# THE BASIC DESIGN STUDY REPORT ON THE PROJECT FOR ENHANCEMENT OF TRAINING CAPABILITIES OF CONSTRUCTION MACHINERY TRAINING INSTITUTE (CMTI) IN THE ISLAMIC REPUBLIC OF PAKISTAN

**MARCH, 2005** 

JAPAN INTERNATIONAL COOPERATION AGENCY

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No.

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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 for Enhancement of Training Capabilities of Construction Machinery Training Institute and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Pakistan a study team from 23rd August to 15th September, 2004.

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 this result, the present report was finalized.

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

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

March, 2005

Seiji Kojima President Japan International Cooperation Agency

## Letter of Transmittal

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

The study was conducted by Construction Project Consultants, Inc. and Yachiyo Engineering Co., Ltd. under a contract to JICA, during the period from August, 2004 to February, 2005. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation 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 Chief Consultant,

Basic design study team on the Project for Enhancement of Training Capabilities of Construction Machinery Training Institute Construction Project Consultants, Inc.



**PROJECT SITE** 



## Equipment



1. Bulldozer



3. Motor Grader



4. Wheel Loader



2. Hydraulic Excavator



5. Rough terrain Crane



6. Mini Bus



7. Pickup Car



8. Diesel Engine Cut-Away Model



9. Alternator Cut-Away Model



10. Electric Wiring Training Board



11. Truck (Diesel) Electric Devices Trainer



12. MIG Welder

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## Abbreviations

CAD	Computer Aided Design
CAM	Computer Aided Manufacturing
CDA	Capital Development Authority
CMTC	Construction Machinery Training Center
CMTI	Construction Machinery Training Institute
DAE	Diploma Associated Engineering
FWO	Frontier Works Organization
GDP	Gross Domestic Product
EIA	Environmental Impact Assessment
E/N	Exchange of Notes
IEE	Initial Environmental Examination
IT	Information Technology
JICA	Japan International Cooperation Agency
MHA	National Highway Authority
MOC	Ministry of Communications
NLC	National Logistic Cell
OS	Operating System
PC	Personal Computer
RC	Reinforced Concrete

#### Summary

Since its independence in 1947, the Islamic Republic of Pakistan (hereinafter referred to as "Pakistan") has formulated a series of medium and long-term national development plans in its effort to create a modern nation. Special emphasis has been placed on the development of socioeconomic infrastructure, including roads, dams and irrigation facilities, as an essential requisite for economic development. As of 2004, the Ten Year Perspective Plan for 2001 to 2011 and the Three Year Development Plan for 2001 – 2004 are in progress with the assistance of the IMF which was restarted following the decision by the Government of Pakistan to collaborate with the international community. Together with these plans, the Devolution Plan (DP: announced in March, 2003) and the Poverty Reduction Strategy Paper (PRSP: announced in December, 2003) have been publicly endorsed as part of the national efforts to achieve economic development with a target average annual GDP growth rate of 6.3%. The Ten Year Perspective Plan re-emphasizes the critical importance of the development of economic infrastructure, such as roads and dams, etc., for the purpose of vitalizing the country's economic activities to realize a high level of economic growth, promotion of employment improvement of the income level and poverty reduction.

In 1983, the Government of Pakistan requested the Government of Japan's provision of grant aid for the establishment of the Construction Machinery Training Centre (CMTC) for the purpose of training technicians and engineers involved in the operation and maintenance of construction machinery, the number of which had been increasing with the progress of projects to construct or improve such infrastructure as roads and dams, etc. After a series of studies, the CMTC was finally built in March, 1986 and began to function as a training organization for technicians and engineers for construction machinery. In subsequent years, Phase 2 of Japan's grant aid cooperation commenced in 1996 and has been implemented to the present time in order to enhance its capacity as a training organization to meet the growing demand for training of wide-ranging engineers related to construction machinery in a greater number. [In the meantime the Training Centre was renamed the Construction Machinery Training Institute (CMTI): hereinafter it is indicated as "CMTI".]

However, since around 1998 construction machinery used in the construction of roads and dams, etc. has been rapidly incorporating electronic control technologies aimed at making their operation and maintenance easier. As a result, there have been many changes in operation method and maintenance of construction machinery with conventional machinery components.

While the amount of modernized equipment being utilized in Pakistan has been increasing, and suitable training to master the necessary skills for efficient use and maintenance of new machinery is essential for operators and mechanics, the equipment and teaching materials currently used by the CMTI do not meet the need, making CMTI's acquisition of new equipment and teaching materials crucial.

In November 2003, the Government of Pakistan requested the Government of Japan's provision of grant aid for the procurement of modern construction machinery and other equipment required for technical training on the operation and maintenance of such machinery as well as training equipment for new training courses necessitated by the expanding training needs, the procurement of computers and related equipment and apparatus to consolidate the training

contents of the existing DAE courses and the construction of a new training building, accommodation building and canteen building.

In response to the above-mentioned request, the Japan International Cooperation Agency (JICA) dispatched the Basic Design Study Team between August 23rd and September 15th 2004. The Study Team conducted a detailed study on the state of management and utilization of equipment and facilities at the CMTI, the training contents and auxiliary equipment and materials for training and needs of technicians and engineers related to construction machinery. At the same time, it conducted a study on the necessity for introducing modernized construction machinery and related data on maintenance capacity and facility construction.

In addition, the impact of new construction machinery on the social and natural environments, contents and planning for training courses to be newly established were confirmed through discussions with CMTI and through a field survey.

On its return to Japan, the Study Team prepared a draft final report on the Basic Design by examining the relevance of the Project and by formulating equipment and facility specifications and the implementation plan of the Project in due consideration of the findings of the field survey. The Study Team was dispatched between January 25th and February 5th 2005 to explain a draft final report on the Basic Design and to confirm the contents of the final equipment by explaining the reasons for change with respect to individual equipment by comparing the requested equipment results and the contents of the request.

With respect to the facility, the total fixed number of trainees in the three new courses is 150, and 50% to 75% of these trainees are scheduled to reside at the accommodation facilities. In the formulation of the plan, the results examined by the Study Team as the contents of the plan with an appropriate scale after due consideration of the existing facility and consistency with outward appearance were approved.

No.	Equipment Name	Rough Specifications	Request	Plan	Reason for Change
	Bulldozers	26 ton, 230 horse power (HP)	5 units 3 unit		3 units of bulldozers in total: 2 units for operations and 1 unit for maintenance since equipment procured in 1996 can be effectively utilized for training for normal operations.
	Hydraulic shovels	20 ton, 0.7m <sup>3</sup>	5 units	3 units	3 units of hydraulic shovels: 2 units for operations and 1 unit for maintenance since equipment procured in 1996 can be effectively utilized for training for normal operations.
	Motor graders 3.7m blade, 150HP 3 units 1 u		1 unit	1 unit minimum because electronic control is limited by engine parts.	
	Hydraulic shovel simulators	To be manufactured based on 20 ton class	2 units	0	This is excluded because no existing product is available. Product is a single item and of single specifications so that maintenance is a problem and cost effectiveness is not expected.

Major items that are different from the contents of the request are as follows:

Crane simulators	To be manufactured based on 20 ton class	2 units	0	This is excluded because no existing product is available. Product is a single item and of single specifications so that maintenance is a problem and cost effectiveness is not expected.
PC for CAD/CAM	Compatible with CAD software	67 unita	26 units	The number was changed to an appropriate number of units considering educational effects.
General-purpose PC	To be compatible with basic software	07 units	21units	The number was changed to an appropriate number of units considering educational effects.

The outline of the plan is as follows:

No		Equipment Name	Quantity	Specifications and Other
1	Cor	Bulldozers	3 units	24 ton class, 2 units with ripper, 1 unit with winch
2	nstruc	Hydraulic shovels	3 units	20 ton class, 0.7m <sup>3</sup> bucket
3	traii	Wheel excavators	2 units	14 ton class, 0.4m3 bucket
4	mach 1ing	Motor graders	1 unit	14 ton class, 3.7m blade, 150 HP
5	inery	Wheel loaders	3 units	13 ton class, 2.5m <sup>3</sup> bucket, 160 HP
6	for	Rough terrain cranes	1 unit	25 ton head capacity, 30m
7	Equipmer	Training equipment for construction vehicle mechanic course	1 set	20 items of equipment to allow trainees to understand structure and functions, 26 items utilized for factory practice, 21 items utilized for parts repair or manufacture, 13 items utilized for inspections
8	nt for new train courses	Training equipment for construction machinery electrician course	1 set	5 items to allow trainees understand structure and functions, 15 items utilized for factory practice, 8 items utilized for parts repair or manufacture, 8 items utilized for inspections
9	ing	Training equipment for welding and fabrication	1 se	7 welders, 5 items of equipment for auxiliary welding work, 8 items of sheet metal
10	Tr	Desktop type PC for CAD	26 units	20 units for trainees, 6 units for instructors
11	aining C	General desktop type PC	21 units	20 units for trainees, 1 unit for instructors
12	; equip P/CA	PC for servers	2 units	Utilized for network construction, 1 unit for pack-up
13	ment f D	Software for CAD/PC	26 sets	Software for CAD
14	or	Peripheral equipment	1 set	4 printers & plotters in total, un-interruptive power supply, etc.
15	Equ adminis	Microbus	2 units	Utilized for trainees to commute and to move to training sites. About 25 persons vehicle capacity
16	ipment tration s	Pick-up truck	1 unit	Approx. 800kg offloading volume to transport parts for replacement, repair & training, equipment & materials
17	for section	Generator	lunit	Utilized as emergency power supply during power failures at training building to be enlarged.

## Contents of Equipment Plan

#### Contents of Construction Facility

Facility Name	Structure	Number of Stories	Floor Area
1. Training building	Steel reinforced concrete	2	1,413.0 m2
	construction		
2. Trainees Accommodation Building	Steel reinforced concrete	2	1,248.0 m2
	construction		
3. Canteen Building	Steel reinforced concrete	1	448.0 m2
	construction		
		Total	3,109.0 m2

The total cost for implementing the Project in accordance with Japan's grand aid scheme is estimated to be 921 million Japanese yen (913 million Japanese yen by Japan and 8 million Japanese yen by the recipient country). The Project is expected to take 19 months.

As a result of the Project, training equipment at CMTI will be significantly improved and the contents of training to be conducted will be improved to further meet operation and maintenance technologies utilized in Pakistan. As a consequence, the following direct and indirect effects can be expected. The effect of the benefit will spread whole nation (148.72 Million people, as of 2004) in Pakistan.

#### (1) Direct effects

- The contents of training will meet the present needs at construction sites by the training programs newly established with new equipment in Pakistan.
- · Road construction engineers mastering the new technology will increase.

#### (2) Indirect effects

- The economy will be revitalized through the performance of new types of construction machinery utilized extensively at construction sites to promote a road improvement plan.
- Construction machinery or vehicles with electronic control devices will be repaired as soon as possible in order to reduce the number of equipment stoppages.

After careful examination of the Project contents, the level of benefit, equipment applications, and competence with regards to maintenance, in accordance with Japan's grand aid scheme the Project is judged to be appropriate. The following are recommendations to display and continue the effects through the implementation of the Project.

- Due to the insufficient knowledge of instructors at CMTI with regards to electric and electronic control technologies incorporated in equipment to be procured under the Project, to examine Japanese technical cooperation.
- Single courses should be divided into three specialized training models for operation because 16 types of equipment are currently being used in the operator course, which could lead to shortages in operating time.
- In similar manner as the operator course, more trainees should be given as many opportunities as possible to carry out repair work in the mechanic course.
- An annual budget for necessary upgrading of equipment should be prepared since improvements in construction machinery are expected to continue in the future. Accordingly, equipment should be systematically and independently renewed by the CMTI.

Basic Design Study Report on the Project for Enhancement of Training Capabilities of Construction Machinery Training Institute in the Islamic Republic of Pakistan

Preface

Letter of Transmittal

Location Map / Perspective

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Exchange Rate US\$ 1 = JPY 110.62 (as of Aug. 2004) Rs. 1 = JPY 1.91 (as of Aug. 2004)

## CHAPTER 1 BACKGROUND OF THE PROJECT

## **CHAPTER 1 BACKGROUND OF THE PROJECT**

The Construction Machinery Training Institute (CMTI; previously known as the Construction Machinery Training Centre until 1993) was established in 1984 to train skilled technicians and engineers for construction machinery, etc. In both 1984 and 1995, the construction machinery and auxiliary equipment required for training were procured together with the construction of the training/administration building, canteen building and accommodation building under the grant aid scheme of the Government of Japan. Meanwhile, project-type technical cooperation was provided for five years from 1985 to 1990 to transfer the skills required for management and training at a training organization.

The rising demand for road construction in Pakistan makes the development of such human resources as operators and mechanics for construction machinery and technicians and engineers for work supervision an urgent task. There are great expectations of the CMTI as the relevant training organization and the CMTI has so far accepted some 9,200 trainees. It acquired an international dimension when it accepted trainees from Afghanistan in 2001 to assist the reconstruction process of the country.

Much of the construction machinery in Pakistan which was purchased in the 1980's and early 1990's has passed its expected life and the replacement of this machinery not only by the NHA but also by private companies has been gaining momentum since 2000. However, the replacement machinery is not entirely new as second-hand machinery imported from Japan accounts for more than 70%. The investigation results of the Study Team show that most of this second-hand machinery was originally manufactured in the late 1990's and thereafter, incorporating electric or electronic control technologies which have made rapid progress since the late 1990's.

This machinery is currently unable to perform to its full potential because of (i) the absence of mechanics with in-depth knowledge of electric or electronic control, resulting in the impossibility of electrical repair, and (ii) the shortage of operators who can set the appropriate operation mode by operating various switches to perform efficient machine operation without damaging the machine. This situation has increasingly highlighted the need to train technicians/engineers with knowledge and skills which differ from those required to operate conventional machinery principally comprising mechanical components.

Meanwhile, 68% and 32% of the existing machinery at the CMTI was manufactured in the 1980's and the first half of the 1990's respectively, showing an alarming gap in the required operating skills for the machinery used for training and the machinery actually used at construction sites. Moreover, the inadequate training on electronic control techniques for construction machinery and the shortage of CAD and other IT-related equipment makes the CMTI unable to fully meet the training needs of the construction industry. To solve these problems, the Government of Pakistan made a request to the Government of Japan for the provision of grant aid cooperation for the construction (extension) of the training facilities and the procurement of training equipment to ensure high level training with three new training courses as well as upgraded training of the existing training courses.

CHAPTER 2 COMPONENTS OF THE PROJECT

## CHAPTER 2 COMPONENTS OF THE PROJECT

## 2-1 Contents of the Project

The ratio of modern construction machinery in Pakistan has been increasing in recent years, making it necessary for operators and mechanics to possess appropriate skills to ensure the proper use and operation of such machinery.

As mentioned in Chapter 1, while modern construction machinery with built-in electric or electronic control mechanisms can experience breakdown of the control circuit which does not occur with conventional machinery, there is a massive shortage of technicians/engineers capable of properly dealing with this type of breakdown.

The newest construction machinery and teaching materials possessed by the CMTI, which was established in 1985 as a training organization for construction machinery operators and mechanics, was procured in 1996 and their technical levels are far below those of modern construction machinery. Under these circumstances, the CMTI is unable to conduct certain necessary training, resulting in a shortage of operators and mechanics capable of dealing with modern construction machinery in Pakistan.

The CMTI has made the maximum effort to improve its training syllabus and to maintain its equipment as well as facilities and still maintains the enthusiasm felt at the time of its establishment 20 years ago. However, the fiscal situation of the Government of Pakistan does not allow the procurement of new machinery and equipment with its own funding.

The present Project aims at (i) procuring modern construction machinery and other equipment required for technical training on the operation and maintenance of such machinery as well as training equipment for new training courses to meet the training needs which are not met by the existing courses, (ii) procuring computers and related equipment and apparatus to consolidate the training contents of the existing Diploma Associated Engineering (DAE) courses and (iii) constructing a new training building, accommodation building and canteen building, etc. The resulting improvement of the CMTI's training courses to make them more suited to the construction machinery currently in use in Pakistan will facilitate the development and improvement of such infrastructure as roads and dams in Pakistan, thereby contributing to improving the standard of living in the country.

## 2-2 Basic Design of the Requested Japanese Assistance

For the basic design, it was decided to fully study and examine (i) the implications of the Project as the third grant aid by the Government of Japan for the CMTI, (ii) the principal function of the CMTI of the training of skills related to construction machinery and (iii) the required level of technicians and engineers for the construction of roads in Pakistan.

Accordingly, the conditions of the machinery and equipment in the possession of the CMTI will be carefully studied to compare their technical levels with those of construction machinery actually in use in Pakistan (how modernised the machinery in use is?) to determine the necessity for the procurement of new machinery/equipment and the necessary

## quantity.

In regard to the three new courses of which the introduction is planned by the CMTI, the necessity to set up new training courses for the maintenance of construction machinery will be examined from the viewpoint of their connection to the development of roads. Each piece of machinery requested will be checked in terms of its necessity and anticipated effects to plan an appropriate range of machinery/equipment to be procured. The same principles will apply to the machinery/equipment requested for the existing mechanics course.

In the case of the computer equipment requested for consolidation of the curriculum for the DAE course, the required level and contents of the education and practical training will be judged based on the technical level required of DAE class engineers in Pakistan. The contents and quantity of such equipment will be planned with reference to the actual situation of use of computers for the education of similar engineers in Japan.

In regard to the new facilities, the appropriate scale of the training building, accommodation building and canteen building for the accommodation building to supplement the shortage of the existing facilities will be determined after clearly establishing the increased number of trainees while referring to the examination results of the equipment plan. The design and construction plan for the new facilities will then be finalised taking their compatibility with the existing facilities and the design principles adopted for the existing facilities into consideration.

Table 2-1 shows the basic annual training plan for the CMTI's existing and planned new courses.

	Annual Course	Number	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
1.	Existing Training Course			70	70	70				70	70	70	70	70	70
	Operator	70			10	10				- 10	- 10	10		- 70	10
	Mechanic-III	30		30	30	30				30	30	30	30	30	30
	Mechanic-II Engine	30		30	30	30	30	30		30	30	30	30	30	
	Mechanic-II Chassis	30		30	30	30	30	30		30	30	30	30	30	
	Turner Machinist	40		40	40	40	40			40	40	<u>4</u> 0	40	40	40
	DAE 1st Year	40	40	40	40	40	40	40	40	40	40	40	40	40	
	DAE 2nd Year	40	40	40	40	40	40	40	40	40	40	40	40	40	
	DAE 3rd Year	40	40	40	40	40	40	40	40	40	40	40	40	40	
	Third Country 20 (Training Duration : One Month)														
	Construction Machinery Planning & Employment	20	20												
	Construction Machinery Supervisory	25							25						
	Steel Fixer	20	20	20	20	20	20	20	20		20	20	20		
	Computer Software	16			16	16	16	16	16	16			16	16	16
	Computer Hardware	16	16	16						16	16				
	Monthly Trainee Number (1)		176	356	356	356	256	216	181	352	356	340	356	336	156
Z.	New Training Course	50		50	50	50				50	50	50	50	50	50
	Vehicle Electrician	50		50	50	50				50	50	50	50	50	50
	Welding & Fabrication	50		50	50	50				50	50	50			
	Monthly Trainee			150	150	150	0	0	0	150	150	150	100	100	100
	Total Monthly Traine Number (1)+(2)	Ð	176	506	506	506	256	216	181	502	506	490	456	436	256
3.	New Subject in Existing C	Course													
	Computer Basic	20													
	CAD	20													

Table 2-1 Training Schedule

\* DAE : Diploma of Associate Engineering

CAD : Computer Aided Design

Based on the concept of the Project described above, the Basic Design on Equipment Plan and Facilities Pan has been prepared in accordance with the following basic policies.

## (1) Equipment Plan

- 1) Selection of the equipment and decision on the specification and quantities to suit the technological level of the construction equipment used in the market.
- 2) The maximum utilization of existing equipment and decision on the minimum quantities of modern construction equipment.
- 3) For new training courses, decision on the specification and quantities to suit the technological level of trainees.
- 4) Selection of the equipment considering the maintenance level of Pakistan

## (2) Facilities Plan

- 1) Construction plan suited to the conditions, including the technological standard of the local construction industry as well as the climate and other environmental aspects
- 2) Planning of easy to maintain and safe facilities
- 3) Planning of facilities which are compatible with the existing facilities
- 4) Design based on local design standards

- 5) Structures utilizing local construction methods
- 6) Scale of facilities compatible with the training plan

#### 2-2-1 Design Policies for Equipment

### 2-2-1-1 Basic Policies

On the basis of above mentioned consideration, the design policies for the equipment has been prepared with reference to effective utilization of the new equipment. The planned equipment to be newly provided is largely classified into five categories: (i) construction machinery for training, (ii) equipment for new training courses, (iii) operation simulators, (iv) computer/CAD training equipment and (v) transport vehicles. As the design policies vary depending on the type of equipment, they are described below for each category of equipment.

- (1) Construction machinery for training
  - 1) Introduction of construction machinery electronically controlled different from the operation of the existing machinery.
  - 2) Introduction of construction machinery to training the operation of modern (high-tech) machinery
  - 3) Provision of as many attachments as possible to enable trainees to obtain as much experience as possible
  - 4) Spare parts (periodic replacement parts and initial expendable parts) for initial operation of 2,000 hours (two years)
  - 5) Examination of hard and soft equipment for failure diagnosis as accessory.
- (2) Equipment for new training course
  - 1) For vehicle mechanic course, introduction of equipment as the basis for damp track
  - 2) For vehicle electrician course, introduction of equipment to master from the basic to applied electrical control technology.
  - 3) For welding and fabrication course, introduction of equipment to train the welding operation level required enough mechanical strength
  - 4) For mainly vehicle mechanic course, introduction of testing equipment to check the repair work of the trainees

#### (3) Operation simulators

- 1) Grasp of the expected function and purpose of simulators.
- 2) Examination of the maintenance condition after the introduction
- 3) Because of custom-made and expensive equipment, examination of the cost-effectiveness

#### (4) Computer/CAD Training Equipment

- 1) Introduction of the latest AV equipment to achieve a higher training efficiency
- 2) Introduction of digital equipment in response to the changing media for AV education from films (8 mm, 16 mm and 35 mm), OHP and video tapes to computer-based memories, media, CDs and CDVs
- 3) Introduction of computers capable of serving lessons on basic knowledge concerning computers and also of running CAD software
- 4) Introduction of laser printers to achieve a higher production efficiency of training materials

5) Introduction of those models of IT equipment (computers and projectors, etc.) and equipment composing the LAN, all of which are widely used in Pakistan

#### (5) Transport Vehicles

- 1) Personnel transporter: as the main purpose of this vehicle is to transport trainees to and from the CMTI, the basic specifications include at least 23 seats and a diesel engine
- 2) Equipment transporter: the basic specifications are four-wheel drive and single cabin type

#### 2-2-1-2 Policies Regarding Unique Local Situation

In view of the fact that the requested machinery/equipment will be used for educational and training purposes, it is necessary to consider shorter overall operating hours and a lower frequency of breakdowns. Accordingly, the main focus of the work to determine the quantity of spare parts, which is usually determined in view of the implementation period in the case of a conventional construction project, is placed on those parts required for training on maintenance work rather than those parts likely to be worn or damaged during the construction period. For example, the quantities of those parts which cannot be re-used after training on their replacement will be increased to ensure their availability in line with the training programme.

In the case of auxiliary apparatus attached to construction machinery, general-purpose auxiliary apparatus is planned based on an accurate understanding of the reality of road construction work in Pakistan.

There are no special local circumstances to be considered for other types of equipment. However, given the fact that 44 organizations in Pakistan are either listed or subject to the catch all regulations under Japan's current export control regime for prevention of the proliferation of weapons of mass destruction, the compliance of all of the equipment to be procured and supplied to the CMTI under the Project with the regulations currently in force will be checked and confirmed. In regard to the storage of the machinery, there is little likelihood that the new machinery will be directly exposed to rain as the Pakistani side will construct new sheds in the existing motor pool area at its own expense. However, in view of the inevitable invasion of rainwater into the operating panels and instrument panels around the operator's seat under this arrangement, the mounting of a vandalism protector around these panels will be considered. The mounting of a canopy top will also be required to protect the operator from direct sunlight in view of training under the scorching sun in summer.

In the case of computer equipment, a suitable cooling method will be examined in consideration of a temperature rise inside the training building in summer.

#### 2-2-1-3 Policies Regarding Management and Maintenance Capabilities of Implementing Organization

As the CMTI is an organization conducting training on the operation and maintenance of construction machinery, CMTI has technical capacity regarding equipment maintenance under the Project. In effect, the capability of the CMTI to manage the spare parts required for periodic maintenance and breakdown repair work and its repair skills using these parts are comparable with those of major dealers of construction machinery. In addition, the CMTI has its own budget to meet the cost of oil, etc. required at the time of periodic maintenance and of parts which are not included in its

inventory.

However, much of the machinery and equipment procured in 1986 is still stored at the CMTI and the deterioration of the rubber hoses for hydraulic lines and brake lines and other components is highly noticeable in addition to the outdated nature of these models. The CMTI fully understands that equipment procured with Japanese grant aid cannot be arbitrarily disposed of and has stored such equipment in the motor pool shed. Although this is not an issue related to the maintenance capability of the CMTI, a suitable direction for this old equipment should be indicated under the Project.

Meanwhile, in regard to the new equipment to be procured under the Project, unlike the case of ordinary users of construction machinery where it is sufficient to be able to operate the machinery using the necessary reference materials (operation manual, etc.), it is essential for instructors at the CMTI to completely master the structure and operational requirements of each equipment. In some cases, it may be necessary for the instructors to prepare their own textbooks for training.

In view of these special requirements, a sufficient number of parts catalogues which are required to identify the necessary parts for breakdown repair and workshop manuals detailing the concrete repair processes will be included in the equipment specifications. To be more precise, the number shall be equal to the number of each type of machinery or equipment plus two.

No management problems are anticipated in regard to the educational and training equipment for the new courses because of the very orderly management of the equipment for the existing courses. Nevertheless, given the fact that as many as 118 items, totaling 275 pieces of equipment, are requested this time, the CMTI's proper storage of equipment not in use from the time of procurement, i.e. from the time of their initial delivery to the CMTI, is essential. For this reason, steel racks and work tables for the storage/installation of equipment are included in the scope of procurement under the Project.

#### 2-2-1-4 Policies Regarding Equipment Grade

The policies regarding the equipment grade vary depending on the type of equipment. In the case of construction machinery, general construction machinery currently marketed in Japan will be selected without including special attachments (optional functions) as the main purpose of the machinery to be procured under the Project is training on the operation and maintenance of electric and electronic control systems.

In the case of the training equipment for the new courses, there is some special apparatus, such as cut models for visual confirmation of the internal structure of the functional components and an electrical training board where all of the electric/electronic control-related parts are mounted on a single board to facilitate understanding of their functions and to assist training on breakdown diagnosis. This special apparatus will be designed so that it can be used for training on maintenance skills for as wide a range of vehicles and machinery as possible. In the case of brake testers and other inspection equipment to check the repair results, the selection priority will be given to that used by repair shops in Pakistan.

In the case of computer equipment for CAD and other general computing, the hardware and software will have standard specifications, allowing their maintenance in Pakistan, and unnecessarily high specifications will be avoided.

#### 2-2-1-5 Policies Regarding Supply Sources of Construction Machinery

The procurement of construction machinery made in Japan is basically planned because of the reasons given below. However, in the case of the equipment is limited only one manufacturer in Japan and has no competition or detachment, the EU is added to Japan as a possible supply source.

- (1) A technical note strongly requesting construction machinery made in Japan has been officially issued by the CMTI.
- (2) The procurement of Japanese construction machinery for which educational and training materials are easy to obtain is advantageous in view of the fact that all of the construction machinery currently possessed by the CMTI was made in Japan. This assessment is also backed by the past history of technical cooperation provided by Japan and the assumed necessity for further technical cooperation based on the dispatch of experts for a short period of time in the future.
- (3) More than 80% of the currently machinery currently used in Pakistan was made in Japan (based on a survey at several leading construction companies located near Islamabad) and training using construction machinery made in Japan is likely to facilitate the application of the training results to actual construction sites.
- (4) Japanese manufacturers of construction machinery are among the world's leaders in this industry and are the fore-runners in terms of the innovation of machinery, including the introduction of electronic control. Accordingly, education and training using Japanese construction machinery will increase the likelihood that the trainees will be able to deal with any modern machinery available in the global market.
- (5) There are good after-service networks of dealers of Japanese construction machinery in Pakistan and reliable services, such as the fabrication of attachments at the time of procurement and breakdown diagnosis, are available.

#### 2-2-2 Design Policies for Facilities

## 2-2-2-1 Policies Regarding Conditions for Construction/Procurement and Unique Circumstances/Trade Customs of Local Construction Industry

- (1) Conditions for Construction
  - 1) Design Standards

Because of the fact that Pakistan was governed by the United Kingdom for a long period of time, the various design standards in Pakistan are based on British standards and British building laws and regulations and such Pakistani design standards will, therefore, be used as the design standards under the Project. The seismic design as part of the structural design will be based on the UBC of the US as the British standards do not include the relevant standards because of the virtual non-existence of earthquakes in Britain.

#### 2) Designation Under Urban Planning System and Application for Building Approval

While the area around the CMTI is designated as an industrial zone, the land adjacent to the CMTI is currently farmland without any buildings. In regard to the application for building approval, a local consultant registered with the Association of Engineers in Pakistan will act as the agent for the CMTI, which is the applicant, and will submit the application to the Department of Building Examination of the CDA. The documents requiring approval, including the application form and drawings, etc., must be submitted to the person in charge of building examination at the CDA.

#### 3) Use of Local Construction Methods

RC structures are more popular than steel structures in Pakistan because the former are less expensive and it is easier to obtain the necessary materials. Among the planned facilities (buildings) under the Project, the training building and accommodation building are both two story buildings while the canteen building is a single story building. As none of these buildings have such special structural elements as a large span, etc., they will have a RC rigid structure with some earthquake-proof walls. This type of structure is very common in Pakistan. The partition walls will be brick walls with a mortar and paint finish while the external walls will be fair-faced brickwork to match the image of the existing buildings.

#### (2) Procurement Conditions and Unique Circumstances of Local Construction Industry

Most of the materials for building work can be basically procured in Pakistan. No problems are anticipated in regard to the local procurement of such basic building materials as cement, sand, gravel, reinforcing bars, timber and wooden doors and window frames or in regard to the leasing of construction machinery. In the case of other building materials, Pakistani products will be procured in a preferential manner provided that the quality is satisfactory. However, the procurement of some electrical equipment and mechanical equipment in Japan will be considered because of the need for high reliability and safe functioning.

#### (3) Policies Regarding Local Trade Customs

Past trading records are extremely important in Pakistan for the procurement of building materials. Local companies almost exclusively procure merchandise from companies with which they have traded in the past. Conversely, sellers seldom provide a quotation for companies with which they have previously traded. In short, it is essential that outsiders properly understand that the establishment of trust through a series of trading is a crucial factor for trading.

#### (4) Policies Regarding the Use of Local Companies

Some 4,500 construction companies in Pakistan are classified into five grades, i.e. A to E, based on their turnover, work capacity, equipment in possession and number of engineers employed, etc. In Islamabad and Rawalpindi, there are several construction companies, building services companies and electrical installation companies which have worked as subcontractors for Japanese grant aid projects involving building construction work in the past. The smooth progress of the building work and the strict observance of the building schedule can be planned by employing these local companies as subcontractors.

#### 2-2-2-2 Policies Regarding Construction/Procurement Methods and Construction Schedule

#### (1) Policies Regarding Construction/Procurement Methods

The components of the Project include the construction of such buildings as a training building (RC two story building; 1,413 m2), accommodation building (RC two story building; 1,248 m2) and canteen building (RC single story building; 448 m2) and the procurement and installation of construction machinery for training, inspection and repair equipment for training and computers, etc.

The three buildings will have a RC structure which is the most common building structure in Pakistan. As the total floor area of some 3,100 m2 is not particularly large, no special techniques or construction methods will be required. The labour and building materials required for the construction of these buildings can be almost entirely procured locally. Local procurement will be the principal method of procurement, partly to reduce the overall cost and partly to assist the local economy. Some industrial products (such as distribution boards and storage pumps, etc.) will be procured in Japan in view of the fact that electrical installation work and building services work using local products are not entirely free of concern regarding durability and safety.

#### (2) Policies Regarding the Schedule

The Project is a complex project combining the construction of buildings and the procurement/installation of equipment and the installation work for the equipment to be installed in the workshops in the training building will commence immediately after the completion of construction of these workshops on the ground floor and of the related building services work as well as electrical installation work. For this reason, the total length of the Project will be approximately 19 months from the commencement of the detailed design work to the handing over to the Pakistani side after test operation following the completion of the equipment installation work.

#### 2-2-2-3 Basic Policies Regarding Natural Conditions

In connection with the specifications of the new buildings, the training hours, i.e. from 08:00 to 14:00, at the CMTI will be taken into consideration. During these hours, the trainees undergo classroom lessons and practical training at a workshop in turn. As the windows of the existing training building face east, they are exposed to direct sunlight during morning lessons. As a result, the teaching effects are reduced because of the very hot environment.

Under the Project, the training building will be located along the east-west axis so that the windows of the classrooms on the first floor face north to avoid direct sunlight in order to provide a cooler environment for classroom lessons.

Air-conditioning will be introduced in the PC/CAD classroom, server room, administration office and instructors' room in the training building, instructors' bedrooms in the accommodation building and staff canteen in the canteen building. Other rooms will be provided with ceiling fans to facilitate natural ventilation.

The Capital Development Authority (CDA) has published the Islamabad Building and Town Planning Regulations, 2002. As these regulations stipulate that the seismic force must be calculated in accordance with the UBC (Uniform Building Code) of the US, the aseismatic standards of the UBC will be used for the design of the planned buildings.

Islamabad is located deep inland and is beyond the reach of cyclones born in the Indian Ocean. As a result, the city is not subject to strong wind. The maximum wind velocity associated with low pressure is 35 m/sec which is approximately half of the velocity of typhoons observed in Japan. Accordingly, hardly any building damage is caused by wind pressure and no special measures to deal with cyclones are considered.

## 2-2-3 Basic Equipment Plan

#### 2-2-3-1 Construction Machinery for Training

At present, the CMTI possesses 85 road construction machines, consisting of 44 machines provided under the Phase 1 Project (1986) and 41 machines provided under the Phase 2 Project (1996) for the practical training of operators and mechanics and these machines are mainly used for the training of operators. These machines can still be used without any problems for the training of the required skills for civil engineering work using construction machinery. Accordingly, the new machinery to be procured under the Project will be that of which the current models have built-in functions (particularly related to electric or electronic control) which the existing machines lack. The quantity of the new machinery will be planned to meet the minimum requirements.

Table 2-2-(1) shows the conditions of the existing equipment and the necessity for the procurement of modern machinery in regard to the construction machinery requested by the CMTI.

	Planned New Machinery			Existing Similar	Machinery	Durran of Line on d
No.	Type of	Rough	05.	Type of Condition P		Purpose of Use and Reason for Renewal
	Machinery	Specifications	Qty.	Machinery	Condition	Reason for Renewal
				D155	A/B	The introduction of high-tech
		220 LID		D85	В	machinery to deal with problems
1	Bulldozer	230 HP 24 tons	5	D65	В	arising from the outdated existing
1	(angledozer)	ripper winch	5	D50	В	machinery is necessary to improve
		ripper which		D60	р	the quality of training on operation
				(second-hand)	В	and maintenance.
				PC200 (x 3)	A/B	Among the main construction
				PC150-1	В	machinery, Hydraulic excavators are
	Hydraulic	$0.8  {\rm m}^3$		PC300	А	at the forefront of the incorporation
2	excavator	20 tons	5	PC30-7	А	of advanced technologies, such as
2	tractor type	140 HP	5	PC120-6Z (x	^	electronic control. The differences
	unctor type	110111		2)	Λ	from 10 year old machinery are
				PC120		obvious. The necessity for renewal is
				(second-hand)		the strongest.
	Hydraulic	$0.4 \text{ m}^3$				The use of this machinery has
3	excavator wheel type	14 tons 110 HP	2	None		rapidly become popular in urban
5				rione		areas and it is necessary to add this
	, meer of pe					machinery to the training curriculum.
				MG200	В	This is a type of machinery which
				GD605A	В	demands a high level of operating
4		155 HP	2	MG330	A	skill. While advanced technologies
4	Motor grader	3.7 m with scarifier	3	MG430 (x 2)	А	have been mostly introduced to
						engines, the importance of training
						using this machinery warrants
				W/A 450 1	D	Consideration of its renewal.
				WA450-1	B	I his is one type of the main
				WA200-1	В	advanced technologies are
5 Wheel le	Whaallandar	$2.5 \text{ m}^3$	2	928F	A	incompared in now models
3	wheel loader	160 HP	5			Denouval is considered because of the
				966F (x 3)	А	fact that the existing machinery is
						had that the existing machinery is
				10 + TS 100 I		Cronos are propo to appidente such
				$10 \ 13 \ 100 \ L$	В	of falls, and many advanced
	Rough terrain			(X 2)		technologies are incorporated in new
6	crane	25 tons	1			models for better safety. The
	crane			30 ton crane	А	necessity for the producement of new
						machinery is strong
						machinery is strong.

Table 2-2-(1) Construction Machinery for Training

Note

Condition grades: A = operable, B = partially operable, C = out of working order

## 2-2-3-2 Equipment for New Training Courses

The range of equipment described here assumes its use for training for the planned three new courses, i.e. 1) Vehicle Mechanic Course, 2) Vehicle Electrician Course and 3) Welding and Fabrication Course. The requested equipment can be classified into four categories, i.e. 1) auxiliary equipment used for the teaching of machine structures and theories, 2) training equipment used for repair work, including disassembly and assembly, 3) machine tools used for the repair of damaged parts or the manufacture of new parts and 4) inspection equipment used at the time of repair work or for the checking of proper repair. Further classification is conducted based on the target parts. The examination results of the necessity and suitability of each equipment are shown in Table 2-2-(2) for each category of equipment.

	Pl	anned New Equipm	ent			
No.	Purpose of Use	Subject Part/Device	No. of Items	Sub- Total	Purpose of Use and Reason for Requirement	
I. \	Vehicle Mechanic Co	ourse (78 items, 138	pieces)			
		Diesel engine	6		Most medium size or large vehicles use a diesel engine. As a diesel engine can frequently break down, directly affecting the efficiency of a vehicle, it is essential for any mechanic to properly understand its structure. The provision of such engines for training purposes is, therefore, planned.	
		Petrol engine	5		A petrol engine is used for small vehicles, such as pick-up trucks, and small construction machinery, such as tampers. It is essential for mechanics to properly understand the structure of a petrol engine.	
1	Auxiliary equipment for understanding of machine structure	Steering system	3	19	Construction vehicles employ various mechanisms to realise straight movement and reduction of the operating force and understanding of the steering mechanisms helps mechanics to conduct proper maintenance.	
		Transmission (T/M, shaft and bevel pinion, etc.)	4			The transmission is the mechanism which conveys the engine output to the tyres and involves a rotating movement throughout. The falling of a single bolt can cause a serious disaster and accurate understanding of this mechanism is essential.
		Others (air-conditioning unit; tyres)	1		An air-conditioning unit has a high operating rate level given the local weather conditions and understanding of its proper use is also essential from the viewpoint of environmental consideration. The tyres are parts which directly relate to safe travelling.	
		Diesel engine	9		The engine is a functional component and is suitable for overhauling and assembly practical training. Consideration should be given to avoiding a bias of the training contents and the number of diesel engines to be provided is determined taking the entire training plan into consideration.	
	Equipment for	Petrol engine	4		The remarks for diesel engines also apply to petrol engines. The required quantity is determined based on the detailed contents of the training plan.	
2	practical training	Steering system	1	26	In regard to steering systems, good or bad repair results can be easily checked using inspection equipment. This equipment is, therefore, suitable for practical training.	
		Transmission (T/M, shaft and bevel pinion, etc.)	2		This is used for training on the replacement of brake liners and bleeding of the brake line and is highly necessary.	
		Others (air-conditioning unit and tyres)	10		Equipment used for tyre repair constitutes the main items here with a high level of general applicability.	
3	Machine tools for repair or manufacture of parts		20	20	Wide-ranging equipment from hand grinders to lathes and drilling machinery is included. Given the fact that the own manufacture of parts is necessary in Pakistan, training using this	

Table 2-2-(2) Sele	ection of Equipment for New Training Courses

					equipment and machinery is necessary.
4	Inspection equipment		13	13	Inspection equipment is used to check repair work in progress or the results of repair work and is
П	Vehicle Electrician (	Course (35 items 58	R nieces)		useful to improve the quality of training.
1	Auxiliary equipment for understanding of structure	Electrical/ electronic items for engine Electrical/ Electronic items	5	6	These are used to assist understanding of the structure of the starting motor, alternator and ignition system to build up basic knowledge All electrical parts used in a vehicle are mounted on a single board to facilitate understanding of
		for chassis			electrical circuits.
		Diesel engine	2		This equipment is used for training on the diagnosis of starting motor and alternative breakdowns and on their adjustment using a test stand. Its necessity is examined.
		Petrol engine	3		This equipment is used to adjust the ignition timing of a petrol engine and is suitable equipment for training on electrical parts.
2	Equipment for practical training	Vehicle in general	1	15	Electrical parts for a truck with a diesel engine are mounted on a single board. This equipment also functions as a simulator. As simulated breakdowns can be generated with circuits for training on repair, this is very useful equipment.
		Battery and related parts	8		This equipment is used for repair of the battery system which often malfunctions and has a high level of general-purpose applicability.
		Lighting-related parts	1		This equipment is used to adjust the optical axis of the head lamps and is used at the time of repairing head lamps. Its provision is based on judgement of its necessity in Pakistan.
3	Equipment for processing of parts, etc.		8	8	This equipment includes an electrical tool set and portable drilling machine with general-purpose applicability. Its necessity is examined in connection with the equipment to be procured for other courses.
4	Electrical instruments		6	6	These include a circuit tester and insulation tester and are required to diagnose electrical breakdowns and to check the proper functioning of electrical parts after repair. They are essential as the trainees must become familiar with the use of these instruments.
III.	Welding and Fabric	ation Course (21 ite	ems, 49 pie	eces)	
	Equipment for practical training	Various welding machines	7		Seven types of welding machines, including MIC welding, AC arc welding and gas welding machines, are planned. All of these are used in Pakistan and are necessary for the trainees to master welding skills.
1		Auxiliary equipment for welding work	5	21	painting machine and air-compressor, etc., all of which are required for welding work. This equipment is, therefore, necessary for practical training on welding.
		Equipment for sheet metal processing	9		This equipment is used to bend or cut sheet metal for welding and is necessary to widen the scope of training on welding.

IV.	Fixtures for Equipment Storage (5 items, 33 pieces)					
1	Fixtures for workshops	Storage rack for parts and equipment	4	5	These are used for the storage of training equipment which is not permanently placed on the floor or a work table so that they can be retrieved when necessary. They are necessary for the management of equipment and the maintenance of a clean and tidy workshop.	
		Table for training work	1		A portable drilling machine is mounted on this table which is used as a work table during training. This item is essential to teach the importance of quality control by making working on a table become a habit.	

## 2-2-3-3 Operation Simulators

Operation simulators are used by the trainees at the initial stage of training for the purpose of preventing a safety risk arising from the first contact of the trainees with construction machinery as the trainees have generally had no previous opportunity to operate construction machinery prior to their enrolment at the CMTI.

However, there are no mass-produced operation simulators for construction machinery. It is, therefore, necessary to start with the design of suitable simulators, causing concern in regard to the high cost and maintenance problems. Accordingly, the necessity and suitability of introducing operation simulators is judged while assessing the feasibility of establishing a safe training method using actual machinery. The contents of the request regarding operation simulators are shown in Table 2-2-(3).

	Planned New Equip	oment	Existing Similar Equipment		Durness of Use and
No.	Type of Equipment	Qty.	Type of Equipment	Condition	Reason for Requirement
1	Hydraulic excavator	2	None		These equipments are used at the initial stage of training on operation for trainees
2	Crane	2	None		who have not operated construction machinery before. As this equipment is assumed to be fairly expensive, the suitability of procurement is judged by comparison with the feasibility of establishing safe introductory training using actual machinery.

Table 2-2-(3) Selection of Operation Simulators

## 2-2-3-4 Computer/CAD Training Equipment

Computer-related equipment aims at upgrading the level of the existing DAE course. A range of necessary equipment subject to examination is planned to enable trainees to use basic computer applications (MS Office, etc.) as well as CAD software, the use of which can be described as one of the basic requirements for engineers. Further details are given in Table 2-2-(4).

	Planned New Equipment Existing Similar Equipment		Dumage of Lice and		
No.	Type of Equipment	Qty.	Type of Equipment	Condition	Reason for Requirement
	Computers				
1	Desk top (high end type)	67			Highly functional PCs for CAD training and instructors
	Desk top (standard type)	07	Desk top (CPU 2.4 – 2.8 MHz)	Old model, unstable	Standard PCs for basic computer training
2	Server computer	2			Two server computers for network management
3	CAD software	67			CAD software with a high level of general applicability in Pakistan
	Printers				
	Monochrome laser printer	4	Ink jet printer (x 1)	Old model	For improved teaching efficiency
4	Colour printer	1	Portable colour ink jet printer (x 1)	Old model	For instructors to improve the quality and efficiency of the work to prepare teaching materials
	Colour plotter	1			A1 size colour plotter for CAD training
5	Projector	1			Multi-media projector for efficient teaching
6	Uninterruptible power supply (UPS)	2			Mainly supporting server computers

Table 2-2-(4) Selection of Computer/CAD Training Equipment

## 3-2-3-5 Equipment for Administration Section

Although the vehicles, etc. for the administration section are not directly used for classroom teaching or practical training, they are required to improve the training environment and to facilitate the attendance of the trainees at their courses. As such, the necessity for such vehicles, etc. must be examined. The list of required vehicles and the reasons for their requirement are given in Table 2-2-(5).

Planned New Equipment			Existing Similar I	Equipment	Dumon of Use and
No.	Type of Equipment	Qty.	Type of Equipment	Condition	Reason for Requirement
1	Micro bus	2	Micro bus (x 2)	А	To provide transport for some 60 additional trainees who are expected to travel to the CMTI instead of boarding to attend one of the three new courses
2	Pick-up truck	1	None		There is a strong need for a vehicle to transport training materials and repair parts, etc. purchased.
3	Generator	1	None		This is planned as an emergency power source for the new training building.

Table 2-2-(5) Selection of Vehicles, etc. for Administration Section

## 2-2-3-6 Determination of Equipment Quantity

To determine the required quantity of each type of equipment, it is necessary to describe the presupposition for each type of equipment as such presupposition differs from one type of equipment to another. Where there is a difference between the planned quantity and requested quantity, the reasons for such difference are also given in the relevant

tables.

## (1) Construction Machinery for Training

The trainees undergoing practical training on the operation of construction machinery are expected to (i) master the necessary skill to properly use the operation levers and switches and then to (ii) acquire the right sense of operation which is commonly described as operator's skill.

All of the construction machinery requested this time is typical construction machinery and the use of modern machinery, the number of which is increasing in Pakistan, is essential to properly master how to use such machinery as well as switches. However, the existing machinery should be sufficient for the trainees to acquire the right sense of operation.

Accordingly, it is judged that the procurement of a maximum of three modern (high-tech) construction machines, i.e. two for operation training and one for maintenance training, should be sufficient for the present purposes. The examination results for each type of equipment are given in Table 2-3-(1).

No.	Type of Equipment	Specifications/Functions	Requested Qty.	Planned Qty.	Presupposition
1	Bulldozer	Vehicle weight: $24.0 - 25.0$ tons Engine output: $220 - 240$ HP Blade size: >5.5 m <sup>3</sup> ROPS; CAB; air-conditioning	5	3	Two for practical training for the operator course and one for the other courses
2	Hydraulic excavator tractor type	Body weight: $19.0 - 20.0$ tons Engine output: $135 - 145$ HP Capacity: approx. $0.7$ m <sup>3</sup>	5	3	Two for practical training for the operator course and one for the other courses
3	Hydraulic excavator wheel type	Engine output: 105 – 120 HP Weight in working order: 13.2 – 14.0 tons Bucket capacity: 0.4 m <sup>3</sup> Cabin: 0.4 m <sup>3</sup>	2	2	Two for practical training for the operator course
4	Motor grader	Engine output: 150 – 160 HP Blade width: >3,700 mm Operator's canopy Vibromotive force: >60 kN	3	1	Because the introduction of the latest technologies is limited to the engine, there is not a very strong need for the latest model. However, the procurement of one motor grader is planned in view of the small number of existing machines (two in 1996).
5	Wheel loader	Engine output: >160 HP Bucket capacity: >2.5 m <sup>3</sup> Operator's seat; ROPS; CAB	3	3	Two for practical training for the operator course and one for the other courses
6	Rough terrain crane	Maximum lifting load: 25 tons Beam length: >30 m Maximum lift above ground level: >30 m Crane driving method: hydraulic T/M manual; four forward speeds	1	1	For practical training for the operator course

Table 2-3-(1) Examination Results for Required Quantity of Construction Machinery for Training

## (2) Equipment for New Training Courses

One set of equipment should, in principle, be sufficient for that to be used for classroom lessons for the three new courses. In the case of equipment used for practical training, at least one piece of equipment for 12 - 13 trainees is believed to be necessary in order for the trainees to master practical repair skills. The quantity of equipment is kept to the minimum necessity while efforts to maximum the efficiency of equipment use are expected to be made. These include simultaneous training on different types of equipment. The efficient use of the limited training space should also be realised.

The presuppositions for determination of the equipment quantity and the planned quantity vis-à-vis the requested quantity for each type of equipment are given in Table 2-3-(2).

		Planned New Equi	pment		
No.	Purpose of Use Subject		Requested	Planned	Presupposition
	r uipose or Ose	Part/Device	Qty.	Qty.	
I. V	/ehicle Mechanic Co	122 pieces co	ompared to rec	quested 79 items and 188 pieces)	
		Diesel engine	6 items 8 pieces	4 items 4 pieces	As multiple cut models of engines of different sizes were requested, efforts were made to streamline them to determine the appropriate quantity, reducing the overall quantity by one item (one piece).
	Auxiliary	Petrol engine	6 items 8 pieces	4 items 4 pieces	The requested quantity is upheld to facilitate the trainees' understanding of the structure of the engine of small vehicles, such as pick-up trucks, and small construction machinery, such as tampers.
1	equipment for understanding of structure	Steering system	3 items 3 pieces	3 items 3 pieces	As the steering system is an important mechanism in the structure of construction machinery, the requested quantity is upheld.
		Transmission (T/M, shaft and bevel pinion, etc.)	4 items 4 pieces	4 items 4 pieces	As the steering system is an important mechanism in the structure of construction machinery, the requested quantity is upheld.
		Others	1 item 2 pieces	0 item 0 pieces	Although it is used for understanding the outline of a car, other equipment can be substituted for it. Therefore, this is cancelled.
2	Equipment for practical training	Diesel engine	10 items 26 pieces	10 items 21 pieces	The engine is a functioning component requiring the most maintenance work and repair work is often necessary. Consolidation of the training equipment is attempted to deal with wide-ranging repair work. Basically, the requested quantity is upheld but two types of similar equipment are combined.
		Petrol engine	3 items 8 pieces	3 items 4 pieces	Practically the same as above but the necessary quantity is planned based on the detailed contents.
		Steering system	1 item 2 pieces	1 item 2 pieces	In regard to steering systems, good or bad repair results can be easily checked using inspection equipment. This equipment is, therefore, suitable for practical training. The requested quantity is upheld.

Table 2-3-(2) Examination Results for Required Quantity of Equipment for New Training Courses

		Transmission (T/M, shaft and bevel pinion, etc.)	2 items 2 pieces	2 items 2 pieces	As it is the training equipment for repair and adjustment of a construction machinery braking portion, and influence affecting the safety of vehicle is large, the requested quantity is upheld.
		Others (air-conditioning unit and tyres)	10 items 13 pieces	6 items 9 pieces	These are used for practical training on tyres of which the frequency of repair and adjustment is comparable to or even higher than that of engines. The requested quantity is upheld.
3	Machine tools for repair or manufacture of parts		21 items 95 pieces	18 items 55 pieces	As practical training is essential to be able to properly use machine tools to manufacture parts, the requested quantity is upheld.
4	Inspection equipment		13 items 18 pieces	11 items 14 pieces	While the requested items are appropriate, the quantity of safety gear which must be worn during training is increased because of the insufficient requested quantity.
II.	Vehicle Electrician	Course (28 items a	nd 59 pieces	compared to 1	requested 37 items and 109 pieces)
1	Auxiliary equipment for	Electrical/ electronic items for engine	5 items 8 pieces	4 items 7 pieces	As the fuel injection volume, injection timing and ignition mechanism of an engine must be properly understood, the requested quantity is upheld.
1	understanding of structure	Electrical/ electronic items for chassis	1 item 1 piece	1 item 1 piece	As the requested board is effective for understanding of the electrical circuits of an entire vehicle, the requested quantity is upheld.
	Equipment for practical training	Diesel engine	2 items 3 pieces	1 items 1 pieces	Because of its importance, the requested quantity is upheld, taking the need for practical training on repair and maintenance into consideration.
		Petrol engine	3 items 5 pieces	3 items 3 pieces	As the requested items are judged to be suitable for training on electrical components, the requested quantity is upheld.
2		Vehicle in general	1 item 1 piece	1 item 1 piece	In view of the importance of practical training (breakdown diagnosis, investigation and repair) on the electrical systems in general of construction vehicles, the requested quantity is upheld.
		Battery and related parts	8 items 12 pieces	6 items 7 pieces	The requested items are used for practical training on the performance diagnosis and recharging of batteries and the requested quantity is upheld in view of their frequent use.
		Lighting-related parts	1 item 1 piece	1 item 1 piece	Adjustment of the optical axis is necessary even in Pakistan and the relevant maintenance skills must be mastered. As such, the requested quantity is upheld.
3	Equipment for processing of parts, etc.		8 items 58 pieces	6 items 23 pieces	As in the case of the vehicle mechanic course, the requested quantity of safety gear has been increased to the necessary level.
4	Electrical instruments		8 items 20 pieces	5 items 15 pieces	Two items which are unsuitable for use for the electricians course (suitable for the mechanic course) in the original request have been omitted.

III.	Welding and Fabri	cation Course (19 it	ems and 61 p	ieces compare	ed to requested 22 items and 102 pieces)
1	Equipment for practical training	Various welding machines	7 items 27 pieces	6 items 24 pieces	The requested quantity of gas welding machine was inadequate and has been increased by two.
		Auxiliary equipment for welding work	5 items 55 pieces	5 items 22 pieces	As in the case of the other two new courses, the requested quantity of safety gear was inadequate and has been increased to a suitable level.
		Equipment for sheet metal processing 10 items 20 pieces		8 items 15 pieces	The pipe bender included in the request is not often used and does not require practical training. This item has been omitted from the scope of planning.
IV.	Fixtures for Equipr	nent Storage (5 item	ns and 33 piec	ces compared	to 2 items and 2 sets)
	Fixtures for workshops	Storage rack for parts and equipment	None	4 items 21 pieces	In view of the quantities of various types of equipment and the floor area of the workshops, it is confirmed on the layout plan that 21 pieces of storage racks of four different types are required. These are now included in the plan.
1		Table for training work	None	1 item 12 pieces	The required quantity of tables is calculated based on the number of equipment to be fixed on a table, the number of trainees and the suitable number of trainees of each group and the resulting quantity of tables is now included in the plan.

## (3) Operation Simulators

There is no ready-made simulator for the operation of construction machinery in Japan or any third country and its procurement will require new design and subsequent manufacturing work. For this reason, there is concern in regard to initial problems and an ineffective response to dealing with such problems, pushing up the cost to the point of inadequate benefit for the investment. Operation simulators for a hydraulic shovel and crane will, therefore, be excluded from the scope of the Project because of the reasons described above.

## (4) Computer/CAD Training Equipment

The computer-related equipment and items aim at improving the technical level of the DAE course in that the trainees of this course will be able to use not only general-purpose applications but also specialist applications for CAD, etc. In general, the computers used for CAD are required to have high specifications and their cost is high. Therefore, the basic presuppositions are that the minimum required number of computers for CAD and CAD software will be procured and that the CAD training programme will be arranged in line with the available number of computers for CAD training.

The number of trainees on the DAE course is 40. These will be divided into two groups of 20 trainees each for the efficient use of the limited number of computers for CAD training. This grouping of trainees is also necessary because of the limit to the number of trainees who can be efficiently taught by a CAD instructor. The actual training will be conducted in rotation. The number of computers to be used in a classroom lesson on CAD will be 20 for the trainees and one for the instructor, totalling 21 computers.

As a precondition for CAD training, the trainees must learn the basic knowledge of computers and OS, etc. and also undergo initial training on the use of computers. For the efficient use of the limited number of CAD computers, standard type computers will be additionally provided for basic training on the use of computers. The number of these computers to be used in the classroom will be the same as the number of CAD computers, i.e. 20 for the trainees and one for the instructor. These standard type computers will also be used for short computer courses. In addition to those computers to be used in the classroom, five CAD computers will also be provided to assist the instructors and administrative work. These will also act as reserve computers.

No.	Type of Equipment	Specifications/Functions	Qty.	Purpose of Use/Relevant Training
1	Desk top PC A	High end type (for CAD)	26	To teach the basic operation of CAD software; the specifications must allow the smooth operation of CAD software; 21 for the CAD classroom (20 for trainees and one for the instructor) and five for the administration office
2	Desk top PC B	Standard type	21	To teach basic knowledge and the operation of computers; 21 for the PC classroom (20 for trainees and one for the instructor)
3	Server computer	Including software for server computers	2	Two planned as the server for the network and as a back-up computer
4	CAD software	Same number as that for the PCs for CAD training (Equivalent to Auto CAD 2005)	26	Software with the prospect of wide application in Pakistan is introduced; the quantity is 21 for the CAD classroom and five for instructors
5	Monochrome laser printer		2	One A4 size monochrome printer for each classroom
6	Colour printer		1	One A3 size colour printer for use by instructors to improve the quality of the teaching materials and the efficiency of their production
7	Colour plotter		1	One A1 size colour plotter for CAD training
8	Projector	Portable multi-media projector	2	One multi-media projector for each classroom to enable all of the trainees to observe operation by an instructor
8	Uninterruptive power supply (UPS)	Suitable capacity for equipment to be used for the LAN system	2	Mainly to support the two server computers

Table 2-3-(3) Specifications, Functions and Purpose of use of Computer/CAD Training Equipment

(5) Vehicles and Equipment for the Administration Section

The quantity of equipment for the administration section depends on whether or not the planned new courses are actually introduced. As the introduction of the three new training courses is judged to be appropriate, the quantity shown in Table 2-3-(4) is planned.

No.	Type of Equipment	Specifications/Functions	Requested Qty.	Planned Qty.	Presupposition
1	Micro bus	23 or more seats; right-hand drive	2	2	Two are required as the number of trainees travelling to the CMTI is expected to increase by some 60.
2	Pick-up truck	Single cabin; 4-wheel drive	1	1	To be used for the transportation of replacement parts on the vast premises and also for procured training items; one should be sufficient in view of the frequency of use.
3	Generator	20 kVA	1	1	To be used as an emergency power supply source for the new training building at the time of a power failure with a sufficient capacity to run the lighting and ventilation fans.

Table 2-3-(4) Examination Results for Required Quantity of Equipment for Administration Section

## 2-2-3-7 Equipment Deployment Plan

All of the planned equipment for procurement under the Project will be deployed in the training building and other parts of the CMTI premises. The detailed plan of the deployment locations is shown in Table 2-4.

No.	Type of Equipment		Deployment Location
1.	Computer-Related Equipment		
1	Personal computers	Set	First floor, training building (classroom)
2	Networking equipment	Set	First floor, training building (classroom)
2.	Construction Machinery for Training		
1	Bulldozers	3	To be stored in the shed(s) to be newly
2	Hydraulic excavator (tractor type)	3	constructed by the Pakistani side by the time of
3	Hydraulic excavator (wheel type)	2	equipment delivery
4	Motor grader	1	
5	Wheel loader	3	
6	Truck type crane	1	
3.	Operation Simulators		
1	Hydraulic excavator	0	
2	Crane	0	
4.	Vehicles and Equipment for Administration Section		
1	Micro bus	2	
2	Pick-up truck	1	
3	Generator	1	Administration office in the training building
5.	Inspection Equipment		
1	Towing gauge	1	Workshop in the training building
2	Chamber caster king pin	1	
3	Turning radius gauge	1	
4	Brake tester	1	
5	Side slip tester	1	
6.	Equipment for New Training Courses		
1	Vehicle mechanic course	Set	Workshop in the training building
2	Vehicle electrician course	Set	Workshop in the training building
3	Welding and fabrication course	Set	Workshop in the training building

## 2-2-4 Basic Facilities Plan

#### 2-2-4-1 Outline of Each Building and Necessity and Suitability of Construction

(1) Training Building (classrooms, PC/CAD classrooms, workshops and others; two story building with an approximately floor area of 1,413 m2)

The training building incorporating various practical training rooms is designed as a two story building. The ground floor will accommodate practical training rooms with a workshop function. The first floor will accommodate three 50 seat general classrooms for the three new courses of which the introduction is planned by the CMTI, (1. vehicle mechanic course, 2. vehicle electrician course and 3. welding and fabrication course), two 20 seat PC/CAD classrooms with a LAN network connection for the DAE course (three years), an instructors' room, an administration office and other necessary rooms.

The total floor area of this training building will be approximately 1,413 m2 (21.0 m deep and 48.0 m wide) and the building will be constructed at an empty site to the north of the existing training building constructed under the Phase I Project.

(2) Accommodation Building (two story building capable of accommodating 50 persons; approximately floor area of 1,248 m2)

The total number of trainees was 292 as at the beginning of the new term on September 4, 2004. The 87 trainees went to CMTI from their homes in the Islamabad suburbs. The other 205 trainees were the boarders from local areas such as Punjab, Balochistan, Sindh and NWFP. The existing accommodation buildings have 36 rooms for 6 persons each (17 rooms in the accommodation building constructed with Japan's grant aid in 1986 and 19 rooms in the accommodation building constructed by Pakistan side). The existing buildings can accommodate 216 trainees and have extra of 11 persons (216-205).

When the Project is implemented, the number of trainees at the CMTI will increase by 150 because of the introduction of the three new courses. Although the CMTI which will run the facility is hoping to see a ratio of day trainees and borders of 50:50 (75 trainees each) because of the accommodation shortage, the MOC (the higher organization) is demanding that the ratio of boarders should be 75% (112 trainees) with 25% (38 trainees) travelling to the CMTI on training days. If the demand of the MOC prevails, a new facility accommodating 101 trainees (112-11) will be required.

Under these circumstances, the planning of a building to accommodate 50 trainees is essential from the viewpoint of providing suitable accommodation for trainees from local areas who cannot travel to the CMTI on a daily basis. The CMTI is planning to compensate for the shortage of beds for 51 trainees (101-50) by increasing the accommodation capacity of each bedroom to 6 - 8 persons.

(3) Canteen Building (100 seats, single story building with an approximately floor area of 448 m2)

Only one canteen constructed under Japan's grant aid project in the past is currently functioning. The canteen building constructed by the Pakistani side during the Phase 2 Project period is no longer functioning as a canteen building and is currently used as a drawing room and geological laboratory.

As a result, most trainees, instructors and visitors rush to the functioning canteen building during the lunch break and the tables serving some 100 people are fully occupied, resulting in late-comers standing in a queue until a place becomes available. The questionnaire survey conducted with existing trainees as part of the present study found many complaints about the congestion in the canteen and the tight seating arrangements which forces people to eat their lunch while almost touching each other. There is, therefore, a strong need to construct a new canteen building under the Project.

#### 2-2-4-2 Site Use Plan/Facility Layout Plan

#### (1) Present Conditions of Existing Facilities at the CMTI

A number of CMTI facilities are distributed in an orderly manner over a huge rectangular site of some 21.6 ha (300 m x 720 m) along Khyabani-I-Sir Saiyed Road. The group of facilities constructed with Japanese grant aid in 1986 (see Table 2-5) and a group of facilities, of which the staff accommodation building is a prominent feature, constructed by the Pakistani side at the same time (see Table 2-6) are commonly called "the Phase 1 facilities".

Name of Building	Structure	No. of Stories	Total Floor Area
Administration Building	Administration Building RC Two story		$1,589 \text{ m}^2$
Training Building	RC	Two story (partly single story)	3,471 m <sup>2</sup>
Trainees' Accommodation	RC	Two story	$1,772 \text{ m}^2$
Building			
Canteen Building	RC	Single story	$347 \text{ m}^2$
Auxiliary Outdoor Facilities	RC/steel construction	Single story	$785 \text{ m}^2$
		Total	$7,964 \text{ m}^2$

Table 2-5 Buildings Constructed with Grant Aid (1986) (Phase 1 Facilities)

Table 2-6 Buildings Independently Constructed by Pakistani Side (1986) (Phase 1 Facilities)

Name of Building	Structure	No. of Stories	Total Floor Area
Staff Accommodation Building	RC	Two story	5,929 m <sup>2</sup>
Single Persons Accommodation Building	RC	Two story	1,584 m <sup>2</sup>
Mosque	RC	Single story	$225 \text{ m}^2$
Warehouse	RC	Single story	$292 \text{ m}^2$
		Total	$8,030 \text{ m}^2$

Following the completion of the Phase 1 facilities, the CMTI (then the CMTC) was capable of sending out 360 trained technicians/engineers a year.

In 1995, further grant aid to renew some equipment and to procure new equipment was provided by Japan for the CMTI Expansion Project in anticipation of an increase of the number of trainees due to the introduction of new courses and expansion of the existing courses. At the time of the basic design study for this project, the Pakistani side was constructing a training building, a trainees' accommodation building and a canteen building with its own funds (see Table 2-7). The group of these buildings is called "the Phase 2 facilities". Among these Phase 2 facilities constructed by the Pakistani side without external assistance, the planned canteen building at the design stage was found to be unusable as a canteen building on its completion and it is now used as a drawing room and a geological laboratory.

At the time of the construction of the Phase 2 facilities, the CMTI acquired adjacent land of some 24 ha to the south of

its premises as a practical training field for the construction machinery operator course as part of its efforts to extend its training facilities.

Name of Building	Structure	No. of Stories	Total Floor Area
Training Building	RC	Two story	$1,932 \text{ m}^2$
Trainees' accommodation	RC	Two story	$1,785 \text{ m}^2$
building			
Canteen Building (Drawing	RC	Single story	$347 \text{ m}^2$
Room, etc.)			
		Total	$4,064 \text{ m}^2$

Table 2-7 Buildings Constructed by Pakistani Side (1995) (Phase 2 Facilities)

Following the completion of these Phase 2 facilities, the training capacity of the CMTI was increased to 840 technicians/engineers a year.

## (2) Site Plan

The planned construction sites under the Project are shown on the facility layout drawing in the attached Basic Design Drawings. As already described in (1) above, there is a total of more than 10 buildings, large and small, on the CMTI premises at present. The facility layout (zoning) for the entire premises was already drawn up in 1986 and the extension in 1996 was based on this basic plan. Accordingly, it is essential for the new buildings to be constructed under the Project to be located based on the basic layout plan to achieve harmony with the existing buildings.

## (3) Facility Layout Plan

The new training building mainly consisting of classrooms and practical training space will have a total floor area of some 1,413 m2 (21.0 m deep and 48.0 m wide). It will be constructed on a vacant site to the northeast of the Phase 1 training building. At this planned site for the new training building, dense trees of some 10 m in height are currently growing and the site slopes in the east-west direction with an overall difference of 4 m between the higher and lower ground.

The Study Team conducted a level survey at the planned construction site using surveying equipment (level gauge, levelling rod and 30 m measuring tape). The findings of this field survey appear to suggest that it is preferable to develop the plan and cross-section without touching the existing trees and sloping topography, not least because of environmental considerations.

The new trainees' accommodation building and new canteen building will be located on a vacant site to the west of the Phase 2 facilities constructed in 1995 by the Pakistani side. As there is a flat strip of land (some 30 m wide) between the Phase 2 facilities and the sports ground to the west, it is entirely possible to construct two new buildings in parallel with the existing buildings.

According to the overall layout plan for the new buildings, the new training building will be located on a site which is visible from the front gate area while the new trainees' accommodation building and new canteen building will be located at the far end from the front gate. All of these locations are in line with the basic layout plan prepared at the time of the Phase 1 Project.

## 2-2-4-3 Building Plan

## (1) Plan

The functions and planned floor area of each room/workshop in the new buildings are shown in Table 2-8.

	1		Dlannad	
N	Seating		Flanned	E stisses 1 Dans 1
Name of Room	Capacity	Unit Area	Floor Area $(m^2)$	Functions and Remarks
(1) Washahang ata in Training Davilding			(m)	
(1) workshops, etc. in Training Building (		5.0	45.0	Durt a survey to set any state
Vehicle Inspection Room		5.0m x 9.0m/bay	45.0	slip meter
Mechanical and Electrical Training		4.0m x 9.0m/bay	72.0	2 bays
Room				
Chassis and Tyre Replacement Room		4.0m x 9.0m/bay	72.0	2 bays
Cut Model Storage Room			36.0	
Fuel Injection System Workshop			18.0	
Tool Room			18.0	
Electrical System Workshop			15.0	
Engine Overhaul and Assembly			39.0	
Workshop				
Welding and Fabrication Workshop			117.0	
Corridors			93.0	
Toilets			24.0	4 bowls; 4 urinals; 3 washbasins
Staircases; Hand Washing Areas;			60.0	
Storage Space				
		Sub-Total	609.0	
Training Building (1F)				
Administration Office	5	10.0-15.0m <sup>2</sup> /person	72.0	
Instructors' Room	5	10.0-15.0m <sup>2</sup> /person	72.0	
PC/CAD Classroom	40	3.5m <sup>2</sup> /person	144.0	2  classrooms (8mx9m=72m <sup>2</sup> )
Server Room			36.0	
Classroom	150	1.2-1.5m <sup>2</sup> /person	225.0	3  classrooms (72+72+81=225m <sup>2</sup> )
Kitchenette			4.0	
Toilets			32.0	6 bowls; 5 urinals; 3 washbasins
Corridors/Staircases/Porches			219.0	
		Sub-Total	804.0	
		Total	1.413.0	
(2) Trainees' Accommodation Building (	GF)		,	
Bedroom for Visiting Instructor	5	20.0-22.0m <sup>2</sup> /person	110.0	5 bedrooms $(5.5 \times 4.0 - 22.0 \times 5)$
Trainas Padraam	19	$7.0.7.5m^2/marsan$	122.0	(3.3x4.0-22.0x3)
	18	7.0-7.5m /person	132.0	(5.5x8.0=44.0x3)
Lobby	30	1.2-1.5m <sup>2</sup> /person	110.4	
Shower Room and Toilets			28.3	3 bowls; 3 urinals; 3 washbasins; 3 showers
Machine Room			19.8	
Staircases			48.0	
Entrance Hall and Corridors			111.6	
Terrace			72.0	
		Sub-Total	632.0	

Table 2-8	Functions and Planned Floor Area of Each Room by	/ Buildina
	Functions and Flanned Floor Area of Each Room by	/ Duile

Trainees' accommodation building (1F)						
Trainee Bedroom	32	7.0-7.5m <sup>2</sup> /person	264.0	6 rooms		
				(5.5x8.0=44.0x6)		
Self-Teaching Room	30	1.2-1.5m <sup>2</sup> /person	44.0	1 (5.5x8.0=44.0)		
Lobby			22.0			
Corridors			118.0			
Staircases			48.0			
Showers			22.0	6 shower booths		
Toilets			26.0	6 bowls; 5 urinals; 4 washbasins		
Balcony			72.0			
		Sub-Total	616.0			
Total 1,248.0						
(3) Canteen Building						
Trainees' Canteen	100	2.4m <sup>2</sup> /person	240.0	4 washbasins		
Staff Canteen	5	3.0-3.5m <sup>2</sup> /person	16.0			
Kitchen			64.0			
Food Storage			16.0			
Kiosk			22.0			
Rest Room for Kitchen Staff			8.0			
Laundry (including Store Room)			19.0			
Ante Room (including Store Room)			18.0			
Toilets			3.0			
Porch and Terrace			42.0			
		Total	448.0			

(1) Training Building		$1,413.0 \text{ m}^2$	
(2) Trainees' Accommodation Building		$1,248.0 \text{ m}^2$	
(3) Canteen Building		$448.0 \text{ m}^2$	
	Grand Total	$3,109.0 \text{ m}^2$	

## (2) Cross-Section

- The story height will be 3.8m, consisting of a floor to ceiling height of 3.0 m and an additional structural beam height of 0.8 m for both the ground floor and the first floor.
- The floor height of the ground floor will be raised by 300 mm from the ground surface to prevent the penetration of sand dust inside the building.

## (3) Structure

- · All three buildings will have a reinforced concrete construction.
- While the canteen building will be a single story building, both the training building and the trainees' accommodation building will have two stories.
- Spread foundations will be used as the allowable soil bearing capacity of the local silt layer mixed with sand or clay layer mixed with sand is assumed to be 10 tons/m2 according to existing data.
- The area of the spread foundations will be as large as possible to prevent differential settlement and all of the isolated footings will be connected by underground beams.
- A design coefficient for the shearing force caused by an earthquake of 0.10, which is half of the minimum standard of 0.20 in Japan, should be sufficient given the fact that the project site belongs to the Grade III Zone (minor earthquake zone).
- · The material strength of the structural members will be 18 N/mm2 or higher for concrete and equivalent to or higher

than SD295 for reinforcing bars as stipulated by JIS standards. The structural design will refer to the ACI, UBC and ASTM standards of the US.

### (4) Finishings

- The external and internal finishings of all of the buildings will copy those finishing materials used for the Phase 1 facilities to maintain as much uniformity as possible.
- For the training building in particular, the finishing materials and colours will be the same as those of the existing training building as the new building will be highly visible from the entrance gate area.
- The floor of the ground floor of the training building will have an RC floor to enable it to withstand the entry of the vehicles to be inspected.

#### 2-2-4-4 Electrical Systems

For the planning of the electrical systems, the principal criteria are ease of operation and ease of maintenance. The equipment and materials to be used for these systems will be standard products and materials of which local procurement is possible. However, the distribution panels, broadcasting equipment and other important equipment from the viewpoints of safety and durability will be those made in Japan.

#### (1) Power Receiving and Transforming Equipment

There is a power room located in a corner of the existing administration building and high voltage power (three phase, three wire, 11 kV) is supplied to this room by the WAPDA. Power is supplied through a watt hour meter with a transformer and high voltage switchgear, both of which are the responsibility of the WAPDA and which are used to step down the 11 kV high voltage to low voltages of 400V/230V (three phase, four wire) and 230 V (single phase) to the various distribution panels (which are the responsibility of the Japanese side), for the further distribution of power to the lighting equipment, building service systems and training equipment, etc. As this power room has no extra space due to the many panels and equipment serving the existing facilities, a new independent power room will be constructed under the Project to serve the three new buildings.

#### (2) Power Supply Circuits

Power will be supplied from the main low voltage distribution panel in the new power room to the distribution boards, power boards, equipment distribution boards and on-site switches for equipment. In regard to cabling, the standard local cables will be protected by either vinyl conduit piping or steel conduit piping. The storage pump and training equipment will receive power from the corresponding distribution boards. The cabling arrangements for this will consist of the protection of the local standard cables by either vinyl conduit piping or steel conduit piping supported by cable racks.

#### (3) Lighting Equipment and Plug Sockets

Planning of the lighting mainly features the use of locally manufactured fluorescent lamps which are easy to replace and also easy to maintain in view of the present general situation in Pakistan and that of the existing facilities. Mercury lamps with a longer life will be used for the workshops which will have a high ceiling height and also for outdoor lighting. The planned luminous intensity for the main rooms is shown in Table 2-9.

Building/Room	Luminous Intensity (Lx)
(1) Training Building:	
Classrooms, PC/CAD Classrooms, Administration Office and	200
Instructors' Room	500
Workshops	200
Toilets, Corridors and Staircases	75
(2) Trainees' Accommodation Building:	
Study Room	300
Lobby, Trainees' Bedrooms and Instructors' Bedrooms	100
Toilets, Showers, Corridors and Staircases	75
(3) Canteen Building:	
Kitchen	300
Kiosk and Catering Administration Office	200
Trainees' Canteen and Staff Canteen	150
Laundry and Toilets	75

Table 2-9 Planned Luminous Intensity by Room

As the electricity tariff is more expensive than the tariff for gas or other energy sources, the number of lighting apparatus will be kept to a minimum. Individual switches will be installed to allow flexible lighting.

The type of socket plug will be either round with two pins and earthing or round with two pins without earthing, both of which are commonly used in Pakistan. Ordinary plug sockets will be introduced in the classrooms, offices, toilets, staircases and canteens, etc. while exclusive plug sockets will be introduced for the equipment to be used in the workshops, etc. and in the PC/CAD classrooms and server computer room.

## (4) Telephone System

At present, the private branch exchange (PBX) has five external lines via the main distributor frame (MDF) installed in the administration office in the administration building. Further extension will be made from the PBX to serve 40 extensions distributed to the various facilities on the CMTI premises. Three external lines and some 10 extensions will be added to serve these new buildings.

#### (5) Public Address System

Each existing building has its own public address system which is used for the emergency reporting of a fire, earthquake or other incident and also for business communication, including the beginning and end of lessons/training hours. A similar public address system will be installed in the three new buildings to establish a communication system with the trainees and staff members.

#### (6) Fire Alarm System

A fire alarm system will be installed in accordance with the building regulations of Islamabad. Each room of each building will have an emergency bell and a push button. At the time of a fire, all of the bells will ring and the location of the fire will be reported to the fire warning panel installed in the administration office in the new training building as well as the existing administration building.

## (7) Outdoor Lighting

Outdoor lighting is installed around the existing buildings and along the roads on the premises. Mercury lighting posts

will be introduced for the new buildings at intervals of some 30 m for night security purposes.

#### (8) Private Power Generating Unit

Electricity supply in Pakistan is not very stable and power failures occur every day in and around Islamabad, the capital. For this reason, the installation of an emergency generator is essential. Even though it is unnecessary to continue practical training at the time of a power failure, one 20 kVA diesel generator will be installed to ensure power supply for the indoor lighting and computers.

## (9) Lightning Rod

As all of the new buildings will be lower than 20 m in height, the installation of a lightning rod is unnecessary.

#### 2-2-4-5 Building Services Plan

The design of the building services will take the local climate and environment into full consideration. Ease of operation and ease of maintenance will be the main selection criteria for equipment selection.

#### (1) Air-Conditioning and Ventilation Systems

#### 1) Air-Conditioning System

An indoor unit of an individually operated wall-mounted, split type air-conditioning system will be installed in the new administration office, instructors' room and server computer room in the training building, bedrooms for visiting instructors in the new accommodation building and staff canteen in the new canteen building. Outdoor units will be installed outside or on the roof top.

A gas boiler for the heating of water will be installed in the new accommodation building to provide convection heating through panel heaters installed in the bedrooms and study room.

## 2) Ventilation System

In principle, natural ventilation will be used for the ventilation of the buildings. At the welding workshop for practical welding training in the training building, a ventilation duct will be introduced for each welding machine to remove the toxic gases generated by welding work for forced ventilation to the outside. In addition, a Type III mechanical ventilation (forced ventilation) system will be installed in the kitchen of the canteen building.

#### (2) Plumbing Installations

#### 1) Municipal Water Supply System

Water supply to the training building will be made through a line which branches out from the 100 mm diameter water line running along the access road on the premises at the front gate for storage at a water pit near the training building. This water will then be pumped to a water tank on the roof top of the building for gravity supply to the toilets and water taps on each floor. For the new accommodation building and canteen building, water will be pumped to a water tank on the roof of the access of the solution building for gravity supply to the toilets and water tank on the roof of the accommodation building from a cylindrical underground tank at the side of

the existing building used for the drawing room, etc. for gravity supply to the shower rooms, toilets and water taps.

#### 2) Drainage System

At present, waste water from the toilets and other places is discharged to an infiltration pond at a corner of the premises through open ditches via a purification tank. Storm water is discharged to Nara River in front of the premises via a separate open ditch. However, waste water from the kitchen in the canteen building is directed to a grease trap for further discharge to the purification tank.

#### 3) Purification Tank

In accordance with the drainage system described in 2) above, a new concrete purification tank will be constructed at each of the three new buildings for further discharge to the infiltration pond.

#### 4) Sanitary Fixtures

The sanitary fixtures will mainly feature Arabian closets while one will be a Western type closet. Both Arabian closets and the Western closet will be provided with a flushing hose. Urinals will be installed on the wall and will be separated by partition boards.

#### 5) Hot Water Supply System

Hot water will be supplied to the shower room in the accommodation building and to the kitchen in the canteen building from the gas water boiler.

#### 6) Fire Extinguishing System

Indoor fire plugs will be introduced in all three new buildings so that initial fire-fighting activities can be conducted by starting the fire pump.

## 7) Gas Supply

A medium pressure gas main of Sui Northern Gas Supply runs along the front road and gas is supplied to the existing buildings via a branch line equipped with a gas meter. A new branch line will be introduced to supply gas to the new accommodation building and canteen building from the existing accommodation building for single persons. In the case of the new training building, a new branch line from the main will be introduced from near the front gate of the access road on the premises.

#### 2-2-5 Basic Design Drawings

### 2-2-5-1 Layout Plan and Building Plan

The design drawings, such as the layout plan, floor plan and cross-section, etc. for the new training, accommodation and canteen buildings to be constructed under the Project are included in the Appendices.

## 2-2-5-2 Outline of Finishing Materials

The finishing materials required for the planned facilities under the Project will, in principle, be procured in Pakistan or

third countries. The following points will be taken into consideration in the selection of the materials.

- · Selection of highly durable materials to ensure ease of maintenance
- · Selection of materials based on JIS standards or equivalent quality
- Selection of materials commonly used in Pakistan to ensure the familiarity of the construction workers with the selected materials to ensure very precise work and to shorten the overall construction period if possible

The main exterior and interior finishings for each building are outlined in Table 2-10.

## Table 2-10 Planned Exterior and Interior Finishings for Each Building

Exterior Finish Outline (Common for All Buildings)

Structure	RC, independent footings
External Walls	Fair-faced brickwork; partial mortar coating EP
Roofing	Asphalt waterproofing on top of concrete slabs; protective concrete
Windows and Doors	Aluminium sash windows and doors; steel doors; steel shutters
Porch	Floor: terrazzo tiles; ceiling: plaster board EP
Berm	Gravel Paving (1m width)
Footpath	Concrete trowel finish
Building Services	Water supply and drainage; sanitary fixtures; air-conditioning; ventilation; electricity
	supply

Building	Room	Floor	Skirting Boards	Walls	Ceiling	Remarks
	Workshop	Concrete with hardener finish	Terrazzo H=100mm	Mortar; EP	Concrete repair; EP	
Training	Corridors	PVC tiles	As above	As above	As above	
Duilding	Staircase	As above	As above	As above	As above	
GF	Storage Room	Concrete trowel finish	Mortar trowel finish H=100mm	Mortar	No finishing work	
	Toilets	Ceramic tiles		Ceramic tiles	Cement board; EP	
	PC/CAD Classroom	System floor (carpeted)	Wood OP H=100mm	Mortar; EP	System Ceiling	AC; curtain box, wood OP
	Server Room	As above	As above	As above	As above	As above
	Instructors' Room	PVC tiles	Terrazzo H=100mm	As above	As above	As above
1F	Classroom	As above	As above	As above	As above	Curtain box; wood OP
	Administration Office	As above	As above	As above	As above	AC; curtain box; wood OP
	Corridors	As above	As above	As above	As above	
	Kitchenette	As above	As above	As above	Cement board; EP	
	Staircase	As above	As above	As above	As above	
	Toilets	Ceramic tiles		Ceramic tiles	As above	
Accommodation Building	Entrance, Corridors and Lobby	PVC tiles	Terrazzo H=100mm	Mortar; EP	System Ceiling	
	Staircase	As above	As above	As above	As above	
	Six Bedrooms	As above	As above	As above	As above	Curtain box; wood OP

	One Bedroom	As above	As above	As above	As above	AC; curtain box; wood OP
	Study Room	As above	As above	As above	As above	Curtain box; wood OP
	Toilets/Shower Room	Ceramic tiles		Ceramic tiles	Cement board; EP	
	Storage Room	Concrete trowel finish	Mortar steel trowel finish H=100mm	Mortar	No finishing work	
	Balcony	Waterproofing mortar steel trowel finish			Concrete repair; EP	
Canteen Building	Trainees' Canteen	PVC tiles	Terrazzo H=100mm	Mortar; EP	System Ceiling	Curtain box; wood OP
	Staff Canteen	As above	As above	As above	As above	AC; curtain box; wood OP
	Kiosk	Terrazzo tiles	Terrazzo H=100mm	As above	As above	
	Kitchen	As above	Ceramic tiles H=2,100mm	As above	Cement board; EP	
	Laundry	As above	Terrazzo H=100mm	As above	As above	
	Staff Room	As above	As above	As above	As above	
	Ante Room	As above	As above	As above	As above	
	Storage Room	As above	As above	As above	As above	
	Toilets	Ceramic tiles	-	Ceramic tiles	As above	

## 2-2-6 Implementation Plan

## 2-2-6-1 Equipment Procurement Plan

## 2-2-6-1 (1) Implementation Policy

## (1) Project Implementation Mechanism

In the case of the Project's implementation under the grant aid scheme of the Government of Japan, the Project will be implemented according to the mechanism shown in Figure 2-1 with each organization concerned fulfilling a specific function(s).



Figure 2-1 Project Implementation Mechanism

The project implementing agency in Pakistan is the Ministry of Communications (MOC) and the actual work will be conducted by the director and training course managers of the CMTI, a subordinate organization of the MOC. In accordance with the grant aid scheme of the Government of Japan, the detailed design and procurement supervision will be conducted by a Japanese consulting firm. Meanwhile, a Japanese supplier will conclude a procurement and supply agreement with the Pakistani side for the Project.

#### (2) Consultant

Following the signing of the Exchange of Notes (E/N), the MOC will conclude a consultancy agreement with a Japanese consulting firm. The said firm will provide engineering services for the procurement of machinery/equipment, including the detailed design, preparation of tender documents, assistance for the tender, procurement supervision, confirmation of machinery/equipment performance and inspection for acceptance, and will be responsible for the Project up to the completion of the handing over of the planned machinery/equipment to the Pakistani side.

#### (3) Equipment Supplier

The MOC will conclude an agreement concerning the procurement and supply of the planned equipment under the Project with a Japanese trading firm which has passed the prequalification and which is the successful bidder in the subsequent open competitive bidding. The said supplier will complete the delivery of the machinery/equipment required by the MOC and the guidance on initial operation and maintenance within the set period in the agreement.

#### 2-2-6-1 (2) Implementation Conditions

The CMTI is familiar with the mechanism for the procurement of machinery/equipment under Japan's grant aid scheme as it experienced the Construction Machinery Training Centre Construction Project in 1984 and the Construction Machinery Training Institute Expansion Project in 1995. Given the facts that it has been some time since the previous project for those staff members of the CMTI who were involved in the previous project and that some staff members have no relevant experience at all, full explanation and discussions on the procedural and other matters will be made at

each project implementation stage so that no delay or omission occurs.

The machinery/equipment to be procured in Japan will be transported by sea to Port Karachi and will be handed over to the Pakistani side (CMTI) at Islamabad after inland transportation. It will be necessary for the Equipment Supplier to implement the necessary measures regarding product liability arising from damage or theft during the maritime transportation and landing of the machinery/equipment so that no problems occur with the Pakistani side.

### 2-2-6-1 (3) Scope of Work

The Japanese side will bear the equipment procurement cost, including the maritime transportation cost to Port Karachi and the cost of domestic road transportation from Port Karachi to Islamabad (CMTI) via Lahore on National Route 5. Meanwhile, the Pakistani side will bear all other expenses, including those resulting from the exemption of import and other taxes after the handing over of the machinery/equipment, expenses at the port of landing and the re-assembly cost.

#### 2-2-6-1 (4) Consultant Supervision

#### (1) Basic Principles for Consultant Supervision

In the case of the Project's implementation under the grant aid scheme of the Government of Japan, the Consultant will establish a project implementation system under a person with rich experience of procurement supervision to properly conduct the detailed design and procurement supervision with a full understanding of the matters listed below.

- 1. Background of the Project
- 2. Contents of the Basic Design Study Report
- 3. Requirements under Japan's grant aid scheme
- 4. Contents of the Exchange of Notes agreed upon by the two governments

Based on a proper understanding of the matters listed above, the contents, responsibilities and special points to be noted for the detailed design and procurement supervision are outlined below.

#### (2) Scope of Consulting Services

After the signing of the E/N, the Consultant will conclude a consultancy agreement with the implementing agency for the Project on the Pakistani side within the scope of the services specified in the E/N. These services are outlined below.

- 1) Detailed Design
- · Signing of the consultancy agreement (Pakistan) and its verification (Japan)
- · Assistance for the issue of the Authorization to Pay (A/P) (Pakistan)
- Final confirmation of the project contents and preparation of and discussions on the tender documents (Pakistan and Japan)
- · Obtaining of approval of the tender documents from the Pakistani side (Pakistan)
- · Announcement of the tender and distribution of the tender documents (Japan)
- Execution of the tender, evaluation of the tender results, reporting of the evaluation results and obtaining of approval of the evaluation results (Japan)
- · Witnessing of the signing of the agreement for equipment procurement and supply and verification of the

agreement (Japan)

- · Confirmation of the obligations of the Pakistani side (Pakistan and Japan)
- 2) Supervision of Equipment Procurement
- · Confirmation of the issue of orders for the equipment
- · Checking of the procurement situation
- · Pre-delivery inspection and pre-shipment inspection
- Progress report
- · Witnessing of the final handing-over
- · Preparation of completion notes and the final report

3) Guidance on Equipment Operation and Maintenance

Mechanical engineers of the equipment suppliers will provide guidance on on-site reassembly, initial operation and preventive as well as routine maintenance under the supervision of an engineer(s) dispatched by the Consultant.

#### (3) Important Points

- 1) The Consultant will check whether or not there is any change of the procurement conditions of the machinery/equipment and the construction conditions of the buildings defined at the basic design stage.
- 2) In accordance with the objectives of Japan's grant aid for equipment procurement and facility construction projects, the Consultant will hold sufficient discussions with the Pakistani side at the time of the final confirmation of the project contents and will obtain approval of the tender documents, including the detailed design, from the Pakistani side.

## 2-2-6-2 Facility Construction Plan

#### 2-2-6-2 (1) Implementation Policies

The Project aims at constructing a new training building and other necessary facilities and also at providing construction machinery for training and inspection purposes as well as repair equipment for the CMTI with grant aid provided by the Government of Japan. The CMTI will act as the implementing agency under the supervision of the MOC and will conclude an agreement with a Japanese consulting firm which will consistently conduct a series of consulting work, including the detailed design, preparation of the tender documents, evaluation of bids and signing of a supplier agreement (construction contract and equipment procurement and installation agreement), procurement supervision, construction work supervision and supervision of the test operation and handing over of the machinery/equipment by the contractor for equipment supply.

Under the advice of the Consultant, the CMTI will organize separate tenders for the construction of the facilities and the supply and installation of the machinery/equipment and will conclude the respective agreements with the successful bidders. Immediately after the signing of the agreement, it will be necessary for the successful bidder for the construction work (the Contractor) to apply for a building permit to the Building Control Department of the CDA in

collaboration with the CMTI. This application for a building permit will be made using an architectural firm registered with the Engineering Association in Pakistan or an architectural design firm in Islamabad certified by the Consultant.

This application for a building permit will be made by the Contractor within the one month preparatory period to set up temporary facilities on the site prior to the commencement of the actual construction work after signing of the contract. The likely implementation mechanism for the facility construction work under the Project is shown in Figure 2-2.



Figure 2-2 Project Implementation Mechanism (Construction Work)

## 2-2-6-2 (2) Implementation Conditions

The CMTI trains some 300 trainees at any time using the existing facilities. As some 500 people, including CMTI staff, are expected to be present on the premises during the assumed construction period (from January to December, 2006), the safety of the CMTI staff, trainees and visitors will be essential in addition to the safety of people involved in the construction work.

Although there are two construction sites, only one access road is available, making it inevitable for construction vehicles to travel alongside ordinary vehicles used by members of the CMTI. Proper attention must, therefore, be paid to traffic safety and special measures should be introduced at the time of the movement of construction vehicles.

- (2) 95% of the population of Pakistan are Muslims and the work efficiency of construction workers declines during Ramadan when people are not allowed to eat or drink during the daytime. When Ramadan occurs during the scorching summer, the work efficiency drastically declines. Given the assumed construction schedule, Ramadan in 2006 will start in late September which should not be as hot as the summer months. Nevertheless, this will be a time when the construction work moves to the finishing stage when workability, quality and workmanship really matter. The timing of Ramadan must, therefore, be taken into careful consideration in the planning of the construction schedule.
- (3) Under the catch all export control adopted by the Government of Japan, all goods and technologies to be exported to

Pakistan are, in principle, subject to such control except for some items which are certified as having no link with the development of weapons of mass destruction. Even though being a subject to export control does not necessarily mean that the item (or technology) in question is denied export, it may be necessary to obtain an export permit. The tender documents will clearly indicate that the equipment supplier is responsible for obtaining an export permit if such a permit is required.

(4) The equipment supplier will also be responsible for obtaining permits from the Government of Japan or the US government for such hardware as computers and projectors and related software.

## 2-2-6-2 (3) Scope of Work

Japanese Side	Pakistani Side
1. Construction work	1. Provision of land for building construction
Structural work and finishing work	2. Removal and/or repair of existing fencing
2. Electrical work	3. Remodelling of existing power receiving and
Power receiving and transforming system; cabling; power	transforming system (if necessary)
plant; plug sockets; lighting; telephone system; private	4. Extension of power, water and telephone lines to
power generation system	the building sites
3. Plumbing work	5. Desks, chairs and curtains, etc. (furniture not
City water supply system; sanitary fixtures; drainage	included in the Japanese portion)
system; purification tanks	6. Obtaining of building permit, customs clearance
4. Air-conditioning and ventilation work	and tax exemption measures
Air-conditioning system; ventilation system; gas heating	7. Necessary expenses not included in the Project
system	8. Operation and maintenance costs
5. Disaster prevention system	
6. Equipment for training	
7. Others	

Table 2-11 Scope of Work for Japanese and Pakistani Sides

## 2-2-6-3 Consultant Supervision

## (1) Basic Principles

The Consultant will organize a consistent project team to conduct the detailed design and supervision of the construction work and procurement work in accordance with the grant aid scheme of the Government of Japan and the consultancy agreement was well as the principles for the basic design in order to ensure the smooth implementation of the Project to its completion. Separate tenders will be organized for the construction of the buildings and the procurement and supply of the machinery/equipment.

## (2) Details of Consultancy Work

- Following the signing of the consultancy agreement with the Government of Pakistan, the Consultant will hold discussions with the project-related organizations in Pakistan and will conduct the detailed design. The Consultant will prepare such tender documents as the detailed design drawings, building work specifications and equipment specifications in Japan and will have these approved by the MOC, the owner, and the CMTI.
- 2) The Consultant will announce the pre-qualification and tender, distribute the tender documents, receive the bidding documents and evaluate the bidding documents and will advise the MOC and CMTI on the conclusion of the

construction contract and equipment procurement and supply agreement with Japanese companies.

- 3) After the signing of the contract agreement between the MOC/CMTI and the successful bidders, the Consultant will check the shop drawings and equipment fabrication drawings, etc. submitted by the Contractor and the Equipment Supplier and will conduct the factory inspection and pre-shipment inspection of the processed members and equipment.
- 4) The Consultant will establish an on-site supervision system, including an on-site supervision office at which a full-time Japanese site manager and the Consultant will be stationed.
- 5) The Consultant will organize weekly and monthly meetings to clarify the progress situation of the construction work and will supervise the Contractor.
- 6) For the on-site work supervision, the Consultant will employ one well-experienced local architectural engineer to perform various checks and inspections during the structural work (checking of the supporting ground, bar arrangement inspection, form inspection, concrete placing inspection and concrete strength inspection, etc.)
- 7) The Consultant will conduct on-site work supervision, including the checking of each supervision item, using the locally employed architectural engineer and will discuss the check results at regular meetings.
- 8) The Consultant will issue the necessary certificates and other documents.
- The Consultant will conduct all types of necessary work, including liaisoning with and the submission of reports to the MOC, CMTI, Japanese embassy and JICA office in Pakistan.

## (3) Personnel Plan

- 1) Project Manager
- · Overall control of the consulting work
- · Signing of the agreements and discussions with project-related organizations in Pakistan
- · Preparation of the tender documents and witnessing of the tender
- · Witnessing of the inspection and handing over of equipment
- 2) Engineer Responsible for Building Design
- · Overall control of the design work (building, structural, electrical, sanitation and air-conditioning plans)
- · Planning of the buildings and preparation of the tender documents
- Instruction on matters to be discussed or examined in relation to the equipment plan to engineers responsible for the structural, electrical and building service plans
- · Cooperation for the application for the building permit and discussions with the local consultant

- · Evaluation of pre-qualification document
- · Witnessing of the tender
- Witnessing of the building inspection at the time of the commencement of the work, at the interim stage and on completion
- 3) Engineer Responsible for Structural Design
- · Preparation of the tender documents (technical specifications and design documents) and witnessing of the tender
- Preparation of the design documents and provision of the technical information required for the application for the building permit
- · Examination and approval of the shop drawings
- · Work inspection (foundations and bar arrangement for each story) at the interim stage
- 4) Engineer Responsible for Design of Electrical Installations
- · Preparation of the tender documents (technical specifications and design documents) and witnessing of the tender
- Preparation of the design documents and provision of the technical information required for the application for a building permit
- · Examination and approval of the shop drawings and equipment
- Supervision of the electrical installation work in progress and confirmation of equipment installation at the time of building completion
- 5) Engineer Responsible for Design of Air-Conditioning and Ventilation Systems and Plumbing Work
- · Preparation of the tender documents (technical specifications and design documents) and witnessing of the tender
- Preparation of the design documents and provision of the technical information required for the application for a building permit
- · Examination and approval of the shop drawings and equipment
- 6) Administrator for Preparation of Tender Documents
- · General administrative work relating to the preparation of the tender documents
- 7) Cost Engineer
- · Cost estimation at the time of the detailed design
- · Preparation of a cost comparison sheet between the basic design and the detailed design
- 8) Full-Time Supervisor
- · Checking of the quantity and strength of the building materials
- · Guidance for and supervision of the work quality
- · Checking of the work progress

9) Engineer Responsible for Equipment Plan (A)

- · Discussions on and confirmation of the detailed specifications
- · Preparation of the tender documents and witnessing of the tender
- Approval of equipment, witnessing of the factory inspection and supervision of the pre-shipment inspection and installation work
- · Witnessing of the inspection and handing-over of the equipment

10) Engineer Responsible for Equipment Plan (B)

- Discussions on and confirmation of the detailed specifications for the inspection equipment and peripheral equipment
- · Preparation of the tender documents and witnessing of the tender
- Approval of equipment and supervision of the factory inspection, pre-shipment inspection, transportation and installation work
- · Witnessing of the inspection and handing-over of the equipment

## 2-2-6-4 Quality Control Plan

Based on the design documents (specifications and drawings, etc.), the Contractor will submit a construction plan describing the target values for strength and dimensions, testing and inspection methods and construction methods prior to the commencement of the construction work. The Consultant will then check the contents of this construction plan submitted by the Contractor. Particularly in regard to various tests and inspections, the methods, timing and frequency will be clearly indicated based on the schedule control plan and the target values to act as reference values for tests and inspections will also be indicated to ensure the good quality of the completed work. The Consultant will determine the reference values for supervision (material quality, design strength, structure, shape and dimensions) to ensure proper quality control and will fully examine the contents of the various testing and inspection methods (draft) included in the construction plan to prepare a quality control plan. The main items to be checked are listed below.

#### (1) Materials

- 1) Name of the manufacturer of reinforcing bars and the testing method
- 2) Name of the manufacturer of cement and the testing method
- 3) Specific gravity and water content of aggregates (sand and gravel) and methods to test the dimensions and constituents of aggregates
- 4) Obtaining of quality guarantee certificates for other materials and testing methods

#### (2) Earth Work

1) Slope gradient, accuracy for level of foundation bottom and height of gravel and stone below concrete foundation

2) Confirmation of the compacting management method

#### (3) Reinforced Concrete

- 1) Test mixing using a mixing table
- 2) Target values for water-cement ratio, air volume and slump in the mixing plan
- 3) Confirmation of each value of the design standards
- 4) Types of mixers, weighing method and plan for assignment of a concrete engineer(s)
- 5) Testing methods and frequency for slump and air volume; compilation of test data
- 6) Curing method for concrete test pieces
- 7) Tensile strength testing of reinforcing bars

### (4) Brick Work

1) Target values for horizontal and vertical accuracy

#### (5) Plaster Work

- 1) Target values for horizontal and vertical accuracy
- (6) Waterproofing Work

1) Water leakage test

- (7) Window, Door and Ceiling Work
  - 1) Target values for horizontal and vertical accuracy

#### (8) Control Standards

As there are no quality control standards in Pakistan, those standards which are adopted by the Contractor in the construction plan and which are approved by the Consultant will be used as the quality control standards for the Project while referring to the standard specifications published by the Minister's Secretariat of the Japanese Ministry of Construction or the relevant US standards.

#### 2-2-6-5 Procurement Plan

Most construction/building materials can be procured in Pakistan. However, a substantial increase of the prices is rumored due to expansion of the domestic construction demand as well as the construction boom in Afghanistan. Therefore, the necessary construction materials for the Project should be promptly procured after the signing of the construction contract.

## (1) Labour

While there are no problems in regard to the recruitment of ordinary workers or unskilled workers in Pakistan, the absolute number of skilled workers is not very large. A labour management system with special attention being paid to securing the services of skilled workers will be established to proceed with the construction work under the Project to ensure the accuracy and quality of the work.

## (2) Materials

1) Construction Materials

Cement and reinforcing bars, etc. can be easily procured as they are produced in Pakistan. Meanwhile, problems in regard to the quality and available quantity may arise in the case of aluminum sashes and paint, etc. and, therefore, ASEAN countries including Taiwan are contained in the possible supply sources of these products.

## 2) Electrical and Air-Conditioning Equipment

Although some of the planned electrical and air-conditioning equipment is manufactured in Pakistan, Japan is included in the possible supply sources in view of the quality and prompt delivery of the equipment.

## 3) Construction Machinery

Leading construction companies in Pakistan possess certain types of construction machinery which can be leased. All types of construction machinery required for the construction work under the Project can be hired in Pakistan.

The list of materials and equipment are listed by supply source in Table 2-12 through Table 2-14. The procurement of some items from third countries (ASEAN countries) will be considered in connection with the construction of the buildings under the Project.

I.t	Supply Source			December 6 - Colorida / December 1
Item	Japan	Pakistan	Third Country	Reason for Selection/Remarks
Sand		0		Mountain sand
Cement		0		
Aggregates		0		
Reinforcing bars		0		
Structural steel		0		
Bricks		0		
Timber		0		
Roof waterproofing materials		0		Only asphalt waterproofing material can be procured locally.
Waterproof expansion joints			0	Local procurement is not possible.
Aluminium top beam for			0	
roof			0	
Coking material			0	For assured quality, performance and supply
Aluminium windows and			0	For assured quality, performance and supply
Steel windows and doors (locks included)			0	For assured quality, performance and supply
Wooden windows and doors		0		
Glass		0		
Plastering materials		0		
Paint		0		
Metal furring strips for		0		
ceiling		0		
Ceiling boards		0		
Acoustic materials			0	
Nameplate for building			0	

Table 2-12 Supply Sources of Construction/Building Materials

Itom	Supply Source		ource	Demonstra
Item	Japan	Pakistan	Third Country	Remarks
(Mechanical Systems)				
Water supply and drainage				
equipment				
Elevated water tank		0		Concrete tank
Water pump	0			
Sanitary fixtures		0		
Purification tank		0		Concrete tank
Water boiler		0		
Kitchen sink (stainless steel)		0		
Pipes		О		
Valves		0		
Supporting metalware		0		
Fire plug box		0		
Fire extinguisher		0		
Pipes		0		
Grease trap		О		Concrete grease trap
(Air-Conditioning and				
Ventilation Systems)				
Air-conditioning unit		0		
Ventilation fan	0			Some are made in Japan.
Ceiling fan (circulation fan)		0		
Ceiling pipes		0		
Insulation materials		0		
Supporting metalware		0		
Water boiler	0			
Heat exchanger	0			
Heat source tank	0			
Pump	0			
Panel heater	0			
Constant flow valve	0			

## Table 2-13 Supply Sources of Equipment (Mechanical Work)

## Table 2-14 Supply Sources of Equipment (Electrical Work)

Itom	Supply Source		ource	Demerica
Item	Japan	Pakistan	Third Country	Remarks
Transformer		Ο		Siemens (specified by the electric company)
High voltage panel		0		Siemens (specified by the electric company)
Distribution panel	0			
Lighting fixtures		0		
Telephone equipment		0		Imported products (Siemens, etc.)
Public address equipment	0			Imported product if procured locally
Automatic fire alarm	0			Imported product if procured locally
equipment	0			Imported product if proceded locally
Steel conduit	0			
Vinyl conduit		Ο		
Boxes		Ο		
Cables and wires		Ο		
Wiring equipment (switches		0		
and plug sockets)		0		
	0			
Hand hole	(lids	Ο		Cast-in concrete
	only)			
Supporting metalware		0		

#### 2-2-6-6 Implementation Schedule

In the case of the implementation of the Project with grant aid provided by the Government of Japan, it will proceed in accordance with the following processes.

#### (1) Detailed Design

After the signing of the consultancy agreement, the Consultant will prepare the detailed design for the planned facilities based on the basic design study report and the tender documents. The detailed design and tender documents must be approved by the competent government offices in Pakistan and Japan. This process will require 3.0 months to complete.

#### (2) Tender

After obtaining approval of the detailed design, the Consultant will announce the pre-qualification before the tender and evaluate submitted P/Q document. Then the consultant will distribute the tender documents in Japan. The tender will be witnessed by representatives of the project-related organizations and the pre-qualified bidder who made the lowest bid and of which the bid contents are evaluated as appropriate will be announced as the successful bidder. This successful bidder will then conclude an agreement with the MOC/CMTI. Two tenders will be held and two contract agreements will be concluded, i.e. one for the construction of facilities and another for equipment procurement and installation. This process will require 3.0 months to complete.

#### (3) Construction Work and Equipment Procurement/Installation Work

The contract agreement concluded between the MOC/CMTI and two Japanese companies will become valid after their validation by the Government of Japan. These companies, i.e. the Contractor and Equipment Supplier, will then commence their work, including the preparation of shop drawings, manufacture of machinery/equipment and shipment to Islamabad in Pakistan.

These companies will be responsible for the entire project-related work, including the road transportation of the machinery/equipment, until the test operation of the machinery/equipment on site has been completed and approved.

#### (4) Completion of the Work

Following completion of the work to install the building service systems, including electrical installations on the ground floor of the training building, the work to install the vehicle inspection and other equipment to be used by the trainees for practical training will be conducted. On completion of the installation work, training on the operation of each equipment will be provided and pre-handing over inspection will be conducted in the presence of the persons concerned.

The equipment will be handed over to the Pakistani side after confirmation that the specifications are exactly as specified in the agreement. The facilities/buildings will be handed over to the Pakistani side after confirmation that they exactly match the approved drawings. Provided that the construction of all of the facilities and the procurement and installation of the equipment are smoothly conducted as planned, approximately 12 months from the signing of the contract agreement to the handing over of the facilities and equipment will be required.



 Table 2-15
 Project Implementation Schedule

## 2-3 Obligations of Recipient Country

In the case of the implementation of the Project with grant aid provided by the Government of Japan, the Pakistani side will be required to fulfill the following obligations.

- (1) To clear and level the planned construction sites and to secure a stock yard for the construction work
- (2) To extend the water and power supply lines and telephone line to the planned construction sites
- (3) To apply for and obtain project-related permits and approval from the relevant government ministries
- (4) To pay the cost of environmental impacts assessment if such assessment is necessary
- (5) To prepare furniture for the new buildings, including laboratory tables, desks and chairs, those for not including by the Japan's grant
- (6) To pay commission to a Japanese bank based on the banking arrangement (B/A)
- (7) To exempt machinery/equipment procured under the Project from customs duties and import tax, etc. at the port of import in Pakistan
- (8) To accord Japanese nationals such facilities as may be necessary for their entry into Pakistan and stay therein for the performance of their work under the Project
- (9) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Pakistan with respect to the supply of products and services under the validated contracts
- (10) To use and properly and effectively maintain all machinery/equipment and facilities provided under the Project with Japanese grant aid
- (11) To bear all expenses other than those to be borne by the Japanese side as part of the grant aid

The Pakistani side will construct a shed for the construction machinery and a vehicle washing yard prior to the planned handing over of the construction machinery and vehicles in December, 2006 as part of the proper and effective operation and management of the procured machinery/vehicles. This shed is outlined in Table 2-16.

Table 2-16 Outline of Machinery Shed to be Constructed by Pakistani Side

Name	Floor Area
Construction machinery storage shed	$950 \text{ m}^2$

## 2-4 Project Operation Plan

### 2-4-1 Facility and Equipment Maintenance System

It is judged that the application of the existing maintenance practices should be sufficient to maintain the facilities and machinery/equipment newly constructed/provided under the Project. The existing maintenance system is competent as described below and is capable of conducting the proper maintenance of the new facilities and machinery/equipment.

### 2-4-1-1 Routine Inspection, Periodic Maintenance and Repair Work

The routine inspection of equipment is currently conducted by assistant instructors in accordance with routine inspection sheets and the operating hours and fuel, cooling water and oil consumption volumes are recorded at the time of replenishment. Any signs of malfunctioning are also recorded on routine inspection recording sheets. The contents and schedule of periodic maintenance are planned based on the conditions of machinery/equipment described on the routine inspection recording sheets and implemented in accordance with the planned schedule as part of the training with the necessary parts being prepared in time. When an instructor of the construction machinery operator course finds such irregularities as fuel/oil leakage and/or a sudden increase of the fuel/oil consumption, etc., he issues a work request to an engineer of the repair shop to conduct further inspection and, in necessary, repair. When irregularities are discovered during various inspections of the machinery operator or mechanic course, the repair work is conducted as practical training or is conducted by an instructor to avoid hindering the training.

## 2-4-1-2 Control of Spare Parts

For the control of spare parts, the existing system uses parts sheets and cards to verify the part number, part name, inventory and storage place, etc. In addition to these parts sheets, a computer is also used for inventory control. Replacement parts for periodic inspections and consumables are procured from their local agents when necessary.

## 2-4-2 Personnel Plan

The CMTI will be responsible for the operation and maintenance of the new facilities and machinery/equipment. The staff composition of the CMTI as of 2004 is shown in Table 2-17. With the introduction of the new training courses and expansion of the facilities and equipment, it will be necessary for the CMTI to recruit new instructors and administrative staff members. To be more precise, the new recruitment of four instructors, 15 assistant instructors and eight administrative staff members will be necessary. A plan is already in place to increase the staff strength should the Project be implemented.

Although the instructors of the CMTI have sufficient technical capability to maintain the existing construction machinery/equipment, they will require upgrading training by means of counterpart training and/or the dispatch of Japanese experts for a short period of time to make them capable of providing instruction on machinery incorporating the latest technologies, including electronic control systems.

Jo	ob Title	Staff Strength (Unit: persons)
D	Director	1
Training Department	Instructor	10
	Assistant Instructor	65
	Clerk, etc.	14
	Sub-Total	89
Administration Departr	nent	55
	Total	145

Table 2-17 Staff Composition of the CMTI

## 2-5 Estimated Cost of Project

## 2-5-1 Estimated Cost of a Portion of the Cooperation for the Project

The total estimated cost of a portion of the cooperation for the project in case of the decision is about 921 million Japanese yen. This cost estimation is provisional and would be further examined by the Government of Japan for the approval of the Grand.

## 2-5-1-1 A portion of the Cooperation by Japanese Side for the Project

Contents of expense for the project	Cost (million Japanese yen)
Facilities: Training Building	
Accommodation Building	383
Canteen Building	
Equipment	452
Design and Consulting	78
Total	913

## 2-5-1-2 A portion of the Cooperation by Pakistan Side for the Project

The total estimated cost of a portion of Pakistan side is about 4,014,000 Rs (about 7.67 million Japanese yen). The breakdown is as follows. CMTI will apply to Ministry of Communications for this cost.

- (1) Equipment procurement
  - 1. Preparation expense such as fuels and materials for the equipment operation 42,000Rs (about 80,000 yen)

2. Construction expense of shed for the training eq	luipment	2,487,000Rs (about 4.75 million yen)
3. Installed cost		157,000Rs (about 300,000 yen)
	Total :	2,686,000Rs (about 5.13 million yen)
(2) Facilities		
1. Removal expense of existing entrance near wall	(200m)	23,000Rs (about 40,000 yen)
2. Construction expense of new boundary wall		405,000Rs (about 780,000 yen)
3. Laying expense of electric power line (expansio	on)	500,000Rs (about 960,000 yen)
4. Laying expense of Telephone line (expansion)		200,000Rs (about 380,000 yen)
5. Others (not included in this plan)		200,000Rs (about 380,000 yen)
	Total :	1,328,000Rs(about 2.54 million yen)

### 2-5-1-3 Condition of Cost Estimation

- (1) Time of Estimation: August, 2004.
- (2) Exchange rate: 1US\$=110.62 Japanese yen 1 Pakistan Rs=1.91 Japanese yen
- (3) The procurement Schedule: About 19 months as shown in Figure 2-15 (54p)
- (4) Others: The Project is executed under the Japan's Grant Aid Scheme.

## 2-5-2 Operation and Maintenance Cost

The operation and maintenance cost will be financed by the budget of MOC. The expenses for the new training building and equipment, and the increase of instructors and stuff are roughly estimated as follows:

(1) Personal Expenses

The increase of instructors stuff for the establishment of three new courses and the CAD practice in DAE course will be 4 chief instructors, 15 assistant instructors, 3 machine management staff and 5 administrative staff, total 27 personnel. The estimated personal expense of the increase personnel are shown in Table 2-18.

Job Title	Increase	Average Monthly Salary	Estimated Personal Expenses
	Personnel	Rs./month	Rs./month
Chief Instructor	4	20,000	80,000
Assistant Instructor	15	6,000	90,000
Machine management staff	3	2,000	6,000
Administrative Staff	5	2,000	10,000
Amount of increased Personal		Amount of increased Personal	186,000
		Expenses a month	
Total	27	Amount of increased Personal	2,232,000
		Expenses a year.	

 Table 2-18
 Estimated Personal Expenses for Increase Personnel

The personal expenses of 2003/2004 fiscal year were 14.54 million Rs. The total personnel expenses are estimated at 16.772 million Rs and will be increase 15.3% a year.

## (2) Management and maintenance expenses of Facilities

- 1) Estimation of electricity cost
- 1 Condition of Cost Estimation
  - a) Amount of used electric charge: one month
  - b) Operating time of equipment: 6 hours a day, 22 days a month

② Load Capacity

	Light outlet	General power	Equipment power
① Training Building	72KW	26KW	221KW
② Accommodation	17KW	22KW	-
Building			
③ Canteen Building	17W	10KW	-
④ Outdoor facilities	3KW	-	-
Sub-Total	109KW	58KW	221KW
Total: 388KW			

Table 2-19 Electric Load Capacity

③ Amount of used electric power (year)

 $(109KW \times 0.6 + 58KW \times 0.6 + 221KW \times 0.2) \times 6$  hours  $\times$  22 days  $\times$  12 months

= 228,700 kWh/year

④ Electricity Cost (year)

Electricity cost = annual used electric power (kWh/year) x unit charge (Rs/kWh)

=228,700 kWh x 4.0 Rs/kWh

=914,800 Rs/year (about 1.747 million Japanese yen)

2) Estimation of Gas Cost

The gas rate used for kitchen, hot water supply and heater a year is estimate based on SUI-NORTHERN GAS company rate.

① Amount of used gas (year)

Kitchen: 1,000 foods/day × 22 day/month ×12 months in kitchen/day ×600Kcal/food

 $\div$ 8,700Kcal/m3×1.0Rs/m3 =18,200Rs/year

Hot water supply: 250 people×30 liter/person day×22 day÷8,700 Kcal/m3

÷0.8×365/year×1.0Rs/m3 =8,600Rs/year

Heater: 62,000Kcal/h÷8,700Kcal/m3×2250 /year ×1.0Rs/m3 =16,000Rs/year

The total annual gas cost is estimated at 42,800Rs (82,000 Japanese yen).

3) Estimation of Water Cost

CMTI has paid CDA the fixed amount of 12,000Rs/6 month as the water charge. The annual water charge is 24,000Rs (46,000 Japanese yen) regardless of the water-consumption.

The total amount of the electricity, gas and water cost for the maintenance of facilities is estimated at about 981,000Rs (1.875 million Japanese yen) a year.

## (3) Fuel and oil cost

The estimation of the fuel and oil cost for training operation of the construction equipment newly introduced is shown in Table 2-20. The fuel and oil cost for the new construction equipment is estimated at about 2.14 million Rs. The total fuel and oil cost including the existing construction equipment will be 2.59 million Rs.

					(Unit: Liter
No.	Equipment	Specification	No.	Consumption of Fuel and oil (liter/day/No.)	Consumption of Fuel and oil (liter/day)
1	Bulldozer	240 hp	3	0.138 x 240 hp x 2.5h = 83	249
2	Hydraulic excavator	145hp	3	0.133 x 145 hp x 2.5h = 48	114
3	Wheel excavator	120hp	2	0.133 x 120 hp x 2.5h = 40	80
4	Motor grader	160hp	1	0.081 x 160 hp x 2.5h =32	32
5	Wheel loader	160hp	3	0.115 x 160 hp x2.5h = 35	105
6	Rough terrain Crane	220hp	1	0.077 x 220 hp x 2.5h =42	42
7	Mini bus	120ph	2	0.044 x 120 hp x 2.5h = 13	26
8	Pickup car	80ph	1	$0.037 \ge 80 \text{ hp } \ge 2.54 \text{ h} = 7$	7
		Total	22		655

Condition of Estimation;

1. Operation days a year: 120 days

40 days per course X 3 times a year =120 days

- 2. Operating time a day: 2.5 hours
- 3. Oil and fuel consumption of an hour (liter/hp-h);"Standard of the Ministry of Land, Infrastructure and Transport of Japan, Oil cost; 1% of amount of fuel consumption"
- 4. Average diesel fuel price: 24.5 Rs/liter =46.8 Japanese yen/liter
- (As of December, 2004: 1=57.8 Rs = 110.62 Japanese yen, 1 Rs = 1.91 Japanese yen)
- 5. Annual fuel and oil cost: New construction equipment: (655+7) liter/day x 120 days x 24.5Rs/liter = 1,946,280 Rs = 3,720,000 Japanese yen

#### (4) Maintenance Expenses of Vehicles and Training Equipment

The vehicles and training equipment newly introduced in the Project will not need the additional expenses of the spare parts for 2-3 years by the appropriate planning of spare parts. The maintenance expenses of the existing equipment have already been included in the budget. Moreover, the maintenance expenses in the future will be reduced, because the training will use mainly the new equipment and the existing training equipment as the supplementary. The half of the maintenance expenses will be the repair fee. Additional budget will not be required, because the most of the repairing works will be able to conduct in the training of CMTI. Consequently, with the actual expenditure of 1,800,000 Rs in fiscal year 2003, the maintenance expenses of the new facilities and equipment will be secured in the budget.

#### (5) Annual Management and Maintenance Cost

The annual management and maintenance expenses are estimated at 16.772 million Rs (32.03 million Japanese yen) as the personal cost, 2.781 million Rs (5.31 million Japanese yen) as the maintenance cost of facilities, 2.396 million Rs (4.55 million Japanese yen) as he fuel and oil cost and 1.88 million Rs (3.59 million Japanese yen) as the maintenance cost of the equipment respectively. The total annual management and maintenance expenses will be 23.899 million Rs and increase by 13 % of the annual budget in fiscal year 2004. Pakistan side has already drawn up the budget of the approximately same amount of 2005/fiscal year 2006. The budget will be enough to excute the Project. Moreover, the course fees and boarding fees paid by the trainees are shared between the CMTI and the MOC and have been used for special expenses, such as the major repair of the existing facilities and the training of its staff members. Consequently, the management and maintenance expenses will be certainly within the limit of the budget.

				(Unit: One million Rs
Fiscal Year	2003/2004	2004/2005	Additional Management	Management and
Budget applied	28 6 4 0	21 652	and Maintenance	Maintenance
	28.049	51.055	Expenses (forecast)	Expenses
Budget finally approved (income)	18.740	21.148	-	-
Personnel cost	14.540		2.232	16.772
	78%			70%
Facility maintenance cost	1.800		0.981	2.781
	10%			12%
Fuel cost	0.450		1,946	2.396
	2%			10%
Vehicle/machinery maintenance	1.880		0	1.880
cost	10%		0	8%
Others	0.070		0	0.070
	0%		0	0%
Expenditure total	18.740			23.899
Balance	0.000			
Total of Course and Boarding Fees	0.082			
Paid and Share of the CMTI	0.982			

## Table 2-21 Result and Estimate of Management and Maintenance Expenses of CMTI