Department of Highways (DOH)
Ministry of Construction
Republic of the Union of Myanmar

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

November 2015

JAPAN INTERNATIONAL COOPERATION AGENCY

(JICA)

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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 51.41 million people (census, 2014). 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 areas of Kachin State and Chin State are one of the most undeveloped regions in the country and are slower than other states and regions in developing roads. Main roads serving as logistics and transportation routes are in bad conditions, there are frequent flood, sediment disaster and loss of bridges caused by torrential rains. Improvement of roads for access to public services and stable logistics network to contributing to improvement of living conditions is crucial and imminent issue in Myanmar. Department of Highways, the Ministry of Construction, which implements the construction and maintenance of major roads in its direct management, is faced with shortages and deterioration of road construction and maintenance equipment. It is in difficult situation to implement road development efficiently.

In view of these conditions, the Government of Myanmar on 10th December 2013 submitted an

official request for grant aid concerning improvement of equipment for road construction and maintenance in Kachin State, which is located at the northernmost of the country and is especially slow in regional development.

As a result of discussion with Ministry of Construction and other concerning organization based on the above-mentioned request in the Preparatory Survey, the following road was selected as a target section in the Project:

- Nansiaung – Namiti (Approximately 141km) on the Shwebo – Myitkyina Road

Regarding Chin State, in view of synergistic regional development in collaboration with the ongoing Regional Development Project for Poverty Reduction Phase I which targets road development in the state, the following road was selected as a target section in the Project:

- Falam area – Hakha (Approximately 109km) on the Kalay – Hakha Road

③ Outline of the Survey Findings and Contents of the Project

Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the survey team to Myanmar from 8th February to 26th March 2015 as a first field survey. The survey team confirmed contents requested by Myanmar side for the Project and conducted field surveys at target sites where Public Works which was the executing agency of Myanmar government at that time planed road construction by its own budget in Kachin State and Chin State. After being back in Japan, the survey team analyzed their survey result, conducted the outline design and cost estimation of the Project. Based on their result, the survey team conducted the second survey in Myanmar for explanation of the outline design to Myanmar side from 7th to 19th July 2015. Ministry of Construction executed organizational change in April 2015. As a result, after Public Works, Department of Highways was designated by the Ministry of Construction as the executing agency of the Project.

The equipment to be procured in the Project will comprise items needed to construct and maintain 141 kilometers - road connecting Nansiaung and Namiti in Kachin State and 109 kilometers - road connecting Falam area and Hakha in Chin State by Department of Highways (the Project target road, see the Location Map at the beginning of the report). The equipment of the Project consists of construction equipment, road/bridge test equipment, operator-training equipment and training equipment for Central Training Center (hereinafter referred to as "CTC"). Each kinds of equipment is delivered to facilities of Ministry of Construction in Kachin State and Chin State, Mandalay Mechanical Compound, Mayangone Mechanical Compound, Road Research Laboratory (hereinafter referred to as "RRL") and Bridge Research Laboratory (hereinafter referred to as "BRL").

Furthermore, the Project will conduct a Soft Component (Technical Assistance) to introduce an equipment management system and to conduct pilot road construction, technical guidance for slope stability and protection and training at CTC so that Department of Highways can acquire the method to utilize and manage equipment to be procured in the Project in the proper manner.

The contents of equipment in the project are described below.

Table-1 Construction Equipment to be procured

No.	Equipment	Quantity			
		Kachin	Chin	Mandalay Mechanical Compound	Total
1	Bulldozer	3	3	-	6
2	Excavator (Crawler)	3	3	-	6
3	Hydraulic Breaker	-	3	-	3
4	Wheel Excavator	2	2	-	4
5	Motor Grader	3	3	-	6
6	Wheel Loader	3	3	-	6
7	Sheep Foot Compactor	3	3	-	6
8	Vibratory Tandem Roller	2	2	-	4
9	Tire Roller	2	2	-	4
10	Plate Compactor	10	10	-	20
11	Asphalt Kettle	2	2	-	4
12	Bitumen Distributor	2	2	-	4
13	Asphalt Hand Sprayer	10	10	-	20
14	Chip Spreader	2	2	-	4
15	Mobile Crusher	2	2	-	4
16	Water Bowser (Tanker)	3	4	-	7
17	Dump Truck	30	20	-	50
18	Cab-back Crane	1	2	-	3
19	Rough Terrain Crane	1	1	-	2
20	Low Bed Semi-trailer (with Tractor Head)	1	-	-	1
21	Low Bed Self-loading Truck	-	2	-	2
22	Mobile Workshop	2	2	-	4
23	Inspection Vehicle	2	2	-	4
24	Generator	3	3	-	6
25	Concrete Sprayer	-	2	-	2
26	Desktop Computer	1	1	2	4
27	Database Software	1	1	2	4

Table-2 Road/Bridge Test Equipment to be procured

No.	Equipment	Quantity						
		RRL			BRL			Total
		RRL (Delivery Point)	Kachin (Site)	Chin (Site)	BRL (Delivery Point)	Kachin (Site)	Chin (Site)	
1.	Equipment for Geotechnical Investigation							
1-1	Boring Machine with Standard Accessories	-	-	1	-	1	-	2
2.	Equipment for Geotechnical Test							
2-1	Triaxial Apparatus	1	-	-	1	-	-	2
2-2	Sieves Set and Shaker for Soil	1	-	-	1	-	-	2
2-3	CBR Test Apparatus	1	-	-	-	-	-	1
2-4	Digital Moisture Meter	-	3	3	-	-	-	6
2-5	Dynamic Cone Penetrometer	-	3	3	-	-	-	6
2-6	Soil Density Apparatus (Sand Replacement Method)	-	3	3	-	-	-	6
3.	Equipment for Concrete Test							
3-1	Pan Type Concrete Forced Mixer	-	-	-	1	-	-	1
3-2	Concrete Compressive Strength Testing Device	-	-	1	-	2	-	3
3-3	Load Cell with Digital Tester for Calibration	-	-	1	-	1	-	2
3-4	Sieves Set and Shaker for Aggregate	-	-	1	-	1	-	2
3-5	Specific Gravity Apparatus for Coarse Aggregate	-	-	-	1	-	-	1
3-6	Photometer	-	-	-	1	-	-	1
3-7	Aggregate Crashing and Test Apparatus	1	-	-	-	-	-	1
3-8	Unbonded Capping Apparatus	-	-	5	-	-	5	10
3-9	Concrete Test Hammer	-	-	3	-	3	-	6
4.	Common Equipment							
4-1	Oven	-	-	-	2	-	-	2
4-2	Digital Caliper	1	-	3	1	3	-	8

Table-3 Operator-training Equipment to be procured

No.	Equipment	Quantity		
		Mandalay Mechanical Compound (Upper Myanmar)	Mayangone Mechanical Compound (Lower Myanmar)	Total
1	Mini Dozer	2	2	4
2	Mini Excavator (Crawler)	2	2	4
3	Mini Wheel Loader	2	2	4
4	Mini Vibratory Tandem Roller	2	2	4
5	Mini Cab-back Crane	2	2	4

Table-4 CTC-training Equipment to be procured

No.	Equipment		Quantity			
			CTC (Delivery Point)	Kachin (Site)	Chin (Site)	Total
1.	Survey Equipment					
1-1	Total Station		2	3	3	8
1-2	Survey Instrument Tools	Tape Measure	5	6	6	17
		Staff	5	6	6	17
		Pole	10	30	30	70
		Slant Rule	5	6	6	17
2.	Formwork Equipment					
2-1	Circular Saw		5	15	15	35
2-2	Pistol-Grip (corded) Drill		5	15	15	35
2-3	Table Saw		1	3	3	7
2-4	Electric Planer		5	-	-	5
2-5	Baggage for Carpenter's Tools		20	30	30	80
3.	Concrete Work Equipment					
3-1	Concrete Vibrator		5	15	15	35
3-2	High Frequency Generator		1	3	3	7
3-3	Concrete Mixer		1	3	3	7
4.	Road Work Equipment					
4-1	Walk Behind Concrete Saw		1	3	3	7
4-2	Asphalt Hand Sprayer		1	-	-	1
4-3	Plate Compactor		2	-	-	2
4-4	Safety Facilities under Construction		1	-	-	1
5.	Rebar Work Equipment					
5-1	Bar Bending Machine		2	4	2	8
5-2	Bar Cutting Machine		2	4	2	8
6.	Scaffolding Material					
6-1	Prefabricated Scaffolding		1	-	-	1
6-2	Pipe Scaffolding		1	-	-	1
6-3	Travelling Scaffolding		1	-	-	1
6-4	Tools for Set Up Scaffolding		20	-	-	20
7.	Safety Item					
7-1	Personal Protective Safety Items (Hardhat, Dust-proof Glasses, Safety Vest, Gloves, Safety Shoes, Safety Belt, Carry bag)		50	50	50	150

④ Project period and cost estimation

The project period is approximately 18.5 months including the detailed design, tendering and procurement periods. The project cost to be borne by the Myanmar side is estimated to be approximately USD133,000 (approximately 15,930,000 JPY) for preparation for the delivery of equipment, the Soft Component 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. Also the Project includes human resource development through trainings in the Soft Component. Thus, the Project covers item 2 above, as well.

The target road in Kachin State is a part of the main road that connects Mandalay, Sagaing and Myitkyina. Heavy vehicle for logistics and passenger cars congests the existing one-lane road and pavement surface has deteriorated. Improvement of the existing road is required to improve transport efficiency and traffic safety. The Project will not only contribute to regional development in Kachin State through achieving stable traffic to neighboring region, but also will vitalize the regional economy and improve living standards and the convenience of residents along the target road.

The target road in Chin State is the main road that connects Kalay in Sagaing Region and Hakha and is the only road that distributes goods from Kaley Hakha. At present, there is not an airport in Chin State due to lack of flat lands. The shortest way connecting major cities Yangon and Mandalay to Hakha is to move by air to Kalay and then drive on the target road. Frequent sediment disaster such as landslides and slope failure make the target road in poor conditions impassable. Improvement of the existing road is urgently required to not only improve a transportation route for goods distribution, but also to secure traffic safety for vehicles and pedestrians. In the circumstances, the Regional Development Project for Poverty Reduction Phase I loaned by Japan that includes road construction at the adjacent section is currently ongoing. In collaboration with the loan project above, the road stably connecting Chin State and neighboring areas will be secured and is expected to contribute to regional development of the state.

As mentioned above, improvement of the target roads in Kachin State and Chin State is crucial and imminent issue and also is in line with the road development strategy in medium and long period of the central and state governments in Myanmar.

- **Effectiveness**

Approximately 649,000 people live along the target road in Kachin State, approximately 64,000 people live along the target road in Chin State. The Project can provide direct benefit to those people.

It is expected that improvement of the target roads is going to increase driving speed from current 32km/hr. to 60km/hr. in Kachin State and from current 28km/hr. to 40km/hr. in Chin State. This increase enables to cut travel time by 47% on the target section in Kachin State and by 30% on the target section in Chin State.

Table-5 and Table-6 shows quantitative effects of the Project.

Table-5 Quantitative effects of the Project in Kachin State

Indicator	Baseline, 2015	Target, 2020
Average driving speed on the target road（km/h）	Approx. 32km/h	Approx. 60km/h
Total length of road improvement on the target road（km）	0km	Approx. 141km

Table-6 Quantitative effects of the Project in Chin State

Indicator	Baseline, 2015	Target, 2020
Average driving speed on the target road（km/h）	Approx. 28km/h	Approx. 40km/h
Total length of road improvement on the target road（km）	0km	Approx. 109km

Department of Highways will measure the average driving speed indicated in the above table by actual driving in the target year 2020.

In addition to abovementioned quantitative effects, after developing the target road, various qualitative effects are expected, such as effect on Traffic Safety, promotion of production, improvement of school-commuting, access to medical services and so on.

CONTENTS

【Appendices】

Delivery Points of the Project Equipment

Equipment	Delivery Point	Location
Construction Equipment for Kachin State	Myitkyina Workshop	Myitkyina, Kachin State
Construction Equipment for Chin State	Hakha Mechanical Compound	Hakha, Chin State
Road/Bridge Test Equipment	Road/Bridge Research Laboratory	Yangon
Operator-training Equipment	Mandalay Mechanical Compound	Mandalay
	Mayangone Mechanical Compound	Yangon
CTC-training Equipment	Central Training Center	Yangon

Location Map

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Abbreviations

AD	Assistant Director
BRL	Bridge Research Laboratory
CE	Chief Engineer
CTC	Central Training Center
DCE	Deputy Chief Engineer
DG	Director General
DDG	Deputy Director General
DMD	Deputy Managing Director
DOB	Department of Bridge
DOH	Department of Highways
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
PS	Permanent Secretary
RRL	Road Research Laboratory
SRL	Soil Testing and Research Laboratory
SE	Superintendent Engineer

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 159,000 kilometers of roads in the Republic of the Union of Myanmar (hereinafter referred to as “Myanmar”), paved roads account for just 23% (approximately 37,000 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 159,000 kilometers of roads in Myanmar, approximately 25% are under the jurisdiction of Ministry of Construction (hereinafter referred to as “MOC”), and approximately 53% of those roads are paved (bituminous treatment 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 MOC according to the type of paving.

Table 1-1.1 Length of Roads under Jurisdiction of the Ministry of Construction (as of March 2014)

Type of Pavement	Road length（km）			Percentage
	Union Highway	Provincial Road	Total	
Bituminous Road	12,658	7,769	20,427	51%
Concrete Paved Road	738	197	935	2%
Crushed Rock Road	1,847	2,779	4,626	11%
Gravel Road	2,833	2,713	5,546	14%
Earth Road	1,564	6,310	7,874	20%
Others	0	721	721	2%
Total	19,640	20,489	40,129	100%

Source: Public Works

Kachin State is located at the northernmost of the country where shares the border with India and China in the north of the state, Shan State in the south of the state and Sagaing Region in the west of the state. Main roads for access to neighboring regions and states are limited and need long time for a trip because of the northernmost area isolated. During the rainy season, landslides and slope failures frequently occur especially around mountainous areas in the state and roads become inundated around flat terrains due to torrential rain. Such situations make it hard to gain access not only to areas inside the state but also to neighboring regions. Kachin State known as an abundant production area of agricultural crops, wood materials and gems, however, the roads in poor conditions stand in the way of economic development of the state.

Chin State is located in the western edge of Myanmar bordering on Bangladesh at the west and on India at the north. It faces Rakhine State at the south and Sagaing and Magway regions at the east.

Most part of the state is mountainous area and even main roads essential for logistics are

undeveloped in poor conditions. Moreover, frequent sediment disaster such as landslides and slope failure many road in the state impassable during the rainy season. Even Hakha, the capital of the state, is isolated from neighboring regions and states.

In the circumstances, Kachin State and Chin State are remarkably slow in developing and roads essential for regional development in the states are in poor conditions. Therefore, improvement of roads for stable logistics network with and for contributing to improvement of living conditions is crucial and imminent issue for both states.

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, Department of Highway (hereinafter referred to as "DOH"), MOC 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 MOC implement road construction and maintenance for 40 years, and they fund operations using tolls levied from passing vehicles.

DOH 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 (Mile/Furlong), Bottom row: Budget (million Kyat)			
	Phase 3 Year 2011 – 2015	Phase 4 Year 2016 – 2020	Phase 5 Year 2021 – 2025	Phase 6 Year 2026 – 2030
International trunk road network	5,665/0	-	5,970/0	-
	392,563.06	-	1,554,198.70	-
Road repair works	4,482/5	2,772/1	-	3,323/5
	1,160,481.59	2,204,053.80	-	1,371,643.68
New road construction	1,052/6	-	-	-
	367,993.87	-	-	-
Total	11,200/3	2,772/1	5,970/0	3,323/5
	1,921,038.52	2,204,053.80	1,554,198.70	1,371,643.68

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, March 2015

The target roads of the Project in Kachin State and Chin State are regarded as important routes in

formation of the main domestic road network connecting each state and its neighboring regions. Thus, the Project conforms to the above plan of the Myanmar government.

1-1-3 Social and Economic Conditions

(1) Myanmar in General

1) Territory and Nature

Myanmar is located between latitude10～28 degree north and longitude 93～103 degree east at the base of Indochina peninsula, bordering on Bangladesh and India at its west side, China, Laos and Thailand at its north to east side, facing the Andaman Sea on the south. The western side of the territory is in Arakan mountains and Patkai hills whose height ranges 1,500m to 3,000m above the sea level and the north eastern side is also in the chain of mountains including Hkakabo Razi with its peak at 5,881m and Shan hills. Surrounded by those mountains, the middle of the country is a large basin holding 2,100m long river Ayeyarwady running north to south

Myanmar is in tropical monsoon region having three typical seasons; dry season from October to March, extreme hot season from April to May and rainy season from June to October. Averaged annual precipitation is about 1,800mm most of which concentrate in the rainy season.

The area of Myanmar is 677,000 ㎢ which is 1.8 times larger than Japan, while population is 51,410,000 according to the national census carried out in 2014, which is about 40 % of Japanese. Myanmar is a multiethnic country comprising more than 100 ethnic groups. Dominant Burma accounts for two thirds of the population and the rest of one third is shared by many minorities such as Shan 9%, Karen 7%, Rakhine 3.5%, Mon 2%, Kachin 1.5%, Indian 1.25%, Kayah 0.75%, others 4.5%.

2) Politics and Economy

Due to closed economy under Burmese Socialism since 1962 and prolonged sanctions against military administration that continued after termination of the Cold War, Myanmar's GDP per person in 2011 was reckoned at 875 US$, which was the lowest among the ASEAN countries. After new constitution was enforced and Mr. Thein Sein inaugurated as the President in 2011, transfer to civilian control was promoted to realize cancellation of the sanction next year. As rapid renovation being exercised, investment from abroad has been increasing.

In 2013, Myanmar's nominal GDP was 59 billion US$ i.e. 914 US$ per person with the substantial growth rate of 7.5%. Major industry of Myanmar is agriculture which is decreasing but still accounts for 38% of GDP. Among other industries, manufacturing accounts for 19 %, commerce 21% and transport/communication 14 % according to IMF report.

Myanmar has been suffering from ethnic problems since its independence in 1948. There have been combats between armed ethnic groups and the government forces. While ceasefire agreements have developed with some groups since 1990, military conflicts are still continuing in Kachin State and Shan State. Many IDP camps spread over the eastern area of Kachin State and northern Shan State where UN organizations and NGOs are deploying humanitarian aids. Under such circumstances, it

is necessary for Myanmar to facilitate settlement of disputes with minor ethnic groups in order to achieve democracy and economic development. The land of Myanmar is fertile and abundant with natural resources. People are diligent and zealous about education with high literacy rate. They have potential for great development when democracy and renovation are achieved with ethnic integration.

(2) Social Conditions in Kachin State and Chin State

Basic social data of whole Myanmar, Kachin State and Chin State are shown below

Table 1-1.3 Basic Social Data

Item	Myanmar as a whole	Kachin State	Chin State
1. Population (2014)	50,213,000	1,293,000	479,000
2. Area (㎢)	677,000	89,000	36,000
3. Distribution of population by Races Religion	Burmese 2/3, Shan 9%、Karen 7%、Rakhine 3.5%、Chinese 2.5%、Mon 2.0%、Kachin 1.5 Buddhism (Burmese)	Kachin 40%、Burmese 33%、Shan 24% Christianity, Buddhism	95% is Chin and Christian
4. Adult Literacy Rate	95.6% (2012)	87.2% (2010)	87.4% (2010)
5. Infant Mortality Rate (Per 1,000 live birth)	41 (2012)	14 (2011)	11 (2011)
6. Unemployment rate	4% (2012)	2.3% (2010)	0.6% (2010)
7. Poverty Head Count Ratio (2010 年)	25.60%	28.60%	73.30%

Source：Item 1 Whole: Myanmar Information Management Unit (MIMU), States: Public Works
Item 2 Ministry of Forest
Item 3 Public Works
Items 4, 5, 6, 7 Myanmar Information Management Unit (MIMU)

1) Social Conditions of Kachin State

Kachin State is located at the northernmost of Myanmar bordering on India at its north west side by Patkai Mountains, China at its north to east side by a chain of mountains including Hkabo Razi which is 5,881 m above sea level. It is connected to Shan State at the south and to Sagaing Region at the west. Fertile plain spreads in south and west area embracing Ayeyarwady river. The area of land is 89 thousand ㎢ which is slightly bigger than Hokkaido with population of 1,293 thousand (as of March 2015) which is almost same as Saitama City. 39% of the population is Kachin followed by 32% Burmese and 23% Shan. With respect to religion, Christianity and Buddhism are dominant. Kachin State is well-balanced and abundant in resources. In addition to affluent productions of rice, peanuts, watermelons and grapefruits, Kachin is famous for production of teak and gems such as jade, ruby, sapphire, gold and amber.

2) Social Conditions of Chin State

Chin State is located in the western edge of Myanmar bordering on Bangladesh at the west and on India at the north. It faces Rakhine State at the south and Sagaing and Magway regions at the east. The area of the State is 36,000 ㎢, which is almost same as the sum of Aomori, Akita and Iwate prefectures. Population is 479,000 (As of March 2015), which is almost same as Kurashiki City Okayama prefecture and the second smallest among 14 states/regions of Myanmar. Majority of the population is Chin who inhabit in Arakan Mountains across Indian-Myanmar border. They are

Christians. There used to be fighting between armed group CNF (Chin National Front) and the Government. There has been no battle recently after ceasefire agreement was reached.

Most of Chin State is in Chin high land where chains of mountains run north to south at the elevation ranging 1,500m～3,000m. The state capital Hakha is at 1,800m above sea level. There is little plain suitable for residence, agriculture or farming. The mountains are so steep exposing soft rock like shale and mudstone that they are not suitable for massive production of timber, either. People cultivate small stepped field to harvest rice, maize, lettuce, onions, potato, straw berries and so on. Almost all food products are consumed in the area with an exception of Elephant's Foot which is gotten in the forest and exported to Japan as a material for noodles. The state is in short of food. Agricultural product and meat are imported from adjacent Sagaing District or Magway District, and fish mainly from Yangon. As illustrated above, present Chin state is lacking productivity thus securing stable distribution of goods all year round is crucial and imminent.

Major part of fund for purchasing goods comes from abroad. It is said that as many as 100 thousand people of Chin state work in foreign countries and there are households that depend on remittance from abroad. Wages earned by labor in road construction in the state is another important source of cash income for local people. An unskilled laborer is paid USD 4～6 per day.

There are three routes for logistics to Chin State; one is from Kaley in Sagaing to Hakha via Falam. Another is from Gangaw in Magway to Hakha. There is another route to southern Mindat and Matupi from Mandalay through Pauk.

(3) Social Conditions along Target Roads

1) Along the Target Road in Kachin State

The object of the Project in Kachin State is 141km long section from Nansiaung to Namiti of Shwebo-Myitkyina Road (total 462.4km). The Government plans to improve section from Namiti to Myitkyina under BOT (Build-Operate-Transfer) project.

As the effect of this project on the areas along the target road is expected to extend up to Myitkyina, social consideration is given to the section from Nansiaung to Myitkyina.

① Population, Economy and Infrastructure

There are 21 towns/villages along the target road from Nansiaung to Myitkyina, total population of which is 649 thousand. As the population of major 6 towns/villages having more than 10 thousand amounts to 595 thousand, averaged population of other 15 towns/villages is calculated as 3,600. Distribution of population by ethnic groups is 45% Burma, 31% Kachin and 24% Shan. It is noted that Burma accounts nearly for half of total population along this target road.

The topography along the road is generally flat where farms spread. Rice is the major product all over the area but Mohnyin is famous for its watermelon as well. Averaged annual income per household is USD 1,800 according to Public Works in March 2015. Electricity is supplied through grid. Source of water is wells.

The target road is a major trunk road connecting Myitkyina and Mandalay which is the major city in

northern Myanmar. Existing pavement covers only one-lane width despite the fact that the road serves large vehicles. The condition can provoke danger not only to vehicles passing each other but also to pedestrians and motorcycles. Improvement of the road pavement would contribute to shortening travel time and to enhancing traffic safety, as well.

② Education and Medical Care

Education system in Myanmar is 5-4-2 i.e. 5-year primary school, 4-year middle school and 2-year high school summing up 11 grades in total. Children who have become 5 years old by the end of May join a primary school in June. Elementary education at primary schools is compulsory.

There are 94 primary schools, 41 middle schools and 14 high schools along the road from Nansiaung to Myitkyina. As for universities, there are 3 in Myitkyina and 1 in Mohnyin. A "middle school" combines primary school with middle school and a "high school" serves as both high school, middle school and primary school in Myanmar. Counting on the above said basis, there is at least 1 primary school in each of 21 town/villages along the road. So all the primary school pupil can go to school of the town/village they live. On the other hand, there are 6 villages that have only a primary school. The pupils living in those areas, if they will, have to go to middle school in adjacent town/village, the distance of which can be about 20km at the farthest.

As for medical care, there are 8 hospitals in 8 towns/villages along the target road with 50 doctors at Myitkyina hospital, 10 doctors at Mohnyin hospital and only 1 to 2 doctors at other hospitals according to information provided by Public Works in March 2015. The number of doctors per 100 thousand people along the target road is calculated as 11 while the average of whole Kachin State is 15 (as of March 2015).

2) Along the Target Road in Chin State

The object of the Project in Chin State is 108.4km long section from the point near Falam to Hakha of Kalay-Hakha Road whose total length is 198.4 km. The northern section of road 75.8 km (Falam to the boundary with Sagaing Region) is now being improved under the Regional Development Project for Poverty Reduction Phase I loaned by Japan.

Study on social conditions shall cover all the section from Sagaing boundary to Hakha because the effect of the Project is expected to extend to whole Kalay – Hakha Road in Chin state including 75.8km northern section.

① Population, Economy and Infrastructure

Kalay – Hakha Road is 198.4 km, 93% or 184.2 km of which runs in Chin State. Entering in Chin state from Kalay, the road soon gets steepened and winding 1-lane pavement continues all the way.

There are 19 towns/villages along the road, whose population is 64,247 in 7,928 households. 57,441 or 90 % of total population reside in 3 major towns; 44,762 in Hakha, 9,359 in Falam and 3,326 in Rih leaving the rest of 16 villages as small as 400 in average. There are many officials and shopkeepers in Hakha, but people are basically engaged in farming. They cultivate stepped field on hillside of the road for their own consumption and sell remainder at the market in town. Averaged annual income per household is about USD 1,500 according to Public Works in March 2015.

Major fuel is firewood and charcoal. 61,717 people in 8 towns/villages receive electricity supply through public grid. Piped water is supplied to taps in part or Hakha and Falam while others depend on delivery of bottled water from wells or springs by distributors.

Public transport between Hakha and Kalay is bus service connecting the two towns in 8 hours. There are 5 services every day except Sundays with total capacity of 138 seats a day. In use of passenger cars, it takes about 7 hours in dry season (28km/hour) and the road becomes impassable due to sediment disaster in rainy season. Some sections have two-lane width but some do not. Cars have to wait for the ones coming in the opposite direction when they pass each other in narrow place, which disrupts smooth traffic and causes delay. The narrow road becomes particularly dangerous when large vehicles pass each other with motorcycles, bicycles and pedestrians together in narrow space.

② Education and Medical Care

There are 5,181 primary school pupils, 4,691 middle school pupils and 2,442 high school students in 19 towns/villages along the road. Middle schools combine primary schools and high schools combine middle schools and primary schools. Every town/village has a primary school whether independent or combined while there are 6 villages that do not have middle school. Pupils living in such villages have to go to middle school in different village. In such case, they go to school in-group by bicycle.

Chin people are zealous about education as common in Myanmar. Many students go to private school in addition to public school or employ private teacher at home. There is a boarding school in Hakha where 42 students in grade 6 to 9 and 117 students in grade 10 to 11 live together and study there before and after school.

As for medical care, there is one hospital with 200 beds or 100 beds in each district, and one hospital with 25 to 50 beds in each township. In addition, there are hospitals with 16 beds in major towns, but no full-time doctor stays at most of 16-bed hospitals. Number of doctors in Chin State is 103 for 479,000 people, which means 21 doctors per 100 thousand people (as of March 2015). It is about one eighth of whole Japan average of 162 per 100 thousand (Year 2013).

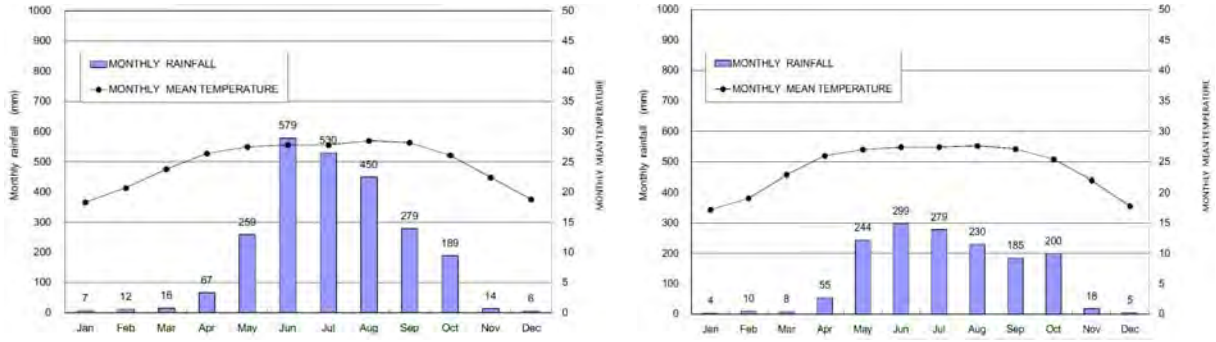
Along the target road between Kalay and Hakha, there is a 200-bed hospital at Falam and Hakha respectively. Access to the large hospital is comparatively easy for those who live along the road. However, people living in small villages far from the road are in difficulty. Motorcycles and even horses are sometimes used to carry a patient to the hospital.

1-1-4 Natural Conditions

(1) Overview of Meteorological Statistics in Kachin State and Chin State

Figure1-1.1 and Figure1-1.2 show the statistical data of average temperature and monthly average rainfall of 2001 to 2010. The rainy season of Kachin State and Chin State is 6 months from May to October. In Myitkyina of Kachin State, the monthly rainfall is more than 500mm in June to July. In Chin State, the month rainfall is approximately 300mm, and is less rainfall in spite of the rainy season.

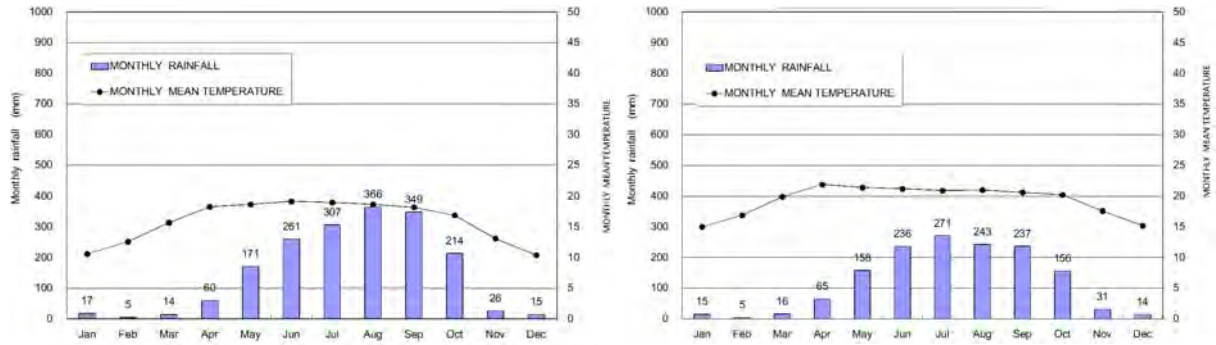
Myitkyina and Mohnyin of Kachin State are located in the lowland with altitude less than 200m. Hakha and Falam of Chin State are located in the highlands of more than 1500m. For this reason, the temperature of Chin State is cool about 10 ° comparing with Kachin State.



Source: Prepared by Survey Team based on Meteorological Data from Department of Meteorology and Hydrology, Myanmar

Figure 1-1.1 Monthly Rainfall and Temperature of Kachin State

(Left: Myitkyina, Right: Mohnyin)



Source: Prepared by Survey Team based on Meteorological Data from Department of Meteorology and Hydrology, Myanmar

Figure 1-1.2 Monthly Rainfall and Temperature of Chin State

(Left: Hakha, Right: Falam)

(2) Outline of Topography and Geology in Myanmar

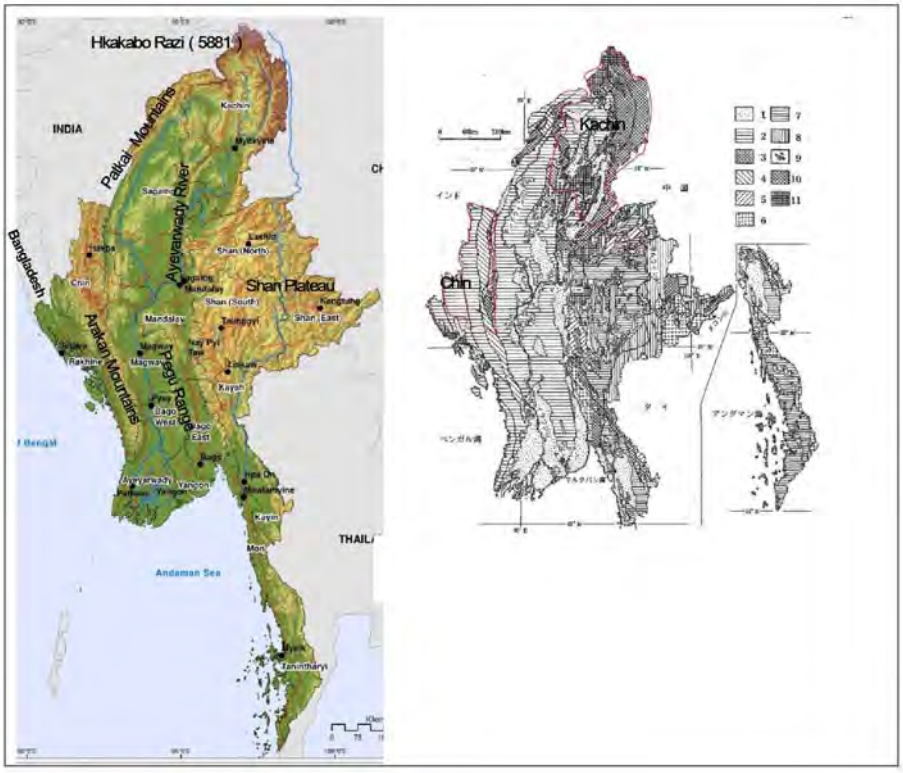
Myanmar terrain is characterized by mountains, hills and plains arranged in a north to south direction. It is roughly divided into the western mountains (Arakan Mountains) near the border with India and Bangladesh, the central plains where Ayeyarwady River flows through, the eastern mountains consisting of Shan Plateau and the northern mountains which is the most upstream part of Ayeyarwady River.

The western mountains consist of mainly the shale formations from Cretaceous to Paleogene. The Fold Mountains with the altitude of 2000 to 3000m are formed.

The central plains are composed from the thick Quaternary strata were deposited from Neogene to Quaternary, which were carried by the Ayeyarwady river, etc. In the plains, Pegu Range and other hills are formed. The alluvium is distributed in the limited area, namely in the Ayeyarwady Delta area.

The eastern mountains are referred to as the Shan Plateau, constitute the plateaus with the altitude approximately 2,000m in border area with China, Laos and Thailand. The rocks which form the continental crust of the Paleozoic are widely distributed. In the boundary area of the eastern mountains, a lot of granites and Neogene volcanic rocks are also distributed.

The northern mountains of Ayeyarwady river most upstream part locate on the border with China, consist of metamorphic rocks of old period. The highest peak of Myanmar, Hkakabo Raji Mountain (5881m) is located in this northern mountain.



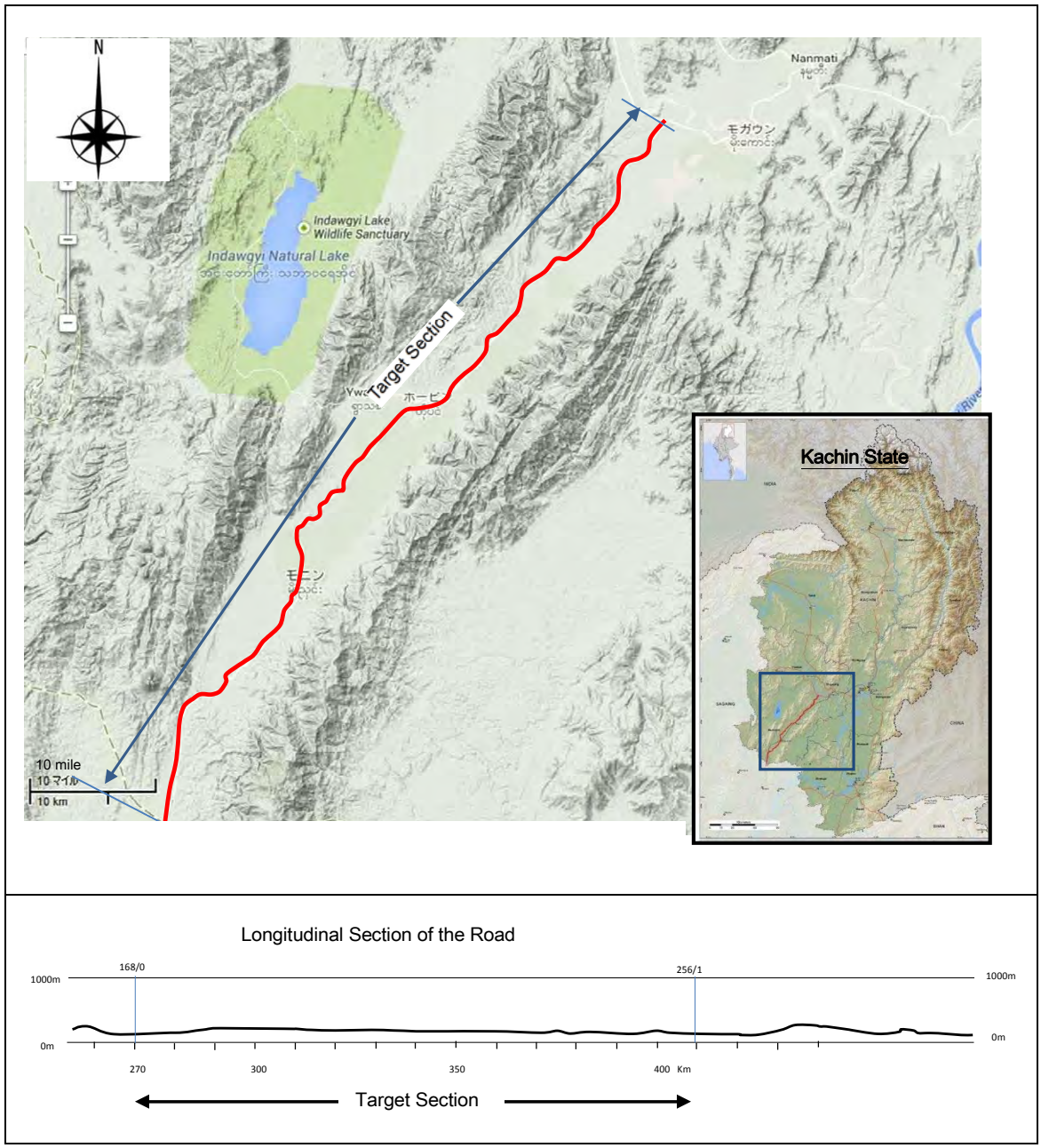
Source: Left; MIMU, Right; Adding partly based on Geological News Vol.524, April, 1998

Figure 1-1.3 Topography (left) and Geology (right) of Myanmar

(3) Topography and Geology along Target Roads and their Surroundings

1) Kachin State

The target road in Kachin State is about 141km section on the Shwebo - Myitkyina Road. The section from Shwebo to Mohnyin - Hopin - Mogaung passes through the low plain elongating northeast to southwest direction with width of about 10km. The longitudinal inclination of the road is very gradual. Because it is not close to the steep mountains, the sections by cut slope are small, and most of the road has been built by the embankment.

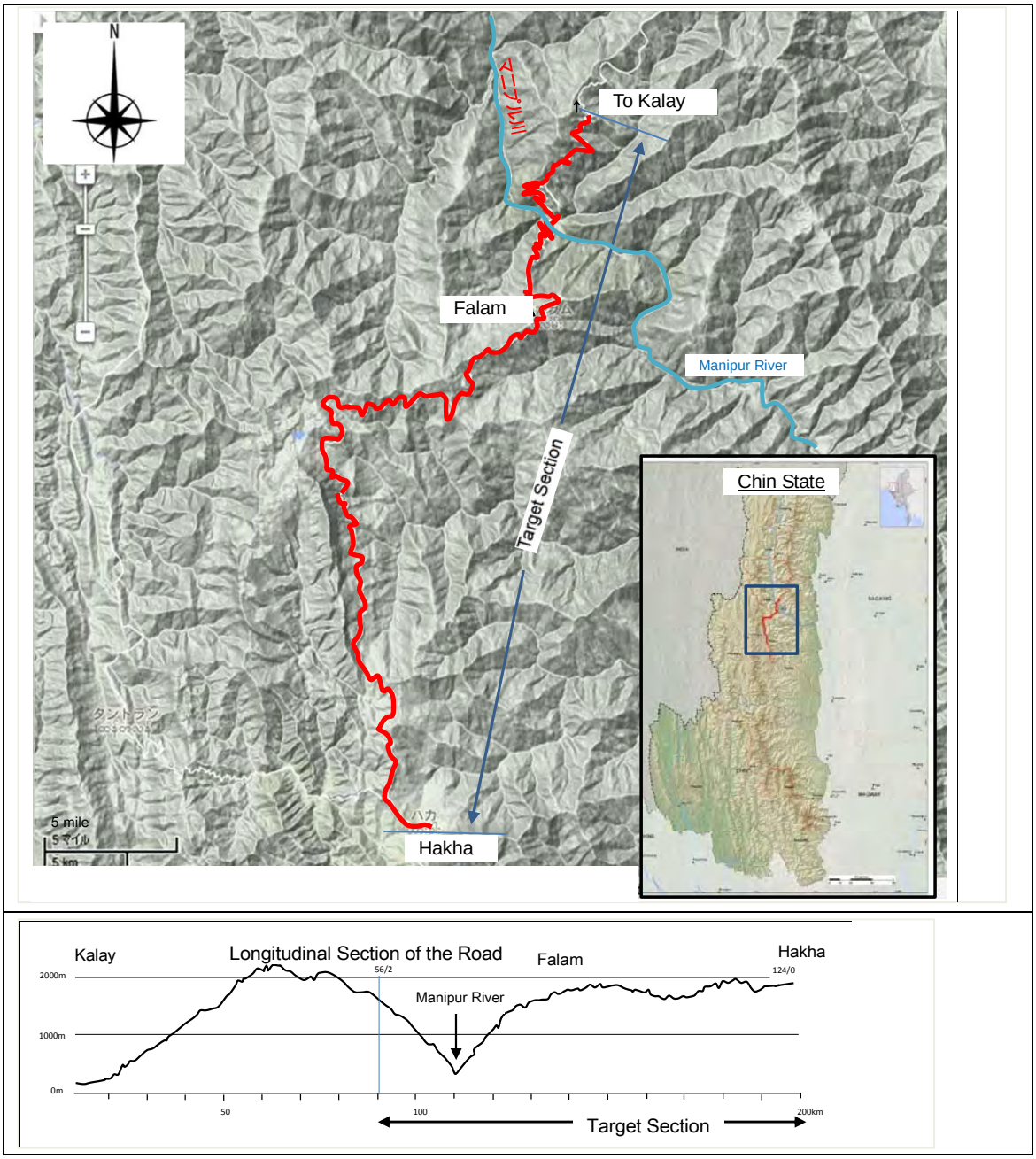


Source: Prepared by Survey Team

Figure 1-1.4 Topographical Outline of Target Road in Kachin State

2) Chin State

The target road in Chin State is the section from 90km point to 200km point of Hakha in Kalay - Falam - Hakha road. The road descends up to the altitude of 300m at the point Manipur River passing across the northern part of Arakan Mountains of Falam north. Other than that, the road passes through the high altitude of 1,500 ~ 2,000m. Also, the road bypasses the ridges in order to maintain a substantially constant altitude. Therefore, the road passes over the extension 110km against the section of the linear distance 40km. Mountains and valleys in the peripheral area of the road roughly arrange in a north-south direction, the terrain is considered that reflects the fault that has been formed in the mountains uplift process in the region. It is also a feature of this area which is poor in flat surfaces such as terrace along the river and at the foot areas of the hillside.



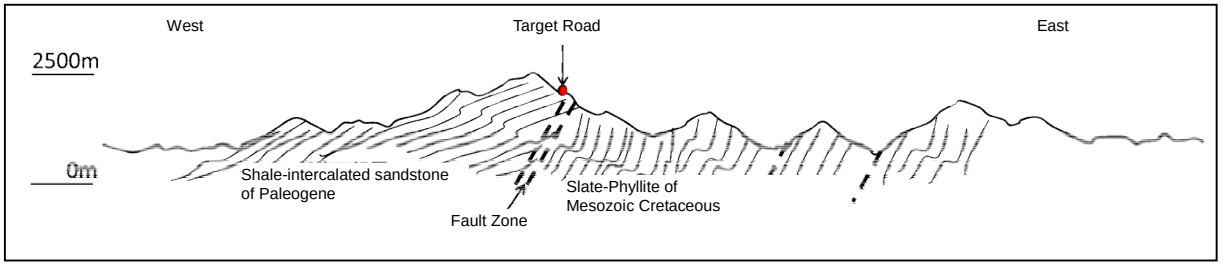
Source: Prepared by Survey Team

Figure 1-1.5 Topographical Outline of Target Road in Chin State

(4) Geological Outline of Target Road in Chin State

1) Geology and Geological Structure of Target Road in Chin State

A schematic cross-sectional diagram indicated geological structure of the east-west direction of the target road is shown in Figure1-1.6. The road passes through the eastern slopes of the mountains that elongated from north to south at altitude of 2,500m. In the east area of the road, the slate - phyllite of Mesozoic Cretaceous is mainly distributed, and the bedding plane is nearly upright. In the western area, the shale intercalated sandstone of Paleogene is mainly distributed, and the strata incline with degree 30° to the west. In the natural slope of the eastern area that the road exists, the received board structures with opposite dip to the slope are formed as an original geological structure, however, by the cracks intersecting therewith the steep slopes of 20 to 50° are formed. At the boundary of the Cretaceous strata and the Neogene strata, the clear lineament of north-south direction can be recognized by the presence of distinct saddle and straight valley. Many of the places, it is estimated to be a fault zone with high angle to medium angle. Besides the talus with thickness 5 ~ 10m is distributed on the slopes of Manipur River of Falam north, the development of the overburden layer is very poor.



Source: Prepared by Survey Team

Figure 1-1.6 Schematic Cross-Sectional Diagram of Geological Structure (East - West Direction)

Following photographs show typical places of geology and geological structure:

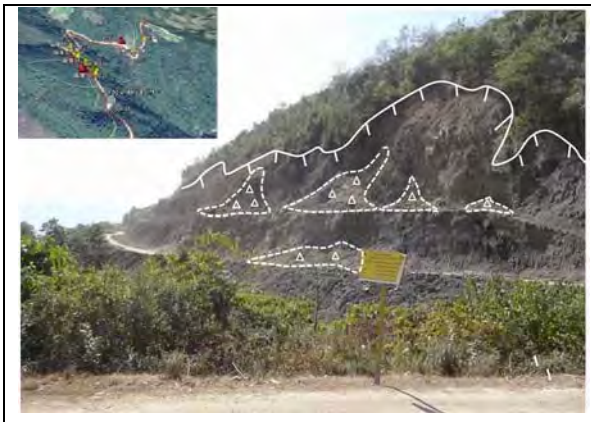
	
View of peak with altitude 2,500m from the road (near the 165km point), the alternation strata of shale and sandstone with received board structure forms rock wall.	Black phyllite of nearly upright geological structure (around 130km point) It is easy to surface weathering by slaking, but the surface of slope here is stable.

	
Received board structure of shale (around 180km point), Big collapse does not occur even at 60° or more of the gradient on the surface of the cut slope.	Fault zone confirmed in the road slopes that landslide occurred (around 171km point)

2) Landslide and collapse

Because the slopes of the target road are in the received board structure as a basic geological structure, the most of the slopes have not occurred collapses, even if the slope is more than 60 degrees and no-countermeasures. Many of places where landslides and rock collapses have occurred are at the vulnerable part comparing with the uncrushed part such as peripheral areas of fault zone, etc. However, many of slopes are large-scale slope, and also the weather and ground conditions cannot be expected surface protection by natural growth of vegetation. Therefore, once a collapse occurs, the collapse tends to expand up to reaching the upper slope. To achieve long-term stabilization of the road slope, the excavation and removal of weak parts or loose areas such as fault zone are carried out. Also, if the scale is large, and if necessary, implementation of a full-scale prevention work is required.

Following photographs show major landslides and collapses along the road.

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Bedrock collapse of cut slope surface at 171km point (extension 300m, height 25m)
Collapse sediment is removed at present, and is shaped to slope with the three stages of 60 ° slope.
It is also unstable at present, it is expected that further collapse will expand during the next rainy season. (The road widening works are planned in 2016.)</td><td>Landslide and bedrock collapse at the 170km point,
Although the slope inclines 30 ° degrees, most of the landslide mass remains in the top of the slope, and it is very unstable.
At the bottom of the slope, the road widening and the slope surface shaping has been carried out.</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Colluvium deposit slip at 145km point
In this road, the colluvium deposit landslide is uncommon.
The upper slope forms a gentle slope of 20 degrees or less.
Ground of deformation occurs in very loose speed in each rainy season.</td><td>Bedrock collapse at 132km point
The collapse is close to the urban area of Falam. It is expanding and sediment is flowing on the road during rainy season every year.
It is under construction a detour for during rainy season behind the hill.</td></tr>
</table>

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.

Involuntary resettlement or uncompensated expropriation of land may generally be mentioned as possibility of adverse social effect which can occur during road-widening operations. This possibility, however, is denied with the project considering the road conditions and circumstances of road improvement works being executed by DOH as tabulated below

Location	Circumstances
Kachin State	Right of way for two lanes have already been obtained by the Government, thus there is no need for further expropriation of land.
Chin State	Most houses along the target road are built protruding from right of way on valley side of the road. Farm land also spreads on the slopes under the road. They can remain as they are because road is widened by cutting hill side of the existing road. In case the road runs with houses on both sides, which happen in some villages, Public Works plans to overlay pavement within the existing right of way.

Three laws are often referred to with regard to acquisition of land by the Government in Myanmar:

- Land Acquisition Act 1984
- Farmland Law 2012
- Registration Act 1908

Land acquisition law stipulates compensation rules. Registration of rights on land is basically required to receive compensation. However, there are many cases where rights are not registered.

It is usual practice that State Government negotiates with an owner of land for expropriation of land that is necessary for road. Even in case the land ownership is not registered, compensation may be granted if the land has been occupied, utilized and tax has been paid by him. Occupants who came after right of way was announced by the Government are not compensated according to Kachin State officer in March 2015.

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.

The Project target areas of Kachin State and Chin State are one of the most undeveloped regions in the country and are slower than other states and regions in developing roads. Main roads serving as logistics and transportation routes are in bad conditions, there are frequent flood, sediment disaster and loss of bridges caused by torrential rains. Improvement of roads for access to public services and stable logistics network to contributing to improvement of living conditions is crucial and imminent issue in Myanmar. DOH of MOC, which implements the construction and maintenance of major roads in its direct management, is faced with shortages and deterioration of road construction and maintenance equipment. It is in difficult situation to implement road development efficiently.

In view of these conditions, the Government of Myanmar on 10th December 2013 submitted an official request for grant aid concerning improvement of equipment for road construction and maintenance in Kachin State, which is located at the northernmost of the country and is especially slow in regional development.

As a result of discussion with MOC and other concerning organization based on the above-mentioned request in the Preparatory Survey, the following road was selected as a target section in the Project:

- Nansiaung – Namiti (Approximately 141km) on the Shwebo – Myitkyina Road

Regarding Chin State, in view of synergistic regional development in collaboration with the ongoing Regional Development Project for Poverty Reduction Phase I which targets road development in the state, the following road was selected as a target section in the Project:

- Falam area – Hakha (Approximately 109km) on the Kalay – Hakha Road

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)	MOC	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 Construction and Maintenance Equipment in Kayin State (Grant Aid)	Fiscal 2012 (Approx. 759 million yen)	Public Works, MOC	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 target road: 146 km
The Project for Improvement of Road Construction and Maintenance Equipment in Rakhine State (Grant Aid)	Fiscal 2013 (Approx. 738 million yen)	DOH, MOC	1) Procurement of road construction equipment (main items: bulldozer, wheel loader, motor grader, vibrating roller, asphalt distributor, rough terrain crane, dump truck, mobile workshop, Bridge Inspection Vehicle, 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) - Technical assistance for the Bridge Inspection Vehicle	Total length of target road: 140km

As assistance relating to MOC, Japan has been implementing the Technical Cooperation Project, Grassroots Technical Cooperation Project, Emergency Development Survey and Sector Project Loan as shown in Table 1-3.2.

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	Completed in June 2015	Completed in September 2014	Being implemented	Being implemented
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, MOC	Public Works, MOC	State government	Public Works, MOC Ministry of Electric Power, state government

1-4 Assistance Trends of Other Donors

Around the Project target area, 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
Indian Government	Myitkyina – Putao Road in Kachin State	The Feasibility Study for Myitkyina – Putao Road (length: 349km) granted by Indian government. Tender was announced on 16th January 2015.As a result of tender, the Indian consulting firm was awarded the Study and it is currently ongoing.

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 159,000 kilometers of roads in the Republic of the Union of Myanmar, paved roads account for just 23% (approximately 37,000 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, MOC, 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 DOH of MOC has the central role to play until the target year.

In order to attain the superior objective described above, the Project aims to provide road construction and maintenance equipment in Kachin State and Chin 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.

Moreover, providing test equipment to the Road Research Laboratory (hereinafter referred to as “RRL”) and the Bridge Research Laboratory (hereinafter referred to as “BRL”) which are responsible for test and quality control in road and bridge works, and training equipment to the Mechanical Training Center (hereinafter referred to as “MTC”) and the Central Training Center (hereinafter referred to as “CTC”) which are training organizations for an equipment operator, engineer and skilled worker will contribute to efficient and high-quality road construction, and also aims to enhance organizational capacities of the mechanical section, road section and bridge section and their technical level.

2-1-2 Outline of the Project

In order to achieve the aforementioned objectives, the Project aims to procure construction equipment and test equipment necessary for Department of Highways (the executing agency in Myanmar) to construct and maintain the roads targeted in Kachin State and Chin State (see the Location Map at the beginning of the report), and the Project also aims to procure training equipment for operators, engineers and skilled workers to enhance their capacity so that trained personnel can contribute to promote to safe and high-quality road construction in the target site.

In addition, the Soft Component that is described in detail in “2-2-4-8 Soft Component (Technical Assistance) Plan” will be implemented as part of the assistance to ensure the efficient operation and management of equipment.

The contents of equipment procurement in the Project are shown in Table 2-1.1 to Table 2-1.4.

Table 2-1.1 Construction Equipment to be Procured

No.	Equipment	Quantity			
		Kachin	Chin	Mandalay Mechanical Compound	Total
1	Bulldozer	3	3	-	6
2	Excavator (Crawler)	3	3	-	6
3	Hydraulic Breaker	-	3	-	3
4	Wheel Excavator	2	2	-	4
5	Motor Grader	3	3	-	6
6	Wheel Loader	3	3	-	6
7	Sheep Foot Compactor	3	3	-	6
8	Vibratory Tandem Roller	2	2	-	4
9	Tire Roller	2	2	-	4
10	Plate Compactor	10	10	-	20
11	Asphalt Kettle	2	2	-	4
12	Bitumen Distributor	2	2	-	4
13	Asphalt Hand Sprayer	10	10	-	20
14	Chip Spreader	2	2	-	4
15	Mobile Crusher	2	2	-	4
16	Water Bowser (Tanker)	3	4	-	7
17	Dump Truck	30	20	-	50
18	Cab-back Crane	1	2	-	3
19	Rough Terrain Crane	1	1	-	2
20	Low Bed Semi-trailer (with Tractor Head)	1	-	-	1
21	Low Bed Self-loading Truck	-	2	-	2
22	Mobile Workshop	2	2	-	4
23	Inspection Vehicle	2	2	-	4
24	Generator	3	3	-	6
25	Concrete Sprayer	-	2	-	2
26	Desktop Computer	1	1	2	4
27	Database Software	1	1	2	4

Table 2-1.2 Road/Bridge Test Equipment to be Procured

No.	Equipment	Quantity						
		RRL			BRL			Total
		RRL (Delivery Point)	Kachin (Site)	Chin (Site)	BRL (Delivery Point)	Kachin (Site)	Chin (Site)	
1.	Equipment for Geotechnical Investigation							
1-1	Boring Machine with Standard Accessories	-	-	1	-	1	-	2
2.	Equipment for Geotechnical Test							
2-1	Triaxial Apparatus	1	-	-	1	-	-	2
2-2	Sieves Set and Shaker for Soil	1	-	-	1	-	-	2
2-3	CBR Test Apparatus	1	-	-	-	-	-	1
2-4	Digital Moisture Meter	-	3	3	-	-	-	6
2-5	Dynamic Cone Penetrometer	-	3	3	-	-	-	6
2-6	Soil Density Apparatus (Sand Replacement Method)	-	3	3	-	-	-	6
3.	Equipment for Concrete Test							
3-1	Pan Type Concrete Forced Mixer	-	-	-	1	-	-	1
3-2	Concrete Compressive Strength Testing Device	-	-	1	-	2	-	3
3-3	Load Cell with Digital Tester for Calibration	-	-	1	-	1	-	2
3-4	Sieves Set and Shaker for Aggregate	-	-	1	-	1	-	2
3-5	Specific Gravity Apparatus for Coarse Aggregate	-	-	-	1	-	-	1
3-6	Photometer	-	-	-	1	-	-	1
3-7	Aggregate Crashing and Test Apparatus	1	-	-	-	-	-	1
3-8	Unbonded Capping Apparatus	-	-	5	-	-	5	10
3-9	Concrete Test Hammer	-	-	3	-	3	-	6
4.	Common Equipment							
4-1	Oven	-	-	-	2	-	-	2
4-2	Digital Caliper	1	-	3	1	3	-	8

Table 2-1.3 Operator-training Equipment to be Procured

No.	Equipment	Quantity		
		Mandalay Mechanical Compound (Upper Myanmar)	Mayangone Mechanical Compound (Lower Myanmar)	Total
1	Mini Dozer	2	2	4
2	Mini Excavator (Crawler)	2	2	4
3	Mini Wheel Loader	2	2	4
4	Mini Vibratory Tandem Roller	2	2	4
5	Mini Cab-back Crane	2	2	4

Table 2-1.4 CTC-training Equipment to be Procured

No.	Equipment		Quantity			
			CTC (Delivery Point)	Kachin (Site)	Chin (Site)	Total
1.	Survey Equipment					
1-1	Total Station		2	3	3	8
1-2	Survey Instrument Tools	Tape Measure	5	6	6	17
		Staff	5	6	6	17
		Pole	10	30	30	70
		Slant Rule	5	6	6	17
2.	Formwork Equipment					
2-1	Circular Saw		5	15	15	35
2-2	Pistol-Grip (corded) Drill		5	15	15	35
2-3	Table Saw		1	3	3	7
2-4	Electric Planer		5	-	-	5
2-5	Baggage for Carpenter's Tools		20	30	30	80
3.	Concrete Work Equipment					
3-1	Concrete Vibrator		5	15	15	35
3-2	High Frequency Generator		1	3	3	7
3-3	Concrete Mixer		1	3	3	7
4.	Road Work Equipment					
4-1	Walk Behind Concrete Saw		1	3	3	7
4-2	Asphalt Hand Sprayer		1	-	-	1
4-3	Plate Compactor		2	-	-	2
4-4	Safety Facilities under Construction		1	-	-	1
5.	Rebar Work Equipment					
5-1	Bar Bending Machine		2	4	2	8
5-2	Bar Cutting Machine		2	4	2	8
6.	Scaffolding Material					
6-1	Prefabricated Scaffolding		1	-	-	1
6-2	Pipe Scaffolding		1	-	-	1
6-3	Travelling Scaffolding		1	-	-	1
6-4	Tools for Set Up Scaffolding		20	-	-	20
7.	Safety Item					
7-1	Personal Protective Safety Items (Hardhat, Dust-proof Glasses, Safety Vest, Gloves, Safety Shoes, Safety Belt, Carry bag)		50	50	50	150

2-2 Outline Design of the Japanese Assistance

2-2-1 Design Policy

(1) Basic Policy

The basic policy is to procure construction equipment necessary for DOH to construct and maintain the targeted roads shown in Table 2-2.1. Moreover, in consideration of specific geographical conditions and terrain conditions in Kachin State and Chin State, the policy is also to procure road/bridge test equipment to contribute to improvement of quality control technology in road and bridge construction and to procure training equipment for operators, engineers and skilled workers to enhance their capacity.

Table 2-2.1 Target Road Section of the Project

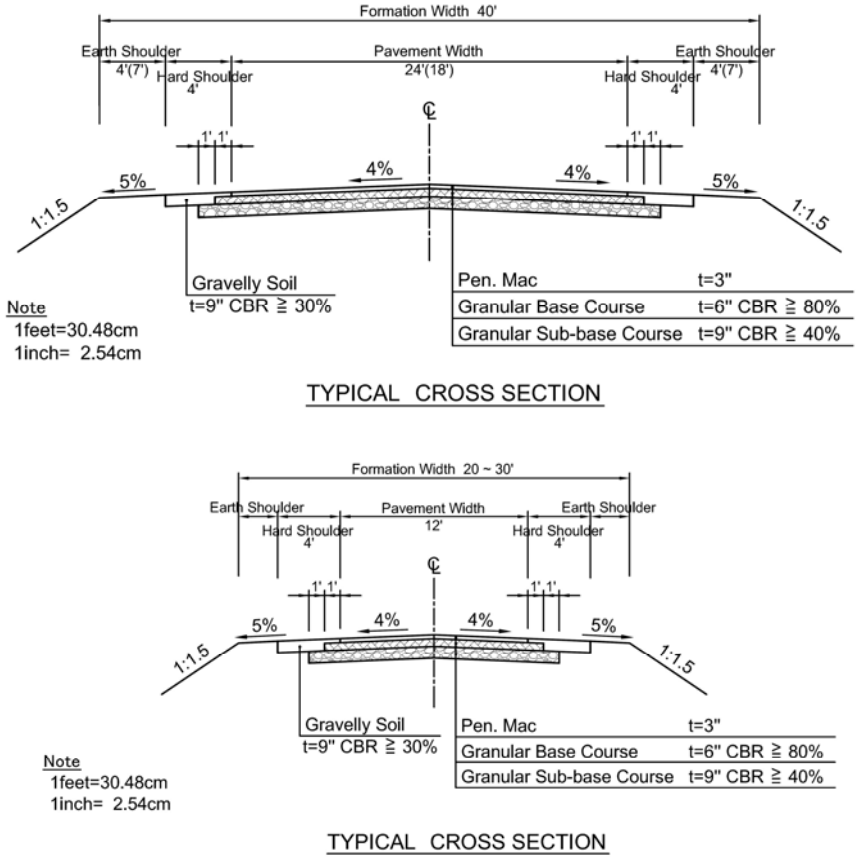
Project Area	Target Section (Mile/Furlong)*	Length
Kachin State	Nansiaung (168/0) ～ Namiti (256/1)	141km
Chin State	Falam area (56/2) ～ Hakha (124/0)	109km

* Mile/Furlong of the target road in Kachin State shows the mile post on Shwebo – Myitkyina Road.
Mile/Furlong of the target road in Chin State shows the mile post on Kalay – Hakha Road.

MOC has a development plan for road improvement including above targeted road sections and intends to conduct road improvement 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.

MOC sets the target section in Kachin State at Stage 3 and the target section in Chin State at Stage 1. Figure 2-2.1 shows typical cross sections planned for target roads in Kachin State and Chin State, respectively.



Source: Prepared by Survey Team based on technical documents from Public Works

Figure 2-2.1 Typical Cross Section for Target Roads
(Upper: Kachin State, Lower: Chin State)

(2) Policy regarding Selection of Equipment

1) Construction Equipment

In the selection of construction equipment to be procured in the Project, it should be considered the actual situations of the targeted road sites and requirements to enable DOH to carry out widening and pavement works at sites in Kachin State and Chin State

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

- Geographical conditions, geological conditions and meteorological conditions around the area of the target roads
- Current road conditions of the target roads
- Types, methods, scale and implementation schedule of road improvement
- Situation regarding development of the equipment acceptance, operation and maintenance setup (organization, personnel, facilities, equipment, budget)
- Contents and conditions of existing equipment
- 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) Road/Bridge Test Equipment

In the selection of road/bridge test equipment in the Project, equipment to be procured should be necessary for survey and quality control in construction of the target roads in Kachin State and Chin State, and equipment component, specifications and quantities will be determined based on the following conditions:

- Association with construction equipment to be procured in the Project
- Survey and inspection items conducted by RRL and BRL
- Contents and conditions of existing equipment

3) Operator-training Equipment

In the selection of operator-training equipment in the Project, equipment to be procured should be necessary to train an efficient operator so that they will be able to contribute to safe and appropriate construction works at the target roads in Kachin State and Chin State, and equipment component, specifications and quantities will be determined based on the following conditions:

- Works at targeted road sites (road, road structure and bridge, etc.)
- Existing training programs of MTCs in Mandalay and Insein
- Contents and conditions of existing training equipment

4) CTC-training Equipment

In the selection of CTC-training equipment in the Project, equipment to be procured should be necessary to train an efficient operator so that they will be able to contribute to safe and appropriate construction works at the target roads in Kachin State and Chin State. Only training courses related to road/bridge construction out of all training courses of CTC will be selected, which means the topographic survey class in the Engineering Training Course and the road worker course in the Construction Workers Training Course for road construction, and also the topographic survey class (same as road construction) in the Engineering Training Course, bar-bender course, carpenter course, concreter course and scaffolder course in the Construction Workers Training Course for bridge construction are focused in selection of CTC-training equipment.

According to the above condition, equipment component, specifications and quantities will be determined based on the following conditions:

- Works at targeted road sites (road, road structure and bridge, etc.)
- Existing training programs of CTC
- Contents and conditions of existing training equipment
- Necessary safety measures in road, road structure and bridge construction

In addition to procurement of CTC-training equipment, the Project includes technical assistance for

appropriate and efficient operation of equipment in the Soft Component as described in "2-2-4-8 Soft Component (Technical Assistance) Plan".

(3) Policy regarding Natural Environmental Conditions

In Kachin State and Chin State where the Project is planned, the dry season lasts from November to April and the rainy season is from May to October, and most of the annual rainfall is during the rainy season. In view of these natural conditions, since it is undesirable to conduct the main construction works during the rainy season in terms of quality control, the equipment procurement will be planned so that construction works can be commenced at the beginning of the dry season.

(4) Policy regarding Construction and Procurement Conditions

In Myanmar, it is normal for DOH under MOC to directly conduct the construction and maintenance of roads. Concerning the Project target road too, since the executing agency, DOH, constructs and maintains roads through deploying its own budget, personnel and construction materials and so on, practicable work components on the target roads should be considered according to work experiences and budget allocation of road and bridge sections, which are the direct implementing departments, and also to construction materials able to be procured around the target sites. In particular, the cost to procure sands in Chin State, which is one of materials for a concrete, is expensive (average in whole Myanmar: approximately USD40/m^3, Chin State: approximately USD50/m^3, as of March 2015), thus slope protection utilizing the Concrete Sprayer in the Project should be planned in practicable scale.

(5) Policy regarding Utilization of Local Contractors

As was mentioned in the section on the Policy regarding Construction and Procurement Conditions, it is normal for DOH under MOC to directly conduct the construction and maintenance of roads.

Since there are numerous rock quarries located close to the target sites, crushed rocks and aggregates required for the base / sub-base course, etc. can be locally procured around the sites.

(6) 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, the 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.

(7) Policy regarding the Grade of Equipment

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

Table 2-2.2 Preconditions for Setup of Project Equipment

Kachin State	Chin State
1) Tonal length of the target road section is 141km.	1) Tonal length of the target road section is 109km.
2) After the handing over of equipment, the planned construction period will be 3 years.	2) Same as on the left.
3) During the rainy season, it will be difficult to conduct works. Accordingly, the available works period is around 6 months (November to April) in the year.	3) Same as on the left.
4) Main works on the target road are bituminous pavement with road widening.	4) Same as on the left.
5) Since the target road section passes along a low flat area (200～400m above sea level), main earthwork will be an embankment for road widening.	5) Since the target road section passes along a mountainous area (1,500～2,000m above sea level), main earthwork will be a cutting of road side.
6) Paving width of a carriage way will be 24 feet (2-lane).	6) Paving width of a carriage way will be 12 feet (1-lane).
7) Construction works is undertaken by 3 units, namely the Sub Project Unit No.2, Sub Project Unit No.4 and Mohnyin District Office. Bridges over 50 feet is undertaken by the Bridge Construction Special Unit No.15.	7) Construction works is undertaken by 3 units, namely the Airfield Construction Special Unit No.3, Falam District Office and Hakha District Office.
8) In the target road section, there are 122 numbers of timber bridges and baily bridges (as of March 2015) to be upgraded. A rough terrain crane which is useful for bridge construction, work (including training) equipment for reinforcing and concreting works and bridge test equipment are considered to be procured.	8) In the target road section, although there is no temporary bridges to be upgraded, retaining walls and box culverts need to be constructed for slope protection because the target road is mostly mountainous route. A rough terrain crane which is useful for structure construction, work (including training) equipment for reinforcing and concreting works and road test equipment are considered to be procured.
9) Excavating equipment that has mobility for emergency work, such as removing landslide, is considered to be procured.	9) Same as on the left.

In light of the above conditions, the Project equipment for Kachin State will mainly comprise general equipment for earthworks and bituminous pavement works. Also, a crane for bridge construction, a mobile workshop which is useful for maintenance of equipment at sites, an

equipment transporter, etc. will be comprised in the Project equipment necessary for the target road construction and equipment maintenance. In consideration of utilization of the equipment after the completion of the target road construction, equipment should have a performance for working around highlands in Kachin State. In terms of expected construction period (3 years), spare parts necessary for 3,000 hours operation (8 hours per day, 150 days per year, thus 1,000 hours per year) will be procured.

Likewise, the Project equipment for Chin State will mainly comprise general equipment for earthworks and bituminous pavement works. Also, a crane for retaining wall and culvert construction, a mobile workshop which is useful for maintenance of equipment at sites, an equipment transporter, etc. will be comprised in the Project equipment necessary for the target road construction and equipment maintenance. An excavator which is one of earthwork equipment should be additionally equipped with a hydraulic beaker to be utilized in excavating rocks. Also, a concrete sprayer for slope protection will be added in the Project equipment in consideration of the local situation where landslides happen a lot. In terms of expected construction period (3 years), spare parts necessary for 3,000 hours operation (8 hours per day, 150 days per year, thus 1,000 hours per year) will be procured.

In addition to above mentioned construction equipment, for improving quality and safety on target road construction, work equipment for reinforcing works, form works and concreting works in structure construction, test equipment for geotechnical investigation and concrete testing, road safety facilities and personal protective safety equipment will be comprised in the Project equipment.

(8) Policy regarding Implementation Schedule

The road improvement with widening and paving of the target sections in Kachin State and Chin State are currently in progress under the annual budget. The following tables show roughly estimated construction volumes of major works for the target road sections in each state.

Table 2-2.3 Construction Volumes of Major Works in Kachin State

(Upper: Road Works, Lower: Structure Work)

Road Works	Unit	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	Total
Section	M/F	244/0 - 256/1	233/0 - 244/0	211/0 - 233/0	190/0 - 211/0	168/0 - 190/0	88/1
Length	km	19.4	17.6	35.2	33.6	35.2	141.0
Earthwork	m3	277,000	254,000	508,000	485,000	508,000	2,032,000
Pavement	m2	104,760	95,040	246,400	235,200	246,400	927,800
Crushed Rock	m3	25,300	23,200	92,700	88,500	92,700	322,400

RC Structure Works		2015-2016		2016-2017		2017-2018		2018-2019		2019-2020		Total	
		Nos (km)	Concrete Vol.(m3)	Nos (km)	Concrete Vol.(m3)	Nos (km)	Concrete Vol.(m3)	Nos (km)	Concrete Vol.(m3)	Nos (km)	Concrete Vol.(m3)	Nos (km)	Concrete Vol.(m3)
Bridge	L<50' (including Box Culvert)	18	2,770	18	3,650	25	4,330	25	5,080	25	4,680	111	20,510
	50' ≦L <100'	3	1,230	0	0	3	1,230	2	960	0	0	8	3,420
	100'≦L<180'	0	0	2	1,620	0	0	0	0	0	0	2	1,620
Retaining Wall(L=100'/no.)		0	0	0	0	15	3,270	15	3,240	10	2,160	40	8,670
Side Drain		0	0	0	0	(40)	21,400	(40)	21,400	(32)	17,120	(112)	59,920
Total			4,000		5,270		30,230		30,680		23,960		94,140

Source: Prepared by the Survey Team based on discussion with site engineers in Kachin State

Table 2-2.4　Construction Volumes of Major Works in Chin State

(Upper: Road Works,　Lower: Structure Work)

Road Works		Unit	2016-2017	2017-2018	2018-2019	2019-2020	Total
Section		M/F	106/0 -124/0	88/0 - 106/0	68/5 -88/0	56/2 -68/	67/6
Length		km	28.8	28.8	31.0	19.8	108.4
Earthwork	Excavation	m3	205,000	391,000	435,000	314,000	1,345,000
	Embankment	m3	42,768	42,768	46,035	29,403	160,974
Pavement		m2	103,680	103,680	111,600	71,280	390,240
Crushed Rock		m3	23,328	23,328	25,110	16,038	87,804

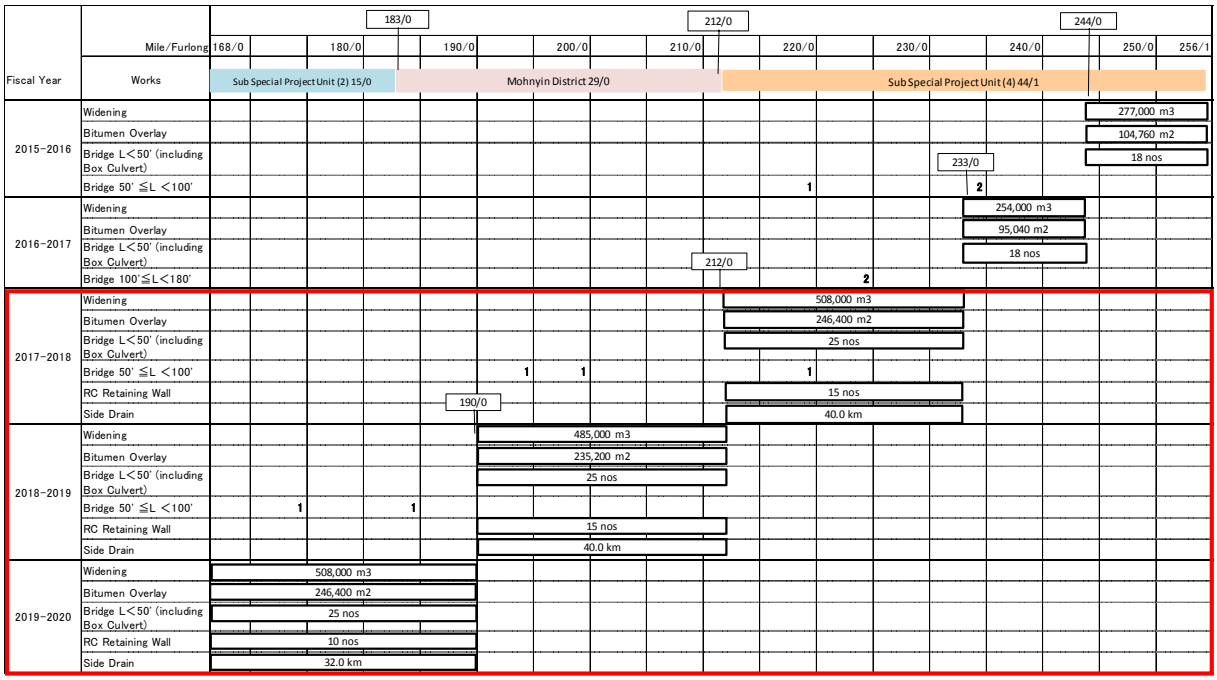
RC Structure Works	2016-2017		2017-2018		2018-2019		2019-2020		Total	
	Nos (km)	Concrete Vol.(m3)	Nos (km)	Concrete Vol.(m3)	Nos (km)	Concrete Vol.(m3)	Nos (km)	Concrete Vol.(m3)	Nos (km)	Concrete Vol.(m3)
RC Box Culvert	22	4,070	30	5,550	30	5,550	8	1,480	90	16,650
RC Retaining Wall	10	2,170	10	2,170	10	2,170	5	1,085	35	7,595
RC Side Drain	(28.8)	15,350	(28.8)	15,350	(31.0)	16,523	(19.8)	10,553	(108.4)	57,777
Total		21,590		23,070		24,243		13,118		82,022

Source: Prepared by the Survey Team based on discussion with site engineers in Chin State

Based on the above construction volumes, the implementation schedules are shown below. In case that the delivery of equipment will be completed before the end of March 2017, it is expected that the Project equipment will be utilized for works in the red box in the following tables.

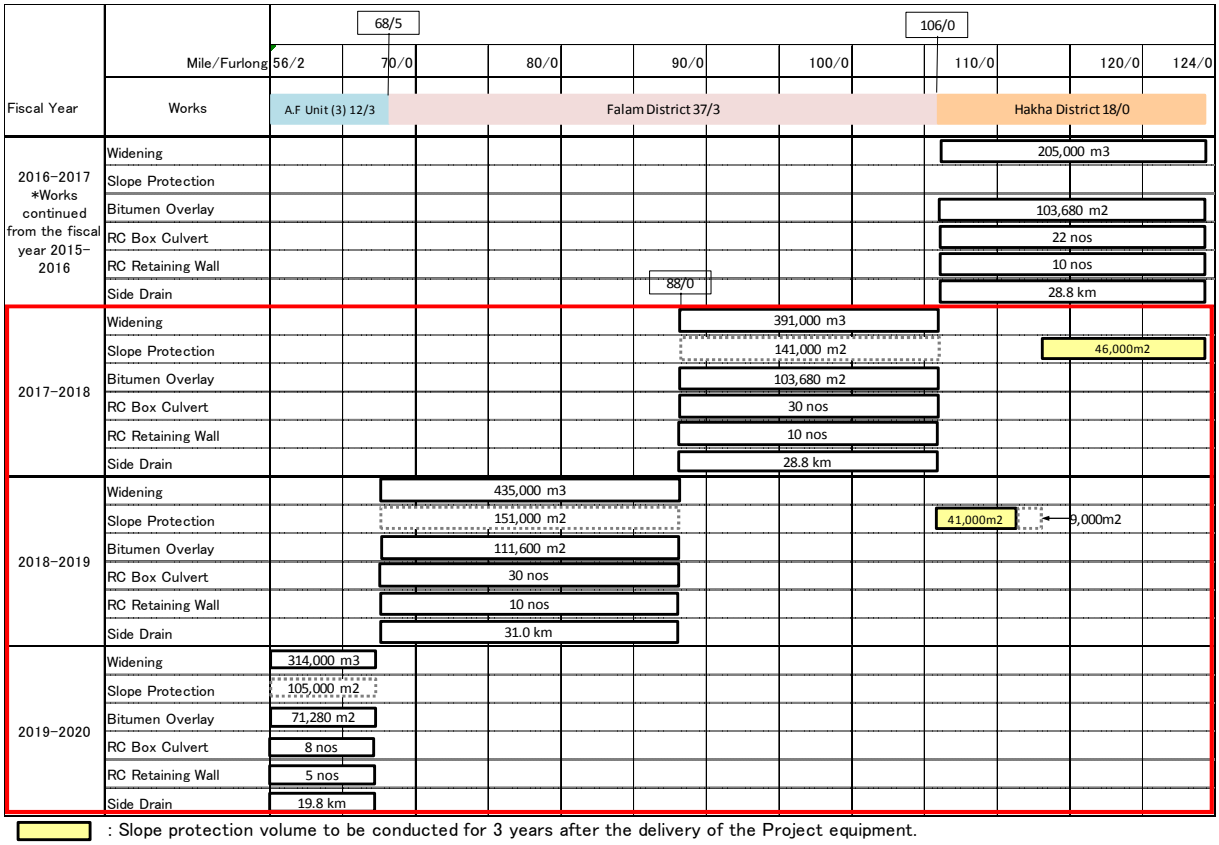
Table 2-2.5　Planned Implementation Schedule in Kachin State

(Targeted Nansiaung - Namiti Section)



Source: Prepared by the Survey Team based on discussion with site engineers in Chin State

Table 2-2.6 Planned Implementation Schedule in Chin State
(Targeted Falam area (56/2) ～ Hakha Section)



Source: Prepared by the Survey Team based on discussion with site engineers in Chin State

2-2-2 Basic Plan

(1) Overall Plan

In examining the location for the delivery of the Project equipment, consideration was given to the related facilities. As a result of discussions with DOH officials and conducting field survey, it was concluded that the following locations would be ideal as delivery points for handing over.

1) Construction Equipment

Delivery points for construction equipment in Kachin State and Chin State were determined based on the following conditions:

- Efficiency and ease of transporting equipment to the target construction site
- Capacity for store (areas, facilities, storehouse for spare parts, etc.)
- Safety situation of surrounding area

According to above conditions, the delivery points are shown as below.

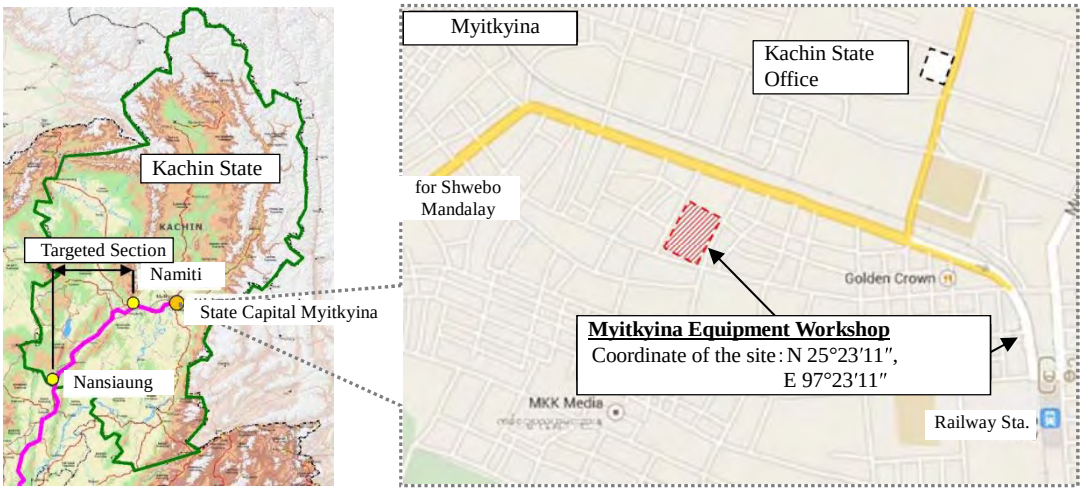
Table 2-2.7　Delivery Point of Construction Equipment

Area	Delivery Point	Items delivered	Description
Kachin State	Myitkyina Mechanical Workshop	All equipment and spare parts	Sub-workshop of MOC, which has an area of approximately 16,000m^2
Chin State	Hakha Mechanical Compound	Mobile Workshop and spare parts of all equipment	Mechanical Compound of MOC, which has an area of approximately 8,000m^2
	Hakha Mechanical Compound No.2 (tentatively named)	All Equipment excluding Mobile Workshop	A land (approximately 14,000m2) owned by Chin State's Government (as of March 2015)

Since Hakha Mechanical Compound has suffered significant damage due to heavy rain in July and August 2015 after the first field survey, MOC is in the process of relocating this facility to neighborhood as of October 2015. Moreover, Hakha Mechanical Compound No.2 is under consideration to be a candidate of resettlement of inhabitants at Hakha by the government of Chin due to significant damage of Hakha downtown.

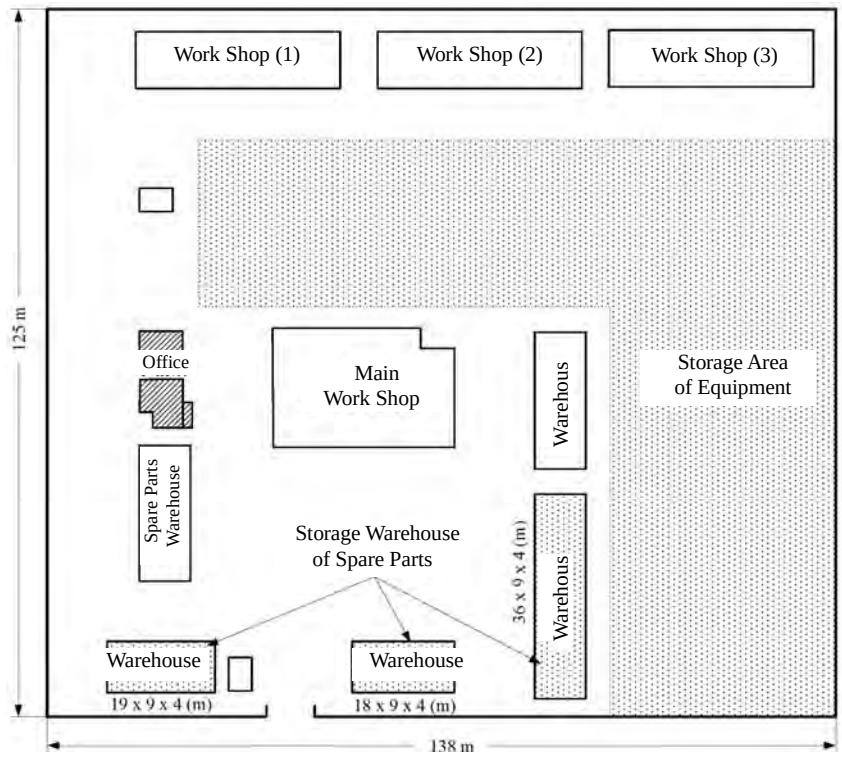
In the circumstances, the delivery points in Chin State are going to be considered again among concerning parties including MOC in the implementation state. However, above Hakha Mechanical Compound and Hakha Mechanical Compound No.2 selected in the first field survey are treated and described as the delivery points in Chin State in this Report since recovery plan and project are still in progress between the state government and concerned authorities at this point.

The following figures show the location map and the layout of the delivery point in Kachin State.



Source: Prepared by the Survey Team

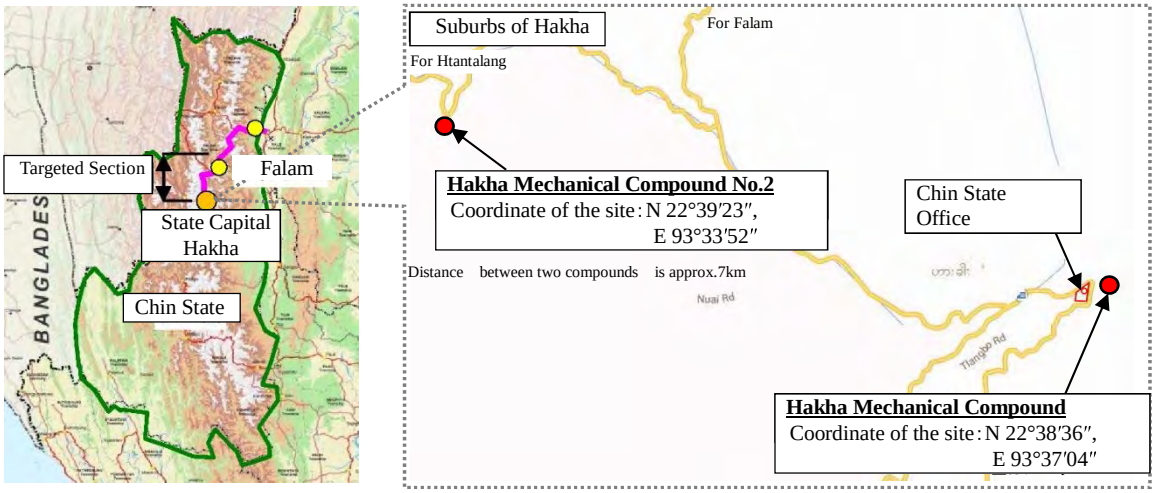
Figure 2-2.2　Location Map of Delivery Point for Construction Equipment in Kachin State



Source: Public Works

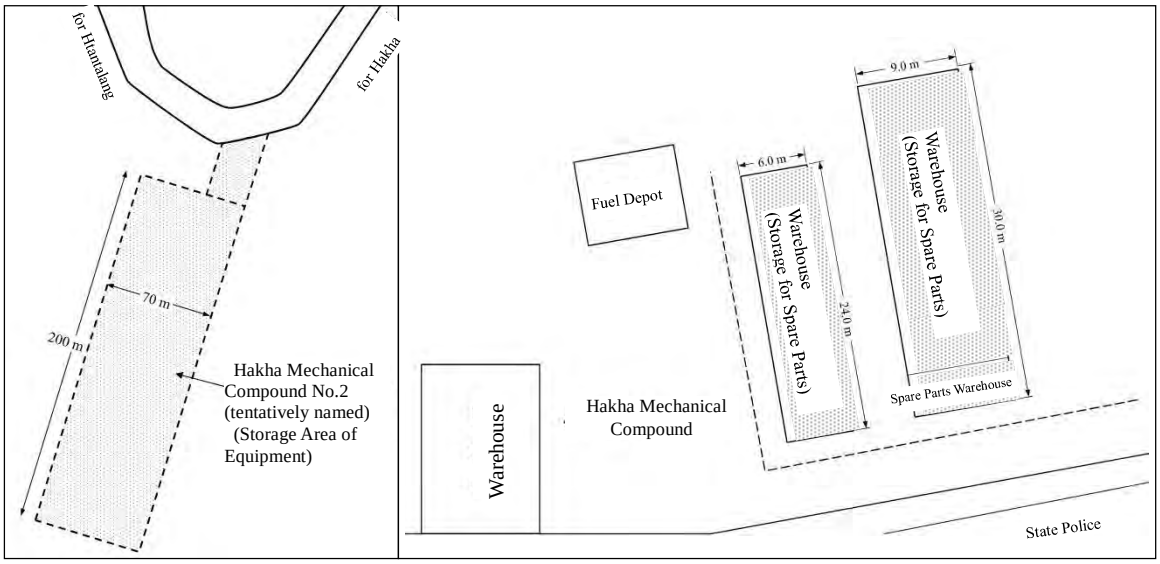
Figure 2-2.3 Layout of Delivery Point for Construction Equipment in Kachin State

The following figures show the location map and the layout of the delivery point in Chin State.



Source: Prepared by the Survey Team

Figure 2-2.4 Location Map of Delivery Point for Construction Equipment in Chin State



Source: Public Works

Figure 2-2.5 Layout of Delivery Point for Construction Equipment in Chin State

Hakha Mechanical Compound No.2 for the delivery point in Chin State is owned by the Chin State's Government (as of March 2015), thus MOC in Chin State needs to borrow this land from the state government and to prepare equipment stock yard by fencing, etc. as described later in "2-2-4-3 Scope of Works".

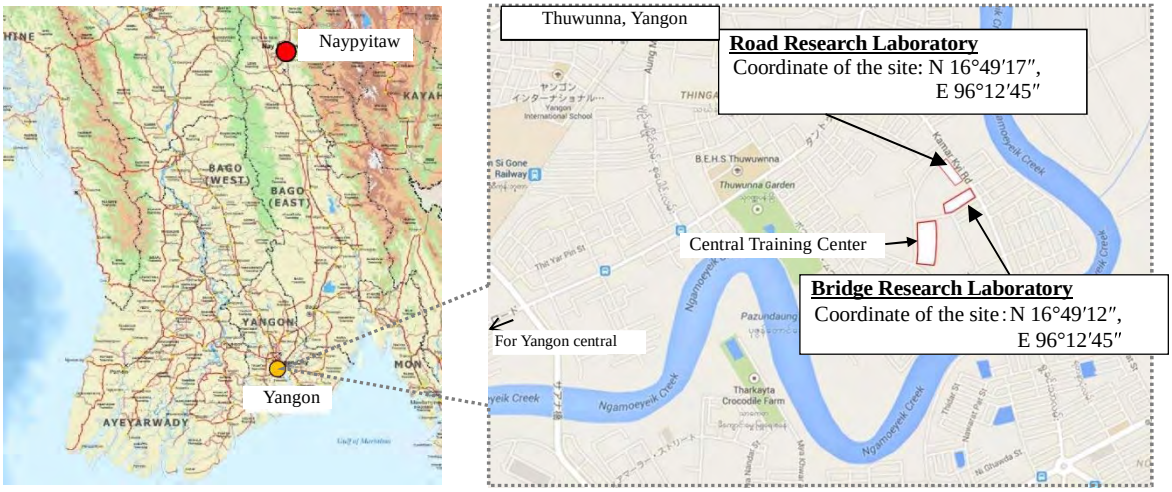
2) Road/Bridge Test Equipment

Delivery points for road/bridge test equipment are shown below.

Table 2-2.8 Delivery Point of Road/Bridge Test Equipment

Items delivered	Delivery Point
Road Test Equipment	Road Research Laboratory (RRL)
Bridge Test Equipment	Bridge Research Laboratory (BRL)

The following figures show the location map of RRL and BRL.



Source: Prepared by the Survey Team

Figure 2-2.6 Location Map of Delivery Point for Road/Bridge Test Equipment

RRL and BRL, which are responsible organizations for road/bridge testing and quality controls, need to register equipment in their inventories and to receive initial operation trainings for proper use of equipment. After the initial operation trainings, RRL and BRL will be responsible to partially transfer equipment to final destinations in Kachin State and Chin State for the target road constructions as described in the subsequent chapter "(2) Equipment Plan".

3) Operator-training Equipment

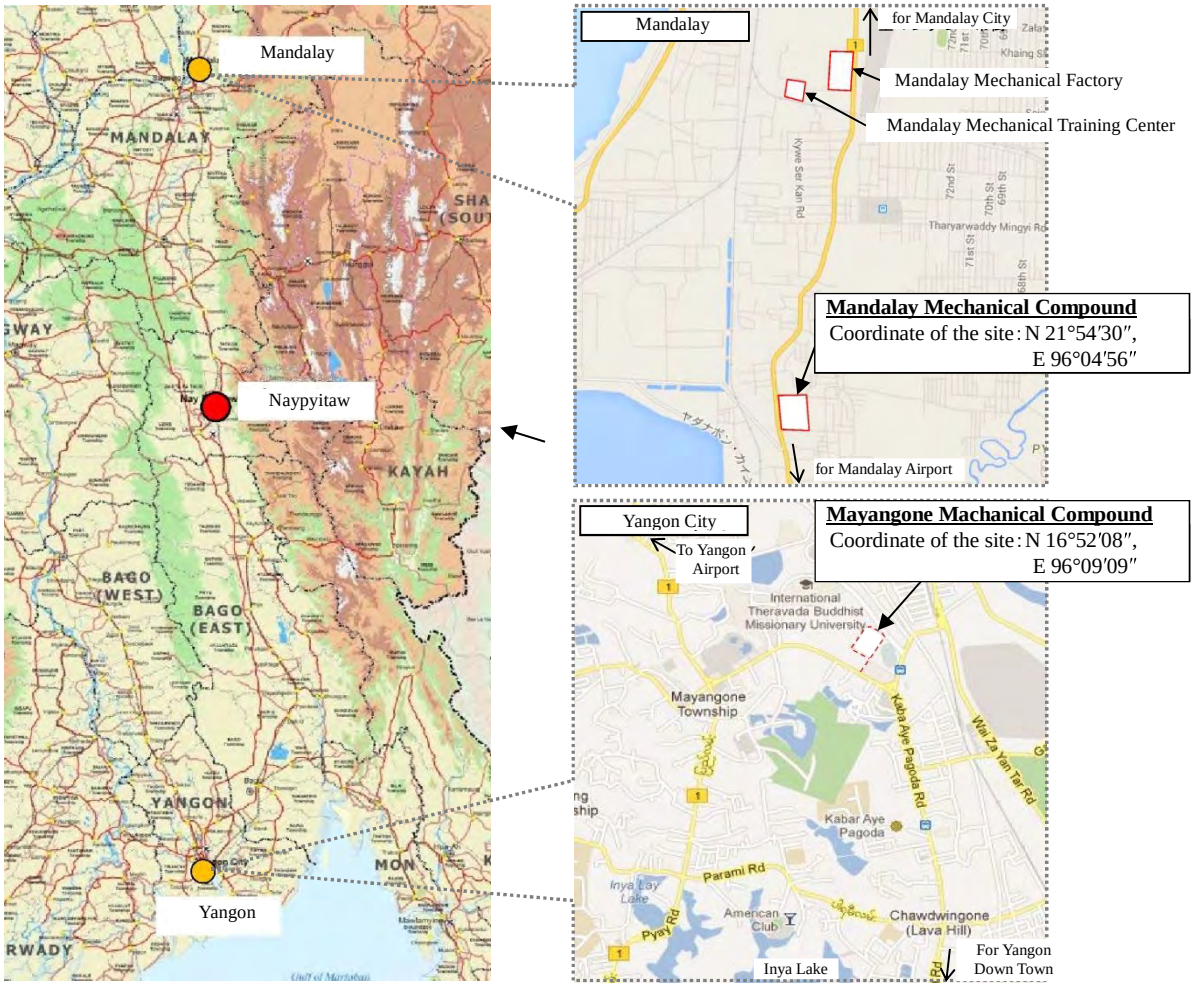
Delivery points for operator-training equipment are shown as below.

Table 2-2.9 Delivery Point of Operator-training Equipment

Items delivered	Delivery Point
Operator-training Equipment for MTC in Mandalay	Mandalay Mechanical Compound
Operator-training Equipment for MTC in Insein	Mayangone Mechanical Compound

Mandalay Mechanical Compound and Mayangone Mechanical Compound, which are responsible organizations for operation and management of construction equipment in Upper Myanmar and Lower Myanmar, respectively, need to register equipment in their inventories and to receive initial operation trainings for proper use of equipment. After the initial operation trainings, each mechanical compound will be responsible to transfer equipment to their training places (e.g. Mechanical Training Center in Mandalay, Upper Myanmar, and Mechanical Training Center in Insein and/or Nwekhay Mechanical Compound, Lower Myanmar) for practical use of equipment in their operator-training courses.

The following figures show the location map of Mandalay Mechanical Compound and Mayangone Mechanical Compound.



Source: Prepared by the Survey Team

Figure 2-2.7 Location Map of Delivery Point for Operator-training Equipment

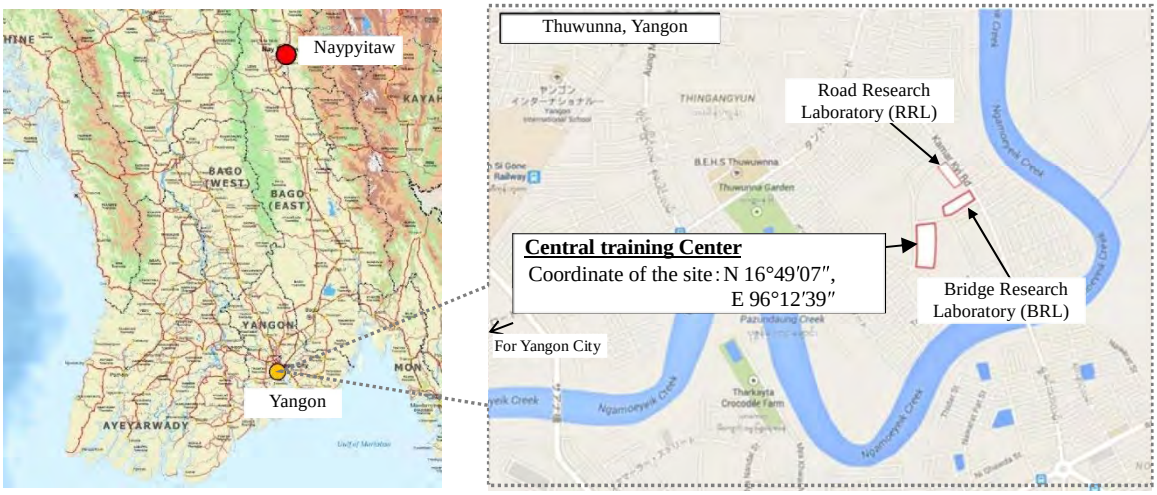
4) CTC- training Equipment

Delivery points for CTC-training equipment are shown as below.

Table 2-2.10 Delivery Point of CTC-training Equipment

Items delivered	Delivery Point
CTC-training Equipment	Central Training Center (CTC)

The following figures show the location map of CTC.



Source: Prepared by the Survey Team

Figure 2-2.8 Location Map of Delivery Point for CTC-training Equipment

CTC, which are responsible organizations for engineer and skilled worker trainings, need to register equipment in their inventories and to receive initial operation trainings for proper use of equipment. After the initial operation trainings, CTC will be responsible to partially transfer equipment to final destinations in Kachin State and Chin State for the target road constructions as described in the subsequent chapter "(2) Equipment Plan".

(2) Equipment Plan

Construction equipment, road/bridge test equipment, operator-training equipment and CTC-training equipment required in the Project are shown as below.

1) Construction Equipment

Construction equipment to be procured in the Project is composed of a bulldozer, excavator, loader, compactor, asphalt sprayer and trucks, etc. which are general equipment necessary to carry out road construction works in the target roads in Kachin State and Chin State. Also, a crane for bridge and structure construction, a mobile workshop which is useful for maintenance of equipment at sites, an equipment transporter, etc. will be comprised in the Project equipment. A concrete sprayer for slope protection for Chin State is added in consideration of the local situation where landslides happen a lot. In determining the quantity and specification of each construction equipment, the following conditions are taken into consideration.

- 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 DOH.
- Equipment should have mobility adequate to carry out the road construction work.

Because the Soft Component aimed at appropriate equipment control is planned, a desktop computer and database software are planned to be procured accordingly.

The, types, quantities, purpose of use, and required basic specifications of the selected road construction equipment for this project are shown as below.

Table 2-2.11 Construction Equipment of the Project, Purpose of Use and Basic Requirement

No.	Name of Equipment	Specification	Quantity		Purpose of Use (Upper) Basic Requirements (Lower)
			Kachin State	Chin Sate	
1	Bulldozer	Operation weight: 27,000 ~ 29,000 kg Engine output: not less than 165 kW Blade width: not less than 3,600 mm Blade height: not less than 1,300 mm	3	3	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.
2	Excavator (Crawler)	Operation weight: 19,000 ~ 26,000 kg Engine output: not less than 100 kW Bucket capacity: not less than 0.8m^3	3	3	Excavating/stockpiling/loading/ hauling/removing soil, trimming slope face 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.
3	Hydraulic Breaker	Operation weight: 1,600 ~ 2,000 kg Chisel diameter: 135 mm Length: not less than 2,500 mm	-	3	Excavating rocks The equipment should suit No.2 Excavator (Crawler) as its attachment.
4	Wheel Excavator	Operation weight: less than 16,500 kg Engine output: not less than 90 kW Bucket capacity: not less than 0.5m^3	2	2	Excavating side-ditch, Excavating/stockpiling/loading/ hauling/removing soil. The machine should suite to the excavating and trimming side ditch, and have mobility to cope with natural disaster such as land slide during the rainy season
5	Motor Grader	Operation weight: not less than 14,000 kg Engine output: not less than130 kW Blade length: 3,700 ~ 4,100 mm Blade height: 500 ~ 800 mm	3	3	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.
6	Wheel Loader	Operation weight: less than 16,000 kg Engine output: not less than 115 kW Bucket capacity: not less than 2.4m^3 Dumping clearance: not less than 2,600 mm	3	3	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.

No.	Name of Equipment	Specification	Quantity		Purpose of Use (Upper) Basic Requirements (Lower)
			Kachin State	Chin Sate	
7	Sheep Foot Compactor	Operation weight: not less than 10000kg Engine output: not less than 80 kW Vibration frequency : 28/30 Hz and over Centrifugal Force: not less than 150/200 kN	3	3	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 7000kg Engine output: not less than 50kW Vibration frequency : 50/67Hz and over Centrifugal Force: not less than 60/68 kN	2	2	Compacting subgrade/sub-base course/base course/surface course. The size and the capacity of the equipment should be suitable for both embankment work and paving work.
9	Tyre Roller	Operation weight: not less than 15,000 kg (including ballasts) Engine output: not less than 65 kW Compaction Width: not less than 2,000mm	2	2	Compacting sub-base course/base course/surface course The size and the capacity of the equipment should be suitable for paving work.
10	Plate Compactor	Operation weight: 50 ~ 70 kg Centrifugal Force: not less than 8 kN Engine output: not less than 2.0 kW	10	10	Compacting narrow part To ensure operability, convenience and compactness.
11	Asphalt Kettle	Tank Capacity: 3,000ℓ Pumping Capacity: not less than: 100 ℓ/min.	2	2	Heating and melting asphalt To give consideration to the combination with the Bitumen Distributor, it should be a transportable size, and stationary type.
12	Bitumen Distributor	Tank Capacity: 4,000 ℓ Engine output: not less than 115 kW Pumping Capacity: not less than 300 ℓ/min. Spray width: not less than 3,600 mm	2	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.
13	Asphalt Hand Sprayer	Hand-cart mounted type Spray capacity: 23 ℓ/min. (fan shape), 10 ℓ/min. (round shape)	10	10	Spraying asphalt for small-scale repair work of the asphalt pavement The machine should have heating and pumping devices to spray the straight asphalt, spraying capacity to be suitable for small-scale repairing work for the asphalt pavement
14	Chip Spreader	Dump Truck mounted, Self-propelled, Tail-gate type Spreading material sizes: from under 50mm stone aggregate to sands Spreading width: 200 mm ~ 2,460 mm	2	2	Spreading aggregate / sand for pavement work Spreading width should be adjustable according to the asphalt spray width.
15	Mobile Crusher	Operation weight: 9,000 ~ 12,000 kg Self-propelled type Capacity: not less than 15 ton/h	2	2	Producing aggregate for pavement and concrete works 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.

No.	Name of Equipment	Specification	Quantity		Purpose of Use (Upper) Basic Requirements (Lower)
			Kachin State	Chin Sate	
16	Water Bowser (Tanker)	GVW: less than 23,000 kg Payload: 10,000 ℓ Engine output: not less than150 kW	3	4	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.
17	Dump Truck	GVW: less than 26,000 kg Payload: 14,000 kg Engine output: not less than 190 kW	30	20	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 14,000 kg payload capacity with vessel volume of 10 m3, and have engine output adequate to carry out the work.
18	Cab-back Crane	GVW: less than 25,000 kg (without crane) Payload: 10,000 kg Lifting capacity: 5,000 kg Engine output: not less than 190 kW	1	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.
19	Rough Terrain Crane	GVW: not less than 26,000 kg Max. lifting capacity: 30,000 kg Max. lifting height: 30 m Engine output: not less than 160 kW	1	1	Loading and unloading the construction equipment and materials Specifications that are suitable for loading and unloading the asphalt kettle and generator, etc. and concrete or steel bridge members will be adopted. Moreover, in order to use for moving and hanging materials in bridge works and slope protection works, etc., specifications that allow for long boom, mobility and easy operation will be adopted.
20	Low Bed Semi-trailer with Tractor Head	Low Bed Semi-trailer Payload: 30,000 kg Dimensions: 8,000mm(Length) x 2,900mm(Width) Height: not more than 1,300mm Tractor Head Engine output: not less than 275 kW GCM: not less than 60000 kg	1	-	Transport heavy equipment Trailer should have an adequate payload capacity to carry the heaviest equipment among the equipment to be provided to the project safely. Tractor head should have adequate pulling power to transport those equipment safely.
21	Low Bed Self-loading Truck	GVW: not less than 41,000 kg Payload: not less than 22,000 kg Engine output: not less than 270 kW Dimensions: 9,000mm(Length) x 2,900mm(Width) Height: not more than 1,300mm	-	2	Transport heavy equipment Truck should have an adequate payload capacity to carry the heaviest equipment among the equipment to be provided to the project safely Truck should be suitable to travel on a winding mountain road in Chin State.

No.	Name of Equipment	Specification	Quantity		Purpose of Use (Upper) Basic Requirements (Lower)
			Kachin State	Chin Sate	
22	Mobile Workshop	4 × 4 drive, with 3 ton crane GVW: not less than 13,000 kg Engine output: not less than 140 kW Equipped with maintenance equipment and tools: (1) Engine generator-cum-welder (2) Arc welding outfit (3) Gas welding and cutting outfit (4) Other mechanic tools	2	2	Repairing / maintaining the construction machines 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.
23	Inspection Vehicle	4 × 4 drive, double-cab pickup truck Engine output: not less than 55 kW Maximum speed: not less than 100km/h	2	2	Going round 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.
24	Generator	Output: 100 kVA, 415V/240V/50 Hz	3	3	Power source of the construction equipment and tools The equipment should be portable type, and have enough power output as the power source of the construction equipment and tools.
25	Concrete Sprayer	Spray capacity: not less than 4.0 m^3/h Air compressor: not less than 0.7Mpa	-	2	Carrying out shotcrete work for slope protection Power source, attachments and components, those are necessary to operate the sprayer should be included in the spray system.
26	Desktop Computer	CPU: not less than Core i3 OS: Windows 8 or more	2(1)	2(1)	For a guidance of equipment management system in the Soft Component Latest model
27	Database Software	FileMaker Pro, version 14 or updated version	2(1)	2(1)	For a guidance of equipment management system in the Soft Component Latest model

Note: Out of quantities of “26. Desktop Computer” and “27. Database Software”, numbers in ( ) show quantities to be placed at Mandalay Mechanical Compound.

2) Road/Bridge Test Equipment

Under the conditions mentioned in above "2-2-1 Design Policy (2) Policy regarding Selection of Equipment 2)", Road Test Equipment and Bridge Test Equipment to be procured for RRL and BRL, respectively, were determined based on several policies set as shown in the table below.

Table 2-2.12 Policies for Component of Road/Bridge Test Equipment

Project target	Policies for Component of equipment
RRL	- Equipment to be placed at a laboratory of RRL, which is considered necessary for geotechnical tests and concrete tests through the target road construction including the structure construction in Kachin State and Chin State - Equipment to be placed at sites in Kachin State, which is considered necessary for quality control through the target road construction - Equipment to be placed at sites in Chin State, which is considered necessary for quality control through the target road construction - Boring machine and equipment for concrete test also to be placed at sites in Chin State where structure constructions (e.g. retaining wall and culvert) are planned on the target road
BRL	- Equipment to be placed at a laboratory of BRL, which is considered necessary for geotechnical tests, concrete tests and for common use (oven) through bridge construction on the target road in Kachin State - Boring machine and equipment for concrete test to be placed at sites in Kachin State, which are considered necessary for tests and quality control through bridge construction on the target road - No equipment procured for Chin State because of no bridge construction site on the target road

According to the above policies, the component of road test equipment and bridge test equipment which are considered appropriate and necessary in the Project are shown as below, respectively.

Table 2-2.13 Road Test Equipment of the Project, and Purpose of Use

No.	Name of Equipment	Specification	Quantity			Purpose of Use
			RRL	Kachin State (site)	Chin State (site)	
1. Equipment for Geotechnical Investigation						
1-1	Boring Machine with Standard Accessories	Boring Machine Spindle: Inner Diameter 43 ~ 48 mm Boring Depth: Not less than 50m Power: Not less than 3.7 kW Grouting Pump Discharge capacity: Not less than 50L/min Working pressure: Not less than 15kg/cm^2 Power unit: Not less than 2.2 kW Other Standard Accessories	-	-	1	Soil investigation for slope stability analysis and road design and construction

2. Equipment for Geotechnical Test						
2-1	Triaxial Apparatus	Type: 4-units slide loading type Applicable Specimen: 100 mm dia., 200 mm height Max. Capacity: 1,000 N Loading Speed: 0.3 ~ 2.0 mm/min Stabilizer: AC230V, 50 Hz,	1	-	-	Testing soil properties taken from site investigation
2-2	Sieves Set and Shaker for Soil	Nominal Size:75.0mm,53.0mm,37.5mm,26.5mm, 19.0mm,9.5mm,4750μm,2000μm,850μm,425μm 、250μm,106μm,75μm, Ro-tap Sieves Shaker: Height of Holder 7 sieves available, Shaking Speed 250 rpm	1	-	-	Soil sieve investigation
2-3	CBR Test Apparatus	Loading Capacity: 50 kN Loading Speed: 50 ~ 0.5 mm/min	1	-	-	CBR test in laboratory (Compare with DCP)
2-4	Digital Moisture Meter	Range: 0 ~ 20% (dry mass) Accuracy: +/- 0.2%	-	3	3	Moisture content control during construction
2-5	Dynamic Cone Penetrometer	Adapted to ASTM 6951-03	-	3	3	Quality control during road construction (measurement of CBR)
2-6	Soil Density Apparatus (Sand Replacement Method)	Jar: Approx. 4 Liter Capacity Base Plate: D 300 mm, Center hole 162 mm	-	3	3	Soil Density Control during Embankment
3. Equipment for Concrete Test						
3-1	Concrete Compressive Strength Testing Device	Max Capacity: 2,000 kN Platen: D 220 mm Max. Plate Span: 320 mm Loading Speed: Max. 20 mm/min	-	-	1	Quality control of concrete on construction
3-2	Load Cell with Digital Tester for Calibration	Capacity: 2 ,000kN Rated Output: 1.5 mV/V (3000 x 10-6 strain) +/- 0.2%	-	-	1	Calibration of concrete compressive strength testing device
3-3	Sieves Set and Shaker for Coarse Aggregate	JIS nominal size : 75μm, 150μm, 300μm, 425μm, 600μm, 1.18mm, 2.00mm, 2.36mm, each 1 pc /set Ro-tap Sieves Shaker: Height of Holder 7 sieves available, Shaking Speed 250 rpm	-	-	1	Quality control of aggregate for concrete and pavement on road construction
3-4	Aggregate Crashing and Test Apparatus	Adapted to BS 812-112	1	-	-	Quality control of aggregate for concrete and pavement
3-5	Unbonded Capping Apparatus	Capping Retainer: D 150 mm x H 300 mm Neoprene Pads: D150 mm x H 300 mm and 6 x 12 inch cylinder	-	-	5	Quality control of capping the top and bottom surface of the concrete specimen.
3-6	Concrete Test Hammer	Measuring Range: 10 ~ 70Nmm2 Impact Energy: 2.207 Nm	-	-	3	Quality control of concrete
Common Equipment						
4-1	Digital Caliper	Measuring Range: 0 ~ 200 mm Accuracy: +/- 0.03 mm/0.0015 inch	1	-	3	Measuring apparatus

Table 2-2.14 Bridge Test Equipment of the Project, and Purpose of Use

No.	Name of Equipment	Specification	Quantity			Purpose of Use
			BRL	Kachin State (site)	Chin State (site)	
1. Equipment for Geotechnical Investigation						
1-1	Boring Machine with Standard Accessories	Boring Machine Spindle: Inner Diameter 43 ~ 48 mm, Stroke: 500 mm, Drilling Depth: Not less than 50m,Hoisting Capacity: Not less than 500kg Power: Not less than 3.7 kW Grouting Pump: Not less than 2.2 kW Standard Accessories: Tripod 6.0 m, Drilling Tools for 50m, Standard Penetration Test 1 set, Working Tools 1 set	-	1	-	Soil investigation for bridge and box culvert
2. Equipment for Geotechnical Test						
2-1	Triaxial Apparatus	Type: 4-units slide loading type Applicable Specimen: 100 mm dia., 200 mm height Max. Capacity: 1,000 N	1	-	-	Testing soil properties taken from site
2-2	Sieves Set and Shaker for Soil	Nominal Size:75.0mm,53.0mm,37.5mm,26.5mm, 19.0mm,9.5mm,4750μm,2000μm,850μm,425μm、250μm,106μm,75μm, Ro-tap Sieves Shaker: Height of Holder 7 sieves available, Shaking Speed 250 rpm	1	-	-	Soil sieve investigation
3. Equipment for Concrete Test						
3-1	Pan Type Concrete Forced Mixer	Mixing Capacity: 60 L Stirring Panels: Three wings Panel Revolution: Approx. 60 rpm	1	-	-	Trial mixing for design of concrete mix
3-2	Concrete Compressive Strength Testing Device	Max Capacity: 2,000 kN Platen: D 220 mm Max. Plate Span: 320 mm Loading Speed: Max. 20 mm/min	-	2	-	Quality control of concrete on construction
3-3	Load Cell with Digital Tester for Calibration	Capacity: 2 ,000kN Rated Output: 1.5 mV/V (3000 x 10-6 strain) +/- 0.2%	-	1	-	Calibration of concrete compressive strength testing device
3-4	Sieves Set and Shaker for Coarse Aggregate	JIS nominal size : 75μm, 150μm, 300μm, 425μm, 600μm, 1.18mm, 2.00mm, 2.36mm, each 1 pc /set Ro-tap Sieves Shaker: Height of Holder 7 sieves available, Shaking Speed 250 rpm	-	1	-	Quality control of aggregate for concrete and pavement on road construction
3-5	Specific Gravity Apparatus for Coarse Aggregate	Measuring Range: 0 ~5,000kg Graduation: 0.5g	1	-	-	Quality control of coarse aggregate for concrete
3-6	Photometer	Measuring System: Absorption Spectrum Photometer Display: 4.7 inch, 320 x 240 dot liquid crystal Power Supply: AC230V AC adapter, battery possible	1	-	-	Checking quality of water for concrete
3-7	Unbonded Capping Apparatus	Capping Retainer: D 150 mm x H 300 mm Neoprene Pads: D150 mm x H 300 mm and 6 x 12 inch cylinder	-	5	-	Quality control of capping the top and bottom surface of the concrete specimen.
3-8	Concrete Test Hammer	Measuring Range: 10 ~ 70Nmm2 Impact Energy: 2.207 Nm	-	3	-	Quality control of concrete

4. Common Equipment						
4-1	Oven	Capacity: Not less than 400 L Temperature Range: 80 ~ 200℃ Accuracy: '+/- 2℃	2	-	-	Quality Control of concrete aggregate and soil
4-2	Digital Caliper	Measuring Range: 0 ~ 200 mm Accuracy: +/- 0.03 mm/0.0015 inch	1	3	-	Measuring apparatus

Based on the arrangement plan of Road/Bridge test equipment considered appropriate for the target road construction, RRL and BRL must be responsible to transfer equipment shown in the tables below to final destinations in Kachin State and Chin State.

Table 2-2.15 Arrangement Plan of Road/Bridge Test Equipment in Kachin State

Equipment		Total Unit	Arrangement Plan (Final Destination)				
			Myitkyina Laboratory	Sub Special Project Unit No.2	Sub Special Project Unit No.4	Mohnyin District Office	Bridge Construction Special Unit No.15
Road Test Equipment from RRL	Digital Moisture Meter	3	-	1	1	1	-
	Dynamic Cone Penetrometer	3	-	1	1	1	-
	Soil Density Apparatus (Sand Replacement Method)	3	-	1	1	1	-
Bridge Test Equipment From BRL	Boring Machine with Standard Accessories	1	-	-	-	-	1
	Concrete Compressive Strength Testing Device	2	1	-	-	-	1
	Load Cell with Digital Tester for Calibration	1	1	-	-	-	-
	Sieves Set and Shaker for Coarse Aggregate	1	1	-	-	-	-
	Unbonded Capping Apparatus	5	2	-	-	-	3
	Concrete Test Hammer	3	-	1	1	1	-
	Digital Caliper	3	-	1	1	1	-

Table 2-2.16 Arrangement Plan of Road/Bridge Test Equipment in Chin State

Equipment		Total Unit	Arrangement Plan (Final Destination)			
			Chin State Office	Airfield Construction Special Unit No.3	Falam District Office	Hakha District Office
Road Test Equipment from RRL	Boring Machine with Standard Accessories	1	1	-	-	-
	Digital Moisture Meter	3	-	1	1	1
	Dynamic Cone Penetrometer	3	-	1	1	1
	Soil Density Apparatus (Sand Replacement Method)	3	-	1	1	1
	Concrete Compressive Strength Testing Device	1	1	-	-	-
	Load Cell with Digital Tester for Calibration	1	1	-	-	-
	Sieves Set and Shaker for Coarse Aggregate	1	1	-	-	-
	Unbonded Capping Apparatus	5	5	-	-	-
	Concrete Test Hammer	3	-	1	1	1
	Digital Caliper	3	-	1	1	1

3) Operator-training Equipment

Under the conditions mentioned in above "2-2-1 Design Policy (2) Policy regarding Selection of Equipment 3)", Operator-training equipment was determined based on several policies set as shown in the table below.

Table 2-2.17 Policies for Component of Operator-training Equipment

Project target	Policies for Component of equipment
MTC in Mandalay (Upper Myanmar) and in Insein (Lower Myanmar)	- According to construction equipment to be procured for Kachin State and Chin State, operator-training equipment consists of those for earthworks (Bulldozer, Excavator and Wheel Loader), paving compaction (Vibratory Tandem Roller) and transportation equipped with a crane (Cab-back Crane). - In consideration that equipment is for training, small-scale equipment which has same functions as construction equipment of the Project is considered in order to avoid large-scale equipment costly to be maintained. - Equipment is to be procured for MTC in both Upper Myanmar and Lower Myanmar because they have a training program between each other.

According to the above policies, the component of operator-training equipment which is considered appropriate and necessary in the Project is shown as below.

Table 2-2.18 Operator-training Equipment of the Project, and Purpose of Use

No.	Name of Equipment	Specification	Quantity		Purpose of Use
			Mandalay Mechanical Compound (Upper Myanmar)	Mayangone Mechanical Compound (Lower Myanmar)	
1	Mini Dozer	Operation Weigh: 4,000 ~ 8,000 kg Engine Rated Output: Not less than 30 kW Blade Width: Not less than 2,100 mm Blade Height: Not less than 600 mm	2	2	Operator Training for a Bulldozer
2	Mini Excavator (Crawler)	Operation Weigh: 4,000 ~ 5,000 kg Engine Rated Output: 4,000 ~ 5,000 kg Rated Output: Not less than 28 kW Bucket Capacity: Approx. 0.14 m^3 (heaped)	2	2	Operator Training for an Excavator (crawler)
3	Mini Wheel Loader	Operation Weight: 1,900 ~ 3,000 kg Engine Rated Output: Not less than 15 kW Bucket Capacity: Not less than 0.3 m^3 (heaped) Max. Dumping Clearance: Not less than 1,800 mm	2	2	Operator Training for a Wheel Loader
4	Mini Vibratory Tandem Roller	Operation Weight: 2,000 ~ 3,500 kg Engine Rated Output: Not less than 19 kW Frequency (low/high): 55 Hz and over Centrifugal Force: Not less than 20 kN	2	2	Operator Training for a Vibratory Tandem Roller

No.	Name of Equipment	Specification	Quantity		Purpose of Use
			Mandalay Mechanical Compound (Upper Myanmar)	Mayangone Mechanical Compound (Lower Myanmar)	
5	Mini Cab-back Crane	Operation Weight (GVW): Not more than 8,000 kg (excluding cargo crane) Max. Payload: Not less than 3,000 kg Engine Rated Output: Not less than 100 kW Max. Lifting Capacity: Not less than 2,000 kg	2	2	Operator Training for a Cab-back Crane

4) CTC-training Equipment

Under the conditions mentioned in above "2-2-1 Design Policy (2) Policy regarding Selection of Equipment 4)", CTC-training equipment was determined based on several policies set as shown in the table below.

Table 2-2.19 Policies for Component of CTC-training Equipment

Project target	Policies for Component of equipment
CTC (Central Training Center)	- In order to contribute to road/bridge construction and maintenance on the target road, training equipment aimed at topographic survey in the Engineering Training Course and at formwork, concrete work, road work, rebar work and scaffolding in the Construction Workers Training Course are procured. (Total 6 course) - According to the Guidance for the Management of Safety for Construction Works in Japanese ODA Projects, September 2014 (JICA), personal protective safety items which should be worn in the above training courses and in actual works are procured.

According to the above policies, the component of CTC-training equipment which is considered appropriate and necessary in the Project is shown as below.

Table 2-2.20 CTC-training Equipment of the Project, and Purpose of Use

No.	Name of Equipment	Specification	Quantity			Purpose of Use
			CTC	Kachin State (site)	Chin State (site)	
1. Survey Equipment						
1-1	Total Station	Magnification: Not less than 30 X Field of View: Not less than 1° Shortest Sighting Distance: Not more than 2 m Range of Distance Measurement: Not less than 2,000 m	2	3	3	Training about operation method of the total station, and route survey, slope survey, and set of finishing stake by using the total station in the engineering training course.
1-2	Surveying Instrument Tools	Tape Measure: 30 m	5	6	6	
		Staff: 5m, 3 steps, Aluminum	5	6	6	
		Pole: 2m, Wood	10	30	30	
		Slant Rule: Approx. 250 x 125 x 25 mm with Magnet	5	6	6	

2. Formwork Equipment						
2-1	Circular Saw	Blade Diameter: 145 mm Power Source: Single phase 220V	5	15	15	Training about safety use of general electric form works tools, and actual form work by using these tools in the form works training course.
2-2	Pistol-Grip (corded) Drill	Drilling Diameter: Not less than 36 mm Power Source: Single phase 220V	5	15	15	
2-3	Table Saw	Blade Diameter: 200 ~ 300 mm Power Source: Single phase 220V	1	3	3	
2-4	Electric Planer	Cutting Width: 120 mm Power Source: Single phase 220V	5	-	-	
2-5	Baggage for Carpenter's Tools	Saw, Hammer, Woodworking Plane, Tape Measure, Slant Rule, Ink Pod, Carpenter's Square, Pincers	20	30	30	
3. Concrete work Equipment						
3-1	Concrete Vibrator	Vibrator Diameter: 43 mm Length: not less than 380 mm Frequency: 200/240Hz Hose Diameter: 35mm Length: Not less than 4.0m	5	15	15	Training about basically knowledge and placing of concrete and actual concrete work by using these tools in the concrete work training course.
3-2	High Frequency Generator	Rated Engine Output: Not less than 5.9kW Frequency: 240 Hz	1	3	3	
3-3	Concrete Mixer	Standard Mixing Capacity: 83 L Number of Rotations: 27 rpm (50 Hz)	1	3	3	
4. Road Work Equipment						
4-1	Walk Behind Concrete Saw	Blade: not less than 305mm Cutting Depth: 70 ~ 100 mm Rated Engine Output: 4.2 kW	1	3	3	Training about basically knowledge of pavement, maintenance, and repair works, and actual repair work by these machines in the road works training course. Leaning about safety control under construction by using these safety facilities.
4-2	Asphalt Hand Sprayer	Mounted on the Hand-cart Spray Capacity Fan (pie)-shaped Spray: approx. 23 L/min Round shaped Spray : approx. 10 L/min	1	-	-	
4-3	Plate Compactor	Operation Weigh: 50 ~ 70 kg Engine Rated Output: Not less than 2.0 kW Frequency: Not less than 95 Hz Centrifugal Force: Not less than 8.0 kN	2	-	-	
4-4	Safety Facilities under Construction	Traffic Cones, Traffic Cones Bar, Barricade Light, Lighting Device for Construction Signboard, Chevron Marker, Steel Crowd Control Barricades, Single-pipe	1	-	-	
5. Rebar Work Equipment						
5-1	Bar Bending Machine	Range of Diameter: D10 ~ D25 Bending Angle: UP to 180° Motor: 220/240V, 50Hz	2	4	2	Training about safety use of the bar bending and cutting machines, and actual reinforcing steel bar works by using these machines in the reinforcing works training course.
5-2	Bar Cutting Machine	Max. Diameter: D25 Cutting Force: 620 N/mm2 Motor: 220/240V, 50Hz	2	4	2	
6. Scaffolding Material						
6-1	Prefabricated Scaffolding	Prefabricated Scaffolding (3 layers, 5 spans)	1	-	-	Training about three (3) popular scaffoldings in Japan. These are prefabricated scaffolding, pipe scaffolding, and
6-2	Pipe Scaffolding	Size: WxLxH : 5.0x5.0x3.0m	1	-	-	

6-3	Travelling Scaffolding	Prefabricated Scaffolding 3 layers (H=Approx. 5.0m)	1	-	-	pipe scaffolding, and travelling scaffolding. Trainees actually assemble and demolish these scaffoldings by using these materials in the scaffolding works training course. Training about safe practice of fall prevention from these scaffoldings.
6-4	Tools for Set Up Scaffolding	Ratchet Wrench, Slant Rule, Anchor Hammer, Cutting Plier	20	-	-	
7. Safety Item						
7-1	Personal Protective Safety Items	Hardhat with Whistle, Dust-proof Glasses, Safety Vest, Safety Gloves, Safety Shoes, Safety Belt, Carry Bag	50	50	50	Safety Items should be rightly worn by all trainees in every training course. Trainees consciously care these safety tools in a carry bag.

Based on the arrangement plan of CTC-training equipment considered appropriate for the target road construction, CTC must be responsible to transfer equipment shown in the following tables to final destinations in Kachin State and Chin State.

Table 2-2.21 Arrangement Plan of CTC-training Equipment in Kachin State

Equipment		Total Unit	Arrangement Plan (Final Destination)				
			Kachin State Office	Sub Special Project Unit No.2	Sub Special Project Unit No.4	Mohnyin District Office	Bridge Construction Special Unit No.15
Survey Equipment	Total Station	3	3	-	-	-	-
	Tape Measure	6	6	-	-	-	-
	Staff	6	6	-	-	-	-
	Pole	30	30	-	-	-	-
	Slant Rule	6	6	-	-	-	-
Formwork Equipment	Circular Saw	15	10	-	-	-	5
	Pistol-Grip (corded) Drill	15	10	-	-	-	5
	Table Saw	3	2	-	-	-	1
	Baggage for Carpenter's Tools	30	20	-	-	-	10
Concrete Work Equipment	Concrete Vibrator	15	10	-	-	-	5
	High Frequency Generator	3	2	-	-	-	1
	Concrete Mixer	3	2	-	-	-	1
Road Work Equipment	Walk Behind Concrete Saw	3	-	1	1	1	-
Rebar Work Equipment	Bar Bending Machine	4	3	-	-	-	1
	Bar Cutting Machine	4	3	-	-	-	1
Personal Protective Safety Items		50	50	-	-	-	-

Table 2-2.22 Arrangement Plan of CTC-training Equipment in Chin State

Equipment		Total Unit	Arrangement Plan (Final Destination)			
			Chin State Office	Airfield Construction Special Unit No.3	Falam District Office	Hakha District Office
Survey Equipment	Total Station	3	3	-	-	-
	Tape Measure	6	6	-	-	-
	Staff	6	6	-	-	-
	Pole	30	30	-	-	-
	Slant Rule	6	6	-	-	-

Formwork Equipment	Circular Saw	15	15	-	-	-
	Pistol-Grip (corded) Drill	15	15	-	-	-
	Table Saw	3	3	-	-	-
	Baggage for Carpenter's Tools	30	30	-	-	-
Concrete Work Equipment	Concrete Vibrator	15	15	-	-	-
	High Frequency Generator	3	3	-	-	-
	Concrete Mixer	3	3	-	-	-
Road Work Equipment	Walk Behind Concrete Saw	3	-	1	1	1
Rebar Work Equipment	Bar Bending Machine	2	2	-	-	
	Bar Cutting Machine	2	2	-	-	
Personal Protective Safety Items		50	50	-	-	

(3) Equipment Procurement Quantities

1) Estimated Volume of Earthwork and Pavement

Table 2-2.23 and Table 2-2.24 show the estimated volume of earthwork and pavement using equipment of the Project on the target roads. These volumes have been calculated based on the construction volumes indicated in Table 2-2.3 and Table 2-2.4, respectively.

Table 2-2.23 Estimated Volume of Earthwork and Pavement in Kachin State

1) Earthwork

	Earth Volume	Bulldozer	Excavator	Dump Truck	Wheel Loader	Motor Grader
Earthwork (Excavating and Hauling)	(1) 1,501,000 m^3	(2) 851,000 m^3	(4) 650,000 m^3	-	(6) 382,000 m^3	-
Loading Volume		(3) 469,000 m^3	- →	(5) 1,032,000 m^3	← -	(7) 1,032,000 m^3

Note: 30% of cut soil to use as fill materials

2) Aggregates for Paving (Specific weight: 2.2)

	Aggregate	Wheel Loader	Dump Truck
Aggregate Volume	(8) 299,361 m^3	(9) 299,361 m^3	-
Loading Aggregate Volume			(10) 299,361 m^3
Aggregate Weight	(11) 658,594 ton	-	-

Note: Aggregate to produce at site by Mobile Crusher

3) Estimated Volume for each Equipment in the Project

Equipment	Earth Volume	Calculation	Main Works
Bulldozer	851,000 m^3	= (2)	Excavating/dozing/compacting soil
Excavator (Crawler)	650,000 m^3	= (4)	Excavating/loading soil
Wheel Loader	681,361 m^3	= (6) + (9)	Stockpiling/loading soil
Dump Truck	1,331,361 m^3	= (5) + (10)	Hauling construction materials
Motor Grader	1,032,000 m^3	= (7)	Spreading fill soil, finishing base course
Wheel Excavator	300,000 m^3	Excavating side-ditch and soil	Excavating side-ditch, loading soil
Mobile Crusher	219,531 ton	= (11)×1/3	Producing aggregate
Sheep Foot Compactor	873,600 m^2	Base course area	Compacting embankment and base/sub-base course
Vibratory Tandem Roller	728,000 m^2	Pavement area	Compacting pavement
Tire Roller	728,000 m^2	Pavement area	Compacting pavement
Bitumen Distributor	2,184,000 m^2	Pavement area×3times	Spraying asphalt

Note: 1/3 of aggregate to produce by Mobile Crusher in estimation.

Table 2-2.24 Estimated Volume of Earthwork and Pavement in Chin State

1) Earthwork

	Earth Volume	Bulldozer	Excavator	Dump Truck	Wheel Loader	Motor Grader
Earthwork (Excavating and Hauling)	(1) 932,880 m^3	(2) 371,280 m^3	(4) 561,600 m^3	-	(6) 371,280 m^3	-
Loading Volume		(3) 227,710 m^3	-	(5) 705,170 m^3	-	(7) 118,206 m^3

Note: 30% of cut soil to use as fill materials

2) Aggregates for Paving (Specific weight: 2.2)

	Aggregate	Wheel Loader	Dump Truck
Aggregate Volume	(8) 65,110 m^3	(9) 65,110 m^3	-
Loading Aggregate Volume			(10) 65,110 m^3
Aggregate Weight	(11) 143,242 ton	-	-

Note: Aggregate to produce at site by Mobile Crusher

3) Estimated Volume for each Equipment in the Project

Equipment	Earth Volume	Calculation	Main Works
Bulldozer	598,990 m^3	= (2) + (3)	Excavating/dozing/compacting soil
Excavator (Crawler)	561,600 m^3	= (4)	Excavating/loading soil
Wheel Loader	636,390 m^3	= (6) + (9) + Removing soil	Stockpiling/loading soil, removing soil (Approx. 200,000m^3)
Dump Truck	770,280 m^3	= (5) + (10)	Hauling construction materials
Motor Grader	118,206 m^3	= (7)	Spreading fill soil, finishing base course
Wheel Excavator	300,000 m^3	Excavating side-ditch and soil	Excavating side-ditch, loading soil
Mobile Crusher	143,242 ton	= (11)	Producing aggregate
Sheep Foot Compactor	343,872 m^2	Base course area	Compacting embankment and base/sub-base course
Vibratory Tandem Roller	286,560 m^2	Pavement area	Compacting pavement
Tire Roller	286,560 m^2	Pavement area	Compacting pavement
Bitumen Distributor	859,680 m^2	Pavement area×3times	Spraying asphalt

2) Quantity of Equipment

In the Project, the construction works for target roads are planned to be carried out by the formation of two (3) construction units in Kachin State and Chin State, respectively.

Table 2-2.25 Construction Teams for the Target Roads

Area	Construction Team	Length
Kachin State	Sub Special Project Unit No.2 (To be integrated in to Mohnyin Office)	24km
	Mohnyin District Office	46.4km
	Sub Special Project Unit No.4 (Name to be changed as Road Construction Special Unit No.2)	70.6km
Chin State	Airfield Construction Special Unit No.3 (Name to be changed as Road Construction Special Unit No.7)	20km
	Falam District Office	60km
	Hakha District Office	29km

Note: Bridges over 50 feet in length in Kachin State will be undertaken by the Bridge Construction Special Unit No.15 (Name to be changed as Bridge Construction Special Unit No.1).

Quantities of construction equipment required in the Project are determined based on earthwork volumes, paving work volumes and also roles undertaken by the above construction teams.

Bases for calculating required number of equipment in Kachin State and Chin State are shown in the tables below.

Table 2-2.26 Bases for Calculating Required Number of Equipment in Kachin State

1. Bulldozer (estimated quantity: 3 units)

Basis of Calculation	Numerical Value	Remarks
Dozing (hauling) distance	25 m	
Cycle time	1.15 min.	
Capacity of dozer blade	3.9 m^3	Blade size: W:3.7 m, H:1.3 m
Quantity of work/machine/h	81 m^3/h	
Quantity of work/machine/day (1)	604 m^3/day	8 hours/machine/day
Working days/year	150 days	25 days/month× 6 months (dry season only)
Estimated period of the construction work	3 years	
Estimated amount of work-volume (2)	851,000 m^3	Excavation / dozing (hauling) / spreading
Work period	3 years	
Required working days to complete the work (3)	450 days	
Required earthwork-volume/day (4) = (2) ÷ (3)	1,313 m^3/day	
Required number of machines = (4) ÷ (1)	3 units	

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

Basis of Calculation	Numerical Value	Remarks
Bucket capacity	0.8 m^3	
Cycle time	30 sec.	Swing angle: 135°
Quantity of work/machine/h	61 m^3/h	Excavation and loading
Quantity of work/machine/day (1)	488 m^3/day	8 hours/machine/day
Working days/year	150 days	25 days/month× 6 months (dry season only)
Estimated period of the construction work	3 years	
Estimated amount of work-volume (2)	650,000 m^3	Excavation and loading
Work period	3 years	
Required working days to complete the work (3)	450 days	
Required earthwork-volume/day (4) = (2)÷ 3)	1,444 m3/day	
Required number of machines = (4) ÷ (1)	3 units	

3. Wheel Excavator (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
Bucket capacity	0.5 m^3	
Cycle time	30 sec.	Swing angle: 135°
Quantity of work/machine/h	38 m^3/h	Excavation and trimming
Quantity of work/machine/day (1)	304 m^3/day	8 hours/machine/day
Working days/year	150 days	25 days/month× 6 months
Estimated period of the construction work	3 years	
Estimated amount of work-volume (2)	300,000 m^3	Excavation and trimming of the drainage, etc.
Work period	3 years	
Required working days to complete the work (3)	450 days	
Required earthwork-volume/day (4) = (2) ÷ (3)	667 m^3/day	
Required number of machines = (4) ÷ (1)	2 units	

4. Motor Grader (estimated quantity: 3 units)

Basis of Calculation	Numerical Value	Remarks
Blade width	3.7 m	
Quantity of work/machine/h	106 m^3/h	Spreading and leveling
Quantity of work/machine/day (1)	848 m^3/day	8 hours/machine/day
Working days/year	150 days	25 days/month× 6 months (dry season only)
Estimated period of the construction work	3 years	
Estimated amount of work-volume (2)	1,032000 m^3	Spreading/leveling materials
Work period	3 years	
Required working days to complete the work (3)	450 days	
Required earthwork-volume/day (4) = (2) ÷ (3)	2293 m^3/day	
Required number of machines = (4) ÷ (1)	3 units	

5. Wheel Loader (estimated quantity: 3 units)

Basis of Calculation	Numerical Value	Remarks
Bucket capacity	2.5 m^3	
Cycle time	120 sec.	
Quantity of work/machine/h	37 m^3/h	
Quantity of work/machine/day (1)	296 m^3/day	8 hours/machine/day
Working days/year (embankment material)	150 days	25 days/month× 6 months (dry season only)
Working days/year (paving material)	120 days	10 months (dry and rainy season)
Estimated period of the construction work	3 years	
Estimated amount of work-volume (2)	681,361 m^3	Loading/hauling materials
Work period	3 years	
Required working days to complete the work (3)	810 days	
Required earthwork-volume/day (4) = (2) ÷ (3)	841 m^3/day	
Required number of machines = (4) ÷ (1)	3 units	

6. Sheep Foot Compactor (estimated quantity: 3 units)

Basis of Calculation	Numerical Value	Remarks
Quantity of work/machine/h	72 m^2/h	
Quantity of work/machine/day (1)	576 m^2/day	8 hours/machine/day
Working days/year	150 days	25 days/month× 6 months (dry season only)
Estimated period of the construction work	3 years	
Estimated amount of work-area (2)	873,600 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 number of machines = (4) ÷ (1)	3 units	

7. Vibratory Tandem Roller (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
Quantity of work/machine/h	104 m^2/h	
Quantity of work/machine/day (1)	832 m^2/day	8 hours/machine/day
Working days/year	150 days	25 days/month× 6 months (dry season only)
Estimated period of the construction work	3 years	
Estimated amount of work-area (2)	728,000 m^2	
Work period	3 years	
Required working days to complete the work (3)	450 days	
Required work-area/day (4) = (2) ÷ (3)	1,618 m^2/day	
Required number of machines = (4) ÷ (1)	2 units	

8. Tire Roller (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
Quantity of work/machine/h	108 m^2/h	
Quantity of work/machine/day (1)	864 m^2/day	8 hours/machine/day
Working days/year	150 days	25 days/month× 6 months (dry season only)
Estimated period of the construction work	3 years	
Estimated amount of work-area (2)	728,000 m^2	
Work period	3 years	
Required working days to complete the work (3)	450 days	
Required work-area/day (4) = (2) ÷ (3)	1,618 m^2/day	
Required number of machines = (4) ÷ (1)	2 units	

9. Plate Compactor (estimated quantity: 10 units)

Basis of Calculation	Numerical Value	Remarks
This equipment to be distributed to the construction units, according to the total extension of the roads under their jurisdiction	-	
Sub Special Project Unit No.2 (24 km)	2 units	
Mohnyin District Office (46.4 km)	3 units	
Sub Special Project Unit No.4 (70.6 km)	5 units	
Required number of machines	10 units	

10. Asphalt Kettle (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
This equipment to be distributed to the construction units, according to the total extension of the roads under their jurisdiction	-	
Sub Special Project Unit No.2 + Mohnyin District Office (70.4 km in total)	1 unit	
Sub Special Project Unit No.4 (70.6 km)	1 unit	
Required number of machines	2 units	

11. Bitumen Distributor (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
Quantity of work/machine/h	3990 m^2/h	
Quantity of work/machine/day (1)	7,980 m^2/day	2 hours/machine/day
Working days/year	50 days	6 months (dry season only)
Estimated period of the construction work	3 years	
Estimated amount of work-area (2)	2,184,000 m^2	
Work period	3 years	
Required working days to complete the work (3)	150 days	
Required work-area/day (4) = (2) ÷ (3)	14,560 m^2/day	
Required number of machines = (4) ÷ (1)	2 units	

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

Basis of Calculation	Numerical Value	Remarks
This equipment to be distributed to the construction units, according to the total extension of the roads under their jurisdiction	-	
Sub Special Project Unit No.2 (24 km)	2 units	
Mohnyin District Office (46.4 km)	3 units	
Sub Special Project Unit No.4 (70.6 km)	5 units	
Required number of machines	10 units	

13. Chip Spreader (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
This equipment to be distributed to the construction units, according to the total extension of the roads under their jurisdiction	-	
Sub Special Project Unit No.2 + Mohnyin District Office (70.4 km in total)	1 unit	
Sub Special Project Unit No.4 (70.6 km)	1 unit	
Required number of machines	2 units	

14. Mobile Crusher (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
Quantity of work/machine/h	13.5 t/h	
Quantity of work/machine/day (1)	108 t/day	8 hours/machine/day
Working days/year	300 days	25 days/month× 12 months
Estimated period of the construction work	3 years	
Estimated amount of work (2)	213,591 t	The 2/3 of the required quantity (658,594 t) of aggregate is going to be produced/ procured from local suppliers, or is going to be prepared before the delivery of the Project equipment by construction teams.
Work period	3 years	
Required working days to complete the work (3)	900 days	
Required hauling-volume/day (4) = (2) ÷ (3)	237 t/day	
Required number of machines = (4) ÷ (1)	2 units	

15. Water Bowser (Tanker) (estimated quantity: 3 units)

Basis of Calculation	Numerical Value	Remarks
This equipment to be deployed to each construction unit with one each.	-	
Sub Special Project Unit No.2	1 unit	
Mohnyin District Office	1 unit	
Sub Special Project Unit No.4	1 unit	
Required number of machines	3 units	

16. Dump Truck (estimated quantity: 30 units)

Basis of Calculation	Numerical Value	Remarks
Hauling distance	20 km	An average distance for a round trip between construction site and stockpile
Traveling (driving) speed	26 km/h	
Hauling capacity/machine/h	6.8 m^3/h	
Hauling capacity/machine/day (1)	54.48 m^3/day	8 hours/machine/day
Working days/year (transporting earth)	150 days	25 days/month× 6 months (dry season)
Working days/year (transporting macadam)	120 days	20 days/month x 6 months (rainy season)
Estimated period of the construction work	3 years	
Estimated amount of work-volume (2)	1,331,361 m^3	A 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)	810 days	
Required hauling-volume/day (4) = (2) ÷ (3)	1,644 m^3	
Required number of machines = (4) ÷ (1)	30 units	

17. Cab-back Crane (estimated quantity: 1 unit)

Basis of Calculation	Numerical Value	Remarks
This equipment to be stationed at the Myitkyina Workshop where the base for equipment control in Kachin State is.	-	
Required number of machines	1 unit	

18. Rough Terrain Crane (estimated quantity: 1 unit)

Basis of Calculation	Numerical Value	Remarks
This equipment to be stationed at the Myitkyina Workshop and to be deployed to construction sites when used.	-	
Required number of machines	1 unit	

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

Basis of Calculation	Numerical Value	Remarks
This equipment to be stationed at the Myitkyina Workshop where the base for equipment control in Kachin State is.	-	
Required number of machines	1 unit	

20. Mobile Workshop (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
This equipment to be stationed at the Myitkyina Workshop where the base for equipment maintenance in Kachin State is, and to be deployed to sites when used.	-	
Sub Special Project Unit No.2 and Mohnyin District Office	1 unit	
Sub Special Project Unit No.4	1 unit	
Required number of machines	2 units	

21. Inspection Vehicle (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
This equipment to be stationed at the Myitkyina Workshop and to be deployed to construction sites when used.	-	
Sub Special Project Unit No.2	1 unit	
Mohnyin District Office	1 unit	
Required number of machines	2 units	

22. Generator (estimated quantity: 3 units)

Basis of Calculation	Numerical Value	Remarks
This equipment to be deployed to each construction unit with one each.	-	
Required number of machines	3 units	

Table 2-2.27 Bases for Calculating Required Number of Equipment in Chin State

1. Bulldozer (estimated quantity: 3 units)

Basis of Calculation	Numerical Value	Remarks
Dozing (hauling) distance	30 m	
Cycle time	1.34 min.	
Capacity of dozer blade	3.9 m^3	Blade size: W:3.7 m, H:1.3 m
Quantity of work/machine/h	56 m^3/h	
Quantity of work/machine/day (1)	448 m^3/day	8 hours/machine/day
Working days/year	150 days	25 days/month× 6 months (dry season only)
Estimated period of the construction work	3 years	
Estimated amount of work-volume (2)	598,990 m^3	Excavation / dozing (hauling) / spreading
Work period	3 years	
Required working days to complete the work (3)	450 days	
Required earthwork-volume/day (4) = (2) ÷ (3)	1,337 m^3/day	
Required number of machines = (4) ÷ (1)	3 units	

2. Excavator (Crawler) (estimated quantity: 3 units) with the Hydraulic Beaker attached

Basis of Calculation	Numerical Value	Remarks
Bucket capacity	0.8 m^3	
Cycle time	35 sec.	Swing angle: 135°
Quantity of work/machine/h	52 m^3/h	Excavation and loading
Quantity of work/machine/day (1)	416 m^3/day	8 hours/machine/day
Working days/year	150 days	25 days/month× 6 months (dry season only)
Estimated period of the construction work	3 years	
Estimated amount of work-volume (2)	561,600 m^3	Excavation and loading
Work period	3 years	
Required working days to complete the work (3)	450 days	
Required earthwork-volume/day (4) = (2)÷ 3)	1,248 m3/day	
Required number of machines = (4) ÷ (1)	3 units	

3. Wheel Excavator (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
Bucket capacity	0.5 m^3	
Cycle time	30 sec.	Swing angle: 135°
Quantity of work/machine/h	38 m^3/h	Excavation and trimming
Quantity of work/machine/day (1)	304 m^3/day	8 hours/machine/day
Working days/year	150 days	25 days/month× 6 months
Estimated period of the construction work	3 years	
Estimated amount of work-volume (2)	300,000 m^3	Excavation and trimming of the drainage, etc.
Work period	3 years	
Required working days to complete the work (3)	450 days	
Required earthwork-volume/day (4) = (2) ÷ (3)	667 m^3/day	
Required number of machines = (4) ÷ (1)	2 units	

4. Motor Grader (estimated quantity: 3 units)

Basis of Calculation	Numerical Value	Remarks
Blade width	3.7 m	
Quantity of work/machine/h	11 m^3/h	Spreading and leveling
Quantity of work/machine/day (1)	88 m^3/day	8 hours/machine/day
Working days/year	150 days	25 days/month× 6 months (dry season only)
Estimated period of the construction work	3 years	
Estimated amount of work-volume (2)	118,206 m^3	Spreading/leveling materials
Work period	3 years	
Required working days to complete the work (3)	450 days	
Required earthwork-volume/day (4) = (2) ÷ (3)	263 m^3/day	
Required number of machines = (4) ÷ (1)	3 units	

5. Wheel Loader (estimated quantity: 3 units)

Basis of Calculation	Numerical Value	Remarks
Bucket capacity	2.5 m^3	
Cycle time	120 sec.	
Quantity of work/machine/h	37 m^3/h	
Quantity of work/machine/day (1)	296 m^3/day	8 hours/machine/day
Working days/year (embankment material)	150 days	25 days/month× 6 months (dry season only)
Working days/year (paving material)	120 days	10 months (dry and rainy season)
Estimated period of the construction work	3 years	
Estimated amount of work-volume (2)	636,390 m^3	Loading/hauling materials
Work period	3 years	
Required working days to complete the work (3)	810 days	
Required earthwork-volume/day (4) = (2) ÷ (3)	786 m^3/day	
Required number of machines = (4) ÷ (1)	3 units	

6. Sheep Foot Compactor (estimated quantity: 3 units)

Basis of Calculation	Numerical Value	Remarks
Quantity of work/machine/h	34 m^2/h	
Quantity of work/machine/day (1)	272 m^2/day	8 hours/machine/day
Working days/year	150 days	25 days/month× 6 months (dry season only)
Estimated period of the construction work	3 years	
Estimated amount of work-area (2)	343,872 m^2	
Work period	3 years	
Required working days to complete the work (3)	450 days	
Required work-area/day (4) = (2) ÷ (3)	764 m^2/day	
Required number of machines = (4) ÷ (1)	3 units	

7. Vibratory Tandem Roller (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
Quantity of work/machine/h	42 m^2/h	
Quantity of work/machine/day (1)	336 m^2/day	8 hours/machine/day
Working days/year	150 days	25 days/month× 6 months (dry season only)
Estimated period of the construction work	3 years	
Estimated amount of work-area (2)	286,560 m^2	
Work period	3 years	
Required working days to complete the work (3)	450 days	
Required work-area/day (4) = (2) ÷ (3)	637 m^2/day	
Required number of machines = (4) ÷ (1)	2 units	

8. Tire Roller (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
Quantity of work/machine/h	45 m^2/h	
Quantity of work/machine/day (1)	360 m^2/day	8 hours/machine/day
Working days/year	150 days	25 days/month× 6 months (dry season only)
Estimated period of the construction work	3 years	
Estimated amount of work-area (2)	286,560 m^2	
Work period	3 years	
Required working days to complete the work (3)	450 days	
Required work-area/day (4) = (2) ÷ (3)	637 m^2/day	
Required number of machines = (4) ÷ (1)	2 units	

9. Plate Compactor (estimated quantity: 10 units)

Basis of Calculation	Numerical Value	Remarks
This equipment to be distributed to the construction units, according to the total extension of the roads under their jurisdiction	-	
Air Field Construction Special Unit No.3 (20 km)	2 units	
Falam District Office (60 km)	5 units	
Hakha District Office (30 km)	3 units	
Required number of machines	10 units	

10. Asphalt Kettle (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
This equipment to be distributed to the Air Field Construction Special Unit No.3 and Falam District Office	-	Incidental equipment to Bitumen Distributor for heating and melting straight asphalt
Air Field Construction Special Unit No.3 (20km) + Hakha District Office (29km)	1 unit	
Falam District Office (60km)	1 unit	
Required number of machines	2 units	

11. Bitumen Distributor (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
Quantity of work/machine/h	1,632 m^2/h	
Quantity of work/machine/day (1)	3,264 m^2/day	2 hours/machine/day
Working days/year	50 days	6 months (dry season only)
Estimated period of the construction work	3 years	
Estimated amount of work-area (2)	859,680 m^2	
Work period	3 years	
Required working days to complete the work (3)	150 days	
Required work-area/day (4) = (2) ÷ (3)	5,731 m^2/day	
Required number of machines = (4) ÷ (1)	2 units	

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

Basis of Calculation	Numerical Value	Remarks
This equipment to be distributed to the construction units, according to the total extension of the roads under their jurisdiction	-	
Air Field Construction Special Unit No.3 (20 km)	2 units	
Falam District Office (60 km)	5 units	
Hakha District Office (30 km)	3 units	
Required number of machines	10 units	

13. Chip Spreader (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
This equipment to be distributed to the construction units, according to the total extension of the roads under their jurisdiction	-	
Air Field Construction Special Unit No.3 (20km) + Hakha District Office (30 km)	1 unit	
Falam District Office	1 unit	
Required number of machines	2 units	

14. Mobile Crusher (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
Quantity of work/machine/h	13.5 t/h	
Quantity of work/machine/day (1)	108 t/day	8 hours/machine/day
Working days/year	300 days	25 days/month× 12 months
Estimated period of the construction work	3 years	
Estimated amount of work (2)	143,242 t	
Work period	3 years	
Required working days to complete the work (3)	900 days	
Required hauling-volume/day (4) = (2) ÷ (3)	159 t/day	
Required number of machines = (4) ÷ (1)	2 units	

15. Water Bowser (Tanker) (estimated quantity: 3 units)

Basis of Calculation	Numerical Value	Remarks
This equipment to be distributed according to the distance between the construction site and the river where water is taken.	-	
Air Field Construction Special Unit No.3	1 unit	
Falam District Office	1 unit	
Hakha District Office	2 units	
Required number of machines	4 units	

16. Dump Truck (estimated quantity: 20 units)

Basis of Calculation	Numerical Value	Remarks
Hauling distance	15 km	An average distance for a round trip, between construction site and stockpile
Traveling (driving) speed	15 km/h	
Hauling capacity/machine/h	5.9 m^3/h	
Hauling capacity/machine/day (1)	47 m^3/day	8 hours/machine/day
Working days/year (transporting earth)	150 days	25 days/month× 6 months (dry season)
Working days/year (transporting macadam)	120 days	20 days/month x 6 months (rainy season)
Estimated period of the construction work	3 years	
Estimated amount of work-volume (2)	770,280 m^3	A 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)	810 days	
Required hauling-volume/day (4) = (2) ÷ (3)	951 m^3	
Required number of machines = (4) ÷ (1)	20 units	

17. Cab-back Crane (estimated quantity: 2 unit)

Basis of Calculation	Numerical Value	Remarks
This equipment to be stationed at Hakha District Office and Falam District Office.	-	
Falam District Office	1 unit	
Hakha District Office	1 unit	
Required number of machines	2 units	

18. Rough Terrain Crane (estimated quantity: 1 unit)

Basis of Calculation	Numerical Value	Remarks
This equipment to be stationed at the Hakha Mechanical Compound (or the Hakha Mechanical Compound No.2), and to be deployed to construction sites when used.	-	
Required number of machines	1 unit	

19. Low Bed Self-loading Truck (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
This equipment to be stationed at Hakha Mechanical Compound and Falam District Office.	-	
Hakha Mechanical Compound	1 unit	
Falam District Office	1 unit	
Required number of machines	2 units	

20. Mobile Workshop (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
This equipment to be stationed at the Hakha Mechanical Compound where the base for equipment maintenance in Chin State, and to be deployed to sites when used as below.	-	
Falam District Office, Air Field Construction Special Unit No.3	1unit	
Hakha District Office	1unit	
Required number of machines	2units	

21. Inspection Vehicle (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
This equipment to be stationed at Hakha District Office and Falam District Office.	-	
Falam District Office	1 unit	
Air Field Construction Special Unit No.3	1 unit	
Required number of machines	2 units	

22. Generator (estimated quantity: 3 units)

Basis of Calculation	Numerical Value	Remarks
This equipment to be deployed to each construction unit with one each.	-	
Hakha District Office	1 unit	
Falam District Office	1 unit	
Air Field Construction Special Unit No.3	1 unit	
Required number of machines	3 units	

23. Concrete Sprayer (estimated quantity: 2 units)

Basis of Calculation	Numerical Value	Remarks
Capacity for spray	4 m^3/h	
Quantity of work/machine/h	3.2 m^3/h	80% efficiency of above capacity
Quantity of work/machine/day (1)	16 m^3/day	5 hours/machine/day
Working days/year	150 days	25 days/month× 6 months (dry season only)
Estimated period of the construction work	3 years	
Estimated amount of work-area in m^2	87,000 m^2	150mm in thickness
Estimated amount of work-area in m^3 (2)	13,050 m^3	
Work period	3 years	
Required working days to complete the work (3)	450 days	
Required work-area/day (4) = (2) ÷ (3)	29 m^3	
Required number of machines = (4) ÷ (1)	2 units	

2-2-3 Outline Design Drawings

Reference drawings of main construction equipment in the Project are indicated below. Incidentally, dimensions indicated in the reference drawings are reference values.

Table 2-2.28 Reference Drawings of Main Construction Equipment

1. Bulldozer	2. Excavator (Crawler)
	※Hydraulic Beaker only for Chin State 
3. Wheel Excavator	4. Motor Grader
	
5. Wheel Loader	6. Sheep Foot Compactor
	
7. Vibratory Tandem Roller	8. Tire Roller
	

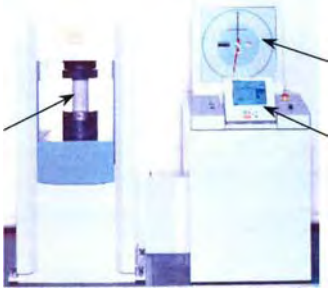
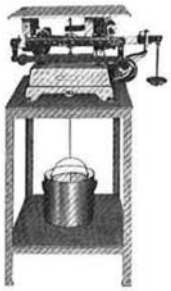
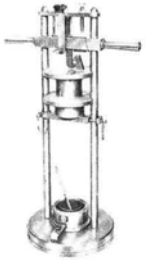
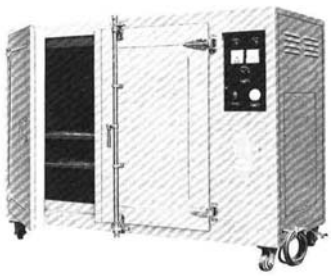
9. Plate Compactor	10. Asphalt Kettle
	
11. Bitumen Distributor	12. Asphalt Hand Sprayer
	
13. Chip Spreader	14. Mobile Crusher
	
15. Water Bowser (Tanker)	16. Dump Truck
	
17. Cab-back Crane	18. Rough Terrain Crane
	

19. Low Bed Semi-trailer (with Tractor Head)	20. Low Bed Self-loading Truck
※Only Kachin State 	※Chin State 
21. Mobile Workshop	22. Inspection Vehicle
	
23. Generator	24. Concrete Sprayer
	※Only Chin State 

Reference drawings of Operator-Training equipment in the Project are indicated below.

Table 2-2.29 Reference Drawings of Road/Bridge Test Equipment

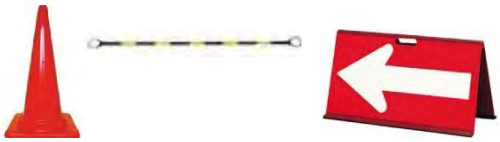
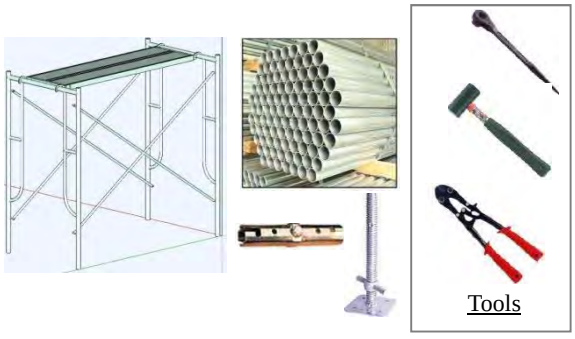
1. Boring Machine with Standard Accessories	2. Triaxial Apparatus
	
3. Sieves Set and Shaker for Soil	4. CBR Test Apparatus
	※Only for RRL 
5. Digital Moisture Meter	6. Dynamic Cone Penetrometer
※Only for RRL 	※Only for RRL 
7. Soil Density Apparatus (Sand Replacement Method)	8. Pan Type Concrete Forced Mixer
※Only for RRL 	※Only for BRL 

9. Concrete Compressive Strength Testing Device	10. Load Cell with Digital Tester for Calibration
	
11. Sieves Set and Shaker for Aggregate	12. Specific Gravity Apparatus for Coarse Aggregate
	※Only for BRL 
13. Photometer	14. Aggregate Crashing and Test Apparatus
※Only for BRL 	※Only for RRL 
15. Unbonded Capping Apparatus	16. Concrete Hammer
	
17. Oven	18. Digital Caliper
※Only for BRL 	

Reference drawings of CTC-Training equipment in the Project are indicated below.

Table 2-2.30 Reference Drawings of CTC-training Equipment

1. Total Station	2. Circular Saw
	
3. Pistol-Grip (corded) Drill	4. Table Saw
	
5. Electric Planer	6. Baggage for Carpenter's Tools
	
7. Concrete Vibrator	8. High Frequency Power Supply
	

9. Concrete Mixer	10. Walk Behind Concrete Saw
	
11. Asphalt Hand Sprayer	12. Plate Compactor
	
13. Road Safety Facilities	14. Bar Bending Machine
	
15. Bar Cutting Machine	16. Materials and Tools for Scaffolding
	 Tools
17. Personal Protective Safety Equipment	—
	—

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

The Project 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 line agency on the Myanmar side will be MOC, and the executing agency will be DOH under the said MOC. Also, following handover of the construction and maintenance equipment, DOH 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 Myanmar 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 and to improve the capacity for construction works using the Project equipment.

(3) Supplier

In accordance with the framework of Japan's Grant Aid scheme, the Supplier that has been selected in competitive tender will implement the procurement, transportation, on-site assembly, initial operation training and maintenance guidance, etc. of the Project 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, Supplier(s) that possesses a local office or other base of activities in Myanmar will be selected.

2-2-4-2 Implementation Conditions

(1) Source Countries of Procurement

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.

(2) Implementation Planning Conditions

Implementation planning conditions are as follows:

- The Project target area usually has its dry season from November to April and rainy season from May to October. During the period of heaviest rain in July and August, provincial access roads sometimes become impassable due to inundation or a landslide. Therefore, this period should be avoided for inland transportation of equipment landed at the port in Myanmar.
- Since parts of the inland transportation route have deteriorated paving, running speeds will fall on these parts. Moreover, because the internal transportation route in Chin State passes steep mountainous areas, 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 DOH's 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 and personnel necessary for constructing the target road.

Moreover, Table 2-2-31 shows the detailed scope of works on the Japanese and Myanmar sides.

Table 2-2.31 Scope of Works

No.	Item	Scope		Remarks
		Japan	Myanmar	
1	Securing of storage area for construction and maintenance equipment and expendable parts		○	Kachin State - Securing the storage for spare parts of construction equipment at Myitkyina Workshop. (Clearing, preparing a shelf, etc.) Chin State - Acquiring/Borrowing the land for a construction equipment yard from the state government before the delivery of the Project equipment. (Hakha Mechanical Compound No.2, tentatively named) - Ground leveling, fencing and appointing security personnel at the Hakha Mechanical Compound No.2 in order to keep the Project equipment in safe custody.
2	Securing of site office		○	As the need arises
3	Manufacture and procurement of the Project equipment	○		
4	Inland transportation of the Project equipment	○		Between a manufacturer's factory and a port in Japan
5	Marine transportation, customs clearance and handling of taxes	-	-	
	(1) Responsibility for marine/air transportation of the Project equipment to Myanmar	○		
	(2) Tax exemption and customs clearance at the port of disembarkation		○	
	(3) Inland transportation of the Project equipment from the port of disembarkation to the delivery point	○		Delivery points are described in "2-2-2 Basic Plan, (1) Overall Plan".
	(4) Ensuring safe inland transportation route from the port of disembarkation to the delivery point		○	For example, removing soils and ensuring the carriage way which is wide enough (at least 12 feet) on the transportation route when a landslide happens in Chin State.
6	Inland transportation of the Project equipment from the delivery points in the Project to final destinations to utilize in the target road construction		○	Road/Bridge Test Equipment - To final destination in Kachin State and Chin State from RRL/BRL as shown in Table 2-2.15 and Table 2-2.16 CTC-training Equipment - To final destination in Kachin State and Chin State from CTC as shown in Table 2-2.21 and Table 2-2.22

No.	Item	Scope		Remarks
		Japan	Myanmar	
7	Appropriate operation and management of the Project equipment and spare parts		○	
8	Procedures and measures necessary for acquiring the following permits: Registration of equipment ■ 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. DOH will be responsible for arranging the registration and/or permission for delivery of equipment from concerned organizations without delay.
9	Assembly and adjustment of construction and maintenance equipment	○		
10	Handover inspection, operation training and maintenance guidance for the Project equipment	○		Myanmar side will secure and assign the personnel to participate in the said training and guidance.
11	Dispatching Japanese instructors for the Soft Component	○		
12	Appointing participants as trainees in the Soft Component		○	
13	Budgets and materials, etc. necessary for the Soft Component, which is to be prepared by Myanmar side		○	<u>Kachin State and Chin State</u> - Budgets and materials for the pilot road construction in Kachin State and Chin State, and the pilot works of slope protection in Chin State <u>CTC-training Equipment</u> - Training materials, such as a concrete, rebar and timber materials, etc. necessary in the training course using CTC-training Equipment
14	Implementation of the target road construction		○	Myanmar side will secure adequate budgets, materials and personnel such as engineers, operators and labors, etc.
15	Bearing all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		○	
16	Bearing the following commissions paid to the Japanese bank for banking services based upon the Banking Arrangement (B/A): ■ Cost of opening an account in a Japanese certified foreign exchange bank ■ Payment commission		○	

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 an agreement for consulting services with the Consultant that is recommended by JICA and strive to ensure the smooth implementation of a detailed design and procurement supervision.

Moreover, where necessary, it will dispatch specialist engineers to witness the factory inspections and pre-shipment inspections of the Project equipment, 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 the Project equipment
- Confirmation of shipping arrangement and inland transportation methods for transporting the Project equipment
- Confirmation of the assignment of personnel concerned with assembly of the Project equipment and the initial operation training, etc.

2) Quality control

The Consultant will implement supervision to determine whether the quality of the Project 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 the Project equipment
- Attendance of factory inspections of the Project equipment, or checking of factory inspection results
- Checking of packing, transportation and temporary storage methods on site
- Checking of guidelines for trial operation, adjustment and inspection
- Supervision of the site assembly of the Project equipment and witnessing of trial operation, adjustment and inspection

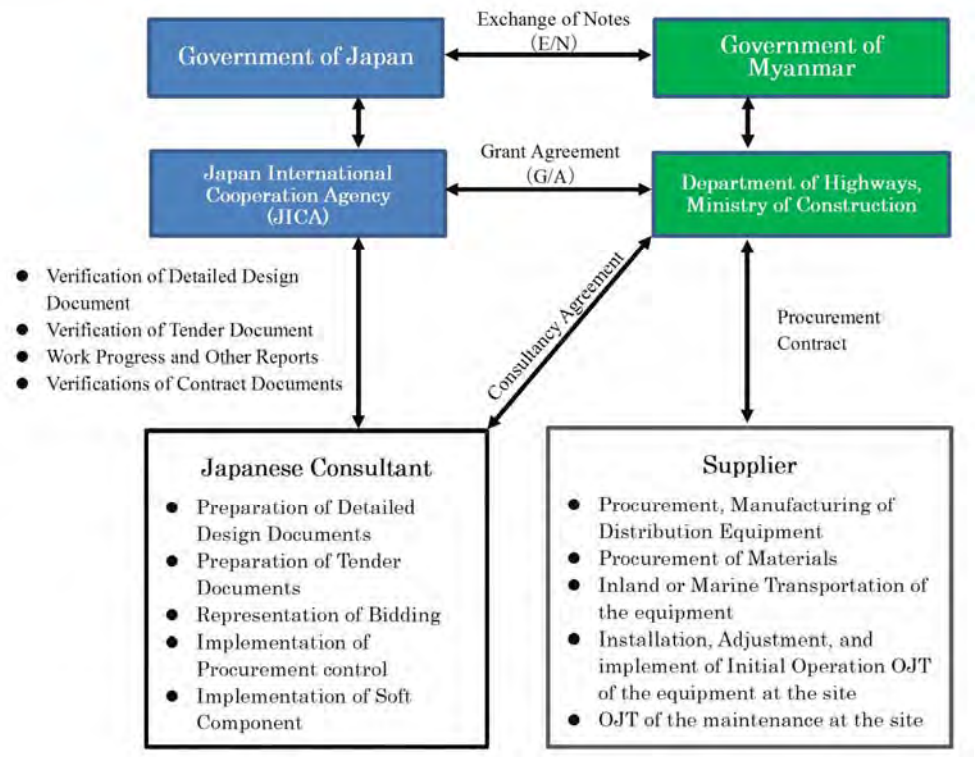
3) Safety control

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 rules and appointment of safety manager
- Prevention of accidents through inspection of safety devices on work tools and equipment, etc.
- Operation training including safety instructions for safe operation of construction equipment
- Planning of inland transportation routes, enforcement of slow driving and prevention of load collapse
- Wearing of safety gear (helmets, safety shoes, gloves, etc.)

(2) Overall relationships for Project implementation

Figure 2-2.9 shows the relationships between the Project implementing parties.



Source: Prepared by the Survey Team

Figure 2-2.9 Project Implementation Relationships

(3) Procurement supervisor

The Supplier(s) will procure and assemble the construction and maintenance equipment and implement the initial operational guidance, etc. based on the contract with the Myanmar side. It will also conduct schedule control, quality control and safety control during the work. The Consultant's

procurement supervisor will instruct and supervise the Supplier(s).

2-2-4-5 Quality Control Plan

The Consultant will implement supervision to determine whether the quality of the Project 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 the Project equipment
- Attendance of factory inspections of the Project equipment, or checking of factory inspection results
- Checking of packing, transportation and temporary storage methods on site
- Checking of guidelines for trial operation, adjustment and inspection
- Supervision of the site assembly of the Project equipment and witnessing of trial operation, adjustment and inspection

2-2-4-6 Procurement Plan

Because the construction equipment and spare 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.

Table 2-2.32 to Table 2-2.35 show countries of procurement in the Project.

Table 2-2.32 Country of Procurement for Construction Equipment

No.	Equipment	Procured from		
		Japan	Myanmar	Thailand
1	Bulldozer	○		○
2	Excavator (Crawler)	○		
3	Hydraulic Breaker	○		
4	Wheel Excavator	○		
5	Motor Grader	○		○
6	Wheel Loader	○		
7	Sheep Foot Compactor	○		
8	Vibratory Tandem Roller	○		
9	Tire Roller	○		
10	Plate Compactor	○		
11	Asphalt Kettle	○		
12	Bitumen Distributor	○		
13	Asphalt Hand Sprayer	○		
14	Chip Spreader	○		
15	Mobile Crusher	○		

16	Water Bowser (Tanker)	○		
17	Dump Truck	○		
18	Cab-back Crane	○		
19	Rough Terrain Crane	○		
20	Low Bed Semi-trailer (with Tractor Head)	○		
21	Low Bed Self-loading Truck	○		
22	Mobile Workshop	○		
23	Inspection Vehicle			○
24	Generator	○		
25	Concrete Sprayer	○		
26	Desktop Computer		○	
27	Database Software	○		

Table 2-2.33 Country of Procurement for Road/Bridge Test Equipment

No.	Equipment	Procured from		
		Japan	Myanmar	Thailand
1. Equipment for Geotechnical Investigation				
1-1	Boring Machine with Standard Accessories	○		
2. Equipment for Geotechnical Test				
2-1	Triaxial Apparatus	○		
2-2	Sieves Set and Shaker for Soil	○		
2-3	CBR Test Apparatus	○		
2-4	Digital Moisture Meter	○		
2-5	Dynamic Cone Penetrometer	○		
2-6	Soil Density Apparatus (Sand Replacement Method)	○		
3. Equipment for Concrete Test				
3-1	Pan Type Concrete Forced Mixer	○		
3-2	Concrete Compressive Strength Testing Device	○		
3-3	Load Cell with Digital Tester for Calibration	○		
3-4	Sieves Set and Shaker for Aggregate	○		
3-5	Specific Gravity Apparatus for Coarse Aggregate	○		
3-6	Photometer	○		
3-7	Aggregate Crashing and Test Apparatus	○		
3-8	Unbonded Capping Apparatus	○		
3-9	Concrete Test Hammer	○		
4. Common Equipment				
4-1	Oven	○		
4-2	Digital Caliper	○		

Table 2-2.34 Country of Procurement for Operator-training Equipment

No.	Equipment	Procured from		
		Japan	Myanmar	Thailand
1	Mini Dozer	○		
2	Mini Excavator (Crawler)	○		
3	Mini Wheel Loader	○		
4	Mini Vibratory Tandem Roller	○		
5	Mini Cab-back Crane	○		

Table 2-2.35 Country of Procurement for CTC-training Equipment

No.	Equipment	Procured from		
		Japan	Myanmar	Thailand
1. Survey Equipment				
1-1	Total Station	○		
1-2	Survey Instrument Tools	○		
2. Formwork Equipment				
2-1	Circular Saw	○		
2-2	Pistol-Grip (corded) Drill	○		
2-3	Table Saw	○		
2-4	Electric Planer	○		
2-5	Baggage for Carpenter's Tools	○		
3. Concrete Work Equipment				
3-1	Concrete Vibrator	○		
3-2	High Frequency Generator	○		
3-3	Concrete Mixer	○		
4. Road Work Equipment				
4-1	Walk Behind Concrete Saw	○		
4-2	Asphalt Hand Sprayer	○		
4-3	Plate Compactor	○		
4-4	Safety Facilities under Construction	○		
5. Rebar Work Equipment				
5-1	Bar Bending Machine	○		
5-2	Bar Cutting Machine	○		
6. Scaffolding Material				
6-1	Prefabricated Scaffolding	○		
6-2	Pipe Scaffolding	○		
6-3	Travelling Scaffolding	○		
6-4	Tools for Set Up Scaffolding	○		
7. Safety Item				
7-1	Personal Protective Safety Items	○		

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, DOH 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 DOH 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 DOH 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

(1) Background of the Soft Component

The Soft Component in the Project is designed to promote capacity of personnel in the government organizations with regard to ⅰ) usage and maintenance of construction equipment, ⅱ) appropriate allocation and utilization of advanced equipment for road works, ⅲ) technique for slope protection to mountain roads, ⅳ) capacity of engineers and trainers working in training centers.

The existing road construction and maintenance equipment in Kachin State and Chin State is centrally controlled by Mechanical Equipment Compound (North) in Mandalay of DOH, MOC. From here, equipment is allocated to states including Kachin and Chin under the Compound's jurisdiction. Although the Compound conducts actual control, its ledgers are paper-based and there are numerous problems in the system. Under the circumstances, it is important to upgrade DOH's management system to an advanced one namely "the Ledger Control System".

In order to realize safe and high-quality roads, DOH personnel are required to learn method for appropriate allocation of equipment to suit type of works and proper operation technique under the Ledger Control System for the equipment. Pilot projects are prepared using part of target road in Kachin State and Chin State for DOH personnel to enhance capacity for construction management and operation technique. The pilot project are useful both for the practical training of construction technique to suit actual site conditions and for the practical training of equipment management system.

Slope cutting is required for the project in mountainous Chin State. Concrete sprayers are planned to be provided as they are very effective machine to stabilize slopes in the area where landslides and slope failures are common in rainy seasons. As there is little technical knowledge and experience for slope protection in DOH personnel, however, it is necessary to promote their capacity by teaching a series of fundamentals about investigation, design, construction and by carrying out a pilot work at a slope in the target road to learn efficient utilization of the project equipment.

In addition to provision of construction equipment for construction sites in Kachin State and Chin State, training equipment is planned to be provided to the Central Training Center (CTC) in Yangon. The equipment is used for training of civil engineers and skilled workers to enhance their capacity. It is important to carry out demonstration of training for each course of subject to promote efficiency of training. In the demonstration of training, safety training is included, as well. The safety training will include introduction of accidents that can happen during road and bridge works aiming to transplant Japanese highly developed awareness on importance of safety.

(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.

Objective ①

Project equipment and spare parts are efficiently managed and maintained with existing

equipment and spare parts.

Objective ②

Project equipment is allocated appropriately for road construction and their potential performance is fully utilized.

Objective ③

Slope protection is appropriately carried out at mountain roads as a result of learning technique for concrete sprayers.

Objective ④

As a result of learning efficient training method utilizing project equipment at CTC, even better personnel start to grow in Myanmar.

(3) Soft Component Outputs

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

Output 1: A system that enables employees of Mechanical Equipment Compound (North) in Mandalay to administer the operating conditions of the Project equipment and stock conditions of spare parts is developed. (Objective ①)

Output 2: Employees of Kachin State and Chin State can grasp the operating conditions of equipment assigned to the stock yard and work sites as well as the need and urgency of maintenance, and through establishment of a systematic control setup with the Mechanical Equipment Compound in Mandalay, they can promptly respond to equipment failures. (Objective ①)

Output 3: The capability of road construction management of DOH site engineers in Kachin State and Chin State is improved, and technique to fully utilize performance of project equipment is achieved by engineers. (Objective ②)

Output 4: DOH engineers master techniques of topographic survey, investigation, design, construction supervision and maintenance for slope stability and master the techniques to utilize project equipment. (Objective ③)

Output 5 Personnel at CTC gain effective method of training using project equipment and learn to be able to provide safety training. (Objective ④)

(4) Soft Component Activities (Plan of Inputs)

Activities set for each soft component is summarized as shown below.

Activities	Target Organization	Relevant Output
(1) Equipment Management System	Mechanical Department in Upper Myanmar, Mechanical teams at Director's Offices in Kachin State and Chin State	Output 1, 2
(2) Pilot Road Construction	Road construction teams at Director's Office in Kachin State and	Output 3

	Chin State	
(3) Slope Stability and Protection	Road Section, Road Research Laboratory, Director's Office in Chin State	Output 4
(4) Training at Central Training Center	Central Training Center (CTC)	Output 5

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) Equipment Management System

Item	Contents
Venue	Mandalay Mechanical Compound, Kachin State and Chin State Office
Targeted Personnel	Responsible personnel at the Mandalay Mechanical Compound, and responsible employees of Kachin State and Chin State
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 Computer - Database Software
Contents of activities	The training consists of two stages; first time for practical training and 2nd time for evaluation and follow-up. The composition is to assure trainees' mastering know-how so that effective utilization will last for long time. Venues will be at Mandalay Mechanical Compound (for Output 1), which is the central organization in Upper Myanmar, and be at Kachin State and Chin State Office (for Output 2), respectively.

2) Pilot Road Construction

Item	Contents
Venue	Out of the roads targeted in Kachin State and Chin State, a section of approximately 200 km around their state's capital
Targeted Personnel	Road engineers and equipment operators in Kachin State and Chin State
Utilized training materials	- Paving manual
Practical training equipment	- Project procured equipment
Contents of activities	Before the guidance at pilot works on site, preliminary discussion and confirmation with engineers in Kachin State and Chin State are necessary regarding budget, execution planning and works materials procurement. Thus the local activities comprise two stages.

3) Slope Stability and Protection

Item	Contents
Venue	Road Section (Naypyitaw), Road Research Laboratory(Yangon), and Director's Office in Chin State
Targeted Personnel	Road engineers and equipment operators at Road Section of Naypyitaw head office, Road Research Laboratory and Director's Office in Chin State
Utilized training materials	- Fundamental materials for topographic survey, investigation, stability analysis, design and construction of slopes in road works - Guideline for slope protection works for road
Practical training equipment	- Project procured equipment : Concrete sprayer, Survey equipment and Boring machine
Contents of activities	On the First time in Myanmar, lectures on technical fundamentals of slope stabilization will be given at two venues, Naypyitaw and Yangon. Then preparatory training for the pilot project will be provided in Chin State to two groups, one group for design and construction and the other for site investigation by boring. On the Second time, the pilot project will be carried out.

4) Training at Central Training Center

Item	Contents
Venue	Central Training Center (CTC)
Targeted Personnel	Lecturers of Central Training Center, civil engineers and skilled workers
Utilized training materials	- Guideline for basic skills in civil works (Formwork, Concrete Work, Road Work, Steel Work, Scaffolding) - Guideline for safety measures in road works
Practical training equipment	- Project equipment for Central Training Center
Contents of activities	The Activities include 6 training courses for CTC: Topographic survey, Formwork, Concrete Work, Road Work, rebar Work and Scaffolding. Each course provides practical training with guidance on safety measures. Another activity included here is to compile improvement plan of existing training programs exercised at CTC and its affiliated body Mechanical Training Center in Insein, Yangon.

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 as below.

Table 2-2.36 Implementation Schedule

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
TENDERING STAGE	4 months															
- Preparation of Tender Documents																
- Obtaining of Approval for Tender Documents																
- Tender Opening (in Japan)																
- Tender Evaluation, Concluding the Contract with the Successful Tenderer																
- **Soft Component**																
PROCUREMENT/MANUFACTURING AND TRANSPORTATION	14.5 months															
- Preparation of Manufacturing Drawings by the Supplier																
- Procurement, Manufacturing, Transportation and set up of Equipment																
- Initial Operation Training																
- **Soft Component**																

2-3 Obligations of Recipient Country

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

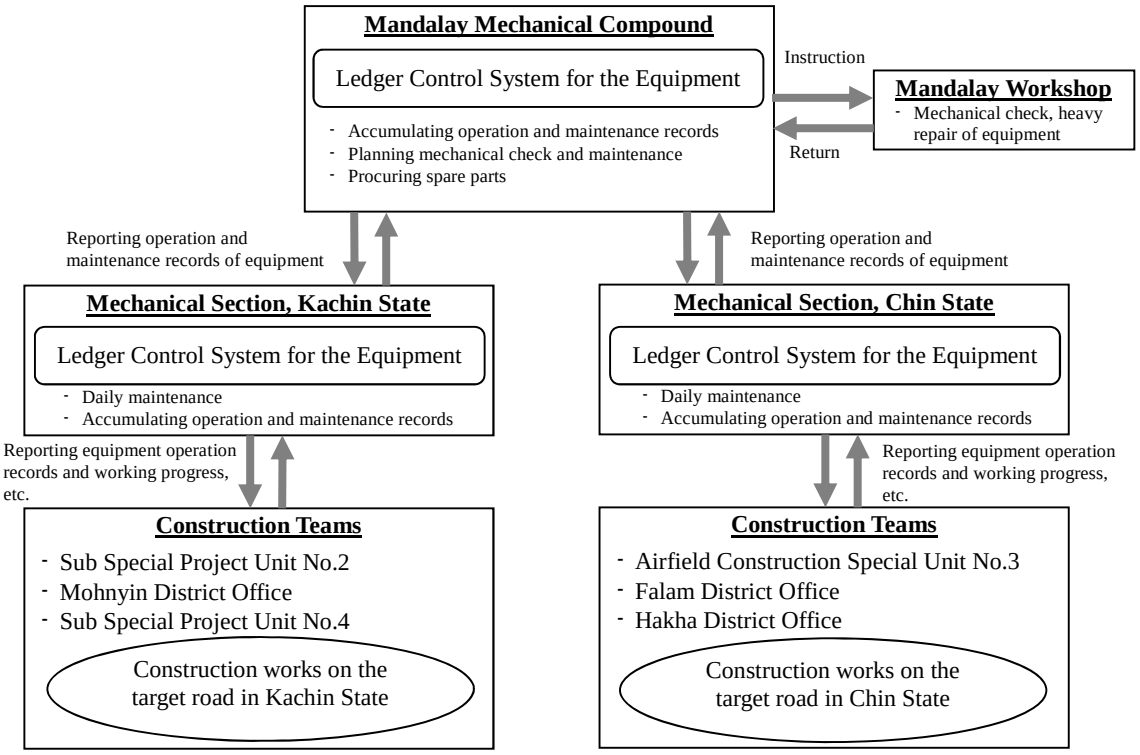
- Following conclusion of the E/N, it will immediately open an account with a Japanese bank. Moreover, the Myanmar side will bear any costs incurred in opening the account.
- With respect to Project officials (Japanese and third country nationals), it will take steps to ensure the entry to Myanmar, stay 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.
- In the case where authorization needs to be secured from government offices, it will apply for and secure the necessary authorization.
- It will secure sites to safely store the equipment and spare parts procured in the Project and implement appropriate operation and maintenance.
- It will secure the budget, personnel and materials needed to conduct the Soft Component.
- It will secure the budget, personnel and materials needed for the target road construction 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.
- It will operate and surely maintain the roads that are constructed under Japan's Grant Aid.
- It will bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project.

DOH, the executing agency, 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 Myanmar side can fulfill its obligations.

2-4 Project Operation and Maintenance Plan

Following handover of the Project equipment, construction teams under Kachin State Office and Chin State Office will be responsible to conduct actual works on the target road, respectively. In daily works, these construction teams need to periodically and timely report equipment operation records and working progress, etc.

Figure 2-4.1 shows the operation and management structure for appropriate use of the Project equipment.



Source: Prepared by the Survey Team

Figure 2-4.1 Operation and Management Structure

Road/Bridge test equipment under the Project needs to be controlled by RRL and BRL. It will be utilized for relevant testing and quality controls at target site in Kachin State and Chin State as well as existing test equipment.

Operator-training equipment under the Project needs to be controlled by mechanical sections in Upper Myanmar and Lower Myanmar. Following handover to Mandalay Mechanical Compound and Mayangone Mechanical Compound, it will be utilized for operator-training at training centers in those areas.

CTC-training equipment under the Project needs to be controlled by CTC. It will be utilized in training courses at CTC as well as existing training and will be in practical use for the target road construction in Kachin State and Chin State.

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

(1) Japan side

This chapter is closed due to the confidentiality.

(2) Myanmar side

The costs shown below must be borne by Myanmar side.

Approximately USD133,000 (Approximately 15,930,000 JPY)

Items		Cost Amount（USD）
Preparation for the delivery of equipment	Securing the storage for spare parts of construction equipment in Kachin State	5,000
	Securing a construction equipment yard in Chin State	10,000
Soft Component	Pilot road construction in Kachin State	36,000
	Pilot road construction in Chin State	24,000
	Pilot works of slope protection in Chin State	25,000
	CTC Training	10,000
Commissions to the bank based on Banking Arrangement		23,000

In addition, Myanmar side is supposed to provide the budget of USD 25.5 million for Kachin State and of USD 15.8 million for Chin State in order to implement the target roads for three year.

(3) Conditions of cost estimation are as follows.

1. Timing of cost estimation : March 2015
2. Exchange rate : 1USD = 119.79 Japanese Yen (JPY)
3. Implementation schedule : Shown in the “2-2-4-9 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 and manage the Project equipment, DOH needs to conduct sustainable maintenance by itself. Therefore, it will be necessary for DOH to take necessary steps to secure the budget and conduct appropriate maintenance based on efficient operation and maintenance plans. Estimated maintenance cost and fuel cost are described as follows:

(1) Maintenance Cost

Annual costs of maintaining construction equipment (periodic maintenance and site repair works, etc.) procured in the Project are estimated approximately 1,323,000 JPY (11,911,000 Kyat) in Kachin State and approximately 1,291,000 JPY (11,618,000 Kyat) in Chin State in the initial three years. These amounts are estimated in consideration of spare parts corresponding to 3,000 working hours and procured with construction equipment in the Project, and are nearly equal to 3.9% (Kachin State) and 4.7% (Chin State) of the average equipment maintenance cost of each state over the past three years as shown in Table 2-5.1 and Table 2-5.2, respectively.

Myanmar side needs to allocate sufficient budgets for equipment maintenance, accordingly.

Table 2-5.1 Estimated costs for equipment maintenance in Kachin State (Initial 3 years)

	Name of Equipment	Estimated Value of Equipment (Kyat) (a)	Machine's life span (years) (b)	Mainte. cost Rate (in life span) (%) (c)	Av. mainte. cost/year (Kyat) (d) = a×(c/100)÷b	Number of machines (e)	Maintenance costs for equipment in initial 3 years		
							Cost rate (%) (f)	Cost/unit (Kyat) (g) = d×(f/100)	Annual expenditure (Kyat×1000) (h) = e×g
1.	Bulldozer (crawler)	253,530,000	15	50	8,451,000	3	5	422,550	1,268
2.	Excavator (Crawler)	115,101,000	15	40	3,069,360	3	5	153,468	460
4.	Wheel Excavator	168,123,600	15	40	4,483,296	2	5	224,165	448
5.	Motor Grader	154,800,000	15	35	3,612,000	3	5	180,600	542
6.	Wheel Loader	144,000,000	15	60	5,760,000	3	5	288,000	864
7.	Sheep foot Compactor	125,280,000	15	30	2,505,600	3	5	125,280	376
8.	Vibratory Tandem Roller	99,072,000	15	30	1,981,440	2	5	99,072	198
9.	Tire Roller	93,816,000	15	40	2,501,760	2	5	125,088	250
10.	Plate Compactor	1,026,000	15	45	30,780	10	5	1,539	15
11.	Asphalt Kettle	84,960,000	15	20	1,132,800	2	5	56,640	113
12.	Bitumen Sprayer Truck	140,940,000	15	50	4,698,000	2	5	234,900	470
13.	Asphalt Hand Sprayer	6,982,200	15	50	232,740	10	5	11,637	116
14.	Chip Spreader	34,992,000	15	45	1,049,760	2	5	52,488	105
15.	Mobile Crusher	311,400,000	15	50	10,380,000	2	5	519,000	1,038
16.	Water Bowser (Tanker)	63,180,000	15	40	1,684,800	4	5	84,240	337
17.	Dump truck	73,530,000	15	50	2,451,000	30	5	122,550	3,677
18.	Boom Truck	89,775,000	15	30	1,795,500	2	5	89,775	180
19.	Rough Terrain Crane	331,200,000	15	30	6,624,000	1	5	331,200	331
20.	Low Bed Semi-trailer with Tractor Head	187,200,000	15	30	3,744,000	2	5	187,200	374
21.	Mobile Workshop	162,000,000	15	50	5,400,000	2	5	270,000	540
22.	Inspection Vehicle	25,312,941	15	50	843,765	2	5	42,188	84
23.	Generator	58,138,560	15	35	1,356,566	3	5	67,828	203
	Estimated annual expenditure for machinery maintenance in initial three years								11,991
	Average annual expenditure for machinery maintenance in Public Works Kachine State Office (for the last three years , 2012-2014)								307,300
	The rate of increase in expenditure for machinery maintenance based on the average annual expenditure for last three years (%)								3.9

Note: Exchange rate: 1.0 JPY = 9.0 Kyat (as of June, 2015)
Source: Prepared by Survey Team

Table 2-5.2 Estimated costs for equipment maintenance in Chin State (Initial 3 years)

	Name of Equipment	Estimated Value of Equipment (Kyat) (a)	Machine's life span (years) (b)	Mainte. cost Rate (in life span) (%) (c)	Av. mainte. cost/year (Kyat) (d) = a×(c/100)÷b	Number of machines (e)	Maintenance costs for equipment in initial 3 years		
							Cost rate (%) (f)	Cost/unit (Kyat) (g) = d×(f/100)	Annual expenditure (Kyat×1000) (h) = e×g
1.	Bulldozer (crawler)	253,530,000	15	50	8,451,000	3	5	422,550.0	1,268
2.	Excavator (Crawler)	115,101,000	15	40	3,069,360	3	5	153,468.0	460
3.	Hydraulic Breaker	18,225,000	15	25	303,750	3	5	15,187.5	46
4.	Wheel Excavator	168,123,600	15	40	4,483,296	2	5	224,164.8	448
5.	Motor Grader	154,800,000	15	35	3,612,000	3	5	180,600.0	542
6.	Wheel Loader	144,000,000	15	60	5,760,000	3	5	288,000.0	864
7.	Sheep foot Compactor	125,280,000	15	30	2,505,600	3	5	125,280.0	376
8.	Vibratory Tandem Roller	99,072,000	15	30	1,981,440	2	5	99,072.0	198
9.	Tire Roller	93,816,000	15	40	2,501,760	2	5	125,088.0	250
10.	Plate Compactor	1,026,000	15	45	30,780	10	5	1,539.0	15
11.	Asphalt Kettle	84,960,000	15	20	1,132,800	2	5	56,640.0	113
12.	Bitumen Sprayer Truck (Bitumen Distributor)	140,940,000	15	50	4,698,000	2	5	234,900.0	470
13.	Asphalt Hand Sprayer	6,982,200	15	50	232,740	10	5	11,637.0	116
14.	Chip Spreader	34,992,000	15	45	1,049,760	2	5	52,488.0	105
15.	Mobile Crusher	311,400,000	15	50	10,380,000	2	5	519,000.0	1,038
16.	Water Bowser (Tanker)	63,180,000	15	40	1,684,800	4	5	84,240.0	337
17.	Dump truck	73,530,000	15	50	2,451,000	20	5	122,550.0	2,451
18.	Cab-back Crane	89,775,000	15	30	1,795,500	2	5	89,775.0	180
19.	Rough Terrain Crane	331,200,000	15	30	6,624,000	1	5	331,200.0	331
20.	Low-bed Self-loading Truck (Equipment Carrier)	187,200,000	15	30	3,744,000	2	5	187,200.0	374
21.	Mobile Workshop	162,000,000	15	50	5,400,000	2	5	270,000.0	540
22.	Inspection Vehicle	25,312,941	15	50	843,765	2	5	42,188.2	84
23.	Generator	58,138,560	15	35	1,356,566	3	5	67,828.3	203
24.	Concrete Sprayer	151,305,300	15	80	8,069,616	2	5	403,480.8	807
	Estimated annual expenditure for machinery maintenance in initial three years (Kyat/year)								11,618
	Average annual expenditure for machinery maintenance in Public Works Chin State Office (for the last three years , 2012-2014)								246,200
	The rate of increase in expenditure for machinery maintenance based on the average annual expenditure for last three years (%)								4.7

Note: Exchange rate: 1.0 JPY = 9.0 Kyat (as of June, 2015)
Source: Prepared by Survey Team

Moreover, after using up spare parts procured in the Project, Myanmar side needs to additionally procure spare parts by itself for continuous maintenance of equipment including heavy repair works. Since above-mentioned spare parts corresponding to 3,000 working hours amounts to approximately 10% of a main unit of equipment, annual costs of maintaining equipment are estimated approximately 25,796,000 JPY (232,161,000 Kyat) in Kachin State and approximately 25,110,000 JPY (225,987,000 Kyat) in Chin State in consideration of additional procurement of spare parts, as shown in Table 2-5.3 and Table 2-5.4, respectively.

Table 2-5.3 Estimated costs for equipment maintenance in Kachin State (After 3 years)

	Name of Equipment	Estimated Value of Equipment (Kyat) (a)	Machine's life span (years) (b)	Mainte. cost Rate (in life span) (%) (c)	Av. mainte. cost/year (Kyat) (d) = a×(c/100)÷b	Number of machines (e)	Annual expenditure (f) = d×e
1.	Bulldozer (crawler)	253,530,000	12	40	8,451,000	3	25,353
2.	Excavator (Crawler)	115,101,000	12	30	2,877,525	3	8,633
4.	Wheel Excavator	168,123,600	12	30	4,203,090	2	8,406
5.	Motor Grader	154,800,000	12	25	3,225,000	3	9,675
6.	Wheel Loader	144,000,000	12	50	6,000,000	3	18,000
7.	Sheep foot Compactor	125,280,000	12	20	2,088,000	3	6,264
8.	Vibratory Tandem Roller	99,072,000	12	20	1,651,200	2	3,302
9.	Tire Roller	93,816,000	12	30	2,345,400	2	4,691
10.	Plate Compactor	1,026,000	12	42	35,910	10	359
11.	Asphalt Kettle	84,960,000	12	10	708,000	2	1,416
12.	Bitumen Sprayer Truck	140,940,000	12	40	4,698,000	2	9,396
13.	Asphalt Hand Sprayer	6,982,200	12	47	273,470	10	2,735
14.	Chip Spreader	34,992,000	12	42	1,224,720	2	2,449
15.	Mobile Crusher	311,400,000	12	40	10,380,000	2	20,760
16.	Water Bowser (Tanker)	63,180,000	12	30	1,579,500	4	6,318
17.	Dump truck	73,530,000	12	40	2,451,000	30	73,530
18.	Boom Truck	89,775,000	12	20	1,496,250	2	2,993
19.	Rough Terrain Crane	331,200,000	12	20	5,520,000	1	5,520
20.	Low Bed Semi-trailer with Tractor Head	187,200,000	12	20	3,120,000	2	6,240
21.	Mobile Workshop	162,000,000	12	40	5,400,000	2	10,800
22.	Inspection Vehicle	25,312,941	12	40	843,765	2	1,688
23.	Generator	58,138,560	12	25	1,211,220	3	3,634
						Total:	232,161

Note: Exchange rate: 1.0 JPY = 9.0 Kyat (as of June, 2015)
Source: Prepared by Survey Team

Table 2-5.4 Estimated costs for equipment maintenance in Chin State (After 3 years)

	Name of Equipment	Estimated Value of Equipment (Kyat) (a)	Machine's life span (years) (b)	Mainte. cost Rate (in life span) (%) (c)	Av. mainte. cost/year (Kyat) (d) = a×(c/100)÷b	Number of machines (e)	Annual expenditure (f) = d×e
1.	Bulldozer (crawler)	253,530,000	12	40	8,451,000	3	25,353
2.	Excavator (Crawler)	115,101,000	12	30	2,877,525	3	8,633
3.	Hydraulic Breaker	18,225,000	12	15	227,813	3	683
4.	Wheel Excavator	168,123,600	12	30	4,203,090	2	8,406
5.	Motor Grader	154,800,000	12	25	3,225,000	3	9,675
6.	Wheel Loader	144,000,000	12	50	6,000,000	3	18,000
7.	Sheep foot Compactor	125,280,000	12	20	2,088,000	3	6,264
8.	Vibratory Tandem Roller	99,072,000	12	20	1,651,200	2	3,302
9.	Tire Roller	93,816,000	12	30	2,345,400	2	4,691
10.	Plate Compactor	1,026,000	12	42	35,910	10	359
11.	Asphalt Kettle	84,960,000	12	10	708,000	2	1,416
12.	Bitumen Sprayer Truck (Bitumen Distributor)	140,940,000	12	40	4,698,000	2	9,396
13.	Asphalt Hand Sprayer	6,982,200	12	47	273,470	10	2,735
14.	Chip Spreader	34,992,000	12	42	1,224,720	2	2,449
15.	Mobile Crusher	311,400,000	12	40	10,380,000	2	20,760
16.	Water Bowser (Tanker)	63,180,000	12	30	1,579,500	4	6,318
17.	Dump truck	73,530,000	12	40	2,451,000	20	49,020
18.	Cab-back Crane	89,775,000	12	20	1,496,250	2	2,993
19.	Rough Terrain Crane	331,200,000	12	20	5,520,000	1	5,520
20.	Low-bed Self-loading Truck (Equipment Carrier)	187,200,000	12	20	3,120,000	2	6,240
21.	Mobile Workshop	162,000,000	12	40	5,400,000	2	10,800
22.	Inspection Vehicle	25,312,941	12	40	843,765	2	1,688
23.	Generator	58,138,560	12	25	1,211,220	3	3,634
24.	Concrete Sprayer	151,305,300	12	70	8,826,143	2	17,652
						Total:	225,987

Note: Exchange rate: 1.0 JPY = 9.0 Kyat (as of June, 2015)
Source: Prepared by Survey Team

(2) Fuel Cost

A direct cost for road construction implemented by DOH consists of material costs, labor costs and fuel costs. Although composition ratio of such a direct cost is deemed to differ according to site condition, construction works, etc., approximately 30% as material costs, 40% as labor costs and 30% as fuel costs are normally allocated by DOH, according to interviews with DOH officials. Table 2-5.5 shows fuel costs calculated by above approximate ratio.

Table 2-5.5 Annual Construction Cost on Target Roads and Fuel budget calculated by Composition Ratio

State	Annual Direct Cost (100%)	Fuel Budget included in Direct Cost (30%)
Kachin State	USD 8.1 million (8,732,691,000 kyat)	USD 2.43 million (2,619,807,000 kyat)
Chin State	USD 5.0 million (5,390,550,000 kyat)	USD 1.50 million (1,617,165,000 kyat)

Note: Annual direct cost was calculated in accordance with the amounts indicated in 2-5-1 Initial Cost Estimation in consideration of 5% of additional cost such as equipment maintenance cost, site preparation cost, etc.
(e.g. USD 25.5 million / 1.05 / 3year = USD 8.1 million, Kachin State)
Exchange rate: 1.0 JPY = 9.0 Kyat (as of June, 2015)
Source: Prepared by Survey Team based on interviews with DOH officials

On the other hand, annual fuel costs by equipment are estimated as shown in Table 2-5.6 and Table 2-5.7. Fuel costs for the target road construction in Kachin State and Chin State are estimated approximately 127,615,000 JPY (1,148,540,000 Kyat) and 131,231,000 JPY (1,181,077,000 Kyat), respectively, and these amount estimated based on running hours are less than budgets shown in above Table 2-5.5. Therefore fuel costs for the target road in both states are deemed expendable and DOH needs to secure sufficient fuel costs for construction in both states.

Table 2-5.6 Estimated Fuel Costs in Kachin State

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. Bulldozer	165	0.175	28.9	1200	3	103,950	946	98,337
2. Excavator (Crawler)	100	0.175	17.5	1200	3	63,000	946	59,598
3. Wheel Excavator	90	0.175	15.8	1200	2	37,800	946	35,759
4. Motor Grader	130	0.133	17.3	1200	3	62,244	946	58,883
5. Wheel Loader	115	0.153	17.6	2160	3	114,016	946	107,859
6. Sheep Foot Compactor	80	0.152	12.2	1200	3	43,776	946	41,412
7. Vibratory Tandem Roller	50	0.152	7.6	1200	2	18,240	946	17,255
8. Tire Roller	65	0.100	6.5	1200	2	15,600	946	14,758
9. Plate Compactor (Petrol Engine)	2.0	0.301	0.6	400	10	2,408	1,100	2,649
10. Asphalt Kettle	17	0.170	2.9	300	2	1,734	946	1,640
11. Bitumen Distributor	115	0.090	10.4	100	2	2,070	946	1,958
(Sub-engine)	10	0.090	0.9	300	2	540	946	511
12. Asphalt Hand Sprayer(Petrol Engine)	2.5	0.227	0.6	200	10	1,135	1,100	1,249
13. Chip Spreader(Petrol Engine)	3	0.127	0.3	200	2	127	1,100	140
14. Mobile Crusher	40	0.185	7.4	2400	2	35,520	946	33,602
15. Water Bowser (Tanker)	150	0.040	6.0	600	3	10,800	946	10,217
16. Dump Truck	190	0.050	9.5	2160	30	615,600	946	582,358
17. Cab-back Crane	190	0.050	9.5	500	1	4,750	946	4,494
18. Rough Terrain Crane	160	0.103	16.5	500	1	8,240	946	7,795
19. Low bed Semi-trailer (with Tractor Head)	275	0.075	20.6	600	1	12,375	946	11,707
20. Mobile Workshop	140	0.050	7.0	500	2	7,000	946	6,622
21. Inspection Vehicle	55	0.047	2.6	700	2	3,619	946	3,424
22. Generator	96	0.170	16.3	1000	3	48,960	946	46,316
							Estimated annual expenditure for fuel	1,148,540

Note: Exchange rate: 1.0 JPY = 9.0 Kyat (as of June, 2015)
Source: Prepared by Survey Team

Table 2-5.7 Estimated Fuel Costs in Chin State

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. Bulldozer	165	0.175	28.9	1200	3	103,950	946	98,337
2. Excavator (Crawler)	100	0.175	17.5	1200	3	63,000	946	59,598
3. Wheel Excavator	90	0.175	15.8	1200	2	37,800	946	35,759
4. Motor Grader	130	0.133	17.3	1200	3	62,244	946	58,883
5. Wheel Loader	115	0.153	17.6	2160	3	114,016	946	107,859
6. Sheep Foot Compactor	80	0.152	12.2	1200	3	43,776	946	41,412
7. Vibratory Tandem Roller	50	0.152	7.6	1200	2	18,240	946	17,255
8. Tire Roller	65	0.100	6.5	1200	2	15,600	946	14,758
9. Plate Compactor (Petrol Engine)	2.0	0.301	0.6	400	10	2,408	1,100	2,649
10. Asphalt Kettle	17	0.170	2.9	300	2	1,734	946	1,640
11. Bitumen Distributor	115	0.090	10.4	100	2	2,070	946	1,958
(Sub-engine)	10	0.090	0.9	300	2	540	946	511
12. Asphalt Hand Sprayer(Petrol Engine)	2.5	0.227	0.6	200	10	1,135	1,100	1,249
13. Chip Spreader(Petrol Engine)	2.5	0.127	0.3	200	2	127	1,100	140
14. Mobile Crusher	40	0.185	7.4	2400	2	35,520	946	33,602
15. Water Bowser (Tanker)	150	0.040	6.0	600	3	10,800	946	10,217
16. Dump Truck	190	0.050	9.5	2160	30	615,600	946	582,358
17. Cab-back Crane	190	0.050	9.5	500	1	4,750	946	4,494
18. Rough Terrain Crane	160	0.103	16.5	500	1	8,240	946	7,795
19. Low-bed Self-loading Truck	270	0.075	20.3	600	1	12,150	946	11,494
20. Mobile Workshop	140	0.050	7.0	500	2	7,000	946	6,622
21. Inspection Vehicle	55	0.047	2.6	700	2	3,619	946	3,424
22. Generator	96	0.170	16.3	1000	3	48,960	946	46,316
23. Concrete Sprayer (Generator)	48	0.170	8.2	1000	1	8,160	946	7,719
(Air Compressor)	140	0.189	26.5	1000	1	26,460	946	25,031
							Estimated annual expenditure for fuel	1,181,077

Note: Exchange rate: 1.0 JPY = 9.0 Kyat (as of June, 2015)
Source: Prepared by Survey Team

CHAPTER 3

PROJECT EVALUATION

Chapter 3 Project Evaluation

3-1 Preconditions

Preconditions to be undertaken by Myanmar for implementation of the Project side are as follows:

- To ensure that tax exemption, clearance, and smooth in-land transportation of the provided equipment.
- To bear 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 the Project sites.
- To use and maintain the Project equipment in proper manner.
- 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 the Project are described below.

- Preparation of delivery sites for equipment
- Preparation of storages for spare parts
- Prompt commencement of road construction on the target roads as soon as equipment is procured.
- The equipment conveyance by land to construction sites
- Appoint engineers and operators for road construction on the target road
- Land acquisition necessary for road construction on the target road
- Proper Operation and Maintenance (O&M) of the equipment and appoint engineers for O&M.
- Continuous practices of technique and skill assisted through the Soft Component
- Proper consideration for people living along the target road
- Proper explanation to residents regarding a construction plan, schedule, matters to be paid attention, etc.

3-3 Important Assumptions

In Kachin State, conflicts between the Government and Kachin Independence Organization (KIO) are still unpredictable. Although the target road of the Project in Kachin State is located in comparatively stable area where KIO is regarded as not dominant, it is important that the target road and equipment procured in the Project are secured soundly and that concerning parties of the Project are secured safely as well.

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. Also the Project includes human resource development through trainings in the Soft Component. Thus, the Project covers item 2 above, as well.

The target road in Kachin State is a part of the main road that connects Mandalay, Sagaing and Myitkyina. Heavy vehicle for logistics and passenger cars congests the existing one-lane road and pavement surface has deteriorated. Improvement of the existing road is required to improve transport efficiency and traffic safety. The Project will not only contribute to regional development in Kachin State through achieving stable traffic to neighboring region, but also will vitalize the regional economy and improve living standards and the convenience of residents along the target road.

The target road in Chin State is the main road that connects Kalay in Sagaing Region and Hakha and is the only road that distributes goods from Kaley Hakha. At present, there is not an airport in Chin State due to lack of flat lands. The shortest way connecting major cities Yangon and Mandalay to Hakha is to move by air to Kalay and then drive on the target road. Frequent sediment disaster such as landslides and slope failure make the target road in poor conditions impassable. Improvement of the existing road is urgently required to not only improve a transportation route for goods distribution, but also to secure traffic safety for vehicles and pedestrians. In the circumstances, the Regional Development Project for Poverty Reduction Phase I loaned by Japan that includes road construction at the adjacent section is currently ongoing. In collaboration with the loan project above, the road stably connecting Chin State and neighboring areas will be secured and is expected to contribute to regional development of the state.

As mentioned above, improvement of the target roads in Kachin State and Chin State is crucial and imminent issue and also is in line with the road development strategy in medium and long period of the central and state governments in Myanmar.

3-4-2 Effectiveness

3-4-2-1 Quantitative effectiveness

Approximately 649,000 people live along the target road in Kachin State, approximately 64,000 people live along the target road in Chin State. The Project can provide direct benefit to those people.

It is expected that improvement of the target roads is going to increase driving speed from current 32km/hr. to 60km/hr. in Kachin State and from current 28km/hr. to 40km/hr. in Chin State. This increase enables to cut travel time by 47% on the target section in Kachin State and by 30% on the target section in Chin State.

Table3-4.1 and Table3-4.2 show quantitative effects of the Project.

Table3-4.1 Quantitative effects of the Project in Kachin State

Indicator	Baseline, 2015	Target, 2020
Average driving speed on the target road（km/h）	Approx. 32km/h	Approx. 60km/h
Total length of road improvement on the target road（km）	0km	Approx. 141km

Table3-4.2 Quantitative effects of the Project in Chin State

Indicator	Baseline, 2015	Target, 2020
Average driving speed on the target road（km/h）	Approx. 28km/h	Approx. 40km/h
Total length of road improvement on the target road（km）	0km	Approx. 109km

DOH will measure the average driving speed indicated in the above table by actual driving in the target year 2020.

3-4-2-2 Qualitative effectiveness

1) Kachin State

Table3-4.3 indicates qualitative effects of the Project in Kachin State.

Table3-4.3 Qualitative effects of the renovated roads in Kachin State

Current Problems	Expected Effectiveness
Traffic Safety The target road of this project is 141km long section from Namiti to Nansiaung on a trunk road connecting the state capital Myitkyina and Mandalay which is a major city in upper Myanmar. The road, however, has only a single paved lane with narrow shoulders causing danger of collision when large vehicles pass each other. Pedestrians, bicycles going to school, motorcycles are pushed aside when large vehicles pass along provoking fear of hitting.	**Effect on Traffic Safety** Providing 2 paved lanes, large vehicles can pass each other without lowering speed. Possibility of collision will be mitigated, and safety of pedestrians and bicycles will be enhanced going on improved shoulders.
Economy Kachin State is relatively wealthy in Myanmar with products of agriculture, forestry and jewel etc. The area along the project road is flat at the elevation of about 200m above sea level, where farm land widely spreads.	**Promotion of Production** Thanks to shortened transport time and cost savings, delivery of agricultural products to consuming cities such as Mandalay and Myitkyina will be more efficient, which will result in promotion of production and economic development
School-commuting road There is at least 1 primary school at each of 21 villages/towns. There are 12 villages without middle school, from where students have to go to a middle school in different village by bicycle (as of March 2015). The longest distance can be 20km spending 3 hours a day.	**Improvement of School-commuting** Time spent for commuting school will be shortened and safety enhanced by improving road.
Access to hospitals There are 8 hospitals along the target road (as of March 2015). As major hospital is located at the capital city Myitkyina, serious patients have to be transferred there. Long travel on bumpy road can even worsen the patients' condition.	**Improvement of Access to Medical Services** Travel time is expected to be shortened by 47%. Chance of saving dying patients will increase. Moreover residents along the improved road will have better medical conditions by obtaining easier access to preventive health care in Myitkyina.

2) Chin State

Table3-4.4 indicates qualitative effects of the Project in Kachin State.

Table3-4.4 Qualitative effects of the renovated roads in Chin State

Current Problems	Expected Effectiveness
Traffic Safety The target section of this project is 109km from the point near Falam to the state capital Hakka on Kalay-Hakha road. Running through Arakan Mountains, the road consists of continuous short curves with steep gradient. It has only a single paved lane with narrow shoulders causing danger of collision and fall when large vehicles pass each other. Moreover, land slide often occurs to block traffic in rainy seasons.	**Effect on Traffic Safety** Widening road area with 1 lane pavement and slope protection will enable more stable traffic conditions, mitigation danger of collision and fall.
Economy There are 64,000 people living along the target road, 70% of which are in Hakha(as of March 2015). They cultivate small stepped farm land on slopes for their own consumption. Surplus is sold at the market in Hakha to earn some money that buys other consumables.	**Promotion of Production** Employment during construction period will increase cash income to the people living in the area. Improved transport to Hakha, which is the largest consumption center, will promote agricultural production to enhance economy of the area.
School-commuting road There are 9,900 children going to primary or middle school along the road. There is at least 1 primary school at each of 19 villages/towns. There are, however, 6 villages without middle school, from where students have to go to a middle school in different village by bicycle(as of March 2015). The longest distance can be 15km spending 2 hours a day.	**Improvement of School-commuting** Bicycles are used for school commuting for long distance. Improved pavement with widened shoulders will shorten commuting time and promote safety.
Access to hospitals Large hospitals with sufficient facilities and staff are only in Hakha and Falam. Those who live in villages far from the two cities have to travel long time to access good medical treatment.	**Improvement of Access to Medical Services** Travel time along the road is expected to be shortened by 30%. That would increase the frequency of doctors' round treatment. Residents along the road will have easier access to preventive health care as well.

As mentioned in 3-4 Project Evaluation, the Project is deemed proper and effective.

APPENDICES

APPENDIX 1

MEMBER LIST OF THE STUDY TEAM

1. Member List of the Study Team

【First Field Survey】

Name	Work Assignment	Position
Hiroshi TAKEUCHI	Leader	Director Team 2 Transportation and ICT Group, Infrastructure and Peacebuilding Department, Japan International Cooperation Agency (JICA)
Toru TSUCHIHASHI	Planning and Management	Planning and Coordination Division, Team 1 Transportation and ICT Group, Infrastructure and Peacebuilding Department, Japan International Cooperation Agency (JICA)
Masatsugu KOMIYA	Chief Consultant/ Implementation Planner	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.
Hisashi FURUICHI	Geography and Geology Surveyor/ Slope Protection	Yachiyo Engineering Co., Ltd.
Susumu TANAKA	Social Surveyor	Yachiyo Engineering Co., Ltd.
Koji Masuda	Procurement Condition/ Cost Estimation	Yachiyo Engineering Co., Ltd.

【**Second Field Survey**】

Name	Work Assignment	Position
Nobuyuki TSUNEOKA	Leader	Senior Advisor Infrastructure and Peacebuilding Department, Japan International Cooperation Agency (JICA)
Yoshihiro KAWASAKI	Planning and Management	Planning and Coordination Division, Team 1 Transportation and ICT Group, Infrastructure and Peacebuilding 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.
Koji Masuda	Safety Planner	Yachiyo Engineering Co., Ltd.
Yoichi HAMATSU	Coordinator/ Safety Planning Assistant	Yachiyo Engineering Co., Ltd.

APPENDIX 2

STUDY SCHEDULE

2. Study Schedule

First Field Survey Schedule

Day	Date		JICA		Chief Consultant/Implementation Planner	Deputy Chief Consultant/Road and Bridge Planner	Equipment Planner/Maintenance Planner	Geography and Geology Surveyor / Slope Protection	Social Surveyor	Procurement Condition/Cost Estimation	Accomodation
			Team Leader	Planning Management							
			Hiroshi Takeuchi	Toru Tsuchihashi	Masatsugu Komiya	Isao Takahashi	Etsuo Hashiguchi	Hisashi Furuichi	Susumu Tanaka	Koji Masuda	
-	8-Feb-15	Sun	-	-	-	Trip by air: [Tokyo(11:45) NH913 → Yangon(17:15)]	-	-	-	-	Yangon
-	9-Feb-15	Mon	-	-	-	9:00 Meeting with Mechanical Compound in Yangon · Yangon → Hpa-an (by car)	-	-	-	-	Hpa-an
-	10-Feb-15	Tue	-	-	-	· Review Kayin State's Project	-	-	-	-	Hpa-an
1	11-Feb-15	Wed	-	-	Trip by air: [Tokyo(11:45) NH913 → Yangon(17:15)]	· Hpa-an → Yangon (by car)	Trip by air: [Tokyo(11:45) NH913 → Yangon(17:15)]				Yangon
2	12-Feb-15	Thu	-	-	10:00 Meeting with PW Mechanical Training Center in Yangon (Insein) 13:00 Meeting with PW Road Research Laboratory and Bridge Research Laboratory in Yangon						Yangon
3	13-Feb-15	Fri	-	-	9:00 Meeting with Mayangone Mechanical Compound (Review Kayin State's Project) · Trip by air: [Yangon(10:45) → Naypyitaw(11:45)] 13:00 Meeting with PW, Naypyitaw (Discussion on Inception Report and Survey Schedule, etc.)						Naypyitaw
4	14-Feb-15	Sat	-	-	· Naypyitaw → Yangon (by car)	· Internal meeting · Meeting with PW's engineers					Naypyitaw
5	15-Feb-15	Sun	Trip by air: [Tokyo(11:45) NH913 → Yangon(17:15)] · Meeting with Jp experts of Road TC		· Data Collection in Yangon	· Naypyitaw → Mandalay (by car)					Yangon/Madalay
6	16-Feb-15	Mon	· Internal meeting 11:00 Meeting with JICA Myanmar Office 13:30-14:30 Courtesy call on Embassy of Japan 15:00-16:30 Meeting withPW RRL, SRL, CTC in Yangon			· Meeting with Mechanical Department in Upper Myanmar and Mechanical Compound in Mandalay · Meeting with Mandalay Workshop					Yangon/Madalay
7	17-Feb-15	Tue	9:15-10:15 Meeting with Mehanical Dept. & Mechanical Equipment Compound in Lower Myanmar (Mayangon) 11:00-12:00 Mechanical Training Center (Insein) · Trip by air: [Yangon(13:30) → Kalay(16:00)] Air KBZ K7 226 · Meeting with PW Chin State in Kalay			· Meeting with Mechanical Training Center in Mandalay · Trip by air: [Mandalay(15:10) → Kalay(16:00)] Air KBZ K7 226					Kalay
8	18-Feb-15	Wed	· Field Survey: around Kaley · Trip by air: [Kalay(15:35) → Mandalay(16:25)] Air Bagan W9 416	· Field Survey: Kalay → Hakha · Visit PW Falam Office	Same as Team Leader		· Field Survey: Kalay → Hakha · Visit PW Falam Office · Meeting with PW Chin State Office				Mandalay/Hakha
9	19-Feb-15	Thu	· Mandalay → NPT (by car) 13:00 Courtesy call & meeting with PW-HQ	· Field Survey: Hakha - Gangaw road · Gangaw→Nyaung U (by car)	Same as Team Leader		· Field Survey in Chin State				NPT/ Nyaung U/ Hakha
10	20-Feb-15	Fri	9:00 Signing on M/D	· Nyaung U→NPT (by car)	Same as Team Leader		Ditto				NPT/ Hakha
11	21-Feb-15	Sat	· Naypyitaw → Yangon (by car) Trip by air: [Yangon → Tokyo]		· Data Collection	· Naypyitaw → Mandalay (by car) · Trip by air: [Mandalay(14:30) → Kalay(15:20)] Air Bagan W9 415	Ditto				Yangon/ Kalay/ Hakha
12	22-Feb-15	Sun	-	-	· Data Collection	· Kalay → Hakha (by car)	Ditto				Yangon/Hakha
13	23-Feb-15	Mon	-	-	· Reporting to JICA Myanmar Office · Leaving Myanmar	· Field Survey in Chin State					Hakha
14	24-Feb-15	Tue	-	-	-	Ditto					Hakha
15	25-Feb-15	Wed	-	-	-	Ditto					Hakha
16	26-Feb-15	Thu	-	-	-	· Hakha → Nyaung U (by car)					Nyaung U
17	27-Feb-15	Fri	-	-	-	· Internal Meeting					Nyaung U
18	28-Feb-15	Sat	-	-	-	· Nyaung U → Mandalay (by car)					Mandalay
19	1-Mar-15	Sun	-	-	-	· Field Survey on Mandalay-Shwebo-Mytkyina Road					Mandalay
20	2-Mar-15	Mon	-	-	-	· Trip by air: [Madalay(14:40) → Myitkyina(15:50)] Air KBZ K7 622					Myitkyina
21	3-Mar-15	Tue	-	-	-	· Meeting with PW Kachin State Office · Survey at Myitkyina Mechanical Compound · Field Survey in Myitkyina					Myitkyina
22	4-Mar-15	Wed	-	-	-	· Field Survey in Myitkyina					Myitkyina
23	5-Mar-15	Thu	-	-	-	Ditto					Myitkyina
24	6-Mar-15	Fri	-	-	-	Ditto					Myitkyina
25	7-Mar-15	Sat	-	-	-	· Trip by air: [Myitkyina(15:35) → Madalay(16:45)] Air Bagan W9 152					Mandalay
26	8-Mar-15	Sun	-	-	-	· Mandalay → Naypyitaw (by car) · Team Meeting					Naypyitaw
27	9-Mar-15	Mon	-	-	-	· Meeting with PW, Naypyitaw (Discussion on Implementation Plan, etc.)					Naypyitaw
28	10-Mar-15	Tue	-	-	-	· Meeting with PW, Naypyitaw (Reporting Field Survey)					Naypyitaw
29	11-Mar-15	Wed	-	-	-	· Naypyitaw → Yangon (by car) · Internal Meeting					Yangon
30	12-Mar-15	Thu	-	-	-	· Interview to local transporter · Meeting with PW Central Training Center in Yangon	· Preparation of Draft Field Report, etc.		· Interview international donors, NGOs, etc.	Same as Deputy Chief Consultant	Yangon
31	13-Mar-15	Fri	-	-	-	· Meeting with PW Central Training Center in Yangon · Meeting with Bridge Research Laboratory			Ditto	Same as Deputy Chief Consultant	Yangon
32	14-Mar-15	Sat	-	-	-	· Internal Meeting · Data Collection					Yangon
33	15-Mar-15	Sun	-	-	-	· Data Collection	· Preparation of Draft Field Report, etc.			· Data Collection	Yangon

Day	Date		JICA		Chief Consultant/Implementation Planner	Deputy Chief Consultant/Road and Bridge Planner	Equipment Planner/Maintenance Planner	Geography and Geology Surveyor / Slope Protection	Social Surveyor	Procurement Condition/Cost Estimation	Accomodation
			Team Leader	Planning Management							
			Hiroshi Takeuchi	Toru Tsuchihashi	Masatsugu Komiya	Isao Takahashi	Etsuo Hashiguchi	Hisashi Furuichi	Susumu Tanaka	Koji Masuda	
34	16-Mar-15	Mon	-	-	-	· Meeting with Road Research Laboratory · Meeting with PW Central Training Center			Ditto	Same as Deputy Chief Consultant	Yangon
35	17-Mar-15	Tue	-	-	-	· Data Collection		Ditto		· Data Collection	Yangon
36	18-Mar-15	Wed	-	-	-	· Reporting to Mechanical Training Center in Yangon		Trip by air: [Yangon → Tokyo]		Same as Deputy Chief Consultant	Yangon
37	19-Mar-15	Thu	-	-	-	· Reporting to Mechanical Training Center in Yangon · Reporting to PW Road Research Laboratory and Bridge Research Laboratory in Yangon		Arrival in Tokyo		Same as Deputy Chief Consultant	Yangon
38	20-Mar-15	Fri	-	-	-	· Preparation of Draft Field Report, etc.		-	-	· Interview local transporters · Interview a construction equipment agents	Yangon
39	21-Mar-15	Sat	-	-	-	Ditto		-	-	Ditto	Yangon
40	22-Mar-15	Sun	-	-	-	Ditto		-	-	Trip by air: [Yangon → Tokyo]	Yangon/Airplain
41	23-Mar-15	Mon	-	-	-	Ditto		-	-	Arrival in Tokyo	Yangon
42	24-Mar-15	Tue	-	-	-	Ditto		-	-	-	Yangon
43	25-Mar-15	Wed	-	-	-	· Reporting to JICA Myanmar Office Trip by air: [Yangon → Tokyo]		-	-	-	Airplane
44	26-Mar-15	Thu	-	-	-	Arrival in Tokyo		-	-	-	-

Second Field Survey Schedule

Day	Date		JICA		Lecturer for Safety Management Seminar		Chief Consultant/Implementation Planner	Deputy Chief Consultant/Road and Bridge Planner	Equipment Planner/Maintenance Planner	Safety Management	Coordinator/Safety Management Assistant	Accomodation
			Team Leader	Planning Management								
			Nobuyuki Tsuneoka	Yoshihiro Kawasaki	Go Nakaya	Yutaka Sakaguchi	Masatsugu Komiya	Isao Takahashi	Etsuo Hashiguchi	Koji Masuda	Yoichi Hamatsu	
1	5-Jul-15	Sun	-	-	-	-	-	-	-	-	Trip by air: [Tokyo(11:00) NH913 → Yangon(15:40)]	Yangon
2	6-Jul-15	Mon	-	-	-	-	-	-	-	-	・ Preparation of Safty Management Seminar with Central Training Center in Yangon	Yangon
3	7-Jul-15	Tue	-	-	-	-	-	Trip by air: [Tokyo(11:00) NH913 → Yangon(15:40)]	-	Trip by air: [Tokyo(11:00) NH913 → Yangon(15:40)]	・ Preparation of Safty Management Seminar with Central Training Center in Yangon	Yangon
4	8-Jul-15	Wed	-	-	-	-	-	・ Meeting with Road Research Laboratory and Bridge Research Laboratory in Yangon	-	・ Preparation of Safty Management Seminar with Central Training Center in Yangon		Yangon
5	9-Jul-15	Thu	Trip by air: [Tokyo(11:00) NH913 → Yangon(15:40)]		-	-	-	・ Meeting with Mayangone Mechanical Compound in Yangon	-	・ Preparation of Safty Management Seminar with Central Training Center in Yangon		Yangon
6	10-Jul-15	Fri	・ Meeting with Central Training Center in Yangon		-	-	-	Same as Team Leader	-	・ Preparation of Safty Management Seminar with Central Training Center in Yangon ・ Assembling scaffolds to be introduced in Safty Management Seminar at Central Training Center		Yangon
7	11-Jul-15	Sat	・ Internal meeting		-	-	Trip by air: [Tokyo(11:00) NH913 → Yangon(15:40)]	・ Internal meeting	Trip by air: [Tokyo(11:00) NH913 → Yangon(15:40)]	・ Yangon → Mandalay (by car)		Yangon/Madalay
8	12-Jul-15	Sun	・ Internal meeting		Trip by air: [Tokyo(11:00) NH913 → Yangon(15:40)]		・ Internal meeting ・ Yangon → Naypyitaw (by car)			・ Preparation of Safty Management Seminar in Mandalay		Yangon/Naypyitaw/Madalay
9	13-Jul-15	Mon	・ Trip by air: [Yangon → Naypyitaw] ・ Meeting for explanation of Draft Final Report and Minites of Discussion(draft) with MoC ・ Meeting for preparation of Safty Management Seminar in Naypyitaw with MoC		・ Trip by air: [Yangon → Naypyitaw] ・ Meeting for preparation of Safty Management Seminar in Naypyitaw with MoC		・ Meeting for explanation of Draft Final Report and Minites of Discussion(draft) with MoC			・ Mandalay → Naypyitaw (by car) ・ Meeting for preparation of Safty Management Seminar in Naypyitaw with MoC		Naypyitaw
10	14-Jul-15	Tue	[AM] ・ Attending Safety Management Seminar at MoC in Naypyitaw [PM] ・ Signing on Minutes of Discussion ・ Naypyitaw → Mandalay (by car)		[AM] ・ Attending Safety Management Seminar at MoC in Naypyitaw [PM] ・ Naypyitaw → Mandalay (by car)		Same as Team Leader			[AM] ・ Attending Safety Management Seminar at MoC in Naypyitaw [PM] ・ Naypyitaw → Mandalay (by car)		Mandalay
11	15-Jul-15	Wed	・ Attending Safety Management Seminar at Sedona Hotel in Mandalay									Mandalay
12	16-Jul-15	Thu	・ Mandalay → Yangon (by car)									Yangon
13	17-Jul-15	Fri	・ Attending Safety Management Seminar at Central Training Center in Yangon ・ Reporting to JICA Myanmar Office ・ Reporting to Embassy of Japan						・ Attending Safety Management Seminar at Central Training Center in Yangon			Airplane/Yangon
			・ Trip by air: [Yangon → Tokyo]				-		-			
14	18-Jul-15	Sat	Arrival in Tokyo				・ Trip by air: [Yangon → Tokyo]					Airplane
15	19-Jul-15	Sun	-				Arrival in Tokyo					-

APPENDIX 3

LIST OF PARTIES CONCERNED IN THE RECIPIENT COUNTRY

3. List of Parties Concerned in the Recipient Country

Name of Organization	Position
Ministry of Construction	
Mr. Kyaw Linn	Permanent Secretary
Mr. Win Pe	Director General, Department of Highways
Mr. Han Soe	Director General, Department of Bridge
Mr. Khin Mg Swe	Chief Engineer, Bridge
Mr. Myo Nyunt	Chief Engineer, Mechanical
Mr. San Wae	Chief Engineer (Civil), Supervisor of Kachin State, Department of Bridge
Mr. Saw Win Naing	Chief Engineer (Civil), Department of Highways
Mr. Kywe Wa	Director (Finance), Department of Highways
Mr. Khin Maung Aye	Chief Engineer, Department of Building Administration
Dr. Hlaing Moe	Deputy Director (Mechanical), Department of Highways
Ms. Yin Yin Swe,	Deputy Director, Department of Bridge
Dr. Cherry Lin	Staff Officer (Civil), Road Planning, Department of Highways
Mechanical Department in Lower Myanmar, Public Works, Ministry of Construction **Mechanical Equipment Compound (South), Mayangone**	
Ms. Mya Win	Director (Mechanical), Department of Highways
Insein Mechanical Training Center, Public Works, Ministry of Construction	
Mr. Khin Sein (retired)	Assistant Engineer, Mechanical, Principal
Mechanical Department in Upper Myanmar, Public Works, Ministry of Construction **Mechanical Equipment Compound (North), Mandalay**	
Mr. Thaung Tun	Director (Mechanical), Department of Bridge
Mr. Nyein Chan	Assistant Director(Mechanical), Department of Bridge, attached in Mechanical Company (North)
Mr. Myint Naing	Staff Officer, (Mechanical), Department of Bridge
Mr. Nay Moe Naing,	Assistant Director(Mechanical), Department of Bridge, attached in Mechanical Company (South)
Mr. Thet Myo Oo,	Assistant Director(Mechanical), Basic Workshop (North), Department of Bridge
Mr. Ko Ko Oo,	Staff Officer (Mechanical), Base Workshop , Department of Bridge

Mandalay Mechanical Training Center, Public Works, Ministry of Construction

Mr. Khine Myo Myint	Staff officer (Mechanical), Principal of Mechanical Training Center (Mandalay)

Ministry of Construction, Kachin State

Mr. Oo Saw Thein	Director(Civil), Department of Highways
Mr. Kyaw Myo Htun	Deputy Director (Civil), Department of Bridge
Mr. Win Shein	Deputy Director, Road Construction Sub Special Project Unit (4), Department of Highways
Ms. Win Win Maw	Assistant Director (Civil), Myitkyina District, Department of Highways
Mr. Wan Zaw	Staff Officer (Mechanical), Department of Highways

Ministry of Construction, Chin State

Mr. Myat Ko Ko	Director (Civil), Department of Highways
Mr. Tha Peng	Assistant Director (Civil), Department of Highways
Mr. Tint lwin	Deputy Director (Civil), Department of Highways
Mr. Kyaw Swe	Assistant Director (Civil), Falam District Department of Highways
Mr. Win Maw	Staff Officer (Mechanical), Department of Highways
Mr. Win Tin	Staff Officer (Mechanical), Department of Highways

Road Research Laboratory (RRL), Ministry of Construction

Ms. Mya Mya Win	Director (Civil), Department of Building Administration
Ms. Htar Zin Thinn Zaw	Deputy Director (Civil), Department of Highways
Mr. Nay Linn Tun	Staff Officer (Civil), Department of Highways
Mr. Nyi Nyi Kyaw	Staff Officer (Civil), Department of Building Administration
Mr. Tint Lwing Oo	Staff Officer (Civil), Department of Highways
Mr. Aung Myint	Consultant

Bridge Research Laboratory (BRL), Ministry of Construction

Ms. Yin Yin Swe	Deputy Director (Civil), Department of Bridge
Mr. Aung Kyi	Staff Officer (Civil), Department of Bridge
Mr. Ko Ko	Testing Grade Ⅰ
Mr. Phone Wai	Testing Grade Ⅱ

Ms. Sonny	Testing Grade Ⅱ

Central Training Center, Ministry of Construction

Mr. Oo Han	Director (Civil), Principal of CCTC, Department of Highways
Ms. Win Thidar Aung	Assistant Director (Administration), Department of Highways
Mr. Win Naing Tun	Staff Officer(Administration), Department of Highways

Kachin State Government

Mr. Kaman Donor	Minister of Transportation

Chin State Government

Mr. Hone Ngai	Chief Minister
Mr. Nan Zamone	Minister of Finance
Mr. Var Thawng	Minister of Agriculture and Livestock
Mr. Raw Mang	Minister of Planning and Economy
Mr. Ngun San Aung	Minister of Transport
Mr. Nin Naing	Minister of Development
Dr. Bar Moung	Minister of Social affairs
Mr. Maung Maung San /	Secretary of Chin state

UNOCHA Myitkyina Office

Mr. Cecil Dunne	Head of Kachin Office

UNHCR Myitkyina Office

Mr. Kazuhiro Kaneko	Head of Field Office Myitkyina

UNICEF Myitkyina Office

Mr. Cesar Villar	Chief Field Office Myitkyina

ADB Myanmar Resident Mission

Mr. Daisuke Mizusawa	Senior Infrastructure Specialist

GRET Chin (NGO): Group of Research and Technology

Mr. Tial Lian	Project Coordinator
Mr. Kil Tu	Operation Manager

KMSS Hakha (NGO): Karuna Myanmar Social Services

Mr. James Ngun Hre	Program Manager

Regional Development Project for Poverty Reduction Phase I

Hideki Yoneyama	Oriental Consultants Global Co., Ltd.

Embassy of Japan

Hideaki Matsuo	Counsellor (Economic and ODA)
Shoichi Watanabe	Second Secretary

JICA Myanmar Office

Akihito Sanjo	Senior Representative
Ayumi Kiko	Representative
Tetsushi Hayakawa	Representative
Maki Morikawa	Project Formulation Advisor
Noriko Sakurai	Project Formulation Advisor

APPENDIX 4

MINUTES OF DISCUSSIONS

MINUTES OF MEETING
ON THE PREPARATORY SURVEY
ON THE PROJECT FOR IMPROVEMENT
OF ROAD CONSTRUCTION AND MAINTENANCE EQUIPMENT
IN KACHIN STATE AND CHIN 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 Improvement of Road Construction and Maintenance Equipment in Kachin State and Chin 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. Hiroshi Takeuchi, Director of Team 1, Transportation and ICT Group, Infrastructure and Peacebuilding Department, JICA and is scheduled to stay in the country from February 8th to March 18th, 2015. 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, February 20, 2015

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

Mr. Hiroshi Takeuchi
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 Kachin state and Chin state.

2. Project site

The sites of the Project are located in Kachin State and Chin 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.

(1) Priority sections to be improved/ constructed

(Kachin state)

Priority	Road name	Road length [approx.]
1st	Nansiaung - Myitkyina section in Mandalay - Shwebo - Myitkyina Road	194 km (121 miles)

(Chin state)

Priority	Road name	Road length [approx.]
1st	Falam area (56 miles 2 furlongs) – Hakha section in Kalay - Falam - Hakha Road	109 km (68 miles)
2nd	Hakha - Matupi Road	277 km (173 miles)

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

(2) Types of the road/ bridge structure to be applied to the above sections

1) Pavement type: Bituminous road
2) Bridge structure: RC (reinforced concrete) bridge including pipe/box culvert

(3) Requested equipment component

Both side confirmed the requested equipment component as shown in **ANNEX 3** (hereinafter, the equipment to be procured under the Project is referred to as "the Equipment".). 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 Sections 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

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 July, 2015

7-2. JICA will finalize the final report and send it to the Government of Myanmar by the end of November, 2015

8. Other issues

8-1. Myanmar side agreed to make necessary arrangements for road and bridge construction of the Target Sections, 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.

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. The Team requested that the Target Sections of the Project should be constructed promptly and preferentially after the hand-over of the Equipment, and Myanmar side agreed.

8-5 Myanmar side shall secure enough budget and personnel necessary for the operation and maintenance of the Equipment, including the periodical maintenance work after the completion of the Project.

8-6. Both sides confirmed that equipment for Kachin State would be out of scope, in case the safety would not recover enough and the Team could not conduct sufficient site survey in Kachin state by the end of May, 2015, in order to assess necessity and appropriateness of the components requested by Myanmar side.

8-7 The Team requested Myanmar side to submit the official application of the Project to the Embassy of Japan by the end of May, 2015.

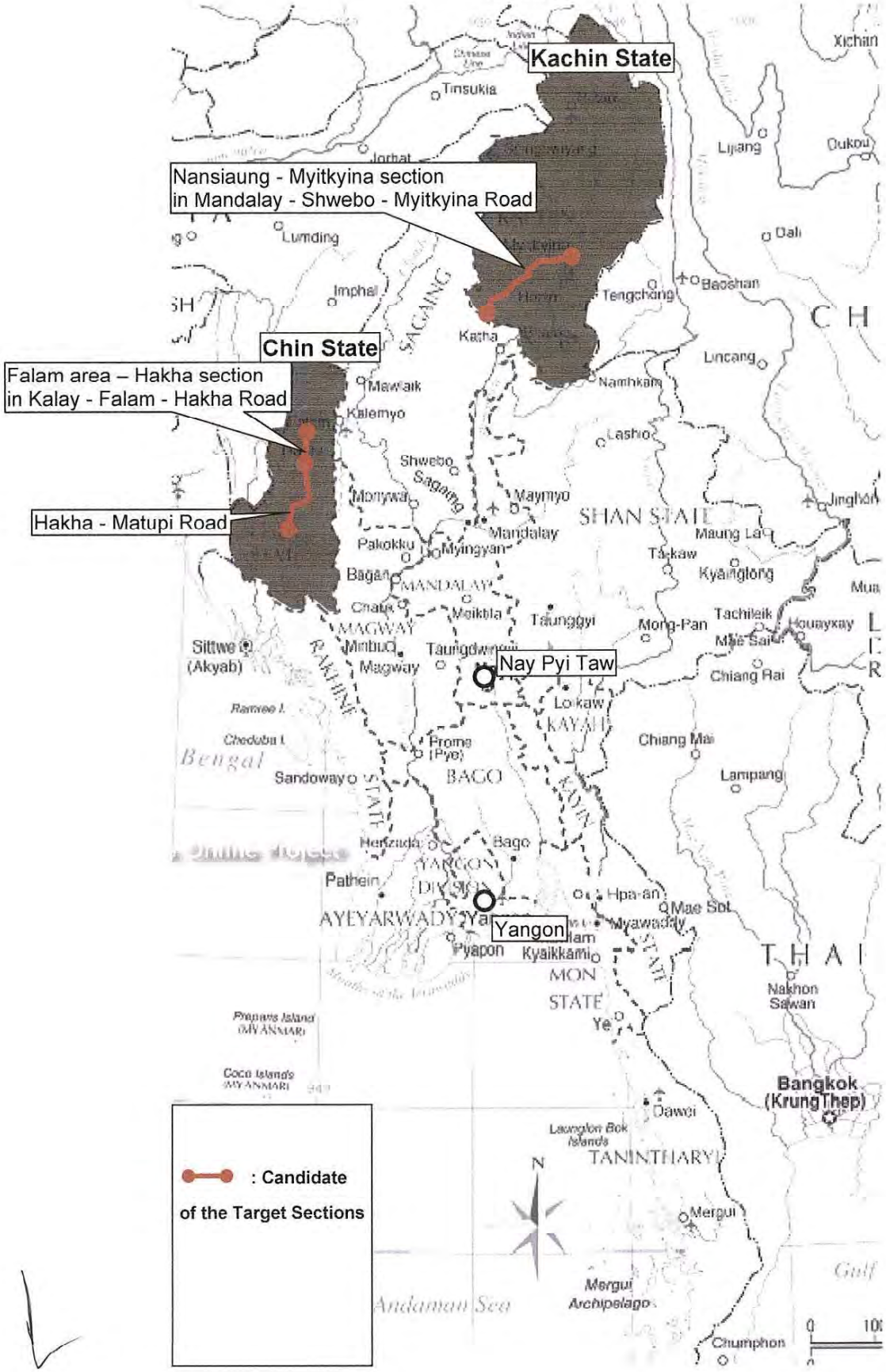
8-8 Myanmar side understood the importance of safety measure in construction and service stage. The Team explained "The Guidance for the Management of Safety for Construction Works in Japanese ODA Projects", and Myanmar side explained that they will respect and refer this Guidance in road construction using the Equipment.

8-9. If JICA receives information concerning suspected corrupt or fraudulent practices, Myanmar side shall take necessary measures in accordance with the Procurement Guidelines in the competition for, or in execution of, the contract funded by the Grant:

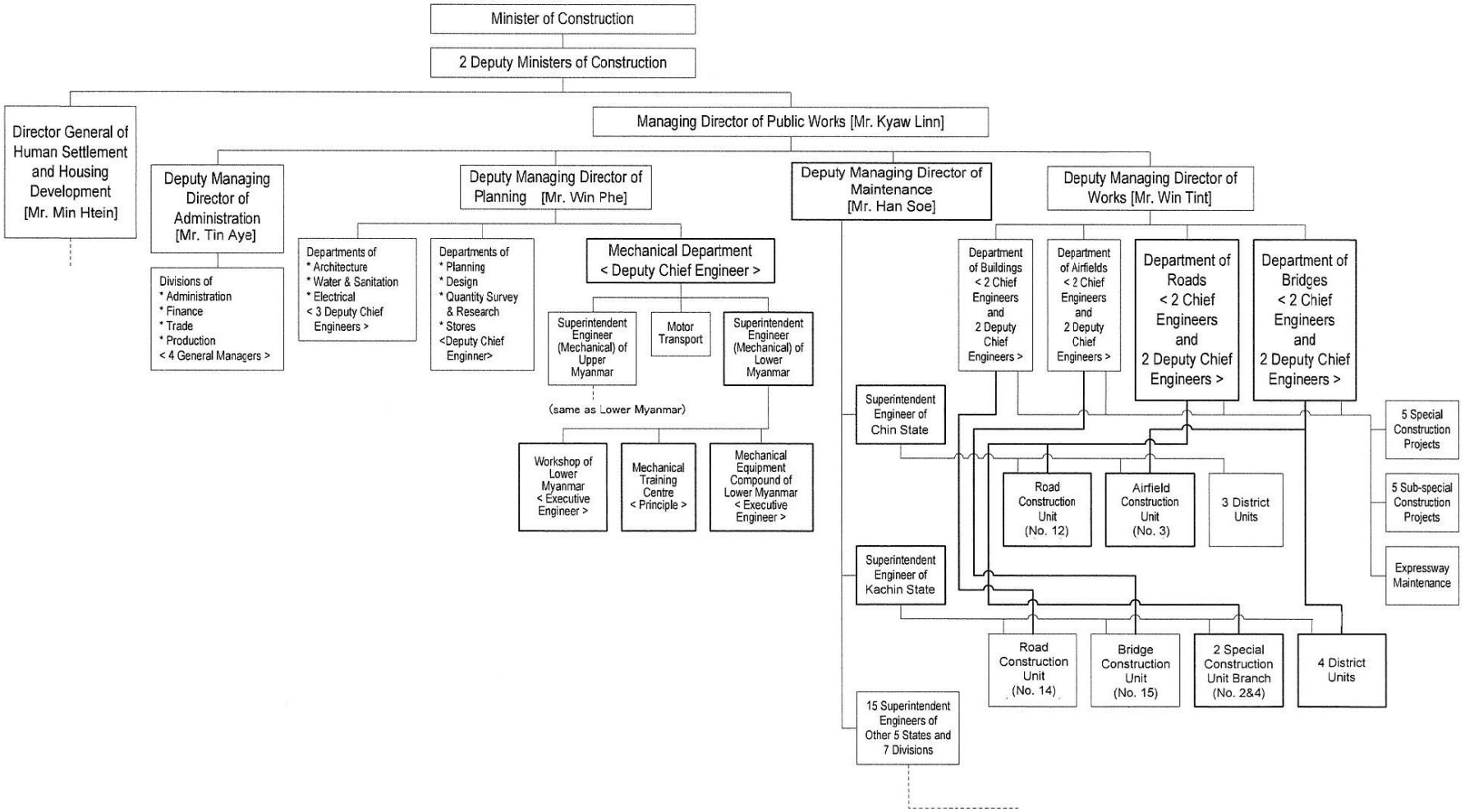
(1) to provide JICA with such information as JICA may reasonably request, including information related to any concerned official of the government and/or public organizations of Myanmar;

(2) not to treat unfairly or unfavorably the physical persons and juridical persons, that provide the information.

Site Map


Kachin State
Nansiaung - Myitkyina section
in Mandalay - Shwebo - Myitkyina Road
Chin State
Falam area – Hakha section
in Kalay - Falam - Hakha Road
Hakha - Matupi Road
Nay Pyi Taw
Yangon
Kachin State
Chin State
Sagaing
Mandalay
Magway
Bago
Yangon
Ayeyarwady
Rakhine
Mon State
Tanintharyi
Shan State
Kayah
Kayin
Andaman Sea
Gulf
Bengal
: Candidate
of the Target Sections

Organization chart of Public Works



ANNEX 3

Tentative requested equipment component

List of equipment.

The delivery point of the equipment shall be respective project sites.

1. For Kachin State

No.	Name of Equipment	Specification	Quantity	Priority
1	Bulldozer (Crawler)	Operation Weight: Approx. 27~28 ton, Engine Output: Approx. 170 kW Straight Tilt Dozer and Multi-shank Ripper with ROPS cab	3	A
2	Excavator (Crawler)	Bucket capacity: Approx. 1.0 m^3 Max. Digging Depth: more than 6 m Operation Weight: Approx. 20 ton Engine Output: Approx. 100 kW	3	A
3	Wheel Excavator	Bucket capacity: Approx. 0.6 m^3 Max. Digging Depth: Approx. 5 m Operation Weight: Approx. 16 ton Engine Output: Approx. 90 kW Max. Travel Speed: 35 km/h	2	A
4	Motor Grader	Engine output: Approx. 130 kW Blade length: Approx. 4 m, with articulation frame Operation weight: Approx. 14 ton	3	A
5	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	3	A
6	Sheep Foot Compactor	Operation Weight: Approx. 13 ton Padfoot drum with removable smooth drum Vibration Power: Approx. 245 kN (25,000 kgf)	3	A
7	Vibratory Tandem Rooler	Operation Weight: Approx. 6~7 ton Smooth drum (front & rear) Vibration Power: (approx.) 70 kN	2	A
8	Tire Roller	Operation Weight: 8 ~ 15 ton (adjustable by ballast) Travel speed: 0 ~ 20 km/h Compaction Width: 2000 mm	2	B
9	Plate Compactor	Weight: 40～60 kg Centrifugal force: 6～10 kN Vibrating plate size : Approx. 550 × 350 (mm)	10	B
10	Asphalt Kettle	Tank capacity : 3,000～4,000 lit. Direct heating type with diesel fuel burner Electric hoist for asphalt drum and asphalt transfer pump with heater Generator 3 ϕ, 415 V, 50 Hz, 20 kVA	2	A
11	Bitumen Sprayer Truck (Bitumen Distributor)	Capacity: 4,000 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
12	Asphalt Hand Sprayer	Capacity: 15~30 lit./min. with heater	10	B
13	Chip Spreader	Dump truck mounted, self-propelled tail-gate type, Hopper : Approx. 0.3 m^3 Spreading width: Approx. 1.6～2.4 m	2	B

No.	Name of Equipment	Specification	Quantity	Priority
14	Mobile Crusher	Operation Weight: Approx.10 t Capacity: Approx. 30 t/h with compact-sized, vibrating screen	2	A
15	Water Bowser (Tanker)	Payload: 10 ton, (10,000 lit.) Engine output: Approx. 150 kW Drive System: 6 x 4, Left-hand steering GVW: Approx. 23 ton	3	B
16	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	30	A
17	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	1	B
18	Rough Terrain Crane	30 ton, Telescopic boom Engine output: Approx. 200 kW	1	A
19	Low bed Semi-trailer (with Tractor Head)	Max. Payload: 30 ton, Rear loading type Two or three axles, 8~16 wheels Air 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	A
20	Mobile Workshop	4x4, cargo truck, with telescopic boom 3 ton crane and equipment and tools necessary to carry out service for construction machines Payload: Approx. 7～10 ton	2	A
21	Inspection Vehicle	4 x 4, Double Cab Pickup, Diesel Engine, Engine output: Approx. 78 kW	2	A
22	Generator	Diesel Engine Driven, 415/240 V, 50 Hz, 150 kVA	3	B
23	Safety Items	--	1 LS	A

2. For Chin State

No.	Name of Equipment	Specification	Quantity	Priority
1	Bulldozer (Crawler)	Operation Weight: Approx. 27~28 ton, Engine Output: Approx. 170 kW Straight Tilt Dozer and Multi-shank Ripper with ROPS cab	3	A
2	Excavator (Crawler)	Bucket capacity: Approx. 1.0 m^3 Capable to attach Hydraulic Breaker Max. Digging Depth: more than 6 m Operation Weight: Approx. 20 ton Engine Output: Approx. 100 kW	3	A
3	Hydraulic Breaker	Attachment of the Excavator (crawler) Operation Weight: 600~800 kg Single Top, Bit size: Approx. Φ= 100 mm, L =: 900 ~ 1100 mm	3	A
4	Wheel Excavator	Bucket capacity: Approx. 0.6 m^3 Max. Digging Depth: Approx. 5 m Max. Cutting Height Approx. 9 m Operation Weight: Approx. 16 ton Engine Output: Approx. 90 kW	2	A

No.	Name of Equipment	Specification	Quantity	Priority
5	Motor Grader	Engine output: Approx. 130 kW, Blade length: Approx. 4 m, with scarifier, and articulation frame Operation weight: Approx. 14 ton	3	A
6	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	3	A
7	Sheep Foot Compactor	Operation Weight: Approx. 13 ton Padfoot drum with removable smooth drum Vibration Power: Approx. 245 kN (25,000 kgf)	3	A
8	Vibratory Tandem Roller	Operation Weight: Approx. 6~7 ton Smooth drum (front & rear) Vibration Power: Approx. 70 kN	2	A
9	Tire Roller	Operation Weight: 8 ~ 15 ton (adjustable by ballast) Travel speed: 0 ~ 20 km/h Compaction Width: 2000 mm	2	B
10	Plate Compactor	Weight:40～60 kg Centrifugal force:6～10 kN Vibrating plate size : Approx. 550 × 350 (mm)	10	B
11	Asphalt Kettle	Tank capacity :3000～4000 lit. Direct heating type with 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
12	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
13	Asphalt Hand Sprayer	Capacity: 15~30 lit./min. with heater	10	B
14	Chip Spreader	Dump truck mounted, self-propelled tail-gate type, Hopper : Approx. 0.3 m^3 Spreading width: Approx.1.6～2.4 m	2	B
15	Mobile Crusher	Operation Weight: Approx. 10 t Capacity: Approx. 30 t/h with compact-sized, vibrating screen	2	A
16	Water Bowser (Tanker)	Payload 10 ton (10,000 lit.) Engine output:(approx.) 150 kW Drive System: 4 x 2, Left-hand steering, Air Brake GVW: Approx. 23 ton	4	B
17	Dump Truck	Payload: 14 ton Engine Output: Approx. 190 kW Drive System: 6 x 4, Left-hand steering, Air Brake GVW: Max. 26 ton	20	A
18	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
19	Rough Terrain Crane	30 ton, Telescopic boom Engine output:(approx.) 200 kW	1	B

No.	Name of Equipment	Specification	Quantity	Priority
20	Low-bed Self-loading Truck (Equipment Carrier)	Max. Payload: 20 ton, Rear loading type, lowbed truck Drive System: 4 axles, 8 x 4 Left-hand steering, Air Brake,	2	A
21	Mobile Workshop	4x4, cargo truck, with telescopic boom 3 ton crane and equipment and tools necessary to carry out service for construction machines Payload: Approx. 7～10 ton	2	A
22	Inspection Vehicle	4 x 4, Five-seater, Double Cab Pickup , Diesel Engine, Engine output: Approx. 78 kW	2	A
23	Generator	Diesel Engine Driven, 415/240 V, 50 Hz, 100 kVA	3	B
24	Concrete Sprayer	Capacity: 1.5 ~ 3.0 m^3/h Distance of the pressure feed (horizontal): 300 m	1	B
25	Safety Items	--	1 LS	A

3. For Road Research Laboratory and Bridge Research Laboratory in Yangon

No.	Name of Equipment	Specification	Quantity	Priority
1	Testing Equipment	--	1 LS	A

4. Others

No.	Name of Equipment	Specification	Quantity	Priority
1	Training Equipment	--	1 LS	A

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.

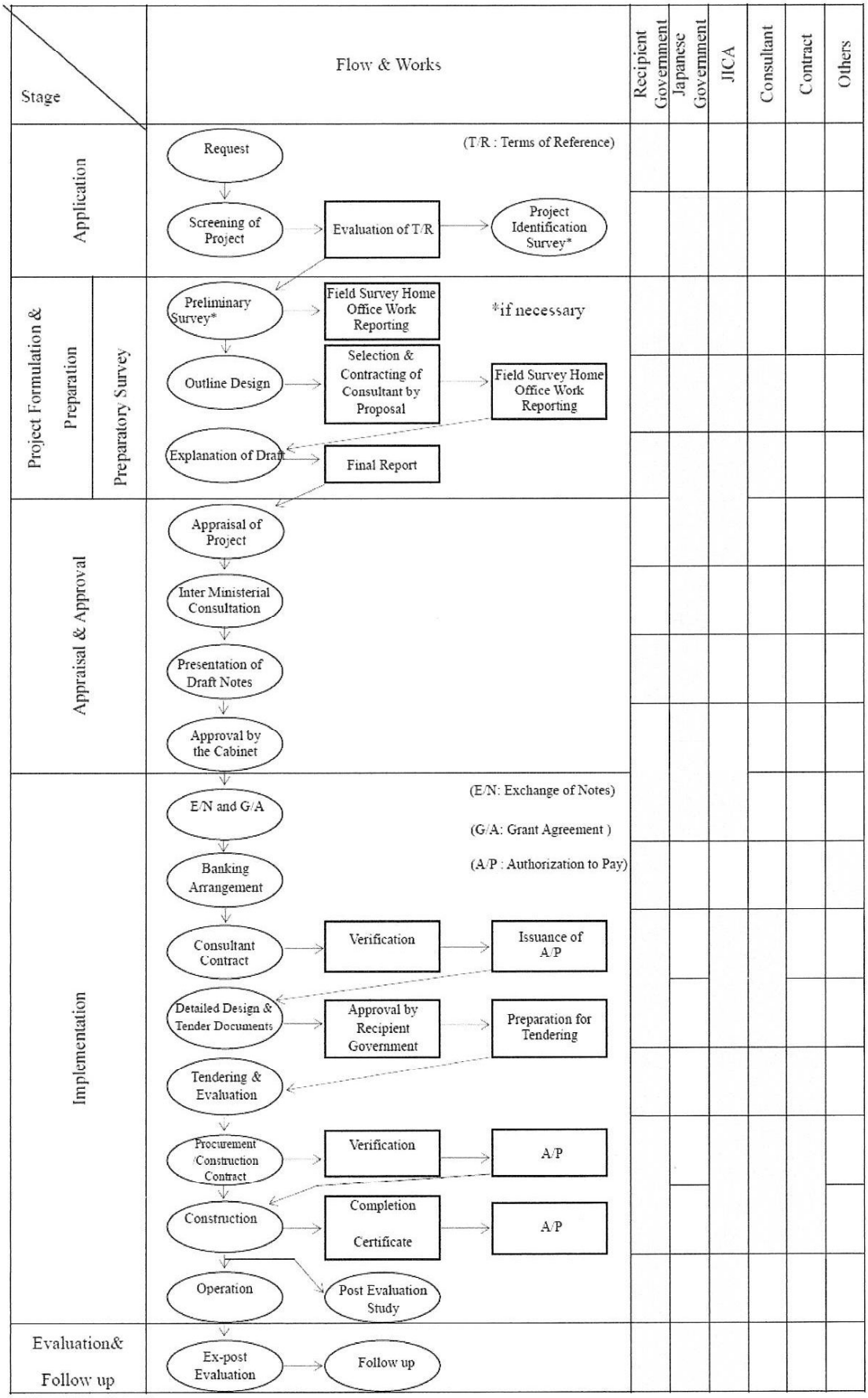
(9) Authorization to Pay (A/P)

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 MEETING
ON THE PREPARATORY SURVEY FOR THE PROJECT FOR IMPROVEMENT OF ROAD CONSTRUCTION AND MAINTENANCE EQUIPMENT IN KACHIN STATE AND CHIN STATE
(Explanation on Draft Preparatory Survey Report)

On the basis of the discussions and field survey in the Republic of the Union of Myanmar (hereinafter referred to as "Myanmar") in February, 2015, and the subsequent technical examination of the results in Japan, the Japan International Cooperation Agency (hereinafter referred to as "JICA") prepared a draft Preparatory Survey Report on the Project for Improvement of Road Construction and Maintenance Equipment in Kachin State and Chin State (hereinafter referred to as "the Project").

In order to explain the draft Preparatory Survey Report and to consult with the concerned officials of the Government of Myanmar on its contents, JICA sent to Myanmar the Preparatory Survey Team (hereinafter referred to as "the Team"), headed by Mr. Nobuyuki TSUNEOKA, Senior Advisor of JICA, and scheduled to stay in the country from July 9th to 17th, 2015.

As a result of the discussions, both sides confirmed the main items described in the attached sheets.

Nay Pyi Taw, July 13th, 2015

U Kyaw Linn
Permanent Secretary
Ministry of Construction
The Republic of the Union of Myanmar

Mr. Nobuyuki TSUNEOKA
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

ATTACHMENT

1. Objective of the Project

   The objective of the Project is to promote road construction using equipment to be procured by the Project, and to improve social infrastructure and living circumstance of people around areas in Kachin State and Chin State. The list of the Equipment to be procured is shown in Annex1.

2. Project Site

   Both sides confirmed that the sites of the Project are in Kachin State and Chin State which are shown in Annex 2.

3. Line Agency and Executing Agency

   Both sides confirmed the line agency and executing agencies as follows:

   3-1. The line agency is Ministry of Construction (hereinafter referred to as "MOC"), which would be the agency to supervise the executing agencies.

   3-2. The executing agencies are Department of Highways, MOC (hereinafter referred to as "DOH") and Department of Bridges, MOC (hereinafter referred to as "DOB"). The executing agencies shall coordinate with all the relevant agencies to ensure smooth implementation of the Project and ensure that the undertakings are taken by relevant agencies properly and on time. The organization chart is shown in Annex 3.

4. Contents of the draft Preparatory Survey Report

   After the explanation of the contents of the draft Preparatory Survey Report (hereinafter referred to as "Draft Report") by the Team, Myanmar side agreed in principle to its contents.

5. Cost Estimation

   Both sides confirmed that the Project cost estimation indicated in Annex 4 and described in Draft Report was provisional and would be examined further by the Government of Japan for its final approval.

6. Confidentiality of the Cost Estimation and Specifications

   Both sides confirmed that the Project cost estimation and technical specifications in Annex 4 and Draft Report should never be duplicated or disclosed to any third

parties until all the contracts of the Project are concluded.

7. Validity of the Previous Minutes of Meeting
   The both sides confirmed that all the agreements in the Minutes of Meeting of the preceding Preparatory Survey signed on February 20th, 2015 should continue to be valid unless information is updated by Draft Report.

8. Project Implementation Schedule
   The Team explained to Myanmar side that the expected implementation schedule is as attached in Annex 5.

9. Expected outcomes and Indicators
   Both sides agreed that key indicators for expected outcomes are as follows. Myanmar side has responsibility to monitor the progress of the indicators and achieve the target in year 2020.

Quantitative effect of road improvement in Kachin state

Performance indicator	Reference value (2015)	Ideal Value (2020)
Average velocity of developed section by project equipment (km/h)	approx. 32km/h	approx. 60km/h
Road length by project equipment (km)	0km	approx. 141km

Quantitative effect of road improvement in Chin state

Performance indicator	Reference value (2015)	Ideal Value (2020)
Average velocity of developed section by project equipment (km/h)	approx. 28km/h	approx. 40km/h
Road length by project equipment (km)	0km	approx. 109km

10. Technical assistance ("Soft Component" of the Project)
    Considering the sustainable operation and maintenance of the provided equipment, technical assistance is planned to be provided under the Project. Myanmar side confirmed that it will assign necessary number of competent and appropriate counterparts as described in the Draft Report.

11. Undertakings Taken by Both Sides

Both sides confirmed undertakings described in Annex 6. Myanmar side assured to take the necessary measures and coordination including allocation of the necessary budget which are preconditions of implementation of the Project. It is further agreed that the costs are indicative, i.e. at Outline Design level. More accurate costs will be calculated at the Detailed Design stage. Contents of Annex 4 will be updated as the Detailed Design progresses, and will finally be the Attachment to the Grant Agreement.

12. Monitoring during the Implementation

The Project will be monitored every 3 months by the executing agencies and using the Project Monitoring Report (PMR) described in Annex 7.

13. Ex-Post Evaluation

JICA will conduct ex-post evaluation three (3) years after the project completion with respect to five evaluation criteria (Relevance, Effectiveness, Efficiency, Impact, Sustainability) of the Project. Result of the evaluation will be publicized. Myanmar side is required to provide necessary support for them.

14. Schedule of the Study

JICA will complete the Final Report of the Preparatory Survey in accordance with the confirmed items and send it to Myanmar side around November, 2015.

15. Other Relevant Issues

15-1. Myanmar side confirmed to make best use of the equipment by construction of selected road sections with necessary arrangements such as budget and personnel.

15-2. Myanmar side agreed to provide the appropriate storage yard for the Equipment.

15-3. Both sides agreed on the tentative program of technical assistance at Central Training Center as shown in Annex 8. MOC should be responsible for ensuring number of trainees planned in Annex 8. Myanmar side expressed their interest that the training will encourage trainees to continue self-development through further chances such as trainings in Japan.

15-4. Myanmar side shall secure enough budget and personnel necessary for the operation and maintenance of the Equipment. Myanmar side agreed to maintain and use properly and effectively the Equipment. MOC explained that such budget had been and was going to be secured by allocating certain portion of concerned project costs. Breakdown of estimated costs for equipment maintenance is described in Annex 9.

15-5. The pilot road construction is planned in Myitkyina, Kachin State. However, JICA explained that the pilot road construction might not be carried out if JICA would determine difficulty of activities by the Consultant due to security reasons.

15-6. Myanmar side understood the importance of safety measure in construction and service stage. The Team explained "The Guidance for the Management of Safety for Construction Works in Japanese ODA Projects", and Myanmar side explained that they will respect and refer this Guidance in road construction using the Equipment.

15-7. If JICA receives information concerning suspected corrupt or fraudulent practices, Myanmar side shall take necessary measures in accordance with the Procurement Guidelines in the competition for, or in execution of, the contract funded by the Grant :

(1) to provide JICA with such information as JICA may reasonably request, including information related to any concerned official of the government and/or public organizations of Myanmar ;

(2) not to treat unfairly or unfavorably the physical persons and juridical persons, that provide the information.

Annex 1 List of Equipment to be procured
Annex 2 Project Site
Annex 3 Organization Chart
Annex 4 Project Cost Estimation
Annex 5 Tentative Project Implementation Schedule
Annex 6 Major Undertakings to be taken by Both Sides
Annex 7 Project Monitoring Report (template)
Annex 8 Technical Assistance at Central Training Center
Annex 9 Estimated Annual Operation and Maintenance Costs

Annex 1

List of Equipment to be procured

List of Construction Equipment

No.	Equipment	Quantity			
		Kachin	Chin	Mandalay Mechanical Compound	Total
1	Bulldozer	3	3	-	6
2	Excavator (Crawler)	3	3	-	6
3	Hydraulic Breaker	-	3	-	3
4	Wheel Excavator	2	2	-	4
5	Motor Grader	3	3	-	6
6	Wheel Loader	3	3	-	6
7	Sheep Foot Compactor	3	3	-	6
8	Vibratory Tandem Roller	2	2	-	4
9	Tire Roller	2	2	-	4
10	Plate Compactor	10	10	-	20
11	Asphalt Kettle	2	2	-	4
12	Bitumen Distributor	2	2	-	4
13	Asphalt Hand Sprayer	10	10	-	20
14	Chip Spreader	2	2	-	4
15	Mobile Crusher	2	2	-	4
16	Water Bowser (Tanker)	3	4	-	7
17	Dump Truck	30	20	-	50
18	Cab-back Crane	1	2	-	3
19	Rough Terrain Crane	1	1	-	2
20	Low Bed Semi-trailer (with Tractor Head)	1	-	-	1
21	Low Bed Self-loading Truck	-	2	-	2
22	Mobile Workshop	2	2	-	4
23	Inspection Vehicle	2	2	-	4
24	Generator	3	3	-	6
25	Concrete Sprayer	-	2	-	2
26	Desktop Computer	1	1	2	4
27	Database Software	1	1	2	4

List of Road/Bridge Test Equipment

No.	Equipment	Quantity						
		Road Research Laboratory (RRL)			Bridge Research Laboratory (BRL)			Total
		RRL (Delivery Point)	Kachin (Site)	Chin (Site)	BRL (Delivery Point)	Kachin (Site)	Chin (Site)	
1. Equipment for Geotechnical Investigation								
1-1	Boring Machine with Standard Accessories	-	-	1	-	1	-	2
2. Equipment for Geotechnical Test								
2-1	Triaxial Apparatus	1	-	-	1	-	-	2
2-2	Sieves Set and Shaker for Soil	1	-	-	1	-	-	2
2-3	CBR Test Apparatus	1	-	-	-	-	-	1
2-4	Digital Moisture Meter	-	3	3	-	-	-	6
2-5	Dynamic Cone Penetrometer	-	3	3	-	-	-	6
2-6	Soil Density Apparatus (Sand Replacement Method)	-	3	3	-	-	-	6
3. Equipment for Concrete Test								
3-1	Pan Type Concrete Forced Mixer	-	-	-	1	-	-	1
3-2	Concrete Compressive Strength Testing Device	-	-	1	-	2	-	3
3-3	Load Cell with Digital Tester for Calibration	-	-	1	-	1	-	2
3-4	Sieves Set and Shaker for Aggregate	-	-	1	-	1	-	2
3-5	Specific Gravity Apparatus for Coarse Aggregate	-	-	-	1	-	-	1
3-6	Photometer	-	-	-	1	-	-	1
3-7	Aggregate Crashing and Test Apparatus	1	-	-	-	-	-	1
3-8	Unbonded Capping Apparatus	-	-	5	-	-	5	10
3-9	Concrete Test Hammer	-	-	3	-	3	-	6
4. Common Equipment								
4-1	Oven	-	-	-	2	-	-	2
4-2	Digital Caliper	1	-	3	1	3	-	8

List of Operator-training Equipment

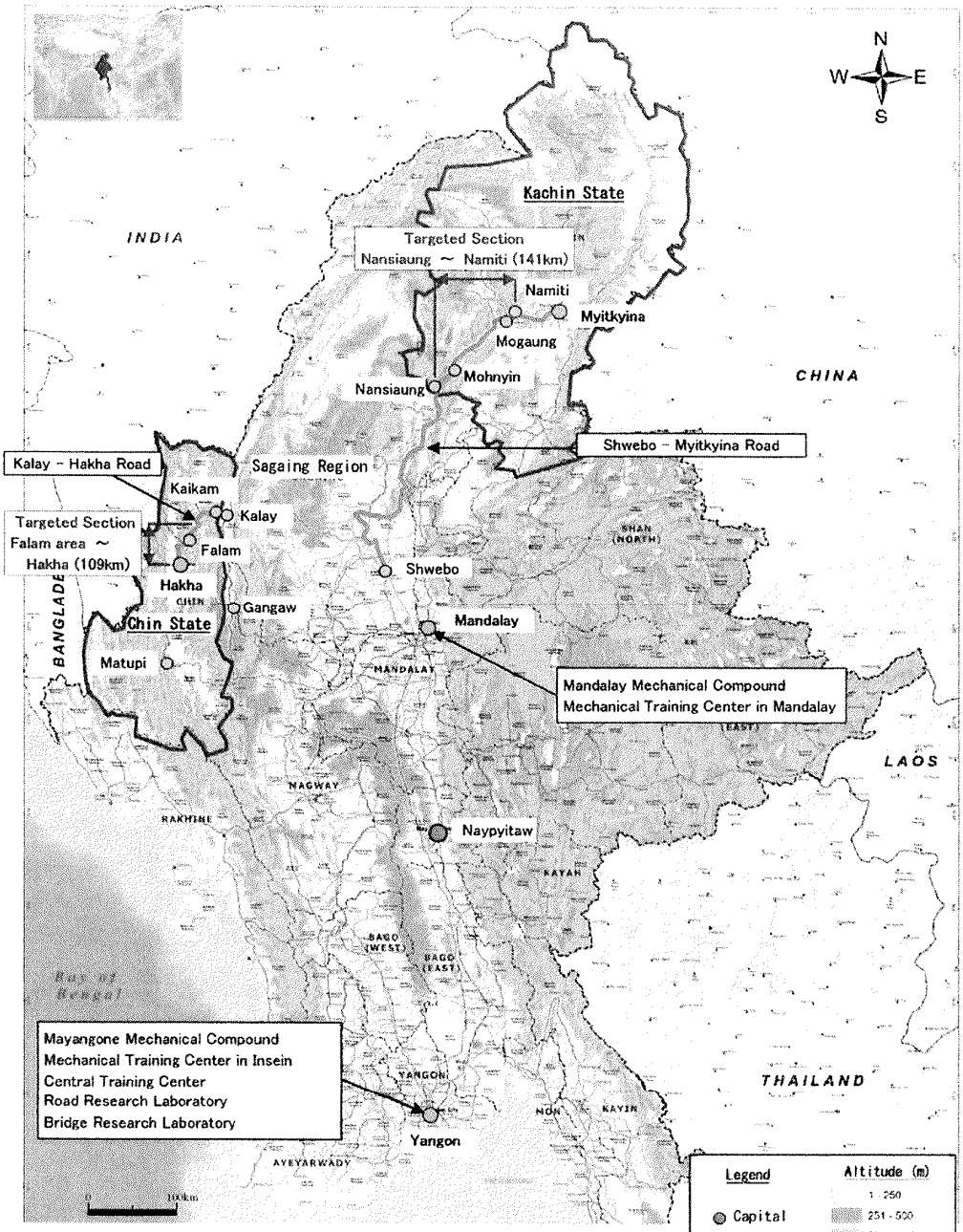
No.	Equipment	Quantity		
		Mandalay Mechanical Compound (Upper Myanmar)	Mayangone Mechanical Compound (Lower Myanmar)	Total
1	Mini Dozer	2	2	4
2	Mini Excavator (Crawler)	2	2	4
3	Mini Wheel Loader	2	2	4
4	Mini Vibratory Tandem Roller	2	2	4
5	Mini Cab-back Crane	2	2	4

List of CTC-training Equipment

No.	Equipment		Quantity			
			CTC (Delivery Point)	Kachin (Site)	Chin (Site)	Total
1.	Survey Equipment					
1-1	Total Station		2	3	3	8
1-2	Survey Instrument Tools	Tape Measure	5	6	6	17
		Staff	5	6	6	17
		Pole	10	30	30	70
		Slant Rule	5	6	6	17
2.	Formwork Equipment					
2-1	Circular Saw		5	15	15	35
2-2	Pistol-Grip (corded) Drill		5	15	15	35
2-3	Table Saw		1	3	3	7
2-4	Electric Planer		5	-	-	5
2-5	Baggage for Carpenter's Tools		20	30	30	80
3.	Concrete Work Equipment					
3-1	Concrete Vibrator		5	15	15	35
3-2	High Frequency Generator		1	3	3	7
3-3	Concrete Mixer		1	3	3	7
4.	Road Work Equipment					
4-1	Walk Behind Concrete Saw		1	3	3	7
4-2	Asphalt Hand Sprayer		1	-	-	1
4-3	Plate Compactor		2	-	-	2
4-4	Safety Facilities under Construction		1	-	-	1
5.	Rebar Work Equipment					
5-1	Bar Bending Machine		2	4	2	8
5-2	Bar Cutting Machine		2	4	2	8
6.	Scaffolding Material					
6-1	Prefabricated Scaffolding		1	-	-	1
6-2	Pipe Scaffolding		1	-	-	1
6-3	Travelling Scaffolding		1	-	-	1
6-4	Tools for Set Up Scaffolding		20	-	-	20
7.	Safety Item					
7-1	Personal Protective Safety Items (Hardhat, Dust-proof Glasses, Safety Vest, Gloves, Safety Shoes, Safety Belt, Carry bag)		50	50	50	150

Annex 2

Project Site

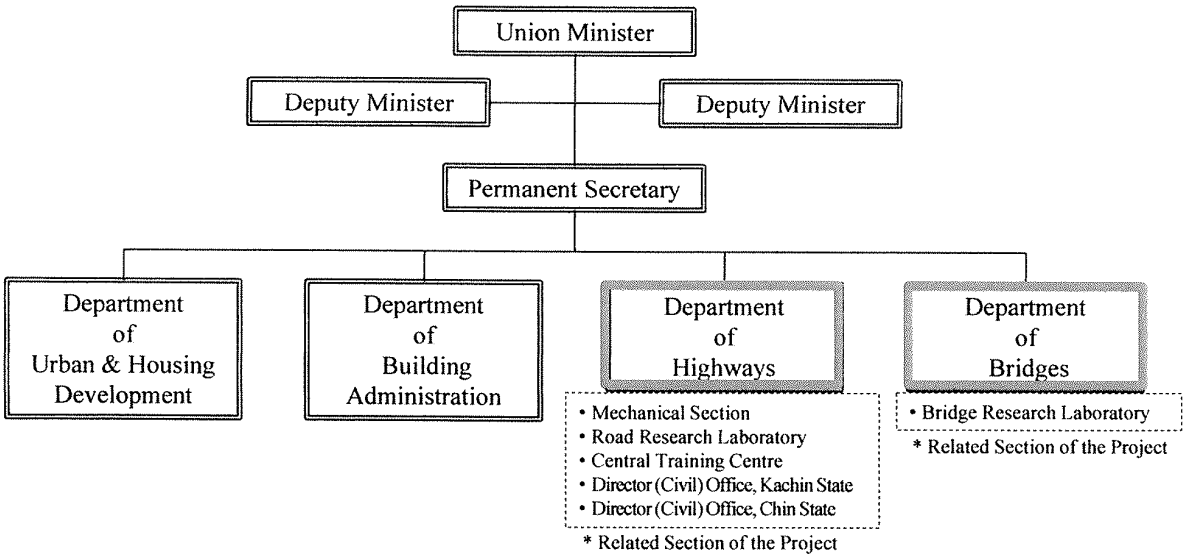


Delivery Points of the Project Equipment

Equipment	Delivery Point	Location
Construction Equipment for Kachin State	Myitkyina Workshop	Myitkyina, Kachin State
Construction Equipment for Chin State	Hakha Mechanical Compound	Hakha, Chin State
Road/Bridge Test Equipment	Road/Bridge Research Laboratory	Yangon
Operator-training Equipment	Mandalay Mechanical Compound	Mandalay
	Mayangone Mechanical Compound	Yangon
CTC-training Equipment	Central Training Center	Yangon

Annex 3

Organization Chart



Annex 4

Confidential

Project Cost Estimation

1. Japan side

This chapter is closed due to the confidenciality.

2. Myanmar side

The costs shown below must be borne by Myanmar side.

Approximately USD 133,000

Items		Cost Amount (USD)
Preparation for the delivery of equipment	Securing the storage for spare parts of construction equipment in Kachin State	5,000
	Securing a construction equipment yard in Chin State	10,000
Soft Component	Pilot road construction in Kachin State	36,000
	Pilot road construction in Chin State	24,000
	Pilot works of slope protection in Chin State	25,000
	CTC Training	10,000
Commissions to the bank based on Banking Arrangement		23,000

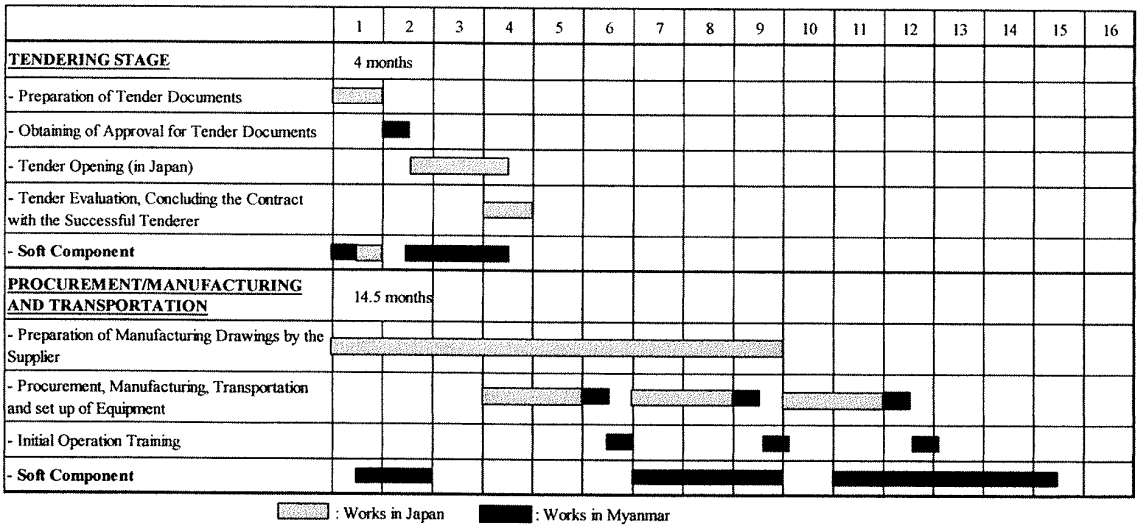
In addition, Myanmar side is supposed to provide the budget of approximately USD 25.5 million for Kachin State and the budget of approximately USD 15.8 million for Chin State in order to implement the target roads in the fiscal year 2017 to 2019.

Conditions of cost estimation are as follows.

1. Timing of cost estimation	:	March 2015
2. Exchange rate	:	1USD = 119.79 Japanese Yen (JPY)
3. Implementation schedule	:	Shown in Annex 5 "Tentative Project Implementation Schedule".
4. Others	:	Cost estimation shall be conducted in accordance with the institution of the Grant Aid Project of the Japanese government.

Annex 5

Tentative Project Implementation Schedule



Annex 6

Major Undertakings to be taken by Both Sides

No.	Item	Scope		Remarks
		Japan	Myanmar	
1	Securing of storage area for construction and maintenance equipment and expendable parts		○	Kachin State - Securing the storage for spare parts of construction equipment at Myitkyina Workshop. (Clearing, preparing a shelf, etc.) Chin State - Acquiring/Borrowing the land for a construction equipment yard from the state government before the delivery of the Project equipment. (Hakha Mechanical Compound No.2, tentatively named) - Ground leveling, fencing and appointing security personnel at the Hakha Mechanical Compound No.2 in order to keep the Project equipment in safe custody.
2	Securing of site office		○	As the need arises
3	Manufacture and procurement of the Project equipment	○		
4	Inland transportation of the Project equipment	○		Between a manufacturer's factory and a port in Japan
5	Marine transportation, customs clearance and handling of taxes	-	-	
	(1) Responsibility for marine/air transportation of the Project equipment to Myanmar	○		
	(2) Tax exemption and customs clearance at the port of disembarkation		○	
	(3) Inland transportation of the Project equipment from the port of disembarkation to the delivery point	○		Delivery points are described in Annex 2.
	(4) Ensuring safe inland transportation route from the port of disembarkation to the delivery point		○	For example, removing soils and ensuring the carriage way which is wide enough (at least 12 feet) on the transportation route when a landslide happens in Chin State.
6	Inland transportation of the Project equipment from the delivery points in the Project to final destinations to utilize in the target road construction		○	Road/Bridge Test Equipment - To construction sites in Kachin State and Chin State. CTC-taining Equipment - To construction sites in Kachin State and Chin State.
7	Appropriate operation and management of the Project equipment and spare parts		○	

No.	Item	Scope		Remarks
		Japan	Myanmar	
8	Procedures and measures necessary for acquiring the following permits: Registration of equipment ■ 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. Myanmar side will be responsible for arranging the registration and/or permission for delivery of equipment from concerned organizations without delay.
9	Assembly and adjustment of construction and maintenance equipment	○		
10	Handover inspection, operation training and maintenance guidance for the Project equipment	○		Myanmar side will secure and assign the personnel to participate in the said training and guidance.
11	Dispatching Japanese instructors for the Soft Component	○		
12	Appointing participants as trainees in the Soft Component		○	
13	Budgets and materials, etc. necessary for the Soft Component, which is to be prepared by Myanmar side		○	Kachin State and Chin State - Budgets and materials for the pilot road construction in Kachin State and Chin State, and the pilot works of slope protection in Chin State CTC-Training Equipment - Training materials, such as a concrete, rebar and timber materials, etc. necessary in the training course using CTC-training Equipment
14	Implementation of the target road construction		○	Myanmar side will secure adequate budgets, materials and personnel such as engineers, operators and labors, etc.
15	Bearing all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		○	
16	Bearing the following commissions paid to the Japanese bank for banking services based upon the Banking Arrangement (B/A): ■ Cost of opening an account in a Japanese certified foreign exchange bank ■ Payment commission		○	

Note: ○: Indicates the scope of responsibility regarding each item

Project Monitoring Report

on

Project Name

Grant Agreement No. XXXXXXX

20XX, Month

Organization Information

3-1-1-1-1 Authority (Signer of the G/A)	Person in Charge _____ (Division) _____ Contacts Address: _____ Phone/FAX: _____ Email: _____
Executing Agency	Person in Charge _____ (Division) _____ Contacts Address: _____ Phone/FAX: _____ Email: _____
Line Agency	Person in Charge _____ (Division) _____ Contacts Address: _____ Phone/FAX: _____ Email: _____

Outline of Grant Agreement:

Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of (_____): _____
Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:

1: Project Description

1-1 Project Objective

1-2 Necessity and Priority of the Project

- Consistency with development policy, sector plan, national/regional development plans and demand of target group and the recipient country.

1-3 Effectiveness and the indicators

- Effectiveness by the Project

Quantitative Effect (Operation and Effect indicators)		
Indicators	Original (Yr)	Target (Yr)
Qualitative Effect		

2: Project Implementation

2-1 Project Scope

Table 2-1-1a: Comparison of Original and Actual Location

Location	**Original:** *(M/D)* **Attachment(s):Map**	**Actual:** *(PMRand PCR)* **Attachment(s):Map**

Table 2-1-1b: Comparison of Original and Actual Scope

Items	Original	Actual
(M/D) 'Soft component' shall be included in 'Items'.	*(M/D)*	*(PMR and PCR)* Please state not only the most updated sc hedule but also other past revisions chron ologically. All change of design shal l be recorded regardless of its degree.

2-1-2 Reason(s) for the modification if there have been any.

(PMR and PCR)

2-2 Implementation Schedule

2-2-1 Implementation Schedule

Table 2-2-1: Comparison of Original and Actual Schedule

Items	Original		Actual
	DOD	G/A	
【M/D】 'Soft component' shall be stated in the column of 'Items'. Project Completion Date*	*(M/D)*		*(PMR,PCR)* As of (Date of Revision) Please state not only the most updated schedule but also other past revisions chronologically.

*Project Completion was defined as _____ at the time of G/A.

2-2-2 Reasons for any changes of the schedule, and their effects on the project.

(PMR and PCR)

2-3 Undertakings by each Government

2-3-1 Major Undertakings

See Attachment 2.

2-3-2 Activities

See Attachment 3.

2-3-3 Report on RD

See Attachment 4.

2-4 Project Cost

2-4-1 Project Cost

Table 2-3-1 Comparison of Original and Actual Cost by the Government of Japan

(Confidential until the Tender)

Items			Cost (Million Yen)	
	Original	Actual	Original	Actual
Construction Facilities (or Equipment)	'Soft component' shall be included in 'Items'.			Please state not only the most updated schedule but also other past revisions chronologically.
Consulting Services	- Detailed design -Procurement Management -Construction Supervision			
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = Yen

Table 2-3-2 Comparison of Original and Actual Cost by the Government of XX

Items			Cost (Million USD)	
	Original	Actual	Original	Actual
	'Soft component' shall be included in 'Items'.			Please state not only the most updated schedule but also other past revisions chronologically.
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = (local currency)

2-4-2 Reason(s) for the wide gap between the original and actual, if there have been any, the remedies you have taken, and their results.

(PMR, PCR)

2-5 Organizations for Implementation

2-5-1 Executing Agency:

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original: *(M/D)*
Actual, if changed: *(PMR and PCR)*

3: Operation and Maintenance (O&M)

3-1 O&M and Management

- Organization chart of O&M
- Operational and maintenance system (structure and the number ,qualification and skill of staff or other conditions necessary to maintain the outputs and benefits of the project soundly, such as manuals, facilities and equipment for maintenance, and spare part stocks etc)

Original: *(M/D)*
Actual: *(PCR)*

3-2 O&M Cost and Budget

- The actual annual O&M cost for the duration of the project up to today, as well as the annual O&M budget.

Original: *(M/D)*

4: Precautions (Risk Management)

- Risks and issues, if any, which may affect the project implementation, outcome, sustainability and planned countermeasures to be adapted are below.

Original Issues and Countermeasure(s): *(M/D)*	
Potential Project Risks	Assessment
1.	Probability: H/M/L
(Description of Risk)	Impact: H/M/L
	Analysis of Probability and Impact:
	Mitigation Measures:

	Action during the Implementation:
	Contingency Plan (if applicable):
2.	Probability: H/M/L
(Description of Risk)	Impact: H/M/L
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action during the Implementation:
	Contingency Plan (if applicable):
3.	Probability: H/M/L
(Description of Risk)	Impact: H/M/L
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action during the Implementation:
	Contingency Plan (if applicable):
Actual issues and Countermeasure(s)	
(PMR and PCR)	

5: Evaluation at Project Completion and Monitoring Plan

5-1 Overall evaluation

Please describe your overall evaluation on Project.

(PCR)

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

(PCR)

5-3 Monitoring Plan for the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

(PCR)

Attachment

1. Project Location Map
2. Undertakings to be taken by each Government
3. Monthly Report
4. Report on RD
5. Monitoring sheet on price of specified materials (Quarterly)
6. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (Completion Report Only)

Annex 8

Technical Assistance at Central Training Center

1. Objective

Efficient training methods utilizing training equipment to be procured for the Central Training Center (CTC) are transferred.

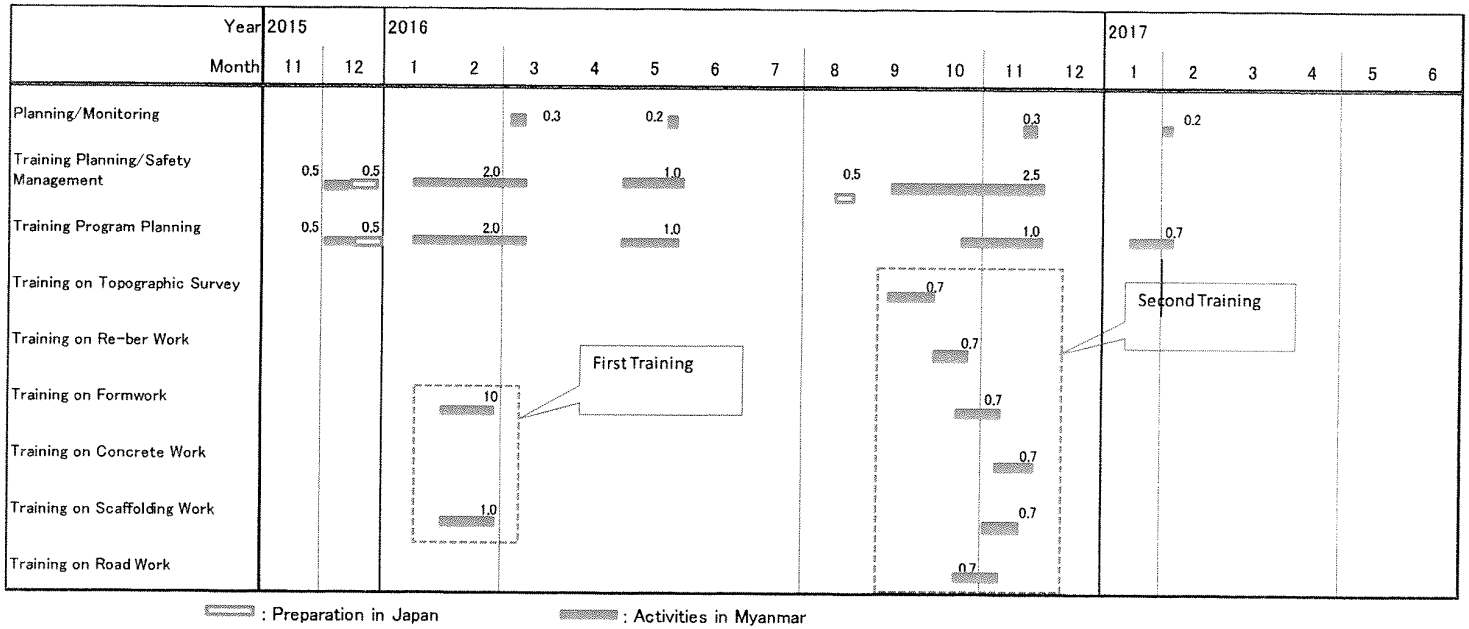
2. Outline of Training

Technical trainings using CTC-training Equipment for topographic survey in the engineering course, bar-bender course, formwork (carpenter) course, concreter course, scaffolding course and road worker course in the worker training course which were selected by both sides for contribution to promotion of road construction in Kachin State and Chin State are going to be conducted with instructions for safety management by the Japanese Consultant and professional skilled instructors at Central Training Center (CTC). Existing training programs for each course of CTC are examined and proposed to be revised for further effective trainings. In addition, existing operator-training programs of Mechanical Training Center (MTC) in Insein, which is a substructure of CTC, are examined and proposed to be revised based on an experience from activities at CTC.

2－1 Trainees (Target personnel) and Instructors from Japan

Trainees	Instructors from Japan
- Supervisors(Trainers) of CTC At least 1 or 2 supervisor(s) for each course are selected from permanent teaching staff of CTC and/or frequently visiting supervisors. - Trainees of CTC (civil engineers and skilled workers) 30 - 50 trainees are expected in each training course. (Participants from a private sector may be included.)	- Engineer for Training Planning and Safety Management (Team Leader) - Engineer for Training Program Planning (Vice Team Leader) - Experienced Instructor on Topographic Survey - Experienced Instructor on Re-bar Work - Experienced Instructor on Formwork - Experienced Instructor on Concrete Work - Experienced Instructor on Scaffolding Work - Experienced Instructor on Road Work

2－2 Tentative Implementation Schedule



The Training on Scaffolding Work scheduled in the budget year 2015-2016 should be established within the external course. A course curriculum of the said Training on Scaffolding Work should be prepared at the commencement of the Project. Curriculums of other courses should be discussed in time in line with existing CTC training courses.

2－3 Utilized Training Materials and Training Equipment

Training Materials:

- Guideline for basic skills in civil works (Formwork, Concrete Work, Road Work, Re-bar Work, Scaffolding Work)
- Guideline for safety measures in road works

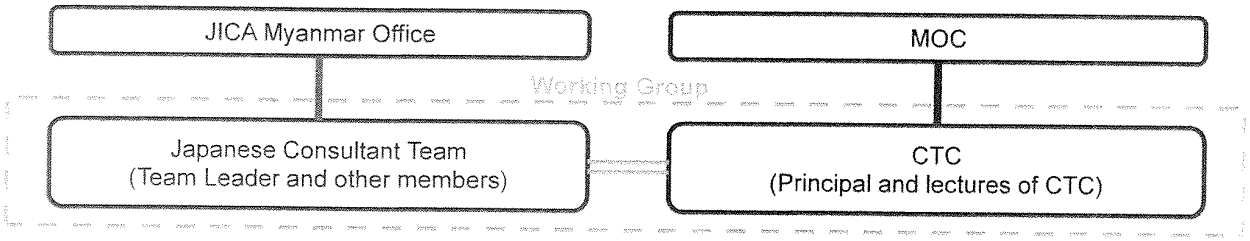
Training Equipment:

- Project equipment for CTC

CTC is required to prepare necessary materials, such as timber, re-bar and concrete, etc. for practical trainings in each course. MOC should allocate the budget to CTC of which the cost is described in Annex 4.

3. Operation Structure

The following working group is going to be organized for smooth and efficient implementation.



4. Evaluation and Monitoring

Evaluation and monitoring are going to be conducted by a member of the Planning/Monitoring shown in 2-2 Tentative Implementation Schedule to confirm achievement of trainings and to give an instruction and/or advice based on the Soft Component (Technical Assistance) Plan.

Estimated Annual Operation and Maintenance Costs

1. Cost for Implementation of Target Road Construction

Myanmar side is supposed to provide the budget of approximately USD 25.5 million for Kachin State and the budget of approximately USD 15.8 million for Chin State including fuels, lubricants, labors, materials, etc. in order to implement the target roads in the fiscal year 2017 to 2019.
And detailed maintenance cost excluding spare parts is as follows:

Estimated costs for equipment maintenance excluding spare parts in Kachin State

Name of Equipment	Estimated Value of Equipment (Kyat) (a)	Machine's life span (years) (b)	Mainte. cost Rate (in life span) (%) (c)	Av. mainte. cost/year (Kyat) (d) = a×(c/100)÷b	Number of machines (e)	Maintenance costs for equipment in initial 3 years: Cost rate (%) (f)	Cost/unit (Kyat) (g) = d×(f/100)	Annual expenditure (Kyat×1000) (h) = e×g
1. Bulldozer (crawler)	253,530,000	15	50	8,451,000	3	5	422,550	1,268
2. Excavator (Crawler)	115,101,000	15	40	3,069,360	3	5	153,468	460
4. Wheel Excavator	168,123,600	15	40	4,483,296	2	5	224,165	448
5. Motor Grader	154,800,000	15	35	3,612,000	3	5	180,600	542
6. Wheel Loader	144,000,000	15	60	5,760,000	3	5	288,000	864
7. Sheep foot Compactor	125,280,000	15	30	2,505,600	3	5	125,280	376
8. Vibratory Tandem Roller	99,072,000	15	30	1,981,440	2	5	99,072	198
9. Tire Roller	93,816,000	15	40	2,501,760	2	5	125,088	250
10. Plate Compactor	1,026,000	15	45	30,780	10	5	1,539	15
11. Asphalt Kettle	84,960,000	15	20	1,132,800	2	5	56,640	113
12. Bitumen Sprayer Truck	140,940,000	15	50	4,698,000	2	5	234,900	470
13. Asphalt Hand Sprayer	6,982,200	15	50	232,740	10	5	11,637	116
14. Chip Spreader	34,992,000	15	45	1,049,760	2	5	52,488	105
15. Mobile Crusher	311,400,000	15	50	10,380,000	2	5	519,000	1,038
16. Water Bowser (Tanker)	63,180,000	15	40	1,684,800	4	5	84,240	337
17. Dump truck	73,530,000	15	50	2,451,000	30	5	122,550	3,677
18. Boom Truck	89,775,000	15	30	1,795,500	2	5	89,775	180
19. Rough Terrain Crane	331,200,000	15	30	6,624,000	1	5	331,200	331
20. Low Bed Semi-trailer with Tractor Head	187,200,000	15	30	3,744,000	2	5	187,200	374
21. Mobile Workshop	162,000,000	15	50	5,400,000	2	5	270,000	540
22. Inspection Vehicle	25,312,941	15	50	843,765	2	5	42,188	84
23. Generator	58,138,560	15	35	1,356,566	3	5	67,828	203
Estimated annual expenditure for machinery maintenance in initial three years								11,991
Average annual expenditure for machinery maintenance in Public Works Kachine State Office (for the last three years , 2012-2014)								307,300
The rate of increase in expenditure for machinery maintenance based on the average annual expenditure for last three years (%)								3.9

Estimated costs for equipment maintenance excluding spare parts in Chin State

Name of Equipment	Estimated Value of Equipment (Kyat) (a)	Machine's life span (years) (b)	Mainte. cost Rate (in life span) (%) (c)	Av. mainte. cost/year (Kyat) (d) = a×(c/100)÷b	Number of machines (e)	Maintenance costs for equipment in initial 3 years: Cost rate (%) (f)	Cost/unit (Kyat) (g) = d×(f/100)	Annual expenditure (Kyat×1000) (h) = e×g
1. Bulldozer (crawler)	253,530,000	15	50	8,451,000	3	5	422,550.0	1,268
2. Excavator (Crawler)	115,101,000	15	40	3,069,360	3	5	153,468.0	460
3. Hydraulic Breaker	18,225,000	15	25	303,750	3	5	15,187.5	46
4. Wheel Excavator	168,123,600	15	40	4,483,296	2	5	224,164.8	448
5. Motor Grader	154,800,000	15	35	3,612,000	3	5	180,600.0	542
6. Wheel Loader	144,000,000	15	60	5,760,000	3	5	288,000.0	864
7. Sheep foot Compactor	125,280,000	15	30	2,505,600	3	5	125,280.0	376
8. Vibratory Tandem Roller	99,072,000	15	30	1,981,440	2	5	99,072.0	198
9. Tire Roller	93,816,000	15	40	2,501,760	2	5	125,088.0	250
10. Plate Compactor	1,026,000	15	45	30,780	10	5	1,539.0	15
11. Asphalt Kettle	84,960,000	15	20	1,132,800	2	5	56,640.0	113
12. Bitumen Sprayer Truck (Bitumen Distributor)	140,940,000	15	50	4,698,000	2	5	234,900.0	470
13. Asphalt Hand Sprayer	6,982,200	15	50	232,740	10	5	11,637.0	116
14. Chip Spreader	34,992,000	15	45	1,049,760	2	5	52,488.0	105
15. Mobile Crusher	311,400,000	15	50	10,380,000	2	5	519,000.0	1,038
16. Water Bowser (Tanker)	63,180,000	15	40	1,684,800	4	5	84,240.0	337
17. Dump truck	73,530,000	15	50	2,451,000	20	5	122,550.0	2,451
18. Cab-back Crane	89,775,000	15	30	1,795,500	2	5	89,775.0	180
19. Rough Terrain Crane	331,200,000	15	30	6,624,000	1	5	331,200.0	331
20. Low-bed Self-loading Truck (Equipment Carrier)	187,200,000	15	30	3,744,000	2	5	187,200.0	374
21. Mobile Workshop	162,000,000	15	50	5,400,000	2	5	270,000.0	540
22. Inspection Vehicle	25,312,941	15	50	843,765	2	5	42,188.2	84
23. Generator	58,138,560	15	35	1,356,566	3	5	67,828.3	203
24. Concrete Sprayer	151,305,300	15	80	8,069,616	2	5	403,480.8	807
Estimated annual expenditure for machinery maintenance in initial three years (Kyat/year)								11,618
Average annual expenditure for machinery maintenance in Public Works Chin State Office (for the last three years , 2012-2014)								246,200
The rate of increase in expenditure for machinery maintenance based on the average annual expenditure for last three years (%)								4.7

2. Cost for After Completion of Target Road Construction

After spare parts procured in the Project have been spent, Myanmar side needs to procure additional spare parts by itself. Estimated costs for equipment maintenance including procurement of spare parts are approximately 232 million Kyat (approximately USD 0.2 million) for Kachin State and 226 million Kyat (approximately USD 0.2 million) for Chin State, respectively. (Exchange rate: USD 1 = 1130 Kyat)