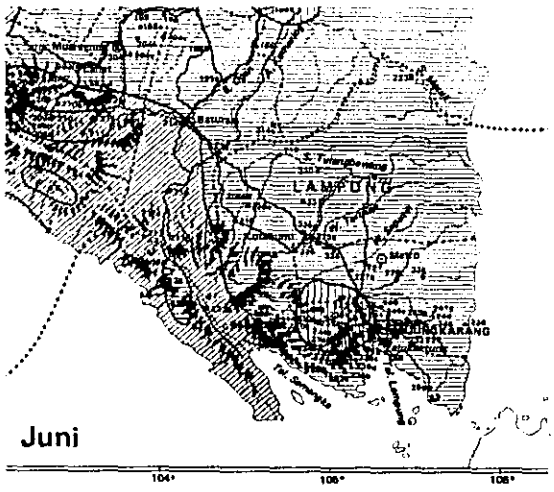
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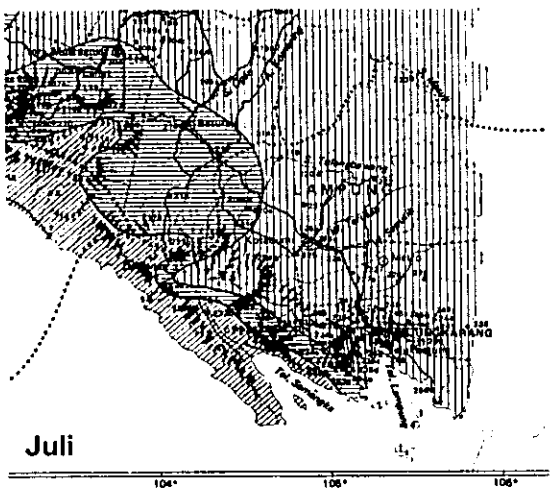
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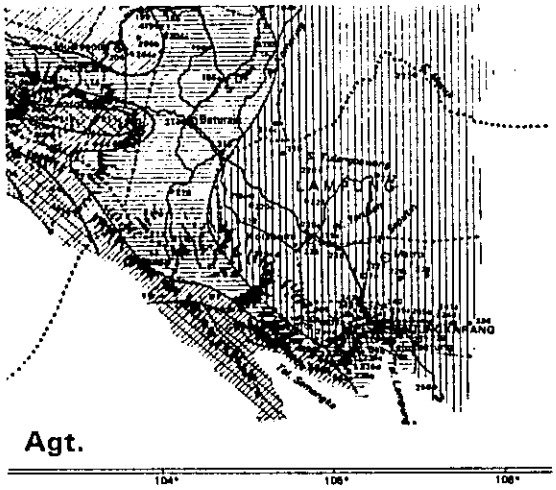
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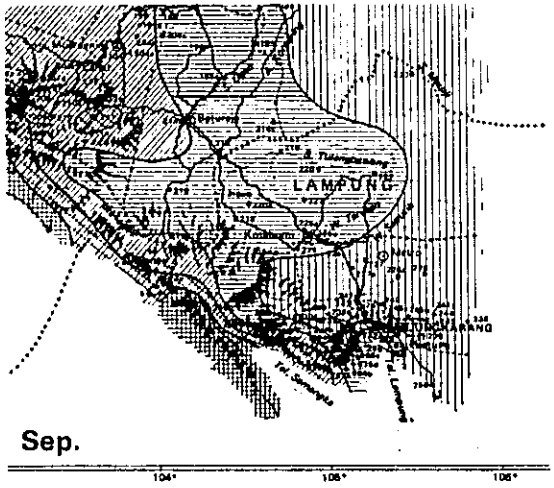
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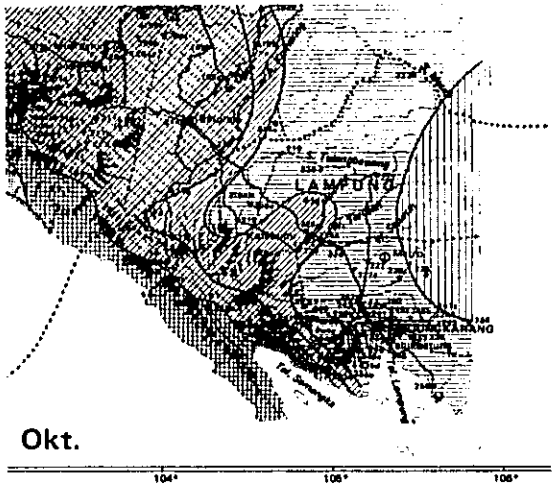
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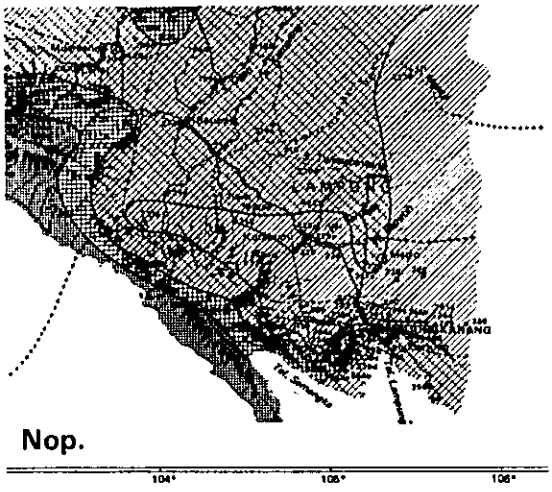
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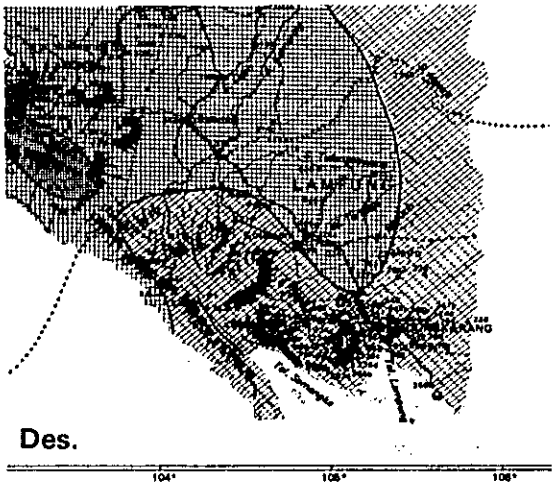
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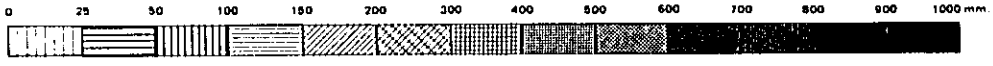
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THE INSTITUTE OF METEOROLOGY AND GEOPHYSICS
DEPARTMENT OF COMMUNICATIONS
INDONESIA

JAKARTA

1974

Daerah = region
Nama setasiun hujan = name of rainfall station
Tinggi atas permukaan laut dalam meter = height above sea level in metres
Tahun peninjauan = years of observation
Jumlah tahun peninjauan = number of years of observation
Rata-rata curah hujan dalam mm. = mean rainfall in mm.
Rata-rata jumlah hari hujan = mean number of rainy days
Rata-rata curah hujan terbesar selama 24 jam dalam mm = mean daily maximum of rainfall in mm
Maksimum mutlak selama 24 jam = absolute maximum of rainfall in one day
Bulan - Tahun terjadinya = month and year of occurrence
Angka tertinggi di bawah maksimum mutlak = highest rainfall next to the absolute maximum of one day rainfall in mm.

TAHUN 1961 — 1970

No.	NAMA STASIUN	Tinggi atas permukaan Laut m.	Tahun peninjauan	Jumlah tahun peninjauan	Rata-rata curah hujan dalam m.m.												Rata-rata jumlah hari hujan												Rata-rata curah hujan terbesar selama 24 jam												Maksimum mutlak selama 24 jam		Angka tertinggi di bawah maksimum mutlak
					Jan	Febr	Mrt	Apr	Mei	Juni	Juli	Agt	Sep	Okt	Nop	Des	Setahun	Jan	Febr	Mrt	Apr	Mei	Juni	Juli	Agt	Sep	Okt	Nop	Des	Setahun	Jan	Febr	Mrt	Apr	Juni	Juli	Agt	Sep	Okt	Nop	Des	Setahun	mm.	Bl. Th. terjadinya	
	SUMATRA · SELATAN																																										
190c	Plaju	1	1961—1970	10	309	248	331	284	253	99	92	76	82	169	237	360	2540	17.7	15.6	17.6	16.9	14.9	8.9	7.4	7.3	6.9	9.9	15.9	19.9	158.9	75	50	58*	61	56	41	36	27	26	57	63	73	97	127	1—1963	117
190d	Sungaigerong	—	1961—1970	10	275	218	280	267	228	74	79	60	60	154	216	308	2219	13.6	12.5	15.0	14.5	12.9	7.6	5.7	5.1	5.0	8.2	12.4	13.9	126.4	86	59	56	62	58	31	33	26	24	52	68	76	105	137	1—1963	131
191a	Talang betutu (Meteo)	—	1961—1970	10	332	286	324	298	282	97	99	74	115	228	253	427	2815	17.0	14.6	17.1	15.6	13.5	6.3	7.5	4.8	6.2	10.9	12.0	18.0	143.5	75	69	70	77	88	50	43	34	50	64	73	110	122	131	9—1965 5—1964	128
191d	Alicia (Perk)	40	1961—1970	10	248	242	352	268	164	114	56	95	104	197	256	359	2455	13.3	12.2	14.8	12.7	8.9	5.4	4.3	4.3	5.9	7.6	12.2	15.0	116.6	66	59	86	68	54	59	27	37	41	69	68	84	120	157	10—1968	150
191b	Musi (Perk)		1962—1970	9	222	271	306	214	198	98	79	85	100	202	242	290	2307	10.1	10.4	12.2	11.0	8.7	5.1	4.4	4.3	5.6	7.9	10.6	11.8	102.1	57	76	75	60	68	52	29	24	40	66	60	74	123	169	10—1968	153
191h	Melania (Perk)	—	1961—1970	10	253	258	321	244	178	87	66	105	93	218	242	366	2431	14.8	14.0	14.7	12.3	9.4	5.5	5.3	5.1	5.2	9.1	11.6	14.9	121.9	66	56	74	54	57	40	31	36	32	72	59	81	110	149	10—1969	133
197	Prabumulih		1961—1970	10	355	292	311	313	164	113	84	85	104	196	254	366	2617	15.8	13.4	14.9	11.1	8.9	5.9	4.6	3.4	4.9	9.9	12.8	15.8	121.2	73	69	69	83	49	55	34	30	33	58	69	84	109	130	12—1970	127
200b	Lubuklinggau/Tugulmulyo	70	1966—1970	5	459	243	328	264	251	74	194	180	186	223	239	506	3147	16.6	9.6	12.0	8.8	9.4	4.4	7.3	7.0	7.6	9.0	11.0	11.6	114.3	88	58	74	70	57	32	55	51	76	57	46	54	111	135	1—1969	118
208	Pagaralam		1961—1970	10	371	294	333	336	253	162	114	102	117	189	251	311	2833	21.3	17.8	18.9	18.8	15.4	11.6	9.2	7.6	8.5	11.9	16.4	20.2	177.6	59	50	58	58	43	38	29	31	39	39	46	42	81	138	1—1964	100
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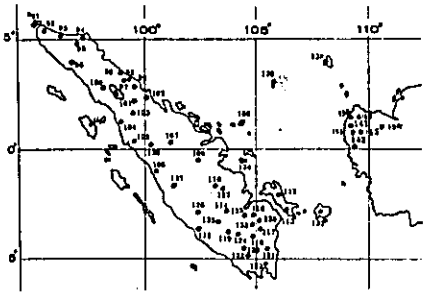
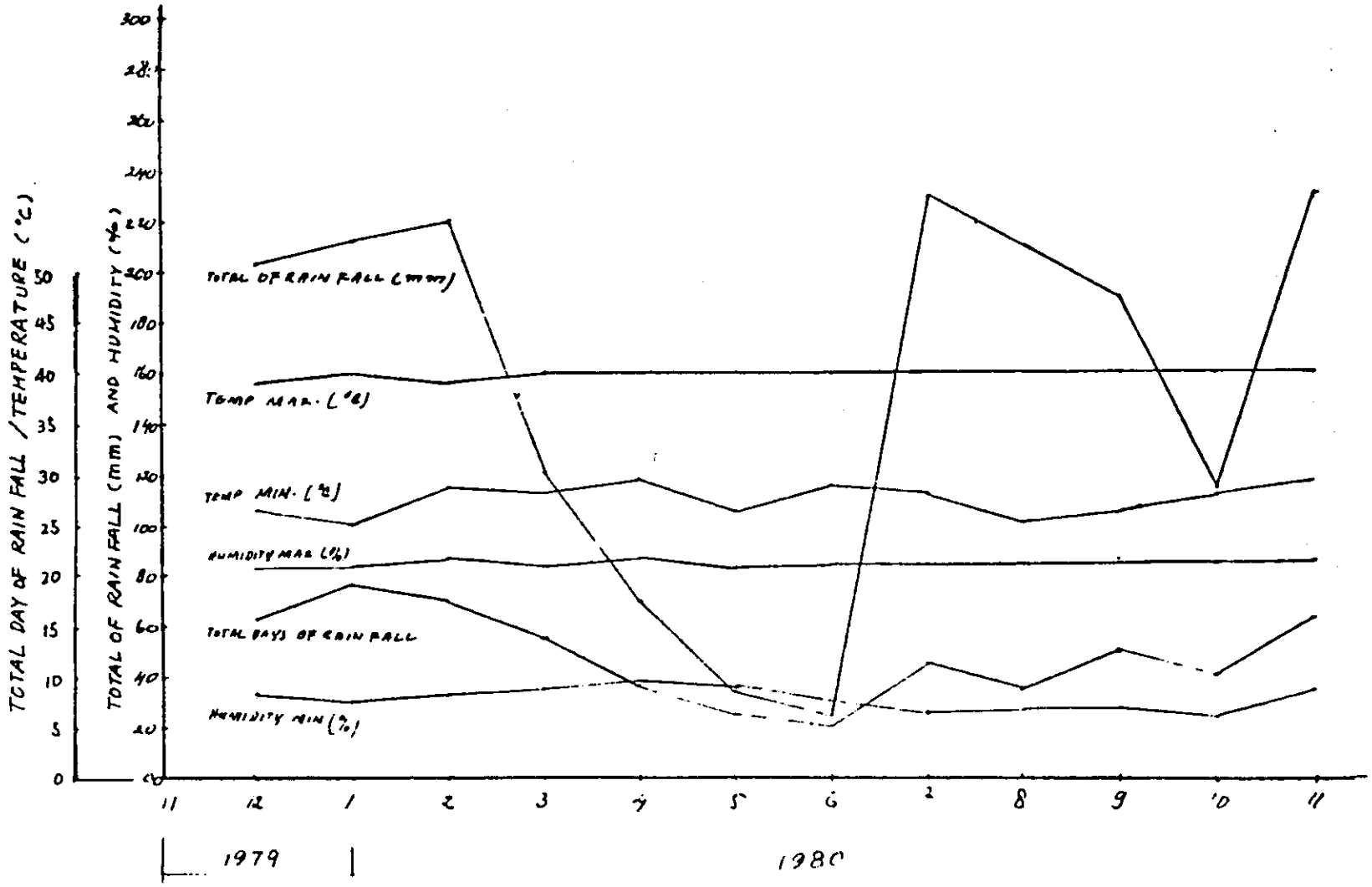
214c	Blitang		1961—1970	6	317	252	321	280	174	106	21	59	85	158	234	427	2434	18.3	15.7	15.8	14.4	11.0	6.6	2.2	5.6	4.6	9.0	13.8	20.6	137.6	69	61	71	80	62	31	17	15	37	40	67	78	100	137	11—1969	117
215	Martapura		1961—1970	8	411	254	421	361	333	150	119	138	86	181	343	432	3229	15.9	12.4	14.4	13.5	12.8	7.6	6.0	5.0	3.7	7.5	12.3	15.9	125.6	88	70	83	85	80	59	40	46	35	78	90	99	131	160	3—1961	159
251	Muntok		1962—1970	6	396	227	142	208	135	90	38	43	54	91	125	290	1839	12.1	9.0	8.8	12.8	8.7	4.6	3.0	2.3	2.8	6.2	9.6	11.8	91.7	128	76	30	42	36	40	23	25	21	30	40	56	153	383	1—1963	208
251c	Klapa		1961—1970	9	460	266	321	436	385	368	144	66	118	261	385	685	3895	15.6	9.2	10.9	14.3	15.3	11.1	4.4	2.5	4.6	9.7	16.1	22.6	136.3	102	78	75	88	80	95	47	30	35	55	87	96	122	133	1—1965	128
253	Blinyu	15	1961—1970	10	403	196	150	252	233	169	169	114	145	178	250	433	2692	11.1	9.0	8.2	11.7	11.2	9.5	8.2	5.5	6.3	10.1	14.2	15.9	120.9	100	58	40	55	60	34	47	35	40	51	56	89	121	200	1—1968	160
253b	Mantung	—	1961—1970	10	382	210	132	275	138	162	176	68	79	175	176	504	2477	11.7	8.3	8.9	10.8	11.0	9.1	8.0	5.1	5.6	9.3	10.8	14.7	113.3	116	74	59	94	40	40	68	31	29	81	47	73	180	300	12—1964	221
254	Sungaiselan	2	1961—1967	7	262	253	356	328	259	160	95	78	139	211	319	315	2775	12.7	13.4	13.9	14.3	12.0	9.3	6.6	4.1	6.9	11.3	15.1	14.5	134.1	70	62	71	64	63	46	33	31	50	59	57	80	117	135	2—1963	128
255	Sungailiat	10	1961—1970	10	412	290	159	271	292	174	128	86	79	181	280	454	2806	12.0	9.2	8.3	11.1	10.7	9.1	7.3	3.6	4.6	6.8	11.9	16.0	110.6	144	149	57	79	94	76	45	44	25	73	95	111	198	283	2—1969	267
255a	Pemali	—	1961—1970	10	298	240	165	261	276	128	81	41	63	210	217	349	2329	12.7	11.6	10.0	13.2	13.0	8.3	5.9	3.4	4.9	10.0	13.3	17.4	123.7	96	76	48	60	84	49	33	28	23	60	58	80	140	350	1—1963	210
257	Pangkalpinang	± 20	1961—1970	10	394	332	244	310	318	230	166	161	107	191	273	385	3111	18.3	13.9	14.8	15.1	16.9	12.3	9.2	7.5	6.9	10.3	14.3	20.9	160.4	87	78	56	80	78	58	55	51	36	47	64	72	123	155	-1—1963	146
261	Toboali	6	1961—1970	10	115	103	119	109	96	102	52	26	37	86	127	93	1065	9.9	9.2	10.6	10.1	10.1	6.5	4.7	2.9	3.5	6.6	10.8	9.1	94.0	34	30	34	35	28	40	24	13	15	31	38	30	60	110	11—1962	96
262b	Buluhtumbang (Meteo)	—	1961—1968	7	403	194	302	311	279	163	104	37	95	250	436	504	3078	17.0	11.7	16.4	20.4	15.4	11.0	9.3	3.0	5.5	13.0	16.8	23.4	162.9	90	43	60	62	68	55	35	24	36	70	85	83	111	135	12—1962	132
	LAMPUNG																																										
220a	Tulungbuyut (Perk)	82	1962—1970	9	479	438	349	316	232	109	103	133	87	138	256	379	3019	14.9	12.8	15.3	13.8	10.1	6.8	6.5	5.8	5.1	7.8	11.4	15.8	126.1	86	80	69	62	108	52	47	47	41	58	74	74	124	196	2—1969	175
225a	Kotabumi (Departa)	32	1961—1970	8	320	241	300	297	175	138	120	88	62	138	223	336	2438	15.9	13.4	13.7	14.9	11.1	8.6	7.6	5.3	3.5	8.4	11.9	15.8	130.1	67	63	66	61	47	38	41	38	32	58	67	88	119	185	12—1969	183
225b	Kotabumi/Nakau	—	1961—1970	10	275	214	259	227	111	75	57	44	58	110	141	306	1877	12.5	10.7	12.3	11.4	6.0	4.7	3.1	2.4	3.8	5.1	6.1	12.2	90.3	56	47	57	44	35	26	29	19	16	43	44	61	80	112	12—1964	104
225c	Kotabumi (D.P.U)	35	1961—1969	9	340	222	269	280	154	95	89	100	72	146	243	394	2404	14.0	9.3	12.3	12.8	9.3	4.6	5.0	4.0	3.7	7.0	11.0	16.4	109.4	83	56	71	64	47	39	39	53	29	57	67	86	128	208	8—1961	153
225d	Bukitkemuning	265	1961—1968	8	339	355	423	278	247	113	73	70	64	115	195	398	2670	15.8	12.4	14.0	10.9	10.5	5.4	4.0	3.3	2.4	6.4	8.4	16.1	109.6	77	86	105	81	68	46	29	36	32	32	22	61	74	210	2—1967	186
227c	Batanghari	—	1961—1966	6	324	286	334	402	140	141	118	50	96	121	213	296	2521	12.8	8.6	8.8	9.3	3.4	4.4	3.3	2.0	3.5	4.0	5.8	7.2	73.1	51	85	67	78	54	35	33	20	11	33	56	79	119	180	12—1964	125
227e	Argoguruh	—	1961—1970	8	366	246	274	239	126	82	57	58	35	41	133	311	1968	14.5	10.8	11.4	9.6	6.6	5.6	2.5	2.3	2.5	4.1	6.2	13.0	89.1	55	71	77	70	42	30	32	25	16	18	38	77	126	230	12—1963	155
228	Sukadana	28	1962—1970	7	359	282	362	221	171	104	106	50	68	122	163	355	2361	17.9	13.7	16.1	12.1	11.1	10.2	6.0	4.6	4.4	6.0	8.6	13.0	124.7	76	60	72	53	47	38	46	17	31	39	66	69	117	137	5—1969	134
228c	Metro (Diperta)	57	1961—1970	10	341	243	275	212	131	58	56	27	53	91	151	206	1844	16.9	12.2	16.1	13.9	11.4	5.9	4.7	2.6	3.8	6.5	9.8	14.2	118.0	76	74	60	63	36	19	30	13	30	25	55	51	94	134	9—1962	120
228d	Metro (D.P.U)	—	1961—1969	8	403	371	303	237	167	220	142	60	180	191	188	293	2755	11.1	9.0	10.5	7.4	6.7	4.9	3.0	2.4	2.2	4.7	6.8	9.3	78.0	98	116	103	113	59	108	75	32	27	50	120	203	205	304	3—1962	291
230f	Pringsewu	—	1962—1969	9	240	162	190	162	93	28	53	64	40	69	109	165	1375	18.1	15.0	14.1	13.3	9.3	3.4	4.7	4.7	3.3	5.9	10.9	15.9	118.6	37	37	40	30	25	8	19	14	19	23	33	38	50	76	9—1964	72
233a	Way Ratai (Perk)	60	1961—1970	10	283	261	230	246	130	57	80	78	91	115	202	245	2018	15.3	12.8	11.6	13.4	7.4	5.4	4.5	5.3	5.2	8.7	10.6	11.7	111.9	64	70	64	73	42	23	34	26	31	34	57	62	106	148	4—1970	126
235	Gedungtatakan	± 100	1962—1967	6	230	261	251	198	146	51	41	65	63	118	143	168	1735	11.2	9.8	18.2	12.3	9.3	3.3	3.2	4.8	3.8	6.2	8.7	10.2	101.0	61	65	42	39	38	23	17	23	25	32	45	30	76	153	1—1964	135
235b	Way Berulu (Perk)	150	1961—1970	10	210	222	234	235	134	76	50	34	44	88	115	218	1660	13.3	11.3	11.7	10.6	7.4	5.0	3.7	1.9	3.0	6.0	7.6	12.0	93.5	54	68	59	72	41	30	21	15	22	28	41	60	100	164	4—1970	150
238	Way Halim (Perk)	100	1961—1970	10	279	223	265	241	121	83	59	72	57	73	106	195	1774	11.3	8.0	7.9	8.7	5.4	4.8	3.2	2.7	3.8	3.6	5.9	8.8	74.1	64	69	109	66	43	30	31	45	25	35	40	59	145	437	3—1969	145
240	Trikora (Perk)	100	1961—1970	10	298	228	220	232	125	65	42	39	62	70	125	215	1721	13.7	10.5	11.6	10.4	10.1	7.0	4.4	3.1	2.6	5.6	8.4	11.1	98.5	67	66	63	56	34	20	22	19	34	25	38	55	112	175	9—1965	162
242	Rejosari (Perk)	100	1961—1970	10	250	252	222	210	142	80	61	55	47	98	133	229	1779	14.1	13.0	11.9	11.2	10.3	5.4	5.6	3.2	4.0	6.0	9.2	14.0	107.9	61	61	59	63	44	33	25	25	27	40	49	50	96	136	11—1968	121
242c	Rejosari IV (Perk)	94	1964—1970	7	322	358	371	274	284	209	84	56	60	102	257	290	2647	16.8	15.4	15.5	12.3	10.9	7.0	4.7	5.4	4.1	6.4	8.1	15.3	121.9	87	89	88	65	52	63	23	18	28	48	34	59	116	220	6—1970	137
243	Negaratu (Perk)	130	1961—1970	10	437	275	377	269	189	97	75	92	115	141	212	312	2591	15.6	13.7	13.5	11.1	10.7	5.8	4.2	3.0	3.2	5.6	7.3	13.9	107.6	101	61	82	85	39	35	34	47	56	36	68	81	122	325	4—1970	280
245b	Bergen (Perk)	100	1961—1970	10	244	249	255	207	148	77	70	47	50	74	119	177	1717	13.3	11.3	12.0	9.8	9.3	8.7	6.5	5.1	4.2	5.0	9.0	11.5	105.7	54	62	61	63	47	21	28	18	19	22	29	40	84	150	4—1966	114
	KALIMANTAN BARAT																																										
271	Singkawang	3	1961—1970	9	347	251	274	256	204	217	215	236	163	332	419	457	3370	12.8	10.5	10.7	10.4	7.8	7.3	6.6	9.0	8.6	12.7	15.6	14.4	126.3	118	86	90	87	72	83	76	70	50	76	92	95	164	277	1—1963	247
273	Pontianak (Meteo)	3	1961—1970	10	315	246	311	314	296	251	203	191	246	341	457	289	3461	18.1	14.9	15.2	17.5	16.3	13.0	10.9	10.7	13.0	18.4	21.9	20.2	190.1	70	63	77	76	69	69	63	56	66	64	104	56	160	341	11—1967	235
277	Ngabang	28	1961—1970	10	312	242	240	314	291	221	156	186	231	312	333	389	3227	11.5	7.4	8.2	9.9	10.2	7.1	5.5	5.9	7.6	8.7	9.8	12.1	103.9	69	77	74	74	62	66	49	62	82	66	76	71	124	170	9—1966	155
278	Sanggau	9	1961—1970	10	308	304	278	269	254	155	193	178	153	245	320	321	2977	15.3	10.7	12.1	12.8	9.6	7.6	6.4	8.6	7.7	10.9	14.0	12.4	128.1	70	78	72	75	69	59	71	53	50	65	79	70	133	232	4—1963	168
278c	Singkawang	—	1961—1968	7	512	362	240	258	250	130	167	187	158	227	303	340	3146	22.2	18.4	20.2	19.4	14.7	12.4	12.0	13.9	14.7	18.8	22.2	24.4	213.3	109	68	56	54	63	37	46	61	49	53	58	60	119	224	1—1963	182
282	Nangajetak	47	1961—1970	10	313	277	386	297	283	213	210	198	206	342	344	365	3434	14.5	11.7	14.4	12.4	9.8	9.5	7.8	7.4	9.3	14.0	15.8	15.3	141.9	65	71	89	71	87	60	67	55	56	61	63	72	121	181	5—1969	138
283	Nangapinoh	42	1964—1970	7	253	208	346	284	241	192	219	200	193	351	313	281	3080	7.4	6.6	9.1	8.1	6.4	5.3	5.3	4.3	5.9	7.1	9.0	8.4	82.9	64	67	63	82	80	80	58	86	53	89	64	65	132	171	8—1966	155
283a	Nangaheerawai	67	1962—1968	7	252	247	338	192	256	160	115	152	162	243	275	299	2691	13.0	11.3	14.3	9.9	10.4	8.3	4.8	5.6	6.4	13.0	13.7	13.7	124.4	53	58	66	51	72	56	29	53	59	60	51	61	101	135	5—1963	109
285	Ketapang	3	1962—1970	9	426	274	190	289	278	217	159	110	166	274	361	415	3159	13.6	10.1	10.0	12.6	10.2	8.2	6.5	5.2	6.1	11.4	16.0	16.5	125.4	61	63	35	50	45	41	49	30	55	45	53	68	96	170	9—1964	148

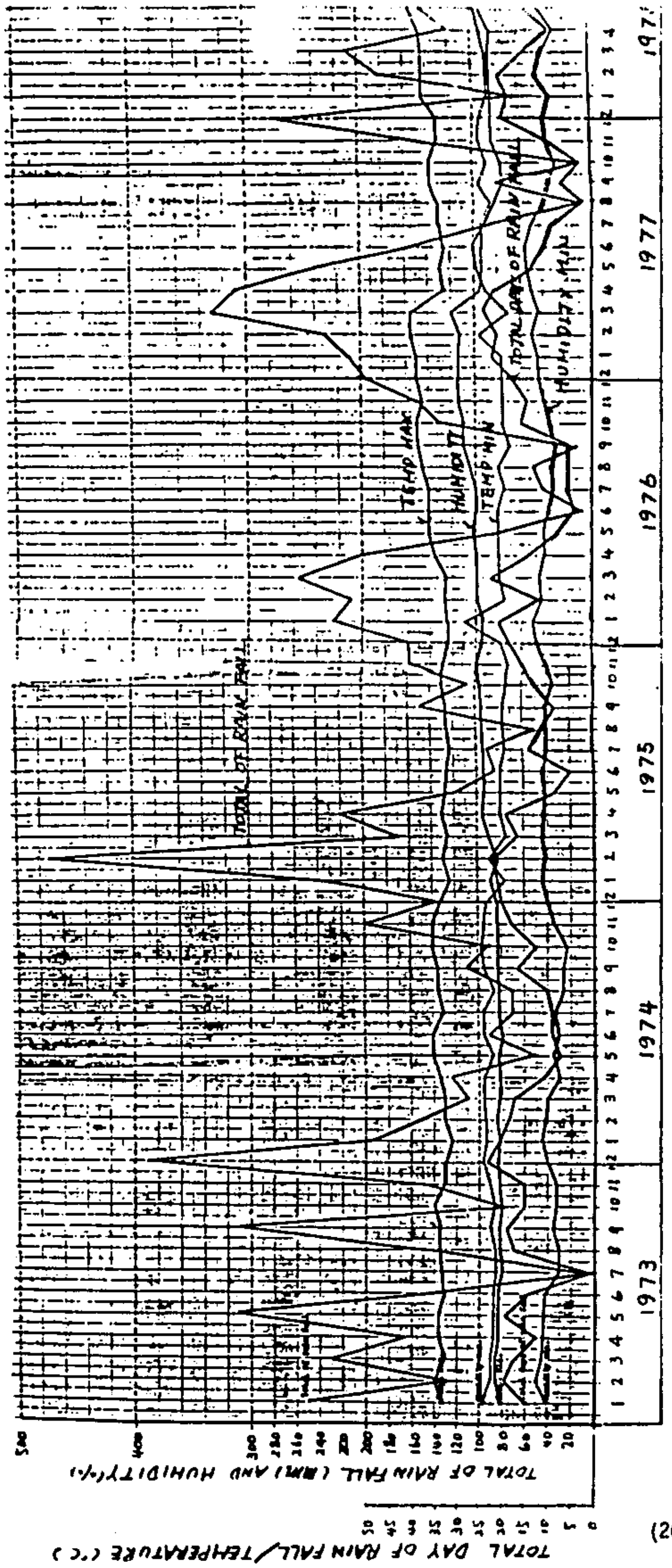
DAFTAR ISI (PER PROPINSI)

NO URUT	NAMA STASIUN	NOMOR JARING-JARING 2	TINGGI METER	TEMPERATUR			H	S.M	T.U.	K.U.	ANGIN		
				RATA2	MAX	MIN					K.R.	K.T.	A.A.T.
				1	2	3	4	5	6	7	8	9	10
I.	D.I. ACEH :												
1.	Blang Bintang - Banda Aceh	92	21	19	23	27	31	35	39	43	47	51	55
2.	Cot Girek	94	25	19	23	27	31	35	39	43	47	51	55
3	Sabang	91	126	19	23	27	31	35	39	43	47	51	55
II.	SUMATERA UTARA :												
1.	Balige - Gurgur	103	1218	19	23	27	31	35	39	43	47	51	55
2.	Belawan	90	03	19	23	27	31	35	39	43	47	51	55
3.	Binaka - G. Sitoli	140	06	19	23	27	31	35	39	43	47	51	55
4.	Marihat St.	101	369	19	23	27	31	35	39	43	47	51	55
5.	Pinangsori - Sibolga	104	03	19	23	27	31	35	39	43	47	51	55
6.	Polonia	97	27	19	23	27	31	35	39	43	47	51	55
7	Sampali	98	25	19	23	27	31	35	39	43	47	51	55
III.	SUMATERA BARAT :												
1.	Padang Gelugur - Pasaman	136	450	19	23	27	31	35	39	43	47	51	55
2.	Sukarami Keb. Perc.	137	928	19	23	27	31	35	39	43	47	51	55
3.	Tabing	106	02	19	23	27	31	35	39	43	47	51	55
IV.	J A M B I :												
1.	Palmerah	110	26	19	23	27	31	35	39	43	47	51	55
2.	Sebapo	127	20	19	23	27	31	35	39	43	47	51	55
V.	R I A U :												
1.	Dabo - Singkep	134	29	19	23	27	31	35	39	43	47	51	55
2.	Japura - Rengat	109	19	19	23	27	31	35	39	43	47	51	55
3.	Kijang - Tg. Pinang	108	17	19	23	27	31	35	39	43	47	51	55
4.	Ranai	138	02	19	23	27	31	35	39	43	47	51	55
5.	Simpang Tiga-Pakanbaru	107	31	19	23	27	31	35	39	43	47	51	55
6.	Tarempa	135	04	19	23	27	31	35	39	43	47	51	55
VI.	SUMATERA SELATAN :												
1.	Belitang	117	48	19	23	27	31	35	39	43	47	51	55
2.	Bukit Besar UNSRI	115	05	19	23	27	31	35	39	43	47	51	55
3.	Buluhtumbang-Tg. Pandan	132	44	19	23	27	31	35	39	43	47	51	55
4.	Kenten	133	04	19	23	27	31	35	39	43	47	51	55
5.	Pangkal Pinang	112	33	19	23	27	31	35	39	43	47	51	55
6.	Rias Toboali	113	06	19	23	27	31	35	39	43	47	51	55
7.	Sei Pinang - Dewi Sri	128	08	19	23	27	31	35	39	43	47	51	55
8.	Sekayu	114	09	19	23	27	31	35	39	43	47	51	55
9.	Tl. Betutu-Palembang	116	11	19	23	27	31	35	39	43	47	51	55
10.	Tg. Tebat - Lahat	119	374	19	23	27	31	35	39	43	47	51	55
11.	Tugu Mulyo	125	70	19	23	27	31	35	39	43	47	51	55
VII.	BENGKULU :												
	Pd. Kemiling - Bengkulu	111	15	19	23	27	31	35	39	43	47	51	55
VIII.	LAMPUNG :												
1.	Astra Ksetra *)	121	19	19	23	27	31	35	39	43	47	51	55
2.	Branti - Tg. Karang	123	85	19	23	27	31	35	39	43	47	51	55

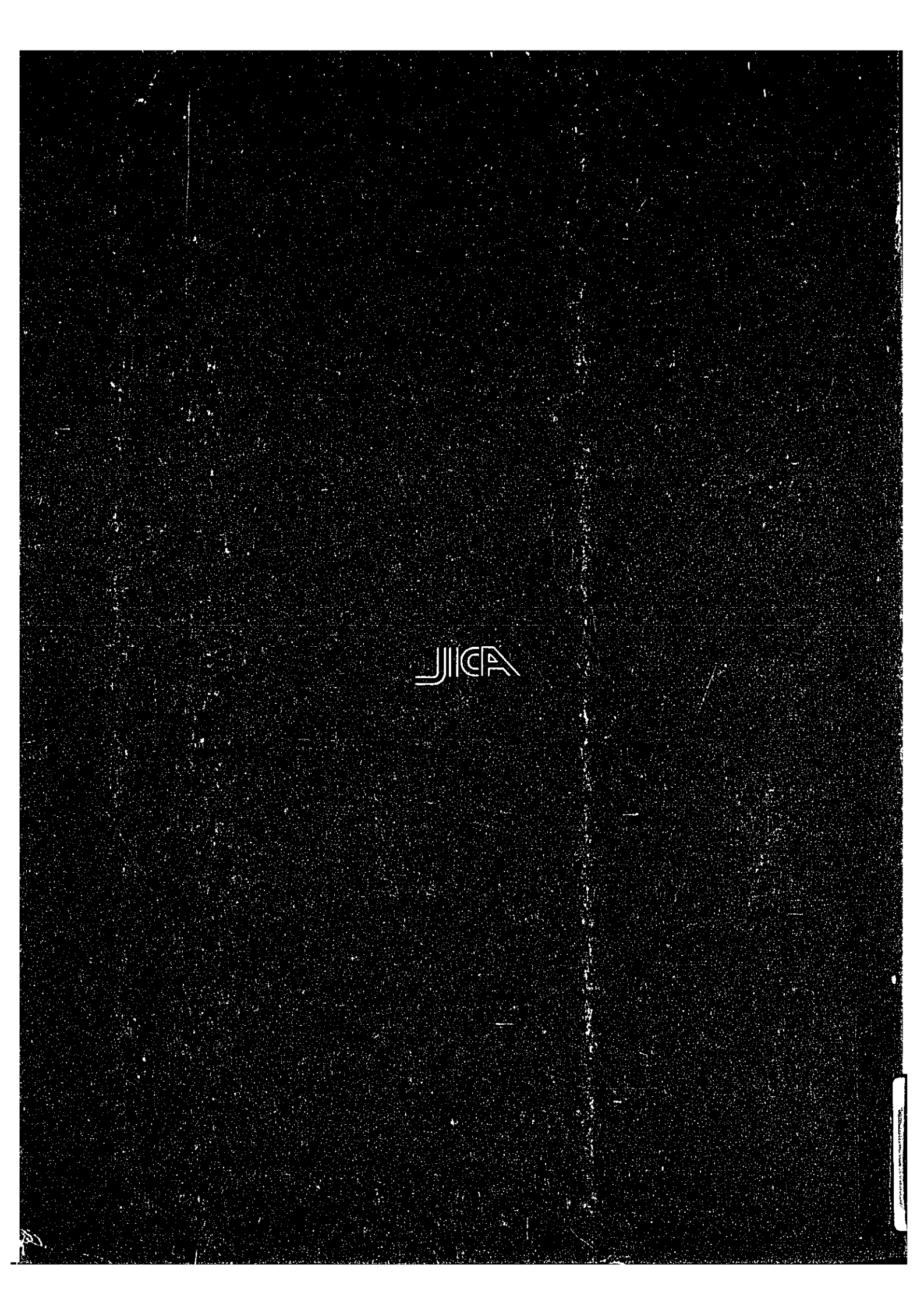




CLIMATE CONDITION : DEC 79 - NOV 80


TOTAL OF RAIN FALL (MM) AND HUMIDITY (%)
TOTAL DAY OF RAIN FALL/TEMPERATURE (°C)
TOTAL OF RAIN FALL
TEMP MAX
HUMIDITY
TEMP MIN
TOTAL DAY OF RAIN FALL
HUMIDITY MIN
1973
1974
1975
1976
1977

(26)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