APPENDIX 1-2

PRESENTATION MATERIAL(2)

Project for Comprehensive Urban Transport Plan of the Greater Yangon

29 August 2014

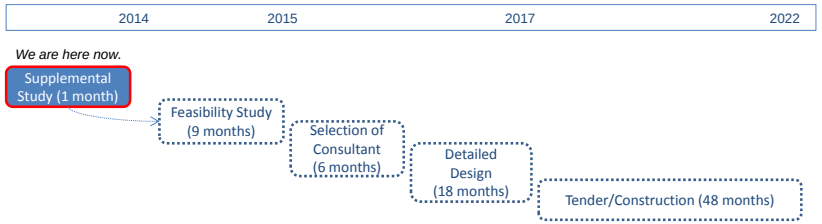
PROPOSED FUTURE MEGA PROJECT

YANGON URBAN EXPRESSWAY (YUEX)

ALMEC
Oriental Consultants
NIPPON KOEI

AGGENDA OF DISCUSSION

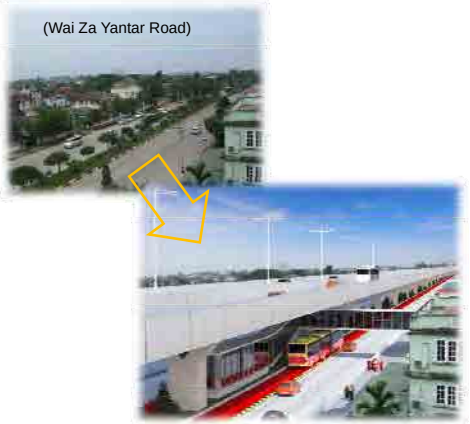
1. INTRODUCTION OF YUEX STUDY TEAM UNDER YUTRA STUDY

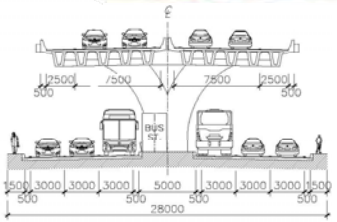


2. INTRODUCTION OF THE PROPOSED PROJECT (YUEX AND YORR)
3. INQUIRIES TO MOC FROM THE TEAM
   - 3.1 General comments to the YUEX (positive or negative)
   - 3.2 Development plan of MOC regarding the urban expressway
   - 3.3 Possibility of J-ODA funding
4. INQUIRIES FROM MOC TO THE TEAM
5. FURTHER SCHEDULE
6. OTHERS IF ANY

What is YUEX ?

OULINE OF YUEX





1. BACKGROUND OF THE PROPOSAL

1) ROAD NETWORK PROPOSED IN SUDP (2013)

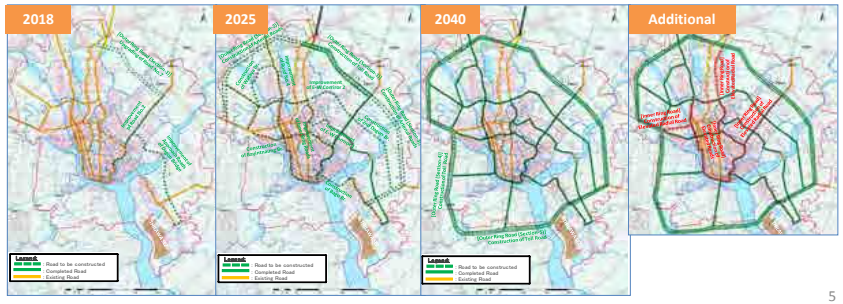
Construct high-capacity road network to cope with future traffic demand.

Radial-circumferential road system is intended.

1) The outer ring road located in suburban area (less land acquisition issue) was proposed to enhance decentralization of the urban area.
2) The inner rind road was proposed as an additional option for further study.

(PW Plan)

Future Road Network for Greater Yangon - tentative



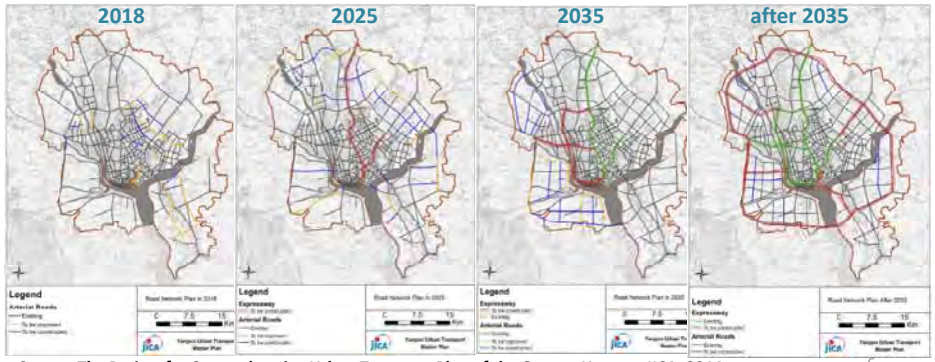
Source: The Project for the Strategic Urban Development Plan of the Greater Yangon, JICA, 2013

2) ROAD NETWORK PROPOSED IN YUTRA (2014)

Traffic demand forecast was conducted and it concluded that;

1) The inner ring road network shall be strengthen to absorb the recent rapid increased traffic demand.
2) The outer ring road shall be strengthen later depending on the development of the suburb area.

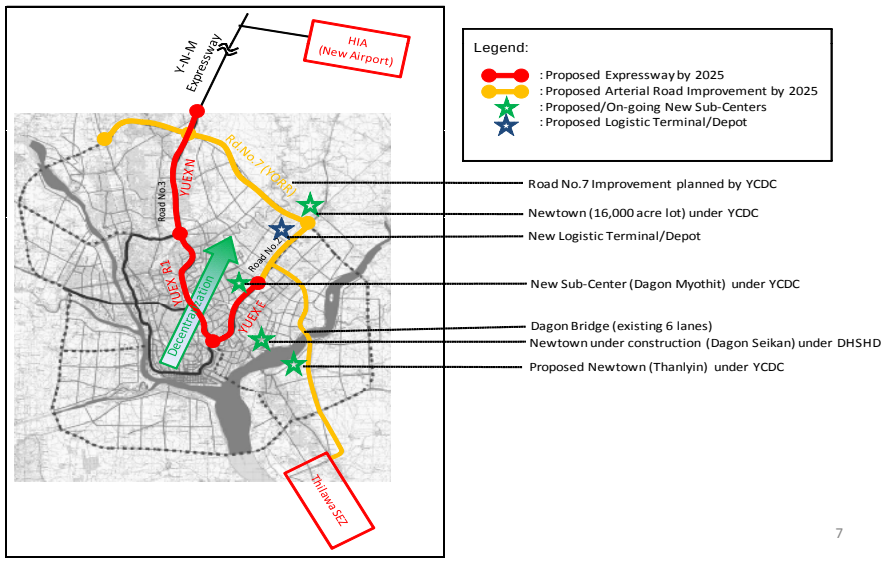
Future Road Network for Greater Yangon - definitive



Source: The Project for Comprehensive Urban Transport Plan of the Greater Yangon, JICA, 2014

2. OUTLINE FEATURES OF YUEX

1) STRATEGIC LAYOUT OF YUEX TOWARD 2025



2) CROSS SECTIONAL CONCEPT OF YUEX

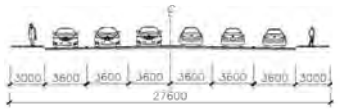
4 lanes Urban Expressways on Existing 6 lanes Aarterial roads

- Expansion of Road Capacity in the dense built-up area

- Elevated viaduct structure "on" the existing wide arterial roads

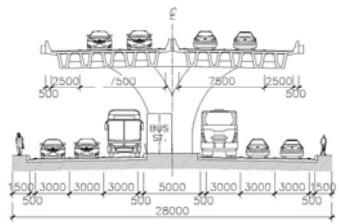
(CURRENT ARTERIAL ROADS)

6 lanes road (width of each lane is approx. 3.6m.)



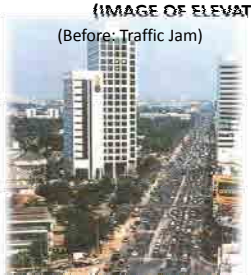
(Wai Za Yan Tar Road)

(Thudhamma Road)

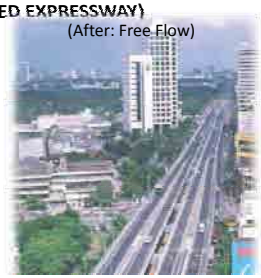


(IMAGE OF ELEVATED EXPRESSWAY)

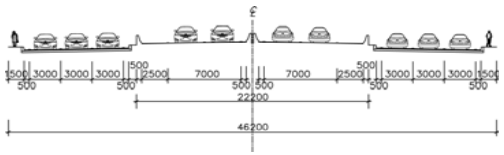
(Before: Traffic Jam)



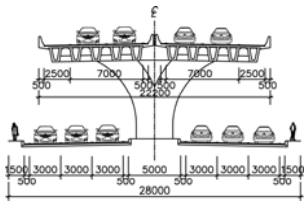
(After: Free Flow)



2) CROSS SECTIONAL CONCEPT OF YUEX



(At-graded Section)
For non-buildup area, at-graded expressway can be proposed.

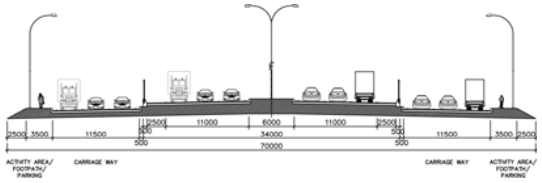


(Elevated Section)
For buildup area, elevated viaduct expressway is proposed.

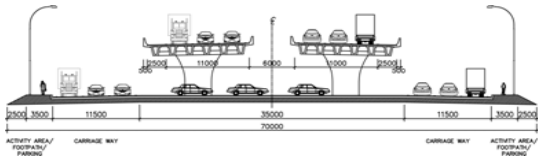
Proposed route (arterial roads) is still not so congested and the construction of the viaduct could be possible now…

[redacted]

2) CROSS SECTIONAL CONCEPT OF YORR



(At-graded Section)
For non-buildup area (most section of YORR), at-graded expressway can be proposed.



(Flyover Section)
For crossing the arterial roads, elevated viaduct expressway is proposed.

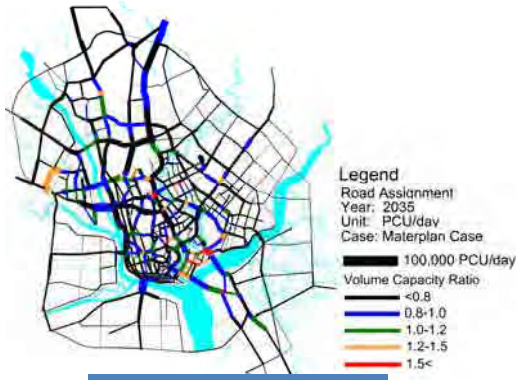
[redacted]

3) TRAFFIC DEMAND FORECAST BY YUTRA (2014)

The results of the traffic demand forecast indicated;

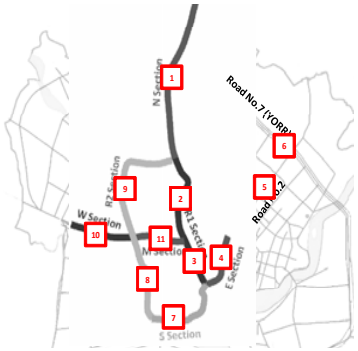
1) Most of the major arterial roads will be saturated in “DO-NOTHING” case.
2) The capacity of the arterial roads need to be extended but the widening will be a difficult measure due to land acquisition.
3) In YUTRA/SUDP, “viaduct ring road” was proposed to extend the capacity of the arterial roads. Also the modal split to MRT was considered in the traffic analysis.

DO-NOTHING CASE (2035)



DO-MAXIMUM CASE (2035)

4) NUMBER OF LANES FOR YUEX

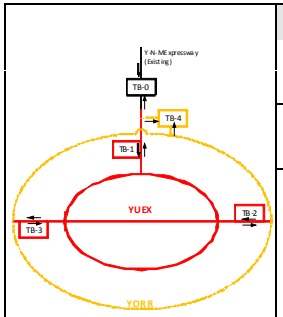


Type of Roads	Traffic Volume (pcu/day/both dir.) at YUEX sections										
	1	2	3	4	5	6	7	8	9	10	11
Expressway	60,584	43,559	34,418	24,057	0	0	11,912	40,910	31,177	27,362	39,046
Arterial	23,722	49,859	27,788	51,595	22,646	11,501	15,033	26,228	31,783	38,065	28,087

Type of Roads	Required Number of Lanes (both dir.) at YUEX sections										
	1	2	3	4	5	6	7	8	9	10	11
Expressway	4	4	2	2	0	0	2	3	2	2	3
Arterial	2	4	3	4	2	2	2	2	4	4	3

5) TOLL LEVY SYSTEM

Toll Barriers



(KEY MAP)

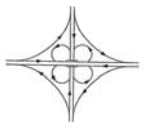
Toll Barriers	Function of Booths		Mode of Tariff
	Ticketing	Payment	
TB-0	IN Booths	OUT Booths	Distance/Area (Y-N-M Expressway)
TB-1	-	IN Booths (YUEX)	Flat (YUEX)
TB-2	IN Booths (YORR)	IN Booths (YUEX) & OUT Booths (YORR)	Distance/Area (YORR) Flat (YUEX) (IN Booths of YUEX and OUT Booths of YORR could be integrated.)
TB-3			
TB-4	IN Booths (YORR)	OUT Booths (YORR)	Distance/Area (YORR)

Interchanges (ON/OFF Ramps)

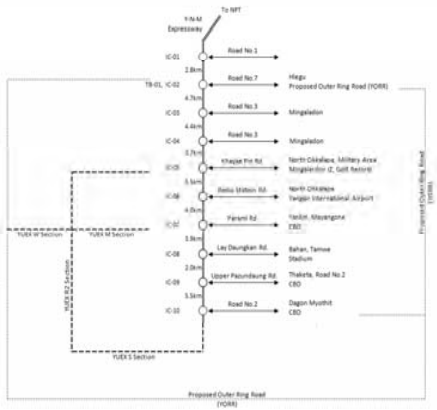
Expressways	Type of Ramps at Interchanges		Mode of Tariff
	ON Ramps	OFF Ramps	
YUEX	Payment	-	Flat
YORR	Ticketing	Payment	Distance/Area
Y-N-M Expressway			

6) TYPE OF INTERCHANGES (ON/OFF RAMPS)

Due to land constraint, “Diamond Type” is proposed for YUEX.

Diamond Type	Trumpet Type	Cloverleaf Type
		

IC layout of YUEX



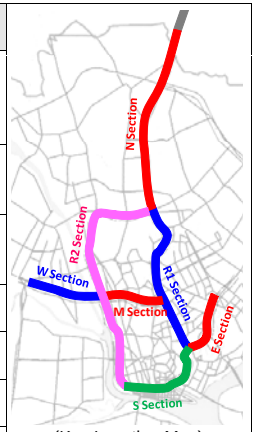
4) PROJECT EVALUATION BY YUTRA (2014)

Preliminary economical/financial evaluation was conducted by YUTRA MP in 2014.

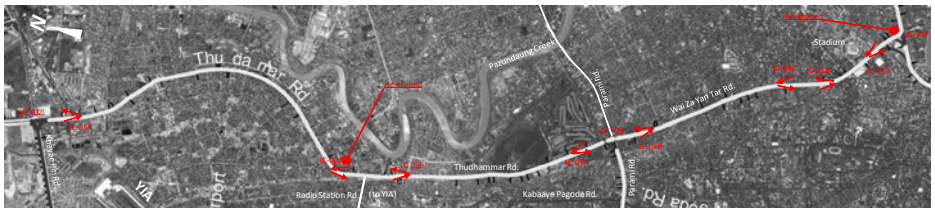
EIRR	18%
B/C	1.7
FIRR	13.1%

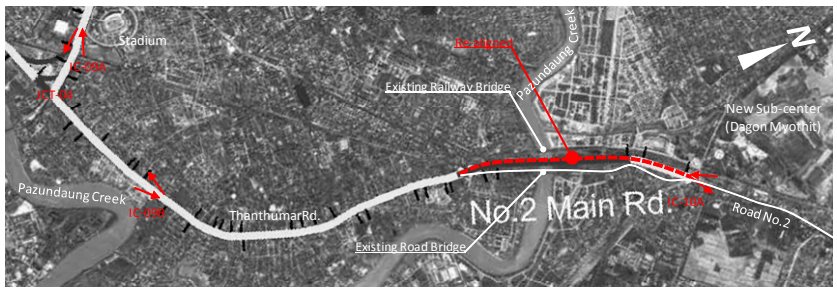
3. PROPOSED ALIGNMENT OF YUEX

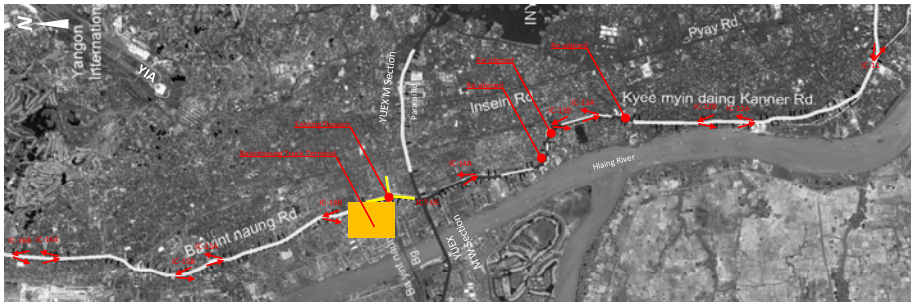
Sections (Length)	General Features and Applied Cross Sections
N Section (16.5km)	Extension from the existing expressway. Mostly in non build-up area and the cross sections (Figure 2.5.2 and 2.5.3) are applied. (Sta.0+000-16+500)
R1 Section (14.5km)	Mostly in build-up area and the elevated cross section (Figure 2.5.1) is applied. (Sta.16+500-31+000)
E Section (6.9km)	Mostly in build-up area and the elevated cross section (Figure 2.5.1) is applied. (Sta.31+000-37+900)
R2 Section (24.3km)	Mostly in build-up area and the elevated cross section (Figure 2.5.1) is applied.
W Section (7.9km)	Mostly in non build-up area and the cross sections (Figure 2.5.2 and 2.5.3) are applied.
M Section (6.7km)	Mostly in build-up area and the elevated cross section (Figure 2.5.1) is applied.
S Section (9.5km)	Mostly in build-up area and the elevated cross section (Figure 2.5.1) is applied.

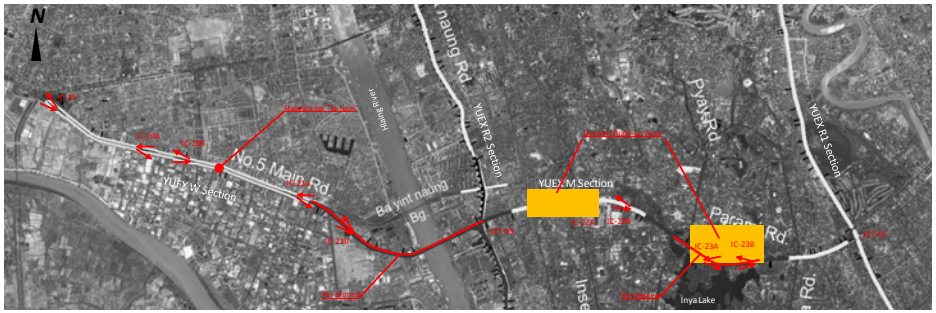


(Key Location Map)



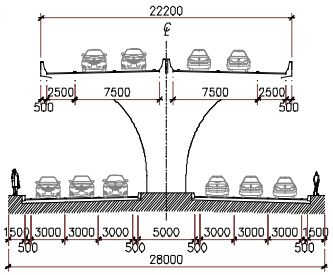






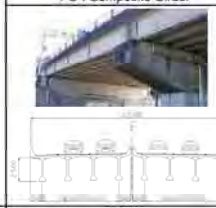
1) Superstructure for Standard Section

Pre-casting PC Girder which is fabricated at factory and/or girder casting yard under quality control are extracted since many number of girders has to be fabricated in short time.

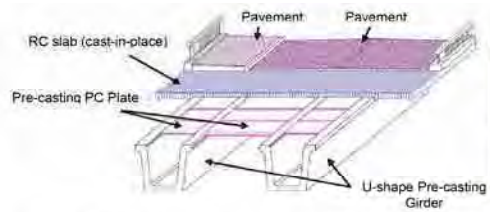


- PC-I Composite Girder : 35m
(applicable length: 25～40m)
- PC-U Composite Girder: 40m
(applicable length: 35～60m)
- Steel Box Girder : 50m
(applicable length : 40m～)

Superstructure for Standard Section

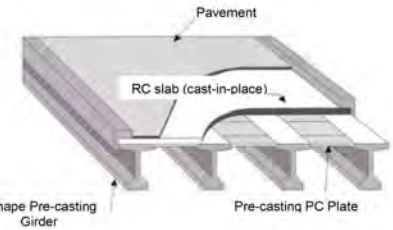
	PC-I Composite Girder	PC-U Composite Girder	Steel Box Girder
			
Span	@35m	@40m	@50m
Structural Feature	Pre-casting girder segments are assembled and erected at site. Pre-casting PC slab is used.	Pre-casting girder segments are assembled and erected at site. Pre-casting PC slab is used.	It can be applied to long span. Thin plates and stiffened member.
Erection Method	Track Crane at standard section and Erection Girder at narrow section	Track Crane and bent at standard section and Erection Girder at narrow section.	Track Crane and Bent at standard section and Launching Erection at narrow section.
Construction Period	1.25	1.25	1.00
Traffic Control during erection	Erection will be carried out at night time. During erection, it is necessary to close traffic.		
Cost Ratio	1	1	1.16
Maintenance	It is necessary to replace EXP joint an Bearing shoes once20-30 years.	It is necessary to replace EXP joint an Bearing shoes once20-30 years.	It is necessary to repaint once 20-30 year according to the traffic condition.
Aesthetic	Moderate	Superior	Moderate
Technical Transfer	It is the first trial for fabrication many precast PC girders in factory and/or fabrication yard in Myanmar.		Some flyover bridges in Yangon are the same type. But it is not many.
Evaluation	**Recommended**	**Recommended**	

Superstructure for Standard Section



Source: Japan Pre-stressed Concrete Contractors Association

Sketch of PC-U Composite Girder



Source: Japan Pre-stressed Concrete Contractors Association

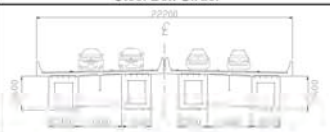
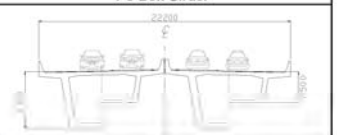
Sketch of PC-I Composite Girder

2) Superstructure for Special Section

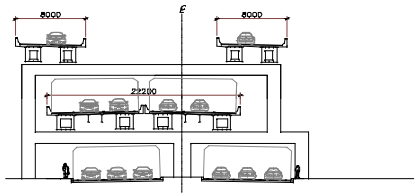
Type of Bridge	Applicable Span Length			
	Steel		PC Concrete	
Continuous Box Girder	Concrete Slab	40m - 80m	Bent Support	40m～ 70m
	Steel plate deck	30m～150m	Cantilever Erection	50m～110m

Steel Box Girder less than 70-80m span length, generally Steel Box Girder with RC slab becomes economical than Steel Box Girder with steel Plate deck.

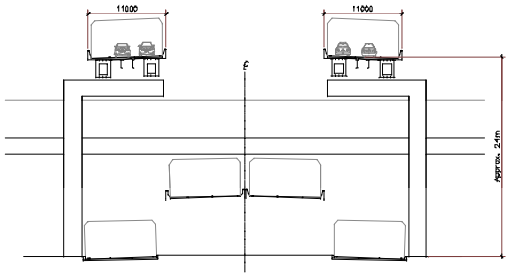
Superstructure for Special Section

Location	Flyover at JCT-3 on YUEX R1 Section	
Type	**Steel Box Girder**	**PC Box Girder**
Cross-section		
Span Arrangement	45+70+45=160m	45+70+45=160m
Structural Feature	Light superstructure is suitable for viaduct because the size of sub-structure becomes smaller.	Heavy superstructure needs a large sub-structure. And girder depth becomes higher than steel box girder.
Constructability	No difficulty (launching erection during night time will be applied)	No difficulty (cantilever method or will be applied)
Construction Period	Short	Long
Traffic Control during Erection	Erection will be carried out in the night time	
Influence on Urban Roads	Small influence on urban roads since the size of sub-structure becomes smaller.	Large influence on urban roads since the size of sub-structure becomes larger.
Construction Cost	1.15	1.00
Maintenance	It is necessary to repaint once 20-30 year according to the traffic condition.	Basically it is necessary to replace EXP joint an Bearing shoes once20-30 years.
Technical Transfer	Some flyover bridges in Yangon are the same type. But it is still new type.	It is still new type.
Aesthetic Ism	Due to smooth surface of girder, side view looks clear. It is possible to improve aesthetics by modifying girder shape.	Girder depth is higher and the size of substructure is larger than Steel Box Girder.
Evaluation	**Recommended**	

Superstructure for Special Section



Cross-section Image at JCT-04 on YUEX R1 Section (Sta. 32+000)

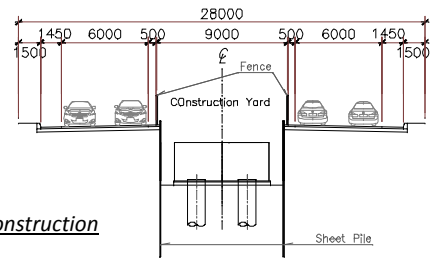


Cross-section Image at YUEX R2 Section (Sta9+960)

3) Sub-structure for Standard Section

The shape of sub-structure adopts 1-Column & T-shape Type.
In this case, there are the following advantages.

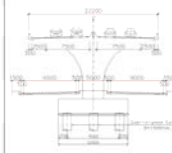
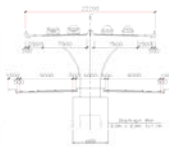
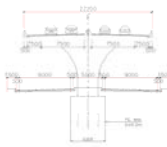
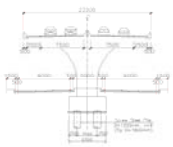
- Detour procedure is simple due to 1 step detour.
- Fence is straight and fixed during construction period for Pier Column and Foundation
- Due to smooth line of fence, traffic flow is smooth.



Detour Plan in Pile Cap Construction

Sub-structure for Standard Section

Rotation Steel Pile type *is selected as the recommended foundation type at area where is difficult to secure enough construction yard.*

		Alternative 1: Bored Pile	Alternative 2: Diaphragm Wall	Alternative 3: PC Well	Alternative 4: Rotation Steel Pile
Sketch					
Structural Issues	Features	- Typical digging method is "Earth Drill" method. - Most typical foundation type, if there is enough space for construction yard - Bearing capacity is calculated by tip resistance at bottom and skin friction at outer surface	- Maximum length of foundation is 140m. - Special digging machine is necessary. - Bearing capacity is calculated by tip resistance at bottom and skin friction at outer surface	- Maximum length of foundation is around 60m. - Foundation shape is cylinder or oval. - Each segment is fabricated at fabrication yard. - Construction method is combination with "Inner-digging method" and "Press-in method", in general. - Bearing capacity is calculated by tip resistance at bottom and skin friction at outer surface	- Maximum length of foundation is around 60m. - Construction method is screwing into the ground. - Bearing capacity is calculated by tip resistance at bottom and skin friction at outer surface - Due to none-excavated method, skin friction becomes bigger by compressing surrounding soil.
	Foundation Size (assumption)	D=1500, N=9	6.0m x 6.0m, t=1.1m	D=6000	D=1200(Tip D=1500), N=6
	Pile Cap Size (assumption)	12.0m x 12.0m	8.0m x 8.0m	D=8000	10.0m x 8.5m
Construction Issues		- Need 1.5~2 days for construction of 1 pile. - Need bentonite circulation system in order to protect surface of bored hole	- Need bentonite circulation system in order to protect surface of bored holls.	- Due to large diameter of foundation, necessary to connect each segment at site. - Necessary to secure enough space as stockyard for segments at construction site	- Need 1 day for construction of 1 pile. - Due to none-excavated method, no bentonite circulation system is required.
Environmental Issues		- Expect some vibration and noise at installation and extraction of casing and sheet pile. - Need drainage system in order to avoid leakage of bentonite water to outside of construction yard - Need cover sheet for excavated soil and tire washing equipment for truck in order to avoid dust.	- Same as alternative 1	- Expect low vibration and noise during piling work. - Need cover sheet for excavated soil and tire washing equipment for truck in order to avoid dust.	- Expect low vibration and noise during piling work. - Expect some vibration and noise at installation and extraction of casing and sheet pile. - Due to none-excavated method, site becomes very clean. And, no dust is expected.
Construction Cost (ratio)		1.00	2.20	3.30	1.20
Construction Period		1.2 month /pile	2.3 month /pile	4.3 month/ pile	0.8 month / pile
Recommendation					Recommended

Sub-structure for Standard Section

However, as for ***PC Pile and PC Well foundation****,*
those foundation type also can be the eco-friendly type and construction cost might be cheaper than other foundation types in future,
when fabrication factory of PC Pile and PC Well is established in Yangon.

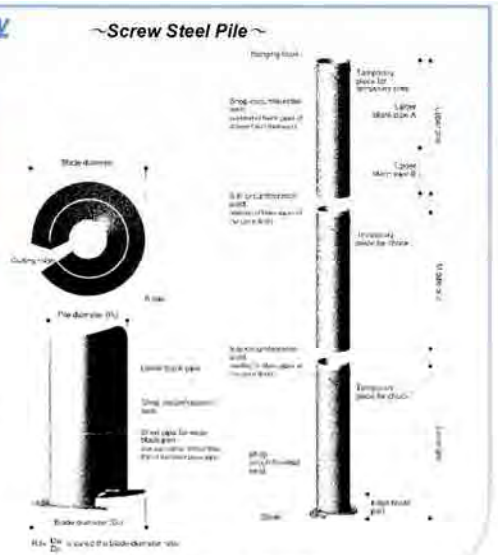
Therefore, more detailed comparison study shall be carried out in consideration of the possibility of application of PC pile and PC Well in next stage.

Sub-structure for Standard Section

New Technology ~Screw Steel Pile~

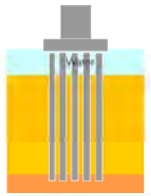
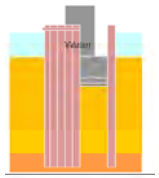
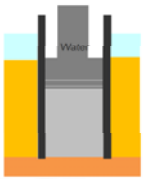
Eco-friendly Method.
- *None-excavated method*
- *No bentonite circulation system*
- *Site becomes very clean. And, no dust is expected*

Compact Shape
Skin friction becomes bigger by compressing surrounding soil.



Sketch of Screw Steel Pile

4) Sub-structure for Inside River

Foundation Type	Cast in Place Concrete Pile	Steel Pipe Sheet Pile	Concrete Caisson
			
Workability on Water	**Inferior** - Temporary cofferdam is required separately. - Permanent casing is required. - Loading test is required.	**Superior** - Temporary cofferdam is not required separately. - Loading test is not required.	**Moderate** - Temporary cofferdam is not required separately. - Loading test is not required.
Work Period	**Moderate**	**Superior**	**Moderate**
Against Ship Collision	**Inferior** - Because multi-pile structure.	**Superior** - Because rigid and massive structure.	**Superior** - Because rigid and massive structure.
Against Scoring	**Inferior**	**Superior**	**Superior**
Safety of Works	**Moderate** - Temporary cofferdam is required separately.	**Superior** - Temporary cofferdam is not required separately.	**Superior** - Temporary cofferdam is not required separately.
Cost	**Superior**	**Moderate**	**Moderate**
Experience in Myanmar	**Many**	**None**	**Some**
Evaluation	- Although the construction cost is cheapest, it is inferior for ship collision and scoring.	- Although the construction cost is inferior to Cast-in- place concrete pile, it is superior in other aspects. - And technical transfer will be done since this type has no experience in Myanmar. **Recommended**	- Although the construction cost is inferior to cast in place concrete pile, it is superior in some aspects. - Some aspects are inferior to steel pipe sheet pile.

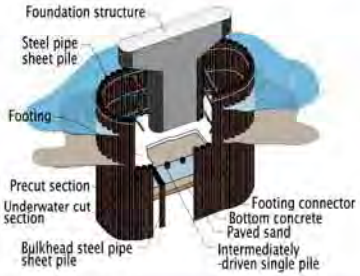
Sub-structure for Inside River

New Technology ~Steel Pipe Sheet Pile(SPSP) Foundation~

Apply to River Crossing Bridge

The SPSP Foundation method has been used to lay the foundation works for more than 2,000 bridges in Japan.

Compared to previous construction methods such as shutting down the river flow or constructing islands in the river, constructing dual-purpose SPSP for temporary cofferdam using steep pipe piles as cofferdam materials can reduce construction times and costs as well as make it easier to build in deep water or soft ground, where construction is often difficult.



4. OPERATION AND MAINTENANCE OF EXPRESSWAY

1) Traffic Control

2) Toll Collection

3) Inspection and Maintenance

Reference

- Development of Ring Roads
- Safety Facilities

1) Traffic Control

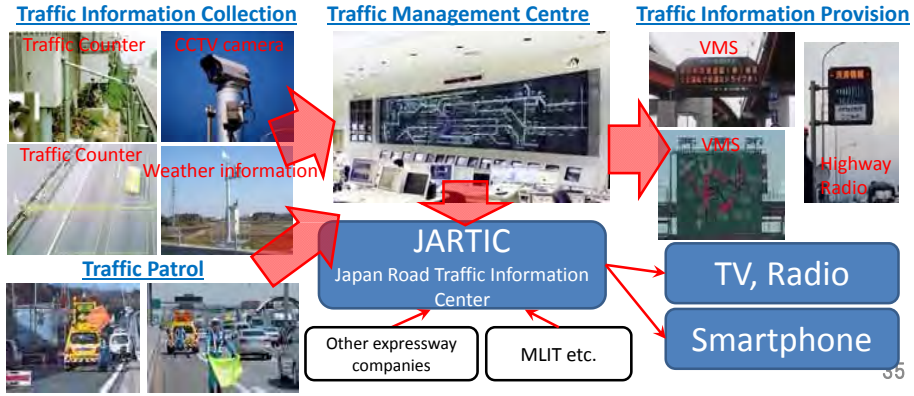
Current Situation of Yangon-Mandalay Expressway

- Traffic Control (information collection / provision) is not conducted.
- CCTV camera is deployed at (6) toll gate, only monitored by toll collection offices.

Proposal in YUEX

- Establishment of "Traffic Control Centre (TCC)" and appropriate "Traffic Management"

⇒ Suitable Traffic Control System should be developed
⇒ Education/Training for traffic control should be conducted



2) Toll Collection

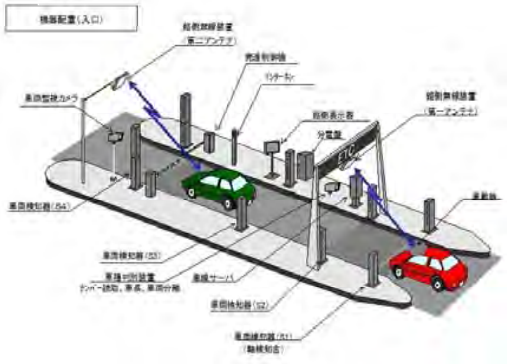
Current Situation of Yangon-Mandalay Expressway

- Toll fee is collected by manual base
- Study of ETC Installation is conducted by PW

Proposal in YUEX

- Installment of "Electric Toll Collection System" and deployment of ETC facilities

⇒ Suitable organization structures for ETC should be developed
⇒ Education/Training for toll collection should be conducted

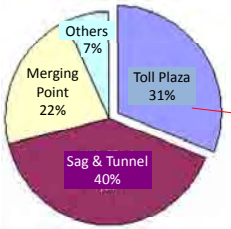


Toll Collection

YUEX
YANGON URBAN EXPRESSWAY

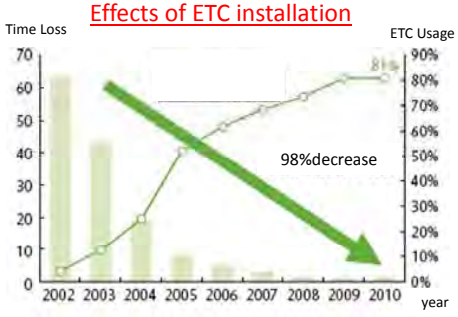
Effects of ETC installment by Japanese Experiences

Causes of congestion on expressways



31% of congestion is due to inadequate capacity at toll gates.

Effects of ETC installation



3) Inspection and Maintenance

YUEX
YANGON URBAN EXPRESSWAY

Current Situation of Yangon-Mandalay Expressway

- Visual base inspection only
- Simple routine maintenance (Cleaning etc.) and rehabilitations of pavement etc.

For appropriate inspection and maintenance for YUEX

⇒ **Suitable and well-planned inspection / maintenance framework should be established**
⇒ **Properties and condition of road structures should be managed by database system**
⇒ **Education / Training for inspection / maintenance should be conducted**

Inspection Framework

BMS/PMS and Strategic Maintenance

Inspection and Maintenance

YUEX
YANGON URBAN EXPRESSWAY

Example of Inspection and Maintenance of Japanese Expressway

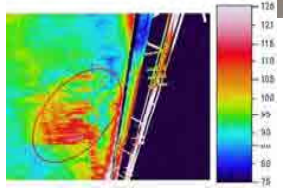
Bridge Inspection

Seismic Retrofitting

Cleaning (Tunnel)

Pavement Inspection

Non-destructive inspection



Rehabilitation of Concrete damaged by Salt

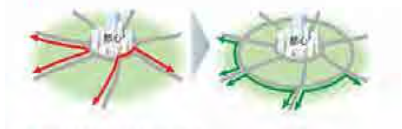
(Reference) Development of Ring Roads

YUEX
YANGON URBAN EXPRESSWAY

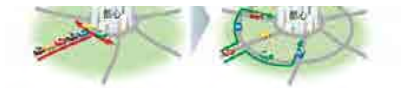
3 Circle, 9 Radial Expressways

In Tokyo Metropolitan Area

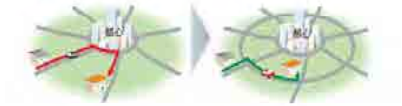
Reduce Traffic in Urban Area



Decentralize Traffic from Urban to Suburb Area



Move Directly between Suburb Areas



Keep Diversion under Emergency Situation

(Reference) Safety Facilities

Example of Safety Facilities on Japanese Expressway

Traffic Light

Guard Rail

Sign Board

Lane Marking and Median

Delineator

Glare Screen

Fence

Not only safety facilities, but also many measures are required to archive safe expressway

	Length (km)	No of Deaths	Traffic Volume	Year	Deaths per Billion Vehicle KM Traveled
Yangon-Mandalay	587	78	Approx. 4,500	2012	40.3
NEXCO East	3,720	70	Approx. 26,500	2012	1.5