MINISTRY OF CONSTRUCTION
REPUBLIC OF THE UNION OF MYANMAR

PREPARATORY SURVEY FOR THE PROJECT FOR STRENGTHENING CONNECTIVITY OF INTERNATIONAL HIGHWAY IN MEKONG REGION

FINAL REPORT

PHASE-I SURVEY REPORT (FEASIBILITY STUDY)

DECEMBER 2016

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS GLOBAL CO., LTD.
INTERNATIONAL DEVELOPMENT CENTER OF JAPAN
CTI ENGINEERING CO., LTD.
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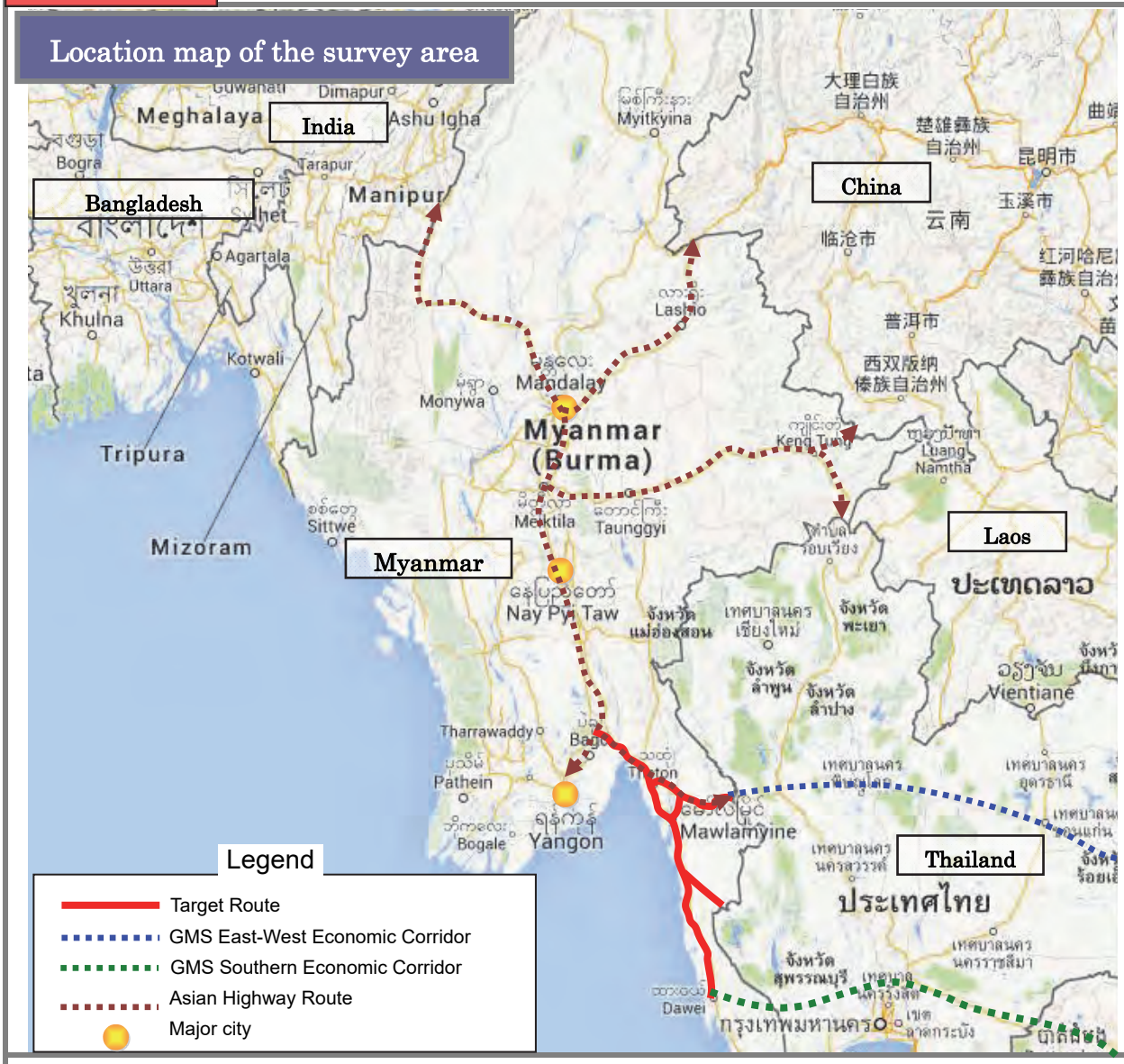
Currency Equivalents

USD 1.00 = MMK 1030.9 = JPY 120.4 (May 2015)

*MMK: Myanmar Kyat

Republic of the Union of Myanmar

Location map of the survey area



Basic data of Myanmar

Source: MOFA

■Area	Approximately 680,000km^2
■Population	Approximately 51.41 million (Sep, 2014 (Provisional statistics by Ministry of Immigration and Population, Myanmar))
■Capital	Nay Pyi Taw
■Ethnicity	Burmese (Approximately 70%) and Many other ethnic minorities
■Language	Burmese
■Religion	Buddhism (Approximately 90%), Christian, Muslim etc.
■Major industry	Agriculture
■GDP per capita	1,113 USD (FY2012/13, IMF Estimate)
■Economic growth	8.25% (FY2013/14, IMF Estimate)
■Inflation rate	6.3% (FY2013/14, IMF Estimate)

■Total trade

(Central Statistical Organization (FY2013/14))

（1）Export：Approximately 11.2 billion USD

（2）Import：Approximately 13.7 billion USD

■Major trading items

（1）Export：Natural gas, beans, clothing, teak, etc.

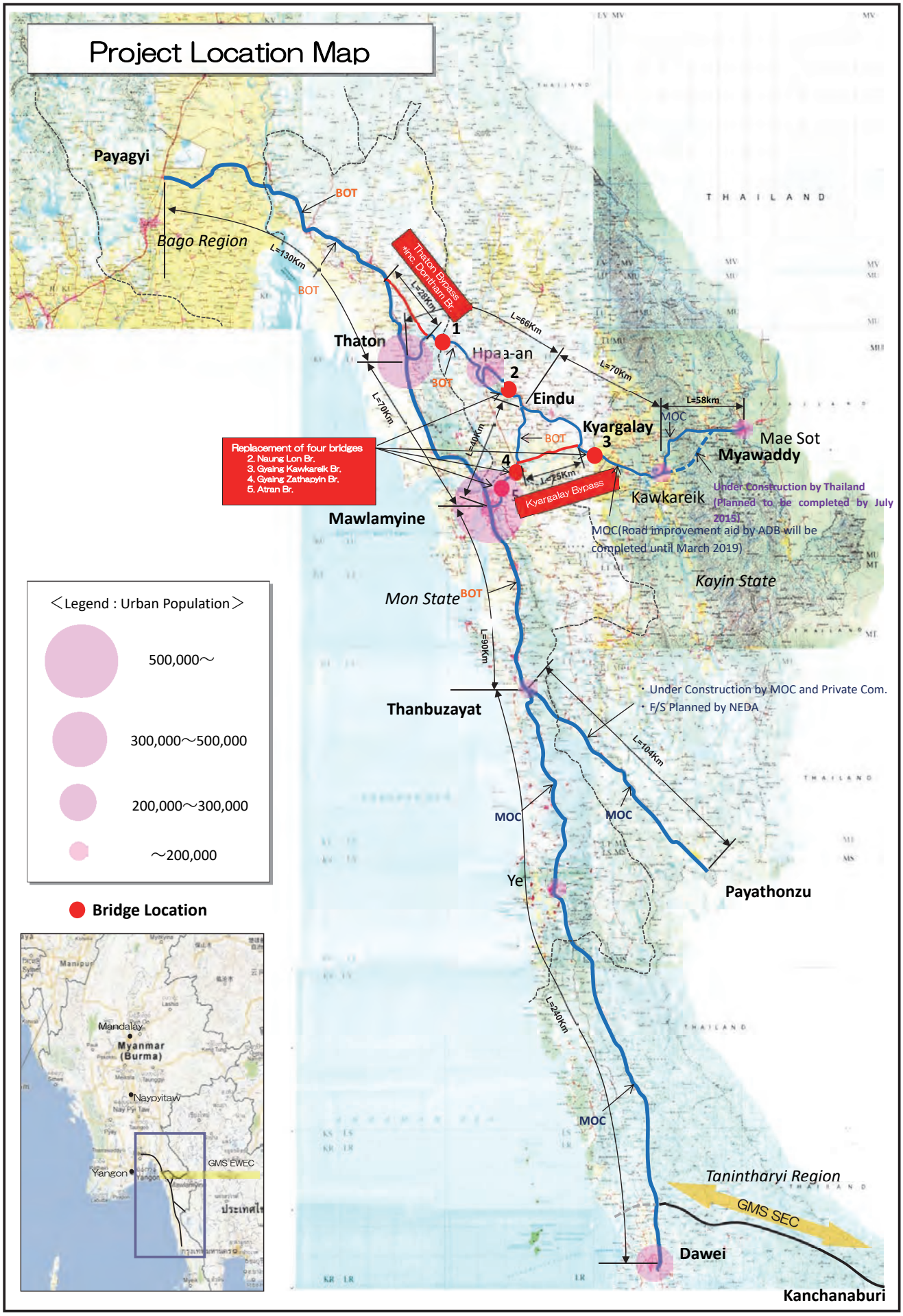
（2）Import：Machinery, essential oil, manufactured goods, etc.

■CurrencyKyat 1USD= 1,285Kyat (Rate of central bank of Myanmar: Feb 2016)

■Japanese ODA

（1）Loans：	98.344 billion JPY
（2）Grant Aid：	18.189 billion JPY
（3）Technical Cooperation:	7.050 billion JPY

（FY2014: Loan and grant aid are based on E/N, technical cooperation is based on cost）


Project Location Map
Payagyi
Bago Region
BOT
L=130Km
BOT
Thaton Bypass
*inc. Donthtam Br.
L=28Km
1
Thaton
L=66Km
Hpaa-an
2
BOT
L=70Km
L=70Km
Eindu
L=58km
MOC
Kyargalay
3
BOT
Mae Sot
Myawaddy
L=40Km
4
L=25Km
Kyargalay Bypass
Kawkareik
Under Construction by Thailand
(Planned to be completed by July 2015)
Replacement of four bridges
2. Naung Lon Br.
3. Gyaing Kawkareik Br.
4. Gyaing Zathapyin Br.
5. Atran Br.
Mawlamyine
MOC(Road improvement aid by ADB will be completed until March 2019)
Kayin State
Mon State
BOT
L=90Km
Thanbuzayat
・Under Construction by MOC and Private Com.
・F/S Planned by NEDA
L=104Km
MOC
MOC
Ye
Payathonzu
L=240Km
MOC
Tanintharyi Region
GMS SEC
Dawei
Kanchanaburi
THAILAND
＜Legend : Urban Population＞
500,000～
300,000～500,000
200,000～300,000
～200,000
Bridge Location
Manipur
Mandalay
Myanmar
(Burma)
Naypyitaw
Yangon
GMS EWEC

Perspective of the Project (Donthami Bridge)

Perspective of the Project (Donthami Bridge)

Perspective of the Project (Naung Lon Bridge)

Perspective of the Project (Naung Lon Bridge)

Perspective of the Project (Gyaing Kawkareik Bridge)

Perspective of the Project (Gyaing Kawkareik Bridge)

Perspective of the Project (Gyaing Zathapyin Bridge)

Perspective of the Project (Gyaing Zathapyin Bridge)

Perspective of the Project (Atran Bridge)

Perspective of the Project (Atran Bridge)

Perspective of the Project (Thaton Byapss)

Perspective of the Project (Kyargalay Byapss)

Outline of the Project

1. Country: Republic of the Union of Myanmar

2. Project Name: Preparatory Survey for the Project for Strengthening Connectivity of International Highways in the Mekong Region

3. Execution Agency: Ministry of Construction (MOC)

4. Survey Objectives:

The aim of the project is

- to collect information concerning the arterial roads located in south-eastern Myanmar (Payagyi-Dawei Road, Eindu-Myawaddy Road, Thaton-Eindu Road, Mawlamyine-Eindu Road, and Thanbyuzayat-Hpayarthonesu Road (Three Pagoda Pass)) including site conditions, progress of existing projects, etc.
- to extract project proposals expected to require implementation in the near future
- to select priority projects
- to conduct necessary procedures to determine the project's suitability as a yen-loan project including examining the outline, estimated project costs, the systems in place for project implementation, management, and operation and maintenance, as well as environmental and social considerations, etc.

5. Survey Contents:

[Stage 1] Confirmation of project necessity and adequacy; decision of project scope

- Collection and analysis of related documentation and data
- Site condition survey
- Selection of target routes

[Stage 2] Preliminary design; confirmation of project effects

- Natural condition survey
- Preliminary design
- Project cost estimation
- Project evaluation

[Stage 3] Prepare the report

- Prepare the preparatory survey report

6. Conclusions and Recommendations:

(1) Conclusions

- The Project is technically and economically feasible and environmentally sound.
- Hence, implementation of the Project is justified for the benefit of the national and its people.
- The Project consists of the replacement of 4 bridges and the construction of 2 bypass roads.
- The Project is divided into 2 sub-projects: improvement of EWEC towards Yangon and improvement of EWEC towards Mawlamyine.
- Three types of bridges are to be constructed in the Project: Steel-I girder (2 bridges), PC extradosed (2 bridges), Steel cable-stayed Bridge and PC-I girder bridges (Many).
- Thaton bypass shall be an asphalt-paved road running for approx. 29 km, beginning at the existing road on the east side of the existing Donthami Bridge, and ending at north Don Wun on NR-8.
- Kyargalay bypass shall be an asphalt-paved road running for approx. 25km,

beginning at the existing road leading to Gyaing Kawkareik Bridge, ending at the road leading to Gyaing Zathapyin Bridge.

(2) Recommendations

- Restructuring of MOC is under implementation as of May 2015 and the general election is scheduled for November 2015. Therefore, coordination of priority and implementation schedule of each project is required.
- Final adjustment with relevant projects such as the ADB-financed Eindu to Kawkareik Road Improvement Project shall be required in the detailed design.
- It is desirable to implement transfer of advanced construction techniques (such as those used in Japan) to Myanmar through project execution, and MOC has expressed strong interest in the learning Japanese construction techniques. Thus, there discussions must be held to form and execute a meaningful specific training programme encompassing each stage of design and construction. As for the weathering steel, appropriateness should be determined in the detailed design stage.
- In this study, preliminary design was performed in consideration of an inventory survey of existing utilities in the project area such as water pipes, telephone lines and electricity lines (which was conducted within the topographic survey). Relocation of existing utilities is expected to be carried out through Myanmar government funds. In the detailed design stage, a detailed study of existing utilities needs to be conducted, and support shall be required in order to coordinate with relevant agencies and develop a relocation plan based on the acquired information.
- MOC hopes to complete the replacement of Gyaing Kawkareik Bridge as early as possible, so the schedule of works assumed in this study includes night-time construction work in order to shorten the construction period. Considering this, in the subsequent detailed design and implementation stages, measures for eliminating bottlenecks to shorten the construction time (while ensuring safety and quality) must be devised.
- After receiving approval of the Environmental Impact Assessment (EIA) Report and Abbreviated Resettlement Action Plan Report (ARAP) from the Environmental Conservation Department (ECD) under Ministry of Environmental Conservation & Forest), these reports must be translated into Burmese and disclosed to project-affected persons and other residents for a period of more than one month.
- Project-affected areas shall be indicated to project-affected persons prior to the detailed design phase. The approved RAP shall be updated based on requirements concluded through detailed design, and compensation and land acquisition must be performed before before construction begins.
- The Project Proponent shall swiftly respond to claims and complaints from project-affected persons and other inhabitants in accordance with the grievance redress scheme given in the approved RAP, and shall endeavour to promote understanding of the project’s necessity.

Preparatory Survey for the Project for Strengthening the Connectivity Of the International Highway in the Mekong Region

EXECUTIVE SUMMERY

1. INTRODUCTION

1.1 Introduction

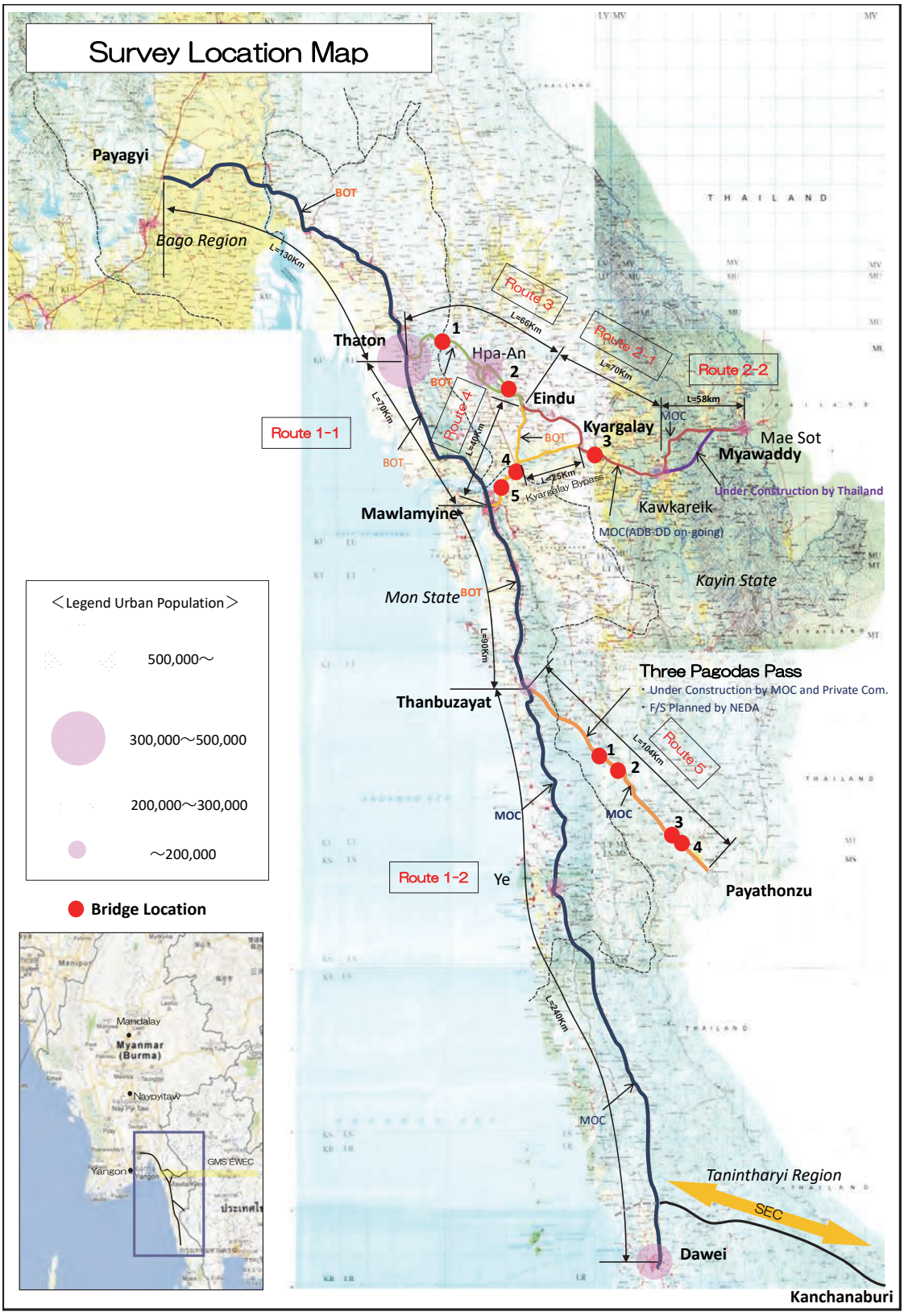
1.1.1 Survey Background

The Republic of the Union of Myanmar (hereinafter "Myanmar") has been accelerating its high economic growth since the transition to democracy in March 2011. During this time, Myanmar requires infrastructure development of international standards before the integration of ASEAN in 2015.The Ministry of Construction (MOC) has been developing roads and bridges with its own budget and private funds, but the development has not reached remote areas due to budget limitations. Particularly in the southeastern part of the country where Myanmar is connected to Thailand, an economically close partner, road development is an urgent task. The major arterial roads in the southeastern part of Myanmar, including the East-West Economic Corridor and the Three Pagoda Pass from Tanbyuzayat to Hpayarthonesu connected to the border with Thailand, act as community roads for neighbouring residents in addition to functioning as arterial roads supporting wider-area traffic. In this connection, the high-speed passage of large cargo vehicles and long-distance buses on roads without shoulders and pavements coexisting with community traffic has been a large problem in terms of traffic safety, which has the potential to become more serious depending on the traffic demand increase in the future. While it is difficult for vehicles to travel on the Three Pagoda Pass during the rainy season, the road is expected to be developed into an international highway providing the shortest route between the Yangon Metropolitan Area and Bangkok. Further, Payagyi-Dawei Road is expected to be developed to connect the East-West Economic Corridor, Three Pagoda Pass, and Dawei in the south to the Yangon Metropolitan Area, which will also strengthen the connectivity between major Myanmar areas and Thailand. As discussed above, this Project requires renovation of priority sections, while taking future traffic demand into account and securing traffic safety.

1.1.2 Survey Objectives

The Project aims to collect information on site condition; progress of existing projects concerning the arterial roads located in the southeastern Part of Myanmar (Payagyi-Dawei, Eindu-Myawaddy , Thaton-Eindu, Mawlamyine-Eindu, Thanbyuzayat-Hpayarthonesu Road (Three Pagoda Pass)); to extract project proposals, which are expected to be implemented in the near future; to select priority projects and to conduct necessary surveys to examine the proposal as a yen-loan project, including the outline, estimated project costs, project implementation system, management, operation and maintenance system, environmental and social considerations, etc.

1.1.3 Survey Area



Source: JICA Survey Team

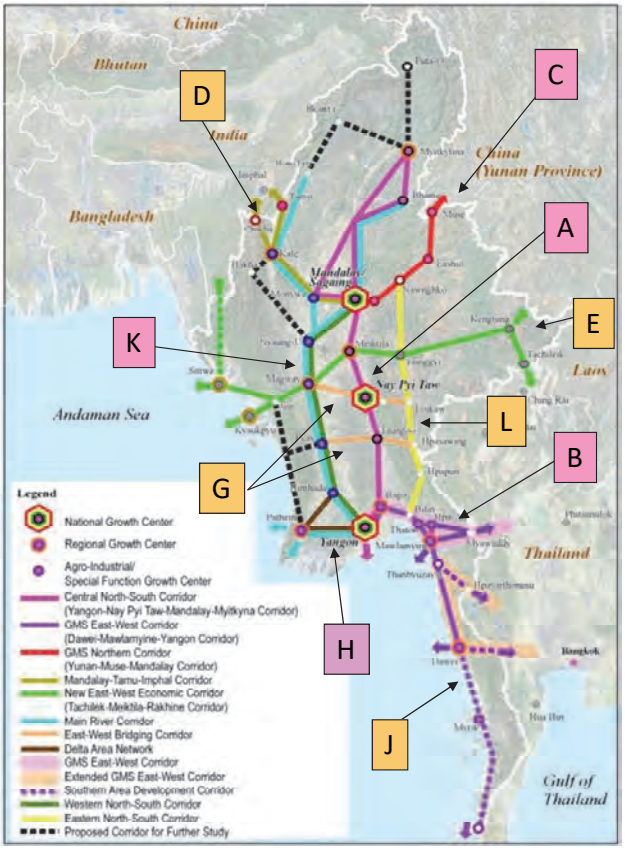
Figure S 1.1.1 Survey Location Map

2. GENERAL UNDERSTANDING

2.1 The National Transport Development Plan in the Republic of the Union of Myanmar

This is the master plan for national transport development in Myanmar prepared by assistance of JICA in 2013 and is the origin of this survey. It is considered that investment in a variety of transportation sectors such as aviation, road, railway, port, and inland water transportation is necessary for sustainable economic development in Myanmar. In the Master Plan, the 2014 – 2020 year is proposed to focus on the development of key infrastructures. In Myanmar, there is no cross-sector transportation development plan. In addition, the quantitative analysis/evaluation has not been carried out for the long-term development plan or the project list formulated by each ministry.

Considering the above situation, in terms of selection and concentration, ten key corridors have been selected to be balanced with growth in urban and rural regions, and to be a basis for national land development. Moreover, five priority corridors, including the targeted roads in this survey, have been selected by the quantitative criteria such as future GRDP, traffic demand, investment effect. The plan will be soon endorsed and authorized by the Cabinet Approval, thus, road improvement in this survey corresponds to the National Transport Development Plan in Myanmar.



Source：The Survey Program for the National Transport Development Plan

Figure S 2.1.1 Priority Five Corridor

Five Priority Corridors

A: Central North-South Corridor (Yangon- Naypyitaw – Mandalay)
B: GMS East-West Corridor (Yangon–Thaton–Myawaddy/Mawlamyine–DaweiThree Pagoda Pass)
C: GMS Northern Corridor (Mandalay – Muse)
H Delta Area Network
K Western North-South Corridor (Yangon - Pyay – Magway)

2.2 Current Site Condition

2.2.1 Current Road and Bridge Condition for Survey Roads

(1) Payagyi – Dawei Section

1) Current Condition of Road

- Payagyi to Mawlamyine section has been developed to “Class-III” road in accordance with

the ASEAN Highway Standards. The road surface is maintained to be in good condition since Shwe Than Lwin Highway Co., Ltd, a private company in Myanmar, is undertaking maintenance of the route under BOT contract.

- There are unpaved roads in the south section of Thanbyuzayat although road improvement has been undertaken by MOC. In particular, the road condition is still poor in the 10km section on the mountain area south of Ye.
- This route also passes several urban areas such as Kyaito, Thaton and Mawlamyine and is used as a community road by wayside residents, so that lots of pedestrians, bicycles, and motor bikes are using this road. Large vehicles are also running in large numbers. As the shoulder is not paved and the road has one lane for each way, it is dangerous for vehicles to overtake and pass the others.

2) Current Condition of Bridge

- No significant damage is observed on major bridges in this section. There is a sufficient load limit for heavy freight vehicles, thus, there is no current need for specific reconstruction or repair.

Table S 2.2.1 Current Status of Major Bridges in Payagyi –Dawei Section

Bridge Name	Length	Superstructure Type	Foundation Type	Weight Limit	Completion Year
Sittaung Bridge (Mokepalin)	729m	Steel truss	Unknown	60t	2006
Thanlwin（Mawlamyine）Bridge	3519m	Steel truss	Unknown	60t	2005

Source: JICA Survey Team

3) Detected Issues in the Concerned Road Section

- ✓ Widening and Improvement of Existing Road (There are many unpaved roads on southern section of Thanbyuzayat and the road condition is especially poor in the 10km section on the mountain area south of Ye）
- ✓ Widening of Existing Road and development of the bypass in the urban area where future traffic volume is expected to increase
- ✓ Safety enhancement and promotion of pedestrian – vehicle separation through improvement of shoulders and pavements
- ✓ Intensification of regulation against entry in the road site (ROW)

(2) Thaton –Eindu Section

1) Current Condition of Road

- The road width is 7m including two-way, two lanes (3.5m per lane). The roadway is paved by macadam pavement with an unpaved shoulder. As motorcycles and ox carts go through the roadway, and it is difficult to overtake low-speed large vehicles, thus the running speed goes down on the whole.
- The road surface is good and right of way (ROW) is secured all through the section. In Thaton, Hpa-an and Eindu, the road passes through urban areas and some houses and stores occupy the road site.
- The section is operated and maintained now by a private concessioner under a BOT contract. Thaton-Myainkalay Section (western part of Thanlwin (Hpa-an) Bridge) is maintained by Shwe Than Lwin Highway Company, a private Myanmar company, and the Myainkalay-Eindu section by AyeKo Family (AK). The road surface is maintained to be in a satisfactory condition by the companies.
- This route is a part of the East-West Economic Corridor and has large traffic of heavy vehicles. In particular, chronic traffic congestion has occurred in the urban area of Thaton,

where a mixture of large-vehicle and regional traffic shows critical problems in terms of traffic safety. In this context, MOC has started a study for Thaton bypass plan since March, 2013, and established centre lines.

- To the north of the Thaton urban area, there is a rural road developed in 2010 by the Ministry of Progress of Border Areas, National Races & Development Affairs. Though partially surfaced with asphalt, this rural road has many unpaved sections and its road surface condition is poor. For the development of the Thaton bypass, it is considered appropriate to employ the measure of upgrading the main road.

2) Current Condition of Bridge

- On Donthami Bridge completed in 1982, no particular failure, except settlement behind the abutment, is observed in the current state, and the load limit is 50 tons. At present, there is no need for specific reconstruction or repair.
- On Thanlwin (Hpa-an) Bridge which consists of a steel truss bridge built in 1997 by MOC, no particular failure is observed in the current state, and the weight limit is 50 tons, enough to accommodate heavy freight traffic. At present, there is no need for specific reconstruction or repair.
- Naung Lon Bridge is an RC bridge built in the 1973, and the weight limit is only 20 tons. Critical damage to the bridge is observed, such as large deflection of the girder and settlement of piers. Considering the significant damage on the structure and insufficient in weight limitation, urgent reconstruction is needed.

Table S 2.2.2 Current Status of Major Bridges in Thaton – Eindu Section

Bridge Name	Length	Superstructure Type	Foundation Type	Weight Limit	Completion Year
Donthami Bridge	183m	PC+RC	---	50t	1982
Thanlwin (Hpa-an) Bridge	686m	Steel truss	Bored pile	60t	1997
Naung Lon Bridge	115m	RC（I Girder)	Spread foundation	20t	1973

Source: JICA Survey Team

3) Detected Issues in the Concerned Road Section

- ✓ Construction of a bypass in order to mitigate chronic traffic congestion and critical problems in terms of traffic safety in the urban areas
- ✓ Safety enhancement and promotion of pedestrian – vehicle separation through improvement of shoulders and pavements
- ✓ Widening of existing roads in accordance with future traffic demand
- ✓ Intensification of regulation against entry in the road site (ROW)
- ✓ Reconstruction of Naung Lon Bridge under severe damage

(3) Eindu –Myawaddy Section

1) Current Condition of Road

- The section of Eindu – Kawkareik with 80km length is supposed to be improved to “Class-II” according to ASEAN Highway Standards until March, 2019 by the project named ” TA-8330 MYA: GMS East-West Economic Corridor Eindu to Kawkareik Road Improvement” under ADB.
- Although the hilly and rough mountain road for about 40 km is limited to one-way traffic (switched for upbound and downbound day by day), the section has been greatly improved by the new bypass with the support of the Thai government, in which some part is under construction and will be completed by May, 2015. Although the design speed for the bypass is 50km/h and the bypass is a two-lane paved road with the total width of 10m, a steep vertical gradient of 12 % and continuous S curves are provided, which is not satisfied with the

ASEAN Highway Standards since it passes through the mountain area. It is thus a concern that loaded trucks may have difficulties negotiating the road sections with steep gradients which can affect transport efficiency, and the road is vulnerable to natural environment such as rainfall since the safety measures (slope protection and drainage) are insufficient even after the completion of the bypass.

- Zathapyin- Kargalay Bypass (hereunder Kyargalay Bypass) is an unpaved 1.5 lane road except for in some urban areas and has difficulties on the route due to flooding during the rainy season. There are several bridges along the route, all of which are wooden temporary ones and broken, so that they must be reconstructed to permanent bridges (the same applies to the box and pipe culverts).
- It is considered that this route has a high potential for becoming a bypass road since it is the shortest route connecting Myawaddy to Mawlamyine, which is the third biggest city in Myanmar. In this context, road improvement of this section is expected.

2) Current Condition of Bridge

- Gyaing Kawkareik Bridge is a 365m long bailey suspension bridge over the Gyaing River, and has a weight limit of 24 tons, forcing heavy freight vehicles to divert toward the pontoon bridge upstream.
- This bridge is suffering from deterioration and the resultant excessive damage, such as the deterioration of the main cable, cracks on RC slabs for the approach bridge etc., all indicate that urgent measures, such as reconstruction, are necessary.

Table S 2.2.3 Current Status of Major Bridges in Eindu – Myawaddy Section

Bridge Name	Length	Superstructure Type	Foundation Type	Weight Limit	Completion Year
Gyaing Kawkareik Bridge	365m	Suspension	Bored pole	24t	1999

Source: JICA Survey Team

3) Detected Issues in the Concerned Road Section

- ✓ Road improvement to international highway in Kawkareik – Myawaddy section
- ✓ Being a mountain road, this section requires large-scale structures (retaining wall, long-span bridges, and tunnels) for the improvement of the alignment. The considerable amount of the project costs will also be needed.
- ✓ Elimination of road flooding and development of bypass by improvement of existing Kyargalay Bypass
- ✓ Special land acquisition procedure in Kayin (Karen) State (necessity of coalition with KNU)
- ✓ Safety enhancement and promotion of pedestrians – vehicle separation through improvement of shoulders and pavements
- ✓ Intensification of regulations against entry in the road site (ROW)
- ✓ Urgent reconstruction of Gyaing Kawkareik Bridge

(4) Eindu – Mawlamyine Section

1) Current Condition of Road

- For this section, the AyeKo Family concluded the concession agreement with MOC and is undertaking the operation and maintenance according to BOT.
- This is a 1.5-lane road of about 40 km in length, with an asphalted roadway. Since the shoulder is not paved, it is extremely dangerous in the case of overtaking and passing. The 20 ton weight limit at Gyaing Zathapyin Bridge and Atran Bridge diverts heavy freight exceeding 20 tons, travelling from Yangon and Myawaddy to Mawlamyine, toward Hpa-an and Thaton.

2) Current Condition of Bridge

- Gyaing Zathapyin Bridge is a suspension bridge crossing the Gyaing River constructed in 1999 with material supply and technology aid from China. The 20 ton weight limit diverts heavy freight exceeding 20 tons travelling from Yangon and Myawaddy to Mawlamyine toward Thanlwin (Mawlamyine) Bridge (weight limit 60 tons) via Thaton. In addition, since the road is not paved, the 4cm gap of moulded steel is dangerous for two wheeled vehicles. (The tires might get caught in the grooves.) The ageing bridge prompted MOC to directly conduct repair work (repainting, cable sheath, and replacement of steel shapes over the bridge surface), which was completed in April 2013. Reconstruction to a permanent structure for both traffic safety and the ability to accept heavy vehicle traffic is urgently necessary.
- Atran Bridge is a cable-stayed bridge and was constructed in 1998 with material supply and technology aid from China. This bridge is also considered a temporary structure, due to its weight limit of 20 tons, and damaged moulded steel bridge surface. Like the Gyaing Zathapyin Bridge, the Atran Bridge is not paved but is instead covered by a moulded steel deck, making it dangerous for two wheeled vehicles to pass safely. Pier scoring has also been observed and is thought to be from a lack of vertical bearing capacity. Reconstruction is necessary.

Table S 2.2.4 Current Status of Major Bridges in Eindu – Mawlamyine Section

Bridge Name	Length	Superstructure Type	Foundation Type	Weight Limit	Completion Year
Gyaing (Zathapyin) Bridge	882m	Suspension Bridge	Bored pile	20t	1999
Atran Bridge	432m	Cable-stayed bridge	Bored pile	20t	1998

Source: JICA Survey Team

3) Detected Issues in the Concerned Road Section

- ✓ As the Eindu – Mawlamyine road has not had the road profile determined by taking into account the high water level in the rainy season, flooding during the rainy season is a problem to be solved. As the road improvement requires raising the road profile, it is possible that the large amount of work costs similarly to the case of new construction may be required.
- ✓ Urgent reconstruction of Gyaing Zathapyin Bridge and Atran Bridge which are bottle necks in the concerned section.

(5) Three Pagoda Pass (Thanbyuzayat—Hpayathonzu Section）

1) Current Condition

- The Three Pagoda Pass is 104km in length and is an unpaved 1.5 lane road at present so that it is quite difficult for vehicles to pass the route due to flooding. Thus, road improvement except pavement, box culverts, and small bridges less than 15m shall be completed by MOC and involved private contractors by April 2015.
- Although there are temporary bridges (bamboo/wooded) on the existing road, four wheeled vehicles are forced to enter rivers, possibly creating engine trouble
- Construction of bridges is an urgent matter since it is likely that this route is impassable in the rainy season even after the completion of earthwork. A feasibility study for road improvement has been carried out by the Neighbouring Countries Economic Development Cooperation Agency (NEDA) since it is considered that road improvement to an international highway is difficult to be completed by MOC due to the limitation of budget and lack of technical capacity in Myanmar.

2) Detected Issues in the Concerned Road Section

- ✓ Bridge construction (Unpassable sections)
- ✓ Road improvement to international highway level

3. TRAFFIC DEMAND FORECAST

3.1 Traffic Demand Forecast

3.1.1 Approach and Methodology of Traffic Demand Forecast in the Study

Basically, the same approach and methodology of the traffic demand forecast applied to the MYT-Plan is adopted for the traffic demand forecast in the Study, considering the following implications. First, the traffic demand forecast is carried out by 2030 (the target year of the MYT-Plan) and 2035 (the target year of the Study). Secondly, the OD matrix is calibrated by the Traffic Survey conducted in the Study. Thirdly, the modal share and route share models are newly developed, considering the sea and land transport of the EXIM cargo between Thailand and Myanmar, and the route share between the East West Economic Corridor and the newly improved Three Pagoda Pass.

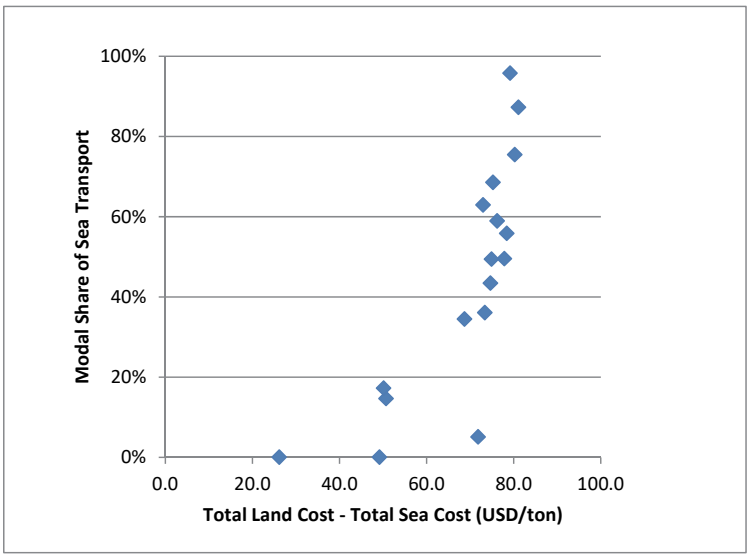
3.1.2 Traffic Demand Forecast in the Study (Base Case)

(1) Projection of Future EXIM Cargo Volume between Thailand and Myanmar

Assuming Myanmar's GDP growth of 7% per annum until 2035 and using the elasticity GDP estimated, the commodity-wise import volume from Thailand to Myanmar is estimated to reach 28 million tons, with export volume from Myanmar to Thailand estimated to reach 17 million tons in total by 2035.

(2) Modal Share of EXIM Cargo between Thailand and Myanmar

Customs data obtained from the Customs Department of Thailand showed 75% of the total import cargo from Thailand, and 56% of the total export cargo to Thailand was transported by sea in 2011. In order to estimate the modal share of the EXIM cargo between Thailand and Myanmar, the current and future zonal impedance (time and cost) is prepared based on the survey report prepared by Nippon Express (2013). The modal split model of the EXIM cargo between sea and land transport was developed assuming that most EXIM cargo is transported between the industrial zones in Ayutthaya and Yangon. Figure S 3.1.1 shows the difference of the generalized cost (time and cost) between sea and land transport, and the share of the sea transport by commodity.



Source: JICA Survey Team

Figure S 3.1.1 Difference of Generalized Cost and Share of Sea Transport between Thailand and Myanmar

The following formula is adopted to estimate the modal share between sea and land transport.

$$Log(Psea) = a \times Log(\alpha \times (Tland - Tsea) + (Cland - Csea)) + b$$

Subject to Psea (Share of Sea Transport), α (Time Value per ton), Tland/Tsea (Transport Time by Land/Sea Transport), Cland/Csea (Transport Cost by Land/Sea Transport), a/b (parameters)

Table S 3.1.1 shows the result of regression analysis of the above formula and parameters estimated through the analysis.

Table S 3.1.1 Result of Regression Analysis and Parameters Estimated

R^2	0.83
a	4.09 (t=5.78)
b	-18.5 (t=－6.21)

Source: JICA Survey Team

Transport and trade facilitation between Thailand and Myanmar (Ayutthaya and Yangon) are expected to reduce transport cost (a reduction of 150 USD between Ayutthaya and Yangon) and transport time (a reduction of 35 hours). Assuming that sea transport service will remain the same, nearly 15% of the EXIM cargo volume is estimated to divert from sea to land transport due to the improvement of the road transport network and service.

As a result, 3.8 million tons (1,660 trucks per day[1]) in 2030, and 6.6 million tons (2,880 trucks per day) in 2035 are estimated to shift from sea to land transport due to the improvement of the road transport network and service between Thailand and Myanmar.

(3) Traffic Assignment and Projection of Traffic Volume

The OD matrix is revised by adding the additional vehicular traffic diverted from sea transport to land transport (1,660 trucks per day in 2030 and 2,880 trucks per day in 2035). The revised OD

[1] Based on the result of OD Interview Survey, the average loading volume of the truck is 8.8 tons. Operation of the trucking service is assumed at 260 days per year.

matrix is assigned to the future network[2].

In order to estimate the route share between the East-West Economic Corridor and the Three Pagoda Pass, dummy links are added to the future road network (assuming that the 440km 4-lane road network between Ayutthaya and Mae Sot and the 350km 4-lane road network between Ayutthaya and Three Pagoda Pass cross border) and traffic generated from Myawaddy/Mae Sot is assigned to these dummy links.

The following table shows the projected traffic volume by the Project and the result of the traffic assignment.

Table S 3.1.2 Projected Traffic Volume by Project (Unit: PCU/day)

Year	① Naung Lon Bridge	②Gyaing (Kawkareik) Bridge	③Thaton Bypass	④Gyaing (Zathapyin) Bridge	⑤Atran Bridge	⑥Kyargalay Bypass
2030	6,000	10,600	9,400	7,900	7,900	6,000
2035	10,900	19,000	17,100	19,300	19,300	9,500-12,100

Source: JICA Survey Team

3.1.3 Traffic Demand Forecast in the Study (Base Case)

The following discussion analyses the future traffic demand on the EWEC, particularly that at Gyaing (Kawkareik) Bridge, setting several EWEC improvement scenarios.

(1) Pre-condition and Case Study of the Traffic Demand Forecast

The following two different improvement scenarios of the EWEC are set:

2035 Scenario: **Partial improvement scenario of the EWEC** (the road section between Myawaddy and the intersection of Kyargalay Bypass is widened to a dual carriage way (four lanes in total).

2040 Scenario: **Full improvement scenario of the EWEC** (the entire road section between Myawaddy and Thaton is widened to a dual carriage way (four lanes in total).)

(2) Summary Result of the Traffic Demand Forecast under EWEC Improvement Case

The following table shows the projected traffic volume by the Project and the results of the traffic assignment under EWEC Improvement Case.

Table S 3.1.3 Projected Traffic Volume by Project under EWEC Improvement Case (Unit: PCU/day)

Yeare	①Naung Lon Bridge	②Gyaing (Kawkareik) Bridge	③Thaton Bypass	④Gyaing (Zathapyin) Bridge	⑤Atran Bridge	⑥Kyargalay Bypass
2035	10,000	27,800	19,500	19,000	20,200	17,800
2040	11,800	42,600	46,500	30,800	33,100	23,300

Source: JICA Survey Team

[2] The road section under the BOT (between Payagyi and Mawlamyine) is assumed to be widened to four lanes and the East-West Economic Corridor, Three Pagoda Pass and the road section between Mawlamyine and Dawei are to be improved to 2-lane roads.

4. SELECTION OF PRIORITY PROJECTS

4.1 Selection of Priority Road Sections and Priority Projects

4.1.1 Listing of Potential Road Sections and Potential Road Improvement Projects

Sub-Project candidates have been identified from interviews with MOC and site surveys done by the JICA Survey Team, as seen in Table S 4.1.1.

Table S 4.1.1 Potential Road Sections and Potential Road Improvement Projects

Road Section		Sub-project
Route 1 Payagyi -Dawei Road	Route 1-1 Payagyi－Mawlamyine	・Construction of a new bypass
	Route 1-2 Mawlamyine－Dawei	・Improvement of existing road
Route 2 Eindu – Myawaddy Road	Route 2-1 Eindu－Kawkareik	・Replacement of Gyaing Kawkareik Bridge
	Route 2-2 Kawkareik－Myawaddy	・Construction of tunnels (Thai Bypass Section)
Route 3 Thaton –Eindu Road		・Replacement of Naung Lon Bridge ・Thaton Bypass (New Bypass)
Route 4 Mawlamyine –Eindu Road		・Replacement of 2 bridges (Gyaing Zathapyin Bridge, Atran Bridge) ・Kyargalay Bypass
Route 5 Thanbyuzayat – Hpayathonzu Road（Three Pagodas Pass）		・Pavement & five bridges

Source: JICA Survey Team

4.1.2 Selection Policy and Criteria Applied

(1) Selection Policy

Priority sub-projects for preliminary design were selected in a series of discussions between MOC and the JICA Survey Team. The following two stage evaluation was applied for the sub-project selection;

- First stage : Selection of priority road section
- Second stage : Selection of priority sub-project

(2) Selection Criteria

First stage Criteria

First stage selection criteria are 1) Road Category (Importance), 2) Traffic Demand (Year 2035), 3) Urgency, 4) Contribution to Local Economy and 5) Ownership and Administration.

Second Stage Criteria

Second stage selection criteria are 6) Environmental and Social Considerations, 7) MOC Priority and 8) possibility of technical transfer.

4.1.3 Selection of Priority Road Sections (First Stage)

Priority road sections were selected during a meeting with MOC from 15 - 16 of May. Results are shown in Table S 4.1.2. Route 1-1 was not selected as it has been improved using international highway standards. There is no significant damage or faults in the route since the addition of BOT administration. The comparison table is shown in Table S 4.1.3.

Table S 4.1.2 Results for Selection of Priority Road Sections (First Stage)

Road Section		Evaluation
Route 1	Route 1-1 Payagyi－Mawlamyine	×
	Route 1-2 Mawlamyine－Dawei	○
Route 2	Route 2-1 Eindu－Kawkareik	○
	Route 2-2 Kawkareik－Myawaddy	○
Route 3 Thaton –Eindu Road		○
Route 4 Mawlamyine –Eindu Road		○
Route 5 Thanbyuzayat – Hpayathonzu Road		○

Legend ○: Selected ×: Not selected

Source: JICA Survey Team

4.1.4 Selection of Priority Sub-Projects

Priority sub-projects were selected from the priority road sections selected during the meeting with MOC on 15 - 16 May. Note that some sub-projects were evaluated as the same sub-project in second stage selection because combining sub-projects should improve effectiveness. The comparison table for the selection of priority sub-projects is shown in Table S 4.1.4.

A : Replacement of two bridges
(Naung Lon Bridge / Gyaing Kawkareik Bridge) ⇒ Sub-project 1
B : Thaton Bypass & Donthami Bridge Improvement of EWEC (to Yangon)

C : Replacement of 2 bridges
(Gyaing Zathapyin Bridge / Atran Bridge) ⇒ Sub-project 2
D : Kyargalay Bypass Improvement of EWEC (to Mawlamyine)

Table S 4.1.3 Selection of Priority Road Section

Criteria/Route		Route1 Payagyi～Dawei Road (app.530Km)				Route2 Eindu～Myawaddy Road (120Km)				Route3 Thaton～Eindu Road (60Km)		Route4 Mawlamyine～Eindu Road (40Km)		Route5 Thanbyuzayat～HpayathonzuRoad (Three Pagodas Pass) (102Km)	
		Route1-1 Payagyi－Mawlamyine		Route1-2 Mawlamyine－Dawei		Route2-1 Eindu－Kawkareik		Route2-2 Kawkareik－Myawaddy							
Length		200km		330km		70km		58km		60km		40km		102km	
1) Road Category (Importance)		・Payagyi～Thaton：AH1/EWEC ・Thaton～Mawlamyine：AH112	A	・AH112	A	・AH1/ EWEC	A	・AH1/ EWEC	A	・AH1/ EWEC	A	・EWEC	A	・International Highway (New)	B
2) Traffic Demand	2014yr (PCU)	3,000～5,800	A	1100	B	2500	A	2500	A	2200	A	1400	A	0	B
	2035yr*1 (PCU)	>37,400		6,900-11,500		9,900-27,800		23,700-28,400		10,000-22,100		6,000-20,200		6,700-10,100	
3) Urgent need		・ 2lane road paved with asphalt(only carriage way) and road condtion is good ・No botteleneck because weight limitation on bridges is over 50t. ・Critical problem in terms of traveling performance at 4sections (Kyaikto、Theinseik、Thaton、Yinnyein) due to a mixture of large vehicles and regional traffic.	C	・Mawlamyine-Thanbyuzayat section improved to be 2lane paved road (only carriageway) and road condtion is good. ・ 1.5 lane unpaved road in southern Thanbyuzayat, especialy road condition is poor in 10km secion on north mountain area of Tanintharyi region.	A	・ 1.5 lane with asphalt penetration macadam damaged. ・Especially, Gyaing Kawkareik Bridge, temporal bailey bridge, is a critical bottleneck for heavy freight vehicles due to its weight limitation of 20t (Reconstruction is needed)	A	・ Kawkareik to Thin Gan Nyi Naung section, traversing Dawna Mountain, is 1-lane and bad road condition. ・The Kawkareik-Thin Gan Nyi NaungBypass, will be completed by July 2015, has sections which are not satisfied with the ASEAN Highway Standard. Accordingly, road improvement may be necessary. ・ Thin Gan Nyi Naung-Myawaddy section is 2-lane paved road and road condition is good (Aid by Thailand)	A	・ Almost section passes flat area and diverting toward south side near Thanlwin river(Conecting to Hpa-an Bypass) ・ 2lane road paved with asphalt(only carriage way) and road condtion is good ・Naung Lon Bridge may be one of potentilal bottlenecks since the bridge has been deteriorated.	B	・ 1.5 lane with asphalt penetration macadam damaged in almost section. ・Gyaing Zathapyin Bridge and Atran bridge, temporal bailey bridge, are critical bottlenecks for heavy freight vehicles due to their weight limitation of 20t (Reconstruction is needed)	A	・ Unpaved and bad road condition, unconectivity in rainy season (Urgent priority)	A
4) Contribution to Local Economy		・The route connecting Mawlamyine and Bago, which are core cities on economic growth of southern area (reffer MYT-Plan and NCDP) ・The route encouraging commerce with Thailand	A	・The route connecting Mawlamyine and Dawei, which are core cities on economic growth of southern area (reffer MYT-Plan and NCDP)	A	・The route connecting Thaton and Hpa-an, which have high potential for industrial and agricultural development (reffer MYT-Plan) . ・The route encouraging commerce with Thailand	B	・The route encouraging commerce with Thailand ・The route connecting Thaton and Hpa-an, which have high potential for industrial and agricultural development (reffer MYT-Plan) .	B	・The route encouraging commerce with Thailand ・The route connecting Thaton and Hpa-an, which have high potential for industrial and agricultural development (reffer MYT-Plan) .	B	・The route encouraging development of Mawlamyine, which is core cities on economic growth of southern area (reffer MYT-Plan and NCDP) ・The route encouraging commerce with Thailand	A	・The route encouraging development of Mawlamyine, which is core cities on economic growth of southern area (reffer MYT-Plan and NCDP) ・The route encouraging commerce with Thailand	A
5) Administration for Road Development and Management		BOT (Bridge section directly controled by MOC)	B	MOC (Mawlamyine～Thanbyuzayat Section is BOT)	A	MOC (A part of section is under FS by ADB)	A	MOC (Under Constructon by Thai Contractors)	A	BOT (Bridge section directly controled by MOC)	B	BOT (Bridge section directly controled by MOC)	B	MOC (Subgrade is under construction by MOC and private companies)	A
Evaluation		C (Not Selected)		A (Selected)		A (Selected)		A (Selected)		B (Selected)		A (Selected)		B (Selected)	
		・Controled by BOT ・Low priority (Higher priority on improvement of EWEC、Three Pagodas Pass and SEC)		・Direct control by MOC ・High urgent priority		・Direct control by MOC ・High urgent priority (Resolution of bottelneck bridge etc) ・ADB aid planned		・Direct control by MOC ・High traffic demand ・Moderate priority		・Controled by BOT ・High urgent priority		・Controled by BOT ・High urgent priority (Resolution of bottelneck bridge etc)		・Direct Control by MOC ・Urgent priority depens on improvement of other international highways (EWEC、SEC)	

*1 Traffic Demand was updated in accordance with the result of the traffic demand forecast for EWEC Improvement Case afther the Fact Find Misson on December, 2014

Source: JICA Survey Team

Table S 4.1.4 Selection of Priority Sub-project

Criteria/Route			EWEC (toYangon)			EWEC (to Mawlamyine)			Improvement of EWEC(Common)		Route5 Thanbyuzayat～Hpayathonzu Road		Route1-2 Thanbyuzayat～Dawei Road	
			Route2-1 Eindu～Kawkareik Road、Route3 Thaton～Eindu Road		Route3 Thaton～Eindu Road	Route4 Mawlamyine～Eindu Road		Route2-1 Eindu～Kawkareik Road、Route4 Mawlamyine～Eindu Road	Route2-2 Kawkareik～Myawaddy Road		Route5 Thanbyuzayat～Hpayathonzu Road		Route1-2 Thanbyuzayat～Dawei Road	
			Plan A		Plan B	Plan C		Plan D	Plan E		Plan F		Plan G	
Project description	Subproject		**Subproject 1 : Improvement of EWEC (toYangon)**			**Subproject 2 : Improvement of EWEC (to Mawlamyine)**			**Subproject 3**		**Subproject 4**		**Subproject 5**	
			Replacement of 2 bridges (Naung Lon Br., Gyaing Kawkareik Br.)		**Thaton Bypass+Replacement of Donthami Br.**	**Replacement of 2 bridges (Gyaing Zathapyin Br., Atran Br.)**		**Kyargaley Bypass**	**Construction of tunnels (Thai Bypass Section)**		**Three Pagodas Pass**		**Improvement of Southern Thanbyuzayat**	
	Road length/Bridgelength		Naung Lon Br. : 150m, Gyaing Kawkareik Br. : 760m		App.28km/Donthami Br. : App.200m	Gyaing Zathapyin Br. : 830m, Atran Br. : 680m		App.25Km	Tunnel length App.3km		App.104km、4 bridges (less than 100m)		App.240km	
	Description of Construction	New Road	—		2-lane road construction (ASEAN Highway Class II) 14.5Km	—		2-lane road construction (ASEAN Highway Class II) 2.5Km	2-lane tunnel construction (ASEAN Highway Class II)					
		Existing road	—		2-lane road improvement (ASEAN Highway Class II) 13.5Km (Widening of existing road)	—		2-lane road improvement (ASEAN Highway Class II) 22.5Km (Widening of existing road)	—		2-lane pavement (ASEAN Highway Class II)		1.5 lane road improvement	
		Bridge	Replacement of 2 bridges (medium to large scale bridges/ASEAN Highway Class II)		Replacement of 6 small bridges and Donthami Br.	Replacement of 2 bridges (medium to large scale bridges/ASEAN Highway Class II)		Replacement of 19 small bridges	—		Replacement of 4 small bridges		Rehabilitation of existing bridges	
	Traffic Demand	Traffic Demand(2014)	2,500 PCU		-	1,400 PCU		-	2,500 PCU		-		1,100 PCU	
		Traffic Demand(2035)*1	10,000, 27,800 PCU		19,500 PCU	19,000 - 20,200 PCU		14,500-17,800 PCU	23,700 PCU		6,700-10,100 PCU		6,900 PCU	
Selection of Priority Subproject	**6) Environmental and Social Considerations**	Supposed Category	Category B	A	Category B	Category B	A	Category B	Category A	C	Category B (only pavement and bridges)	B	Category A	C
		Number of Affected houses (Number of involuntary ressettlements)	Less than 5 (Less than 30 people)		11 (Less than 200 people)	None (Less than 200 people)		N/A (assumued less than 200 people)	N/A (assumued less than 200 people)		Less than 30 (assumued less than 200 people)		N/A (assumued more than 200 people)	
		Reason	Bridge reconstruction and less than 200 ressettlements		Less than 200 ressettlements under COI concept	Bridge reconstruction and less than 200 ressettlements		Upgrade of existing rolad (less than 100km) , New construction(less than 5km), less than 200 ressettlements	New tunnel construction (App.3km)		Bridge reconstruction and pavement, less than 200 ressettlements		New tunnel construction, improvement of existing road (more than 100km) , so that assumued ressettlements is more than 200 people.	
		Remarkable concerns	None		Need alignment avoideing Pagoda dense zone and military accommodations	None		None	・None of environmental and social considerations has been studied in the construction of bypass between Myawaddy and Kawkareik (App.28km) by Thailand ・If GOJ decide to provide financial assistance via ODA with the current condtion(on-going project), the EIA might be required to conduct including the scope of works for Thai bypass section.include the responsibility between JICA and PW should be		None of crucial impact is expected for the EIA of the project even if GOJ decided to provide financial assitance via ODA. However, PW conductes the current construction without any environmental mitigation measure therefore it would be subject to study in the EIA if implemented by GOJ.		It is assumed that total number of ressettlements is more than 200 people due to 240km length. Number of ressettlements depends on design of tunnels and bridges in moutain area.	
	7) Priority in MOC		Very High	A	High (Minister of MOC)	High	B	High (PW)	Premature at present (MD of PW)	C	Very High (Minister of MOC)	A	High interest on the premise of SEC (PW)	B
	8) Possibility for Technology Transfer		High Possibility in technical transfer for foundation and superstructure of large scaled bridge	A	Low possibilty to apply Japanese technique due to general highway construction	High Possibility in technical transfer for foundation and superstructure of large scaled bridge	A	Low possibilty to apply Japanese technique due to general highway construction	Possible utilization of sole Japanese technique due to application of tunnel construction	A	Low possibilty to apply Japanese technique due to general highway construction	B	Low possibilty to apply Japanese technique due to general highway construction. High Possibility in technical transfer in the case that construction of tunnel or large scaled bridge are necessary	B
	Evaluation of subproject		**Contributuion to the development of South-East Region by connecting the link between Mekong region and Mawlamyine(Realization of effectiveness by implementation of both sub-projects on the same network) 。**	**A**		**Contributuion to the development of South-East Region by connecting the link between Mekong region and Mawlamyine(Realization of effectiveness by implementation of both sub-projects on the same network) 。**	**A**		**Higher urgency and effectivess but many outstanding issues to be solved**	**B**	**Urgency and effectiveness relies on the progress of SEC**	**B**	**Urgency and effectiveness relies on the progress of SEC**	**B**
	Prospective year for L/A (Draft)		**F/S for FY2014**		**F/S for FY2014**	**F/S for FY2014**		**F/S for FY2014**	**N/A (later 2015)**		**N/A (later 2015)**		**N/A (later 2015)**	

*1 Traffic Demand was updated in accordance with the result of the traffic demand forecast for EWEC Improvement Case afther the Fact Find Misson on December, 2014

Source: JICA Survey Team

5. PRELIMINARY DESIGN ON PRIORITY PROJECTS

5.1 Preliminary Study for Four Bridges

5.1.1 Comparative Study of Bridge Crossing Point for Four Bridges

As a result of the study, the crossing points of most bridges were decided to be on the upstream side from the point of view to mitigate the influence to new bridges when the existing bridges fall down.

5.1.2 Study of Superstructure Type

(1) Main Bridge

The types of the main bridges have been selected based on the engineering assessment of several criteria including span length, navigation clearance, structural stability, constructability, construction cost, maintenance, technical transfer (new technology in Myanmar) and aesthetic considerations. Comparison results are described below.

a) Naung Lon Bridge

- **First selection**

The existing bridge is a continuous reinforced concrete girder bridge with a span length of approximately 12.5m. The navigation clearance is not specifically required. In addition, there are no special conditions for the river or the topography. Therefore, the following four alternatives were compared.

- ✓ Alternative 1 : PC-I girders (5@30m=150m)
- ✓ Alternative 2 : PC Box girders (4@40m=160m)
- ✓ Alternative 3 : Steel I girders (4@40m=160m)
- ✓ Alternative 4 : RC girders (10@15m=150m)

- **Second selection**

Through the multi-criteria evaluation, Alternative 3: Steel-I Girder Bridge is recommended primarily because it has the most reasonable construction cost and the shortest construction period.

b) Gyaing Kawkareik Bridge

- **First selection**

The main span of existing bridge is 154m, and the required navigation clearance is 360 feet (110m) x 40 feet (12.2m). The river depth is more than 10m. Therefore, the following three alternatives were selected.

- ✓ Alternative 1 : PC extradosed bridge (Main bridge: 100m + 160m + 100m = 360m)
- ✓ Alternative 2 : PC box girder bridge (Main bridge: 90m + 130m + 90m = 310m)
- ✓ Alternative 3 : Steel box girder bridge with steel slab (Main bridge: 100m + 160m + 100m =360m)

- **Second selection**

Alternative 1: PC extradosed Bridge is recommended primarily because of its reasonable construction cost, its contribution to the landscape as a symbolic structure, and the advanced bridge techniques used in its construction.

c) Gyaing Zathapyin Bridge

➢ **First selection**

The main span of existing bridge is 457.20m (no piers within river width), the required navigation clearance is 400 feet (122m) x 40 feet (12.2m), and river depth is more than 15m. In addition, soil investigations by the JICA Survey Team observed limestone layer underlays at very shallow depth on river bed. With this investigation in mind, we decided to select several bridge types in which the construction of piers is not required in deep area in the river.

- ✓ Alternative 1: Steel cable-stayed bridge (210m + 460m + 210m = 880m)
- ✓ Alternative 2: Suspension bridge (210m + 460m + 210m = 880m)

➢ **Second selection**

Alternative 1: Steel Cable-stayed Bridge is recommended in consideration of its reasonable construction cost, its contribution to the landscape as a symbolic structure, and the advanced bridge techniques used in its construction.

d) Atran Bridge

➢ **First selection**

The main span of the existing bridge is 182m, and the required navigation clearance is 400 feet (122m) x 40 feet (12.2m). The river depth is more than 15m. Therefore, the following four alternatives were nominated.

- ✓ Alternative 1 : PC extradosed bridge (Main bridge: 120m+190m+120m=430m)
- ✓ Alternative 2 : PC cable-stayed bridge (Main bridge: 120m+190m+120m=430m)
- ✓ Alternative 3 : PC box girder (Main bridge: 90m+130m+90m=310m)
- ✓ Alternative 4 : Steel box girder with steel slab (Main bridge: 120m + 190m + 120m = 430m)

➢ **Second selection**

Alternative 1: PC extradosed Bridge was chosen in consideration of its reasonable construction cost, its contribution to the landscape as a symbolic structure, and the advanced bridge techniques used in its construction.

e) Approach Bridge

In order to maintain continuity with the main bridge, the cross section of the approach bridge is designed based on the cross-section of the main bridge. Therefore, the span length of the approach bridge is set to 40-60m in consideration of girder depth restrictions, economical factors and the introduction of advanced technology in Myanmar. As shown in the previous section, the main superstructure of Naung Lon Bridge is Steel I Girder, the superstructure of Gyaing Zathapyin Bridge is Steel Cable-Stayed, and the superstructures of Gyaing Kawkareik Bridge and Atran Bridge are both PC extradosed (concrete). Therefore, the following types for the approach bridges are selected to match with its main bridge.

- ✓ Naung Lon Bridge : No approach bridge
- ✓ Gyaing Kawkareik Bridge : Continuous PC Box Girder with 50m span
- ✓ Gyaing Zathapyin Bridge : No approach bridge
- ✓ Atran Bridge : Continuous PC Box Girder with 50m span

5.1.3 Study of Foundation Type and Substructure Type

(1) Foundations within river

The selection of foundation type in a river shall be carefully considered taking into account specific criteria and natural conditions:

- ✓ The water depth for the proposed bridge sites
- ✓ Possibility of scouring (sufficient attention must be paid to scouring)
- ✓ Supporting load of foundation
- ✓ Depth of the supporting layer

Considering the above conditions, three foundation types, (1) Neumatic Caison (2) Cast-in-Place Concrete Pile (3) Steel Pipe Sheet Pile Foundation (SPSPF) were nominated for for Gyaing Kawkareik Bridge, Gyaing Zathapyin Bridge and Atran Bridge. As a result of the comparative studies on Gyaing Kawkareik Bridge (P5) and Gyaing Zathapyin Bridge (P1), SPSPF is recommended for the foundation type within a river because the construction period can be shortened since it does not need a temporary cofferdam and also it is superior to other alternatives in an economic aspect. The piers of Atran Bridge (P5 and P6) are expected to undergo a vertical load on its piers larger than that of Gyaing Kawkareik Bridge (P5) and smaller Gyaing Zathapyin Bridge (P1). Hence, the selection of its foundation type can be based on the results of these two evaluations.

CPCP (the most common foundation type in Myanmar) can be applied as the foundation type for Naung Lon Bridge since the expected loading force is relatively small. As a result of the comparative study, CPCP with 1000mm diameter was selected for the foundation type at Naung Lon Bridge.

(2) Foundations on land

Cast-in-place concrete piled foundations (CPCP) were selected for the foundation types of the piers and abutments on land, due to their ease of constructability and procurement of materials/equipment as well as the experience in Myanmar. The diameter of the cast-in-place concrete pile at Gyaing Kawkareik Bridge was selected using a comparative analysis, and this selected pile diameter (1500mm) is also used for other land foundations.

5.2 Preliminary Study for Bypass

5.2.1 Route Comparative Study

(1) Thaton Bypass

A comparative study for the alignment of Thaton Bypass was executed in consideration of technical issues, social impact, and safety issues.

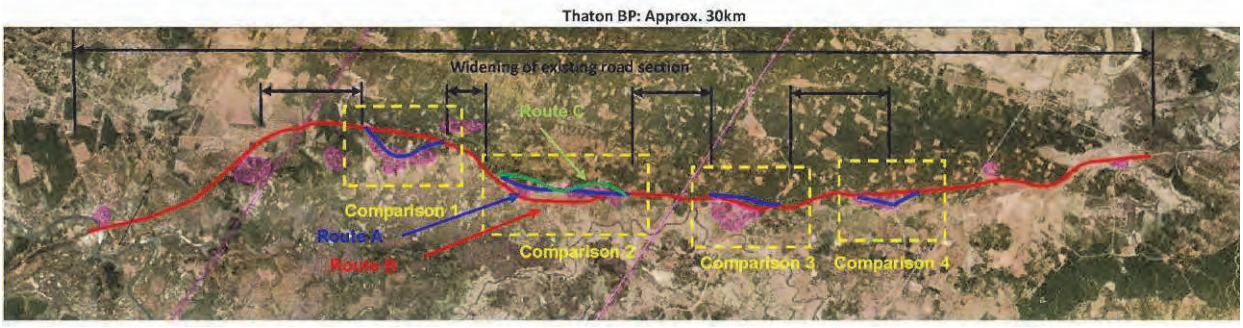
- Routes B and C were selected over Route A in order to avoid involuntary resettlement, and
- Route C was selected over Route B in order to minimize land acquisition of paddy fields (present at one section where the route passes through a mountainside town).

Table S 5.2.1 Route Comparison on Thaton Bypass

	Alternative Route A (Blue)	Alternative Route B (Red), C (Green)*
Concept of Route Setting	Mostly tracing the existing road as much as possible	Avoiding involuntary resettlement of residents
Length	Thaton BP: 28.9km (existing road: 14.3km, new road: 14.6km)	Thaton BP: 29.0km (existing road: 8.6km, new road: 20.4km)
Affected Properties	No. of Structures:34 structures (more than 200 re-settlers)	No. of Structures:17 structures (87 re-settlers)
Traffic Safety	route across the community need to appropriate traffic control	Route away from the community safer than route A
Possibilities for future development	Ultimate widening of four lanes in future requires removal of many affected buildings.	Possible ultimate widening of four lanes does not require additional removal of building
Evaluation	Not Recommended	**Recommended (Route C)**

* Route C is mostly the same as Route B route passing through mountain side to minimize land acquisition of paddy field (one section).

Source: JICA Survey Team



Source: JICA Survey Team

Figure S 5.2.1 Alternative Route Maps on Thaton Bypass

(2) Kyargalay Bypass

A comparative study for the alignment of Kyargalay Bypass was executed in consideration of technical issues, social impact, and safety issues.

At the meeting with MOC on 7th of July, 2014, based on this study, B route was selected in order to avoid involuntary resettlement.

Table S 5.2.2 Route Comparison on Kyargalay Bypass

	Alternative Route A (Blue)	Alternative Route B (Red)
Concept of Route Setting	Tracing the existing road as much as possible	Avoiding involuntary resettlement of residents
Length	24.8km (existing road: 23.9km, new road: 0.9km)	24.5km (existing road: 21.4km, new road: 3.1km)
Affected Properties	21 structures + 57 structures (more than 200 re-settlers)	21 structures (104 re-settlers)
Traffic Safety	- Route crosses the community - Requires appropriate traffic control	- Route away from the community - Safer than route A
Possibilities for future development	Eventual widening into four lanes would require removal of many buildings.	Eventual widening into four lanes would not require additional removal of buildings
Evaluation	Not Recommended	**Recommended**

Source: JICA Survey Team

Source: JICA Survey Team

Figure S 5.2.2 Alternative Route Maps on Kyargalay Bypass

5.2.2 Study of Superstructure Type

(1) Donthami Bridge

For Donthami Bridge, a comparative study of superstructure type alternatives was conducted using the same criteria and evaluation method for the other four major bridges.

➢ **First selection**

The existing bridge is a continuous PC-I girder bridge with a span length of approximately 35m-40m. No navigation clearance is specifically required. However, the feasibility of construction of foundation in deep water was specifically taken into consideration. Therefore, the following four alternatives were nominated.

- ✓ Alternative 1: Steel I girder (5@40m = 200m) [Two piers in the river]
- ✓ Alternative 2: Steel Box girder (64@60m = 240m) [One pier in the river]
- ✓ Alternative 3: PC Box girder (4@50m = 200m) [One pier in the river]
- ✓ Alternative 4: Steel Box girder with Steel Plate Deck (60m + 90m + 60m = 210m) [No piers in the river]

➢ **Second selection**

Alternative 1: Steel-I Girder Bridge is recommended due to its reasonable construction cost.

(2) Small Bridges Along Bypass

Small bridges are defined as those that must be planned along the proposed bypass at points where the bypass crosses existing creeks and rivers of width less than 30m, where there are no special condition of the river or the topography. The proposed span length for small bridges can be up to 30m.

The PC-I girders were selected for the superstructure type due to the ease of constructability and the ease of procurement of materials/equipment, as well as Myanmar's plentiful experience in this type of construction.

5.2.3 Study of Foundation Type

(1) Donthami Bridge

The selection of foundation type in the rivers shall be carefully considered taking into account specific criteria and natural conditions:

- ✓ The water depth for proposed bridge sites
- ✓ Possibility of scouring (sufficient attention must be paid to scouring)
- ✓ Supporting load of foundation
- ✓ Depth of the supporting layer

Considering the above conditions, four different foundation types such as Cast-in-Place Concrete Piles (CPCP), Steel Pipe Piles (SPP), Steel Pipe Sheet Piles (SPSP) and Concrete Caissons (CC) can be applied for the foundations of Donthami Bridge. However, SPSP and Caisson would not be reasonable due to the bridge scale. Hence, two foundation types (Cast-in-Place Concrete Pile, Steel Pipe Pile) can be compared.

As a result of the comparative study, steel pipe piled foundations were found to be economically reasonable.

(2) Small Bridge Along Bypass

Cast-in-place concrete piled foundation (CPCP) was selected for the foundation type of "small bridges" due to CPCP's constructability, the ease of procurement of required materials/equipment, and Myanmar's ample experience in CPCP construction. The pile diameter selected for Naung Lon Bridge can also be applied in this case due to the similar scale of load.

5.3 Preliminary Design

As a result of preliminary design, superstructure type, substructure type, foundation type, bridge and road length were summarized below table.

Table S 5.3.1 Summery of Preliminary Design Results

Project Component	Description	
Naung Lon Bridge	Superstructure	4 span continuous steel plate girder bridge L = 160m
	Substructure	Abutment: Invert T shaped x 2 Pier: Wall type x 3
	Foundation	Abutment: Piled foundation (φ1000) Pier: Pile foundation (φ1000)
	Approach road	Embankment structure (L=316m、L=284m)
Gyaing Kawkareik Bridge	Superstructure	Main span: 3 span continuous PC extradosed bridge L = 360m Approach span: 4 span continuous PC girder bridge L = 200m (Left) 5 span continuous PC girder bridge L = 250m (right)
	Substructure	Main tower: Two column type piers (RC) Differential pier head: 2 Pier (Approach): Wall type x7 Abutment (Approach): Invert T shaped x 2
	Foundation	Main Tower: Steel Pipe Sheet Piled Foundation (φ1200) Differential pier head; Cast-in-place bored pile (φ1500) Abutment/ Pier (Approach): Cast-in-place bored pile (φ1500)
	Approach road	Embankment structure (L = 455m、L = 424m)
	Soft soil ground treatment	Vertical drain + Pre-loading method
Gyaing Zathapyin Bridge	Superstructure	3-span steel girder cable stated bridge L=880m
	Substructure	Main tower: Two column type pier (RC) Abutment (Approach): Invert T shaped x 2nos
	Foundation	Main tower: Steel pipe sheet piled foundation (φ1200) Abutment (Approach)：Cast-in-place bored bile (φ1500)
	Approach road	Embankment structure (L = 477m、L = 517m)
	Soft soil ground treatment	Vertical drain + Pre-loading method

Atran Bridge	Superstructure	Main span：3 span continuous PC extradosed Bridge L = 430m Approach span: 3 span continuous PC girder bridge L = 150m (right) 4 span continuous PC girder bridge L=200m (left)
	Substructure	Main tower: Two column type pier (RC) Differential pier head type：2 Pier (Approach): wall type x 5 Abutment (Approach): Invert T shaped x 2
	Foundation	Main Tower: Steel Pipe Sheet Piled Foundation (φ1200) Differential pier head; Cast-in-place bored pile (φ1500) Abutment/ Pier (Approach): Cast-in-place bored pile (φ1500)
	Approach road	Embankment structure (L = 560.5m、L = 344.5m)
	Soft soil ground treatment	Vertical drain + Pre-loading method
Thaton Bypass (including Donthami Bridge)	Superstructure	5 span continuous steel plate girder bridge L=200m
	Substructure	Abutment: Invert T shaped x 2 Pier: Wall type x 4
	Foundation	Abutment: Cast-in-place bored pile (φ1000) Pier: Cast-in-place bored pile (φ1000)
	Road length	L= Approximately 29.3 km
	Structure	Box culvert × 65 Small bridge × 5 Donthami bridge L = 200m
	Soft soil ground treatment	Vertical drain + Pre-loading method
Kyargalay Bypass	Road length	L=Approximately 25km
	Structure	Box culvert × 82 Small bridge × 8
	Soft soil ground treatment	Vertical drain + Pre-loading method

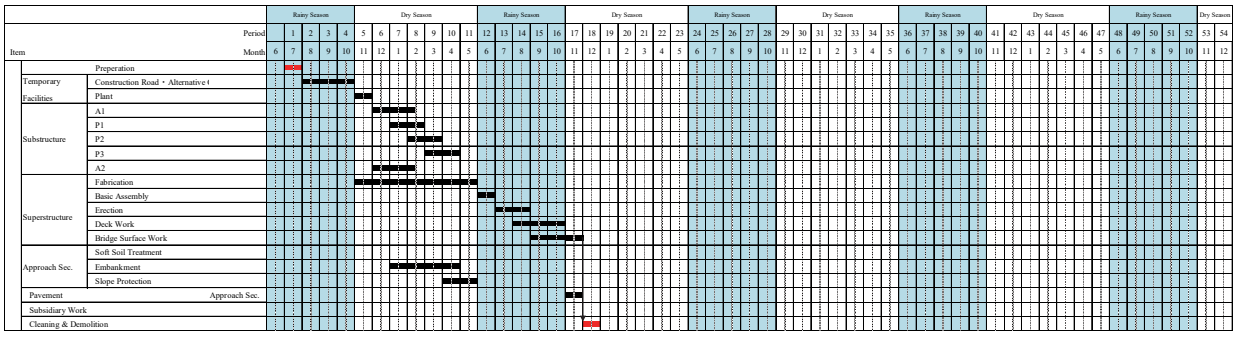
Source: JICA Survey Team

6. CONSTRUCTION PLANNING

6.1 Construction Schedule

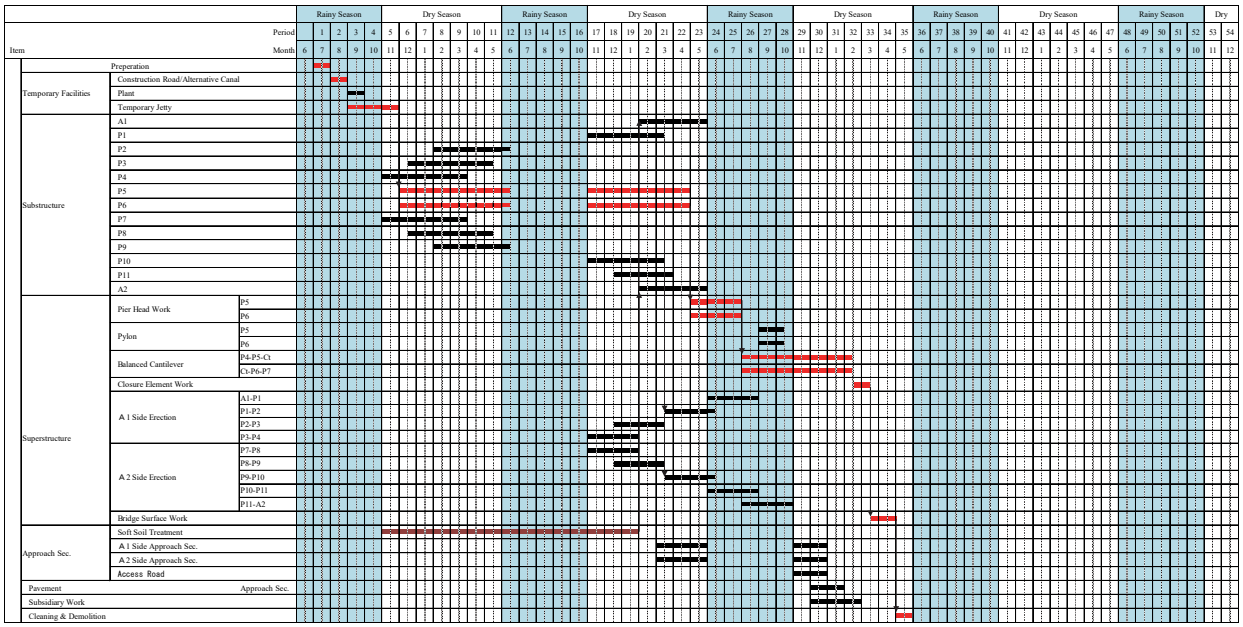
Myanmar is generally considered to have two clearly-definable seasons. The wet season lasts from June to October, and the dry season lasts from November to May. In the hydraulic survey, it is observed that the project areas are mostly submerged during the wet season due to the floods of adjacent rivers. Accordingly, the construction schedule is to be established such that, in principle, major works should be conducted in the dry season. However, superstructure works (including the construction of towers and the erection of girders) are to be conducted during wet season where possible in order to shorten the schedule.

The construction schedules for all major works are given from Figure S 6.1.1 to Figure S 6.1.6.



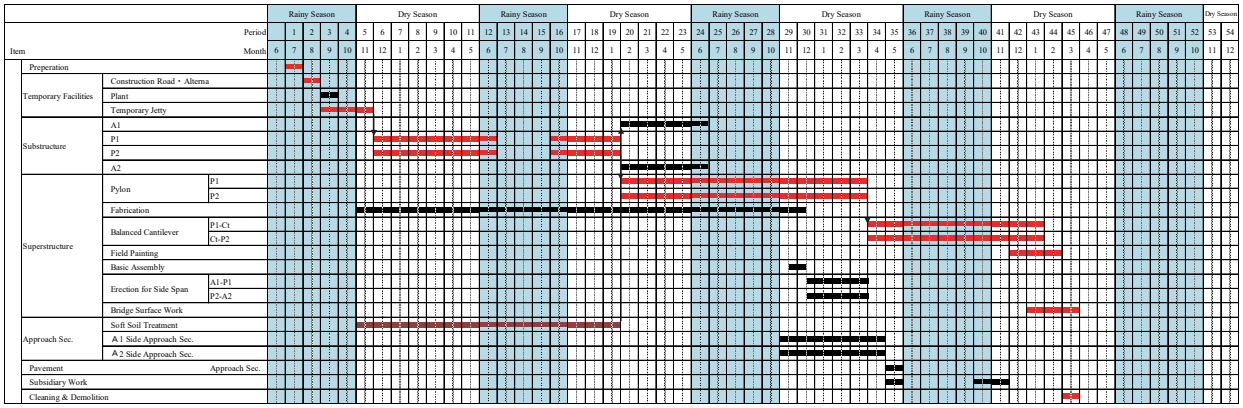
Source: JICA Survey Team

Figure S 6.1.1 Construction Schedule (Naung Lon Bridge)



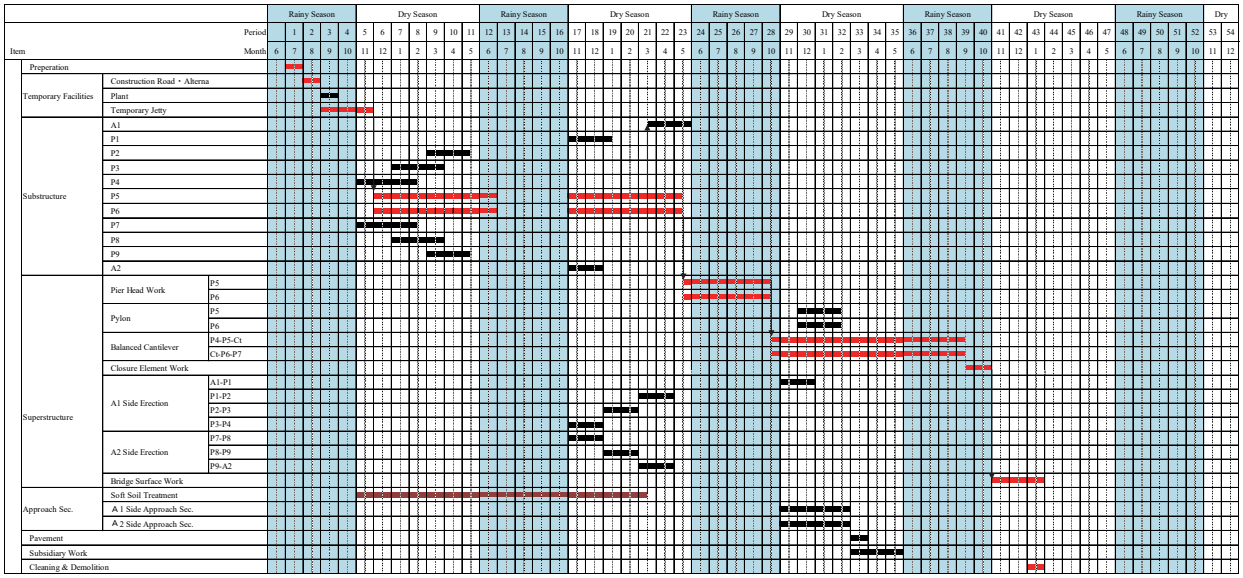
Source: JICA Survey Team

Figure S 6.1.2 Construction Schedule (Gyaing Kawkareik Bridge)



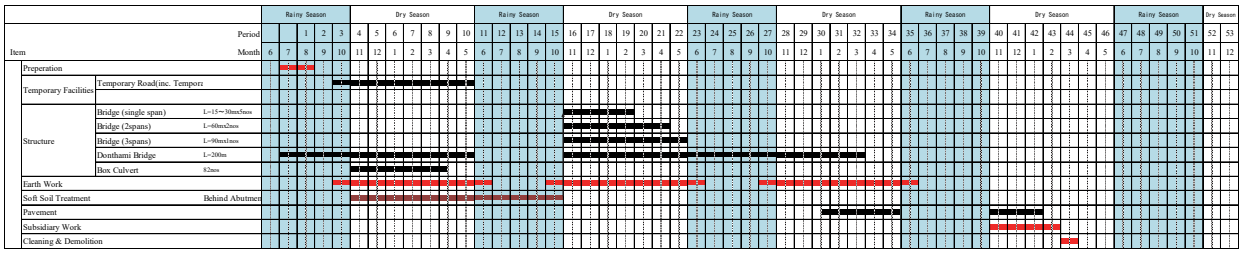
Source: JICA Survey Team

Figure S 6.1.3 Construction Schedule (Gyaing Zathapyin Bridge)



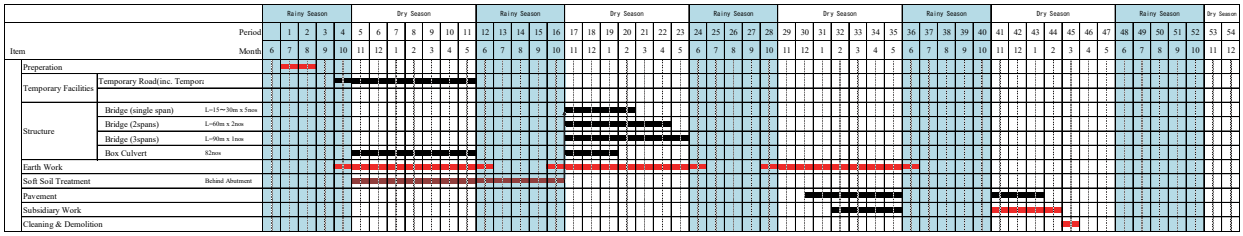
Source: JICA Survey Team

Figure S 6.1.4 Construction Schedule (Atran Bridge)



Source: JICA Survey Team

Figure S 6.1.5 Construction Schedule (Thaton Bypass including Donthami Bridge)



Source: JICA Survey Team

Figure S 6.1.6 Construction Schedule (Kyargalay Bypass)

7. PROJECT COST ESTIMATES

7.1 Total Project Cost

Table S 7.1.1 Total Project Cost

Breakdown of Cost	FC Portion（million USD）			LC Portion（million USD）			Total（million USD）		
	Total	JICA Portion	Myanmar Portion	Total	JICA Portion	Myanmar Portion	Total	JICA Portion	Myanmar Portion
I. Civil Works	140.1	140.1	0.0	210.7	210.7	0.0	350.8	350.8	0.0
(1) Base Cost	138.7	138.7	0.0	197.7	197.7	0.0	336.4	336.4	0.0
(2) Demolition of existing bridges	0.0	0.0	0.0	13.0	13.0	0.0	13.0	13.0	0.0
(3) Dispute Board	1.4	1.4	0.0	0.0	0.0	0.0	1.4	1.4	0.0
II. Relocation of Existing Utilities	0.0	0.0	0.0	2.0	0.0	2.0	2.0	0.0	2.0
III. Price Escalation	11.7	11.7	0.0	53.3	52.9	0.4	65.0	64.5	0.4
IV. Physical Contingency	15.2	15.2	0.0	26.6	26.4	0.2	41.8	41.5	0.2
V. Consultant Service	28.8	28.8	0.0	14.1	14.1	0.0	42.9	42.9	0.0
IV. Land Acquisition	0.0	0.0	0.0	5.3	0.0	5.3	5.3	0.0	5.3
VII. Administration Cost	0.0	0.0	0.0	25.4	0.0	25.4	25.4	0.0	25.4
VIII. Commercial Tax	0.0	0.0	0.0	25.1	0.0	25.1	25.1	0.0	25.1
IX Import Tax	0.0	0.0	0.0	8.3	0.0	8.3	8.3	0.0	8.3
X. Interest During Construction	0.2	0.0	0.2	0.0	0.0	0.0	0.2	0.0	0.2
Total (I～X)	195.9	195.7	0.2	370.8	304.0	66.8	566.7	499.7	67.0

Source: JICA Survey Team

8. OPERATION AND MAINTENANCE PLAN

8.1 Examination of Implementation Capacity of the Executing Agency

After completion of the Project, MOC under MOC is considered to take responsible for operation and maintenance of the project roads and bridges. Implementation capacity in MOC was examined based on the current situation.

- MOC has direct implemented design, construction, operation and maintenance for most of the roads and bridges in Myanmar. Accordingly, MOC has a certain degere of technical capacity regarding road development, thus, it is considered that MOC will be able to operate and maintain roads and bridges constructed in this Project if necessary technical assistance is provided by external experts. Necessary technical assistance is, for instance,; 1) Establishment of standards and manuals, 2) Development of systematic road and bridge inventory data base and 3) Improvement of maintenance capacity.
- With the progress of economic growth in Myanmar which brings a high demand for road development and the expansion of project volumes and duties on MOC, it is expected that various issues will emerge such as the enlargement of the organizations or the lack of engineers. In addition, for the projects funded by foreign countries, it is common to employ a private consultant and contractor which are independent from the government, therefore, the establishment and training of private companies is required to facilitate the road and bridge development.
- The road and bridge development should be secured considering the additional development for rapid traffic demand increase and the lack of funds. Therefore, it is necessary for MOC to strive to secure financial resources for increasing road assets in the near future. The application of a special road fund from fuel tax, road tax and vehicle tax is one of the possible measures to secure the required budget. However, as the high tax rate and imbalanced distribution of tax income could be a controversial issue among the tax payers, the application of a road special fund should be discussed in an appropriate manner. The second countermeasure is to utilize BOT scheme more widely. The current issues on the BOT scheme is that the contract provision and procurement processes are unclear and the contracts vary depending on the project. To facilitate the BOT for road and bridge development, BOT should be enacted and guidelines and manuals which regulate the procurement condition, obligations of the concessionaire and procurement method for construction and maintenance should be established.

8.2 Operation and Maintenance Plan for the Project

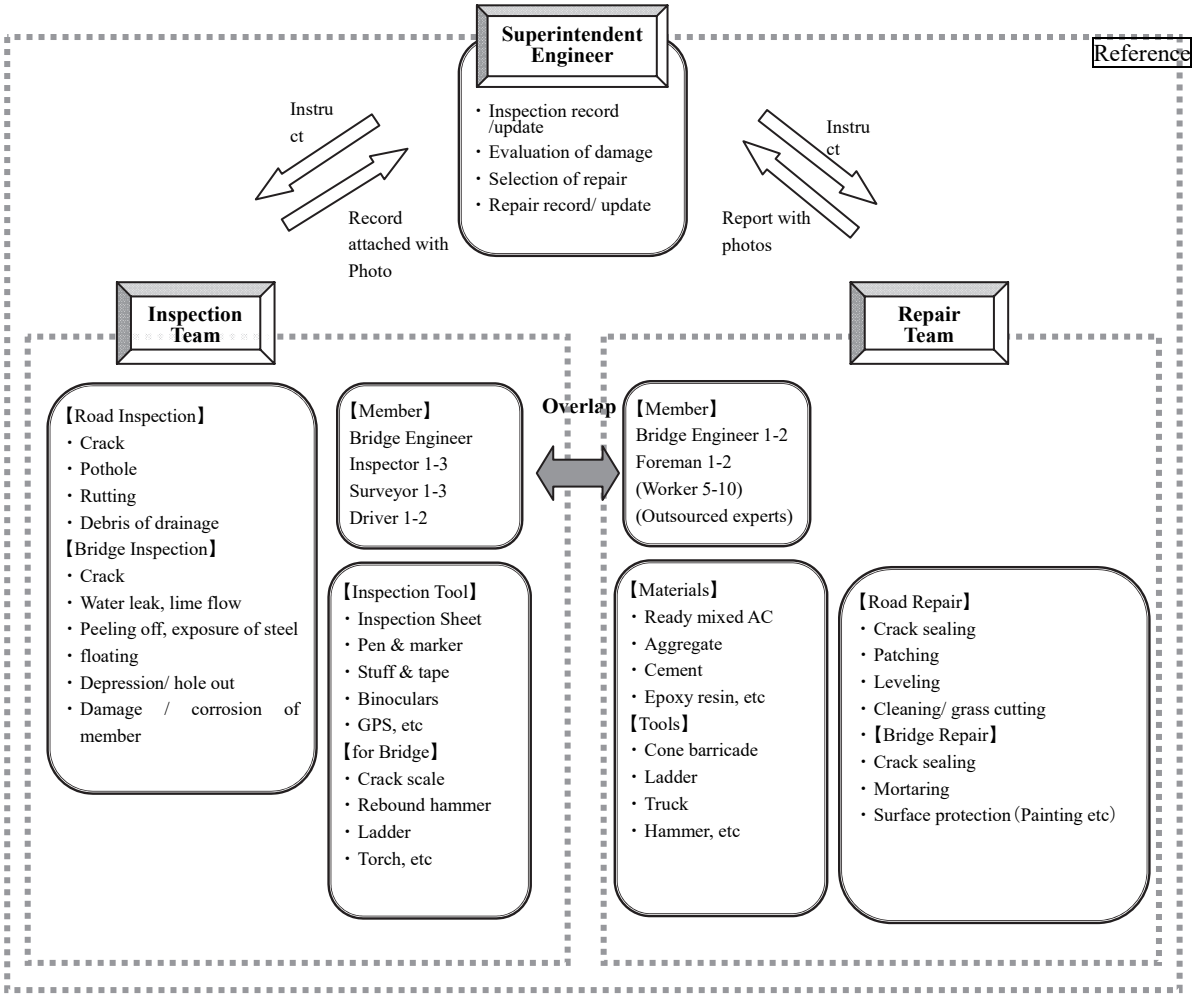
8.2.1 General

The project facilities located on ASEAN Highways and/or the East-West Economic Corridor should be maintained in sound conditions to sustain smooth and safe traffic flow. In general, bridges and roads are administered by the road/bridge management system which consists of:

- Preparation of Inventory Data
- Inspection (Routine, Periodic, Non periodic / Emergency)
- Rating and Prioritization based on inspection results for actual maintenance (Repair) work
- Records of other activities.

It is required to establish an optimal maintenance unit before the completion of the Project in Mon and Kayin States respectively. Tentatively the reference maintenance structure headed by a superintendent engineer in each Mon and Kayin State is proposed in Figure S 8.2.1. The staff of maintenance unit should be properly equipped with the knowledge and skills for bridge maintenance obtained through an appropriate training programme prior to the commencement of

maintenance (Note that the employment of outsourced maintenance experts shall be required for the conduct of periodic maintenance of the bridge).



Source: JICA Survey Team

Figure S 8.2.1 Establishment of the Maintenance Structure after Completion of the Project (Reference only)

8.2.2 Operation and Maintenance Cost

Routine operation and maintenance, and maintenance item/interval/unit cost for periodic maintenance are shown in Table S 8.2.1. In the case that the maintenance duration is for 75 years, the total cost for operation and maintenance is estimated to be about 171 million USD (approximately 176 billion Kyat), the average cost to be about 2.2 million USD (approximately 2.3 billon Kyat). For intensive expenditure on the reconstruction of pavement etc., the maximum annual cost is estimated to be about 24.6 million USD (approximately 25.3 billion Kyat).

Table S 8.2.1 Maintenance scenario and necessary amount of money in each frequency

Units: USD

Item	Frequency	Naung Lon	Gyaing Kawkareik	Gyaing Zathapyin	Atran	Thaton BP	Kyargalay BP
Routine operation and maintenance							
Routine O&M (inc. repair of pavement)	Every year	19,937	47,088	42,264	39,432	285,706	282,613
Periodic maintenance (Road)							
Reconstruction of Pavement	20 year	―	―	―	―	9,918,867	8,321,870
Periodic maintenance (Bridge)							
Periodic inspection	5 year	45,872	232,227	252,296	223,626	126,148	103,212
Reconstruction of Pavement	10 year	38,725	356,075	213,175	187,000	113,225	97,200
Replacement of water proof layer	10 year	97,122	893,036	534,643	468,996	283,968	243,778
Replacement of expansion joint	15 year	138,961	681,359	222,339	387,782	349,323	336,580
Repaint	30 year	134,924	―	580,580	―	168,655	―
Repair of deck	50 year	33,985	―	―	―	42,498	―
Repair of PC girder	20 year	―	612,126	―	303,869	147,437	221,155
Replacement of PC Cable	75 year	―	1,088,320	6,943,360	814,720	―	―

Source: JICA Survey Team

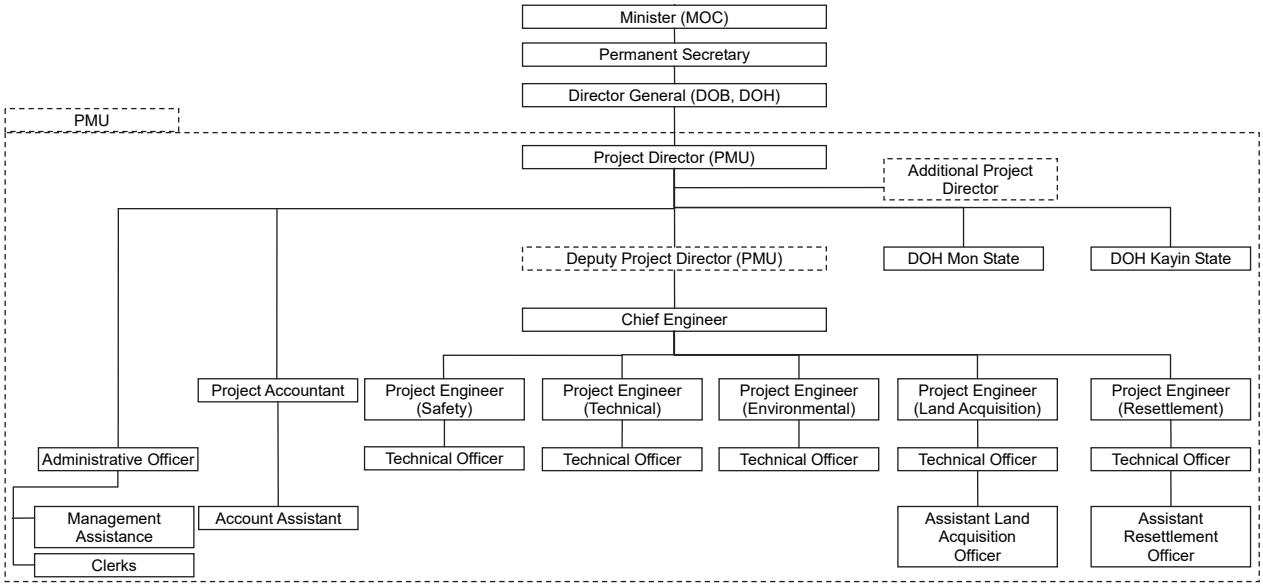
9. IMPLEMENTATION PLAN

9.1 Implementation Organization

The JICA Survey Team recommended for the establishment of a Project Management Unit (PMU) under MOC in order to solely use and facilitate the smooth execution of the Project.

The PMU is responsible for the below works.

- Procurement of Consultant and Pre-Construction Services
- Detailed Design
- Land Acquisition and Relocation/Resettlement
- Construction Management



Source: JICA Survey Team

Figure S 9.1.1 Proposed Organization Chart of the PMU (Draft)

9.2 Implementation Schedule

The implementation schedule is shown in Figure S 9.2.1.

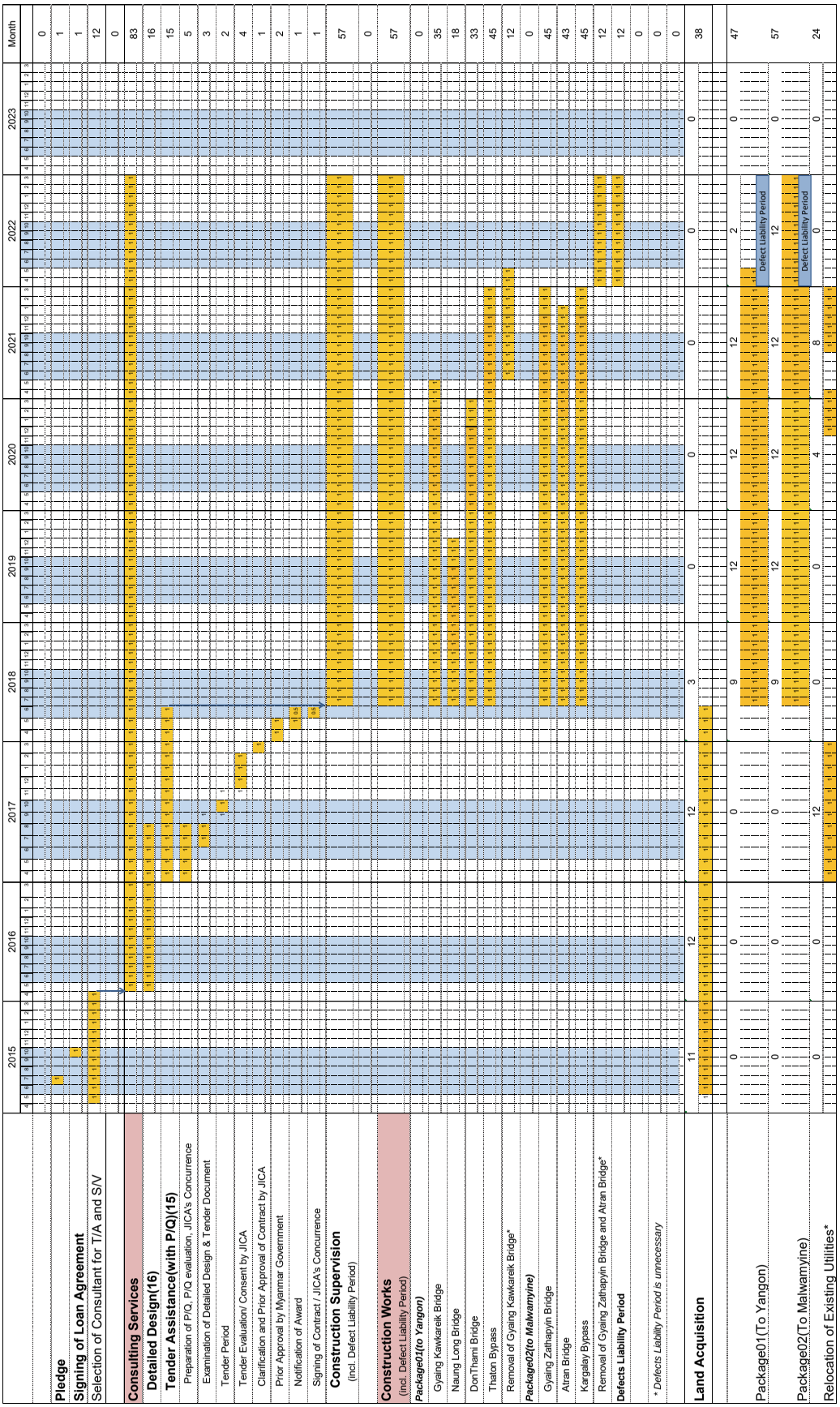


Figure S 9.2.1 Implementation Schedule

10. ECONOMIC ANALYSIS AND EVALUATION

10.1 Economic Analysis

10.1.1 Objective and Preconditions of Economic Analysis

Economic analyses of the projects are conducted in this chapter, in order to assess the contribution of the projects to the national economy. The Economic Internal Rate of Return (hereinafter referred to as EIRR) and Cost-Benefit Ratio (B/C) is employed as evaluation indicators, and these indicators are calculated from the annual benefit and cost of the projects with the discounted cash flow method.

Table S 10.1.1 shows the preconditions for the economic analysis of the Project. Items of investment cost such as taxes and price escalation are deleted from the financial prices in order to introduce economic cost. It is assumed that the standard Conversion Factor (SCF) which is used for transformation from financial cost to economic cost was set 0.97, which is applied in the "TA-8330 MYA: GMS East–West Economic Corridor Eindu to Kawkareik Road Improvement"[3].

Table S 10.1.1 Preconditions for Economic Analysis

Items	Conditions	Remarks
Project life	20 years after opening all bridges and bypass roads 2015–2040	Commencement of the Project: 2015 Opening year: 2019 (Naung Lon Bridge); 2020 (Gyaing Kawkareik Bridge); 2021 fiscal year (other bridges and bypass roads)
Exchange rate	1US dollar = 120.4 Japanese yen 1US dollar = 1,030.9Myanmar kyat	–
Social discount rate	12%	TA-8330 MYA: GMS East–West Economic Corridor Eindu to Kawkareik Road Improvement
Economic cost	97% of financial cost	TA-8330 MYA: GMS East–West Economic Corridor Eindu to Kawkareik Road Improvement

Source: JICA Survey Team

10.1.2 Economic Benefit

Economic benefit of the Project consists of the saving of vehicle operating cost (VOC) and reduction of travel cost. The economic benefit of the Project will be listed in the cash flow table from 2019 when Naung Lon Bridge will be open to the public to 2040 which is 20th year of the opening of all bridges and bypass roads.

(1) Vehicle Operating Cost

Vehicle operation cost includes the purchasing and maintenance cost of vehicles, fuel cost and insurance cost, etc.

In this analysis, VOC data of the "Feasibility Study of Economics, Engineering, and Environmental Impacts of the Four-Lane Highway Widening Project (Phase II), Route No. 12, Section Lom Sak – Consan Intersection", which was conducted in 2010 because data for estimating the VOC of inter-city transportation was limited in Myanmar. The VOC data was used in the pre-feasibility study of the "Survey Program for the National Transport Development Plan". The VOC figures are adjusted to the value in 2014 by use of the inflation rate of Thailand and exchanged into Japanese yen amounts. Data of VOC at 40 kilometres per hour in "flat roads" was utilized in order to calculate savings of VOC.

[3] Hereinafter referred as "Eindu to Kawkareik Road Improvement Project"

(2) Reduction of Travel Time

Reduction of travel time is also a major part of economic benefit. The idea comes from the opportunity cost of working time. Thus, if the reduced time were used for working activity, the more value added is produced in a national economy.

Myanmar people's average unit working revenue (working revenue per hour) is calculated from GDP per capita. According to IMF's "World Economic Outlook Database, October 2014", the estimated GDP per capita of Myanmar is USD 1,270 in 2014. The calculated hourly income is JPY21.2.

The Study Team also calculated the increase of the hourly income (real term) in accordance with Myanmar's economic development. This methodology is the same as the pre-feasibility study of the "Survey Program for the National Transport Development Plan".

10.1.3 Economic Cost

(1) Development cost

Development cost consists of construction cost, consulting service, relocation of existing utilities, land acquisition and administration cost. These costs estimated in Chapter 8 are used for this economic analysis; however, taxes, price escalation, and contingency are eliminated. In addition, the local portion of the development cost is converted from the financial price to the economic price by use of the standard conversion factor (SCF, refer to Table S 10.1.1), in order to correct the distortion between the domestic price (price for non-tradable goods) and the international price (price for tradable goods).

(2) Maintenance cost

Maintenance consists of regular maintenance and periodic maintenance. Periodic maintenance will be conducted every five years and regular maintenance will be conducted every year excluding the year of periodic maintenance.

Maintenance will start from 2019 at Naung Lon Bridge, from 2020 at Gyaing Kawkareik Bridge, and from 2021 fiscal year at other bridges and bypass roads. The total maintenance cost is converted to economic price multiplying by SCF.

10.1.4 Economic Evaluation of the Project

(1) Calculation of EIRR and Cost-Benefit Ratio

Economic Internal Rates of Return (EIRR) of the projects which is calculated from annual net cash flow from 2015 to 2040 is 17.8%. The calculated EIRR exceeds 12%, which is commonly used for a benchmark of social discount rate in developing countries. Therefore, the Project is feasible from the point of national economic development.

The cost-benefit ratio calculated from the sum of discounted economic benefit divided by the sum of discounted economic cost is 1.90.

(2) Sensitivity Analysis

Table S 10.1.2 shows results of sensitivity analysis. Increases in development cost and drop of economic benefit by 10% reduce EIRR by 1.0%. However, it maintains a high enough level. The impact of changes in annual and periodic maintenance costs on EIRR is limited.

Table S 10.1.2 Results of Sensitivity Analysis

Unit: Percent

Cases	EIRR
Base case	17.8
10% increase of development cost	16.9
10% increase of maintenance cost	17.8
10% reduction of economic benefit	16.8

Source: JICA Survey Team

10.2 Operation and Effect Indicators

Like other JICA funded road/bridge improvement projects in Myanmar and other countries, the traffic volume and travel time are set as operation and effect indicators for the Project, respectively.

- Operation Indicator: Annual average daily traffic (vehicles/day and pcu/day),
- Effect Indicator: Travel time (hours per vehicle)

Also, vehicle operating cost is set as a monitoring indicator for the Project.

- Monitoring Indicator : Vehicle operating cost (Kyat per vehicle)

The operation, effect and monitoring indicators are prepared showing present performances in 2014 and targets in 2024, two years after starting operation. The following table summarizes operation and effect indicators of the Project.

Table S 10.2.1 Operation and Effect Indicators of the Project

Indicators		Year	Sub-projects					
			Naung Lon Bridge	Gyaing Kawkareik Bridge	Atran Bridge	Gyaing Zathapyin Bridge	Kyargalay Bypass	Thaton Bypass and Don Tha Mi Bridge
Operation Indicators	Annual average daily traffic (vehicles/day) [1]	2014	1,914	1,794	1,176	1,176	NA	NA
		2024	4,400	10,490	7,270	6,930	6,030	6,200
	Annual average daily traffic (pcu/day) [1]	2014	2,520	2,410	1,485	1,485	NA	NA
		2024	6,080	14,500	10,400	9,830	8,480	9,290
Effect Indicators	Travel time of vehicles excluding heavy vehicles (hours/vehicle)	2014	2.39 [2]				2.39 [2]	3.50 [5]
		2024	2.04 [2]				1.36 [4]	2.91 [5]
	Travel time of heavy vehicles (hours/vehicle)	2014	4.53 [3]				4.53 [3]	3.50 [5]
		2024	2.04 [3]				1.36 [4]	2.91 [5]

Note 1: Refer to traffic volume in 2014 of Table 10.2.2. Annual average daily in 2024 is calculated from linear regression with traffic volume data in 2014 and 2035.
Note 2: Travel time is estimated for the road section between Kawkareik and Mawlamyain (both 2014 and 2024 figures are via Eindu route). 2014 travel time is estimated based on the travel speed survey report (issued in 2013) provided by Japanese forwarding company. 2024 travel time is estimated from traffic capacity–travel speed (QV) condition applied to "Survey Program for the National Transport Development Plan in Myanmar".
Note 3: Travel time is estimated for the road section between Kawkareik and Mawlamyain (2014 figure is estimated via Thaton route and 2024 figure is via Eindu route). Other conditions are the same as Note 2.
Note 4: Travel time is estimated for the road section between Kawkareik and Mawlamyain (2024 figure is via Kyargalay Bypass route). Other conditions are the same as Note 2.
Note 5: Travel time is estimated for the road section between Kawkareik and the end point of Thaton Bypass (2014 figure is estimated via Thaton route and 2024 figure is via Thaton Bypass route). Other conditions are the same as Note 2.

Source: JICA Survey Team

Table S 10.2.2 Traffic Volumes by Sub-Projects

Projects	Naung Lon Bridge	Gyaing Kawkareik Bridge	Thaton Bypass and Don Tha Mi Bridge	Atran Bridge	Gyaing Zathapyin Bridge	Kyargalay Bypass
2014						
Passenger car	1,223	1,120		760	760	
Bus	79	83		95	95	
2 axle truck	375	331		296	296	
3 axle truck	35	14		9	9	
Heavy truck (more than 4 axle)	181	227		16	16	
Articulated Truck	21	19		0	0	
Total (vehicles)	1,914	1,794	0	1,176	1,176	0
Total (pcu)	2,520	2,410	0	1,485	1,485	0
2035						
Passenger car	4,540	12,260	7,210	7,080	6,860	7,260
Bus	360	800	680	370	360	460
2 axle truck (light truck)	150	1,200	300	1,500	1,420	1,000
2 axle truck (medium truck)	400	1,970	960	2,260	2,120	1,560
3 axle truck	250	740	640	680	630	520
Heavy truck (more than 4 axle)	930	1,980	2,090	1,350	1,210	1,200
Articulated Truck	500	1,100	1,140	730	650	670
Total (vehicles)	7,130	20,050	13,020	13,970	13,250	12,670
Total (pcu)	10,000	27,800	19,500	20,200	19,000	17,800

Source: JICA Survey Team

11. ENVIRONMENTAL IMPACT ASSESSMENT

11.1 Outline of the Environmental Impact Assessment

In this chapter, an outline of necessary environmental activities in accordance with relevant Myanmar environmental laws and JICA Guidelines for Environmental and Social Considerations for prioritized projects which have been concluded between Myanmar and Japan Government are summarized. Detailed contents are explained in the two Environmental Impact Assessment (EIA) Reports which will be approved by the Myanmar side in May 2015.

11.2 Components of Prioritized Projects

Components of the discussed prioritized two Sub-Projects and packages are shown in the table.

Table S 11.2.1 Project Components and Activities

Area (Package)	Sub-Project	Activities	Package
I. East West Economic Corridor for Phase-I	1 Construction of Thaton BP and 3 bridges (Don Tha Mi, Naung Lon and Gyaing Kawkareik Bridge)	(1) Thaton Bypass: Total: App 28km (New Road Cost. : app 21km, Widening of ex. Road: app 7km) (2) 3 Bridges 1) Don Tha Mi: 200m 2) Naung Lon : 115m 3) Gyaing Kawkareik: 400m	Package-1
	2 Construction of Kyargalay BP and 2 bridges (Za Tha Pyin and Atran Bridge)	(1) Kyargalay Bypass: Total: App 25km (New Road Cost. : less than 5km and Widening of ex. Road: app 20km) (2) 2 Bridges 1) Za Tha Pyin: 870m 2) Atran: 430m	Package-2

Source: JICA Survey Team

11.3 Environmental Impact Assessment for Prioritized Projects

(1) Environmental Screening

1) Environmental Screening in accordance with Myanmar's law and JICA Guidelines

As of February 2015, EIA procedures which will prescript criteria for Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) have not been issued yet. On the other hand, according to the JICA Guidelines for Environmental and Social Consideration (2010), a project which does not cause less than 200 re-settlers is classified as Category B, thus the two Sub-Projects were classified as "Category B" by the JICA Headquarters as of May, 2014.

2) Applied EIA Process for the Project

Although JICA Guidelines requires an IEE level on this Project, it was concluded in the meeting between MOC, ECD and the JICA Survey Team on 12th March 2014 that the EIA level study and process based on JICA Guidelines have been applied because the criteria of EIA on Myanmar's law has not decided yet.

(2) Result of Baseline Survey, Impact Forecast and Mitigation Measures

Baseline survey for pollution items such as air, water quality, noise and vibration, fauna & flora and social items such as resettlement and cultural heritage have been conducted based on scoping.

1) Natural Environment

There are not any considerable protected areas from the view of biological and cultural heritage in the project affected area. A part of Danu Forest Reserve is located on Thaton Bypass alignment, however a purpose of establishment for this forest reserve is mainly commercial use, not biological and natural conservation. According to Thaton Township and ECD, the proponent can acquire the land after obtaining permission from MOECF and landowners.

Land use in the project areas are developed, and they are mainly paddy fields, rubber plantation and other farming land or secondary forest. Thus all identified fauna and flora species are not considerable[4], and it is not likely to give significant impacts on the natural environment. However

[4] Considerable Species on the project
IUCN Redlist: EN: Endangered, CR: Critically Endangered, EW: Extinct in the wild, EX: Extinct

some mitigation measures such as clarification of the development area and reduction of turbid water shall be planned in the Environmental Management Plan (EMP).

2) Pollution Items

According to baseline survey for air, water, noise and vibration, most of the data meets the standard level except for water quality.

During the construction of road and bridges, dust, turbid water, construction noise and vibration will be caused from construction activities and will affect the nearest residential areas. Especially construction of Gyaing Kawkareik in the night time may give a degree of impact on the nearest residential area.

After construction, adverse impacts on air, noise and vibration are predicted due to the increase of traffic volume. Hence, mitigation measures for noise & vibration and turbid water in the river shall be planned and implemented during construction. After construction, speed control less than 50km/h shall be conducted for the mitigation of noise and vibration levels in residential areas.

3) Social Environment

Main land use in the project areas are paddy fields, rubber tree plantations and swampy open space. However some residential areas are located along the existing road in the Thaton and Kyargalay bypass areas. Thus the widening of existing roads may cause resettlements on such areas. Although the alignment avoids residential areas, 96 re-settlers and 94 ha land acquisition are expected for Sub-Project 1, and 92 re-settlers and 14.5 ha land acquisition are expected for Sub-Project 2.

In the process for the preparation of the resettlement action plan (RAP), socialization meetings have been held under participation of project affected persons. In a series of meetings, the compensation policy and social assistance in accordance with Myanmar's law and JICA Guidelines have been explained and understood without any objection from the participants.

With regard to cultural heritage, some pagodas and religious monuments are observed along the existing roads, however such facilities are not affected by the alignment.

(3) Environmental Monitoring Plan during and after construction

Basically natural, pollution and social monitoring will be conducted at the same points where the baseline survey was conducted. Additionally an interview survey with inhabitants shall be done and additional mitigation measures will be considered based on the result of monitoring.

During construction, it is recommended to establish a "Bridge and Road Construction Committee" for the management of environmental issues. After construction, the project proponent should conduct environmental and social monitoring, and then such results should be reflected to other projects.

11.4 Local Stakeholder Meetings

State and local level stakeholder meetings on EIA scoping stage have been held in accordance with Myanmar's draft EIA procedure and JICA Guidelines, and have formulated project basic consensus with all participants of the meetings. The meetings on stage of draft EIA and RAP have been held in March 2015 and consensus w about project implementation.

11.5 Schedule regarding EIA

An approval for EIA will be obtained from MOC and ECD by April and May 2015, and then the approved EIA report in Burmese will be disclosed to project affected persons at every township office for one month.

With regard to the project schedule, the approved RAP will be updated after the detailed design and implemented land acquisition and compensation under monitoring.

11.6 Other Necessary Certificates

Approximately 0.7 million m3 material on Sub-Project 1 and 2.2 million m3 on Sub-Project 2 are required for embankment soil in accordance with design. Basically such material will be collected from surrounding existing registered quarries and borrow pits, however the following permissions shall be obtained when new quarry and borrow pits are developed during construction by the construction contractor in accordance with Myanmar's law and donor's environmental guidelines.

- ✓ Township development committee permission (new borrow pits, quarry and sand & gravel extraction from rivers)
- ✓ State Government permission (new borrow pits, quarry and sand & gravel extraction from river)s
- ✓ ECD permission (new borrow pits, quarry and sand & gravel extraction from rivers)
- ✓ DWIG permission (sand & gravel extraction from rivers)

These necessary activities and permissions shall be obtained by the contractor during construction phase under MOC.

12. RESETTLEMENT AND ACTION PLAN

12.1 Basic concept for Resettlement Action Plan

This chapter shows the outline of Resettlement Action Plan (RAP) which was created in accordance with Myanmar's related laws and regulations, the JICA Guidelines for Environmental and Social Considerations (April 2010) and the World Bank's Safeguard Policy OP 4.12. The RAP reports including detailed contents are supposed to be accepted by the project affected persons (PAPs) and will be approved by the Myanmar side in May 2015.

As being referred to in Chapter 11, both Sub-Projects 1 and 2 are classified as Category B based on the definitions in the JICA Guidelines and WB OP 4.12 as well. Thus, the projects need an abbreviated RAP (A-RAP) through the results from the demographic and socio-economic census, loss of properties, computation of costs and budget for compensation and relocation.

12.2 Outline of Census and Socio-Economic Survey

Surveys regarding the inventory data of occupied land and assets of each household, land use and socio-economic condition of PAPs were conducted and the results are summarized in Table S 12.2.1.

Table S 12.2.1 Summary of Project Affected Impacts

Item	Sub-Project 1	Sub-Project 2
Survey Period	20 Sep 2014 to 13 Mar 2015	30 Sep 2014 to 4 Mar 2015
Total PAHs and PAPs	1,858 PAPs in 390 PAHs	1,109 PAPs in 223 PAHs
Residential PAHs (PAPs) to be Relocated	96 PAPs in 15 PAHs	92 PAPs in 18 PAHs
Land Acquired (acre)	232 acres including: three for residence, 195 for rubber plantation and 34 for paddy land.	36 acres including: two for residence, one for rubber plantation and 33 for paddy land.
Crops and Trees	Paddy: 1,486 baskets (31.1 tons) Trees:60,200 trees including 43,400 rubber trees, 13,900 of betel plants, etc.	Paddy: 1,360 baskets (28.4 tons) Trees: 590 trees including 320 of banana, 124 rubber trees, etc.
Fishery	127 PAHs	105 PAHs

Note	• Thaton Bypass alignment passes over the land owned by MOI. • No indigenous peoples (IPs) are detected in the project area (based on WB OP 4.10)	• Ethnic groups such KNU, DKBA etc are virtually ruling along the Kyargalay Bypass area. • No indigenous peoples (IPs) are detected in the project area (based on WB OP 4.10)

Source: JICA Survey Team

12.3 Policy and Legal Framework

Currently in Myanmar, there is no law stipulating land acquisition and resettlement comprehensively though the Land Acquisition Act in 1894 and the Farmland Law in 2012 are regarded as the major laws concerned. Regarding the items stipulated in the JICA Guidelines and WB OP 4.12 below, however, intensive assistance is essential for the MOC and related authorities in order to conduct fair compensation based on the relating laws and regulations in Myanmar.

Items on social consideration which are not clearly stipulated in Myanmar's laws and regulations:

- Consideration of alternatives to minimize or mitigate the relocation;
- Restoration to livelihood, income and productivity levels before relocation;
- Compensation payment before relocation;
- Development of Resettlement Action Plan;
- Public consultation with PAPs during RAP development;
- Identification of PAPs in an earlier stage; and
- Assistance provision during relocation.

12.4 Compensation and Entitlement Matrix

Valuation for compensating loss of land and its derivative (crops, plants etc.) shall be in accordance with the relevant laws in Myanmar with support of the project policy. For dwellings and other structures, it shall be based on replacement cost to be computed. Income assistance shall also be necessary to PAPs in case the project adverse affects to such people. An inconvenience allowance shall be given to PAPs with severely affected structures, which require relocation and new construction. The entitlement matrix is a matrix to show systematically the relations of compensation and is shown in Table S 12.4.1.

Table S 12.4.1 Entitlement Matrix

Type of Loss	Application	Entitled Person	Assistance Policy
1. Land	Partial or entire loss of land	Land owner/occupant or a person who has a recognizable right to claim to the land.	- Provide cash compensation in the current reacquisition price or land for land compensation at a place acceptable to PAPs if feasible.
2. Structures (Houses, Shops)	Partial or entire loss of structure	Owner/Tenant	- For the entire affected structure, cash compensation to PAPs at a replacement cost which covers cost for materials, labour, and transport of materials. - For partial affected structure, cash compensation for affected portion of the structure to be computed based on the replacement cost.
3. Community Structures (Rest house etc)	Partial or entire loss of structure		- Cash assistance at full replacement cost. If possible, new structure will be replaced by the project proponent which is similar to the former one.
4. Crops	Loss of paddy and other crops	Owner of crops	- Cash compensation for loss of paddy or other crops yield which is calculated based on the actual market price. Income restoration is paid equivalent to six times of annual earning to PAPs.

Type of Loss	Application	Entitled Person	Assistance Policy
5. Trees	(i) Rubber trees	Owner of trees	- Cash compensation for loss of rubber trees is calculated as age of rubber trees in the current market price. - Income restoration is paid equivalent to six times of monthly earning to PAPs.
	(ii) Others		- Provide cash compensation for loss of trees at standard unit cost
6. Fishery	Impacts on fishing activity during construction time	Fisherman	- Cash compensation for loss of fishing opportunity based on fish catches and current market price by fish type at each area during construction period.
7. Business Loss		PAPs who lose income for any type of business.	- For PAPs for income loss from shops, cash assistance equivalent to six months income.
8. Vulnerable Allowance		Households headed by a woman, disabled person, elderly (over 61 years old), poor household below poverty line or household including a disabled person.	- One time cash assistance for each vulnerable household is paid (150,000 kyats)

Source: JICA Survey Team

12.5 Implementation Framework

MOC is the core responsible body for the resettlement action plan as the driving force of the Project. Besides MOC, the Ministry of Agriculture and Irrigation (MOAI) and the Ministry of Home Affairs (MOHA) shall be involved in order for managing land issues and compensation. Local authorities at state, township and village levels must be constituents as well. The organizations are to form a consortium chaired by MOC, so called the Resettlement Implementation Committee (RIC), to go ahead with the activities of the resettlement action plan in harmony with stakeholders.

12.6 Monitoring

Monitoring activity normally consists of internal and external monitoring. The main purpose of the monitoring activity is to ensure that all PAPs who lost their respective houses, land or other livelihood assets have been provided with sufficient compensation and assistance according to the policies and procedures which is described in the RAP. The external monitoring will be conducted periodically by an independent local/international External Monitoring Agent (EMA) for review and assessment regarding the achievement of the plan.

12.7 Consultation and Public Participation

JICA Guidelines require holding public consultations for a smooth decision making with the PAPs and stakeholders. PAPs must be fully informed at the earliest possible time. A series of the 1st consultation meetings was held in August 2014 at fourteen venues to open the outline of the Project and compensation policy and RAP activities. Through the meetings the Project got consensus and approval by the stakeholders and PAPs. The 2nd round of consultation meetings were conducted in March 2015 and the draft RAP was accepted.

12.8 Implementation Schedule

The abbreviated RAP for each Sub-Project was drafted and the 2nd public consultation meeting with PAPs was held in March 2015 in order to obtain consensus-building and approval on the results. The RAP was approved by the Myanmar side in April 2015. The RAP that is translated in Burmese is to be publicized for a certain period in order for the local people can understand the

contents of the approved RAP. The RAP will be updated after the detailed design stage and land acquisition and compensation will be done by the project entity.

13. CONCLUSION AND RECOMMENDATIONS

13.1 Conclusion

13.1.1 Summary of the Project

Priority projects were selected based on the current condition, the progress of relevant projects etc., in a series of discussions with the related authorities. Preliminary design was conducted for the priority projects.

Table 13.1.1 Project Summary

Component	Summary
Sub-Project 1: Improvement of EWEC (to Yangon)	
Naung Lon Bridge	Bridge Length : 160m Superstructure : Steel-I girder Substructure : Inverted T-shape abutment, Wall-type pier Foundation : Cast-in-place concrete pile Approach Road : Embankment structure (L = 316m / L = 284m)
1. Gyaing Kawkareik Bridge	Bridge Length : 810m Superstructure : Extradosed (Main) / PC box girder (Approach) Substructure : Two column type tower, Wall type pier : Invert T shape abutment Foundation : Steel pipe sheet plied foundation : Cast in-place concrete pile Approach Road : Embankment structure (L = 455m / L = 424m) Demolition of the Existing Bridge : Existing structure above G.L
Thaton Bypass	Road Length : 29.3km Structure : Box culvert x 65, Small bridge x 4, Donthami bridge (Donthami Bridge) Bridge Length : 200m Superstructure : Steel-I girder Substructure : Inverted T-shape abutment, Wall type pier Foundation : Cast-in-place concrete pile, Steel pipe pile
Sub-Project 2: Improvement of EWEC (to Mawlamyine)	
1. Gyaing Zathapyin Bridge	Bridge Length : 880m Superstructure : Steel cable-stayed bridge Substructure : Two column type tower, Wall type pier : Inverted T-shape abutment Foundation : Steel pipe sheet plied foundation Cast in-place concrete pile Approach Road : Embankment structure (L = 477m / L = 517m) Demolition of the Existing Bridge : Existing structure above G.L
2. Atran Bridge	Bridge Length : 780m Superstructure : Extradosed bridge (Main)/ /PC box girder (Approach) Substructure : Two column type tower, Wall type pier : Invert T shape abutment Foundation : Steel pipe sheet plied foundation : Cast in-place concrete pile Approach Road : Embankment structure (L = 560.5m / L = 344.5m) Demolition of the Existing Bridge : Existing structure above G.L
Kyargalay	Road Length : 25.0km Structure : Box culvert x 82, Small bridge x 8

Source: JICA Survey Team

13.1.2 Project Cost and Implementation Schedule

(1) Project Cost

- Civil Works : $350.8 million (USD)
- Consultant Fee : $42.9 million (USD)
- Other : $173.0 million (USD)
- Total Project Cost : $566.7 million (USD)

(2) Implementation Schedule

- Selection of Consultant : May 2015 to April 2016 (12 months)
- Detail Design : May 2016 to August 2017 (16 months)
- Selection of Contractor : September 2017 to June 2018 (10 months)
- Civil Works : July 2018 to March 2022 (57 months)

13.1.3 Environmental and Social Considerations

- The Project is categorized as Category B in accordance with JICA Guidelines.
- A general consensus about project components, area of influence and compensation for the Project has been formulated through stakeholder meetings and public consultation meetings.
- In the Project Area, it was confirmed that there are no environmental or social issues that could impede execution of the project.

13.1.4 Economic Analysis and Evaluation

- Economic Internal Rate of Return (EIRR) : 17.8% (for base case)
- Benefit / Cost : 1.90

From the above study results, this project is considered to be feasible.

13.2 Recommendations

(1) Consistency with the projects of other donors

1) Asian Development Bank (ADB)

The ADB-financed Eindu to Kawkareik Road Improvement Project is related to the Project that we are dealing with, as Gyaing Kawkareik Bridge is included in this section. In the study, uniformity and/or consistency between the two projects must be ensured for basic design conditions such as road standards, configuration of road crossings, and the profile of the connecting point at Gyaing Kawkareik Bridge.

The ADB-financed project was in the Feasibility Study phase at last check, so the final adjustment shall be required through the exchange of information at the time of the detailed design. Similar procedures will be taken in the case that other associated projects are planned in or around the Project Area.

2) Government of Thailand

In the development of the East-West Economic Corridor (the target of the Project), two projects under the aid of the Thai Government are being conducted in parallel. One is the development of a bypass between Thin Gan Nyi Naung and Kawkareik, a one-lane section that passes over the Dawna Mountain. The other is the construction of a second international bridge crossing the

Thaungyin River (which flows along the Thailand-Myanmar border) and border management facilities.

The bypass is almost completed as of June 2015, and service is expected to start in July 2015.

The second international bridge has passed the detailed design phase, and is now entering the construction phase. Currently, the capacity of the border management facility in Myawaddy is low, so the processing of cross-border traffic is limited. The completion of the second international bridge and border management facility shall enable smoother cross-border traffic. The impact on traffic volume through the completion of the border management facility must be considered as a project effect.

(2) Transfer of technology

It is desirable to implement the transfer of advanced construction techniques (such as those used in Japan) to Myanmar through project execution, and MOC has expressed strong interest in the learning Japanese construction techniques. Thus, discussions must be held to form and execute a meaningful specific training programme encompassing each stage of design and construction. As for the weathering steel, appropriateness should be determined in the detailed design stage. Main items for technology transfer are as follows.

- Design and construction of extradosed bridges
- Design and construction of steel pipe sheet pile foundations
- Soft ground stabilization method
- Asphalt pavement technology
- Weathering steel (applicability must be determined at the detailed design stage)
- Bridge maintenance technology (including bridge inspections)

(3) Relocation of existing utilities

In this study, a preliminary design was performed in consideration of an inventory survey of existing utilities in the Project Area such as water pipes, telephone lines and electricity lines (which was conducted within the topographic survey). Relocation of existing utilities is expected to be carried out through Myanmar government funds. In the detailed design stage, a detailed study of the existing utilities needs to be conducted, and support shall be required in order to coordinate with relevant agencies and develop a relocation plan based on the acquired information.

(4) Shortening of the construction period

Targeting ASEAN integration in 2015, maintenance of international trunk roads is an urgent priority in Myanmar. In particular, the Myawaddy-Thaton section is a part of the ASEAN Highway and the Myawaddy- Kawkareik bypass section is expected to open entirely in May 2015. In addition, the construction of Eindu to Kawkareik Road Improvement project by ADB is scheduled to be completed in March 2019. Consequently, the traffic volume of the target route is expected to grow dramatically by the construction of these new routes.

MOC hopes to complete the replacement of Gyaing Kawkareik Bridge as early as possible, so the schedule of works assumed in this Study includes night-time construction work in order to shorten the construction period. Considering this, in the subsequent detailed design and implementation stages, measures for eliminating bottlenecks to shorten the construction time (while ensuring safety and quality) must be devised.

(5) Environmental and social considerations

- After receiving approval of the Environmental Impact Assessment (EIA) Report and Abbreviated Resettlement Action Plan Report (ARAP) from the Environmental Conservation Department (ECD) under the Ministry of Environmental Conservation &

Forest, these reports must be translated into Burmese and disclosed to project-affected persons and other residents for a period of more than one month.

- Project-affected areas shall be indicated to project-affected persons prior to the detailed design phase. The approved RAP shall be updated based on requirements concluded through detailed design, and compensation and land acquisition must be performed before construction begins.
- The Project Proponent shall swiftly respond to claims and complaints from project-affected persons and other inhabitants in accordance with the grievance redress scheme given in the approved RAP, and shall endeavour to promote the understanding of the project's necessity.

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Abbreviations

AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
ADB	Asian Development Bank
AEC	ASEAN Economic Community
AH	Asian Highway/ ASEAN Highway
AHN	ASEAN Highway Network
AHWL	Annual mean Highest-Flood Level
AIDS	Acquired Immune Deficiency Syndrome
AK	AyeKo family
AMSL	Above Mean Sea Level
ARAP	Abbreviated Resettlement Action Plan
ASEAN	Association of South East Asian Nations
ASTM	America Society for Testing and Materials
B/C	Cost-Benefit Ratio
BIMSTEC	Bengal Initiative for Multi‐Sectoral Technical and Economic Cooperation
BOD	Biochemical Oxygen Demand
BOT	Build-Operate-and-Transfer
BP	Bypass
CBR	California Bearing Ratio
CC	Concrete Caisson
CCD	Charge-Coupled Device
CM	Chief Minister
CMP	Cutting-Making-Packaging
COD	Cut-Off Date
CPCP	Cast in Place Concrete Pile
CSO	Central Statistical Office
DCA	Department of Civil Aviation
D/D	Detailed Design
DHSHD	the Department of Human Settlement and Housing Development
DICA	Department of Investment and Company Administration
DICD	Department of Industrial Crops Development, MOAI
DKBA	Democratic Karen Benevolent Army
DMH	Department of Meteorology and Hydrology
DOB	Department of Bridge
DOH	Department of Highways
DPD	Deputy Project Director
DWRIR	Directorate of Water Resources and Improvement of River systems
ECD	Environmental Conservation Department
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMA	External Monitoring Agent
EMP	Environmental Management Plan
ERIA	Economic Research Institute of ASEAN and East Asia
ESAL	Equivalent Single Axle Load
EU	European Union
EWEC	East-West Economic Corridor
EXIM	Export and Import
FC	Foreign Currency
FDI	Foreign Direct Investment
FESR	Framework for Economic and Social Reform
FF	Fact Finding
FHWA	Federal Highway Administration
FIDIC	International Federation of Consulting Engineers
FS	Feasibility Study
FSM	Full Staging Method
FTI	Federation of Thai Industry
GAD	General Administration Department, MOHA
GDP	Gross Domestic Product
GIS	Geographic Information System
GMS	Greater Mekong Subregion
GMS-ECP	GMS Economic Cooperation Program
GOJ	Government of Japan
GOM	Government of Myanmar
GPS	Global Positioning System
GRDP	Gross Regional Domestic Product
GSP	Generalized System of Preferences
HFL	Highest Flood Level
HH	Household Head
HHWL	Historical High Flood Levels
HIV	Human Immunodeficiency Virus
HWL	High Water Level
ID	Irrigation Department, MOAI
IDF	Intensity-Duration-Frequency
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IMA	Internal Monitoring Agent
IMF	International Monetary Fund
IP	Indigenous Persons
IUCN	International Union for Conservation of Nature
IWT	Inland Water Transport
JICA	Japan International Cooperation Agency
JICA GL	JICA Guideline for Environmental and Social Considerations
JRA	Japan Road Association
JSHB	Japanese Specifications for Highway Bridges
JST	JICA Survey Team
KNU	Karen National Union
LC	Local Currency
LGU	Local Government Unit
LRFD	Load and Resistance Factor Design
LTIPP	Workshop on Long Term Investment Promotion Plan
MCDC	Mandalay City Development Council
MCDV	Myanmar Comprehensive Development Vision
MDB	Multilateral Development Bank
MDGs	Millennium Development Goals
MDY	Mandalay
MNPED	Ministry of National Planning and Economic Development
MOAI	Ministry of Agriculture and Irrigation
MOC	Ministry of Construction
MOECAF	Ministry of Environmental Conservation and Forestry
MOHA	Ministry of Home Affairs
MOI	Ministry of Industry
MORT	Ministry of Rail Transportation
MOT	Minister of Transport
MPA	Myanmar Port Authority
MR	Myanmar Railways
MSL	Mean Sea Level
MWL	Mean Water Level
MYT-Plan	The National Transport Development Plan
NATALA	The Ministry for Progress of Border Areas and National Races and Development Affairs
NCDC	Nay Pyi Taw City Development Council
NCDP	National Comprehensive Development Plan
NEDA	Neighboring countries Economic Development cooperation Agency
NSDS	National Sustainable Development Strategy
NSPF	National Spatial Planning Framework
OD	Origin-Destination

ODA	Official Development Assistance
O&M	Operation &Maintenance
OP	Operational Policies
PAHs	Project Affected Households
PAPs	Project Affected Persons
PC	Pre stressed Concrete
PCU	Passenger Car Unit
PD	Project Director
PFI	Private Finance Initiative
PHC	Pretensioned spun High strength Concrete piles
PMU	Project Management Unit
PRC	People's Republic of China
PVD	Prefabricated Vertical Drain
PW	Public Works
PWD	Public Works Department
QV	Traffic Capacity–Travel Speed
RAP	Resettlement Action/Land Acquisition Plan
RBCC	Road and Bridge Construction Committee
RC	Reinforced Concrete
RCC	Roller Compacted Concrete
RIC	Resettlement Implementation Committee
ROW	Right of Way
RTAD	Road Transport Administration Department
SC	Steel Composite piles
SCF	Standard Conversion Factor
SEC	South Economic Corridor
SEZ	Special Economic Zone
SHM	Stakeholder Meeting
SIDA	Swedish International Development cooperation Agency
SLRD	Settlement and Land Records Department
SLSC	Standard Least Squares Criterion
SN	Structural Number
SP	Sub-Project
SPP	Steel Pipe Pile
SPS	Safeguard Policy Statement
SPSP	Steel Pipe Sheet Pile
SPSPF	Steel Pipe Sheet Pile Foundation
SPT	Standard Penetration Test
SS	Suspended Solid
STD	Sexually Transmitted Disease
S/V	Supervision
T/A	Tender Assistance
TFR	Total Fertility Rate
TPD	Transport Planning Department
TSP	TrisodiumPhosphate
TTRs	Transit Transport Routes
UN	United Nations
UNDP	United Nations Development Program
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
UTM	Universal Transverse Mercator
UU	Unconsolidated Undrained
VOC	Vehicle Operation Cost
WB	World Bank
WGS	World Geodetic System
WHO	World Health Organization
YCDC	Yangon City Development Council

CHAPTER 1 INTRODUCTION

1.1 Introduction

1.1.1 Survey Background

The Republic of the Union of Myanmar (hereinafter "Myanmar") has been accelerating its high economic growth since the transition to democracy in March 2011. During this time, Myanmar requires infrastructure development in line with international standards before its integration into ASEAN in 2015. The Ministry of Construction (MOC) has been developing roads and bridges with its own budget and private funds, but the development has not reached remote areas due to budget limitations. Particularly in the southeast (where Myanmar borders Thailand, an economically close partner), road development in is an urgent task. The major arterial roads in southeastern Myanmar, including the East-West Economic Corridor and the Three Pagoda Pass from Tanbyuzayat to Hpayarthonesu connected to the border with Thailand, act as community roads for neighbouring residents in addition to functioning as arterial roads supporting wider-area traffic. In this connection, a high-speed passage of large cargo vehicles and long-distance buses on roads without shoulders and side walks coexisting with community traffic has been a large problem in terms of traffic safety, which has the potential to become more serious depending on the traffic demand increase in the future. While it is difficult for vehicles to travel on the Three Pagoda Pass during the rainy season, the road is expected to be developed into an international highway providing the shortest route between Yangon Metropolitan Area and Bangkok. Further, Payagyi-Dawei Road is expected to be developed to connect the East-West Economic Corridor, Three Pagoda Pass, and Dawei in the south to Yangon Metropolitan Area, which will also strengthen the connectivity between major Myanmar areas and Thailand. As discussed above, this Project requires renovation of priority sections, while taking future traffic demand into account and ensuring traffic safety.

1.1.2 Survey Objectives

The Project aims to collect information on site conditions; progress of existing projects concerning the arterial roads located in southeastern Myanmar (Payagyi-Dawei, Eindu-Myawaddy, Thaton-Eindu, Mawlamyine-Eindu, Thanbyuzayat-Hpayarthonesu Road (Three Pagoda Pass)); to extract project proposals (expected to be implemented in the near future); and to select priority projects and to conduct necessary surveys to examine the proposal as a yen-loan project, including the outline, estimated project costs, project implementation system, management, operation and maintenance system, environmental and social considerations, etc.

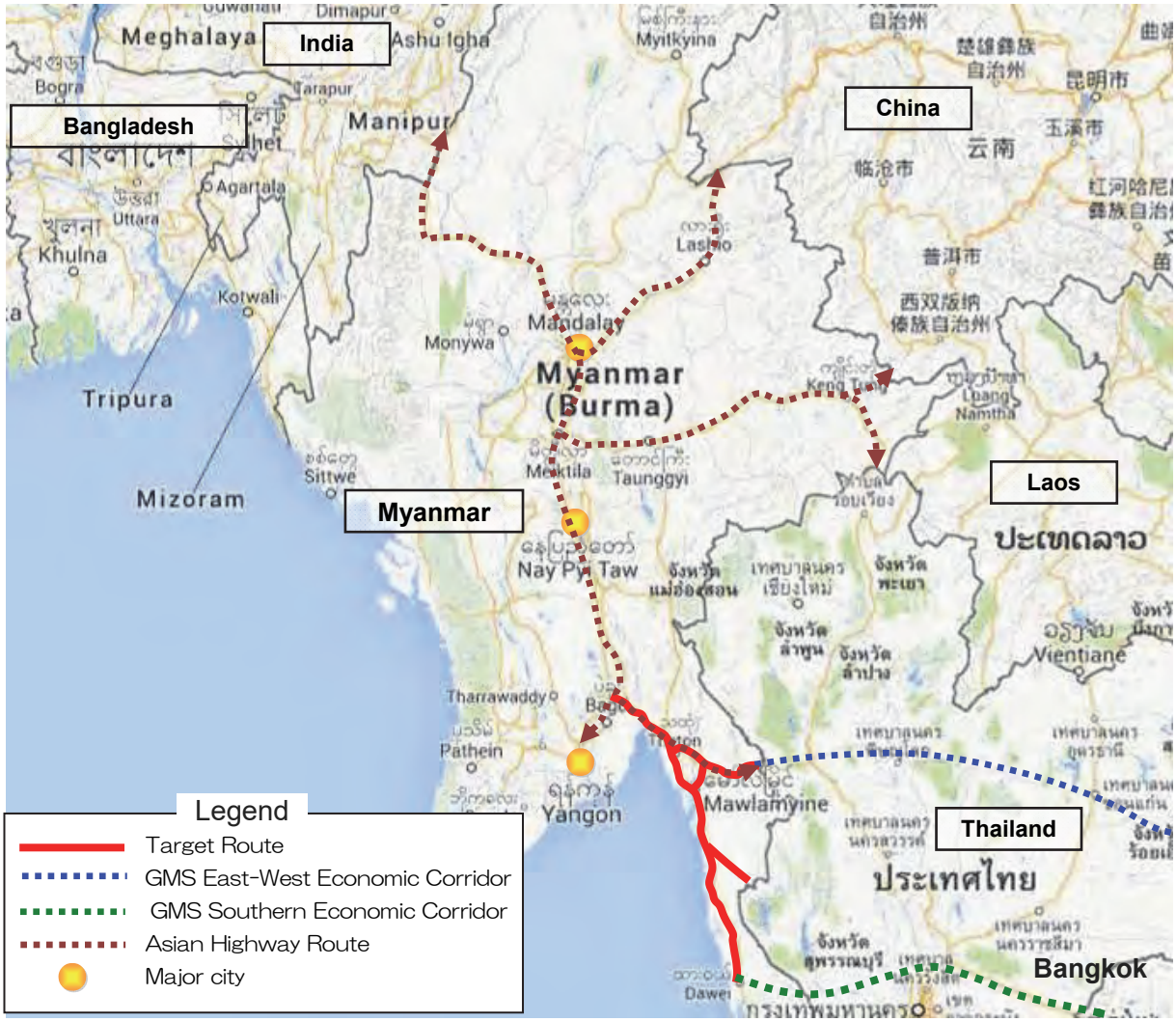
1.1.3 Survey Area

The survey area covers the southeastern part of Myanmar. The details of the Study are shown in Figure 1.1.1 and Figure 1.1.2.

Table 1.1.1 Potential Road Sections and Potential Road Improvement Projects

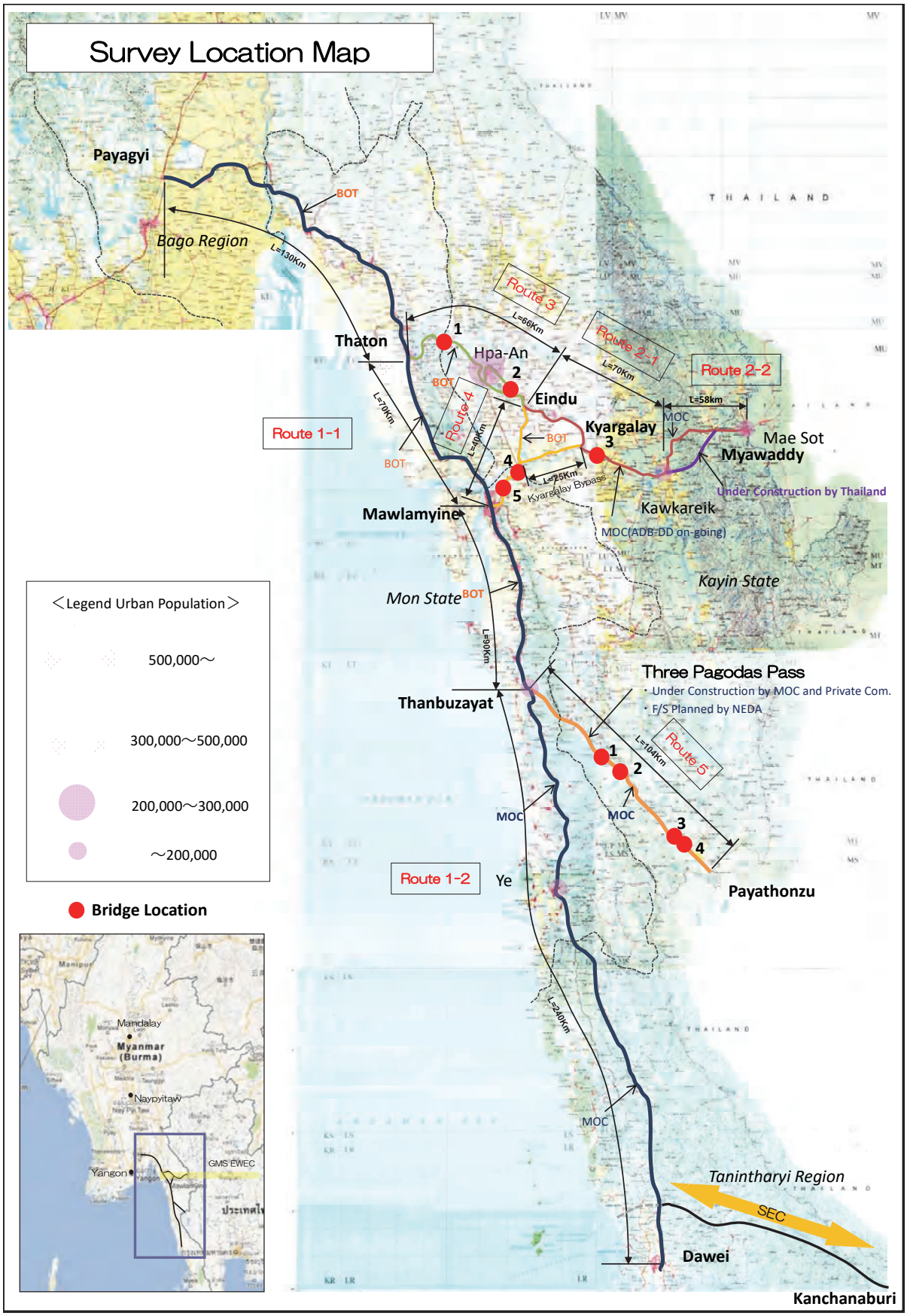
Road Section		Length
Route 1 Payagyi – Dawei Road	Route 1-1 Payagyi－Mawlamyine	200 km
	Route 1-2 Mawlamyine－Dawei	330 km
Route 2 Eindu – Myawaddy Road	Route 2-1 Eindu－Kawkareik	70 km
	Route 2-2 Kawkareik－Myawaddy	58 km
Route 3 Thaton – Eindu Road		66 km
Route 4 Mawlamyine – Eindu Road		40 km
Route 5 Thanbyuzayat – Hpayarthonesu Road (Three Pagodas Pass)		104 km

Source: JICA Survey Team



Source: JICA Survey Team

Figure 1.1.1 Project Location Map



Source: JICA Survey Team

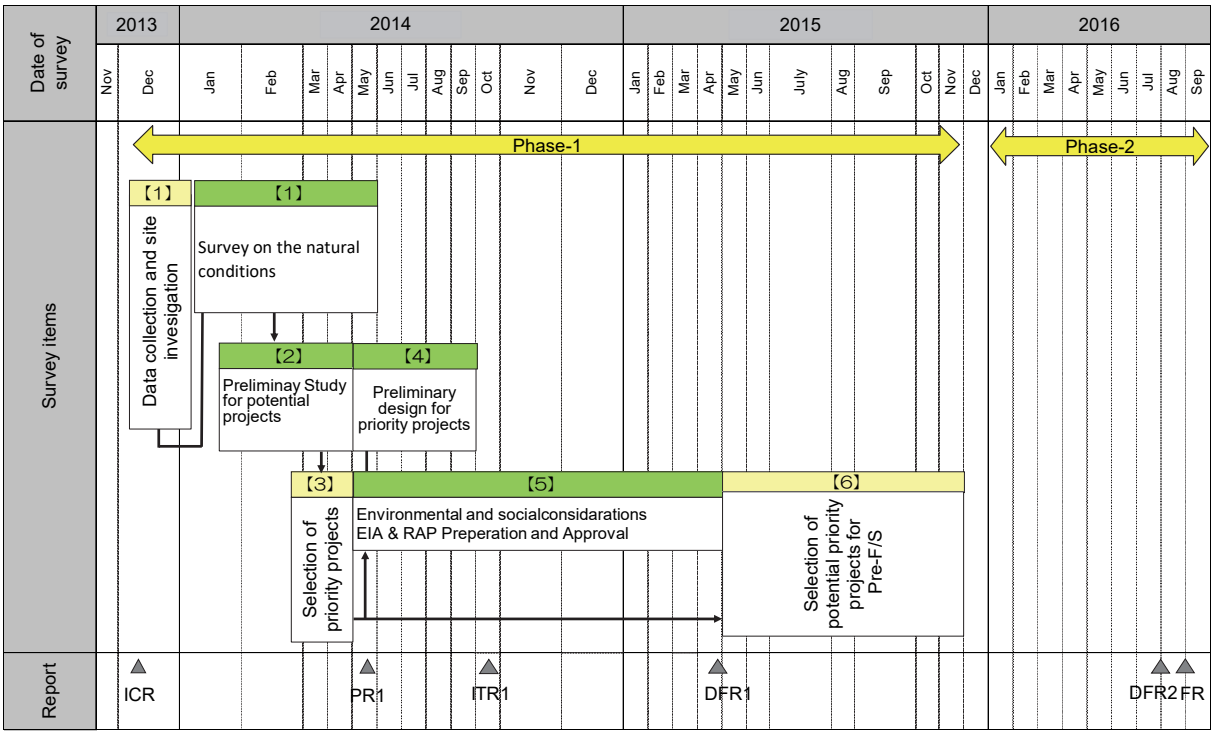
Figure 1.1.2 Survey Location Map (Detailed)

1.2 Schedule and Flow of the Survey

Survey schedule and flow is summarized in Figure 1.2.1. The preparatory survey will be carried out in two phases:

1st Phase: Conduct Feasibility Study of priority projects selected by a series of mutual discussions with MOC

2nd Phase: Conduct Pre-Feasibility Study of potential priority projects selected by series of mutual discussions with MOC



Source: JICA Survey Team

Figure 1.2.1 Survey Schedule and Flow

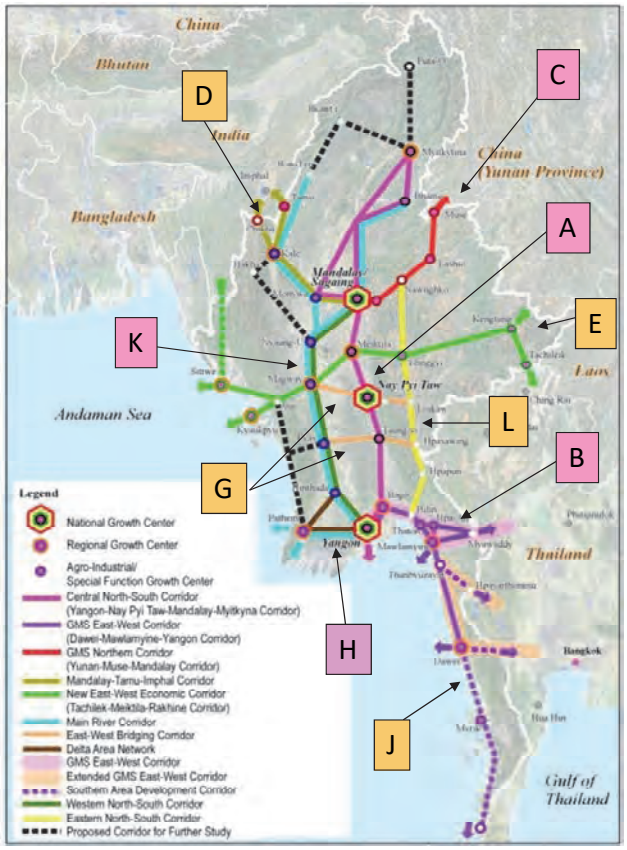
CHAPTER 2 GENERAL UNDERSTANDING

2.1 Upper Plan for This Project

2.1.1 The National Transport Development Plan in the Republic of the Union of Myanmar

The master plan for national transport development in Myanmar was prepared with the assistance of JICA in 2013 and is the origin of this survey. It suggests that investment in a variety of transportation sectors such as aviation, road, railway, port, and inland water transportation is necessary for sustainable economic development in Myanmar. In the Master Plan, a focus on the development of key infrastructures is proposed for the 2014 – 2020 period. In Myanmar, there is no cross-sector transportation development plan. In addition, quantitative analysis/evaluation has not been carried out for the list of long-term development plans and projects formulated by the respective ministries.

Considering the above situation, in terms of selection and concentration, ten key corridors have been selected to be balanced with growth in urban and rural regions, and to be a basis for national land development. Moreover, five priority corridors, including the targeted roads in this survey, have been selected through quantitative criteria such as future GRDP, traffic demand, and investment effect. The plan will be soon endorsed and authorized by Cabinet Approval, and thus road improvement in this survey corresponds to the National Transport Development Plan in Myanmar.



Source: The Survey Program for the National Transport Development Plan

Figure 2.1.1 Five Priority Corridors

Five Priority Corridors

A: Central North-South Corridor (Yangon – Naypyidaw – Mandalay)
B: GMS East-West Corridor (Yangon – Thaton – Myawaddy/Mawlamyine – Dawei Three Pagoda Pass)
C: GMS Northern Corridor (Mandalay – Muse)
H: Delta Area Network
K: Western North-South Corridor (Yangon – Pyay – Magway)

2.2 Road Network in Myanmar and Relative Road Development Plan

2.2.1 Road Network in Myanmar

(1) General

Myanmar is geographically located at the cross roads between east and west, north and south of the Asian Continent, and acts as a natural link between several Asian countries. It can function as a land-bridge connecting Southeast Asia and South Asia, as well as with China and beyond. Myanmar therefore has a great potential to become a regional 'hub,' offering major opportunities to neighbouring countries in the improvement of their regional transport linkages.

Through improved connectivity and access to international routes (including the Asian Highway, the ASEAN Highways, GMS Economic Corridor and Thai-Myanmar-India Tripartite Highways across Myanmar), MOC expects the development of these network segments to accelerate the country's economic growth by encouraging international trade with neighbouring counties.

Source: The Economist (Website)

Figure 2.2.1 Location Map of International Highways in Southeastern Asia

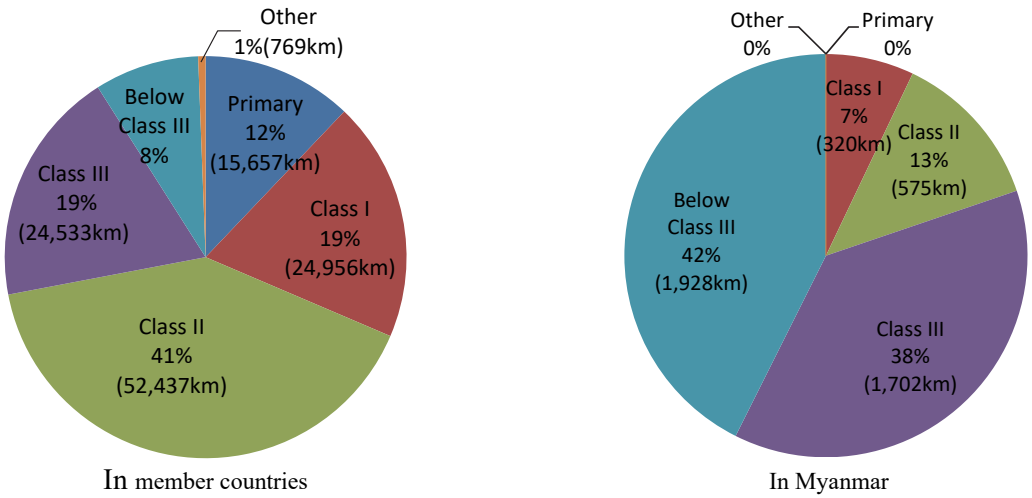
(2) International Highways Network in Myanmar

1) Asian Highways

Asian Highways is the international highway network initially established by UNESCAP in 1959, with its approximately 140,000 km length of road networks covering 32 countries. The Asian Highway Network and status of the network in member countries are shown in Figure 2.2.2 and Figure 2.2.3.

Source: UNESCAP

Figure 2.2.2 ASIAN Highway Route Map



Source: Prepared by JICA Survey Team based on UNESCAP Website

Figure 2.2.3 Status of Asian Highway Network[5]

[5] According to the aggregate results for the status of the Asian Highway Network prepared by the Secretariat of UNESCAP, three (3) routes for ASEAN Highway (AH111,112,123) in Myanmar are included in the results.

Table 2.2.1 Road Classification of Asian Highway

Classification	Description	Pavement Type
Primary	Access-controlled motorway	Asphalt or cement concrete
Class-I	4 or more lanes highway	Asphalt or cement concrete
Class-II	2 lanes	Asphalt or cement concrete
Class-III	2 lanes (narrow)	Double bituminous surface treatment

Source: ASIAN HIGHWAY CLASSIFICATION AND DESIGN STANDARDS

The route number for the Asian Highways is designated by the one digit to three digits numbers with the capital letter "AH". The number of 1 to 9 (one digit number) are given to the main networks passing through ; 1) Southeast Asia, 2) East Asia and Northeast Asia, 3) South Asia and 4) North Asia, Central Asia and Southwest Asia). On the other hand, double digits and three digits number are given to the regional routes connecting several neighbour countries or national highways. Road classification is divided into four classes as shown in Table 2.2.1.

There are four Asian Highways passing through Myanmar: AH1, AH2, AH3 and AH14 linking the neighbouring countries of China, India and Thailand and providing access to Yangon Port as shown in Figure 2.2.4. As indicated in Figure 2.2.3, about 40% of Asian highways running through Myanmar are below Class-III in the Asian Highway Standard. Whereas, the section below Class-III is approximately 8% of whole the section of the Asian Highway Network, indicating that the sections in Myanmar has been behind the other members. Upgrading the Eindu to Myawaddy section, which is one of the targeted roads in the survey and a part of the Asian Highway, ASEAN Highway and GMS East West Economic Corridor, has been planned or implemented by other foreign donors.

Source: UNESCAP

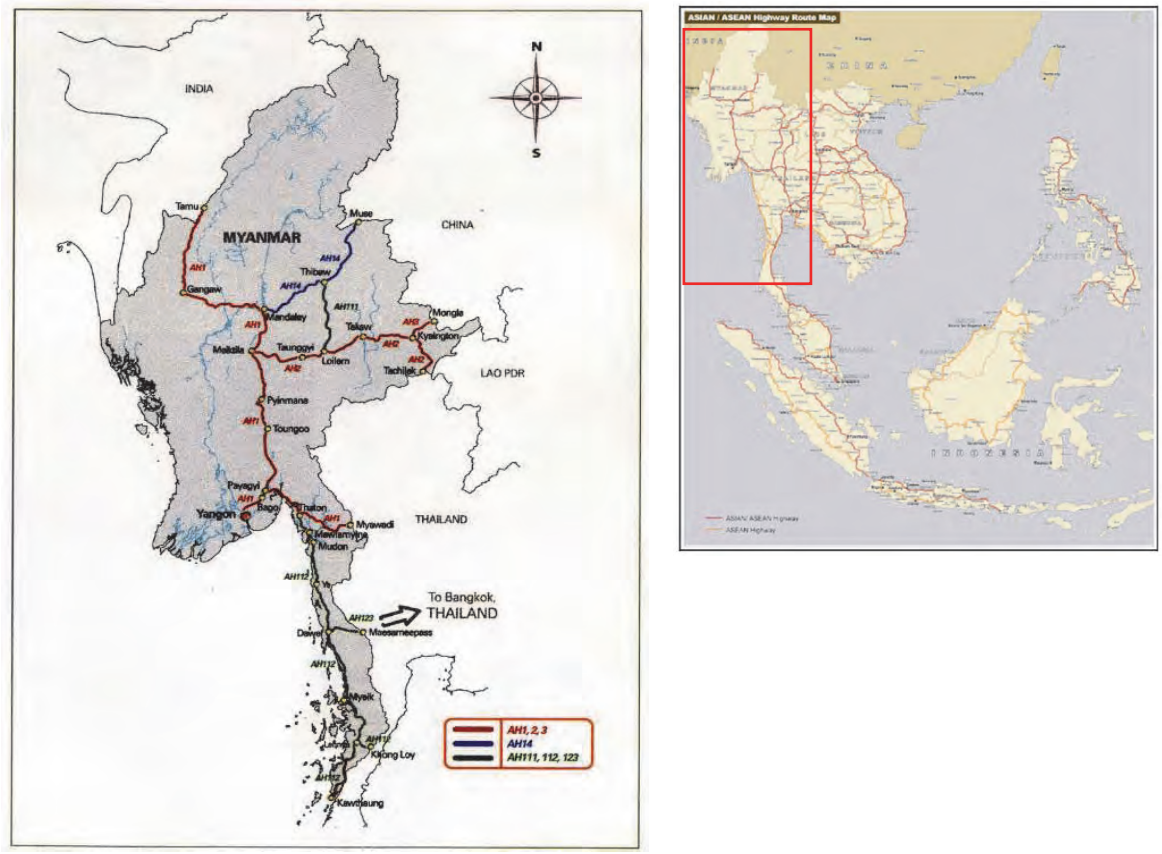
Figure 2.2.4 Asian Highway Route Map (Myanmar)

2) ASEAN Highways

ASEAN cooperation in roads aims to establish efficient, integrated, safe and environmentally sustainable regional land transport corridors linking all ASEAN Member States and countries beyond. The development of the ASEAN Highway Network (AHN) is a flagship land transport infrastructure for projects within ASEAN. The ASEAN Transport Ministers (ATM) adopted a plan to develop the AHN with the following time-frame at its fifth meeting in Ha Noi, Viet Nam in September 1999. The overall route configuration of the ASEAN Highway Network is shown in Figure 2.2.5. The highway network comprises 23 routes involving some 38,400km over ASEAN countries.

- ✓ Stage 1: Network configuration and designation of national routes to be completed by 2000;
- ✓ Stage 2: Installation of road signs at all designated routes, upgrading of all designated routes to at least Class III standards, construction of all missing links and the operationalization of all cross-border points by 2004;

✓ Stage 3: All designated routes to be upgraded to at least Class I standards and the upgrading of low traffic volume non-arterial routes to Class II standards would be acceptable by the year 2020.



Source: MOC

Figure 2.2.5 ASEAN Highway Route Map

There are seven routes within Myanmar designated as parts of the ASEAN Highway Network. These consist of four routes that coincide with the Asian Highway Network (AH1, AH2, AH3 and AH 14), and another three additional routes (AH 111, AH 112 and AH 123, with a total length of a further 1,525km). Therefore, the total length of ASEAN designated routes in Myanmar is 4,543km. AH111 connects AH2 and AH14 in Shan State, AH112 stretches from Thaton to Khon Loy along the coast of south Myanmar, and AH123 is located between Dawei and the Thai border (and is recognized as the Dawei Port Access Road). AH1 and AH112 pass through the project area.

Table 2.2.2 Length of ASEAN Highway Network

Route No.	Section	Length (km)						
		Total	Prima -ry	Class I	Class II	Class III	Below Class III	Missi ng Links
AH 1	Tamu-Mandalay-Meiktila-Yangon-Bago-Pahagyi- Thaton-Myawaddy	1,665	-	80	-	646	939	-
AH 2	Meiktila-Loilem-Kyaing Tong-Tachileik	807	-	-	-	-	807	-
AH 3	Mongla-Kengtung	93	-	-	-	-	93	-
AH 14	Mandalay-Thibaw-Muse	453	-	67	-	386	-	-
AH 111	Thibaw-Loilem	239	-	-	-	-	239	-
AH 112	Thaton-Mawlamyine-Thanbyuzayat - Ye-Dawei- Lehnya-Khamaukgyi, Lehnya-Khong Loy	1,145	-	-	-	-	1,085	60
AH 123	Dawei-Maesamee Pass	141	-	-	-	-	-	141
Total		4,543	-	147	-	1,032	3,163	201

Source: MOC

Master Plan on ASEAN Connectivity

The "Master Plan on ASEAN Connectivity" was adopted by the ASEAN Leaders at the 17th ASEAN Summit in October, 2010 (Hanoi, Vietnam), aiming to develop economic growth, to narrow development gaps, to promote integration within ASEAN and to realize an ASEAN Community by 2015 through enhancement of connectivity to get people, goods, and services closer together among internal and external partners.

In the Master Plan, specific strategies and key actions to enhance the ASEAN Highway Network (AHN) were designated, one of which is to upgrade "Class-II or III" sections with high traffic volume to "Class-I" (four-lanes asphalt pavement road) by 2020. In addition, fifteen prioritized projects were selected, one of which is completion of the ASEAN highway network missing links and upgrade of transit transport routes (TTRs) to Class-III. The prioritized projects are mostly planned in Myanmar, and include AH1 (Payagyi – Thaton – Myawaddy), which is targeted in this survey as shown in the list below.

Missing Links

- ✓ Myanmar：AH112 Thaton – Mawlamyine – Lahnya – Khlong Loy (60km)
- ✓ Myanmar：AH123 Dawei – Maesamepass (141km)

Upgrading of "Below Class-III' TTRs

- ✓ Lao PDR：AH12 Vientiane – Luang Prabang (393km)
- ✓ Lao PDR：AH15 Ban Lao – Namphao (98km)
- ✓ Myanmar：AH1 Tamu – MDY – Bago – Myawadi (781km)
- ✓ Myanmar：AH2 Meikthila – Loilem – Kyaington – Tachikeik (593km)
- ✓ Myanmar：AH3 Kyaington – Mongla (93km)

3) GMS Corridor Networks

The GMS comprises Vietnam, Cambodia, Lao PDR, Myanmar, and Thailand, as well as Yunnan Province and Guangxi Zhuang autonomous region, (both part of the People's Republic of China (PRC)). In 1992, with ADB assistance, the six countries entered into a programme of sub-regional economic cooperation, designed to enhance economic relations among the countries.

The resulting GMS Economic Cooperation Program (GMS-ECP) has contributed to the development of transport infrastructure to foster the exploitation and sharing of the regional resource base, and has promoted the freer flow of goods and people in the sub-region. It has also led to the international recognition of the sub-region as a major future growth area.

Source: Asian Development Bank

Figure 2.2.6 GMS Road Network

The 14th Ministerial Conference of GMS-ECP (held in Manila on June 19-21, 2007) endorsed the Mid-Term Review of the Greater Mekong Sub-region 10-Year Strategic Framework 2002 – 2012. Based on the map of GMS economic corridor, new economic corridors were added, and some parts of the original corridors were changed. Currently, five routes (North-South Economic Corridor, East-West Economic Corridor, Southern Economic Corridor, Northern Economic Corridor and Western Economic Corridor) pass through Myanmar, as shown in Figure 2.2.6.

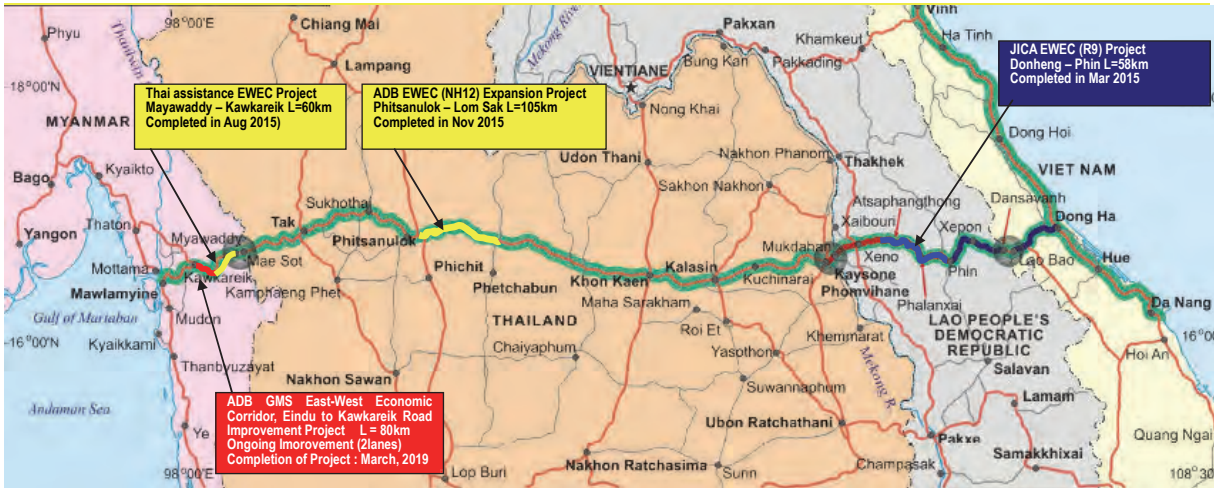
Table 2.2.3 GMS Economic Corridor

Corridor name	Section
North-South Corridor	Kunming – Bangkok
East-West Corridor	Mawlamyine – Danang
Southern Corridor	Dawei – Quy Nhan/Vung Tau
Northern Corridor	Gangheng – Tamu
Western Corridor	Tamu – Malwamyine
Central Corridor	Kunming- Sihanoukville/Sattahip
Eastern Corridor	Kunming – Ho Chi Minh City
Southern Coastal Corridor	Bangkok – Nam Can
Northeastern Corridor	Nanning – Bangkok – Lem Chabang

Source: MOC

GMS East West Economic Corridor

The current road improvement of the GMS East – West Economic Corridor is shown in Figure 2.2.7. Most of the road sections in the EWEC are in good condition or are already being improved. For example, the ADB-funded GMS Highway Expansion Project, co-financed with the Thai Government, covers the upgrading of a 178km section of the EWEC within Thailand; this includes specifically, a 105km section of Highway No.12 running from Phitsanulok to Lom Sak that was completed by Nov of 2015. Also, JICA Grant Aid for the upgrading of a 58km road section in the Savannkahet Province of the Lao PDR and was completed in March of 2015. However, the remaining sections of the EWEC in Myanmar still need substantial improvement if they are to become part of a fully functioning transport corridor. The construction of a 28km length of bypass between Kawkareik and Myawaddy, funded by Thai Government was completed in August 2015, providing a new route to go around the Dawna mountain range. The bypass was completed with two full-width lanes and allows the continuous flow of traffic in both directions. In this respect, the road improvement to two lane asphalt paved road between Eindu and Kawkareik is planned to be completed in March 2019 with the aid by ADB.



Source: Prepared by the JICA Survey Team based on the material obtained from ADB website

Figure 2.2.7 GMS East West Economic Corridor

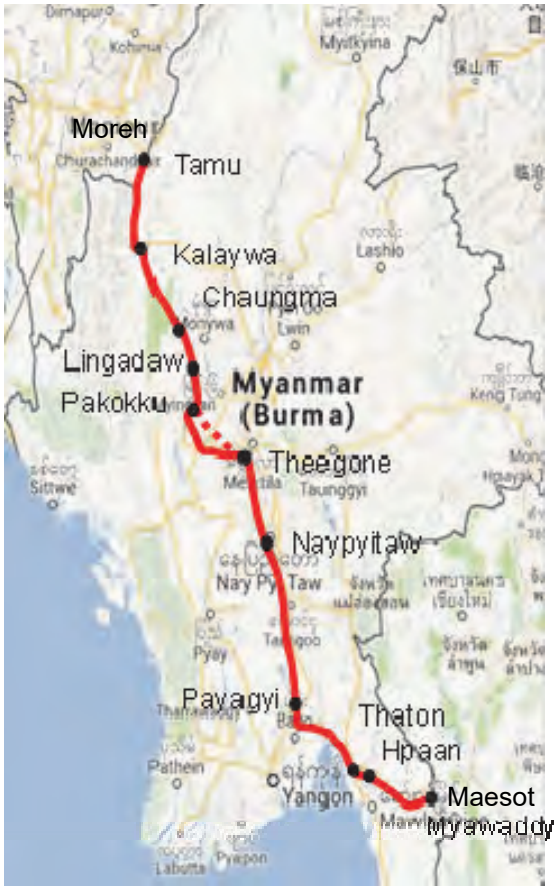
4) India-Myanmar-Thai Tripartite Highways

Among the corridors to be improved in Myanmar, there is the tri-lateral highway from Moreh, India to Mae Sot, Thailand through Bagan, Myanmar with a total length of approximately 1,300km. A tripartite agreement for implementation of transport linkages between the three countries of Myanmar, India and Thailand was concluded at a Ministerial meeting held in New Delhi in December of 2012. Cooperation calls for the implementation planning to include the participation of the private and public sectors, as well as funding by regional organizations and international financial institutions. This transport linkage route will not only link India, Myanmar and Thailand, but will also connect Mae Sot, Savannakhet (Lao PDR) and OaNang (Vietnam), in the East – West Economic Corridor. Hence, the completion of this group of highways is expected to enhance the connectivity not only of those countries but also to connect India more directly with other South Asian countries.

Table 2.2.4 Length of Tri-partite Highways

Section	Length (km)
Tamu – Kyeegone – Kalaywa	145.5
Kalaywa – Yargyi – Chaungma	159.5
Chaungma – Pale – Lingadaw	73.0
Lingadaw – Pakokku	77.5
Pakokku – Bagan – Kyaukpadaung – Theegone	154.0
Theegone – Naypyitaw – Bawnatgyi	393.0
Bawnatgyi – Payagyi – Thaton	84.5
Thaton – Hpaan	52.0
Hpaan – Myawaddy	146.0
Total	1,285.0

Source: MOC



Source: JICA Survey Team based on Google Maps

Figure 2.2.8 Tri-partite Highway Route Map

(3) National Development Plan and Road Development in Myanmar

The National Transport Development Policies of Myanmar traditionally give priority to the development of all regions including border areas, with a focus on the facilitation of access for economic activities – in particular those that promote trade and tourism with neighbouring countries. Road transport is the dominant mode of transportation in Myanmar and plays an important role in rural areas where roads support agriculture and enable the local population to secure access to markets, schools, hospitals and other important social services. Roads are therefore a key element of the basic infrastructure crucial to the support of both regional and international trade and commerce within Myanmar.

Most of the roads that run through the country from north to south were developed in early times. The high mountain ranges and the crossing of several wide rivers hinder the development of roads for east to west links. In spite of this, many roads and related bridge structures have been

constructed since the late 1980s as part of the development of the national road network necessary to link all regions and ethnic groups.

The Ministry of Construction (MOC) has established a road network with a total length of approximately 22,000km (13,635 miles)[6] by 1988. Even during the time of the State Peace and Development Council government, a road network with about 36,000km[7] in length has been developed by the end of the fiscal year 2010-2011 by MOC based on the "Thirty Year Long Term Plan".

1) National Road Development Plan (Thirty Year Long Term Plan)

The MOC established a 30-year long-term road development plan in 2000, which is composed of six five-year short-term plans. The development plan stipulates the objectives for road development, the proposed road width and surface type and the project list to be implemented per short term plan, including the participation of private companies for road development, namely the BOT scheme.

Table 2.2.5 to Table 2.2.7 describe the planned value, the actual value and comparison between planned and actual value in the first and second five-year short term plans. At the end of March 2011, the road network with about 21,900km in length was developed and approximately 2,600km was greater the original plan. Especially, it was found that the sections of bituminous roadway (completed with a length of 17,600km) was greater than the original plan (about 7,700km) in the second five-year plan. It is considered that this achievement is due to cooperation with private companies under the BOT scheme.

Table 2.2.5 First Five Year Development Plan (2001-2006)

Project Type	Length (Mile)						Cost (Billion Kyat)
	Concrete	Earth	Gravel	Metalled[8]	Asphalt	Total	
Road improvement	-	1052/4	954/5	866/1	656/4	3529/6	28.804
Ongoing projects	197/6	1009/0	890/5	366/2	223/0	2686/5	24.082
Road Construction	654/3	216/3	13/4	-	-	884/2	2.381
Total	852/1	2277/7	1858/6	1232/3	879/4	7100/5	55.267

Source: MOC

Table 2.2.6 Second Five Year Development Plan (2006-2011)

Project Type	Length (Mile)						Cost (Billion Kyat)
	Concrete	Earth	Gravel	Metalled	Asphalt	Total	
Road upgrading	-	849/4	1612/5	2327/2	2703/5	7502/0	98.074
Ongoing projects	363/0	1110/0	1307/4	1415/2	1207/5	5403/3	44.620
Build new roads	640/0	44/0	-	-	-	684/0	1.901
Total	1003/0	2003/4	2929/1	3742/4	3911/2	13589/3	144.595

Source: MOC

Table 2.2.7 Comparison of the Planned Value and Actual Value in the First and Second Five Year Short Term Plans

Road Surface Type	Plan(Mile)	Actual	Actual－Plan
Asphalt	4790/6	10942/5	6151/7
Metalled	4974/7	4296/0	-678/7
Gravel	4787/7	3222/5	-1565/2
Earth	6136/4	3845/3	-2291/1
Total	20690/0	22306/5	+1616/5

Source: MOC

[6] From the "30-year Long Term Plan"
[7] Including road sections developed by BOT scheme
[8] Metalled road is a hardened gravel road.

After completion of the second five-year plan, the original 30-year plan had to be revised and modified as a result of political changes and in the interests of improving international relationships, the country's general economic system and social welfare. The general objectives of the 30-year plan were revised to include the following aspects.

- To upgrade connecting roads to ASEAN countries standards
- To upgrade Union Highways connecting regions and states

In the revised 30-year Long Term Plan, road width and pavement type are proposed in accordance with future traffic demand (Table 2.2.8) and phased project lists are provided as shown in Table 2.2.10 to Table 2.2.13[9].

In the third five-year short term plan, international highways are to be upgraded to two-lanes with asphalt pavement covering a length of about 9,100km, and union highways are also to be upgraded to single lane asphalt paved road with 8,900km in length including sections of new construction (1,700km).

In the fourth five-year short term plan, additional union highways (4,500km) will be developed as single lane asphalt paved roads.

In the fifth five-year short term plan, international connections will be upgraded into four-lane roads.

In the sixth five-year short term plan, main union highways (5,400km) will be developed as two-lane asphalt paved road.

The 30-Year plan should be properly revised and updated depending on the progress of road development and the changes of development policy.

Table 2.2.8 Proposed Road Width and Surface Type for the Future Plan

Future Traffic Volume (vehicle/day)	Proposed Width	Surface Type
Less than 50	12 feet (3.6 meter)	Asphalt Concrete
50 to 200	16 feet (4.8 meter)	
200 to 500	18 feet (5.4 meter)	
500 to 1000	22 feet (6.6 meter)	
1000 t o2500	24 feet (7.2 meter)	
2000 to 5000	48 feet (14.4 meter)	
More than 5000	72 feet (21.6 meter)	

Source: MOC

Table 2.2.9 Road Length and Cost for 30 year Development Plan

Year	Duration	Road Type	Length (Mile)	Type of Work
3	2011-2016	International Highway	5667/0	Upgrading to 24 feet(2 lanes) asphalt pavement road
		Union Highway	4482/5	Upgrading to 12 feet(1 lane) asphalt pavement road
		New Road construction	1052/6	Construction of 12 feet(1 lane) asphalt pavement road
4	2016-2021	Union Highway	2772/1	Upgrading to 12 feet(1 lane) asphalt pavement road
5	2021-2026	International Highway	5970/0	Upgrading to 48 feet(4 lanes) asphalt pavement road
6	2026-2031	Union Highway	3323/5	Upgrading to 24 feet(2 lanes) asphalt pavement road

Source: MOC

[9] There is no technical study results regarding future traffic demand in the 30-Year Long Term Plan

Table 2.2.10 Third Five Year Development Plan (2011-2016)

a-1) Highways of international connection（Upgrading from 12ft to 24ft asphalt pavement road）					
Road Section		Length of road (mile)			Remark
		BOT	MOC	Total	
AH1	Myawaddy-Kawkareik-Hpaan-Thaton-Payagyi-Taungoo	573/6	348/2	922/0	
AH2	Pyinmana-Meikhtila-Mandalay-Monywa-Gangaw -Kalay-Tamu	446/7	498/2	945/1	
AH3	Kengtung-Mongla	—	56/0	56/0	
AH14	Mandalay-Lashio-Theinni-Kutkhaing-Muse road	288/2	—	296/4	8-0 mile (development committee)
AH111	Loilin-Lesha-Pankaytu-Thipaw road	—	149/2	149/2	
AH112	Thahton-Mawlamyine-Yay-Dawei-Myeik-Kawthaung road	219/5	477/5	697/2	
AH112	Laynha-Thai border (Khalonloi)	—	37/4	37/4	
AH123	Dawei- Thai border (Minthamee pass)	—	88/1	88/1	
Triparite	Tamu- Bagan- Myawaddy road	304/2	524/3	828/5	177/5 (AH1)
BIMSTEC	Tamu- Gangaw- Htilin-Mandalay- Meikhtila-Taunggyi -Kengtung- Tachilek road	436/6	539/2	976/0	749/0 (AH1)
GMS	Tachilek- Kengtung-Mongla road	102/2	56/0	158/2	Included in AH2, AH3
GMS	Lashio-Muse road	102/3	—	102/3	Included in AH14
GMS	Kengtung-Loilin-Thipaw- Lashio road	34/4	373/6	408/2	Included in AH2, AH14, AH111
Total		**2508/5**	**3148/3**	**5667/0**	
a-2) Union Highways (Upgrading to 12ft asphalt pavement road)					
No.	Road name	Length of road (mile)			Remark
		BOT	MOC	Total	
1	Yangon-Sittway road	—	302/4	302/4	Magway/Rakhine
2	Shwebo-Myitkyina road	116/1	144/2	260/3	Kachin/Sagaing
3	Shwebo-Sabe Nantha-Kantbalu-Kyunhla road	—	25/0	25/0	Sagaing
4	Myitkyina-Sunprabon-Putao road	—	218/0	218/0	Kachin
5	Monywa-Yagyi-Kalaywa road	40/0	75.5	115.5	Sagaing
6	Thetkaykyin-Phaungpyin-Homalin-Khanti road	—	330/0	330/0	Sagaing
7	Shwebo-Kyaukmyaung road	—	15/4	15/4	Sagaing
8	Letpanhla-Sintku road	5/4	—	5/4	Mandalay
9	Yangon-Mandalay express road	—	366/6	366/6	Bago/ Mandalay/Yangon
10	Mandalay-Takaung-Bamo- Myitkyina road	59/6	115/6	175/4	Kachin/Sagaing/ Mandalay
11	Aungpan-Pinlaung-Moebye-Loikaw road	—	91/4	91/4	Kayah/Shan(south)
12	Taunggoo-Laiktho-Yado-Loikaw-Hopone road	—	208/0	208/0	Kayah/Kayin/Bago /Shan(south)
13	Kalay-Phalam-Haka road	—	115/1	115/1	Chin
14	Pakhukku-Pauk-Kyauk Htu-Mindet road	8/4	89/3	97/7	Chin/Magway
15	Haka-Ganggaw road	—	70/4	70/4	Chin/Magway
16	Hanmyintmo-Myogyi-Ywangan-Aungpan road	—	79/1	79/1	Mandalay /Shan(south)
17	Namsan-Moene-Linkhe-Mongpan-Tahsan-Mongtung-Mongset- Tachileck road	—	251/3	251/3	Shan(east)/ Shan(south)
18	Ayethaya-Nyaungshwe-Mongthauk-Nangpan-Tonghone-Pinlaung road	—	57.4	57.4	Shan(south)
19	Nyaungshwe-Yetsauk-Eintaw-Kyaukgu-Naungcho road	36/0	108/7	144/7	Shan(south) /Shan(north)
20	Teddin-Reid road	—	31/5	31/5	Chin
21	Yayoo-Kalaywa road	—	105/4	105/4	Sagaing
22	Thityakauk-Malun-Minhla road (the approach road of Malun Bridge)	—	20/0	20/0	Magway
23	Naypyitaw-Kintha-Kokwae-Laneli-Pinlaung road	—	66/3	66/3	Mandalay/Shan(South)
24	The approach road of Yadanathienga Bridge (Singu side bank)	—	3/3	3/3	Mandalay

25	Yangon-Kyaukphyu road (Taunggup-Maei-Kyaukphyu road)	—	119/7	119/7	Rakhine/Yangon
26	Hinthada-Sonkone- Myanaung road	—	65/2	65/2	Ayeyawady
27	Kyeinpainse-Setkaw-Danuphu-Zalun road	27/3	—	27/3	Ayeyawady
28	Phapon-Kamamaung road	—	57/4	57/4	Kayin
29	Khamti-Sinthe-Lahe road	—	54/0	54/0	Sagaing
30	Kyauktan-Kawlin-Wingyi-Pinlebu-Phaung Pyin road	—	108/1	108/1	Sagaing
31	Twingne-Moemeik road	—	46/0	46/0	Mandalay/Shan(north)
32	Kentung-Mongkhat-Mongyan road	—	73/0	73/0	Shan(East)
33	Lesha-Mongnaung-Mongshu-Mongkaung-Tanyang-Mongye road	—	113/0	113/0	Shan(South)/South(North)
34	Mongnaung-Mongsan road	—	22/5	22/5	Shan(South)
35	Maubin-Yaykalay-Shwetaunghmaw-Kyaikpi-Mawlmayingkyun road (including 7-mile Kyunhteik-Yondaungkyi-Taungbogyi road)	—	51/6	51/6	Ayeyawady
36	Mawlmayingkyun-Hlaingbon-Thitpoke-Kyunpauk-Pyinsalu road	—	72/3	72/3	Ayeyawady
37	Laputta-Thingankyi- Pyinsalu road	—	35/2	35/2	Ayeyawady
38	Laputta(Kyaukphyalay)-Thonkwa-Oaktwin-Hteiksun road	—	62/3	62/3	Ayeyawady
39	Bokalay-Kyeinchaung-Kadonkani road	—	41/2	41/2	Ayeyawady
40	Bokalay-Setsan-Htawpaing-Amar road	—	38/5	38/5	Ayeyawady
41	Phyapon- Kyunkadon-Dawnyein- Amar road	—	51/5	51/5	Ayeyawady
42	Kyunkadon-Setsan road	—	19/1	19/1	Ayeyawady
43	Pathein-Thaletkwa-Mawtinsyun road	—	96/0	96/0	Ayeyawady
44	Bokalay- Mawlmayingkyun-Kyonemangay –Wakhema-Myaungmya road	—	66/0	66/0	Ayeyawady
45	Kali-Mongsan-Mongshu road	—	68/0	68/0	Shan(South)
46	Namsang-Mansan road	—	33/1	33/1	Shan(North)
47	Kanbalu detour road	—	2/7	2/7	Sagaing
Total		**293/2**	**4189/3**	**4482/5**	

a-3) New Road Construction (Upgrading to 12ft asphalt pavement road)

No	Road Name	Length of road (mile)			Remark
		BOT	MOC	Total	
1	Kyaukse-Pyinoolwin-Moegoke road	—	132/6	132/6	Mandalya/Shan(North)
2	Minhla-Seinkanlant-Myochaung-Phado-Peinzaloke road	—	89/6	89/6	Bago
3	Koebin- Thagara road	—	96/3	96/3	Bago / Magway
4	Katha-Sinkhan road	—	65/0	65/0	Kachin/Sagaing
5	Thilon-Tapaung-Pata-Nabu-Aukbote road	—	54/2	54/2	Kayin
6	Mongpyin-Metmeng road	—	73/0	73/0	Shan(East)
7	Mongpan-Monhta-Monhtaw road	—	65/0	65/0	Shan(East)/Shan(South)
8	Punnakyun-Yathedaung road	—	22/6	22/6	Rakhine
9	Kyauktaw-Platwa road	—	33/5	33/5	Chin/Rakhine
10	Myaypon-Kantha-Kapaing road	—	8/6	8/6	Rakhine
11	Pauktaw-Minbya road	—	20/6	20/6	Rakhine
12	Tale-Pacho-Kyainglet road	—	37/0	37/0	Shan(East)
13	Kyutkhaing-Tamoenye-Monsee-Tapaa road	—	66/0	66/0	Shan(North)
14	Thipaw-Panlon-Namhsan road	—	48/4	48/4	Shan(North)
15	Mentong-Namhsan road	—	37/0	37/0	Shan(North)
16	Pathein-Ngaputaw road	—	21/0	21/0	Ayeyawady
17	Kyunhla-Chatthin-Kawlin road	—	38/0	38/0	Sagaing
18	Sisnow- Yaynanma-Kyaukpon-Kantook road	—	28/0	28/0	Magway
19	Moontaekhun-Kyitaung-Khawma-Naypyitaw ring road	—	22/0	22/0	Mandalay
20	Monywa-Kani-Minkin-Taungtwinchaung road	—	93/2	93/2	Sagaing
Total		—	**1052/6**	**1052/6**	

Source: MOC

Table 2.2.11 Forth Five Year Development Plan (2016-2021)

b-1) Union Highways (Upgrading to 12ft asphalt pavement road)					
No.	Road name	Length of road (mile)			Remark
		BOT	MOC	Total	
1	Hopin-Kontha-Lontong-Nyaungpin road	40/0	―	40/0	Kachin
2	Lawa-Karmine-Longkhin-Phakant road	―	43/0	43/0	Kachin
3	Minbu-Salin-Tanyaung-Seikphyu road	68/4	20/3	88/7	Magway
4	Ywamon-Zeephyukone-Kyaupantaung road	―	21/2	21/2	Magway/Mandalay
5	Mandalay -Moegoke road	73/0	49/0	122/0	Mandalay
6	Bagan-Nyaungoo-Myingyan road	40/2	―	40/2	Mandalay
7	Twantay-Kawhmu-Kungyankon road	27/7	―	27/7	Yangon
8	Kungyankon -Dedaye road	8/0	―	8/0	Yangon
9	Halinthaya-Dala- Twantay road	11/0	―	11/0	Yangon
10	Laputta-Myaungmya-Einme-Kyaungkon-Kyonpyaw road (Laputta-Myaungmya section)	―	46/2	46/2	Ayeyawady
11	Padaung-Taunggup road	102/0	―	102/0	Bago/Rakhine
12	Gangaw-Saingdu-Hanthawady-Netchaung road	―	83/0	83/0	Sagaing/Magway
13	Pyawbway-Ywamon-Natmauk-Kanpya road	―	91/4	91/4	Magway/Mandalay
14	Pakokkhu-Myaing road	―	26/2	26/2	Magway
15	Myitnge-Htonbo-Pyinoolwin road	9/3	―	9/3	Mandalay
16	Paleik-Tadaoo road	―	6/6	6/6	Mandalay
17	Ann-Padekyaw-Maei road	―	41/5	41/5	Rakhine
18	Taunggup-Thandwe road	44/3	―	44/3	Rakhine
19	Phyapon-Bokalay road	―	19/2	19/2	Ayeyawady
20	Mudon-Myawady road	―	59/0	59/0	Kayin /Mon
21	Ngathaingchaung-Gwa road	49/2	―	49/2	Rakhine/ Ayeyawady
22	Putao-Naungkahing-Machanbaw road	―	14/0	14/0	Kachin
23	Entrance road of Khawbude	―	3/6	3/6	Kachin
24	Chebwe-Sawlaw-Makyi-Welton road	―	90/0	90/0	Kachin
25	Phasaung-Maesenan-Nanman road	―	40/0	40/0	Kayah
26	Thanphuzayat-Phayathonzu road	―	64/5	64/5	Kayin/Mon
27	Haka-Htantalan-Sasichauk road	―	65/2	65/2	Chin
28	Katha-Inndaw-Mansi road	12/0	59/6	71/6	Sagaing
29	Htamathi-Leishi road	―	41/0	41/0	Sagaing
30	Seikphyu-Saw-Kanpalet road	―	85/6	85/6	Chin/Magway
31	Meikhtila-Mahlaing-Taungtha road	40/4	―	40/4	Mandalay
32	Maei-Peinnetaung-Yanbye road	―	9/3	9/3	Rakhine
33	Kanbae-Pyawbwelay-Dala road	9/0	―	9/0	Yangon
34	Mongset-Mongpuoan-Mongpyin road	―	89/0	89/0	Shan(East)
35	Maehan-Mongyay-Kaythee road	―	92/0	92/0	Shan(South)/Shan(North)
36	Theinni-Kunlon-Hopan-Mongmaw road	―	85/3	85/3	Shan(North)
37	Myitkyina-Pansauk-Lido road	228/0	―	228/0	Kachin/Sagaing
38	Waingmaw-Sadon-Kanpaiktee road	77/0	―	77/0	Kachin
39	Machanbaw-Pharukha-Naungmoon road	―	64/0	64/0	Kachin
40	Yapbaw- Ngalondan-Khaunglanphu road	―	65/4	65/4	Kachin
41	Manmin-Chibwe-Lawchaung-Htawgaw-Phimaw road	―	123/0	123/0	Kachin
42	Loikaw-Ponchaung-Shataw-Tatamaw road	―	49/7	49/7	Kayah
43	Bawlache-Ywathit-Swetpaing road	―	27/3	27/3	Kayah
44	Kawkayeaik-Metharaw-Kokekwa road (Metharaw-Kokekwa section)	―	14/2	14/2	Kayin
45	Haka-Matupi road	―	172/7	172/7	Chin
46	Teddin-Tunzan-Kyikha road	―	80/0	80/0	Chin
47	Myingyan-Myittha-Yaywun road	53/7	―	53/7	Mandalay
48	Twantay detour	3/6	―	3/6	Yangon
49	Twantay-Maubin road	―	30/1	30/1	Ayeyawady/Yangon
Total		**898/0**	**1874/1**	**2772/1**	

Source: MOC

Table 2.2.12 Fifth Five Year Development Plan (2021-2026)

c-1) Highways of international connection（Upgrading from 24ft to 48ft asphalt pavement road）					
Road Section		Length of road (mile)			Remark
		BOT	MOC	Total	
AH1	Myawaddy-Kawkareik-Hpaan-Thaton-Payagyi-Taungoo	573/6	348/2	922/0	
AH2	Pyinmana-Meikhtila-Mandalay-Monywa-Gangaw -Kalay-Tamu	446/7	498/2	945/1	
AH3	Kengtung-Mongla	—	56/0	56/0	
AH14	Mandalay-Lashio-Theinni-Kutkhaing-Muse road	288/2	—	296/4	8-0 mile (development committee)
AH111	Loilin-Lesha-Pankaytu-Thipaw road	—	149/2	149/2	
AH112	Thahton-Mawlamyine-Yay-Dawei-Myeik-Kawthaung road	219/5	477/5	697/2	
AH112	Laynha-Thai border (Khalonloi)	—	37/4	37/4	
AH123	Dawei- Thai border (Minthamee pass)	—	88/1	88/1	
Lido road	Kanpaiktee-Sadon-Waimaw-Myitkyina-Pansauk-Lido road	305/0	—	305/0	
Triparite	Tamu- Bagan- Myawaddy road	304/2	524/3	828/5	177/5 (AH1)
BIMSTEC	Tamu- Gangaw- Htilin-Mandalay- Meikhtila-Taunggyi -Kengtung- Tachilek road	436/6	539/2	976/0	749/0 (AH1)
GMS	Tachilek- Kengtung-Mongla road	102/2	56/0	158/2	Included in AH2, AH3
GMS	Lashio-Muse road	102/3	—	102/3	Included in AH14
GMS	Kengtung-Loilin-Thipaw- Lashio road	34/4	373/6	408/2	Included in AH2, AH14, AH111
Total		**2813/5**	**3148/3**	**5970/0**	

Source: MOC

Table 2.2.13 Sixth Five Year Development Plan (2026-2031)

d-1) Union Highways (Upgrading to 24ft asphalt pavement road)					
No.	Road name	Length of road (mile)			Remark
		BOT	MOC	Total	
1	Yangon-Sittway road	—	302/4	302/4	Magway/Rakhine
2	Shwebo-Myitkyina road	116/1	144/2	260/3	Kachin/Sagaing
3	Monywa-Yagyi-Kalaywa road	40/0	75.5	115.5	Sagaing
4	Shwebo-Kyaukmyaung road	—	15/4	15/4	Sagaing
5	Letpanhla-Sintku road	5/4	—	5/4	Mandalay
6					
7	Mandalay-Takaung-Bamo- Myitkyina road	59/6	115/6	175/4	Kachin/Sagaing/ Mandalay
8	Aungpan-Pinlaung-Moebye-Loikaw road	—	91/4	91/4	Kayah/Shan(south)
9	Kalay-Phalam-Haka road	—	115/1	115/1	Chin
10					
11	Hanmyintmo-Myogyi-Ywangan-Aungpan road	—	79/1	79/1	Mandalay /Shan(south)
12	Namsan-Moene-Linkhe-Mongpan-Tahsan-Mongtung-Mongset- Tachileck road	—	251/3	251/3	Shan(east)/ Shan(south)
13	Ayethaya-Nyaungshwe-Mongthauk-Nangpan-Tonghone-Pinlaung road	—	57.4	57.4	Shan(south)
14	Nyaungshwe-Yetsauk-Eintaw-Kyaukgu-Naungcho road	36/0	108/7	144/7	Shan(south) /Shan(north)
15	Theinni-Kunlon-Chinshwehaw road	66/0	—	66/0	Shan(North)
16	Tapa-Tashehtan-Lukkaing road	—	12/0	12/0	Shan(North)
17	Mandalay-Moegoke-Moemeik-Mabein-Sioo road (Konwut- Sioo section)	—	88/6	88/6	Shan(North)
18	Mandalay-Lashio-Bamo- Myitkyina road	415/5	63/5	479/2	Kachin/Mandalay/ Shan(North)
19	Monywa-Ayataw-Shwebo shortcut road	—	44/0	44/0	Sagaing
20	Koepin-Sanmagyi-Thityakauk road	19/3	—	19/3	Magway
21	Thityakauk- =Malun-Minhla road (Malun bridge approach road)	—	20/0	20/0	Magway

22	Naypyitaw-Kintha-Kokwae-Laneli-Pinlaung road	—	66/3	66/3	Mandalay/Shan(South)
23	Letpanhla-Sinkuu	5/4	—	5/4	Mandalay
24	The approach road of Yadanathienga Bridge (Singu side bank)	—	3/3	3/3	Mandalay
25	Thandwe-Gwa road	—	83/0	83/0	Rakhine
26	Yangon-Kyaukphyu road (Taunggup-Maei-Kyaukphyu road)	—	119/7	119/7	Rakhine/Yangon
27	Aungpan-Pindaya-Yetsauk road	—	56/0	56/0	Shan(South)
28	Hinthada-Sonkon-Myanaung road	—	65/2	65/2	Ayeyawady
29	Kyeinpainse-Setkaw-Danuphu-Zalun road	27/3	—	27/3	Ayeyawady
30	Taunggoo-Laiktho-Yado-Loikaw-Hopone road	—	208/0	208/0	Kayah/Kayin/Bago /Shan(South)
31	Yayoo-Kalawa road	—	105/4	105/4	Sagaing
Total		**791/2**	**2532/3**	**3323/5**	

Source: MOC

2) Priority Projects Presented by MOC

MOC proposes the priority projects in terms of road construction, bridge construction and bridge rehabilitation for inviting domestic and international investment. The priority projects which were proposed in the international donor meeting held in January 2013 is introduced in this part.

(1) Priority Road Projects

MOC proposes seven road projects which are highly required for rehabilitation or new construction as necessary improvements of the road network. The proposed roads have similar features; narrow road width and bituminous treated surfaces. The priority projects were concentrated mostly in the suburban areas of the country and it seems that they have been determined without technical assessment. Upgrading of the two lane road network to consistent standards is a key aim of the national road system in light of the current road development policy.

(2) Priority Bridge Projects

Similar to the road projects, MOC announced a short list which nominates some bridge projects to place a request for technical and financial assistance from international donors. The proposed bridges were selected to improve the accessibility in the transport network or replace those obsolete bridges which exceed the design period and have serious damage. First priority has been given to Hinthada Bridge, which will be a major crossing over the Ayeyarwady River and will function as a focus for intersecting roads along the Ayeyarwady River.

(3) Priority Bridge Rehabilitation Projects

A total of twenty existing bridges are proposed to be urgently rehabilitated to secure a reliable road network. The bridges proposed for rehabilitation are at risk of degradation due to damage on the piers, abutments, decks and cables. The cause of damage is the age, the poor construction skill and damage by sea water. Fourteen of the twenty bridges are located in Rakhine State and are mainly damaged by sea water.

Table 2.2.14 Priority Road Projects

	Road Section	Length (km)	Width of Paved Road (km)			Unpaved Road	Region/State
			12‘	22‘	24‘		
1	Shwebo-Myitkyina	476	406	3	6	61	Kachin / Sagaing
2	Thanphyuzayat-Ye-Dawei-Myeik-Kawtaung	934	559	111	21	243	Mon / Tanintharyi
3	Meiktila-Taunggyi-Loilem-Kengtung	677	439	82	156	..	Mandalay / Shan(S) / Shan(N)
4	Minbu-Ann-Sittwe	477	367	5	6	99	Magway / Rakhine
5	Monywa-Pale-Gangaw-Kalaymyo	311	262	8.5	3	37.5	Sagaing / Magway
6	Mandalay-Thabeikkyin-Tagaung-Bhamo	282	13	13	..	56	Kachin / Sagaing / Mandalay
7	Monywa-Yargyi-Kalewa	186	186				Sagaing

Source: MOC

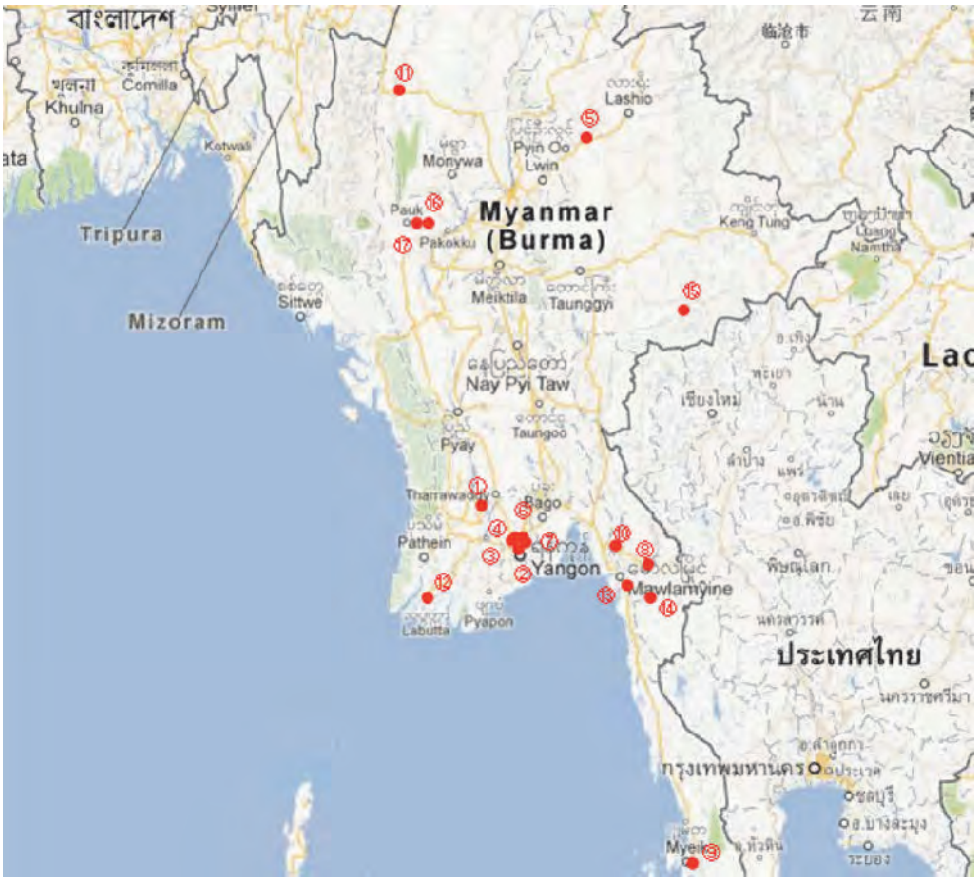
Source: JICA Survey Team

Figure 2.2.9 Locations of Priority Road Projects

Table 2.2.15 Priority Bridge Projects

	Name of project	State / Region	Project Type	Length (m)
1	Hinthada Bridge	Ayeyarwaddy	New construction	3620
2	Dala Bridge	Yangon	New construction	1210
3	Hlaing River Bridge	Yangon	New construction	1200
4	Bayinanung Bridge No.2	Yangon	New construction	1200
5	New Goat twin Viaduct	North Shan	New construction	910
6	Wataya Bridge	Yangon	New construction	500
7	New Thakata Bridge	Yangon	Replacement	190
8	Gyaing (Kawkareik) Bridge	Kayin	Replacement	450
9	Tha Mouk Bridge	Tanintharyi	New construction	350
10	Don Tha Mi Bridge	Mon	Replacement	215
11	Chindwin (Kawlaywa) Bridge	Sagaing	New construction	600
12	Thetkal Thoung Bridge	Ayeyarwaddy	New construction	760
13	Thanlwin (Chaungsone) Bridge	Mon	New construction	600
14	Chaungnitkwa Bridge	Mon	New construction	360
15	Thanlwin (Tarsotpha) Bridge	Kachin	New construction	305
16	Yaw Chaung (Yepyar) Bridge	Magway	Replacement	1000
17	Yaw Chaung (Ohn Taw) Bridge	Magway	Replacement	760

Source : MOC



Source: JICA Survey Team

Figure 2.2.10 Locations of Priority Bridge Projects

Table 2.2.16 Priority Bridge Rehabilitation Projects

	Bridge name	State/Region	Bridge type	Length (m)
1	Maubin	Ayeyarweddy	Steel truss	709
2	Balaminhtin	Kachin	Steel truss	806
3	Twantay	Yangon	steel suspension	1071
4	Pathein	Ayeyarweddy	steel suspension	633
5	Myaungmya	Ayeyarweddy	Suspension	381
6	Gyaing (Zarthapyin)	Mon	Suspension	870
7	Atran	Mon	Cable-stayed	426
8	Maei	Rakhine	RC	282
9	Kyaukkyipauk	Rakhine	Steel truss	90
10	Snarepauk	Rakhine	Steel truss	237
11	Lonetawpauk	Rakhine	Steel truss	347
12	Dedokepauk	Rakhine	Steel truss	178
13	Tanthamagyi	Rakhine	Steel truss	166
14	Thanthamachay	Rakhine	Steel truss	180
15	Thazintanpauk	Rakhine	Steel truss	178
16	Wanphite	Rakhine	Steel truss	248
17	Minkyaung	Rakhine	Steel truss	811
18	Yanmaung	Rakhine	Bailey	390
19	Kisspanaddy	Rakhine	Steel truss	754
20	Minchaung	Rakhine	Steel truss	601

Source: MOC

Source: JICA Survey Team

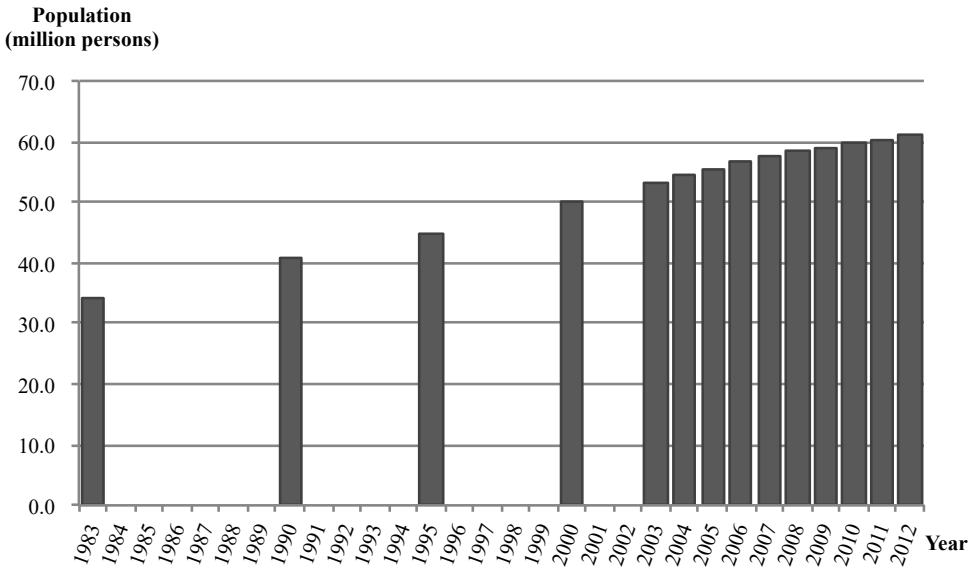
Figure 2.2.11 Locations of Priority Bridge Rehabilitation Projects

2.3 Socio-economic Condition

2.3.1 Population and GDP

(1) National Socio-economic Development

A nation-wide census, "Myanmar Census 2014" was conducted for the first time in 30 years, between 30 March and 10 April. The provisional results of the census were published by the Ministry of Immigration and Population, Republic of the Union of Myanmar on 30 August 2014. The total population counted was 51.41 million people, which was about 10 million people less than the population conventionally estimated by international organizations. (The population in Myanmar had been estimated at around to be 61 million to 64 million by the International Monetary Fund (IMF) and the Asian Development Bank (ADB).) The final results of the census, including the distribution of population by religions, electrification rate and diffusion of consumer durables etc., was set to be published in May 2015.



Source: Myanmar Data CD-ROM 2010 and 2011 issued by Ministry of Planning and Finance

Figure 2.3.1 National Population of Myanmar 1983–2012

Figure 2.3.1 shows the national population of Myanmar estimated between 1983 and 2012. In 1983, the national population accounted for 34.13 million. After that, national population was estimated year by year. In 2012, the national population was estimated at 60.98 million.

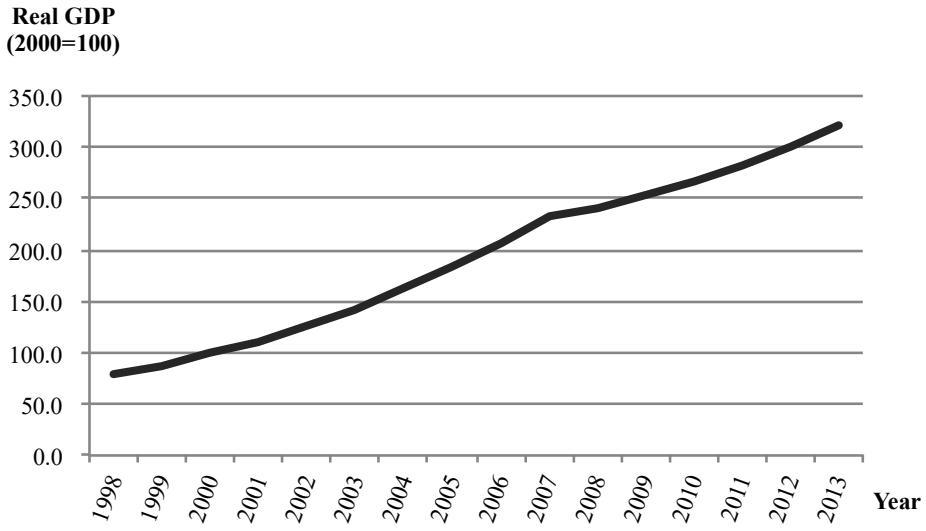
Table 2.3.1 shows area and population changes of each region and state in 2011 and 2012. The Study Area (Kyain State, Mon State and Tanintharyi Region) occupies 13% in terms of area and 11% of in terms of population. The population density of the Study Area was 79.1 persons/km^2, which is lower than the national average of 90.1 persons/km^2.

Table 2.3.1 Population by Regions and States in 2011 and 2012

Region/State	Area (km^2)	Population (1000 persons)	
		2011	2012
Kachin State	89,042	1,598	1,616
Kayah State	11,732	360	365
Kayin State	30,383	1,836	1,855
Chin State	36,019	563	571
Sagaing Region	93,702	6,598	6,654
Tanintharyi Region	43,345	1,734	1,755
Bago Region	39,404	6,067	6,125
Magway Region	44,821	5,677	5,730
Mandalay Region	30,888	8,124	7,423
Mon State	12,297	3,165	3,193
Rakhine State	36,778	3,339	3,370
Yangon Region	10,277	7,097	7,170
Shan State	155,801	5,720	5,779
Ayeyarwaddy Region	35,032	7,353	8,205
Naypyitaw Council Territory	7,057	1,153	1,164
Total	676,577	60,384	60,976

Source: Area data was obtained from Ministry of National Planning and Economic Development (MNPED); Population data was obtained from the Population Department, Ministry of Immigration and Population.

Economic data in Myanmar is even more inaccurate than population data. For example, GDP growth rate recorded more than 10% in 2000s, according to the government data. Real GDP measured with local currency has tripled in fifteen years, according to the World Economic Outlook Database (Figure 2.3.2). According to recent economic consultation reports by IMF, the accurate GDP growth rate was around 5% in the 2000s[10], and the growth rates in recent years were 5.1% in 2009/10, 5.3% in 2010/11 and 5.9% in 2011/12[11].



Source: World Economic Outlook Database October 2013, IMF

Figure 2.3.2 Development of Real GDP from 1998 to 2013

Table 2.3.2 shows Gross Regional Domestic Product (GRDP) by state and region in 2011 and 2012. The 2011 data was presented by an official of MNPED at the 2nd workshop of Myanmar Comprehensive Development Vision (MCDV) in January 2013, and the 2012 data was estimated by the JICA Survey Team on "The Survey Program for The National Transport Development Plan."

[10] Figure 2 of Myanmar: Staff-Monitored Program (IMF Country Report No. 13/13), IMF, January 2013
[11] 2013 Article Iv Consultation And First Review Under The Staff-Monitored Program (IMF Country Report No. 13/250), IMF, August 2013

The proportion of GRDP in the Study Area was 9.7%. The Yangon Region (21.9%), Sagaing Region (11.7%), Ayeyarwaddy Region (11.6%) and Mandalay Region (11.1%) occupy a larger share but the percentages of Mon State (4.4%), Tanintharyi Region (3.6%) and Kayin State (1.8%) are smaller.

Table 2.3.2 GRDP in 2011 and 2012

Unit: 10^9 Kyat

Regions/State	2011	2012
Kachin State	987	1,097
Kayah State	155	172
Kayin State	746	829
Chin State	139	154
Sagaing Region	4,958	5,508
Tanintharyi Region	1,511	1,679
Bago Region	3,625	4,027
Magway Region	4,168	4,631
Mandalay Region	4,668	5,186
Mon State	1,857	2,063
Rakhine State	1,671	1,856
Yangon Region	9,266	10,294
Shan State	3,036	3,373
Ayeyarwaddy Region	4,919	5,465
Naypyitaw Council Territory	523	581
Total	**42,229**	**46,915**

Source: Figures of 2011 were presented by Department of Planning, MNPED in the 2nd Workshop of MCDV dated 28th of January 2013. 2012 Figures estimated by JICA Survey Team on "The Survey Program for The National Transport Development Plan"

(2) Socio-economic development of the Study Area

Table 2.3.3 shows the total population and urban population[12] of the Study Srea in 2012. Mawlamyine District and Thaton District of Mon State occupy 29% and 18% of GRDP in the Study Area, respectively. Mawlamyine District also occupies 40% of the urban population in the Study Area.

The percentage of urban population to the total population in Mawlamyine District was 44%. Kawthoung District (46%) and Myeik District (36%) of the Tanintharyi Region, and Myawaddy District (34%) also have high percentages of urban population, but the size of the total population is limited in these districts.

Table 2.3.3 Total Population and Urban Population by District in 2012

Unit: 1000 persons

District	Total population	Urban population
Kayin State	**1,855**	**376**
Hpa-An (South)	916	195
Hpa-An (North)	113	12
Myawaddy	64	22
Kawkareik	595	129
Hpapun	167	18
Mon State	**3,193**	**1,205**
Mawlamyine	1,942	862
Thaton	1,251	343
Tanintharyi Region	**1,756**	**595**
Dawei	811	242
Myeik	790	282
Kawthoung	155	71

Source: Population Department, Ministry of Immigration and Population. Urban Population is estimated by JICA Survey Team in "The Survey Program for The National Transport Development Plan."

[12] "Urban" and "rural" is defined by the General Administration Department (GAD), Ministry of Home Affairs. GAD classifies township, which is an administrative unit under district, into urban and rural.

Table 2.3.4 shows GRDP and GRDP per capita by district in 2012. Mawlamyine (1,258 billion Kyat) had the highest GRDP by far in the Study Area. Thaton District (805 billion Kyat), and Dawei District (781 billion Kyat) and Myeik District of Tanintharyi Region are ranked 2nd, 3rd and 4th, respectively.

However, Mawlamyine District is ranked first in terms of GRDP per capita. GRDP per capita of the districts of the Tanintharyi Region accounted for around 950,000 Kyat, the highest level in the Study Area. The amount in Mawlamyine District and Thaton District were around 650,000 Kyat, and districts in Kayin State recorded district numbers between 380,000 and 450,000 Kyat, excluding the Myawaddy District.

Table 2.3.4 GRDP and GRDP per Capita by Districts in 2012

District	GRDP (10^9 Kyat)	GRDP per Capita (Kyat)
Kayin State	**829**	**446,900**
Hpa-An (South)	431	470,524
Hpa-An (North)	50	442,478
Myawaddy	41	640,625
Kawkareik	224	376,471
Hpapun	83	497,006
Mon State	**2,063**	**646,101**
Mawlamyine	1,258	647,786
Thaton	805	643,485
Tanintharyi Region	**1,679**	**956,150**
Dawei	781	963,009
Myeik	755	955,696
Kawthoung	143	922,581

Source: Estimation by JICA Survey Team on "The Survey Program for The National Transport Development Plan

2.3.2 Industrial Composition, Trade and FDI

(1) Industrial Composition

Table 2.3.5 shows the industrial composition of Myanmar and its regions/states. Proportions of the primary (agriculture and mining), secondary (manufacturing and construction, etc.) and tertiary (services) sectors are 35%, 27% and 38%, respectively. Percentages in Kayin State are 40%, 21% and 38%, in Mon State, 39%, 24% and 37%, and in Tanintharyi Region, 59%, 14% and 27%. Percentages of the secondary sector in the Study Area are lower than the national average by 3-13%; on the other hand, percentages of the primary sector are higher than the national average by 4- 24%. In particular, the share of the primary sector in Tanintharyi Region is estimated at 59%. Such estimation comes from commercially based agriculture, such as palm oil, natural rubber, etc.

Table 2.3.5 Industrial Composition by Regions/States in 2011

Region/State	Primary	Secondary	Tertiary	GRDP
Kachin State	434	215	338	987
Kayah State	76	25	54	155
Kayin State	301	159	286	746
Chin State	80	16	43	139
Sagaing Region	2,370	1,251	1,337	4,958
Tanintharyi Region	890	208	413	1,511
Bago Region	1,462	812	1,351	3,625
Magway Region	2,067	938	1,163	4,168
Mandalay Region	1,282	1,332	2,054	4,668
Mon State	724	447	686	1,857
Rakhine State	503	359	809	1,671
Yangon Region	680	4,378	4,207	9,266
Shan State	1,297	676	1,063	3,036
Ayeyarwaddy Region	2,408	636	1,875	4,919
Naypyitaw Council Territory	154	137	232	523
Total	**14,728**	**11,589**	**15,911**	**42,229**

Source: Presentation of Department of Planning, MNPED in the 2nd Workshop of MCDV dated 28th of January 2013

(2) Trade

According to UN ComTrade, Myanmar's exported merchandise was valued at 6,048 million USD in 2010/11. 47% of which (2,814 million USD) was exported to Thailand. Table 2.3.7 shows total export volume to Thailand and export volume at major national border crossing points (Mae Sot, Three Pagodas and Mae Sai) with Thailand. Mae Sot and Three Pagodas are along the target routes. Mae Sot is major route for almost all export goods excluding "Petroleum, Oil and Gas" and "Coal, Ore, Stone and Sand." The Three Pagoda Pass is a route for transporting "Petroleum, Oil and Gas" by pipeline.

Table 2.3.6 Major Partners of Merchandise Export for Myanmar in 2010/11

Major Partners	Export amount (USD million)	Share (%)
Thailand	2,814	42.7
India	1,122	17.0
China	966	14.7
Japan	386	5.9
Malaysia	229	3.5
Korea	160	2.4
Vietnam	103	1.6
Singapore	82	1.3
World	6,582	100.0

Note: Export amounts above are reported from trade partners.
Source: UN ComTrade

Table 2.3.7 Export Volume with Thailand in 2010/11

Export items (HS 2 digit)	Total Export Volume to Thailand		Mae Sot		Three Pagodas		Mae Sai	
	Volume (ton)	Share (%)	Volume (ton)	Share (%)	Volume (ton)	Share (%)	Volume (ton)	Share (%)
Live Animal & Animal Products	5,688	100.0	4,949	87.0	498	8.8	241	4.2
Fish and Aquatic Products	134,189	100.0	3,577	2.7	1	0.0	0	0.0
Vegetable and Fruits	43,646	100.0	23,183	53.1	23	0.1	5,420	12.4
Grain and Grain Products	945	100.0	24	2.5	0	0.0	21	2.2
Other Agricultural Products	11,064	100.0	3,930	35.5	2,623	23.7	1,341	12.1
Foodstuff, Beverage and Animal Food	4,784	100.0	0	0.0	0	0.0	0	0.0
Petroleum, Oil and Gas	8,899,324	100.0	0	0.0	8,899,324	100.0	0	0.0
Coal, Ore, Stone and Sand	66,618	100.0	2,784	4.2	1,200	1.8	59,555	89.4
Cement, Construction Material (incl. steel frame)	2	100.0	2	100.0	0	0.0	0	0.0
Fertilizer (incl. Urea)	1,428	100.0	1,419	99.4	9	0.6	0	0.0
Garment, Textiles and fabric	2,554	100.0	56	2.2	103	4.0	46	1.8
Wood and Wood Products	135,753	100.0	52,315	38.5	9,030	6.7	4,956	3.7
Paper and Printed Matter	1,993	100.0	0	0.0	0	0.0	179	9.0
Metal and Metal Products (excl. construction material)	3,147	100.0	344	10.9	0	0.0	159	5.1
Industrial Material, Chemicals	687	100.0	17	2.5	2	0.3	7	1.0
Household articles, miscellaneous	3,733	100.0	3,599	96.4	133	3.6	1	0.0
Machinery and Parts, Transportation	409	100.0	73	17.8	193	47.2	143	35.0

Note: Export of natural gas (Petroleum, Oil and Gas) is excluded in calculation of shares.
Source: Total export volume is from UN ComTrade. Export volumes at 3 national borders are from Thai Customs web site.

In the same year, Myanmar's merchandise import value was 8,982 million USD. China was the largest import partner at 39% (3,476 million USD) followed by Thailand at 23% (2,072 million USD). Table 2.3.9 shows the total import volume to Thailand at major national border points (Mae Sot, Three Pagodas and Mae Sai) with Thailand. Mae Sot seems to be a major import as well as export route in terms of land transport, but the proportion of other transport routes, such as sea transport, seems to be larger than export.

Table 2.3.8 Major Partners of Merchandise Import for Myanmar in 2010/11

Major Partners	Import amount (USD million)	Share (%)
China	3,476	38.4
Thailand	2,073	22.9
Singapore	1,159	12.8
Korea	479	5.3
Japan	262	2.9
Malaysia	370	4.1
Indonesia	284	3.1
India	273	3.0
World	9,040	100.0

Note: Export amounts above are reported from trade partners.
Source: UN ComTrade

Table 2.3.9 Import Volume with Thailand in 2010/11

Import items (HS 2 digit)	Total Export Volume to Thailand		Mae Sot		Three Pagodas		Mae Sai	
	Volume (ton)	Share (%)	Volume (ton)	Share (%)	Volume (ton)	Share (%)	Volume (ton)	Share (%)
Live Animal & Animal Products	11,716	100.0	2,808	0.5	3,999	8.6	870	0.3
Fish and Aquatic Products	830	100.0	698	0.1	3	0.0	86	0.0
Vegetable and Fruits	18,253	100.0	5,398	0.9	36	0.1	3,779	1.2
Grain and Grain Products	5,602	100.0	1,510	0.2	1,164	2.5	162	0.1
Other Agricultural Products	1,773	100.0	1,462	0.2	1	0.0	310	0.1
Foodstuff, Beverage and Animal Food	328,124	100.0	133,609	21.6	25,644	55.1	50,432	16.6
Petroleum, Oil and Gas	337,285	100.0	90,080	14.6	4,539	9.8	43,917	14.4
Coal, Ore, Stone and Sand	63,681	100.0	4,013	0.6	64	0.1	11,575	3.8
Cement, Construction Material (incl. steel frame)	2,729,441	100.0	192,030	31.1	3,976	8.5	152,721	50.1
Fertilizer (incl. Urea)	21,556	100.0	601	0.1	0	0.0	308	0.1
Garment, Textiles and fabric	31,213	100.0	23,195	3.8	188	0.4	3,266	1.1
Wood and Wood Products	3,647	100.0	877	0.1	0	0.0	735	0.2
Paper and Printed Matter	14,573	100.0	4,514	0.7	4	0.0	69	0.0
Metal and Metal Products (excl. construction material)	125,074	100.0	56,666	9.2	191	0.4	13,923	4.6
Industrial Material, Chemicals	191,469	100.0	53,346	8.6	4,900	10.5	12,804	4.2
Household articles, miscellaneous	23,394	100.0	16,455	2.7	482	1.0	2,427	0.8
Machinery and Parts, Transportation	39,267	100.0	30,750	5.0	1,353	2.9	7,164	2.4

Source: Total import volume is from UN ComTrade. Import volumes at 3 national borders are from Thai Customs.

(3) Foreign Direct Investment

Most foreign direct investment (FDI) projects during the 2000s were by China and Thailand in the power and oil gas sectors. However, FDI approval trends have been changing in Myanmar since 2012/13. FDI in manufacturing, hotel, tourism and real estate sectors have been increasing. Table 2.2.10 shows such changes. The average permitted investment amount is almost the same in the agriculture sector, but the figures increase in manufacturing (17M USD to 1,310M USD), hotel and tourism (3M USD to 351M USD) and real estate (zero to 148M USD). On the other hand, the figures dropped in mining (208M USD to 11M USD), power (1,716M USD to 222M USD) and oil and gas (1,064 M USD to 155M USD).

Table 2.3.10 Changes of Average Permitted Investment Amount

Unit: USD million

Sectors	Average Permitted Investment Amount from 2001/02 to 2011/12	Average Permitted Investment Amount from 2012/13 to 2013/14
Agriculture	13	13
Livestock & Fisheries	4	18
Mining	208	11
Manufacturing	17	1,310
Power	1,716	222
Oil and Gas	1,064	155
Construction	0	0
Transport & Communication	3	0
Hotel and Tourism	3	351
Real Estate	0	148
Industrial Estate	0	0
Other Services	0	10
Total	3,028	2,238

Note: Permitted investment amount in 2013/14 is estimated from an achievement until October.
Source: Department of Investment and Company Administration (DICA)

Out of these changes, the most remarkable is investment in the manufacturing sector. Almost all investment in the manufacturing sector in 2012/13 has been garment contract manufacturing[13]. Major partners include China, Hong Kong, Japan and the Republic of Korea.

According to "Foreign Direct Investment Companies in Myanmar," compiled by an economic research company in Myanmar, sixteen active FDI projects are identified in the Study Area as of April 2012. Table 2.3.11 shows a list of active projects. Out of sixteen projects, fourteen are located in the Tanintharyi Region, and the major sectors are hotel and tourism, livestock & fisheries and oil & gas.

[13] In Myanmar, contract manufacturing is called CMP (cutting-making-packaging). Companies that conduct CMP business receive exemptions from import tax for materials, if the company receives CMP permission from the Myanmar Investment Commission.

Table 2.3.11 Active FDI Project in the Study Area

Name of FDI Project	Origin Country	Sector	FDI Amount	Location
Myanmar Basin Island Resort Co Ltd (Suvana Bumi Hotel)	Malaysia	Hotel and Tourism	44.00 million USD	Tanintharyi Region
Pearl Laguna Resort Hotel Group	Thailand	Hotel and Tourism	1.5 million USD	Tanintharyi Region
St. Luke's Island Co Ltd	Thailand	Hotel and Tourism	3.50 million dollar	Tanintharyi Region
Victoria Entertainment Resort Club Ltd	Singapore	Hotel and Tourism	40.53 million USD	Tanintharyi Region
The Hutgyi Dam Project	China, Thailand	Hydro Power	1 billion USD (281.22 million USD Sinohydro share)	Kayin State
A.S.K Andaman Ltd (Myanmar)	Malaysia	Livestock & Fisheries	18.25 million USD	Tanintharyi Region
Myanmar Aquamargue Ltd (France Company)	Singapore	Livestock & Fisheries	6.1 million USD	Tanintharyi Region
Myanmar Atlantic Co Ltd	Australia	Livestock & Fisheries	5.82 million USD	Tanintharyi Region
Myanmar Fisheries Int'l Joint Venture Ltd	UK	Livestock & Fisheries	10.00 million USD	Tanintharyi Region
Myanmar Tasaki Co Ltd	Japan	Livestock & Fisheries	8.01 million USD	Tanintharyi Region
Italian-Thai International Co Ltd	Thailand	Manufacturing	521.00 million USD	Kayin State
Emerald Ray Company	Thailand	Mining		Tanintharyi Region
Dataran Isibumi Sdn Bhd (Malaysia)	Malaysia	Oil and Gas	61.80 million USD	Tanintharyi Region
Petronas Carigali Myanmar (Hong Kong) Ltd ·	Malaysia	Oil and Gas	342.5 million US4 ($44 million for the first phase)	Tanintharyi Region
PTT Exploration and Production Public Co Ltd	Thailand	Oil and Gas	22.0 million USD for Block M-7, M-11	Tanintharyi Region
Roundhay Ltd	Malaysia	Oil and Gas	3.17 million USD	Tanintharyi Region

Source: Foreign Direct Investment Companies in Myanmar, Myanmar Survey Research, 2010

The Industrial Estate at Hpa-An, which is developed by the Kyain State government was transferred to UHM Co., Ltd. The company constructed a factory for garment manufacturing and products are exported to Japan. The investments are classified as domestic investment, but the company's activities are strongly related with foreign companies.

2.3.3 Social Profile

(1) Monthly Household Expenditure

Table 2.3.12 shows monthly household expenditure by region/state surveyed in the "Household Income and Expenditure Survey 2006." In comparison with the national average monthly household expenditure (97,700 Kyat), Tanintharyi Region (1.44) and Kayin State (1.20) recorded higher total monthly expenditures. The total monthly expenditure of Mon State was 97% of the national average.

The national average of the percentage of food expenditure to the total expenditure was 70.8%. The Tanintharyi Region (66.1%) is lower than the national average, and the percentages of Kayin State (73.7%) and Mon State (73.5%) are higher than the national average.

Table 2.3.12 Monthly Household Expenditure by Regions/States in 2006

Unit: Kyat

Region/ State	Food	Non-food	Total
National Average	69,171	28,529	97,700
Kachin	78,920	36,594	115,513
Kayah	55,049	25,555	80,603
Kayin	86,194	30,798	116,993
Chin	54,578	20,273	74,851
Sagaing	71,648	26,919	98,566
Tanintharyi	92,914	47,675	140,589
Bago (East)	68,813	27,623	96,436
Bago (West)	57,770	23,492	81,261
Magway	64,354	25,151	89,505
Mandalay	70,442	29,446	99,888
Mon	69,963	25,186	95,150

Region/ State	Food	Non-food	Total
Rakhine	72,805	26,799	99,605
Yangon	75,199	36,836	112,034
Shan (South)	72,367	31,885	104,252
Shan (North)	70,572	28,863	99,434
Shan (East)	75,073	41,936	117,009
Ayeyarwady	56,125	20,882	77,007

Source: Central Statistical Office (CSO)

(2) Poverty Incidence in "Integrated Household Living Condition Survey"

MNPED conducted the "Integrated Household Living Condition Survey" in cooperation with UNDP and Sida in 2005 and 2010, investigating items such as situation of poverty, demographic characteristics, the labour market, housing conditions and health and nutrition status.

18,660 households across all regions were selected though multiple-stage random sampling in the 2005 survey, and 343,130 households from 45 townships were selected in the 2010 survey.

The sampling households were divided into four groups by household income, and a "poor" reference group was selected, which was the second quartile (25%) of the consumption distribution, i.e. the bottom 25-50%. The poverty line was defined as the simple average consumption amount for the second quartile. Therefore, the poverty line in this survey is not absolute poverty but relative poverty. The poverty line per adult per year was set at 162,136 Kyat in the 2005 survey and 376,151 Kyat in the 2010 survey, and those people whose consumption amount is under these figures are defined as poor in this survey.

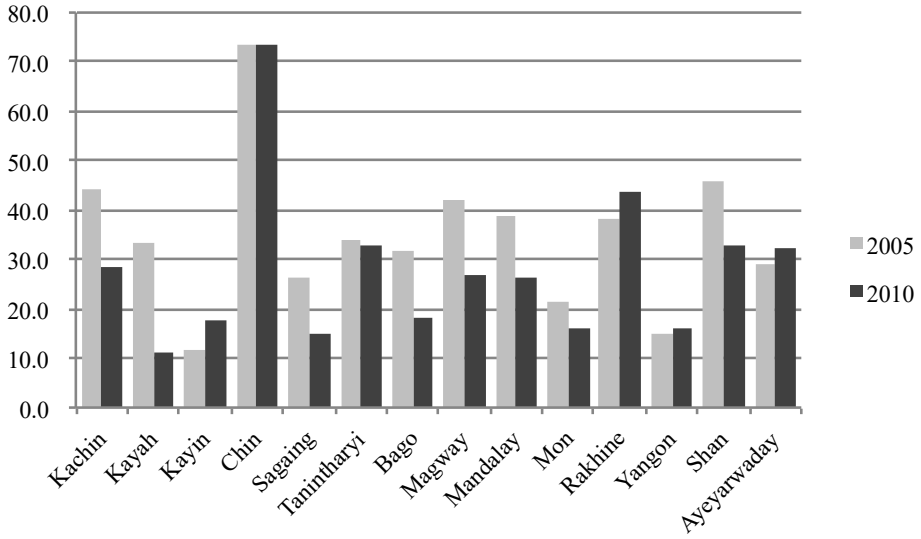
Table 2.3.13 and Figure 2.3.3 show the Poverty Incidence (generation of poverty population) by region/state. At the national level, the percentage of the population in poverty was 32.1% in 2005, with 21.5% in urban areas and 35.8% in rural areas. In 2010, these percentages had improved to 25.6%, 15.7% and 29.2%, respectively.

In Kayin State and Mon State, the Poverty Incidence is lower than the national average. However, the result may not be an accurate depiction, particularly in Kyain State where ethnic conflict ceased in January 2012. The Poverty Incidence of Tanintharyi Region is larger than the national average and the total Poverty Incidence and Rural Poverty Incidence had no significant change between the 2005 and 2010 surveys in the Study Area.

Table 2.3.13 Change of Poverty Incidence between 2005 and 2010

Region/State	Urban		Rural		Total	
	2005	2010	2005	2010	2005	2010
Kachin	37.7	23.4	46.8	30.6	44.2	28.6
Kayah	26.1	2.3	38.2	16.3	33.6	11.4
Kayin	7.8	16.8	12.5	17.5	11.8	17.4
Chin	45.9	52.1	80.9	80.0	73.3	73.3
Sagaing	21.9	16.0	27.4	14.9	26.6	15.1
Tanintharyi	20.8	16.7	37.2	37.5	33.8	32.6
Bago	30.7	19.0	31.8	18.2	31.6	18.3
Magway	25.8	15.8	43.9	28.2	42.1	27.0
Mandalay	24.1	14.1	44.7	31.6	38.9	26.6
Mon	22.5	17.8	21.3	16.0	21.5	16.3
Rakhine	25.5	22.1	41.2	49.1	38.1	43.5
Yangon	14.4	11.9	17.4	28.7	15.1	16.1
Shan	31.0	14.1	50.5	39.2	46.1	33.1
Ayeyarwady	24.4	23.1	30.3	33.9	29.3	32.2
Union	21.5	15.7	35.8	29.2	32.1	25.6

Source: Integrated Household Living Conditions Survey in Myanmar (2009–10) Poverty Profile, UNDP and Sida, June 2010



Source: Integrated Household Living Conditions Survey in Myanmar (2009–10) Poverty Profile, UNDP and Sida, June 2010

Figure 2.3.3 Change of Poverty Incidence in 2005 and 2010 (Total)

2.4 Road Transportation

2.4.1 Overview of Road Transport in Myanmar

(1) Passenger Demand by Transport Mode

Road transport, including buses and private cars, is the dominant passenger transportation mode in Myanmar, carrying over 90% of the domestic trips in the four-year period from 2008 to 2012. In 2012, road transport carried 92% of total passengers, followed by railway transport (5%) and inland water transport (3%). The modal split (in terms of percentage) had no significant change, and the actual figures in the number of passengers do not show any trend.

Table 2.4.1 Number of Passengers by Transport Mode[14] (million trips/year)

Mode	2008		2009		2010		2011		2012	
Road	1,632	94%	1,166	92%	1,294	93%	1,233	93%	1,085	92%
Rail	75	4%	72	6%	69	5%	67	5%	55	5%
River	27	2%	27	2%	28	2%	23	2%	33	3%
Air	1	0%	1	0%	1	0%	1	0%	2	0%
Total	1,735	100%	1,267	100%	1,391	100%	1,325	100%	1,175	100%

Source: TPD/RTAD, MR, IWT, DCA (http://www.ajtpweb.org/)

The following figure shows the number of road and rail passenger-kilometres between 2008 and 2011. In 2011, road transport carries 84% of total passenger kilometres while rail transport carries 16%. The number of passenger-kilometre by road transport tends to increase in recent years but that of rail passengers remains nearly same during the same period.

Table 2.4.2 Number of Passenger Trip-Kilometre by Road and Rail (million trip-kilometre/year)

Mode	2008		2009		2010		2011	
Road	18,303	77%	26,215	83%	28,385	84%	28,389	84%
Rail	5,482	23%	5,296	17%	5,336	16%	5,282	16%
Total	23,785	100%	31,511	100%	33,721	100%	33,671	100%

Source: TPD/RTAD, MR, IWT, DCA (http://www.ajtpweb.org/)

The following table shows the average trip-kilometre per passenger by road and rail transport between 2008 and 2011. In 2011, the average trip-kilometre by road user is estimated at 23 kilometres/passenger, while that by rail transport is at 79 kilometres/passenger, and which indicates the road transport accommodates relatively shorter distance trips while rail transport carries longer distance trips. The time-series trend shows the average of trip-kilometre by both road and rail transport tends to increase during the said period.

Table 2.4.3 Average Trip-Kilometre by Road and Rail (trip kilometre/passenger)

Mode	2008	2009	2010	2011
Road	11	22	22	23
Rail	73	73	78	79

Source: TPD/RTAD, MR, IWT, DCA (http://www.ajtpweb.org/)

[14] The figure shows the number of domestic passengers who travelled and does not include international passengers. According to MORT, the aggregation method and/or sample-based unit rate (e.g., average passenger volume) differs year by year and which contributes to distortions in annual passenger volume.

As seen in above figures in passenger transport trends, considering the increase in passenger kilometre, modal share of the passenger transported, and increase in average trip kilometre, future passenger demand forecast and future modal share of passenger demand in this Study need to be estimated, utilizing the result of traffic demand forecast carried out in the Survey Program for the National Transport Development Plan (JICA, 2014).

(2) Freight Volume by Transport Mode

Similar to passenger transport, road transport is the dominant freight transportation mode, handling about 70-80% of total freight volume in the five-year period from 2008 to 2012. Looking at freight, road, railway and river transport are the major freight transport modes. Like passengers, road transport (truck) is dominant among all transport modes, and carries around 83% of the domestic freight by tonnage. Following road transport, railway (10% of the domestic freight) and inland water (7%) also carry considerable amounts of domestic cargo.

Table 2.4.4 Freight Volume (Tonnage) by Transport Mode[15] (million tons)

Mode	2008		2009		2010		2011		2012	
Road	22,733	75%	30,474	79%	20,664	72%	22,532	75%	25,528	83%
Rail	2,976	10%	3,236	8%	3,322	12%	3,576	12%	3,124	10%
River	4,513	15%	4,733	12%	4,767	17%	3,997	13%	2,149	7%
Air	1	0%	3	0%	1	0%	1	0%	1	0%
Total	30,223	100%	38,446	100%	28,754	100%	30,106	100%	30,802	100%

Source: TPD/RTAD, MR, IWT, MPA, DCA (http://www.ajtpweb.org/)

The following table shows domestic freight volume by tonnage-kilometre carried by different transport modes between 2008 and 2012. In 2012, road transport carried 64% of the domestic freight cargoes by tonnage-kilometres, followed by inland water transport (19%) and rail transport (17%). The total volume of domestic cargoes by tonnage-kilometre increases sharply since 2008.

Table 2.4.5 Freight Volume (Tonnage-kilometre) by Transport Mode (million ton-kilometre)

Mode	2008		2009		2010		2011		2012	
Road	1,128	55%	2,320	52%	2,206	47%	2,897	57%	3,854	64%
Rail	905	45%	1,021	23%	1,085	23%	1,160	23%	1,041	17%
River	NA	NA	1,092	25%	1,394	30%	999	20%	1,120	19%
Air	0	0%	0	0%	0	0%	0	0%	2	0%
Total	2,033	100%	4,434	100%	4,686	100%	5,056	100%	6,018	100%

Source: TPD/RTAD, MR, IWT, MPA, DCA (http://www.ajtpweb.org/)

The following table shows the average freight kilometre carried by different transport mode between 2008 and 2012. In 2012, the average kilometre carried by road is estimated at 151 kilometres, while that by rail/inland water transport is at 333/521 kilometeres respectively, and which indicates the road transport accommodates relatively shorter distance freight trips while rail/inland water transport carries longer distance freight trips. The time-series trend shows the average of freight kilometre by road/inland water transport tends to increase during the said period, while that by rail transport remains nearly same.

Table 2.4.6 Average Freight Kilometre by Transport Mode (kilometre)

Mode	2008	2009	2010	2011	2012
Road	50	76	107	129	151
Rail	304	315	327	324	333
River	NA	231	292	250	521
Air	369	96	383	301	1,623

Source: TPD/RTAD, MR, IWT, MPA, DCA (http://www.ajtpweb.org/)

[15] The figure shows the volume of domestic freight and does not include international freight volume.

As seen in above figures in freight transport trends, considering the increase in freight ton kilometre, modal share of the freight transported, and increase in average freight kilometre, future freight demand forecast and future modal share of freight demand in this Study need to be estimated, utilizing the result of the traffic demand forecast carried out in the Survey Program for the National Transport Development Plan (JICA, 2014).

(3) Bus and Trucking Services

1) Bus Services

Bus transport in Myanmar has been expanding in recent years. As discussed previously, both the number of registered buses and bus passengers are increasing year by year. Also, as Table 2.4.7 indicates, the number of registered bus operators increased between 2008 and 2012.

Table 2.4.7 Number of Fixed Route Bus Operators (nos.)

	2008	2009	2010	2011	2012
Number of fixed route bus operators	1,129	1,184	1,184	1,651	1,815

Source: TPD (http://www.ajtpweb.org/)

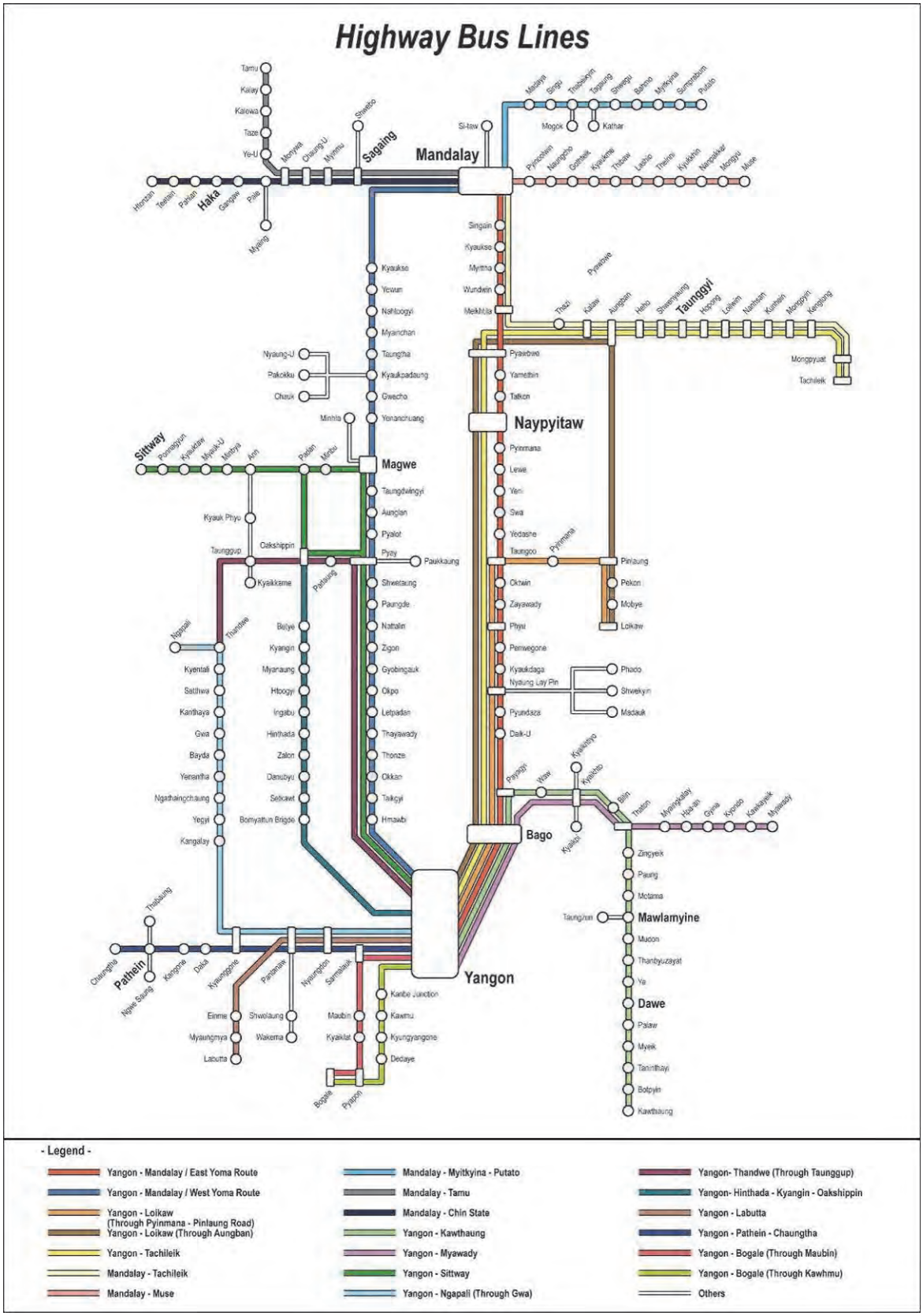
As of 2011, there are over 20,000 buses registered in Myanmar. The number of registered buses is distorted geographically, and more than half of the buses are registered in Yangon. Likewise, the number of buses per population also differs by region and state. Yangon shows 1.57 buses per 1,000 people, the largest number of buses per population among the States and Regions, whereas Chin and Kachin States show 0.05 buses per 1,000 people, the least number of buses per population. These figures imply that the public and private bus service and network is limited in less populated areas.

Table 2.4.8 Number of Registered Buses by State and Region

State/Region	No. of Buses Registered (vehicle)	2012 Population (1000)	No. of Bus per 1000 people (vehicle/1000 people)
Yangon	11,240	7,170	1.57
Mandalay	3,639	8,587	0.42
Bago	594	6,125	0.10
Sagaing	1,449	6,654	0.22
Magway	650	5,730	0.11
Tanintharyi	280	1,755	0.16
Ayeyarwaddy	815	8,205	0.10
Shan	891	5,779	0.15
Mon	668	3,193	0.21
Kachin	88	1,616	0.05
Kayin	136	1,855	0.07
Rakhine	143	3,370	0.04
Chin	27	571	0.05
Kayah	63	365	0.17
Total	20,683	60,975	0.34

Source: JICA Survey Team, Based on RTAD

The busiest intercity bus routes are observed at Yangon–Naypyitaw (87 buses per day in both directions), Yangon–Mandalay (77 buses per day), Yangon–Mawlamyine (47 buses per day), Yangon–Hpa-an (45 buses per day), and Yangon–Hinthada (35 buses per day). The intercity bus service, originating from three major terminals, covers Myanmar nationwide. Intercity buses travel to all capital cities of the fourteen states and regions. Buses also travel to major cross border cities, including Myawaddy (six buses per day to/from Yangon), Muse (four buses to/from Yangon/Mandalay) and Tamu (five buses to/from Yangon/Mandalay).



Source: TPD

Figure 2.4.1 Myanmar's Inter-city Bus Routes

2) Trucking Services

Like bus transport, trucking transport in Myanmar has been expanding rapidly in recent years. As discussed in the previous section, both the number of registered trucks and freight volume transported by trucks have been increasing. Also, as the following table indicates that the number of trucking companies and domestic forwarders registered has increased between 2009 and 2013, with 801 trucking companies and 865 forwarders registered in 2013.

Trucking companies in Myanmar are considered small entrepreneurs (one owner one truck company) and trucking companies with more than 20 trucks are scarce. The service area of these trucking companies is limited to local distribution within their states and regions, and there is no single trucking company that provides a regular nationwide service.

Table 2.4.9 Number of Trucking Companies and Domestic Forwarders (nos.)

	2009	2010	2011	2012	2013
Number of trucking companies	527	546	546	800	801
Number of domestic forwarders	716	734	734	849	865

Source: TPD (http://www.ajtpweb.org/)

In this regards, considering the increase in bus operators, geographical disparity in registered buses and operation of nation-wide fixed bus routes in recent years, future bus passenger demand and number of necessary buses need to be estimated, based on the result of the traffic demand forecast carried out in the Survey Program for the National Transport Development Plan (JICA, 2014). Likewise, considering an increase in truck operators, the future freight demand needs to be estimated based on the result of traffic demand forecast carried out in the Survey Program for the National Transport Development Plan (JICA, 2014)

(4) Registered Vehicles

The number of registered vehicles in Myanmar increases year by year, incrementally by around 400,000 vehicles p.a. Amongst them, road transport modes, including buses and trucks, increase constantly, amounting to around 60,000 trucks and 40,000 buses registered every year. The demand for both passenger buses and truck transport seems to be expanding in recent years. Between 2012 and 2013, the number of registered vehicles, particularly that of passenger cars, taxis and trucks, increased and the total number of registered vehicles reached 572,000 in 2013.

Table 2.4.10 Number of Registered Vehicles by Type ('000 vehicles)

Type	2009	2010	2011	2012	2013
Passenger Car	243	260	263	282	360
Taxi	27	28	28	41	56
Truck	60	64	67	71	111
Bus	20	21	20	20	21
Public Bus	25	28	27	23	24
Total	375	401	405	437	572

Source: RTAD (http://www.ajtpweb.org/)

2.5 Current Road and Bridge Condition for Survey Roads

2.5.1 Road Conditions for Survey Roads

(1) The Sections of the Covered Routes

The current conditions and issues on the concerned roads and bridges in this survey are based on the site survey and report from the Ministry of Construction. Due to the breadth of the coverage, the summary was made by dividing roads into five sections, as shown in Table 2.5.1.

Table 2.5.1 The Sections covered by the Survey

	Section	Length	State
1	Payagyi-Dawei	530km	Bago, Mon
2	Thaton-Eindu	60km	Mon, Kayin
3	Eindu- Myawaddy	120km	Kayin
4	Eindu-Mawlamyine	40km	Mon, Kayin
5	Three Pagoda Pass (Thanbyuzayat–Hpayathonzu)	104km	Mon, Kayin

Source: JICA Survey Team

Source: JICA Survey Team

Figure 2.5.1 Location Map for this Survey

2.5.2 Current Road and Bridge Condition for Survey Roads

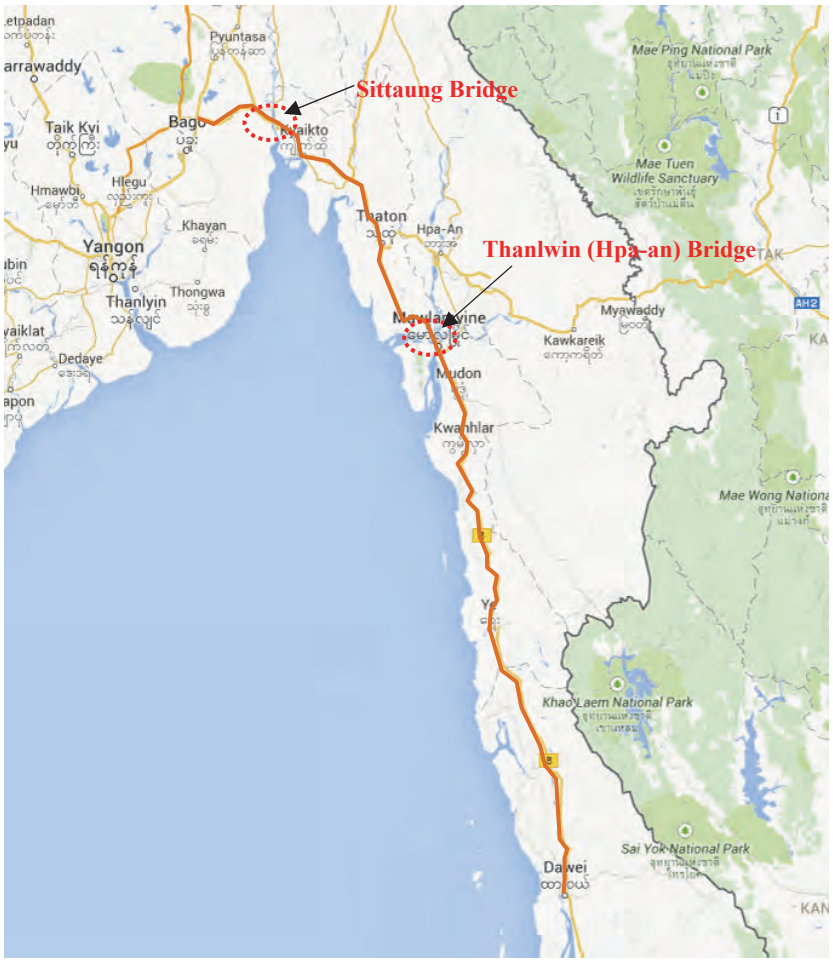
(1) Payagyi – Dawei Section

1) Current Condition of Road

This route is a part of the principal trunk road connecting the country's largest city, Yangon, with Dawei. This route is also a route forming a part of the Asian Highway (AH1) and ASEAN Highway (AH112). The Payagyi to Mawlamyine section has been developed as a "Class-III" road in accordance with the ASEAN Highway Standards. The road surface is maintained to be in good condition as Shwe Than Lwin Highway Co., Ltd, a private company in Myanmar, is undertaking maintenance of the route under BOT contract.

Maintenance for the south section of Mawlamyine is undertaken by MOC. The road condition is in satisfactory condition in the section of Mawlamyine to Thanbyuzayat, but there are unpaved roads in the south section of Thanbyuzayat (although road improvement has been undertaken by MOC). In particular, road condition is still poor in the 10km section in the mountain area south of Ye.

This route also passes several urban areas such as Kyaito, Thaton and Mawlamyine and is used as a community road by wayside residents, and thus many pedestrians, bicycles, and motor bikes are using this road. Large vehicles are also running in large numbers. As the shoulder is not paved and the road has only one lane in each direction, it is dangerous for vehicles to overtake and pass each other.



Source: Google Map, JICA Survey Team

Figure 2.5.2 Payagyi – Dawei Section Location Map

	
Road surface condition is good. Road markings are installed as well. (Payagyi – Mawlamyine Section)	Toll gate (Toll is collected by BOT undertaken by Shwe Than Lwin Highway Co., Ltd)
	
Road surface condition (Mawlamyine – Thanbyuzayat Section)	Road surface condition (Thanbyuzayat – Dawei Section)

Source: JICA Survey Team

Figure 2.5.3 Current Road Condition for Payagyi – Dawei Section

2) Current Condition of Bridges

This section has two major bridges as shown in Figure 2.5.2. No significant damage is observed on either bridge. There is sufficient load capacity for heavy freight vehicles, thus, there is no current need for specific reconstruction or repair.

Table 2.5.2 Current Status of Major Bridges in Payagyi –Dawei Section

Bridge Name	Length	Superstructure Type	Foundation Type	Weight Limit	Completion Year
Sittaung Bridge (Mokepalin)	729m	Steel truss	Unknown	60t	2006
Thanlwin (Mawlamyine) Bridge	3,519m	Steel truss	Unknown	60t	2005

Source: JICA Survey Team

	
Overall view of Sittaung Bridge (Mokepalin)	Old bridge substructure is downstream of Sittaung Bridge

	
Under girder view of Thanlwin (Hpa-an) Bridge	Two-lane road and railway bridge (Thanlwin (Hpa-an) Bridge)

Source: JICA Survey Team

Figure 2.5.4 Current Condition of Major Bridges in Payagyi –Dawei Section

3) Detected Issues in the Concerned Road Section

Issues related to the existing roads and bridges in the section concerned are as listed below:

- ✓ Widening and improvement of the existing road (There are many unpaved roads south of Thanbyuzayat and the road condition is especially poor in the 10km section on the mountain area south of Ye)
- ✓ Widening of existing road and development of the bypass in the urban areas where future traffic volume is expected to increase
- ✓ Safety enhancement and promotion of pedestrian – vehicle separation through improvement of shoulders and pavements

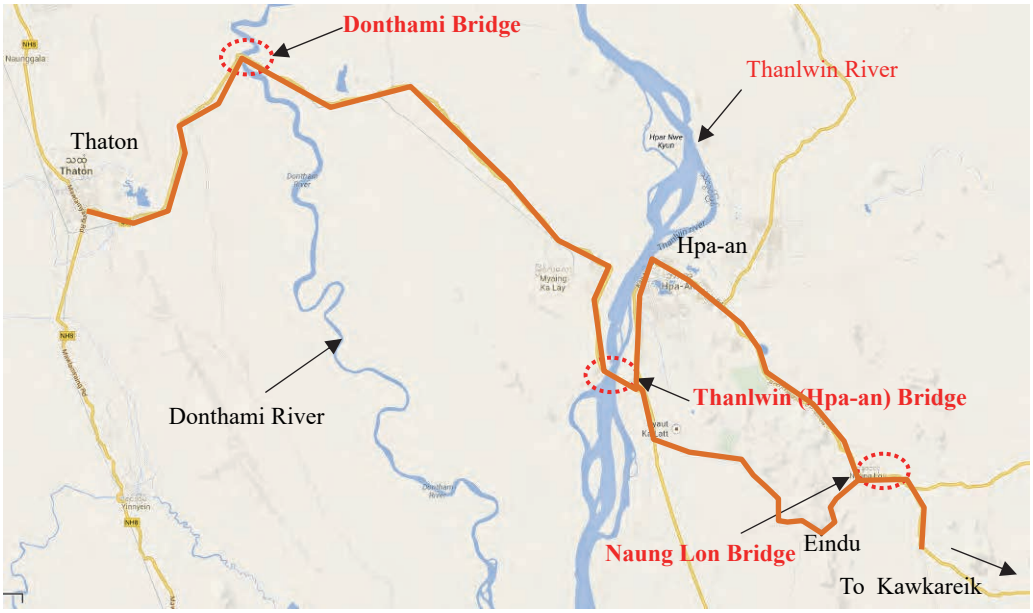
(2) Thaton –Eindu Section

1) Current Condition of Road

The section of about 60km between Thaton and Eindu through Mon and Kayin State borders and Hpa-an plays an important role as a component of the East-West Economic Corridor. The section passes through plains for the most part and crosses the Thanlwin River and the Donthami River on the way. In terms of alignment, a design speed of 60km/h is generally secured, and there are moderate curves and bends in the subsection before and behind Thanlwin Bridge and in urban areas. The road width is 7m including two-way, two lanes (3.5m per lane). The roadway is paved by macadam pavement with an unpaved shoulder. As motorcycles and oxcarts go through the roadway, and it is difficult to overtake low-speed large vehicles, and thus the running speed goes down on the whole. The road surface is good and the right of way (ROW) is secured all through the section. In Thaton, Hpa-an and Eindu, the road passes through the urban areas and some houses and stores occupy the road site.

The section is operated and maintained now by a private concessioner under a BOT contract. Thaton-Myainkalay Section (western part of Thanlwin (Hpa-an) Bridge) is maintained by Shwe Than Lwin Highway Company, a private Myanmar company, and the Myainkalay-Eindu section by AyeKo Family (AK). The road surface is maintained to be in a satisfactory condition by the companies.

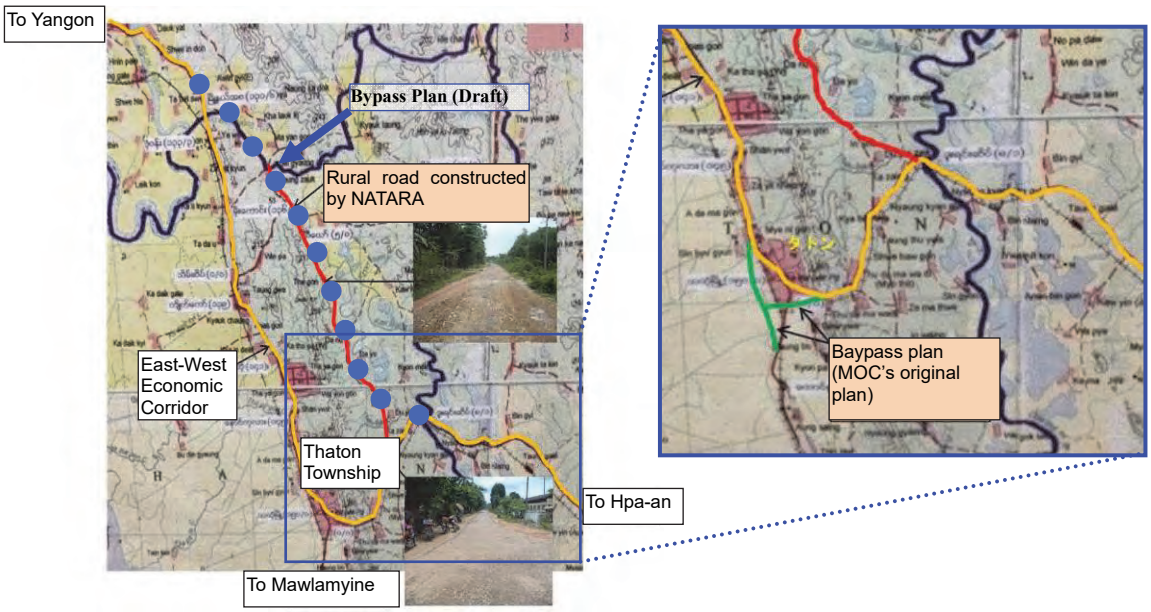
On the other hand, Naung Lon-Kawkyaik Bypass has been developed as two-lane, macadam pavement road which can go to Thanlwin (Hpa-an) Bridge from Eindu without passing the city area of Hpa-an. This route is also operated and maintained by AyeKo Family (AK) by BOT, and mainly used by large vehicles.



Source: Google Map, JICA Survey Team

Figure 2.5.5 Thaton – Eindu Section Location Map

This route is a part of the East-West Economic Corridor and has large traffic of heavy vehicles. In particular, chronic traffic congestion has occurred in the urban area of Thaton, where a mixture of large-vehicle and regional traffic shows critical problems in terms of traffic safety. In this context, MOC has started a study for Thaton bypass plan since March, 2013, and established centre lines (two green routes in Figure 2.5.6). However, when the JICA Study Team for "the Survey Program for the National Transport Development Plan in the Republic of the Union of Myanmar" visited the site and proposed another route plan (the red routes in Figure 2.5.6), the MOC staff accompanying the visit reported the proposal to the Minister of MOC, and the proposed route was adopted. To the north of the Thaton urban area, there is a rural road which was developed in 2010 by the Ministry of Border Affairs. Though partially surfaced with asphalt, this rural road has many unpaved sections and its road surface condition is poor. For the development of the Thaton bypass, upgrading the main road is considered appropriate.



Source: The Survey Program for the National Transport Development Plan

Figure 2.5.6 Thaton Bypass Plan

	
Road surface condition (Thaton–Hpa-an section)	Road surface condition (Hpa-an–Eindu section)
	
Heavy freight traffics pass through Thaton city area	Existing road in the north of Thaton city area
	
Rural road constructed by NATALA	

Source: JICA Survey Team

Figure 2.5.7 Current Road Condition for Thaton – Eindu Section

2) Current Condition of Bridge

There are three major bridges in this section, as shown in Figure 2.5.5.

i) Donthami Bridge

This is a concrete girder bridge built on the boundary of Mon and Kayin States in 1982. In its current state, there are no particular faults other than settlement behind the abutment, and the load limit is 50 tons. At present, there is no need for specific reconstruction or repair.

ii) Thanlwin (Hpa-an) Bridge

This is a two-lane bridge built by MOC in 1997, which consists of a steel truss bridge for the five central spans, and a concrete girder bridge for the five spans on both ends. No particular failure is observed in its current state, and it has a weight limit is 50 tons (which is enough to accommodate

heavy freight traffic). At present, there is no need for specific reconstruction or repair.

iii) Naung Lon Bridge

This is an RC bridge built in 1973, and is less than 7m-wide. The weight limit is only 20 tons. Critical damage to the bridge is observed, such as a large deflection of the girder and settlement of piers, as shown in Figure 2.5.8. Considering the significant damage on the structure and insufficient load capacity, urgent reconstruction is needed.

Table 2.5.3 Current Status of Major Bridges in Thaton – Eindu Section

Bridge Name	Length	Superstructure Type	Foundation Type	Weight Limit	Completion Year
Donthami Bridge	183m	PC+RC	---	50t	1982
Thanlwin (Hpa-an) Bridge	686m	Steel truss	Bored pile	60t	1997
Naung Lon Bridge	115m	RC (I Girder)	Spread foundation	20t	1973

Source: JICA Survey Team

Good road surface condition (Donthami Bridge)

No large-scale damage on either the superstructure or the substructure (Donthami Bridge)

No large-scale damage on either the superstructure or substructure. (Thanlwin (Hpa-an) Bridge)

Good road surface condition (Thanlwin (Hpa-an) Bridge)

Overall view (Naung Lon Bridge)

Unevenness of road surface (Naung Lon Bridge)

	
Large deflection of the superstructure (Naung Lon Bridge)	Settlement of Pier No.1 and 2 (Naung Lon Bridge)

Source: JICA Survey Team

Figure 2.5.8 Current Condition of Major Bridges in Thaton–Eindu Section

3) Detected Issues in the Concerned Road Section

Issues related to the existing roads and bridges in the section concerned are as listed below:

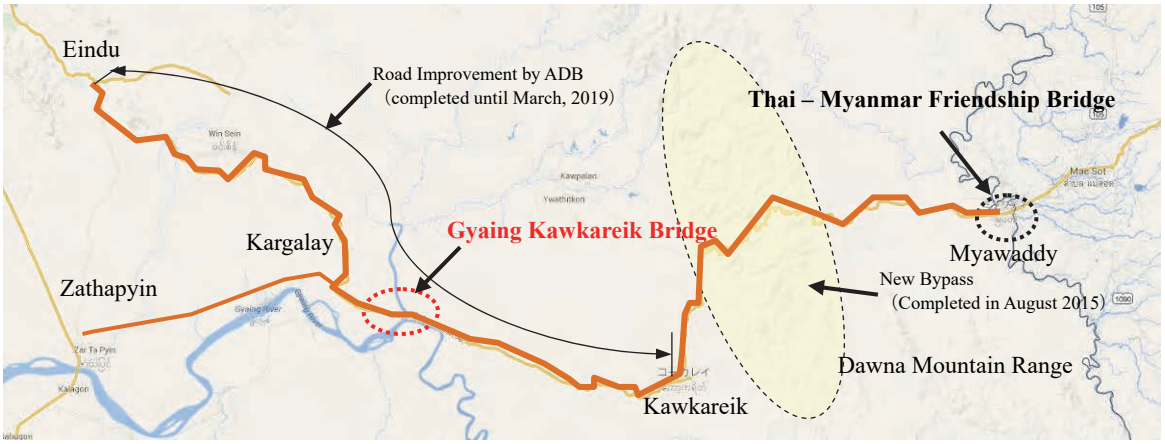
- ✓ Construction of a bypass in order to mitigate chronic traffic congestion and critical problems in terms of traffic safety in the urban area
- ✓ Safety enhancement and promotion of pedestrian-vehicle separation through improvement of shoulders and pavements
- ✓ Widening of existing roads in accordance with future traffic demand
- ✓ Intensification of regulation against entry in the road site (ROW)
- ✓ Reconstruction of Naung Lon Bridge under severe damage

(3) Eindu –Myawaddy Section

1) Current Condition of Road

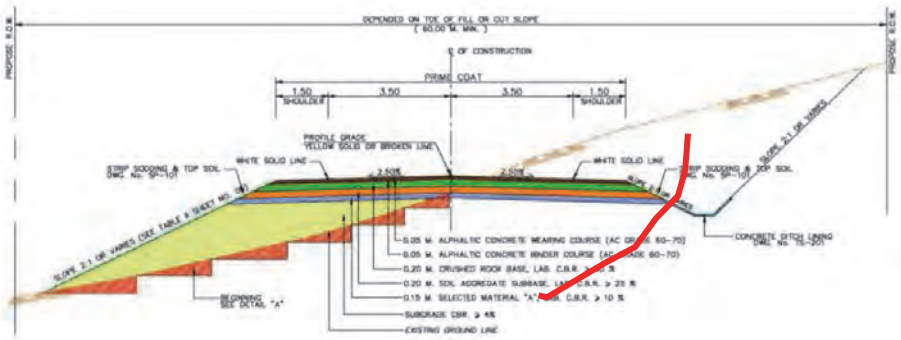
This section is a cross border road with about 120km length connecting Eindu, Kawkareik, Dawna Moutain Range, Myawaddy which is located at the border with Thailand. In the section between Eindu to Kawkareik in which route runs through the flatland, the width of two-lane road is 7 metres (each 3.5m), the roadway section is provided with asphalt pavement (macadam pavement), but the shoulder is not paved. In terms of road alignment, a design speed 60km/h is generally secured and there are small curves and bends in the urban areas and some sections. There are a few houses along the entire road and ROW is basically assured, except in the urban areas of Eindu and Kawkareik where occupation of ROW by houses and shops is observed. The section of Eindu – Kawkareik with a length of 80km is supposed to be improved to "Class-II" according to ASEAN Highway Standards by March, 2019 under the project named " TA-8330 MYA: GMS East-West Economic Corridor Eindu to Kawkareik Road Improvement" under ADB.

Although 40km of the hilly and rough mountain road is limited to one-way traffic (switching between upbound and downbound every day), the section has been greatly improved by the new bypass completed in August 2015 with the support of the Thai government. Although the design speed for the bypass is 50km/h and the bypass is a two-lane paved road with a total width of 10m, steep vertical gradient of 12% and continuous S curves are provided, it does not satisfy the ASEAN Highway Standards since it passes through the mountain area. It is thus a concern that loaded trucks may have difficulties negotiating the road sections with steep gradients which can affect transport efficiency, and the road is vulnerable to the natural environment such as rainfall since the safety measures (slope protection and drainage) are insufficient even after the completion of the bypass. It could take two to three years after the opening of this road to realize if the concerns are valid or not. At this stage, it would be better to identify possible measures to mitigate possible problems. In addition, there are many minorities in the Dawna Mountain Range where a special community has been formed.



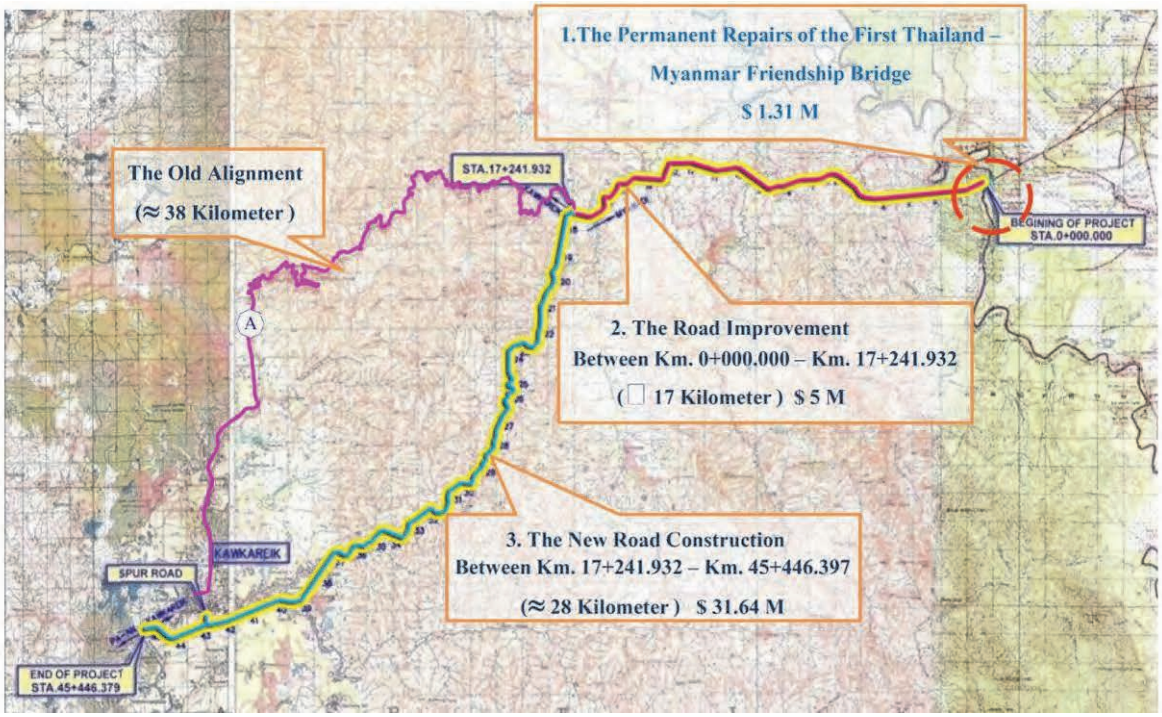
Source: Google Map, JICA Survey Team

Figure 2.5.9 Eindu–Myawaddy Section Location Map



Source: Presentation Material by DOH in Thailand

Figure 2.5.10 Typical Cross Section of Dawna Range Bypass



Source: Prepared by JICA Survey Team based on presentation Material by DOH in Thailand

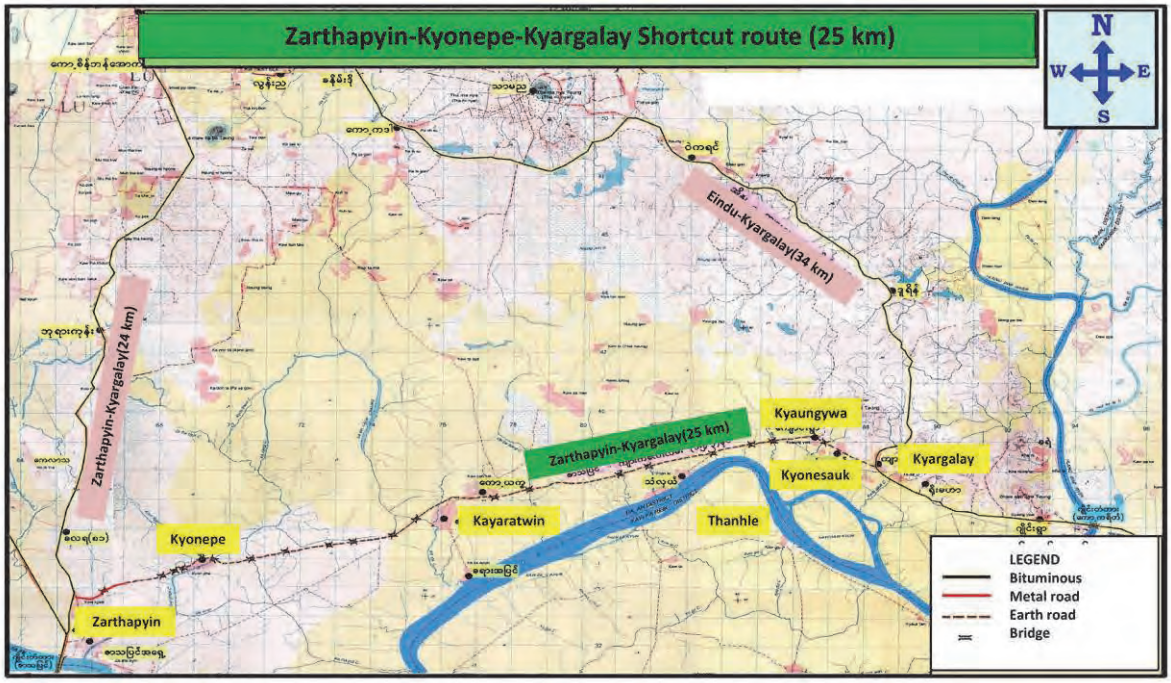
Figure 2.5.11 Road Construction Project by Thai Government (Kawkareik - Myawaddy Section)

	
Road surface condition (Eindu – Kawkareik section)	Existing road constructed following mountainous terrain (Dawna Mountain Range)
	
Dawna Range Bypass (taken in Feb, 2014)	Cutting condition in Dawna Range Bypass (taken in Feb, 2014)

Source: JICA Survey Team

Figure 2.5.12 Current Road Condition for Eindu – Myawaddy Section

As shown in Figure 2.5.9, there is a related road, called Zathapyin–Kargalay Bypaass (Kargalay Bypass), which branches from the East-West Corridor at a point 6km northwest away from the Gyaing Kawkareik Bridge and connects to Zathapyin. This is originally a route running parallel on the north side of the Gyaing River, which was developed by the Ministry of Border Affairs and completed in 2003. The administration of this road has already been transferred from the Ministry of Border Affairs to MOC. As compared with the existing route of Kyagale–Eindu–Zathapyin, this road can have the length shortened by about 33 km. This route is also an unpaved 1.5 lane road (except for some urban areas) and has been mainly used as a service road for roadside residents. Large vehicle traffic is not significant at present. There are traffic difficulties on the route due to flooding during the rainy season. MOC is, thus, implementing widening of the road, elevation, and bridge construction. There are several bridges along the route, all of which are temporary wooden ones and broken, so that they must be reconstructed into permanent bridges (the same applies to the box and pipe culverts). It is considered that this route has a high potential as a bypass road since it is the shortest route connecting Myawaddy to Mawlamyine (the third-largest city in Myanmar). In this context, road improvement of this section is expected.



Source: MOC

Figure 2.5.13 Zathapyin–Kargalay Bypass Plan

	
Road surface condition (Unimproved section)	Temporary bridge needed to be replaced
	
Road improvement section by MOC (taken in June, 2014)	Bridge under construction by MOC (taken in June, 2014)

Source: JICA Survey Team

Figure 2.5.14 Current Condition of Kargalay Bypass

2) Current Condition of Bridge

Gyaing Kawkareik Bridge is part of the GMS East-West Economic Corridor, shown in Figure 2.5.9. On the border between Thailand and Myanmar, there is a 420m long bridge, called the Thai-Myanmar Friendship Bridge constructed in 1997 with aid from Thailand. This bridge is under rehabilitation for the protruding pier foundations due to scoring by river flow. The bridge is not concerned in this survey because Thai contractors have conducted the rehabilitation.

Gyaing Kawkareik Bridge is a 365m long bailey suspension bridge over the Gyaing River, which was built independently by MOC with technical support and the provision of materials from China in 1999. The superstructure consists of simple steel member girders and moulded steel plate deck is applied to bridges surface instead of pavement. The navigation clearance is 12m high from the design high-water level, and 109m wide for the navigation of the navy's patrol boats. This bridge has a weight limit of 24 tons, diverting heavy freight vehicles toward the pontoon bridge upstream (completed in 2010).

This bridge is suffering from deterioration and excessive resultant damage, such as the deterioration of the main cable, cracks on RC slabs of the approach bridge etc. These all indicate that urgent measures, such as reconstruction, are necessary. In addition, settlement behind the abutment is significant, causing deformation of the approach bridge road surface. The main cable was repaired with mortar covering by MOC in 2012. However, this repairing method could lead to main cable corrosion by water inflating in mortar cracks. The removal of cable mortar is necessary to inspect inner corrosion.

Table 2.5.4 Current Status of Major Bridges in Eindu – Myawaddy Section

Bridge Name	Length	Superstructure Type	Foundation Type	Weight Limit	Completion Year
Gyaing Kawkareik Bridge	365m	Suspension	Bored pole	24t	1999

Source: JICA Survey Team

Overall View

Bridge surface

Settlement behind the abutment

Cracks on RC slab (Approach bridge)

Mortar crack at main cable (corrosion)

Mortar deficit around suspension member (corrosion)

Source: JICA Survey Team

Figure 2.5.15 Current Condition of Major Bridges in Eindu – Myawaddy Section (Gyaing Kawkareik Bridge)

3) Detected Issues in the Concerned Road Section

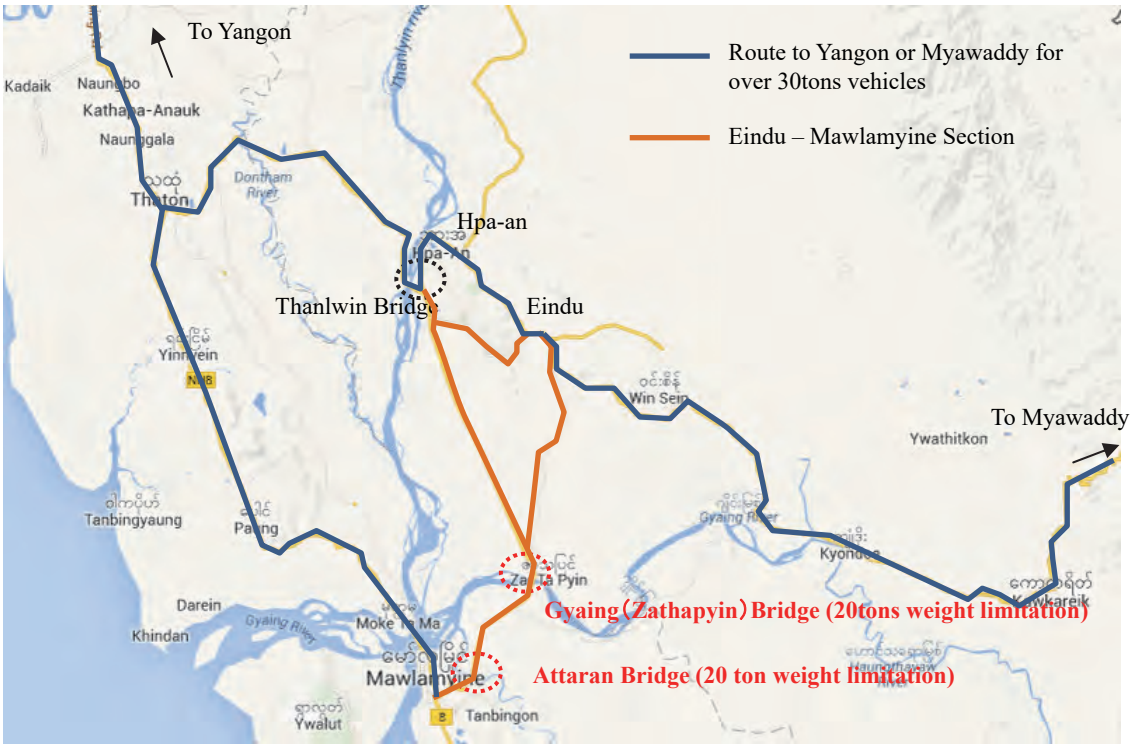
Issues related to the existing roads and bridges in the section concerned are as listed below:

- ✓ Road improvement into an international highway in the Kawkareik–Myawaddy section
- ✓ Being a mountain road, this section requires large-scale structures (retaining walls, long-span bridges, and tunnels) for improvement of the alignment. Considerable project costs will be incurred.
- ✓ Elimination of road flooding and development of bypass by improvement of existing Kargalay Bypass
- ✓ Special land acquisition procedure in Kayin (Karen) State (necessity of coalition with KNU)
- ✓ Safety enhancement and promotion of pedestrian-vehicle separation through improvement of shoulders and pavements
- ✓ Intensification of regulations against entry in the road site (ROW)
- ✓ Urgent reconstruction of Gyaing Kawkareik Bridge

(4) Eindu – Mawlamyine Section

1) Current Condition of Road

For this section, the AyeKo Family concluded the concession agreement with MOC and is undertaking the operation and maintenance according to BOT. As the road passes through the flatland, there is almost no undulation while crossing the Gyaing and Atran Rivers. This is a 1.5-lane road of about 40 km in length, with an asphalted roadway. Since the shoulder is not paved, it is extremely dangerous in case of overtaking and passing. As compared with the road surface of other neighbourhood sections, this section has a poorly damaged surface, with remains of simple repair observed here and there. Flooding of the road surface during heavy rain in the wet season is considered the most significant cause of damage to the pavement. The 20 ton weight limit at Gyaing Zathapyin bridge and Atran bridge diverts heavy freight exceeding 20 tons, travelling from Yangon and Myawaddy to Mawlamyine, toward Hpa-an and Thaton as shown in Figure 2.5.16.



Source: Google Map, JICA Survey Team

Figure 2.5.16 Eindu – Mawlamyine Section Location Map

Road surface condition (Nearby Zathapyin)

Source: JICA Survey Team

Figure 2.5.17 Current Road Condition for Eindu – Zathapyin Section

The road (about 35 km in length) connecting Hpa-an and Zathapyin runs parallel on the west side of this section. This road is the shortest route connecting Hpa-an and Mawlamyine. This is a two-lane asphalted (Macadam pavement) roadway. This road is similarly operated and maintained by the AyeKo Family in accordance with BOT. At present, the traffic volume is limited and the road surface is better than that of the Eindu – Zathapyin section.

Relatively good road surface condition of two-lane road

Road maintenance by private company (BOT)

Source: JICA Survey Team

Figure 2.5.18 Current Road Condition for Hpa-an – Zathapyin Section

2) Current Condition of Bridge

In this section, there are two major bridges as shown in Figure 2.5.16.

i) Gyaing Zathapyin Bridge

Gyaing Zathapyin Bridge is a suspension bridge crossing the Gyaing River constructed in 1999 with material supply and technology aid from China. The navigation clearance is approximately 12m high and 122m wide (according to MOC). This bridge is considered a temporary structure, due to its easy steel member girder and moulded steel deck design. The bridge has a 20 ton weight limit, so heavy freight vehicles exceeding this limitation travelling from Yangon/Myawaddy to Mawlamyine are diverted via Thaton towards Thanlwin (Mawlamyine) Bridge (which has a weight limit of 60 tons). In addition, since the road is not paved, the 4cm gap of moulded steel is dangerous for two-wheeled vehicles. (The tires might get caught in the grooves.) The bridge's deterioration prompted MOC to directly conduct repair work (repainting, cable sheath, and replacement of steel shapes over the bridge surface), completed in April 2013. Reconstruction into

a permanent structure is urgently needed for both traffic safety and the ability to accept heavy vehicle traffic.

ii) Atran Bridge

Atran Bridge is a cable-stayed bridge and was constructed in 1998 with material supply and technology aid from China. The navigation clearance is approximately 12m high and 122m wide, according to information from MOC. This bridge is also considered a temporary structure, due to its weight limit of 20 tons, and the damaged moulded steel bridge surface, as shown in Figure 2.5.19. Like the Gyaing Zathapyin Bridge, the Atran Bridge is not paved but is instead covered by a moulded steel deck, making it dangerous for two wheeled vehicles to pass safely. Pier scoring has also been observed and is thought to be from a lack of vertical bearing capacity. Reconstruction is necessary.

Table 2.5.5 Current Status of Major Bridges in Eindu – Mawlamyine Section

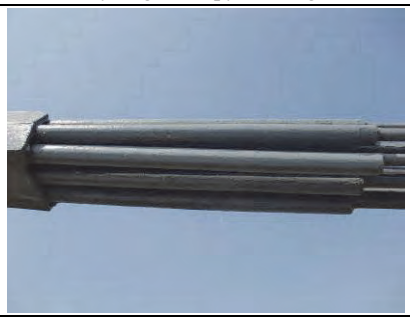
Bridge Name	Length	Superstructure Type	Foundation Type	Weight Limit	Completion Year
Gyaing (Zathapyin) Bridge	882m	Suspension Bridge	Bored pile	20t	1999
Atran Bridge	432m	Cable-stayed bridge	Bored pile	20t	1998

Source: JICA Survey Team

Overall View（Gyaing Zathapyin Bridge）

Deformation of moulded steel
（Gyaing Zathapyin Bridge）

Settlement around the abutment
（Gyaing Zathapyin Bridge）



Repaired main cable
（Gyaing Zathapyin Bridge）

Deformation of moulded steel
（Atran Bridge）

Repaired main cable
（Atran Bridge）

	
Settlement behind abutment （Atran Bridge）	Pier Scoring （Atran Bridge）

Source: JICA Survey Team

Figure 2.5.19 Current Condition of Major Bridges in the Eindu – Mawlamyine Section

3) Detected Issues in the Concerned Road Section

Issues related to the existing roads and bridges in the section concerned are as listed below:

- ✓ As the Eindu–Mawlamyine road has a road profile unsuited to high water level in rainy season, flooding is a problem to be solved. As road improvement requires raising the road profile, it is possible that a large work cost (similar to the cost of new construction) may be required.
- ✓ Urgent reconstruction of Gyaing Zathapyin Bridge and Atran Bridge which are bottle necks in the concerned section.

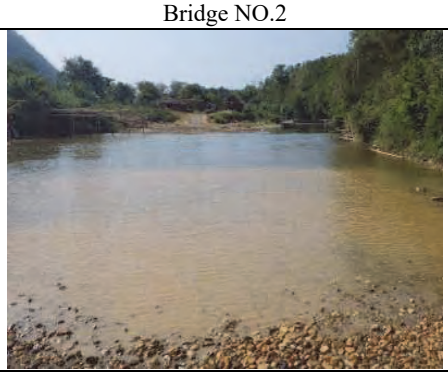
(5) Three Pagoda Pass (Thanbyuzayat—Hpayathonzu Section）

1) Current Condition

It is expected that this route, Three Pagoda Pass, shall be developed into an international road as soon as possible, since the section is the shortest route connecting Yangon and Bangkok. The Three Pagoda Pass is 104km in length and is an unpaved 1.5 lane road at present, so that it is quite difficult for vehicles to pass the route when flooded. Thus, road improvement is under implementation by MOC. Although there are temporary bridges (bamboo/wooden) on the existing road, four wheeled vehicles are forced to enter rivers, possibly creating engine trouble as seen in Figure 2.5.21. In these kinds of sections, four bridges with a length over 55m are planned, as shown in Figure 2.5.21, but may not be completed due to budget. Construction of bridges is an urgent matter since it is likely that this route is impassable in rainy season (even after completion of earthwork). A feasibility study for road improvement has been carried out by Neighbouring Countries Economic Development Cooperation Agency (NEDA) since road improvement into an international highway is considered to be difficult to complete by MOC due to budget limitations and the lack of technical capacity in Myanmar.

Source: JICA Survey Team

Figure 2.5.20 Thanbyuzayat—Hpayathonzu Section Location Map

	
Bridge NO.1	Bridge NO.2
	
Bridge NO.3	Bridge NO.4

	
Crossing creek by vehicles	Road improvement

Source: JICA Survey Team

Figure 2.5.21 Current Condition for Thanbyuzayat—Hpayathonzu Section

2) Detected Issues in the Concerned Road Section

Issues related to the existing roads and bridges in the section concerned are as listed below:

- ✓ Bridge construction (Impassable sections)
- ✓ Road improvement to international highway level

CHAPTER 3 TRAFFIC DEMAND FORECAST

3.1 Socio-economic Framework

3.1.1 Upper Plans

(1) National Socio-economic Development Plans

Myanmar has attracted attention from all over the world as the country with the greatest development opportunities in Southeast Asia, due to the country's accelerated economic and social reforms in 2010. The government is preparing a series of national development plans and intends to achieve further economic development.

(2) Framework for Economic and Social Reforms

Framework for Economic and Social Reforms (FESR) was presented to development partners in January, 2013 during a donor meeting in Naypyitaw. The document is an essential policy tool for the government to realize both the short- and long-term potential of Myanmar. First, FESR provides a reform bridge linking the on-going government programs to the National Comprehensive Development Plan (NCDP). Next, FESR serves as a required reference for various entities of the government to develop more detailed sectoral and regional plans. Finally, FESR can serve as a guide for building lasting cooperation with development partners and international bodies to obtain mutual benefits.

FESR states that Myanmar's vision is "to become a modern developed nation that meets the aspirations of its people for a better life; and to achieve greater integration with the international community by 2020," and describes necessary reforms in economic policies and social systems.

(3) Five-Year Plan (2011-15) and National Comprehensive Development Plan

Preparation of the first Five-Year Plan (2011-15) apparently has not been completed, and will be discussed in Parliament. Therefore, detailed plan contents are yet to be presented.

- 7.9% of average GDP growth (Primary sector 3.2%, Secondary sector 11.1% and Tertiary sector 9.8%)
- Structural change of industry share (from 36.4:26.0:37.6 in 2010/11 to 28.1:36.1:35.8 in 2015/16)
- Project proposals (both of private and state projects) with financial resources (state budget, aids, loans, FDIs)

After the preparation of the first Five-Year Plan, the Ministry of National Planning and Economic Development (MNPED) will prepare medium- and long-term comprehensive NCDP plans. NCDP is prepared based on input from line ministries and local governments. In this sense, NCDP also received input from LTIPP, prepared by DICA.

(4) Myanmar Comprehensive Development Vision

During the third Mekong-Japan Summit in November, 2011, ASEAN and Japanese leaders agreed to formulate the Myanmar Comprehensive Development Vision (MCDV) to support Myanmar's long-term development, initiated by ERIA. MCDV is a long-term development goal and a set of growth strategies that provide the foundation for a comprehensive and consistent set of economic policies, infrastructure and human resource development plans, industrial sector-wise growth paths, region and state development master plans, and so forth. MCDV puts forth an outline for Myanmar's development over the next 20-year period and is considered the comprehensive reference material for Myanmar's present and future economy.

MCDV can be chiefly divided into five strategies; (i) the "Agriculture Plus Plus" Growth Strategy, (ii) Export-oriented growth, (iii) FDI-driven growth, (iv) Two-polar growth, and (v) the development of domestic economic corridors. A more detailed explanation of MCDV's five strategies can be found in Table 3.1.1.

Table 3.1.1 Five MCDV Strategies and Messages

Strategy	Main Message
"Agriculture Plus Plus"	- Increasing productivity through irrigation, fertilizer, agriculture machine use; Establishing an agriculture credit system (the first "plus") - Expanding economic functions of agriculture along its value chain: R&D, qualified seed, crop choice at the upstream side, and post harvesting, processing marketing, exporting and branding at the down streaming side (the second "plus")
Export-oriented growth	- Difference between garment and electronic exports since the 1990s - Diversifying export goods (from raw material to diverse manufactured goods)
FDI-driven growth	- Promoting FDI for export-oriented growth - Crowding in domestic investment instead of crowding out - Spillover effect from foreign companies or joint-venture companies to domestic firms - Entering the asian production system though "export-oriented growth" and "FDI-driven growth"
Two-polar growth	- Concentrating investments into developed industrial bases in Yangon and Mandalay - Contributing to balanced national development though poverty reduction in the Mandalay Region (accelerating economic development in Mandalay) and the delta area (accelerating economic development in Yangon) through two-polar growth
Development of domestic economic corridors	- Developing border areas (national borders with Thailand, China and India) - Creating four economic corridors (north-south, east-west, right sash and left sash corridors) to make Myanmar a "connecting node" or "land bridge" between Thailand, Laos, China, India, Bangladesh and the Indian Ocean

Source: Compiled by JICA Survey Team

(5) Provincial Development Plans

Table 3.1.2 indicates the Regional Comprehensive Development Plans of three regions/states. The Department of Planning, MNPED has collected these plans to compile the NCDP.

Each plan consists of four parts: identification of problems, policies, objectives and action plans. Industrial development and narrowing the gap between urban and rural areas is a common policy issue and objective through the three region/states.

Table 3.1.2 Regional Comprehensive Development Plans of 3 Regions/States

	Kayin State	Tanintharyi Region	Mon State
Identification of problems	- Lack of quality and high yield seed usage. - Need for livestock capital , especially for low interest rate and long-term loans - Inadequate lodging for tourism - Airport for foreigners from Thai border to Kayin State - Communication difficulties and weak private transportation - Less-developed health sector, inadequate medical instruments and pharmacies	- Difficulties in narrowing paddy fields for reclamation - Need for technology, vessels and instruments for catching fish and prawn to breed valuable fish species - Inadequate machinery to construct roads and bridges with new design - High cost of electricity and not electricity in rural areas - Lack of high quality training for educational staff	- Expensive agricultural implements - Informal cultivation of rubber - Inadequate timber for growing population - Operating gold with micro joint venture - Prioritizing only short-term economy - Upgrading technology and machinery in shipyards - At the time of standstill in hydroelectric power, others are

	Kayin State	Tanintharyi Region	Mon State
		- Receiving health information in a timely manner	not produced more. - Overloaded express buses - Little education knowledge - Lack of emergency health care and complying health knowledge
Policies	- Implement pacts laid down by state for prosperity, development of living standards and millennium development goals - Implement AEC in 2015	- Sustain agricultural development towards industrialization and improve value-added products, emphasizing small and medium enterprise towards heavy industry	- Sustain agricultural development towards industrialization and improve job opportunities and ensuring health and education towards the flourishing of socio-economic.
Objectives	- To maintain dam and tanks for effective cultivation use - To effectively use vacant and virgin lands for land use right to farmers and economic development. - To increase the production of meat, fish and eggs for more consumption by the people per year. - To develop wood-based industries and produce less waste when using natural resources - To narrow the gap between rural and urban development and create job opportunities by establishing industries - To promote local and foreign investment in hotels and tourism - To improve transportation (for improving socio-economic.) - To electrify households, industrial zones and establishments - To price communication services reasonably. - To develop the economy through cross-border transit trade according to strategic geo location - To develop human resources proficient in basic education and advanced technology to build peace and develop the nation.	- To get expected income for farmers by PPP in cultivation, processing, production of value-added goods. - To maintain and manage the biodiversity of Lanpi Marine National Garden in the Kauth Thaung District - To undertake the production, sales and distribution of electricity from the Ministry, national investors and foreign direct investment To support rural development and alleviate poverty by acquiring technology - To upgrade transportation services with a door-to-door system - To improve telephone and internet usage in rural areas to 75% and 50% - To donate to educational fields with the help of well-wishers - To improve health standards	- To develop agricultural products and enhance finished goods - To develop fishery production and reduce poverty - To develop wood-based industry and reduce waste of natural resources - To develop industry sector laid down by national objectives - To cooperate with foreign and local investors for land development - To implement ports in line with ASEAN standards - To develop the health sector according to MDGs - To protect national heritage
Action Plans	- Use hybrid and high yield seeds to get a higher yield per acre - Set up the development of a livestock village project with cooperation from Thailand in the Kyauk Lone Gyi livestock zone of Myawaddy township. - Produce value-added products to develop the border area - Encourage small and medium enterprises in import substitution and export promotion. - Develop hotels and tourism without affecting the environment, especially the special conservation district around Zwe Ka Pin Mountain, Than Taung Gyi and the ancient caves that interest foreigners.	- Have Market Validity for rice and use high quality and hybrid seeds Establish commercial livestock through foreign and local investments - Develop Special Economic Zone - Implement new renewable energy projects - Increase school enrolment with international organizations, local education funds and government - Fulfil health care needs by expanding infrastructure, health care services and constructing a health department and hospital	- Have Market Validity for rice and use high quality and hybrid seeds - Implement effective supervision in the livestock sector to obtain reliable data and increase production - Produce wood and non-wood products to conserve the forest and reserved forest - Expand mining areas by region - Maintain and repair Thahtone hydropower for more efficient production - Fulfil transportation requirements to develop a modern nation - Install Optical Fibre network connections around the state

	Kayin State	Tanintharyi Region	Mon State
	- Develop hydro power, coal electricity and other energy electricity with international cooperation. - Improve trade by connecting industrial zones and commodity markets at the border trade area. - Open a compacting school in accordance with increasing school enrolment. - Give health information from television, journals and posters to locals through discussion		- Develop financing sector - Promote health sector development - Endeavouring to come out private school systematically.

Source: Study on Regional Comprehensive Development Plans, Department of Planning, Ministry of National Planning and Economic Development, presentation at 2nd Workshop of Myanmar Comprehensive Development Vision, January 2013

(6) Regional Development Plan for Southeast Myanmar

JICA conducted a Study titled "Preparatory Survey for The Integrated Regional Development for Ethnic Minorities in The South-East Myanmar" during February and July of 2013. The Study Area was in Mon and Kayin States.

In the Study, a basic strategy for the regional development of Southeastern Myanmar was established in reference to the problem factors. Problem factors included (1) security problems and a lack of mutual trust between governments and ethnic peoples; (2) the Union Government's newly introduced localization policy has not been implemented locally; and (3) reflecting this, rich resources have not been effectively utilized due to inadequate environmental resource management. Therefore, the following components were proposed as part of the basic strategy.

- Improve security conditions through sharing development and security-related information with all stakeholders to cultivate mutual trust,
- Establish a mechanism for broad-based participation of all stakeholders in the development planning and implementation process, and
- Promote alternative socio-economic activities that are less resource intensive and environmentally friendly, and combine traditional practices with modern technology.

The study for the regional development of Southeast Myanmar has the following vision:

- Realization of a robust and resilient socio-economy adapting to a changing world and open to the global society supported by abundant natural resources, diverse economic activities and a rich cultural heritage.

The study also proposes a list of projects. The projects include: return and settlement support, an integrated regional development master plan and feasibility study for the Hpayathonzu to Thanbyuzayat road, water supply, roads and bridges, power supply, and industrial development.

3.1.2 Development Scenario

(1) Urban Development

JICA Survey Team on "The Survey Program for The National Transport Development Plan" prepared the National Spatial Planning Framework (NSPF) after an analysis of national development plans, 71 towns identified by the Department of Human Settlements and Housing Development of the Ministry of Construction, industrial estate locations, and areas of cultivation land.

The survey team set four kinds of centres: National Centres, Regional Centres, Agro-industry Centres, and Special Function Centre. The survey team classified districts in which 71 towns belong into the four levels by criteria such as urban population in 2012, percentage of urban

population in each district in 2012, district population in 2030 and population density of each district in 2030. The survey team also classified 71 towns into four kinds of centres by roles and functions of the towns such as administration/public service, industry and transportation service. Table 3.1.3 indicates the classification of seven towns in the Study Area.

Table 3.1.3 Four Centres Concept and 4-level Centres Hierarchy in the Study Area

Centres	1st level	2nd level	3rd level	4th level
National Centres	Yangon Mandalay Naypyitaw	-	-	-
Regional Centres	Hpa-An Dawei Mawlamyine	-	-	-
Agro-industry Centres	Thaton	-	-	-
Special Function Centres	-	Myeik	-	Myawaddy Kawthoung

Source: Interim Report 1 of "The Survey Program for the National Transport Development Plan"

State/region capitals in the Study Area are classified as first-level Regional Centres. Thaton is classified as a first-level Agro-industry Centre. Myeik, Myawaddy and Kawthoung are classified as Special Function Centres.

(2) Economic Development

Further assessment of natural and human resources and regional development plans is necessary but the JICA Survey Team has the following perspective on regional economic development:

- *Industrial Development:* There are currently 380 factories located in Mae Sot, Tak Province, Thailand, 80% of which are engaged in the CMP industry with around 30,000 Burmese workers (according to the Federation of Thai Industry (FTI) Mae Sot Office). The wage level in Thailand is increasing and the European Union plans to terminate the Generalized System of Preferences (GSP) for Thailand in 2015. Considering the aforementioned factors, labour-intensive industry in Mae Sot and other areas of Thailand have the potential to move to southwestern Myanmar. Infrastructure development, including road and electricity networks, will be required for the move.
- *Connectivity with Thailand:* Thailand is an important trade partner for Myanmar. Economic development and the formation of AEC in 2015 will increase both import and export volume. Southwest Myanmar connects Yangon with Bangkok. As indicated in Table 2.1.6 and Table 2.1.7, the East-West Economic Corridor is a major transport route with Thailand and the Three Pagodas Pass Road can also connect Yangon with Bangkok if the road network is improved.
- *Dawei Special Economic Zone:* Development of the Dawei Special Economic Zone (SEZ) will influence regional economic development; however, it is expected that the resultant acceleration of development will take some time. In addition, the economic relationship between Dawei SEZ and other regions of Myanmar is unclear. It will depend on the SEZ development concept and what types of industries are promoted.

3.1.3 Socio-economic Framework

(1) Population Growth

JICA Survey Team on "The Survey Program for The National Transport Development Plan" projected the national population until 2040. The Survey Team utilized a "comfort method," and prepared three alternative population growth scenarios in accordance with the difference of diminishing Total Fertility Rate (TFR). The Survey Team selected the middle scenario, in which TFR drops from 2.31 in 2015 to 1.71 in 2040. Population in this scenario will amount to 73.80 million in 2040.

Table 3.1.4 shows changes in region/state-wise population from 2012 to 2040. The Study Team distributed the population to regions/states, while considering migration due to regional economic development.

The table shows that the population of Kayin State will increase from 1.86 million in 2012 to 2.50 million in 2040. In Mon State, the population will increase from 3.19 million to 4.00 million and the population will increase from 1.76 million to 2.40 million in Tanintharyi Region. Percentages of region/state populations to the national population increase gradually in the three region/states.

Table 3.1.4 Population by region/state from 2012 to 2040

Unit: 1000 persons

Region/State	2012	2015	2020	2030	2040
Kachin State	1,616	1,721	1,820	1,935	1,973
Kayah State	365	391	424	450	460
Kayin State	1,855	1,986	2,151	2,401	2,496
Chin State	571	597	630	656	666
Sagaing Region	6,654	6,864	7,029	7,179	7,236
Tanintharyi Region	1,755	1,886	2,051	2,301	2,396
Bago Region	6,125	6,361	6,691	7,261	7,507
Magway Region	5,730	5,914	6,013	6,113	6,151
Mandalay Region	7,423	7,685	7,949	8,370	8,617
Mon State	3,193	3,324	3,489	3,846	3,998
Rakhine State	3,370	3,501	3,666	4,016	4,130
Yangon Region	7,170	7,617	8,739	10,445	11,015
Shan State	5,779	5,963	6,128	6,378	6,473
Ayeyarwaddy	8,205	8,520	8,685	8,864	8,902
Naypyitaw Council Territory	1,164	1,269	1,434	1,684	1,779
Total	**60,976**	**63,600**	**66,900**	**71,900**	**73,800**

Source: Population Department, Ministry of Immigration and Population (2012)
and JICA Survey Team on "The Survey Program for the National Transport Development Plan"

Table 3.1.5 Population by District in the Survey Area from 2012 to 2040

Unit: 1000 persons

District	2012	2015	2020	2030	2040
Kayin State	**1,855**	**1,987**	**2,150**	**2,401**	**2,497**
Hpa-An (South)	916	981	1,067	1,213	1,273
Hpa-An (North)	113	121	129	130	130
Myawaddy	64	69	99	122	132
Kawkareik	595	637	667	744	774
Hpapun	167	179	189	192	187
Mon State	**3,193**	**3,324**	**3,489**	**3,846**	**3,998**
Mawlamyine	1,942	2,022	2,114	2,231	2,119
Thaton	1,251	1,302	1,375	1,615	1,879
Tanintharyi Region	**1,756**	**1,886**	**2,051**	**2,301**	**2,397**
Dawei	811	871	954	1,105	1,318
Myeik	790	848	927	1,030	935
Kawthoung	155	167	170	166	144

Source: Population Department, Ministry of Immigration and Population (2012) and JICA Survey Team on "The Survey Program for the National Transport Development Plan"

Table 3.1.5 indicates population by districts in the Study Area. Rapid population growth is expected in Myawaddy District, Kayin State, Thaton District, Mon State and Dawei District, Tanintharyi Region. Table 3.1.6 shows the urban population change[16] in the same period. The urban population of Mon State will increase from 55.4% in 2012 to 56.7% in 2040, and the increase will be greater in Thaton District. Myawaddy District, Kayin State and Dawei District, Tanintharyi Region will also experience rapid urban population growth.

[16] General Administration Department, Ministry of Home Affairs classifies all townships in Myanmar into "urban" township and "rural" township. The urban population in a district is the sum of the populations of urban townships in Table 3.1.6.

Table 3.1.6 Urban Population by District in the Survey Area from 2012 to 2040

District	2012	2015	2020	2030	2040
Kayin State	**376**	**431**	**492**	**600**	**683**
Hpa-An (South)	195	225	260	324	369
Hpa-An (North)	12	14	16	17	17
Myawaddy	22	25	37	50	57
Kawkareik	129	146	156	179	186
Hpapun	18	21	24	25	24
Mon State	**1,205**	**1,360**	**1,567**	**2,048**	**2,481**
Mawlamyine	862	973	1,127	1,455	1,557
Thaton	343	387	440	593	924
Tanintharyi Region	**595**	**685**	**800**	**1,026**	**1,209**
Dawei	242	281	332	443	606
Myeik	282	325	385	498	526
Kawthoung	71	79	83	85	77

Source: Population Department, Ministry of Immigration and Population (2012) and JICA Survey Team on "The Survey Program for the National Transport Development Plan"

(2) Economic Development

The JICA Survey Team on "The Survey Program for The National Transport Development Plan" also projected GDP growth until 2035. Observing the government's economic growth target, experiences of other Asian countries and limited population growth prospect, the Study Team set the GDP growth rate from 2015 to 2035 at 7.2%. As a result, the National GDP in real terms will increase 3.4 times between 2012 and 2030, or from 46,915 billion Kyat to 160,498 billion Kyat .

Table 3.1.7 indicates GRDP changes by regions/states until 2030. The three region/states of the Study are projected to achieve more rapid economic growth than the national average and raise their GRDP share in the national GDP.

Table 3.1.7 Projection of GRDP by Region/State until 2030

Unit: billion Kyat

Region/State	2012	2015	2020	2030
Kachin State	1,097	1,317	1,858	3,467
Kayah State	172	227	345	667
Kayin State	829	1,033	1,503	3,583
Chin State	154	182	253	542
Sagaing Region	5,508	6,320	7,731	12,320
Tanintharyi Region	1,679	1,941	2,646	5,863
Bago Region	4,027	4,700	6,581	14,124
Magway Region	4,631	5,171	6,582	9,660
Mandalay Region	5,186	6,388	9,915	22,782
Mon State	2,063	2,502	3,560	7,580
Rakhine State	1,856	2,244	3,420	7,676
Yangon Region	10,294	13,710	21,705	47,162
Shan State	3,373	3,753	4,929	9,185
Ayeyarwaddy Region	5,465	6,267	7,772	12,597
Naypyitaw Concil Territory	581	810	1,280	3,290
Total	**46,915**	**56,565**	**80,080**	**160,498**

Source: JICA Survey Team on "The Survey Program for the National Transport Development Plan"

Table 3.1.8 indicates GRDP changes by district until 2030. Rapid economic development is expected in Myawaddy District (annual average economic growth rate from 2012 to 2030 will account for 11.0%), Hpa-An District (southern part, 9.1%), Thaton District (8.2%), Dawei District (7.9%) and Kawkareik District (7.8%). The proportion of GRDP in the Study Area will increase in these districts toward 2030.

Table 3.1.8 GRDP by District in the Study Area until 2030

	2012	2015	2020	2030
Kayin State	**829**	**1,032**	**1,504**	**3,583**
Hpa-An (South)	431	547	819	2,024
Hpa-An (North)	50	57	75	161
Myawaddy	41	46	83	215
Kawkareik	224	279	398	949
Hpapun	83	103	128	233
Mon State	**2,063**	**2,502**	**3,560**	**7,580**
Mawlamyine	1,258	1,514	2,100	4,245
Thaton	805	988	1,460	3,335
Tanintharyi Region	**1,679**	**1,941**	**2,645**	**5,862**
Dawei	781	922	1,296	3,049
Myeik	755	864	1,177	2,520
Kawthoung	143	155	172	293

Source: JICA Survey Team on "The Survey Program for the National Transport Development Plan"

3.2 Traffic Demand Forecast

3.2.1 Overview of Traffic Demand Forecast in MYT-Plan

The comprehensive traffic demand forecast was practised in the JICA-supported Survey Program for The National Transport Development Plan (hereinafter referred to as the MYT-Plan). The conventional four-step traffic demand model was developed based on the result of traffic surveys (traffic count survey, roadside OD interview survey, terminal interview survey and transport operators survey) and secondary information, such as population and economic indicators.

During modelling in the traffic demand forecast, the Study Area (the whole country) was divided into 71 traffic analysis zones. A traffic generation and attraction model was developed with a formula encompassing the population and GRDP as explanatory factors. The traffic distribution model was developed by a gravity model with zonal impedances (time and cost) as explanatory factors.

The traffic demand forecast was carried out by the intermediate and target years of 2020 and 2030 in the MYT-Plan. The OD matrix was prepared by seven different types of vehicles (passenger car, bus, small 2-axle truck, large 2-axle truck, 3-axle truck, four and over axle truck and trailer). The future road network (free flow speed and traffic capacity) was developed, considering the number of lanes, topography and pavement type.

3.2.2 Approach and Methodology of Traffic Demand Forecast in the Study

Basically, the same approach and methodology of the traffic demand forecast applied to the MYT-Plan is adopted for the traffic demand forecast in the Study, considering the following implications. First, the traffic demand forecast is carried out by 2030 (the target year of the MYT-Plan) and 2035 (the target year of the Study) [17]. Secondly, the OD matrix is calibrated by the Traffic Survey conducted in the Study. Thirdly, the modal share and route share models are newly developed, considering the sea and land transport of the EXIM cargo between Thailand and Myanmar, and the route share between the East West Economic Corridor (EWEC) and the newly improved Three Pagoda Pass.

3.2.3 Summary Result of Traffic Survey

(1) General

Both Traffic Count Survey and Roadside Interview Survey were carried out at designated locations in the Study Area. The primary objective in carrying out the Roadside Interview Survey is to gather demographic information and trip information, such as origin-destination (OD) data. The Traffic Count Survey, carried out at the same locations as the Interview Survey, is used to estimate traffic volumes across different vehicle types. Results from these two surveys serve as the basis for forecasting future vehicular traffic demand. The survey locations are determined, considering the administrative boundaries of Mon, Kayin, Tanintharyi States/Region and project locations.

The Traffic Count Survey was carried out at nine different locations and the Roadside Interview Survey at three locations, as illustrated in the following tables and map. The Traffic Count Survey was conducted on weekdays between 17th February and 4 March, 2014 and the survey duration varied from 16 hours to 24 hours per location and 16-hour duration traffic surveys were conducted from 5:30am to 9:30pm[18]. Surveys with 24-hour duration began at 5:30 AM on the first day and end at 5:30 AM on the following day.

[17] Generally, the 20th year is applied as the target year of economic infrastructure project, considering the design period of traffic demand forecast, design and economic analysis. Accordingly, 2035 is set as a target year of the project.

[18] The survey period of 16 hours is determined by the following reasons: i) To secure security in remote areas during the survey implementation, ii) The 16-hours traffic survey can capture 80% of the 24-hours traffic based on the result of the traffic survey conducted by JICA-supported Survey Program for The National Transport Development Plan.

Traffic Analysis Zone, applied for traffic survey and traffic demand forecast in the Study, is shown in Figure 3.2.2 and Table 3.2.2

Table 3.2.1 Roadside Interview and Traffic Count Locations and Durations

Site #	Road / Highway	State / Division	Traffic Counts	Survey Duration	Roadside Interview
1	Theinzayat (Theinzayat Toll Gate)	Bago-Mon	24 hours	2 weekdays	10 hours (07:30 – 17:30)
2	Bilin–Lagunpyo (Mon-Kayin Border)	Mon-Kayin	16 hours (05:30 – 21:30)	2 weekdays	NA
3	Thaton – Hpa-an (Don Tha Mi Bridge)	Mon	16 hours (05:30 – 21:30)	2 weekdays	NA
4	Mawlamyine (Mawlamyine Bridge)	Mon	24 hours	2 weekdays	NA
5	Mawlamyine–Eindu (Gyaing (Za Tha Pyin) Bridge)	Mon-Kayin	16 hours (05:30 – 21:30)	2 weekdays	NA
6	Hpa-an–Eindu (Naung Lon Bridge)	Kayin	16 hours (05:30 – 21:30)	2 weekdays	NA
7	Kawkareik Gyaing(Kawkareik) Br.	Kayin	16 hours (05:30 – 21:30)	2 weekdays	NA
8	Myawaddy (Myawaddy Toll Gate)	Kayin	16 hours (05:00 – 21:00)	4 weekdays	10 hours (07:30 – 17:30)
9	Mon-Tanintharyi Border	Mon-Tanintharyi	16 hours (05:30 – 21:30)	2 weekdays	10 hours (07:30 – 17:30)

Source: JICA Survey Team

Source: JICA Survey Team

Figure 3.2.1 Roadside Interview and Traffic Count Locations

Source: JICA Survey Team

Figure 3.2.2 Traffic Analysis Zone

Table 3.2.2 Summery of Traffic Analysis Zone

Code	State/Division/Province	District
1	Kachin	Myitkyina
2	Kachin	Mohnyin
3	Kachin	Bhamo
4	Kachin	Puta-O
5	Kayah	Loikaw
6	Kayah	Bawlake

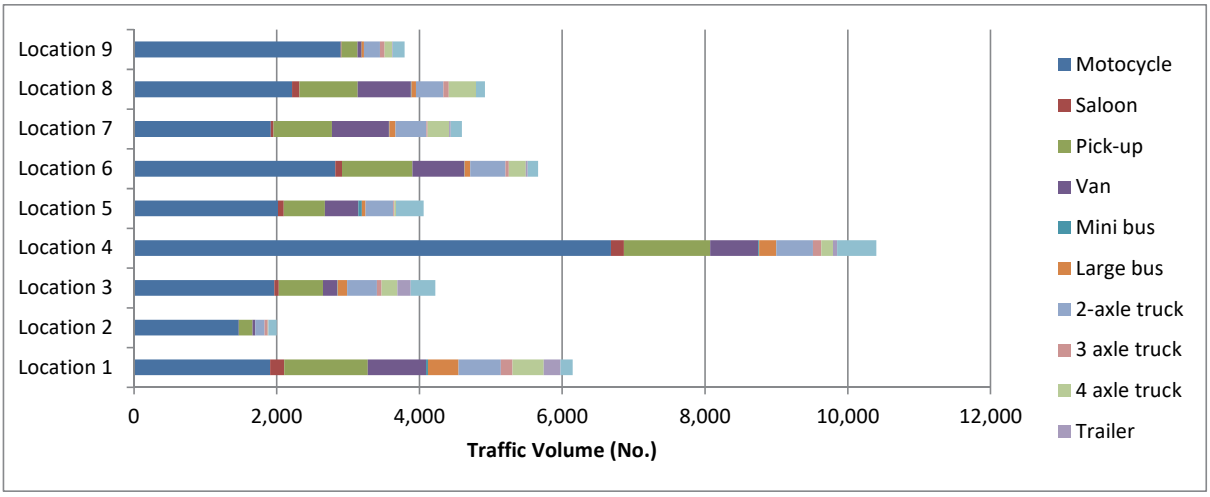
7	Kayin	Hpa-An South
8	Kayin	Myawaddy
9	Kayin	Kawkareik
10	Kayin	Hpapun
11	Chin	Falam
12	Chin	Mindat
13	Sagaing	Sagaing
14	Sagaing	Shwebo
15	Sagaing	Monywa
16	Sagaing	Katha
17	Sagaing	Kale
18	Sagaing	Tamu
19	Sagaing	Mawlaik
20	Sagaing	Hkamti
21	Tanintharyi	Dawei
22	Tanintharyi	Myeik
23	Tanintharyi	Kawthoung
24	Bago East	Bago
25	Bago East	Taungoo
26	Bago West	Pyay
27	Bago West	Thayarwady
28	Magway	Magway
29	Magway	Minbu
30	Magway	Thayet
31	Magway	Pakokku
32	Magway	Gangaw
33	Mandalay	Mandalay
34	Mandalay	Pyinoolwin
35	Mandalay	Kyaukse
36	Mandalay	Myingyan
37	Mandalay	Nyaung-U
38	Mandalay	Yamethin
40	Mandalay	Meiktila
39	Mandalay	Nay Pyi Taw
41	Mon	Mawlamyine
42	Mon	Thaton
43	Rakhine	Sittwe
44	Rakhine	Maungdaw
45	Rakhine	Kyaukpyu
46	Rakhine	Thandwe
47	Yangon	Yangon (North)
48	Yangon	Yangon (East)
491	Yangon	Yangon (Southeast)
492	Yangon	Yangon (Southwest)
50	Yangon	Yangon (West)
51	Shan (South)	Taunggyi
52	Shan (South)	Loilen
53	Shan (South)	Langkho

54	Shan (North)	Lashio
59	Shan (North)	Muse
55	Shan (North)	Kyaukme
56	Shan (North)	Kunlong
57	Shan (North)	Laukkaing
58	Shan (North)	Hopang
60	Shan (East)	Kengtung
61	Shan (East)	Monghsat
62	Shan (East)	Tachileik
63	Shan (East)	Monghpyak
64	Ayeyarwady	Pathein
65	Ayeyarwady	Hinthada
66	Ayeyarwady	Myaungmya
67	Ayeyarwady	Labutta
68	Ayeyarwady	Maubin
69	Ayeyarwady	Pyapon
70	Kayin	Hpa-An North

Source: JICA Survey Team

(2) Daily Traffic Volume

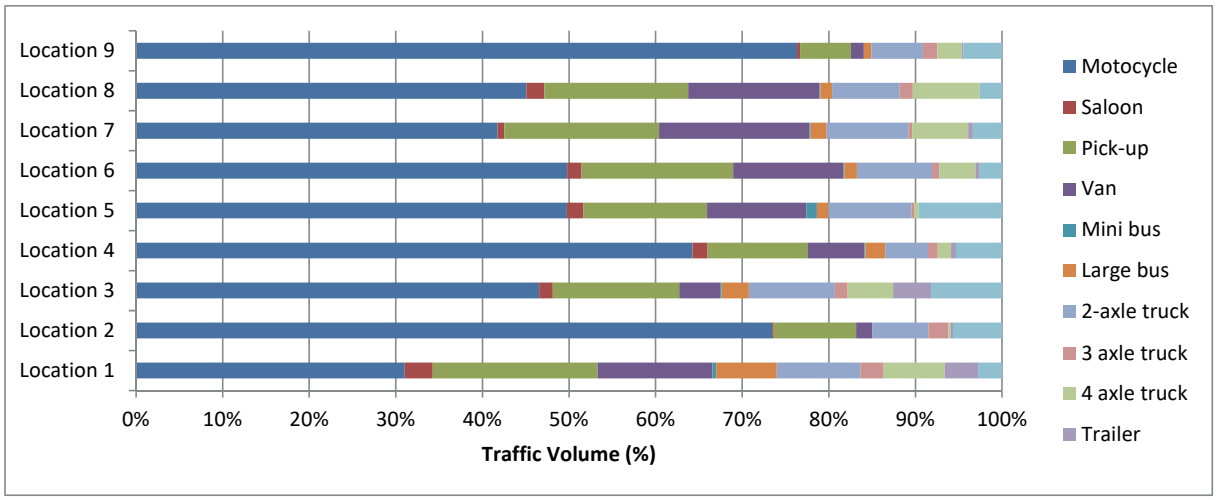
The 16-hour traffic is converted to the 24-hour daily traffic, using the 24/16 hour traffic conversion factor, prepared from the result of 24 hour traffic count survey. As seen in the following figure, the daily traffic volume varies among the survey locations and the busiest traffic is observed at Mawlamyine (Survey Location 4), exceeding 10,000 vehicles per day. Along the East-West Corridor, the traffic volume is observed non-significantly-different and ranges between 4,000 and 6,000 vehicles per day.



Source: JICA Survey Team

Figure 3.2.3 Traffic Volume by Vehicle Type

Like the traffic volume, the composition of the traffic varies between survey locations. More motorcycles were observed in both urban and remote areas, such as the Mon-Kayin Border (Location 2), Mawlamyine (Location 4) and Mon-Tanintharyi Border (Location 9), where motorcycles took up 65 to 75% of the traffic. Along other trunk roads in the Study Area, particularly the East-West Corridor, the heavy vehicles consisted of the larger share of the traffic and the share of the trucks/trailers reaches approximately 20% of the traffic.



Source: JICA Survey Team

Figure 3.2.4 Composition of Traffic Volume by Vehicle Type

Table 3.2.3 Traffic Volume by Vehicle Type (Vehicle/Day) [19]

Location	Motocycle	Saloon	Pick-up	Van	Mini bus	Large bus	2-axle truck	3 axle truck	4 axle truck	Trailer	Other	Total	Total (PCU)
Location 1	1,907	199	1,170	815	27	429	592	166	434	237	170	6,146	5,872
Location 2	1,468	4	190	38	0	0	129	46	5	6	113	1,999	544
Location 3	1,965	66	617	199	8	133	418	63	221	185	346	4,221	2,873
Location 4	6,684	181	1,207	674	13	239	515	116	162	59	551	10,401	4,076
Location 5	2,019	78	580	465	49	55	388	13	22	0	390	4,059	1,964
Location 6	2,819	95	990	723	5	81	491	47	237	28	146	5,662	3,411
Location 7	1,917	37	821	797	7	84	434	19	298	25	154	4,593	3,256
Location 8	2,216	102	818	744	7	66	383	74	380	0	127	4,917	3,384
Location 9	2,896	13	223	56	1	32	225	64	107	7	169	3,793	1,081

Source: JICA Survey Team

(3) Origin-Destination

The trip patterns of the sampled vehicles differ between survey locations. The following tables show the origin and destination matrix by passenger car/bus/truck. At Theinzayat, more traffic to/from Yangon, Bago and Mone is observed and for instance, the traffic between Yangon and Mone consists of 35 to 50% of the traffic sampled during the survey at Theinzayat.

Table 3.2.4 Proportional Car OD at Theinzayat Toll Gate (percentage)

Trucks	Mon	Bago	Kayin	Yangon	Others	**Total**
Mon	2	23	0	47	4	**77**
Bago		0	4	0	0	**4**
Kayin			0	15	4	**19**
Yangon				0	0	**0**
Others					0	**0**
Total						**100**

Passenger Cars	Mon	Bago	Kayin	Yangon	Others	**Total**
Mon	1	35	0	34	2	**72**
Bago		0	11	0	0	**11**

[19] The following table shows conversion factors of the PCU (Passenger Car Unit). Note that motorbikes and other vehicles are excluded from Passenger Car Unit since those two modes are considered as inner zonal traffic with shorter trip distance.

Vehicle type	Saloon, Pick-up, Van	Mini bus	Large bus	2-axle truck	3-axle truck	4-axle truck	Trailer
Conversion factor of PCU	1.0	1.5	2.0	1.5	2.0	2.25	2.5

Kayin			0	14	1	**15**
Yangon				0	2	**2**
Others					0	**0**
Total						**100**

Buses	Mon	Bago	Kayin	Yangon	Others	**Total**
Mon	0	33	0	47	6	**86**
Bago		0	3	0	0	**3**
Kayin			0	6	3	**8**
Yangon				0	3	**3**
Others					0	**0**
Total						**100**

Source: JICA Survey Team

At Myawaddy, the inner-traffic within Kayin is observed to be dominant, with trips from 65% of sampled passenger cars and 47% of sampled trucks being contained within Kayin. Buses travelled longer than passenger cars and trucks and more bus traffic is observed between Kayin and Bago/Yangon during the interview survey at Myawaddy.

Table 3.2.5 Proportional Car OD at Myawaddy Toll Gate (percentage)

Trucks	Mon	Bago	Kayin	Yangon	Others	**Total**
Mon	0	0	18	0	0	**18**
Bago		0	5	0	0	**5**
Kayin			47	23	7	**77**
Yangon				0	0	**0**
Others					0	**0**
Total						**100**

Passenger Cars	Mon	Bago	Kayin	Yangon	Others	**Total**
Mon	0	0	32	0	0	**32**
Bago		0	1	0	0	**1**
Kayin			65	2	0	**67**
Yangon				0	0	**0**
Others					0	**0**
Total						**100**

Buses	Mon	Bago	Kayin	Yangon	Others	**Total**
Mon	0	0	16	0	0	**16**
Bago		0	21	0	0	**21**
Kayin			16	47	0	**63**
Yangon				0	0	**0**
Others					0	**0**
Total						**100**

Source: JICA Survey Team

At the Mon-Tanintharyi border, as expected, most OD pairs are observed between Mon and Tanintharyi (74% of passenger cars, 56% of buses and 45% of trucks).

Table 3.2.6 Proportional Car OD at Mon-Tanintharyi Border (percentage)

Trucks	Mon	Bago	Kayin	Tanintharyi	Yangon	**Total**
Mon	7	0	0	45	5	**57**
Bago		0	0	2	0	**2**
Kayin			0	7	0	**7**
Tanintharyi				0	33	**33**
Yangon					0	**0**
Total						**100**

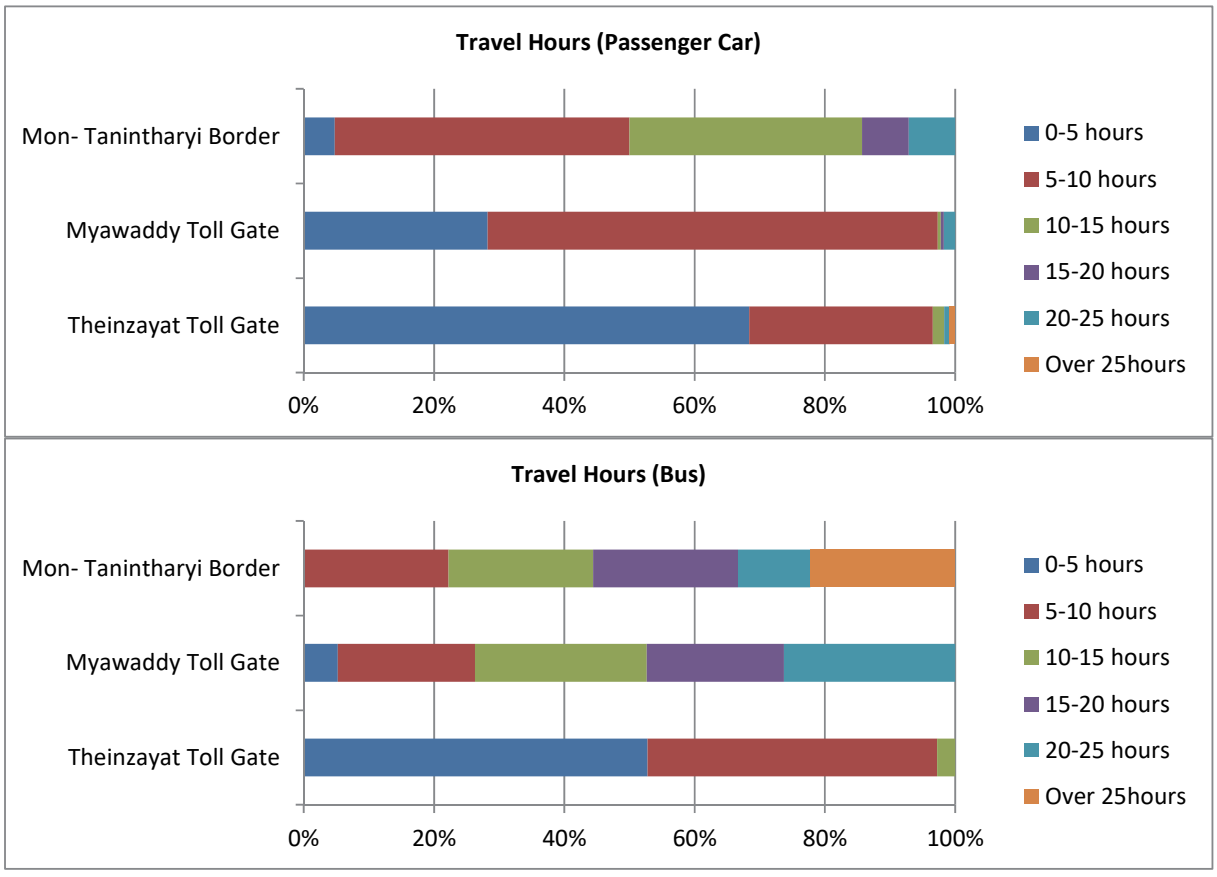
Passenger Cars	Mon	Bago	Kayin	Tanintharyi	Yangon	Total
Mon	0	0	0	74	0	**74**
Bago		0	0	2	0	**2**
Kayin			0	7	0	**7**
Tanintharyi				0	17	**17**
Yangon					0	**0**
Total						**100**

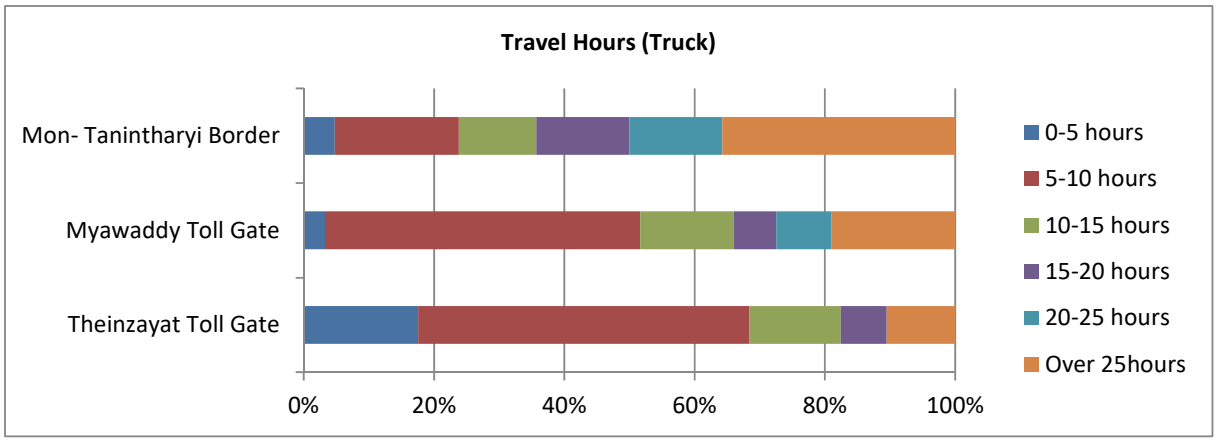
Buses	Mon	Bago	Kayin	Tanintharyi	Yangon	Total
Mon	0	0	0	56	0	**56**
Bago		0	0	0	0	**0**
Kayin			0	0	0	**0**
Tanintharyi				0	44	**44**
Yangon					0	**0**
Total						**100**

Source: JICA Survey Team

(4) Travel Time

Travel time also differs between survey locations and vehicle type. Sampled passenger cars travel for an average of 5.6 hours per trip (4.1 hours at Theinzayat Toll Gate, 5.6 hours at Myawaddy Toll Gate and 10.2 hours at Mon- Tanintharyi Border). The sampled buses travelled for an average of 9.9 hours per trip (4.9 hours at Theinzayat Toll Gate, 14.2 hours at Myawaddy Toll Gate and 21.0 hours at the Mon-Tanintharyi Border). The sampled trucks travelled for an average of 14.3 hours per trip (10.5 hours at Theinzayat Toll Gate, 13.7 hours at Myawaddy Toll Gate and 21.5 hours at Mon- Tanintharyi Border). Clearly, the trucks have the longest trips, followed by buses and then passenger vehicles.



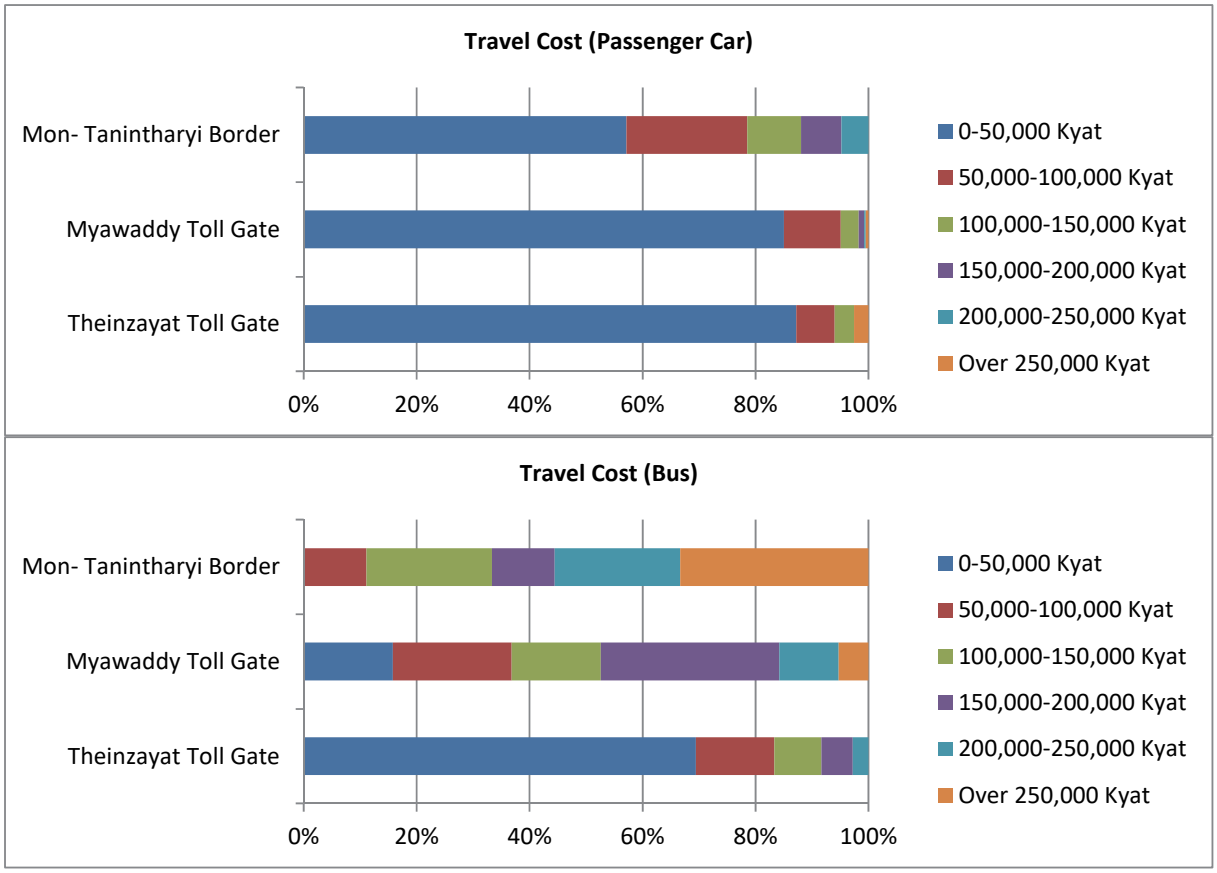


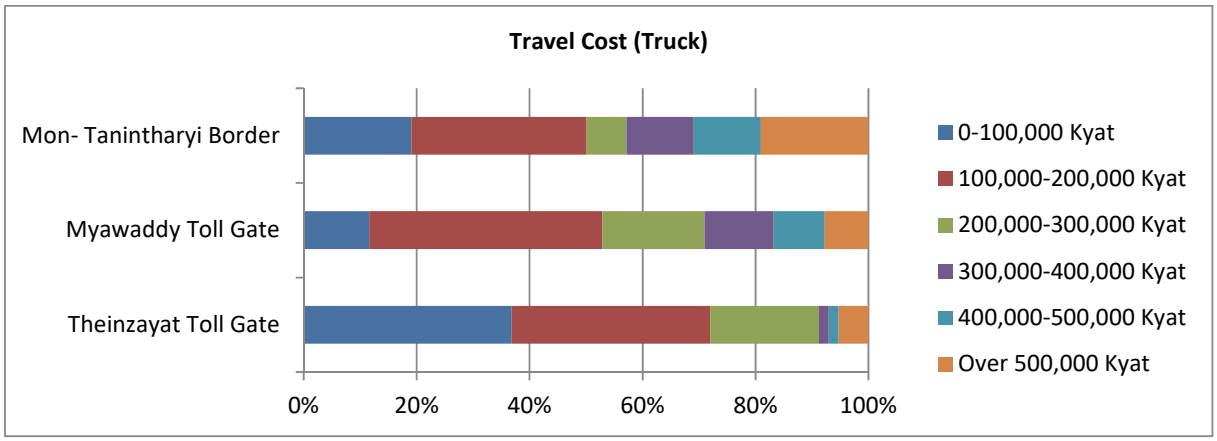
Source: JICA Survey Team

Figure 3.2.5 Travel Time (by Vehicle Type)

(5) Travel Cost

Travel costs for passenger cars were 38,000 Kyat per trip on average (30,000 Kyat at Theinzayat Toll Gate, 38,000 Kyat at Myawaddy Toll Gate and 61,000 Kyat at Mon-Tanintharyi Border). For buses, the average cost was 90,000 Kyat per trip (48,000 Kyat at Theinzayat Toll Gate, 119,000 Kyat at Myawaddy Toll Gate and 192,000 Kyat at Mon-Tanintharyi Border). For trucks, the average travels costs were 220,000 Kyat per trip (169,000 Kyat at Theinzayat Toll Gate, 231,000 Kyat at Myawaddy Toll Gate and 251,000 Kyat at Mon-Tanintharyi Border). Trucks pay the most, followed by buses and then passenger vehicles. This is consistent with the previous observation about travel time.





Source: JICA Survey Team

Figure 3.2.6 Travel Cost by Vehicle Type

(6) Commodity of the Truck

In addition to trip information, truck drivers provided information about the commodities carried by their trucks. At Theinzayat, the most common commodity observed was construction materials at 21%, followed by stone/sand at 18%. At Myawaddy, imports from Thailand were the major commodities transported, and the sampled trucks carried foodstuff (14% of the samples), construction materials (11%) and household articles (7%). At Mon-Tanintharyi Border, the most common commodity was agricultural products at 19%, followed by foodstuff at 17%, wood (and wood products) at 12%, and then fish products at 10%.

Empty trucks are also observed frequently during the survey period and 21% of the sampled trucks at Theinzayat, 32% at Myawaddy, and 29% of the Mon-Tanintharyi Border are empty.

Table 3.2.7 Commodity Type carried by Sampled Trucks (percentage)

	Theinzayat Toll Gate	Myawaddy Toll Gate	Mon-Tanintharyi Border
1_Live Animal & Animal Products	2	1	0
2_Fish and Aquatic Products	0	1	10
3_Vegetable and Fruits	5	3	0
4_Grain and Grain Products	7	0	0
5_Other Agricultural Products	2	5	19
6_Foodstuff, Beverage and Animal Food	5	14	17
7_Petroleum, Oil and Gas	7	6	7
8_Coal, Ore, Stone and Sand	18	1	0
9_Cement, Construction Material	21	11	7
11_Garment, Textiles and fabric	0	2	0
12_Wood and Wood Products	2	0	12
13_Paper and Printed Matter	2	1	0
14_Metal and Metal Products	2	2	0
15_Industrial Material, Chemicals	0	1	0
16_Household articles, miscellaneous	0	7	0
17_Machinery and Parts, Transportation	5	14	0
18_Empty	21	32	29
Total	100	100	100

Source: JICA Survey Team

(7) Loading Volume/Capacity of the Truck

The truck drivers also provided the loading capacity of their trucks and loading volume carried by their trucks. 2-axle trucks were found to have an average loading capacity of 5.7 tons and to be carrying 3.9 tons. 3-axle trucks had an average capacity of 12.1 tons and carried 9.7 tons, whereas 4-or-more-axle trucks had an average capacity of 19.4 tons and carried an average of 13.5 tons. The loading volume/capacity ratio of these trucks ranges between 70 to 80%. However, the loading volume/capacity ratio of trailers was observed to be relatively small. During the survey, trailer trucks had an average loading capacity of 26.7 tons but carried an average of only 6.7 tons.

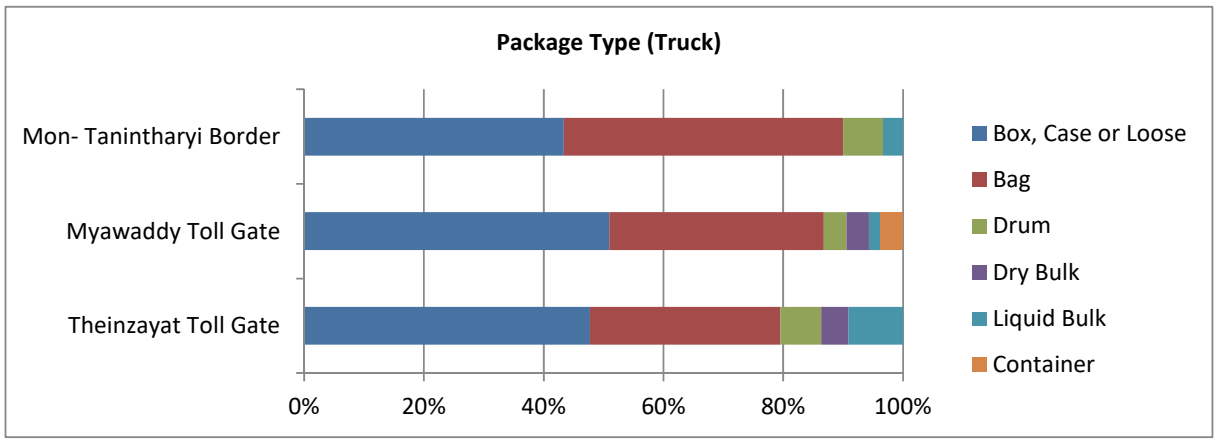
Table 3.2.8 Commodity Type carried by Sampled Trucks

	Loading Volume (Ton)	Loading Capacity (Ton)	Loading volume/capacity
2-axle truck	3.9	5.7	68%
3-axle truck	9.7	12.1	81%
4+-axle truck	13.5	19.4	69%
Trailer truck	6.7	26.7	25%

Source: JICA Survey Team

(8) Package Type of the Commodity

Over 80% of the trucks surveyed carried their commodities in boxes and bags. Containerization (the world-wide trend for freight business) is not yet commonplace in the Study Area, with only 4% of the sampled trucks at Myawaddy using containers, and none of the sampled trucks in the other two survey areas using them.



Source: JICA Survey Team

Figure 3.2.7 Package Type carried by Sampled Trucks

3.2.4 Overview of International Trade

(1) EXIM in Myanmar

In terms of tonnage, major import commodities in Myanmar include petroleum, construction materials, industrial materials (such as metal products and chemicals) and foodstuff. Myanmar's total import volume reached over 9.2 million tons in 2010.

Myanmar's major export commodity is natural gas, exported mainly to Thailand. Other export goods include raw materials (such as coal and ore), wood products and vegetables. Myanmar's total export volume reached 19.1 million tons in 2010.

Table 3.2.9 2010 Import Volume to Myanmar

Commodities	Import (ton)	Share
Petroleum, Oil and Gas	2,666,392	29%
Cement, Construction Material (incl. steel frames)	2,588,534	28%
Metal and Metal Products (excl. construction material)	1,069,031	12%
Industrial Material, Chemicals	765,393	8%
Foodstuff, Beverage and Animal Food	617,868	7%
Grain and Grain Products	437,234	5%
Machinery and Parts, Transportation	289,820	3%
Paper and Printed Matter	167,590	2%
Coal, Ore, Stone and Sand	161,706	2%
Garment, Textiles and fabric	139,011	2%
Household articles, miscellaneous	120,003	1%
Live Animal & Animal Products	96,076	1%
Fertilizer (incl. Urea)	91,427	1%
Wood and Wood Products	21,990	0%
Other Agricultural Products	8,725	0%
Vegetable and Fruits	387	0%
Fish and Aquatic Products	225	0%
Total	**9,241,410**	**100%**

Source: UN ComTrade (prepared by JICA Survey Team)

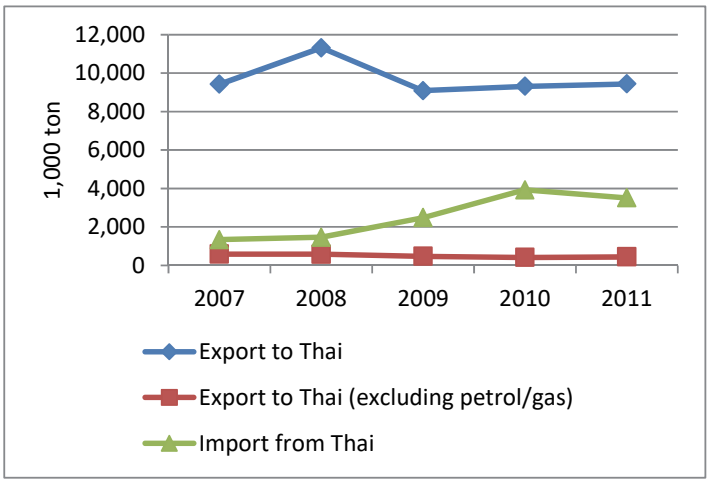
Table 3.2.10 2010 Export Volume from Myanmar

Commodities	Export (ton)	Share
Petroleum, Oil and Gas	11,159,772	58%
Coal, Ore, Stone and Sand	2,034,070	11%
Wood and Wood Products	1,881,029	10%
Vegetables and Fruits	1,842,003	10%
Grain and Grain Products	1,014,173	5%
Industrial Material, Chemicals	459,249	2%
Fish and Aquatic Products	378,849	2%
Other Agricultural Products	150,496	1%
Foodstuff, Beverage and Animal Food	83,496	0%
Garment, Textiles and fabric	29,667	0%
Paper and Printed Matter	24,133	0%
Live Animal & Animal Products	22,126	0%
Metal and Metal Products (excl. construction material)	16,188	0%
Household articles, miscellaneous	7,719	0%
Machinery and Parts, Transportation	173	0%
Cement, Construction Material (incl. steel frames)	55	0%
Fertilizer (incl. Urea)		0%
Total	**19,103,197**	**100%**

Source: UN ComTrade (prepared by JICA Survey Team)

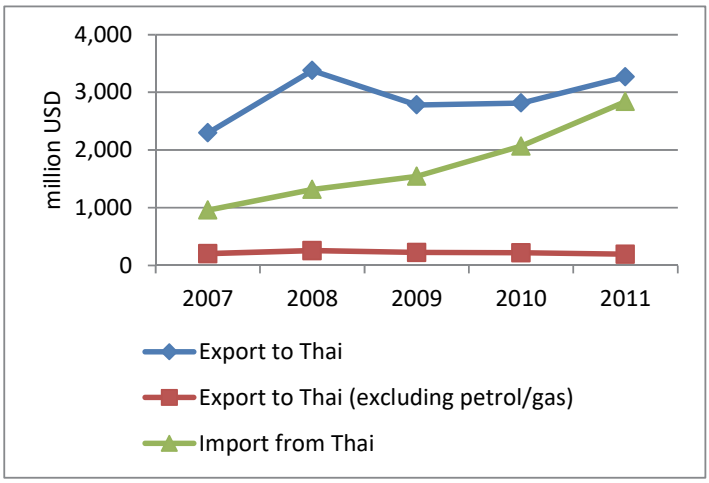
(2) EXIM between Myanmar and Thailand

Since the traffic network in the Study Area includes the East-West Economic Corridor, and the traffic in the area is affected by Myanmar-Thailand trade, the following discussion overviews the recent trade trends between these two countries. Looking at the EXIM volume between Myanmar and Thailand, the import volume from Thailand has drastically increased in terms of both tonnage and value. The import volume from Thailand was observed at 1.3 million tons in 2007, and increased by 32% p.a., reaching 3.5 million tons in 2011. Likewise, the import value from Thailand was 958 million USD in 2007 and increased to 2,840 million USD in 2011. On the other hand, export volume and value to Thailand remained stagnant during the same period.



Source: UN ComTrade (prepared by JICA Survey Team)

Figure 3.2.8 Myanmar EXIM to/from Thailand (by tonnage)



Source: UN ComTrade (prepared by JICA Survey Team)

Figure 3.2.9 Myanmar EXIM to/from Thailand (by value)

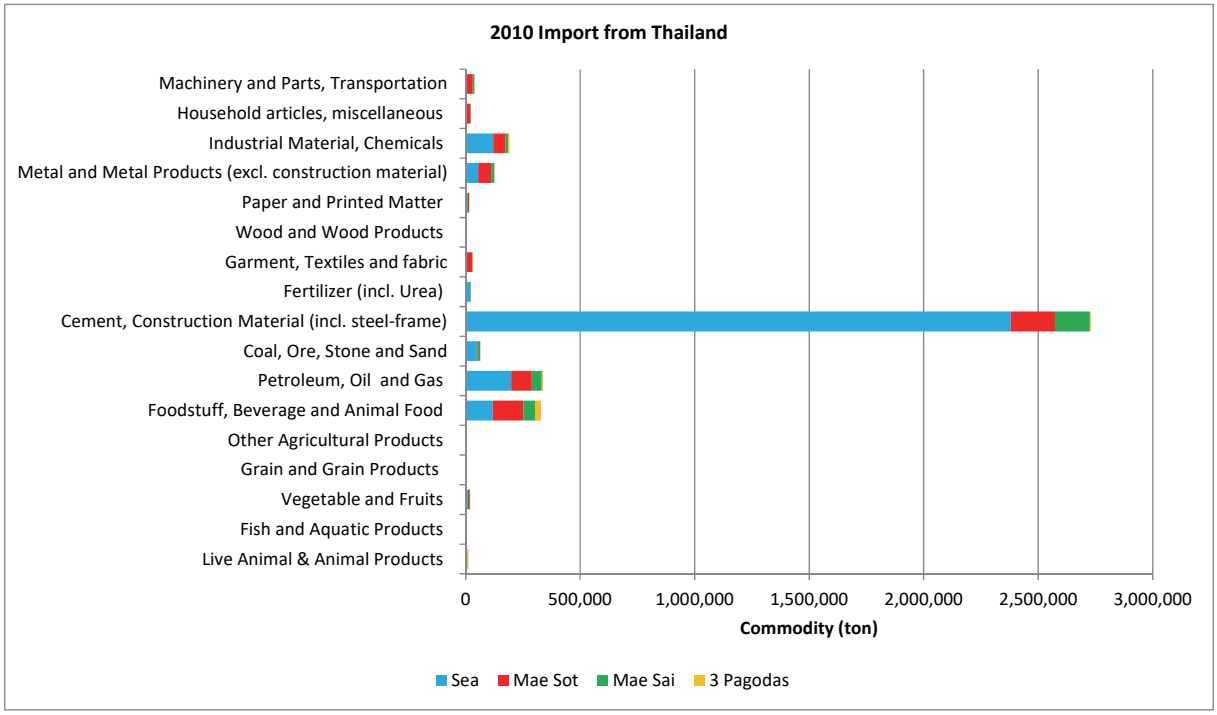
(3) EXIM by Transport Route between Myanmar and Thailand

The detailed EXIM data between Myanmar and Thailand was obtained from the Customs Department of Thailand. Data analysis implies that the majority of import goods from Thailand are transported by ship, but a considerable amount of import goods are also transported by land, especially by the East-West Corridor through Myawaddy/Mae Sot.

The import volume from Thailand totalled 3.9 million tons in 2010. 3.0 million tons (75%) of import goods were carried by ship while 0.6 million tons (16%) were transported though Myawaddy/Mae Sot. Major import goods from Thailand include construction materials (2.7

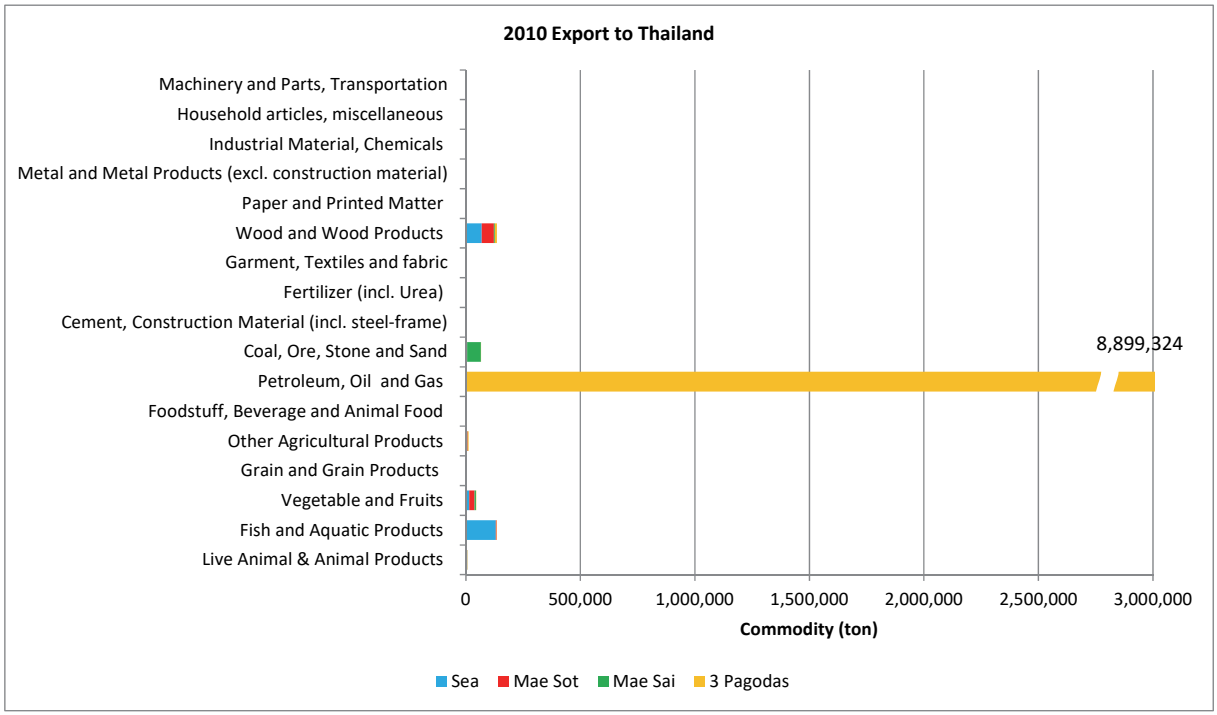
megatons in 2010), petroleum (0.3 megatons) and foodstuff (0.3 megatons).

The dominant export to Thailand is natural gas (8.9 megatons in 2010). A pipeline near Three Pagoda Pass transports 100% of the natural gas. Other than natural gas, a minimal amount of exports goods were observed, including wood products (0.1 megatons in 2010) and fish products (0.1 megatons).



Source: Customs Department of Thailand (prepared by JICA Survey Team)

Figure 3.2.10 2010 Import from Thailand by Import Route



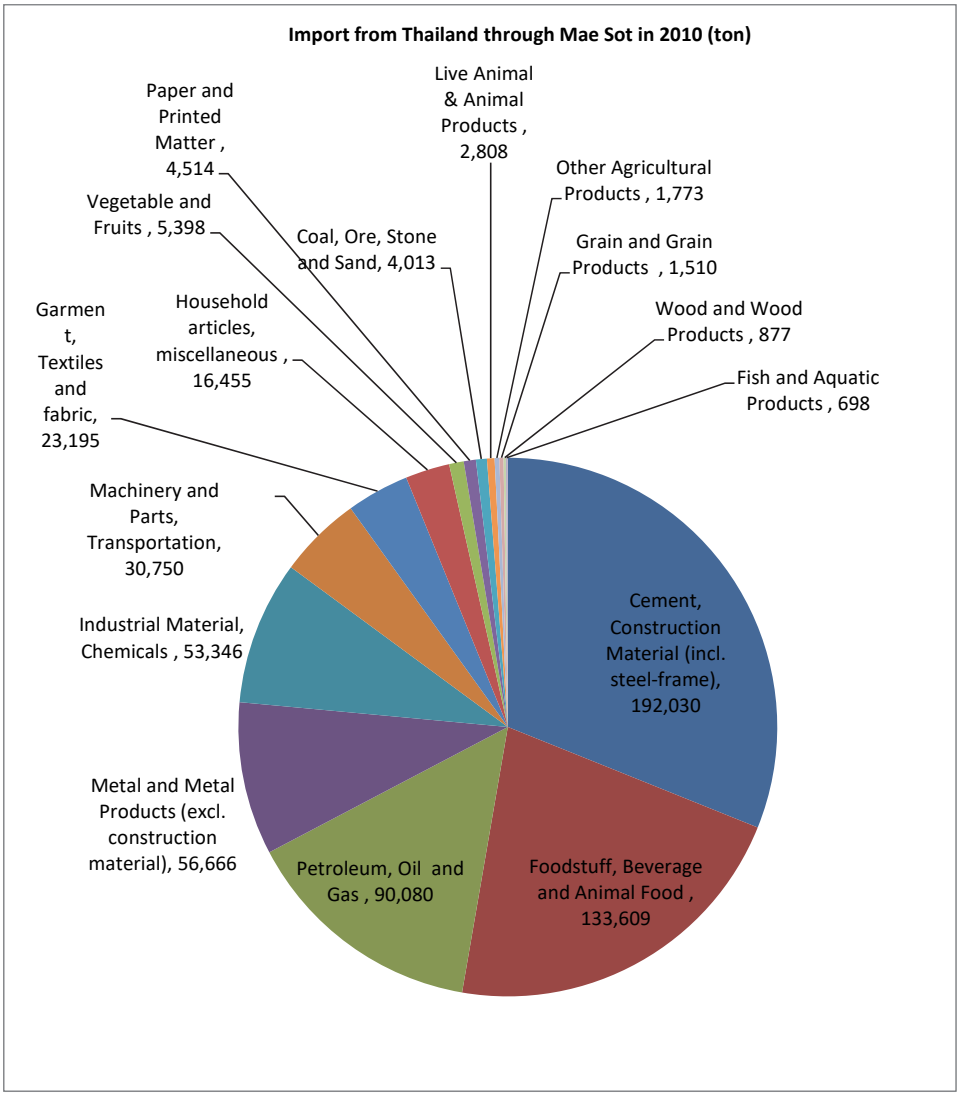
Source: Customs Department of Thailand (prepared by JICA Survey Team)

Figure 3.2.11 2010 Export to Thailand by Export Route

(4) EXIM through Myawaddy/Mae Sot

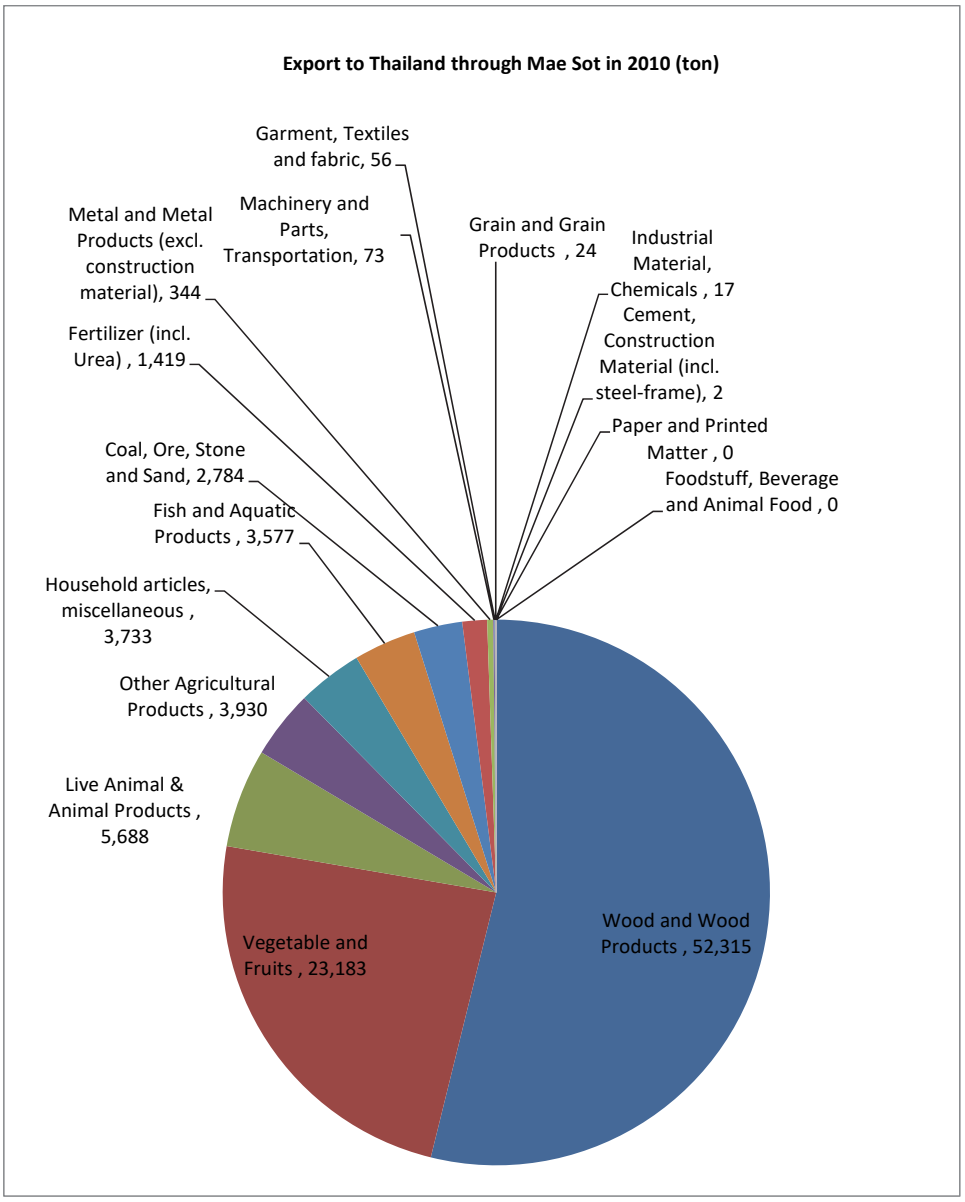
From the same customs data provided by the Customs Department of Thailand, the total amount of import goods from Thailand through Myawaddy/Mae Sot was observed at 618,000 tons in 2010. Major import goods from Thailand include construction materials (192,000 tons in 2010), foodstuff (134,000 tons), petroleum (90,000 tons), and metal products (57,000 tons). The average volume of the import commodity was 809 USD per ton.

Less export goods to Thailand are observed at Myawaddy/Mae Sot. The total amount of export goods reached 97,000 tons in 2010. Major export goods to Thailand include wood products (52,000 tons in 2010) and vegetables (23,000 tons).



Source: Custom Department of Thailand (prepared by JICA Survey Team)

Figure 3.2.12 2010 Import from Thailand through Myawaddy/Mae Sot



Source: Custom Department of Thailand (prepared by JICA Survey Team)

Figure 3.2.13 2010 Export to Thailand through Myawaddy/Mae Sot

3.2.5 Traffic Demand Forecast in the Study (Base Case)

(1) Calibration of the OD Matrix

As described in Chapter 2, the Traffic Count Survey was carried out at nine survey locations along the main trunk roads in the Study Area (Mon and Kayin States and Tanintharyi Region), where the administrative boundaries of the Study Area and the projects are located. The Roadside OD Interview Survey was also conducted in three survey locations within the administrative boundaries of the Study Area. Using the results of the Traffic Count and OD Interview Surveys, the current and future OD matrices were calibrated.

During the calibration of the OD matrix, the estimated OD matrix and assigned traffic volume was adjusted to match the observed traffic volume, in order to ensure accuracy of the traffic demand forecast in the Study[20]. As a result, distortion between the assigned traffic volume of the project roads and observed traffic volume is curtailed to a maximum of 7%. The correlation coefficient between estimated traffic volume and actual traffic volume is quite high, estimated at 0.94.

Table 3.2.11 Assigned Traffic Volume and Observed Traffic Volume[21]

Location		Actual (PCU)	Estimates (PCU)	Difference	Projects
Location 1	Theinzayat	5,885	5,900	0%	
Location 2	Belin–Lagunpyo	391	0	-	
Location 3	Thaton–Hpa-an	2,160	2,200	2%	Thaton Bypass
Location 4	Mawlamyine	3,014	2,900	4%	
Location 5	Mawlamyine– Eindu	1,448	1,400	3%	Gyaing (Zathapyin) Bridge, Atran Bridge
Location 6	Eindu–Kyondo	2,473	2,300	7%	Naung Lon Bridge
Location 7	Kawkareik	2,369	2,500	6%	Gyaing (Kawkareik) Bridge
Location 8	Myawaddy	2,463	1,900	22%	
Location 9	Ye	1,082	1,100	2%	Thanbyuzayat – Dawei

Source: JICA Survey Team

(2) Projection of Future EXIM Cargo Volume between Thailand and Myanmar

In the MYT-Plan, a socio-economic framework was developed that suggested the increase of the population from 59M in 2010 to 72M in 2030 (and 74M in 2035), with an average annual growth rate of 1.0%. The GDP was projected to increase from $45B (USD) in 2010 to $176B in 2030 (and $246B USD in 2035) assuming the 2010 annual growth rate of 7.0% remains constant. Accordingly, the MYT-Plan suggested the GDP per capita shall increase from $770 (USD) in 2010 to $1,800 in 2025 (equal to the current GDP per capita of Vietnam), $2,400 in 2030 (equal to that of Philippines and half of Thailand) and $3,300 in 2035 (equal to that of Indonesia).

Considering Myanmar's population and industrial development potential, the Study assumes that Myanmar will develop its economy similar to that of Vietnam. Looking at the GDP and EXIM volume of Vietnam in the last decade (2000–2011), the elasticity of the EXIM cargo volume against GDP is estimated at 1.29 for import commodities and 2.37 for export commodities[22] and is summarized in Table 3.2.12.

[20] OD matrix is calibrated by adjusting the traffic generation and attraction volume (multiplying the same enlargement factor to the OD pair traffic volume of the traffic generation/attraction generated from the same zone.)

[21] The figure of actual traffic volume observed during the traffic survey at Locations 2 to 8, in the above table, excludes inner-zonal traffic (excluding the cordon line survey carried at Location 1 and Location 9). The inner-zonal traffic rate is estimated at 32% passenger cars, 8% buses and 24% trucks, based on the OD interview survey conducted in the Study.

[22] Elasticity of the import of Commodity_9 (Cement and Construction Material) is referred to that projected by Thai EXIM data and estimated at 1.865 since extra-ordinal projection is observed using the Vietnam EXIM data.

Table 3.2.12 Elasticity of the Commodity-wise EXIM Cargo Volume against GDP

Commodity	EXIM ton - GDP elasticity (Constant Price 2005)	
	Import	Export
1_Live Animal & Animal Products	2.92	-0.56
2_Fish and Aquatic Products	1.36	-0.94
3_Vegetable and Fruits	2.62	0.08
4_Grain and Grain Products	1.48	1.80
5_Other Agricultural Products (ex. Plantation Product)	2.52	1.57
6_Foodstuff, Beverage and Animal Food	2.52	1.30
7_Petroleum, Oil and Gas	0.17	3.77
8_Coal, Ore, Stone and Sand	2.18	3.40
9_Cement, Construction Material (incl. steel - frame)	1.87	2.15
10_Fertilizer (incl. Urea)	0.10	2.51
11_Garment, Textiles and fabric	1.25	1.22
12_Wood and Wood Products	4.12	1.83
13_Paper and Printed Matter	1.46	1.92
14_Metal and Metal Products (excl. construction material)	1.80	3.04
15_Industrial Material, Chemicals	1.49	1.77
16_Household articles, miscellaneous	1.34	0.44
17_Machinery and Parts, Transportation	0.67	1.50
Total	1.29	2.37

Source: JICA Study Team

Assuming Myanmar's GDP growth to be 7% p.a. until 2035 (the same growth rate applied to the MYT-Plan) and using the elasticity GDP estimated above, the commodity-wise import volume from Thailand to Myanmar is estimated to reach 28 million tons with an increase to 9% p.a. (GDP growth rate of 7.0% * 1.29), and the export volume from Myanmar to Thailand is estimated to reach 17 million tons with an increase to 17% p.a. (7% * 2.37) by 2035.

Table 3.2.13 Current and Future EXIM Cargo Volume between Thailand and Myanmar[23]

Commodity	Myanmar-Thailand (Unit: '000 ton)							
	2011 Import	2030 Import	2035 Import	Growth Rate	2011 Export	2030 Export	2035 Export	Growth Rate
1_Live Animal & Animal Products	15	250	496	16%	5	2	2	-5%
2_Fish and Aquatic Products	1	2	3	5%	102	28	16	-7%
3_Vegetable and Fruits	12	140	253	14%	25	28	23	0%
4_Grain and Grain Products	6	18	23	6%	0	0	0	12%
5_Other Agricultural Products (ex. Plantation Product)	1	16	27	13%	9	68	93	10%
6_Foodstuff, Beverage and Animal Food	395	4,280	7,544	13%	4	18	23	8%
7_Petroleum, Oil and Gas	388	240	199	-3%	-	-	-	-
8_Coal, Ore, Stone and Sand	72	526	837	11%	107	6,074	14,443	23%
9_Cement, Construction Material (incl. steel - frame)	2,122	10,814	15,626	9%	0	0	0	14%
10_Fertilizer (incl. Urea)	36	20	16	-3%	1	14	26	17%
11_Garment, Textiles and fabric	36	86	103	5%	0	1	1	8%
12_Wood and Wood Products	6	377	1,047	24%	179	1,751	2,617	12%
13_Paper and Printed Matter	17	54	68	6%	3	30	46	12%
14_Metal and Metal Products (excl. construction material)	118	556	787	8%	3	131	283	20%
15_Industrial Material, Chemicals	206	674	867	6%	0	3	5	11%
16_Household articles, miscellaneous	30	83	101	5%	1	1	1	2%
17_Machinery and Parts, Transportation	52	62	61	1%	0	1	1	10%
Total	3,511	18,198	28,060	9%	439	8,151	17,581	17%

Source: JICA Study Team

[23] The export of Commodity_7 (Petroleum, Oil and Gas) is excluded from the analysis since the export of thenatural gas from Myanmar to Thailand uses a pipeline as a transport mode and which will not change the transport mode in future.

(3) Modal Share of EXIM Cargo between Thailand and Myanmar

Customs data obtained from the Customs Department of Thailand showed 75% of the total import cargo from Thailand, and 56% of the total export cargo to Thailand was transported by sea in 2011[24,25].

Table 3.2.14 Commodity-wise Share of EXIM Cargo between Thailand and Myanmar by Sea Transport

Commodity	2011 Import from Thai (Unit:'000 ton)			2011 Export from Thai (Unit:'000 ton)		
	Total Volume	Volume by Sea Transport	Share	Total Volume	Volume by Sea Transport	Share
1_Live Animal & Animal Products	12	4	34%	6	0	0%
2_Fish and Aquatic Products	1	0	5%	134	131	97%
3_Vegetable and Fruits	18	9	50%	44	15	34%
4_Grain and Grain Products	6	3	49%	1	1	95%
5_Other Agricultural Products (ex. Plantation Product)	2	0	0%	11	3	29%
6_Foodstuff, Beverage and Animal Food	328	118	36%	5	5	100%
7_Petroleum, Oil and Gas	337	199	59%	-	-	-
8_Coal, Ore, Stone and Sand	64	48	75%	67	3	5%
9_Cement, Construction Material (incl. steel - frame)	2,729	2,381	87%	0	0	14%
10_Fertilizer (incl. Urea)	22	21	96%	1	0	0%
11_Garment, Textiles and fabric	31	5	15%	3	2	92%
12_Wood and Wood Products	4	2	56%	136	69	51%
13_Paper and Printed Matter	15	10	69%	2	2	91%
14_Metal and Metal Products (excl. construction material)	125	54	43%	3	3	84%
15_Industrial Material, Chemicals	191	120	63%	1	1	96%
16_Household articles, miscellaneous	23	4	17%	4	0	0%
17_Machinery and Parts, Transportation	39	0	0%	0	0	0%
Total	3,947	2,978	75%	418	234	56%

Source: Prepared by JICA Study Team based on Thai Custom Department

In order to estimate the modal share of the EXIM cargo between Thailand and Myanmar, the current and future zonal impedance (time and cost) is prepared based on the survey report prepared by a Japanese forwarding company (2013). The following tables summarize the sea and land transport cost and time between Thailand and Myanmar, in the case of transporting EXIM cargo between Ayutthaya[26] and Yangon. Future land transport costs between Thailand and Myanmar are estimated considering the future road network improvement along the EWEC in Myanmar.

[24] As discussed in Chapter 2, total trade volume between Thailand and Myanmar is referred from UN COmTrade database and trade volume by land transport is estimated from Thai Custom Data. Since trade volume by air transport is considered minor, the modal share of cargo by shipping is estimated, assuming the remaining cargo transported other than by land transport is transported by shipping. As mentioned above, a considerable amount of natural gas is exported from Myanmar to Thailand by pipeline, but which is excluded from the analysis and thus is not shown in the table. (See the table in Chapter 2)

[25] As shown in the following table, 89% of the cargo in a monetary term handled in the major ports across the country is handled in Yangon/Thilawa Ports(Source: Myanmar Statistical Yearbook 2010)

Port	Handling Volume (Million Kyat)	Composition
Sittwe	783.6	2%
Pathein	-	-
Coco Gyun	1.1	0%
Kyaukpyu	22.9	0%
Myeik	1,380.1	4%
Mawlamyine	-	-
Yangon	28,924.8	89%
Thandwe	-	-
Dawei	84.5	0%
Kawthaung	1,230.7	4%
Maungdaw	-	-
Total	**32,427.7**	**100%**

[26] Ayutthaya is selected as an origin in Thailand for the cost/time analysis on EXIM cargo between Thailand and Myanmar since a number of factories are located in industrial zones in Ayutthaya and commodities produced from these factories have modal choices between land and sea transport, according to the Japanese forwarder. It is also selected as a destination for the cost/time analysis since both at present and in the future, the volume of import cargo from Thailand to Myanmar exceeds the volume of export cargo from Myanmar to Thailand.

Table 3.2.15 Transport Cost between Thailand and Myanmar by Sea and Land Transport[27] (in case of transporting cargo from Ayutthaya to Yangon)

Cost Item	Sea Transport (USD)	Land Transport (USD)	
		Current	Future
1. Transport Charge	400	2,000	2,000
2. Customs Clearance	160	400	400
3. Import License	200	300	300
4. Documentation	250		
5. Transshipment	0	300	150
6. Port Charge	60	-	-
7. Others	30	300	300
Total	1,100	3,300	3,150

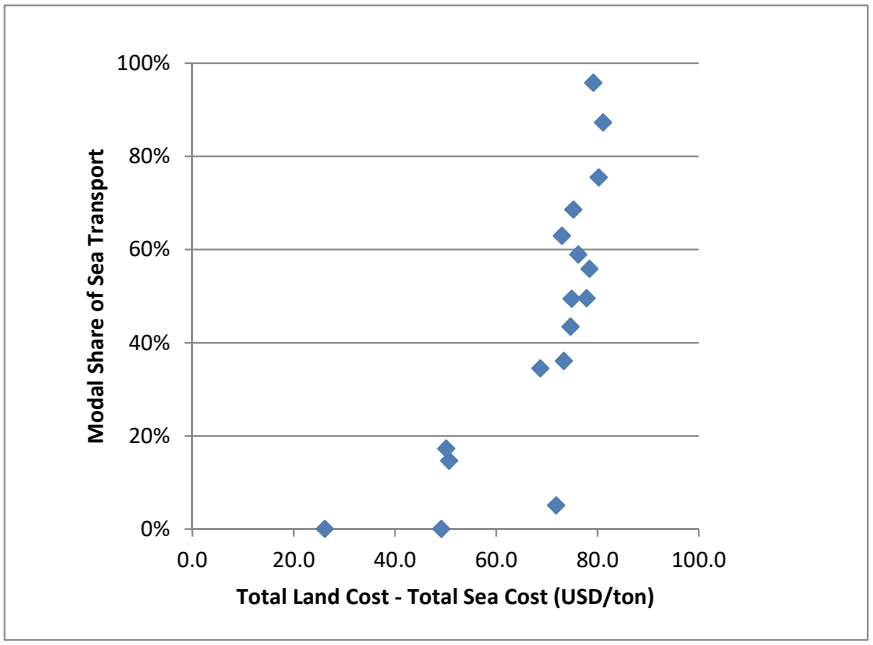
Source: JICA Survey Team, based on the survey report provided by Japanese forwarding company

Table 3.2.16 Transport Time between Thailand and Myanmar by Sea and Land Transport[28] (in case of transporting cargo from Ayutthaya to Yangon)

Sea Transport (Hour)		Land Transport (Hour)	Current	Future	Difference	Note
1. Transport		1. Transport				
Sea Transport	360.0	From Ayutthaya to Mae Sot	10.5	10.5	0.0	No change
Dredge (From Ayutthaya to Lenchabang)	12.0	From Myawaddy to Yangon	16.1	11.0	5.1	Travel speed of 60 km/h due to improvement of East West Corridor
Delivery (Yangon)	48.0	Waiting and Transshipment Time	47.8	17.8	30.0	Reduction in Transshipment (2 hours), One-way Operation (12 hours), Waiting time (16 hours)
2. Customs Clearance		2. Customs Clearance				
Export Clearance (Thailand)	24.0	Export Clearance (Thailand)	0.5	0.5	0.0	No change
Import Clearance (Myanmar)	72.0	Import Clearance (Myanmar)	5.4	5.4	0.0	No change
Total	516.0	Total	80.3	45.1	35.1	

Source: JICA Survey Team, based on the survey report provided by a Japanese forwarding company

The modal split model of the EXIM cargo between sea and land transport was developed assuming that most EXIM cargo is transported between the industrial zones in Ayutthaya and Yangon. Figure 3.2.14 shows the difference of the generalized cost (time and cost) between sea and land transport, and the share of the sea transport by commodity.



Source: JICA Survey Team

Figure 3.2.14 Difference of Generalized Cost and Share of Sea Transport between Thailand and Myanmar

[27] Current figure shown in the table indicates 2014 and the future figure is in 2035.
[28] Current figure shown in the table indicates 2014 and the future figure is in 2035.

The generalized cost of both sea and land transport is calculated by multiplying the time value of the cargo and travel time, and then adding the transport cost. The time value of the cargo is estimated by multiplying the cargo value and interest rate (i.e., cargo value*10% (borrowing interest rate at commercial banks in Myanmar)/365 days/24 hours).

Table 3.2.17 Commodity-wise Time Value of EXIM Cargo between Thailand and Myanmar

Commodity	Value (USD/Ton)	Time Value (USD/Hour/Ton)
1_Live Animal & Animal Products	2,569	0.03
2_Fish and Aquatic Products	1,939	0.02
3_Vegetable and Fruits	727	0.01
4_Grain and Grain Products	1,315	0.02
5_Other Agricultural Products (ex. Plantation Product)	6,495	0.07
6_Foodstuff, Beverage and Animal Food	1,627	0.02
7_Petroleum, Oil and Gas	1,051	0.01
8_Coal, Ore, Stone and Sand	250	0.00
9_Cement, Construction Material (incl. steel - frame)	77	0.00
10_Fertilizer (incl. Urea)	467	0.01
11_Garment, Textiles and fabric	6,189	0.07
12_Wood and Wood Products	608	0.01
13_Paper and Printed Matter	1,253	0.01
14_Metal and Metal Products (excl. construction material)	1,361	0.02
15_Industrial Material, Chemicals	1,710	0.02
16_Household articles, miscellaneous	6,293	0.07
17_Machinery and Parts, Transportation	11,117	0.13

Source: Prepared by JICA Study Team based on Thai Custom Department

As seen in the above figure, a modal share of sea transport and cost difference between land and sea transport can be explained by applying an exponential function and therefore the following formula (log-function) is adopted to estimate the modal share between sea and land transport.

$$Log(P_{sea}) = a \times Log(\alpha \times (T_{land} - T_{sea}) + (C_{land} - C_{sea})) + b$$

where P_{sea} is the share of Sea Transport)

α is the Time Value per ton

T_{land} & T_{sea} are the Transport Times by Land & Sea

C_{land} & C_{sea} are the Transport Costs by Land/Sea

a/b are additional parameters

Table 3.2.18 shows the result of regression analysis of the above formula and parameters estimated through the analysis. Both regression and t-value[29] of the parameters suggest the modal split model of sea and land transport between Thailand and Myanmar can be judged adequate.

Table 3.2.18 Result of Regression Analysis and Parameters Estimated

R^2	0.83
a	4.09 (t=5.78)
b	-18.5 (t=－6.21)

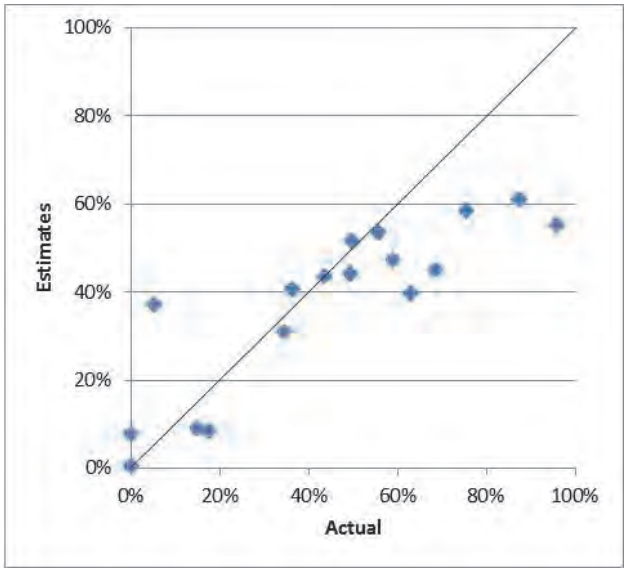
Source: JICA Survey Team

[29] When the t-value exceeds 1.96, the parameter is considered valid with 95% of accuracy.

The following table and figure compares the actual modal share and projected modal share of the sea transport between Thailand and Myanmar by commodity.

Table 3.2.19 Commodity-wise Comparison of Actual Modal Share and Projected Modal Share of Sea Transport between Thailand and Myanmar

Commodity	Actual Modal Share of Sea Transport	Estimated Modal Share of Sea Transport
1_Live Animal & Animal Products	34%	31%
2_Fish and Aquatic Products	5%	37%
3_Vegetable and Fruits	50%	52%
4_Grain and Grain Products	49%	44%
5_Other Agricultural Products (ex. Plantation Product)	0%	8%
6_Foodstuff, Beverage and Animal Food	36%	41%
7_Petroleum, Oil and Gas	59%	47%
8_Coal, Ore, Stone and Sand	75%	59%
9_Cement, Construction Material (incl. steel - frame)	87%	61%
10_Fertilizer (incl. Urea)	96%	55%
11_Garment, Textiles and fabric	15%	9%
12_Wood and Wood Products	56%	53%
13_Paper and Printed Matter	69%	45%
14_Metal and Metal Products (excl. construction material)	43%	44%
15_Industrial Material, Chemicals	63%	40%
16_Household articles, miscellaneous	17%	9%
17_Machinery and Parts, Transportation	0%	1%
Source: JICA Study Team		



Source: JICA Survey Team

Figure 3.2.15 Commodity-wise Comparison of Actual Modal Share and Projected Modal Share of Sea Transport between Thailand and Myanmar

As shown in Table 3.2.19, both road network improvement of the EWEC, and transport and trade facilitation between Thailand and Myanmar (Ayutthaya and Yangon) are expected to reduce transport cost (a reduction of 150 USD between Ayutthaya and Yangon) and transport time (a reduction of 35 hours). Assuming that sea transport service will remain the same, a maximum of 15% of the EXIM cargo volume is estimated to be diverted from sea-based transport to land-based transport due to the improvement of the road transport network and services.

Table 3.2.20 Modal Share changed from Sea Transport to Land Transport by Road Network Improvement and Transport Facilitation between Thailand and Myanmar[30]

Commodity	Present				Future				Modal Share changed to Land Transport
	Time Land - Time Sea (USD/ton)	Cost Land - Time Sea (USD/ton)	Total Cost Land - Total Cost Sea (USD/ton)	Estimated Modal Share of Sea Transport	Time Land - Time Sea (USD/ton)	Cost Land - Time Sea (USD/ton)	Total Cost Land - Total Cost Sea (USD/ton)	Estimated Modal Share of Sea Transport	
1_Live Animal & Animal Products	-12.8	81.5	68.7	**31%**	-13.8	75.9	62.1	**21%**	**10%**
2_Fish and Aquatic Products	-9.6	81.5	71.8	**37%**	-10.4	75.9	65.5	**25%**	**12%**
3_Vegetable and Fruits	-3.6	81.5	77.9	**52%**	-3.9	75.9	72.0	**38%**	**14%**
4_Grain and Grain Products	-6.5	81.5	74.9	**44%**	-7.1	75.9	68.9	**31%**	**13%**
5_Other Agricultural Products (ex. Plantation Product)	-32.3	81.5	49.2	**8%**	-34.9	75.9	41.0	**4%**	**4%**
6_Foodstuff, Beverage and Animal Food	-8.1	81.5	73.4	**41%**	-8.7	75.9	67.2	**28%**	**12%**
7_Petroleum, Oil and Gas	-5.2	81.5	76.3	**47%**	-5.7	75.9	70.3	**34%**	**13%**
8_Coal, Ore, Stone and Sand	-1.2	81.5	80.2	**59%**	-1.3	75.9	74.6	**43%**	**15%**
9_Cement, Construction Material (incl. steel - frame)	-0.4	81.5	81.1	**61%**	-0.4	75.9	75.5	**46%**	**15%**
10_Fertilizer (incl. Urea)	-2.3	81.5	79.2	**55%**	-2.5	75.9	73.4	**41%**	**15%**
11_Garment, Textiles and fabric	-30.8	81.5	50.7	**9%**	-33.3	75.9	42.7	**4%**	**5%**
12_Wood and Wood Products	-3.0	81.5	78.5	**53%**	-3.3	75.9	72.7	**39%**	**14%**
13_Paper and Printed Matter	-6.2	81.5	75.2	**45%**	-6.7	75.9	69.2	**32%**	**13%**
14_Metal and Metal Products (excl. construction material)	-6.8	81.5	74.7	**44%**	-7.3	75.9	68.6	**31%**	**13%**
15_Industrial Material, Chemicals	-8.5	81.5	73.0	**40%**	-9.2	75.9	66.7	**28%**	**12%**
16_Household articles, miscellaneous	-31.3	81.5	50.2	**9%**	-33.8	75.9	42.1	**4%**	**4%**
17_Machinery and Parts, Transportation	-55.3	81.5	26.2	**1%**	-59.8	75.9	16.2	**0%**	**1%**

Source: JICA Survey Team

As a result, 3.8 million tons (1,660 trucks per day[31]) in 2030, and 6.6 million tons (2,880 trucks per day) in 2035 are estimated to shift from sea to land transport due to the improvement of the road transport network and service between Thailand and Myanmar.

Table 3.2.21 Commodity-wise Future EXIM Cargo Volume shifted from Sea Transport to Land Transport between Thailand and Myanmar

	2030 EXIM Volume with Thai ('000ton)	2030 Trade Volume shifted from Sea to Land Trasnport ('000ton)	2035 EXIM Volume with Thai ('000ton)	2035 Trade Volume shifted from Sea to Land Trasnport ('000ton)
1_Live Animal & Animal Products	252	26	497	52
2_Fish and Aquatic Products	30	3	19	2
3_Vegetable and Fruits	167	24	276	39
4_Grain and Grain Products	18	2	23	3
5_Other Agricultural Products (ex. Plantation Product)	83	3	121	5
6_Foodstuff, Beverage and Animal Food	4,298	530	7,567	933
7_Petroleum, Oil and Gas	240	32	199	27
8_Coal, Ore, Stone and Sand	6,601	999	15,281	2,313
9_Cement, Construction Material (incl. steel - frame)	10,814	1,675	15,626	2,420
10_Fertilizer (incl. Urea)	34	5	42	6
11_Garment, Textiles and fabric	87	4	104	5
12_Wood and Wood Products	2,127	306	3,664	528
13_Paper and Printed Matter	84	11	114	15
14_Metal and Metal Products (excl. construction material)	688	88	1,070	138
15_Industrial Material, Chemicals	677	82	872	106
16_Household articles, miscellaneous	84	4	103	5
17_Machinery and Parts, Transportation	63	0	62	0
Total	26,349	3,797	45,641	6,596

Source: JICA Survey Team

(4) Traffic Assignment and Projection of Traffic Volume

The OD matrix is revised by adding the additional vehicular traffic diverted from sea transport to land transport (1,660 trucks per day in 2030 and 2,880 trucks per day in 2035). The revised OD matrix is assigned to the future network[32].

[30] Current figure shown in the table indicates 2014 and the future figure is in 2035.

[31] Based on the result of OD Interview Survey, the average loading volume of the truck is 8.8 tons. Operation of the trucking service is assumed at 260 days per year. Thus, 3.8 million tons (diverted from sea to land transport in 2030)/8.8 tons/truck /260 working days = 1,660 trucks/day.

[32] The road section under the BOT (between Payagyi and Mawlamyine) is assumed to be widened to 4 lanes and East-West Economic Corridor, Three Pagoda Pass and the road section between Mawlamyine and Dawei are to be improved to 2 lane roads.

In order to estimate the route share between the East-West Economic Corridor and the Three Pagoda Pass, dummy links are added to the future road network (assuming that the 440 kilometre 4-lane road network between Ayutthaya and Mae Sot and the 350 kilometre 4-lane road network between Ayutthaya and Three Pagoda Pass cross border) and traffic generated from Myawaddy/Mae Sot is assigned to these dummy links.

The following table and figures show projected traffic volume by the project route and Project and result of the traffic assignment.

Table 3.2.22 Projected Traffic Volume by Project Route (Unit: PCU/day)

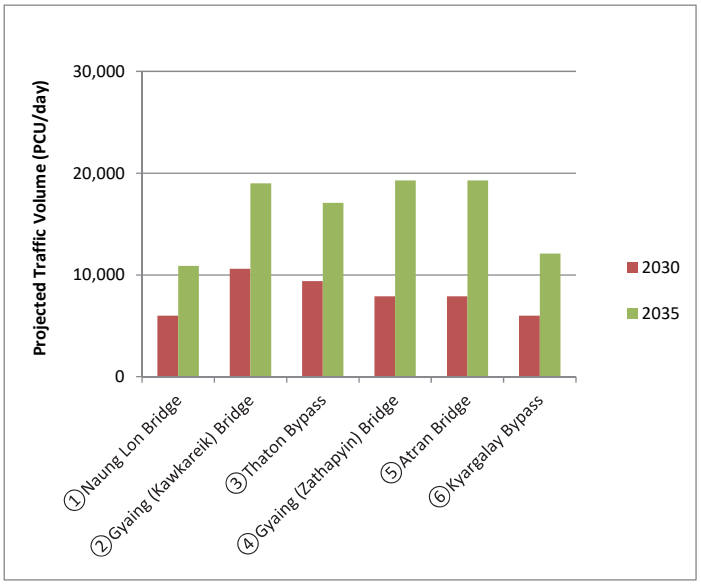
Year	Payagyi－Dawei		Eindu－Myawaddy		Thaton－Eindu	Mawlamyine－Eindu	Three Pagoda Pass
	Payagyi－Mawlamyine	Mawlamyine－Dawei	Eindu－Kawkareik	Kawkareik－Myawaddy			
2030	>25,900	2,900-10,800	4,700-10,600	8,000-10,800	4,800-10,000	1,900-7,900	5,700-9,100
2035	>40,600	4,800-15,100	10,900-19,000	19,000-26,600	9,600-18,800	7,000-19,300	6,700-11,900

Source: JICA Survey Team

Table 3.2.23 Projected Traffic Volume by Project (Unit: PCU/day)

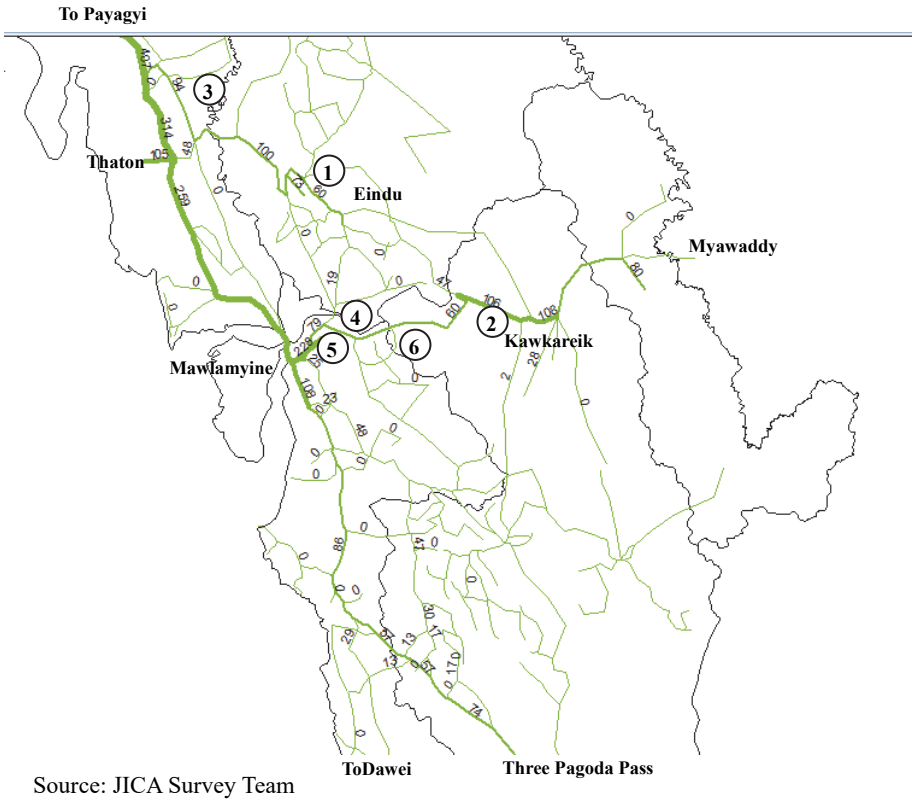
Year	Naung Lon Bridge	Gyaing (Kawkareik) Bridge	Thaton Bypass	Gyaing (Zathapyin) Bridge	Atran Bridge	Kyargalay Bypass
2030	6,000	10,600	9,400	7,900	7,900	6,000
2035	10,900	19,000	17,100	19,300	19,300	9,500-12,100

Source: JICA Survey Team



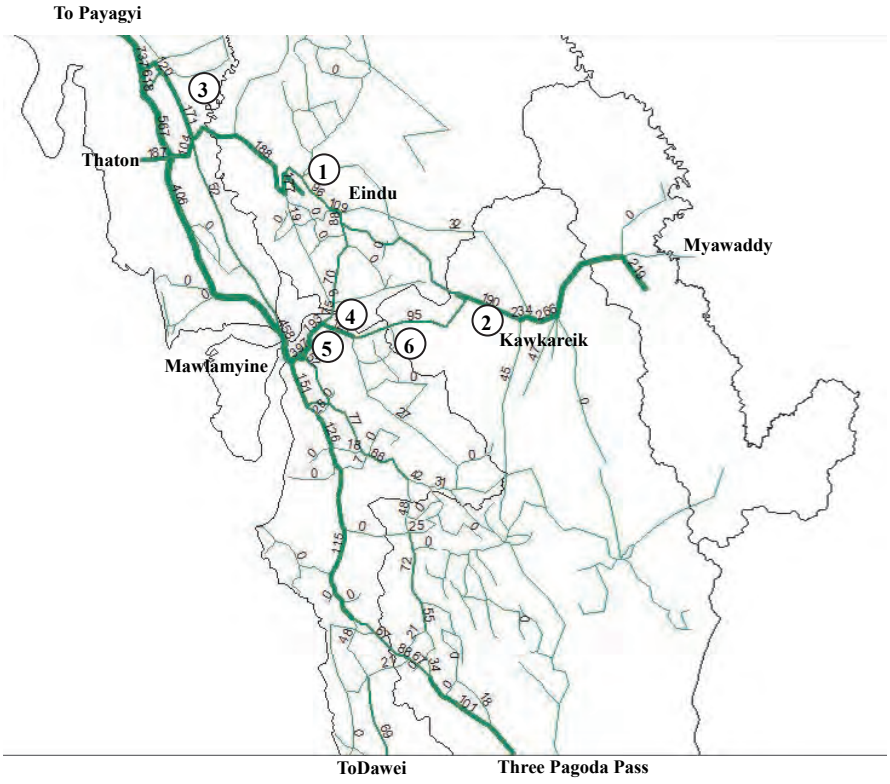
Source: JICA Survey Team

Figure 3.2.16 Projected Traffic Volume by Project



Source: JICA Survey Team
Note: The number in a circle in the figure shows the project number in the above table.

Figure 3.2.17 Result of Traffic Assignment (2030, Unit: 100 PCU)



Source: JICA Survey Team
Note: The number in a circle in the figure shows the project number in the above table.

Figure 3.2.18 Result of Traffic Assignment (2035, Unit: 100 PCU)

3.2.6 Traffic Demand Forecast in the Study (EWEC Improvement Case)

During the Fact Finding Mission held in December, 2014, MOC requested the JICA Survey Team to examine the feasibility of widening Gyaing (Kawkareik) Bridge from 2-lanes to 4-lanes, considering the rapid increase of traffic demand along the EWEC, and the future road widening project on the East-West Economic Corridor (EWEC) as a pipeline project of MOC. Accordingly, the following discussion analyses the future traffic demand on the EWEC, particularly that at Gyaing (Kawkareik) Bridge, assuming several different EWEC improvement scenarios.

(1) Pre-condition and Case Study of the Traffic Demand Forecast

The target year of the traffic demand forecast is set in Year 2035 and 2040, considering the improvement scenarios of the EWEC. The same 2035 vehicular OD matrix is utilized, prepared for the Base Case scenario discussed in the above section. The 2040 vehicular OD matrix is newly developed to examine this EWEC Improvement Case, applying the same growth rate of traffic between Year 2030 and Year 2035. Also, the future EXIM cargo between Thailand and Myanmar, and the diversion traffic from sea to land transport between Thailand and Myanmar are separately estimated. As a result of the analysis, the EXIM cargo of 11.8 million tons between Thailand and Myanmar, equivalent to 5,145 trucks per day, is estimated to shift from sea to land transport in 2040[33]. (See the spreadsheets in Annex)

As suggested by MOC (and also supported by the traffic demand forecast), there is a rapid increase of the traffic demand observed on the EWEC. Particularly, the traffic demand on the road section between Myawaddy and Kawkareik, the eastern part of the EWEC (Myawaddy–Thaton Section), is projected to increase at a relatively higher growth rate than other sections. Accordingly, the following improvement scenario for the EWEC is assumed:

Partial improvement scenario of the EWEC

The road section between Myawaddy and the intersection of Kyargalay Bypass is widened to a dual carriage way (four lanes in total) in 2035. Note that the ongoing bypass construction at Myawaddy by the Thai Government is assumed to finish on schedule, and the road section between Myawaddy and Kawkareik is assumed to accommodate four lanes in total using the existing carriageway and the bypass.

(2) Summary Result of the Traffic Demand Forecast under EWEC Improvement Case

The following table and figures show projected traffic volume by project route and results of the traffic assignment under EWEC Improvement Case.

Table 3.2.24 Projected Traffic Volume by Project Route under EWEC Improvement Case (Unit: PCU/day)

Year	Payagyi－Dawei		Eindu－Myawaddy		Thaton -Eindu	Mawlamyine -Eindu	Three Pagoda Pass
	Payagyi－Mawlamyine	Mawlamyine －Dawei	Eindu－Kawkareik	Kawkareik －Myawaddy			
2035	>37,400	5,900-11,500	9,900-27,800	23,700-28,400	10,000-22,100	6,000-20,200	6,700-10,100
2040	>66,000	7,700-29,000	13,900-42,600	38,500-46,100	11,700-50,200	11,700-33,100	13,100-27,400

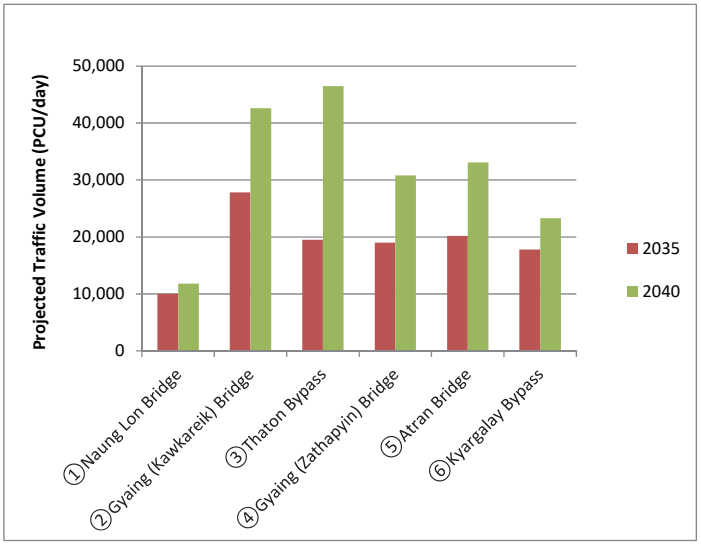
Source: JICA Survey Team

Table 3.2.25 Projected Traffic Volume by Project under EWEC Improvement Case (Unit: PCU/day)

Year	Naung Lon Bridge	Gyaing (Kawkareik) Bridge	Thaton Bypass	Gyaing (Zathapyin) Bridge	Atran Bridge	Kyargalay Bypass
2035	10,000	27,800	19,500	19,000	20,200	17,800
2040	11,800	42,600	46,500	30,800	33,100	23,300

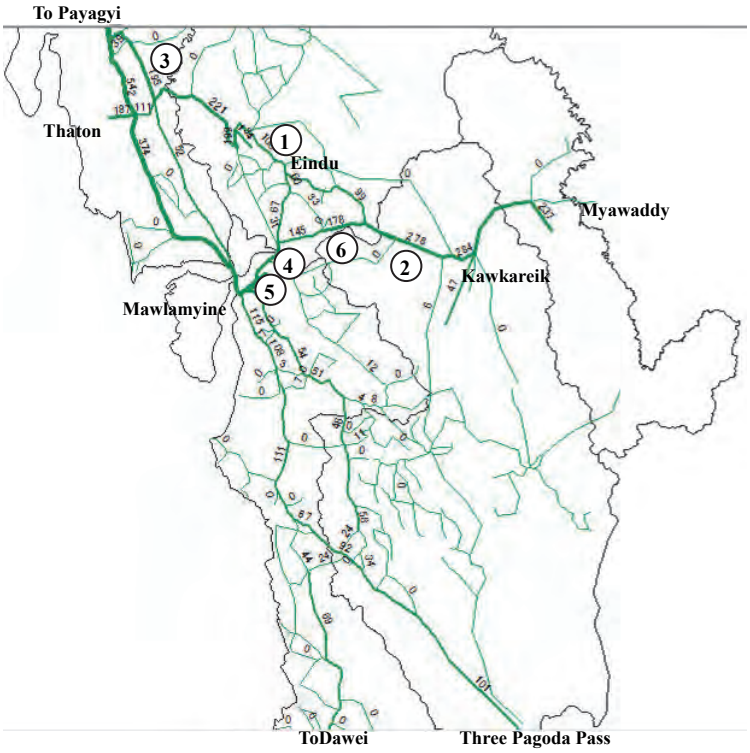
Source: JICA Survey Team

[33] The spreadsheet to estimate a total volume of EXIM cargo between Thailand and Myanmar and the volume of cargo shifted from sea to land transport is available in the Annex. As a result of analysis, 11.8 million tons (diverted from sea to land transport in 2030)/8.8 tons/truck /260 working days = 5,145trucks/day are estimated to shift to land transport between Thailand and Myanmar.



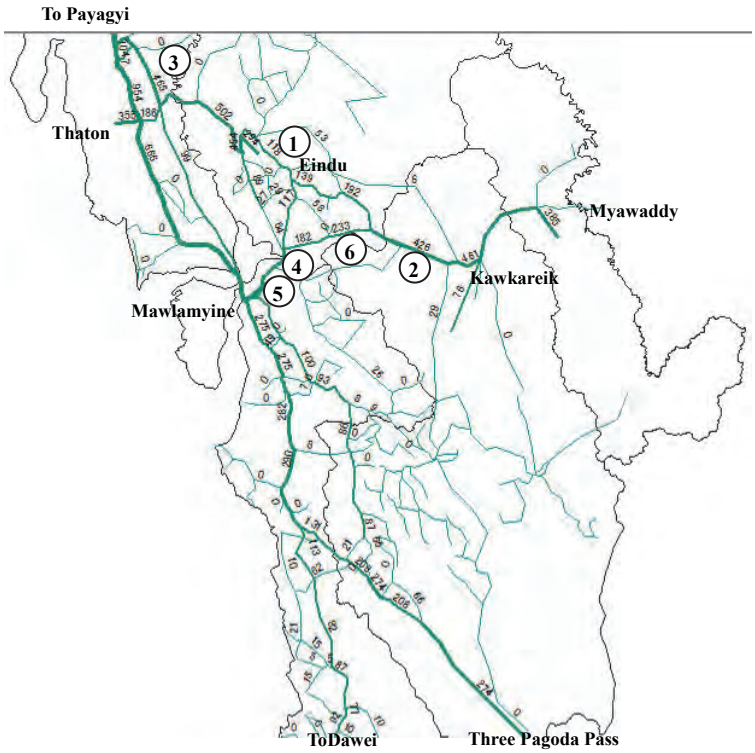
Source: JICA Survey Team

Figure 3.2.19 Projected Traffic Volume by Project under EWEC Improvement Case



Source: JICA Survey Team
Note: The number in a circle in the figure shows the project number in the above table.

Figure 3.2.20 Result of Traffic Assignment under EWEC Improvement Case (2035, Unit: 100 PCU)



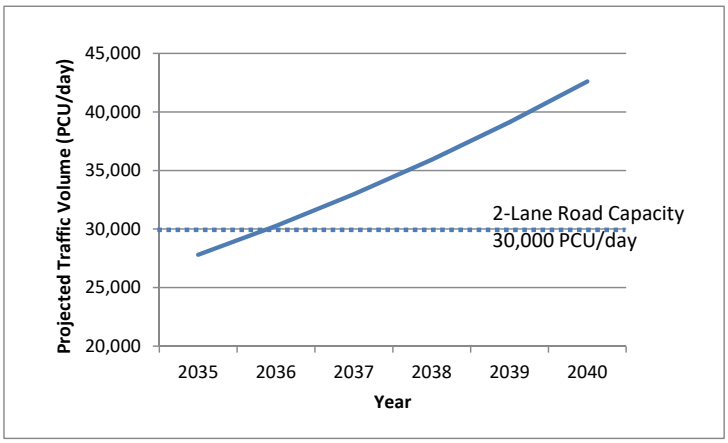
Source: JICA Survey Team
Note: The number in a circle in the figure shows the project number in the above table.

Figure 3.2.21 Result of Traffic Assignment under EWEC Improvement Case (2040, Unit: 100 PCU)

3.3 Implications for EWEC Improvement

As per the following clarification, it was confirmed that the road section between Myawaddy and Kawkareik (diversion point of Kyagalay bypass) in the EWEC should be upgraded to four lanes by the Myanmar side by 2035.

1. In accordance with ASEAN Connectivity Master Plan in 2010 (See the details in Chapter 2), the ASEAN member countries, including GOM, agreed that all designated national routes should be upgraded to Class I or Primary Roads by the target year of 2020 (projected to be when significant traffic volume shall be observed).
2. MYT-Plan, which was developed with assistance from JICA and will be soon endorsed and authorized by Cabinet Approval, defines the upgrade and/or widening of EWEC as part of the pipeline projects by 2030.
3. The traffic demand forecast, conducted by the JICA Survey Team, finds the traffic demand along part of EWEC exceeds the traffic capacity of two lanes by 2035.
4. Along the EWEC in JICA's Study Area, the increase of traffic demand along the section between Myawaddy and Kawkareik (diversion point of Kyagalay bypass) in particular is remarkable and is expected to exceed the 2-lane traffic capacity (30,000 PCU per day) and thereby the said section, given the first priority along the EWEC, should be widened by 2035, following the JICA traffic demand forecast.



Source: JICA Survey Team

Figure 3.3.1 Trend of Projected Traffic Volume at Gyaing (Kawkareik) Bridge

5. As mentioned above, it is recommended that Gyaing Kawkareik Bridge be widened to be four lanes by 2035. As shown in Table 3.3.1, widening of the bridge to four lanes is more reasonable economically than the construction of an additional 2-lane bridge by 2035, considering price escalation in the future.

Table 3.3.1 Comparison of investment for Gyaing Kawkareik Bridge

	Alternative 1 Widening of Existing Bridge to 4 lanes	**Alternative 2** Additional 2 lane Bridge Construction
Initial Cost	74 million USD	41.7 million USD
Cost for additional 2 lane bridge	—	54.2 million USD*[2]
Operation and Maintenance Cost*[1]	0.83 million USD	—
Total	**74.83 million USD 1.00)**	**95.9 million USD (1.28)**

*[1] Maintenance cost until 2035 after completion.

*[2] Considering price escalation

Source: JICA Survey Team

Annex:

Table A-1 Current and Future EXIM Cargo Volume between Thailand and Myanmar

Commodity	Myanmar-Thailand (Unit: '000 ton)							
	2011 Import	2035 Import	2040 Import	Growth Rate	2011 Export	2035 Export	2040 Export	Growth Rate
1_Live Animal & Animal Products	15	496	956	16%	5	2	1	-5%
2_Fish and Aquatic Products	1	3	3	5%	102	16	9	-7%
3_Vegetable and Fruits	12	253	447	14%	25	23	19	0%
4_Grain and Grain Products	6	23	29	6%	0	0	0	12%
5_Other Agricultural Products (ex. Plantation Product)	1	27	47	13%	9	93	124	10%
6_Foodstuff, Beverage and Animal Food	395	7,544	12,946	13%	4	23	28	8%
7_Petroleum, Oil and Gas	388	199	161	-3%	-	-	-	-
8_Coal, Ore, Stone and Sand	72	837	1,297	11%	107	14,443	33,239	23%
9_Cement, Construction Material (incl. steel - frame)	2,122	15,626	21,981	9%	0	0	0	14%
10_Fertilizer (incl. Urea)	36	16	13	-3%	1	26	46	17%
11_Garment, Textiles and fabric	36	103	119	5%	0	1	2	8%
12_Wood and Wood Products	6	1,047	2,831	24%	179	2,617	3,787	12%
13_Paper and Printed Matter	17	68	85	6%	3	46	68	12%
14_Metal and Metal Products (excl. construction material)	118	787	1,085	8%	3	283	588	20%
15_Industrial Material, Chemicals	206	867	1,086	6%	0	5	7	11%
16_Household articles, miscellaneous	30	101	121	5%	1	1	1	2%
17_Machinery and Parts, Transportation	52	61	58	1%	0	1	2	10%
Total	3,511	28,060	43,266	9%	439	17,581	37,922	17%

Source: JICA Survey Team

Table A-2 Modal Share changed from Sea Transport to Land Transport by Road Network Improvement and Transport Facilitation between Thailand and Myanmar

Commodity	Present				Future				Modal Share changed to Land Transport
	Time Land - Time Sea (USD/ton)	Cost Land - Time Sea (USD/ton)	Total Cost Land - Total Cost Sea (USD/ton)	Estimated Modal Share of Sea Transport	Time Land - Time Sea (USD/ton)	Cost Land - Time Sea (USD/ton)	Total Cost Land - Total Cost Sea (USD/ton)	Estimated Modal Share of Sea Transport	
1_Live Animal & Animal Products	-12.8	81.5	68.7	**31%**	-13.8	75.9	62.1	**21%**	**10%**
2_Fish and Aquatic Products	-9.6	81.5	71.8	**37%**	-10.4	75.9	65.5	**25%**	**12%**
3_Vegetable and Fruits	-3.6	81.5	77.9	**52%**	-3.9	75.9	72.0	**38%**	**14%**
4_Grain and Grain Products	-6.5	81.5	74.9	**44%**	-7.1	75.9	68.9	**31%**	**13%**
5_Other Agricultural Products (ex. Plantation Product)	-32.3	81.5	49.2	**8%**	-34.9	75.9	41.0	**4%**	**4%**
6_Foodstuff, Beverage and Animal Food	-8.1	81.5	73.4	**41%**	-8.7	75.9	67.2	**28%**	**12%**
7_Petroleum, Oil and Gas	-5.2	81.5	76.3	**47%**	-5.7	75.9	70.3	**34%**	**13%**
8_Coal, Ore, Stone and Sand	-1.2	81.5	80.2	**59%**	-1.3	75.9	74.6	**43%**	**15%**
9_Cement, Construction Material (incl. steel - frame)	-0.4	81.5	81.1	**61%**	-0.4	75.9	75.5	**46%**	**15%**
10_Fertilizer (incl. Urea)	-2.3	81.5	79.2	**55%**	-2.5	75.9	73.4	**41%**	**15%**
11_Garment, Textiles and fabric	-30.8	81.5	50.7	**9%**	-33.3	75.9	42.7	**4%**	**5%**
12_Wood and Wood Products	-3.0	81.5	78.5	**53%**	-3.3	75.9	72.7	**39%**	**14%**
13_Paper and Printed Matter	-6.2	81.5	75.2	**45%**	-6.7	75.9	69.2	**32%**	**13%**
14_Metal and Metal Products (excl. construction material)	-6.8	81.5	74.7	**44%**	-7.3	75.9	68.6	**31%**	**13%**
15_Industrial Material, Chemicals	-8.5	81.5	73.0	**40%**	-9.2	75.9	66.7	**28%**	**12%**
16_Household articles, miscellaneous	-31.3	81.5	50.2	**9%**	-33.8	75.9	42.1	**4%**	**4%**
17_Machinery and Parts, Transportation	-55.3	81.5	26.2	**1%**	-59.8	75.9	16.2	**0%**	**1%**

Source: JICA Survey Team

Table A-3 Commodity-wise Future EXIM Cargo Volume shifted from Sea Transport to Land Transport between Thailand and Myanmar

	2035 EXIM Volume with Thai ('000ton)	2035 Trade Volume shifted from Sea to Land Trasnport ('000ton)	2040 EXIM Volume with Thai ('000ton)	2040 Trade Volume shifted from Sea to Land Trasnport ('000ton)
1_Live Animal & Animal Products	497	52	957	100
2_Fish and Aquatic Products	19	2	12	1
3_Vegetable and Fruits	276	39	466	66
4_Grain and Grain Products	23	3	29	4
5_Other Agricultural Products (ex. Plantation Product)	121	5	172	7
6_Foodstuff, Beverage and Animal Food	7,567	933	12,975	1,600
7_Petroleum, Oil and Gas	199	27	161	22
8_Coal, Ore, Stone and Sand	15,281	2,313	34,536	5,227
9_Cement, Construction Material (incl. steel - frame)	15,626	2,420	21,981	3,405
10_Fertilizer (incl. Urea)	42	6	59	9
11_Garment, Textiles and fabric	104	5	120	5
12_Wood and Wood Products	3,664	528	6,619	953
13_Paper and Printed Matter	114	15	153	20
14_Metal and Metal Products (excl. construction material)	1,070	138	1,673	215
15_Industrial Material, Chemicals	872	106	1,093	133
16_Household articles, miscellaneous	103	5	122	5
17_Machinery and Parts, Transportation	62	0	60	0
Total	45,641	6,596	81,188	11,773

Source: JICA Survey Team

CHAPTER 4 SELECTION OF PRIORITY PROJECTS

4.1 Selection of Priority Road Sections and Priority Projects

4.1.1 Selection of Prioritized Candidate Sub-projects

In this chapter, considering the traffic demand forecasts, the surrounding situation and subjects for the development of each priority route in the Study Area which are provided in Chapter 2 and 3, the prioritized sub-projects are to be selected refer to the following key subjects.

1) Retrieve and improvement of road networks by resolving bottlenecked sections

There are several bottlenecked sections lowering both accessibility and traffic safety due to the narrow width of the road and malfunctioned crossing structures on international corridors and arterial roads linking between the major towns. It is highly expected to retrieve and improve the function of the road network by resolving the bottlenecked section and that would activate the economic situation and bring benefits into the region.

2) Improvement of traffic safety and correspondence to the future's traffic demand

There are several potential sections where traffic volume are assumed to increase rapidly if the relevant road projects were developed. These road sections are currently used by the roadside communities for their life access. The improvement of road capacity may cause an unfavourable situation increasing the risk of traffic accidents by mixing in more heavy vehicles. In the future, if the traffic were increased as estimated in Chapter 3, the situation would be worse so that needs certain countermeasures, such as the construction of bypasses and widening the road width to ensure traffic safety.

3) Improvement to all-weather access roads

The southeast region of Myanmar has an average annual rainfall more than 6,000 mm therefore several road sections need to be closed during the rainy season. The closure of a road gives a high negative impact to economic activities so that improvement to all-weather access roads is very significant, and especially requires the urgent improvement of the vital links of the road network.

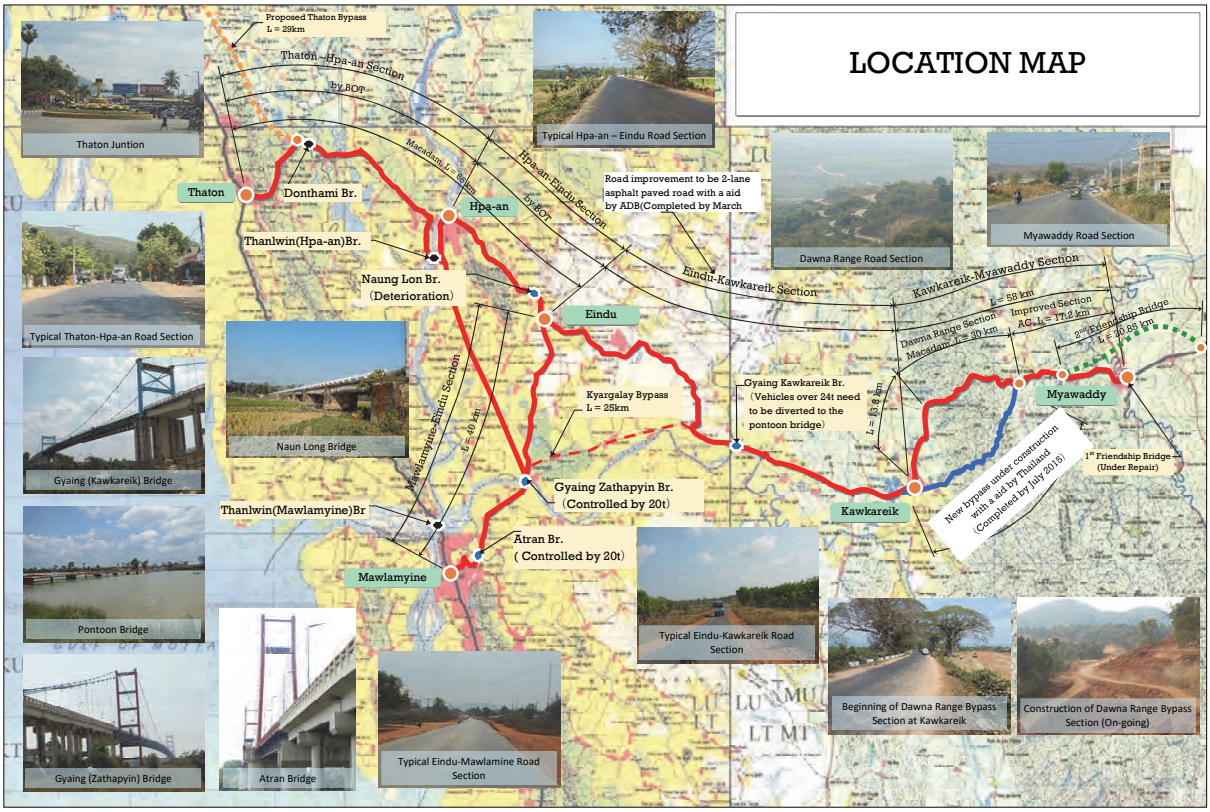
a) <u>Retrieve and improvement of function of road network</u>

<u>a-1) Replacement of Bottlenecked Bridges (Four Bridges)</u>

As described in Chapter 2.3.1 and 3.1, Mawlamyine, the capital city of Mon state, should be the centre of the southeastern region of Myanmar considering the economic scale and number of people. Thaton, Dawei and Hpa-an follow after Mawlamyine in importance. Accordingly, the links between these major towns are very important to in order to keep the sustainable development of the economy in the southeast region. The road links between the major towns would indicate the order of priority of the road network. Especially, AH1 starting from Myawaddy

(border town with Thailand) to Yangon thru Hpa-an and Thaton and/or ending at Mawlamyine called as "GMS East West Economic Corridor (EWEC)" is a vital link which many donors are involved in giving financial assistance. For instance, a new bypass linking Thin Gan Nyi Naung and Kawkareik will be opened in July 2015 by financial support from Thailand. Also, the section between Eindu and Kawkareik will be improved to Class-II (a complete two lane asphalt pavement road) of the ASEAN Highway standards so that can be increasingly expected to develop the area along these road sections.

As the results of the site survey, it was revealed that the five existing bridges are currently bottlenecks for the road section among the project road as given in Fig. 4.1.1. Gyaing/ Kawkareik Brdige, Gyaing/ Zathapyin Bridge and Atran Bridge are obstacles for heavy weight vehicles since the weight limitation of 20t to 24t is applied to the section due to the structural defects. Rehabilitation/ replacement of the three bridges were proposed as priority projects in the international donor meeting held in January 2013 by MOC as described in 2.2.1 (3). Heavy freight vehicles over 20t can be actually pass at the Naung Lon Bridge though the section has a weight limitation of 20t since the bridge is located on the AH1, the main route connecting Myawaddy to Hpa-an. It is considered that the replacement of Naung Lon Bridge is necessary in order to avoid one of the potential bottlenecks since significant structural damage has been observed.



Source: JICA Survey Team

Figure 4.1.1 Location of Bottlenecked Bridges

a-2) Road Improvement of the new bypass through the Dawna Mountain Range

The Dawna Mountain Range section (Kawkareik- Thin Gan Nyi Naung) has been greatly improved by the construction of a new bypass with financial support from the Thai government, which was fully opened in August 2015. Although the bypass is a two-lane paved road, in which some parts do not satisfy the ASEAN Highway Standards since it passes through the steep mountainous area. It is thus a concern that heavy freight trucks may have difficulties in negotiating the road sections with steep gradients which can affect transport efficiency and safety measures such as slope protection and drainage which are insufficient even after the completion of the bypass. Therefore, further improvement should be considered in order to retain/restore the service level as an

international connection through the improvement of the road profile by the construction of bridges or tunnels. The necessity for improvement of the section should be carefully studied considering actual issues after opening.

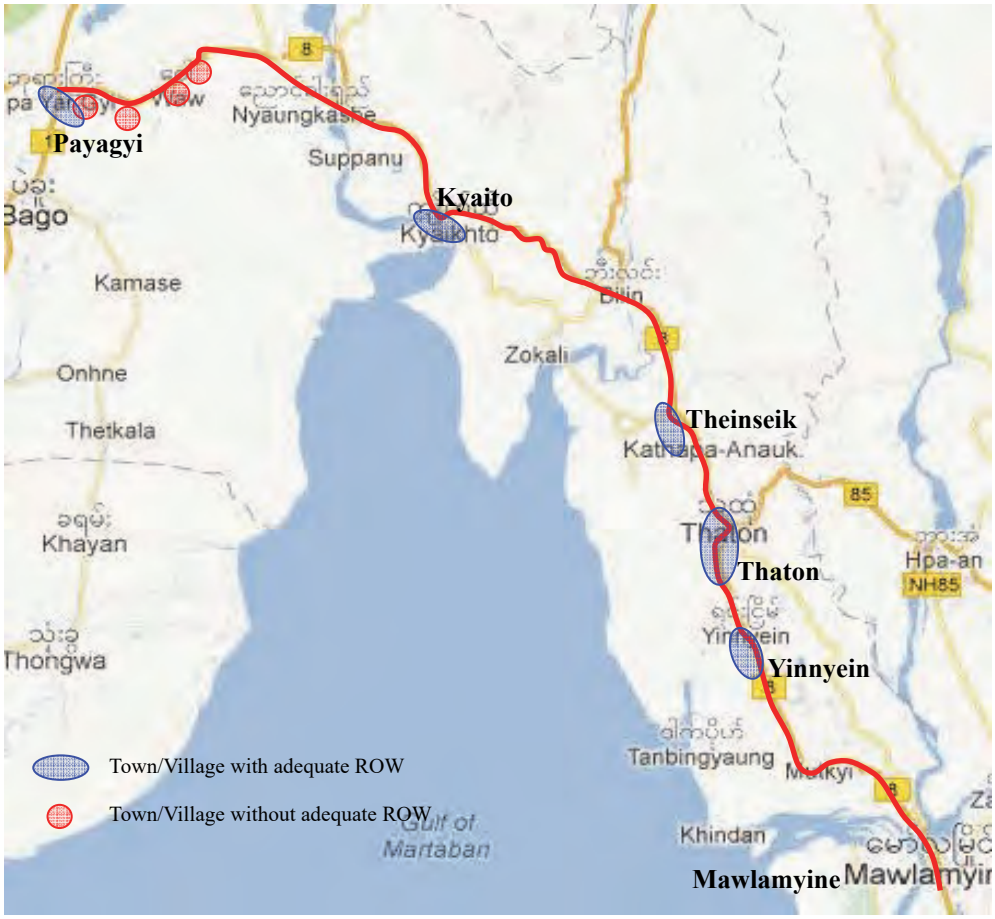
b) Road Upgrading Corresponding to Future Traffic Demand

b-1) Widening to 4-Lane Road (Payagyi – Mawlamyine Section)

It is expected that the future traffic demand will be greatly increased and to reach to more than 40,000 PCU in the section through Myawaddy, Mawlamyine and Payagyi as estimated in Chapter 3. The future traffic is supposed to result in social problems such as heavier traffic congestion and a lower level in traffic safety. Accordingly, the upgrading to a 4-lane paved road should be required to retain the function of the road network and obviate the social problems.

b-2) New Bypass Construction

In the sections where widening to a 4-lane road is necessary in accordance with future traffic demand, there are some city areas without a sufficient ROW for the widening. In city areas, the mixture of large-vehicle and regional traffic shows the (potential) critical problems in terms of traffic safety and there are in total five locations (Payagyi, Kyaito, Theinseik, Thaton and Yinnyein) in the Payagyi – Mawlamyine section as seen in Figure 4.1.2. Therefore, new bypass construction should be proposed in the city areas in order to enhance the traffic safety by the separation of regional traffic and through traffic. Especially, in Thaton which has the second highest population of 350,000 in southeast Myanmar and is the junction of AH1 and AH112, the critical traffic issues are supposed to be realized along with the growth in traffic demand. The new bypass in Thaton can be necessary in consideration of the fact that MOC has planned the bypass construction as described in 2.5.5 (2). In addition, a new Donthami bridge needs to be constructed on the new bypass.



Source: Prepared by JICA Survey Team based on Google maps

Figure 4.1.2 Location of Potential Bypass

b-3) Improvement of Kyargalay Bypass

As mentioned above, there are two potential priority routes in southeast Myanmar, one is a part of AH1 from Myawaddy, the hub for trade with Thailand, to Yangon passing through Hpa-an and Thaton, and the other is a part of the GMS East-West Economic Corridor between Myawaddy to Mawlamyine which is the largest city in southeast Myanmar.

It is considered that the upgrading of Kyargalay Bypass is one of the remaining potential projects for the latter corridor. The existing bypass is a 1.5-lane unpaved road and is not an all-weather road because of flooding in the rainy season. As compared with the existing route of Kyagale–Eindu–Zathapyin, this road can shorten the travel length by about 33km. Considering the drastic growth in future traffic demand along the route to Yangon or Mawlamyine from Myawaddy in accordance with the completion of road improvements by other foreign donors, it is expected that the upgrading can mitigate traffic congestion and enhance transport efficiency.

b-4) Road Improvement of the Southern Thanbuzayat

The road improvement of the section between Maylamyine and Dawei has lagged behind even though the route has been designated as a part of the ASEAN Highway Network. The Mawlamyine to Thanbuzayat section has been developed as a "Class-III" road in accordance with the ASEAN Highway Standards under the BOT scheme. On the other hand, there are unpaved sections in southern Thanbuzayat and the road condition is, in particular, poor in the 10km section in the mountain area south of Ye.

The future traffic in the section of Thanbuzayat and Dawei is estimated to be more than 10,000 PCU from the traffic demand forecast in Chapter 3. It is assumed that future traffic demand may be greater than expected if development of the Dawei SEZ is accelerated which has a great impact on the regional economy in southeast Myanmar. In addition, the improvement of the section between Thanbuzayat and Dawei was also proposed in the international donor meeting held in January 2013 by MOC.

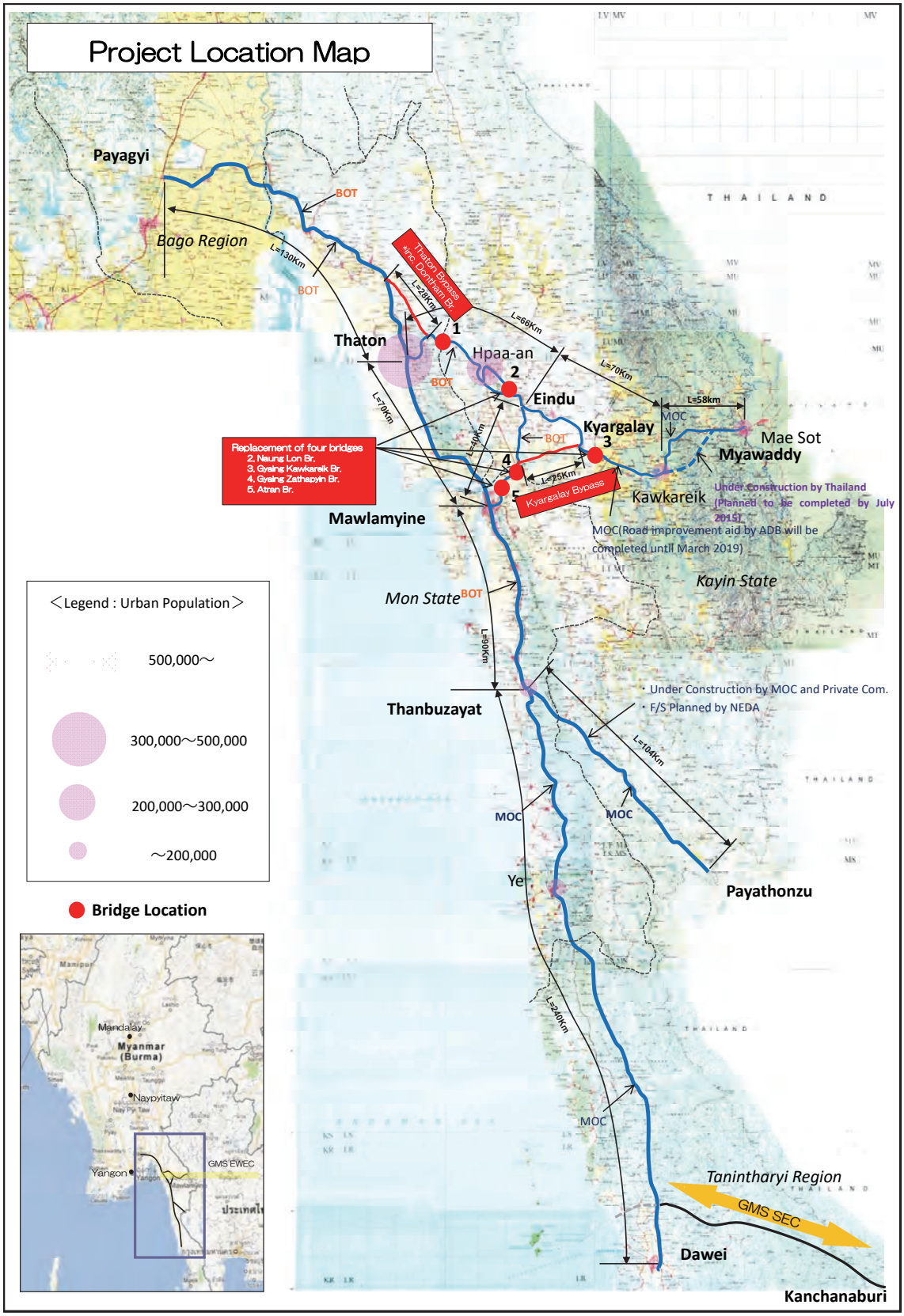
Considering current/future situation as mentioned above, the section of Thanbuzayat and Dawei needs to be upgraded as a 2-lane paved road. In particular, the section of southern Ye has a potential need for technical assistance by foreign donors since the construction of large-scaled bridges/tunnels is assumed, which can be advanced technology for Myanmar.

c) Upgrading of Three Pagoda Pass (All-weather Road)

The Three Pagoda Pass is the shortest link connecting Yangon with Bangkok that will be developed focused mainly on the boost of tourism for both countries. The road section in Thailand has already been improved into a complete 4-lane asphalt-paved road, therefore it is urgently required to improve the section in Myanmar.

The current road on the Myanmar side is a 1.5-lane unpaved road that is difficult to pass through during the rainy season. MOC has commenced the improvement works for the road bed with minor road structures by employing private contractors and would have been completed by April 2015. However, the construction was called off and has not been realized as an all-weather road yet due to the lack of budget for the construction of bridges (more than 50m in length). Therefore, the government searches for foreign investment necessary for the completion of a pass which can contribute to the economic development in southeast Myanmar and the return of refugees.

Figure 4.1.3 provides the location map of potential priority projects in the Survey Area. In the next section, the selection of a priority sub-project among the priority road sections is provided.



Source: JICA Survey Team

Figure 4.1.3 Location Map of Potential Candidate Sub-projects

4.1.2 Selection Policy and Criteria Applied

(1) Selection Policy

Priority sub-projects for preliminary design were selected in a series of discussions between MOC and the JICA Survey Team. The following two stage evaluation was applied for the sub-project selection:

- First stage : Selection of priority road section
- Second stage : Selection of priority sub-project

In the first stage, the selection of a priority road section was conducted by qualitative criteria based on the current condition of roads and structures, and interviews with concerned authorities. In the second stage, priority sub-projects were evaluated by additional criteria.

(2) Selection Criteria

First stage Criteria

First stage selection criteria are as follows. "A" describes the highest priority.

1) Road Category (Importance)

A: The route is categorized as an international highway, contributing to linkage with neighbouring countries, in which large growth in traffic volume is envisaged in the future. In particular, the road is categorized as Asian Highway or ASEAN Highway, or is included in Myanmar Master Plans.
B: The route is categorized as a major arterial road in Myanmar contributing to the improvement of accessibility among major cities, industrial areas and special economic zones.
C: The road other than those above

2) Traffic Demand (Year 2035)

A: Over 20,000PCU
B: 10,000PCU to 20,000PCU
C: less than 10,000PCU

3) Urgency

A: The route has an insufficient road width and/or weight limitation and suffers from traffic congestion, creating bottlenecks. The road cannot act as an international highway due to ageing and poor alignment.
B: The route has an insufficient road width and/or weight limitation and suffers from traffic congestion, creating bottlenecks. The road cannot act as an arterial road due to ageing and poor alignment.
C: The route is in good condition and has a sufficient road width

4) Contribution to Local Economy

A: Contributes to economic growth in the southern region and/or poor areas
B: Contributes to economic growth in other regions
C: N / A

5) Ownership and Administration

A: MOC
B: BOT (including MOC section)
C: BOT (All sections)

Second Stage Criteria

Second stage selection criteria are as follows. "A" describes the highest priority.

6) Environmental and Social Considerations

A: Category B (Number of involuntary resettlements is less than 200 people)
B: Category B (Number of involuntary resettlements is less than 200 people & Remarkable Concerns in environmental and social considerations)
C: Category A

7) MOC Priority

A: Very high
B: High
C: Moderate

8) Possibility for Technical Transfer

A: Very high
B: Moderate
C: Low

4.1.3 Selection of Priority Road Sections (First Stage)

Priority road sections were selected using the criteria mentioned in Article 3.5.2 during a meeting with MOC from 15 - 16 of May 2014. Results are shown in Table 4.1.1. Route 1-1 was not selected as it has been improved using international highway standards. There is no significant damage or faults in the route since the addition of BOT administration.

A comparison table is shown in Table 4.1.2.

Table 4.1.1 Results for Selection of Priority Road Sections (First Stage)

Road Section		Evaluation
Route 1	Route 1-1 Payagyi－Mawlamyine	×
	Route 1-2 Mawlamyine－Dawei	○
Route 2	Route 2-1 Eindu－Kawkareik	○
	Route 2-2 Kawkareik－Myawaddy	○
Route 3 Thaton –Eindu Road		○
Route 4 Mawlamyine –Eindu Road		○
Route 5 Thanbyuzayat – Hpayathonzu Road		○

Legend ○: Selected ×: Not selected

Source: JICA Survey Team

Table 4.1.2 Selection of Priority Road Section

Criteria/Route		Route1 Payagyi～Dawei Road (app.530Km)				Route2 Eindu～Myawaddy Road (120Km)				Route3 Thaton～Eindu Road (60Km)		Route4 Mawlamyine～Eindu Road (40Km)		Route5 Thanbyuzayat～HpayathonzuRoad (Three Pagodas Pass) (102Km)	
		Route1-1 Payagyi－Mawlamyine		Route1-2 Mawlamyine－Dawei		Route2-1 Eindu－Kawkareik		Route2-2 Kawkareik－Myawaddy							
Length		200km		330km		70km		58km		60km		40km		102km	
1) Road Category (Importance)		・Payagyi～Thaton：AH1/EWEC ・Thaton～Mawlamyine：AH112	A	・AH112	A	・AH1/ EWEC	A	・AH1/ EWEC	A	・AH1/ EWEC	A	・EWEC	A	・International Highway (New)	B
2) Traffic Demand	2014yr (PCU)	3,000～5,800	A	1100	B	2500	A	2500	A	2200	A	1400	A	0	B
	2035yr*1 (PCU)	>37,400		6,900-11,500		9,900-27,800		23,700-28,400		10,000-22,100		6,000-20,200		6,700-10,100	
3) Urgent need		・ 2lane road paved with asphalt(only carriage way) and road condtion is good ・No botteleneck because weight limitation on bridges is over 50t. ・Critical problem in terms of traveling performance at 4sections (Kyaikto、Theinseik、Thaton、Yinnyein) due to a mixture of large vehicles and regional traffic.	C	・Mawlamyine-Thanbyuzayat section improved to be 2lane paved road (only carriageway) and road condtion is good. ・ 1.5 lane unpaved road in southern Thanbyuzayat, especialy road condition is poor in 10km secion on north mountain area of Tanintharyi region.	A	・ 1.5 lane with asphalt penetration macadam damaged. ・Especially, Gyaing Kawkareik Bridge, temporal bailey bridge, is a critical bottleneck for heavy freight vehicles due to its weight limitation of 20t (Reconstruction is needed)	A	・ Kawkareik to Thin Gan Nyi Naung section, traversing Dawna Mountain, is 1-lane and bad road condition. ・The Kawkareik-Thin Gan Nyi NaungBypass, will be completed by July 2015, has sections which are not satisfied with the ASEAN Highway Standard. Accordingly, road improvement may be necessary. ・ Thin Gan Nyi Naung-Myawaddy section is 2-lane paved road and road condition is good (Aid by Thailand)	A	・ Almost section passes flat area and diverting toward south side near Thanlwin river(Conecting to Hpa-an Bypass) ・ 2lane road paved with asphalt(only carriage way) and road condtion is good ・Naung Lon Bridge may be one of potentilal bottlenecks since the bridge has been deteriorated.	B	・ 1.5 lane with asphalt penetration macadam damaged in almost section. ・Gyaing Zathapyin Bridge and Atran bridge, temporal bailey bridge, are critical bottlenecks for heavy freight vehicles due to their weight limitation of 20t (Reconstruction is needed)	A	・ Unpaved and bad road condition, unconectivity in rainy season (Urgent priority)	A
4) Contribution to Local Economy		・The route connecting Mawlamyine and Bago, which are core cities on economic growth of southern area (reffer MYT-Plan and NCDP) ・The route encouraging commerce with Thailand	A	・The route connecting Mawlamyine and Dawei, which are core cities on economic growth of southern area (reffer MYT-Plan and NCDP)	A	・The route connecting Thaton and Hpa-an, which have high potential for industrial and agricultural development (reffer MYT-Plan) . ・The route encouraging commerce with Thailand	B	・The route encouraging commerce with Thailand ・The route connecting Thaton and Hpa-an, which have high potential for industrial and agricultural development (reffer MYT-Plan) .	B	・The route encouraging commerce with Thailand ・The route connecting Thaton and Hpa-an, which have high potential for industrial and agricultural development (reffer MYT-Plan) .	B	・The route encouraging development of Mawlamyine, which is core cities on economic growth of southern area (reffer MYT-Plan and NCDP) ・The route encouraging commerce with Thailand	A	・The route encouraging development of Mawlamyine, which is core cities on economic growth of southern area (reffer MYT-Plan and NCDP) ・The route encouraging commerce with Thailand	A
5) Administration for Road Development and Management		BOT (Bridge section directly controled by MOC)	B	MOC (Mawlamyine～Thanbyuzayat Section is BOT)	A	MOC (A part of section is under FS by ADB)	A	MOC (Under Constructon by Thai Contractors)	A	BOT (Bridge section directly controled by MOC)	B	BOT (Bridge section directly controled by MOC)	B	MOC (Subgrade is under construction by MOC and private companies)	A
Evaluation		C (Not Selected)		A (Selected)		A (Selected)		A (Selected)		B (Selected)		A (Selected)		B (Selected)	
		・Controled by BOT ・Low priority (Higher priority on improvement of EWEC、Three Pagodas Pass and SEC)		・Direct control by MOC ・High urgent priority		・Direct control by MOC ・High urgent priority (Resolution of bottelneck bridge etc) ・ADB aid planned		・Direct control by MOC ・High traffic demand ・Moderate priority		・Controled by BOT ・High urgent priority		・Controled by BOT ・High urgent priority (Resolution of bottelneck bridge etc)		・Direct Control by MOC ・Urgent priority depens on improvement of other international highways (EWEC、SEC)	

*1 Traffic Demand was updated in accordance with the result of the traffic demand forecast for EWEC Improvement Case afther the Fact Find Misson on December, 2014

Source: JICA Survey Team

4.1.4 Selection of Priority Sub-projects

Priority sub-projects were selected from the priority road sections selected in Article 3.5.3 during the meeting with MOC on 15 - 16 May. Note that some sub-projects were evaluated as the same sub-project in the second stage selection because combining sub-projects should improve effectiveness.

A : Replacement of two bridges
(Naung Lon Bridge / Gyaing Kawkareik Bridge) ⇒ Sub-project 1
B : Thaton Bypass & Donthami Bridge Improvement of EWEC (to Yangon)

C : Replacement of two bridges
(Gyaing Zathapyin Bridge / Atran Bridge) ⇒ Sub-project 2
D : Kyargalay Bypass Improvement of EWEC (to Mawlamyine)

A comparison table for the selection of priority sub-projects is shown in Table 4.1.3.

Table 4.1.3 Selection of Priority Sub-project

Criteria/Route			EWEC (toYangon)		EWEC (to Mawlamyine)		Improvement of EWEC(Common)	Route5 Thanbyuzayat~Hpayathonzu Road	Route1-2 Thanbyuzayat~Dawei Road
			Route2-1 Eindu~Kawkareik Road、Route3 Thaton~Eindu Road	Route3 Thaton~Eindu Road	Route4 Mawlamyine~Eindu Road	Route2-1 Eindu~Kawkareik Road、Route4 Mawlamyine~Eindu Road	Route2-2 Kawkareik~Myawaddy Road		
			Plan A	Plan B	Plan C	Plan D	Plan E	Plan F	Plan G
Project description	Subproject		**Subproject 1 : Improvement of EWEC (toYangon)**		**Subproject 2 : Improvement of EWEC (to Mawlamyine)**		**Subproject 3**	**Subproject 4**	**Subproject 5**
			Replacement of 2 bridges (Naung Lon Br., Gyaing Kawkareik Br.)	**Thaton Bypass+Replacement of Donthami Br.**	**Replacement of 2 bridges (Gyaing Zathapyin Br., Atran Br.)**	**Kyargaing Bypass**	**Construction of tunnels (Thai Bypass Section)**	**Three Pagodas Pass**	**Improvement of Southern Thanbyuzayat**
	Road length/Bridgelength		Naung Lon Br. : 150m, Gyaing Kawkareik Br. : 760m	App.28km/Donthami Br. : App.200m	Gyaing Zathapyin Br. : 830m, Atran Br. : 680m	App.25Km	Tunnel length App.3km	App.104km、4 bridges (less than 100m)	App.240km
	Description of Construction	New Road	–	2-lane road construction (ASEAN Highway Class II) 14.5Km	–	2-lane road construction (ASEAN Highway Class II) 2.5Km	2-lane tunnel construction (ASEAN Highway Class II)		
		Existing road	–	2-lane road improvement (ASEAN Highway Class II) 13.5Km (Widening of existing road)	–	2-lane road improvement (ASEAN Highway Class II) 22.5Km (Widening of existing road)	–	2-lane pavement (ASEAN Highway Class II)	1.5 lane road improvement
		Bridge	Replacement of 2 bridges (medium to large scale bridges/ASEAN Highway Class II)	Replacement of 6 small bridges and Donthami Br.	Replacement of 2 bridges (medium to large scale bridges/ASEAN Highway Class II)	Replacement of 19 small bridges	–	Replacement of 4 small bridges	Rehabilitation of existing bridges
	Traffic Demand	Traffic Demand(2014)	2,500 PCU	-	1,400 PCU	-	2,500 PCU	-	1,100 PCU
		Traffic Demand(2035)*1	10,000, 27,800 PCU	19,500 PCU	19,000 - 20,200 PCU	14,500-17,800 PCU	23,700 PCU	6,700-10,100 PCU	6,900 PCU
Selection of Priority Subproject	**6) Environmental and Social Considerations**	Supposed Category	Category B	Category B	Category B	Category B	Category A	Category B (only pavement and bridges)	Category A
		Number of Affected houses (Number of involuntary ressettlements)	Less than 5 (Less than 30 people)	11 (Less than 200 people)	None (Less than 200 people)	N/A (assumued less than 200 people)	N/A (assumued less than 200 people)	Less than 30 (assumued less than 200 people)	N/A (assumued more than 200 people)
		Reason	Bridge reconstruction and less than 200 ressettlements	Less than 200 ressettlements under COI concept	Bridge reconstruction and less than 200 ressettlements	Upgrade of existing rolad (less than 100km) , New construction(less than 5km), less than 200 ressettlements	New tunnel construction (App.3km)	Bridge reconstruction and pavement, less than 200 ressettlements	New tunnel construction, improvement of existing road (more than 100km) , so that assumued ressettlements is more than 200 people.
		Remarkable concerns	None	Need alignment avoideing Pagoda dense zone and military accommodations	None	None	・None of environmental and social considerations has been studied in the construction of bypass between Myawaddy and Kawkareik (App.28km) by Thailand ・If GOJ decide to provide financial assistance via ODA with the current condition(on-going project), the EIA might be required to conduct including the scope of works for Thai bypass section.include the responsibility between JICA and PW should be	None of crucial impact is expected for the EIA of the project even if GOJ decided to provide financial assitance via ODA. However, PW conductes the current construction without any environmental mitigation measure therefore it would be subject to study in the EIA if implemented by GOJ.	It is assumed that total number of ressettlements is more than 200 people due to 240km length. Number of ressettlements depends on design of tunnels and bridges in moutain area.
			A	A	A	A	C	B	C
	7) Priority in MOC		Very High	High (Minister of MOC)	High	High (PW)	Premature at present (MD of PW)	Very High (Minister of MOC)	High interest on the premise of SEC (PW)
			A	B	B	B	C	A	B
	8) Possibility for Technology Transfer		High Possibility in technical transfer for foundation and superstructure of large scaled bridge	Low possiblity to apply Japanese technique due to general highway construction	High Possibility in technical transfer for foundation and superstructure of large scaled bridge	Low possiblity to apply Japanese technique due to general highway construction	Possible utilization of sole Japanese technique due to application of tunnel construction	Low possiblity to apply Japanese technique due to general highway construction	Low possiblity to apply Japanese technique due to general highway construction. High Possibility in technical transfer in the case that construction of tunnel or large scaled bridge are necessary
			A	B	A	B	A	B	B
	Evaluation of subproject		**Contributuion to the development of South-East Region by connecting the link between Mekong region and Mawlamyine(Realization of effectiveness by implementation of both sub-projects on the same network) 。**	**A**	**Contributuion to the development of South-East Region by connecting the link between Mekong region and Mawlamyine(Realization of effectiveness by implementation of both sub-projects on the same network) 。**	**A**	**Higher urgency and effectivess but many outstanding issues to be solved**	**Urgency and effectiveness relies on the progress of SEC**	**Urgency and effectiveness relies on the progress of SEC**
							B	**B**	**B**
	Prospective year for L/A (Draft)		**F/S for FY2014**	**F/S for FY2014**	**F/S for FY2014**	**F/S for FY2014**	**N/A (later 2015)**	**N/A (later 2015)**	**N/A (later 2015)**

*1 Traffic Demand was updated in accordance with the result of the traffic demand forecast for EWEC Improvement Case afther the Fact Find Misson on December, 2014

Source: JICA Survey Team