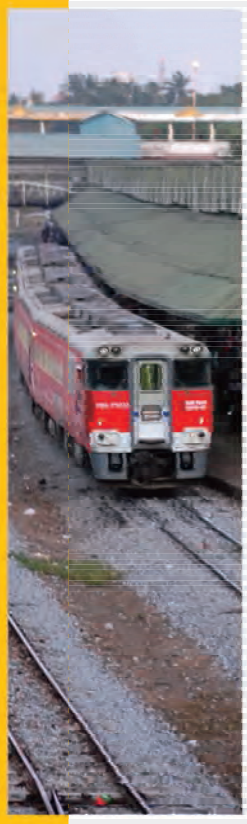
Japan International Cooperation Agency (JICA)
Yangon Region Government



Project for
Comprehensive Urban Transport Plan
of the Greater Yangon (YUTRA)

Pre-Feasiblitity Study on the Yangon Circular Railway Modernization Project

Final Report

January 2015

ALMEC Corporation
Oriental Consultants Co., Ltd.
Nippon Koei Co., Ltd.

toward YUTRA 2035

EI
JR
14-208

Republic of the Union of Myanmar
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PROJECT FOR COMPREHENSIVE URBAN TRANSPORT PLAN OF THE GREATER YANGON (YUTRA)

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The exchange rate used in the report is:

US$ 1.00 = MMK 1,000.00

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ABBREVIATION

AASHTO	American Association of State Highway and Transportation Officials
ACMECS	Ayeyawady-Chao Phraya-Mekong Economic Cooperation Strategy
ADB	Asia Development Bank
AFC	Automatic Fare Collection system
AH	Asian Highways
ASEAN	Association of Southeast Asian Nations
ATCS	Area Traffic Control System
AWPT	Asia World Port Terminal
BIMSTEC	Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation
BLC	Bus Line Committees
BOT	Build-Operate-Transfer
BRT	Bus Rapid Transit
BSC	Bus Supervisory Committees
BSW	Bo Aung Kyaw Wharf
C/P	Counterpart
CBD	Central Business District
CBTA	Cross-Border Transportation Agreement
CFS	Container Freight Station
CNG	Compressed Natural Gas
DCA	Department of Civil Aviation
DEMU	Diesel-Electric Multiple Unit
DDA	Department of Development Affair
DHSHD	Department of Human Settlement and Housing Development
DMH	Department of Meteorology and Hydrology, Ministry of Transport
DMU	Diesel Multiple Unit
DOT	Department of Transport
DVD	Digital Versatile Disk
DWIR	Department of Water Resources and Improvement of River System
DWT	Dead Weight Tonnage
EDCF	Economic Development Cooperation Fund
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EVD	Enhanced Video Disk
F/R	Final Report
F/S, FS	Feasibility Study
FIRR	Financial Internal Rate of Return
FOB	Foot Over Bridge
FOC	Free of Charge
GAD	General Administration Department
GDP	Gross Domestic Product
GRDP	Gross Regional Domestic Product
GFCF	Gross Fixed Capital Formation
GIS	Geographic Information System
GMS	Greater Mekong Sub-region
GPS	Global Positioning System
HCM	Highway Capacity Manual
HFTSA	Highway Freight Transportation Services Association

HH	Household
HHWL	The Highest High Water Level
HIA	Hanthawaddy International Airport
HIS	Household Interview Survey
HPH	Hutchison Port Holding
IAPH	International Association of Ports & Harbors
IC/R	Inception Report
ICD	Inland Container Depots
ID, MOAI	Irrigation Department, Ministry of Agriculture and Irrigation
IEE	Initial Environmental Examination
IFCL	Irrawaddy Flotilla Company Limited
INGO	International Non-Governmental Organization
IT/R	Interim Report
ITS	Intelligent Transport Systems
IWT	Inland Water Transport
IZ	Industrial Zone
JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
JICA-SUDP	Project for Strategic Urban Development Plan of the Greater Yangon
JPT	JICA Project Team
JPY	Japanese Yen
KLIA	Kuala Lumpur International Airport
KPMG	Proper noun. Global network of professional firms providing Audit, Advisory and Tax services
LAD	Land Administration Department
LCD	Liquid Crystal Display
LCL	Less than Container Load
LED	Light-Emitting Diode
LIBOR	London Inter-Bank Offered Rate
LOA	Length Overall
LRT	Light Rail Transit
MEB	Myanmar Economic Bank
MEC	Myanmar Economic Corporation
MES	Myanmar Engineering Society
METI	Ministry of Economy, Trade and Industry of Japan
MFSL	Myanmar Five Star Line
MFTB	Myanma Foreign Trade Bank
MIC	Myanmar Investment Commission
MIP	Myanmar Industrial Port
MIPL	Myanmar Integrated Port Limited
MITT	Myanmar International Terminal Thilawa
MMK	Myanmar Kyats
MNPED	Ministry of National Planning and Economic Development
MOC	Ministry of Construction
MOECAF	Ministry of Environmental Conservation and Forestry
MOHA	Ministry of Home Affairs
MORT	Ministry of Rail Transportation
MOT	Ministry of Transport
MPA	Myanmar Port Authority

MPPA	Million passengers per annum
MR	Myanma Railways
MRT	Mass Rapid Transit
MRTV	Myanmar Radio and Television
MWL	Mean Water Level
MYT-Plan	The Survey Program for the National Transportation Development Plan in the Republic of the Union of Myanmar
NGO	Non-Governmental Organization
NTU	Unit of Turbidity
OCC	Operation Control Center
OD	Origin-Destination
ODA	Official Development Assistance
OECD	Organized for Economic Cooperation and Development
OJT	On the Job Training
OPEC	Organization of Petroleum Exporting Countries
PCC	Program Coordinating Committee
PCU	Passenger Car Unit
PFS	Pre-Feasibility Study
PHPDT	Passenger Per Hour Per Direction
PM	Particulate Matter
PPP	Public Private Partnership
PW	Public Works
RBE	Rail Bus Engine
ROB	Road Over Bridge
RoW	Right-of-Way
ROW	Right-of Way
RT	Road Transport
RTAD	Road Transport Administration Department
S/C	Steering Committee
SD	Side Drainage
SEA	Strategic Environmental Assessment
SEZ	Special Economic Zone
SLRD	Settlement and Land Record Department
SPW	Sule Pagoda Wharves Terminal, Sule Pagoda Wharf
STRASYA	Standard Urban Railway System for Asia
SUDP	The Strategic Urban Development Plan of the Greater Yangon, JICA (2013)
TEU	Twenty-foot Equivalent Unit
TOD	Transit Oriented Development
TOR	Terms of Reference
TPD	Transport Planning Department
TRESC	Yangon Region Traffic Rules Enforcement Supervisory Committee
TSPM	Total Suspended Particulate Matter
UHF	Ultra High Frequency
UMRT	Urban Mass Rapid Transit
UN	United Nations
UNDP	United Nations Development Programme
UNHABITAT	United Nations Human Settlements Programme
UNHCR	United Nations High Commissioner for Refugees
U.S	the United States of America

USD	US Dollar
VCD	Video Compact Disk
VHF	Very High Frequency
VIP	Very Important Person
VOC	Vehicle Operation Cost
WG	Working Group
WHO	World Health Organization
WS	Workshop
YCDC	Yangon City Development Committee
YCR	Yangon Circular Railway
YIA	Yangon International Airport
YRDC	Yangon Region Development Committee
YRG	Yangon Region Government

SUMMARY OF DRAFT FINAL REPORT
PROJECT FOR COMPREHENSIVE URBAN TRANSPORT PLAN OF THE GREATER YANGON (YUTRA)
PRE-FEASIBILITY STUDY ON YANGON CIRCULAR RAILWAY MODERNIZATION PROJECT

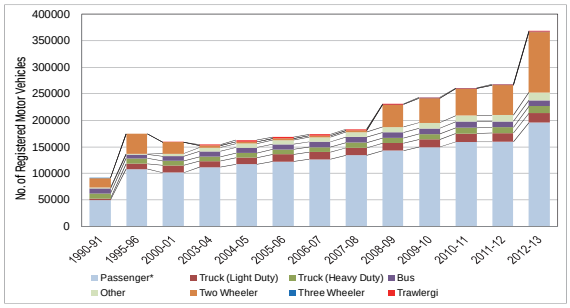
ALMEC Corporation, Oriental Consultants Co., Ltd., Nippon Koei Co., Ltd.

1 CURRENT ISSUES AND UPPER PLANNING

1.1. Current Situation and Issue of Transport Sector in the Greater Yangon

Population in the study area is 5.5 million and average annual growth rate in Yangon City Development Committee (YCDC) is 2.6%. Population density in the Central Business District (CBD) is very high, 36,500 persons/km^2. So far, per capita GDP of Yangon residents is still low and the household car ownership is kept low as well at around 12%.

New vehicle registration is rapidly increasing from 2011-12 year to 2012-13 year in Yangon after deregulation from September 2011 as shown below.



Source: Road Transport Administration Department, As of July 4, 2013

Figure 1.1 Registered Motor Vehicles by Type in Yangon Region

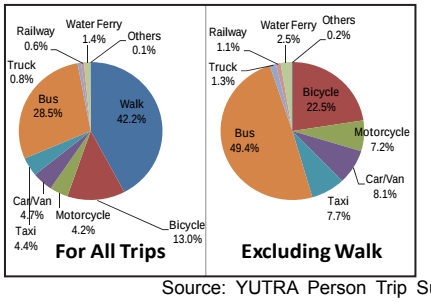
11 million trips are made in a normal weekday in 2013 in the study area as summarized below.

Table 1.1 Number of Person Trip in the Study Area by Mode, 2013

Groups of Mode	The number of Trips (trips /day)	Groups	The number of Trips (trips /day)
Walk	4,777,672	Motorcycle	471,386
Bus	3,228,532	Water Ferry	160,200
Bicycle	1,471,790	Truck	88,199
Car/Van	529,644	Railway	71,215
Taxi	501,689	Others	12,858
		Total	11,313,185

Source: YUTRA 2013 (Person Trip Survey)

In case of public transport, buses can be considered as the main workhorse of public transportation in Yangon Region. Excluding walking, it is to be noted that the largest share of bus is at 49.4%.



Source: YUTRA Person Trip Survey, 2013

Figure 1.2 Modal Share, 2013

Road length in Yangon Region under Ministry of Construction (MOC) is 980km, and 3,928km under YCDC. The supply of road infrastructure is getting tighter due to rapid motorization.

The bus transport would continue to remain as the main mode of public transportation despite the facts that its level of service is not very satisfactory. On the other hand, the modal share of railway in Greater Yangon is 1.1% (excluding walking). Taking into account the current road traffic congestion getting serious more and more, the role of railway is essential in Yangon to ease the serious traffic situation by maintaining the present high modal share of public transport at about 62%. It is required to develop the sustainable railway network.

1.2. Current Situation and Issue of Railway Sector in the Greater Yangon

The current railway network in Greater Yangon is composed of eight lines, total length 146.9km with non-electrified, 1000mm gauge, 58 stations, 208 train operation numbers. Current network figure and information are shown below.

Rought	Length	No. of Railway Station	Sigle track/ Double track
Main Line			
YCR Line	46.12	38	Double Track
Yangon-Mandalay Line	28.3	6	Double Track
Yangon-Pyay Line	20.1	4	Double Track
Branch Line			
Thilawa Branch Line	26.2	5	Single track
Eastern Univ. Branch Line	5.4	1	Single track
Dagon Univ. Branch Line	8.0	1	Single track
Computer Univ. Line	2.9	1	Single track
Yangon Port Freight Exculusive Branch Line	9.9	2	Single track
Total	146.92	58	Single track

Source: YUTRA Project Team (2013)

Figure 1.3 Current Railway Network and Information in Greater Yangon

Main issues are summarized as below.

Table 1.2 Summary of Issues of YCR

Issues	Contents
Quite low modal share (11%)	(i) poor railway network (ii) poor passenger service (iii) poor access to station (iv) poor feeder at station (v) many accidents (vi) dirtiness at station and in trains
Poor Railway network	Absolutely insufficient from the viewpoint of (i) present high population of Yangon (ii) rapid economic growth (iii) the urban structure (Decentralized Urban Pattern)
Ineffective Budget allocation System	MR's regional administration/division in charge of Yangon area has no budget of its own which can be control
Deteriorated Infrastructures	Track (i) relatively light, 37kg/m rail (ii) railhead is thoroughly worn out (iii) the ballast thickness under the sleeper is not enough (iv) poor side drainage Signaling system (i) frequent trouble (ii) malfunction happen Telecommunications (i) old-fashioned Rolling Stock (i) aging and deteriorated
Mismatching between Railway User's Needs and Current Railway Service	MR is providing "circular railway" for users who want to move circularly in Yangon city, however, such needs may be quite rare.
Poor Passenger Service and Insufficient Feeder Service at Station	(i) poor condition of station plaza (ii) poor ticketing system (iii) poor access to station (iv) no feeder service
Many Level Crossings	Induce road traffic jam due to no track circuit train detection system and manual operation.
Bottleneck due to Mixing Long-Distance Trains with YCR	(i)grade crossing from Yangon Central station to Pazundaung station (Yangon - Mandaley Line) (ii) mixing train operation for both YCR and long distance trains from Yangon Central station to Danyingone station (Yangon - Pyay Line)

Source: YUTRA Project Team (2014)

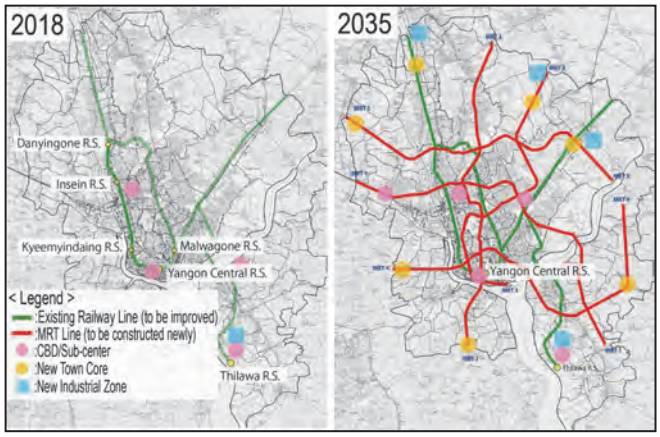
Above issues should be solved to realize the modal shift from road transport to rail transport.

1.3. Current Upper Planning of Railway Sector in Yangon Region

There are three upper planning for railway sector named as “Strategic Urban Development Plan of the Greater Yangon (SUDP)”, “Comprehensive Urban Transport Plan of the Greater Yangon (YUTRA)” and “Fact about Myanma Railways”. Three target years, which are 2018 as short-term, 2025 as middle-term, and 2035 as long term, were decided in SUDP and YUTRA.

The conceptual layout plans for railway infrastructure development prepared in 2018 and 2035 by SUDP and YUTRA are shown in the following figures.

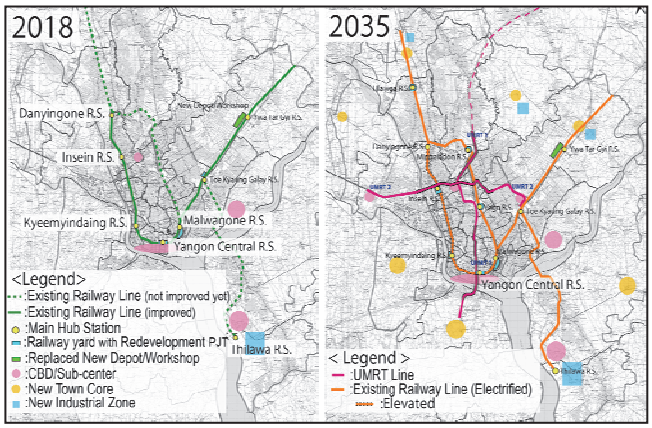
Improvement of all existing railway line and installation of five MRT lines were proposed by SUDP in order to realize environmental-friendly, and comfortable / convenient transport system (high-mobility and reliable transportation system led by modernized urban railway, and contribution to promote the planned new urban development).



Source: SUDP, JICA(2013)

Figure 1.4 Conceptual Layout Plan for Railway Infrastructure Development by SUDP

YUTRA is the sector master plan derived from SUDP. All urban transport plans including railway were reviewed based on the detail traffic demand forecast result, and proposed to modernize/electrify all existing railway line and install two UMRT lines as the final layout in 2035.



Source: SUDP, JICA(2013)

Figure 1.5 Conceptual Layout Plan for Railway Infrastructure Development by YUTRA

Regarding YCR, both SUDP and YUTRA proposed to improve it as high priority project.

SUDP is required to follow three principles which are “to fit with the concept and layouts of the urban function of each target years”, “to give priority to the improvement and upgrading of the existing railway line” and “to give priority to high population density areas in case of improvement of the existing railway line”.

YUTRA is basically following the concept of SUDP. In addition, principles which are related to YCR were planned as “short-term projects shall have high maturity status”, “to give first priority to existing line improvement in terms of cost aspect” and “to apply modernization of existing lines step-by-step such as electrification, grade separation and etc.”

Based on above principles of SUDP ad YUTRA, following plans were proposed for YCR.

Table 1.3 Summary of Proposal of Upper Planning

Title	Year	Proposed
SUDP	2012	(i)improve the western half (short-term) (ii)improve the eastern half (middle-term)
YUTRA	2013	apply "step-wise development" for upgrading YCR, (i)improved on at-grade and non-electrification basis for Western - half (short - term) (ii)improved on at-grade and non-electrification basis for Eastern - half (middle - term) (iii)modernized the western half on elevated and electrified (long - term) (iv)upgrade the eastern half on electrified (long - term)
Fact about Myanma Railways	2013	(i)procurement and rehabilitation of rolling stock (ii)improvement of signaling and telecommunication (iii)renew tracks and bridges

Source: YUTRA Project Team (2014)

According to SUDP and YUTRA, improvement of the western half of YCR is considered as high priority section.

1.4. Related Project by Other Donor or Private Company

Although official answer hasn't been got from MR yet, China takes some kind of action about improvement of Pyay line, according to the information from MR.

On the other hand, the private companies including Korea, Myanmar local, etc. plan some activities as follows.

Table 1.4 Summary of Documents by Private Company

Company	Year	Title / Contents
TESO and Seoul Metro(Korea)	2012	"Mass Transport (BRT, LRT, MRT) in Yangon City" Install new mass transport (BRT, LRT, MRT)
TESO and Seoul Metro(Korea)	2013	"Urban Railway Construction in Yangon City" Raise the operation speed (i)Improve roadbed, track architecture, electric power, signaling and communication facilities (ii)improving cross-section by overpass and fence installation
Several private companies(Myanmar)	2011	"Upgrading of Yangon Circular Railway Project" (i)Replace wooden sleeper to PC sleeper (ii)Full filling of new ballast for whole line. (iii)Maintenance for lining, levelling, and mechanized tamping etc.
Several private companies(International)	2013	"Yangon Station Yard Redevelopment" Redevelop Yangon Central station yard

Source: YUTRA Project Team (2014)

1.5. The Issue and Review of the Urban Railway in the Other Countries

Other countries are also facing some difficulties about urban railway project. Major lessons and issues about seven cities are summarized as following table.

Table 1.5 Major Lessons and Issues of Urban Railway in other Cities

City (Country)	Major lessons and Issues
(i) Delhi (India)	The construction speed of Delhi Projects is generally higher than other projects in Asian Developing countries because of the leadership of Managing Director.
(ii) Jakarta (Indonesia)	Since consultant services for tender document preparation stage, tender assistance stage and construction stage are divided into three packages, it takes time to execute the project.
(iii) Manila (Philippines)	Interchange stations of two lines are located far away each other and it takes time for passengers to transfer from line to another line.
(iv) Hanoi (Vietnam)	Since different donors and executing agencies manage the each line, it is very difficult to unify system.
(v) Ho Chi Minh City (Vietnam)	Two main challenges (i) a huge investment capital that is very difficult to acquire (ii) requirement to harmonize between Sponsor's guidelines and Vietnamese regulations.
(vi) Bangkok (Thailand)	It has taken time to execute urban railway projects in Bangkok due to political situation instability (change of government) in Thailand.
(vii) Karachi (Pakistan)	Karachi Circular Railway (KCR) was closed due to longer running time, low frequency of trains, lack of punctuality, and lack of adequate integration with other transportation modes. YCR may also follow the same pattern with KCR.

Source: YUTRA Project Team (2014),

2 BASIC INFORMATION AND ISSUES OF MYANMA RAILWAYS

2.1. Summary of Basic Information and Criteria of YCR

Basic information and criteria about YCR are summarized in the table below.

Table 2.1 Basic Information and Criteria

Length	46.12km (measured by Google. MR's data is 45.68km)	
No. of Station	38	
Track Number	Double Track	
Track Gauge	1,000 mm	
Rail Weight	75 Lb / yard (37 kg/m)	
Minimum Curve	R=291m (6 Degree) ; D=1,750 / 6' = 291m	
Maximum Gradient	10 ‰ (Station and Stabling yard area less than 2.5 ‰)	
Construction Gauge	Height	3200～3801mm
	Width	3810mm
Car Gauge	Height	3200～3429mm
	Width	2490～2590mm
Minimum Ballast Thickness	20cm (from the bottom of sleeper)	
Maximum Axle Load	12.5 ton (P.C. Sleeper design axle load = 16 ton)	
Speed	Design speed of YCR and the suburban line is 25 mph (=40.3km/h)	
	Operating speed of YCR is 12.5 mph (=20.1km/h)	
Turnout	1:12, 1: 8.5	

Source: YUTRA Project Team (2014),
The answer to the questionnaire by MR

At present, YCR which runs through the mostly urbanized area of Yangon is used by two types of commuters according to the ridership survey by SUDP.

(i) Relatively low income earners

(ii) Poor farmers who bring their cultivated products from the northern part of Yangon City to sell in CBD area

It seems that upper class people tend to use bus transport and seldom use railway due to the issues which mentioned at 1.2.

2.2. Financial

Financial statement of MR is shown in the table below. The table shows that profitability worsened after 2008 and every year thereafter and the total expense became twice of the total revenue in FY2012. Although it has improved in FY2013 as a result of raising the ticket fare, it is expected to require a huge investment continuously for intercity train operations and maintenance, etc. because of the large country and the rapidly expanding railway network.

Table 2.2 Financial Statement of MR

Items	2008-09	2009-10	2010-11	2011-12	2012-13 *
Revenue					
- Passenger	20,541.15	20,204.27	20,639.34	29,460.28	36,205.13
- Goods	5,468.90	7,689.97	8,288.01	16,734.96	19,623.33
- Others	2,104.36	2,210.64	4,237.27	4,803.63	5,826.15
Total Revenue	28,114.96	30,104.88	33,164.62	50,998.87	61,654.61
Expense					
- Operation	52,600.71	58,864.77	66,346.52	71.535.05	78,058.67
- Interest	26.5	36.61	61.66	12.61	4,217.61
- Profit & Loss on Foreign Exchange	-8.85	-5.41	-25.22	-1.75	
Total Expense	52,618.36	58,895.97	66,382.96	71,545.91	
Operation Ratio (=Expense/Revenue)	187.15%	195.64%	200.16%	140.29%	133.45%

*... The number for 2012-13 is provisional

Source: Fact about Myanma Railways 2012-13

Financial statement for YCR and the Suburban Lines is shown in the table below. Official financial statement for YCR and the Suburban Lines was virtually non-existent because MR's financial management system is fully controlled by MR headquarters, and each office division has no data about expenditures in their jurisdiction area. The following table is prepared by a local private company based on their survey and estimation.

Table 2.3 Financial Statement of YCR and the Suburban Lines (Estimation)

(unit: million MMK)

Items	A month in 2011
Monthly Expenses	
- Salary	27.807
-Engine fuel (65,337 gallons)	196.011
-Maintenance expenses for YCR office, engines, coaches	22.692
- Maintenance for railways	14.9
Total	261.41
Monthly Income	
- Fare box revenue	29.488
- Income from shops / rental fee	13.41
Total	42.898
Income-Expenses	-218.51
Operation Ratio (=Expense/Revenue)	609%

Source: Upgrading of the YCR Project, Fact about Yangon Myanma Railways, 2012

The fare for two riding tickets was MMK 20 unit November 2011. However, it was raised to MMK 100 afterwards. US$1 per one way is sold for foreigner.

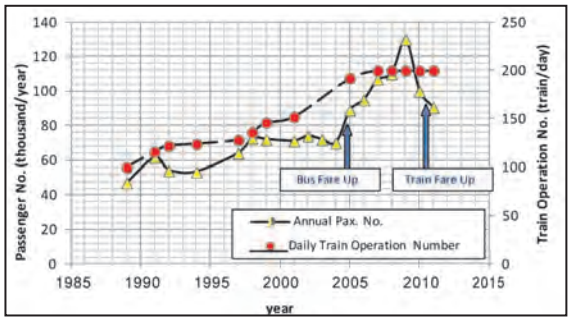
2.3. Operation

The number of operated trains among section is shown in the figure below. The figure shows that V shaped lines between Danyingone and Toe Kyaung Galay via Yangon Central Station is the most important corridor in YCR and the suburban lines.

Source: SUDP, JICA (2013)

Figure 2.1 Current Number of Train Operation

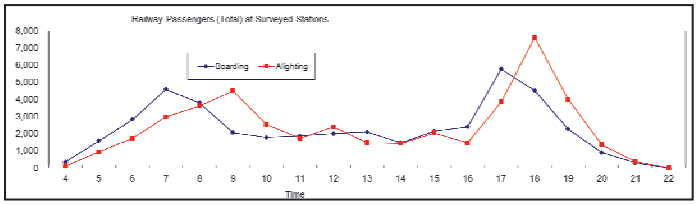
The highest annual passenger is app.128,000/year in 2009, after that the number of passenger is decreasing to app.88,000/year in 2011 because of implementation of fare increase as described below.



Source: Upgrading of YCR Project: Facts About Myanma Railways, 2011, Presentation Material by MR, and Traffic Data YCR, 2012.

Figure 2.2 Change in the Number of Passengers and Train Operations of YCR and the Suburban Lines

Morning peak hour is 7:00 – 9:00 (Peak ratio: 11%) and evening peak hour is 17:00 – 18:00 (Peak ratio: 17%). 4 trains per hour (15 min. headway) are operated during peak hours on YCR.



Source: YUTRA Project Team (2013)

Figure 2.3 Train Hourly Number of Passengers by Boarding and Alighting

The freight train is not operated in YCR, however, Malwagone Depot for freight train operate inside YCR.

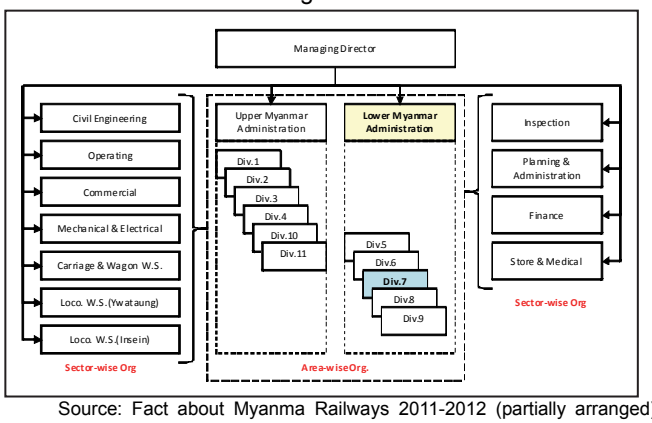
2.4. Accident and Disaster

7 accidents on YCR are reported in 2013. The main reasons of the accidents are derailment due to poor maintenance of track as mentioned before.

Measurable disaster impact on railway, for example, by Cyclone Nargis is happen in July 2008. 800,000 homes were destroyed, 600,000 hectares of farmland flooded, and 138,000 are dead or missing. Regarding YCR, there were no dead or missing according to interview to MR.

2.5. Organization

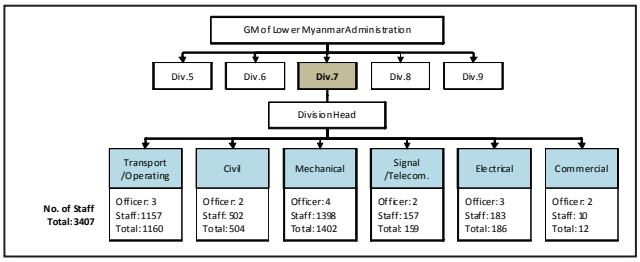
The organization of MR is divided into sector-wise and area-wise as shown in the figure below.



Source: Fact about Myanma Railways 2011-2012 (partially arranged)

Figure 2.4 Organization Chart of Myanma Railways

In terms of the area-wise aspect, MR has two administrations for Upper Myanmar and Lower Myanmar, which consist of 11 divisions. Organization chart of Division 7 which is in charge of Yangon Region is shown in the figure below.



Source: interview with Head of Div.7 in MR

Figure 2.5 Organization Chart of Division 7

3 EXISTING INFRASTRUCTURE OF YCR

It is obvious that railway track and infrastructures are deteriorated and not maintained well according to eye-check survey. Two types of surveys were conducted, and data was collected by questionnaire and interview to MR.

3.1. Track

Track condition survey was conducted by eye-check and could grasp the evaluation of nine items as shown in the table below between each station both outer line and inner line.

Table 3.1 Roughly Summary of Evaluation of Nine Items

Evaluation Items	Roughly Evaluation of Outer Line (Clockwise)	Roughly Evaluation of Inner Line (Anti-clockwise)
(1)Filling up condition of track ballast	Eastern half :B Western half :A-B	Eastern half :B-C Western half :A-B
(2)Installed condition of sleeper	A	A
(3)Ride comfortability	A-B	A-B
(4)Irregularity of rail alignment	Eastern half :B Western half :A-B	Eastern half :B-C Western half :A-B
(5)Condition of rail joint	A-B	Eastern half :B-C Western half :A-B
(6)Track environment	A-B	A-B
(7)Installed condition of side drainage	C	Eastern half :C Western half :B-C
(8)Condition of embankment/cut	Eastern half :B-C Western half :A-B	B-C
(9)Sureness of construction gauge	A	A-B

Source: YUTRA Project Team (2014)

Above nine items were evaluated in three stages as below.

- A : Sound condition
- B : Need repair
- C : Serious condition

Evaluation is conducted on “between neighboring stations” basis. Summary of total evaluation at each section is shown as below.

Table 3.2 Summary of Total Evaluation

No	Station	Evaluation of Outer Line	Evaluation of Inner Line	No	Station	Evaluation of Outer Line	Evaluation of Inner Line
1	Yangon Central	B	B	20	Aungsanmyo	B	B
2	Phaya Rd.	B	B	21	Danyingone	B	B
3	Lanmataw	B	B	22	Gauk Kwin	A-B	B
4	Pyay Rd.	B	B	23	Kyaikkalel	B	B
5	Shan Rd.	B	B	24	Mingaladon Buzza	B	B
6	Ahlone Rd.	B	B	25	Mingaladon	B	B
7	Panhlaing Rd.	B	B	26	Waibagi	B	B-C
8	Kyeemyindaing	B	B	27	Okkalapa	B	B
9	Hanthawaddy	B	B	28	Paywetseikkon	B	B
10	Hletan	B	B	29	Kyaukyetwin	B	B
11	Kamayut	B	B	30	Tadakalay	B-C	B
12	Thiri Myine	B	B	31	Yegu	B	B
13	Okakyin	B	B	32	Parame	B	B
14	Thamine	B	B	33	Kanbe	B	B
15	Thamine Myothit	B	A-B	34	Baukthaw	B	B
16	Kyunkon	B	A-B	35	Tarmwe	B	B
17	Insein	B	B	36	Myittanyunt	B	B
18	Ywama	B	B	37	Malwagone	B	B
19	Phwakan	B	A-B	38	Pazundaung	A-B	B
20	Aungsanmyo			39	Yangon Central		

Source: YUTRA Project Team (2014)

3.2. Railway Infrastructures (Bridge, ROB, FOB)

Condition of five types of infrastructures related to railway was investigated by eye-check based on the infrastructure list from MR. Investigated number and listed number are summarized as following table.

Table 3.3 Summary of the Number of Infrastructures

	Bridge	ROB	FOB	Level Crossing	Side Drainage
Investigated Number	53	25	36	25	7
Listed Number	46	26	34	25	0

Source: YUTRA Project Team (2014)

Side drainage is not managed by MR, therefore it is not listed. 7 extra bridges were found and 2 new FOBs are under construction. One missing ROB which listed from MR is not for YCR’s bridge.

This survey was conducted with handing the GPS in order to collect the accurate place.

Type and condition of bridge, ROB and FOB are summarized and those superstructure, abutment/pier and shoe were evaluated three stages same as track evaluation by eye-check.

(1) Bridge

Steel I girder is mainly used in YCR. Following table summarizes bridge type and length.

Table 3.4 Summary of the Type and Length of Bridge

Length		Type				
	Number	Steel	RC	Culvert	Others	None
≧10 (m)	8	7	1	0	0	0
5-10 (m)	11	7	3	0	1	0
5≦ (m)	32	16	7	4	3	3
Not calculated	2	0	0	0	1	1
Total	53	30	11	4	5	4

Source: YUTRA Project Team (2014)

Following table summarizes the evaluation of current condition of bridge.

Superstructure and abutment/pier majorly need repair due to a lot of rust and crack. Danger conditions are also confirmed due to the lack of rivet and deteriorated by aging.

Table 3.5 Summary of the Evaluation of Current Condition of Bridge

Evaluation	Current condition		
	Superstructure	Abut/Pier	Shoe
A	7	11	1
A-B	4	0	1
B	29	31	11
B-C	2	1	1
C	3	3	9
Others	8	7	30
Total	53	53	53

Source: YUTRA Project Team (2014)

(2) ROB

Steel, PC and RC types are applied for ROB. Following table summarizes ROB type and span.

Table 3.6 Summary of the Type of ROB

Span		Type		
	Number	Steel	PC	RC
1-3 Span	16	7	3	6
4-9 Span	5	0	3	2
>10 Span	4	0	1	3
Total	25	7	7	11

Source: YUTRA Project Team (2014)

Half of evaluation were need repair as shown in the table below.

Table 3.7 Summary of the Evaluation of Current Condition of ROB

Evaluation	Current condition		
	Superstructure	Abut/Pier	Shoe
A	12	11	1
A-B	0	0	0
B	11	14	1
B-C	1	0	0
C	1	0	0
Others	0	0	23
Total	25	25	25

Source: YUTRA Project Team (2014)

(3) FOB

Steel truss is mainly used for FOB. Following table summarizes FOB type and span.

Table 3.8 Summary of the Type of FOB

	Number	Type	
		Steel Truss	RC
1 Span	15	15	0
2~3 Span	11	8	3
>4 Span	3	3	0
None	3	3	0
Total	32	29	3

Source: YUTRA Project Team (2014)

Half of superstructure, Walking panel and Pier need repair or serious condition as summarized below.

Table 3.9 Summary of the Evaluation of Current Condition of FOB

Evaluation	Current condition		
	Superstructure	Walking Panel	Pier
A	15	15	17
A-B	0	0	0
B	14	9	12
B-C	0	3	0
C	1	1	1
None	2	4	2
Total	32	32	32

Source: YUTRA Project Team (2014)

3.3. Existing Rolling Stock and Maintenance Machinery

The number of rolling stock for YCR is summarized below.

Table 3.10 Summary of the Number of Rolling Stock

Rolling Stock Type	Locomotive	Coach	RBE
Number	17	91	6

Source: The answer to the questionnaire by MR

Many rolling stocks were procured around 50 years ago. Height of all rolling stock is not satisfied with car gauge though in range of construction gauge as summarized below.

Table 3.11 Summary of Construction Gauge, Car Gauge and Lowest Height of Rolling Stock

Gauge and Lowest Height	Height
Construction gauge	3200～3810.0mm
Car gauge	3200～3429.0mm
Lowest height of coaching	3403.6mm
Lowest height of locomotive	3450.0mm

Source: The answer to the questionnaire by MR

There are five maintenance facilities in YCR as following below.

- Insein workshop
- Insein maintenance shed
- Malwagone depot and maintenance shed
- Yangon Central station depot and maintenance shed
- Keemyindaing stabling yard

YCR's light maintenance is mostly dealt in Insein maintenance shed.

3.4. Existing Safety System

Regarding Signal, telecommunication, OCC and Level Crossing, old style system or manual operation by MR staff are still applied. Overview of safety system is summarized as below.

Table 3.12 Overview of Safety System

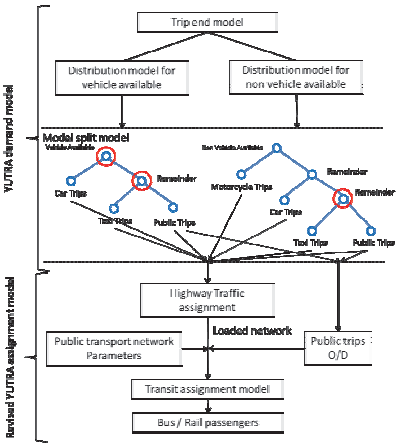
Safety System	Overview
Signal	All sections : Automatic block system 8 stations : Interlocking system
Telecommunication	All stations : Clerk Phone 15 stations : UHF transceiver
OCC	Not provided in YCR
Level Crossing	Barrier : All manually Automatic Alarm : Half alarms are broken or none

Source: YUTRA Project Team (2014)

4 CONSIDERATION OF DEMAND FORCAST

4.1. Updates the YUTRA Demand Model for YCR

YUTRA strategic demand forecast model was modified for the pre-feasibility study to prepare preliminary demand forecast for YCR. Following figure illustrates the overall structure of the upgrade YUTRA demand model.



Source: YUTRA Project Team (2014)

Figure 4.1 YCR Pre-Feasibility Study Demand Model Outline

4.2. Demand Forecast for YCR

Number of boarding and alighting passengers is calculated for the forecast years of 2018 and 2035. The total boarding passengers of YCR is expected to increase from the current demand of around 76,900 pax/day to 280,000 pax/day in 2018 to 630,000 pax/day by 2035. The 2018 & 2035 YCR forecast total passenger boarding are compared with the actual 2012 passengers. The YUTRA Master Plan Forecast is also given below. There is virtually no difference in the total forecast patronage due to change in modeling procedure.

Table 4.1 Total YCR Daily Patronage

Year	2012	2018	2035
Actual	76,900	-	-
YUTRA Master Plan	-	280,600	631,400
Pre-FS Model	-	277,500	658,897

Source: YUTRA Project Team (2014)

4.3. Issues and Considerations

YUTRA travel demand model was developed to test and evaluate alternative land use and transport infrastructure development strategies. The model outputs are coarse and not detailed enough for the implementation of the proposed transport infrastructure projects. Therefore preliminary and detailed feasibility studies and required for the project sizing, engineering design and other economic, financial and environmental evaluation purposes. The model refinements and update tasks which will yield the suitable detailed demand forecast are outlined in three sections.

(i)Future YUTRA model refinement for YCR feasibility

(ii)YUTRA traffic zone system

(iii)YCR station spacing.

5 SURVEY ON ENVIRONMENTAL AND SOCIAL CONSIDERATION

5.1. Environmental Conservation Law

The Environmental Conservation Law consists of the objectives, formation of the environmental conservation committee, environmental conservation functions and powers of the Ministry of Environment Conservation and Forestry (MOECAF), environmental emergency, and so on.

Objectives are summarized as below

- To implement the Myanmar National Environment Policy
- To provide the basic principles
- To give guidance on the systematic integration of environmental conservation matters
- To promote a good and clean environment

etc.

5.2. Environmental Impact Assessment (EIA)

The above law, however, does not stipulate the detail procedures to be taken for conducting EIA. With regard to this, Ministry of Environmental Conservation and Forestry (MOECAF) proposed Environmental Impact Assessment Procedures, draft, 2013 (“the EIA procedures”) and are waiting for further brush up and official enactment.

According the EIA Procedures, Lists of IEE/EIA required projects related to transport development are shown in the table below

Table 5.1 List of IEE/EIA required Transport Project of Infrastructure Development

Purpose and type of project	Project feature (size, etc.)
(I) IEE required project (Schedule I)	
1) River Training Works	All projects
2) Construction of Bridges	more than 50 feet and less than 200 feet
3) Port Development	All projects
(II) EIA (full EIA) required project (Schedule II)	
1) Construction of Highways and fly-over	all projects if recommended by IEE
2) Ports Development	all projects if recommended by IEE
3) Construction of Subways	all projects if recommended by IEE
4) Construction of Bridges	more than 200 feet
5) Construction of Shipyards	dead weight tonnages greater than 5,000 tons
6) Construction of Airports	airstrips of 8,200 feet (2,500 meters) or longer
7) Construction of Railways including Construction of new routes	all projects if recommended by IEE

Note: Project activities other than new construction such as rehabilitation, extension and/or improvement are not clearly stipulated.

Source: Compiled from Environmental Impact Assessment Procedures (Draft, 2013)

Schematic processes of Environmental approval in the EIA Procedures are shown in the figure below

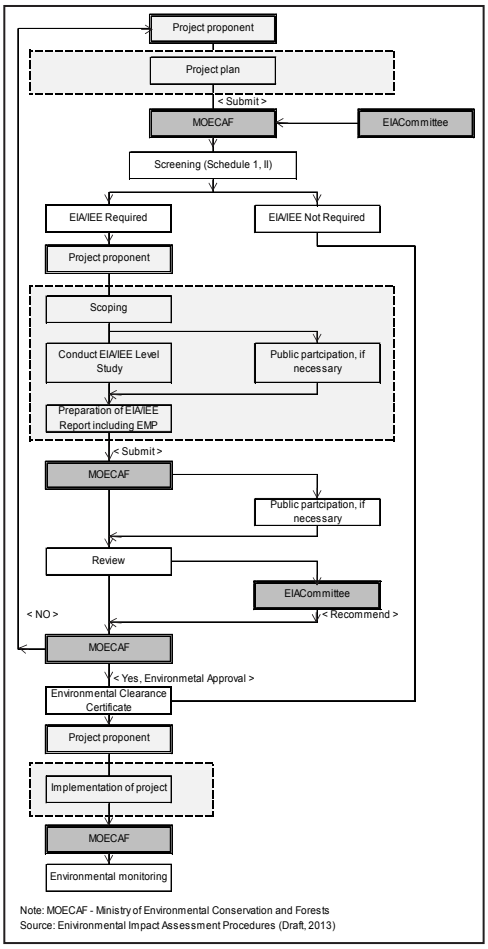


Figure 5.1 Schematic Processes of Environmental Approval

5.3. Land, Land Acquisition and Resettlement

In Myanmar definition of land are poorly defined in the legal framework and type of land can be classified into the following eleven categories; (i) Freehold Land, (ii) Grant Land, (iii) Agricultural Land, (iv) Garden Land, (v) Grazing Land, (vi) Cultivatable Land, Fallow Land and Waste Land, (vii) Forest Land, (viii) Town Land, (ix) Village Land, (x) Cantonment, and (xi) Monastery.

Regarding issues related to land acquisition and resettlement, the Land Acquisition Act 1894 promulgated in the British Colonial Era is even now the core law for land acquisition and resettlement in Myanmar. The Land Acquisition Act 1894 promulgated in the British Colonial Era is even now the core law for land acquisition and resettlement in Myanmar.

5.4. Gaps EIA procedure and Land Acquisition and Resettlement between Myanmar and JICA Guidelines for Environmental Social Considerations

As far as "Environmental Impact Assessment Procedures drafted in 2012 by MOECAF is concerned, there is little difference of EIA procedures between Myanmar legislation and JICA Guidelines. For the EIA Procedures were prepared basically by following ADB Safeguard Policy, which is mostly same as World Bank Safeguard Policy and JICA Guidelines. However, following gaps can be pointed out:

(i)The EIA Procedures are even now under disputes of concerned government organizations. In addition, institutional arrangement and budget for implementation of EIA Procedures is not established. Thus, execution of EIA is not materialized.

(ii)Land acquisition and resettlement, which may often cause critical social impacts, are out of scope in EIA procedures and approval. Therefore, MOECAF, as responsible organization for environmental conservation cannot manage whole EIA.

(iii)In addition, as for policy of land acquisition and involuntary resettlement, neither the avoidance and minimization of involuntary resettlement and loss of livelihood nor the requirement of preparation of Resettlement Action Plan is stated in any law. For the compensation only market value of the land is considered. No law is identified on the participation of project Affected Persons (PAPs) in public consultation in the land acquisition and resettlement procedures.

5.5. Inventory Survey on YCR

The survey was conducted roughly existing land use and structures within and along Right-of-Way (ROW) of YCR. Data for 76 stations and sections were obtained.

Major finding of structures/facilities and land use within ROW regardless of legality are described as below.

(i) Occupation by houses and buildings on ROW

(ii) Occupation by framing

(iii) Occupation by vendors

(iv) Occupation by sensitive receptor such as monastery

5.6. Natural Conditions to Be Considered for Planning

The present natural conditions in Yangon City to consider planning candidate projects for YCR modernization are summarized as below.

Table 5.2 Overview of Natural Condition

Natural Condition	Overview
Topographic features	• Generally slopes dwonward from the north to south • Yangon city is located 34km upstream from the river mouth of Ynagon river
Water body	• Yangon River is the largest water body • Bago River is the second largest body
Geological and soil condition	• Sagaing Fault is located eastern of Myanmar which cause large earthquakes • Most of Greater Yangon area consists of fluvial flood plain
Climate	Tropical monsoon climate • Summer (March to middle of May) • Rainy (Middle of May to middle of October) • Cool (Middle of October to February)
Tidial conditions of river	• the Highest High Water Level (HHWL) is +6.74m • Mean Water Level (MWL) is +3.21m

Source: YUTRA Project Team (2014)

In addition, flooding and inundation is one of major natural hazards in Yangon City.

5.7. Results of IEE (Initial Environmental Examination)

(i) Planning Stage

There is some possibility to occur involuntary resettlement, land acquisition and resettlement may occur, although the extent and features are depending upon project plan.

(ii) Construction Stage

Generation of pollutants such as air, water and noise as well as solid waste due to construction work. In addition, traffic congestion, disturbance of business activities and inconvenience to living conditions of residents and train passengers due to construction work

(iii) Operation Stage

In general, any negative impacts are not expected. Rather, railway project may bring about positive impact, i.e., decrease in emission of air pollutants and greenhouse gases reduction.

6 PROPOSAL FOR THE CIRCULAR RAILWAY STATION PLAZA PLANNING UNITED URBAN DEVELOPMENT

6.1. Station Plaza Space (2035)

Station plaza is necessary to meet the future demand in 2035. Necessary amount of area for station plaza are calculated by year-98(1998) formula / MLIT, Japan as shown below.

Table 6.1 Present Condition and Result of Calculation of Station Plaza Space

No.	Name of Station	Present condition of station plaza area (m2)	Necessary amount area for station plaza (m^2)	No.	Name of Station	Present condition of station plaza area (m2)	Necessary amount area for station plaza (m^2)
1	Yangon Central	10,000	11,100	20	Aungsanmyo	-	1,200
2	Phaya Rd.	-	1,400	21	Danyingone	-	2,500
3	Lanmataw	-	800	22	Gauk Kwin	-	1,700
4	Pyay Rd.	-	1,600	23	Kyaikkalel	-	3,100
5	Shan Rd.	-	700	24	Mingaladon Buzza	-	4,800
6	Ahlone Rd.	-	500	25	Mingaladon	-	5,000
7	Panhlaing Rd.	-	900	26	Waibagi	-	1,000
8	Kyeemyindaing	-	1,900	27	Okkalapa	-	2,900
9	Hanthawaddy	-	300	28	Paywetseikkon	-	600
10	Hletan	-	2,500	29	Kyaukyetwin	-	4,900
11	Kamayut	-	100	30	Tadakalay	-	900
12	Thiri Myine	-	100	31	Yegu	-	200
13	Okakyin	-	100	32	Parame	-	1,900
14	Thamine	-	1,700	33	Kanbe	-	800
15	Thamine Myothit	-	100	34	Baukthaw	-	400
16	Kyuntkon	-	700	35	Tarmwe	-	2,100
17	Insein	1,500	1,900	36	Myittanyunt	-	3,100
18	Ywama	-	1,300	37	Malwagone	-	800
19	Phwakan	-	600	38	Pazundaung	-	3,000

Source: YUTRA Project Team (2014)

6.2. Introduction of the Facility Development Plan for the Elderly/Disables Person of Railway and Road Users

In consideration for the movement facilitation based on the universal design for an elderly/disable person, it is necessary to ride on and ride off train/vehicle smoothly as possible alone using for station plaza and public passage. Other necessities are easily approach and layout of public passage and entrance, easily approach to an entrance of ticket sales office, waiting room and information desk and secure a line of flow with continuity.

Instruction and information guidance facilities are also necessary such as a tactile paving for the instruction/guidance of a visually impaired person and installation of indicating equipment to exhibit their functions of original facility enough.

Passenger facilities are also necessary for disable person. One of examples is ticket gate for wheelchair user. It is difficult to use a usual gate without any support of staffs. Fall prevention facilities are important to install on a platform for visually impaired person.

In Japan, the guidelines and the design standards about the facilities for elderly/disabled person are already prepared, and the utilization to the project is expected.

6.3. Study for the Proper Place Selection Integrally with Urban Development

MR has large lands along the railway and these lands are appropriate for redevelopment and TOD because project can be conducted inside railway area with no land acquisition and resettlement. In addition, there are several UMRT and BRT plan, therefore the development or redevelopment plan of each station plaza should be considered with these traffic development plans.

Each station plaza plan is categorized to five classes based on the above mentioned calculation result of station plaza space, and present condition and transportation development plan as following below.

Table 6.2 Definition of Categorizing the Station

Category	Definition
Category-1	Stations which are important in traffic function and the land acquisition for the station plaza are relatively easy
Category-2	Stations which are important in traffic function, however, the land acquisition for the station plaza are relatively difficult
Category-3	Traffic demand is not so large, though there are plans of BRT
Category-4	Traffic demand is large, though there are no plan of BRT
Category-5	Traffic demand is not so large, and there are no plan of BRT

Source: YUTRA Project Team (2014)

Summary of MR's yard for redevelopment, existing development plan and categorize of station plaza plan are summarized below table. 16 stations which are category-5 don't have existing development plan.

Table 6.3 Categorize of Station Plan

Station No.	Name of Station	MR's Yard for redevelop-ment (m^2)	Existing Development Plan	Categorize of Station Plaza Plan
1	Yangon Central	160,000	RL-7,RL-8, BRT2&5, UMRT-1	Category-1
4	Pyay Rd.	-	BRT2	Category-3
7	Panhlaing Rd.	-	BRT2	Category-3
8	Kyeemyindaing	50,000	RL-6, RL-9	Category-1
10	Hletan	-		Category-4
14	Thamine	-	BRT3	Category-3
17	Insein	260,000	RL-6,RL-10, BRT, UMRT-2	Category-1
18	Ywama	-	BRT2	Category-3
21	Danyingone	-	RL-6	Category-2
22	Gauk Kwin	-	BRT2	Category-3
23	Kyaikkalel	-		Category-4
24	Mingaladon Buzza	-		Category-4
25	Mingaladon	-		Category-4
26	Waibagi	-	UMRT-1	Category-3
27	Okkalapa	-		Category-4
29	Kyaukyetwin	-		Category-4
31	Yegu	-	BRT3, UMRT-1	Category-3
32	Parame	-	BRT3	Category-2
35	Tarmwe	-	BRT9	Category-2
36	Myittanyunt	-		Category-4
37	Malwagone	610,000	RL-14	Category-3
38	Pazundaung	-		Category-4

Source: YUTRA Project Team (2014)

7 *PRELIMINARY COMPARISON FOR PRIORITY SECTION SELECTION*

7.1. Criteria for Section Comparison

Criteria for section comparison are decided as below six items.

(1)Integrity of upper plans of railway sector

(2)Traffic demand

(3)Environmental and social impact

(4)Damage level of infrastructure

(5)Technical Feasibility

(6)Cost aspect.

7.2. Section Comparison and Selection of Priority Section

Relatively important seven stations which mean many boarding /alighting passengers, large station yard, train starting station, are chosen and divided into 7 sections as table below.

Table 7.1 Divided Sections

	Section
Section1	Yangon Central - Kyeemyindaing
Section2	Kyeemyindaing - Insein
Section3	Insein - Dayingone
Section4	Dayingone - Mingaladon
Section5	Mingaladon - Paywetseikkon
Section6	Paywetseikkon – Malwagone
Section7	Malwagone - Yangon Central

Source: YUTRA Project Team (2014)

Evaluation rank and point of all sections are summarized as table below.

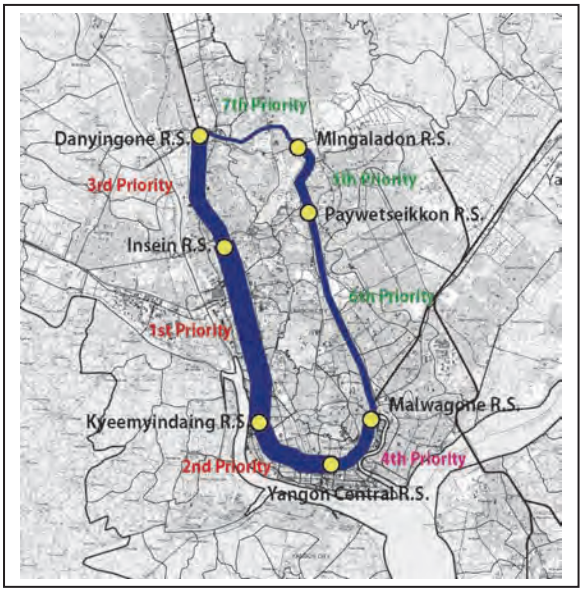
Table 7.2 Comparison Table for Selection of Priority Section

	Section1	Section2	Section3	Section4	Section5	Section6	Section7
(1)Consistency with Upper Plans of Railway Sector	A SUDP, YUTRA	A SUDP, YUTRA	A SUDP, YUTRA	C	C	C	B YUTRA
(2)Traffic Demand	A	A	B	D	C	C	A
・At present	79 trains/day	79 trains/day	54 trains/day	14 trains/day	34 trains/day	38 trains/day	102 trains/day
・Future demand in 2018	B	A	C	B	B	B	C
	12,000 pax./day	31,100 pax./day	8,800 pax./day	17,000 pax./day	23,200 pax./day	13,500 pax./day	6,600 pax./day
・Future demand in 2035	B	A	B	C	B	B	B
	44,100 pax./day	54,000 pax./day	42,400 pax./day	26,300 pax./day	44,700 pax./day	44,600 pax./day	36,900 pax./day
(3)Environmental and Social Impact	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	To be evaluated by the next FS						
(4)Damage Level of Infrastructure	A	A	A	A	A	A	A
	All infrastructures are deteriorated and there is no remarkable difference of damage						
(5)Technical Feasibility	A	A	A	A	A	A	B
(6)Cost Aspect (USD)	A	B	A	B	A	C	A
	83.3mil.	135.0mil.	86.3mil.	101.1mil.	59.9mil.	172.4mil.	64.3mil.
Total Evaluation Ranke and point	2nd	1st	3rd	7th	5th	6th	4th
	26point	27point	24point	19point	22point	20point	23point

Note: A(Excellent:4point), B(Good:3point), C(Fair:2point), D(Poor:1point)

Source: YUTRA Project Team (2014)

As the result, Section2 (Kyeemyindaing - Insein) is evaluated as highest priority section. Secondary, Section1 (Yangon Central – Kyeemyindaing) and Section3 (Insein – Dayingone) are evaluated as 2nd and 3rd ranked priority sections respectively. Section7 (Malwagone - Yangon Central) is evaluated as 4th ranked priority section. The other sections, mainly eastern half of Yangon Circular Railway, are evaluated as lower priority sections in comparison of the western half sections and these section should be improved after the completion of the western half improvement.



Source: YUTRA Project Team (2014)

Figure 7.1 Evaluation Result for Priority of Each Section

1 UPPER PLANNING, COMPREHENSION OF THE CURRENT ISSUE

1.1 Current Situation and Issue of Transport Sector in the Greater Yangon

1.1.1 General

1) Urban Development

Because Yangon is surrounded by the river on three sides, urban growth is mainly observed on the north direction from the CBD until 1980s, but after 1990s the urbanization is extended to east-west axis also. Industrial area has been mixed in the residential area, but they have been relocated to the east and north, and west of the Hlaing River after 1990s.

Population in the Study Area is 5.5 million and average annual growth rate in YCDC is 2.6%. Population density in the CBD is very high, 36,500 persons/km2. About half of the residents is working (Refer to Table 1.1.1.1)

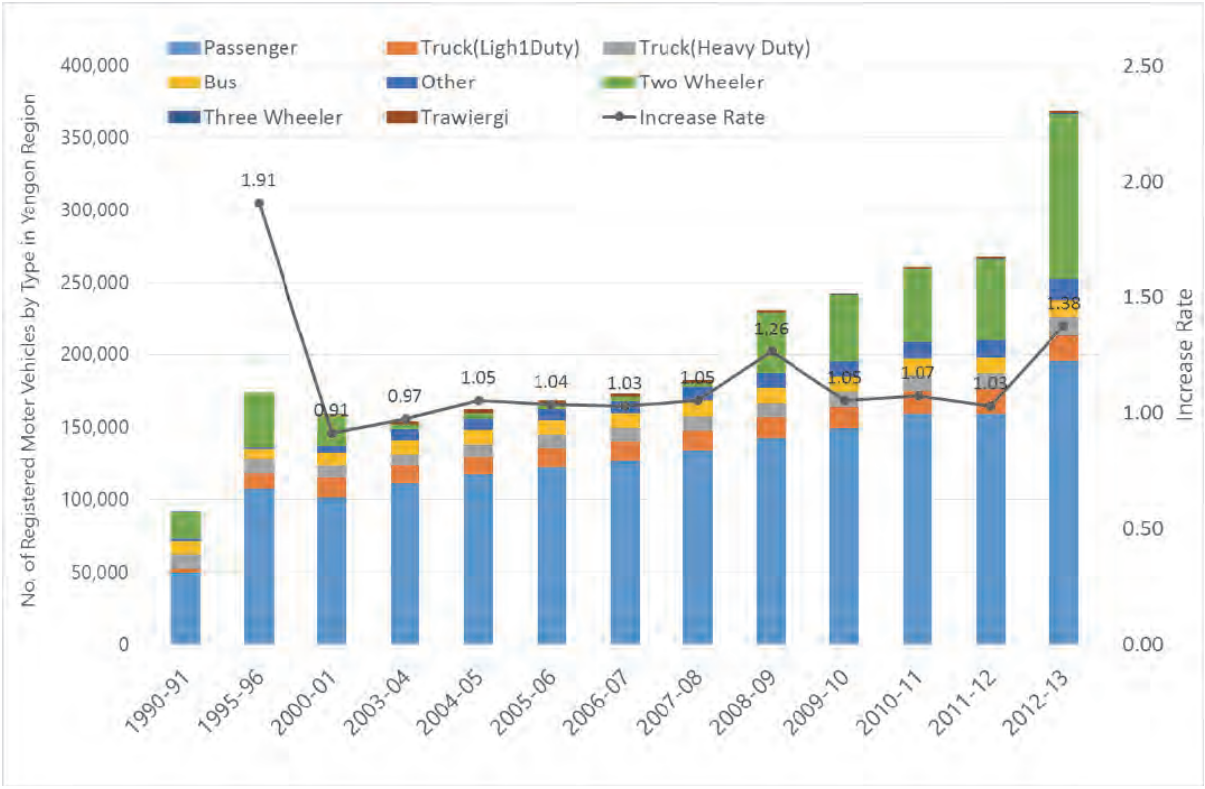
Table 1.1.1.1 Implementation Schedule of Public Transport Projects

Township	Population			Density (000 pers./ km2)	Area (km2)	No. of Workers	
	1998	2011	Annual Growth '98-'11			Total Workers	% to Total Pop.
CBD	255,685	252,391	-0.10%	36.5	6.9	118,297	46.9%
Inner City	689,081	778,156	0.94%	15.7	49.4	559,800	71.9%
Outer City	598,436	596,426	-0.03%	17.4	34.2	265,464	44.5%
Old Suburb	1,386,581	1,803,129	2.31%	5.2	345.1	1,048,538	58.2%
New Suburb	687,098	1,642,030	6.93%	4.1	404.9	575735	35.1%
YCDC Total	3,691,941	5,142,128	2.58%	6.2	829.0	2,611,977	50.8%
Periphery Total	N.A.	430,114	-	0.6	706.8	N.A.	-
Study Area Total	N.A.	5,572,242	-	3.6	1,534.9	N.A.	-

Source: SUDP, JICA (2013)

2) Motorization

Car ownership rate in Myanmar has been kept low since the per capita GDP is still low and the import of foreign cars has been regulated by the government. However, the deregulation was performed to facilitate the renewing of the old vehicle from September 2011. Now new vehicle registration is rapidly increasing in Yangon shown Figure 1.1.1.1. It shows that the number of registered car in 2012-13 is about 370,000 cars which increased by 38 % from a year ago, while the number during last 10 years increased by about 5 % year on year.



Source: Road Transport Administration Department, As of July 4, 2013

Figure 1.1.1.1 Registered Motor Vehicles by Type in Yangon Region

1.1.2 Main Transport Components

1) Road

(1) Current Road Network

YCDC classified roads based on road width and number of lanes as shown below.

- Main Road: Connects major cities and towns with paved type links (incl. Union Highways inside YCDC area)
- Collector Road: Secondary paved roads connecting cities/towns with Main Roads
- Minor Road: Other roads connecting towns

Major roads in Yangon City are illustrated in Figure 1.1.2.1.

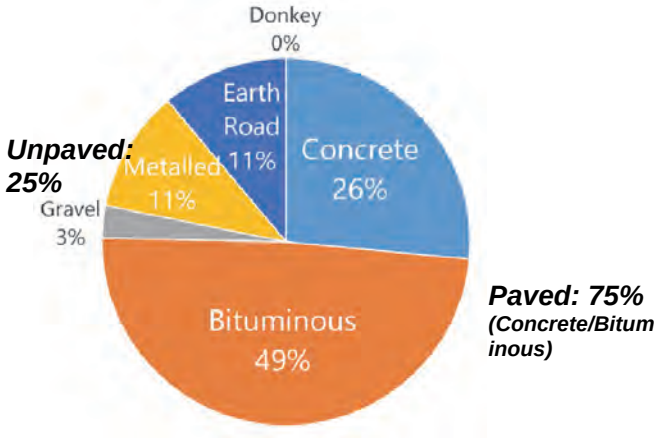
Source: SUDP (JICA), 2013

Figure 1.1.2.1 Current Road Network in Yangon City

(2) Road Length and Surface Conditions

Total road length in Myanmar is 148,690 km. In Yangon region, total road length is 4,908 km which includes 980 km under MOC and the rest 3,928 km under YCDC.

Figure 1.1.2.2 shows the road length in Myanmar by responsible authority and by type of road surface. 54% of roads under control of MOC are still unpaved. On the other hand, 76% of roads under control of YCDC is paved.



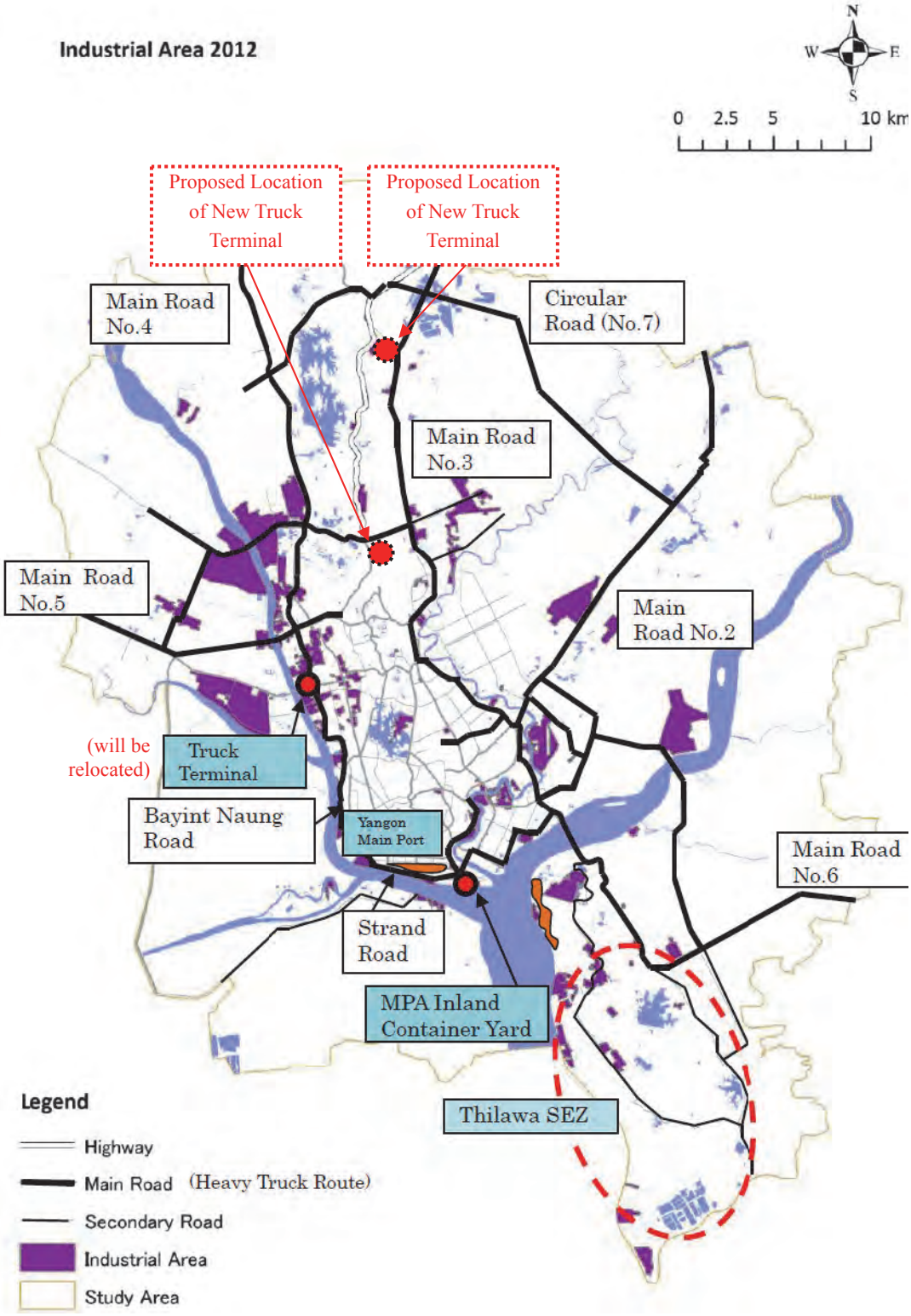
Source: YUTRA Project Team, Department of Public Works, MOC, reported in 2012

Figure 1.1.2.2 Surface Condition of Roads under MOC and YCDC

(3) Other Road Related Facilities

(i) Truck Terminals and Inland Container Depot (ICD)

Figure 1.1.2.3 shows the main roads connecting the ports, logistic facilities and industrial areas. There are more than 30 truck centers in Yangon City and the largest one, Bayint Naung Truck Terminal, is located near the Bayint Naung Bridge. The terminal is located inside the densely developed area and causing traffic congestion in Baying Naung area which is well-known as one of serious congestion area in the city. Highway Freight Transportation Services Association (HFTSA) and Yangon Region Government are discussing where to transfer the terminal.

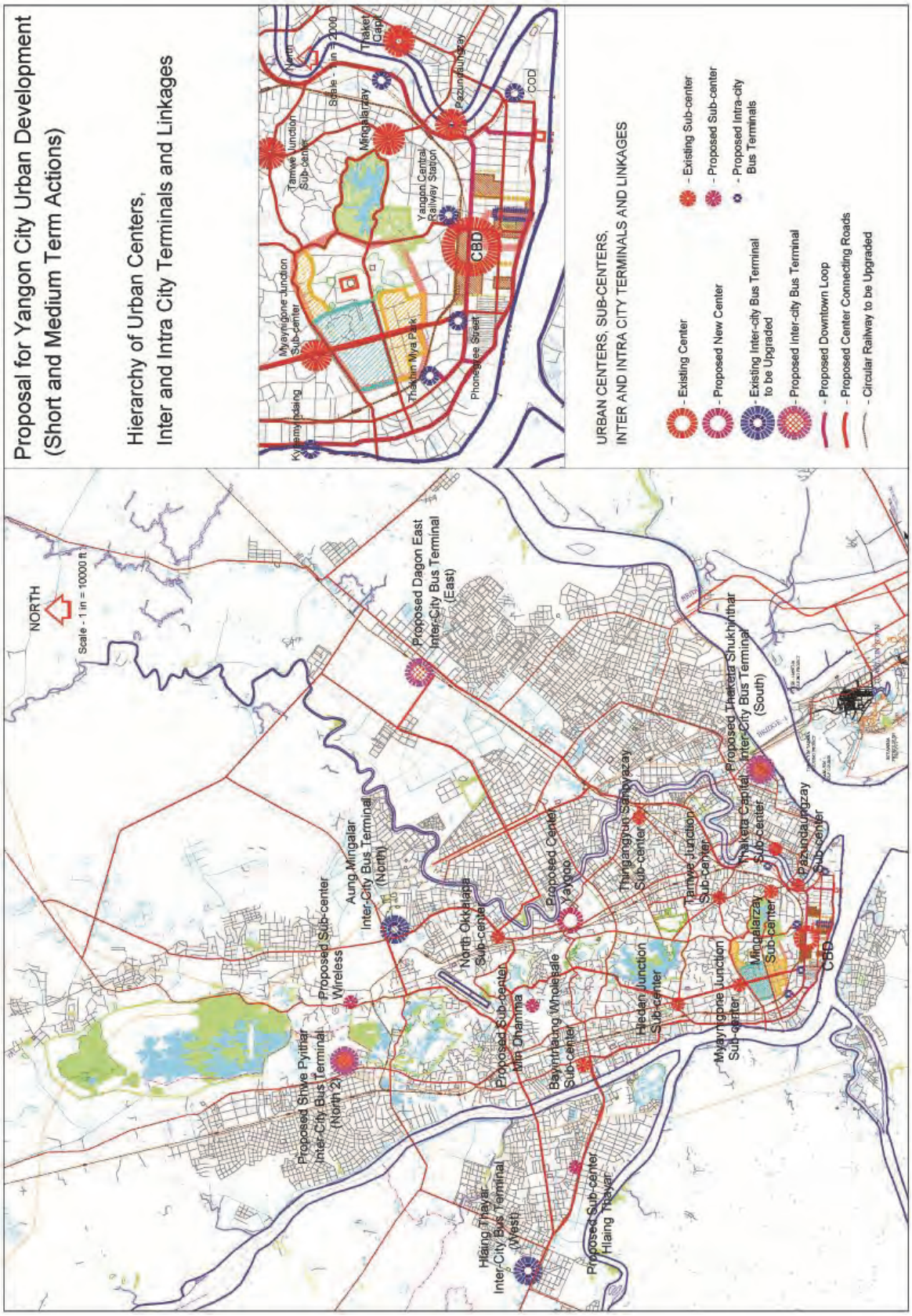


Source: based on the information from the Traffic Regulation Control Committee, YCDC

Figure 1.1.2.3 Connectivity with Ports, Logistic Facilities and Industrial Areas

(ii) Bus Terminals

Figure 1.1.2.4 shows existing and proposed bus terminal planned by DHSHD, MOC. The location of proposed bus terminals is considered connection with future ring road. The connection with railway network is also important. Detailed plan with a view to railway network planned by YUTRA is required.



Source: DHSHD

Figure 1.1.2.4 Existing and Proposed Bus Terminals

2) Public Transport Services

(1) Existing Situations

Bus can be considered as the main workhorse of public transportation in Yangon Region. Chapter 1.1.3 stated bus accounted for high modal share. Within Yangon City limits, it is illegal to drive trishaws, bicycles, and motorcycles. The bus transport, therefore, would continue to remain as the main mode of public transportation despite the facts that its level of service is not very satisfactory.

(2) Structure of Bus Transport Industry

Currently bus services are provided through a multiplicity of mechanisms by a mix of public and private sector operators. Generally, it can be categorized as 3 main groups in the provision of bus services in Yangon Region. These are:

- Private bus companies: The private bus companies are large-scale bus operators who provide bus services with their own vehicles, drivers and conductors. At present, there are two private bus companies in Yangon.
- Individual private bus owners managed by Bus Supervisory Committees (BSC): BSCs are non-government organizations. The committees do not engage themselves in any bus service supply of their own vehicles rather they monitor and supervise bus operation and individual bus operators. They employ dispatchers, route supervisory staff and office staff. Their revenue comes mainly from the commission fee paid by individual bus operators. Currently there are six BSCs in Yangon Region.
- Bus Line Committees (BLC): BLCs are also non-government organizations and similar function with Bus Supervisory Committees. There are 10 BLCs in Yangon Region.

There are total 18 bus line organizations and all are under the supervision of Yangon Region Central Supervisory Committee for Motor Vehicles and Vessels (Ma-hta-tha-Central).

(3) Bus Related Facilities

Even though bus transport has a predominant share in people's travel, levels of service are not sufficient enough in terms of reliability of operation, comfort and safety. And bus related facilities such as bus stop shelter, and seating facilities are also in poor conditions. Nearly half of the commuters stated long waiting time and on-board crowding (HIS, 2012).

A poorly planned system resulted in bus route overlapping; add to traffic congestion as well as on-road competition among the operators.

More importantly, bus fare level is strictly regulated by the Yangon Region Government. The present bus fare in Yangon is at low levels (50-300 MMK) for benefit of people. However, bus operators must follow this government policy. Consequently, in order to maximize revenue from bus operation, uncomfortable, unreliable and unsafe travel is resulted.

Additionally, the supply of buses cannot keep up with demand which leads to overcrowded on buses because of poor management of the fleets, low maintenance standard, vehicle

wear out due to poor road condition, lack of supply of spare parts and inadequate funds are available for fleet replacement.

1.1.3 Transport Demand Characteristics

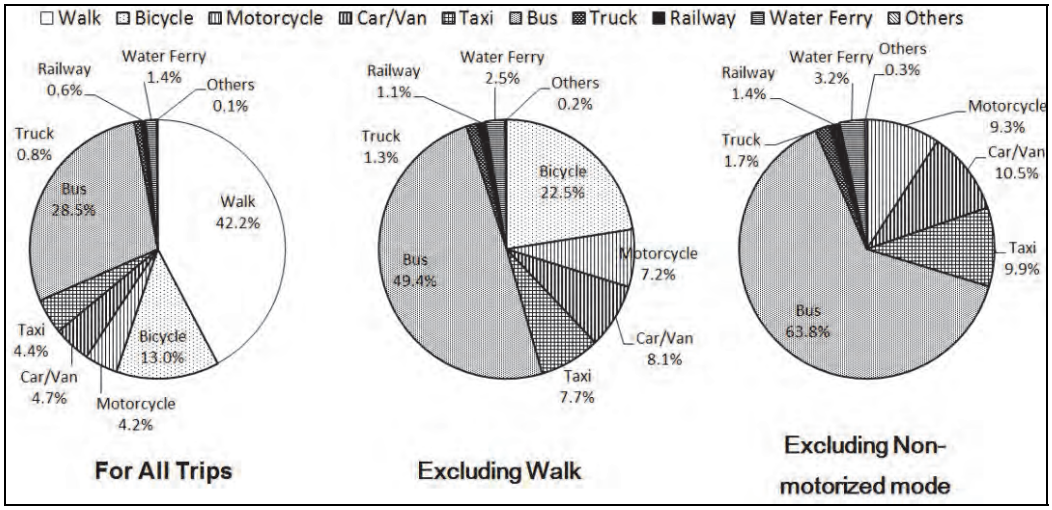
In the study area, about 11 million trips are made in a normal weekday in 2013 as shown in Figure 1.1.2.1. However, about 4.78 million trips or 42% of the total trips are of walking.

Modal shares obtained by the YUTRA person trip survey is summarized in Figure 1.1.2.5. It is to be noted that the share of walking is remarkably high at 42.2 % in the Greater Yangon. Excluding walking, bus has the largest share at 49.4 %, followed by bicycle (22.5 %), car/van (8.1%), taxi (7.7 %), motorcycle (7.2 %), etc. The combined share of public transport (bus, taxi, railway and water ferry) is 60.7 % ("excluding walking").

Table 1.1.2.1 Number of Person Trips in the Study Area by Mode, 2013

Mode	Groups	The number of Trips (Trips /day)	Modal Share by Each Mode (%)			Modal Share by Group (%)		
			For all Trips	Excluding Walk	Excluding Non-Motorized Mode	For all Trips	Excluding Walk	Excluding Non-Motorized Mode
Walk	Walk	4,777,672	42.2	-	-	42.2	-	-
Bicycle	Bicycle	1,471,790	13.0	22.5	-	13.0	22.5	-
Motorcycle	Motorcycle	471,386	4.2	7.2	9.3	4.2	7.2	9.3
Car	Car/Van	440,759	3.9	6.7	8.7	4.7	8.1	10.5
Van		88,885	0.8	1.4	1.8			
Taxi	Taxi	501,689	4.4	7.7	9.9	4.4	7.7	9.9
Sc / Co Bus	Bus	603,674	5.3	9.2	11.9	28.5	49.4	63.8
Passenger Truck		390,923	3.5	6.0	7.7			
Small-Bus		377,662	3.3	5.8	7.5			
Large-Bus		1,856,273	16.4	28.4	36.7			
Pick-up	Truck	63,619	0.6	1.0	1.3	0.8	1.3	1.7
Medium-Truck		13,963	0.1	0.2	0.3			
Large-Truck		5,544	0.0	0.1	0.1			
Trailer		5,073	0.0	0.1	0.1			
Railway	Railway	71,215	0.6	1.1	1.4	0.6	1.1	1.4
Water Ferry	Water Ferry	160,200	1.4	2.5	3.2	1.4	2.5	3.2
Others	Others	12,858	0.1	0.2	0.3	0.1	0.2	0.3
Total		11,313,185	100	100	100	100	100	100

Source: YUTRA Person Trip Survey, 2013



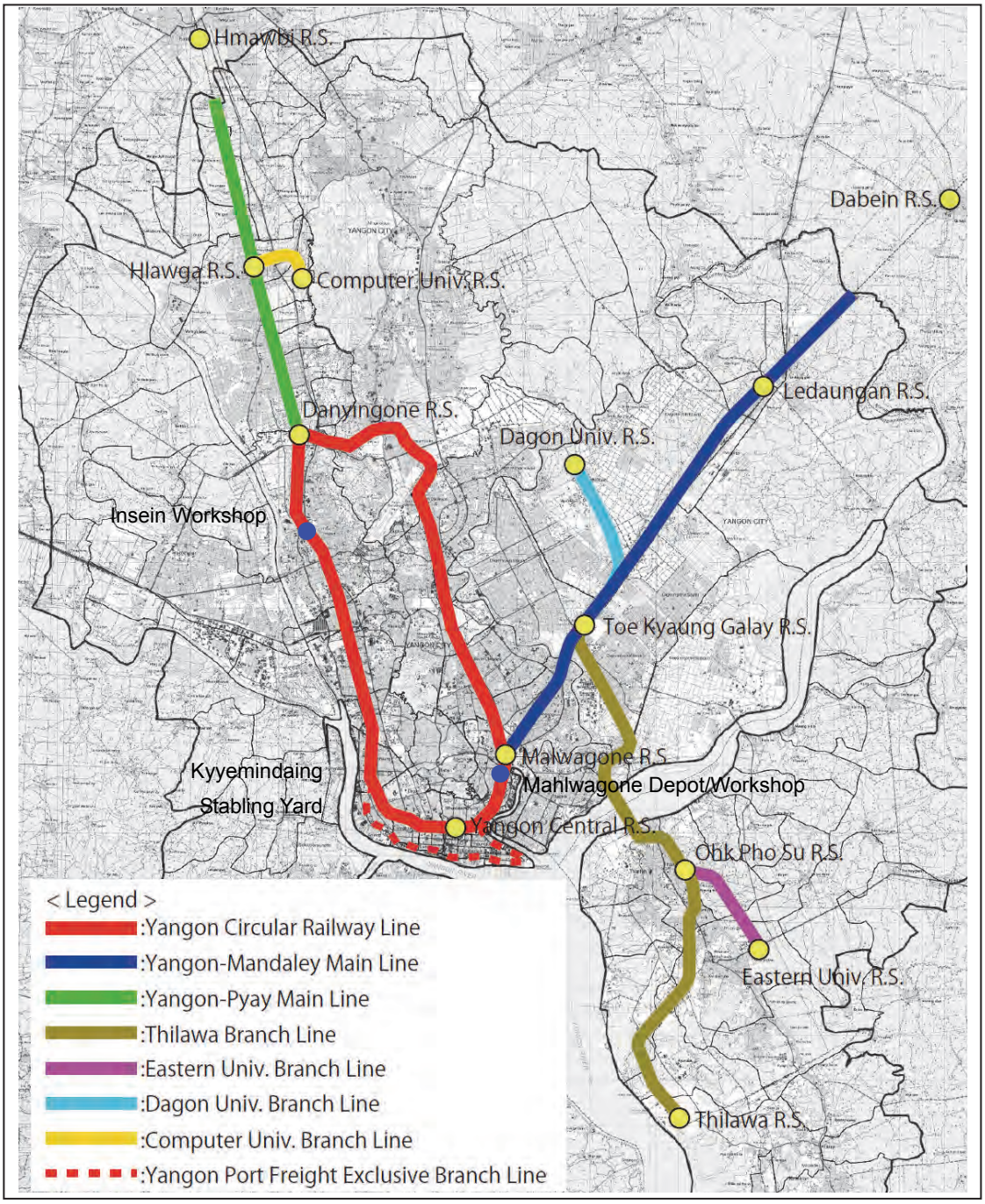
Source: YUTRA Person Trip Survey, 2013

Figure 1.1.2.5 Modal Share, 2013

1.2 Current Situation and Issue of Railway Sector in the Greater Yangon

1.2.1 Railway in Greater Yangon

All railway in Greater Yangon is managed and operated by Myanma Railways (MR), which is under the umbrella of Ministry of Rail Transport (MORT). The current railway network in Greater Yangon is composed of eight lines, which include three main lines and five branch lines (including one exclusive freight line), as shown below.



Source: YUTRA Project Team

Figure 1.2.1.1 Current Railway Network in Greater Yangon

Greater Yangon has eight railway lines consisted of 3 main lines, 4 branch lines and 1 exclusive freight line, all owned and operated by MR. The features of each line are shown in table below.

Table 1.2.1.1 Summary of Current Railway Routes in Greater Yangon

Route Name	Section	Length (km)	No. of Railway Station	Single track/ Double track	No. of Daily Operated Train	Remarks
Main Line						
Yangon Circular Railway Line	Whole Yangon Circular Railway	46.12 km	38	Double-double Track: (Yangon–Malwagone:3.6km) Double Track: (Remaining Section)	Yangon – Malwagone: 102 Malwagone – Paywatseikkone: 38 Paywatseikkone – Mingaladon: 34 Mingaladon – Danyingone:14 Danyingone – Insein: 54 Insein – Yangon: 79	
Yangon – Mandalay Main Line	Malwagone R.S. – a point between Ledaungan R.S. and Dabein R.S.	28.3 km	6	Double Track	Malwagone – Toe Kyaung Galay: 64 Toegyaunggalay – Ywarthagyi: 16	
Yangon – Pyay Main Line	Danyingone R.S.- Hlawga R.S.- a point between Hlawga R.S. and Hmawbi R.S.	20.1 km (10.5 km +9.6 km)	4	Double Track: (Yangon–Hlawga) Single Track: (Hlawga –Hmawbi)	Danyingone – Hlawkar: 40	
Branch Line						
Thilawa Branch Line	Toe Kyaung Galay R.S. – Ohk Pho Su R.S. – Thilawa R.S.	26.2 km	5	Single Track	Toe Kyaung Galay – Ohk Pho Su: 18 Ohk Pho Su – Thilawa: 4	
Eastern Univ. Branch Line	Ohk Pho Su R.S. – Eastern Univ. R.S.	5.4 km	1	Single Track	12	
Dagon Univ. Branch Line	Toe Kyaung Galay R.S. – Dagon Univ. R.S.	8.0 km	1	Single Track	18	
Computer Univ. Branch Line	Hlawga R.S. – Computer Univ. R.S.	2.9 km	1	Single Track	4	
Yangon Port Freight Exclusive Branch Line	Pazundaung R.S. – Botahtung Freight R.S. – Wadan Freight R.S. - Kyee Myin Daing R.S	9.9 km	2	Single Track	2 to 3 (irregular trains, Botahtaung Sta. / Dahnitaw Oil Sta. – Malwagone Sta.) 0 (No operation between Kyeemyindaing Sta. and Botahtaung Sta.)	No Passenger service. Freight train only.
Total		148.3 km (138.4 km for passenger line)	58 (56 for passenger station)		200	No. of R.S. is except Halts. R.S. + Halts =80 (78 for Pax.)

Source: "Traffic Data Yangon Circular Railway 2012 by MR", interview to MR, and Google Earth

At present, Yangon Circular Railway, which runs through the mostly urbanized area of Yangon, is used by two types of commuters; i) relatively low income earners and ii) poor farmers who bring their cultivated products from the northern part of Yangon City to sell in CBD area, according to the ridership survey. It seems that upper class people tend to use bus transport and seldom use railway due to the low frequency, low punctuality, low comfort ability, poor feeder service, and slow speed in spite of the low fare.

1.2.2 Current Situation and Issues

The modal share of railway in Greater Yangon is merely 1.4% only. It is because of poor railway network, poor passenger service, poor access to station, poor feeder at station, many accidents, dirtiness at stations and in trains, and so on. Followings are major issues for current railway system in Greater Yangon including Yangon Circular Railway.

1) Poor Railway Network

The number of railway lines is absolutely insufficient judging from the present population (6.5 million) of Yangon, rapid economic growth and the urban structure (Decentralized Urban Pattern) proposed in this study.

2) Deteriorated Infrastructures

All railway infrastructure has been deteriorated due to the lack of maintenance budget for many years. As some major example, there are terrible track irregularity, worn out light rail, broken track bed and frequent signal trouble due to flooded track in rainy season by insufficient drainage system, unstable telecommunication system, poor performed rolling stocks (passenger cars with low transport capacity hauled by old diesel locomotives with poor acceleration/deceleration performance), etc.

3) Inappropriate track maintenance work

Inappropriate track maintenance work is conducted including ballast spreading to meaningless place, lack of ballast tamping, irregular interval of placing sleepers, inappropriate rail joint treatment, etc

4) Mismatching between railway user's needs and current railway service

Currently MR is operating large number of trains which is more than 200 trains in Yangon Circular Railway and the Suburban Lines. It means MR is already providing moderate transport capacity as a whole. However, railway's modal share is quite low. It seems that the one of the reasons is mismatching between railway user's needs and current railway service. For example, MR is providing "circular railway" for users who want to move circularly in Yangon city. However, such needs may be quite rare and almost users may want to move radially from CBD.

5) Poor passenger service and insufficient feeder service at stations

The stations are not functional as key traffic connecting areas, due to poor condition of station plaza and poor ticketing system. It takes time for boading and alighting to/from train because of low height platform. In addition, poor access to station and no feeder service discourage commuter against using railway.

6) Many Level Crossings in Yangon Circular Railway

Yangon Circular Railway has 25 level crossings and it induces traffic jam. In addition, level crossing operation for manually opening/closing a barrier takes a long time, and it impairs the shortening of train operation interval.

7) Ineffective train diagram and bottleneck due to mixing long-distance trains with Yangon Circular trains

There is a bottleneck caused by inappropriate track layout between Yangon R.S. and Pazundaung R.S. In the section, two tracks for Yangon Circular Railway and long distance

Yangon-Mandalay Line are grade crossing, and the number of tracks in this section is reduced. In addition, the section between Yangon R.S. and Danyingone R.S. is used for both Yangon circular trains and long distance trains, and it causes a delay in Yangon circular trains and restrict shortening of train operation interval.

8) Ineffective Budget Allocation System in MR

Myanma Railways regional administration/division in charge of Yangon area (Division 7 in Lower Myanmar Administration) has no budget of its own which they can control because the authority for budget allocation is given to Myanma Railways headquarters only, and it causes an obstruction in establishing Division 7's own development/maintenance plan.

9) Lack of business mind of MR

MR has commercial section, however, it is only for administration of non-rail business, and there is no section to study and establish the strategies for increasing railway users. In addition, authority for budget allocation and implementation is only given to MR headquarter in Nay Pyi Taw. Division 7, which administrate Yangon Circular Railway, etc., has no authority to control budget, revenue and expenditure, therefore motivation for increasing revenue is low.

10) Unclear demarcation of authorities and duties among MORT/MR

It seems that although railway infrastructure including Yangon Circular Railway is managed and administrated by MR, decision-making whether large-scale improvement project with borrowing huge fund is implemented or not is conducted by MORT. However, the demarcation of authorities and duties among MORT/MR is not clear because both are actually one and inseparable. In case of conducting large-scale upgrading project, it is necessary to make the demarcation of duties among them clear, and establish an counterpart organization such as Project Management Unit (PMU) which has authority including budget implementation.

11) Poor moral and unmannerly behaviour by resident along the line, and citizen crossing the line

Train is frequently forced to reduce the operation speed due to some residents along the line entering to the track to throw their rubbishes, etc., and many cars coming into level crossing even closed, etc.

1.3 Comprehension of the Current Upper Plans of Railway Sector in Yangon Region

There are four upper plans about Railway Sector shown as below.

- Strategic Urban Development Plan of the Greater Yangon (SUDP)
- Comprehensive Urban Transport Plan of the Greater Yangon (YUTRA)
- Fact about Myanma Railways 2013 (Latest Year Book of Myanma Railways)

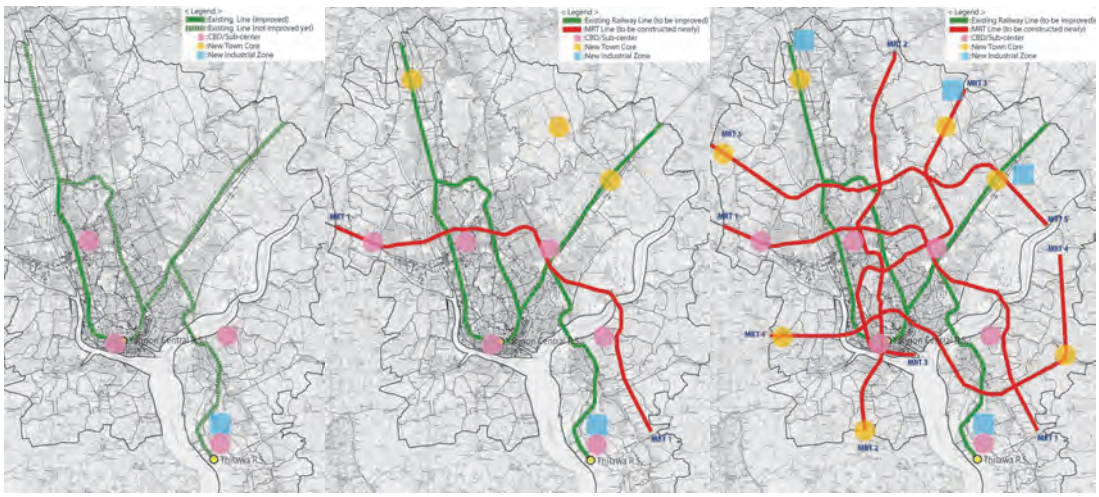
These recommendations and future plans about railway in these upper plans are summarized as below

1.3.1 Strategic Urban Development Plan of the Greater Yangon (SUDP)

SUDP decided three target years, which are 2018 as short-term, 2025 as middle-term, and 2035 as long term, and proposed to improve all existing railway line and install five MRT lines as the final layout in 2035, in order to realize environmental-friendly, and comfortable / convenient transport system (high-mobility and reliable transportation system led by

modernized urban railway, and contribution to promote the planned new urban development). Regarding Yangon Circular Railway, it is proposed to improve the western half as short-term project and eastern half as middle-term project according to the principle “to give priority to the improvement and upgrading of the existing railway line”, and “to give priority to high population density areas in case of improvement of the existing railway line”. It notes that railway development plan in SUDP is established by preliminary analysis without any traffic survey such as PT survey etc.

The conceptual layout plans for short-term, middle-term, and long-term railway infrastructure development prepared by SUDP are shown in the following.



Short-term(2018) Middle-term(2025) Long-term(2035)

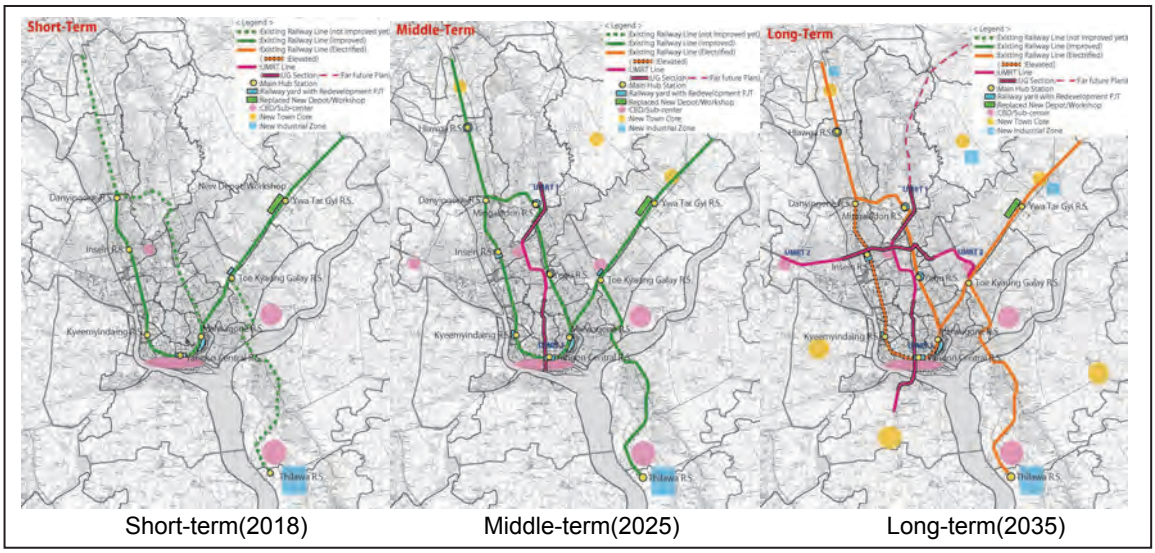
Source: SUDP, JICA (2013)

Figure 1.3.1.1 Conceptual Layout Plan for Railway Infrastructure Development by SUDP

1.3.2 Comprehensive Urban Transport Plan of the Greater Yangon (YUTRA)

YUTRA is the sector master plan derived from SUDP and also follows SUDP’s target years, which are 2018 as short-term, 2025 as middle-term, and 2035 as long term. In YUTRA, all urban transport plan including railway was reviewed based on the detail traffic demand forecast result, and proposed to modernize/electrify all existing railway line and install two UMRT lines as the final layout in 2035, in consideration of more realistic development taking into account of necessary budget than SUDP. Regarding Yangon Circular Railway, YUTRA proposed to apply “step-wise development” for upgrading Yangon Circular Railway, which means at first the existing line is improved on at-grade and non-electrification basis as short-term and middle term measure, and then the western half is modernized on elevated and electrified line and the eastern half is upgraded on electrified lines.

The layout plans for short-term, middle-term, and long-term railway development prepared by YUTRA are shown in the following.

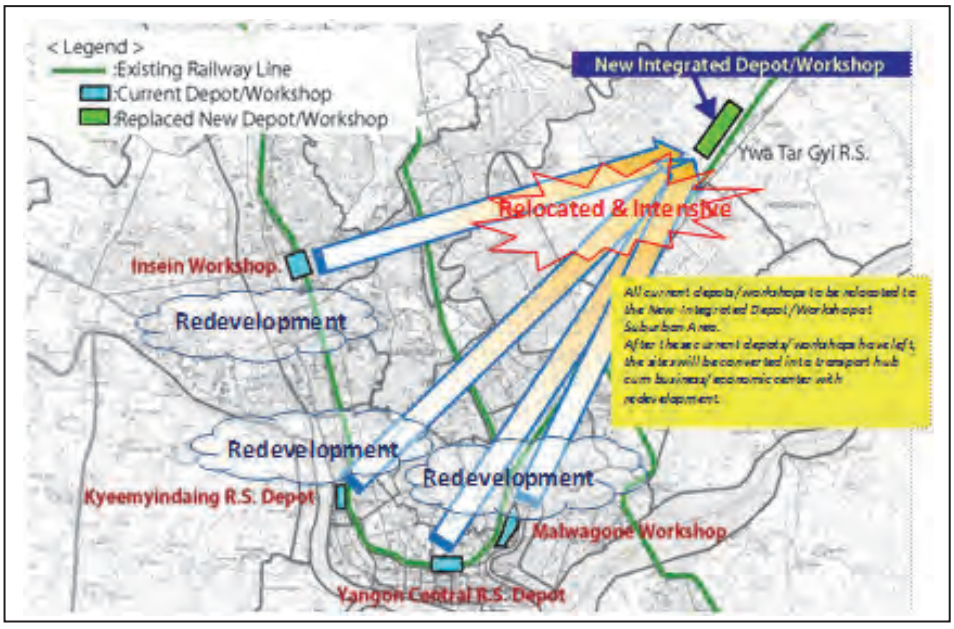


Short-term(2018) Middle-term(2025) Long-term(2035)

Source: YUTRA Project Team (2013)

Figure 1.3.2.1 Conceptual Layout Plan for Railway Infrastructure Development by YUTRA

In addition, YUTRA proposed to enhance transport connection function at stations and redevelop plenty MR land lots along railway lines for business / commercial area by using private fund. Regarding Yangon Circular Railway, Yangon central station maintenance shed/stabling yard, Kyeemyindaing station yard, Insein workshop/maintenance shed yard, and Malwagone depot/maintenance shed yard are listed as candidate land. At present, these lands have some functions for railway operation and maintenance. Therefore, YUTRA also proposed to relocate and concentrate these functions to large vacant area located at the northern side of Ywa Tar Gyi station along Yangon-Mandalay Line. The schematic figure is shown below.



Source: YUTRA Project Team (2013)

Figure 1.3.2.2 Conceptual Plan to Relocate Functions at Existing Depots and Workshops proposed by YUTRA

1.3.3 Fact about Myanma Railways 2013

Myanma Railways have issued their yearbook named “Fact about Myanma Railways” every year. The book is composed of a) History & Chronology, b) Railway Network, c) Organization, d) Fixed Assets, e) Financial Status, f) Present Traffic Volume, g) Present Freight Traffic, h) Rolling Stocks, i) Depot/Workshop, j) Train Operation k) Track l) Track Maintenance, m) Signal & Telecommunication, n) Future Development Plan, of Myanma Railways. In the chapter for “Future Development Plan”, MR plans i) procurement and rehabilitation of rolling stock, ii) improvement of signalling and telecommunication system, iii) track and bridge renewal, iv) Yangon-Mandalay track rehabilitation, v) new line extension, and vi) railway links to the neighbouring countries, as their development plan. In the development plan, the following articles are related to Yangon Circular Railway.

- Procurement and rehabilitation of rolling stock: “Rehabilitation of the aged stocks and acquisition of new motive power and rolling stock” including for Yangon Circular Railway.
- Improvement of signalling and telecommunication system: “Installation of underground communication cable line between Yangon and Ahlone station. After completion of this section, the whole section Yangon circular line will be communicated with underground line, and “Kyeemyindaing yard will be upgraded with all relay interlocked and colour light signalling system”.
- Track and bridge renewal: “renewal of track on various line”, and “construction and rehabilitation of super structures and bridges” including for Yangon Circular Railway.

The development plan has a problem that it is not clear “what is the purpose / objective to be achieved”.

1.4 Confirmation of the Contents, Progress and Existence of Related Project of Public Transport Sector by Other Donor or Private Company

1.4.1 Other Donor

According to the interview to MR headquarter, there are some movement from the other donors at present as below.

- Korea Exim Bank plans to give ODA loan of USD 45 million to purchase passenger coaches with AC and freight wagons for whole MR.
- India decided to finance non-ODA loan of USD 60 million (USD30mil. for civil work and USD30mil. for rolling stock procurement which consist of 50 timber wagons, 100 hopper wagons, 100 container freight wagons, 20 diesel locomotives, and 20 passenger coaches with AC) for whole MR. In addition, additional USD 15 million is under negotiation with Myanmar government as future loan.
- There was a plan to improve Pyay line (Insein to Pyay) by China. However, it was only general proposal submission and it is not necessary to coordinate with the other project.
- MR announced on newspaper to invite EOI for E-ticket system establishment.

1.4.2 Private Company

According to the questionnaire survey to MR, there is no movement from any private company at present. However, we obtained some documents and information about the interest by some private companies as below.

- Urban Railway Construction in Yangon City, TESO-Seoul Metro (Korea), 2013
- Mass Transport (BRT, LRT, MRT) in Yangon City, TESO-Seoul Metro (Korea), 2012
- Upgrading of Yangon Circular Railways Project, several private companies including Shwe Taung Development Co.,Ltd. (Myanmar), 2011
- Yangon Station Yard Redevelopment, several international private companies, 2013

These plans and current status are summarized as below

1) Urban Railway Construction in Yangon City, TESO-Seoul Metro (Korea)

This is the project for improvement of Yangon Circular Railway. Two Korean private companies named TESO and Seoul Metro conducted the pre-feasibility study in 2013.

They planned to improve the line divided by two sections, the western half as section 1 (between Yangon Central Station – Insein Station - Danyingone Station) and the eastern half as section 2 (between Yangon Central Station – Malwagone Station - Danyingone Station). In addition, the improvement work is conducted by two steps, 1st step: improving roadbed, track architecture, electric power, signalling and communication facilities in order to raise the operation speed from 18 to 30km/hr and the maximum speed from 30 to 80km/hr, and 2nd step: improving cross-section by overpass and fence installation in order to raise the operation speed from 30 to 45km/hr and the maximum speed from 80 to 100km/hr. However, the study has some problems as below.

- The demand forecast is not calculated based on any full scale traffic survey result. It means their initial input for design and cost estimation is not reliable.
- They estimates the transport capacity after improvement as 1,877pax./hr in 2021 and 2,990pax./hr in 2040 with 18min. and 11min. interval respectively. It means the transport capacity is quite small and the operational interval is also not convenient. Therefore, the total cost is restricted as US$451mil. for 1st step of Section 1 (US$648mil. for 1st step of both sections.).
- They proposed to implement the project by using PPP scheme, but it is doubtful whether any private company express their interest due to the study level is quite rough.

2) Mass Transport (BRT, LRT, MRT) in Yangon City, TESO-Seoul Metro (Korea)

This is the project for installation of new mass transport (BRT, LRT, MRT). Two Korean private companies named TESO and Seoul Metro conducted the pre-feasibility study in 2012. They planned to install ten mass transport route, which consists of two MRT lines, one LRT line, one monorail/AGT line, and six BRT lines. However, the study has some problems as below.

- The demand forecast is not calculated based on any full scale traffic survey result. It means their recommendation including railway network and the route alignment is not reliable.
- They proposed to implement the project by using PPP scheme, but it is doubtful

whether any private company express their interest due to the study level is quite rough.

No.	Length (km)	Road Name (pass through)
① C1	21.4	KyeeMyindaing-**Bayint Naung**
② C2	28.0	Phonegyi-Pyay-**Insein**
③ C3	27.8	SwedagonPagoda-**Uwisara-Pyay**-No.1Rd.
④ C4	20.1	SulePagoda-**KabarAye pagoda-YG Airport**-No.3Rd.
⑤ C5	23.5	UpperPazundaung-**ThanThuMar-No.2Rd.**
⑥ C6	9.5	Ahlone-**UHtaungBo-KanYeikThar**-Mill-Yamonnar
⑦ C7	22.3	No.5Rd.-**MingyiMahat MinGaung - Parami**-Pinlon
⑧ C8	19.8	**Hlaing RiverRd.-pyay-Oakkaia**-BoHmuebaHtoe
⑨ C9	11.4	ShwePyiTharBr.Rd.- **Khayan Pin**
⑩ C10	10.5	(CBD)AnawrahTa-Merchant St.

Source: Pre-feasibility Study on Mass Transport in Yangon City, TESO-Seoul Metro, Korea (2013)

Figure 1.4.2.1 Proposed Ten Mass Transport Routes

3) Upgrading of Yangon Circular Railways Project, Several private companies (Myanmar)

In 2011, MR announced to privatize Yangon Circular Railway and the Suburban Lines, and several Myanmar companies expressed their interest to be a concessionaire. Then Shwe Taung Development Co.,Ltd., which is the one of candidate concessionaires, conducted a survey to know the fact about Yangon Circular Railway and to prepare their technical proposal for the concession bidding. According to the survey report, they investigate the current condition of Yangon Circular Railway in terms of both technical and financial, and proposed the following activities to be conducted.

- Replace wooden sleeper to PC sleeper.
- Full filling of new crushed stone for whole line.
- Immediate action of maintenance for lining, levelling, and mechanized tamping.
- Welding 39ft standard rail length to 3 pieces by Alumino thermit welding method.
- Newly construction of ROB and FOB
- Install fence along railway due to safety and security reason.
- Change the track maintenance method from labour intensive system to semi or fully mechanized system.

However, the bidding was postponed and no plan to be restarted as of March 2014.

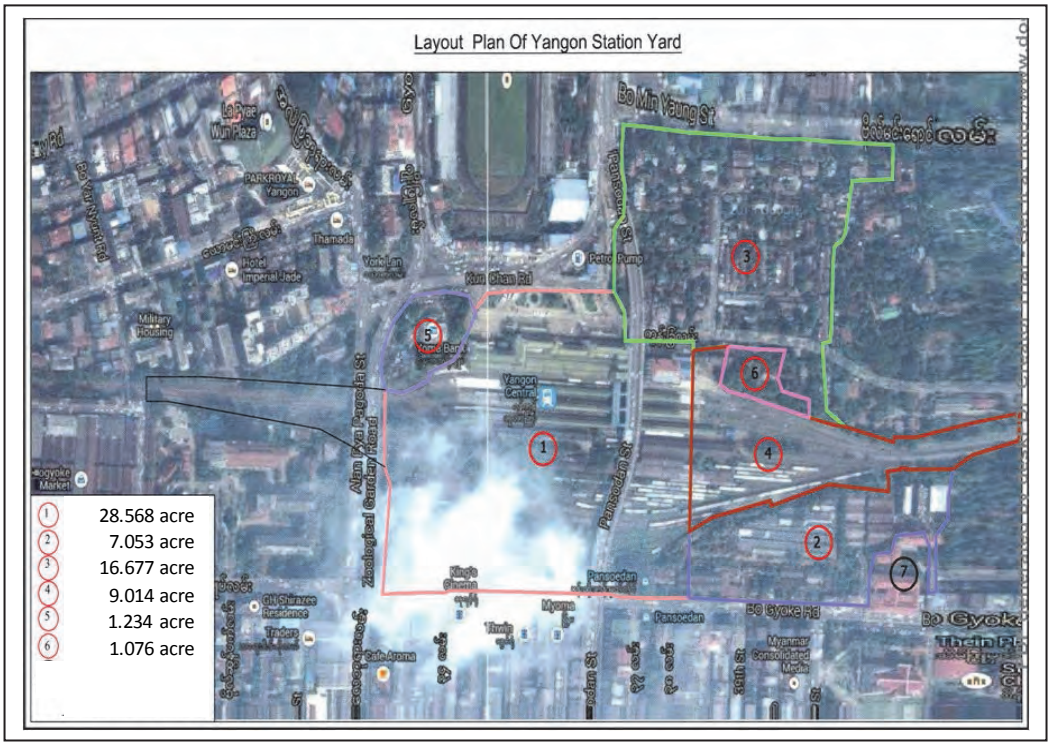
4) Yangon Central Station Yard Redevelopment Project, Several international private companies

Some private companies expressed their interests to MR in redevelopment of Yangon Central station yard, which is the most attractive land for commercial and business use among MR's

lands, because the yard has large area and is situated at the heart of Yangon city and commercially strategic location.

Based on the movement, MR decided to call tender to procure developer for redeveloping Yangon Central station yard. Area of Yangon Central station yard is approximately 25.3ha including not only approximately 16ha area surrounded by wall but also MR staff's residential area beside station. MR plans to call EOI in March 2014.

Layout plan of Yangon Central station yard prepared by MR is shown in the figure below.



Source: MR

Figure 1.4.2.2 Land map of Yangon Central Station Yard Area

1.5 Necessity of the Project Implementation and Arrangement of the Issue

As mentioned above, Yangon Circular Railway has many issues both technically and organizationally to be solved such as "deteriorated infrastructures", "poor passenger service and insufficient feeder service at stations", "many manually operated level crossings", "ineffective train diagram and bottleneck due to mixing long-distance trains with Yangon Circular trains", etc. These issues should be solved in order to realize attractive mass transit system as the main corridor in Yangon

In addition, all upper plans, which are SUDP, YUTRA, and Fact About Myanma Railways, are recommending to conduct modernization and upgrading project for Yangon Circular Railway as the high priority project in terms of urban planning aspects like "high-mobility and reliable transportation system led by modernized urban railway, and contribution to promote the planned new urban development".

Furthermore, at present no other donor expresses their interest to conduct the improvement project by their fund. Although a private company express their interest, there is no concrete plan including funding.

From the abovementioned reasons, it is recommended to conduct modernization and

upgrading project for Yangon Circular Railway in order to increase transport capacity of mass rapid public transport.

1.6 Potentiality of the Railway Sector Privatization

Myanmar government was encouraging the development of the infrastructure through BOT schemes, etc. In line with this policy, MR was trying to proceed with the privatization of the Yangon Circular Railway and the Suburban Lines. Detail Explanation will be done in next chapter.

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1.7 Sorting out of the Issue and Review of the Other Countries Railway Case, Categorize and Arrangement of Lesson

1.7.1 Delhi (India)

1) Current Situation of Urban Railway

The Delhi Metro is being built in phases as follows.

Phase-I

The Delhi Metro Phase-I project consists of implementation of 3 corridors of heavy rail urban transport system, covering a route length of 68km and 58 stations, including procurement, construction and commissioning of double line electrified tracks with all its appurtenances, signals, telecommunication, facilities, traction arrangement, air conditioning & ventilation, rolling stock, maintenance depots, stations, operation control centers, offices, station integration areas, bridges, flyovers, elevated, surface and underground sections over the project routes, integration with other modes of transport, future property development, including all maintenance and operational facilities. The Phase-I was completed on October 2006.

Phase-II

The Delhi Metro Phase-II project consists of implementation of 125km route and 85 stations of metro railway system, including procurement, construction and commissioning of double line electrified tracks with all its appurtenances, signals, telecommunication, facilities, traction arrangement, air conditioning & ventilation, rolling stock, maintenance depots, stations, operation control centers, flyovers, elevated, surface and underground sections over the project routes, including all maintenance and operational facilities. The Phase-II was completed on August 2011.

Phase-III

The Delhi Metro Phase-III project consists of implementation of 103km route and 69 stations of metro railway system and it is panned to be completed by 2016.

Phase-IV

The Delhi Metro Phase-IV project consists of implementation of 113km route of metro railway system and it is panned to be completed by 2021.

Delhi Airport Metro Express

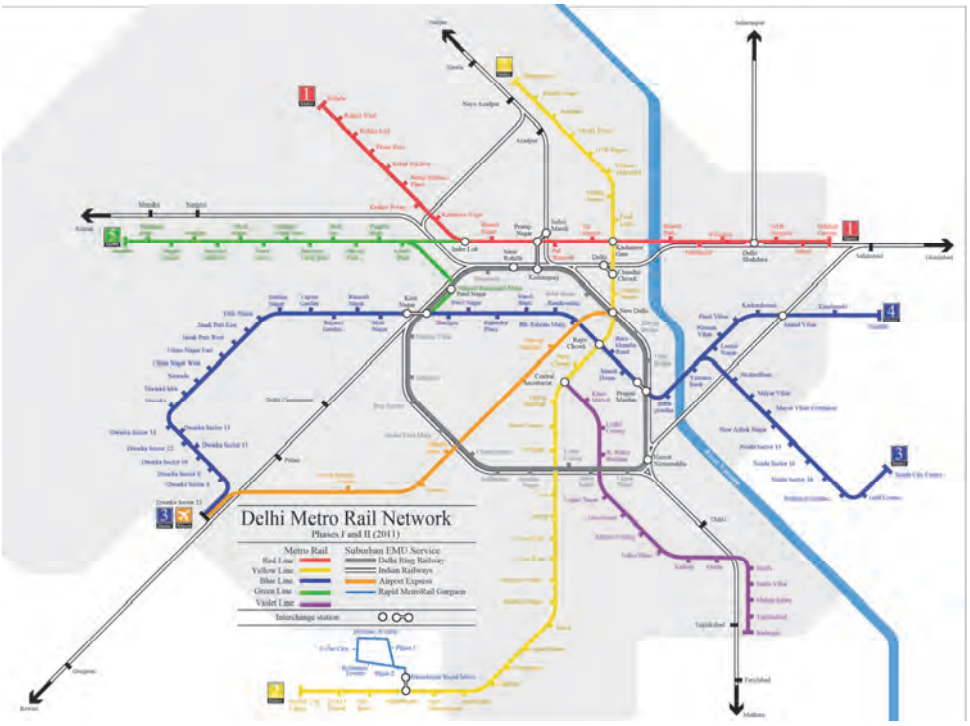
Delhi Airport Metro Express is one of Delhi Metro lines, however, it is operated by Delhi Airport

Metro Express Pvt. Ltd. (DAMEL) who is subsidiary of Reliance Infrastructure as concessionaire. The total length of the line is 22.7 km, of which 15.7 km is underground and 7 km, from Buddha Jayanti Park and Mahipalpur, is elevated. The line was opened in February 2011.

Table 1.7.1.1 Delhi Metro Lines

Line	First Operation	Last Extension	Stations	Length (km)	Rolling Stock	Gauge	Power
Red Line	24 December 2002	4 June 2008	21	25.09	26 trains	1,676 mm	25kv OHE
Yellow Line	20 December 2004	3 September 20100	35	44.65	60 trains	1,676 mm	25kv OHE
Blue Line	31 December 2005	30 October 2010	43	49.93	70 trains	1,676 mm	25kv OHE
	7 January 2010	14 July 2011	7	8.74		1,676 mm	25kv OHE
Green Line	3 April 2010	-	14	15.14	15 trains	1,435 mm	25kv OHE
	27 August 2011	-	1	3.32		1,435 mm	25kv OHE
Violet Line	3 October 2010	14 January 2011	15	20.04	30 trains	1,435 mm	25kv OHE
Airport Express	23 February 2011	-	6	22.70	8 trains	1,435 mm	25kv OHE
Total			141	189.61			

Source: Website Delhi Metro Wikipedia



Source: Website Delhi Metro Wikipedia

Figure 1.7.1.1 Delhi Metro Rail Network

2) Historical Background of Urban Railway Development

The concept of a mass rapid transit for New Delhi first emerged from a traffic and travel characteristics study which was carried out in the city in 1969. Over the next several years, many official committees by a variety of government departments were commissioned to examine issues related to technology, route alignment, and governmental jurisdiction. In 1984, the Delhi Development Authority and the Urban Arts Commission came up with a proposal for developing a multi-modal transport system, which would consist of constructing three underground mass rapid transit corridors as well augmenting the city's existing suburban railway and road transport networks.

While extensive technical studies and the raising of finance for the project were in progress, the city expanded significantly resulting in a twofold rise in population and a fivefold rise in the number of vehicles between 1981 and 1998. Consequently, traffic congestion and pollution soared, as an increasing number of commuters took to private vehicles with the existing bus system unable to bear the load. An attempt at privatising the bus transport system in 1992 merely compounded the problem, with inexperienced operators plying poorly maintained, noisy and polluting buses on lengthy routes, resulting in long waiting times, unreliable service, extreme overcrowding, unqualified drivers, speeding and reckless driving. To rectify the situation, the Government of India and the Government of Delhi jointly set up a company called the Delhi Metro Rail Corporation (DMRC) on 3 May 1995.

Physical construction work on the Delhi Metro started on 1 October 1998. About 60% of the construction cost for Phase-I project was covered by Japanese ODA (Yen Loan) and Japanese Yen Loan has been continued for Phase-II and III as well.

3) Future Plan

Phase III and IV extensions, which will expand the network to 413.8km, are scheduled to open

in 2016 and 2021 respectively.

Phase III was approved in August 2011. It involves construction of 140km line with 92 stations and 17 interchange points. It is scheduled to be completed by 2016, carry about four million passengers.

4) Major lessons and Issues

The broad gauge of 1,676 mm, which is the same as the gauge adopted for Indian National Railways, was initially adopted for three lines of Red Line, Blue Line and Yellow Line to accept request from the Ministry of Railway in India. After that the standard gauge of 1,435 mm is adopted for Green Line and Violet Line in the reason why compatibility between Delhi Metro Rail and Indian National Railway is not required in future. It is usually discussed that which gauge and power supply system are adopted for railway system to be newly built, however, it is not so easy to determine them and it is required to consider detailed future plan considering not only technical aspect but also Government policy.

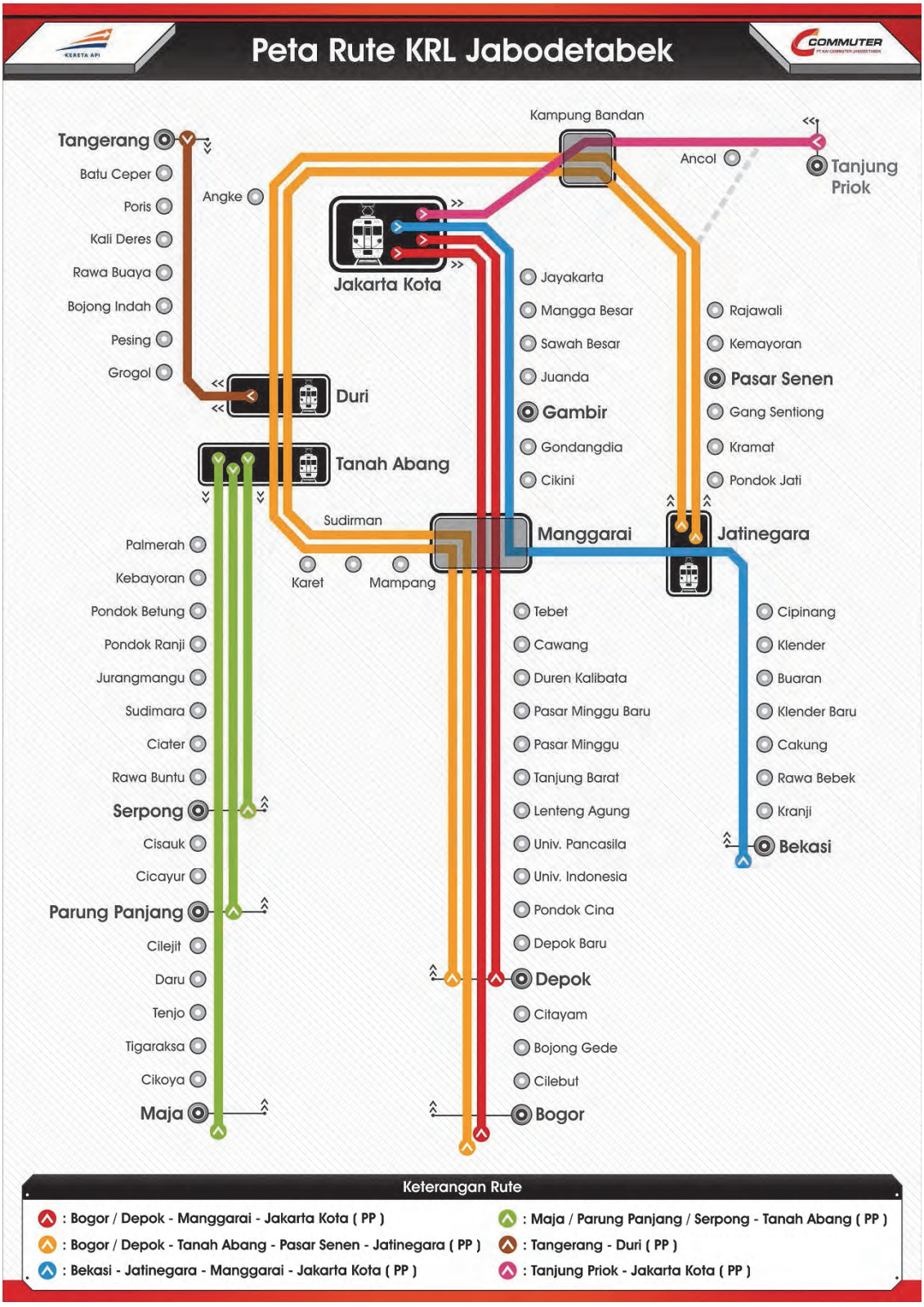
The construction speed of Delhi Metro Projects is generally higher than other projects in Asian Developing countries. Serious accident was happened during the construction of viaducts on September 2009, however, the Delhi Metro Project has been leaded by competent Managing Director and it is praised as one of excellent projects.

1.7.2 Jakarta (Indonesia)

1) Current Situation of Urban Railway

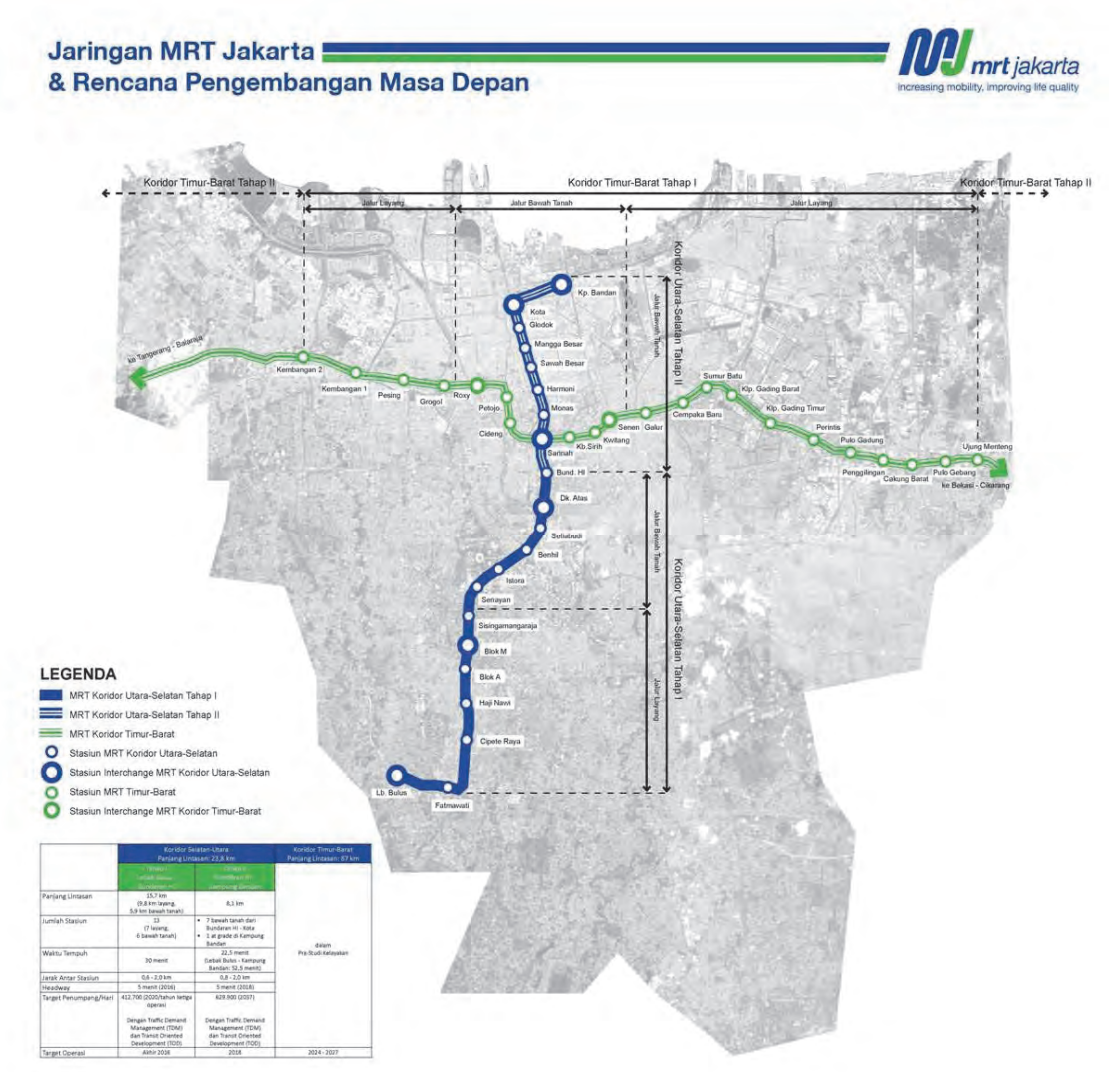
Urban railway network in the Greater Jakarta (JABOTABEK) currently consists of several liens operated by PT. Kereta Api who is a railway company owned by Indonesia Government. The network had been developed during operation by Indonesia National Railways (PJKA). Signalling Improvement Project, Central Line Track Elevation Project, Central Line Track Addition Project, Bekasi Electrification Project etc. have been executed by Japanese ODA (Yen Loan).

In addition to the above railway network, the Phase-1 section (Lebak Bulus – Bundaran HI, about 15.7km) of new rapid transit system to be operated by PT Mass Rapid Transit Jakarta is currently under construction and it is expected to open in 2016. This is the first railway project which has underground section in Indonesia.



Source: Website Wikipedia KRL JABOTABEK

Figure 1.7.2.1 Urban Railway Network in Greater Jakarta (PT. Kereta Api)



Source: MRT Jakarta

Figure 1.7.2.2 Urban Railway Network in Greater Jakarta (PT. MRT Jakarta)

The technical parameters for both railway systems are as follows.

Table 1.7.2.1 Technical Parameters for Urban Railway System in Jakarta

	Track Gauge	Power Supply
PT. Kereta Api	1,067 mm	DC1,500 V Overhead Catenary
PT. MRT Jakarta	1,067 mm	DC1,500 V Overhead Catenary

Source: JICA Study Team

2) Historical Background of Urban Railway Development

Travel in the greater Jakarta metropolitan area is largely dependent on road transportation. The traffic mode split among motorized vehicles in 2002 shows: motorcycles 23%, cars 17%, buses 58% and railway a mere 2%.

Traffic conditions in every corner of the metropolis are getting worse and the economic loss

caused by the traffic congestion is causing a serious impact to the national economy.

Under such circumstances, enhancement of the railway transport system is set to be prioritized as one of the most important agendas in the Mid-Term Development Plan (RPJM: 2004 – 2009) of the Republic of Indonesia. To achieve this goal, the revitalization and construction of the Mass Rapid Transit project in Jakarta are set as principal agendas. To implement the plan, the land planning department of DKI Jakarta has put priority on the building capacity of railway transportation through the construction of an elevated and underground railway.

With the above understanding, the Government of Indonesia has decided to develop a Mass Rapid Transit project (Lebak Bulus – Bundaran HI, about 15.7km) as phase-1 of North-South Corridor, with the objective to enhance passenger transport capacity and consequently improve traffic congestion and contribute to the betterment of the investment environment in the metropolitan areas. This project is now called the Jakarta Mass Rapid Transit (MRT) Development Project.

In view of the above stated facts, JBIC signed a Yen Loan Agreement with the Government of Indonesia in November 2006. The Loan is to assist with the required preparatory work for the smooth implementation of the Project, focused on the Engineering Services (E/S) to cover the basic design, provision of auxiliary service for tender process, and supporting services to establish the management & operating company of the MRT.

Tenders for contractor selection for civil works have been completed in 2013 and the civil works for the section is currently under construction.

3) Future Plan

In continuation to the phase-1 project of MRT North-South Corridor, the following projects are planned to be constructed for Jakarta MRT.

North-South Corridor Phase-2 (Bundaran HI – Kp. Bandan Section): The total length is 8.1 km and it has 9 stations including Bundaran HI. It is expected to open in 2020.

East-West Corridor Phase-1 (Kernbangan 2 – Ujung Menteng)

4) Major lessons and Issues

Since consultant services for tender document preparation stage, tender assistance stage and construction stage are divided into three packages, it takes time to execute the project.

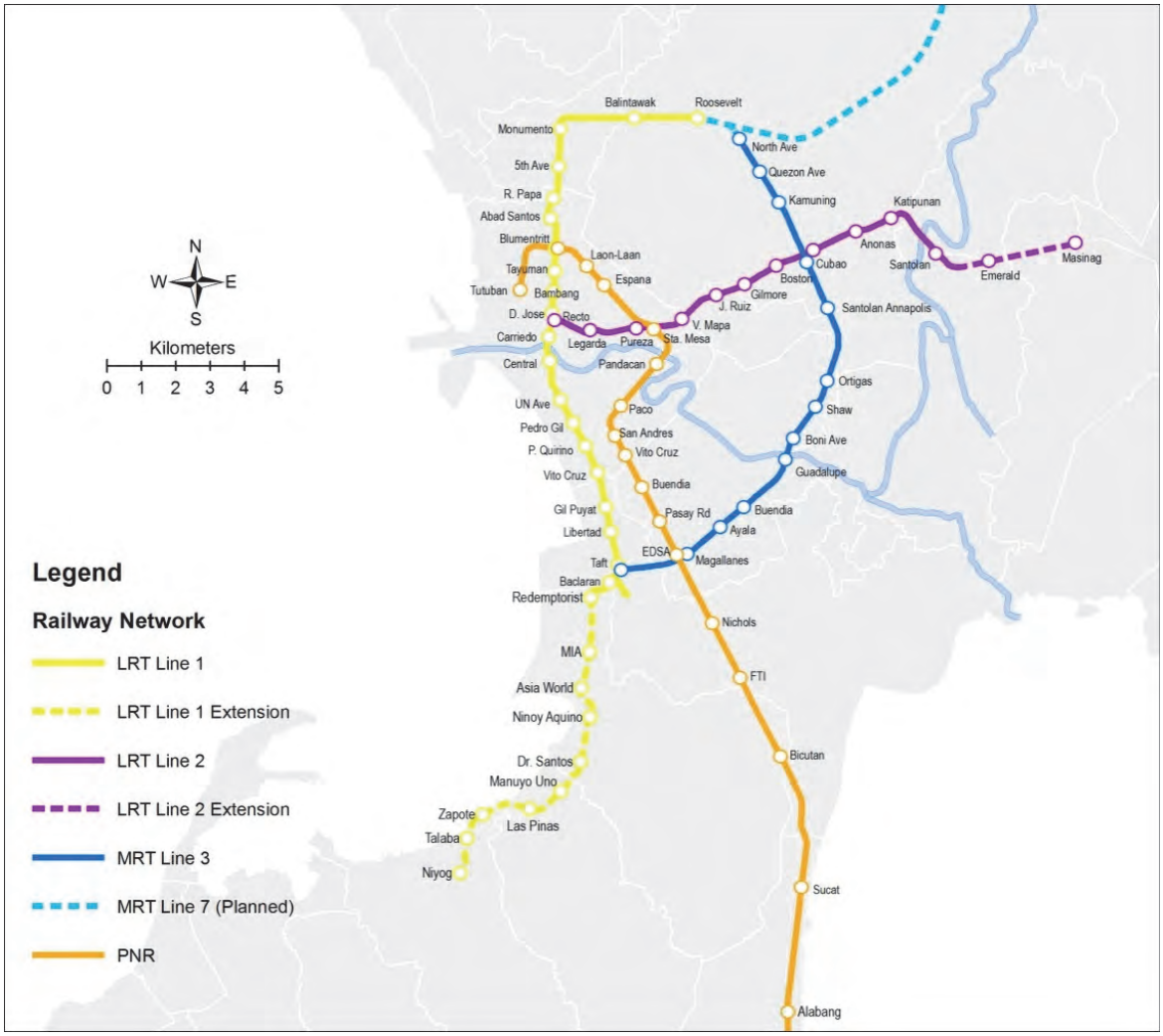
1.7.3 Manila (Philippines)

1) Current Situation of Urban Railway

The current rail network in Greater Capital Region consists of the Philippines National Railway Lines and urban mass transit lines within Metro Manila. The operational lines shown by solid lines in the following figure are as follows.

- PNR Commuter service between Metro Manila and Alabang; and PNR long distance services in Luzon Island;
- LRT Line-1, a north-south line from Roosevelt (Quezon City) to Baclaran (Pasay City);
- LRT Line-2 an east-west line from Santolan (Pasig City) to Recto in Manila City, and
- MRT Line-3 a semi-circle north-south line from North Avenue in Quezon City to EDSA station

in Pasay City.



Source: JICA Study Team

Figure 1.7.3.1 Railway Network in Greater Capital Region

2) Historical Background of Urban Railway Development

PNR

The PNR network on Luzon Island mainly consists of a north-south line operating out of Metro Manila main railway station of Tutuban. The services and patronage has been in decline as far the record is available, as per the Philippines Statistical Year Book. Services to the north out of MM have been suspended almost since the conception of the North Rail Project, and the long distance services to the south of MM to Bicol were suspended after the severe typhoon in September 2006. The only remaining on-going service since 2006 has been between Metro Manila and Alabang.

The PNR network in the Greater Capital Region extends from Tutuban to Alabang, which is a narrow gauge double track (except Sucat–Alabang section) over a length of about 28km. PNR operates this section from 5:00AM to 19:00 daily, with ½ hourly service during the AM & PM peak periods (06:00-11:00 & 15:00-19:00) from Monday through Saturday and hourly service during the inter-peak times and on Sundays. The average week-day ridership by station for the Metro Manila - Alabang during Jan-Nov 2011 was about 46,700 passengers per day,

compared with around 34,700 Pax over the average week-end day.

LRT Line 1

Metro Manila's first elevated Light Rail Transit 14km long line from Baclaran in the south to Monumento in the north, with 18 stations along some of the busiest roads, Rizal Avenue and Taft Avenue opened for revenue service in December 1984. In 1985, the 1st full year of operation, the patronage of Line-1 was 69.7 million passengers (Pax). The growth in demand was steady and it reached 127.8m by 1990, and increased to a peak of 145.8millionPax by 1994 (an average growth rate of about 8.5% p.a. from 1985 to 1994). Then the ridership started to decline due to poor maintenance and other technical reasons. The decline in patronage continued until 2004 (further exacerbated by the 20% increase in LRT fares in December 2003) and it was 96.8 million Pax in 2004, almost 40% less than it was a decade before that.

However, the declining patronage trend was reversed in 2005, and since then it has been increasing steadily. In 2011 patronage of 156.9 million Pax were recorded on Line-1 after an eastward extension from Monumento of 5.7km with two new stations (Balintawak & Roosevelt), which opened in 2010.

LRT Line 2

Metro Manila's latest elevated Light Rail Transit Line-2 12.6km long with 11 stations runs from Recto in Manila City to Santolan (Pasig City) in the east along the busy east-west radial Marcos Highway, Aurora Blvd. Magsaysay Av. and CM Recto Av. The line opened for revenue service in April 2003. In 2004, the 1st full year of operation, the patronage on Line-2 was 20.6 million passengers (Pax). The growth in demand was instantaneous and the ridership more than doubled by 2005 to 41.9 million Pax, and increased by another 40% by 2008 to reach 58.9 million Pax. After that the demand growth rate steadied and an average growth of about 3% from 2008 to 2011 has been recorded. By the end of 2011 the annual patronage had reached nearly 63.8 million Pax.

MRT Line 3

Metro Manila's Mass Rail Transit MRT Line-3, is 16.9km long with 13 stations from EDSA (Pasay City) in the south to North Avenue (Quezon City) in the north-east. The alignment is mostly elevated along the busiest circumferential road (C-4) of Metro Manila, with the exception of a small section in Makati City where it is underground. It partially opened to service in late 1999, and the full line opened for revenue service in July 2000. In 2001, the 1st full year of operation, the patronage on the line was 90.2 million passengers (Pax), more than double the Pax carried in 2000. The growth in demand was instantaneous from the opening and the ridership grew at more than 10% per annum for the next two years and then steadied to around 5% p.a.

By 2009 it had reached almost peak carrying capacity and exceeded 150 million Pax per annum, with some month's patronage above 13million passengers.

3) Future Plan

Extension of LRT Line 1 to the South & North

The Line-1 south extension project (in tendering stage as of December 2012) would extend the line by 11.8km to Niyog in Cavite province, with ten new stations. The extension would also provide new rolling stock for the existing section of the line, thus improving the much needed

service standard.

The Line-1 extension to the north-east to connect with MRT Line-3 would provide direct transfer of passengers between Line-3 and Line-1. It involves the construction of a 5.5-km double track elevated line from Monumento Station of Line 1 to North Avenue Station of Line 3.

To date, Balintawak and Roosevelt Stations are now open for commercial operations, while the Malvar and Common Stations are being completed.

Extension of LRT Line 2 to the East

The Line-2 extension to east for about 4.2km with two new stations at Emerald and to terminate at Masinag has been recently studied by JICA and DOTC. The project, which was identified in the Metro Manila Urban Transport Integration Study (MMUTIS) as one of the priority components of the long term master plan for transport development, involves the construction of a 4-km eastern extension of MRT Line 2 from its current terminus and depot at Santolan in Pasig City to Masinag Junction in Antipolo, Rizal with additional two (2) passenger stations. The project aims to expand the existing LRTA rail transport services of LRTA Line 2 Project for the benefit of passengers coming from Marikina, Cainta and Antipolo.

MRT 3 Capacity Expansion

The design peak capacity of 23,600 passengers per hour per direction (pphpd) of MRT3 has already been achieved and surpassed on many occasions. The project aims to improve the passenger-carrying capacity of the MRT 3 to 32,160 pphpd corresponding to the projected increase of 36%. The project involves the expansion of current fleet of 73 new Light Rail Vehicles or LRVs. by MRTC. The current 3car train 3.0 minute headway configuration is to be improved to achieve a 4-car train 2.0 minute headway configuration.

Implementation of the MRT Line 7

MRT Line 7 seeks to address the need to provide an efficient means of mass transit for commuters from the North. It will connect Quezon City with San Jose Del Monte in Bulacan. The system includes 14 stations, approximately 23 km of dual-main line tracks, traction power substations and third rail system, and signal facilities. The Project has been awarded to the MRT 7 Consortium under the Build - Lease - Gradual Transfer Scheme and is awaiting financial closure with funders.

North - South Commuter Railway

It is planned to construct North – South Commuter Railway using right of way of Philippines National Railways. The feasibility study on this project is being conducted by JICA.

4) Major lessons and Issues

As for urban railway network in Manila, poor design for each interchange station is pointed out. Interchange stations of two lines are located far away each other and it takes time for passengers to transfer from line to another line.

As another lesson, it is pointed out that not light rail transit system but mass transit system should have been introduced for urban railway system in Manila. Especially the demand on MRT Line 2 exceeds the capacity of MRT Lin2 and another system is required at present.

1.7.4 Hanoi (Vietnam)

1) Current Situation of Urban Railway

In 2008 five urban transit lines were approved by Vietnamese Prime Minister, however, Line 1, 2, 2A and 3 are currently in progress. Feature for each line are as follows.

Table 1.7.4.1 Feature for Hanoi Line 1, 2, 2A and 3

	Line-1 (MOT, VNRA)	Line-2 (HPC, HRB)	Line-2A (MOT, VNRA)	Line-3 (HPC, HRB)
Funds	Japanese ODA (JICA STEP Loan)	Japanese ODA (JICA STEP Loan)	Chinese ODA (EPC Contract)	French ODA +ADB
Railway System	STRASYA (Japanese)	STRASYA (Japanese)	China GB50157-2003 Metro Design Standard	European Standard (EN)
Track	Dual gauge (1000,1435mm)	Standard (1435mm)	Standard (1435mm)	Standard (1435mm)
Power Supply & Distribution	AC25 KV Overhead Catenary	DC1500 V Overhead Catenary	DC750 V Third rail	DC750 V Third rail
Safety, Fire Evacuation Standard	MLIT, Building Code (Japan)	MLIT, Building Code (Japan)	China GB50157-2003 Metro Design Standard	NFPA130 (American)

Source: UMRT Line 2 Project

Source: UMRT Line 2 Project

Figure 1.7.4.1 Hanoi UMRT Line1, 2, 2A and 3

The current status of each line is as follows.

Line-1: Elevated Structure 15.4km (Ngoc Hoi: 3.9km, Hanoi: 11.5km)

- The detailed design of Phase I has been completed.
- Loan Agreement for the detailed design of Phase-IIa has been concluded. The detailed design is scheduled to start soon.

Line-2: 11.5km (Elevated Structure: 2.6km, Underground Structure: 8.9km)

- The basic design for underground section and E&M has been completed. The detailed design for elevated section and depot has been completed.
- It was scheduled to proceed with tender stage in 2013, however, it is delayed.

Line-2A: Elevated Structure 14km

- Piers for viaducts are currently under construction.
- Construction of depot was started in October 2011.

Line-3: 12.5km (Elevated Structure: 8.5km, Underground Structure: 4km)

- Construction of depot was started in October 2010 and civil works have been completed.
- Tenders for elevated and underground section are in progress.

2) Historical Background of Urban Railway Development

Currently, commuters in Hanoi use walking, bicycles, motorbikes, buses, and taxis to get around. The metro project is part of the Vietnam Ministry of Transport's master plan, which aims to reduce the use of private motorised transport and enhance the urban environment. The entire project is being carried out by Hanoi Metropolitan Rail Transport Project Board (HRB), formerly known as the Hanoi Authority for Tram and Public Transport Development Management (HATD).

In July 2008, Vietnamese Prime Minister approved an overall transport development plan for Hanoi, which, among other projects, proposed a metro system with five routes. The project is being carried out by the Hanoi Metropolitan Rail Transport Project Board (HRB).

3) Future Plan

In addition to the five routes, it is planned to construct Line 6, Line 7 and Line 8 as future plan.

Source: UMRT Line 2 Project

Figure 1.7.4.2 Metro and Urban Railway Network in Hanoi City

Table 1.7.4.2 List of UMRT Line in Hanoi City

Name	Section	Length
Line1	Ngoc Hoi – Yen Vien	38.7 km
Line2	Noi Bai –Thuong Dinh	35.2 km
Line2A	Cat Linh – Ha Dong	14 km
Line3	Troi – Nhon – Yen So	21km
Line4	Lien Ha – Bac Thang Long	53.1 km
Line5	Southern West Lake – Ngoc Khanh –Hoa Lac	34.5 km
Line6	Noi Bai – Ngoc Hoi	47 km
Line7	Me Linh – Ngoc Hoi	35 km
Line8	Co Nhue –Trau Quy	28 km

Note: Line 4 is BRT or LRT.

Source: General Construction Plan of Hanoi Capital City till 2030, July 2011

4) Major lessons and Issues

Since donors and executing agencies for each line differ, it is very difficult to unify system. Especially ticket system should be compatible (common ticket) so that passenger can use the same ticket.

1.7.5 Ho Chi Minh City (Vietnam)

1) Existing Railways in Ho Chi Minh City

The existing railway system in Viet Nam consists of national single track-gauge lines operated with diesel type locomotives, and most of the lines were constructed in the period from1900 to 1936 and were rehabilitated between 1975 and 1985 as summarized below:

Table 1.7.5.1 General Feature of Railway Network in Vietnam

No.	Description	Main Line (km)	Feeder Line (km)	Total (km)
1	Mixed Track-Gauge 1000/1435	219.66	72.523	292.183
2	Track-Gauge 1000	2,261.06	371.188	2,632.249
3	Track-Gauge 1435	188.988	33.218	222.206
	Total	2,669.708	476.93	3,146.638

No.	Railway Route	Length (Km)
	Vietnam Railway	2,669.70
1	National Railway	1,726.26
2	Yen Vien - Lao Kay	285.14
3	Pho Lu - Pom Han	12.83
4	Dong Anh - Quan Trieu	54.68
5	Kep - Lu Xa	55.59
6	Bac Hong - Van Dien	34.52
7	Ha Noi - Dong Dang	165.43
8	Kep - Ha Long	105.66
9	Mai Pha - Na Dong	29.75
10	Chi Linh - Pha Lai	14.88
11	Gia Lam - Hai Phong	96.77
12	Cau Giat - Nghi Dan	30.00
13	Dieu Tri - Quy Nhon	10.31

Source: VNRA Website www.vnra.gov.vn

According to a general assessment of Viet Nam Railway Authority (VNRA), for many reasons (war, climate impacts, and insufficient maintenance budget) the National Railway does not meet technical standards, as reflected by, inter-alia, poor facilities, many tight curves on horizontal alignment, and many sections located along valleys and beaches limiting the transportation capacity and affecting safety services. Investment was increased recently but rather concentrated on staff salary increase, and the investment on maintenance, especially for procurement of maintenance materials are still very limited.

In the South, the national railway with 1000mm single track-gauge ends at Sai Gon Station

(formerly Hoa Hung Station), which is the only railway line in Ho Chi Minh City. Following is a general route map of the National Railway System:

Source: YUTRA Study Team

Figure 1.7.5.1 General Route Map of Vietnam National Railway

2) Historical Background of Urban Railway Development

The national railway system as described above has been mostly constructed in 1900-1936, as an inter-city railway system, with the completion of the different railway lines in the following years:

- Year 1902: Railway line from Ha Noi to Dong Dang;
- Year 1902: Railway line from Ha Noi to Hai Phong;
- Year 1906: Railway line from Ha Noi to Lao Cai;
- Year 1931, Railway line from Thap Cham to Da Lat (Highlands);

- Year 1933, Railway line from Sai Gon to Loc Ninh;
- Year 1899 - 1936: National Railway from North to South.

The first line connecting Hanoi and Ho Chi Minh (total 1726 km) was completed in 1899.

At that time, there was no development plan for construction of urban railway systems in the major cities such as Hanoi and Ho Chi Minh City.

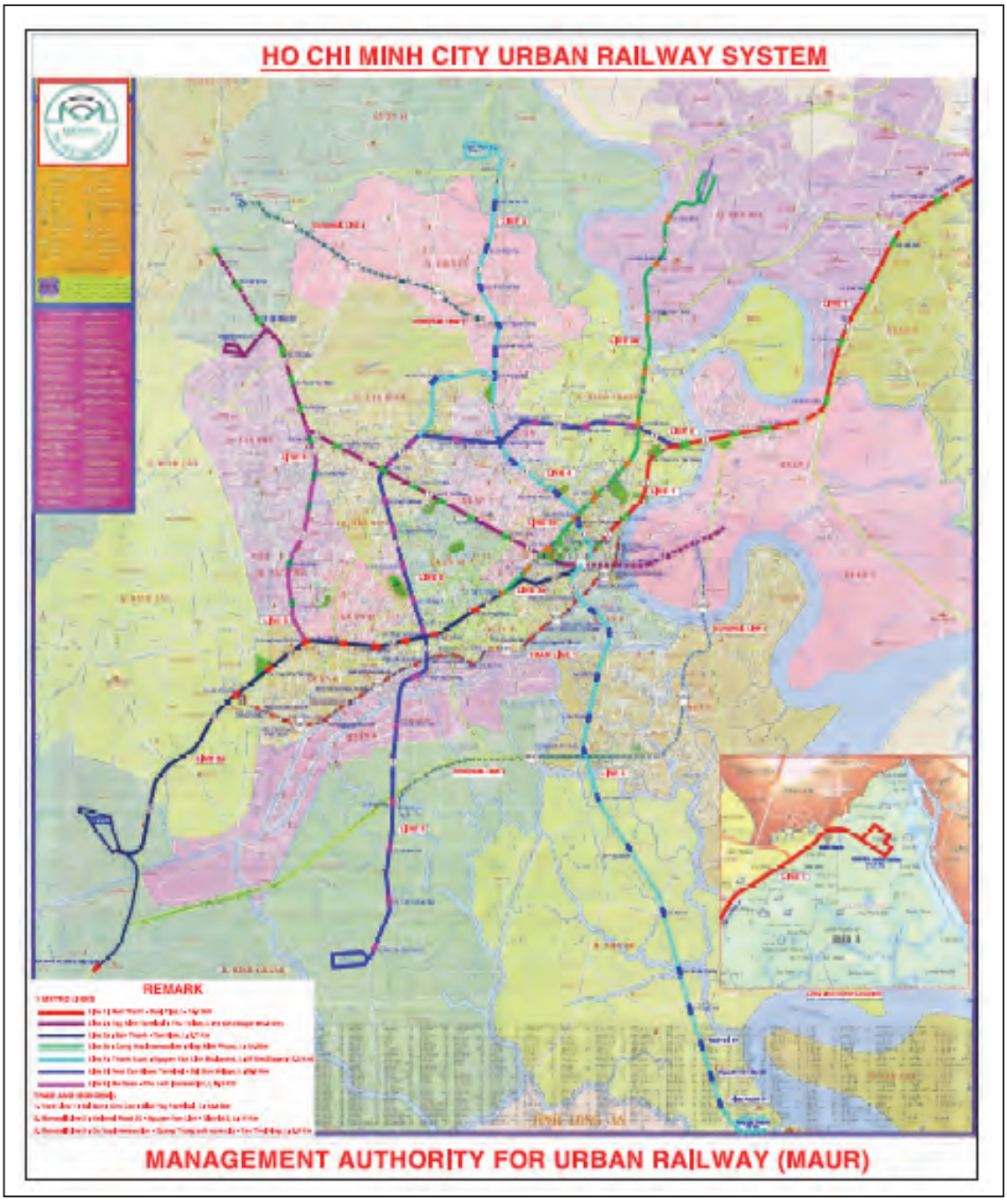
3) Future Urban Railway Development Plan

In 2004, there was a master plan study carried out by JICA, and the first development plan for the urban railway system in Ho Chi Minh City was established. Through several supplemental studies and refinement, the current development plans are summarized as follows:

HCMC will develop 7 MRT Lines with a total length of 120km and 7 Depots, 3 LRT Lines including Tramway and Monorail with a total length of 35km and 3 Depots. Urban railway stations, especially underground stations will be developed incorporating Complex Trading Centres in accordance with the transportation- oriented development and urbanization plan. HCMC will continue to develop MRT Lines: (i) to the Hiep Phuoc Complex Ports in Nha Be District, (ii) to the Northwest Urban Area in Cu Chi Province, and (iii) to the International Long Thanh Airport.

As of 2013, Line 1 is in the implementation stage and the elevated civil structures are under construction. Commercial operation of the Line 1 is scheduled to be in 2018. The other lines are still in the basic study/design stage, except Line 2 which is under the definitive design stage.

Please refer to the following urban railway map and summary of development plans for the above 7 MRT lines including monorails.



Source: SUDP, JICA (2013)

Figure 1.7.5.2 Urban Railway Map and Development Plans for 7 MRT Lines

4) Major lessons and Issues

HCMC has just assigned its Departments the task of reviewing all railway lines to fit the actual and practical conditions of use. Accordingly, all lines shall be built using advanced technology, land saving and incorporating other transport means and models.

However, according to MAUR, there are two main challenges: (i) a huge investment capital that is very difficult to acquire, and (ii) requirement to harmonize between Sponsor's guidelines and Vietnamese regulations. In order to cope with these issues, HCMC PC will set forth criteria, which are under study, to select capable Sponsors.

1.7.6 Bangkok (Thailand)

1) Current Situation of Urban Railway

Four lines are currently operated by three operators in Bangkok as shown in the following table.

Table 1.7.6.1 Urban Railway System in Bangkok

	BTS (Skytrain)		Subway (Blue Line)	Airport Link
	Searom Line	Sukmvit Line		
Operator	Bangkok Mass Transit System Public Company Ltd. (BTSC)		Bangkok Metro Public Company Ltd. (BMCL)	SRT Electrified Train Company Ltd. (SRTET)
Regulatory Body	Bangkok Metropolitan Administration (BMA)		Mass Rapid Transit Authority (MRTA) under Ministry of Transport	State Railway of Thailand (SRT) under Ministry of Transport
Track	1,435 mm		1,435 mm	1,435 mm
Power Supply	Third Rail, DC 75 V		Third Rail, DC 750V	OHC, AC 25kV
Total Length (m)	about 37 km		about 21 km	about 28 km
The number of stations	34 stations (1 common station)		18 stations	8 stations

Source: JICA Study Team

Outlines of these lines are as follows.

BTS (Skytrain)

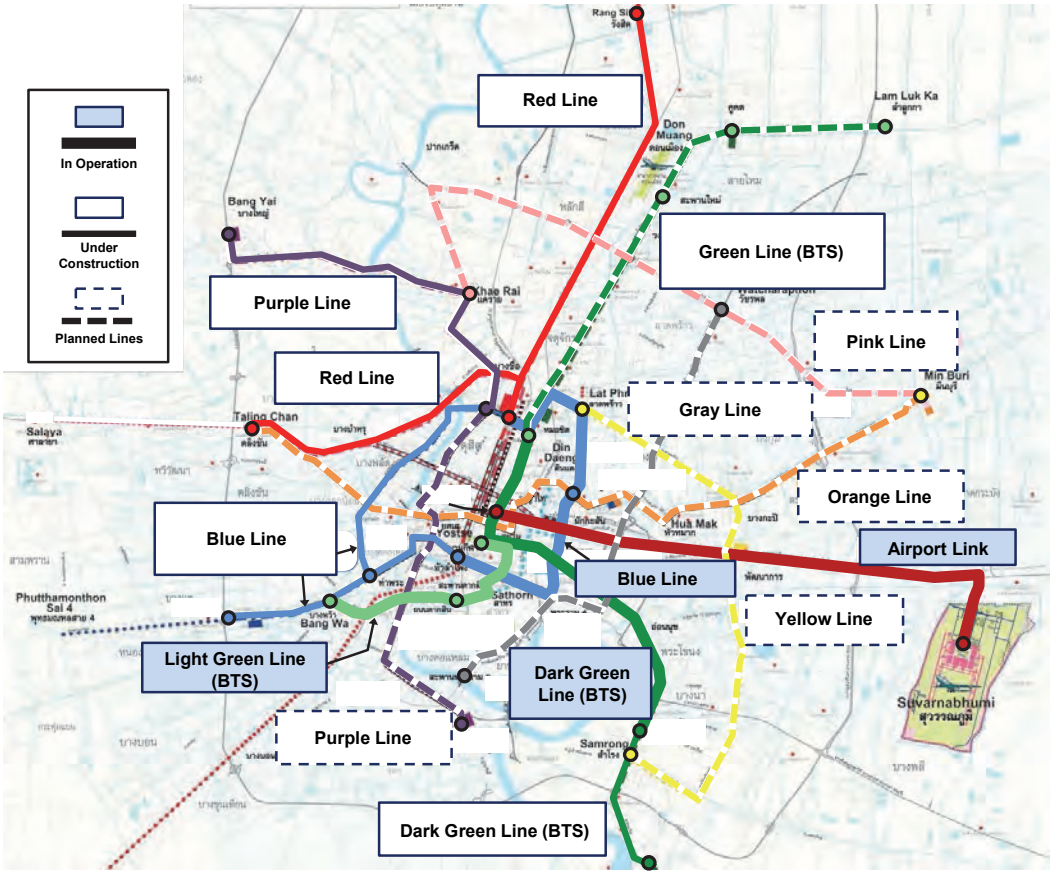
Concession contract was concluded between BMA and BTSC as BOT scheme on April 1992. The construction of BTS was started in 1995 and it was opened on December 1999. Since ridership had not increased at the beginning, deficit operation had continued until around 2003. After that ridership had increased year by year and it had reached to about 600 thousand pax per day in 2013. Extensions for three directions had been completed until 2013.

Subway (Blue Line)

The construction of this subway was started in 1997 and it was opened on August 2004. PPP (Public-Private Partnership) scheme is adopted for the subway, and infrastructure was constructed by MRTA and procurements of rolling stocks, railway system such as signal & telecommunication and other facilities were carried out by concessioner who made contract with MRTA. Japanese ODA is used for the construction of the infrastructure. The ridership per day in 2005 was about 170 thousand pax and the ridership per day in 2006 was about 180 thousand pax.

Airport Link

The services of airport link consist of commuter train and express train. The construction of this line was started on February 2005 and it was opened on August 2010. City line which is a local train is operated every 12 minutes for peak hour and every 15 minutes for off peak. Makkasan Express and Payatai Express are currently operated every 45 minutes and every 60 minutes respectively. The ridership of both lines in 2013 is about 50,000 pax per day.



Source: JICA Study Team

Figure 1.7.6.1 Urban Railway Network in Bangkok

2) Historical Background of Urban Railway Development

In order to alleviate the traffic congestion of Bangkok, urban transportation network development plan of Bangkok was formulated in the 1990s. After that the plan has been revised and updated many times. The first urban railway system in Bangkok is BTS (Skytrain) which was opened in December 1999. Since there had not been electrified railway system in Thailand until that, BTS is the first electrified railway system as well. Construction of Blue Line, which is the first subway in Thailand, was started in the late 1990s and it was opened in July 2004. Third rail type is adopted for both railway systems as power supply system. Airport Link connecting the Suvarnabhumi Airport and central Bangkok was opened in August 2010. Maximum operating speed of the Airport link is 160km/h and it is the first railway system which adopts overhead catenary system in Thailand. Electrified railways in Thailand are currently only three (BTS has two lines.).

3) Future Plan

Extension of BTS (Mo Chit / Khu Khot)

North extension of BTS (as first phase from Mo Chit station to Ku Kotto station (about 18.2km, 16 stations) and as phase 2 from Ku Kotto station to Eastern Outer Ring station) is planned and the executing agency for this section is also MRTA. Tenders for elevated structure between Mo Chit station Span Mai station with 12 stations, elevated structure between Sapan Mai and Ku Kotto with 4 stations, depot, two park & ride facilities and track wok are in progress. It is expected to start the construction in 2014 and open the line in 2019.

Orange Line

Orange line is the line which connects between Minbuli area and Talinchan area and crosses the central Bangkok. It is possible to transfer between the existing blue line and the line at Thai Culture Centre station. Construction of the line is divided into two phases which have the section between Minbuli and Thai Culture Centre and the section between Thai Culture Centre and Talinchan. The total length is about 38 km (about 27 km for underground section and about 11 km for elevated section) and the line has 22 underground stations and 7 elevated stations. The feasibility study on this line has been completed and approval for the execution of phase 1 by parliament is in progress. It is expected to start the construction of phase 1 in 2016 and open the line on June 2020.

Pink Line

Pink Line is the line which crosses Kerai area and Minbuli area at north parts of Bangkok and has the length of about 34.5 km with 30 stations. It is proposed to adopt monorail system for the line. The starting point of the line is Nontabuli Civic Centre station and it is connecting to the ending point at Minbuli by way of Paklet, Amuntontan and Rakshi. The feasibility study on the line has been completed and it is expected to start the construction on May 2016 and open the line on December 2018.

Yellow Line

Yellow Line is the line which connects between Raprao station and Samron station. It is proposed to adopt monorail system for whole elevated section. The total length is about 30 km and the line has 23 stations. The feasibility study on this line is in progress and it is expected to start the construction on May 2019 and open the line on March 2019.

Extension of Purple Line

It is planned to extend Purple Line which is under construction from Taopun station to Rabrana. The total length is about 20 km and the extension line has 16 stations (about 13 km and 11 stations for underground section, about 7 km and 5 stations for elevated section). The feasibility study on this line is in progress and it is expected to start the construction on April 2015 and open the line April 2019.

Extension of BTS (Ku Kotto/Eastern Outer Ring)

It is planned to extend BTS from Ku Kotto to Eastern Outer Ring as phase 2. The targets for the start of construction and the open of the line have not been determined.

Extension of BTS (National Stadium/Yotuse)

The terminal station of Searom line is currently National Stadium. It is planned to extend the line to Yotuse in future with the length of about 6.8 km. However, since the street for the section is narrow, it is expected to take time to construct the line.

Gray Line

Gray line is the line which is newly proposed recently. The starting point is Wacharapon station which is intersection to Pink Line and the line is going South to Rama Nine Bridge. The total length is about 26 km and the line has 21 stations. Monorail system is proposed for the line at present.

Red Line

Red Line consists of two lines which have Grand Bang Sue Station as terminal station for both

lines. One is a West line which connects between Bang Sue and Talinchan and the other one is a North line which connects between Bang Sue and Ransit. The project is executed under State Railway of Thailand (SRT). The Red Line is planned to extend to East and South as well in future.

4) Major lessons and Issues

Since contract was divided into several packages and construction start of each contract differed, problem on interface between contracts occurred. The problem occurred especially for the interface between civil contract and track contract and it was settled by variation order.

As for MRTA purple line project, since it was decided that procurement and installation for E&M were conducted by PPP contractor, JICA was not in a position to make suggestions for PPP tender and JICA had to follow the manner and the method of Thailand.

1.7.7 Karachi (Pakistan)

1) Current Situation of Urban Railway

Karachi City is the largest city in Pakistan, which has a population of 18 million, and the capital of Sindh Province. Karachi continues to be the national center of finance, industry, and overseas trade as well as an international center of southwest Asian countries. However, its urban transport infrastructure has been insufficiently developed. About 99% of trips generated in Karachi are by means of cars and buses, while the registered number of automobiles has increased exponentially. This has worsened traffic jams and air pollution to such a degree of average vehicle speed of about 15 km/h and particulate matter (PM10) of twice the WHO guideline. Therefore, to resolve the traffic problems in Karachi and enhance economic growth with better living environment, urban mass transit systems that facilitate modal shift from road transportation are indispensable.

2) Historical Background of Urban Railway Development

In 1964, the Karachi Circular Railway (KCR) opened in the 26.56-km section between Drigh Road and Wazir Mansion as an unelectrified at-grade single track railway and was extended from Wazir Mansion to Karachi City in 1970. As a result, it had a total route length of 29.32 km with 16 stations. However, the operational efficiency of KCR was marginalized and its ridership dwindled with every passing day beyond the year 1985 and was eventually closed to traffic in 1999, due to longer running time, low frequency of trains, lack of punctuality, and lack of adequate integration with other transportation modes. In 2005, KCR reopened partially using the Pakistan Railway (PR) main line, but the daily number of passengers was only about 3,000 persons. The remaining closed KCR sections have been increasingly occupied by squatters and the right of way (ROW) has not been well-defined due to surrounding housing development.

3) Future Plan

The Medium Term Development Framework 2005-2010 recognizes that urban public transportation development in the mega cities such as Karachi and Lahore will play a key role in Pakistan's economic development in the decades ahead. The Karachi Strategic Development Plan 2020 prepared in 2007 also emphasizes the need for mass rapid transits in Karachi. The Government of Pakistan (GOP), the Government of Sindh (GOS) and the City District Government of Karachi (CDGK) prioritize the KCR revival project.

Source: Presentation Material of Urban Forum in Karachi

Figure 1.7.7.1 Planned Renewal Route of KCR

4) Major lessons and Issues

As mentioned above, KCR was closed due to longer running time, low frequency of trains, lack of punctuality, and lack of adequate integration with other transportation modes. Currently, YCR also is in the same situation. Although YCR has approximately 90,000 passengers/day at present, if MR does not conduct any countermeasure, YCR may also follow the same pattern with KCR due to increasing the number of road vehicles.

1.8 Sorting out Related Document and projects

According to Myanma Railways, sources of foreign development assistance for Myanma Railways are as follows.

Table1.8.1.1 Sources of Foreign Development Assistance

Japan

Sr.	Project Name	Type of Aid	Amount
1	The Project on Improvement of Service & Safety of Railway in Myanmar Technical (Pilot Project is from Thingangyun – Ledaungan 18km) by JICA	TA	2 million US$
2	Rehabilitation and Modernization of Yangon – Mandalay Project – 1 (Yangon – Taungoo 166 miles project) by JICA	ODA Loan	647.80 million US$
3	Project for Installation of Operation Control Center System and Safety Equipment (OCC) (Japan)	Grant	4 billion Japanese yen

India

Sr.	Project Name	Type of Aid	Amount
1	Procurement of Rolling Stocks, Machines, Equipment and Accessories	Loan	60 million US$
2	Procurement of Rolling Stocks, Bogies, Spare parts, Machines and Accessories	Loan	145 million US$
3	Procurement of Equipment for two Locomotive Workshops and one Carriage & Wagon Workshop	Loan	10 million US$

China

Sr.	Project Name	Type of Aid	Amount
1	Establishment of New Locomotive Workshop and Carriage & Wagon Workshop by (CMC).	Loan	94.53 million US$

Korea

Sr.	Project Name	Type of Aid	Amount
1	Procurement of 100 New Passenger Coaches	EDCF Loan	45 million US$

Asian Development Bank (ADB)

Sr.	Project Name	Type of Aid	Amount
1	Upgrading of Bago-Dawei Railway Line 507 km as Pile line Project (Project implementation in 2016 to 2020)	Loan	60 million US$
2	Modernizing Myanma Railways through Institutional Capacity Building and Rehabilitation (ADB) in 2013 to 2016	TA	1 million US$

Source: Myanma Railways

In addition to the above projects, some studies and technical assistance on Myanma Railways have been conducted by JICA and Japanese Ministries as follows.

Table1.8.2.1 Studies and Technical Assistance on Myanma Railways by Japan

Project Name	Client	Consultant / Study Firms	Category	Project Outline	JFY 2011	JFY 2012	JFY 2013	JFY 2014	JFY 2015
1 Study for Yangon Circular Railway Improvement Project	The Overseas Construction Association of Japan, Inc. (OCAJI)	-The Overseas Construction Association of Japan, Inc.	Study	Site survey for Yangon Circular line was conducted and scope of works of improvement for Yangon Circular line were proposed.	Study				
2 Study on Traffic Sector in Myanmar	Ministry of Land, Infrastructure Transport & Tourism (MLIT)	-Nomura Research Institute, Ltd.	Study	Survey on the conditions for each traffic sector in Myanmar and intension of Japanese firms were conducted and suitable projects and operation scheme were proposed.	Study				
3 Study on Yangon Circular Line Rehabilitation and Urban Railway System	Ministry of Economy, Trade and Industry (METI)	-Nomura Reserch Institute -Oriental Consultants Co., Ltd. -Japan International Consultants for Transportation Co., Ltd. -Mitsubishi Reserch Institute -Marubeni Corporation	Study	Site survey for Yangon Circular line was conducted and scope of works of improvement for Yangon Circular line were proposed.		Study			
4 Feasibility Study on Railway Projects in Myanmar	Ministry of Economy, Trade and Industry (METI)	-Marubeni Corporation	Study	This is feasibility study on railway projects in Myanmar.		Study			
5 The Survey Program for The National Transport Development Plan in The Republic of The Union of Myanmar	JICA	-Oriental Consultants Co., Ltd. -ALMEC Corporation -Japan International Consultants for Transportation Co., Ltd. -Asia Air Survey Co., Ltd.	Study	Policy of transport in Myanmar was developed considering traffic survey, demand forecast and enviromental consideration.			Study		
6 Yangon - Mandalay Railway Improvement Project	JICA	-Oriental Consultants Co., Ltd. -ALMEC Corporation -Japan International Consultants for Transportation Co., Ltd. -Asia Air Survey Co., Ltd.	Study	since in the above study the improvement of the section between Yangon and Mandary for the existing railway was nominated as first priolity, the feasility study on it was conduceted.			FS		
7 The Project for Installation of Operation Control Center System and Safety Equipment (Conseptual Design Stage)	JICA	-Japan International Consultants for Transportation Co., Ltd. -Oriental Consultants Co., Ltd.	Study (Conceptual Design)	Study on operation control system and safety equipments for grant aid project is being conducted.			Conceptual Design		
8 Improvement of safety and services for Myanma Railways	JICA	-Japan International Consultants for Transportation Co., Ltd. -Oriental Consultants Co., Ltd. -Sumitomo Corporation	Technical Assistance	Scope of works for the improvement of railway services was analyed based on accident data and track rehabilitation was conducted on the job training.			Expert Dispatch, Seminor		
9 Railway Policy Advisor	JICA	-Japan International Consultants for Transportation Co., Ltd.	Dispatch of Expert	This technical assistance is to give some advices after studing policy, institutional building, improvement, donars for Myanma Railways.			Expert Dispatch		
10 Project for Comprehensive Urban Transport Plan of the Grater Yangon (YUTRA)	JICA	-ALMEC Corporation -Oriental Consultants Co., Ltd. -Nippon Koei Co., Ltd.	Study	This is master plan on urban transport in Greater Yangon.			Study		
11 Yangon Circular Line Upgrading Project	JICA	-Oriental Consultants Co., Ltd. -Nippon Koei Co., Ltd. -ALMEC Corporation -Japan International Consultants for Transportation Co., Ltd. -Asia Air Survey Co., Ltd.	Study	Since in the above study the improvement of Yangon Circular line was nominated as first priolity, the feasility study on it will be conduceted.				FS	

Source: JICA Project Team(2014)

2 MYANMA RAILWAYS' ORGANIZATION, MAINTENANCE SITUATION, OPERATION AND MANAGEMENT SITUATION

2.1 Outline of Current Railway Lines in Greater Yangon

2.1.1 Current Condition of Yangon Circular Railway

The Yangon Circular Railway was opened in January 1959. It was originally a circular railway completed by linking Danyingone station on the route extending to Pyay north of Yangon, which was completed in 1877, to Malwagone station on the route extending to Tungoo north of Yangon, which was completed in 1855. The circular railway is all double tracks and is of non-electrification.

Wears-advanced rails and wooden sleepers are used for track structure. The replacement with PC sleepers was being carried out. There is no trace showing that ballast has been replenished and compacted years ago. Track irregularity is so large that a train can barely manager to run as fast as 25 km/hr.

The track profile of the Yangon Circular Railway is shown in Figure 2.1.2.1 to Figure 2.1.2.9. The track is laid on surface of gentle grade up to a maximum gradient of 5‰. The minimum radius of curvature is 291 metre (six degrees).

There are a total of 25 level crossings but only half have crossing gates, and are paved. The Circular lines intersect at a point between Yangon and Pazundaung, where tangent 6# diamond crossing with tangent 8.5# and tangent 12# turnouts are installed. However, this site of the rail line crossing is built to reduce the rail line routes from the normal six to four, which poses speed restrictions. There are other facilities as FOB 36 places, ROB 25 places and Bridges 53 places in Yangon Circular Railway.

2.1.2 Layout of Yangon Circular Railway

Total length of Yangon Circular Railway is 46.12 km, by measured on Google Earth to trace the railway between inner and outer line. On the one hand, according to MR's official data, the total mile is 28.39 mile (The clockwise distance of between Yangon and Danyingone = 12.56 mile, The anti clockwise distance of between Danyingone and Yangon =15.39 mile.) The grand total mile is 12.56 + 15.83 = 28.39 mile, equivalent to 45.68 km. Consequently, 46.12 km is applied temporally for this pre-F/S report. Next feasibility study will be able to fix the accurate kilometre post by topology survey.

The track layout is shown in Figure 2.1.2.1 to Figure 2.1.2.9 as "Schematic Sketch on Existing Yangon Circular Railway".

The study team received existing technical data from MR, however, the location gradient and curve of track are difference with measurement on Google Earth. Next feasibility study will be able to fix these difference distance.

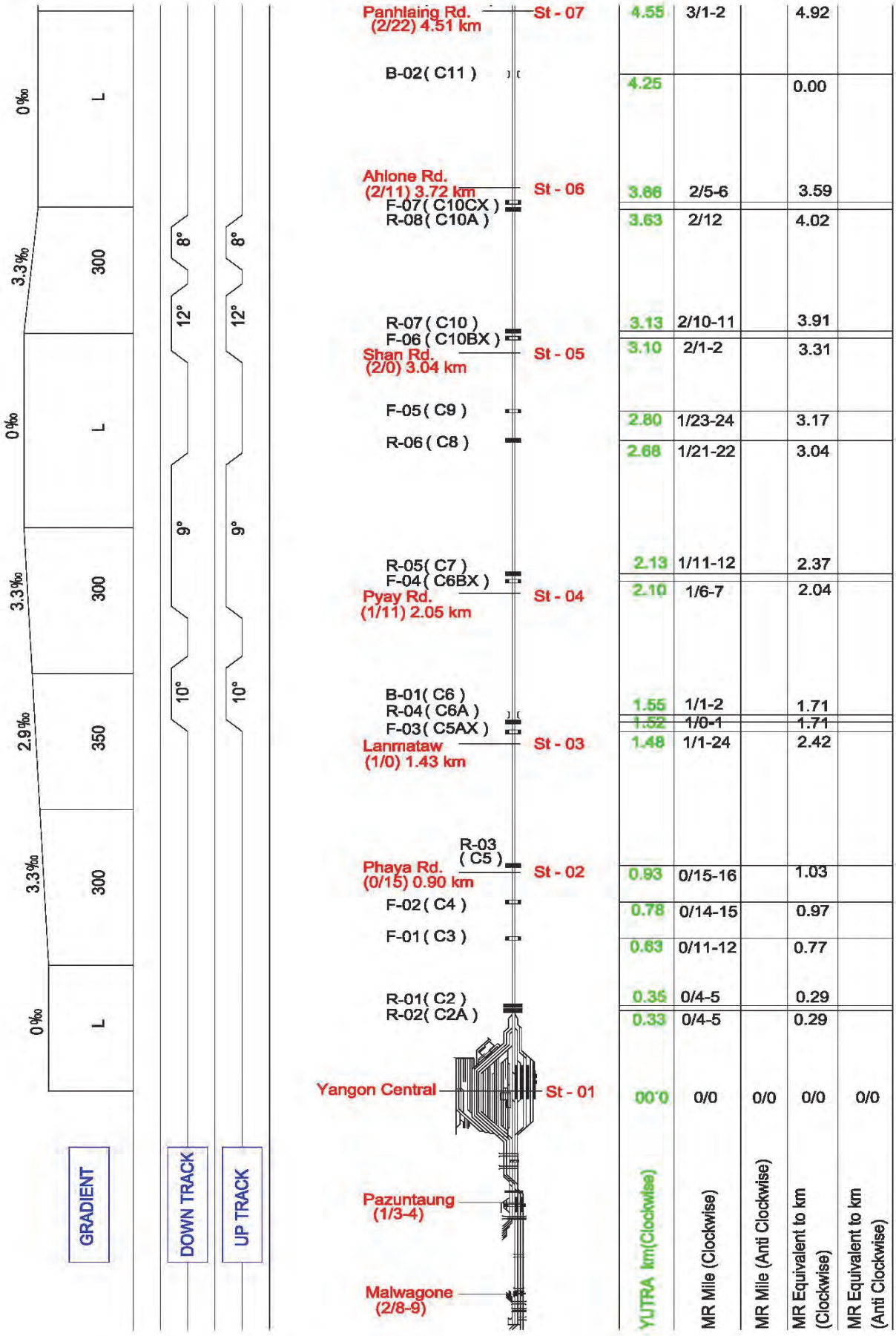


Figure 2.1.2.1 Schematic Sketch on Existing Yangon Circular Railway (1/9)

Source: MR

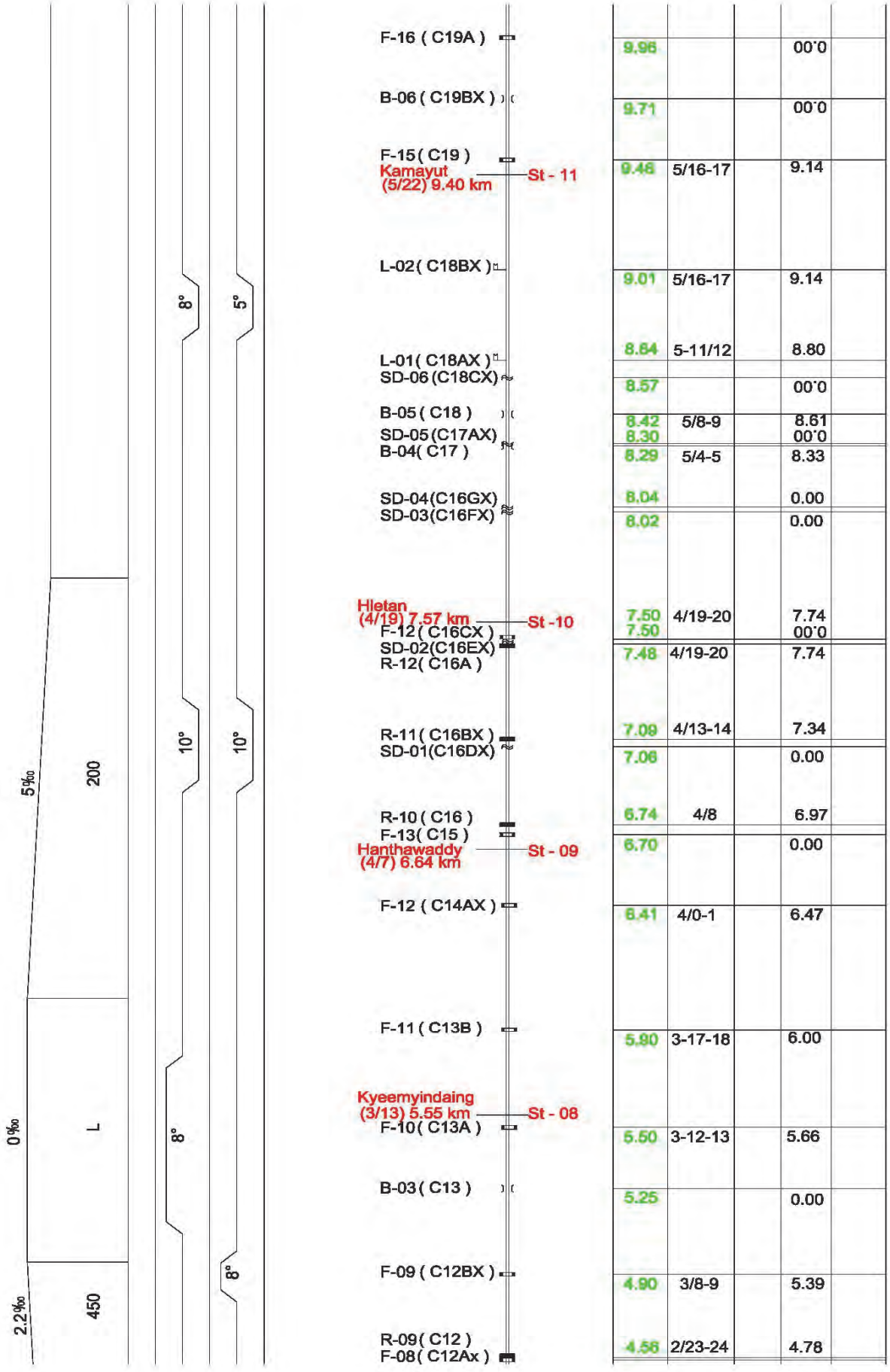


Figure 2.1.2.2 Schematic Sketch on Existing Yangon Circular Railway (2/9)

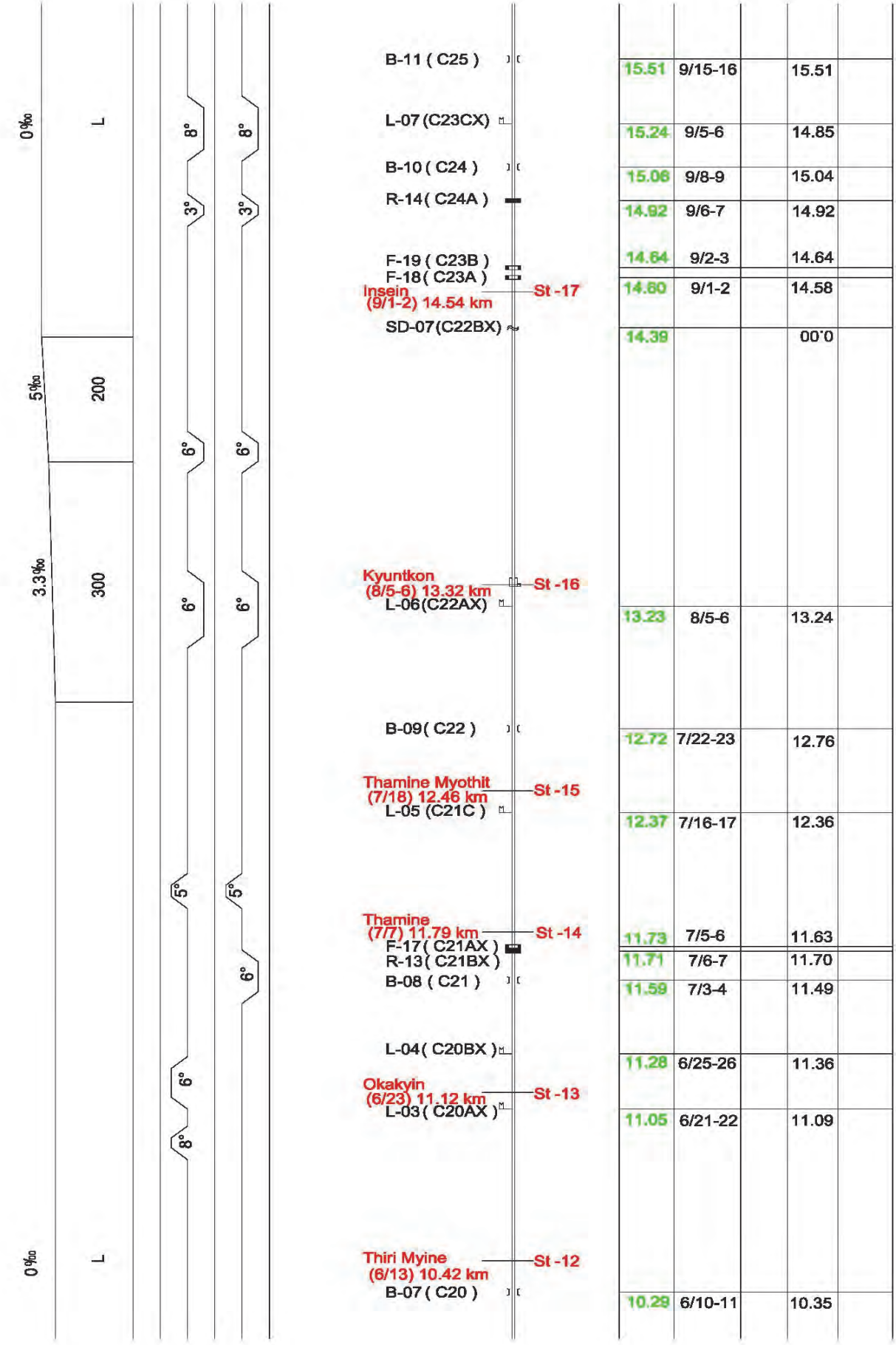


Figure 2.1.2.3 Schematic Sketch on Existing Yangon Circular Railway (3/9)

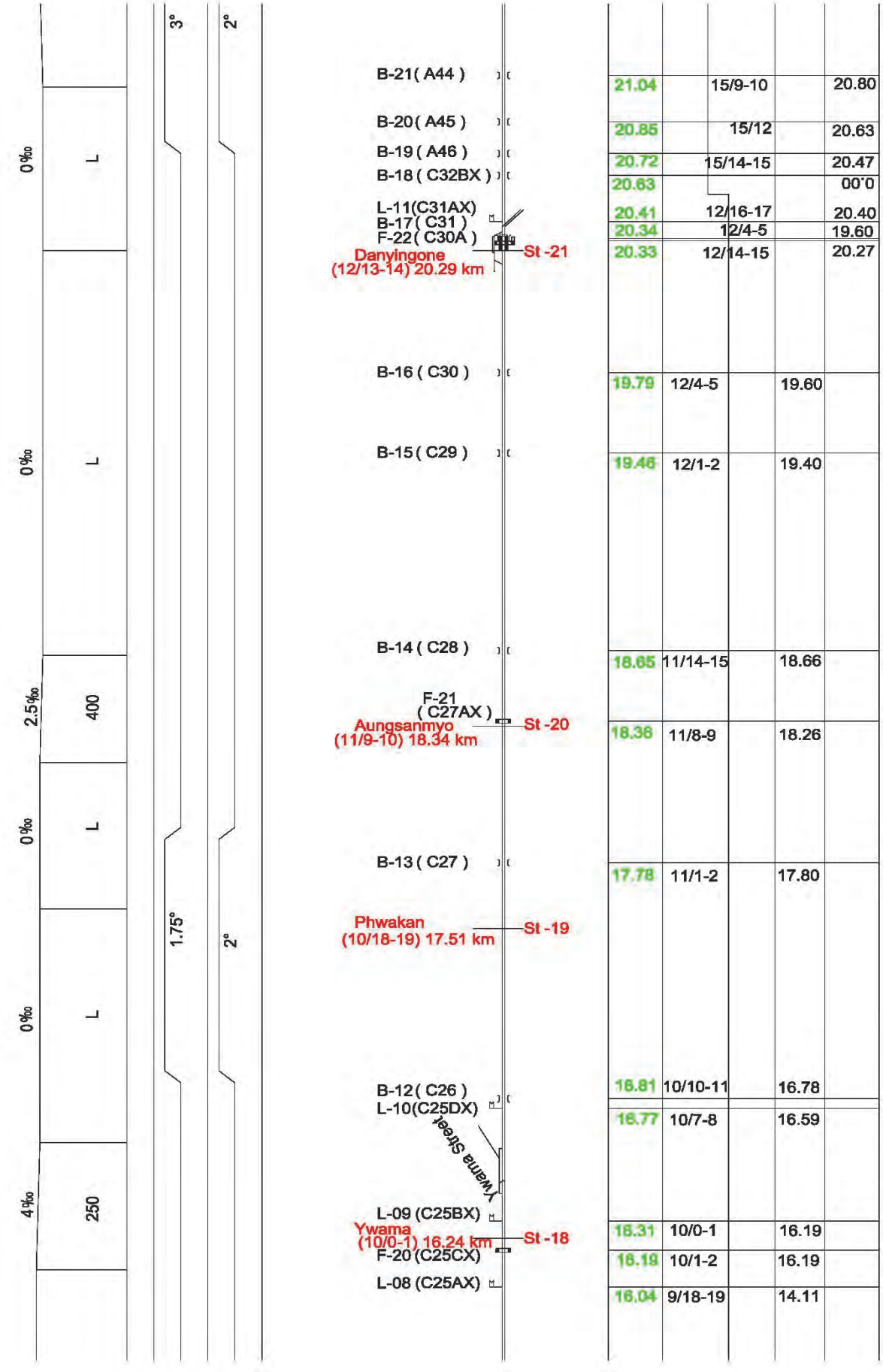


Figure 2.1.2.4 Schematic Sketch on Existing Yangon Circular Railway (4/9)

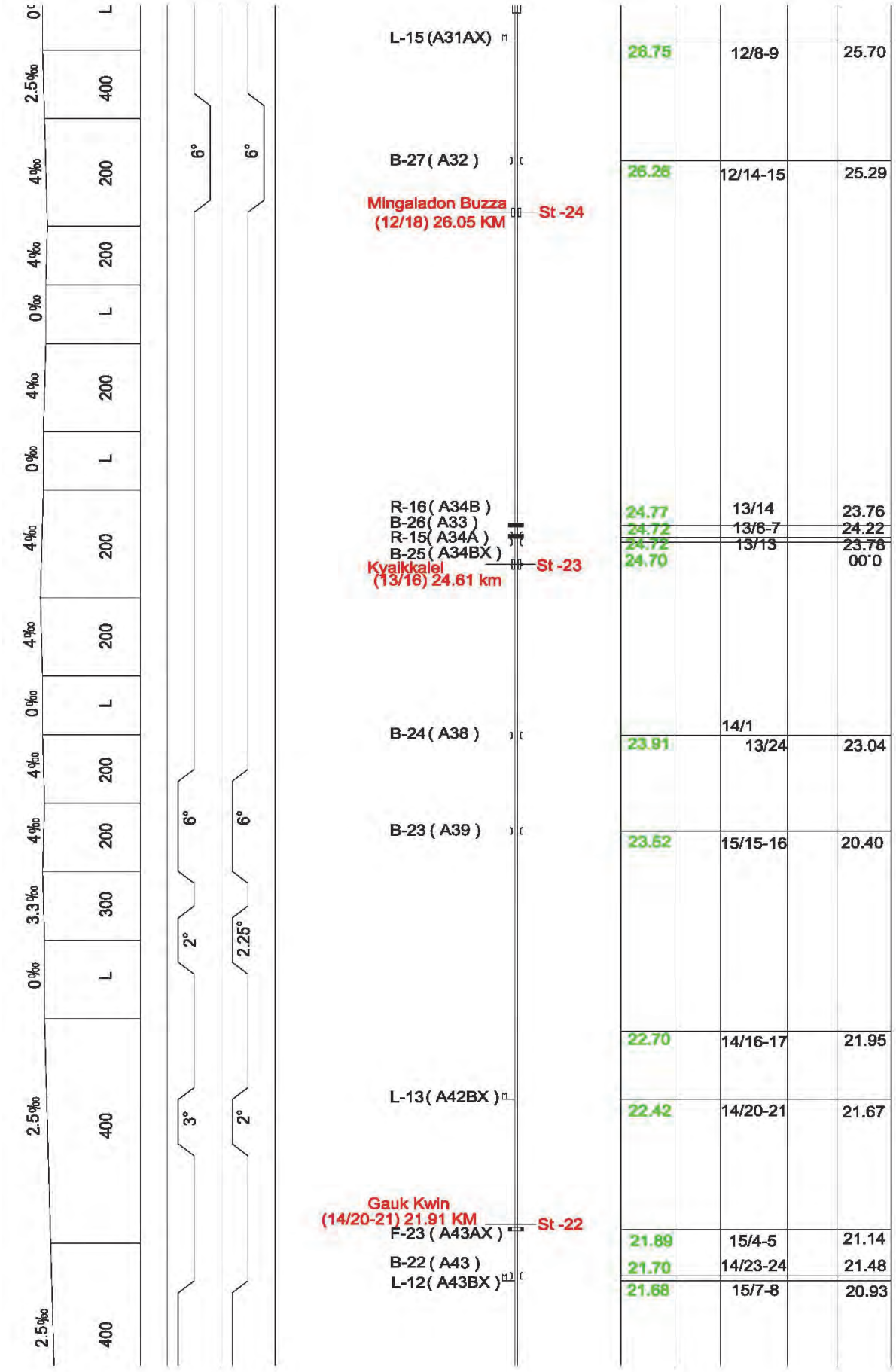


Figure 2.1.2.5 Schematic Sketch on Existing Yangon Circular Railway (5/9)

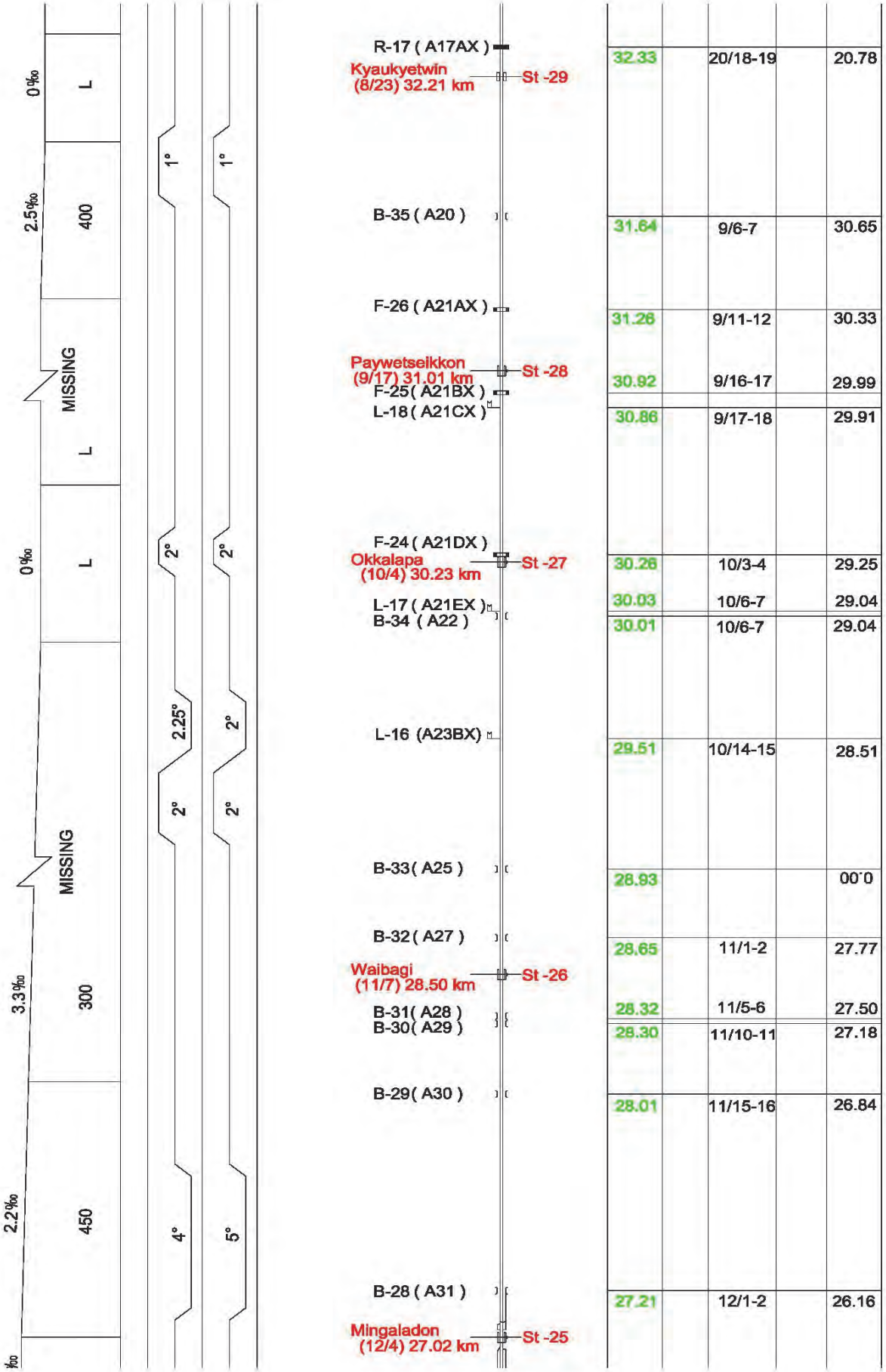


Figure 2.1.2.6 Schematic Sketch on Existing Yangon Circular Railway (6/9)

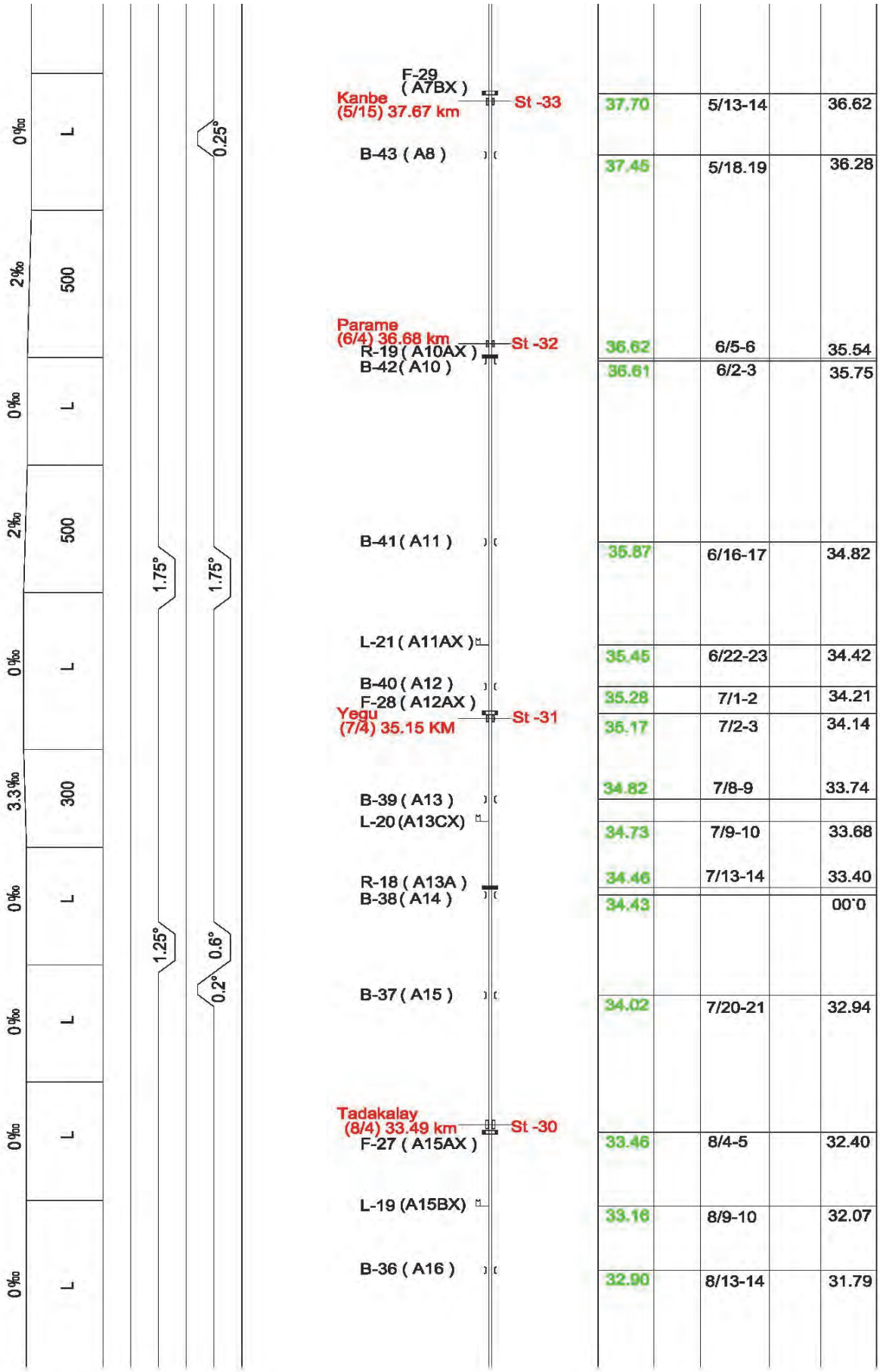


Figure 2.1.2.7 Schematic Sketch on Existing Yangon Circular Railway (7/9)

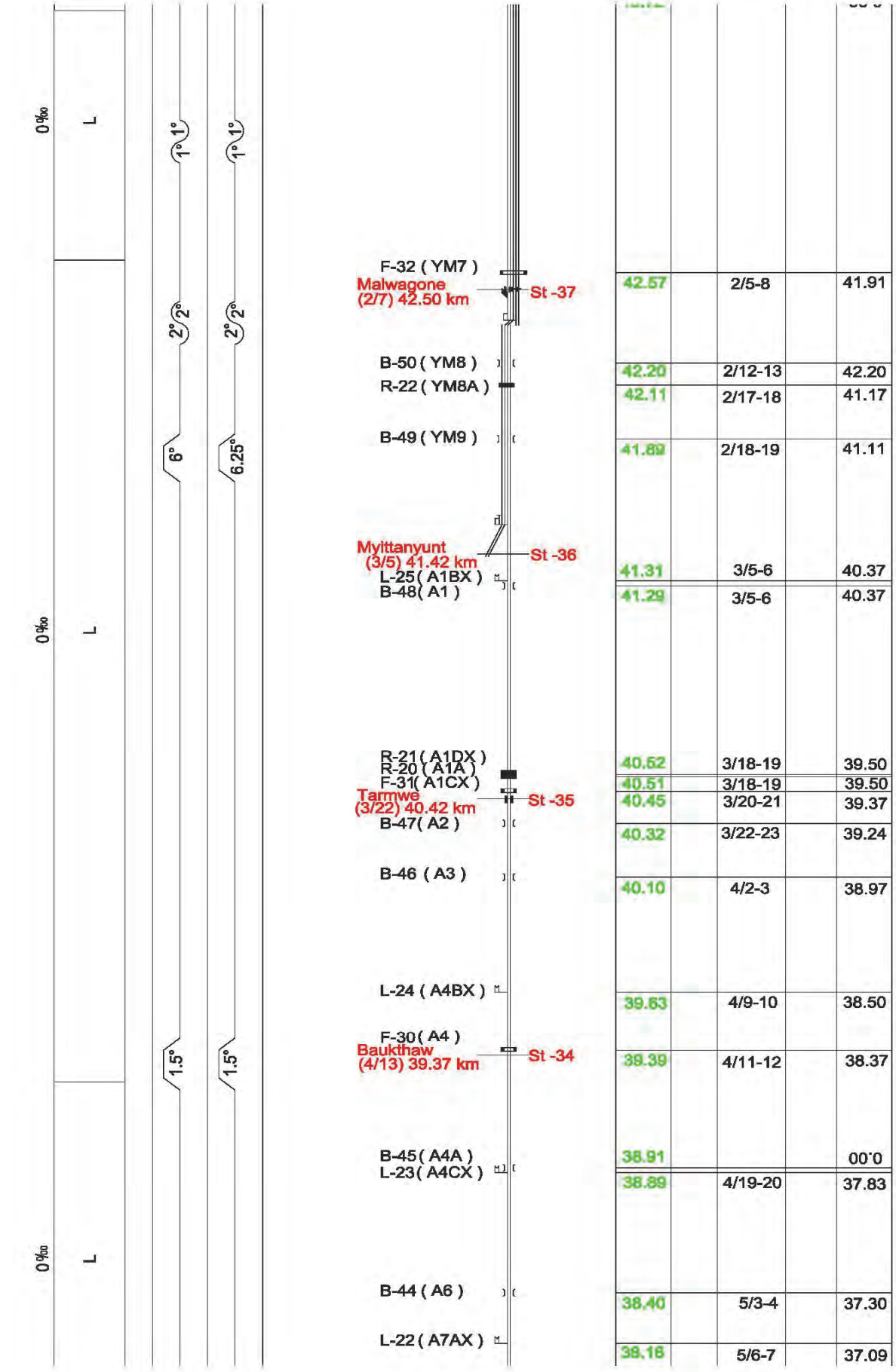


Figure 2.1.2.8 Schematic Sketch on Existing Yangon Circular Railway (8/9)

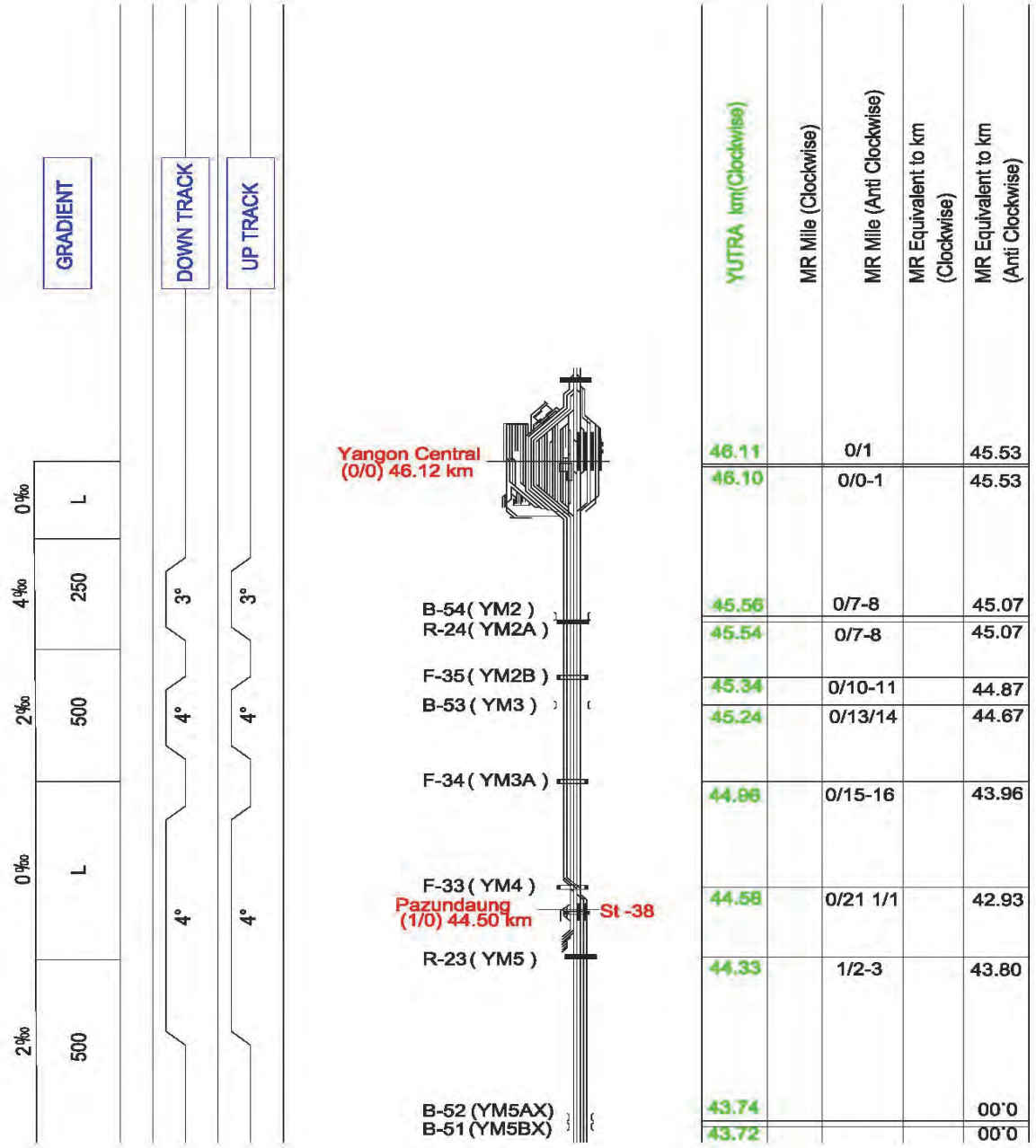


Figure 2.1.2.9 Schematic Sketch on Existing Yangon Circular Railway (9/9)

2.1.3 Track Layout of Yangon Station

Track Layout of Yangon Station is shown in Figure 2.1.3.1. And the Length of track of Yangon Station is shown in Table 2.1.3.1, Yangon Station Building is shown in Table 2.1.3.2.

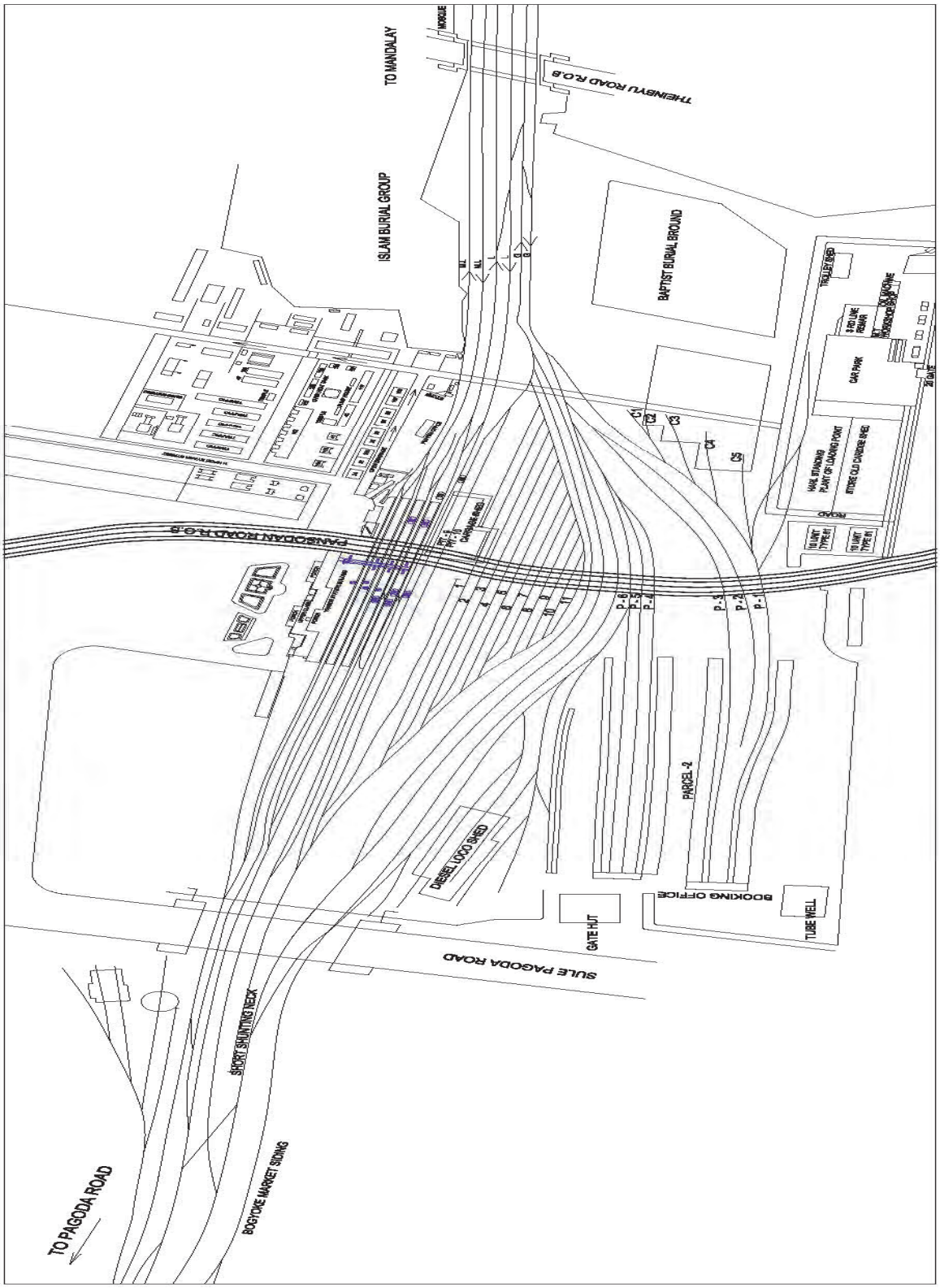


Figure 2.1.3.1 Layout Plan of Yangon Station

Source: MR

Table 2.1.3.1 Length of Track of Yangon Station

TRACK LINE NO:	LENGTH OF TRACK (FT)	LENGTH OF TRACK (M)	NO. OF COACH	REMARKS
1	1540'	469 m	18	Pt.TO Pt.
2	1520'	463 m	16	Pt.TO Pt.
3	2200'	670 m	20	Pt.TO Pt.
4	1970'	600 m	15	Pt.TO Pt.
5	1500'	457 m	14	5E + 5W
6	1500'	457 m	14	6E + 6W
7	1450'	441 m	14	7E + 7W
8	1300'	396 m	14	8E + 8W
9	2600'	792 m	38	Pt.TO Pt.
10	1770'	539 m	20	Pt.TO Pt.
YARD-1	830'	252 m	14	
YARD-2	450'	137 m	8	
YARD-3	450'	137 m	8	
YARD-4	900'	274 m	16	
YARD-5	350'	106 m	6	
YARD-6	300'	91 m	5	
YARD-7	450'	137 m	8	
YARD-8	450'	137 m	8	
YARD-9	100'	30 m	1	
YARD-10	350'	106 m	6	
YARD-11	900'	274 m	16	

Source: YUTRA Project Team (2014)

Table 2.1.3.2 Yangon Station Building

FACTS ABOUT YANGON RAILWAYS STATION YARD		
AREA OF YANGON RAILWAYS STATION BUILDING		
55000 SQUARE FEET (1.26 ACRES)		
LENGTH = 878' (FROM PARCEL -1 TO SAKHANTHAR		
WIDTH = 102'		
AREA OF YANGON RAILWAYS STATION YARD INCLUDING STATION BUILDING		
3152198.60 SQUARE FEET (72.364 ACRES)		
TRACK LINE IN STATION YARD		
FOR EXPRESS & LOCAL TRAINS		= 4 LINES (1 TO 4)
CIRCULAR & SUB URBAN TRAINS		= 4 LINES (5 TO 8)
PIT LINE		= 2 LINES
TLE		= 1 LINES
SICK LINE		= 2 LINES
MARSHAL LINE		= 10 LINES
TOWER LINE OR THROUGH LINE		= 3 LINES
GOODS SHED LINES		= 5 LINES
	TOTAL LINES	= 31 LINES

Source: YUTRA Project Team (2014)

2.2 Design Criteria, Standard and Technical Specification

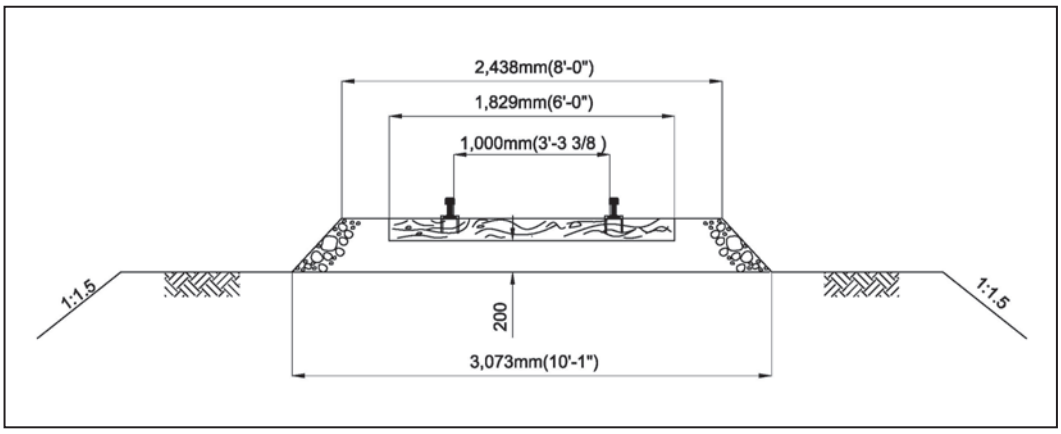
2.2.1 Design Criteria of Track Structure

Table 2.2.1.1 Design Criteria

(a)	Track Gauge	1,000 mm
(b)	Rail Weight	75 Lb / yard (37 kg/meter)
(c)	Standard Rail length	39’
(d)	Minimum Curve	R=291m (6 Degree) ; D=1,750 / 6’ = 291m
(e)	Maximum Gradient	10 ‰ (Station and Stabling yard area less than 2.5 ‰)
(f)	Sleeper	P.C Sleeper and untreated wooden sleeper 4 in 1 (4 sleeper spacing + one P.C sleeper)
(g)	Spacing of Sleeper	(N + 3) total no of sleeper 16 Nos. (P.C 4 + wooden 12) Sleeper spacing is 60 cm centre to centres of Sleeper.
(h)	Dimension of Sleeper	P.C Sleeper = 1,960mm x 350mm x 170 mm Wooden Sleeper = 1,828.8mm x 203.2mm x 114.3mm
(i)	Ballast	Crushed Stone Ballast for Standard 8 Cft / Rft
(j)	Joint	Suspended Joint
(k)	Fastening	Ordinary Track spike and Pandrol clip fastning
(l)	Maximum Axle Load	12.5 Ton (P.C. Sleeper design axle load = 16 Ton)
(m)	Speed	Design speed of circular and suburban line = 25 mph Operating speed of circular line = 12.5 mph Operating speed of suburban line = 14.5 mph Operating speed of circular and suburban line = 13.0 mph
(n)	Minimum Ballast Thickness	20 cm (Under sleeper below)
(o)	Turnout	12#, 8.5#
(p)	Construction Gauge	Refer to Chapter 3.1.1
(q)	Profile of formation level	Refer to Chapter 2.2.2 (Formation Level)

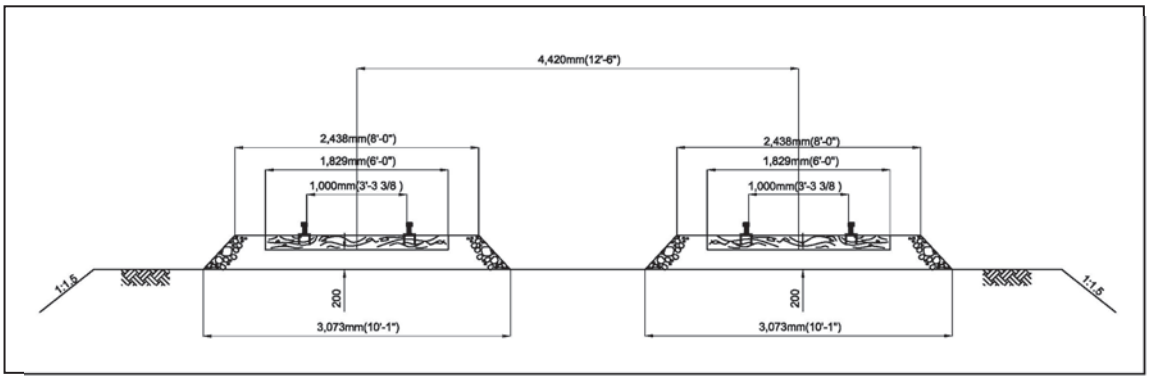
Source: YUTRA Project Team (2014)

2.2.2 Profile of Formation Level and Photo



Source: MR

Figure 2.2.2.1 Single Track Formation Level



Source: MR

Figure 2.2.2.2 Double Track Formation Level

Cut earth section

Under construction of Retaining wall

Passing under the ROB (Not enough height)

Preparing the ballast along platform

Ballast condition on station

Tracks covered with wall and trees

B41 Bridge, under construction

B39 Bridge, 3 span L=41.5 m

Under construction retaining wall

Under construction retaining wall

Passing under the ROB (Not enough height for electrification)

Source: MR

Figure 2.2.2.3 Overview Photo of Yangon Circular Railway

2.3 Review of Income and Expense Planning (Include Fare and Other Income)

2.3.1 Financial Condition of Railway Sector

Regarding finance, MORT allocates an annual budget to MR headquarters, and MR headquarters allocates it to the sector's departments in the headquarters. Then, the sector's departments decide which necessary projects will be distributed. Hence, the general manager of Lower Myanmar Administration has no authority to decide the budget allocation.

Financial statement of MR is shown in the table below. The table shows that profitability worsened after 2008 and every year thereafter and the total expense became twice of the total revenue in FY2012. Although it has improved in FY2013 as a result of raising the ticket fare, it is expected to require a huge investment continuously for intercity train operations and maintenance, etc. because of the large country and the rapidly expanding railway network. It is an important issue to consider how to develop an appropriate operations and management system for urban railway.

Table 2.3.1.1 Financial Statement of MR

Items	2008-09	2009-10	2010-11	2011-12	2012-13 *
Revenue					
- Passenger	20,541.15	20,204.27	20,639.34	29,460.28	36,205.13
- Goods	5,468.90	7,689.97	8,288.01	16,734.96	19,623.33
- Others	2,104.36	2,210.64	4,237.27	4,803.63	5,826.15
Total Revenue	28,114.96	30,104.88	33,164.62	50,998.87	61,654.61
Expense					
- Operation	52,600.71	58,864.77	66,346.52	71.535.05	78,058.67
Expenses					
- Interest	26.50	36.61	61.66	12.61	4,217.61
- Profit & Loss on Foreign Exchange	-8.85	-5.41	-25.22	-1.75	
Total Expense	52,618.36	58,895.97	66,382.96	71,545.91	
Operation Ratio (=Expense/Revenue)	187.15%	195.64%	200.16%	140.29%	133.45%

Note: The number for 2012-13 is provisional. Source: Fact about Myanma Railways 2012-2013, etc.

Financial statement for Yangon Circular Railway and the Suburban Lines is shown in the table below. Official financial statement for Yangon Circular Railway and the Suburban Lines was virtually non-existent because MR's financial management system is fully controlled by MR headquarters, and each office division has no data about expenditures in their jurisdiction area.

Table 2.3.1.2 Financial Statement of Yangon Circular Railway and the Suburban Lines (Estimation)

(unit: million MMK)

Items	A month in 2011
Monthly Expenses	
- Salary	27.807
- Engine fuel (65,337 gallons)	196.011
- Maintenance expenses for YCR office, engines, coaches	22.692
- Maintenance for railways	14.900
Total	261.410
Monthly Income	
- Fare box revenue	29.488
- Income from shops / rental fee	13.410
Total	42.898
Income-Expenses	-218.510
Operation Ratio (=Expense/Revenue)	609%

Source: Upgrading of the Yangon Circular Railway Project, Fact about Yangon Circular Railways, 2012

2.3.2 Fare System

The fare table for Yangon Circular Railway and the Suburban Lines is shown below. The fare for two riding tickets was MMK 20 until November 2011. However, it was raised to MMK 100 afterwards.

Ticket of long distance train is sold since one day before. All tickets are sold manually at ticket booth in stations

Table 2.3.2.1 Fare Table of Yangon Circular Railway and the Suburban Lines

Type	Fare (MMK)	Remarks
two riding tickets	100	For foreigner, US$1 per one way.
Monthly ticket	1,700	
Monthly ticket (for Student)	1,150	
Luggage	50	1 bundle,10 viss(=16 kg)
Without ticket (adult)	1,000	As fine
Without ticket (child)	500	As fine
Without ticket (luggage)	150	As fine

Note:
1) 1 riding ticket is not available.
2) Same price regardless of riding length as long as inside Yangon Circular Railway and the Suburban Lines
3) 6 ticket inspection group which consist of 37 ticket inspectors conduct ticket inspection

Source: Traffic Data Yangon Circular Railway 2012, and MR Presentation Material for Yangon Circular Railway

2.4 Review of Train Operation Planning

2.4.1 Railway Transport Volume and Train Operation in Myanma Railways

The following Table 2.4.1.1 shows the railway transport volume, and passenger and freight from 2006 to 2012. In the last six years, passenger volume has decreased to about

4.7% while freight volume has increased to approximately 31.1%. Annual passenger and freight volumes per total railway length in 2011-2012 are about 11,000 persons/km and 609 t/km, respectively.

Table 2.4.1.1 Railway Transport Volume

	2007 -2008	2008 -2009	2009 -2010	2010 -2011	2011 -2012	2012 -2013
Passenger						
- No. of passengers (million)	75.959	73.561	71.602	67.650	64.352	53.852
- Daily passengers (million)	0.21	0.20	0.20	0.19	0.18	0.148
- Passenger mile (100 million･mi)	33.784	33.489	33.376	33.287	31.428	23.867
- Passenger km (100 million･km)	54.370	53.895	53.713	53.570	50.578	38.4009
Freight						
- Tons carried(million･t)	2.93	2.95	3.33	3.41	3.58	2.85
- Ton/day(thousand･t)	8.03	8.09	9.12	9.34	9.83	7.81
- Ton mile (10 million･mi)	53.54	56.99	65.83	69.78	72.27	60.30
- Ton km(10 million･km)	86.164	91.717	105.943	112.300	116.307	97.041

Source: Facts about Myanma Railways 2012-2013

Myanma Railways has a future annual railway transport demand plan up to 2016 as shown in the table below. Included in the plan are some high priority projects such as the improvement of Yangon-Mandalay Line, enhancement of Yangon Circular Line, maintenance of railway transportation network in Shan State, and development of access lines to the neighbouring countries. They also have a railway transportation network expansion plan which has a total length of 1,779.43 mi (2,863.71 km). It is expected that these plans will be developed until 2016, as well as the updating plan of the signalling and telecommunication systems.

Table 2.4.1.2 Future Railway Transport Demand from 2011/2012 to 2015/2016

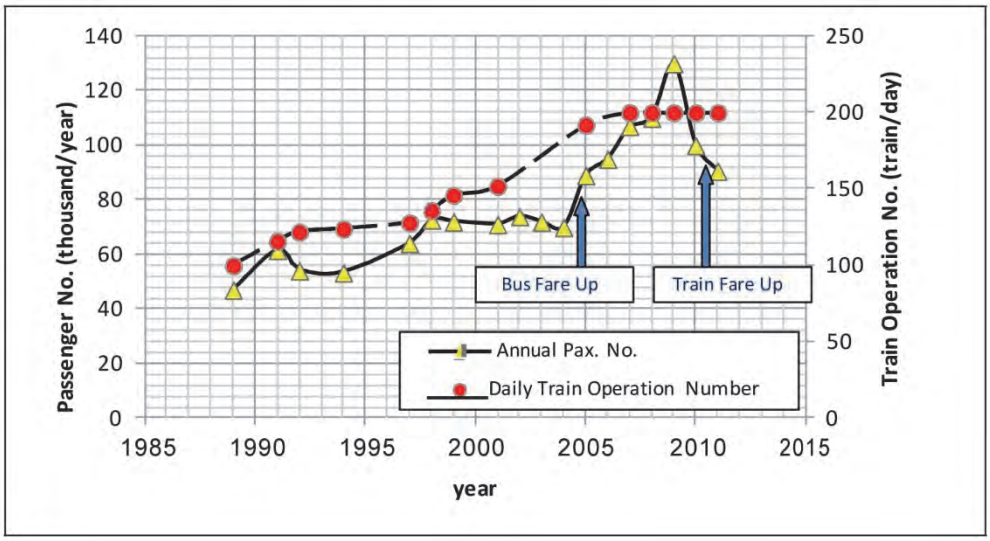
	2011 -2012	2012 -2013	2013 -2014	2014 -2015	2015 -2016
Passenger					
No. of passengers (million)	68.012	69.870	66.200	67.000	68.000
Passenger mile (100 million・mi)	3,825.188	3,439.708	3,217.320	3,281.100	3,346.100
Passenger km (100 million・km)	6,156.043	5,535.673	5,177.775	5,280.419	5,385.026
Freight					
Tons carried (million・t)	3.657	3.768	3.734	4.115	4.192
Ton mile (10 million・mi)	730.949	755.811	735.598	810.655	825.824
Ton km (10 million・km)	1,176.348	1,216.360	1,183.830	1,304.623	1,329.035

Source: Facts about Myanma Railways 2011-2012

2.4.2 Railway Transport Volume and Train Operation in Greater Yangon

The average daily ridership of Yangon Circular Railway and the Suburban Lines in FY2011 is 90,620 passengers/day and the daily number of operated trains in the lines is 200 train/day. The change in the number of annual passengers and daily operated trains by year in Yangon Circular Railway and the Suburban Lines are shown in Figure 2.4.2.1.

The figure shows that Yangon Circular Railway and the Suburban Lines are used as a means of citizens' transportation and that the number of the users showed an increasing trend as a whole until late 2000s though there is somewhat an increase or decrease within short periods. However, the number of passengers in FY2011 dropped drastically because of implementation of fare increase.



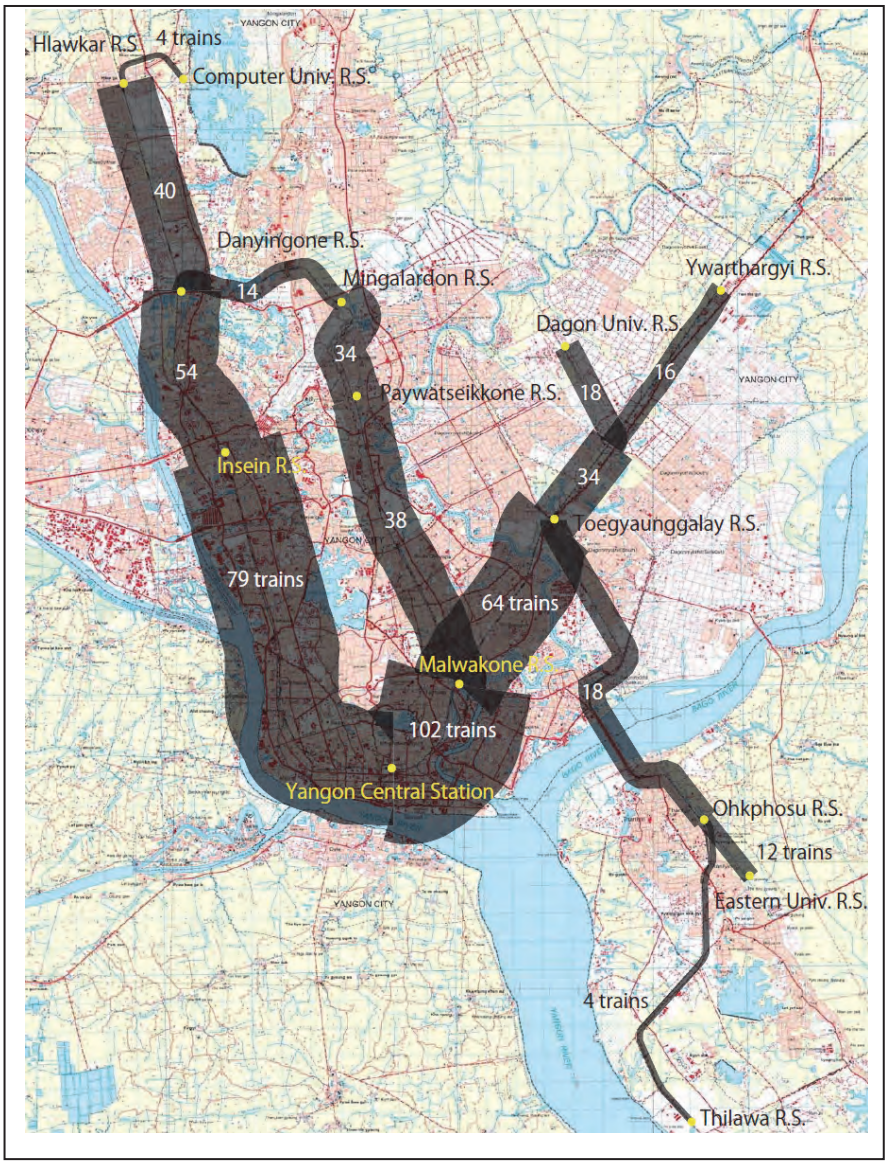
Source: Upgrading of Yangon Circular Railway Project: Facts About Yangon Circular Railways, 2011, Presentation Material by MR, and Traffic Data Yangon Circular Railway, 2012.

Figure 2.4.2.1 Change in the Number of Passengers and Train Operations of Yangon Circular Railway and the Suburban Lines

2.4.3 Train Operation of Yangon Circular Railway

The number of operated trains among sections is shown in Figure 2.4.3.1. The figure shows that V shaped lines between Danyingone and Toe Kyaung Galay via Yangon Central Station is the most important corridor in Yangon Circular Railway and the Suburban Lines.

The figure also shows that Yangon Circular Railway and the Suburban Lines play an important role as urban transport in Yangon Region as a whole. However, the operational performance and capacity is quite poor due to the deterioration of all infrastructures and lack of proper maintenance. Even the sections in relatively good condition in Yangon Circular Railway, Yangon-Mandalay Main Line and Yangon-Pyay Main Line in Yangon Region, which are the most maintained line, the maximum speed is approximately 25-30 km/hr, while the other suburban lines are forced to operate at quite slow speeds of 5-10 km/hr due to terrible track conditions. The time it takes to make a round trip of Yangon Circular Railway, which has 46.12 km (Depend on Google Earth survey), is approximately three hours (equivalent to 15 km/hr).



Source: Traffic Data Yangon Circular Railway, and Train Operation Diagram in Yangon Circular Railway and Yangon Suburban Line

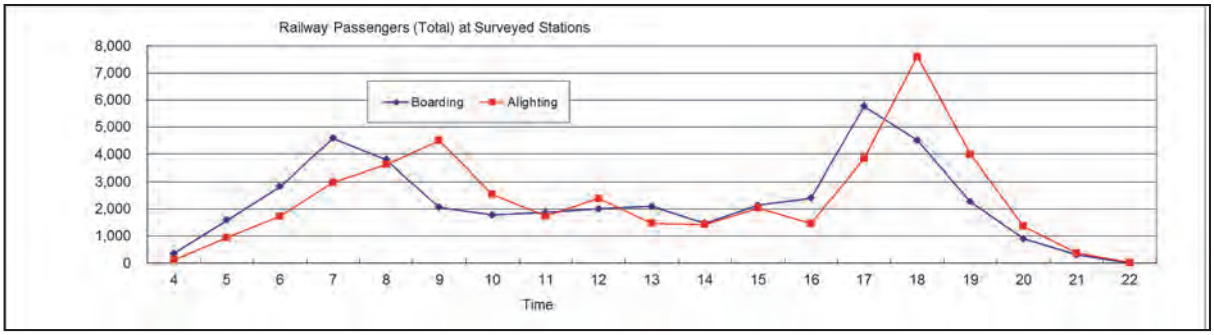
Figure 2.4.3.1 Train Operation Number at Each Section

Figure 2.4.3.2 shows hourly number of passengers by boarding and alighting, Figure 2.4.3.3 shows trip purpose and access/egress mode, as a result of railway passenger OD survey by YUTRA project team.

Morning peak hour is 7:00 – 9:00 (Peak ratio: 11%) and evening peak hour is 17:00-18:00 (Peak ratio: 17%). 4 trains per hour (15 min. headway) are operated during peak hours on loop line.

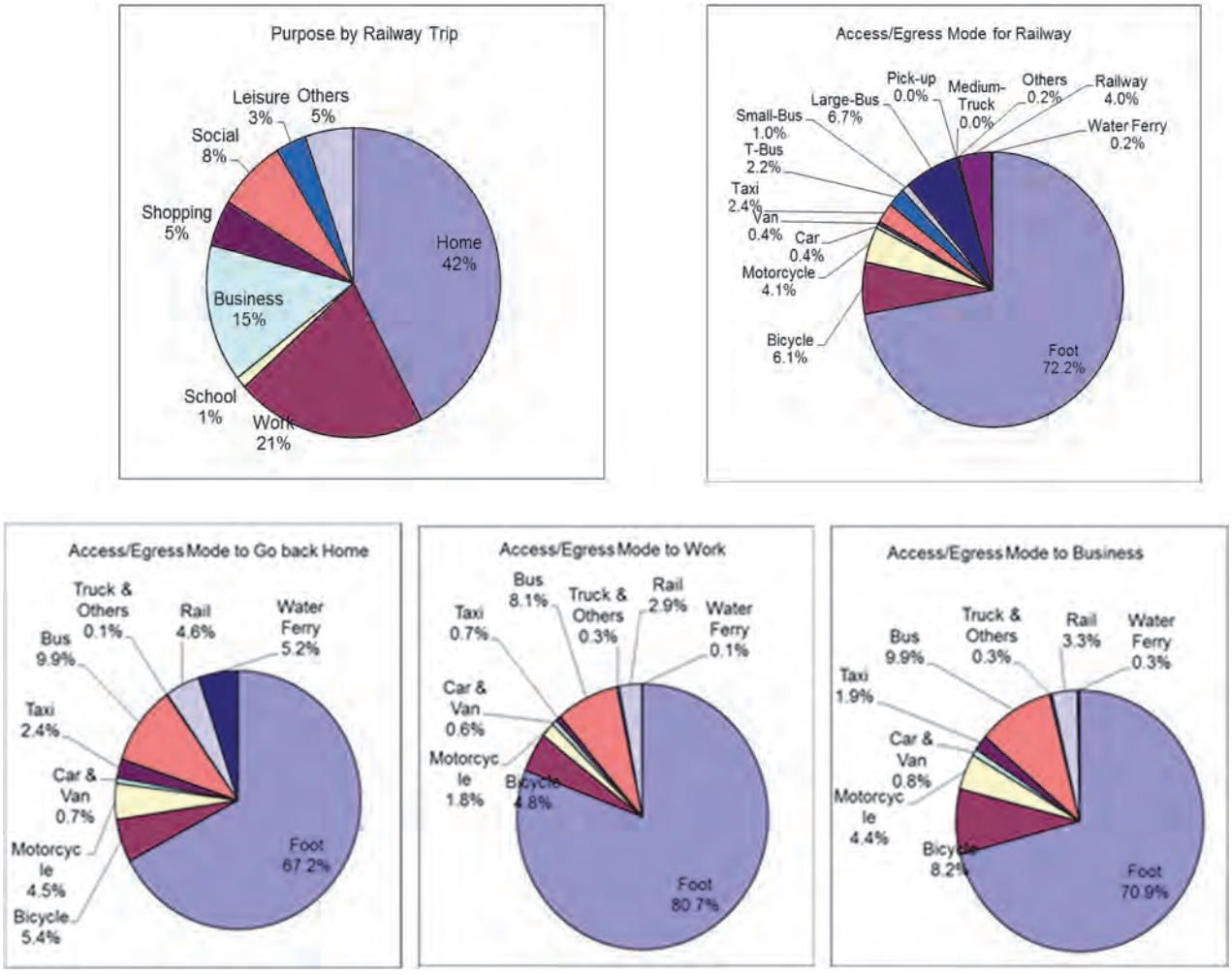
42% of the rail passenger use railway for going home, and 36% for work/business.

Main access/egress mode (72%) is foot. It means poor feeder service is provides at stations. Integrated transportation station is desirable in order to make suitable transit oriented development.



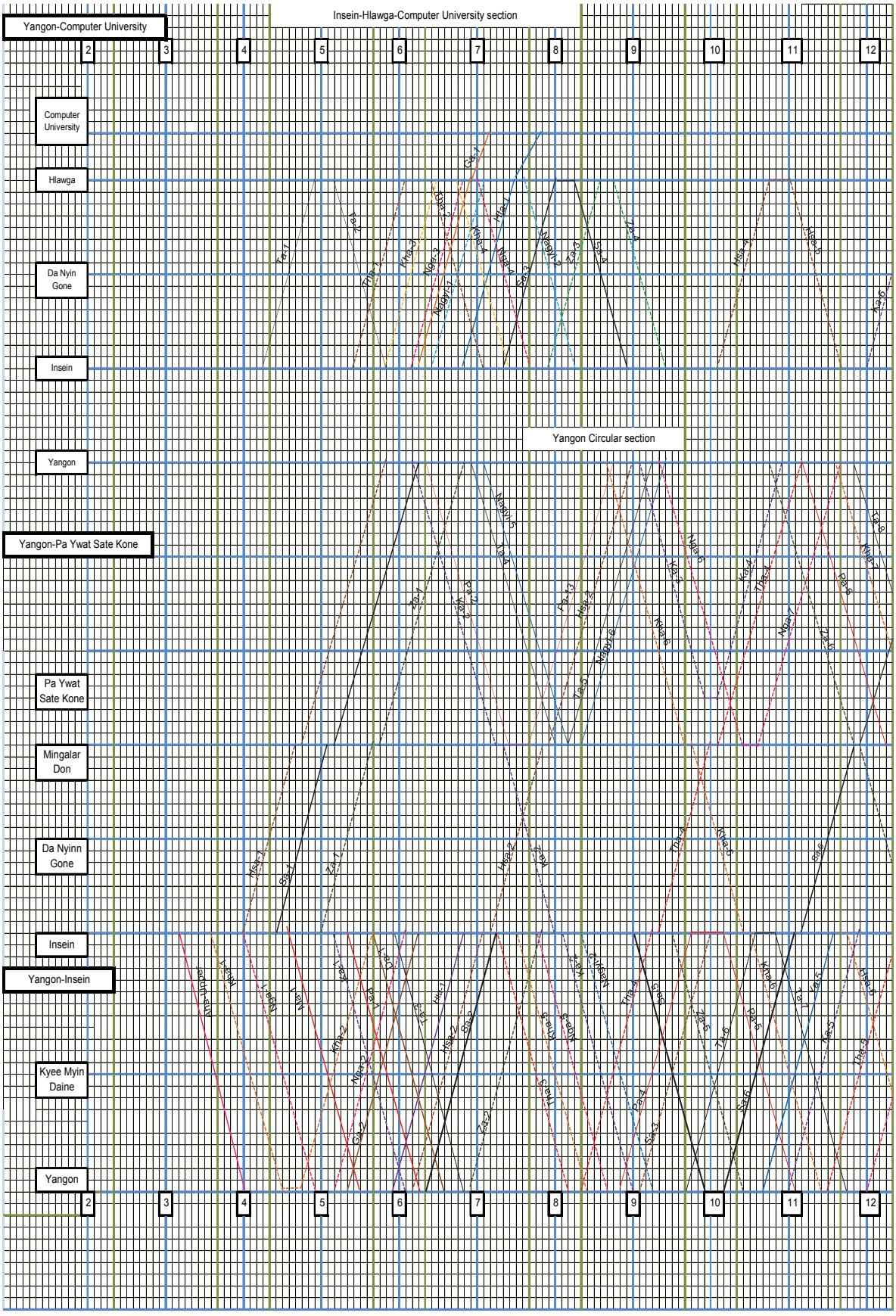
Source: YUTRA Project Team (2013)

Figure 2.4.3.2 Train Hourly Number of Passengers by Boarding and Alighting



Source: YUTRA Project Team

Figure 2.4.3.3 Trip Purpose and Access/Egress Mode



Source: MR

Figure 2.4.3.4 Train Diagram of Yangon Circular Railway (1/2)

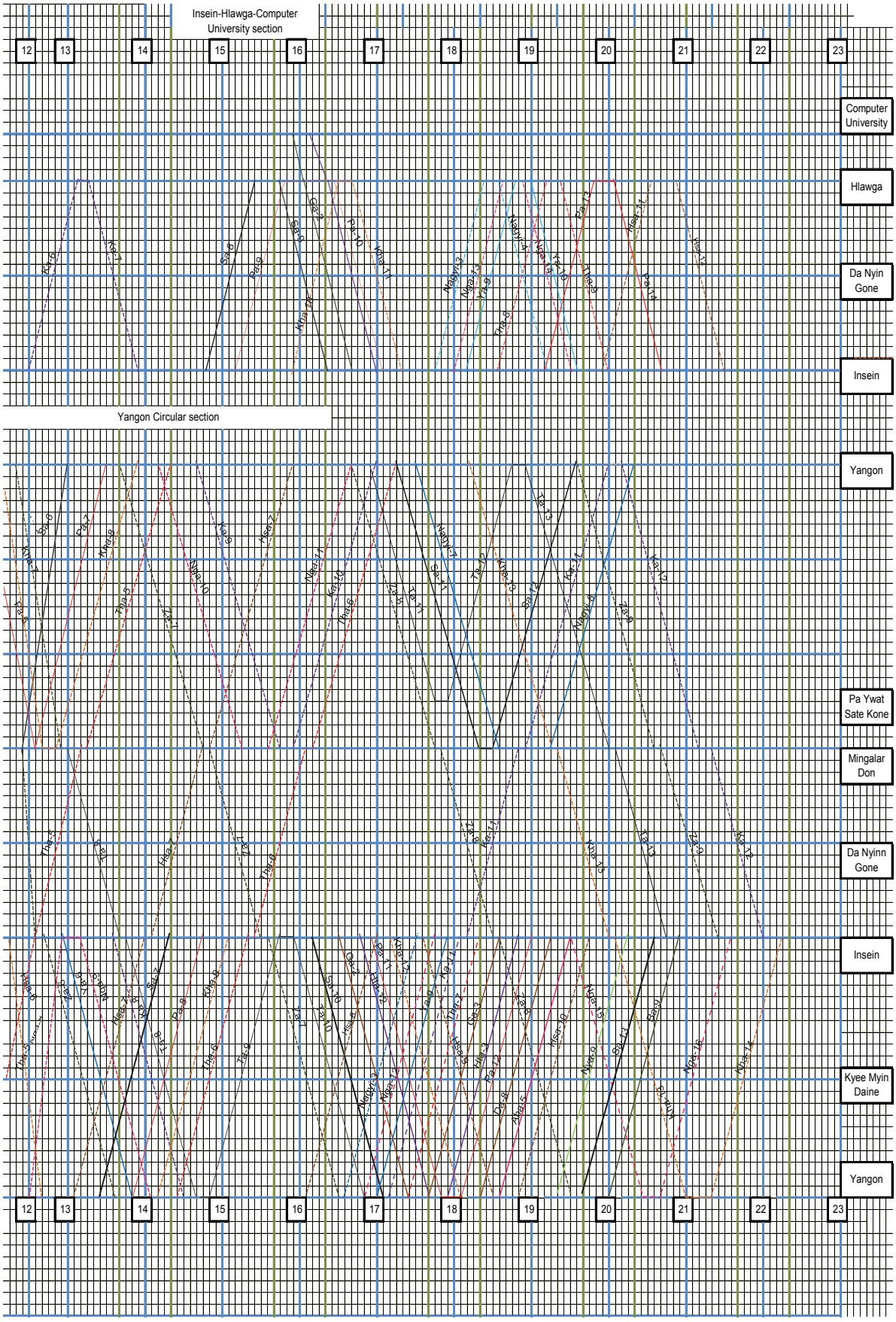
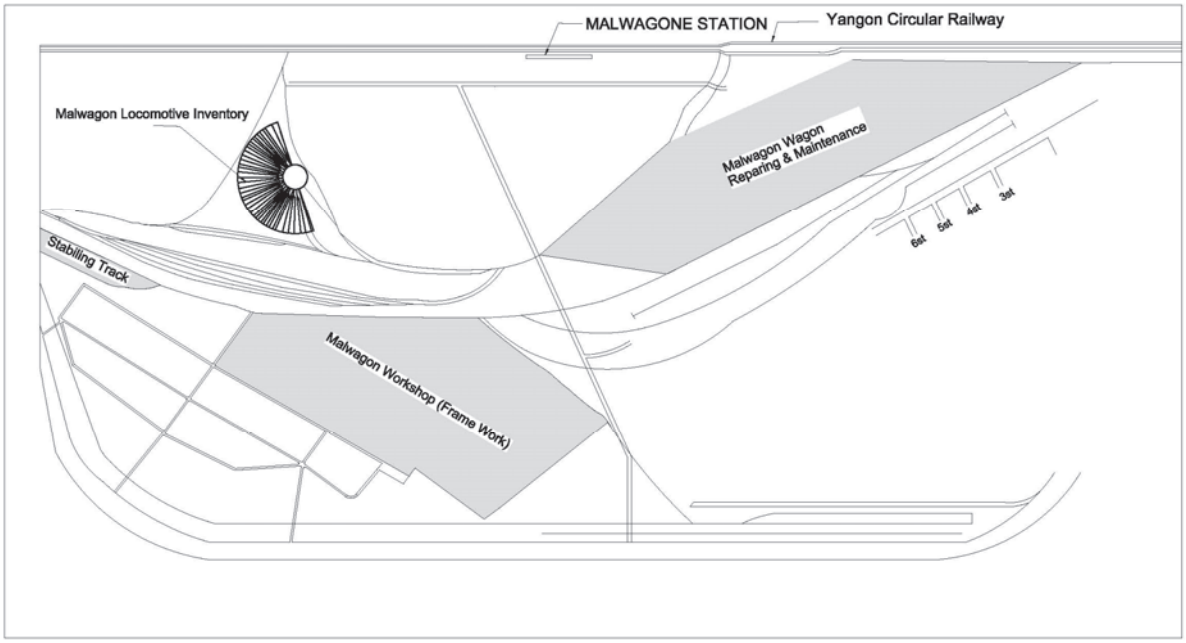


Figure 2.4.3.5 Train Diagram of Yangon Circular Railway (2/2)

2.4.4 Freight Operation in Myanma Railways

The freight train operation is not deal with Yangon Circular Railway, however, Malwagone Depot for freight train operate inside of Yangon Circular Railway. The location of Malwagone Depot is shown in Figure 2.4.4.1 and the tonnage of freight train of Myanma Railway is shown in Table 2.4.4.1. The map of Myanma Freight Railway is shown in Figure 2.4.4.2.



Source: MR

Figure 2.4.4.1 Layout of Malwagone Depot

Malwagone Workshop

Malwagone Workshop

Locomotive Inventory

Locomotive Inventory

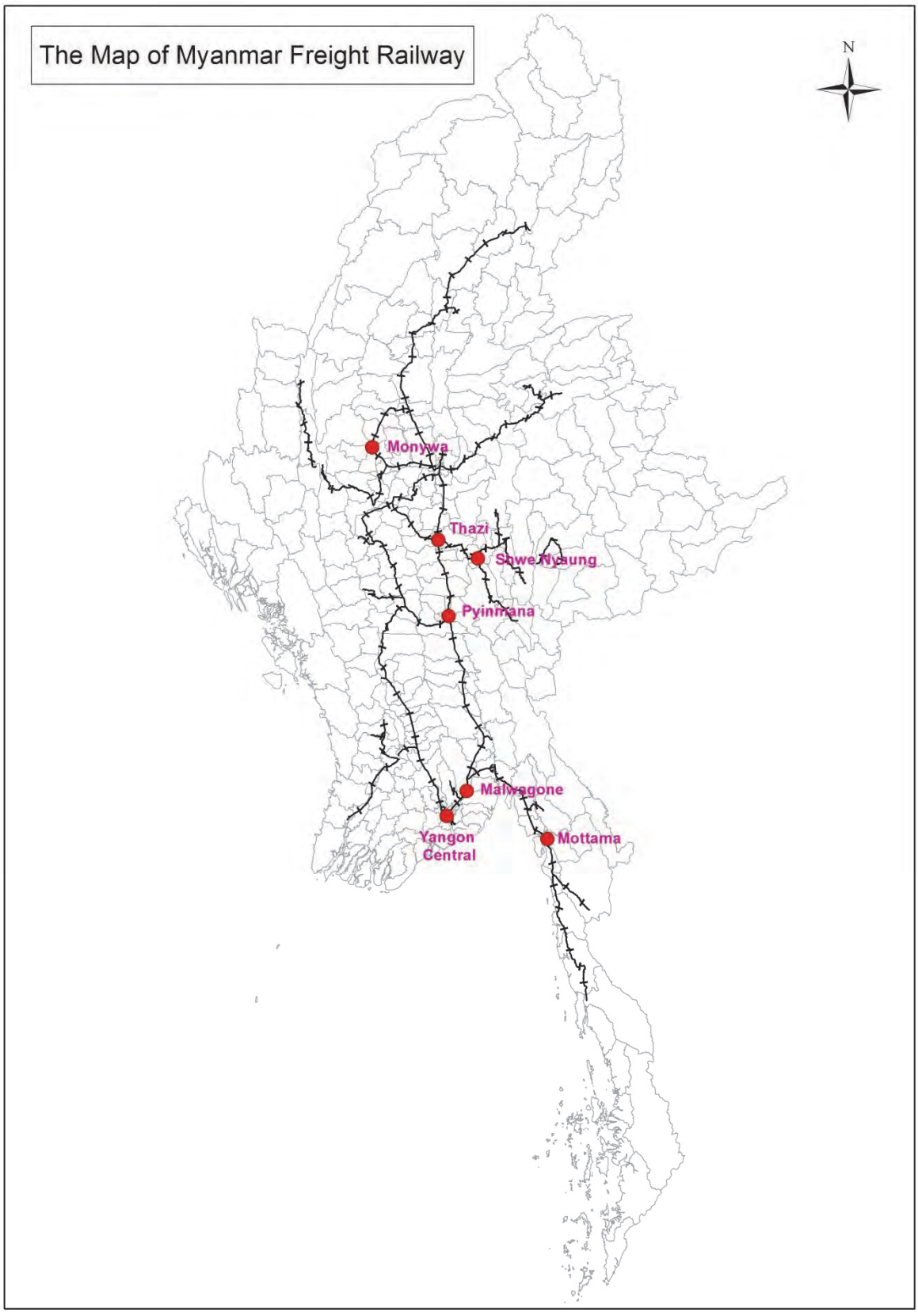
Source: YUTRA Project Team(2014)

Figure 2.4.4.2 Malwagone Photo

Table 2.4.4.1 Tonnage of Freight Train (2013) of Myanma Railways

Starting to Destination	Tonnage
Yangon - Mongywa	3,810
Mongywa - Yangon	3,150
Yangon - Shwenyaung	25,980
Yangon - Pyinmana	74,955
Pyinmana - Yangon	51,605
Zinkyaik - Malwagone	38,864
Tharsi - Malwagone	51,077
Malwagone - Zinkyaik	16,435
Malwagone - Tharsi	55,292
Total	**321,167**

Source: MR



Source: MR

Figure 2.4.4.3 The Map of Myanma Freight Railway

2.5 Review of Safety Control and Security Situation (Include Accident, Disaster Nature and Human)

2.5.1 Safety Control of MR

Many accidents are occurred due to aged infrastructures and poor maintenance on Yangon Circular Railway. According to the accident record since January 2011 to November 2011 prepared by Myanma Railways, 34 accidents are reported for 11 months. One or two accidents per month are occurred. Therefore accident rate is calculated as follows.

34 accidents / (330 days x 200 train per day) = 0.05%

The main reasons of the accident are derailment due to poor maintenance of track, failure of rolling stock, signal, turnout, and careless of train driver. Urgent actions should be taken for safety train operation.

Table 2.5.1.1 Changes in the Number of Accidents that Occur on Yangon Circular Railway

Year / Accident	2010	2011	2012	2013
Train Collision	0	0	0	0
Level Crossing	2	1	0	3
Train Parting	0	0	0	0
Derailment (Station Yard)	0	4	7	3
Derailment (Section)	6	5	6	1
Total	8	10	13	7

Source; JICA Project Team

For example, accident rate on Yangon Circular Railway in 2012 year is calculated as follows.

13 accidents / (330 days + 79 train per day) = 0.05 %

This number of Yangon Circular is almost same figure with Myanma Railways.

Table 2.5.1.2 Changes in the Number of Accidents that Occur on Yangon Circular Railway

Type of Accident	Train Collision	Level Crossing	Train Parking	Derailment (Yard)	Derail (Section)
Yangon Circular in 2010	0	2	0	0	6
Yangon Circular in 2011	0	1	0	4	5
Yangon Circular in 2012	0	0	0	7	6
Yangon Circular in 2013	0	3	0	3	1

Source; JICA Project Team

The detail data of Yangon Circular Railway are shown in Appendix 2-3.

2.5.2 Disasters Nature

The numerous types of natural disasters that occur in Myanmar, typhoons and earthquakes are believed to have the greatest impact on railways. Below are examples of typhoons and earthquakes that have hit Myanmar in recent years, and the damages they have caused.

Table 2.5.2.1 Examples of Damage Caused by Typhoon

Date	Occurrence	Damage
July 2008	Cyclone Nargis	800,000 homes were destroyed, 600,000 hectares of farmland flooded, and 138,000 are dead or missing.

Source: According to the news.

Table 2.5.2.2 Examples of Damage Caused by Earthquake

Date	Occurrence	Damage
March 2011	6.8 magnitude in Shan State in eastern Myanmar	The Myanmar government that there were 74 fatalities within the country.

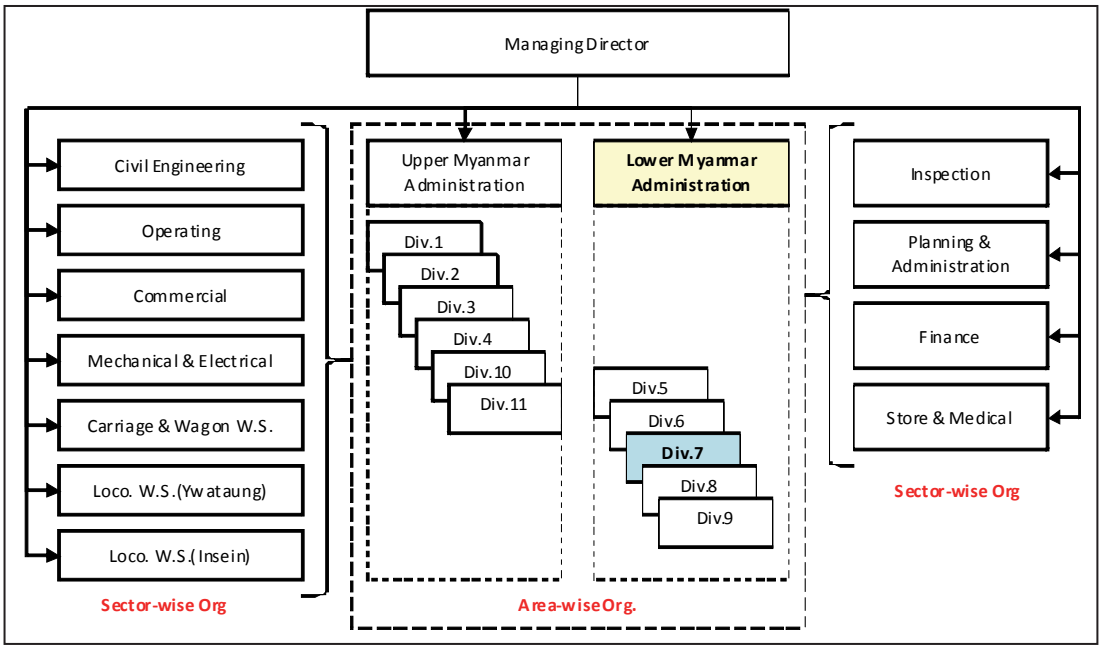
Source: According to the news.

Depend on interview by MR, there were no dead or missing in Yangon Circular Railway area above descried.

2.6 Operation and Management Organization (Organization, Budget Personnel and Technical Level)

2.6.1 Organization Chart of Myanma Railways

All railway operations and management in Myanmar are conducted by Myanma Railways (MR) which is under the umbrella of Ministry of Rail Transportation (MORT). Organizational structure of MR is shown below.



Source: Fact about Myanma Railways 2011-2012 (partially arranged)

Figure 2.6.1.1 Organizational Chart of Myanma Railways

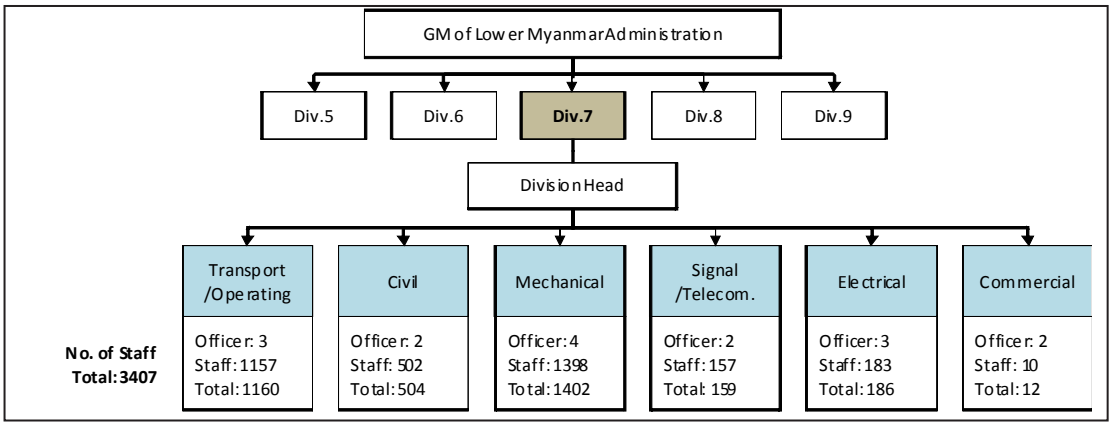
Table 2.6.1.1 Number of Staff of Myanma Railways

	Enrolment Limit	Actual Number as of Mar. 2013
Officers	431	347
Others	31,622	20,712
Total	32,053	21,059

Source: Fact about Myanma Railways 2012-2013

The organization of MR is divided sector-wise and area-wise. In terms of the area-wise aspect, MR has two administrations for Upper Myanmar and Lower Myanmar, which consist of 11 divisions. Regarding the sector-wise aspect, there are 11 sector departments in the headquarters such as Civil Engineering, Operations, etc. and the departments dispatch their staff to regional administrations and divisions. Therefore, the staff which belong to regional administrations and divisions receive instructions and orders from both the general manager of his sector in the headquarters and of his administration.

Division 7 is in charge of Yangon Region. Organizational chart of Division 7 is shown in the figure below.



Source: interview with Head of Div.7 in MR

Figure 2.6.1.2 Organizational Chart of Division 7

2.7 Operation and Management Budget Planning (Financial Condition)

2.7.1 Yangon Circular Budget on Division 7 (Yangon Region)

The following data comes from the Chief Engineer (Civil) Division (7) Yangon Region ,Function of Yangon Circular and usage of Budgets.

Table 2.7.1.1 Usage of Budget in Yangon Circular Railway Division7

(Unit-million MMK)

	Name of Jobs	Usage of Budgets				
		2010-2011	2011-2012	2012-2013	2013-2014	Total
1	Changing Concrete sleepers between Hanthawadi-Hletan	2.09				2.1
2	Changing Concrete sleepers between Yangon-Yegu	2.31				2.31
3	Changing Concrete sleepers between KyeeMyindaing-Insein		25.51	1.8		27.3
4	Raffling Stones and cleaning grasses between Danyingone-Hletan and Ajusting Level of sleepers betweeen Gyoegone-Insein Road		3.37			3.40
5	Changing Concrete sleepers between Yegu-Kyaukyetwin		3.44			3.4
6	Changing Concrete sleepers between Danyingone-Pazundaung		305.6	43.29		348.89
7	Changing Concrete sleepers and railroad between Yangon-Kyeemyindaing			9.35	8.80	18.2

(Unit-million MMK)

	Name of Jobs	Usage of Budgets				
		2010-2011	2011-2012	2012-2013	2013-2014	Total
8	Changing Concrete sleepers Yangon-Pazundaung			8.00		8.00
9	Changing Concrete sleepers Insein-Danyingone			16.40		16.40
	Grand Total	4.41	337.92	78.84	8.80	429.96

Source: MR

2.7.2 Privatization of Yangon Circular Railway and the Suburban Lines

There is a tendency for Myanmar, in recent years, to push forward the infrastructure improvement by PPP and BOT. The Yangon Circular Railway as well, a plan to proceed with the privatizations is being discussed. According to the interview conducted to Myanma Railways, its contents are as follows.

- A tender for Concession Contract was announced in autumn 2011 and as of December 2011, nine companies has applied for it.
- Privatization covers the eastern half of the Yangon Circular Railway and the western half remains as it is and the government has a policy to keep it holding and carrying out maintenance as before.
- The part covered by privatization is also subject to the involvement and supervision by the government with regard to the improvement and maintenance of track and signal, etc. which affect the safety.
- The pattern of privatization is an upper and lower separate type and its details have yet to be decided.

Myanmar government is encouraging the development of the infrastructure through BOT schemes, etc. In line with this policy, MR is trying to proceed with the privatization of the Yangon Circular Railway and the Suburban Lines. The tender for Concession Contract was announced in September 2011 without any closing date and consequently, nine companies submitted their proposal to the management committee.

According to the tender document, i) the concessionaire is responsible for the maintenance of the eastern half of Yangon Circular Railway, Thilawa branch line and three university branch lines and MR will continue to be responsible for the maintenance of the western half of Yangon Circular Railway, Yangon - Mandalay Line and Yangon-Pyay Line because long distance trains are operated in addition to suburban trains in these sections; ii) train operations system is provided by MR due to the importance of safety in the facility, iii) rolling stocks shall be procured by the concessionaire. Regarding the ownership of infrastructure, MR owns the ground track and concessionaire has elevated track according to MR although the tender document is not mentioned clearly.

2.8 Current Situation and Progress of Land Acquisition

2.8.1 Progress of Land Acquisition

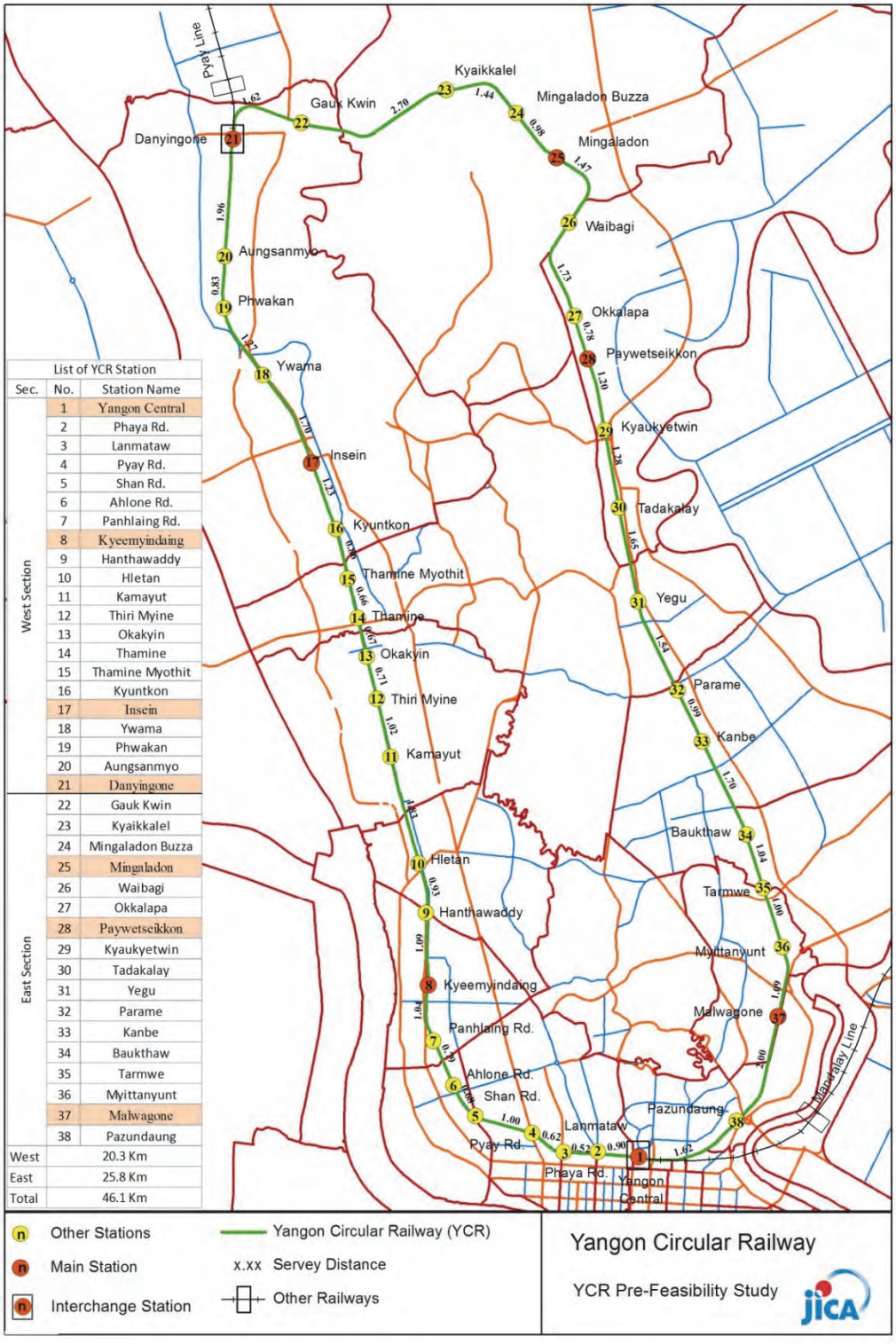
JICA Study Team conducted an interview with Myanma Railways on Land Acquisition and the answers are as follows.

1) Past experience for land acquisition

Any projects are implemented by the agreement of the government. For land acquisition, the Myanma Railways, Ministry of Rail Transportation may cooperate with the state or Division Governor, the Ministry of Forest, the Ministry of Agriculture and so on.

2) Future Plan of land acquisition

For the future project, the Ministry of Rail Transportation must approve a report to the government which containing the EIA (Environmental Import Assessment) report other such as public cooperation.



List of YCR Station		
Sec.	No.	Station Name
West Section	1	Yangon Central
	2	Phaya Rd.
	3	Lanmataw
	4	Pyay Rd.
	5	Shan Rd.
	6	Ahlone Rd.
	7	Panhlaing Rd.
	8	Kyeemyindaing
	9	Hanthawaddy
	10	Hletan
	11	Kamayut
	12	Thiri Myine
	13	Okakyin
	14	Thamine
	15	Thamine Myothit
	16	Kyuntkon
	17	Insein
	18	Ywama
	19	Phwakan
	20	Aungsanmyo
	21	Danyingone
East Section	22	Gauk Kwin
	23	Kyaikkalel
	24	Mingaladon Buzza
	25	Mingaladon
	26	Waibagi
	27	Okkalapa
	28	Paywetseikkon
	29	Kyaukyetwin
	30	Tadakalay
	31	Yegu
	32	Parame
	33	Kanbe
	34	Baukthaw
	35	Tarmwe
	36	Myittanyunt
	37	Malwagone
	38	Pazundaung
West	20.3 Km	
East	25.8 Km	
Total	46.1 Km	

Source: YUTRA Project Team (2014)

Figure 2.8.1.1 Location of Yangon Circular Railway Stations and Sections

2.9 Issues and Considerations

Issues and considerations on maintenance and operation on Myanma Railways are as follows.

2.9.1 Safety/Reliability for the Railway Transportation

A number of problems with the railway transportation system in Myanmar make commuting difficult and time consuming. Current railway systems are in a poor state, namely due mainly to the obsolete facilities and operation systems. Due to the incomplete function of these systems, a lot of derailed accident and the delay of railway transport service have happened and it is getting difficult to secure the safety and reliability for the railway transportation system. Therefore, it is important to check and analyze the cause of accident from the various viewpoints (track, coach, signal, telecommunication and operation) based on the above check and take a safety measure deliberately and synthetically.

2.9.2 Transportation Capacity

Due to the following causes, it is getting difficult to keep the suitable transport frequency service and transport capacity for the passenger.

- Low transport speed of coach due to the weak track facilities (metal fatigue of the rail in existence, the lightweight rail in existence and the old/rotten sleepers)
- Low transport speed of coach chiefly due to the maladjustment of signal facilities and the delays of modernization of signal system.
- No appropriate maintenance for the coach, which is the main cause of derailed accidents in Myanmar.

Therefore, the following measures are required to keep the suitable transport frequency service and transport capacity.

- Reformation and maintenance of track/road bed
- Reinforcement by procurement of new and used coach
- Appropriate maintenance of coach by means of the sufficient of repair parts, improvement of check-up capacity for coach and modernization of depot facilities (step-up for the rate of operation of coach)
- Improvement and renewal of signal facilities/systems and appropriate maintenance
- Railway operation services according to plan

2.9.3 Level for Railway Operation Service

Due to the decline of level for railway operation service, railway transportation service is not now superior to the road transportation service. In comparison with the road transportation service, railway transportation service is not superior due to the following reasons.

- Loss of time by means of low transport speed of coach, and the increase of waiting

time in terminal station.

- Due to the shortage of transport capacity and a lot of railway accidents, they can not keep the suitable transport frequency service with the scheduled time, and moreover it is difficult to react to the potential demand.

Therefore, the following measures are required to improve the level of railway operation service.

- Railway terminal business should more closely work in cooperation with the harbor transport business on transport system.
- Preparation for full container transport system, which is the main field of freight transport in the future.

2.9.4 Encouragement of Talent

The staff members of Myanma Railways lack skill for the maintenance of the railway facilities and the officials of Myanma Railways lack knowledge, experience, ability for railway management and administration of PPP and privatization. Therefore, the following measures are required to encourage talent.

- Training to the staff members for the maintenance of the facilities by specialist
- Working at the management method and the improvement of ability to control the railway management by the outside specialist
- Participation in the outside workshop