Public Works, Ministry of Construtions
Republic of the Union of Myanmar

PREPARATORY SURVEY REPORT
ON
THE PROJECT FOR CONSTRUCTION OF NEW THAKETA BRIDGE
IN
THE REPUBLIC OF THE UNION OF MYANMAR

NOVEMBER 2014

JAPAN INTERNATIONAL COOPERATION AGENCY

ALMEC CORPORATION
ORIENTAL CONSULTANTS CO., LTD.
NIPPON KOEI CO., LTD.

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PREFACE

The Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrust the survey to a team consisting of Almec Corporation, Oriental Consultants Co., Ltd., and Nippon Koei Co., Ltd.

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

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

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

November 2014

Akira Nakamura
Director General,
Infrastructure and Peacebuilding Department
Japan International Cooperation Agency

SUMMARY

Outline of the Country

Myanmar with an area of approximately 680,000 km^2, which is 1.8 times that of Japan, is the largest country in South Asia. The size of Myanmar is about 2,100 km from south to north, and about 900 km from east to west. The total population of Myanmar is about 63.6 million (International Monetary Fund (IMF) estimates, 2012). Myanmar borders Thailand, Lao, China, India, and Bangladesh.

According to the IMF estimates in 2012, Myanmar's nominal gross domestic product (GDP) is around US$54 billion, per capita nominal GDP is US$834, and annual GDP growth rate is about 5.0%.

From 2006 to 2010, the share of primary industry decreased from 45.3% to 37.8%, share of secondary industry increased from 18.6% to 24.3%, and there was no change in the share of tertiary industry.

The total export amount is about US$9.9 billion. Liquefied natural gas (LNG) has the highest export amount and almost all quantities have been exported to Thailand. The other major items for export are beans, sewn products, and wood including teak. The total import amount is about US$6.5 billion. The major import items are diesel, and general and transport machinery.

Background, Situation and Outline of the Project

The total number of vehicle imports increased due to the changed policy for renewal of import license and preferential taxation. In Yangon Region, the number of registered vehicles was 270,000 in 2011, and 370,000 in 2012. As a result, congestion of the existing road is heavy, and heavy traffic jam is the norm in Yangon City, especially during rainfall, and morning and evening times.

In the Yangon City area, which has urban transportation on a road network that is divided by two rivers and one creek, there are 15 bridges at present that facilitate the movement between the surrounding area and the city center. The existing Thaketa Bridge (length: 285 m, road width: 8.5 m, two-lane) is one of the most useful bridge among the 15 bridges. It is located on the route that connects the city center and the harbor and the future Thilawa Industrial Park. It has become an important bridge as well as a link to the city center, South Dagon District, which is a commuter town, and Thaketa Township from Thanlyin Township.

The total traffic volume at the existing Thaketa Bridge was about 29,000 vehicles/day in 2013 according to the traffic count survey results. It exceeds the traffic capacity specified in the road design manual for a two-lane road. The existing Thaketa Bridge was constructed 47 years ago. At present, its deterioration is progressing. The weight limit of passing vehicles on the bridge is 10 t only. The existing bridge is forced to be closed to traffic for repair and it is one of the bottlenecks of the transportation network in Yangon. The construction of a new bridge can be a solution to the bottleneck.

The Public Works (PW), Ministry of Construction (MOC) reported in "Infrastructure Development in Myanmar, Feb 2012" that expansion and strengthening of the road network in major cities and transportation strategic points across the country is a major task. The Project for Construction of New Thaketa Bridge is recognized as a national project by the Myanmar government.

Summary of the Survey Results and Main Feature of Project Facilities

The Preparatory Survey on the Project for Construction of New Thaketa Bridge is carried out following a basic policy that is based on the principle of Japanese grant aid. A letter of request dated December 4, 2013 proposed the elimination of current traffic congestion by construction of a new bridge and road with a total of four lanes. According to the traffic survey of the Project for Comprehensive Urban Transport Plan of the Greater Yangon (YUTRA), traffic volume of the existing bridge exceeds the general traffic capacity of two lanes. Therefore, the design policy shall be as follows:

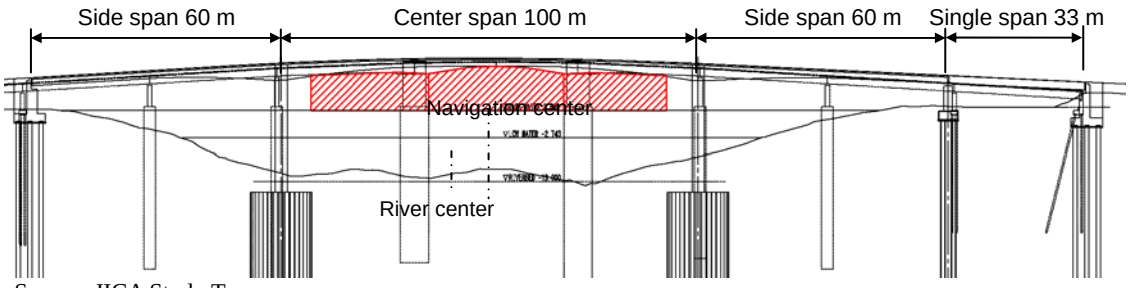
- The new bridge construction and road widening will achieve the objective of the project, which is to eliminate the bottleneck in the area.
- It is planned to widen the dual, one-lane section of Yamonnar Road (present condition) to a dual, two-lane section.
- New Thaketa Bridge will replace the existing bridge as planned based on the dual, two-lane road plan including bridge length, span arrangement, and optimal bridge type.

With respect to structural guidelines, specialized structural design criteria associated with complex bridge types are compiled with the Japanese Standard for Highway Bridge (JSHB) and the Japanese Standard for Highway (JSH) associated with developing preliminary bridge concepts. The general structural limitations and restrictions for the New Thaketa Bridge such as span length restrictions, typical bridge cross sections, location of abutment, and restrictions on distance to adjacent structures on land or water are individually identified and verified.

The New Thaketa Bridge was proposed to run parallel with the existing Thaketa Bridge at the upstream side due to land availability. Referring to the JICA Guidelines for Environmental and Social Considerations (April 2010), the environmental category is defined as Category B for resettlement of less than 200 people.

The location of the A1 abutment is set to the nearest position of Pazundaung Creek. The location of the A2 abutment is considered so as not to affect the community road. Thus, the abutments are placed at STA. 0+738 of A1 and STA. 0+738 of A2. Bridge length is determined to be 253.000 m.

According to the site survey, many vessels sailing and mooring have been observed on the water area from the junction to Nga Moe Yeik Bridge. The water area seems to have good hydrographical conditions and is relatively calm with sufficient navigation and depth for sailing vessels. Actually, many vessels have been found in the recent satellite photograph of Pazundaung Creek obtained in this study. The central span length is planned considering the navigation clearance of ships sailing along Pazundaung Creek and passing through Thaketa Bridge. Thus, the navigation width for the New Thaketa Bridge shall be set to 100 m because the room for navigation and width of pier shall be considered to be as much as the general navigation width, i.e., 85 m. The navigation height shall be the same as that of the existing Thaketa Bridge because there is hardly any difficulty encountered in the present condition. As indicated in the following figure, the present navigation area of the existing bridge, which has three spans, is almost equal to that of the new bridge having one span.



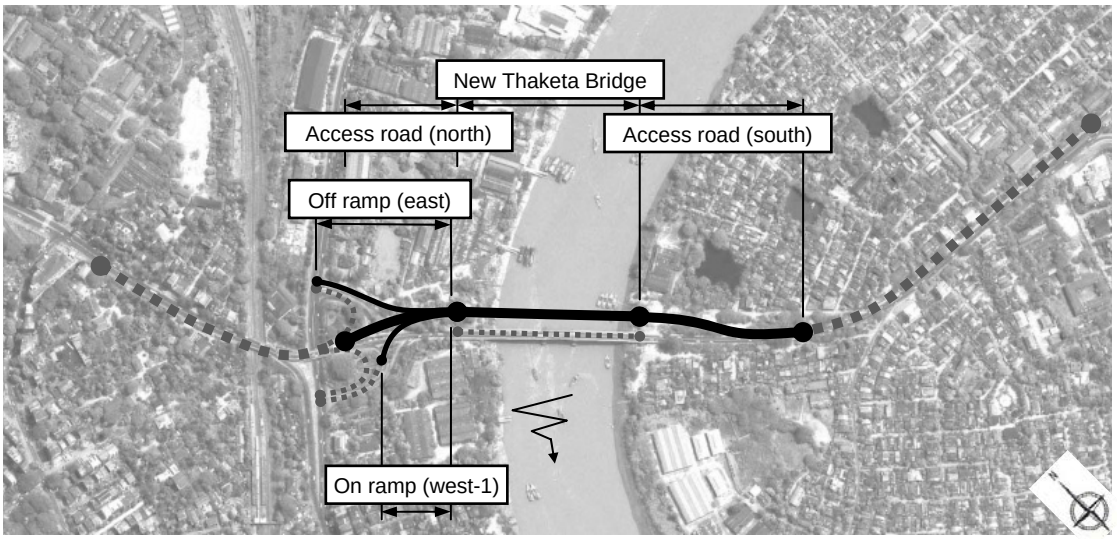
Source: JICA Study Team

Relation between Spanning of the New Thaketa Bridge and Existing Navigation

The center span of the new bridge is located at the deepest point of Pazundaung Creek. Foundation design of P1 and P2 piers shall consider the river depth, range of tide, and speed of tide, and secure navigability of sailing vessels during construction. Among these conditions, the river depth shall prevail. Generally, 1) ready-made pile, 2) caisson, or 3) steel pipe sheet pile (SPSP) can be used for this condition without massive temporary work. But with massive temporary work, cast-in-place pile can be used for the foundation. SPSP foundation is the most economical and reasonable based on the results of a comparative study. SPSP is a foundation that connects arrayed steel pipe piles and is closed like a sunk well. The steel pipe piles act as a cofferdam during construction. For the foundation of abutments and P3 pier, cast-in-place concrete pile, which is generally used in bridge construction projects in Myanmar, can be selected.

Among the applicable superstructure types for a 100 m span and girder depth, a) steel box girder with steel deck plate, b) steel truss, or c) prestressed concrete (PC) extradosed bridge can be selected. Structural conditions, construction conditions, maintenance, landscape and economic aspects are considered for a comparative study of the three types. Based on the results of the study, the PC extradosed bridge is the type selected to be suitable for the New Thaketa Bridge.

The scope of works to be undertaken by the Japanese government is from STA. 0+320.0 to STA. 0+940.0 including the new bridge, two access roads (north and south), off-ramp (east), and on-ramp (west-1).



Source: JICA Study Team

Scope of Works

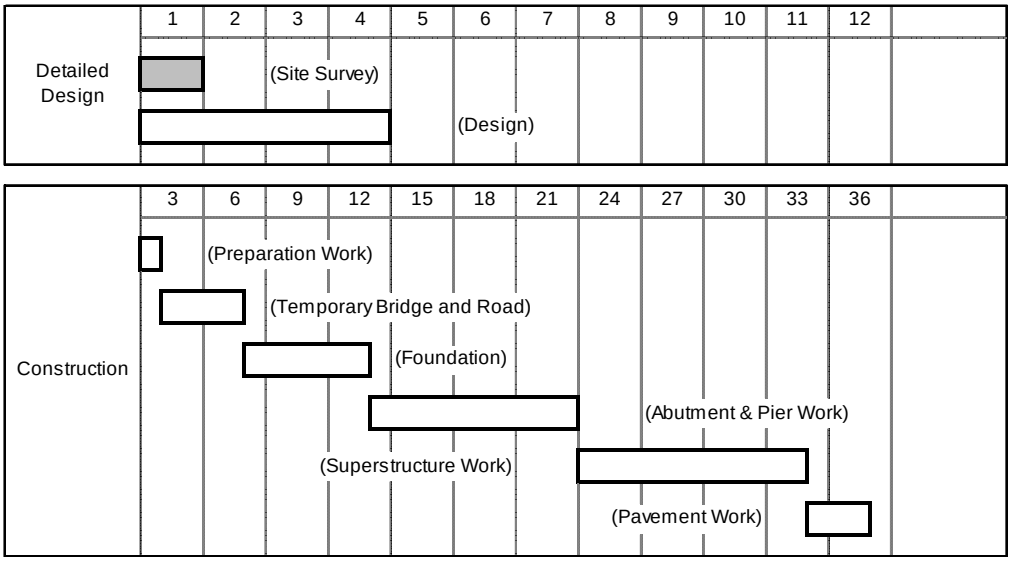
Scope of Facility

Category	Item	Scope
Bridge Construction	Bridge Length	253.0 m
	Bridge Width	21.3 m (0.4 m + 2.0 m + 0.5 m + 2-lane x 3.5 m + 0.5 m + 0.5 m + 0.5 m + 2-lane x 3.5 m + 0.5 m + 2.0 m +0.4 m)
	Bridge Type	PC 3 Span Continuous Extradosed Bridge : 220 m PC Box Girder Bridge : 33 m
	Foundation Type	P2, P3 : Steel Pipe Sheet Pile (dia 1,000 mm) A1, P3, A2 : Cast-in-place Pile (dia 1,000 mm)
Road Construction	Length	Access road (north) : 165 m
		Off-ramp (east) : 104 m
		On-ramp (west-1) : 88 m
		Access road (south) : 202 m

Source: JICA Study Team

Project Implementation Period and Estimated Project Cost

The implementation schedule for the project to be executed under a Japanese grant aid scheme is estimated. After the signing of the Exchange of Notes and grant agreement, the Japanese consultant recommended by JICA to the Myanmar government will agree and sign with MOC and commence the detailed design and bidding assistance. The period of the detailed design is four months, and the period of the bidding assistance is two months. The consultant will commence the site survey including geotechnical survey under a subcontract and the detailed design and preparation of bidding documents in Japan. The results of the detailed design and preparation of bidding documents will be approved by MOC. The bidding process for three months includes prequalification of bidders (Japanese contractor only), consideration and distribution of the reply to bidders' questions, bidding, negotiation, award of successful bidder, and signing with contractor. The contract will be verified by JICA. After verification by JICA, the consultant will issue the letter requesting for the commencement of the works to the contractor. The total construction period is estimated at 35 months as follows.



Source: JICA Study Team

Tentative Implementation Schedule

The project cost required to be undertaken by the Government of Myanmar is about US$212,000.

Project Evaluation

(1) Relevance

The construction of the New Thaketa Bridge is second in the priority list for the construction of bridges prepared by PW, MOC. The construction of the New Thaketa Bridge is selected by YUTRA as one of the highest priority project. The new bridge will be one of the connection routes between the city center and the Thilawa SEZ area in the future. In this survey, the project cost was estimated properly based on the outline design, price quotations/procurement conditions for construction, and implementation schedule including construction plan. Therefore, it is confirmed that the relevance of the implementation of this project under grant aid is quite reasonable.

(2) Effectiveness

Quantitative effects of the project are selected according to the demand forecasting model studied in YUTRA and shown in the following table.

Quantitative Effects of the Project

Indicator	Baseline Year (2013)	Target Year (2021)
Traffic Volume	1.000	1.597
	28,635 vehicles/day	45,723 vehicles/day
Average Travelling Speed	21.7 km/h	27.2 km/h
Congestion Rate	1.04	0.76
Weight Limit	10 t	Non-limit (25 t)

Source: JICA Study Team

Qualitative effects of the project are shown as follows:

- Improvement of logistics efficiency, and lives of local residents

  The existing Yamonnar Road including existing Thaketa Bridge is two lanes and connects the city center with Thaketa area and Thilawa area as a trunk road. Heavy traffic jam occurs on this section regularly. The improvement of this section from two to four lanes will increase traffic capacity and travelling speed and reduce logistic and travelling time. Therefore, the improvement of logistics efficiency and the lives of local residents can be expected.

- Securing safety and relief road

  A part of the section of the road has not enough width and radius according to appropriate design criteria. The improvement of safety can be expected from the implementation of the project using Japanese Road Standards.

- Introduction of new technology (Extradosed Bridge and Steel Pile Sheet Pile Foundation)

  The new bridge has a 100 m long center span and SPSP foundation which can be applied for construction at deep river. Technical transfer for the design and construction for the new type of structure in Myanmar can be expected. The new technology can give alternatives for the selection of bridge type.

- Introduction of bridge maintenance technology

  The improvement of capacity for bridge maintenance and technology can be expected through the project. The reduction of the life cycle cost of the bridge with appropriate maintenance can be recognized and the long life of the new bridge can also be expected.

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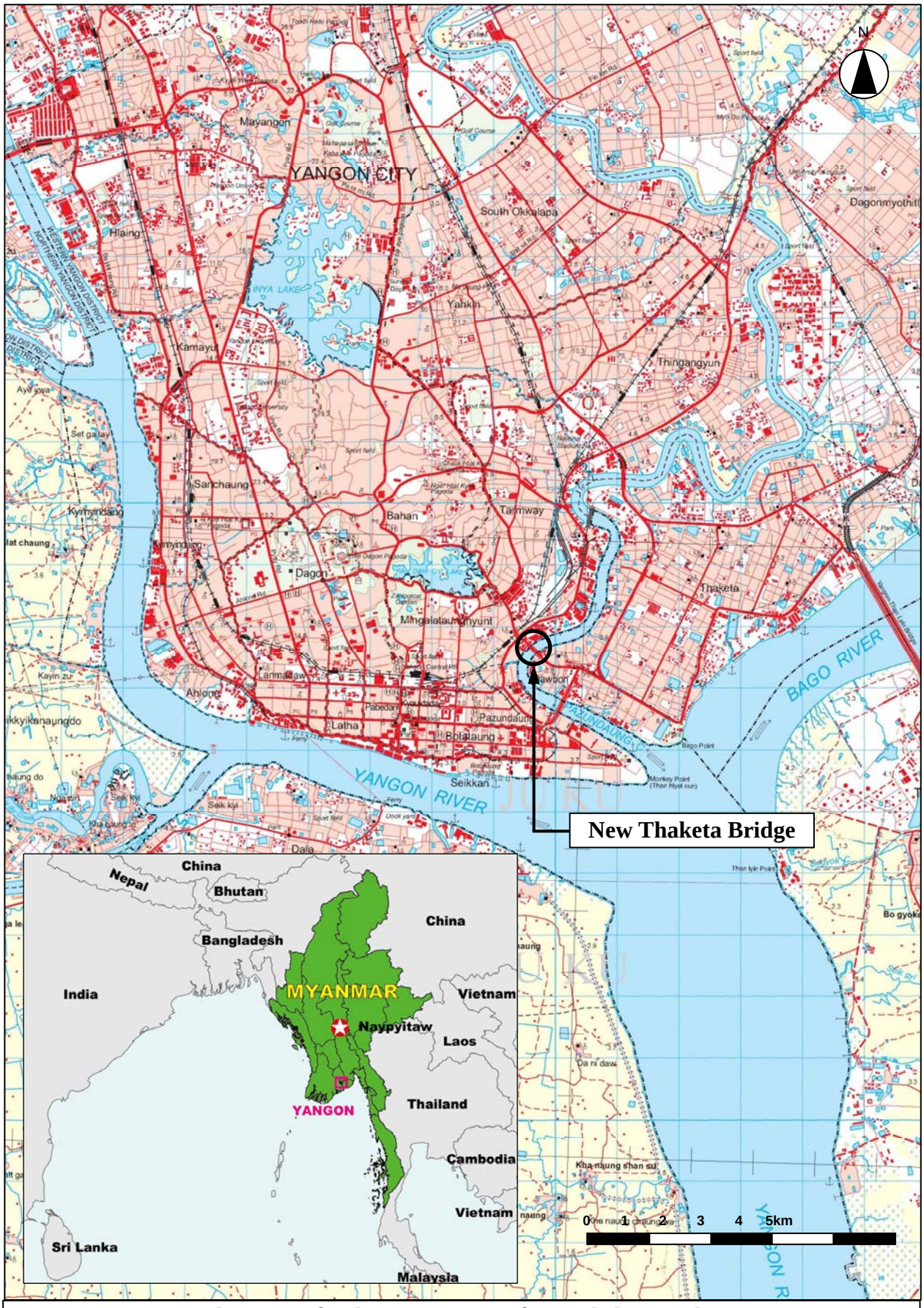


The Project for the Construction of New Thaketa Bridge
Location Map

New Thaketa Bridge (PC Extradosed Bridge) Perspective

Abbreviations

ADB	Asia Development Bank
AH	Asian Highways
EIA	Environmental Impact Assessment
GDP	Gross Domestic Product
IMF	International Monetary Fund
IWT	Inland Water Transport
JICA	Japan International Cooperation Agency
MOC	Ministry of Construction
MORT	Ministry of Rail Transportation
MOT	Ministry of Transport
MP	Master Plan
MPA	Myanmar Port Authority
MR	Myanmar Railways
PCU	Passenger Car Unit
SEZ	Special Economic Zone
SUDP	Project for Strategic Urban Development Plan of the Greater Yangon, JICA (2013)
UG	Union Government
YCDC	Yangon City Development Committee
YRG	Yangon Region Government

Chapter 1 Background of the Project

1.1 Background and Overview of the Request for Grant Aid

The Project for Comprehensive Urban Transport Plan of the Greater Yangon (YUTRA) was conducted under Japanese assistance. In this project, the Project for Construction of New Thaketa Bridge was selected as the short-term project.

The Myanmar government has requested the implementation of the New Thaketa Bridge construction over Pazundaung Creek near the existing Thaketa Bridge under Japanese grant aid in consideration of vehicle weight limitation (10 t) due to heavy traffic volume, and deterioration of the existing bridge.

1.2 Natural Conditions

1.2.1 Meteorological Conditions

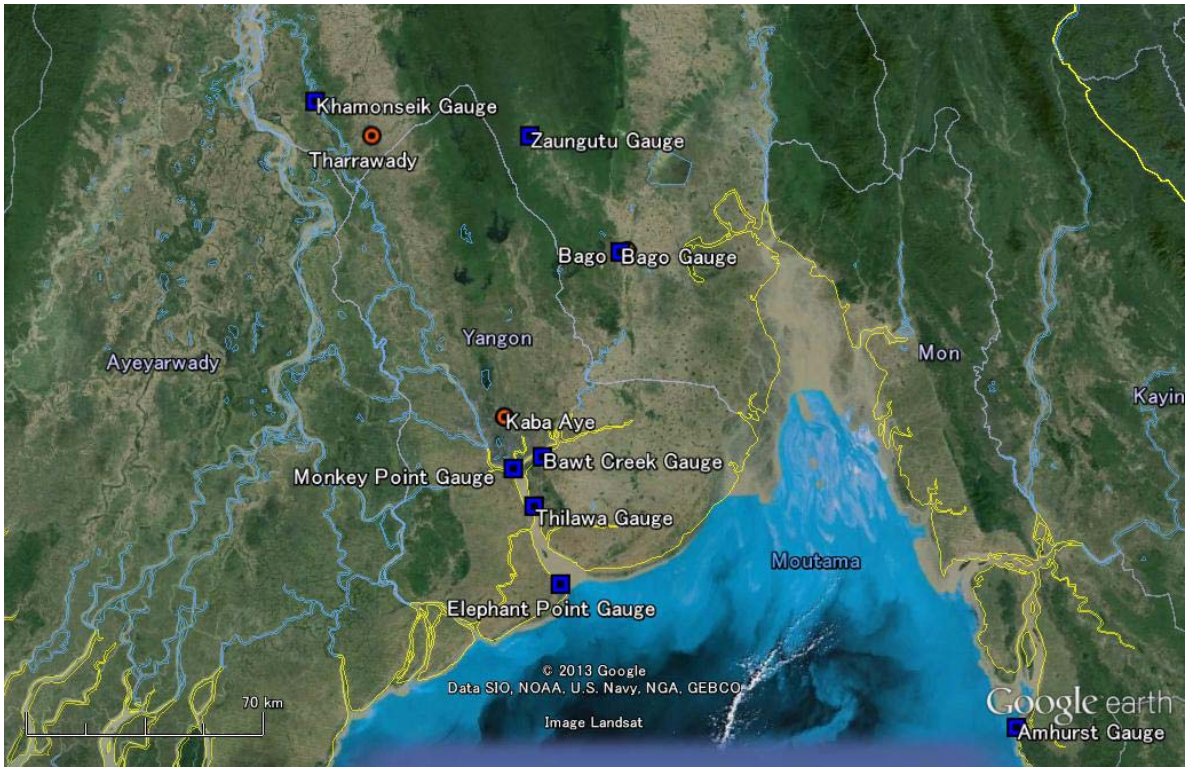
Yangon City has a tropical monsoon climate. Rainfall is highly seasonal being concentrated in the hot humid months of the southwest monsoon (May to October). By contrast, the northwest monsoon (December to March) is relatively cool and dry. Occasionally, severe cyclones cross the Myanmar coast from April to May.

There are three observation stations of climatic data in and around Greater Yangon, which have been installed and operated by the Department of Meteorology and Hydrology (DMH) of the Ministry of Transport as shown in Table 1.2.1. Also, the locations of meteorological and hydrological stations are shown in Figure 1.2.1.

Table 1.2.1 Inventory of Meteorological Stations

Meteorological Station	Code (WMO)	Coordinates		Height (m)	Period of Records						Remarks
		Latitude	Longitude		Temperature	Relative Humidity	Rainfall	Sunshine	Evaporation	Wind	
1. Kaba Aye (Yangon)	48097	16-54	96-10	20	1968-	1968-	1968-	1977-	1975-	1968-	
2. Bago	48093	17-20	96-30	9	1965-	1965-	1965-	-	-	1965-	
3. Tharrawady	48088	17-38	95-48	15	1965-	1965-	1965-	-	-	1965-	

Source: DMH



Source: DMH, MPA, ID (Google Earth Map)

Figure 1.2.1 Location Map of Meteorological and Hydrological Stations

1.2.2 Temperature

The monthly mean temperature ranges from 24.8℃ to 30.3℃ in and around Yangon City. According to collected data, a mean monthly maximum temperature of 37.6℃ (April) and mean minimum temperature of 16.4℃ (January) at Yangon region were recorded in the recent 18 years.

1.2.3 Relative Humidity

The relative humidity has been observed twice a day (at 9:30 and 18:30). Humidity difference between the morning and evening is quite small. Mean monthly relative humidity in Yangon City ranges from 51% to 91%.

1.2.4 Wind Speed and Direction

The mean monthly wind speed is stable between 1.0 m/s and 1.2 m/s throughout the year. The wind condition in the Yangon area depends on the influence of the southwest monsoon during the rainy season. The maximum wind speed of 42.9 m/s was recorded during Cyclone Nargis in 2008.

1.2.5 Evaporation

The annual mean evapotranspiration is 1,349 mm in the Yangon area with 50% of annual rainfall.

1.2.6 Sunshine Hours

The annual mean sunshine hour is about 6.5 hours/day in Yangon area. Sunshine hours during the rainy season are shorter than during other seasons showing different fluctuation patterns.

1.2.7 Rainfall

(1) Annual Rainfall and Seasonal Fluctuation

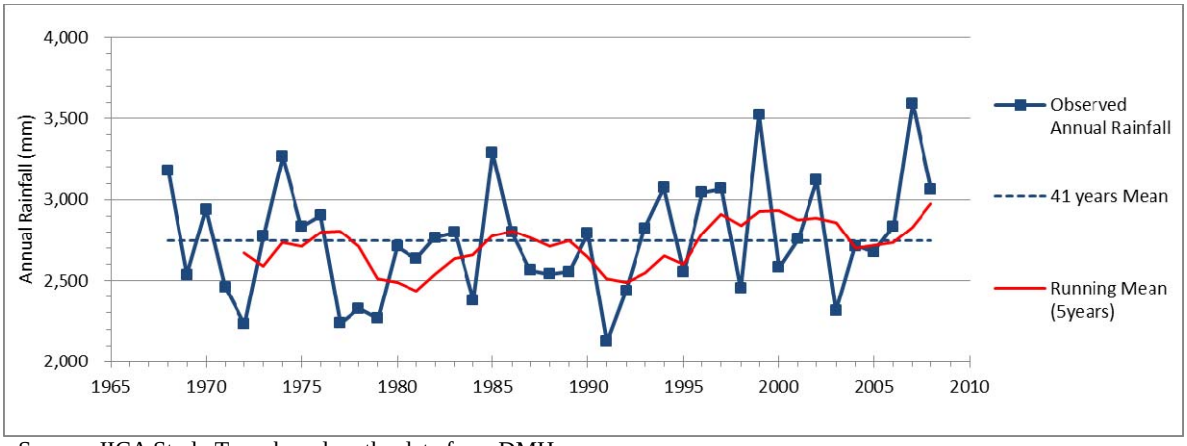
Seasonal variation of monthly total is similar in Yangon City (Kaba-aye) and Bago City. Regarding seasonal fluctuation of rainfall, most rainfall or about 96% of annual rainfall is brought by the rainy season from May to October, with the highest amount of rainfall in July or August.

The annual mean rainfall is 2,745 mm in Yangon City and 3,288 mm in Bago City. Also, annual rainfall fluctuates between 3,592 mm and 2,127 mm in Yangon City. According to collected data/documents, the following characteristics in Yangon area can be observed:

- ✓ Bago at the eastern side of the Yangon area has the highest annual rainfall volume.
- ✓ Tharrawady at the northwestern side of the Yangon area has the lowest annual rainfall. Annual rainfall gets progressively smaller toward the north (upstream) side of the Hlaing River.

(2) Long-term Fluctuation of Annual Rainfall

Figure 1.2.2 shows the long-term fluctuation of annual rainfall by using five-year running mean at Kaba-aye. Although the cycle of wet and drought periods is not clear, there are clear wet and drought periods according to this figure. It is indicated that a limited rising trend of annual rainfall is happening in recent years.



Source: JICA Study Team based on the data from DMH

Figure 1.2.2 Annual Rainfall and Five-year Running Mean Rainfall at Kaba-aye (1968-2008)

1.2.8 Hydrological / Hydraulic Conditions

In order to predict the flow rate / water level during flood season, it is necessary to collect and correlate the hydrological and hydraulic conditions of Yangon (Hlaing) and Bago rivers and Pazundaung Creek surrounding Yangon City. This study is examined with reference to previous reports (JICA report, etc.) and with the collection of information from relevant organizations in Myanmar.

Six existing gauging stations (water level / discharge) are managed by DMH and Myanmar Port Authority (MPA) in the Hlaing, Bago, and Yangon River basins. Of these stations, the three stations of MPA do not observe the discharge records. Also, the Bago Station of DMH is influenced by tidal level from October to May (dry season); therefore, discharge records during this period are not available. (However, discharge records at the Bago Station during the rainy season can be utilized for flood probability calculation.)

DMH has discharge rating tables, which have been changed several times using discharge measurement record taking into account the flow condition. The inventory of river/tidal gauge stations is shown in Table 1.2.2

Table 1.2.2 Inventory of River / Tidal Gauging Stations

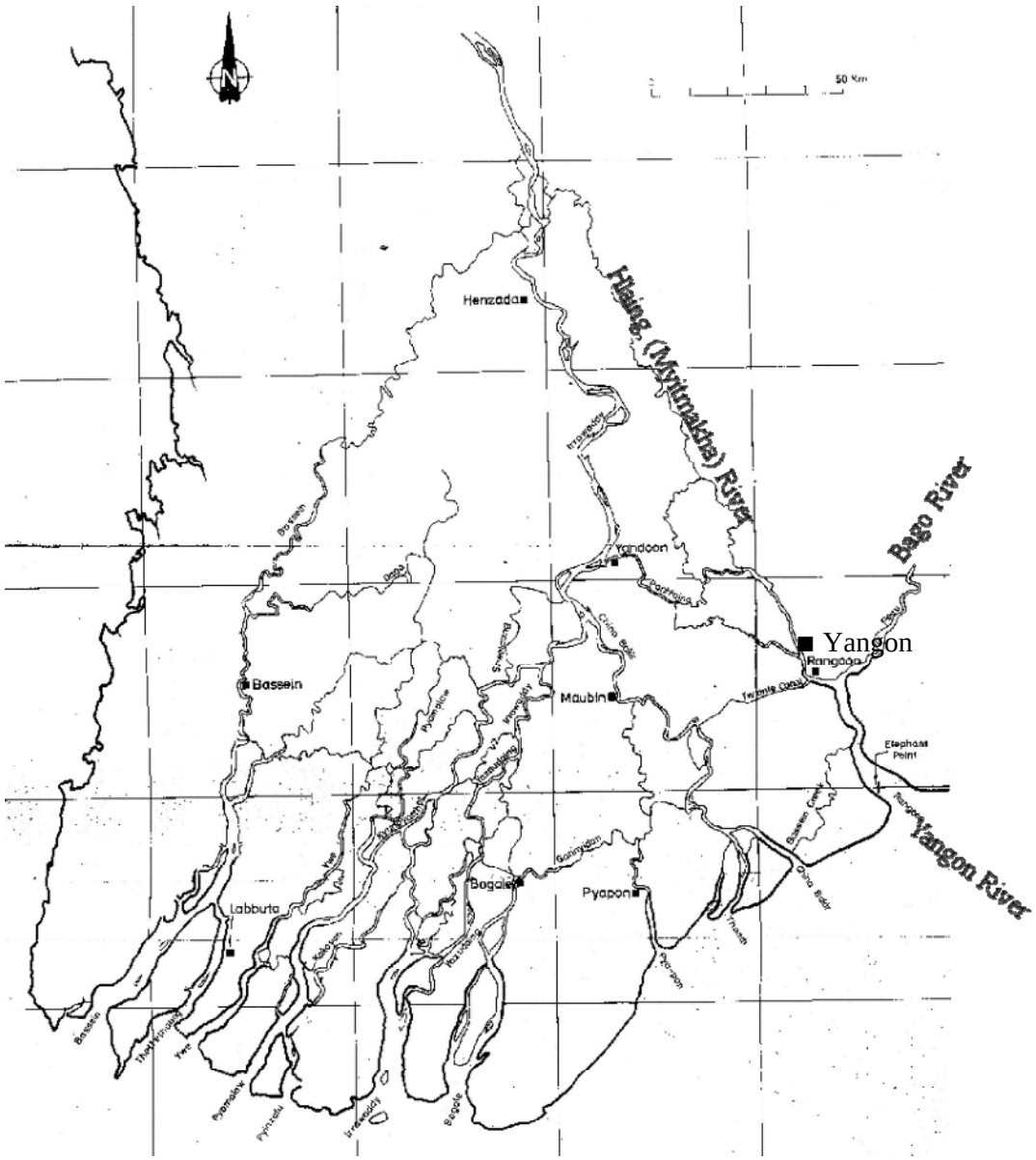
River / Gauging Station	Code	Coordinates		Catchment Area (km2)	Height (m)	Type of Gauge	Period of Record	Water (Tide) level	Discharge	Observed by	Remarks
		Latitude	Longitude								
1. Hlaing River / Khamonseik	6020	16-35	95-30	5,840	14.465	Pile Gauge	1987-	○	○	DMH	
2. Bago River / Zaungutu	6220	17-38	96-14	1,927	9.8	Pile Gauge	1987-	○	○	DMH	
3. Bago River / Bago (Pegu)	48093	17-20	96-30	2,580	9	Pile Gauge	1970-	○	○	DMH	
4. Hlaing River / Yangon Port	210	16-46	96-11	-	-	Steel Plate (Automatic)	-	○	-	MPA	other 2 stations at Yangon port
5. Yangon River / Thilawa Point	-	16-40	96-15	-	-	Steel Plate (Automatic)	-	○	-	MPA	
6. Yangon River / Elephant Point	-	16-28	96-19	-	-	Steel Plate (Manual)	-	○	-	MPA	

Source: DMH, MPA

(1) Rivers and Characteristics of River Flow

The Yangon Riverine system is located at the east end of Ayeyarwady (Irrawaddy) Delta as shown in Figure 1.2.3.

In Yangon City, the Yangon River is formed by the junction of the Panhlaing and Hlaing rivers at a point about 13 km (8 mi) upstream of Monkey Point. The Panhlaing River is a distributary of the Ayeyarwady River, while the Hlaing River is a true river rising in the Bago Yomas and having a drainage area of about 12,950 km^2 (5,000 mi^2). Pazundaung Creek, named Ngamoyeik Creek in the northern part of the city, joins the Yangon River at Monkey Point, the southeastern extremity of the city. Pazundaung Creek has a drainage area of about 1,487 km^2 (574 mi^2). The Bago River with a drainage area of 5,180 km^2 (2,000 mi^2), also joins the Yangon River just east of the city, from which point the Yangon River flows south some 45 km (28 mi) into the Gulf of Bengal. Catchment area at the mouth of the Yangon River is 25,640 km^2 (9,900 mi^2).



Source: A one dimensional analysis of the tidal hydraulics of deltas (Nicholas Odd, Report OD 44, July 1982, Hydraulics Research Station, UK), from MoAI Library

Figure 1.2.3 Ayeyarwady (Irrawaddy) Delta and Yangon River

1) Characteristics of Related Tidal River (Tidal Area of Mixed Tide)

As mentioned above, the lower reaches of the Yangon Riverine system are tidal rivers that are affected by the tidal variability over more than 100 km from the estuary.

The tidal ranges around Yangon Port are about 5.1 m and 2.5 m at spring tide and neap tide, respectively. The spring tide to Yangon Port from estuaries is accompanied by flow of up to 3.0 m/s. (Velocities around Yangon Port on nautical chart are 1.6-1.8 m/s.)

In addition to "upland flow (river own flow) arising from the catchment area" and "tidal flow based on tidal motion", there are "density current at a river mouth due to the salinity difference between seawater and river water", "density flow by concentration difference of suspended solids", "heat convection", and "wind-driven current" in the river tidal compartment. The scale of these flows is varied greatly in both time and space, and since it shows a complex phenomenon, their prediction is difficult. However, since these flows are assumed as well mixed type tide for great tidal variability, it is considered that the effects of the stratified flow and density flow under

the actual streaming motion are smaller at the time of rising tide and ebb tide. (Thus, in this study, the hydraulic analysis is performed by only simulating the river flow (upland flow) and tidal flow.)

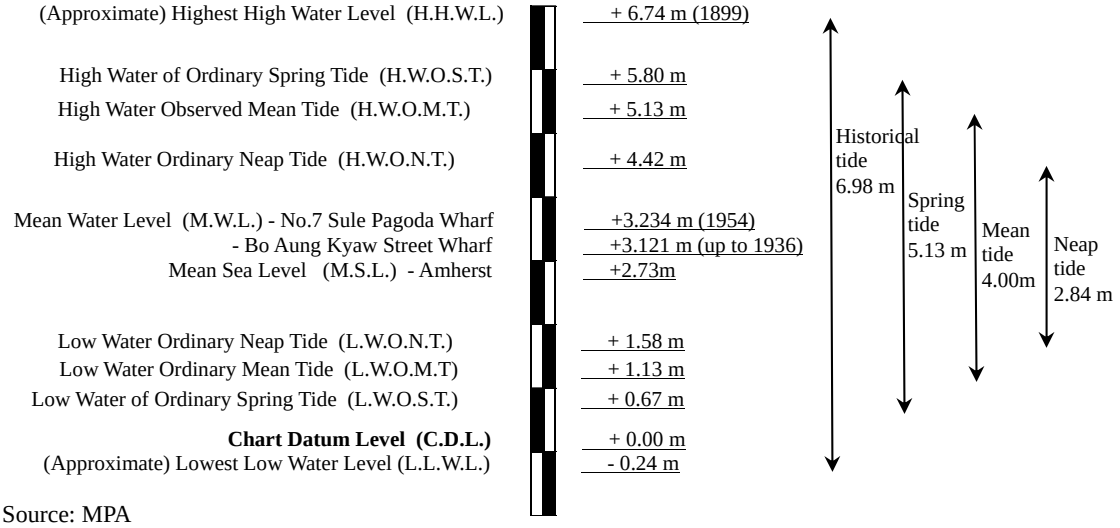
In addition, the tide is based on celestial motion. It is represented as the sum of many periodical components, and tidal flow (rising tide, falling tide) in the tidal river also shows periodic fluctuations. Furthermore, the average velocity in one tidal cycle at one point in a tidal compartment does not become zero. The average flow associated with oscillatory tidal motion like this is defined as the tidal residual current resulting from the asymmetry of the tidal motion.

(Therefore, the simulation period is desired to be the relatively long period from the neap tide to the spring tide, and not only one tidal cycle. Also, the entire riverine system which affects the tidal motion is desirable to be the simulation range.)

On the other hand, large amount of sediments has been flowing out of the vast basin of the Yangon Riverine system and deposited on the estuarine regions from Yangon Port. Hence, the river channel / bed of the tidal reach at Yangon River have been changed a little. According to Myanmar Rivers Reference (1996, DWIR of MoT), the annual sediment transport has been estimated at 37 million t for Yangon River based on the size and character of the drainage area. In the vicinity of Yangon Port, MPA has been dredging the sediment to secure the navigation channel.

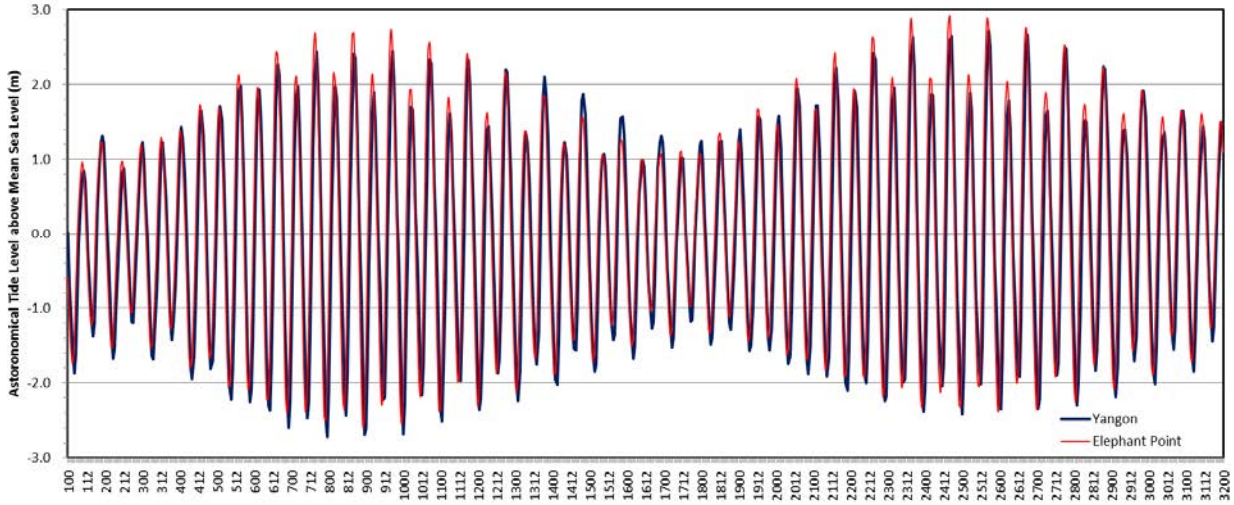
2) Tidal Level around Yangon Area

Hourly calculated data of astronomical tide at Yangon Port (located 36 km upstream from the mouth of the Yangon River) and at the river mouth of Elephant Point are available from the tidal information website. Both stations' astronomical tide levels in March 2005 are shown in Figure 1.2.4. The tide chart diagram of Yangon Port is shown in Figure 1.2.5. (Ground elevation of land survey is normally indicated as zero from the MWL of MPA.) From the tide chart diagram, fluctuations of spring, average, and neap tides are observed as 5.13 m, 4.00 m, and 2.84 m, respectively. Also, according to the hearing survey with MPA, the maximum storm surge (namely, the sea level departure from normal or the difference between astronomical tide and observed tide) at Yangon Port is reported at 2.13 m. (During Cyclone Nargis on May 3, 2008, MPA measured 2.13 m from the flood mark after the storm.). For comparison, the probable surge amplitudes (the sea level departure from normal) at Elephant Point as calculated by the Hydrology Branch of the Irrigation Department are shown in Table 1.2.3. It is understood that the storm surge during Cyclone Nargis at Yangon Port was very big. In addition, the calculation of major 4 (8) constituents tide at Elephant Point is shown in Table 1.2.4 from the existing study.



Source: MPA

Figure 1.2.4 Tide Level of Yangon Port



Source: Earthquake Research Institute, the University of Tokyo

Figure 1.2.5 Astronomical Tide at Elephant Point and Yangon Port (2005)

Table 1.2.3 Return Period and Surge Amplitude at Elephant Point

Return Period (year)	5	10	20	25	50	**100**	200
Surge (m)	0.889	1.046	1.196	1.244	1.391	**1.537**	1.682

Source: JICA Library (The Project for preservation of farming area for urgent rehabilitation of agricultural production and rural life in areas affected by Cyclone Nargis, 2011), MoAI,

Table 1.2.4 Amplitude of Major Tidal Constituents Actually Measured in 1978-79 at Elephant Point (Past Computation Result of Harmonic Decomposition)

Latitude			16 30'		
Longitude			96 18'		
			Amplitude H		Phase G
			ft	m	degree
Major 8 Con-stituents	Major 4 Con-stituents	M2	5.743	1.750	99.18
		K1	0.673	0.205	20.53
		S2	2.299	0.701	141.96
		O1	0.305	0.093	40.86
		N2	1.097	0.334	90.91
		K2	0.625	0.191	141.96
		P1	0.223	0.068	20.53
		Q1	0.049	0.015	307.42
Sum of Major 4 Constituents				2.749	

Source: Irrawaddy Delta Hydrological Investigations and Delta Survey, Volume 3 – Analysis, Sir William Halcrow & Partners, January 1982, MoAI,

Note: In above document, major 32 constituents were calculated by harmonic analysis.

3) Estimation of Probable Floods and Water Levels

(a) Probable Floods at Gauge Stations

The past annual maximum discharges (extreme values) of three stations (Zaungtu, Bago, Khamonseik) for the design discharges are collected as shown in Table 1.2.5.

Table 1.2.5 Collected Data for Annual Maximum Discharge

Station Name	River Name	Catchment Area (km^2)	Period of Record	Collected Data No.	Remarks
Zaungtu	Bago	1,927	1987-	25 (1987-2011)	
Bago	Bago	2,580	1970-	43 (1970-2012)	
Khamonseik	Hlaing	5,840	1987-	22 (1987-2011)	3 years - missing observation

Source: DMH

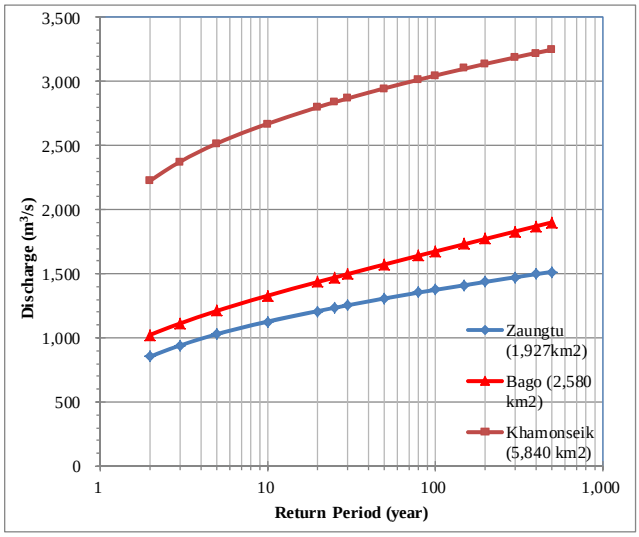
The probable discharges are calculated according to the following:

- ✓ To select the appropriate model for probability distribution from the three methods, namely: Gumbel distribution, Iwai distribution, and log-normal distribution. In this study, Iwai distribution of the most common method is adopted.
- ✓ Calculation return periods are 2, 3, 5, 10, 20, 25, 30, 50, 80, 100, 150, 200, 300, 400, and 500 years.

The results of probable discharge at the three discharge gauge stations (Zaungtu, Bago, Khamonseik) are shown in Table 1.2.6.

Table 1.2.6 Probable Flood Calculation at Zaungtu, Bago, and Khamonseik Stations

Return Period (Probability) (Year, %)		Probable Discharge: Qmax (m3/s)		
		Bago	Zaungtu	Khamonseik
		2580 km2	1927 km2	5840 km2
2	50.0%	1,024	855	2,227
3	33.3%	1,114	942	2,374
5	20.0%	1,211	1,030	2,517
10	10.0%	1,329	1,127	2,671
20	5.0%	1,437	1,210	2,800
25	4.0%	1,471	1,235	2,838
30	3.33%	1,498	1,255	2,868
50	2.0%	1,574	1,308	2,947
80	1.25%	1,642	1,354	3,015
100	1.0%	1,674	1,375	3,046
150	0.667%	1,732	1,412	3,101
200	0.5%	1,773	1,438	3,138
300	0.33%	1,830	1,473	3,188
400	0.25%	1,871	1,498	3,223
500	0.2%	1,902	1,516	3,249



Source: JICA Study Team based on the data from DMH

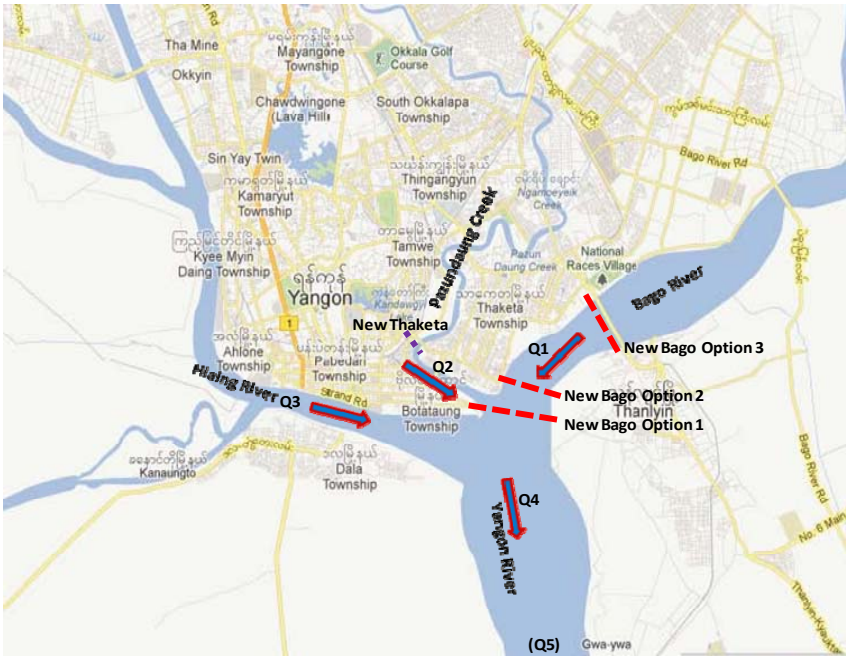
(b) Probable Floods from River Flow for Design

The discharge at the proposed bridge sites are calculated by multiplying the proportion of each catchment area with the probable discharges upstream of each gauge station ("specific discharge" method).

Probable discharges used for the hydraulic calculation are shown in Table 1.2.7. Incidentally, these discharges are runoff volume from the river's own flow, and additional flow rates due to the influence of the falling tide are not included in these discharges.

Table 1.2.7 Probable Floods from River Flow for the Design

Riverine System Name	Yangon river					Remarks
River Name	Bago river		Hlaing river		Pazundaung Creek	
Gauge Station Name	Bago		Khamonseik		(Bago)	
Catchment Area at Station (km2)	2,580	-	5,840	-	-	
Catchment Area at Construction Site (km2)	-	5,180	-	12,950	1,490	
Return period	Probability value	Discharge	Probability value	Discharge	Discharge	
1/2	1,024	2,056	2,227	4,938	591	
1/3	1,114	2,237	2,374	5,264	643	
1/5	1,211	2,431	2,517	5,581	699	
1/10	1,329	2,668	2,671	5,923	768	
1/20	1,437	2,885	2,800	6,209	830	
1/25	1,471	2,953	2,838	6,293	850	
1/30	1,498	3,008	2,868	6,360	865	
1/50	1,574	3,160	2,947	6,535	909	
1/80	1,642	3,297	3,015	6,686	948	
1/100	1,674	3,361	3,046	6,754	967	
1/150	1,732	3,477	3,101	6,876	1,000	
1/200	1,773	3,560	3,138	6,958	1,024	
1/300	1,830	3,674	3,188	7,069	1,057	
1/400	1,871	3,757	3,223	7,147	1,081	
1/500	1,902	3,819	3,249	7,205	1,098	
		Q1		Q3	Q2	
100 year discharge per unit drainage area (m^3/sec/km2)	0.64884		0.52158			=specific discharge



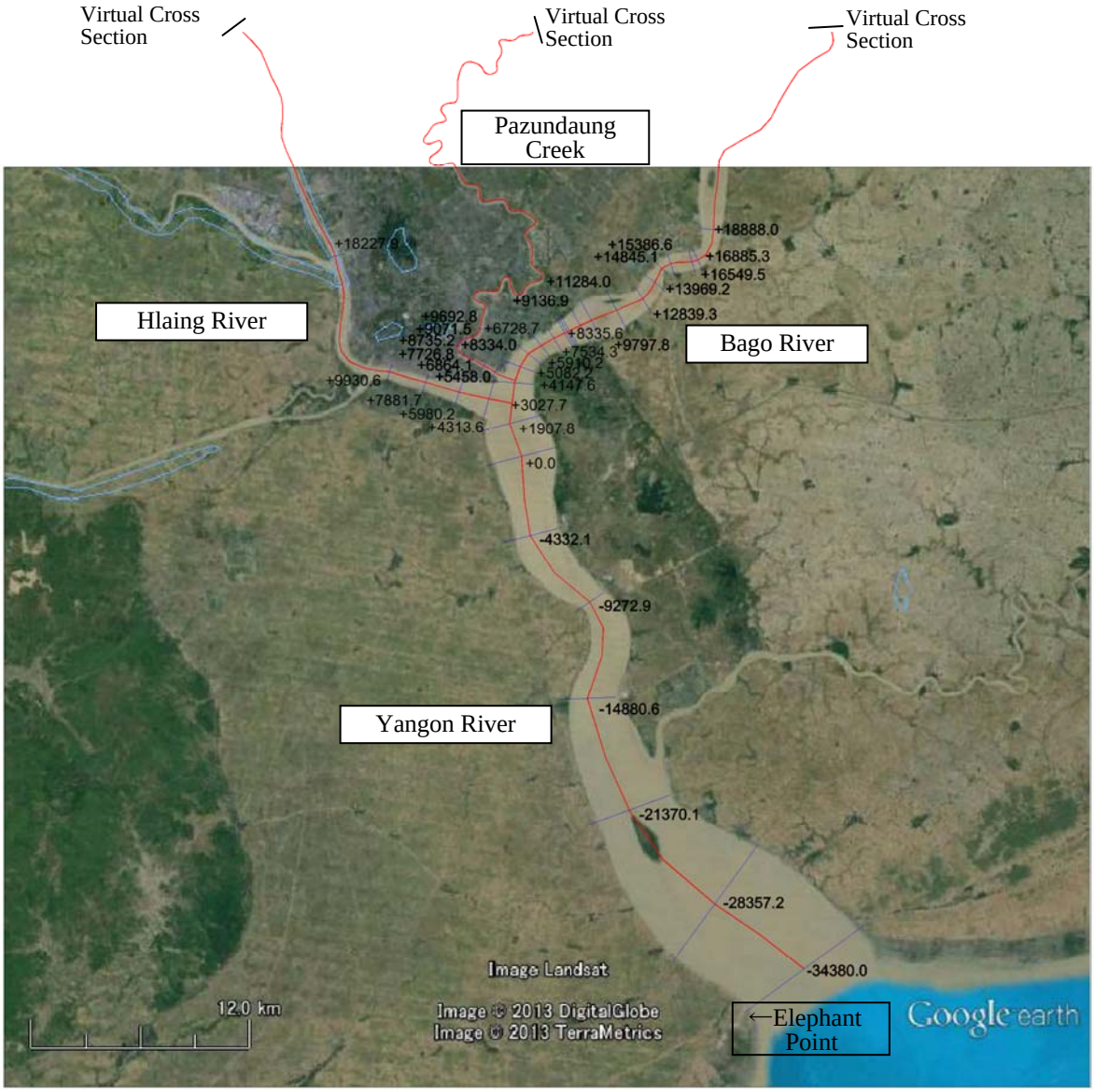
	Bago River Q1	Pazundaung Creek Q2	Hlaing River Q3	Yangon River (Monkey P.) Q4	Yangon River-mouth Q5	Remarks
Catchment Area (km^2)	5,180	1,490	12,950	19,620	(25,640)	
10 year flood (m^3/s)	2,668	768	5,923	9,359	(12,112)	
30 year flood (m^3/s)	3,008	865	6,360	10,232	(13,189)	
50 year flood (m^3/s)	3,160	909	6,535	10,604	(13,642)	
100 year flood (m^3/s)	3,361	967	6,754	11,082	(14,222)	Design Discharge
500 year flood (m^3/s)	3,819	1,098	7,205	12,122	(15,471)	

Source: JICA Study Team based on the data from DMH

(c) Hydraulic Calculation

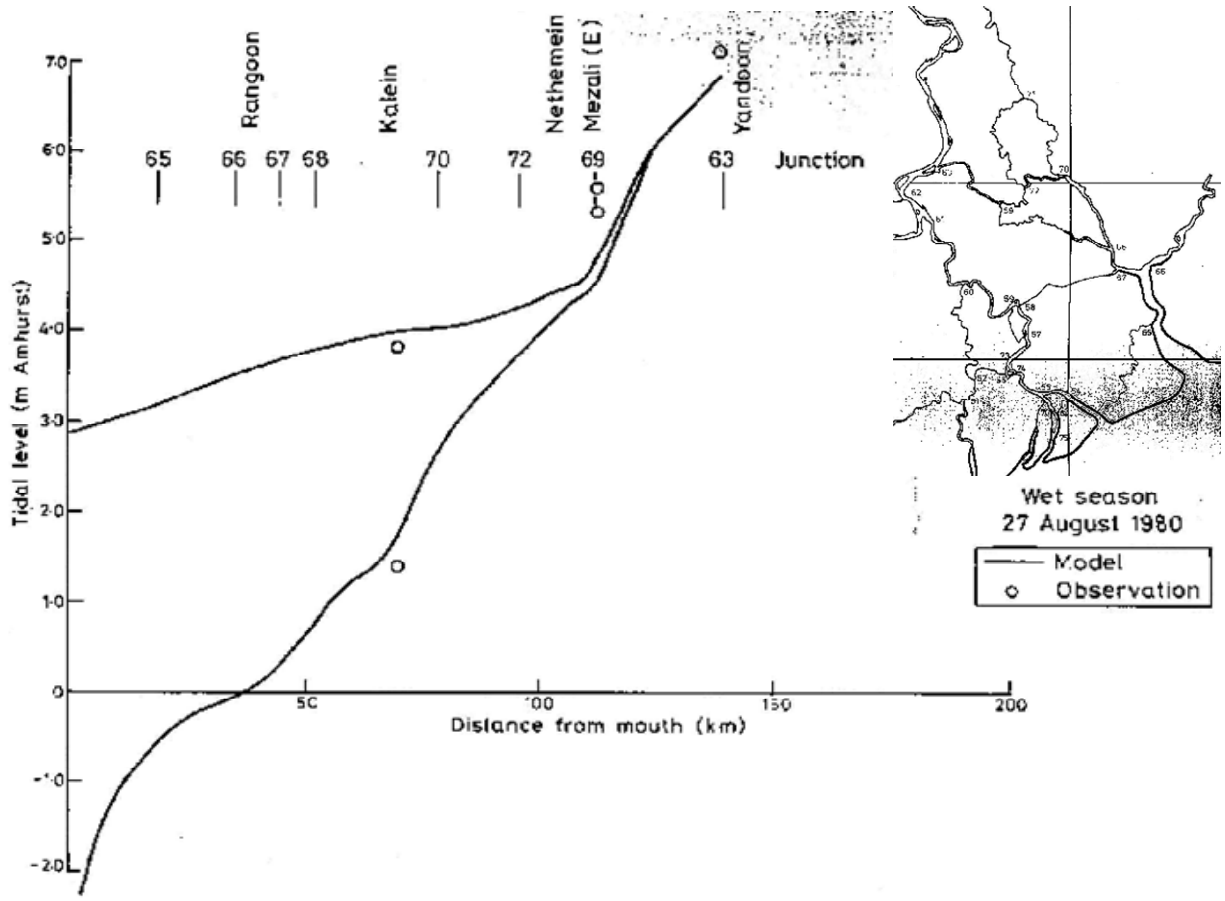
The hydraulic phenomena (rising tide, falling tide, in addition to the river own flow) at tidal compartment of the river are needed to simulate all of the tidal reaches. Therefore, the range of numerical calculation shall target all of the tidal area of the Yangon Riverine system together with tributaries such as the Bago River and Pazundaung Creek. The downstream boundary is assumed to be the Elephant Point (river mouth of Yangon River). The upstream boundary of tributaries is assumed with reference to past documents (Figure 1.2.7); the river length is measured based on the river route on the topographic map; and the river cross section at the upstream end is assumed as the virtual cross section. The distance to the upstream boundary from the river mouth is 100 km or more.

The hydraulic calculation model of the Yangon Riverine system is shown in Figure 1.2.6.



Source: JICA Study Team

Figure 1.2.6 Hydraulic Calculation Model of the Yangon Riverine System



Note: High Water Level of around Yangon on above Figure is estimated 6.23m (=2.73+3.5). (Tide level on above Figure is based on Amherst station chart. Difference between Amherst and Yangon station chart is 2.73m.)

Source: A one dimensional analysis of the tidal hydraulics of deltas (Nicholas Odd, Report OD 44, July 1982, Hydraulics Research Station, UK), from MoAI Library

Figure 1.2.7 Past simulation example of high water and low water profiles at Yangon River (on Wet season of Aug 1980)

i) Analysis Software

Hydraulic analysis was carried out to simulate the tidal and flood phenomena in the Yangon River using Hydrologic Engineering Center - River Analysis System (HEC-RAS) developed by the US Army Corps of Engineers, USA.

HEC-RAS has the capability to compute one-dimensional water surface profiles for both steady and unsteady flow. Subcritical, supercritical, and mix flow regime profiles can be calculated.

Water surface profiles are computed from one cross section to the next by solving the energy equation using standard step method. Energy losses are evaluated by friction (Manning's equation) and contraction/expansion coefficients. HEC-RAS requires inputs for boundary conditions of upstream discharge and either downstream water level or known energy gradient.

Also, tidal waves are very dynamic. According to the user's manual of this software, in order for the solution to be able to accurately model a tidal surge, theta implicit weighting factor must be close to 0.6.

ii) Hydraulic Analyses and Precondition

The hydraulic analyses are conducted through the following procedure:

- ✓ Estimate the roughness coefficient of the river channel by using the existing astronomical tide levels at two places during the dry season. (The water level upstream of Yangon Port, which is calculated from the astronomical tide downstream of Elephant Point, is approximated as the astronomical tide waveform of Yangon Port by changing the roughness coefficient of the tidal reaches. The tide table of Elephant Point and Yangon Port in 2005 is given as known water level data.)
- ✓ Conduct the calculation at the time of flood (rainy season) by using the above roughness coefficient calculated from real tide level.

Also, preconditions of the calculation are as follows:

- ✓ The cross sections for the hydraulic calculation are given by using the bathymetry survey results, nautical chart and others with reference to the above hydraulic model.
- ✓ The downstream boundary for the hydraulic calculation during the dry season is given by the tide level (from February 4 to 24, 2005, neap tide - spring tide - neap tide) at the Elephant Point which varies from hour to hour. (Hence, the flow becomes unsteady flow.) The upstream boundary during the dry season is given by the steady low-water runoff (275-day discharge).
- ✓ The downstream boundary for the hydraulic calculation during the rainy season is given by the tide level (from October 17 to 21, 2005, spring tide) at Elephant Point. The upstream boundary during the rainy season is given by the 100-year flood as the steady flow to each river.
- ✓ The flow rate to the upstream end is given as the proportional distribution between the catchment area at the upstream end and the total area; the flow rate of the remaining catchment area is given as "the uniform lateral inflow" against the stream length.

iii) Hydraulic Analyses and Results

Hydraulic analyses of the two cases in Table 1.2.8 are performed.

Table 1.2.8 Cases of Hydraulic Analyses

Case No.	Boundary Condition of Upstream (m^3/s)				Boundary Condition of Downstream (Elephant Point)	Remarks (Objectives)
	Discharge	Hlaing	Bago	Pazun-daung	Period of Tidal Waveform	
1	Low-water runoff	44	8	5	Feb. 4 – 24, 2005 (Annual Minimum Tide, Neap - Spring – Neap Tide)	(for calibration of roughness coefficient)
2	100-year flood	6,754	3,361	967	Oct. 17 – 21, 2005 (Annual Maximum Tide, Spring Tide)	(for calculation of HWL)

Note: Discharge indicates the value at the confluence of Hlaing, Bago and Pazundaung.

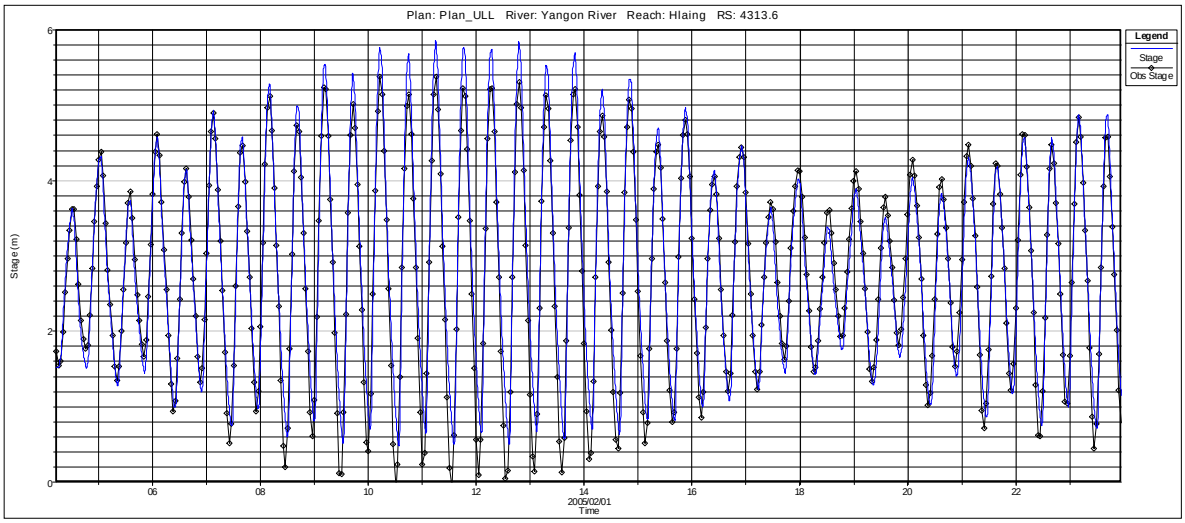
Source: JICA Study Team

If the river bed material is very small and the river bed slope is very gentle such as in the delta area, the roughness coefficient of the river channel is generally very small and its coefficient is estimated to be about 0.015 according to the past literatures[1]. (From the results of the geotechnical survey of this study, the mean grain size of river bed material in the Thaketa / Bago bridge site is very small and it was measured as 0.015-0.15 mm.)

The roughness coefficients for Case 1 were set as 0.010, 0.015, 0.020, and 0.025. From the hydraulic calculation results, the calculated surge amplitude that was properly synchronized with

[1] Bed Form and Bed Variation During Floods of the TONE River Mouth, Journal of Japan Society of Civil Engineers, Ser. B1 (Hydraulic Engineering) Vol. 54 (2010), Japan

astronomical tide, with a roughness coefficient of 0.015, and a margin of error of at most 40 cm is as shown in Figure 1.2.8.



Source: JICA Study Team

Figure 1.2.8 Synchronization between Astronomical Tide and Calculated Tide at Yangon Port by Hydraulic Calculation (Roughness Coefficient: 0.015, Case 1)

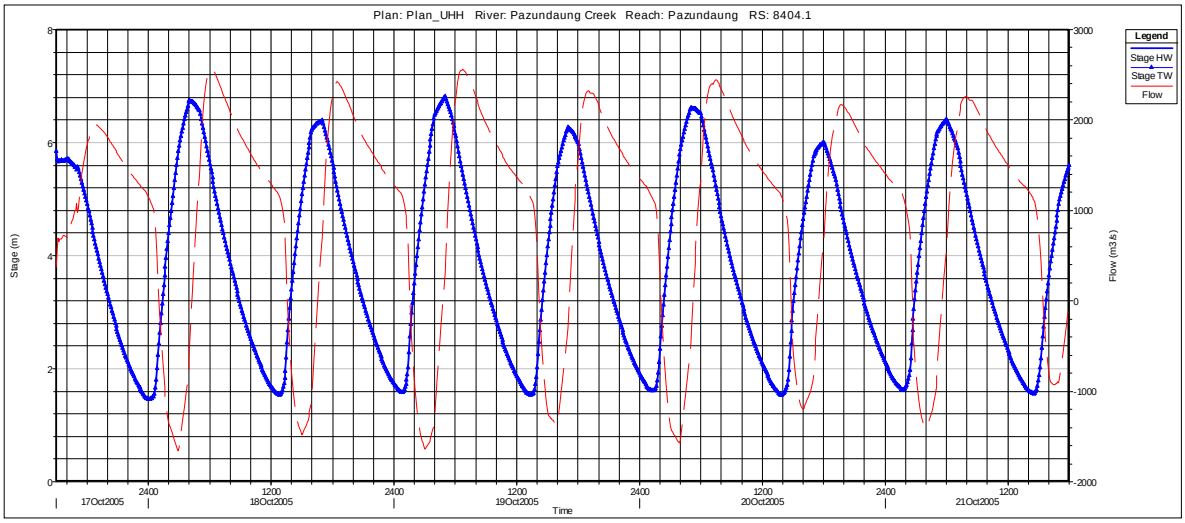
From the results of low discharge during the dry season, the hydraulic calculation of the high water level is carried out using a roughness coefficient of 0.015. The hydraulic calculation results for Case 1 and Case 2 are shown in Table 1.2.9 and Figure 1.2.9.

Table 1.2.9 Hydraulic Calculation Results

Item	Unit	Value at Thaketa Bridge (+8404.1)
Design High Water Level	m	6.81
Maximum River Discharge at 100-year Flood	m^3/s	966.77
Maximum Tidal Discharge	m^3/s	1589.60

Source: JICA Study Team

Design high water level is estimated at 3.689 m (= 6.81 m – 3.121 m (mean sea level)) from the results of the hydraulic calculation.



Source: JICA Study Team

Figure 1.2.9 Tidally-dominated Water Level and Discharge Fluctuation (Rising and Falling Tide) at the New Thaketa Bridge – Case 2

1.3 Environmental and Social Considerations

1.3.1 Environmental Impact Assessment

(1) Environmental and Social Baselines

1) Natural Environment

(a) Topographic Features of Yangon City

Yangon City is located 34 km upstream from the mouth of Yangon River. Low hills, which are long, and narrow spur of hill range in the central area run in the north-south direction with an average height of 30 m and degenerates gradually into delta plains eastwards and westwards.

(b) River System in Yangon City

Yangon City is bounded on the south, southeast, and southwest by the Yangon River, Hlaing River, and Bago River, respectively. The Pan Hlaing River in the downstream changed its name to the Yangon River. Nga Moe Yeik Creek flows from the north side into Yangon City and has changed its name to Pazundaung Creek. It penetrates the center of the city up to the Bago River.

Pazundaung Creek, over which the new bridge will be constructed by the project, flows from north to south in the easterly center of Yangon City and joins the Bago River at the southern part of the city. The Bago River flows down further south and joins the Yangon River.

(c) Climate and Weather

i) Climate

Greater Yangon is located in a tropical monsoon climate, characterized by three distinct seasons, namely: dry season (middle of February to middle of May), rainy season (end of May to middle of October), and winter dry season (end of October to middle of February).

ii) Temperature

Of the weather stations in Greater Yangon Metropolitan Area, the Kaba-aye Meteorological Station in Kaba-aye is closest to the project site. The Kaba-aye Meteorological Station, which is managed by the Department of Meteorology and Hydrology, Ministry of Transport (DMH, MOT), has been observing meteorological conditions since 1968.

Generally, temperature in April is high, and the maximum monthly temperature recorded in April 2001 was 39.1 °C. The minimum monthly temperature recorded in December 2004 was 13.8 °C.

The difference between the monthly maximum and monthly minimum temperatures is more than 20 °C from December to February, and around 10 °C from June to August.

iii) Rainfall

Rainfall in Greater Yangon increases as it goes eastward.

According to the monthly rainfall observed at the Kaba-aye Meteorological Station from 1991 to 2008, the mean annual rainfall is 2,749 mm. The maximum mean monthly rainfall is 591 mm in August, and the minimum mean monthly rainfall is 3 mm in January and February. The maximum annual rainfall was recorded at 3,592 mm in 2007. The maximum monthly rainfall was 868 mm in August 1968, and the minimum monthly rainfall was zero in the past several months.

Rainfall in Greater Yangon is short in duration and intensity. Remarkably, 50-year probable 60-minute rainfall intensity exceeds 100 mm/hour. Such a high intensity of rainfall is a major cause of inundation problems in downtown Yangon.

(d) Biota and Ecosystem

Actual field survey of flora and fauna and ecosystem was conducted under the project. The aim of the survey is to get the data of current conditions of flora and fauna as well as the ecosystem, and to use the data as baseline data for environmental impact assessment.

Details of the survey area, date, and survey results are shown in Appendix 1.1.

2) Environmental Pollution

(a) Actual Measurement of Ambient Air Quality (hereinafter "Air Quality"), Ambient Noise (hereinafter "Noise"), Water Quality, Sediment Quality, and River Flow Rate

The actual field survey of air quality, noise, water quality, sediment quality, and river flow rate was conducted in the project. The aim of the survey is to get data on current conditions with regard to these items, and to use such data as baseline data for environmental impact assessment.

Details of the survey results are shown in Appendix 1.2. A summary of the results are as follows:

i) Air Quality

There were five measurement points around the project site. The period of measurement was from November 14 to 29, 2013. Measurement was conducted for 24 hours for each point, each time.

The results at all the measurement points were within the range of the environmental standards of Japan and the World Health Organization (WHO) guidelines.

ii) Noise

The measurement points were the same as those for air quality. The period of measurement was from November 15 to 29, 2013. Measurement was conducted for 24 hours for each point, each time.

The results at all the measurement points were within the range of the environmental standards of Japan and the WHO guidelines.

iii) Water Quality in the River

Measurement points were at the surface and bottom layers of the upstream and downstream sections of the existing bridge. Measurement and sampling were conducted on November 7, 2013.

The measured values of suspended solids, pH, dissolved oxygen, and biochemical oxygen demand (BOD_5) were within the range of the Japanese environmental standards for river water quality of Category D.

iv) Sediment Quality

The measurement points and date are the same as those for water quality.

According to the results of the measurement, there is no sediment quality item whose concentration has a particular problem.

v) River Flow Rate

The flow rate of Pazundaung Creek was measured immediately upstream and 200 m downstream of the bridge.

Date of the measurement: November 7, 2013.

From the measurements of water depth of river crossing direction and velocity, the river flow is calculated as follows:

Flow rate immediately upstream = 249 m^3/s

Flow rate 200 m downstream of the bridge = 202 m^3/s

(b) Waste

The Pollution Control and Cleansing Rules (2001) for managing solid waste give the basic responsibilities and restrictions of the Yangon City Development Committee (YCDC), business owners, and people in the city. Under these rules, Pollution Control and Clerisy Dept. (PCCD) is responsible for waste management in Yangon City specifically for activities such as collection/ transportation of waste, treatment/disposal, fee structure, and penalty rules.

There are two main final disposal sites and five temporary sites in Yangon City. These two disposal sites, operated by PCCD, are open and receive waste for 24 hours/day. The temporary sites are also supervised by PCCD.

3) Social Environment

With regard to the administrative location of the project site, the north side of the bridge is within the area of Dawbon Township and the south side is within the area of Mingalar Taung Nyunt Township.

Because the urban structure of Mingalar Taung Nyunt Township is continuous with the central part of Yangon City, its urbanization is more advanced than Dawbon.

The central administrative organization of Yangon City is YCDC.

The results of the survey of population/household, races/religion, industries/labor force, poor people, land use, infrastructure/social services (electricity, water supply/sewage, medical/health/ sanitary, education), historical buildings, and traffic accidents are shown in Appendix 1.3.

(2) Systems and Organizations Concerned with Environmental and Social Considerations

1) Major Legislation

Major legislations relevant to environmental and social considerations in Myanmar are shown in Table 1.3.1.

Table 1.3.1 Laws and Regulations Relevant to Environment in Myanmar

	Name of Law, Rule or Regulation	Year
1. Constitution and Environmental Policy		
	Constitution of the Republic of the Union of Myanmar	2008
	Myanmar National Environmental Policy	1994
	National Sustainable Development Strategy	2009
2. Environmental Conservation		
	Myanmar Environmental Conservation Law	2012
	Environmental Impact Assessment Procedures (Draft)	2013
	The Protection and Preservation of Cultural Heritage Regions Law	1998
3. Biodiversity and Natural Conservation		
	Wildlife Protection Act	1936
	Myanmar Marine Fisheries Law	1990
	Fresh Water Fisheries Law	1991
	Forest Law	1992
	Animal Health and Development Law	1993
	Protection of Wildlife and Conservation of Natural Area Law	1994
	Conservation of Water Resources and River Law	2006
	National Biodiversity Strategy Action Plan in Myanmar	2012
4. Urban Development and Management		
	The City of Rangoon Municipal Act	1922
	Law Amending the City of Yangon Development Law	1966
	City of Yangon Development Law	1990
	The City of Yangon Municipal Amendment Act	1961

	Name of Law, Rule or Regulation	Year
5. Land Acquisition and Resettlement		
	The Upper Burma Land and Revenue Regulation	1889
	The Land Acquisition Act	1894
	Transfer of Immovable Property Restriction Act	1947
	Land Nationalization Act	1953
	Disposal of Land Tenancies Law	1963
	Transfer of Immovable Property Restriction Law	1987
	Farmland Law	2012
	Farmland Rules	2012
	Vacant, Fallow, Virgin Land Management Law	2012
	Vacant, Fallow, Virgin Land Management Rules	2012
6. Pollution Control and Occupational Health		
	Factory Act	1951
	Standing Order 2_95 Occupational Health Plan	1995
	Standing Order 3_95 Water and Air Pollution Control Plan	1995
	Occupational Safety and Health Law (Draft)	2012
	The Science and Technology Development Law	1994
	Myanmar Mines Law	1994

Source: JICA Study Team

In September 2011, the Ministry of Environment Conservation and Forestry (MOECAF) was established. Then, the Environmental Conservation Law was enacted in March 2012.

The Environmental Conservation Law holds the position of a so-called basic environment law but it does not define in detail the contents of operation and practices for the execution of each environmental activity. The law only serves as a large basic framework.

The specific enforcement, planned on the basis of the Environmental Conservation Law, is defined by the Environmental Conservation Rules, and various laws and regulations, environmental standards, and guidelines that will be developed by MOECAF.

With regard to the procedures for environmental impact assessment (EIA), MOECAF has been preparing the Environmental Conservation Rules. The draft of the Environmental Impact Assessment Procedures (hereafter "the EIA Procedures") was created in 2012. As of January 2014, the EIA Procedures are still in the draft stage and waiting for further brushing up and official enactment.

The outline of the EIA Procedures (draft) is shown in Appendix 1.4.

2) Existing Procedures of Project and Environment Approval

The process is as follows:

(i) At first, the project proponent shall submit project proposal documents together with a feasibility study report including the results of EIA/social impact assessment (SIA) to the Foreign Economic Relations Department (FERD) of the Ministry of National Planning and Economic Development (MNPED).

(ii) After examining all the required documents by FERD, the documents are forwarded to the Planning Department of MNPED.

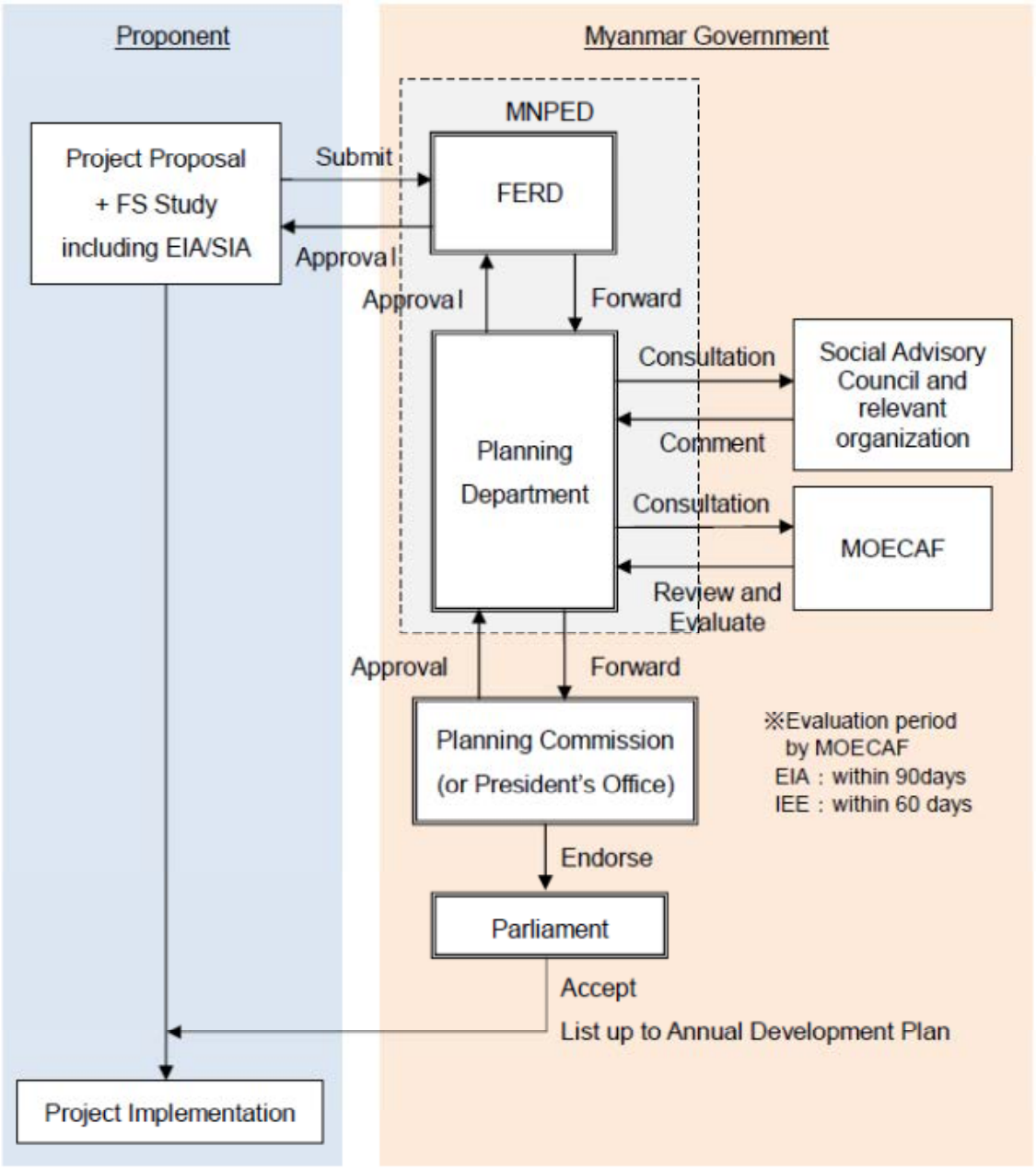
(iii) The Planning Department consults with the Social Advisory Council and other relevant organizations as well as MOECAF for detailed examination of the documents. In this process, MOECAF reviews and evaluates the results of EIA/SIA in terms of environmental and social considerations.

(iv) After all the above organizations approved the submitted documents, the Planning Department forwards the documents together with the results of the above examination and evaluation to the Planning Commission (or the President's Office).

(v) After the approval of the documents, the Planning Commission will endorse them together with its recommendation to the Parliament.

(vi) In the Parliament, after acceptance of the project approval, the project will be registered into the national annual project list without which no project will be able to be conducted in the target year.

Because the governing agency of this project is MOC and the project is a foreign donor project, the project and environment approval is carried out in accordance with the process described in Figure 1.3.1.



Source: JICA Study Team

Figure 1.3.1 Existing Procedures for Project and Environment Approval

3) Gaps Between the Legal System on Environmental and Social Considerations in Myanmar and the JICA Guidelines

The existing legal system related to environmental and social considerations of Myanmar was relatively insufficient, particularly relating to EIA, as compared to the JICA Guidelines and World Bank Safeguard Policy. Through the EIA Procedure, which is currently in the draft stage, this basic gap will be resolved.

However, there still remain several points in the provisions of the Myanmar regulations including EIA Procedures that are more lenient than the JICA Guidelines and World Bank Safeguard Policy. For example, the JICA Guidelines and World Bank Safeguard Policy describe that, in addition to the direct impact, the derivative, cumulative, and secondary impacts should also be assessed in the EIA. However, there is no provision that mentions such policy in the Myanmar regulations.

Moreover, there is no regulation or guideline in Myanmar that clearly defines the effort by a proponent to create and implement the monitoring plan, and to inform the monitoring results to the stakeholders

Taking into consideration the above situation, necessary survey and initial environmental examination (IEE) shall be conducted for the project in accordance with both the processes and details which are prescribed in relation to a Category B project under the JICA Guidelines. Measures concerning the regulations prescribed by the regulations of Myanmar shall be taken within the scope which does not contradict with the JICA Guidelines.

4) Organization Related to Environmental Conservation in Myanmar

The outline of the organization related to environmental conservation in Myanmar is shown in Appendix 1.5.

(a) Comparative Consideration of Alternatives

Three alternatives including the zero option were considered for the project.

The alternatives were compared from the viewpoint of economic efficiency, engineering, environmental and social considerations, and harmony with YUTRA (project implementation effect).

Comprehensive evaluation was implemented and the current plan was selected as the project target plan.

The contents of the comparative consideration of alternatives are shown in Appendix 1.6.

(b) Scoping

In the stage before the field survey, expected impacts were assessed and summarized as scoping with the evaluation of the extent of the impacts.

The results of scoping are shown in Appendix 1.7.

(c) Terms of Reference of Surveys on Environmental and Social Considerations

For the items selected from the results of scoping, the details and methods were set as the terms of reference.

The terms of reference of surveys on environmental and social considerations are shown in Appendix 1.8.

(d) Results of Survey on Environmental and Social Considerations

The main important points of the results of the survey on environmental and social considerations are summarized. The contents are shown in Appendix 1.9.

(e) Environmental Impact Assessment

Based on the results of the surveys on environmental and social considerations and scoping, for items with a rating of B-, C-, or C during the planning/construction or operation stage, the environmental impacts of the project are assessed.

Table 1.3.2 shows the results of the assessment with the reason of assessment.

Table 1.3.2 Results of Environmental Impact Assessment

Category		Assessment Rating of Impacts in the Scoping		Assessment Rating of Impacts based on the Results of the Survey		Reason of Assessment (Identified Impacts and Reasons)
		Planning Stage / Construction Stage	Operation Stage	Planning Stage / Construction Stage	Operation Stage	
Social Environment	1. Land Acquisition and Involuntary Resettlement	B-	D	B-	D	**Planning Stage:** (1)Following structures replacement and involuntary resettlement occur. 1) Around the interchange in the north side of the bridge - Replacement of three automobile repair workshops - Involuntary resettlement of three employees of two automobile repair workshops 2) Around the park in the south side of the bridge - Replacement of 24 hours snack shop and involuntary resettlement of one employee of the shop - Relocation of tea shop, barber shop, game shop /mobile card shop and replacement of the building in which these shops exist -Involuntary resettlement of three persons of the game shop. (2) All land to be used by the project is public land (PW, YCDC). Public authorities have the right of ownership or use. Accordingly, acquisition of private land is not required for all the project sites.
	2. Poor People	C	B+	D	B+	**Construction Stage:** No poor people were found in the project site. **Operation Stage:** By the construction of new bridge, positive effects are expected also for the poor people, such as provision of easy access to social services, market, schools, hospitals, etc.
	3. Utilization of Land and Local Resources	C-	D	D	D	**Construction Stage:** -There is no possibility to affect the local resources around the project site. - Quarry (stone, gravel) and soil to be used for construction are obtained from a location far away from the project site and water to be used for construction will be publicly supplied water and drinking water will be brought in. - Impact on land use is not expected, because there is no activity of agriculture and forestry in and around the project site.
	4. Existing Social Infrastructures and Services	B-	B+	B-	B+	**Construction Stage:** - Because the current bridge is present during the new bridge construction period, there is no permanent closure of the road. However, due to transportation of construction material/ equipment and construction waste, temporary closure of roads or speed limit may occur. Therefore, there is a possibility of occurrence of some inconvenience, such as traffic congestion and reduction of accessibility to public

Category		Assessment Rating of Impacts in the Scoping		Assessment Rating of Impacts based on the Results of the Survey		Reason of Assessment (Identified Impacts and Reasons)
		Planning Stage / Construction Stage	Operation Stage	Planning Stage / Construction Stage	Operation Stage	
						facilities such as schools, medical, and health care facilities. -Within the planned area of the bridge and access roads, there are 26 electric poles (including small light poles) and these are necessary to be relocated. - Transportation vessels and heavy machines working on the river may affect the ships navigating on the river. However, the location of the abutment and pier of the new bridge is designed so that there is no change of the current navigation route. **Operation Stage:** Traffic infrastructure will be improved by the development of the new bridge and access roads and there will be improvement in the access to social service facilities in the region.
Social Environment	5. Misdistribution of Benefit and Damage	C-	C-	B-	B-	**Construction Stage:** -The project itself would not cause any unfair misdistribution of damages and benefits to the peripheral areas. - However, with regard to the operation of transportation vehicles and heavy machines and generation of waste during construction, if an explanation to the residents and local authorities is insufficient, misdistribution of benefit and damage is possible to occur. **Operation Stage:** If an appropriate explanation to inhabitants and related organizations is not carried out considering both the possibility of negative impacts such as air pollution, noise and vibration and of positive impacts such as improvement of traffic infrastructure, misdistribution of benefit and damage is possible to occur.
	6. Water Rights, Fishing Rights, and Rights of Common	C	C	B-	D	**Planning Stage/ Construction Stage:** - No water right and fishing right are established in the river around the project sites. No rights of common in the peripheral forest areas are established. -The area around the riverbank is owned and under the control of Myanmar Port Authority (MPA). For using and occupying the area for the project, it is necessary to apply to MPA and obtain its permission.
	7. Landscape	D	C-	D	D	**Construction Stage:** There is no important landscape element that needs special consideration. **Operation Stage:** Even if the existing bridge and the new bridge stand side by side, there is no particular landscape disharmony between the new and old bridges.

Category		Assessment Rating of Impacts in the Scoping		Assessment Rating of Impacts based on the Results of the Survey		Reason of Assessment (Identified Impacts and Reasons)
		Planning Stage / Construction Stage	Operation Stage	Planning Stage / Construction Stage	Operation Stage	
Social Environment	8. Right of Children	B-	B-	B-	B-	**Planning Stage/ Construction Stage/ Operation Stage:** The planned area of the access road in the Dawbon side includes a part of the park. In this park, children play sports or play with playground equipment. So, the project will have a negative impact.
	9. Public Health and Sanitation	B-	C-	B-	B-	**Construction Stage:** Although the impact is temporary, air pollutants such as SPM, NOx, SOx emitted from construction vehicles and heavy machines may cause some adverse effect to respiratory organs. **Operation Stage:** Air pollution due to the increase of traffic volume may cause some adverse effect to respiratory organs. However, extent of impact is expected to be small.
	10. Infectious Diseases such as HIV/AIDS	B-	D	B-	D	**Construction Stage:** There is a possibility that migrating construction workers and drivers spread infectious diseases such as HIV/AIDS by contact with local women.
	11. Working Condition (Including Occupational Health)	C-	D	B-	D	**Construction Stage:** Depending on the working condition or contents of work, it is expected that there are risks of impairment to the health and safety of construction workers.
	12. Accidents	B-	C-	B-	B-	**Construction Stage:** Occurrence of accidents due to transportation vehicles/vessels and construction heavy machines is expected. **Operation Stage:** Traffic congestion may be resolved by the construction of the new four-lane bridge. Otherwise, there is a possibility of traffic accidents due to an increase in traffic volume and running speed.
	13. Electromagnetic Interference	C-	C-	D	D	**Construction Stage/ Operation Stage:** Vertical retaining wall of access roads is not high. There are only few houses and buildings in the immediate vicinity of the access roads. Accordingly, there is no possibility of occurrence of electromagnetic interference around the access roads.

Category		Assessment Rating of Impacts in the Scoping		Assessment Rating of Impacts based on the Results of the Survey		Reason of Assessment (Identified Impacts and Reasons)
		Planning Stage / Construction Stage	Operation Stage	Planning Stage / Construction Stage	Operation Stage	
Natural Environment	14. Terrestrial Fauna, Flora and Ecosystem	B-	D	B-	D	**Planning Stage/ Construction Stage:** - According to the biological and ecological survey in this project, two vulnerable species (tree) in the Red List of the International Union for Conservation of Nature and Natural Resources (IUCN) were found in the survey area, namely, (i) *Delonix regia* (Seinban/ Flame Tree) and (ii) *Swietenia macrophylla* King (Mahogany Tree). Flame Tree and Mahogany Tree are commonly found at parks or greenery in Yangon area. - According to the survey conducted after the planning area of the access roads was determined, none of the two species above exists in the affected area. - Lots of trees (not rare species) exist in the project-affected area. - According to the instruction from the Forestry Department of MOECAF, for removal or transplanting and/or alternative planting of trees, it is necessary to submit application document including data on tree species, location, and number of trees to the department, and it is necessary to obtain permission. - Actual action of removal or transplanting and/or alternative planting of trees is requested to YCDC-PPGD with payment as prescribed.
	15. Aquatic Fauna, Flora and Ecosystem	C	D	D	D	**Planning Stage/ Construction Stage:** -There is no endangered or rare aquatic species and benthos in the rivers around the project sites, and there is no environmentally sensitive area. - Pazundaung Creek is a tidal river and there are only weakened mangroves a little near the project site. It was confirmed by the survey that no mangroves exist in the planned area.
	16. Hydrological Situation	B-	C-	B-	D	**Construction Stage:** Excavation and dredging works on the bed and bank of the river for construction of abutment and piers of the bridge may result in changes of the hydrological situation of the river. **Operation Stage:** Depending on the installation situation of the abutment and piers of the bridge, there is a possibility of changes in the hydrological situation. However, the possibility of the change is expected to be small.
	17. Topography and Geology	C-	D	D	D	**Construction Stage:** - Construction under the project does not include large-scale land alteration. - As regards the topography of the water area, there is a possibility to modify the portion of the river bank/bed around the bridge. However, the scale of the alteration is not large.

Category		Assessment Rating of Impacts in the Scoping		Assessment Rating of Impacts based on the Results of the Survey		Reason of Assessment (Identified Impacts and Reasons)
		Planning Stage / Construction Stage	Operation Stage	Planning Stage / Construction Stage	Operation Stage	
	18. Soil Erosion	C-	D	D	D	**Construction Stage:** Because the scale of cutting and filling activities is small, there is almost no possibility of soil erosion and soil destabilization.
	19. Groundwater	C-	D	D	D	**Construction Stage :** Possibility of groundwater use for the project activities is not expected.
Environmental Pollution	20. Air Pollution	B-	C	B-	B-	There is no environmental standard of ambient air quality. **Construction Stage:** -During peak time of operation of the transportation vehicles/vessels and heavy machines or during slow traffic time, the deterioration of air quality is expected. -Power for construction work will generally come from the power supplied to the area. However, the power for blower or pump will also be supplied by diesel fuel generator, and it is expected that air pollutants such as NOx and particulate matter will be exhausted. **Operation Stage:** -By easing traffic congestion and low running/ idling, there is a possibility to reduce air pollution such as NOx. -On the other hand, increase in traffic volume (2013: 290,000 vehicles/day, 2021: 460,000 vehicles/day) may result in the increase of emission load of air pollutants.
	21. Water Pollution	B-	B-	B-	D	There is no environmental standard of water quality for river. **Construction Stage:** -Generation of water pollutants from construction site, transportation vehicles/vessels, heavy machines, and worker's lodge is expected. -Water pollution by soil runoff from ground construction area is not expected.
	22. Soil Contamination	B-	D	B-	D	**Construction Stage:** There is a possibility of soil contamination caused by emissions of pollutants or oils from construction site, heavy machines, and worker's lodge.
	23. Bottom Sediment	B-	D	B-	D	**Construction Stage:** Sedimentation and accumulation of water pollutants and soar of bottom mud in dredging/ excavation work may result in the increase of sediment pollution.
	24. Waste	B-	D	B-	D	**Construction Stage:** - Dredging sludge from water bed, waste sand/ soil and other construction waste materials are generated. - Daily general waste is expected to be generated in worker's lodge.

Category		Assessment Rating of Impacts in the Scoping		Assessment Rating of Impacts based on the Results of the Survey		Reason of Assessment (Identified Impacts and Reasons)
		Planning Stage / Construction Stage	Operation Stage	Planning Stage / Construction Stage	Operation Stage	
Environmental Pollution	25. Noise and Vibration	B-	B-	B-	B-	There is no environmental standard of noise and vibration in Myanmar. **Construction Stage:** -Generation of noise and vibration from transportation vehicles/vessels and heavy machines for construction works is expected. -It is expected that the noise is more than the work noise standards of Japan (85 dB) in the work site for pile driving using hydraulic hammer. However, by effect of attenuation, the noise will meet the standards in the place where houses are located. **Operation Stage:** -Increase of noise and vibration due to increase in traffic volume is expected. -However, the impact is slight in facilities that need a quiet environment, such as hospitals, schools, and temples, because they are away from the project site.
	26. Offensive Odor	C-	C-	D	D	**Construction Stage:** There is some possibility of offensive odor spreading over along the road due to poor emission control of construction machines and vehicles. However, since construction scale is not large, the impact is expected to be slight. -There is some possibility of generation of bad odor released from soared riverbed mud by excavation and dredging works on the riverbed. However, the impact is slight because of easier dispersion due to wind on the creek. **Operation Stage:** There is some possibility of offensive odor spreading due to increase of vehicle traffic. However, because there is dispersion effect by wind on the creek and residences are away from the roads, the impact is expected to be quite small.

<Stage>
Ⅰ : Planning Stage
Ⅱ : Construction Stage
Ⅲ : Operation Stage

<Rating>
A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses).
D: No impact is expected.

Source: JICA Study Team

(f) Mitigation Measures and Cost of Implementation of the Mitigation Measures

The mitigation measures and cost of implementation of such items classified as "B-" in the EIA are shown in Appendix 1.10.

(g) Mitigation Measures and Environmental Monitoring Plan

For the implementation of this project, there is no serious environmental and social impact. However, some items have negative environmental impacts to some extent. Accordingly, mitigation measures will be taken for these items.

In consideration of the scale of impacts on environmental and social conditions by the project, the environmental management plan will consist of two aspects as shown in Table 1.3.3.

Other environmental management issues for the project are not included.

Table 1.3.3 Environmental Management Plan

Plan Item	Important Matters in the Environmental Management Plan
Implementation of the monitoring plan	-Monitoring shall be implemented according to the plan. -Response/action to a comment and instruction from the local government and inhabitants shall be made according to the plan. -The report on the monitoring result shall be made according to the monitoring form, and reporting shall be conducted at a designated frequency.
Implementation of the mitigation measures	-PW and the contractors shall securely implement the respective mitigation measures. -When a problem on environmental and social conditions still remains after implementing the mitigation measures, more effective and feasible mitigation measures shall be examined and applied to mitigate the impact under the responsibility of PW.

Source: JICA Study Team

The monitoring plan is shown in Appendix 2.11.

(h) Stakeholders Meeting

The stakeholders meeting was held in Yangon on March 22, 2014 (10:30 to 12:30).

Venue: Assembly room in Public Works Office, Ministry of Construction, Mingalar Taung Nyunt Township, Yangon Region

Participants: 73 people (Table 1.3.4)

Table 1.3.4 Participants of the Stakeholders Meeting

Government Officers			
Public Works (MOC)	12	Department of Water Resources and Improvement of River System	1
YCDC	3	Ministry of Environment Conservation and Forestry	1
Department of Human Settlement and Housing Development (MOC)	2	River Development Department (Ministry of Transport)	1
Myanmar Electronic Power Enterprise (Ministry of Electronic Power)	2	Myanmar Port Authority	1
General Administration Department (Ministry of Home Affairs)	4	Myanmar Railway	1
Fishery Department (Ministry of Livestock and Fisheries)	1	Inland Water Transport	1
Total Number of Participants			30

Residents, Private Organizations			
Owners of Restaurants	2	Merchants	2
Owners of Shops	10	Political Party	2
Automobile Repair Workshops	9	Local Non-governmental Organization	4
Residents and Head/Leader of Residents	11	REM (Consulting Company)	3
Total Number of Participants			43

Source: JICA Study Team

The minutes of the stakeholders meeting is shown in Appendix 1.12.

1.3.2 Land Acquisition and Resettlement

(1) Necessity of Structures Replacement and Resettlement

1) Necessity of Structures Replacement and Resettlement

Land acquisition is unnecessary in the project because the project-affected land is owned by public authorities. However, involuntary resettlement of four units (seven persons) occurs. Planned area of access roads will affect several shops. Three automobile repair workshops that exist in the north side of the existing bridge and four shops that exist in the periphery of the park in the south side of the bridge are relocated.

2) Comparative Consideration of Alternatives

During the stage where the entire framework of the current plan was being decided, alternatives of the road construction plan were considered in order to minimize environmental and social impacts. The alternatives were for slope works. The following three options were compared.

Alternative 1: Embankment Slope
Alternative 2: Concrete Wall （Inverted T-Type）
Alternative 3: Reinforced Earth Wall

The contents of the comparison are shown in Appendix 1.13.

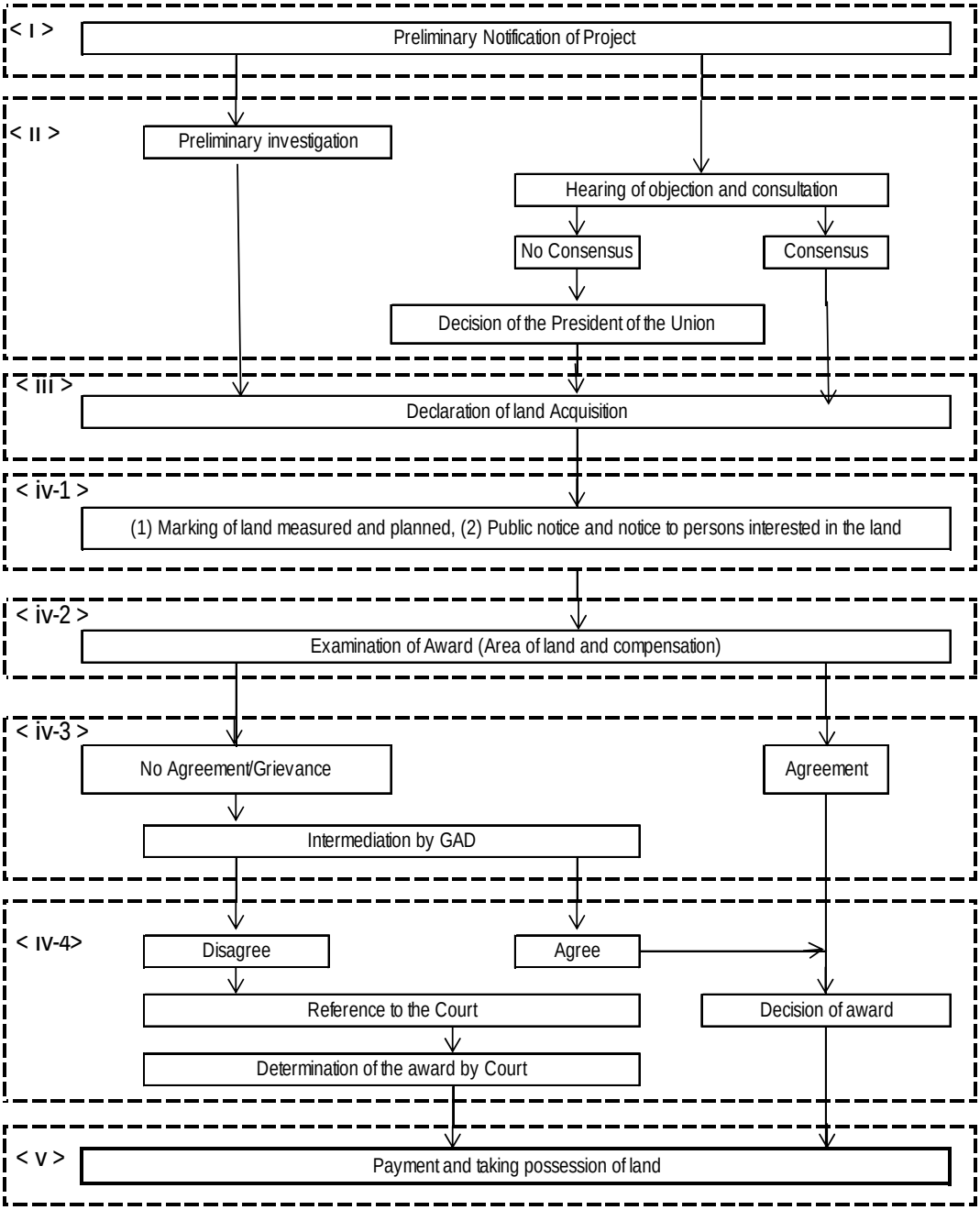
(2) Legal Framework Concerning Land Acquisition and Resettlement

1) Legal Framework in Myanmar

There are many significant laws which govern land issues, land administration, and land ownership in Myanmar such as the Land Nationalization Act (1953), Disposal of Tenancies Law (1963), Land Acquisition Act (1894), Forest Law (1992), Farm Land Law (2012), and so on.

Among them, the Land Acquisition Act (1894) promulgated during the British Colonial Era is now the core law for land acquisition and resettlement in Myanmar.

The flow of land acquisition under the Land Acquisition Act (1894) is shown in Figure 1.3.2.



Source: JICA Study Team

Figure 1.3.2 Flow of Land Acquisition under Myanmar Legislation

2) JICA's Policy

JICA's policy is shown in Appendix 1.14.

3) Comparison of Laws of Myanmar and the JICA Guidelines

The comparison of laws of Myanmar with the JICA Guidelines is shown in Table 1.3.5.

Table 1.3.5 Comparison of Laws of Myanmar and the JICA Guidelines

No.	JICA Guidelines/World Bank	Laws of Myanmar	Gaps between JICA Guidelines/World Bank and Laws of Myanmar
1	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. (JICAGL)	None	No law was identified.
2	When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken.(JICAGL)	Land Acquisition Act of 1894 (Article 3)	Article 3 of the Land Acquisition Act stipulates that a person who has right in land would be entitled to claim compensation if the land were acquired under this Act. However, it does not state effective measures to minimize impact.
		Farm Land Law of 2012 (Article 26)	Article 26 of the Farmland Law of 2012 stipulates that suitable compensation and indemnity in farmland acquisition for the interest of the State or public would be taken.
		Farmland Rules of 2012 (Article 64)	Article 64 of the Farmland Rules of 2012 stipulates that the compensation in farmland for the interest of the State or public would be taken.
3	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.(JICAGL)	Land Acquisition Act of 1894 (Article 23)	Article 23 of the Act stipulates that damages on standing crops and trees, land, properties, incidentals to relocate residence or business and losses of profits due to land acquisition are considered for compensation although it does not clearly state to support PAPs can improve or at least restore their standards of living.
4	Compensation must be based on the full replacement cost as much as possible. (JICAGL)	Land Acquisition Act of 1894 (Article 23)	Article 23 of the Act stipulates that “the market value of the land at the date of the publication of the notification" is considered, although it does not state “the full replacement cost."
5	Compensation and other kinds of assistance must be provided prior to displacement. (JICAGL)	Land Acquisition Act of 1894 (Article 34)	In the Act it is not stipulated specifically that compensation and other kinds of assistance must be provided prior to displacement. However, Article 34 of the Act stipulates that when compensation is not paid before taking possession of the land, the amount awarded with interest thereon shall be paid.
6	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. (JICAGL)	None	No law specifically mentions the requirement of resettlement action plans for large-scale involuntary resettlement.
7	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. (JICAGL)	None	No law specifically mentions that consultations must be held with the affected people and their communities in the planning and action process of resettlement.
8	When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. (JICAGL)	None	No law specifically mentions the requirement of consultation.
9	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans. (JICAGL)	None	No law specifically mentions the appropriate participation of affected people in the action planprocess of resettlement.
	Appropriate and accessible grievance	Land Acquisition	Article 5A of the Land Acquisition Act

No.	JICA Guidelines/World Bank	Laws of Myanmar	Gaps between JICA Guidelines/World Bank and Laws of Myanmar
10	mechanism must be established for the affected people and their communities. (JICAGL)	Act of 1894 (Article 5A, 18)	stipulates that any person whose land is affected (acquired) can object to the land acquisition within thirty days of the notification. Besides, Article 18 stipulates that any PAP who has not accepted the award can refer to the Court for determination. It seems no clear gaps in necessity of grievance system itself between JICA Guidelines and Land Acquisition Act. An accessible, fair and transparent grievance system must be established based on JICA Guidelines and Land Acquisition Act.
11	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits (WBOP4.12 Para.6)	Land Acquisition Act of 1894 (Article 4)	Article 4 of the Act stipulates that a notification of land requirement for public purposes is published to start surveys and land marking although it does not state the details of surveys to establish eligibility through an initial baseline survey (including population census).
12	Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying. (WB OP4.12 Para.15)	Land Acquisition Act of 1894 (Article 9)	Article 9 of the Act stipulates regarding occupier (if any) of land and all persons known or believed to have rights on lands are notified or invited for explanations although the eligibility is not clearly prescribed in the Act.
13	Preference should be given to land-based resettlement strategies for displaced persons whose livelihood are land-based. (WB OP 4.12 Para.11)	None	No law was identified on preference to land-based resettlement strategies for displaced person.
14	Provide support for the transition period (between displacement and livelihood restoration). (WB OP 4.12 Para.6)	None	No law was identified on the provision of support for the transition period.
15	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities, etc. (WB OP4.12 Para.8)	None	No law was identified on particular attention to vulnerable groups.
16	For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared. (WB OP 4.12 Para. 25)	None	No law was identified on the criteria of abbreviated resettlement plan.

Source: JICA Study Team tabulated based on Land related laws of Myanmar and JICA Guidelines (2010.4) and World Bank OP 4.12.

4) Policy on Structures Replacement and Resettlement for the Project

The policy on structures replacement of and resettlement for the Project is due to JICA Guidelines and Myanmar Legislation relating to land acquisition and resettlement.

However, for the matter where gaps exist between them, the policy on the Project shall be complied with JICA Guidelines.

In details, the Project Policy is shown as follows.

1. Structures replacement and resettlement will be avoided or minimized where feasible by identifying possible alternative project designs.
2. Where structures replacement and resettlement are unavoidable, all PAPs will be fully compensated and assisted so that they can improve, or at least restore, their former economic and social conditions.
3. Compensation and rehabilitation support will be provided to any PAPs, that is, any person or household or business which on account of project implementation would have his, her or their:
   - standard of living adversely affected;
   - right, title or interest in any property (including commercial properties, tenancy or any other fixed or moveable assets) acquired or possessed, temporarily or permanently;
   - income earning opportunities and work adversely affected, temporarily or permanently.
4. All PAPs residing, working, or doing business within the project-affected areas as of the date of the latest census and inventory of lost assets are entitled to compensation for their lost assets, at replacement cost, if available, and restoration of incomes and businesses, and will be provided with rehabilitation measures sufficient to assist them to improve or at least maintain their pre-project living standards, income earning capacity, and production levels.
5. PAPs that lose only part of their physical assets will not be left with a portion that will be inadequate to sustain their current standard of living. The minimum size of remaining structures will be agreed during the compensation process.
6. PW shall prepare abbreviated resettlement action plan (ARP).
7. ARP will be disclosed for the reference of PAPs as well as other interested groups.
8. Payment for land will be based on the principle of replacement cost.
9. Assistance for structure relocation and resettlement will be provided not only for immediate loss, but also for transition period needed to restore livelihood and standards of living of PAPs.
10. ARP must consider the needs of those most vulnerable to the adverse impacts of resettlement (including the poor, those without legal title to land, ethnic minorities, women, children, elderly and disabled). Assistance should be provided to help them improve their socioeconomic status.
11. PAPs and their communities will be consulted about the project, the rights and options available to them, and proposed mitigation measures for adverse effects, and to the extent possible be involved in the decisions that are made concerning their loss of land.
12. Adequate budgetary support will be fully committed and made available to cover the costs of land acquisition within the agreed implementation period. The funds for all replacement activities will come from PW.
13. Payment of compensation will be completed prior to any construction activities, except when a court of law orders so in expropriation cases.

14. Organization and administrative arrangements for the effective preparation and implementation of the ARP will be identified and set in place prior to the commencement of the process; this will include the provision of adequate human resources for supervision, consultation, and monitoring of land acquisition and rehabilitation activities.
15. Appropriate reporting (including redress functions and monitoring) will be identified and set in place as part of the ARP system.

(3) Scope of Structures Replacement and Resettlement

Table 1.3.6 shows the scope of structures replacement and resettlement.

Table 1.3.6 Scope of Structures Replacement and Resettlement

Place		Affected structure	Classification of Structure Replacement and Resettlement	Quantity	Information of PAPs	Note
North side of the Bridge Around the Interchange	1	Automobile repair workshop Iron roler shutter and doors	Replacement	1 structure	1 workshop owner, 6 employees	
	2	Automobile repair workshop Car Painting	Replacement	1 structure	1 workshop owner, 9 employees	
			Resettlement	2 persons	2 employees	Living /sleeping in the workshop
	3	Automobile repair workshop Car Body Repair	Replacement	1 structure	1 workshop owner, 4 employees	
			Resettlement	1 person	1 employee	Living /sleeping in the workshop
South side of the Bridge Around the Park	4	24 hours Snack shop	Replacement	1 structures	1 shop owner, no employee	
			Resettlement	1 person	1 employee	Living /sleeping in the shop
	5	1) Tea shop	Replacement	1 structure	1 shop owner, 2 employees	In the same building. The structure owner is the tea shop owner. The barber shop owner is a daughter of the tea shop owner. The owner of the game shop & mobile phone card shop is a nephew of the tea shop owner.
	6	2) Barber shop (Beauty salon)			1 shop owner, 1 employee	
	7	3) Game shop & Mobile phone card shop			1 shop owner, 7 employees	

Place		Affected structure	Classification of Structure Replacement and Resettlement	Quantity	Information of PAPs	Note
			Resettlement	3 persons	1 game shop & mobile phone card shop owner, his wife and their child	Living /sleeping in the shop

Source: JICA Study Team

(4) Specific Procedure for Replacement of Structure and Resettlement for the Project

The Project specifies the following procedure for Structures Replacement and Resettlement.

1. Setting up of implementation team for ARP in PW
2. Final identification of PAPs
3. Setting cut-off-date
4. Finalization of ARP and submission to JICA by PW
5. Forming of Compensation Committee

   -Members: PW, Yangon Regional Government, YCDC, Officer of GAD

   -Task: Estimation and decision of offer amount of Compensation rate

6. Negotiation with PAPs, obtaining agreement of compensation with them and arrangement of payment procedure

Appendix 1.15-1.18 shows the following items relating to ARP.

(5) Entitlement Matrix

Appendix 1.15

(6) Grievance redress mechanism

Appendix 1.16

(7) Framework for implementation

Appendix 1.17

(8) Implementation schedule

Appendix 1.18

(9) Estimated cost and source of funds

Appendix 1.19

(10) Monitoring（Structures Replacement and Resettlement）

Appendix 1.20

1.3.3 Others

(1) Monitoring Form (draft)

(2) Environmental Checklist

(3) Scoping and TOR of Surveys for the Project under the Myanmar Portion

The contents above are shown in Appendix 1.21 - Appendix 1.23.

Chapter 2 Contents of the Project

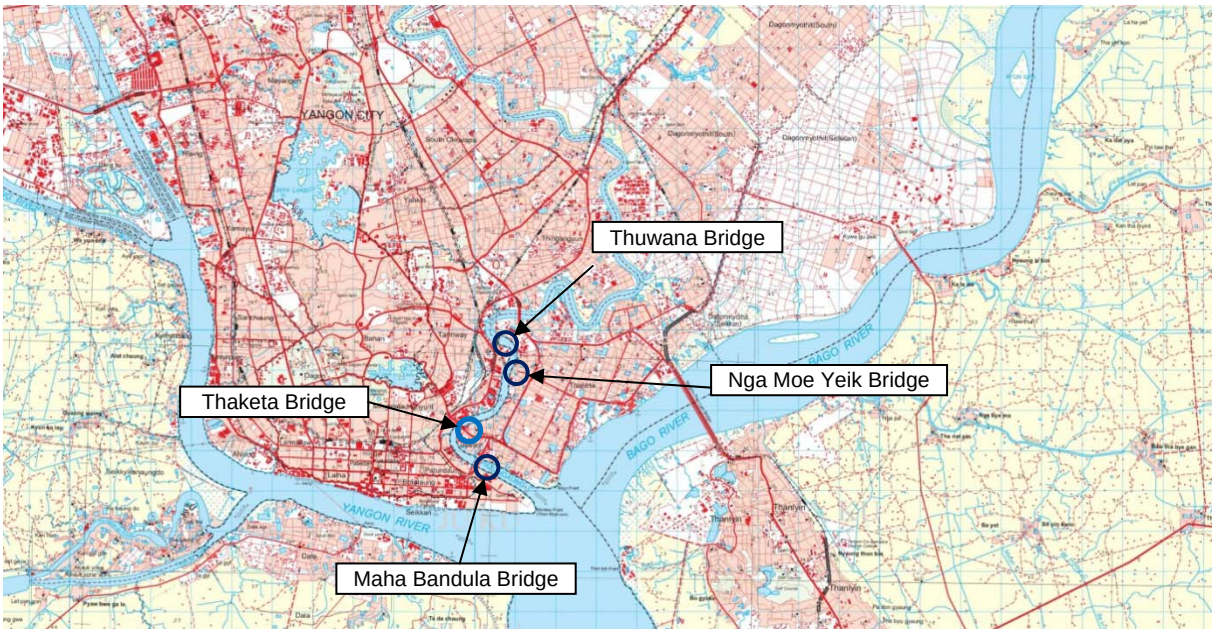
2.1 Basic Concept of the Project

2.1.1 Present Condition and Problems

Myanmar is a country of abundant natural resources, and has great potential to attain rapid economic growth in the coming years. Yangon is the former capital, the main center of Myanmar's economic activities, and the largest city of Myanmar having a population of about five million, which is 12% of the national population (2010). The Port of Yangon, the largest international port (river port) of Myanmar, is located on the left bank of the Yangon River, next to the Yangon downtown area.

During fiscal year 2010~2011, the scale of the economy of Yangon Region was 23% of the national gross domestic product (GDP). The Myanmar government is now undertaking the fifth five-year plan for fiscal years 2011~2012 to 2015~2016, which sets a GDP growth target of 6.7% for fiscal year 2012~2013. Due to the recent rapid growth of the economy, Yangon shows excessive centralization of daily economic activities which generates transport demands larger than ever, and which reveals insufficient capacity of the present transport infrastructure to cope with further economic growth/development.

At the moment, there are four bridges across Pazundaung Creek in the southern part of Yangon City. From the downstream side as shown in Figure 2.1.1, the four bridges are Maha Bandula Bridge, Thaketa Bridge, Nga Moe Yeik Bridge and Thuwana Bridge. Maha Bandula Bridge was completed in 2000 and is a cable-stayed bridge. Its roadway section is a three-lane dual carriageway. Thaketa Bridge was completed in 1966 and is a dual, one-lane bridge. Nga Moe Yeik Bridge is utilized as a pedestrian bridge, while Thuwana Bridge was completed in 1985 with financial assistance from Japan and is a dual, one-lane bridge. However, the four bridges are distant from each other. Due to this distance in the southern part of Yangon City, the three bridges used by vehicles seem to be concentrated with daily traffic volume.

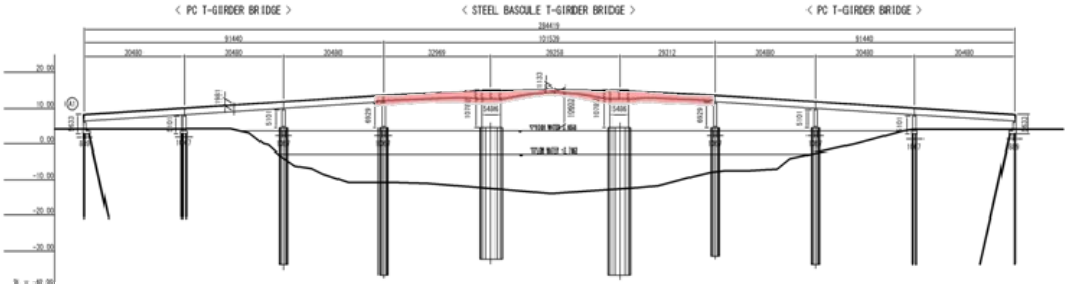


Source: JICA Study Team

Figure 2.1.1 Four Existing Bridges on Pazundaung Creek

The existing Thaketa Bridge, having a length of 284 m, crosses Pazundaung Creek on the existing Yamonnar Road. Yamonnar Road is one of the main roads connecting the Yangon City center and

the eastern/southeastern area such as Thaketa Township. This bridge was constructed with financial assistance from Canada as part of the Colombo Plan in 1966. Its center span is a bascule, and its upward swing provides clearance for ship traffic. Because 47 years have passed since the completion of construction of this bridge, vibration and deflection due to aging have occurred. At present, weight regulation of 10 tonne is being enforced on the existing Thaketa Bridge. At present, the Project for Comprehensive Urban Transport Plan of the Greater Yangon (YUTRA) is conducted under Japanese assistance. This project already pointed out the insufficiency of transport infrastructure between the Yangon City center and the southern/southeastern area. According to the traffic survey of YUTRA, the present traffic volume of the existing Thaketa Bridge exceeds the general traffic capacity. Furthermore, the development of Thilawa Port and SEZ (Special Economic Zone) will make the traffic through Thaketa Bridge more heavier. Therefore, the construction of New Thaketa Bridge is urgently required.



Source: JICA Study Team

Figure 2.1.2 Side View of the Existing Thaketa Bridge


Existing Thaketa Bridge


Bascule part vibrating


Traffic congestion

Source: JICA Study Team

Figure 2.1.3 Current Conditions of the Existing Thaketa Bridge

2.1.2 Project Objectives

As stated in the minutes of discussions among the Public Works (PW), the Ministry of Construction (MOC), and the Japan International Cooperation Agency (JICA) signed on October 9, 2013, the objective of the project is to improve efficiency of transportation in Yangon City through elimination of a bottleneck by replacing the existing Thaketa Bridge with a new one.

2.1.3 Project Location

The Preparatory Survey area for this project is near the existing Thaketa Bridge in the southern part of Yangon City. The existing Yamonnar Road crosses Pazundaung Creek at this point as shown in the Project Location Map.

2.2 Outline Design of the Japanese Assistance

2.2.1 Design Policy

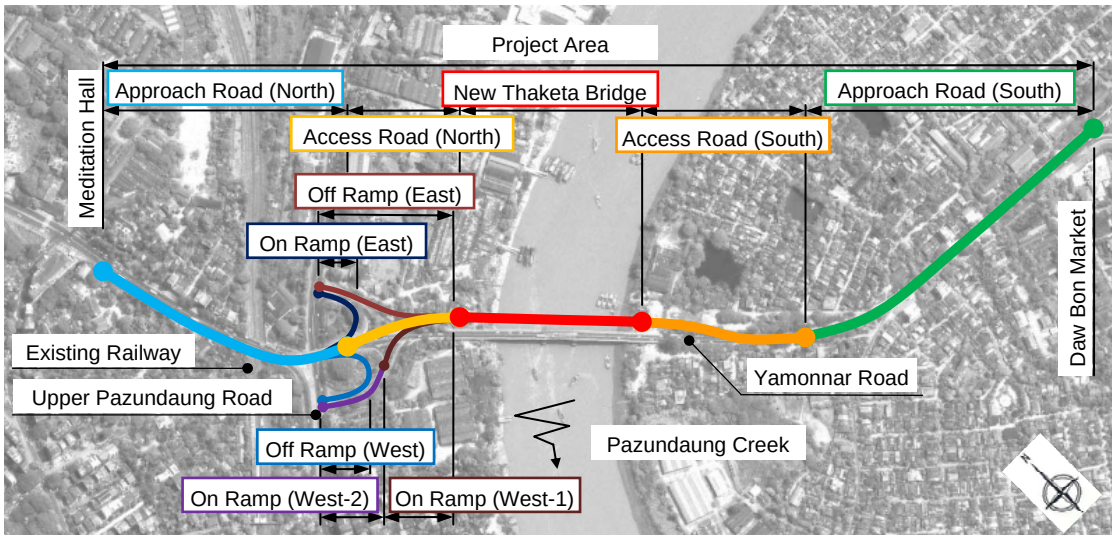
"The Preparatory Survey on The Project for Construction of New Thaketa Bridge" is carried out following a basic policy that is based on the principle of Japanese Grant Aid. A letter of request dated December 4, 2013 proposed the elimination of current traffic congestion by construction of a new bridge and road with a total of four lanes. According to the traffic survey of the Project for Comprehensive Urban Transport Plan of the Greater Yangon (YUTRA), traffic volume of the existing bridge exceeds the general traffic capacity of two lanes. Therefore, the design policy shall be as follows:

- The new bridge construction and road widening will achieve the objective of the project, which is to eliminate the bottleneck in the area.
- It is planned to widen the dual, one-lane section of Yamonnar Road (present condition) to a dual, two-lane section.
- New Thaketa Bridge will replace the existing bridge as planned based on the dual, two-lane road plan including bridge length, span arrangement and optimal bridge type.

2.2.2 Procedure of Design

The project area is shown in Figure 2.2.1. Development of the design is based on the following steps:

- Plan to widen from dual, one-lane section to dual, two-lane section (approximately 1.4 km long) of Yamonnar Road.
- The section to the existing Yamonnar Road from the new bridge, and its horizontal and vertical alignments are planned for the access road.
- The access road will have a minimum length for the purpose of cost reduction.
- The outside area of the intersection of Yamonnar Road and the access road is defined as the approach road.
- Replacement of the interchange ramps, to be connected to Upper Pazundaung Road.



Source: JICA Study Team

Figure 2.2.1 Project Area

2.3 Basic Plan (Construction Plan)

2.3.1 Design Criteria Applied to the Project Design

In order to carry out the project design of the New Thaketa Bridge and its approach roads, the design criteria shall be established. Considering the bridge design, the road design and navigation clearance are discussed in the following subchapters.

(1) Existing Conditions

The existing conditions of Yamonnar Road, the existing Thaketa Bridge, and Pazundaung Creek are detailed in Table 2.3.1.

Table 2.3.1 Existing Conditions

No.	Item	Condition	Remarks
Yamonnar Road			
1.	Carriageway Width	Carriageway width: 4.720m Pedestrian width: 1.990m (both side)	Survey map
2.	Horizontal Alignment	Minimum curve radius: R=50m	Survey map
3.	Vertical Alignment	Maximum slope gradient: I=6.0%	Existing bridge drawing
Existing Thaketa Bridge			
1.	Jurisdiction Authority	PW, MOC	
2.	Bridge Type	Steel and PC 9 span girder bridge	Existing bridge drawing
3.	Bridge Length	L=284.382m (933ft)	
4.	Width	W=12.192m (40ft)	
5.	Formation Height	FH=15.394m (50.505ft, center of span)	
6.	Horizontal Alignment	Straight line	
7.	Vertical Alignment	Slope 6%	
Pazundaung Creek			
1.	Jurisdiction Authority	Myanmar Port Authority, MPA	Natural condition survey
2.	H.W.L/ Quantity	HWL=3.689m/ Q=967m^3/s	
3.	Navigation Clearance	Not specified	Hearing investigation

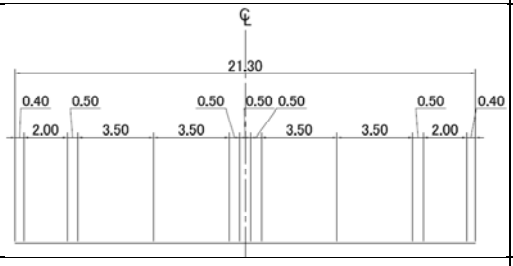
Source: JICA Study Team

(2) Design Criteria

With respect to structural guidelines, specialized structural design criteria associated with complex bridge types are compiled with the Japanese Standard for Highway Bridge (JSHB) and the Japanese Standard for Highway (JSH) associated with developing preliminary bridge concepts. The only cords related to the application of live loading system are applied using the American Association of State Highway and Transportation Officials (AASHTO) standards and other design loads such as earthquake are studied and applied or modified with JSHB considering local conditions. The general structural limitations and restrictions for New Thaketa Bridge such as span length restrictions, typical bridge cross sections, location of abutment, and restrictions on distance to adjacent structures on land or water are individually identified and verified.

According to the traffic survey of YUTRA, the northbound traffic volume toward the city center is approximately 16,000 units (16 hours), and the southbound volume is approximately 13,000 units. The total of both, which is 29,000 units, is much higher than 12,000 units, which is the general allowable traffic volume of the dual, one-lane road. Therefore, widening to a dual, two-lane section is an urgent issue. It should be noted that two-stage construction of two-lane bridges is undesirable because it requires greater project cost and time.

Table 2.3.2 Design Criteria

No.	Item	Condition	Remarks
Design Speed		50km/hr	JSH
Cross Section			Existing or equivalent condition
Horizontal Alignment			
	Minimum curve radius	100m	JSH
	Maximum superelevation	5.0%	
	Minimum transition curve	40m	
Vertical Alignment			
	Maximum slope gradient	6.0%	JSH
	Minimum vertical curve length	40m	
	Minimum vertical curve radius	1200/1000	
Height of Construction Gauge		5.2m	T/N

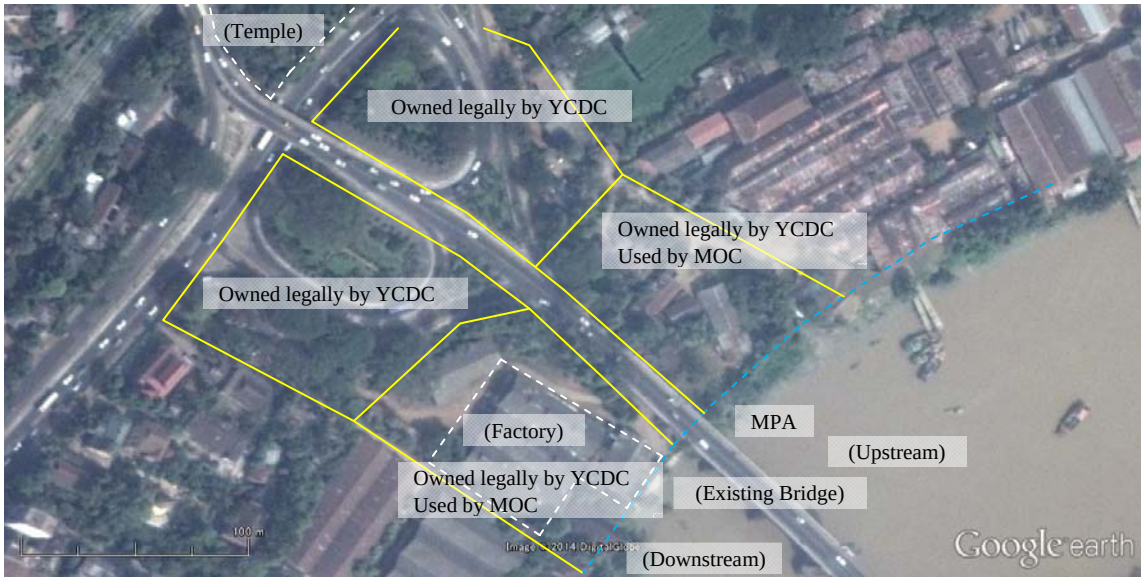
Source: JICA Study Team

2.3.2 Bridge Location

From the viewpoint of minimizing land acquisition and effective use of the existing Yamonnar Road, the selection of the New Thaketa Bridge location results in its proximity to the existing bridge. The Preparatory Survey Team has finished the inventory survey regarding land use and assessment of the scale of involuntary resettlement.

(1) Right Bank of Pazundaung Creek

The project route passes through land owned by the Yangon City Development Committee (YCDC). There are some accommodation for staff of the Ministry of Construction (MOC) located at the upstream side and a large plant (production of power generation equipment) at the downstream side.



Source: JICA Study Team

Figure 2.3.1 Land Use Conditions at the Right Bank

(2) Left Bank of Pazundaung Creek

The project route passes through a park located on a land owned by YCDC. There is land with sufficiently wide area for access road at the upstream side of the new bridge. On the other hand, a residential district and a community road for residents are near the existing Yamonnar Road at the downstream side.

Source: JICA Study Team

Figure 2.3.2 Land Use Conditions at the Left Bank

New Thaketa Bridge was proposed to run parallel with the existing Thaketa Bridge at the upstream side due to land availability.

2.3.3 Road Plan

(1) Alignment Design

The access roads connecting the new bridge with the existing Yamonnar Road, and the rampways connecting the access road to Upper Pazundaung Road or to existing ramps shall be constructed with widening to four lanes for the whole section of the project.

The design controls considered and the approaches taken for the alignment design are shown in Table 2.3.3.

Table 2.3.3 Design Controls for Alignment Design

No.	Design Control	Approach Taken for Alignment Design
1	ROW of Yamonnar Road	The right-of-way (ROW) of Yamonnar Road is 50 ft (approximately 15 m) from the center line (CL) on both sides of the road. The new bridge is to be located out of the ROW, and the access roads are required to come into the existing ROW quickly to minimize land acquisition.
2	Interchange	The alignment shall become close to the existing CL with the minimum required distance to minimize the length of the project.
3	Existing Community Road	It is necessary to avoid closing of the existing community road that surrounds abutment A2 since it will have a large impact to the daily lives of the residents.
4	Religious Facility	A Hindu temple is located between Upper Pazundaung Road and the railway at the A1 side. Approach road shall be designed to minimize use of the land of the temple.

Source: JICA Study Team

The alignment parameters applied considering geometry and design controls are shown in Table 2.3.4.

Table 2.3.4 Applied Alignment Parameters

No.	Element	Parameter	Length (m)
1	Tangent	R = ∞	51.521
2	Circle	R = 700.000	96.172
3	Tangent	R = ∞	23.041
4	Spiral	A = 80.000	53.333
5	Circle	R = 120.000	58.453
6	Spiral	A = 80.000	53.333
7	Tangent	R = ∞	14.374
8	Spiral	A = 85.000	62.301
9	Spiral	A = 85.000	62.301
10	Tangent	R = ∞	251.321
11	Spiral	A = 125.000	52.651
12	Spiral	A = 125.000	52.651
13	Tangent	R = ∞	6.503
14	Spiral	A = 100.000	50.000
15	Circle	R = 200.000	126.026
16	Spiral	A = 100.000	50.000
17	Tangent	R = ∞	96.008
18	Circle	R = 4000	179.667
19	Tangent	R = ∞	69.056

Source: JICA Study Team

(2) Profile Design

A gradient of 6.0% was applied to the existing Thaketa Bridge and it was observed that some large trucks and buses were only to climb up the slope at low speeds. It is therefore desirable not to apply a gradient exceeding 6.0% with consideration of the vehicle conditions at the site. On the other hand, navigation clearance of the Pazundaung River shall be secured at the center of the new bridge, and thus application of small gradient may affect the cost due to large-scale construction of access roads. Considering site conditions mentioned above, a maximum gradient of 6.0% (the same as that of the existing bridge) was applied for the profile design of the new bridge.

The design controls considered and the approaches taken for profile design are shown in Table 2.3.5.

Table 2.3.5 Design Controls for Profile Design

No.	Design Controls	Approach Taken for Profile Design
1	Railway Crossing	Clearance of 5.900m (electrification considered) shall be secured.
2	Upper Pazundaung Road Crossing	Clearance of 5.200m shall be secured.
3	Interchange	Proposed height shall come close to the existing height with the minimum required length to minimize length of the project.
4	New Thaketa Bridge	Navigation clearance of 14.261m shall be secured at the center of New Thaketa Bridge.

Source: JICA Study Team

The profile parameters applied considering geometry and design controls are shown in Table 2.3.6.

Table 2.3.6 Applied Profile Parameters

No.	PVI Elevation (m)	Vertical Curve		Gradient (%)	Length (m)
		VCL (m)	VCR (m)		
1	7.500	-	-		
2				2.500	215.000
3	12.875	150	2310		
4				-4.000	170.000
5	6.075	100	1000		
6				6.000	210.000
7	18.675	150	1250		
8				-6.000	232.000
9	4.755	100	1590		
10				0.300	293.000
11	5.634	150	25000		
12				-0.300	288.700
13	4.768	-	-		

Source: JICA Study Team

(3) Slope Work Design

Figure 2.3.3 shows the area affected by the embankment slopes in case no wall is applied. The existing embankment will be affected by the slopes of the new embankment and thus, it may cause undesirable deformation at both abutment sides. In addition to that, the community road will be closed at the A2 side.

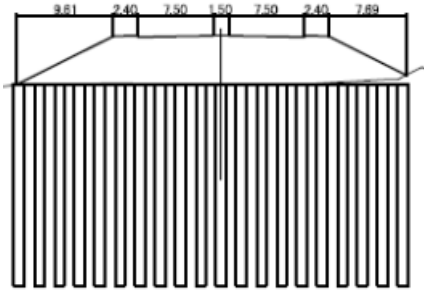
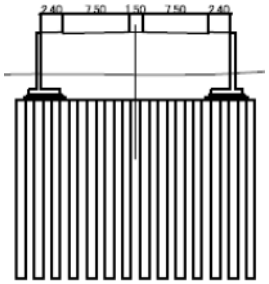
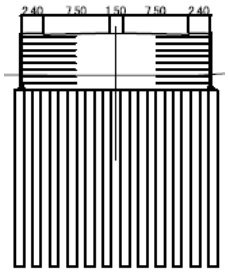
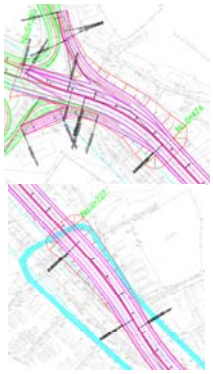
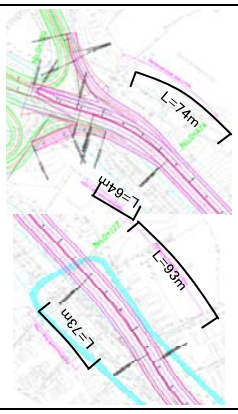
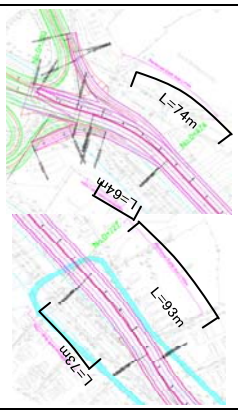
(a) A1 Side (b) A2 Side

Source: JICA Study Team

Figure 2.3.3 Areas Affected by Embankment Slopes

Therefore, the retaining walls are to be planned for the section where the embankment slopes affect the existing Yamonnar Road or the community road. A comparison of the slope works to be applied is shown in Table 2.3.7.

Table 2.3.7 Comparison Table for Slope Works

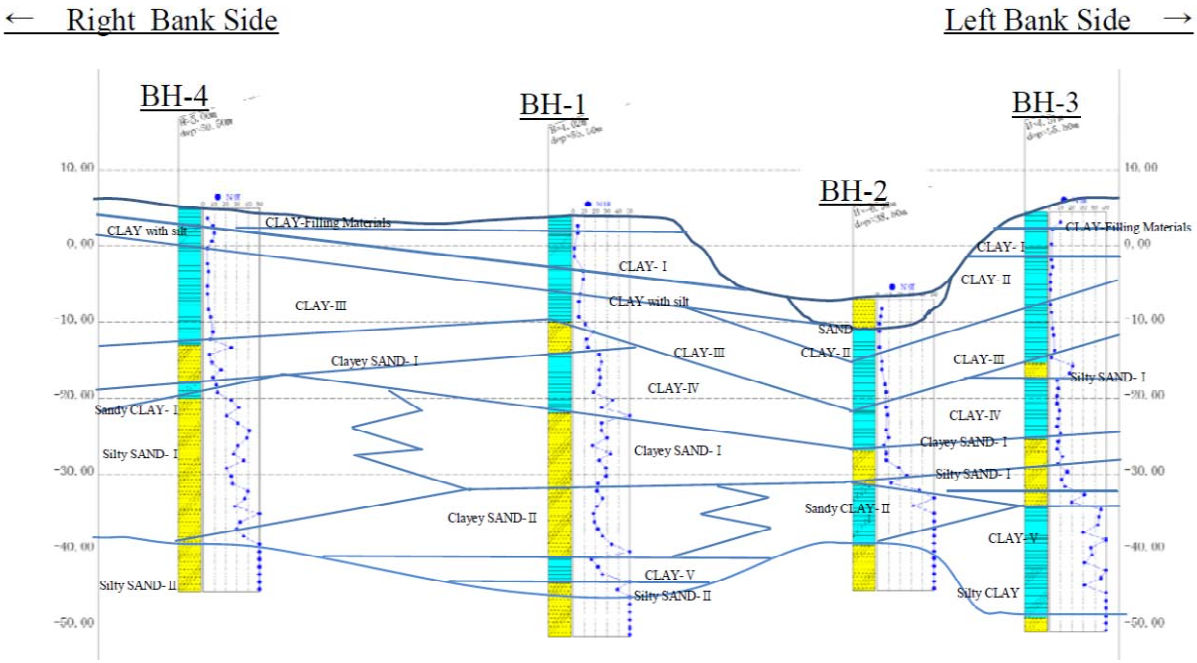
No.	Option 1	Option 2	Option 3
Slope Work	Embankment Slope	Concrete Wall (Inverted T-Type)	Reinforced Earth Wall
Cross Section			
Layout Upper: A1 Side Lower: A2 Side			
Objects Affected	Existing embankments at the A1 side and A2 side will be affected. Community road will be closed at the A2 side.	Existing embankments will be less affected. Closing of community road can be avoided.	Existing embankments will be less affected. Closing of community road can be avoided.
Soft Soil Treatment	Area of soft soil treatment will be large.	Area requiring soft soil treatment will be small.	Area requiring soft soil treatment will be small.
Constructability	Can be constructed without any critical problem. Area of traffic restriction will be large.	Can be constructed without any critical problem. Area of traffic restriction will be small.	Can be constructed without any critical problem. Area of traffic restriction will be small.
Economic Aspect	Most costly. Construction cost: 1.36	More costly than Option 3. Construction cost: 1.04	Most economical. Construction cost: 1.00
Overall Evaluation	Poor	Fair	Good

Source: JICA Study Team

Based on the results of comparison, Option 3 (Reinforced Earth Wall), which is the most economical option, will be applied for the slope work of approach roads.

(4) Soft Soil Treatment Plan

According to soil investigation results, soft cohesive soil layer with N values from 1 to 9 (average = 5) is deposited to a depth of 14 m at the A1 abutment side, and soil layer with N values from 1 to 10 (average = 3) is deposited to a depth of 20 m at the A2 abutment side. Hard layers, which can be considered as bearing layer, are deposited under a depth of G.L. -45 m at the A1 abutment side, and under a depth of G.L. -39 m at the A2 abutment side.



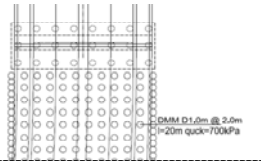
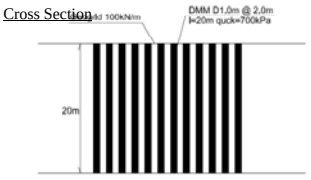
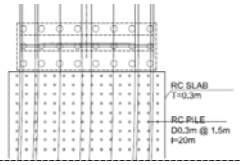
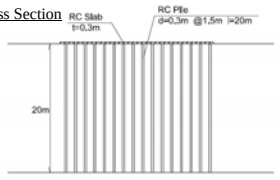
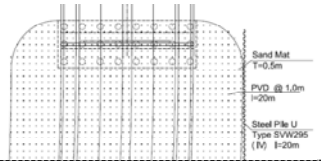
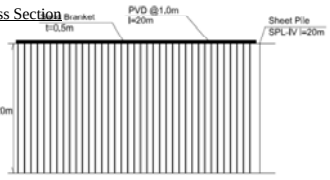
Source: JICA Study Team

Figure 2.3.4 Geological Profile

Cohesive soil and that with organic soil which have N values from 4 to 6 are defined as soft soil in the Japanese standard, "Design Standards on Soft Soil Treatment for Road Embankment" (Japan Road Association, 2012). There are problems expected such as occurrence of differential settlement due to consolidation, sliding of the embankment and negative effect to neighboring structures including horizontal movement of newly constructed abutment in case of executing embankment structure on soft soil ground. Thus, in order to avoid these problems, soft soil treatment measures are planned for the foundation of the high embankment section near the abutment. The solution is selected comparing some major methods as shown in Table 2.3.8.

As a result of the study, the deep mixing method is adopted in the area where the embankment height is over 3 m behind the abutment.

Table 2.3.8 Comparison Table for Soft Soil Treatment Methods

	Deep Mixing Method	Piled Slab Method	Prefabricated Vertical Drain (PVD) Method
Concept Draw	Plan  Cross Section  	Plan  Cross Section  	Plan  Cross Section 
Advantage	Reliable effect can be expected. Design methods have been established.	Reliable effect can be expected. Construction period can be shortened.	Construction cost can be reduced. Design methods have been established.

	Deep Mixing Method	Piled Slab Method	Prefabricated Vertical Drain (PVD) Method
Disadvantage	Construction cost is higher than the PVD method.	Construction cost is highest among the compared methods. Negative impact on the adjacent structure and houses will be a concern during construction.	Careful technical consideration will be required during construction. Waiting period is necessary, and construction period is longest among the compared methods.
Construction Period	(1) Cement Column : 2 months (2) Waiting Period : 1 month (3) Earthworks : 1 month Total : 4 months	(1) Pile Construction : 1 month (2) Slab : 1 month (3) Earthworks : 1 month Total : 3 months	(1) PVD : 2 months (2) Waiting Period : 1 month (3) Earthworks : 2 months (4) Waiting Period : 5 months (5) Excavation & Re-Fill : 1 month Total : 11 months
Construction Cost	Higher than the PVD method Cost Rate: 1.00	Highest Cost Rate: 1.15	Lowest Cost Rate: 0.95
Applicability	Although careful consideration for selecting appropriate improvement material and mixing rate is required in order to ensure the column strength after mixing, applicability of this method is high.	Construction noise and vibration are intense, thus applicability is low in the residential area.	Large amount of consolidation settlement will be expected during construction, thus applicability is low in case of reinforced earth retaining wall.
Evaluation	Highly Recommended	Recommended	Not Recommended

Source: JICA Study Team

(5) Land Impact Area

Details of the affected area and houses in this project are shown in Table 2.3.9.

Table 2.3.9 Project Affected Area and Houses

Location			Japanese Portion		Myanmar Portion	
			Area (m^2)	Houses	Area (m^2)	Houses
Right bank	Private Land	Hindu temple	0	---	30	None
	Public land	MOC, YCDC land	470	6 (residence for officers) 2 (service factory)	3,420	3 (service factory)
Left bank	Public land	MOC, YCDC land	4,630	1 (material seller) 2 (general shop)	120	None

Source: JICA Study Team

Referring to the JICA Guidelines for Environmental and Social Considerations, the environmental category is defined as Category B for resettlement of less than 200 people. In addition, there will be no major impact on the neighboring area because almost all the land for the project is public land. Although some car service factory is located around the rampways, its landowners are cooperative and are ready to agree to resettle once the project begins.

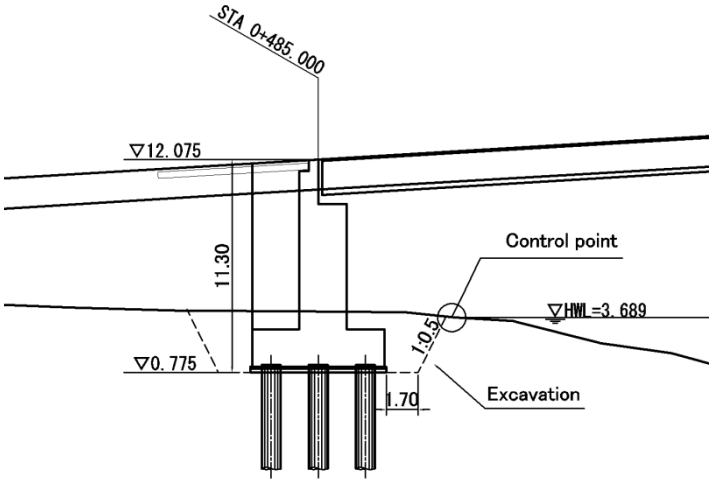
2.3.4 Bridge Plan

(1) Bridge Length

Based on the superelevation plan for the New Thaketa Bridge, the height differences between planning height and ground height are 7 m at the right bank and 5 m at the left bank. Reverse-T type abutment can be applied because the height of abutment will be around 10 m. The locations of each abutment are planned to be placed so that the bridge length can be minimized.

1) A1 abutment

The location of the A1 abutment is set to the nearest position of Pazundaung Creek. This position is determined from the excavation area and high water level line. Thus, the A1 abutment (surface of the parapet) is placed at STA. 0+485.

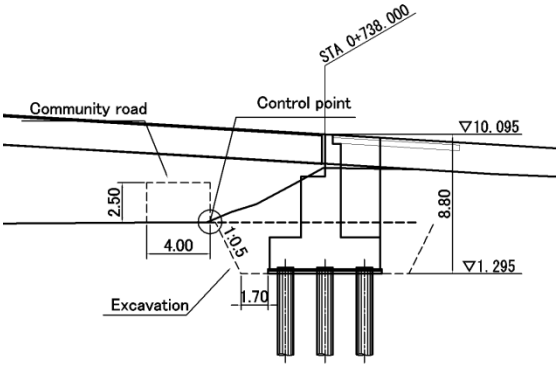


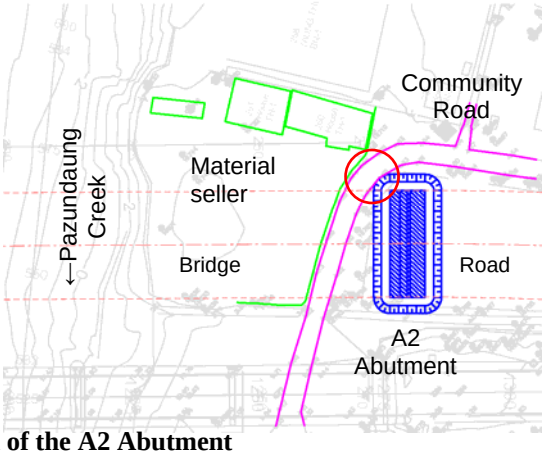
Source: JICA Study Team

Figure 2.3.5 Location of the A1 Abutment

2) A2 abutment

The location of A2 abutment is considered so as not to affect the community road. The position is determined from the excavation area and the width of the community road. Thus, the A2 abutment (surface of the parapet) is placed at STA. 0+738.





Source: JICA Study Team

Figure 2.3.6 Location of the A2 Abutment

3) Bridge length

Bridge length is determined to be 253.000 m.

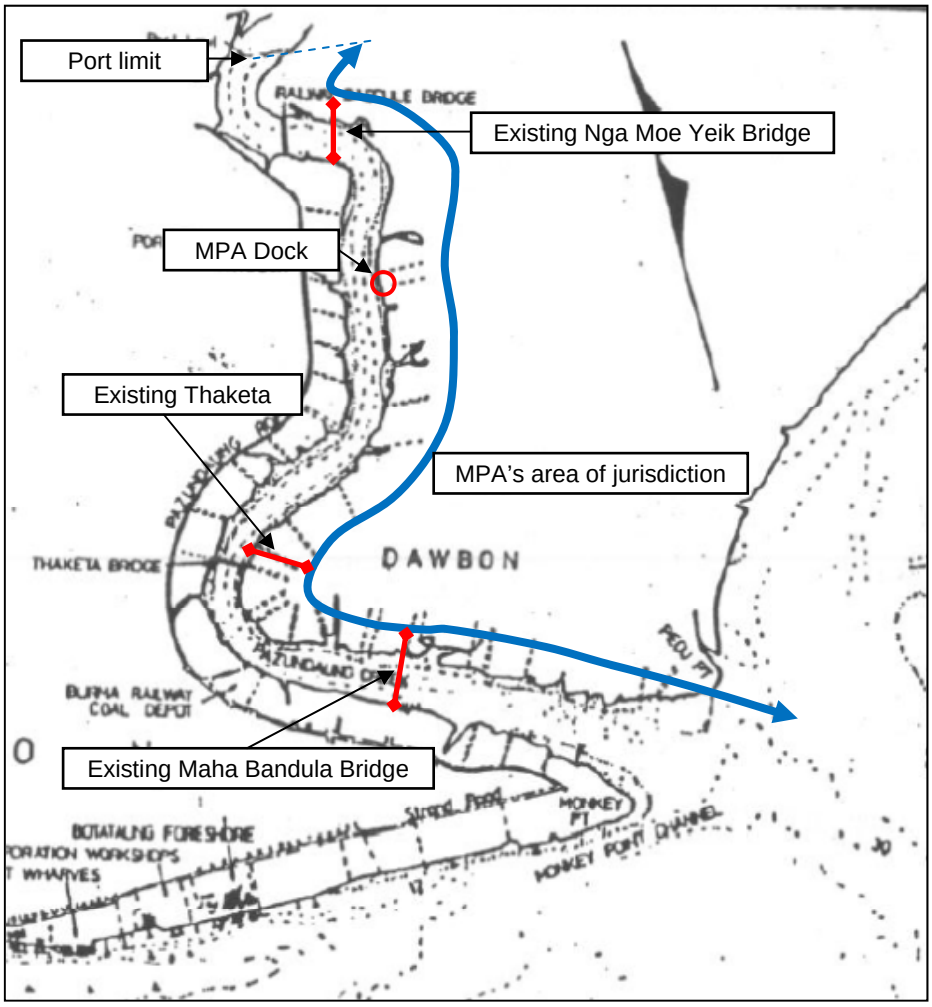
(2) Central Span Length

1) Request from Myanma Port Authority

The central span length is planned considering the navigation clearance of ships sailing along Pazundaung Creek and passing through Thaketa Bridge. The location of the New Thaketa Bridge is under the jurisdiction of Myanma Port Authority (MPA). Also, MPA owns large dredgers and a

dock for both MPA's ships and private ships on the bank of Pazundaung Creek upstream of the existing Thaketa Bridge.

The largest dredger has a length of 227 ft (84.4 m), width of 46 ft (14.0 m), draft of 45 ft (13.7 m) and depth of 13 ft (4.0 m).



Source: General information on ports and shipping in Myanmar

Figure 2.3.7 MPA's Area of Jurisdiction and Location of Existing Bridges

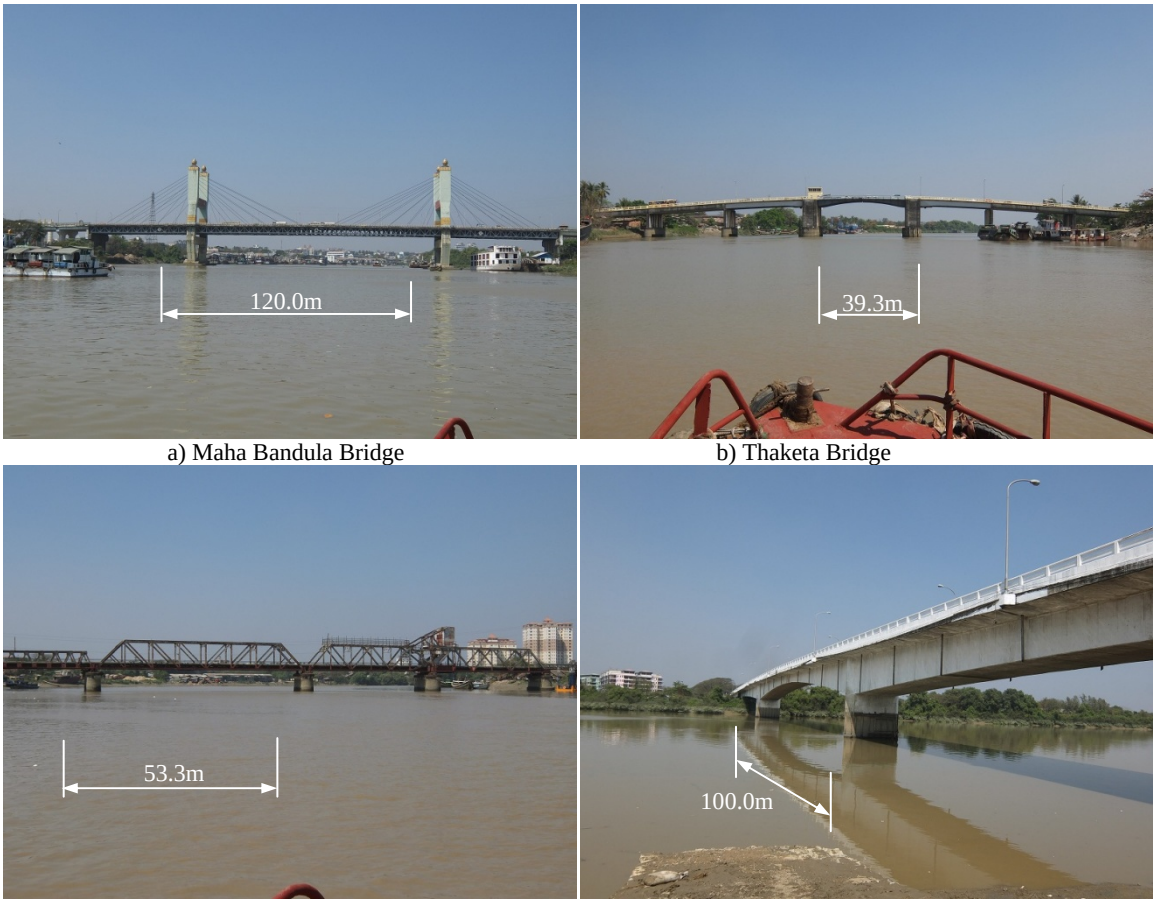
MPA requests the JICA Study Team for the navigation clearance in the new bridge plan as follows:

- The center span of the New Thaketa Bridge shall be 100 m for the safety of sailing ships.
- The clearance of the existing bridge at the center span is only 35 m such that vessels will be able to pass through without any difficulty.
- The current is skewed at about 85 to 97 degrees from the axis of the bridge and slightly curved.
- The navigation height shall be at least the same height as that of the existing Thaketa Bridge.

At present, MPA has no official document mentioning about navigation clearance. The JICA Study Team shall study MPA's requests regarding the navigation clearance of the New Thaketa Bridge so that it meets the actual conditions of Pazundaung Creek based on the present state survey.

2) Current situation of sailing vessels

Four bridges, shown in Figure 2.3.8, have been constructed at the downstream section of Pazundaung Creek. Only Thuwana Bridge, which is 7.5 km upstream from the junction of Pazundaung Creek and the Bago River, is out of the MPA's area of jurisdiction.



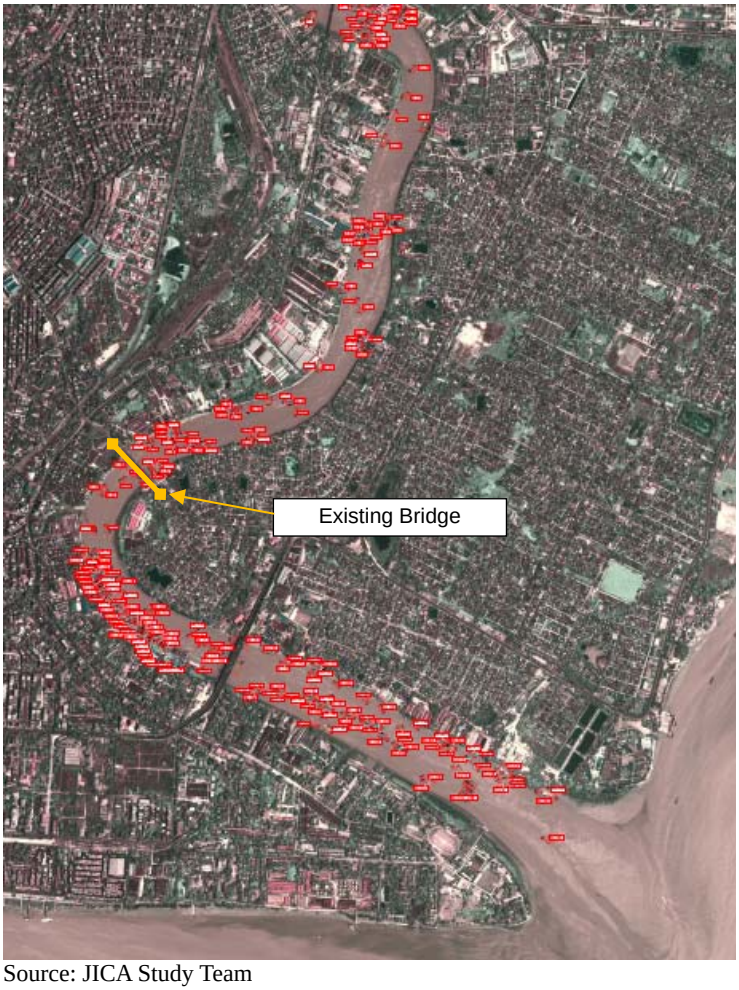
a) Maha Bandula Bridge b) Thaketa Bridge

c) Nga Moe Yeik Bridge d) Thuwana Bridge

Source: JICA Study Team

Figure 2.3.8 Existing Bridges over Pazundaung Creek

According to the site survey, many vessels sailing and mooring have been observed on the water area from the junction to Nga Moe Yeik Bridge. The water area seems to have good hydrographical conditions and is relatively calm with sufficient navigation and depth for sailing vessels. Actually, many vessels have been found in the recent satellite photograph of Pazundaung Creek, as shown in Figure 2.3.9, obtained in this study.

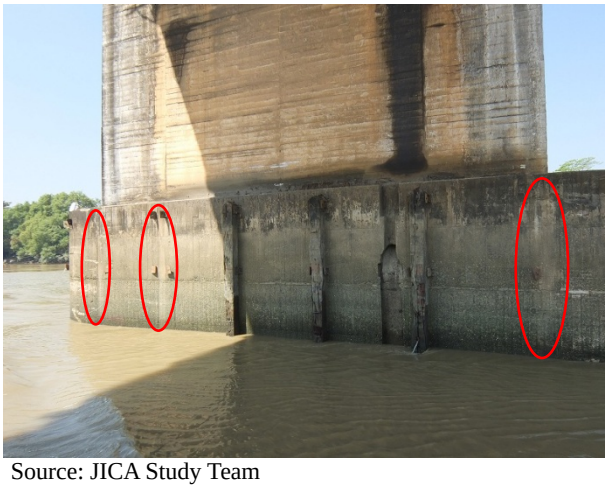


Source: JICA Study Team

Figure 2.3.9 Vessels on Pazundaung Creek (Satellite Photo Taken on March 25, 2012)

According to this photograph, over 300 vessels are estimated to use Pazundaung Creek for sailing and mooring. Among these vessels are big vessels that are over 60 m in length and 15 m in width.

In addition, many fenders on the pier of the existing bridge were found to have collapsed. This may indicate that the clearance of each bridge span is not enough for sailing vessels.



Source: JICA Study Team

Figure 2.3.10 Collapse of Fenders on the Pier of the Existing Thaketa Bridge

Then, the JICA Study Team plans the navigation clearance for the dimensions of the following vessels:

- Barge ships: 84.4m in length, 14.0 m in width and 13.7 m in draft
- Other ships: 62m in length, 11 m in width
- Barge ships: 64m in length, 15 m in width

3) Verification of navigation clearance

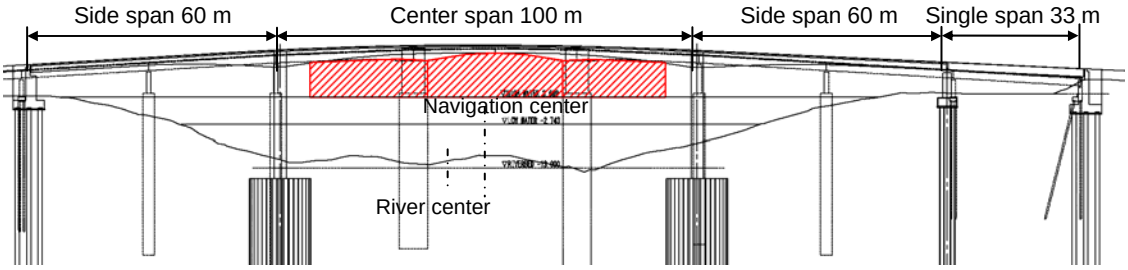
Generally, the navigation width of the sailing route is determined as 1L (L is the length of the longest length of the vessel) at interconnection route. This value equals to 85 m or more in Pazundaung Creek. Also, navigation height of 10.6 m is not enough for 13.7 m high dredgers.

Thus, the navigation width for the New Thaketa Bridge shall be set to 100 m because the room for navigation and width of pier shall be considered to be as much as the general navigation width, i.e., 85 m. The navigation height shall be the same as that of the existing Thaketa Bridge because there is hardly any difficulty encountered in the present condition. Therefore, the navigation clearance requested by MPA is considered reasonable and proper.

(3) Span Arrangement

The main span of the New Thaketa Bridge is planned to consider the present navigation because the navigation and center of the river channel is situated at the main span of the existing Thaketa Bridge. Because the side span length from A1 to P1 is 60 m based on structural considerations, the side span length from P2 to P3 shall be 60 m for structural balance. The remaining 33 m shall be single span.

As indicated in Figure 2.3.11, the present navigation area of the existing bridge, which has three spans, is almost equal to that of the new bridge having one span.



Source: JICA Study Team

Figure 2.3.11 Relation between Spanning of New Thaketa Bridge and Existing Navigation

(4) Limited Girder Height by Vertical Alignment

The connection road of the new bridge is planned to be attached to the existing road and as short as possible in order to minimize the total construction cost. At the A1 side, Yamonnar Road has a grade separation crossing over Upper Pazundaung Road, as shown in Figure 2.3.12. Because the existing off-ramp (east side) and existing on-ramp (west side) are diverged before the new road connecting to the existing road, these two rampways shall be replaced with new rampways.

To reduce the modification of land, the new road shall attach to the present grade at the divergence nose of the existing on-ramp (east) and existing off-ramp (west). Based on this policy, the connection road is planned to be connected at this point at both plain and elevation, and the superelevation is set from this point. To clear the navigation height of Pazundaung Creek, the girder depth of New Thaketa Bridge is restricted.

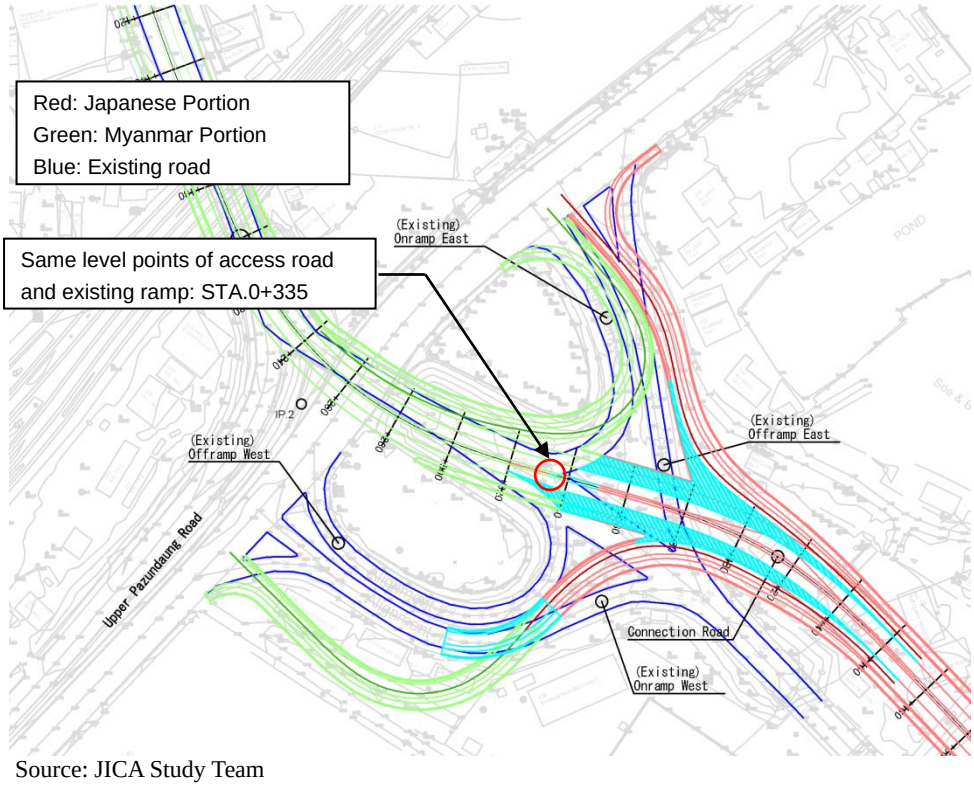
1) From the perspective of plain planning, the connection road is attached from the back of the A1 abutment of New Thaketa Bridge and the existing Yamonnar Road with a clothoid curve.

2) The connecting point is at STA. 0+335.0, the planned height is 8.075 m, and the superelevation is 4.000% downgrade.

3) The superelevation is set to be 6.000% from the connection point at STA. 0+335.0.

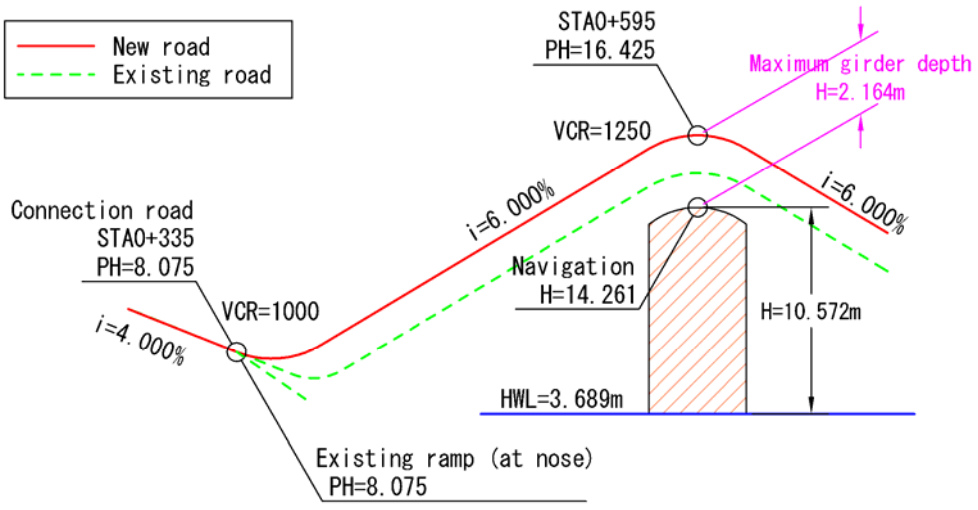
4) The planned height will be 16.425 m. On the other hand, the top of the navigation height is at 14.261 m (10.752 m above HWL 3.689).

5) The height difference of 2.164 m will be the maximum girder depth of the main span of New Thaketa Bridge.



Source: JICA Study Team

Figure 2.3.12 Vertical Connection Between Access Road and Existing Rampway



Source: JICA Study Team

Figure 2.3.13 Superelevation Plan and Maximum Girder Depth

2.3.5 Selection of Bridge Foundation Type

(1) River Conditions

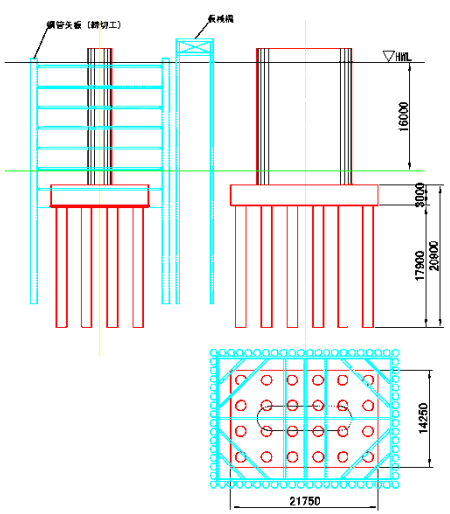
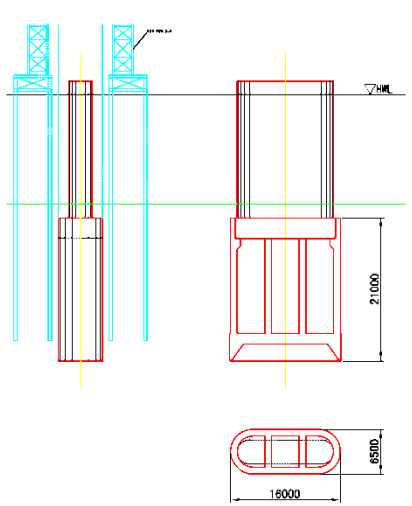
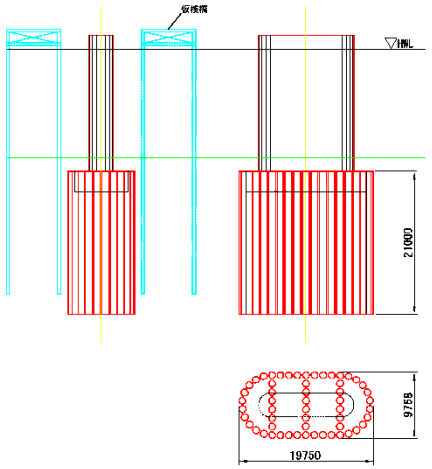
The center span of the new bridge is located at the deepest point of the Pazundaung Creek. Foundation design of P1 and P2 piers shall consider the following conditions: a) the river depth is 16 m at most, b) the range of tide is 6 m, c) the speed of tide is 3 m/s at most, and d) secure navigability of sailing vessels during construction. Among these conditions, the river depth is prevailing. Generally, 1) ready-made pile, 2) caisson, or 3) steel pipe sheet pile can be used for this condition without massive temporary work. But with massive temporary work, cast-in-place concrete pile can be used for the foundation.

(2) Comparative Study

The results of a comparative study of foundation types are shown in Table 2.3.10. The results indicate that steel pipe sheet pile foundation (SPSP) is the most economical and reasonable. SPSP is a foundation that connects arrayed steel pipe piles and is closed like a sunk well. The steel pipe piles act as a cofferdam during construction.

For the foundation of abutments and P3 pier, cast-in-place concrete pile, which is generally used in bridge construction projects in Myanmar, can be selected.

Table 2.3.10 Comparative study of foundation types

Alternatives	Cast-in-place pile foundation	Caisson foundation	Steel pipe sheet pile foundation
Sketches	 Cast-in-place pile ϕ1500, N=24	 Pneumatic caisson 16.0mx6.5m	 Steel pipe pileϕ1000 N=56 (oval N=38, bulkhead N=18)
Temporary work	Cofferdam by steel pipe sheet	Hoisting frame for steel shell	None
Structural features	For unit capacity of vertical resistance of each pile is small, the number of piles becomes large. Pile cap becomes thicker.	Vertical load is resisted by the caisson foundation bottom. The size of the foundation can be compact.	Vertical load is resisted by vertical ground reaction and shear ground reaction. The size of the foundation becomes larger than caisson foundation.
Construction features	The scale of cofferdam becomes larger. Constraint of work is low because of many struts and waling.	All the items for temporary work shall be introduced from Japan.	Temporary bridge around the foundation is required for pile work.
Construction cost (million JPY)	Main work 97 Temporary work 542 Total cost 639 (1.28)	Main work 563 Temporary work 220 Total cost 784 (1.56)	Main work 444 Temporary work 57 Total cost 501 (1.00)
Evaluation	Poor	Poor	Good

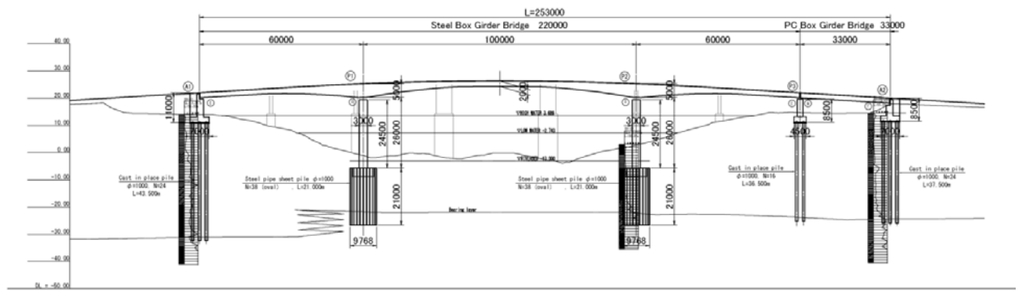
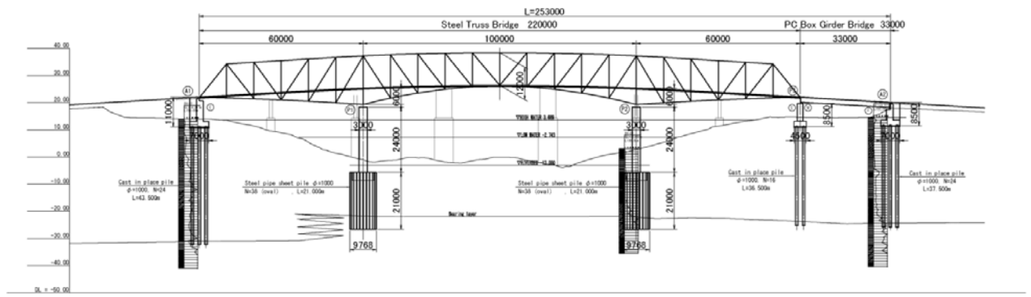
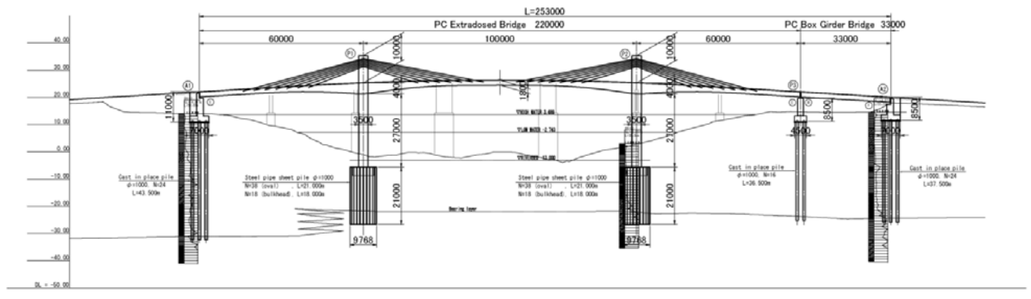
Source: JICA Study Team

2.3.6 Selection of Bridge Type

Among the applicable superstructure types for a 100 m span and girder depth lower than 2.1 m, a) steel box girder with steel deck plate, b) steel truss, or c) prestressed concrete (PC) extradosed bridge can be selected. Structural conditions, construction conditions, maintenance, landscape and economic aspects are considered for a comparative study of the three types.

Based on the results of the study, the PC extradosed bridge is the type selected to be suitable for New Thaketa Bridge.

Table 2.3.11 Comparison of Bridge Types

General View	Description		Comments for the features		Evaluation	
Alternative 1 Steel box girder with steel deck plate		Superstructure Bridge type: Steel box Length: 220.00 1st span: 60.00 2nd span: 100.00 3rd span: 60.00 4th span: 33.00 Substructure Abutment: Reverse T Pier: Wall Foundation P1、P2: SPSP A1、P3、A2: Cast in place Connection Road North: 165.00 South: 202.00	Structural condition	Girder depth H=2.0m corresponds to the 1/50 of depth-span ratio. This girder depth is feasible by using chicker steel plate for girder members.	10 / 10	Fair
			Construction condition	Erection metohd will be; launching erection method for side span and hoisting from barge ship for center span. Construction period will be 29months.	12 / 15	
			Maintenance	Maintenance cost will be relatively high because repainting is needed.	7 / 10	
			Landscape	Simple shape of girder produces less impressive landscape. Road noise is relatively high.	3 / 5	Total score
			Cost (Ratio)	1.070	56 / 60	88 / 100
Alternative 2 Steel truss girder		Superstructure Bridge type: Steel Truss Length: 220.00 1st span: 60.00 2nd span: 100.00 3rd span: 60.00 4th span: 33.00 Substructure Abutment: Reverse T Pier: Wall Foundation P1、P2: SPSP A1、P3、A2: Cast in place Connection Road North: 165.00 South: 202.00	Structural condition	Uneven loading might cause harmful secondary stress for gusset plates.	9 / 10	Fair
			Construction condition	Balancing cantilever erection method using traveler cranes is applicable. Special attention is needed for the countermeasure for superelevation. Construction period will be 31months.	13 / 15	
			Maintenance	Maintenance cost will be high because repainting is needed. It consumes more time than other types because truss girder has many members and repainting area.	5 / 10	
			Landscape	Truss girder is very popular and fearureless in Myanmar.	4 / 5	Total score
			Cost (Ratio)	1.066	56 / 60	87 / 100
Alternative 3 PC Extradosed bridge		Superstructure Bridge type: PC Extradosed Length: 220.00 1st span: 60.00 2nd span: 100.00 3rd span: 60.00 4th span: 33.00 Substructure Abutment: Reverse T Pier: Wall Foundation P1、P2: SPSP A1、P3、A2: Cast in place Connection Road North: 165.00 South: 202.00	Structural condition	Girder depth H=1.8m corresponds to the 1/55 of depth-span ratio. This girder depth is feasible for Extradosed girder.	10 / 10	Good
			Construction condition	Cantilever overhang erection method from piers is applicable. Duration of erection work takes relatively longer than other alternatives. Construction period will be 35months.	10 / 15	
			Maintenance	Maintenance cost is relatively low because PC bridge is basically maintenance-free except cable.	9 / 10	
			Landscape	Extradosed bridge is impressive for the slender girder , low tower and cables.	5 / 5	Total score
			Cost (Ratio)	1.000	60 / 60	94 / 100

Selection of preferable bridge type

In these three alternatives, construction cost of PC Extradosed bridge is estimated the most economical.
Little difference can be found in structural condition, for all these bridge types have been used successfully.
Duration of construction work will be shorter in steel bridges, but construction plannnig shall carefully be considered because the bridge has large gradient.
From the perspective of bridge maintenance, PC bridge has lower maintenance cost than steel bridges.
Landscape is most impressive in PC Extradosed bridge.

Taking into account these all aspects, "Alternative 3: PC Extradosed bridge" is recommendable for New Thaketa Bridge.

Distribution Criteria

Economy: 60
Structure: 10
Construction: 15
Maintenance: 10
Landscape: 5

Source: JICA Study Team

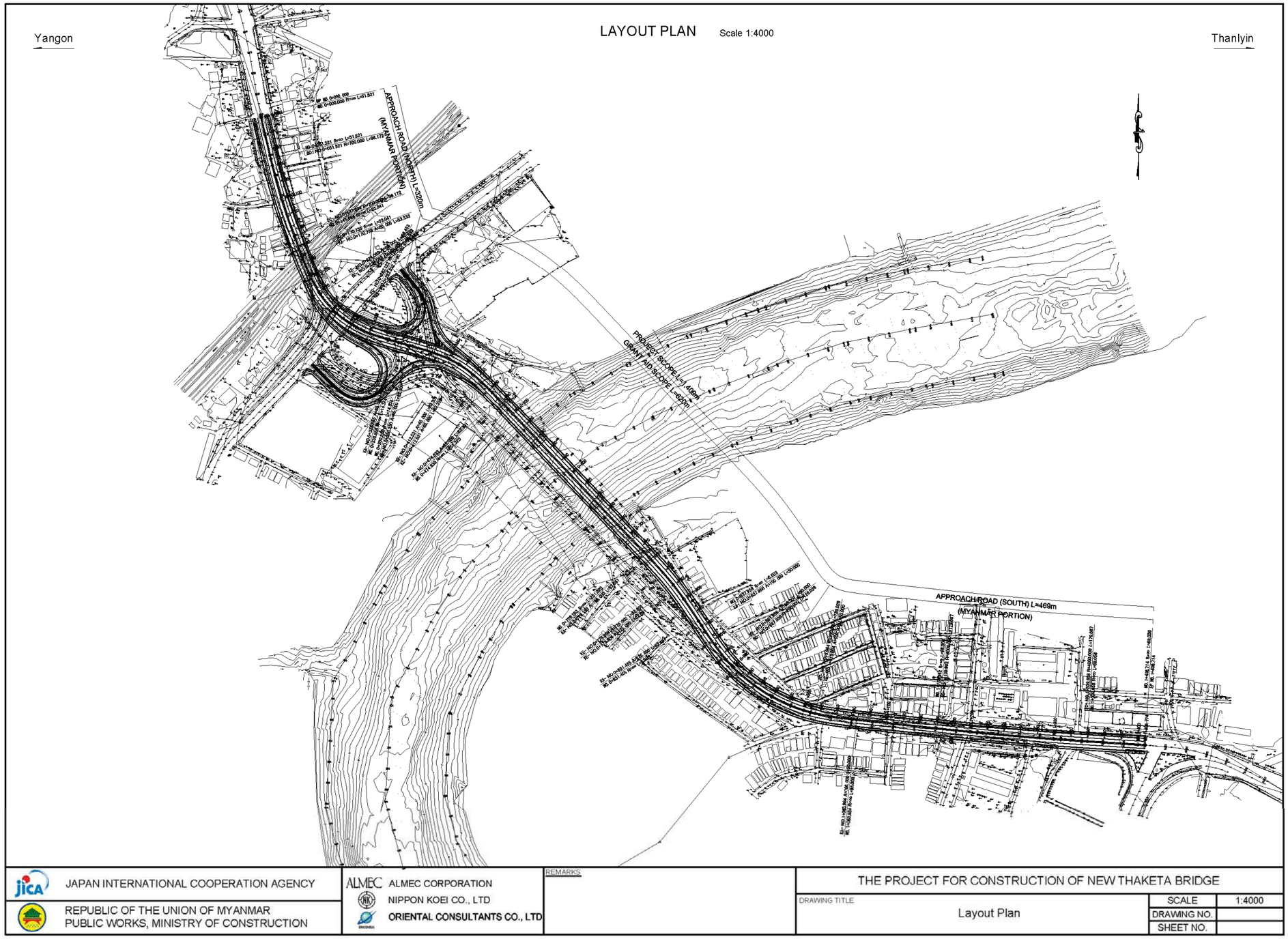
2.4 Outline Design Drawing

The scope of facility of the grant aid project is shown in Table 2.4.1, and the outline design drawings are shown in Figure 2.4.1 to Figure 2.4.6.

Table 2.4.1 Scope of Facility

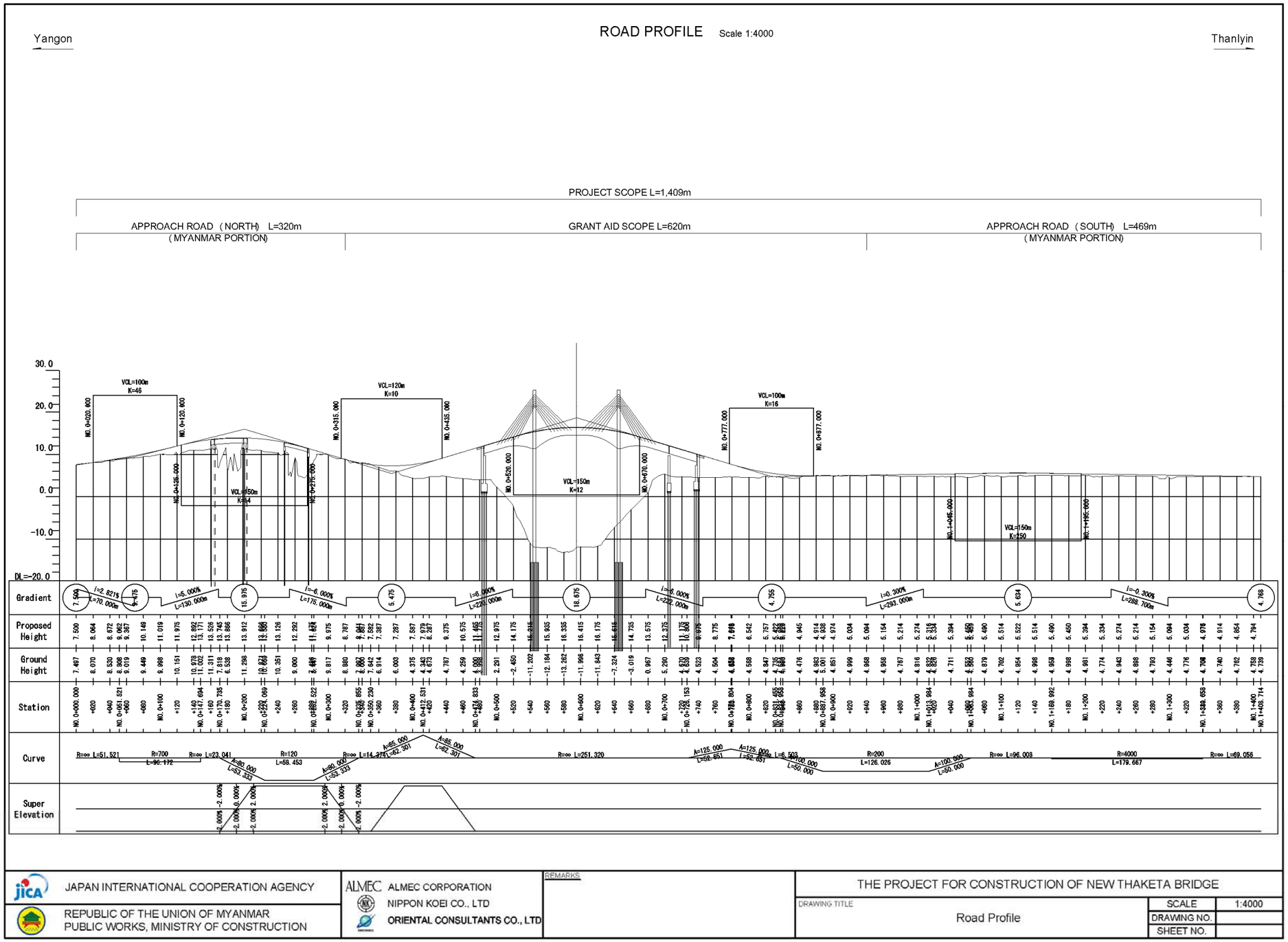
Category	Item	Scope
Bridge Construction	Bridge Length	253.0m
	Bridge Width	21.3m (0.4m + 2.0m + 0.5m + 2-lane x 3.5m + 0.5m + 0.5m + 0.5m + 2-lane x 3.5m + 0.5m + 2.0m +0.4m)
	Bridge Type	PC 3 Span Continuous Extradosed Bridge : 220m PC Box Girder Bridge : 33m
	Foundation Type	P2, P3 : Steel Pipe Sheet Pile (dia 1000mm) A1, P3, A2 : Cast-in-place Concrete Pile (dia 1000mm)
Road Construction	Length	Access Road (North) : 165m
		Off ramp (East) : 104m
		On ramp (West-1): 88m
		Access Road (South) : 202m

Source: JICA Study Team



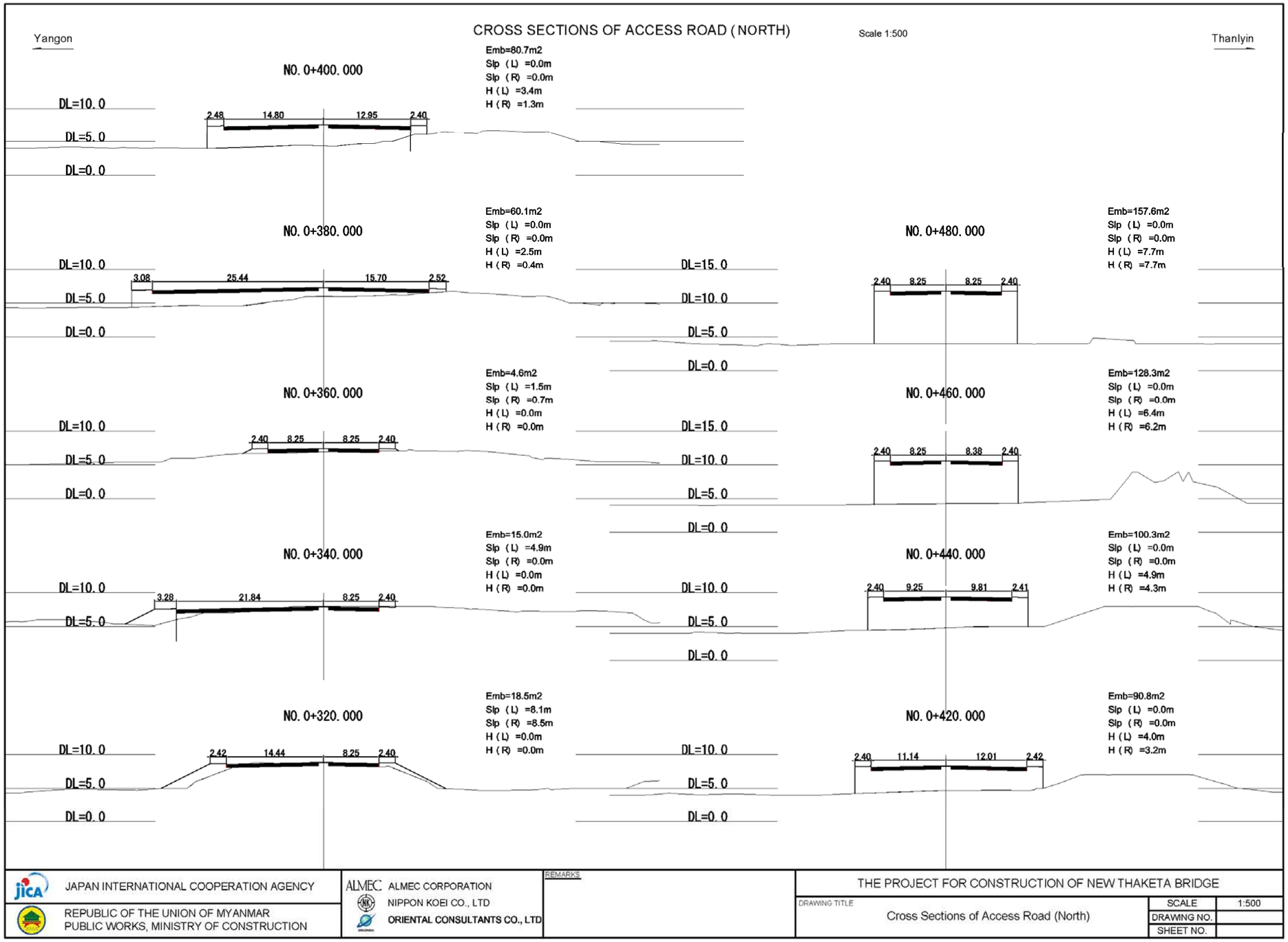
Source: JICA Study Team

Figure 2.4.1 Layout Plan



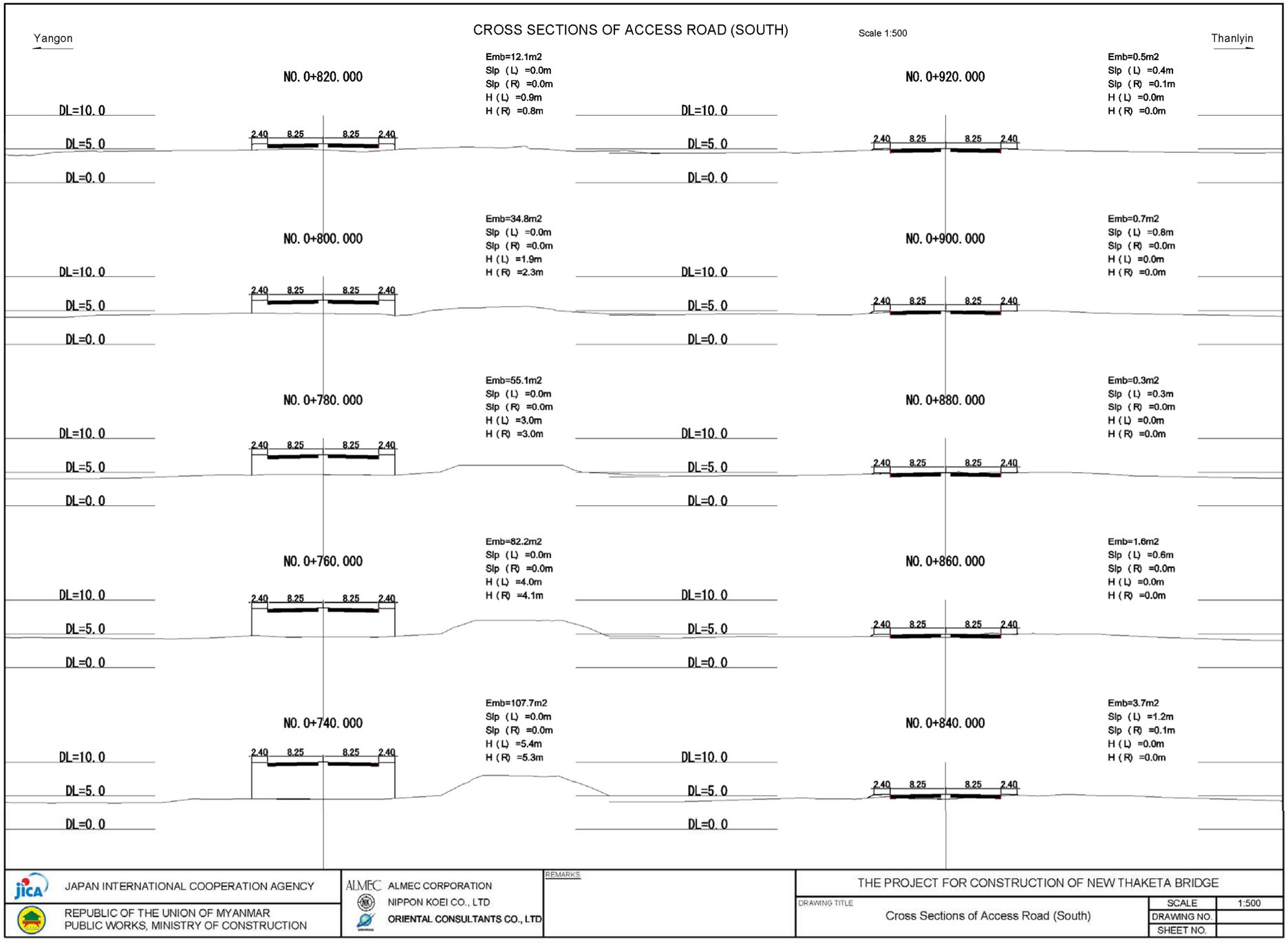
Source: JICA Study Team

Figure 2.4.2 Road Profile



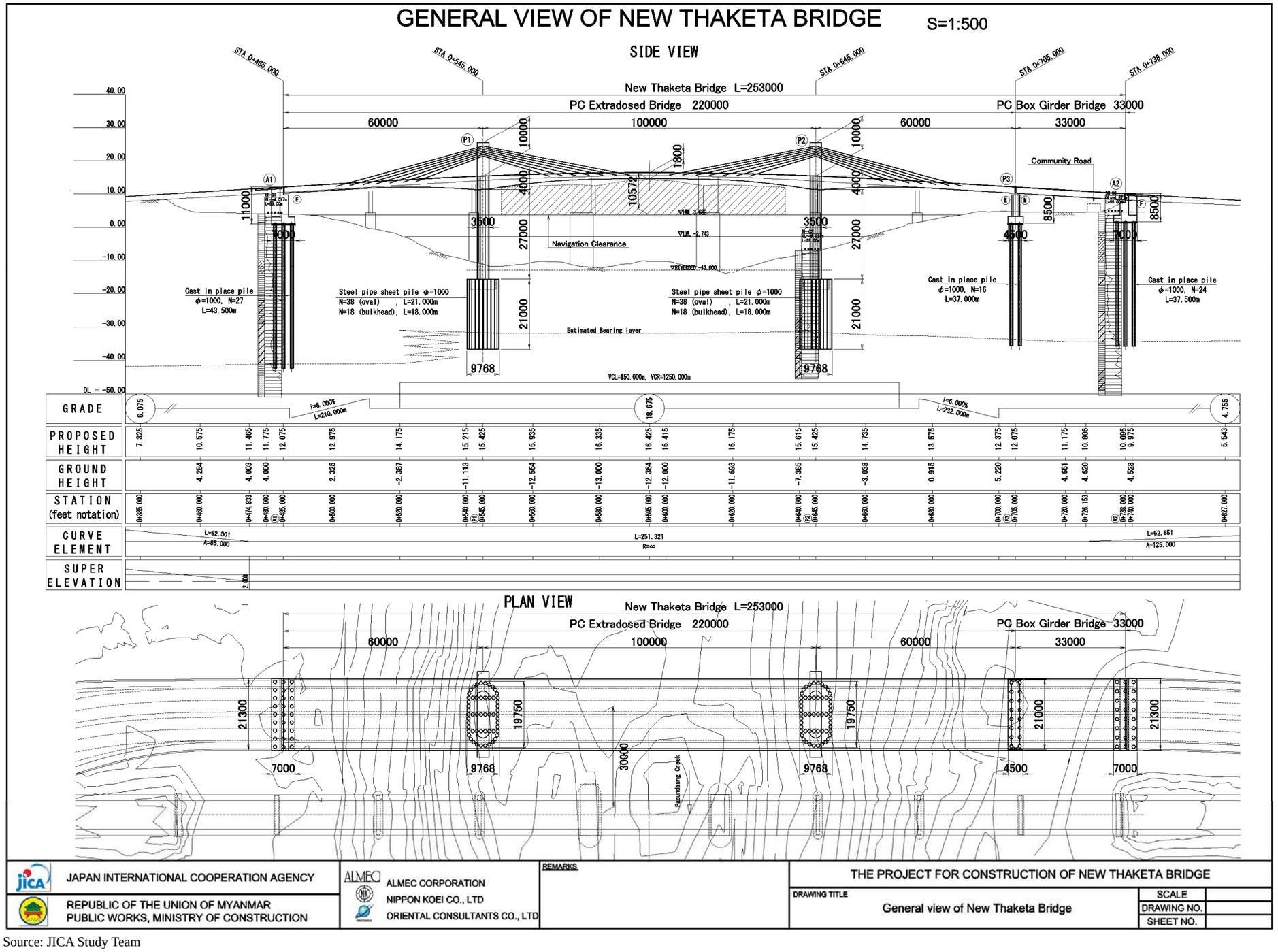
Source: JICA Study Team

Figure 2.4.3 Cross Sections of Access Road (North)



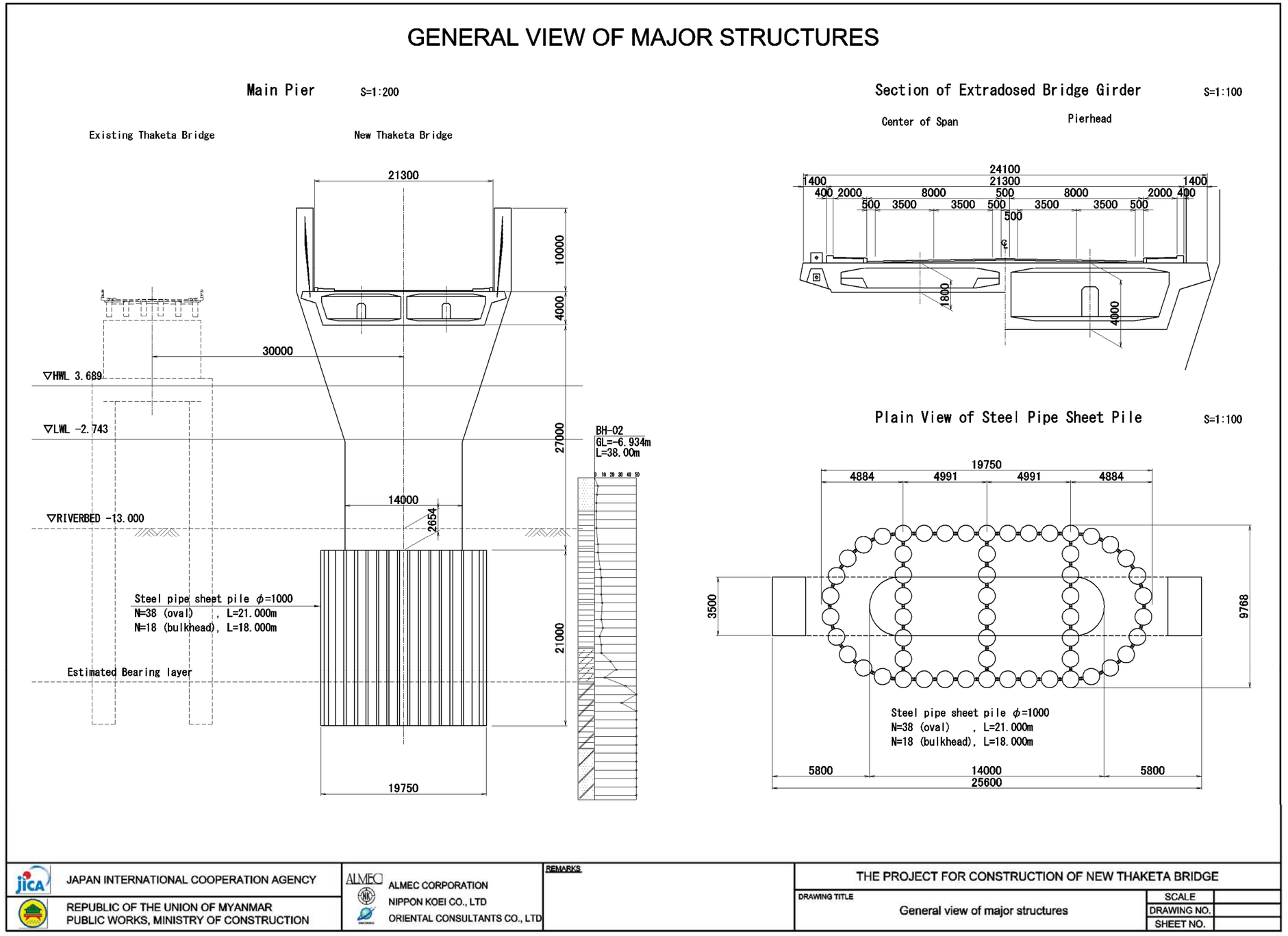
Source: JICA Study Team

Figure 2.4.4 Cross Sections of Access Road (South)



Source: JICA Study Team

Figure 2.4.5 General View of New Thaketa Bridge



Source: JICA Study Team

Figure 2.4.6 General View of Major Structures

2.5 Implementation Plan

2.5.1 Implementation Policy

The center line alignment of the New Thaketa Bridge is located on the upstream side of the existing bridge.

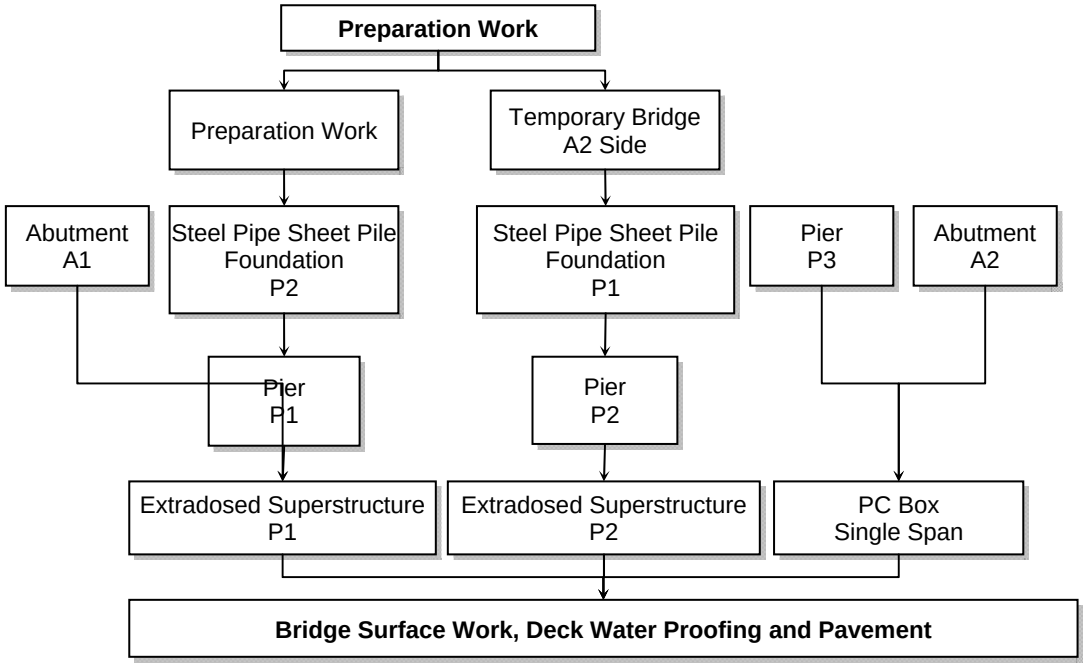
The steel pipe sheet pile foundation, pier, and in-situ PC box girders by balanced cantilever method, are to be constructed in the river. The rainy season is from June to October while the dry season is from November to May. Temporary bridges are planned for the construction of foundation, pier, and PC extradosed girder due to the tide effects of the mean high water level at the construction site.

The construction of PC extradosed girder consists of 11 blocks, seven extra PC cables, and internal PC cables. A hanging type support is applied for closure segments at the center span and side spans.

Open excavation method is applied for the construction of pile and footing structures of abutment A1, Pier 3, and abutment A2, which are located on the land.

The in-situ concreting of PC box girder is supported by all staging pipe supports during construction.

The construction flowchart of Thaketa Bridge is shown in Figure 2.5.1.



Source: JICA Study Team

Figure 2.5.1 Construction Flowchart of Thaketa Bridge

2.5.2 Implementation Condition

(1) Labor Law

The contractor should manage its labor properly with an adequate safety control plan and should prevent conflicts with local labor. In any circumstance, the contractor should abide by the labor laws and regulations enforced in Myanmar.

(2) Safety Management during Construction

For the navigation on the river, two patrol boats are scheduled on the upstream and downstream of the existing bridge for the mobilization and demobilization of temporary bridges as a safety measure. Moreover, the buoys in the river and indicators on the temporary bridge which will have blinker lights are to be installed for navigation safety.

(3) Traffic Safety

For traffic safety during construction of the connection between the access road and the ramp of the existing road, the traffic control plan is to be submitted by the contractor. The consultant will check the plan with the YCDC and PW. In this case, the Myanmar side has to be responsible for announcing and notifying the plan to the public using mass media for broadcasting the safety measures on site, detours, and traffic control plans before implementation of the plan.

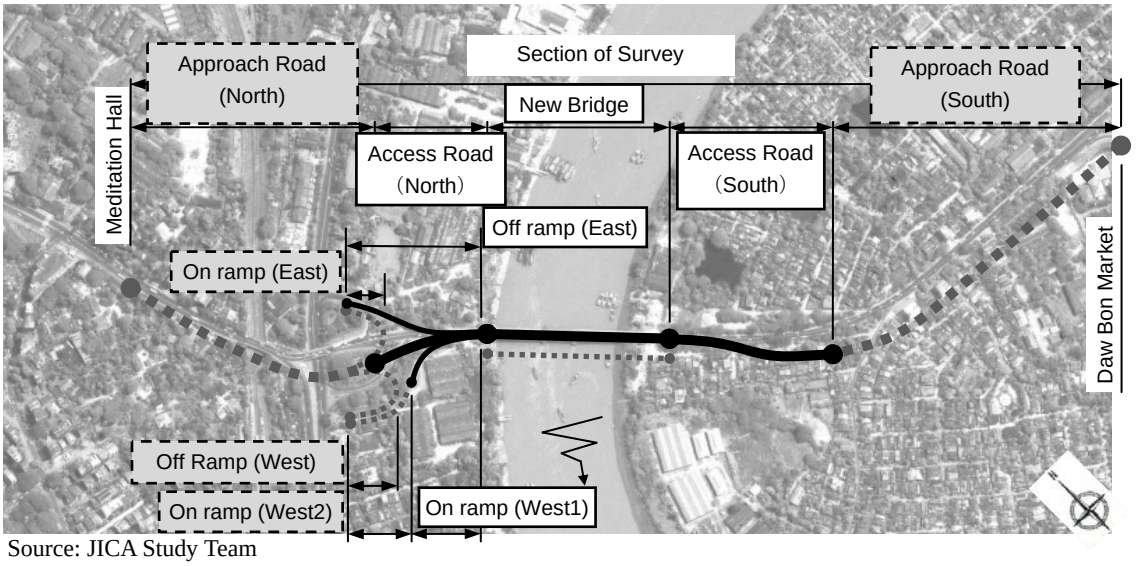
(4) Importance of Concrete Quality Control

The quality of concrete has a huge influence on the lifetime of the concrete structures such as bridges. It is important to produce good quality and durable concrete to reduce cracks. Concrete material selection factors such as aggregates, sand, water and cement, low W/C ratio, contained air, calibration of concrete plant, and regulation of transporting and placing concrete, are given priority in order to produce high quality concrete. In case the mean daily temperature is likely to exceed 25 degrees Celsius during the dry season, the provisions of hot weather concreting should apply.

2.5.3 Scope of Works

The scope of works to be undertaken by the Japanese government is from STA. 0+320.0 to STA. 0+940.0 including the new bridge, two access roads (north and south), off-ramp (east), and on-ramp (west 1). (Refer to Figure 2.4.1 and 2.4.2.)

The scope of works to be undertaken by the Myanmar government is from STA. 0+000.0 to STA. 0+320.0 and from STA. 0+940.0 to STA. 1+408 including two approach roads (north and south), on-ramp (east), on-ramp (west 1), and off-ramp (west).



Source: JICA Study Team

Figure 2.5.2 Scope of Works

2.5.4 Consultant Supervision

(1) Supervision

The engineering services for construction supervision will begin with the acceptance of the construction contract and the issuance of a Notice to Proceed (N/P) to the contractor.

The consultant shall perform his duties in accordance with the criteria and standards applicable to the construction works and shall exercise the powers vested in him as the engineer under the contract to supervise the field works done by the contractor.

The consultant, within his capacity as the engineer, shall directly report to PW, JICA Myanmar, and the Embassy of Japan in Myanmar about the field activities and shall issue field memos or letters to the contractor regarding various matters, including progress, quality, safety, and payment for the works under the project. After one year from the completion of the construction, the final inspection for defects liability will be conducted as the final task of the consultant.

(2) Implementation Organization

Resident engineers basically stay at the construction site to conduct both construction supervision and project management. The necessary specialists for each stage are shown as follows:

- Team Leader: Support tender/contract process, resident engineer on commencement and end of construction period
- Resident Engineer: Coordination and liaison for all the project activities to ensure smooth progress and management of all technical aspects
- Soft Soil Ground Engineer: Technical and quality control of counter measure for soft soil ground works
- Foundation Engineer: Technical and quality control of foundation works
- Superstructure Engineer: Technical and quality control of superstructure works

2.5.5 Quality Control Plan

There is no specific quality control plan for PC box bridge in Myanmar. Consequently, the quality control plan of the project is formulated based on the design concepts as shown in Table 2.5.1.

Table 2.5.1 Quality Control Tests Plan

Item			Test Method	Frequency
Concrete	material	Cement	Quality Guarantee, Chemical and physical Analysis	Every Material
		Water	Chemical Analysis	Every Material
		Admixture	Quality Guarantee and Chemical Analysis	Every Material
		Fine Aggregate	Bulk Specific Gravity Dry	Every Material
			Sieve Gradation and Finesse Modulus	
			Clay and Friable Particles	
		Coarse Aggregate	Bulk Specific Gravity Dry	Every Material
			Flakiness Index	
			Sieve Gradation	
			Sodium Sulfate Soundness	
	Mixing Test		Calibration of Batching Plant	Before Starting Concrete Works
	Pouring		Slump(Concrete)	Daily
			Concrete Temperature Before Pouring	Daily
	Strength		Compressive Strength at 7 and 28 Days	Daily or Every 50m^3
Re-bar/PC strand	Material		Quality Certificate	Each Lot
PC Stressing	Prestressing Equipment		Calibration of Hydraulic Jacks and Pump	Before Starting Prestressing Works
	Control of Prestressing		Graph of Prestressing Control	Each stressing
Grouting	Mixing Test		Calibration of Mixer	Before Grouting Works
	Pouring		Consistency and Temperature	Every Mixing
	Strength		Compressive Strength at 7 and 28 Days	

Source: JICA Study Team

2.5.6 Procurement Plan

The contractor in Myanmar has no experience in the construction of PC box girder bridge except for PW. To ensure the quality and safety of the construction, special workers for bridge (e.g., bridge foreman, bridge special worker, and operator for crane) are to be procured from Japan

Bridge construction materials such as steel, reinforcing bars, PC cables, etc., could not be procured in Myanmar. PC cable and its anchors, including tensioning jacks, rubber bearings, and expansion joints, are to be imported from Japan to ensure good quality and durability. Equipment such as cantilever erection equipment, bored pile machine, pile driving machine, and equipment for steel pipe sheet piles are also not available from contractors in Myanmar. This equipment will likewise be procured from Japan. However, there are concrete plant and asphalt concrete plant in Yangon.

Major construction materials and construction equipment can be procured as shown in Table 2.5.2 and Table 2.5.3.

Table 2.5.2 Country of Procurement for Major Construction Materials

Item	Country			Reason of Procurement
	Myanmar	Japan	Other	
PC Strand		○		Difficulty with quality/workability of item coming from Myanmar and other country
Steel Handrail		○		
Materials for Temporary Work		○		Difficulty with quality/workability of item coming from Myanmar and other country
H-shape Beam, Supporting			○	Available from Singapore
Rubber Bearing		○		Difficulty with quality/workability of item coming from Myanmar and other country
Steel Pipe		○		Difficulty with quality/workability of item coming from Myanmar and other country
Aggregate	○			
Asphalt Concrete	○			
Cement			○	Thailand: Difficulty from Myanmar and other country about quality
Mixed Concrete	○			
Expansion Joint		○		Difficulty with quality/workability of item coming from Myanmar and other country
Soil Improvement Material		○		Difficulty with quality/workability of item coming from Myanmar and other country
Deformed Steel Bar		○		Difficulty with quality/workability of item coming from Myanmar and other country
Road Marking Paint		○		Difficulty with quality/workability of item coming from Myanmar and other country
Diesel	○			
Petrol	○			
Deck Water Proofing		○		Difficulty with quality/workability of item coming from Myanmar and other country

Source: JICA Study Team

Table 2.5.3 Country of Procurement for Major Construction Equipment

Item	Country			Reason of Procurement from Japan
	Myanmar	Japan	Other	
Excavator		○		High price in Myanmar
Crawler Crane		○		High price in Myanmar
Rough Terrain Crane		○		High price in Myanmar
Bored Piling Machine		○		Difficulty in Myanmar
Equipments for Steel Pipe Sheet Pile		○		Difficulty in Myanmar
Equipment for PC		○		Difficulty in Myanmar
Cantilever Equipment		○		Difficulty in Myanmar

Source: JICA Study Team

2.5.7 Soft Component Plan

The YCDC has responsibility over the New Thaketa Bridge after its completion. However, the YCDC has no experience in PC box girder bridges and may be requesting for maintenance work. Due to this reason, a seminar with Japanese bridge specialists is requested during the construction as part of the soft component plan. The purpose of the seminar is for the YCDC to recognize the importance of daily and periodical inspections, to understand targets and methods of inspection, and to evaluate soundness of existing bridge conditions. Detailed plan is shown in appendix.

- Japanese Bridge Specialist (0.5 month) : Guidance for daily and periodical bridge inspection
- Japanese Bridge Specialist (0.5 month) : Guidance for deterioration factor, non-destructive inspection, and inspection manual for extra cable

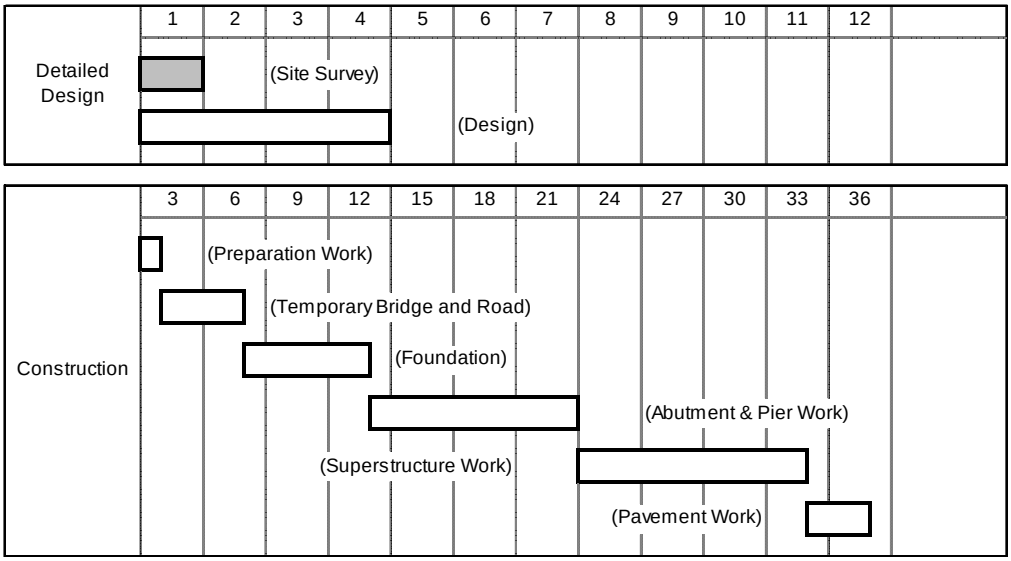
2.5.8 Implementation Schedule

The construction period is estimated at 35 months according to cost estimation based on the Cost Estimation Standards for Civil Work supervised by the Ministry of Land, Infrastructure, Transportation and Tourism, Japan, and JICA design and cost estimation manual. The budgetary year of Japan could be applied to the project implementation in accordance with the Japan Grant Aid Guideline.

Consulting services will be commenced under the Grant Aid project only after the Exchange of Notes (E/N), covering the detailed design, tendering, construction supervision, and civil works, has been signed.

In the beginning of the service, the consultant will carry out site surveys to confirm the preparatory design within two weeks and then the detailed design including preparation of the tender documents will follow in Japan for three months. All designs and documents will be approved by the MOC at the end of the detailed design. The tender activities such as prequalification of contractors, tender evaluation, selection of a contractor, etc., will be carried out under the assistance concept. After selection of a contractor through competitive bidding, the Government of Myanmar will sign the civil works contract with the selected contractor after verification of the contract. The contractor can commence the works upon receipt of the letter for commencement of works issued by the consultant.

Total construction period including mobilization and demobilization is 35 months. Tentative Implementation schedule is shown in Figure 2.5.3.



Source: JICA Study Team

Figure 2.5.3 Tentative Implementation Schedule

2.6 Obligations of Recipient Country

2.6.1 General Obligations

General obligations to be taken by the recipient country are shown in Table 2.6.1

Table 2.6.1 Major Undertakings to be Taken by Recipient Government

No.	Items
1	To secure lots of land necessary for the implementation of the project and to clear these sites
2	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products
3	To ensure that customs duties, internal taxes, and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services be exempted or be borne by the authority without using the grant
4	To accord Japanese personnel and/or personnel of third party countries whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work
5	To ensure that the facilities and/or the products be maintained and used properly and effectively for the implementation of the project
6	To bear all the expenses, other than those covered by the grant, necessary for the implementation of the project
7	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A: advising commission of A/P and payment commission
8	To give due environmental and social consideration in the implementation of the project.

Source: JICA Study Team

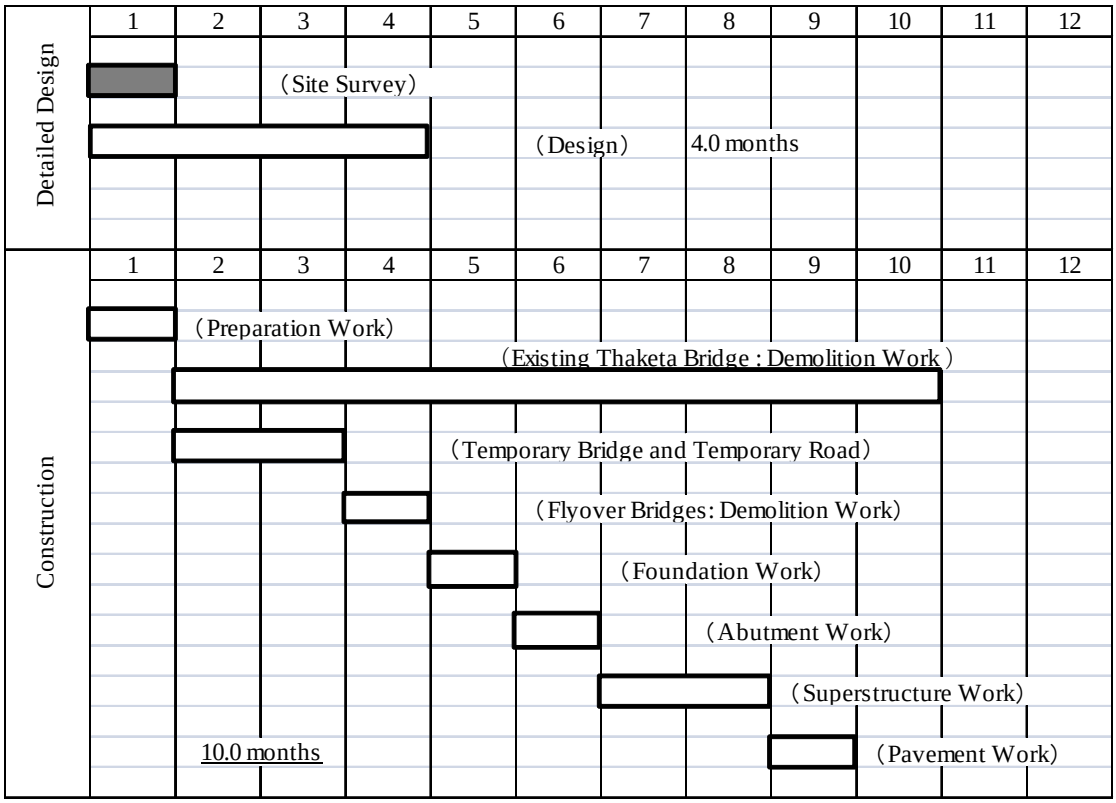
2.6.2 Unique Obligations of this Project

(1) Construction of Approach Roads

The objective of the project is the implementation of a 4-lane road construction of Yamonnar Road connecting central Yangon and Dawbon/Thaketa Township. The scope of the Grant Aid by the Japanese government is the construction of the New Thaketa Bridge and its access road.

Although the impact of the 4-lane implementation of the New Thaketa Bridge is established in this study, to maximize the effect of the project, a 4-lane widening of the approach roads shall be implemented by the Myanmar government promptly or at least upon completion of the Japanese construction work.

The outline design of approach roads and flyover bridges is prepared in this study (see appendix), while detailed design and construction work shall be performed by PW. The tentative implementation schedule for the approach roads project is shown in Figure 2.6.1.



Source: JICA Study Team

Figure 2.6.1 Tentative Implementation Schedule of Approach Roads Project (Reference)

(2) Demolition of the Existing Thaketa Bridge

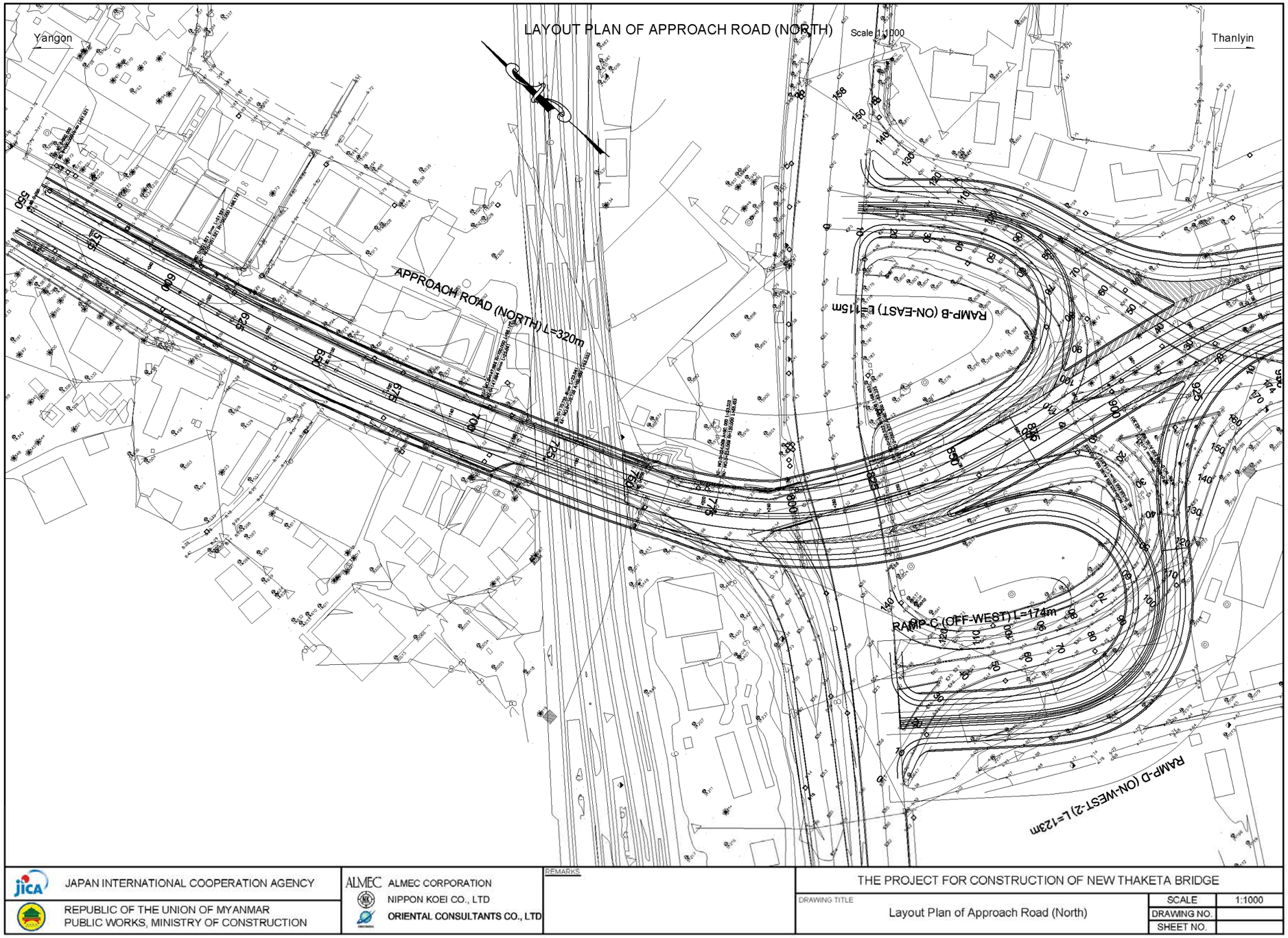
The center span of the New Thaketa Bridge is 100 m to secure the navigation clearance of Pazundaung Creek. It is desirable to demolish the existing Thaketa Bridge for it has a shorter span than the New Thaketa Bridge. The work procedure for the demolition of the existing Thaketa Bridge is prepared in this study and shown in Appendix 7.

(3) Approval of Import and Export Trade by Japanese Construction Company

In Myanmar, import and export trade by construction company is approved only for the Myanmar construction company who registered to the Ministry of Commerce. On the other hand, the construction works of the New Thaketa Bridge project under the Japanese Grant Aid will be implemented mainly by Japanese construction company. The Japanese construction company might not have the approval for import and export trade. It is thus requested to have a special permission and approval for the Japanese construction company to undertake import and export trade.

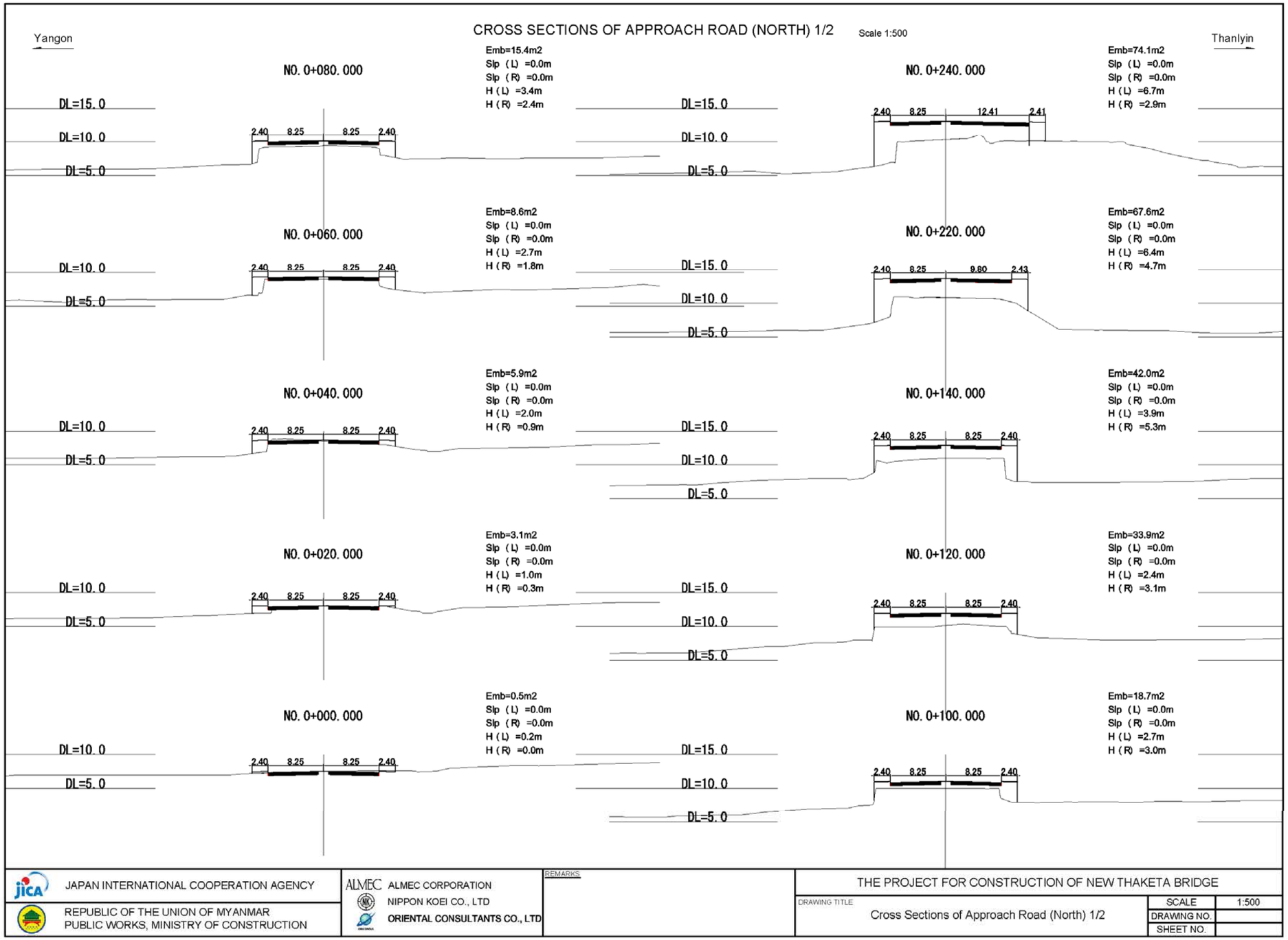
2.6.3 Outline Reference Drawing

The outline reference drawings to be implemented by the recipient country are shown in Figure 2.6.2 to 2.6.9.



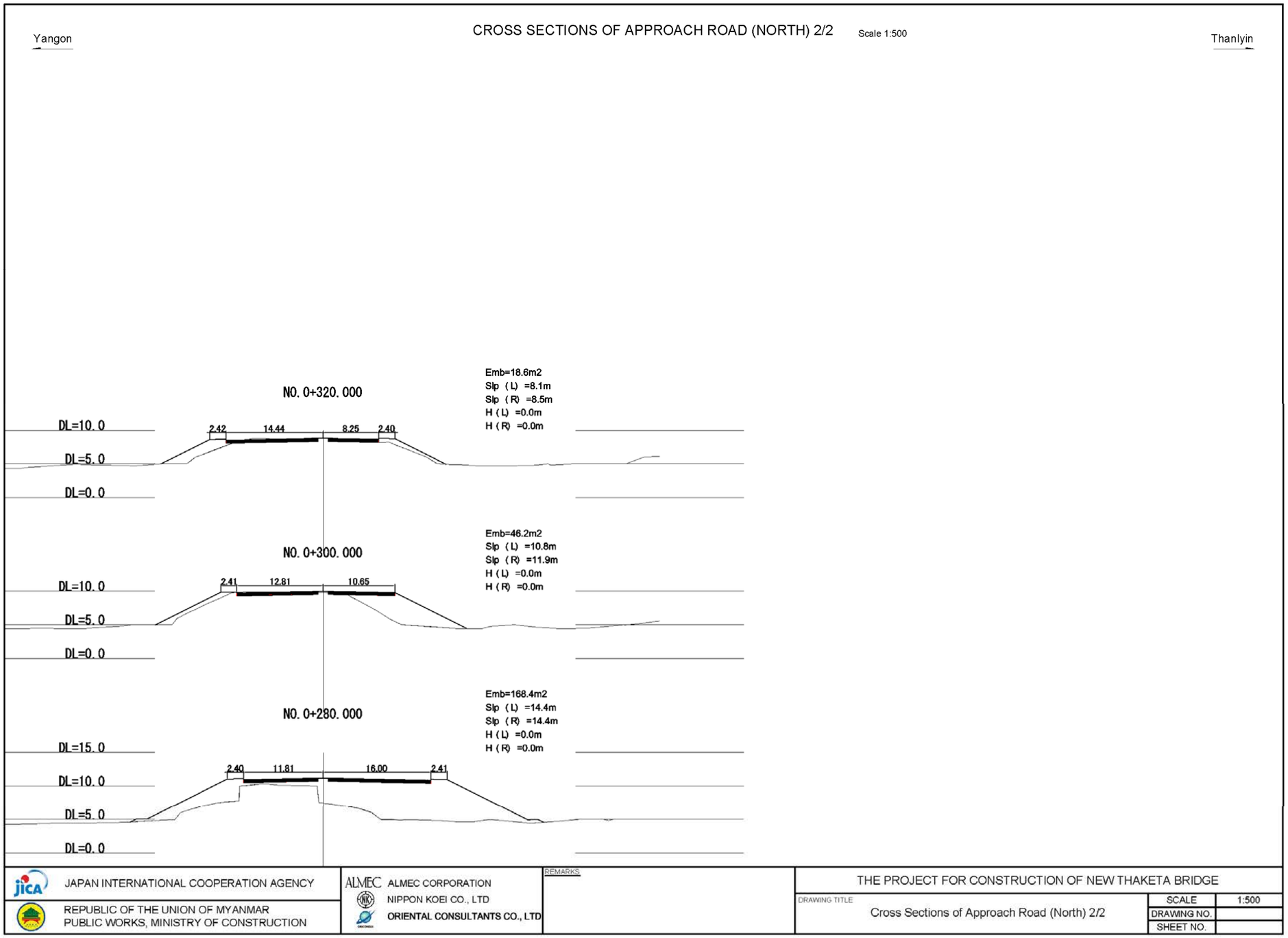
Source: JICA Study Team

Figure 2.6.2 Reference Drawing (1/8): Layout Plan of Approach Road (North)



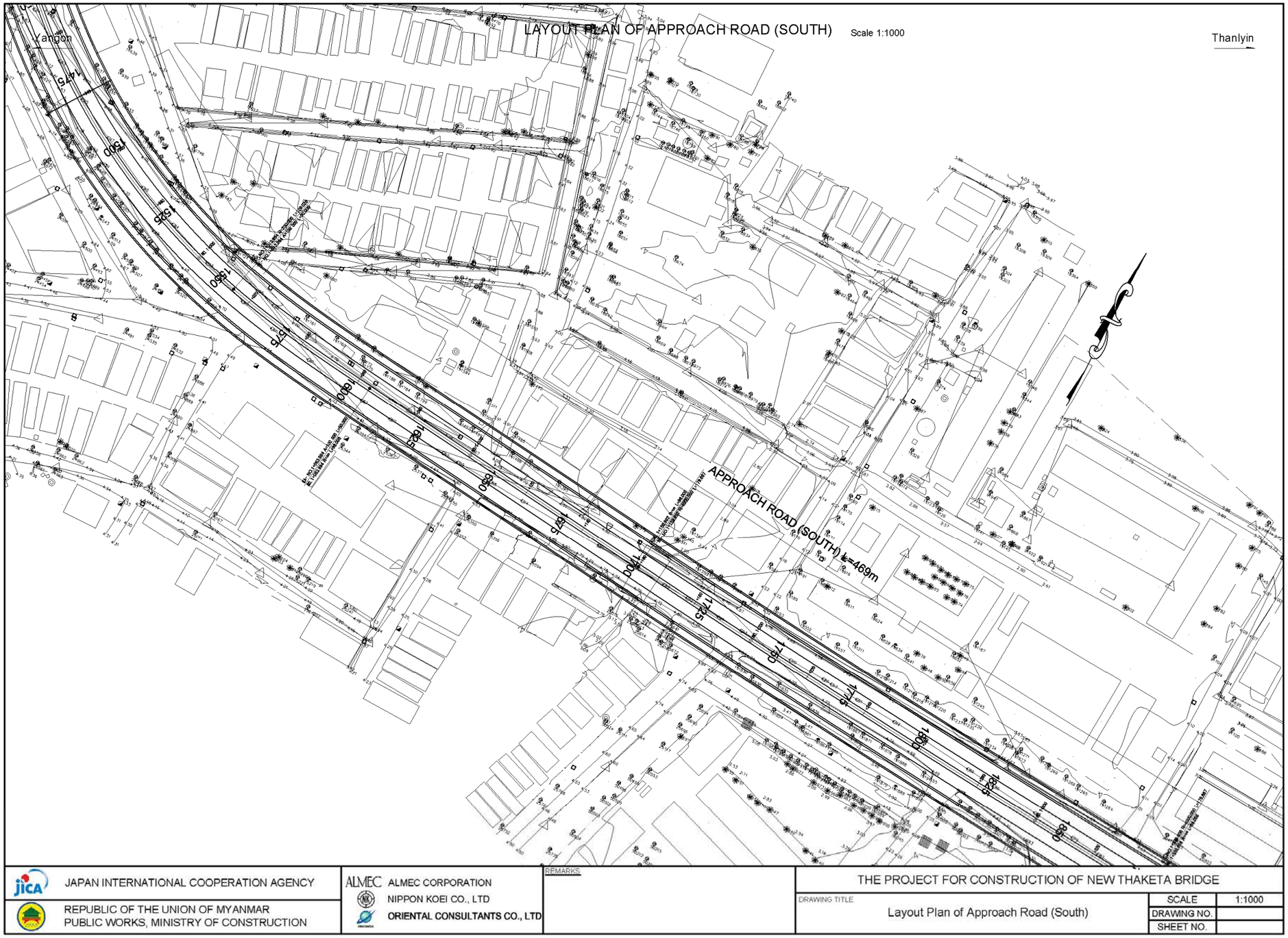
Source: JICA Study Team

Figure 2.6.3 Reference Drawing (2/8): Cross Section of Approach Road (North) (1/2)



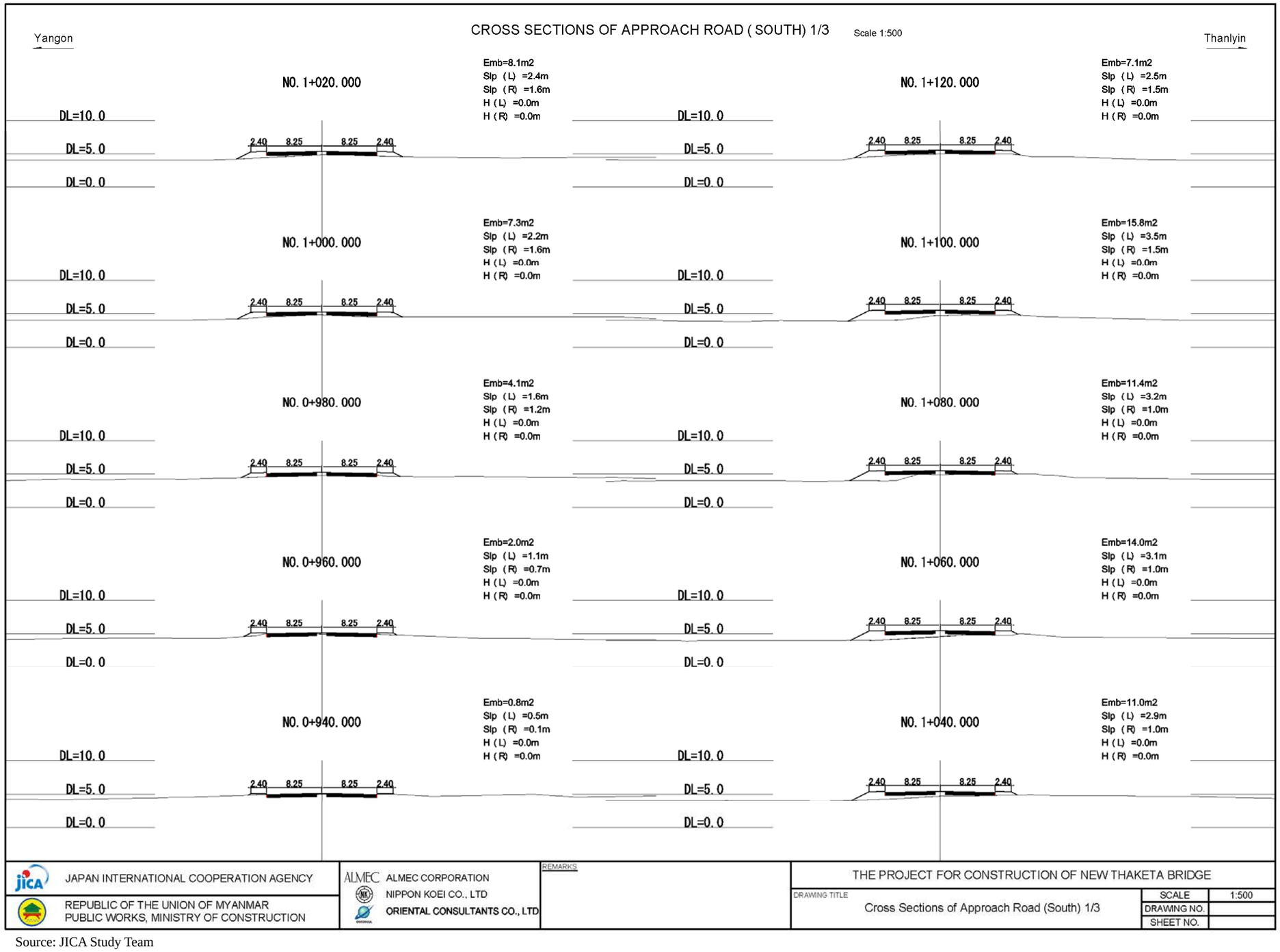
Source: JICA Study Team

Figure 2.6.4 Reference Drawing (3/8): Cross Section of Approach Road (North) (2/2)



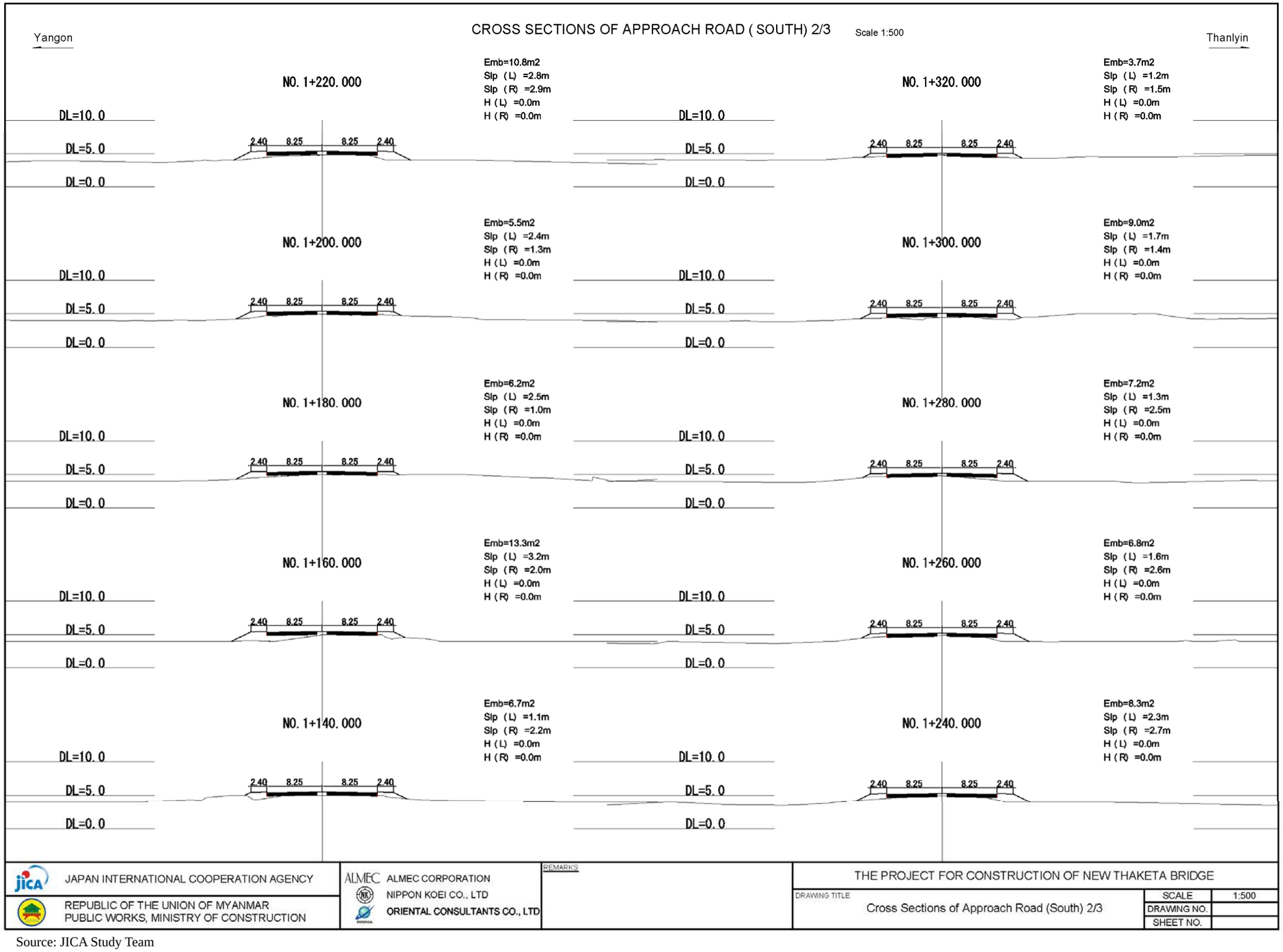
Source: JICA Study Team

Figure 2.6.5 Reference Drawing (4/8): Layout Plan of Approach Road (South)



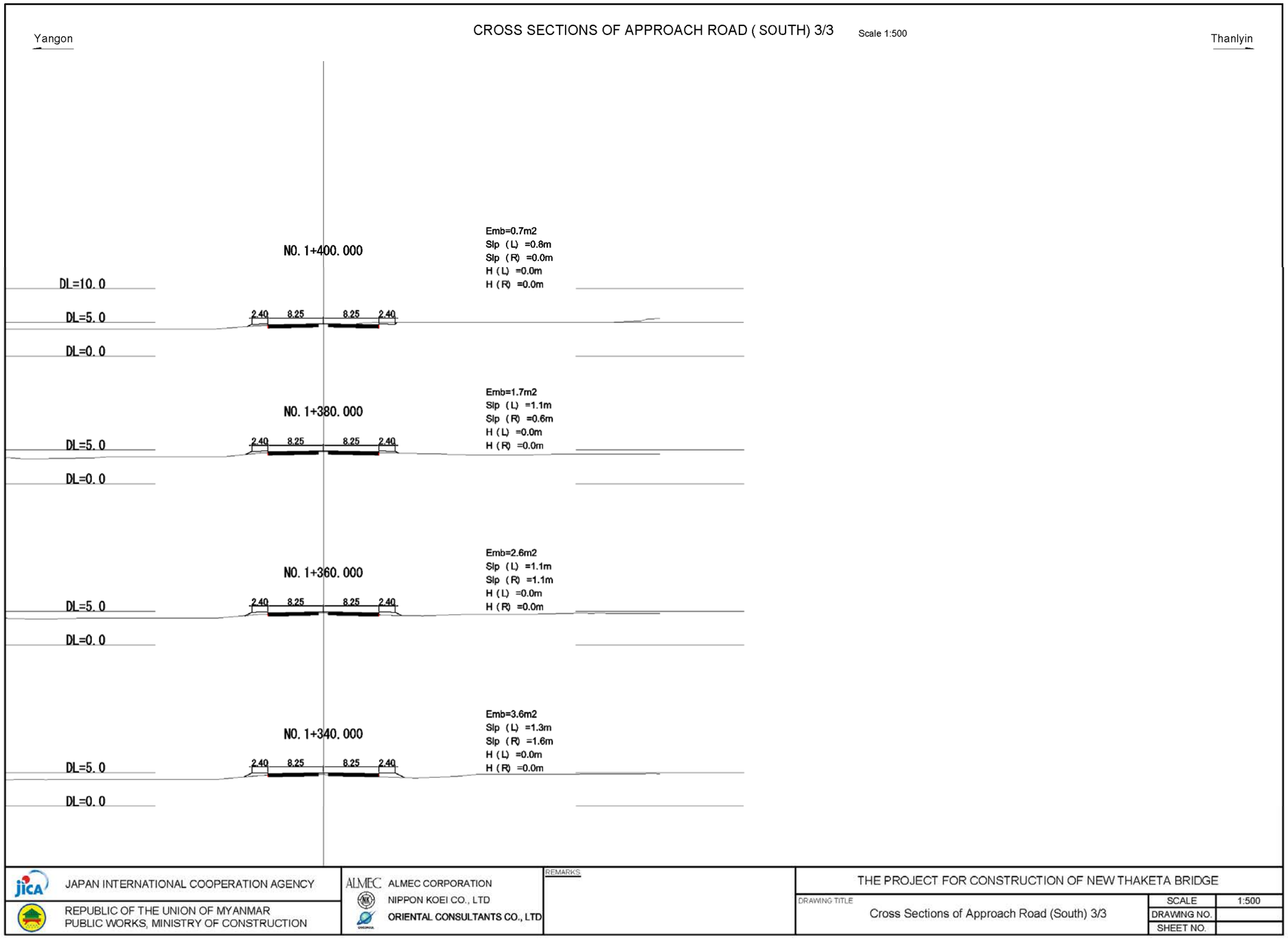
Source: JICA Study Team

Figure 2.6.6 Reference Drawing (5/8): Cross Section of Approach Road (South) (1/3)



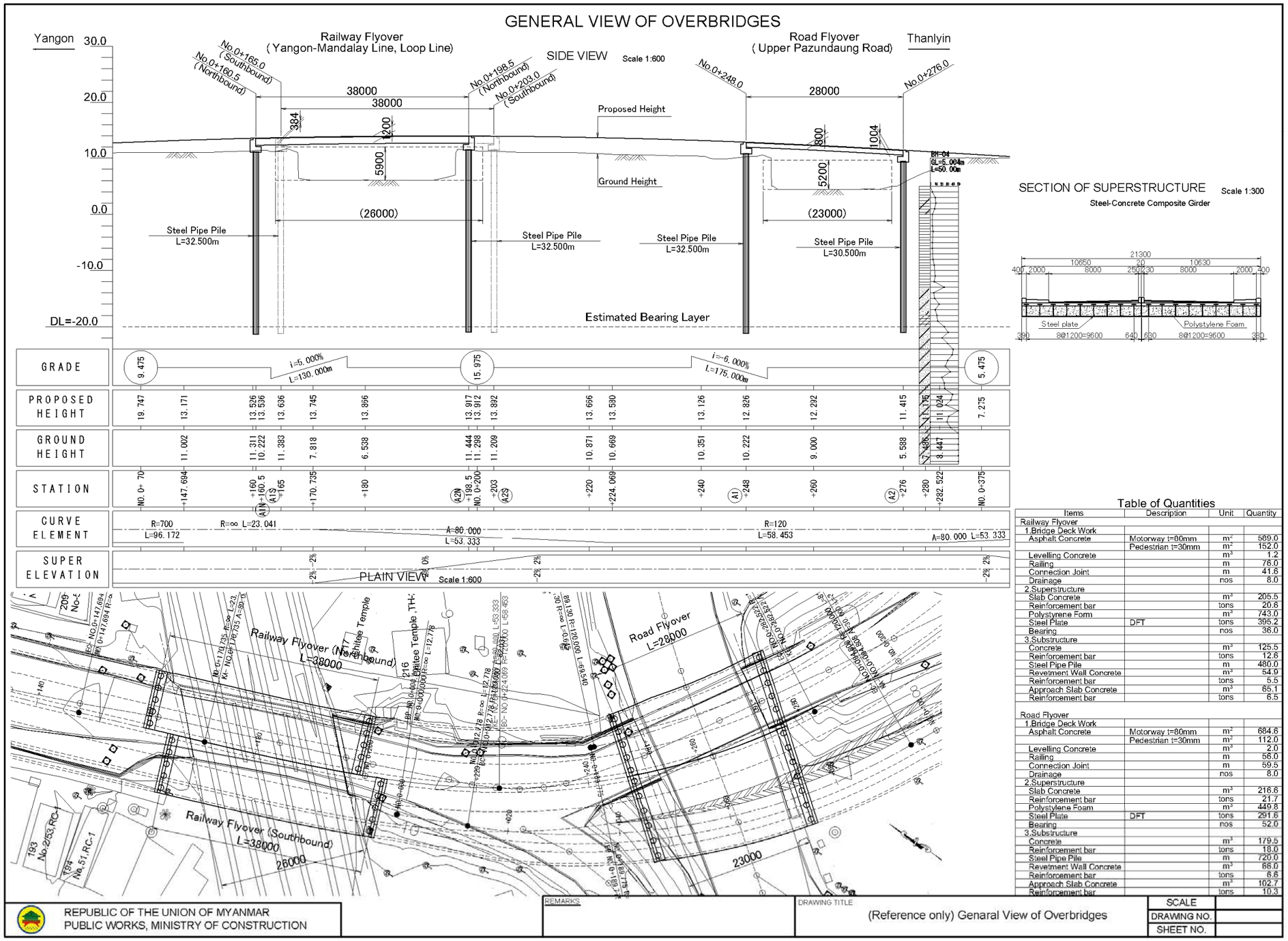
Source: JICA Study Team

Figure 2.6.7 Reference Drawing (6/8): Cross Section of Approach Road (South) (2/3)



Source: JICA Study Team

Figure 2.6.8 Reference Drawing (7/8): Cross Section of Approach Road (South) (3/3)



Items	Description	Unit	Quantity
Railway Flyover			
1.Bridge Deck Work			
Asphalt Concrete	Motorway t=80mm	m²	589.0
	Pedestrian t=30mm	m²	152.0
Levelling Concrete		m³	1.2
Railing		m	76.0
Connection Joint		m	41.6
Drainage		nos	8.0
2.Superstructure			
Slab Concrete		m³	205.5
Reinforcement bar		tons	20.6
Polystyrene Form		m²	743.0
Steel Plate	DFT	tons	395.2
Bearing		nos	36.0
3.Substructure			
Concrete		m³	125.5
Reinforcement bar		tons	12.6
Steel Pipe Pile		m	480.0
Revetment Wall Concrete		m³	54.9
Reinforcement bar		tons	5.5
Approach Slab Concrete		m³	65.1
Reinforcement bar		tons	6.5
Road Flyover			
1.Bridge Deck Work			
Asphalt Concrete	Motorway t=80mm	m²	684.6
	Pedestrian t=30mm	m²	112.0
Levelling Concrete		m³	2.0
Railing		m	56.0
Connection Joint		m	59.5
Drainage		nos	8.0
2.Superstructure			
Slab Concrete		m³	216.6
Reinforcement bar		tons	21.7
Polystylene Foam		m²	449.8
Steel Plate	DFT	tons	291.6
Bearing		nos	52.0
3.Substructure			
Concrete		m³	179.5
Reinforcement bar		tons	18.0
Steel Pipe Pile		m	720.0
Revetment Wall Concrete		m³	88.0
Reinforcement bar		tons	8.8
Approach Slab Concrete		m³	102.7
Reinforcement bar		tons	10.3

Source: JICA Study Team

Figure 2.6.9 Reference Drawing (8/8): General View of Flyover

2.7 Project Operation Plan

The scope of works to be maintained by Myanmar is from STA. 0+320.0 to STA. 0+940.0 including the new bridge, two access roads (north and south), off-ramp (east), and on-ramp (west 1).

The scope of maintenance work consists of yearly and periodical maintenance works as follows:

Yearly inspection and maintenance

- Removal of debris and cleaning of drain pits and ditches and around bearing shoes
- Maintenance of traffic safety such as repainting of lane marks and guardrails, and replacing of the light bulbs of the illumination poles
- Cutting grass on the slope of embankments and shoulders of roads.

Periodical inspection and maintenance

- Overlay of surface layer on bridges, causeway and approach roads every five years
- Repair of bearing shoes and expansion joints every ten years

2.8 Project Cost Estimation

2.8.1 Initial Cost Estimation

(1) Project Costs Required for the Undertakings of the Government of Myanmar

The project costs required for the undertakings of the Myanmar are shown in Table 2.8.1.

Table 2.8.1 Project Costs Required for the Undertakings of Myanmar Government

Items	Amount (USD)	Equivalent in JPY (JPY 1,000)
(1) Countermeasure for Residence	1,000	100
(2) Countermeasure/Compensation	41,000	4,097
(3) Environmental Monitoring	75,000	7,495
(4) Relocation of Public Facilities	30,000	2,998
(5) Bank Fee, Remittance Commission	40,000	3,997
(6) Custom Clearance Fee and Storehouse Fee	8,000	799
(7) Electricity	7,000	700
(8) Navigation Marking and Lighting	10,000	999
Total	212,000	21,185

Source: JICA Study Team

(2) Project Costs Required for the Undertakings of the Government of Myanmar (Reference)

The project costs required for the undertakings of the Myanmar are shown in Table 2.8.2.

Table 2.8.2 Project Costs Required for the Undertakings of Myanmar Government (Reference Only)

Items	Amount (USD)	Equivalent in JPY (JPY 1,000)
(1) Re-Construction of Approach Roads (North/South)	5,020,000	501,649
(2) Demolition of Existing Thaketa Bridge	982,000	98,131
Total	6,002,000	599,779

Source: JICA Study Team

2.8.2 Operation and Maintenance Cost

Operation and maintenance cost for ten years after completion is estimated and shown in Table 2.8.3.

Table 2.8.3 Maintenance Cost for Major Items

Items	Frequency	Details	Work Item	Cost	Currency Conversion	Remarks
				USD	(JPY 1,000)	
Surface Drainage	Two Times per Year	Surface/ Bearing	Remove Debris/ Cleaning	500	50	
		Side Ditch	Remove Debris/ Cleaning	1,000	100	
Guard Rail	Once per Year		Repair/ Replace	500	50	
Shoulder/ Slope	Two Times per Year		Cutting Glass	500	50	
Maintenance Cost per Year				2,500	250	
Pavement	Once per Five Years		Repair	6,500	650	10% of design quantity
Handrail	Once per Ten Years		Re-painting	1,000	100	
Expansion Joint	Once per Ten Years		Replace	50,000	5,000	
Average per Year for Maintenance				8,900	890	

USD1 = JPY 100, only for Direct Cost not including Indirect Cost

Source: JICA Study Team

Chapter 3 Project Evaluation

3.1 Preconditions

Detailed design and bidding assistance will commence from July 2014. The commencement of construction will be in April 2015 based on the results of the detailed design and bidding. The obligations of the recipient country described in Chapter 2 shall be implemented without delay before the commencement of each stage.

The implementation of the obligations without delay is a precondition for the construction of the New Thaketa Bridge.

3.1.1 Commencement of Detailed Design in July 2014

- To ensure that customs duties, internal taxes, and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and services be exempted, or be borne by the authority without using the grant;
- To accord Japanese personnel and/or personnel of third party countries whose services may be required in connection with the supply of the products and services such as facilities that may be necessary for their entry into the recipient country and stay therein for the performance of their work;
- To bear all the expenses, other than those covered by the grant, necessary for the implementation of the project; and
- To bear the commissions paid to the Japanese bank for banking services based on the Banking Agreement (B/A), namely, advising commission of Authorization to Pay (A/P) and payment commission.

3.1.2 Commencement of Bidding in November 2014

- To secure lots of land necessary for the implementation of the project and to clear these sites.

3.1.3 Commencement of Construction in April 2015

- To provide facilities for distribution of electricity, water supply, drainage, and other incidental facilities necessary for the implementation of the project outside the sites;
- To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products; and
- To give due to environmental and social considerations in the implementation of the project.

3.1.4 After Completion in February 2018

- To maintain the New Thaketa Bridge with other facilities after construction of the project for proper and effective use.

3.2 Necessary Inputs by Recipient Country

3.2.1 Improvement of Approach Roads including Bridges Across Railway and Road

The approach roads shall be improved to four lanes in the whole preparatory survey area to achieve the objective of the project. The detailed design and construction of four-lane approach roads including two bridges shall be implemented by the Public Works (PW).

3.2.2 Removal of the Existing Thaketa Bridge after completion of the New Thaketa Bridge

The center span length of the New Thaketa Bridge is designed at 100 m for appropriate navigation. The center span length of the existing Thaketa Bridge located at a distance of 30 m from the new bridge is 39 m only. The existing bridge shall be removed to secure the appropriate navigation same as for the New Thaketa Bridge.

3.3 Important Assumptions

3.3.1 Appropriate Maintenance Works by Yangon City Development Committee (YCDC) and the Ministry of Construction (MOC)

PW is not only the agency for the maintenance of the new bridge. YCDC will also have responsibility for the proper implementation of the maintenance work in the future.

Special skill and knowledge will be required for the maintenance of the New Thaketa Bridge in the future. The soft component for PW and YCDC is planned to acquire the required maintenance technique.

The details of the soft component plan are described in the appendices of this report.

YCDC and MOC are required to secure staff/team for the New Thaketa Bridge's maintenance after its completion.

YCDC and MOC are required to establish the organization for the proper maintenance of the New Thaketa Bridge to implement the inspection, record the inspection results, and undertake repairs /appropriate actions based on the inspection results.

3.4 Project Evaluation

3.4.1 Relevance

The construction of the New Thaketa Bridge is second in the priority list for construction of bridge prepared by PW, MOC. The construction of the New Thaketa Bridge is selected in the Project for Comprehensive Urban Transport Plan of the Greater Yangon (YUTRA) as one of the highest priority projects. The new bridge will be one of the connection routes between the city center and Thilawa SEZ area in the future. In this survey, the project cost was estimated properly based on the outline design, price quotations/procurement conditions for construction, and implementation schedule including construction plan.

Therefore it is confirmed that the relevance of the implementation of this project under grant aid is quite reasonable.

3.4.2 Effectiveness

3-4-2-1 Quantitative Effectiveness

The quantitative effects of the project are selected according to the demand forecasting model studied in YUTRA and shown in Table 3.4.1.

Table 3.4.1 Quantitative Effects of the Project

Indicator	Baseline Year (2013)	Target Year (2021) 【3 years after completion】
Traffic Volume	1.000	1.597
	28,635 vehicles/day	45,723 vehicles/day
Average Travelling Speed	21.7 km/h	27.2 km/h
Congestion Rate	1.04	0.76
Weight Limit	10 t	Non-limit (25 t)

Source: JICA Study Team

(1) Qualitative Effectiveness

1) Improvement of Logistics Efficiency, and Lives of Local Residents

The existing Yamonnar Road including the existing Thaketa Bridge consists of two lanes and connects the city center with the Thaketa area and the Thilawa area as a trunk road. Heavy traffic jam occurs on this section regularly. The improvement of this section from two to four lanes will increase traffic capacity and travel speed, and reduce logistics and travel time. Therefore, the improvement of logistics efficiency and the lives of local residents can be expected.

2) Securing Safety and Relief Road

A part of the section of road has not enough width and radius according to appropriate design criteria. The improvement of safety can be expected from the implementation of the project using Japanese Road Standards.

3) Introduction of New Technology (Extradosed Bridge and Steel Pile Sheet Pile Foundation)

The new bridge has a 100 m long center span, and steel pile sheet pile foundation, which can be applied for construction in deep rivers. Technical transfer for the design and construction of the new type of structure in Myanmar can be expected. The new technology can give alternatives for the selection of bridge type.

4) Introduction of Bridge Maintenance Technology

The improvement of capacity for bridge maintenance and technology can be expected through the project. The reduction of the life cycle cost of the bridge with appropriate maintenance can be recognized, and the long life of the new bridge can also be expected.

Appendix

Appendix 1 Member List of the Study Team

- First Survey

Name	Position	Organization
Mr. Tomoyuki Yasuda	Leader	Japan International Cooperation Agency Director, Peace Building and Urban and Regional Development Group, Economic Infrastructure Department
Dr. Phan Le Binh	Project Coordinator	Japan International Cooperation Agency Advisor, Peace Building and Urban and Regional Development Group, Economic Infrastructure Department
Mr. Tomokuni Hayakawa	Construction Planning / Cost Estimation / Procurement 2	Nippon Koei Co., Ltd.

- Second Survey

Name	Position	Organization
Ms. Katsura Miyazaki	Leader	Japan International Cooperation Agency Deputy Director General, Peace Building and Urban and Regional Development Group, Economic Infrastructure Department
Dr. Phan Le Binh	Project Coordinator	Japan International Cooperation Agency Advisor, Peace Building and Urban and Regional Development Group, Economic Infrastructure Department
Mr. Takeshi Yoshida	Road and Bridge Design	Nippon Koei Co., Ltd.
Mr. Hiroaki Ueyama	Construction Planning / Cost Estimation / Procurement 3	Nippon Koei Co., Ltd.

- Draft Report Explanation

Name	Position	Organization
Mr. Tomoyuki Yasuda	Leader	Japan International Cooperation Agency Director, Peace Building and Urban and Regional Development Group, Economic Infrastructure Department
Dr. Phan Le Binh	Project Coordinator	Japan International Cooperation Agency Advisor, Peace Building and Urban and Regional Development Group, Economic Infrastructure Department
Mr. Takeshi Yoshida	Road and Bridge Design	Nippon Koei Co., Ltd.
Mr. Tomokuni Hayakawa	Construction Planning / Cost Estimation / Procurement 2	Nippon Koei Co., Ltd.
Mr. Hiroaki Ueyama	Construction Planning / Cost Estimation / Procurement 3	Nippon Koei Co., Ltd.

- Environmental and Social Consideration Survey

Name	Position	Organization
Mr. Shinjiro Okuzawa	Environmental and Social Consideration	Almec Corporation

Appendix 2 Study Schedule

➢ First Survey

Date Day		Leader Mr. T. Yasuda	Coordinator Dr. P. L. Binh	Consultant Mr. T. Hayakawa
7-Oct-13	Mon	Move from Tokyo to Yangon		
8-Oct-13	Tue	Discussion with EOJ & JICA		
		Site survey (Thaketa Bridge, Thanlyin Bridge, Thilawa SEZ)		
9-Oct-13	Wed	Move from Yangon to NayPhiTaw		
		Discussion of the scope of the work with PW		
		Move from NayPhiTaw to Yangon		
10-Oct-13	Thu	Discussion with Yangon Regional Government & PW for M/D		
		Reporting		
11-Oct-13	Fri	Reporting for EOJ & JICA		
		Move from Yangon To Tokyo		
12-Oct-13	Sat			

➢ Second Survey

Date Day		Leader Ms. K. Miyazaki	Coordinator Dr. P. L. Binh	Consultant Mr. T. Yoshida	Consultant Mr. H. Ueyama
4-Mar-14	Tue	Move from Tokyo to Yangon			
5-Mar-14	Wed	Discussion with EOJ & JICA		Site Survey	
6-Mar-14	Thu	Move from Yangon to NayPhiTaw			
		Discussion of the scope of the work with PW for M/M			
7-Mar-14	Fri	Move from NayPhiTaw to Yangon			
		Move from Yangon To Tokyo			
8-Mar-14	Sat				

➢ Draft Report Explanation

Date Day		Leader Mr. T. Yasuda	Coordinator Dr. P. L. Binh	Consultant Mr. T. Hayakawa	Consultant Mr. T. Yoshida	Consultant Mr. H. Ueyama
6-Apr-14	Sun			Move from Tokyo to Yangon		
7-Apr-14	Mon		Move from Tokyo to Yangon	Move from Yangon To NayPhiTaw		
8-Apr-14	Tue	Move from Tokyo to Yangon		Discussion with PW on DF/R		
		Internal meeting				
9-Apr-14	Wed	Move from Yangon To NayPhiTaw		Discussion with PW on DF/R		
		Discussion with PW for M/D				
		Signing on M/D				
		Move from NayPhiTaw to Yangon			Technical discussion with PW	
10-Apr-14	Thu	Discussion with Yangon Regional Government & YCDC			Move from Yangon To NayPhiTaw	
		Reporting for EOJ & JICA	Move from Yangon To Hanoi	Move from Yangon To Tokyo		
		Move from Yangon To Tokyo				
11-Apr-14	Fri					

Appendix 3 List of Parties Concerned in the Recipient Country

1.	Ministry of Construction (MOC)	
	Mr. Kyaw Lwin	H. E Minister
	Dr. Win Myint	Deputy H.E Minister
2.	Public Works (PW)	
	Mr. Kyaw Linn	Managing Director
	Mr. Win Pe	Deputy Managing Director
	Mr. Win Tint	Deputy Managing Director
	Mr. Han Soe	Deputy Managing Director
	Mr. Kywe Wa	General Manager (Finance)
	Mr. Khin Maung Swe	Chief Engineer (Bridge)
	Mr. Shwe Lay	Chief Engineer (Bridge)
	Mr. Khin Maung Kyaw	Chief Engineer (Road)
	Mr. Aung Myat Oo	Chief Engineer (Bridge)
	Mr. Myint Thein	Deputy Chief Engineer (Electrical Department)
	Mr. Kyi Hlaing Win	Superintendent Engineer (Electrical Department)
	Ms. Khin Than Win	Superintendent Engineer
	Ms. Saw Saw Sein	Superintendent Engineer (Bridge)
	Ms. Hla Hla Thwe	Superintendent Engineer (Road)
	Mr. Soe Min	Superintendent Engineer (Special Project Unit - 5)
	Mr. Zaw Win Myint	Superintendent Engineer (Bridge)
	Mr. Kyi Hlaing Win	Superintendent Engineer (Electrical Department)
	Ms. Thein Nu	Deputy Superintendent Engineer
	Ms. Than Yi	Deputy Superintendent Engineer (Bridge)
	Mr. Saw Alferd	Executive Engineer (Electricity Workshop)
	Mr. Htay Aung	Executive Engineer (Special Project Unit - 5)
	Ms. May Thant Zin	Executive Engineer Eastern Part (Yangon Region)
	Mr. Kyaw Kaung Cho	Executive Engineer (Bridge)
	Mr. Nyi Nyi Zaw	Executive Engineer (Bridge)
	Ms. Ei Ei Myo	Executive Engineer (Road)
	Mr. Thet Zaw Win	Executive Engineer (Road)
3	Myanma Port Authority (MPA)	
	Mr. Ni Aung	Master Attendant
4	Myanmar Railways (MR)	
	Mr. Tin Win	Deputy General Manager (Civil)
5	Ministry of Environment Conservation and Forestry (MOECAF)	
	Dr. San Oo	Director
6	Ministry of Electrical Power	
	Mr. Khin Maung Thwin	Deputy Director
7	Yangon City Development Committee (YCDC)	
	Mr. Nyan Thar	Assistant Head of Department
8	Embassy of Japan	
	Mr. Hideaki Matsuo	Counsellor
	Mr. Go Nakaya	Second Secretary (Former)
	Mr. Toshihiro Watanabe	Second Secretary
9	JICA Myanmar Office	
	Mr. Masahiko Tanaka	Chief Representative
	Mr. Akihito Sanjo	Senior Representative
	Mr. Maki Morikawa	Project Formulation Advisor
	Mr. Khin Maung	JICA Advisor
	Mr. Win Ko Ko	Program Assistant

Appendix 4 Minutes

4-1 Minutes of Discussion (M/D) on October 9, 2013

MINUTES OF DISCUSSIONS

ON

THE PREPARATORY SURVEY

ON

THE PROJECT FOR CONSTRUCTION OF NEW THAKETA BRIDGE

IN THE REPUBLIC OF THE UNION OF MYANMAR

Based on the Minutes of Meetings agreed on June 25, 2013, between the Public Works (herein after referred to as PW) and the Japan International Cooperation Agency (hereinafter referred to as "JICA"), JICA study team is implementing the Feasibility Study (herein after referred to as "F/S) for "the Project for Construction of New Thaketa Bridge" (herein after referred to as "the Project").

As a result of discussion with relevant organizations in Myanmar, JICA, in consultation with the Government of Japan, decided to rename the F/S to "Preparatory Survey on the Project for Construction of New Thaketa Bridge".

JICA dispatched to Myanmar the Preparatory Survey Team (hereinafter referred to as "the Team"), headed by Mr. YASUDA Tomoyuki, Director of Peace Building and Urban and Regional Development Division 1, Economic Infrastructure Department, JICA. The Team schedule to stay in the country from October 7th to October 11th, 2013. During the period, the Team held discussions with the officials concerned in the Government of Myanmar and conducted a field survey in the study area.

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

Nay Pyi Taw, October 9, 2013

U Kyaw Linn
Managing Director,
Public Works,
Ministry of Construction

Mr. Yasuda Tomoyuki
Director,
Peace Building and Urban and Regional
Development Division 1,
Economic Infrastructure Department,
Japan International Cooperation Agency

ATTACHMENT

1. Objective of the Project

The objective of the Project is to improve efficiency of transportation in Yangon City through elimination of a bottle neck by replacing the existing Thaketa bridge into a new Thaketa bridge.

2. Project Site

The site of the Project is proposed to locate nearby the existing Thaketa bridge, connecting Mingalar Taung Nyunt township and Dawpon township, crossing over Pazundaung creek in Yangon city as shown in Annex 1.

3. Responsible and Implementing Organization

The Responsible and implementing organization for the Project is Public Works (PW), Ministry of Construction. The organization chart PW is shown in Annex 2.

4. Project Components

4-1. Both sides confirmed the components of the Project as follows:
Construction of new Thaketa bridges. Approach roads to the new Thaketa bridges will be constructed under responsible of the MOC.

4-2. Based on preliminary results of the F/S, JICA proposed and PW agreed that to ensure smooth implementation of the Project, the Project should be divided into two phases, as showed in Annex 3:

(1) Phase 1: construction of a new two lane bridge, which will be connected to existing approach roads.
(2) Phase 2: re-construction of existing Thaketa bridge by a new two lanes bridge.

4-3. Myanmar side explained that land clearance for phase 1 will be committed by January 2014.

4-4. JICA side explained that phase 2 only can be considered by the Government of Japan (herein after referred to as "GOJ") if Myanmar side can firmly ensure construction of four lanes approach roads.

4-5. PW will be responsible in coordinating with Yangon City Development Committee (herein after referred to as "YCDC") and Yangon Region Government to implement land clearance for the Project.

4-6. JICA will assess necessity, relevance and degree of urgency of the components of the Project through the Preparatory Survey and will report the findings to GOJ. Implementation and components of the Project will be decided by GOJ.

5. Japan's Grant Aid Scheme

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

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

6. Schedule of the Study

6-1. JICA Survey Team will continue the Preparatory Survey, prepare the draft report in English and explain its contents around December, 2013.
6-2. JICA will finalize the final report and send it to the Government of Myanmar around March, 2014.

7. Official request from the Myanmar side

7-1. The Japanese side explained procedures and application form necessary for official request for the Project to the Japanese government.
7-2. The PW acknowledged that the official request of the Project must be submitted to the Japanese Government, and agreed to follow up the procedure within Myanmar government.
7-3. The official request will be sent out from the PW by the end of October, 2013 and the PW will follow up such that it will reach Japanese side (To: Embassy of Japan in Myanmar, CC: JICA Myanmar Office) by 1rst week of December, 2013.

8. Environmental and Social Consideration

8-1. JICA side emphasized and Myanmar side agreed that procedure for environmental and social considerations (i.e. Initial Environmental Examination, EIA, land acquisition and resettlement, etc.) has to comply with the environmental regulations of Myanmar and "JICA Guidelines for Environmental and Social Considerations" (April 2010).
8-2. Myanmar side explained that the Environmental Law was promulgated on April 1, 2012 by Ministry of Environmental Conservation and Forestry. Related regulations/circulars which define actual implementation procedure and standards do not exist in Myanmar yet.

9. Other relevant issues

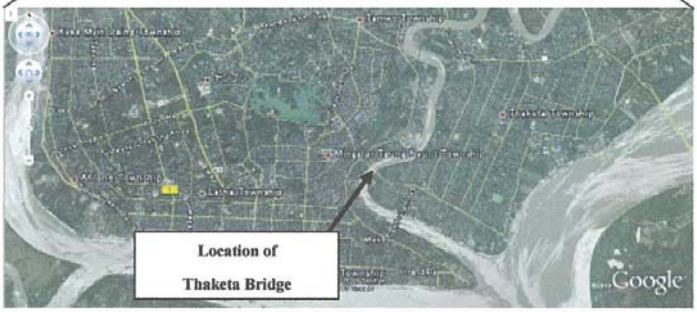
9-1. Myanmar side agreed to make necessary arrangements for construction of the Project, such as budget and personnel which are not cover by Grant Aid budget and the both sides confirmed that necessary information for approximate estimation of construction cost would be provided by Myanmar side and the Survey Team would present its result in the draft final report.
9-2. Both sides confirmed that current government buildings and workshops shall be relocated by Myanmar side with its own expense.
9-3. PW shall take necessary measures applied to the Project, to grant privileges, exemptions and benefits to the members of the Preparatory Study, which are no less favorable than those granted to experts and members of the missions of third countries or international organizations performing similar missions in the Republic of the Union of Myanmar.
9-4. Myanmar side requested that structure of the new bridges should apply advanced technology, e.g. PC Extradosed, and environmental impact should be considered during replacement of existing Thaketa bridge. The Survey Team noted the request for further consideration.

Annex 1	Project Site
Annex 2	Organization chart of Public Works
Annex 3	Scope of the Project

Annex 4 Japan's Grant Aid
Annex 5 Major Undertakings to be taken by Each Government

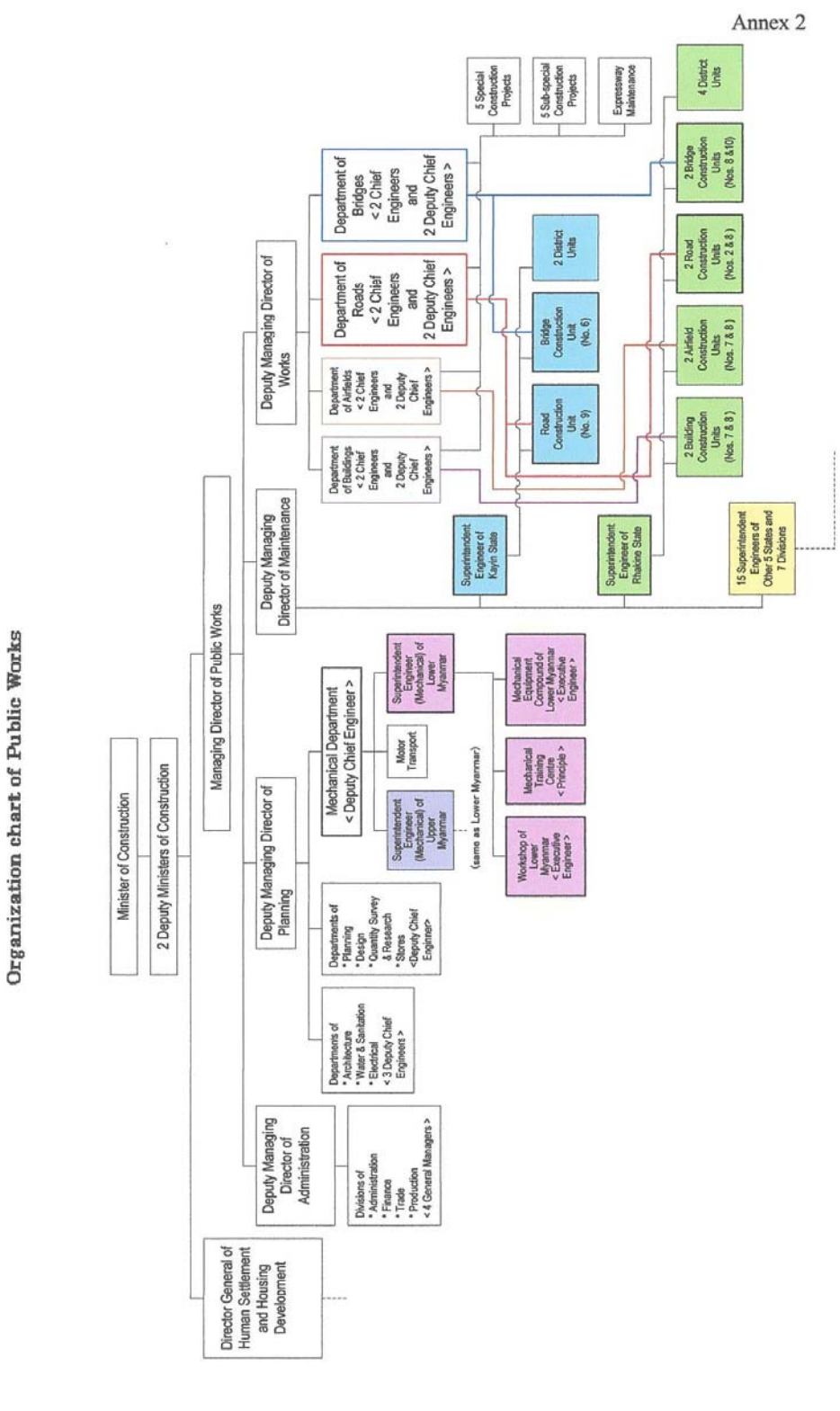
Annex 1

Project Site



Project site

Annex 2


Organization chart of Public Works
Minister of Construction
2 Deputy Ministers of Construction
Managing Director of Public Works
Director General of Human Settlement and Housing Development
Deputy Managing Director of Administration
Divisions of
• Administration
• Finance
• Trade
• Production
< 4 General Managers >
Deputy Managing Director of Planning
Departments of
• Architecture
• Water & Sanitation
• Electrical
< 3 Deputy Chief Engineers >
Departments of
• Planning
• Design
• Quantity Survey
& Research
• Stores
<Deputy Chief Engineer>
Mechanical Department
< Deputy Chief Engineer >
Motor Transport
Superintendent Engineer (Mechanical) of Upper Myanmar
Superintendent Engineer (Mechanical) of Lower Myanmar
(same as Lower Myanmar)
Workshop of Lower Myanmar
< Executive Engineer >
Mechanical Training Centre
< Principle >
Mechanical Equipment Compound of Lower Myanmar
< Executive Engineer >
Deputy Managing Director of Maintenance
Superintendent Engineer of Kayin State
Superintendent Engineer of Rhakine State
15 Superintendent Engineers of Other 5 States and 7 Divisions
Deputy Managing Director of Works
Department of Buildings
< 2 Chief Engineers and 2 Deputy Chief Engineers >
Department of Airfields
< 2 Chief Engineers and 2 Deputy Chief Engineers >
Department of Roads
< 2 Chief Engineers and 2 Deputy Chief Engineers >
Department of Bridges
< 2 Chief Engineers and 2 Deputy Chief Engineers >
Road Construction Unit (No. 9)
Bridge Construction Unit (No. 6)
2 District Units
5 Special Construction Projects
5 Sub-special Construction Projects
Expressway Maintenance
2 Building Construction Units (Nos. 7 & 8)
2 Airfield Construction Units (Nos. 7 & 8)
2 Road Construction Units (Nos. 2 & 8)
2 Bridge Construction Units (Nos. 8 &10)
4 District Units

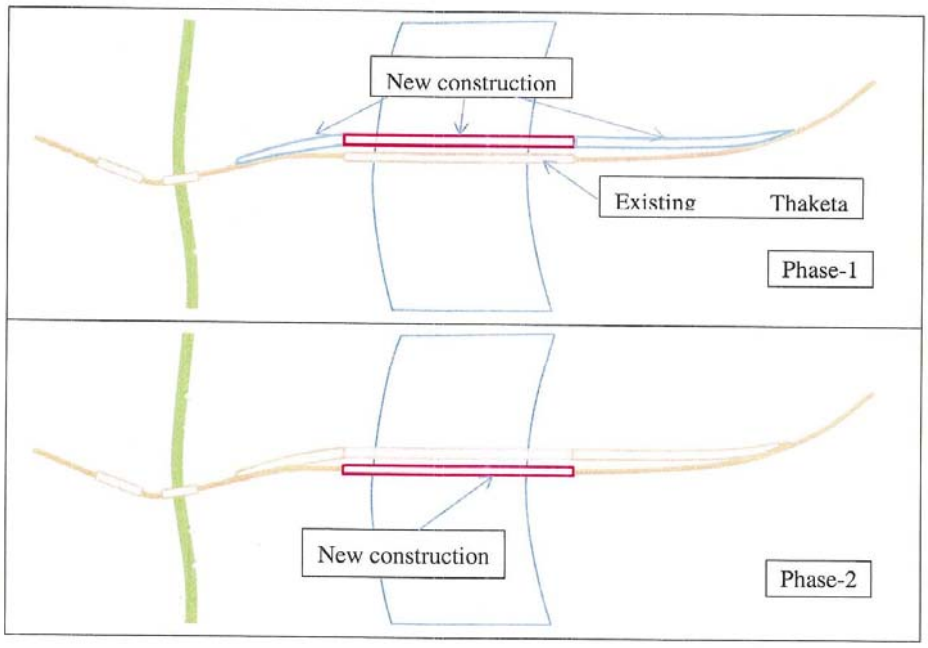
Annex 3

SCOPE OF THE PROJECT

Step by step construction

1. Phase-1
Construction of New 2-lane Thaketa Bridge nearby the existing Thaketa Bridge

2. Phase-2 (after commitment on construction of 4 lanes approach roads by PW)
Replacement of existing Thaketa bridge.



Annex 4

JAPAN'S GRANT AID

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

The Grant Aid is non-reimbursable fund provided to a recipient country to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

1. Grant Aid Procedures

The Japanese Grant Aid is supplied through following procedures :

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

2. Preparatory Survey

(1) Contents of the Survey

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

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

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

JICA requests the Government of the recipient country to take whatever measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization of the

recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of Discussions.

(2) Selection of Consultants

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

(3) Result of the Survey

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

3. Japan's Grant Aid Scheme

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

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

(2) Selection of Consultants

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

(3) Eligible source country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

(4) Necessity of "Verification"

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

(5) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex 4.

(6) "Proper Use"

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

(7) "Export and Re-export"

The products purchased under the Grant Aid should not be exported or re-exported from the recipient country.

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account under the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). JICA will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

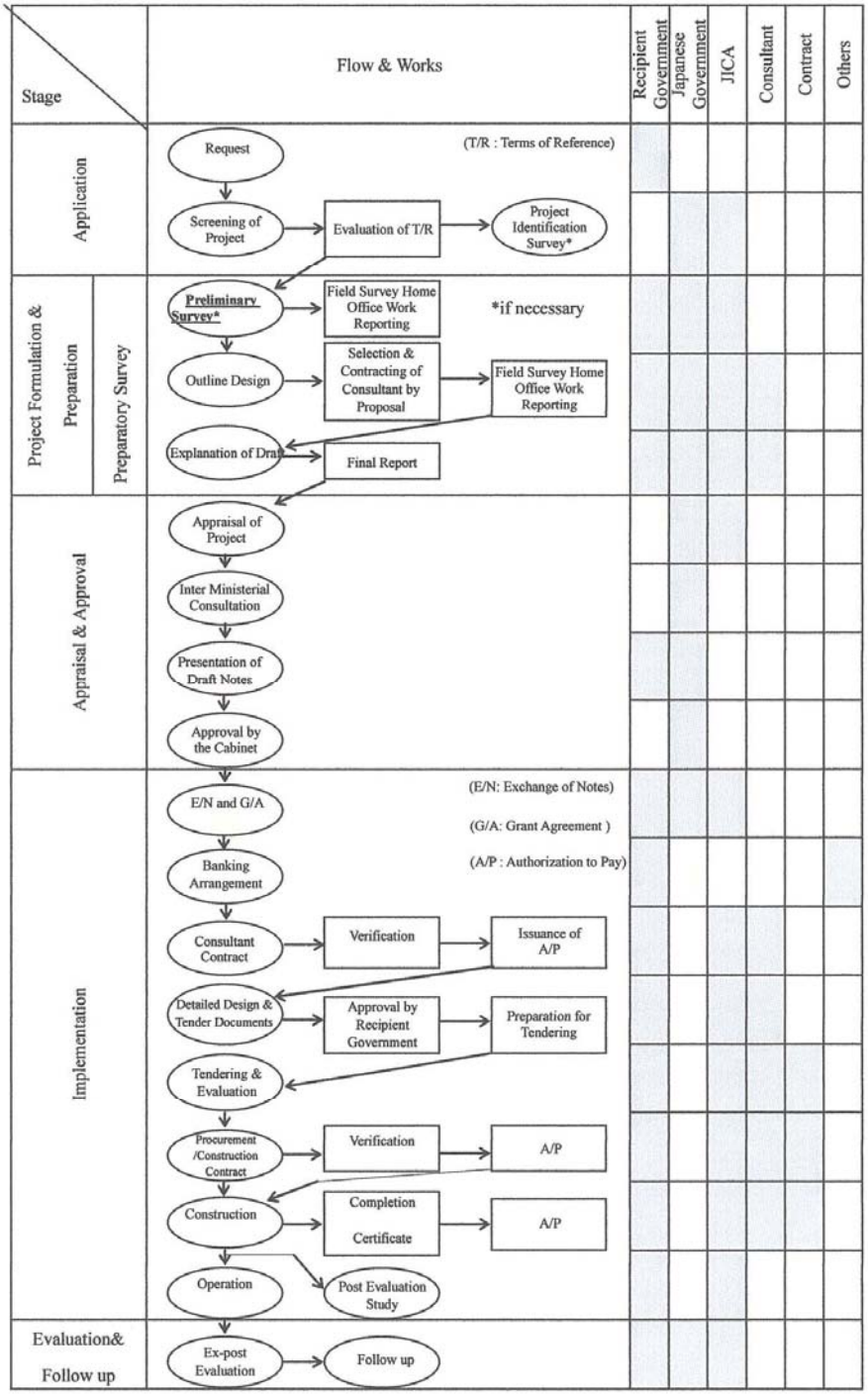
(9) Authorization to Pay (A/P)

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

(10) Social and Environmental Considerations

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

FLOW CHART OF JAPAN's GRANT AID PROCEDURES



Annex 5

Major Undertakings to be taken by Each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products		
	1) Marine (Air) transportation of the Products from Japan to the recipient country	●	
	2) Tax exemption and custom clearance of the Products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site (delivery point)	●	
2	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services be borne by the Authority without using the Grant		●
3	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
4	To ensure that the products be maintained and used properly and effectively for the implementation of the Project		●
5	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●
6	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●

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

4-2 Minutes of Meeting (M/M) on March 6, 2014

MINUTES OF MEETING
ON
THE PREPARATORY SURVEY
ON
THE PROJECT FOR CONSTRUCTION OF NEW THAKETA BRIDGE
IN THE REPUBLIC OF THE UNION OF MYANMAR

Based on the Minutes of Meetings agreed on June 25, 2013, between the Public Works (herein after referred to as PW) and the Japan International Cooperation Agency (hereinafter referred to as "JICA"), JICA study team is implementing the Feasibility Study (herein after referred to as "F/S") for "the Project for Construction of New Thaketa Bridge" (herein after referred to as "the Project").

As a result of discussion with relevant organizations in Myanmar, JICA, in consultation with the Government of Japan, decided to rename the F/S to "Preparatory Survey on the Project for Construction of New Thaketa Bridge" (herein after referred to as "Preparatory Survey").

From October 7th to October 11th, 2013, JICA dispatched to Myanmar the Preparatory Survey Team, headed by Mr. YASUDA Tomoyuki, Director of Peace Building and Urban and Regional Development Division 1, Economic Infrastructure Department, JICA. After discussions, The Preparatory Survey Team and Myanmar side confirmed key factors of the Projects as described in the Minute of Discussions signed in October 9th, 2013.

From March 5th, 2014 to March 7th, 2014, JICA dispatched to Myanmar the second Preparatory Survey Team (hereinafter referred to as "the Team"), headed by Ms. MIYAZAKI Katsura, Deputy Director General, Economic Infrastructure Department, JICA. During the period, The Team held discussions with the officials concerned in the Government of Myanmar on results of the Preparatory Survey.

In the course of discussions, both sides agreed to revise "Project components" and "Schedule of the Study" as described in attachment. The Team will proceed to further works and prepare the Preparatory Survey Report.

Nay Pyi Taw, March 6, 2014

U Kyaw Linn
Managing Director,
Public Works,
Ministry of Construction

Ms. Miyazaki Katsura
Deputy Director General,
Economic Infrastructure Department,
Japan International Cooperation Agency

ATTACHMENT

1. Project Components

1-1. Both sides agreed to share the role in the Project as described below:

<Japanese side (JICA)>

- Construction of a new four-lane bridge

<Myanmar side (MOC)>

- Construction of four-lane approach roads to the new bridge
- Removal of existing Thaketa bridge. But Myanmar side will need technical assistance for the removal such that not to give negative impacts to river environment, to surrounding area and the new bridge.

Details of above mentioned components are showed in Annex.

1-2. Response to the request from Myanmar side, JICA agreed to provide planning and designing for the whole project at master plan level.

1-3. Myanmar side requested OJT and lecture type training at the time of construction of the new Thaketa bridge.

1-4. JICA side explained that land clearance need to be committed by Myanmar side at the occasion of the discussion on the draft report of the Study in April of 2014.

1-5. JICA will assess necessity, relevance and degree of urgency of the components of the Project through the Preparatory Survey and will report the findings to GOJ. Implementation and components of the Project will be decided by GOJ.

2. Schedule of the Study

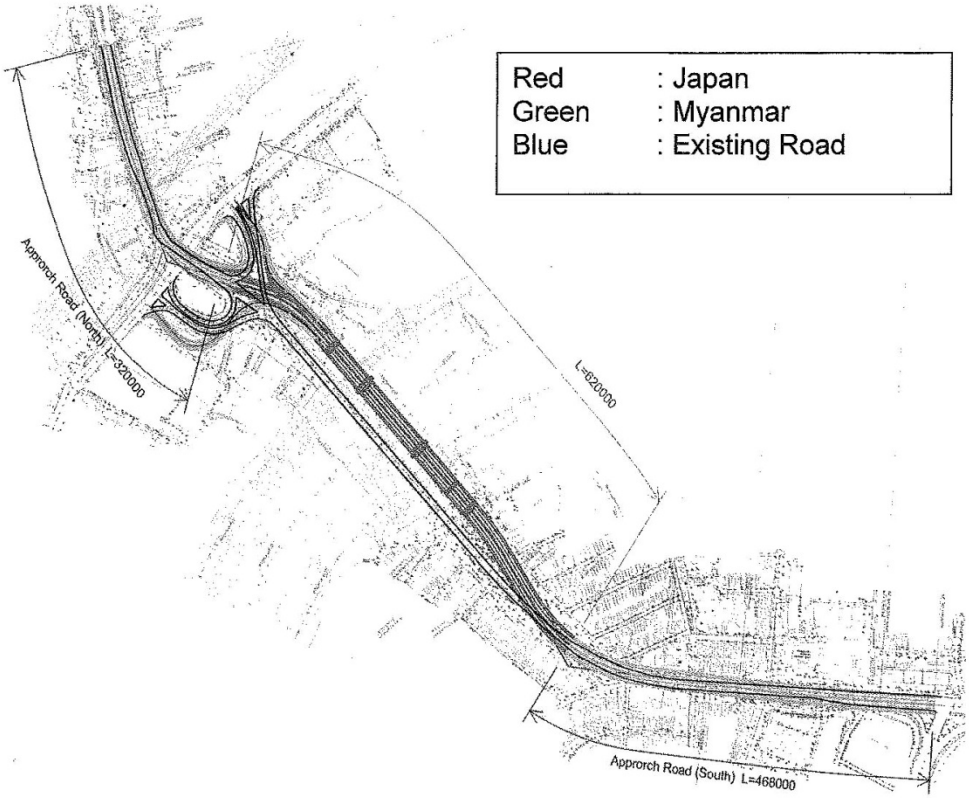
2-1. JICA Survey Team will continue the Preparatory Survey, prepare the draft report in English and explain its contents around the beginning of April, 2014.

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

END.

Annex Scope of the Project

Annex


Red : Japan
Green : Myanmar
Blue : Existing Road
Approrch Road (North) L=320000
L=820000
Approrch Road (South) L=468000

Minutes of MEETING

ATTENDED LISTS (1/2)

Date 6 - 3 - 2014

Sr. No.	Name	Designation	Sign	Remark
1.	U Kyaw Lwin	Minister		
2.	U Kyaw Linn	M D		
3.	U Hon Soe	DMD (M)		
4.	U Win Tint	DMD (W)		
5.	U Khin Mg Kyaw	DE (Road)		
6.	U Aung Myat Oo	DE (Bridge)		
7.	U Shwe Lay	DE (")	6/3/14	
8.	U Khin Mg Shwe	DE (")		
9.	U Soe Min	CE (Q:B-4)		
10.	Daw Saw Saw Hein	CE (Bridge)		
11.	Daw Than Yi	DSE (")		
12.	Daw Thein Nu	DSE (")		
13.	Daw Htwe Nyo Nyo Myint	EE (")	6.5.14	
14.	Daw Pa Pa Htwe	EE (")		
15.	U Kyaw Kaung Cho	EE (")		
16.	U Ayi Nyi Zaw	EE (")		
17.	Daw Ei Ei Nyein	AE (")		
18.	U Hlaing Phyo Lwin	AE (")		

Minute of Meeting

Attendance List (2/2)

ID No	Name	Position	Department	Signature
1	Ms. Katsuwa Miyazaki		Deputy Director General / HQ.	
2	Dr. Nobuyuki TSUKAOKA		Senior Advisier / JICA HQ.	
3	Mr. Phan Le Binh		Deputy Director / JICA HQ.	
4	U Win Ko Ko		Program Assistant	
5	Dr. Maki Morikawa		Project Formulation Advisor	
6	Mr. Takashi SEKI		Executive Officer / NK	
7	Mr. Hiroaki UEYAMA		Construction Planning / NK	
8	Mr. Takeshi YOSHIDA		Highway & Bridges Dept. / NK	
9	Mr. SANO		General Manager / Highway & Bridges Dept. (NK) / (YBS)	
10	Mr. Tamura		Officers / NK Yangon Office	
11	Ms. Aye Aye Khaing		Project Secretary / YUTRA	
12	Mr. Thae Htoo Maung		Office Staff	

4-3 Minutes of Discussion (M/D) on April 9, 2014

MINUTES OF DISCUSSIONS

ON

THE PREPARATORY SURVEY

ON

THE PROJECT FOR CONSTRUCTION OF NEW THAKETA BRIDGE

IN THE REPUBLIC OF THE UNION OF MYANMAR

(Explanation on Draft Final Report)

In July 2013, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Preparatory Survey Team on the Project for Construction of New Thaketa Bridge (hereinafter referred to as "the Project") to the Republic of the Union of Myanmar (hereinafter referred to as "Myanmar"). Through discussions, field survey and technical examination of the results in Japan, JICA prepared a Draft Final Report of the survey.

In order to explain and to consult with the concerned officials of the Government of Myanmar (hereinafter referred to as "the Myanmar side") on the contents of the Draft Final Report, JICA sent to Myanmar the Explanation Team of Draft Final Report (hereinafter referred to as "the Team"), which is headed by Mr. Tomoyuki YASUDA, Director of Peace Building and Urban and Regional Development Division 1, Economic Infrastructure Department, JICA, from April 6 to April 11, 2014.

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

Nay Pyi Taw, April 9, 2014

U Han Soe
Deputy Managing Director,
Public Works,
Ministry of Construction

安田 智幸

Mr. Yasuda Tomoyuki
Director,
Peace Building and Urban and Regional
Development Division 1,
Economic Infrastructure Department,
Japan International Cooperation Agency

ATTACHMENT

1. Contents of the Draft Final Report

The Myanmar side agreed and accepted in principle the contents of the Draft Final Report of the Preparatory Survey and draft specification of the New Thaketa Bridge explained by the Team.

Both sides reconfirmed role sharing in the Project as described in the Minutes of Meeting signed on March 6, 2014.

2. Japan's Grant Aid Scheme

The Myanmar side reconfirmed the Japan's Grant Aid scheme and the necessary measures to be taken by each government are explained by the Team described in Annex 1.

3. Schedule of the Study

JICA will complete the Final Report in English and send it to the Myanmar side through JICA Myanmar Office by end of June, 2014.

4. Project Cost

The Myanmar side understood that the Project Cost Estimation attached in Annex 2 is not final and is subject to change by the result of examination through revision of the Outline Design in the stage of Detail Design.

The Myanmar side was also informed that the Project cost should not exceed the upper limit of the amount agreed in the Exchange of Notes (E/N) and the Grant Agreement (G/A).

5. Confidentiality of the Project

Both sides agreed that, in order to secure a fair and equitable procurement, the Project Cost Estimation in Annex 2 should never be duplicated or released to any third parties before conclusion of all the contract(s) for the Project.

6. Environmental and Social Considerations

(1) Necessary land lots for the construction of the New Thaketa Bridge are shown in Annex 3.

(2) The Myanmar side agreed that completion of clearance of necessary land lots for the construction of the New Thaketa Bridge and relocation of all affected utilities at Myanmar's own expense, is a condition to proceeding to the bidding process for construction, planned in November, 2014.

(3) Myanmar side confirmed that land acquisition procedure shall comply with the "Policy on structures removal and resettlement for the Project", described in Chapter 2 of the Draft Final Report. Remarkable points as follows:

1) The Public Works (PW) shall set up an implementation team for preparation of Abbreviated Resettlement Plan (ARP) and for land acquisition and resettlement to be implemented in accordance with ARP.

2) The PW shall issue notification of "Land usage by the Project" as soon as after the signature of this Minutes of Discussions.

3) The PW shall complete the ARP by end of May 2014.

(4) Both sides agreed on the contents of environmental checklist as shown in Annex 4.

(5) Both sides agreed to monitor the procedures in accordance with the monitoring forms shown in Annex 5.

(6) The Myanmar side confirmed that the result of environmental monitoring will be provided to JICA as a part of Monthly Progress Report by filling in the monitoring form attached as Annex 5 on a quarterly basis until the completion of the project.

7. Maintenance of the Project Structures

The Team explained the necessary cost for the maintenance of the structure as shown in Chapter 5 of the Draft Final Report. The Myanmar side confirmed that the cost will be secured in the annual budget.

8. Other Relevant Issues

(1) The Myanmar side shall complete the expansion of approach roads by its own expenses or with external assistance by the time of completion of the New Thaketa Bridge, planned in February 2018, in order to make the most benefit of the Project.

In order to secure consistence between approach roads and the New Thaketa Bridge, the construction of approach roads will follow outline figures provided in the Final Report.

(2) After completion of the New Thaketa Bridge, the Myanmar side shall commence the removal of existing Thaketa Bridge by its own expenses or with external assistance.

In the stage of Detail Design of the New Thaketa Bridge, the Japan side shall provide reference information regarding technologies to be applied in removing existing bridge so as not to give negative impacts to river environment, to surrounding area and to the New Thaketa Bridge.

(3) Based on request from the Myanmar side, to assist the Myanmar side to enhance its construction and maintenance capacity for new bridge type, Japanese consultant shall provide technical knowledge related to new technologies, e.g. extradosed bridge and steel sheet pipe pile foundation, in the soft component of the project.

<List of Annex>

Annex 1	Major Undertakings to be taken by each Government
Annex 2	Project Cost Estimation (Confidential)
Annex 3	Necessary land lots for the construction
Annex 4	Environmental Check List
Annex 5	Monitoring Form

Annex 1

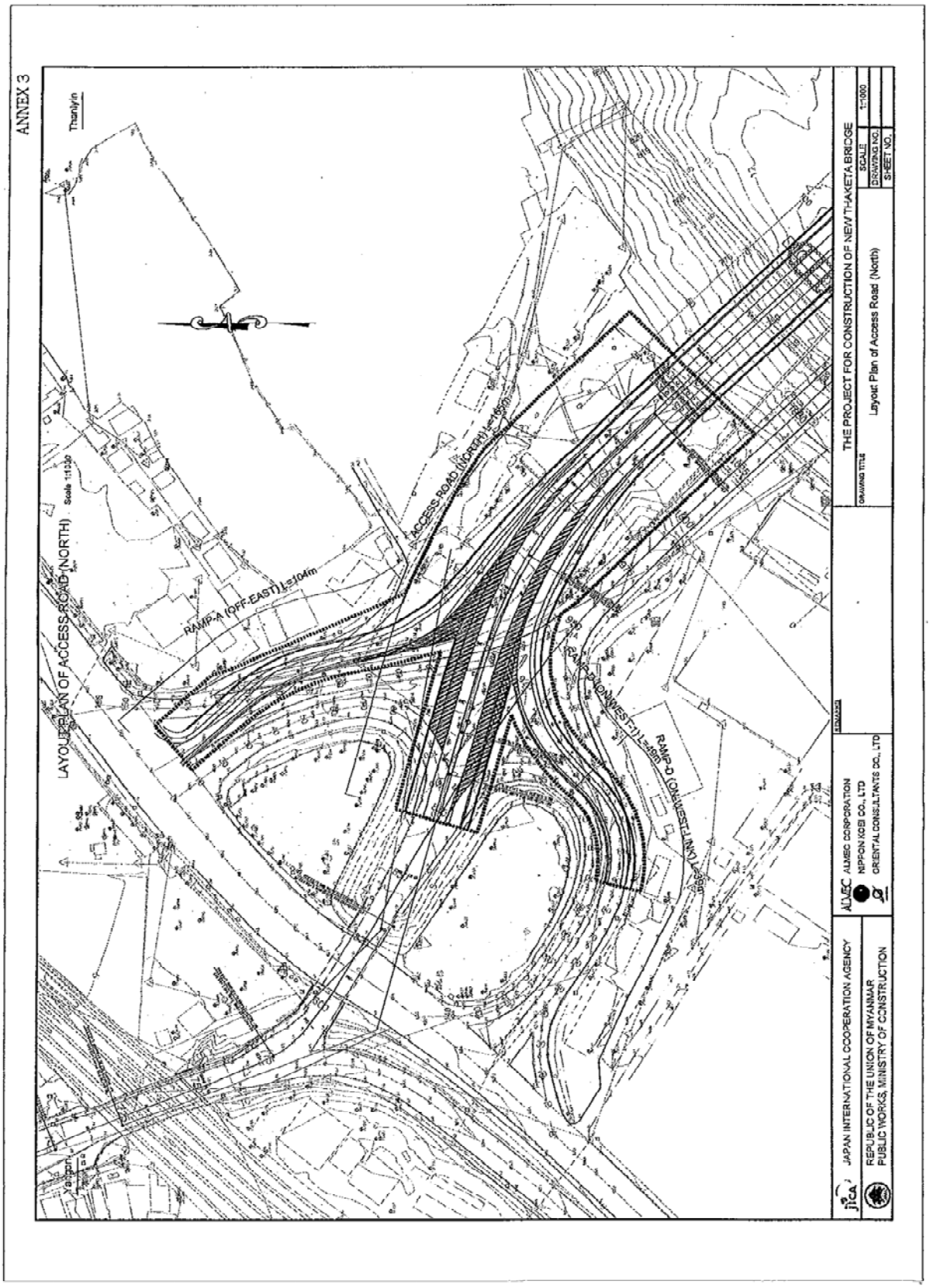
Major Undertakings to be taken by Each Government

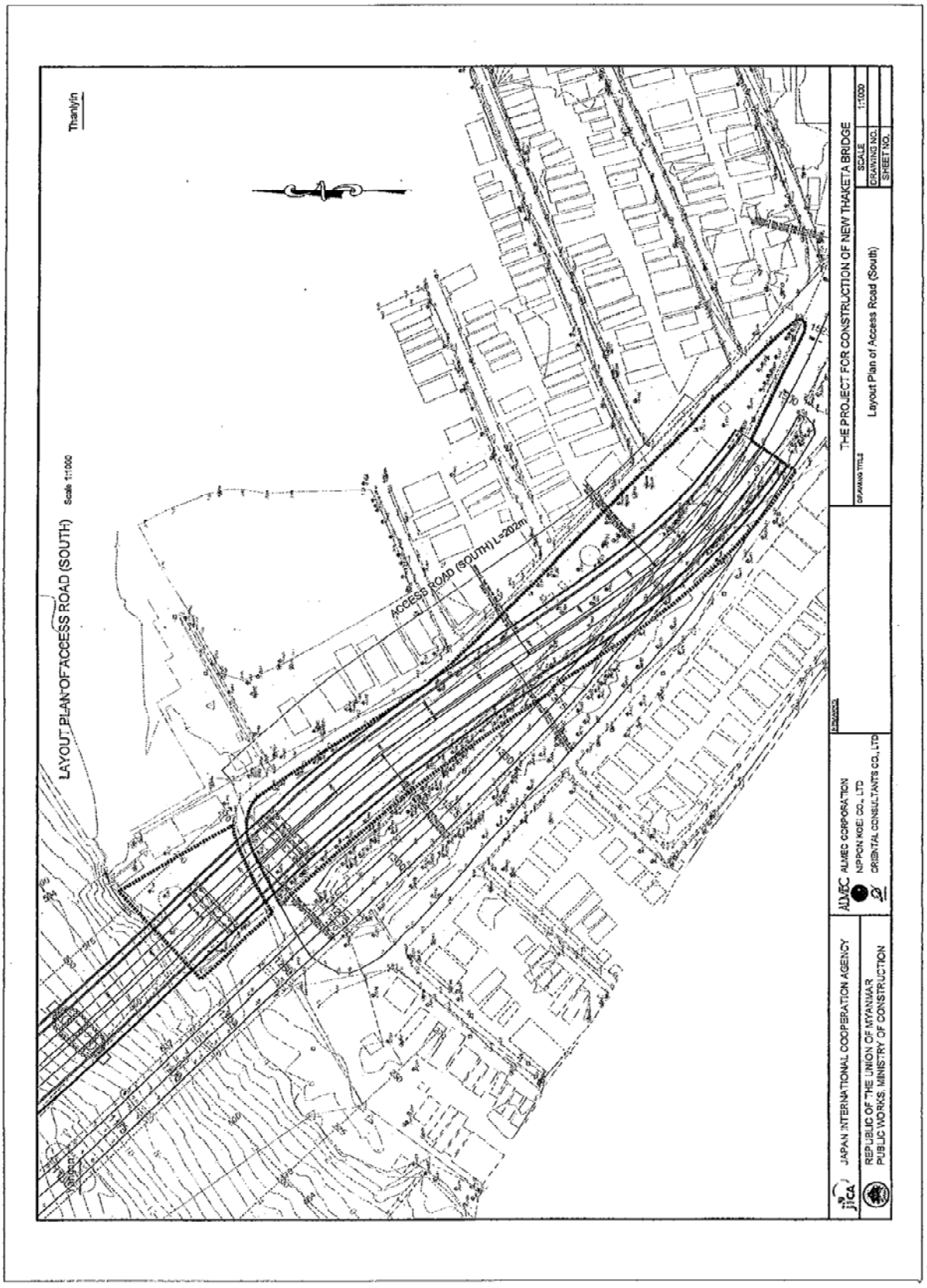
No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	To secure lots of land necessary for the implementation of the Project and to clear the sites.		●
2	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the sites referred to in No.1 above;		●
3	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist domestic transportation of the products		
	1) Marine (Air) transportation of the Products from Japan to the recipient country	●	
	2) Tax exemption and custom clearance of the Products at the port of disembarkation		●
	3) Domestic transportation from the port of disembarkation to the project site	●	
4	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services be exempted		●
5	To accord Japanese nationals and/or nationals of third countries whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
6	To ensure that the facilities be maintained and used properly and effectively for the implementation of the Project		●
7	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●
8	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
9	To give due environmental and social consideration in the implementation of the Project		●

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

Project Cost Estimation (Confidential)

Nondisclosure until Contract


ANNEX 3
LAYOUT PLAN OF ACCESS ROAD (NORTH)
Scale 1:1000
Thanlyin
Yaegan
RAMP-A (OFF-EAST) L=104m
ACCESS ROAD (NORTH) L=650m
RAMP-C (ON-WEST) L=459m
RAMP-D (ON-WEST) L=459m
JAPAN INTERNATIONAL COOPERATION AGENCY
REPUBLIC OF THE UNION OF MYANMAR
PUBLIC WORKS, MINISTRY OF CONSTRUCTION
ALMEC CORPORATION
NIPPON KOEI CO., LTD
ORIENTAL CONSULTANTS CO., LTD
REMARKS
THE PROJECT FOR CONSTRUCTION OF NEW THAKETA BRIDGE
DRAWING TITLE
Layout Plan of Access Road (North)
SCALE
1:1000
DRAWING NO.
SHEET NO.


LAYOUT PLAN OF ACCESS ROAD (SOUTH)
Scale 1:1000
ACCESS ROAD (SOUTH) L=202m
Thanlyin
JICA
JAPAN INTERNATIONAL COOPERATION AGENCY
REPUBLIC OF THE UNION OF MYANMAR
PUBLIC WORKS, MINISTRY OF CONSTRUCTION
ALMEC
ALMEC CORPORATION
NIPPON KOEI CO., LTD
ORIENTAL CONSULTANTS CO., LTD
THE PROJECT FOR CONSTRUCTION OF NEW THAKETA BRIDGE
DRAWING TITLE
Layout Plan of Access Road (South)
SCALE
1:1000
DRAWING NO.
SHEET NO.

9

Annex 4

Environmental check list

Category	Environmental Item	Main Check Items	Yes/ No	Confirmation of Environmental Considerations
1. Permits and Explanation	(1) EIA and Environmental permits	(a) Have EIA reports been already prepared in official process?	(a) N	(a) Categories of the Project are set as B by JICA, and IEE is being prepared.
		(b) Have EIA reports been approved by authorities of the host country's government?	(b) N	(b) IEE report will be submitted to Ministry of Environment Conservation and Forestry (MOECAF) through Myanmar Foreign Economic Relations Department: FERD (Ministry of National Planning and Economic development). (Note) - Obligation of preparing of EIA report for projects is stipulated in "Environmental Impact Assessment Procedures: EIA Procedures, draft)." - In the EIA Procedures, following procedures are described. Screening of the project (which is required EIA or IEE), required conditions for EIA /IEE, contents, submission and approval, etc. - The EIA Procedure is still a draft as of March 2014, but it is beginning to be actually operated recently. - For investment from abroad or foreign donor project, EIA Procedures is as following. IEE/EIA Report prepared by a proponent (attached to the project Proposal) >> Sector line Ministry >> FERD of Ministry of National Planning and Economic Development >> Planning Department >> MOECAF will review and present comments. MOECAF will approve after the response of the proponent.
		(c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	(c) N	(c) With regard to conditions on the approval of IEE report, PW will confirm before submission of IEE Report.
		(d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(d) N	(d) Along with the confirmation of process (b), PW will confirm those matters.
	(2) Explanation to the Public	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders?	(a) Y	(a) The stakeholders meeting was conducted on 22nd March, 2013. Appropriate explanation was made for the outline and environmental impacts of the Project, including information disclosure, was made. Local stakeholders understood well the explanation content.

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Category	Environmental Item	Main Check Items	Yes/ No	Confirmation of Environmental Considerations
		(b) Have the comments from the stakeholders (such as local residents) been reflected to the project design?	(b) Y	(b) The comments from the stakeholders have been reflected to the Project content such as environmental and social considerations.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) The following alternatives were examined including environmental and social perspective. -Zero option -Construction of two lane new bridge upstream of the existing bridge - Construction of two lane new bridge downstream of the existing bridge -The current plan
2. Pollution Control	(1) Air Quality	(a) Is there a possibility that air pollutants emitted from the project related sources, such as vehicles traffic will affect ambient air quality? Does ambient air quality comply with the country's air quality standards? Are any mitigation measures taken?	(a) N	(a) Traffic volume is expected to be higher due to the construction of the new bridge. In some cases temporary traffic congestion occurs in the vicinity. At the same time, Vehicles traffic is smoothed. As a consequence, emissions of air pollutants is expected to increase slightly or not the same as before the project. It is assumed that increase in the level of air pollution will be slight around the access roads.
		(b) If air quality already exceeds country's standards near the route, is there a possibility that the project will make air pollution worse?	(b) N	(b) Currently, there is no environmental standard of ambient air quality in Myanmar. According to the actual measurement result, measurement values of air qualities near the access roads are within the range of the environmental standard of Japan and WHO Guidelines.
	(2) Water Quality	(a) Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas?	(a) N	(a) Because the cross section structure of access roads is not slopes, but vertical retaining wall, there is almost no cutting and filling activities. So, there is almost no possibility that soil runoff from the bare lands.
		(b) Is there a possibility that surface runoff from roads will contaminate water sources, such as groundwater?	(b) N	(b) There is no water source, such as groundwater, in and around the Project site.
		(c) Do effluents from various facilities, such as stations and parking areas/service areas comply with the country's effluent standards and ambient water quality standards? Is there a possibility that the effluents will cause areas that do not comply with the country's ambient water quality standards?	(c) N/A	(c) Not applicable. (There are no facilities, such as stations and parking areas/ service areas in the Project site.)
	(3) Noise and Vibration	(a) Do noise and vibrations from vehicle and train traffic comply with the country's standards?	(a) Y	(a) Traffic volume is expected to be higher due to the construction of the new bridge. In some cases temporary traffic congestion occurs in the vicinity. At the same time, vehicles traffic will be smoothed. As a consequence, noise and vibration generated from vehicle traffic are expected to increase slightly or not the

Category	Environmental Item	Main Check Items	Yes/ No	Confirmation of Environmental Considerations
				same as before the project. It is expected that adverse impact of noise and vibration around the access roads is small. Currently, there is no environmental standard of noise and vibration in Myanmar. According to the actual measurement result, measurement values of noise near the access roads are within the range of the environmental standard of Japan and WHO Guidelines.
		(b) Do low frequency sound from the vehicle and train traffic comply with the country's standards?	(b) N/A	(b) Not applicable. It is assumed that the impact of low frequency sound by vehicle traffic is small as of the noise, but the actual measurement data does not exist at all. There is no standard for low frequency sound in Myanmar. A new measurement is also technically difficult in Myanmar.
	(4) Waste	(a) Are wastes generated from the project facilities, such as parking areas/service areas, properly treated and disposed of in accordance with the country's regulations?	(a) N/A	(a) Not applicable. (There are no facilities, such as stations and parking areas/ service areas in the Project site.)
		(b) In the case of that large volumes of excavated/dredged materials are generated, are the excavated/dredged materials properly treated and disposed of in accordance with the country's standards?	(b) N	(b) Volumes of generated excavated/dredged materials are very small.
3. Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) There is no protected area in and around the project site.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	(a) N	(a) There are no primeval forests, tropical rain forests, ecologically valuable habitats that the project site encompasses. There mangroves, but do not form a scale of wetlands ecologically important.
		(b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?	(b) Y	(b) - According to the biological and ecological survey in this project, two vulnerable species of the Red List of IUCN (International Union for Conservation of Nature and Natural Resources) were found in survey area in the Red List. (i) Delonix regia (Seinban/ Flame tree f. and (ii) Swietenia macrophylla King (Mahogany tree). Vulnerable species means in the condition of less threatened than "critically endangered" or "endangered species". In the Red list. - One of Flame tree exists in the Project affected area (in the land used by PW). Flame tree is a common garden tree in