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CHAPTER 1

INTRODUCTION

1.1 Project Background

The two-lane road connecting Dawei Special Economic Zone (DSEZ) to Thai-Myanmar border is a part of the Dawei Special Economic Zone Development Project and related project areas. This road is a part of the ASEAN Connectivity Masterplan which supports international cooperation for the development of linkage along the southern economic corridor of the regional economic cooperation development plan of GMS Southern Economic Corridor. Moreover, the road will be the gateway of the region towards the East and the West. Also, it connects development along the Eastern Economic Corridor (EEC) from the eastern seaboard of Thailand to the Dawei Special Economic Zone as shown in **Figure 1.1-1.**

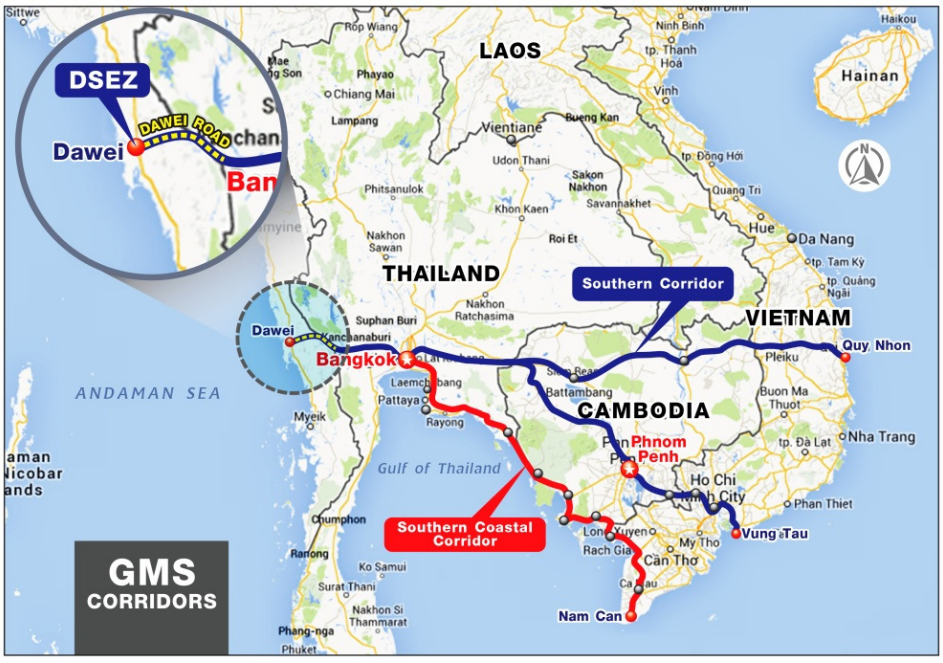


Figure 1.1-1 Location of Two-Lane Road Connecting the DSEZ to Thai-Myanmar Border

The development of two-lane road is a basic necessity of infrastructure to support the development of the Dawei Special Economic Zone and relevant initial projects in the first phase. The road construction project is a two-lane roadway link between Dawei Industrial Estate, Republic of the Union of Myanmar and the Thai border at Phu Nam Ron Sub-District, Kanchanaburi province. The total distance is about 140 kilometers. This road will be linked to the road network of Thailand, which is a special highway project between cities of Bang Yai - Kanchanaburi - Phu Nam Ron. Once the two-lane road project and the special highway project are completed, this link will

create a road network from the deep sea port and industrial estates in Myanmar's Dawei Special Economic Zone to Laem Chabang Port and Industrial Estates in Thailand to promote economic development, increase investment, transportation and international logistics.

On 7 May 2015, the Thai Cabinet approved in principle the guidelines for providing financial assistance to the Myanmar government and assigned Neighbouring Countries Economic Development Cooperation Agency (Public Organization) (NEDA) as responsible for financial assistance programs. On 31 May 2018, representatives from Thailand and Myanmar discussed together to determine the steps and guidelines for implementation of the project. According to the current condition of the two-lane road, it is different from the original construction design that the Myanmar side prepared, and together with the project proposal from the Myanmar side that proposed for financial aid to NEDA on 5 April 2018. The proposal consists of (1) To prepare a detailed design project for road improvement in accordance with the standards. (2) To improve this road to be a two-lane asphaltic concrete pavement road. Both sides agreed to conduct a survey and detailed design of the two-lane road in order to reach a conclusion and clarity on the construction and the project costs by studying and improving the original detailed design that the Myanmar side had designed. The detailed design covers all issues of safety, stability of the road structure, drainage system, environment study, and improves the geometry design of route up to standards before considering to provide financial assistance (FA).

1.2 Objectives

1. To review the plan, policy and guidelines for the development of the project.
2. To review the appropriateness on engineering and environment of the project.
3. To conduct a review on the original detailed design and / or conduct a redesign where it is required to improve the construction of the original two-lane road to connect the Dawei Special Economic Zone to the Thai-Myanmar border.
4. To evaluate the total construction cost of the project and prepare tender documents that conform with the current conditions of the road.

1.3 Project Characteristics

The detailed design of two-lane road improvement project starts at Sta.18+500 (refer to TOR), but in this study, the project starts at Sta.16+458 and connects with the road within the DSEZ Project, Myanmar, to Sta.156+500 on the Myanmar-Thailand border at Phu Nam Ron Sub-District, Kanchanaburi at the distance is about 140 kilometers. The project is an improvement of construction design to meet requirements of two-lane road of the ASEAN Highway standard and must not be lower than the standard class 4 of the Department of Highways (DOH), Thailand.

1.4 Objective of the Report

This Executive Summary Report has been prepared to summarize all the work that has been done, including reporting various obstacles in order to efficiently complete the operations according the objectives of Neighbouring Countries Economic Development Cooperation Agency (Public Organization) ; (NEDA).

1.5 Submission of Reports and Documents

1.5.1 Reports and Documents Submitted

The consultant has already delivered reports and documents as follows;

1. Inception Report
2. Progress Report
3. Interim Report
4. Draft Final Report
5. Draft of Executive Summary Report
6. Draft Final Drawing of Construction (A3)
7. Amendment to Environmental Impact Assessment Report on Two-lane Road Project, Linking Dawei SEZ with Thai Border.
8. Draft Tender Document (Recruitment of Consulting Firms and Contractor)

1.5.2 Reports and Documents on the Last Stage of Implementation

The consultant did prepare the follow reports and documents;

1. Executive Summary Report
2. Final Report
3. Final Drawing of Construction (A3)
   - 3.1 Completed highway plan, at the scale of 1: 1,000
   - 3.2 Completed filed survey data
   - 3.3 All original formats must conform with the report, including;
     - Master plan with appropriate scale
     - Highway layout plan in the long form of the scale 1: 1,000
     - Detailed design of project intersections
     - Detailed design of drainage system
     - Detailed design of cut – fill along the route

- Bridge positions and pedestrian crossing
- Other details such as bus stop, guard rails, fence, and relevant components of road, etc.
- Signs and traffic signal systems
- Implementation plan, construction process, traffic management during construction
- Extension of utilities with new positions, existing positions which hinder construction, including showing the details of where to remove that mentioned utilities
- Detailed design for the construction of bridges, box and pipe culverts, and other structures that show the detail of steel reinforcement and placement of reinforcement of the structure
- Plan showing detail of electrical installation, and lighting system
- Schematic plan showing locations of the quarry and other construction materials with transportation distance

3.4 Tender Document (Recruitment of Consulting Firms and Contractor)

3.5 Details of project report on the condition of the area, construction draft, tender documents, field book report and map data

4. Animation video showing studies results, describing project characteristics and create a model of the project including video presentation by using an unmanned aircraft vehicle (UAV or Drone)
5. A project's website with complete information to promote the project, in Thai, English and Myanmar Languages

1.6 Coordination

Up to the present, there have been activities of meetings, contacts and coordination between Neighbouring Countries Economic Development Cooperation Agency (Public Organization); (NEDA), as given below;

1.6.1 Between Domestic Agencies

22 March 2019 A meeting with Mr. Boonchu Wiwatthanathon, President of the Kanchanaburi Chamber of Commerce for an interview on the road improvement project between Dawei - Ban Phu Nam Ron.

22 April 2019 The consultant meets with World Wildlife Fund (WWF) at Phaya Thai Office, Bangkok. The aim of the meeting is to present information and listen to advices and suggestions from WWF.

30-31 July 2019 Together with Neighbouring Countries Economic Development Agency (Public Agency); NEDA, the consultant participated in a workshop on environmental study of the project by an invitation from WWF.

1.6.2 International Cooperation

14-15 February 2019 The first on site survey with Myanmar officials.

25-25 March 2019 A survey on traffic volume in the project area.

4 April 2019 A meeting to approve the inception report at the meeting room on the second floor of The Ministry of Construction, Republic of the Union of Myanmar.

5 April 2019 The second survey of the project area by NEDA, Myanmar officials and the consultant.

29 April 2019 Survey of the terrain by aerial photograph by Unmanned Aerial Vehicle (UAV)

7 May 2019 Meeting with local leaders and community leaders who will be stakeholders in the project. The aim is to publicize the project and to get comments and suggestions.

17 May 2019 Consultant organizes the first Public Relations and Participation at the conference room of One Stop Service Center (OSSC) of DSEZ, Dawei, Myanmar.

4-6 June 2019 Geological survey for sources of materials.

15-17 July 2019 Meeting with community leaders and local people who are stakeholders in the area to hear opinion and suggestions.

26 July 2019 A meeting for the approval of the Interim Report at the meeting room on the second floor of The Ministry of Construction, Myanmar.

28 August 2019 A meeting to report the operation results at a meeting room of Regional Ministers, Dawei.

29 August 2019 Consultant holds the second Public Relations and Participation at the meeting room of One Stop Service Center (OSSC) of DSEZ , Dawei, The Union Of The Republic Of Myanmar.

30 August – 1 September 2019 Consultant meets and talks with community leaders and people who will be stakeholders to hear opinion and suggestions.

16 September 2019 A meeting for the approval of the results of implementation at the Regional Ministers, Dawei.

28 November 2019 Additional Meeting – Steering Committee Meeting for Final Report at Meeting Room 2nd Floor, Ministry of Construction Office, Republic of the Union of Myanmar

11 -15 December 2019 Surveying the Control Monuments together with Myanmar's DOH.

11-15 February 2020 Surveying the GPS Primary Control Points together with NEDA and Myanmar's DOH officials, positioning the coordinates for all 6 sections consisting Tolls Plaza period, Rest Area and Traffic Changeover including other coordinates Primary Control Points in the project area. Between 11-15 February 2020, with the NEDA participated in planning and coordination before the surveying on February 11, 2020.

CHAPTER 2

SUMMARY OF THE PROJECT IMPLEMENTATION

2.1 The Summary of Progress

The Survey and Detailed Design Project for Two-Lane Road Project Connecting Dawei Special Economic Zone to Myanmar-Thailand Border (1st February 2019 to 28th September 2019). The total duration is 240 days as stated in Terms of Referance (TOR). The details on the final progress of the project are shown in **Table 2.1-1** : Cumulative Progress Compared to Cumulative Plan.

Table 2.1-1 Cumulative Progress Compared to Cumulative Plan

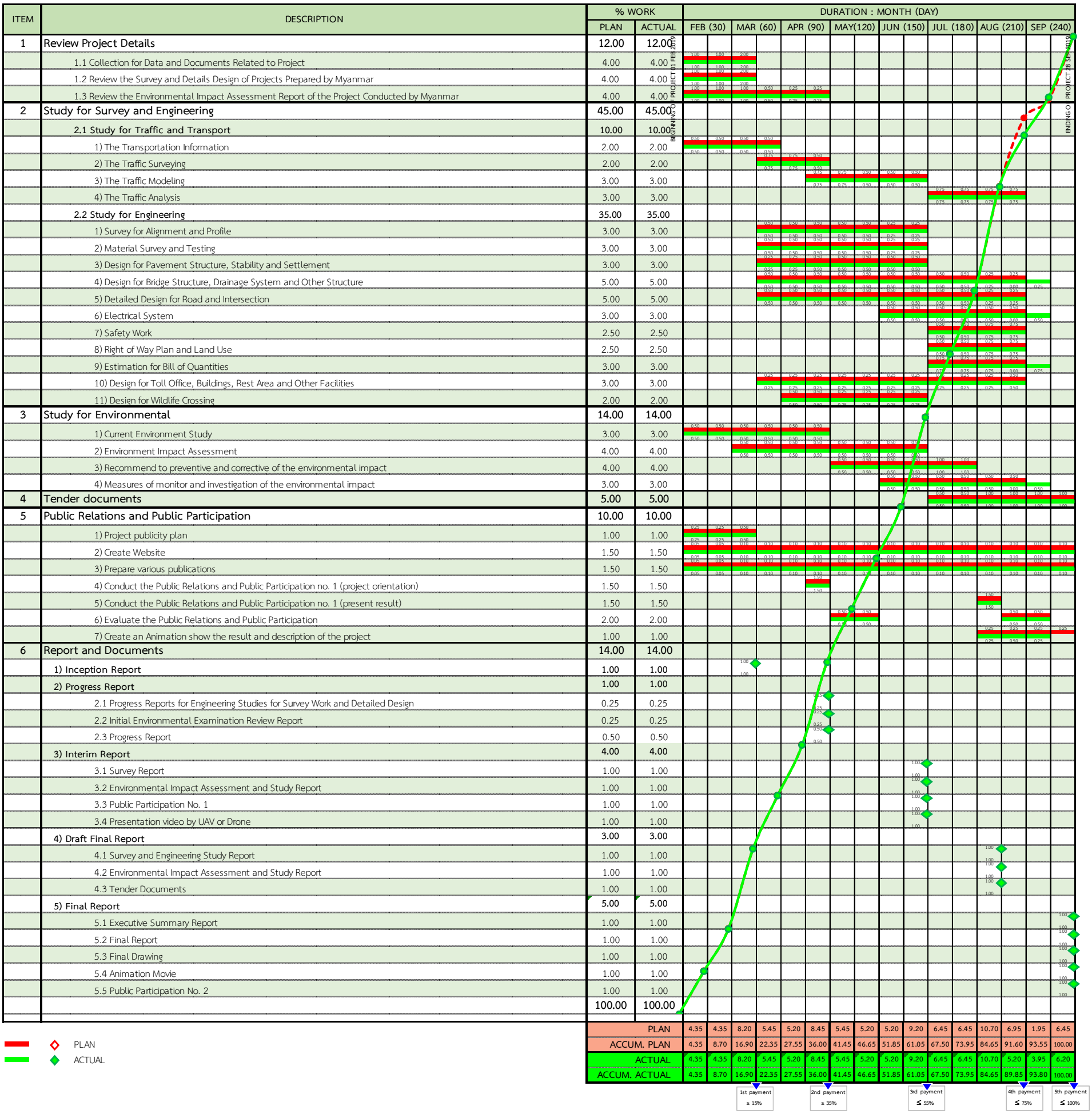
No.	All Tasks	Total %	Plan %	Current %
1	Review Project Details	12.00	12.00	12.00
2	Study on Survey and Engineering	45.00	45.00	45.00
3	Study on Environment	14.00	14.00	14.00
4	Tender documents	5.00	5.00	5.00
5	Public Relations and Public Participation	10.00	10.00	10.00
6	Report and Documents	14.00	14.00	14.00
	Total	**100.00**	**100.00**	**100.00**

	Inception Report	Progress Report	Interim Report	Draft Final Report	Final Report
TOR %	15.00	35.00	55.00	75.00	100.00
Plan %	16.90	36.00	61.05	90.00	100.00
Current %	16.90	35.50	62.40	90.10	100.00

Source: The consultant, 2019

PROJECT SCHEDULE

ITEM	DESCRIPTION	% WORK PLAN	% WORK ACTUAL
1	**Review Project Details**	12.00	12.00
	1.1 Collection for Data and Documents Related to Project	4.00	4.00
	1.2 Review the Survey and Details Design of Projects Prepared by Myanmar	4.00	4.00
	1.3 Review the Environmental Impact Assessment Report of the Project Conducted by Myanmar	4.00	4.00
2	**Study for Survey and Engineering**	45.00	45.00
	2.1 Study for Traffic and Transport	10.00	10.00
	1) The Transportation Information	2.00	2.00
	2) The Traffic Surveying	2.00	2.00
	3) The Traffic Modeling	3.00	3.00
	4) The Traffic Analysis	3.00	3.00
	2.2 Study for Engineering	35.00	35.00
	1) Survey for Alignment and Profile	3.00	3.00
	2) Material Survey and Testing	3.00	3.00
	3) Design for Pavement Structure, Stability and Settlement	3.00	3.00
	4) Design for Bridge Structure, Drainage System and Other Structure	5.00	5.00
	5) Detailed Design for Road and Intersection	5.00	5.00
	6) Electrical System	3.00	3.00
	7) Safety Work	2.50	2.50
	8) Right of Way Plan and Land Use	2.50	2.50
	9) Estimation for Bill of Quantities	3.00	3.00
	10) Design for Toll Office, Buildings, Rest Area and Other Facilities	3.00	3.00
	11) Design for Wildlife Crossing	2.00	2.00
3	**Study for Environmental**	14.00	14.00
	1) Current Environment Study	3.00	3.00
	2) Environment Impact Assessment	4.00	4.00
	3) Recommend to preventive and corrective of the environmental impact	4.00	4.00
	4) Measures of monitor and investigation of the environmental impact	3.00	3.00
4	**Tender documents**	5.00	5.00
5	**Public Relations and Public Participation**	10.00	10.00
	1) Project publicity plan	1.00	1.00
	2) Create Website	1.50	1.50
	3) Prepare various publications	1.50	1.50
	4) Conduct the Public Relations and Public Participation no. 1 (project orientation)	1.50	1.50
	5) Conduct the Public Relations and Public Participation no. 1 (present result)	1.50	1.50
	6) Evaluate the Public Relations and Public Participation	2.00	2.00
	7) Create an Animation show the result and description of the project	1.00	1.00
6	**Report and Documents**	14.00	14.00
	1) Inception Report	1.00	1.00
	2) Progress Report	1.00	1.00
	2.1 Progress Reports for Engineering Studies for Survey Work and Detailed Design	0.25	0.25
	2.2 Initial Environmental Examination Review Report	0.25	0.25
	2.3 Progress Report	0.50	0.50
	3) Interim Report	4.00	4.00
	3.1 Survey Report	1.00	1.00
	3.2 Environmental Impact Assessment and Study Report	1.00	1.00
	3.3 Public Participation No. 1	1.00	1.00
	3.4 Presentation video by UAV or Drone	1.00	1.00
	4) Draft Final Report	3.00	3.00
	4.1 Survey and Engineering Study Report	1.00	1.00
	4.2 Environmental Impact Assessment and Study Report	1.00	1.00
	4.3 Tender Documents	1.00	1.00
	5) Final Report	5.00	5.00
	5.1 Executive Summary Report	1.00	1.00
	5.2 Final Report	1.00	1.00
	5.3 Final Drawing	1.00	1.00
	5.4 Animation Movie	1.00	1.00
	5.5 Public Participation No. 2	1.00	1.00
		100.00	100.00



PLAN	4.35	4.35	8.20	5.45	5.20	8.45	5.45	5.20	5.20	9.20	6.45	6.45	10.70	6.95	1.95	6.45
ACCUM. PLAN	4.35	8.70	16.90	22.35	27.55	36.00	41.45	46.65	51.85	61.05	67.50	73.95	84.65	91.60	93.55	100.00
ACTUAL	4.35	4.35	8.20	5.45	5.20	8.45	5.45	5.20	5.20	9.20	6.45	6.45	10.70	5.20	3.95	6.20
ACCUM. ACTUAL	4.35	8.70	16.90	22.35	27.55	36.00	41.45	46.65	51.85	61.05	67.50	73.95	84.65	89.85	93.80	100.00

1st payment ≥ 15% | 2nd payment ≥ 35% | 3rd payment ≤ 55% | 4th payment ≤ 75% | 5th payment ≤ 100%

Figure 2.1-1 The Implementation Plan and Progress of the Project

2.2 Submission of Reports and Documents

Consultant did prepare relevant reports and documents for submssion to the NEDA within the specified period as follows;

1. Inception Report

Consultant did send the Inception Report of 8 sets in Thai, 8 sets in English and 2 copies of all data in digital form of CD-ROMS within 45 days from the date of commencement. Such reports will include the background, objective plan, project management organization, time schedule, implementation and methods of study according to the scope of study and data collection, related project report and documents report on the evaluation of the environmental impact assessment approved by the Myanmar side and public relations program and public participation plan as well.

2. Progress Report

Consultant did submit Progress Report of 8 sets in Thai, 8 sets in English, and 2 CDs of all data (CD-ROMS) within 90 days from the starting date. The report will consist of progress of survey and engineering studies (accounted for 30% of all engineering work), creating a website to promote the project and update information until the report is completed. As well, reviews on environmental impact report approved by Myanmar side (accounted for 35% of all environmental work) shall be tabled. All progress reports and plans for further implementations as well as problems, obstacles and solutions are to be submitted.

3. Interim Report

Consultant did deliver Interim Report, each at 8 sets in Thai and English and 2 CDs of all data (CD-ROMS) within 150 days from the date assigned as the starting date. The report will consist of survey reports and engineering studies (accounted for 60% of all engineering work). The consultant shall file additional field survey work, traffic and transportation survey, soil and material inspection, the structural design, additional environmental study progress report (accounted for 60% of all environmental work). The consultant shall campaigne for the first public participation of the people in the project area. Presentation covering the whole route shall be done in the video form taken by Drone.

4. Draft Final Report and Draft of Executive Summary Report

The consultant did submit draft final report and draft of executive summary report, which consists of 8 sets in Thai, 8 sets in English and Digital Files of Auto CAD, PDF, Word, Excel and others (if any) in the form of 2 CDs of all data (CD-ROMS) consisting of draft the results of all studies conducted (accounted for 90% of all work), according to the scope of the study within 210

days from the starting date. This includes detailed draft and supporting documents in 8 Thai sets and 8 sets in English. The draft final also contains survey reports and engineering studies, design of bridges structure and drainage systems, detailed design of roads and intersections, lighting system and traffic signal lights, safety work, right of way, land use data, population migration plan. Calculation on the amount of construction work and estimated cost, location and design of toll booths, rest area and various facilities, positioning and design of wildlife crossings, environmental impact assessment and tender documents shall be found here.

5. Final Report

Consultant did submit Final Report which consists of the results of all studies conducted (accounted for 100% of all work) in accordance with the scope of the modified, revised study corresponding to recommendations from the commission of inspection and receiving under employedment of consultants by NEDA and Myanmar within 240 days from the date of commencement, with the following details;

1) Executive summary report of 15 sets in Thai and 20 in English
2) Final Report will show all results of studies conducted in accordance with the scope of study defined. The report shall number 15 sets in Thai and 20 sets in English.
3) Details and other supporting documents at 15 sets in Thai and 20 in English, including
    - Completed highway plan, at the scale of 1: 1,000. The plan must show details of all areas where management of ownership is needed, including buildings, barricades, fences, ponds, etc.
    - Completed filed survey data
    - Final draft form at full-size original format (A1) and half-size printing format (A3) and all original formats must conform with the report, including
        - Master plan with appropriate scale
        - Highway layout plan in the long form of the scale 1: 1,000 or as appropriate in horizontal layout, at 1: 100 scale in vertical layout with bar scale on every sheet
        - Detailed design of project intersections
        - Detailed design of drainage system
        - Detailed design of cut – fill along the route

- Bridge positions and pedestrian crossing
- Other details such as the bus stop, guard rails, fence, and relevant components of road, etc.
- Signs and traffic signal systems
- Implementation plan, construction process, traffic management during construction that will be obstacles to construction and showing details of moving existing utilities
- Extension of utilities with new positions, existing positions which hinder construction, including showing the details of where to remove that mentioned utilities
- Detailed design for the construction of bridges, box and pipe culverts, and other structures that show the detail of steel reinforcement and placement of reinforcement of the structure
- Plan showing detail of electrical installation, and lighting system
- Schematic plan showing locations of the quarry and other construction materials with transportation distance

- Tender documents (Recruitment of Consulting Firms and Contractor)
- Details of project report on the condition of the area, construction draft, field book report and map data

4) Animation video showing studies results, describing project characteristics and create a model of the project including video presentation by using an unmanned aircraft vehicle (UAV or Drone) to cover the area along the project route.

5) A project's website with complete information to promote the project, in Thai and English. All documents mentioned above must be delivered in Digital Files format (Auto CAD, PDF, Word, Excel and others (if any), in the form of 5 CD-ROMS / DVDs, except for animation movies, to be packed in CD-ROMS / DVD separately from other 2 document sets.

6) Conduct the second public participation of people in the area.

2.3 Organization of Project Management and Time Scheduling

2.3.1 Organization of Project Management

The consultant has organized the project management organization in accordance with the project characteristics by selecting experienced project personnel. The Project Manager, who has several experiences in overseeing large projects will ensure that the team and personnel will be able to work effectively in this project and in accordance with the proposed implementation plan.

Project management organization plan is shown in **Figure 2.3-1**, in addition to showing the relationship and coordination between NEDA and the consulting group, also demonstrates the relationship and coordination of various personnel in the project as well as various support staffs.

2.3.2 Time Schedule

The implementation plan of the consultant has divided the details the work as mentioned above by focusing on the responsibilities of each key person involved in each step of work for use in the management and the appropriate time spent in the operation in order to be able to perform duties and responsibilities effectively and achieve the goal.

Tasks in the duties and responsibilities of key personnel as shown in **Figure 2.3-2,** according to the duties and responsibilities of each section in order to be in line with the implementation plan at the specified time. The consultant has studied and carefully considered the duration of the project plan, in order to arrange each key personnel to perform smoothly by the duration of the project plan as shown in **Figure 2.3-3.**

Figure 2.3-1 Organization Chart of Project Management

ITEM	DESCRIPTION / POSITION	Project Manager	Project Advisor	Higway Engineering	Geotechnical Engineer	Structure Engineering	Survey Engineering	Transport Engineering	Electrical Engineering	Road Safety Specialist	Costestimeted and Tender documents Specialist	Architect	Landscape Architect	Environment specialist	Wildlife Specialist	Plant Specialist	Social Economic Specialist	Land Handover Specialist	Toll Collection System Implementation Specialist	Public Relation and Information specialist
1	Review Project Details																			
	1.1 Collection for Data and Documents Related to Project	○	○	△			△	■												
	1.2 Review the Survey and Details Design of Projects Prepared by Myanmar	○	○				■													
	1.3 Review the Environmental Impact Assessment Report of the Project Conducted by Myanmar	○	○											■	■	■	■			△
2	Study for Survey and Engineering																			
	2.1 Study for Traffic and Transport																			
	1) The Transportation Information	○	○					■												
	2) The Traffic Requirement	○	○					■												
	3) The Traffic Modeling	○	○					■												
	4) The Traffic Analysis	○	○	△				■												
	2.2 Study for Engineering																			
	1) Survey for Alignment and Profile	○	○	△			■													
	2) Material Survey and Testing	○	○	△	■															
	3) Design for Pavement Structure, Stability and Settlement	○	○	△	■															
	4) Design for Bridge Structure, Drainage System and Other Structure	○	○	△		■														
	5) Detailed Design for Road and Intersection	○	○	■	■				△	△			△					△		
	6) Electrical System	○	○	△					■											
	7) Safety Work	○	○							■										
	8) Right of Way Plan and Land Use	○	○	△			△				△					△	△	■		
	9) Estimation for Bill of Quantities	○	○								■									
	10) Design for Toll Office, Buildings, Rest Area and Other Facilities	○	○			△						■	■						■	
	11) Design for Wildlife Crossing	○	○											△	■	△		△		
	2.3 Study for Environmental	○	○	△										■	■	■	■	△		
	2.4 Tender documents																			
	1) Contractors Selection	○	○								■									
	2) Consultant Selection	○	○								■									
	2.5 Public Relations and Public Participation	△	○	△										△				△		■

Legend

○ Supervise ■ Responsible △ Cooperate

Figure 2.3-2 Duties and Responsibilities of Key Personnel

No.	Position	Name	Project Duration (Month)								Man - Month
			1	2	3	4	5	6	7	8	
	Project Advisor	Mr. Tawat Benjapolchai									-
1	Project Manager	Mr. Winit Chiarasathawong									4.0
2	Higway Engineering	Dr. Pisit Kuntiwattanakul									4.0
3	Geotechnical Engineer	Mr. Sarlidpong Chareonsuphong									2.5
4	Structure Engineering	Mr. Bandhit Saiwilai									2.5
5	Survey Engineering	Mr. Sitichoke Sirivivat									2.0
6	Transport Engineering	Dr. Sathita Malaitham									2.0
7	Electrical Engineering	Mr. Chanchai Vorachatdecha									1.5
8	Road Safety Specialist	Dr. Chalat Thipakornkiat									1.5
9	Costestimeted and Tender Documents Specialist	Ms. Rungsima Chanahaswasdikul									2.0
10	Architect	Mr. Precha Keawchairuk									1.5
11	Landscape Architect	Mr. Somchai Tharaphat									1.5
12	Environment specialist	Mr. Preeda Thongsukngam									4.0
13	Wildlife Specialist	Mr. Theerapan Putyuen									2.0
14	Plant Specialist	Ms. Worakai Usa									2.0
15	Social Economic Specialist	Ms. Piyathida Thangpaisankit									2.0
16	Land Handover Specialist	Mr. Apiwachr Thamsiri									1.5
17	Toll Collection System Implementation Specialist	Mr. Arnuparp Tippapart									1.5
18	Public Relation and Information specialist	Ms. Natta Rattakul									2.0
											40.0

Figure 2.3-3 Work Plan of Key Personnel

CHAPTER 3

PROJECT REVIEW:

GATHERING OF INFORMATION RELATED TO THE PROJECT

The consultant has gathered information related to the project and divides it into the following three topics;

- Compilation of potential project area.
- Policy and National Development Plan of Thailand and Myanmar and connection in economic dimension according to cooperation framework.
- Expected Benefits and Guideline for increasing project value addition.

3.1 Compilation of Potential Project Area and Connection in Economic Dimension according to Cooperation Framework

In this section, we will compile potential area data including Myanmar general information and socio-economic data of studied area, population data, economic data, statistical data such as number of vehicles, industrial data, and tourism data etc., as following details;

3.1.1 General Information of Myanmar

Myanmar, officially known as Republic of the Union of Myanmar, is a sovereign state in South East Asia with an area of 676,578 square kilometers (about 1.3 times of Thailand) making Myanmar ranked 40th largest country of the world and 2nd largest country in Southeast Asia. Myanmar has the most territory that is connected to Thailand by 10 provinces, starting from Northern Thailand including Chiang Rai, Chiangmai, Mae Hong Son, Tak, Kanchanaburi, Ratchaburi, Phetchaburi, Prachuap Khiri Khan, Chumphon, and Ranong.

Moreover, capital city of Myanmar and administrative center is Naypyidaw, which is far from Yangon, old capital city, by 320 kilometers. Republic of the Union of Myanmar has divided regional administrative area into 7 regions which consist of Myanmar population, while the area that consists of ethnic minorities has 7 states and 1 union territory.

3.1.2 Myanmar Population Data

Considering number of population in Myanmar between 2005-2019, it showed that Myanmar population growth rate increased by 0.80 percent per year from 48.5 Million in 2005 to 54.1 Million in 2019.

3.1.3 Economic Status of Myanmar

1. Economic Indicators of Myanmar

Myanmar is a developing country with low GDP per capita. In 2018, it was reported that GDP per capita of Myanmar was equivalent to 1,325.95 USD. According to World Bank data, it was expected that Myanmar economy will grow by the driving force of government expenditure and private investment as well as service sector that is growing constantly. Moreover, the economic reform of Myanmar is starting to raise the confidence in consumption and investment of private sector consequently.

Gross Domestic Product or GDP of Myanmar was growing progressively from 65.446 Billion USD in 2014 to 71.215 Billion USD in 2018 causing GDP per capita to rise afterward. In addition, GDP growth rate between 2014-2018 was about 5-6% whereas most economic activity of Myanmar can be categorized as follows ;

- **Agricultural Dimension :** As agriculture is a main occupation of most Burmese which consists of mostly rice planting, jute planting, sugar cane farming, and other tropical plants farming.
- **Mining Dimension :** There are stone mining, zinc mining in North-East of Myanmar, tin mining and forestry in South-East of Myanmar, teakwood forestry in North of Myanmar, and petroleum rig in upper central of Myanmar.
- **Industry Dimension :** In general, Myanmar industry is still in progress of development for instance boatbuilding industry around Yangon, Myeik, and Dawei. Moreover, Myanmar is also full of essential resources such as natural gas, jewelry, forest, mineral (tin) and oil.

2. Trade Data between Thailand and Myanmar

(1) Border Trade between Thailand and Myanmar

In 2019, the value of border trade between Thailand and Myanmar is approximately 237,056.25 million baht. Thailand registered a surplus of 33,222.97 million baht compared to 2018. It was found that the value decreased by 0.22 percent (YoY), divided into exports worth 135,139.60 million baht, a decrease of 8.08 percent (YoY) and imports worth 101,916.60 million baht. 4.50 percent increase (YoY).

The Thai Customs House that had highest trade border value is Mae Sot. Its total trade value was 77,962.71 million Baht. Followed by Sangkhla Buri Customs House that had total trade value of 75,824.55 million Baht.

(2) Ban Phu Nam Ron Customs Border Trade

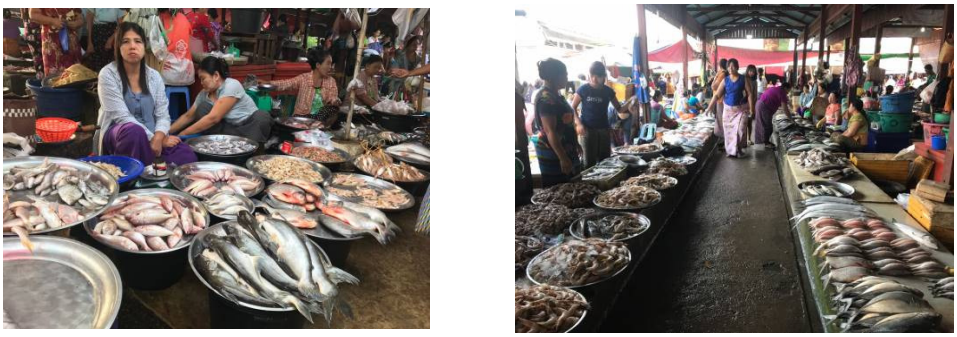
Ban Phu Nam Ron Customs Border located in Mueang District, Kanchanaburi Province is relevant to the Project. The imported products in 2014 were worth 46.71 million Baht, (such as lignite coal, machinery and research equipment, tin ore, etc). Export products in 2014 were worth up to 290 million Baht, (such as diesel oil, machinery and teak, etc).

3.1.4 Various Statistical Data of Studied Area

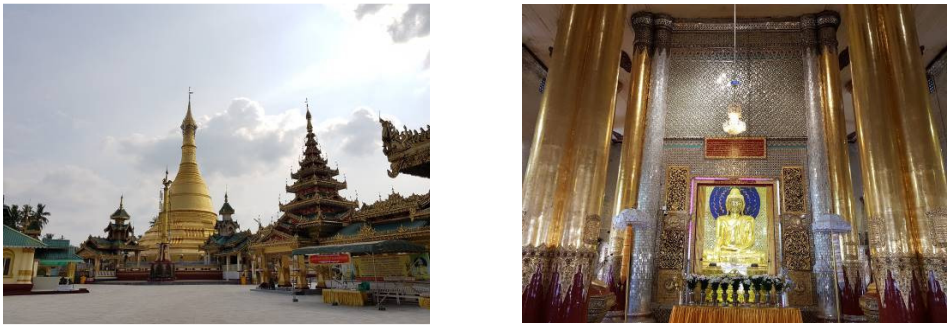
The population and household data during 2013 - 2018 of the Tanintharyi region, it was found that The population is constantly increasing, with 1,408,401 people and 283,099 households in 2014 was 1,464,701 people and 294,416 households in 2018. The population of Dawei has increased from 125,605 people and 24,943 households in 2014 to 130,626 people and 25,940 households in 2018.

General information of Dawei, including number of populations, area land, number of households, literacy rate, number of disabilities people, energy source for cooking, power source for lighting, main water source for consumers, availability of communication facilities and the availability of transportation facilities, etc.

Most of the land use characteristics of Dawei are residential. With agriculture and forest areas, current habitat of houses, wooden buildings houses, cement buildings and houses of semi-cement wooden buildings, there are also commercial buildings, as well as hotels. For agriculture, we found that a large number of rice, banana and betel tree plantations were cultivated along with fishery occupations because Dawei city has an area West to the Andaman sea which Dawei has an area adjacent to the sea causes Dawei to be one of Myanmar's tourist attraction sites on **Figure 3.1-1** shows tourist attractions and products in the morning market of Dawei.



Morning Market



Shwe Taung Zar Temple

Source: The Consultant 2019

Figure 3.1-1 Attractions and Morning Markets in Dawei

The population data of Kanchanaburi province in 2013-2018 has increased around 1.17% per year. In 2013, it was 842,882 persons, while the population in 2018 was around 893,151 persons. The population is divided into 449,086 male and 444,065 females, with the most populous district being Muang Kanchanaburi District, the number of 100,282 people, followed by Tha Maka District, the number of 92,263 people, Thong Pha Phum District, the number 65,081, Tha Muang District, the number 57,963 and Sai Yok District, the number 57,763 people.

Gross Provincial Product (GPP) of Kanchanaburi in 2013-2018 has increased respectively from 85,930 million Baht (2,786 million USD) in 2013 to 100,384 million Baht (3,255 million USD) in 2018. GPP per capita income increased from 107,129 Baht (3,474 USD) in 2013 to 125,500 Baht (4,069 USD) in 2018.

3.2 Gathering of Policies and Strategic Development Plans of Thailand and Myanmar Connection in Economic Dimension according to Cooperation Framework

It is an understanding of the direction of transportation management and Logistics of both Thailand and Myanmar Before going into the operation of a detailed survey and design project Two-lane road improvement project connecting the Dawei Special Economic Zone to the Thai-Myanmar border To analyze the relationship and impact on the project As a result, the project implementation is in line with the aforementioned policies, strategies and development plans, and able to create a more complete operational plan. In **Figure 3.2-1** is an overview of the assessments and relevant historical developments of both countries including framework of ideas and related international development projects.

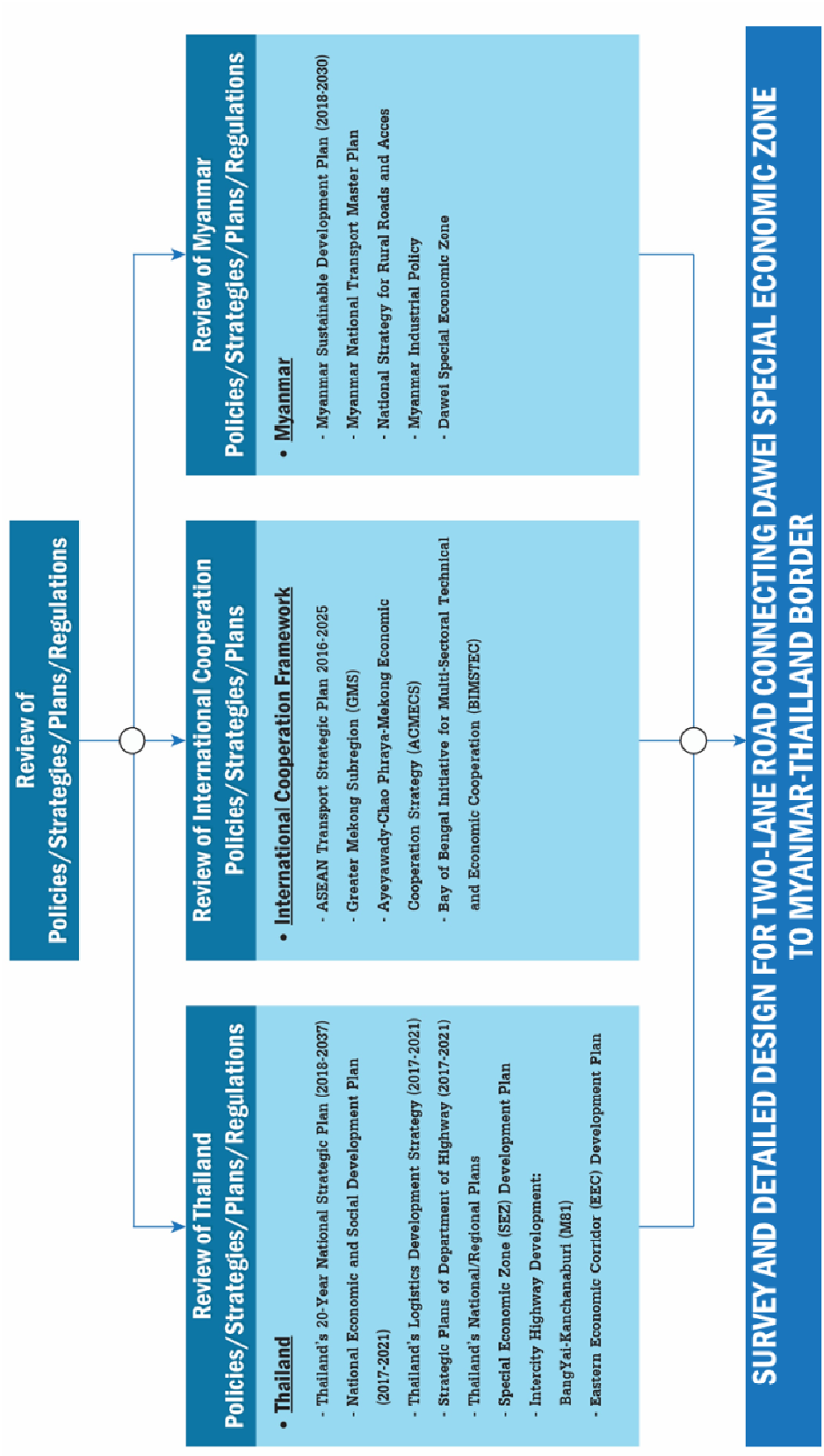


Figure 3.2-1 Relevant Policies Strategies and Plans

3.3 Expected Benefits and Value Addition of Project

Road construction project from Dawei to Ban Phu Nam Ron is the path to link the Dawei Deep Sea Port & Industrial Estate Project and Transborder Corridor and Transborder Corridor Link is the new Gate Way of the West and East. Projects in Dawei are the center of large regional logistics and trade systems, linking transportation and trade between countries in Southeast Asia and countries in the South China Sea through the Andaman Sea to the Indian Ocean, which is a main route to deliver products both to and from the water through the Middle East, Europe and Africa. It will save costs and time of transportation and can help develop trade, investment and regional economies in the long term.

Reviewing policies and development strategies related to project development was found that in the case of the development route from Phu Nam Ron to Dawei, it would be promoting the economic cooperation framework policy in the Mekong River Basin (GMS), which engourages the Southern Economic Corridor: SEC link Myanmar-Thailand-Cambodia-Vietnam.

The developed network will help reduce the 5-day period of shipping goods from the Middle East to 5 days in Indochina. For Thailand, Dawei will be the new economic gateway connecting Dawei Deep Sea Port and Laem Chabang Port according to the trading strategy, linking the neighboring countries. Therefore, products sent from Europe, Africa, the Middle East, South Asia will pass through the Dawei Deep Sea Port to Laem Chabang Port for a period only 1 day, and can be delivered to China, Korea, Japan or Pacific countries.

The Dawei Deep Sea Port Project and Dawei Special Economic Zone will have a positive impact and benefits for both Myanmar and Thailand.

CHAPTER 4
REVIEW ON DETAILS OF THE PROJECT: RESULTS OF SURVEY AND DETAILED DESIGN FOR TWO-LANE PROJECT CONDUCTED BY MYANMAR

4.1 Collection of Relevant Transportation and Traffic Information

Consultant reviewed and collected information on transportation both passenger and freight, past and present. Information gathered is used in analyses and assessment of transportation circumstances at present and in the future, which consisted of following topics;

4.1.1 Review of Relevant Transportation and Traffic Information in Previous Study

The consultant conducted a review of the traffic and transportation studies of the Detailed Engineering Design Report: Dawei-Phu Nam Ron Two-Lane Road Project. The trip purposes of traveling between Dawei and Phu Nam Ron were freight traffic and passenger traffic. The transportation of goods is the type of raw materials used for production or finished products. The goods will be transported to Dawei Industrial Estate. In addition, construction is transported from the Thai side across the construction site to the Dawei Industrial Estate. Besides, most of the passenger traffics are traveling to work at Dawei Industrial Estate. The journey of the Myanmar workers come from Thailand via Phu Nam Ron and also travel for tourism.

The results of the review of the traffic and transportation survey showed that the traffic forecast on the two-lane roads was divided into two phases: Phase 1 (2015-2023), which was the development phase of the DSEZ project, The traffic forecast is quite high. It is assumed that the average traffic growth rate is 57% per year, For phase 2 (2023-2040) is the phase that the DSEZ project is completed. There is an assumption of the average traffic volume growth rate of 1% per year, with most types of vehicles being trucks. (For cargo) and personal cars.

Table 4.1-1 Summary of Traffic Demand Forecast by the Previous Study

Unit : (x1,000 veh/year)

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Freight													
Westbound													
AT&Trailer	7.48	19.97	44.75	114.53	216.87	299.19	445.93	521.23	608.62	612.29	616.08	619.99	624.02
10 Wheeler	10.00	23.69	44.39	86.86	148.09	198.25	281.87	328.36	375.14	377.60	379.00	379.57	380.45
Eastbound													
AT&Trailer	7.48	19.97	44.75	114.53	216.87	299.19	445.93	521.23	608.62	612.29	616.08	619.99	624.02
10 Wheeler	10.00	23.69	44.39	86.86	148.09	198.25	281.87	328.36	375.14	377.60	379.00	379.57	380.45
Total Freight	**34.96**	**87.32**	**178.28**	**402.78**	**729.92**	**994.88**	**1,455.60**	**1,699.18**	**1,967.52**	**1,979.78**	**1,990.16**	**1,999.12**	**2,008.94**
Passenger													
Westbound													
Car&Van	11.40	19.71	30.58	39.72	51.15	59.41	69.08	78.47	88.94	92.02	96.24	98.01	103.95
Bus	0.59	0.57	0.68	0.71	0.76	0.83	0.91	1.01	1.14	1.30	1.49	1.72	2.14
Eastbound													
Car&Van	11.40	19.71	30.58	39.72	51.15	59.41	69.08	78.47	88.94	92.02	96.24	96.01	103.95
Bus	0.59	0.57	0.68	0.71	0.76	0.83	0.91	1.01	1.14	1.30	1.49	1.72	2.14
Total Passenger	23.98	40.56	62.52	80.86	103.82	120.48	139.98	158.96	180.16	186.64	195.46	197.46	212.18
Total	**58.94**	**127.88**	**240.80**	**483.64**	**833.74**	**1,115.36**	**1,595.58**	**1,858.14**	**2,147.68**	**2,166.42**	**2,185.62**	**2,196.58**	**2,221.12**

Source: Detailed Engineering Design Report: Dawei-Phu Nam Ron Two-Lane Road Project (2015)

Table 4.1-1 Summary of Traffic Demand Forecast in Previous Study (Cont'd)

Unit : (x1,000 veh/year)

	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Freight													
Westbound													
AT&Trailer	628.17	632.45	636.85	641.38	646.24	650.82	655.73	660.77	665.94	671.24	676.68	682.25	687.96
10 Wheeler	381.66	383.21	384.59	386.29	388.32	390.69	393.41	395.86	398.63	401.74	405.19	409.00	413.19
Eastbound													
AT&Trailer	628.17	632.45	636.85	641.38	646.24	650.82	655.73	660.77	665.94	671.24	676.68	682.25	687.96
10 Wheeler	381.66	383.21	384.59	386.29	388.32	390.69	393.41	395.86	398.63	401.74	405.19	409.00	413.19
Total Freight	2,019.66	2,031.32	2,042.88	2,055.34	2,069.12	2,083.02	2,098.28	2,113.26	2,129.14	2,145.96	2,163.74	2,182.50	2,202.30
Passenger													
Westbound													
Car&Van	108.30	113.84	120.38	128.10	136.64	145.71	155.22	164.71	173.64	182.02	189.56	195.49	204.17
Bus	2.49	2.89	3.34	3.85	4.39	4.96	5.55	6.14	6.70	7.25	7.75	8.18	8.57
Eastbound													
Car&Van	108.30	113.84	120.38	128.10	136.64	145.71	155.22	164.71	173.64	182.02	189.56	195.49	204.17
Bus	2.49	2.89	3.34	3.85	4.39	4.96	5.55	6.14	6.70	7.25	7.75	8.18	8.57
Total Passenger	**221.58**	**233.46**	**247.44**	**263.90**	**282.06**	**301.34**	**321.54**	**341.70**	**360.68**	**378.54**	**394.62**	**407.34**	**425.48**
Total	**2,241.24**	**2,264.78**	**2,290.32**	**2,319.24**	**2,351.18**	**2,384.36**	**2,419.82**	**2,454.96**	**2,489.82**	**2,524.50**	**2,558.36**	**2,589.84**	**2,627.78**

Source: Detailed Engineering Design Report: Dawei-Phu Nam Ron Two-Lane Road Project (2015)

4.1.2 Traffic and Logistic/Tourism Planning and Policy

1. Feasibility Study on Economic, Engineering, and Environment Effects of Intercity Motorway between Kanchanaburi and Thailand-Myanmar Border (Ban Phu Nam Ron)

The cabinet has come to a resolution on the guideline for supporting the development of Dawei Deep Sea Port of the Republic of the Union of Myanmar.Moreover, the Dawei Deep Sea Port is a joint venture project of Thailand private sector that aims to build a Port City covering major sea port, road network, train, oil pipelines, and industrial centers. According to the Cabinet's resolution, there is a construction project of Dawei-Kanchanaburi Land Bridge, connecting Dawei-Kanchanaburi from Dawei to Ban Phu Num Ron, Kanchanaburi, with the distance of 160 kilometers as well as a toll. Therefore, the project is considered to be a potential project for physical and area development which can cover the expansion of Thailand industry base in the long run, especially petrol chemical, iron and steel and automotive industries. In addition, The Department of Highways has a vision in developing a motorway which is a transport and logistics system with high efficiency, fastness, and safety in order to connect the area to Dawai Deep Sea. As a result, the development plan for developing a network that connects Kanchanaburi to Thailand-Myanmar border in order to support the traffic in local grade, and national grade is expected to expand in the future as well as supporting the potential of economic growth, transportation and logistics, tourism, and the emergence of border trade between Thailand and neighboring country.

2. A Study of Area Suitability for Planning Industrial Zone in Border Area of Phu Nam Ron Checkpoint, Amphoe Muang Checkpoint, and Other Suitable Areas in Kanchanaburi (Industrial Estate Authority of Thailand (IEAT), November 2012)

With the potential of Kanchanaburi, it is suitable for an establishment of Thailand-Myanmar border economic zone. It also plays important role in connecting global commercial activites across Dawei port-Laem Chabang economic corridor connecting logistics activity between 2 oceans together. The Industrial Estate Authority of Thailand (IEAT) has studied the area suitability in order to plan industrial area. Furthermore, Kanchanaburi is planned to be the location of industrial estate as logistics hub and light industry or eco industrial estate.

Industrial estate service is established for supporting logistics business between Dawei Deep Sea Port and Lam Cha Bang Port of Thailand. It is responsible for being Inland Container Depot, domestic Containers transportation center, warehouse and distribution center, containers yard, and freight station. The location is planned for Tung Sala-Ban Lam Tsai, Tambon Ban Kao,

Amphoe Muang, Kanchanaburi with the development area of 600 rais and reserved area for future development of 3,500 rais.

Eco-industrial estate is built for light, eco industries such as electronics and electrical parts, automotive and auto parts, food processing, textile and garment, furniture and household, polymer and chemicals, plastic packaging and medical equipment and cosmeceuticals, etc. The location is planned for Ban Nong Song Ton-Ban Nong Jok area, Tambon Gang Sian, Amphoe Muang, Kanchanaburi with initial development area size of 1,000 rais and the area for future development of 3,100 rais.

4.1.3 Transportation and Freight Statistics

1. Border Crossing/Entry Data: Passenger and Freight

From the vehicle entry-exit statistics of immigration checkpoints at the permanent border crossing, Ban Phu Nam Ron since the opening of the year 2013 onwards, there were people traveling in and out of the border crossing for the duration of 6 last years, with the growth rate of 71%, showing the need for cross-border travel for both Thais and the people of The Republic of The Union of Myanmar in dealing with trading business etc.

2. The Traffic Volume from Related Project

The traffic data from related projects, including traffic forecast results, annual average daily traffic (AADT) near the project area (Thailand section) of 2007-2012 with the following details ;

- **Traffic Forecast Results from Intercity Motorway between Kanchanaburi-Thailand/Myanmar Crossing Border (Ban Phu Nam Ron)**

  Intercity Motorway between Kanchanaburi-Thailand/Myanmar Crossing Border (Ban Phu Nam Ron) project with a total distance of 68.4 km. is expected to open for service in the year 2024. The forecast of traffic volume results on motorway found that, in 2021 the traffic volume on the project route was in the range of 13,000 - 18,000 pcu/day, in 2030 with traffic volume 23,000 - 42,000 pcu/day and increased to 34,000 - 42,000 pcu/day in 2040 and 2050, with a total traffic volume of 48,000 - 59,000 pcu/day. Most of the traffic comes from Motorway no.M81 (Bang Yai–Kanchanaburi) and Highway no.323. Which is the main route used for traveling in and out of the project area and other areas the main highways that have an effect on the traffic volume change consists of Highway no.323, Tha Muang District, Kanchanaburi Province, Highway no.3512 and the Intercity Motorway Bang Yai – Kanchanaburi.

- **Traffic Forecast Results of the Intercity Motorway Bang Yai - Kanchanaburi (M81)**

  The Motorway Bang Yai - Kanchanaburi (M81) with a total distance of 96 km. is expected to open for service in 2020. The forecast results of the analysis of the amount of travel in the study area showed that, about 1,483,000 pcu/day, will increase to 2,039,000, 2,6787,000 and 3,264,000 pcu/day in 2030, 2040 and 2050 respectively. The average of traffic volume growth is about 2.00% to 3.28% per year.

- **Traffic Volume Forecast of the Two-Lane Road Project (Dawei-Phu Nam Ron)**

  A review on the report of design of the two-lane road from Dawei to Phu Nam Ron is for the distance of 138 km. The forecast result from 2015-2040 is as shown in the **Table 4.1-2** below. The table composes of forecast result of passenger and freight volume. Measurement is shown in number of vehicles per day.

Table 4.1-2 Traffic Forecast per Year

Unit: Vehicles per year (X1,000)

Year	Freight				Total Freight (veh/year)	Passenger				Total Passenger (veh/year)	Grand Total (veh/year)
	Westbound		Eastbound			Westbound		Eastbound			
	AT & Trailer	10 Wheels	AT & Trailer	10 Wheels		Car & Van	Bus	Car & Van	Bus		
2015	7.48	10.00	7.48	10.00	**34.97**	11.40	0.59	11.40	0.59	**23.98**	**58.95**
2019	216.87	148.09	216.87	148.09	**729.91**	51.15	0.76	51.15	0.76	**103.83**	**833.74**
2020	299.19	198.25	299.19	198.25	**994.89**	59.41	0.83	59.41	0.83	**120.47**	**1,115.36**
2025	616.08	379.00	616.08	379.00	**1,990.16**	96.24	1.49	96.24	1.49	**195.45**	**2,185.61**
2030	636.85	384.59	636.85	384.59	**2,042.89**	120.38	3.34	120.38	3.34	**247.44**	**2,290.33**
2035	660.77	395.86	660.77	395.86	**2,113.26**	164.71	6.14	164.71	6.14	**341.70**	**2,454.96**
2040	687.96	413.19	687.96	413.19	**2,202.29**	204.17	8.57	204.17	8.57	**425.49**	**2,627.79**

Source: Final Design Report, The Consulting Service for the Detailed Design and Related Assistances for the Two-Lane Road Project (Dawei – Phu Nam Ron), October 2015

4.2 Review & Study of Topographic Surveying and Leveling

All previous Topographic Map and Survey Data are now gathered from "Consulting Services for Detailed Engineering Design Dawei – Phu Nam Ron Two Lane Road Project, MIE". Review and study of Control and Topographic data must be considered as follows;

1. 61 GPS Primary Control Points were constructed by The GPS Static Method, referring to the MOAC monuments No. A-102012 Conforms to Class C Royal Thai Survey Department standards.
2. 102 Traverse Monuments were installed by the Closed Traverse Surveying complied with The Third Order Class II of FGCC Standard.
3. All of GCPs elevation is the elevation above Mean Sea Level (MSL.) (Koh Lak, Prachuap Khiri Khan Province Thai Gulf), run by Differential Leveling.
4. All Topographic Data appeared on Topographic Map and the Contour Map were homogeneous and corresponding to topography.

4.3 Review of Soil and Material Investigation

4.3.1 Geological Study

Study area is located in the south of Sino Burman Ranges or Eastern High Lands, called Slate Belt (Mitchell et al., 2012), consisting of rocks from Mesozoic to Paleozoic, including red sandstone, gravel, limestone, shale, and granite. Most rock types in the study area are of Murgui Series, which accumulate in the Upper Carboniferous – Lower Permian (Hai Jiang et al., 2016). Structural Geology in the study area consists of 2 fault zones as follows;

1. Tenasserim Fault Zone is the right lateral strike-slip fault. The northwest – southeast, the north – south, and the northeast – southwest trending along the borders of Myanmar.
2. Kungyaungale Fault Zone is the right lateral strike-slip fault, which is the north – south and the northwest – southeast trending.

4.3.2 Geological Study and Material Availability

The consultant reviewed the soil and material investigation report, the result was completed and covers all routes of project and can be used as a design information for the project. This can be summarized as follows;

Test Pit Material Survey: One hundred samples were collected for test pits which covered the whole route. The previous study report can be summarized as follows;

- CBR of subgrade along the route: 1.8 % - 24.8 %
- Maximum Dry density: 1.682 - 2.105 t/m^3
- OMC (Optimum Water Content): 8.8 - 16.9 %

For soil boring test, the total of soil boring and testing of material in this project are 48 boreholes that cover 19 locations of bridges.

4.3.3 Survey and Construction Material Testing

The consultant reviewed and surveyed the source of material in order to ensure that there will be sufficient materials for construction. There will be survey of nearby area by coordinating with local authorities and entrepreneurs to create a map of material source as shown in **Table 4.3-1**.

Table 4.3-1 Locations of Construction Materials

Contract	Materials	Locations of Material (Source)
1	Laterite	15
	Crushed Rock	6
	Sand & Gravel	3
2	Laterite	73

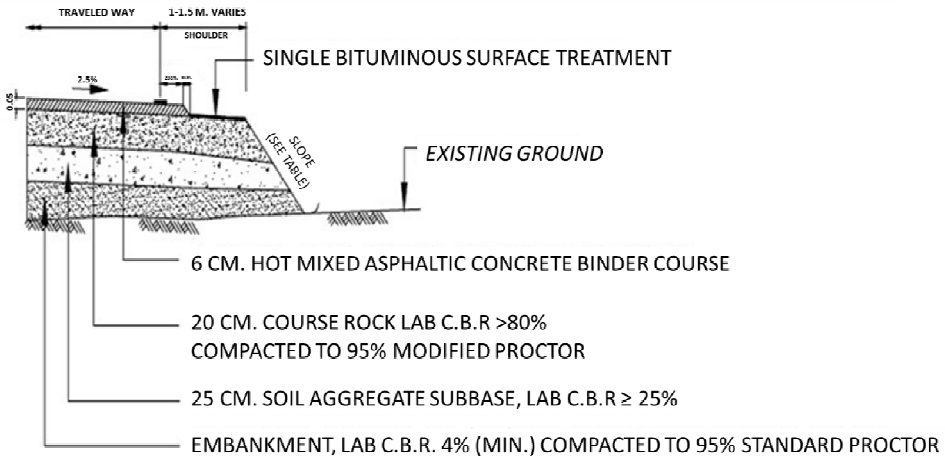
Source: MIE; Soil and Material Sources Investigation Report, October 2015 by TESCO Consultant

4.4 Pavement Structure and Embankment Design

According to a review of the previous of pavement design report, the consultant designed the Pavement in 2 types namely, Asphalt Concrete Pavement and Reinforced Concrete Pavement, the details are as follows;

4.4.1 Asphalt Concrete Pavement Design

Asphalt concrete pavement is flexible pavement. The thickness design of asphalt concrete pavement follows the method described in The Asphalt Institutes Manual Series No. 1 Eighth Edition (1970): Thickness Design – Full-Depth Asphalt Pavement Structures for Highways and Streets. The pavement is designed as a Full-Depth Asphalt and replaced with other types of materials by Substitution Ratio. The parameters for design are traffic load and volume and the strength of subgrade. The asphalt concrete pavement is shown in **Figure 4.4-1.**

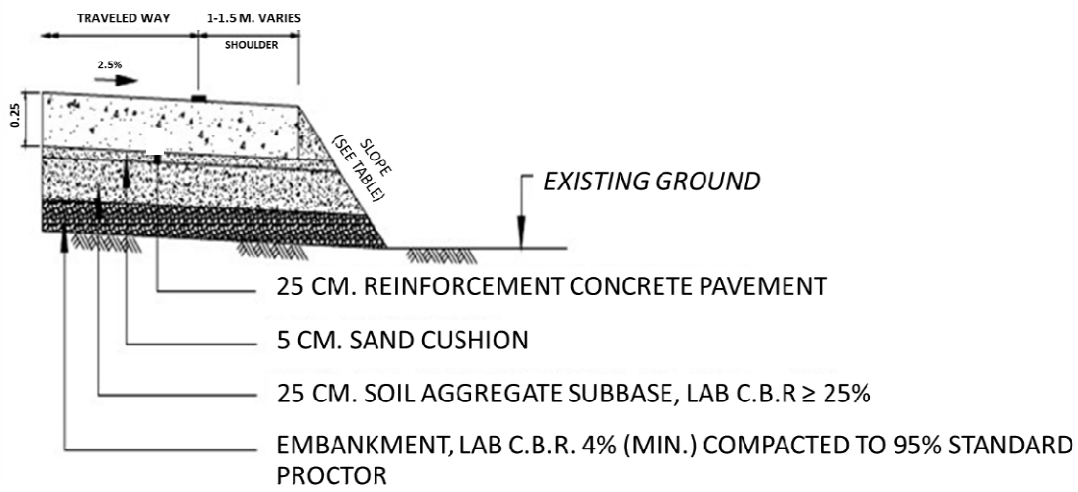


Source: MIE; Final Design Report, October 2015 by TESCO Consultant.

Figure 4.4-1 Previous Design of Asphalt **Concrete Pavement**

4.4.2 Reinforced Concrete Pavement Thickness Design

Reinforced concrete pavement thickness design follows the method presented in Road Note 29. The design factor area traffic road and volume in terms of number of equivalent standard axle load carrying 18,000 pounds and subgrade strength in terms of CBR value. The reinforcement concrete structure on subgrade composes of subbase and concrete pavement shown in **Figure 4.4-2.**



Source: MIE; Final Design Report, October 2015 by TESCO Consultant.

Figure 4.4-2 Previous Design of Reinforced **Concrete Pavement**

4.5 Review of Bridges and Drainage System

4.5.1 Review of Bridges

a. Procedure and Criteria for Review of Bridge Structures

1. Study on existing drawings and design calculations
2. Setting up for the contents to be reviewed
3. Review and report preparation
4. If there are any contents required to be improved, the related documents to be prepared

b. Bridges in the Project

Based on review results, there are 19 locations of bridges whose key function is for crossing the rivers or channels. The locations, total length and related information of bridges are summarized in **Table 4.5-1.**

Table 4.5-1 Summary of Bridges in the Project

Station	width(m.)	No of lane	Bridge Arrangement	Total Length(m)
16+885.787	11.00	7	(1x32.25)+(5x35.00)+(1x32.25)	239.50
19+271.168	11.00	5	(1x29.65)+(3x30.00)+(1x29.65)	149.30
21+933.446	11.00	5	(1x29.65)+(3x30.00)+(1x29.65)	149.30
22+660.669	11.00	3	(1x14.70)+(1x15.00)+(1x14.70)	44.40
45+904.237	11.00	3	(1x14.70)+(1x15.00)+(1x14.70)	44.40
49+159.614	11.00	3	(1x14.70)+(1x15.00)+(1x14.70)	44.40
66+397.180	11.00	4	(1x14.70)+(2x15.00)+(1x14.70)	59.40
68+596.000	11.00	5	(1x29.65)+(3x30.00)+(1x29.65)	149.30
72+914.808	11.00	1	(1x15.00)	15.00
76+512.788	11.00	3	(3x15.00)	45.00
77+175.806	11.00	3	(3x15.00)	45.00
81+454.206	11.00	3	(3x15.00)	45.00
90+901.487	11.00	3	(3x15.00)	45.00
106+956.450	11.00	3	(3x15.00)	45.00
107+951.157	11.00	1	(1x15.00)	15.00
120+248.408	11.00	1	(1x15.00)	15.00
140+081.438	11.00	1	(1x15.00)	15.00
150+591.392	11.00	1	(1x15.00)	15.00
154+755.965	11.00	1	(1x15.00)	15.00

Source: MIE; Final Design Report, October 2015 by TESCO Consultant.

c. Details of a Large Bridge in the Project

There are 19 bridges in the project with 4 bridges crossing over the large rivers. These are the bridge at Sta.16+885.787 Sta.19+271.168 Sta.21+933.446 and Sta.68+596.000.

The consultant review on existing design on structural design criteria and design calculation results nearly most of them are to be checked in existing design documents.

Summary of bridge design review The existing detailed design had been designed based upon the flooding situation. The designed bridge composes of total length of (1x32.25)+(5x35.00)+(1x32.25) = 239.50 m. The level of roadway is +18.00 m. The highest water level is +12.00 m. The piers are designed by using double column with circular shape to reduce stream water pressure.

The footing and foundation are designed as raised foundation. The footing is on the top pile group with appx. 4.00 m. free standing height. The footings are to be protected by skirt. However, the existing design is protected with some short skirt which is insufficient in protecting the bridge as illustrated in **Figure 4.5-2. The consultant will consider designing protection skirt not less than 3.00 m. in height.**

4.5.2 Review of Drainage System Design

The consultant inspected particulars of the project's drainage system. The system is divided into cross drainage and side drainage, including calculating whether or not the designed drainage building is sufficient to take water out of the road. The details are as follows;

1. Consultant reviewed the previous calculation of the hydrological and hydraulic calculations. By hydrological calculation requirements, method to calculate runoff volume and the calculation of the drainage capacity of the designed drainage **Indicates that the designed drainage system is sufficient for drainage in the project area.**
2. Cross Drainage Building examination found that the design of the building is in the draft of Plan & Profile throughout the project which is consistent with the hydrological and hydraulic calculations list. The drainage system consists of

- 19 bridges is specified by location and length of bridge span.
- 21 reinforced concrete box culverts are assigned with position, size, length and level of them.
- 402 pipe culverts diameters 0.8, 1.00 and 1.20 meters are designated by position, size, length and level of the pipe.

4.5.3 Erosion Protection

The consultant went through **the previous design and found that the drainage building ran parallel with the road to prevent erosion but did not show the type, size, location and where water would be discharged.** Since the road runs past high slopes, it is highly likely that there will be erosion caused by rain water flowing at speed which road side cannot endure and the erosion will follow. Therefore, it is necessary to show the type, size, parallel type, location of the side drainage for use in the construction process by determining the position required to install the R.C. DITCH LINING, it is determined by the flight of the air from the Manning Formula Method, the faster the water is greater than the resulting erosion, the R.C. DITCH LINING needs to be installed so that erosion does not occur.

4.6 Review of Road and Intersection Design

The consultant reviewed the detailed design of the two-lane road project which was prepared by the Myanmar from the beginning of the project at Sta.16+458 to the end of project at Sta.156+500. The total distance is approximately 140 km. Most of the route is rolling and passing mountainous terrain. The following details;

4.6.1 Procedures in Consideration of Horizontal and Vertical Curve Design

Review of the original design There are criteria and guidelines for consideration as follows.

- Compliance with Design Class 4 of the Department of Highways (DOH) according to the TOR.
- Retain the alignment, preferably to the existing access road.
- Avoid increasement of high cut-fill volume and reduce environmental impact.
- Decrease percentage of Gradian Design to not over 10% (Except at the Elephant Cry Hill where the gradian must not exceed 12%), according to the specified TOR.

4.6.2 Criteria Applied in Consideration on Horizontal Curve Design

1) Standard Procedures applied in Consideration of Horizontal Curve Design

Horizontal Curve Design Consideration Procedure is in conformity with "A Policy of Geometric Design of Highway and Streets" 2011 with relevant standards as follows;

- The minimum radius (R_{min})
- Stopping Sight Distance (S)
- Horizontal Sight Offset (HSO)

2) Horizontal Curve Design Consideration Procedure

- Check if the minimum radius (R_{min}) and design radius (R_D) is according to the design speed range.
- Verify if the stopping sight distance (S) and length of horizontal curve (L) according to the design speed range
- Inspect the Horizontal Sight Offset (HSO)

4.6.3 Vertical Curve Design Consideration Criteria

(1) Vertical Curve Design standard Consideration Procedure

Vertical Curve Design Consideration Procedure is in accordance with "A Policy of Geometric Design of Highway and Streets" 2011 is a variable in determining the length of vertical curve. The S and K values vary according to the design speed range.

(2) Step for Vertical Curve Design Consideration Procedures

(2.1) Check the Vertical Curve Rate (K) that AASHTO suggests (K_a) with the designed K value (K_D).

(2.2) Inspect the stopping sight distance (S) and the vertical curve length (L) according to the design speed range.

4.6.4 Summary of the Horizontal and Vertical Curve Design Consideration Procedures

The Horizontal Geometric Design considers re-alignment is preferable to the existing road (Access Road) at 2 locations namely, the Dewahda Hill (Sta.27+250 to Sta.28+250) and the Saddle Hill (Sta.49+700 to Sta.50+850). For the Elephant Cry Hill (Sta.100+250 to Sta.103+351), the consultant considers re-alignment to reduce the amount of soil, cut the soil filling with details of the revision of 3 stages and the design of all horizontal and vertical geometry of the project will

be discussed in chapter 5 Survey and Engineering Studies Topic 5.6.2 Design of horizontal and vertical geometry.

4.6.5 Review of Intersection Design

The consultant reviewed the previous design and found that that there were no details in the intersection design. There are 3 positions in Plan and Profile as follows;

The Intersection No.1: (Sta.18+500) it is designed as a ground level intersection, this intersection receives traffic volume from Dawei Special Economic Zone (DSEZ) and Highway 8, both inbound and outbound.

The Intersection No.2: (Sta.54+300) The intersection is between the project road and community road (Rural Road) for villagers in the area. The previous design considered to use a reinforced box culvert with a width of 3.6 x 3.6 m. in height.

The Intersection No.3: (Sta.67+677) The intersection is between the project road and Rural Road to Myitta Town.

The consultant has designed the traffic lanes Additional Lane and arranged for additional lanes in order to be able to make left turn in and out of the intersection and wait for the right turn safely. The intersection control design is appropriate to the principles of engineering.

4.7 Electrical Lighting and Signal Lights

The consultant reviewed **the previous design without designing lighting and signal lights.** The consultant has designed the lighting system along the route such as the bridge at Sta.16+885.787, the Intersections, the Rest Area, the Toll Plaza and the Traffic Change Over.

4.8 Review of the Safety Condition

The consultant considered and provided safety condition to road users, including considering risk positions where accidents can happen and adjust them to be safer according to engineering principles. Review of security work are as follows;

1. **Additional Lane or Climbing Lane, the previous design did not specify additional lane location :** The consultant has considered the criteria for additional lane for trucks or climbing lane at steep slopes where radius of curves is small in order to climb up. This causes traffic speed of the trucks to decrease and results in vehicles to be at risk of overtaking accidents. Therefore, additional lane needs to be designed for trucks, in other words, additional lane for more safety.

2. **Safety at intersection, None in the previous design :** The consultants will design the intersection to be safe by arranging traffic lanes in accordance with the standards. Including installing safety equipment such as traffic signs and traffic signs, etc.

3. **Safety Equipment :** The consultant has reviewed the previous design with installation of Roadside barrier such as steel beam guard rail and concrete barrier in the detailed design drawing. Which the consultant will further consider the additional design as necessary.

4. **Traffic Sign :** The consultant has reviewed the previous design been installed in the number of 2,680 posts, Milestone 280 milestone, with he traffic signs consist of Regulatory Sign, Warning Sign and Guide Sign. The consultant will design additional traffic signs during dangerous curves, the three sections of the route aligned (as detailed in Section 5.6.2) and the re-designed intersections for the 3 positions (as detailed in Section 5.6.3).

5. **Pavement Marking :** The consultant has reviewed the previous design that has pavement markings made of Thermoplastic Paint consist yellow marking 21,000 m^2 and white marking 84,450 m^2, according to the standards of the Department of Highways, Thailand and International Standard. Pavement markings consist of normal dividing lines, traffic dividing lines, do not overtake lines, traffic change forbidden, road center line, the outer and inner edges of the road, warning lines to reduce speed, direction arrows, etc. The consultant has considered the design of the normal directional lines, overtaking traffic dividing line, traffic prohibition lines, road center line, the outer and inner of the road, which the re-designed intersections for the 3 positions, including Additional Rumble Strip by designed in various dangerous areas.

6. **Traffic Management Plan During Construction :** The previous design does not have this plan. Which the consultants will prepare the traffic management plan during construction.

7. **Traffic Change Over :** The consultant has reviewed the previous design, located at Sta.156+000 near the Thai/Myanmar border on Myanmar side.

4.9 Review of the Construction of the Right of Way Land Use Data

The consultant reviewed the map showing details of the existing terrain and the existing boundary. The width of the general road is 40.00 meters. In some parts there will be a wider area, such as the toll plaza location and rest area, etc. The most of the terrain is forest area with a community zone in some areas of the project route.

4.10 The Amount of Construction and Cost Estimation

The consultant reviewed the construction volume and estimated the cost of the previous design. With details as follows

4.10.1 Unit Cost Estimate

There are 3 elements to be considered for unit cost of previous designed:

1. Material Cost

The previous designed as no any source of material information around or nearby the site, for conservative reason, material price at Kanchanaburi plus those as listed in the Price List Book published by Ministry of Commerce, Thailand, January 2017 are adopted. Transportation costs vary between the three roadway sections, using fuel cost of diesel at 30-31 Baht/liter However, in case any materials can be purchased with the lower price in Myanmar, the material cost can be adjusted to suit.

2. Labour and Machine/Equipment Costs

Labour cost, machine/equipment and its operation costs are as published by the Ministry of Finance, Thailand. However, in case we can find labor and machine/equipment in Myanmar, of course the cheaper price, the labor and machine/equipment cost can be adjusted to suit.

3. Indirect Cost

The Indirect Cost, in terms of "Factor F," which shall include an overhead cost, interest, profit, tax, and rain condition at the construction site is adopted from the November 2016 "Construction Budget Calculation Regulations," published by The Comptroller General's Department of the Ministry of Finance, Thailand. The key conditions in selecting Factor F

values are : Advance Payment : 10% Interest Rate : 6% per annum

Retention : 0% Value Added Tax (VAT) : 7%

The consultant will update the unit price to be current and correspond to the project area as much as possible.

4.10.2 Summary of Construction Cost Estimation of the Previous Design

Cost estimation by the previous design is 4,307 billion Baht. The cost will be 5,014 billion Baht including the Factor F. This is shown in **Table 4.10-1.**

Table 4.10-1 Summary of Construction Cost Estimation of the Previous Design

The Two-Lane Road , Connecting Dawei SEZ. With Thai Border

Sta.16+458 - Sta. 156+500 **Dist. 140.042 Km.**

SUMMARY

Item No.	Description	Amount Exc.factor F (Baht)	factor F	Amount Inc.factor F (Baht)
1	GENERAL PROVISIONS	116,488,400.00	-	116,488,400.00
2	EARTHWORKS	2,040,697,700.00	1.1733	2,394,350,611.41
3	PAVEMENT	1,154,889,400.00	1.1733	1,355,031,733.02
4	DRAINAGE	116,756,800.00	1.1733	136,990,753.44
5	STRUCTURES	377,345,188.00	1.1438	431,607,426.03
6	MISCELLANEOUS	383,712,100.00	1.1733	450,209,406.93
7	BUILDING	60,000,000.00	1.2111	72,666,000.00
8	PARTICULAR SPECIFICATIONS	57,600,000.00	1.0000	57,600,000.00
	GRAND TOTAL	4,307,489,588.00		5,014,944,330.83

Source: MIE; Final Design Report, October 2015 by TESCO Consultant.

4.11 Review of Location and Design of Toll Plaza and Rest Area

4.11.1 Review of Location of Toll Plazas and Rest Area

The consultant determined the position of toll plaza and rest area (Vista Point) found that in the previous design, the location of toll booths has been determined to 4 points and 1 rest area. Summary of positions of toll booths and rest area are shown in the **Table 4.11-1. The consultant will consider the toll plaza position and the rest area to be suitable, including considering the design of details to be efficient and worthwhile for further investment.** The details of the previous design consist;

Table 4.11-1 Summary of Toll Plazas and Rest Area Positions

No.	Station	Description (Previous Design)
1	18+850	Toll Plaza no.1
2	65+150	Toll Plaza no.2
3	68+393	Toll Plaza no.3
4	73+000	Rest Area (Vista Point)
5	155+700	Toll Plaza no.4

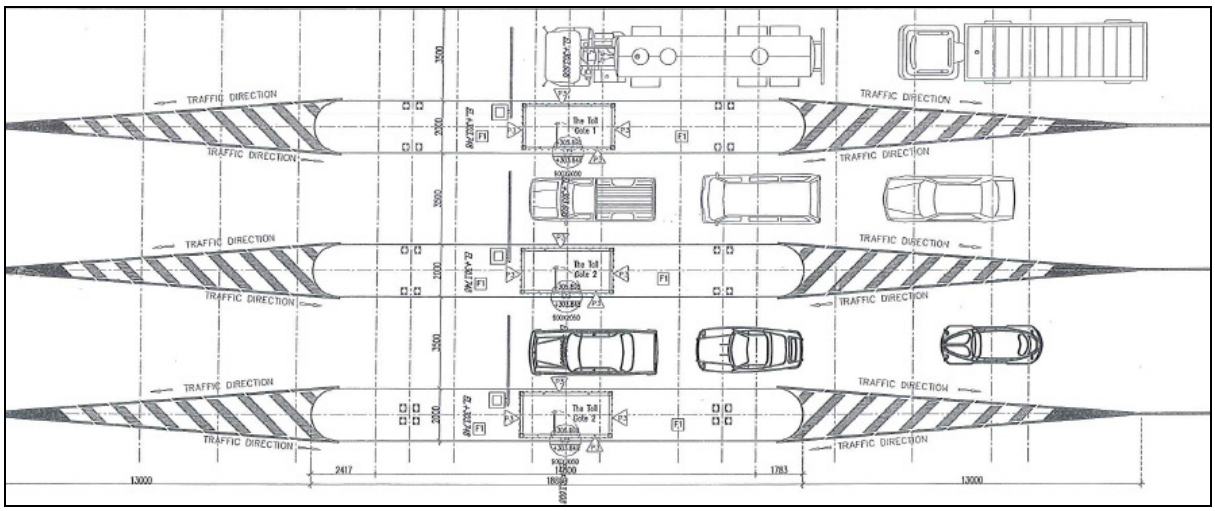
Source: MIE; Final Design Report, October 2015 by TESCO Consultant.

4.11.2 Review of Toll Collection System

(1) Review of the Toll Collection

Toll collection building System consists of 3 lanes width configuration as shown in **Figure 4.11-1** as follows;

- 1 Lane for medium and large trucks with 3.5 m. width.
- 2 Lanes for small cars and motorcycles with 3.5 m. width.



Source: MIE; Final Design Report, October 2015 by TESCO Consultant.

Figure 4.11-1 Previous Design of Toll Collection Building System

(2) Toll Booth Structure

In the previous toll collection structure design, the roof structure design is a metal sheet roof. The consultant has considered it appropriate but will consider adjusting the roof structure to be smaller in order to comply with usage and budget and other assembly buildings designed as a reinforced concrete building.

(3) Toll Collection System

None contain the Toll Collection System design in the previous design. The consultant will be design Toll Collection System.

4.11.3 Review of Rest Area Design

The consultant reviewed the previous design of rest area namely Rest Area or Vista Point, at Sta.73+000, which consists of Service Center, Staff Accommodation, Service center retails shop and Toilet, which without building structure design. The consultant will consider, should design only the necessary parts. **However, no building structure detailed design in previous design.**

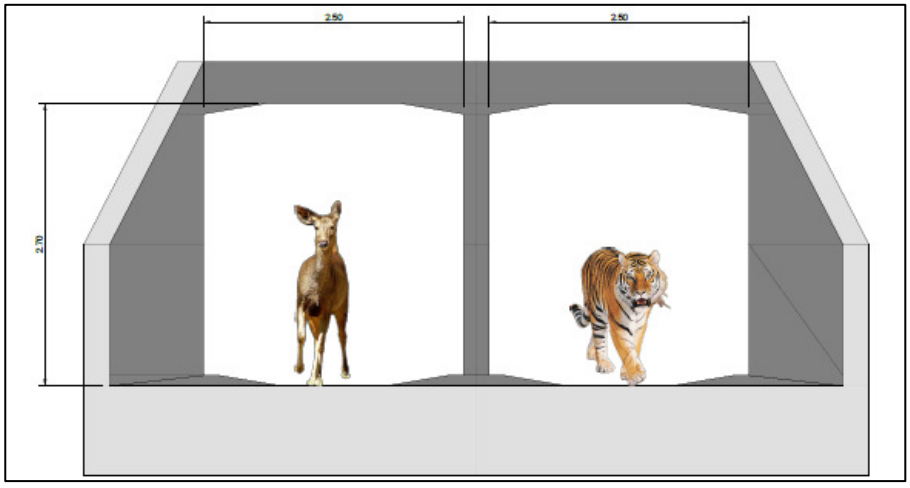
The consultant will be detailed design the building structure of rest area as necessary and appropriate. The architect of rest area previous design

4.12 Review Location and Design of Wildlife Crossing

The consultant reviewed the location and design of wildlife crossing along the road and focused on Myitta-Sinphyudaing to be corresponding to the environmental review given in the previous EIA report approved by the Myanmar side (2018), which refer to information in the Design Manual Building a Sustainable Road to Dawei Enhancing Ecosystem Services and Wildlife Connectivity (WWF Report 2016). The wildlife crossing specifily all 8 locations consisting of 2 forms as followed;

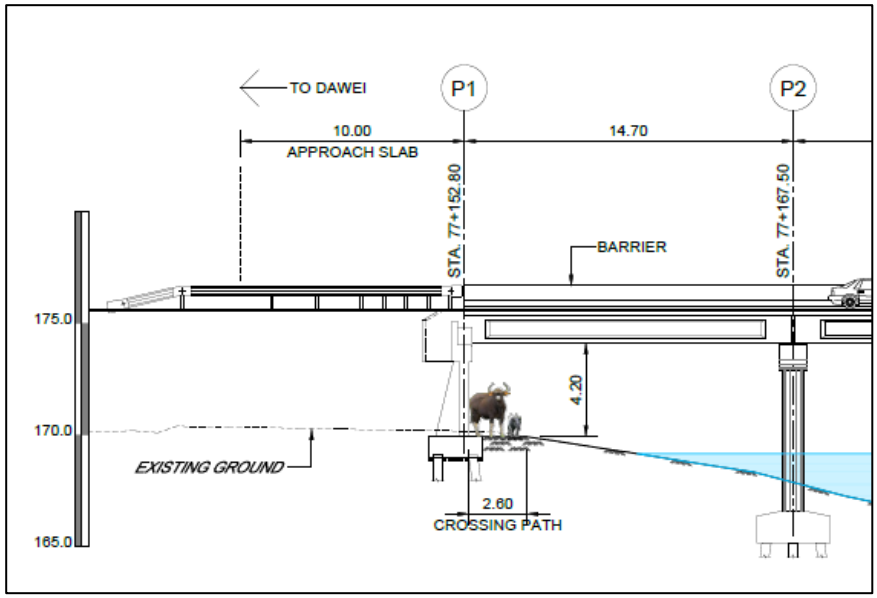
1. **The Wildlife Crossing RC. Box Culverts** at the width of 2.50 m. and height of 2.70 m. at Sta. 33 34 35 53 and 126 as shown in **Figure 4.12-1.**
2. **The Wildlife Crossing Under Bridges** number 11, 12 and 13 on both left and right sides as shown in **Figure 4.12-2.**

In this regard, the consultant did determine the location and design of the wildlife crossing to be suitable for the animal type and in accordance with the results of wildlife resource survey data.



Source: Design Manual Building a Sustainable Road to Dawei Enhancing Ecosystem Services and Wildlife Connectivity (WWF Report 2016)

Figure 4.12-1 Wildlife Crossing RC. Box Culvert



Source: Design Manual Building a Sustainable Road to Dawei Enhancing Ecosystem Services and Wildlife Connectivity (WWF Report 2016)

Figure 4.12-2 Wildlife Crossing Under Bridge

4.13 Tender Documents Preparation

The consultant scrutinized the previous tender documents and found out that **there is only General Specifications article,** which is a part of the complete document. It composes of;

SERIES 100 GENERAL PROVISIONS

SERIES 200 EARTHWORKS

SERIES 300 PAVEMENT

SERIES 400 DRAINAGE

SERIES 500 STRUCTURES

SERIES 600 MISCELLANEOUS

In this regard, the consultant will prepare Bidding Document of Contractor and Recruitment of Consulting Firms for Projects according to the TOR.

CHAPTER 5

SURVEY AND ENGINEERING STUDY

In reviewing the survey and detailed design of the two-lane road project conducted by the Myanmar department (Previous Design), the consultant conducted additional survey and engineering design, summarized as in **Table 5.1**

Table 5.1 Additional Survey and Engineering Design

No.	Contents	Design	Detail
5.1	Traffic Survey and Transportation	Traffic Survey and Transportation Modeling	• Traffic Survey (25-27 March 2019). • Transportation Modeling 3 Scenario
5.2	Topographic Surveying and Leveling	Additional Survey by UAV (29 April - 3 May 2019)	• Use all the previous survey results. • Survey by UAV • Additional Topographic Data must be collected in areas of Sta.27+250 to Sta.28+250 (Dewahda Hill) and Sta.49+700 to Sta.50+850 (Saddle Hill).
5.3	Soil and Material Investigation	Additional Survey	• Geological investigation on 4-6 June 2019 • Recheck 5 Main Material Resources
5.4	Pavement Structure and Embankment Design	• Asphaltic concrete pavement (116 km. of distance) • Reinforcement concrete pavement (24 km. of distance)	• Along the route Design asphaltic concrete pavement • The steep slopes, Rest Area, Tolls Plaza and Intersections design Reinforcement concrete pavement
5.5	Bridge and Drainage System	• Reviewed and no revision on 19 bridges • Design to use Foundation Protection Fin (Skirt) at bridge Sta.16+885.787 • 21 Box culvert no revision • Re-design all 402 pipes culvert to R.C. BOX CULVERT 1.20x1.20 m. • Design side drain	The R.C.Box Culvert 1.20x1.20 m. did new designed total 402 points. • 152 points for new design of contract 1. • 250 points for new design of contract 2.
5.6	Road and Intersection Design	• Re-design the previous alignment to the existing road total 3 locations. • Re-Gradiant $\leq$ 10%. (Along Alignment) • Intersection Design (Sta.18+500 / Sta.54+300 / Sta.67+667)	Re-alignment to the existing road total 3 locations 3 locations • Sta.27+250 to Sta.28+250 (The Dewahda Hill). • Sta.49+700 to Sta.50+850 (The Saddles Hill). • Sta.100+250 to Sta.103+351 (The Elephant Hill)

No.	Contents	Design	Detail
5.7	Electrical Lighting and Signal Lights	• Solar cell Electrical Lighting and Signal Lights. • Designed the Proposed Traffic Signal Lights	Electrical Lighting • Bridge at Sta.16+885.787 • 3 Intersections (Sta.18+500 / Sta.54+300 / Sta.67+667). • Rest Area • Toll Plaza 2 locations • Traffic Change Over Warning Flashing Light • 3 Intersections (Sta.18+500 / Sta.54+300 / Sta.67+667). • Traffic Change Over at Sta.156+075
5.8	Safety Condition	• Additional Lane for Truck or Climbing Lanes for Truck • Channelization Intersection • Safety Equipment • Emergency Stop Bay Station • Road Stud • Traffic Sign and Marking • Traffic Management Plan during Construction • Traffic Change Over	• Designed 7 Locations of Additional Lane for Truck. There are total distances about 5.28 km. • Channelize 3 Intersections are Sta.32+750 Sta.98+600 and Sta.128+500 • Designed 3 Locations of Emergency Stop Bay are Sta.32+750 Sta.98+600 and Sta.128+500 • Installed Road Stud • Installed Traffic Sign and Marking • Installed Ramble Strip • Design of Traffic Change Over at Sta.156+075
5.9	Right of Way (R.O.W.)	Width 70.00 m.	R.O.W has width 70.00 m. Along alignment (Except 2 Tolls Plaza & Rest Area).
5.10	The Amount of Construction and Cost Estimation	• Update the unit price to be current.	• Construction cost about 3.95 million Thai Baht. (excluded %Vat and %Contingency)s
5.11	Toll Plaza & Rest Area	• Sta.18+918: Toll Plaza No.1 • Sta.69+050: Rest Area • Sta.155+700: Toll Plaza No.2	Toll Plazas • Office • Toll Collection and Electrical Rest area • Office + Toilet + Parking + (Proposed Shop Area / Service Area / Proposed Fuel Station) • Electrical Design
5.12	Wildlife Corridors Design	• Design of Wildlife Corridors 12 Locations	• The Wildlife Crossing RC. Box Culverts 3.60 m. x 3.60 m. (2 locations) • The Wildlife Crossing Under Bridge (10 locations)
5.13	Tender Documents Preparation	• Selection of Contractors • Selection of Consulting Engineers	Contract 1: distance 52.592 km. • 8 bridges: at 880.00 m. 152 RC. Box Culverts. • Duration of construction: 30 months. Contract 2: distance 87.450 km. • 11 bridges: at 315.00 m. 250 RC. Box Culverts. • Duration of Construction: 30 months.

5.1 Traffic Survey and Transportation

5.1.1 Traffic Volume and Freight Transport Survey

The traffic and transportation data survey and data collection are divided into 4 types in order to find normal traffic, traffic deviations and traffic induction. The finding shall be used in traffic volume forecast in the future. The survey employs studying methods as follows;

1) Mid-Block Classified Counts: MB

The traffic data will be used for the traffic conditions analysis on network and used to calibrate and validate traffic modeling in order to make data accurate and update. The survey will be conducted between 07:00 am. to 07:00 pm. (12 hr.), with the distribution of traffic counts every 15 minutes and classify vehicles class following the DOH vehicle types. The survey will be conducted on 3 exploration points as shown in **Figure 5.1-1.**

2) Turning Movement Count: TMC

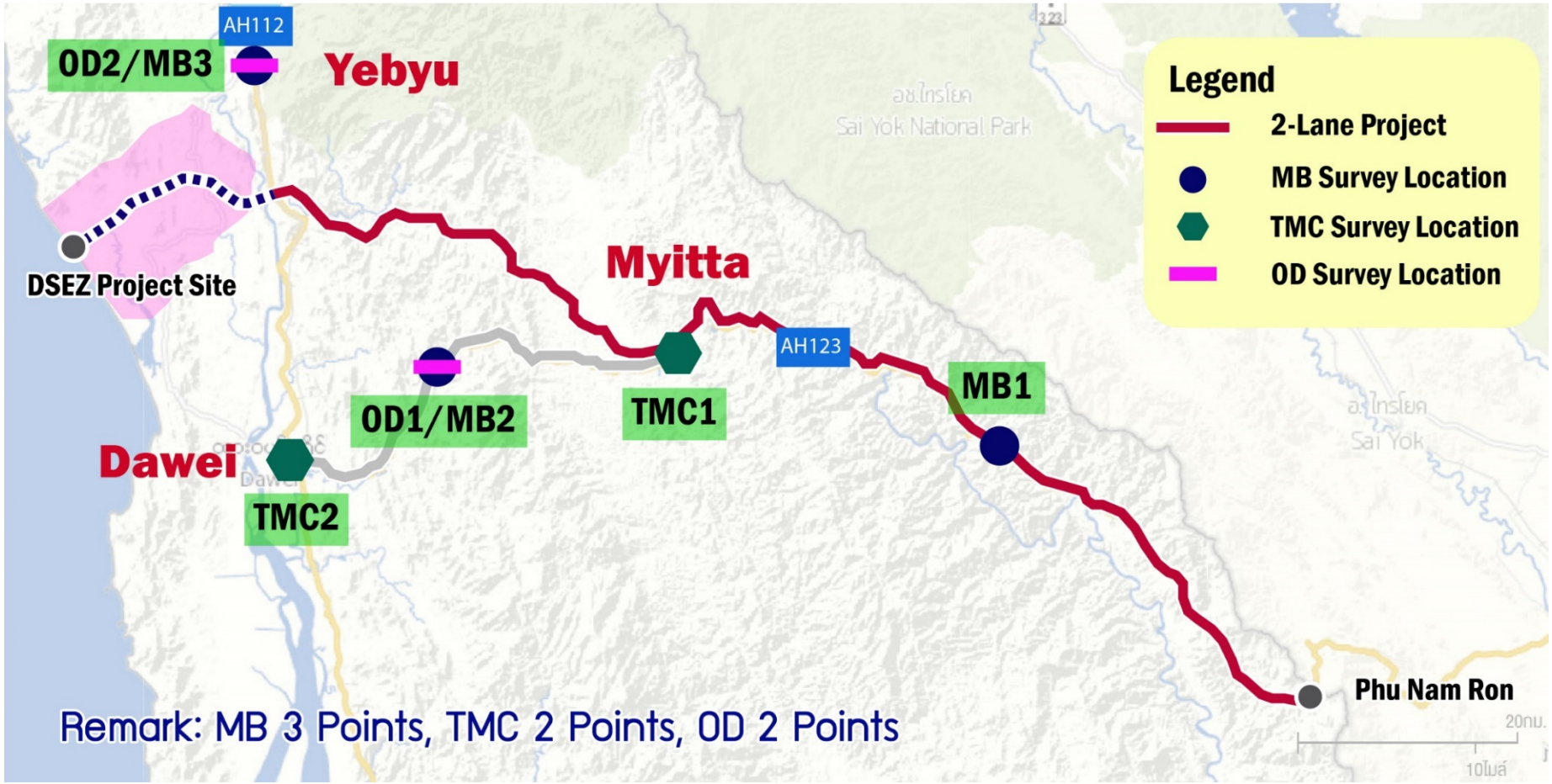
This survey aims to collect traffic data in each direction that enters and exits the intersection. The traffic data will be used to analyze traffic conditions on network and used to calibrate and validate traffic modeling to be accurate with current condition. The surveying will be conducted from 07:00 am. to 07:00 pm. (12 hr.), with the distribution of traffic counts every 15 minutes and classify vehicles class like the mid-block surveying, The TMC survey will be conducted on 2 points as shown in **Figure 5.1-1.**

3) Origin–Destination Survey (O-D Survey)

This survey aims to explore the origin–destination (O-D survey) of traveling, travel volume in study area, the traveling through traffic of study area, and the traveling behavior of freight. The traffic data will be used for the O-D Matrix analysis on network and used to calibrate and validate the travel behavior on modeling to be accurate with current condition. The surveying will be conducted from 07:00 am. to 07:00 pm. (12 hr.), by stopping vehicles along the road and asking travelers to fill in questionnaires and giving interviews. The O-D survey will be conducted on 2 points as shown in **Figure 5.1-1.**

4) Travel Speed Survey

This survey aims to find the average speed of traveling on the road network for assembling, modifying the model to be suitable for the behavior of the drivers, physical characteristics of the road, and characteristics of traffic conditions in the project area. The survey will use a testing car equipped with a GPS-Tracking running in the specified route, recording distance and time when passing various reference points during 07:00-19:00 hrs. The consultant will explore on the same day as surveying of MB, TMC and OD by dividing the survey on the road into 4 sections with different physical characteristics and city conditions.



Source : Consultants 2019

Figure 5.1-1 Mid-Block Survey Points, Turning Movement Survey Points and Origin-Destination Survey Point

The summary of traffic survey plan is shown in **Table 5.1-1** and **Figure 5.1-2** which show the overview of survey.

Table 5.1-1 Details of Traffic Survey

Location	Road Name/Intersection	Time Duration	Date
MB1	Dawei-Ban Phu Nam Ron Sta.111+500	12 hours (07:00 - 19:00)	25 March 2019
MB2 / OD1	Dawei Police Sub-Station (Location: 14.082670, 98.217430)	12 hours (07:00 - 19:00)	26 March 2019
TMC1	Kyauk Me Taung Police Station (Myitta – Dawei Road)	12 hours (07:00 - 19:00)	26 March 2019
TMC2	Junction NH8 – Myitta (Location: 14.082310, 98.215001)	12 hours (07:00 - 19:00)	26 March 2019
MB3/OD2	Yebyu Toll Booth on NH8 (Location: 14.186567,98.2057458)	12 hours (07:00 - 19:00)	27 March 2019

Source : The Consultants 2019

Figure 5.1-2 Overview of Field Traffic Survey

5.1.2 Traffic Condition Analysis Guidelines

In the analysis of traffic volume data, analysis of the traffic volume of both vehicle unit (car) and passenger car equivalent unit (PCU) is important. This is because each type of vehicle has different size and usage characteristics. Therefore, it is necessary to convert those vehicles into the same unit by specifying the PCU Factor values of each vehicle type.

5.1.3 Traffic Survey Results

1. Mid-Block Classified Counts: MB

- **Traffic Volume**

The survey of traffic volume on the road network is shown in **Table 5.1-2** found that MB-02 has the highest traffic volume in both directions throughout the day compared to other survey points. This is because it is a residential area with traffic volume in both directions equal to 5,634 veh/day, followed by the traffic volume on MB-03 with the total traffic volume of 4,782 veh/day. Considering the change in the amount of hourly traffic during the survey period, it was found that during the period from 07.00-19.00 hrs., there was no significant change since it was traveling between areas outside the city.

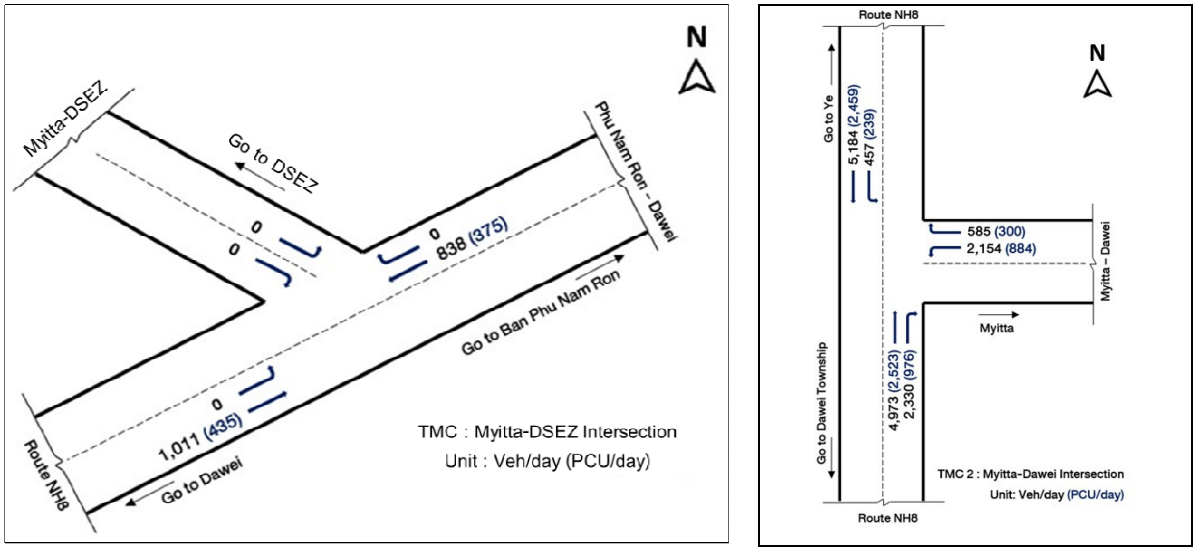
According to the survey, it is found that most of the vehicles used by people in urban areas are motorcycles. In each survey point, there will be at least 50% of motorcycles, but at the junction between Myitta city to the Myanmar-Thai border checkpoint. The majority of the vehicle proportions are light trucks, such as 4WD trucks and 6-wheel trucks.

Table 5.1-2 Traffic Volume Data Analysis from Field Survey

Survey Point	Direction	Traffic Volume 24 hrs.	
		Vehicle	PCU
MB1	to Dawei	76	59
	to Kanchanaburi	87	71
	Total	**163**	**130**
MB2	to Dawei	2,933	1,226
	to Myitta	2,701	1,163
	Total	**5,634**	**2,389**
MB3	to Dawei	2,306	1,396
	to Yangon	2,476	1,403
	Total	**4,782**	**2,799**

2. Traffic Turning Movement Count (TMC)

The consultant surveyed the turning movement count at the two intersections. The first point is located on the intersection between Dawei Road - Ban Phu Nam Ron, intersecting with the road connecting to the DSEZ project area. The second point is located on three-way intersection between NH8-Myitta Road. The obtained traffic data are used to predict traffic volume that enters the intersection in the next 25 years and is used to design and improve the intersection for future travel volume. This is shown in **Figure 5.1-3.**



(a.) Traffic Turning Movement Count at TMC 1 **(b.) Traffic Turning Movement Count at TMC 2**

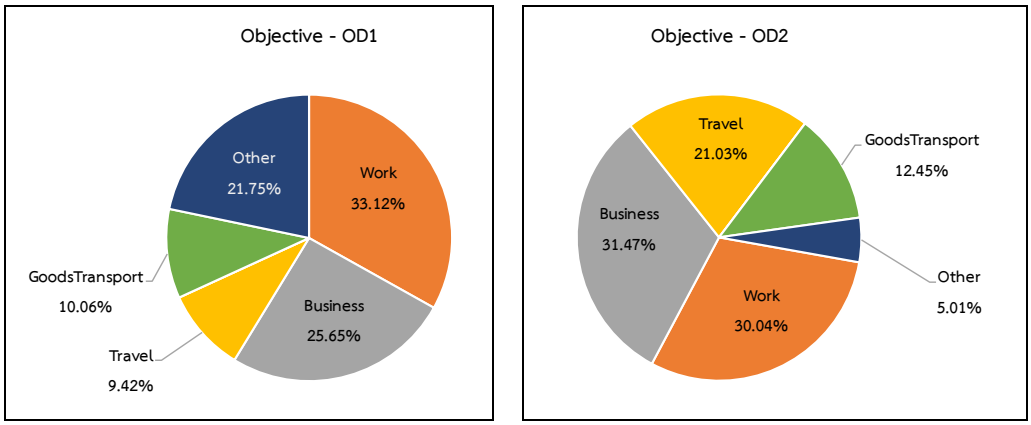
Figure 5.1-3 Traffic Turning Movement Count Results

3. O-D Survey

The purpose of this survey is to understand the behavior of various trips in the project including the amount of traffic within the study area, traffic through or entering or leaving the study area. This will be used as basic information in the development of travel demand models. We conducted the survey by interviewing travelers by means of roadside interview with freight vehicles only. The interview result consists of the following;

We found that most of travel objective is Working trips at 33.12%. It is followed by Business trips at 25.65% at OD1 (between Myitta to Dawei township). The OD2 (Dawei District corridor to Yangon) found that most of Business trips and Working trips at 31.47% and 30.04%, respectively. But at the OD2 survey, which is the boundary of the Adjacent area between Dawei to Mawlumyine, Yangon, it was found that the proportion of travel

at 21.03% while the OD1 survey point, which is the area between Dawei to Myitta, found only 9.42% as shown in **Figure 5.1-4.**



(a.) Purpose to Travel of OD1 **(b.) Purpose to Travel of OD2**

Figure 5.1-4 Purpose of Travel

From the results, the goods transported from OD1 and OD2 are significantly different. The OD results found that goods types are consumer products, household appliances transported through Thailand border and the goods types transported from Myanmar to Thailand are seafood and other agricultural produces and so on. The Results of OD2 will be different from OD1 because the transport through the OD2 area is the main domestic transportation between northern to southern Myanmar, so goods types are food and beverage products, seafood and processed products and consumer products.

Considering the volume of goods, it was found that, the weight volume of goods results of OD1 are in full truck loads at 35% and empty load at 40%, as goods transport trips are delivery and receiving between Thailand/Myanmar crossing the border. While the weight volume results of OD2 are full truck loads at 70% because this route is the main route for goods transport from northern to southern Myanmar.

4. Travel Speed Survey Results

This survey is to observe traffic speed on road network in the study area for calibrating traffic model in term of driver behavior, profiles of road, etc. GPS-tracking will be installed on floating vehicles running along the assigned road section to collect data such as travel time, route, distance, etc. The results are presented below;

- **Section 1: Phu Nam Ron - Myitta**

  This section starts from Phu Nam Ron and crosses the border to Myitta sub township. The average speed is 30.2 km./hr.

- **Section 2: Myitta – Dawei Urban**

  This section starts from Myitta sub township to Dawei urban area. The average speed is 50.12 km./hr.

- **Section 3: Myitta -DSEZ Project Site**

  This section starts from Myitta sub township to DSEZ project site. The average speed is 21.23 km./hr. The road travels uphill, meandering and the road is laterite.

- **Section 4: Dawei Urban – DSEZ Project Site**

  This section starts from Dawei Urban – DSEZ project site (along NH8 road). The average speed is 67.23 km./hr. The road is well paved.

5.1.4 Transportation Modeling

For traffic volume forecast of the project, we will be using the transportation model "Cube" programming to apply travel behavior by developing models to be consistent with the current study area and will analyze the project over the period of 25 years.

5.1.4.1 Assumption for Traffic Volume Forecast

For traffic volume forecast of the project, the consultant used Program Cube to apply by developing the project to match with study area using analyzing period for 25 years as follows;

1. **Duration of the Simulation Analysis:**

   The consultant will predict the traffic volume throughout the 25-year project life by dividing the analysis into every 5 years (2019, 2022, 2027, 2032, 2037, 2042 and 2047)

   - 2019: Base case model
   - 2022: Opening project
   - 2027: Opening DSEZ

2. **Case Study**

   The consultant divided the study into 3 scenarios, namely

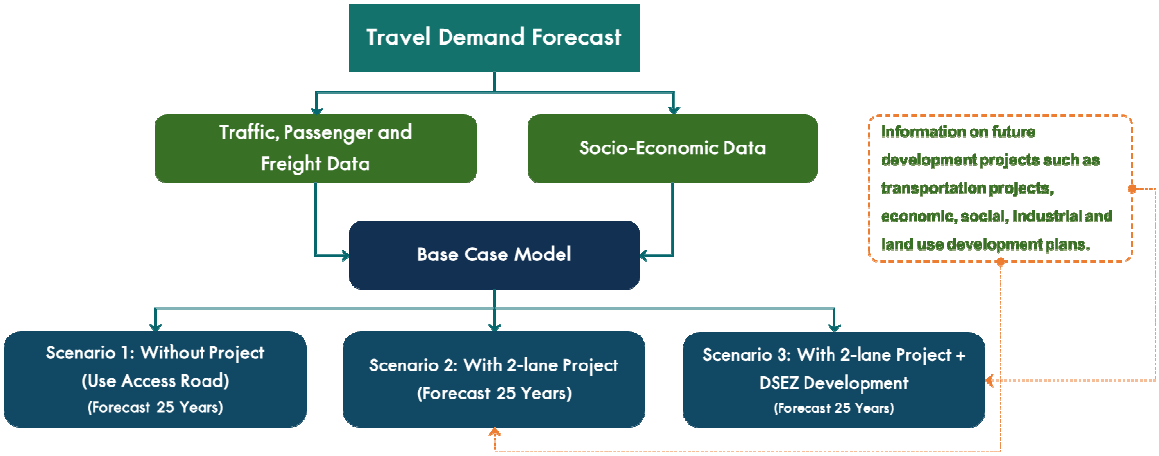
   - **Scenario 1:** "Without Project" (Use Access Road)
   - **Scenario 2:** "With 2-lane Project"
   - **Scenario 3:** "With 2-lane Project + DSEZ Development"

3. Growth of Traffic in Inner and Outer Area:

Future traffic volume will be analyzed into 2 categories, which are non-truck vehicles and trucks. The forecast of future traffic volume is based on assumptions as follows;

- The growth rate of non-truck vehicles is obtained from the "The Preparatory for the Project for Expansion of Yangon Port in Thilawa Area Study in Myanmar", which was conducted by JICA in March 2014. The growth rate of traffic volume during 2019-2047 is about 9.50% per year and this growth rate gradually declines 0.99% per year.
- In case of improvement of two-lane road project without development of DSEZ, the growth rate of truck vehicles is obtained from "Pre-feasibility Study of Establishing a Dry Port in Mandalay region" conducted by UNESCAP in October 2012 and The Preparatory for the Project for Expansion of Yangon Port in Thilawa Area conducted by JICA in March 2014. The growth rate of traffic volume during 2019-2047 is about 13.8% per year and this growth rate gradually declines 0.99% per year.
- The assumptions of traffic volume that enters the project route through the Ban Phu Nam Ron border checkpoint is referred to the project from Three Pagodas / Phaya Tong Su-Tan - Phuphay Yod (At the end of Phaya Tong Su-Ban Chong Song Village). The analysis periods are divided into 2 periods, namely
  - **Phase 1:** In the case of the year of the project opening up to the 10th year, considering that the newly opened checkpoints have a growth rate of 10% of traffic per year.
  - **Phase 2:** After the project has been opened for 10 years to the 25th year, considering that the checkpoint has the ability to be used effectively that lead to increased traffic volume of trucks and personal cars and with economic expansion. Also, the expansion from the ASEAN community, with an average growth rate of 15% per year.
- In case of improvement of two-lane road project with development of DSEZ, DSEZ will be opened in 2027 (after 5 year of the implementation of two-lane road project). The future traffic volume and growth rate during 2019-2047 referred to the "The Consulting Service for the Detailed Design and Related Assistances for the Two-lane Road Project (Dawei-Phu Nam Ron), 2015", which can be divided into 2 types of vehicles, namely, non-truck vehicles and truck vehicles. This growth rate from the previous study will be decreased around 50%

from the estimation of previous project. However, the growth rate of non-truck vehicle is still the same. As the results of the review of the Traffic and Transportation Survey in Chapter 4, it was found that the two-lane traffic projections on the road were divided into two phases: Phase 1 (2015-2023), which was the development phase of the DSEZ project. The traffic forecast is quite high. There is an assumption of the average traffic volume growth rate of 57% per year, but for the second phase (2023-2040) it is the period that the DSEZ project is completed. It is assumed that the average traffic volume growth rate is only 1% per year, with most types of vehicles being trucks for cargo and Non-Truck with the same quantity.



Source : The Consultants 2019

Figure 5.1-5 Modeling Procedures

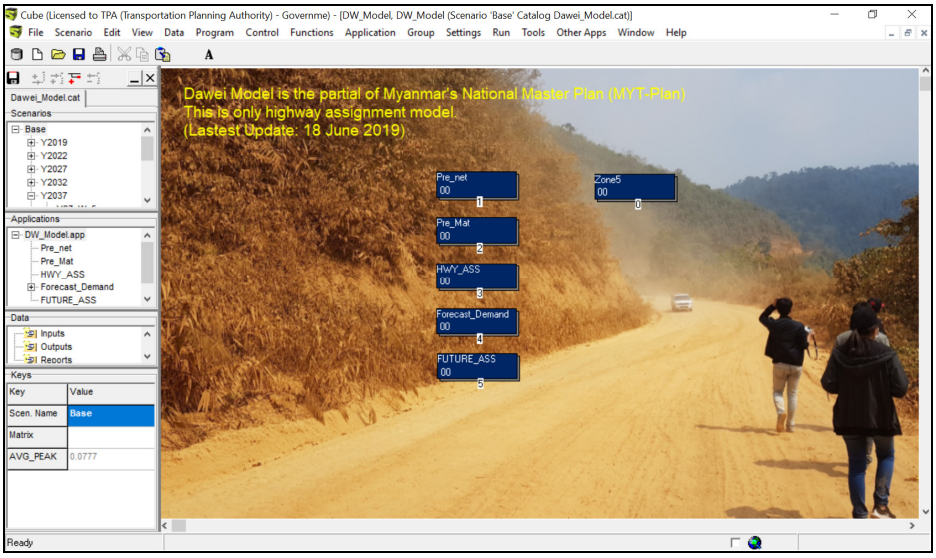
5.1.4.2 Modeling Procedures in the Current and Future Years

Dawei district is selected as study area and it is divided into traffic zones and will be used for determination of traffic patterns between various zones through the origin and destination estimation with the modal shares. The number and size of zone vary depending on each project. However, in this project, traffic analysis zone is classified by subdivisions such as village, Sub district, district, etc.

The study area can be divided into 8 sub-areas which consist of internal zones (number of 5 areas and 3 external zones.

5.1.4.3 Development of Traffic Model in Base Year

Traffic model for traffic volume analysis in the future year. The consultant uses the Cube Transportation Modeling Application model of Citilabs[1] as convincing and widely used around the world as shown in the Dawei model made from Cube Application in **Figure 5.1-6.**



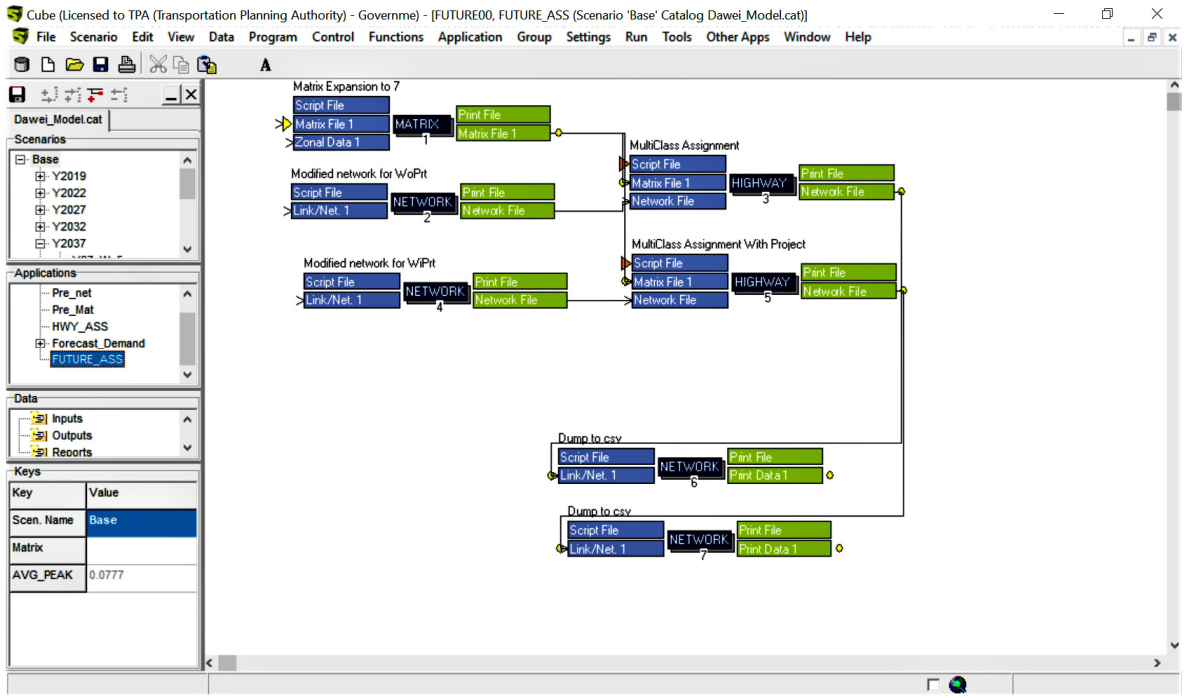
Source : The Consultants 2019

Figure 5.1-6 Model Application for Dawei Project

5.1.4.4 Results of Traffic Volume Forecasting

Traffic model in future years will be built based on the future estimated data both primary and secondary. The process of future traffic volume forecasting is presented in **Figure 5.1-7.**

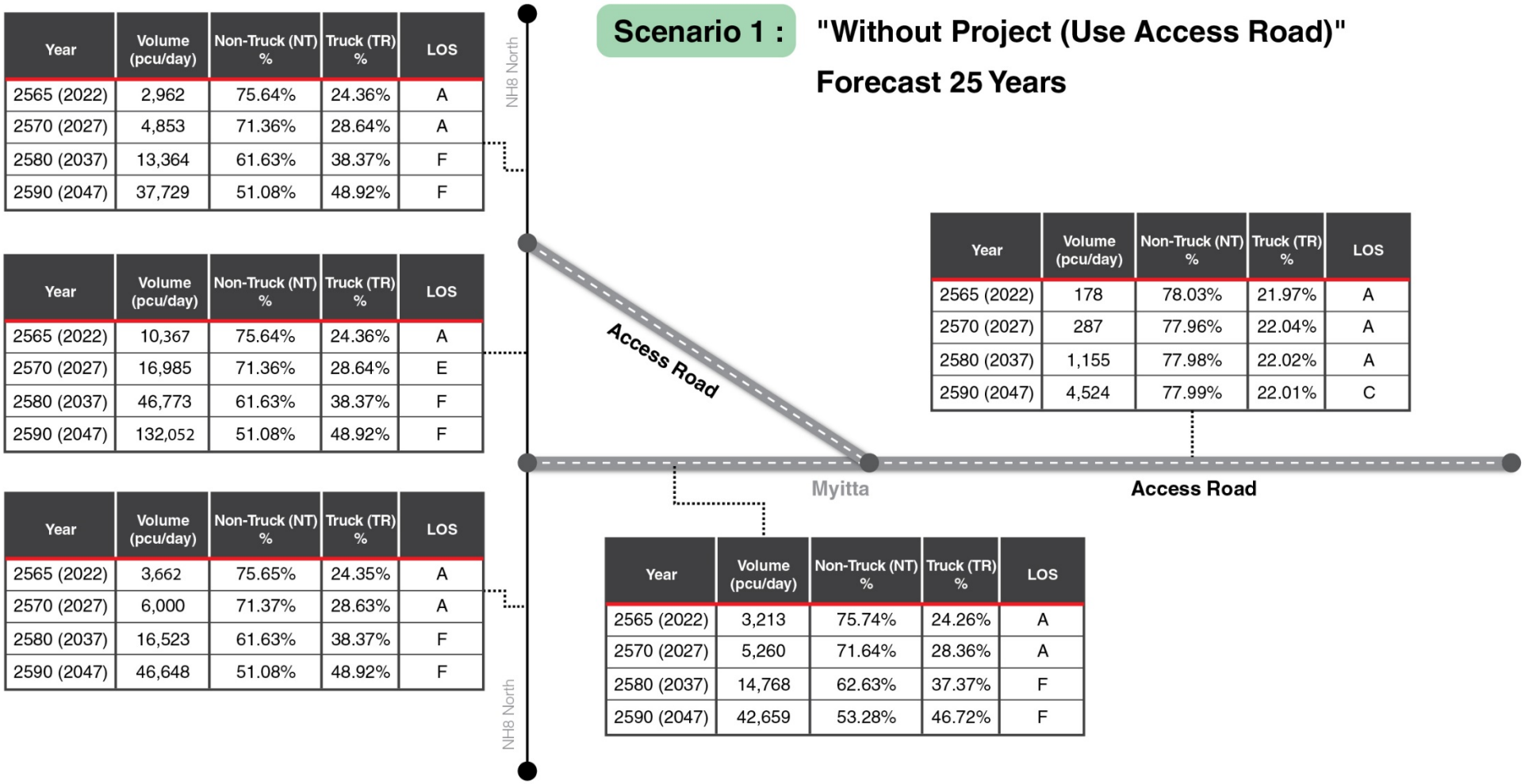
[1] http://www.citilabs.com/software/cube/



Source : The Consultants 2019

Figure 5.1-7 Cube Traffic Model

The results of forecasting traffic volume on the network in the study area in the future year divided according to different road sections along the project road. The results are presented in **Figure 5.1-8** to **Figure 5.1-11.**



Year	Volume (pcu/day)	Non-Truck (NT) %	Truck (TR) %	LOS
2565 (2022)	2,962	75.64%	24.36%	A
2570 (2027)	4,853	71.36%	28.64%	A
2580 (2037)	13,364	61.63%	38.37%	F
2590 (2047)	37,729	51.08%	48.92%	F

Year	Volume (pcu/day)	Non-Truck (NT) %	Truck (TR) %	LOS
2565 (2022)	10,367	75.64%	24.36%	A
2570 (2027)	16,985	71.36%	28.64%	E
2580 (2037)	46,773	61.63%	38.37%	F
2590 (2047)	132,052	51.08%	48.92%	F

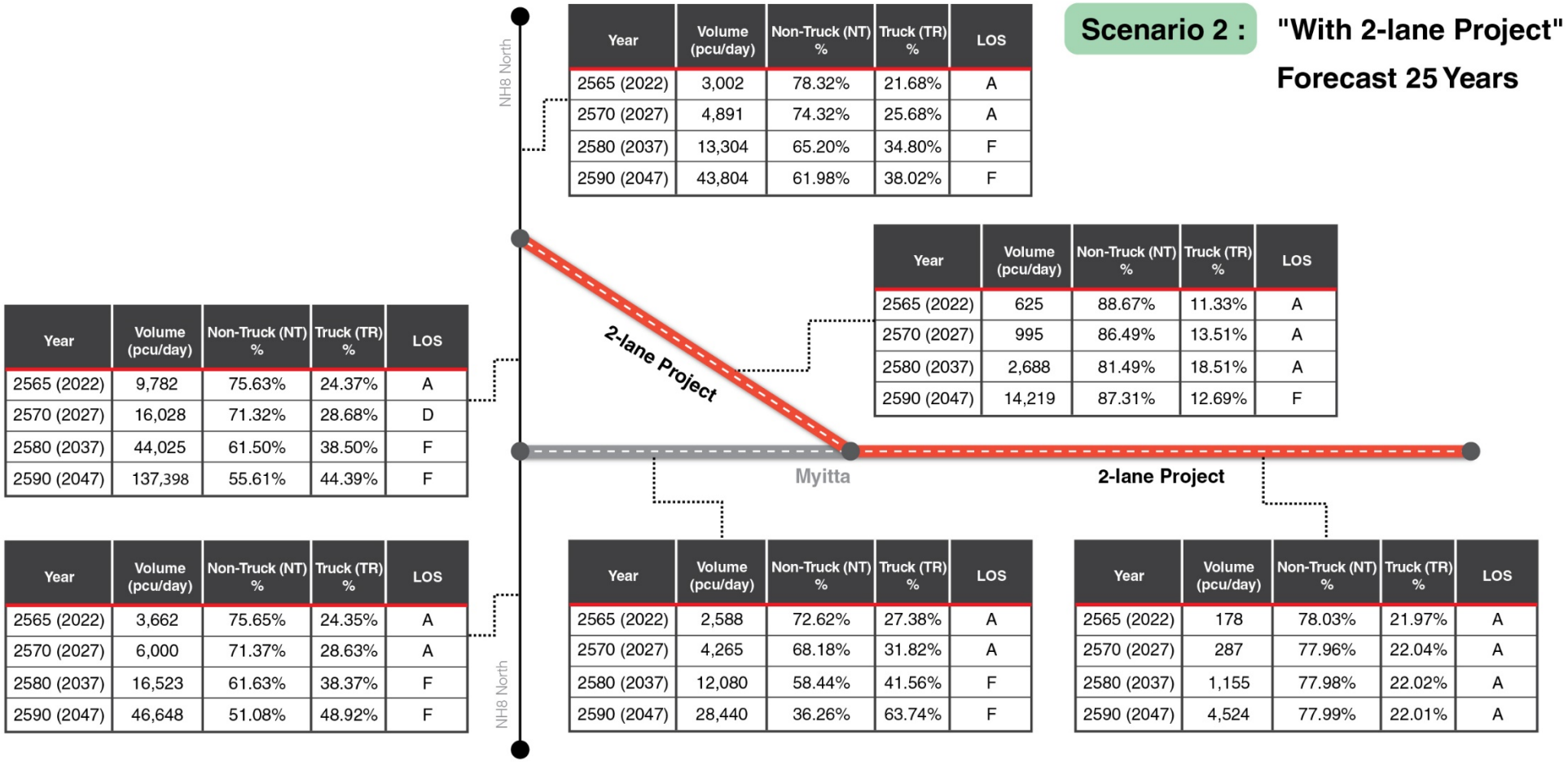
Year	Volume (pcu/day)	Non-Truck (NT) %	Truck (TR) %	LOS
2565 (2022)	3,662	75.65%	24.35%	A
2570 (2027)	6,000	71.37%	28.63%	A
2580 (2037)	16,523	61.63%	38.37%	F
2590 (2047)	46,648	51.08%	48.92%	F

Year	Volume (pcu/day)	Non-Truck (NT) %	Truck (TR) %	LOS
2565 (2022)	178	78.03%	21.97%	A
2570 (2027)	287	77.96%	22.04%	A
2580 (2037)	1,155	77.98%	22.02%	A
2590 (2047)	4,524	77.99%	22.01%	C

Year	Volume (pcu/day)	Non-Truck (NT) %	Truck (TR) %	LOS
2565 (2022)	3,213	75.74%	24.26%	A
2570 (2027)	5,260	71.64%	28.36%	A
2580 (2037)	14,768	62.63%	37.37%	F
2590 (2047)	42,659	53.28%	46.72%	F

Source : The Consultants 2019

Figure 5.1-8 Traffic Volume (Scenario 1)



Year	Volume (pcu/day)	Non-Truck (NT) %	Truck (TR) %	LOS
2565 (2022)	3,002	78.32%	21.68%	A
2570 (2027)	4,891	74.32%	25.68%	A
2580 (2037)	13,304	65.20%	34.80%	F
2590 (2047)	43,804	61.98%	38.02%	F

Year	Volume (pcu/day)	Non-Truck (NT) %	Truck (TR) %	LOS
2565 (2022)	625	88.67%	11.33%	A
2570 (2027)	995	86.49%	13.51%	A
2580 (2037)	2,688	81.49%	18.51%	A
2590 (2047)	14,219	87.31%	12.69%	F

Year	Volume (pcu/day)	Non-Truck (NT) %	Truck (TR) %	LOS
2565 (2022)	9,782	75.63%	24.37%	A
2570 (2027)	16,028	71.32%	28.68%	D
2580 (2037)	44,025	61.50%	38.50%	F
2590 (2047)	137,398	55.61%	44.39%	F

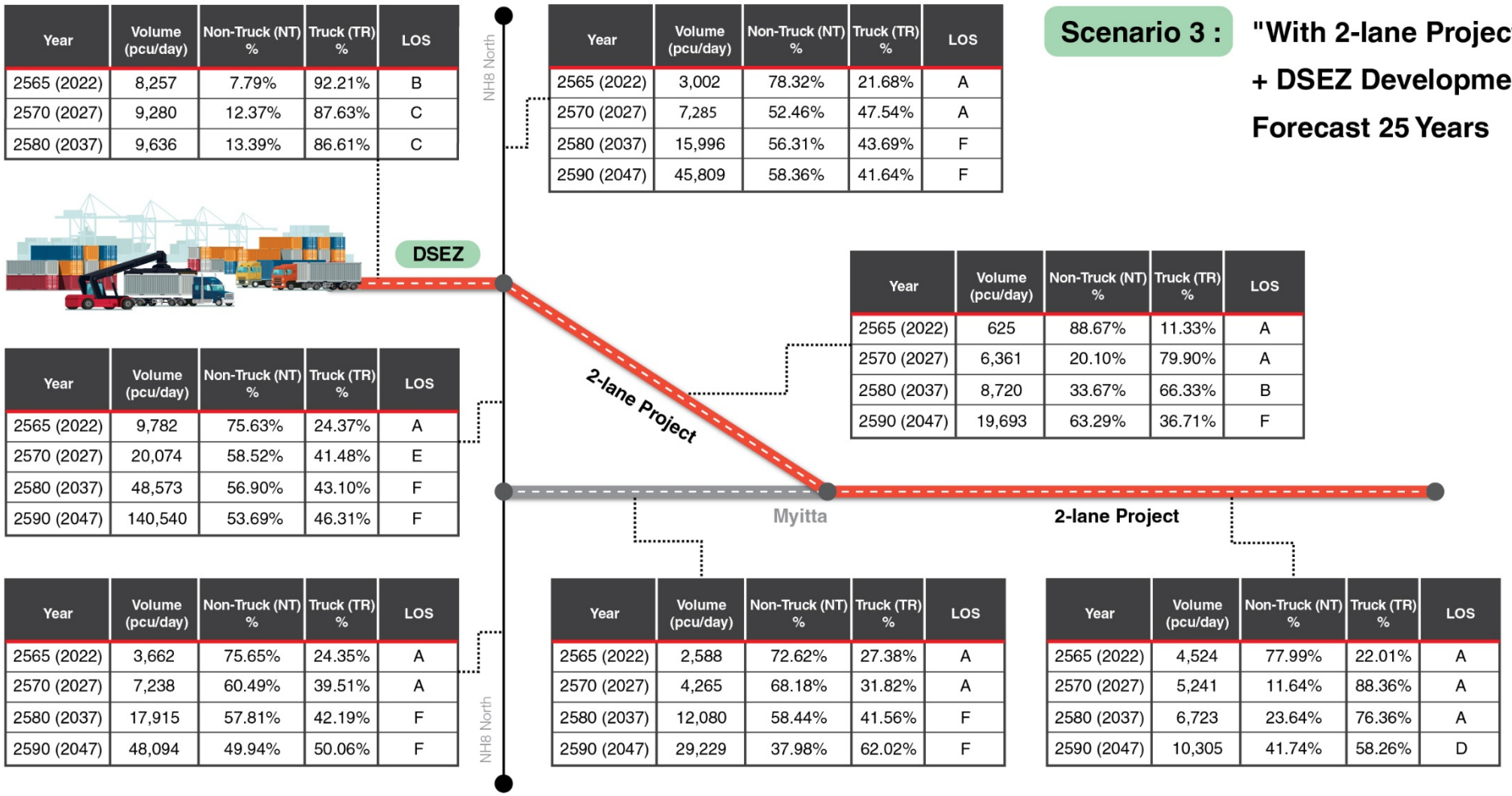
Year	Volume (pcu/day)	Non-Truck (NT) %	Truck (TR) %	LOS
2565 (2022)	3,662	75.65%	24.35%	A
2570 (2027)	6,000	71.37%	28.63%	A
2580 (2037)	16,523	61.63%	38.37%	F
2590 (2047)	46,648	51.08%	48.92%	F

Year	Volume (pcu/day)	Non-Truck (NT) %	Truck (TR) %	LOS
2565 (2022)	2,588	72.62%	27.38%	A
2570 (2027)	4,265	68.18%	31.82%	A
2580 (2037)	12,080	58.44%	41.56%	F
2590 (2047)	28,440	36.26%	63.74%	F

Year	Volume (pcu/day)	Non-Truck (NT) %	Truck (TR) %	LOS
2565 (2022)	178	78.03%	21.97%	A
2570 (2027)	287	77.96%	22.04%	A
2580 (2037)	1,155	77.98%	22.02%	A
2590 (2047)	4,524	77.99%	22.01%	A

Source : The Consultants 2019

Figure 5.1-9 Traffic Volume (Scenario 2)



Year	Volume (pcu/day)	Non-Truck (NT) %	Truck (TR) %	LOS
2565 (2022)	8,257	7.79%	92.21%	B
2570 (2027)	9,280	12.37%	87.63%	C
2580 (2037)	9,636	13.39%	86.61%	C

Year	Volume (pcu/day)	Non-Truck (NT) %	Truck (TR) %	LOS
2565 (2022)	3,002	78.32%	21.68%	A
2570 (2027)	7,285	52.46%	47.54%	A
2580 (2037)	15,996	56.31%	43.69%	F
2590 (2047)	45,809	58.36%	41.64%	F

Year	Volume (pcu/day)	Non-Truck (NT) %	Truck (TR) %	LOS
2565 (2022)	625	88.67%	11.33%	A
2570 (2027)	6,361	20.10%	79.90%	A
2580 (2037)	8,720	33.67%	66.33%	B
2590 (2047)	19,693	63.29%	36.71%	F

Year	Volume (pcu/day)	Non-Truck (NT) %	Truck (TR) %	LOS
2565 (2022)	9,782	75.63%	24.37%	A
2570 (2027)	20,074	58.52%	41.48%	E
2580 (2037)	48,573	56.90%	43.10%	F
2590 (2047)	140,540	53.69%	46.31%	F

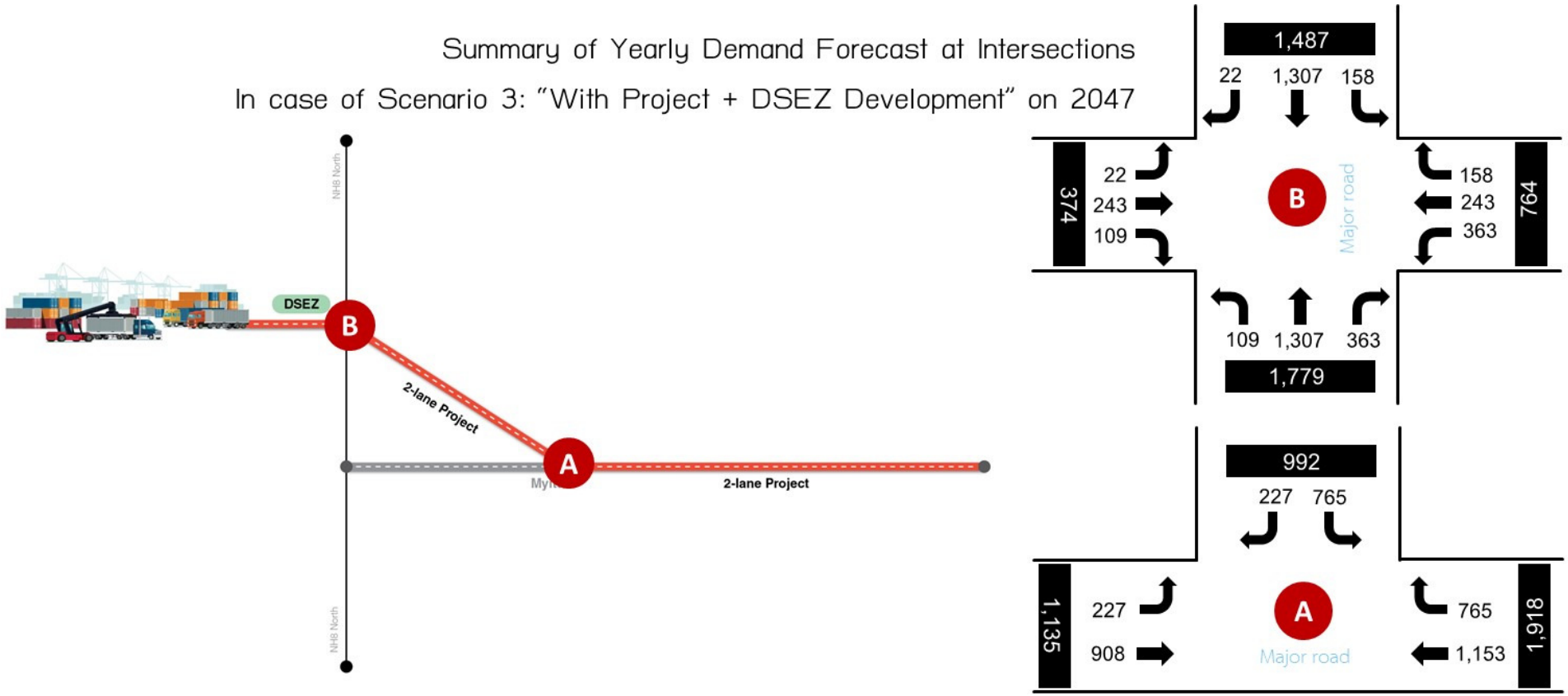
Year	Volume (pcu/day)	Non-Truck (NT) %	Truck (TR) %	LOS
2565 (2022)	3,662	75.65%	24.35%	A
2570 (2027)	7,238	60.49%	39.51%	A
2580 (2037)	17,915	57.81%	42.19%	F
2590 (2047)	48,094	49.94%	50.06%	F

Year	Volume (pcu/day)	Non-Truck (NT) %	Truck (TR) %	LOS
2565 (2022)	2,588	72.62%	27.38%	A
2570 (2027)	4,265	68.18%	31.82%	A
2580 (2037)	12,080	58.44%	41.56%	F
2590 (2047)	29,229	37.98%	62.02%	F

Year	Volume (pcu/day)	Non-Truck (NT) %	Truck (TR) %	LOS
2565 (2022)	4,524	77.99%	22.01%	A
2570 (2027)	5,241	11.64%	88.36%	A
2580 (2037)	6,723	23.64%	76.36%	A
2590 (2047)	10,305	41.74%	58.26%	D

Source : The Consultants 2019

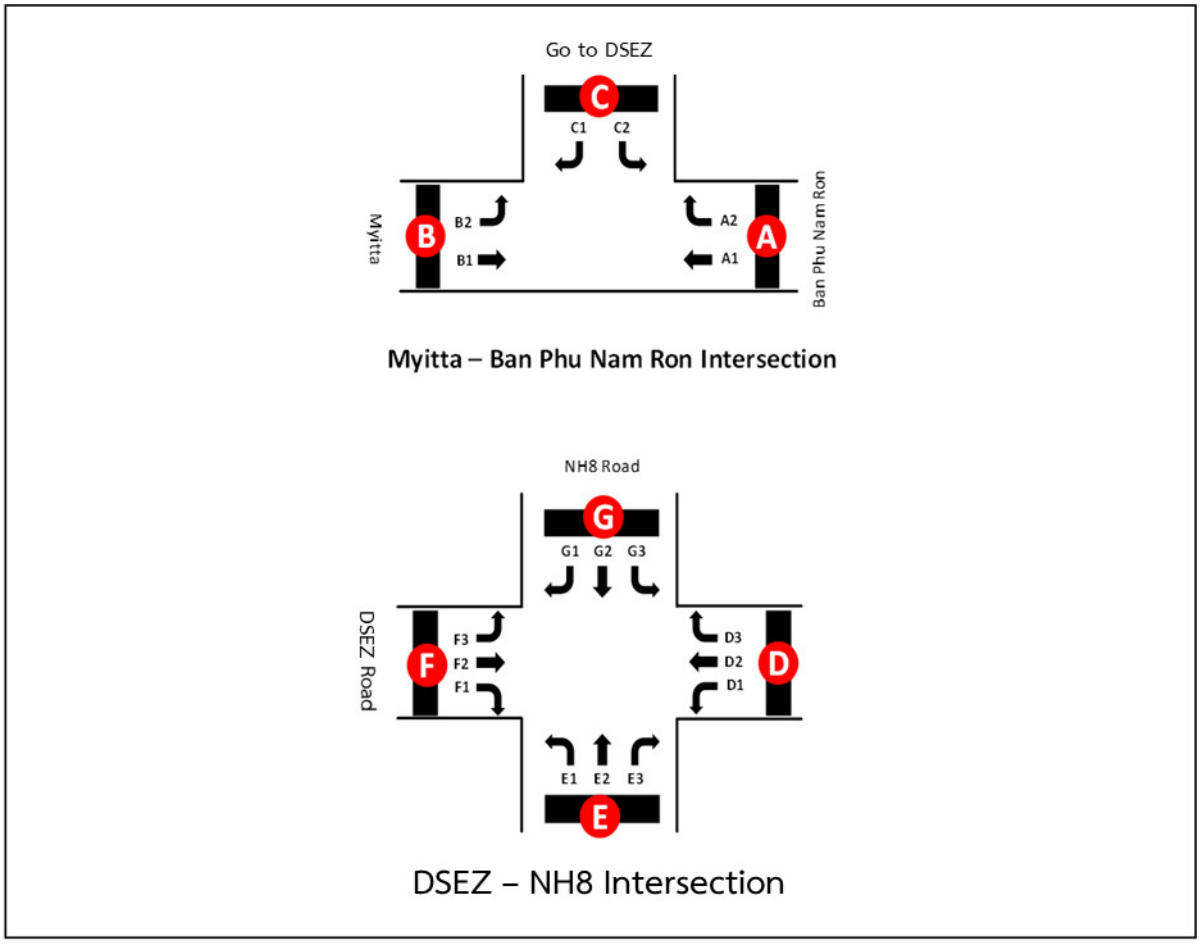
Figure 5.1-10 Traffic Volume (Scenario 3)



Source : The Consultants 2019

Figure 5.1-11 Traffic Volume at Intersections in 2047 (Unit PCU/Hour)

From demand forecast on related intersections, in case of road of project and DSEZ was implementation from year 2027 to 2047. The consultant found that the traffic volume at intersections was shown in **Figure 5.1-12,** and the direction of intersection was shown in **Table 5.1-3.**



Source : The Consultants 2019

Figure 5.1-12 Directions of Related Intersections

Table 5.1-3 Traffic Volume by Traffic Composition on Intersection in Case Study 3

Year	Y2027			Y2037			Y2047		
Direction	Volume (pcu/hr.)			Volume (pcu/hr.)			Volume (pcu/hr.)		
	Total	Non-Truck	Truck	Total	Non-Truck	Truck	Total	Non-Truck	Truck
A1	166	113	53	469	274	195	1,135	431	704
A2	247	50	197	339	114	225	765	484	281
B1	133	90	50	375	219	185	908	345	669
B2	33	23	3	94	55	10	227	86	35
C1	33	23	3	94	55	10	227	86	35
C2	247	50	197	339	114	225	765	484	281
D1	20	20	0	51	51	0	363	363	0
D2	208	16	192	234	29	205	243	33	211
D3	19	13	5	53	34	19	158	88	70
E1	93	7	86	105	13	92	109	15	94
E2	170	121	49	466	286	180	1,307	660	647
E3	20	20	0	51	51	0	363	363	0
F1	93	7	86	105	13	92	109	15	94
F2	208	16	192	234	29	205	243	33	211
F3	19	1	18	22	3	19	22	3	19
G1	19	1	18	22	3	19	22	3	19
G2	170	121	49	466	286	180	1,307	660	647
G3	19	13	5	53	34	19	158	88	70

Source : The Consultants 2019

5.1.4.5 Analysis of Traffic Conditions on Future Road Networks

In analyzing the traffic control system arrangement at the intersection, the consultant has taken a step by step consideration of the need to install traffic lights. The installation of the signals cannot be installed anywhere as it may lead to increase in traffic problems, such as delay, traffic accidents, etc. Criteria or conditions for installing traffic signals for safety and accident reduction are considered based on various requirements according to the Warrants for Signalized Intersection (MUTCD 2003) standard. It is found that intersections that need signals are intersections A and B (refer to **Figure 5.1-11**) which are in the areas on the road in the town of Myitta, and the intersection B is the intersection that crosses between the main road of the country (North-South) and the road into the DSEZ project. The results showed that both intersections need to have signal light in 2037. **Table 5.1-4** summarizes the analysis of signal installation needed in the project area.

Table 5.1-4 Summaries of the Signal Installation Analysis Results

Year	Intersection	
	A	B
2027	X	X
2037	O	O
2047	O	O

Remark: X = no need to install signal light, O = need to install signal light

5.2 Topographic Surveying and Leveling

Unmanned Aerial Vehicle (UAV) is operated for aerial photographing to create Base Map for this project. Consultant employed UAV to take aerial photos of the whole road during 29 April to 3 May 2019. This results in high-resolution and up-to-date information. And make a base map For use in design**.**

Additional Topographic Data must be collected in areas of Sta.27+250 to Sta.28+250 and Sta.49+700 to Sta.50+850. However, the existing data (previous design) can be used in designing the alignment.

Surveying Results Summary

1. Used all database of the previous design.
2. Use Unmanned Aerial Vehicle (UAV) to create a base map for the design of the project.
3. Additional Topographic Data are collected in areas of Sta.27+250 to Sta.28+250 (Dewadah Hill) and Sta.49+700 to Sta.50+850 (Saddle Hill).
4. Surveying the Control Monuments together with Myanmar's DOH between 11-15 December 2019. There 24 Existing Survey Control Monuments have been found in the project area as shown in **Table 5.2-1.**
5. Surveying the GPS Primary Control Points together with NEDA and Myanmar's DOH officials, positioning the coordinates for all 6 sections consist Tolls Plaza period, Rest Area and Traffic Changeover. Including, other coordinates Primary Control Points in the project area. Between 11-15 February 2020, with The NEDA participated in planning and coordination before the surveying on February 11, 2020.

Table 5.2-1 List of Existing Project Survey Control Monuments

GPS MONUMENT NAME	NORTHING (m.)	EASTING (m.)
GPS3-07A	1,535,436.487	504,603.643
GPS3-06A	1,539,622.550	500,852.764
GPS3-04B	1,546,638.139	495,470.083
GPS3-04A	1,546,718.610	495,376.695
GPS3-03B	1,551,678.813	491,697.253
GPS3-02B	1,554,080.879	487,249.454
GPS3-02A	1,554,153.209	486,955.865
GPS2-08B	1,562,020.019	476,004.676
GPS2-08A	1,562,083.127	475,913.278
GPS2-07A	1,564,989.057	472,270.729
GPS2-01B	1,566,887.024	450,380.354
GPS2-01A	1,566,799.897	450,408.512
GPS-09/1A	1,568,130.617	444,126.212
GPS-08/1B	1,570,332.821	441,105.735
GPS-08/1A	1,570,361.759	440,996.381
GPS1-08-A1	1,574,608.544	435,209.933
GPS1-08-B1	1,574,631.396	435,271.714
GPS1-06-B1	1,578,439.240	425,331.009
GPS1-06-A1	1,578,370.731	425,259.955
GPS1-06B	1,577,468.150	424,437.887
GPS1-06A	1,577,525.607	424,498.595
GPS1-05B	1,576,626.548	422,374.816
GPS1-03B	1,578,740.982	416,614.057
GPS1-03A	1,578,837.104	416,666.775

Source : Surveying the Control Monuments together with Myanmar's DOH between 11-15 December 2019

5.3 Geological Study and Material Availability

5.3.1 Test Pit Material Survey

The consultant has allowed the geological engineer to investigate the geological conditions and collect samples to review the original test results. For further testing, the engineer collected 7 subgrade samples on 5 – 6 June 2019 by digging at the depth of 0.5 – 1.0 m. The samples were tested for the engineering properties in laboratory and the location of the sampling are shown in **Table 5.3-1**. The results of 7 additional samples are shown in **Table 5.3-2**, with similar test results as the previous results, therefore the design can use both of them to calculate the layer structure.

Table 5.3-1 Additional Test Pit Locations

No.	No. of Test Pit	LT-RT	Sta.	Coordinate (UTM : 47 P)	
				N	E
1	TP-1	RT	16+800	1580168.22	412465.75
2	TP-2	LT	36+800	1578432.21	425589.17
3	TP-3	RT	54+300	1573025.85	437670.80
4	TP-4	LT	98+300	1565896.45	469558.31
5	TP-5	RT	116+500	1556338.21	482470.41
6	TP-6	LT	136+950	1545122.70	496784.73
7	TP-7	RT	146+500	1538312.00	501535.00

Source: The Consultants 2019

Table 5.3-2 Result of Test Pit

No	Point	Description	Classification		Sta.	Sieve Analysis % Passing							Atterberg Limits		Compaction		CBR,	Swell,
			ASSHTO	USCS		1"	3/4"	3/8"	#4	#10	#40	#200	LL	PI	γ_{dmax}	OMC, %	%	%
1	TP-1	Silty clay trace gravel, light brown	A-4	ML	16+800		100	98.4	97.5	96.8	95.3	81.6	26.2	4.3	1.736	16.0	7.9	0.873
2	TP-2	Clayey sand trace gravel, brown	A-2-4	SM	36+800		100	96.2	94.1	77.4	47.9	29.7	33.2	7.8	1.764	16.2	11.0	0.219
3	TP-3	Clayey sand trace gravel, dark brown	A-4	SM	54+300	100	94.1	85.3	79.2	72.0	60.0	37.8	28.4	6.0	1.805	15.0	10.5	0.087
4	TP-4	Sandy clay trace gravel, brown	A-4	CL	98+300		100	95.3	92.5	89.2	78.9	55.3	24.9	5.1	1.797	15.4	5.97	0.395
5	TP-5	Clayey sand trace gravel, dark brown	A-4	SM	116+500	100	94.3	91.4	88.5	88.1	71.4	39.6	19.5	2.8	1.882	13.0	9.6	0.218
6	TP-6	Clayey sand trace gravel, brown	A-2-4	SC	136+950	100	91.2	83.0	71.8	58.3	44.2	32.5	24.1	7.4	2.035	10.7	13.7	0.220
7	TP-7	Clayey sand trace gravel, brown	A-2-4	SM	146+500	100	89.5	72.4	56.8	44.0	36.0	25.8	23.7	2.9	1.959	12.4	19.0	0.177

Source: The Consultants 2019

5.3.2 Study and Collection of Geological Data in the Project Area

The survey was conducted at 20 locations and can be summaries as the **Table 5.3-3**.

Table 5.3-3 Summaries of Geological Survey (20 Stations)

No.	Station	Description
1	21+600	Weathered sandstone, fresh color is yellowish-brown to reddish-brown. Weathered siltstone, fresh color is reddish-purple, lamination layer thickness 1-2 mm., found weathered granite dyke with width at 2-3 m. and quartz vein (stock work type), width 0.5-5.0 cm.
2	24+750	Sandstone, fresh color is white, weathered color is yellowish brown-reddish brown, grain size is medium, rock composition is rock fragment. Weathered siltstone, weathered color is reddish-purple, thickness 5 cm.
3	26+050	Sandstone and silt are interbedded, Dyke was found.
4	27+250	Sandstone and siltstone show lamination texture and interbedded, found granite dyke (thickness 3-4 m.) and reverse fault direction 217/31 NW
5	28+025	Granite fresh color white and weathered color is yellowish-brown, rock composition is quartz, feldspar and biotite. Most surface is weathered.
6	30+600	Weathered sandstone and siltstone are interbedded. Did not find structure for measure attitude. But found small quartz vein in outcrop.
7	40+900	Little weathered sandstone, fresh color is gray to greenish gray, weathered color is yellowish brown. Rock composition is quartz, grain size is fine to medium grain, well sorted, roundness is sub-round to round, high sphericity, secondary minerals as iron-oxide.
8	46+050	Sandstone, fresh color is white, weathered color is yellowish-brown to reddish-brown. Rock composition is quartz and feldspar, grain size is fine to medium, well sorted, roundness is sub-round to round, high sphericity, secondary minerals as iron-oxide.
9	51+000	Meta-sandstone, fresh color is dark-gray, weathered color is reddish-brown to dark brown. Rock composition is quartz, mica and rock fragment. Found quartz granule in texture and characteristics of rock is wavy. Found secondary minerals is iron-oxide.
10	72+700	Sandstone and siltstone are interbedded, fresh color is reddish-purple, weathered is yellowish-brown, grain size is fine grain. Rock composition is quartz and feldspar.
11	76+750	Mudstone, very weathering, fresh color is dark gray to greenish gray, weathered color is yellowish-brown.

No.	Station	Description
12	79+900	Sandstone, mudstone, siltstone and conglomerate are interbedded. Sandstone color is gray. Mudstone color is gray. Siltstone color is reddish-purple and gray. Thickness of bedding is 1-1.5 m. Shale are laminate. Conglomerate color is reddish-purple.
13	82+100	Sandstone and siltstone are interbedded, fresh color is gray, weathered color is yellowish-brown to reddish-brown. Grain size of sandstone is very fine to fine.
14	83+500	Shale, fresh color is dark gray, rock composition is mica, arranged and shiny, the texture show the fissility.
15	102+100	Conglomerate, fresh color is reddish-purple, weathered color is yellowish-brown. Rock composition is sandstone and calcite, grain size is coarse sand to gravel (2-2.56 mm.), poorly sorted, sub-rounded to rounded, low sphericity. Cement is silica. Metrix is quartz, sub-rounded to rounded.
16	110+250	Sandstone, fresh color is greenish-gray, weathered color is reddish-purple to reddish brown. Rock composition is quartz, grain size is very fine grain. Cement is silica. Found secondary minerals as iron-oxide and the part of rock with a recrystallization of cement and quartz.
17	124+750	Conglomerate, sandstone and siltstone are interbedded. Conglomerate, fresh color is reddish-brown to reddish-purple, rock composition is rock fragment (sandstone), coarse sand to cobble grain size, poorly sorted, sub-angular to sub-rounded, cement is silica. Metrix is quartz, moderately sorted, sub-rounded to rounded, high sphericity. Sandstone, fresh color is reddish-purple, very fine to fine grain size. Rock composition is quartz, mica and rock fragment, moderately sorted, secondary mineral as iron-oxide. Thickness of bedding about 20-30 cm. Siltstone is reddish-purple color.
18	143+250	Sandstone and shale are interbedded. Sandstone, fresh color is white to dark-gray, weathered color is reddish-brown, rock composition is quartz, mica and secondary is iron-oxide, grain size is fine grain. Cement is silica. Thickness of bedding about 15-30 cm. Shale, fresh color is dark gray, weathered color is reddish-brown, rock composition is mica and clay minerals, the texture show fissility, texture thickness of about 5 cm.
19	143+800	Sandstone, fresh color is dark-gray, weathered color is reddish-brown, rock composition is quartz and muscovite, secondary mineral is iron-oxide, medium to fine grain, well sorted, well rounded, high sphericity. Thickness of bedding about 30-100 cm. Found small calcite vein in outcrop.

No.	Station	Description
20	146+500	Weathered sandstone, fresh color is gray, dark-gray, weathered color is reddish brown. Rock composition is quartz, muscovite, grain size is fine sand, and secondary mineral is iron-oxide and manganese-oxide.

5.3.3 Material Availability

The consultant surveyed the locations of material and found that it was covered by the previous report. The investigation for the availability of material was to ensure the sufficient availability of material for the project. Coordination with local suppliers will be done to determine quality, availability and suitability of the material for use in this project. Finally, the consultant surveyed the locations of up to 5 locations as shown in **Table 5.3-4** and **Figure 5.3-1.**, and the results of surveying and testing of materials are compiled in **Table 5.3-5.**

Table 5.3-4 Locations of Construction Materials

No.	Description	Sta.	Coordinate (UTM : 47 P)	
			N	E
1	Sand (S-1) & Laterite (L-1)	22+200	1579761.64	416854.36
2	Rock (R-0)	24+900	1578478.15	418379.39
3	Crushed Rock (R-1)	42+850	1576829.98	429381.36
4	Laterite (L-2)	102+400	1564843.13	472581.83
5	Crushed Rock (R-2)	145+300	1539598.38	500705.00

Location of Sand and Laterite at Sta.22+200

Location of Rock at Sta.24+900

Location of Rock at Sta.42+850

Location of Laterite at Sta.102+400

Location of Rock at Sta.145+300

Source: The Consultants 2019

Figure 5.3-1 Photograph of Location of Materials

Table 5.3-5 Summary Subbase Materials Testing Result

TYPE NO.	GRADE	ATTERBERG LIMITS		GRADATION % PASSING (BY WEIGHT)							ABRASION TEST	SPECIFIC GRAVITY	SOUNDNESS % TOTAL LOSS	LAB. CBR TEST AT 95% MDD		COMPACTION TEST MDD (t/m^3)		OMC (%)
		LL (%)	PI (%)	2"	1"	3/8"	#4	#10	#40	#200	(%)WEAR			SOAKED CBR (%)	SWELL (%)	STANDRAD PROCTOR	MODIFIED PROCTOR	
CRUSHED ROCK																		
R-1 (Sta.42+850)	B	NP			100	61	46	35	25	10	48.5	1.27	0.40	80.0	0.000	-	2.268	5.90
R-2 (Sta.145+300)	A	NP		100	61	31	21	15	9	5	49.1	1.38	0.36	75.6	0.000	-	2.175	7.80
SAND																		
S-1 (Sta.22+200)	-	NP				100	100	88	19	1	-	-	2.04	26.4	0.000	-	1.831	15.50
LATERITE																		
L-1 (Sta.22+200)	D	25.0	1.6	100	93	71	61	51	44	35	100.0	-	-	39.5	0.153	-	2.032	10.10
L-2 (Sta.102+400)	B	25.9	8.2	100	97	72	55	38	21	15	100.0	-	-	35.2	1.540	-	2.105	11.30

Source : The Consultant 2019

Material Testing Results Summary

Based on the previous data, based on "Soil and Material Sources Investigation Report the Two-lane Road Project (Dawei - Phu Nam Ron)", that surveying the material source on 24 September 2015, totally 30 points. Random survey to recheck the quality of the material to ensure that it meets the reference source or not. In this regard, the random surveys were conducted at 5 locations, which are at Sta.42+850, Sta.145+300, Sta.22+200 (Sand), Sta.22+200 (Laterite) and Sta.102+400. **And the results show that the characteristics of the materials tested at each point Are like the characteristics of the material previously surveyed. The Material can conclude that the characteristics of the material are in the same direction. Including enough quantities for construction.**

5.4 Pavement Structure and Embankment Design

5.4.1 Pavement Design

The consultant has designed Pavement Structure which can be divided into 2 types which are Asphalt concrete pavement design and Reinforced concrete pavement with the design details as follows;

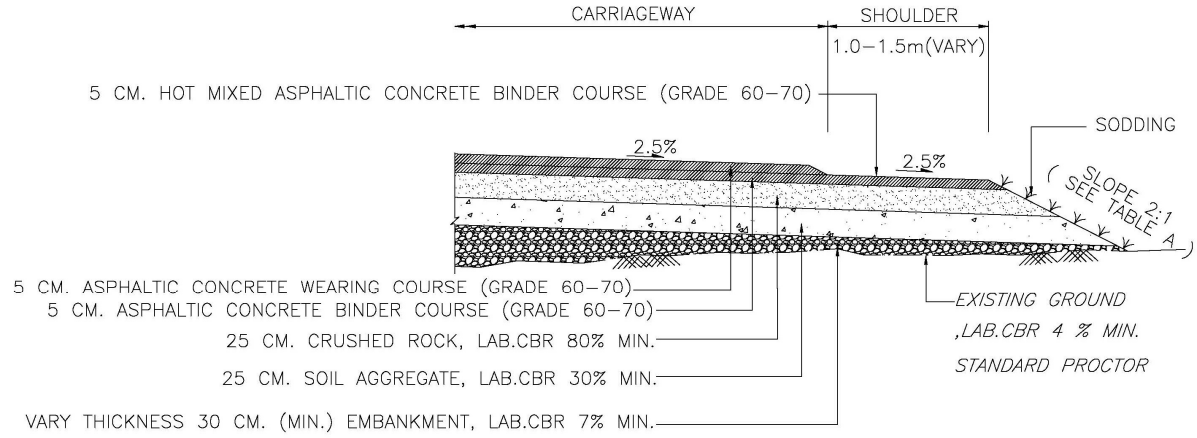
5.4.1.1 Asphalt Concrete Pavement Design

Asphalt concrete pavement is flexible pavement. The thickness design of asphalt concrete pavement follows the method described in The Asphalt Institutes Manual Series No. 1 Eighth Edition (1970): Thickness Design – Full-Depth Asphalt Pavement Structures for Highways and Streets. The pavement is designed as a Full-Depth Asphalt pavement that composes of asphalt concrete on prepared subgrade. The asphalt thickness is then substituted by granular materials. The parameters for design are traffic load and volume and the strength of subgrade. The asphalt concrete pavement is shown in **Figure 5.4-1.**

Summary of Asphalt Concrete Thickness. It is forecast traffic volume of heavy vehicles in both directions since the opening year (2022) for a period of 15 years with a traffic volume of 996 vehicles/day, an increase in the volume of heavy vehicles averages 7% per year. It is assumed that the number and weight of heavy vehicles passing through the road in both directions are the same (The structure in each direction receives traffic volume of 50% of total traffic volume). It's found that the number of heavy vehicles in traffic lane designed in the first year is 996 x 0.50 = 498 units/day. The summary of the thickness of asphalt concrete obtained from the calculation is as shown in **Table 5.4-1.**

Table 5.4-1 Thickness of Asphalt Concrete Obtained from a Calculation

Material	Thickness (mm.)	Substitution Ratio	T_A (mm.)
Asphalt	100.00	1.00	100.00
Base Course; CBR ≥ 80 %	250.00	2.00	125.00
Subbase; CBR > 25 %	250.00	2.70	92.59
Total Thickness			**317.59**



Source : The Consultant 2019

Figure 5.4-1 Asphalt Concrete Pavement

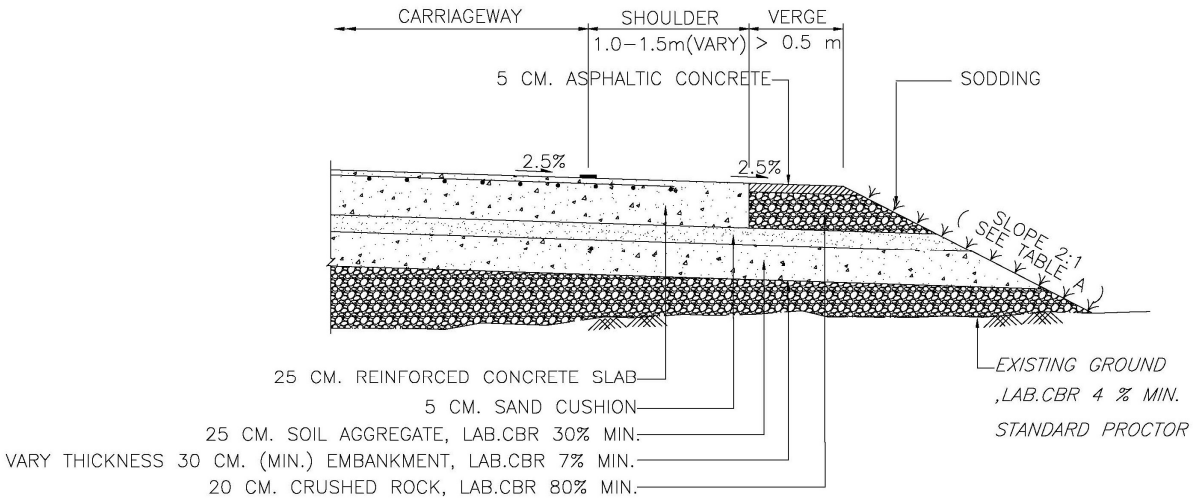
5.4.1.2 Reinforced Concrete Pavement Design

Reinforced concrete pavement design follows the method presented in Road Note 29. The factors for the design are traffic load and volume in terms of number of Equivalent Standard Axle Load carrying 18,000 pounds and subgrade strength in terms of CBR value. The concrete pavement is shown in **Figure 5.4-2.**

Summary of Reinforced concrete pavement. According to **Table 5.4-2,** the thickness of **Reinforced** concrete pavement depends on traffic volume. Accumulated Equivalent Standard Axle Load (ESAL) through the design period can be obtained from total number of trucks from traffic. So, traffic volume = 10,743,737.58 ESAL. Thickness of concrete pavement = 210 mm. Then, use the thickness of **Reinforced** concrete pavement at 250 mm. For the **Reinforced** concrete pavement structure, it is shown in **Table 5.4-2.**

Table 5.4-2 Thickness Summary of Reinforced Concrete Pavement

Material	Thickness (mm.)
Reinforced Concrete	250.0
Sand Cushion	50.0
Soil Aggregate Subbase	250.0



Source : The Consultant 2019

Figure 5.4-2 Reinforced Concrete Pavement

5.4.2 Analysis of Stability and Settlement of the Pavement

Slope analysis is based on the 2D Limit Equilibrium Slope Stability method. In the case where the slope of the circle is assumed to be the curve of the circle, the "Simplified Bishop Method" is used. The slope stability is shown as a safety factor.

Stability analysis uses the SLIDE V.5.0 computer program. The results of the slope stability analysis are shown in the Factor of Safety. The criteria for determining the stability of the slope and the soil is shown in **Table 5.4-3.**

Table 5.4-3 Criteria for Considering the Slope Safety Ratio

Condition	Factor of Safety
During Construction (Short Term Condition)	1.30
During Operation (Long Term Condition)	1.50

Summary of Soil Slopes Stability Analysis in the Project

The stability of the slope in each station depends on the hardness of the rock on the slope in the area and the geological conditions. For preliminary analysis, the consultant has prepared data for analysis in the SLIDE 6.0 program.

Therefore, since the consultant went to explore and collect data in June 2019, it can be concluded that the project has levels and the angle between 45-76 degrees or the slope (X: Y) of 1: 1 to ¼: 1 and the slope height is from 5.0 to 10.0 meters.

As a result of the slope stability analysis, the case where Typical 1 to 8 is safe over the long-term condition for all slopes specified in the case of Typical 9 where the slope is 1: 1 and ½: 1 are Safety can be taken for construction. But where the slope of ¼: 1 is not safe, it is not suitable for construction.

The surface protection of the pavement structure is construction through the mountain. It should be using the rock fall protection net to protect the rock falling on the pavement structure. The plants growing on side slope helps reduce soil failure may have to be planted with local plants that grow in that area. But, the gradient ratio of 60 degrees or more or the mountainous area, it may not be suitable for plant growth. Therefore, the drainage rails should be on each floor of the slope to help the drainage of water not to flow freely into the slope area.

On the other hand, the wet or side of the river sections, the side slope should be compacted to fill soil to be the Embankment, Gabion wall or Concrete retaining wall, etc. Finally, the side slope in this section is based on the typical drawing and is appropriate on the construction site.

Finally, the contractor should be investigating soil and rock before the construction to recheck the soil or rock data. And, the data must be approved by consultant before constructions.

5.5 Bridge Structure Drainage System and Protect Erosion Design

5.5.1 Structural Design for Bridges

1. Design Criteria

On structural design for bridges, box culverts or other related structures, the consultant will use the AASHTO-LRFD Bridge Specifications 5th Edition, 2010 as reference. The other relevant codes and standards are to be considered on parts that can be applied.

Normally, the moving live load -- as defined by AAHSTO-LRFD- is HL-93. The load includes truck load which is the same as HS-20 in previous version standard. The truck load composes of gross weight of 325 KN with two 145 KN and one 35 KN axle load. The truck load shall be combined with lane load with 9.3 KN/m uniformly distribution load or tandem load with 2 axles of 110 KN/axle which produces larger forces. The HL-93 is illustrated in **Figure. 5.5-1.**

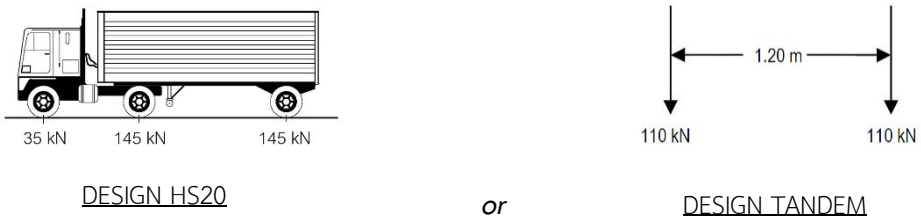


Figure 5.5-1 Moving Live Load HL-93 (AASHTO-LRFD)

2. Loads Consideration in Bridge Design

The bridge design in addition to the load, following loads are to be considered for design of bridge structures (AASHTO LRFD).

3. Summary of Design Bridge Structure Improvement

- **Stability and the Bridge Structure :** The considering the design of all 19 bridges, it has strength in accordance with AASHTO-LRFD standards by designing the foundation as a driven pile size 0.40x0.40 meters. Super Structure

is the I-Girder structure, details can be summarized in **Table 5.5-1** with the additional skirt design at the Bridge Sta.16+885.787.

- **The Protect Erosion Structure :** Having considered the bridge at Sta.16+885.78, the foundation is designed in the form of floating foundation, with 4 m. clearance from the ground. There are protection skirts but these are too short. The consultant decided to design and add more skirts in order to reduce the chance of collision by logs and debris. The protection skirts are a measure to prevent logs and debris collision and being stuck between posts. Reason behind this design is that the job site cannot be opened since water flows all year round and there is no way to divert the water during construction. Design of the skirts is shown in **Figure 5.5-2.**

Table 5.5-1 Summary of Details of Bridges in the Project

No	Station	Total Width	No. of	Span Arrangement	Total Length	Substructure	Superstructure	
		(m)	Span		(m)		Main Girder	Deck Slab
1	16+885.787	11.00	7	(1x32.25)+(5x35.00)+(1x32.25)	239.50	Reinforced Concrete	Reinforced Concrete	Prestressed I-Girder
2	19+271.168	11.00	5	(1x29.65)+(3x30.00)+(1x29.65)	149.30	Reinforced Concrete	Reinforced Concrete	Prestressed I-Girder
3	21+933.446	11.00	5	(1x29.65)+(3x30.00)+(1x29.65)	149.30	Reinforced Concrete	Reinforced Concrete	Prestressed I-Girder
4	22+660.669	11.00	3	(1x14.70)+(1x15.00)+(1x14.70)	44.40	Reinforced Concrete	Reinforced Concrete	Prestressed I-Girder
5	45+904.237	11.00	3	(1x14.70)+(1x15.00)+(1x14.70)	44.40	Reinforced Concrete	Reinforced Concrete	Prestressed I-Girder
6	49+159.614	11.00	3	(1x14.70)+(1x15.00)+(1x14.70)	44.40	Reinforced Concrete	Reinforced Concrete	Prestressed I-Girder
7	66+397.180	11.00	4	(1x14.70)+(2x15.00)+(1x14.70)	59.40	Reinforced Concrete	Reinforced Concrete	Prestressed I-Girder
8	68+596.000	11.00	5	(1x29.65)+(3x30.00)+(1x29.65)	149.30	Reinforced Concrete	Reinforced Concrete	Prestressed I-Girder
9	72+914.808	11.00	1	(1x15.00)	15.00	Reinforced Concrete	Reinforced Concrete	Prestressed I-Girder
10	76+512.788	11.00	3	(3x15.00)	45.00	Reinforced Concrete	Reinforced Concrete	Prestressed I-Girder
11	77+175.806	11.00	3	(3x15.00)	45.00	Reinforced Concrete	Reinforced Concrete	Prestressed I-Girder
12	81+454.206	11.00	3	(3x15.00)	45.00	Reinforced Concrete	Reinforced Concrete	Prestressed I-Girder
13	90+901.487	11.00	3	(3x15.00)	45.00	Reinforced Concrete	Reinforced Concrete	Prestressed I-Girder
14	106+956.450	11.00	3	(3x15.00)	45.00	Reinforced Concrete	Reinforced Concrete	Prestressed I-Girder
15	107+951.157	11.00	1	(1x15.00)	15.00	Reinforced Concrete	Reinforced Concrete	Prestressed I-Girder
16	120+248.408	11.00	1	(1x15.00)	15.00	Reinforced Concrete	Reinforced Concrete	Prestressed I-Girder
17	140+081.438	11.00	1	(1x15.00)	15.00	Reinforced Concrete	Reinforced Concrete	Prestressed I-Girder
18	150+591.392	11.00	1	(1x15.00)	15.00	Reinforced Concrete	Reinforced Concrete	Prestressed I-Girder
19	154+755.965	11.00	1	(1x15.00)	15.00	Reinforced Concrete	Reinforced Concrete	Prestressed I-Girder

Source : MIE; Final Design Report, October 2015

Note : The bridge at Sta.16+885.78 is design skirts for protect foundation. There are reduce the chance of collision by logs and debris

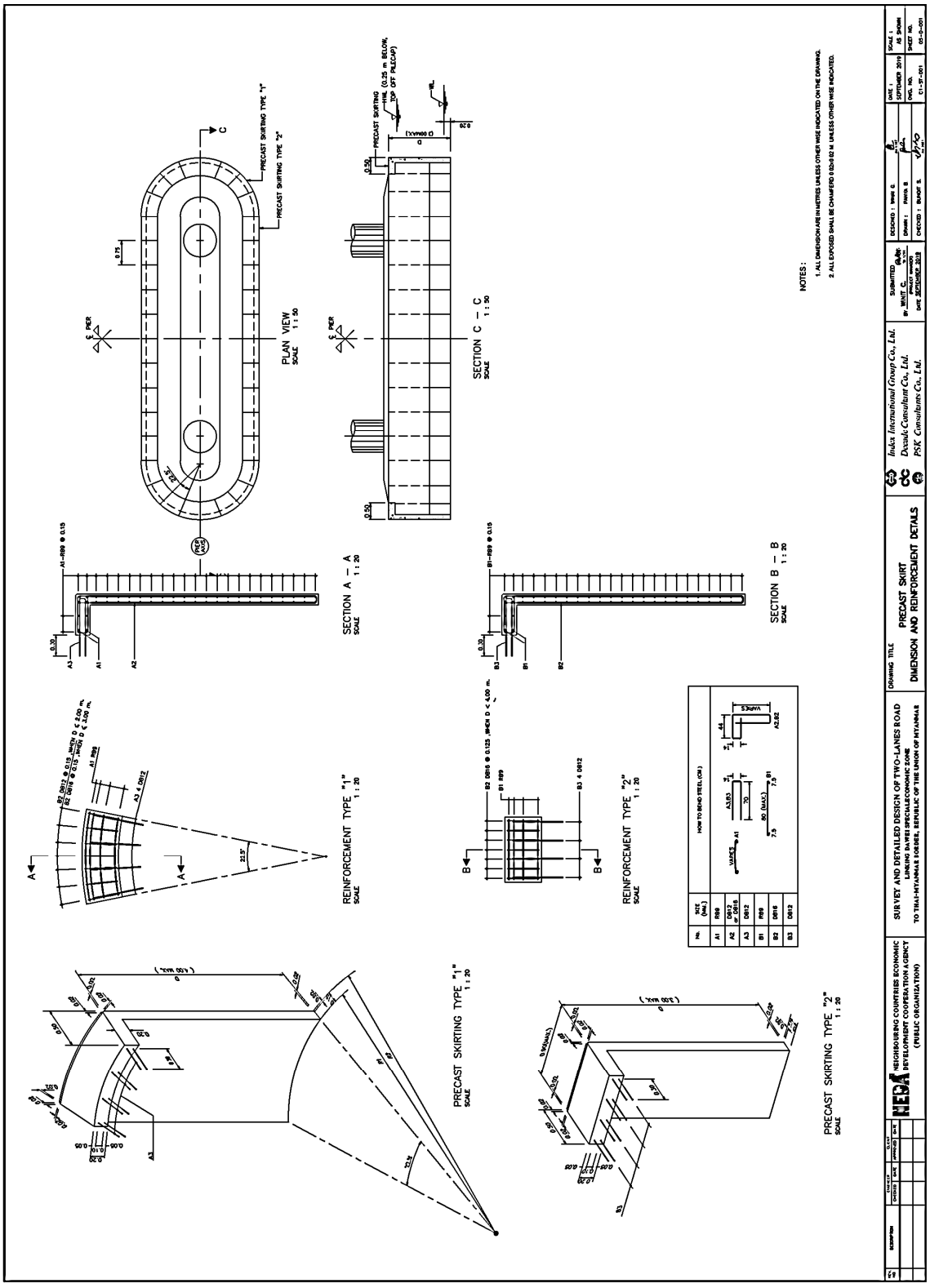


Figure 5.5-2 The Details of Foundation Protection (Skirt)

Source : The Consultants 2019

5.5.2 Cross Drainage System Design

The consultant has re-designed the drainage from pipe concrete diameter 1.00 m. configuration to R.C.Box Culverts at the size of 1.20x1.20 m. for the whole project. The consultant also increases the size of the R.C.Box Culverts to 2-3.60x3.60x38 m. at two locations.

- Re-design the pipe from round to R.C.Box Culverts at the size of 1.20x1.20 meters Total number is 402 locations, according to suggestion from the Myanmar Steering Committee. The purpose is that it is easy to do maintenance.
- Design R.C.Box Culverts at size of 2-3.60x3.60 m. dimensions at Sta.100+375 and Sta.126+373 to accommodate for both drainage system and wildlife crossings as suggested by environmentalists.

5.5.3 Erosion Prevention

The previous design indicated that there was a design to prevent erosion on the side of the road. However, there is no plan in details for position and type of drainage buildings. Since this road is on steep slopes, erosion will definitely occur as waterflow at road side is too fast for the drainage to handle. **The consultant has designed erosion prevention with indications on position of side drainage buildings. These buildings also need cement grouting to prevent erosion along 110 km. of the distance of the whole road.**

5.6 Road Detailed Design and Intersection Design

In terms of detailed design of roads and intersections, the consultant considers locations that need to be corrected and improved to comply with standards as follows;

5.6.1 Pavement Design

On the design of road surface, the consultant has two alternatives, namely asphaltic concrete and reinforced concrete. Details of which are as follows;

1. Asphaltic concrete pavement is Flexible Pavement; the design is based on the Asphalt Institutes Manual Series No.1 Eighth Edition (1970): Thickness Design – Full-Depth Asphalt Pavement Structures for Highways and Streets. The design of road structure complies with the Full-Depth Asphalt criteria and replace asphaltic concrete with other materials in compliance with Substitution Ratio. Factors considered are traffic loading and traffic volume and the strength of subgrade. **The thickness of asphalt concrete pavement is 10 cm.**

2. Reinforced concrete pavement is rigid pavement, considered for use at steep slopes, intersections, rest area, toll plaza and additional lane for truck. The Reinforced concrete pavement is more durable. The thickness of reinforced concrete pavement depends on traffic volume in terms of the number of standard single wheel or ESAL at the design lane for the whole of design period, with reference to relationship on design graph. This design refers to the traffic volume of 10,743,737.58 ESAL, the thickness of reinforced concrete pavement = 210 mm. which concludes that **the thickness of reinforced concrete pavement is 25 cm.**

Table 5.6-1 Path That is Designed as a Concrete Pavement

Station	Remark
Sta.18+500	Intersection No.1
Sta.18+918	Toll Plaza No.1
Sta.24+825 – Sta.30+750	
Sta.49+200 – Sta.52+550	
Sta.54+300	Intersection No.2
Sta.67+667	Intersection No.3
Sta.69+050	Rest Area
Sta.99+350 – Sta.102+970	
Sta.112+500 – Sta.114+150	
Sta.135+650 – Sta.138+300	
Sta.141+750 – Sta.143+800	
Sta.146+350 – Sta.147+550	
Sta.150+450 – Sta.151+800	
Sta.155+700	Toll Plaza No.2

Source: The Consultants 2019

5.6.2 Horizontal and Vertical Geometric Design

1. **Horizontal Geometric Design.** The consultant considered the total number of horizontal curves in the previous design that follows the class 4 standard of the Department of Highways, Thailand and AASHTO Standard "A Policy of Geometric Design of Highway and Streets 2011", but the consultant considers adjusting the previous design back to the Access Road at 3 locations, namely, the Dewahda Hill (Sta.27+250 to Sta.28+250) and the Saddle Hill (Sta.49+700 to Sta.50+850). For the Elephant Cry Hill (Sta.100+250 to Sta.103+351) consider re-alignment to decrease of high cut-fill volume as shown in **Figure 5.6-1** to **Figure 5.6-3.**

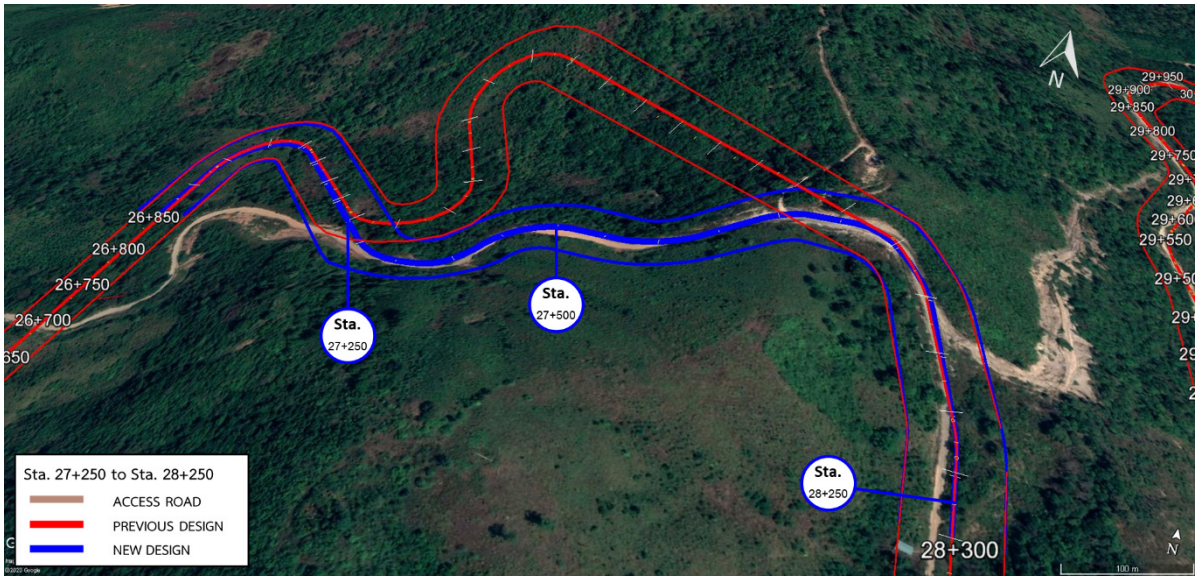


Figure 5.6-1 Re-Alignment at Dewahda Hill (Sta.27+250 to Sta.28+250)

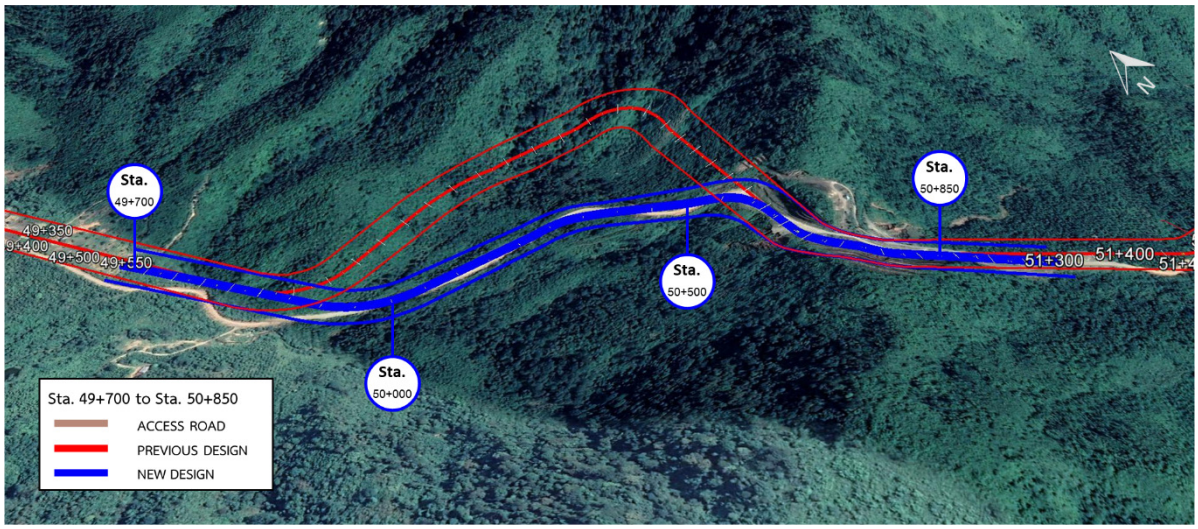
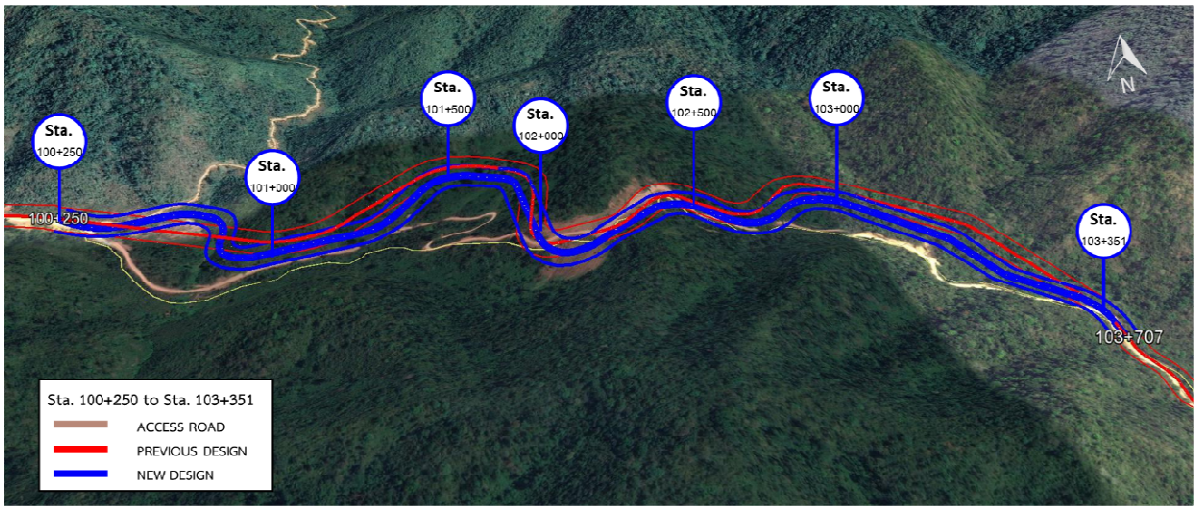


Figure 5.6-2 Re-Alignment at Saddle Hill (Sta.49+700 to Sta.50+850)



Source : The Consultants 2019

Figure 5.6-3 Re-Alignment at Elephant Cry Hill (Sta.100+250 to Sta.103+351)

2. **Vertical Geometry Design:** The consultant has considered the previous design that follows the class 4 standard of the Department of Highways, Thailand and AASHTO Standard "A Policy of Geometric Design of Highway and Streets 2011". The consultant has adjusted the vertical slope to a value of not more than 10 percent throughout the project.

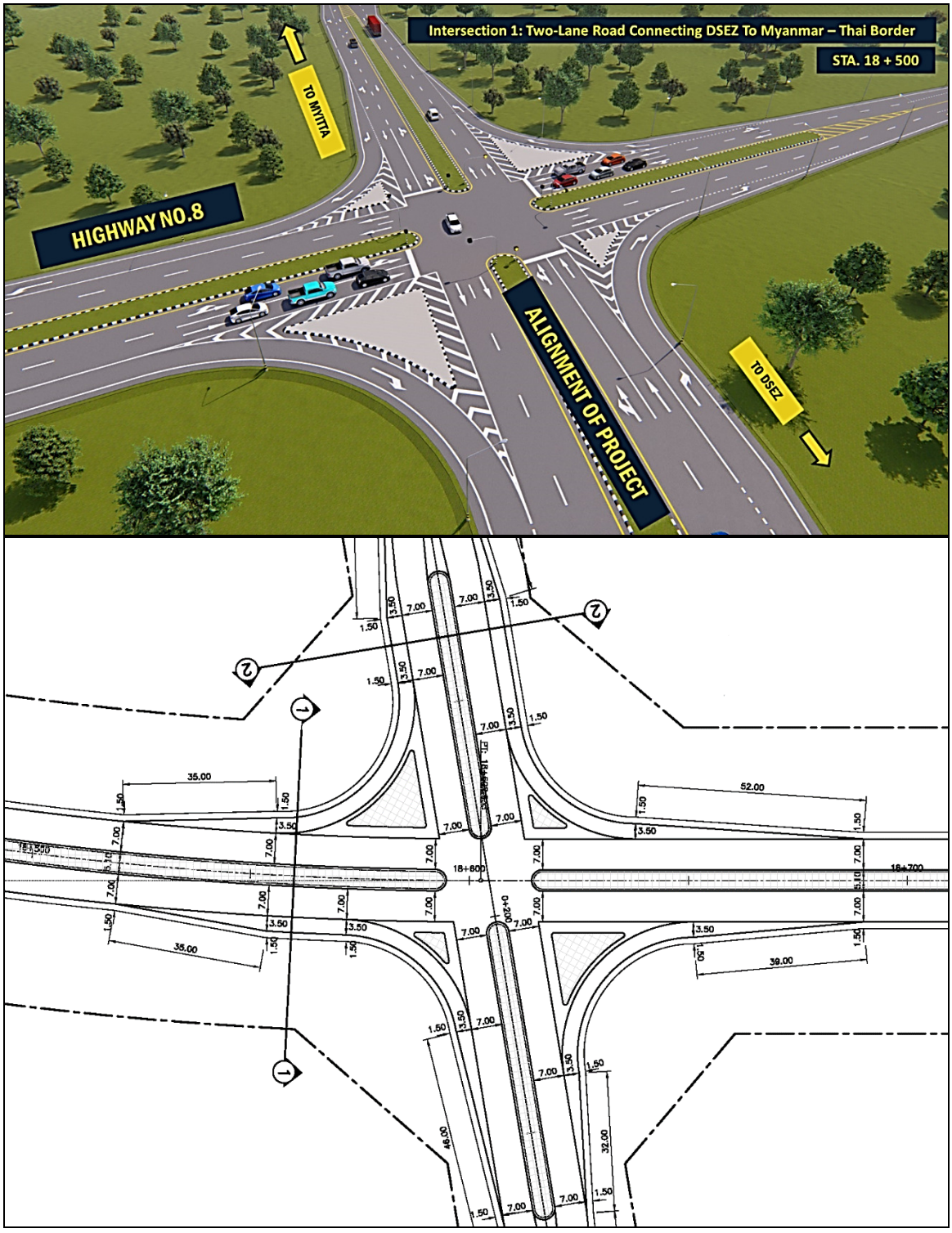
3. **Shoulder width:** Since most of the road travels on mountainous terrain, the shoulder width is generally designed at 1.00 m. and at 1.50 m. in the plain parts. There are three plains at Sta.18+000 to Sta.24+000, Sta.65+800 to Sta.99+300 and the third at Sta.152+100 to Sta.156+950. The total distance is length 44.35 km.

5.6.3 Intersection Design

The consultant has reviewed the survey results and detailed design of intersections with other roads to evaluate the appropriateness of applying the survey results.

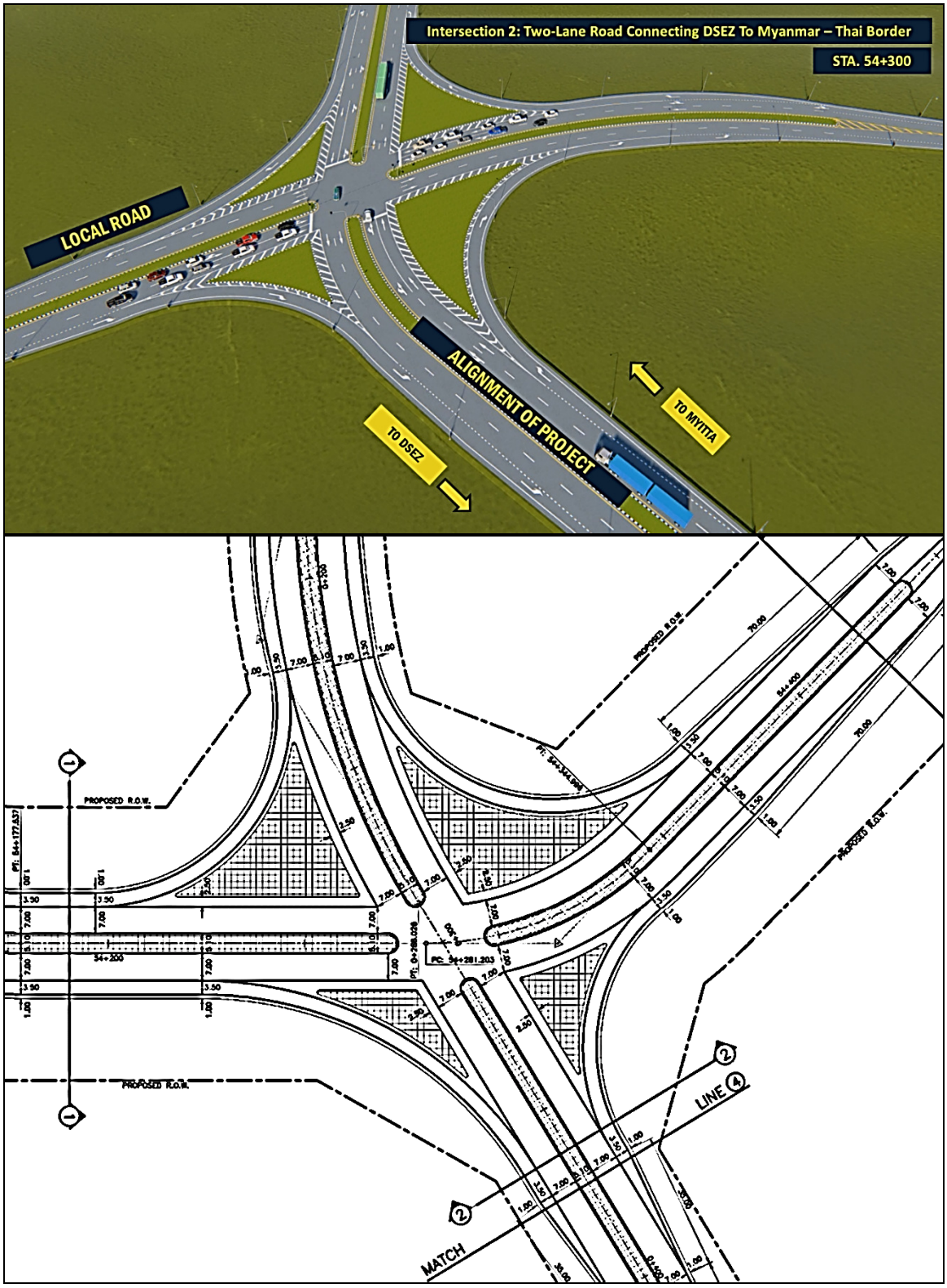
The results of the intersection review compose of 3 main locations of the intersection No.1 at Sta.18+500 (the intersection of project road and highway No.8), as shown in **Figure 5.6-4**. The intersection No.2 at Sta. 54+300 (the intersection of project road and local road), is shown in **Figure 5.6-5**. The intersection No.3 at Sta.67+667 (the intersection of project road and Myitta road), as shown in **Figure 5.6-6**. The consultant has designed additional lane for vehicles to make a left turn in and out of the intersection including those waiting to make a right turn more safely.

Design of intersection follows observes engineering standards. The design composes of advice, warning, yield and stop signs. It also considers installing yellow flashing signals for the highest safety possible. An analysis on traffic volume found that the two intersections (No.1 and No.3 need traffic lights by the year 2037.



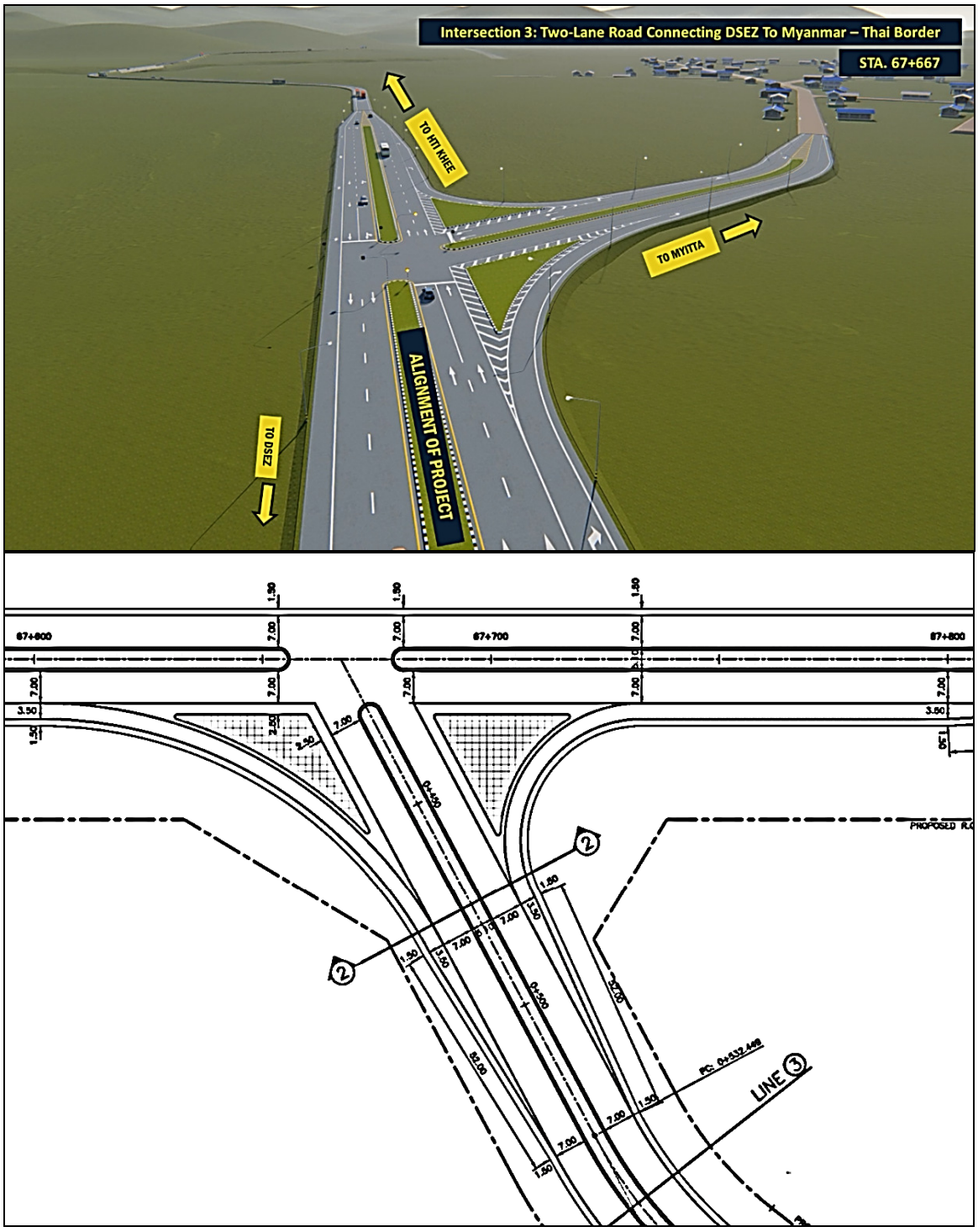
Source : The Consultant 2019

Figure 5.6-4 Intersection No.1 at Sta.18+500 :
the Intersection of the Project Road and Highway No. 8.



Source : The Consultant 2019

Figure 5.6-5 Intersection No.2 at Sta.54+300 :
the Intersection of the Project Road and Rural Road.



Source : The Consultant 2019

Figure 5.6-6 Intersection No.3 at Sta.67+667 :
Intersection of the Project Road and the Intersection to Myitta

5.7 Road Lighting and Traffic Signal

The electric lighting design of the road for this project will use **LED lamp powered by Solar Cell** with control devices and battery backup, installed on a pole of 9 meters high. The areas that need to install lighting systems in the project can be summarized in **Table 5.7-1.**

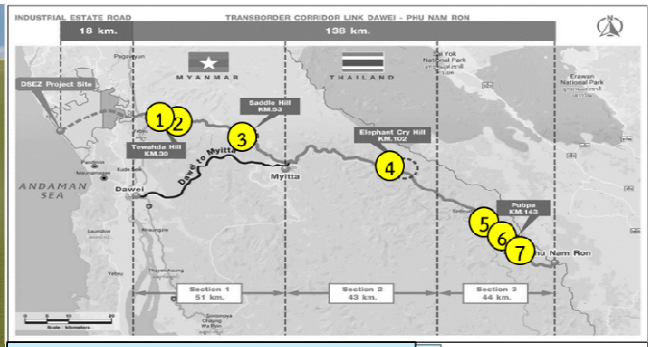
Table 5.7-1 Summary of Electrical Lighting Installation

No.	Sta.	Area	Remark
1	Sta.16+880 to Sta.17+120	Bridge No.1 (Length 240 m.)	- Installation of Lighting (Solar Cell) both sides.
2	Sta.18+400 to Sta.18+800	- Intersection No.1 - Toll Plaza 1 and at office building, walkway, parking lot, public area and lavatory.	- Installation of Lighting and warning flashing light (Solar Cell) And deep into the other side 200 meters on all 4 sides - Toll plaza: Installation of Lighting (Solar Cell)
3	Sta.53+350 to Sta.53+750	Intersection No.2	- Installation of Lighting and warning flashing light (Solar Cell) Deep into the other side 200 meters in every direction - Toll plaza: Installation of Lighting (Solar Cell)
4	Sta.66+650 to Sta.67+050	Intersection No.3	- Installation of Lighting and warning flashing light (Solar Cell) into the other side 200 meters - Toll plaza: Installation of Lighting (Solar Cell)
5	Sta.69+050	At the rest area, there are lightings at parking lot, inside road, office building, shops, lavatory and public area.	- Installation of Lighting (Solar Cell)
6	Sta.150+000 to Sta.156+500	- Project end point, community - Traffic changeover - Toll the second place and office, corridors, parking, common areas, restrooms	- Installation of Lighting (Solar Cell)

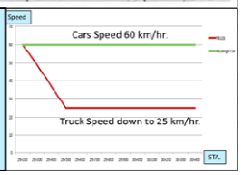
5.8 Safety Condition

The consultant reviewed the previous design and emphasized on safety in using the route. This includes considering risk positions which can cause accidents and adjust them to be in accordance with safety according to engineering principles as follows;

1. **Additional Lane for Trucks or Climbing Lane.** The consultant considered designing an additional lane with criteria on the climbing lane. Locations where additional lane is needed shall be a long and uphill drive. Vehicles, especially trucks, would lose speed and overtaking becomes riskier. There are 7 locations where additional lane is needed, with total distance of 5.28 km. as shown in **Figure 5.8-1**.



- Truck runs at a low speed from 60 km/hr to 25 km/hr
- Trucks will affect the movement of cars and other vehicles (Speed of 60 km/hr) on the Uphill.
- May cause traffic to move slowly
- There is a risk of overtaking accidents
- Design with Concrete pavement of 7 locations (5.28 km.)



No.	STA.	To	STA.	Length(m.)	Direction	*
1	27+590	to	28+220	630	Right	Tewahda Hill
2	29+250	to	30+320	1,070	Left	Tewahda Hill
3	50+170	to	51+010	840	Right	Saddle Hill
4	99+480	to	103+110	363	Right	Elephant Hill
5	135+870	to	137+670	1,080	Right	Puppa Hill
6	142+590	to	143+700	607	Right	Puppa Hill
7	146+690	to	147+650	690	Left	Puppa Hill
Total				5,280		

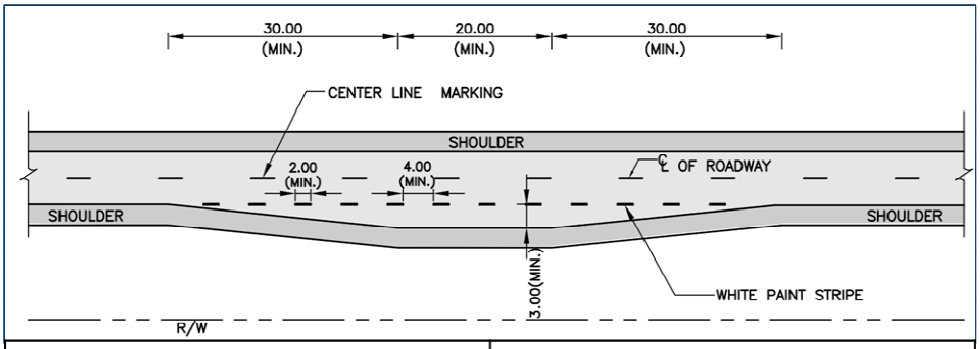
Source : The Consultant 2019

Figure 5.8-1 Summary of the Additional Lane Design

2. **Safety Design at Intersections.** Conduct the additional lane which can facilitate incoming and outgoing at intersections and vehicles waiting to make the right turn. Analysis on current and future traffic condition found that these two intersections (No.1 and No.3 intersections) need traffic by the year 2037. The consult has designed intersection control in accordance with engineering criteria for safety and efficiency. The design includes suggestion and warning, yield, stop signs and yellow flashing light.

3. **Safety equipment.** There is safety equipment in the previous design such as steel beam guard rail or concrete barriers where they are needed. The consultant designed more safety equipment, such as

   - **Emergency Stop Bay Station** designed at Sta.32+750, Sta.98+600 and Sta.128+500 as shown in **Figure 5.8-2.**



EMENGENCY STOP BAY STATION	STA. 32+750
	STA. 98+600
	STA. 128+500

Source : The Consultant 2019

Figure 5.8-2 Emergency Stop Bay Station

   - **Road Stud** used on the road are reflective glass road stud. These can be used as locations require. Normally, there are two colors, the yellow studs shall be installed at the edge line and the white ones at lane division. They are to be installed at the 3 intersections and hazardous points as shown in **Figure 5.8-3.**

ROAD STUDS AT INTERSECTION	STA. 18+600
	STA. 54+300
	STA. 67+667

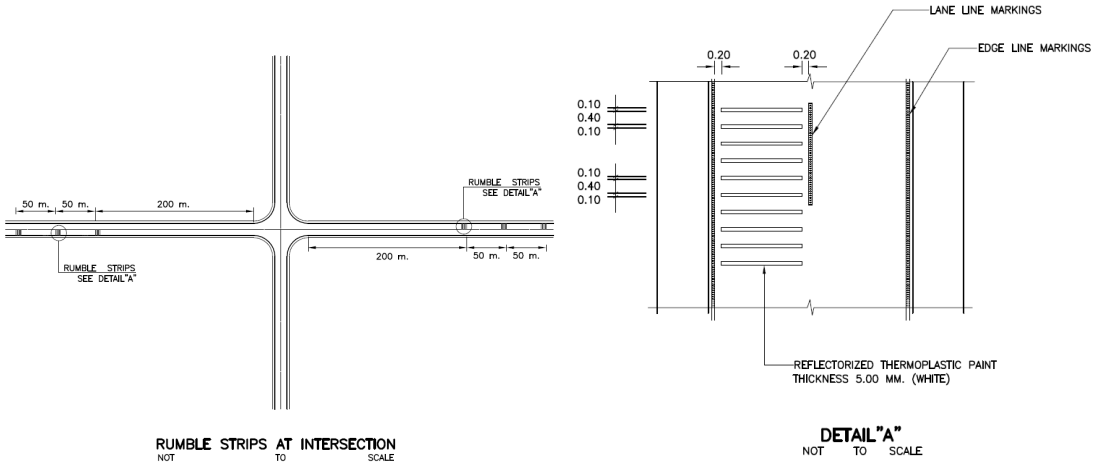
Source : The Consultant 2019

Figure 5.8-3 Reflective Glass Road Stud

4. **Traffic Signs** The consultant designed and installed additional traffic signs at dangerous curves, re-alignment all 3 paths (as detailed in Section 5.6.2) and new designed all 3 intersections (as detailed in Section 5.6.3). Traffic signs consist of regulatory, Warning Signs, Guide Signs, and Limit Speed Sign.

5. **Pavement Markings** such as the center line, outer and inner edge lines, reduce speed line and directions arrows. Besides, the consultant has designed rumble strips to reduce speed at 20 hazardous points as shown in **Figure 5.8-4**.

RUMBLE STRIPS	
STA.	SIDE
18+594	RT
18+615	LT
26+656	RT
31+487	LT
32+489	RT
33+050	LT
47+691	RT
47+818	LT
48+108	LT
54+273	RT
54+298	LT
59+151	RT
59+279	LT
67+655	RT
67+678	LT
72+829	RT
144+609	LT
146+373	RT
156+200	RT
155+964	RT



Source : The Consultant 2019

Figure 5.8-4 Rumble Strips

6. **Traffic Management Plan During Construction** is a plan on moving equipment, control and provide safety and convenience during construction period. This would accommodate local and passing users. Plans include lane division, detours courses and bridges and construction machinery.

7. **Traffic Change Over** The consultant designs traffic change over at Sta.156+075. The design is in one lane at 5.00 m. with 2 shoulders at 1.50 m. width. The total width is 8.00 m., as shown in **Figure 5.8-5.**

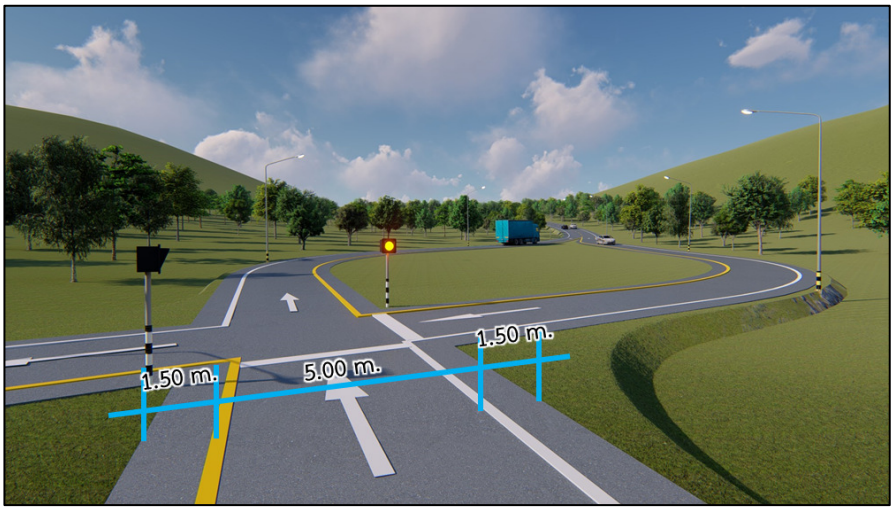


Figure 5.8-5 Traffic Change Over at Sta.156+075

5.9 Right of Way Plan

The consultant has processed and created the topographic and right of way map with detailed terrain as the background. The topographic and right of way map will be carried out by digitizing various buildings from photographs obtained from using the UAV in aviation photography with field surveys to indicate the type of building that has been digitized and into the map according to the symbols specified. For example 1-SW, meaning one floor wooden building, etc., and all are operated in the form of AutoCAD Drawing.

The consultant has put down the Proposed Centerline and expand width of R.O.W. from 40.00 meter to 70.00 meter in the topographic map according to meeting to approve the inception report at the meeting room on the second floor of The Ministry of Construction, Republic of the Union of Myanmar (4 April 2019). Including the positioning of the pins and also table showing the table coordinate (UTM) values of these placemarks. The consultant conducted a map showing details of land use and land type or cadastral plan in digital file format of software AutoCAD. All buildings appeared in project area have been classified in each type followed as **Table 5.9-1**.

Table 5.9-1 List of Classified Affected Buildings in Project Area

Unit : Building

Building Type	Amount
1-SC	226
2-SC	2
1-SW	123
2-SW	2
1-SCW	4
1-SZ	3
TOTAL	**360**

Note : 1-SC = Building, One – Storey concrete
1-SW = Building, One – Storey wooden frame
1-SZ = Building, One – Storey-Zinc
1-SCW = Building, One – Storey- concrete and wood
2-SC = Building, Two – Storey concrete
2-SW = Building, Two – Storey wooden frame

Source: Consultant Survey 2019

5.10 The Amount of Construction and Cost Estimation

5.10.1 Unit Cost Estimate

There are 3 elements to be considered for unit cost:

1. Material Cost

The material prices used from Kanchanaburi or nearby provinces using the estimated engineering price of the Ministry of Commerce, Thailand, July 2020, using the diesel price at 22.19 baht / liter (fuel price at Muang District, Kanchanaburi on 19 August 2020)

2. Labor and Machine/Equipment Costs

Use the reference price of labor costs Operation and machine depreciation at diesel fuel price 22.00-22.99 baht / liter according to the criteria of the estimated engineering price according to the calculation regulations of the Comptroller General's Department Ministry of Finance.

3. Factor F

Factor F Building work, road work and bridge and box culvert work adjusted in accordance with the announcement of the Comptroller General's Department dated June 19, 2020.

5.10.2 The Amount of Construction and Cost Estimation

The amount of construction calculation and cost estimation are divided into 8 parts as in **Table 5.10-1.**

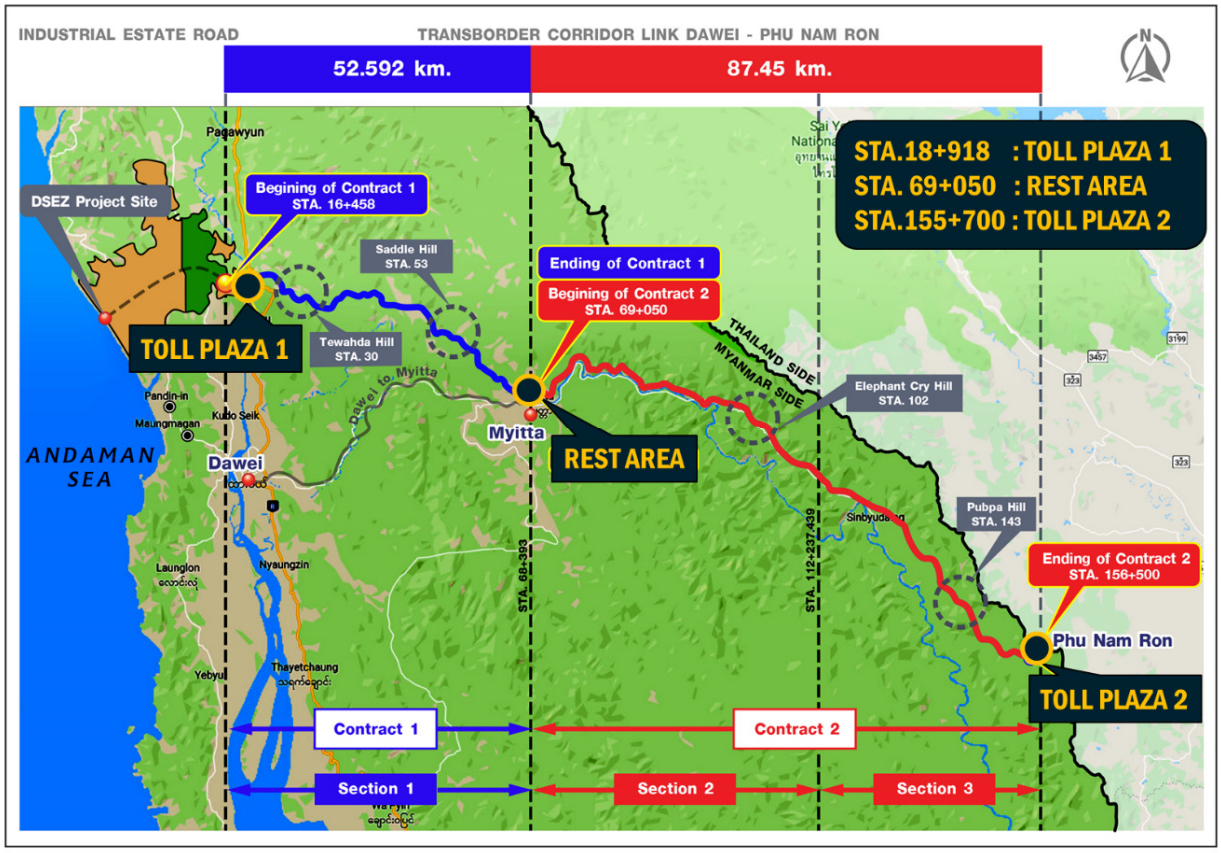
Table 5.10-1 Cost Estimate Table

No.	Description	Cost (Thai Baht)		
		Contract 1	Contract 2	All
1	BILL No.100 General Provisions	81,440,000.00	81,440,000.00	162,880,000.00
2	BILL No.200 Earthworks	705,065,450.20	515,756,777.10	1,220,822,227.30
3	BILL No.300 Pavement	535,434,137.34	724,912,870.58	1,260,347,007.92
4	BILL No.400 Drainage	127,313,266.18	132,422,708.64	259,735,974.82
5	BILL No.500 Structures	244,449,369.00	66,709,943.76	311,159,312.76
6	BILL No.600 Miscellaneous	212,305,674.83	352,535,670.93	564,841,345.76
7	BILL No.700 Street Lighting	28,392,941.10	5,566,966.36	33,959,907.46
8	BILL No.800 Building and Other Works	79,190,053.09	52,771,661.86	131,961,714.95
Total Cost Estimate		**2,013,590,891.74**	**1,932,116,599.23**	**3,945,707,490.97**

5.11 Toll Plaza and Rest Area Design

5.11.1 Locations of Toll Plazas and Rest Area

The consultant determines the number of rest area at 1 location at Sta.69+050 and toll plaza in the first phase at 2 locations at Sta.18+918 and Sta.155+750, the first one is at the starting point area and the second at the end of the project can be summarized in **Figure 5.11-1**.

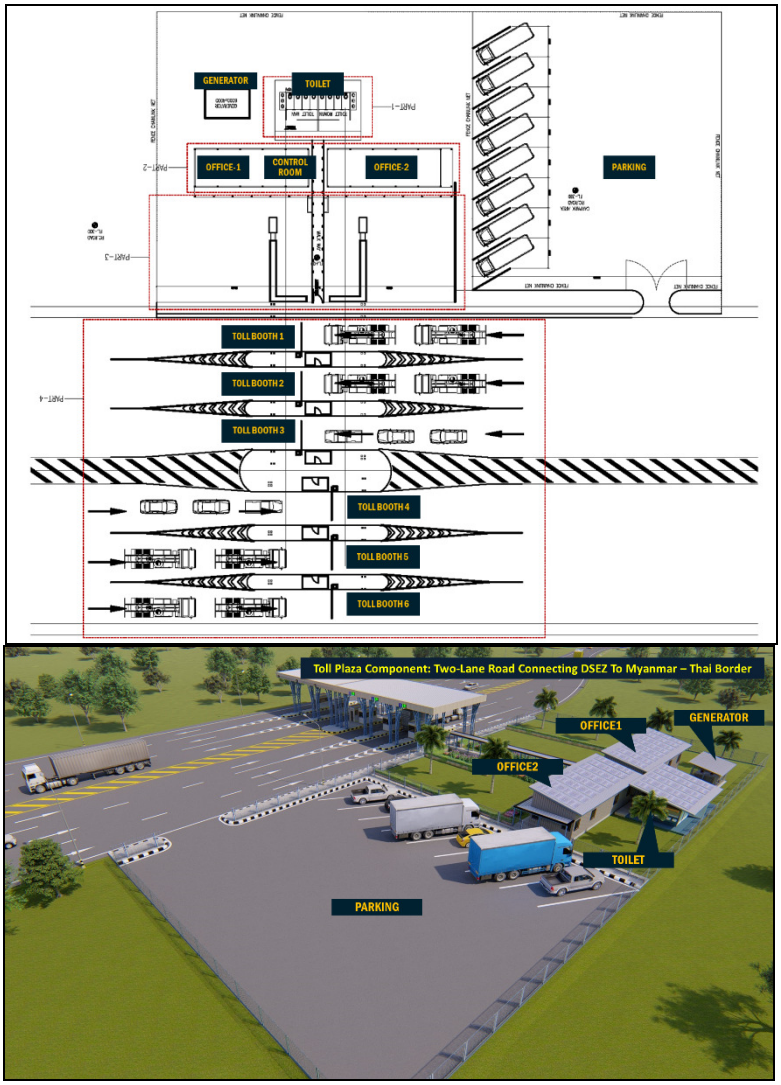


Source : The Consultants 2019

Figure 5.11-1 Summaries of Position of Toll Plaza and Rest Area

5.11.2 Toll Plaza

The toll plaza design consists of Office, Control room, Generator Room, Toilet and Parking. The toll plaza plan and layout are shown in **Figure 5.11-2.**



Source : The Consultant 2019

Figure 5.11-2 Toll Plaza Plan and Layout

5.11.2.1 Structural Design for Buildings

(1) Design Standards

On structural design of buildings, the following codes and standards are to be used for reference:

- ACI : American Concrete Institute, “Building Code Requirement for Structural Concrete” (ACI 318-99)
- AISC : American Institute of Steel Construction, “Manual of Steel Construction”
- AWS : American Welding Society
- UBC : Uniform Building Code 1997
- ASCE : American Society of Civil Engineer

- Standard for Earthquake Resistance Design by Department of Public Works and Town & Country Planning (DOPC), Thailand

(2) Loads and Forces

1. Live Load

The live loads on each functional component in the buildings are as follows:

• Roof	50	Kg/sq.m.
• Façade and concrete roof deck	100	Kg/sq.m.
• Office	300	Kg/sq.m.
• Store	500	Kg/sq.m.
• Meeting Roof	500	Kg/sq.m.
• Warehouse	1,000	Kg/sq.m.

2. Wind Load

Design of wind load structures designed in accordance with ASCE 7-05 Chapter 6 and RAJ 1311-50 by Equivalent Static Method.

3. Earthquake (EQ)

The Earthquake design designed according to ASCE 7-05 Chapter 11 and MRP 1302-52. In the design of the seismic force, the seismic force was calculated by the equivalent static force method.

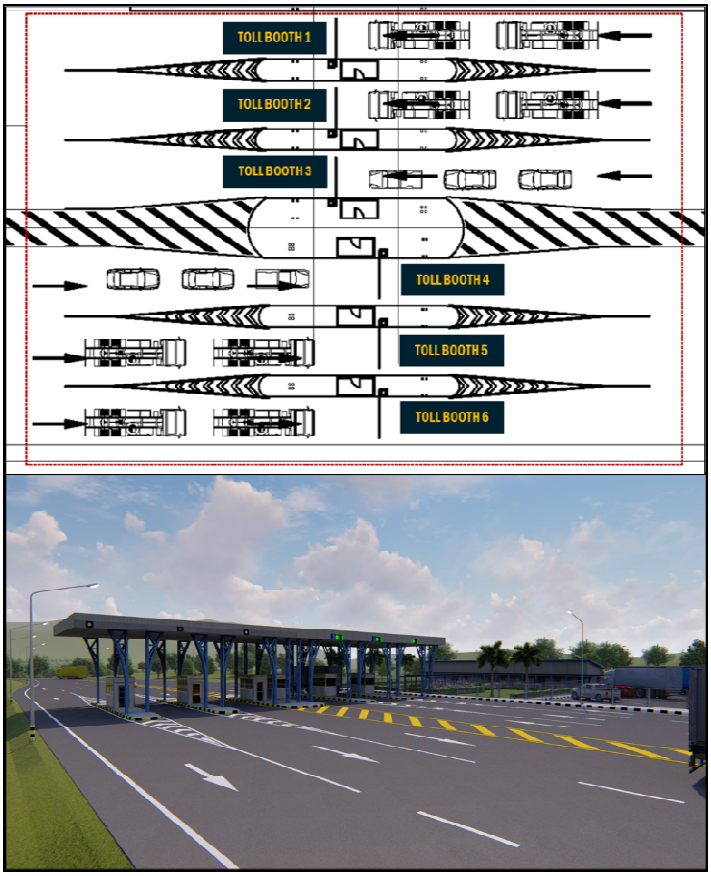
(3) Analysis and Design Method

The method of analysis and design of structural component are as follows:

- Reinforced Concrete Components — Ultimate Strength Design
- Steel Components — Working Stress Design

5.11.2.2 The Design of Toll Collection System

The consultant designed toll collection system at two places, each with three traffic lanes (outgoing and incoming). It composes of two lanes for trucks and one for small vehicles, altogether six lanes as shown in **Figure 5.11-3.**



Source: The Consultants 2019

Figure 5.11-3 Toll Booth Lanes

1. **Manual Toll Collection System: MTC**

- The toll fee will be collected by car types at specified rate.
- Lane Equipment Controller (LC) will be interfaced with all toll devices and Toll Collection Terminal (TCT) which are installed at the lane and then transfer toll transaction to PLC.
- TCT will process all vehicles. TCT will be operated with Toll Keyboard and Display, Smart Card Reader to record staffs working time.
- Network communication between Plaza with Lane will be separated from Toll System.
- Signal display, traffic light, counting equipment and Automatic Lane Barrier (ALB) or Manual Lane Barrier (MLB) will be installed at the lane and can report and follow up all equipment problems to inform maintenance department.

2. **Design of MTC (Manual Toll Collection) Payment are in 3 models;**

- Cash Payment
- The MTC Lane is equipped with a credit card payment.

- Payment for future technologies or code payments, coupons, special passes or via mobile phone (Smart phone App).

3. Design of Toll Collection System Overview

- Lane Controller (LC) will record all cars which pass through the lane. The accuracy depends on the processor CPU and interface with input /output controlled by ALB. Traffic light, all sensors that are controlled by Toll Program include all Revenue report, traffic report at plaza system of RTO TOD PCS.
- The MTC Lane system. Automatic Vehicle Classification (AVC) is installed to determine whether an employee charges by vehicle type. Vehicle classification is categorized by car type, which is classified by the number of wheels and heights. The system is able to support the standard vehicle classification as follows: Cars and motorcycles with do not have more than 4 wheels, trucks with over 4 wheels, small trucks or more than 10 wheels.
- Digital Video Enforcement System (DVES) are duty record clip & picture at all time as open/close of the lane. This is used together with toll data and picture in toll transaction for inspection system.
- Real Time Overview Workstation: RTO and TOD (Tour of Duty) are computer control which employees and supervisors use to operate toll collection system. This monitor is used for status view and control toll equipment, including reporting equipment problems. Although there are exemption and unauthorized passing cases, employee will inform all cases to the supervisor to adjust the total of toll collected.
- Plaza Computer System: PCS are server computer and database. This system will process and produce revenue report, traffic report, QR report for the management.
- Communication (Intercom) is used to communicate with the operator at the control room with the employee in the storage cabinet, which must coordinate closely. Communicate with each employee without a hand in the Intercom System, the IP system has a clear sound quality and an easy-to-use class function.
- The Public Announcement System is used to provide users with information and the users non-payment notice and pedestrians with the amplifier and Microphone 1. Set with Horn speaker around canopy at front and rear

- Connection between systems at the Toll plaza system and central control Center, the system must be able to support the connection to the future control center during the next construction period.
- CCTV & Video Recording Security System are CCTV cameras which will be installed in all area to record all events, including toll lane. All areas then are recorded by NVR (Network Video Recording). All Cameras use IP Camera.

4. Solar Cell Energy

Solar Cells installed on the roof and Battery to supply electricity to MDB distribution cabinet, LC sub-distribution box, and design power distribution to the bill system, etc., with a Generator Power Supply in case of a power outage and a power charger with Battery.

Generator is a kind of device. That can convert mechanical energy into electrical energy, type Dynamo and alternator, 1-phase and 3-phase. But in general, 3-phase generators are more commonly used because they can produce and supply three times the power of a 1-phase generator.

The operation of the power supply backup system is as follows;

- Backup power supply, use a Generator size not less than 13 KVA Single Phase 1 set for charging the battery in the case of low sunlight and at night.
- The backup power supply uses a Generator of not less than 33 KVA Single Phase 1 set for the Hybrid Off Grid power supply and in the case of the main solar cell supply system failure or maintenance.
- Sets of diesel engines to backup power system.
  1) Generator for Electric charger Battery of 13KVA.
  2) Generators to back up power supply, main system maintenance of 33KVA.

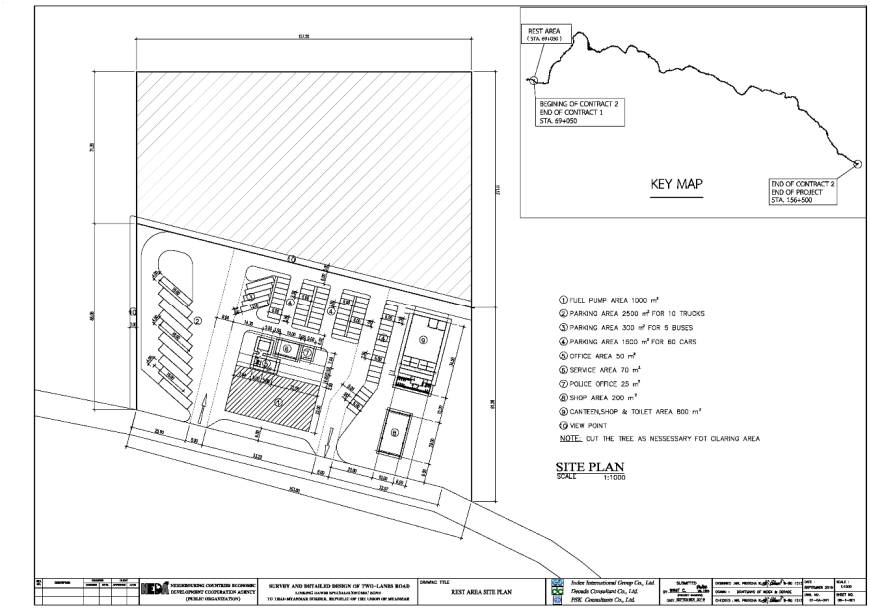
5.11.2.3 Electrical and Lighting System Design of Toll Plaza

The consultant has designed electrical and lighting system for the toll plaza. The design consists of electrical appliances, office air-conditioning and parking lot system. The system is powered by solar cell the batteries supply electricity to the main distribution board MDB. There is a power reserve system called generator power supply.

5.11.3 Rest Area

The rest area consists of staff buildings, shops, parking area, canteen, restrooms, proposed fuel service areas and a viewpoint of the Tanintharyi River which beautiful scenery are shown in **Figure 5.11-4.**

- The design of building uses reinforced concrete. Structural design standard is the same as toll plaza structural design.
- The design of lighting at rest area includes appliances, office air-conditioning and parking system. This is powered by solar cell. The batteries supply electricity to the main distribution board, MDB. There is a power reserve system called generator power supply.



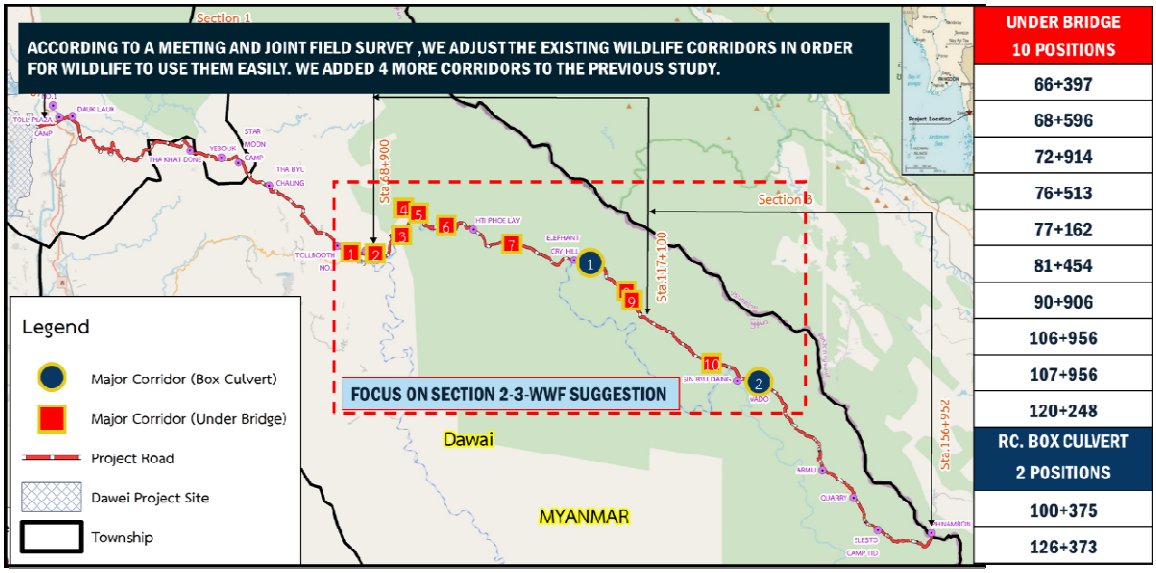
Source : The Consultant 2019

Figure 5.11-4 Rest Area Site Plan

5.12 Design of Wildlife Corridors

5.12.1 Design of Wildlife Crossing Positions

The consultant has reviewed information on the Design Manual Building a Sustainable Road to Dawei Enhancing Ecosystem Services and Wildlife Connectivity (WWF Report 2016) including conducting field survey with wildlife experts and environmentalists to assign locations of wildlife crossings. In assigning crossings positions, practicality and safety to wildlife must be borne in mind at all time. Safety is emohasized along rivers, streams and bridges. There are 12 wildlife crossings, being 10 underpasses under bridges and two box culverts crossings, as in **Figure 5.12-1.**



Source : The Consultant 2019

Figure 5.12-1 Locations of Wildlife Corridors

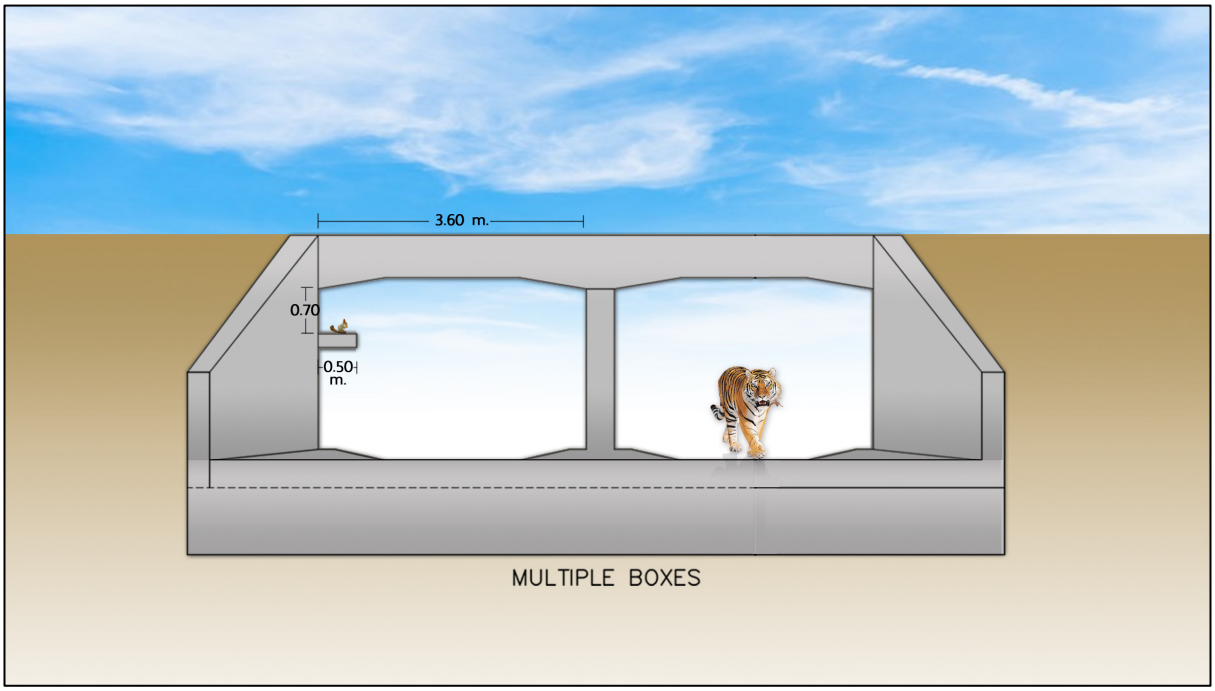
5.12.2 Configuration of Wildlife Crossing

Wildlife crossing design consists of two formats;

1. The Wildlife Crossing RC. Box Culvert with the dimensions of 3.60x3.60 m., with additional design for smaller wildlife such as squirrels to use, as shown in **Figure 5.12-2.**
2. The Wildlife Crossing Under Bridge configuration. There are 10 locations in the form of mortar riprap, as shown in **Figure 5.12-3**.

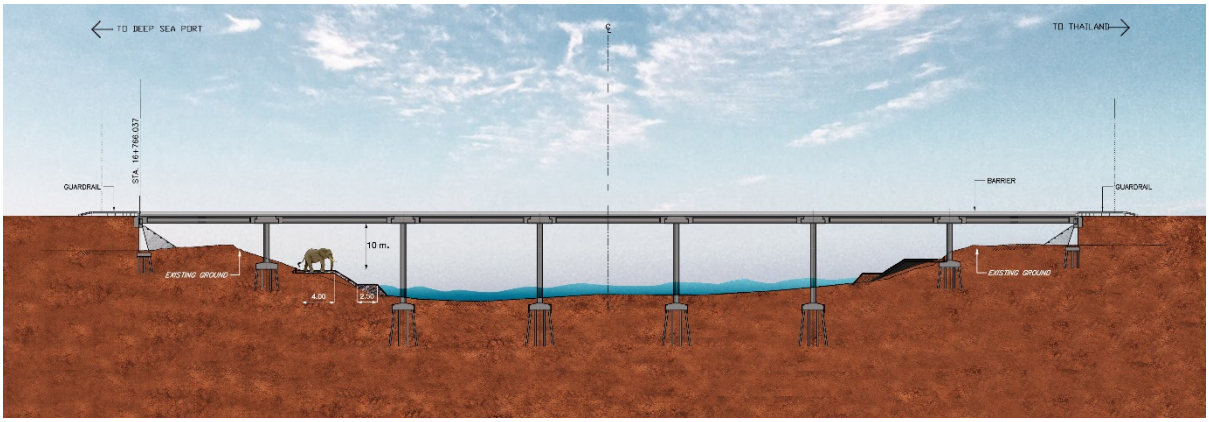
5.12.3 Fencing

Install fencing at least 500 m of length on each side (2 km./Location), as shown in **Figure 5.12-4.**



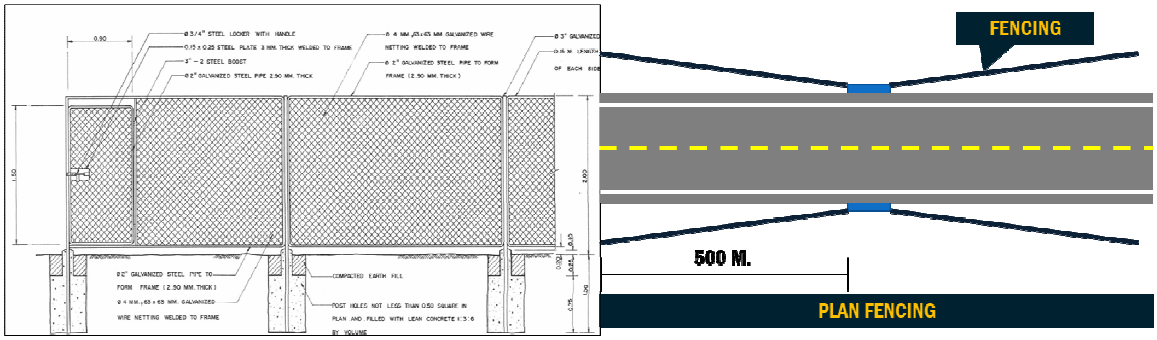
Source : The Consultant 2019

Figure 5.12-2 Wildlife Crossing RC. Box Culvert



Source: The Consultants 2019

Figure 5.12-3 Wildlife Crossing Under Bridge



Source: The Consultants 2019

Figure 5.12-4 Fencing

5.13 Tender Documents Preparation

5.13.1 Contract Arrangement

The contract shall be separated into two contracts, considered dividing the distance of that contract have a similar construction cost of the project by;

Contract 1: The beginning of the Contract 1 (Sta.16+458) to the end of Contract 1 (Sta.69+050), the distance is approximately 52.592 km., the total length of bridge construction is 880.00 m. (8 locations) and RC. Box culvert 152 points.

Contract 2: The beginning of Contract 2 (Sta.69+050) to the end of the Contract 2 (Sta.156+500), the distance is approximately 87.450 km., the total length of bridge construction 315.00 m. (11 locations) and RC. Box culvert 250 points.

5.13.2 Preparation of Bidding Documents

5.13.2.1 Contractor selection

Preparation of bidding documents needs prudent consideration. This process must conform and in accordance with relevant standards and regulations and must be fair to all parties. The topics of preparation of bidding documents are shown in **Table 5.13-1.**

Table 5.13-1 Topic of Preparation of Tender and Bidding Documents

No.	Topics
1	Pre-Qualification: PQ
2	Form of Tender
3	Instruction to Tenderers
4	General and Particular Conditions of Contract
5	Detailed Construction Specification
6	Contract Drawing
7	Equipment and Material Specification
8	Bill of Quantities
9	Cost Breakdown
10	Term of Reference: TOR

5.13.2.2 Selection of Consulting Engineers to Supervise the Project

Consultant recruitment documents for the project consist Terms of Reference (TOR) and various forms, shown in **Table 5.13-2.**

Table 5.13-2 Topics of Preparation of Consultant Recruitment Documents

No.	Topics
1	Preface
2	Letter of Invitation
3	Instructions to Consultants
4	Technical Proposal
5	Financial Proposal
6	Terms of Reference
7	Standard Forms of Contract

CHAPTER 6

ENVIRONMENT STUDY

The consultant has reviewed detailed information from the previous EIA report approved by the Myanmar government (2018) and conducted an assessed environmental impact to determine additional measures to be completed, which was divided into 2 cases : (1) determining additional measures based on the results of previous studies and (2) determining additional measures based on the project design changes. The details of environment study are in the amendment to EIA report. The final report will have a summary of the evaluation which is summarized as follows;

6.1 Reviewing the Previous Environment Study

According to the previous EIA report (2018EIA), approved by Myanmar governmental office, the project planned to improve the two-lane asphaltic road with distance of 138 km. The road was designed with 2 parts, with asphaltic concrete and reinforced concrete road structure. It was the two-lane road with Class 4 standard of Department of Highways (DOH). The road had right of way (R.O.W) of 40.00 m. wide, traffic surface of 7 m. wide (two lanes 3.50 m. each and shoulders with 1.00 m. wide for each). The project road sections will be re-aligned along the current access road as much as possible.

The project road was divided into 3 sections for construction and maintenance, as given as listed;

Section 1 with distance of 50.9 km. begins on the west of Dawei River at Sta.18+500 and ends at Sta.69+400.

Section 2 with distance of 42.9 km. extends from Sta.69+400 to Sta.112+300.

Section 3 with distance of 44.2 km. extends from Sta.112+300 to Sta.156+500.

There will be ten major sections, with a total length of approximately 31 km. (around 22% of the total length of 138 km), which will be realigned to improve their geometry and the project will construct 19 bridges with an approximate total length of 1,330 m. The project construction period is 37 months. (Previous Design).

Project Facilities and Infrastructure: The Project road will be operated as a toll road with controlled access and toll booths. The toll booth and access control facilities including administration and rescue building will be constructed at four locations as same as toll booth along the road as

follows; Booth 1 to be located at approximately Sta.21+000, Booth 2 to be located at approximately Sta.66+200 and Booth 3 at Sta.69+433 in Myitta area and Booth 4 be located at approximately Sta. 155+700, namely "Hti Khee". It is the first entry gate from the Thai border. In addition, there is the vista point in rest area or service center or vista point to be developed at Sta.73+000.

6.2 The Amendment to the Project Details

The proposal for change of the project details comprises the assessment and the improvement of the previous construction design prepared by the Republic of the Union of Myanmar. The project road R.O.W. has been asked by the Republic of the Union of Myanmar to be expanded to 70.00 m, as given in details below.

(1) The Re-Alignment

As the previous design, in terms of detailed design of roads and intersections, the consultant considers locations that need to be corrected and improved to comply with standards. The consultant would use current access road to its limit. Therefore, the consultant considers adjusting the route of previous design to re-align with the current access road at 2 locations and 1 section that was adjusted the route in order to reduce the amount of soil cutting and filling, as follows,

- Dewadah Hill (Sta.27+250 to Sta.28+250) due to previous design route is designed on steep hill and valley. That cause the road in Dewadah Hill to be shorter by 253 meters. Therefore, the distance from 1,000 meters is reduced to approximately 747 meters.

- The Saddles Hill (Sta.49+700 to Sta.50+850) due to previous design route is designed on steep hill and valley. That cause the road in Saddles Hill to be shorter by 279 meters. Therefore, the distance from 1,150 meters is reduced to approximately 871 meters.

- The Elephant Cry Hill (Sta.100+250 to Sta.103+351) is adjusted to reduce soil cutting and filling. The previous design has the amount of soil cutting about 648,000 m^3 and the amount of soil filling about 59,000 m^3. For the new design route of the Elephant Cry Hill, the amount of soil cutting is approximately 576,000 m^3 and the amount of soil filling approximately 26,000 m^3. Therefore, the new alignment route between Elephant Cry Hill area will reduce the amount of soil cutting by 72,000 m^3 and reduce the amount of soil filling about 33,000 m^3. For the distance of the new alignment in Elephant Cry Hill, the distance will

increase slightly by approximately 50 meters from the original distance of 3,101 m., will increase to 3,151 m.

Therefore, the previous designed route re-alignment on 3 sections to be in the access road resulting in a shorter overall distance of approximately 482 meters In addition, this study will conduct a comprehensive study to 140 km. two-lane roads (a study in the 2018EIA report studying 138 kilometers from all 140 kilometers of design) The project construction period is 30 months.

(2) Expanded to Right of Way (R.O.W.)

In the 1st meeting with the Myanmar Department on April 4, Republic of the Union of Myanmar required the consultant to expand the width of Right of Way (R.O.W.) from the original design to 70.00 meters. The designated original R.O.W. is 40.00 meters according to the standard of the 4th floor highway. In addition, the project will expand the pavement in the flat area from 1.0 m. to 1.5 m. The pavement expansion will be in the R.O.W. which is approved in 2018EIA. These is a positive impact on transportation safety.

In addition, according to the approval letter for the EIA report of the project of two-lane road linking Dawei Special Economic Zone to Thai-Myanmar border in the Republic of the Union of Myanmar (EIA 2018 and Term of Reference (TOR), the project is assigned to propose the monitoring plan for wild animal crossings on the project road. The project needs to conduct assessment along the whole the two-lane road route. The road should have wildlife corridors and constructions of wildlife crossings.

(3) Reducing the Toll Plazas Location and adjusting Rest area Position

In the project design, the toll plaza positions were decreased from the original 4 positions to 2 positions (Sta.18+918 and Sta.155+700) in order to be most suitable for the project and worth the investment.

6.3 Review on EIA Data

Aligning the road back to the original access road to ensure safety and comply with the highway standard, it shortens the project road distance during the alignment period and reduce the trees cutting. While expanding the project R.O.W. according to the meeting with the Republic of the Union of Myanmar government, it is only a territorial protection of project R.O.W. zone, there are still same traffic lanes, there are no trees cutting in the expansion R.O.W. In summary, it changes the impact of biological resource in positive.

The Comprehensive environmental impact study on the distance is approximately 140 km. (138 km. distance in previous 2018EIA), it found that the most of the area along the extending road being on the original access road. Therefore, it does not cause much change in the environment existing from the present.

For the expansion of the R.O.W, it has a higher impact on landowners due to more land acquisition.

As for the reduction of the toll booths, this reduces the building and the construction activity in the project area. It is a positive effect on the environment. For changing the position of the rest area is not too far from the original position and still in the project R.O.W.. Therefore, it does not affect the change from the previous study as follow

6.3.1 Land Use

(1) The Existing Environment

The field investigation conducted during 15-17 May 2019. Result of land use investigation can be divided into 2 parts as 1) project study area within 500 m on both sides of project alignment, and 2) project road R.O.W. 70.00 m. Land use classification results can be demonstrated as follows :

The Studied Area Covering 500 m. on both sides from the project route axis covers the area of about 33,737.47 acres. Most lands were forests with 49.30%, orchard and perennial crops plantation area with 22.90%, para rubber plantation area with 5.70% and degraded and abandoned forest area with 5.50%, Bamboo forest area with 3.68%, Betel palm garden area with 3.30%, Agricultural abandoned area with 3.10%, Grassland area with 2.90% Establishment or Enterprise area with 0.77%, Urban and residential area with 0.72%, Road area with 0.60%, Paddy field area with 0.55%, Oil palm plantation area with 0.48%, Water body area with 0.48%, and Religious place area with 0.02%, respectively.

The Right of Way (R.O.W.) Covering 70.00 m. (35 m. strips on the both sides of project alignment) covers the area of 2,339.87 acres. Most lands were forests with 31.44%, orchard and perennial crops plantation area with 25.63%, para rubber plantation area with 9.96% and bamboo forest area with 5.83%, Degraded and abandoned forest area with 4.29%, Road area with 4.84%, Agricultural abandoned area with 4.82%, Grassland area with 3.76%, Betel palm garden area with 3.55%, Paddy field area with 1.70%, Urban and residential area with 1.30%, Establishment or Enterprise area with 1.10%, Water body area with 1.10%, and Oil palm plantation area with 0.68% respectively.

(2) Potential Impacts

(2.1) Construction Period

According to the previous 2018EIA report, during construction period, the land use pattern will be permanently changed to be road right of way about 1,532.07 acres. Impact on loss of the areas was limited to the required Right of Way which would not exceed 40.00 meters of width.

For this study, the study will be conducted to cover the total distance of 140 km and extend the R.O.W. to 70.00 meters. The land use pattern will be permanently changed to become the project area of approximately 2,339.87 acres. However, there are no construction plans in the expanded R.O.W. and the road extending study area are already access road. In addition, the roads that returned to the original access road are 2 sections, which are the Dewadah Hill (Sta.27+250 to Sta.28+250) and the Saddle Hill (Sta.49+700 to Sta.50+850). Therefore, the distance will be shortened approximately 532 meters by the re-alignment of these 2 sections. As for the Elephant Cry Hill (Sta.100+250 to Sta.103+351), the route was adjusted to reduce soil cutting and soil filling and the new alignment route has been increased by approximately 50 meters. The overall distance of the road during the alignment was shorter from the original design of approximately 482 meters and adapted to the original access road which reduces the impact on land use.

So, it can be concluded that changes to the project description will reduce the land use impacts as given in the 2018EIA report.

(2.2) Operation Period

As the previous 2018EIA, It was expected that during the operation period the development of transport networks and the convenience of travelling would be improved. The land utilization impacts would be changed due to the expansion of communities and commercial lands (positive impacts) in the future.

For the new designed road, it is found that the project will increase the R.O.W from 40.00 meters to 70.00 meters, resulting in a change in land use to permanently increase the area from that specified in the 2018EIA. However, the project will have a positive effect on improved transportation, communities and establishments will expand because the convenience of traveling which is not different from the 2018EIA.

6.3.2 Biological Resource

(1) The Existing Environment

1.1 Forest Resource

WWF report 2019 showed total forest loss was calculated for 2000-2014. During the baseline pre-construction phase, less than 0.2% of the landscape surrounding the road was being deforested annually. During construction of the access road and clearing for the main road, deforestation increased dramatically to rates of around 2% annually within 200 metres of the road, declining to just under 0.5% at 2 km. distance away from the road. After construction of the access road and clearing for the main road, deforestation rates remained elevated over the pre-construction baseline.

From 2018EIA, Based on the existing forest resources within R.O.W along the road alignment, there were 242 plant species. The threatened species in IUCN red list (2013) are Critically Endangered Species (CR)–one species found in this area is namely Dipterocarpus Chartaceus Symington. Endangered Species (EN)–one species found in this area is namely Shorea Roxburghii G. Don Vulnerable Species (VU)-three species were found, namely Borassodendron Machadonis (Ridl.) Becc., Cycas Pectinata Buch.-Ham. and Hopea Odorata Roxb.

Within the study area (500 m Strips from Center line), there were 247 plant species. The threatened species are Critically Endangered Species (CR)–two species found in this area are namely Dipterocarpus Chartaceus Symington and Dipterocarpus Turbinatus C. F. Gaertn. Endangered Species (EN)–one species found in this area is namely Shorea Roxburghii G. Don. Vulnerable Species (VU)–three species were found, namely Borassodendron Machadonis (Ridl.) Becc., Cycas Pectinata Buch.-Ham. and Hopea Odorata Roxb.

The field survey conducted during 15-17 May B.E. 2562 revealed that land utilization patterns in the studied area are changed from those given in the previous 2018EIA report (surveyed during 16-23 March B.E. 2558). The overall forest areas were reduced. The areas of enterprise, city zone and accommodation, betel nut farm, rubber tree plantation, mixed fruit and trees and paddy field were increased. This indicates the increases of forest intrusion.

1.2 Wildlife Resources

WWF report 2019 showed historical records and camera trap data from this region highlight the global conservation significance of the Dawna Tenasserim Landscape. For instance, a 2014-2015 biodiversity survey from northern Tanintharyi Region detected some of Asia's rarest and most threatened mammal species, including Clouded Leopard, Asian Elephant, Gaur, and Asian Tapir. More recently, surveys undertaken by the Karen Forest Department and supported by WWF in 2016-17 and 2017-18 confirmed the continued presence of 12 globally threatened mammal species within 10 kilometres of the current road alignment. Overall, these surveys documented a total of 23 mammal species along the current access road.

The results from the WWF workshop and subsequent analysis showed a number of likely movement routes across the landscape for nine globally-threatened species: Tiger, Clouded Leopard, Leopard, Asian Elephant, Gaur, Asian Tapir, Sambar Deer, Sun Bear, Asiatic Black Bear and White-Handed Gibbon. The locations of these movement corridors were validated by the recent camera trap survey along the Dawei-Htee Khee road in 2018, which was the first of its kind in the identified wildlife corridor.

From 2018EIA, Based on the existing wildlife resources within R.O.W. along the road alignment, there were 135 wildlife species. Vulnerable Species (VU) - one species were found. Near Threatened Species (NT)–five species were found

Within the study area (500 m Strips from Center Line) in total 152 wildlife species were found in this outer area, 17 species were found as threatened species within the study area in 500 m strips from center line. The threatened species were: Endangered Species (EN)-four species were found. Vulnerable Species (VU)–four species were found. Near Threatened Species (NT)–Nine species were found.

The field survey conducted during 15-17 May 2019 focused mainly on interviewing people living along the project route in order to confirm the diversity of wild animals living in the project area and within the studied area with radius of 500 m by using the data of TEAM and WWF, particularly the data of wild animals important for conservation or key species, as guidelines. The direct survey of wild animals along the route by using a car was also

conducted. In this study found threatened wildlife in a total of 19 species, most of which are threatened wildlife, as surveyed by TEAM and WWF, and this study found a tiger (Panthera Tigris) with is an additional endangered wildlife.

1.3 Laws related to the Conservation of Environmental Resources for Sustainable Development

Project implementation and development of Survey and Detailed Design Project for Two-Lane Road Connecting Dawei Special Economic Zone to Myanmar-Thailand Border, The Republic of the Union of Myanmar. There are related laws, namely the Environmental Conservation Law, 2012, by the Ministry of Environmental Conservation and Forestry performed by the Environmental Conservation Committee established by the Union Government. There will be an **Environmental Management Fund** in accordance with the financial regulations and laws of the Union to carry out effective environmental conservation operations. So that the environmental management fund is a fund to look after natural resources such as forests, wildlife, as well as the environmental impact of the project for sustainable environment care by the Myanmar government who is the project developer.

(2) Biological Impact Assessment

2.1 Construction period

(2.1.1) Forest resource

(2.1.1.1) Worst Case of All the Route

From the previous 2018EIA, the project road has distance of about 138 km. with R.O.W. of 40.00 m. width. The road construction would cause tree loss within R.O.W.. For the worst case (138 km) in the area of 1,364 acres.

For this study, the project has considered the impact to cover the road surveyed and designed. The distance is around 140 km and the road alignment between Dewadah hill and Saddle hill for increased safety for passers that will make the project road shorter by approximately 482 meters and the R.O.W. has been extended from 40.00 meters to 70.00 meters.

In the worst case, at R.O.W. of 70.00 meters, the construction of roads will result in the loss of trees within the R.O.W. approximately

2,413 acres. However, the project will not have any construction plans in the area along the R.O.W. expansion.

(2.1.1.2) Worst Case of Re-alignment Route

1. Dewadah Hill (Sta.27+250 to Sta.28+250) distance of 1,000 meters to be in current access road. Therefore, the distance is reduced to approximately 747 meters.

In the worst case, the previous design road has a total distance of about 1,000 meters with 70.00 meters R.O.W.. Loss of trees within the area for the worst case is about 17.3 acres (1,000 m x 70 / 4,047 m^2).

For EIA new design has a total distance of about 747 meters with 70.00 meters R.O.W. Loss of trees within the area for the worst case is about 12.9 acres (747 m. x 70 / 4,047 m^2).

However, there are no construction activities in the R.O.W. The project will have a total distance of approximately 1,000 meters and 40.00 meter R.O.W. The worst case of loss of trees within the boundary area due to the construction is about 9.8 acres (1,000 m. x 40/4,047 m^2).

For EIA new design has a total distance of about 747 meters with 40.00 meters R.O.W. Loss of trees within the area for the worst case is about 7.4 acres (747 m x 40 / 4,047 m^2).

Therefore, the change of project details will result in decreasing the loss of forest areas.

2. Saddle Hill (Sta.49+700 to Sta.50+850) distance of 1,150 meters to be in current access road. Therefore, the distance is reduced to approximately 871 meters.

In the worst case, the previous design road has a total distance of about 1,150 meters with 70.00 meters R.O.W. Loss of trees within the area for the worst case is about 19.8 acres (1,150 m x 70 / 4,047 m^2)

For EIA new design has a total distance of about 871 meters with 70.00 meters R.O.W. Loss of trees within the area for the worst case is about 15.1 acres (871 m x 70 / 4,047 m^2).

However, there are no construction activities in the R.O.W. The project will have a total distance of approximately 1,150 meters and 40.00 meter R.O.W. The worst case of loss of trees within the boundary area due to the construction is about 11.4 acres (1,150 m. x 40/4,047 m^2).

For EIA new design has a total length of about 871 meters with 40.00 meters R.O.W. Loss of trees within the area for the worst case is about 8.6 acres (871 m. x 40 / 4,047 m^2).

Therefore, the change of project details will result in decreasing the loss of forest areas.

3. Elephant Cry Hill (Sta.100+250 to Sta.103+351) distance of 3,101 meters to be reduced soil cutting and filling. The distance will be increased slightly is approximately 3,151 meters

In the worst case, the previous design road has a total length of about 3,101 meters with 70.00 meters R.O.W. Loss of trees within the area for the worst case is about 53.64 acres (3,101 m x 70 / 4,047 m^2). For EIA new design has a total length of about 3,151 meters with 70.00 meters R.O.W. Loss of trees within the area for the worst case is about 54.50 acres (3,151 m x 70 / 4,047 m^2)

However, there are no construction activities in the R.O.W. The project will have a total length of approximately 3,101 meters and 40.00 meter R.O.W. The worst case of loss of trees within the boundary area due to the construction is about 30.65 acres (3,101 m. x 40/4,047 m^2). For EIA new design has a total length of about 3,151 meters with 40.00 meters R.O.W. Loss of trees within the area for the worst case is about 31.14 acres (3,151 m x 40 / 4,047 m^2)

Nevertheless, Road re-alignment is causing all 3 newly designed sections have a shorter overall distance of about 482 meters and adjust the road to the original access road causing the loss of forest areas will be reduced. The loss of forested area is less than that specified on the approved EIA.

(2.1.2) Wildlife Resources

From present survey and design of the project details, the project has re-designed the road parts to be re-aligned in the current access road as much as possible by adding 2 more sections of the current access road to those given in the previous 2018EIA report. They include Dewadah Hill section (Sta.27+250 to Sta.28+250) and Saddles Hill section (Sta.49+700 to Sta.50+850). That cause the overall distance to be shortened by 532 meters resulting in less forest area loss. This will reduce perturbation of wild animals and their habitats. As for the road alignment around Elephant Cry Hill (Sta.100+250 to Sta.103+351), the new route has not changed much, with a distance of approximately 50 meters increasingly.

Nevertheless, the road re-alignment resulting in the overall redesigned of the 3 sections of the route has been shorter from the previous approximately 482 meters and the adjustment of the road will be to the original access road. So, the new design route reduces the loss of forest areas and the impact on wildlife habitats. Therefore, the new road re-alignment might reduce the level of wildlife resources impact as specified on the approved EIA.

2.2 Operation Period

Project road parts will be constructed on the current access road, which has impacts mentioned above. These impacts will be increased with increasing number of vehicles due to the project growth. According to the present survey and design of the project details, the route change accounts for 482 m reduction with 2 traffic lanes which increase the traffic convenience cause the increase of vehicles and air pollution impacts or accidents on wildlife. There are no different from what was stated in 2018EIA. The use of 2 sections of the current access road also reduce deforestation, which in turn reduces perturbation of wild animal habitats. Regarding the R.O.W. expansion, the project will not have additional construction. Thus, the change of the project details will not cause impact level changes from those given in the approved EIA report.

However, in order to reduce the impact on wildlife resources and according to the approval letter for the EIA report of the two-lane road improvement

project connecting DSEZ to the Thai-Myanmar border in the Republic of the Union of Myanmar (EIA 2018) and Term of Reference (TOR), the project had assigned to propose the monitoring plan for wild animal crossing the project road by studying along the whole two-lane road of the project and there must have wildlife corridors.

(2.2.1) Wildlife Corridor

The wildlife crossing has 2 types as follows :

A. **Wildlife Crossing Under Bridge** is an elevated bridge for large wildlife which having a height of 4-5 meters (10 positions).

B. **Wildlife Crossing RC. Box Culvert** is the reinforcement concrete box is 3.6 m. x 3.6 m. size; (2 positions) and designed to have a shelve for small wild life to pass through during the rainy season.

The wildlife crossing position must have a steel fence installed to force the wildlife animal to pass through to wildlife crossing. The fence size is specified a minimum length of 500 meters per side (2 km. / point) as shown in **Figure 5.12-4**

In this study use the satellite photographs of years 2012, 2015 and 2019 to reveals some potential wildlife corridor construction points. This indicates that during construction of the access road the forest was deteriorated and the wildlife habitat was disturbed. After that the forest underwent recovery and was suitable for wildlife habitat. However, construction of accommodation close to a wildlife corridor point will make wild animals escape and they will not use such wildlife corridor assigned by the project.

The field survey on the present status of wildlife corridor positions during 15-17 May 2019 and during 26-30 August 2019 revealed that, the construction of underpasses, the position Sta.81+454 has present status of forest alternating with agricultural lands. Tracks of various wild animals were observed, particularly raised elephants used a route parallel to a river to get to a forest. Thus, this position is suitable for construction of an underpass according to the WWF recommendation.

For Sta.68+596 is a large bridge which is suitable for large animals but there are agricultural lands and villages. Therefore, the construction of accommodation close to a wildlife corridor point may disturb the use of corridor by wild animals.

However, the positions Sta.72+914 Sta.76+513 Sta.77+162 Sta. 90+906 Sta.106+956 and Sta.107+956 are mostly agricultural lands and villages with year-round stream. Wild animals use upstream water normally. However, construction of accommodation close to a wildlife corridor point may disturb the use of corridor by wildlife.

Sta.120+248 is an agricultural lands and villages. There are frequently passing cars and motorcycles which may disturb the use of corridor by wildlife.

There are 2 positions for construction of steel-reinforced box culvert wildlife corridors, which are the Sta.100+375, agricultural lands and villages with year-round stream. There were wild animals using upstream water normally. Sta.126+373 is an agricultural lands and villages. There are frequently passing cars and motorcycles which may disturb the use of corridor by wild animals.

All wildlife corridor positions for the project (from technical workshop on July 30 - 31, 2019, with WWF) and the wildlife corridor locations from document of Wildlife Crossing, 2016 (WWF) are all the same, except for 2 wildlife corridor locations, where the wildlife corridor positions of the project are far from the locations as suggested by WWF for distances of 3.1 and 4.0 kilometers, respectively. However, wildlife is adaptable and can use wildlife corridors since the distance is not far. Moreover, the wildlife corridor is also the point of waterways which will be a water source for wildlife and may attract wildlife to this area.

6.3.3 Land Acquisition

From the 2018EIA, the project would acquire about 340.5 acres of additional land outside the existing right-of-way for construction of all project components.

For this study, it was found that the project needed to expropriate approximately 2,339.87 acres, an area beyond the original boundary, to be used for the construction of various parts of the project. There are more than what was stated in 2018EIA due to the expanded road area.

6.3.4 Human Rights Impact

The project shall seriously follow the measures for reduction of environmental impacts and measures for monitoring environmental impacts given in the Final Report for Environmental Social Impact and Assessment (ESIA) on Two-Lane Road Project, Linking the Dawei SEZ with Thai Border in Dawei District, The Republic of the Union of Myanmar, approved in June 2018. The project shall follow the action plan in EMP and conditions for implementing measures given in the approval letter for 2018EIA, and additional measures in the amendment to EIA report to cover various environmental impacts to not affect the community and the environment. In addition, the project will follow the guidelines specifying the labor action plan and Action plan for community, land, natural resources and the environment from the 1st National Action Plan on Business and Human Rights (2019-2022) from Thailand in order to further reduce the impact on human rights.

6.4 Review Measures for Prevention and Mitigation Environmental Impacts and Measures for Monitoring Environmental Impacts.

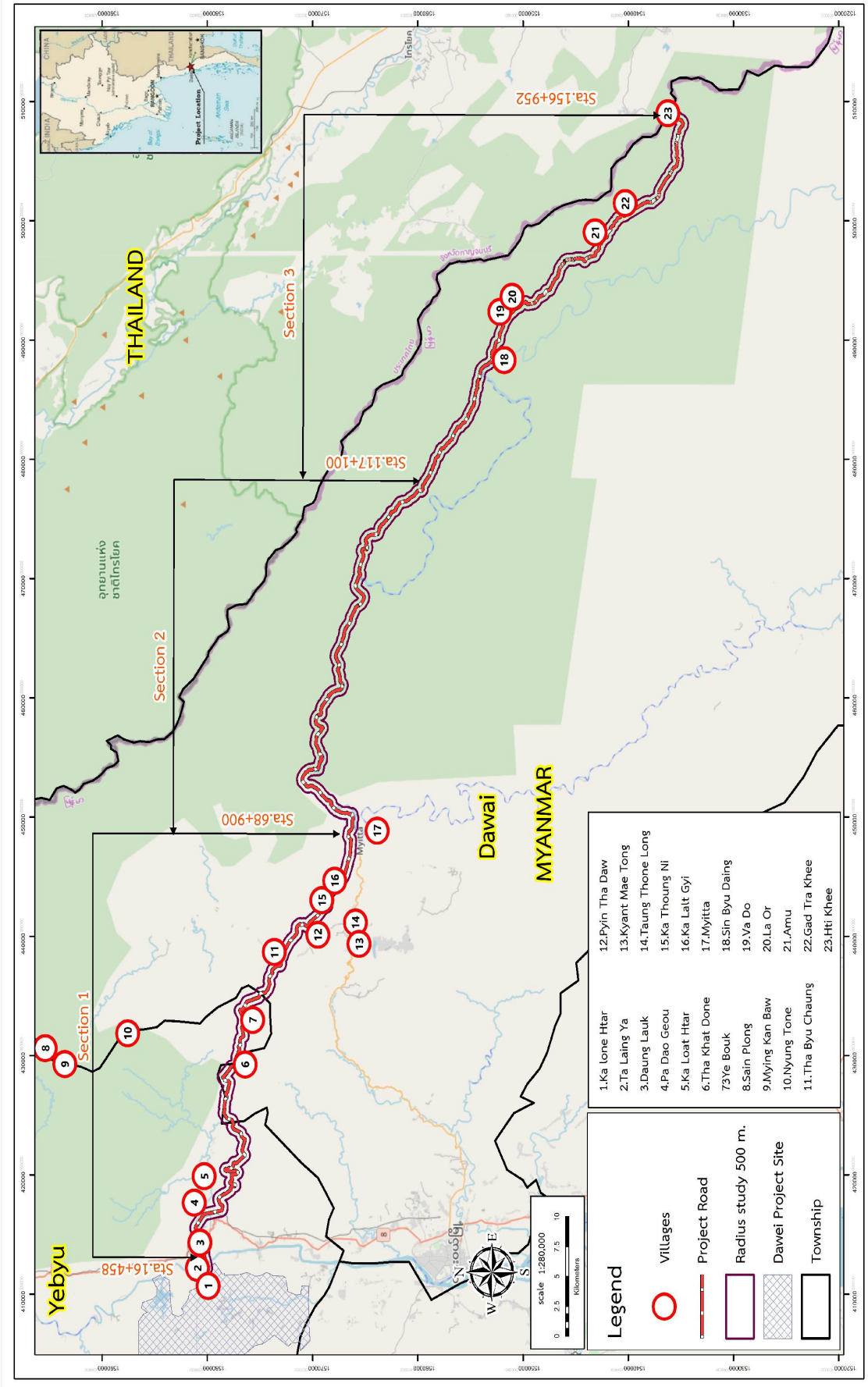
The project also reviewed and designed on safety issues as 2018EIA and compared the between the additional mitigation and mitigation from Final Report for Environmental Social Impact and Assessment (ESIA) on Two-Lane Road Project, Linking the Dawei SEZ with Thai Border in Dawei District, The Republic of the Union of Myanmar, approved in June 2018. It was found that the environmental measures covered the impact of changes in project details. However, the project has improved and added transportation and biodiversity measures to be consistent. With the change of project details and to prevent impacts on ecology system in the project area then there are additional measures for wild resources. They include wildlife corridor and prevention of accidents between vehicles on the project road and wild animals with literature review and consultation with relevant organizations, such as WWF and adjusted the budget for operations in accordance with additional or changed environmental measures.

The project shall seriously follow the measures for reduction of environmental impacts and measures for monitoring environmental impacts and the action plan in EMP and conditions for implementing measures given in the approval letter for Environmental Social Impact and Assessment (ESIA) on Two-Lane Road Project, Linking the Dawei SEZ with Thai Border in Dawei District, The Republic of the Union of Myanmar.

CHAPTER 7

PUBLIC RELATIONS AND PARTICIPATION

The consultant held public relations and participation meeting twice on 17 May 2019 and 29 August 2019 at the meeting room of One Stop Service Center (OSSC) in Dawei, Myanmar. In addition, consultant conducted to hear opinion and suggestion from 16 villages within 500 m. radius from center line according to the guidelines given in the old report of Environmental and Social Impact Assessment (ESIA) On Two-Lane Road Project, Linking the Dawei SEZ with Thai Border in Dawei District, The Republic of the Union of Myanmar: TA Laing YA Village, Dauk Lauk Village, Pa Dao Geon Village, Tha Loat Htar Village, Tha Khat Done Village, Ye Bouk Village, Tha Byu Chaung Village, Pyin Tha Daw Village, Taung Thone Long Village, Myitta Village, Sin Byu Daing Village, Va Do Village, La or Village, Amu Village, Gad Tra Khee Village and Hti Khee Village. Another seven villages 500 m. outside the center line: Ka lone Htar Village, Ka Lalt Gyi Village, Ka Thoung Ni Village, Nyung Tone Village, Mying Kan Baw Village, Sain Plong Village and Kyant Mae Tong Village. were also visited for public relations purpose. Summary of visit can be seen in **Figure 7.1.** A website to publicize the project was also created at "www.neda-daweiroad.com" in Thai, English and Myanmar language. Details of the study are;



Source : The Consultants 2019

Figure 7.1 Locations and Names of Visited Villages in the Public Relations and Participation Task

7.1 The First Public Participation Meeting (The Project Orientation)

The activity was conducted on Friday, 17th May 2019, 10.00 A.M. - 12.00 P.M. at the meeting room of One Stop Service. U Hla Htwe Minister of Regional Government of Myanmar and Senior Colonel Saranyu Viriyavejakul, D.Sc., Vice President of NEDA presided over the meeting. The attendants included relevant governmental offices, such as union, regional and local governmental offices, relevant organizations and potentially affected groups (community leaders/people) in the project area. There were 124 attendants summarized in **Table 7.1-1**. The details are given below. The meeting comments are summarized in **Table 7.1-2**.

Table 7.1-1 Attendants of the First Public Participation Meeting

No.	Target Groups	Number (Person)
1	Relevant governmental offices	45
2	Relevant organizations	20
3	Potentially affected groups in the project area (community leaders/people)	59
Total Attendant		**124**

Table 7.1-2 Summaries of Opinion and Comment

Comment	Explanation
- People's rights in the use road of projects	The general public can use the project road. The project road is divided into 2 phases, which are free service periods. And during which tolls have to be paid in which road users have to pay the same service fee.
- Project road construction may affect the environment and people Especially during the time passing through the forest area	The EIA will review the old EIA report and add more studies according to the changes of project details. Additional evaluations of environmental impact-causing factors due to the project development and measures for prevention and mitigation of environmental impacts will be presented in the next meeting.
- The project website cannot be reached by all groups of people. Does the project have any other channel in publicizing project progress to people?	The project has made public relations media, brochures, distributed to the general public. In addition, the meeting attendants there are representatives from the community leaders. They could be the project public relations media for disseminating the project information and development to relevant people. Community

Comment	Explanation
	leaders are able to report the progress to their area.
- There are a lot of Karen people living around and what benefits to be obtained by these people from the road construction?	The benefits of road development include prosperity, trading convenience, and increase of income and jobs.
- Stages and construction period for the project	The project is in the process of exploring and designing the project route. To be used as supporting documents between NEDA and the Myanmar government for use in the construction of road projects It is expected that it will take 3-5 years to complete the construction.
- Responsible party in compensation payment in case the project affects people in the area.	The road construction, Myanmar government is responsible for compensation payment. NEDA only supports with loan for construction of project.
- Regarding the problem in rainy season that vehicles cannot use such road, what offices are responsible for repair.	The relevant offices will repair such broken road section. The request for road repair can be informed to relevant offices.
- Flood is the main problem of the road route.	The consultant will design the road to prevent flood problem. Which is already set as a Preventive measures both during the construction phase and when the route opened.
- Additional studies on animal crossings given in the previous EIA report are required to minimize impacts to wild animals so they can live normally.	The consultant has collected data of wild animals and designs of wild animal crossings from relevant organizations, such as KNU and WWF and conducted field survey and additionally assessed environment. The project will report the study results to Myanmar government for further consideration.

7.2 The Second Public Participation (Conclusion of Project Study)

The second meeting on project presentation and public participation was (conclusion of the project study) on Thursday 29 August 2019 from 09.30 A.M. - 12.00 P.M. at the meeting room of One Stop Service Center (OSSC) Dawei Special Economic Zone-DSEZ, Myanmar. The meeting was jointly chaired by U Aung Thura - Regional Minister of Energy and Electricity, Tanintharyi Regional Government and Col. Dr. Saranyu Viriyavejakul, Vice President of The Neighbouring Countries Economic Development Cooperation Agency (Public Organization) (NEDA). Attendants include related Myanmar government agencies such as union, regional and local authorities and groups to be affected by the project (community leaders/villagers). There were 162 attendants. Details of attendants are summarized in **Table 7.2-1** and the details are given below. The meeting comments are summarized in **Table 7.2-2**.

Table 7.2-1 Attendants at Project Presentation and Public Hearing

No.	Target Groups	Number (Person)
1	Related government agencies	35
2	Related organization	14
3	Groups that may be potentially affected (community leaders/villagers).	111
4	The press	2
Total Attendants		**162**

Table 7.2-2 Summaries of Questions and Suggestions from Second Meeting on Project Presentation and Public Participation (Conclusion of Project Study)

Questions/Suggestions	Explanation
- The majority is in favor of the project but should listen to opinions from the local people as they are the ones who will be directly affected.	The project always prioritizes opinions from the people. Two public hearings were held. However, as many people faced difficulty in coming to the meeting. The consultant will therefore hold additional meetings at village level for more opinions and suggestions on later date.
- Approaches to alleviate environmental impacts on people and forest in the area.	There are measures in mitigation of impacts in the study during construction and operation periods.
- Myanmar language should be used in communication so people can understand and support the project.	The consultant hires Myanmar interpreter to communicate with local people.
- Stages and construction period for the project	The project is in the stage of survey and design of the project route. The next will be the stage of loan process by NEDA to Myanmar government. After that the construction bid will be opened, eexpected will take 3-5 years to complete the construction.
- Responsible party in compensation payment in case the project affects people in the area.	The road construction, Myanmar government is responsible for compensation payment. NEDA only supports with loan for construction of project.

7.3 Public Relations and Hearing at the Village Level

There had been two public relations and hearings. The first one (Project Orientation) is to publicize the project and hear opinions and suggestions from local people. The second one (Conclusion of the project study) is to present the results of study. As many people live far away from the meeting venue, the consultant cooperated with community leaders to bring the information to them. The consultant was allowed by some leaders to talk and listen to villagers. Small group meetings were held at some villages. This was conducted during 15-17 May 2019 and during 30 August 2019 – 1 September 2019 in 23 villages. Details are listed in **Table 7.3-1.** Summary of suggestions and concerns from the village level details are in **Table 7.3-2.**

Table 7.3-1 Date/Venue/Village and Hearing Method

Date/ Venue	Village	Distance from Project Route	Method
15 May 2019	1. Myitta Village	Within study radius of 500 m.	Meet and explain to community leader
17 May 2019	1. TA Laing YA Village	Within study radius of 500 m.	Meet and explain to community leader
17 May 2019	1. Gad Tra Khee Village	Within study radius of 500 m.	Meet and explain to community leader
17 May 2019	1. Hti Khee Village	Within study radius of 500 m.	Meet and explain to community leader
30 August 2019 At the Village Meeting Hall	1. Pa Dao Geon Village 2. Dauk Lauk Village 3. Tha Loat Htar Village	Within study radius of 500 m.	Small group meetings
	4. Ka lone Htar Village	Outside the radius of 500 m.	
30 August 2019 At the Village Meeting Hall	1. Ye Bouk Village	Within study radius of 500 m.	Small group meetings
31 August 2019 At the Community Leader Office	1. Tha Khat Done Village	With study radius of 500 m.	Meet and explain to community leader
31 August 2019 At the Community Leader Office	1. Sin Byu Daing Village	Within study radius of 500 m.	Meet and explain to community leader

Date/ Venue	Village	Distance from Project Route	Method
31 August 2019 At the Village Meeting Hall	1. Pyin Tha Daw Village 2. Taung Thone Long Village 3. Tha Byu Chaung Village 4. Myitta Village	With study radius of 500 m.	Small group meetings
	1. Ka Lalt Gyi Village 2. Ka Thoung Ni Village 3. Nyung Tone Village 4. Mying Kan Baw Village 5. Sain Plong Village 6. Kyant Mae Tong Village	Outside the radius of 500 m.	
1 September 2019 At the Community Leader Office	1. Gad Tra Khee Village	Within study radius of 500 m.	Meet and explain to community leader
1 September 2019 At the Community Leader Office	1. Va Do Village 2. La or Village	Within study radius of 500 m.	Meet and explain to community leader
1 September 2019 At the Community Leader Office	1. Hti Khee Village 2. Amu Village	Within study radius of 500 m.	Small group meetings

Tale 7.3-2 Summaries of Suggestions and Concerns from the Village Level

Village	Opinion on the Project	Suggestions/Concerns
1. TA Laing YA Village	Villagers need the road in order to travel safely.	Information on construction should be given to community leader to pass it to villagers.
1. Ka lone Htar Village 2. Dauk Lauk Village 3. Tha Loat Htar Village 4. Pa Dao Geon Village	Ask to build the road as soon as possible for more convenient travel. They ask whether or not they have to pay to use the road or are able to use it for free as before.	Road construction will try best to save forest along the both sides of the road, as this is the place where villagers utilize for their living.
1. Ye Bouk Village	There should be compensation payment in case the road runs through their land. The compensation shall be spent on the resettlement.	Myanmar language should be used in construction plan as people nearby can understand. The majority of villagers are positive towards the project.
1. Tha Khat Done Village	The existing road is in deterioration, particularly in rainy season. It is full of potholes and unpassable at some points. The new road shall provide more convenience and safety to travel. It is a supporting accessory for more earning.	People should be able to use the road without paying tolls. Tolls collection should be on trucks.
1. Sin Byu Daing Village	Compensation on land acquisition and plantation should be considered in case a road is built.	Emphasize should be given on water resources. This is vital to people in the area.
1. Tha Byu Chaung Village 2. Pyin Tha Daw Village 3. Taung Thone Long Village 4. Ka Lalt Gyi Village 5. Ka Thoung Ni Village 6. Myitta Village 7. Nyung Tone Village 8. Mying Kan Baw Village 9. Sain Plong Village 10. Kyant Mae Tong Village	Impacts on forest should be the least to preserve environment and villagers' source of income and subsistence.	The project is long and has many intersections. There should be traffic signs when traffic becomes dense. Traffic signs may invite more users to the road as it is safe to travel.

Tale 7.3-2 Summaries of Suggestions and Concerns from the Village Level (Cont'd)

Village	Opinion on the Project	Suggestions/Concerns
1. Gad Tra Khee Village	There should be a training course to people on traffic regulations before the road is opened for use. Most are not literate in reading signs.	Meeting with local leaders should be done prior to construction. This is to inform people of impacts on their way of life and can prepare themselves.
1. Va Do Village 2. La or Village	People living 4-5 households in Va Do Village where the road passes are willing to cooperate in land acquisition. Constructor should inform them before construction starts.	Officals should educate people on traffic rules and regulations to prevent accidents.
1. Hti Khee Village, 2. Amu Village	In case there is land acquisition, please inform them first and prepare new place for must villagers as they are impoverished.	Two weeks warning should be given to community leaders before construction starts. Measures and / or prohibition should be written in a language local people can understand.

Summaries of Public Participation

No.	Activities	Number (Person)
1	First Meeting for Project Presentation and Public Participation (Project Orientation)	124
2	Second Meeting on Project Presentation and Public Participation (Conclusion of Project Study)	162
3	Public Relations and Hearing at the Village Level	118
Total Attendants		**404**