Public Works (PW)
Ministry of Construction
Republic of the Union of Myanmar

PREPARATORY SURVEY REPORT
ON
THE PROJECT FOR IMPROVEMENT OF ROAD CONSTRUCTION AND MAINTENANCE EQUIPMENT IN RAKHINE STATE
IN
REPUBLIC OF THE UNION OF MYANMAR

February 2014

JAPAN INTERNATIONAL COOPERATION AGENCY

(JICA)

YACHIYO ENGINEERING CO., LTD

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrust the survey to Yachiyo Engineering Co., Ltd.

The survey team held a series of discussions with the officials concerned of the Government of Republic of the Union of Myanmar, and conducted field investigations. As a result of further studies in Japan, 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.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Myanmar for their close cooperation extended to the survey team.

February, 2014

Kazunori MIURA
Director General,
Economic Infrastructure Department
Japan International Cooperation Agency

SUMMARY

① Overview of Myanmar

Republic of the Union of Myanmar (hereinafter referred to as “Myanmar”) shares borders with China, Thailand, Laos, India and Bangladesh and is a multiethnic country with a population of 64.95 million people (IMF estimate value in 2013). Myanmar’s land area is 680 thousand square kilometers and is approximately 1.8 times larger than Japan. The Ayeyarwady river runs through their central area. Myanmar is situated in the monsoon belt and it has three distinct seasons, namely the dry season from the end of October to March, the very hot season in April and May, and the rainy season from June to the middle of October.

The nominal GDP in 2013 is approximately 59.4 billion USD, and the GDP growth rate is more than 10% per year according to the government and 6.8% according to the IMF. Moreover, per capita GDP in 2013 is USD 914 according to the IMF.

The main industry of Myanmar is agriculture. The rate of agriculture in the country is gradually declining but still account for nearly 40% of country’s all industries. On the other hand, the rate of manufacturing industry is currently increasing and is about to reach 20% the GDP. According to the IMF, each rate by industry is 39% in the primary sector (agriculture 38%, mining industry 1%), 24% in the secondary sector (manufacturing industry 19%, construction industry 5%) and 37% in the tertiary sector (commerce 21%, transportation and telecommunication 14%, public administration 1%, others 1%), respectively.

② Background and Outline of the Project

Having more than 135 ethnic groups, Myanmar is one of the most ethnically diverse countries in the world. Following independence in 1948, various ethnic groups launched armed struggle against the government seeking more active assistance, greater self-rule and complete autonomy and so on, however, the government promoted reconciliation with the armed groups from the 1990s, and the current administration that came to power in March 2011 has actively sought to reach ceasefire and peace agreements with ethnic minorities with a view to realizing national unification.

The Project target area of Rakhine State is a frontier province on the border with Bangladesh. The primary industry of agriculture is characterized by low productivity and local development is slowed down as a result of a lack of irrigation facilities and issues concerning land use rights. Also, since the annual rainfall of 6,000 millimeters is largely concentrated in the rainy season, there is frequent destruction and inundation of roads and loss of bridges, leading to great inconvenience in local transportation. Moreover, in the north of the state, where many repatriated refugees enter from Bangladesh, there is a lot of poverty and living conditions are extremely poor.

In view of these conditions, the Government of Myanmar on August 7, 2012 submitted an official request for grant aid concerning the supply of equipment for road construction and maintenance in Rakhine State and also Kayin State, where there are especially high numbers of repatriated

citizens and local development has been slow.

In response to the request, the Government of Japan consigned JICA to implement the Preparatory Survey for the fiscal 2012 Project for Provision of Road Construction and Maintenance Equipment in Rakhine and Kayin State. However, due to the deterioration of civil order in Rakhine State from June 2012 and continuation of this situation into the survey, Rakhine State was omitted from the Project components in October 2012, thereby leaving Kayin State as the sole target of the assistance. However, considering that road improvement is of vital and urgent importance for improving the lives of citizens in Rakhine State, it was decided to implement the survey anew in fiscal 2013 in view of the latest civil order situation.

In the first field survey, Public Works, which is the implementation agency of the Project, proposed the following three routes as priority sections in the Project:

- First priority section: Toungup – Ann (Approximately 140km)
- Second priority section: Tandwe - Ngathaningchang (Approximately 182km)
- Third priority section: Minbyar - Pauktaw (Approximately 34km)

In the field survey, upon considering Public Works's proposed sections, examination was conducted on the urgency and beneficial effects of works from the viewpoint of local development. As a result, it was concluded that the first priority section between Toungup – Ann should be the Project target road, and agreement was reached with Public Works about procuring equipment for construction and maintenance on this section.

③ Outline of the Survey Findings and Contents of the Project

Japan International Cooperation Agency (hereinafter referred to as the "JICA") dispatched the study team to Myanmar from 1st to 29th September 2013 as a first field survey. The study team confirmed contents requested by Myanmar side for the Project and conducted field surveys at target sites where the Public Works which is the implementation agency of Myanmar government plans road construction by its own budget in Rakhine State. After being back in Japan, the study team analyzed their survey result, conducted the outline design and cost estimation of the Project. Based on their result, the study team conducted the survey in Myanmar for explanation of the outline design to Public Works from 12th to 20th December 2013.

The equipment to be procured in the Project will comprise items needed to construct and maintain 140 kilometers of the north-south road by Public Works (the Project target road, see the site map at the beginning of the report) connecting Toungup and Ann in Rakhine State.

Furthermore, the Project will conduct a Soft Component (Technical Assistance) to introduce a database control system and to conduct pilot road construction and training of bridge inspection so that Public Works can acquire the method to control equipment to be procured in the Project more efficiently.

The contents of equipment procurement in the project are described below.

Table-1 Contents of the Assistance

	Equipment	Quantity	Remarks
1	Bridge Inspection Vehicle	1	
2	Motor Grader	2	
3	Excavator (crawler)	2	
4	Wheel Loader	2	
5	Wheel Excavator	2	
6	Bulldozer (crawler)	2	
7	Sheep Foot Compactor	2	
8	Vibratory Tandem Roller	4	
9	Bitumen Distributor	2	
10	Asphalt Kettle	2	
11	Mobile Workshop	2	
12	Water Bowser (Tanker)	2	
13	Dump Truck	12	
14	Cab-back Crane	2	
15	Low bed Semi-trailer (with Tractor Head)	1	
16	Mobile Crusher	2	
17	Inspection Vehicle	2	
18	Asphalt Hand Sprayer	10	
19	Desktop Computer	2	For Soft Component
20	Database Software	1	Ditto

④ Project period and cost estimation

The project period is approximately 19 months including the detailed design, bidding and equipment procurement. The project cost to be borne by the Myanmar side is estimated to be 18.39 billion Japanese yen (18.5 million USD) for the road construction targeted in Rakhine State, preparation of the storage for equipment and the banking commission.

⑤ Project Evaluation

- **Relevance**

Japanese government set the major support fields for Myanmar to assist to spread the result of democracy, reconciliation within the country and economic revolution to all nationals living in Myanmar.

1. Improve quality of life for all nationals. (including ethnic minorities, poverty households and development of urban and rural area)
2. Capacity development for human resources and maintenance of regulations for economic and social development.

3. Infrastructure and regulation for sustainable economic growth

The Project covers 1 and 3 mentioned above, and it is suitable for directions of Japanese major support fields.

The Project target road runs north-south in the central region of Rakhine State and forms a part of the arterial roads running north-south in the state. The Project will contribute to the development of arterial roads of the whole country since it will ensure a stable traffic flow between north and south of the state, and also connects to Ayeyarwady Region neighboring to the south-east, and subsequently to Yangon, economic center in Myanmar.

Moreover, Public Works intends to develop an arterial road from Minbu, (in Magway Region adjacent to the east to the state) to Sittwe (the capital of the state) via Ann (the northern end of the Project target road) , Mrauk-u and Kyauktaw (northern parts of the state). (See Figure 3-4.1)

Development of the Project target road and the road section between Ann and Sittwe will cover approximately two-thirds of the total length of the roads running north-south of the state.

As mentioned above, the Project is in line with the road development strategy of the Public Works, considered to contribute largely to the regional development not only in the Project target area but also in the whole state.

- **Effectiveness**

Approximately 62,000 people live along the Project target road, and the Project can provide direct benefit to those people.

It is expected that improvement of the target road is going to increase driving speed from current 25km/hr. to 60km/hr. This increase enables to cut travel time between Toungup and Ann to two and half hour.

Table-2 shows quantitative effects of the Project.

Table-2 Quantitative effects of the Project

Indicator	Baseline,2013	Target, 2018
Average driving speed on the target road（km/h）	Approx. 25km/h	Approx. 60km/h
Total length of road improvement on the target road（km）	0km	Approx. 140km

Public Works will measure the average driving speed indicated in the above table by actual driving in the target year 2018.

In addition to abovementioned quantitative effects, after developing the target road, various qualitative effects are expected, such as making goods transportation more efficient, improving traffic in rainy season and traffic safety, improving accessibility to medical services in an emergency, reducing transportation costs, revitalizing local economic activities and so on.

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Abbreviations

CE	Chief Engineer
CTC	Central Training Center
DCE	Deputy Chief Engineer
DMD	Deputy Managing Director
DSE	Deputy Superintending Engineer
EE	Executive Engineer
LBT	Labor Based Technology
MD	Managing Director
MES	Myanmar Engineering Society
MoC	Ministry of Construction
MoBA	Ministry of Border Affairs
MTC	Mechanical Training Center
PW	Public Works
RRL	Road Research Laboratory
SRL	Soil Testing and Research Laboratory
SE	Superintending Engineer
SEZ	Special Economic Zone

CHAPTER 1

BACKGROUND OF THE PROJECT

Chapter 1 Background of the Project

1-1 Current Conditions and Issues in the Sector

1-1-1 Current Conditions and Issues

Out of a total 146,000 kilometers of roads in the Republic of the Union of Myanmar (hereinafter referred to as “Myanmar”), paved roads account for just 20% (approximately 30,000 kilometers) of the total, and the country has been slow in constructing and maintaining arterial roads which act as lifelines for local people through the country.

Out of the said 146,000 kilometers of roads in Myanmar, approximately 27% are under the jurisdiction of the Ministry of Construction, and approximately 50% of those roads are paved (asphalt basic paving or concrete paving). Moreover, asphalt paving is not commonly seen on roads in Myanmar; rather, roads mainly have basic paving comprising a surface layer over the sub-base. Table 1-1.1 shows the length of road under jurisdiction of the Ministry of Construction according to the type of paving.

Table 1-1.1 Length of Roads under Jurisdiction of the Ministry of Construction (as of March 2013)

Type of Pavement	Road length（km）			Percentage
	Union Highway	Provincial Road	Total	
Bituminous Road	12,467	6,683	19,150	48%
Concrete Paved Road	654	51	705	2%
Crushed Rock Road	2,092	3,347	5,439	13%
Gravel Road	2,710	3,143	5,853	15%
Earth Road	1,699	6,155	7,854	20%
Others	18	763	781	2%
計	19,640	20,142	39,782	100%

Source: Public Works

The Project target area of Rakhine State is situated on the north-south axis along the coast of the Bay of Bengal in western Myanmar. During the rainy season, this area is battered by torrential rains and cyclones. It is one of the most underdeveloped states in terms of road construction in Myanmar. Roads to Magway Region and Bago Region in the east of the state have to cross the Arakan Mountains, however, during the rainy season, roads become inundated due to torrential rain and landslides are caused by unstable soil all over the state, making it hard to gain access not only to areas inside the state but also to neighboring districts. Accordingly, even main roads, which are the prime arteries of physical distribution, face appalling conditions and there is an urgent need to

upgrade existing roads and bridges.

Moreover, Public Works of the Ministry of Construction, which implements the construction and maintenance of major roads in Myanmar, is faced with shortages and deterioration of road construction equipment. In particular, compared to other districts and states, Rakhine State, where regional development has so far been slow, is faced with a poor road situation.

1-1-2 Development Plans

The Government of Myanmar has been advancing road construction and development based on the 30-year Road Development Plan for 2001 to 2030.

Within the Project, based on the understanding that road and bridge development makes a direct contribution to national development, Public Works of the Ministry of Construction (hereinafter referred to as the "Public Works") is implementing road development geared to the target year of 2030 assuming six phases of five years each.

Moreover, the Build-Operate-Transfer (BOT) style of project operation was adopted on main roads in Myanmar in 1996, and road construction and maintenance have been outsourced to the private sector based on this ever since. Private construction companies that bind BOT agreements with Public Works implement road construction and maintenance for 40 years, and they fund operations using tolls levied from passing vehicles. Out of the roads currently under the jurisdiction of Public Works, roughly 17% (in terms of length) are operated based on the BOT scheme.

Public Works aims to realize a road network made up of international trunk roads that comprise width of 48 feet (approximately 14.6m) and four lanes, key trunk roads that comprise width of 24 feet (approximately 7.3m) and two lanes, and single lane roads that comprise width of 12 feet (approximately 3.6m), by the end of the 30-year Road Development Plan. It also intends to replace all the many wooden bridges that can be seen in Myanmar within the period of the 30-year Road Development Plan. Table 1-1.2 shows the future length of road development and budget plans within this development plan.

Table 1-1.2 30-year Road Development Plan

Item	Upper row: Developed length (km), Bottom row: Budget (million Kyat)			
	Phase 3 2011 – 2015	Phase 4 2016 – 2020	Phase 5 2021 – 2025	Phase 6 2026 – 2030
International trunk road network	9,064	-	9,552	-
	375,333.99	-	1,821,153.80	-
Road repair works	7,172	4,435	-	5,318
	1,108,794.39	401,661.62	-	1,113,801.52
New road construction	1,684	-	-	-
	350,764.81	-	-	-
Total	17,920	4,435	9,552	5,318
	1,834,893.19	401,661.62	1,821,153.80	1,113,801.52

Remarks: The accounting year in Myanmar is from April 1 to the following March 31, as is also the case in Japan.
Source: Thirty year National Plan of Public Works (Road and Bridges), 26 June, 2012

The road targeted for development in Rakhine State based on the above plan (Rakhine State, Toungup to Ann) will pass through the state on the north-south axis and enable stable access to inland parts. This road is regarded as an important route in formation of the main domestic road network.

Against this background, the central government of Myanmar and the local government are in agreement that priority should be given in the 30-year Road Development Plan to the development of the road targeted in the Project.

1-1-3 Social and Economic Conditions

(1) Overview of Rakhine State

Rakhine State, one of the most undeveloped states in Myanmar, is surrounded by the Bay of Bengal and Rakhine Yoma, and it is very difficult to access it from other Myanmar regions or states in. On the other hand, Rakhine State has some development potentials: Thandwe as a leading beach resort; Murak-U as a heritage city; Kyaukphyu as a SEZ of oil and gas generation invested by Myanmar and China capitals.

Northern part of Rakhine State shares the border with Bangladesh. The incidents happened mainly in June and October 2012 promoted tensions between Buddhists and Muslims in northern part of the state.

Table 1-1.3 Comparison basic social data between Myanmar and Rakhine State

	Myanmar	Rakhine State
Population (thousand;2012)	Approx. 46,030 ppl	Approx. 2,968 ppl
Area	676,000 km^2	36,780 km^2
People	Mainly Burma and other ethnic minorities	Rakhine, Chin, Muslims and others
Adult literacy rate (2010)	90.6%	75.1%
Infant mortality rate (per 1000 ppl; 2011)	12.6 ppl	11.3 ppl
Unemployment rate (2010)	2%	6.7%
Poverty rate (2010)	26%	44%

Source: ”Area” : Myanmar Guide Map issued by D.P.S.
“People” of Rakhine State: Appendix 7-1
“Population” “Adult literacy rate”, ” Infant mortality rate”, “Unemployment rate”, ”Poverty rate”: Myanmar Information Management Unit

Rice makes about 80 % of the total agro crops produced in Rakhine State. Other crops are Sesames, ground nuts, Gamon, the leaf of chewing tobacco, potato for chips etc.

However, there is almost no processing factory in Rakhine, and the crops are transported to big cities like Mandalay or Yangon. Rakhine State is also known for its marine products.

As mentioned above, it is difficult to access Rakhine State due to the steep mountain paths and the coast surrounding the state. In order to enter the state by in-land transportation, local people should

go over the Rakhine Yoma and the mountain paths are not suitable for trucks with heavy materials. Besides, Rakhine State has heavy rain in the rainy season, and the roads are frequently damaged. Therefore, marine transportation is popular transportation in Rakhine. Although the marine transportation is inexpensive, it takes much time (around five to seven days are necessary to reach Yangon from Sittwe). As a result, marine products, one of the specialties of Rakhine, are hardly transported in fresh condition.

Bad roads conditions also hinder active in-land transportation in Rakhine State. Hence, there are piers in main cities and goods and materials are transported to those piers.

(2) Social Situation of Target Area

The target road of the Project is from Ann, the middle part of Rakhine state, to Toungup via Maei and it is approx. 140km. Ann and Toungup are the starting points connecting to other regions.

1) Ethnicity and religion

Approx. 93 % of the state population is Rakhine, and the rest is composed of Chin and Burma. A few Kachin, Karen, Mon people are, however, living around Toungup. (See Appendix 7-2)

Rakhine people are almost all Buddhists, and some temples are located along the roads. It is said that Chins are almost all Christians.

2) Main industry

Rice productions are relatively small due to mountainous nature of the area. Instead, we found rubber plants along the roads. Moreover, there are mangroves around the coastal area near Kyaukpyu. At mountains in Maei, eggs of Royal Orchid are gathered. They are served at enrollment and graduation ceremonies in schools.

3) Social services

a) Schools

There are 33 primary schools, three middle schools and five high schools along the target road. 13,553 students are enrolled in the schools and 520 teachers are working in the area (See Appendix 7-2). According to Education department of Rakhine state, 220 new constructions or renovations of school facilities are planned in this FY. As for the target area, 16 school facilities in Ann Township, and 12 school facilities in Toungup Township are planned for construction or renovation.

Students go to schools mainly by walk, bicycle, and side car (called “sai car”, bicycle based transportation mode of which a customer sits next to the rider).

In Toungup, second college in Rakhine state opened in December 2012. Currently the college gives five sciences and mathematics courses (chemistry, physics, mathematics, zoology, and botany), and three humanistic courses (Myanmar, history, and geology. English is also opened as

semi-course).

The university has 350 regular students, and 880 distance education students who come to the school mainly in weekends and holidays. Most of the regular students are from Toungup, and others are from Thandwe, Kyaukpyu, Manan, Ann and Gwa Townships.

There are two laboratories, one language laboratory, one computer room, and one gym, which are fully-equipped.

Other than school facilities, it is planned to construct staff quarter and small dam for water supply outside of the school area.

		
School building	Computer room	Small dam for water supply

Regular students coming from outside of Toungup basically stay at hostels near the school and it costs MMK 30,000/week. One way transportation costs MMK 5,000 between Ann-Toungup; MMK 7,000 – 8,000 between Manan – Toungup by boat and vehicle.

b) Hospital

Six Sub-regional Health Centers (SHC), four Regional Health Centers (RHC), and two hospitals are located along the target road and seven doctors, and 10 midwives are appointed. (See Appendix 7-2)

According to the Health Department of Rakhine State, the construction and renovation of 10 medical facilities are planned in this FY. The construction of three new SHCs is also planned in the target area.

Although a bit outside of the target area, 100 bedded hospital with special doctor in each medical field is located in Ann and playing an important role in providing medical service to the people.

Table 1-1.4 District Hospital, Ann Township (100 bedded hospital)

Medical officers and staff	Eight doctors, 23 nurses, and other 29 staff Total of 60 officers and staff.
Outpatients	Approx. 20ppl／day
General treatment provided by the hospital	Malaria, delivery, accidents (mainly by motorbike), trauma, treatment for illegal abortion
Serious patients	Most of the patients are sent to a hospital in Magway. The patients should pay additional MMK 100,000 for transportation.
Electricity	By generator Patients coming in night time should pay the oil costs.

Though it is graded as 100 bedded hospital, only 75 beds are working at this time. Medicines are transported from Sittwe, the capital of the state.

		
Hospital	Delivery room	Treatment room for minor cases

In Toungup, on the other hand, 50 bedded hospitals are located.

Table 1-1.5 Township hospital, Toungup Township (50 bedded hospital)

Medical officers	Seven doctors, including four doctors officially appointed in other city, 19 nurses
Outpatients	10–20ppl／day
General treatment provided by the hospital	Internal medicine, general and special delivery, surgery, dentistry
Serious patients	The patients are sent to Thandwe hospital with special doctor in each medical field. The patients should pay about MMK 50,000 for transportation cost.
Electricity	By generator. Thanks to the “Toungup regional development committee”, electricity is stably provided.

The hospital will be upgraded as 100 bedded hospital next FY. The hospital covers 20,010 villages, and 144,761 villagers and is comprised of delivery room, surgery room, inpatient wards (children, pregnant, men and women), outpatient ward, laboratory (general blood tests and urine tests), and fridge for vaccines.

		
Hospital	Surgery room	Dentistry room

1-1-4 Natural Conditions

Myanmar is situated in the monsoon belt and it has three distinct seasons, namely the dry season

from the end of October to March, the very hot season in April and May, and the rainy season from June to the middle of October.

Moreover, Myanmar suffers heavily from earthquakes and cyclones. In particular, the Project target area of Rakhine State, which faces the Bay of Bengal, together with Ayeyarwady Region, is directly affected by cyclones every year.

1-1-5 Environmental and Social Consideration

The Project aims to procure equipment and is deemed not to be linked to sectors or characteristics prone to causing impacts or areas prone to receiving impacts, and any undesirable environmental impacts are deemed to be minimal.

Road construction and maintenance work using the project equipment will be implemented according to the laws of Myanmar. The Government of Myanmar is currently preparing a law that describes environmental consideration study and related issues necessary when implementing projects.

Moreover, as a result of the field survey in Rakhine State, it has been confirmed that Public Works has secured ROW (Right of Way) for constructing a two-lane bituminous penetration method paved road over almost the entire section of the target road. Moreover, according to the current procedures in Myanmar, in cases where farmland or privately owned land is affected by road works, Public Works issues requests for land appropriation to the state government, which responds accordingly.

1-2 Background to and Outline of the Grant Aid

Having more than 135 ethnic groups, Myanmar is one of the most ethnically diverse countries in the world. Following independence in 1948, various ethnic groups launched armed struggle against the government seeking more active assistance, greater self-rule and complete autonomy and so on, however, the government promoted reconciliation with the armed groups from the 1990s, and the current administration that came to power in March 2011 has actively sought to reach ceasefire and peace agreements with ethnic minorities with a view to realizing national unification.

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request for grant aid concerning the supply of equipment for road construction and maintenance in Rakhine State and also Kayin State, where there are especially high numbers of repatriated citizens and local development has been slow.

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- First priority section: Toungup – Ann (Approximately 140km)
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- Third priority section: Minbyar - Pauktaw (Approximately 34km)

In the field survey, upon considering Public Works's proposed sections, examination was conducted on the urgency and beneficial effects of works from the viewpoint of local development. As a result, it was concluded that the first priority section between Toungup – Ann should be the Project target road, and agreement was reached with Public Works about procuring equipment for construction and maintenance on this section.

1-3 Trends of Japanese Assistance

(1) Japan's Assistance Policy

Japanese economic assistance to Myanmar has so far been conducted on a case by case basis with emphasis on basic human needs (BHN) projects while watching closely for democratization and improvements in human rights. However, from 2011 onwards, in light of the release of political detainees, the realization of direct dialogue between President Thein Sein and Aung San Suu Kyi, the signing of ceasefire agreements between the government and armed minority ethnic groups, and the realization of political participation by Aung San Suu Kyi and a wide array of other figures as a result of by-elections for the national diet on April 1, 2012, the Government of Japan decided to revise its policy of economic cooperation at that time.

Under the Government of Japan's new policy, it is intended to mainly implement assistance in the following fields to ensure that the benefits of democratization, national reconciliation and economic reform are widely imparted to the citizenry, while monitoring the progress of reform efforts. Japanese assistance thus aims to support reform efforts by Myanmar in a wide variety of fields geared to realizing democratization, national reconciliation and sustainable development.

① Assistance for improvement of the national standard of living (including support for ethnic minorities and impoverished people, agricultural development and local development)
② Assistance for capacity building of human resources and institutional development for supporting economy and society (including assistance of democratization)
③ Assistance for development of infrastructure systems required for sustainable economic growth

The Project is consistent with the first of the above policies, i.e. assistance for improvement of the national standard of living (including support for ethnic minorities and impoverished people, agricultural development and local development).

(2) Related Assistance Plans by Japan

Table 1-3.1 shows past projects that are similar to the one here.

Table 1-3.1 Past Similar Projects by Japan

Project Name	Procured Year (Procured Amount)	Implementing Agency	Project Outline	Remarks
The Project for Improvement of Kokang Living Environment in Notehrn Shan State (Grant Aid)	Fiscal 2001 (approx.. 584 million yen)	Progress of Border Areas and National races department (NATALA)	1) Procurement of road construction equipment (main items: motor grader, vibrating roller, tire roller, back hoe, dump truck, wheel loader, etc.) 2) Construction of equipment repair workshops 3) Pilot implementation of road repair works (approx. 10 km) 4) Soft Component concerning improvement of operation and maintenance and execution supervision capacity for procured equipment	Total length of roads targeted for repair : 71.64 km Of this, the pilot works section by the Japanese side is 10.04 km, and the section by the Myanmarese side is 61.6 km
Non-project Grant Aid for Flood Countermeasures	Fiscal 2012 (approx.. 1600 million yen)	Ministry of Construction	Procurement of road construction equipment (main items: motor grader, vibrating roller, tire roller, back hoe, dump truck, wheel loader, etc.)	Road repair work in Magway Region, Bago Region, Rakhine State, and Ayeyarwady Region
The Project for Provision of Road and Maintenance Equipment in Kayin State (Grant Aid)	Fiscal 2012 (approx.. 759 million yen)	Ministry of Construction, Ministry of Agriculture & Irrigation	1) Procurement of road construction equipment (main items: bulldozer, wheel loader, motor grader, vibrating roller, asphalt distributor, rough terrain crane, dump truck, mobile workshop, etc.) 2) Soft Component concerning improvement of operation and maintenance for procured equipment. - Introduce and training of equipment control system - Pilot road construction works (approx. 200 m)	Total length of targeted road: 146 km

As assistance relating to Public Works, Ministry of Construction, Japan is currently examining implementation of the Technical Cooperation Project, Grassroots Technical Cooperation Project, Emergency Development Survey and Sector Project Loan (see Table 1-3.2).

Concerning the Sector Project Loan, it is planned to conduct bridge rebuilding works in six locations in Rakhine State. Because these six bridges are all situated on the Project target road, it is anticipated that Japan's assistance plans will mutually complement each other in order to contribute to efficient road development in the target area.

Table 1-3.2 Related Assistance Plans by Japan

Item	Technical Cooperation Project	Grassroots Technical Cooperation	Urgent Development Survey	Sector Project Loan (SPL)
Project title	Development of Road Technology in Disaster Prone Areas	Human Resources Development Project of the Labour-intensive-type Road Improvement Works(Road Sufrace Treatment)in order to increase the job opportunities in Ayeyarwady-Delta Region	Comprehensive Development and Improvement Program for Ethnic Minorities in the Southeast Region	Regional Development Project for Poverty Reduction (Phase I)
Implementation status	Ongoing until August 2015	Ongoing until September 2014	Survey Completed	Started from October 2013
Project target area	Ayeyarwady Region	Ayeyarwady Region	Kayin State, Mon State	All regions and states
Project contents	Establishment of technical standards and training of engineers for road construction and maintenance	Transfer of technology for labor-intensive works	Regional development (roads, electric power, water)	Regional development (roads, electric power, water)
Implementing agency	Public Works, Ministry of Construction	Public Works, Ministry of Construction	State government	Public Works, Ministry of Construction, Ministry of Electric Power, state government

1-4 Assistance Trends of Other Donors

In the Project target area of Rakhine State, assistance activities by other donors and aid agencies are limited, however, the following activities are being implemented in the road and transport fields.

Table 1-4.1 Contents of Activities by Other Donors and International Agencies (Roads and Transport Field)

Donor/Agency	Project Area	Outline
Bridge Asia Japan (BAJ)	Northern Rakhine	It continues to implement assistance for infrastructure development in the fields of roads, bridges and water, etc. in the state capital of Sittwe and northern parts. In addition, BAJ conducts the construction of elementary schools all over Rakhine on the community level.
UNDP	Northern Rakhine (Minbyar, Pauktaw, Mrauk-U and so on)	It implements infrastructure development on the community level in a manner that brings Buddhists and Muslims together. So far it has built ponds and community roads linking villages and so on.
India	Northern Rakhine	It intends to conduct infrastructure development including development of Karadan Rivr in order to strengthen water and land transportation capacity between the state capital of Sittwe and India in the north. The Government of India and Government of Myanmar have signed an MOU and are advancing the works. An Indian company is executing the actual works, however, it is working jointly with local Myanmarese. Currently work is being conducted on the section between Karadan (Sittwe)→[Water channel: 7 hours~1 day]→Barawan (Chin)→[Land route]→Karawa (Chin)→[Land route]→Mizoram (India), and it is scheduled to be completed in two or three years.
China	Northern Rakhine	It is implementing a crude oil and gas pipeline project between Kyaukphyu in the middle of Rakhine State and Yunnan Province in China. Supply has already commenced over part of the pipeline. Moreover, this gas pipeline intersects with the Project target road (at a point approximately 30 kilometers south of Ann), and field survey has found that the construction of pipeline here have already been finished.
Korea	Rakhine State to Magway Region	In 2012, it implemented a feasibility study for road construction between Ann in Rakhine~Magway~Minbu. The study has already been finished, however, no concrete project plans have been compiled yet.

CHAPTER 2

CONTENTS OF THE PROJECT

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Superior Objective and Project Goals

Out of a total 146,000 kilometers of roads in Myanmar, paved roads account for just 20% (approximately 30,000 kilometers) of the total.

Against this background, the Government of Myanmar has been advancing road construction and development based on the 30-year Road Development Plan for 2001 to 2030. Based on the premise that development of the nation is dependent on the development of roads and bridges, the Ministry of Construction, which is responsible for the Project, has made the repair of existing roads, construction of new roads and promotion of an international trunk road network its fundamental objectives, and Public Works of the Ministry of Construction has the central role to play until the target year.

However, because Public Works, which implements construction and maintenance of trunk roads (approximately 53,000 kilometers), faces problems due to the absolute shortage and deterioration of road construction and maintenance equipment, the level of progress regarding road development is inadequate.

Moreover, in the Project target area of Rakhine State, which is situated on the coastal part of the Bay of Bengal in western Myanmar, the annual rainfall of 6,000 millimeters is largely concentrated in the rainy season. Accordingly, there is frequent destruction and inundation of roads and loss of bridges, etc. and the local residents are faced with major inconvenience and limitations on local transport and mobility during this period.

In order to attain the superior objective described above, the Project aims to provide road construction and maintenance equipment in Rakhine State, which has faces particularly slow development compared to the rest of the country. In doing so, the Project intends to promote the construction and maintenance of major roads (basic infrastructure for provincial areas) and promote local development in the target area. Through doing this, arterial state roads, which are an important element of infrastructure, will be secured and can be expected to lead to socioeconomic vitalization and improvement of living standards for citizens in the target area.

2-1-2 Outline of the Project

In order to achieve the aforementioned objectives, the Project aims to procure construction equipment necessary for Public Works (the implementing agency in Myanmar) to construct and maintain approximately 140 kilometers of the north-south road linking Toungup, Ma-ei and Ann in Rakhine State (the Project target road, see the site map at the beginning of the report). In addition, the soft component activities that are described in detail in section 3-2-4-8 (Soft Component Plan) will be implemented as part of the assistance to ensure the efficient operation and maintenance of equipment.

The contents of equipment procurement in the Project are described in Table 2-2.1.

Table 2-1.1 Quantity of Construction Equipment to be Procured

	Equipment	Quantity	Priority
1	Bridge Inspection Vehicle	1	A
2	Motor Grader	2	A
3	Excavator (crawler)	2	A
4	Wheel Loader	2	A
5	Wheel Excavator	2	A
6	Bulldozer (crawler)	2	A
7	Sheep Foot Compactor	2	A
8	Vibratory Tandem Roller	4	A
9	Bitumen Distributor	2	A
10	Asphalt Kettle	2	A
11	Mobile Workshop	2	A
12	Water Bowser (Tanker)	2	B
13	Dump Truck	12	B
14	Cab-back Crane	2	B
15	Low bed Semi-trailer (with Tractor Head)	1	B
16	Mobile Crusher	2	B
17	Inspection Vehicle	2	B
18	Asphalt Hand Sprayer	10	B
19	Desktop Computer	2	-
20	Database Software	1	-

Note) Priority A indicates the minimum required equipment for conducting construction and maintenance on the target road, while B denotes equipment that will be effective for improving the efficiency and quality of the works.

2-2 Outline Design of the Japanese Assistance

2-2-1 Design Policy

(1) Basic Policy

The equipment to be procured in the Project will comprise items necessary for Public Works to execute basic paving works on 140 kilometers (the Project target road, see the site map at the beginning of the report) connecting Toungup and Ann in Rakhine State.

In examining the composition, the types, specifications and quantities of equipment to be procured will be determined in view of the local conditions in Rakhine State based on the following conditions:

- Geographical conditions, soil quality and meteorological conditions in the area of the target road
- Current conditions of the target road
- Types, methods, scale and implementation schedule of works to be executed by Public Works

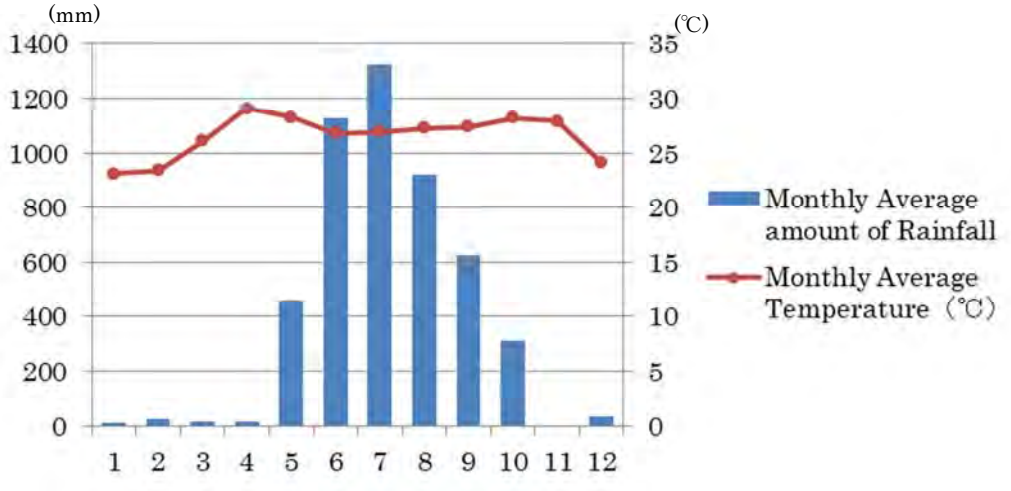
on the target road

- Situation regarding development of the equipment acceptance, operation and maintenance setup (organization, personnel, facilities, equipment, budget)
- Contents and conditions of the existing equipment owned by Public Works
- Situations of Myanmar in connection with import of equipment, for example, current conditions of harbor facilities and equipment, etc.
- Conditions of inland transportation of equipment, for example, transport routes and weight limitations, etc.
- Current conditions and setup of local private operators involved in after-sale services following the handover of equipment

(2) Policy regarding Natural Environmental Conditions

In the Project target area, the dry season lasts from October to March and the rainy season is from April to September, and most of the annual rainfall of approximately 5,000 millimeters falls during the rainy season. In view of these natural conditions, since it is undesirable to conduct the main paving works during the rainy season in terms of quality control, the equipment procurement will be planned so that works can be commenced at the beginning of the dry season.

The following table shows average rainfall and average temperatures over the past five years (2007~2011) in the Project target area of Toungup in Rakhine State.



Source: Prepared by the Study Team based on meteorological data from the Department of Meteorology and Hydrology, Myanmar

Figure 2-2.1 Meteorological Data in the Target Area of Rakhine State

(3) Policy regarding Construction and Procurement Conditions

In Myanmar, it is normal for the Public Works under the Ministry of Construction (the road manager) to directly conduct the construction and maintenance of roads. Concerning the Project target road too, since the implementing agency, Public Works, constructs and maintains roads through deploying its own budget, personnel and construction materials and so on, the relevance of

the works components on the target road will be confirmed upon considering the works performance and budget allocation of the Public Works Roads Department and Bridges Department, which are the direct implementing departments.

(4) Policy regarding Utilization of Local Contractors

As was mentioned in the section on the policy regarding construction and procurement conditions, it is normal for the Public Works under the Ministry of Construction to directly conduct the construction and maintenance of roads.

Since there are numerous rock quarries located close to the target works site, Public Works itself will locally procure all crushed rock required for the base / sub-base course roadbed works, etc.

(5) Policy regarding Operation and Maintenance

Guidance concerning the initial operation and maintenance of the Project equipment will be conducted in OJT by instructors from manufacturers according to operation and maintenance manuals when handing over the equipment. In addition to this guidance, a soft component aimed at introducing a computerized and efficient equipment control system will be planned to ensure the sustainable operation and maintenance of the equipment after handover.

(6) Policy regarding the Grade of Equipment

In light of the above policies and results of site survey on the target road, the preconditions for configuring the Project equipment will be as indicated below.

- The total length of the target road is 140 kilometers between Toungup and Ann in Rakhine State.
- The construction period covered of the Project will be three years.
- Since the target road passes along flat section in hilly area, normal construction equipment such as excavator, bulldozer is effective on the site.
- Main works of the Project are earth work and basic paving works.
- During the rainy season, since almost the entire area becomes inundated, it will be difficult to conduct works. Accordingly, the available works period is around six months in the year.
- Public Works will be planning the construction by two-units: Road construction special unit No. 8 on Toungup and Airfield construction special unit No.8 on Ann will carry out improvement of the target road.
- Basic paving of the target road will be improved to 1 lane (12 feet wide), 1.5 lane (18 feet wide), and 2 lanes (24 feet wide) step by step.

In light of the above conditions, the Project equipment will mainly comprise construction and maintenance equipment for general civil engineering works as well as basic paving equipment. Also,

Bridge Inspection Vehicle, mobile workshop for maintaining equipment on sites, trailers necessary for moving equipment around sites, and other backup equipment will be added to ensure that the minimum required items for the target road works are provided.

(7) Policy regarding Implementation Schedule

Regarding the condition of the target road section of 140 kilometers between Toungup and Ann as of September 2013, road width of 6~9 meters has been constructed and the paved width is approximately 3.6 meters. As for the structure of paving, pen-mac pavement accounts for approximately 24% and crushed stone macadam pavement accounts for 76%.

Public Works has compiled a 30-year plan for road improvement over this section. According to this, it is intended to conduct works according to the following three stages with the effects of construction being realized in each stage:

① Stage 1: Implement pen-mac paving with a width of 3.6 meters (single lane road) over the entire length of road.

② Stage 2: Expand the road width to 12 meters and the paved width to 5.4 meters so that vehicles traveling in opposite directions can smoothly pass by each other.

③ Stage 3: Expand the paved width to 7.2 meters so that there can be two lanes in both directions.

The construction work of Stages 2 and 3 is scheduled to be implemented in three years between 2015 (when the Project equipment is handed over) and 2017. The works will be implemented by the Public Works Road Construction Special Unit No. 8 based in Toungup and Public Works Airfield Construction Special Unit No. 8 based in Ann.

Table 2-2.1 shows the works implementation schedule between Toungup and Ann, while Table 2-2.2 shows the expected construction situation at the beginning of 2015 and the end of 2017. Also, Table 2-2.3 shows the rough quantities of the major works over these three years.

Table 2-2.1 Construction Schedule for the Target Road from Toungup to Ann

Item \ Fiscal year	2013	2014	2015	2016	2017
Toungup-Ma-ei L=68.8km					
As Pen. Mac. of 3.6m wide Pavement Work	17.4km	16.0km			
Embankment for rainy-season submergence place		7.6km			
As Pen. Mac. of 5.4m wide Pavement Work			12.0km		
Extension earth work (8m→12m)			4.0km	4..8km	6.4km
As Pen. Mac. of 3.6m to 5.4m wide Pavement Work			4.0km	4..8km	6.4km
Budget (million kyat)	1,594.8	3,820.0	4,362.5	600.0	800.0
Ann-Ma-ei L=66.6km					
As Pen. Mac. of 3.6m wide Pavement Work	27.4km	30.8km			
As Pen. Mac. of 3.6m to 5.4m wide Surface Work			66.6km		
As Pen. Mac. of 3.6m wide Surface Work			8.2km		
Extension earth work (8m→12m)				66.6km	
As Pen. Mac. of 5.4m to 7.2m wide Base course Work				66.6km	
As Pen. Mac. of 5.4m wide Surface Work				12.8km	12.8km
As Pen. Mac. of 3.6m to 7.2m wide Surface Work					8.0km
Budget (million kyat)	2,085.8	2,958.2	4,657.5	7,354.7	1,114.5
Total Budget (million kyat)	3,680.6	6,778.2	9,020.0	7,954.7	1,914.5

Note) Fiscal year in Myanmar is from April to following March as in Japan.

Note) The pavement work is not implemented during rainy season, May to October.

Source: Prepared by the Study Team based on the road development plan for 30 years planned by Public Works.

Table 2-2.2 Road Condition between Toungup to Ann

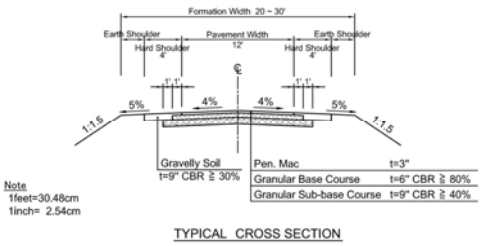
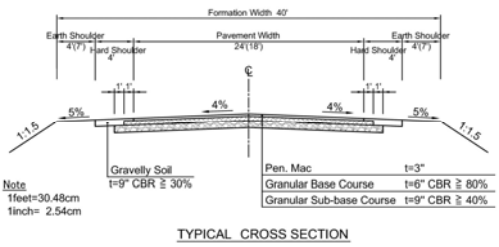
Item	Beginning of 2015 fiscal year	End of 2017 fiscal year
Toungup-Ma-ei		
Earth Work	W=6-9m	W=12m 27.2km (40%) W= 8m 41.6km (60%)
Pavement	As Pen. Mac. W=3.6m 56.8km(83%) Macadam W=3.6m 12.0km(17%)	As Pen. Mac. W=5.4m 27.2km(40%) W=3.6m 41.6km(60%)
Ann-Ma-ei		
Earth Work	W=6-9m	W=12m 66.6km (100%)
Pavement	As Pen. Mac. W=3.6m 66.6km(100%)	As Pen. Mac. W=7.2m 8.0km(12%) W=5.4m 58.6km(82%)
Toungup-Ann		
Earth Work	W=6-9m	W=12m 93.8km (69%) W= 8m 41.6km (31%)
Pavement	As Pen. Mac. W=3.6m 123.4km(91%) Macadam W=3.6m 12.0km(9%)	As Pen. Mac. W=7.2m 8.0km(6%) W=5.4m 85.8km(63%) W=3.6m 41.6km(31%)
Typical Cross Section	 TYPICAL CROSS SECTION	 TYPICAL CROSS SECTION

Table 2-2.3 Rough Construction Quantities

Toungup-Ma-ei L=68.8km

fiscal year	Pavement Works Width	Length	Area (㎡) Pen. Mac.	Base Course	Sub-base Course	3.6m Pavement As Pen. Mac. m	Macadam m	Total m	Earth Works Embankment Height	Embankment Width	Volume (m3)	Remarks
2012(existing)						23,400	45,400	68,800				
2013	3.6	17,400	62,640	73,080	83,520	40,800	28,000	68,800				3.6m Mac.→3.6m As Pen. Mac.
2014	3.6	16,000	57,600	67,200	76,800	56,800	12,000	68,800				3.6m Mac.→3.6m As Pen. Mac.
2015	5.4	12,000	64,800	72,000	79,200	68,800	0	68,800	1.5	4.0	72,000	3.6m Mac.→5.4m As Pen. Mac.
	1.8	4,000	7,200	9,600	12,000				1.5	4.0	24,000	3.6→5.4m extension As Pen. Mac.
2016	1.8	4,800	8,640	11,520	14,400				1.5	4.0	28,800	3.6→5.4m extension As Pen. Mac.
2017	1.8	6,400	11,520	15,360	19,200				1.5	4.0	38,400	3.6→5.4m extension As Pen. Mac.
3 years Total	Area (m2)		92,160	108,480	124,800						163,200	
	Materials (m3)		7,023	16,532	28,529							

Pen.Mac. pavement of 3.6m wide are completed

Ann-Ma-ei L=66.6km

fiscal year	Pavement Works Width	Length	Area (㎡) Pen. Mac.	Base Course	Sub-base Course	3.6m Pavement As Pen. Mac. m	Macadam m	Total m	Earth Works Embankment Height	Embankment Width	Volume (m3)	Remarks
2012(existing)						8,400	58,200	66,600				
2013	3.6	27,400	98,640			35,800	30,800	66,600				3.6m Mac.→3.6mAs Pen. Mac.
2014	3.6	30,800	110,880			66,600	0	66,600				3.6m Mac.→3.6mAs Pen. Mac.
2015	1.8	66,600	119,880	159,840	199,800							3.6m Mac.→5.4mAs Pen. Mac.
	3.6	8,200	29,520									3.6m Mac.→3.6mAs Pen. Mac.
2016	1.8	66,600		159,840	199,800				1.5	4.0	399,600	5.4→7.2m extension As Pen. Mac. 8m→12m extension earth work
	5.4	12,800	69,120									5.4m As Pen. Mac.
2017	5.4	12,800	69,120									5.4m As Pen. Mac.
	3.6	8,000	28,800									3.6→7.2m extension As Pen. Mac.
3 years Total	Area (m2)		316,440	319,680	399,600						399,600	
	Materials (m3)		24,113	48,719	91,349							

Pen.Mac. pavement of 3.6m wide are completed

Width of embankment 8m→12m extension

Toungup-Ann 135.4km

3 years Total	Area (m2)		408,600	428,160	524,400				Volume (m3)		562,800	
	Materials (m3)		31,135	65,252	119,878							

2-2-2 Basic Plan

(1) Overall Plan

In examining the location for handover of the Project equipment, consideration was given to the Public Works related facilities in the vicinity of the target road in Rakhine State. As a result of holding discussions with Public Works and conducting field survey, it was concluded that the following locations would be ideal for handover.

1) Public Works Road Construction Special Unit No. 8 (Toungup)

Located in Toungup, Rakhine State, this Public Works facility is in charge of the construction and maintenance of roads in the local area including the road between Toungup and Ma-ei. The sites for handing over equipment to this Unit will be as follows:

- Main equipment bodies: equipment parking space situated next to the offices of Public Works Road Construction Special Unit No. 8
- Spare parts: store room owned by Public Works Road Construction Special Unit No. 8

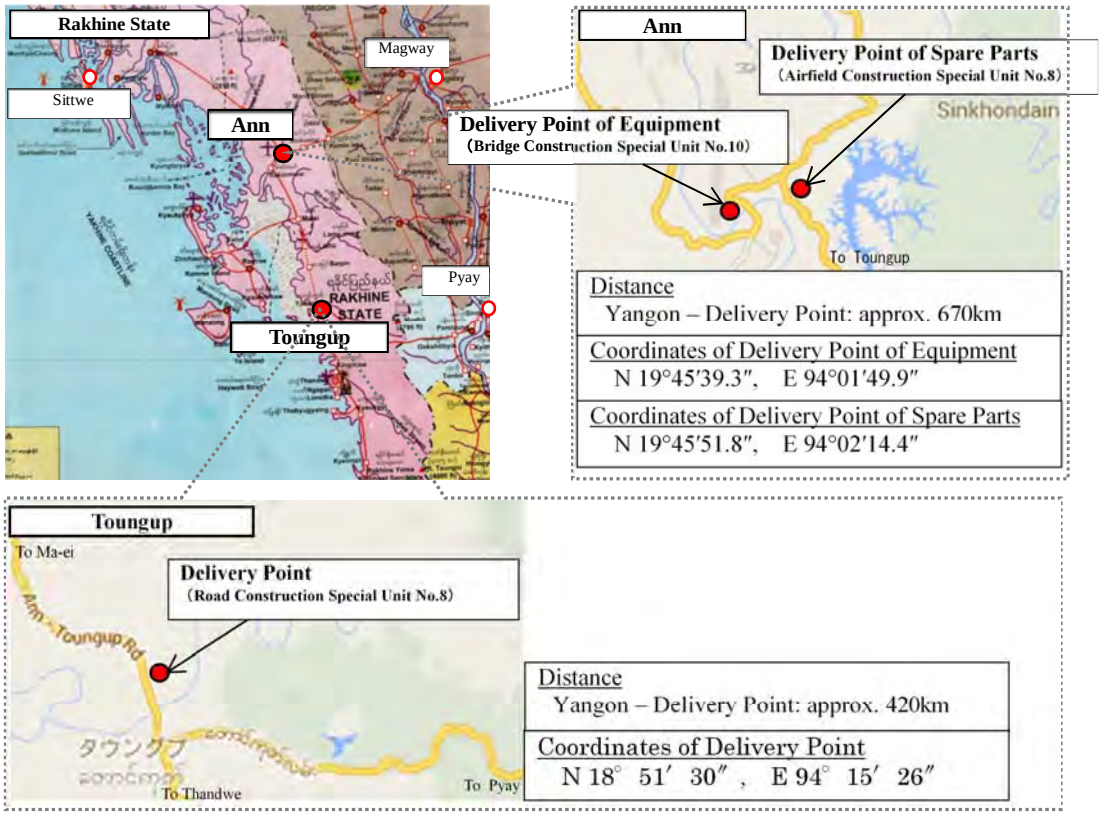
2) Public Works Airfield Construction Special Unit No. 8 (Ann)

Located in Ann, Rakhine State, this Public Works facility is in charge of the construction and maintenance of roads in the local area including the road between Ann and Ma-ei. The sites for

handing over equipment to this Unit will be as follows:

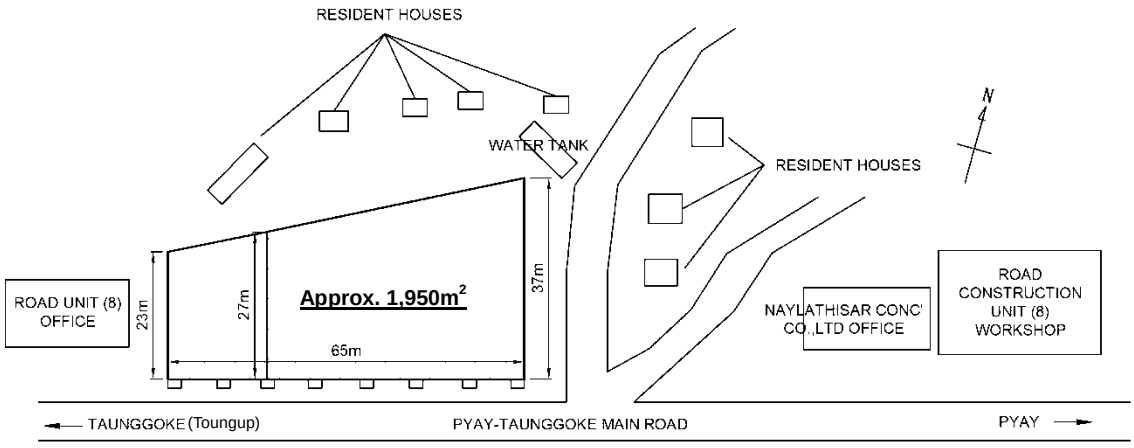
- Main equipment bodies: equipment parking space situated next to the offices of Public Works Bridge Construction Special Unit No. 10
- Spare parts: store room owned by Public Works Airfield Construction Special Unit No. 8

Following Figure 2-2.2 and 2-2.3 show delivery points of the Project equipment and their layouts, respectively.

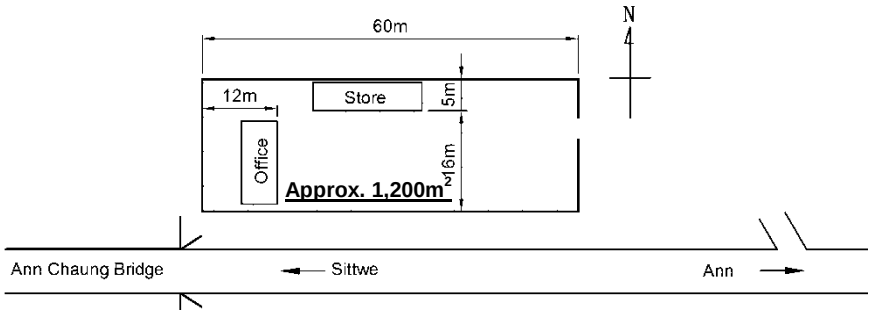


Source: Survey Team

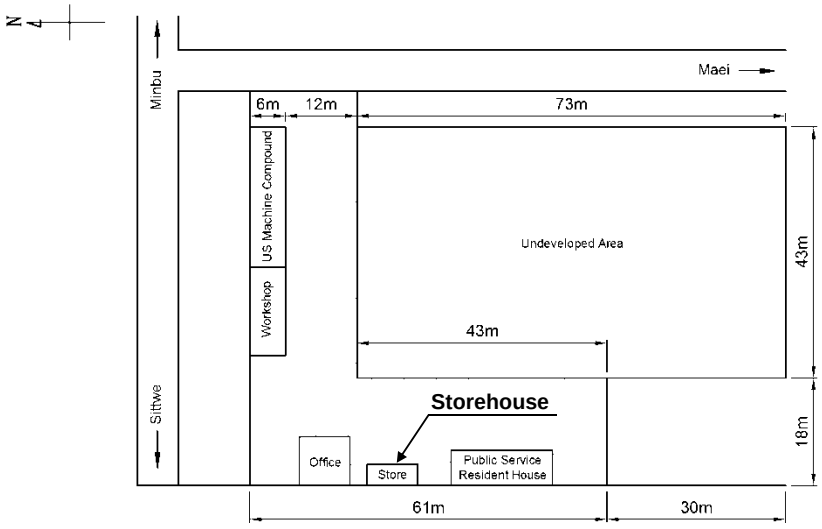
Figure 2-2-2 Location Map of Delivery Points



Layout of Delivery Point (Toungup)



Layout of Delivery Point of Equipment (Ann)



Layout of Delivery Point of Spare Parts (Ann)

Source: Public Works

Figure 2-2-3 Layouts of Delivery Points

(2) Equipment Plan

The road construction equipment to be required in this Project should be composed of earth moving equipment and asphalt paving equipment such as bulldozer, excavator, loader, compactor, asphalt sprayer and trucks necessary to carry out road construction work on the target road, and a mobile workshop for maintenance of equipment at sites, a bridge inspection vehicle for bridge inspection and maintenance, and so on.

In determining the quantity and specification of those construction equipment required for this project, the following conditions are taken into consideration as a precondition.

- The equipment should have a capacity and fully equipped to carry out road construction works in the target road efficiently.
- The number of equipment should be sufficient to carry out road construction works in the target road efficiently.
- Size and weight of the equipment should be suited to the conditions in the construction site.
- The equipment can be safely operated
- The equipment can be operated in agreeable environment without harming operator's health.
- Specification of the equipment should be suited to the natural environment in the construction site.
- Operating cost or maintenance cost of the equipment does not impose a heavy burden on the Public Works.
- Equipment should have mobility adequate to carry out the road construction work

The, types, quantities, purpose of use, and required basic specifications of the selected road construction equipment for this project are shown in Table 2-2.4

Table 2-2.4 List of the equipment for the Project

	Name of Equipment	Specification	Q'ty	Purpose of use (Upper) Basic Requirements (Lower)
1	Bridge Inspection Vehicle	Capacity of Deck: 200 kg Max. downward reach of the deck: 5.5 m Max. working Height of the deck: 6 m Max. working radius: 5.5 m	1	Bridge inspection for detecting abnormalities and conditions of the bridges The equipment should have specifications that enable to inspect the underneath and side of the bridge safely without using scaffolding.
2	Motor Grader	Operation weight: not less than 14 ton Engine output: not less than130 kW Blade length: 3,700 - 4,100 mm Blade height:500 - 800mm	2	Spreading fill soil, finishing sub-base course/base curse, The equipment should be equipped with the blade, which width matches with the width of the target road, and have engine output adequate to carry out the work.

3	Excavator (crawler)	Operation weight: 19 - 26 ton Engine output: not less than 100 kW Bucket capacity: not less than 0.8m^3	2	Excavating/stockpiling/loading/hauling/removing soil The equipment should be equipped with a favorable size and type of bucket, boom, and arm that is suitable to use in the project site, and have engine output adequate to carry out the work.
4	Wheel Loader	Operation weight: less than 16 ton Engine output: not less than 115 kW Bucket capacity: not less than 2.4 m^3	2	Stockpiling/loading/hauling /removing soil Its bucket size and working range should suit the size of the dump truck for loading material, and the equipment should have engine output adequate to carry out the work.
5	Wheel Excavator	Operation weight: less than 16.5 ton Engine output: not less than 90 kW Bucket capacity: not less than 0.5 m^3	2	Excavating side-ditch, Excavating/stockpiling/loading/ hauling/removing soil The equipment should suite to the excavating and trimming side ditch.
6	Bulldozer	Operation weight: 27 - 29 ton Engine output: not less than 165 kW	2	Excavation/dozing/spreading/ hauling/compacting soil The equipment should be equipped with ripper, and have engine output adequate to carry out the work, and have an operation weight suitable for spreading and compacting soil in embankment work.
7	Sheep Foot Compactor	Operation weight: not less than 10 ton Centrifugal Force: not less than 200 kN	2	Compacting subgrade/sub-base course/base course The equipment should be equipped with pad foot with removable smooth drum, and have compaction capacity equivalent to 25 ton class macadam roller.
8	Vibratory Tandem Roller	Operation weight: not less than 7 ton Centrifugal Force: not less than 68 kN	4	Compacting subgrade/sub-base course/surface course The size and the capacity of the equipment should be suitable for both embankment work and paving work.
9	Bitumen Distributor	Tank Capacity: 4,000 ℓ Pumping Capacity: not less than 300 ℓ/min. Spray width: not less than 3.6 m	2	Spraying asphalt The equipment should have a control device for spraying width and spraying amount, which can be adjusted by simple operation To give consideration to the mobility of the equipment.
10	Asphalt Kettle	Tank Capacity: 3,000ℓ Pumping Capacity: not less than: 100 ℓ/min.	2	Heating and melting asphalt To give consideration to the combination with the Bitumen Distributor The equipment should be a transportable –sized, stationary type.

11	Mobile Workshop	4 × 4 drive, with 3 ton crane, Equipped with maintenance equipment and tools	2	Repairing / maintaining the construction equipment at the construction site The carrier should be 4 × 4 drive, box-bodied truck, equipped with crane, a set of workshop equipment, and sets of the tools necessary to carry out repair / maintenance work for the construction equipment at the construction site.
12	Water Bowser (Tanker)	GVW: less than 23 ton Payload: 10,000 ℓ Engine output: not less than150 kW	2	Watering for embankment or to supply water for concrete work The specification of the equipment should be suitable to use in earth and paving works for watering road surface, and have a function of water tanker to supply water for concrete works.
13	Dump Truck	GVW: less than 26 ton Payload: 14 ton Engine output: not less than 190 kW	12	Hauling the road construction materials Considering the conditions of the construction site and amount of work volume of the equipment , this equipment should have at least 14 ton payload capacity with vessel volume of 10 m^3, and have engine output adequate to carry out the work.
14	Cab-back Crane	Payload: 10 ton Lifting capacity: 3 ton Engine output: not less than 190 kW	2	Loading and unloading, and to transport the construction materials The specification of the equipment should be suitable to loading/unloading and transport the road construction materials and equipment.
15	Low Bed Semi-trailer with Tractor Head	Payload: 30 ton Engine output: not less than230 kW (Tractor Head)	1	Transport heavy equipment Trailer should has an adequate payload capacity to carry the heaviest equipment among equipment to be provided to the project site safely Tractor head should have adequate pulling power to transport those equipment safely.
16	Mobile Crusher	Self-propelled type Capacity: 15-50 ton/h	2	Producing aggregate for pavement The equipment should be able to shift its operation site easily with the progress of the road construction work, and have adequate production capacity to meet a demand of the road construction.
17	Inspection Vehicle	4 × 4 drive, double-cab pickup truck	2	Going around the road construction sites for inspection and supervision The specification of this equipment should be fit with the road conditions and the natural environment in the project area.

18	Asphalt Hand Sprayer	Mounted on the hand-cart Spray capacity: 23 ℓ/min.	10	Spraying asphalt for small-scale repair work of the asphalt pavement The equipment should be a hand-cart laden type, and have heating and pumping devices to spray the straight asphalt The spraying capacity to be suitable for small-scale repairing work for the asphalt pavement.
19	Desktop Computer	CPU 3.3GHz or more	2	Utilizing in the Soft Component for equipment ledger system. Latest model
20	Database Software	FileMaker Pro 12 or updated version	1	Utilizing in the Soft Component for equipment ledger system Latest version

Note: The Desktop Computer and Database Software are mentioned in "2-2-4-8 Soft Component (Technical Assistance) Plan".

(3) Equipment Procurement Quantities

1) Rough quantities of earth works and paving with the Project equipment

Table 2-2.5 1) 2) shows the rough quantities of earth works and paving that will provide the basis for determining the quantities of equipment to be procured. These quantities have been calculated based on the rough quantities of the main works indicated in Table 2-2.3.

Table 2-2.5 Rough Quantities of Earth, Pavement Work

1) Embankment【Loading ratio(L): 1.25, Compaction ratio(C): 0.90, Specific weight: 1.4）】

	Earth Volume	Bulldozer	Excavator (crawler)	Dump Truck
Embankment Volume (compacted)	562,800 m^3			
Loading Volume	(1) 781,667 m^3	(2) 390,833 m^3		(3) 390,833 m^3
Ground Volume	(4) 625,333 m^3	(5) 312,667 m^3	(6) 312,667 m^3	

Note: 50% of embankment soil will be hauled from cutting sites.

2) Aggregate for Pavement【Loading ratio(L): 1.2, Compaction ratio(C): 0.95, Specific weight: 2.2】

	Earth Volume	Excavator (crawler)	Wheel Loader
Compacted Volume	216,265 m^3		
Loading Volume	(7) 273,177 m^3	(8) 54,635 m^3	(9) 218,541 m^3
Aggregate Volume	(10) 227,647 m^3		
Aggregate Weight	(11) 475,783 t		

Note 1: Rocks for aggregate shall be loaded on the site before delivery of equipment.

Note 2: 80% of aggregate will be loaded with a wheel loader

Note 3: Aggregate is produced on the site by using a moble crusher.

3) Rough Volume for Each Equipment in the Project

Equipment	Earth Volume	Calculation	Main Works
Bulldozer	312,667 m^3	= (5)	Excavation/dozing//compacting soil
Excavator (crawler)	367,302 m^3	= (6) + (8)	Excavating/loading soil
Wheel Loader	609,375 m^3	= (3) + (9)	stockpiling/loading soil
Dump Truck	390,833 m^3	= (3) = (1) - (2)	Hauling the road construction materials
Motor Grader	728,329 m^3	= (3)+(10)	Spreading fill soil, finishing base course
Wheel Excavator	210,000 m^3	=140km×3/4×2 places×1m×1m	Excavating side-ditch,loading soil
Mobile Crusher	475,783 t	= (11)	Producing aggregate for pavement
Sheep Foot Compactor	952,560 m^2	base courese area	Compacting base/sub-base course
	1,876,000 m^2	embankment area	Compacting embankment one(1)layer30cm
Vibratory Tandem Roller	408,600 m^2	pavement area	Compacting each layer of pavement
Bitumen Distributor	1,634,400 m^2	pavement area×4times	Spraying asphalt
Asphalt Hand Sprayer	102,150 m^2	pavement area×0.25	Spraying asphalt for small-scale pavement

2) Required number of equipment

In this Project, the construction work for the target road is planned to be carried out by the formation of two construction units: Road Construction Special Unit No.8 based in Toungup, and Air Field Construction Special Unit No.8 based in Ann.

Types and number of construction equipment required for the project are determined according to the kind of construction works, works plan, and estimated amount of works for the each equipment.

Concerning the equipment, which cannot be shared between the two construction units, the equipment is arranged so that at least one unit of the same type of equipment to be provided to each construction unit.

Bases for calculating required number of equipment are shown in the flowing tables.

Table 2-2.6 Bases for Calculating Required Number of Equipment

1. Bridge Inspection Vehicle (estimated quantity: 1 unit)

Basis of Calculation	Numerical Value	Remarks
This equipment to be stationed at Airfield Construction Special Unit No.8, in Ann.		Equipment will be employed to carry out bridge inspection for checking conditions and detecting abnormalities of the bridges in the target road, as a part of the road maintenance management
Required number of equipment	1 unit	

2. Motor Grader (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
Blade width	3.7 m	
Quantity of work/ equipment/h	121 m^3/h	Spreading and leveling
Quantity of work/ equipment/day (1)	986 m^3/day	8 hours/ equipment equipment/day
Working days/year	150 days	25 day/month× 6 months (dry season only)
Estimated period of the construction work	3 years	After delivery of the construction equipment
Estimated amount of work-volume (2)	728,329 m^3	Estimated earthwork-volume, after delivery of the construction equipment Spreading/leveling base course / sub-base course material
Work period	3 years	
Required working days to complete the work (3)	450 days	
Required earthwork-volume/day (4) = (2) ÷ (3)	1619 m^3/day	
Required number of equipment = (4) ÷ (1)	2 units	1.7units

3. Excavator (crawler) (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
Bucket capacity	0.8 m^3	
Cycle time	35 sec.	Swing angle: 135°
Quantity of work/equipment/h	52 m^3/h	Excavation and loading
Quantity of work/equipment /day (1)	416 m^3/day	8 hours/equipment/day
Working days/year	150 days	25 day/month× 6 months (dry season only)
Estimated period of the construction work	3 years	After delivery of the construction equipment
Estimated amount of work-volume (2)	367,302 m^3	Estimated earthwork-volume, after delivery of the construction equipment Excavation and loading of the road construction material
Work period	3 years	
Required working days to complete the work (3)	450 days	
Required earthwork-volume/day (4) = (2)÷ 3)	816 m^3/day	
Required number of equipment = (4) ÷ (1)	2 units	2.0units

4. Wheel Loader (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
Bucket capacity	2.5 m^3	
Cycle time	55 sec.	
Quantity of work/equipment/h	80 m^3/h	Loading and hauling
Quantity of work/equipment /day (1)	641 m^3/day	8 hours/equipment/day
Working days/year (embankment material)	150 days	25 day/month× 6 months (dry season only)
Working days/year (paving material)	250 days	10 months (dry and rainy season)
Estimated period of the construction work	3 years	After delivery of the construction equipment
Estimated amount of earth work-volume (2)	390,833 m^3	Estimated earthwork, pavement work-volume, after delivery of the construction equipment Loading/hauling materials for embankment and paving
Estimated amount of aggregate work-volume (2)'	218,541 m^3	
Estimated amount of work-volume (2)	609,575 m^3	
Work period	3 years	
Required working days to complete the work (3)	450 days	
Required working days to complete the work (3)'	750 days	
Required earthwork-volume/day (4) = (2) ÷ (3)	869 m^3/day	
Required earthwork-volume/day (4) '= (2)' ÷ (3)'	291 m^3/day	
Required number of equipment = (4) ÷ (1)	2 units	1.8units

5. Wheel Excavator (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
Bucket capacity	0.5 m^3	
Cycle time	35 sec.	Swing angle: 135°
Quantity of work/equipment/h	33 m^3/h	Excavation and trimming
Quantity of work/equipment/day (1)	262 m^3/day	8 hours/equipment/day
Working days/year	150 days	25 day/month× 6 months (dry season only)
Estimated period of the construction work	3 years	After delivery of the construction equipment
Estimated amount of work-volume (2)	210,000 m^3	Estimated earthwork-volume, after delivery of the construction equipment Excavation and trimming of the drainage (140km×3/4×2×1×1)(m3)
Work period	3 years	
Required working days to complete the work (3)	450 days	
Required earthwork-volume/day (4) = (2) ÷ (3)	467 m^3/day	
Required number of equipment = (4) ÷ (1)	2 units	1.8units

6. Bulldozer (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
Dozing (hauling) distance	50 m	
Cycle time	1.7 min.	
Capacity of dozer blade	4.5 m^3	Blade size: W:3.7 m,H:1.4 m
Quantity of work/equipment/h	52 m^3/h	
Quantity of work/equipment/day (1)	414 m^3/day	8 hours/equipment/day
Working days/year	150 days	25 day/month× 6 months (dry season only)
Estimated period of the construction work	3 years	After delivery of the construction equipment
Estimated amount of work-volume (2)	312,667 m^3	Estimated earthwork-volume, after delivery of the construction equipment (volume of the required volume of the natural ground, minus earthwork-volume of the excavator)
Work period	3 years	
Required working days to complete the work (3)	450 days	
Required earthwork-volume/day (4) = (2) ÷ (3)	695 m^3/day	Excavation / dozing (hauling) /spreading/compaction
Required number of equipment = (4) ÷ (1)	2 units	1.7units

7. Sheep Foot Compactor (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
Quantity of work/equipment/h	347 m^2/h	
Quantity of work/equipment/day (1)	2,776 m^2/day	8 hours/ equipment/day
Working days/year	495 days	
Quantity of work/equipment/day (1)	3,960 m^2/day	8 hours/ equipment/day
Working days/year	150 days	6 months (dry season only)
Estimated period of the construction work	3 years	After delivery of the construction equipment
Estimated amount of work-area (2)	952,560 m^2	Estimated work-area, after delivery of the construction equipment Compaction of base course
Estimated amount of work-area (2)’	1,876,000 m^2	
Work period	3 years	
Required working days to complete the work (3)	450 days	
Required work-area/day (4) = (2) ÷ (3)	2,117 m^2/day	
Required work-area/day (4)’ = (2)’ ÷ (3)’	4,169 m^2/day	
Required number of equipment = (4) ÷ (1)	2 units	1.9units

8. Vibratory Tandem Roller (estimated quantity: 4 units)

Basis of Calculation	Numerical Value	Remarks
Quantity of work/equipment/h	94 m^2/h	
Quantity of work/equipment /day (1)	376 m^2/day	4 hours/equipment/day
Working days/year	100 days	6 months (dry season only)
Estimated period of the construction work	3 years	After delivery of the construction equipment
Estimated amount of work-area (2)	408,600 m^2	Estimated work-area, after delivery of the construction equipment Compaction of sub-base course and pavement
Work period	3 years	
Required working days to complete the work (3)	300 days	
Required work-area/day (4) = (2) ÷ (3)	1,362 m^2/day	
Required number of equipment = (4) ÷ (1)	4 units	3.6units

9. Bitumen Distributor (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
Quantity of work/equipment /h	3,990 m^2/h	
Quantity of work/equipment /day (1)	7,980 m^2/day	2 hours/equipment /day
Working days/year	50 days	6 months (dry season only)
Estimated period of the construction work	3 years	After delivery of the construction equipment
Estimated amount of work-area (2)	1,634,400 m^2	Estimated work-area, after delivery of the construction equipment Spraying asphalt in paving work
Work period	3 years	
Required working days to complete the work (3)	150 days	
Required work-area/day (4) = (2) ÷ (3)	10,900 m^2/day	
Required number of equipment = (4) ÷ (1)	2 units	1.4units

10. Asphalt Kettle (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
This equipment to be stationed at Airfield Construction Special Unit No.8 in Ann, and Road Construction Special Unit No.8 in Toungup, each		Incidental equipment to Bitumen Distributor for heating and melting straight asphalt
Required number of equipment	2 units	

11. Mobile Workshop (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
This equipment to be stationed at Airfield Construction Special Unit No.8 in Ann, and Road Construction Special Unit No.8 in Toungup, each with one unit		Equipment to carry out repair and maintenance works for the road construction equipment at the construction site
Required number of equipment	2 units	

12. Water Bowser (Tanker) (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
This equipment to be stationed at Airfield Construction Special Unit No.8 in Ann, and Road Construction Special Unit No.8 in Toungup, each with one unit		Equipment to water for embankment work or to supply water for concrete work
Required number of equipment	2 units	

13. Dump Truck (estimated quantity: 12 units)

Basis of Calculation	Numerical Value	Remarks
Hauling distance	12 km	An average distance for a round trip, between construction site and stockpile
Traveling (driving) speed	20 km/h	Estimated travel speed in the project site
Hauling capacity/equipment/h	10 m^3/h	
Hauling capacity/equipment /day (1)	76 m^3/day	8 hours/equipment/day
Working days/year	150 days	25 day/month× 6 months (dry season only)
Estimated period of the construction work	3 years	After delivery of the construction equipment
Estimated amount of work-volume (2)	390,833 m^3	Estimated earthwork-volume, after delivery of the construction equipment Part of the excavated materials in the construction sites should be utilized as a material for the embankment
Work period	3 years	
Required working days to complete the work (3)	450 days	
Required hauling-volume/day (4) = (2) ÷ (3)	869 m^3	
Required number of equipment = (4) ÷ (1)	12 units	11.5units

14. Cab-back Crane (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
This equipment to be stationed at Airfield Construction Special Unit No.8 in Ann, and Road Construction Special Unit No.8 in Toungup, each with one unit		Equipment to loading and unloading, and to transport the construction materials
Required number of equipment	2 units	

15. Low Bed Semi-trailer with Tractor Head (estimated quantity: 1 unit)

Basis of Calculation	Numerical Value	Remarks
This equipment to be stationed at Road Construction Special Unit No.8, in Toungup		Transporter for heavy equipment
Required number of equipment	1 unit	

16. Mobile Crusher (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
Quantity of work/equipment /h	35 t/h	
Quantity of work/equipment/day (1)	280 t/day	8 hours/equipment /day
Working days/year	300 days	25 day/month× 12 months
Estimated period of the construction work	3 years	After delivery of the construction equipment
Estimated amount of work (2)	475,783 t	Estimated amount of work, after delivery of the construction equipment
Work period	3 years	
Required working days to complete the work (3)	900 days	
Required hauling-volume/day (4) = (2) ÷ (3)	529 t/day	
Required number of equipment = (4) ÷ (1)	2 units	1.9units

17. Inspection Vehicle (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
This equipment to be stationed at Airfield Construction Special Unit No.8 in Ann, and Road Construction Special Unit No.8 in Toungup, each with one unit		Equipment to be used for going round the road construction sites for inspection and supervision
Required number of equipment	2 units	

18. Asphalt Hand Sprayer (estimated quantity: 10 units)

Basis of Calculation	Numerical Value	Remarks
This equipment to be stationed at the Public Wroks sub-branches those located villages along the target road, each with one unit		Equipment to be used for small-scale repair work of the asphalt pavement
The number of sub-branches between Toungup and Ma-ei	5 units	
The number of sub-branches between Ann and Ma-ei	5 units	
The total number of sub-branches in the project site	10 units	
Required number of equipment	10 units	
Reference: Work capacity of the Asphalt Hand Sprayer		
Quantity of work/equipment/h	300 m^2/h	
Quantity of work/equipment/day (1)	300 m^2/day	1 hour/equipment/day
Working days/year	100 days	6 months (dry season only)

Quantities of equipment to be distributed to each delivery point, which is indicated in “2-2-2 (1) Overall Plan”, are shown in the flowing table.

Table 2-2.7 Distribution Plan of Equipment

No.	Items	Unit	Amount	Quantities	
				Road Construction nit 8 in Toungup	Bridge Construction Special Unit 10 / Airfield Construction Special Unit 8 in Ann
1	Bridge Inspection Vehicle	Set	1	1	-
2	Motor Grader	Sets	2	1	1
3	Excavator (crawler)	Sets	2	1	1
4	Wheel Loader	Sets	2	1	1
5	Wheel Excavator	Sets	2	1	1
6	Bulldozer	Sets	2	1	1
7	Sheep Foot Compactor	Sets	2	1	1
8	Vibratory Tandem Roller	Sets	4	2	2
9	Bitumen Distributor	Sets	2	1	1
10	Asphalt Kettle	Sets	2	1	1
11	Mobile Workshop	Sets	2	1	1
12	Water Bowser (Tanker)	Sets	2	1	1
13	Dump Truck	Sets	12	6	6
14	Cab-back Crane	Sets	2	1	1
15	Low Bed Semi-trailer with Tractor Head	Set	1	-	1
16	Mobile Crusher	Sets	2	1	1
17	Inspection Vehicle	Sets	2	1	1
18	Asphalt Hand Sprayer	Sets	10	5	5
19	Desktop Computer	Sets	2	1	1
20	Database Software	Set	1	1	-

Note: Main equipment in Ann will be delivered to the Bridge Construction Special Unit No.10, and their spare parts will be delivered to the Airfield Construction Special Unit No.8.

2-2-3 Outline Design Drawings

Reference drawings of the main construction equipment in the Project are indicated in Table 2-2.8.

Table 2-2.8 Reference Drawings of Main Construction Equipment

1. Bridge Inspection Vehicle	2. Motor Grader
	
3. Excavator (crawler)	4. Wheel Loader
	
5. Wheel Excavator	6. Bulldozer
	
7. Sheep Foot Compactor	8. Vibratory Tandem Roller
	

9. Bitumen Distributor	10. Asphalt Kettle
	
11. Mobile Workshop	12. Water Bowser (Tanker)
	
13. Dump Truck	14. Cab-back Crane
	
15. Low Bed Semi-trailer with Tractor Head	16. Mobile Crusher
	
17. Inspection Vehicle	18. Asphalt Hand Sprayer
	

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

The Plan will be implemented based on the Government of Japan's Grant Aid scheme. According to this, the Project will receive approval by the Government of Japan, and the two countries' governments will sign the Exchange of Notes (E/N) and the Grant Agreement (G/A). The Japanese Consultant, recommended by the Japan International Cooperation Agency (JICA), will bind a contract with the implementing agency in Myanmar concerning execution of work for the tender and supervision of construction and maintenance equipment procurement. The Consultant will supervise the main work component to ensure that the Project is executed smoothly and appropriately. Below is indicated the basic items and points that require particular consideration in the event of Project implementation.

(1) Project Implementing Entities

The responsible and supervisory agency on the Myanmar side will be the Ministry of Construction, and the implementing agency will be Public Works under the said ministry. Also, following handover of the construction and maintenance equipment, Public Works will be in charge of the appropriate operation and maintenance of the said equipment.

(2) Consultant

In order to supervise preparation of the tender specifications and the procurement and installation of the construction and maintenance equipment in the Project, the Myanmarese side will bind a consultant supervision agreement with the Consultant that is recommended by the Japan International Cooperation Agency (JICA). Moreover, the Consultant will also implement the soft component in order to ensure the appropriate operation and maintenance of construction and maintenance equipment and strengthening of spare parts management.

(3) Procurement Agent

In accordance with the framework of Japan's Grant Aid scheme, the procurement agent that has been selected in competitive tender will implement the procurement, transportation, on-site assembly, initial operation and operating guidance, etc. of the Project construction and maintenance equipment.

Following completion of the Project, since it will be necessary to continue supplying spare parts and conducting post-installation service to resolve breakdowns and so on, it will be necessary for the procurement agent to conduct liaison and coordination after the handover of equipment.

Accordingly, a procurement agent that possesses a local office or other base of activities in Myanmar will be selected.

2-2-4-2 Implementation Conditions

(1) Suppliers

Because the construction and maintenance equipment scheduled for procurement in the Project is not manufactured or produced in Myanmar, equipment made by Japanese manufacturers will be selected. However, since some Japanese equipment and vehicle makers, etc. have suspended domestic manufacturing and transferred their production and manufacturing bases to overseas plants, equipment that have been produced at domestic or overseas plants (Thailand) by Japanese makers will be procured, and the port of lading will be determined appropriately. Table 2-2.9 shows the suppliers of the major items of equipment.

Table 2-2.9 Equipment Suppliers, etc.

No.	Equipment	Specification	Procured from		
			Japan	Myanmar	Third Country (Thailand)
1	Bridge Inspection Vehicle	Capacity of Deck: 200 kg Max. downward reach of the deck: 5.5 m Max. working Height of the deck: 6 m Max. working radius: 5.5 m	○		
2	Motor Grader	Operation weight: not less than 14 ton Engine output: not less than130 kW Blade length: 3,700 ~ 4,100 mm Blade height:500 ~ 800mm	○		○
3	Excavator (crawler)	Operation weight: 19 ~ 26 ton Engine output: not less than 100 kW Bucket capacity: not less than 0.8m^3	○		
4	Wheel Loader	Operation weight: less than 16 ton Engine output: not less than 115 kW Bucket capacity: not less than 2.4m^3	○		
5	Wheel Excavator	Operation weight: less than 16.5 ton Engine output: not less than 90 kW Bucket capacity: not less than 0.5m^3	○		
6	Bulldozer	Operation weight: 27 ~ 29 ton Engine output: not less than 165 kW	○		
7	Sheep Foot Compactor	Operation weight: not less than 10 ton Centrifugal Force: not less than 200 kN			
8	Vibratory Tandem Roller	Operation weight: not less than 7 ton Centrifugal Force: not less than 68 kN	○		
9	Bitumen Distributor	Tank Capacity: 4,000 ℓ Pumping Capacity: not less than 300 ℓ/min. Spray width: not less than 3.6 m	○		
10	Asphalt Kettle	Tank Capacity: 3,000ℓ Pumping Capacity: not less than: 100 ℓ/min.	○		
11	Mobile Workshop	4 × 4 drive, with 3 ton crane, Equipped with maintenance equipment and tools	○		
12	Water Bowser (Tanker)	GVW: less than 23 ton Payload: 10,000 ℓ Engine output: not less than150 kW	○		
13	Dump Truck	GVW: less than 26 ton Payload: 14 ton Engine output: not less than 190 kW	○		
14	Cab-back Crane	Payload: 10 ton Lifting capacity: 3 ton Engine output: not less than 190 kW	○		
15	Low Bed Semi-trailer with Tractor Head	Payload: 30 ton Engine output: not less than230 kW (Tractor Head)	○		

16	Mobile Crusher	Self-propelled type Capacity: 15-50 ton/h	○		
17	Inspection Vehicle	4 × 4 drive, double-cab pickup truck			○
18	Asphalt Hand Sprayer	Mounted on the hand-cart Spray capacity: 23 ℓ/min.	○		
19	Desktop Computer	CPU 3.3GHz or more		○	
20	Database Software	FileMaker Pro 12 or updated version	○		

(2) Implementation Planning Conditions

- The Project target area usually has its dry season from October to March and rainy season from April to September. During the period of heaviest rain in July and August, provincial access roads sometimes become impassable due to inundation. Therefore, this period should be avoided for inland transportation of equipment l landed at Tirawa Port in Myanmar.
- Since parts of the inland transportation route have deteriorated paving, running speeds will fall on these parts. Moreover, because part of the internal transportation route runs over the Arakan Mountains, the utmost caution will be required when driving.
- There are numerous bridges with weight restrictions over the inland transportation route. Therefore, since limitations will be imposed in terms of the transportation routes and capacity, it will be necessary to display caution in compiling the transportation plan and planning the schedule. Furthermore, when passing through built-up areas, because power lines and telephone lines and so on are low, it will be necessary to take steps to prevent lines from being severed. Therefore, it will be important to detach cabins from graders and bulldozers when transporting them inland.

2-2-4-3 Scope of Works

The Japanese side will be responsible for the inland transportation of equipment from the port of landing to the Public Works facility where the equipment will be handed over, and the Myanmar side will be responsible for transporting equipment from there to each target site. Moreover, the Myanmar side will procure the construction materials necessary for constructing the target road.

Moreover, Table 2-2.10 shows the detailed scope of works on the Japanese and Myanmar sides.

Table 2-2.10 Scope of Works

No.	Item	Scope		Remarks
		Japanese Side	Myanmarese Side	
1	Securing of storage area for construction and maintenance equipment and spare parts		○	Fencing the delivery point of the Road Construction Special Unit No.8 and building a storehouse there.
2	Securing of site office		○	As the need arises
3	Manufacture and procurement of construction equipment	○		
4	Inland transportation of construction equipment	○		Between a manufacturer's factory and a port in Japan
5	Marine transportation, customs clearance procedure and handling of taxes			
	(1) Responsibility for marine transportation and air transportation of construction and maintenance equipment to Myanmar	○		
	(2) Tax exemption and customs clearance procedures at the port of discharge		○	
	(3) Inland transportation of construction and maintenance equipment from the port of discharge to the handover location	○		
6	Appropriate operation and management of the construction and maintenance equipment and expendable parts		○	
7	Procedures and measures necessary for acquiring the following permits: ■ Registration of equipment ■ Permits necessary for the passage of heavy vehicles ■ Permission for access to restricted areas ■ Permission for entry by Japanese nationals		○	The equipment procured in the Project shall be registered in accordance with the regulation in Myanmar. Public Works will be responsible for arranging the registration and/or permission for delivery of equipment from concerned organizations without delay.
8	Assembly and adjustment of construction and maintenance equipment	○		
9	Handover inspection, equipment initial operating guidance and maintenance guidance	○		The Myanmar side will secure and assign the personnel to participate in the said guidance.
10	Bearing of other costs not included in the grant aid		○	
11	Payment of the following commissions based on the Banking Arrangement: ■ Cost of opening an account in a Japanese certified foreign exchange bank ■ Bearing of payment commissions		○	

Note: "○" in the above table indicates the scope of responsibility regarding each item.

2-2-4-4 Consultant Supervision

Based on the Government of Japan's Grant Aid scheme, the Myanmar side will bind a consultant supervision agreement with the Consultant that is recommended by JICA and strive to ensure the smooth implementation of implementation design and procurement supervision.

Moreover, where necessary, it will dispatch specialist engineers to witness the plant inspections and pre-shipping inspections of the construction and maintenance equipment that is manufactured in Japan, and conduct supervision in order to prevent the occurrence of troubles after the equipment has been brought onto sites.

(1) Basic Policy of Consultant Supervision

As the basic policy of supervision, the Consultant will supervise progress of the overall plan to ensure the Project finishes on schedule, and it will conduct supervision and guidance of the procurement agent under cooperation with the Myanmar side to ensure that the quality specified in the contract is secured and the Project is safely implemented.

The major points to bear in mind in the procurement supervision are described as below.

1) Schedule control

The Consultant will compare progress with the implementation schedule decided by the procurement agent in the contract every month or every week in order to adhere to the delivery deadline given in the contract. In cases where delays are predicted, the Consultant will warn the procurement agent, demand the submission and implementation of a plan of countermeasures, and offer guidance to ensure the Project is finished on schedule.

- Confirmation of work performance in manufacture and procurement of construction and maintenance equipment
- Confirmation of shipping arrangement and inland transportation methods for transporting the construction and maintenance equipment
- Confirmation of the assignment of personnel concerned with assembly of construction and maintenance equipment and guidance on initial operations, etc.

2) Quality control

The Consultant will implement supervision to determine whether the quality of construction and maintenance equipment stated in the contract documents (technical specifications, approved design drawings, etc.) based on the following items:

In cases where doubts arise over quality, the Consultant will demand that the procurement agent make amendments, revisions or corrections.

- Checking of shop drawings and specifications of construction and maintenance equipment
- Attendance of plant inspections of construction and maintenance equipment and checking of plant inspection results

- Checking of construction and maintenance equipment assembly guidelines, and site test, adjustment and inspection guidelines
- Supervision of the site assembly of construction and maintenance equipment and witnessing of trial operation, adjustment and inspection

3) Safety control

Discussions will be held and cooperation will be sought with the procurement agent and supervision will be conducted during the Project implementation period in order to prevent the occurrence of industrial accidents or other incidents. Important points to consider in safety control on the ground are as follows

- Establishment of safety control regulations and appointment of manager
- Prevention of accidents through inspection of safety devices on work tools and equipment, etc.
- Planning of inland transportation routes, enforcement of slow driving and prevention of load collapse
- Wearing of safety gear (helmets, safety boots, gloves, etc.)

(2) Overall relationships for Project implementation

Figure2-2.4 shows the relationships between the Project implementing parties including the consultant supervision.

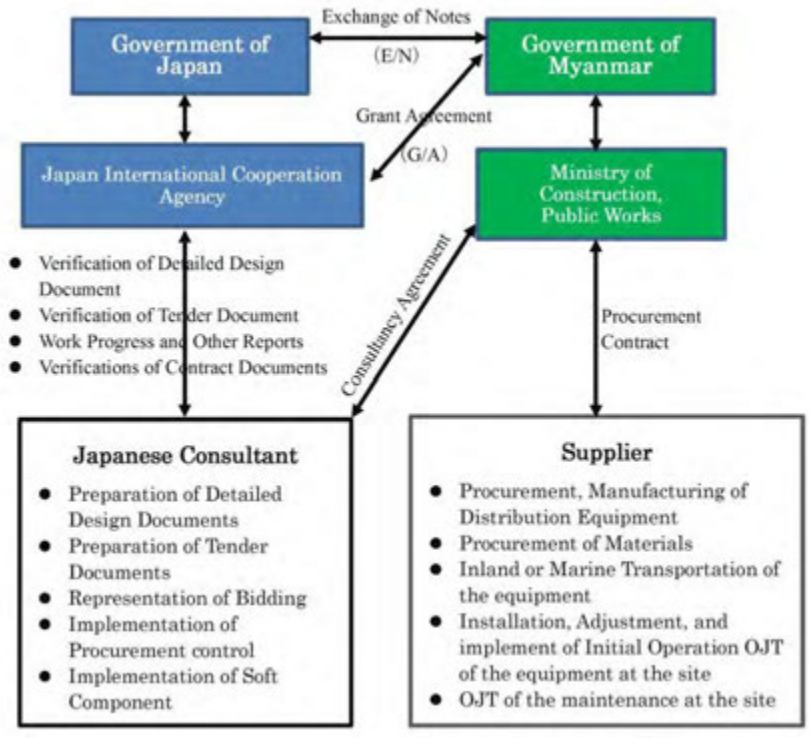


Figure 2-2.4 Project Implementation Relationships

(3) Procurement supervisor

The procurement agent will procure and assemble the construction and maintenance equipment and implement the initial operational guidance, etc. based on the contract with the Myanmarese side. It will also conduct schedule control, quality control and safety control during the work, although the Consultant's procurement supervisor will instruct and supervise the procurement agent.

2-2-4-5 Quality Control Plan

The Consultant will implement supervision to determine whether the quality of construction and maintenance equipment stated in the contract documents (technical specifications, approved design drawings, etc.) based on the following items:

In cases where doubts arise over quality, the Consultant will demand that the procurement agent make amendments, revisions or corrections.

- Checking of shop drawings and specifications of construction and maintenance equipment
- Attendance of plant inspections of construction and maintenance equipment and checking of plant inspection results
- Checking of packing, transportation and temporary storage methods on site
- Checking of construction and maintenance equipment assembly guidelines, and site test, adjustment and inspection guidelines
- Supervision of the site assembly of construction and maintenance equipment and witnessing of trial operation, adjustment and inspection

2-2-4-6 Procurement Plan

Because the construction and maintenance equipment and expendable parts scheduled for procurement in the Project are not manufactured or produced in Myanmar, the main equipment will basically be procured in Japan. However, since some Japanese makers have suspended domestic manufacturing and transferred their equipment, vehicle and parts production and manufacturing to overseas plants, the scope of procurement will be extended to include such overseas production facilities.

Irrespective of the country of procurement, all the procured equipment will have the Government of Japan ODA symbol applied either by paint or by sticker.

2-2-4-7 Operational Guidance Plan

Guidance concerning the initial operation and maintenance of the Project equipment will be conducted in OJT by instructors from manufacturers according to operation and maintenance manuals when handing over the equipment. In order to smoothly advance this guidance plan, Public Works will need to conduct close liaison and discussion with the Consultant and equipment procurement agent and appoint specialist engineers to participate in the OJT. The appointed Public Works engineers will need to horizontally extend the technology to other employees who couldn't

participate in the Project, and thereby cooperate in improving the maintenance capability of Public Works. Moreover, since expert engineers of makers who possess a certain level of expertise will need to operate and adjust the procured road construction and maintenance equipment and it will be difficult to utilize local firms for this purpose, it will be necessary to dispatch engineers from Japan to conduct the technical guidance.

2-2-4-8 Soft Component (Technical Assistance) Plan

To ensure that the operation and maintenance of equipment procured in the Project, which is the responsibility of the local side, is implemented appropriately, the operation and maintenance setup of the implementing agency will be strengthened.

In Rakhine State, Public Works workshops located in various parts implement periodic inspections and minor repairs of the construction equipment deployed in the state. Public Works Road Construction Special Unit No. 8 based in Toungup and Public Works Airfield Construction Special Unit No. 8 based in Ann operates and maintain the equipment procured in the Project, and these units look after existing equipment out of similar workshops. Equipment management is thus implemented, however, it is based on paper ledgers and does not constitute an efficient system.

In view of these circumstances, the soft component will be implemented according to the following contents.

(1) Improvement and enhanced efficiency of operation and maintenance management (ledger control) for construction and maintenance equipment

1) Objective

- Improvement of the equipment management system for equipment procured in the Project

2) Implementation method and contents

- Soft component implementing party: Consultant
- Implementation site: Road Construction Special Unit No.8 office (Toungup)
- Implementation period: 1.0 months practical guidance and 0.5 months evaluation and follow-up
- Targets: Staff of Road Construction Special Unit No.8, Airfield Construction Special Unit No.8 and central equipment control (roughly 20 members in total)
- Creation of the following manuals and plans
  - Construction and maintenance equipment operating record manual (operating log)
  - Construction and maintenance equipment operation and maintenance manual (spare parts control ledger)
  - Control software for the above (general-purpose software)
- Staging of workshops

- Practical learning that utilizes the above manuals and PCs

■ Practical learning equipment
- 2 sets of desktop computer and database software will be procured and utilized as the practical learning equipment.
- Allocation destinations of the procured practical learning equipment
  - ➢ Road Construction Special Unit No.8: 1 set
  - ➢ Airfield Construction Special Unit No.8: 1 set

(2) Pilot road construction works utilizing the construction and maintenance equipment

1) Objective

■ OJT in the ledger control system via pilot execution utilizing the Project equipment

2) Implementation method and contents

■ Soft component implementing party: Consultant
■ Implementation site: Target road in Rakhine State (section of approximately 200 meters near Toungup)
■ Implementation period: 0.5 months prior meeting and 1.5 months execution
■ Targets: Staff of Road Construction Special Unit No.8, Airfield Construction Special Unit No.8 and central equipment control (roughly 20 members in total)
■ Creation of the following manuals and plans
- Construction and maintenance equipment operating record manual (operating log) (utilize the manual prepared above)
- Construction and maintenance equipment operation and maintenance manual (spare parts control ledger) (utilize the manual prepared above)
- Control software for the above (general-purpose software) (utilize the software prepared above)

3) Practical learning equipment
- Procured equipment
- The desktop computer and database software that were used in (1) will be utilized.

(3) Technical guidance of bridge inspection utilizing the Bridge Inspection Vehicle

1) Objective

■ Improvement of the technology of bridge inspection and maintenance utilizing the Bridge Inspection Vehicle procured in the Project

2) Implementation method and contents

■ Soft component implementing party: Consultant
■ Implementation site: Road Construction Special Unit No.8 office (Toungup) and the

Khai- she Bridge sampled on the Project target road

- Implementation period: 0.5 months preparation by the Consultant in Japan and 1.1 months practical guidance
- Targets: Staff in charge of inspection and maintenance of bridges in Rakhine State (roughly 15 members in total)
- Creation of the following manuals and plans
  - Bridge Inspection Handbook
  - Bridge ledger
- Staging of workshops
  - Practical learning that utilizes the above handbook and bridge ledger

3) Practical learning equipment
   - Bridge Inspection Vehicle (procured in the Project)

2-2-4-9 Implementation Schedule

The implementation schedule for the implementation design and procurement supervision to be conducted by the Japanese side is set in Table 2-2.11.

Table 2-2.11 Implementation Schedule

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
TENDERING STAGE	4 month														
Preparation of Tender Document															
Obtaining of Approvals for the Tender Document															
Tender Opening (in Japan)															
Tender Evaluation,Concluding the Contract with the Successful Tenderer															
PROCUREMENT / MANUFACTURING AND TRANSPORTATION	15 month														
Preparation for Manufacturing Drawings by the Supplier															
Procurement, Manufacturing, Transportation and set up of Equipment and Machinery															
OJT for Operation at the Site															
SOFT COMPONENT															

2-3 Obligations of Recipient Country

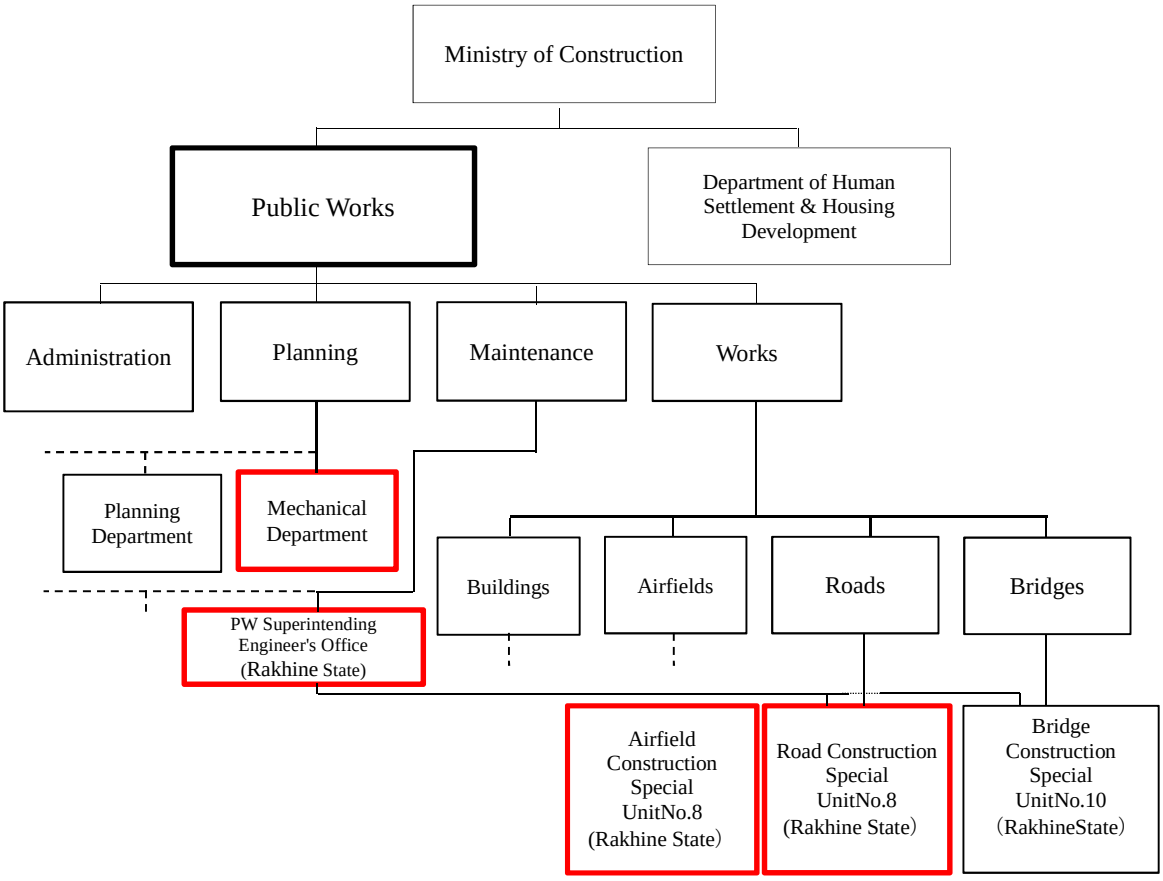
Following the conclusion of the E/N, the Myanmarese side will implement the following tasks based on cooperation of the responsible agency and each implementing agency.

- Following conclusion of the E/N, it will immediately open an account with a Japanese bank. Moreover, the Myanmarese side will bear any costs incurred in opening the account.
- There should not be any additional import of equipment and materials in the Project, however, if import does become necessary, the Myanmarese side will promptly secure landing and take customs clearance steps.
- With respect to Project officials (Japanese and third country nationals), it will take steps to ensure the entry to Myanmar, stay therein and safety.
- It will exempt or bear any tariffs and domestic taxes that would otherwise be levied on the services, equipment and materials and Japanese nationals related to the Project.
- It will operate and surely maintain the roads and incidental facilities that are constructed under Japan's grant aid.
- It will bear any other costs that are necessary for the Project but are not included in the grant aid.
- It will secure sites to store the equipment and expendable parts procured in the Project and implement appropriate operation and maintenance.
- It will secure the budget, personnel and materials needed to execute works on the target road and promptly start work following the handover of equipment.
- In the case where additional road area needs to be secured for constructing and maintaining the target road in the Project, it will certainly secure the necessary land according to Myanmarese laws to ensure that the works can be started without delay.
- In the case where authorization needs to be secured from government offices, it will apply for and secure the necessary authorization.

Public Works has the capacity to allocate budget and personnel to conduct road construction and maintenance following the handover of equipment. Moreover, since it has been confirmed in site survey that the storage site for the procured equipment has already been secured, it is deemed that the local side can fulfill its obligations.

2-4 Project Operation and Maintenance Plan

Following handover of the Project equipment, Public Works will implement works on the target road in Rakhine State. Figure 2-4.1 shows the works implementation setup of Public Works.



NOTE : The organization in red shows actual implementation body in the project
Source: Public Works

Figure 2-4.1 Pblic Works Organization Chart

The construction works on the road along the target road in the Project will be directly implemented by the Roads Department and Airfield Department of Public Works. The Roads Department and Airfield Department have respectively assigned Road Construction Special Unit No. 8 and Airfield Construction Special Unit No. 8 as roads works teams in Rakhine State, and these units will execute the road construction and maintenance works in the Project.

The Project equipment will be handed over and stored inside the premises of Road Construction Special Unit No. 8 on Toungup and Bridge Construction Special Unit No.10 on Ann. Moreover, Public Works Rakhine State Offices will be in charge of the routine maintenance of the procured equipment, while expendable parts for the equipment will be stored in the sub-workshop located next to the office. Public Works Rakhine State Offices will periodically report on the operating condition and maintenance of equipment to the Lower Myanmar Mechanical Equipment Compound in Mayangone Township in Yangon.

Based on the procured equipment maintenance plans and reports from the site unites, the Mechanical Equipment Compound will prepare appropriate stores of expendable parts and conduct the efficient operation and maintenance of equipment.

Public Works basically has facilities for conducting maintenance work on equipment, however, it is intended to implement a soft component (technical guidance) of initial control and operational guidance on handover geared to realizing3 even more efficient operation and maintenance. Incidentally, spare parts and expendable items can be purchased via local agents and so on.

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

(1) Japan side

This chapter is closed due to the confidential.

(2) Myanmar side

Myanmar side must pay costs as shown below.

Items		Cost Amount (USD)	
Road construction of the Project site in Rakhine state	Toungup-Ma-ei	5.4million	18.5 million
	Ann-Ma-ei	13.1 million	
The storage cost of construction equipment of the Project (fence, storage house for spare parts)			5,000
Commissions to the bank based on Banking Arrangement			7,500

Note) Public Works plans to construction work of the Project site from fiscal year 2015 to 2017.

(3) Conditions of cost estimation are as follows.

1. Timing of cost estimation : September 2013
2. Exchange rate : 1USD = 99.38 Japanese Yen (JPY)
3. Implementation schedule : Shown in the “2-4-8 Implementation Schedule”.
4. Others : Cost estimation shall be conducted in accordance with the institution of the Grant Aid Project of the Japanese government.

2-5-2 Operation and Maintenance Cost

To efficiently operate the Project equipment, Public Works needs to conduct sustainable maintenance by itself. Therefore, it will be necessary for Public Works to take necessary steps to secure the budget and conduct appropriate maintenance based on efficient operation and maintenance plans.

Annual costs of maintaining construction equipment (periodic maintenance and site repair works,

etc.) procured in the Project are estimated approximately 2,394,000JPY (22,506,000 Kyat) as shown in Table 2-5.1. This amount is nearly equal to 2.2% of the average equipment maintenance cost of whole Rakhine State under Public Works over the past three years shown in Table 2-5.3. Moreover, in addition to equipment maintenance costs, the fuel cost of approximately 22,326,000JPY (209,868,000 Kyat) per year for running equipment will be necessary for target road construction as shown in Table 2-5.2.

Public Works is required to secure these necessary costs for appropriate control and maintenance of equipment and also for secure implementation of target road construction.

Table 2-5.1 Estimated costs for equipment maintenance

Name of Equipment	FOB Value (×1000 JY) (a)	Machine's life span (years) (b)	Mainte. cost Rate (in life span) (%) (c)	Av. mainte. cost/year (×1000 JY) (d) = a×(c/100)÷b	Number of machines (e)	Machinery maintenance costs in initial 3 years		
						Cost rate (%) (f)	Cost/unit (×1000 JY) (g) = d×(f/100)	Annual expenditure (×1000 JY) (h) = e×g
1. Under Bridge Inspection Vehicle	42,750	15	45	1,283	1	15	192.4	192
2. Motor Grader	18,549	15	40	495	2	15	74.2	148
3. Excavator (Crawler)	9,691	15	50	323	2	15	48.5	97
4. Wheel Loader	12,778	15	70	596	2	15	89.4	179
5. Wheel Excavator	18,932	15	40	505	2	15	75.7	151
6. Bulldozer	24,000	15	45	720	2	15	108.0	216
7. Sheep Foot Compactor	13,864	15	15	139	2	15	20.8	42
8. Vibratory Tandem Roller	10,520	15	20	140	4	15	21.0	84
9. Bitumen Distributor	14,814	15	55	543	2	15	81.5	163
10. Asphalt Kettle	7,747	15	20	103	2	15	15.5	31
11. Mobile Workshop	17,169	15	45	515	2	15	77.3	155
12. Water Bowser (Tanker)	7,854	15	40	209	2	15	31.4	63
13. Dump Truck	7,441	15	50	248	12	15	37.2	446
14. Cab-back Crane	10,088	15	30	202	2	15	30.3	61
15. Low bed Semi-trailer (with Tractor Head)	25,872	15	45	776	1	15	116.4	116
16. Mobile Crusher	20,322	15	50	677	2	15	101.6	203
17. Inspection Vehicle	2,146	15	50	72	2	15	10.7	21
18. Asphalt Hand Sprayer	501	15	50	17	10	15	2.5	25
Estimated annual expenditure for machinery maintenance in initial three years (Kyat)								2,394(22,506)
Average annual expenditure for machinery maintenance in Public Works Rakhine State Office (for the last three years , 2011-2013)								108,079
The rate of increase in expenditure for machinery maintenance based on the average annual expenditure for last three years (%)								2.2

Exchange rate: 1.0 JY = 9.4 Kyat (As of November 2013)
Source:Survey Team

Table 2-5.2 Estimated costs for fuel

Name of Equipment	Engine Output (kW) (a)	Fuel Consumption Rate (ℓ/kW·h) (b)	Fuel Consumption Rate (ℓ/h) (c) = a×b	Working Hrs. (hrs./year) (d)	Number of Machines (e)	Fuel Consumption (ℓ/year) (f) = c×d×e	Fuel Price (Kyat/ℓ) (g)	Fuel Costs/year (Kyat×1000) (h) = f ×g
1. Bridge Inspection Vehicle	100	0.040	4.0	500	1	2,000	950	1,900
2. Motor Grader	130	0.108	14.0	1200	2	16,848	950	16,006
3. Excavator (Crawler)	100	0.175	17.5	1200	2	21,000	950	19,950
4. Wheel Loader	120	0.153	18.4	2400	2	44,064	950	41,861
5. Wheel Excavator	90	0.175	15.8	1200	2	18,900	950	17,955
6. Bulldozer	165	0.175	28.9	1200	2	34,650	950	32,918
7. Sheep Foot Compactor	80	0.152	12.2	1200	2	14,592	950	13,862
8. Vibratory Tandem Roller	50	0.152	7.6	400	4	3,040	950	2,888
9. Bitumen Distributor	115	0.090	10.4	400	2	4,140	950	3,933
Sub Engine	10	0.090	0.9	400	2	360	950	342
10. Asphalt Kettle	17	0.170	2.9	300	2	867	950	824
11. Mobile Workshop	140	0.050	7.0	700	2	4,900	950	4,655
Generator-cum-Arc Welder	20	0.170	3.4	300	2	1,020	950	969
12. Water Bowser (Tanker)	150	0.040	6.0	600	2	3,600	950	3,420
13. Dump Truck	190	0.050	9.5	1500	12	14,250	950	13,538
14. Cab-back Crane	190	0.050	9.5	700	2	6,650	950	6,318
15. Low bed Semi-trailer (with Tractor Head)	230	0.075	17.3	600	1	10,350	950	9,833
16. Mobile Crusher	40	0.185	7.4	2400	2	17,760	950	16,872
17. Inspection Vehicle	55	0.047	2.6	700	2	1,810	950	1,719
18. Asphalt Hand Sprayer (Petrol Engine)	2.5	0.227	0.6	200	10	114	950	108
Estimated annual expenditure for fuel								209,868

Exchange rate: 1.0 JY = 9.4 Kyat (As of November 2013)
Source:Survey Team

Table 2-5.3 Budget for equipment maintenance (Public Works Rakhine State Office)

Financial Year	Expenses for major repair	Expenses for periodic maintenance/minor repair	Total (Kyats)	Total (JY)
2011-2012	158,650,000	363,000,000	521,650,000	55,494,681
2012-1013	85,362,700	1,416,000,000	1,501,362,700	159,719,436
2013-1014	137,820,000	887,000,000	1,024,820,000	109,023,404
Average amount for the past three years			1,015,944,233	108,079,174

Exchange rate: 1.0 JY = 9.4 Kyat (As of November 2013)
Source:Public Works

CHAPTER 3

PROJECT EVALUATION

Chapter 3 Project Evaluation

3-1 Preconditions

Preconditions of this project are as follows:

- To secure storage areas for the construction and maintenance equipment and spare parts.
  (It is necessary for the Road Construction Special Unit No.8 to fence the delivery point of the equipment and to build a storehouse for spare parts.)
- To ensure that tax exemption, clearance, and smooth in-land transportation of the provided equipment.
- Myanmar government bears custom duties, internal taxes and other fiscal levies which may be imposed in Myanmar with respect to the purchase of the products and
- To accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into Myanmar and stay therein for the performance of their work.
- To arrange registration of equipment, and permission necessary for the passage of heavy vehicle and for access to restricted areas.
- To ensure that the facilities and the products be maintained and used properly and effectively for the implementation of the project.
- To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project.
- To bear the following commissions paid to the Japanese bank for banking services based on the B/A.
  - Advising commission of A/P
  - Payment commission

3-2 Necessary Inputs by Recipient Country

Necessary inputs by Myanmar government of this project are described below.

- Prompt implementation of road construction in target road as soon as the equipment is procured.
- The equipment conveyance by land to targeted road construction site.
- Appoint engineers and operators for implementation of the project
- Land acquisition necessary for implementation of the project.
- Proper Operation and Maintenance (O&M) of the equipment and appoint engineers for O&M.
- The equipment procured for Soft Component (desktop computers, database software) and the equipment control system acquired in Soft Component are properly and sustainably operated.
- Proper consideration for people living along the target road at the improvement stage.
- Proper explanation to residents about improvement planning, schedule, matters to be paid attention and etc.

3-3 Important Assumptions

At present, security situation of Rakhine State seems to be relatively stable and also the risk of the target area of the Project is lower than other areas in the state. However, the situation does not allow making premature conclusions, and thus it ensuring and keeping the safety for concerned workers of the Project and proper operation of the equipment during the construction time and after the project are preconditions. The security situation in Rakhine State will significantly affect the overall conditions of the Project.

3-4 Project Evaluation

3-4-1 Relevance

Japanese government set the major support fields for Myanmar to assist to spread the result of democracy, reconciliation within the country and economic revolution to all nationals living in Myanmar.

1. Improve quality of life for all nationals. (including ethnic minorities, poverty households and development of urban and rural area)
2. Capacity development for human resources and maintenance of regulations for economic and social development.
3. Infrastructure and regulation for sustainable economic growth

The Project covers 1 and 3 mentioned above, and it is suitable for directions of Japanese major support fields.

The Project target road runs north-south in the central region of Rakhine State and forms a part of the arterial roads running north-south in the state. The Project will contribute to the development of arterial roads of the whole country since it will ensure a stable traffic flow between north and south of the state, and also connects to Ayeyarwady Region neighboring to the south-east, and subsequently to Yangon, economic center in Myanmar.

Figure 3-4.1 Arterial Road from Magway Region to Sittwe, Rakhine State

Moreover, Public Works intends to develop an arterial road from Minbu, (in Magway Region adjacent to the east to the state) to Sittwe (the capital of the state) via Ann (the northern end of the Project target road) , Mrauk-u and Kyauktaw (northern parts of the state).

Development of the Project target road and the road section between Ann and Sittwe will cover approximately two-thirds of the total length of the roads running north-south of the state.

As mentioned above, the Project is in line with the road development strategy of the Public Works,

considered to contribute largely to the regional development not only in the Project target area but also in the whole state.

3-4-2 Effectiveness

3-4-2-1 Quantitative effectiveness

Approximately 62,000 people live along the Project target road, and the Project can provide direct benefit to those people.

It is expected that improvement of the target road is going to increase driving speed from current 25km/hr. to 60km/hr. This increase enables to cut travel time between Toungup and Ann to two and half hour.

Table 3-4.1 shows quantitative effects of the Project.

Table 3-4.1 Quantitative effects of the Project

Indicator	Baseline,2013	Target, 2018
Average driving speed on the target road（km/h）	Approx. 25km/h	Approx. 60km/h
Total length of road improvement on the target road（km）	0km	Approx. 140km

3-4-2-2 Qualitative effectiveness

Table 3-4.2 indicates qualitative effects of the Project.

Table 3-4.2 Qualitative effects of the renovated roads in Rakhine State

Present state and Problems	Measures to be implemented by this project	Effects and Improvements
The target road has only one lane and is mixed unpaved, macadam, and SBST/DBST pavement, and driving condition is bad due to serious damages of road surface. The area has heavy rain in the rainy season, and then damages of the road and bridges happen frequently.	➢ Improvement of the road between Ann – Maei - Toungup	After improvement of the target road and bridges by this project, vehicle transport becomes easier for local people. Also, materials will be transported easily and it will contribute to promote industrial development. <Beneficiary population and facilities around the target road> Population along the road：62,272 Number of schools along the target area：42 (including primary school and universities) Number of medical facilities：12 (Including sub-rural health center, rural health center, hospitals)

Present state and Problems	Measures to be implemented by this project	Effects and Improvements
<Residential environment> ・School zone Most of the middle and high school students usually go to school by walk, bicycle, and "Sai car"; however, road conditions and drainage in the rainy season are quite bad and it is too difficult to ride bicycles. ・Access to health centers/ hospitals Primary health care is provided by sub-rural health centers. Patients need higher medical services should go to Township health centers or hospitals in the towns. Although some hospitals have ambulances, they rarely utilize them due to bad road condition. ・Access to electricity Electricity is limited in the target road and its area; some of the people living there accesses electricity by diesel generator. Not only households but also public infrastructures such as hospitals are not able to access stable electricity.		・After the road is paved, rut or paddle occurred in rainy season become fewer, and people living in the area can travel easily. For the students also, it becomes easier and safer to go to school by walk and bicycle. ・The road improvement may promote periodical in-land public transportation service, and it can improve accessibility to emergency medical services. Ambulances may also be utilized effectively and subsequently decrease patients' cost. ・Fuel cost for electricity may become lower by the road improvement, and access of electricity may become easier.
<In-land transportation> ・Roads in middle and southern part of Rakhine State are in bad conditions, and in-land transportation is limited. As a result, marine transportation by small ports along a coast is popular in the area. However, uncertainties of marine transportation stifle active physical distribution even though their costs are relatively low. Marine transportation is affected by natural conditions frequently and need much time. It takes five to seven days to transport heavy materials from Yangon to Sittwe; marine products, one of the specialties in Rakhine, are hard to be transported keeping them fresh. According to a local transportation company, choice of marine transportation	Same as above	・Target road is a key road to connect main cities in middle part of Rakhine to Sittwe or outside of the state. Improvement of the road can promote effective physical distribution with less cost and time. Especially, Ann and Toungup are the starting points of the in-land transportation in middle of Rakhine, and effective physical distribution also can be promote small business by villagers living in the area.

Present state and Problems	Measures to be implemented by this project	Effects and Improvements
by local people is rooted their culture. But it is also unwilling choice due to bad road condition. ・Medicines are first gathered at Sittwe and distributed to each city in the state.		・Medicines can be distributed quickly, and vaccines which need to refrigerated also can be distributed wider.

APPENDICES

APPENDIX 1

MEMBER LIST OF THE STUDY TEAM

1. Member List of the Study Team

【First Field Survey】

Name	Work Assignment	Position
Shigeki MIYAKE	Leader	Director Transportation and ICT Division 2, Transportation and ICT Group, Economic Infrastructure Department, Japan International Cooperation Agency (JICA)
Kenichi KOBAYASHI	Planning and Management	Assistant Director Grant Aid Project Management Division 1, Financial Cooperation Implementation Department, Japan International Cooperation Agency (JICA)
Masatsugu KOMIYA	Chief Consultant	Yachiyo Engineering Co., Ltd.
Isao TAKAHASHI	Deputy Chief Consultant/ Road and Bridge Planner	Yachiyo Engineering Co., Ltd.
Etsuo HASHIGUCHI	Equipment Planner/ Maintenance Planner	Yachiyo Engineering Co., Ltd.
Ayumi KOYAMA	Social Surveyor	Yachiyo Engineering Co., Ltd.
Masatoshi BABA	Procurement Specialist/ Cost Estimation	Yachiyo Engineering Co., Ltd.

【**Second Field Survey**】

Name	Work Assignment	Position
Shigeki MIYAKE	Leader	Director Transportation and ICT Division2, Transportation and ICT Group, Economic Infrastructure Department, Japan International Cooperation Agency (JICA)
Toru TSUCHIHASHI	Planning and Management	Planning and Coordination Division, Economic Infrastructure Department, Japan International Cooperation Agency (JICA)
Masatsugu KOMIYA	Chief Consultant	Yachiyo Engineering Co., Ltd.
Isao TAKAHASHI	Deputy Chief Consultant/ Road and Bridge Planner	Yachiyo Engineering Co., Ltd.

APPENDIX 2

STUDY SCHEDULE

First Field Survey Schedule

Day	Date		JICA Team leader and plannning management	Chief Consultant	Deputy Chief Consultant/ Road and Bridge Planner	Equipment Planner/ Maintenance Planner	Social Surveyor	Procurement Specialist/ Cost Estimation	Accomodation
			Shigeki Miyake and Kenichi Kobayashi	Masatsugu Komiya	Isao Takahashi	Etsuo Hashiguchi	Ayumi Koyama	Masatoshi Baba	
1	1-Sep-13	Sun	Tokyo⇒Yangon	-	Trip by air : [Tokyo (11:00) TG641→Bangkok (15:40) /(17:50) TG305 →Yangon(18:45)]				Yangon
2	2-Sep-13	Mon	・ Yangon→Rakhine state (by air: 6T-607 12:30/15:05) ・ Meeting w/ PW in Thandwe, discussion on Inception Report	-	Same as Chief consultant				Thandwe
3	3-Sep-13	Tue	・ Field Survey in Rakhine state(Thandwe~Maei~Ann)(by car)	Trip by air : [Tokyo (11:00) TG641→Bangkok (15:40) /(17:50) TG305 → Yangon(18:45)]	Same as Chief consultant				Ann / Yangon
4	4-Sep-13	Wed	・ Field Survey in Rakhine state(Ann~Magwey~Naypyitaw)(by car:6hrs)	・ Yangon →Naypyitaw (by air: FMI-A1 07:30/08:30)	Same as Chief consultant				Naypyitaw
5	5-Sep-13	Thu	・ Discussion on Inception Report and M/M w/ PW						Naypyitaw
6	6-Sep-13	Fri	・ Signing of M/M ・ Naypyitaw→Yangon (by air: FMI-B2 1300/1400 ・ Visit to Embassy of Japan in Myanmer, report of M/M						Yangon
7	7-Sep-13	Sat	Yangon⇒Tokyo	・ Yangon→Sittwe(by air: 6T-611 11:30/12:55)	・ Team Meeting		Same as Chief consultant	Same as Deputy chief consultant	Sittwe/Yangon
8	8-Sep-13	Sun	-	・ Team Meeting	・ Team Meeting		Same as Chief consultant	Same as Deputy chief consultant	Sittwe/Pyay
9	9-Sep-13	Mon	-	・ Meeting w/ state government	10:00 Meeting w/ PW at Mechanical Equipment Compound in Mayangone 14:00 Meeting w/ Road Research Laboratory		Same as Chief consultant	Same as Deputy chief consultant	Sittwe/Thandwe
10	10-Sep-13	Tue	-	・ Sittwe→Ann (by car)	・ Yangon→Pyay (by car)		Same as Chief consultant	Same as Deputy chief consultant	Ann/Thandwe
11	11-Sep-13	Wed	-	・ Ann→Thandwe (by car) ・ Interview survey	9:00 Meeting w/ Pinta workshop ・ Pyay→Thandwe (by car)		Same as Chief consultant	Same as Deputy chief consultant	Thandwe
12	12-Sep-13	Thu	-	・ Thandwe→Pyay (by car)	・ Meeting w/ PW road construction special unit No.8		・ Thandwe→Toungup (by car) ・ Interview survey along the target road	Same as Deputy chief consultant	Pyay/Thandwe
13	13-Sep-13	Fri	-	・ Thandwe→Yangon (by car)	・ Meeting w/ PW road construction special unit No.8		・ Thandwe→Toungup (by car) ・ Interview survey along the target road	Same as Deputy chief consultant	Yangon/ Thandwe
14	14-Sep-13	Sat	-	Trip by air : [Yangon(19:45) TG306→ Bangkok(21:40/23:50) TG642	・ Team Meeting				Airplane/ Thandwe
15	15-Sep-13	Sun	-	Narita,Japan(07:25)	・ Field Survey in Rakhine State (Thandwe ~ Gwa) (by car)				Gwa
16	16-Sep-13	Mon	-	-	・ Field Survey in Rakhine State (Gwa ~ Ngathaingchaung ~ Pathein) (by car)				Pathein
17	17-Sep-13	Tue	-	-	・ Pathein→Yangon (by car)				Yangon
18	18-Sep-13	Wed	-	-	・ Meeting w/ PW at Mechanical Equipment Compound in Mayangone		・ Data collection in Yangon	Same as Deputy chief consultant	Yangon
19	19-Sep-13	Thu	-	-	・ Yangon→Naypyitaw (by air: FMI-A1 07:30/08:30) ・ Discussion w/ PW on technical field report				Naypyitaw
20	20-Sep-13	Fri	-	-	・ Discussion w/ PW on project plan				Naypyitaw
21	21-Sep-13	Sat	-	-	・ Naypyitaw→Yangon (by car) ・ Meeting w/ PW at Nuekuai parking place (on the way to Yangon from Naypyitaw)				Yangon
22	22-Sep-13	Sun	-	-	・ Preparation of Draft Field Report				Yangon
23	23-Sep-13	Mon	-	-	・ Meeting w/ PW at Insein garage ・ Preparation of Draft Field Report		・ Data collection in Yangon ・ Preparation of Draft Field Report	Same as Deputy chief consultant	Yangon
24	24-Sep-13	Tue	-	-	・ Interview to Yangon port ・ Meeting w/ Ministry of Rail Transport and other ministries concern		・ Data collection in Yangon ・ Preparation of Draft Field Report	Same as Deputy chief consultant	Yangon
25	25-Sep-13	Wed	-	-	・ Preparation of Draft Field Report				Yangon
26	26-Sep-13	Thu	-	-	・ Team meeting, data collection, revising Draft Field Survey				Yangon
27	27-Sep-13	Fri	-	-	・ Report to Embassy of Japan in Myanmer ・ Report and explalin Draft Field Report to JICA Myanmer Office				Yangon
28	28-Sep-13	Sat	-	-	Trip by air : [Yangon(19:45) TG306→Bangkok(21:40/23:50) TG642				Airplain
29	29-Sep-13	Sun	-	-	Narita, Japan(07:25)				-

Second Field Survey Schedule

Day	Date		JICA Team leader and plannning management	Chief Consultant	Deputy Chief Consultant/ Road and Bridge Planner	Accomodation
			Shigeki Miyake and Toru Tsuchihashi	Masatsugu Komiya	Isao Takahashi	
1	12-Dec-13	Thu	-	・ Trip by air : [Tokyo (10:45) TG641→Bangkok (15:45) /(17:55) TG305 →Yangon(18:40)]		Yangon
2	13-Dec-13	Fri	-	・ Yangon→Naypitaw (by car) 13:00 Meeting for explanation of Draft Final Report and Minites of Discussion(draft) with PW, MoC		Naypitaw
3	14-Dec-13	Sat	・ Japan→Yangon	・ Team meeting		Naypitaw
4	15-Dec-13	Sun	・ Team meeting	・ Naypitaw→Yangon (by car) ・ Team meeting		Yangon
5	16-Dec-13	Mon	8:00 Attending the Founding Ceremony of the Myanmar Engineering Council 11:00 Signing on Minutes of Discussion			Yangon
6	17-Dec-13	Tue	9:00 Meeting with Mayangone Mechanical Equipment Compound 11:00 Meeting with Insein Base Workshop			Yangon
7	18-Dec-13	Wed	・ Team meeting			Yangon
8	19-Dec-13	Thu	10:00 Report to JICA Myanmer Office 14:00 Report to Embassy of Japan in Myanmer			
			・ Yangon→Japan	・ Trip by air : [Yangon(19:40) TG306→Bangkok(21:35/23:55) TG642		Airplain
9	20-Dec-13	Fri	-	Narita, Japan(07:35)		-

APPENDIX 3

LIST OF PARTIES CONCERNED IN THE RECIPIENT COUNTRY

3. List of Parties Concerned in the Recipient Country

Name of Organization	Position
Public Works, Ministry of Construction	
Mr. Kyaw Linn	Managing Director (Civil)
Mr. Han Soe	Deputy Managing Director (Maintenance)
Mr. Myo Nyunt	Deputy Chief Engineer (Mechanical)
Mr. Ohn Lwing	Chief Engineer (Road)
Mr. Khin Maung Kyaw	Chief Engineer (Road)
Mr. Shwe Lay	Chief Engineer (Bridge)
Mr. Thein Zaw	Chief Engineer (Airfield)
Mr. Kyaw Shein	Deputy Chief Engineer (Planning)
Mr. Khin Thet,	Deputy Chief Engineer (Airfield)
Ms. Hla Hla Thue	Superintending Engineer (Road)
Dr. Hlaing Moe	Deputy Superintending Engineer (Mechanical)
Ms. Mya Mya Win	Deputy Superintending Engineer (RRL)
Mr. Nay Linn Tun	Assistant Engineer (RRL)
Rakhine State Government	
Mr. Hla Maung Tin	Chief Minister
Mr. Hla Haw	Minister of Transportation
Mr. Tha Tun	Minister of Development Affair
Mr. Tun Way	Deputy Superintendent Engineer Ministry of Border Affair Department of Rural Development
Public Works, Ministry of Construction at Rakhine State	
Mr. Soe Taw Tu Htwo	Superintending Engineer
Mr. Aye Thwin,	Deputy Superintending Engineer
Mr. Khin Maung Than	Deputy Superintending Engineer
Mr. Kyaw Thet	Deputy Superintending Engineer
Mr. Saw Thawdu Htoo	Deputy Superintending Engineer
Mr. Kyaw Kyaw Htwe	Executive Engineer
Mr. Min Thant Oo	Assistant Engineer
Mr. Zayar Soe Tint	Assistant Engineer
National Planning Department at Thandwe Township	
Mr. Tin Thein,	Assistant Director of National Planning and Economic Department

Department of Agriculture, Rakhine State, Sittwe

Mr. Khin Maung Win	Deputy Director

Department of Health, Rakhine State, Sittwe

Dr. Aye Nying	State Health Director
Dr. Win Win Mar	State TB Officer
Dr. Soe Win Paing	Team Leader Special Disease Control
Dr. Mya Mya Than	Team Leader Nutrition Team
Dr. Pyae Phyo San	Team Leader STD Champing
Mr. Thein Nyunt	State VBDC Sittwe

Department of Education, Rakhine State, Sittwe

Mr. Myo Swe Director	Director
Mr. Hla Sein Tun	Deputy Director

Ann District Hospital

Dr. Zaw Tun	Consultant Surgery Specialist

Tounggoke Collage

Professor Thar Tun Maung	Principal of Tounggoke College

Tounggoke Township Hospital

Dr. Nyunt Oo	Township Medical Officer

UNOCHA Yangon Office

Ms. Barbara Manzi	Head of Myanmar Office

UNHCR Yangon Office

Mr. Ayaki Ito	Deputy Representative
Ms. Noriko Takagi	Senior Programme Officer
Ms. Mai Terawaki	Associate Programme Officer

UNDP Yangon Office

Ms. Monica Rijal	Early Recovery Specialist

WHO Yangon Office

Dr. Liviu Vedrasco	Health Cluster Coordinator

Bridge Asia Japan Yangon Office

Ms. Akiko Mori	Country Representative
Mr. Kenichi Minoda	Programme Manager
Ms. Sayaka Yoshida	Coordinator

Embassy of Japan

Mr.Hideaki Matsuo	Counsellor (Economic and ODA)
Takeshi Nakaya	Second Secretary

JICA Myanmar Office

Akihito Sanjo	Senior Representative
Yasuyuki Sato	Representative
Maki Morikawa	Project Frpmulation Advisor

APPENDIX 4

MINUTES OF DISCUSSIONS

MINUTES OF DISCUSSIONS
ON THE PREPARATORY SURVEY
ON THE PROJECT FOR PROVISION
OF ROAD CONSTRUCTION AND MAINTENANCE EQUIPMENT
IN RAKHINE STATE

In response to a request from the Government of the Republic of the Union of Myanmar (hereinafter referred to as "Myanmar"), the Japan International Cooperation Agency (hereinafter referred to as "JICA"), in consultation with the Government of Japan decided to conduct a Preparatory Survey on the Project for Provision of Road Construction and Maintenance Equipment in Rakhine State (hereinafter referred to as "the Project").

JICA sent to Myanmar the Preparatory Survey Team (hereinafter referred to as "the Team"), which is headed by Mr. MIYAKE Shigeki, Director of Transportation and ICT Division 2, Economic Infrastructure Department, JICA and is scheduled to stay in the country from September 1st to September 28th, 2013. The Team held discussions with the officials concerned with the Government of Myanmar and conducted a field survey in the study area.

In the course of discussions and field survey, both sides confirmed the main items described on the attached sheets. The Team will proceed to further works and prepare the Preparatory Survey Report.

Nay Pyi Taw, September 5, 2013

U Kyaw Linn
Managing Director
Public Works
Ministry of Construction
The Republic of the Union of Myanmar

Mr. MIYAKE Shigeki
Leader
Preparatory Survey Team
Japan International Cooperation Agency

ATTACHMENT

1. Objective of the Project

The objective of the Project is to promote road construction using machineries to be procured by the Project, and to improve social infrastructure and living circumstance of people around areas in Rakhine state.

2. Project site

The sites of the Project are located in Rakhine state as shown in **ANNEX 1**.

3. Responsible and Implementing Agency

The Responsible and Implementation Agency is Public Works (PW), Ministry of Construction. The organization chart of PW is shown in **ANNEX 2**.

4. Confirmation of the items requested by the Government of Myanmar

After discussions with the Team, the requested components were confirmed as follows. JICA will assess the appropriateness of the requests and will recommend them to the Government of Japan for approval.

- Priority sections to be improved/ constructed

1st priority: Toungup - Ann road (approximately 140km)

2nd priority: Ngathaingchaung - Thandwe road (approximately 182km)

3rd priority: Pauktaw - Minbyar (approximately 34km)

The Target Section of the Project will be finally confirmed at the mission to explain the contents of draft final report.

- Types of the road structure to be applied to the above sections

1) Pavement type: Bituminous road

- Requested equipment component

Both side confirmed the requested equipment component as shown in **ANNEX 3**. The Project component will be determined in consideration with the priority shown in **ANNEX 3** as well as the result of field survey by the Team.

5. Japan's Grant Aid Scheme

5-1.Myanmar side understands the Japan's Grant Aid Scheme explained by the Team, as described in **ANNEX 4**.

5-2. Myanmar side will take the necessary measures, as described in **ANNEX 5**, for smooth implementation of the Project.

6. Proper Use of the Equipment

6-1. Myanmar side understood the importance of "Proper Use" of the equipment procured under the Japan's Grant Aid and they should be utilized in road construction for the road sections which were specified as the Target Section of the Project.

6-2. Myanmar side agreed to share the equipment ledger once a year with JICA Myanmar Office to monitor "Proper Use" of the equipment to be procured under the Project.

7. Schedule of the Study

7-1. JICA will prepare the draft report in English and dispatch a mission in order to explain its contents around middle of December, 2013

7-2. JICA will finalize the final report and send it to the Government of Myanmar around March, 2014

8. Other issues

8-1. Myanmar side agreed to make necessary arrangements for road construction of the Target section, such as budget and personnel. The both sides confirmed that necessary information for approximate estimation of construction cost would be provided by Myanmar side and the Team would present its result in the draft final report.

8-2. Myanmar side agreed to provide the appropriate storage yard for the Equipment to be procured under the Project.

8-3. Myanmar side requested to conduct a soft component as guidance for operation and maintenance on the Equipment to be procured under the Project.

8-4. Myanmar side explained to the Team that 6 bridges construction between Toungup–Ann road are planned using JICA's Yen loan scheme. The Team appreciates the plan as a good coordination to facilitate the effect of the Project.

8-5. The Team requested that the Target Section of the Project should be constructed within 3 years after the hand-over of the equipment.

8-6. Myanmar side requested to procure some testing apparatuses for road construction for Road Research Laboratory (RRL) in Yangon (see ANNEX3). The Team explained that it would be considered on the condition that those testing apparatuses could contribute to the road construction of the Target Section of the Project in Rakhine state.

ANNEX 1

Site Map

ANNEX 2

Organization chart of Public Works

Tentative list of the equipment requested by the Public Works (Rakhine State)

-Equipment for the road construction Priority : A = 1st, B=2nd

No.	Name of Equipment	Specification	Quantity	Priority
1	Under Bridge Inspection Vehicle		1	A
2	Motor Grader	Engine output: (approx.) 130 kW, Blade length: (approx.) 4 m, with scarifier Operation weight: (approx.) 14 ton	2	A
3	Excavator (Crawler)	Bucket capacity: (Approx.) 1.0 m^3 Max. Digging Depth: more than 6 m Operation Weight: (approx.) 25 ton Engine Output:(approx.) 100 kW	2	A
4	Wheel Loader	Engine output: (approx.) 120 kW , Bucket capacity: (approx.) 2.5 m^3, Operation Weight: (approx.) 16 ton, Max Dumping Clearance: (approx.) 3 m with ROPS cab	2	A
5	Wheeled Retro Excavator	Operation Weight: (approx.) 6 ton, Engine Output: (approx.) 70 kW Backhoe Bucket capacity: (approx.) 0.2 m^3 Loader bucket Capacity: (approx.) 1.0 m^3	2	A
6	Bulldozer (crawler)	Operation Weight: (approx.) 27~28 ton, Engine Output:(approx.) 170 kW Straight Tilt Dozer and Multi-shank Ripper with ROPS cab	2	A
7	Vibration Roller (Sheep foot Compactor)	Operation Weight: (approx.) 13 ton Padfoot drum with removable smooth drum Vibration Power: (approx.) 245 kN (25,000 kgf)	2	A
8	Vibratory Combined Roller	Operation Weight: (approx.) 5~8 ton	4	A
9	Bitumen Sprayer Truck (Bitumen Distributor)	Capacity: 4000 lit. With sub-engine for asphalt pump Diesel Fuel Burner and Heater Splay width: (approx.) 3.6 m Carrier: 4 x 2, left-hand steering	2	A
10	Asphalt Kettle	Tank capacity :3000～4000 lit. Direct heating type with heat tube and diesel fuel burner Electric hoist for asphalt drum Electric asphalt transfer pump with heater Generator 3 ϕ, 415 V, 50 Hz, 20 kVA	2	A
11	Mobile Workshop	4x4, cargo truck, with telescopic boom 3 (t) crane and equipment and tools necessary to carry out service for construction machines Payload: (approx.) 7～10 ton	2	A

12	Water Bowser (Tanker)	2400 Gal. (10,000 lit.) Engine output:(approx.) 150 kW Drive System: 6 x 4, Left-hand steering GVW(approx.) 23 ton	2	B
13	Dump truck	Max. payload: 14 ton Engine Output: (approx.) 300 kW Drive System: 6 x 4, Left-hand steering, Air Brake GVW: Max. 26 ton	12	B
14	Boom Truck (Cab-back Crane)	Max. Lifting capacity: 3 ton Telescopic boom crane Carrier: 10 ton payload, 6x4 cargo truck, Left-hand steering, Air Brake, Engine output:(approx.) 240 kW	2	B
15	Low bed Semi-trailer(with Tractor Head) (Tractor Head)	Max. Payload: 30 ton, Rear loading typeTwo or three axles, 8~16 wheelsAir Brake, Suspension: Multi-leaf spring Forward control, 6x4 drive system Engine output:(approx.) 350 kW Payload (Fifth wheel) :(approx.) 18 ton Left-hand steering, Air Brake	1	B
16	Mobile Crusher	Operation Weight (approx.):10 t Capacity (approx.): 30 t/h	2	B
17	Inspection Vehicle	4 x 4, Double Cab Pickup , Diesel Engine, Engine output:(approx.) 78 kW	2	B
18	Asphalt Hand Sprayer	Capacity: 15~30 lit./min. with heater	10	B

- Testing apparatuses for road construction

	Name of Equipment	Standard
1	CBR Testing Machine complete with - Penetration Piston - Penetration Dial Guage - Bracket & Adeptor - Load Ring (28KN)	BS-1377
2	Field Lab. CBR Testing Machine complete with - 45KN Mechanical Scale - 28KN Load Ring - Penetration Piston - Bracket & Adeptor - Penetration Dial Guage	BS-1377
3	Hand Auger for Taking insitu Undisturbed Simple	-
4	Core Drilling Machine (with Core barrel 100mm)	BS-4019
5	Centrifugal Extractor (Replacement Bowl 1500g)	ASTM-D2172
6	Oven for finding moisture content (720 liters Capacity) (Dial thermometer = 0 to 200 °C)	BS-1377
7	Apparatus for finding International Roughness Index	-

JAPAN'S GRANT AID

The Government of Japan (hereinafter referred to as "the GOJ") is implementing the organizational reforms to improve the quality of ODA operations, and as a part of this realignment, a new JICA law was entered into effect on October 1, 2008. Based on this law and the decision of the GOJ, JICA has become the executing agency of the Grant Aid for General Projects, for Fisheries and for Cultural Cooperation, etc.

The Grant Aid is non-reimbursable fund provided to a recipient country to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for its economic and social development 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

The Japanese Grant Aid is supplied through following procedures :

- Preparatory Survey
  - The Survey conducted by JICA
- Appraisal &Approval
  - -Appraisal by the GOJ and JICA, and Approval by the Japanese Cabinet
- Authority for Determining Implementation
  - -The Notes exchanged between the GOJ and a recipient country
- Grant Agreement (hereinafter referred to as "the G/A")
  - -Agreement concluded between JICA and a recipient country
- Implementation
  - -Implementation of the Project on the basis of the G/A

2. Preparatory Survey

(1) Contents of the Survey

The aim of the preparatory Survey is to provide a basic document necessary for the appraisal of the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the recipient country necessary for the implementation of the Project.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Aid scheme from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of a outline design of the Project.

- Estimation of costs of the Project.

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant Aid project. The Outline Design of the Project is confirmed based on the guidelines of the Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures necessary to achieve 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 of the recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA employs (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the Report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the appropriateness of the Project.

3. Japan's Grant Aid Scheme

(1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes(hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the recipient country to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

(2) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue to work on the Project's implementation after the E/N and the G/A.

(3) Eligible source country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority 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, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

(4) Necessity of "Verification"

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

(5) Major undertakings to be taken by 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 Annex.

(6) "Proper Use"

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

(7) "Export and Re-export"

The products purchased under the Grant Aid should not be exported or 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 under the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). JICA 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 JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

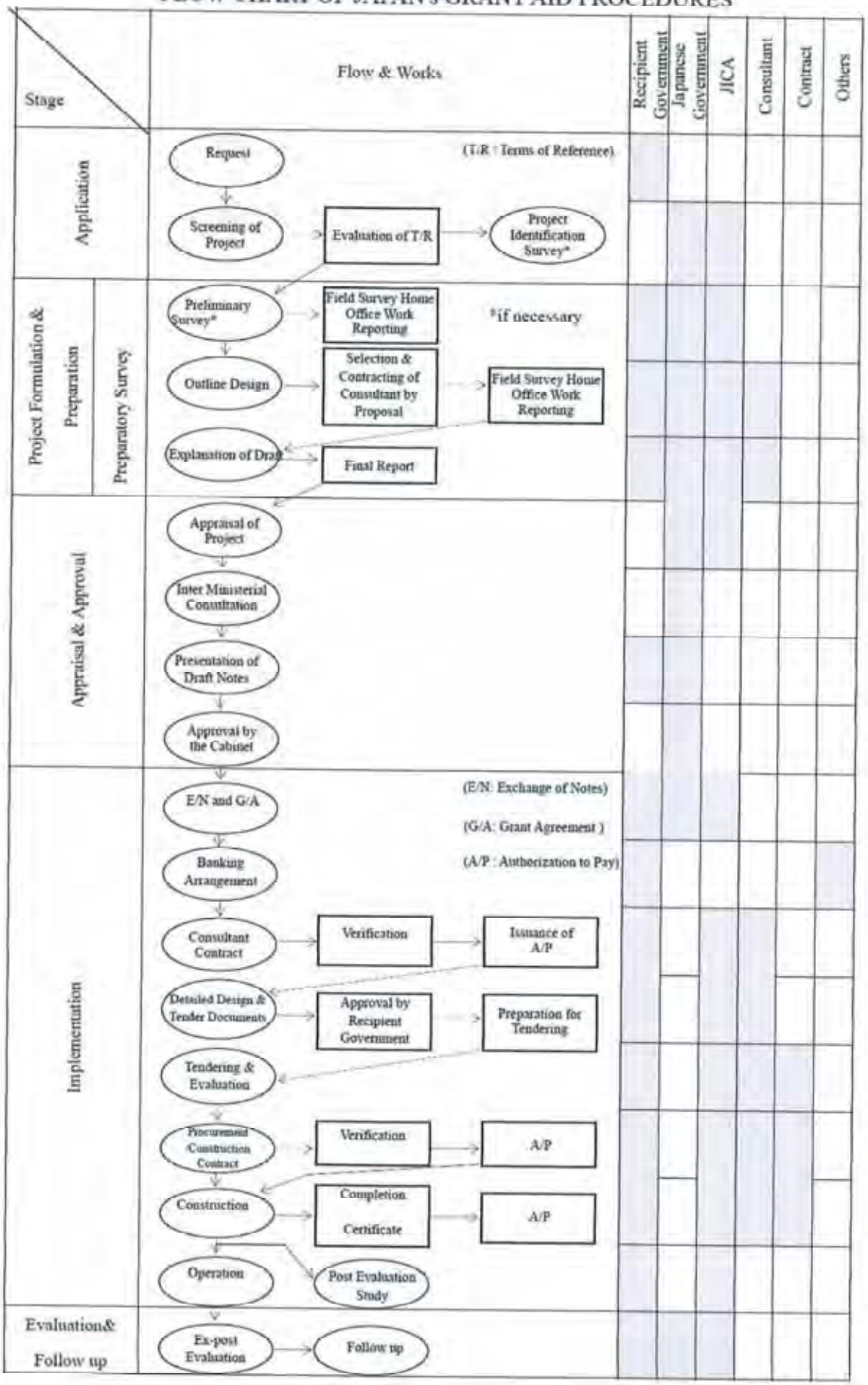
(9) Authorization to Pay (A/P)

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

(10) Social and Environmental Considerations

A recipient country must carefully consider social and environmental impacts by the Project and must comply with the environmental regulations of the recipient country and JICA guidelines for environmental and social considerations.

FLOW CHART OF JAPAN's GRANT AID PROCEDURES



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 ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products		
	1) Marine (Air) 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 (delivery point)	•	
2	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services be borne by the Authority without using the Grant		•
3	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		•
4	To ensure that the products be maintained and used properly and effectively for the implementation of the Project		•
5	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		•
6	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		•
	2) Payment commission		•

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

MINUTES OF DISCUSSIONS
ON THE PREPARATORY SURVEY
ON THE PROJECT FOR PROVISION
OF ROAD CONSTRUCTION AND MAINTENANCE EQUIPMENT
IN RAKHINE STATE
(SECONDARY SURVEY)

In September 2013, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a study team (hereinafter referred to as "the Previous Team") on the Project for Provision of Road Construction and Maintenance Equipment in Rakhine State (hereinafter referred to as "the Project") in the Republic of the Union of Myanmar (hereinafter referred to as " Myanmar"), and JICA is conducting technical examination of the results of the surveys in Japan.

In order to explain and to consult with the concerned officials of the Government of Myanmar about the progress of the study, JICA sent Myanmar the Secondary Preparatory Survey Team (hereinafter referred to as "the Team"), which was headed by Mr. Shigeki MIYAKE, Director, Transportation and ICT Division 2, Economic Infrastructure Department, JICA, from December 12th to 19th, 2013.

As a result of discussion, both sides confirmed the main items described in the attachment.

Yangon, December 16th, 2013

U Kyaw Linn
Managing Director
Public Works
Ministry of Construction
The Republic of the Union of Myanmar

Mr. Shigeki MIYAKE
Leader
Preparatory Survey Team
Japan International Cooperation Agency

ATTACHMENT

1. Project Components Provided by Japan

The Team explained to the Myanmar side that the tentative Project components provided by Japan as shown in ANNEX 1 and 2 as a result of the first field survey. The Team also explained that the tentative components as well as cost estimation have been studying in Japan, and the final components will be given in a final report. The Myanmar side agreed with the tentative Project components and Team's explanations.

2. Implementation Plan of Construction

Both sides confirmed that the road construction of the target section, Toungup, Ma-ei and Ann road (approximately 140 km), should be completed by the end of Myanmar fiscal year 2017. The Myanmar side agreed to provide necessary budget and personnel for the construction work.

3. Project Cost obligated by the Myanmar side

The Myanmar side agreed to take necessary budget for the Project which was described in ANNEX 3 to be conducted in a timely manner.

4. Schedule of the Study

JICA will complete the final report and send it to the Government of Myanmar around March, 2014.

List of Equipment

The Project for Provision of Road Construction and Maintenance Equipment in Rakhine State

No.	Name of Equipment	Specification	Quantity
1	Under Bridge Inspection Vehicle	Max working depth of the deck (below the ground):(approx.) 5.5 m Max working height of the deck (above the ground):(approx.) 7m GVW: (approx.) 10 ton	1
2	Motor Grader	Engine output: (approx.) 130 kW, Blade length: (approx.) 4 m, with scarifier Operation weight: (approx.) 14 ton	2
3	Excavator (crawler)	Bucket capacity: (Approx.) 1.0 m^3 Max. Digging Depth: more than 6 m Operation Weight: (approx.) 19 ~ 26 ton Engine Output:(approx.) 100 kW	2
4	Wheel Loader	Engine output: (approx.) 110 kW, Bucket capacity: (approx.) 2.5 m^3, Operation Weight: (approx.) 16 ton, Max Dumping Clearance: (approx.) 2.6 m with ROPS cab	2
5	Wheel Excavator	Bucket capacity: (Approx.) 0.5 m^3 Max. Digging Depth: more than 4.8 m Operation Weight: (approx.) 16 ton Engine Output:(approx.) 90 kW	2
6	Bulldozer	Operation Weight: (approx.) 27~29 ton, Engine Output:(approx.) 165 kW Straight Tilt Dozer and Multi-shank Ripper with ROPS cab	2
7	Sheep Foot Compactor	Operation Weight: (approx.) 10 ton Pad-foot drum with removable smooth drum Vibration Power: (approx.) 200 kN	2
8	Vibratory Tandem Roller	Operation Weight: (approx.) 7 ton Smooth drum Vibration Power: (approx.) 70 kN (7,000 kgf)	4
9	Bitumen Distributor	Capacity: 4000 lit. With sub-engine for asphalt pump Diesel Fuel Burner and Heater Splay width: (approx.) 3.6 m Carrier: 4 x 2, left-hand steering	2
10	Asphalt Kettle	Tank capacity : 3000~4000 lit. Direct heating type with heat tube and diesel fuel burner Electric hoist for asphalt drum Electric asphalt transfer pump with heater Generator 3 ϕ, 415 V, 50 Hz, 17 kVA	2
11	Mobile Workshop	4x4, cargo truck, with telescopic boom 3 (t) crane and equipment and tools necessary to carry out service for construction machines GVW: (approx.) 13 ton	2
12	Water Bowser (tanker)	2400 Gal. (10,000 lit.) Engine output:(approx.) 150 kW Drive System: 6 x 4, Left-hand steering GVW(approx.) 23 ton	2
13	Dump Truck	Max. payload: 14 ton Engine Output: (approx.) 190 kW Drive System: 6 x 4, Left-hand steering, Air Brake GVW: Max. 26 ton	12
14	Cab-back Crane	Max. lifting capacity: 3 ton, telescopic boom crane Carrier: 6x4 cargo truck, Left-hand steering, Air Brake, Max. payload: 10 ton Engine output:(approx.) 190 kW	2
15	Low Bed Semi-trailer with Tractor Head	(1) Semi-trailer Max. Payload: 30 ton, Rear loading type Two or three axles, 8~12 wheels Air Brake, Suspension: Multi-leaf spring (2) Tractor Head Forward control, 6x4 drive system Engine output : (approx.) 230 kW Payload (Fifth wheel) : (approx.) 16 ton Left-hand steering, Air Brake	1
16	Mobile Crusher	Operation Weight (approx.): 9 ~ 12 ton Capacity (approx.): 15 ~ 50 t/h	2
17	Inspection Vehicle	4 x 4, Double Cab Pickup , Diesel Engine, Engine output:(approx.) 55 kW	2
18	Asphalt Hand Sprayer	Capacity: 10 ~ 20 lit./min., with heater, mounted on the hand-cart	10
19	Desktop Computer	CPU 3.3GHz or more	2
20	Database Software	FileMaker Pro. 12 or updated version	1

Outline of Soft Component

1. Objective

Japanese consultant is going to support to introduce a Ledger Management System to improve PW staff's capability so that equipment provided by Japanese Grant Aid, PW's existing equipment and their spare parts can be efficiently managed and maintained.

2. Main Activity

- Instruction for operation of the Ledger Management System to the Road Construction Special Unit No.8 and the Airfield Construction Special Unit No.8
- Pilot road construction works of approximately 200m-road construction near Toungup on the Project target road. All the equipment to be provided under the Project shall be utilized for the Pilot road construction works.
- Technical guidance for the Bridge Inspection Vehicle to be procured in the Project

3. Participants

Around 35 staffs who belong to following or related section,

- Staff of management section and maintenance section at the Road Construction Special Unit No.8, the Airfield Construction Special Unit No.8 and the Mayangon Mechanical Compound
- Staff of management and maintenance section of the Bridge Dept.

4. Equipment

- Desktop Computer and Database Software

5. Tentative Schedule

		2015						
		Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
	Procurement Schedule of Grant Aid		▼Handing over of Equipment				▼Project Completion	
Soft Component	Training of Database Ledger Control System		Instruction			Evaluation and Follow-up		
	Pilot Road Construction Works			Preparation		Implementation		
	Technical Guidance of Bridge Inspection			Presentation to Japan		Technical Guidance		

Project Cost Estimation of Myanmar side

1. Initial Cost Estimation

Items		Cost Amount (USD)	
Road construction of the Project site in Rakhine state	Toungup-Ma-ei	5.4million	18.5 million
	Ann-Ma-ei	13.1 million	
The storage cost of construction equipment of the Project (fence, storage house for spare parts)			5,000
Commissions to the bank based on Banking Arrangement			7,500

Note) PW plans to construction work of the Project site from fiscal year 2015 to 2017.

2. Operation and Maintenance Cost

(1) Estimated costs for equipment maintenance

Name of Equipment	FOB Value (×1000 JY) (a)	Machine's life span (years) (b)	Maintenance Rate (in life span) (%) (c)	Av. maintenance cost/year (×1000 JY)	Number of machines (e)	Machinery maintenance costs in initial 3 years		
						Cost rate (%) (f)	Cost/unit (×1000 JY) (g = d × f/1000)	Annual expenditure (×1000 JY) (h) = g × e
1. Under Bridge Inspection Vehicle	42,750	15	45	1,283	1	15	192.4	192
2. Motor Grader	18,589	15	40	495	3	15	74.2	148
3. Excavator (Crawler)	9,691	15	50	323	2	15	48.5	97
4. Wheel Loader	12,778	15	70	596	2	15	89.4	179
5. Wheel Excavator	18,932	15	40	505	2	15	75.7	151
6. Bulldozer	24,000	15	45	720	2	15	108.0	216
7. Sheep Foot Compactor	13,864	15	15	139	2	15	20.8	42
8. Vibratory Tandem Roller	10,520	15	20	140	4	15	21.0	84
9. Bitumen Distributor	14,814	15	55	543	2	15	81.5	163
10. Asphalt Kettle	7,747	15	20	103	2	15	15.5	31
11. Mobile Workshop	17,169	15	45	515	2	15	77.3	155
12. Water Bowser (Tanker)	7,854	15	40	209	2	15	31.4	63
13. Dump Truck	7,441	15	50	248	12	15	37.2	446
14. Cab-back Crane	10,088	15	30	202	2	15	30.3	61
15. Low bed Semi-trailer (with Tractor Head)	25,872	15	45	776	1	15	116.4	116
16. Mobile Crusher	20,322	15	50	677	2	15	101.6	203
17. Inspection Vehicle	2,146	15	50	72	2	15	10.7	21
18. Asphalt Hand Sprayer	501	15	50	17	10	15	2.5	25
Estimated annual expenditure for machinery maintenance in initial three years (Kyat)								2,394(22,506)
Average annual expenditure for machinery maintenance in Public Works Rakhine State Office (for the last three years , 2011-2013)								108,079
The rate of increase in expenditure for machinery maintenance based on the average annual expenditure for last three years (%)								2.2

(2) Estimated costs for fuel

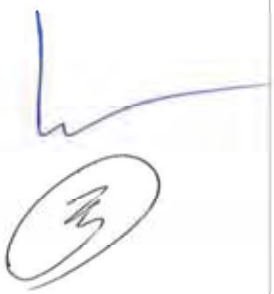
Name of Equipment	Engine Output (kW) (a)	Fuel Consumption Rate (ℓ/kW·h) (b)	Fuel Consumption Rate (ℓ/h) (c) = a×b	Working Hrs. (hrs./year) (d)	Number of Machines (e)	Fuel Consumption (ℓ/year) (f) = c×d×e	Fuel Price (Kyats/ℓ) (g)	Fuel Costs/year (Kyat×1000) (h) = f×g
1. Bridge Inspection Vehicle	100	0.040	4.0	500	1	2,000	950	1,900
2. Motor Grader	130	0.108	14.0	1200	2	16,848	950	16,006
3. Excavator (Crawler)	100	0.175	17.5	1200	2	21,000	950	19,950
4. Wheel Loader	120	0.153	18.4	2400	2	44,064	950	41,861
5. Wheel Excavator	90	0.175	15.8	1200	2	18,980	950	17,955
6. Bulldozer	165	0.175	28.9	1200	2	34,650	950	32,918
7. Sheep Foot Compactor	80	0.152	12.2	1200	2	14,592	950	13,862
8. Vibratory Tandem Roller	50	0.152	7.6	400	4	3,040	950	2,888
9. Bitumen Distributor	115	0.090	10.4	400	2	4,140	950	3,933
Sub Engine	10	0.090	0.9	400	2	360	950	342
10. Asphalt Kettle	17	0.170	2.9	100	2	867	950	834
11. Mobile Workshop	140	0.050	7.0	700	2	4,900	950	4,655
Generator-cum-Arc Welder	20	0.170	3.4	300	2	1,020	950	969
12. Water Bowser (Tanker)	150	0.040	6.0	600	2	3,600	950	3,420
13. Dump Truck	190	0.050	9.5	1800	12	14,250	950	13,538
14. Cab-back Crane	190	0.050	9.5	700	2	6,650	950	6,318
15. Low bed Semi-trailer (with Tractor Head)	230	0.075	17.3	600	1	10,350	950	9,833
16. Mobile Crusher	80	0.185	7.4	2400	2	17,760	950	16,872
17. Inspection Vehicle	55	0.047	2.6	700	2	1,810	950	1,719
18. Asphalt Hand Sprayer (Petrol Engine)	2.5	0.227	0.6	200	10	114	950	108
						Estimated annual expenditure for fuel		209,868

(3) Budget for equipment maintenance (Public Works Rakhine State Office)

Financial Year	Expenses for major repair	Expenses for periodic maintenance/minor repair	Total (Kyats)	Total (JY)
2011-2012	158,650,000	363,000,000	521,650,000	55,494,681
2012-2013	85,362,700	1,416,000,000	1,501,362,700	159,719,436
2013-2014	137,820,000	887,000,000	1,024,820,000	109,023,404
Average amount for the past three years			1,015,944,233	108,079,174

Note: Conditions of cost estimation are as follows;

1. Timing of cost estimation : September 2013
2. Exchange rate : 1USD = 99.38 Japanese Yen (JPY)
3. Others : Cost estimation shall be conducted in accordance with the institution of the Grant Aid Project of the Japanese government.



APPENDIX 5

SOFT COMPONENT (TECHNICAL ASSISTANCE) PLAN

The Project for
Provision of Road Construction and Maintenance Equipment
in Rakhine State

Soft Component (Technical Assistance) Plan

November 2013

Yachiyo Engineering Co., Ltd.

Contents

1. Background of the Soft Component

The Project for Provision of Road Construction and Maintenance Equipment in Rakhine State (hereafter called the Project) has the objective of improving the standard of living for the residents of Rakhine State, where development has been comparatively slow compared to the rest of Myanmar, and it intends to procure construction and maintenance equipment necessary for conducting works on roads and bridges that are targeted by state plans under the direct management of the implementing agency (Public Works, Ministry of Construction).

The existing road construction and maintenance equipment in Rakhine State is centrally controlled by the Mechanical Equipment Compound (Mayangone Township in Yangon) of Public Works, Ministry of Construction. From here, equipment is allocated to states including Rakhine under the Compound's jurisdiction. The Mechanical Equipment Compound also controls spare parts for equipment. Although the Compound conducts actual control, its ledgers are paper-based and there are numerous problems in the system, for example, due to the complicated procedure for deleting equipment from the ledger, equipment is discarded in the Compound yard until this is completed.

In these circumstances, in order for the construction and maintenance equipment procured in the Project to be operated and maintained efficiently, it is vital for the local implementing agency to reinforce its control system for equipment and spare parts. Guidance on the initial operation and management of the procured equipment will be implemented as part of the equipment procurement work, however, through implementing the Soft Component aimed at strengthening the above equipment control system, contribution can be made towards realizing the appropriate control of not only the Project equipment but also existing equipment and spare parts.

In the Soft Component, in addition to reinforcement of the equipment control system, pilot construction works will be executed on sections of the road targeted for work in Rakhine State. Pilot construction works aim to acquire technology for appropriate allocation of equipment and work procedure so that they can ensure quality of road construction using equipment to be procured by the Project. It will be possible for the local side to acquire practical technology for operating and controlling equipment via the pilot work and to practically utilize the equipment control system within the pilot work. In doing so, the Project will deepen the level of proficiency of local personnel in procedures and methods so that they can efficiently operate the system on an ongoing basis.

In addition, guidance for management of bridges utilizing the Bridge Inspection Vehicle, which is one of equipment in the Project, will be conducted with existing bridges selected on the road targeted in Rakhine State. The Bridge Inspection Vehicle is expected to be effectively utilized for inspection of soundness, early detection of aged deterioration and simple maintenance works of bridges. However, since it is considered that Public Works needs to acquire methods of maintenance utilizing this vehicle, guidance for inspection and maintenance works, such as clearing, additional painting and so on, will be conducted in the Soft Component so that Public Works can acquire effective technology to extend life-span of bridges.

2. Soft Component Objectives

In light of the above background, the following objectives are set with a view to realizing the effects and sustainability of the Project.

- Fully utilize the performance of the Project equipment in executing road construction and maintenance works, and place the Project equipment under efficient operation and maintenance together with existing equipment and spare parts.
- Effectively utilize the performance of the Bridge Inspection Vehicle procured in the Project for inspection and maintenance of bridges, and manage existing bridges in systematic and effective manner.

3. Soft Component Outputs

The direct outputs that will be achieved on completion of the Soft Component are as stated below.

Output 1: Employees of Public Works in Rakhine State can grasp the operating conditions of equipment assigned to the stock yard and works sites as well as the need and urgency of maintenance, and through establishment of a systematic control setup with the Mechanical Equipment Compound in Yangon, they can promptly respond to equipment failures.

Output 2: The capability of the employees of Public Works in Rakhine State for road construction and management is improved. Moreover, the employees learn technology to get the best performance of equipment to be procured in the Project.

Output 3: Employees of Public Works understand frequency of daily and periodic inspection for bridges, inspection items and evaluation method of damage, grasp soundness and damage of bridges based on the accumulated results from such inspection, and also can reflect in a maintenance plan when necessary.

4. Method for confirming Achievement of Outputs

In order to confirm the level of achievement of the Soft Component outputs in the Project, confirmation items will be set as follows according to each output. When it comes to confirming the level of achievement, evaluation will be conducted through implementing before and after questionnaires of the personnel targeted by the Soft Component.

Output	Items for Confirming Level of Achievement
Output 1: Employees of Public Works in Rakhine State can grasp the operating conditions of equipment assigned to the stock yard and works sites as well as the need and urgency of maintenance, and through establishment of a systematic control setup with the Mechanical Equipment Compound, they can promptly respond to equipment failures.	1. Can the operating conditions and stock conditions of the Project equipment and spare parts be grasped?
	2. Are ledger control methods and procedures that utilize a database understood, and can accurate data control be implemented?
	3. Do personnel understand the importance of and implement regular reporting on equipment control conditions to the Mechanical Equipment Compound?
	4. Based on the Project equipment control methods, can the conditions of allocation and operation be controlled through listing the existing equipment owned by Rakhine State?
	5. For long-term operation of the Project equipment, can the ledger control system be effectively utilized for maintenance of equipment and their spare parts?
Output 2: The capability of the employees of Public Works in Rakhine State for road construction and management is improved. Moreover, the employees learn technology to get the best performance of equipment to be procured in the Project.	1. Can the Project equipment be safely and appropriately operated on works sites?
	2. Can works that fully realize the functions and performance of the Project equipment be executed, particularly in improving quality of compaction of earth works, pavement works, and of flatness?
	3. Can works materials be procured according to the design documents and specifications, and can works be executed according to the execution plans?
Output 3: Employees of Public Works understand frequency of daily and periodic inspection for bridges, inspection items and evaluation method of damage, grasp soundness and damage of bridges based on the accumulated results from such inspection, and also can reflect in a maintenance plan when necessary.	1. Can bridge inspection according to a working plan be executed?
	2. Do personnel understand types and causes of structural damage or deterioration of bridges? Also can results from inspection be managed as cumulated data?
	3. Can personnel consider countermeasures appropriate to damage level and reflect them in a maintenance plan?

5. Soft Component Activities (Plan of Inputs)

(1) Contents of Activities

Targeting the Road Construction Special Unit No.8 and the Airfield Construction Special Unit No.8 stationed in Rakhine State, the Soft Component will be implemented for equipment control personnel and maintenance personnel, etc. Construction equipment in Lower Myanmar including Rakhine State is under control of the Mechanical Department in Lower Myanmar (see Figure 5-1), and personnel assigned by the Mechanical Department to regional Units in Rakhine State (see Figure 5-2) are in charge of control and maintenance of equipment.

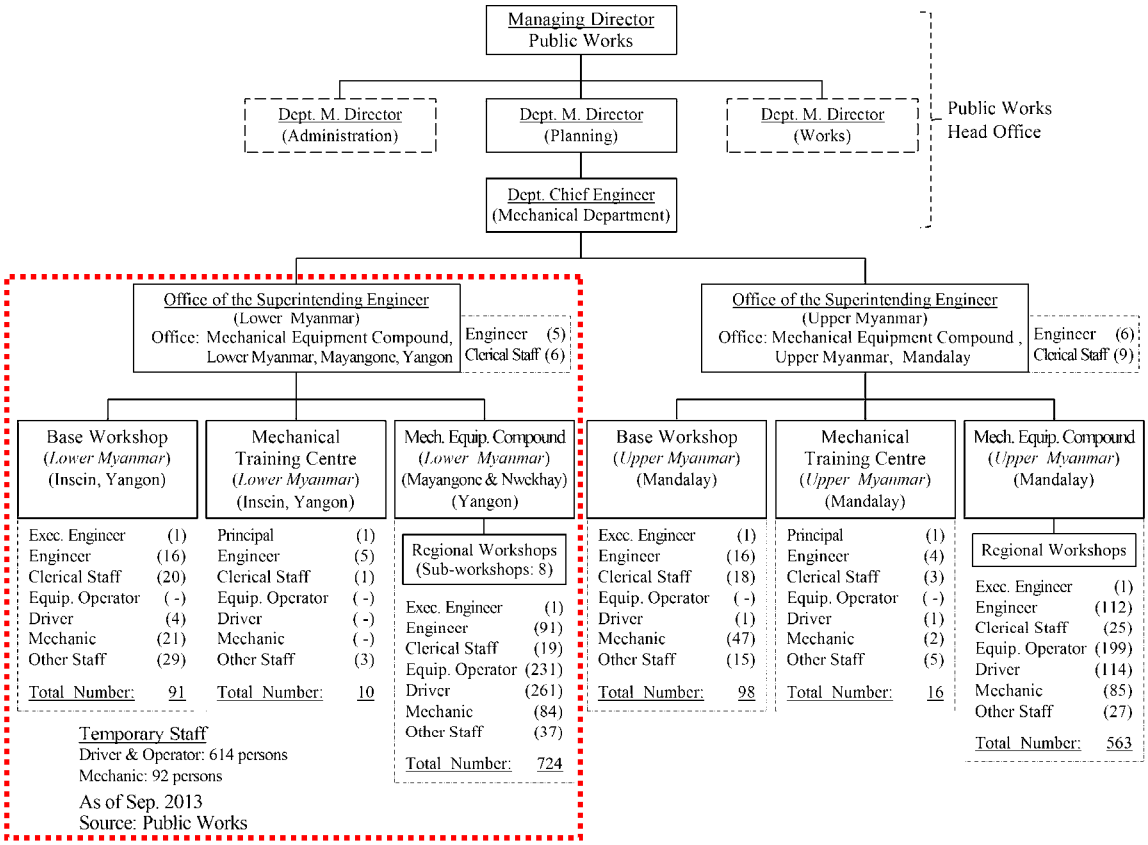


Figure 5-1 Organization Chart of Mechanical Department under the Public Works

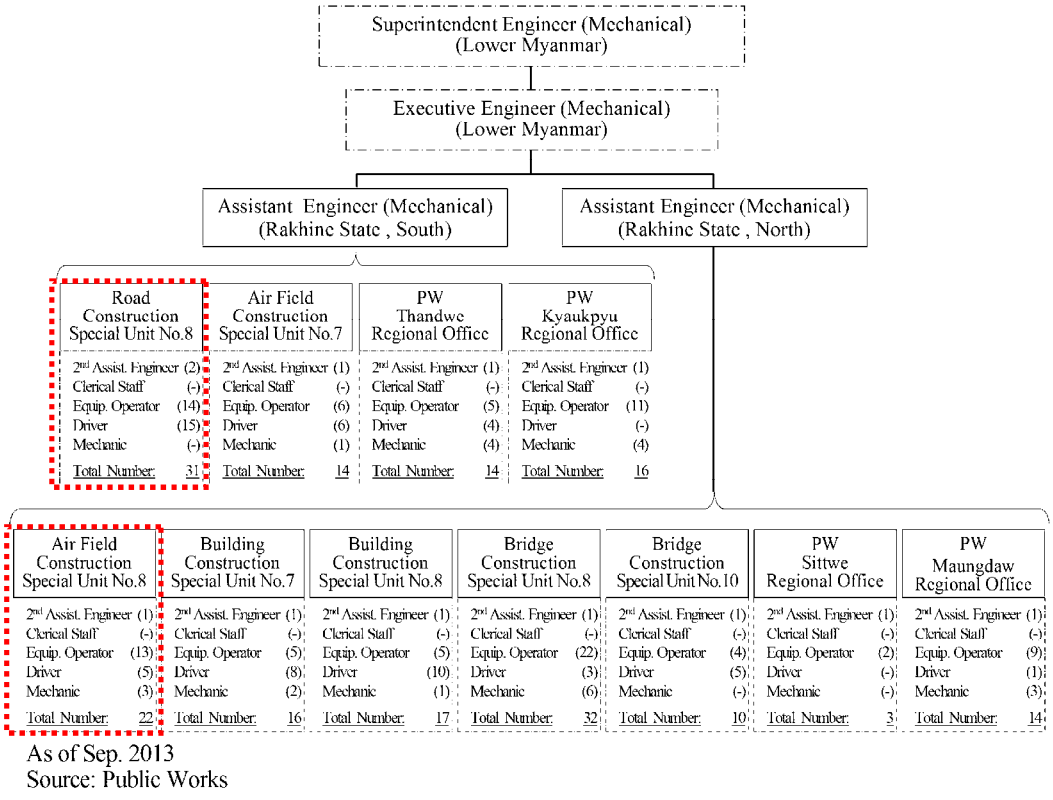


Figure 5-2 Organization Chart of Mechanical Department stationed in Rakhine State

The Soft Component will be implemented under direct support by the contracted consultant, and the contents of activities for realizing the outputs of the Soft Component are as indicated below.

1) Activities regarding Output 1

(a) Necessary technology and line of work

Equipment ledger system controllers and mechanics

(b) Technical level

Current technical level	Required technical level
Some of the allocated equipment isn't operating due to breakdown or deterioration, however, basic maintenance equipment is inadequate, and provision of spare parts from the Mechanical Equipment Compound tends to be delayed. As a result, it is difficult to implement appropriate maintenance or conduct prompt repairs when failures occur.	Appropriately implement routine basic maintenance through making use of the mobile workshop procured in the Project. Also, for long-term operation of the Project equipment, utilize the PC database to control the operating conditions of allocated equipment and make periodic reports to the Mechanical Equipment Compound in Yangon and the Superintending Engineer's Office in Rakhine State.

(c) Target personnel

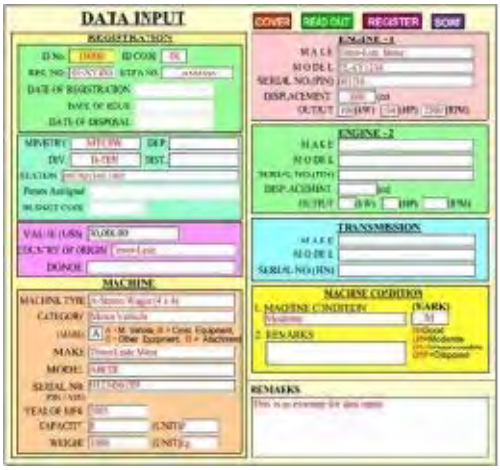
Personnel of the Road Construction Unit No.8, the Airfield Construction Special Unit No.8 in Rakhine State, and the Mechanical Equipment Compound in Yangon (approximately 20 persons in total)

(d) Implementation method

Venue	Road Construction Special Unit No.8 Office in Toungup, Rakhine State
Implementation period	First time: Practical guidance 0.9 months (15 activity days, 8 travel days, 4 rest days) Second time: Evaluation and follow-up 0.6 months (6 activity days, 8 travel days, 4 rest days)
Utilized training materials	- Construction and maintenance equipment operating record manual (operating log) - Construction and maintenance equipment operation and maintenance manual (spare parts control ledger)
Practical training equipment	- Desktop PCs: 2 units - Control database (general-purpose software): 1 set Note: As software, FileMaker, which offers excellent controllability, is recommended for procurement.
Contents of activities	<u>First time:</u> Introduce the Project equipment and spare parts ledger control database and conduct training according to the above two manuals in order to impart know-how on operating the control system. In the Soft Component, since pilot road construction works will be implemented on a section of the targeted roads in Rakhine State, the allocation of Project equipment to this site will be treated as a case study.

Training will be implemented just after delivering the Project equipment, and the main training contents will be as follows:

- Outline explanation of database software and orientation: 0.5 days
- Data inputting of equipment specifications (makers, models, suppliers, registration numbers, etc.) : 2days
- Equipment operating conditions and stock entry/exit control: 2 days
- Stock control of spare parts and expendable items: 2 days
- Control of equipment fuel and oil consumption levels: 1 day
- Periodic inspection and maintenance implementation planning: 2 days
- (Compile implementation plans based on operating hours or running distance, etc.)
- Periodic inspection and maintenance implementation recording: 2 days
- Periodic reporting on Project equipment allocation conditions, operating conditions and maintenance recording, etc. to the Mechanical Equipment Compound in Mayangone Township in Yangon: 1 day
- Follow-up of the above activities by the target personnel themselves: 0.5 days
- After all activities as above, allocating one unit of the system to the Airfield Construction Special Unit No.8: 1 days



Sample of Database

Following completion of the first training at the Road Construction Special Unit No.8, one out of the two PCs will be left at the Road Construction Special Unit No.8 and the another PC will be allocated to the Airfield Construction Special Unit No.8.

Second time:

Personnel will utilize the know-how they acquired in the first training to confirm and evaluate database usage.

Also, support will be offered for listing the existing equipment allocated in Rakhine State into the control system. This support will target not only the Project equipment but also all equipment in the state that is controlled by the system. Evaluation and, where necessary, follow-up will be conducted with a view to enabling PW's personnel in Rakhine State to independently utilize the

	system. The activities in Rakhine State will last six days, i.e. two days for evaluation and one day for follow-up at the Road Construction Special Unit No.8 and the Airfield Construction Special Unit No.8, respectively.

2) Activities regarding Output 2

(a) Necessary technology and line of work

Road engineers, equipment operators

(b) Technical level

Current technical level	Required technical level
Existing equipment can be utilized to implement road paving works.	Through efficiently utilizing the latest equipment procured in the Project, it will be possible to construct and maintain high-quality roads.

(c) Target personnel

Road engineers and equipment operators in Rakhine State

(d) Implementation method

Implementation site	A section of approximately 200 m near Toungup on the Project target road
Implementation period	First time: 0.5 months (preparation for pilot road construction works) Second time: 1.5 months (practical training on pilot road construction works)
Utilized training materials	- Execution manual of road construction
Practical training equipment	- Project procured equipment
Contents of activities	<u>First time:</u> In order to smoothly start the pilot work, hold discussions with personnel of the PW (implementing agency) and confirm conditions regarding budget, execution planning and works materials procurement. <u>Second time:</u> Conduct the following technical guidance via the pilot work: - Efficient introduction of equipment according to work processes and site conditions - Operation control geared to realizing the execution performance of Project equipment according to site conditions - Appropriate reporting to the Mechanical Equipment Compound in Yangon and the Superintending Engineer's Office in Rakhine State on equipment conditions

	- Advice for safety measures of construction works, when necessary  Site of Pilot Road Construction Works (to be determined)

3) Activities regarding Output 3

(e) Necessary technology and line of work

Road engineers, equipment operators

(f) Technical level

Current technical level	Required technical level
Public Works has no experience to introduce the Bridge Inspection Vehicle, and so a bridge inspection and maintenance method utilizing such equipment has not been developed.	Bridge inspection works are conducted according to an execution plan, and inspection results are recorded on the bridge ledger. Moreover, such works will be reflected in a repairing plan based on damage type and level.

(g) Target personnel

Personnel of the Road Construction Unit No.8, the Airfield Construction Special Unit No.8 in Rakhine State, and the Bridge Dept. (approximately 15 persons in total)

(h) Implementation method

Venue/Site	Road Construction Special Unit No.8 Office One existing bridge (Khai-she Bridge) sampled on the target on the Project target road
Implementation period	Preparation in Japan: 0.5 months (preparation of instructional material) Technical Guidance: 1.1 months (18 activity days, 7 travel days, 8 rest days))
Utilized training materials	- Bridge inspection handbook - Bridge ledger
Practical training equipment	- Management database (general-purpose software for bridge ledger) - Bridge Inspection Vehicle procured in the Project

Contents of activities	<u>First time (Preparation stage in Japan):</u> The Consultant will prepare following instructional materials. - Preparation of the bridge inspection handbook in English: 4 days - Preparation of the bridge ledger in English: 6 days  Sample of bridge ledger system in Japanese <u>Second time (Technical Guidance):</u> Technical guidance utilizing above-mentioned materials will be implemented and then practical training targeting 2 bridges sampled on the target road will be implemented as follows: - Outline explanation of the bridge inspection handbook and orientation: 1 days - Explanation of how to operate the bridge ledger and initial data inputting: 3days - Explanation of bridge inspection procedure and example of damage types: 3 days - Practical training of bridge inspection works (including safety measures): 5 days - Training of data inputting and management based on inspection results: 3 day - Introduce of countermeasures for repairing according to damage type and level in Japan: 1 days - Follow-up of the above activities by the target personnel themselves: 2 days

(2) Implementation Resources

1) Japan side

The human resources to be dispatched by the Japanese side in order to implement the Soft Component, the period of dispatch and the major contents of activities are described below.

Responsible field	Number of people	Period (M/M)	Major contents of activities
Equipment Planning （Japanese engineer）	1	1：0.9M/M 2：0.6M/M Total：1.5M/M	First time: Guidance on ledger control system training Second time: Confirmation and evaluation of conditions of system utilization
Road Planning （Japanese engineer）	1	1：0.5M/M 2：1.5M/M Total：2.0M/M	First time: Pilot work preparation Second time: Technical guidance on pilot work
Bridge Inspection Planning （Japanese engineer）	1	1：0.5M/M 2：1.1M/M Total：1.6M/M	First time: Guidance on ledger control system training Second time: Confirmation and evaluation of conditions of system utilization
Interpreter/Assistant-1 (Myanmarese）	1	1：0.9M/M 2：0.6M/M Total：1.5M/M	Interpreting, translating and assistance for Japanese engineers in charge of equipment planning
Interpreter/Assitant-2 (Myanmarese）	1	1：0.5M/M 2：1.5M/M Total：2.0M/M	Interpreting, translating and assistance for Japanese engineers in charge of road planning
Interpreter/Assitant-3 (Myanmarese）	1	1：- 2：1.1M/M Total：1.1M/M	Interpreting, translating and assistance for Japanese engineers in charge of bridge inspection planning

2) Myanmar side

The human resources to be recruited by the Myanmarese side in order to implement the Soft Component are described below.

Responsible field	Number of people	Period
Equipment control and maintenance	Around 20 persons	1：1.9 months 2：0.6 month Total：1.5 months
Works supervisors, road engineers, operators, labors	Appropriately recruit according to the type of pilot works	1：0.5 month（except operators and labors） 2：1.5months Total：2.0 months
Bridge inspection and maintenance	Around 15 persons	1：- 2：1.1 month Total：1.1 months

(3) Types of Outputs

1) Japan side

- Construction and maintenance equipment operating record manual (operating log)

- Construction and maintenance equipment operation and maintenance manual (spare parts control ledger)
- Bridge inspection handbook
- Bridge ledger

2) Japan and Myanmar

- Operation flow of the ledger control system prepared in the training

  (The operating flow including the periodic reporting setup between the central (Mechanical Equipment Compound in Yangon) and local (Regional construction units and office) levels will be jointly created).

6. Procurement Method for Soft Component Implementation Resources

For implementing the Soft Component, from the viewpoint of utilizing database ledger control in order to strengthen the setup on the side of the implementing agency, it is considered more appropriate to utilize Japanese engineers rather than local resources. The reasons are as follows: ① Since computerized ledger control for managing diverse construction and maintenance equipment like that to be procured in the Project is not well disseminated in Myanmar, it will be impossible for local resources to conduct the necessary work; and ② Since it is likely that most of the Project equipment will be procured from Japanese makers, Japanese engineers will have the best know-how for operating and controlling it.

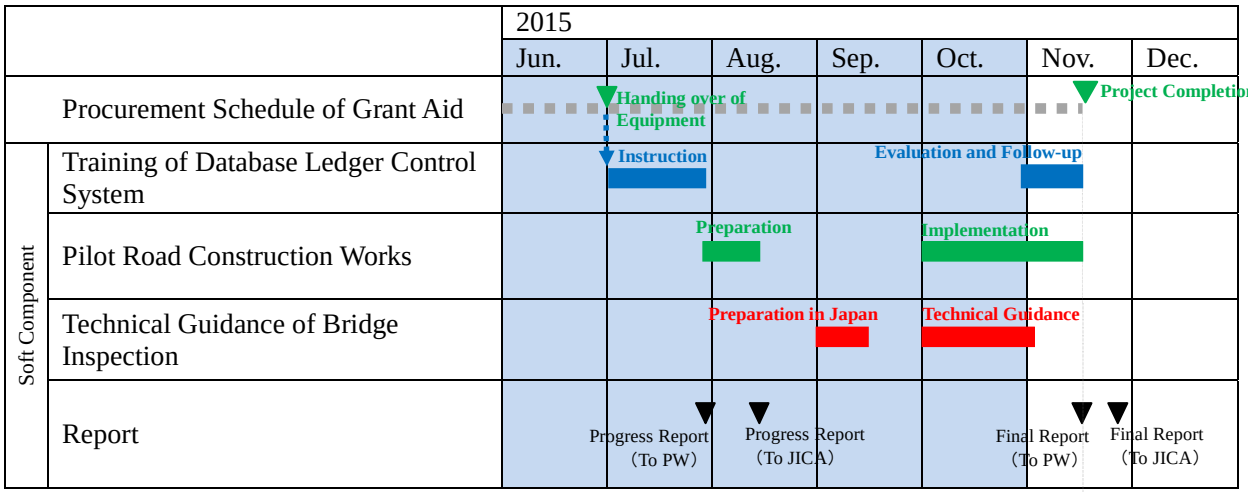
Likewise, implementing under the technical instruction by the Japanese engineer who is well experienced in controlling equipment made in Japan is able to contribute to quality improvement in the pilot road construction works utilizing equipment procured in the Project.

Moreover, since inspection and maintenance methods utilizing the Bridge Inspection Vehicle which will be instructed in bridge inspection guidance and training are advanced technologies of Japan to effectively inspect and manage existing bridges which have aged deterioration and damages, it is appropriate to be conducted by the Japanese engineer.

Therefore, it will be appropriate for the contracted consultant to directly implement the Soft Component.

7. Implementation Schedule of Soft Component

The implementation schedule of Soft Component is as follows.



※ May to October is a rainy season in Myanmar.

8. Types of Outputs

The outputs to be created in the Soft Component are as follows:

- Construction and maintenance equipment operating record manual (operating log)
- Construction and maintenance equipment operation and maintenance manual (spare parts control ledger)
- Bridge Inspection Handbook
- Bridge Ledger
- Soft Component completion report

  The completion report will include the following outputs:
  - Record of activities, for example, photographs of works, etc.
  - The above-mentioned manuals and system operation flow
  - Results of the before and after questionnaire implemented with targeted personnel of Public Works
  - Final Report to be submitted to the client

9. Soft Component Cost Estimation

The cost for Soft Component is not disclosed.

10. Obligations of Myanmar Side

In order to achieve the objectives of the Soft Component, in addition to the outputs of implementation, the following items will need to be implemented as the obligations of Myanmar side:

- To ensure the ongoing operation of the equipment control system and the bridge inspection method established under the Soft Component, disseminate and horizontally extend within the organization the technologies and control methods that have been learned.

- Utilizing the Project equipment, advance construction and maintenance of the target roads without delay, and utilize the control system in order to efficiently operate and maintain the roads.
- In order to appropriately conduct operation and maintenance utilizing the control system, secure the necessary budget to maintain the Project equipment and procure additional spare parts.

APPENDIX 6

OTHER RELEVANT DATA

Survey result of candidate roads for the Project

In the selection of a target road for the Project, the following three roads shown in the Figure-1 were proposed as prioritized road sections by the Public Works and were specified in the Minutes of Discussions singed on 5th September between the Public Works and the Team.

1st Priority: Toungup – Ann Road (approximately 140km)

2nd Priority: Ngathaningchang – Thandwe Road (approximately 182km)

3rd Priority: Minbyar – Pauktaw Road (approximately 34km)

Figure-1: Prioritized Roads for the Project

In the field survey, the Team visited above-mentioned three roads and conducted site observations in the presence of concerned personnel from the Public Works.

Results of the field survey are shown in the Table-1.

Table-1: Field Survey Result

	1st Priority Road	2nd Priority Road	3rd Priority Road
Site photos	 Road condition  Thanlwae Bridge (600feet)	 Road condition  Kyaukpasup Bridge (300feet)	 Road condition  Bridge under construction
Existing road condition	The road passes mostly hilly areas. Some flood areas were observed especially in Toungup – Maei section. Embankment works and installation of some box culvert for prevention of further flood damage seem to be needed before pavement works in such areas. Existing wooden bridges and Bailey bridges are expected to upgrade to RC superstructure. At present, upgrading six bridges are expected to implement in ODA loan project by Japan.	The road of Thandwe – Gwa section passes flat areas and somewhere hilly areas. The flood area was observed at 27 miles point from Thandwe. Embankment works and installation of some box culvert for prevention of further flood damage seem to be needed before pavement works in such areas. The road of Gwa – Ngathaningchang passes mostly mountainous area and massive landslide sites were observed at 37 miles to 40 miles from Ngathaningchang. Many existing wooden bridges and Bailey bridges are under construction for upgrade to RC superstructure.	The road of Minbyar - Pauktaw section passes flat area. Therefore, longitudinal gradient is under 2%, and the typical cross section is embankment 3 feet to 6 feet high. Pavement width of this road is nearly 12 feet. The road has earth shoulder on each side. When an oncoming car comes, it is running yielding a lane mutually. Since the pavement is mostly only macadam, driving conditions are not smoothly. Villages stand continuously in a row by the road side. New concrete Bridge is under construction.
Importance of road improvement	Importance of road improvement on this section is to: ・ stably connect northern area and southern area throughout the year in the State. ・ improve access from the State to neighboring areas since Toungup and Ann are junction points of connecting roads heading to Bago Region and Magway Region, respectively. In addition to above, the State Government in Rakhine mentioned this road was most important to urgently improve in three candidate sections.	Importance of road improvement on this section is to: ・ stably connect middle area and southern area of the State and also to improve access between the State and Ayeyarwady Region. ・ make smoother traffic for the people from the south who visit Thandwe, which is famous for a beach.	Importance of road improvement on this section is to: ・ improve access for the people living at the roadside area. ・ shorten the time for transport, especially for sea products since it is said that approximately 60% of sea products in Myanmar are produced at this coastal area.

APPENDIX 7

REFERENCES

7-1 Social Data of Rakhin State

Township	# of Village Tracts	# of Villages	Ethnic composition							Foreigner					# of Teacher	# of Student	# of Schools				# of Doctor	# of Nurse	# of Mid-wife	# of Health Center		
			Burma	Rakhine	Chin	Kachin	Kayin	Mon	Shan	Chinese	Indian	Bengali	others	Total			Primary	middle	High shool	University				Hospital	RHC	SHC
Maungdaw	88	381	1,183	20,118	66	-	29	-	-	-	3	393,919	469	415,787	1166	98057	142	12	5	-	8	32	39	5	8	41
Buthidaung	78	339	954	45,205	7	-	-	-	-	-	-	258,501	417	305,084	1165	72429	146	7	3	-	4	7	30	2	6	31
Rathedaung	88	196	888	141,769	-	-	33	-	4	-	-	34,162	284	177,140	993	34317	161	7	4	-	2	11	34	2	6	26
Kyauktaw	79	283	3,240	208,201	66	-	-	-	-	9	-	42,734	362	254,612	1272	42722	192	8	6	-	4	14	27	3	6	25
Ponnagyun	92	193	38	138,625	16	-	-	-	1	-	-	1,699	285	140,664	1018	27868	168	7	3	-	3	13	29	2	5	23
Sittwe	27	169	8,496	146,397	540	90	97	93	93	168	-	125,342	196	281,512	1575	35376	95	12	8	1	66	276	34	2	6	24
Mrauk-U	94	248	934	151,338	3,300	14	35	-	3	1	-	22,307	342	178,274	1242	37956	188	9	3	-	3	13	45	3	8	34
Pauktaw	5	177	67	153,563	-	-	-	-	-	-	-	17,897	182	171,709	873	28816	137	9	3	-	3	11	34	2	6	32
Minbya	62	246	1,692	154,495	30,253	22	46	9	22	-	-	21,968	308	208,815	1024	34287	179	9	2	-	4	8	35	2	6	27
Myebon	52	156	48	109,005	17,936	2	1	-	-	-	-	3,563	208	130,763	846	31818	136	9	3	-	3	14	40	2	8	32
Ann	36	242	3,436	96,464	25,372	7	50	22	18	-	-	-	278	125,647	872	23876	145	4	7	-	15	30	29	4	5	27
Kyaukpyu	54	261	113	200,263	863	-	13	-	-	1	-	5,358	315	206,926	1312	32467	192	7	7	-	13	54	45	3	8	34
Ramree	51	207	250	148,919	1,379	-	-	-	-	-	-	-	258	150,806	1062	18582	150	8	7	-	5	24	36	4	6	28
Munaung	36	137	19	103,705	1,340	-	-	-	-	-	-	-	173	105,237	681	9201	105	5	5	-	4	22	37	3	7	28
Toungup	42	207	874	140,161	11,552	1	7	3	2	-	-	-	249	152,849	1185	29962	153	6	8	1	7	31	37	4	6	29
Thandwe	63	254	4,503	141,092	6,900	6	347	40	109	1	-	8,034	317	161,349	1178	20382	174	9	6	-	15	21	45	3	8	34
Gwa	21	156	2,217	79,188	2,296	7	52	8	10	-	-	-	177	83,955	669	10257	109	9	3	-	2	22	27	3	5	20
Total	**968**	**3,852**	**28,952**	**2,178,508**	**101,886**	**149**	**710**	**175**	**262**	**180**	**3**	**935,484**	**4,820**	**3,251,129**	**18,133**	**588,373**	**2,572**	**137**	**83**	**2**	**161**	**603**	**603**	**49**	**110**	**495**

出所：ラカイン州政府

7-2 Basic information of Project Site

Toungup ~ Maei ~ Ann																			
Village Tract/ Ward	*Township*	*# of population*	*By ethnicities*							*# of Students*	*# of Teachers*	*# of Schools*			*# of Doctors*	*# of Mid-wives*	*# of Health Center*		
			Burma	*Rakhine*	*Chin*	*Kayin*	*Kachin*	*Mon*	*Others*			*Primary*	*Middle*	*High*			*SHC*	*RHC*	*Hospital*
Toungup	Toungup	28,510	353	27,822	322	7	3	3	-	7775	339	10	2	2	5	3	-	-	1
Mi Kyaung Htoe	Toungup	603	-	603	-	-	-	-	-	76	3	1	-	-	-	-	-	-	-
Kin Taung	Toungup	6,089	-	6,089	-	-	-	-	-	533	3	-	-	1	-	1	-	1	-
Tayaba	Toungup	1,102	-	1,102	-	-	-	-	-	86	6	1	-	-	-	-	-	-	-
Thin Chay Koune	Toungup	283	-	283	-	-	-	-	-	21	2	1	-	-	-	-	-	-	-
Pauk Pyin	Toungup	638	-	638	-	-	-	-	-	57	3	1	-	-	-	1	1	-	-
Zani	Ma-ei	320	-	320	-	-	-	-	-	52	2	1	-	-	-	-	-	-	-
Sar Pyin	Ma-ei	3,269	-	3,009	260	-	-	-	-	716	20	-	1	-	-	1	1	-	-
Aung Mingalar	Ma-ei	336	-	313	23	-	-	-	-	65	3	1	-	-	-	-	-	-	-
Zee Kwin	Ma-ei	676	-	642	34	-	-	-	-	102	2	1	-	-	-	-	-	-	-
Kamar	Ma-ei	1,238	-	1,200	38	-	-	-	-	298	7	1	-	-	-	-	-	-	-
Yone	Ma-ei	461	-	440	21	-	-	-	-	75	2	1	-	-	-	-	-	-	-
Lae Phar	Ma-ei	332	-	300	32	-	-	-	-	44	3	1	-	-	-	-	-	-	-
Padar	Ma-ei	1,719	-	1,619	100	-	-	-	-	189	9	2	-	-	-	1	1	-	-
Lamu	Ma-ei	7,876	-	7,384	492	-	-	-	-	841	29	-	-	1	1	1	-	1	-
Ma-ei	Ma-ei	4,514	-	4,514		-	-	-	-	814	35	-	-	1	1	1	-	-	1
Sak han Maw	Ann	1,256	20	432	804	-	-	-	-	240	6	3	-	-	-	-	-	-	-
Naung Chanung	Ann	1,108	4	250	854	-	-	-	-	510	12	2	-	-	-	1	1	-	-
Tha Linetaung	Ann	1,942	-	1,356	586	-	-	-	-	1059	34	6	-	-	-	-	2	2	-
Total		***62,272***	***377***	***58,316***	***3,566***	***7***	***3***	***3***	***-***	***13,553***	***520***	***33***	***3***	***5***	***7***	***10***	***6***	***4***	***2***

Source：Public Works in Rakhine State