BASIC DESIGN STUDY REPORT
ON
THE IRRIGATION ENGINEERING CENTER
ESTABLISHMENT PROJECT
IN
THE KINGDOM OF THAILAND

JUNE 1983

JAPAN INTERNATIONAL COOPERATION AGENCY

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P R E F A C E

In response to the request of the Government of the Kingdom of Thailand, the Government of Japan decided to conduct a study on basic design of the Project to construct an Irrigation Engineering Centre of RID and entrusted the study to the Japan International Cooperation Agency (JICA). The JICA sent to Thailand a survey team headed by Mr. Sadao NISHIDE, Director General, Land Improvement Engineering Service Centre in Tokyo Regional Office, Ministry of Agriculture, Forestry and Fisheries, from February 18 to March 12, 1983.

The team had discussions with the officials concerned of the Government of Thailand and conducted a field survey in Bangkok.

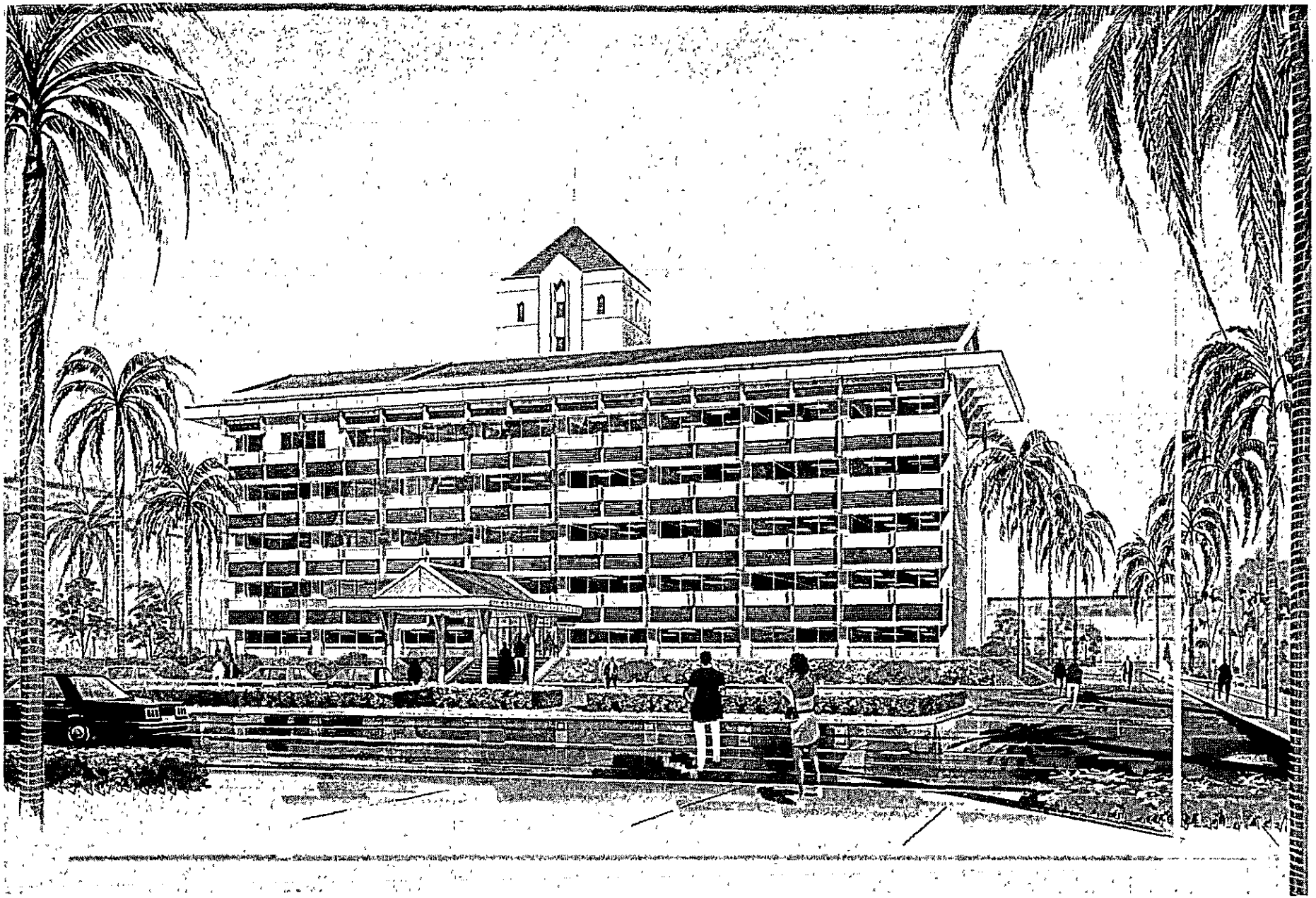
After the team returned to Japan, further studies were made and the present report has been prepared.

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

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

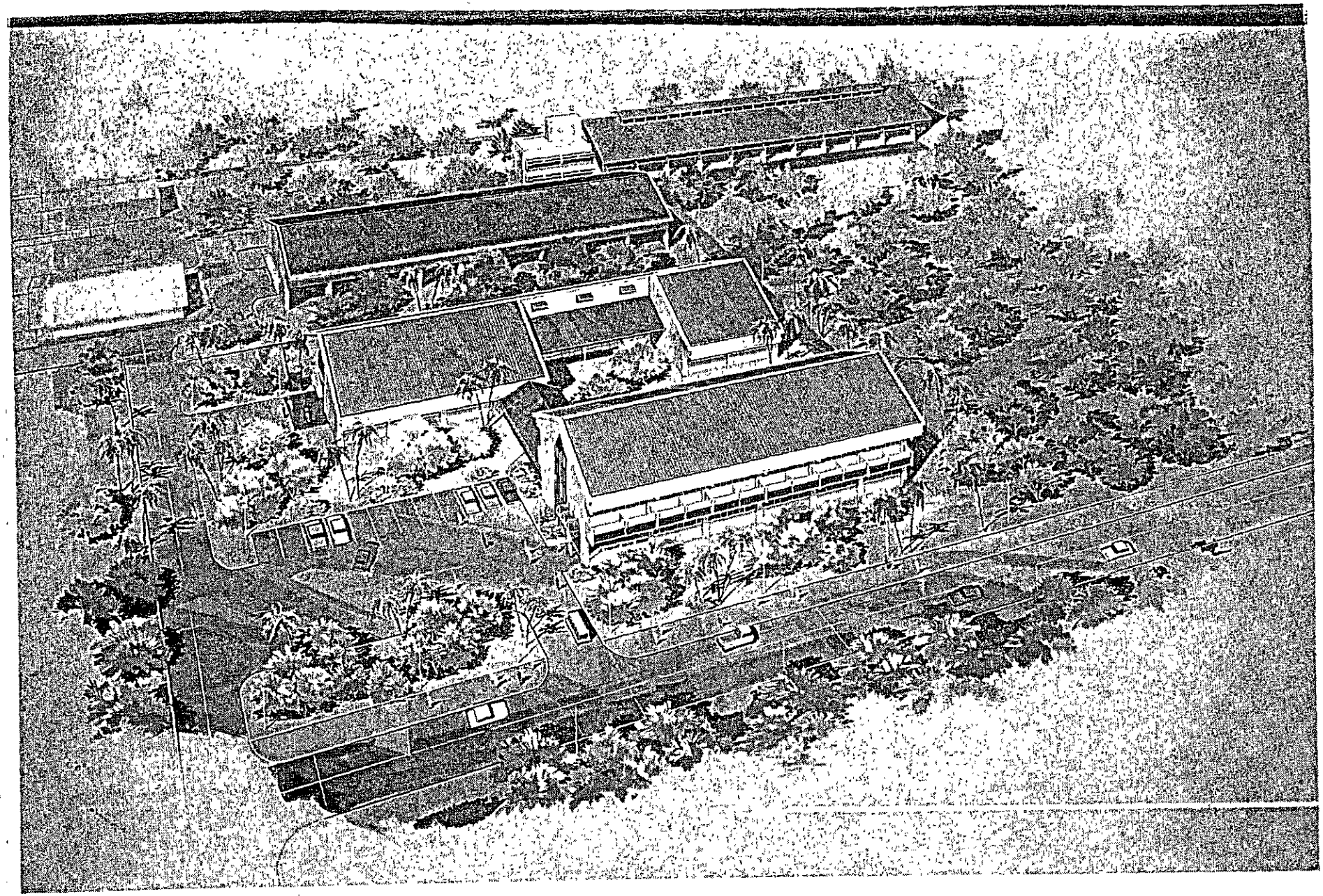
June, 1983

Keisuke Arita
President
Japan International Cooperation Agency



THE IRRIGATION ENGINEERING CENTER, THE KINGDOM OF THAILAND

SAMSEN CENTER



THE IRRIGATION ENGINEERING CENTER, THE KINGDOM OF THAILAND

RESEARCH & LAB. CENTER,
SOIL ENGINEERING TEST LAB.,
HYDRAULIC MODEL TEST HANGAR

C O N T E N T S

SUMMARY

Upon request of the Government of the Kingdom of Thailand in regard to a establishment plan for an Irrigation Engineering Center (IEC or the Center) as a grant aid project, studies have been conducted by the Japan International Cooperation Agency (JICA). The Royal Irrigation Department (RID) of the Ministry of Agriculture and Cooperatives acted as the counterpart for the project. Based on discussions between the counterpart and study team and findings of the survey, detailed plan for the IEC has been developed. The results are summarized with its background as follows.

Agriculture provides the largest source of the national income of Thailand, accounting for approximately one fourth of the Gross Domestic Product.

During past 20 years, agricultural output has expanded at a high rate of 5 per cent per annum compared with the world average growth rate of only 2.5 to 2.8 per cent per annum. This performance has been achieved mainly through development of cash crops and expansion of farmland area at a rate of approximately four per cent per annum.

However, the growth rate of agricultural products has recently been declining to 3.5 per cent per annum. The major reason is that the expansion of available land frontier has nearly ended because suitable land for agriculture is running out.

The Fifth National Economic and Social Development Plan (the 5th NESDP, covering the period of 1982 through 1986) has set a new growth target rate of 4.7 per cent per annum to recover productivity, and the Government has given the highest priority to the productivity improvement of paddy which is the most important agricultural product in the country.

One of the disadvantages for agriculture in Thailand is a general shortage of water during the dry season. Another disadvantage is insufficient supply of water for rice production, due to high

evaporation in the tropical climate. In order to cope with these difficulties, expansion and improvement of irrigation facilities are required. Accordingly, the 5th NESDP has given high priority to them.

The total area of farmland in Thailand is now approximately 147 million rai.*1 It includes 84 million rai of paddy field. Out of this 84 million rai, only 16 million is under irrigation, while the rest is rain-fed paddy field. The well-irrigated area, which receives water throughout the entire year and is suitable for double cropping, is only four to five million rai.

One of the distinctive features of the new 5th NESDP is a great change in RID's development policy regarding future projects. The past development had been oriented predominantly to large-scale irrigation projects, but now the emphasis has been increasingly shifted to medium and small-scale projects to obtain quick improvement results. As a result, many medium- and small-scale projects will be executed in extensive areas, which will require new engineering methods and development technology as well as a large amount of manpower.

RID of the Ministry of Agriculture and Cooperatives is an organization responsible for the development of these irrigation facilities. RID is the largest department having 78,000 employees and 12 district offices in addition to the head office. 60 per cent of the total budget of the Ministry is appropriated for RID. The annual RID budget allocation for fiscal 1983 is 8,650 million Baht.*2

In the past, RID has depended to a large extent upon the technology and manpower of foreign consultants to develop irrigation projects, since such projects were so large in scale that foreign aid was required to raise fundings necessary for construction. As a result, different and various kinds of foreign technologies were introduced in the country, and they now exist in parallel with each other. Certainly, engineering information and competence accumulated through the projects in the past are available, but they belong to a limited number of engineering staff who are scattered throughout the head office, regional

*1: 1 rai = 1,600 sq. m.

*2: Conversion rate: 1.00 Thai Baht is approximately 10.00 Japanese Yen. This figure dose not include foreign loans.

offices and project sites. On the other hand, the technical level of the nucleus engineers appears to be insufficient, and advanced training is required for the purpose of strengthening available manpower.

In order to execute medium- and small-scale projects, which will be increased in number in the future and also be of different nature from the project in the past, the RID now faces a number of problems that must be resolved urgently. Development of appropriate technology and its consolidation and systematic transfer of information are required as well as strengthening of manpower and establishment of a new organization.

RID is now studying reformation of its organization. The establishment of IEC would be one of the important component of the reformation.

The objectives of the planned Center shall be to perform systematically the following functions in each technical area of research, survey, planning, designing and construction in order to reinforce RID's capabilities in response to diverse needs arising from future development projects and to technology required therein as well as to the increase in the number of projects:

1) To collect and centralize technical data and information currently mothballed at various places and to reorganize them so that such data and information can be readily available whenever and wheresoever required.

2) To develop irrigation development technology adapted to local needs and conditions such as climate, geography and so forth (hereinafter referred to as "appropriate technology"), and further to strengthen the capabilities of research and test of each technological area.

3) To set up engineering criteria of each technical area and to develope design standards.

4) To provide technical training for engineering staff, putting emphasis on nucleus engineering staff.

5) To establish a section to cope with special engineering problems.

In order to fulfill the above requirements, IEC is planned to be composed of an engineering information service section, criteria development section, systems engineering section and special engineering section under the wing of an engineering development division as well as another-training branch being established. Inspection and monitoring section, library and computer room are established and belong to the office of IEC. Further, existing Research and Laboratory division is transferred to the jurisdiction of the planned Center. The present Chief Civil Engineer is expected to be assigned as the head of IEC concurrently. Coordination with the divisions of RID will be undertaken at board meetings of the directors of RID, and coordination between the Technical Training Branch and the Personnel Division of RID will be done directly.

The required personnel for IEC totals 302 persons, with 166 of them being transferred from the present Research and Laboratory Division. The other 136 staff will be transferred from the Design Division and other related divisions of RID.

The major focus of the technical training program is on the groups of nucleus and younger engineers engaged in research, survey, planning, design and construction. The annual training schedule targets at about 1,500 persons. The field of engineering is divided into three sectors; 1) civil engineering, 2) mechanical engineering and 3) surveying. Each sector is further classified into the three grades of junior, intermediate and senior classes. Terms are two to eight weeks long for short courses and 20 weeks long for more intensive courses, and differ by respective subjects. According to the schedule, it takes five years for the faster groups and nine years for the slower groups to complete one training cycle. Thus, the cycle of the refreshment training repeats continuously.

The head office of RID is located at Samsen in the central area of Bangkok, and Research and Laboratory Division is located at Pakret on the outskirts of greater metropolitan Bangkok. Facilities at the

Samsen Compound are already overcrowded, and it is impossible to utilize the existing facilities for new IEC. The present situation of existing Research and Laboratory Division in the Pakret Compound is the same as that of Samsen, and facilities should be expanded or renovated on a large scale, with new equipment for research and laboratory work being furnished at the same time. It is to be noted that the existing computer system is out-of-date and far from meeting the present engineering requirements.

Based on the understanding of the existing facilities and equipment, for the establishment of new IEC, it is absolutely necessary to build an additional facility in the Samsen Compound. In the Pakret Compound, facilities for high priority sections such as Soil Engineering, Hydraulic Laboratory and others of the Research and Laboratory Division should be appropriately expanded. At the same time, supply of equipment is indispensable. After completion of the new facilities, the said Laboratories evacuate the space in the existing main building, which is planned to be remodeled and utilized for other research and laboratory work at the expense of the Thai Government as part of the overall scheme of this project.

As the results of the surveys and study, the following facilities and equipment are recommended.

1. Required Facilities to be Built

1)	Samsen Center	4,583 sq.m.
2)	Expansion of Pakret Research and Laboratory Division	3,897 sq.m.
	a. Research & Lab. Center	(1,356 sq.m.)
	b. Soil Engineering Test Lab.	(1,115 sq.m.)
	c. Hydraulic Model Test Hangar	(1,426 sq.m.)
	Total	8,480 sq.m.

2. Required Equipment to be Furnished

1) Equipment for Training
2) Equipment for Engineering Development
3) Equipment for Technical Calculation
4) Equipment for Soil Engineering Lab.
5) Equipment for Hydraulic Lab.

The construction of the above facilities and the supply of equipment on a grant basis requires approximately 16 months to complete.

We believe that the establishment of IEC as outlined above is the most timely and effective method of ensuring future promotion and development of agricultural policy in Thailand, and will also contribute to maintain friendly relation between the countries of Thailand and Japan.

Chapter 1 INTRODUCTION

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Following the request by the government of the Kingdom of Thailand, the government of Japan started a study on the appropriateness of grant aid for the construction of an Irrigation Engineering Center (hereinafter referred to as IEC or the Center) in the country, and the findings of the Basic Design Study (Phase I) ascertained that it would be appropriate for Japan to promote further study on the requested project.

The planned Irrigation Engineering Center purposes to develop appropriate technology and to upgrade the technical levels of the nucleus engineering staff, both of which are most imperatively needed for the future development of irrigation in Thailand, which has significant implications on the nation's agriculture development.

Another mission sent by JICA on February 18, 1983 has conducted Basic Design Study (Phase II) on the basis of the findings of the preceding study.

Through the discussions with the counterparts of Royal Irrigation Department (RID), the Ministry of Agriculture and Cooperatives, and the surveys performed at the proposed sites, the circumstances and details of the project became clearer to the mission members. Subsequently, both parties reached a basic understanding regarding the organization and functions of the Center as well as the priorities on the construction of the planned facilities. This understanding was then put into a minutes of discussions which were signed and exchanged on March 10, 1983 between Mr. Sunthorn Ruanglek, Director General of RID, and Mr. S. Nishide, representing Thai and Japanese sides respectively.

Based on the basic understanding and findings by the survey, a study was conducted to give a concrete form to the plan of this project and the results have been compiled into this report which defines the Basic Design of the facilities and equipment as well as the significance of the project.

For text of the minutes and records of the survey carried out in Thailand, refer to attached Appendices.

Chapter 2 BACKGROUND AND JUSTIFICATION

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2.1 Agriculture and Irrigation in Thailand

2.1.1 Outline

Agriculture in Thailand is the highest single source of income, accounting for 25% of the total income. Employment in agriculture totals 15.6 million which is approximately 70% of total employment.

The total cultivated area amounts to 147 million rai (23.5 million ha.) consisting of 84 million rai (13.4 million ha.) of paddy fields and 63 million rai (10.1 million ha.) of upland crop area. However, not a small slice of these areas are considered to be economically unsuitable for cultivation. Systematic improvement of those land seems to be difficult owing to the rapid increase of agricultural population. In recent years there has been a decline in the annual growth rate of agriculture, and a near-stagnant yield indicates that expansion of a new arable land has come to a halt.

On the other hand the production growth rate of upland crops, such as fruits, vegetable and oil crops has been increased. This suggest that the encouragement to use high yield seeds and chemical fertilizers is making effect. It may be concluded that in order to improve agricultural productivity in Thailand, it is necessary to raise the per rai yield. Regional crop distribution is as follows:

Table 2-1-1 Percentage of Production by Region (1975 ∿ 1979)

(%)

Crop/Region	North	Northeast	Central	South
Non-glutinous rice	25.6	16.8	49.3	8.3
Glutinous rice	35.3	63.6	0.2	0.9
Maize	54.2	14.7	31.1	-
Sweetpotato	8.0	3.6	88.4	-
Kenaf	4.4	92.7	2.9	-
Cassava	7.7	19.1	69.6	3.6
Rubber	-	-	4.9	95.1

Aggregate crop distribution by region is 25% in North, 26% in Northeast, 35% in Central and 14% in South.

The annual production growth from 1972 to 1979 are 3.6% in North, 3.3% in Northeast, 7% in Central and 6% in South, and the share of the Central region is large.

2.1.2 Agricultural Productivity

In general, irrigation increases yield per rai of rice up to twice Yield per rai of other crops such as soya beans is also increased. Production in non-irrigated area is liable to be affected by weather. For example the rice production of 15.2 million tons in 1976 dropped to 12.3 million in 1977 as a result of the drought. In 1980 the floods due to heavy rain were the major reason for extremely low production of rice. For these reasons it is difficult to maintain stable production level as required.

The following table shows paddy production by cultivated area and yield per rai in the four regions:

Table 2-1-2

Regions	Cultivated Area (million rai) (million ha.)	Paddy Yield kg/rai (ton/ha)		
		1973∿76	1977∿1978	1981
North	33.4	3.62	3.41	3.43
	(5.34)	(2.3)	(2.1)	(2.1)
Northeast	60.2	2.00	1.66	2.24
	(9.63)	(1.3)	(1.0)	(1.4)
Central	35.1	3.06	3.04	3.02
	(5.62)	(1.9)	(1.9)	(1.9)
South	18.20	2.67	2.77	2.85
	(2.91)	(1.7)	(1.73)	(1.78)
Total	146.70			
	(23.47)			

In some Regions growth of yield is nearly minus and this poses a problem. Major reasons are firstly that high yield varieties have not been well utilized yet and secondly that fertilizer can not be used enough due to its high cost compared with relatively lower price of rice, owing to the fact that 60% of the fertilizer is imported. The production of other crops such as soya beans, cotton, maize and others have increased due to improved irrigation seeding methods, improved varieties and improved insecticide measures.

2.1.3 Regional Problems

(1) North: The lowlands along the rivers are considered as the main production areas for maize. Yield per rai of rice is relatively high due to some old existing irrigation facilities as this area was the first rice growing area in Thailand. If more proper dam sites in un-developed small basins are sought and developed and if the farmland become free from rain-fed conditions this region offers potential.

(2) Northeast: As shown in the tables above this region is the problem area to be improved. There are many farmland which has been turned from forest to farmland and not suitable for cultivation, and it is necessary to establish a long range plan for improvement of farmland. As the largest area of agricultural land is existing in this region, water resources should be secured much more actively in the future, so that the agriculture could be improved and stabilized. In parallel new varieties tolerant to drought and suitable for poor fertile soil are to be sought.

(3) Central: In the Central region many water reservoirs have been built in large scale and irrigation systems have been well developed as a target area for agricultural productivity improvement campaigns. However, there are still so many counter measures to be taken against problems in the north highland, flood in the central and saline soil problems in the coastal area of this Region.

(4) South: In the Southern region rainfall is sufficient and agricultural condition is not too bad. Major crops are paddy and rubber, and recently production of perennial crops, such as fruites, coffee and cacao have been much improved. If enough extension is provided, future improvement is expected.

2.1.4 Irrigation

Irrigation projects were started about eighty years ago and up to now the Thai government has invested 80 billion Bahts (800 billion yen). Today 60% of the budget of the Ministry of Agricultural and Cooperatives is allocated to RID.

Budget of RID has been increased from 3 billion Bahts in 1976 to 8.6 billion in 1983 with annual growth of approximately 27 per cent. The growth for large-scale projects were 16 per cent per annum, and for small-scale projects 20 per cent. Medium-scale projects were initiated since 1978 and its share has been gradually increased. (Note 1) The construction period is usually 4∿5 years for large projects, 2∿4 years for medium and one year for small projects. Most of the planned schedules in regard to the construction period have been maintained.

The projects are divided into the following categories:

(1) weir with irrigation canal
(2) dam & weir with irrigation canal
(3) pumps with irrigation canal
(4) drainage and flood protection

(1) and (4) are constructed in the South with heavy rainfall, (3) mainly in the Central flat region, and (2) mainly in Central region and also in the area with little rainfall in other Region. Accomplishments until 1980 were as follows:

Note 1: Sources: RID's budgetary documents

Table 2-1-4 Contents of Projects (Note 2)

Classification	Completed	Under Construction
Water Resources Development	27,420 million cu.m.	1,845 million cu.m.
Irrigation Development (Note 3)	16,000,000 rai	4,740,000 rai

Number of dams completed until 1980 is 870 as follows:

(1)	Capacity over 100 million cu.m.	16
(2)	Capacity over 1 to 100 million cu.m.	156
(3)	Capacity under 1 million cu.m.	698
	Total	870 (Note 4)

As a result, the total irrigated area has been increased to 16 million rai (2.56 million ha.). Of this figure 11∿12 million rai (1.76∿1.92 million ha.) is now possible to receive water in the rainy season and 4∿5 million rai (0.64∿0.8 million ha.) in the dry season. The total irrigated area is further classified as follows:

Level 1: Area with a complete irrigation system which has already been under land consolidation schemes, approximately 1 per cent.

Level 2: Irrigated area with ditches and dikes, but which has not been consolidated, approximately 52 per cent.

Level 3: Area with irrigation canals, but no ditches and dikes which has not been consolidated, approximately 28 per cent.

Level 4: Irrigated area with no canals, due to geographical obstacles, approximately 19 per cent.

Note 2: Same as above.

Note 3: Whether these figures include drainage system or not is not clear.

Note 4: Confirmed by the study team on RID's Dam Register.

Note 5: Source of other figures; the 5th NESDP.

2.2 Policy

2.2.1 The Fifth Five Year Plan (5th NESDP)

The developments in the past, especially that of large-scale water resources in the Central Region and expansion of new farmland all over the country, raised the farmer's motivation and increased the potential of Thai agriculture. However, they have caused the disparity between regions still higher than ever.

Recently, the expansion of new farmland has almost come to its limits. The constructions of large-scale reservoirs which demand for large baisen area become difficult owing to the facts that suitable sites become less than ever and also farmer's objections against it are coming out. Further large-scale projects take long period of time to be completed and to bear fruits.

These are the reasons why the policy direction of the Fifth National Economic and Social Development Plan(1982 - 1986, hereinafter referred to as the Fifth Plan or 5th NESDP), concerning to the irrigation development, has sifted to the development of medium - and small-scale water resources from the expansion of farmland and the development of large-scale resources. And the emphasis is put firstly on the development of the Northeast Region where its farmland accounts for 41 per cent of the nation's total, yet has a law share of only 26 per cent of the total agricultural production, and secondly on the North Region where the economic level is still low.

The Policy which closely relates to the present establishment of the Center set forth its targets and development measures as follows.

(1) Targets

The overall agriculture growth target is 4.5 per cent per annum with crops to be expanded by 4.7 per cent per year.

The overall productivity of economic crops will be expanded by 4.0 per cent per year with a special emphasis on productivity increase of paddy as it is the most important crop in the country. The followings are the targets for paddy productivity.

1) Targets for the yields of paddy during the Fifth Plan period are:

	Yield (kg/rai) 1981	1986	Average growth rate 1982 ∿ 1986 %
Paddy	290	336	3.0
- First crop	272	312	2.8
- Second crop	550	600	1.7

2) Targets for paddy productivity by regions are:

	1981	1986
First crop (kg/rai)		
Northeast	224	293
South	285	290
Central	302	320
North	343	355
Second crop (kg/rai)		
Northeast	500	500
South	480	480
Central	564	625
North	490	490

In order to provide consistency with production and productivity improvement targets, the natural resources management and efficiency improvement targets have been formulated. The 16 million rai of irrigated land will be further improved in order to create a complete irrigation system and increase land productivity. The improvement is classified as following categories:-

- Improve non-irrigated land to irrigated land of level 4 or level 3 in the Northeast, Upper Ping river basin, Pasak river basin and the South at an annual rate of 1 million rai. This will raise paddy productivity from 250 ∿ 300 kg/rai to 400 ∿ 450 kg/rai.

- Improve irrigated land from level 3 to level 2 in the Central region by 500,000 rai per year. This will raise paddy productivity from 390 kg/rai to 480 kg/rai.

- Improve irrigated land in water abundant areas from level 2 to level 1 in the North by 50,000 rai per year. This will raise paddy productivity from 480 kg/rai to 600 kg/rai.

- Expand area under irrigation through water pumping projects using electricity for the Northeast and other regions in areas where there is sufficient water by 200,000 rai per year. This will raise paddy productivity from 300 kg/rai to 500 kg/rai.

- Expand area under irrigation through small water resources projects by 50,000 rai per year. This will raise paddy productivity from 250 kg/rai to 400 kg/rai.

To this end, the existing dams or reservoirs like Lampao dam and Lamdom noi dam will be fully utilized in accordance with the operational targets above.

(2) Development measures

In order to implement the said targets, the Fifth Plan set forth various development measures. The measures which relate to irrigation development are the items concerning to the efficiency improvement of the natural resources utilization and research and extension, which is formulated as follows:

1) Water resource is a basic factor for raising productivity, particularly for paddy. Thus, during the Fifth Plan period, the following water resource development measures will be implemented:-

a) Speed up the improvement of existing irrigated areas which total 16 million rai to provide maximum benefit, especially for dry season cultivation.

b) Speed up the development of neglected river basins to provide more benefit, especially Wang, Yom, Pasak, Sakaekrang, Bangpakong, Rayong, and Chantaburi river basins.

c) Accelerate the development and dispersion of small-scale water resources to non-irrigated areas to be used as additional water reserves in order to reduce the impact of climatic uncertainties.

d) Explore and develop a scheme to draw water from the mekhong river into Chao Phya river plain and the Northeast for long term irrigation purposes.

e) Collect water charges in irrigated areas in order to create water utilization efficiency and introduce cost recovery principle for further expansion in these areas.

f) Improve the organizationnal structure and management of various government organizations concerned with water resource management at both the policy and operational levels in order to systematically coordinate water resource development works in each river basin, and to decentralize authority for small projects to the local level. This will enable the provinces to participate in project management from the project initiation stage onwards to construction and maintenance stages.

2) Research and extension

Productivity increases through water resources development and efficiency improvement of the utilization of land and water, has a limited scope. It is essential to simultaneously develop in other supplementary factors of production, particularly research and extension. Thus, it is necessary to speed up the research and extension using modern technology with the following measures.

Speed up the formulation of the national agricultural research plan to be used in the coordination of research projects of various institutions both domestic and foreign, the priority ranking of research works, and in the management of research work to provide consistency with major issues which are consistent in each locality. Emphasis should be placed on yield improvement in rainfed areas by concentrating on major crops; for example, paddy capable of withstanding drought and saline soil; high yield cash crops; and perennial crops (by speeding up the production of high quality shoots or branches). This should be consistent with the variety of crops which will promote further agricultural diversification.

2.2.2 Budget

The budgetary allocation for the large-scale development projects of this fiscal year (1982∿83) is 2.2 billion Bahts with an increase of 90 million Bahts over the previous year and for the medium- and small-scale development projects 2.0 billion Bahts with an increase of 180 million. The higher increase of the latter reflects the shift of the policy which seeks for quick results. Further this means the direction of emphasis have been changed from depending on foreign technology to the development by themselves.

Here we can see RID's strong resolve and determination to accomplish this great task through the measures which is formulated as the objectives of the establishment of the planned Center.

The budget allocations of RID in the past and its forecast in the future are shown in the Fig. 2-2-2 and the Table 2-2-2 on the following pages.

2.3 The Royal Irrigation Department (RID)

2.3.1 Organization

Since the establishment of the Royal Canal Department in 1902, the organization of the Royal Irrigation Department (RID) has gone through several changes as the number of personnel grew and the scope of activities expanded. As indicated in Fig. 2-3-1, the current organization (as of February 1982) is composed of 22 Divisions of the Head Office and 12 Regional Offices. The organization was last reformed in 1975, however, needs for further reorganization have arisen in recent years. RID is currently planning to carry out a restructuring with the aid of the International Bank for Reconstruction and Development (the World Bank), which will take at least another three years to complete. The establishment of the planned Engineering Center would be part of the structural reform now under way. Of the 22 Divisions of RID, the three Divisions, namely Project Planning Division, Design Division and Research and Laboratory Division, would be subject to reform with the present establishment of IEC.

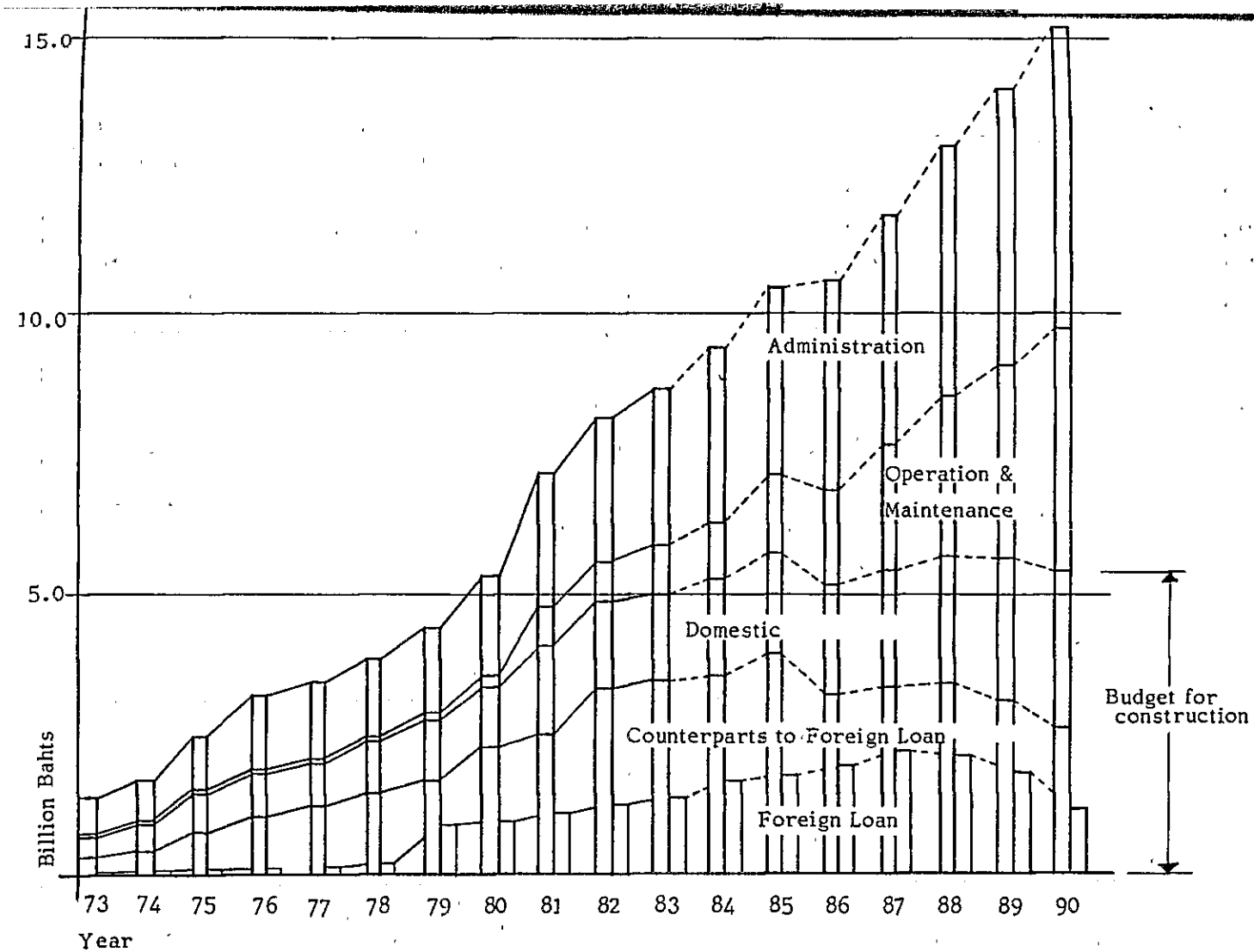

Fig. 2-2-2 Budget Allocation of RID

(1973-1982: Actual & 1983-1990: Forecast)

Note: This figure does not include the foreign aid (loan), but its past performance is shown in the following table. Counterparts construction is of the foreign aid.

Table 2-2-2 BUDGET ALLOCATION OF RID

(1973-1982: Actual & 1983-1994: Forecast)

Unit: 1,000 Bahts

Year	Administration	Operation and Maintenance	Domestic for Construction	Counterparts Foreign Aid to for Construction	Foreign Aid for Constructions (Loan)	Total (loan not included)
ACTUAL						
1973	716,319	41,756	336,718	299,035	20,077	1,393,830
1974	818,084	42,791	431,737	401,856	28,108	1,694,469
1975	1,096,734	41,100	621,917	729,450	52,201	2,489,201
1976	1,400,457	67,292	694,872	1,049,725	99,848	3,212,347
1977	1,450,364	102,107	698,534	1,216,575	115,730	3,467,581
1978	1,544,751	107,474	874,142	1,443,266	228,130	3,969,634
1979	1,770,214	105,196	848,286	1,727,773	905,848	4,451,470
1980	1,991,421	104,893	982,700	2,297,527	937,138	5,376,544
1981	2,478,504	788,580	1,390,225	2,507,882	1,120,500	7,165,193
1982	2,558,525	875,890	1,403,140	3,327,831	1,288,182	8,165,387
FORECAST						
1983	2,792,121	940,917	1,400,231	3,513,337		8,646,000
1984	3,071,333	1,176,146	1,540,254	3,591,618		9,379,000
1985	3,378,466	1,470,182	1,694,280	3,914,199		10,457,000
1986	3,716,313	1,837,727	1,863,708	3,193,865		10,611,000
1987	4,087,944	2,297,158	2,050,079	3,353,759		11,788,000
1988	4,496,738	2,871,447	2,256,086	3,381,053		13,005,000
1989	4,946,411	3,589,308	2,480,595	3,045,875		14,062,000
1990	5,441,052	4,486,635	2,728,655	2,571,800		15,228,000
1991	5,985,157	5,608,293	3,001,520			
1992	6,583,672	7,010,366	3,301,672			
1993	7,242,039					
1994	7,966,242					

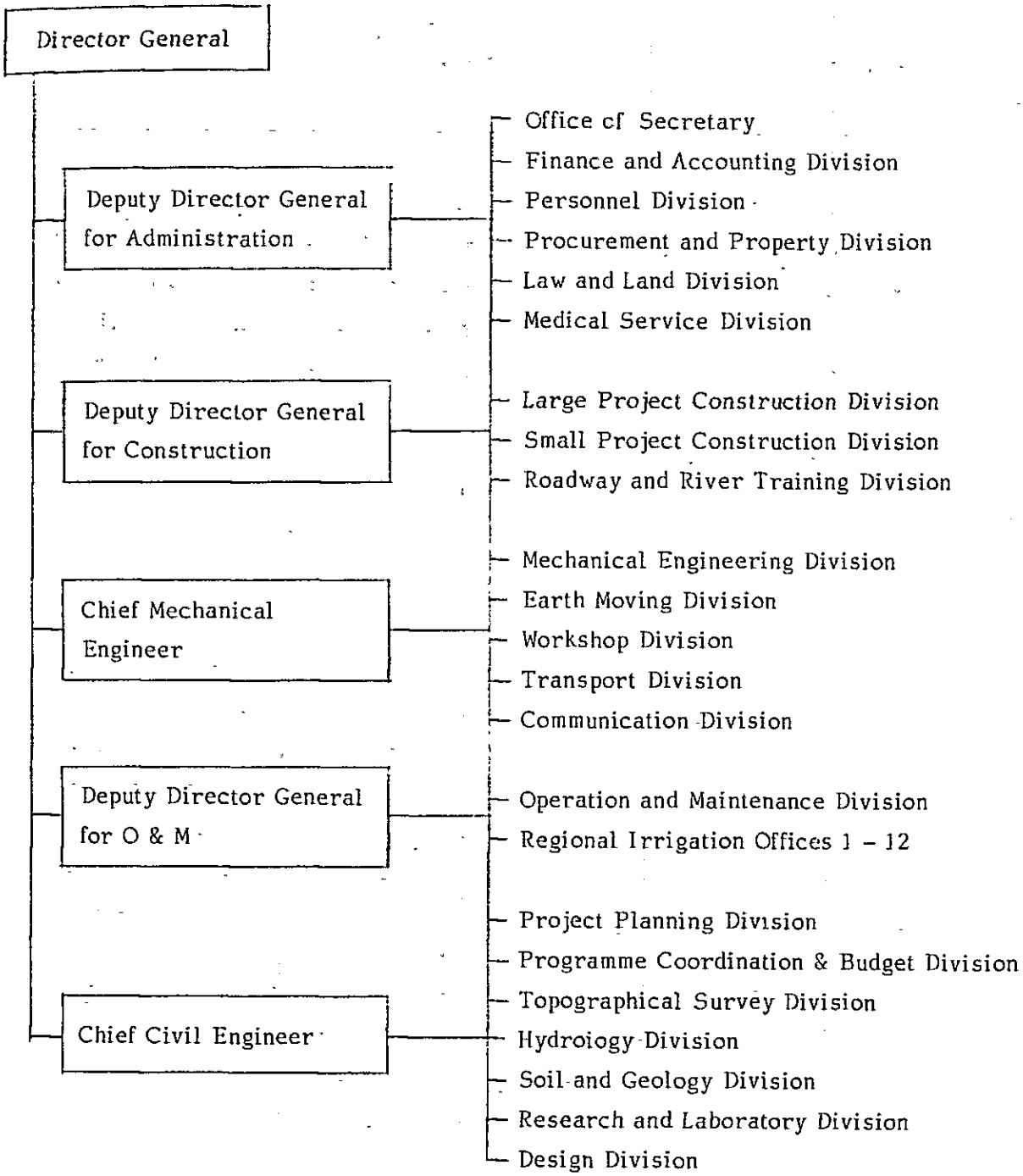

Fig. 2-3-1 RID Organization (as of February 1983)

2.3.2 Facilities

Head office of RID is now located in two separate places, i.e. at Samsen in Bangkok and at Pakret, the outskirts of the city. (See Fig. 2-3-2-(a).)

1) Samsen Compound

Samsen Compound with an area of 10 ha. is as shown in Fig. 2-3-2(b). Main building is a four-story building while most of the other buildings are single storied except for a few 2-story structures. The layout of the divisions and sections is extremely mixed in confusion, and the office area is very crowded as well. The existing computer room is located at Project Planning Division in the Compounds, however, the small area of 200 sq.m. is fully packed with the computer hardware and bookshelves. The computer system has been on rental from IBM since 1968. (See 3.6.2 (3) Table 3-6-2(a).)

2) Pakret Compound

The Pakret Compound located approximately 17 km away from the Samsen Compound occupies a vast area of about 400 ha. The Compound includes a temple, schools, hospital and workships, in addition to some offices of the Head Office. Also situated in the Compound are Research and Laboratory Division and part of the facilities of Design Division. The details on the test equipment that Research and Laboratory Division currently owns are given in Appendices. This Division is becoming underequipped in terms of its facilities, thereby requiring an across-the-board remodelling and extension. In parallel to the present project, a remodelling work for the existing facilities is being planned. (See Appendices.)

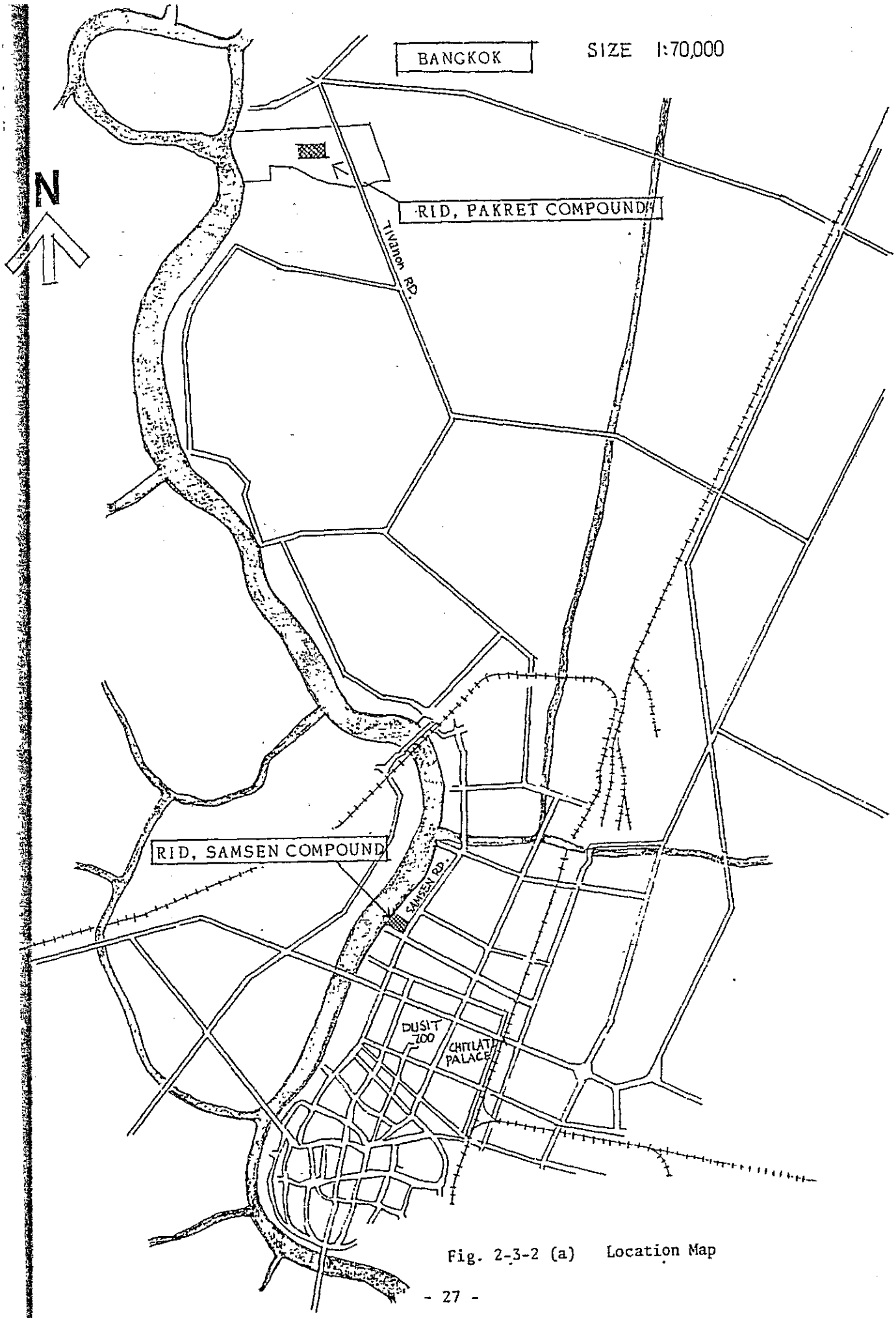

Fig. 2-3-2 (a) Location Map

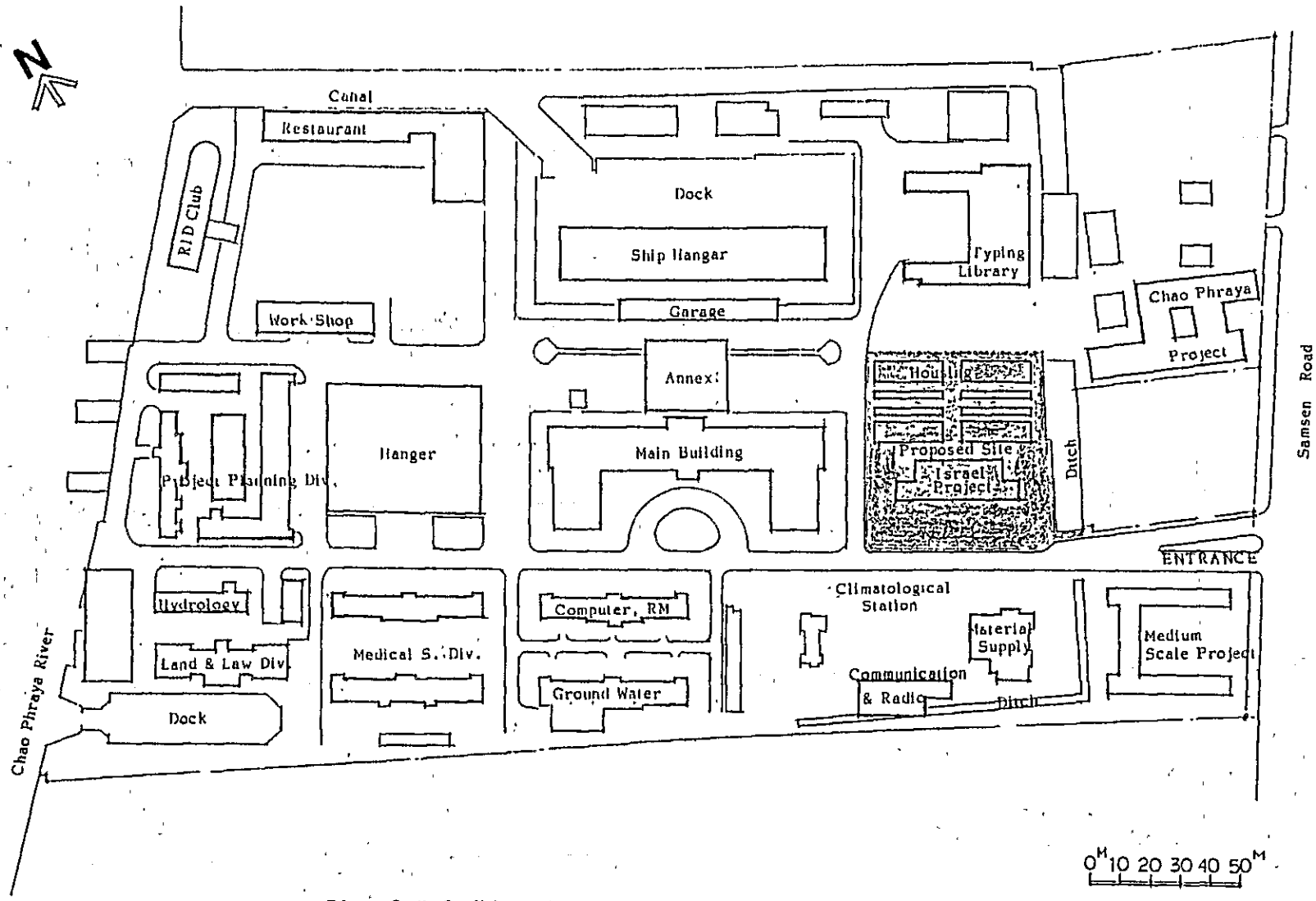

Fig. 2-3-2 (b) Samsen Compound

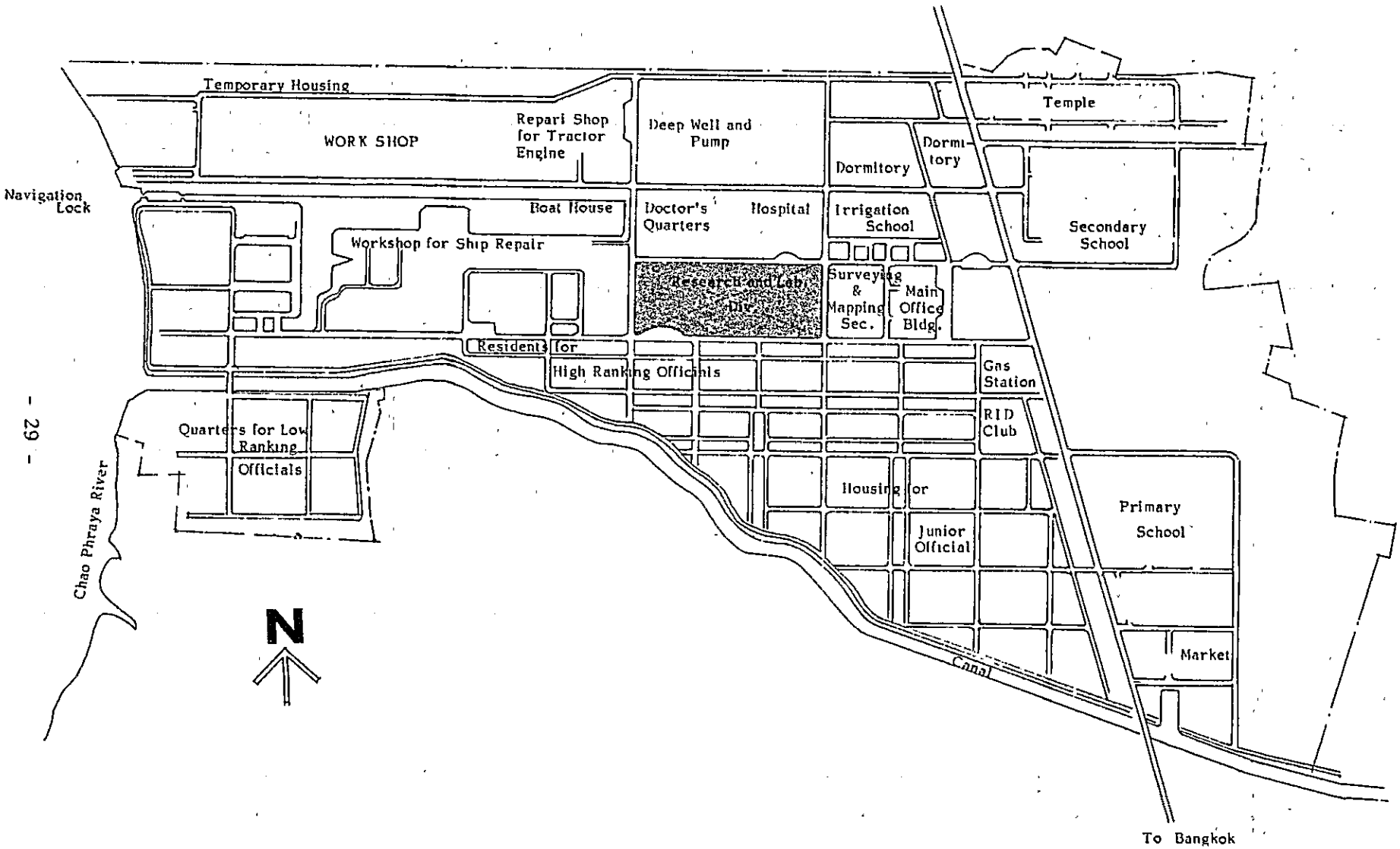

Fig. 2-3-2 (c) Pakret Compound

0 10 20 40 M

2.3.3 Personnel

The personnel working for RID across the nation numbers 78,000, of which 5,300 are officials, and 31,000 are permanent employees, and 41,700 are temporary employees. The number of personnel in individual Divisions is shown in Table 2-3-3(a) and Table 2-3-3(b) shows the number of officials by grades. As is pointed out, the organizational expansion have resulted in a shortage of the middle-rank management staff (grades 8 and 9). The divisions which subject to a major reform under the present project are Project Planning Division, Design Division and Research and Laboratory Division.

2.3.4 Technology

RID which has a history of nearly 80 years behind it have accumulated various technology and technical information through the past development projects and the technology transfer via foreign consultants. The organization, however, has not been successful in organizing and taking advantage of such accumulation. At the present, both the technology and technical information are scattered among individual engineers, regional offices and project offices. Take for an example, a vast amount of technical data of the past projects are lying unclassified in a warehouse of the Head Office in Samsen Compound.

2.4 Justification of the Project

RID is the largest Department in the Ministry of Agriculture and Cooperatives having approximately 78,000 personnel working at the Bangkok offices, 12 regional offices and project site offices. About 60 per cent of the total budget of the Ministry is earmarked for the RID accounts.

However, apart from its own resources, RID has been heavily dependent upon the technology and personnel supplied by foreign consultants in the development of irrigation in the past because of its extremely large scale of the projects and necessity of loans for them from foreign countries. As a result, various foreign technologies and

Table 2-3-3(a) NUMBER OF PERSONNEL

Division/Office	Number of Employee			
	Officials	Permanent Employees	Temporary Employees	Total
Director General	1	–	–	1
Deputy Director Generals	3	–	–	3
Chief Civil Engineer	1	–	–	1
Chief Mechanical Engineer	1	–	–	1
Office of the Secretary	20	279	282	581
Finance and Accounting	212	204	–	416
Personnel	40	87	–	127
Procurement & Property	177	250	62	489
Laws and Land	80	150	324	554
Medical Service	181	210	8	399
Project Planning	112	79	17	208
Programme Coordination & Budget	74	178	–	252
Topographical Survey	278	839	1,450	2,567
Hydrology	78	499	203	780
Soil & Geology	129	327	180	636
Research & Laboratory	38	147	74	259
Design	285	289	109	683
Large Project Construction	579	2,218	10,640	13,437
Small Project Construction	587	2,072	4,984	7,643
Roadway and River Training	116	1,338	3,175	4,629
Mechanical Engineering	222	1,125	1,639	2,986
Earth-Moving Equipment	116	2,236	2,955	5,307
Workshop	71	854	589	1,514
Transport	68	864	324	1,256
Communication	12	107	67	186
Operation & Maintenance	625	1,683	2,662	4,970
Regional Irrigation Offices	1,181	14,970	11,883	28,034
Total	5,287	31,005	41,627	77,919
			Say	78,000

Source: Royal Irrigation Department
Organization and Administration Study, Mar. 1979

Table 2-3-3(b) NUMBER OF OFFICIALS IN GRADE-LEVEL

Division		Level 10	9	8	7	6	5	4	3	2	1	Total
Top Management		1	5	–	–	–	–	–	–	–	–	6
Office of the Secretary		–	–	–	–	2	4	4	4	2	4	20
Finance and Accounting		–	–	1	–	8	29	32	70	48	24	212
Personnel		–	–	–	1	5	7	3	17	6	1	40
Procurement and Property		–	–	–	1	3	23	22	70	37	21	177
Law and Land		–	–	–	1	5	42	5	16	8	3	80
Medical Services		–	–	1	10	13	10	22	18	25	82	181
Project Planning		–	–	–	1	12	29	11	44	14	1	112
Programme Coordination & Budget		–	–	–	2	7	22	10	18	9	6	74
Topographical Survey		–	–	1	–	13	17	22	95	108	22	278
Hydrology		–	–	1	–	4	16	4	28	16	9	78
Soil and Geology		–	–	1	–	6	14	19	40	34	15	129
Research and Laboratory		–	–	1	–	7	10	5	11	3	1	38
Design		–	–	1	2	23	62	41	106	41	9	285
Large Project Construction		–	–	1	7	30	42	72	218	118	91	579
Small Project Construction		–	–	1	1	14	25	13	142	129	262	587
Roadway and River Training		–	–	1	1	4	17	7	48	35	3	116
Mechanical Engineering		–	–	1	1	10	12	46	91	34	25	222
Earth-Moving Equipment		–	–	1	2	5	13	20	43	26	6	116
Workshop		–	–	1	1	2	8	11	22	12	14	71
Transport		–	–	–	1	4	9	10	22	15	7	68
Communication		–	–	–	–	1	1	2	3	5	–	12
Operation and Maintenance		–	–	1	3	17	36	53	274	212	29	625
Regional Irrigation Office	1	–	–	–	1	2	7	7	25	8	–	51
do	2	–	–	–	1	2	7	9	26	29	2	76
do	3	–	–	–	1	2	9	9	14	31	8	74
do	4	–	–	–	1	4	4	8	25	26	8	76
do	5	–	–	–	1	3	8	5	22	24	11	74
do	6	–	–	–	1	7	8	8	29	9	2	64
do	7	–	–	–	1	16	6	27	98	68	43	259
do	8	–	–	–	1	11	6	19	71	46	48	202
do	9	–	–	–	1	5	6	15	30	33	14	104
do	10	–	–	–	1	9	7	11	36	40	4	108
do	11	–	–	–	1	2	4	7	10	12	9	45
do	12	–	–	–	1	2	3	12	11	18	1	48
TOTAL PERSONNEL		1	5	14	47	261	523	571	1799	1281	785	5,287
UNFILLED POSITIONS		–	–	–	–	–	13	25	463	879	848	2,228
TOTAL POSITIONS		1	5	14	47	261	536	596	2262	2160	1633	7,515

* As of Mar. 1979

domestic one co-exist in this field, and although the technical competence and information are accumulated through the past projects, they are scattered among a handful of small individual staff groups or each office and each project site rather than centrally managed and readily accessible. In terms of manpower, it cannot be denied that the overall technical levels of the engineering staff of middle ranks are short of what is required for the future expansion of development projects.

As seen above, RID has yet to resolve some organizational problems before it can proceed with the extensive development of small- and medium- scale projects, which are expected to grow in number and also change in nature in the coming years. To this goal, the RID is currently making an effort to reorganize itself so that it can develop and promote appropriate technology, bring about an efficient dissemination system of engineering information and initiate a new structure to develop necessary manpower. The establishment of the Irrigation Engineering Center is one of the crucially required components of the ongoing reform.

The main office of RID is located at Samsen in the city of Bangkok and its Research and Laboratory Division is situated in Pakaret, outskirts of Bangkok. The facilities in Samsen compound are already overcrowded to the extent that it is impossible to manage to make room for the additional functions of the new Center. The same holds true for the existing facilities in Research and Laboratory Division. In order for this Division to function properly under the new Center, substantial extension and remodelling of the existing buildings along with the installation of new laboratory equipment would be required. It is also pointed out that the existing old computer system is inappropriate to perform necessary technical calculations.

The current situation of facilities and equipment in RID requires the construction of new buildings at Samsen and the extension of facilities of such sections as Soil Engineering and Hydraulic Engineering as well as some other equally high-priority section. The installation of new equipment will also be necessary in these new facilities.

Chapter 3 PLAN OF THE CENTER

Chapter 3 PLAN OF THE CENTER

3.1 Objectives

The objectives of the planned Center shall be to perform systematically the following functions in each technical area of research, survey, planning, designing and construction in order to reinforce RID's capabilities in response to diverse needs arising from the nature of development projects in the future and to technology required therein as well as to the increase in the number of projects.

1) To collect and centralize technical data and information currently mothballed at various places and to reorganize them so that such data and information can be readily available whenever and wheresoever required.

2) To develop irrigation development technology adapted to local needs and conditions such as climate, geography and so forth (hereinafter referred to as "appropriate technology"), and further to strengthen the capabilities of research and test of each technological area.

3) To set up engineering criteria of each technical area and to develop design standards.

4) To provide technical training for engineers, putting emphasis on nucleus engineering staff.

5) To establish a section to cope with special engineering problems.

3.2 Organization

The organizational structure is indicated in Fig. 3.2 on the next page. The post of Director of the Center will be concurrently held by Chief Civil Engineer. Coordination with the divisions of RID will be secured through the Board of Directors. The coordination between Technical Training Branch and Personnel Division of RID will be made directly. The existing Research and Laboratory Division will be transferred to the jurisdiction of the planned Center. The same applies to the existing Library as well.

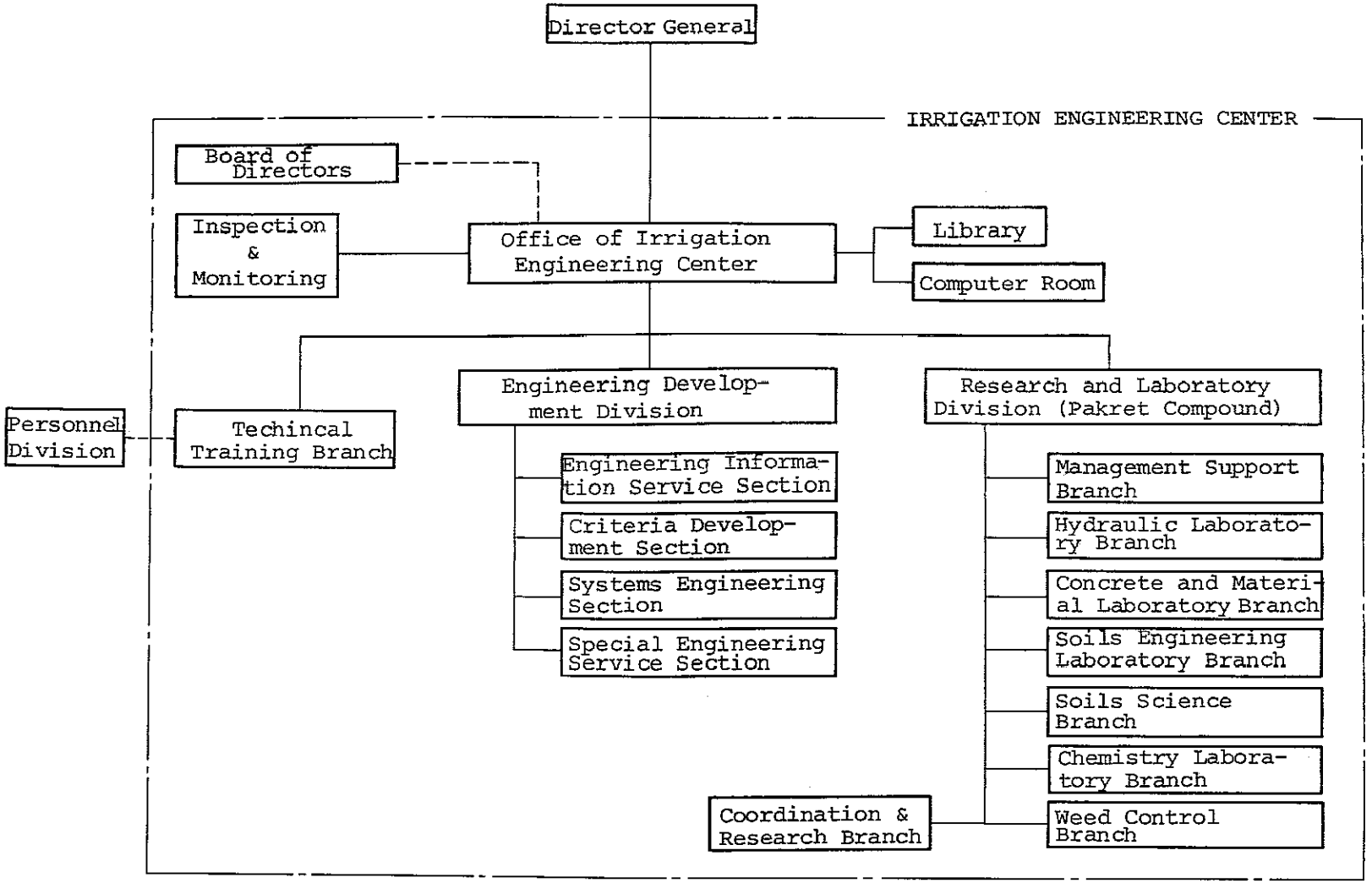

Fig. 3-2 Organization Chart of the Irrigation Engineering Center

3.3 Function

The function and job description of each section of the Center are planned as follows:

Table 3-3 Function and Job Description of the Sections

Division/Section	Function and Job Description
1. Office of Irrigation Engineering Center	1) Secretarial services for board of Directors
	2) Coordinative and liaison services to the divisions of RID and the Sections within IEC
	3) Inspection & Monitoring for evaluation of projects, and research and development work within IEC from engineering and technical point view
	4) Library services
	5) Computer services for engineering
	6) Preparation of training plan
2. Engineering Development Division	
a. Engineering Information Services Section	1) Collection and processing of existing engineering data and information
	2) Retrieving and providing engineering information
	3) Maintenance of retrieving system
b. Criteria Development Section	1) Preparation of criteria for: i. Planning ii. Design iii. Cost estimate iv. Specification v. Construction supervision
	2) Preparation of design standard
c. System Engineering Section	1) Rearrangement and filing of the following basic data i. Meteorological data ii. Hydrological data iii. Cost estimate iv. Other basic data and information

(Cont'd)

Division/Section	Function and Job Description
	2) Development of system analysis i. Hydrological analysis ii. Hydraulics analysis iii. Structural analysis iv. Cost analysis v. Other engineering analysis
d. Special Engineering Service Section	1) To study and develop new technologies 2) To solve urgent and high technical problems
3. Research and Laboratory Division	1) In addition to current research and testing activities following items are reinforced. i. Quality control of earth embankment for large-scale fill type dam ii. Hydraulic model test for spill way and intake iii. Utilization of computer for hydraulic model test
4. Technical Training Branch	1) Preparation of implementation programmes and its implementation for: i. Basic Engineering Course (a) Irrigation & Drainage (b) Machinery (c) Surveying ii. Medium Course (a) Design and Cost Estimates (b) Mechanized Construction iii. Senior Course (a) Computer (b) Dam (c) Gate and Pump (d) Others

3.4 Staff Allocation

The staff allocation required for the Center is as shown in Table 3.4 of the following page. The present staff allocation for Research and Laboratory Division, however, will remain as same in the new Center. The rest of the Center's staff will be provided mainly from the Design Division of RID, and to a lesser degree from other related Divisions.

3.5 Training Plan

3.5.1 Planned Training System

(1) Basic Conditions

The technical training program aims at training approximately 1,500 engineering staff per year. They are officials and permanent employees ranking from Grade I to V, and section chiefs are principally extempted from the regular training courses.

Age zone of trainees shall be between 18 to 40 years for high-school graduates and 22 to 35 for university graduates, and trainees should complete specified courses from Junior to Senior. Management staff older than 40 years may be allowed to participate in the management training course conducted by the nation wide annual conference of the Regional Offices and also they shall be responsible for advising younger engineering staff on their trainings from the view point of senior management.

Fields of engineering is divided into three sectors; 1) civil engineering, 2) mechanical engineering and 3) surveying. Further each of the sectors are classified into three grades of junior, intermediate and senior classes. Quorum of one class is approximately 40 members. Terms are 2∿8 weeks for short courses and 20 weeks for more intensive courses and differ by respective subjects. However the civil engineering staff should take an additional course of engineering fundamentals after completion of the junior course. According to the planned schedule, it takes five years for short-term groups and nine years for long-term groups to complete one training cycle. Thus the refreshment training cycles will repeat continuously.

Table 3-4 Staff Allocation Plan

Division/Section		Chief Civil Engineer	Division Director	Section Chief	Technical Personnel	Clerical Personnel	Other	Total
1. Office of IEC	Total							(48)
1) Director General's Office		1				1		2
2) Administration Section				1		10	8	19
3) Technical Inspection Section				1	4	2		7
4) Library				1		2		3
5) Training Section				1	6	9		16
2. Engineering Development Division	Total							(89)
1) Division Director's Office			1			1		2
2) Engineering Information Service Section				1	12	6		19
3) Criteria Development Section				1	28	6		37
4) Systems Engineering Section				1	21	4		26
5) Special Engineering Service Section				1	7	3		11
3. Research & Laboratory Division	Total							(167)
1) Division Director's Office			1			1		2
2) Administration Secton				1		5	3	9
3) Hydraulic Model Laboratory				1	8	3	28	40
4) Concrete-Material Laboratory				1	6	3	10	20
5) Geological Laboratory				1	18	6	6	31
6) Soil Laboratory				1	12	2	19	34
7) Water Analysis Laboratory				1	5		10	16
8) Weed Control Laboratory				1	4		9	14
Grand Total								(346)

Note: Most of the clerical personnel indicated under 3. Research and Laboratory Division above will work in the office of Administration Section.

Civil engineering course will be conducted at Samsen Compound, and the mechanical and the surveying at Pakret because these some courses include field trainings and laboratory tests. Summary of overall training plan is shown in Table 3-5-1(a).

The training terms are decided according to the total amount of the terms in which the trainees have practiced their jobs. These will be 5 to 6 percent of the latter terms for highschool graduates and will amount to 14 months until they will become senior. For university graduates, 3 to 4 percent and 9 to 10 months.

Particulary, staff assigned to the Regional Offices and project sites is busy in dry seasons, so effective use of rainy seasons has to be taken into account.

Although details of curricula for respective courses should be decided finally by the lecturers in charge and also be subeject to the future technical assistance programme, tentative curricula are prepared as shown in the paragraph 3.5.2.

In respect to the implementation of the training programme Technical Training Branch will be established within the Center at Samsen and liaison officers will be assigned to the Management Support Section at Pakret to maintain good coordination and relationship with the Personnel Division of the Head Office to carry out and complete perfect execution of the training programme.

(2) Participants

All necessary personnal data and information for the officials were available in the Head Office of RID, so it is possible to analyse and classify participants by division, by grade, by sectors, such as Civil, mechanical and surveying in order to prepare complete assignment schedule for training. However as for the permanent employee only available was division-wise population. So we estimated multipliers in per cent to figure out expected number of participants based on the available figure provided by divisions. Approximately a half of the total civil engineering staff assigned to the Regional Offices are engaged in operation and maintenance work at site, so 50 per cent of them are assumed as the target of this training programme.

Number of participants was figured out and summarized in the four tables of "Classification of Trainees by Speciality and Grade", 3-5-1-(b) to (e). Table (b) shows summary of calculation in result based on estimated number of participants and classified in three sectors. Table (c) shows basic number of trainee of officials (Civil Servant) and permanent employee respectively. High ranking officers or engineering management staff should have much wider engineering knowledge, so some of civil engineers should take mechanical engineering courses and vice versa. Table (e) shows the rate of speciality component. Those rates are applied on the calculation as shown in the Table 3-5-1-(d), Details of Permanent Employee.

(3) Training programme

Quorum of trainee for one class is 40 members except for laboratory tests and field trainings. For there special trainings the class is divided into two groups of twenty members each. The grade corresponding to training courses are, for example, the trainees must attend all classes for junior training courses of civil engineering within seven years after leaving from highschool. This period correspond to the Grade I-10 to III- 1 on the official "Salary Table".

Especially the junior training courses are important, so attendance rate is estimated at as high as 90%.

Training schedule throughout the year is shown in Fig. 3-5-1.

3.5.2 Curricula

Curricula for the Training in three sectors by three courses, junior, intermediate and senior, are planned tentatively suggested in detail as follows:

(1) Civil engineering

1) Junior course

a) Trainee:

Highschool Graduate: After one year service and below 24 years old.

University Graduate: Soon after engaged.

Table 3-5-1-(a)

T R A I N I N G P L A N

COURSE		GRADE	COURSE				PARTICIPANT		
			No. of Trainee	No. of Class	Frequency	Terms (week)	Total	Year	Annual
CIVIL ENGINEERING	Junior Training	I,II,III(1)	40	2	6	2	5,040	7	720
	Foundamental	III(2),IV(1)	40	2	2	20	960	6	160
	Intermediate	IV(2),V(1)	30	1	4	8	600	5	120
	Senior	V(2)	15	1	2	4	150	5	30
	Subtotal								1,030
MECHANICAL ENGINEERING	Junior	I,II,III(1)	40	1	4	2	1,120	7	174
	Intermediate	III(2),IV	20	1	3	8	540	9	60
	Senior	V	15	1	1	4	105	7	15
	Subtotal								249
SURVEYING	Junior	I,II,III(1)	40	1	3	2	840	7	120
	Intermediate	III(2),IV	20	1	2	4	360	9	40
	Senior	V	15	1	1	2	105	7	15
	Subtotal								175
Total									1,454

Table 3-5-1-(b) CLASSIFICATION OF TRAINING TARGETS BY SPECIALITY & GRADE (SUMMARY TABLE)

Category	Office	Salary Grade						Remarks
		Total	V	IV	III	II	I	
1. Civil Engineering Staff	Head	7,500	496	1,171	2,342	2,154	1,337	(Actual)*
	(Regional)	(6,365)	(378)	(980)	(1,773)	(1,834)	(1,400)	50% of above
	Regional	3,183	189	490	887	917	700	
	Sub total	10,683	685	1,661	3,229	3,071	2,037	
2. Mechanical Engineering Staff	Head	3,537	232	565	1,012	995	733	
	Regional	894	53	132	249	260	200	
	Sub total	4,431	285	697	1,261	1,255	933	
3. Surveyor	Head	1,322	72	209	344	455	242	
	Regional	1,511	80	233	444	448	306	
	Sub total	2,833	152	442	788	903	548	
4. Total	Head	12,359	800	1,945	3,698	3,604	2,312	
	Regional	5,588	322	855	1,580	1,625	1,206	
	Total	17,947	1,122	2,800	5,278	5,229	3,518	

* Regional staff of engineering field in charge of planning, design and/or construction shares about 50%, and shall be the objective of training. Remaining 50% is in charge of operation and maintenance and out of the objective.

Table 3-5-1-(c)

CLASSIFICATION OF TRAINEE BY SPECIALITY & GRADE

(Total Number of Trainee, Officials & Permanent)

Classification	Office	Salary Grade						Remarks
		Total	V	IV	III	II	I	
(CIVIL SERVANT)*								
1. Civil Engineering	Head	3,113	277	513	1,025	837	461	
	Regional	1,125	116	194	201	262	352	
	Sub total	4,238	393	707	1,226	1,099	813	
2. Mechanical Engineering	Head	780	95	154	181	164	186	
	Regional	145	16	20	24	35	50	
	Sub total	925	101	174	205	199	236	
3. Surveying	Head	391	26	71	63	174	57	
	Regional	24	5	8	0	4	7	
	Sub total	415	31	79	63	178	64	
Total	Head	4,294	398	738	1,269	1,175	704	
	Regional	1,294	137	222	225	301	409	
	Total	5,588	535	960	1,484	1,476	1,113	

Table 3-5-1-(c) cont'd

Classification	Office	Salary Grade						Remarks
		Total	V	IV	III	II	I	
(PERMANENT EMPLOYEE)**								
1. Civil Engineering	Head	4,387	219	658	1,317	1,317	876	
	Regional	5,240	262	786	1,572	1,572	1,048	
	Sub total	9,629	481	1,444	2,889	2,889	1,924	
2. Mechanical Engineering	Head	2,757	137	411	831	831	547	
	Regional	749	37	112	225	225	150	
	Sub total	3,506	174	523	1,056	1,056	697	
3. Surveying	Head	931	46	138	281	281	185	
	Regional	1,487	75	225	444	444	299	
	Sub total	2,418	121	363	725	725	484	
Total	Head	8,075	402	1,207	2,429	2,429	1,608	
	Regional	7,576	374	1,123	2,241	2,241	1,497	
	Total	15,551	776	2,330	4,670	4,670	3,105	

Note: * Source: Personnel Division, RID, as of February 1983.
** Estimated and analized from Table 3-5-2-(d) and Table 1. Number of Personnel.

Table 3-5-1-(d) CLASSIFICATION OF TRAINING TARGETS BY SPECIALITY & GRADE
(Detail of Permanent Employee)

Classification of Speciality	Office & Div. concerned **	Salary Grade						Remarks
		Total	V	IV	III	II	I	
Speciality Component	Rate	100%	5%	15%	30%	30%	20%	
1. Civil Engineering	Head Office							
	Civil Engg.	4,178	219	658	1,317	1,317	878	
	Mech. Engg.	211						
	Regional Office	5,240	262	786	1,572	1,572	1,048	
	Sub total	9,629	481	1,444	2,889	2,889	1,926	
2. Mechanical Engg.	Head Office							
	Civil Engg.	418	137	410	821	821	547	
	Mech. Engg.	2,318						
	Regional Office	749	37	112	225	225	150	
	Sub total	3,485	174	522	1,046	1,046	697	
3. Surveying	Head Office							
	Civil Engg.	418	46	138	276	276	185	
	Surveying	503						
	Regional Office	1,497	75	225	449	449	299	
	Sub total	2,418	121	363	725	725	484	
Total	Head Office	8,046	402	1,206	2,414	2,414	1,610	
	Regional Office	7,486	374	1,123	2,246	2,246	1,497	
GRAND TOTAL		15,532	776	2,329	4,660	4,660	3,107	

Note: * Basic figure of permanent employee (Source: Operation and Administration Study, RID, March 1979)
Staff number in division concerned on:

Civil Engineering	8,356
Mechanical Engineering	4,215
Surveying	839
Regional Office	14,970

** Rate of Speciality Components: See Table 3-5-1(e)

Table 3-5-1-(e)

RATE OF SPECIALITY COMPONENT

Unit: %

Speciality	Head Office			Regional Office
	Divisions concerned to Civil Engineering	Divisions concerned to Mechanical Engg.	Survey Division	
Civil Engineering	50	5	0	35
Mechanical Engineering	5	55	0	5
Surveying	5	0	60	10
Others	40	40	40	50
Total	100	100	100	100

Courses		No. of Participant	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Terms (week)	Location
Civil Engineering	Junior	40 x 2													2	Samsen
	Foundamental	40 x 2													20	"
	Medium	30													8	"
	Senior	15													4	"
Mechanical Engineering	Junior	40													2	Pakret
	Medium	20													8	"
	Senior	15													4	"
Surveying	Junior	40													2	Pakret
	Medium	20													4	"
	Senior	15													2	"
Seasons			Dry Season						Rainy Season							

Fig. 3-5-1 Training Schedule

b) Curricula and terms:

o Basic Research Method(I); Geophysical research
..... 1 week

o Basic Research Method(II); Hydrological research
..... 1 week

o Survey; Preparation of survey reports and application
..... 2 weeks

2) Fundamental course

a) Trainee:

Highschool Graduate:

Experience: After 5 to 7 years services on the job

Age : 23 ∿ 30 years old

University: Not necessary to take this course graduate

b) Terms: 20 weeks

c) Curricula:

o Applied Hydraulics(I); Fundamentals of Hydraulics and Hydrology

o Construction Practice(I); Basic problems at the construction site

o Engineering Structures(I); Fundamentals on engineering structures

o Computer(I); Computer programming

o Hydraulic Research Work; discharge flow measurement and nonuniform flow

o Soil Investigation; Grain size analysis, single and triaxial tests

o Material Test; Concrete mixing test and steel bars

o Research and Investigation(II); further detail in advanced courses

3) Intermediate course

a) Trainee:

Highschool graduate:

Age : 30 to 35

University graduate:

Age : 25 to 30 years old

b) Terms: 8 weeks

c) Curricula:

- o Design of Head Works; Standard design of head work
- o Design of Small Dams; Standard design of dam
- o Design of Canal Works; Standard design of canal
- o Design of Water Management Facilities; Standard design of water management facilities
- o Applied Hydraulics(II); River and Ocean engineering
- o Engineering Structures(II); Soil mechanism and foundation work
- o Computer(II); Numerical analysis
- o Construction Practice(II); Foundation, mass concrete and temporary works at site

4) Senior course

a) Trainee:

Highschool graduate:

Age : 35 to 40

University graduate:

Age : 35 to 40

b) Terms: Total 4 weeks, twice of 2 weeks course

c) Curricula:

- o Trend of Newly Developed Technology(I); Soil engineering, foundation and construction method
- o Trend of Newly Developed Technology(II); Hydraulics and Hydrology

(2) Mechanical engineering course

1) Junior course

- o Construction Equipment in general
- o Operation of Equipment
- o Gate and Pump in general

2) Intermediate course

- o Maintenance of Diesel Engines
- o Maintenance of Pumps
- o Maintenance of Electric Motors
- o Maintenance of Construction Equipment
- o Maintenance of Agricultural Equipment

3) Senior course

- o Selection of Gates
- o Selection of Pumps
- o Construction Schedule of Construction Equipment

(3) Surveying course

1) Junior course

- o Leveling
- o Traversing
- o Measurement of distance

2) Intermediate course

- o Plane table survey
- o Triangulation survey

3) Senior course

- o Introduction to Aerial Mapping (preparation of specification for bidding)
- o Curve Setting
- o Introduction to Remote Sensing

3.5.3 Annual Expenditure for Training

Based on the tables and figures shown above further detail number of annual participants are developed as shown in Table 3-5-3(a).
The salaries and wages of the participants are borne by the divisions and sections where the participants belong to, so there is no extra training expenditure arisen except travel expenses, lodging and perdiem allowances for those who belong to the Regional Offices in remote area. The per diem and lodging allowances by Grade at present is as follows:

Grade	Allowances (Bahts)	
	Perdium	Lodging
I	30	60
II	40	60
III	50	80
IV	50	80
V	60	100

Necessary travel expense in addition to the above another 300 Bahts per person for round trip is taken into account on average. Table 3-5-3(b) shows calculation based on the above mentioned terms and conditions to estimate total figure of required recurring cost for the training on 1982 bases. Estimated total cost is Bahts 1,837,170.

Table 3-5-3 (a) Annual Participants

Unit: Bahts

	Name of Courses	Grade	Training (Days)	Travel Allowance	Number of Participants	Total Amount
Civil Engineering	Junior Course	I	13	1,410	90	126,900
		II	13	1,540	118	181,720
		III	13	1,910	23	43,930
		IV	-	-	-	-
		V	-	-	-	-
	Subtotal		39	4,860	231	352,550
	Foundamental Course	III	139	18,290	35	640,150
		IV	139	18,290	10	182,900
	Subtotal		278	36,580	45	823,050
	Intermediate Course	IV	55	7,370	29	213,730
		V		8,000	5	40,000
	Subtotal			15,370	34	253,730
	Senior Courses	V	27	5,060	13	65,780
	Subtotal		27	5,060	13	65,780
	Total					1,495,110
Mechamical Eugg.	Junior Course	I	13	1,410	14	19,740
		II	13	1,540	19	29,260
		III	13	1,910	4	7,640
	Subtotal			4,860	37	56,640
	Intermediate Course	III	55	7,370	10	73,700
		IV	55	7,370	4	29,480
	Subtotal			14,740	14	103,180
	Senior Course	V	27	4,520	2	9,040
	Subtotal			4,520	2	168,860
	Total					235,680

Name of Courses			Grade	Training (Days)	Travel Allowance	Number of Participants	Total Amount
Surveying	Junior Course		I	13	1,410	22	31,020
			II	13	1,540	32	49,280
			III	13	1,910	6	11,460
		Subtotal			4,860	60	91,760
	Intermediate Course		III	27	3,730	12	44,760
			IV	27	3,730	8	29,840
		Subtotal			7,460	20	74,600
	Senior Course		V	13	2,280	3	6,840
		Subtotal			2,280	3	6,840
	Total						173,200
GRAND TOTAL							1,837,170

Table 3-5-3 (b) Annual Travel Allowance for Regional Staff

	Name of Courses	Total	Grade V	Grade IV	Grade III	Grade II	Grade I	Product Rotal	Duration of Year
Civil Engineering	Junior Training Course	–	–	–	887 x 1/5 160/23	917 825/118	700 630/90	90%	7
	Foundamental Course	–	–	490x2/5 59/10	887x1/5 213/35	–	–	30%	6
	Intermediate Course	–	189x2/7 27/5	490x3/5 47/29	–	–	–	50%	5
	Senior Course	–	189x5/7 41/8	–	–	–	–	30%	5
	Annual Participants.	328	13	39	59	118	90		
Mechanical Eugg.	Junior Course	–	–	–	249x1/5 25/4	260 130/19	200 100/14	50%	7
	Intermediate Course	–	–	132 40/4	249x4/5 93/10	–	–	30%	9
	Senior Course	–	53 16/2	–	–	–	–	30%	7
	Annual Participants	53	2	4	14	19	14		
Surveying	Junior Course	–	–	–	444x1/5 44/6	448 224/32	306 153/22	50%	7
	Intermediate Course	–	–	233 70/8	444x4/5 107/12	–	–	30%	9
	Senior Course	–	80 24/3	–	–	–	–	30%	7
	Annual Participants	83	3	8	18	32	22		
Total		464	18	51	90	162	126		

3.6 Facilities and Equipment

3.6.1 Required Facilities

Except for the functions of Research and Laboratory Division, all the facilities of the Center will be constructed in Samsen Compound, which for the present will be referred to as the Samsen Center.

With respect to Research and Laboratory Division, the facilities related to Hydraulic Laboratory and Soil Engineering Laboratory will be constructed in the Pakret compound as new buildings independent of the existing facilities there. Also accommodated in the new building will include Administration Office, Concrete-Materials Laboratory and part of the training facilities. Taking advantage of the extra space created in the existing Main Building as a result of the transfer of the administration- and soil-related facilities, a project is planned to remodel that portion of the Main Building by local cost to expand and renew the rest of Research and Laboratory Division. (See Appendices.)

The required facilities for the Samsen Center and Pakret Laboratorys are studied and the results are listed with their requirements in the following pages. (Table 3-6-1)

The required floor areas per person for each purpose are mostly based on a design standard for the government office building in Thailand. The other required floor areas are based on Japanese standard or layout study.

The background, necessity and/or plans which are deleted from the following list are explained here as follows:

(1) Conference room in the office of IEC director:

The existing facilities in Samsen Compound are very limited in spaces for meeting. On the other hand, because Chief Civil Engineer who manages several divisions in RID will move into the Office of IEC Director, a conference room which could be used for the conference of senior officials of these divisions is strongly wanted for.

(2) Library:

RID has a small existing library with approximately 5300 books and with room space of approximately 80 m^2. However, it is obvious that it never meet the future demand for the library. On the other hand, a proper space for the large number of trainees to study by themselves are needed.

(3) Lecture rooms:

Number of rooms and the sizes are determined by the requirement of the training schedule. However, the schedule may be modified according to the circumstances that project sites where large number of trainees come from are busy in the dry season. The training may be concentrated in the rainy season, resulting in the necessity of additional facility. On the other hand, there is no conference hall in RID, which is wished for its large meeting held once a month on the average currently utilizing facilities of other departments. These are the reasons why a Lecture Hall is required. For A/V training Room and A/V Studio, refer to 3.6.2(1) Equipment for Training.

(4) Researcher's room (both in Samsen and Pakret):

Sometimes high technological researchs are needed in various phases of project, such as planning, design and construction phases. These rooms are prepared for the visiting researchers for this purpose.

(5) Copying service center:

Refer to 3.6.2(2) Equipment for Engineering Development.

(6) Soil engineering laboratory:

This Branch is to evacuate the laboratory in the existing Main Building in order to house the other Branch's laboratory in the space being remodeled. As to the requirements of the new laboratory and the activities of this section, refer to 3.6.2(4) Equipment for Soil Test. In each Test Laboratory, floor space for approximately 20 trainees is necessary in addition to the space for the tests.

(7) Concrete & material laboratory:

In the existing test laboratory building, there is a small room currently used for a engineers' study room which was originally built as a test piece storage. As a result, the test pieces are kept in a reservoir not appropriate for the ageing purpose. Consequently, a new study room is wanted to secure the storage space to be use for the test piece as is originally planned.

(8) Hydraulic engineering laboratory:

The activities of this laboratory are categorized as follows:

a) Studies on the hydraulic propriety of the hydraulic structures. Development of the shape and other fractures of the structures which are normally undertaken to determine the most effective use of the structures.

b) Studies on the bank erosion by model studies and investigation at site.

c) Studies on the existing irrigation structures by the models and field investigation for the purpose of increasing efficiency and decreasing the cost of maintenance and operation.

d) Studies on the existing irrigation structures for the purpose of decreasing the sedimentation.

e) Calibration of the irrigation structures not only to calibrate in the laboratory but also calibrate at site.

f) Training for RID students and the technicians of RID.

g) The existing workshop is responsible in construction of hydraulic models, produces flowmeters (Pitot tube), makes all facilities required for experiments.

At present this Branch has three test Laboratories and a workshop as follows:

	Floor Area
a) Standard Setup Laboratory in the existing Main Building	24 x 35 m
b) River Model Laboratory	10 x 96 m
c) Hydraulic Structure Laboratory (Hangar)	20 x 60 m
d) Workshop	10 x 30 m

After planned facilities are completed, the a) will be changed to other laboratory and the b) will be taken out for the new facilities. As a result, the Hydraulic Structure Laboratory and Workshop are left and can be utilized.

However, according to the investigation of the mission, the said Laboratory (hangar) is appeared to be inappropriate for the required high technological experiment owing to narrowness of the test area divided by a test channel which exists in the center of the hangar and inappropriateness of other requirements.

Consequently, a new hangar is necessary to comply with future engineering demand, which shall have a total floor area 20M x 60M divided into four test areas of 20M x 15M each with other relevant required facilities.

Table 3-6-1 Required Facilities

Groups and Rooms	Persons	Requirements	Calculation	Floor Area	
				Required (sq. m.)	Actual on the Plan
A. IRRIGATION ENGINEERING CENTER (IEC) Samsen Compound					
1. Office of IEC Director				(1,691.9)	(1,636.0)
1) Office of Director				(129.0)	(136.0)
Director's Room	1	Separate lavatory and drawing room required	30 sq.m. x 1	30.0	30.0
Secretary's Room	1	Reception and waiting chairs required	6 sq.m. x 1 + 2 sq.m. x 9	24.0	24.4
Conference Room	30	For in-house officers and outside guests	2.5 sq .m. x 30	75.0	81.6
2) Management Support Section				(111.0)	(108.8)
Chief's Room	1		12 sq.m. x 1	12.0	12.0
Office	10	Some meeting area required	4.5 sq.m. x 10 + 2 sq.m. x12	69.0	69.6
Filing Room		For documents and stationery		30.0	27.2
3) Inspection & Monitoring Section				(89)	(81.6)
Chief's Room	1		12 sq.m. x 1	12.0	12.0
Office	6	Some meeting area required	6 sq.m. x 4 + 4.5 sq.m. x 2 + 2 sq.m. x 12	57.0	54.4
Filing Room				20.0	15.2

Groups and Rooms	Persons	Requirements	Calculation	Floor Area	
				Required (sq. m.)	Actual on the Plan
4) Library				(231.0)	(217.6)
Reading Room	30	Wall side book shelves and display rack required	(1000/150 + 30/0.6) x 2.0	113.0	108.8
Chief's Room	1		12 sq.m. x 1	12.0	12.0
Office	2	Wall side book shelves and a copy machine to be installed	4.5 sq.m. x 2 + 9	18.0	15.2
Book Stocking Room		For 15,000 book and repair work room	15000/220 + 20	88.0	81.6
5) Technical Training Branch				(968.9)	(941.6)
Chief's Room	1	Some meeting area required	12 sq.m. x 1 + 2 sq.m. x 6	22.0	19.2
Office	9	Some area for meeting required	4.5 sq.m. x 9 + 2 sq.m. x 6	52.5	54.4
Lecturers' Room	10	In addition to in-house lecturers and anteroom for visiting lecturers	4.5 sq.m. x 10	45.0	38.4
Filing Room				25.0	19.2
A/V Studio	3	Some area for preparation & edition of traching materials required	See Layout Drawing	54.4	54.4
A/V Training Room	80		1.5 sq.m. x 8	120.0	108.8
2 Small Lecture Rooms	20 x 2	Platform are required	(2 sq.m. x 20 + 10) x 2	100.0	96.0
3 Lecture Rooms	40 x 3	Platform are required	(2 sq.m. x 40 + 10) x 3	270.0	285.6
Lecture Hall	300	In addition to training purposes to be used for nation-wide general assembly and all center staff meeting and others	0.7 sq.m. x 300 + 70	280.0	265.6
		Including stage, anterooms, warehouse and audio equipment			

Groups and Rooms	Persons	Requirements	Calculation	Floor Area	
				Required (sq. m.)	Actual on the Plan
6) Rooms for Visiting Specialists		For research and development of special projects		(163.0)	(150.4)
5 Researcher's Room	3 x 5	Movable partitions and some meeting area required	(6 sq.m.x3+2sq.m.x4) x 5	100.0	96.0
1 Large Research's Room	10	Some meeting area required	6 sq.m.x4+4.5sq.m.x6 + 2sq.m.x6	63.0	54.4
2. Engineering Development Division				(1,187.4)	(1,194.4)
1) Office of Director				(76.0)	(76.8)
Director's Room	1	Separate Lavatory and drawing room required	16 sq.m. x 1	16.0	16.8
Secretary's Room	1	Reception and waiting chairs required	6 sq.m. + 2 sq.m. x 2	10.0	9.6
Conference Room	25	For in-house officers and quests from outside	2 sq.m. x 25	50.0	50.4
2) Engineering Information Service Section				(463.0)	(464.0)
Chief's Room	1		12 sq.m. x 1	12.0	12.0
Office	18	Some meeting area required	4.5 sq.m. x 18 + 2 sq.m.x 12	105.0	96.8
Data Storage I		Storage for classified and compiled data and documents, also work area required	7,500 books/150	100.0	108.8
Data Storage II		Storage for not classified data and documents before compiling	15;000 books/150	100.0	96.0
Information Room	25	For information services to meet outside persons of the section	2 sq.m. x 25	50.0	54.4

Groups and Rooms	Persons	Requirements	Calculation	Floor Area	
				Required (sq.m.)	Actual on the Plan
Copying Service Center		Reproduction and copying services shall be centralized and all machinery and equipment to be installed here; a dark room and storage required	See Equipment Layout	96.0	96.0
3) Criteria Development Section				(257.0)	(259.2)
Chief's Room	1		12 sq.m.x 1	12.0	12.0
Office	36	Some meeting area required	6 sq.m. x 18 + 4.5 sq.m. x 18 + 2 sq.m. x 18	225.0	228.0
Filing Room				20.0	19.2
4) Systems Engineering Section				(299.9)	(299.2)
Chief's Room	1		12 sq.m.x 1	12.0	12.0
Office	13	Some meeting and work area required	6 sq.m. x 9 + 4.5 sq.m. x 4 + 2 sq.m. x 12 + 8	104.0	104.8
Data Storage Room			1,200 rolls/60	20.0	19.2
Operators' Room	4	Some work area required	4.5 sq.m. x 4 + 35.5	53.5	54.4
Data Entry Room	8	Some work area required	6 sq.m. x 8 + 8	56.0	54.4
Computer Machine Room			See Equipment Layout	54.4	54.4
5) Special Engineering Service Section				(91.5)	(95.2)
Chief's Room	1		12 sq.m. x 1	12.0	12.0
Office	10	Some meeting area required	6 sq.m. x 7 + 4.5 sq.m. x 3 + 2 sq.m. x 12	79.5	83.2

Groups and Rooms	Persons	Requirements	Calculation	Floor Area	
				Required (sq.m.)	Actual on the Plan
3. Common Use Facilities				(199.6)	(196.8)
1) Seminar/ Conference Room	25	Seminar for training and conference -for every day's adivities in IEC	2 sq.m. x 25	50.0	54.4
2) 2 Storage		For miscellaneous items		50.0	46.4
3) Maintenance Personnel Room	8	Maintenance engineers and technicians, including warehouse for equipment and tools	4.5 sq.m. x 8 + 6	42.0	38.4
4) Electric Room		Transformer and Switchgears	See Equipment Layout	57.6	57.6
TOTAL FLOOR AREA				3,078.9	3,027.2
4. Corridor, Stairs, Lavatory and others			50% of total required floor area	1,539.0	1,555.8
GRAND TOTAL in Samsen Compound				4,617.9	4,583.0

Groups and Rooms	Persons	Requirements	Calculation	Floor Area	
				Required (sq.m.)	Actual on the Plan
B. RESEARCH & LABORATORY DIVISION, Pakret Compound					
5. Management, Soil Engineering and Hydraulic Lab. Sections				(3,203.3)	(3,118.9)
1) Office of Director				(16.0)	(16.8)
Director's Room	1	Separate lavatory and drawing room required	16 sq.m. x 1	16.0	16.8
2) Management Support Section				(140.0)	(127.2)
Chief's Room	1		12 sq.m. x 1	12.0	12.0
Office	20	o Including some other personnel transferred from other sections o Receptional and Secretarial Service for training instruction o Including waiting chairs and area required	4.5 sq.m. x 20 + 2 sq.m. x 12 + 14	128.0	115.2
3) Technical Training Branch				(198.0)	(220.8)
2 Lectures Room	40 x 2	Audio-visual systems to be available Platform are required	2 sq.m. x 80 + 20	180.0	201.6
Lecturer's Room	3	Anterooms for visiting lecturers and stock room for training material	6 sq.m. x 3	18.0	19.2

Groups and Rooms	Persons	Requirements	Calculation	Floor Area	
				Required (sq.m.)	Actual on the Plan
4) Library				(80.0)	(76.8)
Reading Room	20	Office area and shelves for 1,000 books required	(1,000/150 + 20/0.6) x 2.0	80.0	76.8
5) Common Use Room				(78.4)	(76.8)
Conference Room	20	To be used for training sometimes	2 sq.m. x 20	40.0	38.4
Copying Service Room		Photo copy, blue print and storage	See Equipment Layout	19.2	19.2
Data Analysis Room			See Layout Drawing	19.2	19.2
6) Rooms for Visiting Specialist				(90.0)	(96.0)
Researcher's Room	3 x 5		(6 sq.m. x 3) x 5	90.0	96.0
7) Soil Engineering Lab. Section				(1,009.0)	(967.9)
Chief's Room	1		12 sq.m. x 1	12.0	12.0
Study Room	12	Some meeting area and book shelves required	6 sq.m. x 11 + 4.5 sq.m. x 1 + 2 sq.m. x 12 + 10	104.5	103.2
Assistant's Room	13		6 sq.m. x 13	78.0	69.2
Lab. I		Area for 20 trainees, testing and material and equipment	See Layout Drawing	92.2	92.2
Lab. II		"	See Layout Drawing	92.2	92.2

Groups and Rooms	Persons	Requirements	Calculation	Floor Area	
				Required (sq.m.)	Actual on the Plan
Lab. III		"	See Layout Drawing	92.2	92.2
Lab. IV		"	See Layout Drawing	92.2	92.2
Disburbed Sample Room		500 pcs. sample	0.2 sq.m. x 500	100.0	92.2
Disturbed Sample Preparation Room		Some area for equipment and material	See Layout Drawing	30.7	30.7
Undisturbed Sample Room		10 m long, 4 rows shelf	0.6 sq.m. x 40m	24.0	23.0
Undisturbed Sample Preparation Room		Some area for equipment and material	See Layout Drawing	23.0	23.0
Keeping Room		500 pcs. sample	0.2 sq.m. x 500	100.0	92.2
Accessory Storage		30 m long, 4 rows shelf	0.6 sq.m. x 120 m	72.0	61.4
Out-door Equipment Storage		40 m long, 4 rows shelf	0.6 sq.m. x 160 m	96.0	92.2
8) Hydraulic Lab. Section				(1,485.4)	(1,431.0)
Chief's Room	1		12 sq.m. x 1	12.0	12.0
Study Room	9	Meeting area and Book shelves required	6 sq.m. x 8 + 4.5 sq.m. x 1 + 2 sq.m. x 12 + 10	86.5	74.4
Assistant's Room	28		4.5 sq.m. x 28	126.0	80.7

Groups and Rooms	Persons	Requirements	Calculation	Floor Area	
				Required (sq.m.)	Actual on the Plan
In-door Model Test Hanger		20 m x 15 m experimental hanger required	(20 sq.m. x 15) x 4	1,200.0	1,203.0
Equipment Storage				60.9	60.9
Other Test Facilities					
Low Water Tank					
High Water Tank					
Pump Room					
Water Dist. System					
Recirculation System					
9) Concrete & Material Lab. Section				(86.5)	(86.4)
Chief's Room	1		12 sq.m. x 1	12.0	12.0
Study Room	7	Meeting area and Book shelves required	6 sq.m. x 6 + 4.5 sq.m. x 1 + 2 sq.m. x 12 + 10	74.5	74.4

Groups and Rooms	Persons	Requirements	Calculation	Floor Area	
				Required (sq.m.)	Actual on the Plan
10) Other Common Use Facilities				(20.0)	(19.2)
Storage for common use		For miscellaneous items		20.0	19.2
TOTAL FLOOR AREA				3,203.3	3,118.9
6. Corridor, Stairs, Lavatory and Others			50% total required floor area	1,601.0	778.1
GRAND TOTAL in Pakret Compound				4,804.3	3,897.0

3.6.2 Required Equipment

The following is the equipment required for the Center. As to the equipment in Research and Laboratory Division the necessity are studyed after assessing the existing equipment.

(1) Equipment for training

Audio-visual (A/V) equipment is employed to carry out the training effectively and efficiently. It includes the equipment necessary for the production of A/V teaching materials and is installed in a A/V Equipment Room. An A/V training room is planned for the exclusive use of training with A/V aid. A/V equipment is employed in the training room at Pakret and Lecture Hall in Samsen Center as well. For the use in the conference rooms and other training rooms at the Samsen Center a portable video unit is required to be equipped to take advantage of its merits.

For higher efficiency of office work related to the training, some office equipment is necessary.

(2) Equipment for engineering development

Micro-film processing equipment, a blue print machine, photo copy machines, a small offset press and small binding machine and other office equipment are necessary to serve the needs arising from the engineering information services, development work for technical criteria, standardization of design, library services, production of training materials and preparation of reports and conference materials.

(3) Equipment for techinical calculation (Computer)

1) Present situation

RID has had a IBM-1130 small computer at a computer center since 1968 on a rental basis.

The service of the computer center is limited mainly within technical & engineering calculation recently. Administrative use has been very limited in the scope, due to the existing machine's capacity.

a) Existing facilities and equipment

As of March-1983, RID's Computer Center has following equipment.

Table 3-6-2-(a)

IBM 029-A22	Card Punch	6 Nos.
IBM 029-C22	Card Punch	1 No.
IBM 059-001	Card Verifier	1 No.
IBM 059-002	Card Verifier	3 Nos.
IBM 083-001	Card Sorter	1 No.
IBM 1131-02B	CPU 8 kW	1 No.
IBM 1132-001	Printer	1 No.
IBM 1442-007	Card Read Punch	1 No.
Apple II (1-disk, 1-printer, 1-CRT)		1 set

The computer center occupies one wing of a building of Project Planning Division and total floor area of about 212 m^2. The area is subdivided as follows.

Computer Room	164 m^2
Branch Head office	16 m^2
Programing office	32 m^2
	212 m^2

All equipment and card, paper, desk, chair, tape disk etc. are there in above limited area.

b) Present staff

The center is a Branch under the Project Planning Division. The present staffing is shown in the following table.

Position	Number
1. Official	
- System Analyst	7
- Engineer	3
2. Permanent Employee	
- Operator	4
- Key Puncher	8
- Clerical Staff	4
Total	26

c) Computer usage

In Fig. 3-6-2(a) is shown the RID's IBM-1130 computer utilization in terms of machine hours*1 per year since 1977. Average of 1,716 hours per year is the same as the total available time of 1,715 hours in one year (7 hours by 245 work days). Considering daily maintenance time, idle time, etc., this is extremely high rate of utilization for the IBM-1130.

The present IBM-1130 could not absorb the expansion of RID's computer usage during last decade. Then RID have used outside computer belonging to other Government agencies such as NSO, EGAT. Fig. 3-6-2(b) shows this evidence. This Fig. shows the RID's computer utilization including outside computer utilization, in terms of machine charge per year since 1968.

The outside computer have been used for large size program, wide file access program such as aerial triangulation, payroll, water allocations which could not have been implemented on the IBM-1130.

*1: CPU working hours

Fig. 3-6-2(c) shows the computer usage by each job category in percentage during last six years. It can be seen that RID's IBM-1130 has been used mainly for planning, water management and data base.

d) Computer application

RID's computer center processes following major important application by own IBM-1130 and other agency's computer such as IBM-370, UNIVAC-1100.

- Pay roll
- Vouchers
- Budget report
- Project cost analysis
- Electricity billing
- Rainfall statistics
- Irrigation water requirements
- Reservoir operation
- System simulation model
- Flood routing
- Backwater program
- Project control system
- Canal design and earthwork
- Slope stability
- Topographical survey
- Socio-Economic farm survey
- Structural engineering system solver (STRESS)
- Flood forecasting
- Data storage and vertical

2) Need of new computer in IEC

As mentioned above, existing RID's IBM-1130 has no potential for new applications. It is absolutely needed to install a new computer system in the planned Center for developing new program, retrieving information and data and developing new technology which are the major functions of IEC.

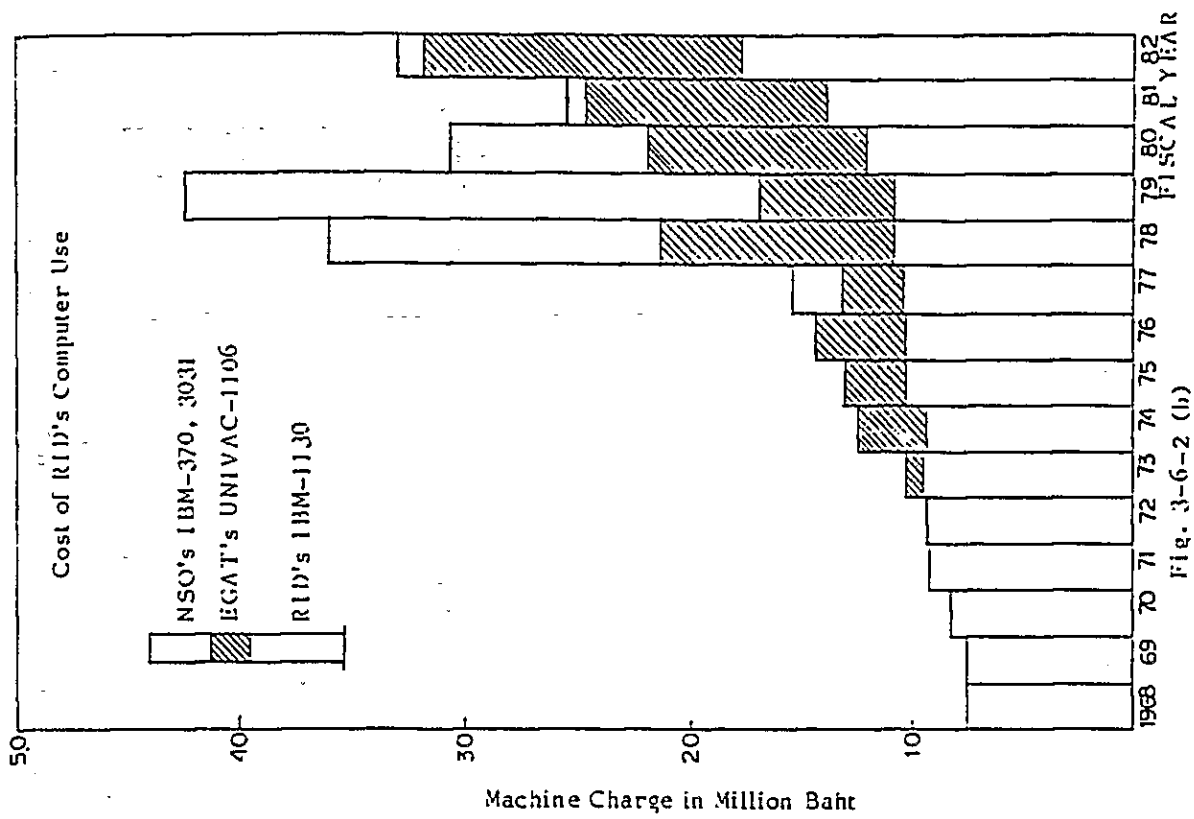

Fig. 3-6-2 (b)

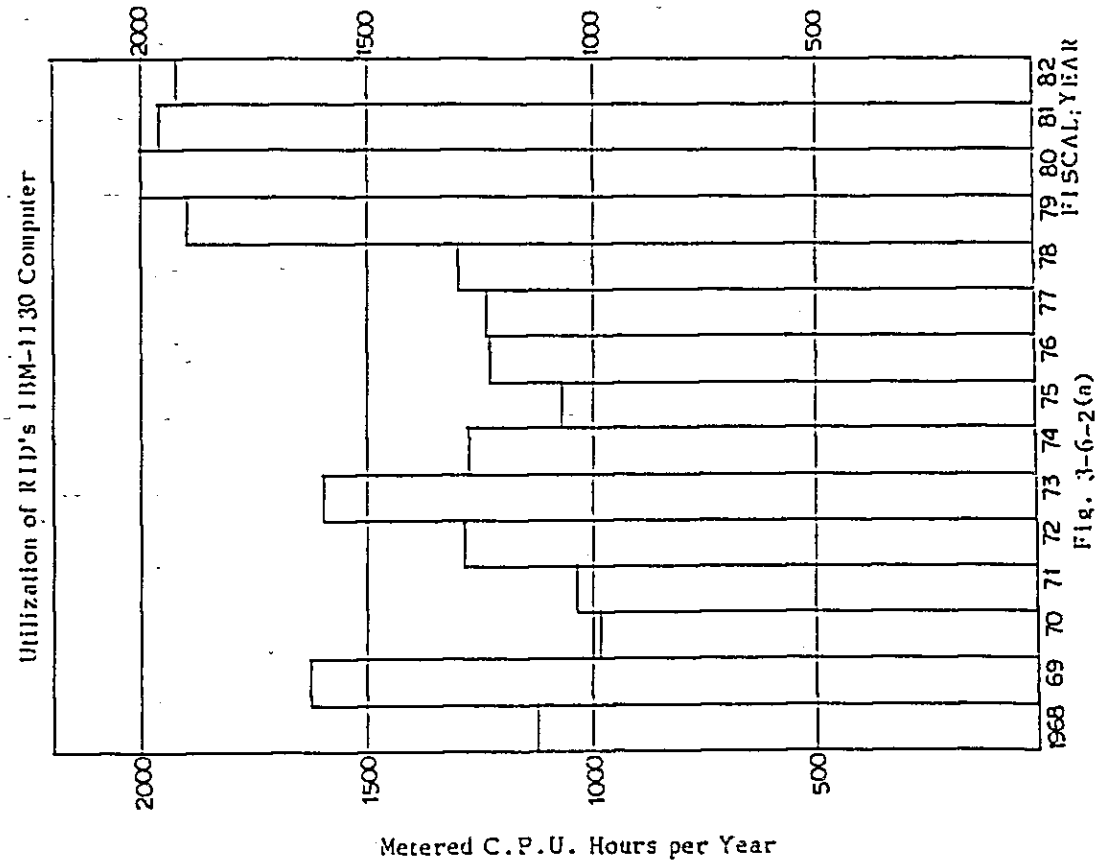

Fig. 3-6-2(a)

Computer Usage of RID by Job Category

in Percentage of Machine charge

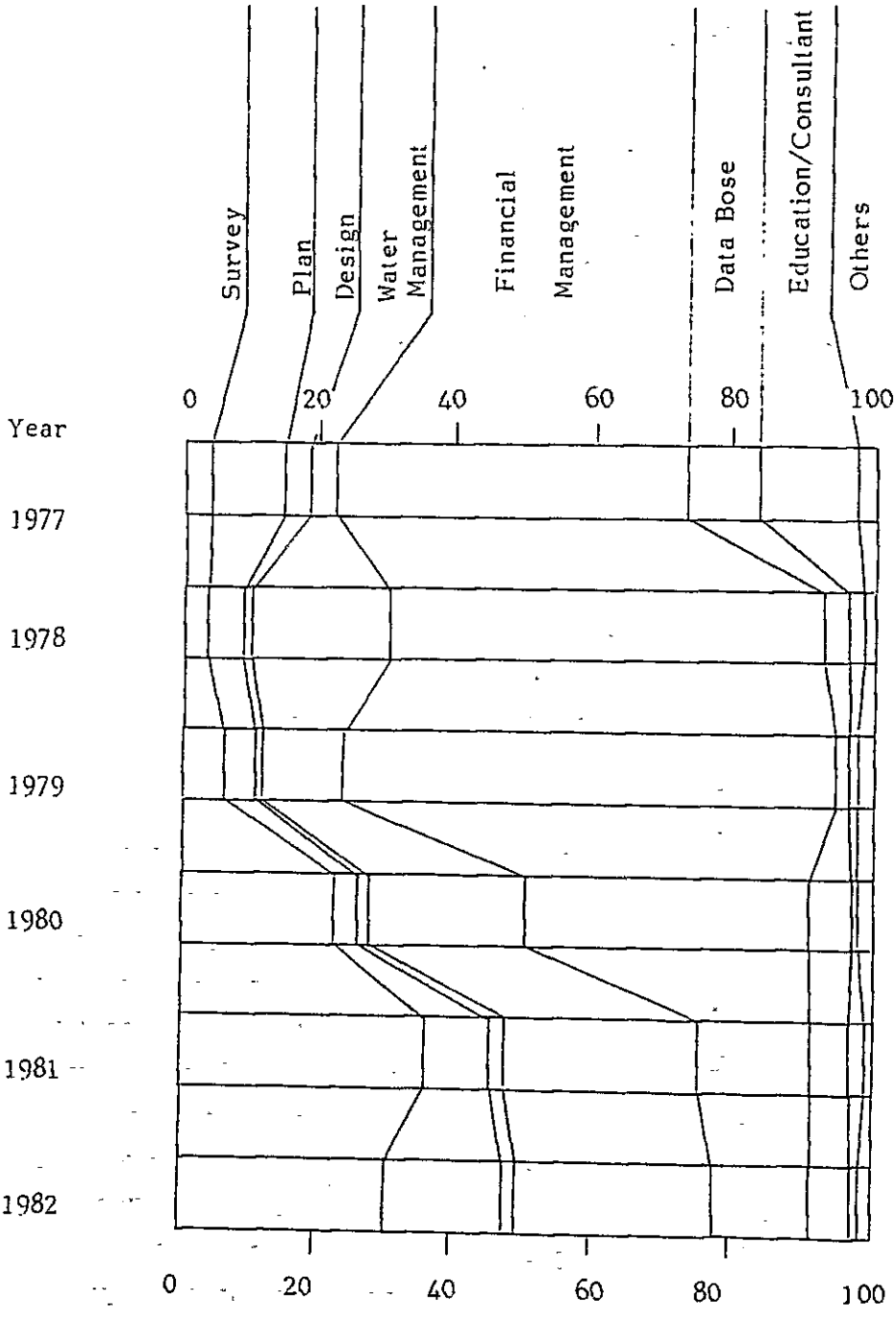

Fig. 3-6-2 (C)

Requirements of the new system shall be determined taking the activities in the following engineering areas into consideration.

Planning

At present, RID is making extensive use of both RID's own IBM and outside UNIVAC or IBM for the analysis in this field. Present applications consist of:

- Listing and analysis hydrological data
- Flood routing
- Computation of water surface profiles
- Ground water basin model
- Economic and financial analysis

The new IEC system will review existing applications and revise & redesign or develop new applications for effective usage of hydrological data, forecasting method, simulation model etc.

Specifically the new IEC system will be required for:

- Communication with the outside computers such as IBM, UNIVAC
- Use of existing programme packages for hydrology, flood control and other aspects related to water resources project.
- Graphical presentation of masses of input/output data on a display or plotter.

Design

Present IBM-1130 has limited hardware capability for developing applications in this field. It has been used only for the basic & principal applications. New applications which would save design costs and make possible more economical designs are:

- Dam design
- Road design
- Tunnel design
- Structural analysis
- Irrigation system design

Finite element method will be employed for analysing dams, tunnels, structures.etc.

To input the data of finite element method, a digitizer must be attached to this new system.

Construction

The most promising new applications in this field are:

- Scheduling construction equipment
- Equipment inventory and utilization
- Inventory of spare parts for construction equipment
- Net work scheduling

Data processing

There is a great potential for computer applications in this field. Experiences of various irrigation projects and studies could be sorted at IEC's new system and any RID staff could refer any kind of information to the new system. Major information reference are for:

- Meteorological and Hydrological data
- Personnel data
- Technical Book reference
- RID's construction know how
- Report reference

3) Minimum configuration

To meet the above requirement, the IEC's computer should have the following minimum configuration.

	Number
Central Processing Unit	1
Line Printer	1
Character Display	5
Disk Drive	2
X-Y Plotter	1
Digitiger	1
Graphic Display	1

(4) Equipment for soil test

Major laboratory equipment installed in the existing Soil Engineering Laboratory of Research and Laboratory Division at Pakret compound are as follows:

1) Triaxial test apparatus 4

3 are out of order and only one, British made, is working.

2) Consolidation test machine 1

Manufacturer: Soiltest Inc., Evanstone, Ill., USA.

3) Permiability test machine 1

Manufacturer: American Test Co., USA, installed 15 years ago.

4) Direct shearing test machine

Manufacturer: Soiltest Inc., Model D-120B

5) Oven

a) 2,400 W 1

Manufacturer: Modern Laboratory Equipment Co., Inc., New York, USA.

b) 1,200 W

Manufacturer: Soiltest Inc., Model L-72A

Most of the machinery and equipment were installed approximately 15 to 20 years ago, and imported from various countries, such as U.S.A., U.K., Japan and West Germany. Working conditions are not so good due to inadequate maintenance and lack of spare parts supply. Some of the machinery were installed provided under the foreign aids for particular development projects. Layout of the machinery and equipment are not well arranged from viewpoint of overall functional operation of the Laboratory.

However RID has ever recognized importance of the soil test from the view point of agricultural civil engineering, and basic engineering tests including triaxial test, compaction, consolidation, percolation and further liquidification have been conducted appropriately. So there

is no particular problem in operating laboratory test work even if expanded in the future, if appropriately qualified engineering staff could be assigned to new additional positions in time. So the problems would be summarized in two points, i.e., adequate supply and installation of necessary test equipment with appropriate facilities which should be expanded and establishment of well organized training programme.

Since future trend of development focused on the development of medium-and small-scale projects increased in number and expanded in area, a long range organizational and functional plan of Soil Engineering Laboratory shall be developed based on the following fundamental understanding:

1) Much quicker preparation of the soil test report in response to demands of the design sector.

2) Efficient execution of the soil test work in response to the increased job in the future.

3) Strengthening of no-the-job trainings at local job sites sending senior staff of the laboratory there.

4) As the final goal, simple soil testing job should be transferred to the Regional Offices when additional equipment could be properly installed there in the future.

In conformity with a long range development schedule when established in detail, the present Soil Engineering Laboratory should be equipped with latest equipment and machinery with appropriate facilities and also should senior staff be increased in number and their engineering standard strengthened more quickly and systematically. The section should perhaps become a national soil engineering center for the purpose of up-grading the present engineering level of geotechnical technology.

Major items of soild tests to be conducted are as follows:

1) Sieve Analysis
2) Hydrometer Analysis

3) Atterberg Limits
4) Soil Classification
5) Natural Moisture Content
6) Specific Gravity
7) Compaction
8) Unconfined Compression
9) Direct Shear
10) Triaxial Shear
11) Consolidation
12) Percolation and Settlement
13) C.B.R.
14) Relative Density
15) Field Density
16) Rapid Compaction Control
17) Pile Load Test

RID has realized the importance of soil testing, and the staff have overcome the present difficulties, such as poor maintenance situation of the test equipment due to insufficient spare parts and shortage of technical staff, and are working hard responding to requirements both from the design department and construction sites.

In order to improve present testing conditions, much advanced and more systematic technology which recently developed should be introduced to the processing lines, and simple and reasonable work-flow should be established. Installation of modern test equipment and construction of adequate facilities enabling staff to work under the much more comfortable circumstances than ever are the most urgent tasks to be given at present.

The above mentioned conditions should be taken into consideration and the necessary test equpment should be carefully selected.

(5) Equipment for hydraulic model test

A stationary type canal model for hydraulic tests is installed in the existing Laboratory Main Building. This shall be demolished prior to the construction of the new building, and a new model should be installed in the new hydraulic model test hangar for test, research and training purposes. Further a new set of measuring instruments shall be installed to collect more accurate and precise data from the tests conducted there. A micro-computer and programmable calculators should also be provided for future simulation study.