NO. 04

BASIC DESIGN STUDY

FOR

THE CONSTRUCTION MACHINERY

TRAINING CENTER PROJECT

IN THE ISLAMIC REPUBLIC OF PAKISTAN

JULY 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

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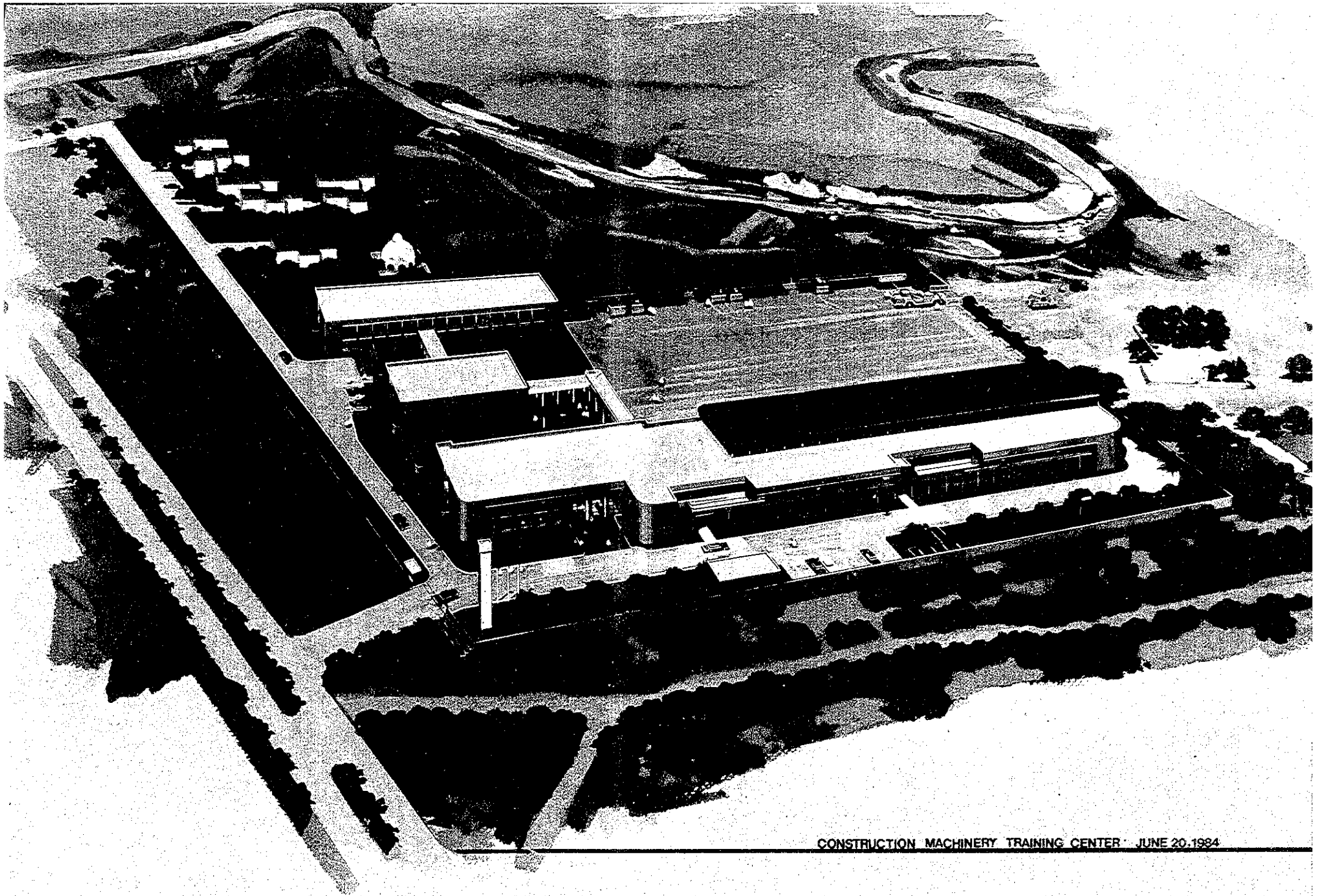
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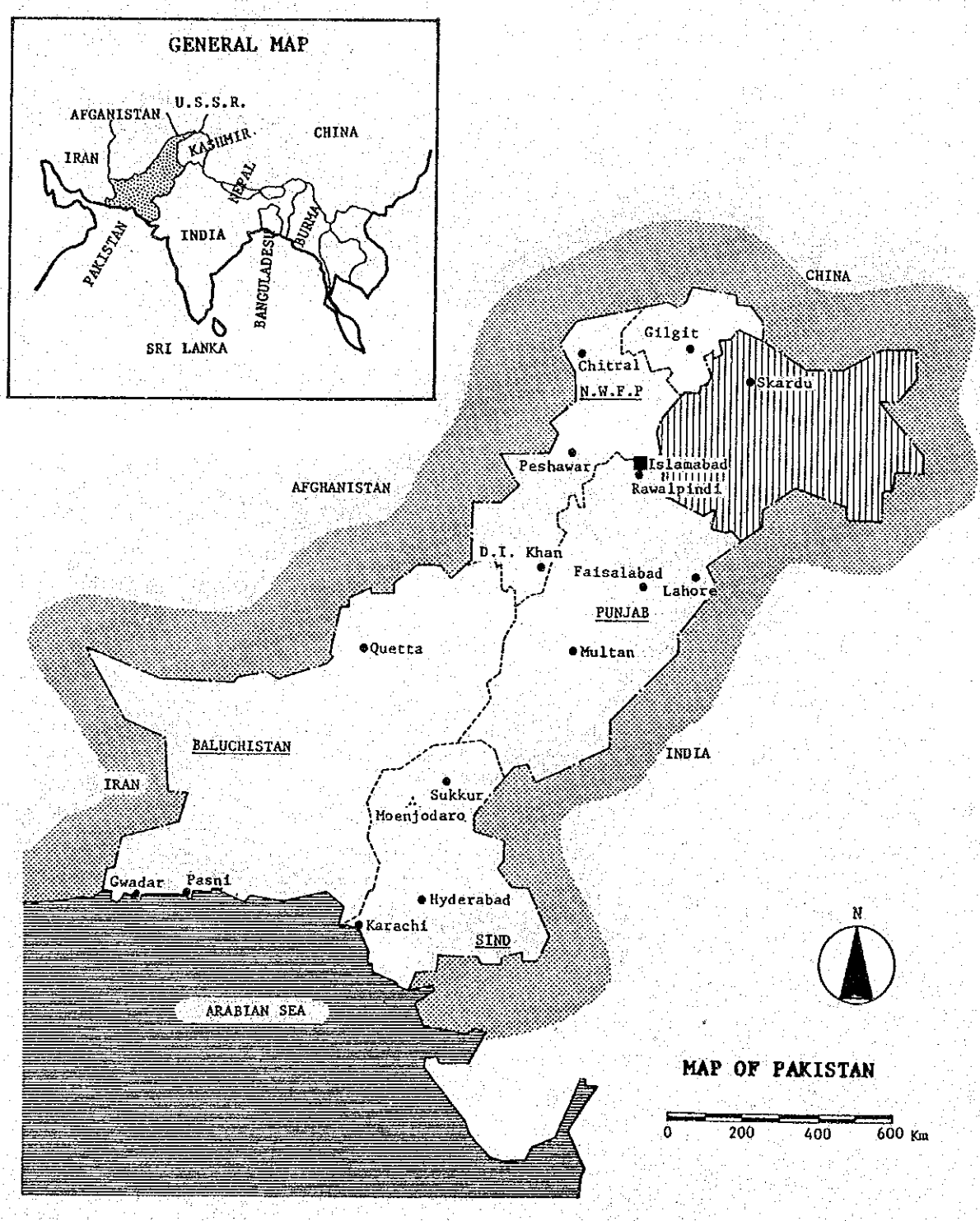
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Rawalpindi
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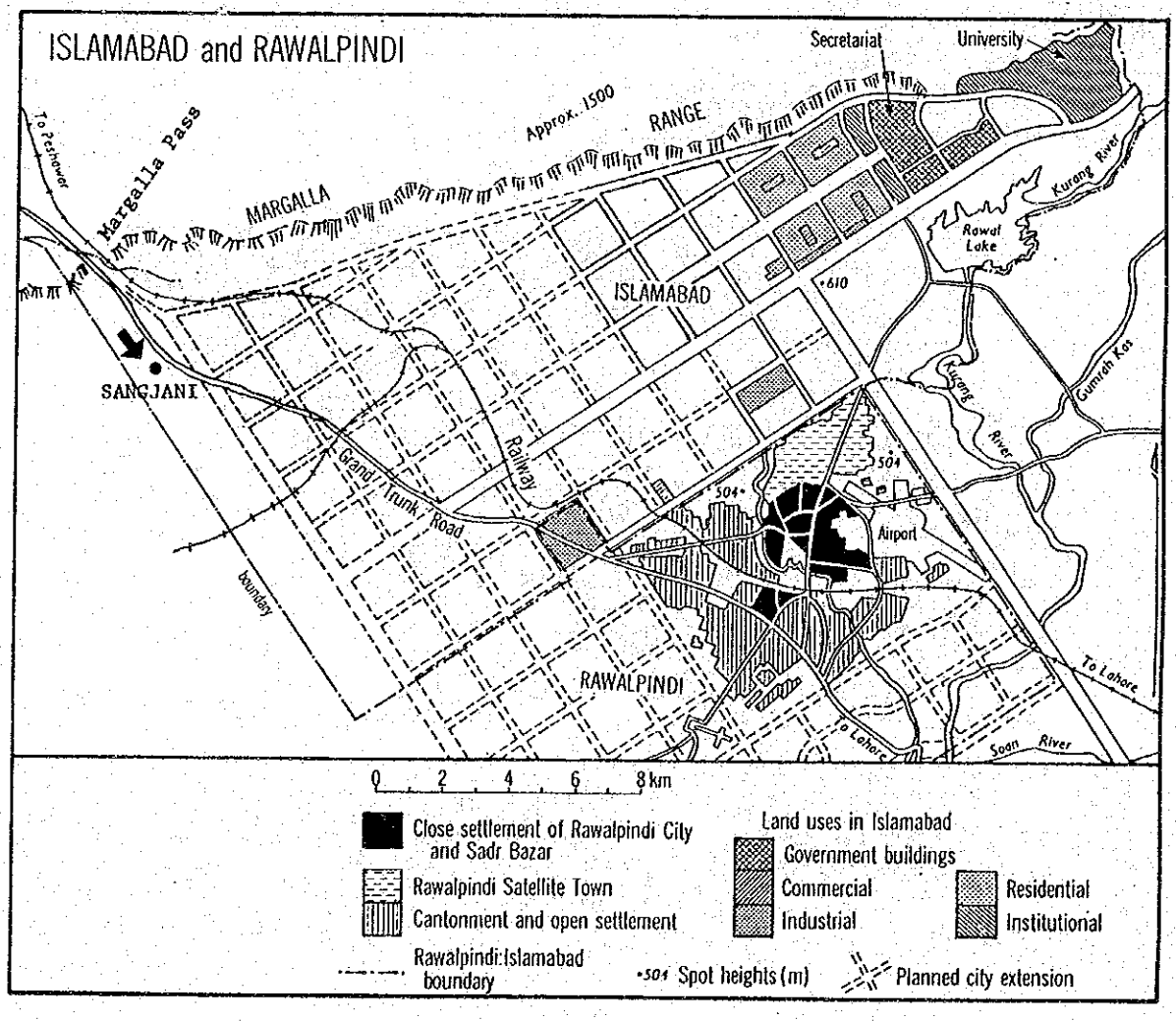
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To Lahore
Soan River
0 2 4 6 8 km
Close settlement of Rawalpindi City and Sadr Bazar
Rawalpindi Satellite Town
Cantonment and open settlement
Rawalpindi:Islamabad boundary
Land uses in Islamabad
Government buildings
Commercial
Industrial
Residential
Institutional
504 Spot heights (m)
Planned city extension

PREFACE

In response to the request of the Government of the Islamic Republic of Pakistan, the Government of Japan decided to conduct a basic design study for the Construction Machinery Training Centre Project and entrusted the study to the Japan International Cooperation Agency (JICA). The JICA sent to Pakistan a study team headed by Mr. Yoshifusa SHIKAMA, Basic Design Study Division, Grant Aid Department, JICA from March 23 to April 11, 1984.

The team had discussions on the Project with the officials concerned of the Government of Pakistan and conducted a field survey in Sangjani area. 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 Islamic Republic of Pakistan for their close cooperation extended to the team.

July, 1984

Keisuke Arita

Keisuke Arita
President
Japan International Cooperation Agency

SUMMARY

Pakistan (the Islamic Republic of Pakistan) has attained a steady course of economic development since its independence in 1947 together with India, despite the continuous geo-political difficulties resulting from the separation of East Pakistan, a series of hostilities with India, and recent Afgan Refugees problems. However, the country's rapid economic growth has been accompanied by serious national problems such as the permanent deficit in the trade balance and sharp commodity price escalation, the growing instability of employment, and the productivity decline caused by the Nationalization Policy.

To overcome these problems, the Government has formulated the Sixth Five Year Plan (1983 - 1988) and introduced new policies aimed on the development of oil-substituting energy sources, priority shifting from parallel promotion to economic efficiency in the implementation of major development projects, and transfer of certain State enterprises to private management, while at the same focusing its efforts on mass training of skilled workers and engineers to attain higher productivity and quality levels essential for increased domestic production and animated export business. Emphasis is also placed on regional development, reinforcement of primary education and improvement of social security and welfare to elevate the social and financial footing of submerged, lower classes and include them in the country's economic structure for a balanced growth of the national economy.

Under the said Sixth Development Plan, the future economic growth of the Pakistan depends on whether or not the economic infrastructure developed by sizable past capital input can be utilized effectively to attain the productivity levels, and this will call for manpower development aimed at providing an increased number of well-trained, capable engineers and skilled workers.

Pakistan worked out many large-scale projects for rapid national development with large quantities of construction machinery introduced for their implementation. Considering the prevailing socio-economic situation, it is incumbent on the Government to utilize such construction machinery most effectively and maintain a high level of efficiency in the construction of newly formulated development projects. Here arises again the need for

intensive manpower development to provide a large number of well-trained construction machinery operators and mechanics.

From this point of view, the Government formulated a Construction Machinery Training Center (CMTC) project and requested Japanese cooperation in its implementation. Responding to this request, the Government of Japan sent the Basic Design Study Team to Pakistan for a survey from March 23 to April 11, 1984.

This survey was conducted to ascertain the contents of the said request from the Pakistani Ministry of Communications (MOC), study the feasibility of cooperating in the project under the Japanese Grant Aid Programme, make a reconnaissance survey at the proposed project site, investigate the related infrastructure improvements so far attained, determine the scale and arrangement of the facilities required for the project operation, and thereby present the Basic Design Study for the project including the supply of necessary equipment and materials.

The project is intended to meet the growing demand for construction machinery operators and mechanics in Pakistan by conducting training courses in the operation, maintenance and repairs of such machinery and by supplying the facilities, equipment and materials needed for the training. It aims at training of school graduates and also improving the technical level of existing operators and mechanics so as to attain a higher operating efficiency of construction machinery and increase employment opportunities in Pakistan.

The project site adjoins Sangjani village along the Grand Trunk Road linking Peshawar and Karachi, about 18 km to the northwest of the capital city of Islambad. It covers an area of about 21,600 m^2 and delcines to a small river on the east, so that ground leveling is required. Basic infrastrutcural facilities are not available except electricity, and a deep well needs to be drilled for water supply.

The CMTC will have four buildings (Administrative building, Training building, Dormitory and Canteen) and outside facilities including Staff Houses, as shown below.

Administrative building	: Director's office, administrative room, conference rooms, library, copy room, display corner, etc.	1,589 m^2
Training building	: Classrooms, audio visual room, shop classrooms, sub-instructors' room, test rooms, workshops, etc.	3,471 m^2
Canteen	: Trainees' canteen, staff dining room, kitchen, shop, etc.	347 m^2
Dormitory	: Dormitory office, rooms for trainees, rooms for invited instructors, shower room, washing place, etc.	1,772 m^2
Outside facilities	: Construction machinery garage, machinery washing stand, storage of dangerous substances, covered way, etc.	785 m^2
Staff House (Pakistan side work)	: 20 units (3-type)	1,834 m^2
	Total	9,798 m^2

The Government of Japan will be responsible for the construction of the facilities and supply of the related equipment. While, the Government of Pakistan will be responsible for the cost of site reclamation, construction of access road, provision of utilities and services for construction.
Project implementation period is estimated 4 months for the detail design and tender procedure, and about 15 months for the construction work.

Project execution body in Pakistan is the Ministry of Communication (MOC), and he will head the Managing Board of the project, which will consist of board members such as FWO, NLC, NHB and MOPD.

The project will provide higher-quality services of construction machinery operators and mechanics by conducting training courses at the CMTC and contribute to infrastructural improvement for Pakistan's development. The CMTC will be built as a model of construction machinery training

facilities in Pakistan. Hence, early implementation of the project is expected.

The significance of cooperating in the project under the Japanese Grant Aid Programme following the supply of construction machinery is quite great. It is expected that Japan's cooperation in the CMTC project will produce immense incentive effects.

ABBREVIATIONS

ADP	Annual Development Programme
A/P	Authorization to Pay
B/A	Banking Arrangement
BS	British Standard
CCI & E	Chief Controller of Imports and Exports
CDA	Capital Development Authority
CMTC	Construction Machinery Training Centre
EAD	Economic Affairs Division Ministry of Finance and Economic Affairs
E/N	Exchange of Notes
FWO	Frontier Works Organization
GOJ	Government of Japan
GOP	Government of Pakistan
GSP	Geological Survey of Pakistan
GVI	Government Vocational Institutions
IRDP	Integrated Rural Development Programme
JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standard
KDA	Karachi Development Authority
KPT	Karachi Port Trust
MOC	Ministry of Communications
MOD	Ministry of Defence
MOPD	Ministry of Planning and Development
NLC	National Logistic Cell
NHB	National Highway Board
NWFP	North Western Frontier Province
R/D	Record of Discussions
T & T	Telephones and Telegraphs Department
WAPDA	Water and Power Development Authority

CONTENTS

CHAPTER 1. INTRODUCTION

Infrastructural improvement in Pakistan has been promoted through the sound development efforts since its independence 37 years ago. However, the level so far attained is not satisfactory, so that the development of infrastructure is listed as one of the top priorities in the Sixth Five Year Plan (1983-1988) which has been focused on the economic efficiency of all development projects. Under preceding five year plans, the Government has actively introduced construction machinery to implement of development projects efficiently and the Government of Japan has so far offered under its grant valued at a cumulative total of Yens 10 billion.

As the introduction of such machinery began no long ago, the number of operators and mechanics is limited and their technical level is rather low. The newly introduced construction machinery is not necessarily maintained in good service condition, often becoming inoperative before used for its full life span.

On the other hand, there is an acute shortage of skilled workers in sharp contrast to the aggravating underemployment of unskilled workers, so that manpower development under technical/vocational training programmes is urgently required to improve the employment situation and pave the way to the future economic development.

Against this background, the Government of Pakistan formulated a "Construction Machinery Training Center Project" in February 1982 to reinforce and expand the FWO's training facilities in Resalpur and requested Japanese Grant Aid and Project-based Technical Cooperation.

In June 1983, the Government of Japan requested a partial revision of this project because the FWO was the only agency for which Japanese assistance was asked and also because the project site condition was not satisfactory.

In November 1983, the Government of Japan sent the Contact Mission to Pakistan through the Japan International Cooperation Agency (JICA) to discuss improvement of the project contents with the concerned Pakistan Authorities and study the situations of construction machinery in Pakistan.

On the basis of the discussion with the said Contact Mission, the Government of Pakistan organized the Project Managing Board headed by the MOC consisting of the FWO, NHB, NLC and MOPD, secured a new construction site situated 18 km to the north-west of Islambad, and formulated the "Construction Machinery Training Center (CMTC) Project." In January 1984, a formal request was forward to the Government of Japan for Grant Aid and Project-based Technical Cooperation in this project.

The Government of Japan responded to this request and sent the Technical Implementation Team in March 1984 through the JICA to study the feasibility of technical cooperation. In the same month, the JICA sent the Basic Design Team to study the possibility of providing the grant aid.

The Basic Design Study was conducted for 20 days from March 23 to April 11, 1984, on the basis of the findings of the preceding Technical Implementation Survey (May 16-29, 1984). In this survey, the team ascertained the contents of the request and the functions of the Pakistan-side project execution body, investigated the existing training facilities similar to the proposed one, and discussed the conditions that led to the project implementation with the Pakistani Authorities. The Minutes of Discussion was signed and exchanged between Mr. S.G. Ahmed, Economic Affairs Division (EAD), the Ministry of Finance and Economic Affairs, and Yoshi Shikama, leader of the Basic Design Study Team. (See Appendix, Part I 1, 2)

This report presents the findings of the said Basic Design Study for the CMTC project.

CHAPTER 2. BACKGROUND OF THE PROJECT

2-1. Economic Development Plans in Perspective

In 1974 Pakistan gained its independence together with India. In the immediate post-independence day, the country's main products were cotton and wheat in West Pakistan and jute and rice in East Pakistan (present Bangladesh). Agricultural sector was thus the mainstay of the country's economy, accounting for 59% of GDP, and industrial sector held a small share of 7%.

In 1951, four years after the independence, a "Six Year Development Programme (1951-1957)" was formulated with a budget of Rs. 2.6 billion appropriated with the recommendation from the Colombo Plan Consultative Committee. This programme was aimed at developing social infrastructure to open up the way to the future economic development of the country, but it was terminated two years before completion owing to the worsened situation in international economy. The plan produced no development growth in the agricultural sector, but augmented in certain individual projects.

The "First Five Year Plan (1955-1960)", worked out with a budget of Rs. 10.8 billion, was the first systematic development plan adopted in Pakistan. It was designed to prepare the ground for rapid development and potential productivity of the economy.

But the plan performance fell below the project targets owing to its delayed approval and enforcement and also because of the shortage of capital investment. During the period of this plan, however, the country succeeded in providing infrastructural basis for the rapid economic growth enjoyed under the subsequent Second Five Year Plan, but its foreign currency holdings dropped owing to increased food imports necessitated by the shortage of agricultural production, and this resulted in a sharp escalation of domestic commodity price.

The "Second Five Year Plan (1960-1965)", mapped out with a budget of Rs. 23 billion, realized a rapid growth of the national economy, backed up by the development efforts made under the preceding First Plan. The

Fig. 2.1.1 GDP and GNP Growth

	First Plan (1955-60)	Second Plan (1960-65)	Third Plan (1965-70)	Non-Plan Period (1970-78)	Fifth Plan (1978-83)	Sixth Plan (1983-88)
				Annual Growth Rate		
Agriculture	2.1	3.8	6.3	1.7	4.4	4.9
Major Crops	2.3	4.7	9.1	0.9	4.8	3.6
Minor Crops	0.8	4.8	3.8	4.7	3.1	7.0
Others	2.2	2.1	2.3	2.0	4.3	6.0
Manufacturing	5.2	11.7	8.1	3.5	9.0	9.3
Large Scale	7.6	16.8	9.9	2.2	9.7	10.0
Other Sectors	3.6	8.3	6.6	6.2	6.0	6.4
GDP (FC)	3.1	6.8	6.7	4.2	6.0	6.5
GNP (FC)	3.0	6.8	6.8	4.9	6.3	6.3

Source: Economic Affairs Division

Fig. 2.1.2 Public Sector Shifts

(Percentage Share)

Sl. No.	Sector	First Plan (1955-60)	Second Plan (1960-65)	Third Plan (1965-70)	Non-Plan Period (1975-78)	Fifth Plan (1978-83)	Sixth Plan (1983-88)
1.	Agriculture	9.5	8.5	10.4	8.6	9.7	5.0
	(a) Agriculture	9.5	6.5	6.2	5.5	4.0	4.0
	(b) Fertilizer Subsidy	-	2.0	4.2	3.1	5.7	1.0
2.	Water	19.9	43.3	34.2	16.9	10.3	10.5
3.	Energy	12.4	12.2	13.3	18.3	25.4	38.2
	(a) Power	11.8	11.0	11.9	14.4	18.4	28.7
	(b) Fuels	0.6	1.2	1.4	3.9	6.9	9.0
	(c) Renewables Energy	-	-	-	-	0.1	0.5
4.	Industry	15.3	4.5	6.0	15.0	16.6	6.7
5.	Minerals	2.5	0.9	2.0	0.7	0.3	1.9
6.	Transport and Communications	22.2	15.0	19.1	20.7	23.0	18.9
7.	Physical Planning and Housing	10.4	9.0	5.3	7.5	5.9	5.1
8.	Education and Manpower	4.8	4.4	4.3	4.6	3.7	6.5
9.	Health	1.6	1.6	2.1	3.1	3.0	4.3
10.	Population Planning	-	0.2	1.1	1.1	0.4	0.7
11.	Others/Misc. Programmes	1.4	0.4	2.2	3.5	1.7	2.2
	Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: Economic Affairs Division

country's economic structure was consolidated to a notable extent by the increased agricultural production realized by favorable weather condition and also because the development investments made under the First Plan brought about an augmented productive force. Export business became animated, and financial aids also increased with an upturn in the world economy.

Stimulated by the success of the Second Five Year Plan, the Government increased the budget for the "Third Five Year Plan (1965-1970)" to as much as Rs. 52 billion, with the focal point on the diversification of industry and acceleration of development projects. However, the plan had to be reviewed soon after it was started owing to the hostilities with India, lower inflow of foreign aids, and poor weather condition. Hence, it registered achievements that fell considerably lower than the target levels.

The subsequent "Fourth Five Year Plan (1970-1975)" was drawn up with a budget of Rs. 75 billion, with specific emphasis on correcting the large income differentials resulting from the country's rapid economic growth. But the plan was not put in operation owing to the continued hostilities with India and the separation of East Pakistan. During the period from 1971 to 1977, a number of policies for reforming the economic system, including the Nationalization Policy were put in force under Annual Development Plans. However, domestic economy suffered a regression because of the depression in the private sector, decreased agricultural production due to unfavorable weather condition, and the impact of the oil crisis of 1973.

Fig. 2.1.3 Central Government Expenditure by Function (As Percent of Total Expenditure)

Country/Year	General Public Services	Defence	Education	Health	Social & Security Welfare	Housing & Community Amenities	Other Community Social Services	Economic Services	Agriculture Fishing, Forestry & Hunting	Raods	Others T&C	Other Purpose
Pakistan (1980)	7.22	30.63	2.69	1.47	1.28	2.83	1.86	37.19	2.13	1.65	9.94	14.84
India (1980)	6.25	19.40	1.95	1.68	-	-	-	23.86	6.93	-	-	42.35
Indonesia (1980)	33.25	13.49	8.31	2.47	-	1.79	1.03	29.47	10.05	-	7.60	10.18
Egypt (1980)	5.74	7.35	9.88	3.02	7.60	3.66	5.47	9.69	5.46	0.39	0.55	39.94
Thailand (1981)	8.26	20.37	19.19	4.25	2.12	5.33	0.40	21.52	10.07	7.37	1.42	17.93
Philippines (1980)	20.05	14.62	12.91	4.09	1.36	4.47	0.82	48.28	5.95	13.85	3.77	10.94
Nigeria (1977)	13.47	17.93	9.56	2.19	1.09	3.24	1.93	45.78	2.55	13.89	9.17	4.81
Bangladesh (1978)	14.41	11.46	10.83	5.26	3.33	-	0.38	45.96	12.04	-	8.01	11.03
Burma (1979)	15.94	24.24	10.05	6.39	6.14	3.58	0.87	29.77	20.20	4.54	1.68	3.02
Sudan (1980)	32.77	13.20	9.82	1.40	0.68	0.18	0.09	19.84	9.44	-	4.71	25.50

Source: Government Finance Statistics, Year Book Vol-VI 1982, IMF.

Fig. 2.2.1 Physical Achievements of the Fifth Plan

Sector		Unit	1977-78 Benchmark Production	1977-78 Actual	1982-83 Fifth Plan Targets	1982-83 Achievement
Agriculture						
Rice		Mill. M.T.	2.95	2.95	3.96	3.369
Wheat		Mill. M.T.	8.84	8.37	13.01	12.267
Sugarcane		Mill. M.T.	28.45	30.10	34.85	33.474
Cotton		Mill. Bales	3.3	3.4	5.0	4.84
Industry						
White sugar		000 M.T.	800	861	1,000	1,300
Vegetable ghee		000 M.T.	412	360	650	600
Cigarettes		Bill. Nos.	32	31	42	39
Cotton Yarn		Mill. Kg.	295	298	548	430
Cement		000 M.T.	3,150	3,224	5,000	4,250
Fertilizer (N)		000 M.T.	334	322	1,381	932
M.S. Products		000 M.T.	280	315	490	630
Water						
Water Availability at Farm Gate		M.A.F.	91.75	91.75	100.85	101.22
Power						
Installed Generation Capacity		MW	3,280	3,265	5,370	4,780
Villages Electrified		No.	7,609		12,609	16,443
Transport						
(a) Railway	Passenger	MPKM	13,706	15,375	15,357	16,502
	Freight	MTKM	9,280	8,557	12,856	7,500
(b) Road	Passenger	MPKM	65,005	63,260	100,534	79,513
	Freight	MTKM	11,497	13,280	19,091	21,200
(c) Air	Passenger	MPKM	4,714	4,414	5,941	5,941
	Freight	MTKM	218	197	249	249
(d) Port	Liquid Cargo	M.Tonnes	4.5	5.2	7.3	8.4
	Dry Cargo	M.Tonnes	5.5	5.8	11.6	8.9
(e) T & T	Trunk Traffic	Million Calls	75	75	145	145
	Telex Traffic Annual Paid Minutes in Million		1.89	1.89	7.0	13.0
Physical Planning and Housing						
Development of Residential Plots		Nos.			425,000	285,000
Education and Training						
Primary Schools		Nos.	56,121	55,302	63,463	66,839

Source: Planning and Development Division

*Cumulative Figures.
MPKM-Million Passenger Kilomectres
MTKM-Million Tonne Kilomeetres

2-2. Fifth Five Year Plan (1978–1983) and Social Problems

When new administration came to power in July 1977, it framed the "Fifth Five Year Plan (1978-1983)" with a huge budget of Rs. 210.2 billion. In this plan, the Government held up the following basic targets to clear away the political and economic confusion caused in the past years.

a) to increase industrial and agricultural production, and restore a balanced national economy.
b) to develop rural areas and sectors that have so far been left out of national development.
c) to make best use of domestic economic resources, and diminish reliance on foreign assistance.
d) to give greater importance to the private sector's roles in industrial development.
e) to improve social security and welfare.

The Government carried out various policies to materialize these targets, which included the management improvement of State enterprises, transfer of certain State enterprises to private management, and encouragement of domestic and foreign investments in principal industries. As a result, the following achievements were realized.

- Annual GDP growth rate over 6% was attained.
- Food shortage was filled up to exporting surplus.
- Inflation was reduced from 16% to 5%.
- Capital funds were sharpened for preferential investment in selected sectors.
- Development of underdeveloped areas was accelerated.
- Restrictions on industrial operations were relaxed, whereby the annual growth rate was recovered to over 9%.
- Rural electrication was carried out more than proceeding 30 years.

With these notable achievements realized under the Fifth Plan, Pakistan's economy began to show signs of recovery, but the country is still confronted with a number of social problems enumerated below just as other developing countries in the world.

Fig. 2.2.2 Fifth Plan Financing

(Rs. Billion)

	1977-78	Percent Contribution	1982-83	Percent Contribution	Total Fifth Plan	Percent Contribution
1. Revenue Surplus	1.6	9.4	(-)1.4	(-)5.0	15.2	12.4
2. Net Capital Receipts	2.5	14.6	6.1	21.6	12.4	10.1
3. Self-financing by Public Corporation	0.5	2.9	2.3	8.2	8.7	7.1
4. Borrowing from the Banking System	5.3	31.0	6.2	22.0	27.1	22.0
5. External Resources	7.2	42.1	15.0	53.2	59.4	48.4
Total	17.1	100.0	28.2	100.0	122.8	100.0

Source: Economic Affairs Division

Fig. 2.2.3 Fifth Plan Current Account Balance

($ Million, Current prices)

	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	Compound Growth (% p.a.)
Exports, fob	1,287	1,646	2,341	2,798	2,319	2,628	15.3
Imports, fob	-2,751	-3,816	-4,857	-5,563	-5,769	-5,532	15.0
Workers' Remittances	1,156	1,397	1,748	2,097	2,224	2,885	20.1
Current Account Balance	-630	-1,126	-1,149	-991	-1,610	-433	-7.2
Memo: Current Account Balance as a % of GNP	-3.7	-5.3	-4.5	-3.3	-4.9	-1.4	

Source: Economic Affairs Division

Fig. 2.2.4 Distribution of Labour Force Employment and Productivity

	Unit	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83
Labour Force	Million	22.22	22.93	23.68	24.45	25.24	26.06
Labour Force Growth	Percent	2.90	3.20	3.30	3.20	3.30	3.20
Employment	Million	21.84	22.54	23.13	23.81	24.50	25.21
Productivity*	Rupees per worker	600	609	637	657	681	-

*Value added (GDP) per worker per month at 1977-78. Source: Manpower Division

1) Low rate of savings

Owing to the Nationalization Policy adopted in the 1970s which decelerated the private sector investment and invited productivity decline of State enterprises, and also because of very high propensity to consume, the nation's rate of savings is rather low. As a consequence, the country is forced to rely heavily on foreign assistance for the supply of development funds.

2) Permanent deficit in current account balance

As the past economic growth accelerated to import of capital goods and petroleum products for development projects, the country's trade balance has permanently been in red figures. Aggravation of the situation has been eased by the remittances from Pakistani workers abroad, any further increase of such remittances can no longer be hoped for because of the recent political unrest in the Middle East.

3) Enlargement of underemployment

Those in underemployment who can find only short-term, temporary jobs or low-level jobs not requiring their ability account for more than 20% of total labor foce poluation. Underemployment show signs of further aggravation owing to the high growth rate of labor force population and ceaseless concentration of population in urban areas. This is enhancing labour emigration to the countries in the Near and Middle East. Creation of an active labour demand and alleviation of underemployment are indispensable factors for the future economic growth of Pakistan.

As the economic development scheme is pushed forward by accelerating development investments, the social problems mentioned above have caused a vicious cycle of increased capital goods import, deficit in the international balance of payments and resultant import restrictions, and stagnation of productive activities due to the shortage of raw materials.
In order for the Pakistani economy to make an enormous leap forward on an independent, self-reliant basis, the country's industrial structure needs to acquire a higher economic efficiency and investments for new development projects should also be received its priority from the viewpoint of economic efficiency.

Fig. 2.3.1 Quality of Life Indices

	1960-61	1982-83	1987-88
1. Literacy			
-number (million)	4.8	13.9	32.7
-percentage	15.0	23.5	48.0
2. Primary Education			
-number enrolled (million)	2.0	6.8	12.3
boys	1.6	4.6	7.7
girls	0.4	2.2	4.6
-percentage of primary age population	30	48	75
boys	44	63	90
girls	11	32	60
3. Infant Mortality (age 0-1)			
-per thousand	162	100	60
4. Life Expectancy			
-number of years	43	55	60
5. Access to Clean Water			
-% of total population	n.a.	38	60
-% of rural population	n.a.	22	45
-% of urban population	n.a.	77	90
6. Access to Sewerage Facilities			
-% of total population	n.a.	16	26
-% of rural population	n.a.	4	10
-% of urban population	n.a.	48	60
7. Availability of Electricity			
-number (million)	2.46	30.8	52.9
-% of total population	5.4	35.5	53.3
8. Availability of Telephones			
-number	87,500	414,000	934,000
-% of total population	1.8	5.0	9.0

Source: Planning Commission

2-3. Sixth Five Year Plan (1983–1988)

The Sixth Five Year Plan was formulated with a budget amount to Rs. 490 billion for the dual purpose of fructifying the 35 years development efforts since the independence and strengthening social infrastructure to open up greater possibilities for the country's self-reliant economic development. In this Sixth Plan, the Government listed up the following as basic shortcomings in the Pakistani economy.

a) Low productivity as compared with the international levels.
b) Acute necessity for developing basic social infrastructure (medical service system, education, water supply and sewerage systems, electricity, etc.).
c) Unsufficient progress to introduce advanced technologies.
d) Low rate of savings due to high propensity to consume and the resultant low investment capabilities.

To bring solution for these shortcomings, the Government focused on the following targets of the Sixth Plan.

1) Improvement of social services including primary education, clean water supply and basic medical service.
2) Development of road networks, communication facilities, power transmission networks, etc. to rectify regional differences.
3) Implementation of adequate development project in poverty-stricken areas.
4) Enforcement of the poor relief measures and income improvement measures.
5) Improvement of the nation's nutritive conditions.
6) Employment promotion and productivity increase.

Table 8 showing the target quality of life indices indicates that the Sixth Plan attaches specific importance to the improvement of literacy rate and primary education. On the other hand, Table 2 showing public sector expenditure indicates that energy holds the largest share of 38.2%, suggesting the Government's determined resolution to step up the development of oil-substituting energy sources. This is followed by transport and communications given a share of 18.9%, which indicates that the development of arterial/rural roads is another focal point of the Sixth Plan.

Fig. 2.3.2 Public Sector Outlays

(Million Rupees)

Sector	First Plan (1955-60)	Second Plan (1960-65)	Third Plan (1965-70)	Non-Plan Period (1970-78)	Fifth Plan (1978-83)	Sixth Plan Allocations (1983-88)
1. Agriculture	461	902	1377	6492	14860	15350
(a)Agriculture	461	695	822	4141	6060	12350
(b)Fertilizer Subsidy	-	207	555	2351	8800	3000
2. Water	969	4597	4513	12810	15770	32100
3. Energy	607	1293	1760	13841	38830	116500
(a)Power	575	1165	1571	10880	28119	87400
(b)Fuels	32	128	189	2961	10597	27500
(c)Renewables Energy	-	-	-	-	114	1600
4. Industry	742	478	786	11294	25400	20500
5. Minerals	124	8=94	271	492	400	5750
6. Transport and Communications	1080	1595	2521	15653	35210	57520
7. Physical Planning and Housing	505	957	698	5687	9000	15500
8. Education and Manpower	232	463	563	3442	5640	19850
9. Health	76	174	281	2381	4580	13000
10.Population Welfare Programme	-	9	145	820	600	2300
11.Others/Misc. Programmes	67	44	289	2632	2320	6630
Total	4863	10606	13204	75544	152610	305000
Plus: Special Development Programmes	-	-	-	-	600	15000
Less: Operational shortfall	-	-	-	-	-	30000
Total (Net)	4863	10606	13204	75544	153210	290000

Source: Economic Affairs Division

Sector-wise development strategies as envisaged by the Sixth Plan are introduced below.

a) Agriculture
- Modernization of farm management/operations by positive introduction of chemical fertilizers, agrochemicals and improved seeds and seedlings.
- Productivity increase by mechanization of small and medium scale farming operations, including the introduction of small-capacity tractors.
- Expansion of farmland area, with specific emphasis on soil improvement in areas frequently afflicted salt/flood damage.
- New construction and reinforcement of irrigation canals and reservoirs.
- Crop conversion to export oriented agriculture.

b) Rural development
- Development of farm-to-market roads (40,000 km).
- Development of canal roads (30,000 km).
- Introduction of road construction machinery to the Local Governments.
- Control of population inflow into cities by agricultural and regional industrial development to increase local employment promotion.

c) Industrial development
- Managal and technical improvement by promotion of joint ventures with foreign enterprises.
- Introduction of high technologies with a special funds.
- Productivity improvement by advanced labour management and stricter quality control.
- Expansion of research and development facilities, and promotion of technical training.

d) Energy development
- Increase of domestic energy supply ratio to minimize imported energy sources.

Fig. 2.3.3 Level of Education 1981

(In thousand)

Level	Both Sexes	Male	Female
Primary	5,851	4,092	1,759
Middle	3,084	2,281	803
Matric	2,241	1,830	591
Intermediate	709	518	191
Certificate/Diploma (Less Degree)	131	104	72
B.A./B.Sc.	478	351	127
MA/MSc.	134	101	33
B.Sc. Engineering and above	27	26	1
MBBS/BDS and above	26	20	6
LLB nad above	37	36	1
Others	7	6	1

Source: Population Census Organisation

Fig. 2.3.4 Estimated Labour Force by Major Occupational Groups and Level of Education 1982–83

(In thousand)

Major Occupations	Total	Less than Primary including Illiterates	Primary and less than Matric	Matric and less than Degree	Degree & (General Education)	Degree & Postgraduate Diploma other than General Education
Professional Workers	795	94	151	292	125	133
Administrative Workers	188	13	26	65	52	32
Clerical Workers	758	60	122	479	81	16
Sales Workers	2,635	1,379	839	370	39	8
Service Workers	1,198	831	289	73	5	-
Agricultural Workers	13,723	11,524	1,819	349	10	21
Production Workers	6,763	4,842	1,480	417	1	8
Total	26,060	18,743	4,726	2,045	328	218

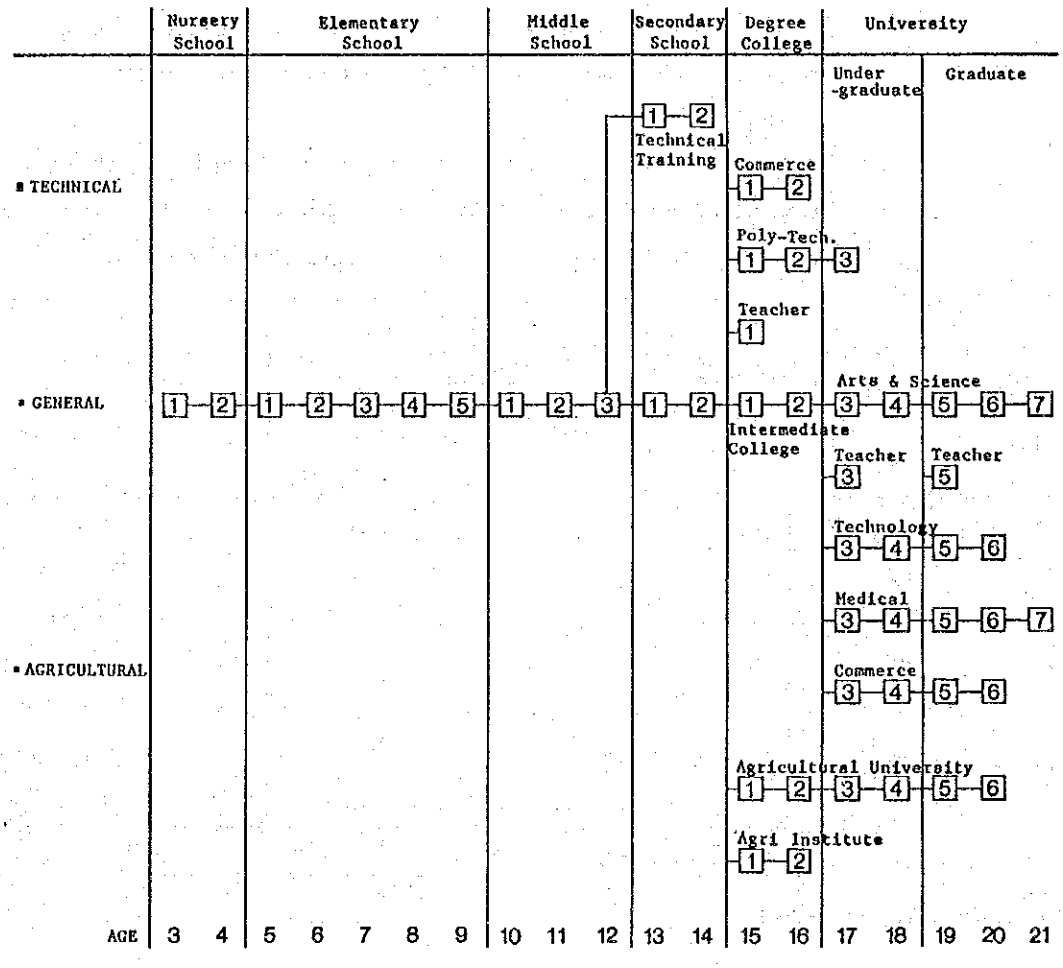
Source: Manpower Division

- Infrastructural improvement to provide the basis for attaining complete self-sufficiency in energy during the Seventh Plan and beyond.
- Promotion of the private sector's participation in energy development.
- Proper institutionalization of long-term energy planning, monitoring and evaluation.

e) Transport and communications development
- Improvement/widening of arterial roads for smoother physical distribution in order to accelerate economic development.
- Development of rural roads as an incentive to rural economy.
- Expansion of communication networks to rectify regional differences.
- Establishment of new training facilities for skilled manpower such as drivers and mechanics.

f) Educational development
- Reinforcement of primary education to elevate the literacy rate.
- Diversification of secondary education to meet the new needs of society.
- Promotion of technical manpower development for applying modern technologies.
- Training of teachers of science and mathematics.

■ Education System of Pakistan



2-4. Development of Education and Vocational Training

From the past experience in economic development, it has often pointed out in Pakistan that productivity improvement and high quality standards of export industries are essential to the country's future growth. This view is reflected in the Sixth Plan which attaches special importance to skilled manpower development, with the focal point on the literacy rate improvement by reinforced primary education and amplified technical training.

The present literacy rate of 23.5% is planned to be elevated to 48% by raising the primary school attendance rate from the present level of 48% to 75%. As this calls for reinforcement of rural and female education, it is planned to construct new primary school buildings, utilize of mosques for primary education, and introduce the mixed enrolment system for low graders.

For secondary education, curriculum diversification is considered to provide easier access to technical/professional education and higher education, and the number of science and mathematics teachers is also planned to be increased.

In rural areas, efforts are made for additional construction of secondary school buildings to enable students to commute from their own homes and thereby raise the attendance rate. There is an acute shortage of teachers in Pakistan, and it is foreseen that 200 thousand new teachers will be required and 45 thousand existing ones will have to be replaced by 1989. For this reason, training of teachers is planned in many different localities in the country.

Technical training is given very high priority because of the extreme shortage of skilled workers and technical/professional workers. The importance of technical training is accentuated for two reasons. First, the labour market shows a growing tendency toward underemployment owing to the oversupply of unskilled workers resulting in the ceaseless skilled workers emigration numbering some 150 thousand and also because of the very high growth rate (3.3%) of labour force population. Second, the private sector is pressed hard for the supply of highly skilled technical workers to introduce advanced technologies essential to making a shift from basic consumer goods industries to technology-oriented industries and to developing export-oriented industries including agriculture. For these reasons, the following technical/vocational training programs are now

carried out to increase the number of skilled workers and upgrade their technical level.

Federal Programme for Skill Development

This programme aims at making arangements for managing vocational training systems estimated cost of Rs. 30.117 million of which Rs. 28.390 million will be financed from the UNDP/ILO. Under this programme, training centers in ten places including Lahore, Multan and Karachi have already been provided with training equipment and materials, and syllabus and trade standards have also been prepaired. It is planned that in-plant training and instructor training will also be conducted under this programme.

Training of Skilled and Semi-skilled Workers

Evening shifts vocational training is provided under this programme at a total of 29 training centers including two in Lahore and three in Karachi. Of the planed cost of Rs. 70.763 million, the Government has approved Rs. 19.248 million 26,300 trainees in 45 different trades have already been enrolled.

National Vocational Training Project

Of the total approved budget of Rs. 425.853 million (Rs. 36.035 million allocated for 1982/83), Rs. 250 million will be covered by the World Bank and Rs. 15.802 million by the UNDP. The project aims at providing an increased number of instructors and staff to the National and Provincial training centers. It will be operated to develop technical standards and unified trade tests and to provide short-term training courses covering 29 trades. For this purpose, new training centers will be built in six places including Islambad, and existing centers in 31 places including Lahore and Karachi will be suitably modified. Annual enrolment is 10,800, and it is expected that a total of 4,444 instructors and staff will be trained in five years.

The following three new Training Programmes will be undertaken during the Sixth Plan.

Rural Training-cum-Production Workshops

This project is intended to establish Training-cum-Production workshops in rural areas confronting a shortage of skilled/technical workers owing to their outflow to cities or overseas countries. The workshops will be opened in large towns of local area, with five instructors assigned to each wrokshop to cover five trades. Women's workshops will also be built to increase their income of rural women. A total of 6,000 trainees are planned to be enrolled each year under the project, with each workshop having an annual enrollment of 60. The estimated cost of the project is US$10 million.

Training Programmes

About 500 training institutions across the country will be supplied with training equipment and materials, financed by a loan and a subsidiary amounting to Rs. 10,000 and Rs. 12,000, respectively, per trainee. An initial enrolment of 5,000 is planned for training of 1,500 persons annually. A budget of US$6 million has estimated for these programmes.

Instructor Training Facilities

Existing instructor training facilities, located in Lahore and Islambad, can accommodate 60 persons each. The additional facilities produce 400 new instructors annually through one-year training courses, and about 2,500 new instructors will be serviced to 48 training centers. With a budget of US$7 million, this project is intended to overcome the attrition of instructors about 20% each year.

Fig. 2.4.1 Province-wise Urban-rural, Male-Female, Participation Rates – 1978–79

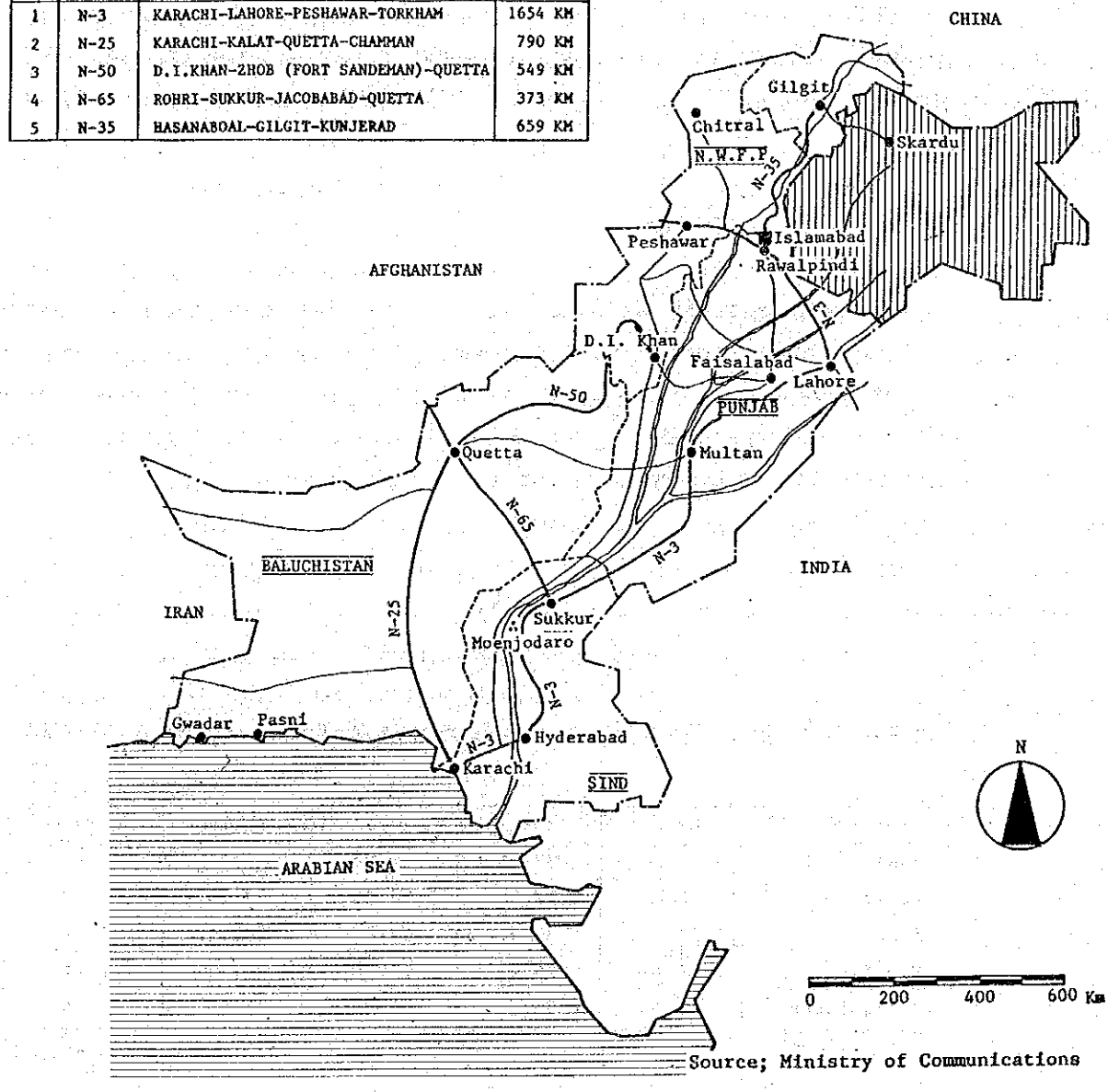
(Percentages)

Area	Total	Rural	Urban	Male	Female
Pakistan	31.02	32.55	27.06	27.23	3.79
Punjab	31.12	32.30	27.39	27.15	3.97
Sind	33.44	38.67	27.00	28.64	4.81
N.W.F.P.	24.96	24.97	24.90	23.54	1.42
Baluchistan	32.34	33.71	26.04	31.38	0.96

Source: Manpower Division

■ National Highway Network (1983)

NO.	HIGHWAY NO.	NAME OF HIGHWAYS	DISTANCE
1	N-3	KARACHI-LAHORE-PESHAWAR-TORKHAM	1654 KM
2	N-25	KARACHI-KALAT-QUETTA-CHAMMAN	790 KM
3	N-50	D.I.KHAN-ZHOB (FORT SANDEMAN)-QUETTA	549 KM
4	N-65	ROHRI-SUKKUR-JACOBABAD-QUETTA	373 KM
5	N-35	HASANABOAL-GILGIT-KUNJERAD	659 KM



Source; Ministry of Communications

2-5. Infrastructural Improvement and Construction Mechanization

2-5-1. Infrastructural Improvement

Infrastructural improvement ahs always been an important supporting factor of Pakistan's economic growth and its has been promoted at a steady pace through 35 years of development efforts since the country gained its independence. However, it is still dissatisfied if compared with the average of developing countries. Fully cognizant of this fact, the Government has given high priority to infrastructural improvement in the Sixth Plan, placing special emphasis on the development of rural infrastructure to rectify the existing regional differences.

Infrastructural development attained so far and envisaged by the Sixth Plan is outlined below, broken down by sector.

1) Road network

Total length of roads in 1982 was 97,517 km, of which paved roads accounted for 40% (39,372 km). Road density is 0.12 km/sq.km, which is considerably lower than the average density of 0.33 km/sq.km of developing countries, and paved road density is still lower, registering only 0.05%. The road network covers nearly all municipalities and industrial zones. However, with the exception of trunk roads, the pavement has a width of only about 3 m or cannot withstand heavy traffic or is submerged in the wet season. Rural roads have a total length of 48,000 km, comprising mostly of Ketcha roads (earth roads) for access only the dry season.

Under the Sixth Plan it is proposed to construct 5,800 km of new roads, of which 2,150 km of paved roads and 3,650 km of all-weather earth roads. Improvement and widening of existing roads is also planned for a total length of 7,860 km. In addition, construction of 40,000 km-long Farm-to-Market roads is also envisaged by the Sixth Plan.

2) Port facilities

Karachi is composed of two port, the East Port (17 berths) and the West Port (7 berth), where cargo handling work is performed mostly at

Fig.2.5.1 Road Condition in Developing Countries

	Road (1977)			Number of automobiles	
	Total Length (1,000 Km)	Length per Km^2 of land (m)	Pavement Ratio (%)	Total (1,000 cars)	Number of cars per 1,000 persons
Pakistan	87.5	102.8	28.0	279.0	3.9
Korea	45.5	462.1	24.0	219.0	6.1
Thailand	31.0	62.4	50.9	657.4	15.3
Philippine	119.2	365.6	18.7	738.4	16.9
Indonesia	93.1	48.9	28.6	614.6	4.4
Malaysia	19.5	58.1	79.9	558.7	45.4
Burma	25.4	37.6	32.7	76.0	2.5
Bangladesh	28.4	197.1	13.5	56.5	0.8
India	1,190.2	362.4	21.2	1,187.0	2.0
Nepal	1.6	11.4	42.2	15.2	1.2
Sri Lanka	31.2	474.8	66.4	110.9	8.1
Mean	150.1	198.5	36.9	416.8	9.7
Japan	1,079.2	2,898.7	34.5	28,893.0	256.2

Source: Road and Motor vehicle Statistics per 1976, 1977

quaywall because the water depth is about 8 m. Karachi is the only seaport in Pakistan, and its cargo handling capacity (10 - 13 million tons) is not large enough to meet the need of the country's population of about 90 million. To cover this shortage, a new port (Qasim Port) is now under construction in an outlet of the former Indus, about 20 km to the east of Karachi.

Under the Sixth Plan, this new port is planned to be provided with cranes and grain warehouses.

3) Power generation facilities

For the purpose of attaining self-sufficiency in energy, positive efforts are now being made for development of electric power and domestic energy resources including petroleum, natural gas and coal. The power plant construction project initiated under the Fifth Plan is pushed forward at a rapid pace to augment the total installed capacity to 8,600 MW at the earliest possible date from the present level of 3,800 MW. This project includes the long-term programme of the Tarbela Dam expansion, among others.

4) Farmland and irrigation facilities

Cultivation of a new farmland area of about 4 million ha is planned to increase the total arable land area by 126% with emphasis on rural development. This will call for extensive reclamation, soil improvement and irrigation works. As regards irrigation facilities, construction of new irrigation canals with a total length of 2,400 km and 43 new irrigation dams is planned, and smaller irrigation programmes are also planned to be carried out in 331 places through the country. Furthermore, improvement and repairs of existing canals with a total length of 10,700 km will be carried out as the Second Phase for protecting national land and infrastructural facilities against flood damage.

2-5-2. Construction Mechanization and Problems

Because of the urgent national demand for infrastructural improvement, Pakistan is required to introduce construction machinery effective in cutting down the construction period and cost of various development projects.

No statistical data is available pertaining to the quantities of construction machinery used in Pakistan, but it is estimated that a total of about 2,300 units are now in operation excluding dump trucks. Of this total, about 1,300 units are used in the agricultural sector, and the remainder, owned mostly by government agencies such as the NLC, FWO, NHB and WAPDA, is used for earth moving and civil engineering works related to infrastructural improvement.

The maintenance condition of construction machinery is not quite satisfactory. Owing to the shortage of knowledge and skill required for routine inspection, maintenance and repairs, the operating rate is rather low. For example at the survey of the FWO disclosed that nearly 30% of the 610 units are in need of maintenance or repair service.

This is because Pakistani maintenance personnel are trained by the engineers from manufacturers or dispatched experts from abroad only at the project site during a short preparatory period for the project implementation. In addition, such training is offered only for a large-scale project when a great deal of construction machinery is introduced. The number of operators and mechanics given such training is just too small to meet the national demand for their service.

It admits no argument that if the Government continues introducing construction machinery to expedite large-scale infrastructural improvement projects or accelerate medium-scale construction works for improvement of existing infrastructure or rural development, the current shortage of machinery operators and mechanics will become prrogessively severe. It is also likely that the shortage will be more serious if the Government proceeds to supply construction machinery for Local Governments to promote rural infrastructural development under their management.

CHAPTER 3. CONTENTS OF THE PROJECT

3-1. Project Objectives

The Sixth Five Year Plan includes many projects intended specifically for promoting infrastructural improvement which is essential to Pakistan's economic growth. As these projects need to be implemented smoothly and efficiently, the Government is positive in introducing construction machinery. But the operators and mechanics of such machinery are available only in a small number and their technical level is rather low because the Government began introducing such machinery only recently. For this reason, many of the construction machines and equipment supplied from overseas countries including Japan are not given satisfactory maintenance service and consequently prevented from exhibiting their performance to the full.

On the other hand, the shortage of skilled workers and under-employment of unskilled workers pose a serious problem despite the rapid increase of labour force population. To bring solution for this problem, technical/vocational training is conducted at various levels. These include the Provincial technical training facilities (training period: 18 - 24 months) and the Government-run vocational training centers (training period: 12 months) which are operated for training of an annual total of 3,640 skilled workers, the Short-term training programme carried out by the Provincial Labour Departments at 30 training centers to send out 5,880 skilled workers annually, and the Short-term (3 - 4 months) training courses conducted by the overseas agencies for an enrolment of 2,650 trainees. Despite these training efforts, it is still found difficult to meet the heavy demand of skilled workers/technicians. Accordingly, manpower development focused on technical training is urgently required to pave the way to the country's economic development in the coming years.

Against this background, the Government formulated the CMTC project to improve the technical level of construction machinery operators and mechanics and promote manpower development focused on unskilled workers, and thereby to speed up infrastructural improvement for the future growth of the national economy.

3-2. Project Contents

The CMTC will be operated to provide lectures and practical training on the knowledge and skill required for the operation and maintenance of construction machinery to be used in the infrastructural improvement works such as road construction, dam construction, irrigation, reclamation, etc. The following three training courses will be conducted at the CMTC.

- Operator Course
- Mechanic I Course
- Mechanic II Course

3-2-1. Outline of Training Programme

An outline of the training programme is given below for each course.

1) Operator Course

Period	: 3 months
Enrolment	: 40 (20 each for A and B courses)
Trainee age	: 18 years and over
Qualifications	: Secondary School graduate with knowledge of written English, experience preferable but not necessary.
Objective	: Cultivate capable operators of construction machinery used in the construction of roads, dams and irrigation facilities, who have acquired the skill in operating such machinery as well as sufficient theoretical knowledge and minor maintenance know-how related to.
Contents of training	: 1) Explanation of construction machinery in general. 2) Explanation of machine components. 3) Practical training in machine operation. 4) Construction work execution procedure. 5) Inspection/maintenance know-how.

2) Mechanic I Course

Period	:	3 months
Enrolment	:	20
Trainee age	:	18 years and over
Qualifications	:	Secondary School graduate with knowledge of written English, experience preferable but not essential.
Objective	:	Cultivate all-round mechanics capable of simple repairs of construction machinery, who have acquired sufficient theoretical knowledge and assembling/disassembling know-how of such machinery.
Contents of training	:	1) Handling of general tools and measuring instruments. 2) General knowledge of construction machinery and components. 3) Inspection/maintenance know-how. 4) Practical training in disassembling/assembling. 5) Troubleshooting and practical training in repairs.

3) Mechanic II Course

Period : 5 months
Enrolment : 40 (20 each for Engine and Chassis Groups)
Trainee age : 20 years and over
Qualifications : Secondary School graduate with 3 years or longer experience as assistant mechanic, or Intermediate College graduate with 1 year or longer experience as assistant mechanic. Knowledge of written English is essential.

Objective : Cultivate mechanics capable of maintenance, repairs and testing of construction machinery, who have acquired theoretical knowledge and disassembling/assembling know-how of such machinery.

Contents of training :

Engine Group

1) Handling of general tools and measuring instruments.
2) General knowledge of construction machinery and components.
3) Repairs and overhauling of engine body.
4) Repairs and testing of engine electric circuit and fuel system.
5) Engine testing, adjustment and repairs.

Chassis Group

1) Handling of general tools and measuring instruments.
2) General knowledge of construction machinery and components.
3) Structure and repairs of stiring gear.
4) Structure and repairs of hydraulic system.
5) Operation of machine tools and trouble shorting.

3-2-2. Training Curriculum

1) Operator Course

Training Method

40 trainees divided into A and B groups will be given joint classroom lectures in the first month. In the second and third months, the two groups will take the monthly curriculum alternately. Five-member trainee groups will be organized to provide each trainee with operator training by actual machines as long as possible.

Curriculum

1st month	- Explanation of construction machinery.		
(Lectures)	- Functions of component elements.		
	- Preventive inspection and maintenance.		
	- Operation procedure.		
	- Construction work execution procedure.		
	- Handling of general tools.		
2nd month	- 1st week	Bulldozer.	4 groups
(Practical training)	- 2nd week	Motor Scraper Bulldozer	"
	- 3rd week	Motor Grader Compactor	"
	- 4th week	Hydraulic Excavator Dump Truck	"
3rd month	- 1st week	Dozer Shovel Wheel Loader	4 groups
	- 2nd week	Road Stabilizer Asphalt Distributor	2 groups
	- 3rd week	Truck Crane Compressor, Generator	4 groups
	- 4th week	Review and Examination	

2) Mechanic I Course

Training Method

Lectures will be given to all 20 trainees, and practical training by dividing them into two 10-member groups. Textbooks and teaching materials will be developed according to the trainees' technical level.

Curriculum

1st month (Lectures)	- Handling of general tools and measuring instruments. - Explanation of construction machinery. - General knowledge of engine, chassis, hydraulic system and electric circuit.
2nd month (Lectures and practical training)	- Importance of preventive inspection and maintenance. - Explanation of construction machinery. - Explanation of disassembling/assembling procedure. - Practical training in components disassembling/assembling.
3rd month (Practical training)	- Repairs of engine system. - Troubleshooting. - Gas cutting and welding.

3) Mechanic II Course

Training Method

Trainees will be divided into 20-member groups, the Engine Group and the Chassis Group. Lectures will be given to all 20 members of each group, and practical training by dividing them into two 10-member groups.

Curriculum

Engine Course

1st month (Lectures and practical training)	- Handling of general tools and measuring instruments. - Explanation of engine system, electric circuit and fuel system. - Explanation of different types of engines and engine components.
2nd month (Lectures and practical training)	- Explanation of overhauling procedure. - General information on practical training. - Engine disassembling, cleaning, assembling and reconditioning. - Repairs of engine components.
3rd month (Practical training)	- Overhauling of different types of engines. - Repairs and testing of engine electric circuit.
4th month (Practical training)	- Repairs and testing of fuel pump and nozzle. - Turbo charger disassembling/assembling.
5th month (Practical training)	- Engine dynamometer testing, adjustment, trouble-shooting and repairs.

Chassis Course

1st month	- Handling of general tools and equipment.
(Lectures)	- General knowledge of construction machinery.
	- Functions of components.
2nd month	- Structure and repairs of stiring system.
(Lectures and	(clutch, transmission and brake adjustment)
practical training)	
3rd month	- Structure and repairs of hydraulic system.
(Lectures and	(hydraulic pump, motor control valve, cylinder,
practical training	plunger type pump and motor, etc.)
	- Testing of hydraulic components.
4th month	- Structure and repairs of under-carriage system.
(Lectures and	- Tire disassembling and assembling.
practical training)	
5th month	- Troubleshooting and repairs of components.
(Lectures and	- Handling of machine tools.
practical training)	- Gas cutting and welding.

3-2-3. Training Programme

The trainees will be recruited on an open basis from eligible applicants for an annual enrolemnt of 300 and 1,200 numbers expected to produce during four years. The NLC's Karachi Workshop (see Appendix) received a total of 3,000 applications when it was opened in 1978 for an enrolemnt of 75, although this workshop was not established for maintenance and training of construction machinery but truck/trailer. Accordingly, it is expected that the CMTC will receive a considerably large number of applications.

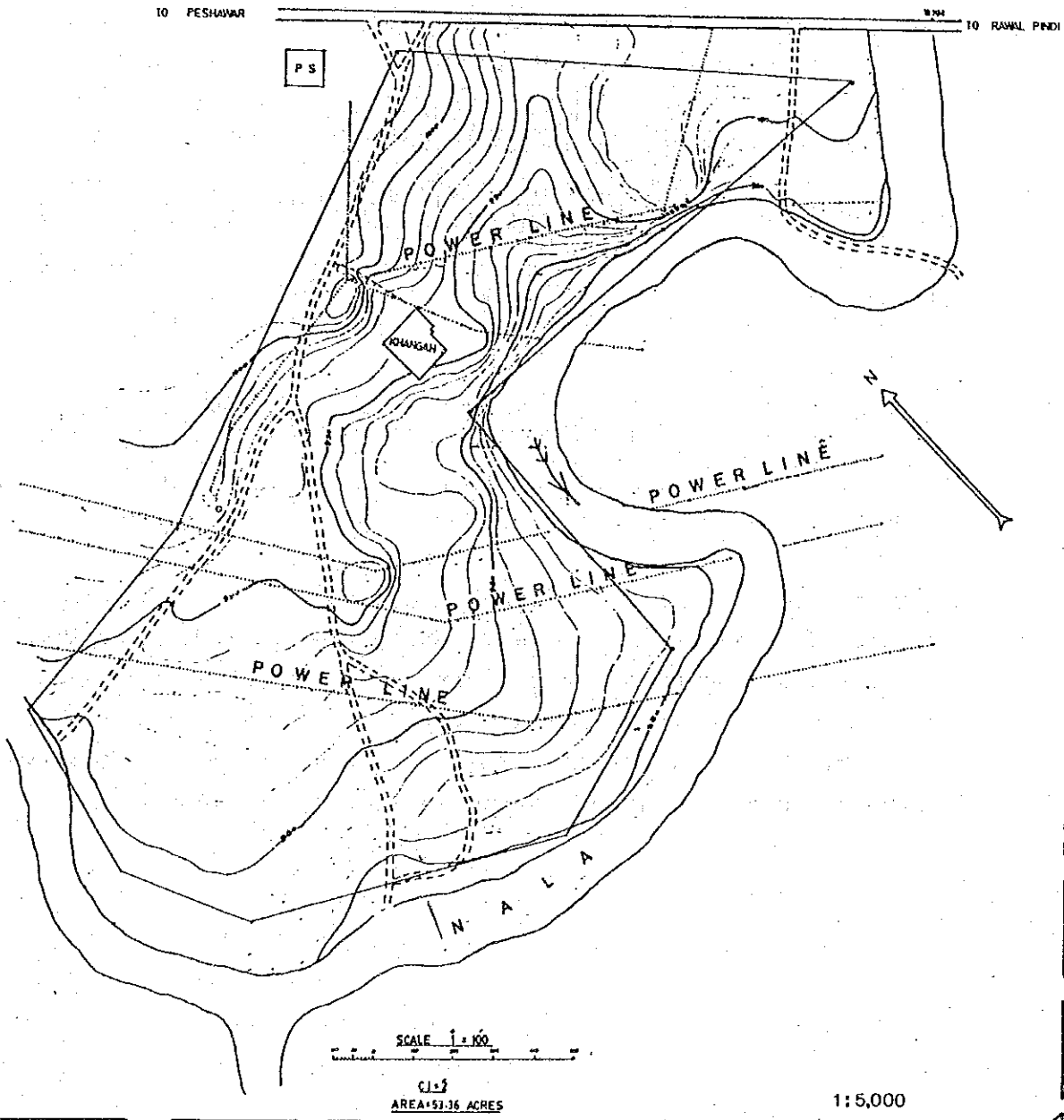
The CMTC's training programme is shown below for each course

Fig. 3.2.1 Training Programme of CMTC

	Training Period (month)	Capacity (person)	Number of Training	Annual Outpet	Instructor Chief	Instructor Sub
Operator Course	3	(A) 20 (B) 20	4	160	1	3+4
Mechanic I	3	20	3	60	1	3
Mechanic II						
Engine Course	5	20	2	40	1	3
Chasis Course	5	20	2	40	1	3
Total	-	100	-	300	4	16

Considering the expected English acquirement of trainees and for the purpose of attaining the maximum training effects, it is preferable to give lectures and training in Urudu. From our hearing, Urudu is generally used at the NLC's training centers and training in English is extremely difficult, though not totally impossible. For this reason, textbooks and teaching materials need to be prepared partially in Urudu.

PROPOSED SITE FOR CONSTRUCTION MACHINERY TRAINING CENTRE SANGJANI



Surveyed by F.W.O.

CHAPTER 4. OUTLINE OF THE PROJECT SITE

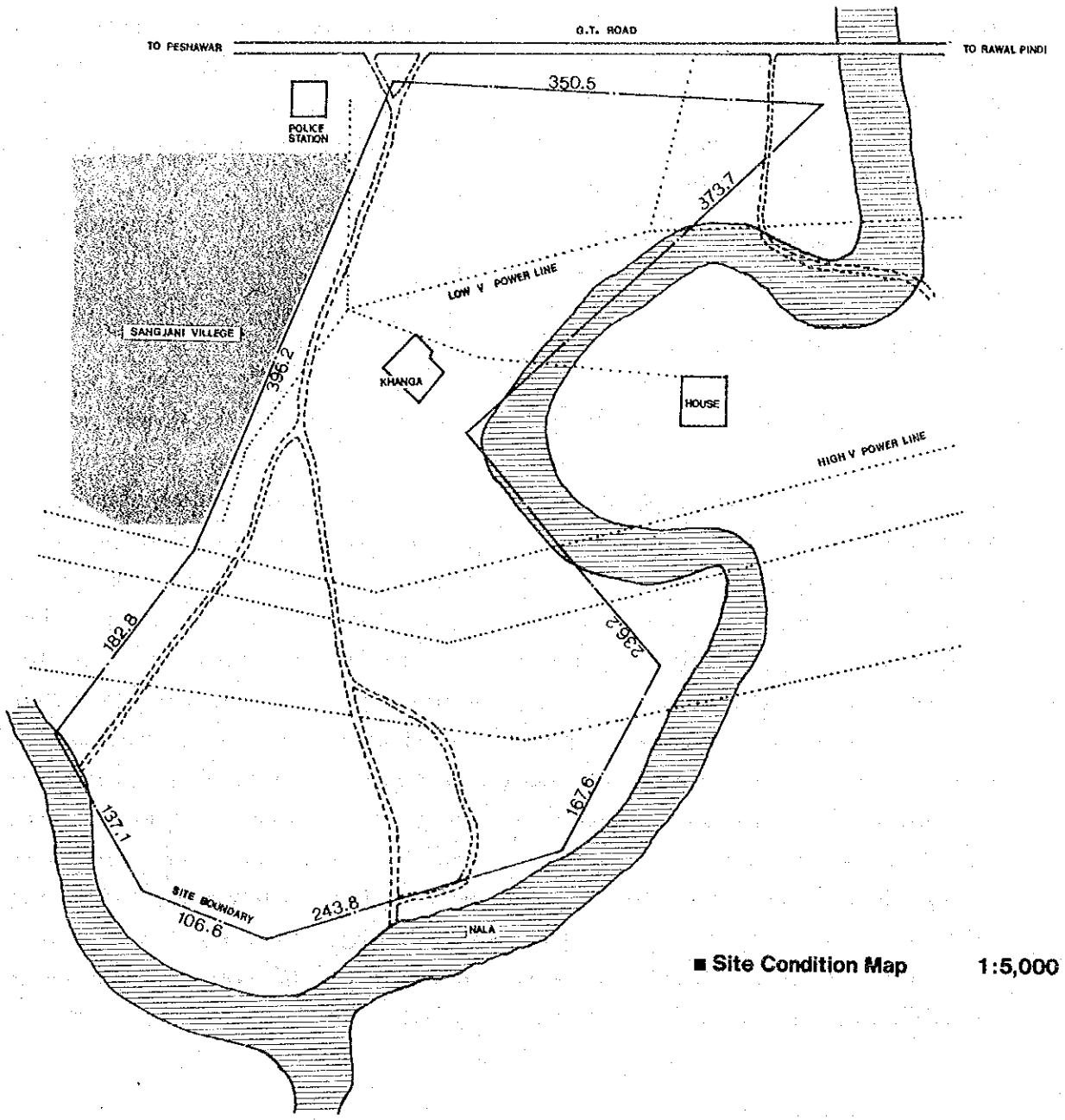
4-1. Proposed Construction Site

The proposed construction site of the CMTC adjoins Sangiani Village located 18 km to the north west of Islambad, the capital city with a population of 350,000. It is situated along the Grand Trunk Road (Peshawar Road) linking Karachi and Peshawar about 25 minutes by car from Islambad and about 30 minutes' to Taxila from the proposed site. Furthermore, it will be at the northwestern periphery of the Islambad Capital Development Area and the construction of a new International Airport is planned around this are so that it seems an area with high possibilities of future development.

(See Appendix)

4-2. Site Condition

The proposed site covers an area of about 21.6 ha (53.36 acres) adjoins Sangjani Village on the northwest and the Grand Trunk Road on the northeast. On all other sides, it faces the river (Nala) which has never flooded the site area even in the wet season because of its relatively small discharge. However, as land inclines from Sangjani to this river, it is probable that surface water will flow across the site to this river. The village cemetery (Khanga) at the center divides the site area into the northern and southern parts. In the southern part, there are three steel towers supporting three high-voltage transmission lines. The transmission lines have a minimum height of about 6 m above the ground and their relocation is not considered possible. The northern part of the site area also has two transmission lines, but the WAPDA stated that these low-voltage lines can be relocated if requested. Other structures found in the site are include the access roads and dwellings used by the villages. Relocation of these structures is considered difficult owing to the long-established custom and habit of the villagers.



■ Site Condition Map 1:5,000

No basic living facilities such as shopping centers and schools are found near the site area. This point needs to be taken into careful account in planning the construction of dormitory for trainees and staff houses.

Soil test pits conducted in six places to a depth of about 1 m disclosed that the project site is covered with a clayey silt formation. Standard penetration test will have to be conducted in the future to check the bearing capacity of land. As the site faces the river, a suitable drainage plan needs to be formulated and the fill work on the slope should be given sufficient compaction. (See Appendix)

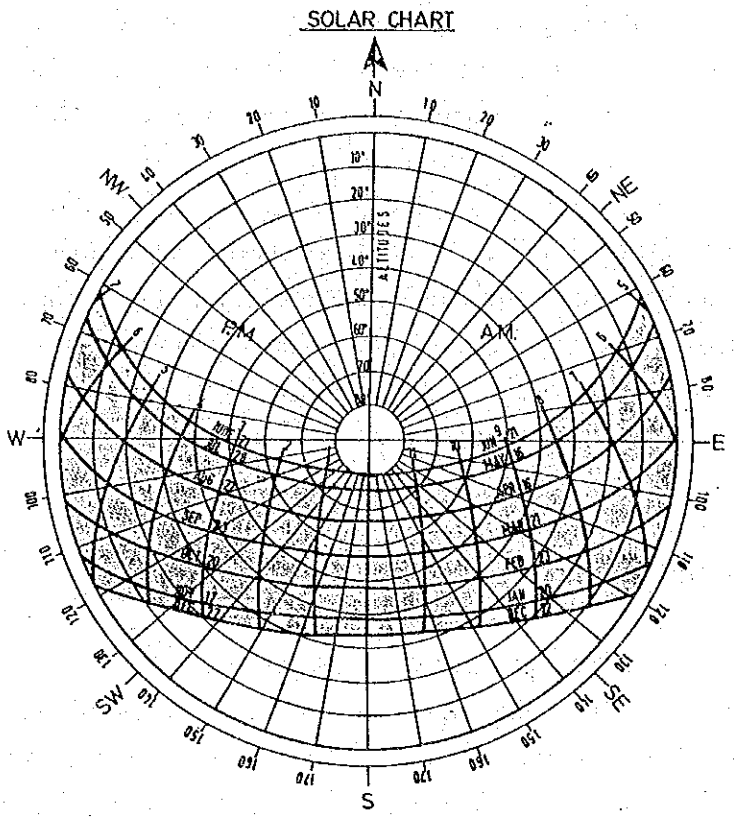
4-3. Existing Infrastructure

As for basic infrastructural facilities around the project site, a telephone and gas trunk-line run along the trunk road. Connection of branch lines from these main lines is possible, but may taken some time to go through the necessary formalities. Electricity can be obtained from the 11 KV transmission lines crossing the site. Clean water supply system is not available, so that well water utilization need to be planned. As regards drainage, no specific municipal restrictions are applied and direct discharge into the Nala river is possible. (See Appendix)

4-4. Climatic Conditions

Temperature in Islambad is high in summer (May - July) when it rises to 42°C in the day time. In June, the area is occasionally afflicted with a sandstorm, then comes the wet season lasting from June to August. In September, fine weather continues, and autumn (October - November) is cool and refreshing. In winter (December - February), it is comfortable in the day time, but the temperature drops to about -2°C in the night time so that air-conditioning is required to keep the room temperature at a comfortable level.

In formulating the architectural plan, consideration should be given to the need for shutting out the strong sunbeam and making the ceiling high for providing large air volume in each room. Ventilation in summer is very essential, but it should be adjustable for night time temperature drop in



LATITUDE 33° NORTH

■ Meteorological Data of Islamabad (5 Years based)

month	Temperature (°C) daily min.	daily max.	AM8:00	PM5:00	Rel. Humidity (%) AM8:00	PM5:00	Rainfall (m/m) monthly total	Wind Velocity (m/s) AM8:00	PM5:00
Jan.	-0.1	22.0	4.8	14.4	78	50	42.6	0.49	0.85
Feb.	0.1	24.0	7.3	16.5	79	51	57.2	0.49	1.12
Mar.	0.6	30.0	13.1	21.1	69	46	86.6	0.76	1.39
Apr.	10.0	38.0	19.8	28.1	64	42	105.2	0.89	1.25
May	15.0	40.0	26.9	35.3	43	26	48.8	0.94	1.88
Jun.	16.0	42.0	30.3	37.4	37	21	26.2	1.25	2.06
Jul.	16.0	40.0	28.7	35.1	69	53	332.5	0.98	1.52
Aug.	18.0	37.0	27.0	33.7	79	62	281.7	0.54	0.85
Sep.	15.0	36.0	24.3	33.7	74	53	193.5	0.49	0.85
Oct.	0.7	33.0	17.5	29.4	55	35	12.7	0.45	0.72
Nov.	0.4	29.0	9.1	22.3	60	40	28.4	0.40	0.67
Dec.	1.5	23.0	4.7	16.1	71	49	39.4	0.49	0.58
Annual Mean	7.8	32.8	17.8	26.9	65	44	(Mean) 106.3 (Total) 1,275.1	0.68	1.15

Source: Pakistan Meteorological Department

winter. Prevention of sandstorm intrusion must also be planned. Prevailing wind direction is northeast or southwest. (See Appendix)

4-5. Building Code

As the project site is situated within the Capital Development Area, the owner (MOC) is requested to submit an application for development with the CDA (Capital Development Agency) prior to the construction of the CMTC facilities.

The CDA's approval must also be obtained at the design stage because the building standards in Islamabad are not consolidated except for residential houses and commercial/industrial establishments. (See Appendix)

Fig. 5.5.1 The Altitudes and Azimuths as Observed from a Latitude of 33°N

Time	22 June		16 May & 28 July		16 Apr.& 27 Aug.		21 Mar.& 23 Sept.		23 Feb.& 20 Oct.		26 Jan.& 17 Nov.		22 Dec.	
	Az	Al	Az	Al	Az	Al	Az	Al	Az	Al	Az	Al	Az	Al
Sunrise & Sunset	62°	0°	67°	0°	78°	0°	90°	0°	102°	0°	113°	0°	118°	0°
5 a.m. & 7 p.m.	62°	1°	-	-	-	-	-	-	-	-	-	-	-	-
6 a.m. & 6 p.m.	70°	13°	74°	10°	82°	5°								
7 a.m. & 5 p.m.	77°	25°	81°	22°	90°	18°	98°	13°	107°	7°	114°	2°	-	-
8 a.m. & 4 p.m.	84°	37°	89°	35°	98°	30°	107°	25°	116°	19°	123°	13°	126°	10°
9 a.m. & 3 p.m.	92°	50°	98°	48°	109°	43°	119°	36°	127°	29°	134°	23°	137°	19°
10 a.m. & 2 p.m.	102°	62°	110°	60°	123°	54°	133°	47°	141°	38°	147°	31°	149°	27°
11 a.m. & 1 p.m.	122°	74°	133°	71°	146°	63°	154°	54°	159°	45°	162°	36°	164°	32°
12 noon	180°	80°	180°	76°	180°	67°	180°	57°	180°	47°	180°	38°	180°	34°

Source: "Tropical Architecture"

Fig. 5.5.2 Incident Direct Solar Radiation of Horizontal Roof and Differently Oriented Walls on A Clear Day (Daily mean for each month in gm. cal/sq. cm/day)

Month	Horizontal	East or West	South-east or South-west	South	North-east or North-west	North
	LATITUDE 33°N					
Jan.	248	131	292	395	11	-
Feb.	326	164	295	375	30	-
Mar.	430	205	284	310	66	-
Apr.	532	239	253	203	119	9
May	608	256	212	104	168	37
June	640	262	189	63	194	71
July	630	260	197	74	185	54
Aug.	576	249	233	148	145	21
Sep.	482	224	270	261	127	2
Oct.	376	185	293	348	46	-
Nov.	281	145	295	390	18	-
Dec.	230	123	289	396	9	-

Source: "Tropical Architecture"

CHAPTER 5. BASIC DESIGN

5-1. Basic Design Criteria

The CMTC project is intended to provide training in construction machinery operation and maintenance in order to meet the rapidly growing demand for the services of operators and mechanics of such machinery. Accordingly, its Basic Design must be developed to realize the Center which should meet the purpose of technical training to the full and should create a comfortable atmosphere. At the same, it must be noted that the CMTC will be the only construction machinery training center in Pakistan and should consequently be provided with versatile, effective facilities for training that can produce great spread-out effects in the country. Furthermore, due account must be taken of the following points to fully adapted to the natural climate and environment in Pakistan because the CMTC will be operated and maintained by the Government of Pakistan.

1) Solar Radiation Prevention

To avoid the strong solar radiation in summer, the building should preferably planed with its long axis set in the east-west direction for daylighting from the northern and southern sides, as practiced in other tropical and subtropical countries. Besides using materials with high resistance to heat transmission, direct incident solar radiation should be prevented by means of eaves and light-control louvers.

2) Heat Insulation

Summer in Islambad is very hot, with the temperature rising to as high as 42°C. The room area must be large enough to provide a sufficient air space per person, and the ceiling height must be large enough for natural ventilation. Consideration must also be given to the use of ceiling fans used in Pakistan as well as to introduction of a mechanical ventilation system.

3) Energy-saving and Ease of Maintenance

In formulating the building design apart from the installation plan, adequate energy saving measures should be introduced by natural daylighting and ventilation and by preventing direct sunbeams and radiant heat.

Consideration should be given to the need for minimizing the running cost and introducing a system which assures great ease of maintenance and spare parts replacement.

4) Building Materials

Local building materials should used positively to cut down construction cost and for ease of maintenance, insofar as they present no problems in terms of quality and supply volume. However, a carefully through-out procurement plan based on the execution schedule should be prepared in advance to cope with the possible case where local materials fail to be supplied smoothly.

5-2. Required Functional Elements and Facilities

The CMTC's functions will be composed of four elements, the administrative, training and welfare functions and the training function is divided into the classroom training and the practical training functions. Training facilities, equipment and materials need to be planned on the basis of careful preparations in order that each functional space will exhibit its performance efficiently and produce the highest training effects.

1) Administrative Function

The administrative sector is required to control all sectors of the CMTC and ensure a smooth, efficient management of classrooms and practical training, outdoor facilities, dormitory and staff houses. For this purpose, the sector will have a director's office, assistant director's office, teachers' room, administrative room, conference rooms and storage. It also must have a library, copy room, and lecture hall for lectures and entrance/graduation ceremonies, which will be used by all sectors. Space for demonstration/publicity of training activities is also necessary because the CMTC is the only construction machinery training center in Pakistan.

2) Classroom Training Function

The grade and layout of the CMTC's facilities should be planned according to various patterns/methods of training and also various kinds of teaching materials. Accordingly, a medium-size Classroom (for 40 - 50 trainees) should be provided in addition to ordinary Classrooms for the purpose of joint lectures. Simple educational equipment such as an overhead projector and a slide projector should also be installed in each classroom. Furthermore, racks and space for cut-models of construction machinery should be provided in each classroom which will be used frequently in the training.

3) Practical Training Function

As the CMTC will conduct four different training courses, its facilities should be planned according to the contents/method of practical training given in each course in order to attain the maximum training effects.

o Outdoor practical training function

- Practical training by the Actual Machinery;
  the Operator Course

o Indoor practical training function

- Practical training in maintenance and repairs using of actual construction machinery;
  the Mechanic I Course
- Practical training in Engine Components, etc.
  the Mechanic II (Engine Group) Course
- Practical training in Chassis Components, etc;
  the Mechanic II (Chassis Group) Course

Outdoor practical training will be given in the operation of machinery used in the standard construction work and in the actual execution of construction work. Accordingly, a training space suited to each type of construction machinery where training in actual earth moving work can be conducted should be provided. Outdoor facilities should also include those for washing/storage practices. (See Appendix)

As indoor practical training will be conducted using actual machinery components as training equipment, consistency must be maintained in the selection of such equipment and their efficient shop layout should be ensured. In planning the layout of training equipment, a work space and a training space should be secured as these equipment will be used for training by a large number of trainees.

Indoor practical training facilities should include a Chassis Shop for actual machinery disassembling/assembling practice, an Under-charriage Shop for under-carriage repair practice, a Machine Shop for parts/crankshaft repairs, a Hydraulic Shop, an Engine Shop for engine disassembling/assembling practice, and a Parts Storage and Tool Room for accommodating the tools and parts used in such practices. Furthermore, a Fuel Pump Test-room, an Engine Test-room, a Hydraulic Test-room and an Electric Test-room are required for testing and adjusting practices. All these Test-rooms should be designed as noise-proof, explosion-proof facilities with air-conditioning and exhaust-gas discharge systems. Shop Classrooms and Sub-instructors' Rooms will also be necessary to hold short/ectures and give instructions/guidance to the trainees for the purpose of efficient training.

4) Welfare Function

Besides the three functions summarized above, the CMTC is required to have Welfare Facilities for trainees and staff to ensure a smooth operation of its short-term training periods. Specifically, the following facilities should be provided according to the training schedule.

- Dormitory for trainees

  The Dormitory building needs to be constructed for the purpose of efficient short-term training because no suitable accommodations are available in the vicinity of the CMTC and also because of the long distance from Islamabad. The Dormitory will also be used to afford accommodations for invited instructors.

- Staff Houses

  These are necessary to provide accommodations for the staff members recuited from far away places.

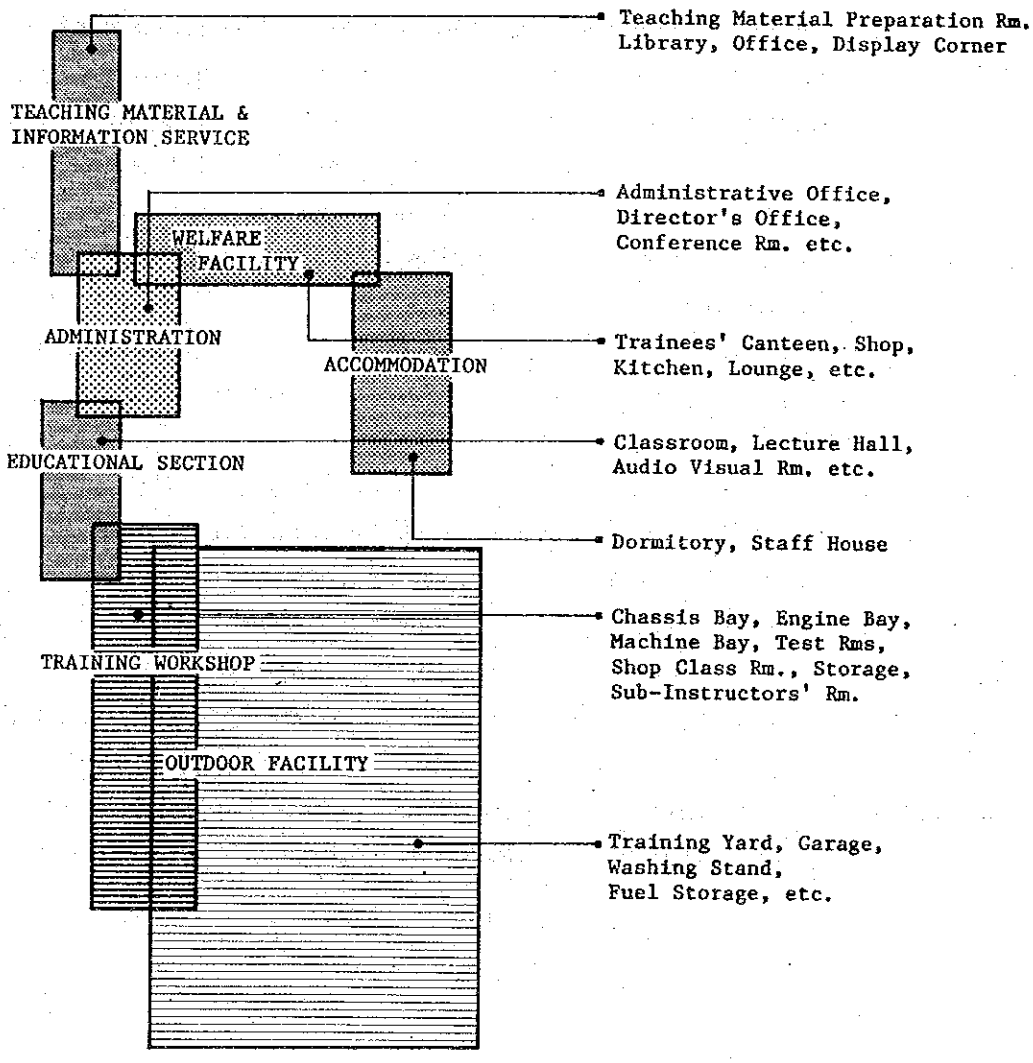
- Trainees' Canteen and Staff Dining

  The canteen will be designed to provide services for trainees and staffs including a shop selling daily necessities to trainees.

- Recreation Facilities

  An outdoor space for trainees and staff members to enjoy recreational sports such as volley ball and an indoor recreation room where table tennis can be enjoyed should preferably provided.

■ Linkage - Diagram of Facility



5-3. Design Process and Layout Plan

After studying the objective and positioning of the project, it was concluded that the CMTC should have three Sections of Administration, Classroom and Practical Training as well as Welfare Sectioropm meeting the needs of trainees and staff members. At the outset, the Pakistan side proposed that buildings designated for these Sections be built separately and arranged in the entire site area. However, on finding that the cemetery at the center divides the site area into northern and southern halves and three high-voltage transmission line cross the site area, it was concluded that all buildings should be constructed in the northern part of the site. As this necessitated a compact layout of facilities that can make best use of the site area, it was determined that the following buildings would be constructed with consideration given to inter-sector relationships and mutual utilization

- Administrative Section

  This will be settled in an administrative building.
- Classroom and Practical Training Sections

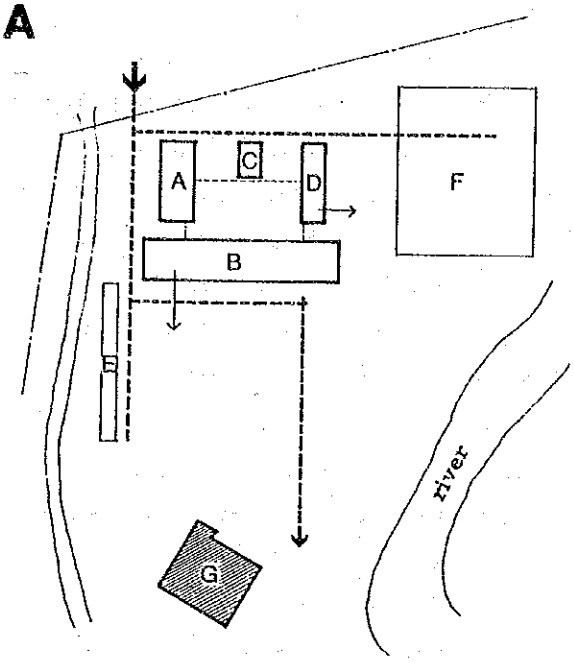
  A training building will be designed to accommodate both sections with consideration to inter-sector mutual utilization. This section will also have a construction machinery garage and washing stand, etc.
- Welfare Section

  A canteen, a staff dining room and staff houses will constitute this section.

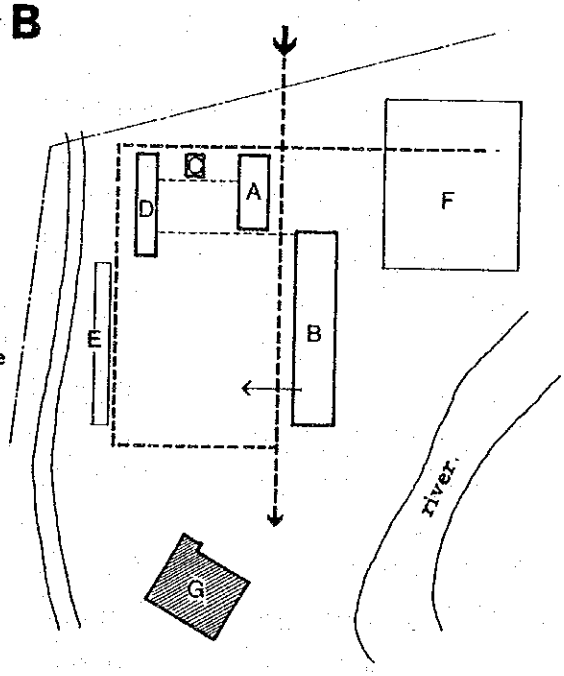
The different layout of the above sections were subjected to a careful study of the following requirements.

1) Simple and highly functional.
2) Land inclination is utilized to minimize reclamation/leveling work and make the foundation structure free from any undue restraints.
3) Proposed area for Staff Houses are located far from the noise sources such as construction machinery and training machines.
4) Noise transmission to Sangjani Village is minimized.
5) The practical Training Building and Staff Houses are provided with a space for the future expansion.

Alternative **A**



Alternative **B**



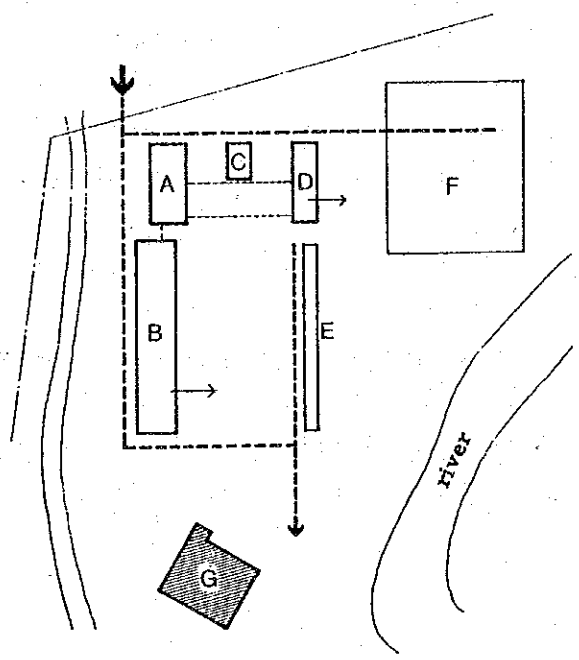
A Administrative building
B Training building
C Canteen
D Dormitory
E Construction machinery garage
F Staff Housing area
G cemetary (Khanga)

In Alternative-A, it is possible to secure a space for the future expansion of the Training Building and Staff Houses, but the noise generated by machinery is liable to be transmitted directly to Sangjani Village. And the Training Building land reclamation/foundation works because it crosses the existing inclination at right angles.

Alternative-B reduces the volume of reclamation work because buildings are designed to be constructed along the inclination, but does not solve the noise problem and cannot secure a sufficient space for the future expansion. Furthermore, the Training Building is liable to subjected to rainwater inflow because it will be located on the lower side of the slope.

Alternative-C is considered most appropriate for the following reasons. The buildings layout along the inclination causes little difficulty in the reclamation/foundation work, and the training building serves to intercept the noise transmission to Sangjani Village. Furthermore, it is possible to secure an ample space for the future expansion, and the dormitory can be located near the staff houses, thus making possible to create a satisfactory environment. In this arrange, it is appropriate to consider about three different ground levels for relcamation/foundation work. From the comparsion of three layout plans described above, it was determined to adopt Alternative-C training.

Alternative **C**



5-4. Facilities Planning

Contents of main facilities planned for the CMTC are as follows.

1) Administration Building

Adjacent to the entrance hall, a space for publicity/demonstration of the CMTC's activities will be secured to provide information to visitors and trainees. On the ground floor, this demonstration space will lead to the Administrative room, Conference rooms, and Library with Copy room where training materials and text books can be prepared. On the first floor will be provided the Lecture Hall large enough to accommodate all trainees and staff at graduation ceremonies and lecture meetings. Director's room, Senior staff room, Teachers' room, Locker room for instructors and staff Janitors' room, and Electrical room also will be settled.

2) Training Building

The Training building will have Work shops and related rooms for practical training on the ground floor and Classrooms on the first floor. The Chassis shop on the ground floor will have a span of 14 m and a 5-ton hoist crane for engine mounting/dismantling because actual construction machinery will be used for training in this shop. This will be followed by four shops of the Engine, Hydraulic, Machine and Under-carriage where a 3-ton crane will be installed. These shops will be accommodated continuously to make it possible to perform an actual line suitable for machinery maintenance. In parallel with these shops, four Test-rooms such as the Engine, Hydraulic, Fuel Pump and Electric, having a noise and explosion-proof and an exhaust gas discharge system will be arranged functionally together with the Shop Classrooms, Sub- instructors' Room, Tool Room and Parts Warehouse.

On the first floor of the training building will be arranged for classroom training section such as three small Classrooms and a medium-size Classroom and A-V room. The Corridor linking the first-floor classroom will be designed to offer a view of the practical training on the ground floor to produce high demonstration effects on trainees and visitors.

3) Canteen Building

The Canteen will be situated between the Administrative building and the Dormitory for utilization by both trainees and staffs. The Canteen will be designed to accommodate about 100 trainees for 1 to 1.5 rotations of self-service. The Staff Dining room will have a seating capacity of 20 - 25 persons for 1 - 1.5 rotations of attended service. In the Canteen, shops selling daily necessities to trainees will be provided.

4) Dormitory

The Dormitory will have 17 rooms each accommodating six trainees to maintain a capacity of about 100 persons as well as the Invited Instructor's room for accommodating a maximum 5 persons.

5) Covered Walk-Way

The Administrative building, Dormitory and Canteen will be connected with Covered Walk-ways. One of them will be a field-side walk way designed for viewing the field on the roof the exhibit the demonstration effects of the construction machinery operation.

6) Staff Houses

As the CMTC will be constructed at a newly acquired site and no accommodations are available in surroundings, the Pakistan side made a request for 20 residential houses within the site area to accommodate staff who will be recruited from distant places. Availability of accommodations is apparently a condition essential especially for attracting capable technical staff members including instructors. It is also a prequisite to recruiting drivers, cooks, dormitory janitors, etc., who attentive service can be expected by bringing their residence and work place close together.

However, the living environment is not favorable around the site because there are neither schools nor shopping facilities for securing daily necessities. This point must be given due consideration.

5-5. Scale of Facilities

1). Administrative Building

Room Name	Breakdown	Floor Area (m^2)	Capacity	Remarks
Administrative Rm.		60	for 9 staff	6.6 m^2/P.
Director Office		30	for 1 staff	30 m^2/P.
Senior Staff Rm.		30	for 1 staff	30 m^2/P.
Teacher's Rm.		60	for 8 staff	7.5 m^2/P.
Conference Rm.	able to separate two rooms by movable Partition	90	for 35-45 seats	2-2.6 m^2/P.
Copy & Preparation Rm.		27		
Lecture Hall		160	for 100-120 seats	1.3-1.6m^2/P.
Library		108		
Locker/Shower Rm.		47		
Electrical Rm.		68		
Storage		25		
WC/Corridor/Stair /Pantry		884		

Total 1,589 m^2

2). Training Building

Room Name	Breakdown	Floor Area (m^2)	Capacity	Remarks
Classroom	3 Rooms	57 x 3	for 20-25 trainee	2.2-2.8 m^2/P.
	1 Room	86	for 40-50 trainee	1.7-2.2 m^2/P.
A-V Rm.		100	for 40-50 trainee	2.0-2.5 m^2/P.
Preparation Rm.		28		
Simulator Rm.		57		
Sub-Instructor Rm.	1 Room	48	for 7-9 staff	5.3-6.8 m^2/P.
	3 Rooms	24 x 3	for 3-5 staff	4.8-8.0 m^2/P.
Parts Warehouse		189		
Tool Storage		36		
Janitor Rm.		20	for 7-10 staff	2.0-2.8 m^2/P.
Shop Classroom	2 Rooms	48 x 2	for 20-25 trainee	1.9-2.4 m^2/P.
Store Keepers' Rm.		10	for 3 staff	3.3 m^2/P.
Chassis Shop		560		
Welding, Fabrication & Undercarriage Shop		210		
Machine Shop		126		
Power Line & Hydraulic		196		

Engine Shop		168		
Fuel Injection Pump Rm. & Elec. Test		108		
Engine Test Rm.		36		
Hydraulic Test Rm.		42		
Control Rm.		18		
WC/Storage/Corridor /Stair		1,094		

Total 3,471 m^2

3). Canteen

Room Name	Breakdown	Floor Area (m^2)	Capacity	Remarks
Trainee's Canteen		170	for 70-80 trainee	2.1-2.4 m^2/P.
Staff Dining		44	for 15-20 staff	2.2-2.9 m^2/P.
Kitchen		52		
Shop		24		
Staff Rm.		8	for 3 staff	2.6 m^2/P.
Storage/WC		16		
Laundry & Utility		33		

Total 347 m^2

4). Dormitory

Room Name	Breakdown	Floor Area (m^2)	Capacity	Remarks
Office		12	for 3-4 Staff	3.0-4.0 m^2/P.
Night Duty		12		
1 Bed Rm.	5 Rooms	22 x 5	for 1 staff	22.0 m^2/P.
6 Bed Rm.	17 Rooms	44 x 17	for 6 trainee	7.3 m^2/P.
WC/Shower/Wash		190		
Storage		27		
Study Rm.		44		
Lounge & Recreation Corner		66		
Corridor/Ent. Hall		563		
Stair				

Total 1,785 m^2

5). Covered Walk Ways Total: 272 m^2

6). Garage for Construction Machinery Total: 425 m^2

7). Workshop for Building Maintenance Total: 88 m^2

Total Floor Area of 1) - 7) 7,964 m^2

8). Residential Houses for Staff Total: 1,834 m^2
(Pakistan side work)

Type A	62 x 3 =	186 m^2
Type B	84 x 6 =	504
Type C	104 x 11 =	1,144
Total		1,834 m^2

Grand Total of 1) - 8): 9,798 m^2

The actual construction work will be preceded by a detailed review of the above scale and breakdown, which may result in minor changes in the original plan.

5-6. Element Planning

Local climatic condition, selection of materials suited to local natural environment, and ease of maintenance after completion are the decisive factors in planning elements. As the temperature at Islamabad rises to as high as 42°C maximum in summer and drops down to -2°C minimum in winter, the CMCT should be designed with consideration of solar radiation prevention and ventilation in summer with each element devised to be maintenance-free as possible.

1) Roofs

Temperature rise of roof surfaces arrises the room temperature increase due to radiation heat and deteriorates the water-proofing layer. Accordingly, the concrete slabs should be covered with a heat insulating layer to prevent their temperature rise, and the room inside should also be provided with a heat insulating layer to prevent heat transfer. The heat insulating effect can be used by making the ceiling height large for quicker ascent of heated air and by providing a ventilation system in the ceiling.

2) External Walls

The external walls should have no openings on the east and west to prevent the direct incidence of solar radiation when the sun is low in the morning and evening, and should preferably have a double wall to increase the heat insulating effects. On the south and north, they should be provided with windows for ventilation as well as eaves and louvers to shut off direct sun beams. The paint to be coated on the external walls should be selected with care because some paints are liable to discoloration due to high temperature. In Pakistan, fair brick masonry is generally adopted.
As the lower part of the building is liable to be soiled by splashes of raindrops, the beam should be covered with plants or gravels.

3) Interior Walls

Because of the nature of the CMTC, the interior walls should be given a soil-resistant finish. If they are to be coated with a paint, it is necessary to select one that makes it easy to clean the coated surface.

4) Floors

The open walk ways are liable to cause rainwater inflow into the room in the wet season, so that the detail of entrances should be designed carefully. For flooring the work shops where oils will be used frequently, it is advisable to select a highly oil-resistant floor finish that can be washed with water.

Fig. 5.6.1 Table of Solar Radiation Absorption

Roofs		Paints	
white asbestos cement	50%	white-wash	21%
copper sheeting	64%	bright aluminium	30%
red roofing tile	70%	yellow	48%
galvanised iron, clean	77%	dark aluminium	63%
bituminous felt	89%	bright red	65%
galvanised iron, dirty	89%	light green	73%
asphalt	95%	black	97%
Walls		**Surroundings**	
concrete	70%	grass	80%
fire clay brick (red)	70%	sand, grey	82%
aluminium foil	39%	rock	84%

Source: "Building in the Tropics"

5-7. Material Planning

As the CMTC will be used by a large number of people, it is necessary to pay attention to the durability in selecting building materials. For cost down and greater ease of maintenance, locally available materials will be used positively, insofar as they are acceptable in quality and can be supplied smoothly.

1). Material Planning

(1) Structural Materials

The basic structure is reinforced concrete frame and brick walls will be used for partitions.

(2) External Finish Schedule

Roof Materials	: Double roofs using heat insulating materials
External Wall	: Mortar trowel with painting, Fair faced brick masonry
Sash and Fixtures	: Aluminum and steel
Eaves	: Reinforced concrete

(3) Interior Finish Schedule (main rooms only)

a) Classrooms

Floors	: PVC sheets
Walls	: Paint finish
Ceilings	: Sound-absorbing boards, etc.

b) Shop classroom

Floors	: Color mortar finish
Walls	: Paint finish
Ceilings	: Sound-absorbing boards, etc.

c) Audio-visual room and lecture hall

Floors	: Carpet-tiles
Walls	: Sound-absorbing materials
Ceilings	: Sound-absorbing boards, etc.

d) Conference rooms

Floors	:	PVC sheet, carpet-tiles
Walls	:	Sound-absorbing materials
Ceilings	:	Sound-absorbing boards, etc.

e) Halls and walk ways

Floors	:	Terrazo blocks
Walls	:	Fair brick masonry, paint finish
Ceilings	:	Sound-absorbing boards, etc.

f) Workshops

Floors	:	Mortar hardner finish
Walls	:	Paint finish
Ceilings	:	Sound-absorbing boards, etc.

2) Colour Schedule

The colour schedule will be worked out on the basis of three conditions, i.e., climatic condition, suitability to surrounding environment, and creation of an orderly atmosphere be fitting as a training centre.

(1) Climatic condition

The materials and paint colours will be selected with attention to the free from discoloration due to strong incident solar radiation.

(2) Suitability to surrounding environment

Colour tones matching nicely with the surrounding environment and causing no psychological resistance will be selected.

(3) Orderly atmosphere

Paint colours producing clean and soothing impressions making soiled parts not conspicuous will be selected.

5-8. Structural Planning

5-8-1. Background of Planning

As the Europe-Asian seismic belt crosses through Pakistan, earthquakes have been recorded in the Islamabad area. Accordingly, an aseismatic structural design must be developed for the CMCT.
The proposed construction site is on an inclined land adjoining a river, so that land grading by filling is required. The ground is consist of a clayey silt layer, and buildings in Islamabad are constructed directly on this layer. The CMCT buildings will also constructed by the spread foundation method as practiced in local structure design. The structural design will be preceded by a detailed soil bearing test.

5-8-2. Structural Design

In Pakistan, the code of structural design is specified in the Islamabad Building Regulations 1963 enacted by the Capital Development Authority (CDA), and this Regulations is followed by British Standards. However, as the BS per se is not intended for application in earthquake countries, so that new regulations are now being made on the enact of the "National Building Code of Pakistan". Accordingly, the structural design of the CMTC facilities will be based on the relevant Japanese Standards (AIJ: Standard for Structural Calculation of Reinforced Concrete Structures, and others) and the external forces like wind load, seismic force, etc. will be determined by assuming values suited to Pakistan.

1) Dead Loads

Dead loads of all structural members, finishing materials and interior fixing materials will be summed up.

2) Live Loads

The live loads to be adopted in the design of main rooms of the CMTC will be determined according to the Japanese Building Standards Law.

List of Live Loads (Kg/m²)

	Floor slab. Garder	Beam. Column Foundation	Sesmic force
Classroom	230	210	110
Office	300	180	80
Meeting Room Corridor Hall	360	330	210
Storage Library	500	300	200
Bed Room	180	130	60
Practice Room	550	400	200

3) Wind Load

Wind load may be disregarded for two-storied reinforced concrete buildings, but needs to be given special attention for steel-framed portions of the CMTC facilities.

For these portions, the design velocity load will be obtained from the largest wind velocity recorded in Islamabad for final determination according to the Japanese Building Standards.

Maximum wind velocity recorded in Islamabad: V = 35 m/sec.

by assuming the air density (P) at 0.125 $kg.sec^2/m^4$, as shown in the following calculation.

Design 8 = 1/2 x P x $(V)^2$ = 1/2 x 0.125 x $(35)^2$ = 77 Kg/m^2

velocity pressure will be taken at q = 80 kg/m^2.

4) Seismic Force

As no standards pertaining to aseismic structural design have yet been established in Pakistan, it appears that the aseismic design is left to the discretion of each engineer. For the structural design of the CMTC facilities, the seismic force will be inferred from the past earthquake record at Islamabad for determination according to the Japanese Building Standards.

a) Seismic force in the Islamabad area

i) Maximum seismic acceleration

According to the seismic risk map of the Indian area prepared by Mr. S. Hattori as fig. 18, the maximum ground acceleration that occurs in the durable years of the CMTC facilities is in the range of 20 - 50 gals.

ii) Response speed

The response speed estimated with the attenuation constant of reinforced concrete buildings taken at h = 0.05 and by using the standard response spectrum obtained by statistical processing of seismic data in Japan and the United States, as Fig. 22.
Hence, the maximum input ground acceleration is estimated about 2 - 2.5 times.

iii) Standard shearing force coefficient (Co)

$$Co = \frac{(20 - 50 \text{ gal.}) \times (2 - 2.5)}{980} = 0.041 - 0.128$$

It is considered appropriate to take the median (Co = 0.10) as the standard shearing force coefficient.

b) Seismic intensity recorded in the past

No reliable data is available concerning heavy earthquakes that occurred in the Islamabad area in the past. According to "the Geodyanmics of Pakistan" edited by Abul Farah & Kees A. Dejong, however, the earthquake intensity recorded in the past corresponds to 6 - 7 of the modified Mercalli scale. This is equivalent to 20 - 100 gal. of ground accleration, and the response speed estimated from this value is 40 - 250 gal. This means that the elastic design based on Co = 0.10 of standard shearing strength coefficient mentioned above can be justified from the viewpoint of durability.

5) Load Bearing Capacity of Soil

Although no detailed soil survey including the standard penetration test has yet been conducted, the field reconnaissance and soil survey disclosed that the construction site is covered with a clayey silt layer. As most

reinforced concrete buildings in the Islamabad area are constructed directly on this layer, the CMTC buildings will also be designed for construction by the spread foundation method and built directly on the said layer. The design bearing capacity of ground will be determined on the basis of various soil tests, but it will be necessary to consider the possibility of its decline because the construction site adjoins a river. Filling work will be required because the site is inclined, and ground subsidence after the filling work must be taken into account in the floor design of first floors.

5-8-3. Structural Materials

Reinforced concrete structure will be adopted for the major portion of the CMTC. For the workshop portion, however, steel frame structure will be employed because the 14.0 m of large span between supports makes the reinforced concrete structure extremely costly and uneconomical.
The structural materials need to be selected in consideration of quality, supply capacity and price.

1) Aggregate for Concrete

River sand available in Panjab and northern Sind Reagions can be used as find aggregate. As for coarse aggregate, the demand is quite huge and cannot be met by the excavation from gravel pits at present, but crushed stones can be obtained in place of gravels. Although both types of aggregate are somewhat short of supply at present, they can be obtained for the project.

2) Cement

Cement production is under the management of a Stage Cement Corporation that turns out normal Portland cement. The production capacity was not large enough to meet the demand in the past, but increased after the Government permitted the private sector investment in the cement industry. Locally produced cement will be used for the project as its quality is high and meets the British Standard.

3) Reinforcements

Deformed and round bars produced in Pakistan are neither large enough in quantity nor uniform in quality. As all these bars are cut to a length of about 12 m, they cause a big loss and not economical for construction of the CMTC facilities which have a span of about 7.0 m.
Accordingly, hot-rolled deformed bars SD30 manufactured in Japan will be used for the project.

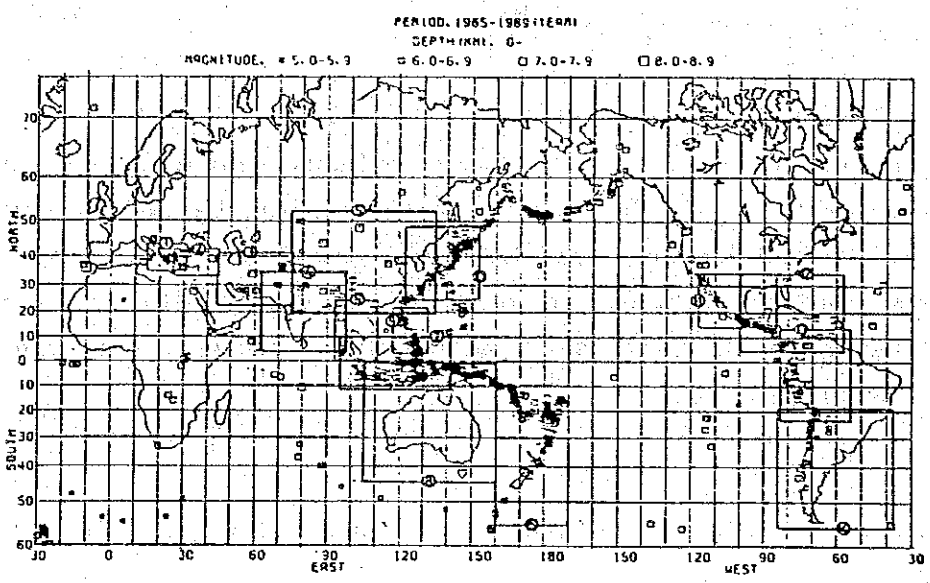
4) Steel Frames

Structural steel frames manufactured in Pakistan are not sufficient in quantity and quality just as steel bars. In addition, the technical level of steel work and welding work is still rather low. Accordingly, welded steel frames will be transported from Japan for bolting at site. These will be rolled steel SS41 for general structures.

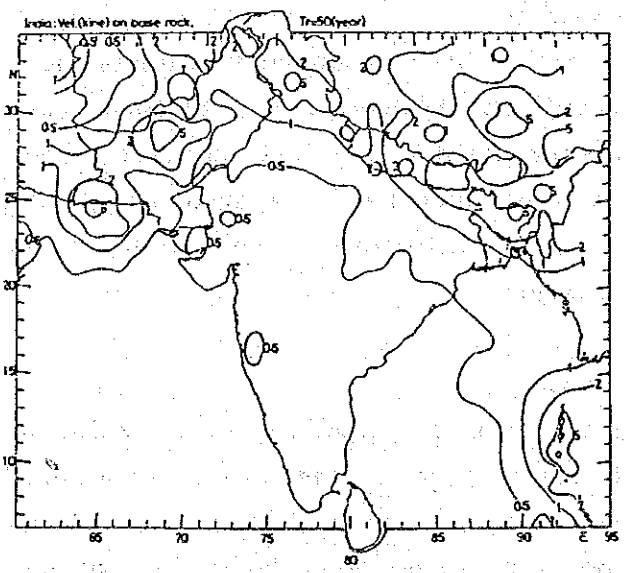
NOTES:

S. HATTORI "Seismic Risk Map of the World - regional distributions of maximum earthquake motion and maximum ground acceleration"

Report No. 88, Feb 1980, Construction Research Institute, Ministry of Construction

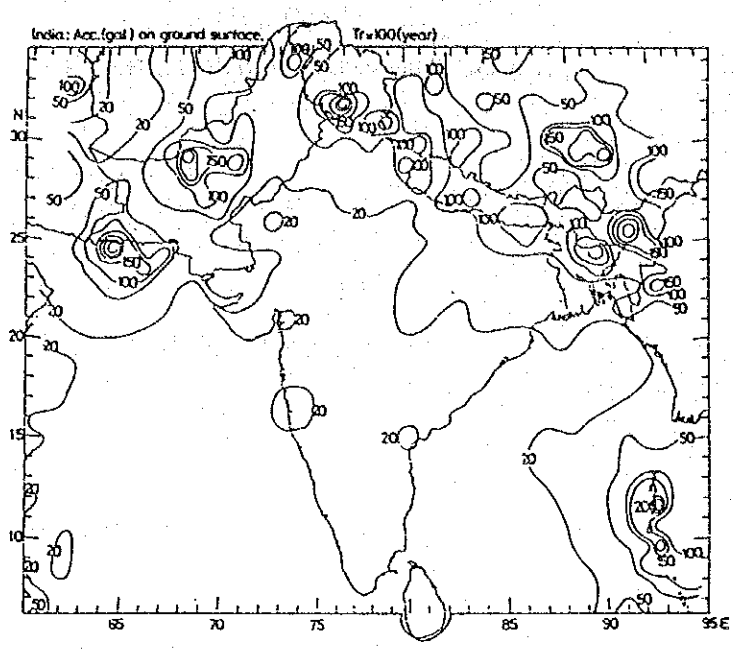


■ **Areas for which the seismic risk maps were made in this research.**

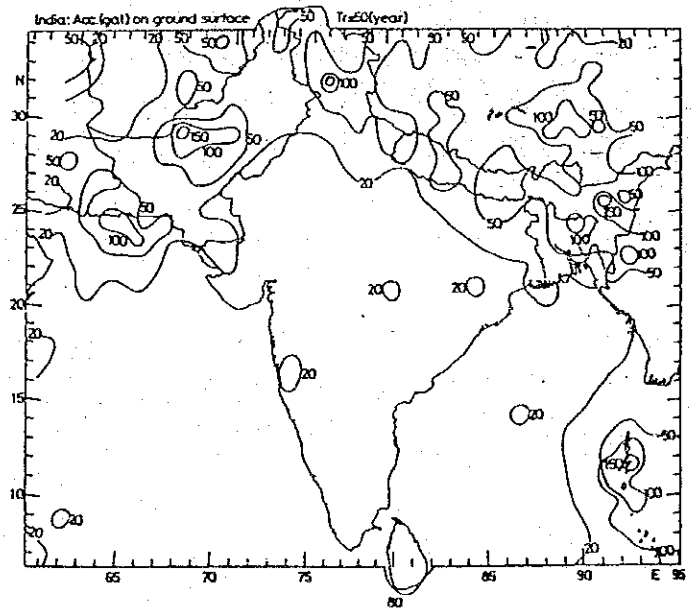


■ **Regional distributions of the maximum earthquake motion in and around India (V_{max} (kine): Maximum particle velocity on the base rock, A_{max} (gal): Maximum acceleration on the ground). (a) V_{max} for return period Tr=50 years**

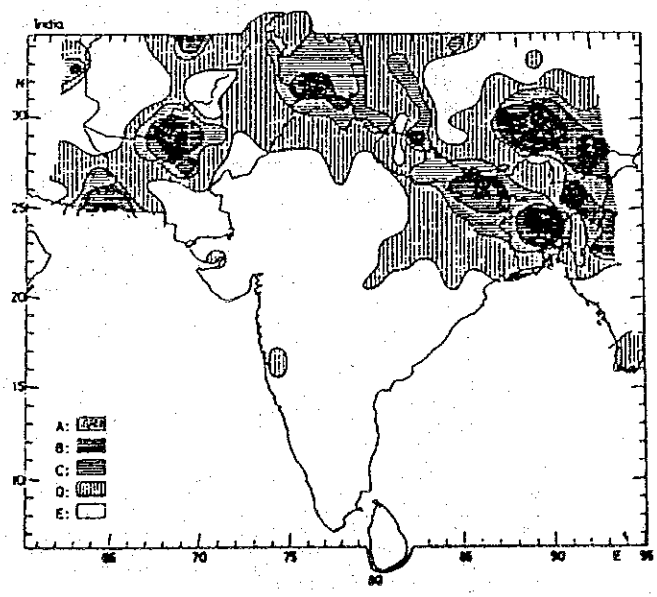
■ A_{max} for return period Tr=100 years



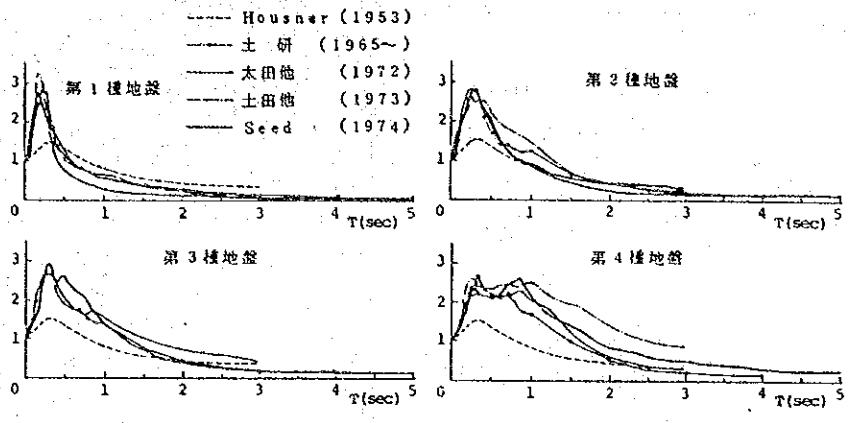
■ A_{max} for return period Tr=50 years



■ Seismic regional coefficient map in and around India

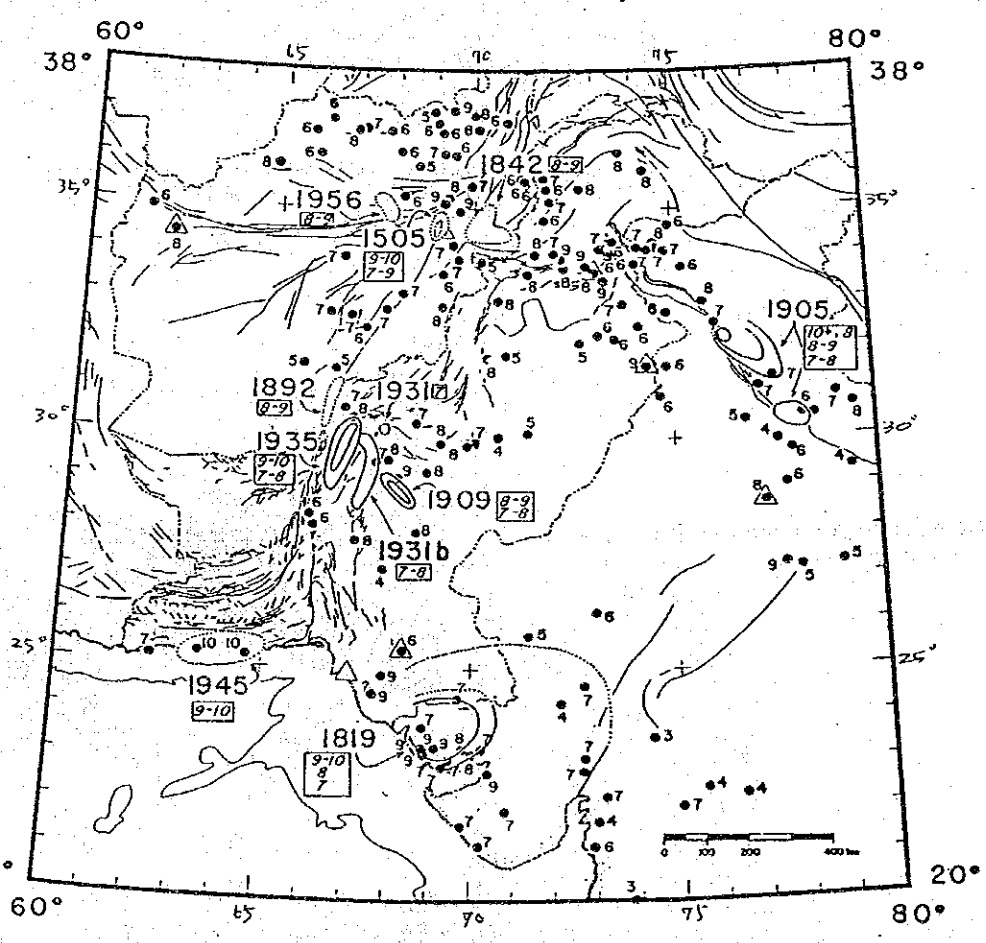


■ Average Response Spectrum of Different Standardized Accelerations (h=0.05)



■ "The Geodynamics of Pakistan"
edited by Abul Farah
Kees A. Dejong

Seismicity of Pakistan and its Relation to Surface Faults



● Map of maximum documented intensity (Modified Mercalli scale) at any given location. Data for mapped portions of USSR and China are not considered. Isoseismal lines (dotted where inferred) are plotted for some of the larger events. The year of occurrence for each such large event is indicated. The intensity value associated with a given isoseismal line is indicated in the box near each date. The first value given is for the innermost isoseismal line, etc. A few locations for which a documented intensity is known are not plotted so that isoseismal lines will be more clearly visible. The open triangles represent cities (see Figs. 3, 6, and 9). Note that this figure must not be misinterpreted as representing the maximum credible intensity at a given location. It is a record of past observed intensities, not future predicted intensities.

5-9. Mechanical Planning

The following basic points will be observed for installation various equipment systems of the CMCT.

- Ensure a close linkage with the building functions.
- Pay attention to the climatic conditions and convenience for users.
- Select systems and types easy for management, maintenance and inspection.
- Reduce the running cost and energy consumption.

5-9-1. Air-conditioning and Ventilation System

Ventilation will be planned to cope with the heat in summer harmonized with the building design by taking full advantage of natural ventilation and minimizing the heat volume due to incident solar radiation so as to secure a sufficient air space per person.
If air-conditioning is required for some unavoidable reason, due consideration should be given to the economic efficiency and ease of maintenance in selecting the system and component equipment. In winter, main rooms should be covered by the air-conditioning system to keep the room temperature at a comfortable level when the outside temperature drops, occasionally causes a snowfall.

1) Air-conditioning System

The air-conditioning system will be installed for individual control of specific temperature conditions in the following rooms

	Cooling	Heating
Administrative Room	O	O
Conference Rooms	O	O
Library	O	O
Instructors' Room	O	O
Senior Staff Room	O	O
Director's Room	O	O
Lecture Hall	O	O
Simulation Room	O	–
Fuel Pump Test Room	O	O
Hydraulic Test Room	O	O
Classrooms	O	–
Audio-visual Room	O	–
Staff Dining Room	O	O
Invited Instructor's Rooms	O	–

Separate or package type air-conditioning equipment will be selected according the system operational condition/scale in the above rooms.

2) Design Criteria for Air-conditioning System

	(Summer)	(Winter)
Outdoor conditions	42°C, 55%	5°C
Indoor conditions	28°C, approx. 50%	20°C

3) Ventilation System

As a rule, all buildings will be designed for natural ventilation. However, the kitchen, WCs and workshops where exhaust gas needs to be discharged or welding work is performed will be provided with a forced mechanical ventilation system. In the following rooms not covered by the air-conditioning system, the ventilating fans generally used in Pakistan will be installed.

Shop classroom, Sub-instructors' room, Workshops, Canteen, Dormitory

5-9-2. Plumbing System

1) Clean Water Source

As no clean water supply system is found near the construction site, a well will be drilled within the site area for water supply. The well will have a bore diameter of 150 and be drilled to a depth of about 100 m to secure a daily supply of 87 m^3 or more. A submersible pump will be installed in this well as follows.

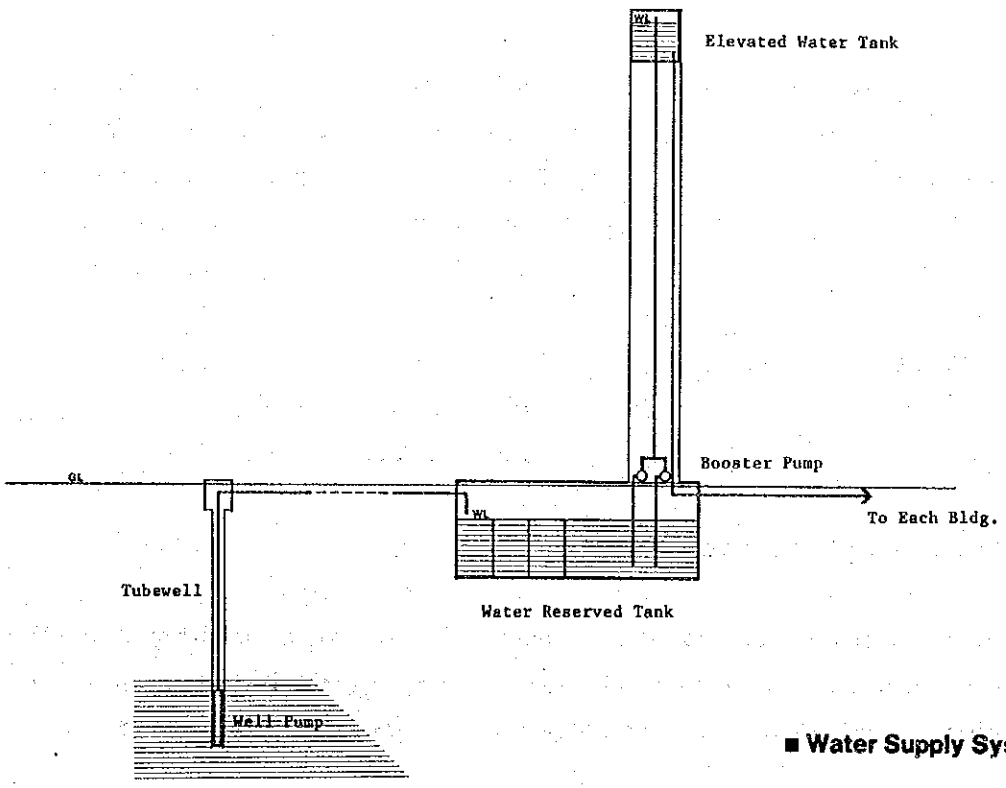
40ϕ x 100L./min. x 80m x 3.7kw

2) Water Quantity Calculation

- Service population	Trainees + Staff	165 persons
	Staff Houses	80
	Total	245 persons
- Supply volume	245 x 250L./man.day	= 61,250 L./day
	Sprinkling, etc.	= 25,000 L./day
	Total	86,250 L./day
		87 m^3/day
- Pump yield	87 m^3/day = 5,800 L./h (15 hrs/day)	
	= 97 L./min.	
		100 L./min
- Well yield	100 L./min x 60 min x 24 H	
	= 144,000 L./day	
	= 144 m^3/day	

3) Water Supply System

Well water pumped up by the submerged pump will be stored in the sand setting water reservoir and pumped further up to the elevated water tank, and then supplied to each building by the gravity flow method.



■ Water Supply System

4) Hot Water Supply System

Dormitory rooms for trainees and the kitchen will be provided with gas water heaters.

5) Drainage System

The drainage system will be planned separately for soil water, effluent from the machinery washing yard, and storm water.

- Soil water drainage
Soil water from various parts of the CMTC will be purified in the septic tank and then soak away to the ground in the site.

- Effluent from machinery washing yard
Effluent from the machinery washing yard led into the oil train and soil setting pit and then soak away to the ground in the site.

- Storm water
Storm water from the roofs and ground of site area will be discharged into the river along the project site.

6) Sanitary Fixtures

Lavatories, urinals and water closets will be installed in toilets and lavatories as required the Architectural planning. Especially, local traditional style water closets will be applied for trainees use.

7) Sewage Treatment System

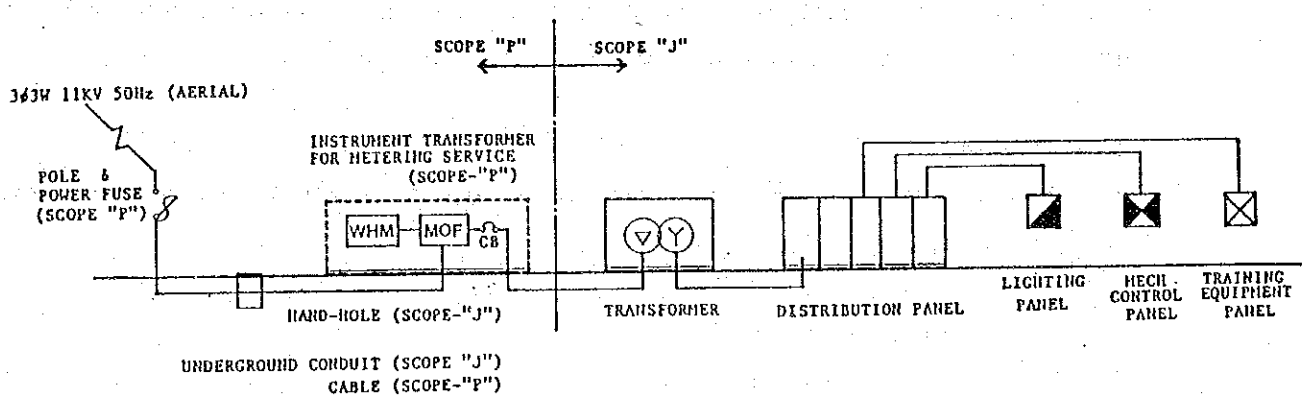
Septic tanks will be installed for each building by the decentralized treatment system.

8) Fire Protection System

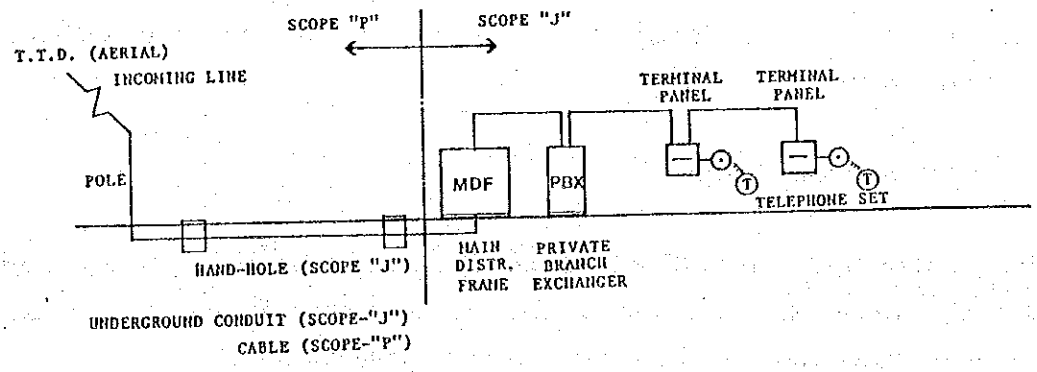
Indoor water hydrants will be installed in suitable places in each building and a fire pump will also kept ready for operation at all times in order to be able to start the fire fighting operation immediately.

9) Gas Supply System

Trunk line of a medium-pressure gas runs from Rawalpindi to Peshawar, so that a branch line leading from this main to the site can be laid through meters after reducing the pressure with a regulator to each building. The piping from the trunk line to the regulator and meters will be undertaken by the Pakistan side.



■ Electrical Power Supply



■ Telephone Main Line