No.

BASIC DESIGN STUDY REPORT

ON

THE PROJECT FOR IMPROVEMENT OF EQUIPMENT FOR ROAD CONSTRUCTION AND MAINTENANCE

IN

THE KINGDOM OF BHUTAN

FEBRUARY 2004

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

DOCON CO., LTD.

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PREFACE

In response to a request from the Government of the Kingdom of Bhutan, the Government of Japan decided to conduct a basic design study on the Project for Improvement of Equipment for Road Construction and Maintenance and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Bhutan a study team from 10 October to 1 November, 2003.

The team held discussions with the officials concerned of the Government of Bhutan, 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 Bhutan 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 Kingdom of Bhutan for their close cooperation extended to the teams.

February 2004

Kunimitu YOSHINAGA
Director
Japan International Cooperation Agency

February 2004

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Improvement of Equipment for Road Construction and Maintenance in the Kingdom of Bhutan.

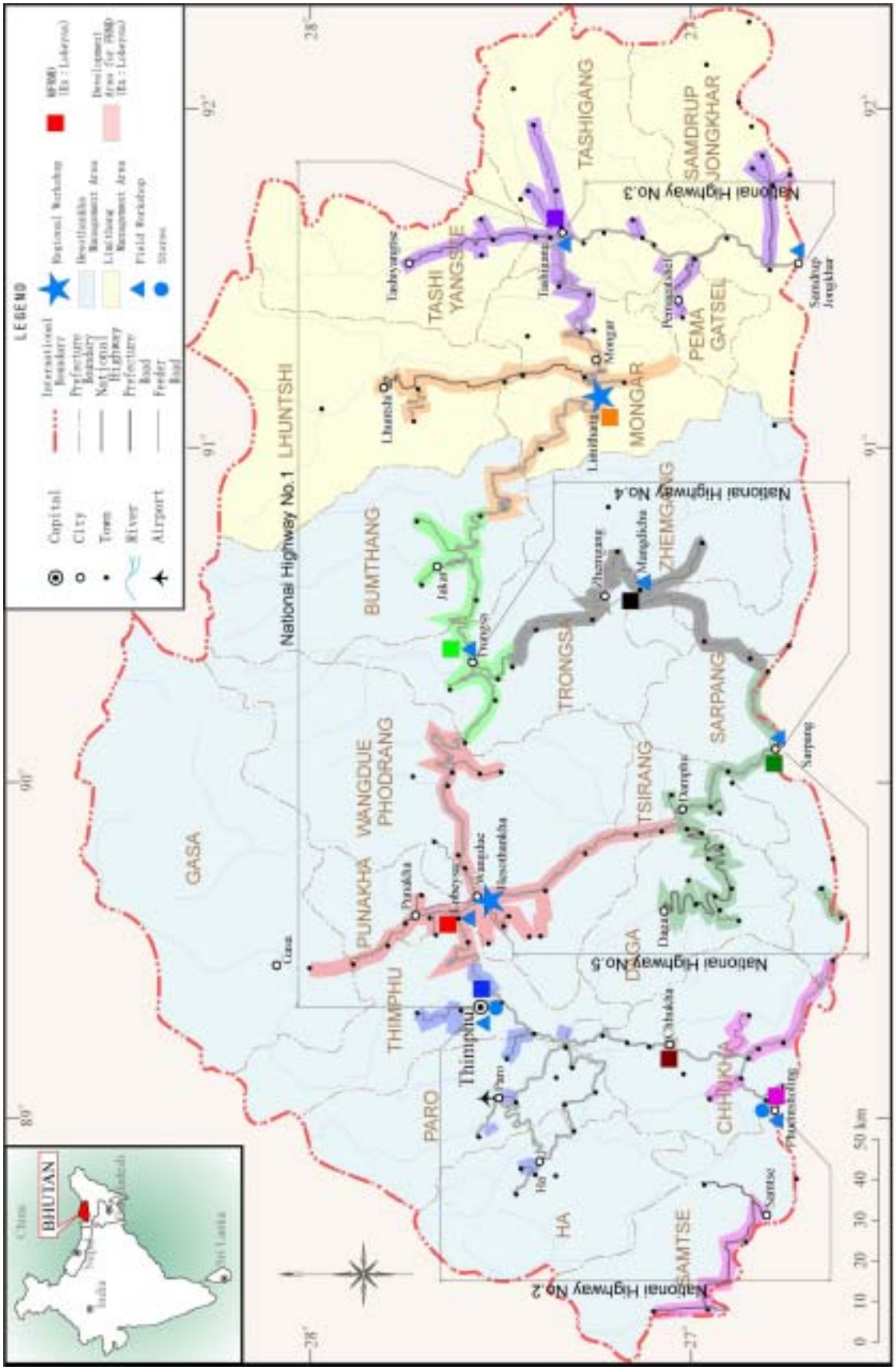
This study was conducted by Docon Co., Ltd. under a contract to JICA, during the period from 3 October 2003 to 27 February 2004. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Bhutan and formulated the most appropriate 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,

Akihiko KITAYAMA
Project Manager,
Basic design study team on
the Project for Improvement of Equipment
for Road Construction and Maintenance
Docon Co., Ltd.

Location Map of Project Sites



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Abbreviations

A/P	Authorization to Pay
ADB	Asian Development Bank
B/A	Banking Arrangement
BDFC	Bhutan Development Finance Corporation
BHN	Basic Human Needs
DOR	Department of Roads
EASG	Environmental Assessment Sector Guidelines
EFRC	Environment Friendly Road Construction
E/N	Exchange of Notes
FRMD	Field Road Maintenance Division
GOI	Government of India
GOJ	Government of Japan
JICA	Japan International Cooperation Agency
LDC	Least Development Countries
LLDC	Least among Less Development Countries
LTO	Liaison and Transit Office
MOA	Ministry of Agriculture
MOF	Ministry of Finance
MOWHS	Ministry of Works and Human Settlement
Nu.	Bhutanese Currency or Ngultrum
OJT	On-the-Job Training
PIU	Project Implementation Unit
RGOB	Royal Government of Bhutan
RCO	Regional and Custom Office
TOR	Terms of Reference
UN	United Nations
UNCDF	United Nations Capital Development Fund
UNDP	United Nations Development Programme
WB	World Bank
WEP	World Food Programme

Summary

The Kingdom of Bhutan is an inland country located at the southern foot of the Himalayas. The northern border of Bhutan adjoins the Chinese autonomous district of Tibet, and its other borders adjoin the Assam area of India. The country has an area of about 46,500 km^2, and a population of 699,000 as of 2001. The annual average growth rate of the gross domestic product (GDP) was 5~7% from 1995 to 2000, and the GDP per capita was 666 dollars in 1999.

Road transportation is the only means of transport in Bhutan. There are some feeder roads, urban and agricultural roads that give access to villages, irrigation areas and markets, while the national highways and district roads link twenty prefectures within the road network. However, due to an increase in the number of vehicles, especially large-scale vehicles, in recent years, the inefficiency of the road network and the deterioration of the roads have become apparent. Disasters such as landslides and subsidence also occur every year during the southeast monsoon period because of the geological features of the Himalayan belt in Bhutan, with resulting serious damage to the life of the people when the roads remain blocked for long periods of time.

Under such circumstances, and in conformity with the Ninth Five Year Road Development Plan (2002~2007), the Royal Government of Bhutan is aiming to rehabilitate the national highway and feeder-road network, in order to achieve sound economic development on a nationwide scale and to secure a basic standard of living for residents.

However, road development and construction equipment is still under the direct control of the Royal Government of Bhutan, since private companies are not capable of handling such public works. Therefore, for the Bhutan government, the road construction and its maintenance equipment is an essential requirement for the accomplishment of the Ninth Five Year Road Development Plan.

Most of the road construction equipment being maintained presently was procured by major aid donors, such as Grant Aid from Japan including the Indian government, and by purchase capitalizing on the Asia Development Bank, the United Nations Capital Development Fund. This road construction equipment being operated currently was introduced after 1982.

The road construction equipment which has an operating time of 10,000 hours or more (economical life year: 10,000 hours) amounts to 62% of the total. A large part of the road construction equipment is out of date, and there is not enough equipment in number. The renewal of the road construction equipment through funding by Bhutan is also difficult, from the financial point of view. Thus the Royal Government of Bhutan has requested from the Japanese government grant aid assistance for "The Project for Improvement of Equipment for

Road Construction and Maintenance".

After receiving the request from the Bhutan government, the Japanese government sent a preparatory survey team to Bhutan from 12th January to 5th February 2003, through the offices of Japan International Cooperation Agency (JICA) to confirm the validity of the content of the request. Following on from the results of the preparatory survey, JICA sent a basic design study team to Bhutan from 10th October to 1st November 2003.

The basic design study team held consultations on the content of the request with the Department of Roads (DOR) of the Ministry of Works and Human Settlement (MOWHS), which represents the executive body for the project. The necessary data were collected from on-site road maintenance divisions in eight places and from the Hesothangkha and Limithang regional workshops in Bhutan, which are under the jurisdiction of the DOR.

On the basis of the results of the above survey, the basic design study team examined and proposed a project scheme for essential road maintenance and disaster recovery work needed to maintain and improve the society and everyday economic activity. Working from 17th to 26th December 2003, the basic design study team sent to Bhutan obtained a basic agreement from the Royal Government of Bhutan with regard to the proposed project scheme.

The content of the road construction and maintenance equipment plan is proposed as follows:

Road Construction and Maintenance Equipment Plan

No.	Name of Equipment	Outline of Specification	Quantity
1	Generator	55KVA	2 units
2-1	Excavator	140~150 HP (2 0 tons) with bucket	4 units
2-2	Excavator	80~95 HP (12 tons) with bucket	4 units
3	Back Hoe Loader	90~100 HP	1 unit
4	Breaker for Excavator	for excavator 140~150 HP	2 units
5	Motor Grader	130~140 HP	2 units
6	Wheel Loader	125~135 HP	6 units
7	Dump Truck	8~10 tons 4×2	8 units
8	Vibrator Road Roller	6.5~8-ton tandem roller	1 unit
9	Hand Guided Roller	0.5~1 ton	8 units
10	Vibrator Plate Compactor	2.5~5 HP 60~80 kg	6 units
11	Asphalt Distributor	3,000 lit	1 unit
12	Mobile Crushing Plant	20~30 tons/hr	1 unit
13	Mobile Asphalt Mixer	8~10 tons/hr	1 unit
14	Cement Concrete Mixer	4 m^3	1 unit
15	Fuel Tanker	6,000Lit	2 units
16	Truck with Mounted Crane	4×2 8-ton crane：3.2 tons	1 unit
17	Self Loading Short Body Truck	6×4 more than 15 tons	1 unit
18	Service car (cab type)	4×2 4-ton crane：2.9 tons	2 units
19	Single Cab Cargo Car	4×4 single cab	8 units
20	Maintenance Equipment for workshop	-	Lump-sum
	Fork lift for workshop	4.2 ton, 3t lift	1 unit
Spare parts for the above equipment		-	Lump-sum

If the project is undertaken using grant aid assistance from Japan, the project cost is estimated at 606 million yen (Japanese side 606 million yen: Bhutan side 365,000 yen). The period necessary for execution of the project is 11 months including the detailed planning.

The direct and indirect effects to be brought about by the execution of this project are as follows:

Direct Effect

(1) Promotion of Mechanization of Road Work

The mechanization of road development, which is one of the strategies of the Ninth Five Year Road Development Plan, will be promoted through the procurement of construction equipment, so that road development can be carried out efficiently.

(2) Improvement of Regional Workshops' Ability to Maintain Equipment

The ability of the Hesothangkha and newly-established Limithang regional workshops will thus be improved, and it will be possible both to improve the technology for the repair of construction equipment and to shorten the time needed for repairs. As a result, the operational efficiency of the construction equipment will be improved.

Indirect Effect

(1) Promotion of Accessibility by Road Improvement

The road improvement to maintain the accessibility to the capital, prefecture capitals, gewog capitals and communities isolated will lead improving the society and everyday economic activity as part of the Ninth Five Year Road Development Plan, which is on-going at present, through the procurement of the necessary construction equipment.

(2) Expansion of Economic Activity

Strengthening of the road network will reduce transport time and cost.

Traffic hold-ups due to the road disasters that occur every year will be reduced, because restoration work against road disaster will be executed within a short period of time, while economic activity in the market economy, such as strengthening of existing markets and the expansion to new markets, can be promoted.

Road Development to be Achieved

a) Road Rehabilitation (Re-surfacing) : 1,010 km
b) Road Rehabilitation (Widening, related structures etc.) : 100 km
c) Daily Road Maintenance (Resurfacing) : 2,220 km
d) Daily Bridge Maintenance : 147 Nos.

e) Road Disaster Prevention Work : 12 locations (60 km)

In addition, it is judged that the content of the project is appropriate from the following viewpoints:

(1) The benefit brought by this project will reach the whole nation (699,000 inhabitants) including the direct beneficiaries in areas along the project road and also indirect beneficiaries.

(2) The purpose of the project is to improve the accessibility to isolated areas from national highway, and to secure and improve basic living standards of local residents against the disasters that occur every year, by linking the access road (feeder road) to a previously completely isolated residential area.

(3) Bhutan will be able to manage and maintain the construction equipment using the capital, talent and technology of Bhutan following the execution of the project.

(4) The project will contribute to the accomplishment of not only the Ninth Five Year Road Development Plan but also the Road Development Master Plan of Bhutan from 2007 to 2027, which the Department of Roads (DOR) determined in 2001 in cooperation with the Asian Development Bank (ADB).

(5) The following steps to minimize the negative effect on the environment will be adopted:

- The procurement of transportation equipment needed for the removal of surplus soil and asphalt scrap.
- The procurement of construction equipment with reduced vehicle exhaust emission, noise and vibration.
- The processing of waste oil discharged from the regional workshop so as to avoid pollution of the surrounding area.

(6) It is possible to execute the project within the ability of the Bhutan government to implement the system of the Japan's Grant Aid Scheme.

The proposal for a more efficient and effective execution of the project is as follows:

(1) Technical Cooperation

OJT training through JICA counterpart training to be planned in 2004 and/or senior overseas volunteer from Japan is necessary for the persons involved in road construction and in construction and maintenance in the regional workshops, so that this project can be effective in assisting road development in Bhutan. It is also

necessary to improve asphalt plant technology, including not only equipment operation but also the technology for improving quality control of the asphalt mixture.

(2) Promotion of Privatization in Road Development

The project should be undertaken without affecting the privatization of road maintenance, for this it is necessary for private companies to be given a fair opportunity to participate in the project, which they bring their ability. In the future, it is expected that the road maintenance work system, including daily road maintenance, will be transited to the contract method involved a private company rather than the direct management method.

Contents

[Appendices]

Chapter 1 Background of the Project

Road transportation is the only means of transport in Bhutan. There is a road network consisting of national highways, district roads, urban roads, agricultural roads, and forest roads that give access to villages, irrigation areas and markets, and the national highways and district roads link twenty prefectures within Bhutan. However, due to an increase in the number of vehicles, especially large-scale vehicles, in recent years, the inefficiency of the road network and the deterioration of the roads have become apparent. Disasters such as landslides and subsidence also occur every year during the southeast monsoon period because of the geological features of the Himalayan belt in Bhutan, with resulting serious damage to the life of the people when the roads remain blocked for long periods of time.

Under such circumstances, and in conformity with the Ninth Five Year Road Development Plan (2002~2007), the Royal Government of Bhutan is aiming to rehabilitate the national highway, district road and feeder-road network, in order to achieve sound economic development on a nationwide scale and to secure a basic standard of living for residents.

However, road development and construction equipment is still under the direct control of the Royal Government of Bhutan, since private companies are not capable of handling such public works. Therefore, for the Bhutan government, the development of the road construction/maintenance equipment is an essential requirement for the accomplishment of the Ninth Five Year Road Development Plan.

Most of the road construction equipment being maintained presently was procured by major aid donors, such as Grant Aid from Japan including the India government, and by purchase capitalizing on the Asia Development Bank, the United Nations Capital Development Fund. This road construction equipment being operated currently was introduced after 1982.

The road construction equipment which has an operating time of 10,000 hours or more (economical life year: 10,000 hours) amounts to 62% of the total. A large part of the road construction equipment is out of date, and there is not enough equipment in number. The renewal of the road construction equipment through funding by Bhutan is also difficult, from the financial point of view. Thus the Royal Government of Bhutan has requested from the Japan’s Grant Aid for "The Project for Improvement of Equipment for Road Construction and Maintenance". The content of the request is indicated in Table 1-1 as of signing of Minutes of Discussions in the Basic Design Study.

Table 1-1 Construction Equipment Requested by the Royal Government of Bhutan

No.	Name of Equipment	Outline of Specification	Quantity
1	Generator	55KVA	2 units
2-1	Excavator	140~150HP (20ton) with bucket	8 units
2-2	Excavator	80~95HP (12ton) with bucket	4 units
3	Back Hoe Loader	90~100HP	2 units
4	Breaker with Engine	25kg	10 units
5	Breaker for Excavator	for excavator 140~150HP	2 units
6	Motor Grader	130~140HP	2 units
7	Wheel Loader	125~135HP	8 units
8	Dump Truck	8~10ton 4×2	16 units
9	Vibrator Road Roller	6.5~8ton tandem roller	2 units
10	Tire Roller	8ton	2 units
11	Hand Guide Roller	0.5~1ton	8 units
12	Vibrator Plate Compacter	2.5~5HP 60~80kg	8 units
13	Asphalt Distributor	3,000lit	2 units
14	Mobile Crushing Plant	20~30ton/hr	2 units
15	Mobile Asphalt Mixer	8~10ton/hr	2 units
16	Cement Concrete Mixer	$4m^3$	2 units
17	Asphalt Finisher	2.5~4.5m	2 units
18	Mechanical Chip Spreader	12mm dia.	2 units
19	Rough Terrain Crain	25ton	1 unit
20	Fuel Tanker	6,000Lit	2 units
21	Truck with Mounted Crane	4×2 8ton crane：3.2ton	2 units
22	Self Loading Short Body Truck	6×4 more than 15ton	1 unit
23	Service car (cab type)	4×2 4ton crane：2.9ton	4 units
24	Single Cab Cargo Car	4×4 single cab	8 units
25	Bridge Inspection Vehicle	-	1 unit
	Maintenance Equipment for workshop	-	Lump-sum
	Spare parts for the above Equipment	-	Lump-sum

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Objectives of the Project

As a land-locked country, Bhutan's socioeconomic development depends on largely an efficient and reliable road network. However, the lack of a well-developed transport network in Bhutan has been identified as one of the major constraints to the development of more remote areas of the country. Road infrastructure development has therefore been given priority in all the past five year plans. At present, according to the Ninth Five Year Plan, which is ongoing (March, 2002~August, 2007), the Royal Government of Bhutan is undertaking road development works giving high priority to the periodic and daily maintenance such as a widening, improvement of curves and re-surfacing, recovery work against disasters such as a slope failure, land slide, settlement and scouring. However, many of the construction equipments needed to maintain and construct the national roads and feeder roads are becoming superannuated, and their number is also absolutely insufficient. Therefore, the purpose of this project is to select and procure the most suitable construction equipments needed to promote the road development in Bhutan, and it aims is to improve basic life of Bhutan's people and its economy.

2-1-2 Road Development Plan

A high-ranking target of the project is the promotion of the road development in the Ninth Five Year Plan of Bhutan to strength road accessibility to capital, prefecture (Dzongkhang), district (Gewog), community for securing basic life in the regions that have been completely isolated, and to improve the society and the economic activities. The implementation agency, the maintenance strategy, the budget and activities for the road development plan are as follows,

(1) Implementation Agency

The implementation organization of the road development is Department of Road (DOR) under Ministry of Works and Human Settlement (MOWHS) control. DOR has eight branch offices so called Field Road Maintenance Division (FRMD) in the whole country (refer to Figure 2-1).

The construction equipment needed for the above FRMD is procured from Hesothangkha Regional Workshop and Limithang Regional Workshop that has jurisdiction over center part/west and the east part of Bhutan respectively. Both the regional workshops function under the guidance and administrative control of the Mechanical Division of DOR.

(2) Development Strategy

- Promotion of the private sector company to entry into road business
- Mechanization for road construction and maintenance works
- Adoption of Environment Friendly Road Construction (EFRC) technology
- Construction of new road (national highway, district road and feeder road)
- Improvement of alignment and widening of the existing national highways
- Strengthening of road maintenance management against road disaster
- Replacement of existing temporary bridges

(3) Budget

Budget related to the road development in the Ninth Five Year Plan is Nu.7,000.3 million and the budget of DOR is Nu.6,660.3 million.

Table 2-1 Budget for Ninth Five Year Road Development Plan

(million Nu.)

Budget	Recurrent	Capital	Total	Distribution Ratio
Central government	23,879.0	29,000.2	52,879.2	-
Local government	7,802.5	9,318.3	17,120.8	-
Total (Ninth Five Plan) A	31,681.5	38,318.5	70,000.0	-
MOWHS Budget B	1,710.6	8,672.5	10.383.1	B/A=14.8%
Budget related to Road C	1,268.8	5,731.4	7,000.3	C/A=10.0%
・Central (DOR)	1,136.2	5,524.1	6,660.3	-
・Prefecture	132.7	3.0	135.7	-
・Block	0.0	204.3	204.3	-

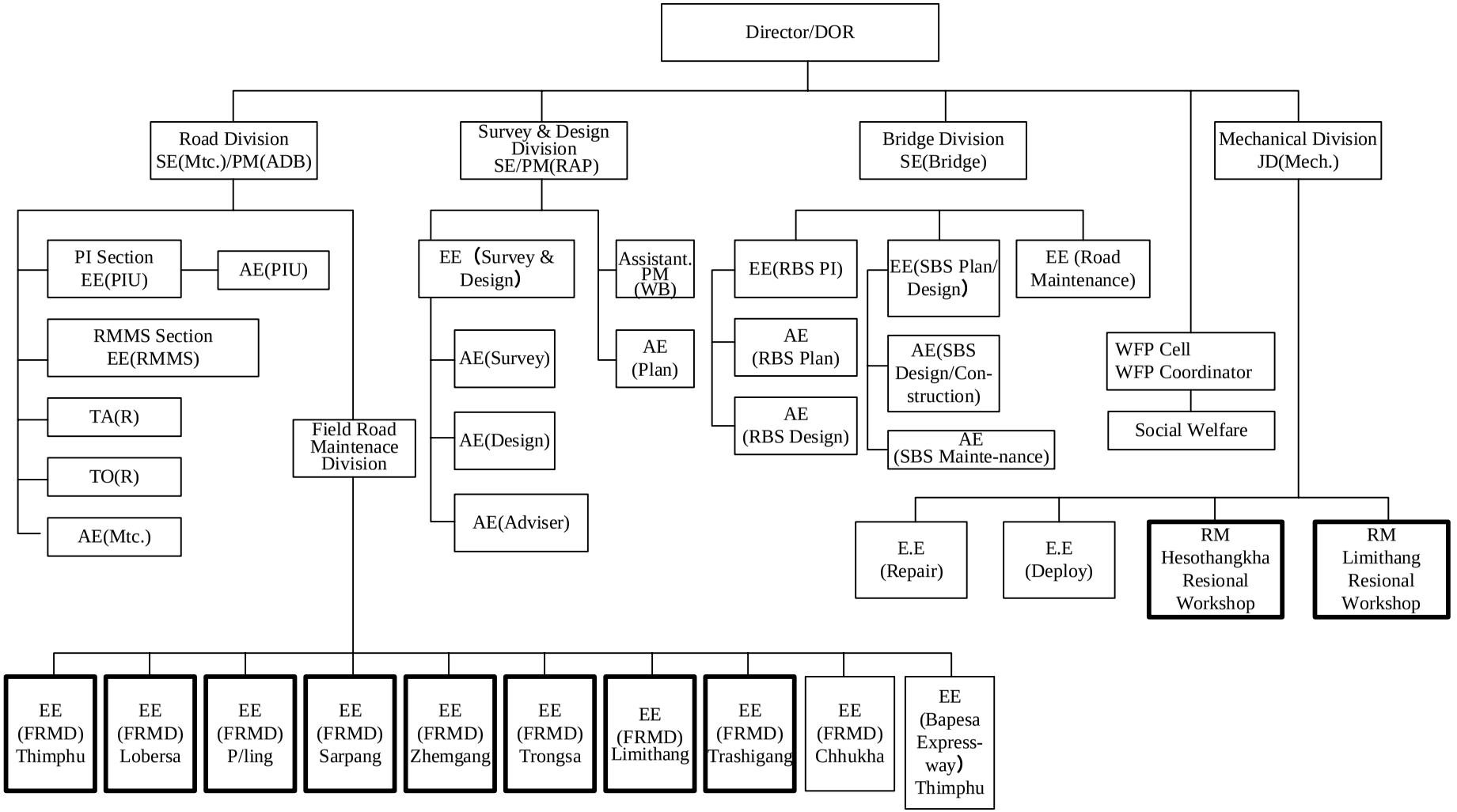
Source：Ninth Five Year Plan, Main Document(2002~07), Planning Commission

(4) Activities

Road development project under the jurisdiction of Hesothangkha and Limithang regional workshops in the Ninth Five Year Plan is shown in Table 2-2.

2-1-3 Target Project

Road development project such as a periodic maintenance, daily maintenance and disaster recovery and prevention work, which are indispensable for the society and the economic activities in daily life, is performed chiefly by using Bhutan's budget, though the projects mainly implemented by the fund of World Bank (WB), Asian Development Bank (ADB) and the donor countries and uncertain projects are occupied in the new road construction plan. Therefore, construction equipment procurement is targeted for the daily and periodic road maintenance, and road disaster recovery and prevention project. Table 2-3 shows the construction equipment needed to carry out the projects.



（Note） PM : Project Manager, SE : Superintendent Engineer(Director), EE : Executive Engineer(Section Chief or Office Head), AE : Assistant ,Engineer(Sub Section Chief), TA(R) : Tecnical Adviser(Road), TO(R) : Technical Officer(Road), RM : Regional Manager, FRMD : Feild Road Maintenance Division, RAP : Rural Access Project, WB : World Bank, ADB : Asian Development Bank, WFP : World Food Program, RMMS : Road Maintenance Monitoring System, PI : Project Implementation, PIU : Project Implementation Unit, RBS : Road Bridge Section, SBS : Suspention Bridge Section, Mtc. : Maintenance,

Legend ： □ Field Road Maintenance Division and Regional Workshop to be Target of Equipment Deployment

Figure 2-1 Organization Chart of Department of Roads (DOR)

Table 2-2 Road Development Project on the Ninth Five Year Plan in Bhutan (1/3) - within the jurisdiction of Hesothangkha Regional Workshop -

Development Type	Outline of Road and Bridge Development Project				Development Schedule				
	Name of Project	Quantity	Development Content	Fund Source	2002-03	2003-04	2004-05	2005-06	2006-07
New Road (NH& NHBypass)	1. Nagar-Ura Bypass	32	-	Undecided		10km	10km	10km	2km
	2. Tashichhodzong-Babesa Expressway	6.2	Carriageway width : 4lane (12.5m), Asphalt concrete (Thickness:10cm)	RGoB	on-going, completed until 2005 year				
	3. Wangdue-Khotokha Road	32	Carriageway width : 1lane (3.5m), Asphalt premix Pavemen (Thickness2.5~5cm)	Request to GoI		10km	10km	10km	2km
	4. Damchu-Chukha Road	25	-	Undecided			10km	10km	5km
	5. Gomphu-Pangbang Road	45				10km	15km	15km	5km
	Total	**140.2 km**							
New Road (Feeder Road& Bypass)	1. Pelela-Tashidingkha Road	8	-	Undecided		5km	3km		
	2. Samtegang feeder Road	7.6		Undecided	7.6km				
	3. Tashithang-Damji Road	8		Undecided	8km				
	4. Yangto-Yangthang Goenpa Road	2		Undecided			2km		
	5. Dakpai-Buli Road	12	Carriageway width : 1lane(3.1~3.4m), Crushed stone Pavement (Thickness : less than 30cm)	WB	on-going, completed until 2004year				
	Total	**37.6 km**							
Improvement (Widening)	NH No.1	100	-	Undecided	5km	20km	30km	30km	15km
	Total	**100 km**							
Road Pavement	1. Bumthang Dzongkhang	96	Carriageway width : 1lane(3.5m), Asphalt Premix Pav. (thickness : 2.5~5cm). Resurfacing for the section 308km in the National Highway No.1 is done by ADB fund from year 2002 until year 2005. Carriageway width : 1lane(3.5m),Asphalt Premix coat (thickness : 2.5~5cm) (included NH and district road)	RGoB & ADB	2km	25km	25km	25km	19km
	2. Thimphu Dzongkhang	80		RGoB & ADB	11.6km	20km	20km	20km	8.4km
	3. Trongsa Dzongkhang	155.7		RGoB & ADB	6.5km	50km	40km	35km	24.2km
	4. Wangdue Dzongkhang	91.5		RGoB & ADB	3km	30km	30km	20km	8.5km
	5. Chukha Dzongkhang	42		RGoB	1.5km	10km	15km	10km	5.5km
	6. Dagana Dzongkhang	55		RGoB		10km	15km	20km	10km
	7. Gasa Dzongkhang	1.5		RGoB		1km	0.5km		
	8. Paro Dzongkhang	7		RGoB		5km	2km		
	9. Punakha Dzongkhang	33		RGoB	5km	10km	10km	8km	
	10. Samtse Dzongkhang	58.8		RGoB	5km	10km	20km	15km	9km
	11. Sarpang Dzongkhang	77		RGoB	11km	10km	20km	20km	16km
	12. Tsirang Dzongkhang	55.5		RGoB	26.5km	10km	10km	10km	
	13. Zhemgang Dzongkhang	71		RGoB	5km	20km	20km	20km	6km
	Total	**824.0 km**							

Source : MOWHS,DOR Oct. 2003

Table 2-2 Road Development Project on the Ninth Five Year Plan in Bhutan (2/3) - within the jurisdiction of Hesothangkha Regional Workshop -

Development Type	Outline for Road/Bridge Development Project				Development Schedule				
	Name of Project	Quantity	Development Content	Fund Source	2002-03	2003-04	2004-05	2005-06	2006-07
Maintenane	Daily Maintenance (Clearing snow & prevention work against road surface freeze)		Counter measure work such as clearing snow and salt spraying against snow and freezing on the road surface at the Doch-La, Pele-la, Yotong-la pass.		Every winter season (December~February)				
	Dochula/Pelela Pass &Yotongla/Sheytangla Pass	4		RGoB					
	Total	**4 place**		RGoB					
	Daily maintenance (ordinary)	1,563	Clearing of road, side ditch and culvert, repair of road facilities, patching, road marking, counter measure against small-scale slope failure.	RGoB	done as daily work every year				
	Total	**1,563 km**							
Bridge Construction	1. Sunkosh zam Bridge	1	Bridge length：90m, width：5.5m,superstructure：Langer	Request to GoJ		40%	60%		
	2. Wakleytar Bridge	1	Bridge length：75m, width：5.5m, superstructure：Langer	Request to GoJ					
	3. Chamkhar Bridge	1	Bridge length：45m, width：7.5m, superstructure：Pony truss	GoJ	completed				
	4. Bjee Bridge	1	Bridge length：50m, width：5.5m, superstructure：Pony truss	GoJ	completed				
	5. Mangdechu Bridge	1	Bridge length：120m, width：5.5m, superstructure：Langer	GoJ	completed				
	6. Wachey Bridge	1	Bridge length：33m, width：5.5m, superstructure：Pony truss	GoJ	completed				
	7. Panjurmani Bridge	1	-	Undecided		40%	60%		
	8. Langthel zam Bridge	1	-	Undecided		40%	60%		
	9. Tshorimo zam Bridge	1	-	Undecided	100%				
	10.Rableythang zam Bridge	1	-	Undecided	100%				
	Total	**10 bridge**							
Bridge Maintenance	Bridge under Hesothangkha workshop **Total**	**110 bridge**	Clearing and repair of drainage, partially restoration for bridge itself and painting and pavement	RGoB	Daily and periodic maintenance for every year.				
Disaster Prevention Work	Gelephu-Trongsa Highway		Counter measure against disaster such as a slope failure, landslide, settlement - Removal of debris and falling stone - Restoration of road, pavement and retaining wall, etc - Realignment of the existing road		Emergency work is conducted after a monsoon every year				
	1. Shercamp	1		RGoB					
	2. Rewtala	1		RGoB					
	3. Panjurmani	1		RGoB					
	4. Batasey (km49)	1		RGoB					
	5. Raffe (km204)	1		RGoB					
	6. Baling (km173)	1		RGoB					
	Wangdi-Tsirang Highway: Tintalay slide	1		RGoB					
	Sunkosh-Dagana RoadKhagochen slide	1		RGoB					
	Total	**8 place**							

Table 2-2 Road Development Project on the Ninth Five Year Plan in Bhutan (3/3) - within the jurisdiction of Limithang Regional Workshop -

Development Type	Outline for Road/Bridge Development Project				Development Schedule				
	Name of Project	Quantity	Development Content	Fund Source	2002-03	2003-04	2004-05	2005-06	2006-07
New road (Feeder Road and Bypass)	1. Yadi-Shershong Road	7	-	Undecided		7km			
	2. Gyalposhing-Nganglam Road	25	Width：1 lane(3.1~3.4m), Crushed pavement (Thickness：less than 30cm)	GoI		5m	10km	10km	
	3. Chompa-Themnangbi Road	6	-	Undecided	km(BC)				
	4. Lhuntse-Dungkhar Road	21	Width：1 lane(3.1~3.4m),Crushed pavement (Thickness：less than 30cm)	WB	Ongoing at present, completed until 2004 year				
	5. Mukuzor-Tshogonpa Road	5		WB	Ongoing at present, completed until 2004 year				
	6. Thrimshing-Tsangpo School Road	3		WB	Ongoing at present, completed until 2004 year				
	7. Pangthang-Yechen BHU Road	2		WB	Ongoing at present, completed until 2004 year				
	8. Bartsam-Ramjar Road	7.4		WB	Ongoing at present, completed until 2004 year				
	9. Gom Kora-Tomzhangtsen Road	6		WB	Ongoing at present, completed until 2004 year				
	10. Bartsam-Bidung Road	10		WB	Ongoing at present, completed until 2004 year				
	Total	**92.4 km**							
Road Pavement	Mongar Dzongkhang	75	Re-pavement using pre-mix coat work is on going funded by ADB L=308 km (2002~2005year) Width： 3.5m 1 lane, pavement thickness: 2.5~5cm (including NH and the feeder road)	RGob&ADB	5.6km	25km	20km	15km	9.4km
	Trashigang Dzongkhang	28				10km	10km	8km	
	Lhuntse Dzongkhang	16			10km	5.9km			
	Pema Gatshel Dzongkhang	26			8km	10km	8km		
	S/Jongkhar Dzongkhang	5		RGoB	5km				
	Tashi Yangtse Dzongkhang	26			3.3km	10km	10km	2.7km	
	Total	**176.0 km**							
Road Maintenance	Periodic maintenace (Removal snow)		Counter measure work such as clearing snow and salt spraying against snow and freezing on the road surface at the Thrumseng pass.		Every winter season (December~February)				
	NH No.1 Wangthong pass	1		RGoB					
	Thumshingla pass	1		RGoB					
	Total	**2 place**							
	Periodic maintenance (ordinary)	565km	Clearing of road, side ditch and culvert, repair of road facilities, patching, road marking, counter measure against small-scale slope failure.	RGoB	done as daily work every year				
	Total	**565 km**							
Bridge Construction	Tangmachu Zam Bridge	1	Bridge length：90m, width：5.5m, superstructure：Langer	Request toGoJ			40%	60%	
	Kurichu Bridge	1	Bridge length：50m, width：5.5m, superstructure：Pony truss	JICA	completed				
	Rangjung zam Bridge	1	-	Undecided		40%	60%		
	Jabrakhey zam Bridge	1	-	Undecided	40%	60%			
	Johori zam Bridge	1	-	Undecided	40%	60%			
	Total	**5 place**							
Bridge Maintenance	Lhuntse/Mongar Dzongkhang	19	Clearing and repair of drainage, partially restoration for bridge itself and painting and pavement	RGoB	Daily and periodic maintenance for every year.				
	S/Jongkhar/ Tashi Yangts	18		RGoB					
	Total	**37 place**							
Disaster Prevention Work	NH No.1		Counter measure against disaster such as a slope failure, landslide, Settlement.		Emergency work is conducted after a monsoon every year				
	Namling /Latongla	1		RGoB					
	Mongar-Lhuntse: Rotpashong	1	- Removal of debris and falling stone	RGoB					
	Total	**4 place**	- Restoration of road, pavement and retaining wall, etc						

Table 2-3 Construction Equipment needed for the Ninth Five Year Road Development Plan

Type of Road Development		Development Content	Construction Equipment needed	Quantity of Project	
				Hesothangkha Regional Workshop (to support 6 FRMD)	Limithang Regional Workshop (to support 2 FRMD)
New Road	NH and Bypass	Earth work & pavement work using pre-mix coat	- Excavator, Grader, Road roller, Asphalt distributor, Chip spreader, Asphalt kettle, Loader, Compressor, Dump truck, Asphalt plant	6.2 km	-
	Feeder and Bypass	Earth work & pavement work using crushed stone	- Excavator, Grader, Road roller, Loader, Compressor, Dump truck	-	-
Rehabilitation	Re-pavement	Restoration work of pavement	- Road cutter, Asphalt distributor-, Chip spreader, Asphalt kettle, Hand guide roller, Vibrator plate compactor, Asphalt plant	830 km	180 km
	Widening and Structure	Cutting work & pavement work Installation of retaining wall and culvert	- Excavator, Dump truck, Road roller, Loader Grader, - Cement concrete mixer, Truck with crane - Asphalt distributor, Chip spreader, Asphalt kettle, Hand guide roller, Vibrator plate compactor, Asphalt plant	100 km	-
Daily Maintenance	Road	Clearing of road, drainage and slope Patching	- Asphalt distributor, Chip spreader, Asphalt kettle, Hand guide roller, Vibrator plate compactor, Asphalt plant	1,600 km	620 km
		Removal of snow	- Loader, Grader, Dump truck	4 places (＝20 km)	2 places (＝20 km)
	Bridge	Restoration of drainage, painting, partial restoration of bridge	- Cement concrete mixer - Asphalt distributor, Chip spreader, Asphalt kettle, Hand guide roller, Vibrator plate compactor	110 Bridge	37 Bridge
Bridge Construction		- Concrete & excavation work for foundation - Installation of approach road	- Excavator, Dump truck, Cement concrete mixer, Truck with crane - Excavator, Road roller	4 Bridge	3 Bridge
Disaster Prevention Work	Landslide、slope failure, settlement	- Removal of debris - Restoration of road, drainage and concrete structure	- Excavator, Loader, Dump truck, Compressor, - Grader - Chip spreader, Asphalt kettle, Asphalt distributor, Hand guide roller, Vibrator roller, - Truck with crane, small-size excavator	8 places(=40 km)	4 places(=20 km)

(Remark) (1) The 308km section in the re-pavement section (830+180km) is on-going
(2) The project planned by donors and international organ is excluded from the above table

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

(1) Maintenance Management Ability of DOR

The system concerning the management and operation of the road construction and maintenance equipment is formulated by the Mechanical Division of DOR, which controls the branch offices (the regional workshops, field workshops and stores) established for maintaining road equipment at the field level. Consequently the Mechanical Division has not much obstacle in the current system at present and also it is judged that sufficient ability to perform this task is provided in the current system. Accordingly, the current system will be recommendable effectively to operate the equipment to be newly procured through the project.

(2) Natural Condition

For the determination of the type of a construction and maintenance equipment and its specification, natural conditions to be considered are indicated as follows;

a) Atmospheric temperature varies from –10°C to +35°C, so that particular consideration for specification is likely not required,
b) Altitude is at maximum 4,000 meters above sea level, thus heavy-duty construction equipment such as hydraulic excavator, wheel loader, motor grader are to be equipped with a device like turbocharger.

(3) Environment Aspects

Considering the basic aspects of the natural environment of Bhutan, the following points are reflected in the determination of the type of construction equipment and its specification.

a) Fuel in Bhutan contains higher sulfur; therefore, double fuel filtration or other device for such fuel is desirable for heavy-duty construction equipment,
b) Maintenance and rehabilitation of road is to be undertaken in coordination with a fleet such as hydraulic excavator, wheel loader, backhoe loader, dump truck, etc. The objective of introducing such a fleet is not to drop surplus soil and stone excavated toward valley side so as to reserve the environment at the site.
c) Mobile asphalt mixer is fitted with wet type dust collector. Wet type dust collector prevents exhaust of a lot of dust and sulfur dioxide in the atmosphere.
d) Sewage treatment plant such as oil water separator is set up to treat a sewage is the regional workshop.

Table 2-4 Environment Guideline for Construction Equipment

Item	Environment Load	Mitigation Measure	Administrator
Removal of surplus soil	・ Damage of facilities & flora ・ Interception of water ・ Slope sliding	・ Transport to spoil bank using Equipment (excavator, loader , dump truck, etc) ・ Balance between cutting and banking	PIU DOR
Heating of asphalt bitumen using firewood	・ Contamination of water and soil ・ Deforestation	・ Control of firewood ・ Use bitumen heating kettle	PIU DOR
Slope stability	・ Slope failure ・ Destruction of forest ・ Influence to people	・ Removal of debris using loader ・ Use low vibration equipment ・ Slope protection by vegetation	DOR
Management of quarry site	・ Water pollution、noise	・ Selection of site ・ Control of operation time	PIU DOR
Air pollution and noise	・ Health obstacle ・ Influence to livestock	・ Control of blasting ・ Control in the high density population area	DOR
Blasting	・ Noise	・ Prohibition in natural reservation area ・ Control using static method	DOR

Source：Environmental Codes of Practice (ECP), DOR,2000

(4) Policy for Construction Condition

As there are lots of narrow roads, specification of road construction equipment for the construction condition is to be considered taking into account of the existing road condition and its countermeasures in Bhutan, which is as follows:

- Trafficability of a large-scale vehicle,
- Damage reduction on the existing pavement,
- Reduction of the traffic disturbance to other traffic,
- Electricity is single phase: 220V 50Hz and 3-phase: 380V 50Hz.,
- Steering wheel of vehicle is right hand

Restoration works such as overlay, sealing, patching, and rebuilding etc. has high priority and is carried out at large scale in Bhutan. Therefore, the scale of the construction equipment to be used is assumed to be small and portable.

(5) Policy for Spare Parts

Spare parts are prepared for the periodic replacement of parts and for the irregular consumption that is necessary for operating of the each equipment for the period of two-years. Operating time and distance for two years of the each construction equipment are indicated in Table 2-5 as follows:

Table 2-5 Operation Hour and Distance for 2 Years of Each Equipment

No	Construction Equipment	Operation Hour and Distance (H or Km)
1	Generator	2,000 H
2	Air Compressor	1,750 H
3	Backhoe Loader	1,750 H
6	Motor Grader	1,000 H
7	Wheel Loader	1,750 H
8	Dump Truck	2,000 H
9	Vibration Roller	1,000 H
11	Hand Guide Roller	1,000 H
12	Vibration Plate Compactor	750 H
13	Asphalt Distributor	20,000 km
14	Mobile Stone Crushing Plant	2,000 H
15	Asphalt Mobile Mixer	1,500 H
18	Cement Concrete Mixer Vehicle	35,000 km
20	Fuel Tanker	30,000 km
21	Truck with crane	30,000 km
22	Self Loading Short Body Truck	30,000 km
23	Service Truck with Crane	30,000 km
24	Single Cab Cargo Car	30,000 km

Remark: (1) Running distance: 20km/hour
(2) Periodic Maintenance ：Construction Equipment…250 hours each
：Vehicle…5,000km each

(6) Policy for Procurement

1) Procurement Equipment

Reliability, quality, price of spare parts, system of after-sales service, and the difficulty and delivery time of obtaining of the spare parts after installation of the equipment are adequately investigated and analyzed for the procurement equipment.

2) Procurement Channel

After receiving the consignment/load from the Indian customs house, and completing the procedure for the consignment/load at the Liaison and Transit Office (LTO) belonging to Ministry of Finance (MOF), Royal Government of Bhutan at the Kolkata port, the consignment/load is transported to Regional Revenue & Custom Office (RCO) of MOF at Phuentsholing in Bhutan through the Indian territory. It is possible on the above route for the trailer to ply carrying maximum volume capacity of 40 feet container, 12m in length, 3.75m in width, and 3.75m in height. After completing customs formalities at Regional Revenue & Custom Office (RCO) of MOF, the consignment/load is transported to the Hesothangkha regional workshop (the destination of transportation for the project) through the national highway No.1 and No.2. It is also possible on the above route to transport the equipment through even the trailer procured in the previous Japan's Grant Aid from Phuentsholing up to Hesothangkha regional workshop at Wangdue Phodrang, because the road and its alignment up to Hesothangkha is improved wider in width and smoothly in curve.

(7) Policy for Destination of Equipment

Hesothangkha regional workshop has been identified as a destination of the construction and maintenance equipment due to the following reasons;

- It is difficult to transport safely up to Limithang during winter season, because of snowfall and freezing on the road from December to February,
- For the inspection and assembling of the construction and maintenance equipment, and On-the-job Training (OJT) for the initial operation and the maintenance and operation guidance, Hesothangkha regional workshop will be reasonable with having adequate equipment/tool, facilities and space for such purposes and personnel concerned.

(8) Policy for Completion Period

This plan is implemented as an affair in 2003 fiscal year, and the construction and maintenance equipment is to be handed over probably at the end of February 2005.

(9) Policy for Technical Assistance

Technical assistance for the counterpart of Bhutan side will be extended especially to the mechanics and operators through the supplier's job during the equipment inspection/examination at Hesothangkha regional workshop, the trial run of the equipment, the assembly and installation of the equipment and the driving practice (practice of the driving operation and the servicing for about two weeks). After procurement of the construction and maintenance equipment, the counterpart will be enable to take OJT of technology education training by JICA senior overseas volunteer who is assigned in Hesothangkha regional workshop or will be dispatched to Bhutan next year.

2-2-2 Basic Equipment Plan

(1) Construction Equipment Plan

The target of the project is to procure road construction and maintenance equipment needed for the periodic and daily maintenance work including re-pavement, widening and road recovery work against disaster such as a slope failure, settlement, land slide and scouring, which is indispensable for the maintenance and improvement of the society and the economic activities in daily life, and which is carried out by Bhutan's budget. The basic concept of the disposition plan of the equipment is as follows. Table 2-6 indicates the disposition plan for the each equipment,

1) Construction equipment needed for daily maintenance or urgent maintenance work is basically provided for the each field road maintenance division. In the other hand, construction equipment needed for periodic maintenance work or construction

equipment to be not used frequently is basically provided for the each regional workshop.

2) The usable construction equipment is clarified from the inventory survey result of the existing construction equipment (operating time, mileage and state of the operation) to examine equipment required. Moreover, the construction equipment that requires repair is also examined to know whether the new construction equipment is needed or not, taking account of the repair cost-effectiveness in the future.

(2) Maintenance Equipment Plan

1) Hesothangkha regional workshop

Hesothangkha regional workshop was established by the Austria government in 1998 under the control of Public Works Department (PWD), Ministry of Communication (MOWHS at present). This regional workshop provides construction equipment needed for the road development of the central, western and southern region in Bhutan to the Field Road Maintenance Divisions (Thimphu, Lobeysa, Sarpang, Zhemgang, Trongsa, Phuentsholing), and has been technically enhanced in repairing capability and function in Bhutan. Main function of the Hesothangkha regional workshop as bellows should be improved,

- Engine overhaul for construction equipment,
- Rebuilt under-carriage for bulldozer, hydraulic excavator,
- Regular overhaul such as brake system, tire repair, and shops exist for hydraulic system, electric, machine, welding, sheet metal, painting, spare parts and materials.

2) Limithang Regional Workshop

Limithang regional workshop has been constructed newly for regular maintenance, minor repair of road maintenance and construction equipments.

Limithang regional workshop has the facilities of 78,537 m^2 with 2 welding bays, 2 overhaul bays, 3 minor repair bays, 2 sheet metal and welding bays, 1 painting bay in total 10 bays, and electric, engine overhaul, tools, spare parts and battery shops. This regional workshop is located at very important position as a central workshop for the eastern part of Bhutan, however, it does not have sufficient maintenance equipment and tools. Therefore, the maintenance equipment/tool for Limithang regional workshop should be improved.

The function and role of Limithang regional workshop is the same as that of Hesothangkha regional workshop. However, since major repair such as fuel injection pump repair, engine overhaul and undercarriage rebuilding cannot are done in

Hesothangkha regional workshop at the moment.

The content to be improved in the Hesothangkha and Limithang regional workshop and the branch office under the regional workshops is shown in Table 2-7. In addition, the disposition plan of the each maintenance equipment is shown in Table 2-8 and Table 2-9.

2-2-3 Basic Design Drawing

Figure 2-2 shows the layout plan of maintenance equipment/tools for the Limithang regional workshop, which has been built recently.

Table 2-6 Construction Equipment Plan (1/5)

No	Name of Equipment	Outline of specification	No. of Unit	Plan for Requested Construction Equipment						
				Purpose to be used	Use Condition			Disposition Plan		
						Hesothangkha	Limithang	Necessity and Reason	Hesothangkha	Limithang
1	Generator	55KVA	2 units	It is used for the power failure of the workshop.	G	4	3	In DOR, there are seven dynamos to be able to operate. It is provided for each branch office (Hesothangkha (2 units: 1992, 2 units: 2002), Limithang (3 units: 1992)) by local and ADB fund. Neither Hesothangkha nor Limithang workshop are owned. Each one is provided for Hesothangkha and Limithang Regional workshops.	1 unit	1 unit
					FG	0	0			
					W	0	0			
					S	0	0			
					Total	4	3			
2-1	Excavator	140~150HP (20ton) with bucket for bedrock	8 units	It is used for the earthwork on the road rehabilitation, road repair at urgent disaster, and foundation of bridge, etc. Medium equipment with the bucket for the rock is provided because there are a lot of hard rocks in the site.	G	4	0	Each one is needed for all FRMD. Each one is provided in FRMD that doesn't have it because four unit are in operation now (2 units: in Hesothangkha, 2 units : in Limithang)	2 units	2 units
					FG	0	0			
					W	0	0			
					S	1	0			
					Total	5	0			
2-2	Excavator	80~95HP (12ton) with bucket for bedrock	4 units	It is used for the earthwork on the road rehabilitation in narrow work area. Small equipment with the bucket using the rock is selected because there are a lot of hard rocks in the site.	G	4	0	Each one is needed for each FRMD. Each one is provided in FRMD that doesn't have it because four unit are in operation now (2 units: in Hesothangkha, 2 units : in Limithang)	2 units	2 units
					FG	0	1			
					W	0	0			
					S	1	0			
					Total	5	1			
3	Back Hoe Loader	90~100HP	2 units	It is used for the earthwork (cutting, loading and transport) on the road rehabilitation such as widening, pavement/side ditch/ retaining wall repair. Medium machine is suitable for quarrying and loading is selected.	G	1	0	Each one is needed for both regional workshops. One unit is arranged in Limithang workshop because one unit is operating now.	0 unit	1 unit
					FG	0	0			
					W	0	0			
					S	0	1			
					Total	1	2			
4	Breaker with engine	25kg	10 units	It is used for the crushing work of the rock in the site where air compressor cannot be used,	G	0	0	This is not provided, because the breaker with the air compressor is usually used in the road maintenance work of the existing road.	0 unit	0 unit
					FG	0	0			
					W	0	0			
					S	0	0			
					Total	0	0			
5	Breaker attachment for Excavator	(Hydraulic excavator) 140~150HP	2 units	The breaker attached in the hydraulic excavator is used for hard rock crushing	G	0	0	Each one is provided in each regional workshop.	1 unit	1 unit
					FG	0	0			
					W	0	0			
					S	0	0			
					Total	0	0			

Legend G: Good FG: Fairy Good W: Worse S: Scrap

Table 2-6 Construction Equipment Plan (2/5)

No	Name of Equipment	Outline of specification	No. of Unit	Plan for Requested Construction Equipment						
				Purpose to be used	Use Condition			Disposition Plan		
						Hesothangkha	Limithang	Necessity and Reason	Hesothangkha	Limithang
6	Motor Grader	130~140HP	2 units	It is used for spreading and leveling of the base course and subgrade material on the road surface, and for snowplow in the pass. Equipment is suitable 130-140HP considering the existing narrow road situation.	G	0	0	Each one is needed for the each regional workshop. Each one (2 in total) is provided for both regional workshops.	1 unit	1 unit
					FG	0	0			
					W	2	1			
					S	1	0			
					Total	3	1			
7	Wheel Loader	125~135HP	8 units	It is used for loading and transport of soil and gravel. Medium equipment is selected	G	6	0	Each one is needed for the each FRMD. Six units are provided in FRMD because two units are in operation at present (Four units are in operation for 10,000 hours or more).	4 units	2 units
					FG	0	2			
					W	10	2			
					S	0	2			
					Total	16	6			
8	Dump Truck	8~10ton (Capacity load) 4×2	16 units	It is used for transport embankment material, construction material and surplus soil transportation. Equipment is suitable for the hydraulic excavator and the wheel loader is selected.	G	7	1	Each two are used for the each FRMD (sixteen dump tracks are usually needed for the eight hydraulic excavators). Considering the eight dump trucks for which it is possible to operate among 13 dump tracks and 20 tippers exist in DOR, it is provided for Hesothangkha: 5 units and Limithang: 3 units.	5 units	3 units
					FG	0	1			
					W	15	3			
					S	0	6			
					Total	22	11			
9	Vibrator Road Roller	6.5~8ton Tandem roller The back and forth circle drive	2 units	It is used for vibration rolling on the pavement and banking of the behind of the wall Medium type, and articulates, and back and forth circle drive type is selected considering the existing narrow road situation.	G	4	0	Each one is needed for both regional workshops. One unit is provided in Limithang regional workshop because four units is in operation in Hesothangkha regional workshop at present.	0 unit	1 unit
					FG	3	0			
					W	6	1			
					S	0	0			
					Total	13	1			
10	Tire Roller	6.5~8 ton	2 units	It is used for securing uniform rolling and compaction on the asphalt concrete pavement.	G	2	0	It is excluded as there are two tire rollers in DOR used only 6-7hr for operating hour.	0 unit	0 unit
					FG	0	0			
					W	0	0			
					S	0	0			
					Total	2	0			

Legend: G: Good FG: Fairy Good W: Worse S: Scrap

Table 2-6 Construction Equipment Plan (3/5)

No	Name of Equipment	Outline of specification	No. of Unit	Plan for Requested Construction Equipment						
				Purpose to be used	Use Condition			Disposition Plan		
						Hesothangkha	Limithang	Necessity and Reason	Hesothangkha	Limithang
11	Hand Guide Roller	0.5~1ton	8 units	On the asphalt pavement repair work, it used for a small-scale restoration work. Small type equipment is selected considering narrow road situation.	G	0	0	One unit one is provided for each FRMD.	6 units	2 units
					FG	0	0			
					W	0	0			
					S	0	0			
					Total	0	0			
12	Vibrator Plate Compacter	2.5~5HP 60~80kg	8 units	It is used for the vibration compaction on the pavement work in a narrow place and small-scale construction.	G	2	0	One unit is needed for the each FRMD. It is provided for FRMD that doesn't have plate compacter considering two units that are in operation at present.	4 units	2 units
					FG	0	0			
					W	0	0			
					S	0	0			
					Total	2	0			
13	Asphalt Distributor	3,000 Lit	2 units	It is used for spraying high temperature bitumen material (asphalt emulsion and tar) especially for surface dressing by SBST (DBST)). Medium type equipment is selected considering narrow road condition.	G	1	0	One unit is needed for the each workshop. One unit is provided for Limithang regional workshop because one unit in Hesothangkha regional workshop is in operation at present.	0 unit	1 unit
					FG	0	0			
					W	0	0			
					S	1	0			
					Total	2	0			
14	Mobile Crushing Plant	20~30ton/hr	2 units	It is used to insure crushed stone for various grain degrees for pavement and concrete structure.	G	0	1	One unit is needed for the each workshop. One is provided for Hesothangkha regional workshop because one unit in Limithang regional workshop is in operation at present.	1 unit	0 unit
					FG	0	0			
					W	0	1			
					S	0	0			
					Total	0	2			
15	Mobile Asphalt Mixer	8~10ton/hr	2 units	Heating asphalt mixture for the asphalt concrete is produced.	G	0	0	One unit is provided for the asphalt concrete work done and planned in Thimphu city (30km) and Babesa expressway (6.2km), especially for asphalt concrete pavement in urban area.	1 unit	0 unit
					FG	0	0			
					W	1	0			
					S	2	0			
					Total	3	0			

Legend: G: Good FG: Fairy Good W: Worse S: Scrap

Table 2-6 Construction Equipment Plan (4/5)

No	Name of Equipment	Outline of specification	No. of Unit	Plan for Requested Construction Equipment						
				Purpose to be used	Use Condition			Disposition Plan		
						Hesothangkha	Limithang	Necessity and Reason	Hesothangkha	Limithang
16	Asphalt Finisher	2.5~4.5m Crawler type	2 units	It is used for spreading and compaction with designated width and thickness of asphalt mixture. Small type equipment is selected considering narrow road width.	G	1	0	It is not provided because there is one asphalt finisher is in operation in DOR at present (provided at 2nd Japan grand aid). Recently, though it is used for overlay work of asphalt concrete pavement in Thimphu, operating time is only 690 hours.	0 unit	0 unit
					FG	0	0			
					W	0	0			
					S	0	0			
					Total	1	0			
17	Mechanical Chip Spreader	8 ton (Capacity load) φ12mm	2 units	It is used for scattering crush stone and sand on the surface dressing by SBST. Equipment to scatter sand and crushed stone is installed at the back of the dump truck.	G	0	0	DOR remodels a back of a usual truck to scatter crushed stone and sand for surface dressing of seal coat. New disposition is not thought.	0 unit	0 unit
					FG	0	0			
					W	0	0			
					S	0	0			
					Total	0	0			
18	Cement Concrete Mixer Vehicle	4 m^3	2 units	It is used for making cement concrete for concrete structure such as retaining wall and culvert. Mobile type equipment is selected.	G	0	1	Each one is needed for the each regional workshop. One unit is provided in Hesothangkha regional workshop because one unit is in operation in Limithang regional workshop at present.	1 unit	0 unit
					FG	0	0			
					W	1	1			
					S	0	0			
					Total	1	2			
19	Rough Terrain Crain	25 ton	1 unit	It is used for lifting up construction material, and supporting maintenance work in regional workshop. Equipment for 25ton or less is preferable.	G	0	0	It is excluded because there is a possibility to be able to repair one rough terrain crane is not in operation in phuentsholing in DOR (the 1st Japan grand aid, and operating time is only 188hr until now).	0 unit	0 unit
					FG	1	0			
					W	0	0			
					S	0	0			
					Total	1	0			
20	Fuel Tanker	6,000 Lit	2 units	The fuel is replenished with the equipment that is the operation on the construction site. Medium type equipment is selected considering narrow road condition.	G	0	0	Each one is needed and provided for each regional workshop. Regional workshops don't have usable fuel tanker.	1 unit	1 unit
					FG	0	0			
					W	1	2			
					S	0	0			
					Total	1	2			
21	Truck with Mounted Crane	4×2 8ton Crane：3.2ton	2 units	It is used for transporting small construction equipment, construction material, and repaired equipment parts, etc to the site. 4×2 equipment is selected considering narrow road condition.	G	2	0	Each one is needed for the each regional workshop. One unit is provided for Limithang workshop cause trouble in operation.	0 unit	1 unit
					FG	0	1			
					W	0	0			
					S	1	0			
					Total	3	1			

Legend: G: Good FG: Fairy Good W: Worse S: Scrap

Table 2-6 Construction Equipment Plan (5/5)

No	Name of Equipment	Outline of specification	No. of Unit	Plan for Requested Construction Equipment						
				Purpose to be used	Use Condition			Disposition Plan		
						Hesothangkha	Limithang	Necessity and Reason	Hesothangkha	Limithang
22	Self Loading Short Body Truck	6×4 more than 15ton	1 unit	It is used to transport construction equipment to the site. 6×4 truck trailer is selected considering narrow road condition.	G	1	0	Each one is needed for the each regional workshop. One is provided in Limithang regional workshop because one unit granted by the first Japan grant aid is in operation at present.	0 unit	1 unit
					FG	0	0			
					W	0	0			
					S	0	0			
					Total	0	0			
23	Service car (Cab type)	4×2 4ton Crane：2.9ton	4 units	It is used for transporting to the exchange and repair plant of the repair and the trouble part of the construction equipment on the construction site (as mobile workshop). Small type equipment is selected.	G	0	0	Each one unit is needed and provided for the each regional workshop.	1 unit	1 unit
					FG	0	0			
					W	2	0			
					S	0	1			
					Total	2	1			
24	Single Cab Cargo Car	4×4 Single cab	8 units	It is used for supervising and inspecting the site, for reporting to the workshop and the DOR headquarters, and for transport service for machine parts. 4×4 singles cab is selected considering disaster scenes of the landslide and the road subsidence, etc.	G	0	0	Each one unit is needed for the each FRMD to manage or supervise in the site or to report to the regional workshop or DOR headquarters, and for transport service for equipment.	6 units	2 units
					FG	4	3			
					W	1	0			
					S	0	0			
					Total	5	3			
25	Bridge Inspection Vehicle	The arm length：6~8m	1 unit	It is used for periodic and emergency inspection of superstructure of bridge.	G	0	0	It is difficult to inspect effectively the superstructure using such kind of vehicle from the point of the terrain condition in the river.	0 unit	0 unit
					FG	0	0			
					W	0	0			
					S	0	0			
					Total	0	0			
26	Maintenance Equipment for Workshop		Lump sum	Maintenance equipment is provided for Both regional workshops to maintain construction equipment with durability.	**Hesothangkha regional workshop**: Machine shop is excluded from the reason of (1) Use frequency is few, (2) There is no space to install, (3) Existing machine shop is in operation now. **Limithang regional workshop:** (1) Over head crane is changed for the gantry crane and fork lift, (2) Machine shop needed for rebuilding of engine and undercarriage is excluded because big-repair is done in Hesothangkha regional workshop.				lump sum	lump sum
27	Spare parts for the above equipment	2,000hr (Operation corresponding)	Lump sum	It is provided to maintain construction equipment efficiently and economically	Regular maintenance and irregular expendable spare parts needed for two years operation.				lump sum	lump sum

Legend: G: Good FG: Fairy Good W: Worse S: Scrap

Table 2-7 Function and Work for Each Workshop

Name of Workshop			Use Equipment	Function	Development Content
Central , Western and Southern	Regional Workshop	Hesothangkha	1. Machine shop (1) Lathe machine (2) Brake drum machine (3) Surface grinding machine (4) Milling machine (Universal type) (5) Boring machine (6) Radial ball machine, etc. 2. Welding and Panel works (1) Arc welding machine (2) Engine welder (3) Gas cutting equipment 3. Tools	1. Engine overhaul 2. Overhaul under-carriage 3. Rebuilt under-carriage 4. Repair hydraulic system 5. Supporting for field maintenance shop	1. Engine overhaul tools excepted for engine rebuilt machine 2. Special tools for assembly of under-carriage 3. Equipment/tool for electric equipment and tire repair 4. Mobile workshop (Service truck with crane) 5. Waste oil separator 6. General/measuring tool 7. Washing equipment
	Field Workshop	1. Thimphu 2. Trangsa 3. Phuentsholing 4. Lobeysa 5. Sarpang 6. Mangdechu 7. Gelephu	1. Welding machine 2. Battery charger 3. Air compressor 4. Tire repair tools, parts, 5. Fuel lubrication shop 6. Mobile workshop	1. Minor repair a. Welding for cracks b. Repair pinches c. Battery charger d. Greasing and supply of fuel 2. Daily, regular inspection 3. Regular inspection	1. Hand tools, grease pump 2. Waste oil to Hesothangkha regional work shop
Eastern	Regional Workshop	Limithang	1. Welding, panel works machine (1) Arc welding (2) Body repair tools set (3) Air compressor 2. Repair tools set (Lack of tools)	1. Pin and bushing is producted in Hesothangkha regional workshop (after completaion, it is returned to Limithang) 2. Supporting for field maintenance shop	1. Hangings equipment, replaced from overhead crane to portable gantry crane with forklift 2. Machine shop of high-speed abrasive cutting 3. Equipment to repair chassis and engine 4. Equipment/tool for electric equipment and tire repair 5. Mobile workshop (Service truck with crane) 6. Installation of tire shop 7. Waste oil separator 8. General/measuring tool
	Field Workshop	1. Trashigang 2. Tashgang 3. Pemagatshel	1. Lubrication and fuel storage	1. Minor repair a. Welding for cracks b. Repair pinches c. Battery charger d. Greasing and supply of fuel 2. Daily, regular inspection 3. Regular inspection	1. Hand tools set and greasing pump 2. Waste oil send Limithang regional workshop

Table 2-8 Maintenance Equipment Plan for Hesothangkha Regional Workshop (1/2)

No.	Description	Total	Disposition H	T	P	Ti	S	M	G	L	Examination of Maintenance Equipment
(1)	**MACHINE SHOP**										
1	~~Lathe machine~~ ~~Swing: 560mm~~ ~~Center distance: 3,000mm~~	~~1~~ unit									- Hesothangkha Workshop has one lathe machine, so this is excluded.
2	~~Cylinder boring machine~~ ~~Boring: diameter: 31-180mm~~ ~~Boring depth:460mm~~ ~~Table dimension: 1,200x400mm~~	~~1~~ unit									- Hesothangkha Workshop has one cylinder boring machine, so this is excluded.
3	~~Line boring machine~~ ~~- Max: length of block:1,800mm~~ ~~- Boring capacity :22-200mm~~	~~1~~ unit									- Hesothangkha Workshop has one line boring machine, so this is excluded.
4	~~Semi-automatic CO2 gas shield arc welder~~ ~~Rated welding current:200A~~ ~~Rated input:7.4kVA with gas regulator~~ ~~wire feeder and torch~~	~~1~~ unit									- Hesothangkha Workshop has one semi-automatic Co2 gas welder, so this is excluded.
(2)	**EQUIPMENT FOR CHASSIS AND ENGINE REPAIR**										
1	Portable jack Capacity: 10 ton Height: 240 - 480 mm	17 pcs.	3	2	2	2	2	2	2	2	- It is necessary for vehicles (truck and service car).
2	Portable jack Capacity: ~~50 ton~~ Height: 305 - 475 mm	8 pcs.	2	2		2			2		- It is necessary for lifting up construction machinery. - However, specification changes 50ton to 30ton because 50ton is overspec.
3	Garage jack Capacity: 20 ton Height: 190 - 610 mm	9 pcs.	4	2	1			1	1		- It is necessary for lifting up vehicles and construction machinery.
4	Drum can carrier Capacity: 300 kg with three wheels	1 pc.	1								- It is necessary for drum can cart.
5	Oil drain Capacity: 77 liter Height: 1,090 - 1,686 mm	1 unit	1								- It is necessary for waste-oil ball.
6	Air hose reel Hose: 8.0mm x 6m length	1 unit	1								- It is necessary for using air compressor.
7	Air hose, 9x10m with quick coupler	10 units	4	1		1	1	1	1	1	- It is necessary for taking off air hose easily .
8	Air compressor Max. working pressure:9.5kg/cm2 Motor: Three phase 7.5kW Receiver tank: 260 liters	1 pc.	1								- It is necessary for supplementing tire exchanger.
9	General tools Details are as per attached sheet 1	1 pc.	1								- One set is needed for mechanics.
10	Measuring tools Details are as per attached sheet 2	1 unit	1								- It is necessary for adjustment of tightening torque especially engine.
11	Diesel Fuel Injector Tester (Nozzle type)	1 unit	1								- It is necessary for nozzle test.
12	Repair and adjustable tools for Injection Pump	1 set	1								- It is necessary for pipe line between injection pump tester and injection pump.
13	~~Jet parts Washer~~ ~~Maximum Washable mass:250kg~~ ~~Motor: 3.7kW~~	~~1 unit~~									- This is excluded because it does not use frequently
14	PM tune-up kit Measuring items: 1) Hydraulic system pressure 2) Engine & transmission speed 3) Blow-by pressure 4) Time 5) Dimensions	3 sets	1	1					1		
15	~~Vibro centric valve seat grinder~~ ~~Capacity: value seat dia,28-60mm~~	~~1 set~~									- This is excluded because it does not use frequently
16	~~Hydraulic Pressure Gauge Set~~ ~~Gauge:25,60,400,600kg/cm2~~ ~~with hose and adapters set~~	~~1 set~~									- This is excluded because it does not use frequently

Table 2-8 Maintenance Equipment Plan for Hesothangkha Regional Workshop (2/2)

No.	Description	Total	Disposition								Examination of Maintenance Equipment
			H	T	P	Ti	S	M	G	L	
17	Diesel Welding Machine,450A	1 unit	1								- It is necessary for welding at job-site
18	Gas welding/cutting set Contents; 1) Oxy.& acetyl. Pressure regulator: each 1 pc. 2) Rubber hose: each 10m 3) Welding torch 4) Cutting torch 5) Welding glass	1 set	1								- It is necessary for repairing blade, bucket, etc. at job-site.
(3)	**ELECTRIC COMPONENT REPAIR AND BATTERY SERVICE**										
1	Battery charger Type: Quick and normal charger DC output: 140 A (12 - 24 V) AC input: Three phase 6.5 kVA	3 units	1	1					1		- It is necessary for charging battery of construction machinery and vehicles.
2	Electricians tool set Total 27 items of hand tools with caring case	4 sets	2	1					1		- It is necessary for inspecting and repairing of electric parts (dynamo).
3	Circuit tester Type: Digital AC A / DC A : 300μ - 10 A AC V : 3 - 75 V DC V : 300m - 1,000 V Resistance : 300 -- 30M ohm	2 pcs.	1						1		- It is necessary for inspecting electrical parts (dynamo).
4	Tire bead remover Length: 1.6 m	4 pcs.	1	1		1			1		- It is necessary for removing tire of vehicle.
5	Tire changer Applicable wheel size: 16-26 inch rim Max. wheel dia.: 1,500 mm Max. wheel width: 700 mm	3 units	1	1					1		- It is necessary for removing large size tire of construction machinery.
6	Portable Brake Booster Tester Gauge: 10, 100, 200 kg/cm2 Vacuum: 76 cmHg.	1 set	1								- It is necessary for inspection of brake system after overhauling.
(4)	**WASHING EQUIPMENT**										
1	Hot water high pressure washer Discharge volume: 900 liter/hour Discharge pressure: Max. 100 kg/cm2 Temperature: Max. 80 degree	1 unit	1								- It is necessary for washing construction machinery and vehicles.
2	Oil bucket pump with flowmeter and wheel (Portable, Lubricator) Capacity: 20 liters	8 sets	1	1	1	1	1	1	1	1	- It is necessary for supplying oil to transmission and differential equipment.
3	Side slip tester Board Dimension :850 X 500mm Effective Width, Getting -in : 730-2430mm	1 set	1								- It is necessary for inspecting steering system after overhauling.
4	Attack (Impact) driver Set	2 sets	1						1		- It is necessary for tightening small screws of construction equipment.

Note)
H: Hesothangkha Regional Workshop
Branches under Hesothangkha Regional Worksh T: Trongsa, P: Phuentsholing, Ti: Thimphu, S: Sarpang, M: Mangdechu
G: Gelephu, L: Lobeysa

Table 2-9 Maintenance Equipment Plan for Limithang Regional Workshop (1/7)

No.	Description	Total	Disposition Li	Ta	T	P	Examination of Maintenance Equipment
(1)	**EQUIPMENT FOR CHASSIS AND ENGINE REPAIR**						
1-1	~~Over Head Crane~~ ~~3 ton capacity~~ ~~with column and runway materials~~	1 unit					- This overhead crane is excluded, because it is difficult for new overhead crane to install in the existing Limithang Workshop.
(1-1)	Gantry crane	1 unit	1				- In behalf of this overhead crane, gantry crane and the forklift (3ton) is provided.
1-2	Sling chain kit Contents; 1) Sling chain: 7 different size 2) Clamp 3 kinds, 7 pcs. 3) Joint: 3 pcs. 4) Pin: 35 pcs. 5) Eyebolt: 20 pcs. 6) Shackle: 17 pcs. 7) Stand: 1 unit	1 set	1				- It is necessary for lifting up engine, transmission, etc.
2-1	Portable jack Capacity: 10 ton Height: 240 - 480 mm	2 pcs.	2				- It is necessary for lifting up vehicle and construction machinery.
2-2	Portable jack Capacity: ~~50 ton~~ Height: 305 - 475 mm	2 pcs.	2				- It is necessary for repairing construction machinery. - However, specification changes 50ton to 30ton
3-1	Garage jack Capacity: 10 ton Height: 150 - 570 mm	2 pcs.	2				- It is necessary for lifting up vehicle and construction machinery.
3-2	Garage jack Capacity: 20 ton Height: 190 - 610 mm	2 pcs.	2				- It is necessary for lifting up vehicle and construction machinery.
4	Service creeper, wood type Dimensions: 450 x 840 mm	4 pcs.	1	1	1	1	- It is necessary for checking underside of vehicle.
5	Rigid Rack Capacity: 10 ton Height: 570 - 1,000 mm	4 pcs.	4				- It is necessary for using fork lift.
6	Blocking tool Capacity: 20 ton Height: 800mm	2 pcs.	2				- It is necessary for lifting construction machinery and vehicle.
7	Drum can carrier Capacity: 300 kg with three wheels	1 pc.	1				- It is necessary for taking off undercarriage of construction equipment.
8	Oil drain Capacity: 77 liter Height: 1,090 - 1,686 mm	1 unit	1				- It is necessary for waste-oil ball.
9	Portable lubricator for oil (air driven) Delivery of lubricant:12.5 liter/min. Pressure ratio 5:1 Container capacity: 200 liters Hose: 1/2"dia. x 10 m length, with hose reel Caster: 4	1 unit	1				- It is necessary for supplying with oil or draining oil off for engine
10	Portable lubricator for grease (air driven) Delivery of lubricant: 350 g/min. Delivery pressure: 230 kg/cm2 Container capacity: 16kg pail can	1 unit	1				- It is necessary for greasing vehicle and construction machinery.
11	Air hose reel Hose: 8.0mm x 6m length	4 pcs.	4				- It is necessary for using air compressor.
12	Air hose, 9x10m with quick coupler	10 pcs.	10				- It is necessary for taking off easily.

Table 2-9 Maintenance Equipment Plan for Limithang Regional Workshop (2/7)

No.	Description	Total	Disposition				Examination of Maintenance Equipment
			Li	Ta	T	P	
13	Mobile workbench with vise Dimensions: 1,200x800x740mm No. of drawers: 2 with 4pcs. of casters and 1pc. of vice	2 sets	2				- It is necessary for repairing component of vehicle and construction machinery.
14	Workbench with vise Workbench: 900x600x740mm Vise: opening: 100mm	2 units	2				- It is necessary for repairing component of vehicle and construction machinery.
15	Parts Cleaner Tank capacity: 70 liters x 2 No. of solvent outlet: 2	1 unit	1				- It is necessary for washing important parts of diesel engine.
16	Parts shelf for medium parts Dimensions: WxDxH 955x613x1,805mm No. of shelf: 4 (included top plate) Capacity: 300kg/each shelf	4 pcs.	4				- It is necessary for keeping parts after taking engine apart.
17	Mobile Floor Crane Capacity: 1,500 - 2,000 kg Effective boom reach: 902-1283mm	1 unit	1				- It is necessary for transporting after taking off reversing engine, transmission.
18	Engine stand Service capacity: 2,000kg Rotation: manual, 360degree	1 unit	1				- It is necessary for repairing engine, for serious fault, it is sent to Hesothangkha Regional Workshop.
19	Hydraulic shop press Capacity: 100 ton Ram stroke: 250 mm Motor: Three-phase 2.2kW	1 unit	1				- It is necessary for pressing and removing bush, pin, etc.
20	Push tool set	1 set	1				- It is necessary for removing bearing, bush, etc.
21	Nozzle tester Gauge: 50MPa	1 pc.	1				- It is necessary for testing nozzle of diesel engine.
22	Nozzle cleaning kit	1 set	1				- It is necessary for cleaning nozzle before nozzle test.
23	~~Diesel Generator~~ ~~Capacity: 100 kVA~~ ~~Output Voltage: 3-phase 380V, 50 Hz~~ ~~Engine: Water-cooled diesel, 126PS~~ ~~with Electric wiring materials, distribution boxes~~	~~1 unit~~					- It is excluded, because generator mentioned here is already included in the list of construction equipment. - Specification is changed 100 KVA to 55 KVA.
24	Air compressor Max. working pressure: 9.5kg/cm2 Motor: Three phase 7.5kW Receiver tank: 260 liters	1 unit	1				- It is necessary for repairing vehicle and construction machinery.
25	Air receiver tank and piping materials Capacity: 600 liter	1 unit	1				- It is necessary for air receiver tank and piping materials, because capacity of existing air receiver is not enough after delivered tire changer.
26	DC Arc welding machine Welding current range: 10-300A Input: Three phase 16.4 kVA	1 unit	1				- It is necessary for repairing vehicle and construction machinery.
27	Welding accessories set Contents; 1) Welding cable (10m) with electrode holder:1 pc. 2) Earth cable(10m) with earth clip: 1 pc. 3) Welding shield: 1 pc. 4) Leather gloves: 1 pair 5) Double-end chipping hammer: 1 pc.	2 sets	2				- It is necessary for using welder.

Table 2-9 Maintenance Equipment Plan for Limithang Regional Workshop (3/7)

No.	Description	Total	Disposition				Examination of Maintenance Equipment
			Li	Ta	T	P	
28	Gas welding/cutting set Contents; 1) Oxy. & acetyl. Pressure regulator: each 1 pc. 2) Rubber hose: each 10m 3) Welding torch 4) Cutting torch 5) Welding glass	2 sets	2				- It is necessary for cutting blade, bucket, etc. at job-site.
29	Diesel Welding Machine, 450A	1 unit	1				- It is necessary for welding work in the workshop or at job-site.
(2)	**TOOLS FOR CHASSIS AND ENGINE REPAIR**						
1	General tools Details are as per attached sheet 1	1 set	1				- It is necessary for mechanics.
2	Measuring tools Details are as per attached sheet 2	1 set	1				- It is necessary for measuring tightened torque especially for engine.
3	Parts shelf, partition type Dimensions: WxDxH: 900x450x1800mm No. of shelf: 5 (included top plate)	2 sets	2				- It is necessary for keeping parts after disassembly of component.
4	Parts shelf, drawer type Dimensions: WxDxH: 900x450x1800mm No. of drawers Small: 42 pcs. Large: 6	1 set	1				- It is necessary for keeping small parts such as bolt, nut, pin, spring, washer, etc.
5	Workbench with vise Workbench: 900x600x740mm Vise: opening: 100mm	1 unit	1				- It is necessary for repairing construction machinery and vehicle.
6	Lubrication tools Contents; 1) Oil measure, 2, 4 liter: each 1 pc. 2) Oiler: metal, 250cc: 1 pc. 3) Funnel, 200mm dia,: 1 pc. 4) Oil filter wrench: 1 pc. 5) Grease gun, 300cc: 1 pc. 6) Micro hose for grease gun: 1 pc. 7) Drain plug wrench: 1 pc.	2 sets	2				- It is necessary for lubricating to the construction equipment.
7	Mechanic tool set Over 140 items of metric and inch size hand tools with lockable steel tool cabinet	5 sets	2	1	1	1	- It is necessary for repairing construction machinery and vehicle.
8	Tool Cabinet Dimensions: 740x400x840 mm with drawers, lockable door and casters	3 sets	3				- It is necessary for keeping tools.
9	Automotive puller set Contents; 1) Push puller: 1 set 2) 2-jaw puller: : 4 pcs. 3) Gear and pulley puller: 1 pc. 4) Flange type puller: 1 pc. 5) Steering wheel puller: 1 pc. 6) Pilot bearing puller: 1 pc. 7) Slide hammer puller: 1 pc. 8) Pitman a	1 set	1				- It is necessary for removing bearing, gear, flange, etc.
10	Mechanic puller set Contents; 1) Push puller: 1 set 2) 2-jaw puller: : 3 pcs.	1 set	1				- It is necessary for removing bearing, gear, etc.

Table 2-9 Maintenance Equipment Plan for Limithang Regional Workshop (4/7)

No.	Description	Total	Disposition				Examination of Maintenance Equipment
			Li	Ta	T	P	
11	Hydraulic puller set Contents; 1) Hydraulic pump with hose and gauge 2) 30 ton ram 3) H puller 4) 2-jaw puller 5) Bearing cup attachment	1 set	1				- It is necessary for removing bearing, gear, bush, etc.
12	Paint tools Contents; 1) Paint spray gun 2) Container, 1 liter 3) Spray mask: 10 pcs.	2 sets	2				- It is necessary for painting.
13	Air valve lapper	1 pc.	1				- It is necessary as the valve grinding stick.
14	Valve lapping compound, fine & course	5 sets	5				- It is necessary.
15	PM tune-up kit Measuring items; 1) Hydraulic system pressure 2) Engine & transmission speed 3) Blow-by pressure 4) Time 5) Dimensions	1 set	1				- It is necessary for preventive maintenance such as engine, transmission, hydraulic system, etc. of construction machinery.
16	Valve lifter and compressor Opening range: 50-225 mm	1 pc.	1				- It is necessary for repairing engine.
17	Piston ring compressor Range: 75-175 mm	1 pc.	1				- It is necessary for repairing engine.
18	Piston ring tool Range: 70-105 / 100-175mm	1 set	1				- It is necessary for repairing engine.
19-1	Cylinder Bore Gauge, 35-80mm (0.01mm)	1 pc.	1				- It is necessary for measuring inner diameter of the engine .
19-2	Cylinder Bore Gauge, 50-150mm (0.01mm)	1 pc.	1				- It is necessary for measuring inner diameter of the engine.
19-3	Cylinder Bore Gauge, 100-160mm (0.01mm)	1 pc.	1				- It is necessary for measuring inner diameter of the engine.
19-4	Cylinder Bore Gauge, 160-250mm (0.01mm)	1 pc.	1				- It is necessary for measuring inner diameter of the engine.
20	Hydraulic Pressure Gauge Set Gauge: 25,60, 400, 600 kg/cm2 with hose and adapters set	1 set	1				- It is necessary for inspecting hydraulic pressure of transmission, torque converter, hydraulic system, etc.
21	~~Portable hydraulic tester~~ ~~- Capacity Flow: 15-350 liter/min.~~ ~~- With adapter and hose set~~	~~1 set~~					- It is unnecessary because it is not frequent use.
22	Orbital Sander Pad size: 114x220mm	1 pc.	1				- It is necessary for polishing machine after welding.
23	Polisher Pad size: 150mm dia.	1 pc.	1				- It is necessary for polishing machine after welding.
24	Body puller set Shaft length: 630 mm Shaft mass. 4 kg with accessories	1 set	1				- It is necessary to repair plate such as fender, etc.
25	Body repair tool set Contents; 1) Pad: 5 pcs. 2) Spoon: 2 pcs. 3) Flange tool: 1 pc. 4) Thinner scissors: 3 pcs. 5) Hammer: 6 pcs. 6) Chisel: 1 pc.	1 set	1				- It is necessary to repair plate such as fender etc..

Table 2-9 Maintenance Equipment Plan for Limithang Regional Workshop (5/7)

No.	Description	Total	Disposition				Examination of Maintenance Equipment
			Li	Ta	T	P	
26	Double-face Sledge Hammer Weight: 4.5 kg	2 pcs.	2				- It is necessary for repair plate such as fender, etc.
27	Iron anvil, 50 kg	1 pc.	1				- It is necessary for repair and bend plate such as fender, etc.
(3)	**ELECTRIC COMPONENT REPAIR AND BATTERY SERVICE**						
1	Battery charger Type: Quick and normal charger DC output: 140 A (12 - 24 V) AC input: Three phase 6.5 kVA	1 unit	1				- It is necessary for charging battery of construction machinery and vehicle.
2	Battery service tool set Contents; 1) Battery filer: 1 pc. 2) Battery syringe: 1 pc. 3) Booster cable, 200A, 3m 4) battery hydrometer set: 1 set	1 set	1				- It is necessary for maintenance of battery.
3	Electricians tool set Total 27 items of hand tools with caring case	1 set	1				- It is necessary for inspecting and repairing of electrical parts.
4	Circuit tester Type: Digital AC A / DC A : 300µ - 10 A AC V : 3 - 75 V DC V : 300m - 1,000 V Resistance : 300 -- 30M ohm	2 pcs.	2				- It is necessary for inspecting electrical parts.
5	Volt ampere regulator tester DC V: 0 - 500V AC A: 0 - 500 A	1 pc.	1				- It is necessary for inspecting voltage of construction machinery and vehicle.
6	Solderless terminal kit for Automotive Contents; 1) Terminal clamp: 1 pc. 2) Terminal, plug, socket and etc.	2 sets	2				- It is necessary for repairing electric circuit.
7	Solderless terminal kit for Construction Machine Contents; 1) Terminal clamp: 1 pc.	1 set	1				- It is necessary for repairing electric circuit.
8	Work bench Dimensions LxDXH: 900x600x740 mm with 3 drawers	1 unit	1				- It is necessary for repairing component of construction machinery and vehicle.
(4)	**MACHINE SHOP**						
1	~~Lathe machine~~ ~~Swing: 460mm, Center: 1,500mm~~ ~~Motor: Three-phase 3.7 kW~~ ~~with following accessories~~ ~~1) Steady rest~~ ~~2) Follow rest~~ ~~3) Coolant system~~ ~~4) Face plate, 460mm~~ ~~5) 3-jaw chuck~~ ~~6) Cutting tool set~~	~~1 unit~~					- This is excluded, because major repair such as rebuilding is done in Hesothangkha Regional Workshop .
2	~~Upright drilling machine~~ ~~Drilling capacity: 32mm~~ ~~with accessories~~	~~1 unit~~					- This is excluded because major repair such as rebuilding is done in Hesothangkha Regional Workshop .
3	Drill bit set, 1.0-32.0mm	2 sets	2				- It is necessary for grinding.
4	~~Hack sawing machine~~ ~~Cutting capacity: 210mm dia.~~ ~~Stroke: 108mm~~ ~~Motor: Three-phase 0.75 kW~~	~~1 unit~~					- This is excluded because major repair such as rebuilding is done in Hesothangkha Regional Workshop .

Table 2-9 Maintenance Equipment Plan for Limithang Regional Workshop (6/7)

No.	Description	Total	Disposition				Examination of Maintenance Equipment
			Li	Ta	T	P	
5	High-speed abrasive cutting machine Cutting wheel dia.: 405mm Cutting capacity: 75mm Motor: Three-phase 2.2 kW	1 unit	1				- It is necessary for cutting pipe, channel, etc.
6	Bench grinder with pedestal stand wheel dia. 205mm Motor: Single phase 0.53 kW	1 unit	1				- It is necessary for grinding point of drill.
7	Tool grinder Applicable drill dia.: 2 - 13mm Motor: Single phase 60W	1 unit	1				- It is necessary for grinding tool.
8	Workbench with vise Workbench: 900x600x740mm Vise: opening: 100mm	1 set	1				- It is necessary for repairing.
9	Tool Rocker and Cabinet Dimensions: WxDxH: 900x450x1,760 No. of shelf: 3 with lockable door	1 set	1				- It is necessary to keep measuring tools, PM tools, etc.
10	Mechanic tool set Over 140 items of metric size hand tools with lockable steel tool cabinet	1 set	1				- It is necessary for mechanics.
11	Parts shelf, partition type Dimensions: WxDxH: 900x450x1800mm No. of shelf: 5 (included top plate)	2 sets	2				- It is necessary for keeping parts such as bolt, nut, washer, gasket, oil seal, O-ring, etc.
(5)	**TIRE REPAIR SHOP**						
1	Tire service tools Contents; 1) Cross rim wrench: 1 pc. 2) Tire gauge: 2 pcs. 3) Valve repair tool: 1 pc. 4) Long nose Plier: 1 pc. 5) Soft hammer: 1 pc. 6) Tire lever: 3 pcs. 7) Wire brush: 1 pc. 8) Tire spreader: 1 pc. 9) Tire depth gauge: 1 pc.	2 sets	2				- It is necessary for repairing tire at job-site.
2	Tire bead remover Length: 1.6 m	2 pcs.	2				- It is necessary removing tire of vehicle.
3	Tire changer Applicable wheel size: 16-26 inch rim Max. wheel dia.: 1,500 mm Max. wheel width: 700 mm	1 unit	1				- It is necessary for removing large size tire of construction equipment.
4	Portable Brake Booster Tester Gauge: 10, 100, 200 kg/cm2 Vacuum: 76 cmHg.	1 set	1				- It is necessary for inspection of brake system after overhauling.
5	Brake Lining Riveter Capacity: 5 ton at 10 kg/cm2 Stroke: 40 mm Overall height: 1,440 mm	1 unit	1				- It is necessary for riveting brake lining.
6	Workbench with vise Workbench: 900x600x740mm Vise: opening: 100mm	1 unit	1				- It is necessary for repairing.

Ta ble 2-9 Maintenance Equipment Plan for Limithang Regional Workshop (7/7)

No.	Description	Total	Disposition				Examination of Maintenance Equipment
			Li	Ta	T	P	
(6)	**WASHING EQUIPMENT**						
1	Hot water high pressure washer Discharge volume: 900 liter/hour Discharge pressure: Max. 100 kg/cm2 Temperature: Max. 80 degree Fuel: Diesel	1 unit	1				- It is necessary for washing construction equipment.
2	Water hose reel Size: 14mm dia. x 10 m length	1 pc.	1				- It is necessary for using washing equipment.
(7)	~~**TRAINING EQUIPMENT**~~						
1	~~Overhead Projector~~	~~1 pc.~~					- This is excluded .
2	~~Screen~~	~~1 pc.~~					
3	~~Video Tape Recorder~~	~~1 pc.~~					
4	~~TV Monitor, 21 inch~~	~~1 pc.~~					
5	~~LCD Projector~~	~~1 pc.~~					
6	~~Digital Video Camera~~	~~1 unit~~					
7	~~Training Soft~~	~~1 set~~					
(8)	~~**OILY WATER SEPARATOR**~~						
1	~~Oily water separator, flow rates of 1000l/hr, vertical gravity separation type, complete with pumps, electric motor, control panels, piping~~	~~3 units~~					- This is excluded, because oil-water separator is provided by Bhutan side.

Note)
Li: Limithang Regional Workshop
Branches under Limithang Regional Worksh Ta: Tashigang, T: Tashiyangste, P: Pemagatsel

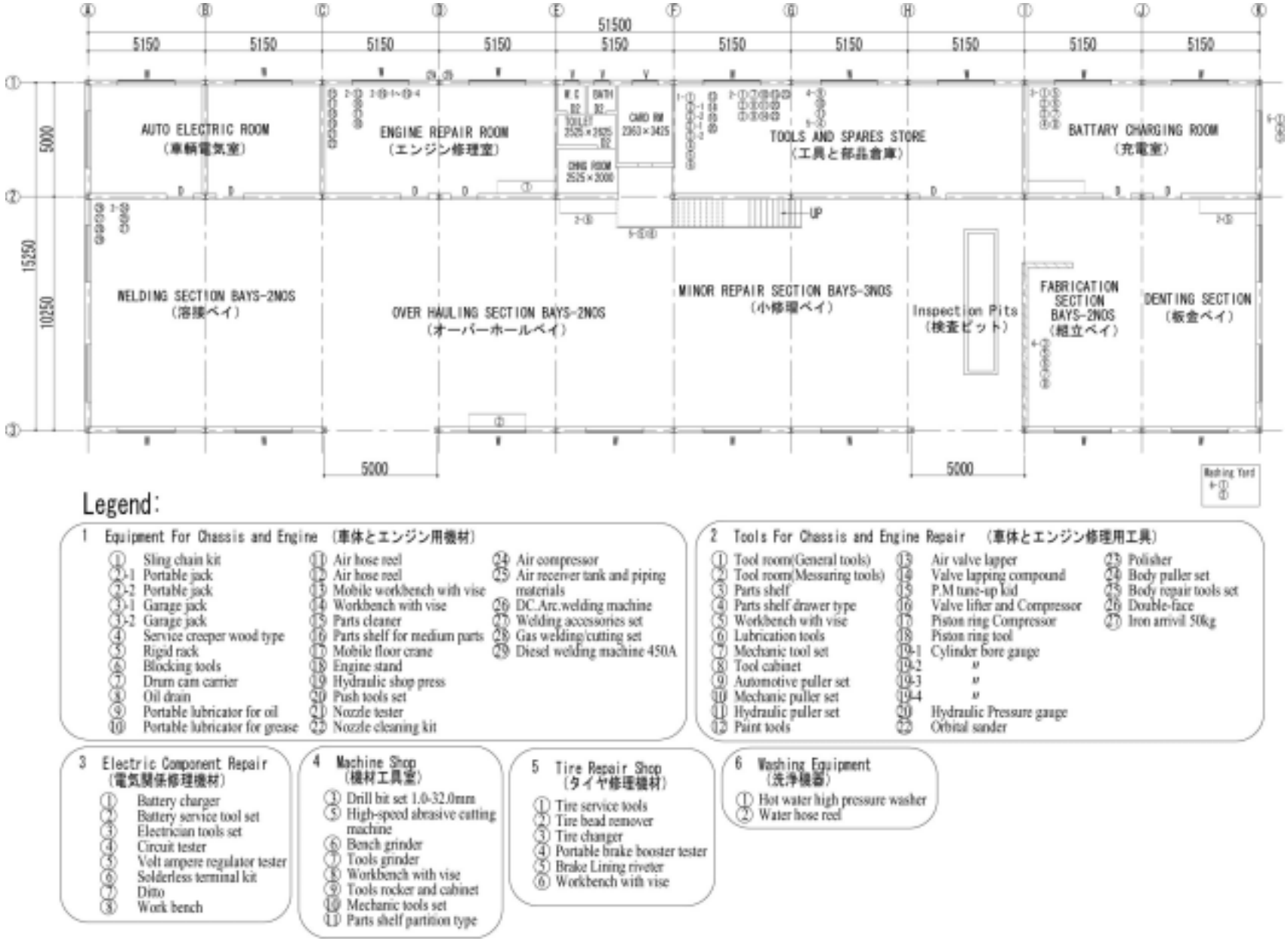


Figure 2-2 Equipment Arrangement Plan for Limithang Regional Workshop

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

(1) Project Implementation Agency

In the implementation of the project under Japan's Grant Aid, the relationship between the organizations concerned shall be as illustrated in Fig.2-3.

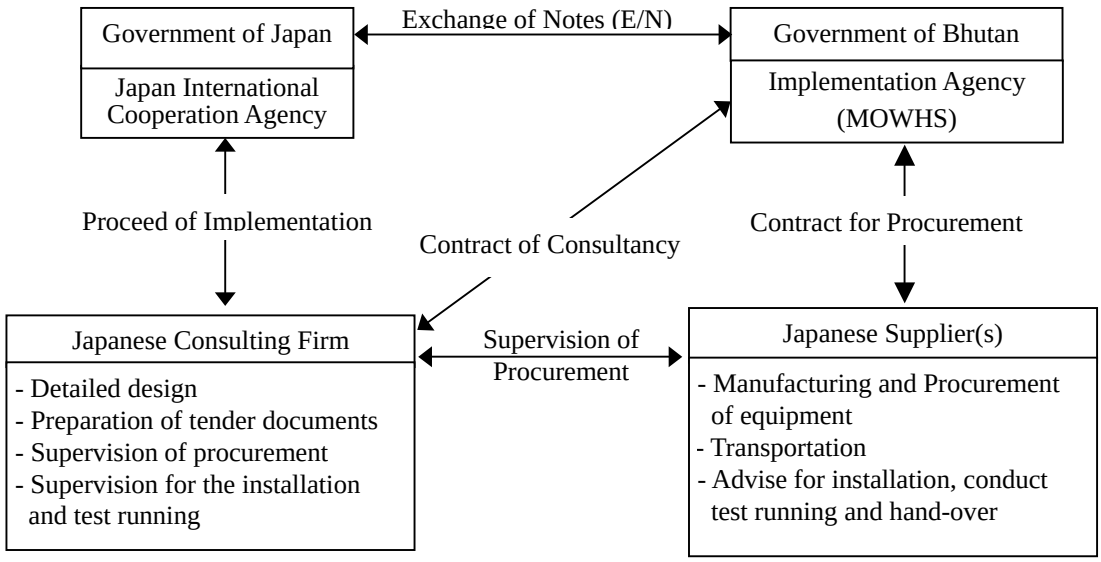


Figure 2-3 Project Implementation Diagram

Implementation agency of the project in Bhutan is MOWHS.

In accordance with Japan's Grant Aid Scheme, a Japanese consulting firm will undertake the detailed design and supervision of the project, and Japanese trading firm(s) will undertake the supply of construction equipment under the project.

(2) Consultant

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

The said firm will provide engineering services for the procurement of equipment 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 hand-over of the construction equipment under the project.

(3) Supplier(s)

MOWHS will conclude contract(s) for the supply of equipment under the project with the Japanese trading firm(s) who has (have) been awarded the tender(s) after having passed successfully the examination of the quality being required at the competitive tender with limited qualification.

The said firm(s) has (have) the obligation to deliver the equipment requested by MOWHS, DOR and carry out its initial operation diligently within the term and termination stipulated in the contract.

2-2-4-2 Implementation Conditions

The equipment to be procured in Japan and the third countries is unloaded at Kolkata port. After receiving the construction equipment from India customs house, the construction and maintenance equipment is transported by the supplier(s) upto the Hesothangkha regional workshop through the procedure of MOF customs house in Phuentsholing.

The construction and maintenance equipment is kept in the specified area in the Hesothangkha regional workshop by the supplier(s) and is officially handed over to MOWHS, DOR after the supplier(s) has(have) carried out the initial running of the construction and maintenance equipment kept and has(have) provided instructions for the maintenance and operation of the construction and maintenance equipment.

Furthermore, after the transport of the construction and maintenance equipment to Hesothangkha regional workshop, the supplier undertakes the storage and installation of that equipment as his responsibility until the completion of hand-over equipment.

2-2-4-3 Scope of Work

(1) Equipment and Inland Transport

The cost of procurement of equipment including the cost of inland transport to the place of hand-over shall be borne by the Japanese side.

(2) Imposition of Duties and Taxes

Bhutan side shall take necessary measures for the exemption of all duties and taxes including VAT imposed in Bhutan in relation to the procurement of the equipment under the project.

(3) Transport after Hand-over of the Equipment under the Project

All transport and installation costs for the equipment under the project after their hand-over are to be borne by Bhutan side.

2-2-4-4 Consultant Supervision

(1) Principles of Procurement Supervision

For the implementation of the project under Japan's Grant Aid Scheme, the consultant shall carry out the detailed design and supervision of procurement with thorough understanding of the following:

a) Background of the implementation program
b) Contents of the basic design report
c) System of Japan's Grant Aid
d) Contents of the Exchange of Notes between the two governments

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

(2) Scope of Consulting Services

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

The scope of services can be summarized as follows;

1) Detailed Design
   - Consultancy agreement (in Bhutan) and verification (in Japan)
   - Prompting the issuance of the Authorization to Pay (A/P) (in Bhutan)
   - Site survey, detailed design and preparation of tender documents (in Bhutan/ Japan)
   - Obtaining approval of tender documents from the Bhutan side (in Bhutan)
   - Announcement of tender and distribution of tender documents (in Japan)
   - Execution of tender(s), evaluation of tenders, preparation of evaluation report, obtaining approval of the report (in Bhutan/Japan)
   - Witness of the contract(s) for the supply of equipment (in Japan), and obtaining verification of the supply contract(s) (in Japan)
   - Confirmation of the obligations of Bhutan side (in Bhutan/Japan)

2) Supervision of the Procurement of Construction Equipment
   - Confirmation of the procurement order
   - Follow-up of the procurement
   - Ex-factory inspection
   - Inspection before shipment
   - Progress report

- Witness of final hand-over
- Preparation of completion note and final report

3) Initial Operation of the Equipment

It will be necessary to provide instructions of a mechanical engineer dispatched by supplier(s) for installation of mobile asphalt mixer and mobile crushing plant, initial operation, preventive maintenance and routine maintenance of the equipment under the supervision of the consultant.

(3) Special Remarks

1) It is necessary to check whether the procurement conditions of the equipment fixed at the basic design stage have changed or not.

2) Tender and contract documents should be in accordance with the Japan's Grant Aid System, and it is necessary to discuss these documents fully with the Bhutan side during the field survey of the Detailed Design. Finally the tender documents including the Detailed Design have to be approved by the Bhutan side.

2-2-4-5 Procurement Plan

The procurement plan of the construction and maintenance equipment from Japan, Bhutan and the third countries is described as follows;

From Japan**:**

As for the equipment for road construction and maintenance, numbers of the equipment procured through the Japan's Grant Aid are currently operated in DOR, MOWHS as well as in MOA in Bhutan. DOR has understood the equipments from Japan are reliable in terms of the technical specification. Consequently, it can be judged that the system of procuring spare parts between Japanese manufacturers and suppliers is also reliable.

From Bhutan**:**

Procurable equipment is nil.

From Third Country**:**

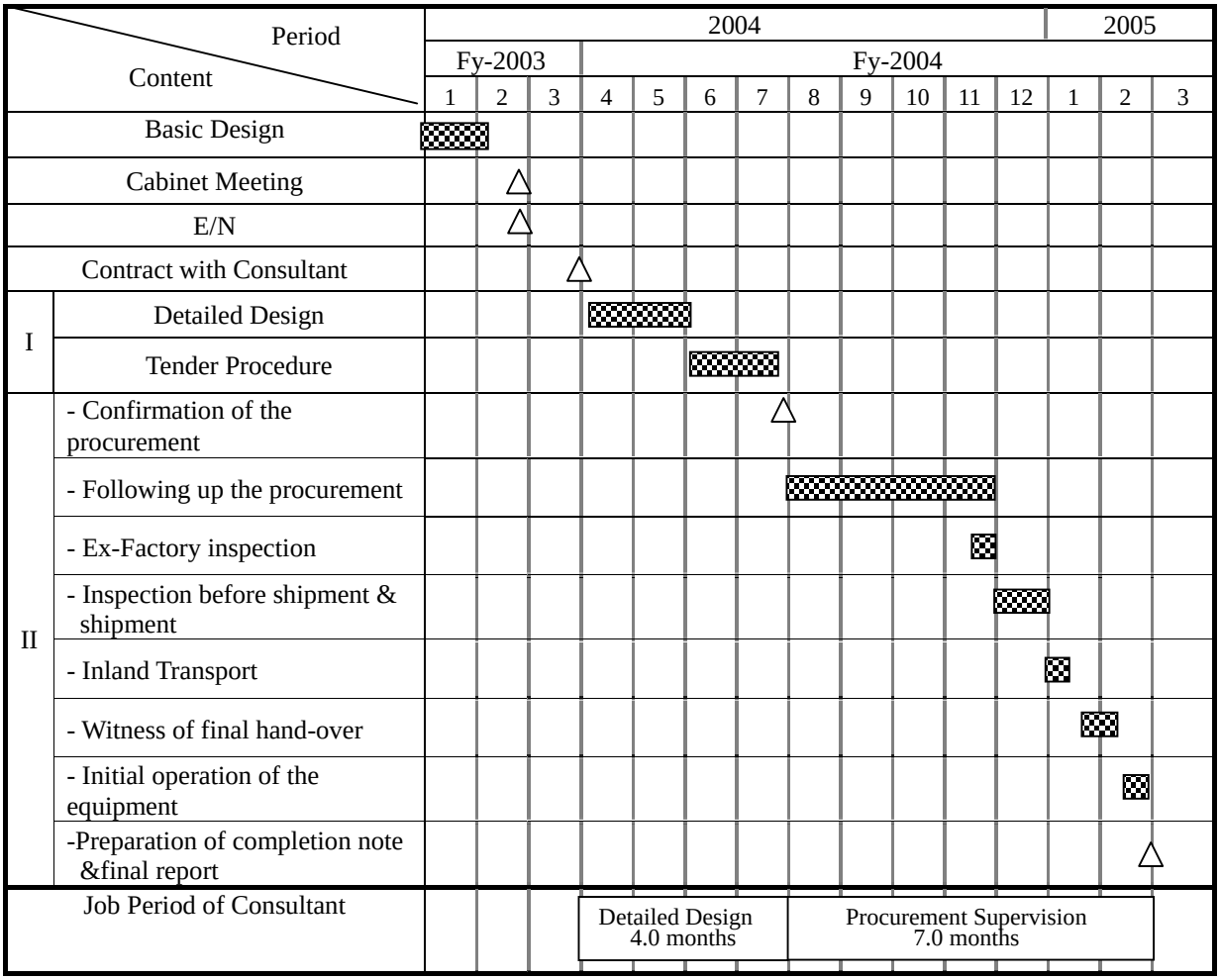
Although the Government of Bhutan requests to procure the equipment from Japan in consideration of the quality, procuring term, spare parts supply and services after the completion of the project, some of the equipment planned in the project are limited and not manufactured in Japan. Such equipment will be obtained in the third courtiers.

In this context, the following equipments are to be procured from the third countries in the Basic Design Study.

From Japan and Third Country:	Motor Grader, Single Cab Cargo Car
From Third Country:	Backhoe Loader

2-2-4-6 Implementation Schedule

The project shall be implemented according to the schedule in shown in the Figure2-4 based on Japan's Grant Aid System.



Legend : I: Detailed Design II: Procurement Supervision

Figure 2-4 Implementation Schedule

2-2-5 Project Cost Estimation

(1) Japan side

Project cost be borne by Japan side is estimated as follows;

1)	Construction equipment and maintenance equipment/tool :	589 millionYen
2)	Detailed design and supervision	17 millionYen
Total		606 millionYen

This cost estimate is provisional and would be further examined by the Government of Japan for the approval of the Grant.

(2) Bhutan side

Project cost to be borne by Bhutan side is estimated as follows:

1) Oil-water separator in the Hesothangkha and Limithang Regional Workshop: 120,000 Yen
2) Tire repair shop and air pipe for the air compressor in the Limithang Regional Workshop: 38,000 Yen
3) Concrete-made water pool using for dust collection of the Mobile Asphalt Mixer: 155,000 Yen
4) Groundsill to be stabilized basis of the Mobile Asphalt Mixer and Mobile Crushing Plant: 52,000 Yen

Total 365,000 Yen

(3) Condition for Cost Estimation

1) US$1.0 = Yen 117.32 (November 2003)
2) Nu.1.0 = Yen 2.71 (November 2003)
3) Procurement period including detailed design and procurement supervision is indicated in the implementation schedule (Figure2-4).
4) Project Cost is estimated according to the Japan Grant Aid system

2-3 Obligations of Recipient Country

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

(1) Payment of the following commissions to a bank of Japan for the banking services based on the banking arrangement (B/A) for the project.

1) Commission for the advising of A/P

2) Commission for payments

(2) Speedy unloading and customs clearance of the equipment procured under the project at the place of hand-over.

1) Exemption from import duties and all taxes including VAT.

2) All expenses for the transport of equipment after their hand-over.

(3) Obtaining permission for entering and staying in Bhutan and providing assistance to the Japanese personal engaged in the project based on the contract verified by the Japanese Government.

(4) Exemption from customs duties, internal taxes and other fiscal levies in Bhutan for the Japanese firms and personnel engaged in the project based on the contract verified by the Japanese Government.

(5) Ensuring of the necessary yard to arrange and make a trial run of all construction equipment in or around the Hesothangkha Regional Workshop.

(6) Setting up the oil-water separator in the Hesothangkha and Limithang Regional Workshop, and expenses burden.

(7) Setting up the tire repair shop and piping work for the air compressor in the Limithang Regional Workshop, and expenses burden.

(8) Setting up the concrete-made water pool using for dust collection of the Mobile Asphalt Mixer, and expenses burden.

(9) Groundsill to be stabilized basis of the Mobile Asphalt Mixer and Mobile Crushing Plant, expenses burden.

(10) Payment of all expenses for transport, installation, operation, maintenance etc. of the equipment except other than those to be borne by the Japanese side under the Grant Aid for the project.

(11) Proper and effective use and maintenance of the equipment to be provided under the Grant Aid.

2-4 Project Operation Plan (Project Maintenance and Management Plan)

2-4-1 Organization

The Mechanical Division under the DOR is the substantial executing agency for the project implementation, and arranges the plan concerning maintenance and the operation of the road

construction equipment and prepares the budget plan. The organization of the Mechanical Division is shown in Figure 2-5 and Table 2-10 respectively. Moreover, the organization of the Hesothangkha and Limithang regional workshop, which support FRMD and take responsibility for the road development in a central/western/southern region and the eastern region in Bhutan respectively, is shown in Figure 2-6 and Figure 2-7. The Mechanical Division has not much obstacle in the current system at present. Accordingly, the current system will be recommendable effectively to operate the equipment to be newly procured through the project.

2-4-2 Finance and Budget

Fiscal resource of the Mechanical Division is the lending/hire charges of the equipment, being possession of the DOR, obtained from the other divisions of DOR and private companies. This revenue is allocated for purchase of the spare parts and maintenance expense of the construction equipment. The result of the expenditure in fiscal year 2003 and the budget in fiscal year 2004 for the Mechanical Division are shown in Table 2-11. According to this budget plan, the general expenditures budget of 122.5 million Nu and the investment annual expenditure budget of 13.8 million Nu are summed up to the 136.3 million Nu in total. On the other hand, the lending annual revenue of 133.9 million Nu obtained from the MOWHS, 2.5 million Nu obtained from other agencies, the lending annual revenue of 2.6 million Nu obtained from of the private enterprise and others are summed up to the 138.9 million in total. Consequently, the annual revenue will be exceeded the annual expenditure in fiscal year 2004. In addition to the above, since the balance from the previous account of 174.4 million Nu was occurred at the time of ending of the fiscal year 2003, there is no financial problem for the execution of the project.

2-4-3 Operation and Maintenance Cost

The annual costs of fuel and oil, and maintenance and repair of construction equipment (refer to Table 2-12 and Table 2-13) for the new one under the project are estimated as follows:

Fuel and oil :	about 20,000 thousand Japanese yen	(7,822,049Nu)
Maintenance and repair:	6,326 thousand Japanese yen	
Total	26,326 thousand Japanese yen	

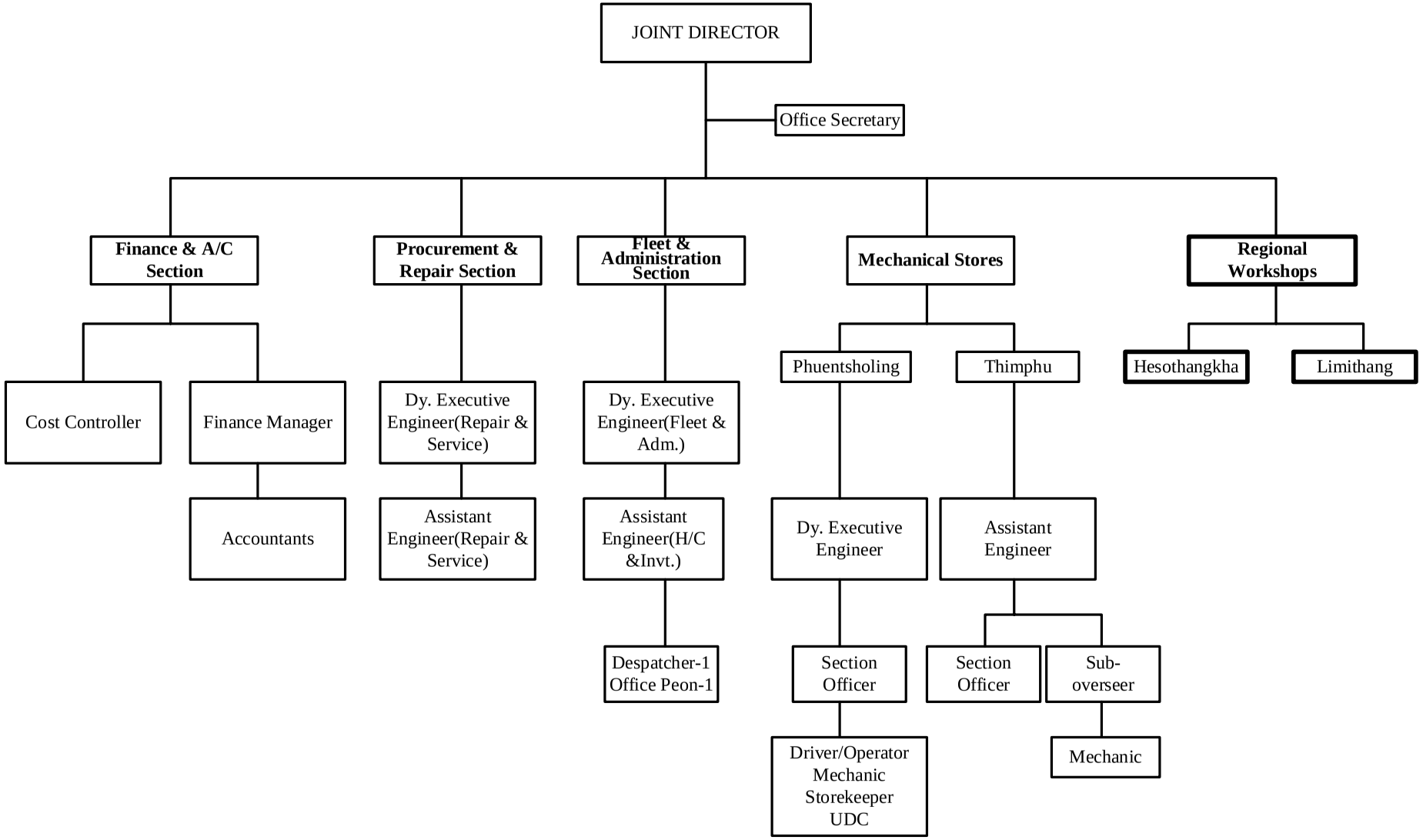


Figure 2-5 Organization of Mechanical Division

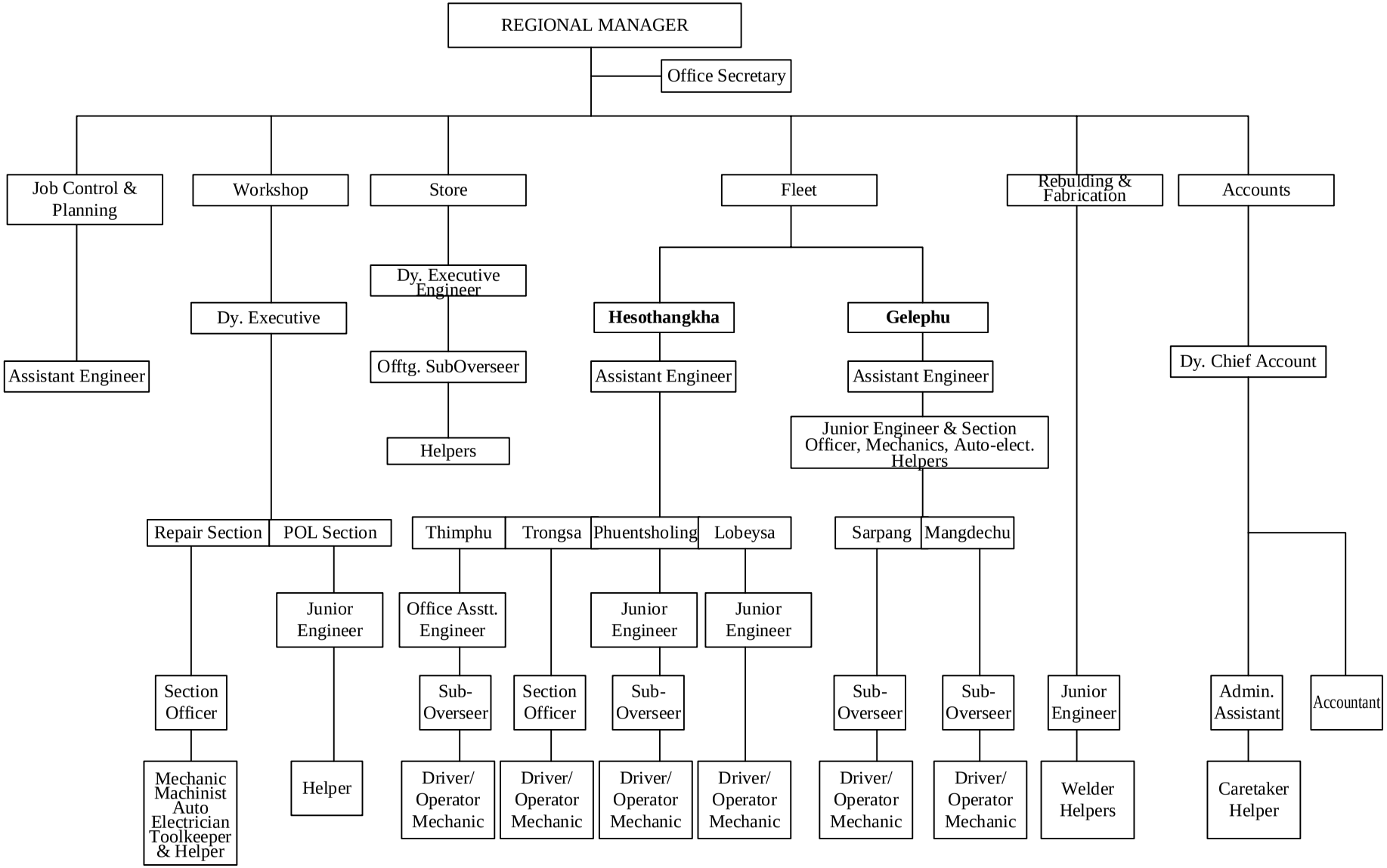


Figure 2-6 Organization of Hesothangkha Regional Workshop

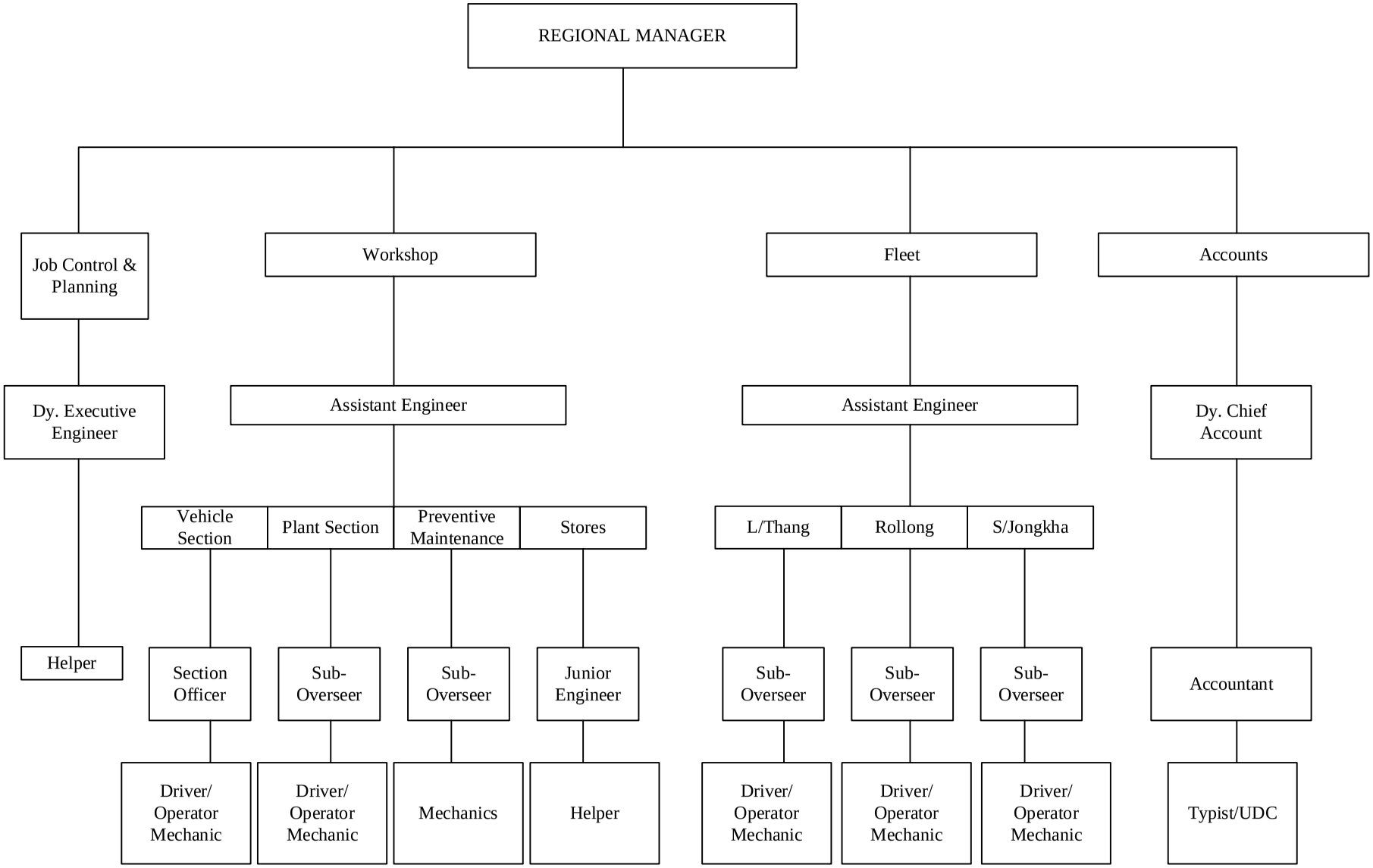


Figure 2-7 Organization of Limithang Regional Workshop

Table 2-10 Personnel Organization for Mechanical Division (September, 2003)

Designation	Head Office	Regional Workshop		Mechanical Stores		Total
		H/thangkha	L/thang	P/ling	Thimphu	
Joint Director	1					1
Finance Manager	1					1
Regional Manager		1	1			2
Executive Engineer	2	2	1	1		6
Assistant Engineer	2	3	2		1	8
Junior Engineer		5	1			6
Section Officer		3	3	1	1	8
Dy. Chief Accountant		1	1			2
Sub Overseer		6	4		1	11
Accountant	1	2	1			4
Machinist		3	1			4
Mechanic		31	5	1	1	38
Auto Election		5	4			9
Welder		6	2			8
Office Secretary	1					1
Stores Keeper				2		2
UDC/Typist			1	1		2
Bull Dozer Operator		18	5			23
Excavator		3	1			4
Pay Loader Operator		14	7			21
Motor Grader Operator		3				3
Road Roller Operator		8	6			14
Driver (Heavy)	1	49	24	7		81
Driver (Light)	1	8	3			12
Driver (Medium)		1				1
Air Compressor Operator		2	4			6
Jack Hammer Operator			1			1
Despatcher	1					1
Peon	1					1
Black-Smith		1				1
Helper		1				1
Night Guard		1				1
Care Taker		1				1
Total	12	177	78	13	4	284

Table 2-11 Finance and Budget of Mechanical Division

(unit：million Nu.)

Item of Expenditure	2003Ficical year (2003/1~6)	2004year budget (2003/7~2004/6)
①Revenue	133.511	138.972
（Breakdown）		
Lending of equipment	129.393	133.870
Repair for private company		1.956
Lending of equipment to other Ministry		2.538
Sale of spar part unnecessary		0.006
Other	4.118	0.602
②General Expenditure	126.128	122.519
（Breakdown）		
Manpower		43.239
Fuel		44.265
Communication & remittance		1.415
Electric & water service		0.160
Administration & miscellaneous		2.740
Purchase equipment		1.110
Repair of equipment & workshop		26.590
Training		3.000
③Invest Expenditure	12.324	13.800
（breakdown）		
Facilities & equipment		1.050
Spar parts		4.650
Purchase vehicle		1.650
Computer etc.		1.295
Office equipment		5.155
Ground Total ① - (② + ③)	－4.941	+2.652

(Remark)

Previous fiscal year (before 2002) balance : 179.300 million Nu

2003 fiscal year (2002/7~2003/6) balance : －4.941 million Nu

Balance brought forward （Total） 174.359 million Nu

Table 2-12 Estimation of Annual Costs of Fuel and Oil

No	Designation	Specification (kW)	Unit ②	Fuel and Oil Consumption ①=(Lit/kW-H)x(H/year)/unit	Fuel and Oil Consumption ①x②
1	Diesel Generator	48.5	2	0.173x48.5kW x1108H=9297	18,594
4-1	Hydraulic Excavator	106	4	0.188x106kW x880H=17537	70,148
4-2		65	4	0.188x65kW x880H=10754	43,016
5	Backhoe Loader	74.5	1	0.188x74.5kW x880H=10754	10,754
10	Motor Grader	101	2	0.110x101kW x460H=5111	10,222
11	Wheel Loader	97	6	0.156x97kW x810H=12257	73,542
12	Dump Truck	142	8	0.054x142kW x1030=7898	63,184
13	Vibration Roller	56	1	0.155x56kW x520H=4524	4,514
15	Hand Guide Roller	3.7	8	0.205x3.7kW x460H=349	2,792
16	Vibration Plate Compactor	2.5	6	0.310x2.5kW x320H=248	1,488
18	Asphalt Distributor	128.5	1	0.090x128.5kW x440=5089	5,089
19	Mobile Stone Crushing Plant	140	1	0.173x140kW x930H=22525	22,525
20	Asphalt Mobile Mixer	33.5	1	0.152x33.5kW x700H=3564	3,564
24	Cement Concrete Mixer Vehicle	118	1	0.059x118kW x870H=6057	6,057
26	Fuel Tanker	177	2	0.054x177kW x700H=6691	13,382
27	Truck with crane	177	1	0.054x177kW x700H=6691	13,382
28	Self Loading Short Body Truck	213	1	0.054x213kW x700H=8051	8,051
30	Service Truck with Crane	140	2	0.050x140kW x700H=4900	9,800
31	Single Cab Cargo Car	76	8	0.047x76kW x700H=2500	20,000
(Total): Annual Cost				400,104Lit x 19.70=7,822,049Ngutrum	

(Note): 1) Fuel efficiency per hour of operation (Lit/kW-H) included oils for daily maintenance and periodical maintenance is based on the standard of the Ministry of Land, Infrastructure and Transportation, of Japan.

2) Annual machinery working hours and annual machinery working month is based on the standard of the Ministry of Land, Infrastructure and Transportation, of Japan.

1) Price of diesel oil:	19.70	Ngutrum/Lit
2) Price of gasoline:	29.71	Ngutrum/Lit
3) Price of lubricating oil (engine oil)	110~120	Ngutrum/Lit
4) (Grease)	104	Ngutrum/kg
5) Electricity charge:	0.80	Ngutrum/kWh

Table 2-13 Estimation of Annual Maintenance and Repair Cost

(Unit: Thousand Japanese Yen)

No	Designation	Specification (kW)	Unit ①	Maintenance & Repair Cost per 1 unit-year ②	③= ①x②
1	Diesel Generator	48.5	2	3978x0.07/9.1=31	62
4-1	Hydraulic Excavator	106	4	18718x0.09/7.1=237	948
4-2		65	4	13260x0.09/7.1=168	672
5	Backhoe Loader	74.5	1	15821x0.09/7.1=201	201
10	Motor Grader	101	2	14994x0.09/11.1=122	244
11	Wheel Loader	97	6	12566x0.12/7.1=212	1,272
12	Dump Truck	142	8	9000x0.09/8.9=91	728
13	Vibration Roller	56	1	10098x0.07/11.3=63	63
15	Hand Guide Roller	3.7	8	1153x0.07/9.8=8	64
16	Vibration Plate Compactor	2.5	6	204x0.07/4.3=3	18
18	Asphalt Distributor	128.5	1	12700x0.06/10.8=71	71
19	Mobile Stone Crushing Plant	140	1	81600x0.09/8.8=835	835
20	Asphalt Mobile Mixer	33.5	1	39600x0.07/9.2=301	301
24	Cement Concrete Mixer Vehicle	118	1	7800x0.12/9.7=96	96
26	Fuel Tanker	177	2	6936x0.12/10.1=83	166
27	Truck with crane	177	1	9384x0.12/10.1=111	111
28	Self Loading Short Body Truck	213	1	13260x0.12/10.1=158	158
30	Service Truck with Crane	140	2	7212x0.12/10.1=86	172
31	Single Cab Cargo Car	76	8	2592x0.07/10.1=18	144
(Total)				6,326	

(Note) 1) Coefficient of maintenance and repair cost: Based on the machine cost calculation formula of the Ministry of Land, Infrastructure and Transportation, of Japan.

2) Considering annual machinery working hours and annual machinery working month is based on the standard of the Ministry of Land, Infrastructure and Transportation, of Japan.

3) Maintenance and repair cost per unit-year:
= (Estimated cost of machinery: CIF) x (Coefficient of maintenance and repair) / Service life

2-4-4 Personnel Necessary and Technical Level

Technical training at Hesothangkha regional workshop was done by the senior overseas volunteer from Japan during the year 1996~1998. This training was on-the-job training for rebuilding of undercarriage, roller, idler, bucket, etc, which is still being continued at Hesothangkha workshop.

From the year 2002, another on-the-job training by the senior overseas volunteer from Japan started according to the request of DOR. New techniques of on-the-job training is about trouble-shooting, disassemble, assemble and adjustment of electric system and hydraulic system, including how to examine electric and hydraulic circuit. The other most important technical training for DOR is on-the-job training for repairing and adjusting effectively based on the right trouble-shooting by the experienced senior overseas volunteer from Japan.

Regarding new construction equipment procured through the project, operators and mechanics of DOR need to take part in the assembly, adjustment and test-operation work, and on-the-job training of the service maintenance including daily visual check of the each construction equipment, while the equipments is arranged for assembly and others by the Supplier at Hesothangkha Workshop. Also, on-the-job training for the structure and function on the equipment especially for new technology for mechanics, operators and engineers is necessary. For the above training, it will take about 2 weeks. On conclusion, the most important on-the-job training is daily and periodical maintenance in order to maintain the equipment for long time.

2-4-5 Maintenance and Management

Plan for maintenance and management of the construction equipment is basically executed based on the procedure shown in Table 2-14. Regarding the flow of maintenance activities, all staffs need to master such work processes and ensure the smooth running of workshop operation.

Table 2-14 Maintenance System for Construction Equipment

No	Item	Contents of Implementation	Charge of
1	Daily Check	a) Daily check of equipment shall be carried out according to daily check sheet to be prepared based on the manual of the equipment maker. Operators record operating hours or distance on the check sheet every day, and the consumption volume of fuel and lubrication oil each time of their refilling. b) The result of check-up is reported daily to site supervisor, and site supervisor reports to engineer of fleet.	Operators ↓ Site supervisor ↓ Engineer of fleet
2	Periodical Maintenance	a) Periodical maintenance of equipment shall be carried out based on the daily check sheet submitted by engineer of fleet. Engineer of fleet follows the condition and operating hours or distance of each machine, and decides periodical exchange parts, contents of maintenance work and periodical maintenance schedule, and requests engineer of workshop to keep man-hours of mechanics and store officer to supply necessary parts through engineer of job control & planning. b) The result of periodical maintenance shall be recorded on machine history book.	Engineer of fleet ↓ Engineer of job control & planning ↓ Engineer of workshop & Store officer
3	Repair & Adjustment	a) In case of operators find abnormal conditions, they shall request a check-up through site supervisor. b) Mechanics investigate causes of trouble at the job site, and record the results of the investigation on the repair record sheet describing causes of trouble, repair method, replaced parts and quantity, required man-hours and repair period. After that they inform to engineer of fleet. In case of the complicated accident and the trouble cannot be identified at the job site, machines out of order are brought to regional workshop and repaired on the investigation of workshop engineer. c) Repair work at workshop is carried out according to the repair process sheet issued by the workshop engineer. Repair process sheet is to be filled with information such as machine user's number, date of failure, cause of trouble, required parts, staff in charge of repair, repair completion schedule, etc. d) Workshop engineer checks the items filled in the repair process sheet and keeps the repair process sheet after having filled in the repair cost and having registered the repair record on the computer system and machine history book.	Operators ↓ Site supervisor ↓ Engineer of fleet ↓ Engineer of job control & planning ↓ Engineer of workshop & Store officer
4	Management of spare parts	a) Spare parts are managed by means of computer system. Store officer shall stock only periodical replacement parts according to machine history book in order not delay working schedule. b) However, in case of emergency parts, he requests DOR stock house in Thimphu to send these parts by Fax with parts order sheet. c) DOR Thimphu stock house shall send these parts within 3 days.	Store officer ↓ Charge of DOR Thimphu stock house
5	DOR Thimphu stock house	a) In case of parts are out of order, the In-charge of DOR Thimphu stock house shall order them directly to overseas maker's parts stock house.	In-Charge of DOR Thimphu stock house

Chapter 3 Project Evaluation and Recommendations

3-1 Project Effect

The direct and indirect effects to be brought about by the execution of this project are as follows:

Direct Effect

(1) Promotion of Mechanization of Road Work

The mechanization of road development, which is one of the strategies of the Ninth Five Year Road Development Plan, will be promoted through the procurement of construction equipment, so that road development can be carried out efficiently.

(2) Improvement of Regional Workshops' Ability to Maintain Equipment

The ability of the Hesothangkha and newly-established Limithang regional workshops will thus be improved, and it will be possible both to improve the technology for the repair of construction equipment and to shorten the time needed for repairs. As a result, the operational efficiency of the construction equipment will be improved.

Indirect Effect

(1) Promotion of Accessibility by Road Improvement

The road improvement to maintain the accessibility to the capital, prefecture capitals, district capitals and communities isolated will lead improving the society and everyday economic activity as part of the Ninth Five Year Road Development Plan, which is on-going at present, through the procurement of the necessary construction equipment.

(2) Expansion of Economic Activity

Strengthening of the road network will reduce transport time and cost.

Traffic hold-ups due to the road disasters that occur every year will be reduced because restoration work against road disaster will be executed within a short period of time, while economic activity in the market economy, such as strengthening of existing markets and the expansion to new markets, can be promoted.

(3) Road Development to be Achieved

a) Road Rehabilitation (Re-surfacing) : 1,010 km
b) Road Rehabilitation (Widening, related structures etc.) : 100 km
c) Daily Road Maintenance (Resurfacing) : 2,220 km
d) Daily Bridge Maintenance : 147 Nos.

e) Road Disaster Prevention Work : 12 locations (60 km)

3-2 Justification of the Project

In addition to the above, the content of the project is appropriate from the following viewpoints:

(1) The benefit brought by this project will reach the whole nation (699,000 inhabitants) including the direct beneficiaries in areas along the project road and also indirect beneficiaries.

(2) The purpose of the project is to improve the accessibility to isolated areas from national highway, and to secure and improve basic living standards of local residents against the disasters that occur every year, by linking the access road (feeder road) to a previously completely isolated residential area.

(3) Bhutan will be able to manage and maintain the construction equipment using the capital, talent and technology of Bhutan following the execution of the project.

(4) The project will contribute to the accomplishment of not only the Ninth Five Year Road Development Plan but also the Road Development Master Plan of Bhutan from 2007 to 2027, which the Department of Roads (DOR) determined in 2001 in cooperation with the Asian Development Bank (ADB).

(5) The following steps to minimize the negative effect on the environment will be adopted:

- The procurement of transportation equipment needed for the removal of surplus soil and asphalt scrap.
- The procurement of construction equipment with reduced vehicle exhaust emission, noise and vibration.
- The processing of waste oil discharged from the regional workshop so as to avoid pollution of the surrounding area.

(6) It is possible to execute the project within the ability of the Bhutan government to implement the system of the Japan's Grant Aid Scheme.

3-3 Recommendations

The proposal for a more efficient and effective execution of the project is as follows:

(1) Technical Cooperation

OJT training through JICA counterpart training to be planned in 2004 and/or senior overseas volunteer from Japan is necessary for the persons involved in road construction and in construction and maintenance in the regional workshops, so that

this project can be effective in assisting road development in Bhutan. It is also necessary to improve asphalt plant technology, including not only equipment operation but also the technology for improving quality control of the asphalt mixture.

(2) Promotion of Privatization in Road Development

The project should be undertaken without affecting the privatization of road maintenance, for this it is necessary for private companies to be given a fair opportunity to participate in the project, which they bring their ability. In the future, it is expected that the road maintenance work system, including daily road maintenance, will be transited to the contract method involved a private company rather than the direct management method.

Content of Appendices

[Appendix 1] Member List of the Study Team

1. Basic Design Study (9 October ~2 November 2003)

No.	Name	Assignment	Position
1	Mr. Hiroyuki HAYASHI	Leader	JICA Third Project Management Division, Grant Aid Management Department
2	Mr. Akihiko KITAYAMA	Chief of Consultant/Road Maintenance Plan	Docon Co.,Ltd
3	Mr. Hiroyuki SASAKI	Road Machinery Plan (1)	Docon Co.,Ltd
4	Mr. Susumu USHIDA	Road Machinery Plan (2)	Docon Co., Ltd (Inter Techno Consultant Co.,Ltd)
5	Mr. Keiji NAKAOKA	Procurement Plan/Cost Estimate	Docon Co.,Ltd

2. Explanation on Draft Report of Basic Design (16 December ~27 December 2003)

No.	Name	Assignment	Position
1	Mr. Mitsukuni SUGIMOTO	Leader	Director Disclosure Management Division, General Affairs Department , JICA
2	Mr. Akihiko KITAYAMA	Chief of Consultant/Road Maintenance Plan	Docon Co.,Ltd
3	Mr. Hiroyuki SASAKI	Road Machinery Plan (1)	Docon Co.,Ltd

[Appendix 2] Study Schedule

(1) Basic Design Study

Study Schedule (1/2)

Date (2003)	Movement & Activities					Stay
	JICA	Consultant				
	Hayashi Team leader	Kitayama Leader/ Road Maintenance Plan	Sasaki Road Machinery(1)	Nakaoka Procurement/ Cost Estimate	Ushida Road Machinery(2)	
Oct.9 (Thr)	・Narita－Bangkok					Bangkok
10 (Fri)	・Paro Airport (11:00 KB127) ・Courtesy call to JICA Office and Ministry of Works & Human Settlement (MOWHS)					Thimphu
11 (Sat)	・Site survey －Thimphu – Jakar					Jakar
12 (Sun)	・Site survey －Jakar – Mongar					Mongar
13 (Mon)	・Site survey －Mongar - Limithang Survey of Limithang Regional Workshop －Limithang - Jakar				Site survey 1)*	Jakar Mongar
14 (Tue)	・Site survey －Jakar- Wangdi Survey of Hesothankha Regional Workshop －Wangdi - Thimphu				Site survey 2)*	Thimphu Mongar
15 (Wed)	・Discussion with MOWHS		Hearing for private construction companies		Site survey 3)*	Thimphu Trongsa
16 (Thr)	・Discussion with MOWHS（DOR）for M/D				Site survey 4)*	Thimphu
17 (Fri)	・Survey for Thimphu Central Store & Soil laboratory ・Survey for Thimphu sub workshop ・Consultation with FRMD ・Report to JICA/JOCV Bhutan Office					
18 (Sat)	-	・Data Collection				Thimphu
19 (Sun)		・Data collection		・Site survey －Thimphu-Phuentsholing		Thimphu
20 (Mon)	・Leave Bhutan	・Data collection		・Site survey －Survey for Phuentshling central store －Consultation with FRMD －Survey for RRCO		Thimphu Phuentsholin

(Rmark)
1)* Site survey Mongar – Limithang Mongar – Tashigang – Mongar Limithang Regional Workshop
2)* Site survey Tashigang Sub workshop Tashigang, FRMD
3)* Sitesurvry Mongar – Trongsa Limithang – Mongar
4)* Sitesurvey Tronga – Thimphu

Study Schedule (2/2)

Date (2003)	Movement & Activities				Stay
	Kitayama Leader/Road Maintenance Plan	Sasaki Road Machinery(1)	Nakaoka Procurement/ Cost Estimate	Ushida Road Machinery(2)	
Oct.21 (Tue)	・Data collection		・Site survey －Phuentsholing–Thimphu		Thimphu
22 (Wed)	Site survey 5)*	・Data collection	・Data collection	Site survey 5)*	Thimphu Trongsa
23 (Thr)	Site survey 6)*	・Data collection	・Data collection	Site survey 6)*	Thimphu Trongsa
24 (Fri)	Site survey 6)*	・Data collection	・Data collection	Site survey 6)*	Thimphu
25 (Sat)	・Data collection	・Site survey －Thimphu –Jakar	・Data collection		Thimphu Jakar
26 (Sun)	・Data collection	・Site survey －Jakar–Mongar	・Data collection		Thimphu Mongar
27 (Mon)	Consultation with DOR (Machinery Division), Conclusion with T/M	・Site survey Mongar–Limithang Survey for Limithang Rogional workshop Limithang–Jakar	・Data collection	- Meeting - Data analysis	Thimphu Jakar
28 (Tue)	Consultation with DOR (Machinery Division), Conclusion with T/M	・Site survey Jakar–Thimphu	・Data collection	Leave Bhutan	Thimphu
29 （Wed)	Meeting Data analysis				Thimphu
30 (Thr)	Meeting Data analysis				Thimphu
31 (Fri)	・Report to Joint Director, DOR and conclusion with T/M ・Report to JICA Office			-	Thimphu
Nov.1 (Sat)	・Paro–Bangkok				Bangkok
2 (Sub)	・Bangkok – Narita				Tokyo

(Remark)

5)* Site survey Hesothankha Rgional Workshop 及び Trongsa FRMD

6)* Site survey Trongsa & Tashigang FRMD

(2) Explanation on Draft Report of Basic Design Study

Study Schedule

Date	Movement & Activities			Stay
	JICA	Consultant		
	Sugimoto Leader	Kitayama Chief of Consultant/Road Maintenance Plan	Sasaki Road Machinery Plan (1)	
Dec.16 (Tue)	-	Narita (10:45)→BKK (15:40), TG647		Bangkok
17 (Wed)	-	Bangkok(06:50)→Paro (11:10), KB127		Thimphu
18 (Thr)	-	Discussion with JICA Office & Explanation to MOWHS, DADM		Thimphu
19 (Fri)	-	Consultation with MOWHS		Thimphu
20 (Sat)	-	Site survey		Thimphu
21 (Sun)	-	Site survey		Thimphu
22 (Mon)	Meeting with JICA Office as to M/D			
23 (Tue)	M/D Signing			
24 (Wed)	-	Site survey		Thimphu
25 (Thr)	-	Report to JICA Office		Thimphu
26 (Fri)	-	Paro (09:30)→BKK (14:50), KB124		Bangkok
27 (Sat)	-	Bangkok (11:20)→Narita (19:00), TG642		Tokyo

[Appendix 3] List of Parties Concerned

(1) Department of Aid & Debt Management (DADM)

Mr. Pema Chewang	Officiating Director

(2) Ministry of Works & Human Settlement（MOWHS）

Mr. Tsering Dorji	Secretary

(3) MOWHS Department Road (DOR) Headquarter

Mr. Phuntsho Wangdi	Director
Mr. Sonam Dorji	Joint Director (Mechanical Division)
Mr. Tshering Wangdi	Superintending Engineer (Road Division)
Mr. Kunzang Wangdi	Superintending Engineer (Survey & Design Division)
Mr. M.N. Lamichaney	Superintending Engineer (Bridge Division)
Mr. Phuba Gyelsshen	Executive Engineer (Mechanical Division)

(4) MOWHS (DOR), Local

Mr. Sangay Dorji	Regional Manager (Hesothangkha Regional Workshop)
Mr. Tshewang Phuntsho	Regional Manager (Lingmethang Regional Workshop)
Mr. Tshering Wangdi	Executive Engineer (EE) (Thimphu Field Road Maintenance Division (FRMD))
Mr. Tashi Norbu	EE (Lobeysa FRMD)
Mr. Dago Kencho	EE(Trongsa FRMD)
Mr. Jigme Dorji	EE(Limithang FRMD)
Mr. Tshcten Dorji	EE(Phuentsholing FRMD)
Mr. Tshering Cyeltshen	EE(Tashigang FRMD)
Mr. Nima Tshering	Store officer (Phuentsholing center store, DOR)
Mr. Shacha Gyeltsmen	AE (Thimphu center store, DOR)
Mr. Tharchin Lhendup	Deputy Collector (Customs office)

(5) JAPAN SIDE

Masatoshi SASAKI	JICA Expert (Bridge Engineering, DOR)
Yukio KAMATANI	JICA Senior Overseas Volunteer (Maintenance Technology of Construction Equipment Hesothangkha Regional Workshop)
Shigeo HAYASHI	JICA Senior Overseas Volunteer (Road Engineering, DOR)

(6) JICA/JOCV Bhutan Office

Yasuyuki MORI	Resident Representative
Yusuke KUBO	Project Formulation Advisor

[Appendix 4] Minutes of Discussion

(1) Basic Design Study

Minutes of Discussions
on the Basic Design Study
on the Project for Improvement of Equipment
for Road Construction and Maintenance
in the Kingdom of Bhutan

Based on the results of the Preparatory Study which was held on January 2003, the Government of Japan decided to conduct a Basic Design Study on the Project for Improvement of Equipment for Road Construction and Maintenance (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to the Kingdom of Bhutan (hereinafter referred to as "Bhutan") the Basic Design Study Team (hereinafter referred to as "the Team"), headed by Mr. Hiroyuki Hayashi, an Officer of the Third Project Management Division, the Grant Aid Management Department, JICA, and is scheduled to stay in the country from October 10 to November 1, 2003.

The Team held discussions with the officials concerned of the Government of Bhutan and conducted a field survey at the study area.

In the course of the discussions and field survey, both sides have confirmed the main items described in the attached sheets. The Team will proceed to further works and prepare the Basic Design Study Report.

Thimphu, October 16, 2003

Hiroyuki Hayashi
Leader
Basic Design Study Team
Japan International Cooperation Agency

Tshering Dorji
Secretary
Ministry of Works & Human Settlement
Kingdom of Bhutan

Witness:

Yasuyuki Mori
Resident Representative
Bhutan Office
Japan International Cooperation Agency

Pema Chewang
Officiating Director
Department of Aid & Debt Management
Ministry of Finance
Kingdom of Bhutan

ATTACHMENT

1. Objective

The objective of the Project is to improve and maintain roads in Bhutan by procuring the equipment for road construction and maintenance.

2. Project Site

The sites of the Project are shown in Annex-1.

3. Responsible and Implementing Organizations

(1) The responsible organization is the Ministry of Works and Human Settlement (hereinafter referred to as "MOWHS").

(2) The implementing agency is the Department of Roads (hereinafter referred to as "DOR"), MOWHS.

The organization chart of the implementing agency is shown in Annex-2.

4. Items Requested by the Government of Bhutan

After discussions with the Team, the items described in Annex-3 were finally requested by the Bhutanese side. JICA will assess the appropriateness of the request and will recommend to the Government of Japan for approval.

5. Japan's Grant Aid Scheme

(1) The Bhutanese side understands the Japan's Grant Aid scheme and the necessary measures to be taken by the Government of Bhutan explained by the Team as described in Annex-4.

(2) The Bhutanese side shall take necessary measures, as described in Annex-5, for smooth implementation of the Project as a condition for the Japan's Grant Aid to be implemented.

6. Schedule of the study

(1) The consultants will proceed to further studies in Bhutan by November 1, 2003.

(2) JICA will prepare the draft report in English and dispatch a team to Bhutan in order to explain its contents around the middle of December 2003.

(3) In case that the contents of the report are accepted in principle by the Government of Bhutan, JICA will complete the final report and send it to the Government of Bhutan by March 2004.

7. Other Relevant Issues

(1) The Bhutanese side shall submit detailed operation and allocation plan for the requested equipments described in Annex-3 by October 27, 2003.

(2) The equipments shall be used mainly for maintenance and recovery of damages caused by natural disaster (such as landslides and snow slips) of the existing roads. The Team will study the type, specification, and quantity of each equipment based on the above-mentioned condition.

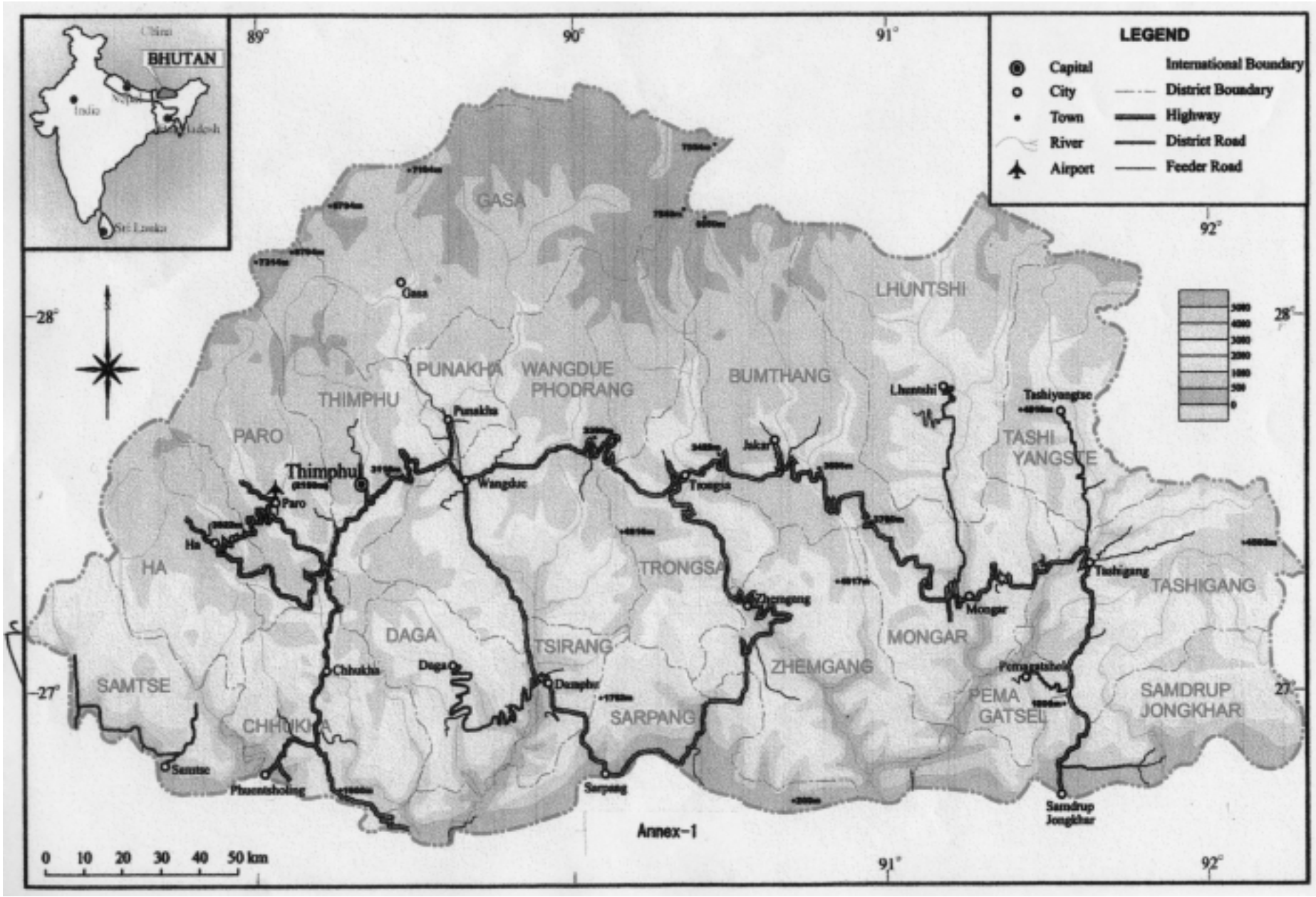
(3) The installation work of the equipments, such as asphalt mixing plant, crane, etc. shall be done by the Bhutanese side, if needed.

(4) The Ministry of Works & Human Settlement shall allocate necessary budget from the Mechanical Division's Current Account of the Department of Roads to set up the oily water separator in the Hesothanka and Lingmethang Regional Workshop by the end of February 2005.

(5) The training equipment, such as LCD projector, screen, TV monitor, training aid and software, and etc, shall be excluded from the Project.

(6) The Bhutan side requested the Team to include the On-the-Job-Training (OJT) for the equipments in the Hesothanka and Lingmethang Regional Workshop into the Project. The Team will study the contents and necessary period of the OJT and show the results in the draft report.

(7) The Bhutanese side shall provide necessary number of counterpart personnel to the Japanese side during the installation and workout period for the procured equipment to obtain their operation skills.


BHUTAN
India
89°
90°
91°
92°
28°
27°
LEGEND
Capital
City
Town
River
Airport
International Boundary
District Boundary
Highway
District Road
Feeder Road
GASA
PUNAKHA
WANGDUE PHODRANG
BUMTHANG
LHUNTSHI
TASHI YANGSTE
THIMPHU
PARO
HA
TRONGSA
TASHIGANG
DAGA
TSIRANG
MONGAR
ZHEMGANG
SAMTSE
CHHUKHA
SARPANG
PEMA GATSEL
SAMDRUP JONGKHAR
Gasa
Punakha
Thimphu
Paro
Ha
Wangduc
Trongsa
Jakar
Lhuentse
Tashiyangtse
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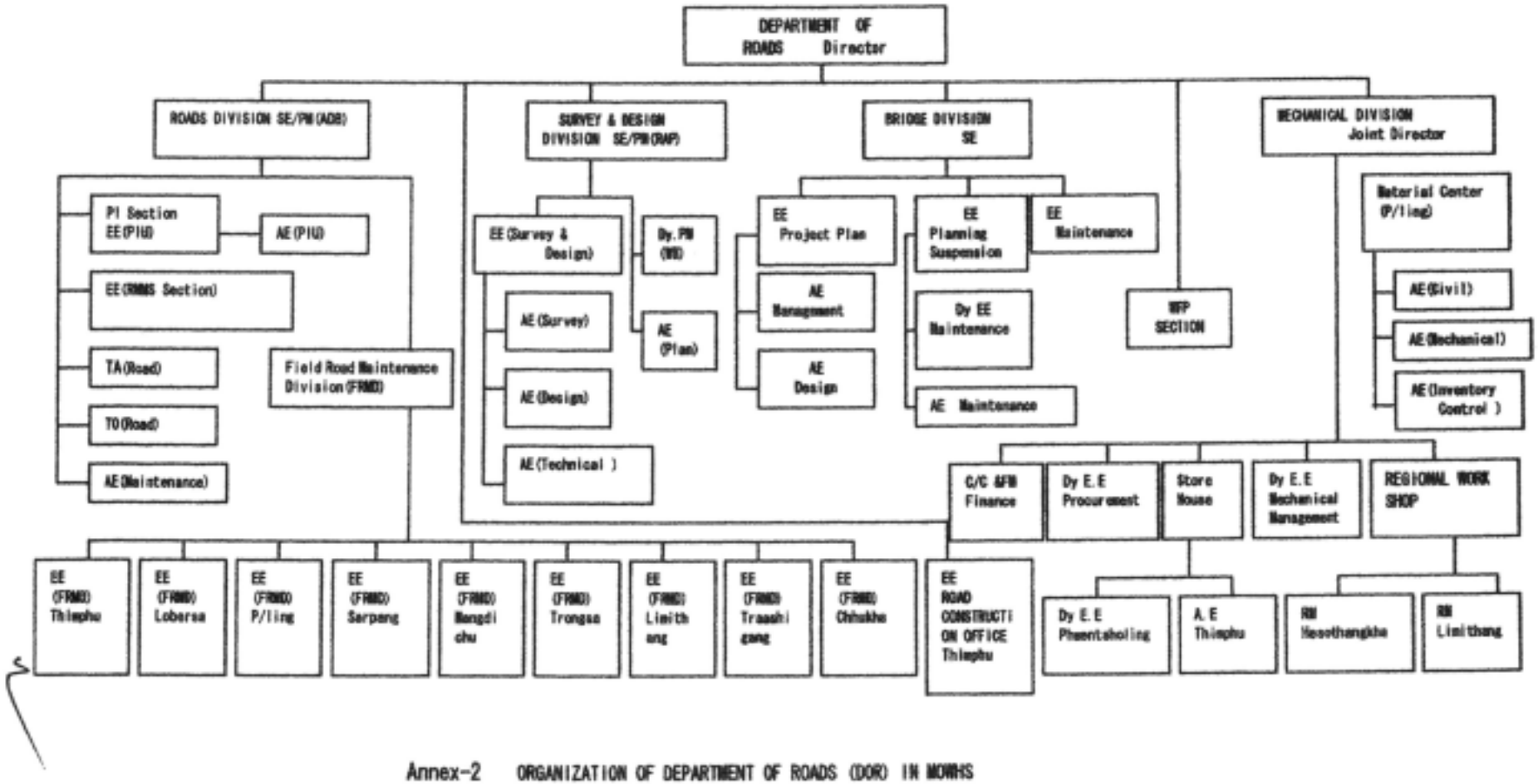
0 10 20 30 40 50 km
Annex-1



Annex-2 ORGANIZATION OF DEPARTMENT OF ROADS (DOR) IN MOWHS

Annex –3 Items Requested by the Government of Bhutan

No.	Description		Q'ty	Priority			Remarks
				A	B	C	
①	1. Generator	55 kVA	2	○			1)*
	~~2. Air Compressor, Rotary~~		~~0~~				Deleted
	~~3. Bull Dozer ——— Medium size —— Small size~~	~~110 HP~~	~~4~~				Deleted
		~~—~~	~~0~~				Deleted
	4. Excavator Medium size	20 ton	8	○			2)*
	Small size	12 ton	4	○			Two number for the each regional workshop
	5. Back Hoe Loader	90-100 HP	2	○			1)*
	6. Breaker with engine	25 kg	10		○		3)*
	7. Breaker attachment for Excavator	—	2	○			1)*
	~~8. Grip Coupler attachment for Excavator~~	~~—~~	~~0~~				Deleted
	~~9. Pneumatic Crawler Drill with~~	~~—~~	~~4~~				Deleted
	10. Motor Grader	135 HP	2	○			1)*
	11. Wheel Loader	120-130HP	8	○			2)*
	12. Dump Truck	8-10 ton	16	○			Two number for the each FRMD without Chhukha
②	13. Vibrator Road Roller (Tandem type)	8 ton	2	○			1)*
	14. Tire Roller	8 ton	2	○			1)*
	15. Hand Guide Roller	—	8	○			2)*
	16. Vibrator Plate Compactor	60-80 kg	8	○			2)*
③	~~17. Bitumen Heating Kettle~~	~~3,000 lit.~~	~~3~~				Deleted
	18. Asphalt Distributor	3,000 lit.	2	○			1)*
	19. Mobile Crushing Plant	20-30 ton / hr	2	○			1)*
	20. Asphalt Mobile Mixer	8-10 ton/hr	2	○			1)*
	21. Asphalt Finisher (Crawler type)	2.5-4.5m (width)	2	○			1)*
	22. Mechanical Chip Spreader	12 mm dia.	2	○			1)*
	~~23. Sweeper Truck mounted/ Tractor~~	~~—~~	~~0~~				Deleted
④	24. Cement Concrete Mixer Vehicle	4 m^3	2	○			1)*
⑤	25. Rough Terrain Crain	25 ton	1	○			4)*
	26. Fuel Tanker	6,000 lit.	2	○			1)*
	27. Truck with Mounted Crane	3 ton (Crane)	2	○			1)*
	28. Self Loading Short Body Truck (6x4)	18 ton	1	○			4)*
	~~29. Hydraulic Operated Recovery Van~~	~~8-10 ton~~	~~1~~				Deleted
⑥	30. Service car (cab type)	4 x 4	4	○			Two number for the each regional workshop
	31. Single Cab Cargo Car	4 x 4	8	○			2)*
	32. Bridge Inspection Vehicle (Arm length: 6~8m)	—	1		○		4)*
	33. Maintenance equipment for Workshop	—	1				
34. Spare parts for the above equipment		—	1	○			

Legend: ①:Machinery for Earth work, □:Machinery for compaction, ③: Machinery for Pavement work, ④: Cement Concrete, ⑤: Machinery for transport, ⑥: Machinery for repair and management

Note: 1)* :One number for the each regional workshop, 2)*: One number for the each FRMD without Chhukha, 3) *: One number for the each FRMD without Chhukha and the each regional workshop, 4)*: One number for Hesothangkha workshop

JAPAN'S GRANT AID

The Grant Aid Scheme 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.

1. Grant Aid Procedures

Japan's Grant Aid Scheme is executed through the following procedures.

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

Firstly, the application or request for a Grant Aid project 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 Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA (Japan International Cooperation Agency) to conduct a study on the request.

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

Thirdly, the Government of Japan appraises the project to see whether or not it is suitable for Japan's Grant Aid Scheme, based on the Basic Design Study report prepared by JICA, and the results are then submitted to the Cabinet for approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes (E/N) signed by the Governments of Japan and the recipient country.

Finally, for the implementation of the project, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

2. Basic Design Study

(1) Contents of the study

The aim of the Basic Design Study (hereafter referred to as "the Study") conducted by JICA on a requested project (hereafter referred to as "the Project") is to provide a basic document necessary for the appraisal of the Project by the Government of Japan. The contents of the Study are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of agencies concerned of the recipient country necessary for the Project's implementation.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, social and economic point of view.
- Confirmation of items agreed on by both parties concerning the basic concept of the Project.
- Preparation of a basic design of the Project.
- Estimation of 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 the 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 though 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 through the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Study, JICA uses (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms. The firm(s) selected carry(ies) out a Basic Design Study and write(s) a report, based upon terms of reference set by JICA. The consultant firm(s) used for the Study is (are) recommended by JICA to the recipient country to also work on the Project's implementation after the Exchange of Notes, in order to maintain technical consistency.

3.Japan's Grant Aid Scheme

(1) 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.

(2) "The period of the Grant Aid" means the one fiscal year, which the Cabinet approves, the Project for. Within the fiscal year, all procedures such as exchanging of the Notes, concluding contracts with (a) consultant firm(s) and (a) contractor(s) and final payment to them must be completed. However, in case of delays in delivery, installation or construction due to unforeseen factors such as national disaster, 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.

(3) 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, constructing and 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.)

(4) Necessity of "Verification"

The Government of 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.

(5) Undertakings required of the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as the following:

a) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the construction,

b) To provide facilities for the distribution of electricity, water supply and drainage and other incidental facilities in and around the sites,

c) To secure buildings prior to the procurement in case the installation of the equipment,

d) To ensure all the expenses and prompt excursion for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid,

e) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts,

f) To accord Japanese nationals, whose services may be required in connection with the supply of the products and services under the Verified contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.

(6) "Proper Use"

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

(7) "Re-export"

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

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "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 payments will be made when payment requests are presented by the Bank to the Government of Japan under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

(9) Authorization to Pay (A/P)

The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions to the Bank.

(End)

Annex-5

Major Undertakings to be taken by Each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	To bear the following commissions to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
2	To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country		
	1) Marine and land transportation of the products from Japan to the recipient country	●	
	2) Tax exemption and custom clearance of the products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
3	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contact, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.		●
4	To exempt Japanese nationals from customs 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 verified contracts		●
5	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid		●
6	To bear all the expenses, other than those to be borne by the Grant Aid, necessary for the transportation and installation of the equipment		●

(B/A: Banking Arrangement, A/P: Authorization to pay)

(2) Explanation on Report of Basic Design Study

Minutes of Discussions
on the Basic Design Study Draft Report
on the Project for Improvement of Equipment
for Road Construction and Maintenance
in the Kingdom of Bhutan

In October 2003, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Basic Design Study Team on the Project for Improvement of Equipment for Road Construction and Maintenance (hereinafter referred to as "the Project") to the Kingdom of Bhutan (hereinafter referred to as "Bhutan"), and based on through discussions, field survey and technical examination of the results in Japan, JICA prepared a draft report of the study.

In order to explain and to consult with the officials concerned of the Government of Bhutan on the components of the draft report, JICA sent to Bhutan the Basic Design Study Team (hereinafter referred to as "the Team"), headed by Mr. Mitsukuni Sugimoto, Resident Representative of the JICA Bhutan Office, from December 17 to 26, 2003.

In the course of the discussions, both sides confirmed the main items described in the attached sheets.

Thimphu, December 23, 2003

Mitsukuni Sugimoto
Leader
Basic Design Study Team
Japan International Cooperation Agency

Tshering Dorji
Secretary
Ministry of Works and Human Settlement
Kingdom of Bhutan

Witness:

Nima Wangdi
Director
Department of Aid & Debt Management
Ministry of Finance
Kingdom of Bhutan

ATTACHMENT

1. Objective

The objective of the Project is to improve and maintain roads in Bhutan by procuring the equipment for road construction and maintenance.

2. Project Site

The sites of the Project are shown in Annex-1.

3. Responsible and Implementing Organizations

(1) The responsible organization is the Ministry of Works and Human Settlement (hereinafter referred to as "MOWHS").

(2) The implementing agency is the Department of Roads (hereinafter referred to as "DOR"), MOWHS.

The organization chart of the implementing agency is shown in Annex-2.

4. Items Requested by the Government of Bhutan

After discussions with the Team, the items described in Annex-3 were finally requested by the Bhutanese side. JICA will assess the appropriateness of the request and will recommend to the Government of Japan for approval.

5. Japan's Grant Aid Scheme

(1) The Bhutanese side understands the Japan's Grant Aid scheme and the necessary measures to be taken by the Government of Bhutan explained by the Team as described in Annex-4.

(2) The Bhutanese side shall take necessary measures, as described in Annex-5, for smooth implementation of the Project as a condition for the Japan's Grant Aid to be implemented.

6. Schedule of the study

(1) The consultants will proceed to further studies in Bhutan by November 1, 2003.

(2) JICA will prepare the draft report in English and dispatch a team to Bhutan in order to explain its contents around the middle of December 2003.

(3) In case that the contents of the report are accepted in principle by the Government of Bhutan, JICA will complete the final report and send it to the Government of Bhutan by March 2004.

7. Other Relevant Issues

(1) The Bhutanese side shall submit detailed operation and allocation plan for the requested equipments described in Annex-3 by October 27, 2003.

(2) The equipments shall be used mainly for maintenance and recovery of damages caused by natural disaster (such as landslides and snow slips) of the existing roads. The Team will study the type, specification, and quantity of each equipment based on the above-mentioned condition.

(3) The installation work of the equipments, such as asphalt mixing plant, crane, etc. shall be done by the Bhutanese side, if needed.

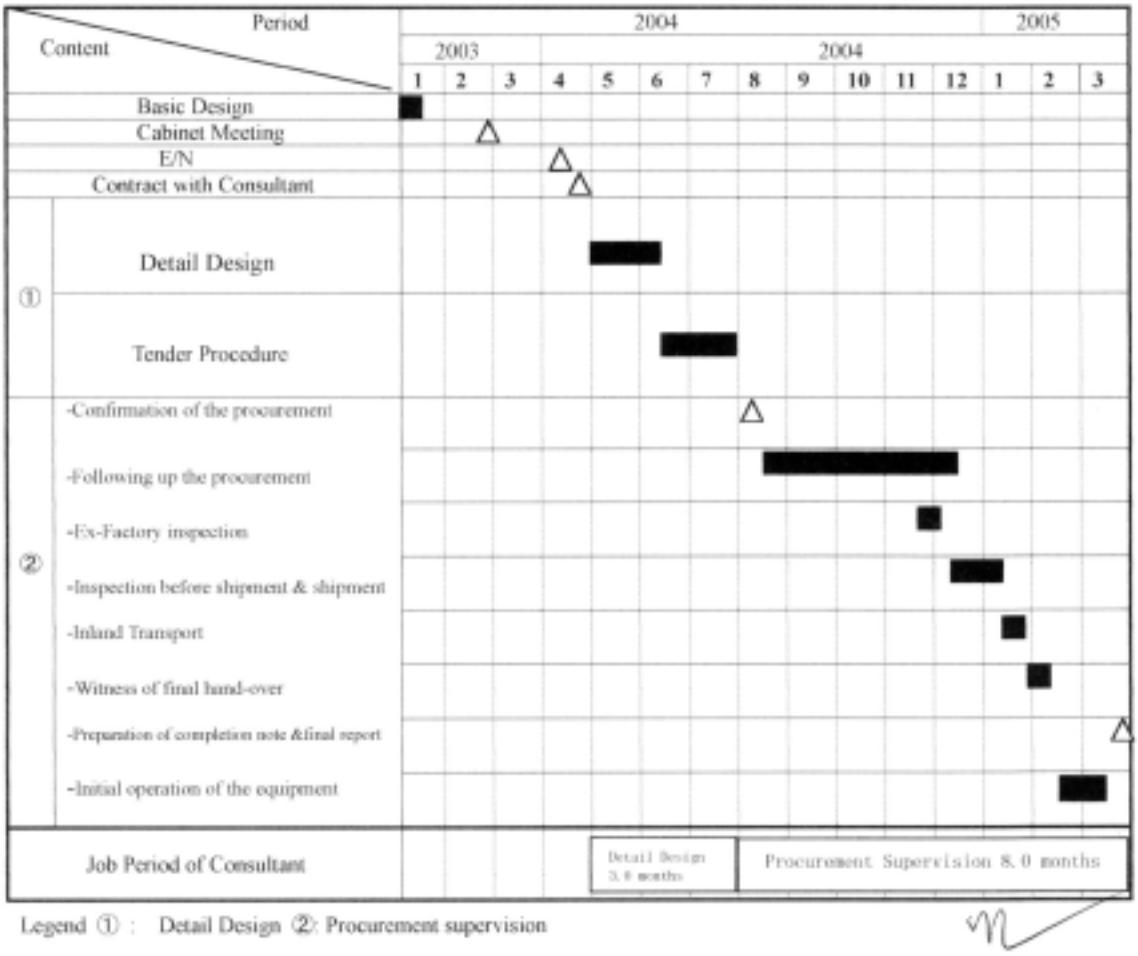
(4) The Ministry of Works & Human Settlement shall allocate necessary budget from the Mechanical Division's Current Account of the Department of Roads to set up the oily water separator in the Hesothanka and Lingmethang Regional Workshop by the end of February 2005.

(5) The training equipment, such as LCD projector, screen, TV monitor, training aid and software, and etc, shall be excluded from the Project.

(6) The Bhutan side requested the Team to include the On-the-Job-Training (OJT) for the equipments in the Hesothanka and Lingmethang Regional Workshop into the Project. The Team will study the contents and necessary period of the OJT and show the results in the draft report.

(7) The Bhutanese side shall provide necessary number of counterpart personnel to the Japanese side during the installation and workout period for the procured equipment to obtain their operation skills.

ANNEX-1 Implementation Schedule



Legend ① : Detail Design ②: Procurement supervision

Existing Condition of Construction Equipment in Hesothangkha Regional Workshop (1/4)

No.	Equipment Name	No. of Management Section	Registration No.	Fund Source	Year	Specifi-cation	Working Hour Hr/Km	Estimated Condition Remaining Working Life (Year)
1	Air Compressor	DoR/1982/VT250/20	-	RGOB	1982	8.5m3/Min	38,023H	Workable sometimes, Difficult Repair W-(0.5)
2	Air Compressor	DoR/1997/VT250/74	-	RGOB	1997	8.5m3/Min	34,265H	Workable W-(2)
3	Air Compressor	DoR/1997/VT250/75	-	RGOB	1997	8.5m3/Min	33,952H	Workable W-(2)
4	Air Compressor	-	-	RGOB	1999	8.5m3/Min	38,216H	No problem G
5	Air Compressor	DoR/2001/CPS300/82	-	RGOB	2001	8.5m3/Min	2,525H	No problem G
6	Air Compressor	DoR/2001/CPS300/83	-	RGOB	2001	8.5m3/Min	2,423H	No problem G
7	Air Compressor	DoR/2002/CPS300/84	-	RGOB	2002	8.5m3/Min	2,367H	No problem G
8	Air Compressor	DoR/2002/CPS300/86	-	ADB	2002	8.5m3/Min	390H	No problem G
9	Asphalt Finisher	Hanta	BG-4-0089	Japan Grant 2	1997	40~60HP	1,321H	No problem, Being standby G
10	Asphalt Kettle	-	BG-4-0090	Japan Grant 2	1997	4KL	-	No problem, Being standby G
11	Backhoe Loader	-	BG-1-0394	ADB	2003	60~80HP	159H	No problem, New equipment G
12	Bulldozer	DoR/1985/CatD7G/34	BG-2-0149	ADB	1985	200HP	12,960H	S
13	Bulldozer	DoR/1986/CatD6D/53	BG-3-0010	ADB	1986	175HP	12,240H	S
14	Bulldozer	DoR/1989/CatD4H/48	BG-1-0155	Japan Grant 1	1989	82HP	10,862H	Workable sometimes, Difficult Repair W-(1)
15	Bulldozer	DoR/1989/Catd4H/49	BG-1-0024	Japan Grant 1	1989	82HP	11,245H	Workable sometimes, Difficult Repair W-(1)
16	Bulldozer	DoR/1989/Catd4H/50	BG-1-0201	Japan Grant 1	1989	82HP	10,234H	Workable sometimes, Difficult Repair W-(1)
17	Bulldozer	DoR/1997/Catd5M/83	BG-2-0235	Japan Grant 2	1997	110HP	8,136H	Workable G-(3)
18	Bulldozer	DoR/1997/Catd5M/84	BG-2-0238	Japan Grant 2	1997	110HP	6,541H	Workable G-(3)
19	Bulldozer	DoR/1997/Catd5M/85	BG-2-0237	Japan Grant 2	1997	110HP	8,216H	Workable G-(3)
20	Bulldozer	DoR/1997/Catd5M/86	BG-2-0234	Japan Grant 2	1997	110HP	8,446H	Workable G-(3)
21	Bulldozer	DoR/1997/Catd5M/87	BG-2-0236	Japan Grant 2	1997	110HP	7,653H	Workable G-(3)
22	Bulldozer	DoR/1987/IHTD20/42	BG-4-0020	UNCDF	1990	200HP	12,560H	S
23	Dump Truck	-	BG-2-0401	KOICA	2001	8ton	57,708km	No problem, New equipment G
24	Excavator	DoR/1995/Cat320/4	BG-1-0021	Aust.	1995	153HP	11,193H	Workable G-(3)
25	Excavator	DoR/1997/Cat312B/7	BG-2-0248	Japan Grant 2	1997	84HP	7,563H	Workable G-(3)
26	Excavator	DoR/1997/Cat312B/8	BG-2-0249	Japan Grant 2	1997	84HP	10,231H	Workable G-(3)
27	Excavator	DoR/1997/Cat312B/9	BG-2-0250	Japan Grant 2	1997	84HP	9,121H	Workable G-(3)
28	Excavator	DoR/2002/Cat320CL/13	BG-2-0247	RGOB	2002	153HP	1,689H	No problem, New equipment G
29	Excavator	DoR/1982/IH640/2	BG-1-0390	UNDP	1982	153HP	25,241H	S
30	Excavator	DoR/1987/PC-60/5	BG-1-0011	AMC,Paro	1987	54HP	18,245H	S
31	Excavator	DoR/2001/PC-200/11	BG-2-0389	RGOB	2001	153HP	3,757H	No problem, New equipment G

(Note) G : Good FG : Good, but to be trouble sometimes W : Workable, but difficult repairing due to obsolescence and high repairing cost economically
S : Scrap ( ) : ( ) figure in the brackets indicating the remaining working year

Existing Condition of Construction Equipment in Hesothangkha Regional Workshop (2/4)

No.	Equipment Name	No. of Management Section	Registration No.	Fund Source	Year	Specifi-cation	Working Hour Hr/Km	Estimated Condition Remaining Working Life (Year)
32	Excavator	DoR/2000/PC-120-6/10	BG-2-0372	RGOB	2000	84HP	5,070H	G
33	Fuel Tanker	-	BG-3-0031	RGOB	2002	6kL	224,132km	Workable sometimes, Difficult Repair W-(1)
34	Hino Dump Truck	-	BG-3-0032	Japan Grant 1	1989	8ton	215,432km	Workable sometimes, Difficult Repair W-(1)
35	Hino Dump Truck	-	BG-3-0028	Japan Grant 1	1989	8ton	201,547km	Workable sometimes, Difficult Repair W-(1)
36	Hino Dump Truck	-	BG-1-0148	Japan Grant 1	1989	8ton	201,421km	Workable sometimes, Difficult Repair W-(1)
37	Motor Grader	DoR/1989/CAT-130/5	BG-1-0102	ADB	1993	95HP	9,821H	Workable, Difficult Repair W-(2)
38	Motor Grader	DoR/1989/CAT-130/7	BG-4-0005	ADB	1993	95HP	9,254H	Workable, Difficult Repair W-(2)
39	Motor Grader	DoR/1989/MG-330/4	BG-1-0160	Japan Grant 1	1989	137HP	12,321H	Transmission & Engine Deficiency S
40	Nissan Dump Truck	-	BG-1-0075	ADB	1989	8ton	267,854km	High Cost Repair, Switch Deficiency W-(1)
41	Nissan Dump Truck	-	BG-1-0107	ADB	1989	8ton	301,214km	High Cost Repair, Switch Deficiency W-(1)
42	Nissan Dump Truck	-	BG-2-0344	RGOB	2000	10ton	39,906km	No problem G
43	Nissan Dump Truck	-	BG-2-0304	RGOB	2000	10ton	40,215km	No problem G
44	Nissan Dump Truck	-	BG-2-0304	RGOB	2000	10ton	39,542km	No problem G
45	Nissan Dump Truck	-	BG-2-0339	RGOB	2000	10ton	40,531km	No problem G
46	Nissan Dump Truck	-	BG-2-0304	RGOB	2000	10ton	33,214km	No problem G
47	Nissan Dump Truck	-	BG-1-0110	ADB	1989	8ton	295,214km	High Cost Repair、Switch Deficiency W-(1)
48	Nissan Dump Truck	-	BG-2-0342	RGOB	2000	10ton	120,673km	No problem G
49	Nissan Trailer	-	BG-3-0044	ADB	1989	8ton	86,709km	Refabrcated W-(1)
50	Wheel Loader	DoR/1985/CAT930/3	BG-1-0015	AMC Paro	1987	130~140HP	21,548H	Workable, Difficult Repair W-(2)
51	Wheel Loader	DoR/1985/CAT930/5	BG-1-0046	ADB	1985	130~140HP	20,158H	Workable, Difficult Repair W-(2)
52	Wheel Loader	DoR/1985/CAT930/6	BG-4-0049	ADB	1985	130~140HP	23,546H	Workable, Difficult Repair W-(2)
53	Wheel Loader	DoR/1988/CAT926/13	BG-100141	ADB	1988	110~120HP	19,254H	Workable, Difficult Repair W-(2)
54	Wheel Loader	DoR/1988/CAT 926/16	BG-3-0017	ADB	1988	110~120HP	18,972H	Workable, Difficult Repair W-(2)
55	Wheel Loader	DoR/1988/CAT926/18	BG-1-0081	ADB	1988	110~120HP	19,872H	Workable, Difficult Repair W-(2)
56	Wheel Loader	DoR/1989/CAT910/30	BG-1-0030	Japan Grant 1	1989	80HP	16,854H	Workable, Difficult Repair W-(2)
57	Wheel Loader	DoR/1989/CAT910/24	BG-1-0162	Japan Grant 1	1989	90~100HP	16,254H	Workable, Difficult Repair W-(2)
58	Wheel Loader	DoR/1989/CAT916/26	BG-4-0009	Japan Grant 1	1989	90~100HP	15,784H	Workable, Difficult Repair W-(2)
59	Wheel Loader	DoR/1989/CAT916/27	BG-4-0003	Japan Grant 1	1989	90~100HP	19,253H	Workable, Difficult Repair W-(2)
60	Wheel Loader	DoR/1997/CAT928F/43	BG-2-0244	Japan Grant 2	1997	120HP	9,524H	No problem in 3 years G-(3)
61	Wheel Loader	DoR/1997/CAT928F/44	BG-2-0242	Japan Grant 2	1997	120HP	10,486H	No problem in 3 years G-(3)
62	Wheel Loader	DoR/1997/CAT928F/45	BG-2-0247	Japan Grant 2	1997	120HP	8,901H	No problem in 3 years G-(3)

(Note) G : Good FG : Good, but to be trouble sometimes W : Workable, but difficult repairing due to obsolescence and high repairing cost economically
S : Scrap ( ) : ( ) figure in the brackets indicating the remaining working year

Existing Condition of Construction Equipment in Hesothangkha Regional Workshop (3/4)

No.	Equipment Name	No. of Management Section	Registration No.	Fund Source	Year	Specifi-cation	Working Hour Hr/Km	Estimated Condition Remaining Working Life (Year)
63	Wheel Loader	DoR/1997/CAT928F/46	BG-2-0243	Japan Grant 2	1997	120HP	10,366H	No problem in 3 years G-(3)
64	Wheel Loader	DoR/1997/CAT928F/48	BG-2-0245	Japan Grant 2	1997	120HP	11,723H	No problem in 3 years G-(3)
65	Wheel Loader	DoR/1997/CAT928F/50	BG-2-0246	Japan Grant 2	1997	120HP	10,986H	No problem in 3 years G-(3)
66	Road Roller	DoR/1997/BP/55	BG-1-0009	RGOB	1997	60~80HP	3,524H	Much Trouble in Tata Equipment FG-(3)
67	Road Roller	DoR/1997/BP/56	BG-3-0053	RGOB	1998	60~80HP	2,954H	Much Trouble in Tata Equipment FG-(3)
68	Road Roller	DoR/1997/BP/58	BG-1-0019	RGOB	1999	60～80HP	2,641H	Much Trouble in Tata Equipment FG-(3)
69	Road Roller	DoR/1988/CS551/35	BG-1-0158	ADB	1988	100~140HP	9,102H	High cost by Difficult Repair W-(2)
70	Road Roller	DoR/1988/CS551/36	BG-4-0010	ADB	1988	100~140HP	8,952H	High cost by Difficult Repair W-(2)
71	Road Roller	DoR/1988/CS551/37	BG-1-0016	ADB	1993	100~140HP	9,525H	High cost by Difficult Repair W-(2)
72	Road Roller	DoR/1988/CS551/39	BG-1-0159	ADB	1993	100~140HP	7,562H	High cost by Difficult Repair W-(2)
73	Road Roller	DoR/1989/SV-91/40	BG-1-0103	Japan Grant 1	1989	100~140HP	8,421H	Workable sometimes, Difficult Repair W-(1)
74	Road Roller	DoR/1989/SV-91/42	BG-1-0064	Japan Grant 1	1989	100~140HP	9,961H	Workable sometimes, Difficult Repair W-(1)
75	Road Roller	DoR/1999/SCR/63	BG-1-0304	RGOB	1999	60~80HP	2,101H	No problem G
76	Road Roller	DoR/1999/SCR/64	BG-1-0305	RGOB	1999	60~80HP	2,068H	No problem G
77	Road Roller	DoR/1999/SCR/65	BG-3-0061	RGOB	1999	60~80HP	2,021H	No problem G
78	Road Roller	DoR/2002/SCP/66	BG-2-0406	RGOB	2002	60~80HP	2,270H	No problem G
79	Truck with crane	-	BG-2-0255	Japan Grant 2	1997	8ton	114,521km	No problem G
80	Truck with crane	-	BG-2-0254	Japan Grant 2	1997	8ton	115,428km	No problem G
81	Truck with crane	-	BG-3-0003	ADB	1989	8ton	186,521km	- S
82	Service Van	-	BG-1-0078	UNCDF	1990	8ton	154,214km	High cost by Difficult Repair W-(2)
83	Service Van	-	BG-1-0241	UNCDF	1994	8ton	165,212km	High cost by Difficult Repair W-(2)
84	Spot Mixer Plant	DoR/2001/SMP/06	-	RGOB	2001	10/16TPH	-	Indian Made Scrap in 1 year W-(1)
85	Spot Mixer Plant	DoR/2001/SMP/07	-	RGOB	2001	10/16TPH	-	Engine Cylinder Broken S
86	Spot Mixer Plant	PWD/1991/HM/04	-	RGOB	1991	6/10TPH	-	Engine Broken S
87	TaTa Mini Truck	-	BG-1-0228	RGOB	1994	3ton	162,415km	Indian Made, Clutch Change Everyweek W-(1)
88	TaTa Mini Truck	-	BG-1-0256	Aust.Govt.	1997	3ton	262,451km	Indian Made, Clutch Change Everyweek W-(1)
89	TaTa Dump Truck	-	BG-1-0200	RGOB	1988	8ton	198,541km	Indian Dump, Not Workable within 1 Year W-(1)
90	TaTa Dump Truck	-	BG-4-0053	RGOB	1985	8ton	235,612km	Indian Dump, Not Workable within 1 Year W-(1)
91	TaTa Dump Truck	-	BG-1-0227	Aust.Govt.	1995	8ton	166,802km	Indian Dump, Not Workable within 1 Year W-(1)
92	TaTa Dump Truck	-	BG-4-0062	UNCDF	1994	8ton	221,542km	Indian Dump, Not Workable within 1 Year W-(1)
93	TaTa Dump Truck	-	BG-4-0063	UNCDF	1995	8ton	216,573km	Indian Dump, Not Workable within 1 Year W-(1)

(Note) G : Good FG : Good, but to be trouble sometimes W : Workable, but difficult repairing due to obsolescence and high repairing cost economically
S : Scrap ( ) : ( ) figure in the brackets indicating the remaining working year

Existing Condition of Construction Equipment in Hesothangkha Regional Workshop (4/4)

No.	Equipment Name	No. of Management Section	Registration No.	Fund Source	Year	Specifi-cation	Working Hour Hr/Km	Estimated Condition Remaining Working Life (Year)
94	TaTa Dump Truck	-	BG-1-0226	Aust.Govt.	1995	8ton	171,234km	Indian Dump, Not Workable within 1 Year W-(1)
95	TaTa Dump Truck	-	BG-2-0154T	RGOB	1984	8ton	249,521km	Indian Dump, Not Workable within 1 Year W-(1)
96	TaTa Dump Truck	-	BG-4-0060	UNCDF	1995	8ton	105,000km	Indian Dump, Not Workable within 1 Year W-(1)
97	TaTa Dump Truck	-	BG-2-0154G	RGOB	1988	8ton	189,781km	G
98	TaTa Dump Truck	-	BG-1-0198	RGOB	1989	8ton	201,554km	Indian Dump, Not Workable within 1 Year W-(1)
99	TaTa Dump Truck	-	BG-2-0029	WFP	1993	8ton	101,174km	Indian Dump, Not Workable within 1 Year W-(1)
100	TaTa Dump Truck	-	BG-2-0059	RGOB	1993	8ton	100,971km	Indian Dump, Not Workable within 1 Year W-(1)
101	TaTa Dump Truck	-	BG-2-0028	WFP	1993	8ton	108,321km	Indian Dump, Not Workable within 1 Year W-(1)
102	TaTa Dump Truck	-	BG-2-0027	WFP	1993	8ton	126,701km	Indian Dump, Not Workable within 1 Year W-(1)
103	Mixer Truck	-	BG-4-0073	UNCDF	1996	4cubic m.	56,481km	Indian Dump, Not Workable within 2 Year W-(2)
104	Water Tanker	-	BG-1-0147	ADB	1989	6KL	158,624km	Indian Dump, Much Trouble in Engine W-(2)
105	Water Tanker	-	BG-4-0075	WFP	1996	6KL	127,321km	Indian Dump, Much Trouble in Engine W-(2)
106	Water Tanker	-	BG-4-0067	UNCDF	1995	6KL	112,412km	Indian Dump, Much Trouble in Engine W-(2)
107	Water Tanker	-	BG-3-0049	AMC Paro	1996	6KL	128,453km	Indian Dump, Much Trouble in Engine W-(2)
108	Water Tanker	-	BG-2-0019	WFP	1996	6KL	128,641km	Indian Dump, Much Trouble in Engine W-(2)
109	Workshop Van	-	BG-2-0155	UNCDF	1990	8ton	31,201km	High cost by Difficult Repair W-(2)
110	Workshop Van	-	BG-2-0152	UNCDF	1989	8ton	75,621km	High cost by Difficult Repair W-(2)
111	Isuzu Truck	-	BG-1-0026	UNCDF	1989	8ton	36,215km	Workable sometimes, Difficult Repair W-(2)
112	Isuzu Truck	-	BG-1-0258	UNCDF	1989	8ton	35,473km	Workable sometimes, Difficult Repair W-(2)
113	Generator	-	-	RGOB	1992	-	-	G
114	Generator	-	-	ADB	2002	-	-	G
115	Generator	-	-	ADB	2002	-	-	G
116	Generator	-	-	Indian Grant	2002	-	-	G
117	Hi-lux	-	BG-1-0298	RGOB	1989	-	250,960km	W-(1)
118	Hi-lux	-	BG-1-0856	Aust.	1998	-	102,084km	FG
119	Hi-lux	-	BG-4-0099	UNCDF	1996	-	195,229km	FG
120	Pick-up	-	BG-1-0645	Japan Grant 2	1997	-	158,599km	FG
121	Rover	-	BG-1-0727	UNCDF	1995	-	141,615km	FG
122	Asphalt Distributor	-	BG-4-0090	Japan Grant 2	1997	-	32,150km	G

(Note) G : Good FG : Good, but to be trouble sometimes W : Workable, but difficult repairing due to obsolescence and high repairing cost economically
S : Scrap ( ) : ( ) figure in the brackets indicating the remaining working year

Existing Condition of Construction Equipment in Limithang Regional Workshop (1/2)

No.	Equipment Name	Model	No. of Management Section	Registration No.	Fund Source	Year	Specifi-cation	Working Hour Hr/Km	Estimated Condition Remaining Working Life (Year)
1	Bulldozer	IHDT12E	DoR/1986/IH/ TD 12/40	BG-2-0147	UNDP	1986	90	16,320H	W-(1) Workable sometimes
2	Bulldozer	IHDT20E	DoR/1987/IH TD 20/41	BG-4-0017	UNCUNCDFDF	1987	120	23,040H	W-(1) Engine Overhoul 3 Times
3	Bulldozer	D4G	-	BG-1-0393	ADB	2003	84	47H	G
4	Bulldozer	D4H	DoR/1989/Cat D4H/51	BG-4-0013	Japan Grant I	1989	80	20,160H	W-(2) Engine Overhoul 3 Times
5	Bulldozer	D5M XL	DoR/1987/Cat D5M/82	BG-2-0239	Japan Grant II	1997	85	6,207H	FG-(3) Engine Overhaul, Steering & Hydloulic System Refabricated
6	Excavator	Cat 3128	DoR/1997/Cat 312B/6	BG-2-0251	Japan Grant II	1997	85	9,171H	
7	Fuel Tanker	CP12ELRT	-	BG-4-0151	ADB	1989	95	257,806km	W-(4)
8	Fuel Tanker	CP12ELRT	-	BG-4-0012	ADB	1989	95	304,826km	W-(2)
9	Isuzu Pick-up		-	BG-1-0647	Japan Grant II	1997	-	110,621km	W-(0)
10	Motor Grader	130G	DoR/1989/CAT-130G/7	BG-4-0005	ADB	1989	100	13,440H	W-(0)
11	Nissan Dump Tru	CP12ELRT	-	BG-1-0176	ADB	1989	95	260,146km	W-(1) Quite Old around Power Shaft, Workable sometimes
12	Nissan Dump Tru	CP12ELRT	-	BG-1-0144	ADB	1989	95	330,640km	
13	Nissan Dump Tru	CP12ELRT	-	BG-1-0145	ADB	1989	95	347,886km	
14	Tata Tipper	1210SK/32	-	BG-4-0044	RGOB	1984	-	-	S
15	Tata Tipper	1210SK/32	-	BG-4-0043	RGOB	1984	-	-	S
16	Tata Tipper	1210SK/32	-	BG-4-0025	RGOB	1984	-	133,228km	S
17	Tata Tipper	1210SK/32	-	BG-4-0011	RGOB	1985	-	63,185km	S
18	Tata Tipper	1210SK/32	-	BG-1-0175	RGOB	1985	-	11,688km	S
19	Tata Tipper	1612SE	-	BG-4-0064	UNCDF	1994	-	372,651km	S
20	Tata Tipper	1612SE	-	BG-4-0065	UNCDF	1994	-	16,731km	G
21	Tata Tipper	1612SE	-	BG-4-0066	UNCDF	1994	-	213,523km	FG
22	Wheel Loader	Cat 910	DoR/1989/CAT 910/33	BG-4-0020	Japan Grant I	1989	85	13,440H	S
23	Wheel Loader	Cat 910	DoR/1989/CAT 910/31	BG-1-0106	Japan Grant I	1989	85	12,800H	W-(1)
24	Wheel Loader	Cat 916	DoR/1989/CAT 916/25	BG-4-0017	Japan Grant I	1989	90	20,160H	W-(1)
25	Wheel Loader	Cat 928F	DoR/1997/CAT 928F/47	BG-2-0240	Japan Grant II	1997	95	11,334H	FG-(3)
26	Wheel Loader	Cat 928F	DoR/1997/CAT 928F/49	BG-2-0241	Japan Grant II	1997	95	10,687H	FG-(3)
27	Wheel Loader	IH515B	DoR/1987/IH-515B/12	BG-4-0015	UNDP	1987	85	23,040H	S

(Note) G : Good FG : Good, but to be trouble sometimes W : Workable, but difficult repairing due to obsolescence and high repairing cost economically
S : Scrap ( ) : ( ) figure in the brackets indicating the remaining working year

Existing Condition of Construction Equipment in Limithang Regional Workshop (2/2)

No.	Equipment Name	Model	No. of Management Section	Registration No.	Fund Source	Year	Specifi-cation	Working Hour Hr/Km	Estimated Condition Remaining Working Life (Year)
28	Backhoe Loader	Cat 416	DoR/1988/Cat 416/20	BG-2-0157	ADB	1988	65	13,640H	S
29	Backhoe Loader	Cat 416B	DoR/1994/Cat 416B/40	BG-4-0059	UNCDF	1994	65	13,300H	W-(1) Workable sometimes
30	Road Roller	CS551	DoR/1988/CS 551/34	BG-4-0006	ADB	1988	90	13,200H	W-(0.5) Workable sometimes
31	Truck with crane	GT3HHKA	-	BG-2-0256	Japan Grant	1997	90	166,611km	FG-(3)
32	Workshop Van	JALHTS	-	BG-1-0146	UNCDF	1989	100	201,600km	S
33	Generator	-	DOR/1992/GEN/05	-	RGOB	1992	-	-	G
34	Generator	-	DOR/1992/GEN/08	-	RGOB	1992	-	-	G
35	Generator	-	DOR/1992/GEN/09	-	RGOB	1992	-	-	G
36	Mixer Truck	Tata	-	BG-4-0070	UNCDF	1996	4cubic m.	58,214km	W(2)
37	Mixer Truck	Tata	-	BG-4-0071	UNCDF	1996	4cubic m.	41,396km	G
38	Hi-lux	Toyota	-	BG-4-0054	UNCDF	1994	-	222,898km	FG
39	Hi-lux	Toyota	-	BG-4-0123	RGOB	1998	-	110,519km	FG
40	Pick-up	Isuzu	-	BG-1-0647	Japan Grant II	1997	-	96,662km	FG

(Note) G : Good FG : Good, but to be trouble sometimes W : Workable, but difficult repairing due to obsolescence and high repairing cost economically
S : Scrap ( ) : ( ) figure in the brackets indicating the remaining working year

Existing Condition of Construction Equipment in Phuentsholing Workshop

No.	Equipment Name	Model	No. of Management Section	Registration No.	Fund Source	Year	Specifi-cation	Working Hour Hr/Km	Estimated Condition Remaining Working Life (Year)
1	Rough Terrain Cra	Kato KR250	BG-20010	-	Japan Grant I	1989	-	1,888H	Defect of crane operation
2	Truck with crane	Hino GT3HHKA	BG-2-0233	-	Japan Grant II	1997	-	205,725km	FG
3	Forklift	Toyota	BG-2-0252	-	Japan Grant II	1997	-	2,901H	G
4	Van	Maruti	BG-1-0731	-	Aust	1997	-	105,992km	FG
5	Truck with trailer	Hino Motors	Bg-2-0232	-	Japan Grant II	1997	-	136,264km	FG
6	Longbody Truck	TATA-1210 SE/42	BG-2-0172	-	RGOB	1993	-	211,993km	W
7	Longbody Truck	TATA-1210 SE	BG-2-0031	-	WFP	1993	-	261,324km	W

(Note) G : Good FG : Good, but to be trouble sometimes W : Workable, but difficult repairing due to obsolescence and high repairing cost economically
S : Scrap ( ) : ( ) figure in the brackets indicating the remaining working year