

CHAPTER 4. UPDATE OF ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

4.1 INTRODUCTION

4.1.1 Background

Preparatory survey for construction of Bago River Bridge project¹ was carried out in 2014. Before constructing a new Bago River Bridge, traffic congestion due to the Bridge will become worse at both Yangon side and at Thanlyin side. In order to study this issue, a supplemental survey for construction project of Bago River Bridge was carried for improvement at intersections at Yangon side and at Thanlyin side² in February and March 2016.

Major points of study of supplemental survey for construction of Bago River Bridge are: i) to prepare plan and design for improvement at intersections such as construction of a flyover or on-ramp or at-grade in Thaketa Township at Yangon side and in Thanlyin Township at Thanlyin side, ii) to propose future road development plan in Yangon in consideration of an increased traffic by Bago River Bridge, iii) to examine the relationship with future development plan and improvement at intersections. Several options are proposed for improvement of intersections in Thaketa Township and in Thanlyin Township and the best one is selected in each Township by considering environmental and social impacts in addition to technical feasibility.

4.1.2 Project Owner and Proponent

Project owner and project proponent of the construction of Bago River Bridge as well as the Intersection Portion is Department of Bridge (DOB) in the Ministry of Construction (MOC). The address of the project owner is Building No. 11, Naypyitaw, Myanmar

4.1.3 Type of Environmental Impact Assessment Study

Regarding Environmental Impact Assessment (EIA) system in Myanmar, the EIA Procedure and the National Environmental Quality (Emission) Guidelines (EQG) were promulgated on 29 Dec, 2015 by the Ministry of Environmental Conservation and Forestry (MOECAF)³. The EIA Procedure stipulates the process of IEE investigation, requirements in IEE report for example, identification and assessment of potential Environmental Impacts, preparation of Environmental Management Plan (EMP) and the process of IEE review and approval. Therefore, it is necessary to comply with the EIA Procedure when implementing a new project in Myanmar in addition to the Japan International Cooperation Agency (JICA) Guidelines for Environmental and Social Considerations if a project is implemented in Myanmar with Japanese ODA loan. The EIA Procedure determines

¹ Construction of Bago River Bridge is referred to as “the construction of Bago River Bridge” or “the Bridge Portion” in this chapter.

² Improvement of intersections at Yangon side and at Thanlyin side is referred to as “improvement at intersections” or “the Intersection Portion” in this chapter.

³ From 1 April, 2016, the name of the Ministry of Environmental Conservation and Forestry (MOECAF) was changed to the Ministry of Natural Resources and Environmental Conservation (MONREC). In other words, MOECAF and the Ministry of Mining were combined to the Ministry of Natural Resources and Environmental Conservation (MONREC).

type of environmental assessments such as EIA or Initial Environmental Examination (IEE) or Environmental Management Plan (EMP) necessary for each project depending on their sizes. A list of a related transportation project, which requires IEE/EIA is shown in Table 4-1.

Table 4-1 A List of Related Transportation Project Which Requires IEE/EIA

Transportation		Criteria for IEE Type (or Level) Study ¹	Criteria for EIA Type (or Level) Study ²
126.	Bridges, River Bridges and Viaducts (new construction)	Length ≥ 200 m but < 2 km	Length ≥ 2 km

Source: The EIA Procedure (2015)

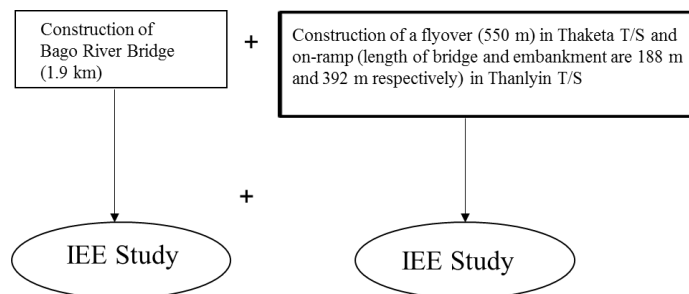
1 In general, when criteria for an economic activity are grouped together with “and” all such criteria must be met. This means for example that to be categorized as an IEE type economic activity, the economic activity must meet all the IEE criteria that are grouped together with “and” for that specific economic activity.

2 In general, when criteria for an economic activity are grouped together with “or” at least one of such criteria must be met. This means for example that to be categorized as an EIA type economic activity, the economic activity must meet at least one of the EIA criteria that are grouped together with “or” for that specific economic activity.

The length of the Bago River Bridge is 1.9 km. The length of a straight flyover in Thaketa Township and the length of on-ramp in Thanlyin Township is 547 m and 188 m respectively. The following environmental impact assessment studies are planned to carry out by the project proponent.

- i) IEE study is necessary for the construction of the Bago River Bridge
- ii) IEE study is necessary for improvement of intersections at Yangon side and at Thanlyin side.

A summary of environmental impact assessment study for construction project of Bago Bridge and improvement at intersections as shown in Figure 4-1.



Source: JICA Study Team

Figure 4-1 Type of Environmental Study for the Project

The IEE report for the Bridge Portion was originally prepared by JICA Study Team during the previous preparatory survey in 2014. IEE report for the Intersection Portion at Yangon side and at Thanlyin side is prepared based on the result of investigation in this supplemental survey for construction project of Bago River Bridge in accordance with the EIA Procedure in Myanmar. Environmental evaluation matrix, mitigation measures, EMP, Environmental Monitoring Plan (EMoP) and Checklist for the Bridge Portion, which were prepared in the previous preparatory survey in 2014 was updated as necessary in this survey.

4.1.4 Type of Resettlement Action Plan (RAP)

The World Bank (WB), Operational Policies (OP) 4.12- Involuntary Resettlement, Para. 25 stipulated that for projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement

plan is to be prepared. As of June, 2016, the project of construction of Bago River Bridge and improvement at intersection entails land acquisition or involuntary resettlement is assumed to be less than 200 and Abbreviated Resettlement Action Plan (A-RAP) is necessary to prepare. The exact number of PAPs for improvement at intersections cannot be determined as an inventory survey could not be conducted in this survey. Only investigation without asking any questions to PAPs was conducted in this survey in Feb and March, 2016 to evaluate impacts due to the improvement at intersections since both of the construction of Bago River Bridge and improvement at intersections were not approved by the Parliament. Conducting an inventory survey and holding consultation with PAPs are necessary to confirm the actual impact when the Parliament approval is obtained. If the number of PAPs is greater than 200 based on the results of an inventory survey in the future, Resettlement Action Plan (RAP) should be prepared to reduce impacts on them as much as possible according to the EIA Procedure (2015) and JICA Guidelines for Environmental and Social Considerations (April, 2010; the JICA Guidelines). If vulnerable people such as female-headed household, elderly people, the poor is included in PAPs, special assistance measures will be planned for them in order to mitigate impacts by the Project. A-RAP enclosed in Appendix B-3 shows detailed information.

4.1.5 Policy, Legislation, and Institutional Framework

(1) Legislation related to Environmental and Social Considerations

Major legislations relevant to environmental and social conservation are shown in Table 4-2. Balancing of three main factors such as economic, social and environmental conservation is an important data to make sustainable development in an integrated world.

Table 4-2 Laws and Regulations Relevant to Environmental Conservation

	Name of Laws, Rules, etc.	Year
1. Constitutional and Environmental Policy		
	Constitution of the Republic of the Union of Myanmar	2008
	Myanmar Environmental Conservation Policy	1994
	National Sustainable Development Strategy	2009
2. Environmental Conservation		
	Myanmar Environmental Conservation Law	2012
	Environmental Conservation Rules	2014
	Environmental Impact Assessment (EIA) Procedure	2015
	National Environmental Quality (Emission) Guidelines	2015
	Consultant Registration Scheme (Draft)	
	Administrative instruction of EIA Procedure (Draft)	
	The Order on the Hazardous Wastes (Draft)	
3. Biodiversity, Natural and Cultural Conservation		
	Wildlife Protection Act 1936	1936
	Myanmar Marine Fisheries Law	1990
	Fresh Water Fisheries Law	1991
	Forest Law	1992
	Animal Health and Development Law	1993
	Protection of Wildlife and Conservation of Natural Area Law	1994
	Conservation of Water Resources and River Law	2006
	National Biodiversity Strategy Action Plan in Myanmar	2012
	Conservation of Water Resources and River Rules	2013
	The Law Protecting the Antique Objects	2015
	The Law Protecting the Antique Buildings	2015
4. Urban Development and Management		
	The City of Rangoon Municipal Act 1922	1922

	Name of Laws, Rules, etc.	Year
	The City of Yangon Municipal Amendment Act 1961	1961
	Road and Bridge Utilization Law	1985
	City of Yangon Development Law	1990
	Law Amending the City of Yangon Development Law	1996
	Yangon City Development Committee	1999
	Road Law	2000
	Law Amending the Road and Bridge Utilization Law	2014
	The Second Amending Law of the Road and Bridge Utilization Law	2015
	The Second Amending Law of the Road	2015
	Highways Law	2015
	Law Amending the Highways Law	2015
	Condominium Law	2016
5. Land Acquisition and Resettlement		
	The Upper Burma Land and Revenue Regulation	1889
	The Land Acquisition Act 1894	1894
	Lower Burma Town and Village Lands Act	1899
	Transfer of Immovable Property Restriction Act	1947
	Land Nationalization Act	1953
	Disposal of Land Tenancies Law	1963
	Transfer of Immovable Property Restriction Law	1987
	Farmland Law 2012	2012
	Farmland Rules 2012	2012
	Vacant, Fallow, and Virgin Lands Management Law	2012
	Vacant, Fallow, and Virgin Lands Management Rules	2012
	The Law Amending the Lower Myanmar Town and Village Lands Act	2015
6. Pollution Control and Occupational Health		
	Factory Act	1951
	Standing Order 2_95 Occupational Health Plan 1995	1995
	Standing Order 3_95 Water and Air Pollution Control Plan 1995	1995
	Occupational Safety and Health Law (Draft)	2012
	The Science and Technology Development Law	1994
	Myanmar Mines Law 1994	1994
	The Law Amending the Myanmar Mines Law	2015
	The Law Amending the Factories Act (1951)	2016
7. Social Security		
	Leave and Holiday Act 1951	1951
	Labour Organization Law	2011
	Social Security Law	2012
	Social Security Rules	2012
	Minimum Wages Law	2013
	Employment and Social Security Notification	2013
	Minimum Wages Rules	2013
	The Law Amending Leave and Holiday Act 1951	2013
	Employment and Skill Development Law	2013
	Settlement of Labour Dispute Law	2014
	Notification for Minimum Wages Law	2015
	Payment of Wages Law	2016

Source: JICA Study Team (data obtained in 2014 and in June, 2016)

(2) Environmental Conservation Law, 2012

To establish sound environment policies in the utilization of water, land, forests, mineral, marine resources, and other natural resources in order to conserve the environment and prevent its degradation, the National Environment Policy of Myanmar was proclaimed on 5 December 1994. The drafting of 'Myanmar Agenda 21' followed the Policy in 1997.

However, progress in the development of environmental policy has moved at a rather slow pace since then. In addition, the legal framework for environmental protection has been based on sectoral that do not possess holistic visions on environmental protection.

In order to solve the above situation, the Environmental Conservation Law was established and enacted by the Union Hluttaw on 30 March 2012 and promulgated on 1 April 2012. Table 4-3 shows outline of Environmental Conservation Law.

Table 4-3 Outline of Environmental Conservation Law

Chapter		Sections
1	Title and Definition	1-2
2	Objectives	3
3	Formation of the Environmental Conservation Committee	4-6
4	Duties and Powers relating to the Environmental Conservation of the Ministry	7-8
5	Environmental Emergency	9
6	Environmental Quality Standards	10-12
7	Environmental Conservation	13-16
8	Management of Urban Environment	17
9	Conservation of Natural Resources and Cultural Heritages	18-20
10	Prior Permission	21-25
11	Insurance	26-27
12	Prohibitions	28-30
13	Offences and Penalties	31-34
14	Miscellaneous	35-42

Source: Environmental Conservation Law 2012

(3) Environmental Conservation Rules (2014)

In order to implement Environmental Conservation Law, Environmental Conservation Rules (the Rules) including precise information of implementation process for environmental conservation was promulgated on 5 June 2014. Table 4-4 shows outline of Environmental Conservation Rules.

Table 4-4 Outline of Environmental Conservation Rules

Chapter		Sections
1	Title and Definition	1-2
2	Adopting Policy Relating to Environmental Conservation	3-6
3	Environmental Conservation	7-26
4	International, Regional and Bi-lateral Cooperation Relating to Environmental Conservation	27-28
5	Environmental Management Fund	29-35
6	Environmental Emergency	36-37
7	Environmental Quality Standards	38-39
8	Management of Urban Environment	40
9	Waste Management	41-46
10	Conservation of Natural Resources and Cultural Heritages	47-50
11	Environment Impact Assessment	51-61
12	Prior Permission	62-68
13	Prohibitions	69
14	Miscellaneous	70-74

Source: Environmental Conservation Rules 2014

(4) Environmental Impact Assessment (EIA) Procedure

EIA Procedure was promulgated on 29 Dec,2016 by MOECA. Table 4-5 outlines the EIA Procedure.

Table 4-5 Outline of EIA Procedure

Chapter		Sections
1	Title and Definition	1-2
2	Establishment of the Environmental Impact Assessment Process	3-16
	Requirements concerning Third Person or Organization undertaking IEE and EIA	17-22
3	Screening	23-30
4	Initial Environmental Examination	31-34
	IEE Report Requirements	35-36
	Review and Approval Process for IEEs	39-43
5	Environmental Impact Assessment	
	EIA Process	45-46
	Scoping	47-54
	EIA Investigation	55-61
	EIA Report Requirements	62-63
	Submission of EIA Report	64-66
	Review and Approval Process for EIA Report	67-70
6	Appeal Process	71-75
7	Environmental Management Plan	76-82
8	Environmental Consideration in Project Approval	83-86
	Environmental Compliance Certificate, Conditions and Revisions to Conditions	87-101
	Responsibility for all Adverse Impacts	102-105
9	Monitoring	106-110
	Monitoring and Inspection by the Ministry, Relevant Government Departments and Organizations	111-122
10	Strategic Environmental Assessment	123-124
11	Administrative Punishment	125-131

Source: *The EIA Procedure (2015)*

i) Projects requiring IEE and EIA

1) IEE type projects

IEE type projects mean that a project judged by MOECAAF as having some adverse environmental and/or social impacts, but these impacts are less significant than those of EIA type projects due to its scope and size and these impacts can be mitigated by using technologies and practices.

The EIA Procedure determined that IEE report shall contain the following subjects.

- 1) Project Description
- 2) Identification of the project Proponent
- 3) Identification of IEE experts
- 4) Description of the surrounding environmental condition
- 5) Identification and Assessment of potential Adverse Impacts
- 6) Results of public consultation/ participation
- 7) Environmental protection measures,
- 8) Conclusion
- 9) Environmental Management Plan (EMP) and
- 10) The budget necessary for implementation of EMP

The procedure of screening, IEE investigation and review, IEE review and approval and EMP review and approval are explained with flow chart in Figure 3-2.

2) EIA type projects

All projects judged by MOECAAF as being likely to have potential or significant adverse environmental or social impacts are required to carry out EIA. EIA Procedure describes that EIA report shall include following subjects.

- 1) Executive Summary
- 2) Introduction
- 3) Policy, Legal and Institutional Framework
- 4) Project Description and Alternative Selection
- 5) Identification of the project Proponent
- 6) Identification of IEE experts
- 7) Description of the surrounding environment
- 8) Impact and Risk Assessment and Mitigation Measures
- 9) Cumulative Impact Assessment
- 10) Environmental Management Plan (EMP)
- 11) The budget needed for implementation of EMP and
- 12) Result of Public Consultation and Disclosure

EIA process including screening, IEE investigations and review, IEE review and approval, EMP review and approval, scoping for EIA, EIA investigations and review, EIA review and approval, and Appeal process is outlined in the diagram in Figure 4-2.

3) Sensitive area that should not be included in any development project

In addition, Table 4-6 identifies environmentally, ecologically, and socio-culturally sensitive areas, which should not be included in any development project, and a reasonable distance should be ensured from such area so as not to cause any permanent damage or result in any adverse environmental, ecological, or social impacts.

Table 4-6 Environmentally, Ecologically, and Socio-cultural Sensitive Areas

No.	Sensitive Areas
1	Areas of unique historical, cultural, archaeological, scientific, or geographical significance
2	Wetlands
3	Ecologically fragile area
4	National parks, wildlife sanctuaries, and protected areas
5	Wilderness areas containing rare or endangered species of flora or fauna and their habitat
6	Areas susceptible to natural hazards
7	Major sources of public drinking water
8	Areas surrounding lakes and reservoirs
9	Resort areas and areas closed to oyster fishing and pearl farms areas
10	Floodplains or other hazardous zones

Source: JICA Study Team (data obtained in 2014)

ii) Categorization of Projects requiring IEE/EIA/EMP

EIA Procedure (2015) determined criteria of IEE and EIA study for each economic activity. Table 4-7 shows the criteria of IEE and EIA study for transportation projects.

Table 4-7 A list of transportation projects which requires IEE/EIA

Transportation		Criteria for IEE Type Economic Activities*	Criteria for EIA Type Economic Activities**
123.	Railways and Tramways (construction and maintenance of rail infrastructure and operation of rolling stock)	Length < 5 km	Length ≥ 5 km
124.	Cable Cars	Length < 0.5 km	Length ≥ 0.5 km
125.	Airports and Runway Construction	Runway length < 2,100 m	Runway length ≥ 2,100 m
126.	Bridges, River Bridges and Viaducts (new construction)	Length ≥ 200 m but < 2 km	Length ≥ 2 km
127.	Bridges, River Bridges and Viaducts (upgrading)	Length ≥ 300 m	All activities where the Ministry requires that the Project shall undergo EIA
128.	Tunnels	Length < 1 km	Length ≥ 1 km
129.	Expressways and Highways (ASEAN Highway Standard; new construction or widening with one lane or more)	Length ≥ 2 km but < 50 km	Length ≥ 50 km
130.	Other Roads (state, region, urban; new construction or widening ≥ one lane)	Length ≥ 50 km but < 100 km	Length ≥ 100 km
131.	Road Improvement (upgrading from seasonal to all weather surface, widening of shoulders)	Length ≥ 50 km	All activities where the Ministry requires that the Project shall undergo EIA

Source: *The EIA Procedure (2015)*

Note (*): In general, when criteria for an economic activity are grouped together with “and” all such criteria must be met. This means for example that to be categorized as an IEE type economic activity, the economic activity must meet all the IEE criteria that are grouped together with “and” for that specific economic activity.

Note (**): In general, when criteria for an economic activity are grouped together with “or” at least one of such criteria must be met. This means for example that to be categorized as an EIA type economic activity, the economic activity must meet at least one of the EIA criteria that are grouped together with “or” for that specific economic activity.

Regarding any project already in existence prior to the issuance of the Rules, or the construction of which has already commenced prior to the issuance of the Rules, EMP is required to be carried out within the timeframe prescribed by ECD to obtain Environmental Compliance Certificate (ECC) according to the EIA Procedure. For project activities other than new construction such as rehabilitation, extension, and/or improvement, IEE or EIA is required to carry out if the extension or improvement would increase the project size or production. If no IEE or EIA is required to carry out in respect of such project extension or expansion, then the EMP and ECC for such project shall be revised as necessary within the timeframe prescribed by Environmental Conservation Department (ECD). EIA Procedure stipulates that EMP report shall include:

- 1) Description of the project,
 - 2) Rules, commitment, legal requirements and arrangement for organization concerning with environment, social and if necessary health care of the project,
 - 3) Impacts and summary of action for mitigation measures, and
 - 4) Management and monitoring plan in each project phase: pre-construction, construction, operation, decommissioning and after decommission
- iii) Process of Environmental Approval
- The schematic drawing of environmental approval in the EIA Procedure (2015) is shown in Figure 4-2. This process is to be applied even after the new administration of the government inaugurated in April 2016.

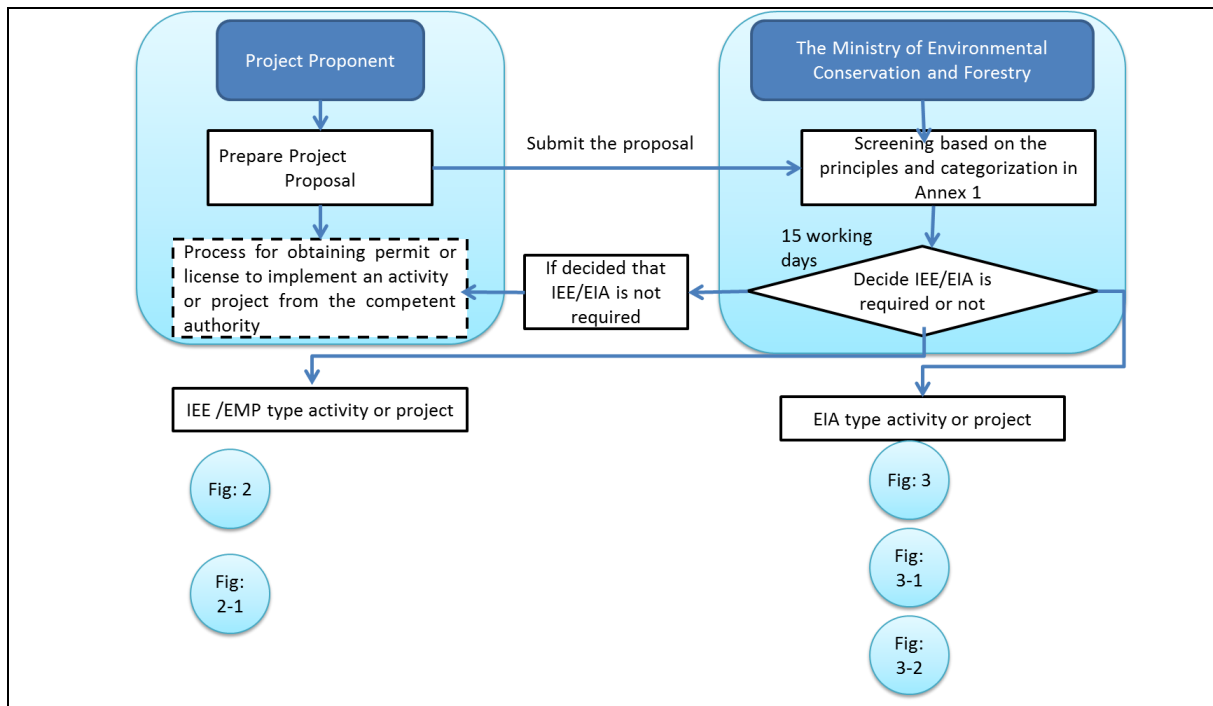


Fig 1: Screening

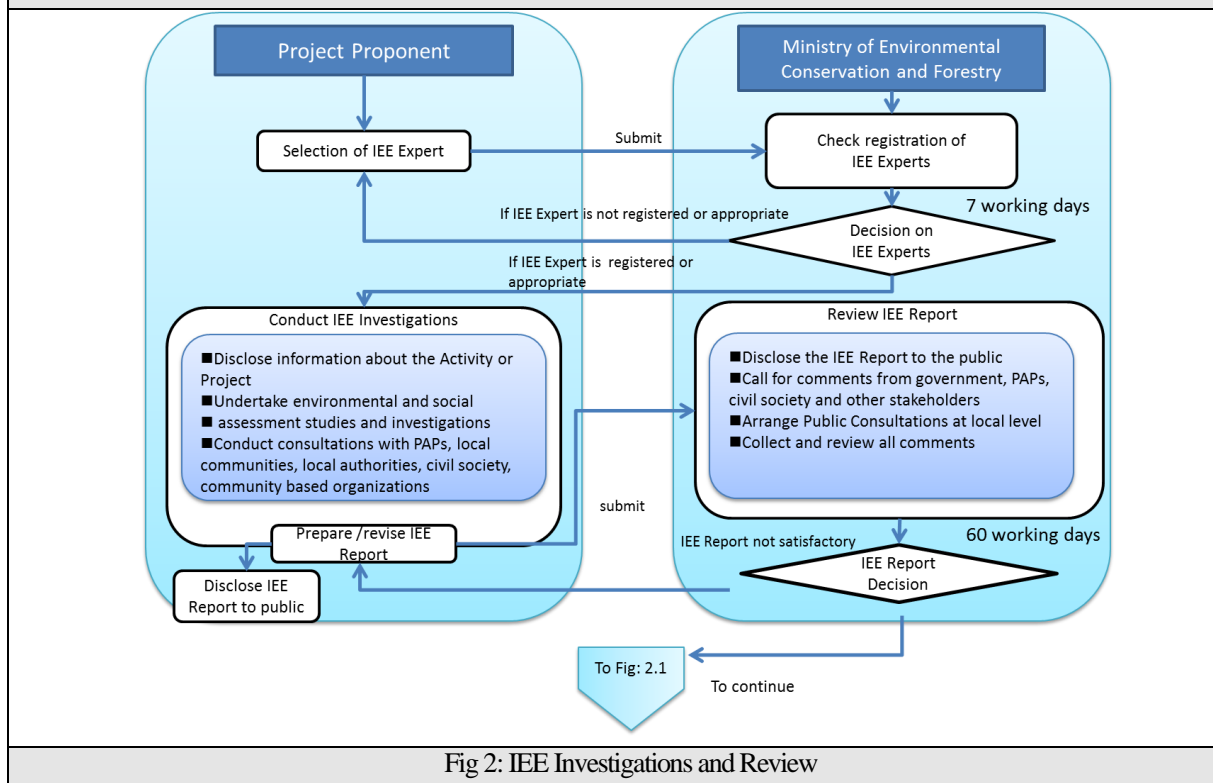


Fig 2: IEE Investigations and Review

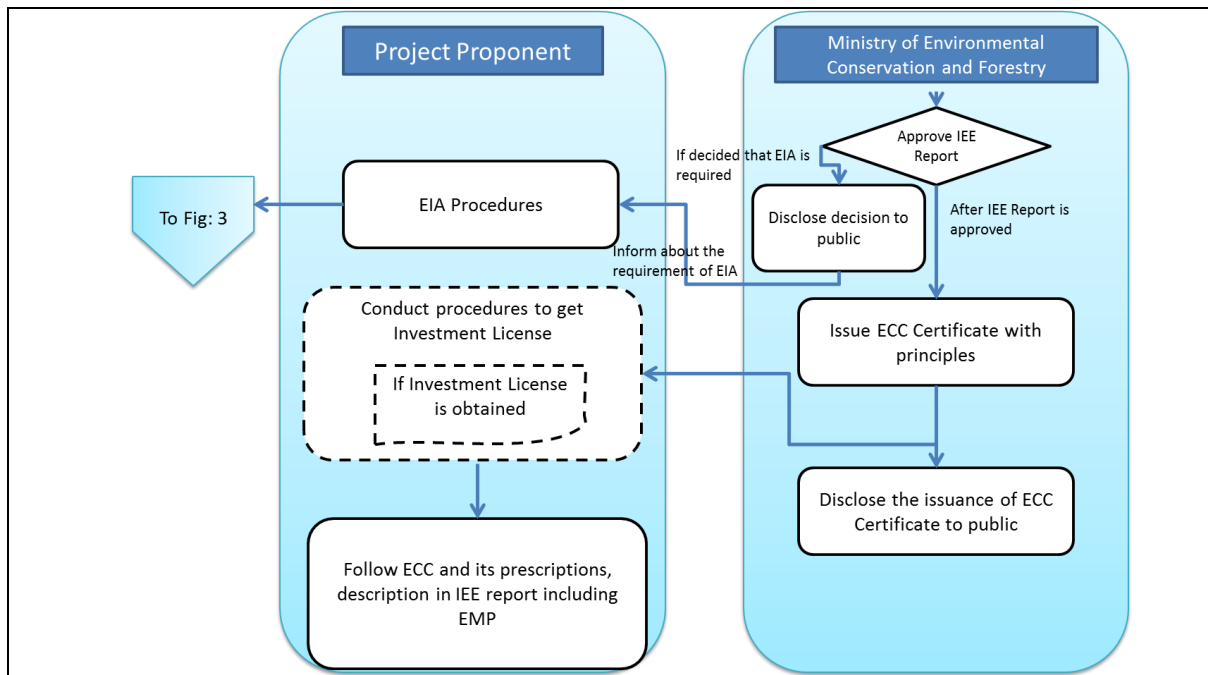


Fig 2(1): IEE Review and Approval

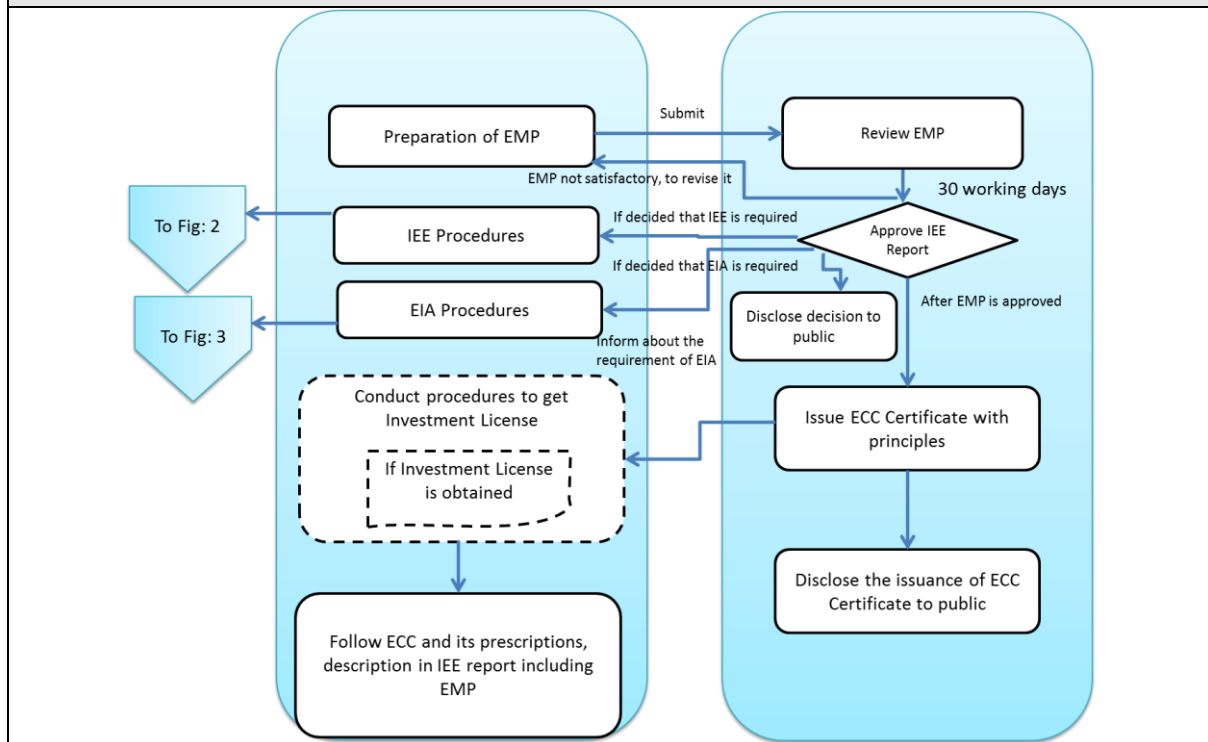


Fig 2(2): EMP Review and Approval

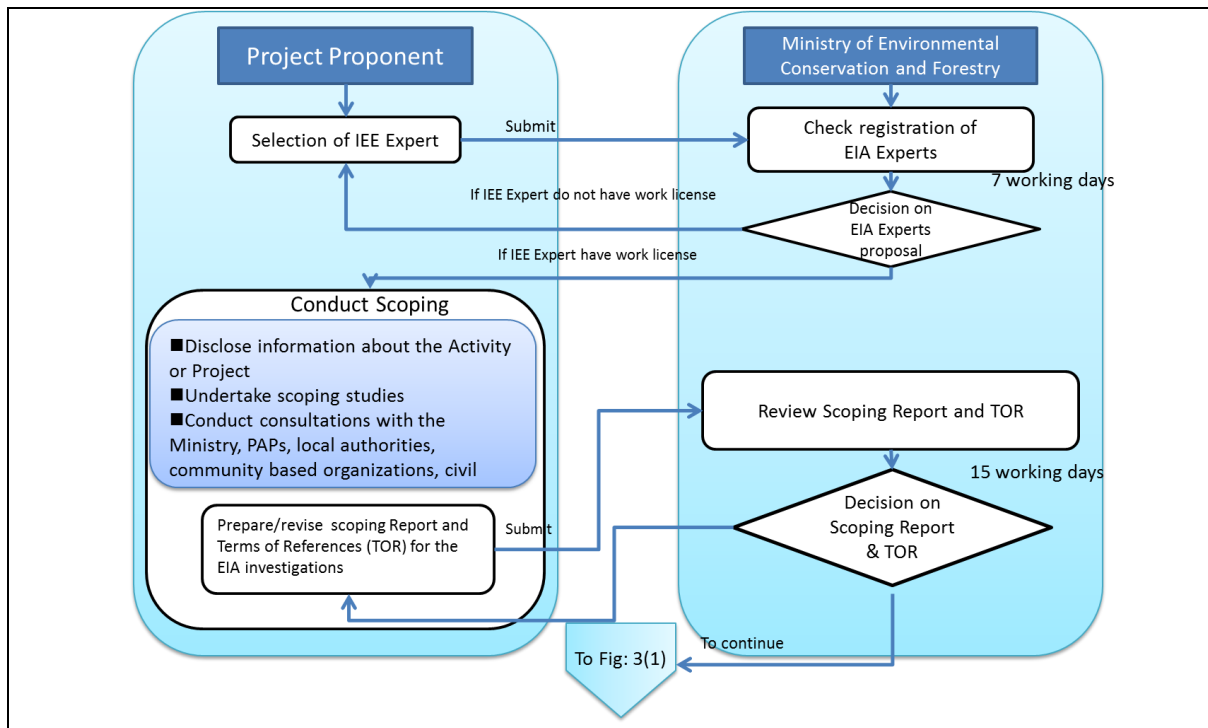


Fig 3: Scoping for EIA

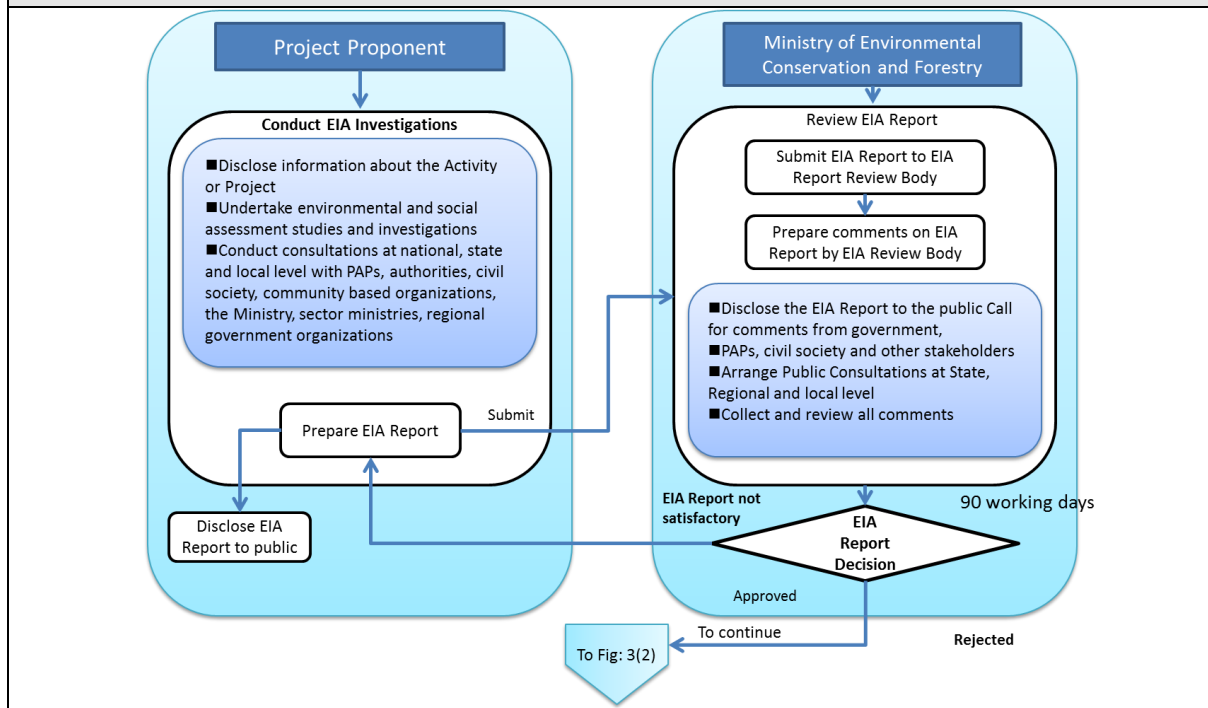


Fig 3 (1) : EIA Investigations and Review

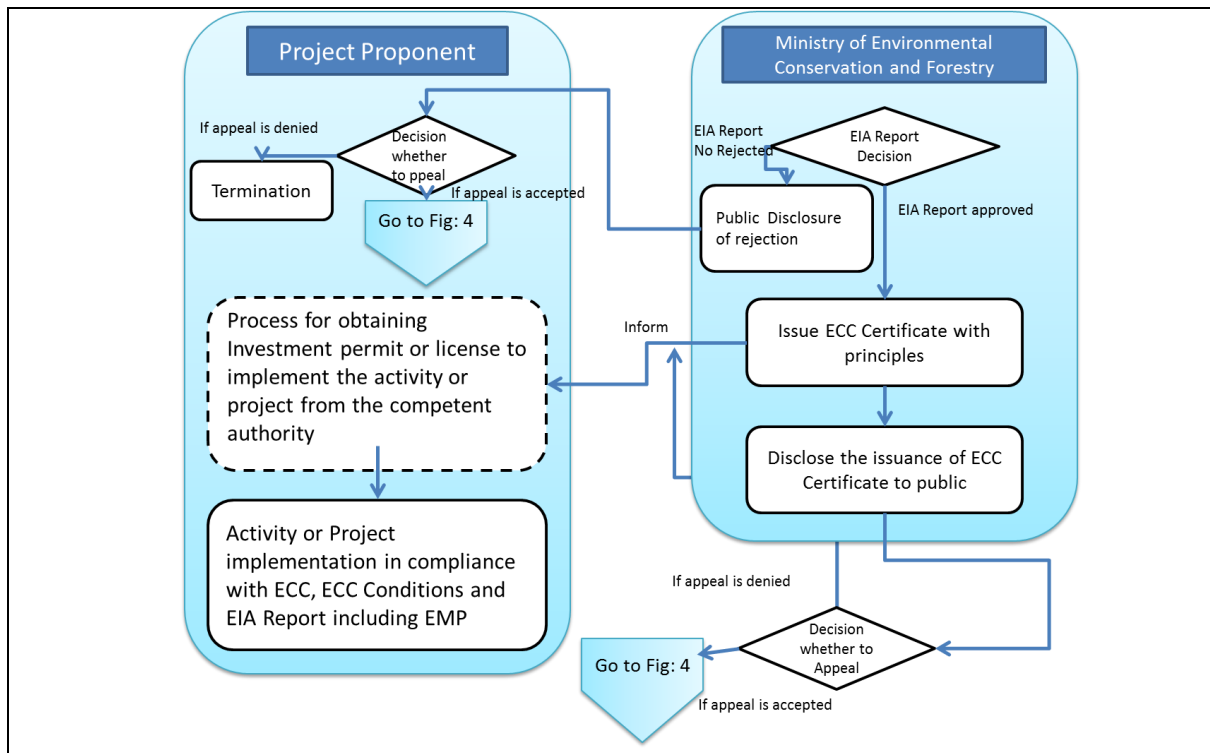


Fig 3 (2) : EIA Review and Approval

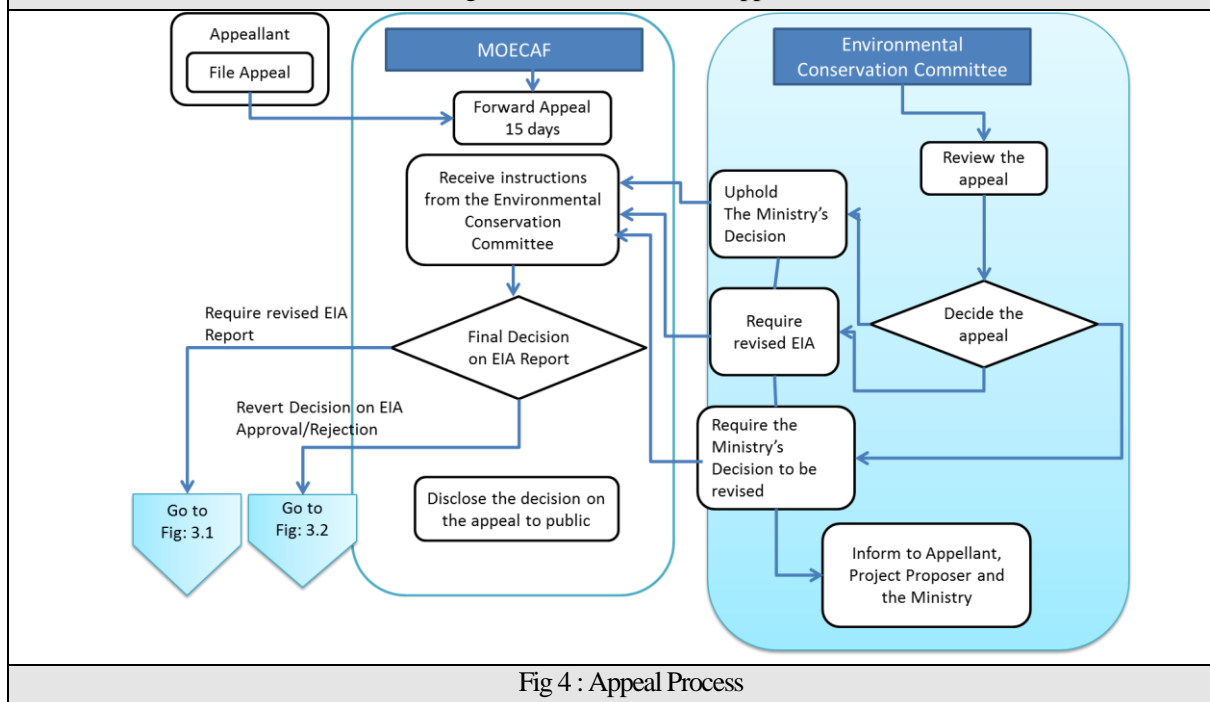


Fig 4 : Appeal Process

Source: The EIA Procedure (2015)

Figure 4-2: Schematic Process of Environmental Approval

iv) Gaps of Environmental and Social Considerations between Myanmar Legislations and the JICA Guidelines for Environmental and Social Considerations (April, 2010)

Regarding the policies for environmental and social considerations, those of the JICA guidelines are basically the same as that of the World Bank and ADB. Table 4-8 shows the results of the comparison between the policies of Myanmar legislations including the EIA Procedure and those of the JICA

guidelines. It is found that there are still considerable gaps between Myanmar legislations and the JICA guidelines.

Table 4-8 Gaps between the JICA Guidelines and Myanmar Legislations

JICA Guidelines/WB OP4.12	Legislation of Myanmar	Gaps between the JICA Guidelines/WB OP 4.12 and the Law of Myanmar
Underlying Principles		
1. Environmental impacts that may be caused by projects must be assessed and examined in the earliest possible planning stage. Alternatives or mitigation measures to avoid or minimize adverse impacts must be examined and incorporated into the project plan.	EIA-P (A 3,58)	Article 3 of the EIA Procedure stipulates that all Projects and Project expansions which have the potential to cause Adverse Impacts, are required to undertake IEE or EIA or to develop an EMP to obtain an ECC.
		Article 58 of the EIA Procedure stipulates that EIA investigation shall also include an analysis of Alternatives. Such analysis shall include a description of each Alternative, and an assessment and comparison of the Adverse Impacts, required mitigation measures and Residual Impacts of the Alternatives while there is no line which stipulates the timing of the above implementation.
2. Such examinations must be endeavored to include an analysis of environment and social costs and benefits in the most quantitative terms possible, as well as a qualitative analysis; these must be conducted in close harmony with the economic, financial, institutional, social, and technical analyses of projects.	EIA-P (A 58)	Article 58 of the EIA Procedure stipulates that EIA investigation shall also include an analysis of Alternatives. Such analysis shall include a description of each Alternative, and an assessment and comparison of the Adverse Impacts, required mitigation measures and Residual Impacts of the Alternatives. However, cost and benefits are not demanded.
3. The findings of the examination of environmental and social considerations must include alternatives and mitigation measures, and must be recorded as separate documents or as a part of other documents. EIA reports must be produced for projects in which there is a reasonable expectation of particularly large adverse environmental impacts.	EIA-P (A 58, Figure 2 and 3(1))	Article 58 of the EIA Procedure stipulates that EIA investigation shall also include an analysis of Alternatives. Such analysis shall include a description of each Alternative, and an assessment and comparison of the Adverse Impacts, required mitigation measures and Residual Impacts of the Alternatives.
		Figure 2 and 3(1) of the EIA Procedure requires the preparation of the EIA report for projects that need EIA, preparation of IEE report for projects that need IEE.
4. For projects that have a particularly high potential for adverse impacts or that are highly contentious, a committee of experts may be formed so that JICA may seek their opinions, in order to increase accountability.	None	No laws were identified which mention to establish a committee for projects.
Examination of Measures		
1. Multiple alternatives must be examined in order to avoid or minimize adverse impacts and to choose better project options in terms of environment and social considerations. In the examination of measures, priority is to be given to avoidance of environmental impacts; when this is not possible, minimization and reduction of impacts must be considered next. Compensation measures must be examined only when impacts cannot be avoided by any of the aforementioned measures.	EIA-P (A 58, 63)	Article 58 of the EIA Procedure stipulates that EIA investigation shall also include an analysis of Alternatives. Such analysis shall include a description of each Alternative, and an assessment and comparison of the Adverse Impacts, required mitigation measures and Residual Impacts of the Alternatives while the conduct of compensation measure is not stipulated in the EIA procedures
		Article 63 of the EIA Procedure stipulates that the project proponent is responsible to prepare EIA report which contains Impact and Risk Assessment and Mitigation Measures.
2. Appropriate follow-up plan and system, such as monitoring plans and environmental management plans, must be prepared; the costs of implementing such plans and systems, and the financial methods to find such costs, must be determined. Plans for	EIA-P (A 36 (i), 36(j), 63 (8))	Article 36 (i) of the EIA Procedure stipulates that EMP is necessary in IEE report.
		Article 36 (j) of the EIA Procedure stipulates that budgets needed for implementation of the EMP is necessary in IEE report.

JICA Guidelines/WB OP4.12	Legislation of Myanmar	Gaps between the JICA Guidelines/WB OP 4.12 and the Law of Myanmar
projects with particularly large potential adverse impact must be accompanied by detailed environmental management plans.		Article 63(8) of the EIA Procedure stipulates that stipulates that EMP, Monitoring Plans, mitigation measures and overall budget for implementation of the EMP is necessary in IEE report. However, financial methods to find such costs are not determined.
Scope of Impacts to Be Assessed		
1. The impacts to be accessed with regard to environmental and social considerations include impacts on human health and safety, as well as on the natural environment, that are transmitted through air, water, soil, waste, accident, water usage, climate change, ecosystem, fauna and flora, including transboundary or global scale impacts. These also include social impacts, including migration of population and involuntary resettlement, local economy such as employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable	EIA-P (A 63(6))	Article 63(6) of the EIA Procedure stipulates that (I) identification and assessment of potential Environmental Impacts including (i) physical, biological, social, socio-economic, health, cultural, and visual impacts; (ii) potential impacts on climate change such as greenhouse gas emissions and loss of carbon sinks or stocks; and (iii) identification of impacts of climate change on the Project based on available climate change predictions from designated national authorities or international scientific research bodies, (II) Identification and assessment of the likelihood and severity of natural and industrial hazards relevant to the Project are necessary in EIA report. However, social impacts, local economy, social institution and social infrastructures are not determined.
2. In addition to the direct and immediate impacts of projects, their derivative, secondary, and cumulative impacts as well as the impacts of projects that are indivisible from the project are also to be examined and assessed to a reasonable extent. It is also desirable that the impacts that can occur at any time throughout the project cycle should be considered throughout the life cycle of the project.	EIA-P (A 58, 63(7))	Article 58 of the EIA Procedure stipulates that EIA investigation shall also include an analysis of Alternatives. Such analysis shall include a description of each Alternative, and an assessment and comparison of the Adverse Impacts, required mitigation measures and Residual Impacts of the Alternatives. Article 63 (7) of the EIA Procedure stipulates that the project proponent is responsible to prepare EIA report which contains Cumulative Impact Assessment.
Compliance with Laws, Standards, and Plans		
1. Projects must comply with the laws, ordinances, and standards related to environmental and social considerations established by the governments that have jurisdiction over project sites (including both national and local governments). They must also conform to the environmental and social consideration policies and plans of the governments that have such jurisdiction.	Environmental Conservation Law 2012 (A 28, 29)	No law directly prescribes that projects must comply with laws, ordinances, and standards related to environmental and social considerations. Article 28 of The Environmental Conservation Law prescribes that “No one shall, without prior permission, operate business, work-site or factory, and workshop which is required to obtain prior permission under this Law” Article 29 of the law stipulates that “No one shall violate any prohibition contained in the rules, notifications, orders, directives, and procedures issued under this Law.”
2. Projects must, in principle, be undertaken outside of protected areas that are specifically designated by laws or ordinances for the conservation of nature or cultural heritage (excluding projects whose primary objectives are to promote the protection or restoration of such areas). Projects are also not to impose significant adverse impacts on designated conservation areas.	EIA-P (A 25)	Article 25 of EIA Procedure stipulates that an EIA is required in all cases where the Project will be located in or will have foreseeable adverse effects on any legally protected national, regional or state area, including without limitation: (i) a forest conservation area (including biodiversity reserved area); (ii) a public forest; (iii) a park (including marine parks); (iv) a mangrove swamp; (v) any other sensitive coastal area; (vi) a wildlife sanctuary; (vii) a scientific reserve; (viii) a nature reserve; (ix) a geophysically significant reserve; (x) any other nature reserve nominated by the Minister; (xi) a protected cultural heritage area; and (xii) a protected archeological area or area of historical significance
	Protection and Preservation of Cultural Heritage Regions Law (Article 18)	This law stipulates that no person shall construct, extend, renovate a building, or extend the boundary of any ancient monumental zone or ancient site zone without prior permission granted under this law.

JICA Guidelines/WB OP4.12	Legislation of Myanmar	Gaps between the JICA Guidelines/WB OP 4.12 and the Law of Myanmar
Social Acceptability		
<p>1. Projects must be adequately coordinated so that they are accepted in a manner that is socially appropriate to the country and locality in which they are planned. For projects with a potentially large environmental impact, sufficient consultations with local stakeholders, such as local residents, must be conducted via disclosure of information at an early stage, at which time alternatives for project plans may be examined. The outcome of such consultations must be incorporated into the contents of project plans.</p>	<p>EIA-P (A 36 (g), 50, 52, 63 (9))</p>	<p>Article 36 (g) of the EIA procedures stipulates that public consultation and public participation processes, recommendations received from the public, and the Project Proponent's written responses to comments received during that process is necessary in IEE report.</p>
		<p>Article 50 of the EIA Procedure stipulates that as part of the Scoping, the Project Proponent shall ensure that the following public consultation and participation process. a) disclose information about the proposed Project to the public and civil society through posting on the Project or Project Proponent's website(s) and local media, including by means of the prominent posting of legible sign boards and advertising boards at the Project site which are visible to the public; and b) arrange the required complement of consultation meetings as advised by the Ministry, with local communities, potential PAPs, local authorities, community based organizations, and civil society, and provide appropriate and timely explanations in press conferences and media interviews.</p>
		<p>Article 52 of the EIA Procedure stipulates that EIA investigations shall include all necessary data collection, technical studies, modeling, field surveys, field sampling, laboratory analysis, engineering designs and calculations, and consultations to determine and document that all feasible measures are taken to ensure that all Residual Impacts are within applicable limits and are acceptable to the Ministry and interested and affected persons.</p>
		<p>Article 63 (9) of the EIA Procedure stipulates that the project proponent is responsible for the preparation of EIA report which contains 9.0 Public Consultation and Disclosure.</p>
<p>2. Appropriate consideration must be given to vulnerable social groups, such as women, children, the elderly, and the poor and ethnic minorities, all members of which are susceptible to environmental and social impacts and may have little access to decision-making processes within society.</p>	<p>EIA-P (A 7)</p>	<p>Article 7 of the EIA Procedure describes that projects that involve Involuntary Resettlement or which may potentially have an Adverse Impact on Indigenous People shall comply with specific procedures separately issued by the responsible ministries. Prior to the issuance of any such specific procedures, all such Projects shall adhere to international good practice (as accepted by international financial institutions including the World Bank Group and Asian Development Bank) on Involuntary Resettlement and Indigenous Peoples. However, the details of actions are not provided in the draft procedures. However, the details of actions are not provided in the draft procedures.</p>
Ecosystem and Biota		
<p>1. Projects must not involve significant conversion or significant degradation of critical natural habitats and critical forests.</p>	<p>Environmental Conservation Law 2012 (A 18)</p>	<p>The Environmental Conservation Law prescribes that relevant government departments/ organizations shall carry out conservation, management, beneficial use, sustainable use and enhancement of regional cooperation of environmental natural resources.</p>
	<p>Forest Law 1992 (A 40)</p>	<p>Article 40 of the Forest Law (1992) prescribed that cause of any damage to reserved forest and its environment is prohibited and will be punished.</p>
	<p>Protection of Wildlife and Conservation of Natural Areas Law 1994 (A 36)</p>	<p>Article 36 of The Protection of Wildlife and Conservation of Natural Areas Law prescribed that cause of any damage to protected areas is prohibited and will be punished.</p>
<p>2. Illegal logging of forests must be avoided. Project proponents etc. are encouraged to obtain certification by forest certification systems as a way</p>	<p>Forest Law 1992 (A 17, 40)</p>	<p>The Law stipulates that forest produce may only be extracted after obtaining a permit.</p>

JICA Guidelines/WB OP4.12	Legislation of Myanmar	Gaps between the JICA Guidelines/WB OP 4.12 and the Law of Myanmar
to ensure the prevention of illegal logging		
Involuntary Resettlement		
1. Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. When, after such an examination, avoidance is proved unfeasible, effective measures to minimize impact and to compensate for losses must be agreed upon with the people who will be affected.	EIA-P (A 7)	Article 7 of the EIA Procedure describes that projects that involve Involuntary Resettlement or which may potentially have an Adverse Impact on Indigenous People shall comply with specific procedures separately issued by the responsible ministries. Prior to the issuance of any such specific procedures, all such Projects shall adhere to international good practice (as accepted by international financial institutions including the World Bank Group and Asian Development Bank) on Involuntary Resettlement and Indigenous Peoples. However, the details of actions are not provided in the draft procedures.
2. People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported by project proponents etc. in a timely manner. Prior compensation, at full replacement cost, must be provided as much as possible. Host countries must make efforts to enable people affected by projects and to improve their standard of living, income opportunities, and production levels, or at least to restore these to pre-project levels. Measures to achieve this may include: providing land and monetary compensation for losses (to cover land and property losses), supporting means for an alternative sustainable livelihood, and providing the expenses necessary for the relocation and re-establishment of communities at resettlement sites.	Land Acquisition Act 1894 (A 3)	Article 3 of the Land Acquisition Act stipulates that a person who has rights on the land would be entitled to claim compensation if the land was acquired under this Act.
	Farmland Rules 2012 (A 64)	Article 64 of the Farmland Rules 2012 stipulates the compensation in farmland acquisition for the interest of the state or public.
	Land Acquisition Act 1894 (A 23)	Article 23 of the Act stipulates that damages on standing crops and trees, on land, properties, incidental to relocate residence or business and losses of profits due to land acquisition are considered for compensation although it does not clearly state that support to project-affected persons (PAPs) can improve or at least restore their standard of living. However, these laws do not clearly state any more details of compensation and supporting measures.
	EIA-P (A 102)	Article 102 of the EIA Procedure stipulates that the Project Proponent shall bear full legal and financial responsibility for: PAPs until they have achieved socio-economic stability at a level not lower than that in effect prior to the commencement of the Project, and shall support programs for livelihood restoration and resettlement in consultation with the PAPs, related government agencies, and organizations and other concerned persons for all Adverse Impacts.
3. Appropriate participation by affected people and their communities must be promoted in the planning, implementation, and monitoring of resettlement action plans and measures to prevent the loss of their means of livelihood. In addition, appropriate and accessible grievance mechanisms must be established for the affected people and their communities.	EIA-P (A 36(g), 50, 52, 63(9))	Article 36 (g), 50, 52, 63(9) of the EIA Procedures describe that stakeholders including PAPs are invited as appropriate to provide comments and suggestions on the IEE/ EIA/EMP reports. However, it does not describe resettlement action plan.
	Land Acquisition Act 1894 (A 5A, 18)	Article 5A of the Land Acquisition Act stipulates that any person whose land is affected (acquired) can claim the objection for the land acquisition within thirty (30) days of the notification.
4. For projects that will result in large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP4.12, Annex A.	None	No laws were specifically mentioned about the requirement of resettlement action plans for large-scale involuntary resettlement.
		However, the General Administration Department (GAD) of the Ministry of Home Affairs (MOHA) explained that the Land Acquisition and Resettlement Action Plan (LARAP) will be required for large-scale developments and GAD will approve it. (hearing as of January 2013)

JICA Guidelines/WB OP4.12	Legislation of Myanmar	Gaps between the JICA Guidelines/WB OP 4.12 and the Law of Myanmar
Indigenous People		
1. Any adverse impacts that a project may have on indigenous peoples are to be avoided when feasible by exploring all viable alternatives. When, after such an examination, avoidance is proved unfeasible, effective measures must be taken to minimize impacts and to compensate indigenous peoples for their losses.	EIA-P (A 7)	Article 7 of the EIA procedures describes that projects that involve Involuntary Resettlement or which may potentially have an Adverse Impact on Indigenous People shall comply with specific procedures separately issued by the responsible ministries. Prior to the issuance of any such specific procedures, all such Projects shall adhere to international good practice (as accepted by international financial institutions including the World Bank Group and Asian Development Bank) on Involuntary Resettlement and Indigenous Peoples.
2. When projects may have adverse impacts on indigenous peoples, all of their rights in relation to land and resources must be respected in accordance with the spirit of relevant international declarations and treaties, including the United Nations Declaration on the Rights of indigenous Peoples. Efforts must be made to obtain the consent of indigenous peoples in a process of free, prior, and informed consultation.	EIA-P (A 7)	Article 7 of the EIA Procedure describes that projects that involve Involuntary Resettlement or which may potentially have an Adverse Impact on Indigenous People shall comply with specific procedures separately issued by the responsible ministries. Prior to the issuance of any such specific procedures, all such Projects shall adhere to international good practice (as accepted by international financial institutions including the World Bank Group and Asian Development Bank) on Involuntary Resettlement and Indigenous Peoples.
3. Measures for the affected indigenous peoples must be prepared as an indigenous peoples plan (which may constitute a part of other documents for environmental and social consideration) and must be made public in compliance with the relevant laws and ordinances of the host country. In preparing the indigenous peoples plan, consultations must be made with the affected indigenous peoples based on sufficient information made available to them in advance. When consultations are held, it is desirable that explanations be given in a form, manner, and language that are understandable to the people concerned. It is desirable that the indigenous peoples plan include the elements laid out in the World Bank Safeguard Policy, OP4.10, Annex B.	EIA-P (A 7)	Article 7 of the EIA Procedure describes that projects that involve Involuntary Resettlement or which may potentially have an Adverse Impact on Indigenous People shall comply with specific procedures separately issued by the responsible ministries. Prior to the issuance of any such specific procedures, all such Projects shall adhere to international good practice (as accepted by international financial institutions including the World Bank Group and Asian Development Bank) on Involuntary Resettlement and Indigenous Peoples.
Monitoring		
1. After projects begin, project proponents etc. monitor whether any unforeseeable situations occur and whether the performance and effectiveness of mitigation measures are consistent with the assessment's prediction. They then take appropriate measures based on the results of such monitoring.	EIA-P (A 100, 106)	<p>Article 100 of the EIA Procedure stipulates that The Project Proponent shall incorporate all relevant environmental commitments and requirements set forth in the EIA Report, Construction Phase EMP and/or Operational Phase EMP as the case may be, and in the ECC, applicable Emission Limit Values and Environmental Quality Standards, into detailed designs, construction contract specifications, and contracts on Project operations related to any part of the Project.</p> <p>Article 106 of the EIA Procedure stipulates that the Project Proponent shall, during all phases of the Project (pre-construction, construction, operation, decommissioning, closure and post-closure), engage in continuous, proactive and comprehensive self-monitoring of the Project and activities related thereto, all Adverse Impacts, and compliance with applicable laws, the Rules, this Procedure, standards, the ECC, and the EMP.</p>

JICA Guidelines/WB OP4.12	Legislation of Myanmar	Gaps between the JICA Guidelines/WB OP 4.12 and the Law of Myanmar
2. In cases where sufficient monitoring is deemed essential for appropriate environmental and social considerations, such as projects for which mitigation measures should be implemented while monitoring their effectiveness, project proponents etc. must ensure that project plans include feasible monitoring plans.	EIA-P (A -106)	Article 106 of the EIA Procedure stipulates that the Project Proponent shall, during all phases of the Project (pre-construction, construction, operation, decommissioning, closure and post-closure), engage in continuous, proactive and comprehensive self-monitoring of the Project and activities related thereto, all Adverse Impacts, and compliance with applicable laws, the Rules, this Procedure, standards, the ECC, and the EMP.
3. Project proponents etc. should make efforts to make the results of the monitoring process available to local project stakeholders.	EIA-P (A -110)	Article 110 of the EIA Procedure stipulates that within ten (10) days of completing a monitoring report as contemplated in Article 108 and Article 109 in accordance with the EMP schedule, the Project Proponent shall make such report (except as may relate to National Security concerns) publicly available on the Project's website, at public meeting places (e.g. libraries, community halls) and at the Project offices. Any organization or person may request a digital copy of a monitoring report and the Project shall, within ten (10) days of receiving such request, submit a digital copy via email or as may otherwise be agreed upon with the requestor. No laws were identified, which stated that project proponents etc. should make efforts to make the results of the monitoring process available to local project stakeholders.
Others		
1. Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits. (WB OP4.12 Para.6)	Land Acquisition Act of 1894 (A 4)	Article 4 of the Act stipulates that a notification of land requirement for public purposes is published to start surveys and land marking although it does not state the details of the surveys that will establish eligibility through an initial baseline survey (including population census).
2. Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying. (WB OP4.12 Para.15)	Land Acquisition Act of 1894 (A 9)	Article 9 of the Act stipulates that the occupier (if any) of land and all persons known or believed to have rights on lands are notified or invited for explanations, although the eligibility is not clearly prescribed in the Act.
3. Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WBOP4.12 Para.11)	EIA-P (A -7)	Article 7 the EIA Procedure stipulates that projects that involve Involuntary Resettlement or which may potentially have an Adverse Impact on Indigenous People shall comply with specific procedures separately issued by the responsible ministries. Prior to the issuance of any such specific procedures, all such Projects shall adhere to international good practice (as accepted by international financial institutions including the World Bank Group and Asian Development Bank) on Involuntary Resettlement and Indigenous Peoples.
4. Provide support for the transition period (between displacement and livelihoods are land-based. (WB OP4.12 Para 6)	EIA-P (A -7)	Ditto
5. Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly women and children, ethnic minorities etc. (WB OP4.12Para.8)	EIA-P (A -7)	Ditto
6. For projects that entail land acquisition or involuntary resettlement for fewer than 200 people,	None	No law was identified about the criteria of abbreviated

JICA Guidelines/WB OP4.12	Legislation of Myanmar	Gaps between the JICA Guidelines/WB OP 4.12 and the Law of Myanmar
abbreviated resettlement plan is to be prepared, (WB OP4.12 Para.25)		resettlement plan.

Source: JICA Study Team

Note (JICA): JICA Guidelines for Environmental and Social Considerations (April, 2015), (WB): World Bank Safeguard Policy, (OP): Operational Policies, (EIA-P): Environmental Impact Assessment (EIA) Procedure (2015, by MOECAP), (A): Article.

Source: JICA Guidelines for Environmental and Social Considerations (April, 2010), World Bank OP 4.12, the EIA Procedure (2015) and other relevant Myanmar legislations

(5) Environmental Quality Standards

i) Environmental Quality Emission Guidelines (EQG) set up by MOECAP

In Article 10 of the Environmental Conservation Law, 2012, there is a statement that MOECAP may stipulate the Environmental Quality Standards (EQS) for items such as surface water quality, coastal and estuarine areas water quality, underground water quality, air quality, noise and vibration, effluent standard and solid waste standard with the approval of the Union Government and the Committee. EQS preparation sub-committee includes 31 numbers of members from governmental ministries such as Environmental Conservation Department in MOECAP, Health Department in the Ministry of Health, Meteorology and Hydrology Department, the Ministry of Labour (MOL), the Ministry of Industry (MOI), the Ministry of Agricultural and Irrigation (MOAI), the Ministry of Livestock, Fisheries and Rural Development, the Ministry of Rail Transportation (MRT), Naypyitaw Council Development Committee, Yangon City Development Committee (YCDC), Mandalay City Development Committee (MCDC), the Ministry of Transportation, the Ministry of Science and Technology. EQS has been prepared by EQS sub-committee in collaboration with International Organizations (ADB, European Union (EU)-International Management Group (IMG)), NGOs (Union Me F CCI), Coordinator (Private employer), Experts and Specialists.

Before National Environmental Quality Standard is enacted, the Environmental Quality (Emission) Guidelines (EQG) was promulgated on 29 December 2015 to be applicable as environmental quality guidelines for monitoring and implementation of IEE/EIA/EMP type of projects. It takes time to stipulate National EQS. The target of enactment of environmental quality standards is at the end of 2017 by MOECAP. EQG was prepared with the reference to EHS Guidelines for each sector by International Finance Corporation (IFC), which provides technical guidance on good international industry pollution prevention practice in developing countries. EQG includes guideline values of air emission, effluent level, noise and odor for general and each industry. Appendix B-1 shows general guidelines and a list of industry specific guideline determined in the EQG (2015).

Regarding road construction, this guideline applies to construction, operation and maintenance of large, sealed road projects including associated bridges and overpasses. While roads do not typically give rise to significant point source effluents or air emissions, discrete point source sanitary wastewater and storm water should achieve the following source effluent levels and general air emissions guidelines shall apply. Air emission guidelines, effluent level guidelines and noise level related to the project are shown in Table 4-9, Table 4-10 and Table 4-11 respectively.

Table 4-9 Air Emission Guidelines

Parameter	Unit	Concentration ($\mu\text{g}/\text{m}^3$)
Nitrogen dioxide	1-year	40
	1-hour	200
Ozone	8-hour daily maximum ()	100
Particulate matter PM ₁₀	1-year	20
	24-hour	50
Particulate matter PM _{2.5}	1-year	10
	24-hour	25
Sulphur dioxide	24-hour	20
	10-minute	500

Source: Myanmar EQG (2015)

Table 4-10 Effluent Level Guidelines

Parameter	Unit	Concentration
Biological oxygen demand	mg/l	30
Chemical oxygen demand	mg/l	125
Oil and grease	mg/l	10
pH	Standard Unit	6-9
Total coliform bacteria	100 ml	400
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Total suspended solids	mg/l	50

Source: Myanmar EQG (2015)

Table 4-11 Noise Level

Category	One Hour LAeq (dBA)	
	Day time 7:00 - 22:00 (10:00 - 22:00 for Public holidays)	Evening Time (Leq) 22:00 - 7:00 (22:00-10:00 for Public holidays)
Residential, institutional, educational	55	45
Industrial, commercial	70	70

Source: Myanmar EQG (2015)

While EQG generally applies to all projects subject to the EIA Procedure, it is the prerogative of the MOECAAF to decide how the Guidelines should be applied to existing projects as referred to in the EIA Procedure, as distinguished from new projects. Air emissions, noise, odor, and liquid/effluent discharges will be sampled and measured at points of compliance as specified in EMP and ECC.

ii) Environmental Quality Standards set up by other Ministries

Some emission and/or discharge standards and environmental standards were established by other ministries and practically, used standards and/or guidelines as references. Table 4-12 shows environmental quality standard stipulated by other Ministries.

Table 4-12 Environmental Quality Standard stipulated under other Ministries

No.	Ministry	Environmental Quality Standards
1	Ministry of Industry (MOI)	Air Quality
2	Ministry of Electrical Power (MOEP)	Air Quality, Noise and Vibration Quality
3	Ministry of Health (MOH)	Air Quality, Noise and Vibration Quality
4	Ministry of Mine (MOM)	Air Quality, Noise and Vibration Quality

No.	Ministry	Environmental Quality Standards
5	Ministry of Rail Transportation (MRT)	Air Quality, Noise and Vibration Quality
6	Naypyitaw City Development Committee (NCDC)	Water Quality
7	Yangon City Development Committee (YCDC)	Water Quality
8	Mandalay City Development Committee (MCDC)	Water Quality

Source: Formulation of Environmental Quality Guidelines by Mr. Hla Maung Thein from ECD on 6 Jan, 2015

iii) Pollution Control Standards at Generation Source

The Private Industrial Enterprise Law (1990) stipulates that one of the basic principles of the law is to avoid or reduce the usage of technology which causes environmental pollution. In addition, the law also stipulates that one of the duties of the Ministry of Industry (MOI) is to secure or prevent any pollution to cause any adverse effect on the environment as well as on the health of residents and factory workers.

Standing Order 3/95 of the Water and Air Pollution Control Plan of MOI stipulates that factories shall conduct monitoring of wastewater for items defined in the Order. The emission and effluent standards are shown in Tables 4-13 and 4-14 respectively.

Table 4-13 Emission Standards

Gas	mg/m ³	ppm
CO ₂	9,000	500
CO	55	50
H ₂ S	14	10
Ammonia	18	25
Benzene	30	10

Source: MOI Standing Order 2/95 Occupational Health Plan (1995)

Table 4-14 Effluent Standards

Item	Threshold	Standard Value
BOD (5 days at 20.BOD and 5 days at 20 °C)	max	20 ppm or more but not exceeding 60 ppm, depending on the geography of waste discharging point
Suspended solids	max	30 ppm
Dissolved solids	max	2,000 ppm
pH value	Between 5 and 9	
Permanganate value	max	60 ppm
Supplied (as H ₂ S)	max	1 ppm
Cyanide (as HCN)	max	0.2 ppm
Oil and grease	max	5 ppm
Tar	none	
Formaldehyde	max	1 ppm
Phenols and cresols	max	1 ppm
Free chlorine	max	1 ppm
Zinc	max	5 ppm
Chromium	max	0.5 ppm
Arsenic	max	0.25 ppm
Copper	max	1.0 ppm
Mercury	max	0.005 ppm
Cadmium	max	0.03 ppm
Barium	max	1.0 ppm
Selenium	max	0.02 ppm
Lead	max	0.2 ppm
Nickel	max	0.2 ppm
Insecticides	none	
Radioactive materials	none	

Item	Threshold	Standard Value
Temperature	max	40 °C
Color and odor	Not objectionable when mixed in receiving water	

Source: MOI Standing Order 3/95: Water and Air Pollution Control Plan

iv) Regulation of Wastewater Discharge in Yangon City Development Committee (YCDC) Area

Section 7 (7) of the YCDC Order No. 10/99 prohibits discharging of wastewater into common properties. Disposal of waste and discharging of sewage or wastewater from activities such as business, factory and construction projects to drainages, creeks and rivers without necessary treatment not complying with standards, norms, and criteria designated by the concerned agency are prohibited. The effluent standards from factories and facilities are shown in Table 4-15.

Table 4-15 Effluent Standards for Wastewater from Factories and Facilities

No.	Item	Value
1	pH	6-9.6
2	BOD	20-60 ppm
3	COD	< 200 ppm
4	TS	up to 2,000 ppm
5	SS	up to 500 ppm

Source: Proposed National Standard from Occupational Health Division, Department of Health under the Ministry of Health

v) Water Quality Standards

With regard to the water quality, however, the guidelines proposed in the workshops in 1990, 2011 (draft) and 2014 (draft) by National Water Resources Committee (NWRC) were compared with the World Health Organization (WHO) guidelines in Table 4-16. Compared with 1990, the values for 2011 and 2014 tended to be closer to the WHO guidelines. However, for copper and iron, the values are less strict than in the WHO guidelines.

Table 4-16 Water Quality Standard in Myanmar

Parameters	Unit	Myanmar Standard		NWRC* in Myanmar	WHO Guidelines	
		1990	2011 (Draft)	2014 (Draft)		
1	pH	-	6.5-9.2	6.5-8.5	6.5-8.5	Preferably <8.0
2	Turbidity	NTU	20	5	5	5
3	Colour	Pt-unit	6.5-9.2	15	15	15
4	Aluminum (Al)	mg/l	0.2	0.2	0.2	0.2
5	Arsenic (As)	mg/l	0.05	0.05	0.05	0.01
6	Calcium (Ca)	mg/l	75-200	100	200	-
7	Chloride (Cl)	mg/l	200-600	250	250	250
8	Copper (Cu)	mg/l	1	2	2	1
9	Cyanide (CN)	mg/l	0.05	0.07	0.07	0.07
10	Hardness	mg/l	500	500	-	-
11	Iron (Fe)	mg/l	0.5 -1.5	1	1.0	0.3
12	Manganese (Mn)	mg/l	0.3	0.3(0.1)	0.4	0.1
13	Lead (Pb)	mg/l	0.05	0.01	0.01	0.01
14	Magnesium (Mg)	mg/l	30-50	500	150	-
15	Nitrate (NO ₃)	mg/l	10 (as N)	50	50	-
16	Sulfate	mg/l	400	250	250	250

Parameters	Unit	Myanmar Standard		NWRC* in Myanmar	WHO Guidelines	
		1990	2011 (Draft)	2014 (Draft)		
17	Total dissolved solids	mg/l	1,000	1,000	1,000	
18	Zinc (Zn)	mg/l	5 - 15	3	3	
19	Total Coliform	No/100 ml	0	0	<ul style="list-style-type: none"> ▪ 0 (treated pipe water) ▪ 10 (for untreated pipe water) ▪ To be confirmed (Water in distribution system) ▪ 10 (unpipied water) ▪ 0 (bottled drinking water) ▪ 10 (emergency water) 	0
20	<i>E.Coli</i>	No/100 ml	0	0	0	0

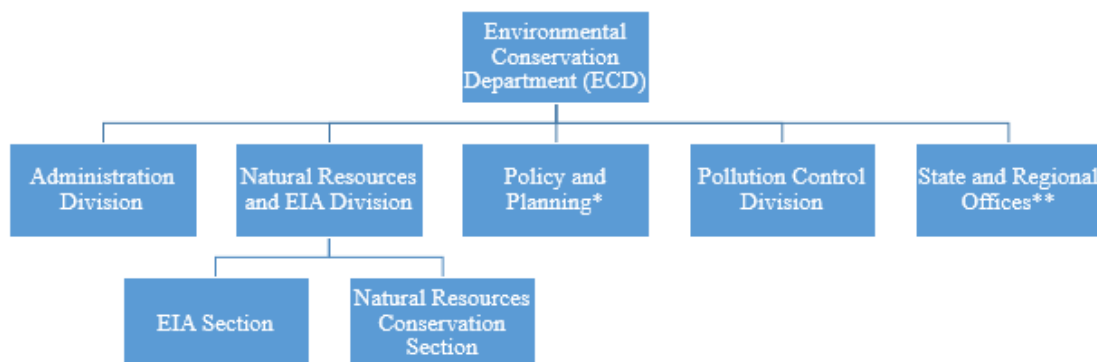
Source: *The Study on the Improvement of Water Supply and Wastewater Treatment in Yangon (2012, METI, Japan), Challenges & Solutions to Improving Water Supply* presentation by Mr. Khin Maung Htaey, Chairman of Water Supply and Sanitation Technical Division in Myanmar Engineering Society

Note (*): National Water Resources Committee

(6) Institutional Framework for Environmental Management Administration

i) Institutional Framework for Environmental Conservation in Myanmar

MONREC is responsible for undertaking both environmental and forest conservation in Myanmar. The Environmental Conservation Department (ECD), which was established in MONREC in 2012, is responsible for environmental affairs including EIA study. ECD includes five divisions as shown in Figure 4-3 and it has offices in each state and region as shown in Note (**) of Figure 4-3.



Note: (*) Policy, Planning, and International Relations, Research and Extension Division

Note (**): State and Regional Offices (Yangon, Mandalay, Sagaing, Bago, Tanintharyi, Bago, Rakhine, Kachin, Shan, Mon, Magwe, Chin, Kayah and Kayin)

Source: *Edited from the documents of ECD by JICA Study Team in 2014*

Figure 4-3 Organization Chart of ECD

Among the above mentioned departments, divisions, and sections, Policy and Planning department and the EIA Section has the following main duties and responsibilities:

- To develop the EIA Procedure and regulations in order to avoid, minimize, and/or mitigate adverse environmental impacts,
- To monitor the implementation of environmental conservation, and
- To review the EIA/IEE reports for development of projects.

Pollution control department is mainly responsible to set up Environmental Quality Standard, Environmental Quality Emission Guidelines, Hazardous waste management and many more.

4.2 EXISTING SOCIAL AND ENVIRONMENTAL CONDITIONS AROUND THE PROJECT AREA

Site investigation for the Bridge Portion and the Intersection Portion in Thaketa Township and Thanlyin Township was carried out in 2014 and in Feb and March in 2016 respectively.

Social Environment such as administrative location, population and population density, ethnicity, religion, employment, education, health, land use, transportation, cultural, historical, and religious facilities, protected areas and parks, water supply, sanitation, electricity, telecommunication and fishing rights and activities in Thaketa Township and Thanlyin Township were confirmed based on the data received from respective GAD in March 2016, YCDC in Thaketa Township, the 2014 Census result and field survey on flora, fauna and ecosystem in 2014.

Field survey on flora, fauna and ecosystem were conducted in 2014, and natural environment such as topology, geology and soil type, climate, hydrological conditions, and natural disasters and hazards were confirmed based on the result of field survey in 2014.

Environmental survey on air quality, water quality, bottom sediment quality and ambient noise which were conducted in the previous preparatory survey for the bridge portion in 2014.

Collected information and survey results on social and natural environment were compiled in Chapter 3 in IEE report.

4.3 INITIAL ENVIRONMENTAL EXAMINATION (IEE) OF THE PROJECT

4.3.1 Table of Contents of IEE report

IEE report for the supplemental survey for construction of Bago River Bridge and improvement at intersections is prepared separately in Appendix B-2, and the Table of Contents of IEE report is shown in Table 4-17.

Table 4-17 Table of Contents of IEE Report

Chapter	Contents
1	Introduction
1.1	Background
1.2	Project Description
1.3	Project Owner and Proponent
1.4	Type of Environmental Impact Assessment Study
1.5	Implementation Organizations of IEE
1.6	Overall Framework of IEE Study
2	Policy and Legislation of Environmental and Social Considerations and Institutional Framework
2.1	Policy of Environmental and Social Considerations
2.2	Environmental Quality Standards
2.3	Institutional Framework
3	Overall Conditions in the surrounding area
3.1	Surrounding Conditions around the Project area
3.2	Social Environment
3.3	Natural Environment
3.4	Environmental Pollution
4	Selection of Alternatives for Improvement at intersections
4.1	Comparison of Alternatives for improvement at intersections

Chapter	Contents
4.2	Comparison with No Action Plan for improvement of intersections
5	Results of IEE
5.1	Setting of Environmental Components and Items
5.2	Activities of the Project
5.3	Identification and Evaluation of Possible Impacts
5.4	Mitigation Measures against Negative Impacts and Environmental Management Plan (EMP)
5.5	Environmental Monitoring Plan (EMoP)
6	Stakeholder meeting
6.1	First Stakeholder Meeting
6.2	Second Stakeholder Meeting

Source: JICA Study Team (data obtained in 2014 and in 2016)

4.3.2 Identification and Evaluation of Possible Impacts

Identification and evaluation of possible impacts due to implementation of the construction of Bago River Bridge and improvement at intersections are discussed below.

(1) Results of the Identification and Evaluation of Possible Impacts for construction of Bago River Bridge

In previous preparatory survey in 2014, possible impacts by construction of Bago River Bridge were identified and the extent of the impacts was also evaluated one by one and rated against the 40 environmental items under five main components of social environment, health, safety and risks, natural environment, environmental pollution and others. Results of the identification and evaluation of possible impacts for construction of Bago River Bridge in IEE report of previous preparatory report in 2014 are shown together with the results of scoping in Table 4-18.

In the evaluation, the following rating criteria were adopted depending on the extent of impacts:

A (+/-) – Significant positive/negative impact is expected.

B (+/-) – Positive/negative impact is expected but not significant.

C (+/-) - Extent of impact is unknown or not clear. Further examination is needed. It should be taken into consideration that impacts may become clear as study progresses.

D or Blank - Negligible or no impact is expected.

Table 4-18 Results of the Identification and Evaluation of Possible Impacts for construction of Bago River Bridge

Environment Item */**	Rating***				Identification and Evaluation of Anticipated Impacts and their Reasons
	Scoping		After Survey		
	I/II ****	III ****	I/II ****	III ****	
(A) Social Environment					
1) Involuntary resettlement (land acquisition and resettlement)	B-		B-		1) The right-of-way (ROW) for the planned bridge and approach roads is on public lands and owned by the government such as Myanmar Railways, Ministry of Construction, YCDC, and YRDC. Thus, land acquisition and displacement of houses and people is not expected. 2) However, there were some encroachment of stalls and three small religious facilities within the ROW of an approach road. They are necessary to be relocated.

Environment Item */**	Rating***				Identification and Evaluation of Anticipated Impacts and their Reasons
	Scoping		After Survey		
	I/II ****	III ****	I/II ****	III ****	
					3) About 160 trees within the ROW should be removed, and/or planted. 4) About ten electric poles within the ROW should be relocated. 5) Diesel fuel, oil and CNG pipelines laid down within the ROW should be relocated or properly protected in order to avoid damage caused by construction works and bridge operation. 6) Secure land for construction-related facilities (construction office, worker's camp, storage of construction materials, and wastes).
		D		D	No additional involuntary resettlement is expected during the operation stage.
2) Local economy such as employment and livelihood	B+		B+		Beneficial impacts such as creation of employment opportunity for construction works are expected.
				A+	Through the construction of the Bago River Bridge, existing traffic congestion will be greatly solved in Greater Yangon. Thus improved road network may raise the living condition and make social services easily accessible, leading to the enhancement of the local economy.
3) Fishing activity	B-		B-		There are small scale fishing activities in the Bago River. Thus, construction works including dredging and excavation may disturb their environment.
				D	No significant negative impact is expected.
4) Utilization of land and local resources	B-		B-		1) Quarries and/or borrow pits will be utilized for procurement of construction materials. 2) Water for construction works including worker's camp may compete with the existing water resources.
				D	No significant negative impact is expected.
5) Existing social infrastructures and services: i) Road and railway traffic	B-		B-		Basically, traffic condition will not be changed by using the existing Thanlyin No. 1 Bridge during the construction stage. However, the delivery of construction machines and materials as well as traffic created by construction vehicles may cause temporary closure of roads, one-way traffic, and restriction of vehicle speed. Therefore, using diversion route will be required in these situations. Even so, these may result in traffic congestion and inconvenience in accessing public facilities.
				A+	Road traffic condition will be significantly improved by the operation of the new bridge and approach roads.
6) Existing social infrastructures and services: ii) Water transport	B-		B-		Bridge construction works such as riverbed dredging may disturb water transport due to change in navigation channel.
				B-	Bridge foundations and piers may change the flow conditions of the Bago River, resulting in disturbance of navigation.
7) Existing social infrastructures and services: iii) Others	B-		B-		1) There are utility lines such as high voltage electrical lines, water pipes, and telephone lines, underneath the proposed bridge and approach roads. Thus they are necessary to relocate. 2) Utilization of water for construction work may compete with the community water supply.
				A+	Improvement of traffic condition among Yangon City, Thanlyin Township, and Thilawa SEZ will greatly enhance the economic and industrial development of Greater Yangon as well as improve the accessibility to social services.
8) Social institutions such as social infrastructure and local decision-making institutions	B-		B-		If information disclosure of the project plan, and procedure and public participation are not properly conducted, people's anxieties and complaints may occur and spread over the communities resulting in difficulties to obtain a thorough understanding of the Project and consensus among the people.
				B-	
9) Vulnerable groups such as the poor, women, children, elderly, and disabled.	B+		B+		The Project may create employment opportunities for the vulnerable groups such as the poor and women in the construction works.
				B+	Vulnerable groups such as children and women are also encouraged to go to the hospitals and schools in Yangon City due to the improvement of accessibility and resolution of traffic congestion.
10) Indigenous people or ethnic minority	D		D		Myanmar is an ethnically diverse nation with 135 distinct ethnic groups. However, neither indigenous people nor ethnic minority group are found in the project area.
				D	
11) Misdistribution of benefit and damage	B-		B-		There is some possibility of misdistribution of benefit and damage, if the project plan including procedures of the implementation and involuntary resettlement matters are not properly disseminated and consulted with residents, communities, and other stakeholders.
				B-	
12) Local conflict of interests	B-		B-		There is some possibility of local conflicts of interest, if the project plan including implementation procedures and involuntary resettlement matters are not properly disseminated and consulted with the residents, community, and other stakeholders.
				B-	
13) Cultural, historical, archaeological, and religious	B-		B-		1) In Greater Yangon Region, there are many religious facilities such as Buddhist temples (pagodas) and monasteries, Hindu temples, and mosques. However, no

Environment Item */**	Rating***				Identification and Evaluation of Anticipated Impacts and their Reasons
	Scoping		After Survey		
	I/II ****	III ****	I/II ****	III ****	
heritage sites					cultural and religious sites are distributed in and around the project site. 2) Recently, two small religious praying facilities (Buddhism and traditional religion) were installed within the ROW in the Thanlyin Township side. However, according to Myanmar Railway Authority, which owns the ROW, it has already been agreed with the real estate company, who rented the land from the authority, to remove and/or relocate these structures before the commencement of construction works.
				D	No significant negative impact is expected.
14) Water rights, fishing rights, and rights of common	B-		B-		1) The Bago River in the project area is under the control of MPA and Inland Water Transport and Directorate of Water Resources and Improvement of River Systems in the Ministry of Transport and Communication. Water right is permitted from this Ministry. 2) In Myanmar, there are two types of fishing rights: one is "fishing grant", which is given for specified river area, and the other is "license", which is a permit for fishing. In the project area, no fishing grant is established. Thus, permission from fishermen is not required. 3) As the fishing activity in the project area is only small in scale, bridge construction work may only cause little adverse impact on such activity. 4) Rights of commons are not established in the project area.
				D	
15) Landscape	B-		B-		1) During construction, the project site is filled with construction machineries, construction workers, construction materials, workers' camps and many more. This condition will affect the landscape of the project area. 2) In addition, 160 numbers of trees are necessary to cut and cutting trees degrade the level of landscape. 3) Cutting greenery trees on MR's Land in Thanlyin Township to construct an approach road degrade the view of landscape.
				B-	Existing bridge landscape in and around the Bago River produced by the Thanlyin No. 1 Bridge will somehow change due to the appearance of Bago River Bridge, which is planned to be constructed nearby at about 140 m downstream of the existing Thanlyin No. 1 Bridge. Thus, it is required to design the bridge so as to establish the new attractive landmark and to harmonize it with Thanlyin No. 1 Bridge.
16) Gender	D		D		Significant impact of gender discrimination is not expected by the project intervention.
		B+		B+	Both gender can get benefits from the Project as they are encouraged to commute to schools, universities, works and social activities by vehicles by using smoother road connection as a result of implementation of improvement at intersections.
17) Children's Right	D		D		This project is expected not to induce any significant impact to children's right.
		B+		B+	Improved access, safety and traffic congestion by the Project may contribute to provide more opportunities to children to go to schools, parks and social activities.
18) Sunlight shading	D		D		The site of the Bago River Bridge and approach roads are surrounded by scattered area and the Bago River. Thus, adverse impact on sunlight shading is not expected.
				D	
(B) Health, Safety and Risk					
19) Community health and safety	B-		B-		1) Air pollutants such as dust, SPM, NOx, and SOx emitted from construction vehicles and machines as well as construction works may cause some adverse effects to respiratory health. 2) Moreover, noise and vibration from construction may affect local community's living condition and health although it is temporary. 3) Waste from construction sites and workers' camps may deteriorate sanitary of surrounding area if they lack proper facilities for sanitation. 4) Exposure of construction accidents to the Public is anticipated. 5) Although the project activities will not pose any hazard or risk, migration of workers from other areas may worsen the condition of public security temporarily and community awareness should be promoted.
				B-	1) Air pollution, traffic noise and vibration due to an increase in traffic volume may cause some adverse effects to health for example respiratory organs. 2) Hazard of safety due to increased traffic is anticipated.
20) Infectious diseases such as HIV/AIDS	B-		B-		Road construction workers and truck drivers are considered as having high potential for the spread of sexually transmitted diseases (STDs) and HIV/AIDS due to their mobility. Reports on infection with HIV/AIDS and venereal diseases at worker's camp during road construction stage were observed in other developing countries.
				D	No significant negative impact is expected.
21) Occupational health and	B-		B-		Many workers will be engaged in construction works and stay at worker's camps

Environment Item */**	Rating***				Identification and Evaluation of Anticipated Impacts and their Reasons
	Scoping		After Survey		
	I/II ****	III ****	I/II ****	III ****	
safety					under poor living conditions. Thus, the health and occupational safety of the workers may be jeopardized in case of severe working conditions.
				D	No significant negative impact is expected.
22) Hazards/security risks	B-		B-		Although the project activities will not pose any hazard or risk, migration of workers from other areas may worsen the condition of public security and community awareness should be increased.
				D	No significant negative impact is expected.
23) Accidents	B-		B-		Occurrence of accidents may increase due to construction works, machine and plant deployment, and construction materials handling, as well as the occurrence of traffic accidents caused by construction vehicles.
				B-	Improvement of traffic congestion may give rise to an increase in number of traffic accidents due to the increase in vehicle speed and number of vehicles travelling.
24) Emergency risks	B-		B-		1) Risk of fire is expected with a fixed probability. 2) Flood risk such as heavy rain, cyclone and tsunami is expected with a fixed probability.
				B-	3) Earthquake risk is anticipated with a fixed probability.
(C) Natural Environment					
25) Protected area	D		D		1) There is neither protected nor environmentally sensitive area in and around the project area. 2) No significant negative impact is expected.
				D	
26) Terrestrial fauna, flora, and biodiversity	B-		B-		1) According to the field survey, two plant species of globally threatened species registered in IUCN Red List were found in the project area. 2) Trees planted along the road contribute to the greenery and visual amenity providing an area of relaxation and recreation for local residents. Thus, cutting or removal of trees along the roads may spoil the greenery environment and its amenities.
				D	No significant negative impact is expected.
27) Aquatic fauna, flora, and biodiversity	B-		B-		1) No rare, endangered, or endemic aquatic plant or animal species are reported in the project area. 2) The Bago River is a tidal river, and mangroves, which are places for breeding and hatchery of fishes, are distributed with isolated or with a small community along the riverbank. Mangroves function in the reproduction of fish resources and sheltering from high tidal waves and tsunami as well as making riparian natural landscape. 3) Riverbed dredging and excavation caused by the bridge construction work may increase turbidity and deteriorate mangrove communities.
				B-	
28) Hydrological situation/drainage pattern	B-		B-		Excavation and dredging works at the bottom and sides of the river for the construction of the bridge may result in changes of hydrogeological situation of the river.
				B-	There is some awareness about river scouring at the bridge site. Scouring action will be strong especially during rainy season.
29) Topography and geology	D		D		No large-scale land alteration is expected. The scale of dredging and excavating river bed is expected to be too small to change the topographical and geological features
				D	
30) Soil erosion	B-		B-		No large-scale land cutting and filling is expected. However, improper soil embankment works will likely cause soil erosion during rainy season.
				D	
31) Groundwater	D		B-		There is some possibility of pumping up of groundwater if water supply is not available. There is some possibility of pumping up of groundwater if water supply is not available. There should be a limitation in the amount of pumping up of groundwater to prevent impacts on groundwater.
				D	No significant negative impact is expected.
32) Coastal zone	B-		B-		New bridge foundation and piers may somehow change the tidal flow of the Bago River. Thus, there is a possibility of coastal erosion, sand sedimentation, and some changes in the aquatic ecosystem including mangrove community, but they are small in scale.
				B-	
33) Micro-climate	D		D		The site of Bago River Bridge and approach roads are surrounded by scattered flat area and the Bago River. In addition, neither construction of tall buildings nor large-scale reclamation is planned. Thus, change in microclimate is not expected.
				D	
(D) Environmental Pollution					
34) Air pollution	B-		B-		Emission of air pollutant such as PM and NOx from construction vehicles and machines, and earthmoving and construction works may temporarily deteriorate air quality.
				B-	1) Improvement of traffic congestion will result in a smoother traffic condition through the construction of Bago River Bridge. Thus, reduction in the emission of air pollutants

Environment Item */**	Rating***				Identification and Evaluation of Anticipated Impacts and their Reasons
	Scoping		After Survey		
	I/II ****	III ****	I/II ****	III ****	
					such as NO and PM is expected due to decrease in idling time. 2) On the other hand, improvement of traffic congestion may increase the number of vehicles travelling (about 34,820 pcu/day in 2023). This may also result in an increase in emission load of air pollutants such as PM and NOx.
35) Water pollution	B-		B-		Water pollution is expected due to the following pollutant generation from construction works, although they are only temporarily: (i) Runoff of dirty water including soils from cutting, filling, and excavation from earthmoving work. (ii) Wastewater from worker' camps and construction office. (iii) Increase in turbidity of river water due to stirred river bottom mud. (iv) Spilling over of toxic materials such as asphalt emulsifiers.
				D	No significant negative impact is expected.
36) Soil contamination	B-		B-		Leakage of toxic materials such as lubricating oil from construction vehicles and machines, and asphalt emulsifiers utilized for road construction may give rise to soil contamination.
				D	No negative impact is expected.
37) Bottom sediment	B-		B-		Sedimentation and accumulation of water pollutants including toxic materials in the river may result in the pollution of bottom sediments.
				D	No significant negative impact is expected.
38) Solid Waste	B-		B-		Generation of soil, sand, and construction wastes is expected at quarries, borrow pits, site of bridge and road construction works, and worker's camp.
				D	No significant negative impact is expected.
39) Noise and vibration	B-		B-		Generation of noise and vibration from construction machines and vehicles is expected.
				B-	Improvement of traffic congestion may give rise to an increase in the number of vehicles travelling (about 34,820 pcu/day in 2023). This may also result in an increase in vehicle noise and vibration.
40) Ground subsidence	D		D		Neither major reclamation nor pumping up of large amount of groundwater is expected.
				D	
41) Offensive odor	B-		B-		Noxious odor from polluted river bottom sediment may generate due to the dredging work for bridge construction.
				D	No significant negative impact is expected.
(E) Environmental Pollution					
42) Global warming/climate change	D		D		Small scale and temporary generation of greenhouse gases like CO ₂ are expected due to construction vehicles and machines. However, impact on transboundary and climate change is negligible.
				D	Increase in greenhouse gases like CO ₂ is expected in a small scale due to increase of traffic volume. However, impact on transboundary and climate change is negligible.

Note (*): Environmental items are chosen based on the JICA Guidelines for Environmental and Social Considerations (April, 2010) and relevant legislations of the Myanmar government as well as the project plan and environmental condition of the project area, as indicators expressing environmental and social conditions.

Note (**): Regarding the impacts on "gender" and "children's right" might be related to all items under social environment.

Note (***): Rating - In general, both positive impact (+) and negative impact (-) are expected due to the anticipated project activities. Thus, the following rating criteria are adopted with respect to the extent of impacts: A (+/-): Significant positive/negative impact is expected, B (+/-): Positive/negative impact is expected to some extent, C (+/-): Extent of positive/negative impact is unknown or not clear (Further examination is needed. It should be taken into consideration that impacts may become clear as study progresses), Blank: Negligible or no is expected.

Note (****) I : Planning Stage, II : Construction Stage, III : Operation Stage

Source: JICA Study Team (data obtained in 2014 and updated in June, 2016 as necessary)

(2) Results of the Identification and Evaluation of Possible Impacts for improvement at intersections

Possible impacts by improvement at intersections were identified and the extent of the impacts was also evaluated one by one and rated against the 40 environmental items, which were updated a little based on environmental items for the construction project of Bago River Bridge, under three main components of

social environment, natural environment, and environmental pollution. Results are shown together with the results of scoping in Table 4-19.

Table 4-19 Identification and Evaluation of Anticipated Impacts for Improvement at Intersections

Environment Item **/**	Rating***				Identification and Evaluation of Anticipated Impacts and their Reasons
	Scoping		After Survey		
	I/II ****	III ****	I/II ****	III ****	
(A) Social Environment					
1) Involuntary resettlement (land acquisition and resettlement)	B-		B-		Land acquisition is required at some extent in both Thaketa township and Thanlyin township. Tentative total number of PAH which requires relocation is estimated as 33 and total number of PAH which requires some kind of assistance or compensation but relocation is not required is estimated as 58. If it is assumed that there are four members in each household, the total number of PAPs is 190. As of June, 2016, it is assumed that the number of PAPs is not greater than 200.
		D		D	No additional land acquisition and involuntary resettlement is expected during the operation stage.
2) Local economy such as employment and livelihood.	B+		B+		Beneficial impacts such as creation of employment opportunity as construction workers for construction of a flyover, on-ramp and widening of roads are expected.
		B+		B+	<ul style="list-style-type: none"> ▪ By making improvement at intersections in Thaketa Township and in Thanlyin Township, it promotes smooth road network in Greater Yangon and existing traffic congestion will be greatly solved in Thaketa Township and Thanlyin Township. ▪ Improved road network may raise the living condition and make social services easily accessible, leading to the enhancement of the local economy.
3) Fishing activity	D		D		No significant negative impact is expected.
		D		D	
4) Utilization of land and local resources	B-		B-		<ul style="list-style-type: none"> ▪ Excavation of land for construction of foundation for a straight flyover in Thaketa Township and that for construction of foundation for on-ramp in Thanlyin Township is expected. ▪ Utilization of land temporarily for keeping construction machineries in Thaketa Township and Thanlyin Township is necessary. ▪ Water for construction works including worker's camp may compete with the existing water resources.
		D		D	No significant negative impact is expected.
5) Existing social infrastructures and services: i) Road and railway traffic	B-		B-		During construction stage in Thaketa Township and Thanlyin Township, the delivery of construction machines and materials as well as traffic created by construction vehicles may cause temporary closure of roads, one-way traffic, and restriction of vehicle speed due to the limitation of ROW of the Road. Therefore, using diversion route will be required in these situations. These may result in traffic congestion and inconvenience in accessing public facilities.
		A+		A+	Road traffic condition will be improved significantly by the operation of a flyover in Thaketa Township and that of on-ramp in Thanlyin Township.
6) Existing social infrastructures and services: ii) Water transport	D		D		No related activities which disturb water transport is expected.
		D		D	
7) Existing social infrastructures and services: iii) Others	B-		B-		<ul style="list-style-type: none"> ▪ In Thaketa Township, there are utility lines such as about 68 numbers of electric poles, about 29 numbers of telephone poles, lighting poles, underground diesel fuel, CNG and gasoline pipelines, signals, signboards, a control bar of water supply pipeline called Gyo Phy pipeline a water pipeline for fire extinguishing, a bus stand along the ROW of roads and they are required to relocate. ▪ Water use for construction work may compete with the community water supply.
		B+		B+	Improvement of traffic condition among Yangon City, Thanlyin Township, and Thilawa SEZ will greatly enhance the economic and industrial development of Greater Yangon as well as improve the accessibility to social services.
8) Social institutions such as social infrastructure and local decision-making institutions	B-		B-		If information disclosure of the project plan, and procedure and public participation are not properly conducted, people's anxieties and complaints may occur and spread over the communities resulting in difficulties to obtain a thorough understanding of the Project and consensus among the people.
		B-		B-	
9) Vulnerable groups such as the poor, women, children,	B-/B+		B-/B+		<ul style="list-style-type: none"> ▪ Before construction stage in Thaketa Township, resettlement of 19 number of temporary houses in which vulnerable groups live on government land is necessary. ▪ During construction stage, the Project may create employment opportunities as

Environment Item **/**	Rating***				Identification and Evaluation of Anticipated Impacts and their Reasons
	Scoping		After Survey		
	I/II ****	III ****	I/II ****	III ****	
elderly, and disabled					construction workers for the vulnerable groups such as the poor and women in the construction works.
		B+		B+	<ul style="list-style-type: none"> Vulnerable groups such as children and women are also encouraged to commute to works and schools, to go to hospitals, social activities and public facilities in Greater Yangon due to the improvement of accessibility and resolution of traffic congestion. Basically, infrastructure development enhances economic development which increases employment opportunity in this area.
10) Indigenous people or ethnic minority	D		D		Myanmar is an ethnically diverse nation with 135 distinct ethnic groups. There may be people from Pao, Danu and many more ethnic groups residing at the surrounding of the project area but no significant negative impact on them is expected from the project intervention.
		D		D	
11) Misdistribution of benefit and damage	B-		B-		There is some possibility of misdistribution of benefit and damage, if the project plan including procedures of the implementation and involuntary resettlement are not properly disseminated and consultation with residents, communities, and other stakeholders are not properly carried out.
		B-		B-	While traffic congestion is solved, local people may suffer from degradation of living standard due to increase in noise, vibration, air pollution and decrease in landscape which are occurred by increased traffic during operation of the Project.
12) Local conflict of interests	B-		B-		There is some possibility of local conflicts of interest, if the project plan including implementation procedures and involuntary resettlement are not properly disseminated and consultation with residents, communities, and other stakeholders are not properly carried out.
		D		D	<ul style="list-style-type: none"> No significant negative impact of uneven distribution of benefit and damage is expected from the operation of the project.
13) Cultural, historical, archaeological, and religious heritage sites	B-		B-		<ul style="list-style-type: none"> In Thaketha Township, 35 m long fence of a monastery called Dhamma Thu Kha Monastery on Nawarat Pat Road is required to set back 2 m when widening of this road as it encroaches the ROW of the road. Prior agreement with the monastery is necessary and reconstruction of a new fence is required. In Thanlyin Township, there is no related activities to affect cultural, historical, archaeological and religious heritages sites.
		D		D	No significant negative impact is expected.
14) Water rights, fishing rights, and rights of common	D		D		No significant negative impact on water rights, fishing rights and rights of common are expected from the Project.
		D		D	
15) Landscape	B-		B-		<ul style="list-style-type: none"> During construction, the project site is filled with construction machineries, construction workers, construction materials, workers' camps and many more. This condition will affect the landscape of the project area. In addition, 667 numbers of trees on Thanlyin Chin Kat Road, Shu Khin Thar Pat Road and Nawarat Pat Road are necessary to cut and cutting trees degrade the level of landscape in Thaketa Township. Cutting trees on MR's Land to construct on-ramp degrade the view of landscape in Thanlyin Township.
		B-/B+		B-/B+	<ul style="list-style-type: none"> In Thaketa Township, due to 547 m long flyover, landscape is significantly changed. A flyover may degrade the view of landscape. Magnificent design of a flyover is proposed to reduce negative impact. In Thanlyin Township, due to 188 m long magnificent on-ramp from the west side of Bago River Bridge may be attractive to people as this design is new in Myanmar.
16) Gender	D		D		Significant impact of gender discrimination is not expected by the project intervention.
		B+		B+	Both gender can get benefits from the Project as they are encouraged to commute to schools, universities, works and social activities by vehicles by using smoother road connection as a result of implementation of improvement at intersections.
17) Children's Right	D		D		This project is expected not to induce any significant impact to children's right.
		B+		B+	Improved access, safety and traffic congestion by the Project may contribute to provide more opportunities to children to go to schools, parks and social activities.
18) Sunlight shading	D		D		No significant negative impact is expected.

Environment Item **/**	Rating***				Identification and Evaluation of Anticipated Impacts and their Reasons
	Scoping		After Survey		
	I/II ****	III ****	I/II ****	III ****	
		B-		B-	<ul style="list-style-type: none"> There exist some structures where people are living along the alignment of a flyover on Thanlyin Chin Kat Road. Construction of a flyover makes facilities, which are lower in height than a flyover, get less sunlight than before construction. In Thanlyin Township, there is no significant negative impact of sunlight shading as surrounding area of on-ramp is open.
(B) Health, Safety and Risk					
19) Community health and safety	B-		B-		<ul style="list-style-type: none"> During construction, air pollutants such as dust, PM, NOx, and SOx emitted from construction vehicles and machines as well as construction works may cause some adverse effects to respiratory health of local community. Moreover, noise and vibration from construction may affect local community's living condition and health although it is temporary. Waste from construction sites and workers' camps may deteriorate sanitary of surrounding area if they lack proper facilities for sanitation. Exposure of construction accidents to the Public is anticipated. Although the project activities will not pose any hazard or risk, migration of workers from other areas may worsen the condition of public security temporarily and community awareness should be promoted.
		B-		B-	<ul style="list-style-type: none"> Air pollution, traffic noise and vibration due to an increase in traffic volume may cause some adverse effects to health for example respiratory organs. Hazard of safety due to increased traffic is anticipated.
20) Infectious diseases such as HIV/AIDS	B-		B-		There may be risks of increase in infectious diseases by further influx of people from different regions to work at the construction site of the project.
		D		D	No significant negative impact is expected.
21) Occupational health and safety	B-		B-		<ul style="list-style-type: none"> Many workers will engage in construction works such as working at height, handling and operating of heavy construction machineries, which may have risks of accidents They may stay at worker's camps under poor living conditions. Thus, there may be risks in the health and occupational safety of the workers in case of severe working conditions and insufficient countermeasures.
		D		D	No significant negative impact is expected.
22) Hazards/security risks	B-		B-		Although the project activities will not pose any hazard or risk, migration of workers from other areas may worsen the condition of public security and community awareness should be increased.
		D		D	No significant negative impact is expected.
23) Accidents	B-		B-		Occurrence of accidents may increase due to construction works, working at height, machine, plant deployment, and construction materials handling, as well as the occurrence of traffic accidents caused by construction vehicles and vehicles and machineries.
		B-		B-	Improvement of intersections may give rise to an increase in number of traffic accidents due to the increase in vehicle speed and number of vehicles travelling.
24) Emergency risks	B-		B-		<ul style="list-style-type: none"> Risk of fire is expected with a fixed probability. Flood risk such as heavy rain, cyclone and tsunami is expected with a fixed probability. Earthquake risk is anticipated with a fixed probability.
		B-		B-	
(C) Natural Environment					
25) Protected area	D	D	D	D	According to the site survey, there is no natural protected area near the Project area.
26) Terrestrial fauna, flora, and biodiversity	B-		B-		<ul style="list-style-type: none"> According to the field survey, two plant species of globally threatened species in IUCN Red List were found in the project area and some of them are necessary to cut. However, these species are common in the region. Thus the impact on flora and fauna due to the construction activities is anticipated, but the overall impact will be limited. Trees planted along roads contribute to the greenery and visual amenity providing an area of relaxation and recreation for local residents. Thus, cutting or removal of trees along the roads may spoil the greenery environment and its amenities.
		D		D	No significant negative impact is expected.
27) Aquatic fauna, flora, and biodiversity	D		D		No significant negative impact is expected.
		D		D	
28) Hydrological	D		D		No significant negative impact is expected.

Environment Item */**	Rating***				Identification and Evaluation of Anticipated Impacts and their Reasons
	Scoping		After Survey		
	I/II ****	III ****	I/II ****	III ****	
situation/drainage pattern		D		D	
29) Topography and geology	D		D		<ul style="list-style-type: none"> No large-scale land alteration is expected. The scale of excavating of land for a foundation of a flyover in Thaketa Township and a foundation of a on-ramp is expected to be small to change the topographical and geological features
		D		D	
30) Soil erosion	B-		B-		There may be risks of soil erosion during rainy season in case of improper soil embankment works during construction.
		D		D	No significant negative impact is expected.
31) Groundwater	B-		B-		<ul style="list-style-type: none"> There is some possibility of pumping up of groundwater if water supply is not available. There should be a limitation in the amount of pumping up of groundwater to prevent impacts on groundwater.
		D		D	No significant negative impact is expected.
32) Coastal zone	D		D		No significant negative impact is expected.
		D		D	
33) Micro-climate	D		D		Neither large extent of construction nor large-scale reclamation is planned. Thus, change in microclimate is not expected.
				D	
(D) Environmental Pollution					
34) Air pollution	B-		B-		<ul style="list-style-type: none"> Emission of air pollutant such as PM and NOx from construction vehicles and machines, earthmoving and construction works may temporarily deteriorate air quality. Improvement of traffic congestion will result in a smoother traffic condition through the construction of a flyover in Thaketa Township and that of on-ramp in Thanlyin Township. Thus, reduction in emission of air pollutants such as NOx and PM is expected due to decrease in idling time. On the other hand, improvement of traffic congestion may increase the number of vehicles travelling. This may also result in an increase in emission load of air pollutants such as PM and NOx.
		B+/ B-		B+ /B-	
35) Water pollution	B-		B-		Water pollution is expected due to the following pollutant generation from construction works, although they are temporary. <ul style="list-style-type: none"> Runoff of dirty water including soil from cutting, filling, and excavation of earthwork. Wastewater from workers' camps and construction offices. Spilling over of toxic materials such as asphalt emulsifiers and lubricating oil.
		D		D	No significant negative impact is expected.
36) Soil contamination	B-		B-		Leakage of toxic materials such as lubricating oil from construction vehicles and machines, and asphalt emulsifiers utilized for road construction may give rise to soil contamination temporarily.
		D		D	No significant negative impact is expected.
37) Bottom sediment	D		D		No significant negative impact is expected.
38) Solid Waste	B-		B-		Generation of soil, sand, and construction wastes is expected from flyover, roads and on-ramp construction site and workers' camp in both Townships.
		D		D	No significant negative impact is expected.
39) Noise and vibration	B-		B-		Generation of noise and vibration from construction machines, vehicles and construction work is expected temporarily during construction.
		B-		B-	Improvement of traffic congestion may give rise to an increase in the number of vehicles travelling. This may also result in an increase in vehicle noise and vibration during operation.
40) Ground subsidence	D		D		Neither major reclamation nor pumping up of large amount of groundwater causing ground subsidence is expected.
		D		D	
41) Offensive odor	D		D		No significant negative impact is expected.
		D		D	
(E) Others					
42) Global warming/climate change	D		D		<ul style="list-style-type: none"> Small scale and temporary generation of greenhouse gases like CO₂ are expected due to construction vehicles and machines. However, impact on global warming and climate change is negligible. During operation, an increase in greenhouse gases like CO₂ is expected in a small scale due to an increase in traffic volume. However, impact on global warming and climate change is negligible.
		D		D	

Note (*): Environmental items are chosen based on the JICA Guidelines for Environmental and Social Considerations (2010.4) and relevant legislations of the Myanmar government as well as the project plan and environmental condition of the project area, as indicators expressing environmental and social conditions.

Note (**): Regarding the impacts on "gender" and "children's right" might be related to all items under social environment.

Note (***) : Rating - In general, both positive impact (+) and negative impact (-) are expected due to the anticipated project activities. Thus, the following rating criteria are adopted with respect to the extent of impacts: A (+/-) : Significant positive/negative impact is expected, B (+/-): Positive/negative impact is expected to some extent, C (+/-) : Extent of positive/negative impact is unknown or not clear (Further examination is needed. It should be taken into consideration that impacts may become clear as study progresses), Blank: Negligible or no impact is expected.

Note (****): I: Planning Stage, II: Construction Stage, III: Operation Stage

Source: JICA Survey Team (data obtained in Feb and March, 2016)

4.3.3 Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMoP)

Mitigation measures to the potential negative impacts identified in Table 4-18 for Bridge construction and Table 4-19 for Improvement of Intersections, and responsibility of each relevant authority to implement mitigation measures were examined as Environmental Management Plan (EMP). In addition, Environmental Monitoring Plan (i.e. monitoring items, locations, frequency and responsibility of each relevant authority to implement the monitoring plan) at the construction phase and operation phase including reporting structure was examined at the construction phase and the operation phase respectively. EMP and EMoP were compiled into Sections 5.4 and 5.5 in IEE enclosed in Appendix B-2.

4.4 A-RAP

4.4.1 Principles of A-RAP Preparation

A-RAP for the construction of Bago River Bridge and improvement at intersections was prepared in accordance with the JICA Guidelines and the World Bank Safeguard Policy OP 4.12 Annex A, and it contains: i) project description, ii) potential impacts, iii) legal framework, iv) institutional framework, v) eligibility, vi) compensation policies, vii) public participation (i.e. the result of the stakeholder meeting), viii) provisional implementation plan, and ix) monitoring and evaluation.

A-RAP is generally prepared based on the results of the detailed measurement survey (i.e. socio-economic survey, census and inventory of loss) to each PAP. Such survey was able to be conducted if the construction of Bago River Bridge and improvement at intersections were approved by the union parliament. Since the construction of Bago River Bridge and improvement at intersections were not approved by the union parliament as of June 2016, such survey was not conducted as of June 2016. Accordingly, potential impact was evaluated by conducting initial site reconnaissance (i.e. just checking number, location and type of structures) in February and March 2016 with officers from Thaketa Township and Thanlyin Township without making socio-economic interview to PAPs.

The contents of A-RAP especially impact and socio-economic condition of PAP are necessary to be updated when the detailed measurement survey to each PAP is conducted.

4.4.2 Land Acquisition and Relocation Scope

As shown in Figure 4-4, land belongs to MR, MOC and YCDC is located at the surrounding area of the project.



Source: JICA Study Team (2014)

Figure 4-4 Map of the Proposed Approach Road and Surrounding Area in Thaketa Township

A summary of land acquisition and resettlement necessary for the construction of Bago River Bridge and improvement at intersections in Thaketa Township and Thanlyin Township are shown in Table 4-20.

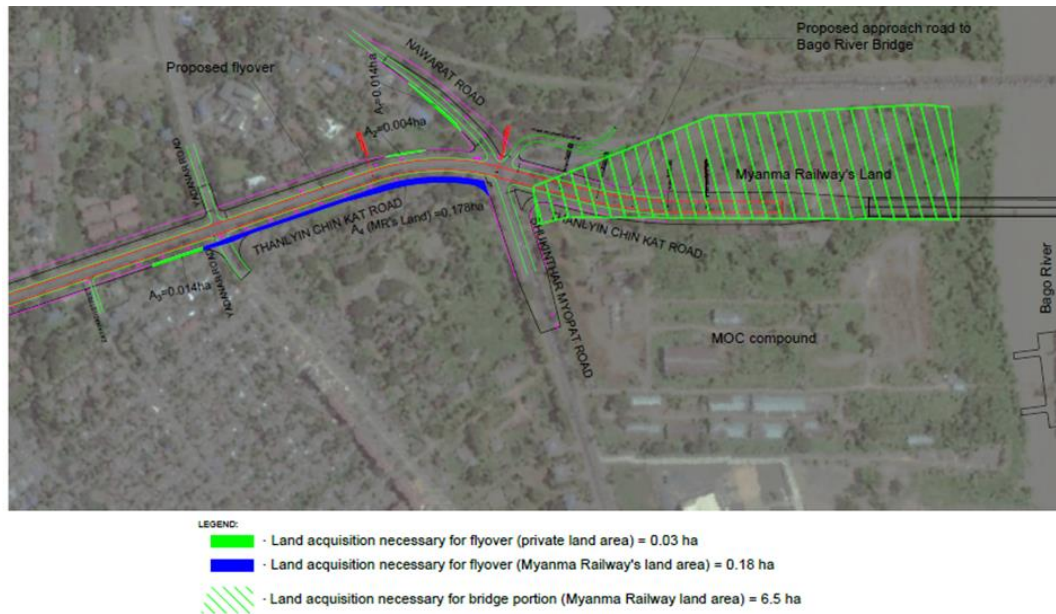
Table 4-20 A summary of necessary land acquisition classified into MR’s land, other Ministries’ land area and Private land area for Bago River Bridge and Flyover

Township	Thaketa Township		Thanlyin Township		Total (Thaketa Township and Thanlyin Township)		Total
	Bridge	Improvement at intersections	Bridge	Improvement at intersections	Bridge	Improvement at intersections	
Project							Bridge and Improvement at intersections
Total area (ha)	6.77	0.21	3.50	0.07	10.27	0.28	10.55
MR (ha)	6.50	0.18	3.50	0.07	10.00	0.25	10.25
Other Ministries (MOC, CDC)	0.27	0	0	0	0.27	0	0.27
Private land area (ha)	0	0.03	0	0	0	0.03	0.03

Source: JICA Study Team

In Thaketa Township, most of the land acquisition necessary for the Bridge Portion is located on government land which belongs to MR, MOC and YCDC and land acquisition necessary for construction of a flyover is located along an alignment of an existing Thanlyin Chin Kat Road because of the limitation of land available for widening

of the road. Figure 4-5 shows the location of land acquisition necessary for the Bridge Portion and the Intersection Portion in Thaketa Township.



Note: $A_1+A_2+A_3=0.03$ ha (land acquisition necessary for a flyover from private land area in Thaketa Township)

$A_1+A_2+A_3+A_4=0.21$ (Total land acquisition necessary for a flyover in Thaketa Township)

Source: JICA Study Team

Figure 4-5 Location of land acquisition necessary for the Project in Thaketa Township

As shown in Figure 4-6, proposed project area for construction of approach road to Bridge and construction of on-ramp to Bridge belongs to MR.



Source: JICA Study Team (2014)

Figure 4-6 Map of the Proposed Approach Road and Surrounding Area in Thanyin Township

In Thanlyin Township, all area of land acquisition necessary for construction of an approach road and on-ramp are within the Right of Way (ROW) of the Thanlyin No. 1 Bridge which belongs to MR as shown in Figure 4-7. Thus, no land acquisition in Thanlyin Township is assumed.



Source: JICA Study Team

Figure 4-7 Location of land acquisition necessary for the Project in Thaketa Township

Table 4-21 shows a summary of anticipated PAPs categorized in only land acquisition, land acquisition and facilities and only facilities due to the construction of Bago River Bridge and improvement at intersections in Thaketa Township and Thanlyin Township.

Table 4-21 A summary of anticipated number of PAPs for land acquisition and resettlement due to the Project

	Resident/ Non-resident	Bridge				Improvement at intersections				Total PAHs	Total PAPs
		Thaketa Township		Thanlyin Township		Thaketa Township		Thanlyin Township			
		PAHs	PAPs	PAHs	PAPs	PAHs	PAPs	PAHs	PAPs		
Only Land Acquisition		-*	-*	-*	-*	-	-	-*	-*		
Land Acquisition ¹ and Facilities	Resident	4 ^a	20 ^b	-	-	33 ^{**}	132 ^{**}	-	-	37	152
	Non-Resident	-	-	-	-	5 ^{***}	5 ^{***}	-	-	5	5
Only Facilities	Resident	-	-	-	-	-	-	-	-	-	-
	Non-resident	2 ^c	5 ^c	2 ^d	2 ^d	53 ^{*****}	53 ^{*****}	-	-	57	60
Total		6	25	2	2	91	190			99	217

Note (1): It does not mean that the land is owned by the residents. Land owners may be different from residents.

Note (*): Only land acquisition is necessary but all necessary land acquisition belongs to Government such as MR, YCDC and MOC.

Note (**): 33 No. is a number of houses where people are living, and relocation and resettlement are necessary for them. Among 33 No. of PAHs, 14 No. of PAHs are living at MR's staff apartments and the remaining 19 No. of PAHs are living at houses made of bamboo and wood. According to 2014 census result in Myanmar, the mean household size 4.4. Therefore, it is assumed that there are 4 numbers of family members in each household which needs relocation and resettlement. Therefore, the total number of resident PAPs is 33×4=132.

Note (**): Among 5 No. of PAHs, 1 No. is a fence of a Monastery where monks are living, 1 No. is a fence of a vacant land, 1 No. is a fence of YCDC water supply tank where no person lives, 1 No. is a tea shop made of concrete where no person lives and 1 No. is a hair-saloon made of concrete where no person lives. All 5 No. of PAHs do not need relocation or resettlement. A fence of a Monastery is included in Non-resident category although monks are living inside the Monastery as only the fence is necessary to set back and resettlement or relocation is not necessary for it. Assume that in case there is no relocation and resettlement, the number of PAPs is the same as the number of PAHs.

Note (***) : 53 No. are the number of stalls within the Right of Way of roads. Assume that the number of PAPs is the same as the number of PAHs in this case.

Note (a) : All 4 No. of PAHs live at each single story wooden terrace house and all PAHs lend from MOC.

Note (b) : The number of PAPs is based on site reconnaissance conducted in 2014.

Note (c) : Among 2 No. of PAHs, 1 No. is the number of affected religious facility whose owner rent the land from MR and 1 No. is the number of an affected stall. It was assumed that there is one number of PAPs in each religious facility. There are 4 No. of PAPs in the stall according to site reconnaissance conducted in 2014. Therefore, the total number of non-resident PAPs is 1+4=5.

Note (d) : 2 No. is the number of religious facility whose owners rent the land from MR and it was assumed that there are one number of PAPs in each religious facility.

Source: JICA Study Team

4.4.3 Eligibility

The Cut-off Date (COD) is the day to determine eligibility for entitlement of compensation due to land acquisition and relocation caused by a Project. Persons (or households) living or doing income generation activities inside a project area on the COD are eligible for compensation, and persons (or households) who occupy a project area after the COD are not eligible for resettlement assistance.

The COD is normally the day that the census begins according to World Bank Safeguard Policy OP 4.12. In some neighboring countries, the COD is also set as the date of issuing official documents (i.e. notice or decree) on land acquisition for a project. In the case of the Bridge Portion and the Intersection Portion, either census or the official documents on land acquisition was not conducted or issues as of June 2016. However, since initial site reconnaissance was conducted in February and March 2016, 1 March 2016 as the first date of site reconnaissance for confirming number and location of structures in the project area was regarded as the COD for the Bridge Portion and the Intersection Portion, which was explained to public and stakeholders at the time of stakeholder meeting on 12 November 2016.

4.4.4 Entitlement Policy Matrix

The entitlement policy matrix for the Bridge Portion and the Intersection Portion is prepared based on the result of the initial site reconnaissance in February and March 2016. and the outcome of gap analysis between international practices and laws and regulations in Myanmar. The compensation policy will be explained to PAPs through holding a consultation meeting in the process of A-RAP updating when the detailed measurement is able to be conducted, and will be finalized by reflecting comments from PAPs. Table 4-22 shows the provisional Entitlement Policy Matrix for the Bridge Portion and the Intersection Portion.

Table 4-22 Provisional Entitlement Policy Matrix

Type of Losses/ Category of Assistance	Quantity (No.)	Unit	Concerned portion of the Project	Application	Entitled Person	Assistance Policy
1) Assets and Structures						
i) Private Land acquisition	0.03	ha	Improvement at intersections	located within ROW of widening of Thanlyin Chin Kat Road and Nawarat Pat Road in Thaketa Township for improvement at intersections	Legal Land Owner	<ul style="list-style-type: none"> Provide compensation for land acquisition by replacement cost⁴
ii) Permanent houses on MOC Land	4	No. of PAHs	Bridge portion	located within ROW of construction of an approach road to Bago River Bridge in Thaketa Township	People living in those apartments at the time of Cut-off Date and having the lease agreement of the structure	<ul style="list-style-type: none"> Setback the structures within MOC land and provide cash assistance for the days of not living due to setback works if MOC land is available for setback, OR Provide cash assistance for renting a living structure with an equivalent specification in case setback is difficult
iii) 23 m ² MR staff's apartments	14	No. of PAHs	Improvement at intersections	located within ROW of widening of Thanlyin Chin Kat Road in Thaketa Township for improvement at intersections project	People living in those apartments at the time of Cut-off date	<ul style="list-style-type: none"> Provide substitute living structure, AND Cash assistance for moving
iv) Houses made of bamboo and wood on Government Land	19	No. of PAHs	Improvement at intersections	located within ROW of widening of Thanlyin Chin Kat Road in Thaketa Township for improvement at intersections project	People living in those houses at the time of Cut-off Date	<ul style="list-style-type: none"> Compensation loss of assets, structures and facilities based on replacement cost
v) Small praying religious facilities	3	No.	Bridge portion	located within ROW of construction of an approach road for Bago River Bridge	Owner of each facility	<ul style="list-style-type: none"> Cash assistance for moving
vi) Fences and structures such as Tea shop and Hair Saloon	5	No.	Improvement at intersections	located within ROW of construction of widening of roads in Thaketa Township	Legal Owners of respective structure	<ul style="list-style-type: none"> Reconstruction of fence and structures at necessary setback distance if land for

Type of Losses/ Category of Assistance	Quantity (No.)	Unit	Concerned portion of the Project	Application	Entitled Person	Assistance Policy
						setback is available
vii) Compensation for temporary stop of business for Tea shop and Hair Saloon in vi) under 1) Assets and Structures	20	Days for above two shops	Improvement at intersections	located within ROW of construction of widening of roads in Thaketa Township	Owners of these shops in vi	<ul style="list-style-type: none"> Compensation for those days when they cannot do their business during destruction and reconstruction of their shops
2) Stalls						
i) A stall which is easily reassemble	1	No.	Bridge portion	located within ROW of construction of an approach road of Bago River Bridge	Owner of the stalls	<ul style="list-style-type: none"> Cash assistance for moving
ii) Stalls which are easily reassemble	52	No.	Improvement at intersections	located within ROW of widening of roads in Thaketa Township	Owner of the stalls	<ul style="list-style-type: none"> Cash assistance for moving
iii) A stall with a fixed asset (50 ft×30 ft)	1	No.	Improvement at intersections	located within ROW of construction of widening of roads	Owner of the stall	<ul style="list-style-type: none"> Cash assistance for moving
iv) Compensation for temporary stop of business for a stall with a fixed asset in iii) under 2) Stalls	10	Days	Improvement at intersections	located within ROW of construction of widening of roads	Owner of a stall with a fixed asset in iii	<ul style="list-style-type: none"> Compensation for those days when it cannot do their business during destruction and reconstruction of its shops

Note: With regard to land and structures, "replacement cost" is defined as follows according to World Bank: For agricultural land, it is the pre-project or pre-displacement, whichever is higher, market value of land of equal productive potential or use located in the vicinity of the affected land, plus the cost of preparing the land to levels similar to those of the affected land, plus the cost of any registration and transfer taxes. For land in urban areas, it is the pre-displacement market value of land of equal size and use, with similar or improved public infrastructure facilities and services and located in the vicinity of the affected land, plus the cost of any registration and transfer taxes. For houses and other structures, it is the market cost of the materials to build a replacement structure with an area and quality similar to or better than those of the affected structure, or to repair a partially affected structure, plus the cost of transporting building materials to the construction site, plus the cost of any labor and contractors' fees, plus the cost of any registration and transfer taxes. In determining the replacement cost, depreciation of the asset and the value of salvage materials are not taken into account, nor is the value of benefits to be derived from the project deducted from the valuation of an affected asset. Where domestic law does not meet the standard of compensation at full replacement cost, compensation under domestic law is supplemented by additional measures so as to meet the replacement cost standard. Such additional assistance is distinct from resettlement measures to be provided under other clauses in [OP 4.12, para. 6](#).

Source: JICA Study Team

4.4.5 Removal of Trees and Relocation of Utilities

Several trees and utilities were confirmed within ROW during the site survey in February and March 2016, and which are necessary to be removed and/or relocated by cooperating relevant authorities before commencement of construction. Table 4-23 summarizes existing trees and Table 4-24 shows utilities locating within ROW confirmed at the site reconnaissance on June 2016.

Table 4-23 Number of Trees Confirmed in ROW

Sr.	Project	Quantity	Township	Ownership and tenure
1	Bridge	46 trees	Thanlyin	Myanmar Railways
2	Bridge	114 trees	Thaketa	Myanmar Railways
3	Improvement at intersections	701 trees	Thaketa	YCDC

Source: JICA Survey Team

Table 4-24 Utilities Confirmed in ROW

Sr.	Facilities	Description	Owner	Quantity	Unit
1	Electric poles and power distribution lines	Concrete electric poles with power lines	YESC	68	No.
2	Communication Poles and cable lines	Concrete electric poles with telecommunication lines	MPT	29	No.
3	Diesel fuel Pipeline	10" underground pipeline	MPPE	230*	m
4	Gasoline Pipeline	8" underground pipeline	MPE	230*	m
5	CNG Pipeline	4" underground pipeline	MOGE	230*	m
6	Water pipe	12" PVC underground pipe	WSSD in YCDC	730	m
7	Signal**	With Power lines	YCDC	8	No.
8	Big Sign Board	With Concrete foundation	YCDC	8	No.
9	Police Box	Concrete	YCDC	2	No.
10	Bus stand	Concrete	YCDC	1	No.

Note (*): The length of pipeline will be changed after the detailed inventory survey

Note (**): When a signal is relocated, power lines inside it are necessary to replace with new ones.

Abbreviation: MOGE: Myanmar Oil and Gas Enterprise, MONREC: Ministry of Natural Resources and Environmental Conservation, MPPE: Myanmar Petroleum Products Enterprise, MPT: Myanmar Posts and Telecommunications, MR: Myanmar Railways, WSSD: Water Supply and Sanitation Department in YCDC, YCDC: Yangon City Development Committee, YESC: Yangon City Electricity Supply Corporation

Source: JICA Study Team (data obtained in Feb and March, 2016)

4.5 STAKEHOLDER MEETING

4.5.1 First Stakeholder Meeting

The first stakeholder meeting (the 1st SHM) for the results of both IEE and the land acquisition and resettlement issues for construction of Bago River Bridge portion was held on January 24, 2014. Table 4-25 shows a summary of the 1st SHM. Minutes of meeting of the 1st SHM is enclosed in Appendix-B-13.

Table 4-25 Summary of 1st Stakeholder Meeting

No.	Concerned portion of the Project	Date of Stakeholder Meeting	No. of Participants including PAPs	Place
1.	Bridge Portion (1st SHM)	24 Jan, 2014	46	MOC office in Thaketa Township

Source: JICA Study Team

4.5.2 Second Stakeholder Meeting

In addition to the 1st SHM, 2014, another stakeholder meeting (i.e. the 2nd SHM) was held on November 12, 2016 with the purpose of explaining the latest project description, IEE and land acquisition and resettlement issues on construction of the Bago River Bridge and improvement of the intersections to various stakeholders such as relevant authorities in Thaketa and Thanlyin Township and communities in and around the project area. Total two meetings were held in the Thaketa side and the Thanlyin side (i.e. one session in the Thaketa side and the Thanlyin side respectively) to secure easy access of participants though the contents of explanation was same at both SHMs. Total 89 of invitation letters (27 invitation letters at Yangon, 21 invitation letters at Thaketa and 41 invitation letters at Thanlyin) and were sent to relevant authorities and organization, leaders of communities in and around the Project site, NGOs and media in Thaketa and Thanlyin Township. In addition, total 20 notices were posted at General Administration Department offices, the concerned wards offices, MOC offices and several places in communities in and around the Project site in Thaketa Township, and total 10 notices in Thanlyin Township were posted at similar places as Thaketa Township to announce the SHM to stakeholders widely. When the notices were posted, holding the SHM was also verbally announced from the concerned ward administrators to local residents.

There were four questions in the Thaketa side, and all of them were confirmation of relocation target or not. As for the Thanlyin side, two comments and one question were raised as Table 4-26 shows summary. Minutes of meeting and materials used for the 2nd SHM are enclosed in the Appendix B-14.

Table 4-26 Summary of 2nd Stakeholder Meeting

Date and Time	Venue	No. of Participants	Questions and Answers
November 12, 2016 9:00 – 10:30	MOC office in Thaketa Township	181 - Gov. officials: 71 - Local residents: 100 - NGO: 1 - Media: 7 - Other 2	Q1-4 (all of them were local residents): Confirmation of relocation target or not. A: It was not sure at this moment. The compensation committee chaired by YRG would be organized later. Compensation would be evaluated by the committee, and would be provided according to consultation with target households.
November 12, 2016	MOC office in	59	Q1 (suggestion from a national parliament representative

Date and Time	Venue	No. of Participants	Questions and Answers
13:30 – 15:00	Thanlyin Township	- Gov. officials: 35 - Local residents: 10 - Media: 3 - Other: 11	from Thanlyin Township): It was suggested to consider the organizational structure to operate and maintain the Bago River Bridge after it was handed over to the Myanmar side since operation and maintenance of bridges and road in current Myanmar was not appropriate. A1: It would be considered among relevant authorities. Q2 (question from a local developer): The road currently developing was very close to the on-ramp at the Thanlyin side. Thus, potential impacts to be caused by the on-ramp construction to the currently developing road were requested to be explained. A2: It would be confirmed in this Detailed Design. Q3-1 (suggestion from a YCDC officer): Construction of embankment or installing piers in the river would bring impact on erosion or sedimentation. It was suggested to plant trees at the river banks. Q3-2 (suggestion from a national parliament representative from Thanlyin Township): It was heard that low trees with depth roots such as vetiver would be effective for erosion or sedimentation.

Remark:

- Q stands for a question from a participant, and A stands for an answer from DOB.
- Q3-1 and Q3-2 were suggestion. Thus, there was no answer from DOB.

Source: JICA Study Team

During the SHM, feedback forms were distributed to the participants to receive frank comments and opinions from them. The major comments and opinions written in the collected feedback forms (total 20 forms in Thaketa and 1 form in Thanlyin were collected) are as follows:

- Project plan is good
- Request to explain relocation scale and how comments from participants are reflected
- Difficult to relocate to another place due to the economic condition
- Need to consider water flow rate and sedimentation in river to be caused by construction of the Bago River Bridge

4.6 JICA ENVIRONMENTAL CHECKLIST, SCREENING FORMAT, ENVIRONMENTAL AND SOCIAL MONITORING FORM AND ABBREVIATED RESETTLEMENT ACTION PLAN MONITORING FORM

JICA Environmental Checklist, Screening Format, Environmental and Social Monitoring Forms, A-RAP Monitoring Forms prepared in this study are enclosed in Appendixes as shown in Table 4-27.

Table 4-27 A list of JICA Environmental Checklist, Screening Format, Environmental and Social Monitoring Form and A-RAP Monitorin Form

Appendix	Contents
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Appendix	Contents
Appendix B-4	Confirmation of Environmental and Social Considerations for construction of Bago River Bridge (Bridge portion) by using JICA Environmental Checklist
Appendix B-5	Confirmation of Environmental and Social Considerations for Improvement at Intersections by JICA Environmental Checklist
Appendix B-6	Screening Format for construction of Bago River Bridge and Improvement at Intersections
Appendix B-7	Environmental and Social Monitoring Form for construction of Bago River Bridge (Bridge portion)
Appendix B-8	Environmental and Social Monitoring Form for Improvement at Intersections (the Intersection Portion)
Appendix B-9	Abbreviated Resettlement Action Plan (A-RAP) Monitoring Form for construction of Bago River Bridge (the Bridge Portion)
Appendix B-10	Abbreviated Resettlement Action Plan (A-RAP) Monitoring Form for improvement at intersections

Source: JICA Study Team

CHAPTER 5. UPDATE OF COST ESTIMATE

5.1 INTRODUCTION

Cost estimate for the Project was examined and updated because the situations around the Project have drastically changed since the submission of the Final Report of the Preliminary Survey for the Project for Construction of Bago River Bridge prepared in August, 2014. In the Supplemental Survey, new scope for the Project to improve the intersection at both Yangon side and Thanlyin side have been added.

In addition, the Survey Team was requested to verify the results of the cost estimate of the Project by comparison to similar bridge construction projects in Myanmar.

5.2 COST ESTIMATE FOR IMPROVEMENT OF ADJACENT INTERSECTIONS AND CONNECTING ROADS

Based on the results of the study on adjacent intersection and connecting roads in Chapter 2, cost estimate of the roads with flyover was conducted. The outline and quantities of cost estimate are shown in Table 5-1.

Table 5-1 Outlines of Flyover

Location	Description
Yangon side	Flyover
	Combination of PC T girder and Steel plate girder L= 34+(40+60+33) +7@30+(33+64+40) +33=547m
	Road construction 37,000m ²
Thanlyin side	Flyover
	PC T girder L=6@31.3=187.8m
	Road construction 1,800m ²

Source: JICA Study Team

Cost estimate of the flyover was conducted by the procedures listed below.

- Cost estimate of superstructure of flyover was conducted with summation method by “Guideline for the construction cost estimate of bridge erection works” (Kyouryou kasetu koji no sekisan)
- Cost estimate of substructure and access road was adopted the same unit price of Bago River Bridge.
- Detailed quantity of the superstructure of flyover was based on the “Standard drawings of civil works” (Doboku kozobutsu hyojyun zussyu) by Ministry of Construction, Japan.
- The indirect cost contained in the unit price (20% of each unit direct cost) as of the same procedure of Bago River Bridge.

The result of the cost estimate for the additional roads are shown in Table 5-2 and Table 5-3. Detailed summary of cost estimate is shown in Appendix D.

Table 5-2 Estimated cost of Flyover at Yangon side

Item	Description	Cost (USD)
Substructure	Reverse-T Abutment with bored piles	711,328
	Hammerhead pier with bored piles	2,653,102
Superstructure	Steel plate girder, L=140m, 137m	6,433,776
	PC T girder, L=33, 210m, 34m	4,456,266
Approach road	A=37,000m ²	6,988,600
Total		21,243,072

Source: JICA Study Team

Table 5-3 Estimated cost of Flyover at Thanlyin side

Item	Description	Cost (USD)
Substructure	Reverse-T Abutment with bored piles	237,722
	Hammerhead pier with bored piles	465,776
Superstructure	PC T girder, L=187.8m	1,763,897
Approach road	A=1,800m ²	451,400
Total		2,918,795

Source: JICA Study Team

5.3 UPDATE OF COST ESTIMATE

The aspects of cost estimate were reviewed as shown in Table 5-4.

Table 5-4 Summary of updating items in cost estimate

Item	Updated points		Description
	Former	Updated	
Time point	January 2014	March 2016	
Exchange rate	1USD =103.45JPY =981.6MMK	1USD =109.9JPY =1218.0MMK	3 months inter rate
Price escalation	FC:1.3%, LC:3.7%	FC:1.8%, LC:3.9%	JICA instruction
Physical contingency	5.0%	5.8%	JICA instruction
Construction period	28months	32months	Consideration of break period in rainy season
Unit price	No revision basically but local labor cost, some material costs and work fees		Recent increase in wages and costs
Consultant schedule	Addition of some engineers in terms of the flyover construction		Scope change

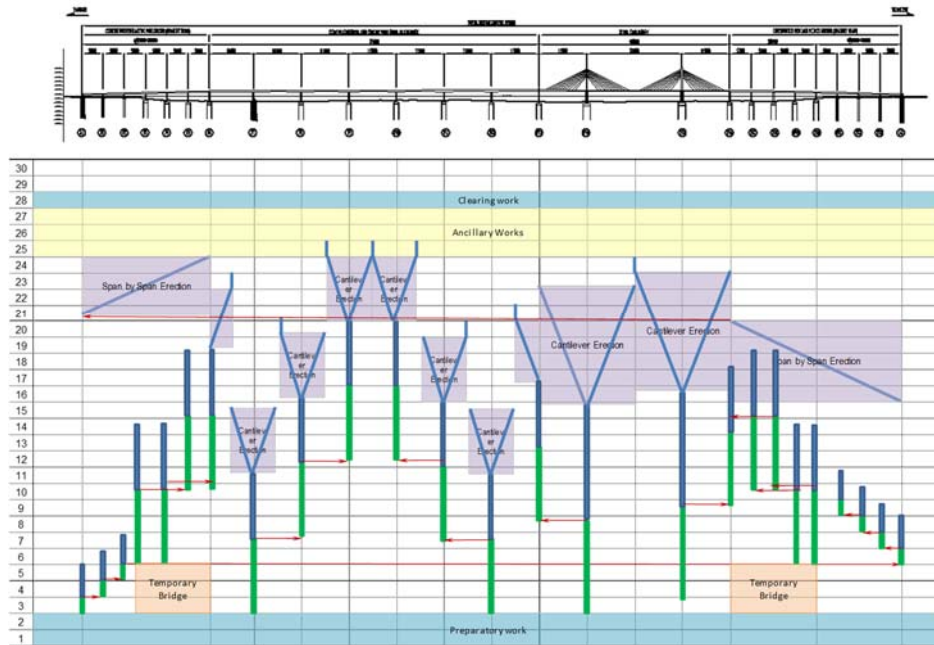
Source: JICA Study Team

5.3.1 Revision of construction period

Overall construction period in F/S was specified as 28 months, which was considered as the shortest scenario in which any margins of error such as natural and meteorological conditions were not considered.

After Submission of the F/S report, it was revealed that the heavy rain in rainy season (5 months from June to October) compelled the construction work on the river to stop in some cases. In this Supplemental Survey, construction time schedule was revised and proposed in consideration of break periods during rainy seasons.

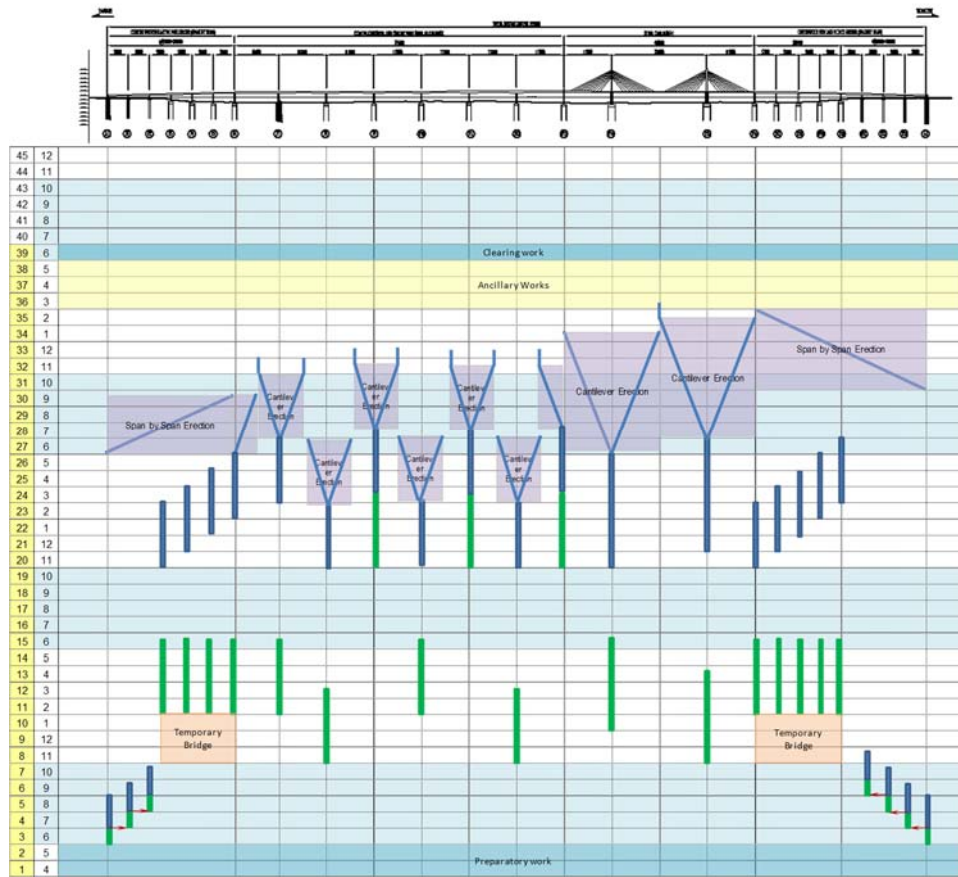
The original construction schedule is shown in Figure 5-1. Two scenarios of the revised construction schedules are introduced: the one starting in April and the other starting in August. In the revised schedules, foundation and substructure works in the river are suspended, which results in construction periods of 39 months and 32 months, depending on the timings of commencement of the works. (See Figures Figure 5-2 and Figure 5-3, respectively.)



*Legend: **green bar**-Foundation, **blue bar**-substructure and superstructure

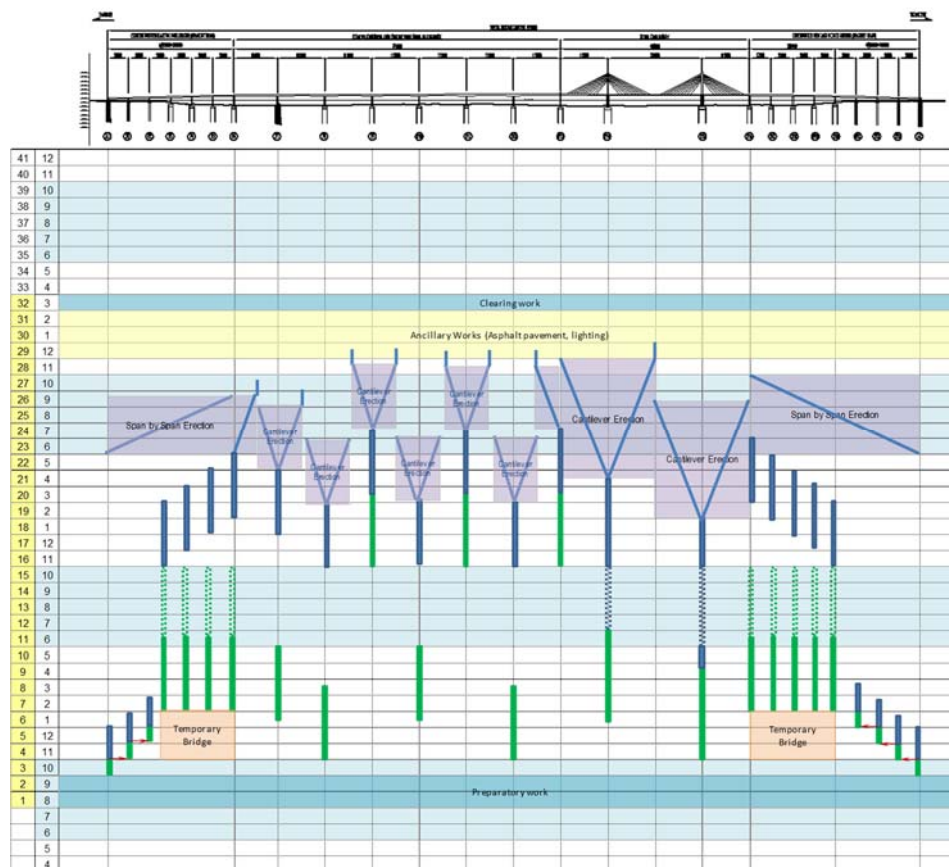
Source: JICA Study Team

Figure 5-1 Construction schedule in F/S (28 months total)



Source: JICA Study Team

Figure 5-2 Revised construction schedule (starts from April, 39 months total)



Source: JICA Study Team

Figure 5-3 Revised construction schedule (starts from August, 32 months total)

5.3.2 Revision of cost for consulting services for D/D and C/S

The new scope of the flyover construction was considered in the cost estimate for consulting services. It is noted that the construction of the flyover will be done along the existing road in service with heavy traffic where issues on safety, utility relocation, resettlement, operation and maintenance are matters of serious concern. Therefore, assignment of the following engineers/specialists are proposed to be added:

- Safety Engineer
- Utility Engineer
- Social Consideration Specialist
- O&M Specialist

In addition, the following assignments are proposed to be revised from F/S:

- Deputy Project Manager (National) is assigned from the detailed design stage to the end of the construction supervision to strengthen the management capability of consulting services.
- Assistant Resident Engineers (National) are assigned to assist Resident Engineers.

5.3.3 Revision of unit prices

The revision of cost estimate was conducted from principal unit prices listed below.

- Wages of laborers
- Materials (ready mixed concrete)
- Work fee (asphalt paving)
- Changes position of some International engineers to national engineers (rebar worker, form work engineer, etc.)

Other material costs and wages are in accordance with “Prices of Construction Materials and Wages” (Japanese quarterly for civil engineers).

5.3.4 The result of updating of cost estimate

The results of update of cost estimate are shown in Table 5-5 and Table 5-6. Detailed summary of cost estimate is shown in Appendix D.

Table 5-5 Result of cost estimate (construction cost)

Work item		Construction cost		
		Foreign currency ('000 JPY)	Local currency ('000 USD)	Total ('000 JPY)
Right bank (Package-2)	Substructure	1,918,23	8,890	2,895,299
	Superstructure	4,644,828	8,661	5,596,636
	Access road	95,058	1,431	252,374
	Miscellaneous	873,389	13,684	2,377,256
Left bank (Package-3)	Substructure	1,680,213	8,366	2,599,679
	Superstructure	5,440,581	10,070	6,547,283
	Access road	242,280	3,652	643,640
	Miscellaneous	776,886	7,928	1,648,166
Flyover at Yangon side (Package-1)		1,281,156	7,566	2,112,698
6-lane widening (Package-1)		0	1,583	173,928
Utility relocation		0	663	72,908
Total		16,952,627	72,494	24,919,867

Source: JICA Study Team

Table 5-6 Result of cost estimate (project cost with 32 months construction schedule)

Work item	Project cost ('000 USD)		
	JICA eligible portion	Non-eligible portion	Total
Construction cost	224,504	2,246	226,750
Price escalation	20,174	287	20,461
Physical contingency	24,468	253	24,721
Consulting service	13,394	0	13,394
Land acquisition	0	351	351
Administration cost	0	14,284	14,284
VAT	0	14,266	14,266
Import tax	0	8,892	8,892
Interest during construction	0	86	86
Total cost	282,540	40,666	323,205

Source: JICA Study Team

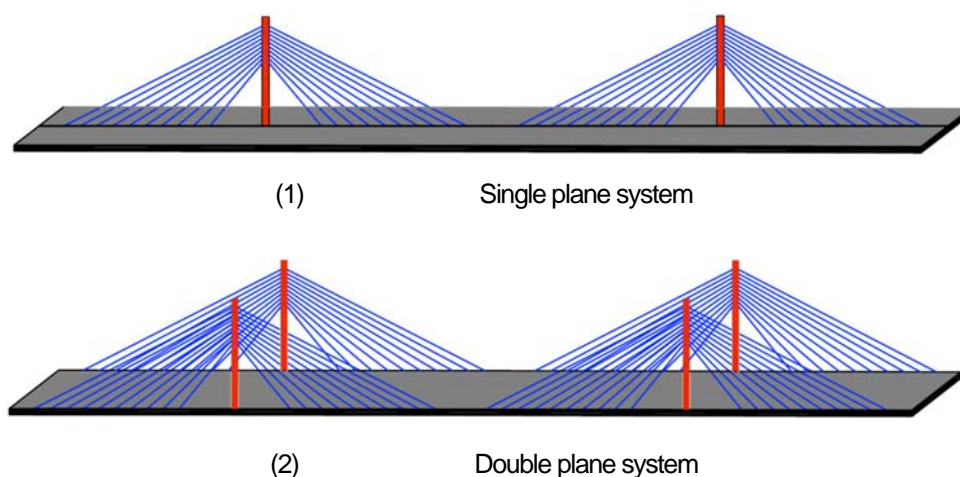
5.4 POSSIBLE OPTIONS OF THE BRIDGE TYPES AT THE COST REDUCTION POINT OF VIEW

In the F/S, the study team selected the bridge structure types by reasonability, constructability and economic points of view. Because almost all the foundations of Bago River Bridge are submerged in water when the large flood comes, the steel pipe sheet pile foundation (SPSP), which is advantageous for the stability and constructability in the river flow, but relatively costly, was applied inside the river area. Superstructure types are selected by not only economy but also newly introduced technology in Myanmar.

In this alternative study, structural types focused on the economic aspect.

5.4.1 Revision of cable stayed bridge

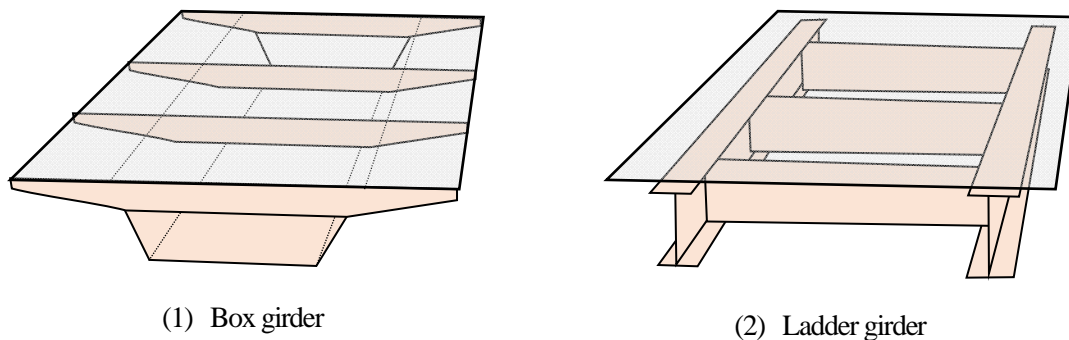
In the F/S, single plane cable system was applied for the cable stayed bridge section of Bago River Bridge. The system is advantageous for aesthetic and smaller piers, while construction cost of superstructure is relatively high.



Source: JICA Survey Team

Figure 5-4 Cable system of cable stayed bridge

For the purpose of reduction of the steel weight, which may lead to the reduction of the construction cost, double plane cable system was examined in this study. While box-shaped steel girder with steel deck slab was planned in single plane system to resist the torsional deformation, ladder girder with concrete slab can fit the structural demand for the double plane cable system with low torsional deformation. Applying ladder girder to cable stayed bridge is becoming popular around the world, Nyat Tan Bridge in Viet Nam for example.



Source: JICA Survey Team

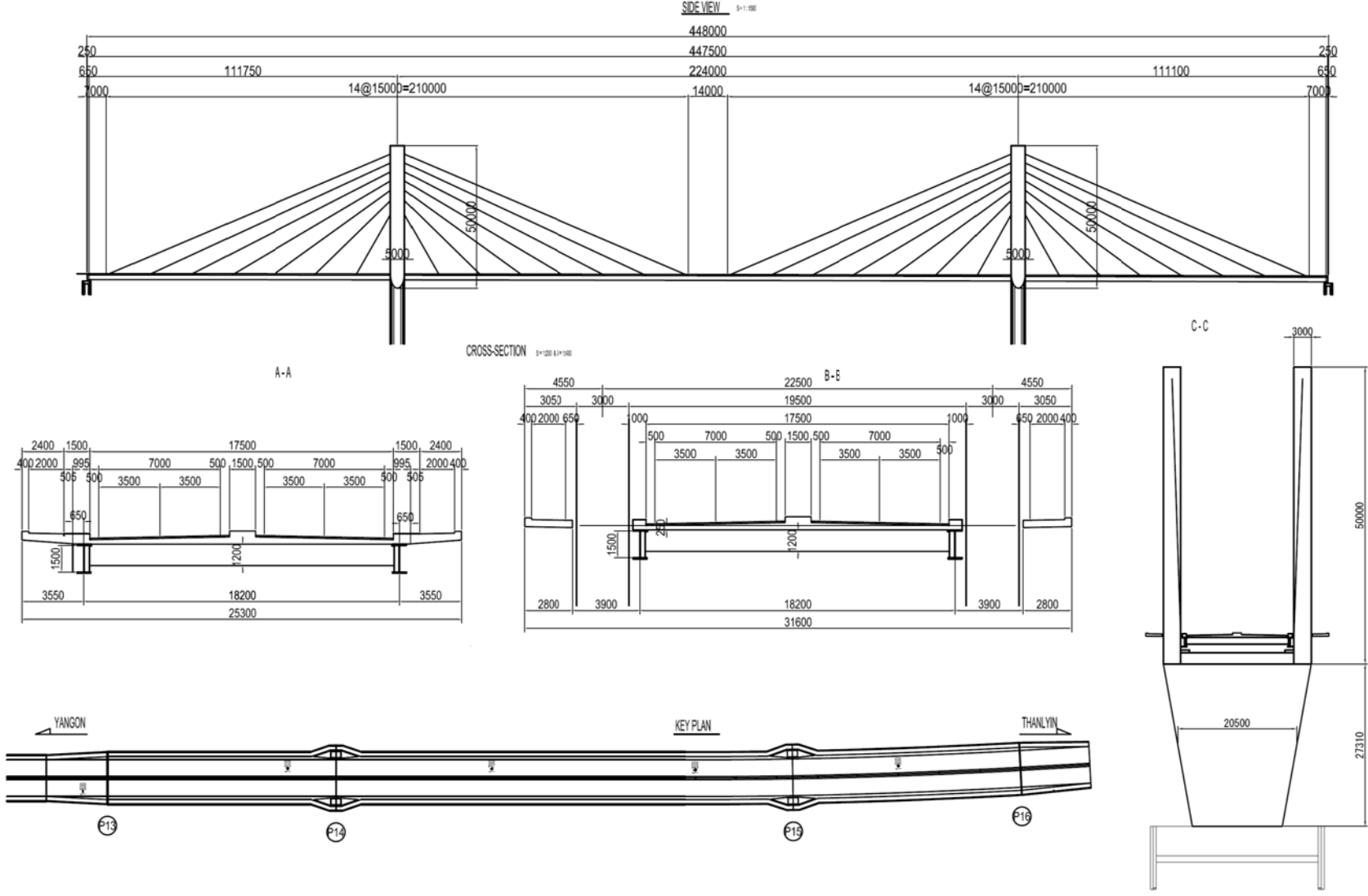
Figure 5-5 Main girder concept for cable stayed bridge

Table 5-7 indicates the result of the preliminary design. The steel weight of the double plane cable system can be reduced about 60% lighter than that of single plane cable system. Cost comparison is discussed in section 5.4.4.

Table 5-7 Result of the preliminary design of cable stayed bridge

	Original design	Alternative design
Steel girder (ton)	5,775	2,075
Steel pylon (ton)	578	-
Stay cable (ton)	357	757
Concrete pylon (m ³)	-	3,000
Concrete pier (m ³)	-	5,966

Source: JICA Survey Team



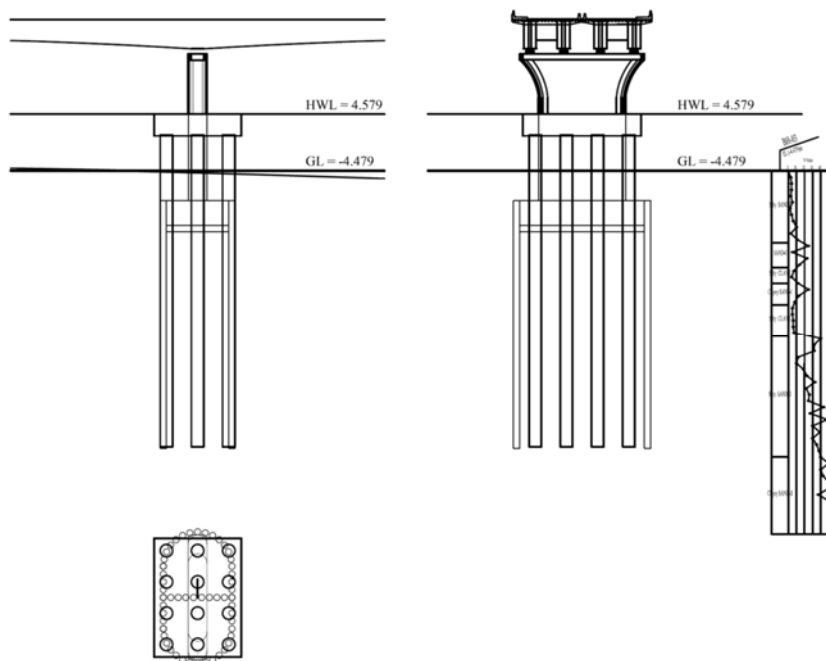
Source: JICA Survey Team

Figure 5-6 Alternative of cable stayed bridge with double plane cable system

5.4.2 Revision of foundation type

In the F/S, steel pipe sheet pile foundation (SPSP) was adopted to the piers in the river.

Conventional multicolumn foundation was examined in this study only to clarify economic merit.



Source: JICA Survey Team

Figure 5-7 Multicolumn foundation (P12 pier)

5.4.3 Combination of the bridge types

Bago River Bridge can be divided into 4 sections at the point of superstructure types:

- A1-P6: PC box girder (span-by-span erection method)
- P6-P13: Steel continuous box girder with steel deck plate
- P13-P16: Steel cable stayed girder with single plane cable system
- P16-A2: PC box girder (span-by-span erection method)

Comparison study for cost reduction was carried out by combination of these sections.

Table 5-8 Combination of the structure

Span	Original structure	Alternative study structure	Description
A1-P6	PC box girder + SPSP	PC box girder + multicolumn	Option3, Option4, Option5
		PC I girder + multicolumn	Option6, Option7
P6-P13	Steel box girder + SPSP	Steel box girder + multicolumn	Option4, Option5
P13-P16	Steel cable stayed bridge + SPSP	Alt. steel cable stayed bridge + SPSP	Option2, Option7
		Steel cable stayed bridge + multicolumn	Option5
P16-A2	PC box girder + SPSP	PC box girder + multicolumn	Option3, Option4, Option5
		PC I girder + multicolumn	Option6, Option7

Source: JICA Survey Team

5.4.4 Result of the option study

The result of the option study is shown in Table 5-9.

Table 5-9 Result of the option study (cost comparison)

	Description	Span arrangement		Total cost ('000 USD)*
Option 1	Original configuration	A1-P6	PC box girder + SPSP	182,914 (1.000)
		P6-P13	Steel box girder + SPSP	
		P13-P16	Steel cable stayed bridge +SPSP	
		P16-A2	PC box girder + SPSP	
Option 2	Revision of the structural type of cable stayed bridge	A1-P6	PC box girder + SPSP	169,184 (0.925)
		P6-P13	Steel box girder + SPSP	
		P13-P16	Steel cable stayed bridge +SPSP	
		P16-A2	PC box girder + SPSP	
Option 3	Revision of the foundation of approach bridge (PC box girder)	A1-P6	PC box girder + multicolumn	175,034 (0.957)
		P6-P13	Steel box girder + SPSP	
		P13-P16	Steel cable stayed bridge +SPSP	
		P16-A2	PC box girder + multicolumn	
Option 4	Revision of the foundation of approach bridge (PC box girder and steel box girder)	A1-P6	PC box girder + multicolumn	162,957 (0.891)
		P6-P13	Steel box girder + multicolumn	
		P13-P16	Steel cable stayed bridge +SPSP	
		P16-A2	PC box girder + multicolumn	
Option 5	Revision of the foundation of whole bridges	A1-P6	PC box girder + multicolumn	153,552 (0.839)
		P6-P13	Steel box girder + multicolumn	
		P13-P16	Steel cable stayed bridge +multicolumn	
		P16-A2	PC box girder + multicolumn	
Option 6	Revision of the superstructure (PC box girder to PC I girder)	A1-P6	PC I girder + multicolumn	165,870 (0.907)
		P6-P13	Steel box girder + SPSP	
		P13-P16	Steel cable stayed bridge +SPSP	
		P16-A2	PC I girder + multicolumn	
Option 7	Combination of Option 2 and Option 6	A1-P6	PC I girder + multicolumn	152,140 (0.832)
		P6-P13	Steel box girder + SPSP	
		P13-P16	Steel cable stayed bridge +SPSP	
		P16-A2	PC I girder + multicolumn	

Note: The cost includes the construction cost with miscellaneous work without access road (behind the abutments)

Source: JICA Survey Team

It is noted that the revision of foundation type is more economic but less structurally stable than original options of steel pipe sheet pile foundation, because multicolumn foundation is vulnerable to scouring. It is also noted that the smaller spanning of the approach bridge will provoke more complex river flow, which causes more severe scouring. Thus, these options are not recommendable.

In the F/S, single plane system was recommended mainly for the road alignment and aesthetical aspects. But single plane system tends to walter around the cable mounts on the bridge deck along bridge axis. To resist the torsional moment, stiffened floor slab and girder are needed. In the F/S, to meet the requirement steel girder with steel deck slab were applied, which is slight more costly.

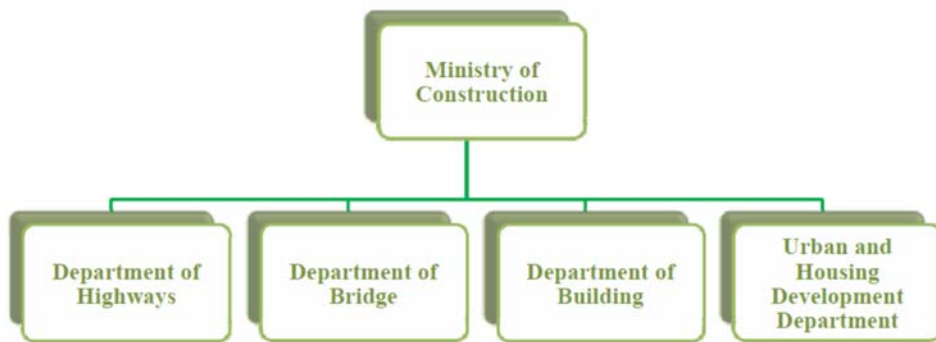
CHAPTER 6. UPDATE OF IMPLEMENTATION PROGRAM

6.1 IMPLEMENTATION STRUCTURE

6.1.1 Implementation Agency

The MOC is "the Line Agency" and concurrently "the Employer"; of the Project. Department of Bridge (hereinafter "DoB") is "the Employer's Representative" and concurrently "the Implementation Agency" managing total implementation of the Project.

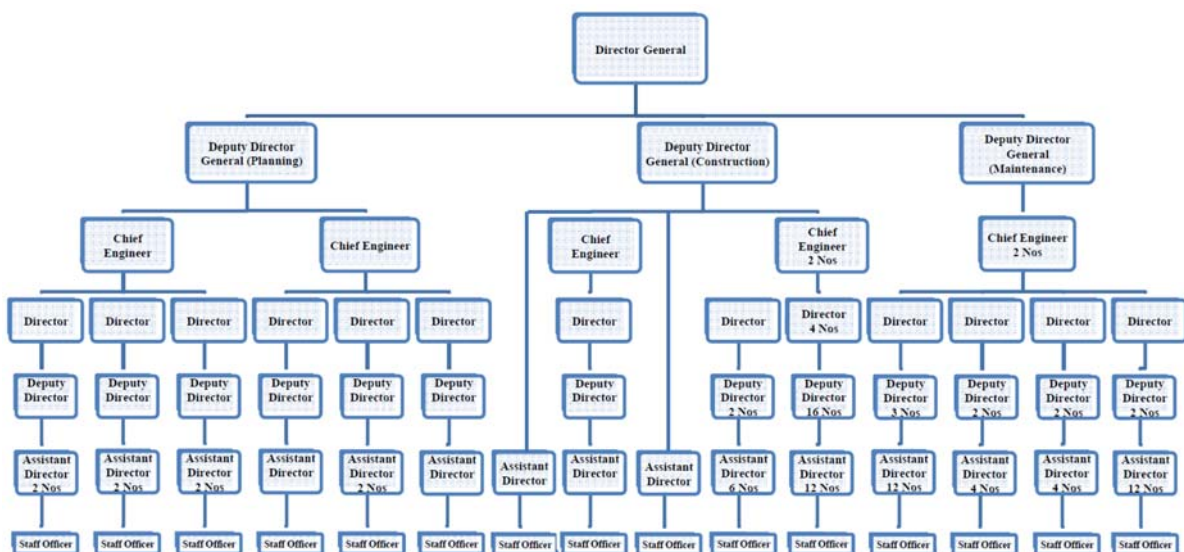
Figure 6-1 shows the organization chart of MOC.



Source: MOC

Figure 6-1 Organization of MOC

As seen in Figure 6-1, MOC consists of four departments under the Minister: namely, Department of Bridge (DoB), Department of Highway (DoH), Department of Building, and Urban and Housing Development Department. Figure 6-2 shows the organizational chart of the Department of Bridge.



Source: MOC

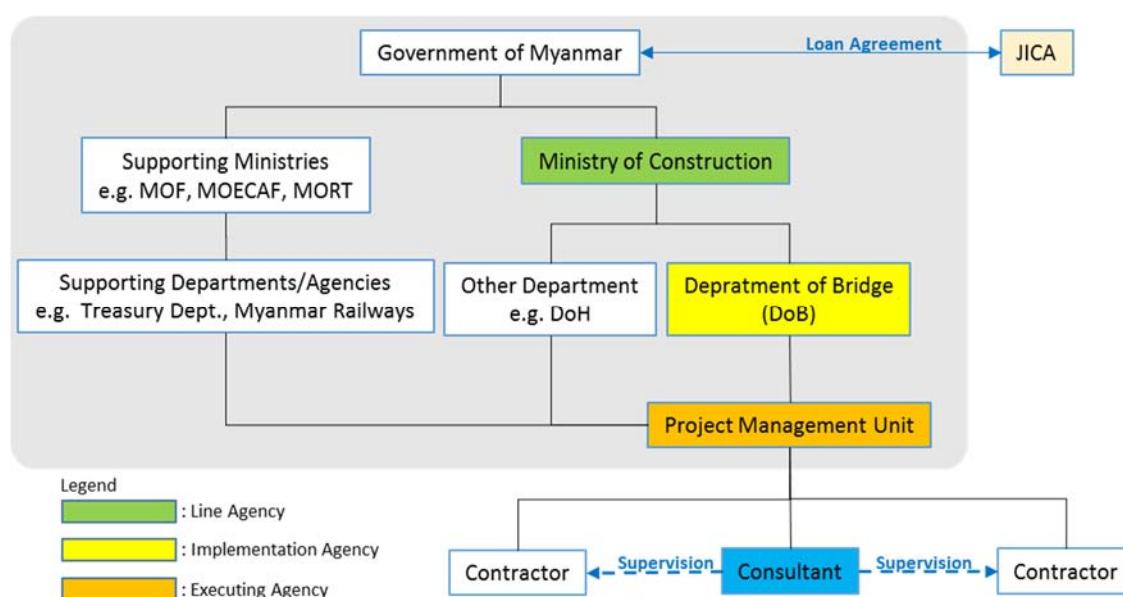
Figure 6-2 Organizational Chart of Department of Bridge, DoB

6.1.2 Project Management Unit

For implementation of the construction project, it is recommended to establish an exclusive Project Management Unit (PMU). PMU is desirable to be established prior to Detailed Design Services, so that all the implementation works can be supervised by PMU consistently.

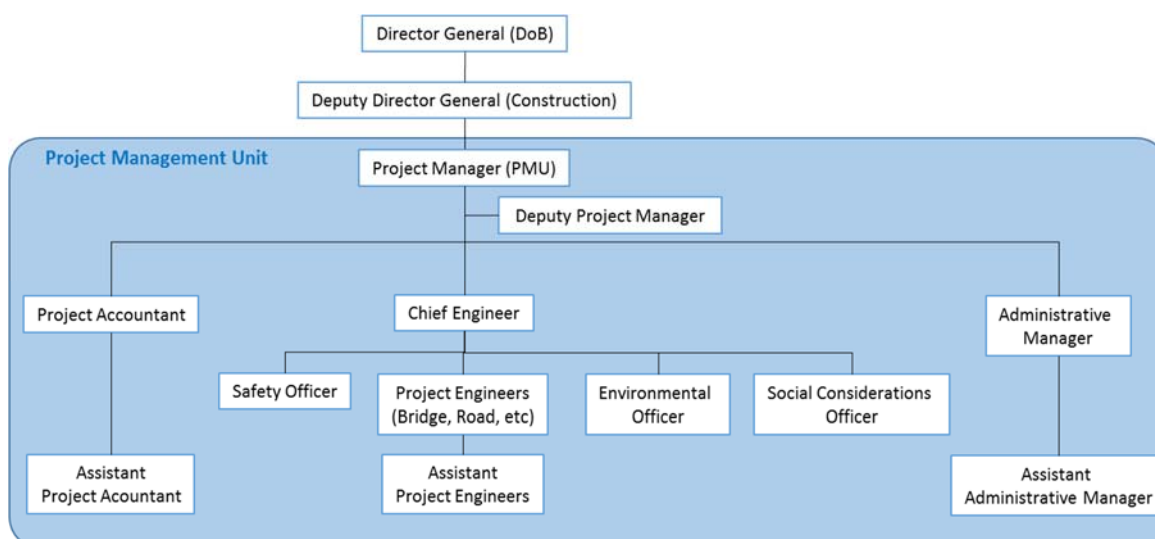
It is critical for supporting efficiently PMU that a competent DD/CS consultant who has enough experience in design/supervision of Cable Stayed Bridge, Span-by-Span PC Girder and Steel Pipe Sheet Pile Foundation can be selected by QBS (Quality-based Selection) bidding since these technologies need to be applied through experienced technical guidance.

Figure 6-3 and Figure 6-4 show the implementation structure with PMU and a proposed organization of PMU, respectively.



Source: JICA Study Team

Figure 6-3 Implementation Structure



Source: JICA Study Team

Figure 6-4 Proposed Organization of Project Management Unit (PMU)

The Executing Agency will be PMU under DoB, and will be responsible for all project works as follows:

- Pre-construction works comprising engineering design, land acquisition, relocation/resettlement, and tender
- Construction supervision
- Traffic safety management during Construction
- Operation and maintenance of civil works and equipment during defect liability period.

6.1.3 Demarcation among DoB, DoH and YCDC

After the construction, operation and maintenance of the bridge between the abutments will be conducted by DoB of MOC while YCDC will be responsible for the approach road, the adjacent intersections and the connecting roads on Yangon Side and Department of Highways (DoH) of MOC will be responsible for the approach road, the adjacent intersections and the connecting roads on Thanlyin Side including Thilawa Access Road. The summary of the responsible authorities are shown in Table 6-1 which was confirmed by MOC and YCDC on February 18th 2016 and February 24th 2016, respectively.

Table 6-1 Responsible Authorities on Implementation of Bago Bridge

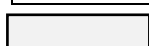
		Design	Construction	Operation & Maintenance
Bago Bridge (between Abutments)		MOC (DoB)	MOC (DoB)	MOC (DoB)
Yangon Side	Approach Road	MOC (DoB)	MOC (DoB)	YCDC
	Intersection	MOC (DoB)	MOC (DoB)	YCDC
	Connecting Roads	MOC (DoB)	MOC (DoB)	YCDC
Thanlyin Side	Approach Road	MOC (DoB)	MOC (DoB)	MOC (DoH)
	Intersection	MOC (DoB)	MOC (DoB)	MOC (DoH)
	Connecting Roads except for Thilawa Access Road	MOC (DoH)	MOC (DoH)	MOC (DoH)

Source: JICA Study Team

Table 6-2 shows the demarcation updated by including the flyover and the on-ramp and agreed between MOC and JICA on March 25th, 2016. The hatched items are the ones financed by JICA ODA Loan as Bago Bridge Construction Project.

Table 6-2 Responsible Authorities on Implementation of Bago Bridge (2)

		Design	Construction	Operation & Maintenance
Bago Bridge (River Bridge Section)		MOC (DoB)	MOC (DoB)	MOC (DoB)
Yangon Side	Approach Road of Bago Bridge	MOC (DoB)	MOC (DoB)	YCDC
	Flyover and its Approach Road	MOC (DoB)	MOC (DoB)	YCDC
	Connecting Roads and Intersections (Including Thanlyin Chin Kat RD under Flyover)	MOC (DoB)	MOC (DoB)	YCDC
Thanlyin Side	Approach Road	MOC (DoB)	MOC (DoB)	MOC (DoH)
	On-ramp	MOC (DoB)	MOC (DoB)	MOC (DoH)
	Connecting Road to On-ramp	-	-	Thanlyin Yadanar Housing Project
	Thilawa Access Road (including intersection from/to housing projects)	MOC (DoH)	MOC (DoH)	MOC (DoH)

 Financed by JICA as Bago Bridge Construction Project

Source: JICA Study Team

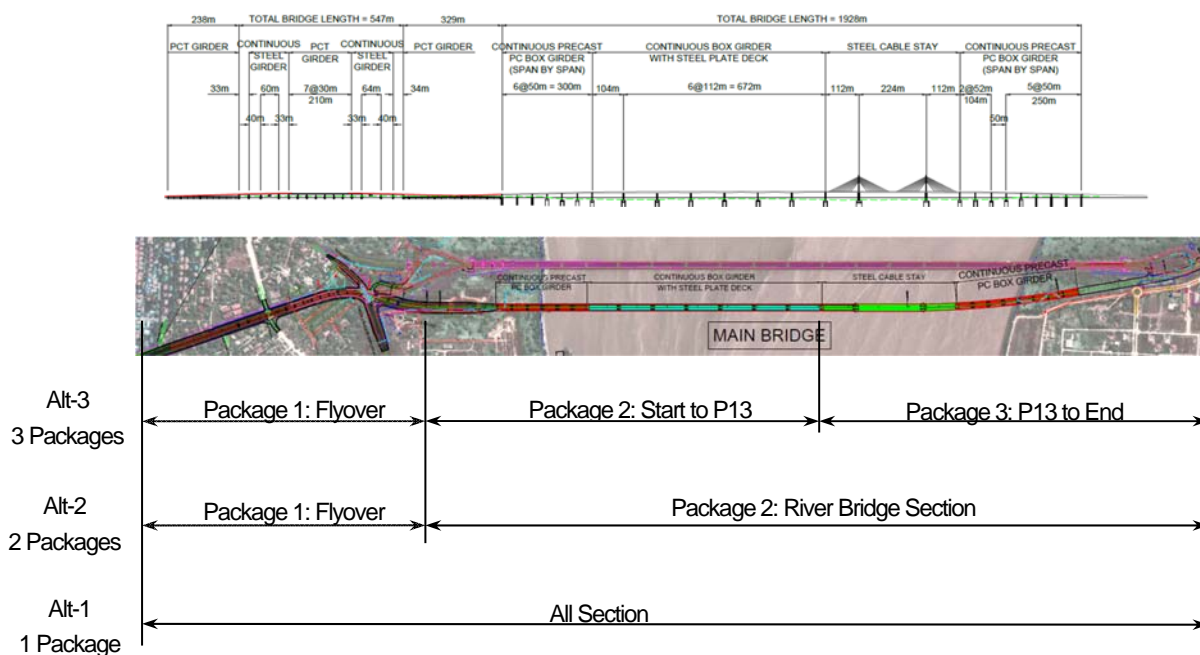
Table 6-3 shows the demarcation updated by including the flyover and the on-ramp and confirmed with on May 20th, 2016. One row was newly added for confirming the demarcation on land acquisition and compensation. Design of Bago River Bridge with approach road and flyover is confirmed to be conducted by JICA Grant.

Table 6-3 Responsible Authorities on Implementation of Bago Bridge (3)

		Land Acquisition & Compensation	Design	Construction	Operation & Maintenance
Bago Bridge (River Bridge Section)		MOC (DoB)	JICA Grant	MOC (DoB) (Financed by JICA)	MOC (DoB)
Yangon Side	Approach Road of Bago Bridge	MOC (DoB)	JICA Grant	MOC (DoB) (Financed by JICA)	MOC (DoB) / YCDC
	Flyover and its Approach Road	MOC (DoB)	JICA Grant	MOC (DoB) (Financed by JICA)	MOC (DoB) / YCDC
	Connecting Roads and Intersections (Including Thanlyin Chin Kat RD under Flyover)	YCDC (MOC will back-up)	MOC (DoB)	MOC (DoB)	MOC (DoH) / YCDC
Thanlyin Side	Approach Road	MOC (DoB)	JICA Grant	MOC (DoB) (Financed by JICA)	MOC (DoH)
	On-ramp	MOC (DoB)	JICA Grant	MOC (DoB) (Financed by JICA)	MOC (DoH)
	Connecting Road to On-ramp	-	-	-	MOC / Thanlyin Yadanar Housing Project
	Thilawa Access Road (including intersection from/to housing projects)	MOC (DoH)	MOC (DoH)	MOC (DoH)	MOC (DoH)

6.2 CONTRACT PACKAGING

In order to select the optimal construction package, the alternatives as shown in Table 6-4 were studied and discussed in the section below.



Source: JICA Study Team

Figure 6-5 Plan of Construction Packaging Alternatives

Table 6-4 Contents of Packaging Alternatives

Alternative-1	Alternative-2	
One Package: ICB	Package No. 1: ICB	Package No. 2: ICB
All Sections	Flyover Section: Embankment (L=321m) Viaduct (L=547m) Embankment (L= 179m)	Bridge Section: West Approach Road (L=539m) Bridge (L=1,928 m) East Approach Road (L=460 m) On-ramp (L=579m)
Alternative-3		
Package No.1: ICB	Package No. 2: ICB	Package No. 3: ICB
Flyover Section Embankment (L=321m) Flyover (L=550m) Embankment (L=179m)	West Approach Road (L=539m) Bridge (Right Bank Side): Bridge (L=1,076 m, PC Box & Steel Box)	Bridge (Left Bank Side): East Approach Road (L=460 m) Bridge (L=852 m, Cable Stay& PC Box) On-ramp (L=579m)

Source: JICA Study Team

(1) Alternative No.1: One Package

First proposed alternative is to incorporate all construction works into one package, which will be procured by International Competitive Bidding (ICB) considering the specific construction technologies and materials applied to Main Bridge.

Advantages:

- a) Construction schedule can be managed comprehensively, which is good in terms of overall project implementation.
- b) Problems concerning interference can be solved as part of the scope of one contractor.
- c) The number of necessary temporary facilities such as offices and plants can be minimized.
- d) Joint venture between international contractor(s) and local contractor(s) can be expected since the package includes various levels of construction technologies.

Disadvantages:

- a) As the contract amount is too large, many construction companies cannot afford to bid. There is a risk that no companies would apply to bid
- b) There is a risk where the competition is very limited, which results in high contract amount.

(2) Alternative No.2: Two Package

Another proposed alternative is to separate Flyover Section and Bridge Section.

Package 1: Flyover Section from KM -760 to KM 0+434, before Abutment

Package 2: Bridge Section from KM 0+434 to KM 2+826, Project End.

Bridge Section will be procured by ICB but Flyover Section in which conventional bridge type are utilized can be procured by either Local Competitive Bidding (LCB) or ICB.

Advantages:

- a) Construction schedule can be managed comprehensively, which is good in terms of overall project implementation.
- b) Problems concerning interference can be solved as part of the scope of one contractor.
- c) The number of necessary temporary facilities such as offices and plants can be minimized.

Disadvantages:

- a) As the contract amount of Package-2 is very large, many construction companies cannot afford to bid. There is a risk that no companies would apply to bid.
- b) It is difficult to control the overall construction schedule as the completion of each package varies.
- c) Some temporary facilities such as offices and plants should be duplicated.

(3) Alternative No.3: Three Packages

Another proposed alternative of construction contract packaging are as follows:

Package 1: Flyover Section from KM 0-760 to KM 0+434, before Abutment

Package 2: Bridge Section (Right Bank) from KM 0+434 to KM 1+500, Pier P13

Package 3: Left Bank from KM 1+500 to KM 2+826, Project End.

Advantages:

- a) All packages have reasonable contract amounts in terms of road and bridge works.
- b) The boundary of the packages at the west end of the cable-stayed bridge; hence, no major interference to the construction works is anticipated.
- c) Since the contract amounts in Bridge Sections are attractive for a number of experienced contractors, competitive bidding is expected.

Disadvantages:

- a) It is difficult to control the overall construction schedule as the completion of each package varies.
- b) Some temporary facilities such as offices and plants should be duplicated.

(4) Recommendations

As shown in the comparison in Table 6-5, Alternative No. 3 with three packages is the most recommended for competitive bidding.

Table 6-5 Comparative Study on Contract Packaging

	Alt-1: Single Package	Alt-2: Two Packages		Alt-3: Three Packages		
Project	Flyover + Bridge	Flyover Section	Bridge Section	Flyover Section	Bridge Section (Right Bank)	Bridge Section (Left Bank)
Procurement	ICB	ICB	ICB	ICB	ICB	ICB
Concept	Single Package	Dividing into Land and River Sections		Dividing into 1 Land and 2 River Sections		
Construction Period	39 months	15 months	39 months	15 months	39 months	39 months
Construction Cost (Preliminary estimate)	USD 215 mil	USD 19 mil	USD 196 mil	USD 19 mil	USD 92 mil	USD 104mil
Management	Most appropriate for consistent control in Time and Quality	Controllable in Time and Quality.		It can be difficult to have consistent control in Time & Quality because of different contractors, which needs a competent consultant for supervision		
Redundancy of Equipment	Able to avoid redundancy	Able to avoid redundancy in Bridge Section		Redundant for each package.		
Qualification of Bidders	The contract amount is too large for most of bidders	Intermediate		No major problem in qualification of bidders as there are many construction companies having experience in similar works.		
Evaluation	Not Recommended Too limited for competitive bidding	Recommended Bridge Section (Package-2) is still too large for competitive bidding		Most Recommended The amounts of the contracts are appropriately distributed among packages		

Source: JICA Study Team

6.3 IMPLEMENTATION PROGRAM

In this section, implementation program of the Project is discussed, introducing two options: one with standard practice, and the other of the shortest scenario with D/D supported by the Japanese grant.

(1) Standard Practice

The implementation program (I/P) with standard practice was established based on the following assumptions:

- Pledge by the Japanese Government will be in July 2016,- Loan agreement will be signed in 2016
- Construction period will be 39 months
- Scheme of Japanese ODA loan will be applied
- Consultancy services of detail design (D/D) will be supported by the Japanese grant
- Procurement of D/D consultant will begin after the pledge of the Japanese government.

The implementation milestones and I/P are shown in Table 6-6 and Figure 6-6 respectively, assuming that common practice will be adopted.

Table 6-6 Implementation Milestones and Periods

Event/ Milestone	Period
Actions by the Governments	
Pledge by the Japanese Government	: Assumed as beginning in this I/P
Exchange Note and Loan Agreement	: 3 rd month from Pledge
Land Acquisition	: 24 months
Resettlement	: 24 months
Consultancy Services	
Procurement of D/D Consultant (by JICA)	: 6 months from E/N
Detail Design (by JICA)	: 12 months after Procurement
Procurement of C/S Consultant (by Myanmar)	: 9 months
Pre-construction Services (Tender Period)	: 12 months
Construction Supervision	: 39 months
Post-construction Services (Defect Liability Period)	: 12 months
Construction	
Procurement of Contractor (by Myanmar)	: 12 months
Construction	: 39 months
Defect Liability Period	: 12 months

Source: JICA Study Team

Financial Year	2016				2017				2018				2019				2020				2021				2022				2023				Total Month
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	
Pledge, E/N and L/A	△	△																															
Procurement of DD/CS Consultant			■	■	■	■	■	■																									6
Detailed Design					■	■	■	■	■	■	■	■																					12
Pre-construction Services (Tender Period)									■	■	■	■																					12
Construction Supervision													■	■	■	■	■	■	■	■	■	■	■	■									39
Post Construction Services (Defect Liability Period)																									■	■	■	■	■	■	■	■	12
Land Acquisition/Resettlement					■	■	■	■	■	■	■	■																					24

Source: JICA Study Team

Figure 6-6 Assumed Implementation Program for Construction of Bago Bridge

(2) Shortest Scenario

The implementation program (I/P) in this Preparatory Study was established based on the following assumptions:

- Pledge by the Japanese Government will be in July 2016
- Exchange Note and Loan Agreement will be signed in 2016
- Scheme of Japanese ODA loan will be applied
- Consultancy services of detail design (D/D) will be conducted by the Japanese grant
- Procurement of D/D consultant will begin after the pledge of the Japanese government
- Construction period will be 32 months as a consequence of commencement in August.

The implementation milestones and I/P are shown in Table 6-7 and Figure 6-7 respectively, assuming that common practice will be adopted.

Table 6-7 Implementation Milestones and Periods

Event/Milestone	Period
Actions by the Governments	
Pledge by the Japanese Government	: Assumed as beginning in this I/P
Exchange Note and Loan Agreement	: 3 rd month from Pledge
Land Acquisition	: 17 months
Resettlement	: 17 months
Consultancy Services	
Procurement of D/D Consultant (by JICA)	: 3 months after Pledge
Detail Design (by JICA)	: 12 months after Procurement
Procurement of C/S Consultant (by Myanmar)	: 9 months
Pre-construction Services (Tender Period)	: 12 months
Construction Supervision	: 39 months
Post-construction Services (Defect Liability Period)	: 12 months
Construction	
Procurement of Contractor (by Myanmar)	: 12 months
Construction	: 32 months
Defect Liability Period	: 12 months

Source: JICA Study Team

Financial Year	2016				2017				2018				2019				2020				2021				Total Month
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	
Pledge, E/N and L/A	△	△																							
Procurement of D/D Consultant		■																							3
Detailed Design			■	■	■	■	■	■																	12
Procurement of C/S Consultant						■	■	■																	6
Pre-construction Services (Tender Period)							■	■	■	■	■	■													12
Construction Supervision											■	■	■	■	■	■	■	■	■	■					32
Post Construction Services (Defect Liability Period)																					■	■	■	■	12
Land Acquisition/Resettlement					■	■	■	■	■	■	■	■													17

Note: Financial year I:April to June, II:July to September, III:October to December, IV:January to March

Source: JICA Study Team

Figure 6-7 Assumed Implementation Program for Construction of Bago Bridge

As shown in Figure 6-7, the detailed design services is planned to be commenced in September 2016 assuming the services are granted by JICA. As a consequence, the construction works are planned to be commenced in August 2018 and completed in March 2021 by assuming the works of foundation and substructure can be completed in 18 months with only one rainy season which is the shortest scenario. The period of construction can be longer depending on the commencement of the works.

CHAPTER 7. PROJECT EVALUATION

7.1 GENERAL

As described in previous chapters, it is anticipated that the traffic between Yangon area and Thanlyin area will increase in the near future because Thanlyin area is developing and many development projects are planned such as the commercial area in Thilawa SEZ. The current traffic capacity of the two existing bridges cannot accommodate the future traffic demand generated in the area, and will soon become a serious bottleneck. Therefore, the new Bago River Bridge is highly expected to see increased traffic demand and prevent traffic congestion in the area.

Implementation of the Bago River Bridge Construction Project should be evaluated considering the national economy (income) due to the large capital cost required. Comparative advantage and absolute value (contribution) of the Project to the national economy should be measured in a numerical manner as much as possible to evaluate the feasibility of the Project prior to the decision for actual implementation.

This chapter presents the results of updated demand forecast analysis and evaluation of the Project from the viewpoint of the national economy based on future demand forecast. Financial analysis is newly added considering MOC's intention for toll collection.

7.2 SOCIO-ECONOMIC FRAMEWORK AND UPDATED TRAFFIC DEMAND FORECAST

This section provides results of the travel demand forecast for the YUTRA study area (the Greater Yangon including Yangon City and part of the six adjacent townships (namely Thalyin, Hmawbi, Helgu, Htantabin, Twantay, and Kyauktan) for the master plan development¹ horizon years of 2025 and 2035. The inputs to the travel demand forecast are the future years of the socio-economic framework and the data for the forecast years, 2018, 2025, and 2035. Subsection 11.2.1 shows the socio-economic framework, Subsection 11.2.2 presents the future transport demand without the Project (Do Nothing + Bago Bridge case), and Subsection 11.2.3 provides the demand forecast of the base case with the Project.

7.2.1 Socio-Economic Framework

The future socio-economic framework was prepared by YUTRA based on past trends, future land use planned by SUDP, national framework estimated by MYT-Plan, and a series of GIS analyses. It covers the following indicators by traffic zone:

- Population (night-time and day-time)
- Employment by sector (night-time and day-time)
- Number of students (night-time and day-time)
- Household income;

¹ As for the details in the master plan projects proposed by YUTRA, please refer to the Final report of YUTRA. Subsection 11.2.3 of this chapter also mentions the master plan projects.

- Ratio of car-owning households.
- Table 7.1 summarizes the socio-economic framework for Greater Yangon estimated by YUTRA.

Table 7.1 Summary Socio-economic Framework for Greater Yangon

			2013	2018	2025	2035	Annual Growth Rate			
							2013-2018	2018-2025	2025-2035	Average 2013-2035
Night-time Population (000)	Workers	Primary	58	58	58	58	0.0%	0.0%	0.0%	0.0%
		Secondary	219	263	350	562	3.7%	4.2%	4.8%	4.4%
		Tertiary	2,263	2,601	3,214	4,470	2.8%	3.1%	3.4%	3.1%
		Total Workers	2,540	2,921	3,622	5,089	2.8%	3.1%	3.5%	3.2%
	Student at Residence		1,164	1,303	1,532	1,938	2.3%	2.3%	2.4%	2.3%
	Others		2,013	2,212	2,462	2,685	1.9%	1.5%	0.9%	1.3%
	Total Night-time Population		5,716	6,437	7,615	9,712	2.4%	2.4%	2.5%	2.4%
Day-time Population (000)	Employment	Primary	58	58	58	58	0.0%	0.0%	0.0%	0.0%
		Secondary	244	289	378	595	3.4%	3.9%	4.6%	4.1%
		Tertiary	2,263	2,610	3,242	4,547	2.9%	3.1%	3.4%	3.2%
		Total Employment	2,565	2,956	3,678	5,200	2.9%	3.2%	3.5%	3.3%
	Student at School Places		1,164	1,303	1,532	1,938	2.3%	2.3%	2.4%	2.3%
	Others		2,013	2,212	2,462	2,685	1.9%	1.5%	0.9%	1.3%
	Total Day-time Population		5,741	6,472	7,672	9,823	2.4%	2.5%	2.5%	2.5%
Household Income (000 MMK/month)		240.6	340.5	522.2	954.7	7.2%	6.3%	6.2%	6.5%	
Household Car Ownership Ratio (%)		11.6	16.8	23.2	32.3	7.8%	4.7%	3.4%	4.8%	

Source: JICA Survey Team

7.2.2 Transport Demand Forecast (Do Nothing + Bago Bridge Case)

This subsection analyzes the future traffic condition of the present road network within YUTRA study area, for the case where no projects will be implemented (Do Nothing + Bago Bridge case) by the master plan development target years of 2018 (short term), 2025 (medium term), and 2035 (long term).

Travel demand estimates were made for a single urban development scenario as stipulated by the JICA SUDP study. The travel demand estimates for three years are summarized in Table 7.2 It compares the demand growth for each of the forecast years.

The table reflects the rapid growth in travel demand with almost constant population growth rate of just over 2.4% per annum. The demand forecast growth in trip rate is reflective of the rapid growth in mechanized trips. The high growth in mechanized trips is caused by the increase in vehicle-owning households from some 12% of the population to over 34% of all households by 2035. The pace of growth is more rapid in earlier years than in the later years due to higher growth of car ownership in earlier years.

The mechanized person trips are forecast to almost double from 4.9 million trips in 2013 to 9.5 million trips by 2035. The share of walk trips and by bicycle would also grow steadily, albeit at slower pace as vehicle-ownership grows. There is a tendency for all members of households to use vehicles for all trips, once the vehicle is available. This is a common phenomenon in developing countries, wherein the purchase of a vehicle is a major step towards a 'status' in a society, and then its maximum use is inevitable as there are few limitations or restraints (parking availability/charges, no road user charges).

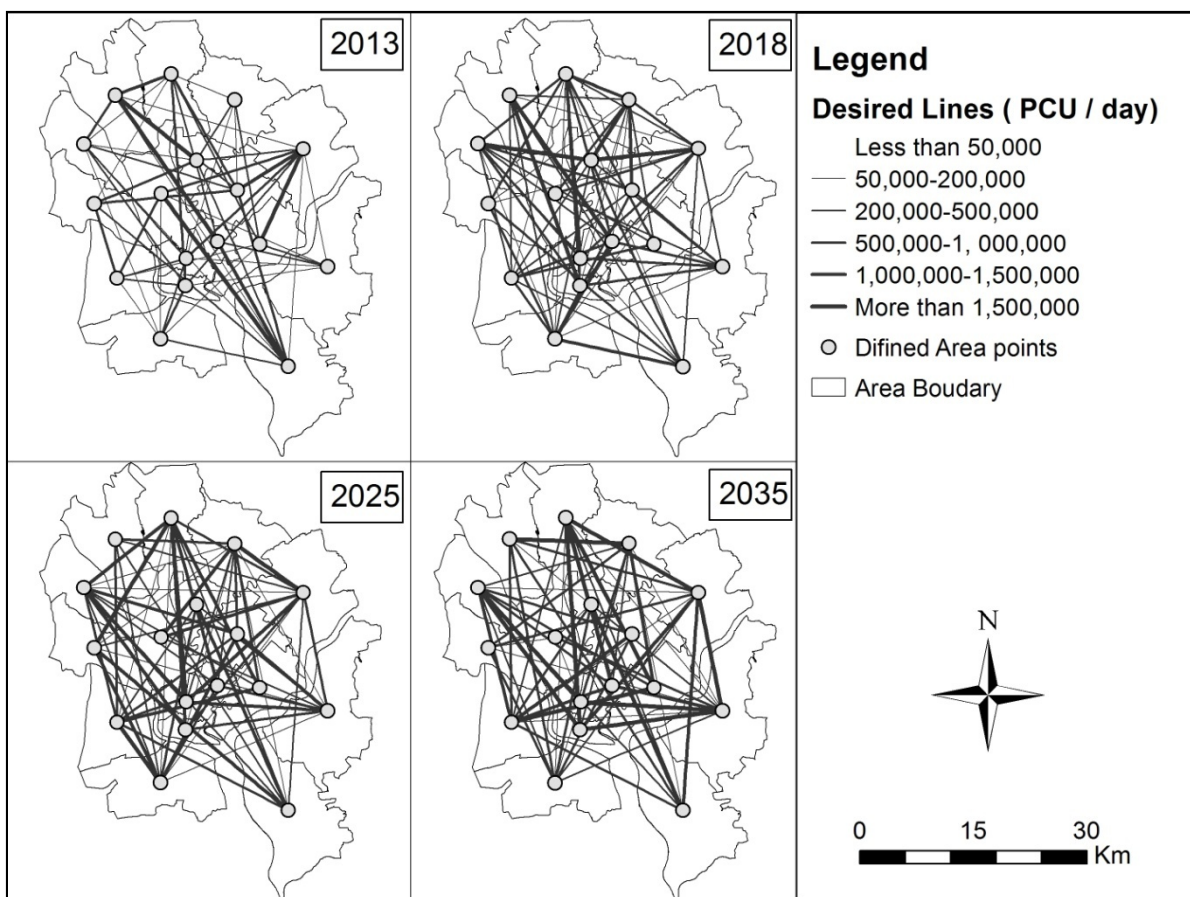
Table 7.2 Growth in Total Travel by All Modes, Person Trips ('000)

Description	2013	2018	2025	2035
Walk	4,778	5,238	6,072	7,403
Bicycle	1,472	1,661	1,981	2,704
Mechanised	4,935	5,862	7,185	9,477
%mechanised	44.1	45.9	47.2	48.4
Total Trips	11,185	12,761	15,238	19,584
Population	5,716	6,437	7,616	9,712
Trip Rate	1.96	1.98	2.00	2.02
Growth Indicator	Growth Rate %p.a.			
	2013-18	2018-25	2025-35	
Walk	1.86	2.13	2.00	
Bicycle	2.45	2.55	3.16	
Mechanised	3.50	2.95	2.81	
Total Trips	2.67	2.57	2.54	
Population	2.40	2.43	2.46	
Trip Rate	0.26	0.13	0.08	

Source: JICA Survey Team

The next stage in the demand forecast process is the distribution of estimated trip ends between origins and destinations. Results of the trip distribution patterns are illustrated by the desire-line diagrams for base and forecast years in Figure 7.1. It is evident that the demand for travel from the new town centers that spread around the central core of Yangon City would considerably grow.

Travel demand to and from areas outside the YUTRA area (external trips) was exogenously estimated, and added to the above described estimated demand. The external travel demand forecast was then compared with the MYT-Plan, and controlled by the MYT-Plan travel demand to/from Yangon and those that pass through the YUTRA area by private and public modes as well as for the goods vehicles. Table 7.3 summarizes the total travel demand in the study area by mode of travel and commercial vehicles.



Source: JICA Survey Team

Figure 7.1 Current and Forecast Trip Distribution Patterns in YUTRA Areas

Table 7.3 Total Travel Demand in the YUTRA Study Area

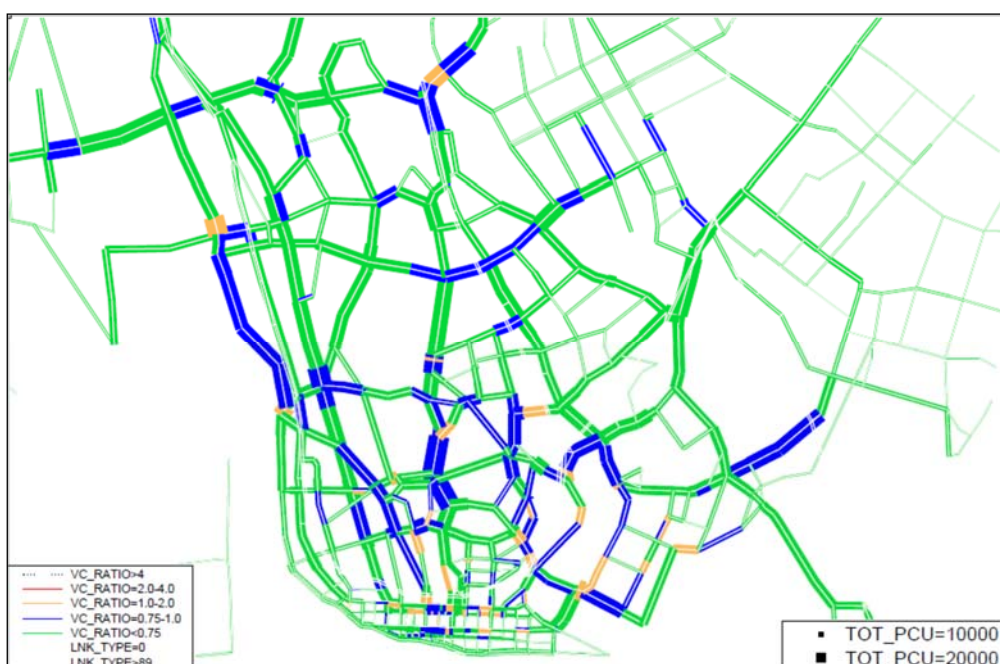
Summary of Trip Totals by Mode (Inter-zonal)					% Growth			% Growth p.a.		
Total Trips	2013	2018	2025	2035	2013-2018	2018-2025	2025-2035	2013-2018	2018-2025	2025-2035
Bicycle	598,500	422,900	504,200	688,900	-29.3	19.2	36.6	-6.7	2.5	3.2
Motorcycle	304,500	208,200	246,100	320,300	-31.6	18.2	30.2	-7.3	2.4	2.7
Car & Van	628,400	1,201,300	1,771,300	2,728,000	91.2	47.4	54.0	13.8	5.7	4.4
Taxi	595,000	756,200	909,200	1,173,100	27.1	20.2	29.0	4.9	2.7	2.6
Bus / Train / Ferry	3,065,900	3,915,400	4,560,400	5,672,600	27.7	16.5	24.4	5.0	2.2	2.2
Total Person Trips	5,192,300	6,504,000	7,991,200	10,582,900	25.3	22.9	32.4	4.6	3.0	2.8
% by Public (Taxi, Bus, Ferry & Train)	70.5	71.8	68.4	64.7						
Goods Vehicle PCU	110,900	151,200	205,200	301,600	36.3	35.7	47.0	6.4	4.5	3.9

Source: JICA Survey Team

The impact of traffic assignment is measured in terms of volume (assigned traffic) capacity (road capacity of each section of road in the network) ratio commonly called “V/C Ratio”. This section outlines the impact of future traffic demand on the current network. Figure 7.2 shows the current traffic volumes on the current road network in 2013 with the V/C ratios that are illustrated by color.

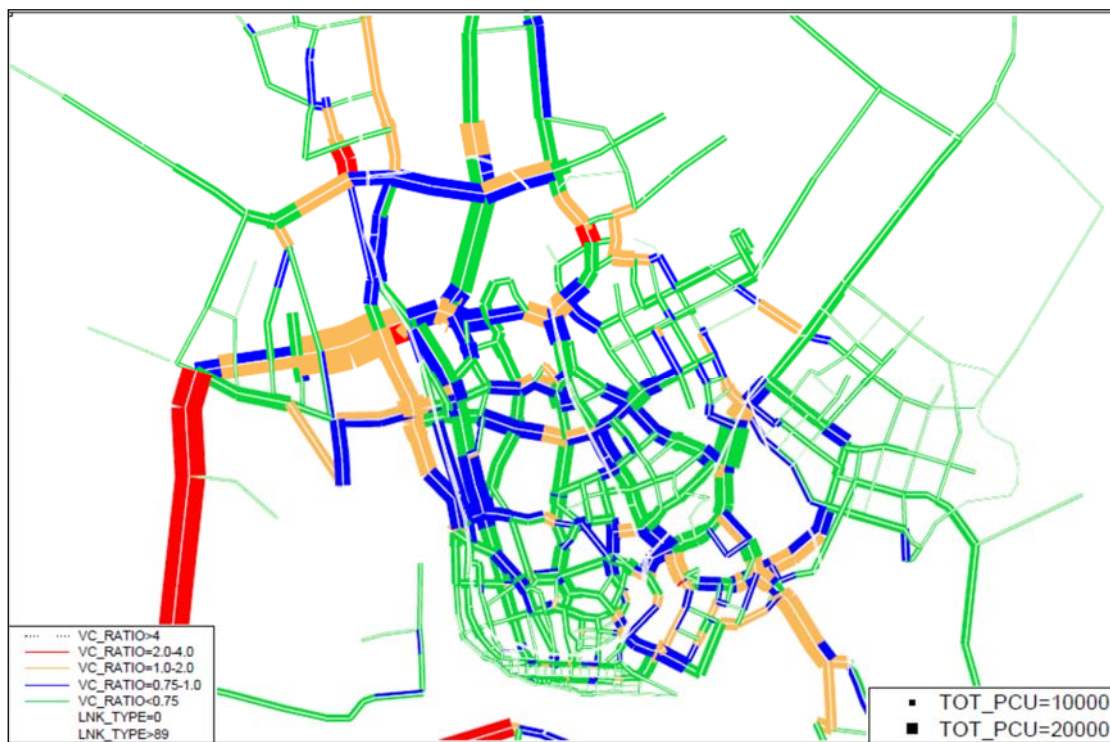
Figure 7.2 also shows that most of the network is congestion free (i.e., green links with V/C Ratio <0.75) and there are only limited number of road sections which are above capacity. This network also reflects the impact of the current rampant on-street parking, which is the main reason of traffic congestion in the CBD area. There are some key links outside the CBD area that are at near capacity (blue links with V/C Ratio between 0.75~1.0). Some bottlenecks are also illustrated by the brown color links.

Figure 7.3 shows the assigned traffic volumes on the current road network in 2018 with the V/C ratios illustrated by color. The figure clearly illustrates that if the current transport infrastructure is not improved, congestion would worsen. The most severe impact would be the rapidly growing urban areas in the west and south of the Yangon River, where the V/C Ratio exceeds 2.0 at the only arterial road in the area. Congestion on bridges from the west and from the Bago area would be operating almost at its capacity most of the day. This illustrates the immediate need for additional Yangon and Bago River crossings.



Source: JICA Survey Team

Figure 7.2 2013 Assigned Traffic Volume on the Current Transport Network

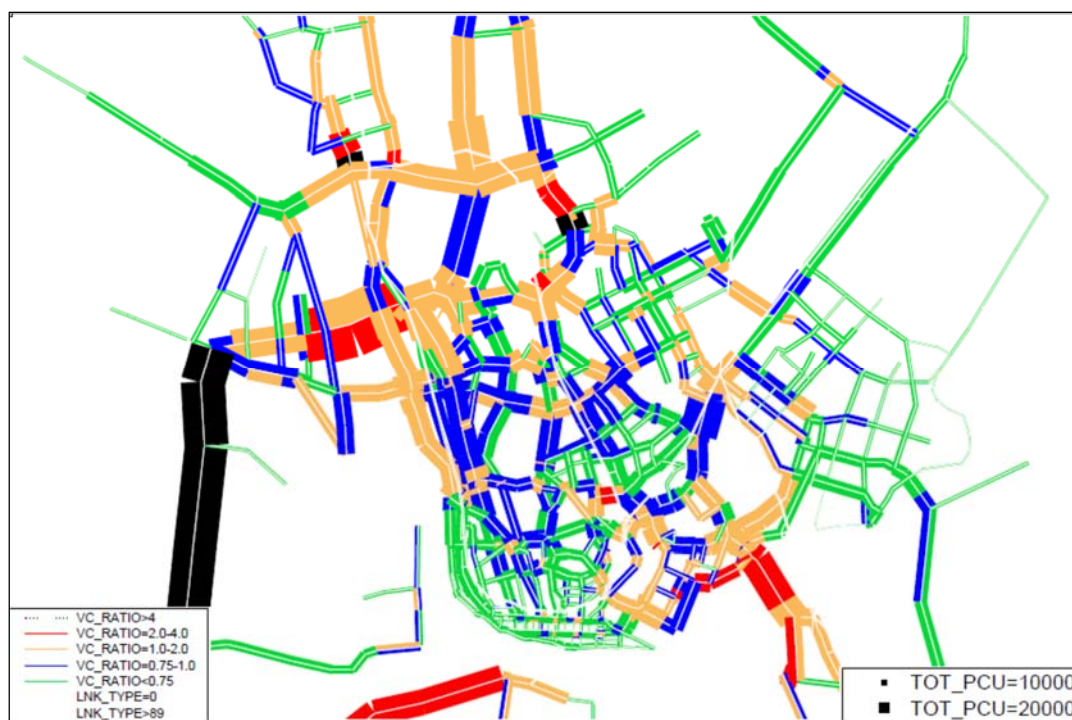


Source: JICA Survey Team

Figure 7.3 2018 Assigned Traffic Volume on the Current Transport Network

Figure 7.4 shows the assigned traffic volume on the current road network in 2025 with the V/C ratios are illustrated by color.

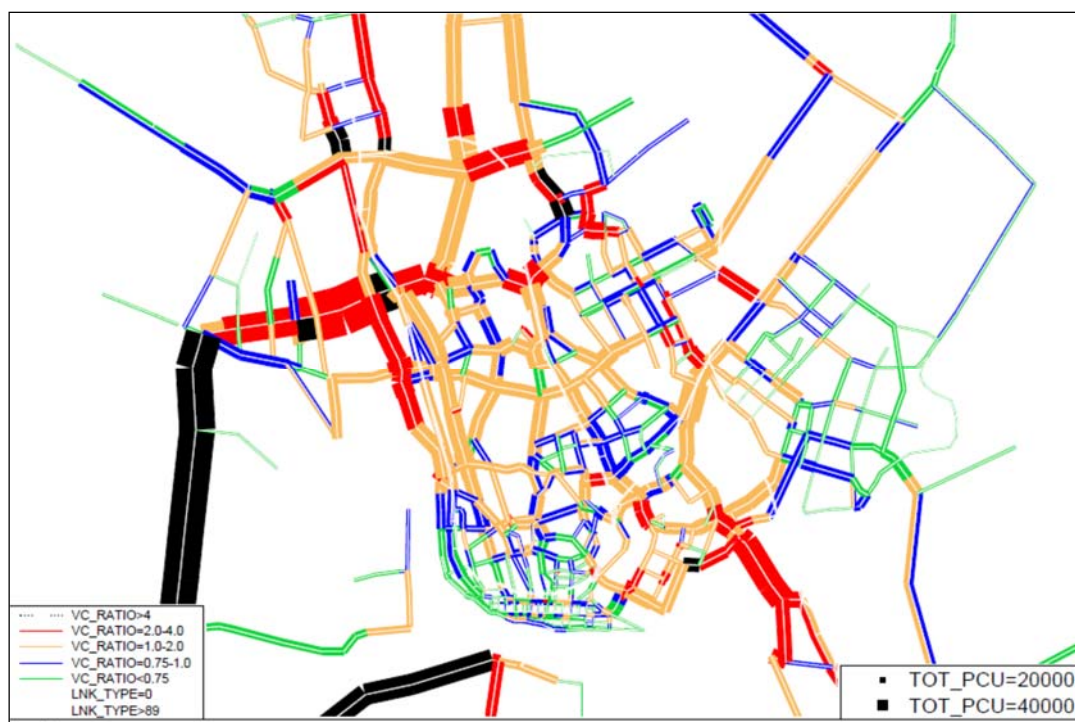
The figure demonstrates that considerable road network capacity would be required to accommodate almost 80% increase in road traffic volume (see Table 7.3 above). The need for a comprehensive arterial and secondary road network would be required in the townships at the west of the Yangon River, as indicated by the black color wherein the only current north-south road reached the V/C Ratio of over 4. Additional river crossings would be required as shown in the 2018 V/C Ratio figures. By 2025, the whole of the Yangon area road network would be required to almost double its road network capacity, or carry out some traffic restraints and use of toll system would need to be in place. The demand for public transport would also require more efficient systems other than the regular bus services to alleviate congestion. The stress on the outer area highway network is also evident in the V/C Ratio between 1~2 (brown) and over 2.0 indicated by the red color. By 2025, the internal external traffic would also require arterial or expressway network to be in place to meet the demand efficiently.



Source: JICA Survey Team

Figure 7.4 2025 Assigned Traffic Volume on the Current Transport Network

The impact on the road network by 2035 under the stress of increase in the total passenger car unit (PCU) to 2.3 million would be unthinkable if the city will grow but the transport infrastructure remains at the current 2013 level. The need for additional capacity is illustrated below in Figure 7.5, which shows the projected 2035 traffic volume and illustrates the likely V/C ratios on the network. It can be seen that on most of the networks the V/C ratios exceeds 1.0, and the brown, red, and black colors show the intensity of the poor level of service. In fact the red and black colors imply the need to further double the current road capacity and the need for an efficient mass transit system by 2035. A corridor based supply demand analysis is presented in the next section.



Source: JICA Survey Team

Figure 7.5 2035 Assigned Traffic Volume on the Current Transport Network

In summary, these figures above show that V/C of the existing Thanlyin Bridge is expected to rapidly increase between 2013 and 2018. In addition, V/C will reach over 2.0 in 2025, which means that under the current road network there will be severe congestion on the existing Thanlyin Bridge after 2025.

7.2.3 Demand Forecast

In this subsection, future travel demand of the targeted area (existing Thanlyin Bridge and the new Bago Bridge) of this Survey in “Do Nothing + Bago Bridge Case” and “YUTRA Master Plan Case” is presented. The road and rail network in the future years of “Do Nothing + Bago Bridge Case” will not change from current network. YUTRA proposed some prioritized projects² for the master plan of the urban transport in Greater Yangon and the Do Master Plan Scenario in this section is defined as “YUTRA Master Plan Case”. The Do Master Plan Scenario assumes the following transport facilities to be developed on the condition that the major road network, the urban railways including two lines of the Urban Mass Rapid Transit (UMRT), and four routes of the Bus Rapid Transport (BRT) will be conducted as scheduled.

- **Road Network:** Road Projects are composed of three types of projects: i) arterial roads, ii) expressways, and iii) traffic control and the Intelligent Transport Systems (ITS). A total of 27 projects were proposed by YUTRA. The Bago Bridge construction project is also included in the project list.
- **Public Transport:** Urban Railway Projects and BRT Projects are also included. The Urban Railway Projects are composed of three types of projects: i) Urban sections of the existing Myanmar Railways, ii) UMRT, and

² The projects are divided into three categories by implementation schedule: short-term (2014-2018), medium-term (2019-2025), and long-term (2026-2035).

iii) Transit Oriented Development (TOD). A total of 29 projects were proposed. A BRT line is planned to be developed on Thanlyin Bridge. After the new Bago Bridge is constructed, roads of the existing bridge will be occupied by BRT.

- **Traffic Management:** The purposes of the Traffic Management Projects are to manage traffic congestion and keep traffic safety. Six short-term projects were proposed.
- **Freight Transport:** Two truck terminal projects (medium term) were proposed.

On the assumption that the prioritized projects will be conducted as scheduled, the future travel demand in PCU on the existing Thanlyin Bridge and the new Bago Bridge was calculated through a benchmark year. Table 7.4 and Table 7.5 present the travel demand in PCU by mode of transport in two cases: Do Nothing + Bago Bridge Case and YUTRA Master Plan Case. Traffic volume of New Bago Bridge in 2035 will achieve to 84,000 pcu/ day/ 2way in Do Nothing + Bago Bridge Case and 58,000 pcu/ day/ 2way in YUTRA Master Plan Case.

The travel speed and V/C Ratio by each benchmark year also are summarized in Table 7.4 and Table 7.5. The result of the demand forecast shows that travel speed at each bridge will increase and the V/C Ratio will be improved by the construction of the new bridge.

Table 7.4 Travel Demand on Thanlyin Bridge and new Bago Bridge (Do Nothing + Bago Bridge Case)

Indicator		Year	2016	2021	2023	2025	2035	
		Direction	Thanlyin Bridge	New Bago Bridge				
Traffic Volume (PCU/day/1 way)	BC, MC, Others	South bound	171	382	409	437	515	
		North bound	175	216	233	251	326	
	Car, Taxi, Van	South bound	9,507	20,917	22,288	23,659	30,952	
		North bound	10,813	14,505	16,190	17,875	23,544	
	Bus	South bound	5,530	5,490	5,369	5,247	8,981	
		North bound	5,386	10,420	10,490	10,560	10,988	
	Truck	South bound	2,999	2,345	2,528	2,711	3,842	
		North bound	2,208	3,460	3,689	3,918	5,493	
	Total	South bound	18,207	29,134	30,594	32,055	44,290	
		North bound	18,582	28,601	30,603	32,604	40,351	
	Travel Speed (km/h)		South bound	4.7	21.8	18.8	16.3	5.2
			North bound	4.7	23.0	18.8	15.4	7.4
Congestion Ratio (V/C)		South bound	1.3	1.0	1.0	1.1	1.5	
		North bound	1.3	1.0	1.0	1.1	1.3	

Source: JICA Survey Team

Table 7.5 Travel Demand on Thanlyin Bridge and new Bago Bridge (YUTRA Master Plan Case)

Indicator		Year	2016	2021	2023	2025	2035
		Direction	Thanlyin Bridge	New Bago Bridge			
Traffic Volume (PCU/day/1 way)	BC, MC, Others	South bound	171	275	294	312	370
		North bound	175	166	179	191	245
	Car, Taxi, Van	South bound	9,507	11,379	12,770	14,161	20,489
		North bound	10,813	7,994	9,038	10,082	16,118
	Bus	South bound	5,530	6,502	6,129	5,756	2,466
		North bound	5,386	7,434	7,665	7,896	2,980
	Truck	South bound	2,999	1,344	1,467	1,591	2,331
		North bound	2,208	1,851	2,021	2,191	3,213
	Total	South bound	18,207	19,500	20,660	21,819	25,656
		North bound	18,582	17,445	18,903	20,360	22,555
Travel Speed (km/h)		South bound	4.7	52.1	47.8	43.5	30.7
		North bound	4.7	59.6	54.3	48.9	40.8
Congestion Ratio (V/C)		South bound	1.3	0.6	0.7	0.7	0.9
		North bound	1.3	0.6	0.6	0.7	0.8

Source: JICA Survey Team

7.3 ECONOMIC EVALUATION

7.3.1 Methodology and Assumptions

The economic analysis is to determine whether a proposed public infrastructure project deserves investment of public funds. The concept is to analyze whether the return on a project is worth the investment from the viewpoint of the national economy as a standpoint of the government. The rationality of the investment in the project is evaluated by comparing the economic costs and benefits over the life of the Project.

In general, the economic benefit of a transportation development project is defined as the savings in vehicle operation costs (VOC) and travel time costs (TTC) of users attributable to the project. The benefit is quantified and is estimated through a “with-and without” comparison of traffic demand analysis, that is, comparison of traffic assignment results on a network with the Project and without the Project.

In this section, economic analysis is conducted for two cases: (1) Do Nothing + Bago Bridge case and (2) Project for Comprehensive Urban Transport Plan of the Greater Yangon (YUTRA) Master Plan case (YUTRA MP case). In consideration of the probability that YUTRA Master Plan proceeds as scheduled, a base case is Do Nothing + Bago Bridge case and an alternative case is YUTRA MP case.

Economic analysis of this Project was conducted based on the following assumptions and standardization.

1) Construction Period

Construction period is four and half years of 2017 to 2021 for this project, including 32 months of construction period and one year of defect liability period.

2) Period of Analysis

Period of analysis is thirty years after starting operation that includes the construction period from 2017 to 2021 and the operation period from 2022 to 2051.

3) Project Life

Thirty years after starting operation. Residual value is assumed to be zero.

4) Traffic Assignment

Traffic assignment of two cases was conducted for the years 2020, 2025, 2030 and 2035, on the assumption that the Bago River Bridge is a toll bridge. The economic benefits were estimated for the four years and an interpolation was done for intermediate years. The economic benefits have been calculated from the results of traffic assignment. After 2035, traffic volume was assumed to keep the same amount.

5) Indicators of Economic Viability

The following three indicators were calculated for economic evaluation of this Project;

+ B/C (Cost Benefit Ratio)

+ Net Present Value (NPV)

+ EIRR (Economic Internal Rate of Return)

6) Social Discount Rate:

12% per annum was assumed as the social discount rate.

7) Annual Maintenance Cost

0.5% of construction cost of the project was assumed.

8) Standard Conversion Factor (SCF)

All the costs are classified into the items of 1) traded goods, 2) non-traded goods and 3) transfer item. It is assumed that traded goods are equivalent to the foreign currency portion, and aggregation of non-traded goods stands for the local currency portion. Transfer item means the portion of taxes such as import duties, which should be excluded from the economic price. The standard conversion factor (SCF) is an index which converts domestic prices to border prices by adjustment of the distortion of domestic prices. The economic prices of the whole portion of non-trade goods are assumed to be obtained by applying the SCF.

The standard conversion factor is estimated based on the value of import, export and taxes. According to the statistical data on foreign trade and governmental revenues in Myanmar and to compensate unclear figures on trading such as custom rates, conversion factors in neighboring countries are also referred, such as Indonesia and Philippines. The SCF for this Project is assumed to be 0.85, which is the same as SCF of a JICA Study, "The Preparatory Survey for The Project for Construction of Bago River Bridge" and YUTRA.

9) Exchange Rate

The following exchange rates on May 2016 were applied.

US \$ 1.00 = MKK 1,281

US \$ 1.00 = JPY 109.9

MMK1.00 = JPY 0.0902

7.3.2 Economic Cost of the Project

Project cost stated in Chapter 5 "Update of Cost Estimate" is presented in the financial price. The financial project cost was converted to economic prices by applying a standard conversion factor (SCF) set as 0.85 above after

excluding the portion of contingency, taxes and interest. The estimated financial cost and economic cost are shown in Table 7.6.

Table 7.6 Project Cost in Financial and Economic Prices

Unit: '000 US\$

Item	Financial Cost	Economic Cost
Construction Cost	226,750	215,876
Engineering Cost	12,036	11,723
(Subtotal)	238,786	227,599
Land Acquisition	297	252
Administration cost	14,284	12,141
Taxes	23,158	0
Contingency	25,391	24,085
Price Escalation	21,204	0
Interest	86	0
Total	323,205	264,077

Source: JICA Study Team

7.3.3 Economic Benefit of the Project

As savings in VOC and TTC were selected as the economic benefit of a project, unit costs of VOC and TTC were required to estimate those benefits. The unit costs were estimated in 2013.

(1) VOC: Vehicle Operation Cost

The savings in VOC is one of the major sources of economic benefits in transport projects. The most important is that the VOC should be a function of vehicle speed so that the improvement of road conditions would be duly reflected as an economic benefit. The unit cost by mode of transport is shown in Table 7.7.

Table 7.7 VOC by Vehicle Type (Economic Price)

Unit: '000MMK/1000km

Speed (km/h)	Motorcycle	Car	HOV/Van	Mini Bus	Standard Bus	Small Truck	Big Truck
5	58	447	633	662	743	840	1,152
10	34	258	374	437	483	611	795
20	22	158	233	304	333	451	568
30	17	122	177	246	270	367	458
40	15	103	144	212	235	313	391
50	14	92	129	193	215	279	354
60	14	87	124	184	204	261	335
70	14	85	124	182	202	257	332
80	14	86	129	189	209	268	349
90	15	90	136	203	224	293	382

Source: YUTRA

(2) VOT: Value of Time

The savings in passenger time cost is another major source of economic benefits of transport projects. Table presents the unit of Value of Time (VOT) by mode of transport calculated from the personal income data which was collected by the Household Interview Survey conducted by YUTRA in 2013.

This value is assumed to increase at the same growth rate as per-capita GRDP used in this study.

Table 7.8: VOT by Travel Mode (US\$/ hour)

No	Mode	2016	2018	2025	2035
1	Motorcycle	1.2	1.4	2.1	3.8
2	Car	3.1	3.6	5.4	9.9
3	Taxi	2.3	2.6	4	7.2
4	Bus/Truck	1.5	1.7	2.5	4.6

Source: YUTRA

(3) Estimation of Economic Benefit: Saving VOC and TTC

By applying the above unit costs to the results of traffic demand and summing VOC and TTC, aggregated transportation costs were estimated. Economic benefit is the difference of the aggregated costs between “with project” and “without project” cases. Table 7.9 and Table 7.10 show the estimated economic benefits of benchmark years, 2022 (opening year), 2025 2030 and 2035.

Table 7.9 Estimated Economic Benefits of Benchmark Years in Do Nothing + Bago Bridge Case

Year	Economic Benefit (mil. US\$)		
	TTC Saving	VOC Saving	Total
2022	28.0	26.8	54.8
2025	3.1	26.7	29.8
2030	153.8	107.0	260.8
2035	217.5	165.8	383.2

Source: JICA Study Team

Table 7.10 Estimated Economic Benefits of Benchmark Years in YUTRA MP Case

Year	Economic Benefit (mil. US\$)		
	TTC Saving	VOC Saving	Total
2022	4.5	3.3	7.8
2025	10.8	3.0	13.7
2030	23.1	7.9	30.9
2035	60.9	33.3	94.3

Source: JICA Study Team

7.3.4 Evaluation Result**(1) Base Case: Do Nothing + Bago Bridge Case**

The evaluation result of economic analysis in Do Nothing + Bago Bridge case is summarized in Table 7.11. As explained above, three indicators of cost benefit analysis, i) B/C, ii) NPV, and iii) EIRR were computed based on the assumptions mentioned in the foregoing section.

The evaluation result shows that the Project in case of Do Nothing + Bago Bridge is highly economically feasible since the EIRR is double (24.9%) the assumed social discount rate of 12%.

Table 7.11 Summary of Cost Benefit Analysis in Do Nothing + Bago Bridge Case

Indicator	Value
EIRR	24.9%
B/C (at discounted rate of 12%)	4.12
NPV (Million US\$ at discounted rate of 12%)	683

Source: JICA Study Team

Table 7.12 Benefit Cost Stream in Do Nothing + Bago Bridge Case

Unit: Million USD

Year	Cost			Benefit			Net Cash Flow
	Investment Cost	O&M Cost	Total	Time Saving	VOC Saving	Total	
2017	4.9	0	4.9	0	0	0	-4.9
2018	103.8	0	103.8	0	0	0	-103.8
2019	75.0	0	75.0	0	0	0	-75.0
2020	68.8	0	68.8	0	0	0	-68.8
2021	11.6	0	11.6	0	0	0	-11.6
1 2022	0.0	1.1	1.1	28.0	26.8	54.8	53.7
2 2023	0.0	1.1	1.1	22.3	27.3	49.6	48.5
3 2024	0.0	1.1	1.1	14.2	27.3	41.5	40.4
4 2025	0	1.1	1.1	3.1	26.7	29.8	28.7
5 2026	0	1.1	1.1	20.4	36.8	57.1	56.1
6 2027	0	1.1	1.1	42.8	49.3	92.0	91.0
7 2028	0	1.1	1.1	71.5	64.8	136.2	135.2
8 2029	0	1.1	1.1	107.9	83.8	191.7	190.6
9 2030	0	1.1	1.1	153.8	107.0	260.8	259.7
10 2031	0	1.1	1.1	165.7	117.1	282.8	281.7
11 2032	0	1.1	1.1	178.1	128.0	306.1	305.0
12 2033	0	1.1	1.1	191.0	139.7	330.7	329.6
13 2034	0	1.1	1.1	204.1	152.3	356.4	355.4
14 2035	0	1.1	1.1	217.5	165.8	383.2	382.2
15 2036	0	1.1	1.1	217.5	165.8	383.2	382.2
16 2037	0	1.1	1.1	217.5	165.8	383.2	382.2
17 2038	0	1.1	1.1	217.5	165.8	383.2	382.2
18 2039	0	1.1	1.1	217.5	165.8	383.2	382.2
19 2040	0	1.1	1.1	217.5	165.8	383.2	382.2
20 2041	0	1.1	1.1	217.5	165.8	383.2	382.2
21 2042	0	1.1	1.1	217.5	165.8	383.2	382.2
22 2043	0	1.1	1.1	217.5	165.8	383.2	382.2
23 2044	0	1.1	1.1	217.5	165.8	383.2	382.2
24 2045	0	1.1	1.1	217.5	165.8	383.2	382.2
25 2046	0	1.1	1.1	217.5	165.8	383.2	382.2
26 2047	0	1.1	1.1	217.5	165.8	383.2	382.2
27 2048	0	1.1	1.1	217.5	165.8	383.2	382.2
28 2049	0	1.1	1.1	217.5	165.8	383.2	382.2
29 2050	0	1.1	1.1	217.5	165.8	383.2	382.2
30 2051	0	1.1	1.1	217.5	165.8	383.2	382.2
Total	264	32	296	4,900	3,805	8,705	8,408
PV@12%	214	5	219	492	410	902	683

Source: JICA Study Team

(2) YUTRA Master Plan Case (YUTRA MP case)

The evaluation result in YUTRA MP case is summarized in Table 7.13. EIRR is 11.0% which is slightly below 12%. This result shows that the project in YUTRA MP case is not economically feasible.

Table 7.13 Summary of Cost Benefit Analysis in YUTRA MP Case

Indicator	Value
EIRR	11.0%
B/C (at discounted rate of 12%)	0.86
NPV (Million US\$ at discounted rate of 12%)	-30

Source: JICA Study Team

Table 7.14 Benefit Cost Stream in YUTRA MP Case

Unit: Million USD

Year	Cost			Benefit			Net Cash Flow
	Investment Cost	O&M Cost	Total	Time Saving	VOC Saving	Total	
2017	4.9	0	4.9	0	0	0	-4.9
2018	103.8	0	103.8	0	0	0	-103.8
2019	75.0	0	75.0	0	0	0	-75.0
2020	68.8	0	68.8	0	0	0	-68.8
2021	11.6	0	11.6	0	0	0	-11.6
1 2022	0.0	1.1	1.1	4.5	3.3	7.8	6.8
2 2023	0.0	1.1	1.1	6.2	3.3	9.5	8.4
3 2024	0.0	1.1	1.1	8.3	3.2	11.5	10.4
4 2025	0	1.1	1.1	10.8	3.0	13.7	12.7
5 2026	0	1.1	1.1	12.5	3.7	16.2	15.1
6 2027	0	1.1	1.1	14.6	4.5	19.1	18.0
7 2028	0	1.1	1.1	17.0	5.4	22.4	21.4
8 2029	0	1.1	1.1	19.8	6.5	26.4	25.3
9 2030	0	1.1	1.1	23.1	7.9	30.9	29.9
10 2031	0	1.1	1.1	28.4	11.2	39.7	38.6
11 2032	0	1.1	1.1	34.7	15.4	50.0	49.0
12 2033	0	1.1	1.1	42.1	20.3	62.4	61.3
13 2034	0	1.1	1.1	50.8	26.2	77.0	75.9
14 2035	0	1.1	1.1	60.9	33.3	94.3	93.2
15 2036	0	1.1	1.1	60.9	33.3	94.3	93.2
16 2037	0	1.1	1.1	60.9	33.3	94.3	93.2
17 2038	0	1.1	1.1	60.9	33.3	94.3	93.2
18 2039	0	1.1	1.1	60.9	33.3	94.3	93.2
19 2040	0	1.1	1.1	60.9	33.3	94.3	93.2
20 2041	0	1.1	1.1	60.9	33.3	94.3	93.2
21 2042	0	1.1	1.1	60.9	33.3	94.3	93.2
22 2043	0	1.1	1.1	60.9	33.3	94.3	93.2
23 2044	0	1.1	1.1	60.9	33.3	94.3	93.2
24 2045	0	1.1	1.1	60.9	33.3	94.3	93.2
25 2046	0	1.1	1.1	60.9	33.3	94.3	93.2
26 2047	0	1.1	1.1	60.9	33.3	94.3	93.2
27 2048	0	1.1	1.1	60.9	33.3	94.3	93.2
28 2049	0	1.1	1.1	60.9	33.3	94.3	93.2
29 2050	0	1.1	1.1	60.9	33.3	94.3	93.2
30 2051	0	1.1	1.1	60.9	33.3	94.3	93.2
Total	264	32	296	1,309	681	1,989	1,693
PV@12%	214	5	219	128	61	189	-30

Source: JICA Study Team

(3) Sensitivity Analysis

The sensitivity analysis was made by changing the estimated project cost and the revenue upward and downward. The elasticity of EIRRs against the project cost is the range of 0.9 and 1.2 and that against the revenue is the range of 0.8 and 1.1.

Table 7.15 and Table 7.16 show the results of sensitivity analysis in two cases. In case of Do Nothing + Bago Bridge, EIRR still keeps 20% even in the worst case that the cost increases by 20% and the benefit decreases by 20%.

Table 7.15 Sensitivity Analysis in Do Nothing + Bago Bridge Case

		Project Cost			
		10% down	Base (0%)	10% up	20% up
Benefit	10% up	27.2%	26.0%	24.9%	23.9%
	Base (0%)	26.1%	24.9%	23.8%	22.9%
	10% down	24.9%	23.7%	22.7%	21.8%
	20% down	23.6%	22.5%	21.5%	20.6%

Source: JICA Study Team

As for YUTRA MP Case, the results show that only when the cost decreases by 10% and the benefit increases by 10%, EIRR is over 12% which indicates that the project is economically feasible. Other than the best case, EIRR is below 12% and the project is not considered economically feasible.

Table 7.16 Sensitivity Analysis in YUTRA MP Case

		Project Cost			
		10% down	Base (0%)	10% up	20% up
Benefit	10% up	12.4%	11.6%	11.0%	10.4%
	Base (0%)	11.7%	11.0%	10.3%	9.7%
	10% down	11.0%	10.3%	9.6%	9.1%
	20% down	10.2%	9.5%	8.9%	8.3%

Source: JICA Study Team

7.4 FINANCIAL EVALUATION

7.4.1 Methodology and Assumption

This section conducts a discounted cash flow analysis to evaluate the project's financial viability. The Bago River Bridge is assumed to be a toll bridge and the toll is a major source of revenue. The analysis is conducted for two cases: (1) Do Nothing + Bago Bridge case as a base case and (2) YUTRA Master Plan case (YUTRA MP case) as an alternative case in the same way as economic analysis above based on the following basic assumptions and standardization.

1) Period of Analysis

Period of analysis is thirty years after starting operation that includes the period of construction from 2017 to 2021 and the operation period from 2022 to 2051.

2) Project Life

Thirty years after starting operation. Residual value is assumed to be zero.

3) Loan Conditions

Interest Rate: 0.1%

Repayment Period: 40 years including Grace Period

Grace Period: 10 years

Repayment method: capital equal system repayment

4) Traffic Assignment

Traffic assignment of two cases was conducted for the year of 2020, 2025, 2030 and 2035. The economic benefits were estimated for the four years and an interpolation was done for intermediate years. The economic benefits have been calculated from the results of traffic assignment. After 2035, the traffic volume was assumed to keep the same amount.

5) Toll

On the assumption that toll is collected from car, taxi, van, passenger truck and small bus, and truck, toll by mode of transport was set based on the current toll rate of Dagon Bridge. Assumed toll in 2016 is summarized below. The toll increase rate is assumed to be 6% until 2025 and 5% from 2026 to 2045 based on estimated GDP growth rate.

Transport mode	Car, Taxi	Van	Pass Truck & Small Bus	Small truck	Truck (2 axels)	Truck (3 axels)	truck (4 axels)
Toll (USD)	0.2	0.2	0.7	0.3	0.4	1.1	1.5

Source: JICA Study Team

6) Indicators for Financial Evaluation

The following three indicators were calculated for financial evaluation of this Project;

+ B/C (Cost Benefit Ratio)

+ Net Present Value (NPV)

+ FIRR (Financial Internal Rate of Return)

7) Social Discount Rate:

12% per annum was assumed as the social discount rate.

8) Exchange Rate

The following exchange rates on April 2016 were applied.

US \$ 1.00 = MKK 1,281

US \$ 1.00 = JPY 109.9

MMK1.00 = JPY 0.0902

7.4.2 Project Cost

(4) Investment Cost and Schedule

Total investment cost is USD 323 million as described in Table 7.17.

The investment schedule is shown in the following table.

Table 7.17: Investment Schedule

Unit: mill. US\$						
	2017	2018	2019	2020	2021	Total
Investment Cost	6	124	92	86	15	323

Source: JICA Study Team

(5) Operation and Maintenance Cost

Annual O&M cost is estimated at 0.5% of construction cost (USD 215 mill) including detail design and construction. Thus annual O&M cost is about USD 1.1 million.

7.4.3 Revenue

For this project, only toll revenue is considered as revenue. The total toll revenue is estimated by multiplying the forecasted traffic volume by the toll amount taking into account different toll rates by vehicle type set in the abovementioned assumption.

(1) Traffic Demand

The estimated traffic demand by vehicle type in benchmark years is summarized in Table 7.18 and Table 7.19.

Table 7.18: Traffic Demand in Do Nothing + Bago Bridge Case in Benchmark Years

Unit: trip/day							
Year	Car & Taxi	Van	Pass Truck & Small Bus	Small Truck	Truck (2 axles)	Truck (3 axles)	Truck (4- axles) & Trailer
2020	16,945	3,285	2,817	842	191	257	57
2025	34,328	7,206	7,851	1,785	989	792	255
2030	37,780	7,920	8,130	2,230	1,232	987	318
2035	45,039	9,457	9,956	2,518	1,389	1,114	359

Source: JICA Study Team

Table 7.19: Traffic Demand in YUTRA MP Case in Benchmark Years

Unit: trip/day								
Year	Car & Taxi	Van	Pass Truck & Small Bus	Small Truck	Truck (2 axles)	Truck (3 axles)	Truck (4- axles) & Trailer	
2020	15,014	3,141	6,990	827	451	364	117	
2025	20,046	4,197	6,800	1,026	559	451	145	
2030	25,149	5,282	2,447	1,266	690	557	179	
2035	30,247	6,360	2,715	1,504	820	661	212	

Source: JICA Study Team

(2) Toll Revenue

Toll revenue in benchmark years calculated based on the unit price of toll and the forecast traffic demand is shown in Table 7.20.

Table 7.20: Toll Revenue in Do Nothing + Bago Bridge Case and YUTRA MP Case

Unit: Million USD		
Year	Do Nothing + Bago Bridge Case	YUTRA MP Case
2022 (opening)	3.8	4.7
2025	7.7	6.0
2030	11.0	6.5
2035	16.6	9.9

Source: JICA Study Team

7.4.4 Evaluation Result

(1) Discounted Cash flow Analysis

The results of discounted cash flow analysis are summarized in Table 7.21 and Table 7.22. FIRR is 2.0% in Do Nothing + Bago Bridge case and -0.5% in YUTRA MP case which are much lower than the maximum lending interest rate set by the Central Bank of Myanmar (13% as of April 2016). The results show that the project in both cases is not financially feasible.

Table 7.21: Summary of Financial Analysis in Do Nothing + Bago Bridge Case

Indicator	Value
FIRR	2.0%
B/C (at discounted rate of 12%)	0.21
NPV (Million US\$ at discounted rate of 12%)	-211

Source: JICA Study Team

Table 7.22: Summary of Financial Analysis in YUTRA MP Case

Indicator	Value
FIRR	-0.5%
B/C (at discounted rate of 12%)	0.14
NPV (Million US\$ at discounted rate of 12%)	-229

Source: JICA Study Team

(2) Comparison of O&M cost and Revenue

Even if FIRR is not high enough to make the project financially feasible, the estimated toll revenue is sufficient to cover annual O&M cost in both cases. Table 7.23 show that the estimated revenue is much larger than O&M cost since opening year.

Table 7.23: Comparison of O&M Costs and Revenues in Do Nothing + Bago Bridge Case and YUTRA MP Case

Unit: Million USD

Year	O&M cost	Revenue	
		Do Nothing + Bago Bridge Case	YUTRA MP Case
2022	1.1	3.8	4.7
2023	1.1	4.8	5.1
2024	1.1	6.1	5.5
2025	1.1	7.7	6.0
2026	1.1	8.3	6.0
2027	1.1	8.9	6.0
2028	1.1	9.5	6.1
2029	1.1	10.2	6.3
2030	1.1	11.0	6.5
2031	1.1	11.9	7.1
2032	1.1	12.9	7.7
2033	1.1	14.1	8.4
2034	1.1	15.3	9.1
2035	1.1	16.6	9.9
2036	1.1	17.4	10.4
2037	1.1	18.3	10.9
2038	1.1	19.2	11.4
2039	1.1	20.2	12.0
2040	1.1	21.2	12.6
2041	1.1	22.2	13.2
2042	1.1	23.4	13.9
2043	1.1	24.5	14.6
2044	1.1	25.8	15.3
2045	1.1	27.0	16.1
2046	1.1	27.0	16.1
2047	1.1	27.0	16.1
2048	1.1	27.0	16.1
2049	1.1	27.0	16.1
2050	1.1	27.0	16.1
2051	1.1	27.0	16.1

Source: JICA Study Team

(3) Sensitivity Analysis

Sensitivity analysis is conducted by changing the project cost and the revenue upward and downward between -10% and +10%

Summary of sensitivity analysis of two cases is shown in Table 7.24 and Table 7.25. Even if the benefit increases by 10% and project cost decreases by 10%, FIRR is still too low to make the project financially feasible.

Table 7.24: Sensitivity Analysis in Do Nothing + Bago Bridge Case

		Project Cost		
		10% down	Base (0%)	10% up
Benefit	10% up	3.1%	2.5%	2.0%
	Base (0%)	2.5%	2.0%	1.5%
	10% down	2.0%	1.4%	0.9%

Source: JICA Study Team

Table 7.25: Sensitivity Analysis in YUTRA MP Case

		Project Cost		
		10% down	Base (0%)	10% up
Benefit	10% up	0.5%	0.0%	-0.5%
	Base (0%)	0.0%	-0.5%	-1.0%
	10% down	-0.5%	-1.1%	-1.6%

Source: JICA Study Team

7.5 ESTABLISHMENT OF OPERATION AND EFFECT INDICATORS

In order to evaluate how the study contributes to the various expected benefits in its ex-ante and ex-post stages, operation and effect indicators are set. Operation indicators quantitatively measure the operational status of a project, while effect indicators measure qualitatively the effects generated by the study. In case of the road project, operation indicators include increase in traffic volume (vehicles/day), etc. and effect indicators are time cost saving, traffic smoothness, and so on.

In the case of Bago River Bridge, the following operation and effect indicators are set, taking into account the collection of baseline and post-project implementation data. The indicators and target figures are summarized in Table 7.26.

Table 7.26 Operation and Effect Indicators

Indicator		Direction	Baseline (2016)	Target (2023)
			Thanlyin Bridge	Bago River Bridge
Operation Indicators	Traffic Volume of All Vehicles (PCU/day/1way)	South Bound	18,207	30,594
		North Bound	18,582	30,603
	Traffic Volume of Tracks (PCU/day/1way)	South Bound	2,208	2,528
		North Bound	2,999	3,689
Effect Indicators	Travel Speed* (km/h)	South Bound	4.7	18.8
		North Bound	4.7	18.8
	Traffic Congestion** (V/C)	South Bound	1.3	1.0
		North Bound	1.3	1.0

Note*): Travel Speed: Speed of vehicle on the bridge at peak hour (the bridge length divided by the travel time on the bridge)

Note **): Traffic Congestion: Traffic volume at peak hour divided by traffic capacity on the bridge

Source: JICA Study Team

CHAPTER 8. OPERATION AND MAINTENANCE

8.1 INTRODUCTION

MOC has an intention to collect tolls for vehicles using the bridge. The purpose is for covering the maintenance cost as the one for Dagon Bridge.

In this chapter, recommended toll collection plan and maintenance plan with preliminary cost estimate are discussed.

8.2 TOLL COLLECTION PLAN

Recommended toll collection system for Bago River Project is as follows:

1) Toll Type

Flat Toll ——— Uniform tolls by vehicle class per entry, regardless of the traveled distance on the toll road.

2) Toll Collection Method

Entry/exit Collection ——— Considering tolls are located in collected at the toll gate entrance/exit, at on/off-ramps.

3) Extent of Toll Charging

Closed Toll System ——— Tolls are charged to all users. The toll road is physically designed so that no users may escape from paying the toll.

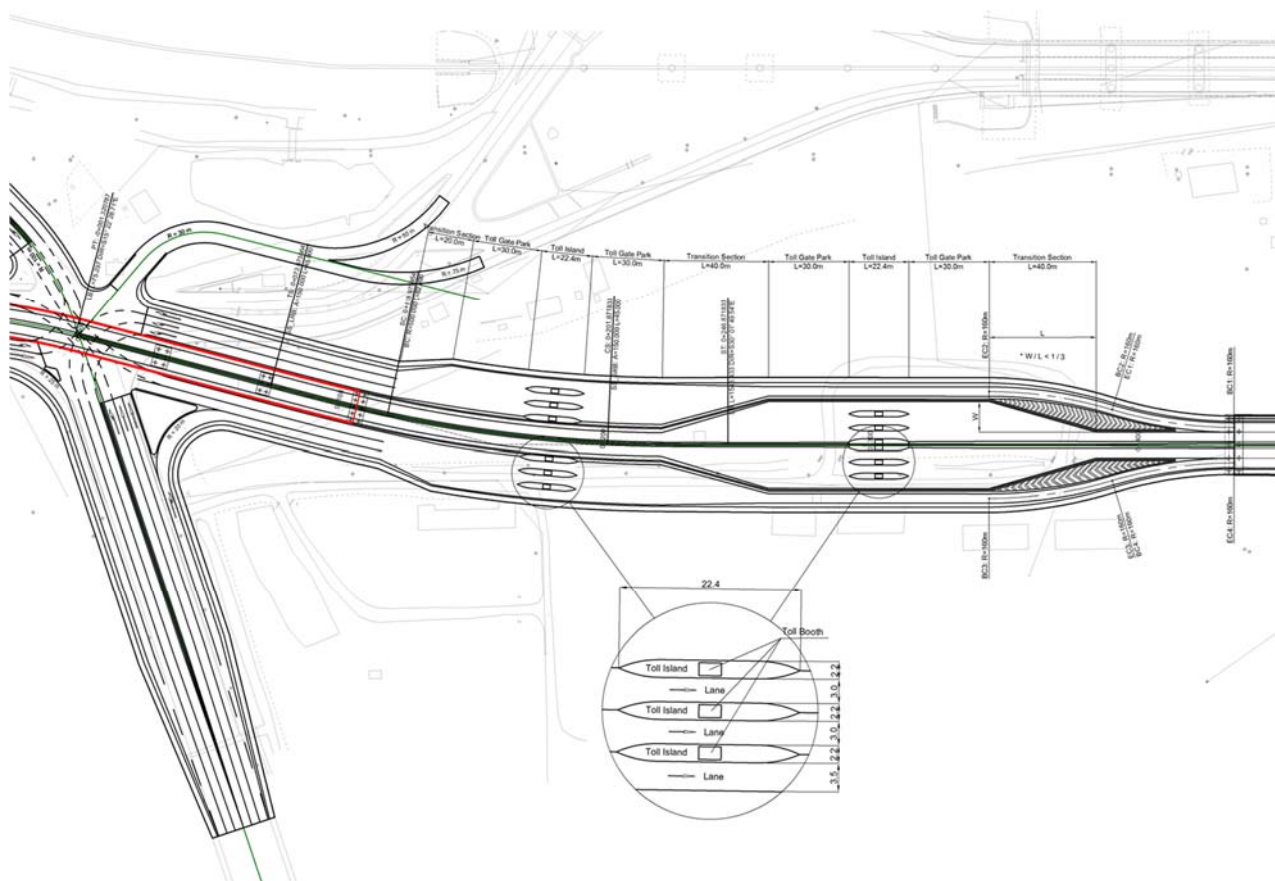
4) Toll Gate Allocation

- a. As shown in the following photo, the toll gate installed at the end of Thanlyin Bridge is inducing serious traffic jam.



Figure 8-1 Photo of Toll Gate at the end of Thanlyin Bridge

- b. For avoiding congestion at toll gate, three (3) toll booths per lane of a carriageway will be required based on the future traffic demand and referring to Technical Specifications of Nippon Expressway Company (NEXCO, see Appendix J for calculation of necessary number of toll booths).
- c. As shown in Figure 8-2, twelve (12) toll gates consisting of on/off-ramp toll gates both for flyover traffic and at-grade traffic are planned at the bridge end on the right bank (Thaketa Side).



Source: Study Team

Figure 8-2 Lane Allocation and Location of Toll Gate

5) Tolerated Vehicle Classification and Toll Rates

The toll rates for each toll-vehicle class will be determined, primarily based on the domestic regulations and also on the business policy of the O&M concessionaire which will be selected by MOC if the O&M is implemented on a concession basis. The toll fees similar to Dagon Bridge, which is shown in Table 8-1 below, are assumed.

Table 8-1 Toll Fees of Dagon Bridge

No.	Type of Car	Unit fees(Ks)
1	Tri Motorcycle	66
2	Tractor with trailer and Salon	66
3	Sedan, Fam Truck and Double Cub, Pajero, Parado, Super Custom	199
4	Hi-Lux, small light truck	265
5	Dynar, Middle light truck	265
6	Fam Truck 4 balls hit	398

7	Truck 4 wheels, Mini Bus (24 personnel) Light Truck	398
8	6 wheels Bus	994
9	Passenger Vehicles (26 to 35 person)	398
10	Passenger Vehicles (over 46 person)	1325
11	TE11/ TE21/GMC/Fuso/UD (6 wheels track)	1325
12	Hyundai/Daewoo Passenger Vehicles(Big) 36 to 45 person	663
13	Hyundai/Daewoo Passenger Vehicles(Big) over 45 person	729
14	6 wheels Big Truck	1325
15	8 wheels Big Truck (24 personnel)	1524
16	10 wheels Big Truck (24 personnel)	1656
17	12 wheels Big Truck (24 personnel)	1988
18	14 wheels Big Truck (24 personnel)	2319
19	14 wheels Big Truck (24 personnel) back trailer include	2650
20	18 wheels Big Truck (24 personnel) back trailer include	3875
21	22 wheels Big Truck (24 personnel) back trailer include	4638
22	Truck without Load	1325

Source: Max Highway Col, Ltd

6) Preliminary Cost Estimate for Toll Gate Installation

For installation of the toll gate, the toll collection facilities and toll rates for each tolled vehicle class will be determined, primarily based on the domestic regulations and also on the business policy of the O&M concessionaire which will be selected by MOC if the O&M is implemented on a concession basis. The toll gate installation costs shown in Table 8-2 below, are assumed.

Table 8-2 Preliminary Const Estimate for Toll Gate Installation

Cost of Toll Collection Facilities

Item	Unit	Unit Cost (USD)	quantity	Cost (USD)
Toll Gate	nos	20,000	4	80,000
Standard Booth	nos	13,000	4	52,000
Long Booth	nos	25,000	4	100,000
Control Panel Distribution	nos	7,000	4	28,000
Control Panel Room	nos	10,000	4	40,000
Generator Set with Mobile Trailer (50KVA)	nos	22,000	1	22,000
Generator Set House	nos	1,000	1	1,000
LCB/Boom Gate	nos	3,000	4	12,000
Grounding	nos	1,400	4	5,600
Lightning Protection	nos	700	4	2,800
Sub total				343,400

Cost of Additional Earthwork

Item	Unit	Unit Cost (USD)	quantity	Cost (USD)
Pavement	m ²	65	5,283	343,395
Embankment	m ³	11	13,803	151,833
Sub total				495,228
Total				838,628

Source: Study Team

8.3 PROPOSED O&M STRUCTURE

Appropriate O&M services for Bago River Bridge can be provided by experienced O&M companies as mentioned above through bidding procurement. Also, considering the requirements mentioned in item 2) toll road maintenance, the O&M company shall provide: 1) traffic control center (TCC), 2) emergency response (ER) team, and 3) general office at least. For reference, Figure 8-3 shows a proposed O&M structure based on a typical structure in Japan for an expressway operator.

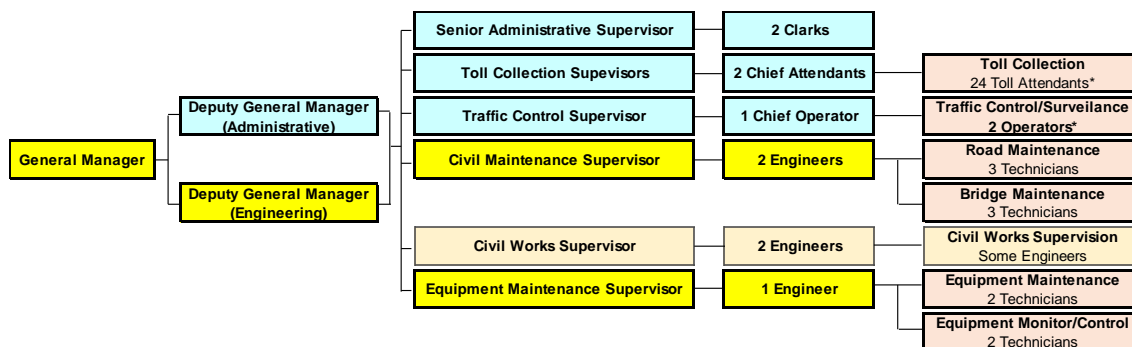


Figure 8-3 Proposed Organization for Operation and Maintenance

8.4 PRELIMINARY ESTIMATE OF O&M COST

8.4.1 Maintenance Cost

(1) Routine maintenance cost

Table 8-3 shows the result of calculated routine maintenance cost of Bago Bridge referring to the above-mentioned data. Consequently, 298,407 USD are needed annually.

Table 8-3 Routine Maintenance Annual Cost

Items	Unit Cost (USD/km)	Length (km)	Cost (USD)	Remarks
Bridge, Flyover, On-ramp and Approach Roads	57,375	5.2	298,407	Referring to routine maintenance cost in Tanjung Priok Access Road (toll road in Jakarta) is adopted
Total		5.2	298,407	

Source: Study Team

(2) Periodic maintenance cost

In periodic maintenance, costs of asphalt pavement overlay, waterproof replacement on bridge slab and expansion joints replacement for bridges are calculated as expected actual works. As for the construction frequency, the pavement overlay is assumed every 10 years. Repainting and replacement of expansion joint, bearing are assumed every 20 years. Periodic maintenance cost calculated based on the above is shown in Table 8-4.

Table 8-4 Periodic Maintenance Cost for 10 Years

Type of Works	Year (after open to the traffic) (USD)				Remarks
	- 10	11 - 20	21 - 30	31 - 40	
Repainting (Steel Bridge)		767,782		767,782	estimated based on Presentation materials of Japan Bridge Association
Expansion Joint replacement		1,250,527		1,250,527	
Bearing replacement		1,250,527		1,250,527	
Pavement replacement	2,616,809	2,616,809	2,616,809	2,616,809	
Total	2,616,809	9,012,026	2,616,809	9,012,026	

Source: Study Team

(3) Total maintenance cost

Future maintenance costs for 40 years after opening to the traffic is calculated based on the above-mentioned result as shown in Table 8-5.

The average annual maintenance cost is estimated as USD 879,849 per year (approx..0.4% of Construction Cost)

Table 8-5 Estimate of Future Maintenance Cost

Kind of Works	Year (Unit: USD)										Total
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
Routine Maintenance	298,407	298,407	298,407	298,407	298,407	298,407	298,407	298,407	298,407	298,407	2,984,074
Periodic Maintenance										2,616,809	2,616,809
Sub-Total	298,407	298,407	298,407	298,407	298,407	298,407	298,407	298,407	298,407	2,915,216	5,600,883

	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	Total
Routine Maintenance	298,407	298,407	298,407	298,407	298,407	298,407	298,407	298,407	298,407	298,407	2,984,074
Periodic Maintenance										9,012,026	9,012,026
Sub-Total	298,407	298,407	298,407	298,407	298,407	298,407	298,407	298,407	298,407	9,310,434	11,996,100

	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	Total
Routine Maintenance	298,407	298,407	298,407	298,407	298,407	298,407	298,407	298,407	298,407	298,407	2,984,074
Periodic Maintenance										2,616,809	2,616,809
Total	298,407	298,407	298,407	298,407	298,407	298,407	298,407	298,407	298,407	2,915,216	5,600,883

	2051	2052	2053	2054	2055	2056	2057	2058	2059	20560	Total
Routine Maintenance	298,407	298,407	298,407	298,407	298,407	298,407	298,407	298,407	298,407	298,407	2,984,074
Periodic Maintenance										9,012,026	9,012,026
Total	298,407	298,407	298,407	298,407	298,407	298,407	298,407	298,407	298,407	9,310,434	11,996,100
Grand Total											35,193,966
Average Annual Cost											879,879

Source: Study Team

8.4.2 Operation Cost

Annual operation cost was estimated preliminarily considering following items:

(a) remuneration of staff for toll collection and traffic control, (b) toll booth operation, (c) toll booth repair, (d) toll booth rehabilitation assuming replacement of every 20 years.

Table 8-6 shows preliminary estimate of annual operation cost.

8.4.3 Total operation and maintenance cost

By adding the estimated operation cost USD 92,490 per year to the estimated maintenance cost USD 879,849, the average annual operation and maintenance cost is estimated as USD 972,339 per year (approx..0.45% of Construction Cost).

Table 8-6 Preliminary Estimate of Annual Operation Cost

(a) Staff Remuneration

	Position	Nos	Months	Unit Salary (USD/month)	Amount (USD/year)
1	Deputy General Manager	1	12	400	4,800
2	Senior Administrative Superviso	1	12	200	2,400
3	Toll Collection Supervisors	1	12	200	2,400
4	Traffic Control Supervisor	1	12	200	2,400
5	Clarks	2	12	150	3,600
6	Chief Attendants	2	12	150	3,600
7	Chief Operator	1	12	150	1,800
8	Toll Collection Attendants	24	12	100	28,800
9	Traffic Control Operator	2	12	100	2,400
Total					52,200

(b) Toll Booth Operation

	Item	Nos	Months	Unit Price (USD/month)	Amount (USD/year)
1	Utilities (Electricity, etc)	12	12	10	1,440
2	Fuel	1	12	100	1,200
3	Vehicle Maintenance	1	12	200	2,400
4	Facility Maintenance	1	12	200	2,400
Total					7,440

(c) Toll Booth Repair

	Item	Nos	Month	Unit Price (USD/month)	Amount (USD/year)
1	Toll Gate	4	12	80	3,840
2	Standard Booth	4	12	50	2,400
3	Long Booth	4	12	100	4,800
4	Control Panel Distribution	4	12	30	1,440
5	Control Panel Room	4	12	40	1,920
6	Generator Set	1	12	90	1,080
7	Generetor Set House	1	12	0	0
8	LCB/Boom Gate	4	12	10	480
Total					15,960

(d) Toll Booth Replacement (Every 20 years)

	Item	Nos		Unit Price (USD/month)	Amount (USD/year)
1	Toll Booth	4		20,000	80,000
2	Standard Booth	4		13,000	52,000
3	Long Booth	4		25,000	100,000
4	Control Panel Distribution	4		7,000	28,000
5	Control Panel Room	4		10,000	40,000
6	Generator Set	1		22,000	22,000
7	Generetor Set House	1		1,000	1,000
8	LCB/Boom Gate	4		3,000	12,000
9	Lightening Protection	4		700	2,800
Total					337,800
Total (per year)					16,890
Ground Total (per year)					92,490

CHAPTER 9. TECHNOLOGY TRANSFER

9.1 OBJECTIVES

The major objective of the program for technology transfer is to improve the bridge engineering of MOC through technical guidance about detailed design and implementation of this Project. The target is improvement of required engineering categories as follows for MOC engineers to develop bridge construction planning properly.

- Natural condition survey: geotechnical, river
- Planning: bridge planning, length/ span arrangement, bridge type selection by alternative comparison
- Design: substructure, superstructure and foundation
- Supervision: safety, quality and schedule control
- Construction: foundation (SPSP foundation), substructure (abutment and pier), superstructure (cable stayed steel bridge and Pre-cast PC box girder bridge)

9.2 EXPECTED ACHIEVEMENT

Through the technical guidance to MOC engineers who are assigned on the project site, the following outcomes are expected:

- MOC engineers understand a series of the Services for detailed design of the bridges including the technical issues and solutions.
- MOC engineers understand the contents of the Services for construction supervision of the bridges.
- MOC engineers understand the Works for the construction of the bridges.

9.3 COMPREHENSIVE TECHNOLOGY TRANSFER IN BRIDGE CONSTRUCTION PROJECT FINANCED BY JICA

Comprehensive technology transfer program is planned by utilizing examples of other Bridge Construction Projects financed by JICA and followed by the capacity building project.

Table 9-1 Technology Transfer in Bridge Construction Projects financed by JICA

Project / Program	Project Period	Services / Tasks	New Bridge Technology Method	Focusing on
New Thaketa Bridge	June 2015 – Feb 2018	Supervision / Construction	Extradosed Bridge SPSP Foundation	Design Supervision Construction (By Lectures)
East-West Economic Corridor Improvement Project.	May 2016 – March 2022	Design / Supervision / Construction	Steel Plate Girder Bridge Steel Cable Stayed Bridge Extradosed Bridge SPSP Foundation	Design Supervision

Project / Program	Project Period	Services / Tasks	New Bridge Technology Method	Focusing on
Bago Bridge	Oct 2016 – Mar 2021	Design / Supervision / Construction	Steel Box Girder Bridge Steel Cable Stayed Bridge Precast PC Box Bridge SPSP Foundation	Design Review by Trainee Supervision by OJT
Road Bridge Technology Capacity Building Project	May 2016- May 2019	Capacity Development	Various Technologies	Supervision in Pilot Projects

9.4 TECHNOLOGY TRANSFER IN BAGO BRIDGE CONSTRUCTION PROJECT

(1) Time Schedule of Technology Transfer

Since the project is in the stage before Detailed Design, it is proper timing to plan for technology transfer on bridge design. However, considering the period of the detailed design is on the critical path for timely completion of the project before March 2021, major design procedures may be performed outside of Myanmar, which is not the desirable environment for technology transfer, and thus it is recommended to plan design training after finishing major design works. It is practical to have design training by reviewing the results of detailed design.

On the other hand, it is recommended to have training of construction supervision during construction period when the construction works are controlled by a CS consultant.

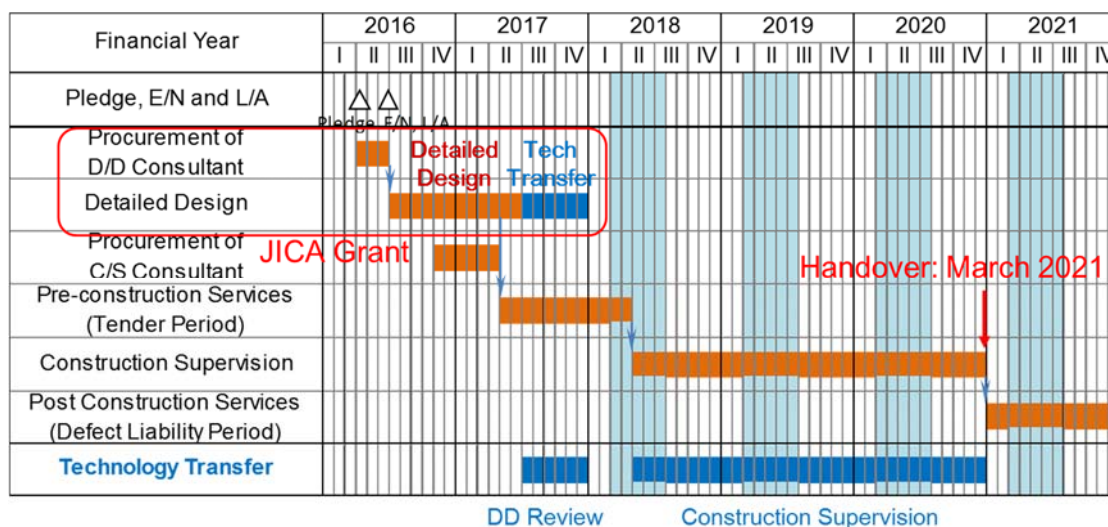


Figure 9-1 Time Schedule of Technology Transfer in connection with Implementation Program

(2) Design

The technology transfers during DD review will focus on structural analysis, in which 3D/2D analytical model will be built to describe approaching actual behavior of the bridges. Trainees will prepare all design conditions, perform data input and computation by using analysis software and compare the results with DD. Examples of Analysis Software which can be procured in the market are as shown in Table 9-2.

Table 9-2 Example of Analytical Software for Design Review

Review Item	Example of Analysis Software	Focusing on
SPSP Foundation	UC-1 Foundation Design (Forum 8)	Stress & strain of members
Steel Cable Bridge	RM-Bridge (Bentley)	Cable Stress, Erection Step
Steel Box Girder	Midas CIVIL (MIDAS)	Stress concentration at connection panel

(3) Construction Supervision

For securing effective training of construction supervision, it is proposed to designate trainees to join with international specialists. Table 9-3 introduces example of coupled international specialists on corresponding major supervision items, together with example of reference and tools and the areas of focus.

Table 9-3 Major Items of Supervision and Proposed Pairing

Item in Supervision	Example of Reference and Tools	Focusing on	Pairing with
Time Control	PROGRAMME PRIMAVERA P6 (ORACLE)	Critical Path	Resident Engineer
Quality Control	Quality Assurance Plan Method Statements	Document Review Inspections	Sr Bridge Engineer ARE
Safety Control	Safety Manual, Safety Plan	Safety Patrol	Safety Engineer
Claim Management	FIDIC MDB Particular Conditions of Contract	Contract Interpretation and Application	Contract Specialist

CHAPTER 10. CONCLUSIONS AND RECOMMENDATIONS

10.1 CONCLUSIONS

This section reviews the project summary in the light of this Supplemental Study and items/issues are included. Updates have been made in accordance with the results of discussions between JICA and MOC held on 25 March and 27 May 2016.

(1) Summary of Facilities of Road and Bridge

As a result of this supplemental survey on the facilities of the road and the bridge including improvement of the adjacent intersections and connecting roads are summarized as follows:

a) Right bank of Bago River

Jurisdiction	Thaketa Township (YCDC)
Road linked to the Project	Shukhinthar-Mayopat Road and Thanlyin Chin Kat Road
Length of approach road	436 m (overlapping with Flyover Section: 353m)
Length of Flyover Section	1099 m
	North Approach Section 248m (retaining wall section 248m)
	Structural Section: 547 m
	South Approach Section: 304 m (retaining wall section: 230m)

b) Bridge - Total length 1,928 m

Superstructure:	Main Bridge: 1,224 m,
	- Steel Continuous Box Girder Bridge with Steel Deck Plate: 776m
	- Steel Cable-stayed Bridge: 448m
	Approach Bridges: 704 m
	- PC Precast Box Girder Bridge :300m,
	- PC Precast Box Girder Bridge: 404m
Substructure:	Piers and Abutment: Reinforced Concrete
Foundation:	In the river: Steel Pipe Sheet Pile Foundation
	On land: Cast-in-situ Concrete Pile

c) Left bank of Bago River

Jurisdiction	Thanlyin Township (YRDC)
Road linked to the Project	Kyaik Khauk Pagoda Road
Length of approach road	463 m (retaining wall section 221m)
Length of On-ramp	579 m
	Approach Section: 391 m (retaining wall section: 89m)
	Flyover Section: 188m

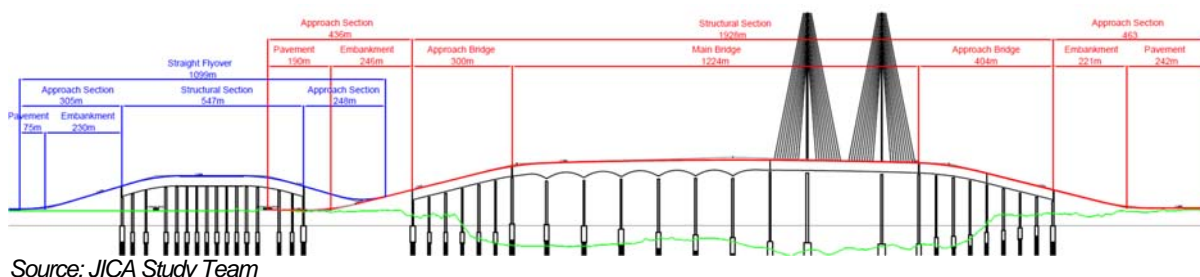


Figure 10-1 Profile of the Project

(2) Cost Estimate for the Project

On the basis of the proposed scope of works, the Project cost was updated considering the unit prices provided by MOC on 22 March 2016, with due examination of the design and constructability. Especially, for the selection of construction method that would reduce construction period, the Study Team paid special attention to the cost estimates. For standard construction methods in Myanmar, the unit rate was updated in accordance with the revised scope of works. The updated construction cost was divided into Foreign Currency (F/C) portion and Local Currency (L/C) portion. The updated project cost was divided into JICA Eligible Portion and Portion covered by Government of Myanmar.

Updated construction cost is tentatively calculated as USD 224.504 million. Updated overall project cost is tentatively calculated as USD 323.205 million of which USD 282.540 million is JICA Eligible Portion and USD 40.666 million is the portion covered by Government of Myanmar.

(3) Project Implementation Program

On the premise that the Project will be pledged by the Japanese Government in July 2016, and the Project will be funded under JUMP scheme, procurement of the detailed design consultant should start immediately after the Japanese Government’s Pledge of the Project.

The updated project implementation program in accordance with the agreement between MOC and JICA in the Follow-up Mission dated 25 March 2016 is as follows:

Financial Year	2016				2017				2018				2019				2020				2021				Total Month
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	
Pledge, E/N and L/A		△	△																						
Procurement of D/D Consultant		■	■																						3
Detailed Design			■	■	■	■	■	■																	12
Procurement of C/S Consultant				■	■	■	■	■																	6
Pre-construction Services (Tender Period)						■	■	■	■	■	■	■													12
Construction Supervision											■	■	■	■	■	■	■	■	■	■					32
Post Construction Services (Defect Liability Period)																					■	■	■	■	12
Land Acquisition/Resettlement					■	■	■	■	■	■	■	■													17

Note: Financial year I:April to June, II:July to September, III:October to December, IV:January to March

Source: JICA Study Team

Figure 10-2 Proposed Implementation Program

The construction works will either be divided into three packages, which will be implemented over 32 months at the most, and completed in March 2021.

(4) Social Consideration Issues

The A-RAP report was also updated considering the additional scope of works, in particular, Flyover Section in Thaketa Township, where PAHs of 33 are counted that they need resettlement and relocation and PAPs of 58 are noted that they need some kinds of assistance or compensation but relocation is not

necessary for them in this supplemental survey. The number of PAPs in total for the whole project is 190 ((33 PAHs× 4)+ 58 PAPs by assuming that there are four members in each household).

There is no social impact in Thanlyin Township where on-ramp is proposed to construct to connect to Bago River Bridge from residential area.

In order to facilitate land acquisition and mitigate impacts caused by the Project to the local communities, the following tasks are recommended to be carried out during the detailed stage.

- 1) Establish a compensation committee including MOC, MR, YCDC, DUHD in MOC, Township administrator of GAD and related ward administrators of GAD.
- 2) Conduct DMS and an inventory survey in the pre-construction phase by a compensation committee to clarify exact land acquisition area, who owns those land and what are PAFs.
- 3) Conduct socio-economic survey in the pre-construction phase by a compensation committee to grasp the socio-economic features of PAPs for policy-making and for preparing baseline data for A-RAP monitoring.
- 4) Update policies on compensation, resettlement, and entitlement for PAPs based on the latest guidelines/regulations, the results of the socio-economic survey and the decision of a compensation committee.
- 5) Prepare concrete plans to relocate affected houses, utilities, etc. and to construct resettlement sites for PAPs.
- 6) Prepare an income/livelihood restoration plan for PAPs.
- 7) Identify institutional organization for A-RAP implementation.
- 8) Work out a schedule for resettlement-related activities.
- 9) Prepare a plan for information dissemination and public consultation (including the preparation of a leaflet to introduce the Project)
- 10) Revise A-RAP monitoring plan to guide activities related to A-RAP monitoring and supervision.
- 11) Revise cost estimation for land acquisition, compensation, resettlement, livelihood restoration, social monitoring and supervision.
- 12) Prepare an HIV/AIDS prevention plan during the early stages of detailed design.
- 13) Entrust a consultant or NGO with the implementation of the HIV/AIDS prevention plan during pre-construction phase and construction phase.

(5) Environmental Consideration Issues

IEE report was also updated considering the additional scope of works, in particular, Flyover Section in Thaketa Township and On-ramp Section in Thanlyin Township.

In order to mitigate impacts on the natural environment of the localities, it is suggested to implement the following tasks during the detailed design stage:

- 1) Conduct environmental survey on air quality, noise, surface water quality, and ecosystems in and around the project area to collect baseline data during pre-construction phase.

- 2) Work together with members of the technical design teams to examine and work out concrete measures for mitigating impacts to ambient air, acoustic environment, surface water bodies, ecosystems, etc... during Detailed Design.
- 3) Prepare detailed Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMoP) during pre-construction phase.
- 4) An officer of DOB who attended JICA training on Environmental and Social consideration process of Japanese ODA loan will give training to an Environmental and Social staff in PMU of MOC during pre-construction phase if they did not attend this training.
- 5) An Environmental and Social staff in PMU of MOC will conduct environmental supervision and monitoring to reduce environmental pollution during construction phase.

(6) Update of Project Evaluation

The project evaluation was updated considering the updated project cost mentioned above is as follows:

Do Nothing + Bago Bridge case

EIRR: 24.9%, B/C: 4.12, NPV: 683 million USD

FIRR: 2.0%, B/C: 0.21, NPV: -211 million USD

YUTRA Master Plan case (YUTRA MP Plan case)

EIRR: 11.0%, B/C: 0.86, NPV: -30 million USD

FIRR: -0.5%, B/C: 0.14, NPV: --229 million USD

10.2 RECOMMENDATIONS

The recommendations in this study are summarized as follows:

(1) Coordination with YCDC

YCDC has plan for widening of Thanlyin Chin Kat Rd to 6 lanes. Since Straight Flyover is along to the road, the construction plan need to be in accordance with the plans of road widening.

(2) BRT

Since Thanlyin Bridge and Thanlyin Chin Kat Road is planned as a BRT route in YUTRA, the improvement plan of the roads need to be in accordance with BRT plan.

(3) Thaketa Roundabout

The traffic volume at the roundabout will be beyond its capacity and it is recommended to improve the capacity of the roundabout. Since YCDC does not have any plan to improve Thaketa Roundabout, common understanding with Thanlyin Township is important. It would be appreciated, if MOC could decide about the improvement after discussion with YCDC.

(4) Use of Tentative Project Cost

The project cost estimated in this study at USD 267 million (JICA Eligible Portion with JUMP Scheme), is still tentative, and should only be used for JICA's appraisal of the Project due in 2016. A more accurate cost estimate will be provided in the detailed design of the Project.

(5) Technology Transfer

Knowledge on new construction technologies should be transferred to Myanmar through the projects. This Project can contribute to such transfer of knowledge on new technology involved in the following works:

- Steel pipe sheet pile foundation for offshore construction
- Steel cable-stayed bridge
- Steel box girder
- SBS erection method of precast-box girder

SPSP foundation will be widely used in Myanmar because there are potentially many offshore constructions in Myanmar. Steel cable-stayed bridge and box girder will be commonly used for crossing over wide rivers. SBS PC-BOX will be commonly used in the urban infrastructure project in the near future. For instance, elevated roads and railways will be soon required in Yangon.

During this project, transfer of knowledge on new technologies should be initiated through technical seminars, workshops, construction site visits, and overseas training and study tours.

Transfer of technology should be paid to these new and advantageous technologies during both the design and construction stages.

(6) Steady and Progressive Implementation of Environmental and Social Considerations

The environmental and social requirements to realize a Japanese ODA loan for the Project will be clarified when the RAP is approved. For the successful implementation of the Project, the tasks for the environmental and social consideration must be progressively undertaken by DOB during the entire Project period.

(7) Construction Safety

Since the Flyover Portion is located in an urban area, safety measures should be taken.

The main bridge is located offshore and cyclone attacks the region almost every year. Very strong winds and high waves could damage the construction site, facilities and equipment. Special attention should be taken for the protection of the construction site from cyclones and heavy rains.

(8) Operation and Maintenance (O&M)

The road and bridge of the Project is like an "Industrial Road" with busy freight transport between the industrial core in the northern economic focal regions and Thilawa. There will be huge traffic of heavy trucks.

Pavement surface conditions are very much effect to the transport speed, and as a result, it adversely affects the growth of the national economy. O&M quality should be seriously studied, and institutional and organizational preparation should be timely established.

In addition, the road is hit by cyclones and heavy seasonal rains almost every year. Operation of the bridge should closely cooperate with the meteorological center of the region.

(9) Risks of Delay and Countermeasures

Since there are several “Delay Risks”, progress of the works and related activities should be officially monitored and appropriate countermeasure should be taken to avoid or reduce further delay.

Anticipated measures for risks on delay are summarized in Table 10-1.

Table 10-1 Anticipated Measures for Risks of Delay

No.	Kind of Risk on Delay	Potential Risks	Anticipated Measures
1	Design Works	<ul style="list-style-type: none"> • Delay of works. • Delay of approval by the client. • Lack of communications between the client and the consultant. 	<ul style="list-style-type: none"> • Select competent consultant. • Coordinate well with relevant stakeholders.
2	Land Acquisition	<ul style="list-style-type: none"> • Delay of preparation of land acquisition documents. • Delay of land acquisition by local authorities. 	<ul style="list-style-type: none"> • Monitor the progress of the land acquisition issue and review the progress periodically.
3	Procurements	<ul style="list-style-type: none"> • Delay of preparation of tender documents. • Delay of approval of tender documents. • Delay of tender evaluation. • Delay of approval of tender evaluation. • Delay of contract negotiation. • Delay of approval of the contract. 	<ul style="list-style-type: none"> • Timely procure the supervision consultant. • Timely procure the contractors.
4	Construction Works	<ul style="list-style-type: none"> • Unfamiliar with the local culture and custom. • Not mobilizing the proper equipment, key personnel, and materials on site. • Unfamiliar with technical method. • Unfamiliar with FIDIC conditions of contract. • Unforeseeable natural disaster, i.e. typhoon. • Delay of possession of site. • Delay of clarification of the work demarcation • Lack or delay of work coordination with neighboring works. 	<ul style="list-style-type: none"> • Select competent contractor(s). • Monitor and control the construction progress strictly.
5	Environmental Impacts Mitigation Actions	<ul style="list-style-type: none"> • Unfamiliar with environmental issues. • Lack of regular monitoring. 	<ul style="list-style-type: none"> • Prepare good and suitable Environmental Management Plan (EMP) in detailed design phase. • Monitor and control the contractor's EMP execution strictly. • Review monthly contractor's environmental monitoring report and give comments on it.
6	Road Widening of Thanlyin Chin Kat Rd.	<ul style="list-style-type: none"> • Delay of construction works. • Delay of work coordination between two projects. 	<ul style="list-style-type: none"> • Monitor the construction progress. • Prepare a contingency plan for delay of the road widening.
7	Establishment of O&M Organization	<ul style="list-style-type: none"> • Delay of preparation of O&M unit. • Delay of approval of O&M institutional arrangement for the project road. 	<ul style="list-style-type: none"> • Coordinate with DOB for selection of O&M organization. • Prepare good O&M plan.

Source: JICA Study Team