

JAPAN INTERNATIONAL COOPERATION AGENCY

MINISTRY OF COMMUNICATIONS  
THE ISLAMIC REPUBLIC OF PAKISTAN

BASIC DESIGN STUDY REPORT  
ON  
THE PROJECT FOR EXPANSION  
OF  
CONSTRUCTION MACHINERY TRAINING INSTITUTE  
IN  
THE ISLAMIC REPUBLIC OF PAKISTAN

MARCH 1996

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CONSTRUCTION PROJECT CONSULTANTS, INC.  
YACHIYO ENGINEERING CO., LTD.

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## PREFACE

In response to a request from the Government of the Islamic Republic of Pakistan, the Government of Japan decided to conduct a basic design study on the Project of Expansion of Construction Machinery Training Institute and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Pakistan a study team from 2nd October to 22nd October, 1995.

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

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

I wish to express my sincere appreciation to the officials concerned of the Government of the Islamic Republic of Pakistan for their close cooperation extended to the teams.

March, 1996



Kimio Fujita  
President

Japan International Cooperation Agency

March, 1996

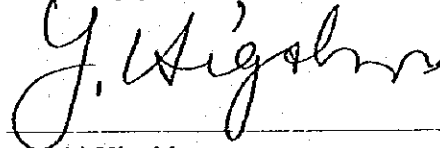
## LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on the Project for Expansion of Construction Machinery Training Institute in the Islamic Republic of Pakistan.

This study was conducted by the Joint Venture of Construction Project Consultants, Inc. and Yachiyo Engineering Co., Ltd. under a contract to JICA, during the period from 29th September, 1995, to 14th March, 1996. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of the Islamic Republic of Pakistan and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

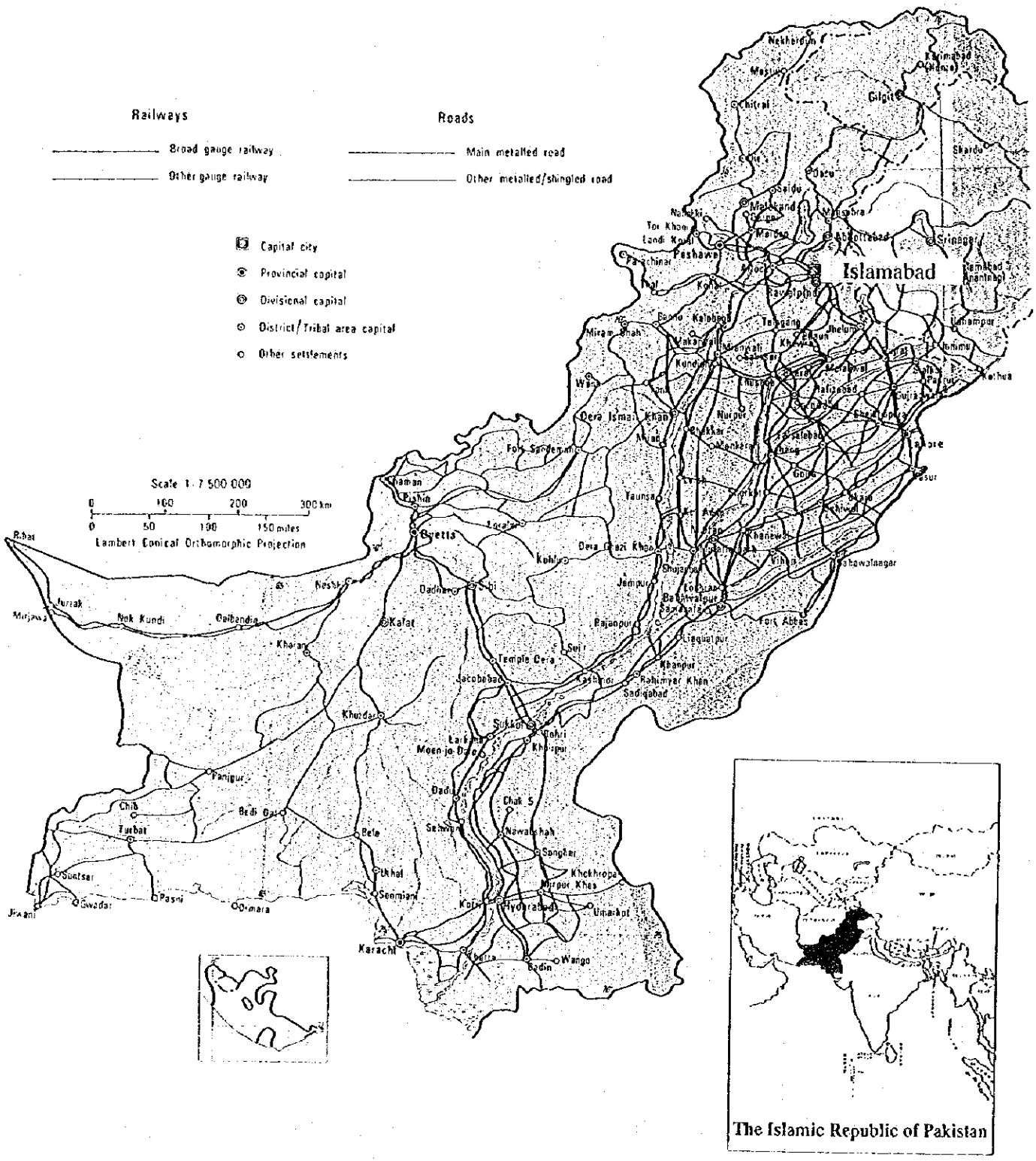
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,



---

Yoichi Higaki  
Project Manager  
Basic design study team on  
The Project for Expansion of Construction  
Machinery Training Institute  
Joint Venture of  
Construction Project Consultants, Inc. and  
Yachiyo Engineering Co., Ltd.



**LOCATION MAP**



## Abbreviations

ADP	Annual Development Programme
AK	Azad Jammu and Kashmir
CMTC	Construction Machinery Training Center
CMTI	Construction Machinery Training Institute
FATA	Federally Administered Tribal Areas
FWO	Frontier Works Organisation
GVI	Government Vocational Institutions
NEC	National Economic Council
NHA	National Highway Authority
NLC	National Logistics Cell
NTB	National Training Bureau
NWFP	North Western Frontier Province
PCSIR	Pakistan Council of Scientific and Industrial Research
PECO	Pakistan Engineering Company
PIDC	Pakistan Industrial Development Corporation
PP	Perspective Plan 1988-2003
PR	Pakistan Railways
PSDP	Public Sector Development Programme
SBP	State Bank of Pakistan
WAPDA	Water and Power Development Authority
ADB	Asian Development Bank
ECC	European Economic Community
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
IDB	Islamic Development Bank
IMF	International Monetary Fund
JICA	Japan International Cooperation Agency
OECD	Organisation for Economic Cooperation and Development
UNDP	United Nations Development Programme
OECE	Overseas Economic Cooperation Fund, Japan

<b>SAL</b>	<b>Structural Adjustment Loan</b>
<b>CIF</b>	<b>Cost, Insurance and Freight</b>
<b>CPI</b>	<b>Consumer Price Index</b>
<b>FOB</b>	<b>Free On Board</b>
<b>GDP</b>	<b>Gross Domestic Product</b>
<b>GNP</b>	<b>Gross National Product</b>

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## **CHAPTER 1. Background of The Project**

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## Chapter 1 Background of the Project

The Government of the Islamic Republic of Pakistan has been promoting the agricultural and industrial sectors whose total share of the GDP exceeds 50%. (Agriculture and industry 24.5% and 26.7%, respectively, in 1995). The road sub sector plays an important role in national transport (freight and passenger) where more than 60% depends on road transport.

Regarding road conditions, of a total of 205,304 km of road network, only 51% are paved with all weather type surfaces but have low geometric standards of single lane.

Development of the road sub sector being a pre-requisite for economic growth and national integration, the Government has intensified efforts to expand and improve the existing facilities and accelerate development of the network by introducing new technologies and developing technical manpower in the road construction industry.

Under the Sixth Five Year Plan (1983-1988) the Road Construction Training Center (CMTI) was established with Japan's Grant Aid Assistance to develop skilled manpower in the field of construction machinery techniques. The facilities constructed included an administration building, training building, dormitory and canteen for trainees (total area of the facilities 7,964 m<sup>2</sup>, project cost 2,970 million yen). Then technical assistance by Japanese experts has been provided during 1983 to 1990 for the training of instructors for construction machinery operation and maintenance. Training equipment of about 61 million yen equivalent was also introduced. During this period, transfer of technology was successfully conducted, and a training capacity of about 260 trainees per year was attained.

Under the Eighth Five Year Plan (1993-1998) the CMTC was renamed the Construction Machinery Training Institute (CMTI) in 1993 establishing the expansion plan which programmes expansion of the existing training courses and introducing new courses such as diploma of associate engineer course.

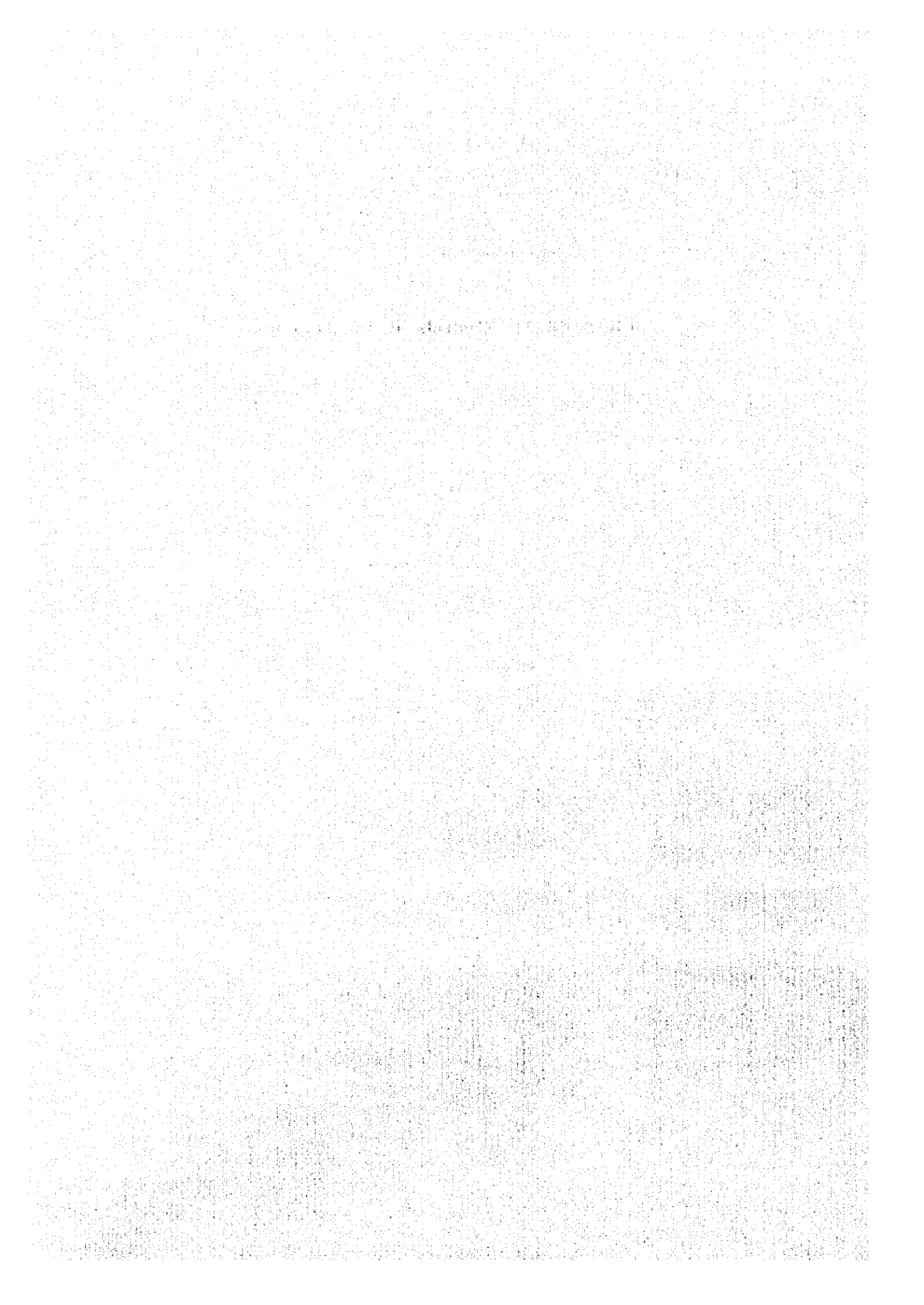
In due course of implementation of the expansion plan, the Government of Islamic Republic of Pakistan made a request to the Government of Japan for the procurement of construction material and training equipment to accomplish the expansion plan together with technical assistance by Japanese experts.

Items requested were as follows:

- Construction material** : Cement, concrete block, steel bars for construction of class room, training building and other facilities
- Training equipment** : Construction machinery such as concrete mixing plant, lifting equipment, vibrator, crane, etc.



## **CHAPTER 2. Contents of The Project**



## **Chapter 2      Contents of the Project**

### **2.1      Objectives of the Project**

Under the Sixth Five Year Plan (1983-1988) the Construction Machinery Training Center (CMTC) was established in 1986 with Japan's Grant Aid Assistance to fulfill an increasing demand for skilled manpower in the construction machinery field. Then technical assistance by Japanese experts has been provided up to 1990 for training purposes in construction machinery operation, maintenance and management.

The Eighth Five Year Plan (1993-98) has given the highest priority to the development of physical infrastructure. In consideration of the fact that more than 60% of inland traffic is shared by roads, more than 60% of the total investment in the transport and communications sector under the Public Sector Development Programme (PSDP) was allocated to the road sub-sector.

In proportion to the increase of construction activities, an adequate supply of skilled man power is required nationwide. Under these circumstances, CMTC was renamed as the Construction Machinery Training Institute (CMTI) in 1993 and its training capacities are being expanded and upgraded.

The objectives of the Project for Expansion of Construction Machinery Training Institute (hereinafter referred to as "the Project") are to assist CMTI's expansion and upgrading plan through the provision of construction machinery, maintenance equipment and training equipment to increase its training capacities

### **2.2      Basic Concept of the Project**

#### **2.2.1      Necessity of CMTI's Expansion Plan**

CMTI's expansion plan was examined from the viewpoint of nationwide manpower demand in the road construction industry, and also from the recent trend of numbers of applicants and employment situation of the graduates of CMTI. The required manpower by category for construction works was estimated from the annual construction workload which was derived from the recent trend of the road programme, its rate of increase and annual output, and then compared to CMTI's present training capacities.

(1) Estimates of Manpower Demand in Road Construction Industry

1) Recent Trend of Road Programme

The growth rate of the nationwide road network during 1980-1994 is shown in Table 2.1 and the summary of on-going road programmes is given in Appendix-6.

Table 2.1 Road Network Development since the Sixth Five Year Plan

Year	High Type Road			Low Type Road			Total			Five Year Plan
	Length km	Growth km	Rate %	Length km	Growth km	Rate %	Length km	Growth km	Rate %	
1980/81	38,035			55,925			93,960			
1981/82	40,380	2,345	6	45,679	554	1	96,859	2,899	3	
1982/83	42,773	2,393	6	57,020	541	1	99,793	2,934	3	
1983/84	49,325	5,552	13	63,591	6,571	12	111,916	12,123	12	6th
1984/85	52,120	3,795	8	66,351	2,760	4	118,471	6,555	6	
1985/86	56,318	4,198	8	69,925	3,574	5	126,243	7,772	7	
1986/87	61,464	5,146	9	72,489	2,564	4	133,953	7,710	6	
1987/88	68,880	7,416	12	74,061	1,572	2	142,941	8,988	7	
1988/89	74,355	5,475	8	77,094	3,033	4	151,449	8,508	6	7th
1989/90	81,981	7,626	10	80,364	3,270	4	162,345	10,896	7	
1990/91	86,839	4,858	6	83,984	3,620	5	170,823	8,478	5	
1991/92	91,181	4,342	5	88,183	4,199	5	179,364	8,541	5	
1992/93	95,740	4,559	5	92,592	4,409	5	188,332	8,968	5	
1993/94	100,527	4,787	5	97,222	4,630	5	197,749	9,417	5	8th
1994/95	104,735	4,208	4	100,569	3,347	3	205,304	7,555	4	
1995/96	108,924	4,189	4	103,586	3,017	3	212,510	7,206	3	
1996/97	113,281	4,357	4	106,693	3,107	3	219,974	7,464	3	
1997/98	117,812	4,531	4	109,893	3,200	3	227,705	7,731	3	

Source: Economic Survey 1994/95

Note: 1) High Type Road = asphaltic surfaced road

Low Type Road = gravel and earthen road

2) On the other hand, classification for administration purposes is as follows:

1. National Roads
2. Provincial Roads
3. District Roads
4. Municipal Roads
5. Cantonment Roads

3) 1994/95 = July/1st, 1994 ~ June/30th, 1995

## 2) Manpower Demand of Road Construction Industry

Annual growth of road network from 1994/95 to the last year of the Eighth Five Year Plan 1997/98 is estimated at 4,000 km and 3,000 km for high type roads and low type roads, respectively.

To estimate the required manpower for construction to achieve this target, productivity analysis was made for typical road works for both high type roads and low type roads, in which the productivity rates by category of workers adopted by the Ministry of Construction of Japan were applied, but with partial modification to suit the current working conditions in Pakistan.

Typical road works in Pakistan are as follows:

### 1. High type roads works

Typical of the high type roads in Pakistan is the asphalt concrete road, Calculation of annual workload of asphalt concrete roads was made based on the following conditions:

Road length	:	4,000 km
Right of way	:	20 m
Pavement width	:	7 m
Base course (thickness)	:	15 cm
Subbase course (thickness)	:	20 cm

Typical work items for an asphalt concrete road are assumed to be earthwork, rock excavation, subgrade preparation, slope works, subbase course, base course, surface course and concrete structural work. Annual out-put for each work item is calculated based on the productivity set out. Then, the required number of engineers, associate engineers, foremen, skilled labours, common labour, operators, mechanics and drivers per year are calculated as (Annual work load) divided by (Annual out-put).

## 2. Low type road works

Typical of the low type road in Pakistan is the gravel road. Calculation of annual workload for gravel roads was made based on the following conditions:

Road length	:	3,000 km
Right of way	:	20 m
Pavement width	:	7 m
Base course (thickness)	:	15 cm
Subbase course (thickness)	:	20 cm

Typical work items for gravel road are assumed to be the same as those for an asphalt concrete road except for the surface course which is to be omitted. To derive the required number of workers by category, the same calculation method as for asphalt concrete roads was used.

## 3. Routine and periodic maintenance

Calculation of annual workload for routine and periodic maintenance of road was made on the following conditions:

High type road / 5% of total road length
Low type road / 10% of total road length

Typical work items for periodic maintenance are assumed to be the same as those of construction works. For routine maintenance-pothole repair, grass cutting, cleaning of drain, etc. were considered.

Productivity analysis for the above three types of works is detailed in Appendix 7. The results indicate that the numbers of required manpower are 200,000, 150,000 and 150,000 for high type road works, low type road works and road maintenance works, respectively.

The required number of workers by category, i.e. construction machinery operators, mechanics, etc. is shown in Table 2.2.

Table 2.2 Required Manpower for Road Works (1995)

Worker	Ratio	Manpower
<b>I. Construction of High Type Roads</b>		
Engineers	1%	2,000
Associate Engineers	2%	4,000
Foremen	2%	4,000
Skilled Labour	4%	8,000
Common Labour	67%	134,000
Operators	13%	26,000
Mechanics	5%	10,000
Drivers	5%	10,000
Others	1%	2,000
<b>Sub-total</b>	<b>100%</b>	<b>200,000</b>
<b>II. Construction of Low Type Roads</b>		
Engineers	1%	1,500
Associate Engineers	1%	1,500
Foremen	2%	3,000
Skilled Labour	3%	4,500
Common Labour	74%	111,000
Operators	9%	13,500
Mechanics	4%	6,000
Drivers	4%	6,000
Others	2%	3,000
<b>Sub-total</b>	<b>100%</b>	<b>150,000</b>
<b>III. Maintenance of the Existing Roads</b>		
Engineers	1%	1,500
Associate Engineers	1%	1,500
Foremen	2%	3,000
Skilled Labour	2%	3,000
Common Labour	87%	130,500
Operators	2%	3,000
Mechanics	1%	1,500
Drivers	3%	4,500
Others	21%	1,500
<b>Sub-total</b>	<b>100%</b>	<b>150,000</b>
<b>IV. Total Manpower Required for Road Works</b>		
Engineers	1%	5,000
Associate Engineers	2%	7,000
Foremen	2%	10,000
Skilled Labour	3%	15,500
Common Labour	75%	375,500
Operators	85%	42,500
Mechanics	4%	17,500
Drivers	40%	20,500
Others	1%	6,500
<b>Total</b>	<b>100%</b>	<b>500,000</b>

### 3) Macroeconomic View

The manpower demand for the road construction industry was derived also from the macroeconomic framework as follows:

The number of workers for the construction sector in 1994/95 is estimated at 2,360,000 as shown in Table 2.3. On the assumption that manpower/capital ratio between sub-sectors in the construction sector is almost equal, the number of workers for the road sub-sector is deemed to be proportional to the amount of public investment within the GDP. Thus, the number of workers for the road sub-sector is calculated as follows:

Manpower in construction industry		GDP share of road sub-sector		GDP share of construction sector		Required manpower for road sub-sector
2,360,000	x	14,226	/	62,202	=	541,271

According to Workforce Situation Report and Statistical Year Book, 1993, the ratio of direct workers, i.e., workers excluding administration, clerical workers, to the total number of workers in the construction sector, is estimated at 90-95%. Thus, of the total of 540,000 for the road sub-sector, 500,000 (540,000 x 92.5%) are assumed to be directly related to construction works. This figure supports, coincidentally, the results of the productivity analysis made in the previous section.

GDP share by sector for 1994/95, Public Sector Development Programme (PSDP) for the road sub-sector for 1994/95 and Employment of Persons by Major Occupational Group and Industry (1993) are shown in Table 2.4, Table 2.5 and Table 2.6, respectively.



Table 2.3 Situation of Workers by Sector for 1994/95

Sector	Occupation	
	Million	%
Agriculture	16.16	47.54
Mining and Manufacturing	3.73	10.89
Construction	2.36	6.94
Electricity and Gas Distribution	0.29	0.85
Transport	1.88	5.52
Trade	4.52	13.31
Others	5.05	14.95
Total of Occupied Workers	33.99	100.00
Unemployed	1.69	
Total Workforce	35.68	

Source: Economic Survey 1994/95

Table 2.4 GDP by Sector for 1994/95

Sector	%
1. Commodity Producing Sectors	51.0
a. Agriculture	24.0
b. Manufacturing	18.5
c. Mining and Quarrying	0.5
d. Construction	4.1
e. Electricity and Gas Distribution	3.9
2. Service Sectors	49.0
a. Wholesale and Retail Trade	16.1
b. Transport, Storage and Communication	10.2
c. Finance and Insurance	2.3
d. Ownership of Dwellings	5.6
e. Public Admn. and Defense	6.5
f. Services	8.3
Total	100.0

Source: Economic Survey 1994/95

Table 2.5 Public Investment for Road Sub-sector for 1994/95

(unit: million Rs)

Item	1992/93	1993/94		1994/95
	Actual	Allocation	Utilize	Allocation
Ministry of Communication	11,407.89	11,800.00	10,382.80	11,323.00
- National Highway Authority				
Main Ministry				
· Construction of Ravi Bridge		245.00	245.00	219.16
· Construction of retention Wall and Diversion of River Flow, Balakot				6.34
- Machinery Training Institute				2.54
· Expansion of CTI				
- NCL	8.20	7.00	7.00	9.06
- Special Area				
· Azad Kashmir	223.10	304.17	290.72	408.30
· Northern Area	262.52	134.85	115.51	120.00
· FATA	148.04	152.40	150.98	148.29
- Research				
· NIT	13.77	11.00	11.00	9.06
Provincial				
- Punjab	1,240.55	970.00	963.31	700.00
- Sind	553.55	568.00	439.84	558.65
- NWFP	494.98	491.31	441.51	569.84
- Baluchistan	426.62	559.25	339.05	192.00
<b>Total</b>	<b>14,779.12</b>	<b>15,242.98</b>	<b>13,386.72</b>	<b>14,266.24</b>

Source: Detailed Annual Plan 1994/95 (Public Sector Development Programme)

Table 2.6 Employment of Persons by Major Occupational Group in the Construction Industry (1993)

(unit: thousand person)

Occupation	Urban Area	Rural Area	All Areas
Professional	18	4	22
Clerical & Sales	57	22	80
Other Services	8	24	31
Production	516	1,361	1,877
<b>Total</b>	<b>599</b>	<b>1,411</b>	<b>2,910</b>
Ratio of professional and production groups to the total	89.2%	96.7%	94.5%

Source: Workforce Situation Report and Statistical Yearbook, 1993

Table 2.7 Population and Workforce 1980/81 - 1992/93  
(unit: thousand person)

Years	Population	Workforce
1980/81	83,840	1,200
1981/82	86,440	1,220
1982/83	89,120	1,240
1983/84	91,880	1,370
1984/85	94,730	1,510
1985/86	97,670	1,420
1986/87	100,700	1,720
1987/88	103,820	1,850
1988/89	107,040	1,910
1989/90	110,360	1,970
1990/91	113,780	1,970
1991/92	117,310	1,970
1992/93	120,830	1,970
Annual Average Growth Rate (%)	2.8%	3.8%

Source: Economic Survey 1994/95

(2) CMTI's Role for Manpower Supply for Road Sub-Sector

The nationwide annual output requirement for engineers, associate engineers, construction machinery operators and mechanics for road works is assumed to be proportional to the annual growth of the workforce in the construction industry, i.e. 3.8% (Table 2.7), thus:

Annual growth of manpower in the construction industry		3.8%
Category	Required number	Required annual output
Engineers	5,000	190
Associate Engineers	7,000	266
Operators	42,500	1,615
Mechanics	17,500	665

On the other hand CMTI's training capacity at present and after expansion is as follows:

Category	Course	Annual Output	
		Present	After expansion
Engineers	CMPE, CMS, CMO&M	60	100
Associate Engineers	DAE	40	40
Operators	OP	120	300
Mechanics	MECH III, II, WELD, ELECT	40	400

Note: CMPE = Construction Machinery Planning and Employment Course  
 CMS = Construction Machinery Supervision Course  
 CMO&M = Construction Machinery Operation and Maintenance Course  
 DAE = Diploma of Associate Engineer Course  
 OP = Operator Course  
 MECH III, II = Mechanic III and II Course  
 WELD = Welding Course (new course)  
 ELECT = Construction Machinery Electrician Course (new course)

Consequently, CMTI's annual output contribution to the overall annual manpower increase requirement (%) for road sub-sector is concluded as follows:

Category	Course	Output Contribution (%)	
		Present	After expansion
Engineers	CMPE, CMS, CMO&M	31	53
Associate Engineers	DAE	15	15
Operators	OP	7	19
Mechanics	MECH III, II, WELD, ELECT	21	60

From the above analysis CMTI's role for manpower supply for road sub-sector is summarized as follows:

- Purpose of the training courses, CMPE, CMS and CMO&M are to provide practical training for engineers. About 53% of the demand from the construction industry will be fulfilled by CMTI after its expansion as compared to the present 31%. A significant contribution is expected from these courses, particularly for the training for junior engineers.
- DAE course is affiliated with Punjab Board of Technical Education. Since CMTI is a unique agency which provides certification of diploma in construction machinery technology, CMTI's contribution is limited to the 15% of the demand. Further expansion is probably anticipated in the near future.

- CMTI is also an unique agency for the Operator Course which provides practical training. At present, CMTI's contribution is limited to 7% of the demand. Some on-the-job training by governmental or private agencies is being conducted to make up for the shortage, however a figure of 19% will be attained after the expansion.
- The courses for training of mechanics meeting about 21% of the demand at present, will be improved to 60%. New courses for welders and electricians will be started under the expansion.

**(3) Trend of Applicants for CMTI**

Trend of applicants for the last 5 years is indicated in Table 2.8. Names of the organizations which have constant vacancies for trainees, the number of vacancies, and the employment situation of certified trainees are shown in Appendix 8.

From Table 2.8 the following can be said:

- Approved numbers for Operator Course has increased by 2.2 times in 1995 as compared to 1991, while the ratio of applicants/approved numbers has increased from 2.7 to 4.8.
- Approved numbers for Mechanic III Course has increased by 1.2 times, while ratio of applicants/approved is being maintained at about 1.6 in the last five years.
- Approved numbers for Mechanic II Engine Course has increased by 1.3 times, while applicants/approved number has increased from 1.2 to 1.5.
- Both the applicants and approved numbers for Mechanic II Chassis Course has decreased for the five years from 1991 to 1995. However, as shown in Appendix 8 the number of applicants at provincial level still remains high. This indicates that a considerable number of applicants are not qualified at the pre-qualification in the relevant provinces.
- For CMTI as a whole, the approved number has increased by 1.6 from the 1991 to 1995, and that of applicants by 2.6 for the same period, while the ratio of applicants/approved number has increased from 2.0 to 3.3.

Maintaining such high ratios for higher educational agency should be noted.

Table 2.8 Applicant and Approved Number for CMTI

	1991	1992	1993	1994	1995	'95 vs.'91
<b>Basic Course</b>						
Operator Course	65	100	150	150	144	2.2
Approved	(176)	(267)	(408)	(770)	(690)	3.9
Applicant	2.7	2.7	2.7	5.1	4.8	1.8
Ratio						
<b>Mechanic III Course</b>						
Mechanic III Course	56	61	65	74	69	1.2
Approved	(90)	(104)	(177)	(130)	(112)	1.2
Applicant	1.6	1.7	2.8	18	1.6	1.0
Ratio						
<b>Mechanic II Course</b>						
Engine Course	23	25	31	9	30	1.3
Approved	(27)	(75)	(54)	(49)	(45)	1.7
Applicant	1.2	3.0	1.7	1.7	1.5	1.3
Ratio						
<b>Mechanic II Course</b>						
Chassis Course	20	13	20	19	15	0.8
Approved	(34)	(18)	(29)	(23)	(17)	0.5
Applicant	1.7	1.4	1.5	1.2	1.1	0.7
Ratio						
<b>Total</b>						
Total	164	199	266	272	258	1.6
Approved	(327)	(464)	(668)	(972)	(864)	2.6
Applicant	2.0	2.3	2.5	3.6	3.3	1.7
Ratio						

Source: CMTI

Note: 1) Figures in parentheses indicate the number of applicants.

As a result of the above examination, it is confirmed that CMTI's contribution for manpower supply will be significantly improved by the expansion plan, and implementation of the plan has high necessity and priority.

## 2.2.2 Examination of the CMTI's Expansion Plan

### (1) Examination of CMTI's Expansion Plan

CMTI's expansion plan comprises three phases, whose content is as follows:

#### Phase 1

- a. Enhancement of scope/intake of operator and Mechanic III Courses
- b. Commencement of Diploma of Associate Engineer Course
- c. Commencement of Construction Machinery Planning and Employment Course

- d. Commencement of Supervisor Construction Machinery Course
- e. Enhancement of Workshop Equipment
- f. Induction of New Equipment for Snow Clearing
- g. Commencement of CNC Machinist Course
- h. Provision of Training Aids
- i. Provision of Accommodation for Training Facilities

Phase 2

- a. Enhancement of scope/intake of Mechanic II Engine and Chassis Courses
- b. Commencement of Construction Machinery Electrician Course
- c. Commencement of Special Welding Technology Course
- d. Enhancement of Construction Machinery Operation and Maintenance Course
- e. Enhancement of Rapid Runway Repair Course
- f. Diagnostic and Maintenance Equipment
- g. Enhancement of Driver Special Vehicle Course
- h. Provision of Accommodation/Workshop Facilities
- i. Provision of Training Transport
- j. Provision of Spares for Construction Machinery

Phase 3

- a. Commencement of Tunneling Courses
  - Surveying Course
  - Drilling Course
  - Blasting Course
  - Concrete Lining Course
  - Supporting Course

1) Buildings and Facilities

Buildings and facilities to be constructed under the Expansion Plan of CMTH are shown in Table 2.9. In the first stage, construction of training building, trainees' dormitory, canteen and related facilities started in 1993 as outlined in Table 2.10. The status of the first stage construction is as follows:

Start of design	June 1993
Contract of works	April 1994
Amount of contract	17,600,000 Rs

Construction period    May 1994 - 20 months  
Progress to date        85% as at October 1995

Funds required for the construction have been financed from the Government's Public Sector Development Programme (PSDP) annual budget. Payments are being made on monthly basis according to progress. Final construction cost is estimated at about 20,000,000 Rs due to price escalation since start of works.

As for building and facilities plan, the examination leads to the following results:

- Dormitory and canteen have identical plans with the existing ones. Training building (DAE building), which was designed by the Pakistani side, conforms with the expected training capacity including the requested equipment.
- Plan for water supply, electricity, gas and telephone is well designed for the expected functions.
- Access to the new buildings from the outside is secured by extending the existing access road within the premises.
- New training yard for equipment operation practice is already secured.

Buildings and facilities expansion plan is shown in Appendix 9.

## 2) Construction Schedule

Construction period is 20 months from May 1994. Physical progress to date is regarded on schedule in spite of delay in delivery time of some construction materials.

Remaining are only finishing works for inner and outer wall of the buildings, installation of equipment for facilities and landscaping. Necessary funds for the works have already been allocated. Completion of the works is duly scheduled for the end of January 1996. Overall schedule since May 1994 is shown in Table 2.11.



### 3) Space and Area Required for the Equipment to be Introduced

The buildings and facilities allow enough space for installation or storage of the equipment to be introduced under the Project. There is no problem in structural strength. The practice area has already been expanded to meet the requirement.

For construction of facilities under CMTI's expansion plan, the Pakistani side can be regarded to have sufficient financial and technical background, thus, provision of construction materials for the expansion plan, which was originally requested by the Pakistani side, should be omitted from the framework of the Project.

Table 2.9 CMTI Expansion Plan

Buildings and Facilities	Expansion Facilities (m <sup>2</sup> )	Existing Facilities (m <sup>2</sup> )
Administration Building	1,589	1,589
Training Building	3,471	3,471
Trainees' Canteen	347	347
Trainees' Dormitory	1,785	1,772
Access Roads, Parking Area, Open Spaces	25,672	8,382
Garage for Construction Equipment	425	725
Workshop	3,471	3,471
Maintenance Shop	88	--
Squash Courts	99	--
Staff Residence	1,834	--
<b>Total</b>	<b>36,947</b>	<b>21,600</b>

Source: PC-1 Phase II Expansion Plan CMTI

Table 2.10 Buildings and Facilities being constructed under CMTI Expansion Plan

Buildings and Facilities	Structure	No. of Stories	Floor Area (m <sup>2</sup> )	Remarks
DAE Training Building	RC	2 (partly 1)	1,589	6 classes
Dormitory for Trainee	RC	2	1,785	5 x single 17 x 6 persons
Canteen	RC	1	347	100 persons
Garage	Steel	1	425	18 cars
<b>Total</b>			<b>1,785</b>	
Corridor	4 m x 200 m		800 m <sup>2</sup>	

Source: CMTI



**(2) Examination of Training Courses**

Enhancement of scope/intake of the existing courses and commencement of new courses in the three phases are as follows:

**Phase 1**

- a. Enhancement of scope/intake of Operator and Mechanic III Courses
- b. Commencement of Diploma of Associate Engineer
- c. Commencement of Construction Machinery Planning and Employment Course
- d. Commencement of Supervisor Construction Machinery Course
- e. Commencement of CNC Machinist Course

**Phase 2**

- a. Enhancement of scope/intake of Mechanic II Engine and Chassis Courses
- b. Commencement of Construction Machinery Electrician Course
- c. Commencement of Special Welding Technology Course
- d. Enhancement of Construction Machinery Operation and Maintenance Course
- e. Enhancement of Rapid Runway Repair Course
- f. Enhancement of Driver Special Vehicle Course

**Phase 3**

- a. Commencement of Tunneling Courses
  - Surveying Course
  - Drilling Course
  - Blasting Course
  - Concrete Lining Course
  - Supporting Course

The existing courses, requested expansion courses, and the selected courses for the Project are shown in Table 2.12.

Table 2.12 CMTI Training Courses

Existing Courses	Requested Expansion Courses	Selected Courses for the Project
Basic Course - Operator Course - Mechanic III Course - Mechanic II Course · Engine Course · Chassis Course - Diploma of Associate Engineer Course	Basic Course - Operator Course - Mechanic III Course - Mechanic II Course · Engine Course · Chassis Course - Diploma of Associate Engineer Course	Basic Course - Operator Course - Mechanic III Course - Mechanic II Course · Engine Course · Chassis Course - Diploma of Associate Engineer Course
Special Course - Construction Machinery Planning & Employment Course - Construction Machinery Supervision Course	Special Course - Construction Machinery Planning & Employment Course - Construction Machinery Supervision Course - Rapid Runway Course - Special Welding Course - Construction Machinery Electrician Course - CNC Machinist Course - Drilling Course - Tunneling Course · Survey Course · Drilling Course · Blasting Course · Concrete Lining Course · Supporting Course	Special Course - Construction Machinery Planning & Employment Course - Construction Machinery Supervision Course - Special Welding Course - Construction Machinery Electrician Course
Short Duration Course - Construction Machinery Operation Maintenance Course	Short Duration Course - Construction Machinery Operation Maintenance Course	Short Duration Course - Construction Machinery Operation Maintenance Course

The courses selected under the Project are determined on the following grounds:

- Rapid Runway Course is omitted because the priority of this course is not considered to be high.

- CNC Machinist Course, Drilling Course and Tunneling Course are omitted, because they require high and sophisticated level of instruction techniques. It will take considerable time for qualified and experienced instructors to become available in CMTI.
- Welding and construction machinery electrical technique are very essential elements of construction machinery technology. Some are already taught under present schemes, but more integrated and systematic training methods are required. Thus, Special Welding Course and Construction Machinery Electrician Course are to be provided under the Project.

(3) Examination of Training Schedule

Number of vacancies for each course and proposed course under the Project are shown in Table 2.13. Training schedules for 1995 and 1996 are shown in Table 2.14.

Table 2.13 Number of Vacancies of Training Courses

Course	Existing			Expansion			Rate of Increase
	No. of Trainee	No. of Course	Annual Output	No. of Trainee	No. of Course	Annual Output	
Basic Course							
- Operator Course	40	3	120	100	3	300	2.5
- Mechanic III Course	20	3	60	40	3	120	2.0
- Mechanic II Course							
· Engine Course	20	2	40	40	2	80	2.0
· Chassis Course	20	2	40	40	2	80	2.0
- Diploma Course	40	1	40	40	1	40	1.0
Special Course							
- Construction Machinery Operation Maintenance Course	20	2	40	20	2	40	1.0
- Construction Machinery Supervision Course	20	2	40	20	2	40	1.0
- Special Welding Course			0	20	3	60	new
- Special Machinery Electrician Course			0	20	3	60	new
Short Duration Course							
- Construction Machinery Operation & Maintenance Course			0	20	1	20	
<b>Total</b>	<b>180</b>	<b>15</b>	<b>380</b>	<b>360</b>	<b>17</b>	<b>840</b>	<b>2.2</b>

Source: CMTI

Table 2.14 Training Schedule for 1995 and 1996

S. NO.	COURSE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
1	Operator Course SER-27, 28, 29 (1995)			11 MAR (40)	1 JUN	1 JUN	1 JUL (20)	21 SEP	28 OCT (40)	18 JAN				
	Operator Course SER-30, 31, 32 (1996)			3 MAR (100)	24 MAY	24 MAY	7 JUL (100)	28 SEP	30 OCT (100)	21 JAN				
2	Mechanic III Course SER-27, 28, 29 (1995)			11 MAR (40)	1 JUN	1 JUN	1 JUL (20)	21 SEP	28 OCT (40)	18 JAN				
	Mechanic III Course SER-30, 31, 32 (1996)			3 MAR (100)	24 MAY	24 MAY	7 JUL (100)	28 SEP	30 OCT (100)	21 JAN				
3	Mechanic II Engine Course SER-18, 19 (1995)		4 FEB	(40)	22 JUN	22 JUN	12 AUG	(40)	28 DEC					
	Mechanic II Engine Course SER-20, 21 (1996)		4 FEB	(40)	22 JUN	22 JUN	4 AUG	(40)	21 DEC					
4	Mechanic II Chassis Course SER-18, 19 (1995)		4 FEB	(40)	22 JUN	22 JUN	12 AUG	(40)	28 DEC					
	Mechanic II Chassis Course SER-20, 21 (1996)		4 FEB	(40)	22 JUN	22 JUN	4 AUG	(40)	21 DEC					
5	Construction Machinery Planning & Employment Course SER-4, 5 (1995)		28 JAN (20)	23 FEB					30 SEP (20)	25 OCT				
	Construction Machinery Planning & Employment Course SER-6 (1996)		27 JAN (20)	22 FEB		(20)								
6	Construction Machinery Supervision Course SER-4 (1995)					3 JUN (40)	29 JUN							
	Construction Machinery Supervision Course SER-3 (1996)					2 JUN (40)	22 JUN							
7	Diploma of Associate Engineer Course SER-4 (1995)									2 SEP (40)			31 AUG 98	
	Diploma of Associate Engineer Course SER-5 (1996)									1 SEP (40)			31 AUG 98	
8	Special Welding Course (1996)		(20)			(20)					(20)			
9	Construction Machinery Electrician Course (1996)		(20)			(20)					(20)			
10	Construction Machinery Operation & Maintenance Course	(20)												

Source: CMTI

#### (4) Examination of Equipment Schedule

##### 1) Consistency between Equipment Schedule and Training Schedule

For the determination of necessary equipment to be introduced under the Project, the required output and efficiency of the training schedule applied should be given primary consideration. Firstly, basic methodology of the selection of equipment is discussed, then detailed analyses of practice hours for every course together with equipment schedule are made as follows:

##### (a) Construction Equipment

- As the number of trainees will increase from 120 to 300 for the Operator Course, a considerable amount of equipment needs to be generally introduced for this course.
- Mechanic III Course does not have any available equipment at present. As training practice of this course is conducted in parallel with OP Course throughout the year, the equipment for the two courses can not be used in common, therefore a considerable amount of equipment needs to be introduced.
- The number of trainees for Diploma of Associate Engineer Course (DAE) will not be changed, but as there is no available equipment actually at present for this course, a considerable amount of equipment needs to be introduced. Training practice of DAE and Operator Course (OP) are conducted in parallel throughout the year, therefore equipment for the two courses cannot be used in common.
- Training practices in Construction Machinery Planning & Employment Course (CMPE) and Construction Machinery Supervision Course (CMS) are conducted for one month, ranging over a period of semester change of OP Course and Mechanic III Course (MECH III), respectively. Thus, basically the equipment of OP Course and MECH III Course will be used for those two courses. However, some special equipment which is not available from OP and MECH III courses needs to be newly introduced.



(b) Maintenance Equipment

- As the number of trainees of Mechanic II and III courses will be doubled, considerable numbers of new equipment need to be introduced.
- As the Special Welding Course is a new course and there is no available equipment at present in CMFI, considerable numbers of equipment need to be introduced.

(c) Training Aids Equipment and Transport Vehicles

- As Construction Machinery Electrician Course is a newly established course and there is no available equipment at present in CMFI, considerable numbers of equipment need to be introduced.
- Training aids such as cutaway models, audio-visual equipment video films will be used for all courses. As the number of trainees will be increased by two and half times, a considerable number of equipment needs to be introduced.
- For supply of fuel, oil and water, and preventive check and maintenance on practice field and also for training on such services on construction sites, several transport and service vehicles need to be introduced. Also, as site visits on actual construction sites or workshops is one of the important training activities for all courses, vehicles for transport for trainees need to be introduced.

2) Examination of Practice Hours of Construction Equipment

Practice hours of construction equipment are analysed as follows:

(a) Daily Hours Available for Practice of Construction Equipment Operation

Working hours:

- Weekday (from Saturday to Wednesday); 7:30 - 14:30  
(1 hour for lunch)
- Thursday; 7:30 - 12:30
- Friday; Holiday

**Gross training hours:**

- Weekday (from Saturday to Wednesday); 6.0 hours
- Thursday; 5.0 hours
  
- Checking before and after operation; 1.0 hours
- Moving from garage to field; 0.5 hour

Thus, daily hours available for practice can be deemed to be about 4.0 hours.

**(b) Examination by Course**

**Operator Course**

- Training Period:  
3 months (net training days - 78 days), of which;  
24 days for lectures  
14 days for maintenance practice  
40 days for operation practice
- Practice hours per course:  
40 days x 4 hours = 160 hours
- Net practice hours for each equipment:  
Net practice hours under the present training programme are shown in Table 2.15, where total of 40 trainees are given practice being divided into 8 groups each using with different equipment.

Table 2.15 Net Practice Hours for the Construction Equipment Operator Course

Group	Equipment	Practice Hours/Man/day
Group 1	Bulldozer (No.1)	0.50
	Bulldozer (No.2)	0.50
	Dozer Shovel (No.1)	0.33
	Total	1.33
Group 2	Bulldozer (No.3)	0.50
	Bulldozer (No.4)	0.50
	Dozer Shovel (No.2)	0.33
	Total	1.33
Group 3	Hydraulic Excavator (No.1)	0.50
	Hydraulic Excavator (No.2)	0.33
	Wheel Loader (No.1)	0.50
	Total	1.33
Group 4	Hydraulic Excavator (No.3)	0.50
	Hydraulic Excavator (No.2)	0.33
	Wheel Loader (No.2)	0.50
	Total	1.33
Group 5	Vibration Roller (No.1)	0.33
	Tyre Roller (No.1)	0.33
	Motor Grader (No.1)	0.66
	Total	1.33
Group 6	Vibration Roller (No.2)	0.33
	Tyre Roller (No.2)	0.33
	Motor Grader (No.2)	0.66
	Total	1.33
Group 7	Dump Truck (off the road)	0.50
	Dump Truck (on the road)	0.50
	Motor Scraper (No.1)	0.16
	Motor Scraper (No.2)	0.16
	Total	1.33
Group 8	Truck Crane (No.1)	0.25
	Truck Crane (No.2)	0.25
	Stabilizer	0.33
	Asphalt Finisher	0.33
	Asphalt Distributor	0.33
	Total	1.33

The training practice hours available for equipment are evaluated as follows:

- Motor Grader  
3 hours and 20 minutes per day (0.66 hours x 5 men):  
accounting for 83% of 4 hours, reasonable.
- Bulldozer, Hydraulic Excavator, Wheel Loader and Dump Truck  
2 hours and 30 minutes per day (0.5 hours x 5 men):  
accounting for 60% of 4 hours, considering time loss from  
interruption of operation for operator's changes and instructions  
during operation, reasonable.
- Vibration Roller, Asphalt Finisher and Asphalt Distributor  
1 hour and 40 minutes per day (0.33 hours x 5 men):  
accounting for 31% of 4 hours.  
Because the operation of this equipment is rather sophisticated,  
the operation practice is interrupted for instruction, reasonable.
- Shovel Dozer  
1 hour and 40 minutes per day (0.33 hours x 5 men):  
accounting for 41% of 4 hours, reasonable.
- Motor Scraper  
50 minutes (0.16 hours x 5 men): accounting for 21% of 4  
hours.  
Motor scraper is not so common in Pakistan, thus it seems  
reasonable that practice hours are diminished to a considerable  
extent.

Number of trainees of the course will be increased from 40 to 100 (2.5 times), while numbers of equipment will be strengthened from 27 to 34 (1.2 times). The requested equipment can be classified into 6 groups according to purpose of the use, i.e. bulldozer, dump truck, wheel loader, hydraulic excavator, compactor and motor grader. Thus, number of trainees per group should be increased from 5 to 7, and practice hours per equipment should be increased.

As for basic equipment such as bulldozers, hydraulic excavators, wheel loaders, dump trucks, etc., practice hours per equipment

should be increased from the present 2.5 to 3.5 hours raising "training practice hour ratio" from present 60% to 87% of 4 hours.

It is concluded that the requested equipment schedule for the Operator Course can satisfy the minimum requirement for training practice, therefore the request is justified.

Mechanic III Course

There is no available equipment at present for Mechanic III Course. The practice hours shall be established taking into consideration the expected number of trainees and equipment.

Training period of MECH III Course is the same as that of OP Course, i.e. 3 months (net 78 days). But operating practice hours of construction equipment of the course can be diminished compared to that of OP Course. Eighteen days out of the total 78 days can be deemed reasonable to be assigned to the practice.

The requested equipment can be categorized into 3 groups (1 group: 13~14 men) according to the purpose of use in the same manner as shown in the OP Course.

Table 2.16 Net Practice Hours of the Construction Equipment for Mechanic III Course

Group	Equipment	Practice Hours/Man·day
Group 1	Bulldozer	0.28
	Motor Grader	0.28
	Total	0.56
Group 2	Wheel Loader	0.28
	Dump Truck	0.28
	Total	0.56
Group 3	Shovel and others	0.56
	Total	0.56

Accordingly, practice hours per equipment per day will be:

0.28 hours x 14 men = 3.92 hours per day  
(for every equipment of Mechanic III Course)

Because these practice hours are maximised up to the daily available hours, i.e. 4.0 hours, the training should be conducted as effectively as possible.

Construction Machinery Planning & Employment Course (CMPE)

Training period of CMPE is 3 months (net 78 days) each, and the equipment of MECH III Course can be basically used for this course.

The requested equipment can be classified into 3 groups (1 group: 13-14 men) according to the purpose of use in the same manner as that of the Mechanic III Course.

Table 2.17 Net Practice Hours of the Construction Equipment for CMPE Course

Group	Equipment	Practice Hours/Man day
Group 1	Bulldozer	0.28
	Motor Grader	0.28
	Total	0.56
Group 2	Wheel Loader	0.28
	Dump Truck	0.28
	Total	0.56
Group 3	Shovel and others	0.56
	Total	0.56

Accordingly, practice hours per equipment per day will be:

$$0.28 \text{ hours} \times 14 \text{ men} = 3.92 \text{ hours per day (CMPE)}$$

As for practice hours the same can be said as that of the Mechanic III Course.

Construction Machinery Supervision Course (CMS)

Training period of CMS is 3 months (net 78 days) each, and the equipment of MECH III Course can be basically used for this course.

The requested equipment will be classified into 3 groups (1 group: 13-14 men) according to the purpose of use in the same manner as that described in the Mechanic III Course.

Table 2.18 Net Practice Hours of the Construction Equipment for CMS Course

Group	Equipment	Practice Hours/Man day
Group 1	Bulldozer	0.28
	Motor Grader	0.28
	Total	0.56
Group 2	Wheel Loader	0.28
	Dump Truck	0.28
	Total	0.56
Group 3	Shovel and others	0.56
	Total	0.56

Accordingly, practice hours per equipment per day will be:

$$0.28 \text{ hours} \times 14 \text{ men} = 3.92 \text{ hours per day (CMS)}$$

Diploma of Associate Engineer Course (DAE)

The training period of DAE is 3 years. The number of trainees is 40 for each year, thus a total of 120 trainees from 1st year to 3rd year receive the training. Three months of practical training are required, of which 40 days are used for operation practice and the remaining time for training of preventive maintenance, routine maintenance and safety control, etc.

The requested equipment can be classified into 3 groups (1 group: 13~14 men).

Table 2.19 Net Practice Hours of the Construction Equipment for DAE Course

Group	Equipment	Practice Hours/Man day
Group 1	Bulldozer (No.1)	0.28
	Wheel Loader (No.1)	0.28
	Total	0.56
Group 2	Bulldozer (No.2)	0.28
	Wheel Loader (No.2)	0.28
	Total	0.56
Group 3	Hydraulic Excavator	0.28
	Motor Grader	0.28
	Total	0.56

Consequently, practice hours per equipment per day will be:

$$0.28 \text{ hours} \times 14 \text{ men} = 3.92 \text{ hours per day}$$

Because these practice hours are maximised up to the daily available hours, i.e. 4.0 hours, the training should be conducted as effectively as possible.

From the above examination, equipment practice hours of the existing training courses range from 1 hour and 40 minutes to 3 hours and 20 minutes. The equipment schedule for the Project was so established as to maximise the practice hours up to 4 hours in order to minimise the number of equipment to be newly introduced.

The results of the equipment schedule are shown in Table 2.20.1 to Table 2.20.5.

Where,

No. of existing equipment : Numbers of the equipment possessed by CMTI.

No. of maximum requirement : Numbers of the equipment derived on the assumption that present practice hours, i.e. 1 hour 40 minutes to 3 hours 20 minutes will not be changed in future training schedule.

No. of minimum requirement : Numbers of the equipment derived on the assumption that the practice hours in future training schedule will be maximised up to 4 hours.

No. of requested equipment : No. of minimum requirement minus No. of Existing equipment.

The existing equipment, requested equipment and selected equipment under the Project are shown in Tables 2.20.1 to Table 2.20.4.



Table 2.20.1 Existing Equipment, Necessary Equipment and Requested Equipment

1) Construction Equipment

Equipment	Specification	No. of Existing Equipment	No. of Maximum Requirement	No. of Minimum Requirement	No. of Requested Equipment
<b>Operator Course</b>					
Bulldozer	285 - 305 HP	1	2	2	1
Bulldozer	200 - 250 HP	1	3	3	2
Bulldozer	155 HP	1	3	1	0
Bulldozer	120 HP	1	2	1	0
Dozer Shovel	160 HP	1	1	1	0
Dozer Shovel	110 HP	1	1	1	0
Dump Truck (Off the road)	20 - 23 t	1	2	2	1
Hydraulic Excavator	0.7 m <sup>3</sup>	1	3	3	2
Hydraulic Excavator	0.5 m <sup>3</sup>	1	3	2	1
Hydraulic Excavator	0.09 m <sup>3</sup>	1	1	1	0
Motor Scraper	16 m <sup>3</sup>	2	2	2	0
Wheel Loader	3.5 m <sup>3</sup>	1	3	2	1
Wheel Loader	1.7 m <sup>3</sup>	1	2	1	0
Motor Grader	130 - 140 HP	1	3	2	1
Motor Grader	110 HP	1	2	1	0
Road Stabilizer	349 HP	1	1	1	0
Asphalt Finisher	W = 6m	1	2	2	1
Asphalt Distributor	3000ℓ	1	1	1	0
Vibration Roller	9.5 - 11 t	1	2	1	1
Vibration Roller	6.5 t	1	1	1	0
Landfill Compactor	200 - 250 HP	0	1	1	1
Vibration Compactor	5 HP	0	1	1	1
Tyre Roller	6 x 4,13 - 14 t	0	1	1	1
Tyre Roller	15.5 t	1	1	1	0
Mobile Hammer	125 - 130 HP	0	1	1	1
Automatic Curber	4 - 5 m <sup>3</sup> /h	0	1	1	1
Power Splitter	145 - 155 HP	0	1	1	1
Rough Terrain Crane	30 t	0	1	1	1
Truck Crane	10 t	2	2	2	0
Air Compressor	3.7 m <sup>3</sup> /min	1	1	1	0
Dump Truck (on road)	12 t	1	1	1	0
Generator	9.7 kW	1	1	1	0
<b>Mechanic III Course</b>					
Bulldozer	200 - 250 HP	0	2	1	1
Wheeler Loader	3.5 m <sup>3</sup>	0	2	1	1
Motor Grader	130 - 140 HP	0	2	1	1
Dump Truck (on road)	6 x 4,13 - 14 t	0	1	1	1

Table 2.20.2 Existing Equipment, Necessary Equipment and Requested Equipment

1) Construction Equipment (cont'd)

Equipment	Specification	No. of Existing Equipment	No. of Maximum Requirement	No. of Minimum Requirement	No. of Requested Equipment
<b>Mechanic III Course (cont'd)</b>					
Hydraulic Excavator	0.5 m <sup>3</sup>	0	1	1	1
Air Compressor	3.5 m <sup>3</sup> /min	0	1	1	1
Generator	5 KVA	0	1	1	1
<b>Diploma of Associate Engineer Course (DAE)</b>					
Bulldozer	200 - 250 HP	0	3	2	2
Wheel Loader	3.5 m <sup>3</sup>	0	2	1	1
Wheel Loader	1.7 m <sup>3</sup>	0	1	1	1
Motor Grader	140 - 155 HP	0	2	1	1
Hydraulic Excavator	0.09 - 0.36 m <sup>3</sup>	0	1	1	1
<b>Construction Machinery Planning and Employment Course (CMPE)</b>					
Pipe Layer	300 - 350 HP	0	1	1	1
Hydraulic Excavator with Extra Long Boom	125 - 135 HP	0	1	1	1
<b>Construction Machinery Supervision Course (CMS)</b>					
Pile Driver	125 - 135 HP	0	1	1	1

2) Maintenance Equipment

Equipment	Specification	No. of Existing Equipment	No. of Maximum Requirement	No. of Minimum Requirement	No. of Requested Equipment
<b>Fuel Injection Test Room and Hydraulic Test Room (Mechanic II and Mechanic III Course)</b>					
Injection Pump Test Stand	Bosch type	1	2	2	1
PT Pump Test Stand	Cummins type	1	2	2	1
Injection Flow Comparator	Cummins type	1	2	2	1
Nozzle Tester		1	2	2	1
Others		1	2	2	1
Air Compressor		1	2	2	1
Hydraulic Testing Unit		1	2	2	1

Table 2.20.3 Existing Equipment, Necessary Equipment and Requested Equipment

2) Maintenance Equipment (cont'd)

Equipment	Specification	No. of Existing Equipment	No. of Maximum Requirement	No. of Minimum Requirement	No. of Requested Equipment
<b>Welding Course (New Course)</b>					
Air Carbon Arc Gouging Equipment		0	1	1	1
Gas Welding Equipment		0	1	1	1
Gas Regulator		0	1	1	1
Flashback Arrester		0	1	1	1
Welding and Cutting Torch		0	1	1	1
Mag Welding Machine and Mig Welding Machine		0	1	1	1
High Speed Abrasive Cutting Machine		0	1	1	1
Spot Welding Gun		0	1	1	1
Pipe Cutting Machine		0	1	1	1
Tig Welding Machine		0	1	1	1
Ultrasonic Flow Detector		0	1	1	1
Grinding Machine		0	1	1	1
Pillar Drill		0	1	1	1
Power Hacksaw		0	1	1	1
Miscellaneous		0	1	1	1
Hand Type Circular Shear Machine		0	1	1	1
Hand Lever Shearing Machine		0	1	1	1
Table Shearing Machine		0	1	1	1
<b>Workshop Equipment (Machine II and III Course)</b>					
Mobile Floor Crane	2 t	0	2	2	2
Hydraulic Tyre Removing Tool	10 t	0	1	1	1
Gasoline Engine Analyser	8 cylinders	0	1	1	1
Spark Plug Cleaner	12, 14 mm	0	1	1	1
Wheel Balancer	Cargo truck	0	1	1	1
Wheel Alignment		0	1	1	1
Distributor Test Bench	Gasoline	0	1	1	1
Injector Reconditioning Machine		0	1	1	1

Table 2.20.4 Existing Equipment, Necessary Equipment and Requested Equipment

3) Training Aids Equipment and Vehicles

Equipment	Specification	No. of Existing Equipment	No. of Maximum Requirement	No. of Minimum Requirement	No. of Requested Equipment
<b>Electrician Course</b>					
Cutaway Model					
Starter Motor		1	2	2	1
Alternator		1	2	2	1
Gasoline Engine		1	2	2	1
Electric System Board					
Crawler Equipment		1	2	2	1
Vehicle		1	2	2	1
Electrical Component					
Starter Motor		0	2	2	2
Alternator		0	2	2	2
Generator		0	2	2	2
Regulator		0	10	10	10
DC Generator	2 kW	0	1	1	1
DC Generator	3 kW	0	1	1	1
<b>All Courses</b>					
Cutaway Model					
Aspiration/Exhaust		0	6	6	6
Transmission		4	12	12	8
Hydraulic		0	3	3	3
Steering		0	1	1	1
Engine		1	1	1	0
Training Video Film		2	12	12	10
Mechatronic Simulator		0	1	1	1
Overhead Projector	Common type	7	12	12	5
Overhead Projector	Direct type	0	10	10	10
Photo Copy Machine		2	6	6	4
LC Display Panel		0	1	1	1
Multi Media Products		0	4	4	4
Microbus	27 - 30 persons	2	4	3	1
Service Car		0	2	2	2
Mobile Workshop	6 t	0	1	1	1
Water Bowzer	8 - 10 kl	1	2	2	1
Fuel Tanker	8 - 10 kl	1	2	2	1
4 WD	2600 - 3000 cc	2	3	2	0

## 2.3 Basic Design

### 2.3.1 Design Concept

#### (1) Natural Conditions

The climatic condition of Islamabad belongs to the temperate zone. Annual rainfall ranges from 500 ~ 1,000 mm, and annual temperature from 10 ~ 30°C.

Operation of the construction equipment will be limited to the CMTI's practice field, and most of the maintenance equipment will be installed in the Training Building (DAE Building), thus, operational conditions are not so severe to require special specifications for the equipment to be introduced.

#### (2) Situation of the Local Construction Industry

Most of the road programmes both by the central and regional governments are being executed on contract basis except some light works of routine maintenance recently. In this connection, the government's policy of promoting the mechanisation of road construction industry is given the highest priority to accelerate its road programmes. The public corporation such as FWO and NLC or several large private companies have been strengthening their equipment situation, however mechanisation of small and medium sized contractors essential for the road construction industry, has not always made progress to date.

As the purpose of the Project is to create skilled technical manpower to meet the demand for the mechanisation of the industry, the equipment under the Project should be that for general construction purposes as much as possible. Also, as the recent road programme is oriented toward higher standards, asphalt paving and maintenance of rehabilitated roads, the equipment should be such as to meet the predominant requirements of the road programme.

#### (3) Capabilities of Equipment Maintenance of the Implementing Agency

Most of the CMTI's existing equipment exceeds an age of 10 years. However, due to an appropriate maintenance operation by CMTI since introduction, there has been no un-operational equipment to date.

Regarding the stock of spare parts, it should be noted that those for routine maintenance and consumables are sufficiently stocked, but those for engine overhaul seem to be in short supply.

In conclusion, CMTI's technical level and capacity for maintenance of equipment is regarded excellent provided that necessary spare parts are supplied appropriately. Thus, spare parts for each equipment under the Project will be selected carefully based on consumption record of the inventory.

**(4) Criteria for Selection of the Equipment under the Project**

The equipment under the Project were selected on the following criteria:

- Equipment which can provide basic operational technique.
- Equipment of high usage rate in the CMTI's on-going training programme.
- Equipment of high popularity in the construction industry and of growing demand in Pakistan.
- Equipment which can provide applicational techniques of operation.

**(5) Criteria for Country of Origin of the Equipment under the Project**

**1) Equipment to be procured from Japan or Third Countries**

The equipment which satisfies the following criteria may be procured from Japan or third countries.

- Equipment from makers of high popularity in Pakistan.
- Equipment from makers having capable agent(s) in Pakistan for spare parts supply, maintenance services and aftercare services.
- The third countries shall be the member countries of OECD DAC.

**2) Equipment to be procured in Pakistan**

- Equipment from member countries of OECD DAC, but normally procurable in Pakistan's domestic market.

**(6) Criteria for Procurement Schedule**

CMTI expects the opening of new courses and an increase in the number of trainees as early as possible. The equipment procurement schedule shall be in conformity with the commencement of the training courses.

Construction of the buildings and facilities is in progress. There will be no equipment which affects adversely the construction schedule, but, several training aids equipment require an initial training to a certain extent. This period shall be included in the procurement schedule.

(7) Criteria for Hand Over

As for the equipment procured from Japan or third countries, the port of disembarkation will be Karachi.

For inland transport from Karachi to Islamabad (approximately 1,000 km) there are two alternatives, i.e. road or rail transport. Since rail transport is not always reliable due to the limited number of trains and the uncertain operational schedule, road transport is recommended.

Place of hand-over for all equipment under the Project will be CMTI in Islamabad.

2.3.2 Basic Design

(1) Design Policy

1) Construction Equipment

The purpose of the equipment to be introduced for each course is as follows:

1. Operator Course

Provide practical training in operation and daily checking technique for basic equipment of road works such as earth moving equipment and paving equipment.

Shortage of equipment will seriously affect the training schedule. Therefore, in formulating the equipment schedule, it is essential to take into account non-operational time due to periodic maintenance or interruptions due to troubles.

2. Mechanic III Course

Provide practical training in preventive maintenance or routine maintenance technique. The practice includes checking of engine sound, color of exhaust gas, level and temperature of radiator water, cooling air amount, temperature and pressure of engine oil, etc. through operational practice.

Since there is no equipment presently assigned to the course, basic equipment such as bulldozer, wheel loader, motor grader, dump truck, hydraulic excavator, air compressor, generator should be included.

3. Diploma of Associate Engineer Course

Provide a practical training in overall construction machinery techniques. The practice includes operation, daily checking, preventive and routine maintenance etc.

Since there is no equipment assigned to the course, basic equipment such as bulldozer, wheel loader, motor grader, dump truck and hydraulic excavator should be included.

4. Construction Machinery Planning and Employment Course

Provide short term practical training in machinery planning techniques. The practice includes operation, daily inspection, preventive and routine maintenance in order to become familiar with the characteristics of the equipment .

The equipment to be introduced for the Mechanic III Course will be commonly used for this course. Since the demand for pipe layers and hydraulic excavators with super long booms has increased recently in Pakistan, these two equipments should be included for this course.

5. Construction Machinery Supervision Course

Provide short term practical training in machinery supervision techniques. The practice includes operation, daily inspection, preventive and routine maintenance to make trainees familiar with the characteristics of equipment on the site.



The equipment to be introduced for the Mechanic III Course will be commonly used for this course. Since demand for pile drivers has increased recently in Pakistan, they will be included for this course.

2) Maintenance Equipment

The equipment will be used for operation of Mechanic III Course, Mechanic II Course, Special Welding Course, Construction Machinery Electrician Course and Workshop in the training building.

Provide practical training in overall maintenance techniques for engine system, fuel system, electric system, hydraulic system, under carriage and chassis, and machinist techniques for reproduction of spare parts. Testing equipment, welding equipment and workshop equipment which are not available at present should be introduced.

3) Training Aids Equipment and Vehicles

The equipment used for lectures such as electrical training equipment, audio-visual equipment, photocopy machine, and vehicles such as service car, mobile workshop, water bowzer and fuel tanker should be introduced in proportion to the expansion of training capacity.

(2) Equipment Schedule

Equipment to be procured under the Project is summarised in Table 2.21.1 to Table 2.21.7.

(3) Procurement Plan

Country of origin of the equipment is summarized in Table 2.22. Situation of the maker's local agents in Pakistan is shown in Appendix 11.

Table 2.21.1 Equipment Schedule

(1) Construction Equipment and Spare Parts

1) Construction Equipment

(Operator's Course)

No.	Item	Specification	Nos.
1.1	Bulldozer	285-305HP	1
1.2	Bulldozer	200-250HP	2
1.3	Dump Truck (off-the-road)	20-23 ton	1
1.4	Hydraulic Excavator	0.7m <sup>3</sup>	2
1.5	Hydraulic Excavator	0.5m <sup>3</sup>	1
1.6	Pneumatic Tire Roller	10-12 ton	1
1.7	Asphalt Finisher (wheel type)	Max. 6m	1
1.8	Wheel Loader	3.5m <sup>3</sup>	1
1.9	Motor Grader	130-140 HP	1
1.10	Vibration Roller (Sheep foot type)	9.5-11 ton	1
1.11	Mobile Hammer attached to Hydraulic Excavator	125-130 HP	1
1.12	Smooth Drum Vibration Compactor	5 HP	1
1.13	Automatic Curber	4-5 m <sup>3</sup> /h	1
1.14	Power Splitter	145-155 HP	1
1.15	Landfill Compactor	200-250 HP	1
1.16	Rough Terrain Crane	30 ton	1

(Mechanic III Course)

No.	Item	Specification	Nos.
2.1	Bulldozer	200-250HP	1
2.2	Wheel Loader	3.5m <sup>3</sup>	1
2.3	Motor Grader	130-140 HP	1
2.4	Dump Truck (on-the road)	6 x 4, 13-14 ton	1
2.5	Hydraulic Excavator	0.5m <sup>3</sup>	1
2.6	Air Compressor	3.5m <sup>3</sup> /min	1
2.7	Generator	5 kVA	1

Table 2.21.2 Equipment Schedule

(Diploma of Associate Engineer in Construction Machinery Technology)

No.	Item	Specification	Nos.
3.1	Bulldozer	200-250 HP	2
3.2	Wheel Loader	3.5m <sup>3</sup>	1
3.3	Motor Grader with scarifier	140-155 HP	1
3.4	Wheel Loader	1.7m <sup>3</sup>	1
3.5	Hydraulic Excavator	0.09-0.36m <sup>3</sup>	1

(Construction Machinery Planning and Employment Course)

No.	Item	Specification	Nos.
4.1	Pipe Layer	300-350 HP	1
4.2	Hydraulic Excavator with Super Long Boom	125-135 HP 0.4-0.5 m <sup>3</sup>	1

(Construction Machinery Supervision Course)

No.	Item	Specification	Nos.
5.1	Pile Driver mounted on Hydraulic Excavator	125-135 Hp	1

2) Spare Parts for Construction Equipment

Basic selecting method of spare parts for construction machinery is as follows:

No.	Item	Specification	Nos.
6.1	Periodical Maintenance Parts	approx. 5 years use	1 Set
6.2	Repair Kits	approx. 5 years use	1 Set
6.3	Consumable Parts	approx. 5 years use	1 Set

Table 2.21.3 Equipment Schedule

(2) Workshop Equipment and Spare Parts

1) Workshop Equipment

(Fuel Injection Test Room)

No.	Item	Specification	Nos.
7.1	Fuel Injection Pump Test Stand	Bosch type	1
7.2	PT-Pump Test Stand	Cummins type	1
7.3	Injection Flaw Comparator	Cummins type	1
7.4	Nozzle Tester	Bosch type	1
7.5	Inspection Instrument Set for Fuel Injection Test	Bosch and Cummins types	1
7.6	Air Compressor	11 kW	1
7.7	Reconstruction of Hydraulic Test Stand	125 HP	1

(Welding Equipment for Welding Course)

No.	Item	Specification	Nos.
8.1	Air -Carbon Arc Gouging Equipment		1
8.2	Gas Welding Equipment (Oxygen and Acetylene)	with connection	9
8.3	Gas Regulator (Oxygen and Acetylene)	with connection	7
8.4	Flashback Arrestor		10
8.5	Welding and Cutting Torch		8
8.6	MAG Welding Machine		1
8.7	MIG Welding Machine		1
8.8	High Speed Abrasive Cutting Machine		1
8.9	Spot Welding Gun	Portable type	1
8.10	Pipe Cutting Machine		1
8.11	TIG Welder		1
8.12	Ultrasonic Flaw Detector		1
8.13	Grinding Machine with Spare Wheels	300x50x25 mm 200x25x20 mm	1 1
8.14	Pillar Drill	dia.30mm	1
8.15	Power Hacksaw	with connections	1
8.16	Accessory Set of welding		1
8.17	Hand Type Circular Shear Machine	thickness: 2 mm	1
8.18	Hand Lever Shearing Machine	thickness: 2 mm	1
8.19	Shearing Machine	thickness: 6 mm	1

Table 2.21.4 Equipment Schedule

(Repairing Equipment for Mechanic II and III Course)

No.	Item	Specification	Nos.
9.1	Mobile Floor Crane	2 ton	2
9.2	Hydraulic Tire Removing Tool	10 ton	1
9.3	Gasoline Engine Analyzer	for 8 cylinders	1
9.4	Spark Plug Cleaner and Tester	plug: 12, 14mm	1
9.5	Wheel Balancer with Tools and Weight Set	10 - 23'	1
9.6	Wheel Alignment Tester		1
9.7	Distributor Test Bench		1
9.8	Injector Reconditioning Machine		1
9.9	Miscellaneous		1

2) Spare Parts for Workshop Equipment

No.	Item	Specification	Nos.
10.1	Consumable Part	approx. 5 years use	1 set

Table 2.21.5 Equipment Schedule

(3) Training Aid Equipment and Vehicles

1) Training Aid Equipment

(Basic Course, Mechanics II Course and Construction Machinery Electrician Course)

No.	Item	Specification	Nos.
	(Cut Away Model)		
11.1	Starter Motor	any type	1
11.2	Alternator	any type	1
11.3	Gasoline Engine	any type	1
	(Electric System Board)		
11.4	Electric System Board for Crawler type	Crawler type	1
11.5	Electric System Board for Wheeled type	Crawler type	1
	(Electrical Component)		
11.6	Starter Motor	7.5-11kW	1
11.7	Alternator	24V,25A	1
11.8	Generator	24V,25A	1
11.9	Regulator	24V,20A	1
	(DC Generators)		
11.10	DC Generator	2 kW	1
11.11	DC Generator	3 kW	1

(Cutaway Model for All Courses)

No.	Item	Specification	Nos.
12.1	Pre-Cleaner	for general construction machine	1
12.2	Air Cleaner	for general construction machine	1
12.3	Muffler Assembly	for dozer	1
12.4	After Cooler	for dozer	1
12.5	Steering Clutch	for dozer	1
12.6	Transmission	sliding selectin type for dozer	1
12.7	Swing Moter	for excavator	1
12.8	Transmission Control Valve	for dozer	1
12.9	Hydraulic Tank	for dozer	1
12.10	Hydraulic Cylinder		1

Table 2.21.6 Equipment Schedule

(Cutaway Model for All Courses) cont'd

No.	Item	Specification	Nos.
12.11	Torque Converter	for dozer	1
12.12	Steering System	for vehicle	1
12.13	Transmission	for dozer	1
12.14	Steering Assembly	for motor grader	1
12.15	Universal Joint		1
12.16	Propeller Shaft	hollow type and soil type	1 set
12.17	Turbo-Charger		1

(Video Film for All Courses)

No.	Item	Specification	Nos.
13.1	Trouble Shooting for Gasoline Engine		1 set
13.2	Function of Calibrator		1 set
13.3	Trouble Shooting for Electrical Component		1 set
13.4	Transmission	for planetary gear	1 set
13.5	Multi Disc Clutch	for dozer	1 set
13.6	Hydraulic Control Valve	for dozer	1 set
13.7	Differential		1 set
13.8	Torque Converter	for dozer	1 set
13.9	Hydro Shift Transmission	for dozer	1 set
13.10	Steering Control	for dozer	1 set

(Mechatronics Simulator for All Courses)

No.	Item	Specification	Unit
14.1	Mechatronics Simulator	for hydraulic excavator	1
14.2	Electronics Governor Controlling System	for hydraulic excavator	1
14.3	Automatic Idling Controlling System	for hydraulic excavator	1
14.4	Hydraulic Pump Controlling System	for hydraulic excavator	1
14.5	Mechatronics Function Checker		1 set
14.6	Mechatronics Device Parts and Cutaway Model	for general construction machine	1 set
14.7	Function Assessment Tool		1 set
14.8	Electric Measuring Implement	table type	1 set

Table 2.21.7 Equipment Schedule

(Miscellaneous for All Courses)

No.	Item	Specification	Nos.
15.1	Overhead Projector	common type	5
15.2	Overhead Projector	direct type	10
15.3	Photo Copier		4
15.4	LCD Display Panel		1
15.5	Multimedia Products for Technical Training		4

2) Vehicles

No.	Item	Specification	Nos.
16.1	Microbus	27 - 30 seats	1
16.2	Service Car with Machine & Diagnostic Tools		2
16.3	Mobile Workshop Lorry with Crane & Winch	6 ton	1
16.4	Water Bowzer	8 - 10 kl	1
16.5	Fuel Tanker	8 - 10 kl	1

3) Spare Parts for Training Aid Equipment and Vehicles

No.	Item	Specification	Nos.
17.1	Periodical Maintenance Parts	approx. 5 years use	1 set
17.2	Repair Kits	approx. 5 years use	1 set
17.3	Consumable Parts	approx. 5 years use	1 set



Table 2.22 Procurement Plan

Equipment	Specification	Country	Reason
Construction Equipment and Vehicle			
Bulldozer (with ripper)	285 - 305 HP	Japan and Third Countries	Equipment numbers high in Pakistan
Bulldozer	200 - 250 HP	Japan	
Hydraulic Excavator	0.7 m <sup>3</sup>	Japan	
Hydraulic Excavator	0.5 m <sup>3</sup>	Japan	
Hydraulic Excavator	0.09 - 0.36 m <sup>3</sup>	Japan	
Hydraulic Excavator with Super Long Boom	0.4 - 0.5 m <sup>3</sup>	Japan	
Wheel Loader	3.5 m <sup>3</sup>	Japan	
Wheel Loader	1.7 m <sup>3</sup>	Japan	
Motor Grader	130 - 140 HP	Japan	
Motor Grader with Scarifier	140 - 155 HP	Japan	
Vibration Roller	9.5 - 11 ton	Japan	
Vibration Compactor	5 HP	Japan	
Landfill Compactor	200 - 250 HP	Japan and Third Countries	Equipment numbers high in Pakistan
Tyre Roller	10 - 12 t	Japan	
Asphalt Finisher	6 m max.	Japan	
Mobile Hammer	125 - 130 HP	Japan	
Power Splitter	100 - 150 HP	Japan	
Pile Driver	125 - 135 HP	Japan	
Pipe Layer	300 - 350 HP	Japan and Third Countries	Equipment numbers high in Pakistan
Automatic Curber	4 - 5 m <sup>3</sup> /h	Japan	
Air Compressor	3.5 m <sup>3</sup> /min	Japan	
Generator	5 kVA	Japan	
Rough Terrain Crane	30 ton	Japan	
Dump Truck (on road)	6 x 4 13 - 14 t	Japan	
Dump Truck (off road)	20 - 23 t	Japan and Third Countries	Equipment numbers high in Pakistan
Micro bus	27 - 30 seats	Japan	
Service Car		Japan	
Mobile Workshop	6 t	Japan	
Water Bowzer	8 - 10 kl	Japan	
Fuel Tanker	8 - 10 kl	Japan	
Testing Equipment		Japan	
Welding Equipment		Japan	
Workshop Equipment		Japan	
Electric Systemboard		Japan	
Electrical Component		Japan	
Cutaway Model		Japan	
Training Video Film		Japan	
Mechatronics Simulator		Japan	
Overhead Projector		Pakistan	Procurable in local market
Photo Copy Machine		Pakistan	Procurable in local market
LC Display Panel		Pakistan	Procurable in local market
Multimedia Equipment		Japan	

## **CHAPTER 3. Implementation Plan**

## Chapter 3 Implementation Plan

### 3.1 Implementation Plan

#### 3.1.1 Implementation Concept

##### (1) Project Implementation Agency

In case the Project is implemented on the basis of Japan's Grant Aid, the overall structure of the Project will be as shown in Fig. 3.1.

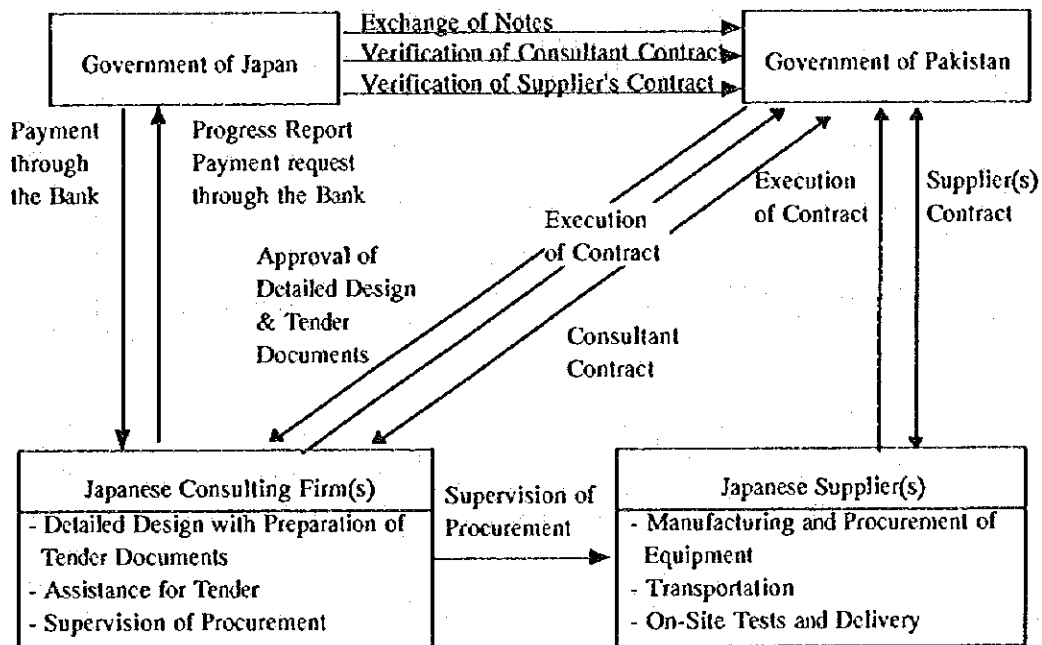


Fig. 3.1 Overall Structure of the Project

Implementation agency of the Project is the Ministry of Communications of Pakistan.

In accordance with Japan's Grant Aid system, Japanese consulting firm(s) will undertake the detailed design and supervision of the Project based on a contract between the Government of Pakistan and the said firm(s), and Japanese general trading company(ies) will undertake the equipment supply based on the contract(s) between the Government of Pakistan and the said company(ies).

(2) Consultant(s)

In accordance with Japan's Grant Aid system, Japanese consulting firm(s) will be employed for engineering services for the Project.

Soon after Exchange Notes (E/N) between the Government of Japan and the Government of Pakistan, the Ministry of Communications will conclude the contract with the Japanese consulting firm(s).

The said firm(s) will provide engineering services for the procurement of equipment which includes detailed design, preparation of contract documents, assistance for tender(s) and contract(s) and supervision of procurement, in accordance with the contract until completion of hand-over of the equipment under the Project.

(3) Supplier(s)

The Ministry of Communications will conclude the contract(s) between the Japanese general trading company(ies) who is(are) awarded the tender(s) in open competitive bidding from the viewpoint of technical capability and cost competitiveness.

The said company(ies) will execute the procurement, transport, installation, initial operation within a period and to the satisfaction of the Ministry of Communications, in accordance with the contract(s).

3.1.2 Implementation Conditions

The port of disembarkation for the equipment procured from Japan and the third country(ies) will be Karachi. The place of hand-over of the equipment will be CMTI, Islamabad.

Any trouble during inland transport of the equipment by road from Karachi to Islamabad (approximately 1,000 km) shall be avoided.

### 3.1.3 Scope of Works

Construction of the buildings and facilities and procurement of construction material under the CMTI Expansion Plan shall be the responsibility of the Government of Pakistan.

### 3.1.4 Consultant Supervision

#### (1) Principles

In case the Project is implemented by Japan's Grant Aid, the consultant must thoroughly understand the background of the Project, contents of the Basic Design Study Report, Japan's Grant Aid system and the contents of the Exchange Notes (E/N) between the Government of Japan and the Government of Pakistan.

#### 1) Scope of the Consulting Services

Scope of the consulting services is as follows:

##### 1. Detailed Design

- Detailed design and preparation of tender documents
- Preparation and explanation of the specifications and tender and contract documents for the Government of Pakistan
- Assistance for tender(s), evaluation for tender(s) and witness of contract(s) for equipment supply
- Confirmation of the obligations of the Pakistan side

##### 2. Procurement of Equipment

- Issue of notice to proceed
- Preparation of inception report
- Discussions with the parties concerned prior to the commencement
- Factory(ies) inspection

- Pre-embarkation inspection
- Preparation of monthly progress report throughout the contract period
- Inspection of final hand-over
- Preparation of final report

### 3. Initial Operation of the Equipment

Initial instruction and training for operation, preventive maintenance, routine maintenance by the supplier(iers) under the control of the consultant are required.

#### 2) Basic Points to Note

- Conformity with the Basic Design

Design conditions set out in the Basic Design Study shall be confirmed. It is important to check whether the specifications of equipment in the Basic Design Study comply with the conditions.

- Tender and contract documents shall be in accordance with Japan's Grant Aid system. During the field survey of the Detailed Design, the documents shall be thoroughly examined and explained to the Pakistani side for its approval.

#### 3.1.5 Procurement Plan

Procurement plan for the equipment from Japan, third countries and local market in Pakistan is as follows:

##### Equipment procured from Japan

Regarding construction equipment and vehicles, the products of Japanese makers have predominant share in the Pakistani market. Thus, operators and mechanics are familiar with these products. Also, capabilities of local agents of the Japanese makers are sufficient from the viewpoint of maintenance techniques and spare parts supply.

Regarding maintenance equipment, workshop equipment and training aids equipment, almost all of the CMTI's existing equipment are products of Japanese makers.

Port of disembarkation is Karachi. For transport from Karachi to CMTI Islamabad National Highway No.4 via Lahore will be used.

#### Equipment procured from Japan or third countries

For several items of construction equipment of large capacity, the products of makers of OECD DAC countries are used in Pakistan. Local agents of these makers have sufficient maintenance capabilities, thus, the following equipment can be procured from third countries.

- Bulldozer 285 - 305 HP
- Land fill compactor 200 - 250 HP
- Dump truck (off the road) 20 - 23 t
- Pipe layer 300 - 305 HP

Delivery route for the equipment from third countries is the same as for the equipment from Japan, i.e. the port of disembarkation is Karachi, then road transport from Karachi to CMTI Islamabad on National Highway No.4 via Lahore.

#### Equipment from local market in Pakistan

The following training aid equipment of makers of OECD DAC countries can be normally procured from the local market in Pakistan.

- Overhead projector
- LC display panel
- Photocopy machine

### 3.1.6 Implementation Schedule

Implementation programme of the Project is shown in Fig. 3.2.

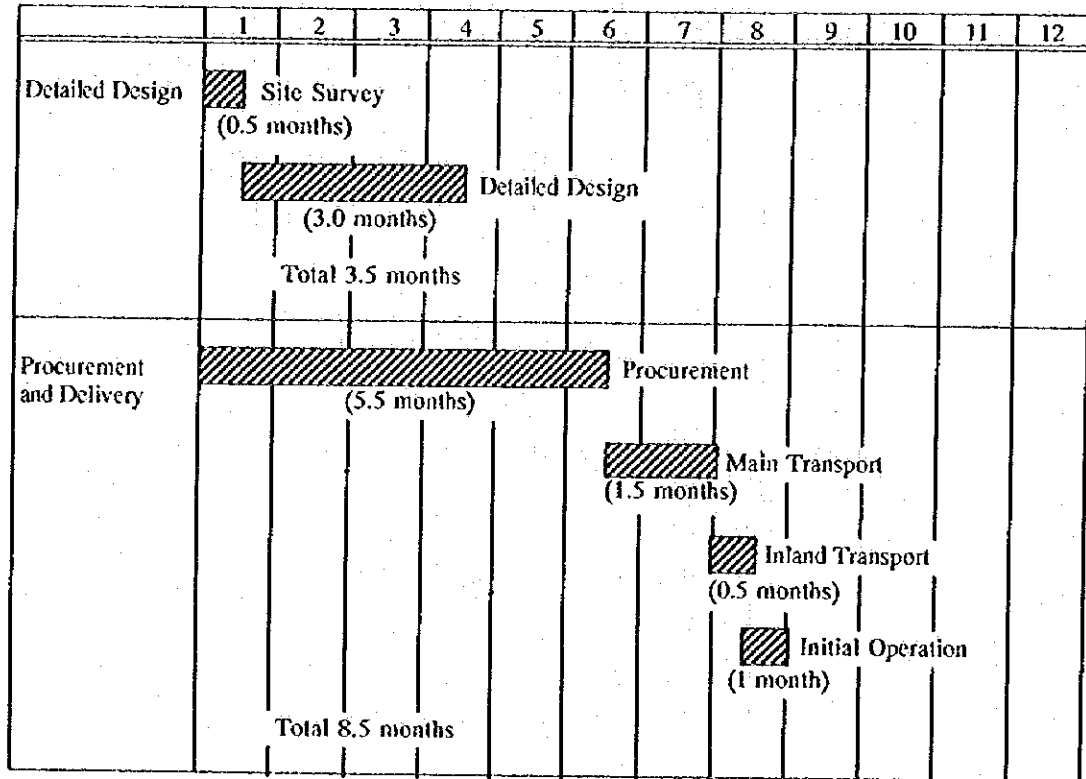


Fig. 3.2 Implementation Schedule



### 3.1.7 Obligations of Recipient Country

Necessary measures to be taken by the Government of Pakistan in case Japan's Grant Aid is executed.

- (1) To secure the site for the Project.
- (2) To undertake every construction works programmed under the CMTI Expansion Plan, and incidental outdoor works such as grading, fencing, gates and exterior lightning in and around the site.
- (3) To secure stockyard and storage facilities prior to delivery of the equipment to be supplied.
- (4) To provide facilities for distribution of electricity, water supply, telephone, drainage, sewage and other incidental facilities to and within the Project site, which include but are not limited to:
  - 1) Electricity distribution line
  - 2) Water distribution line
  - 3) Drainage line
  - 4) Telephone line and the main distribution panel
  - 5) General furniture such as carpets, curtain, tables, chairs and others
- (5) To ensure prompt unloading and customs clearance at port of disembarkation in Pakistan and internal transportation of the products purchased under the Grant.
- (6) To bear the following commissions to the Japanese foreign exchange bank for the banking services based upon the Banking Arrangement.
  - 1) Advising commission of Authorisation to Pay (A/P)
  - 2) Commission for the Payment
- (7) To exempt Japanese nationals involved in the Project from custom duties, international taxes and other fiscal levies which may be imposed in the Islamic Republic of Pakistan with respect to the supply of the products and services under the verified contracts.

- (8) To accord Japanese Nationals whose services may be required in connection with the supply of products and services under the verified contract such facilities as may be necessary for their entry into the Islamic Republic of Pakistan and stay therein for the performance of their work.
- (9) To maintain and use properly and effectively the facilities constructed and equipment purchased under the Grant.
- (10) To bear all the expenses other than those to be borne by the Grant, necessary for construction of the facilities as well as for transportation and the installation of the equipment.

### **3.2 Operation and Maintenance Plan**

#### **3.2.1 Maintenance System**

A maintenance system will be established based on the present system which has worked effectively. The outline of the system is as follows:

##### **(1) Routine Maintenance**

Sub Instructors responsible for routine maintenance check every equipment filling in the check sheet in Appendix 12-1. Check items are mileage, cooling water, engine oil. Check sheets filled in will be reported to the Instructor, and Chief Instructor.

##### **(2) Periodic Maintenance**

Instructors responsible for periodic maintenance check equipment routine maintenance records, then report to Chief Instructor. The Chief Instructor orders workshop engineer to execute periodic maintenance.

##### **(3) Maintenance Procedure**

###### **- Maintenance Request**

Instructors responsible to check water, fuel and oil. If leakage or abnormal consumption observed, request workshop engineers to check and fill in request sheet in Appendix 12-2.

- Maintenance Table

Workshop engineers responsible for repair examine the cause of trouble, prepare repair schedule which includes repair method, necessary parts and time schedule, then submit to workshop sub-engineer to execute repair. In the case that specific spare parts are needed, request spare parts, filling in parts request sheet.

Workshop engineers responsible for execution of repair, check the equipment and the maintenance table, then order the mechanics to execute the works.

After repair the mechanics prepare the repair record filling in the sheet in Appendix 12-3 and 12-4, then report to sub-engineers, engineers of workshop and Chief Instructor.

(4) Spare Parts Control

Inventory sheet which includes parts code, name of parts, stock, stocking place, is used for inventory control. The present inventory sheet control is being replaced by a computerised control system. (Refer to Appendix 12-5).

Necessary spare parts are summarised as follows:

- Spare parts for routine maintenance/elements, filter, corrosion register, etc.
- Abrasive parts/ blade cutting edge, end bit, ripper point, sprocket, segments, bolt, nut, break lining, etc.
- Water, oil/O-ring, gasket, grease fitting, oil seal, etc.
- Consumable/V-belt, lamp, valve, hose, fuel nozzle, fuse, switch, meter, etc.
- Necessity for spare parts for engine cylinder and piston ring is very low, thus keeping a stock seems unnecessary, but a secured channel of supply to be maintained.

In conclusion, since the equipment is used for training purposes only, the anticipated work load will be smaller than for usual construction works, therefore the amount of spare parts can be minimized.

### 3.2.2 Maintenance Cost Estimation

Based on CMTI's annual running costs for the last three years, additional running costs to be borne by the expansion are estimated. Main components which affect the cost increase are; allowance for staff, fuel and lubricant for equipment operation practice, equipment maintenance and fuel and lighting for facilities. Thus, cost estimates were made on the above three items.

#### (1) Pay and Allowance

Average monthly allowances of CMTI staff are as follows:

Position	Monthly allowance Rs/month	Average Rs/month
Instructor	9,000 - 12,000	10,000
Sub Instructor	3,000 - 5,000	4,000
Supporting staff for construction equipment	1,000	1,000

Increment of the above staff and allowance for it required for the expansion are calculated as shown in Table 3.1.

Table 3.1 Cost Estimates for Allowance

Position	No. to be Increased	Additional Cost Rs/month
Instructor	13	130,000
Sub Instructor	49	196,000
Supporting staff for construction equipment	20	20,000
Total of additional cost per month		346,000
Total of additional cost per year		4,152,000

As the budget for staff for the 1995/96 fiscal year is at 6,583,000 Rs, a total of 10,735,000 Rs (63% increase) will be required.

**(2) Fuel and Lubricant for Training Equipment**

Fuel consumption for operation practice of construction equipment and vehicles occupy most of the fuel and lubricant cost. Details of the estimation is shown in Table 3.2, where conditions of the estimates are as follows:

Market price of diesel oil	6.5 Rs/l (September 1995)
Average daily operation hours	2.5 hours (OP Course)
Average annual operation days	120 days (40 days x 3 semesters)
Fuel consumption rate per equipment	40% of usual operation
Lubricant	Lubricant 0.5% of fuel cost

Table 3.2 Cost Estimates for Fuel and Lubricant

Equipment		Hp	No.	Fuel Consumption		Annual Costs Rs
				l/HP·h	l/h	
Bulldozer	300 HP	300	1	0.055	17	32,292
Bulldozer	250 HP	250	5	0.055	69	134,550
Hydraulic Excavator	0.7 m <sup>3</sup>	130	2	0.055	14	27,986
Hydraulic Excavator	0.5 m <sup>3</sup>	90	2	0.055	10	19,375
Hydraulic Excavator	0.09 m <sup>3</sup>	32	1	0.055	2	3,444
Hydraulic Excavator with Super Long Boom	0.5 m <sup>3</sup>	90	1	0.055	5	9,688
Wheel Loader	3.5 m <sup>3</sup>	250	3	0.046	35	67,275
Wheel Loader	1.7 m <sup>3</sup>	110	1	0.046	5	9,867
Motor Grader	140 HP	140	2	0.032	9	17,690
Motor Grader	155 HP	155	1	0.032	5	9,793
Vibration Roller	10 t	130	1	0.046	6	11,560
Vibration Compactor	5 HP	0.9	1	0.060	0	106
Landfill Compactor	2650 HP	250	1	0.034	8	16,380
Tyre Roller	10 t	96	1	0.030	3	5,616
Asphalt Finisher	6 m	90	1	0.046	4	8,003
Mobile Hammer	130 HP	130	1	0.055	7	13,993
Power Splitter	150 HP	150	1	0.055	8	16,146
Pile Driver	135 HP	135	1	0.055	7	14,531
Pipe Layer	350 HP	350	1	0.055	19	37,674
Automatic Curber	5 m <sup>3</sup>	9	1	0.068	1	1,193
Air Compressor	3.5 m <sup>3</sup> /m	34	1	0.062	2	4,111
Generator	5 KVA	10	1	0.051	1	991
Rough Terrain Crane	30 t	286	1	0.031	9	17,177
Dump Truck (off the road)	23 t	296	1	0.025	7	14,545
Dump Truck (on the road)	12 t	335	1	0.016	5	10,452
Service Car	3,000 cc	80	2	0.015	2	4,618
Mobile Workshop	6 t	110	1	0.016	2	3,432
Water Bowzer	10 kl	335	1	0.016	5	10,452
Fuel Tanker	10 kl	335	1	0.016	5	10,452
Total of Annual Costs for Fuel						533,393
Total of Annual Costs for Fuel and Oil						533,660

As the budget for fuel and lubricant for 1995/96 fiscal year is 350,000 Rs a total of 883,660 Rs will be required.

(3) Maintenance Cost of Equipment

For 1995/96 fiscal year a total of 250,000 Rs is allocated for equipment maintenance cost. Of this cost, the cost of spare parts for construction equipment is negligibly small, because most of the spare parts required were fully secured by procurement under Japan's Grant Aid Assistance in the past. Accordingly, appropriate spare parts provision should be made under the Project considering such stock.

The vehicles under the Project are used on the training field only, thus the requirement for spare parts is not so frequent. With appropriate spare parts preparation under the Project, need for additional procurement will be small for the following four to five years.

(4) Fuel and Light Costs for Facilities

Considering the expansion in area, a 50% increase is anticipated.

(5) Anticipated Total Operation Cost

In conclusion, total operation cost will be shown in Table 3.3.

Table 3.3 Anticipated Total Operation Cost

Item		Amount thousand Rs
Pay and Allowance	Fuel and Lubricant	10,735
Emergency and Others	Fuel and Lubricant	885
	Electricity	1,275
	Gas	150
	Others	575
Sub Total		2,885
Maintenance for Facilities and Equipment	Vehicles	50
	Equipment	200
	Buildings	600
	Facilities	75
Sub Total		925
Total		14,545

For 1996/97 fiscal year a total of 9,774 thousand Rs is allocated as CMTI running cost, thus 50% increase of the present cost will be required.

## **CHAPTER 4. Project Evaluation and Recommendations**



## Chapter 4 Project Evaluation and Recommendation

### 4.1 Project Effect

The Project will enable CMTI to supply a total of 840 construction machinery operators, mechanics, associate engineers and engineers annually to the construction industry as compared to the present 360, answering, thus, to the recent increase in applicants for the training (900) as well as to the increased demand for the graduates from both public and private sectors to which the CMTI have supplied 1,068 and 1,699 respectively since its establishment.

The increase of the number of skilled manpower in the civil engineering and mechanical engineering fields will enable the construction industry to accelerate mechanisation of the execution of construction work.

Effective operation and maintenance of the equipment through upgrading the technical level will prolong equipment life and save operation costs, which will contribute to improve the financial situation of the construction industry. Consequently, the government's road development programme will be significantly accelerated.

The Project also contributes to minimize unemployment among young workers and to reduce the number of construction workers from third countries, consequently reducing the drain on foreign currency.

The trainees dispatched from the local governments are expected to upgrade the technical level of construction work on rural development programmes and contribute to stimulate socio-economic activities in rural areas.

Regarding the indirect effects of the Project, the following is expected.

- To stimulate economic activities by providing reliable road facilities, thus saving transport cost.
- To realize price stability by saving distribution cost.
- To facilitate the access of the rural population to social services such as medical, education, etc. services.
- To promote settlement in rural areas.

The present situation and problems of the road sub-sector, the measures to be taken under the Project and the positive impacts and extent of the Project are summarised in the following Table.

### Summary of the Project Effects

Present situation	Measures to be taken under the Project	Positive impacts and extent of the Project
<p>1) Under the 8th Five Year Plan, improvement and upgrading of 4,000km of high type roads and 3,000km of low type roads have been implemented. To accelerate the progress of the road programmes, mechanisation of the construction industry is urgently required.</p> <p>2) The nationwide annual requirement for engineers, associate engineers, construction machinery operators and mechanics for road works are estimated at 190, 270, 1615 and 665, respectively. The present training capacity of CMTI, which is a unique agency to provide training on construction machinery engineering in Pakistan, is limited to 60, 40, 120 and 40.</p> <p>3) The CMTI expansion plan which was implemented under the 8th Five Year Plan, programmes to increase its annual output of engineers, associate engineers, construction machinery operators and mechanics to 100, 40, 300 and 400, respectively. Construction of facilities under the expansion plan is in progress, but there is not adequate training equipment at present and necessary equipment for new courses (welding course and electricians course) is completely missing.</p>	<p>1) The government has been promoting mechanisation of the construction industry through tax measures and improvement of the system of payment for construction work to strengthen the financial condition of the industry. Also, promoting manpower development to meet the mechanisation by implementing the CMTI expansion plan.</p> <p>2) Provide necessary training equipment for the CMTI expansion plan. The equipment includes construction machinery, testing equipment, workshop equipment, training aid equipment and vehicles for transport.</p>	<p>1) CMTI's annual output of engineers, associate engineers, construction machinery operators and mechanics at 100, 40, 300 and 400, which represents 51%, 15%, 19% and 60% of the nationwide requirement, will be realized.</p> <p>2) Starting the welding course and electricians course, CMTI's training programme will cover the complete technical fields of construction machinery management, operation and maintenance.</p> <p>3) Mechanisation of the construction industry will be accelerated, consequently progress of road programmes will be accelerated.</p> <p>4) The Project will contribute to reduce the number of construction workers from third countries, consequently the drain on foreign currency.</p> <p>5) The Project will contribute to minimize unemployment of young workers.</p> <p>6) Provide more equal opportunities for economic development and access to social services.</p> <p>7) Resolve regional disparities.</p> <p>8) Realise sound economic growth.</p>

As described above, significant positive effect is expected from the Project. The Project also contributes to the upgrading of the basic human needs of the residents. Regarding management of the Project, the Pakistani side has sufficient capabilities for its execution. In conclusion, it is strongly recommended to implement the Project by Japan's Grant Aid Assistance.

## 4.2 Recommendation

It is confirmed that there will be no problems for operation and maintenance of the CMTI by the Pakistani side after completion of the Project. However, considering the priority of road development and manpower development programmes of the country, it is recommended that CMTI's expansion plan will be extended to the following courses:

- 1) Drilling course/ Techniques on rock excavation work of road construction is particularly required in the northern area, such as Lahore-Islamabad Highway Construction Project.
- 2) Tunneling course/ Several tunneling projects are going to be implemented such as, Kohat Tunnel Construction Project and Lowari Tunnel Construction Project. There is no agency to date which can provide training in tunneling techniques.
- 3) Bridge course/ Demand for bridge construction is extremely high all over the country. There is no agency to date which can provide training in bridge construction techniques.

CMTI will start a programme from January, 1996, which accepts trainees from developing countries in Asia, Africa and Middle East such as Bangladesh, Bhutan, Central Africa, Ethiopia, etc. From the viewpoint of supporting this programme, early implementation of the Project by Japan's Grant Aid is recommended.

## **APPENDIX**

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| <b>Appendix 13</b> | <b>Condition of the CMTI's Existing Equipment</b>                |
| <b>Appendix 14</b> | <b>References</b>  |

## Appendix 1 Member List of the Survey Team

### Basic Design Study

Mr. Toshio Hinoshita	Leader	Deputy Director Second Maintenance Department Second Operation Bureau Honshu-Shikoku Bridge Authority
Mr. Hisashi Matsui	Project Coordinator	Second Basic Design Study Division Grant Aid Study & Design Department Japan International Cooperation Agency (JICA)
Mr. Yoichi Higaki	Project Manager	Construction Project Consultants Inc. (CPC)
Mr. Takayasu Kase	Facility Planning	Yachiyo Engineering Co., Ltd. (YEC)
Mr. Hiroyuki Sasaki	Equipment Planning	Construction Project Consultants, Inc. (CPC)
Mr. Tamio Shinada	Procurement Estimation	Construction Project Consultants, Inc. (CPC)

### Basic Design Study Draft Final Report Explanatory Survey

Mr. Toshio Hinoshita	Leader	Deputy Director Second Maintenance Department Second Operation Bureau Honshu-Shikoku Bridge Authority
Mr. Noriaki Nishimiya	Project Coordinator	Deputy Resident Representative & Chief Engineer Pakistan Office Japan International Cooperation Agency (JICA)
Mr. Yoichi Higaki	Project Manager	Construction Project Consultants Inc. (CPC)
Mr. Hiroyuki Sasaki	Equipment Planning	Construction Project Consultants, Inc. (CPC)

## Appendix 2 Survey Schedule

### Basic Design Study

No. of Days	Date	Movement	Accommodation	Activities
1	Oct. 2 (Mon)	Depart from Tokyo 12:00 (PK753) Arrive to Islamabad 20:00	Islamabad	Travelling
2	Oct. 3 (Tue)		Islamabad	Courtesy call on: Embassy of Japan (EOJ) and Ministry of Communications Discussions with JICA and relevant officials
3	Oct. 4 (Wed)		Islamabad	Site visit at CMTI Discussions with the relevant officials
4	Oct. 5 (Thu)		Islamabad	Road construction site visit
5	Oct. 6 (Fri)		Islamabad	Internal meeting Preparation of the Minutes of Discussions (Draft)
6	Oct. 7 (Sat)		Islamabad	Discussions with the relevant officials
7	Oct. 8 (Sun)		Islamabad	Sign for the Minutes of Discussions Report to the EOJ and JICA
8	Oct. 9 (Mon)	Official members depart from Islamabad 10:30 (PK778)	Islamabad	Site visit at CMTI Discussions with the relevant officials
9	Oct. 10 (Tue)		Islamabad	- ditto -
10	Oct. 11 (Wed)		Islamabad	- ditto -
11	Oct. 12 (Thu)		Islamabad	- ditto -
12	Oct. 13 (Fri)		Islamabad	Internal Meeting
13	Oct. 14 (Sat)		Islamabad	Road condition survey for main roads Islamabad-Peshawar
14	Oct. 15 (Sun)		Islamabad	Site visit at CMTI Discussions with the relevant officials Data collection
15	Oct. 16 (Mon)		Islamabad	- ditto -
16	Oct. 17 (Tue)		Islamabad	- ditto -
17	Oct. 18 (Wed)		Islamabad	- ditto -
18	Oct. 19 (Thu)		Islamabad	- ditto -

No. of Days	Date	Movement	Accommodation	Activities
19	Oct. 20 (Fri)		Islamabad	Internal meeting Preparation of technical memorandum
20	Oct. 21 (Sat)		Islamabad	Signing of the technical memorandum
21	Oct. 22 (Sun)		Islamabad	Report to the EOJ and JICA
22	Oct. 23 (Mon)	Consultant members depart from Islamabad 10:30 (PK779) Arrive to Bangkok 19:25	Bangkok	Travelling
23	Oct. 24 (Tue)	Depart from Bangkok 11:00 (TG640) Arrive to Tokyo 19:00		Travelling

**Basic Design Study Draft Final Report Explanatory Survey**

No. of Days	Date	Movement	Accommodation	Activities
1	Nov. 11 (Mon)	Depart from Tokyo 12:00 (PK753) Arrive to Islamabad 20:00	Islamabad	Courtesy call on: Embassy of Japan (EOJ) and Ministry of Communications
2	Nov. 12 (Tue)		Islamabad	Explanation of Draft Final Report
3	Nov. 13 (Wed)		Islamabad	Explanation of Draft Final Report
4	Nov. 14 (Thu)		Islamabad	Explanation of Draft Final Report
5	Nov. 15 (Fri)		Islamabad	Preparation of the Minutes of Discussions (Draft)
6	Nov. 16 (Sat)		Islamabad	Construction site visit NLC, Mangla dam
7	Nov. 17 (Sun)		Islamabad	Discussion on the Draft Minutes of Discussion
8	Nov. 18 (Mon)		Islamabad	Sign for the Minutes of Discussion Report to the EOJ and JICA
9	Nov. 19 (Tue)		Islamabad	Supplementary survey
10	Nov. 20 (Wed)		Islamabad	Supplementary survey
11	Nov. 21 (Thu)		Islamabad	Supplementary survey Report to the EOJ and JICA
12	Nov. 22 (Fri)	Depart from Islamabad 00:45 (PK792) Arrive to Bangkok 08:40 Depart from Bangkok 11:10 (TG640) Arrive to Tokyo 19:00	Islamabad	



### Appendix 3 List of Parties Concerned In Pakistan

Mr. Shahid Humayun	Deputy Secretary Economic Affairs Division
Mr. Arshad Sultan	Section Officer Economic Affairs Division
Mr. Ghulam Yazdani	Joint Secretary Ministry of Communications
Mr. Mohammed Iqbal	Deputy Secretary Ministry of Communications
Mr. Wilayat Shah	Section Officer Ministry of Communications
Mr. Masud Hussain	Director CMTI Ministry of Communications
Mr. Shafqat Hayat Raziq	Administrator Officer CMTI Ministry of Communications
Mr. Zahid Rashid	Chief Instructor CMTI Ministry of Communications
Mr. Ammar Haider Bukhari	Instructor CMTI Ministry of Communications
Mr. Iftikhar Hussain	Instructor CMTI Ministry of Communications
Mr. Anjum Majid	Instructor CMTI Ministry of Communications
Mr. M. A. Farouk	Chief National Transport Research Center (NTRC)
Mr. Munir Ahmed Khokhar	Deputy Secretary Manpower & Overseas Pakistanis Wing
Mr. Viqar Ul Haq Khan Khalid	Director General Frontier Works Organisation
Mr. Ijaz Rasoul	Project Manager Islamabad-Lahore Expressway Construction Project National Logistic Cell (Engineer)