


MINISTRY OF PLANNING AND DEVELOPMENT
THE ISLAMIC REPUBLIC OF PAKISTAN

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR IMPROVEMENT OF
CONSTRUCTION MACHINERY FOR ROAD CONSTRUCTION
IN
THE ISLAMIC REPUBLIC OF PAKISTAN

JANUARY 1998

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JAPAN INTERNATIONAL COOPERATION AGENCY
CONSTRUCTION PROJECT CONSULTANTS, INC.

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PREFACE

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

JICA sent to Pakistan a study team from September 15th to October 9th, 1997.

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

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

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

January, 1998



Kimio Fujita
President
Japan International Cooperation Agency

January, 1998

Letter of Transmittal

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

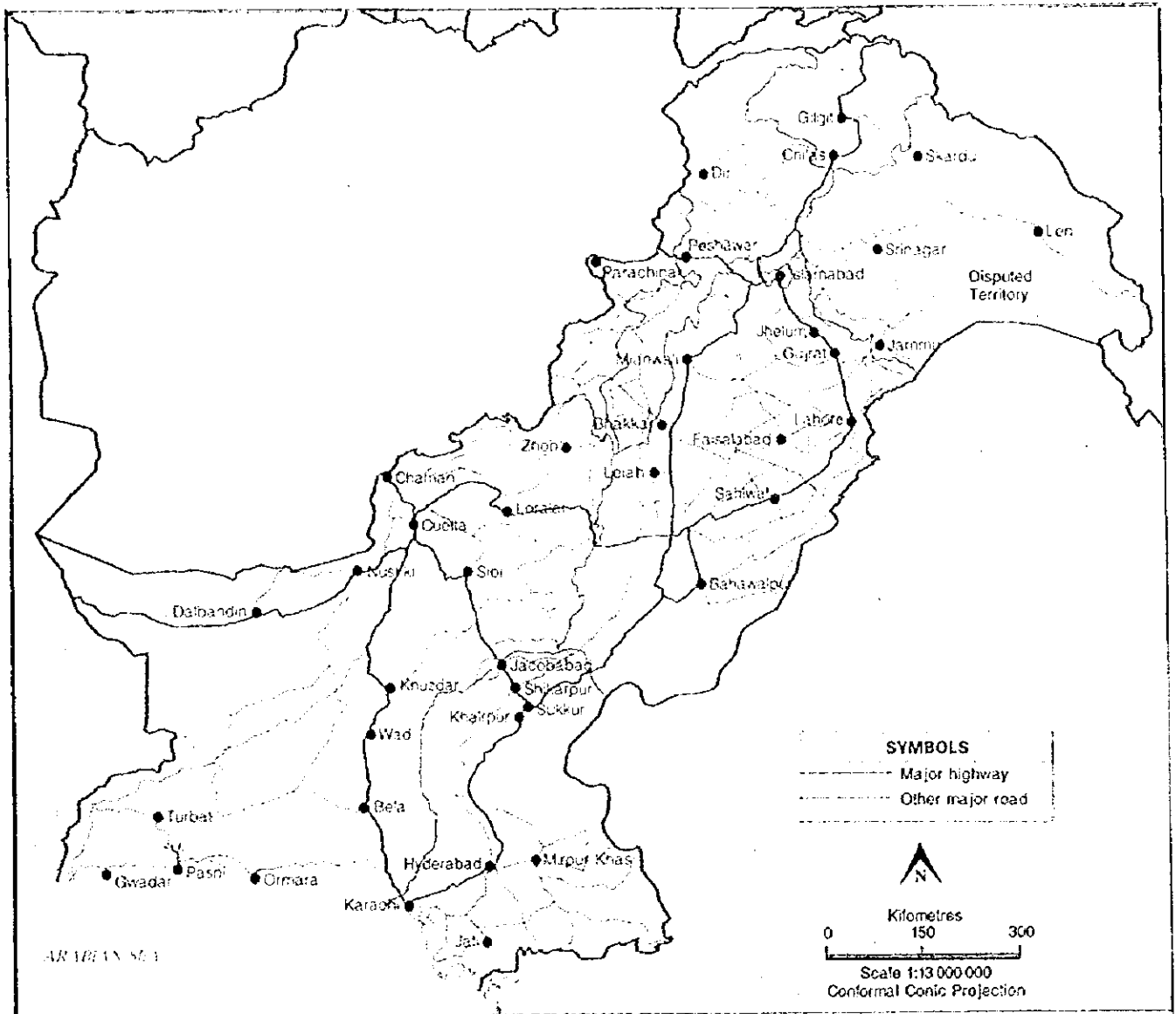
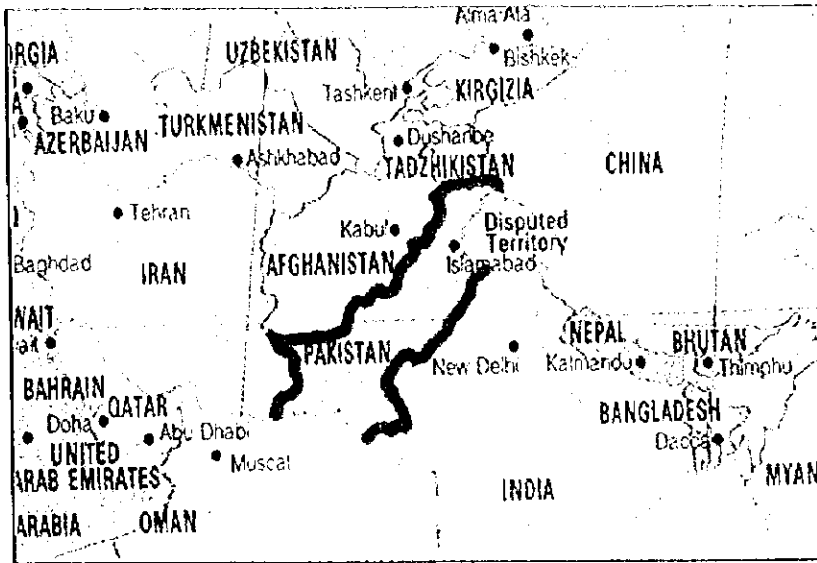
This study was conducted by the Construction Project Consultants, Inc., under a contract to JICA, during the period from September 3rd, 1997 to January 16th, 1998. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Pakistan and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

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

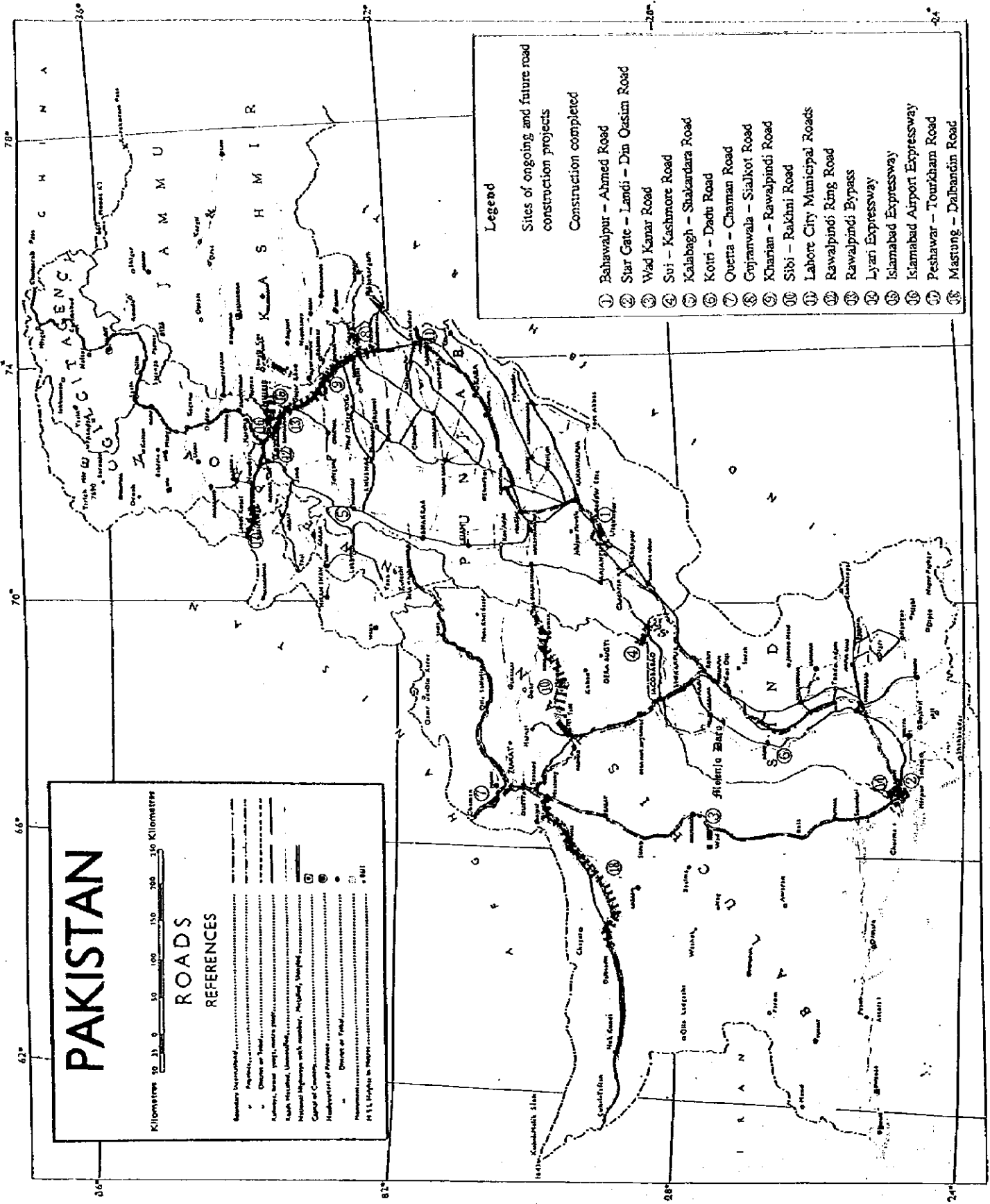
Very truly yours,



Kenzo NAKAMURA
Project Manager
Basic Design Study Team
on the Project for Improvement of
Construction Machinery for Road Construction
in the Islamic Republic of Pakistan
The Construction Project Consultants, Inc.



**LOCATION MAP
- ROAD NETWORK -**



PAKISTAN

Kilometers 0 25 50 100 150 200 300 Kilometers

ROADS REFERENCES

- National Highway
- Provincial Highway
- District Road
- Road
- National Highway with number, Major, Single
- Capital of Province
- District or Town
- Headquarter of District
- M.T. Highway to Neighboring Country

Legend

Sites of ongoing and future road construction projects

Construction completed

- ① Bahawalpur - Ahmed Road
- ② Star Gate - Landi - Din Qasim Road
- ③ Wad Kanar Road
- ④ Sui - Kashmir Road
- ⑤ Kalabagh - Shabardara Road
- ⑥ Kotri - Dadi Road
- ⑦ Quetta - Chaman Road
- ⑧ Gujranwala - Sialkot Road
- ⑨ Kharian - Rawalpindi Road
- ⑩ Sibi - Rakhni Road
- ⑪ Lahore City Municipal Roads
- ⑫ Rawalpindi Ring Road
- ⑬ Rawalpindi Bypass
- ⑭ Lyari Expressway
- ⑮ Islamabad Expressway
- ⑯ Islamabad Airport Expressway
- ⑰ Peshawar - Tourkham Road
- ⑱ Mastung - Dalbandin Road

Road Construction Projects Location Map

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CHAPTER 1

BACKGROUND OF THE PROJECT

Chapter 1 Background of the Project

1.1 Background of the Project

The Government of Pakistan is executing its national development plan based on the growth of GDP of the industrial sector and the expansion of export of manufactured products in the framework of the Perspective Plan (1988 - 2003).

The development plan aims at attaining an average growth rate of 7 percent per annum and generating 6.2 million employment during the period of the 8th Five Year Plan (1993 - 98), the mid-term of the Perspective Plan.

The transport infrastructure, especially road transport accounting for 80 percent of inland transport, plays an important role in the pursuit of the national development plan. In the last 10 years, the registered number of vehicles has doubled (from 1.84 million to 3.67 million in 1986 - 96), and the total road network has increased by 50% (from 126,243 km to 188,300 km). Increased traffic volume and heavier cargo weight have accelerated the deterioration of roads, and about 55 percent of national roads are now in the condition requiring rehabilitation or improvement. Under the circumstances the government of Pakistan is intensifying its operation for the rehabilitation and improvement of existing roads as well as for the construction of new highways to meet the evolution of traffic requirement. The 8th Five Year Plan (1993 - 1998) envisages an allocation of Rs 74,687 million for the national highway development programme comprising the construction of 335 km of new roads, and the rehabilitation and improvement of 4,660 km of existing roads. This amount of allocation accounts for 62 percent of the budget allocated to the Transport and Communications subsector and 22 percent of the total Federal budget.

Against this background, the National Logistic Cell (NLC), contributes greatly to the road development programme above. The NLC, established in 1978 as a national transport corporation, is comprised of two divisions: land transport and construction. The construction division completed the construction and improvement of 379 km of roads in the period of 1982 - 92. The NLC has successfully completed road construction works which are difficult for private contractors to undertake for reasons of remoteness of project site, security problems etc. It has presently under contract 428 km of road construction works, both ongoing and newly contracted.

NLC's achievements in road construction above owe greatly to the construction machinery supplied with Japan's grant aid four times in 1979 - 81. But all these machines have terminated their economic life and are now in unoperable condition. NLC purchased some machinery, in the meantime, with its own funds, but the overall work capacity has decreased

considerably. Therefore it has become difficult for NLC to complete the road construction works under contract with the existing machinery only and also to undertake construction works for important future projects of national road development requiring NLC's capability.

It was against the above background that a request for Japan's Grant Aid was made for the reinforcement of road construction machinery.

1.2 Requested Machinery

The Government of Pakistan has made a request for Japan's Grant Aid for procurement of the road construction machinery as listed in Table 1-1. The table indicates also the specifications of machinery and priority order of procurement desired by the implementing agency.

Table 1-1 List of Machinery Requested by Pakistan Side

Machinery List of Request Letter	Quantity	List of Desired Machinery (confirmed by the site study)			
Equipment	Quantity	No.	Equipment	Specifications	Quantity
1. Bulldozer (large size)	7	Priority A 1	Bulldozer (large size)	320HP	4
2. Bulldozer (medium size)	8	2	Bulldozer (medium size)	225HP	7
3. Wheel Loader	6	3	Wheel Loader	170HP	6
4. Hydraulic Excavator	6	4	Hydraulic Excavator	150HP	3
5. Motor Grader	8	5	Motor Grader	200HP	8
6. Vibration Roller	6	6	Vibration Roller	9.5 t	6
7. Air Compressor Size I	4	7	Asphalt Plant	60 - 80 t/h	1
8. Air Compressor Size II	4	8	Air Compressor	600 Cfm	2
9. Generator - 300 KVA	4	9	Truck Crane	20 - 25 t	1
10. Crane 20 - 50 t	3	Priority B 10	Bulldozer Size I	320HP	3
11. Asphalt Plant	1	11	Hydraulic Excavator	150HP	3
12. Asphalt Finisher	2	12	Air Compressor	600 Cfm	2
13. Equipment for Repair Workshop		13	Truck Crane	20 - 25 t	1
		14	Generator	300 KVA	4
		15	Asphalt Finisher	7.5 m	2
		16	Dump Truck	15 t	15
		Priority C 17	Mobile Workshop		
		18	Tools for Repair Workshop		
		19	Fuel Stand		
		20	Miscellaneous repair tools		

CHAPTER 2

CONTENTS OF THE PROJECT

Chapter 2. Contents of the Project

2.1 Objectives of the Project

The NLC is undertaking road construction works for Kharian Rawalpindi additional carriageway project, Sibi - Rakhni road improvement project and Lahore municipal road rehabilitation project, and is planning to get contracts for the construction of such roads as Rawalpindi Ring Road, Rawalpindi Bypass, Lyari Highway, Islamabad Highway, Islamabad Airport Highway and for the improvement of Peshawar - Tourkham road, of Mastung - Dalbandin Road in 1998-2005.

These projects are part of road sector development programme of the Federal and Provincial governments in the framework of the 8th (1993 - 98) and 9th (1998 - 2003) Five Year Plans.

Some projects are located in areas where conditions are difficult for the private contractors to undertake construction works due to the remoteness of project sites, security problems etc. In such areas NLC as a public corporation is required to carry out construction works while solving those problems in cooperation with project owners.

The construction machinery presently held by NLC consist of the earth moving and paving machinery procured in 1980 - 81 with Japan's Grant Aid and some machinery purchased by NLC with its own funds in 1984 - 93. Anyhow, all machinery procured with Japan's grant aid have outlived their economic life, and most of them are in unoperable condition. As for the machinery purchased later, about 70 percent of them have been in use for more than 10 years, and they would become unoperable before long.

The decline in mechanical capacity has reduced NLC's construction capacity, and is affecting consequently the achievement of the national road development program in Pakistan.

The objective of the present project is to promote the implementation of road development programme of Pakistan by procurement of construction machinery required by NLC for completing the ongoing road construction works as well as for undertaking future road construction works.

2.2 Basic Concept of the Project

2.2.1 Road Construction Programme of the NLC

The road construction works being undertaken or planned to be undertaken in near future by NLC are described briefly below. The machinery to be procured with Japan's grant aid, if it is realized based on the basic design study, shall be assigned to these projects.

1. Kharian - Rawalpindi Road (NS)

Additional Carriageway Project (Continued project)

1) Road Length	125 km
2) Description of Project	Two lanes (Existing Road) --> Four lanes with median strip
3) Project Owner	NHA
4) Commencement	May 1992
5) Completion Schedule (Estimate)	December 1998 (December 1999)
6) Progress (as of September 1997)	66.5%
7) Main remaining works	Pavement (Base course, Surface treatment) 80 km Bridge 600 m Drainage 1,210 m Facilities for traffic safety L.S.
8) Main equipment required	Wheel Loader, Excavator, Motor Grader, Vibration Roller, Asphalt Plant, Asphalt Finisher, Air Compressor, Generator, Dump Truck

2. Sibi - Rakhni Road

Improvement Project (Continued project)

1) Road Length	358 km
2) Description of Project	Single lane earth road (existing road) --> Two lanes with surface treatment
3) Project Owner	Balochistan Province

- | | | |
|----|---------------------------------|---|
| 4) | Commencement | December 1983 |
| 5) | Completion Schedule (Estimate) | Not known (December 2002) |
| 6) | Progress (as of September 1997) | 33% |
| 7) | Main remaining works | Land reclamation 6.62 million m ²
Earth moving works (Cuts and Fills)
482 km
Bridge 1,200 m
Pavement (Base course, Surface treatment)
270 m |
| 8) | Main equipment required | Bulldozer (Ripper), Wheel Loader,
Excavator, Motor Grader, Vibration Roller,
Air Compressor, Truck Crane, Generator,
Dump Truck |
3. Lahore City Municipal Roads (Order received)
- | | | |
|----|--------------------------------|--|
| 1) | Road Length | 331 Sections (50 km) |
| 3) | Description of Project | Rehabilitation of urban road pavement |
| 3) | Project Owner | Lahore City Municipal Corporation |
| 4) | Commencement | December 1997 |
| 5) | Completion Schedule (Estimate) | December 1999 |
| 6) | Main works involved | Asphalt concrete overlay |
| 7) | Main equipment required | Asphalt Plant, Asphalt Finisher, Dump
Truck, Vibration Roller, Air Compressor,
Generator |
4. Rawalpindi Ring Road (Expecting order by nomination)
- | | | |
|----|------------------------|---|
| 1) | Road Length | 25.6 km |
| 5) | Description of Project | Construction of a new road (4 lanes with
median strip) |
| 3) | Project Owner | Rawalpindi Development Authority |
| 5) | Commencement | March 1998 |

- | | | | | | | | | | |
|---|---|--------------|----------------------------|------------------|---|---|---------|---------------------------|---------|
| 5) Completion Schedule (Estimate) | March 2001 | | | | | | | | |
| 6) Main works involved | <table border="0"> <tr> <td>Earth moving</td> <td>1.3 million m³</td> </tr> <tr> <td>Bridge (Flyover)</td> <td>6</td> </tr> <tr> <td>Pavement (Base course, Surface treatment)</td> <td>26.5 km</td> </tr> <tr> <td>Traffic Safety Facilities</td> <td>26.5 km</td> </tr> </table> | Earth moving | 1.3 million m ³ | Bridge (Flyover) | 6 | Pavement (Base course, Surface treatment) | 26.5 km | Traffic Safety Facilities | 26.5 km |
| Earth moving | 1.3 million m ³ | | | | | | | | |
| Bridge (Flyover) | 6 | | | | | | | | |
| Pavement (Base course, Surface treatment) | 26.5 km | | | | | | | | |
| Traffic Safety Facilities | 26.5 km | | | | | | | | |
| 7) Main equipment required | Bulldozer, Wheel Loader, Dump Truck, Vibration Roller, Motor Grader, Excavator, Air Compressor, Asphalt Plant, Asphalt Finisher, Generator, Truck Crane | | | | | | | | |

5. Rawalpindi Bypass (Competitive Tender)

- | | | | | | | | | | |
|---|--|-------------------------------|-----------------------------|------------------|----|---|-------|---------------------------|-------|
| 1) Road Length | 45 km | | | | | | | | |
| 2) Description of Project | Construction of a new road (Four lanes with median strip) | | | | | | | | |
| 3) Project Owner | Rawalpindi Development Authority | | | | | | | | |
| 4) Commencement | April 1999 | | | | | | | | |
| 5) Completion Schedule (Estimate) | March 2002 | | | | | | | | |
| 6) Main works involved | <table border="0"> <tr> <td>Earth moving (Cuts and fills)</td> <td>2.25 million m³</td> </tr> <tr> <td>Bridge (Flyover)</td> <td>10</td> </tr> <tr> <td>Pavement (Base course, Surface treatment)</td> <td>45 km</td> </tr> <tr> <td>Traffic Safety Facilities</td> <td>45 km</td> </tr> </table> | Earth moving (Cuts and fills) | 2.25 million m ³ | Bridge (Flyover) | 10 | Pavement (Base course, Surface treatment) | 45 km | Traffic Safety Facilities | 45 km |
| Earth moving (Cuts and fills) | 2.25 million m ³ | | | | | | | | |
| Bridge (Flyover) | 10 | | | | | | | | |
| Pavement (Base course, Surface treatment) | 45 km | | | | | | | | |
| Traffic Safety Facilities | 45 km | | | | | | | | |
| 7) Main equipment required | Bulldozer, Wheel Loader, Dump Truck, Vibration Roller, Motor Grader, Excavator, Air Compressor, Asphalt Plant, Asphalt Finisher, Generator, Truck Crane | | | | | | | | |

6. Lyari Expressway (Expecting order on negotiation basis)

- | | |
|---------------------------|---|
| 1) Road Length | 34 km |
| 3) Description of Project | Construction of an elevated highway (4 lanes) |

- | | |
|-----------------------------------|--|
| 3) Project Owner | Karachi Municipal Corporation |
| 4) Commencement | August 1999 |
| 5) Completion Schedule (Estimate) | July 2004 |
| 6) Main works involved | Continuous elevated highway |
| 7) Main equipment required | Truck Crane, Asphalt Plant, Asphalt Finisher, Dump Truck, Vibration Roller, Air Compressor, Generator, Pile Hammer, Concrete Plant, Concrete Mixer, Agitator Truck |

7. Islamabad Expressway Construction Project (Competitive Tender)

- | | |
|-----------------------------------|---|
| 1) Road Length | 22 km |
| 3) Description of Project | Construction of new road (4 lanes with median strip, many flyovers) |
| 3) Project Owner | Capital Development Corporation |
| 4) Commencement (Estimate) | Jan. 2001 |
| 5) Completion Schedule (Estimate) | Dec. 2004 |
| 6) Main works involved | Undecided (Under designing) |
| 7) Main equipment required | Undecided |

8. Islamabad Airport Expressway Construction Project (Competitive Tender)

- | | |
|-----------------------------------|--|
| 1) Road Length | Undecided (Under designing) |
| 2) Description of Project | Construction of new road (6 lanes with median strip) |
| 3) Project Owner | Airport Corporation |
| 4) Commencement (Estimate) | Jan. 2001 |
| 5) Completion Schedule (Estimate) | Dec. 2004 |
| 6) Main works involved | Undecided (Under designing) |
| 7) Main equipment required | Undecided |

9. Peshawar - Tourkham Road Improvement Project (Expecting order by nomination)

- | | | | | | | | | | |
|---|---|--------------|------------------------|---|-------|------------------------------|---------|---------------------------|-------|
| 1) Road Length | 30 km | | | | | | | | |
| 2) Description of Project | Road widening → 2 lanes with asphalt concrete pavement | | | | | | | | |
| 3) Project Owner | NHA | | | | | | | | |
| 4) Commencement (Estimate) | Jan. 2002 | | | | | | | | |
| 5) Completion Schedule (Estimate) | Dec. 2004 | | | | | | | | |
| 6) Main works involved | <table border="0"> <tr> <td>Earth moving</td> <td>300,000 m³</td> </tr> <tr> <td>Pavement (Base course, Surface treatment)</td> <td>30 km</td> </tr> <tr> <td>Drainage (including bridges)</td> <td>1,000 m</td> </tr> <tr> <td>Traffic Safety Facilities</td> <td>30 km</td> </tr> </table> | Earth moving | 300,000 m ³ | Pavement (Base course, Surface treatment) | 30 km | Drainage (including bridges) | 1,000 m | Traffic Safety Facilities | 30 km |
| Earth moving | 300,000 m ³ | | | | | | | | |
| Pavement (Base course, Surface treatment) | 30 km | | | | | | | | |
| Drainage (including bridges) | 1,000 m | | | | | | | | |
| Traffic Safety Facilities | 30 km | | | | | | | | |
| 7) Main equipment required | Bulldozer, Wheel Loader, Dump Truck, Vibration Roller, Motor Grader, Excavator, Air Compressor, Asphalt Plant, Asphalt Finisher | | | | | | | | |

10. Mastung - Dalbandin Road Improvement Project (Expecting order by nomination)

- | | | | | | | | | | |
|---|--|-------------------------------|------------------------|---------|----|---|--------|---------------------------|--------|
| 1) Road Length | 180 km | | | | | | | | |
| 2) Description of the Project | Widening of the existing road → 2 lanes with asphalt concrete pavement | | | | | | | | |
| 3) Project Owner | NHA | | | | | | | | |
| 4) Commencement (Estimate) | Jan. 2002 | | | | | | | | |
| 5) Completion Schedule (Estimate) | Dec. 2005 | | | | | | | | |
| 6) Main works involved | <table border="0"> <tr> <td>Earth moving (Cuts and fills)</td> <td>150,000 m³</td> </tr> <tr> <td>Bridges</td> <td>30</td> </tr> <tr> <td>Pavement (Base course, Surface treatment)</td> <td>180 km</td> </tr> <tr> <td>Traffic Safety Facilities</td> <td>180 km</td> </tr> </table> | Earth moving (Cuts and fills) | 150,000 m ³ | Bridges | 30 | Pavement (Base course, Surface treatment) | 180 km | Traffic Safety Facilities | 180 km |
| Earth moving (Cuts and fills) | 150,000 m ³ | | | | | | | | |
| Bridges | 30 | | | | | | | | |
| Pavement (Base course, Surface treatment) | 180 km | | | | | | | | |
| Traffic Safety Facilities | 180 km | | | | | | | | |
| 7) Main equipment required | Bulldozer, Wheel Loader, Dump Truck, | | | | | | | | |

Vibration Roller, Motor Grader, Excavator,
Air Compressor, Asphalt Plant, Asphalt
Finisher, Generator, Truck Crane

2.2.2 Construction Machinery and Facilities Required for Implementation of the Project

(1) Implementation Schedule

Figure 2-1 shows the estimated schedule of the road construction works to which the machinery to be procured under the project shall be assigned.

	1998				1999				2000				2001				2002				2003				2004							
	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv				
i) Kharian - Rawalpindi Additional Carriage-ways Project																																
ii) Sibi - Rakhni Road Improvement Project																																
iii) Lahore Municipal Roads Rehabilitation Project																																
iv) Rawalpindi Ring Road Construction Project																																
v) Rawalpindi Bypass Construction Project																																
vi) Lyari Expressway Construction Project																																
vii) Islamabad Expressway Construction Project																																
viii) Islamabad Airport Highway Project																																
ix) Peshawar - Tourkham Road Improvement Project																																
x) Mastung - Dalbandin Road Improvement Project																																

Fig. 2-1 Estimated Schedule of Road Construction Works

(2) Quantity Required of Main Construction Machinery

The machinery to be procured under the project are presumed to be delivered to job sites and become operable in the end of 1998.

The quantity of the main machines required for each construction works has been estimated based on the road construction programme and the implementation schedule shown in Fig. 2-1, the result of which is presented chronologically in Table A1.1~1.18 (Appendix 5).

The quantities of the main machines to be required by NLC after 1999, together with the time schedule of requirement, can be aggregated from the above mentioned table A1.1~1.18. And the quantities obtained, which will be studied for the period of the 9th Five Year Plan (1998 - 2003), are shown in Tables 2-1 and 2-2: Table 2-1 "the quantity required for the ongoing works" and Table 2-2 "the quantity required for both the ongoing and expected future works".

**Table 2-1 Quantity of the Construction Machinery required by NLC
(for the ongoing construction works)**

	Number of Units					
	1998	1999	2000	2001	2002	2003
Bulldozer (Large size)	5	5	5	3	2	—
Bulldozer (Medium size)	7	7	7	7	6	—
Wheel Loader	10	10	8	6	6	—
Excavator	6	6	4	3	3	—
Motor Grader	10	10	8	6	6	—
Vibration Roller	21	21	18	14	14	—
Asphalt Plant	2	2	1	—	—	—
Asphalt Finisher	4	4	2	—	—	—
Truck Crane	3	3	2	1	1	—
Air Compressor	5	5	3	2	2	—
Generator	5	5	3	2	2	—
Dump Truck	59	59	39	24	24	—
Water Bowser	4	4	4	4	4	—
Tractor	3	3	2	1	1	—
Asphalt Distributor	3	3	3	2	2	—
Crushing Plant	4	4	3	2	2	—
Concrete Mixer	4	4	3	2	2	—

**Table 2-2 Quantity of the Construction Machinery required by NLC
(for the ongoing and expected future construction works)**

	Number of Units					
	1998	1999	2000	2001	2002	2003
Bulldozer (Large size)	7	11	12	16	17	18
Bulldozer (Medium size)	8	13	14	22	17	17
Wheel Loader	11	17	19	23	24	27
Excavator	7	15	16	23	22	26
Motor Grader	11	12	14	16	18	19
Vibration Roller	22	29	31	35	37	31
Asphalt Plant	2	2	3	3	4	4
Asphalt Finisher	4	5	5	6	7	8
Truck Crane	3	4	5	6	7	7
Air Compressor	6	6	7	8	8	9
Generator	6	6	7	8	8	9
Dump Truck	62	69	76	87	95	95
Water Bowser	5	6	6	7	8	8
Tractor	3	4	4	5	6	6
Asphalt Distributor	3	3	4	4	5	5
Crushing Plant	4	4	5	5	6	6
Concrete Mixer	4	5	6	8	9	10

(3) The NLC's Existing Machinery

NLC has at present 461 units of construction machinery at their work sites, but 334 units of them, corresponding to about 72 percent, are aged more than 10 years and their economic life has been terminating (Table 2-3). Therefore, these machinery with reduced efficiency are hardly contributing to the work performance, and the present work capacity is mainly that of 127 units of machines with less than 10 years of age.

Table 2-3 Condition of the Principal Machinery held by NLC

	Total number of machines held	Machines used more than 10 years	Number of Operable Machines (by number of years of use as of 1997)							
			Total Number	3 years	4 years	5 years	6 years	7 years	8 years	9 years
Bulldozer (Large size)	21	20	1	1						
Bulldozer (Medium size)	17	17	0							
Wheel Loader	22	17	5			3	2			
Excavator	11	8	3			1		1		1
Motor Grader	21	17	4	4						
Vibration Roller	71	53	18		4	4	4	2	2	2
Asphalt Plant	3	2	1							1
Asphalt Finisher	16	14	2					1	1	
Truck Crane	5	3	2				1		1	
Air Compressor	4	2	2		2					
Generator	16	14	2		2					
Dump Truck	171	122	40	13	13	13	10			
Water Bowser	31	19	12			4		4		4
Tractor	16	7	9		3		3		3	
Asphalt Distributor	7	4	3		1			1		1
Crushing Plant	14	8	6	1		2	1	1		1
Concrete Mixer	15	7	8	2			3			3
Total	461	334	127	21	25	27	24	10	7	13

It is difficult to estimate the remaining life of construction machinery as it varies with type of machine, fabrication, operating condition, maintenance and repair etc. However, economic operating hours, which take into account the operating cost, are known empirically, and these values are indicated by the manufacturers of construction machinery. And the remaining life of NLC's existing machinery has been estimated based on the economic operating hours indicated by Japanese manufacturers of construction machinery. Standard machine life can be obtained by dividing these economic operating hours by standard annual operating hours in Pakistan as shown in Table 2-4.

Table 2-4 Standard Lifetime of Construction Machinery

Name of Machine	Standard Lifetime Operating Hours	Standard Annual Operating Hours	Standard Lifetime (years)
Bulldozer (Large Size)	10,000	1,000	10
Bulldozer (Medium Size)	10,000	1,000	10
Wheel Loader	10,000	1,000	10
Excavator	10,000	1,000	10
Vibration Roller	10,000	1,000	10
Asphalt Plant	13,000	-	10
Asphalt Finisher	7,000	700	10
Truck Crane	8,000	800	10
Air Compressor	--	--	10
Generator	--	--	10
Dump Truck	9,000	1,300	7

The number of machines remaining in operable condition have been obtained by deducting the number of years the machines have been in use (Table 2-3) from the standard machine lives (Table 2-4). The result of calculation is shown in Table 2-5.

Table 2-5 NLC's Machinery Remaining in Operable Condition

	Number of Machines in Operable Condition					
	1998	1999	2000	2001	2002	2003
Bulldozer (Large size)	1	1	1	1	1	1
Bulldozer (Medium size)	0	0	0	0	0	0
Wheel Loader	5	5	5	5	5	3
Excavator	3	2	2	1	1	0
Motor Grader	4	4	4	4	4	4
Vibration Roller	18	16	14	10	6	3
Asphalt Plant	1	1	0	0	0	0
Asphalt Finisher	2	2	1	0	0	0
Truck Crane	2	2	1	1	0	0
Air Compressor	2	2	2	2	0	0
Generator	2	2	2	2	2	2
Dump Truck	49	39	26	13	0	0
Water Bowser	12	12	8	8	4	4
Tractor	9	9	9	6	6	3
Asphalt Distributor	3	3	2	1	1	1
Crushing Plant	6	6	5	4	3	1
Concrete Mixer	8	8	5	5	5	2

(4) Shortage of Machinery for the Future Requirement

The estimated future shortage of machinery can be obtained by deducting the quantity of operable machinery (Table 2-5) from the quantity required for the future construction projects (Table 2-1, 2-2). Shortage for the requirement of the ongoing projects is shown in Table 2-6 and that for the requirement of all projects comprising expected future contracts in Table 2-7.

**Table 2-6 Quantity of Machinery in Shortage for NLC's Future Requirement
(for the ongoing construction works)**

	Number of Machines in Shortage					
	1998	1999	2000	2001	2002	2003
Bulldozer (Large size)	4	4	4	2	1	--
Bulldozer (Medium size)	7	7	7	7	6	--
Wheel Loader	5	5	3	1	1	--
Excavator	3	4	2	2	2	--
Motor Grader	6	6	4	2	2	--
Vibrator Roller	3	5	4	4	2	--
Asphalt Plant	1	1	1	--	--	--
Asphalt Finisher	2	2	1	--	--	--
Truck Crane	1	1	1	1	1	--
Air Compressor	3	3	1	2	2	--
Generator	3	3	1	--	--	--
Dump Truck	10	20	13	11	24	--
Water Bowser	-8	-8	-4	-4	0	--
Tractor	-6	-6	-5	-5	-5	--
Asphalt Distributor	0	0	1	1	1	--
Crushing Plant	-2	-2	-2	-2	-1	--
Concrete Mixer	-4	-4	-2	-3	-3	--

Table 2-7 Quantity of Machinery in Shortage for NLC's Future Requirement (for the ongoing and future construction works)

	Number of Machines in Shortage					
	1998	1999	2000	2001	2002	2003
Bulldozer (Large size)	6	10	11	15	16	18
Bulldozer (Medium size)	8	13	14	22	17	17
Wheel Loader	6	12	14	18	19	24
Excavator	4	13	14	22	21	26
Motor Grader	7	8	10	12	14	15
Vibrator Roller	4	13	17	25	31	28
Asphalt Plant	1	1	3	3	4	4
Asphalt Finisher	2	3	4	6	7	8
Truck Crane	1	2	4	5	7	7
Air Compressor	4	4	5	6	8	9
Generator	4	4	5	6	6	7
Dump Truck	13	30	50	74	95	95
Water Bowser	-7	-6	-2	-1	4	8
Tractor	-6	-5	4	-1	0	2
Asphalt Distributor	0	0	2	3	4	2
Crushing Plant	-2	-2	0	1	3	5
Concrete Mixer	-4	-3	1	3	4	9

Table 2-6, 2-7 lead to the following considerations concerning the replacement and reinforcement of construction machinery required for NLC after 1998.

1. Earth Moving Machinery : Bulldozer (Large, medium vibration size), Wheel Loader, Excavator, Motor Grader, Vibration Roller

The capacity of machinery is becoming insufficient even for the execution of ongoing works, and the need for these machinery will increase year by year. As for water bowser, the capacity of existing machines is sufficient for the moment but will become insufficient after 2002.

2. Pavement Machinery : Asphalt Plant, Asphalt Finisher

Capacity is not sufficient even for the ongoing works, and there will be increased need for these machinery for future undertakings of construction works. As for asphalt distributor, the capacity of existing machine will be sufficient till about 2000, but will become insufficient thereafter.

3. Common Machinery : Truck Crane, Air Compressor, Generator
They are necessary for the ongoing works, and will become more so in future.
4. Transportation Equipment
Shortage of dump truck is serious. The existing units are far insufficient for the ongoing as well as for the future construction works.
5. Stone Crushing Plant
The existing plant will meet the requirement till about 2000 but will need to be replaced or reinforced after 2001.
6. Concrete Mixer
The existing concrete mixer will need to be replaced or reinforced after 2000.

2.2.3 Project Machinery

Project machinery have been decided based on the following concepts.

1. NLC carries out, under contract by nomination, road construction works which are difficult for private contractors to undertake due to the remoteness of project sites, security problems, relocation of local population etc., and which are of low profitability.

Despite these difficult conditions, NLC accomplishes its contracted works successfully and contributes to the national road development programme. NLC will continue to play this important role in future.
2. NLC undertakes road construction works on contract basis. The contract price should include machine cost, and NLC should be able to depreciate its machinery properly based on the revenue from construction works, so that the renewal of machinery can be done timely. But the depreciation of machinery could not be done properly in the past. NLC will carry out the depreciation of its machinery properly. Recommendations concerning the method of depreciation shall be made in this report.
3. NLC's construction works under execution have high social and economic value but are difficult for private contractors to undertake. Therefore the construction machinery lacking for completion of the ongoing works will be treated as project machinery.

4. Shortage of the machinery required for completion of NLC's ongoing works will be at its peak in 1999, which is also the year when the project machinery come into full operation after delivery. Therefore, the quantity of the project machinery will be decided in view of the requirement in 1999 (Table 2-6).
5. Items excluded from the project machinery
 - 1) Dump truck is excluded from the items of project machinery as it can be rented or purchased relatively easily and its procurement plan can be made according to the demand from the construction works.
 - 2) Repair tools and other equipment of the priority group-C of the request are excluded from the project items, because the machinery to be procured will not need much repair work during the first 3 - 4 years of operation.
6. Replacement parts to be supplied with the project machinery will be considered for about 3 years use after the introduction of the machinery (till about 2000), and within the limit of about 9 percent of the value of machinery.

In consideration of the above, the content of the project machinery shall be decided on the construction machinery which will be lacking in 1999 for completing the ongoing construction works as shown in Table 2-8. The content of the project machinery is as follows:

Table 2-8 Project Machinery

No.	Name of Machinery	Unit
1.	Bulldozer (Large size)	4 units
2.	Bulldozer (Medium size)	7 units
3.	Wheel Loader	5 units
4.	Hydraulic Excavator	4 units
5.	Motor Grader	6 units
6.	Vibration Roller	5 units
7.	Asphalt Plant	1 unit
8.	Asphalt Finisher	2 units
9.	Truck Crane	1 unit
10.	Air Compressor	3 units
11.	Generator	3 units

2.2.4 Verification of the Content of the Project

The quantity of the machinery required for NLC's ongoing works will decrease after 2000 with the progress of these works. After the completion of the ongoing works, the project machinery will be put into the construction works of expected future contracts. In Table 2-9, the project machinery is compared with the shortage of the machinery required for both the ongoing works and the works of expected future contracts in 2000 and 2001, when the requirement of machinery for the ongoing construction works starts decreasing.

Table 2-9 Comparison of the Project Machinery with the Requirement of Machinery after 2000

	Project machinery	Machinery required in 2000	Machinery required in 2001
Bulldozer (Large Size)	4	11	15
Bulldozer (Medium Size)	7	14	22
Wheel Loader	5	14	18
Excavator	4	14	22
Motor Grader	6	10	12
Vibration Roller	5	17	25
Asphalt Plant	1	3	3
Asphalt Finisher	2	4	6
Truck Crane	1	4	5
Air Compressor	3	5	6
Generator	3	5	6

The project machinery corresponds to 25 - 60 percents of the requirement of machinery in 2000 and 18 - 50 percent in 2001. Therefore, even with some fluctuations in NLC's future construction works programme, all machinery supplied under the project will obviously be used effectively.

2.3 Basic Design

2.3.1 Design Concept

The design concept for the machinery being considered as items of Japan's grant aid according to the request for grant aid is explained below.

(1) Concept of Natural Condition

NLC's contracts under execution and those expected in future are for the projects located mostly in low lands of Punjab, Sind and Balochistan Provinces. Therefore special arrangements for the use in high terrain will not be required of the machinery to be procured.

At some work sites of Sibi - Rakhni road, temperature rises up to 50°C in summer time. Therefore some of the machinery to be supplied shall be required to meet the tropical specification, and also "heat balance test" should be required for the machines liable to overheat.

As work sites are generally dusty, the machine to be supplied shall be required to meet anti-dust specification.

(2) Concept of the Local Conditions

The fuel and oil used by NLC cannot be considered to be of fine quality. Especially the handling of fuel at work sites seems inappropriate. Therefore some machines need to be fitted with dual stage oil filter.

Vandalism protection device shall be fitted on request from the user.

(3) Concept of the Implementing Agency's Capacity for the Maintenance and Management

Technical capability of NLC for the maintenance and management of equipment has already been well established. But tools and measuring instruments for the maintenance and repair of machinery are lacking. Therefore it is desirable that NLC procure with its own funds the minimum required repair tools.

(4) Concept of the Implementing Schedule

The present project is to be implemented in the programme of 1997 fiscal year. Therefore, the implementation schedule shall be established in such way as to complete the delivery of machinery by March 1999. For avoiding unnecessary delay, progress of each procedure to be taken by Pakistan side shall be followed step by step according to the implementing schedule.

Regarding the asphalt plant, the preparatory work to be done by Pakistan side and the cooperation by Japan side for the plant assembling are indispensable. It is therefore necessary to confirm beforehand the division of works to be done by each side.

2.3.2 Basic Design

Based on the above concepts, the basic design of the machinery of the present project will have the following content.

(1) General Plan

The construction machinery to be supplied under the project shall be used for the construction of national and provincial roads spread over the wide territory. Works involved are varied, but machinery plan will be established focusing on the earth moving and pavement works.

(2) Machinery Plan

Therefore, the machinery plan has been decided as follows.

1. Bulldozer (large size) 4 units

To be used for heavy earth moving works. Road construction in remote areas needs much cutting and bunking work in sandy terrains mixed with rocks. Therefore bulldozers with capacity of 300HP or above are needed.

One unit of these machines is required to be fitted with ripper for cutting soft rock.

Specifications: Engine 300 ~ 320HP
 Tropical specifications
 Straight tilt U-blade
 Rock shoe (One unit fitted with multi-shank ripper)

2. Bulldozer (medium size) 7 units

To be used for earth moving works. Required for construction of new roads: Rawalpindi ring road, Rawalpindi by-pass, Islamabad new airport road. Bulldozer with a capacity less than 200HP is inefficient as its earth moving capacity is too small.

Specifications: Engine 200 ~ 230HP
fitted with mechanical angle blade

3. Wheel Loader 5 units

The dump trucks used by NLC are mostly of 15 ton capacity. Therefore, loaders with buckets of 2.7~2.9 m³ class are the most adapted for loading these dump trucks.

Specifications: Engine 160 ~ 190HP
fitted with 2.7 ~ 2.9 m³ bucket

4. Hydraulic Excavator 4 units

Much excavation works is needed for side ditches, and excavators with bucket capacity 1.0~1.2 m³ are sufficient.

Specifications: Engine 150 ~ 160HP
Bucket 1.0 ~ 1.2 m³
Crawler type

5. Motor Grader 6 units

The construction works undertaken by NLC are mostly for trunk roads with 2 lanes on each way. The motor grader actually used by NLC has also 4.3 m blade.

Specifications: Engine 200 ~ 220HP
fitted with 4.3 m blade, traffic lights, alarms and other accessories.

6. Vibration Roller 5 units

To be used for construction of trunk roads with traffic of heavy axle load, which requires compaction capacity of about 10 ton.

Specifications: Single drum type
Rear wheel drive
Machine weight 9.5 ~ 10.5 ton

7. Asphalt Plant 1 unit

NLC has one plant of 100~120 ton/h capacity at present, which is adapted to the pavement works of 4 lanes road. But NLC does not have a plant of 60~80 ton/h capacity, which is suitable for pavement of 2 lanes road.

Specifications: Stationary
Capacity 60 ~ 80 ton/h
Fuel: Light oil

8. Asphalt Finisher 2 units

Trunk roads are about 7~8 m wide (excluding shoulders), which is the size required of the asphalt finisher.

Specifications: Working width 7.5 ~ 8 m
Fuel: Light oil

9. Truck Crane 1 unit

NLC uses truck cranes mostly for loading precast products for road and bridge construction, therefore the machine of the following specifications is adapted.

Specifications: Lifting capacity 20~25 ton
Engine 200 ~ 230 HP
Drive 6×4
Right hand drive

10. Air Compressor 3 units

To be used for rock drilling. Machines with the following specifications will have good matching efficiency with NLC's existing rock drills.

Specifications: Capacity 650 ~ 800 Cfm
Engine 190 ~ 200HP

11. Generator 3 units

One unit as power source for the asphalt plant and two units for crushing plants need 250~280 KVA capacity. Therefore 300 KVA will cover the requirement.

Specifications: Capacity 300 KVA
 Engine 420 ~ 480HP

(3) Spare Parts

Spare parts of a value equivalent to about 9 percent of the machinery, consisting mainly of consumable parts and periodical maintenance parts, shall be procured together with the machinery in order to ensure a good operating efficiency.

Importance shall be attached especially to the following parts.

Fuel filter, oil filter, transmission oil filter, air cleaner element, V-belt, hydraulic hose, cutting edge, end bits, seal kits, engine gasket, O-ring, cooling water hose, air hose, hydraulic hose, brake lining, shock absorber, tyre.

(4) Project Machinery

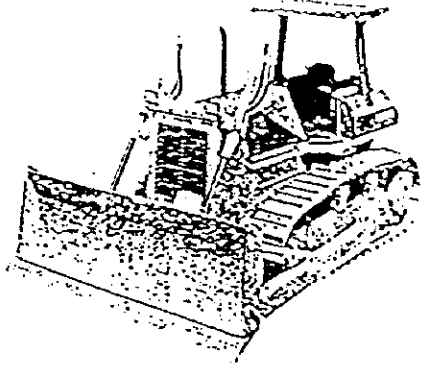
The machinery to be procured under the Project is shown in Table 2-10.

Table 2-10 List of the Machinery to be procured under the Project

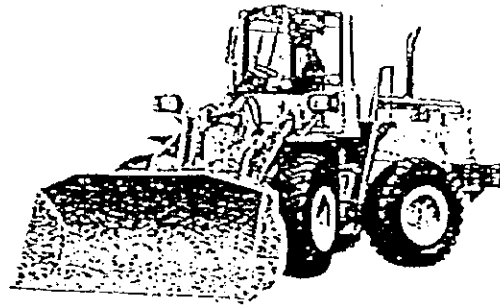
No.	Name of Machine	Main Specification	Quantity
1	Bulldozer	300~320HP	4
2	Bulldozer	200~230HP	7
3	Wheel Loader	160~190HP	5
4	Hydraulic Excavator	150~160HP	4
5	Motor Grader	200~220HP	6
6	Vibration Roller	9.5~10.5 ton	5
7	Asphalt Plant	60~80 ton/h	1
8	Asphalt Finisher	7.5~8 m	2
9	Truck Crane	20~25 ton	1
10	Air Compressor	650~800 Cfm	3
11	Generator		3
	Total		41

Appearances of project machinery are hereunder:

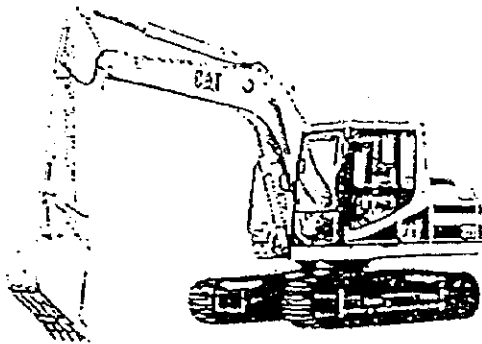
1. Bulldozer



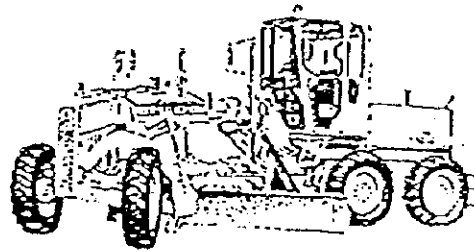
2. Wheel Loader



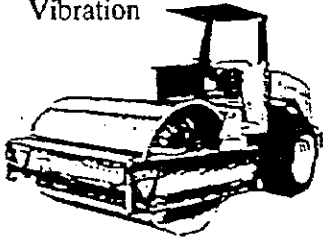
3. Hydraulic Excavator



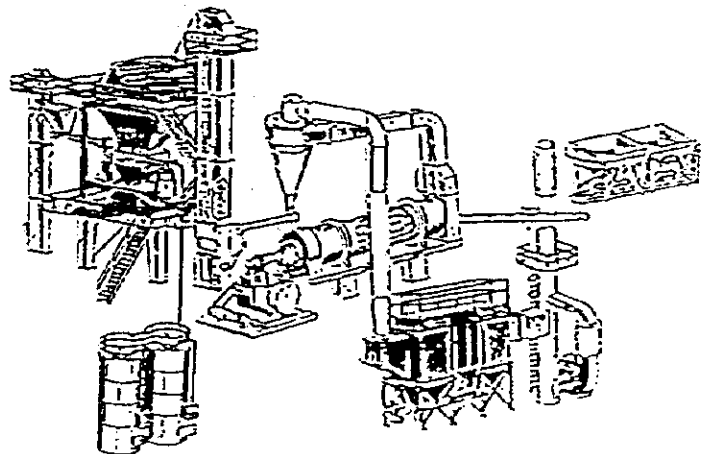
4. Motor Grader



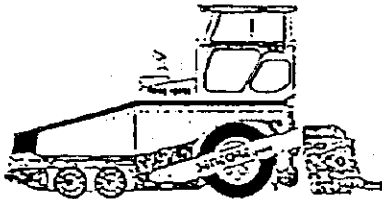
5. Vibration



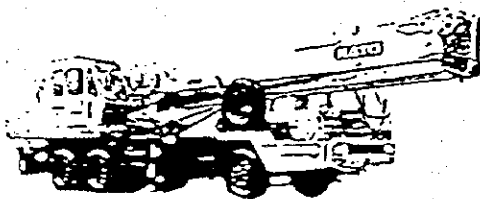
6. Asphalt Plant



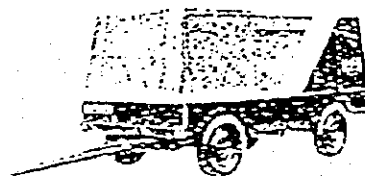
7. Asphalt Finisher



8. Truck Crane



9. Air Compressor



10. Generator

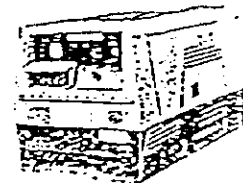


Fig. 3-2 Appearances of Project Machinery

CHAPTER 3

IMPLEMENTATION PLAN

Chapter 3. Implementation Plan

3.1 Machinery Procurement Plan

3.1.1 Implementation Policy

(1) Project Implementing Agency

In case of implementation of the project under Japan's Grant Aid, the organizations concerned with its implementation function with the mechanism as illustrated in Fig. 3.1.

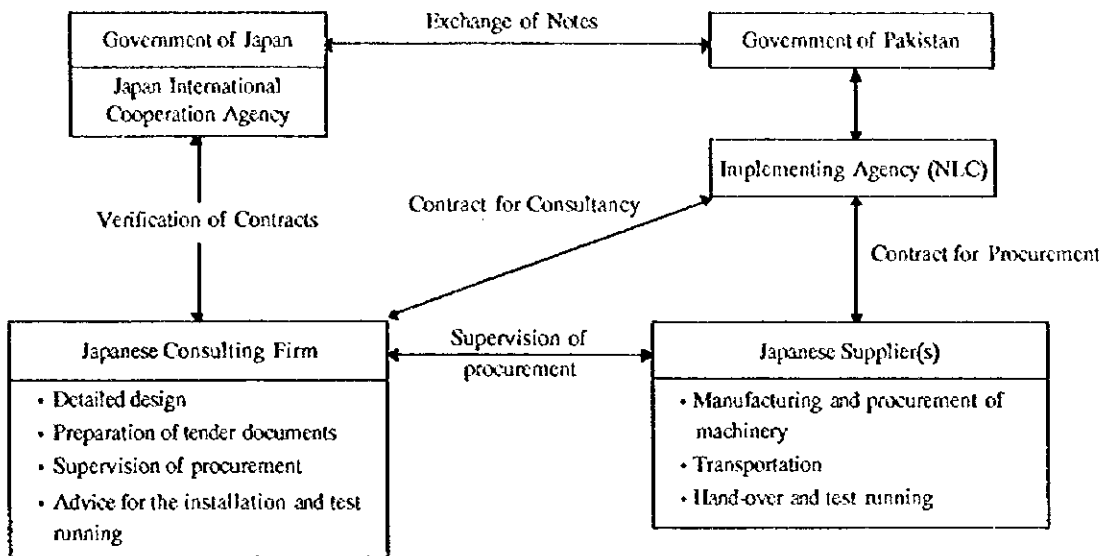


Fig. 3-1 Mechanism of Project Implementation

Implementing agency of the project in Pakistan is the NLC under the Ministry of Planning and Development.

In accordance with Japan's Grant Aid System, a Japanese consulting firm will undertake the detailed design and supervision of the Project, and Japanese trading firm(s) will undertake the supply of machinery under the Project.

(2) Consultant

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

After Exchange of Notes (E/N) between the Government of Japan and the Government of Pakistan, NLC will conclude speedily a contract with Japanese consulting firm for the procurement of consultancy services.

The said firm will provide engineering services for the procurement of machinery including detailed design, preparation of tender documents, assistance for tender(s) and contract(s), and supervision of procurement, in accordance with the contract until the completion of delivery of the machinery under the Project.

(3) Supplier(s)

NLC will conclude contract(s) for the supply of the machinery under project with the Japanese trading firm(s) who has(have) been awarded the tender(s) after having passed successfully the examination on the requested quality in the international tender with limited qualification.

The said firm(s) has(have) the obligation to deliver the machinery requested by NLC and carry out its initial operation diligently within the delay stipulated in the contract.

3.1.2 Special Notes for Implementation

The unloading port of the machinery to be procured from Japan and third countries is Karachi. After unloading, the machinery shall be transported to the dryport (bonded warehouse) at Lahore as bonded cargo and shall clear customs there.

The machinery that have cleared customs shall be handed over to Pakistan side after the initial operation and maintenance guidance.

The supplier(s) of machinery should take necessary measures for avoiding issues with Pakistan side with regard to the responsibilities for the damages or loss of cargoes, which may occur during the inland transportation.

3.1.3 Scope of Works

The machinery cost to be procured and cost of transportation to Lahore dryport will be borne by Japanese side.

Pakistani side should take necessary measures for custom clearance, and bear the construction cost of asphalt plant.

3.1.4 Consultant's Procurement Supervision Plan

(1) Principles of Procurement Supervision

In case of implementation of the project under the grant aid scheme of the Japanese government, the consultant shall carry out the detailed design and supervision of procurement with thorough understanding of the following:

- 1) Background of the implementation programme
- 2) Contents of the basic design report
- 3) System of Japan's grant aid
- 4) Contents of the Exchange of Notes between the two governments

Based on the above understanding, the contents, division of responsibilities, and special notes for the detailed design and supervision of procurement are explained below.

(2) Scope of Consulting Services

After Exchanges of Notes (E/N), the consultant concludes contract for consulting services with the implementing agency within the scope of services specified in the Exchange of Notes (E/N).

The scope of services can be summarised as follows,

1. Detailed Design

- 1) Consultancy agreement (in Pakistan) and verification (in Japan)
- 2) Prompting the procedures for issuance of the Authorization to Pay (A/P) (Pakistan)
- 3) Site survey, detailed design and preparation of tender documents (Japan, Pakistan)
- 4) Obtaining approval of tender documents from Pakistan side (Pakistan)
- 5) Announcement of tender and distribution of tender documents (Japan)
- 6) Execution of tender(s), evaluation of tenders, preparation of evaluation report, approval of the report (Pakistan/Japan)
- 7) Witness of the contract(s) for machinery supply (Pakistan/Japan), and verification of the contract(s) (Japan)
- 8) Confirmation of the obligations of Pakistan side (Pakistan/Japan)

2. Supervision of Machinery Procurement

- 1) Confirmation of the manufacturing order
- 2) Follow-up of the procurement
- 3) Ex-factory inspection
- 4) Attendance to the delivery inspection
- 5) Progress report
- 6) Witness of final hand-over
- 7) Preparation of completion note and final report

3. Initial Operation of the Machinery

It is necessary that instructions for initial running, preventive maintenance and routine maintenance are provided by supplier(s) under the supervision of the consultant.

(3) Special Points to Note

1. It is necessary to check if the procurement conditions fixed by the basic design have not changed.
2. Tender and contract documents should be in accordance with Japan's Grant Aid System. It is necessary to discuss these documents fully with Pakistan side during the field survey of the Detailed Design and get from Pakistan side approval of the tender documents including the Detailed Design.

3.1.5 Procurement Plan

Procurement of the machinery from Japan and third countries shall be done according to the following plan. Pakistan shall be excluded from the eligible countries for procurement as the machinery under the project are not manufactured there.

(1) Items to be Procured from Japan

Operators and repair shop workers are well experienced in handling construction machinery and vehicle of Japanese make as about 90 percent of these machinery operating in Pakistan are Japanese products. Local representatives of Japanese products are judged sufficiently capable from the point of view of both technical level in the maintenance of machinery and of spare parts supply .

(2) Items that can be procured from third countries

Among the construction machinery, bulldozer (Size 1) and asphalt finisher of U.S. make are well introduced in Pakistan. These machinery of U.S. make are of acceptable quality and of reasonable price.

As for European machinery, they will not be included in the third country products qualified for procurement as there is no after-service representative in Pakistan, and adequate after-service and spare parts supply are considered difficult.

For the reasons as above and also for avoiding too much diversification of machine models, the procurement of the following machinery shall be limited to only Japanese and U.S. products.

- 1) Bulldozer (large size)
- 2) Asphalt finisher

3.1.6 Implementation Schedule

The project shall be implemented according to the schedule under the Japan's Grant Aid System.

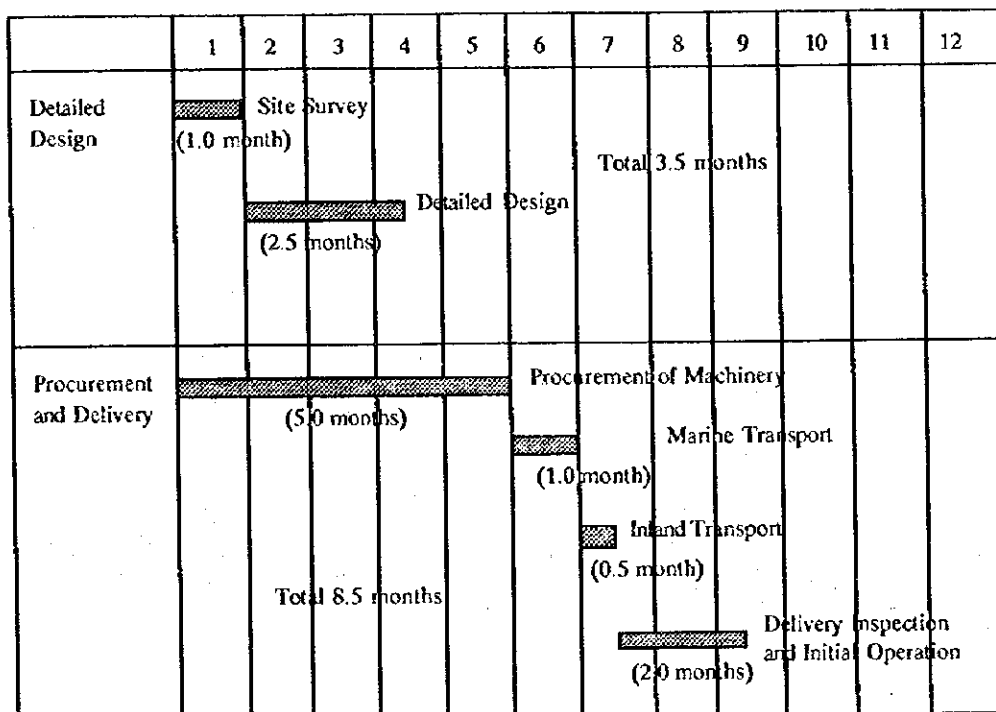


Fig. 3-2 Implementation Schedule

3.1.7 Obligations of the Recipient Country

In case the Project is implemented under Japan's Grant Aid Scheme, the following obligations are to be fulfilled by Pakistan side.

- (1) Tax exemption and preparation of documents necessary for smooth customs clearance of the machinery at Lahore dryport.
- (2) Cost of inland transportation from Lahore to the works sites.
- (3) Payment of commissions to the foreign exchange banks according to the banking arrangement (B/A).
- (4) Exemption from customs duties and taxes in Pakistan for the Japanese firm(s) and personnel engaged in the project.
- (5) Assistance for the Japanese personnel engaged in the project for entering and staying in Pakistan and visiting government organizations and officials.
- (6) Cost of construction of asphalt plant at the installation site.
- (7) Appropriate use and maintenance of the machinery to be procured.
- (8) Payment of all expenses other than those paid under the Grant Aid.

3.2 Project Cost Estimation

Approximate amount of construction cost of asphalt plant to be borne by Pakistan side is estimated as follows.

Construction asphalt plant.....	2 million Yen
---------------------------------	---------------

3.3 Operation and Maintenance Plan

- (1) Maintenance of the Machinery after Hand-over

Maintenance of the machinery to be procured under the project can be sufficiently assured by developing NLC's present maintenance method. It is desirable to establish finally a maintenance system as follows.

1. Daily check

Daily check of the machinery is carried out by operators according to the check list. Operating hours and refilled amount of fuel and lubrication oil are recorded on the check list, and the result is reported to the supervisor.

2. Periodic Maintenance

Operators request the site mechanics to carry out periodic maintenance based on the daily check list, and the mechanics perform it accordingly.

3. Repair work procedure

1) Request for repair

When operators have found abnormal conditions such as noise, leakage or rapid consumption of water, fuel, oil etc., they will request the site mechanics for investigation/repair by issuing a request for inspection of standardized form.

2) Repair sheet

Site mechanics identify cause of trouble, perform repair, then record the detail of trouble, repairing process, man-hours required, parts used, repair period etc., on the standard repair sheet and report to the site supervisor. The parts number, name and quantity required will be filled in the report. In case the cause of trouble cannot be found or the repair on site is judged impossible, the site supervisor requests the chief of the mechanical division of headquarter for repair based on the mechanics' report. The chief of the mechanical division of headquarter contacts workshop, transports the machine in trouble to a workshop nearby and has its repair carried out.

3) Big repair

Repair at workshop is carried out according to the "Repair process sheet" issued by the chief of the repair section. The process sheet is to be filled with such informations as number and date of reception, name of machine, machine number, degree of required repair, presumed cause of trouble, parts number, quantity of the parts required, staff/section in charge of repair, repair completion schedule, name of the inspector etc. The process sheet

that has been filled up at each stage of repair process comes back to the chief of repair section after the completion of repair. The chief of repair section checks the items filled in the process sheet and transfer the sheet to the chief of mechanical division. The repair process sheet is kept in this division after calculation of repair cost and registration of repair record on the history note of individual machine.

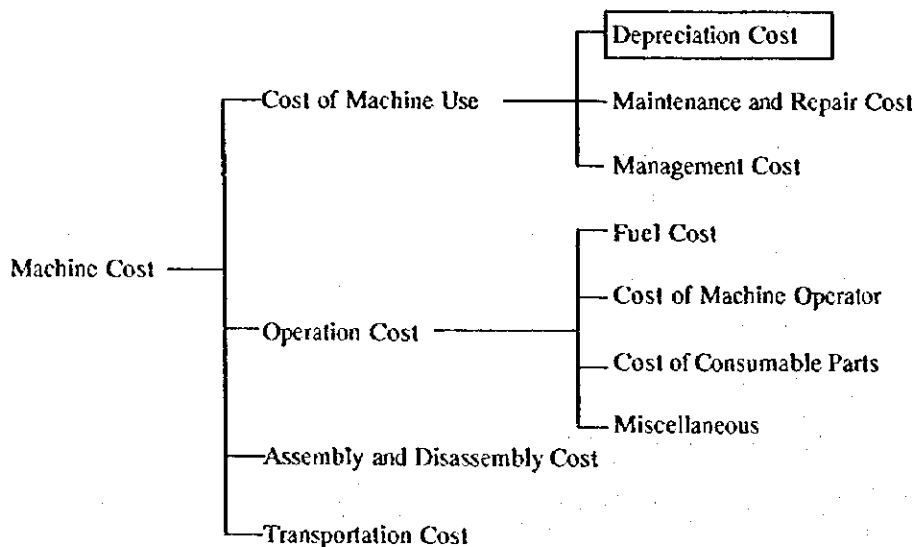
(2) Sustainable Operation of the Machinery

In order to maintain the road construction capacity in long terms, it is necessary to establish a sustainable machinery operation plan. After the procurement of construction machinery under Japan's Grant Aid, NLC has purchased a certain number of machines with its own funds but has not carried out regularly the renewal of the machinery procured in the past. It is therefore necessary to fix the method of depreciation of machinery and carry it out regularly every year, so that the machinery can be renewed at the end of their life. The points to be noted concerning the depreciation method are explained below.

1. Structure of machine cost

Construction costs must be calculated based on a proper machine cost comprising depreciation cost.

Machine cost generally consists of the following items.



2. Depreciation

There are several methods for depreciation, such as fixed rate method, the method allowing to even out machine use price etc., but the most simple method is the straight line depreciation which can be expressed as follows:

$$D = \frac{P - S}{N}$$

Where, D = Annual Depreciation

P = Purchase Price of Machinery

N = Depreciation Period

S = Salvage Value

Depreciation Period (N)

In order to fix the appropriate depreciation period (N), it is necessary to fix the economic life of machine, for which the economic operating hours need to be identified.

The economic operating hours are the operating hours of machinery, at which the sum of purchase price of machinery and the cumulative maintenance and repair cost per cumulative operating hours become the smallest. Such operating hours of machinery must be identified for each type of machine based on the actual maintenance and repair records.

Economic operating hours generally applied in Japan for the types of machinery under the project are shown in Table 3-1 for reference purpose.

Table 3-1 Economic Operating Hours of Construction Machinery

No.	Name of Machine	Specification	Economic Operating Hours
1	Bulldozer	200HP	10,000
2	Hydraulic Excavator	150HP	10,000
3	Motor Grader	200HP	10,000
4	Truck Crane	20~25 ton	8,000
5	Dump Truck	15 ton	9,000

Machine life corresponding to the economic operating hours above can be considered as 7 years for dump truck and 10 years for the other machinery, judging from the general operating condition of road construction machinery in Pakistan, and these can be applied as depreciation periods (N).

Salvage Value (S)

Salvage value of machine at the end of economic operating hours may vary depending on the condition of operation and maintenance of each machine, but it is recommended to apply the price of scrap for depreciation for all types of machine.

The amount of annual depreciation (D) calculated as above should be included in machine cost and reflected in construction cost. And the amounts of annual depreciations corresponding to the numbers of years of use should be recuperated from the construction project in which machinery are put, and reserved for renewal of these machinery.

CHAPTER 4

PROJECT EVALUATION AND RECOMMENDATION

Chapter 4 Project Evaluation and Recommendation

4.1 Project Effect

Pakistan is pursuing its economic policy aimed at attaining an average GDP growth rate of 7 percent per annum through the development of export oriented industry. Importance is attached also to creating enabling environment for the development of regional industry allowing a balanced development of macro-economy.

The key factor in the implementation of the above policies is the development of infrastructure. The 8th Five Year Plan (1993 - 98) allocates the largest part of public sector investment (36 percent) to the Transport and Telecommunication sub-sector, and 62 percent of this sub-sectoral allocation is assigned to the road development. This policy for infrastructure development is considered to be pursued also by the 9th Five Year Plan (1998 - 2003).

The total road network of Pakistan is 188,300 km at present. The proportion of paved and unpaved roads is about 50 percent each but only 20 percent of paved roads and 10 percent of unpaved roads are assessed to be in good condition. As regards traffic volume, it has doubled in the last 10 years, and extensive measures need to be taken in all areas of rehabilitation, improvement and intensive maintenance. Therefore, the road sub-sector's draft plan for the 9th Five Year Plan proposes an investment programme for an amount exceeding by 70 percent the budget amount of the 8th Five Year Plan.

Under these circumstances, NLC plays an important role for the development of transport infrastructure. On the one hand it carries out improvements of trunk roads and construction of deviation roads relieving traffic bottlenecks and, on the other hand, undertakes the rehabilitation and construction of regional trunk roads which are important for the development of regional industry and improvement in social services. It is to be noted in particular that NLC has the capability to carry out construction works in the areas or environments that are difficult for private contractors, and plays a valuable role in the implementation of the whole road development programme.

In such circumstance, NLC's work capacity has decreased considerably due to the deterioration of its road construction machinery, and it has become difficult for NLC to carry out construction works according to the contracted programme. Therefore, procurement of earth moving machinery such as bulldozer, wheel loader, excavator, motor grader etc. and paving machinery such as vibration roller asphalt plant, asphalt finisher etc. will enable NLC to accelerate the ongoing projects and to expedite their completion. Furthermore, maintaining a certain level of work capacity in the future will allow NLC to continue its

contribution to the road development in the areas that might form bottlenecks in the overall road network development of Pakistan.

Benefits expected from the implementation of the project are summarized below.

- (1) Providing NLC with the required machinery will halt the delaying of NLC's ongoing works and will accelerate their progress. NLC will also be able to participate in the road development project of the 9th Five Year Plan (1998 - 2003).
- (2) The progress of Kharian - Rawalpindi Road additional carriageway project can be accelerated, and it will become possible to aim at its completion within 1999. The traffic speed on the road presently under construction is being reduced. But after its completion, the double carriageway road allowing normal traffic speed will substantially increase the transport efficiency.
- (3) The construction of Sibi-Rakhni road can be accelerated, and it will become possible to aim at its completion in 2002. The transport distance between Sibi (Balochistan) area to Punjab province will be shortened by 30 ~ 50 percent increasing considerably the transport efficiency. Consequently early completion of this road will have the effect to promote the development of industry in the middle part of Balochistan province, and contribute to the development of regional economy.
- (4) Lahore city, capital of Punjab province, is an important tourist city, for which it is a matter of vital importance to ensure a smooth traffic in the city.

The rehabilitation of deteriorated paved road will enable to normalize the traffic flow and improve the economic efficiency of vehicle operation, thus improving the social and economic function of the city.

- (5) NLC undertakes road constructions in areas where private contractors have difficulties to carry out construction works for such reasons as remoteness of work site, security problems etc. and contributes to the implementation of the national road development programme. NLC's function in the road development in remote areas is important especially for achieving the objectives of the national development policy consisting of reduced imbalances of regions, exploitation of productive resources of regions and realization of regionally balanced macro-economy. Therefore, NLC will continue to play an important role in the road development programme in the 9th Five Year Plan.

The implementation of the present project will assist NLC to build up the capacity to comply with such need of road development.

The Project is expected to produce a substantial effect as mentioned above and also to contribute to improving widely the living standards of the regional population. Therefore, it has been confirmed that the Project is suitable for implementing with Japan's Grant Aid.

Regarding the operation and management of the Project, the recipient country is judged to have sufficient capability in term of personnel and finance. Therefore, an early implementation of the Project is desirable.

4.2 Recommendation

The implementation of the Project is expected to produce a substantial effect as mentioned above. However, in order to ensure the sustainability of the effect of Project, the following matters need to be solved.

(1) Implementing Organization

It is desirable that the managements of the Transport Division and the Engineers Division, which operate under quite different policy, be separated especially in such matters as budget, accounting etc. At present, the management of the Engineers Division with a small share of 20 percent of the group's operation is not completely independent from that of the Transport Division. It is desirable that the Engineer Division be managed as an independent construction company so as to ensure the transparency of management.

(2) Planning of Works

There seems to be made no long and medium terms contract plans nor their works plans. This might be due to the insufficiency in construction equipment, but with the procurement of machinery under the present project, it is required to establish a firm plan of contract and works.

(3) Establishment of Machinery Renewal System

The machinery to be procured under the Project will have operational life of 7 - 10 years. Therefore, in order to maintain the work capacity after the termination of machine life, it is necessary to keep on renewing the machinery with the depreciation funds to be reserved by proper depreciation of machinery. Thus, NLC can continue

funds to be reserved by proper depreciation of machinery. Thus, NLC can continue its operation and even increase its work capacity, if the efficient operation of machinery comes to allow financially the strengthening of equipment.

(4) Improvement of Machinery Maintenance Capacity

NLC's existing maintenance tools including measuring instruments are not sufficient, therefore, minimum required repair equipment need to be procured by NLC by the end of 2000.

APPENDICES

Appendices

- Appendix 1. Member List of the Survey Team**
- Appendix 2. Survey Schedule**
- Appendix 3. List of Party Concerned in Pakistan**
- Appendix 4. Minutes of Discussion**
- Appendix 4-1 Basic Design Study**
- Appendix 4-2 Consultation on the Draft Basic Design**
- Appendix 5. Data for Calculation of Required Equipment
(Table A1.1~18)**

Appendix 1. Member List of the Survey Team

Mr. H. Adachi	Team Leader	Development Specialist Institute for International Cooperation, JICA
Mr. T. Shimoda	Coordinator	Second Project Study Div., Grant Aid Project Study Dept., JICA
Mr. K. Nakamura	Chief Engineer/Road Development Planner	Construction Project Consultants, Inc.
Mr. D. Inaba	Machinery Planner	Construction Project Consultants, Inc.
Mr. A. Ando	Cost Estimate/Procurement	Construction Project Consultants, Inc.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

6th Floor, Shinjuku Maynds Tower Building
1-1, Yoyogi, 2-chome, Shibuya-ku, Tokyo 151, Japan
Fax: (03) 5352-5381
Phone: (03) 5352-5321

Construction Project Consultants, Inc. (CPC)

No.8 Matsuda Bldg.
2-1-9, Okubo, Shinjuku-ku, Tokyo 169, Japan
Fax: (03) 5273-4861
Phone: (03) 5273-3201

Appendix 2. Survey Schedule

Order of Date	Date	Movement	Accommodation	Activities	Remarks
1	Sep. 15 (Mon)	Narita-Islamabad (by air)	Islamabad		All members
2	16 (Tue)		Islamabad	AM : Embassy of Japan : JICA, Islamabad office - Curtesy call PM : Ministry of Finance and Economic Affairs : Ministry of Planning and Development - Curtesy call	All members
3	17 (Wed)		Islamabad	National Logistic Cell (NLC) - Kick-off meeting - Confirmation of the itinerary - Explanation of the Inception Report	All members
4	18 (Thu)	Islamabad-Rawalpindi- Islamabad (by car)	Islamabad	Survey of road construction site (Rawalpindi)	All members
5	19 (Fri)	Islamabad-Gujranwala- Lahore (by car)	Lahore		All members
6	20 (Sat)	Lahore-Gujranwala- Lahore (by car)	Lahore	Government of Punjab - Discussion Survey of workshop (Gujranwala)	All members
7	21 (Sun)	Lahore-Islamabad (by air)	Islamabad	Internal meeting	All members
8	22 (Mon)		Islamabad	AM : Ministry of Communications National Highway Authority - Discussion PM : NLC - Discussion on the results of site survey	All members
9	23 (Tue)		Islamabad	NLC-Discussion on the results of site survey	All members
10	24 (Wed)		Islamabad	NLC-Discussion on the Minutes of Discussions	All members
11	25 (Thu)		Islamabad	NLC-Signing of the Minutes of Discussions	All members

Order of Date	Date	Movement	Accommodation	Activities	Remarks
12	26 (Fri)		Islamabad	AM : Ministry of Finance and Economic Affairs : Ministry of Planning and Development PM : Embassy of Japan : JICA, Islamabad office - Report	All members
13	27 (Sat)		Islamabad	Compiling of data and documents	All members
14	28 (Sun)	Islamabad-Narita (by air)			Team Leader Mr.H.Adachi Coordinator Mr.T.Shimoda
		Islamabad-Karachi (by air)	Karachi	Internal meeting	Consultants (3 members)
15	29 (Mon)		Karachi	AM : NLC(Karachi) -Discussion PM : Survey of workshop	Consultants
16	30 (Tue)		Karachi	AM : Government of Sindh - Discussion PM : Site Survey (Karachi New Town)	Consultants
17	Oct. 1 (Wed)	Karachi-Lyari/Hyderabad -Karachi (by car)	Karachi	Site survey in Karachi area	Consultants
18	2 (Thu)	Karachi-Quetta (by air)	Quetta	Government of Balochistan -Discussion	Consultants
19	3 (Fri)		Quetta	Site survey in Quetta, Pishin areas	Consultants
20	4 (Sat)	Quetta-Sibi-Quetta (by car)	Quetta	Site survey in Sibi area	Consultants
21	5 (Sun)	Quetta-Islamabad (by air)	Islamabad	Internal meeting	Consultants
22	6 (Mon)		Islamabad	NLC-Discussion	Consultants
23	7 (Tue)	Islamabad-Karachi (by air)	Karachi	AM : Embassy of Japan JICA, Islamabad office - Report PM : Move to Karachi	Consultants
24	8 (Wed)	Karachi-Bangkok (by air)	Bangkok		Consultants
25	9 (Thu)	Bangkok-Narita (by air)			Consultants

Appendix 3. List of Party Concerned in Pakistan

- Economic Affairs Division
 - Joint Secretary
 - Rashid Mahmood Ansari
 - Deputy Secretary
 - S.M. Hasan Ziadi

- Ministry of Planning and Development
 - Planning Commission Member
 - Malik M. Saeed
 - Joint Chief Economist
 - Ghulam Mustafa Awan
 - Chief, Transport and Communication Section
 - Khurram Azad

- National Logistic Cell
 - Director General
 - Ghazanfar Ali
 - Commander, Engineers NLC
 - Shahdab Ali Khan
 - Deputy Commander, Engineers NLC
 - Zubair Abdullah
 - Deputy Commander, Engineers NLC
 - Mumtaz Mohiy Uld Din
 - Staff Officer
 - Mimhaj Ul Hassnain
 - Manager (Gujuranwala Workshop, NLC)
 - Khalid Aziz
 - Manager (Karachi Workshop, NLC)
 - Shahid Muzaffar

- Government of Punjab
 - Secretary Agriculture
 - Abdur Rashid Khan

Appendix 4. Minutes of Discussion

Appendix 4-1. Basic Design Study

**MINUTES OF DISCUSSIONS
ON
THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF
CONSTRUCTION MACHINERY FOR ROAD CONSTRUCTION
IN
THE ISLAMIC REPUBLIC OF PAKISTAN**

In response to a request from the Government of Pakistan, the Government of Japan has decided to conduct a Basic Design Study on the Project for Improvement of Construction Machinery for Road Construction in Pakistan (hereinafter referred to as "the Project"), and entrusted the study to Japan International Cooperation Agency (hereinafter referred to as "JICA")

JICA sent to Pakistan a Basic Design Study Team (hereinafter referred to as "the Study Team"), headed by Mr. ADACHI Hayao, Development Specialist, Institute for International Cooperation, JICA, which is scheduled to stay in the country from September 15 to October 9, 1997.

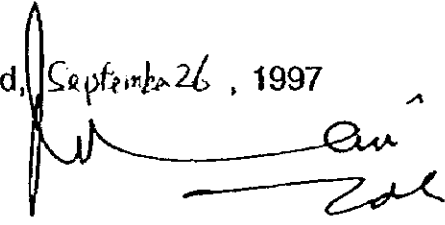
The Study Team conducted field surveys at the study area and held discussions with the officials concerned of the Government of Pakistan. As a result of the field surveys and discussions, both parties confirmed the main items described on the attached sheets.

The Study Team will proceed to further works in Japan and prepare the Basic Design Study Report.




Mr. ADACHI Hayao
Leader
Basic Design Study Team
JICA

Islamabad, September 26, 1997

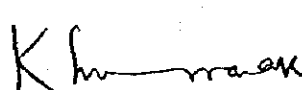


F/ Mr. Shadab Ali Khan
Commander Engineers
National Logistic Cell



(S.M. HASAN ZIADI)
Deputy Secretary
Economic Affairs Division
Government of Pakistan
Islamabad

Economic Affairs Division



MURBAN AZAD KHAN
Deputy Chief (TSC)
Planning & Development Division
Government of Pakistan
Ministry of Planning and
Development

ATTACHMENT

1. Objective of the Project

The objective of the Project is to provide appropriate road construction machinery and maintenance equipment which are necessary for improving the capacities of road construction and maintenance in the Islamic Republic of Pakistan.

2. Responsible Agency and Implementing Agency

The Ministry of Planning and Development is the Responsible Agency, and National Logistic Cell (hereinafter referred to as "NLC") is the Implementing Agency of the Project.

3. Project Sites

NJC's construction sites or workshops in Pakistan (ANNEX-1)

4. Items requested by the Pakistan side

The items requested by the Pakistan side for the Project are listed in ANNEX-2. However, the final items, quantities and specifications will be subject to further studies.

5. Undertakings required of the Pakistan side

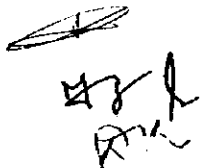
- 1) The Government of Pakistan will take necessary measures described in ANNEX-3 for smooth implementation of the Project on condition that the Grant Aid by the Government of Japan is extended to the Project.
- 2) The Government of Pakistan will take action on extending the period of the Grant Aid, if necessary.

6. Japan's Grant Aid Program

The Pakistan side has understood the system of Japan's Grant Aid Program described in ANNEX-4 and explained by the Study Team.

7. Further Schedule of the Study

- 1) The Study Team will proceed to further study in Pakistan until October 9, 1997.



- 2) Based on the results of the Basic Design Study, JICA will prepare a Draft Basic Design Report and dispatch a Draft Report Explanation Team at the end of November, 1997 in order to explain and to confirm the contents of the Draft Basic Design.
- 3) Upon acceptance of the Draft Basic Design by the Pakistan side, JICA will complete the Basic Design Study Report and send it to the Pakistan side around March 1998.

8. Major Points of Discussions

- 1) Both sides have agreed that the Basic Design Study to be carried out by JICA and the PC-1 to be prepared by the Government of Pakistan will be proceeded simultaneously, to meet the requirements of the official procedures for the both sides.
- 2) Both sides have understood that the Basic Design will be proceeded referring to the priority given in the list of the request of the Pakistan side as described in ANNEX-2, and that the final decision of the items to be granted will be made based on the results of the Basic Design.
- 3) The Pakistan side commented that the machinery to be granted would be taken over on the basis of CIF Lahore and that the installation works, if any, and the inland transportation of the machinery beyond Lahore will be undertaken by the Pakistan side without delay after the delivery of the machinery by the Japanese side. Both sides have agreed that the Basic Design will be proceeded based on this comment.
- 4) The Pakistan side has confirmed that the machinery to be granted by Japan shall be properly depreciated to maintain the sustainability of the NLC's mechanical capacity.
- 5) The Pakistan side has requested some of counterpart engineers to be trained in Japan. The Study Team has recommended that the official request to be submitted to the Government of Japan, in due course, in case that the grant aid is extended.
- 6) The Pakistan side indicated that the implementation of the project is subject to the approval of the PC-1 by the Government of Pakistan.

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ANNEX - 1 : LOCATION MAP



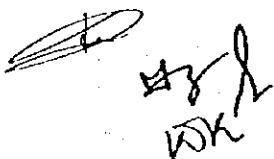
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LEGEND	
Bridges	≡
Roads	—
Silos / Binishell	□
HQ Engrs NLC	★
Field Offices	▲

ANNEX - 2 : MAJOR ITEMS REQUESTED BY THE PAKISTAN SIDE

No.	Equipment	Specifications	Quantity
PRIORITY A			
1.	Bulldozer Size I	320 HP	4
2.	Bulldozer Size II	225 HP	7
3.	Wheel Loader	170 HP	6
4.	Hydraulic Excavator	150 HP	3
5.	Motor Grader	200 HP	8
6.	Vibration Roller	9.5 Ton	6
7.	Asphalt Plant	60-80 Ton/Hour	1
8.	Air Compressor	600 Cfm	2
9.	Truck Crane	20-25 Ton	1
PRIORITY B			
10.	Bulldozer Size I	320 HP	3
11.	Hydraulic Excavator	150 HP	3
12.	Air Compressor	600 Cfm	2
13.	Truck Crane	20-25 Ton	1
14.	Generator	300 KVA	4
15.	Asphalt Finisher	7.5 M	2
16.	Dump Truck	15 Ton	15
PRIORITY C			
17.	Mobile Workshop		3
18.	Chassis Repair Shop Equipment		L.S
19.	Engine Repair Shop Equipment		L.S
20.	Gasoline Engine Service Shop Equipment		L.S
21.	Engine Dynamometer Room Equipment		L.S
22.	Fuel Pump Repair Room Equipment		L.S
23.	Electric System Repair Room Equipment		L.S
24.	Battery Service Shop Equipment		L.S
25.	Hydraulic Repair Shop Equipment		L.S
26.	Tire Repair Shop Equipment		L.S
27.	Machine Shop Equipment		L.S
28.	Welding and Fabrication Shop Equipment		L.S
29.	Undercarriage Rebuilding Equipment		L.S
30.	Painting and Cleaning Equipment		L.S
31.	Compressor Room Equipment		L.S
32.	Tool Room Equipment		L.S
33.	Special Tools		L.S
34.	Fuel Station Facilities		L.S
35.	Miscellaneous		L.S

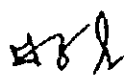
(Note : Some items above include 8~10% of spare parts to the cost of equipment.)

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ANNEX-3 : UNDERTAKINGS REQUIRED OF THE GOVERNMENT OF PAKISTAN

Following necessary measures shall be taken by the Pakistan side on condition that the Grant Aid by the Government of Japan is extended to the Project.

1. to ensure prompt unloading, tax exemption and customs clearance at ports of disembarkation in the recipient country and internal transportation therein of the products purchased under the Project;
2. to exempt Japanese nationals from custom duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the Project;
3. to afford Japanese nationals whose services may be required in connection with the supply of the products and services under the Project such as facilities as may be necessary for their entry into the recipient country and stay therein for the performance of the works;
4. to ensure that the products purchased under the Project be maintained and be used properly and effectively, and to assign the necessary staff for operation and maintenance of them;
5. to bear commissions to the Japanese foreign exchange bank for its banking services based upon the Banking Arrangement, namely the advising commission of the "Authorization to Pay" and payment commissions;
6. to provide with necessary permissions, licenses and other authorizations for implementing the Project, if necessary; and
7. to bear all the expenses other than those covered by the Grant Aid, necessary for the Project.



ANNEX - 4 : JAPAN'S GRANT AID PROGRAM

1. Grant Aid Procedures

- 1) Japan's Grant Aid Program is executed through the following procedures;
 - Application (A request made by a recipient country)
 - Study (Basic Design Study conducted by JICA)
 - Appraisal & Approval (Appraisal by the Government of Japan & Approval by the Cabinet)
 - Determination of Implementation (Exchange of Notes between the Governments of Japan and the recipient country)
- 2) At the first step (Application), a request made by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether it is suitable for the Grant Aid. If it is confirmed that the request has a high priority as a project for the Grant Aid, the Government of Japan instructs JICA to conduct the Study.

At the second step (the Study), the Basic Design Study is conducted by JICA basically under a contract with a Japanese consulting firm.

At the third step (Appraisal & Approval), the Government of Japan appraises the project as to whether or not it is suitable for Japan's Grant Aid Program based on the Basic Design Study Report prepared by JICA, and then it is submitted to the Cabinet for approval.

At the fourth step (Determination of Implementation), once the project is approved by the Cabinet, its implementation is officially determined by signing the Exchange of Notes between the both Governments.

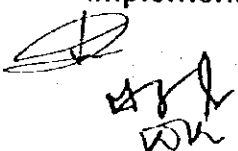
In the course of implementation of the project, JICA will take charge of expediting the execution by assisting the recipient country in terms of the procedures of tender, contract and so on.

2. Basic Design Study

1) Contents of the Study

The purpose of the Study (Basic Design Study) conducted by JICA is to provide basic documents necessary for the appraisal by the Government of Japan as to whether or not the project is viable for Japan's Grant Aid Program. The contents of the Study are as follows :

- a) to confirm the background of the request, objectives and benefits of the project and institutional capability of the recipient country necessary for the implementation;



- b) to evaluate the appropriateness of the project from the technical, social, and economical points of view;
- c) to confirm the basic concept of the project mutually agreed upon through discussion between the both sides;
- d) to prepare a basic design of the project; and
- e) to estimate rough costs of the project.

The contents of the original request are not necessarily approved as it is, as the contents of the Grant Aid. The Basic Design of the project is confirmed considering the guidelines of Japan's Grant Aid Program.

In the implementation of the project, the Government of Japan requests the recipient country to take measures in order to promote its self-reliance. Such measures must be guaranteed even though they may fall outside the jurisdiction of the organization in the recipient country actually implementing the project. Therefore, the implementation of the project is confirmed by all relevant organizations of the recipient country in the Minutes of Discussions.

2) Selection of Consultants


For the smooth implementation of the Study, JICA selects a consultant among those who are registered at JICA by evaluating competitive proposals submitted by those consultants. The selected consultant carries out the Basic Design Study and prepares a report based upon the terms of reference made by JICA.

At the beginning of implementation after the Exchange of Notes, for the services of Detailed Design and Construction Supervision of the project, JICA recommends the same consultant who participated in the Basic Design Study to the recipient country, in order to maintain the technical consistency between the Basic Design and the Detailed Design as well as to avoid any undue delay caused by the selection of a new consultant.

3. Japan's Grant Aid Scheme

1) What is the Grant Aid?

The Grant Aid Program provides a recipient country with non-reimbursable funds to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.


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2) Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes exchanged by the two Governments concerned, in which the objectives of the project, period of execution, conditions and amount of the Grant Aid, etc. are confirmed.

3) Period

The period of the Grant means the one fiscal year which the Cabinet approves the project for. Within the fiscal year, all procedures such as exchanging the Notes, concluding contracts with a consultant and contractors and final payment to them must be completed. However, in case of delays in delivery, installation or construction due to unforeseen factors such as weather, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual agreement between the two Governments.

4) Purchase of Products and Services

Under the Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely consultant, contracting or procurement firms, are limited to Japanese nationals. (The term Japanese Nationals means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

5) Verification

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. This verification is deemed necessary to secure accountability to Japanese taxpayers.

6) Undertakings required of the Government of the recipient country

(As described in ANNEX-3)

7) Proper Use


The recipient country is required to maintain and use the products purchased under the Grant Aid properly and effectively and to assign the necessary staff for operation and maintenance of them.

8) Re-export

The products purchased under the Grant Aid shall not be re-exported from the recipient country.

9) Banking Arrangement (B/A)

a) The Government of the recipient country or its designated authority shall


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open an account in the name of the Government of the recipient country in an authorized foreign exchange bank in Japan (the Bank). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the verified contracts.

- b) The payment will be made when payment requests are presented by the Bank to the Government of Japan under an authorization to pay issued by the Government of recipient country or its designated authority.



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Appendix 4-2. Consultation on the Draft Basic Design

MINUTES OF DISCUSSIONS ON THE BASIC DESIGN STUDY
ON
THE PROJECT FOR IMPROVEMENT OF CONSTRUCTION
MACHINERY FOR ROAD CONSTRUCTION
IN
THE ISLAMIC REPUBLIC OF PAKISTAN
(Consultation on the Draft Basic Design)

The Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched to Pakistan the Basic Design Study Team on the Project for Improvement of Construction Machinery for Road Construction in the Islamic Republic of Pakistan (hereinafter referred to as "the Project") in September to October 1997. As a result of the series of discussions, field surveys in Pakistan and technical examination in Japan, JICA prepared the Draft Basic Design on the Project.

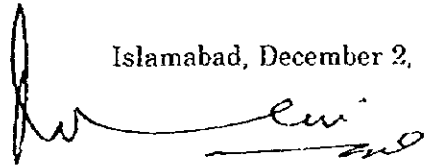
To explain and discuss with the Government of Pakistan (hereinafter referred to as "the Pakistan Side") the components of the Draft Basic Design, JICA sent to Pakistan the Draft Basic Design Explanation Team (hereinafter referred to as "the Draft Team"), headed by Hayao Adachi, Development Specialist, Institute for International Cooperation, JICA, which is scheduled to stay in the country from November 25, 1997 to December 3, 1997.

As a result of discussions, both parties have confirmed the main items described on the attached sheets. The Draft Team will proceed with further works in Japan on the basis of this Minutes of Discussions and finalize the Basic Design Study Report.

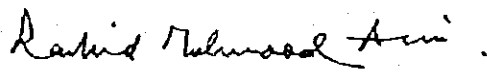
Islamabad, December 2, 1997



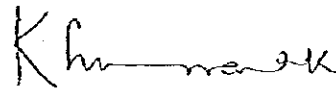
Mr. Hayao Adachi
Leader
Draft Basic Design Explanation Team
JICA



F/ Mr. Shahdab Ali Khan
Commander Engineers
National Logistic Cell



Mr. Rashid Mahmood Ansari
Joint Secretary
Economic Affairs Division



Mr. Khurram Azad
Chief -T&C Section
Ministry of Planning and Development

ATTACHMENT

1. Components of the Draft Basic Design

The Pakistan side has accepted the components of the Draft Basic Design proposed by the Draft Team except Dozers I, Dozers II and Asphalt Finishers. The Draft Team has understood their request of amendment and revised the list of the proposed components as described in ANNEX-1. The Pakistan side has understood that this amendment is subject to the approval of the Government of Japan so as to be incorporated as the components of the Project into the Basic Design Study Report, and it also has understood that in case of the failure to acquire the approval of the Government of Japan, the original components will be incorporated into the Basic Design Study.

2. Responsible Agency and Implementing Agency

The Ministry of Planning and Development is the Responsible Agency, and National Logistic Cell (hereinafter referred to as "NLC") is the Implementing Agency of the Project.

3. Management and Maintenance

NLC will maintain and use properly the equipment purchased under the Project and assign the necessary staff for operation and maintenance of them.

4. Undertakings required of the Pakistan side

- 1) The Pakistan side will take necessary measures described in ANNEX-2 for smooth implementation of the Project on the condition that the Grant Aid from the Government of Japan is extended to the Project.
- 2) The Pakistan side will take action on extending the period of the Grant Aid, if necessary.

5. Japan's Grant Aid Program

The Pakistan side has understood the system of Japan's Grant Aid Program described in ANNEX-3 and explained by the Draft Team.

6. Further Schedule of the Study

JICA will complete the Basic Design Study Report and forward it in its final form

to the Pakistan side around February 1998.

7. Major Points of Discussions

- 1) The machinery to be granted would be taken over on the basis of CIF Lahore and that the installation works, if any, and the inland transportation of the machinery beyond Lahore will be undertaken by the Pakistan side without delay after the delivery of the machinery by the Japanese side.
- 2) The Pakistan side has confirmed that machinery to be granted by the Government of Japan shall be properly depreciated to maintain the sustainability of the NLC's mechanical capacity.
- 3) The Pakistan side, with its own budget, will undertake and accomplish the foundation work for an asphalt plant in time for its arrival and also will undertake the assembly work under the guidance of the consultant.
- 4) The revised components of the Project as described in ANNEX-I are subject to the approval of the Government of Japan so as to be incorporated as the components of the Project into the Basic Design Study Report.
- 5) The implementation of the Project is subject to the approval of the PC-1 by the Government of Pakistan.

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ANNEX-1 COMPONENTS OF THE DRAFT BASIC DESIGN

(Original)

No.	Machine	Specification	Quantity
1	Dozer I	300~320HP	6
2	Dozer II	200~230HP	6
3	Wheel Loader	2.7~2.9 m ³ Bucket	5
4	Hydraulic Excavator	150~160HP	4
5	Motor Grader	200~220HP	6
6	Vibration Roller	9.5~10.5 ton	5
7	Asphalt Plant	60~80 ton/h	1
8	Asphalt Finisher	7.5~8 m	1
9	Truck Crane	20~25 ton	1
10	Air Compressor	650~800 cfm	3
11	Generator	300 KVA	3

(Spare Parts 8%)

(Revised)

No.	Machine	Specification	Quantity
1	Dozer I	300~320HP	4
2	Dozer II	200~230HP	7
3	Wheel Loader	2.7~2.9 m ³ Bucket	5
4	Hydraulic Excavator	150~160HP	4
5	Motor Grader	200~220HP	6
6	Vibration Roller	9.5~10.5 ton	5
7	Asphalt Plant	60~80 ton/h	1
8	Asphalt Finisher	7.5~8 m	2
9	Truck Crane	20~25 ton	1
10	Air Compressor	650~800 cfm	3
11	Generator	300 KVA	3

(Spare Parts 8~10%)

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ANNEX-2 UNDERTAKINGS REQUIRED OF THE PAKISTAN SIDE

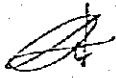
Following necessary measures shall be taken by the Pakistan side on condition that the Grant Aid by the Government of Japan is extended to the Project.

1. to ensure prompt unloading, tax exemption and customs clearance at ports of disembarkation in the recipient country and internal transportation therein of the products purchased under the Project;
2. to exempt Japanese nationals from custom duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the Project;
3. to accord Japanese nationals whose services may be required in connection with the supply of the products and services under the Project such as facilities as may be necessary for their entry into the recipient country and stay therein for the performance of the works;
4. to ensure that the products purchased under the Project be maintained and be used properly and effectively, and to assign the necessary staff for operation and maintenance of them;
5. to bear commissions to the Japanese foreign exchange bank for its banking services based upon the Banking Arrangement, namely the advising commission of the "Authorization to Pay" and payment commissions;
6. to provide with necessary permissions, licenses and other authorizations for implementing the Project, if necessary; and
7. to bear all the expenses other than those covered by the Grant Aid, necessary for the Project.

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ANNEX-4 JAPAN'S GRANT AID PROGRAM

1. Grant Aid Procedures

1) Japan's Grant Aid Program is executed through the following procedures.

Application (Request made by a recipient country)
Study (Basic Design Study conducted by JICA)
Appraisal & Approval (Appraisal by the Government of Japan and
Approval by the Japanese Cabinet)
Determination of Implementation (The Notes exchanged between the
Governments of Japan and the recipient country)

2) Firstly, a request for the Grant Aid submitted by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for the Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA to conduct a study on the request.

Secondly, JICA conducts the study (Basic Design Study), using a Japanese consulting firm.

Thirdly, the Government of Japan appraises the project so as to see whether or not it is suitable for the Grant Aid, basing on the Basic Design Study report prepared by JICA, and then it is submitted to the Cabinet for approval.

Fourthly, once the project is approved by the Cabinet, its implementation is officially determined by signing the Exchange of Notes between the Governments of Japan and of the recipient country.

Finally, in the course of implementation of the project, JICA will take charge of expediting the execution of the project by assisting the recipient country in such matters as preparing tenders, contracts and so on.

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2. Basic Design Study

1) Contents of the Study

The aim of the Basic Design Study, conducted by JICA on the requested project, is to provide basic documents necessary for the appraisal of the project by the Government of Japan. The contents of the study are as follows:

- a) to confirm the background, objectives and benefits of the project and also institutional capacity of the agencies concerned of the recipient country necessary for the project implementation;
- b) to evaluate the appropriateness of the project from the technical, social and economic points of view;
- c) to confirm items agreed on by both parties concerning the basic concept of the project;
- d) to prepare a basic design of the project; and,
- e) to estimate costs of the project.

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the project is confirmed considering the guidelines of Japan's Grant Aid Scheme.

The Government of Japan requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the project. Such measures must be guaranteed even through they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the project. Therefore, the implementation of the project is confirmed by all relevant organizations of the recipient country in the Minutes of Discussions.

2) Selection of Consultants

For the smooth implementation of the study, JICA selects a consultant among those who registered at JICA by evaluating competitive proposals submitted by those consultants. The selected consultant carries out the Basic Design Study and prepare a report based on the terms of reference made by JICA.

At the beginning of the implementation after the Exchange of Notes, JICA recommends the same consultant who participate in the Basic Design Study to the recipient country for the services of Detailed Design and construction

supervision of the project in order to maintain the technical consistency between the Basic Design and the Detailed Design as well as to avoid any undue delay caused by the selection of a new consultant.

3. Japan's Grant Aid Program

1) What is the Grant Aid?

The Grant Aid Program provides a recipient country with non-reimbursable funds to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. Grant Aid is not supplied through the donation of materials as such.

2) Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes exchanged by the two Governments concerned, in which the objectives of the project, period of execution, conditions and amount of the Grant Aid, etc., are confirmed.

3) Period

The period of the Grant Aid means the one fiscal year which the Cabinet approves the project for. Within the fiscal year, all procedure such as exchanging of the Notes, concluding contracts with consulting firms and contractors and final payment to them must be completed. However, in case of delays in delivery, installation or construction due to unforeseen factors such as weather, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual agreement between the two Governments.

4) Purchase of Products and Services

Under the Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely consulting, contracting or procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

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5) Verification

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. This verification is deemed necessary to secure accountability to Japanese taxpayers.

6) Undertakings required to the Government of the recipient country
(As described in ANNEX-2)

7) Proper Use

The recipient country is required to maintain and use the facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign the necessary staff for operation and maintenance of them as well as to bear all the expenses other than those covered by the Grant Aid.

8) Re-export

The products purchased under the Grant Aid shall not be re-exported from the recipient country.

9) Banking Arrangement (B/A)

a) The Government of the recipient country or its designated authority shall open an account in the name of the Government of the recipient country in an authorized foreign exchange bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments to the Bank in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the verified contracts.

b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under "Authorization to Pay" issued by the Government of recipient country or its designated authority.

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**Appendix 5. Data for Calculation of Required Equipment
(Table A.1-1~1-18)**

Table A. 1-1 Required Equipment for

i) Kalian - Rawalpindi Additional Carriageway Project

Construction Schedule	Volume of Works	Unit	1998		1999		2000		2001		2002		2003	
			i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv
Earthwork Equipment														
Earth Moving Bulldozer(Large)	-	CU.M	-	-	-	-	-	-	-	-	-	-	-	-
Spreading Bulldozer(Medium)	-	CU.M	-	-	-	-	-	-	-	-	-	-	-	-
Loading Wheel Loader	-	CU.M	-	-	-	-	-	-	-	-	-	-	-	-
Digging Excavator	-	CU.M	-	-	-	-	-	-	-	-	-	-	-	-
Compection Road Roller	-	CU.M	-	-	-	-	-	-	-	-	-	-	-	-
Earth Hauling Dump Truck	-	CU.M	-	-	-	-	-	-	-	-	-	-	-	-
Shaping Motor Grader	-	Sq.M	-	-	-	-	-	-	-	-	-	-	-	-
Watering Water Tanker	-	TON	-	-	-	-	-	-	-	-	-	-	-	-
Paving Equipment														
Mixing Asphalt Mixing Plant	400,000	TON	1	1	1	1	1	1	1	1	1	1	1	1
Spreading Asphalt Finisher	8,000,000	Sq.M	2	2	2	2	2	2	2	2	2	2	2	2
Compaction Road Roller	8,000,000	Sq.M	4	4	4	4	4	4	4	4	4	4	4	4
Hauling Dump Truck	400,000	TON	10	10	10	10	10	10	10	10	10	10	10	10
tumen Spreading Asphalt Distributer	640,000	Lit	1	1	1	1	1	1	1	1	1	1	1	1
Aggregate Crushing Plant	704,000	CU.M	1	1	1	1	1	1	1	1	1	1	1	1
Loading Wheel Loader	440,000	CU.M	2	2	2	2	2	2	2	2	2	2	2	2
Hauling Dump Truck	704,000	TON	10	10	10	10	10	10	10	10	10	10	10	10
Base Shaping Motor Grader	320,000	Sq.M	2	2	2	2	2	2	2	2	2	2	2	2
Compaction Road Roller	320,000	Sq.M	2	2	2	2	2	2	2	2	2	2	2	2
Bridge & Structures														
Assembling Truck Crane	36,000	TON	1	1	1	1	1	1	1	1	1	1	1	1
Digging Excavator	15,000	CU.M	2	2	2	2	2	2	2	2	2	2	2	2
Hualing Dump Truck	15,000	CU.M	6	6	6	6	6	6	6	6	6	6	6	6
Concrete Mixing Concrete Mixing Plant	6,000	CU.M	1	1	1	1	1	1	1	1	1	1	1	1
General Works														
Air Compressor			2	2	2	2	2	2	2	2	2	2	2	2
Generator			2	2	2	2	2	2	2	2	2	2	2	2
Tractor			1	1	1	1	1	1	1	1	1	1	1	1

Table A.1-2 Required Equipment for
ii) Sibi - Rakuni Road Project

Construction Schedule	Volume of Works	Unit	1998		1999		2000		2001		2002		2003	
			i	ii	i	ii	i	ii	i	ii	i	ii	i	ii
Earthwork Equipment														
Earth Moving Bulldozer(Large)	5,000,000	CU.M	5	5	5	5	5	5	3	3	3	2	2	2
Spreading Bulldozer(Medium)	3,600,000	CU.M	7	7	7	7	7	7	7	7	6	6	6	6
Loading Wheel Loader	2,500,000	CU.M	4	4	4	4	4	4	4	4	4	4	4	4
Digging Excavator	1,000,000	CU.M	2	2	2	2	2	2	2	2	2	2	2	2
Compaction Road Roller	3,000,000	CU.M	6	6	6	6	6	6	6	6	6	6	6	6
Earth Hauling Dump Truck	1,800,000	CU.M	10	10	10	10	10	10	10	10	10	10	10	10
Shaping Motor Grader	3,750,000	SQ.M	4	4	4	4	4	4	4	4	4	4	4	4
Watering Water Tanker		TON	4	4	4	4	4	4	4	4	4	4	4	4
Paving Equipment														
Mixing Asphalt Mixing Plant		TON	-	-	-	-	-	-	-	-	-	-	-	-
Spreading Asphalt Finisher		SQ.M	-	-	-	-	-	-	-	-	-	-	-	-
Compaction Road Roller	8,000,000	SQ.M	2	2	2	2	2	2	2	2	2	2	2	2
Hauling Dump Truck	5,000,000	Lit	1	1	1	1	1	1	1	1	1	1	1	1
Aggregate Spreading Asphalt Distributer	1,000,000	TON	2	2	2	2	2	2	2	2	2	2	2	2
Aggregate Crushing Plant	300,000	CU.M	4	4	4	4	4	4	4	4	4	4	4	4
Loading Wheel Loader	1,000,000	CU.M	2	2	2	2	2	2	2	2	2	2	2	2
Hauling Dump Truck	1,000,000	TON	8	8	8	8	8	8	8	8	8	8	8	8
Base Shaping Motor Grader	2,500,000	SQ.M	2	2	2	2	2	2	2	2	2	2	2	2
Compaction Road Roller	2,500,000	SQ.M	3	3	3	3	3	3	3	3	3	3	3	3
Bridge & Structures														
Assembling Truck Crane	60,000	TON	1	1	1	1	1	1	1	1	1	1	1	1
Digging Excavator	400,000	CU.M	1	1	1	1	1	1	1	1	1	1	1	1
Hauling Dump Truck	400,000	CU.M	4	4	4	4	4	4	4	4	4	4	4	4
Concrete Mixing Concrete Mixing Plant	100,000	CU.M	2	2	2	2	2	2	2	2	2	2	2	2
General Works														
Air Compressor			2	2	2	2	2	2	2	2	2	2	2	2
Generator			2	2	2	2	2	2	2	2	2	2	2	2
Tractor			1	1	1	1	1	1	1	1	1	1	1	1

Table A. 1-3 Required Equipment for
iii) Lahore Municipal Road Pavement Rehabilitation Project

Construction Schedule	Volume of Unit Works	1998		1999		2000		2001		2002		2003			
		i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii
Earthwork Equipment															
Earth Moving Bulldozer(Large)	Bulldozer(La CU.M	-	-	-	-	-	-	-	-	-	-	-	-		
Spreading Bulldozer(Medium)	Bulldozer(Me CU.M	-	-	-	-	-	-	-	-	-	-	-	-		
Loading Wheel Loader	Wheel Loader CU.M	-	-	-	-	-	-	-	-	-	-	-	-		
Digging Excavator	Excavator CU.M	-	-	-	-	-	-	-	-	-	-	-	-		
Compaction Road Roller	Road Roller CU.M	-	-	-	-	-	-	-	-	-	-	-	-		
Earth Hauling Dump Truck	Dump Truck CU.M	-	-	-	-	-	-	-	-	-	-	-	-		
Shaping Motor Grader	Motor Grader SQ.M	-	-	-	-	-	-	-	-	-	-	-	-		
Watering Water Tanker	Water Tanker TON	-	-	-	-	-	-	-	-	-	-	-	-		
Paving Equipment															
Mixing Asphalt Mixing Plant	Asphalt Mixi TON	1	1	1	1	1	1	1	1	1	1	1	1		
Spreading Asphalt Finisher	Asphalt Fini SQ.M	2	2	2	2	2	2	2	2	2	2	2	2		
Compaction Road Roller	Road Roller SQ.M	2	2	2	2	2	2	2	2	2	2	2	2		
Hauling Dump Truck	Dump Truck Lit	1	1	1	1	1	1	1	1	1	1	1	1		
Lumen Spreading Asphalt Distributer	Asphalt Dist TON	1	1	1	1	1	1	1	1	1	1	1	1		
Aggregate Crushing Plant	Crushing Pla CU.M	6	6	6	6	6	6	6	6	6	6	6	6		
Loading Wheel Loader	Wheel Loader CU.M	2	2	2	2	2	2	2	2	2	2	2	2		
Hauling Dump Truck	Dump Truck TON	12	12	12	12	12	12	12	12	12	12	12	12		
Ease Shaping Motor Grader	Motor Grader SQ.M	2	2	2	2	2	2	2	2	2	2	2	2		
Compaction Road Roller	Road Roller SQ.M	2	2	2	2	2	2	2	2	2	2	2	2		
Bridge & Structures															
Assembling Truck Crane	Truck Crane TON	1	1	1	1	1	1	1	1	1	1	1	1		
Digging Excavator	Excavator CU.M	1	1	1	1	1	1	1	1	1	1	1	1		
Hualing Dump Truck	Dump Truck CU.M	4	4	4	4	4	4	4	4	4	4	4	4		
Concrete Mixing Concrete Mixing Plant	Concrete Mix CU.M	1	1	1	1	1	1	1	1	1	1	1	1		
General Works															
Air Compressor	Air Compressor	1	1	1	1	1	1	1	1	1	1	1	1		
Generator	Generator	1	1	1	1	1	1	1	1	1	1	1	1		
Tractor	Tractor	1	1	1	1	1	1	1	1	1	1	1	1		

Table A.1-4 Required Equipment for
iv) Raqwalpindi Ring Road Project

Construction Schedule	Volume of Works	Unit	1998		1999		2000		2001		2002		2003	
			i	ii	i	ii	i	ii	i	ii	i	ii	i	ii
Earthwork Equipment														
Earth Moving Bulldozer(Large)	2,700,000	CU.M	-	4	4	4	4	4	4	2	2	2	2	-
Spreading Bulldozer(Medium)	2,700,000	CU.M	-	-	4	4	4	4	4	4	4	4	4	-
Loading Wheel Loader	1,300,000	CU.M	-	-	2	2	2	2	2	2	2	2	2	-
Digging Excavator	600,000	CU.M	-	-	1	1	1	1	1	1	1	1	1	-
Compaction Road Roller	1,300,000	CU.M	-	-	2	2	2	3	3	3	3	3	3	-
Earth Hauling Dump Truck	1,300,000	CU.M	-	-	12	12	12	12	12	12	12	12	12	-
Shaping Motor Grader	6,500,000	SQ.M	-	-	3	3	3	3	3	3	3	3	3	-
Watering Water Tanker	3,300,000	TON	-	-	3	3	3	3	3	3	3	3	3	-
Paving Equipment														
Mixing Asphalt Mixing Plant	380,000	TON	-	-	-	1	1	1	1	1	1	1	1	-
Spreading Asphalt Finisher	1,050,000	SQ.M	-	-	-	2	2	2	2	2	2	2	2	-
Compaction Road Roller	1,050,000	SQ.M	-	-	-	2	2	2	2	2	2	2	2	-
Hauling Dump Truck	380,000	Lit	-	-	-	1	1	1	1	1	1	1	1	-
Spreading Asphalt Distributor	1,800,000	TON	-	-	-	1	1	1	1	1	1	1	1	-
Aggregate Crushing Plant	2,600,000	CU.M	-	-	-	1	1	1	1	1	1	1	1	-
Loading Wheel Loader	2,600,000	CU.M	-	-	-	2	2	2	2	2	2	2	2	-
Hauling Dump Truck	1,300,000	TON	-	-	-	10	10	10	10	10	10	10	10	-
Base Shaping Motor Grader	6,500,000	SQ.M	-	-	-	2	2	2	2	2	2	2	2	-
Compaction Road Roller	6,500,000	SQ.M	-	-	-	1	1	1	1	1	1	1	1	-
Bridge & Structures														
Assembling Truck Crane	60,000	TON	-	-	1	1	1	1	1	1	1	1	1	-
Digging Excavator	400,000	CU.M	-	-	1	1	1	1	1	1	1	1	1	-
Hauling Dump Truck	800,000	CU.M	-	-	5	5	5	5	5	5	5	5	5	-
Concrete Mixing Concrete Mixing Plant	80,000	CU.M	-	-	-	2	2	2	2	2	2	2	2	-
General Works														
Air Compressor			-	-	2	2	2	2	2	2	2	2	2	-
Generator			-	-	2	2	2	2	2	2	2	2	2	-
Tractor			-	-	1	1	1	1	1	1	1	1	1	-

Table A. 1-5 Required Equipment for
v) Rawalpindi Bypass Project

Construction Schedule	Volume of Works	Unit	1998		1999		2000		2001		2002		2003	
			i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv
Earthwork Equipment														
Earth Moving Bulldozer (Large)	2,400,000	CU.M	-	-	-	2	2	2	2	2	2	2	2	2
Spreading Bulldozer (Medium)	2,000,000	CU.M	-	-	-	2	2	2	2	2	2	2	2	2
Loading Wheel Loader	1,200,000	CU.M	-	-	-	2	2	2	2	2	2	2	2	2
Digging Excavator	800,000	CU.M	-	-	-	2	2	3	3	3	3	3	3	3
Compaction Road Roller	1,800,000	CU.M	-	-	-	1	1	1	1	1	1	1	1	1
Earth Hauling Dump Truck	1,800,000	CU.M	-	-	-	4	4	4	4	4	4	4	4	4
Shaping Motor Grader	5,400,000	SQ.M	-	-	-	1	1	1	1	1	1	1	1	1
Watering Water Tanker	2,700,000	TON	-	-	-	1	1	1	1	1	1	1	1	1
Paving Equipment														
Mixing Asphalt Mixing Plant	2,250,000	TON	-	-	-	-	1	1	1	1	1	1	1	1
Spreading Asphalt Finisher	8,000,000	SQ.M	-	-	-	-	2	2	2	2	2	2	2	2
Compaction Road Roller	8,000,000	SQ.M	-	-	-	-	2	2	2	2	2	2	2	2
Hauling Dump Truck	2,250,000	Lit	-	-	-	-	2	2	2	2	2	2	2	2
Lumen Spreading Asphalt Distributer	7,000,000	TON	-	-	-	-	1	1	1	1	1	1	1	1
Aggregate Crushing Plant	4,400,000	CU.M	-	-	-	-	8	8	8	8	8	8	8	8
Loading Wheel Loader	4,400,000	CU.M	-	-	-	1	1	2	2	2	2	2	2	2
Hauling Dump Truck	8,800,000	TON	-	-	-	4	4	8	8	8	8	8	8	8
Base Shaping Motor Grader	6,300,000	SQ.M	-	-	-	2	2	2	2	2	2	2	2	2
Compaction Road Roller	6,300,000	SQ.M	-	-	-	1	1	1	1	1	1	1	1	1
Bridge & Structures														
Assembling Truck Crane	200,000	TON	-	-	-	1	1	1	1	1	1	1	1	1
Digging Excavator	400,000	CU.M	-	-	-	1	1	2	2	2	2	2	2	2
Hauling Dump Truck	800,000	CU.M	-	-	-	2	2	4	4	4	4	4	4	4
Concrete Mixing Concrete Mixing Plant	150,000	CU.M	-	-	-	2	2	3	3	3	3	3	3	3
General Works														
Air Compressor			-	-	-	2	2	2	2	2	2	2	2	2
Generator			-	-	-	2	2	2	2	2	2	2	2	2
Tractor			-	-	-	2	2	2	2	2	2	2	2	2

Table A.1-6 Required Equipment for
vi) Ryari Expressway Project

Construction Schedule	Volume of Works	Unit	1998	1999	2000	2001	2002	2003
			i i i i i i i v	i i i i i i i v	i i i i i i i v	i i i i i i i v	i i i i i i i v	
Earthwork Equipment	1,000,000	CU.M	-	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1
Earth Moving Bulldozer (Large)	2,000,000	CU.M	-	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1
Spreading Bulldozer (Medium)	1,500,000	CU.M	-	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1
Loading Wheel Loader	500,000	CU.M	-	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1
Digging Excavator	1,500,000	CU.M	-	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1
Compaction Road Roller	1,500,000	CU.M	-	4 4 4 4 4	4 4 4 4 4	4 4 4 4 4	4 4 4 4 4	4 4 4 4 4
Earth Hauling Dump Truck	6,000,000	SQ.M	-	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1
Shaping Motor Grader		TON						
Watering Water Tanker		TON						
Paving Equipment	400,000	TON	-	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1
Mixing Asphalt Mixing Plant	8,000,000	SQ.M	-	2 2 2 2 2	2 2 2 2 2	2 2 2 2 2	2 2 2 2 2	2 2 2 2 2
Spreading Asphalt Finisher	8,000,000	SQ.M	-	2 2 2 2 2	2 2 2 2 2	2 2 2 2 2	2 2 2 2 2	2 2 2 2 2
Compaction Road Roller	260,000	Lit	-	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1
Hauling Dump Truck	1,000,000	TON	-	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1
rumen Spreading Asphalt Distributer	400,000	CU.M	-	6 6 6 6 6	6 6 6 6 6	6 6 6 6 6	6 6 6 6 6	6 6 6 6 6
Aggregate Crushing Plant	440,000	CU.M	-	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1
Loading Wheel Loader	704,000	TON	-	5 5 5 5 5	5 5 5 5 5	5 5 5 5 5	5 5 5 5 5	5 5 5 5 5
Hauling Dump Truck	320,000	SQ.M	-	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1
Base Shaping Motor Grader	320,000	SQ.M	-	-	-	-	-	-
Compaction Road Roller								
Bridge & Structures								
Assembling Truck Crane	36,000	TON	-	2 2 2 2 2	2 2 2 2 2	2 2 2 2 2	2 2 2 2 2	2 2 2 2 2
Digging Excavator	15,000	CU.M	-	4 4 4 4 4	4 4 4 4 4	4 4 4 4 4	4 4 4 4 4	4 4 4 4 4
Hualing Dump Truck	15,000	CU.M	-	8 8 8 8 8	8 8 8 8 8	8 8 8 8 8	8 8 8 8 8	8 8 8 8 8
Concrete Mixing Concrete Mixing Plant	18,000	CU.M	-	2 2 2 2 2	2 2 2 2 2	2 2 2 2 2	2 2 2 2 2	2 2 2 2 2
General Works								
Air Compressor			-	-	-	-	-	-
Generator			-	-	-	-	-	-
Tractor			-	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1

Table A. 1-7 Required Equipment for
vii) Another 4 Road Construction/Rehabilitation Project

Construction Schedule	Volume of Unit Works	1998	1999	2000	2001	2002	2003
Earthwork Equipment							
Earth Moving Bulldozer(Large)	1,000,000 CU.M	-	-	-	8	8	8
Spreading Bulldozer(Medium)	2,000,000 CU.M	-	-	-	8	8	8
Loading Wheel Loader	1,500,000 CU.M	-	-	-	4	4	4
Digging Excavator	500,000 CU.M	-	-	-	4	4	4
Compaction Road Roller	1,500,000 CU.M	-	-	-	4	4	4
Earth Hauling Dump Truck	1,500,000 CU.M	-	-	-	24	24	24
Shaping Motor Grader	6,000,000 SQ.M	-	-	-	8	8	8
Watering Water Tanker	TON	-	-	-	8	8	8
Paving Equipment							
Mixing Asphalt Mixing Plant	400,000 TON	-	-	-	2	2	2
Spreading Asphalt Finisher	8,000,000 SQ.M	-	-	-	4	4	4
Compaction Road Roller	8,000,000 SQ.M	-	-	-	2	2	2
Hauling Dump Truck	260,000 Lit	-	-	-	2	2	2
Tumen Spreading Asphalt Distributer	1,000,000 TON	-	-	-	2	2	2
Aggregate Crushing Plant	400,000 CU.M	-	-	-	10	10	10
Loading Wheel Loader	440,000 CU.M	-	-	-	2	2	2
Hauling Dump Truck	704,000 TON	-	-	-	8	8	8
Base Shaping Motor Grader	320,000 SQ.M	-	-	-	2	2	2
Compaction Road Roller	320,000 SQ.M	-	-	-	2	2	2
Bridge & Structures							
Assembling Truck Crane	36,000 TON	-	-	-	2	2	2
Digging Excavator	15,000 CU.M	-	-	-	4	4	4
Hauling Dump Truck	15,000 CU.M	-	-	-	8	8	8
Concrete Mixing Concrete Mixing Plant	18,000 CU.M	-	-	-	2	2	2
General works							
Air Compressor		-	-	-	2	2	2
Generator		-	-	-	2	2	2
Tractor		-	-	-	2	2	2

Table A. 1-8

Summary of Required Equipment for

i) Kalian - Rawalpindi Additional Carriageway Project.

Standard	1998				1999				2000				2001				2002				2003							
	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv
Bulldozer(Large)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulldozer(Medium)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheel Loader	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Excavator	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Road Roller	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Dump Truck	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
Motor Grader	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Water Tanker	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Asphalt Mixing Plant	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Asphalt Distributer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Asphalt Finisher	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Truck Crane	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Air Compressor	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Generator	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Crushing Plant	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Concrete Mixing Plant	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Tractor	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table A.1-9 Summary of Required Equipment for

ii) Sibi - Rakuni Road Project

Standard	1998				1999				2000				2001				2002				2003							
	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv				
Bulldozer (Large) 300-320 HP	5	5	5	5	5	5	5	5	5	5	5	5	3	3	3	3	2	2	2	2	2	2	2	2	-	-	-	-
Bulldozer (Medium) 200-230 HP	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	6	6	6	6	6	6	6	6	-	-	-	-
Wheel Loader 170-190 HP	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	-	-	-	-
Excavator 150 HP	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-
Road Roller 9.5 Ton	11	11	11	11	11	11	11	11	11	11	11	11	14	14	14	14	14	14	14	14	14	14	14	14	-	-	-	-
Dump Truck 15 Ton	22	22	22	22	22	22	22	22	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	-	-	-	-
Motor Grader 200-220 HP	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	-	-	-	-
Water Tanker 10 Ton	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	-	-	-	-
Asphalt Mixing Plant 60-80 Ton/h	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Asphalt Distributer 6-8 Kl	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	-	-	-	-
Asphalt Finisher 8.0 M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Truck Crane 25 Ton	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-
Air Compressor 655 CFM	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	-	-	-	-
Generator 850 KVA	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	-	-	-	-
Crushing Plant 100 Ton/Hr	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	-	-	-	-
Concrete Mixing Plant 1.0 CU.M	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	-	-	-	-
Tractor	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-

Table A. 1-10 Summary of Required Equipment for

		ii) Lahore Municipal Road Pavement Rehabilitation Project																			
		1998			1999			2000			2001			2002			2003				
Standard		i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv
Bulldozer (Large)	300-320 HP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulldozer (Medium)	200-230 HP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheel Loader	170-190 HP	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0
Excavator	150 HP	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Road Roller	9.5 Ton	4	4	4	4	4	4	4	4	4	4	4	4	0	0	0	0	0	0	0	0
Dump Truck	15 Ton	15	15	15	15	15	15	15	15	15	15	15	15	0	0	0	0	0	0	0	0
Motor Grader	200-220 HP	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0
Water Tanker	10 Ton	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asphalt Mixing Plant	60-80 Ton/h	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-	-
Asphalt Distributer	6-8 Kl	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-	-
Asphalt Finisher	8.0 M	2	2	2	2	2	2	2	2	2	2	2	2	-	-	-	-	-	-	-	-
Truck Crane	25 Ton	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-	-
Air Compressor	655 CFM	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-	-
Generator	350 KVA	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Crushing Plant	100 Ton/Hr	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-	-
Concrete Mixing Plant	1.0 CU.M	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-	-
Tractor		1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0

Table A. 1-11 Summary of Required Equipment for

Standard	1998				1999				2000				2001				2002				2003			
	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv
Bulldozer (Large)	-	-	4	4	4	4	4	4	4	4	4	4	2	2	2	2	-	-	-	-	-	-	-	-
Bulldozer (Medium)	-	-	-	4	4	4	4	4	4	4	4	4	4	4	4	4	-	-	-	-	-	-	-	-
Wheel Loader	0	0	0	2	4	4	4	4	4	4	4	4	4	4	4	4	2	2	2	2	0	0	0	0
Excavator	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	0	0	0	0
Road Roller	0	0	0	2	5	5	5	5	6	6	6	6	6	6	6	6	3	3	3	3	0	0	0	0
Dump Truck	0	0	0	12	24	24	24	24	24	24	24	24	24	24	24	24	12	12	12	12	0	0	0	0
Motor Grader	0	0	0	3	5	5	5	5	5	5	5	5	5	5	5	5	2	2	2	2	0	0	0	0
Water Tanker	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-	-	-
Asphalt Mixing Plant	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-
Asphalt Distributer	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-
Asphalt Finisher	-	-	-	-	2	2	2	2	2	2	2	2	2	2	2	2	-	-	-	-	-	-	-	-
Truck Crane	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
Air Compressor	-	-	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	-	-	-	-
Generator	-	-	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	-	-	-	-
Crushing Plant	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-
Concrete Mixing Plant	-	-	-	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	-	-	-	-
Tractor	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-

Table A. 1-12 Summary of Required Equipment for

v) Rawalpindi Bypass Project	Standard	1998				1999				2000				2001				2002				2003			
		i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv
Bulldozer(Large)	300-320 HP	-	-	-	-	-	-	-	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Bulldozer(Medium)	200-230 HP	-	-	-	-	-	-	-	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Wheel Loader	170-190 HP	0	0	0	0	0	0	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Excavator	150 HP	0	0	0	0	0	0	0	0	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Road Roller	9.5 Ton	0	0	0	0	0	0	0	0	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Dump Truck	15 Ton	0	0	0	0	0	0	9	9	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Motor Grader	200-220 HP	0	0	0	0	0	0	0	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Water Tanker	10 Ton	-	-	-	-	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Asphalt Mixing Plant	60-80 Ton/h	-	-	-	-	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Asphalt Distributer	6-8 KJ	-	-	-	-	-	-	-	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Asphalt Finisher	8.0 M	-	-	-	-	-	-	-	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Truck Crane	25 Ton	-	-	-	-	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Air Compressor	655 CFM	-	-	-	-	-	-	-	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Generator	850 KVA	-	-	-	-	-	-	-	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Crushing Plant	100 Ton/Hr	-	-	-	-	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Concrete Mixing Plant	1.0 CU.M	-	-	-	-	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Tractor		-	-	-	-	-	-	-	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Table A. 1-13 Summary of Required Equipment for

Standard	1998				1999				2000				2001				2002				2003			
	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv
Bulldozer(Large)	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Bulldozer(Medium)	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wheel Loader	0	0	0	0	1	2	2	2	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Excavator	0	0	0	0	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Road Roller	0	0	0	0	1	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Dump Truck	0	0	0	0	4	4	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Motor Grader	0	0	0	0	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Water Tanker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asphalt Mixing Plant	-	-	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Asphalt Distributer	-	-	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Asphalt Finisher	-	-	-	-	-	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Truck Crane	-	-	-	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Air Compressor	-	-	-	-	-	-	-	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Generator	-	-	-	-	-	-	-	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Crushing Plant	-	-	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Concrete Mixing Plant	-	-	-	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Tractor	-	-	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table A. 1-14 Summary of Required Equipment for

Standard	1998				1999				2000				2001				2002				2003			
	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv
Bulldozer (Large)	-	-	-	-	-	-	-	-	-	-	-	-	8	8	8	8	12	12	12	12	16	16	16	16
Bulldozer (Medium)	-	-	-	-	-	-	-	-	-	-	-	-	8	8	8	8	8	8	8	8	14	14	14	14
Wheel Loader	0	0	0	0	0	0	0	0	0	0	0	0	6	6	6	10	10	10	10	20	20	20	20	
Excavator	0	0	0	0	0	0	0	0	0	0	0	0	8	8	8	8	8	8	8	8	16	16	16	
Road Roller	0	0	0	0	0	0	0	0	0	0	0	0	8	8	8	14	14	14	14	24	24	24	24	
Dump Truck	0	0	0	0	0	0	0	0	0	0	0	0	36	36	36	48	48	48	48	88	88	88	88	
Motor Grader	0	0	0	0	0	0	0	0	0	0	0	0	10	10	10	10	10	10	10	20	20	20	20	
Water Tanker	-	-	-	-	-	-	-	-	-	-	-	-	8	8	8	8	8	8	8	8	16	16	16	
Asphalt Mixing Plant	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2	2	2	2	2	2	4	4	4	
Asphalt Distributer	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2	2	4	4	4	4	8	8	8	
Asphalt Finisher	-	-	-	-	-	-	-	-	-	-	-	-	4	4	4	4	0	0	0	0	0	0	0	
Truck Crane	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2	2	2	2	2	2	4	4	4	
Air Compressor	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2	2	2	2	2	2	4	4	4	
Generator	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2	2	2	2	2	2	4	4	4	
Crushing Plant	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2	2	4	4	4	4	8	8	8	
Concrete Mixing Plant	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2	2	2	2	2	2	4	4	4	
Tractor	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2	2	2	2	2	2	4	4	4	

Table A. 1-15 Summary of Required Equipment for All Future Construction Works

Standard	1998				1999				2000				2001				2002				2003				
	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	
Bulldozer(Large)	5	5	9	9	10	10	12	12	12	12	12	12	16	16	16	16	17	17	17	17	17	17	17	19	19
Bulldozer(Medium)	7	7	7	11	12	12	14	14	14	14	14	14	22	22	22	22	17	17	17	17	17	17	17	17	16
Wheel Loader	10	10	10	12	15	15	19	19	19	19	19	19	23	23	23	23	25	25	23	23	27	27	27	27	27
Excavator	6	6	6	8	13	13	16	16	16	16	16	16	23	23	23	23	22	22	22	22	21	21	26	26	26
Road Roller	21	21	21	23	27	27	31	31	31	31	31	31	35	35	35	35	38	38	35	35	31	31	31	31	31
Motor Grader	10	10	10	13	16	16	20	20	18	18	18	18	26	26	26	26	23	23	21	21	21	25	25	25	25
Asphalt Mixing Plant	2	2	2	2	3	3	4	4	4	4	4	4	5	5	5	5	5	4	4	4	4	6	6	6	6
Asphalt Finisher	4	4	4	4	6	6	8	8	8	8	8	8	10	10	10	10	0	0	0	0	0	0	0	0	0
Truck Crane	3	3	3	4	6	6	7	7	6	6	6	6	7	7	7	7	7	7	6	6	7	7	7	7	7
Air Compressor	5	5	5	7	7	7	9	9	9	9	9	9	10	10	10	10	10	10	8	8	8	8	8	8	8
Generator	5	5	5	7	7	7	9	9	9	9	9	9	10	10	10	10	10	10	8	8	8	8	8	8	8
Dump Truck	59	59	59	71	87	87	102	102	88	88	88	88	109	109	109	109	109	109	97	97	97	112	112	112	112
Water Tanker	4	4	4	7	7	7	8	8	8	8	8	8	16	16	16	16	13	13	13	13	13	17	17	17	17
Asphalt Distributer	3	3	3	3	4	4	5	5	7	7	7	7	8	8	8	8	10	10	9	9	11	11	11	11	11
Crushing Plant	4	4	4	4	5	5	7	7	6	6	6	6	7	7	7	7	9	9	8	8	10	10	10	10	10
Concrete Mixing Plant	4	4	4	4	8	8	10	10	10	10	10	10	11	11	11	11	11	11	9	9	9	9	9	9	9
Tractor	3	3	3	4	4	4	4	4	6	6	6	6	7	7	7	7	7	7	6	6	7	7	7	7	7

Table A. 1-16 Summary of Required Equipment for On-going Construction Works

Standard	1998				1999				2000				2001				2002				2003							
	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv				
Bulldozer(Large)	5	5	5	5	5	5	5	5	5	5	5	5	3	3	3	3	2	2	2	2	2	2	2	0	0	0	0	
Bulldozer(Medium)	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	6	6	6	6	6	6	6	0	0	0	0	0
Wheel Loader	10	10	10	10	10	10	10	10	10	10	10	10	8	8	8	8	6	6	6	6	6	6	6	0	0	0	0	0
Excavator	6	6	6	6	6	6	6	6	6	6	6	4	4	4	4	3	3	3	3	3	3	3	3	0	0	0	0	0
Road Roller	21	21	21	21	21	21	21	21	21	21	21	18	18	18	18	14	14	14	14	14	14	14	14	0	0	0	0	0
Motor Grader	10	10	10	10	10	10	10	10	10	10	10	8	8	8	8	6	6	6	6	6	6	6	6	0	0	0	0	0
Asphalt Mixing Plant	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Asphalt Finisher	4	4	4	4	4	4	4	4	4	4	4	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Truck Crane	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	1	1	1	1	1	1	1	1	0	0	0	0	0
Air Compressor	5	5	5	5	5	5	5	5	5	5	5	3	3	3	3	2	2	2	2	2	2	2	2	0	0	0	0	0
Generator	5	5	5	5	5	5	5	5	5	5	5	3	3	3	3	2	2	2	2	2	2	2	2	0	0	0	0	0
Dump Truck	59	59	59	59	59	59	59	59	59	59	59	39	39	39	39	24	24	24	24	24	24	24	24	0	0	0	0	0
Water Tanker	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	0	0	0	0	0
Asphalt Distributer	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	0	0	0	0	0
Crushing Plant	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	2	2	2	2	2	2	2	2	0	0	0	0	0
Concrete Mixing Plant	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	2	2	2	2	2	2	2	2	0	0	0	0	0
Tractor	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	1	1	1	1	1	1	1	1	0	0	0	0	0

Table A. 1-17 Annual Requirement of Equipment for All Future Construction Works

	Standard	1998	1999	2000	2001	2002	2003
Bulldozer (Large)	300-320 HP	7	11	12	16	17	19
Bulldozer (Medium)	200-230 HP	8	13	14	22	17	17
Wheel Loader	170-190 HP	11	17	19	23	24	27
Excavator	150 HP	7	15	16	23	22	26
Road Roller	9.5 Ton	22	29	31	35	37	31
Motor Grader	200-220 HP	11	12	14	16	18	19
Asphalt Mixing Plant	60-80 Ton/h	2	2	3	3	4	4
Asphalt Finisher	8.0 M	4	5	5	6	7	8
Truck Crane	25 Ton	3	4	5	6	7	7
Air Compressor	655 CFM	6	6	7	8	8	9
Generator	350 KVA	6	6	7	8	8	9
Dump Truck	15 Ton	62	69	76	87	95	95
Water Tanker	10 Ton	5	6	6	7	8	8
Asphalt Distributer	6-8 KI	3	3	4	4	5	5
Crushing Plant	100 Ton/Hr	4	4	5	5	6	6
Concrete Mixing Plant	1.0 CU. M	4	5	6	8	9	10
Tractor		3	4	4	5	6	6

Table A. 1-18 Annual Requirement of Equipment for On-going Construction Works

	Standard	1998	1999	2000	2001	2002
Bulldozer (Large)	300-320 HP	5	5	5	3	2
Bulldozer (Medium)	200-230 HP	7	7	7	7	6
Wheel Loader	170-190 HP	10	10	8	6	6
Excavator	150 HP	6	6	4	3	3
Road Roller	9.5 Ton	21	21	18	14	14
Motor Grader	200-220 HP	10	10	8	6	6
Asphalt Mixing Plant	60-80 Ton/h	2	2	1	0	0
Asphalt Finisher	8.0 M	4	4	2	0	0
Truck Crane	25 Ton	3	3	2	1	1
Air Compressor	655 CFM	5	5	3	2	2
Generator	350 KVA	5	5	3	2	2
Dump Truck	15 Ton	59	59	39	24	24
Water Tanker	10 Ton	4	4	4	4	4
Asphalt Distributer	6-8 Kl	3	3	3	2	2
Crushing Plant	100 Ton/Hr	4	4	3	2	2
Concrete Mixing Plant	1.0 CU.M	4	4	3	2	2
Tractor		3	3	2	1	1

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