JAPAN INTERNATIONAL COOPERATION AGENCY

No. 1

THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF HOUSING, CONSTRUCTION AND URBAN DEVELOPMENT

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR ESTABLISHMENT OF CONSTRUCTION EQUIPMENT TRAINING CENTRE (CETRAC) IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

MARCH 1994

KUME SEKKEI Co., Ltd.

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PREFACE

In response to request from the Government of the Democratic Socialist Republic of Sri Lanka, the Government of Japan decided to conduct a basic design study on the Project for Establishment of Construction Equipment Training Centre and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Sri Lanka a study team headed by Mr. Toshimitsu Muramatsu, Deputy Director of Construction Equipment Division, Economic Affairs Bureau, Ministry of Construction and constituted by members of Kume Sekkei Co., Ltd., from October 23 to November 13, 1993.

The team held discussions with the officials concerned of the Government of Sri Lanka, 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 Sri Lanka in order to discuss a draft report, 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 Democratic Socialist Republic of Sri Lanka for their close cooperation extended to the teams.

March, 1994

Kensuke Yanagiya
President
Japan International Cooperation Agency

March, 1994

Mr. Kensuke Yanagiya
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

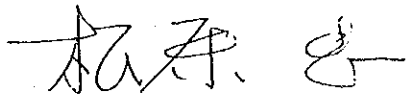
We are pleased to submit to you the basic design study report on the Project for Establishment of Construction Equipment Training Centre in the Democratic Socialist Republic of Sri Lanka.

This study was conducted by Kume Sekkei Co., Ltd., under a contract to JICA, during the period of October 13, 1993 to March 28, 1994. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Sri Lanka and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

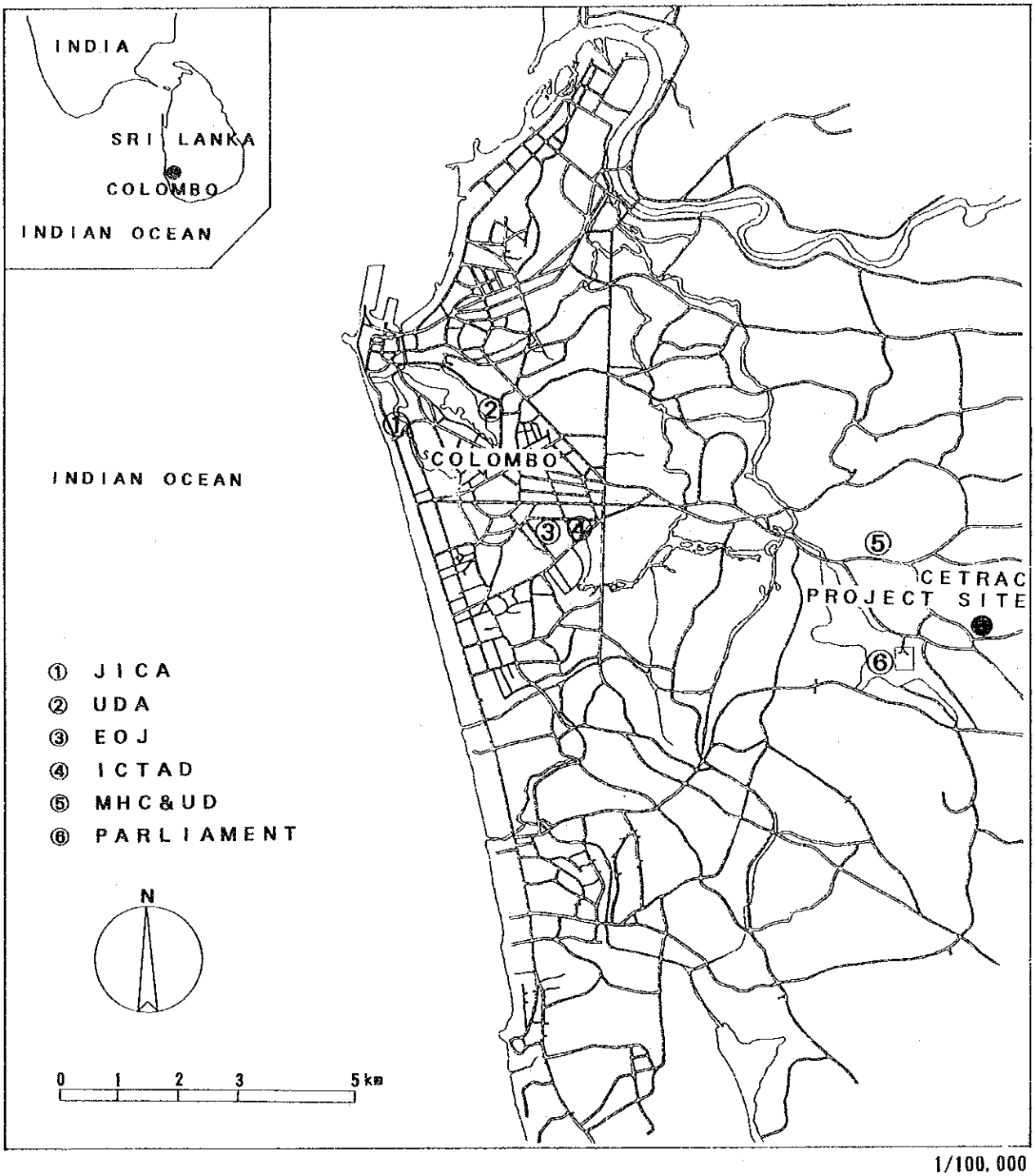
We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs, and the Ministry of Construction. We would also like to express our gratitude to the officials concerned of the Ministry of Housing, Construction and Urban Development, the JICA Sri Lanka office and the Embassy of Japan in Sri Lanka for their cooperation and assistance throughout our field survey.

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

Very truly yours,



Tadashi Matsubara
Project Manager
Basic Design Study Team on the Project for
Establishment of Construction Equipment
Training Centre
Kume Sekkei Co., Ltd.


INDIA
SRI LANKA
COLOMBO
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COLOMBO
CETRAC
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① JICA
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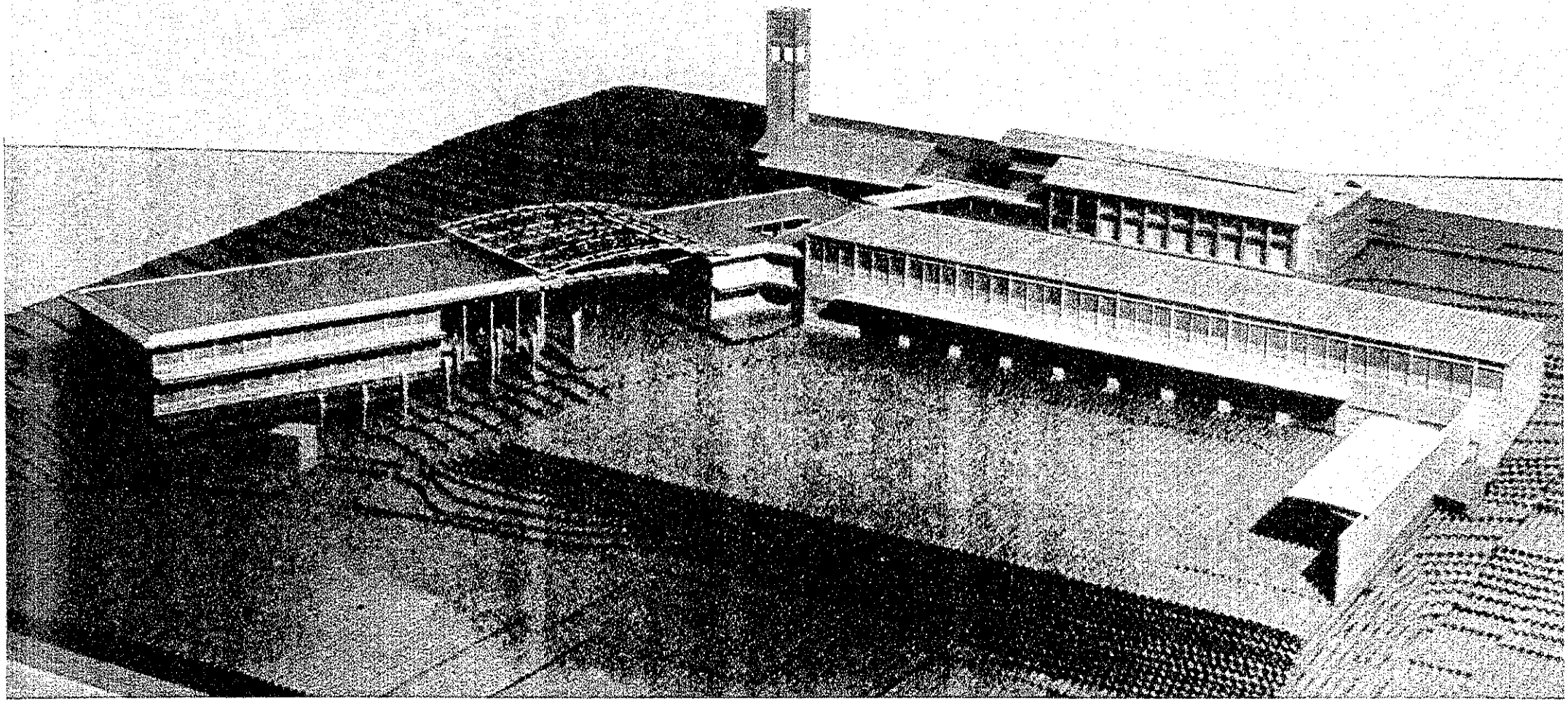

SUMMARY

The Government of Sri Lanka is giving the highest priority to improving and consolidating the social infrastructure, which is essential to promote industrial development and to stabilise the national economy, in order to achieve the continuous development of the country. To support the envisaged vigorous economic activities in Sri Lanka, strengthening and expansion of the socioeconomic infrastructure, particularly electricity supply, telecommunications and transportation, etc., are essential. The vitalisation of the economy will certainly increase the demand for new offices and housing. The construction sector plays a crucial role at every stage of socioeconomic development as the sector which is directly responsible for physical development and further mechanisation is urgently required to improve the productivity of the construction sector. While the personnel cost currently accounts for some 15 - 20% of the total construction expenditure in Sri Lanka, the operation and management cost of construction equipment is as high as 20 - 30%. This high machinery cost indicates the extreme importance of the rational operation and management of construction equipment to improve the productivity of the construction sector.

While there are currently some 6,000 pieces of construction equipment in Sri Lanka, some 3,000 are believed to be in need of repair and/or adjustment. Almost 75% of the existing construction equipment is upto 10 years old and many incorporate such systems as electrical, hydraulic and compressed air systems, etc., the maintenance of which requires special knowledge and skills, making the likely causes of the poor mechanical operation of the existing construction equipment human-related, such as inappropriate operation and a lack of proper maintenance skills. Some machines which normally operate for 8,000 - 10,000 hours are rendered useless after only 3,000 - 3,500 hours of operation. One report states that almost half of the investment in equipment in the construction sector is wasted due to the poor operation and maintenance standards. This huge wastage is a grave obstacle to any effort to improve the productivity of the construction sector and must be improved as soon as possible.

The largest cause of the present situation described above is the lack of a system to educate and train mechanics for construction equipment. Most of the existing construction equipment mechanics in Sri Lanka lack a proper technical educational background and as they learn the necessary skills on-the-job during apprenticeships, many of them are only capable of repairing equipment within the framework of their field of experience. These mechanics find it extremely difficult to cope with the latest construction equipment, the functions of which are very advanced and complicated due to incessant technological innovations.

Under these circumstances, the Institute for Construction Training and Development (ICTAD), established to improve the overall quality and efficiency of the construction sector, has been making and is continuing to make strenuous efforts to standardise and upgrade the skills of construction equipment mechanics, including the development and implementation of the Modules of Employable Skills (MES) which are on-the-job training programmes for such mechanics. Nevertheless, the lack of a central training centre in this particular field has prevented the establishment of a strong nationwide training system. The ICTAD, therefore, concludes that the provision of intensive training at a central training system which has adequate facilities and excellent instructors and administrative staff is essential to keep up with ongoing technical innovations and to meet the increasing social demand for capable mechanics. Based on the ICTAD's opinion, the Government of Sri Lanka prepared the Project to Establish the Construction Equipment Training Centre (the Project) and requested the Government of Japan's provision of official grant aid for the Project.

In response to the Sri Lankan request and based on the findings of 2 Preliminary Study Teams (Preliminary Study Team I and II), the Government of Japan to decided to conduct the Basic Design Study for the Project. Entrusted by the Government of Japan, the Japan International Cooperation Agency (JICA) sent the Basic Design Study Team to Sri Lanka for 22 days from October 23rd to November 13th, 1993 to conduct the field survey. Based on the findings of this field survey, further design details were analysed in Japan. The basic design of the facilities, scope of equipment to be provided and outline of the facility and equipment maintenance plan were then compiled into the Basic Design Draft Final Report and the Explanatory Mission was sent to Sri Lanka for 11 days from March 10th to March 20th, 1994 to explain the contents of the said Report.

The ministry responsible for the supervision of the Project on the Sri Lankan side is the Ministry of Housing, Construction and Urban Development (MHC & UD) and the project implementation agency is the ICTAD which is under the jurisdiction of the MHC & UD. Upon completion of the Project, the Construction Equipment Training Centre (CETRAC) will be managed by its own staff and will become the central training institute for construction equipment mechanics in Sri Lanka under the supervision of the ICTAD.

The CETRAC will consist of 3 divisions, i.e. (i) Training Section, (ii) Curriculum Development Section and (iii) Administration Section, all of which will be under the control of the Manager and Deputy Manager and will have a total manpower strength of 46. The planned main activities of the CETRAC are as follows.

(1) Planning and execution of training of managers and supervisors involved in the supervision of the operation and maintenance of construction equipment.

(2) Planing and execution of training of mechanics involved in the maintenance of construction equipment.

(3) Planning and execution of training for personnel for operations associated with the operation and maintenance of construction equipment.

The site of the planned CETRAC is located at Sri Jayewardenapura Kotte, Sri Lanka's new capital which has a population of some 100,000, in turn situated in an area called Pelawatta some 10km southeast by east of central Colombo. The site has a land area of 15,710m^2 and is continuously sloping land from south to north. The depth is some 130m and there is an overall elevation difference of some 11m.

The main facilities to be constructed under the Project are outlined below.

Phase 1 Construction Work

Administration Building : RC 2 storey building with partial basement
manager's office, deputy manager's office, senior instructors' offices, visiting instructors' offices, instructors' room, senior visiting researchers' office, visiting researchers' office, curriculum development office, library, conference room, administration office and related equipment

Training Building : RC 2 storey building with partial steel frame
engine, transmission, chassis, hydraulic, machinery, fuel injection, electric and mechatronic workshops, test rooms (laboratories), tool and parts storage, lecture rooms, training rooms, computer room and related equipment

Phase 2 Construction Work

Dormitory Building : RC 2 storey buildingsingle
bedrooms, twin bedrooms, study room, living room, dormitory office and related equipment

Canteen Building : RC single storey building
staff dining room, trainee dining room, kitchen, kiosk and related equipment

Total Floor Area: approximately 7,181m^2

The main types of equipment to be provided under the Project are construction equipment for mechanic training purposes, workshop equipment, technical training and education equipment and office equipment for administration purposes.

The Project will require 12 months for the Phase 1 construction work and another 10 months for the Phase 2 construction work.

The implementation of the Project is expected to have the following positive effects.

(1) The improved ability of managers responsible for the operation and maintenance of construction equipment and supervisors responsible for on-site work supervision will make the preparation and implementation of highly efficient construction equipment operation and management plans possible, thus strengthening the system to operate and manage construction equipment.

(2) The intensive technical training of the existing construction equipment mechanics who have had no proper technical education will improve their technical knowledge and skills to implement high level and efficient maintenance of construction equipment, thus strengthening the system to maintain such equipment.

(3) The highly professional, consistent technical training of mechanics with different skill levels through systematic curriculum and syllabus and good textbooks will reduce the technical gap between regions and between individual workshops to achieve the standardisation of maintenance skills throughout the country.

(4) By means of the training of managers and supervisors, of small companies and those companies which find it difficult to improve their technical level without external assistance, will increase the vitality of the construction sector in Sri Lanka.

(5) The operation of the CETRAC's workshops as model workshops for the rest of Sri Lanka will improve construction machinery workshops in terms of their work efficiency due to a better working environment and improved awareness of hygiene and safety requirements, thus facilitating improvement of the work environment and productivity.

(6) By officially certifying the skills of individual mechanics mastered through training, their professional status will be consolidated and job security achieved.

The Project will substantially expand and consolidate the manpower involved in the operation and maintenance of construction equipment in Sri Lanka in terms of both quality and quantity, playing an important part in achieving the goals of the national economic development policies. The Project is expected to not only contribute to the development and vitalisation of the construction sector but will also play a significant role in the successful completion of various development programmes/plans.

This broad contribution by the Project to Sri Lanka's socioeconomic development is deemed to justify the provision of Japanese grant aid for the Project. It is also hoped that project type technical cooperation, including the dispatch of experts, will be authorised by the Government of Japan to further consolidate the important functions of the CETRAC.

CONTENTS

LIST OF ABBREVIATIONS
(Alphabetical Order)

CDS	Curriculum Development Section
CETRAC	Construction Equipment Training Centre
CITP	Construction Industry Training Project
DER	Department of External Resources
ICTAD	Institute for Construction Training and Development
IDA	International Development Association
ILO	International Labour Organization
JICA	Japan International Cooperation Agency
MES	Modules of Employable Skills
MFP	Ministry of Finance and Planning
MHC & UD	Ministry of Housing, Construction and Urban Development
MOE	Ministry of Education and Higher Education
MPPI	Ministry of Policy Planning and Implementation
NAITA	National Apprenticeship and Industrial Training Authority
NEMO	National Equipment & Machinery Organization
OECF	Overseas Economic Cooperation Fund
OJT	On the Job Training
OTC	Operator Training Center
RCDC	Road Construction & Development Company
RDA	Road Development Authority
SEC	State Engineering Corporation
UDA	Road Development Authority

CHAPTER 1 INTRODUCTION

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The Government of Sri Lanka is giving the highest priority to improving and consolidating the social infrastructure, particularly electricity supply, telecommunications and transport, to stimulate the economy and to stabilize society through the accelerated economic development of the country. As the physical infrastructure development work must be conducted by the construction sector, the further mechanization and rationalization of the operation and maintenance of construction equipment are of crucial importance to improve the productivity of the construction sector.

The present operation and maintenance system for construction equipment in Sri Lanka is incapable of meeting the above social demand and much equipment is in need of some kind of repair and/or adjustment. This poor maintenance situation is believed to be largely the result of such artificial causes as inappropriate operation and inadequate maintenance knowledge and skills. The Institute for Construction Training and Development (ICTAD), responsible for providing guidance for the construction sector to improve its productivity, concludes that the establishment of the Construction Equipment Training Centre (CETRAC) is urgently required as the central institution to train those staff, including mechanics, involved in the operation and maintenance of construction equipment. Based on this conclusion, the Government of Sri Lanka prepared the Project to Establish the Construction Equipment Training Centre (the Project) and requested the Government of Japan's grant aid for the construction of facilities and the provision of equipment envisaged under the Project.

In response to the request made by the Government of Sri Lanka, the Government of Japan sent 2 Preliminary Study Teams (Preliminary Study Team I & II), headed by Isamu Goto, Counselor of Engineering of the Construction Method & Machinery Research Institute of the Japan Construction Mechanization Association, to Sri Lanka from July 18th to July 27th, 1993 and from September 19th to September 30th, 1993. It was subsequently decided that the Government of Japan would proceed with the Basic Design Study for the Project based on the examination results of the background of the original request for grant aid.

Entrusted by the Government of Japan, the Japan International Cooperation Agency (JICA) sent the Basic Design Study Team, headed by Toshimitsu Muramatsu, Deputy Director of the Construction Equipment Division, Economic Affairs Bureau, Ministry of Construction, to Sri Lanka from October 23rd to November 13th, 1993. The main items of the study conducted by the Basic Design Study Team are listed below.

(1) Confirmation of the components of the Sri Lankan request and background of the request

(2) Study on the project implementation agency and other related organizations

(3) Confirmation of the planned activities of the CETRAC

(4) Survey on the project site and current conditions of related infrastructure

(5) Examination of the proposed functions and sizes of the various facilities and analysis of technical issues relating to the construction work

(6) Survey on related facilities and equipment

(7) Consultations with various government organizations in Sri Lanka involved in the Project

(8) Gathering of information required to estimate the likely project cost

After conducting the various surveys necessary to prepare the Basic Design and a series of consultations with the Sri Lankan side, the Basic Design Study Team and Government of Sri Lanka agreed on the scope, implementation agency, project site and scope of work for each government, etc. under the Project and the Minutes of Discussions specifying the basic items of the Project were signed and exchanged by Dr. M.E. Joachim, Secretary for Construction & Building Materials of the Ministry of Housing and Construction, Government of Sri Lanka, and T. Muramatsu, leader of the Japanese Basic Design Study Team, on November 5th, 1993.

The above field survey was followed by further analysis in Japan and the Basic Design Report was compiled. The Government of Japan then sent the Basic Design Draft Final Report Explanatory Mission, headed by Isamu Goto, Counselor of Engineering of the Construction Method & Machinery Research Institute of the Japan Construction Mechanization Association, to Sri Lanka for 11 days from March 10th to March 20th, 1994.

The Explanatory Mission explained and discussed the contents of the Basic Design with the Sri Lankan counterparts and the Minutes of Discussions for the Basic Design Draft Final Report were signed and exchanged by Mr. W.D. Ailapperuma, Under-Secretary of the MHC & UD, and Mr. Isamu Goto, leader of the Japanese Mission, on March 17, 1994 to confirm the mutual agreement of the contents of the Basic Design.

The present Basic Design Study Report has been finalized incorporating the comments made by the Sri Lankan counterparts in the course of the above-mentioned discussions.

The list of the Study Team members, study schedule, list of the main interviewees and copies of the M/Ds are incorporated in this Report in the Appendices.

CHAPTER 2 BACKGROUND OF THE PROJECT

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2.1 General National Situation

Country Data

- Name : The Democratic Socialist Republic of Sri Lanka
- Land Area : 65,610 km^2 (17% of Japan's total land area)
- Population : 17.25 million (mid-1991 estimate)
- Capital : Sri Jayawardenepura Kotte (population: 100,000)
- Main Languages : Sinhalese, Tamil, English
- Political System : Constitutional Republic
- President : HE. D. B. Wijetunge
- Parliament : Single parliament (225 members serving a 6 year term)
- Cabinet : Prime Minister Hon. Ranil Wickremesinghe
- Population and Population Density
  - 1981 Census
    Nationwide : 14.85 million (230 persons/km^2)
    Colombo : 1.7 million (2,605 persons/km^2)
  - Estimates

Population

(Unit: 1,000)

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Nationwide	15,195	15,417	15,603	15,842	16,127	16,361	16,586	16,806	16,993	17,247
Colombo	1,737	1,763	1,785	1,812	1,840	1,863	1,886	1,911	1,935	1,965

Population Density

(Unit: persons/km^2)

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Nationwide	235	238	241	245	250	253	257	260	263	267
Colombo	2,660	2,700	2,734	2,758	2,801	2,837	2,871	2,909	2,945	2,991

• Ethnic and Religious Composition

Ethnic Composition

(Unit: 10,000)

	1981		1971	
Sinhalese	1,098.6	(74.0%)	913.1	(72.0%)
Tamils	269.7	(18.2%)	259.9	(20.5%)
Sri Lankan Tamils	187.2	(12.6%)	142.4	(11.2%)
Indian Tamils	82.5	(5.6%)	117.5	(9.3%)
Muslims	110.0	(7.4%)	89.9	(7.2%)
Burghers	3.8	(0.3%)	4.5	(0.3%)
Others	2.9	(0.2%)	1.6	(0.1%)
Total	1,485.0		1,269.0	

Religious Composition

(Unit: 10,000)

	1981		1971	
Buddhists	1,029.26	(69.3%)	853.69	(67.3%)
Hindus	229.58	(15.5%)	223.87	(17.6%)
Muslims	113.46	(7.6%)	90.18	(7.1%)
Christians	111.17	(7.5%)	100.43	(7.9%)
Others	1.53	(0.1%)	0.83	(0.1%)
Total	1,485.00		1,269.00	

Economic Data

• GDP (1991) : 9,072.3 million dollars

• GDP Growth Rate (Real, Rp-base)

(Unit: %)

Year	1989	1990	1991
Annual Growth Rate	2.3	6.2	4.8

• Per Capita GDP (1991) : 526 dollars

• GDP Share by Sector (1991)

(Unit: %)

Sector	Share (%)
Agriculture, Forestry and Fisheries	23.3
Mining and Manufacturing (Including Construction)	27.6
Service and Other Industries	49.1

- Foreign Reserves (end of November, 1992) : 927 million US dollars
- Outstanding Foreign Debt (estimate at end of 1991) : 6,553 million US dollars
- Consumer Price Inflation Rate (1991) : 12.2%
- Currency : Rupee (Rp)
- Foreign Exchange Rate : 46,000 Rp = 1 US$

- External Trade Value

(Unit: million dollars)

Year	1989	1990	1991
Exports	1,540	1,895	2,200
Imports	2,087	2,636	3,163

- Main Trade Items (1991, million dollars, %) (provisional)

Exports (FOB)

Item	Value	%
Agricultural Products	641	31.5
(Tea)	(432)	(21.2)
Industrial Products	1,226	60.1
(Textiles & Apparel)	(804)	(39.4)
Mining Products	62	3.0

Imports (CIF)

Item	Value	%
Consumer Goods	782	25.6
(Food & Beverages)	(405)	(13.2)
Intermediate Goods	1,553	50.7
(Crude Oil)	(311)	(10.2)
Capital Goods	720	23.5

o Main Trade Partners (1991, million dollars, %) (estimate)

Exports (FOB)

Country (Area)	Value	%
USA	595.3	27.1
Germany	208.0	9.5
Japan	119.9	5.5
UK	119.3	5.4
Iran	73.4	3.3

Imports (CIF)

Country (Area)	Value	%
Japan	321.3	10.2
UK	251.2	7.9
Hong Kong	243.8	7.7
Taiwan	197.6	6.2
USA	132.9	4.2

- GNP Share by Sector

Sector	Production Value (million Rp)			Growth Rate (%)		
	1990	1991	1992	1990	1991	1992
Agriculture, Forestry & Fisheries	30,001	30,507	30,112	8.5	1.9	-1.5
Mining	3,901	3,511	3,300	9.1	-10.0	-6.0
Manufacturing	22,427	23,949	26,106	9.5	6.8	9.0
Construction	8,761	9,003	9,665	2.9	3.1	7.0
Service	64,144	68,141	71,777	4.3	6.2	5.3
(GDP)	129,244	135,204	140,960	6.2	4.6	4.3
(GNP)	126,426	132,214	138,097	6.4	4.6	4.4

2.2 State Development Program

History of Development Plans in Sri Lanka

Plan	Period	Summary
1st 6-Year Plan	1947/48 - 1952/53	
2nd 6-Year Plan	1954/55 - 1959/60	The plan was based on an economic development programme proposed by the World Bank in 1952 but was withdrawn in 1956 when the UNP suffered a crushing defeat in the general election to the coalition led by the SLFP.
10-Year Plan	1959/60 - 1968/69	The plan had 5 basic targets, i.e. ① creation of employment opportunities, ② balancing of the international balance of payments, ③ improvement of the standard of living, ④ diversification of the economy and ⑤ fair distribution of the national income. Industrialisation was stressed as the means for diversification of the economic structure, improvement of the international balance of payments and creation of employment opportunities. After 2 years, the plan faced a crisis of the international balance of payments and was revised to a short-term plan for the period between 1962 and 1964. The plan was withdrawn with the defeat of the SLFP administration in the general election in 1965.
New 5-Year Plan	1972 - 1976	This plan also had 5 basic targets, i.e. ① reform of the economic structure from the long-term viewpoint, ② implementation of short-term measures to improve the international balance of payments and to increase employment, etc., ③ mitigation of social tension by means of suppressing unnecessary consumption and the fair distribution of income, etc. ④ implementation of various measures targeted at the low income class, including the provision of housing, hygiene and daily food and an improved nutrition standard, etc. and ⑤ vitalisation and modernisation of agricultural communities and fostering of rural industries. The planned total investment amount for the plan was 14.82 billion Rp, most of which was supposed to be appropriated from domestic savings with a mere 1.5 billion Rp earmarked for aid from overseas. This rather unrealistic plan was virtually abandoned in the second part of the plan period due to the worsening international economic environment caused by the oil-shock and instability of domestic politics with intensified ethnic conflict.

1st 5-Year Public Investment Plan (Rolling Plan)	1979 - 1983	The Jayawardene administration, which came to power after an overwhelming victory in the general election in 1977, intended to combat the economic stagnation of the country and introduced a series of policies designed to improve the international balance of payments, such as privatisation and trade liberalisation to foster private capital and the market economy system. The plan was prepared to provide guidelines for public investment for a period of 5 years and had a provisional nature as a rolling plan with the plan contents reviewed and revised every year based on the actual investment volume of a given year, the maturity of feasibility studies for each project and the availability of investment funds, etc. The targets given at the beginning of the plan were the creation of jobs and capital accumulation by means of the liberalisation and vitalisation of economic activities. Concrete projects included the Mahaweli River Development Project, establishment of export processing zones and housing development. While this rolling plan has been revised every year, the basic plan targets have remained almost the same with different degrees of emphasis on the target investment fields depending on the economic situation of each year. The performance for the period between 1984 and 1988 included an average annual economic growth rate of 3.7%, which was short of the target 5.4%. By sector, the manufacturing sector showed favourable average annual growth of 7.9% due to increased apparel exports by the private sector. The corresponding rates for the agricultural sector and service sector of 1.3% and 5.0% respectively were modest. The high inflation rate of 8.9% for the period was presumably caused by the lasting drought and social instability.
2nd	1980 - 1984	
3rd	1981 - 1985	
4th	1982 - 1986	
5th	1983 - 1987	
6th	1984 - 1988	
7th	1985 - 1989	
8th	1986 - 1990	
9th	1987 - 1991	
10th	1988 - 1992	
11th	1989 - 1993	
12th	1990 - 1994	
13th	1991 - 1995	
14th	1992 - 1996	

2.3 Outline of Construction Sector

2.3.1 Current Conditions and Issues of Construction Sector

The ancient kingdoms in Sri Lanka were supported by irrigated agriculture and Buddhism. The dry area extending from the north central part of the country to the eastern part is suitable for agriculture, particularly rice growing in paddy fields, due to the flat landscape but requires extensive irrigation facilities to compensate for the low rainfall. The most important public works of the ancient kingdoms were the construction of such irrigation facilities and a complicated irrigation network based on much advanced technologies was already in place in Sri Lanka some 2,000 years ago. A notable feature is that these irrigation facilities were not monopolised by the State but entrusted to the management of village communities and Buddhist temples, etc., suggesting the wide spread of advanced technologies across the country and also implying the great potential of Sri Lanka's construction sector.

The construction sector which supported agriculture, in turn the very basis of the ancient societies and economy of Sri Lanka, through the provision of advanced technologies for irrigation facilities is of equal importance in today's society as it is inevitably involved in all economic development activities. The construction sector accounts for some 7 - 8% of Sri Lanka's GDP. Its annual growth rate was as high as 11% in the period of intensive public investment between 1978 and 1983 but declined to an average annual rate of 5% in the second half of the 1980's when the 3 main public investment projects, i.e. the Mahaweli River Development Project, an urban redevelopment and housing project and an export processing zone project, of the 1st 5-Year Public Investment Plan which commenced in 1979 were virtually completed.

The growth rate further declined in the early 1990's but then turned upwards with the revitalised housing construction under the One Point Five Million Houses Programme (OPFMHP) which commenced in 1990 and the Road Network Expansion Programme of the Road Development Authority (RDA), etc., reaching 7% in 1992 which was the second highest annual growth rate of all sectors. (Table 2-1)

In Sri Lanka where mass unemployment has become a social problem, the construction sector is estimated to provide employment opportunities for 500,000 - 600,000 people but the actual employment figure is put at some 300,000. As most of the unemployed are unskilled workers with many skilled workers opting to work abroad for better wages, there is a shortage of skilled workers despite the high unemployment rate. Although construction workers are believed to make up some 3% of the total workforce, there is quite a serious shortage of core engineers and skilled workers. This situation suggests that once appropriate measures are

introduced to systematically train engineers and skilled workers and to stimulate employment, the number of workers in the construction sector may well be doubled within several years.

Apart from the skilled worker shortage, the construction sector also faces such problems as a lack of sufficient work experience on the part of local subcontractors, an inadequate material supply system, poor work management ability in the private sectors, poor knowledge of contract forms, specifications, construction methods and construction materials, etc. and inadequate provision of an established procedure to solve problems arising from contracts, etc.

The following improvements should be made to solve the current problems of the construction sector and to improve its productivity in the future.

(1) Improvement of design capability
(2) Adoption of appropriate construction methods
(3) Improvement of technical training and labour recruitment programme
(4) Qualitative improvement of construction materials
(5) Establishment of a cooperation system between owners and contractors
(6) Establishment of legitimate and proper contract relationships

To restore education, medical care, telecommunications and roads, etc., all of which have suffered from devastating damage due to conflict, and to consolidate the social and economic infrastructure to ensure Sri Lanka's sustainable economic growth, it is essential to improve the productivity of the construction sector through qualitative improvements and cost reductions, in turn resulting from the introduction of capable manpower, appropriate construction methods and high quality construction materials. Consequently, systematic manpower development must be conducted as part of the overall efforts to strengthen the construction sector.

Table 2-1 Composition and Growth Rate of GNP 1990-1992 at Constant (1982) Factor Cost Prices

Item	Amount (Rs. Million)			Growth Rate		
	1990*	1991*	1992*	1990*	1991*	1992*
1. Agriculture, Forestry & Fishing of which	30,011	30,570	30,112	8.5	1.9	-1.5
1.1 Tea	3,004	3,100	2,303	12.6	3.2	-25.7
1.2 Rubber	718	655	662	3.0	-8.8	1.1
1.3 Coconut	3,261	2,827	3,018	1.6	-13.3	9.0
1.4 Paddy	6,378	6,002	5,882	21.3	-5.9	-2.0
1.5 Other (other Agriculture, Forestry & Fishing)	16,650	17,986	18,184	5.2	8.0	1.1
2. Mining & Quarrying	3,901	3,511	3,300	9.1	-10.0	-6.0
3. Manufacturing	22,427	23,949	26,106	9.5	6.8	9.0
3.1 Tree Crop Processing	3,530	3,332	2,959	8.4	-5.6	-11.2
3.2 Other	18,897	20,617	23,147	9.7	9.1	12.3
4. Construction	8,761	9,033	9,665	2.9	3.1	7.0
5. Services	64,144	68,141	71,777	4.3	6.2	5.3
6. G.D.P.	129,244	135,204	140,960	6.2	4.6	4.3
7. Net Factor Income from Abroad	-2,818	-2,990	-2,863	–	–	–
8. G.N.P.	126,426	132,214	138,097	6.4	4.6	4.4

* Provisional
Note : Values for 1992 are basd on available Customs data.
Source : Central Bank of Sri Lanka

2.3.2 Current Conditions of Engineer Training

(1) Education in Sri Lanka

All Sri Lanka's governments have historically emphasised education, achieving a literacy rate of 87% (91% for men and 83% for women) which is much higher than the literacy rates of other countries in Southwest Asia and which is almost on a par with those of industrialised countries. Sri Lanka's educational system has similarities with the British system with a school entrance age of 5 years. General education consists of 8 years of compulsory education (5 years of primary education and 3 years of junior secondary education), 3 years of senior secondary education (Ordinary Level) and 2 years of collegiate education (Advanced Level) , totalling 13 years. (Fig. 2-1)

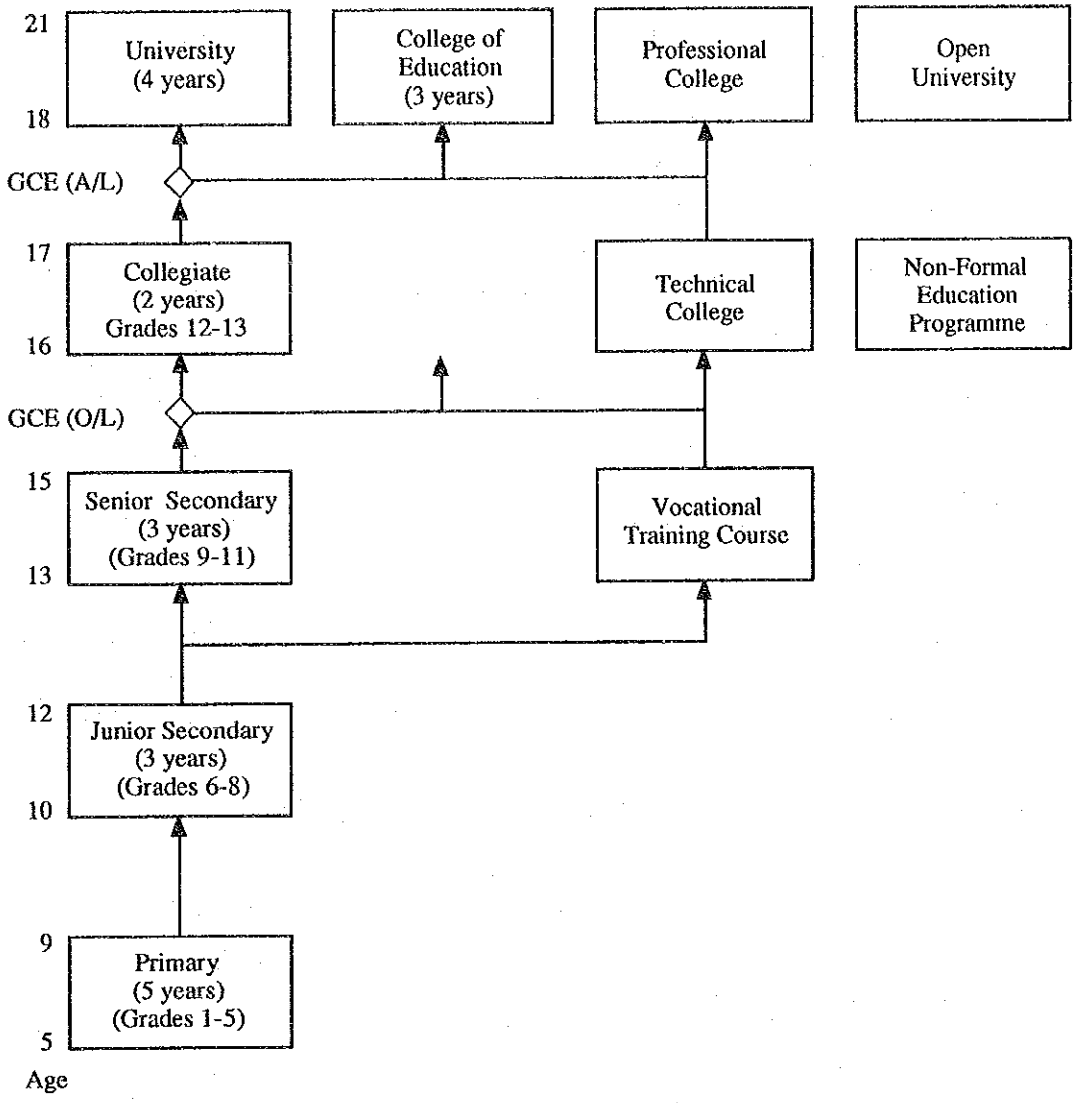


Fig. 2-1 Education System in Sri Lanka

According to 1991 statistics of the Ministry of Education and Higher Education, Sri Lanka has a total of 10,401 schools, ranging from primary schools to senior secondary schools, and 4,251,704 pupils.

Domestic science and vocational/technical education are included in the curriculum for Ordinary Level senior secondary education. At the end of this period, the General Certificate of Education - Ordinary Level (GCE O/L) Examination takes place and the successful students qualify to go on to Advanced Level collegiate education or technical colleges. Advanced Level collegiate education is divided into 3 main courses, i.e. science, commerce and literature, and the General Certificate of Education - Advanced

Level (GCE A/L) Examination takes place at the end of the 2 year course. The successful students qualify to enrol at universities or other institutions of higher education.

There is a total of 18 higher education institutions (8 universities, one college of education, one open university, one private medical college and 7 professional colleges) and students are admitted based on successful Advanced Level Examination results depending on vacancies.

Literature students account for 62.7% of the total number of students undergoing higher education, followed by natural science students (16.1%), medical and pharmaceutical students (10.9%), engineering students (9.7%) and others (0.6%).

The Government of Sri Lanka is attempting to reduce the number of literature students while increasing the number of science and engineering students and expanding the science and engineering faculties to reduce the manpower shortage in the science fields (doctors, engineers and agricultural engineers, etc.). However, the brain drain of capable lecturers overseas has become a serious obstacle to these efforts.

(2) Technical and Vocational Education

Many technical and vocational education courses are provided by government ministries and agencies in Sri Lanka and are basically classified into the following 4 categories.

① Specialised Engineering Courses at University and Graduate School Level

These courses are intended to improve the quality of engineering teachers and the students are registered as qualified teachers upon successful completion of their respective courses. (Table 2-2)

② Technical Education

Various courses are provided by professional colleges. While commercial courses attract 74.2% of students, engineering courses are less popular with only 25.8% of students. The average successful completion ratio is 10 - 18% for engineering courses and 12% for commercial courses. The ratio of successful students is disappointingly small despite the aspiration of professional colleges to actively produce capable manpower to contribute to society. (Table 2-3)

③ Technical Training

These training courses are mainly provided by Moratuwa University, the Open University, the Technical Training Institute (TTI) and Apprenticeship Training Institute (ATI). (Table 2-4)

④ Vocational Training at Skilled Worker Level

These education and training courses are mainly provided by the National Apprenticeship and Industrial Training Authority (NAITA) for a wide range of jobs with emphasis on those jobs with a high demand in the industrial circle. The training courses provided by the NAITA, however, face the problem of inadequate modern facilities for practical training in comparison with those courses provided by the TTI or ATI. A high drop-out rate is another problem of the NAITA training courses. (Table 2-5)

In addition to those courses provided by the NAITA, 21 short courses (6 months - one year) are available at the Technology Improvement Centre and Automobile Centre run by the Ministry of Labour. The Ceylon German Technical Training Institute (CGTTI) run by the Ministry of Transport provides technician training courses. Furthermore, there is a training institute designed to produced the skilled construction workers (bricklayers, plumbers, carpenters and electricians, etc.) required to implement the urgent housing construction programmes of provincial governments and the Ministry of Housing Construction.

Other training schemes include various on-the-job training courses and non-formal training courses provided by skilled workers' unions.

Those students seeking a career in the architecture and construction fields can enrol on the architecture course at Moratuwa University or a construction/civil engineering course at some of the other universities. Nevertheless, many serious students choose to study abroad, especially in Britain.

Technical education in regard to construction machinery is largely classified into operator training and mechanic training and the ICTAD plays a central role in both areas. The main facility for operator training is the Operator Training Centre (OTC) at Anuradhapura. No such facility is currently available for mechanic training except for on-the-job training based on the Modules of Employable Skills (MES) Programmes.

Table 2-2 Engineering Education at University and Graduate School Level

Institution	Courses	Remarks
Peradeniya University Moratuwa University	• Engineering • Science and Technology	4 years; GCE A/L (mathematics and science) required for admission
Open University (Engineering Faculty)	• Civil Engineering • Electrical Engineering • Mechanical Engineering • Computer Engineering	B.Sc. awarded to successful students
Engineering Research Institute	-	Non-formal education at engineering degree level

Table 2-3 Technical Education

	Course Category	No. of Subjects	Name of Subjects	Duration	Eligibility Requirements
1	Higher National Diploma	5	Accounting, Commerce	Full-time (4 years)	Relevant GCE A/L or university level commerce or economics background
			Civil Engineering, Mechanical Engineering, Electrical Engineering	Full-time (4 years)	Relevant GCE A/L (applied science, mathematics and physics)
2	National Diploma	6	Agriculture	Full-time (3 years)	GCE O/L (6 subjects including mathematics, physics and English)
			Commerce	Full-time (2 years)	GCE O/L (economics, commercial finance and accounting)
			Domestic Science	Full-time (2 years)	GCE O/L (3 subjects, including domestic science)
			Jewellery Design/ Handicrafts	Full-time (2 years)	GCE O/L or NCGE
			English English	Full-time Part-time	
3	National Certificate	17	Business	Full-time (2 years)	GCE O/L
			Shorthand, Sales, Civil Engineering, Mechanical Engineering, Jewellery/ Electrical Engineering, etc.	Full-time or part-time (1-3 years)	GCE O/L (depending on subject)
4	National Craft (Trade) Certificate	20	Mechanical Engineering, Car Maintenance, Electrical Engineering, Woodwork, Radio, Wiring, Plumbing, Welding, Electrical Machinery, Air-Conditioning, etc.	Full-time or part-time (1-3 years)	GCE O/L and/or 9 years of education (depending on subject)
5	Short Courses	20	Wood Carving, Radio, Blacksmith, Motorbike Repair, Artificial Flower Making, Doll Making, Tailoring, Batik, etc.	Full-time or part-time (3 months - 1 year)	8 - 9 years of education (depending on subject)

Table 2-4 Technical Training

Institution	Courses	Remarks
Moratuwa University	National Diploma in Technology	GCE A/L required; 3 years; 1 year pre-training
Open University	① Diploma in Textile Engineering Woollen Yarns, Weaving, Knitting, Scientific Processes, Apparel Technologies, Textile Inspection and Statistics ② Diploma in Science and Technology Civil Engineering, Electrical Engineering, Telecommunications, Electrical Appliances, Mechanical Engineering	Basic course for 2 years; 21 days basic training; 30 hours special practical training
Technician Training Institute	Engineer Level Civil Engineering, Mechanical Engineering, Electrical Engineering	3 years industrial training; 1 year group training
Apprenticeship Training Institute (with German assistance)	Technician Training	3 years with 12 months for basic training, 4 months for advanced training and 20 months for on-the-job training

Table 2-5 Vocational Training at Skilled Worker Level at National Apprenticeship Board (NAB)

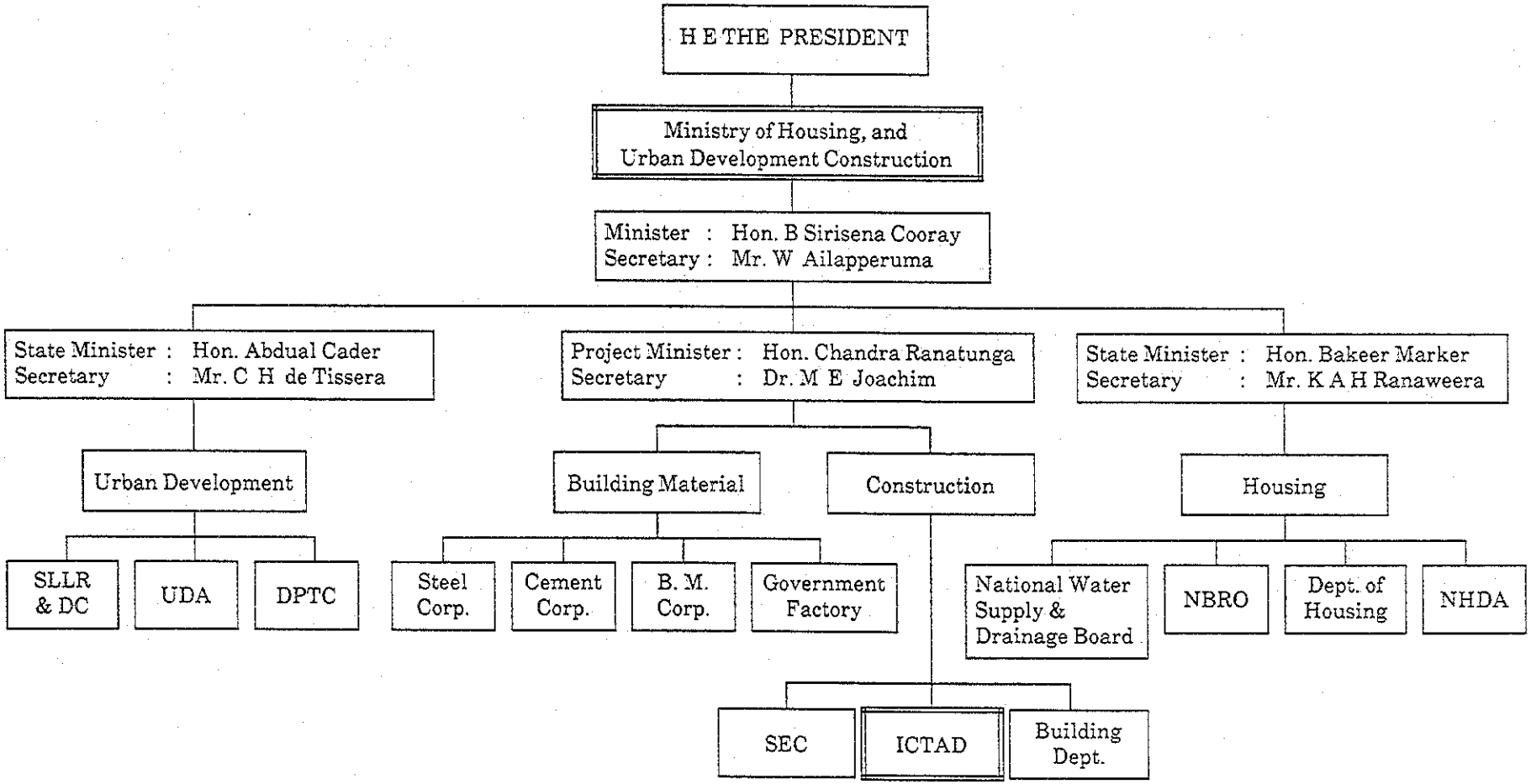
	Course	Duration (months)	Eligibility
1	Engineer Course for Students	6	University students
2	Engineer Course	12	Completion of 2 years of NDT
3	Special Training Course	48	GCE O/L
4	Special Training Supplementary Course	12 - 48	GCE O/L
5	Engineer Course	12	GCE O/L
6	Practical Engineer Training Course	6 - 48	GCE O/L and 7 - 8 years of general education
7	Special Practical Engineer Training Course	6 - 48	GCE O/L and 7 - 8 years of general education
8	Village Level Practical Training Course	12	6 years of general education

All training courses aim at upgrading the skills of existing technicians and skilled workers rather than fostering new technicians and skilled workers. The courses consist of modules so that the trainees can gradually upgrade their skills while retaining their jobs.

There is a tendency in Sri Lanka for qualified engineers and technicians, etc. to seek employment overseas in view of higher wages and the government has not necessarily tried to deter this practice because these workers send foreign currency back to Sri Lanka. As any sustainable economic development in the future will require the sufficient provision of capable engineers and technicians at home, the establishment and consolidation of a manpower development system and the encouragement of their long service in Sri Lanka by providing stable employment and improved wages are extremely important.

Table 2-6 Technical Colleges and Number of Students

	1986	1987	1988	1989	1990	1991
Number of Technical Colleges	27	27	28	29	30	30
Number of Staff						
Teachers	529	593	655	654	681	692
Others	572	600	681	610	612	-
Total	1,101	1,193	1,336	1,264	1,293	692
Higher National Diploma (HND)	965	1,073	942	1,168	1,083	1,304
National Diploma (ND)	579	648	466	619	697	735
National Certificate (NC)	6,314	6,678	5,807	6,839	6,583	6,575
National Craft (Trade) (NCC)	1,105	1,274	975	1,407	1,239	1,753
Others	5,504	5,837	5,965	3,229	2,772	2,269
Total	14,467	15,510	14,155	13,262	12,374	12,636
Number of Students						
Higher National Diploma (HND)	3,250	2,993	2,967	3,197	2,882	3,112
National Diploma (ND)	1,127	921	802	1,070	995	1,219
National Certificate (NC)	9,270	9,969	9,323	9,721	9,512	10,314
National Craft (Trade) (NCC)	1,787	1,745	1,654	1,905	1,802	2,271
Others	5,504	5,792	5,960	3,201	3,381	2,395
Total	20,938	21,420	20,706	19,094	18,572	19,311



SLLR & DC : - Sri Lanka Land Reclamation and Development Corporation
UDA : - Urban Development Authority
DTCP : - Department of Town and Country Planning
BM - Building Materials Corporation
SEC - State Engineering Corporation
ICTAD - Institute for Construction Training and Development
NBRO - National Building Research Organization
NHDA - National Housing Development Authority

Fig. 2-2 Organization of MHC & UD

2.3.3 Activities of ICTAD

(1) General

The Institute for Construction Training and Development (ICTAD) was established in 1986 as a part of the Urban Development Authority (UDA) of the Ministry of Housing and Construction (MHC) and as a successor to its predecessor, the Construction Industry Training Project (CITP). It was subsequently moved to the Ministry of Policy Planning and Implementation which plans and implements Government policies. On 10th June 1992 ICTAD was created a corporation under the Industrial Corporation Act giving it greater authority to implement its programmes for the development of the construction industry. MHC was reorganized as Ministry of Housing, Construction and Urban Development (MHC & UD) in December 1993. (Fig. 2-2)

The ICTAD was established to expand both the qualitative and quantitative aspects of research and training to foster technicians, senior technicians and managers and to improve the quality and efficiency of the construction industry through technological innovation, industrialisation and cost reduction. Its organizational structure mainly consists of the following 5 divisions, forming 3 functional groups. (Fig. 2-3)

1) Training and Research Division/Operator and Mechanic Training Division

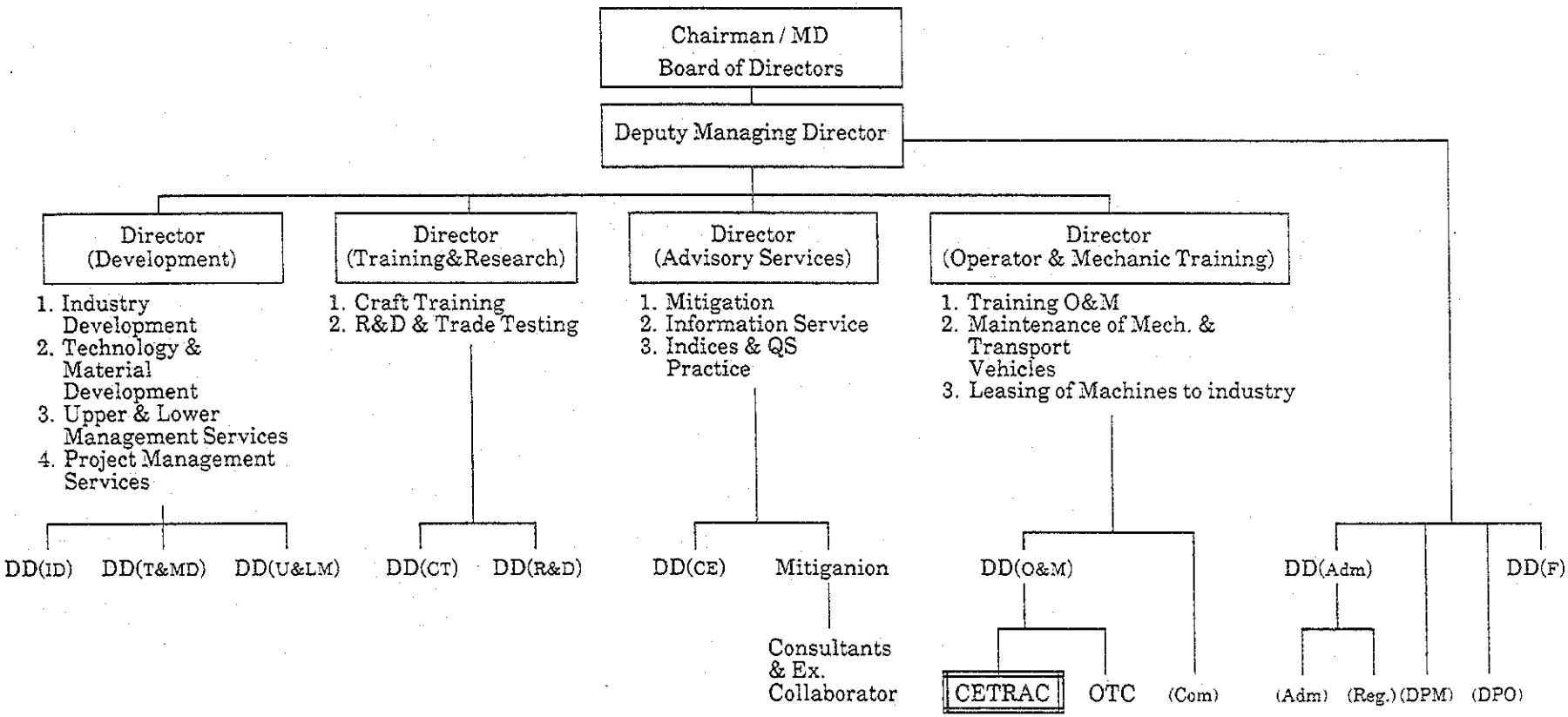
These 2 divisions conduct the following activities to foster capable manpower for the construction industry.

- Planning, design, implementation and monitoring of training programmes
- Preparation of training curriculum designed to satisfy the latest requirements
- Development and implementation of joint training programmes with end users and other organizations
- Joint implementation of training programmes with other organizations
- Establishment and management of a training and information centre
- Provision of assistance to establish skill standards and qualification systems
- Research and surveys on manpower development

2) Development Division/Advisory Services Division

These 2 divisions conduct the following activities to improve the efficiency and productivity of the domestic construction industry

- Provision of management advice
- Establishment of consulting and construction guidelines



MD - Managing Director
QS - Quantity Surveying
U&LM - Upper & Lower Management
F - Finance
Reg. - Registrar
O&M - Operator & Mechanic
DD - Deputy Director
CT - Craft Training
Ex. - External
DPM - Data Processing Manager
R&D - Research & Development
ID - Industry Development
CE - Construction Economics
AD - Assistant Director
DPO - Documentation & Publicity Officer
Mech. - Mechanic
T&MD - Technology & Material Development
Adm. - Administration
Com. - Commercial

Fig. 2-3 Organization of ICTAD

- Establishment of vocational guidelines for PMs (project managers) QSs (quantity surveyors), CMs (construction managers) and architects
- Preparation and control of a constructor register and establishment of constructor selection guidelines
- Preparation of a reform programme for industrial structure
- Research and surveys on construction technologies and materials
- Establishment of specifications, rules and standards
- Provision of an information service
- Analysis of labour management-related issues
- Calculation of economic indices
- Preparation of a database

3) Administration Division

The Administration Division is engaged in the following activities.

- Allocation and efficient use of funds provided by the government or parent organization
- Development and consolidation of ICTAD's organization
- Control of ICTAD assets
- Establishment of a monitoring and evaluation system for ICTAD activities
- Implementation of a management information system
- Provision of communication equipment

The ICTAD intends to continue its activities on the basis of the above 5-division structure and is seeking to improve the quality and productivity of Sri Lanka's construction industry by achieving the objectives and targets of each division.

Table 2-7 Budget of ICTAD

Unit: million Rs

	1990	1991	1992	1993	1994
G.O.S.L. Contribution	22.0	25.0	35.0	46.0	60.0
Foreign Aid	43.0	47.5	40.0	74.0	68.0
Revenue Generation	21.0	18.0	13.5	14.0	15.0
Budget	86.0	90.5	88.5	134.0	143.0

(2) Activities of Operator and Mechanic Training Division

The Operator and Mechanic Training Division is engaged in 2 main training schemes, i.e. the training of construction equipment operators at the Operator Training Centre (OTC) and on-the-job training (OJT) for construction equipment mechanics based on the Modules of Employable Skills (MES) Programme.

1) OTC

In 1982 when the ICTAD was still called the CITP, the OTC was established with guidance provided by the the British Council and the assistance of the International Development Association (IDA). It has since systematically conducted the training of construction equipment operators. Located at Galkulama near Anuradhapura, the OTC currently has 40 heavy construction machines, 45 light construction machines for practical training and 141 staff members, including some 50 training instructors and demonstrators. It has conducted the training of some 3,450 operators since its foundation. (Fig. 2-4) (Table 2-8)

Of the training courses provided by the OTC in fiscal 1994 which are separately shown (Table 2-9), only a start-up inspection and basic inspection course is available for beginners. As the training at the OTC is basically designed for actual operators, the courses have been established on a module basis so that the trainees can gradually improve their skills through the combined learning process of short-term training at the OTC and actual work at their place of employment without having to leave the latter for a long period of time. The trainees are allowed to commence training by selecting a module which is appropriate in terms of their practical experience and skill levels. They then gradually move on to modules involving higher skills.

There are 3 types of training modules at the OTC based on the course duration, i.e. one week, 2 weeks and 3 weeks. One training week consists of 6 days and one training day has 4 classes, i.e. 2 in the morning and 2 in the afternoon. There is a test at the end of the course to check the acquired level of knowledge and skill and any trainee with a test score of 59 points or less out of a total of 100 is deemed to have failed the course.

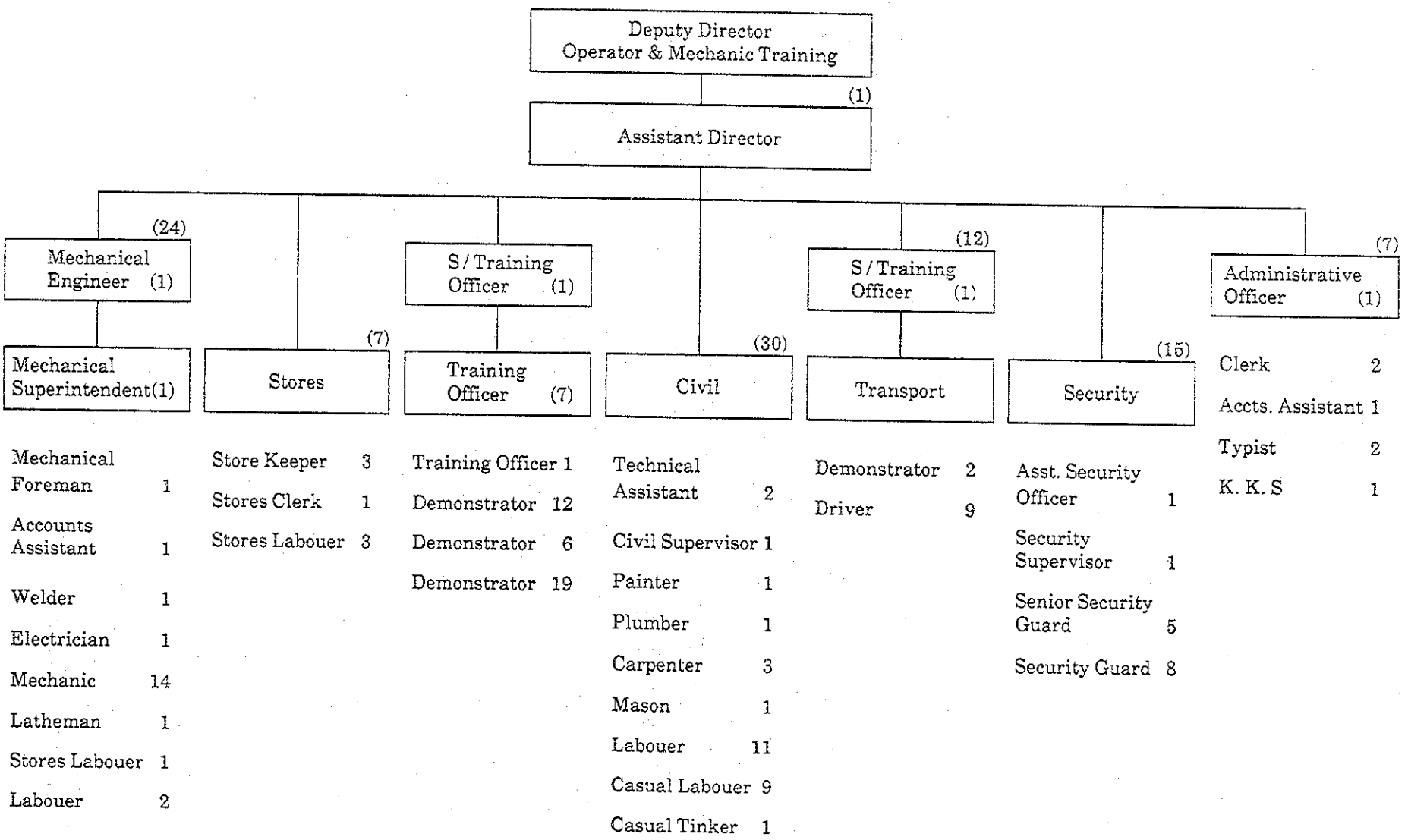


Fig. 2-4 Organization of OTC

Table 2-8 Number of Trainees at OTC (1981 - April, 1993)

Training Subject	1981-1986	81	82	83	84	85	86	87	88	89	90	91	92	93	Sub-Total 87-93	Sub-Total 81-93
Operator Training																
1. Rope Excavator	12	-	-	-	7	5	-	-	-	-	-	-	-	-	-	12
2. Crawler-Dozer	115					57	58	54	64	20	43	32	46	18	277	392
3. Loader	443		97	108	132	50	56	58	60	26	43	32	46	19	284	727
4. Motor Grader	107					53	54	44	41	14	36	36	44	16	231	338
5. Hydraulic Excavator	95	-	-	-	-	49	46	23	16	5	22	24	17	-	107	202
6. Motor-Scraper	48	-	8	4	17	13	6	-	3	-	-	-	3	-	6	54
7. Dump Truck	77	-	-	-	9	23	45	-	17	-	8	18	-	15	58	135
8. Plant Transporter	2	-	-	-	-	2	-	1	4	-	3	1	4	-	13	15
9. Crane	20	-	-	-	16	-	4	6	2	2	4	3	5	-	22	42
10. Elementary Maintenance	-	-	-	-	-	-	-	-	-	-	-	39	328	225	592	592
11. Supervisor/ Maintenance	-	-	-	-	-	-	-	33	53	-	24	16	50	13	189	189
12. Light Construction Equipment	364	-	124	221	-	12	7	12	30	25	41	34	88	47	267	631
Total	1,283	-	229	333	181	164	276	231	290	92	214	235	631	353	2,046	3,329

Table 2-9 Main Training Courses of OTC (fiscal 1994)

Course Title			Duration (weeks)	Class Size and Frequency (persons/class)	Annual Training Capacity (persons)
1.1	BaCEM	Basic Construction Equipment Maintenance for Operators	1	10 × 10 times/year	100
1.2	LEO	Light Equipment Operator Training	2	8 × 6 times/year	48
1.3	DT	Dump Truck Driver Training	2	4 × 5 times/year	20
1.4	HEMOT	Dozer Operator Training	3	4 × 6 times/year	24
1.5	HEMOT	Loader Operator Training	3	4 × 6 times/year	24
1.6	HEMOT	Grader Operator Training	3	3 × 6 times/year	18
1.7	HEMOT	Excavator Operator Training	3	3 × 6 times/year	18
1.8	SCR	Scraper Operator Training	2	2 × once/year	2
1.9	CRN	Crane Operator Training	3	4 × twice/year	8
1.10	PT	Plant Transporter Driver Training	3	2 × once/year	2
1.11	PM	Plant Management Training	1	10 × twice/year	20
1.12	TT	Trade Testing of Operators	1	20 × twice/year	30

Those trainees successfully completing the start-up inspection and basic inspection course, commence work as assistant construction equipment operators to gain experience through basic start-up inspection and daily inspection work. Some of them go on to the next stage of training, i.e. the light construction equipment operator courses at the OTC, at their own choice or under the instruction of the companies or organizations for which they work. Following the completion of training, they commence work as light construction equipment operators. After obtaining further experience, some return to the OTC to undergo training to become heavy construction equipment operators. (Fig. 2-5)

All the training courses at the OTC are placed along a single axis from the introductory level to the supervisor level and the trainees can improve their skills at the level which is appropriate for their expertise. However, the manager course designed to train managers demands a university degree or equivalent as the entry requirement and differs from the other modules (courses) in that it emphasises the management of construction equipment rather than the operation of such equipment.

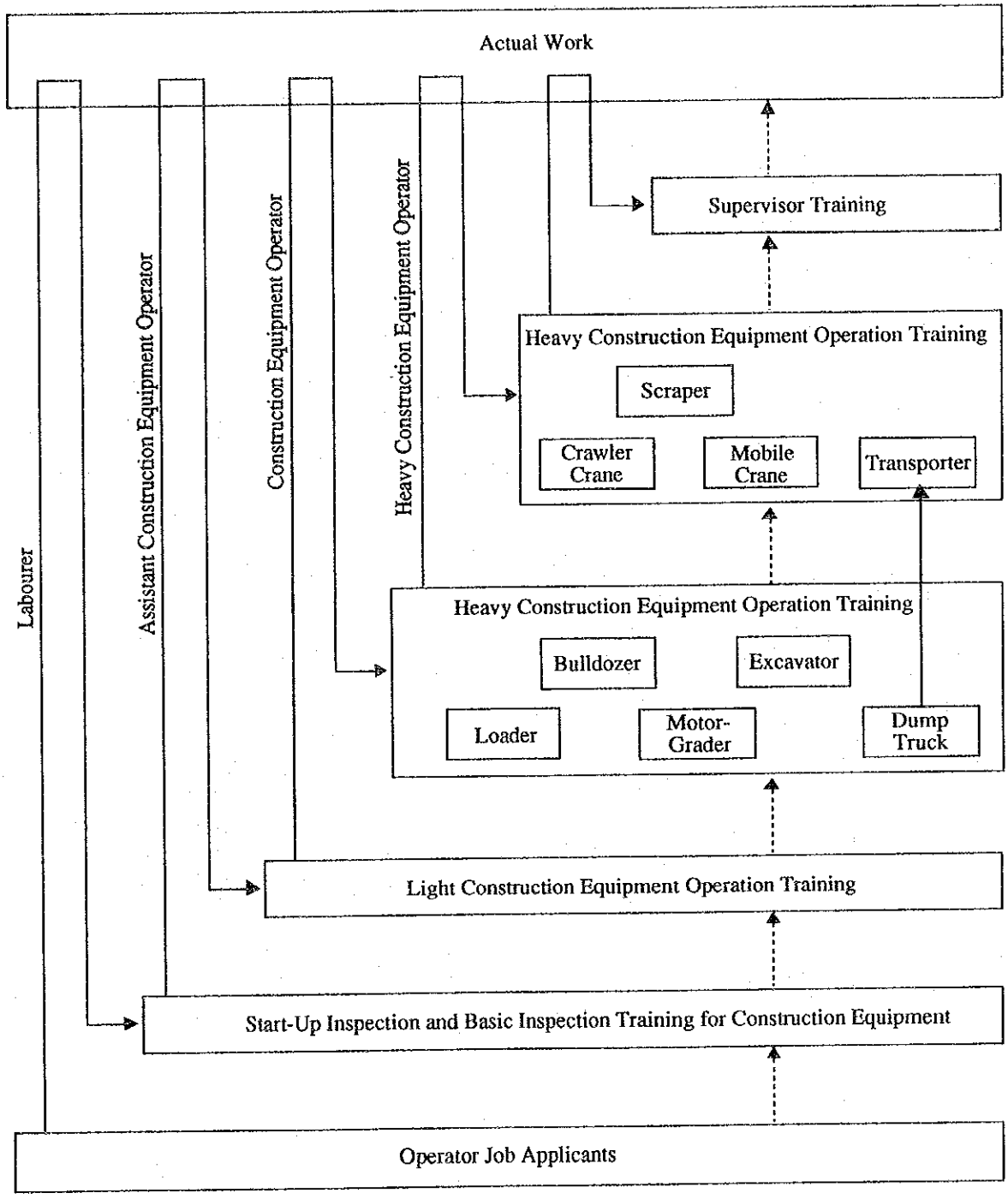


Fig. 2-5 Training Programme Structure of OTC

2) MES

The MES was established in 1991 with the backing of the ILO and is the only official mechanic training programme for construction equipment in Sri Lanka. Traditionally, the training of construction equipment mechanics in Sri Lanka is conducted on-site based on apprenticeships and few mechanics have actually undergone official technical training. As a result, many mechanics are only capable of repairing equipment within the framework of their field of experience and the their technical quality level is rather low. The MES programme was introduced to improve this situation and is an OJT system to be conducted in accordance with textbooks and programmes prepared by the ICTAD. It is similar to the conventional training style in that the actual training takes place at the place of employment. However, it has the additional aspect of establishing uniform technical ability among junior mechanics through OJT at 41 designated workplaces at 26 locations across the country under instructors with rich theoretical and technical understanding in line with the guidelines set by the ICTAD. (Table 2-10)

The MES course also consists of modules. In total, 3,039 OJT modules were completed between January and September, 1993. As many trainees take up more than one module, the actual number of trainees is believed to be some 600.

The ICTAD is currently preparing textbooks for the MES to be completed by the end of 1995. With the completion of textbooks for all modules in 1995, work will then commence to successively revise them so that the contents of the textbooks and training programmes reflect the latest technical innovations in the construction equipment field. This intention illustrates the determination of the ICTAD to develop high quality textbooks which incorporate the latest knowledge and technologies.

Table 2-10 MES Modules

Module Number	Duration (weeks)	Module Title
I	36	Maintenance and Inspection
II	16	Engine Overhaul
III	20	Vehicle Electrical System
IV	16	Hydraulics
V	12	Brakes
VI	12	Diesel Ignition System
VII	10	Wheel Alignment and Tyres
VIII	14	Light Vehicle Transmission and Driving System
IX	18	Heavy Vehicle Transmission and Driving System
X	2	Surveying Equipment and Surveying

2.4 Outline of the Request

The Government of Sri Lanka gives the highest priority of its development efforts to economic development and consolidation of the social infrastructure by introducing a series of policies designed to stabilise the economy, to stimulate future growth and to create employment opportunities in order to guarantee the continuous development of the country. To support the envisaged vigorous economic activities, strengthening and expansion of the socioeconomic infrastructure, particularly electricity supply, transportation and telecommunications, etc., are essential. The expected population and income increases following stabilisation of the economy will certainly increase the demand for housing, water supply, education and medical care, etc. in terms of both quality and quantity. In addition to these new social demands, there are other issues which require urgent attention, including the repair, refurbishment and/or rebuilding of a wide range of facilities which have not been properly maintained and local facilities which were hastily constructed in the past.

The road network, which was in relatively good condition at the time of independence, now faces many problems due to inadequate investment in subsequent years and the poor maintenance system. In recent years, the Government of Sri Lanka has classified improvement of the road network as one of its most important tasks and has introduced such policies as the privatisation of road construction work, decentralisation of the road management authority, adoption of road and bridge standards and the use of modern construction equipment, etc. as well as increased infrastructure investment as part of the public investment programme.

There is no denying that the construction sector, which is the means to improve the economic infrastructure, plays an important role in national development and construction machinery, equipment and manpower are crucial factors in formulating a schedule to achieve Sri Lanka's envisaged social and economic targets.

The emphasis on infrastructure development, increased inward investment and new housing for the poor mean an increased construction work volume in every economic sector, compelling both public and private organizations/companies to import ever more construction equipment. Consequently, some 6,000 pieces of construction equipment, light and heavy, are believed to exist in Sri Lanka today. However, it is also believed that almost half of these are out of order due to poor maintenance. Although appropriate repair and maintenance are essential for the efficient operation of construction equipment, Sri Lanka lacks an organization devoted to the training of mechanics for construction equipment, resulting in a shortage of mechanics in this particular field. Upgrading of the skill level of existing

mechanics is also urgently required as 75% of the present construction equipment is less than 10 years of age, demanding a high level of maintenance skill.

In order to improve the current situation described so far, the Government of Sri Lanka has requested the Government of Japan's grant aid for the Project for Establishment of Construction Equipment Training Centre (CETRAC) to foster mechanics and to upgrade the skill level for construction equipment maintenance. The main components of the request are outlined below.

Facilities (Buildings)	:	Administration Building Training Building Training Workshop Dormitory Garage Others
Equipment	:	Construction Equipment - loader, grader and crane, etc. Workshop Machinery - workshop machinery, training equipment and tools, etc. Training and Educational Equipment - equipment models, copier and computers, etc.

CHAPTER 3 OUTLINE OF THE PROJECT

CHAPTER 3 OUTLINE OF THE PROJECT

3.1 Objective

There are 3 major categories of mechanics working in Sri Lankan society, i.e. automotive mechanics, construction equipment mechanics and agricultural machinery mechanics. According to a survey conducted by the ICTAD in 1989, only 32% of those mechanics currently employed have a formal technical training background. Although technical courses are provided by technical colleges and other institutions to train and upgrade mechanics, few courses are available for those wishing to become construction equipment mechanics. Consequently, most novice mechanics are the products of apprenticeships. Many construction equipment mechanics, therefore, lack the necessary theoretical background for their skills and are only capable of conducting repair work within the framework of their actual experience. The resulting work quality level is generally rather poor, resulting in a low construction equipment operation rate and even reducing the productivity of the entire construction sector.

In view of this situation, the ICTAD, which aims at developing manpower and upgrading the skill level in the construction sector, has prepared the Project for Establishment of Construction Equipment Training Centre (CETRAC) which will play a central role in the establishment of an appropriate operation and maintenance system for construction equipment and in the development of manpower and improvement of the skill level to improve the productivity of the construction sector. The porpose of the Project is to train managers, supervisors and mechanics of construction equipment to improve both the opration rate of construction equipment and the productivity of the entire construction sector by menans of constructing facilities and procuring the necessary equipment to ensure efficient and effective training.

3.2 Examination of the Request

3.2.1 Appropriateness and Necessity of the Project

Since its establishment in 1986, the ICTAD has been actively engaged in the development of manpower, assignment of the right people to the right jobs and improvement of the efficiency and productivity of the construction sector and has achieved steady progress. It has so far emphasised the training of operators to handle construction equipment, a large volume of which has been imported to Sri Lanka in line with the progress of economic development and social infrastructure improvement as a result of the strong initiative of the Government of Sri Lanka. As the training environment for operators is now well established, the similar establishment of a training environment for mechanics who are conversant with the operation and maintenance of the latest construction equipment is the logical next step. The training of mechanics is currently conducted in the form of OJT under the MES programme. The lack of a central training institution equivalent to the OTC in the case of operator training is believed to be a bottleneck for efforts to advance mechanical training. Therefore, the provision of training facilities and equipment for the CETRAC, which will play a central role in the training of mechanics in Sri Lanka, is deemed to be highly necessary. Given the excellent technical expertise of the ICTAD staff members as well as a realistic activity plan for the CETRAC based on the good performance of the ICTAD since its establishment, the CETRAC should be able to achieve its objectives, i.e. implementation of highly efficient mechanic training based on a practical curriculum, development of capable manpower and improvement of the skill level of mechanics, etc. The establishment of the CETRAC as the central mechanic training institute, together with the OTC which is the central institution for operator training, will mean the completion of a systematic and consistent manpower development environment for construction equipment operators and mechanics, considerably strengthening the functions of the ICTAD. These envisaged achievements of the Project are highly significant for the future development of Sri Lanka as they should have both direct and follow-on benefits for the entire construction sector.

(1) Current Conditions of Construction Equipment

According to a survey conducted by the ICTAD, there are some 6,000 pieces of construction equipment in Sri Lanka today. The main heavy equipment includes some 980 bulldozers, some 330 wheel-loaders, some 270 back hoes, some 200 motor-graders and some 150 excavators. Approximately 75% of this equipment has been commissioned in the last 10 years and some equipment has such advanced mechanisms as mechatromics, hydraulic or compressed air systems which require special expertise for their maintenance. The actual equipment operation rate is rather low as half of the

equipment requires some kind of repair or adjustment. In view of the assessment that the construction equipment operation cost accounts for 20 - 30% of the total construction cost compared to a labour cost of 15 - 30%, rationalisation of the operation of construction equipment is essential to improve the productivity of the construction sector. In addition to the existing construction equipment line-up, the procurement of a large volume of the latest equipment is underway for the National Equipment and Machinery Organization (NEMO) and Road Development Authority (RDA), making the establishment of a maintenance system for this latest equipment an urgent task for the government.

The NEMO was established to lease construction equipment to both the public and private sectors and has construction equipment valued at some 2 billion yen at 30 NEMO depots located throughout the country.

The construction equipment provided to the RDA is procured using an Overseas Economic Cooperation Fund (OECF) loan. The first phase of three planned phases is currently in progress to procure some 2.4 billion yens-worth of equipment. Most of this equipment is road construction equipment, including hydraulic excavators, wheel-loaders, motor-graders and bulldozers.

With the continuous improvement of the social infrastructure and social development in general, the amount of construction equipment owned and operated by both the NEMO and RDA is expected to steadily increase.

(2) Necessity to Train Mechanics for Construction Equipment

Almost 3,000 pieces of the some 6,000 pieces of construction equipment currently in Sri Lanka are believed to require repair and maintenance. It is assumed that 70% of this repair and maintenance requirement is due to inappropriate operation and inadequate knowledge of the operation and maintenance of such construction equipment. In some cases, machines which usually promise 8,000 - 10,000 hours of trouble-free operation break down after only 3,000 hours or 3,500 hours. It is reported that nearly half of the equipment investment is wasted due to the poor management level. Such wastage is obviously a hindrance to the productivity improvement of the entire construction sector and requires urgent attention. The foremost cause is the lack of an appropriate education and training system for construction equipment mechanics.

With the establishment of the OTC, the ICTAD has achieved certain positive results in improving the skill level of construction equipment operators but has failed to establish a

maintenance system, including regular inspections, for this equipment. While the functions of new construction equipment are becoming ever more advanced and complex, incorporating technical innovations in the fields of hydraulics and mechatronics, the skill level of the majority of construction equipment mechanics in Sri Lanka is below the required level to attend to this equipment due to the lack of formal technical education/training.

In order to improve the poor maintenance level to ensure the efficient use of construction equipment, the ICTAD has prepared and has been implementing the MES programme to upgrade the general skill level of construction equipment mechanics. However, the MES programme focuses on OJT at designated workplaces and is not associated with any central facility for intensive training, such as the OTC.

Although there is no doubting the usefulness of OJT, intensive training at a training facility which is equipped with machinery and equipment to enable the trainees to learn a wide range of technologies, from basic to advanced, is necessary to consolidate the basic skills and eventual ability of mechanics to deal with such new technologies as mechatronics through systematic technical training.

(3) Appropriateness and Necessity of the Project

The proposed CETRAC is expected to function as a central institution for manpower development and skill improvement in response to the general demands of the construction sector. The ICTAD believes that the CETRAC must be capable of performing the following functions to meet this expectation.

1) Planning and execution of training of managers and supervisors involved in the supervision of the operation and maintenance of construction equipment.

2) Planning and execution of training of mechanics involved in the maintenance of construction equipment.

3) Planning and execution of training for personnel for operations associated with the operation and maintenance of construction equipment.

4) Provision of support for the National Trade Testing (NTT) Programme

5) Establishment of a model workshop environment, incorporating (i) appropriate management and operation systems, (ii) measures to control and maintain tools and equipment and (iii) hygiene and safety control standards, etc.

6) Provision of a consultancy service on management systems designed to ensure the proper maintenance and operation of construction equipment

7) Act as a development centre for a nationwide network of OJT for construction equipment mechanics and as a central institution for the training of mechanics

The appropriateness and necessity of three functions which will be concerned on the Project are examined below.

1) Manager and Supervisor Training

The training of supervisors and managers is currently conducted by the OTC which is the training centre for operators. Some 180 trainees have completed the course in the last 7 years. It is known, however, that some prospective trainees who have received instructions from their respective organizations to attend the course are very reluctant to do so because of the remote location of the OTC.

With regard to the operation and maintenance of construction equipment, managers are responsible for the overall management of he work to meet technical and economic requirements, while supervisors are responsible for overseeing the operation of equipment on-site. In reality, however, there is a shortage of technological information regarding the basic operation principles of construction equipment, which also leads to insufficient efficiency in operating the equipment.

The efficient operation of construction equipment demands the provision of both supervisors and managers who are able to prepare effective maintenance programmes to ensure proper work implementation and are capable of dealing with problems without delay, in addition to the provision of mechanics who actually conduct the maintenance work. The training of managers and supervisors as a key component of the Project is, therefore, deemed highly appropriate and necessary.

2) Training for Mechanics

As described earlier, there is currently no facility in Sri Lanka which provides full-scale training for construction equipment mechanics and therefore, the technical knowledge necessary for appropriate maintenance is not sufficiently shared by

mechanics. To make matters worse, there are few training opportunities for mechanics in regard to such newly introduced technologies as hydraulics and mechatronics and the urgent establishment of a proper maintenance system for the latest equipment, procured in large volume by the NEMO and RDA, etc. is necessary. Improvement of the construction equipment operation rate is essential to improve the productivity of the construction sector, further underlying the importance of producing with adequate technological knowledge.

3) Training of Personnel for Related Fields

Although mechanics, supervisors and managers comprise the central manpower for the operation and maintenance of construction equipment, supporting personnel are also essential to record operation, maintenance and repair work and to control spare parts, etc. for efficient construction operation. No systematic training for this type of personnel is currently available and the inclusion of the training of such supporting personnel in the Project is deemed highly appropriate and necessary.

3.2.2 Examination of Project Implementation and Management Plans

(1) Personnel Plan

The CETRAC will be a new organization to be placed under the Operator and Mechanic Training Division of the ICTAD and is expected to act as a central institution for the training of construction equipment mechanics. The following personnel plan for the CETRAC has been carefully examined in view of the importance of the CETRAC and is designed to establish a highly efficient organizational structure with the minimum staffing level.

1)	Manager	1
2)	Deputy Manager	1
3)	Training Division	
	- Senior Instructors	2
	- Instructors	6
	- Visiting Instructors	2
	- Demonstrators	4
	- Helpers	4

4) Course and Textbook Development Division

- Senior Instructor	1
- Training Textbook Writers	1
- Illustrator	3
- Typist	1

5) Administrative Division

- Chief Administrator	1
- Staff Members	7
- Assistants	14
Total	48

The crucial aspect of the above personnel plan is the quality and strength of the Training Division which will play a central role in the CETRAC. Apart from the necessity to secure an adequate number of teaching staff to complete the planned curriculum for each course without difficulty, it is essential that the appointed instructors be highly capable of providing appropriate guidance and training. However, it is difficult to secure such capable instructors in Sri Lanka where a brain drain has been an acute problem for some time. The ICTAD has set the required qualifications for senior instructor and instructor positions as follows.

1) Senior Instructors

National Diploma of Technology (NDT) or National Certificate in Technology (NCT) in Automobile Engineering or Special Apprenticeship Certificate (SAC) for Automotives or at least 10 years experience (including at least 5 years experience as a training instructor) in the automobile or similar field(s).

2) Instructors

NDT or NCT in Automobile Engineering or SAC for Automotives or at least 5 years of experience (including at least 3 years experience as a training instructor) in the automobile or similar field(s).

The personnel plan also includes the appointment of demonstrators who are capable of assisting the instructors with the actual training and helpers to provide solid training.

All the new positions will be basically offered to the current staff members of the ICTAD at an estimated annual personnel cost of 2.6 million Rs.

(2) Budget Plan

The following annual operation costs of the CETRAC have been estimated by the ICTAD.

1)	Personnel	2,600,000 Rs
2)	Electricity	240,000 Rs
3)	Water	60,000 Rs
4)	Sewerage	10,000 Rs
5)	Communications	120,000 Rs
6)	Maintenance	200,000 Rs
7)	Medical Care	50,000 Rs
8)	Welfare	25,000 Rs
9)	Textbooks	50,000 Rs
10)	Teaching Materials	1,500,000 Rs
11)	Reserve	50,000 Rs
12)	Miscellaneous	500,000 Rs
	Total	approximately 6,000,000 Rs

The budget for the CETRAC has not been appropriated in the fiscal 1994 ICTAD budget but will be appropriated after establishment of CETRAC.

The total budget size of the ICTAD in fiscal 1994 is 143,000,000 Rs, of which 60,000,000 Rs is funded by the central government, 68,000,000 Rs by foreign assistance and 15,000,000 Rs by the profit-making activities of the ICTAD, such as the leasing of construction equipment, use of head office facilities (including the auditorium) by outsiders, project management and advisory services, training courses and textbook sales, etc.

The following tuition fees have been suggested for the planned training courses to reduce the financial burden on the central government.

1)	Management Personnel Course	1,500 Rs	(one week)
2)	Supervisors Course	2,500 Rs	(2 weeks)
3)	Mechanics I Course	2,000 Rs	(2 weeks)
4)	Mechanics II Course	2,000 Rs	(2 weeks)
5)	Basic Mechanics Course	6,000 Rs	(12 weeks)
6)	Record-Keeping Course	1,000 Rs	(one week)
7)	Inventory Control Course	1,000 Rs	(one week)

3.2.3 Relations with Other Assistance Projects

There are several organizations in Sri Lanka which are engaged in the training of mechanics.

(1) AETI	(automobile)	Automobile Engineering Training Institute
(2) NYSC	(automobile, agricultural tractor)	National Youth Service Center
(3) NGOO	(automobile)	Non Government Organization
(4) CGTTI	(large automobile)	Ceylon German Technical Training Institute
(5) NAITA	(large automobile, automobile and machinery)	National Apprenticeship and Industrial Authority
(6) FMRC	(agricultural tractor)	Farm Mechanization & Research Center
(7) DOL	(agricultural tractor)	Department of Labor
(8) SLPA	(ship, crane, forklift)	Sri Lanka Port Authority
(9) Air Lanka	(aircraft)	

Of these, the AETI which is funded by Japanese assistance and the CGTTI which is funded by German assistance have rich experience as a specialised mechanic training organization.

Although the number of organizations, which are funded by the central government or by foreign assistance and which are engaged in the training of mechanics, is not necessary small, there is no organization like the CETRAC which intends to assist improvement of the productivity of the construction sector through the provision of professional training courses for construction equipment mechanics.

The International Development Association (IDA) has provided financial assistance since 1981 for the social development activities of the ICTAD. However, this assistance is minimal for the training of construction equipment mechanics. In short, there is no overlapping between the Project and other assistance projects or plans.

3.2.4 Examination of Project Components

The activities of the CETRAC are basically classified into 3 functional groups, i.e. (i) mechanic training, (ii) research and development of curriculum and textbooks for training and (iii) administration. All these activities are essential for the proper management of the CETRAC, development of skill training and improvement of the technical strength of the CETRAC. The objectives of the CETRAC will only be achieved when these activities are fully complimentary. The relationship between the Training Division, responsible for implementation of the actual training, and the Course and Textbook Development Division, responsible for the development of training courses and textbooks, is particularly important, necessitating constant and effective feedback between these divisions.

In order to maintain an integral relationship between the above activities, the activity details must be determined in an integrated manner. Moreover, the structure of the CETRAC's activities must be such that it can be easily accommodated in the annual activity plan of the ICTAD.

3.2.5 Examination of Requested Facilities and Equipment

The Project intends the establishment of a training centre which is designed to standardise and improve the level of skill of construction equipment mechanics and to upgrade operation and management skills to handle such equipment in order to improve the productivity of Sri Lanka's construction sector through efficient equipment operation. The Project envisages the construction of facilities and the provision of equipment without which the intended training cannot be conducted.

At the time of the Basic Design Study, the main facilities and equipment requested by the Government of Sri Lanka for the CETRAC include the following.

- Main Facilities
  - Administration Building: offices, reception rooms, conference rooms and library and lecture hall, etc.
  - Training Building: classrooms, training rooms, workshops, laboratories and computer room, etc.
  - Canteen Building: canteen, kiosk and kitchen, etc.
  - Dormitory Building: dormitory, study room and recreation room, etc.

• Main Equipment

- Construction Equipment: bulldozer, wheel-loader, hydraulic excavator and motor-grader, etc.
- Workshop Equipment: hoist crane, jib crane and air compressor, etc.
- Training and Educational Equipment: Compornent, personal-computers, AV equipment and vehicles, etc.

Based on the above list of requested items, the scope of facilities and equipment suitable for grant aid has been discussed and examined, taking the expected training courses, facility utilisation plan and management plan, etc. into consideration.

As the CETRAC is a new organization to be established at an independent site from the existing premises of the ICTAD, all the facilities of the CETRAC will be newly constructed. In addition, most of the equipment will require new procurement as no precedent organization from which the CETRAC can expect the transfer of equipment exists.

(1) Facilities

1) Administration Building

The Administration Building will accommodate the administration function of the CETRAC and will comprise such administration-related rooms as a manager's office, administration office, reception rooms and a conference room. The other main requested facilities are an auditorium and library.

The auditorium will have a seating capacity of approximately 75 and will be used for ceremonies and seminars organized by the CETRAC. The library will house reference materials and books to mainly support the research and development function of the CETRAC. It will be open to anyone related to the CETRAC, including trainees, although the main users will be instructors, experts and researchers rather than trainees.

All the facilities requested in connection with the Administration Building are essential or highly useful to ensure the proper administration of the CETRAC and are, therefore, judged to be appropriate subjects for the Project.

2) Training Building

The Training Building will be the vital heart of the CETRAC, supporting the 2 functions of classroom teaching and practical training. The Training Building

facilities must, therefore, be carefully assessed, taking the training curriculum and required equipment into consideration.

All the facilities requested in connection with the Training Building are essential to successfully achieve the objectives of the CETRAC, i.e. classroom teaching to standardise the expertise of construction equipment mechanics, practical training to improve their skill level and a wide range of research and development activities. Consequently, it is judged that all the requested facilities are appropriate subjects for the Project.

3) Canteen Building

The Canteen Building will provide dining facilities for those on the CETRAC premises, such as staff, instructors, consultants and trainees, etc. There are currently no dining facilities near the proposed CETRAC site which can cater for CETRAC's size. As it will be more efficient for those on the CETRAC premises to eat in their own canteen within a limited time from the viewpoint of training efficiency, the requested Canteen Building facilities are judged to be appropriate subjects for the Project.

4) Dormitory Building

The Dormitory Building will provide accommodation for trainees and visiting instructors. The core of trainees to be instructed by CETRAC will be made up of 4,000 mechanics. The majority of construction equipment is employed in improving the infrastructure of rural areas, and approximately 75% the maintenance mechanics are involved in activities outside the Colombo district. Accordingly, in CETRAC's case, more than half of the trainees live in rural areas.

Using the Automobile Engineering Training Institute (AEIT) as an example, to the difficulties of finding suitable accommodation and transport resulted in the rate of withdrawal of rural trainees far exceeding that of trainees from Colombo. In order to enable trainees to concentrate on their studies, there is a need for provision of suitable accommodation.

As access from Colombo to the proposed CETRAC site is provided by regular bus services, however, it will be difficult for trainees from outside Colombo to find inexpensive accommodation given the relatively short period of each course and the lack of suitable accommodation facilities around the proposed site. Moreover, it is undesirable for the accommodation for the trainees of short intensive courses based

on the module system planned at the CETRAC to be scattered. In order to maximise the training efficiency, the provision of exclusive accommodation facilities on or near the premises is desirable and, therefore, the requested Dormitory Building facilities are judged to be appropriate subjects for the Project.

(2) Equipment

1) Construction Equipment

Inspection, maintenance and breakdown diagnosis training for mechanics and general technical training for managers cannot be conducted if actual construction equipment is not available. Effective training demands practical training using actual machines and equipment. As training using actual machines and equipment is the most important aspect of the CETRAC's training programmes, the request for the Project to provide machines and equipment is judged to be appropriate.

The types and specifications of the actual machines and equipment to be procured must be carefully selected to obtain the optimal results of the CETRAC's training curriculum, taking the types and specifications of equipment currently in use in Sri Lanka and of those to be procured in large quantities in the future into consideration.

2) Workshop Equipment

The requested workshop equipment includes hoist and jib cranes and test benches, etc. to be used for training in the workshops.

The workshops at the CETRAC for training purposes must have an equipment level equivalent to that of a real workshop. The practical training should reflect actual work processes, from the diagnosis of the nature of breakdowns to performance testing following the completion of repair work. In addition, as the creation of a model workshop environment is listed as one of the target activities of the CETRAC, the request for typical and practical workshop equipment is judged to be appropriate for the Project.

3) Training Equipment and Educational Equipment

The requested training and educational equipment includes componetns and cut models, etc. to be used for both practical training and classroom teaching.

Toghther with construction equipment proper, this traning and educational equipment is essential for practical training to upgrade the skills of mechanics and

for classsroom teaching to standardise their technical understanding. Consequently, the provision of the requested training equipment is jedged appropriate for the Project. It is necessary that the types and specifications of the equipment to be provided conform to the CETRAC's planned training curriculum.

3.2.6 Examination of Necessity for Technical Cooperation

Together with implementation of the Project, the Government of Sri Lanka has also requested the Government of Japan's project type technical cooperation for the Project.

In addition to the grant aid for physical facilities and equipment for the CETRAC, the project type technical cooperation is judged to be very effective to consolidate the basis for the maximum utilisation of such facilities and equipment to enable the CETRAC to fully perform its function as the central institution in Sri Lanka for the promotion and improvement of skills to properly manage and maintain construction equipment.

As the CETRAC's training curriculum must be constantly reviewed and revised to reflect technical innovations in the construction equipment field as well as changing construction requirements in Sri Lanka, technical cooperation for the transfer of the latest technologies/techniques to instructors and for the development of highly practical syllabuses and teaching materials will be essential at the initial operation stage of the CETRAC.

The components of the technical cooperation requested by the Government of Sri Lanka are outlined below.

(1) Dispatch of Experts

- General management techniques for construction equipment
- Hydraulics-related technologies
- Electrical and mechatronics-related technologies
- General inspection techniques and repair techniques for construction equipment

(2) Acceptance of Counter Part Trainees in Japan

- Training in such individual fields as engines, hydraulics and electrical equipment, etc.
- General maintenance skill training
- CETRAC management training
- Training system development training

3.2.7 Basic Principles for Grant Aid Cooperation

The Project continues on from the preliminary survey on Japanese technology cooperation of July 1990, and the dispatch of a long-term survey team in September 1993. The Project's implementation as a grant aid project of the Government of Japan in judged to be appropriate based on confirmation of its necessity, positive effects, feasibility and the implementation system and implementation capability of the Sri Lankan side and also based on confirmation of the compatibility of the expected project effects with the objectives of the Japanese grant aid system. The basic design for the project is formulated in the following pages, assuming the provision of grant aid for the Project.

Further, the basic design for the project will, in the same way as the basic design survey, be based upon the results of the preliminary survey on Japanese technology cooperation and the long-term survey.

3.3 Outline of the Project

3.3.1 Project Implementation Agency and Management System

The implementation agency for the Project will be the ICTAD of the MHC & UD while the management body will be the CETRAC to be newly established under the Project.

The ICTAD is supervised by the Project Minister who reports to the Minister for MHC & UD and consists of the Development Division, Training and Research Division, Advisory Services Division and Operator and Mechanic Training Division. The CETRAC will be organizationally placed in the Operator and Mechanic Training Division and will be supervised by the Deputy Director in charge of operator and mechanic training.

The CETRAC itself will be composed of 3 divisions, i.e. Training Section, Curriculum Development Section and Administration Section, under the leadership of a manager and deputy manager. The Training Section, which will play the central function of the CETRAC, will be divided into the Manager Training Group and Mechanic Training Group. Each group will have one senior instructor with each course in the group being supervised by an instructor, excepting the Mechanics I and II Courses for which an additional visiting instructor will be assigned to provide 2 instructors per course. As small classes are essential for efficient practical training, the Mechanics Courses will have a total of 4 demonstrators as assistant instructors and 4 helpers to ensure the training intensity. In the case of the Record Keeping and Inventory Control Courses, one instructor will be responsible for running both courses in view of the limited training contents and short course duration. The Curriculum Development Section will be run by one senior instructor and 5 staff members who will develop and revise the teaching curriculum, syllabuses and textbooks in consultation with the instructors of the actual training courses and consultants. The Administration Section will be controlled by a senior administrator and will be responsible for the general operation, management and maintenance of the CETRAC and its facilities. The appointment of a full-time nurse is planned for emergency treatment in the case of accidents during training or illness. 2 janitors and 5 labourers are expected to assist the miscellaneous work of the Training Section if required.

The planned manpower strength of the CETRAC is 48, including 2 visiting instructors, and there is currently no concrete plan for future expansion. (Fig. 3-1)

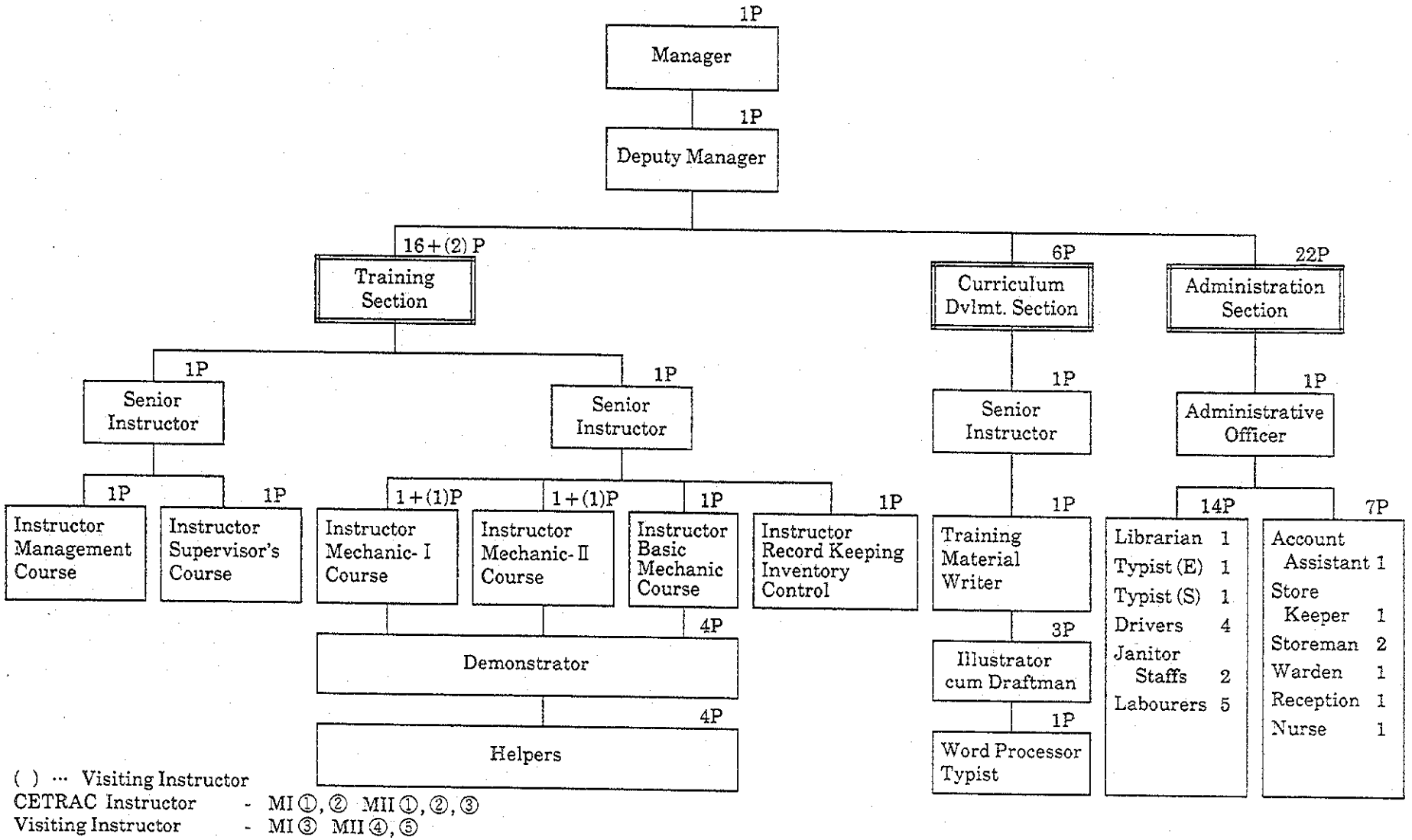


Fig. 3-1 Organization of CETRAC

3.3.2 Activities Plan

The CETRAC is expected to train capable managers, supervisors and mechanics for construction equipment, not only to establish a maintenance system for the latest construction equipment but also to improve the utilization rate of existing construction equipment, half of which is said to be out of order due to poor maintenance. To improve the productivity of all sectors related to the development of the social and industrial infrastructures through the efficient operation of construction equipment in sufficient management in general.

The ICTAD has been steadily building its reputation as a training organization since its foundation and has achieved remarkable results in the training of construction equipment operators through the OTC. The CETRAC is expected to achieve similar results as a training centre for managers, supervisors and mechanics of construction equipment and will help the Government of Sri Lanka to establish a construction machinery management system suitable for the conditions in Sri Lanka while maintaining positive links and cooperating with its elder brother, the OTC.

The expected activities of the CETRAC are largely classified into 3 areas, i.e. training, R & D and general enlightenment. The activities in these 3 areas, however, are not independent from each other but are expected to assist each other to contribute to productivity improvement in the construction sector.

(1) Training Programmes

The first group of target trainees for the CETRAC to improve the operation rate, to reduce the operation cost and to prolong the service life of construction equipment consists of mechanics of all levels and supervisors. The second group consists of managers, including equipment owners and workshop owners/managers. Training for the first group will focus on improved understanding of equipment mechanisms and maintenance skills while training for the second group will focus on improved general knowledge relating to equipment operation and management.

1) Training Courses

There will be a total of 7 training courses, ranging from the Inventory Control Course to the Management Personnel Course, with the following training contents.

- Management Personnel Course
  - To provide knowledge of techno-economic aspects of management of construction machinery repair and maintenance activities to managers.

- To familiarize construction and design of equipment and their functional systems.
- To provide knowledge of diagnostics/trouble shooting of equipment.
- To provide knowledge of designing planned preventive maintenance system for fleet of construction machinery.

• Supervisors Course

- To provide general knowledge of construction equipment structure, operation and their maintenance.
- To familiarize units and assemblies and also functions of various systems of construction machinery.
- To provide knowledge of supervisory management aspects of plant repairs and management.
- To provide knowledge of diagnostics/trouble shooting of equipment.

• Mechanics I Course

- To provide trainees with alround skills and knowledge required for maintenance.
- Repair and testing of construction equipment.
- To provide specialized knowledge on,

· Preventive maintenance
· Mechanical, hydraulic and air operated brake systems
· Auto Electrical systems
· Hydraulics
· Heavy duty Diesel engine repairs and maintenance
· Transmission systems and final drive
· Tyres and tracks
· Diesel fuel system
· Undercarriage maintenance and overhauling
· Mechatronics

• Mechanics II Course

- To provide general knowledge of construction equipment and their components.
- To provide knowledge and skills of repairs and maintenance, of construction equipemtnt.
- To provide necessary knowledge and skills for handling of tools and measuring instruments.

- Basic Mechanics Course

  - To provide basic theory on design of Construction
  - To indicate safe and proper work habits in the workshops.
  - To train appropriate selection and proper care of tools and instruments.

- Record Keeping Course

  - To provide knowledge required for proper record keeping pertaining to construction equipement manitenance.

- Inventory Control

  - To provide knowledge required for store keepers for proper invetory control in the field of construction.

While the educational and training activities of the CETRAC will mainly focus on mechanic training, certain emphasis will be placed on the Management Personnel Course and Supervisor Course to achieve an improved general technical level and efficient management of workshops, diffusion of proper maintenance practices to prevent the mechanical breakdown of equipment and reduction of the adverse impacts of construction equipment operation on the environment.

2) Curriculum

The mechanic training conducted at the CETRAC will be provided for existing mechanics and will consist of modules so that the trainees can complete their respective courses without leaving their jobs by combining short sub-modules. The course curriculum and module contents are given in the Table 3-1 and 3-2.

The total course length will vary from 2 weeks to 3 months depending on the number of sub-modules required to complete a course. The sub-modules can be taken successively or with intervals to provide a flexible training schedule. If necessary, the same sub-modules can be re-taken.

Although there is no official licensing system for construction equipment mechanics, those successfully completing the courses will be issued with a Certificate of Course Completion.

Table 3-1 Course Curriculum (1)

Course Title	Module Code	Scheme	Contents
Management Personnel	MP (1)	• Repair and Maintenance Planning, Scheduling and Control • Fleet Renovation Control • Cost Management	- Repair and Maintenance Planning - Scheduling and Control - Productivity of Construction Equipment - Construction Equipment Hire Calculation Table - Items of Contracted Work Cost - Fleet Renovation Control - Methods of Safety Control
Supervisors	SP (1)	• Trouble Shooting	- Failure Analysis - Engine Dynam Testing - Fuel Injection Pump Testing - Diagnostic Instruments for Trouble Shooting - Inspection and Trouble Shooting of Engine - Inspection and Trouble Shooting of Power Train
	SP (2)	• Testing and Examination	- Failure Analysis - Hydrauric Testing - Electric / Mechatronic Circuit Testing - Diagnostic Instruments for Trouble Shooting - Specific Knowledge of component Unit and Sub-Assembly and Functional system of Equipment - Applicable Knowledge on Electronic/Mechatronic System
Mechanics I	MI (1)	• Engine Repair and O/H (including electric power device)	- Machine Failure Diagnosing Techinic and Adjusting on Engine, Fuel Injection and Electric Device - Removal and Installing Components from Specific Equipment - Disassembly and Assembly Engine, Fuel Injection and Electric Device - Checking, Adjusting, Measuring and Evaluation of Components/Parts
	MI (2)	• Chassis and Powerline Repair and O/H • Attachment Repair and O/H (including welding technic)	- Machine Failure Diagnosing Technic on Power Train, Under Cariage, Tire, Chassis and Attachment - Removal and Installing Components from Specific Equipment - Disassembly and Assmebly of Power Train, Under Cariage, Tire, Chassis and Attachment - Checking, Adjusting, Measuring and Evaluation of Components/Parts - Automatic/ Semi-Automatic Welding Methods and Technique
	MI (3)	• Hydraulic Control Repair and O/H (including Mechatronics)	- Machine Failure Diagnosing Technic and Adjusting on Hydraulic and Electronic/Mechatronics - Removal and Installing Components from Specific Equipment - Disassembly and Assembly Hydraulic Components and Electromic Components - Checking, Adjusting, Measuring and Evaluation of Components and Parts

Table 3-2 Course Curriculum (2)

Course Title	Module Code	Scheme	Contents
Mechanics II	MII (1)	• Checking Point and Maintenance Point	- Outline of Components and Funciton on the Equipment - General Knowledge of Fuel, Oil, Water and Air Line - Procedure of Daily, Periodical Maintenance - Checking and Adjustment of Engine (i.e. Linkage), Steering (i.e. Lever, Pedal, Wheel Alignment) - Checking and Adjustment of Electric/Mechatronic Components - Maintenance of Light Equipement
	MII (2)	• Structure and Function	- Overview of Structure and Function of Component - Structure and Function of Engine, Power Train, Under Cariage, Hydraulic System, Electric System and Attachment
	MII (3)	• Disassembling and Assembling • Trouble Finding	- General Information on Disassembly and Assembly - Usage of Special Tools - Disassembling and Assembling of Engine, Power Train, Hydraulic Component - Checking and Adjusting on Assembling Stage
	MII (4)	• Repair Operation by Models • Construction Method	- Repair of Under Carriage, Trucks and Tire - Repair of Steering/Brake System - Usage of Special Tools - General Knowledge on Construction Method
	MII (5)	• Preventive Maintenance	- General Knowledge on Preventive Maintenance - Introduction of Measuring Instrument - Daily/Periodical Inspection Point - Usage of Mobile Workshop/Lublicaiton Service Truck
Basic Mechanics	BM (1)	• Basic Knowledge of Component, etc. • Basic Practical Taining of Welding and Operation	- Basic Knowledge on Maintenance, Structure and Function by Models - Proper Usage of General Tools - Basic Knowledge on Component (Engine, Power Train, etc.) - Practical Training of Operation - Practical Training of Weldimg
Record Keeping	RK (1)	• Record Control and Assessment	- System of Record Keeping - Format of Record Keeping - Input of Data - Filing System - Using Method of Record Keeping
Inventory Control	IC (1)	• Inventory Control and Logistics of Parts	- System of Inventory Control - Format of Inventory Control - Stock House Installation - Delivery to Workshop - Cyclic Check of Stock House

3) Course Eligibility

In principle, the training courses at the CETRAC will be provided for existing mechanics and construction sector personnel. While the planned eligibility for each course is described below, the mechanic course trainees will probably find that they are assigned to specific courses depending on the number of years of experience. The Management Personnel Course trainees will, in principle, require a university degree of equivalent and the actual length of practical work is expected to be relatively short. In the case of the Supervisor Course designed to train supervisors who are directly responsible for on-site work, the likely trainees will be the most experienced mechanics.

- Management Personnel Course
  - Minimum of 6 months practical experience as a manager at a construction equipment workshop
  - Fluency in English

- Supervisors Course
  - Currently working as a supervisor/foreman in the construction equipment maintenance field
  - Fluency in English

- Mechanics I Course
  - 18 years of age or more
  - Currently working in the construction equipment maintenance field
  - Either completed an automobile mechanic training course or accumulated sufficient technical experience in the relevant field

- Mechanics II Course
  - 18 years of age or more
  - Currently working in the construction equipment maintenance field

- Basic Mechanics Course
  - 18 years of age or more
  - Either completed an automobile mechanic training course or accumulated sufficient technical experience in the relevant field

- Record Keeping Course
  - 18 years of age or more
  - Currently working in the construction equipment maintenance field
  - Currently has a record keeping job in the construction equipment maintenance field
  - GCE (O/L)

- Inventory Control Course
  - 18 years of age or more
  - Accumulated inventory control experience in the construction equipment maintenance field
  - GCE (O/L)

4) Class Size

It is currently difficult to accurately determine the number of construction equipment operators or mechanics in Sri Lanka. The sampling survey conducted by the ICTAD in 1989 and repeated in 1993 estimates the total number of skilled technicians and workers in the construction sector to be 171,500, out of which 8,575 (5%) are operators and 3,430 (3%) are mechanics.

Specialisation of Construction Equipment Operators

Bulldozers/Tractors	1,972	(23%)
Heavy Vehicles	1,458	(17%)
Loaders	1,200	(14%)
Road Rollers	771	(9%)
Graders	523	(6%)
Cranes	523	(6%)
Compactors	257	(3%)
Dumpers	257	(3%)
Earth Drills	257	(3%)
Well Drills	257	(3%)
Others	1,114	(13%)
Total	8,575	

Most of the existing mechanics are believed not to have undergone any systematic, specialised education and/or training. In this context, all the existing mechanics may well be classified as possible CETRAC trainees. As it is difficult to predict the actual number of mechanics who will wish to attend the new training courses provided by the CETRAC, the ICTAD has estimated the likely number of applicants for each course based on the performance of the OTC and MES which is the ICTAD's OJT programme for mechanics.

The class size for both the Management Personnel Course and Supervisor Course was originally set at 20 trainees/years but has been reduced to 10 trainees/year for each course as the original size was considered too large in view of the class size for the mechanic courses. The finalised class size for each course is given in the Table 3-3.

Table 3-3 Annual Training Schedule

Course			Annual No. of Moduels	Annual No. of Trainees
Course Title	Class Size	Duration		
Management Personnel	10	2 months 1week sub-module × 8	1	10
Supervisors	10	3 months 2 week sub-module × 6	2	20
Mechanics I	20	2 months 2 week sub-module × 2 4 week sub-module × 2	3	60
Mechanics II	20	12 months 2 week sub-module × 2 4 week sub-module × 1	5	100
Basic Mechanics	20	3 months 12 week sub-module × 3	1 × 3	60
Record Keeping	15	1.25 months 1 week sub-module × 5	1	15
Inventory Control	15	0.5 months 3 day sub-module × 5	1	15

(2) Research and Development Programmes

Research and development activities at the CETRAC are functionally classified into those to develop the curriculum, syllabus and teaching materials for the training courses and those to develop operation and management techniques/skills for construction equipment. Needless to say, constant feedback between the development of practical operation and management techniques/skills and the training of techniques/skills will be

required with the backing of an appropriate system which will also promote the diffusion of such techniques/skills.

1) Curriculum and Teaching Materials

The research and development of training curriculum and teaching materials will be mainly conducted by the Curriculum Development Section (CDS) of the CETRAC. The ICTAD has its own CDS which undertakes the research and development of curriculum and teaching materials for the MES Programme. As the introduction of the latest construction equipment will presumably change the social requirements for construction equipment mechanics, it will be necessary for the CETRAC to conduct intensive technical training and also to proceed with the research and development of curricula and textbooks responding to the changing social circumstances and requirements in a swift and flexible manner in view of the standardisation of maintenance technologies /techniques and the improvement of the expertise of construction equipement mechanics.

2) Operation and Management Techniques

The present plan for the CETRAC does not include a specific proposal to establish a section committed to the research and development of operation and management techniques. However, vigorous activities are expected to take place to develop operation and management techniques which make the best of the specific characteristics of individual construction equipment and which are suitable for the conditions in Sri Lanka in the form of the joint efforts of both full-time and visiting instructors and experts and cooperation with the development section of the ICTAD. The newly developed techniques will be immediately incorporated into the training curriculum and teaching materials to standardise the skill level of mechanics by providing them with the opportunity to learn the same techniques, the lack of which has so far been one of the biggest problems of construction equipment mechanics in Sri Lanka.

(3) Enlightenment Programmes

While the training and research and development activities described above can be considered enlightenment activities in a broad sense, more specific enlightenment activities by the CETRAC will be those designed to improve work efficiency, hygiene control and safety control through training in the model workshops which will meet all requisites in terms of work efficiency and safety, etc. Transferring the technical expertise accumulated by the CETRAC to emphasise the importance of the efficient operation of construction equipment to improve the productivity of the construction sector.

3.3.3 Location and Conditions of Project Site

(1) Planned Project Site

The planned site for the CETRAC facilities (Project site) is located in Sri Jayewardenapura which is Sri Lanka's new capital with a population of some 100,000 and which is adjacent to Colombo, the largest city in Sri Lanka. The site is in Pelawatta some 10km southeast by east from central Colombo and is a premium site, only a few minutes' drive from the new parliament building and the Ministry of Housing, Construction and Urban Development (MHC & UD) which is the competent ministry for the CETRAC.

While the land is currently owned by the Urban Development Authority (UDA), ownership will be transferred to the ICTAD when construction work under the Project commences.

The area surrounding the new parliament building has been designated a green belt area and other zones to restrict the construction of new buildings but the Project site is not included in any of these restricted zones.

(2) General Conditions of Project Site

The Project site of 15,710 m^2 is located off the trunk Pannipitiya Road in a quiet residential area and is adjoined by the Ministry of Education and Higher Education (MOE) to the south across a road and the Overseas Children's School (OCS), a well-known international school attended by most of the children of foreign diplomats and businessmen living in Colombo, to the west across another road. Although the Project site is surrounded by roads on all sides, the approach road to the Project site will be the some 15m wide Akuragoda Road to the south. The ground of the Project site continuously rises from south to north with a 11m elevation difference in the some 130m between the southern and northern perimeters. The eastern perimeter is dented by 2 houses with a total land area of approximately 1,050 m^2 (35m x 30m).

The existence of these houses clearly hinders the prospective land use efficiency of the Project site. The UDA, which owns the land and which is responsible for the provision of suitable land for the Project, and the ICTAD, the Project implementation agency, discussed this problem and it was finally decided that the house on the south side would swap its land for land situated in the northeastern corner of the Project site. This settlement has increased the size of the southern half of the Project site, improving the land use efficiency and facilitating the layout planning. The relocation of the house and

transfer of land ownership from the UDA to the ICTAD will be completed by June 30, 1994.

(3) Geology

During the field survey for the Basic Design Study, the ICTAD conducted boring at 3 locations on the Project site and found that the geological conditions were not as good as initially expected, possibly requiring piling work. As the ground is sloping, the depth between the ground surface and foundation ground varies from 10m to 20m. Further boring and a survey on the ground bearing capacity must be conducted during the Detailed Design period.

(4) Infrastructure

Such infrastructure as electricity supply, telephone, water supply and sewer systems are already in place or under construction near the Project site and no major problem is anticipated in regard to the implementation of the Project as far as infrastructure is concerned.

1) Electricity Supply

There are 3-phase, 4-wire, low voltage (400/230V, 50Hz) aerial distribution lines supplying electricity to local housing along the roads surrounding the Project site while a 3 -phase, 3-wire, high voltage (11KV, 50Hz) aerial distribution line runs along Akuragoda Road to the south of the Project site. According to the Ceylon Electricity Board (CEB), the area is served by the Pelawatta Power Station. As electricity supply to the parliament building is provided by the same source using the same distribution line, sufficient attention has been paid to electricity supply, making blackouts unlikely. Electricity supply to the Project site can be arranged using the high voltage line.

The planned access to the Project site from Akuragoda Road makes either the relocation or raising of the height of the existing distribution line necessary as the present low height of the aerial line would likely hinder the movement of construction equipment in and out of the site during as well as after the construction period.

2) Temporary Electricity Supply During Construction Work

The electricity required for construction work can be supplied from either the low voltage or high voltage lines. If the use of the high voltage line is opted for, the

electricity authority hopes that the supply facility introduced for construction work will constitute part of the CETRAC facilities.

3) Telephone

Aerial telephone lines run along the roads to the east, south and west of the Project site. An underground trunk telephone line has been recently laid along Akuragoda Road to the south. According to Ceylon Telephone and Telegramme (CTT), there is no room for additional lines in the area as the telephone exchange capacity is already full. However, work to introduce additional switchboards under the national telecommunications improvement project should make new capacity available by around March, 1995 to provide the number of lines required by the CETRAC at the time of the completion of construction work for the Project.

4) Temporary Telephone Lines During Construction Work

With the completion of the expansion work described above, temporary telephone lines for the on-site construction office should be available in March, 1995.

5) Water Supply

A water main (75mm in diameter) runs along Pannipitiya Road which is linked to Akuragoda Road, the planned access road to the Project site. According to the National Water Supply and Drainage Board (NWS & DB), a water supply network extension project is in progress in Kotte District with an OECF loan and 300mm PVC water mains will be laid along the roads running to the south and west of the Project site by January, 1996, providing the Project site with water.

6) Temporary Water Supply During Construction Work

Although it is possible to extend a service pipe from the 75mm water main along Pannipitiya Road, the water authority recommends the use of groundwater due to limited water supply from the main. Many households in the area have their own shallow wells and it should not prove difficult to obtain the water required during construction work from a similar shallow well. Some groundwater is, in fact, also used as drinking water with proper treatment.

7) Drainage and Sewer System

Open drainage ditches are used along the roads around the Project site to drain rainwater to the sewer main (600mm, hume concrete pipe) along Pannipitiya Road. According to the Central Environmental Authority (CEA), the water quality standard

for domestic waste water is a BOD of 30 ppm and domestic waste water treated by septic tank can be discharged to open ditches together with rainwater.

(5) Natural Conditions

1) Climate

Sri Lanka is an island country situated between 5°55'N and 9°50'N and between 79°30'E and 81°50'E and belongs to the oceanic tropical monsoon zone. The Colombo area in which the Project site is located is along the western coast of the island and is subject to a southwestern monsoon from May to September and a northeastern monsoon from December to February.

2) Seasons

Sri Lanka has the following 4 seasons.

① Southwestern Monsoon Season (May - September)

Much rainfall is observed in the southwestern part of the island from the lowland to the highland but rainfall is very scarce in the northeastern part.

② Inter-Monsoon Season (October - November)

This is a calm season in terms of wind except for sea breezes in the afternoon. Rain and lightning caused by low pressure are occasionally observed throughout the island.

③ Northeastern Monsoon Season (December - February)

Rain is observed throughout the island and is particularly strong in the northeastern part.

④ Inter-Monsoon Season (March - April)

Due to the less influence of low pressure, less rainfall than in the inter-monsoon season from October to November is observed.

The Colombo area is characterised by high temperatures and high relative humidity all year round and the mean monthly temperature is fairly constant throughout the year. No major seasonal changes based on temperature are, therefore, observed.

3) Temperature/Relative Humidity/Rainfall

The mean monthly temperature in the Colombo area is around 27°C throughout the year with high relative humidity of 70 - 90%, reflecting its oceanic climate. Rainfall is concentrated in May, June, July, October and November with annual rainfall of between 2,000mm and 2,500mm.

4) Wind Direction/Wind Velocity

The southwestern monsoon called the Maha prevails from May to September while the northeastern monsoon called the Yala prevails from December to February. The constant wind direction in these periods is determined by the northing or southing of a tropical air mass. The average wind velocity rarely exceeds 1 - 3 m/sec although there are days of relatively strong wind depending on conditions in the Indian Ocean.

5) Lightning

Lightning predominantly occurs during the monsoon seasons, particularly in March and April when the monsoon is very strong.

6) Earthquakes

Sri Lanka is located outside the world's major seismic zones. While earthquakes do occur, no damage has been recorded.

7) Other Natural Disasters

Flooding can result from strong downpours and the eastern coastal area occasionally suffers from cyclone damage.

(6) Building-Related Laws and Regulations

Prior to the construction of the planned CETRAC buildings, the ICTAD, the prospective owner of the buildings, must apply to the UDA and CEA for planning permission. In addition, consultation with the following agencies will be required during the Detailed Design Stage.

① Fire Service Department, Colombo Municipal Council - fire-fighting and fire prevention facilities

② Ceylon Electricity Board - extension of power supply to the Project site

③ National Water Supply and Drainage Board - extension of water supply to the Project site

④ Ceylon Telephone and Telegramme - extension of telephone line to the Project site

⑤ Urban Development Authority - compliance with building standards and regulations

⑥ Central Environmental Agency - compliance with environmental standards regarding waste water discharge and air pollution, etc.

3.3.4 Outline of Facilities and Equipment

The overall facility plan for the CETRAC is formulated based on the personnel plan, activity plan and training curriculum implementation plan, etc. by calculating the required number of rooms and their size to achieve the objectives of the Project, taking the components of the original Sri Lankan request into consideration. The planned facilities are outlined below.

(1) Facilities

1) Administration Building: 1,801 m^2

The Administration Building will house administration-related rooms, including the administration office, such R & D-related rooms as the curriculum development office, the library and offices for the manager, instructors and consultants, etc.

Main Rooms - manager's office, deputy manager's office, senior instructors' offices, visiting instructors' offices, instructors' room, senior consultants' office, cousultants' office, curriculum development office, library, conference room, lecture hall, administration office

2) Training Building: 3,351 m^2

The Training Building will house various workshops, lecture rooms, training rooms and a computer room, etc.

Main Rooms - engine, transmission, chassis, hydraulic, machinery, fuel injection, electric and mechatronic workshops, test rooms (laboratories), tool and parts storage, lecture rooms, training rooms, computer room

3) Canteen Building: 424 m^2

The Canteen Building will house dining rooms and a kitchen to serve staff members and trainees.

Main Rooms - staff dining room, trainee dining room, kitchen, snack stand

4) Dormitory Building: 1,300 m^2

The Dormitory Building will house bedrooms, a study room and a living room, etc.

Main Rooms - single bedrooms, twin bedrooms, study room, living room, dormitory office

5) Garage: 166m^2

6) Connecting Corridors (Covered Way): 97 m^2

7) Water Tower: 42 m^2

Total Floor Area 7,181m^2

(2) Equipment

The equipment and tools, etc. required to conduct the activities and training programmes of the CETRAC are outlined below.

1) Construction Equipment

This will be real equipment to be used for operation control, maintenance and trouble shooting training.

Main Equipment - bulldozer, wheel loader, hydraulic excavator, motor-grader

2) Workshop Equipment and Tools

These will be provided to make the equivalent level of the CETRAC's workshops equivalent to that of a real workshop.

Main Equipment - such shared equipment as hoist and jib cranes, special equipment and tools for each workshops, testing equipment and tools

3) Training and Educational Equipment

The range of training and educational equipment includes components for skill training, cut models for classroom lectures, audio-visual equipment and equipment to develop teaching materials, textbooks and curriculum, etc.

Main Equipment - such components as engines and pumps, various cut models and check models, audio-visual equipment, micro-computers

4) Office Equipment

The office equipment to be provided consists of a range of general office equipment and units.

Main Equipment - copiers, electric typewriters, micro-computers

5) Vehicles

The vehicles to be provided will be used to transport trainees, instructors and researchers for training as well as on-site inspection purposes.

Main Vehicles - micro-bus, station wagon (4 wheel-drive), pick-up track (4 wheel-drive)

3.3.5 Management and Maintenance Plans

The positive effects of grant aid are only fully felt when the smooth management of the new facilities and activities to achieve the original objectives have been realised through the self-help efforts of the recipient country well after the handing over of the facilities and equipment. The CETRAC will be required appropriate management and maintenance systems to produce qualitatively as well as quantitatively satisfying results through the smooth implementation of the mechanic training envisaged by the ICTAD.

(1) Management Plan

Following the completion of the construction work under the Project, the new buildings will be handed over to the Government of Sri Lanka and will be managed by the CETRAC which will operate as an independent national training institute similar to the OTC to smoothly conduct training, R & D and enlightenment activities in line with the objectives of the CETRAC described in 3.3.2. The CETRAC will be considered an organization of the Ministry of Housing, Construction and Urban Development as its senior administration and budget will be controlled by the ICTAD.

Although the technical cooperation by the Government of Japan has also been requested in addition to the provision of facilities and equipment under the Project, the Sri Lankan side must establish a proper plan and system for the CETRAC's own management and maintenance of the facilities and training and educational equipment.

In principle, the Administration Section of the CETRAC will be responsible for the management and maintenance of all the CETRAC's facilities. Specialist engineers and

operators should be available to conduct regular inspections of the building service facilities and the establishment of maintenance agreements with the local agents of the manufacturers is extremely important in view of the regular maintenance, inspection and repair of the various equipment.

The training facilities of the CETRAC will be the most superior of all training institutes in Sri Lanka with the completion of the Project. The provision and upgrading of full-time technicians to operate and manage the computer and audio-visual equipment, etc. are strongly desired in view of the importance of the CETRAC's planned activities. Moreover, maintenance staff should participate in equipment installation and test operation to obtain a proper understanding of the building service facilities and equipment for smooth maintenance following the handing over of the new buildings to the Sri Lankan side.

(2) Facility Maintenance Plan

1) Buildings

The main points in regard to building maintenance are daily cleaning, the repair of worn or damaged parts and security to ensure building safety and security.

Daily cleaning will have a favourable effect on the attitude of those using the buildings and is also important to maintain the necessary level of cleanliness for the training facilities, which will in turn have a positive effect on safety control. It also leads to the early discovery of damage and equipment breakdown and subsequent early repair, thereby prolonging the life of the building service equipment and training equipment.

Repair work mainly consists of the repair or renewal of exterior and interior finishing materials which protect the buildings. Based on Japan's experience, it is believed that remodelling or partial rebuilding will be required every 10 years due to changes in activities and/or staff increases. The regular inspections and repairs required to prolong the life of the buildings will be described in detail in the maintenance manuals to be presented to the Sri Lankan side at the time of the handing over of the buildings and are outlined in the Table 3-4.

Table 3-4 Outline of Regular Building Inspections

(Exterior)	
Repair and repainting of exterior finishings	every 5 years
Inspection, repair and repainting of roofing	inspection: annually others: every 5 years
Inspection and repair of roof waterproofing	inspection: annually repair: as required
Cleaning of gutters and drainage facilities	monthly
Inspection and repair of sealing materials around doors and window frames	annually
Painting of exterior doors and window frames	every 5 years
Inspection and cleaning of drainage ditches and manholes	monthly
Repainting of perimeter fencing	every 5 years
Gardening	as required
(Interior)	
Alteration of interior finishings	as required
Repair and repainting of interior walls	as required
Replacement of ceiling materials	as required
Adjustment of doors and windows	annually
Replacement of hardware	as required

2) Building Services

Not only regular operation control and inspection but also the repair and exchange of parts will be required for the proper maintenance of the building services. The life of building service equipment can definitely be extended by proper operation and regular inspection, adjustment, cleaning and repair. The safety of this equipment must be secured by measures to prevent breakdowns and accidents without causing damage to the buildings. Overhauls and the exchange of worn parts must be conducted pursuant to the maintenance manuals at the time of regular inspection.

Maintenance staff must have an exact understanding of the system designs and capacities, etc. so that they can prevent accidents. Technicians with appropriate knowledge in such fields as electricity, air-conditioning, plumbing and special equipment should be appointed full-time and properly trained. Moreover, these technicians should undergo on-site training from the equipment installation and test operation stages to obtain thorough knowledge of the equipment for which they will

be responsible. Maintenance manuals will be provided at the time of project completion and the main service equipment lives are in the Table 3-5.

Table 3-5 Lives of Main Building Service Equipment

Electricity	
Generator	10 - 15 years
Panel Boards	10 - 15 years
Fluorescent Lamps	5,000 - 10,000 hours
Incandescent Lamps	1,000 - 1,500 hours
Telephone Exchange	10 years
Public Address Equipment	10 years
Plumbing	
Pumps, Pipes and Valves	10 - 15 years
Tanks	15 - 20 years
Sanitary Fixtures	25 years
Fire-Fighting Equipment	20 years
Gas Apparatus	6 years
Sewage Treatment Equipment	7 years
Air-Conditioning	
Pipes	10 - 15 years
Fans	10 - 15 years
Air-Conditioners	5 - 10 years

(3) Equipment Maintenance Plan

Regular equipment maintenance will be of crucial importance to ensure the expected achievements of the CETRAC and much of the equipment will require careful handling in view of possible adverse effects caused by vibration and impact.

In view of the above, it will be realistic to introduce a system whereby the CETRAC's own technicians conduct regular maintenance, inspection and repair while making maintenance agreements with the local agents of the manufacturers for some equipment. The frequency of regular inspections for each type of equipment is in the Table 3-6 and further details will be included in the relevant maintenance manuals to be presented to the Sri Lankan side at the time of handing over the equipment.

Table 3-6 Outline of Regular Equipment Inspections

	In House		Agent
	Cleaning	Maintenance Inspection	Maintenance
Computers	daily	monthly	as required
Training Equipment	daily	monthly	annually
AV Equipment	daily	monthly	annually
Educational Equipment	daily	monthly	as required

(4) Estimate of Operation and Maintenance Cost

The operation and maintenance cost of the facilities after their completion and handing over to the Sri Lankan side is estimated here. The major expenditure items to be considered are the personnel cost, operation cost and maintenance cost.

Total Running Cost of CETRAC

① Personnel Cost	2,600,000 Rs/year
② Operation Cost	3,070,000 Rs/year
③ Maintenance Cost	5,060,000 Rs/year
Total	10,730,000 Rs/year

The total operation and maintenance cost is estimated to be 10,730,000 Rs which is converted to approximately 23,700,000 yen.

Refer Appendix.

CHAPTER 4 BASIC DESIGN

Chapter 4 Basic Design

4.1 Design Principles

The number of pieces of construction equipment in operation in Sri Lanka has been rapidly increasing in line with the increasing volume of construction work in the transport and construction sectors. The CETRAC will be designed to function as a facility to upgrade the technical skills of construction equipment mechanics and to train new mechanics. The CETRAC is expected to not only act as a training centre for such mechanics but also as a model mechanic training facility to improve the practices and standards of construction equipment repair and maintenance throughout the country. The basic design described in this chapter has been completed based on the following principles, while taking the expected functions and roles of the CETRAC into consideration.

(1) Facilities Appropriate for Local Climate

The city of Sri Jayewardenapura Kotte where the CETRAC will be located is situated at 6.5°N and 80°E and is subject to a tropical climate as well as an oceanic monsoon climate. The building design must, therefore, take strong sunshine and strong tropical squalls into consideration. Natural lighting and natural ventilation should be used where possible to create comfortable living space without dependence on mechanical equipment.

(2) Facilities Appropriate for the Site

The planned project site has an elevation difference of 10m between its southern edge and northern edge and the ground is expected to have low bearing strength. The facility layout should, therefore, establish a large test yard while achieving maximum safety, economy and functionality.

(3) Easy to Maintain Facilities

Design emphasis should be given to energy saving, simple mechanical systems and durable equipment. In the case of construction materials, priority should be given to durable, easy to maintain and readily available local materials. The use of local construction methods should be positively considered. Even if the initial cost is not necessarily the lowest, low running and maintenance costs should be the main features of the facilities.