DEPARTMENT OF CIVIL AVIATION (DCA)
MINISTRY OF TRANSPORTATION
REPUBLIC OF MYANMAR

PREPARATORY SURVEY
FOR
HANTHAWADDY INTERNATIONAL AIRPORT DEVELOPMENT PROJECT
IN
THE REPUBLIC OF MYANMAR
(PPP INFRASTRUCTURE PROJECT)

FINAL REPORT
(PUBLIC VERSION)

FEBRUARY 2018

JAPAN INTERNATIONAL COOPERATION AGENCY

JGC CORPORATION
ORIENTAL CONSULTANTS GLOBAL CO., LTD.
ALMEC CORPORATION
JAPAN NUS CO., LTD.

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Acronyms

AASHTO	American Association of State Highway and Transportation Officials
ACMS	Air-conditioning Main System
ACS	Access Control System
ACU	Air Conditioning Unit
ACVS	Air Conditioning and Ventilating System
ADB	Asian Development Bank
ADRM	Airport Development Reference Manual
ADS-B	Automatic Dependent Surveillance - Broadcast
AEDT	Aviation Environmental Design Tool
AERMOD	AMS/EPA Regulatory Model
AFNOR	Association Française de Normalisation
AFTN	Aeronautical Fixed Telecommunication Network
AMHS	Automatic Message Handling System
AGLCC	Aeronautical Ground Light Control Center
AHU	Air Handling Unit
AIP	Aeronautical Information Publications
AIS	Aeronautical Information Services
ALS	Approach Lighting System
AMHS	Air traffic services Message Handling System
AMS	American Meteorological Society
Annex	ICAO Annex
AODB	Airport Operational Database System
APU	Auxiliary Power Unit
ARFF	Airport Rescue & Fire Fighting
ART	Antiretroviral Therapy
ASEAN	Association of South East Asian Nations
ASIS	Aircraft Stand Identification Sign
ASR	Airport Surveillance Radar
ATC	Air Traffic Control
ATIS	Automatic Terminal Information Service
ATM	Air Traffic Management
AWOS	Automated Weather Observing System
B/C Ratio	B by C Ratio
BDPFA	Beijing Declaration and Platform for Action
BHS	Baggage Handling System
BMS	Building Management System
BOD	Biochemical Oxygen Demand
CBR	California Bearing Ratio
CCR	Constant Current Regulator
CCTV	Closed Circuit TV System
CD	Compact Disc
CE	Customs Equipment
CEDAW	Convention of Elimination of All Forms of Discrimination Against Women
CIP	Commercially Important Person

CIQ	Customs, Immigration, Quarantine
CNS	Communication, Navigation and Surveillance
COD	Chemical Oxygen Demand
CSC	Construction Supervision Consultants
CT machine	Computed Tomography machine
CUTE	Common Use Terminal Equipment
DATIS	Digital ATIS
DCA	Department of Civil Aviation
DD	Data Deficient
DDC	Detailed Design Consultants
DFS	Duty-free Shop
DME	Distance Measuring Equipment
DMH	Department of Meteorology and Hydrology
DO	Dissolved Oxygen
DS	Distribution System
DS	Duct Space
DVOR	Doppler VHF Omnidirectional Radio range
DVOR/DME	Doppler VHF Omni-directional Radio Range/Distance Measuring Equipment
DW	Dumbwaiter
DWIR	Directorate of Water Resources and Improvement of River System
ECR	Environmental Conservation Rules
EGS	Back-up Generator System
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
ELSS	External Lighting / Socket Outlet System
EMP	Environmental Management Plan
EMU	Environmental Management Unit
EPC	Engineering, Procurement, and Construction
EPS	Electrical Pipe Space
ES	Escalator
EURCAE	European Organization for Civil Aviation Equipment
EV	Elevator
F&B	Food and Beverage
FAA	Federal Aviation Administration
FADS	Fire Alarm / Detection system
FCU	Fan Coil Unit
FIDS	Flight Information Display System
FIRR	Financial Internal Rate of Return
FRP	Fiber-Reinforced Plastics
GBAS	Ground-Based Augmentation System
GDP	Gross Domestic Product
GIS	Geographic Information System
GL	Ground Level
GLPS	Grounding / Lightning Protection System
GNSS	Global Navigation Satellite Systems

GP	Glide Path
GPS	Global Positioning System
GPU	Ground Power Unit
GSE	Ground Support Equipment
GUI	Graphical User Interface
HIA	Hanthawaddy International Airport
HIV/AIDS	Human Immunodeficiency Virus / Acquired Immuno-Deficiency Syndrome
HIV-VCT	HIV Voluntary Counselling and Testing
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ICT	Information & Communication Technology
IE	Immigration Equipment
IEE	Initial Environmental Examination
IFC	International Finance Corporation
ILS	Instrument Landing System
IMKS	Information Multimedia Kiosks System
IRIG	Inter-Range Instrumentation Group
ISA	International Standard Atmosphere
ISO	International Organization for Standardization
IT	Information Technology
ITB	Instruction to Bidders
ITC	Irrigation Technology Centre
IUCN	International Union for Conservation of Nature
LAN	Local Area Network
LARAP	Land Acquisition and Resettlement Action Plan
LC	Least Concern
LCC	Life Cycle Cost
LCC	Low Cost Carrier
LDC	Least Developed Countries
LED	Light Emitting Diode
LLDC	Least Less-Development Countries
LLZ	Localizer
LPD	Log-periodic antenna
LR	Low Risk
LSOS	Lighting and Socket Outlet System
MC	Master Clock System
MCS	Motor Control System
MEP	Ministry of Electrical Power
MEPE	Myanmar Electric Power Enterprise
METAR	Aerodrome routine meteorological report
MITT	Myanmar International Terminal Thilawa
MLIT	Ministry of Land, Infrastructure and Transport
MNCWA	The Myanmar National Committee for Women's Affairs
MNPED	Ministry of National Planning and Economic Development
MOECAF	Ministry of Environmental Conservation and Forestry
MOHT	Ministry of Hotel and Tourism

MOT	Ministry of Transportation
MP3	MPEG-1 Audio Layer-3
MPPA	Million Passengers Per Annum
MPT	Myanmar Post and Telecommunication
MRO	Maintenance, Repair & Overhaul
MSW	Moving Side Walk
MV machine	Machine Vision machine
MYT-Plan	Myanmar National Transport Development Plan
NAS Battery	sodium (Na) - sulfur (S) Battery
NCAR	National Center for Atmospheric Research
NCDP	National Comprehensive Development Plan
NE	Not Evaluated
NLD	National League for Democracy
NM	Nautical Miles
NOx	Nitrogen Oxides
NPV	Net Present Value
NSDF	National Spatial Development Framework
NSPAW	National Strategic Plan for the Advancement of Women
NT	Near Threatened
O&M	Operation and Management
ODA	Official Development Assistance
OHSAS	Occupational Health and Safety Assessment Series
PANS/ATM	The Procedures for Air Navigation Services - Air Traffic Management
PAPI	Precision Approach Path Indicator
PAS	Public Address System
PBB	Passenger Boarding Bridge
PBN	Performance Based Navigation
PCA	Pre-Conditioned Air Supply System
PCU	Passenger Car Unit
PDC	Pre-departure Clearance
PIU	Project Implementation Unit
PM	Particulate Matters
PMC	Programme Management Committee
PQ	Prequalification
PS	Pipe Space
PSS	Power Supply System
PTB	Passenger Terminal Building
PTV	Public TV / Information System
PVC	Polyvinyl Chloride
QFE	Atmospheric pressure at aerodrome elevation
QNH	Altimeter sub-scale setting to obtain elevation when on the ground
RC	Reinforced Concrete
RCS	Radio Communication System
RDP	Radar Data Processing
RIV	Rapid Intervention Vehicle
RVR	Runway Visual Range

S	Steel
SCF	Standard Conversion Factor
SCTS	Structured Cabling / Telephone System
SID	Standard Instrumental Departure
SMP	Safety Management Plan
SOx	Sulfur Oxides
SP	Service Provider
SPECI	Aerodrome special meteorological report
SS	Suspended Solid
SSR	Secondary Surveillance Radar
SSS	Single-Source Selection
STAR	Standard Instrumental Approach
STD	Sexually Transmitted Diseases
STI	Sexually Transmitted Infections
TAC	Technical Advisory Committee
TEQ	Toxic Equivalency Quantity
TS	Total Station
TSS	Total Suspended Solid
TTC	Travel Time Cost
TV	Television
UNDP	UN Development Program
UNICEF	UN Children's Fund
UPS	Uninterrupted Power Supply
USEPA	United States Environmental Protection Agency
VCCS	Voice Communication Control System
VDGS	Visual Docking Guidance System
VHF	Very High Frequency
VIP	Very Important Person
VU	Vulnerable
VVIP	Very, Very Important Person
WB	World Bank
WHO	World Health Organization
WLAN	Wireless LAN System
WS	Work Station
YATMS	Yangon Air Traffic Management System
YIA	Yangon International Airport
YUTRA	Comprehensive Urban Transport Plan of the Greater Yangon

Chapter 1

Current Situation, Key Issues of Aviation Sector in Myanmar, and Necessity of the Project

Chapter 1 Current Situation and Key Issues of Aviation Sector in Myanmar, and Necessity of the Project

1.1 Social and Economic Conditions in Myanmar, the Project Site and the Surrounding Areas

(1) State and Administrative Divisions of Myanmar

Republic of the Union of Myanmar (herein after called as "Myanmar") is a republic sovereign state located in the Southeast Asia. Myanmar spreads over 680,000 square kilometers, which is 1.8 times larger than Japan. The capital city is Naypyidaw after the capital relocation in 2007.

Figure 1.1.1 Geography of Myanmar Source: United Nations

According to the Provisional Results of the Census Report, Myanmar has a population of 51,419,420. Burman people account for 70% of those, where others consists of many ethnic minorities.

Myanmar is divided into seven states, seven administrative regions and state directly controlled Naypyidaw. The area and population of each division are presented below:

Table 1.1.1 Population of each division in Myanmar

	State / Region	Provincial Capital	Population	Area (㎢)
Region	Yangon	Yangon	7,355,075	10,171
	Ayeyarwady	Pathein	6,175,123	35,138
	Mandalay	Mandalay	6,145,588	37,024
	Sagain	Sagain	5,320,299	94,625
	Bago	Bago	4,863,455	39,404
	Magwe	Magwe	3,912,711	44,820
	Taninthary	Dawei	1,406,434	43,343
State	Shan	Taunggyi	5,815,384	155,801
	Rakhaing	Sittwe	3,188,963	36,778
	Mon	Mawlamyine	2,050,282	12,257
	Kachin	Myithyina	1,689,654	89,041
	Kayin	Hpa-an	1,572,657	30,383
	Chin	Hakha	478,690	36,019
	Kayah	Loikaw	286,738	11,733
	Naypyidaw (State Directly Controled City)		1,158,367	7,054

Source: Provisional Results of the Census Report by Ministry of Immigration and Population of the Republic of the Union of Myanmar, September 2014

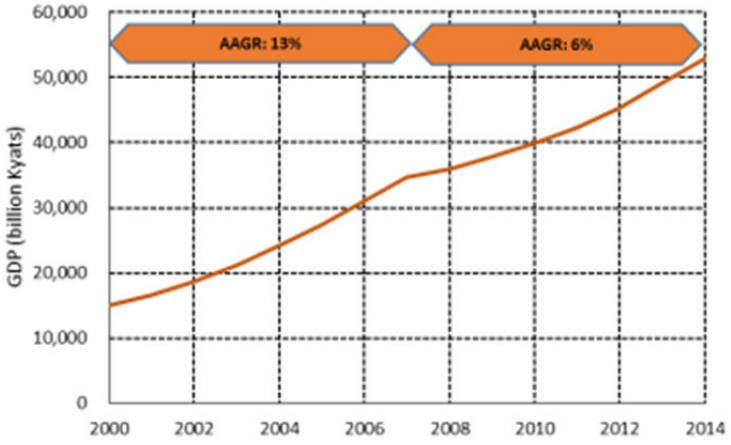
(2) Economic Status of Myanmar

Real Gross Domestic Product (herein after called as “GDP”) is typical socio-economic index which represents the situation of economy in Myanmar. The historical GDP in the last 15 years are released in the web site of International Monetary Fund (herein after called as “IMF”) as shown in Table 1.1.2. During the first half of the 2000’s, the economy in Myanmar had grown by annual growth rate (herein after called as “AGR”) of 11-14% (average annual growth rate, AAGR: 13%, refer to Figure 1.1.2). Although it had been stagnant once in 2008, after that the economy has been growing by AAGR of 6% (refer to Figure 1.1.2).

Table 1.1.2 Historical GDP/GDP per capita

	GDP		GDP per capita	
	Kyats (Billion)	Change (%)	(Kyats)	(USD)
2000	14,982	13.75	323,032	222
2001	16,681	11.34	356,432	160
2002	18,687	12.03	396,319	166
2003	21,275	13.84	448,311	255
2004	24,160	13.57	506,080	255
2005	27,439	13.57	571,247	288
2006	31,027	13.08	641,863	346
2007	34,747	11.99	714,181	479
2008	35,998	3.60	734,902	705
2009	37,850	5.14	767,208	772
2010	39,873	5.35	802,132	998
2011	42,229	5.91	842,720	1,121
2012	45,311	7.30	896,590	1,103
2013	49,049	8.25	962,145	1,113
2014	52,820	7.69	1,027,229	1,221

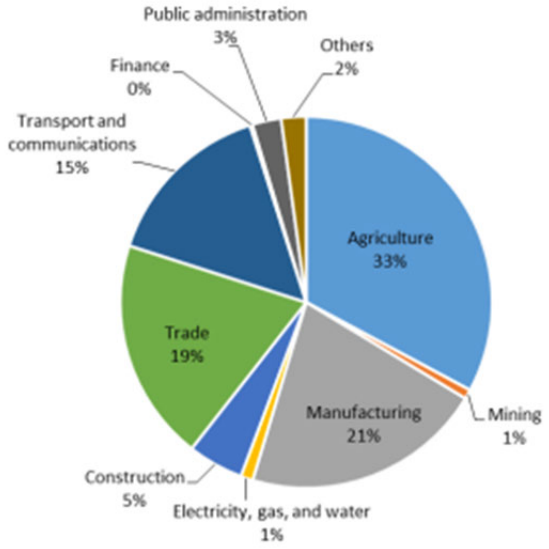
Note: GDP/GDP per capita in Kyats are indicated by constant price in 2010.
GDP per capita in USD are indicated by current price.
Source: IMF, World Economic Outlook Database, April 2015



Note: GDP in Kyats are indicated by constant price in 2010.
Source: IMF, World Economic Outlook Database, April 2015

Figure 1.1.2 Historical GDP

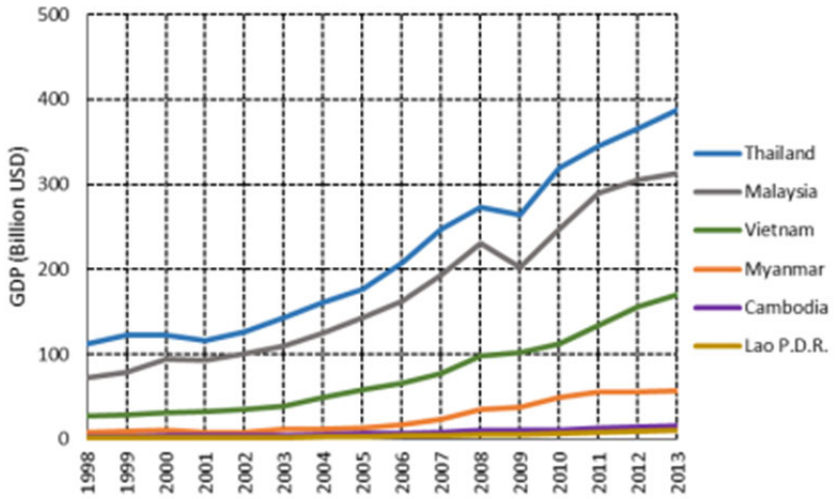
According to GDP by industrial origin, agriculture has largest share of 33%, followed by manufacturing (21%), trade (19%) and transport and communications (15%). These four industries account for 88% of total.



Source :ADB, Key Indicators for Asia and Pacific 2014

Figure 1.1.3 GDP by Industrial Origin

The economy in Myanmar has steadily grown up to now, however the economic clout is still one third of Vietnam, one sixth of Malaysia and one seventh of Thailand in 2013.



Note: GDP: current price
Source: IMF, World Economic Outlook Database, April 2015

Figure 1.1.4 GDP Comparison between Neighboring ASEAN Countries

(3) The Situation of Bago Region

Bago Region lies in the southern-central part of Myanmar and is one of the core regions of central Myanmar. The census reported in September 2014 revealed that Bago Region has a total population of 4.9 million people, which is 9.5 percent of the total population of Myanmar. Overall, 22 percent of the population lives in urban areas, which is slightly below the national average of almost 30 percent. Compared to other States and Regions it has a medium population density of 123 inhabitants per square kilometers.

Bago region is the second largest producer of rice among all States and Regions contributing substantially to Myanmar's GDP and economic growth. Bago Region occupies an area of

39,400 km2. It is geographically divided by the sparsely inhabited Pegu mountain range that runs from north to south through the middle of the Region. Bago Region therefore has a clearly identifiable western part sloping towards the Ayeyarwady River and an eastern part that consists mainly of the floodplains of the Sittaung River. Bago Region benefits from the south west monsoon, but is protected against the violent storms that sometimes hit the western parts of Myanmar along the Bay of Bengal. Combined with its fertile soils Bago Region has therefore very conducive conditions for the production of rice and other crops.

Figure 1.1.5 Map of Bago Region Source: UNDP

Since Bago Region features both mountains and floodplains, the Region has both forest cover for teak production, while the floodplains are important for rice production (covering two-thirds of the area used for crop farming) and other agricultural products. Mining and industries are limited to petroleum production and some processing of agriculture and forest products.
On most of the social indicators Bago Region are rated similar to the national average of Myanmar (see Figure 1.1.6). On access to safe drinking water Bago Region is doing slightly better, on several primary education and health indicators Bago Region remains slightly below the national average while on the overall poverty incidence it is doing better than the national average.

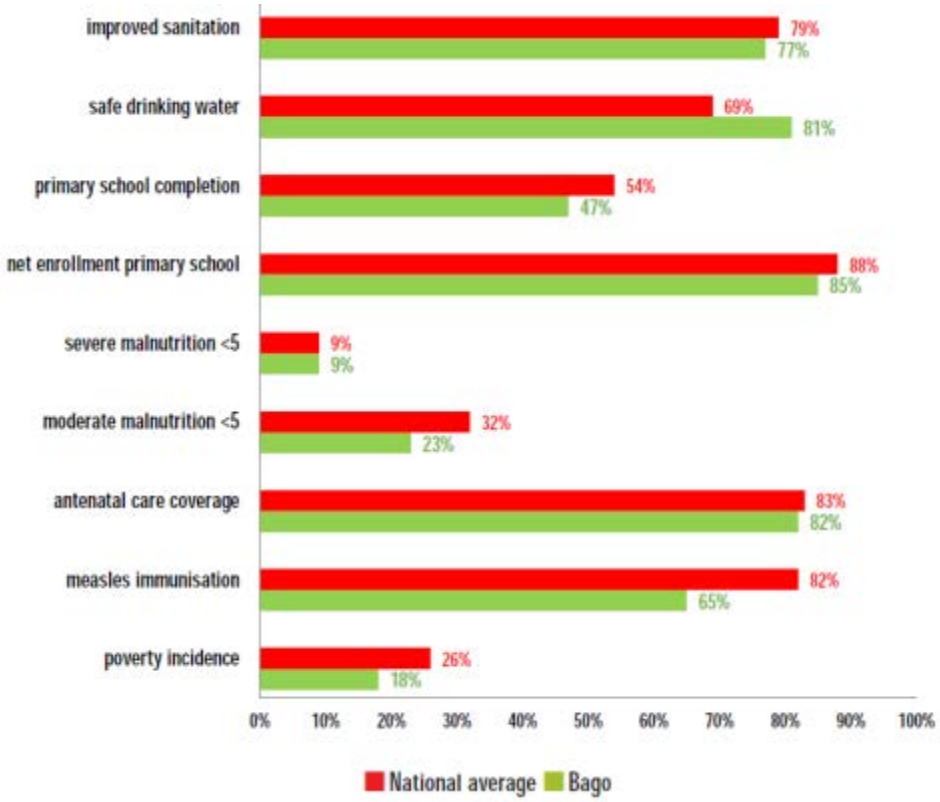


Figure 1.1.6 Selected Social Development Indicators for Bago Region Source: UNICEF

Bago, Pyay and Taungoo townships are university towns. Road and transport infrastructure is comparatively well-developed compared with other States and Regions. The long-standing plans to construct a large new airport outside Bago town (the "Hanthawaddy International Airport") received a greenlight recently by the Myanmar government to build and develop its facilities, which are expected to serve as the country's main international airport.

(4) Bago City and the Project Site

Bago city has a population of about 300 thousands, and is the 5th biggest city in Myanmar in terms of population. It used to be the capital city of Mon period during 13 – 16 century. It is still known as an ancient city and has ample sacred edifices as tourism resources; however, industrialization is on its way to be realized.

The Hanthawaddy International Airport construction project is planned in the western side of suburb of Bago city, which is some 70km Northeast of Yangon city. The project site location is indicated in the below map:

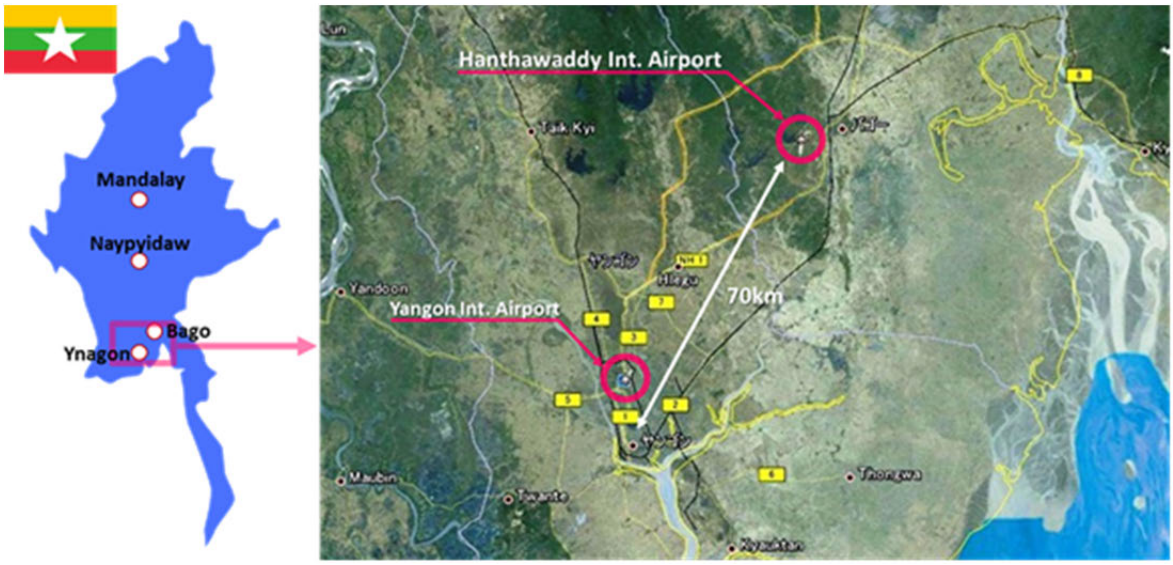


Figure 1.1.7 Project Site for the Hanthawaddy International Airport

In Myanmar, there are a total of 18 industrial zones, namely, 4 in Yangon region, Mandalay, Myingyan, Meikhtihla, Monywa, Yaynanchaung, Pakokku, Bago, Pyay, Pathein, Myaung Mya, Hinthada, Myeik, Taunggyi and Mawlamyine. Among those, the Bago industrial zone which spread over 62.4 acres and additional 31.2 acres are planned to be developed as the Bago industrial park. The project is named i-Land and promoted by a private sector.

Figure 1.1.8 Bago Industrial Park Master Plan Source: www.i-landmyanmar.com

In the Bago industrial park, in addition to the fundamental infrastructure such as its own electricity power supply system consists of mid local grid and centralized co-generation back up power, clean and well treated underground water for drinking and industrial use, centralized waste water treatment plant and robust telecommunication network and internet service, the below services and amenities are also planned to be provided:

- Restaurant, food courts, mini market, supermarket
- Hostel and dormitory, residential villa and apartment

- 24/7 medical center with doctors and nurses
- Round the clock security patrol and police station to maintain maximum security
- Fire prevention and fire-fighting, petrol station, bank and ATM booth
- Community center and conference hall
- Labor recruitment service, vocational training services
- Logistic support, import export custom clearance
- Company incorporation, government licensing and permit, assist in obtaining business visa and work permit

Incorporating a manufacturing company under Foreign Investment Law will receive the following incentives:

- 5 years tax holiday
- Exemption from import taxes on raw materials and machineries and equipment
- Up to 50% of the profits gained from export are not taxed
- Accelerated depreciation in accounting

With these incentives several foreign companies such as a major European beer brewery are starting operation in the Bago industrial park.

Bago industrial park is situated in the suburban area where abundant supply of low cost labor for intensive manufacturing industries is available. There are also many people with secondary and tertiary education who is capable of taking training for different skills and technologies.
Being adjacent to the area planned for the Hanthawaddy international airport which will become the mega logistic hub not only for Bago and Yangon region but also for entire Myanmar, the Bago industrial park is expected to be developed soon and take broader roles.

Figure 1.1.9 Bago City (National Highway No.1)

1.2 Current Situation of Aviation Sector of Myanmar

1.2.1 Superordinate Policies

In Myanmar, the continuous improvement of the aviation infrastructure and tourism are understood as one of the most important agenda for the nation. The importance of development of air transportation and improvement of necessary aviation infrastructure including the development of HIA are duly recognized, and it is actively discussed in various master plan documents such as Myanmar National Comprehensive Development Plan (NCDP), National Spatial Development Framework (NSDF), and the National Transport Development Plan (MYT-Plan).
The excerpt of these documents is summarized in the following section, and MYT-Plan is discussed in the Chapter 1.4.

(1) Myanmar National Comprehensive Development Plan (NCDP, 2014)
The Ministry of National Planning and Economic Development (MNPED) has prepared the National Comprehensive Development Plan (NCDP) for 2011-2030 to reflect the new Government's priorities and major reforms, including people-centered development priorities. It is being prepared with consultation at village, township and district levels as well as with expert advice from state/regional and national level stakeholders.

The NCDP is being designed to provide the development policy framework for Township Development Plans, District Development Plans, State and Regional Development Plans as well as Urban Development Plans. The NCDP will include an interim roadmap that sets short/medium term directions for state and regional programs and projects. The roadmap will set a broad, long-term strategic direction for development plans that includes reforms needed to deliver quick wins. In summary, the NCDP goals focus on:

1. Improving the living standard of the entire population
2. Increasing per capita GDP
3. Promoting public utilities and social sector development such as transportation, water and sanitation, electric power, education, health and social security etc.
4. Creating job opportunities
5. Conserving natural resources
6. Achieving the Millennium Development Goals (MDGs) and other human development objectives by 2015
7. Fully implementing economic integration with ASEAN, in accordance with its ASEAN Economic Community (AEC) 2015 schedules

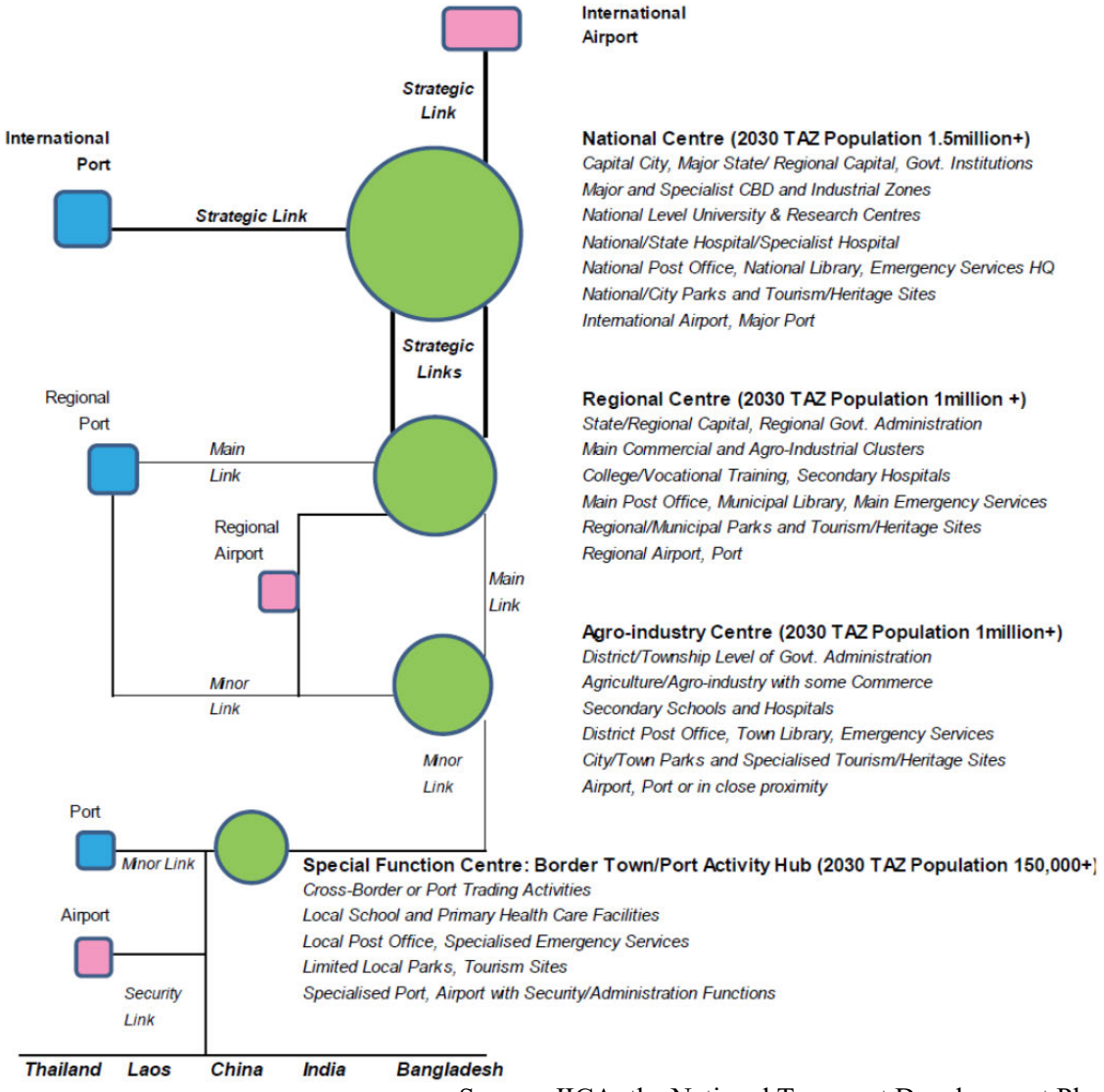
(2) National Spatial Development Framework (NSDF, 2013)
The NSDF was established by Ministry of Construction's (MOC) Department of Human Settlements and Housing Development (DHSHD), Ministry of Environmental Conservation and Forestry, Ministry of Agriculture and Irrigation and Ministry of Home Affairs, in consultation with other key stakeholders, with the planning horizon year 2030.
The purpose of the NSDF is, to maintain consistency with the NCDP and to bring together the key spatial policies and programs of the major transport sector stakeholder Ministries, Agencies and private sector organizations with an interest in strategic land development. In this way, it is expected that the national, state/regional and relevant stakeholders will be able to understand how departmental plans, policies and programs can work together and where there are gaps, allowing stakeholders to plan in more efficient and integrated ways for future implementation.

NSDF has been designed to assist decision-makers to determine priorities for future transport

investment. Key building blocks of the NSDF include:

- Synthesis of regional (i.e. international/ASEAN/Asian/GMS) and national transport sector strategies, policies and programs including economic corridors concepts.
- Identification of existing and committed international, national and regional highway/ railway corridors and strategic transport facilities (i.e. ports, airports, rail stations and interchanges) within the framework laid down under the item above.
- Identification of specialist centers that exhibit commitment to urbanization and investment in terms of transport networks and facilities. The centers' current and future (year 2030) potential were reviewed in terms of functions and services, based on population, density criteria and other attributes like proximity to urban centers, ports, airports, railway hubs, industrial zones/SEZs, border towns, tourism hubs.
- Analysis of the centers' role within the DHSHD strategy and NCDP.

These centers were identified in relation to each other in the hierarchy and illustrated in the Figure 1.2.1 depicting the concept of a 4-level centers hierarchy and the typical range of functions and services they provide or can be expected to provide in the future.



Source: JICA, the National Transport Development Plan

Figure 1.2.1 Hierarchy of Centers Concept

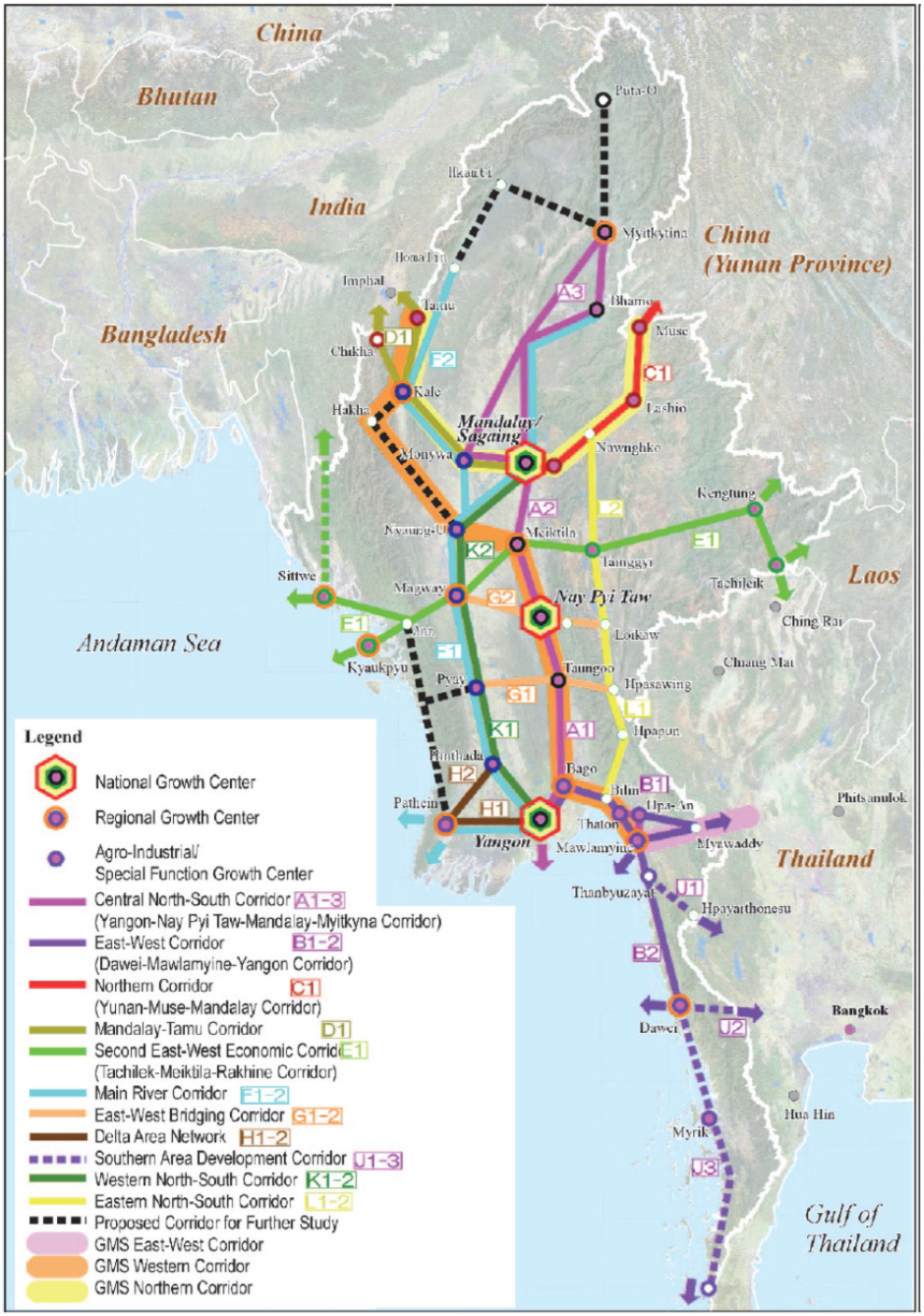
At the primary level in the hierarchy are the national strategic centers Yangon, Mandalay and Nay Pyi Taw where major concentrations of population, economic activity and transport investment already exist and where future investment to increase capacity in highways, railways, ports and airports is being committed or planned. They are also the prime centers of national Government administration institutions, national universities and hospitals and research centers. In the case of Yangon and Mandalay, they perform a role as tourism hubs both for their regions and for the south and north of the country as a whole, supported by national/city parks, heritage sites and international airports and ports.

At the secondary level are the regional cities that have grown up at strategic locations where the inter-connection of highways, railways and/or rivers has formed important transport activity nodes. In these centers, clusters of commercial and industrial activities are found, and state/regional-level government administration, education and health, and other social and emergency services provided. In some locations regional tourism and heritage sites are located nearby and regional airports and ports have been developed to serve the wider area.

At the tertiary level there are major concentrations of population and agro-industrial activities that provide services for their mainly rural and agricultural catchments. Commercial activities are often related to the agricultural economic base of the area. Local markets for farm produce, livestock and agri-businesses as well as small scale repair and maintenance workshops including for farm vehicles and equipment are clustered in these locations. District and township level administrative functions and services are provided and lower levels of health and education, and social and community services and facilities are being supplied with support from the national and regional governments.

At the lowest level in the centers' hierarchy are border towns and other special function settlements that provide a more localized or specialized function because of their particular location at the national/international border or because they have grown up around a domestic port or other transport hub. Some specialized administrative and security/emergency services are provided depending on the particular function of the center. These specialized centers and port towns have often evolved in response to Government investments in infrastructure (e.g. port or handling equipment improvements or dredging), as well as cross-border trading conditions and market demand from neighboring countries.

Figure 1.2.2 illustrates the centers and the hierarchy of strategic linkages that provide a focus for prioritizing future transport sector investment and the foundation for the 2030 NSDF.



Source: JICA, the National Transport Development Plan

Figure 1.2.2 Selected Centers and Related Hierarchy of Strategic Linkages in 2030

The NSDF incorporates strategic activity hubs, based on nationally-important cities, regional/state capital cities and other main urban centers/concentrations of population and economic activity such as industrial zones and Special Economic Zones (SEZs), agro-industrial based centers. Other key cities/towns that provide more specialized functions (e.g. port activities, rail transport hubs, airports and national/international tourism hubs, and/or important border trade towns) are also identified.

The NSDF also includes strategic transportation networks, including ASEAN/trans-national highway and railway corridors, Asian Highways, Myanmar national expressways and other major roads, railways and major rivers with an inland waterway function, which are required to underpin and strengthen the transport (and thereby economic) linkages between the strategic activity hubs.

The NSDF (the balanced mix of economic activity hubs, strategic transport networks and facilities and major environmental protected areas) can therefore provide a useful and robust tool that will assist decision-makers in determining priorities for future transport investment decisions.

1.2.2 Regulatory Organization of Aviation Sector of Myanmar

Air transportation is governed by the Department of Civil Aviation (DCA) under Ministry of Transportation (MOT). The entire organization of MOT is illustrated below.

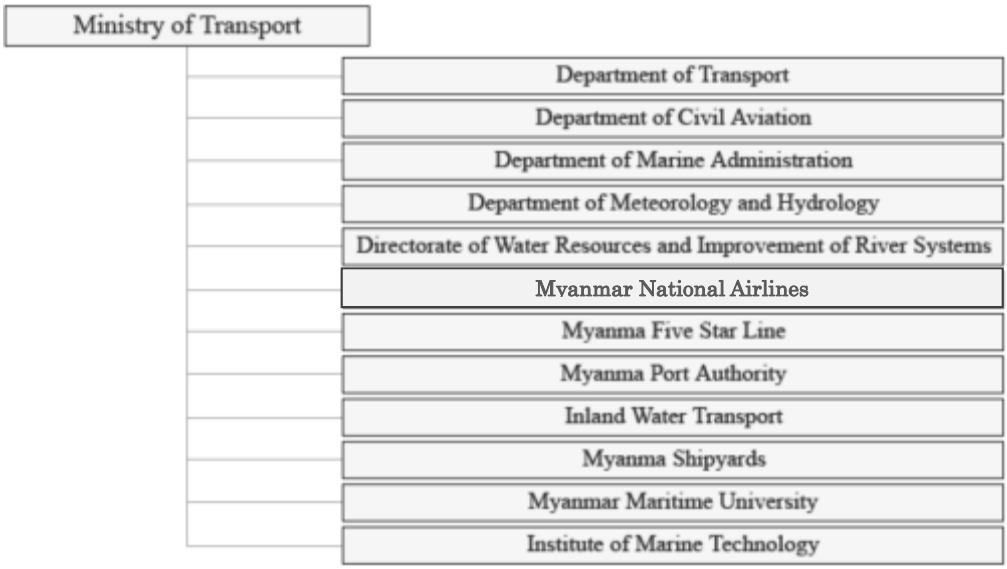


Figure 1.2.3 Organization Chart of MOT Source: http://www.mot.gov.mm

Currently there are 5 departments, 5 enterprises, 1 university and 1 training institute totaling 12 organizations under the Ministry of Transport.

On the other hand, a new function “Airport Authority” will be added under MOT, and take the regulatory roles for the privatized airports, currently including Yangon, Mandalay and Naypyidaw. At present the new Airport Authority Act is under the deliberated at the parliament, and expected to be enacted soon.

DCA is headed by the Director General and is a subordinate organization under MOT. The organization chart of DCA is presented herewith:

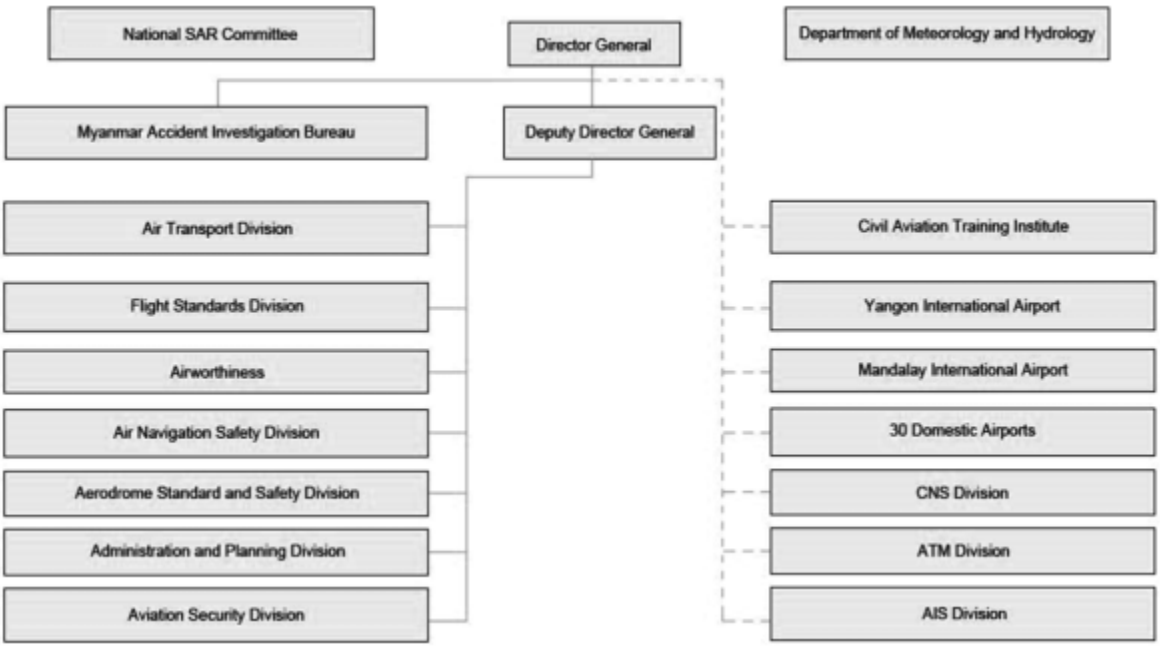


Figure 1.2.4 Organization Chart of DCA Source: http://www.dca.gov.mm

Under Director General, there are Deputy Director General, Myanmar Accident Investigation Bureau and Service Providers. The Service Provider as found on the right hand side of the chart comprises of Civil Aviation Training Institute, Yangon International Airport, Mandalay International Airport, 30 Domestic Airports, CNS (Communication, Navigation and Surveillance) Div., ATM (Air Traffic Management) Div. and AIS (Aeronautical Information Services) Div. The 7 regulators and supporting agencies including Air Transport Div., Flight Standards Div., Airworthiness Div., Air Navigation Div., Aerodrome Standard and Safety Div. and Aviation Security Div., which are presented on the left hand side, are reporting to the Deputy Director General.

DCA considers that air transport contributes to the sustainable economic development of the State, by facilitating tourism and trade. With this, DCA is aiming to develop and strengthen the safe, secure, efficient, sustainable & environmentally-friendly air transport industry, and integrate it with the international air transport environment in order to fulfill requirements of the public. In order to achieve these, DCA has settled aims and objectives of the air transport policies as follows:-

1) To ensure the aviation safety and security as priorities;
2) To promote infrastructure development;
3) To allow forming of new air carries, subject to demand and supply in the market;
4) To allow setting up of efficient air transport auxiliary services;
5) To promote Public-Private Partnership (PPP) in the air transport industry;
6) To develop fair competitions among air transport services;
7) To encourage cooperation between air carriers;
8) To enhance competitiveness of national air carriers;
9) To foster air freight services;
10) To support development of tourism and trade;
11) To continue pursuing gradual liberalization of air transport towards the open sky policy;
12) To enhance the capacity of aviation regulatory body;
13) To create employment opportunities for nationals; and

14) To develop environmentally-friendly air transport.

As a department under MOT, DCA gets its financial resources through the Government budgetary system. The financial figures of DCA are presented in the following tables.

Table 1.2.1 Revenues through DCA's Activities (million Kyats)

Category	FY 2010-2011	FY 2011-2012	FY 2012-2013	FY 2013-2014	FY 2014-2015
Earning from Services	789.49	1,024.16	62,506.41	82,475.24	92,017.16
Earning from Rents	232.36	342.36	2,052.56	2,030.14	3,692.97
Earning from Rents & Taxes	46.67	500.29	967.76	1,262.95	2,904.55
Miscellaneous	6.28	20.29	323.41	134.77	633.05
Other	33.51	51.15	133.20	41.49	36.86
Total	1,108.32	1,938.24	65,983.34	85,944.58	99,284.59

Source: DCA

Table 1.2.2 DCA Budget for Capital Expenditure (million Kyats)

Category	FY 2010-2011	FY 2011-2012	FY 2012-2013	FY 2013-2014	FY 2014-2015
Construction	20,315.24	15,926.80	20,667.70	28,701.81	17,101.62
Machinery and Equipment	6,555.20	1,096.67	16,703.30	7,657.49	11,381.40
Installion	305.98	184.18	3,618.32	1,610.93	5,303.83
Total	27,176.41	17,207.65	40,989.32	37,970.23	33,786.85

Source: DCA

Table 1.2.3 DCA Budget for Current Expenditure (million Kyats)

Category	FY 2010-2011	FY 2011-2012	FY 2012-2013	FY 2013-2014	FY 2014-2015
Pay, Allowance, Honoraria, etc.	1,033.86	1,025.12	1,637.03	1,935.02	2,614.66
Travelling Allowance	19.99	35.94	109.30	124.17	122.37
Goods, Labor, Servicing	875.88	970.80	1,233.04	1,204.59	2,349.44
Maintenance Charges	175.72	215.86	421.71	342.98	400.87
Transfer Payment	0.00	0.00	10.51	0.00	0.00
Entertainment	0.89	1.20	1.39	2.68	2.40
Total	2,106.34	2,248.91	3,412.98	3,609.43	5,489.74

Source: DCA

Myanmar's fiscal year starts from April and ends at March in subsequent year. The revenue figures on the table 1.2.1 shows significant increase in FY 2012-2013, that can be attributed to either of (i) change of currency exchange rate due to the economic reformation, (ii) increase of aeronautical charges for domestic operations, and (iii) introduction of the passenger service charge for domestic passengers. Driven by the skyrocketing passenger traffic, the revenues especially through the services including the passenger service charge are increasing in a continuous fashion. The total revenue of DCA surpasses and is more than twice larger than the total of expenditure of DCA.

1.2.3 Aviation Network in Myanmar

In Myanmar, 69 airports were developed, and 33 among those are operated. Regular services were operated at 27 airports and non-scheduled (charter) flights are served at others. The breakdown of these are summarized and shown in figure 1.2.5.

★International Airports (3)		
Yangon	Mandalay	Naypyitaw
Domestic Airports (30)		
Putao	Heho	Dawei
Myitkyina	Nyaung U	Myeik
Bamaw	Lashio	Kawthaung
Kalay	Magway	Boke Pyin
Khamti	Pakhokku	Mawlamyaing
Hommalin	Kyauk Tu	Pha-an
Loikaw	Ann	Anisakan
Monywa	Sittwe	Coco island
Kyaing Tong	Thandwe	
Tachileik	Kyauk Phyu	
Monghsat	Pathein	
Other Airports (36)		
Total Airport (69)		

Figure 1.2.5 Breakdown of Airports in Myanmar Source: DCA

At present, Yangon, Mandalay and Naypyidaw have international airport facilities, and remaining 30 airports are serving domestic services.

In the National Transport Development Plan in the Republic of the Union of Myanmar (MYT-PLAN) which was established by MOT with the support by JICA, categorization of the airports based on the roles expected from each of these is proposed. DCA in general adopted the proposal and will reflect the idea to the future development planning. The categorization is shown in the table 1.2.4.

Table 1.2.4 Categorization of Airports in Myanmar

Category	Major Function	Airports	Remarks
1	**Airports with international network to/from foreign countries;** ✓ meet relevant ICAO standards and recommendations; and ✓ capable of accommodating at least Code 4E aircraft (A340, B777 class).	Yangon, Mandalay, Naypyitaw and Hanthawaddy, International Airports.	Existing and new international airports.
2	**Airports with regional air network within ASEAN Member States at initial stage and expansion there after.** ✓ meet relevant ICAO standards and recommendations as far as practicable; and ✓ capable of accommodating at least Code 4C aircraft (A320 class) in the short-term, and preferably be expandable in future to cater for Code 4E aircraft.	Heho, Nyaung U and Thandwe Airports.	Major international tourist destinations
3A	**Airports with domestic air network within Myanmar.** ✓ meet relevant ICAO standards; and ✓ capable of accommodating Code 3C (F-100, E-190, ATR 72 class) in the short-term and Code 4C aircraft (A320 class) in the medium to long-term.	Tachileik, Myintkyina, Myeik, Dawei, Sittwe, Kawthoung, Lashiho, Kengtung Airports.	Airports that expect to handle over 600,000 pax in 2030.
3B	**Airports with domestic feeder line within Myanmar.** ✓ meet relevant ICAO standards as much as possible; and ✓ capable of accommodating Code 3C aircraft.	Putao, Ann, Kyaukphyu,, Banmaw, Loikaw, Monywar, Mawlamyine, Kalay, Bokpyinn, Mong-Hsat, Hommalin, Khamti, Pathein, Magway, Kyauktu , Hpa-an, Pakhokku, Anisakan and Coco Island Airports	Airports that expect to handle 600,000 pax or less in 2030.

Source: DCA

According to the categorization, it is expected to develop the four major airports with the highest priority including the three currently operating international services and Hanthawaddy international airport which is being planned, followed by Heho, Nyang U and Thandwe airports so that these airports will be able to serve for international flights. The major specifications for the operating airports are shown in table 1.2.5.

Table 1.2.5 Major Specifications of Operating 33 Airports

No.	Name	Int'l Pax. (2014)	Domestic Pax. (2014)	RWY (m)	RWY Strength	Scheduled Max. Aircraft
1	Yangon	2,903,688	1,480,544	3414 x 61	PCN56/R/C/X/T	A330
2	Mandalay	251,674	649,440	4267 x 61	PCN55/R/A/W/T	B737
3	Naypyitaw	37,747	95,521	3657 x 61	PCN56/R/A/W/T	ATR72
4	Heho	-	407,505	2591 x 30	68,039 kg	F100
5	Nyaung U	-	300,300	2591 x 30	68,039 kg	F100
6	Tachileik	-	255,527	2149 x 30	33,112 kg	F28
7	Myintkyina	-	203,522	1829 x 46	33,112 kg	F28
8	Sittwe	-	140,396	1829 x 46	33,112 kg	F28
9	Kawthaung	-	140,298	1829 x 46	60,781 kg	F28
10	Dawei	-	121,805	3657 x 30	395,987 kg	ATR72
11	Thandwe	-	112,946	2438 x 30	33,112 kg	ATR72
12	Myeik	-	102,357	2743 x 61	60,781 kg	F28
13	Lashio	-	76,758	1600 x 30	20,412 kg	ATR72
14	Putao	-	59,365	2133 x 30	60,781 kg	ATR72
15	Kengtung	-	55,784	2438 x 46	60,781 kg	F28
16	Kyauk Phyu	-	35,206	1408 x 30	20,412 kg	ATR72
17	Kalay	-	30,936	1676 x 30	33,112 kg	ATR72
18	Bamaw	-	27,331	2286 x 30	33,112 kg	ATR72
19	Loikaw	-	23,515	1585 x 23	20,412 kg	ATR72
20	Boke Pyin	-	23,099	3048 x 30	395,987 kg	F28
21	Hommalin	-	21,547	3657 x 61	395,987 kg	F28
22	Ann	-	20,451	2591 x 30	60,781 kg	N/A
23	Khamti	-	17,010	1829 x 30	20,412 kg	ATR72
24	Monghsat	-	10,452	1524 x 30	20,412 kg	ATR72
25	Monywa	-	9,747	2591 x 30	68,039 kg	F28
26	Mawlamyaing	-	7,907	1646 x 46	20,412 kg	ATR72
27	Pathein	-	341	2835 x 61	165,000 kg	N/A
28	Pakhokku	-	-	2591 x 30	68,039 kg	N/A
29	Magway	-	-	2591 x 61	165,000 kg	N/A
30	Anisakan	-	-	3048 x 61	395,987 kg	N/A
31	Pha-an	-	-	1371 x 30	N/A	N/A
32	Kyauk Tu	-	-	3048 x 30	395,987 kg	N/A
33	Coco Island	-	-	1524 x 30	20,412 kg	N/A

Source: DCA

1.2.4 Air Transportation Services

(1) International Services

At present, Yangon, Mandalay and Naypyidaw are operating international flight services. The table 1.2.6 presents the statistics of international passenger movements at these three airports.

Table 1.2.6 Trend of International Passenger in Myanmar

	2008	2009	2010	2011	2012	2013	2014
Yangon	792,446	943,761	1,164,072	1,432,897	1,900,338	2,437,611	2,903,688
Mandalay	12,232	20,246	30,261	44,234	72,311	194,921	251,679
Naypyitaw	0	0	0	0	0	19,270	37,747
Total	804,678	964,007	1,194,333	1,477,131	1,972,649	2,651,802	3,193,114

Source: DCA

At all of these three airports, significant increase of passenger number is observed, that is more than 20% of annual increase by average, and 35% especially after the democratization and government/economic reformation in 2012. The figure 1.2.6 shows the traffic growth of these three international airports.

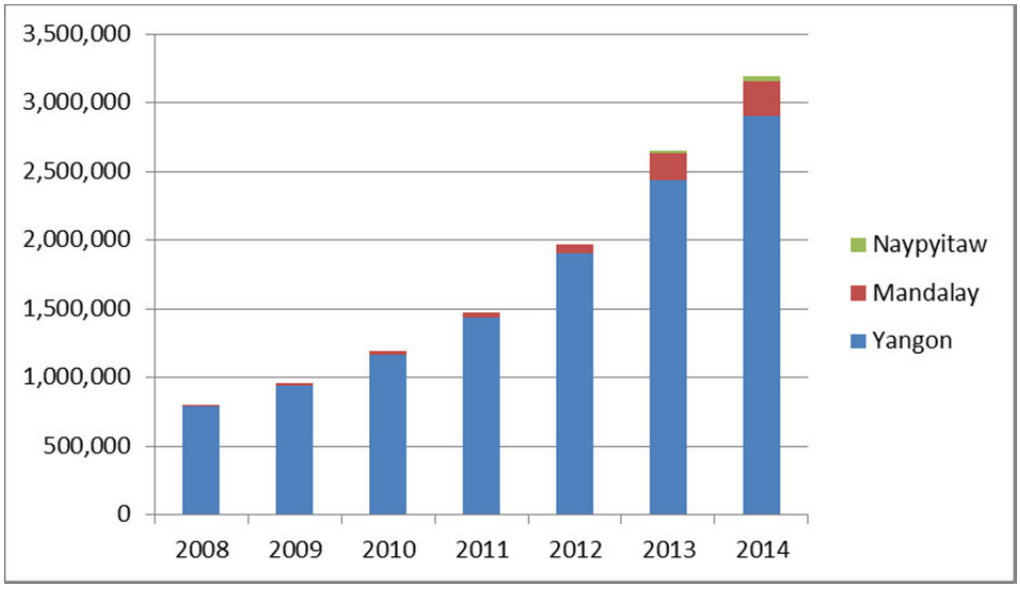


Figure 1.2.6 Passenger Growth of International Airports in Myanmar Source: DCA

The passenger disembarked/embarked at Yangon airports is the vast majority. Yangon served for significantly prevailing number of passengers more than 2.9 million, followed by 250 thousands of passengers by Mandalay. Naypyidaw also inaugurated the international service in 2013.

Although the number of passenger served by Mandalay and Naypyidaw is showing high growth, the passenger used Yangon airport still accounts for more than 90% of total international traffic of Myanmar and it performs the important roles as the major gateway to Myanmar.

(2) Domestic Services

In the table 1.2.7, the numbers of domestic passengers handled at all 33 operating airports from 2008 to 2014 are shown.

Table 1.2.7 Number of Domestic Passengers at Airports in Myanmar

Rank	Airport	2008	2009	2010	2011	2012	2013	2014
	Yangon	654,979	659,667	778,440	998,616	1,157,565	1,260,931	1,480,544
	Mandalay	247,311	280,843	348,097	434,885	496,007	556,929	649,440
	Naypyitaw	27,106	32,815	31,684	29,919	40,423	75,840	95,461
1	Heho	121,395	171,115	227,368	300,600	377,838	385,506	407,506
2	Nyaung U	148,007	187,704	224,821	229,218	255,046	290,544	300,300
3	Tachileik	70,906	80,440	113,149	170,810	217,309	218,885	255,527
4	Myitkyina	52,595	51,416	72,977	115,038	137,569	170,081	203,522
5	Sittwe	57,603	58,758	80,779	107,935	114,187	110,383	140,396
6	Kawthoung	66,734	63,360	54,691	104,453	146,867	144,598	140,298
7	Dawei	51,533	54,965	46,614	86,947	108,909	113,264	121,805
8	Thandwe	26,256	35,638	45,289	119,389	76,882	82,481	112,946
9	Myeik	-	137,851	130,423	103,471	118,110	104,467	102,357
10	Lashio	7,025	4,239	15,414	21,800	45,692	52,916	76,758
11	Putao	17,833	17,003	22,667	25,638	31,462	41,032	59,365
12	Kengtung	36,929	39,426	49,616	51,254	53,446	46,778	55,784
13	Kyaukphyu	8,786	10,973	10,385	17,985	22,005	28,637	35,206
14	Kalay	12,715	13,773	18,174	28,359	25,376	26,409	30,936
15	Bunmaw	3,893	3,531	9,837	20,051	28,704	26,536	27,331
16	Loikaw	5,660	7,886	12,129	12,031	10,819	11,665	23,515
17	Bokpyinn	-	6,012	11,179	14,346	12,120	13,171	23,099
18	Hommalin	-	5,232	9,255	14,615	16,072	15,022	21,547
19	Ann	2,292	8,290	16,173	25,276	24,093	16,172	20,451
20	Kanti	6,704	1,877	4,663	7,127	10,034	11,972	17,010
21	Mong-Hsat	2,937	3,851	7,094	7,079	6,360	7,733	10,452
22	Monywar	4,172	2,717	4,235	14,195	16,440	12,527	9,747
23	Mawlamyine	1,497	851	3,947	2,102	9,369	8,913	7,907
24	Pathein	-	156	1,503	2,550	778	433	341
25	Magway	87	16	-	-	-	-	-
26	Kyauktu	-	94	-	-	-	-	-
27	Hpa-an	-	-	-	-	-	-	-
28	Pakhokku	-	-	-	-	-	-	-
29	Anisakan	-	-	-	-	-	-	-
30	Coco Island	-	-	-	-	-	-	-
	Total	**1,634,955**	**1,940,499**	**2,350,603**	**3,065,689**	**3,559,482**	**3,833,825**	**4,429,551**

Source: DCA

The number of total domestic passenger is increasing by 18% at an average annual rate in the past 7 years. The majority is observed at the Myanmar's center of commerce and industries Yangon, which accounts for more than 30% of total traffic.
Looking at the other airports, Mandalay, the 2nd largest city in Myanmar is placed at the 2nd, followed by the tourism centers Heho and Nyang U. The same trend is kept observed on regular basis, although some minor changes can be found in the order of other airports. The domestic passenger share by airports are shown in the below figure.

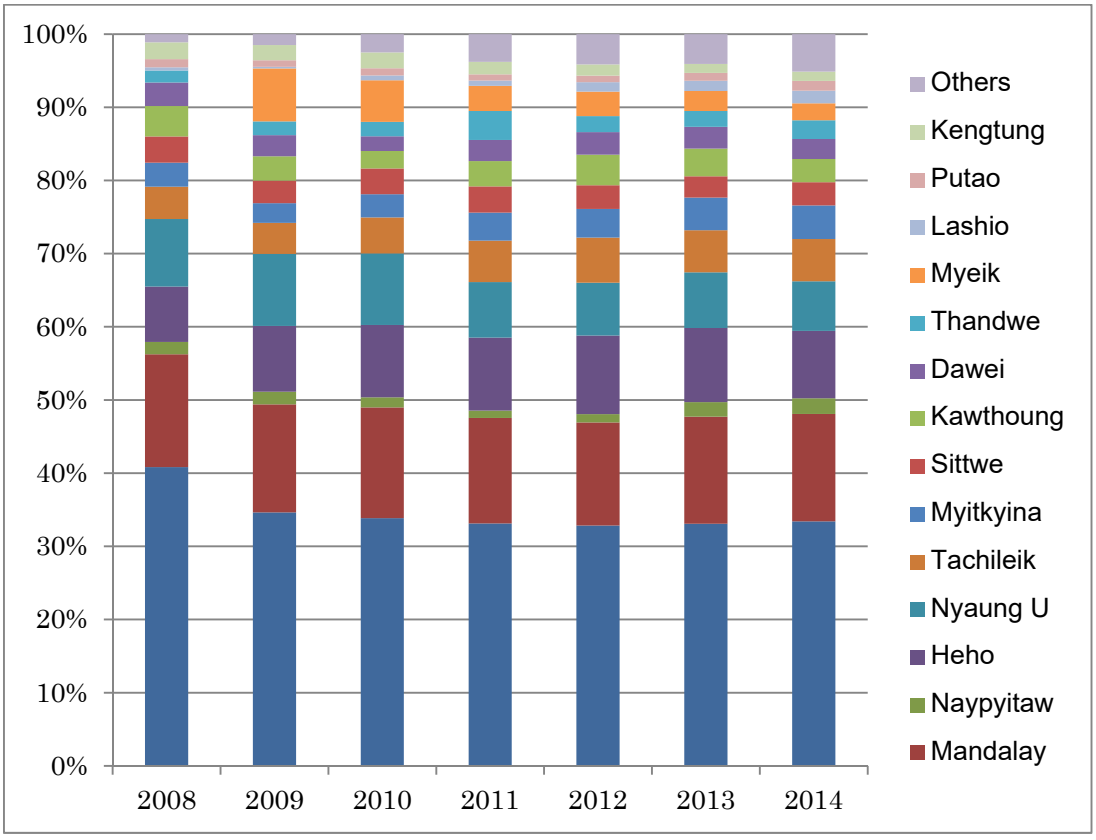


Figure 1.2.7 Trend of Domestic Passenger and Share by Airports Source: DCA

(3) Aircraft Operated by Myanmar Airlines

Having visited the 8 Myanmar airlines, we have conducted interviews with them to find the existing fleet as well as future fleet modification plan. The results were summarized in the following figures.
At present, the majority of the fleet is ATR-72, a turbo prop aircraft which carries 60-70 passengers. Each of the airlines has a few of ATR-72, or Air KBZ operates the maximum 9 ATR-72s. There are not many of jet aircraft of either narrow or wide body. Only Golden Myanmar Airlines and Myanmar Airways International operate a total of 5 Airbus A319 or A320.
Based on the airlines' intention of future fleet modification plan, the expected fleet distribution up to 2020 was summarized and presented in the figure 1.2.9. According to the fleet upgrade plan, ATR-72 will be kept as the core of the aircraft mix of the Myanmar airlines, and such trend that the majority of the domestic services will be short-haul routes by small turbo props will be maintained until at least the year 2020.

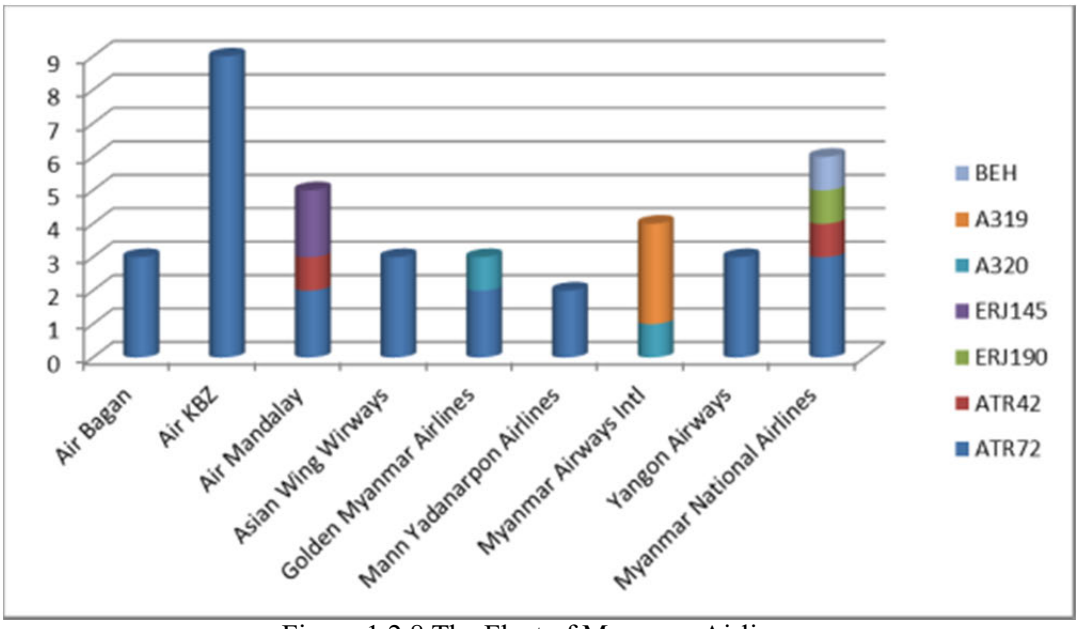


Figure 1.2.8 The Fleet of Myanmar Airlines

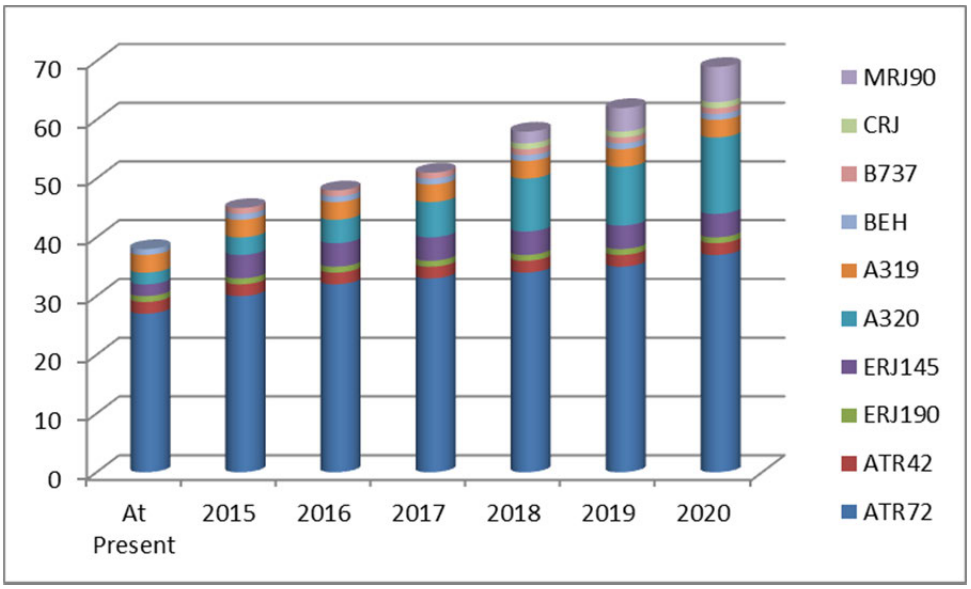


Figure 1.2.9 Expected Future Fleet Distribution of Myanmar Airlines

1.2.5 Current Situation at Yangon International Airport, Issues and Future Plans

(1) Current Situation at Yangon International Airport

a) Airside Facilities

Yangon International Airport (YIA) is located approximately 18 km northwest of downtown Yangon. YIA has the runway of 3,414 m long and is largest airport in terms of the number of passenger.

Parallel taxiway and five exit taxiways are included in the taxiway system.

In the aircraft parking area, 4 parking stands connected by passenger boarding bridge are located in front of the passenger terminal building, and 10 parking stands for small jet aircraft such as A320, B737 etc. are provided in remote area. Most of the remote

area is used by propeller aircraft such as ATR. Besides, expansion of parking stands is under way at south of the existing aircraft parking area and west of runway. Upon completion of the expansion of parking stands, YIA will have the apron capacity of around 6 mppa (million passengers per annum) (refer to Chapter 2, Section 2.2.3).

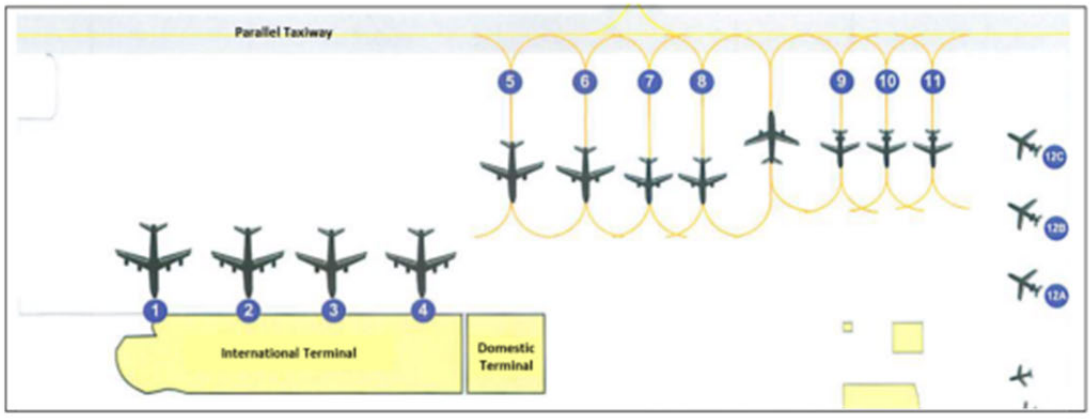
Table 1.2.8 Runway and Taxiway at YIA

Facility	Specification	
Runway	Direction	034° - 214°
	Length/Width	3,414 m/ 61 m
	Bearing Strength	PCN 56/R/C/X/T
	Precision Approach	ILS CAT-I RWY 21
Taxiway		Parallel taxiway
		5 Exit taxiways

Table 1.2.9 Number of Aircraft Parking Stand at YIA

Code Letter	Fixed Gate	Remote Stand	Total
Code E	4	-	4
Code D	-	2	2
Code E	-	8	8

Source: AIP



Source: AIP

Figure 1.2.10 Existing Aircraft Parking Area

b) Terminal Facilities

The new passenger terminal building which has a handling capacity of 4-4.5 mppa is under construction to be completed by the end of 2015.

Existing passenger terminal buildings consist of international and domestic terminal building. The existing international terminal building with designed capacity of 2.7 mppa has commenced its operation in May 2007, and the domestic passengers are handled at the next building which used to be the VIP terminal.

The historical development of passenger terminal building is shown in Table 1.2.10.

Table 1.2.10 History of Development of Passenger Terminal Building

	Old Building	New International Building	VIP Building	New Passenger Building	Total
Before 2007	Domestic International	—	VIP	—	
After 2007	Domestic	International	VIP	—	
Under Construction of New Terminal Building (Current Situation)	Demolish	International	Domestic	Under Construction	
Opening of New Terminal Building	—	International	-—	Domestic	
Annual Handling Capacity	—	2.7 mppa	—	4-4.5 mppa	6.7-7.2 mppa

The new car park is under construction in front of the existing and new passenger terminal building.

Figure 1.2.11 Current Situation of Terminal Area at YIA

c) Land Use of Surrounding Area

At the surrounding area of passenger terminal, the airport facilities such as hangar, international cargo warehouse, fuel storage tank, hotel and DCA office building exist. Besides, the part of surrounding area is used for military operations.

d) Issues of Existing Facilities

The number of international passengers in 2014 has reached 2.9 mppa, and already exceeded the existing terminal building capacity. Therefore, long queue and congestion are observed at processing facilities in the terminal building according to the interviews with airlines. It is conceived that the passenger traffic is exceeding the capacity of existing facilities of terminal building.

Besides, since domestic passenger processing is handled at old VIP terminal building,

long queue and heavy congestion has been chronic.
As for the airside facilities, the aircraft stands for overnight are insufficient.
After the new terminal building with the handling capacity of 4-4.5 mppa will be opened, queue and congestion will be alleviated. However, DCA has estimated the demand in 2020 as 9 mppa, thus even with new terminal building queue and congestion will become a problem sooner or later.

e) Future Plan for YIA
Myanmar government has signed a contract for the transfer of operation of YIA for 30 years with Yangon Aerodrome co., Ltd. which is subsidiary of Pioneer Aerodrome Services Co., Ltd. a member of Asia World Group in January 2015.
Currently, the development has started to construct new terminal building and aircraft parking stand. However, further expansion of terminal area after completion of new passenger building and aircraft parking stands should be difficult due to land use of area surrounding terminal and location of existing facilities. The development restriction imposed to the project by Yangon Aerodrome is shown in Figure 1.2.12.

Figure 1.2.12 Restriction for Future Expansion

(2) Current situation for Air Transport Services
a) Air Traffic Demand
The historical air traffic demand such as passenger, cargo and aircraft movement at YIA are shown in Table 1.2.11.
At this moment the data for domestic cargo has not been available (there is no domestic cargo service).

Table 1.2.11 Historical Air Traffic Demand at YIA

	Passenger			Cargo			Aircraft Movement		
	International (thousand)	Domestic (thousand)	Total (thousand)	International (tons)	Domestic (tons)	Total (tons)	International (times)	Domestic (times)	Total (times)
2000	537			14,044	—	14,044	6,370		
2001	528			11,468	—	11,468	6,026		
2002	562	682	1,244	12,371	—	12,371	5,192	8,717	13,909
2003	548	604	1,152	10,156	—	10,156	5,770	12,887	18,657
2004	670	666	1,336	9,316	—	9,316	7,356	13,056	20,412
2005	726	699	1,425	9,197	—	9,197	7,570	14,181	21,751
2006	825	749	1,574	9,574	—	9,574	7,724	15,606	23,330
2007	868	755	1,623	9,977	—	9,977	8,206	14,722	22,928
2008	825	655	1,480	12,059	—	12,059	7,184	12,336	19,520
2009	968	660	1,628	13,485	—	13,485	7,886	12,117	20,003
2010	1,211	778	1,989	15,667	—	15,667	11,234	14,399	25,633
2011	1,449	999	2,448	15,961	—	15,961	13,944	19,000	32,944
2012	1,926	1,140	3,066	15,227	—	15,227	16,128	22,363	38,491
2013	2,442	1,263	3,705	18,988	—	18,988	22,917	29,309	52,226
2014	2,904	1,481	4,385	24,462	—	24,462	26,590	32,316	58,906

The historical trends of air passengers including international and domestic are shown in Figure 1.2.15. The total air passengers were stagnant up to 2009, however the passengers after 2009 have drastically increased. The average annual growth rate in the last 5 years is 25% and 18% for international and domestic, respectively.
The number of passengers reached 2.9 mppa, 1.5 mppa and 4.4 mppa in 2014 for international, domestic and total, respectively.

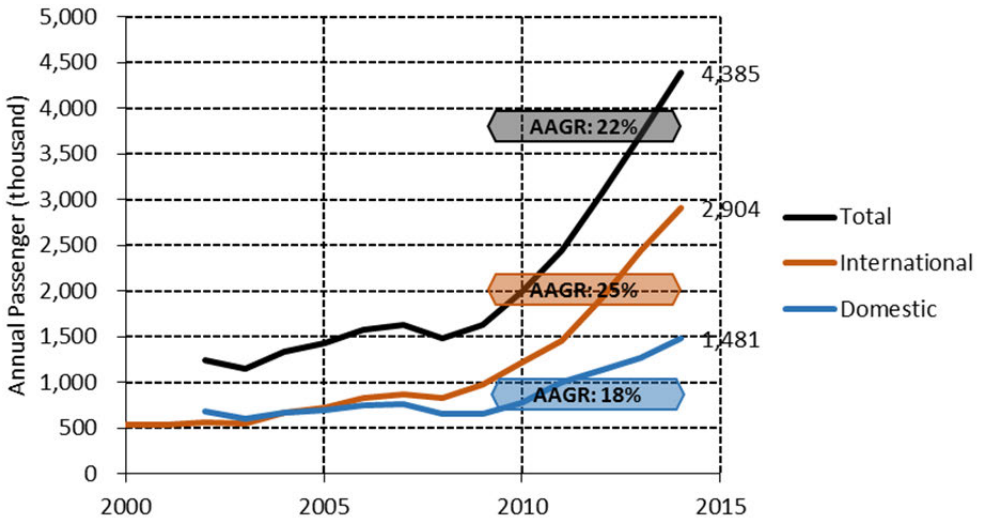


Figure 1.2.13 Historical Trend of Air Passengers at YIA

The historical trend of international cargo at YIA is shown in Figure 1.2.14. The metric volume handled was stagnant in 10 thousand tons during 2003-2007, then that has reached 15 thousand tons in three years. After 2012, the volume has drastically increased with average annual growth rate of 13%, and reached 25 thousand tons in 2014.

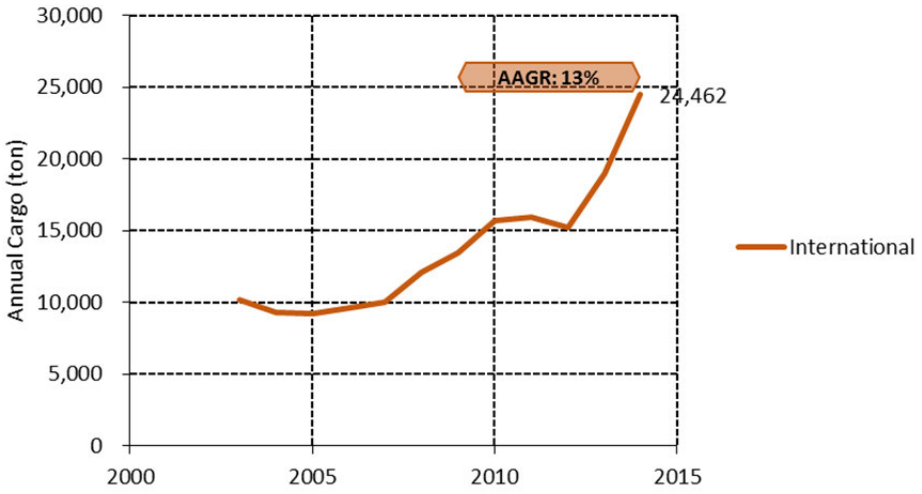


Figure 1.2.14 Historical Trend of International Cargo at YIA

The historical trend of aircraft movements at YIA is shown in Figure 1.2.15. The movements was stagnant in 20 thousand movements up to 2009, after that the movements have drastically increased and reached 60 thousand movements.
The number of passengers per flight is 110 and 50 passengers for international and domestic services, respectively.

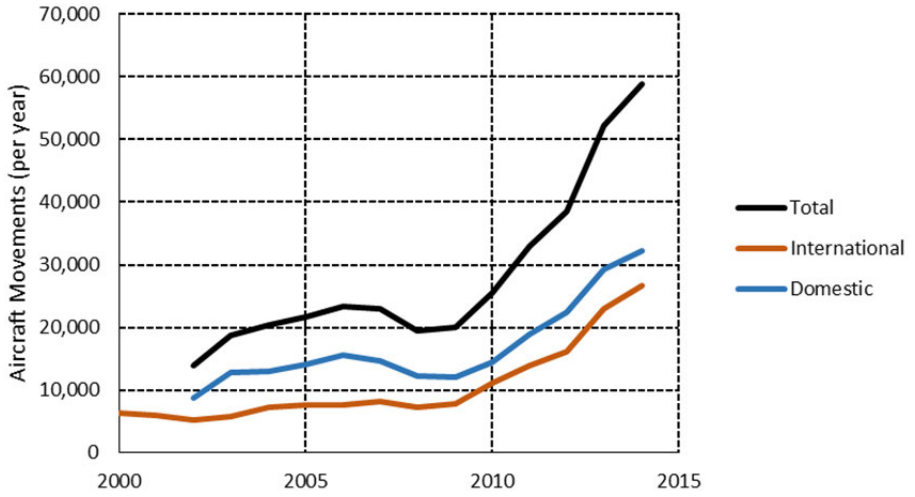


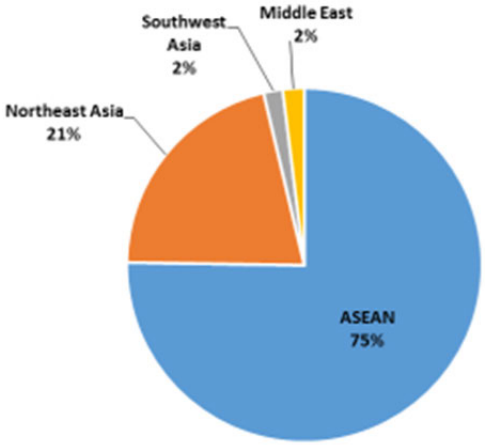
Figure 1.2.15 Historical Trend of Aircraft Movements at YIA

b) Destination

At YIA, the international flights are operated to/from 21 routes of 12 countries, the longest routes are Narita, Japan and Doha, Qatar which has the range of 3,000 miles (refer to Table 1.2.12).
The ASEAN routes account for 75%, followed by the Northeast Asia routes of 21% (refer to Figure 1.2.16).

Table 1.2.12 International Routes at YIA

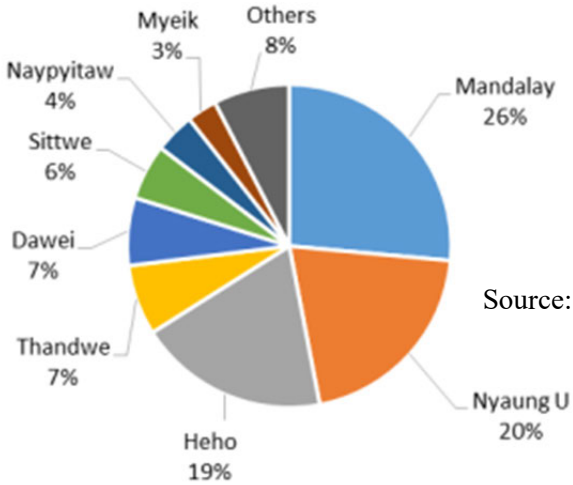
Country	City	Country	City
Vietnam	Hanoi	China	Beijing
	Ho Chi Minh City		Guangzhou
Cambodia	Phnom Penh		Hong Kong
	Siem Reap		Kunming
Thailand	Bangkok		Nanning
	Chiang Mai	Taiwan	Taipei
	Mae Sot	Bangladesh	Dhaka
Malaysia	Kuala Lumpur	India	Kolkata
Singapore	Singapore		Gaya
Japan	Narita	Qatar	Doha
Korea	Seoul		



Source: FlightStats website data (2-8 April 2015)

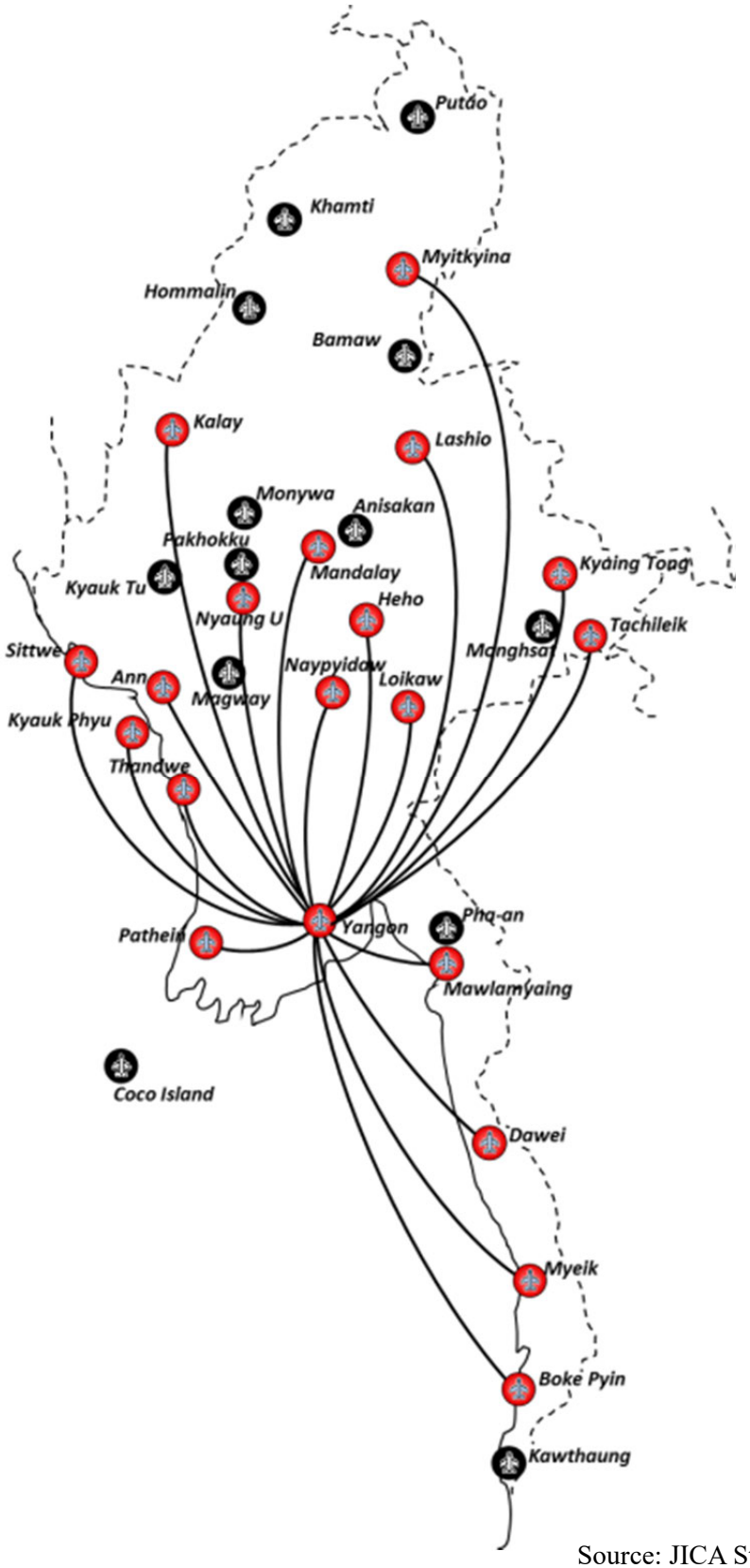
Figure 1.2.16 Share of International Route per Region

The domestic scheduled flights are operated to/from 19 airports (refer to Figure 1.2.18). The seat provided by route is shown in Figure 1.2.17. Three airports including Mandalay, Nyaung U and Heho account for 65%.



Source: FlightStats website data (2-8 April 2015)

Figure 1.2.17 Share of Seat Provided by Route

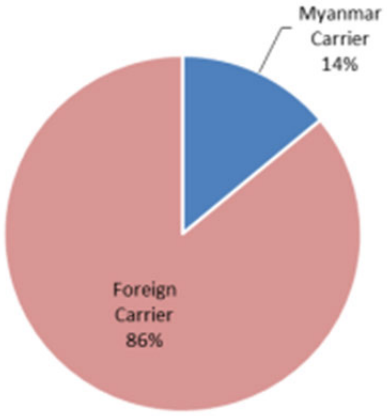


Source: JICA Study Team

Figure 1.2.18 Domestic Routes at YIA

c) Airline

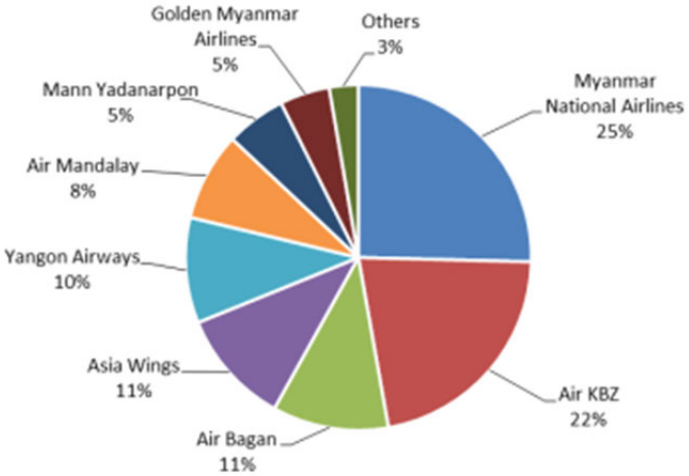
3 Myanmar airlines and 23 foreign airlines are operating international flights at YIA. Myanmar airlines; namely Myanmar Airlines International, Golden Myanmar Airlines and Air Bagan account for 14% in terms of the number of international passenger (see Figure 1.2.19). LCC from Thailand, Malaysia and Singapore account for 33%.



Source: JICA Study Team

Figure 1.2.19 Share of International Passenger by Airline at YIA

8 Myanmar airlines are operating domestic flights at YIA. Myanmar National Airlines accounts for 25% in terms of the number of passenger, followed by Air KBZ with 22% share (see Figure 1.2.20).



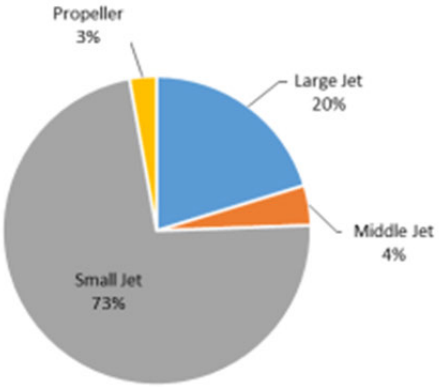
Source: JICA Study Team

Figure 1.2.20 Share of Domestic Passenger by Airline at YIA

d) Aircraft Mix

The aircraft operating international routes are shown in Figure 1.2.21 summed based on seat capacity. Small jet aircraft such as A321/320/319 and B737 accounts for 73%. Large jet aircraft such as A330 follows small jet with 20% share.

Figure 1.2.22 shows aircraft mix by international destination.



Note: Large Jet: A330
Medium Jet: B767
Small Jet: A321/320/319, B737
Propeller: ATR72/42, DHC-80Q400

Figure 1.2.21 Aircraft Mix of International Flight

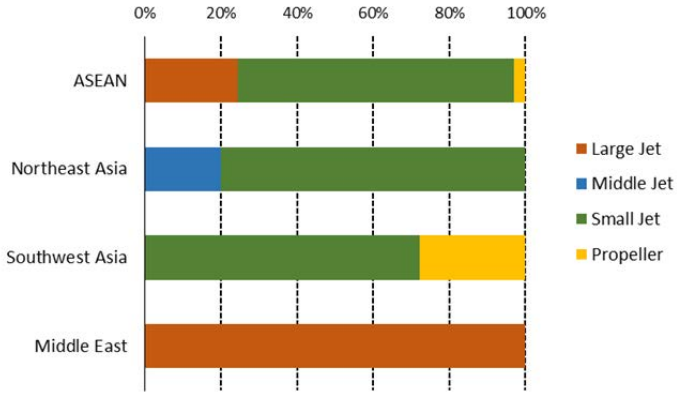


Figure 1.2.22 Aircraft Mix by International Destination

Figure 1.2.23 shows aircraft mix of domestic flights. Turbo props accounts for 73%, and the remaining share is for jet aircraft.

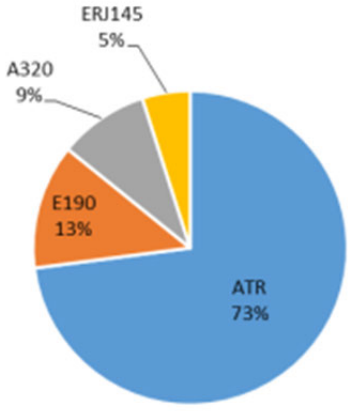


Figure 1.2.23 Aircraft Mix of Domestic Flight

(3) Outline of PPP Projects for Yangon and Mandalay International Airports

a) Announcement of PPP Projects

In 2012, DCA has announced the airport development including Yangon, Mandalay and Hanthawaddy Airports by using private investment based on PPP scheme.

b) Yangon International Airport Project

In January 2015, Myanmar government has sold out the operation of Yangon International Airport (YIA) for 30 years to Yangon Aerodrome Co., Ltd. Yangon Aerodrome has already started their management including the construction of new passenger terminal building and the expansion of aircraft parking area.

YIA has passenger handling capacity of 2.7 mppa, however the passengers has already exceeded this capacity, and reached 4.4 mppa in 2014.

The objective of this project is to develop, manage and maintain the airport facilities which have the designed capacity of 6 mppa.

Demand Framework

The demand framework of this project is as shown in Table 1.2.13 based on the RFP which has been announced by DCA in February 2013.

According to this framework, the facilities with 6 mppa capacity will be developed and maintained in future.

Table 1.2.13 Demand Framework for YIA Project

	Phase 1		Phase 2	
	Operation Start (2015)		After HIA Operation (2025)	
	Passenger	Aircraft Movements	Passenger	Aircraft Movements
Domestic	2 mppa	20,000	4.5 mppa	45,000
International	4 mppa	29,000	1.5 mppa	11,000
Total	6 mppa	49,000	6 mppa	56,000

Note: mppa: million passengers per annum

Outline of Project

According to RFP of YIA project, the project includes the works listed below:

- Master planning including design criteria
- Preliminary and detailed design
- Terminal Building(s) etc.
- Taxiway, Parking apron
- Landside service road, car parking lot, storm drainage system etc.
- Water supply and sewage treatment system
- Electric power supply and distribution system
- Solid waste disposal system
- Ground service equipment
- Fuel hydrant system
- Environmental impact study (EIS)
- Management, operation and maintenance of the airport

Project Development Area and Layout Plan

Figure 1.2.24 shows the project development area, and Figure 1.2.25 shows the layout plan of airport facilities indicated in RFP.

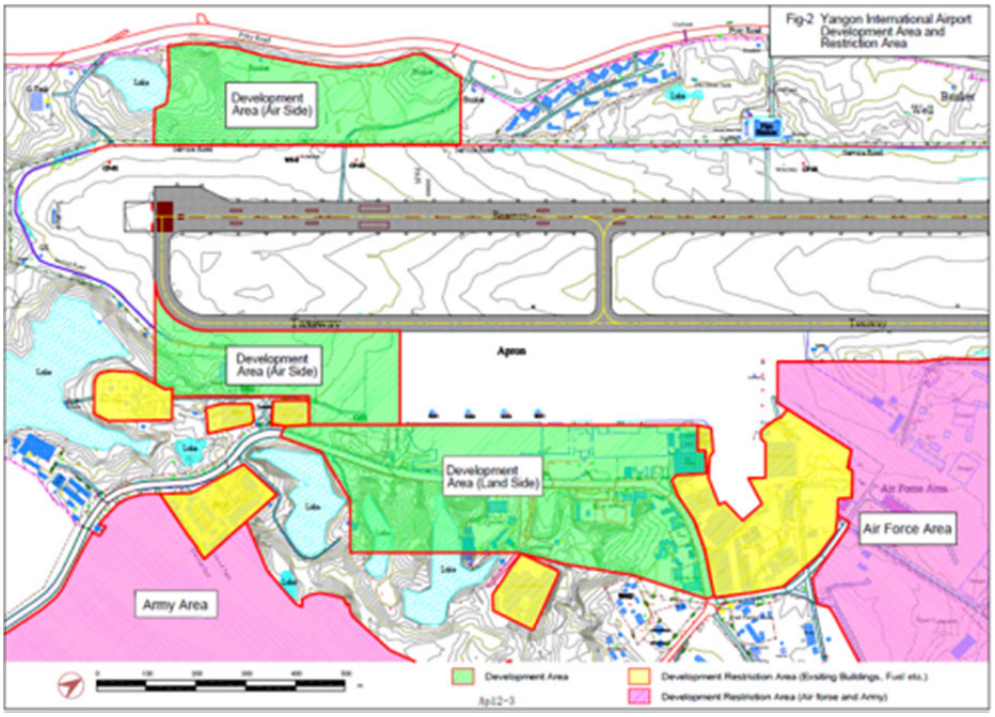


Figure 1.2.24 Project Development Area

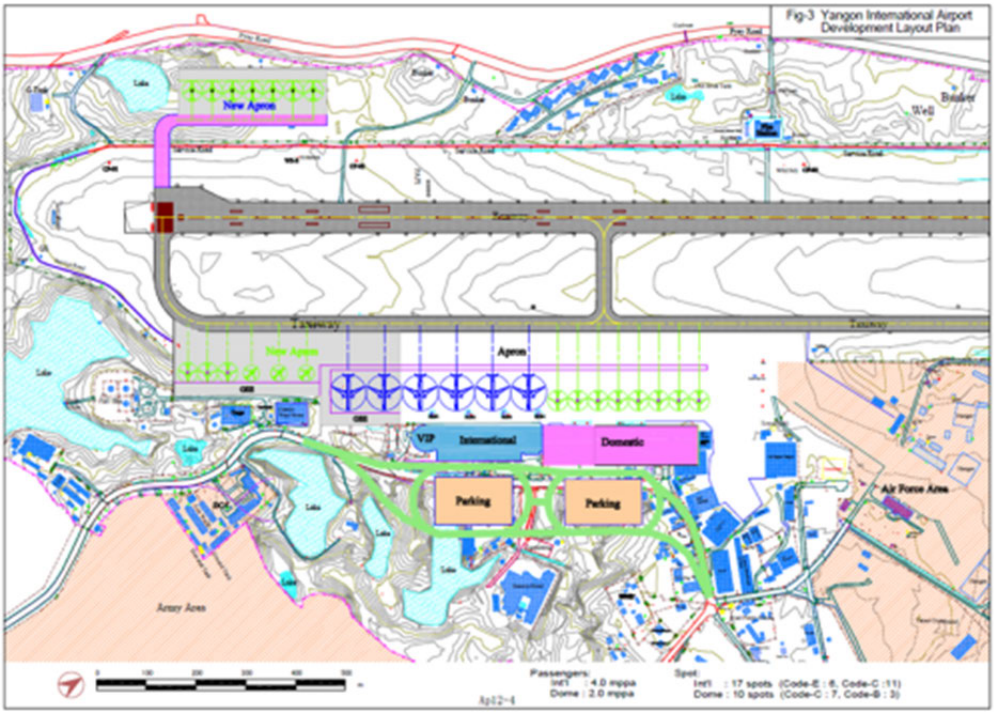


Figure 1.2.25 Airport Facilities Layout Plan

c) Mandalay International Airport Project

Mandalay International Airport (MIA) has the runway approx. 4,000 m long which can accommodate the operation of wide-body aircraft such as B747, and the passenger terminal which has the passenger processing capacity of 3 mppa. MIA has handled passenger of 0.9 mppa (including both the international and domestic passengers).
In November 2014, Myanmar government has signed the contract for the transfer of operation of MIA for 30 years to MC-Jalux Airport Service Co., Ltd. The project has commenced in April 2015.

Demand Framework

The demand framework of this project is as shown in Table 1.2.14 based on the RFP which has been announced by DCA in March 2013.

Table 1.2.14 Demand Framework for MIA Project

	2023	2033	2043
Domestic	1.4 mppa	3.5 mppa	7.5 mppa
International	0.6 mppa	1.5 mppa	3.2 mppa
Total	2 mppa	5 mppa	11 mppa

Note: mppa: million passengers per annum

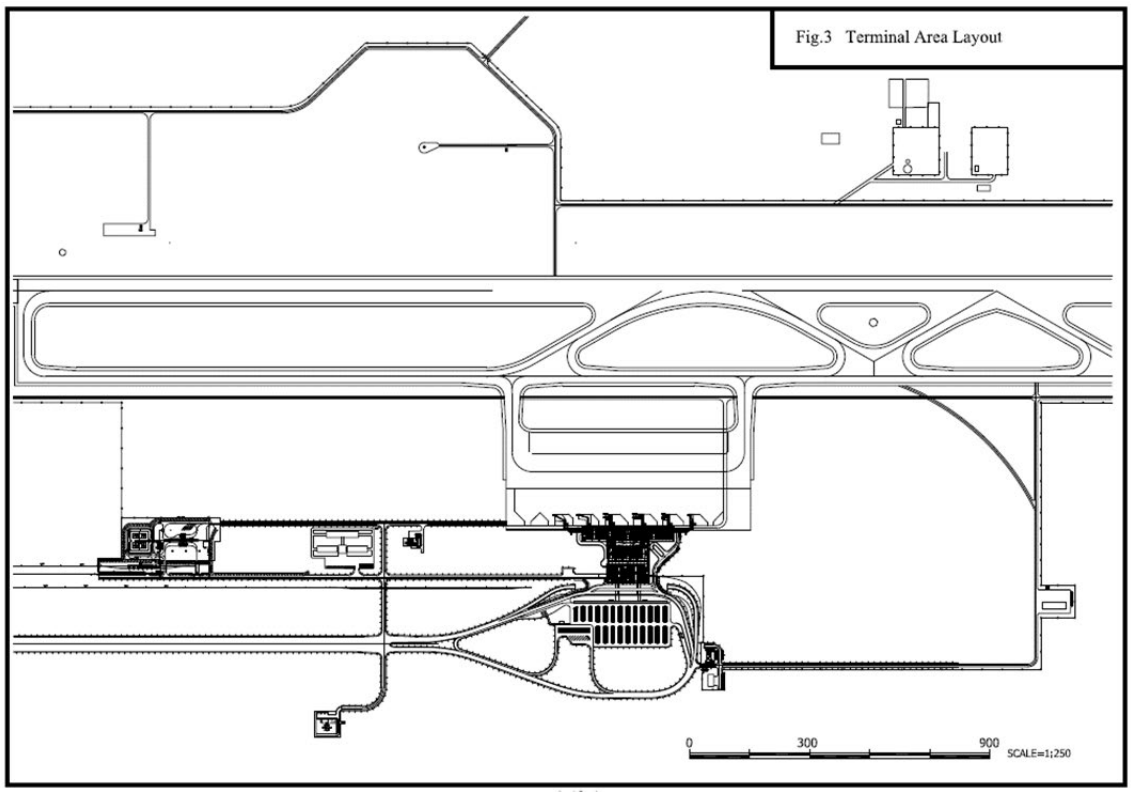
Outline of Project

According to RFP of MIA project, the project includes the works listed below:

- Master planning including new domestic terminal building and catering building
- Preliminary and detailed design
- Rehabilitation of Terminal Building
- Cargo terminal building
- Airlines and maintenance hangar and aprons
- Landside service road, car parking lot, storm drainage system etc.
- Water supply and sewage treatment system
- Electric power supply and distribution system
- Ground service equipment
- Environmental impact study (EIS)
- Management, operation and maintenance of the airport

Project Development Site

Figure 1.2.26 shows the project development site indicated in RFP.



Source: DCA, Request for Proposal, Mandalay International Airport Project

Figure 1.2.26 Terminal Site at MIA

1.2.6 Current Situation and Issue of Access Infrastructure from Yangon City area to HIA

(1) Travel Time to HIA

There are three major routes from Yangon CBD area (Yangon Central St.) to HIA as follows:

Table1.2.15 Major Route from CBD to HIA[1]

Route Name	Distance (km)	Time (min)	Frequency
1. NH1	92	138	-
2. YNG-MDL Expressway	141	172	-
3. YNG-MDL Railway	80	144	20 Trains/day (Express)

Table1.2.16 Major Route from YIA to HIA

Route Name	Distance (km)	Time (min)	Frequency
1. NH1	77	93	-
2.YNG-MDL Expressway	125	127	-

It was observed that NH1 route is the fastest route. However, the travel time depends on traffic condition since tracks and local traffic are mixed on NH1.

On the other hand, only passenger vehicles are allowed on the expressway. However, if passenger takes the expressway, it is required to go a long way around since 1st gate of expressway is located at Phyu Toll Gate which is far away from HIA.

[1] The route through illegal exit has not been included. Travel time is actual observed time.

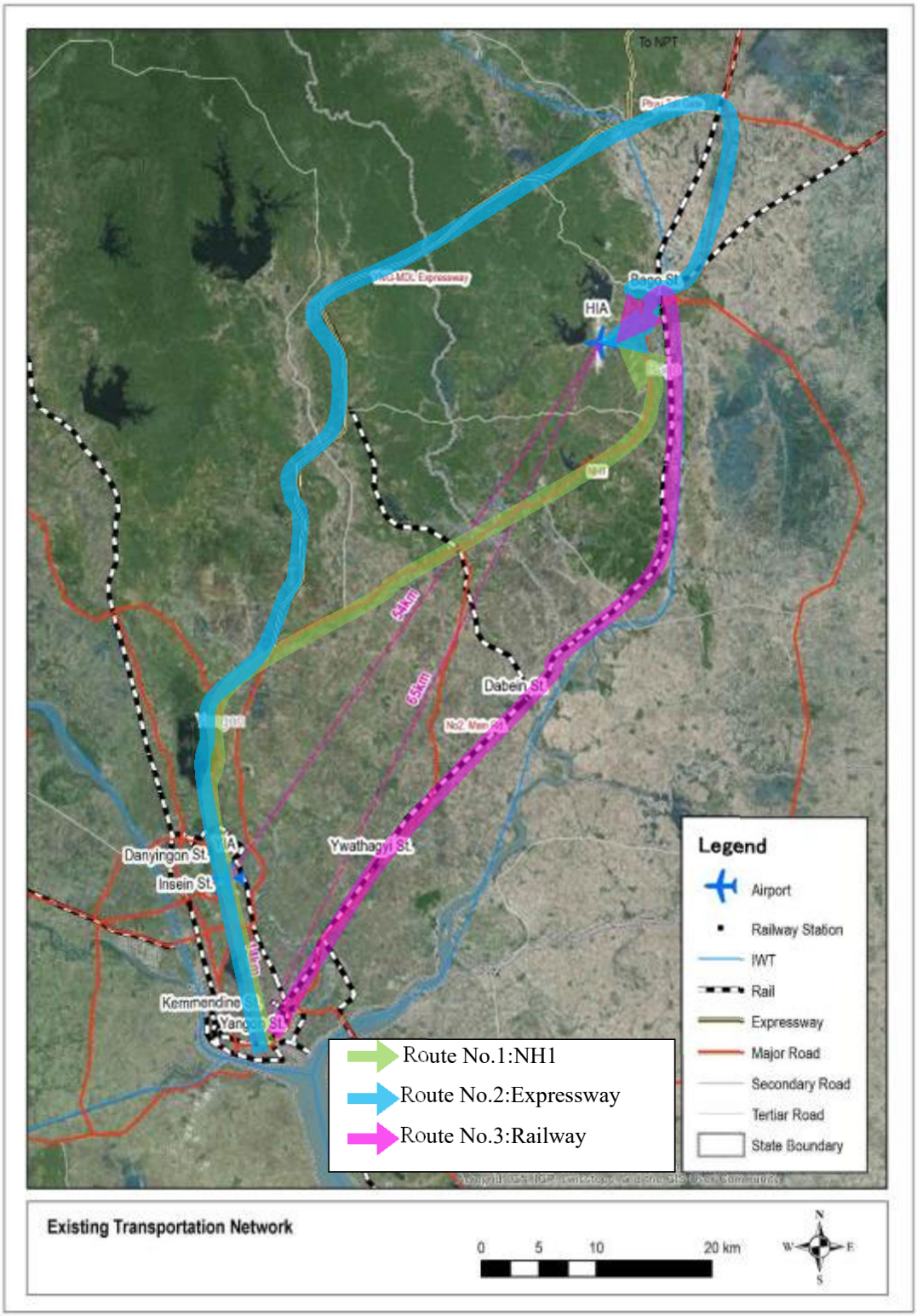


Figure 1.2.27 Major Route to HIA

(2) Current Conditions of Road and Railway

i. National Highway 1 (NH1)

NH1 is the national trunk road connecting Yangon and Mandalay. Huge amount of trucks are using NH1 since commercial vehicles are prohibited to drive through the Yangon – Mandalay expressway which runs parallel to the NH1.

In urban area, such as Bago city and the junction point with expressway, the road is congested due to many roadside vendors.

The road is maintained by private BOT operator, MAX Myanmar, based on the BOT contract which is valid for more than 40years.

・ National Highway No.1 (Yangon – Bago Section)			
・ Pavement	・ Asphalt		
・ No. of Lanes	・ 4 Lanes		
・ Length	・ 45km		
・ Traffic Volume (Yr 2015)	・ Bago Toll Gate	・ 8,565vehicles/day	・ 12,871 PCU/day
・ Average Travel Speed	・ 63km/hr (Observed speed), 70km/hr (Design Speed)		
・ ROW	・ 45m (Urban Area), 75m (Suburban Area)		
・ Land use	・ Lots of houses and shops are located along the road		
・ Operator	・ MAX Myanmar		

ii. Yangon – Mandalay Expressway

The construction of Yangon – Mandalay Expressway was commenced in 2005 and Yangon-Naypyitaw section was opened in 2009. However, commercial vehicles are prohibited from using the expressway.

The road improvement project that includes widening lanes is announced in 2015.

・ Yangon – Mandalay Expressway (Yangon – Phyu Section)		
・ Pavement	・ Asphalt / Concrete	
・ No. of Lanes	・ 4 Lanes	
・ Length	・ 45km	
・ Traffic Volume (as of July 2013)	・ 2,041 vehicle / day	・ 2,336 PCU/day
・ Average Travel Speed	・ 83 Km/hr (Observed speed), 100km/hr (Design Speed)	
・ Land use	・ Farmland	
・ Operator	・ MOC	

iii. Yangon – Mandalay Railway

Yangon – Mandalay railway was constructed in 1909. Due to lack of maintenance budget, the railway facilities including rolling stocks are heavily damaged. Recently, used rolling stocks have been imported; however, travel speed is lower than road now.

・ Yangon - Mandalay Railway (Yangon – Bago Section)	
・ No. of Tracks	・ 2 Tracks
・ Length	・ 75km
・ Average Travel Speed	・ 40km/hr (Express), 20km/hr (Local)
・ Land use	・ Lots of houses and shops are located along the railway
・ Operator	・ Myanma Railway
・ Ferquency	・ 20 Trains/day (Mail&Express), 2 Trains/day (Local)

(3) Issues on Access Transportation

i. Long Journey Time

The travel time from Yangon CBD to HIA is approximately 140 minutes. The time from YIA to HIA is approximately 95 minutes. Those travel time is fluctuate due to traffic congestion. Comparing with other international airports in adjacent countries, the transport service level is low.

Figure 1.2.28 Roadside Vendors on NH1

ii. Traffic Congestion

In just a few years, traffic congestion has emerged as a huge issue in YCDC area. Especially, the road within CBD area is quite congested. Also, there are several bottlenecks along the way to HIA such as, narrow road sections and the section with road side vendors.

iii. Mixed Traffic

Trucks are allowed to drive through NH1. The NH1 is also the community road for the persons who live along the NH1. To increase the average travel speed with safety, the local traffic and long trips should be physically separated.

Figure 1.2.29 Mixed Traffic on NH1

iv. Lack of Redundancy

NH1 is the only way to HIA from Yangon area except for roundabout way.
If NH1 is closed due to traffic accident or natural disaster, it causes serious problem for airport passengers, thus multiple layered transportation system is required for the international airport.

1.3 Consistency with Japan's International Cooperation Policy

(1) Politics and Economics History of Myanmar

In 1962, the military led by General Ne Win took control of Myanmar, and Myanmar had been ruled by the military influenced government. During the period under the military government, almost all aspects of society (business, media, production etc.) were nationalized or brought under government control. The very isolated economic plank was introduced that brought the shortage of foreign currency reserve, stagnancy of production, or accumulation of external debt, and the difficulties in economic activities were grown significantly. Myanmar became one of the world's most impoverished countries and was designated as Least among less developed country (LLDC) by United Nations.

In 1988, General Saw Maung staged a coup d'état to take over the government, and declared that it will bring the end to the socialists' measures.

In May 1990, the government held free elections for the first time in almost 30 years and the National League for Democracy (NLD), the party lead by Aung San Suu Kyi, won 392 out of a total 489 seats. However, the military government refused to cede power to NLD and continued to rule the nation until its dissolution in March 2011. Aung San Suu Kyi seriously criticized such government's actions so that the opposition between two parties became radical, and Aung San Suu Kyi was placed under restraint in May 2003 followed by the home arrest for

the 3rd time. As retortion to these circumstances, the United States enacted the series of economic sanctions on Myanmar, which resulted in the slowing down of its economic growth. In addition, EU decided reinforcement of its economic measures including suppression of giving credit to national enterprises in October 2004. Since then, the economic sanctions by the western nations were kept strengthened.

In November 2010, general elections were held under the new constitution in 2010. The military-backed Union Solidarity and Development Party (USDP) declared victory, stating that it had been favored by 80 percent of the votes. Since the election, the new government lead by new president Thein Sein has embarked on a series of reforms to direct the country towards liberal democracy, a mixed economy, and reconciliation. The series of reforms includes the immediate release of pro-democracy leader Aung San Suu Kyi from house arrest

In response to the historic reforms that had been taking place in Myanmar, the country's foreign relations, particularly with western nations, thawed gradually. The United States began to lift its economic sanctions on Myanmar from November 2012, followed by EU in April 2013.

On November 8, the country's first general election since its transition to civilian rule in 2011 was held generally freely and fairly which is an important milestone in the advancement of democratization in Myanmar.
Among the elected 491 seats, NLD took absolute majority accounts for 67 percent, followed by 59 seats of pro-military USDP and 59 seats by others.
The successful completion of this general election is considered as an evidence of the significant outcomes achieved through the political reforms carried out by the President Thein Sein. It is expected that the dialogue toward launching a new administration that will take place between Chairperson Aung San Suu Kyi, President Thein Sein, and Senior General Min Aung Hlaing, Commander-in-Chief of Defense Services will proceed smoothly, and further advances will be made with Myanmar's democratization and various reforms under a stable administration.

(2) Economic Cooperation between Japan and Myanmar
The economic cooperation by Japan for Myanmar was entered into action since the establishment of peace treaty in November 1954, and it was strengthened by the economy and technology cooperation agreement inked in March 1963. In aviation sector, the financial supports including the following yen credited projects were provided:

- Yangon International Airport Expansion Project (1984)
- Yangon International Airport Expansion Project (2) (1985)
- Yangon International Airport Expansion Project (3) (1986) *note: discontinued in 1988

However, series of actions taken by military including assumption of power through coup d'état and crackdown of democratization movements made Japan to cease in principal the economic cooperation in 1988. Economic cooperation was resumed partially, for the actions related to the civilian activities in 1995 and later on; however, these were discontinued again in response to the home arrest of the democratization leader Aung San Suu Kyi.

Scattered humanitarian supports by which directly benefits populace had been considered and provided for Myanmar on case-by-case basis. Finally since 2011, upon recognizing that the new government lead by president Thein Sein making efforts in reforms in various areas towards its democratization, governance under the law, national reconciliation and economic restructuring, Japan declared to resume supporting Myanmar at the top level conference between Myanmar and Japan in April 2012.

(3) Basic Policy of Japan's Assistance to Myanmar

Myanmar, being situated in the geopolitically strategic location between China and India, is also a member of ASEAN which is very important partner for Japan. Historically, a good relationship has been cultivated between Japan and Myanmar, and Myanmar people have strong affinity toward Japan.

Japan considers that it is valuable for Japan that Myanmar will become stable nation established on democracy and market oriented economy. Also from the perspective to contribute in establishing the ASEAN community, the supports for Myanmar is important. Under the new economic cooperation policy for Myanmar, in order to back up its efforts for reforms in various areas towards its democratization, national reconciliation and sustainable development, Japan decided to monitor these reformations and extend the economic cooperation focusing in the following three areas.

- Improvement of People's Livelihoods
  Including assistance for ethnic minorities and poverty groups as well as agricultural and rural development
- Capacity Building and Development of System to Sustain Economy and Society
  Including assistance for promotion of democratization, accepting students and interns, capacity building by education supports and operation trainings
- Development of Infrastructure and Related Systems Necessary for the Sustainable Economic Development
  Promoting infrastructure development including energy supply and/or transportation system, using Yen loan supports

(4) Consistency for Supporting HIA Project

This project can be categorized in the 3rd area "Development of Infrastructure and Related Systems Necessary for the Sustainable Economic Development".

In April 2013, an official letter was issued to the Minister of Transportation, Myanmar, with the co-signatures of Director-General, International Cooperation Bureau, MoFA and Director-General, Civil Aviation Bureau of Japan, MLIT, ensuring the Japan's support in development of Yangon International Airport, Mandalay International Airport as well as HIA project. In November 2014, a joint venture comprises of JALUX, Mitsubishi Corporation and Yoma Development Group LTD (YOMA) won the contract for the operation of Mandalay International Airport.

Particularly the HIA project draws ministries and agencies wide attention in Japan, and it is expected to support the project with many Japanese companies. The HIA project is also in line with the fundamental policy of Office for Private Sector Partnership of JICA "*Strengthening partnerships with private corporations and private business and supporting improvement of the business environment in developing countries, thereby creating win-win-win situation for developing countries, private enterprises and ODA.*" and is categorized as one of the types of the Private Sector Partnership "*1. Improvement of Business Environment*".

Based on the perspectives summarized in above statements, the HIA project is in compliant and consistent with the Japan's international cooperation policy for supporting Myanmar.

1.4 Consistency with the Myanmar National Transport Development Plan (MYT-Plan)

Under the capable leadership of his excellency president Thein Sein, Myanmar is strengthening its economic policies to take advantage of the social and economic growth potential of an open market economy. While the transport sector has a key role in fostering this economic growth, advancing social development, especially in terms of the infrastructure, will also be needed to capitalize on regional trade opportunities. These policy reforms are important to realizing this growth potential, but success will also require the coordinated and sustained upgrading of the country's transport infrastructure, facilities, and skilled human resources.

The Myanmar National Transport Master Plan (MYT-Plan) is designed to provide guidance for a long-term investment program that will help the Government to achieve its economic growth targets by 2030. In addition, the MYT-Plan will provide guidelines that are adaptable to other industrial sectors and to private investment, to assist with investment planning and decision making for a variety of transport sector projects.

In this way, the MYT-Plan will influence the transport sector's development, by presenting a set of comprehensive policies relevant to all modes of transport, as well as development strategies for specific modes like road, rail, air, maritime and inland waterway, as well as the associated projects and activities that can help these modes achieve the Vision and its Objectives.

In the following subchapters, the positioning of the Hanthawaddy International Airport project in the MYT-Plan was reviewed from the various perspectives, and the consistency with the MYT-Plan was validated.

(1) Economic Growth in Future

GDP was employed as an indicator of the economic growth in MYT-Plan, and set three scenarios as follows:

Scenario 1	High Growth The annual growth rate of GDP from 2015 to 2035 was set as 7.7% which is identified by Myanmar's President H. E. U Thein Sein for the current five-year development plan.
Scenario 2	Medium Growth The annual growth rate of GDP was set as 7.2% which is 0.5% lower than in the High Growth scenario. At this rate of growth, GDP will double every ten years.
Scenario 3	Low Growth Considering the trend of growth rate after 2010 (5.3-6.3%), the annual growth rate of GDP was set as 6.0%.

Meanwhile, The F/S Survey has set GDP growth rate as follows:

Up to 2020	Adopt IMF Forecast
After 2020	Assume 1% decrease every 10 years

Figure 1.4.1 shows the comparison of the future GDP set by both survey. The GDP set by the F/S Survey (refer to Chapter 2, Section 2.2.2) approximates the GDP of scenario 1 of MYT-Plan up to 2025, and scenario 2 after 2025.

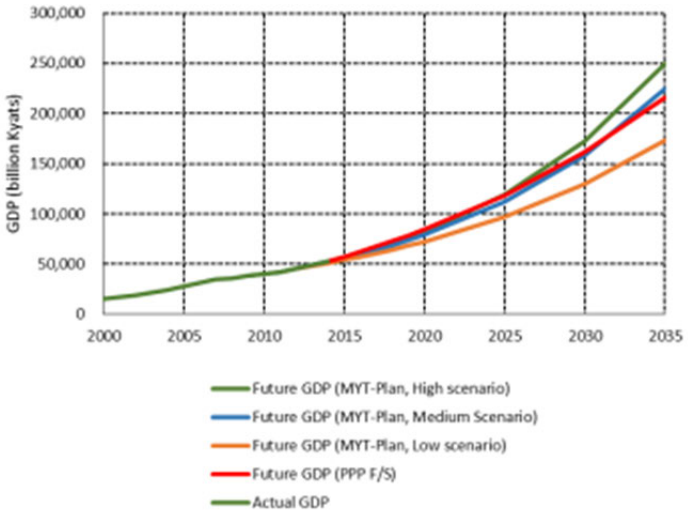


Figure 1.4.1 Comparison of the Future GDP

(2) Air Traffic Demand Forecast

a) Air Traffic Demand Forecast in MYT-Plan

The outlines of demand forecast study in MYT-Plan are as follows:

Domestic

The demand forecast study was conducted based on the conventional four-step method including all transport modes. The study has forecasted the nationwide air traffic demand, however demand for each airport had not been analyzed.

International

The demand for Yangon and Mandalay Airports are forecasted in MYT-Plan.

b) Forecast for Domestic Passengers

The Future domestic passengers in Yangon Metropolitan Area (YMA) are estimated by pro rata allocation of the share of YIA within nationwide air traffic demand. Comparison of this result and forecast by F/S Survey is shown in Figure 1.4.2. The predicted value of MYT-Plan is less than that of F/S Survey in short term, and is higher in the long term.

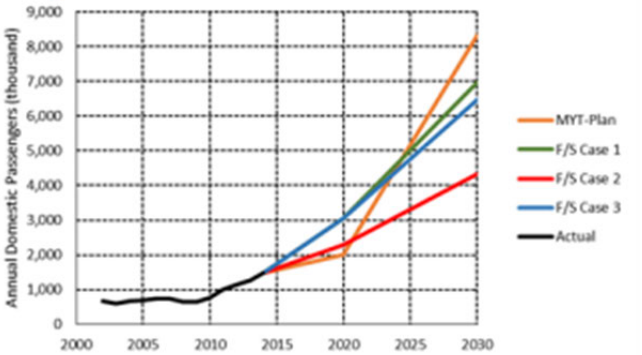


Figure 1.4.2 Comparison of Predicted Value between MYT-Plan and F/S Survey

c) Forecast for International Passengers

Figure 1.4.3 shows the comparison of the demand for YMA forecasted by both survey. The predicted value of MYT-Plan is higher than Case 2 of F/S Survey, and lower than Case 3 of F/S Survey.

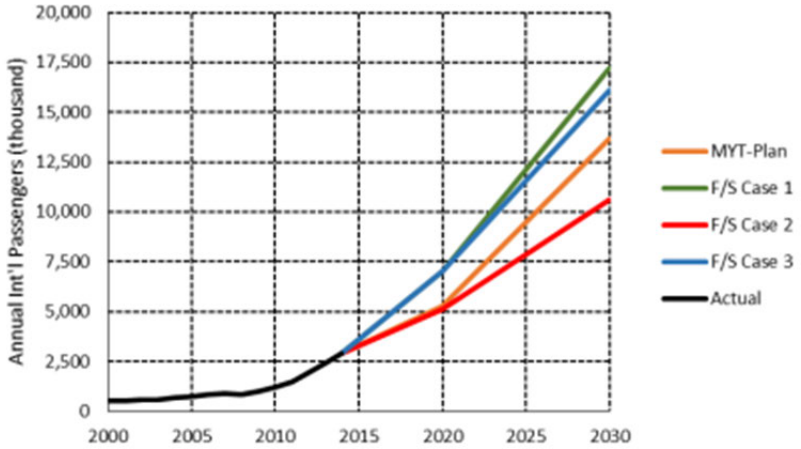


Figure 1.4.3 Comparison of International Demand Forecasted

(3) Implementation Plan of Aviation Sector

Chapter 10 of MYT-Plan summarizes priority investments in the transport sector over the next fifteen years (until 2030) and includes recommended actions to implement the MYT-Plan. While many of these investments may be implemented within the next five years, several are high priority actions that, if not acted upon very soon, would mean that Myanmar will miss opportunities to stimulate domestic growth, either by not taking advantage of favorable trade agreements with neighboring countries or by failing to catalyze domestic growth opportunities.

A framework for this type of support is described in this Chapter, both to implement the short-term investments as well as to launch studies for longer-term capacity activities.
The table 1.4.1 identifies the proposed investments by transportation sector within the two program timeframes. While some infrastructure projects will be implemented within five years, most of the projects will be completed between 2020 and 2030.

Table 1.4.1 Summary of the Proposed Investment by Sectors Unit: Billion Kyats

Sector	Investment				2014 - 2030 (Bil. MMK)	2014 - 2030 + over 2030 (Bil. MMK)
	- Y2015	Y2016 - Y2020	Y2021 - Y2030	Over Y2030		
Air	319	1,155	922	0	2,396	2,396
Road	588	2,788	8,285	2	11,660	11,662
Rail	327	1,994	4,204	413	6,525	6,938
Seaport	501	1,872	2,354	1,796	4,727	6,523
Inland water	39	562	779	372	1,380	1,752
Total	1,774	8,371	16,544	2,582	26,688	29,271

Source: JICA, the MYT-Plan

The proposed investment for Air sector accounts for 9% of the total investment for the transportation infrastructure by 2030.

The breakdown of the investments proposed for the Air sector is presented in the table 1.4.2. The development projects for major airports in Yangon-Mandalay (north-south) transport and development corridor, as well as a couple of soft components are given the highest priority, followed by the improvement of the facilities at airports taking important roles in tourism or transportation and industrial centers. The Hanthawaddy International Airport development

requires the biggest investment more than 1,400 billion Kyats which accounts for almost 60% of overall investment required for Air transport sector.

Table 1.4.2 Breakdown of the Investments in Aviation Sectors

Sector	Corridor	Project ID	Project	Implementation Schedule	Budget				Total Project Cost (Bil. MMK)	Contents
					- Y2015	Y2016 - Y2020	Y2021 - Y2030	Over Y2030		
Aviation	A1,B1,H1,K1	A001	Yangon International Airport		49.0	146.0	0.0	0.0	195.0	Improvement by PPP concessionaire On-going
	A1,B1	A002	Hanthawaddy International Airport		263.0	439.0	701.0	0.0	1,403.0	Construction by PPP concessionaire
	A2,A3,C1,D1,K2	A003	Mandalay International Airport		0.0	21.0	0.0	0.0	21.0	Improvement by PPP concessionaire
	E1,L2	A004	Heho International Airport		0.0	119.0	27.0	0.0	146.0	Runway pavement, TWY, PTB, Apron, Control Tower, Administration building, AGL, Rescue and Fire-fighting, Utilities
	K2,D1	A005	Nyaung U International Airport (Alt. Pakokku)		0.0	88.0	19.0	0.0	107.0	Runway pavement, TWY, PTB, Apron, Control Tower, Administration building, AGL, Rescue and Fire-fighting, Utilities
	Other	A006	Thandwe International Airport		0.0	46.0	11.0	0.0	57.0	Runway pavement, TWY, PTB, Apron, Control Tower, Administration building, AGL, Rescue and Fire-fighting, Utilities
	E1	A007	Tachileik Airport (major domestic)		0.0	54.0	22.0	0.0	76.0	Runway, PTB, Apron, TWY, RWY Renewal of PAPI, SALS
	A3	A008	Myitkyina Airport (major domestic)		0.0	17.0	7.0	0.0	24.0	Installation of PAPI, SALS Expansion of PTB, Renewal of RWY, TWY, Apron Lights
	E1	A009	Sittwe Airport (major domestic)		0.0	15.0	6.0	0.0	21.0	Extension of runway and apron, fire-fighting, renewal of SALS/PAPI/TWY/Apron lights
	B2,J2,J3	A010	Dawei Airport (major domestic)		0.0	26.0	11.0	0.0	37.0	Relocation of apron, TWY, fire-fighting engine, expansion of apron, renewal of RWY lights
	J2,J3	A011	Myeik Airport (major domestic)		0.0	32.0	13.0	0.0	45.0	Expansion of Apron and PTB Renewal of PAPI, RWY, TWY, Apron Lights
	J3	A012	Kawthoung Airport		0.0	6.0	3.0	0.0	9.0	PTB. Apron, Taxiway
	Other	A013	Putao Airport		0.0	5.0	2.0	0.0	7.0	PTB. Apron, Taxiway
	E1	A014	Ann Airport		0.0	5.0	2.0	0.0	7.0	PTB. Apron, Taxiway PAPI, SALS
	E1	A015	Kyaukphyu Airport		0.0	6.0	2.0	0.0	8.0	PTB. Apron, Taxiway PAPI, RTIL, SALS
	C1	A016	Lashio Airport		0.0	5.0	2.0	0.0	7.0	PTB. Apron, Taxiway PAPI, SALS
	E1	A017	Kengtung Airport		0.0	4.0	1.0	0.0	5.0	PTB. Apron, Taxiway
	A3	A018	Bhamo Airport		0.0	6.0	3.0	0.0	9.0	PTB. Apron, Taxiway
	E1,G2,L1,L2	A019	Loikaw Airport		0.0	5.0	2.0	0.0	7.0	PTB. Apron, Taxiway PAPI, RTIL, SALS
	D1	A020	Monywar Airport		0.0	5.0	2.0	0.0	7.0	PTB. Apron, Taxiway PAPI, RTIL, SALS
	B1,B2,J1	A021	Mawlamyine Airport		0.0	1.0	1.0	0.0	2.0	Minor improvement
	D1	A022	Kalay Airport		0.0	3.0	1.0	0.0	4.0	PTB. Apron, Taxiway SALS
	J3	A023	Bokpyinn Airport		0.0	5.0	2.0	0.0	7.0	PTB. Apron, Taxiway PAPI, RTIL, SALS
	E1	A024	Mong-Hsat Airport		0.0	1.0	1.0	0.0	2.0	PTB. Apron, Taxiway PAPI, RTIL, SALS
	D1	A025	Hommalin Airport		0.0	4.0	1.0	0.0	5.0	PAPI, RTIL, SALS
	D1	A026	Kanti Airport		0.0	4.0	1.0	0.0	5.0	PTB. Apron, Taxiway PAPI, RTIL, SALS
	H1	A027	Pathein Airport		0.0	1.0	1.0	0.0	2.0	Minor improvement
	E1,G2,K1,K2	A028	Magway Airport		0.0	1.0	1.0	0.0	2.0	Minor improvement
	K1,K2,D1	A029	Kyauktu Airport		0.0	1.0	1.0	0.0	2.0	PAPI, RTIL, SALS
	Other	A030	Coco Island Airport		0.0	1.0	1.0	0.0	2.0	PAPI, RTIL, SALS
	Common	A031	Soft Component		5.0	80.0	75.0	0.0	160.0	A series of projects for improvement of CNS/ATM systems (refer to the technical note on the aviation sector)
	Common	A032	Soft Component		2.0	3.0	0.0	0.0	5.0	A series of TA and other actions for DCA reorganization (refer to the technical note on the aviation sector)
Total					319	1,155	922	0	2,396	

Projects in the first priority corridor
Projects outside the priority corridor, but of higher priority (projects in the regional centers, etc.)
Projects in the second priority corridor

Source: JICA, the MYT-Plan

(4) Consideration Necessary for the HIA Project

Chapter 9 of MYT-Plan is focusing on the vision, policy, strategy and action necessary for the future transportation infrastructure, and presents proposals for a comprehensive transport visions for each sector. For the Aviation Sector, a strong "Vision" is proposed as below:

"Develop and strengthen the safe, secured, efficient, sustainable and environmentally friendly aviation industry in order to make Myanmar one of the major aviation hubs in Asia."

Under the vision, five strategic objectives are suggested as follows:

CA-01: Strengthen regulatory functions of the Department of Civil Aviation, so as to monitor and regulate the increasingly influential roles and activities of other organizations.

CA-02: Develop a safe and efficient airport system for the Yangon metropolitan area as the country's international prime gateway city to cope with increasing international and domestic air transport demand.

CA-03: Develop a nationwide airport system in order to cope with increasing air traffic demand and contribute to balanced national socio-economic development.

CA-04: Modernize Air Navigation Services in line with the ICAO GANP so as to provide seamless services and support safe and efficient air transport.

CA-05: Allocate service provision functions currently under the Department of Civil Aviation to appropriate entities in order to improve effectiveness and efficiency of the service production and provision.

The CA-02 is explicitly focusing on the Hanthawaddy International Airport project. There are six sector strategies and associated proposed actions as summarized below:

Table 1.4.3 Six Strategies and Action Plans related to the HIA Project

No.	Sector Strategy	Action
CA-02-1	Continue ongoing process of the projects for Yangon International Airport (YIA) and Hanthawaddy International Airport (HIA) with utmost care, and make adjustments as and when necessary.	Continue the ongoing selection process of the concessionaires who will implement the 30-year BOT projects for YIA and HIA with the utmost care so as to coordinate the 2 separate projects to achieve a single goal, i.e. to develop an efficient airport system for Yangon metropolitan area.
CA-02-2	Coordinate with concerned organizations for provision of reasonable access to HIA at appropriate timing, as HIA is located about 70km northeast of downtown Yangon, high-speed access will be required for successful utilization of HIA.	Coordinate with concerned organizations, such as Ministry of Construction, Ministry of Rail Transportation and Yangon City Development Committee in 2014/2015.
CA-02-3	Establish effective means to encourage airlines to utilize both YIA and HIA. In order to make these 2 projects viable, air services should be provided at both	Establish effective means to encourage airlines to utilize both YIA and HIA, (e.g. exemption of Air Navigation Facility Charge for landing aircraft at HIA,

	YIA and HIA, in equal share. However, it is natural that air operators will prefer to stay in YIA, because YIA is much closer to the demand center.	application of preferential cooperate tax, etc.) in 2015/2016
CA-02-4	Establish rules and regulations for monitor and control of various charges at the airports to avoid the abuse of monopoly positions, as there will be competition between YIA and HIA to attract air operators and air passengers.	Establish rules and regulations to monitor and control various charges at the airports to avoid the abuse of monopoly positions by the concessionaires in 2014/2015.
CA-02-5	Monitor and check the performances of the Special Purpose Companies for YIA and HIA if they comply with the contracts.	Monitor and check the performances of the SPCs (Special Purpose Companies) formed by the successful tenderers for YIA and HIA, if they comply with the contracts throughout the 30-year BOT period (2014~).
CA-02-6	Control and regulate operations of YIA and HIA to protect the interest of the travelling public.	Control and regulate operations of YIA and HIA in terms of safety and security of air transport and commercial aspects (based on rules and regulations established by Action 1-4) to protect the interest of the travelling public throughout the 30-year BOT period (2014~).

Throughout the MYT-Plan, a special focus are given on the access transportation to the HIA (CA-02-2) as the airport access will take the significant and essential role for the efficiency and passenger convenience of the airport, so that the same strategies/actions are given highlights in the Road Transport sector and Railway sector as well.

As such, the effective airport access transportation is the key factor for the successful development of HIA.

1.5 Selection Process of the Project Site

(1) Selection Process of the Project Site

The passenger traffic at the Yangon International Airport has kept increasing; however, there was not a sufficient land area for the expansion of the airport, surrounded by the densely populated urban area and military and air force base. In order to cope with the ever increasing demand of passenger of Yangon International Airport, several sites for the alternative airport were evaluated by DCA in 1991 and 1992. At the beginning, 9 sites were selected that had spacious and flat lands, and comparison studies were conducted. The below map presents location of the 9 candidate sites.

Figure 1.5.1 Candidate Sites for the Alternative Airport Source: DCA

DCA selected Hanthawaddy with the following reasons:

① Soil investigation report proved that the ground foundation at the site was ideal
② There are hydraulic power dam nearby which was supposed to supply power for the new airport as well as water resource
③ Adequately apart from the existing Yangon airport and there were no significant constraint or difficulty in arrangement of air space and air route between two airports
④ There are highway and railroad developed nearby thus providing access to the new airport is easy
⑤ Runway can be developed appropriately against prevailing wind direction
⑥ The land is enough above the natural water level even during the mid of rainy season

Contrastingly, there were disadvantages for the other candidate sites as below:

Table 1.5.1 Nonconformance of Other Sites

Site	Nonconformance
Maubin	The site is on the Ayeyarwady delta and surrounded by many rivers
Htantapin	The site is adjacent to the Yangon river and surrounded by many other rivers
Hmawbe	The site is used as air force base and the use for civil aviation was not approved
Hlagu	The vicinity is important for irrigation, and there was plan for developing a dam
Intine	There was many military facilities in the proposed site, and it was impossible to acquire the necessary land area
Taikgyi	The site was in the military training zone, and it was impossible to acquire the necessary land area

Phugyi	There was a plan to develop a dam for the water supply for Yangon city There was air force facilities and it was impossible to acquire the necessary land area
Thanlyin	The soil investigation revealed that the ground foundation was weak

As summarized above, when selecting the project site, natural condition such as flooding risk in the rainy season and ground foundation, as well as the perspective from the social environment were taken into consideration.

If the Hanthawaddy International Airport project will not be implemented, the Yangon International Airport will not be capable of coping with the increasing air traffic demand, and thus subsequently it will be a constraint for the economic growth of Myanmar.

(2) Evaluation of the Land Acquisition Process in Reference to the JICA's Guidelines for Environmental and Social Considerations

According to the Bago Regional Government which has been responsible for the land acquisition and migration of the residents, these procedures were carried out in accordance with the relevant regulations of Myanmar.

However, the history and process of land acquisition are evaluated according to the JICA's Guidelines for Environmental and Social Considerations, and is described in the Chapter 11.

1.6 Infrastructure development situation by PPP scheme in Myanmar

1.6.1 PPP/BOT Infrastructure development by local companies

In Myanmar, BOT (Build, Operate and Transfer) scheme between Ministry of Construction (MOC) and local companies have been applied to some road development projects since 1996. Total 64 roads were improved by 28 local companies, which covers 14% of all road extension in Myanmar[2].

Additionally, such a PPP (Public Private Partnership) scheme has been applied to Myanmar's housing sector development since 1990s.[3]

1.6.2 Foreign investment to Myanmar

The civilian government by the President Thein Sein was established in March, 2011, and economic sanctions measures by Europe and America were relaxed, and the Myanmar government maintained infrastructure as well as willingly invited foreign firms and showed initiatives on the economic development.

On November 2, 2012, a new foreign investment law was enacted, and the investment environment was significantly improved compared to the old one established in 1988.

The situations of direct foreign investment from 2011 to 2013 according to a country and the type of industry are shown below.

[2] Ministry of Construction "Current Situation of Roads Networks and Bridges", 26 March 2014

[3] Ministry of Construction "The Current Situation and Future Trend of Building & Housing sector in Myanmar", March 2014

Table 1.6.1 Direct Foreign Investment by Countries <Authorization base>

(Unit: Number, Million USD)

	2011		2012		2013	
	Number	Amount	Number	Amount	Number	Amount
Singapore	-	-	14	248	25	2,340
Korea	2	26	28	38	13	641
Thailand	-	-	2	1	9	489
United Kingdom	1	100	5	233	10	157
Vietnam	1	18	3	329	1	142
Hong Kong	-	-	9	81	24	119
Japan	2	4	11	54	11	61
China	2	4,346	14	407	16	57
Malaysia	3	52	2	4	3	56
India	1	73	2	12	4	26
Others	-	25	4	12	7	19
Total	13	4,645	94	1,420	123	4,107

(Source) Myanmar Central Statistical Office

Table 1.6.2 Direct Foreign Investment by Type of Industries <Authorization base>

(Unit: Number, Million USD)

	2011		2012		2013	
	Number	Amount	Number	Number	Amount	Number
Manufacturing	5	32	78	401	95	1,837
Transportation, Communication	-	1	-	-	4	1,190
Real Estate	-	-	-	-	4	441
Hotel, Tourism	-	-	1	300	5	434
Fisheries	-	-	1	6	2	89
Electric Power	1	4,344	1	364	1	47
Mining	2	20	1	15	2	33
Agriculture	-	-	2	10	4	20
Petroleum and Gas	5	248	6	309	-	-
Others	-	-	4	15	6	16
Total	13	4,645	94	1,420	123	4,107

(Source) Myanmar Central Statistical Office

1.6.3 Foreign investment law

Myanmar does not have the laws and ordinances about the PPP business, and the new foreign investment law established on November 2, 2012 will become the reliance in PPP business promotion by the foreign firm in future. This law consists of all following 20 chapters Article 57 as follows.

Chapter 1 Title and Definition
Chapter 2 Relevant Economic Activities

Chapter 3	Objectives
Chapter 4	Basic Principles
Chapter 5	Form of Investment
Chapter 6	Formation of the Commission
Chapter 7	Duties and Powers of the Commission
Chapter 8	Duties and Rights of the Investors
Chapter 9	Application for Permit Approval
Chapter 10	Insurance
Chapter 11	Appointment of Employees and Workers
Chapter 12	Exemption and Relief
Chapter 13	Guarantees
Chapter 14	Permission of Land Use
Chapter 15	Foreign Capital
Chapter 16	Right to Transfer Foreign Currency
Chapter 17	Foreign Currency Matters
Chapter 18	Administrative Penalties
Chapter 19	Arbitration
Chapter 20	Miscellaneous

1.6.4 Detailed regulations of foreign investment law

Myanmar Investment Committee (MIC) published the detailed regulations of the new foreign investment law on January 31, 2013. In addition, on August 26, 2014, large relaxation was made by MIC Notification No.49/2014 and No.50/2014 as follows.

(1) Activities in which foreign investment is restricted or prohibited (21 to 11 activities)
   a) Manufacturing and related services of Arms and ammunition for the national defense
   b) Managing and conserving of natural forests
   c) Prospecting, exploration and production of jade/gem stones
   d) Production of minerals by medium scale and small scale
   e) Administration of Electric Power System
   f) Inspection of Electrical Works
   g) Exploitation of minerals including gold in the revering and water way
   h) Air Navigation Services
   i) Pilotage Services
   j) Operate Printing and Broadcasting Service jointly without approval of the Union Government
   k) Periodicals in national ethnical languages including Myanmar

(2) Activities in which foreign investment is permitted only by way of a joint venture with a Myanmar citizen (42 to 30 activities)
   Among the 30 activities, the ones affecting the aviation fields are as follows.
   a) Domestic Air Transport Service
   b) International Air Transport Service

(3) Activities in which foreign investment is permitted upon the recommendation of, and in accordance with, specific conditions imposed by the relevant ministry (112 to 71 activities)
   Among the 71 activities, the ones that affected the aviation fields which needed recommendation of the Ministry of Transportation were all deleted as listed shown below.

Table 1.6.3 Comparison table of foreign investment law and detailed regulation

Original Draft (January 31, 2013)	Revised Version (August 26, 2014)
(7) Ministry of Transportation (23)	(7) Ministry of Transportation (3)
1. Construction and operation of airport	Deleted
2. Aviation training	Deleted
3. Aircraft repair and maintenance	Deleted
4. Air transport services and marketing thereof	Deleted
5. Air ticketing services using computer network	Deleted
6. Aircraft leasing without air stewards	Deleted
7. Aircraft leasing with air stewards	Deleted
8. Air cargo services (the sending)	Deleted
9. Air cargo services (the receiving)	Deleted
10. Airline catering services	Deleted
11. Airline fueling services	Deleted
12. Aircraft inspection services	Deleted
13. Aircraft ground support services	Deleted
14. Passenger baggage handling and support services	Deleted
15. Airport passenger services	Deleted
16. Aircraft ground services	Deleted
17. Airport hotels	Deleted
18. Selling and marketing of aircraft spare parts	Deleted
	1. Passenger and goods forwarding services vessel (added)
19. Maritime training	2. Maritime training
20. Agency for foreign-owned ships	Deleted
21. Shipyards	3. Shipyards
22. Marine/water way transport and related services conducted in inland water transport owned lands	Deleted
23. Other transportation related business and constructions	Deleted

(4) Activities where Environmental Impact Assessment (EIA) becomes the condition of the permission (34 to 30 fields)
Among the 30 activities, the ones affecting the aviation fields are as follows.
a) Construction of large river crossing bridges, overpass bridge, highway, railway, port, dockyard, airport, runway, laying and excavation of water canal of long length and production of heavy motor vehicle.

1.6.5 Myanmar's infrastructure development in future by PPP scheme

Thilawa SEZ project which Japan and Myanmar promotes for PPP business in Myanmar by the foreign investment became very familiar to Myanmar.
On the other hand, in the aviation sector, PPP/BOT Scheme was applied to Yangon International

Airport and Mandalay International Airport projects in 2012. Department of Civil Aviation has conducted the international bid for them and concluded the contracts already. Such a method will be applied to the other fields of infrastructure development projects in future.

However, the establishment of the law related to PPP is delayed in Myanmar. There are many ambiguity in the foreign investment law and detailed regulations, and there are cases which need to seek the approval and/or judgment of MIC or related government office. It is wished that PPP related law is established in Myanmar as soon as possible.
Specifically, there is not the description about the process (procedure) of a business right bid necessary for PPP business promotion in the foreign investment law. The matter which is not covered by the foreign investment law will be judged according to the precedent cases of PPP business carried out in the 2 above-mentioned international airports bids.

1.7 Position of the HIA Project in Myanmar

(1) Development of Yangon International Airport

Passenger terminal building at Yangon International Airport (YIA) has the design capacity of 2.7 million passenger per annum (mppa). Meanwhile, passenger traffic at YIA has rapidly increased by the annual growth rate of more than 20%, and reached 4.4 mppa including international passengers of 2.9 mppa and domestic passengers of 1.5 mppa in 2014. Apparently, the passenger traffic has exceeded design capacity of terminal buildings.
DCA has conducted demand forecast for Yangon Metropolitan Area (YMA). The results of forecast are as shown in Table 1.7.1. According to the results, it is obviously difficult to accommodate the future demand at the existing facilities.

Table 1.7.1 Demand Forecast by DCA

	International	Domestic	Total
2020	6.2 mppa	2.9 mppa	9.1 mppa
2030	16.2 mppa	7 mppa	23.2 mppa

Source: DCA, RFP

The capacity of YIA will be 6 mppa upon completion of new passenger terminal building, however, it is difficult to further expand the airport area due to the space limitations by the existing facilities and land use of surrounding area. Therefore, the capacity of YIA is considered to be limited at 6 mppa.
From the situation mentioned above, second new airport which will accommodates the air traffic demand in YMA will be required. It should be noted that before the opening of the second international airport, the passenger demand is expected to largely surpass the design capacity of the terminal including aircraft stands and passenger building. Therefore, Yangon Airport is required to accommodate the demand before opening of new airport by means of upsizing of aircraft, transfer of night stay aircraft to other airport, efficient operation of aircraft stand, downgrading of the service level at terminal building, etc.

(2) Development of Mandalay International Airport

Mandalay International Airport (MIA) is designated as “International Airport” together with Yangon and Naypyidaw International Airports. The international passengers handled by YIA, MIA and Naypyidaw airport in 2014 are 2,900 thousand, 250 thousand and 40 thousand respectively. YIA accounts for 90% of total international passengers, and forms heavy concentrated traffic.

As Mandalay is located the center of Myanmar and near the border between Myanmar and Chine/India, it is expected to invite new services from China and India.
According to the demand forecast by DCA, the international passengers at MIA is forecasted as 0.6 mppa and 1.5 mppa for 2023 and 2033 which are equivalent to the 10% of YIA's forecast. Considering this situation, concentration of air traffic at YIA will continue in the future. On the other hand, although DCA is aware of the need of load reduction for YIA by use of MIA, it has not come up with the establishment of concrete measures yet.

(3) Position of Hanthawaddy International Airport in Yangon Metropolitan Area
Due to the constraint for the expansion of facilities at YIA and future air traffic demand in YMA, it is conceived difficult to accommodate the future demand by YIA alone and development of the new Hanthawaddy airport is inevitable.
Considering DCA's forecast which estimated the future demand for YMA as 9.1 mppa in 2020, new airport should be developed as early as possible.
As for the policy of traffic demarcation between YIA and HIA, originally, DCA indicated the following policy ① and the limitation of the handling number of passengers to 6 mppa at YIA. However, due to the delay of opening of HIA, DCA has cancelled the 6 mppa limitation. According to this policy change, the JICA Study Team proposed the change of policy ②, considering the fact that the 6 mppa was the demand in 2018 originally HIA has been scheduled to be opened.

① All the international flights excluding Myanmar National Airlines will have to move to HIA from YIA when HIA is opened.
② Maximum passenger capacity of YIA is estimated at 12 mppa, and the demand that exceed 12 mppa will be transferred to HIA.
(12 mppa is estimated for Yangon Metropolitan Area in 2022 when HIA will commence its operation.)

1.8 Interest in Support for Aviation Sector including HIA Project by other Companies or Donors

(1) The supports for the aviation sector of Myanmar from outside donors
Currently there are a few supports provided by outside donors including the ones from JICA. These supports were summarized below:

Table 1.8.1 Current Supports from Outside Donor

Project Name	Nation / Organization	Support Type
Directorate of Civil Aviation Twin Otter Porgram	Canada / Canadian International Development Agency (CIDA)	Program Loan (CAD$) Financial support to procure a canadian aircraft (DHC-6: Twin Otter)
The Project for Improvenment of Nationwide Airport Safety and Security	Japan / Japan International Cooperation Agency (JICA)	Grant Aid: Provision of Air Navigation Facilities, Air Field Lighting, Rescue/Fire Fighting Vehecle, and X-ray screening system etc.
Project for Capacity Development on CNS/ATM Systems	Japan / Japan International Cooperation Agency (JICA)	Technical Cooperation: Assist for Preparation of the Master Plan for the Implementation of CNS/ATM, Establishing the Performance Based Navigation, Improvement of Communication and Surveillance over Satellite, and Enhancement of the Civil Aviation Training Institute

Source: DCA

There are not any other financial or technical supports for the aviation sector, either being provided now or planned in the future.

(2) Interests in participating in the HIA project
At present, a consortium led by JGC Corporation was awarded as the successful tenderer and is in discussion with DCA for the negotiation of the contract conditions.

1.9 Necessity and Importance of the HIA Project

(1) Development of Yangon International Airport and Air Traffic Demand
Yangon International Airport (YIA) has the processing capacity of 2.7 million passenger per annum (mppa). Even though YIA increases the capacity by improvements of facilities, the capacity will be capped at 6 mppa considering the space constraints of existing facilities and land use of surrounding area.
Meanwhile, air traffic demand of Yangon Metropolitan Area (YMA) has rapidly increased in recent years, and will exceed the handling capacity of 6 mppa in the near future. As aircraft movement increase, congestion and delay on runway, taxiway and apron occurs, and affects safety and efficiency of aircraft operation. Also, as the number of passenger increase, congestion and long queue in terminal building increase, and affects convenience and service level for passengers.
Besides, according to demand forecast, additional runway will be required in medium-long term period, however, it is extremely difficult to construct second runway in parallel to the existing runway.
As many houses are located in the area surrounding YIA, the impact of aircraft noise to surrounding area will become major problem.

(2) Necessity and Importance of Hanthawaddy International Airport
In case that only YIA accommodates all the air traffic demand for YMA, it is obvious that the residents near YIA will suffer from a great damage by resettlement or environmental impact such as noise and air pollution. In order to resolve these problems, new airport in YMA which accommodates long term demand is required. The Hanthawaddy site has been selected for the new airport site by the site selection study for new airport conducted in 1990s.
By the development of Hanthawaddy International Airport (HIA), YMA will have multi-airport system with two airports.
In order that multi-airport system should function properly, rational demand demarcation policy is indispensable. DCA intend to apply demarcation policy for two airports as described in Section 1.7. In order to implement such policy effectively, it is highly recommended to separate airport administration function from DCA and make it independent regulator. Then, DCA should be able to regulate SPC (airport operator), and certainly perform demand demarcation between two airports.

Chapter 2

Planning of the Project

Chapter 2 Planning of the Project

2.1 Business objectives and targets of the Project

(1) Background of the Project

In Myanmar, Yangon International airport expansion by Japanese support in 1980s, its new passenger terminal construction (by its own financing) in 2007, new Mandalay airport development in 1990, and the 3rd international airport development in Napyidaw have been carried out in the past. Nevertheless, they still cannot absorb its greater air traffic demand.

Annual numbers of passengers in Yangon International Airport were 3.70MPPA in 2013 and 4.38MPPA in 2014, which were exceeding the terminal capacity (2.70MPPA, about 6.00MPPA after expansion). However, further expansion of the airport will be very difficult, due to the space constraints surrounded by overpopulated areas with rapid urbanization. In addition, increase of capacity for aircraft movement is also very difficult due to environmental (aircraft noise) and safety (plane accident) perspectives. Therefore, construction of a new international airport (Hanthawaddy) is strongly required as an urgent task in order to absorb the rapid air traffic demand growth of YMA.

(2) Objectives of the Project

The Project is to build a new international airport near Bago City, approximately 70km northeast from Yangon Metropolitan Area,

- in order to absorb the rapid demand increase and provide the airport users excellent services of the world class airport.
- Additionally, the Project is expected to contribute to sustainable development including the promotion of employment in Myanmar.

(3) The Project Scheme

According to the above-mentioned background, Department of Civil Aviation, Ministry of Transport, Myanmar (hereinafter “DCA”) have announced invitations to international tenders for three major airports (Yangon, Hanthawaddy and Mandalay) in 2012, to transform these airports to efficient air transport infrastructure using PPP of BOT scheme.

In terms of the bid for Hanthawaddy International Airport Project (hereinafter “the Project”), JGC from Japan, and Yongnam Holdings Ltd and Changi Airports International Pte Ltd from Singapore formed a consortium (hereinafter “JYC Consortium”) and got the exclusive negotiation right with DCA in October, 2014. JYC Consortium is aiming to implement the first PPP project for new airport in Myanmar, by establishing a special purpose company (hereinafter “SPC”) in Myanmar for the airport operation and maintenance.

2.2 Air Traffic Demand Forecast

2.2.1 General

The subject of this section is to forecast the growth of air traffic demand and airport access traffic related to Hanthawaddy International Airport. The study items and flow of demand forecast is shown in Figure 2.2.1.

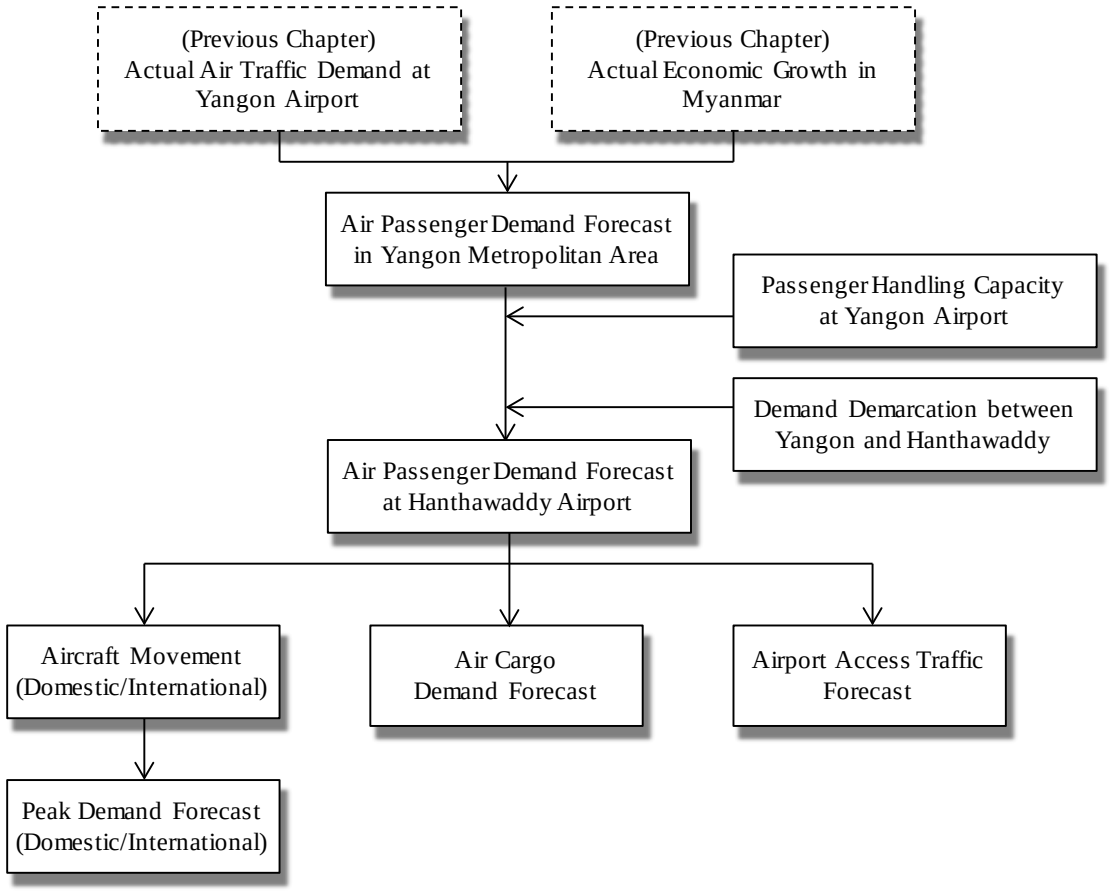


Figure 2.2.1 Study Flow of Demand Forecast

2.2.2 Air Passenger Demand Forecast in Yangon Metropolitan Area

(4) Study Flow

The study flow of air passenger demand forecast in Yangon Metropolitan Area is shown in Figure 2.2.2.

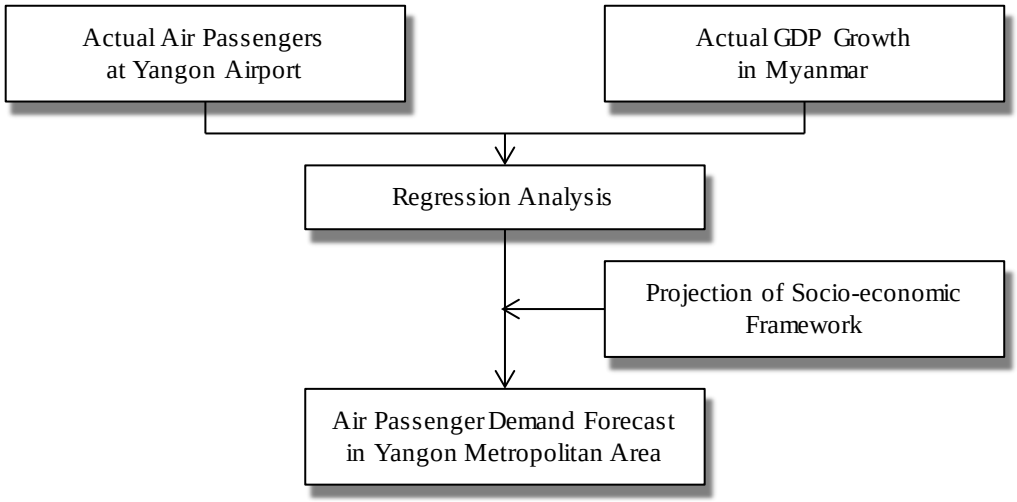
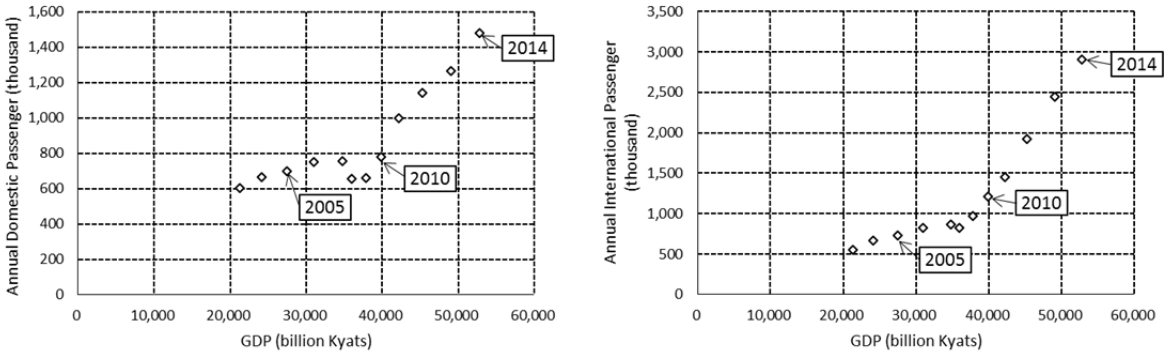


Figure 2.2.2 Study Flow of Air Passenger Demand Forecast in Yangon Metropolitan Area

(5) Relationship between Air Passenger Demand and Economic Growth

Generally speaking, the air passenger demand proportionally grows or falls in line with increase/decrease of socio-economic indices. GDP is a typical index expressing economic condition of country and employed as an explanatory variable of demand forecast model.

The Figure 2.2.3 shows the relationship between air passengers (both for domestic and international) and real GDP. It proves strong relationship between air passenger and GDP especially after the transition from military rule to democratic government.



Source: DCA statistics (Air passengers),
IMF World Economic Outlook Database April 2015(GDP)

Figure 2.2.3 Relationship between Air Passengers and GDP

(6) Projection of Socio-economic Framework

With regards to GDP, a few international organizations namely IMF, World Bank and ADB publish future prospective GDP as shown in Table 2.2.1. IMF publishes the longest projection up to 2020, therefore IMF projection is employed in demand forecast study.

Table 2.2.1 Prospective GDP by International Organizations

	Growth Rate of GDP		
	IMF	WB	ADB
2014			
2015	8.33%	8.5%	7.8%
2016	8.51%	8.2%	
2017	8.30%	8.0%	
2018	7.96%		
2019	7.68%		
2020	7.55%		

Source: IMF, World Economic Outlook Database, April 2015
World Bank, Global Economic Prospects, January 2015
ADB, Asian Development Outlook 2014

On the other hand, it is conceived that the growth rate of GDP for medium and long term future beyond 2020 will decrease gradually. The rate of decrease of GDP growth rate is set based on the historical data in other Asian countries as shown in Table 2.2.2. In neighboring country Thailand, GDP growth has decreased around 4% in 30 years.

According to these trends, the gradual decrease of growth ratio is established as 1% during 10 years.

Table 2.2.2 Trend of GDP Growth Rate in Major Countries in Asia

	1980-1990	1990-2000	2000-2010	2010-2020	Decrease in 30 years
China	9.3%	10.4%	10.5%	7.0%	2.3%
india	5.6%	5.6%	7.5%	7.1%	-1.5%
Thailand	7.9%	4.4%	4.3%	3.4%	4.5%
Malaysia	6.0%	7.1%	4.6%	5.1%	0.9%
Indonesia	5.5%	4.0%	5.4%	5.7%	-0.2%
Vietnam	5.9%	7.6%	6.8%	5.9%	0.0%

Source: JICA Study Team

Based on the above studies, future real GDP are projected as shown in Table 2.2.3.

Table 2.2.3 Forecasted Real GDP in the Future

Year	AAGR	GDP (Billion Kyats)	Remarks
2014		52,820	Actual
2015	8.33%	57,220	
2016	8.51%	62,089	
2017	8.30%	67,242	
2018	7.96%	72,594	
2019	7.68%	78,169	
2020	7.55%	84,071	
2025	7.0%	117,914	
2030	6.5%	161,552	
2035	6.0%	216,193	
2040	5.5%	282,556	
2045	5.0%	360,621	
2050	4.5%	449,399	

Source: JICA Study Team

In the Survey Program for the National Transport Development Plan in the Republic of the Union of Myanmar conducted by JICA (herein after called as “MYT Plan”), future GDP from 2015 to 2035 has been studied based on three growth scenarios. The average annual growth rates of each scenario are 7.7%, 7.2% and 6.0% for high, medium and low scenario, respectively.
The Figure 2.2.4 presents the GDP projection of Table 2.2.3, which approximates the GDP based on medium scenario in MYT Plan.

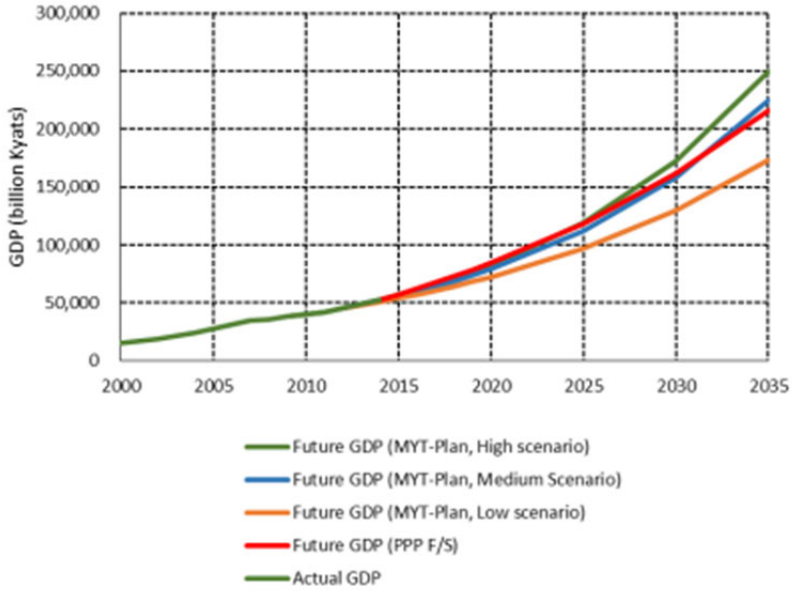


Figure 2.2.4 Comparison with Future GDP

(7) Regression Analysis

Prediction formula for future passenger demand is established by regression analysis based on linear model using real GDP as explanatory variable. Regression analysis is carried out in two cases based on the separate periods of focus, and the third case which is a combination of said two cases.

Case 1 Analysis period is from 2009 to 2014 when the annual growth rate of GDP has indicated double-digit growth.

Case 2 Analysis periods is from 2000 (international) /2002 (domestic) to 2014 which seem to include some stagnation risk during long term period.

Case 3 Combination of Case 1 and Case 2; apply Case 1 for the near future and Case 2 for medium/long term in future.

The results of regression analysis are shown in Table 2.2.4. The relationship between actual air passengers and linear approximation are shown in Figure 2.2.5.

Table 2.2.4 Result of Regression Analysis

	Case 1	Case 2	Case 3
Analysis Period	2009-2014	Dom 2002-2014 Int'l 2000-2014	
Prediction Formula	Y＝a × GDP ＋ b Y : Dom/Int'l Passenger a,b: Parameter Dom a: 0.0504 b: -1180.9 Int'l a: 0.1318 b: -4049.6	Y＝a × GDP ＋ b Y : Dom/Int'l Passenger a,b: Parameter Dom a: 0.022 b: 77.201 Int'l a: 0.0544 b: -653.7	Apply Case 1 for the next decade (up to 2025), expecting double-digit growth. Apply Case 2 after 2025.
Coefficient of Determination	Dom 0.974 Int'l 0.998	Dom 0.711 Int'l 0.782	

Note: Dom: Domestic, Int'l: International

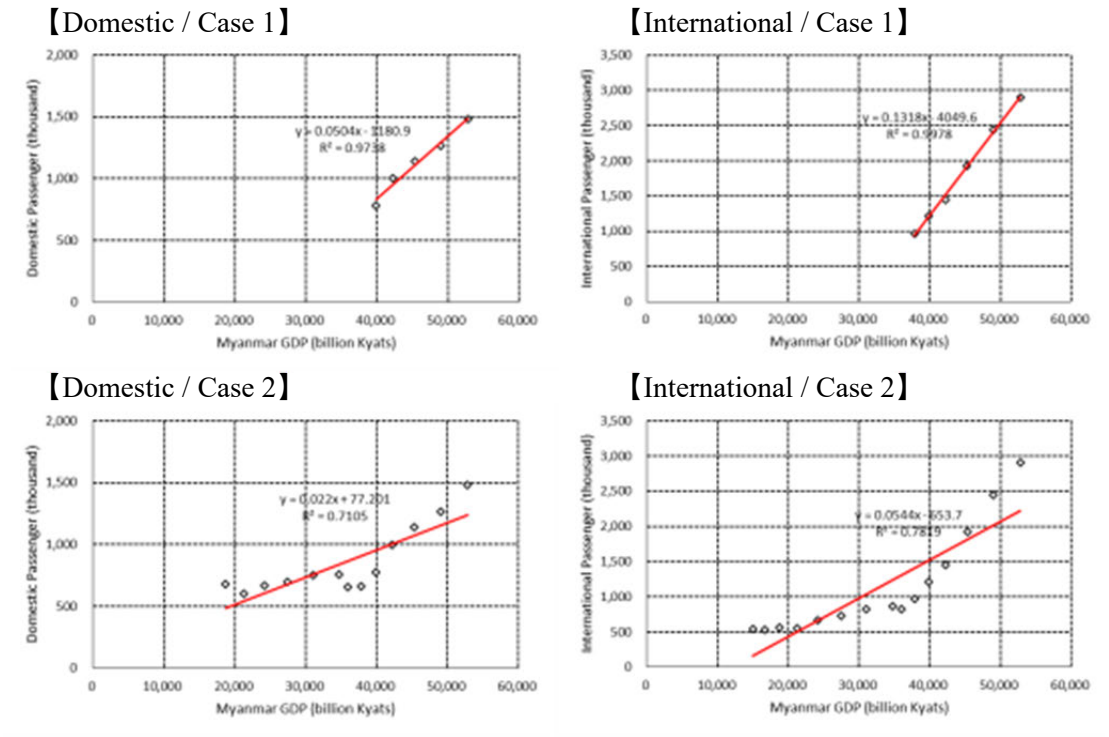


Figure 2.2.5 Approximation of Actual Value and Model

(8) Results of Projection

The future passenger demand are estimated as shown in Table 2.2.5 by the calculation of the given prediction formula using the predicted GDP as the explanatory variables.
Figures 2.2.6 - 2.2.7 shows the comparison between Cases 1-3 and DCA forecast.

Table 2.2.5 Passenger Demand Forecast

	Case 1	Case 2	Case 3
Future Passenger Demand	***Domestic***	***Domestic***	***Domestic***
	2014 (actual) 1,481	2014 (actual) 1,481	2014 (actual) 1,481
	2020 3,051	2020 2,298	2020 3,051
	2030 6,960	2030 4,334	2030 6,459
	2040 13,064	2040 7,509	2040 11,191
	2050 21,482	2050 11,886	2050 17,714
	International	***International***	***International***
	2014 (actual) 2,904	2014 (actual) 2,904	2014 (actual) 2,904
	2020 7,002	2020 5,117	2020 7,002
	2030 17,188	2030 10,595	2030 16,108
	2040 33,026	2040 19,153	2040 29,119
	2050 54,828	2050 30,901	2050 46,980
Average Annual Growth Rate	***Domestic***	***Domestic***	***Domestic***
	2014-2020 12.8%	2014-2020 7.6%	2014-2020 12.8%
	2020-2030 8.6%	2020-2030 6.6%	2020-2030 7.8%
	2030-2040 6.5%	2030-2040 5.6%	2030-2040 5.6%
	2040-2050 5.1%	2040-2050 4.7%	2040-2050 4.7%
	International	***International***	***International***
	2014-2020 15.8%	2014-2020 9.9%	2014-2020 15.8%
	2020-2030 9.4%	2020-2030 7.5%	2020-2030 8.7%
	2030-2040 6.7%	2030-2040 6.1%	2030-2040 6.1%
	2040-2050 5.2%	2040-2050 4.9%	2040-2050 4.9%

Note: Future passenger demand are indicated mppa (million passenger per annum)

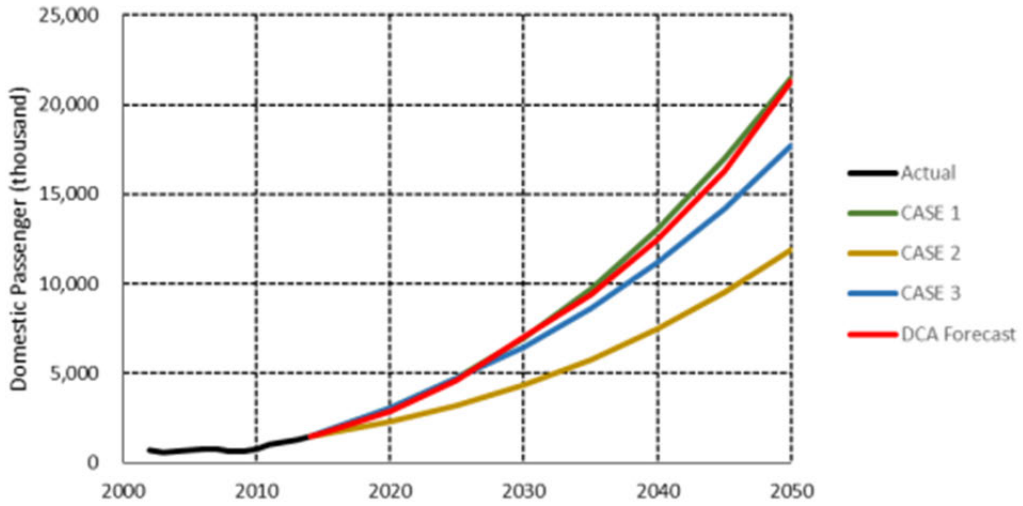


Figure 2.2.6 Domestic Passenger Demand Forecast

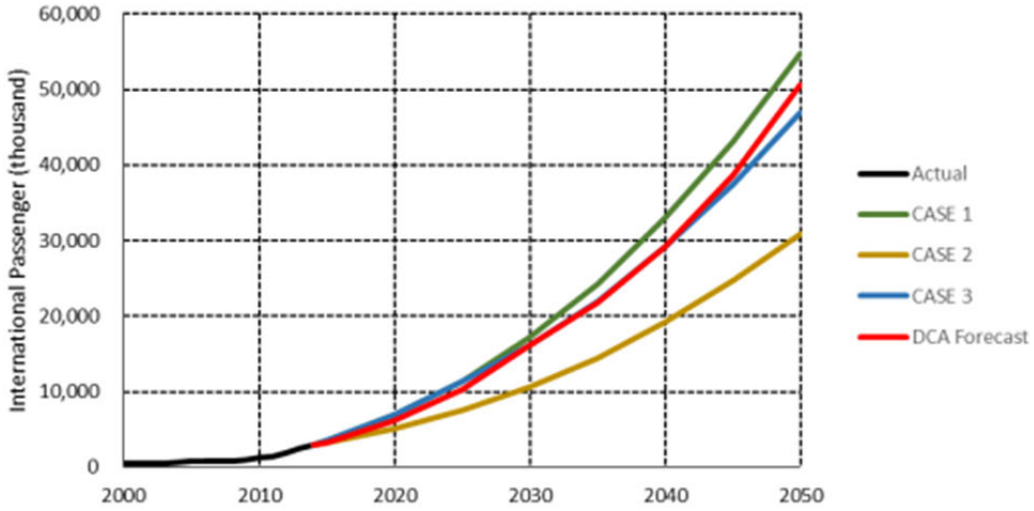


Figure 2.2.7 International Passenger Demand Forecast

(9) Comparison with Major Airports in Southeast Asia

a) Domestic Passenger

In order to evaluate appropriateness of the obtained demand forecast for domestic passenger, the projected passengers are compared with historical trend of domestic passengers at Bangkok and Jakarta Airports which precede Yangon Airport in terms of the number of passengers. Figure 2.2.8 shows the comparison between actual passengers at Bangkok and Jakarta Airport, and projected passengers at Yangon Airport, by superposing projected 2.7-2.8 million passengers at Yangon Airport in 2019/2022 over 2.6 million passengers at Jakarta in 1985 and 2.8 million passengers at Bangkok in 1989.

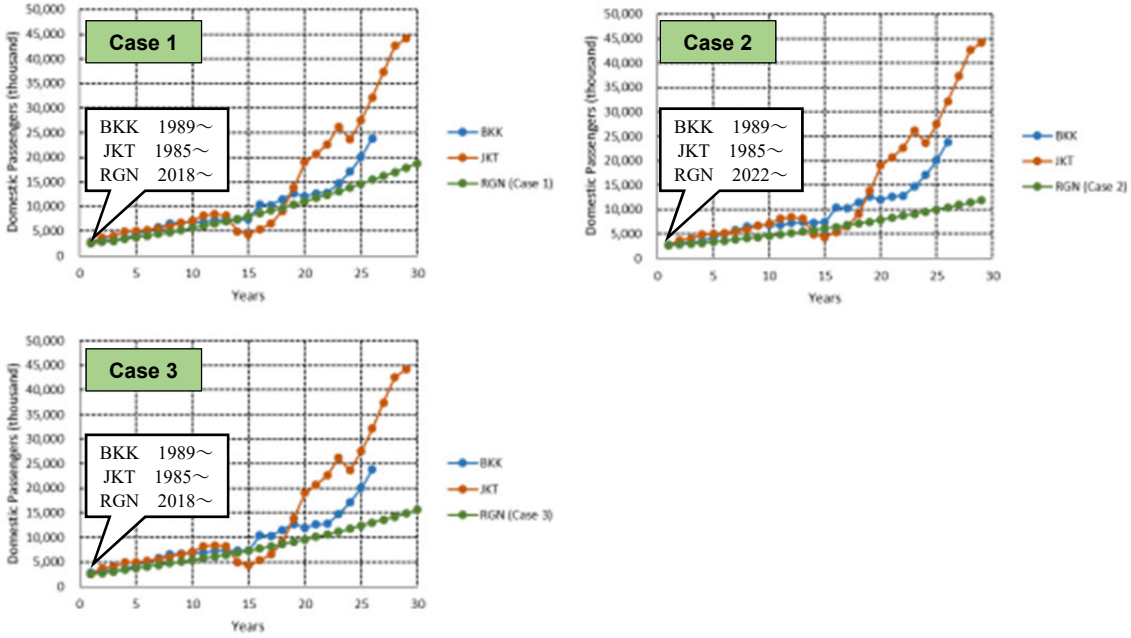


Figure 2.2.8 Comparison of Domestic Passengers Traffic between Major Airports and Yangon Airport

From the comparison with Bangkok/Jakarta Airports, each case of forecast at Yangon Airport is evaluated as follows:

Case 1 The forecast at Yangon Airport beyond 2018 almost follows the historical trend at Bangkok Airport.
Case 2 The forecast at Yangon Airport beyond 2022 stands below of the historical trend at Bangkok and Jakarta Airports.
Case 3 The forecast at Yangon Airport beyond 2018 stands slightly below of the historical trend at Bangkok Airport.

b) International Passenger

Similarly to domestic passenger, the projected international passengers at Yangon Airport are compared with historical trend of Bangkok and Jakarta Airports so as to evaluate appropriateness of the result of demand forecast for international passengers. Figure 2.2.9 shows the comparison between actual passengers at Bangkok and Jakarta Airports and projected passengers at Yangon Airport, by superposing projected 5.6 million passengers at Yangon Airport in 2018/2021 over 5.4 million passengers at Bangkok in 1985 and 5.6 million passengers at Jakarta in 2004.

From the comparison with Bangkok/Jakarta Airports, each case of forecast at Yangon Airport is evaluated as follows:

Case 1 The forecast at Yangon Airport beyond 2018 stands above of the historical trend at Bangkok Airport.
Case 2 The forecast at Yangon Airport beyond 2021 stands below of the historical trend at Bangkok and Jakarta Airports.
Case 3 The forecast at Yangon Airport beyond 2018 almost follows the historical trend at Bangkok Airport.

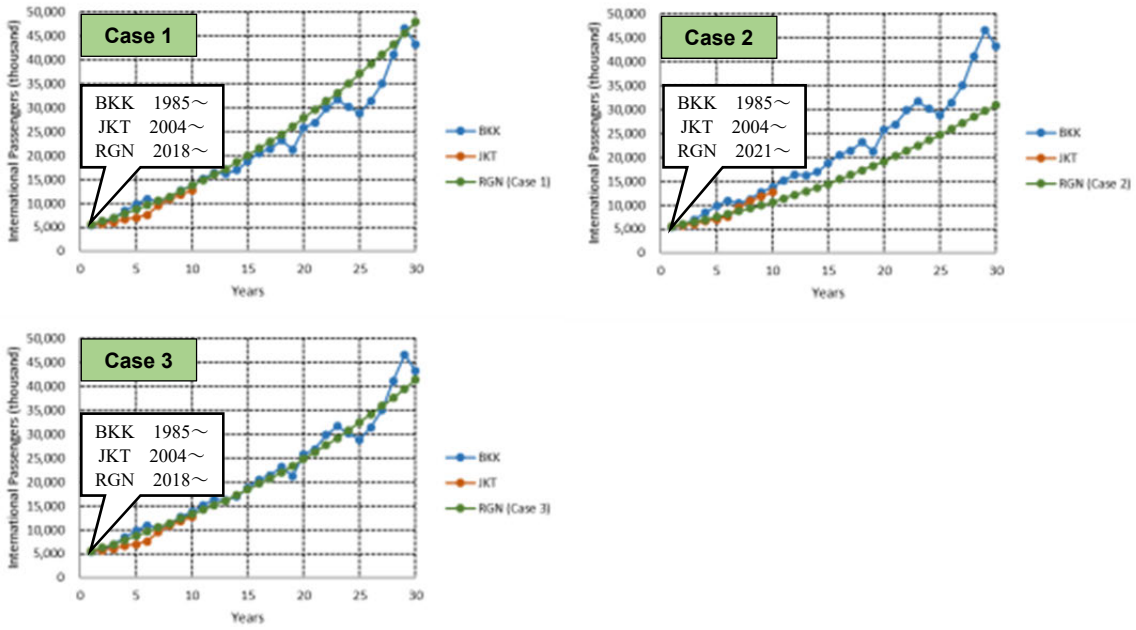


Figure 2.2.9 Comparison of International Passengers between Major Airports and Yangon Airport

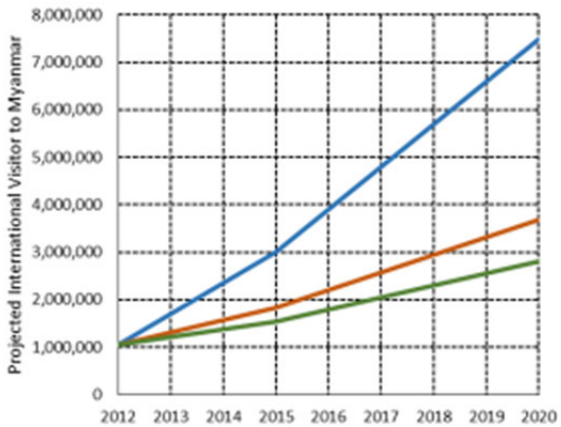
(10) Future Passenger Demand in Yangon Metropolitan Area

a) Demand in Near Future

The air passenger traffics at Yangon Airport in 2014 were 1.5 mppa and 2.9 mppa for domestic and international, respectively. Looking over the historical trend of Bangkok and Jakarta Airports, double-digit growth has continued for 6-15 years from the equivalent passenger demand such as 1.5-2.9 mppa.

In addition, Ministry of Hotels and tourism has projected the number of future international visitors in the Myanmar Tourism Master Plan, 2013-2020 as follows:

International visitor is projected in 3 cases as shown in Figure 2.2.10. All cases have double-digit for the average annual growth rates even in the lowest case namely "Conservative case".



	2012-2015	2015-2020
High	41.6%	20.0%
Mid-range	20.0%	15.0%
Conservative	13.0%	13.0%

Figure 2.2.10 Forecast of International Visitors

Considering above mentioned, it is prospective that air passenger demand in Yangon Metropolitan Area will continue to grow in double-digit in the next decade as forecasted in Case 1 and 3.

b) Demand in Medium/Long Term
According to the comparison between historic Bangkok and Jakarta Airports and projected Yangon Airport, Case 3, in which international demand almost follows the historical trend at Bangkok Airport is recommendable.

c) Future Demand in Yangon Metropolitan Area
Considering the recommendable case in near future and medium/long term, Case 3 is considered appropriate for future demand in Yangon Metropolitan Area.

2.2.3 Passenger Handling Capacity at Yangon Airport

(1) Handling Capacity of Runway
As the runway at YIA has parallel taxiway over the entire length, basically the aircraft does not encounter others on taxiways. Based on this situation, the runway capacity is calculated as follows:

a) Hourly Capacity
The conditions of calculation are as follows:
- The runway occupancy time at take-off and landing is estimated 0.8 minute.
- Take-off and landing is done alternately.
- Radar control is carried out in air traffic control.

Considering a separation between aircrafts, hourly capacity is calculated as 39 movements per hour.
- As for take-off aircraft, the time from start of take-off to runway clearance is 0.8 minute.
- When precedent take-off aircraft exit runway, following landing aircraft is located at 4 miles (1.5 minute) from the runway threshold.
- The time from the following landing aircraft passes through the runway threshold to exit the runway is 0.8 minute.
- As mentioned above, the time required for a cycle including one take-off followed by the immediate landing is 3.1 minutes. Therefore, hourly possible movements are calculated as 39 movements.

60 minutes / 3.1 minutes × 2 movements = 39 movements / hour

b) Daily Capacity
Considering current schedule as shown in Figure 2.2.11, operation hour in a day is assumed to be 14 hours (6 to 19 for departure flights, 8-21 for arrival flights). Therefore, daily possible movements are calculated as 546 movements.

39 movements × 14 hours = 546 movements / day

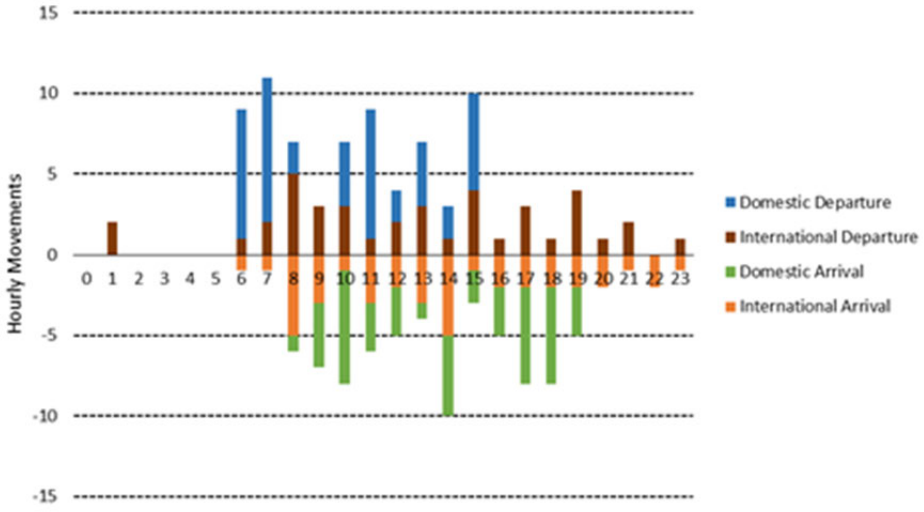


Figure 2.2.11 Current Schedule at YIA

c) Annual Capacity

Annual movement capacity is calculated by multiplying reciprocal of peak day coefficient (1/315 refer to Table 2.2.14) to daily possible movements as follows:

546 movements × 315 = 171,990 movements / annum

In order to convert the runway capacity to passenger number, number of passengers per flight is required. Based on current situation, the average seat capacity per flight is 75 seats and 164 seats for domestic and international, respectively. Assuming the load factor is 70%, the average passenger number is set to 53 and 115 passengers for domestic and international, respectively. The average passenger number combined domestic and international is calculated in 94 passengers, assuming the ratio of domestic 1 vs. international 2. Consequently, runway capacity is calculated as 16 mppa.

171,990 movements × 94 = 16 million passengers / annum

(2) Handling Capacity of Apron

Currently the expansion work of the apron in YIA is under way towards south of the terminal area and western side of runway within the maximum extent of the project site that has been shown in the RFP of YIA project. At the time of completion of expansion work, an apron with1,150 m width at the terminal side and the other one with 600 m width at runway west will be developed (total width of 1,750 m).

Being said that the target demand of YIA project including apron and passenger terminal building is 6 mppa, the apron width for accommodation of 6 mppa is calculated with assumption of passenger split as 4 mppa for international and 2 mppa for domestic. The result of calculation is shown in Table 2.2.6.

The required width is calculated as 1,663 m which is approximately the width of the apron area at the completion of current development (1,750 m).

Therefore, capacity of apron developed this year is considered around 6 mppa.

Table 2.2.6 Required Width of Apron for 6 mppa

	Large J	Medium J	Small J	Prop	Total
International loading spot	2	1	12	1	16
Domestic loading spot			4	10	14
Night stay spot for Myanmar carrier			1	3	4
Required width for each spot	72.5	59.5	40.5	55.0	
Required width for total spot	145.0	59.5	688.5	770.0	1663.0

(3) Handling Capacity of Passenger Terminal Building

Yangon Aerodrome Services has contracted with DCA to construct, operate and maintain the terminal facilities at Yangon Airport in January 2015, and is constructing new passenger terminal building with design capacity of 4-4.5 mppa. After completion, the terminal should be able to accommodate around 7 mppa in conjunction with the international passenger terminal building.

(4) Handling Capacity of YIA

As discussed above, the handling capacity at YIA is considered to be about 6 mppa capped by the apron capacity.

Regarding the further expansion of terminal facilities, it should be difficult to further expand the terminal area, as being surrounded by the army and air force area.

2.2.4 Passenger Demand Forecast at Hanthawaddy Airport

(1) Demand Demarcation between Yangon and Hanthawaddy

As for the demand demarcation between Yangon (YIA) and Hanthawaddy (HIA), originally, DCA indicated the following Policy-1 and limited the processing capacity of passengers to 6 mppa at YIA. However, due to the delay of opening of HIA, DCA has cancelled the 6 mppa limitation. Following this change, JICA Study Team proposed the revision of Policy-2 considering the fact that the 6 mppa is no longer significant.

Policy - 1 All the international flights excluding Myanmar National Airlines (MNA) will have to move to HIA from YIA when HIA is opened.

Policy - 2 Maximum passenger capacity of YIA is restricted at 12 mppa and the demand that exceed 12 mppa will be accommodated in HIA.
(12 mppa is estimated in 2022 when HIA will commence its operation.)

(2) Future Passenger Demand at Hanthawaddy Airport

Based on the policy for demand demarcation between YIA and HIA, Case 3 demand is divided and presented in Table 2.2.7 and Figure 2.2.12. The demarcation was done by the share mentioned below:

- ✓ The 94% of international passengers in Yangon Metropolitan Area will be transferred to HIA. Currently the share of airlines in Myanmar is 14% in terms of international passenger. This share of 14% will be maintained in the future, and the share of MNA is assumed to be 6% based on pro-rata share of domestic Business resources of the 4 airlines (MNA, Air KBZ (Myanmar Airways International), Air Bagan and Golden Myanmar Airlines) which may operate international flights in the future, and have shares of domestic services of 25%, 22%, 11% and 5%.

- ✓ As for demarcation of domestic passenger, 5% of international passenger at HIA will transfer to/from domestic flights, therefore these passenger will be expected as domestic passenger.

- ✓ Number of passenger which exceeds 6 mppa at YIA will be expected as domestic passenger.

Table 2.2.7 Demand Demarcation between YIA and HIA (opening in 2022)

	Yangon Metropolitan			Yangon Airport			Hanthawaddy Airport			備考
	Dom	Int'l	Total	Dom	Int'l	Total	Dom	Int'l	Total	
2014	1,481	2,904	4,385	1,481	2,904	4,385				
2015	1,743	3,587	5,330	1,743	3,587	5,330				
2016	2,004	4,270	6,274	2,004	4,270	6,274				
2017	2,266	4,953	7,219	2,266	4,953	7,219				
2018	2,528	5,636	8,164	2,528	5,636	8,164				
2019	2,789	6,319	9,108	2,789	6,319	9,108				
2020	3,051	7,002	10,053	3,051	7,002	10,053				
2021	3,393	7,888	11,280	3,393	7,888	11,280				
2022	3,734	8,774	12,508	3,322	526	3,848	412	8,248	8,660	94% of Int'l demand move toHIA when HIA open.
2023	4,076	9,659	13,735	3,622	580	4,202	454	9,080	9,534	
2024	4,417	10,545	14,963	3,922	633	4,555	495	9,912	10,408	
2025	4,759	11,431	16,190	4,222	686	4,908	537	10,745	11,282	
2026	5,099	12,366	17,465	4,518	742	5,260	581	11,624	12,205	
2027	5,439	13,302	18,741	4,814	798	5,612	625	12,504	13,129	
2028	5,779	14,237	20,016	5,110	854	5,964	669	13,383	14,052	
2029	6,119	15,173	21,292	5,406	910	6,316	713	14,262	14,975	
2030	6,459	16,108	22,567	5,702	966	6,668	757	15,142	15,899	
2031	6,888	17,280	24,167	6,076	1,037	7,113	812	16,243	17,055	
2032	7,317	18,451	25,768	6,449	1,107	7,556	868	17,344	18,212	
2033	7,745	19,623	27,368	6,823	1,177	8,000	922	18,445	19,368	
2034	8,174	20,794	28,969	7,197	1,248	8,445	977	19,547	20,524	
2035	8,603	21,966	30,569	7,571	1,318	8,889	1,032	20,648	21,680	
2036	9,121	23,397	32,517	8,021	1,404	9,425	1,100	21,993	23,092	
2037	9,638	24,827	34,465	8,471	1,490	9,961	1,167	23,338	24,505	
2038	10,156	26,258	36,414	8,922	1,575	10,497	1,234	24,682	25,916	
2039	10,673	27,688	38,362	9,372	1,661	11,033	1,301	26,027	27,328	
2040	11,191	29,119	40,310	9,822	1,747	11,569	1,369	27,372	28,741	
2041	11,796	30,799	42,595	10,152	1,848	12,000	1,644	28,951	30,595	Dom demand exceeds 12 mppa move to HIA.
2042	12,401	32,479	44,880	10,051	1,949	12,000	2,349	30,530	32,880	
2043	13,005	34,159	47,164	9,950	2,050	12,000	3,055	32,109	35,164	
2044	13,610	35,839	49,449	9,850	2,150	12,000	3,761	33,689	37,449	
2045	14,215	37,519	51,734	9,749	2,251	12,000	4,466	35,268	39,734	
2046	14,915	39,411	54,326	9,635	2,365	12,000	5,279	37,047	42,326	
2047	15,615	41,303	56,918	9,522	2,478	12,000	6,093	38,825	44,918	
2048	16,314	43,196	59,510	9,408	2,592	12,000	6,906	40,604	47,510	
2049	17,014	45,088	62,102	9,295	2,705	12,000	7,719	42,383	50,102	
2050	17,714	46,980	64,694	9,181	2,819	12,000	8,533	44,161	52,694	
2051	18,482	49,071	67,552	9,056	2,944	12,000	9,426	46,127	55,552	
2052	19,249	51,162	70,411	8,930	3,070	12,000	10,319	48,092	58,411	
2053	20,017	53,252	73,269	8,805	3,195	12,000	11,212	50,057	61,269	
2054	20,784	55,343	76,128	8,679	3,321	12,000	12,105	52,023	64,128	
2055	21,552	57,434	78,986	8,554	3,446	12,000	12,998	53,988	66,986	

Note: The figures of this table are calculated based on the demarcation policy mentioned above. It is a separate agenda for the actual allocation.

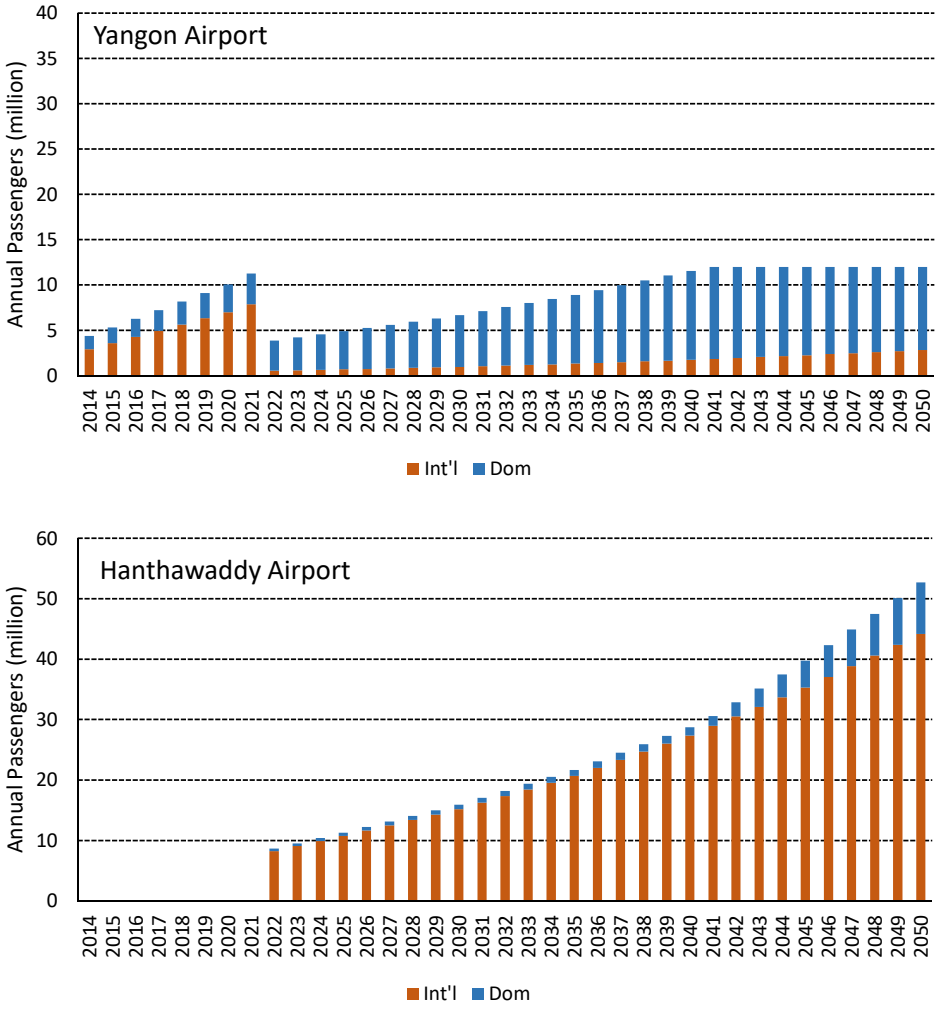


Figure 2.2.12 Future Passenger Demand at Yangon and Hanthawaddy Airports (opening in 2022)

The passenger demand forecast at Hanthawaddy Airport which was prepared according to the aviation policy and measures taken by DCA, will be used as a base figure for a physical planning, such as conceptual design and cost estimation, in the following sections.
On the other hand, the demand forecast in terms of operation, which is utilized for the economic and financial analysis in chapter 8 through 10, shall be conservative with consideration of political risks such as policy change and other risks caused by external factors. This is presented in section 2.2.10.

2.2.5 Aircraft Movements Forecast

(1) Reference Airports

In order to forecast future aircraft movements, passenger demand by destination and type/share of aircraft operated should be provided. Normally, these values are set based on the situation of concerned airport.

However, in case of study on Hanthawaddy Airport (HIA), the data based on the operation at Yangon Airport (YIA) will not be relevant due to the difference of the number of passengers handled at these airports, especially international passenger. Therefore, in order to establish passenger demand by destination and type/share of aircraft operated, the below considerations were adopted for the estimation of aircraft movements.

- Passenger demand for HIA is forecasted as shown in Table 2.2.7. International passengers are projected from 8 mppa at the opening of airport to 48 mppa within 30 years of operation. Domestic passengers are projected from 0.4 mppa at the opening to 10.3 mppa within 30 years of operation.
- In terms of the number of passengers, the situation of Bangkok and Ho Chi Minh Airport which international passengers are 37 mppa and 9 mppa in 2014 respectively should be useful for the forecast of aircraft movements at HIA. The situation of Ho Chi Minh Airport is made as reference for the forecast up to 2030 and Bangkok Airport for beyond 2030.
- As for domestic aircraft movements, they are forecasted based on the situation of YIA.
- As for freight aircraft movements, they are forecasted based on the situation of Bangkok Airport.

The study flow for the forecast of aircraft movement is shown in Figure 2.2.13.

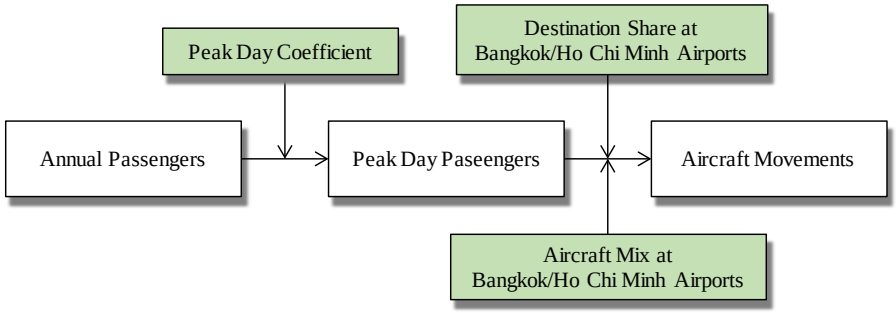
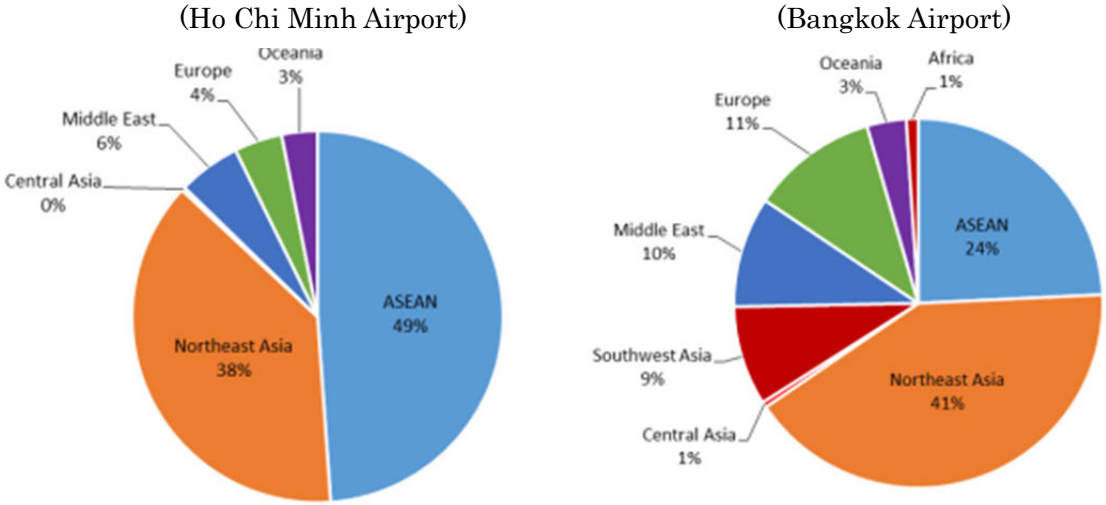


Figure 2.2.13 Study Flow for Aircraft Movement Forecast

(2) Destination Share

a) International Destination

International destination share at Ho Chi Minh and Bangkok Airports are shown in Figure 2.2.14.



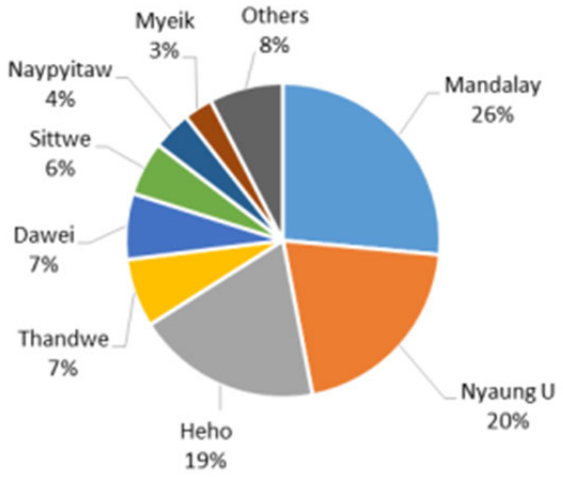
Source: FlightStats website data (31 March – 6 April 2015)

Figure 2.2.14 International Destination Share

b) Domestic Destination

Domestic route share at YIA is shown in Figure 2.2.15.

At HIA, it is assumed that three routes namely Mandalay, Nyaung U and Heho will be operated at the opening of HIA, and all routes which are operated now at YIA will be operated in 2030 and later.



Source: FlightStats website data (2 – 8 April 2015)

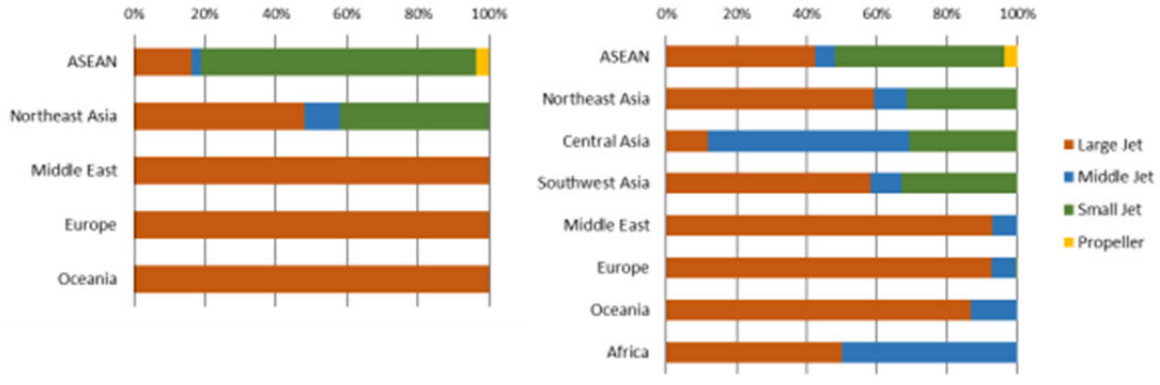
Figure 2.2.15 Domestic Route Share

(3) Aircraft Mix

a) International Aircraft

International aircraft mix by destination at Ho Chi Minh and Bangkok Airports are shown in Figure 2.2.16 and Table 2.2.8-2.2.9. .

(Ho Chi Minh Airport) (Bangkok Airport)



Source: FlightStats website data (31 March – 6 April 2015)

Figure 2.2.16 International Aircraft Mix by Destination

Table 2.2.8 International Aircraft Mix by Destination at Ho Chi Minh Airport

	Large Jet	Middle Jet	Small Jet	Propeller	Total
ASEAN	16%	3%	77%	4%	100%
Northeast Asia	48%	10%	42%	0%	100%
Middle East	100%	0%	0%	0%	100%
Europe	100%	0%	0%	0%	100%
Oceania	100%	0%	0%	0%	100%

Source: FlightStats website data (31 March – 6 April 2015)

Table 2.2.9 International Aircraft Mix by Destination at Bangkok Airport

	Large Jet	Middle Jet	Small Jet	Propeller	Total
ASEAN	42%	6%	48%	4%	100%
Northeast Asia	59%	9%	32%	0%	100%
Central Asia	12%	57%	31%	0%	100%
Southwest Asia	58%	9%	33%	0%	100%
Middle East	93%	7%	0%	0%	100%
Europe	93%	7%	1%	0%	100%
Oceania	87%	13%	0%	0%	100%
Africa	50%	50%	0%	0%	100%

Source: FlightStats website data (31 March – 6 April 2015)

b) Domestic Aircraft

Three types of aircraft namely large jet (B777, A330 etc.), small jet (A320, B737 etc.) and propeller will be operated on domestic routes at HIA. Considering the share of each route, large jet will be operated on a route with bigger demand, and small jet and propeller will be operated on a route with smaller demand. Aircraft mix is decided as shown in Table 2.2.10.

Table 2.2.10 Domestic Aircraft Mix by Route

(2025)

Route	Share	Large Jet	Small Jet	Propeller
Mandalay	40%		100%	
Nyaung-u	30%		100%	
Heho	30%		100%	

(2030)

Route	Share	Large Jet	Small Jet	Propeller
Mandalay	26%	50%	50%	
Nyaung-u	20%	50%	50%	
Heho	19%	50%	50%	
Thandwe	7%		70%	30%
Dawe	7%		70%	30%
Sittwe	6%		70%	30%
Naypyidaw	4%		70%	30%
Others	11%		50%	50%

(2040)

Route	Share	Large Jet	Small Jet	Propeller
Mandalay	26%	60%	40%	
Nyaung-u	20%	60%	40%	
Heho	19%	60%	40%	
Thandwe	7%		100%	
Dawe	7%		100%	
Sittwe	6%		100%	
Naypyidaw	4%		100%	
Others	11%		50%	50%

(2050)

Route	Share	Large Jet	Small Jet	Propeller
Mandalay	26%	70%	30%	
Nyaung-u	20%	70%	30%	
Heho	19%	70%	30%	
Thandwe	7%		100%	
Dawe	7%		100%	
Sittwe	6%		100%	
Naypyidaw	4%		100%	
Others	11%		50%	50%

c) Freight Aircraft

It is set as 75% and 25% for large jet and middle jet, respectively.

(4) Aircraft Movements Forecast

a) International Aircraft Movements

International daily aircraft movements by destination and aircraft are calculated as shown in Table 2.2.11 based on the destination share (Figure 2.2.14) and the aircraft mix (Table 2.2.8-2.2.9). The shares at Ho Chi Minh Airport are applied to calculate the movements up to 2030, and those of Bangkok Airport are applied to calculation beyond 2040.

Design day passengers per destination (Table 2.2.11, Design day passengers)
= Design day passengers (Table 2.2.17) × Destination share (Figure 2.2.14).
Aircraft movements per destination and aircraft type (Table 2.2.11, Large – Propeller)
= Design day passengers per destination × Aircraft type share (Table 2.2.8-9)
/ (Seat capacity × Seat factor)
Seat capacity Large jet: 310, Middle jet: 240, Small jet: 160, Propeller: 70
Seat factor 70%

b) Domestic Aircraft Movements

Domestic daily aircraft movements by route and aircraft are calculated as shown in Table 2.2.12 based on the route share (Figure 2.2.15) and the aircraft mix (Table 2.2.10). .

Design day passengers per route (Table 2.2.12, Design day passengers)
= Design day passengers (Table 2.2.17) × Route share (Figure 2.2.15).
Aircraft movements per route and aircraft type (Table 2.2.12, Large – Propeller)
= Design day passengers by route × Aircraft type share (Table 2.2.10)
/ (Seat capacity × Seat factor)
Seat capacity Large jet: 310, Small jet: 160, Propeller: 70
Seat factor 70%

Table 2.2.11 International Daily Aircraft Movements by Destination

(2025)

		Design Day Passengers	Large Jet (310)	Middle Jet (240)	Small Jet (160)	Propeller (70)	Total
Annual Passengers	ASEAN	18,150	13	3	125	15	156
10,745 thousand	Northeast Asia	14,080	31	8	53	0	92
	Middle East	2,220	10	0	0	0	10
	Europe	1,480	7	0	0	0	7
	Oceania	1,110	5	0	0	0	5
		37,050	66	11	178	15	270

(2030)

		Design Day Passengers	Large Jet (310)	Middle Jet (240)	Small Jet (160)	Propeller (70)	Total
Annual Passengers	ASEAN	25,150	19	4	173	21	217
15,142 thousand	Northeast Asia	19,510	43	12	73	0	128
	Middle East	3,080	14	0	0	0	14
	Europe	2,050	9	0	0	0	9
	Oceania	1,540	7	0	0	0	7
		51,330	92	16	246	21	375

(2040)

		Design Day Passengers	Large Jet (310)	Middle Jet (240)	Small Jet (160)	Propeller (70)	Total
Annual Passengers	ASEAN	21,540	42	8	92	18	160
27,372 thousand	Northeast Asia	36,790	100	20	105	0	225
	Central Asia	900	0	3	2	0	5
	Southwest Asia	8,080	22	4	24	0	50
	Middle East	8,970	38	4	0	0	42
	Europe	9,870	42	4	1	0	47
	Oceania	2,690	11	2	0	0	13
	Africa	900	2	3	0	0	5
		89,740	257	48	224	18	547

(2050)

		Design Day Passengers	Large Jet (310)	Middle Jet (240)	Small Jet (160)	Propeller (70)	Total
Annual Passengers	ASEAN	33,650	65	12	144	27	248
44,161 thousand	Northeast Asia	57,480	156	31	164	0	351
	Central Asia	1,400	1	5	4	0	10
	Southwest Asia	12,620	34	7	37	0	78
	Middle East	14,020	60	6	0	0	66
	Europe	15,420	66	6	1	0	73
	Oceania	4,210	17	3	0	0	20
	Africa	1,400	3	4	0	0	7
		140,190	402	74	350	27	853

Note 1: Design Day Passengers are indicated in Table 2.2.17.
Note 2: Seat factor is set as 70%.

Table 2.2.12 Domestic Daily Aircraft Movements by Route

(2025)

	Route	Design Day Passengers	Large Jet (310)	Small Jet (160)	Propeller (70)	Total
Annual Passengers 537 thousand	Mandalay	780		6		6
	Nyaung-u	590		6		6
	Heho	590		6		6
		1,950		18		18

(2030)

	Route	Design Day Passengers	Large Jet (310)	Small Jet (160)	Propeller (70)	Total
Annual Passengers 757 thousand	Mandalay	720	2	4		6
	Nyaung-u	550	2	2		4
	Heho	520	2	2		4
	Thandwe	190		2	2	4
	Dawe	190		2	2	4
	Sittwe	170		2	2	4
	Naypyidaw	110				
	Others	300		2	4	6
		2,750	6	16	10	32

(2040)

	Route	Design Day Passengers	Large Jet (310)	Small Jet (160)	Propeller (70)	Total
Annual Passengers 1,369 thousand	Mandalay	1,290	4	4		8
	Nyaung-u	1,000	2	4		6
	Heho	950	2	4		6
	Thandwe	350		4		4
	Dawe	350		4		4
	Sittwe	300		2		2
	Naypyidaw	200		2		2
	Others	550		2	6	8
		4,980	8	26	6	40

(2050)

	Route	Design Day Passengers	Large Jet (310)	Small Jet (160)	Propeller (70)	Total
Annual Passengers 8,533 thousand	Mandalay	7,780	26	20		46
	Nyaung-u	5,990	20	16		36
	Heho	5,690	18	16		34
	Thandwe	2,100		18		18
	Dawe	2,100		18		18
	Sittwe	1,800		16		16
	Naypyidaw	1,200		10		10
	Others	3,290		14	34	48
		29,940	64	128	34	226

Note 1: Design Day Passengers are indicated in Table 2.2.17.
Note 2: Seat factor is set as 70%.

c) Freighter Movements

It is assumed that the 25% of international cargo will be transported by freighter, and cargo volume per freighter will be 20 tons based on the situation at Bangkok Airport. The movements are shown in Table 2.2.13.

Table 2.2.13 Daily Freight Aircraft Movements

		2025	2030	2040	2050
International Freight Volume	(thousand ton)	54	76	134	215
Share Transported by Freighter		25%			
Freight Volume by Freighter	(thousand ton)	14	19	34	54
Cargo Volume per Flight	(ton)	20			
Daily Movements	Total	3	4	6	9
	Large Jet	3	3	5	7
	Middle Jet	0	1	1	2

Note: Large Jet: 75%, Middle Jet:25%

2.2.6 Peak Demand Forecast

(1) Peak Characteristic Analysis

In order to study requirements for airport facilities including apron and passenger terminal building, peak demand such as peak hour passengers/movements are required. Peak demands are calculated based on the annual demand which is studied in previous section. The study flow for the forecast of peak demand is shown in Figure 2.2.17.

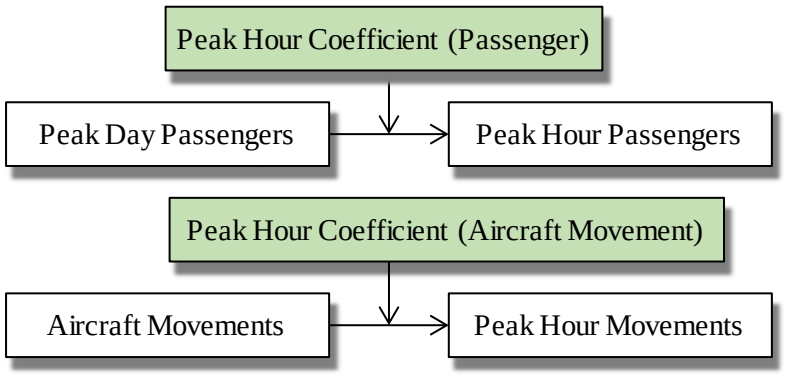


Figure 2.2.17 Study Flow of Peak Demand Forecast

a) Peak Day Characteristic

Peak day demands are calculated by multiplying peak day coefficient to annual demand. Peak day coefficient is set to the ratio of “passengers of average day of peak month” to annual passengers.

In order to identify the relationship between peak day coefficient and passenger, the data at Bangkok and Jakarta Airport as well as YIA were analyzed. The result of regression analysis is shown in Figure 2.2.18.

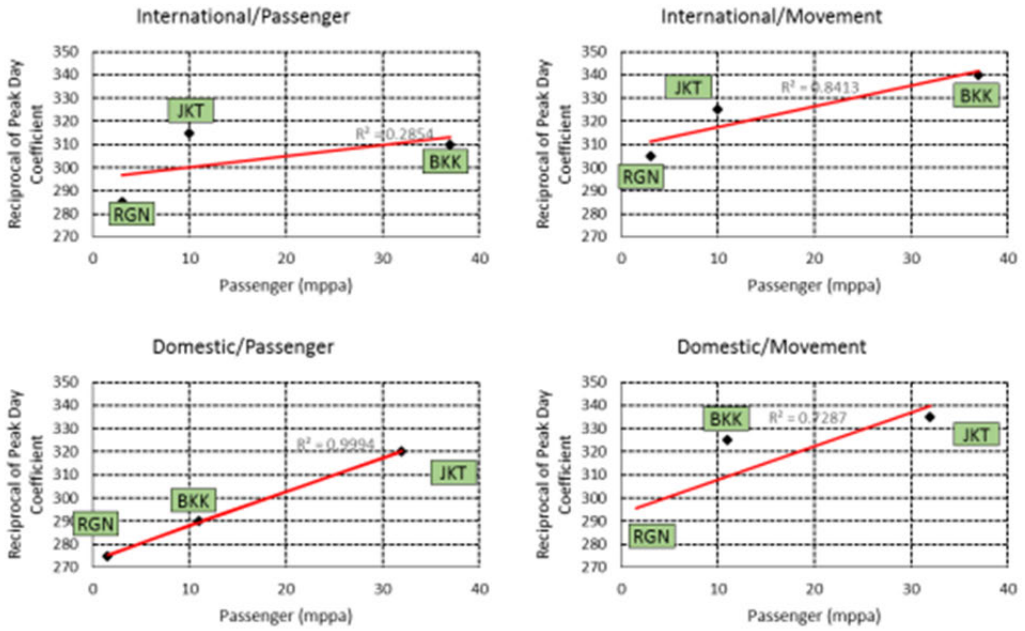


Figure 2.2.18 Relationship between Peak Day Coefficient and Passenger

Based on the Figure 2.2.18, it is found the trend that peak day coefficient decrease as passenger increase.
Since the approximate lines by regression analysis are similar to the line connecting Bangkok and Yangon, peak day coefficients at HIA are set based on the data of two airports as shown in Table 2.2.14.

Table 2.2.14 Peak Day Coefficient

International

Number of Passengers	3 mppa	11 mppa	15 mppa	27 mppa	37 mppa	44 mppa
Airport	Yangon	Hanthawaddy	Hanthawaddy	Hanthawaddy	Bangkok	Hanthawaddy
Year	(2010-2014)	(2025)	(2030)	(2040)	(2007-2011)	(2050)
Design Day Coefficient for Passenger	1/285	1/290	1/295	1/305	1/310	1/315
Design Day Coefficient for Aircraft Movement	1/305	1/315	1/315	1/330	1/340	1/345

Domestic

Number of Passengers	0.5 mppa	0.8 mppa	1.4 mppa	1.5 mppa	9 mppa	11 mppa
Airport	Hanthawaddy	Hanthawaddy	Hanthawaddy	Yangon	Hanthawaddy	Bangkok
Year	(2025)	(2030)	(2040)	(2010-2014)	(2050)	(2007-2011)
Design Day Coefficient for Passenger	1/275	1/275	1/275	1/275	1/285	1/290
Design Day Coefficient for Aircraft Movement	1/280	1/285	1/285	1/285	1/315	1/325

Source: Yangon: DCA data, Bangkok: AOT data

b) Peak Hour Characteristic

Based on the analysis for peak characteristic at Yangon, Bangkok and Ho Chi Minh Airports, formulas for peak hour coefficient are established as shown in Table 2.2.15 and 2.2.16 (see the following pages for detail analysis).

Table 2.2.15 Formulas for Peak Hour Coefficient (Passenger)

	International	Domestic
Departure	$\alpha = \frac{0.2559}{X/2} + 0.0649$	$\alpha = \frac{0.3276}{X/2} + 0.0716$
Arrival	$\alpha = \frac{0.3219}{X/2} + 0.0694$	$\alpha = \frac{0.2018}{X/2} + 0.0908$
Departure＋Arrival	$\alpha = \frac{0.7432}{X} + 0.0473$	$\alpha = \frac{0.2140}{X} + 0.0732$

Note: α : Peak hour coefficient
X: Daily passengers (thousand)

Table 2.2.16 Formulas for Peak Hour Coefficient (Movement)

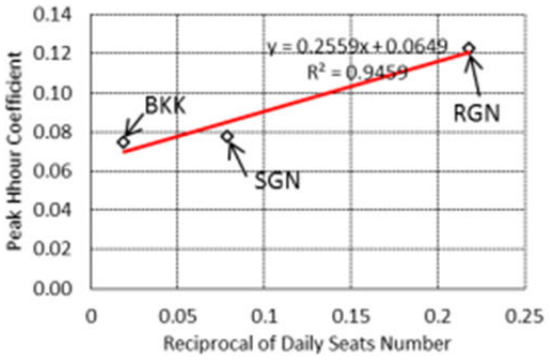
	International	Domestic
Departure	$\alpha = \frac{2.519}{X/2} + 0.0622$	$\alpha = \frac{7.170}{X/2} + 0.0356$
Arrival	$\alpha = \frac{2.609}{X/2} + 0.0657$	$\alpha = \frac{4.180}{X/2} + 0.0628$
Departure & Arrival	$\alpha = \frac{6.076}{X} + 0.0474$	$\alpha = \frac{6.896}{X} + 0.0465$
	International + Domestic	
	$\alpha = \frac{6.663}{X} + 0.0521$	

Note: α : Peak hour coefficient
X: Daily movements (departure + arrival)

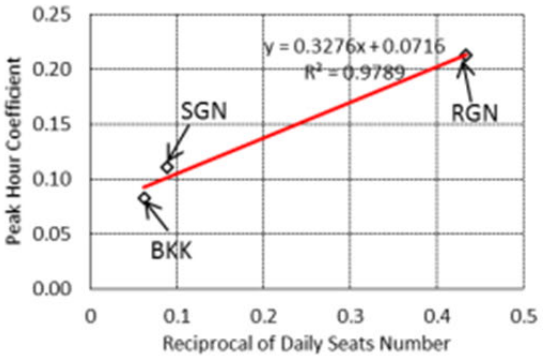
* Reference: Analysis of Peak Hour Characteristic

- Peak Characteristic of Passenger (for Table 2.2.15)

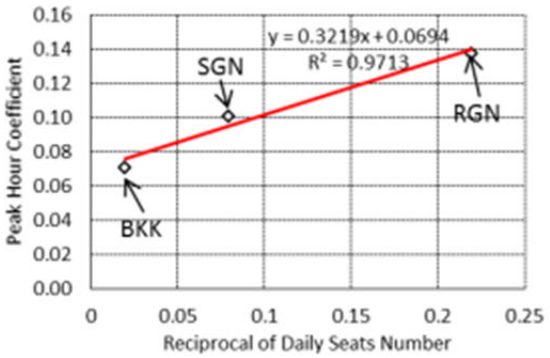
(International/Departure)



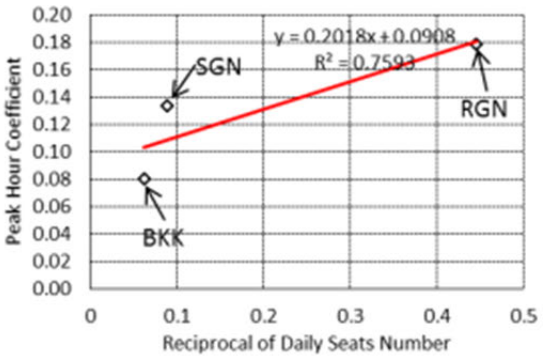
(Domestic/Departure)



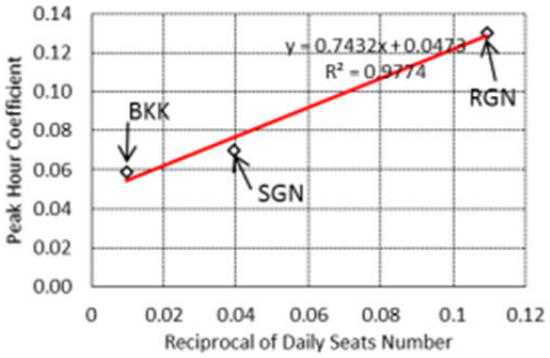
(International/Arrival)



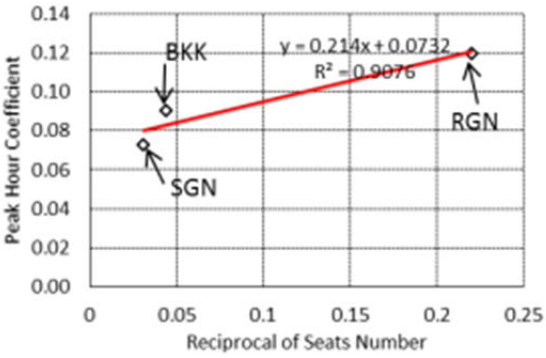
(Domestic/Arrival)



(International/Departure + Arrival)

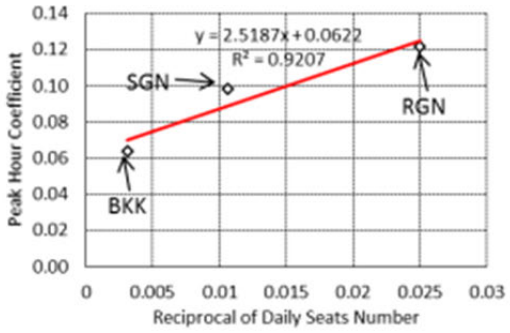


(Domestic/Departure + Arrival)

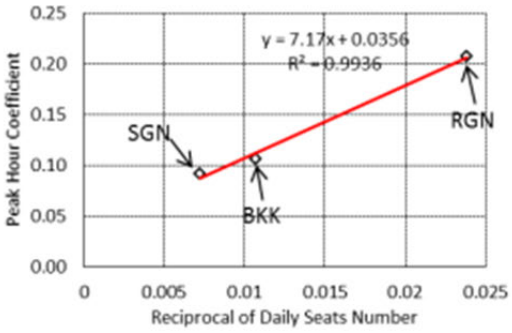


- Peak Characteristic of Movement (for Table 2.2.16)

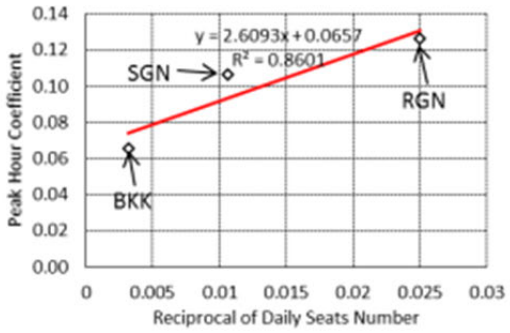
(International/Departure)



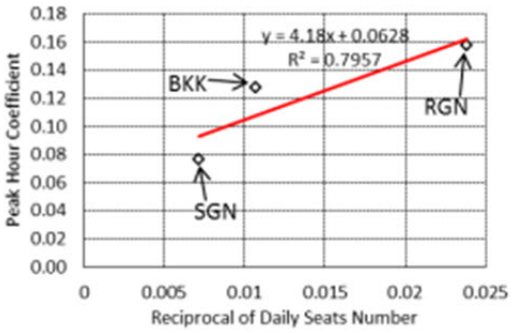
(Domestic/Departure)



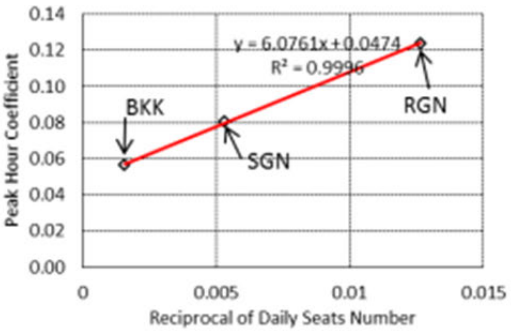
(International/Arrival)



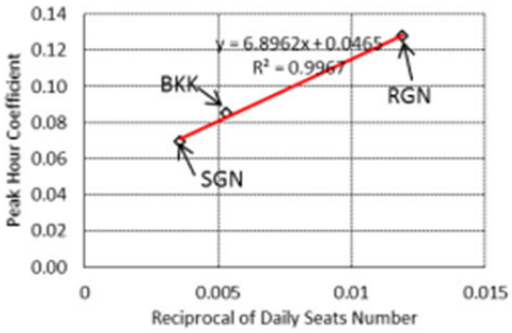
(Domestic/Arrival)



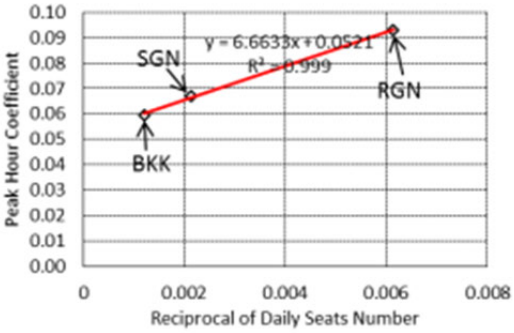
(International/Departure + Arrival)



(Domestic/Departure + Arrival)



(International + Domestic/Departure + Arrival)



(2) Peak Day Passenger Forecast
Peak day passengers are forecast as shown in Table 2.2.17.

Table 2.2.17 Peak Day Passengers

International

Year	Annual Passengers (thousand)	Design Day Ratio	Design Day Passengers
2025	10,745	1 / 290	37,050
2030	15,142	1 / 295	51,330
2040	27,372	1 / 305	89,740
2050	44,161	1 / 315	140,190

Domestic

Year	Annual Passengers (thousand)	Design Day Ratio	Design Day Passengers
2025	537	1 / 275	1,950
2030	757	1 / 275	2,750
2040	1,369	1 / 275	4,980
2050	8,533	1 / 285	29,940

(3) Peak Hour Demand Forecast

a) Peak Passengers

Peak hour passengers are calculated by multiplying peak hour ratio to peak day passengers as shown in Table 2.2.18.

Table 2.2.18 Peak Hour Passengers

International

Year	Design Day Passengers		Design Peak Hour		Design Peak Hour Passengers
			Ratio	Formula applied (Note 1)	
2025	37,050	Departure	0.0787	Int'l/Dep	1,460
		Arrival	0.0868	Int'l/Arr	1,610
		Dep+Arr	0.0670	Int'l/Dep+Arr	2,480
2030	51,330	Departure	0.0749	Int'l/Dep	1,920
		Arrival	0.0819	Int'l/Arr	2,100
		Dep+Arr	0.0620	Int'l/Dep+Arr	3,180
2040	89,740	Departure	0.0706	Int'l/Dep	3,170
		Arrival	0.0766	Int'l/Arr	3,440
		Dep+Arr	0.0560	Int'l/Dep+Arr	5,030
2050	140,190	Departure	0.0686	Int'l/Dep	4,810
		Arrival	0.0740	Int'l/Arr	5,190
		Dep+Arr	0.0530	Int'l/Dep+Arr	7,430

Domestic

Year	Design Day Passengers		Design Peak Hour		Design Peak Hour Passengers
			Ratio	Formula applied (Note 1)	
2025	1,950	Departure	0.4076	Dom/Dep	400
		Arrival	0.2978	Dom/Arr	290
		Dep+Arr	0.1830	Dom/Dep+Arr	360
2030	2,750	Departure	0.3099	Dom/Dep	430
		Arrival	0.2376	Dom/Arr	330
		Dep+Arr	0.1510	Dom/Dep+Arr	420
2040	4,980	Departure	0.2032	Dom/Dep	510
		Arrival	0.1718	Dom/Arr	430
		Dep+Arr	0.1160	Dom/Dep+Arr	580
2050	29,940	Departure	0.0935	Dom/Dep	1,400
		Arrival	0.1043	Dom/Arr	1,560
		Dep+Arr	0.0800	Dom/Dep+Arr	2,400

Note (1): Refer to Table 2.2.15

(2): Design Peak Hour Passengers of Departure/Arrival
= Design Day Passengers × 1/2 × Design Peak Hour Ratio
Design Peak Hour Passengers of Dep+Arr
= Design Day Passengers × Design Peak Hour Ratio

b) Peak Movements

Peak hour movements are calculated by multiplying peak hour ratio to peak day movements as shown in Table 2.2.19.

Table 2.2.19 Peak Hour Movements

International

Year	Daily Movements		Design Peak Hour		Design Peak Hour Movements
			Ratio	Formula applied (Note 1)	
2025	270	Departure	0.0809	Int'l/Dep	11
		Arrival	0.0850	Int'l/Arr	11
		Dep+Arr	0.0699	Int'l/Dep+Arr	19
2030	375	Departure	0.0756	Int'l/Dep	14
		Arrival	0.0796	Int'l/Arr	15
		Dep+Arr	0.0636	Int'l/Dep+Arr	24
2040	547	Departure	0.0714	Int'l/Dep	20
		Arrival	0.0752	Int'l/Arr	21
		Dep+Arr	0.0585	Int'l/Dep+Arr	32
2050	853	Departure	0.0681	Int'l/Dep	29
		Arrival	0.0718	Int'l/Arr	31
		Dep+Arr	0.0545	Int'l/Dep+Arr	47

Domestic

Year	Daily Movements		Design Peak Hour		Design Peak Hour Movements
			Ratio	Formula applied (Note 1)	
2025	18	Departure	—	Dom/Dep	2
		Arrival	—	Dom/Arr	2
		Dep+Arr	—	Dom/Dep+Arr	2
2030	32	Departure	0.4837	Dom/Dep	8
		Arrival	0.3241	Dom/Arr	5
		Dep+Arr	0.2620	Dom/Dep+Arr	8
2040	40	Departure	0.3941	Dom/Dep	8
		Arrival	0.2718	Dom/Arr	5
		Dep+Arr	0.2189	Dom/Dep+Arr	9
2050	226	Departure	0.0991	Dom/Dep	11
		Arrival	0.0998	Dom/Arr	11
		Dep+Arr	0.0770	Dom/Dep+Arr	17

International+Domestic

Year	Daily Movements		Design Peak Hour		Design Peak Hour Movements
			Ratio	Formula applied (Note 1)	
2025	288	Dep+Arr	0.0752	Int'l+Dom/Dep+Arr	22
2030	407	Dep+Arr	0.0685	Int'l+Dom/Dep+Arr	28
2040	587	Dep+Arr	0.0635	Int'l+Dom/Dep+Arr	37
2050	1,079	Dep+Arr	0.0583	Int'l+Dom/Dep+Arr	63

Note (1): Refer to Table 2.2.15

(2): Design Peak Hour Movements of Departure/Arrival
= Design Day Movements × 1/2 × Design Peak Hour Ratio
Design Peak Hour Movements of Dep+Arr
= Design Day Movements × Design Peak Hour Ratio

2.2.7 Air Cargo Demand Forecast

(1) International Cargo

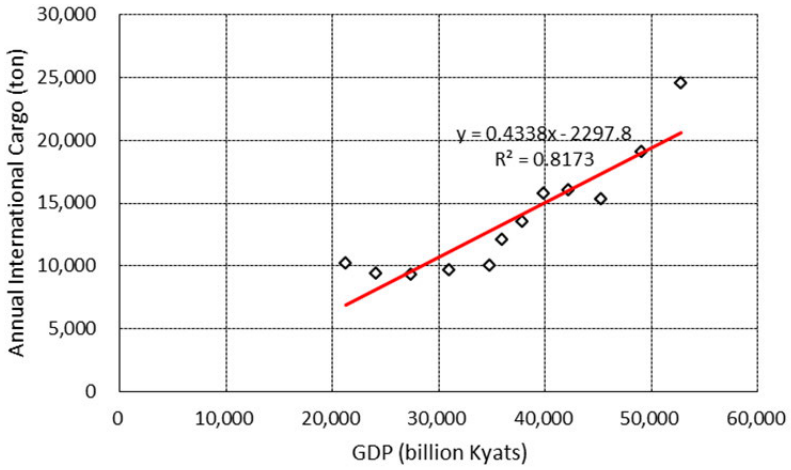
a) Regression Analysis

Prediction formula for future international cargo demand is established by regression analysis for 12 years of analyzes period (2003-2014) based on linear model with explanatory variable of real GDP.

The results of regression analysis are shown in Table 2.2.20. The relationship between actual international cargo and linear approximation are shown in Figure 2.2.19.

Table 2.2.20 Result of Regression Analysis (International Cargo)

Analysis Period	2003-2014
Prediction Formula	Y＝ a ×GDP＋ b Y: International cargo a,b: parameter a: 0.4338, b: -2297.8
Coefficient of Determination	0.817



Source: DCA data

Figure 2.2.19 Approximation of Actual Value and Model

b) Results of Projection

The future international cargo demand in Yangon Metropolitan Area is estimated using the projected GDP as explanatory variables of the prediction formula. The international cargo demand at Hanthawaddy Airport is demarcated in proportion to passenger demand.

The results of forecast are shown in Table 2.2.21.

Table 2.2.21 International Cargo Forecast

	International Cargo (thousand ton)					
	Yangon Metropolitan		Yangon Airport		Hanthawaddy Airport	
Future Cargo Demand	2014(Actual)	24	2014(Actual)	24		
	2025	58	2025	4	2025	54
	2030	80	2030	4	2030	76
	2040	143	2040	9	2040	134
	2050	229	2050	14	2050	215
Average Annual Growth Rate	2014-2025	8.4%				
	2025-2040	6.2%				
	2040-2050	4.8%				

(2) Domestic Cargo

a) Analysis of Model Airport

As almost domestic flights at YIA are operated by propeller aircraft which seldom transports cargo, there is no data regarding domestic cargo traffic recorded. Therefore, in order to forecast future domestic cargo demand, the data at Bangkok and Ho Chi Minh Airport are employed.

According to the regression analysis between the number of passengers and cargo volume at both airports, the prediction formula is obtained as shown in Table 2.2.22 and Figure 2.2.20.

Table 2.2.22 Result of Regression Analysis (Domestic Cargo)

Analysis Period	Bangkok 1990-2005 Ho Chi Minh 1995-2010
Prediction Formula	Y＝ a ×X＋ b Y: Domestic cargo X: Domestic Passengers a,b: parameter a: 0.0049, b: 22.113
Coefficient of Determination	0.2687

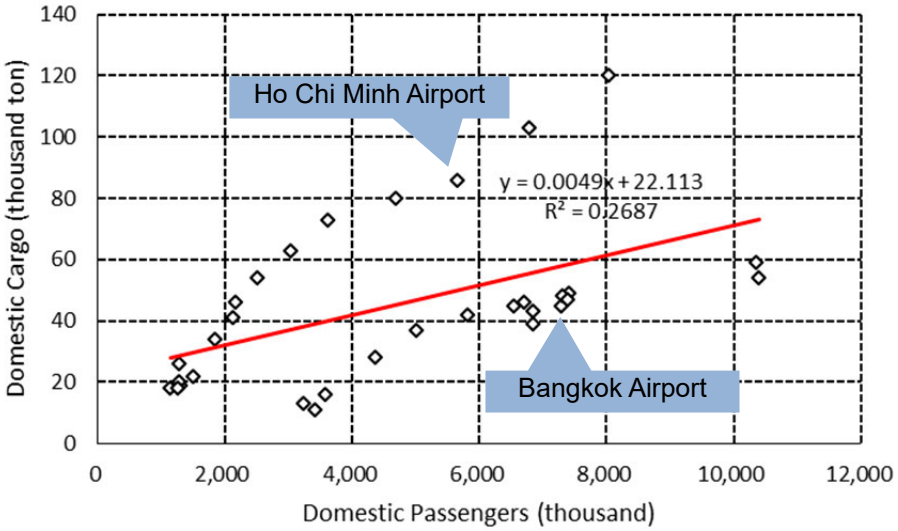


Figure 2.2.20 Relationship between Passenger and Cargo at Bangkok and Ho Chi Minh Airport

b) Result of Projection

The future domestic cargo demand in Yangon Metropolitan Area is estimated using the projected domestic passengers as the explanatory variables of the prediction formula. The domestic cargo demand in HIA is demarcated in proportion to passenger demand between YIA and HIA.

The results of forecast are shown in Table 2.2.23.

Table 2.2.23 Domestic Cargo Forecast

	Domestic Cargo (thousand ton)					
	Yangon Metropolitan		Yangon Airport		Hanthawaddy Airport	
Future Cargo Demand	2014(Actual)	0	2014(Actual)	0		
	2025	45	2025	40	2025	5
	2030	54	2030	48	2030	6
	2040	77	2040	68	2040	9
	2050	109	2050	56	2050	53
Average Annual Growth Rate	2014-2025	- %				
	2025-2040	3.6%				
	2040-2050	3.5%				

2.2.8 Airport Visitor Forecast

Airport visitor forecast is carried out in accordance with study flow as shown in Figure 2.2.20.

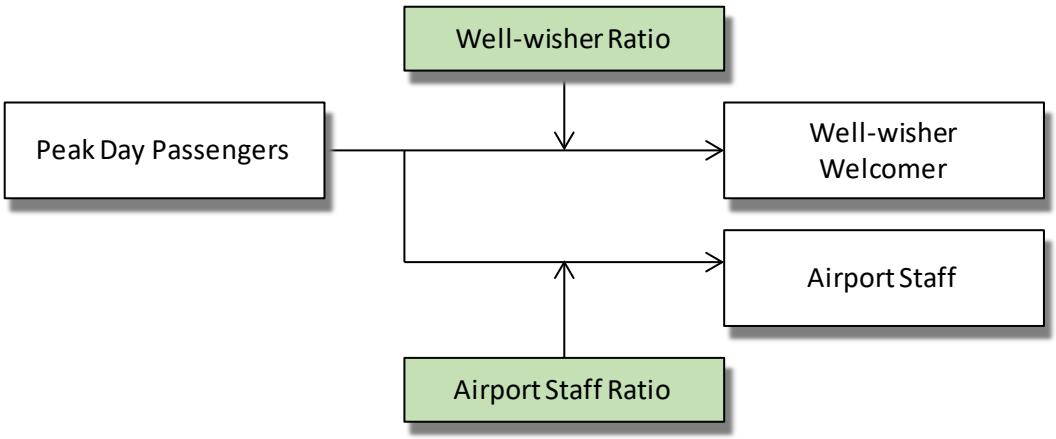


Figure 2.2.21 Study Flow of Airport Access Traffic Forecast

Airport visitor consists of air passenger, well-wisher/welcomer and airport staff. These demands are forecasted using the ratio of each visitor to air passengers in reference to these figures of other airports.
Airport visitors are forecasted as shown in Table 2.2.24.

Table 2.2.24 Forecast for Airport Visitors

		2022	2025	2030	2040	2050	Remarks
Annual International Passengers	(thousand)	8,248	10,745	15,142	27,372	44,161	
Annual Domestic Passengers	(thousand)	412	537	757	1,369	8,533	
Annual Total Passengers	(thousand)	8,660	11,282	15,899	28,741	52,694	
Daily International Passengers		28,440	37,050	51,330	89,740	140,190	
Daily Domestic Passengers		1,500	1,950	2,750	4,980	29,940	
Daily Total Passengers		29,940	39,000	54,080	94,720	170,130	
Daily Well-wisher/Welcomer		11,980	15,600	21,630	37,890	68,050	(1)
Daily Airport Staff		2,100	2,730	3,790	6,630	11,910	(2)

Note (1): Ratio of well-wisher and welcomer to daily passenger is set as 0.4 based on the actual data at Jakarta Airport.
(2): Ratio of airport staff to daily passenger is set as 0.1 based on the actual data at Jakarta Airport. In addition, shift attendance of 70% is considered.

2.2.9 Summary of Future Demand at HIA

The future demand at HIA is summarized as shown in Table 2.2.25.

Table 2.2.25 Summary of Future Demand at HIA

				2025	2030	2040	2050
Annual	Passenger (thousand)	Int'l		10,745	15,142	27,372	44,161
		Dom		537	757	1,369	8,533
		Total		11,282	15,899	28,741	52,694
	Cargo (thousand ton)	Int'l		54	76	134	215
		Dom		5	6	9	53
		Total		59	82	143	268
	Movement (thousand)	Int'l		85	118	181	294
		Dom		5	9	11	71
		Freighter		1	1	2	3
		Total		91	128	194	368
Peak Day	Passenger	Int'l		37,050	51,330	89,740	140,190
		Dom		1,950	2,750	4,980	29,940
		Total		39,000	54,080	94,720	170,130
	Movement	Int'l		270	375	547	853
		Dom		18	32	40	226
		Freighter		3	4	6	9
		Total		291	411	593	1,088
	Visitor other than passenger			18,330	25,420	44,520	79,960
Peak Hour	Passenger	Int'l	Departure	1,460	1,920	3,170	4,810
			Arrival	1,610	2,100	3,440	5,190
			Dep+Arr	2,480	3,180	5,030	7,430
		Dom	Departure	400	430	510	1,400
			Arrival	290	330	430	1,560
			Dep+Arr	360	420	580	2,400
	Movement	Int'l		19	24	32	47
		Dom		2	8	9	17
		Int'l + Dom		22	28	37	63

Note: Int'l: International, Dom: Domestic

2.2.10 Conservative Case of Demand Forecast

The passenger demand forecast at Hanthawaddy Airport described in section 2.2.4 which was prepared in consideration of aviation policy and measures of DCA, and is a base figure for a physical planning, such as conceptual design and cost estimation following from the next section.
While the demand forecast in terms of operation, which is utilized for the economic and financial analysis in chapter 8 through 10, shall be conservative in consideration of political risks such as policy change and other risks caused by external factors because this project is aiming at an investment from private companies and project finance scheme utilizing PSIF as well as ODA loan.
Therefore the economic and financial analysis in these chapters utilizes the Conservative Demand Forecast shown in Table 2.2.26, which results in the project evaluation in complex perspectives.

Table 2.2.26 Conservative Demand Forecast: Demarcation between YIA and HIA (opening in the end of 2022)

Year	Yangon Region			YIA			HIA		
	Dom	Int	Total	Dom	Int	Total	Dom	Int	Total
2014	0.00	0.00	0	0.00	0.00	0	-	-	-
2015	1,599.79	3,831.78	5,432	1,599.79	3,831.78	5,432	-	-	-
2016	1,834.85	4,474.04	6,309	1,834.85	4,474.04	6,309	-	-	-
2017	2,089.57	5,113.89	7,204	2,089.57	5,113.89	7,204	-	-	-
2018	2,369.87	5,714.05	8,084	2,369.87	5,714.05	8,084	-	-	-
2019	2,671.27	6,311.98	8,983	2,671.27	6,311.98	8,983	-	-	-
2020	2,986.86	6,886.10	9,873	2,986.86	6,886.10	9,873	-	-	-
2021	3,326.05	7,469.32	10,795	3,326.05	7,469.32	10,795	-	-	-
2022	3,678.68	8,071.43	11,750	3,678.68	8,071.43	11,750	-	-	-
2023	4,049.47	8,685.73	12,735	3,655.48	1,200.00	4,855	393.99	7,485.73	7,879.71
2024	4,433.81	9,315.95	13,750	4,011.23	1,287.07	5,298	422.57	8,028.88	8,451.46
2025	4,832.49	9,975.24	14,807	3,877.26	1,378.16	5,255	955.23	8,597.08	9,552.32
2026	5,246.43	10,665.88	15,912	3,624.26	1,473.57	5,098	1,622.17	9,192.31	10,814.48
2027	5,675.61	11,387.97	17,064	3,665.38	1,573.34	5,238	2,010.23	9,814.64	11,824.86
2028	6,115.56	12,144.15	18,260	3,971.85	1,677.81	5,650	2,040.00	9,960.00	12,000.00
2029	6,568.86	12,933.08	19,502	4,285.89	1,786.80	6,073	2,040.00	9,960.00	12,000.00
2030	7,035.02	13,755.19	20,790	4,606.93	1,900.39	6,507	2,040.00	9,960.00	12,000.00
2031	7,510.61	14,469.47	21,980	4,956.43	1,999.07	6,955	2,040.00	9,960.00	12,000.00
2032	7,999.23	15,202.95	23,202	5,315.58	2,100.40	7,416	2,040.00	9,960.00	12,000.00
2033	8,497.36	15,957.13	24,454	5,680.58	2,204.60	7,886	2,040.00	9,960.00	12,000.00
2034	9,004.67	16,732.95	25,738	6,050.93	2,311.79	8,363	2,040.00	9,960.00	12,000.00
2035	9,520.78	17,530.70	27,052	6,426.23	2,422.00	8,848	2,040.00	9,960.00	12,000.00
2036	10,048.80	18,348.69	28,398	6,809.85	2,535.01	9,345	2,040.00	9,960.00	12,000.00
2037	10,581.98	19,190.57	29,773	7,194.43	2,651.32	9,845	2,040.00	9,960.00	12,000.00
2038	11,126.94	20,053.07	31,180	7,587.13	2,770.49	10,357	2,040.00	9,960.00	12,000.00
2039	11,677.01	20,940.58	32,618	7,980.54	2,893.10	10,874	2,040.00	9,960.00	12,000.00
2040	12,238.57	21,849.34	34,088	8,381.68	3,018.65	11,401	2,040.00	9,960.00	12,000.00
2041	12,801.75	22,785.84	35,588	8,779.55	3,148.04	11,928	2,040.00	9,960.00	12,000.00
2042	13,376.12	23,744.53	37,121	9,184.69	3,280.49	12,465	2,040.00	9,960.00	12,000.00
2043	13,955.20	24,730.89	38,686	9,589.65	3,416.76	13,007	2,040.00	9,960.00	12,000.00
2044	14,542.14	25,717.91	40,260	10,002.37	3,553.13	13,555	2,040.00	9,960.00	12,000.00
2045	15,136.89	26,709.58	41,847	10,422.06	3,690.13	14,112	2,040.00	9,960.00	12,000.00
2046	15,739.33	27,705.49	43,444	10,848.71	3,827.73	14,677	2,040.00	9,960.00	12,000.00
2047	16,349.40	28,705.87	45,055	11,282.18	3,965.94	15,248	2,040.00	9,960.00	12,000.00
2048	16,967.01	29,707.46	46,674	11,722.99	4,104.31	15,827	2,040.00	9,960.00	12,000.00
2049	17,592.10	30,713.14	48,305	12,170.56	4,243.26	16,414	2,040.00	9,960.00	12,000.00
2050	18,224.63	31,723.24	49,948	12,624.78	4,382.81	17,008	2,040.00	9,960.00	12,000.00

2.3 Revenues estimation of PTB and the tenants

2.3.1 Revenue classification

Revenue which SPC gain from airport facilities and tenants is categorized into aeronautical revenue and non-aeronautical revenue as follows.

(1) Aeronautical Revenue
- Passenger Service Charge
- Landing Charge
- Air Navigation Charge
- Parking Charge
- Housing/Hanger Charge
- Passenger Loading Bridge (Aerobridge) Charges

(2) Non-aeronautical Revenue
- Facilities Utilization Fee
- Revenue from retail and F&B (Food and Beverage)

2.3.2 Aeronautical Revenue

Aeronautical revenue (Tariff) shall be discussed and reviewed with DCA which is an entity of authority, periodically or when needed, in order to SPC can secure their constant profit. As for the tariff structure, DCA controls the price considering the competitiveness among the adjacent nations and with the consistency from the other Myanmar's airports such as Yangon International Airport. Actual aeronautical tariffs in Myanmar airports (note) are as follows.
(note) The DCA homepage does not specify the name of the airports; however, the airports that provide hangers and boarding bridges are limited, and the airports where those usage charges are applied will be the major airports (Yangon, Mandalay, Naypyidaw International Airports) only.

(1) Passenger Service Charge

Airport	International Flight	Domestic Flight
International Airports	USD 15	Kyats 2000
Domestic Airports	USD -	Kyats 1000

* International Airports mean Yangon, Mandalay, Naypyidaw International Airports

(Source: DCA, as of July, 2014)

(2) Landing

Maximum Take-off Weight	International Flight	Domestic Flight
Not exceeding 25,000 Kg	USD 85	Kyats 18800
25,001 Kg to 50,000 Kg	USD 168	Kyats 37500
50,001 Kg to 75,000 Kg	USD 253	Kyats 56100
75,001 Kg to 100,000 Kg	USD 337	Kyats 74900
100,001 Kg to 200,000 Kg	USD 760	Kyats 168300
200,001 Kg to 300,000 Kg	USD 1138	Kyats 252600
300,001 Kg to 400,000 Kg	USD 1518	Kyats 336800

Basis: Take-off weight in the C of A. *(Source: DCA, as of July, 2014)*

(3) Air Navigation

Maximum Take-off Weight	International Flight	Domestic Flight
Not exceeding 25,000 Kg	USD 32	Kyats 6300
25,001 Kg to 50,000 Kg	USD 53	Kyats 10400

50,001 Kg to 75,000 Kg	USD 99	Kyats 15500
75,001 Kg to 100,000 Kg	USD 119	Kyats 20900
100,001 Kg to 200,000 Kg	USD 304	Kyats 53500
200,001 Kg to 300,000 Kg	USD 457	Kyats 80150
300,001 Kg to 400,000 Kg	USD 609	Kyats 106800

Basis: Take-off weight in the C of A. *(Source: DCA, as of July, 2014)*

(4) Parking Charge

Maximum Take-off Weight	International Flight	Domestic Flight
Not exceeding 25,000 Kg	USD 15	Kyats 4200
25,001 Kg to 50,000 Kg	USD 27	Kyats 7500
50,001 Kg to 75,000 Kg	USD 41	Kyats 11300
75,001 Kg to 100,000 Kg	USD 54	Kyats 15000
100,001 Kg to 200,000 Kg	USD 122	Kyats 33800
200,001 Kg to 300,000 Kg	USD 182	Kyats 50500
300,001 Kg to 400,000 Kg	USD 243	Kyats 67400

Basis: Take-off weight in the C of A. *(Source: DCA, as of July, 2014)*

(5) Housing/Hangar Charges

Maximum Take-off Weight	International Flight	Domestic Flight
Not exceeding 25,000 Kg	USD 41	Kyats 11300
25,001 Kg to 50,000 Kg	USD 81	Kyats 22500
50,001 Kg to 75,000 Kg	USD 122	Kyats 33800
75,001 Kg to 100,000 Kg	USD 162	Kyats 44900
100,001 Kg to 200,000 Kg	USD 365	Kyats 101000
200,001 Kg to 300,000 Kg	USD 547	Kyats 151600
300,001 Kg to 400,000 Kg	USD 729	Kyats 202100

Basis: Take-off weight in the C of A. *(Source: DCA, as of July, 2014)*

(6) Passenger Loading Bridge (Aerobridge) Charges

Aircraft Seating Capacity	Aerobridge Basic Charge per flight
0 - 150 seats	USD 80.00 for the first 1½ hours or part thereof; and USD 80.00 for every subsequent 1½ hours or part thereof.
151 - 250 seats	USD 116.00 for the first 1½ hours or part thereof; and USD 116.00 for every subsequent 1½ hours or part thereof.
251 - 350 seats	USD 156.00 for the first 1½ hours or part thereof; and USD 156.00 for every subsequent 1½ hours or part thereof.
Exceeding 350 seats	USD 228.00 for the first 1½ hours or part thereof; and USD 228.00 for every subsequent 1½ hours or part thereof.

Basis: Aircraft Seating Capacity *(Source: DCA, as of July, 2014)*

2.3.3 Non-aeronautical Revenue

Non-aeronautical revenue will be estimated referring to the value in adjacent nations and in Yangon International Airport. Concrete values of non-aeronautical revenue will be defined in the cash flow analysis later.

2.4 Current Condition of the Project Site

Based on the site observations as well as interviewing with relevant officers, the current status of the project site was investigated and summarized as below.

(1) Owner, area and terrain of the project site
A spacious land with the area approximately 4,000ha was secured for the Hanthawaddy International Airport project.

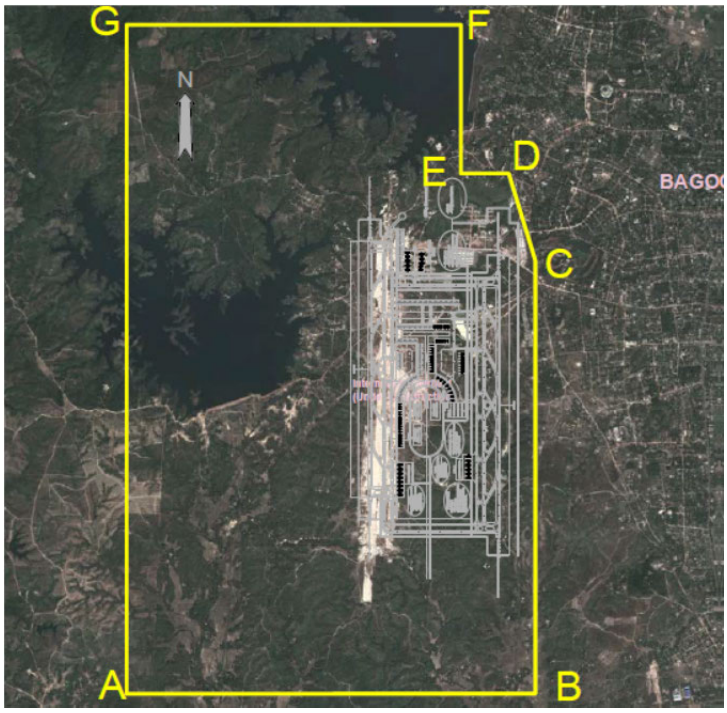


Figure 2.4.1 Outline of the Project Site

Boundary Coordinates		
Point Name	Northern	Eastern
A	17° 16'10.36"	96° 23'46.26"
B	17° 16'14.42"	96° 26'45.46"
C	17° 19'07.12"	96° 26'43.32"
D	17° 19'43.54"	96° 26'32.92"
E	17° 19'42.86"	96° 26'01.96"
F	17° 20'42.25"	96° 26'01.07"
G	17° 20'38.98"	96° 23'41.26"

Source: DCA

Out of the land area, 550ha will be developed as initial phase of the project.
Actually it was used as an air field by Japanese Army during the World War II.

Figure 2.4.2 Current Situation of the Project Site (1)

Figure 2.4.3 Current Situation of the Project Site (2) Viewing South from the Northern End

Figure 2.4.4 Current Situation of the Project Site (3) Viewing North from the Southern End

The land terrain is in general flat but sloping towards east bound; thus, there will be substantial amount of site grading work for the preparation of the airport site. The topographical and geological characteristics are analyzed and reported in the following chapter 2.5, and the outlined design of the site grading work is presented in the chapter 2.11.

(2) Restriction of the land use by regulatory body
As far as the activities are related to the airport project and relevant business, there are no such restrictions.

(3) Land use of the project site in the past
In the past, there were inhabitants in 6 villages and 1 quarter in the project site.
The Hanthawaddy International Airport project site was selected through the study in 1991-1992 conducted by DCA, and resettlements were carried out in 1994 and 2013.
After the first resettlement in 1994, the settlement in the project site was recovered by the

residents including the returned original villager, having realized the airport construction project had not been commenced. The second resettlement was carried out in 2013. The detail of the resettlement process will be reported in the Chapter 11.

(4) Housings of other building facilities around the project site
DCA assumes that some people now live in the project site, supposedly in the western forest of the site. The residents are supposed to include the original villager who did not resettled in 2013 or original villager who returned from the resettlement site seeking for another compensation.
Now the detailed investigation is being carried out by Bago Township General Administration, Department of Land and DCA. The detail of the investigation will be reported in the Chapter 11.

(5) Others
There are a couple of small Pagodas in the project site. Among these pagodas, it is confirmed that there are agreements established between the owner monk and Bago city so that the pagodas will be relocated to the land provided by Bago city.

2.5 Topographic and Geological Survey

2.5.1 Topography of the Project Site

Figure 2.5.1 shows the topographic survey results of the planned airport facility area in the acquired land. The surveyed area (airfield area) is approximately 7.5km in NS direction and 3.5km in EW direction. There is an old runway constructed by Japanese army during the World War II. The old runway is running NS direction with the flat elevations of approximately MSL+40m. The pahse-1 new runway is planned parallel to the old one, approximately 200m to west. The new runway is in the undulated areas incised by streams where site grading is required. Within the survey area, ground elevations are in the range of MSL+12m to MSL+45m. Compared to the huge area, elevation differences are not large. East side is generally lower than the old runway elevations with mild slopes. Small ponds and streams are observed in the survey area generally except for the old runway area. Elevations of them are lower than the surroundings. There are two large water reservoirs north and west of the planned airfield area. Figure 2.5.2 to Figure 2.5.4 show sectional profiles of the surveyed area prepared by the data shown in Figure 2.5.1.

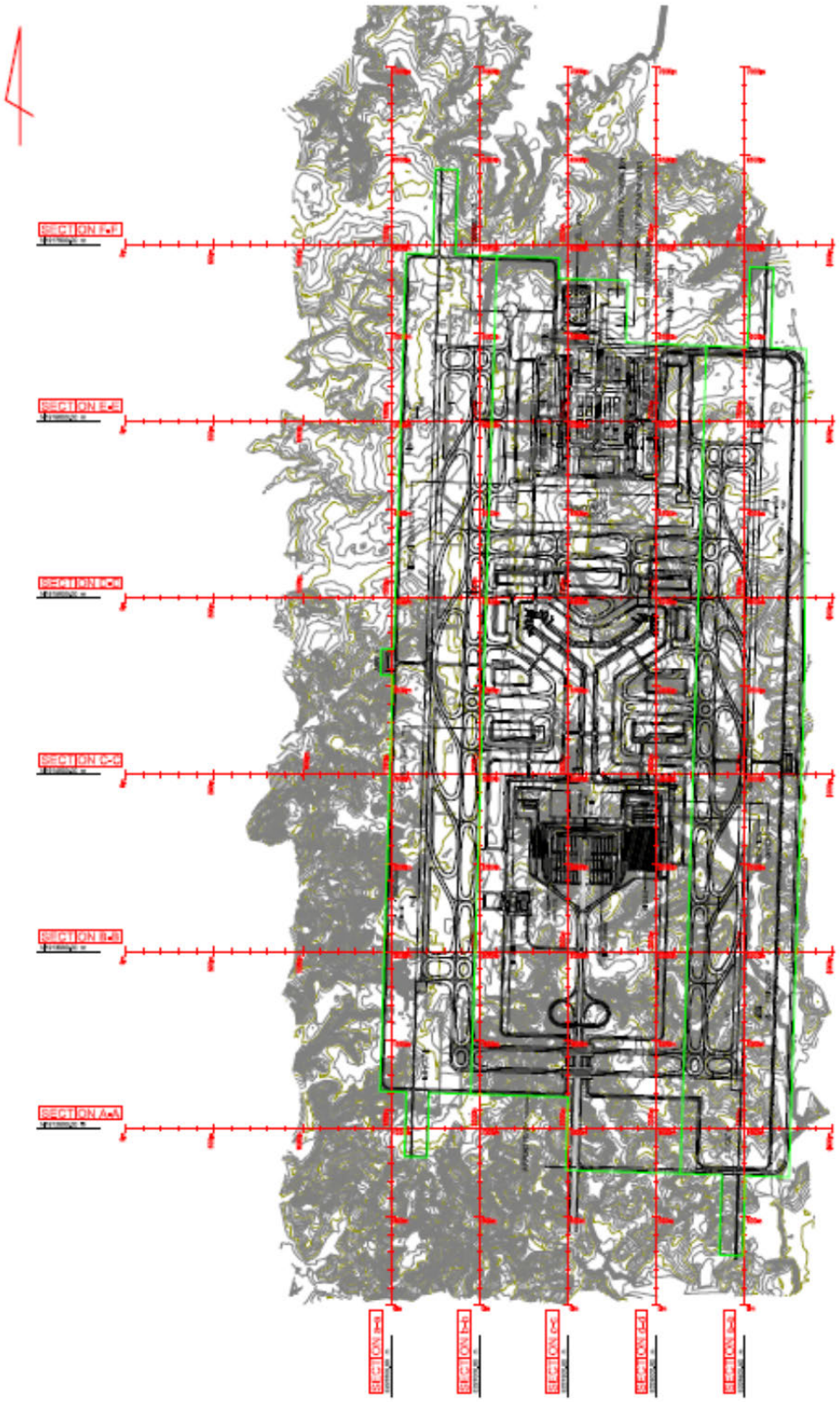


Figure 2.5.1 Sectional profiles of the surveyed area (1)

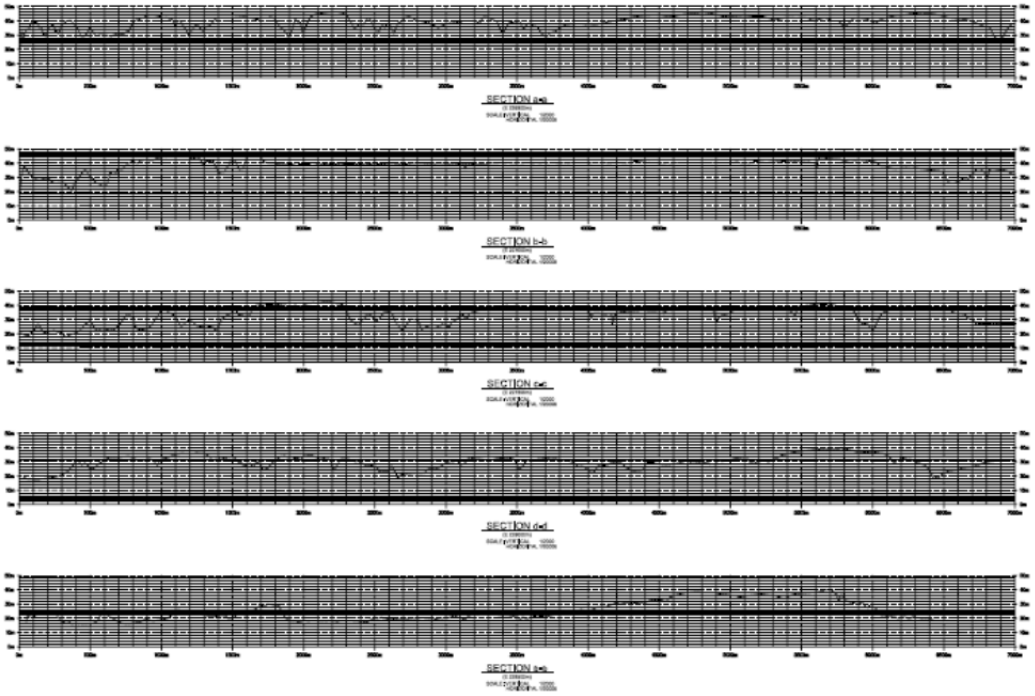


Figure 2.5.2 Sectional profiles of the surveyed area (2)

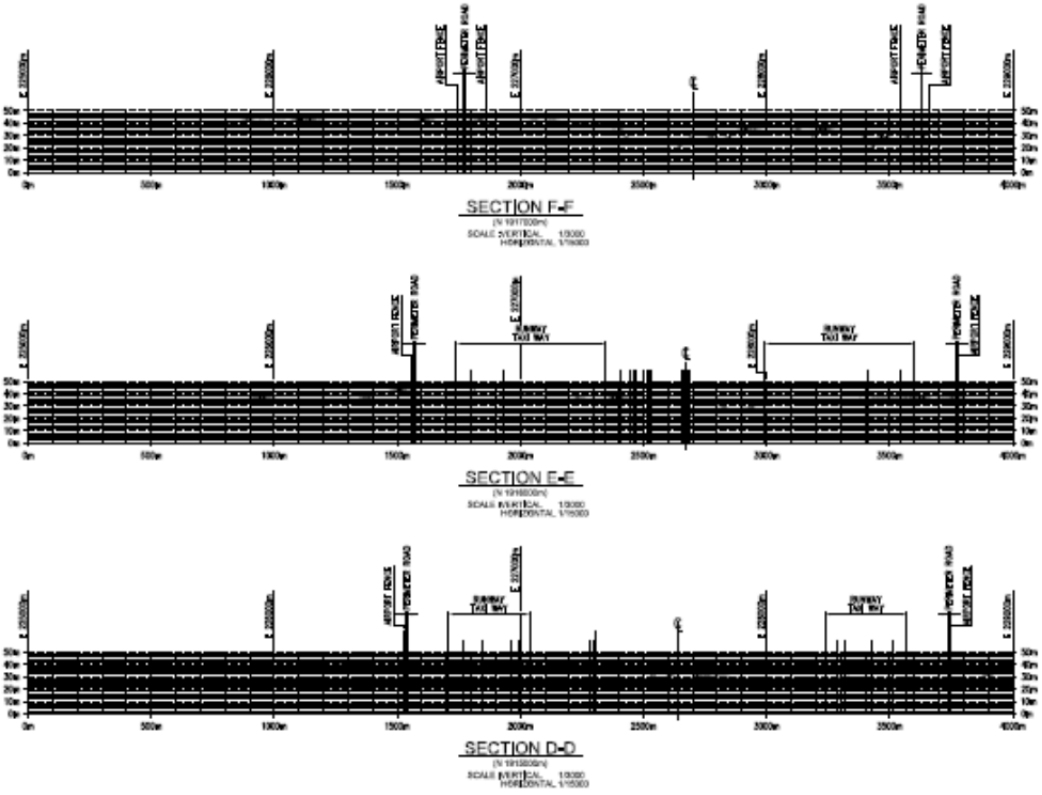


Figure 2.5.3 Sectional profiles of the surveyed area (3)

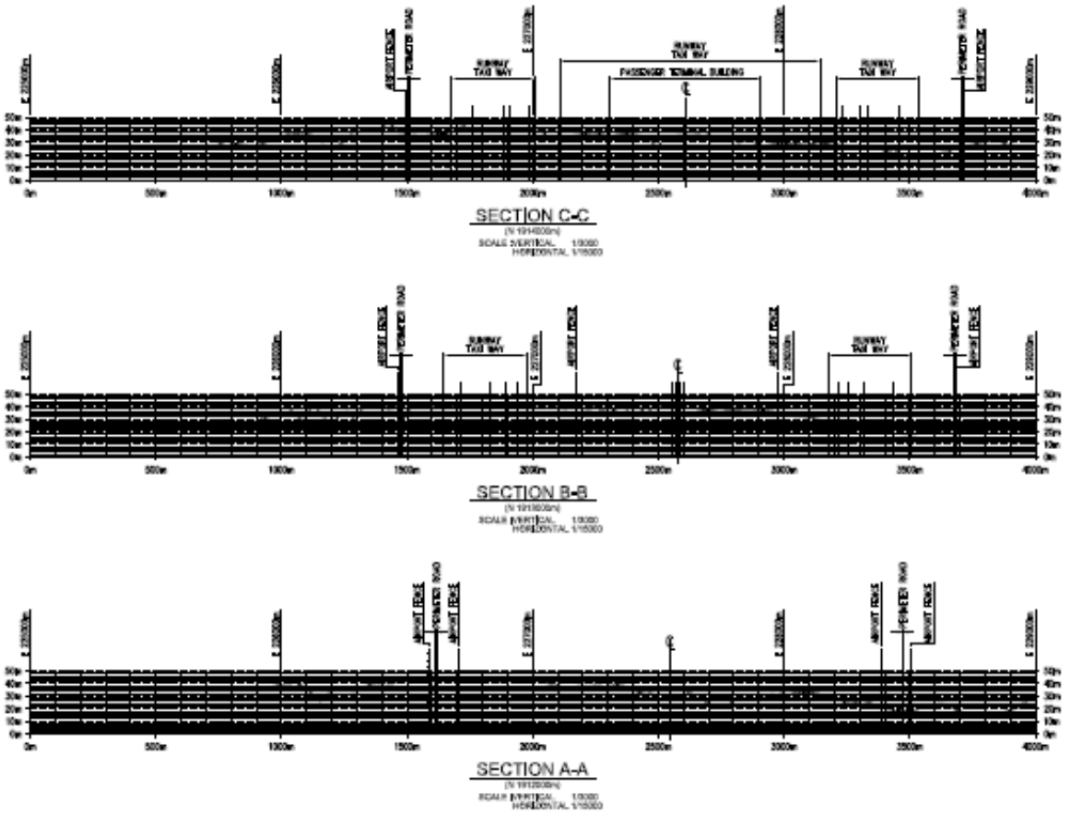


Figure 2.5.4 Sectional profiles of the surveyed area (4)

2.5.2 Geology of the Project Site

According to the geological map, geology of the project site is Oligocene to mid-Miocene rocks consisting of alteration of sandstone and shale. Mostly the shale is transformed to stiff clays by weathering process. Thicknesses of sand (stone) and clay layers vary with locations. Some are turned into lateritic soils with brown color.

In 2001, DCA conducted 9 numbers of 30m deep borings at the locations of planned airport terminal building at the time and some laboratory tests. From the results of the investigations, variation of soil condition is expected. It is difficult to explain the site stratigraphy with a single soil model. Basically the site soils consist of alteration of sand and clay layers. At the depth of 7 to 20m, continuous SPT N value larger than 50 is observed. Shallower than the depth, sandy layers are N=15～40, in medium to dense conditions and clayey layers are N>12, in stiff to very hard conditions except for near ground surface. No ground water is reported for at all 9 borings. Figure 2.5.5 shows the typical boring log.

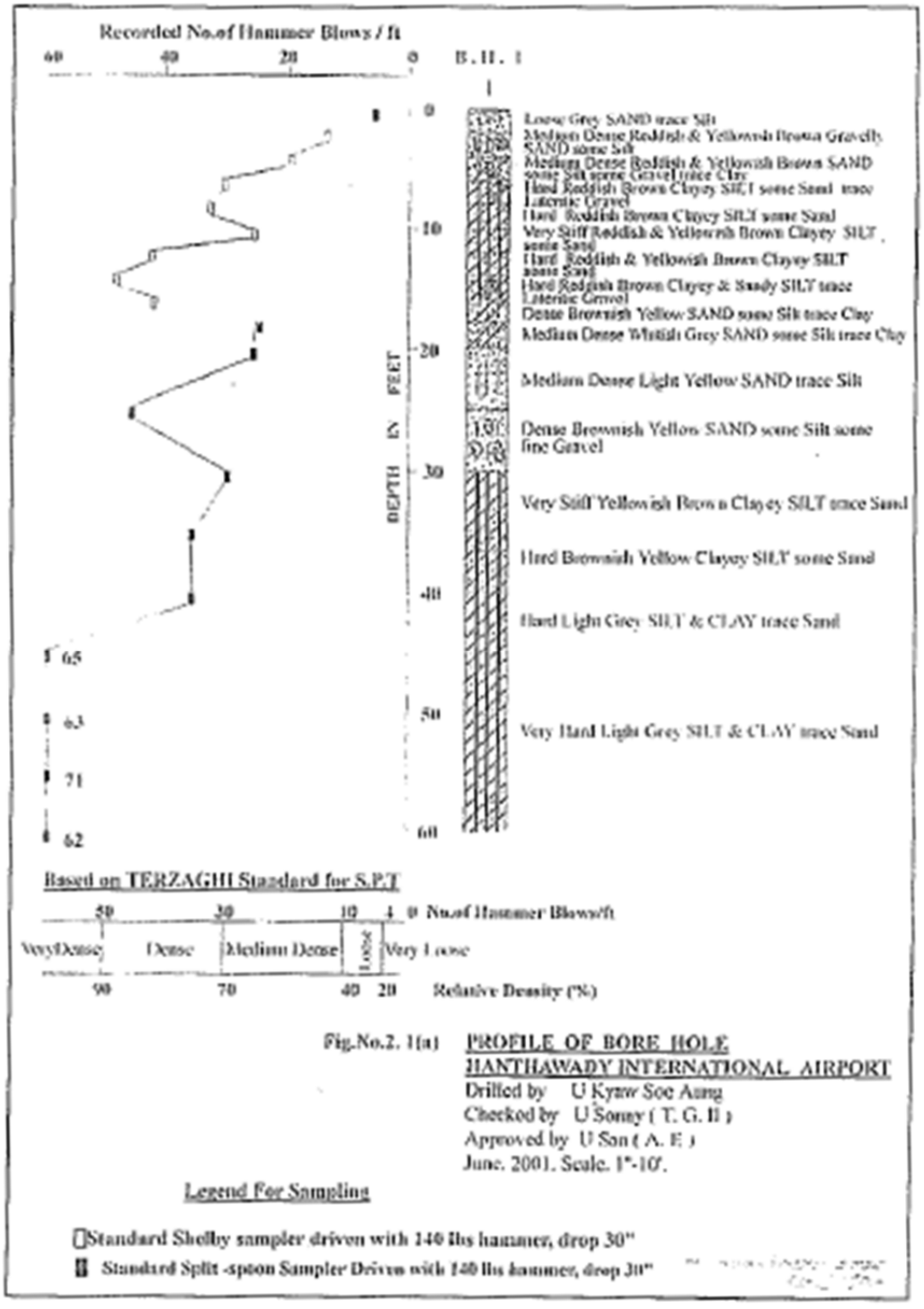


Figure 2.5.5 Typical Boring Log

2.6 Evaluation of the Airport Construction Site

The evaluation and confirmation of the conformity of the project site from various viewpoints were carried out and the conclusions of these assessments are summarized in the following paragraphs.

(1) Climate characteristics

Myanmar's Climate can be described as tropical monsoon climate. It is characterized by strong monsoon influences, features a lengthy rainy season from May through October where a substantial amount of rainfall is received; and a dry season from November through April where little rainfall is seen. During the course of the year, average temperatures show little variance, with average highs ranging from 29 to 36 °C and average lows ranging from 18 to 25 °C. Annual rainfall in the delta region is approximately 2,500 millimeters. The mean temperature and precipitation observed by Department of Meteorology and Hydrology of Myanmar (DMH) at Bago weather station during the past 10 years are presented in the below figure.

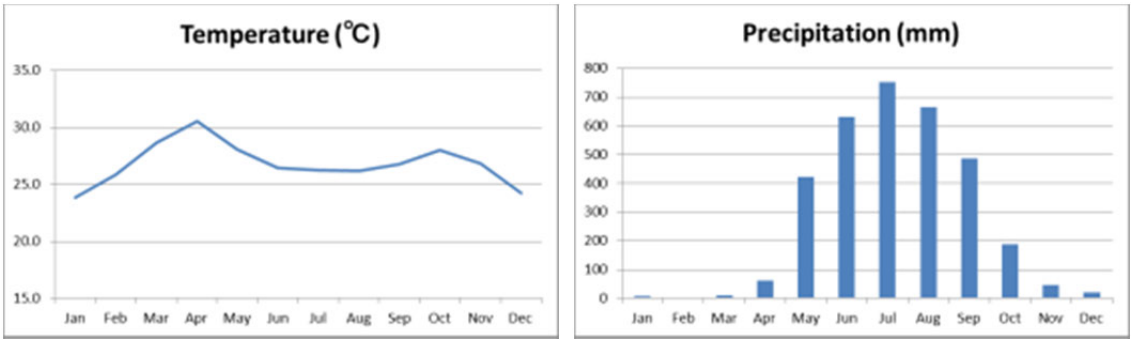


Figure 2.6.1 Mean Temperature and Precipitation at Bago (2002 – 2011) Source: DMH

The warm season lasts from March to May with an average daily high temperature above 36°C. The cold season lasts from June to September with an average daily high temperature below 31°C. The coldest day of the year is usually observed in January, with an average low of 19°C and high of 32°C.

The probability that precipitation will be observed at this location varies throughout the year. Precipitation is most likely around July, occurring in 94% of days. Precipitation is least likely around February, occurring in 2% of days. Over the entire year, the most common and severe forms of precipitation is thunderstorms which is observed during 49% of those days with precipitation.

Over the course of the year typical wind speeds vary from 0 m/s to 5 m/s (calm to gentle breeze), rarely exceeding 6 m/s (moderate breeze). The highest average wind speed of 2 m/s (light breeze) occurs around April, at which time the average daily maximum wind speed is 4 m/s (gentle breeze). The lowest average wind speed of 1 m/s (light air) occurs around January, at which time the average daily maximum wind speed is 3 m/s (light breeze).

Overall, the climate at the project site can be categorized as warm and very moderate and is ideal for the operation of international airport. However, historical data indicate that on an average, every ten years a cyclone had landfall in Myanmar. Hence an appropriate plan should be in place to deal with frequent and potentially damaging events when planning an important facilities such as HIA.

The devastation caused by Cyclone Nargis in the Ayeyarwady delta region has caught

international attention and the fact remains there that the region has a history of severe tropical storms. Over the last sixty years, eleven tropical cyclones had hit the Myanmar, out of which only two made landfall in the delta region. The cyclone tracks of the delta region in the past were analyzed and is shown in Figure 2.6.2.

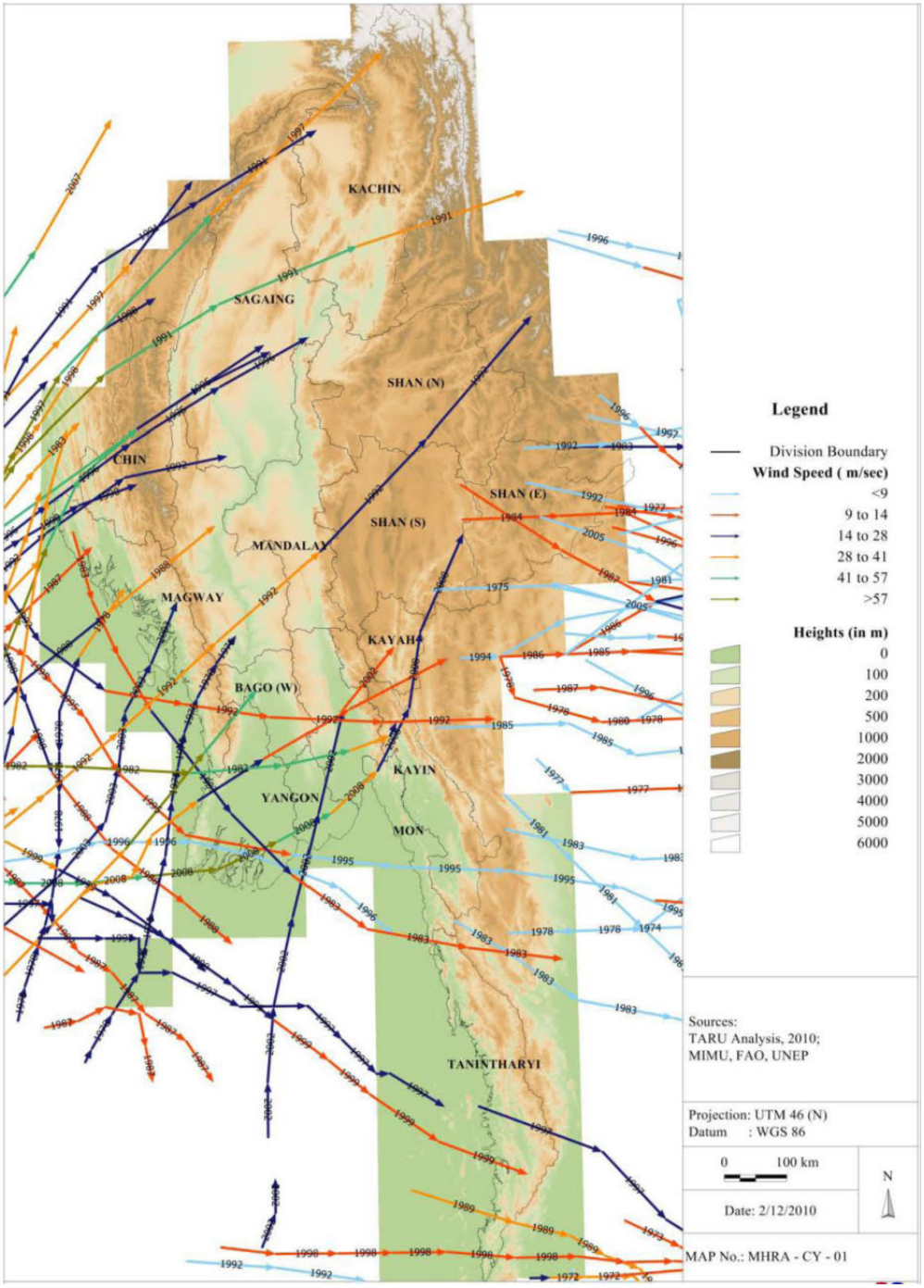


Figure 2.6.2 Cyclone and Storm Tracks (1972-2008) Source: UNDP

Cyclone Nargis hit the coast of Myanmar on 2nd May 2008 and was rated as the eighth deadliest cyclone of all time to hit the region. There are two prominent cyclone seasons for the country i.e. between April to May and October to December. These records reveal that the cyclones

move from West to East, Southwest to Northeast and also from South to North. Among those, it appears that the region experienced the cyclone conditions with the maximum wind speed of over 53m/sec.

Based on the historical cyclone records, probabilities for four return periods (25, 50, 100 and 200 years) were determined for the deltaic area of Myanmar. These are studied per mean expected lifetime for temporary structure (25 years), typical non-engineering housing (50 years), engineering building and critical building (100 years) and critical lifeline infrastructure (200 years). The results obtained are presented in Figure 2.6.3.

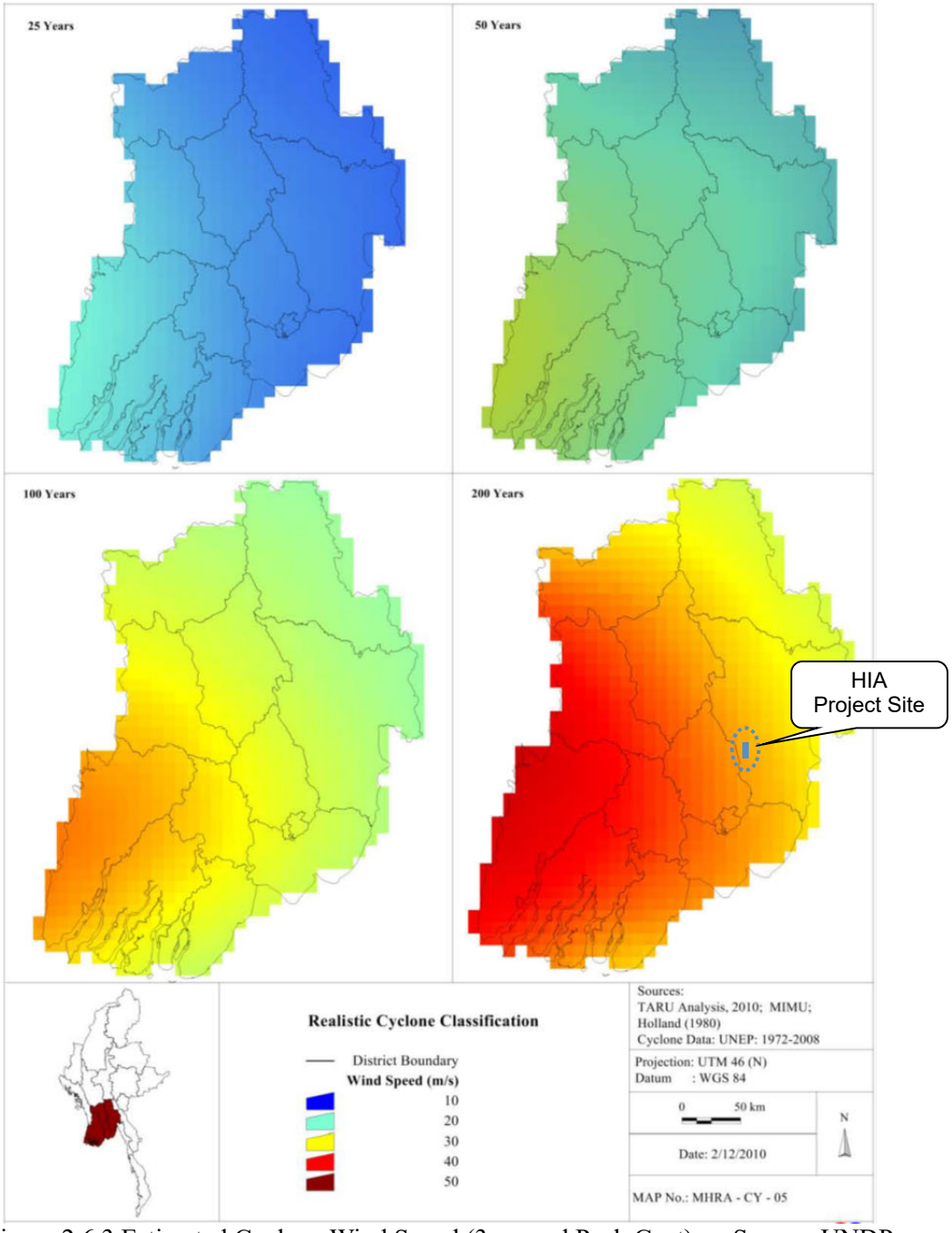


Figure 2.6.3 Estimated Cyclone Wind Speed (3 second Peak Gust) Source: UNDP

It is observed that the wind speeds are mostly higher in the Western delta provinces and it progressively diminishes across the eastern parts. The result indicates higher wind speed for Ayeyarwady division compared to Yangon and Bago divisions. The maximum probable wind speeds of Ayeyarwady division for different return periods are outlined in the table 2.6.1.

Table 2.6.1 Return Periods and Modeled Wind Speed

Return Period (years)	Modeled Highest Wind Speed Range (m/s)
25	16 to 18
50	20 to 30
100	25 to 35
200	> 35

Source: UNDP

Within the 100 year return period scenario, the Bago region exhibits the highest wind speed of around 25m/s, and the project site appears to be relatively safe against the risk of cyclone wind.

(2) Terrestrial Phenomenon

Seismic risk assessment was carried out using Probabilistic methods. Probabilistic seismic hazard assessment methods integrate the intensity of seismic hazards and their temporal probability over specified recurrence period into the analysis. This approach is accepted globally as the better informed method for seismic hazard assessment. The estimation of the probability of Peak Ground Acceleration (PGA) at specified recurrence intervals was carried out to produce maps of seismic hazard risk at appropriate scales.

The overall tectonic setup of the Myanmar region indicates that the present study area falls to the proximity of the Sagaing fault, which is an active fault of the region also passes East of Yangon city and is in the vicinity of the subductive Indian plate and the Burma platelet. The seismotectonic set up of the Delta region and its neighborhood is quite complex with a series of thrust and strike-slip faults, often changing the relative slip over their length. Towards South an active spreading zone is located under the ocean. These tectonic attributes indicate that the region is seismically active. The historical seismicity of the region suggests that the earthquake activity in both the Divisions i.e. Yangon and Bago (West) is high compared to Ayeyarwady Division. Thus, the eastern deltaic region of Myanmar is prone to higher seismic hazard risk compared to Western delta.

Referring to seismogenically active in nature, the Sagaing fault passing through Northern to Southern Myanmar is important (see Figure 2.6.4). This fault roughly trends along North-South direction. This fault is the major source of destructive earthquakes in Myanmar. It is also due to the fact that many large urban centers lie on or in margin of this fault. Out of the five major source zones for earthquakes in Myanmar, three clusters line around this large and active fault.

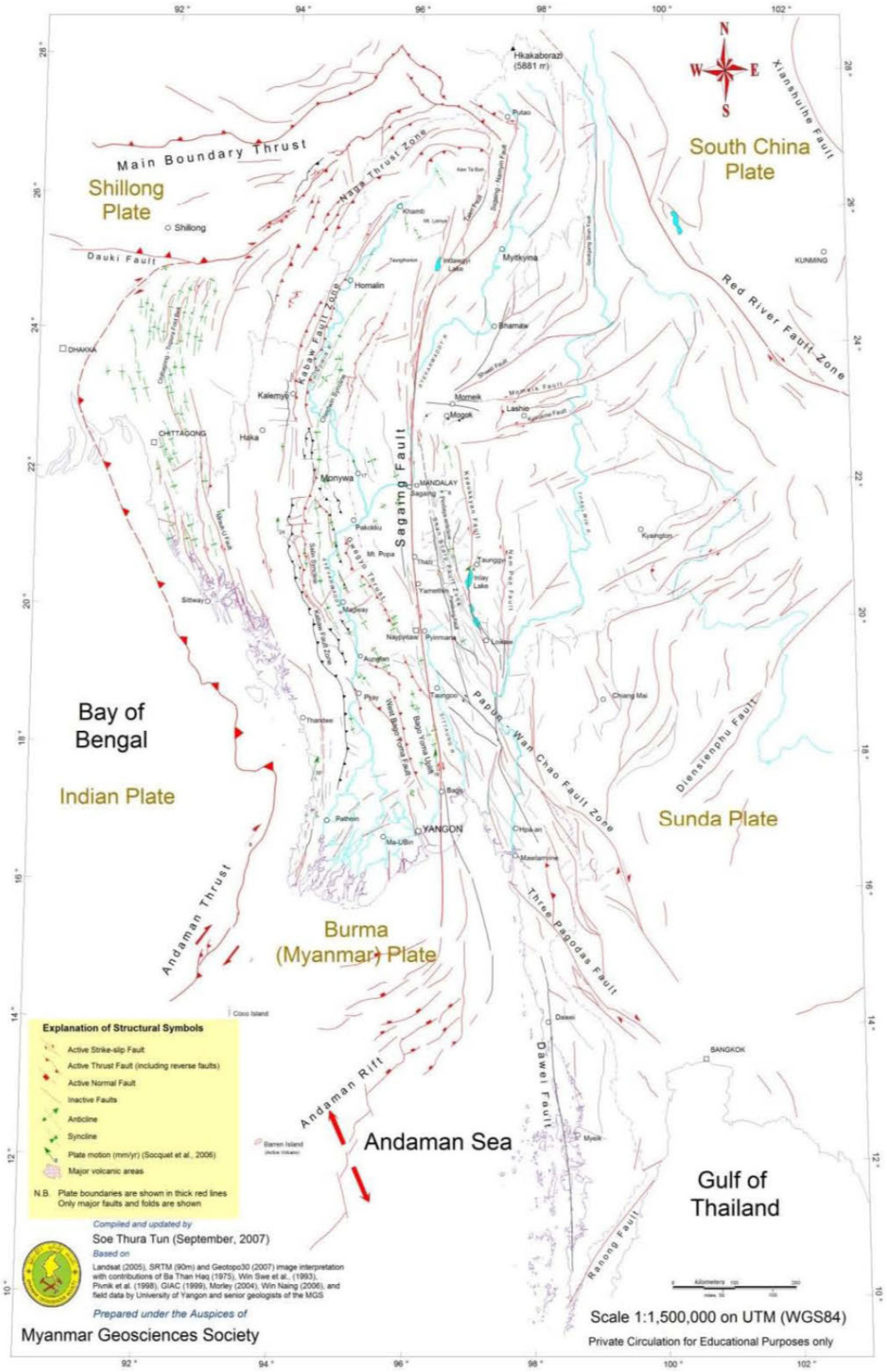


Figure 2.6.4 Tectonic Map of Myanmar Source: UNDP

The seismic activity which has resulted in the great earthquakes in Myanmar can be attributed to the two main causes,

- The continued subduction (with collision only in the North) of the northward moving Indian Plate underneath the Burma Platelet at an average rate of 4.0-6.0 cm/year.
- The northward movement of the Burma Platelet from a spreading center in the Andaman Sea at an average rate of 2.5-3.0 cm/year.

The seismic records of the region show that at least sixteen major earthquakes with magnitude > 7.0 have occurred within the territory of Myanmar in the last 170 years. Among these, are the most destructive four and the 1975 Bagan earthquake that are shown in the Table 2.6.2 in the chronological order.

Table 2.6.2 Most Destructive Earthquake Events in Myanmar

Earthquake	Date	Magnitude
Innwa (Ava) earthquake	23 March 1839	7.0
Maymyo earthquake	23 May 1912	8.0
Bago earthquake	5 May 1930	7.3
Sagaing earthquake	16 July 1956	7.0
Bagan earthquake	8 July 1975	6.8

Source: UNDP

Probabilistic seismic hazard analysis was carried out and a map has been prepared as shown by making empirical and historical approach, based on the European Macro-seismic Scale. Figure 2.6.5 provides the seismic zoning map which indicates moderate to destructive seismic zone for the region. The higher values i.e. 0.2 to 0.4 are in NE of Yangon which depicts strong to destructive zones.

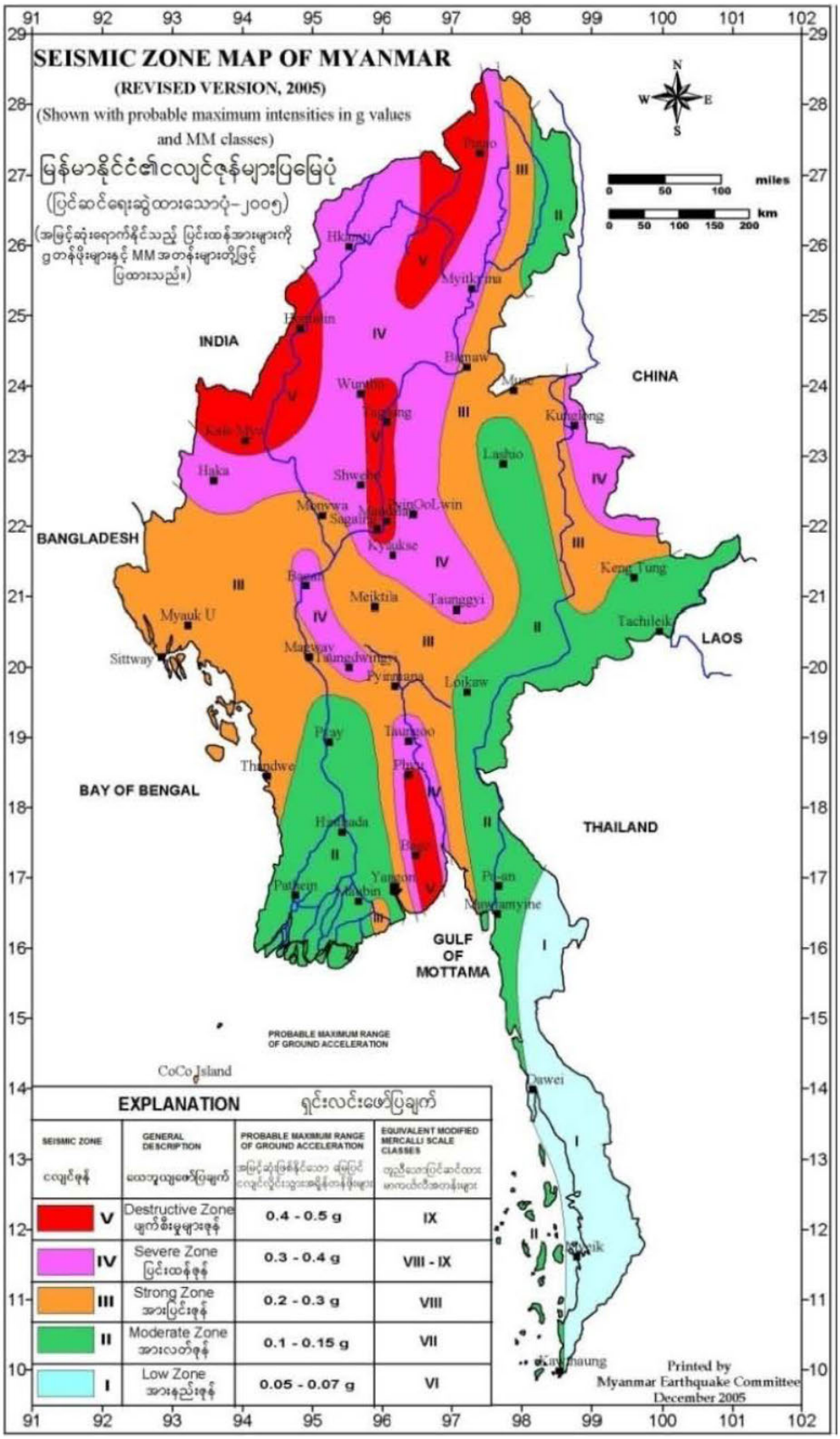


Figure 2.6.5 Seismic Zone Map of Myanmar Source: UNDP

Peak Ground Acceleration (PGA) for the seismic event for four return periods (25, 50, 100 and 200 years) was determined. These were based on the mean expected lifetime for temporary structure (25 years), typical non-engineering housing (50 years), engineering building and critical building (100 years) and critical lifeline infrastructure (200 years). The PGAs for different recurrence intervals obtained in the present study are shown in Figure 2.6.6.
The results of the analysis indicate the PGA values are <0.07/0.1g for all the three districts i.e. Yangon, Bago and Ayeyarwady for the 25 and 50 year return period. The PGA is between 0.15 to 0.30g in Yangon and Bago for the 100 year return period but for the 200 year return period it is >0.30g for most of the Yangon district and Southern Bago.

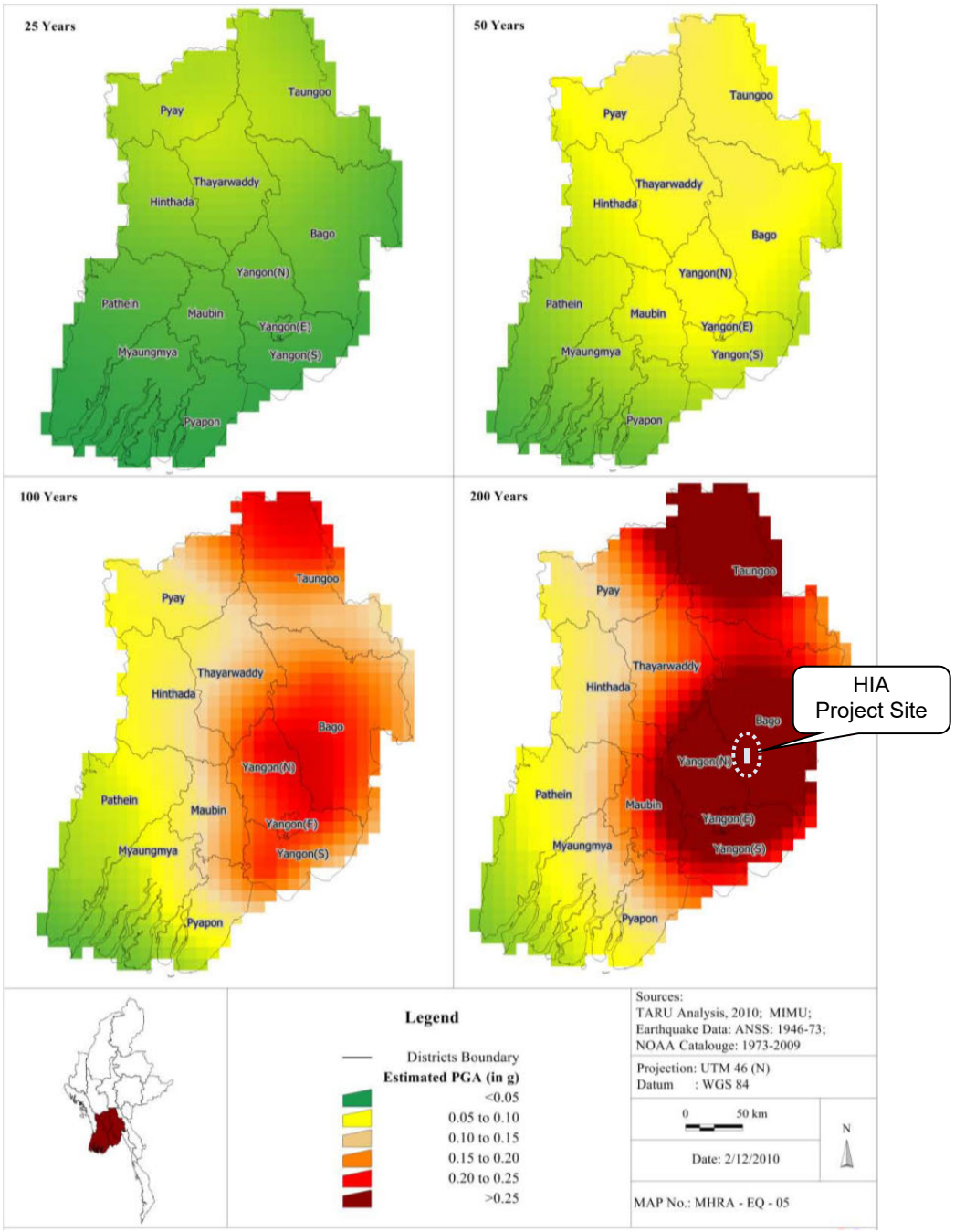


Figure 2.6.6 Estimated PGA (25, 50, 100 and 200 Years Return Period) Source: UNDP

The results indicate that higher values of PGA are distributed mainly in the Yangon and Bago divisions. PGA 0.30g, as the highest value expected in the 100 years return period in Yangon and Bago divisions can be rated between VIII and IX in EMS98 scale which are expressed in the below table.

Table 2.6.3 EMS98 Scale

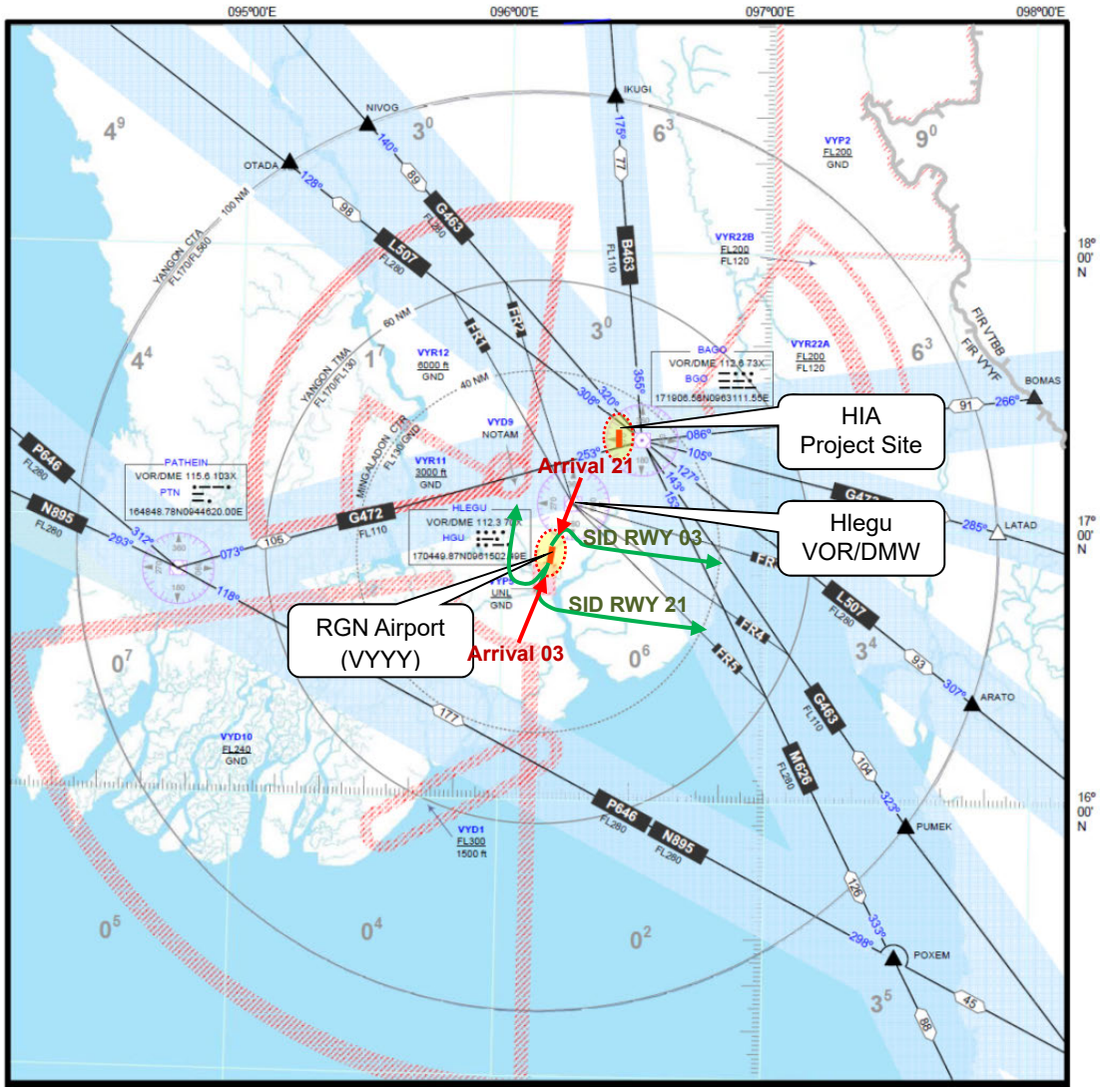
EMS 98 Scale	Observation	Possible PGA
VIII. Heavily Damaging	Furniture may be overturned. Many ordinary buildings suffer damage: chimneys fall, large cracks appear in walls and a few buildings may partially collapse.	0.24 g
IX. Destructive	Monuments and columns fall or are twisted. Many ordinary buildings partially collapse and a few collapse completely	0.36 g

Source: Seismic Vulnerability Scale Risk, EMS-98

These facts are significant as the focused division is densely populated and one of the most important places for commercial activities and industries of Myanmar. When designing the airport facilities for HIA, thorough considerations for risks related to the earthquake should be indispensable. Japanese technology for quake-resistant engineering may have advantage and would be good to apply for the facilities in HIA.

(3) Airspace

The current area chart around Yangon airport (ICAO: VYYY) of Aeronautical Information Publication (AIP) of Myanmar is presented in Figure 2.6.7.



Legend ←:Departure →:Arrival Source: AIP Myanmar, DCA

Figure 2.6.7 Area Chart around Yangon

As shown in the chart, right near by the HIA site, there is a VOR/DME at Bago (see Figure 2.6.8), but it is for en-route (overflight) marker and has nothing to do with the new airport.

Figure 2.6.8 Bago VOR/DME

All the arriving aircraft to Yangon airport with conventional navigation equipment will descend through the HLEGU VOR/DME and then approach to Yangon airport (VYYY) and land on RWY 21 using ILS or go pass the VYYY, turn back and land on RWY 03.

Newer aircraft with Global Navigation Satellite System (GNSS) equipment may pass by HLEGU VOR/DME and make gentle maneuver to approach to VYYY RWY21 or directly come into RWY03 from southbound, according to the Standard Instrument Approach (STAR) of GNSS chart which will be published soon.

On the other hand, there is no departure procedure in current AIP, but in stead, there are Standard Instrument Departure (SID) chart for GNSS equipped aircraft. According to the new SIDs, departing aircraft using RWY 03 will soon maneuver slightly to right and ascend toward eastbound. Departing aircraft will make maneuver soon after taking off the RWY 21 then ascend toward its targeted air route.

These air routes are illustrated on the Figure 2.6.7.

There are some Yangon centered circles and fan-shaped sectors scattered over this region which indicate the prohibited area; however, northern airspace and southern airspace adjacent to the HIA project site is opened and do not have such restriction for civil airport operation.

When HIA project is planned, the aforesaid existing operations, airspaces and air route may need to be reviewed and rearranged for the southbound operation of the runway of HIA.

It is confirmed that DCA will carry out the work related to these rearrangement of air spaces, air routes and arrival/departure procedures.

(4) Geological Formation

As described in the Chapter 2.4, the project site is flat in general, and specious land is secured for the HIA project. There is no building or terrain having conflicts with the obstacle limitation surface.

Backed up by the Ministry of Industry, an industrial park is being formed at the southern vicinity of the HIA project site; however, Ministry of Transport and DCA have issued official notices to the relevant ministries, organizations and regional government of Bago city that the building development plan must be submitted before the commencement of project, so that none of such building interferes the obstacle limitation surface and airport operation will be allowed and built.

2.7 Planning of the Airport Facilities

2.7.1 Handling Capacity

(1) Development Plan

The development plan for the new Hanthawaddy International Airport (HIA) is established based on the necessary period up to opening of the airport, condition of RFP by DCA, and so forth.

a) Phase 1

The Phase 1 is aiming the opening of the airport, and the capacity of Phase 1 is defined as the demand of five years after the opening of the airport. The opening year is assumed in the 2022, considering the time generally required for Yen loan ODA project as indicated below:

- ✓ Up to loan agreement six months
- ✓ Selection of design consultant nine months
- ✓ Detail design nine months
- ✓ Selection of contractor ten months
- ✓ Construction and operational readiness three years and six months

(6 years and 4 months)

The demand in 2027 that is five years after the opening of the airport is forecasted as 13,129 thousand passengers including 12,504 thousand international passenger and 625 thousand domestic passenger. Based on the future demand, the capacity of Phase 1 is defined as 12 million passengers per annum (mppa) for international and 0.6 mppa for domestic.

b) Phase 2

DCA has defined in the RFP Appendix 3, the Phase 2 development target as 30 mppa. Based on the forecasted demand, international and domestic passengers will reach 30 mppa including 28,951 thousand international passenger and 1,644 thousand domestic passenger in 2041. Therefore, the capacity of Phase 2 is designed as 30 mppa including 28 mppa for international and 2 mppa for domestic.

c) Final Phase

The capacity of final phase is designed as 60 mppa including 50 mppa for international and 10 mppa for domestic, based on the air traffic demand in 2052. This matches the end of the concession period of HIA project which is 30 years, as year of 2052 is 30th year after opening of new airport.

Table 2.7.1 Designed Capacity of Phased Development

	Handling Capacity		
	Total	International	Domestic
Phase 1	12.6 mppa	12 mppa	0.6 mppa
Phase 2	30 mppa	28 mppa	2 mppa
Final Phase	60 mppa	50t mppa	10 mppa

(2) Aircraft Movements

Based on the process of calculation described in Section 2.2.5, aircraft movements are calculated as shown in Table 2.7.2-2.7.4.

Table 2.7.2 International Daily Aircraft Movements by Destination

(12 mppa)

		Design Day Passengers	Large Jet (310)	Middle Jet (240)	Small Jet (160)	Propeller (70)	Total
Annual Passengers 12,000 thousand	ASEAN	20,280	15	4	139	17	175
	Northeast Asia	15,720	35	9	59	0	103
	Middle East	2,480	11	0	0	0	11
	Europe	1,660	8	0	0	0	8
	Oceania	1,240	6	0	0	0	6
		41,380	75	13	198	17	303

(30 mppa)

		Design Day Passengers	Large Jet (310)	Middle Jet (240)	Small Jet (160)	Propeller (70)	Total
Annual Passengers 28,000 thousand	ASEAN	22,030	43	8	94	18	163
	Northeast Asia	37,640	102	20	108	0	230
	Central Asia	920	1	3	3	0	7
	Southwest Asia	8,260	22	4	24	0	50
	Middle East	9,180	39	4	0	0	43
	Europe	10,100	43	4	1	0	48
	Oceania	2,750	11	2	0	0	13
	Africa	920	2	3	0	0	5
		91,800	263	48	230	18	559

(60 mppa)

		Design Day Passengers	Large Jet (310)	Middle Jet (240)	Small Jet (160)	Propeller (70)	Total
Annual Passengers 50,000 thousand	ASEAN	37,500	73	13	161	31	278
	Northeast Asia	64,060	174	34	183	0	391
	Central Asia	1,560	1	5	4	0	10
	Southwest Asia	14,060	38	8	41	0	87
	Middle East	15,630	67	7	0	0	74
	Europe	17,190	74	7	2	0	83
	Oceania	4,690	19	4	0	0	23
	Africa	1,560	4	5	0	0	9
		156,250	450	83	391	31	955

Note 1: Design Day Passengers are indicated in Table 2.7.5.

Note 2: Load factor is set as 70%.

Table 2.7.3 Domestic Daily Aircraft Movements by Route

(12 mppa)

	Route	Design Day Passengers	Large Jet (310)	Small Jet (160)	Propeller (70)	Total
Annual Passengers 600 thousand	Mandalay	870		8		8
	Nyaung-u	650		6		6
	Heho	650		6		6
		2,180		20		20

(30 mppa)

	Route	Design Day Passengers	Large Jet (310)	Small Jet (160)	Propeller (70)	Total
Annual Passengers 2,000 thousand	Mandalay	1,890	6	6		12
	Nyaung-u	1,450	4	6		10
	Heho	1,380	4	4		8
	Thandwe	510		4		4
	Dawe	510		4		4
	Sittwe	440		4		4
	Naypyidaw	290		2		2
	Others	800		4	8	12
		7,270	14	34	8	56

(60 mppa)

	Route	Design Day Passengers	Large Jet (310)	Small Jet (160)	Propeller (70)	Total
Annual Passengers 10,000 thousand	Mandalay	8,960	28	24		52
	Nyaung-u	6,900	22	18		40
	Heho	6,550	22	18		40
	Thandwe	2,410		22		22
	Dawe	2,410		22		22
	Sittwe	2,070		18		18
	Naypyidaw	1,380		12		12
	Others	3,790		16	38	54
		34,480	72	150	38	260

Note 1: Design Day Passengers are indicated in Table 2.7.5.
Note 2: Load factor is set as 70%.

Table 2.7.4 Daily Freighter Movements

		12 mppa	30 mppa	60 mppa
International Freight Volume	(thousand ton)	63	142	234
Share Transported by Freighter		25%		
Freight Volume by Freighter	(thousand ton)	16	36	59
Cargo Volume per Flight	(ton)	20		
Daily Movements	Total	3	6	10
	Large Jet	3	5	8
	Middle Jet	0	1	2

(3) Peak Demand

Based on the process of calculation described in Section 2.2.6, peak demands are calculated as shown in Table 2.7.5-2.7.7.

Table 2.7.5 Peak Day Passengers

International

Year	Annual Passengers (thousand)	Design Day Ratio	Design Day Passengers
12 mppa	12,000	1 / 290	41,380
30 mppa	28,000	1 / 305	91,800
60 mppa	50,000	1 / 320	156,250

Domestic

Year	Annual Passengers (thousand)	Design Day Ratio	Design Day Passengers
12 mppa	600	1 / 275	2,180
30 mppa	2,000	1 / 275	7,270
60 mppa	10,000	1 / 290	34,480

Table 2.7.6 Peak Hour Passengers

International

Year	Design Day Passengers		Design Peak Hour Ratio	Design Peak Hour Passengers
12 mppa	41,380	Departure	0.0773	1,600
		Arrival	0.0850	1,760
		Dep+Arr	0.0650	2,690
30 mppa	91,800	Departure	0.0705	3,230
		Arrival	0.0764	3,510
		Dep+Arr	0.0550	5,050
60 mppa	156,250	Departure	0.0682	5,330
		Arrival	0.0735	5,740
		Dep+Arr	0.0520	8,130

Domestic

Year	Design Day Passengers		Design Peak Hour Ratio	Design Peak Hour Passengers
12 mppa	2,180	Departure	0.3722	410
		Arrival	0.2759	300
		Dep+Arr	0.1710	370
30 mppa	7,270	Departure	0.1617	590
		Arrival	0.1463	530
		Dep+Arr	0.1030	750
60 mppa	34,480	Departure	0.0906	1,560
		Arrival	0.1025	1,770
		Dep+Arr	0.0790	2,720

Note: Design Peak Hour Passengers = Design Day Passengers × 1/2 × Design Peak Hour Ratio

Table 2.7.7 Peak Hour Movements

International

Year	Daily Movements		Design Peak Hour Ratio	Design Peak Hour Movements
12 mppa	303	Departure	0.0788	12
		Arrival	0.0829	13
		2 way	0.0675	20
30 mppa	559	Departure	0.0712	20
		Arrival	0.0750	21
		2 way	0.0583	33
60 mppa	955	Departure	0.0675	32
		Arrival	0.0712	34
		2 way	0.0538	51

Domestic

Year	Design Day Passengers		Design Peak Hour Ratio	Design Peak Hour Movements
12 mppa	20	Departure	—	2
		Arrival	—	2
		2 way	—	2
30 mppa	56	Departure	0.2917	8
		Arrival	0.2121	6
		2 way	0.1696	10
60 mppa	260	Departure	0.0908	12
		Arrival	0.0950	12
		2 way	0.0730	19

International+Domestic

Year	Daily Movements		Design Peak Hour Ratio	Design Peak Hour Movements
12 mppa	323	2 way	0.0727	23
30 mppa	615	2 way	0.0629	39
60 mppa	1,215	2 way	0.0576	70

(4) Air Cargo Demand

Based on the process of calculation described in Section 2.2.7, air cargo demand is calculated as shown in Table 2.7.8-2.7.9.

Table 2.7.8 International Cargo Demand

	International Cargo (thousand ton)					
	Yangon Metropolitan		Yangon Airport		Hanthawaddy Airport	
Future Cargo Demand	2014(Actual)	24	2014(Actual)	24		
	12 mppa	67	12 mppa	4	12 mppa	63
	30 mppa	151	30 mppa	9	30 mppa	142
	60 mppa	249	60 mppa	15	60 mppa	234

Table 2.7.9 Domestic Cargo Demand

	Domestic Cargo (thousand ton)					
	Yangon Metropolitan		Yangon Airport		Hanthawaddy Airport	
Future Cargo Demand	2014(Actual)	0	2014(Actual)	0		
	12 mppa	49	12 mppa	43	12 mppa	6
	30 mppa	80	30 mppa	69	30 mppa	11
	60 mppa	116	60 mppa	54	60 mppa	62

(5) Airport Visitor

Based on the process of calculation described in Section 2.2.8, airport visitor are calculated as shown in Table 2.7.10.

Table 2.7.10 Airport Visitors

		12 mppa	30 mppa	60 mppa
Annual International Passengers	(thousand)	12,000	28,000	50,000
Annual Domestic Passengers	(thousand)	600	2,000	10,000
Annual Total Passengers	(thousand)	12,600	30,000	60,000
Daily International Passengers		41,380	91,800	156,250
Daily Domestic Passengers		2,180	7,270	34,480
Daily Total Passengers		43,560	99,070	190,730
Daily Well-wisher/Welcomer		17,420	39,630	76,290
Daily Airport Staff		3,050	6,930	13,350

(6) Summary of Future Demand at HIA

The future traffic demand from the various aspects at HIA is summarized as shown in Table 2.7.11.

Table 2.7.11 Summary of Forecasted Future Demand at HIA

				12 mppa	30 mppa	60 mppa
Annual	Passenger (thousand)	Int'l		12,000	28,000	50,000
		Dom		600	2,000	10,000
		Total		12,600	30,000	60,000
	Cargo (thousand ton)	Int'l		63	142	234
		Dom		6	11	62
		Total		69	153	296
	Movement (thousand)	Int'l		95	184	339
		Dom		6	16	83
		Freighter		1	2	4
		Total		102	202	426
Peak Day	Passenger	Int'l		41,380	91,800	156,250
		Dom		2,180	7,270	34,480
		Total		43,560	99,070	190,730
	Movement	Int'l		303	559	955
		Dom		20	56	260
		Freighter		3	6	10
		Total		324	621	1,225
Peak Hour	Passenger	Int'l	Departure	1,600	3,230	5,330
			Arrival	1,760	3,510	5,740
			Dep+Arr	2,690	5,050	8,130
		Dom	Departure	410	590	1,560
			Arrival	300	530	1,770
			Dep+Arr	370	750	2,720
	Movement	Int'l		20	33	51
		Dom		2	10	19
		Int'l + Dom		23	39	70

Note: Int'l: International, Dom: Domestic

2.7.2 Civil Works

(1) Design Aircraft

Airfield facilities such as runway and taxiways are difficult to shift the location because of its nature. It is reasonable to plan the layout of the facilities such as separation between facilities and width to accommodate maximum aircraft size in current market to avoid heavy investment to modify these facilities. Although there is no plan to operate such large aircraft in regular bases in near future, as the new airport will be a gateway airport to the country, such large aircraft may visit the airport non-regularly. Considering the situation, airfield layout is planned to adopt Code 4F aircraft such as A380 and B747-8 series. However, Code 4E aircraft is also adopted to design pavement strength and Rescue and Fire Fighting Services to reflect future operational conditions.

Runway approach category of instrument precision approach is adopted for planning.

(2) Runway

a) Runway Direction

The statistics of wind available at the time of PPP F/S was monthly maximum wind direction and velocity from 2002 to 2011 at Bago Station of Department of Meteorology and Hydrology. Although it is not enough to prepare wind rose to calculate runway usability factor, this data is analyzed to confirm the runway direction.

The figure below left shows ratio of monthly maximum wind distribution. In the past 10 years, stronger wind than 12 knots, was very rare and it was only 2 % of total data. Most of the month, the wind was calm so it is reasonable to judge that wind in Bago is quite moderate.

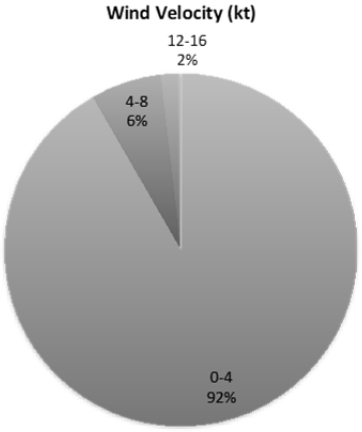


Figure 2.7.1 Wind Velocity Ratio

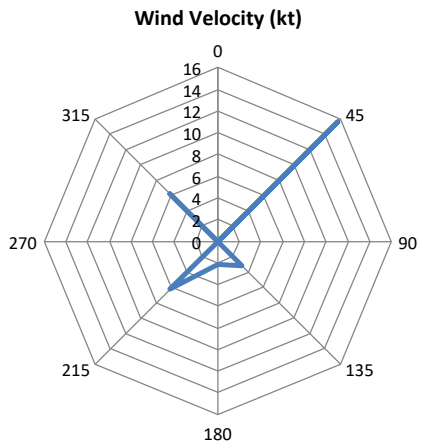


Figure 2.7.2 Maximum Wind Velocity and Direction

Figure above right shows strong wind direction distribution. Strong wind was from northeast and prevailing wind direction is northeast to southwest. The maximum wind velocity for last 10 years was 15.6 knot from the northeast. If the runway direction is 18/36, north to south, cross wind components of 15.6 knot is 11.1 knot and this will not affect commercial jet aircraft operation as maximum permissible cross wind for aircraft where reference field length is 1,500 m or over is 20 kt. Even for small propeller aircraft, occurrence of this strong wind is very unlikely so that runway direction of 18/36 is considered adequate as the main runway direction.

b) Number of Runway

Table below shows peak hour aircraft movements from the result of air traffic demand forecast. When annual passenger will be 12 mppa, peak hour aircraft movements will be 23. Peak hour movements will be 41 when annual passenger reaches 30 million.

Table 2.7.12 Peak Hour Aircraft Movements

Annual Passengers	Daily Peak Hour Movements
12 mppa	23
30 mppa	39

Table below shows hourly runway capacity of single runway airports, which annual passenger was more than approximately 10 million in Europe and USA. The largest recorded capacity of a single runway is Gatwick, which is 55 movements per hour. Most of airports have capacity of 40 or more movements per hour. Airports with low capacity have some difficulties such as lack of rapid exit taxiway in Istanbul/Sabiha Gokcen airport and Alicante airport. As these example proves, it is reasonable to say that with adequate facilities such as taxiway system and air traffic control, the new airport can handle aircraft movements of the first and second phase with a single runway. Construction of the second runway should be considered when peak hour movements exceed 40 movements per hour.

Table 2.7.13 Published runway capacity in single runway airports in Europe and USA

Airport/Runway	Country	Max Arrival	Max Departure	Max Global	Passenger 2014	Source
Gatwick	UK	36	35	55	38,103,667	*3
Istanbul/Sabiha Gokcen	Turkey	14	25	32	23,508,141	*1
Stansted	UK	33	33	50	19,941,593	*3
San Diego	USA	-	-	48	18,700,000	*2
Lisboa	Portuguese	23	23	40	18,142,035	*1
Genève	Switzerland	25	25	40	14,436,000	*1
Alicante	Spain	18	18	30	10,065,873	*1
Stuttgart	German	35	35	48	9,728,710	*1
Tenerife	Spain	21	21	33	9,176,274	*1
Milano Linate	Italy	20	20	34	9,031,855	*1

*1https://www.eurocontrol.int/airport_corner_public
*2https://www.faa.gov/airports/planning_capacity/profiles/media/Airport-Capacity-Profiles-2014.pdf
*3http://www.acl-uk.org/

c) Runway Length

Runway length requirements were calculated based on aircraft manufacture's aircraft characteristics for airport planning. Runway length and take off weight chart of ISA + 15 degrees were applied to plan at the temperature of 37.3 deg. C which is reference temperature of Yangon Airport. Altitude of 44 m was used as the reference elevation of the new airport. Aircraft expected to operate in the new airport was selected. Because longest route from the new airport will be to London (in reference to that currently London is the longest route to/from Bangkok Airport), range of 5,600 miles was used to calculate break release weight. In most of the case, the weight is same as the maximum takeoff weight.

According to ICAO Aerodrome Design Manual, runway length should be increased at the rate

of 1 per cent per every 1 deg. C. by which aerodrome reference temperature exceeds the temperature in the standard atmosphere for the aerodrome elevation. Temperature of standard atmosphere value at the altitude of 44 m is 14.7 deg. C. Calculation of temperature correction factor is shown below:

$$1 + (37.3 - 14.7 - 15) \times 0.01 = 1.076$$

The runway length should be increased at the rate of 7 per cent per 300 m. Calculation of correction factor for altitude is shown below:

$$1 + 0.07 \times 44 \div 300 = 1.010$$

The combined correction factor of temperature and the altitude is:

$$1.076 \times 1.010 = 1.087$$

Calculated runway length by the aircraft characteristics was increased by 1.087. Table below shows the results of the calculation.

Table 2.7.14 Runway Length Requirement

Aircraft Type	Takeoff Weight (kg)	Runway Length from Chart	Runway Length after correction (m)
B777-300ER	354,047	3,200	3,478
B777-300	299,370	3,300	3,587
B747-400	386,000	3,240	3,522
B747-8	447,696	3,250	3,532
B787-8	277,930	3,260	3,543
A340-500	368,000	3,250	3,532
A340-600	465,000	3,260	3,543

Source: JICA Study Team

From above table, runway length of 3,600 m is adequate as the runway length requirements.

d) Runway Separation

In accordance with ICAO Doc 4444 PANS ATM and Doc 9643, additional air navigation equipment and air traffic procedure are required for independent parallel approach when distance between the two open parallel runways is not less than 1,525 m so that distance between two open parallel runways should be not less than 1,525 m.

e) Other Physical Characteristics of the Runway

Physical characteristics of the runway is summarized in the table below:

Table 2.7.15 Summary of Physical Characteristics of Runway

Item	Dimensions	Reference
Runway Width	60 m	3.1.10 Annex 14 / Code 4F
Longitudinal Slope	Not exceed 1 %	3.1.13 Annex 14 / Code 4

Transverse Slope	1.5 %	3.1.19 Annex 14 / Code F
Overall width of Runway Shoulder	75 m	3.2.3 Annex 14 / Code F
Transverse slope on runway shoulders	Not exceed 2.5 %	3.2.4 Annex 14
Runway Strip Length	60 m from runway threshold	3.4.2 Annex 14 / Code 4
Runway Strip Width	300 m	3.4.3 Annex 14 / Code 4
No fixed objet area in the runway strip	77.5 m	3.4.7 Annex 14 / Code F
Grading area of the runway strip	75 m	3.4.8 Annex 14 / Code 4
Runway End Safety Area Width	120 m	3.5.5 Annex 14
Runway End Safety Area Length	240 m from the end of t he runway strip	3.5.4 Anne 14 / Code 4

Source: ICAO Annex 14

(3) Taxiways

a) Physical Characteristics

Physical characteristics of taxiway for code 4F aircraft is summarized in the table below.

Table 2.7.16 Summary of Physical Characteristics of Taxiway

Item	Dimensions	Reference
Clearance distance from aircraft outer main wheel and taxiway edge	4.5 m	3.9.3 Annex 14 / Code F
Width	25 m	3.9.5 Annex 14 / Code F
Minimum Separation Distances		
- Runway center line to taxiway center line	190 m	Table 3.1 Annex 14 / Code 4F Instrument Runway
	97.5 m	Table 3.1 Annex 14 / Code F
- Taxiway center line to taxiway center line	80 m	Table 3.1 Annex 14 / Code E
- Taxiway, other than aircraft stand taxilane, center line to object	57.5 m	Table 3.1 Annex 14 / Code F
	47.5 m	Table 3.1 Annex 14 / Code E
-Aircraft stand taxilane centre line to object	50.5 m	Table 3.1 Annex 14 / Code F
	42.5 m	Table 3.1 Annex 14 / Code E
Transverse Slope	Not exceed 1.5 %	3.9.12 Annex 14 / Code F
Rapid exit taxiway radius	At least 550 m	3.9.16 Annex 14 / Code 4
Overall taxiway shoulder width	60 m	3.10.1 Annex 14 / Code F
	44 m	3.10.1 Annex 14 / Code E
Taxiway Strip Width	115 m	Table 3.1 Annex 14 / Code F
	95 m	Table 3.1 Annex 14 / Code E
Taxiway Strip grading area	30 m from center line	3.11.4 Annex 14 / Code F
	20 m from center line	3.11.4 Annex 14 / Code E
Slope of taxiway strip	Not exceed 2.5 %	3.11.5 Annex 14 / Code F

Source: ICAO Annex 14

b) Taxiway Layout

Considering that there will be no regular flight of Code 4F aircraft in near future, it is reasonable to limit the movement area such as taxiway route by aircraft type. Other area without operation of Code 4F aircraft can be designed for Code 4E aircraft.

In addition, adequate rapid exit taxiways should be planned to maximize runway capacity. Double parallel taxiways are planned in the first phase to avoid nose-to-nose situation on the parallel taxiway and to consider new airport examples in Japan such as Centrair and Kansai International Airport. Design capacity of Centrair and Kansai International Airport was 15 mppa and 20 mppa, respectively, at the opening and complete dual parallel taxiways were provided from the beginning at both airports.

(4) Aprons

a) Loading Spots

Number of aircraft parking spots were calculated by the following formula:

$$N = \sum Ai \times Ti \times 1.2 \div 60 + S$$

Where, N: Number of Parking Spot
A: Number of Landings (half of aircraft movements) during Peak Hour
T: Spot Occupancy Time (minutes)
S: Number of Reserved Spot

Table below summarized number of movements and landings during peak hour as the result of air traffic demand forecast.

Table 2.7.17 Peak Hour Movements and Landings (International)

(12 mppa)

	Large Jet	Middle Jet	Small Jet	Propeller	Total
Peak Day Movements	75	13	198	17	303
Peak Hour Ratio	0.0675				
Peak Hour Movements	5.1	0.9	13.4	1.1	20.5
Peak Hour Landings	2.5	0.4	6.7	0.6	10.2

(30 mppa)

	Large Jet	Middle Jet	Small Jet	Propeller	Total
Peak Day Movements	263	48	230	18	559
Peak Hour Ratio	0.0583				
Peak Hour Movements	15.3	2.8	13.4	1.0	32.6
Peak Hour Landings	7.7	1.4	6.7	0.5	16.3

(60 mppa)

	Large Jet	Middle Jet	Small Jet	Propeller	Total
Peak Day Movements	450	83	391	31	955
Peak Hour Ratio	0.0538				
Peak Hour Movements	24.2	4.5	21.0	1.7	51.3
Peak Hour Landings	12.1	2.2	10.5	0.8	25.7

Table 2.7.18 Peak Hour Movements and Landings (Domestic)

(12 mppa)

	Large Jet	Small Jet	Propeller	Total
Peak Day Movements		20		20
Peak Hour Ratio		—		
Peak Hour Movements		2.0		2.0
Peak Hour Landings		2.0		2.0

(30 mppa)

	Large Jet	Small Jet	Propeller	Total
Peak Day Movements	14	34	8	56
Peak Hour Ratio		0.1696		
Peak Hour Movements	2.4	5.8	1.4	9.5
Peak Hour Landings	1.2	2.9	0.7	4.8

(60 mppa)

	Large Jet	Small Jet	Propeller	Total
Peak Day Movements	72	150	38	260
Peak Hour Ratio		0.0730		
Peak Hour Movements	5.3	11.0	2.8	19.0
Peak Hour Landings	2.6	5.5	1.4	9.5

Spot occupancy time used by the Japanese Civil Aviation Bureau Guideline shown in the table below was adopted.

Table 2.7.19 Spot Occupancy Time

	Large Jet	Middle Jet	Small Jet	Propeller
International (min)	115	105	105	60
Domestic (min)	75	75	60	50

Source: JCAB Airport Facility Planning Guideline

Considering deviation of peak hour movements and peak hour landing, and unexpected delay such as meteorological conditions, a coefficient of 1.2 is adopted as a contingency factor. Also, reserved spot is added in every 10 spots. Table below shows the result of calculation of loading spots requirements.

Table 2.7.20 Loading Spot Requirements for International Flights

(12 mppa)

	Large Jet	Middle Jet	Small Jet	Propeller	Total
Peak Hour Landing (A)	2.5	0.4	6.7	0.6	10.2
Spot Occupancy Time (Min) (T)	115	105	105	60	
Spot Requirements	6	1	15	1	23
Contingency (S)	1	0	2	0	3
Total	7	1	17	1	26

(30 mppa)

	Large Jet	Middle Jet	Small Jet	Propeller	Total
Peak Hour Landing (A)	7.7	1.4	6.7	0.5	16.3
Spot Occupancy Time (Min) (T)	115	105	105	60	
Spot Requirements	18	3	15	1	37
Contingency (S)	2	0	2	0	4
Total	20	3	17	1	41

(60 mppa)

	Large Jet	Middle Jet	Small Jet	Propeller	Total
Peak Hour Landing (A)	12.1	2.2	10.5	0.8	25.7
Spot Occupancy Time (Min) (T)	115	105	105	60	
Spot Requirements	28	5	23	1	57
Contingency (S)	3	0	3	0	6
Total	31	5	26	1	63

Table 2.7.21 Loading Spot Requirements for Domestic Flights

(12 mppa)

	Large Jet	Small Jet	Propeller	Total
Peak Hour Landing (A)	0	2.0	0	2.0
Spot Occupancy Time (Min) (T)	-	60	-	
Spot Requirements	-	3	-	3
Contingency (S)	-	1	-	1
Total	-	4	-	4

(30 mppa)

	Large Jet	Small Jet	Propeller	Total
Peak Hour Landing (A)	1.2	2.9	0.7	4.8
Spot Occupancy Time (Min) (T)	75	60	50	
Spot Requirements	2	4	1	7
Contingency (S)	-	2	-	2
Total	2	6	1	9

(60 mppa)

	Large Jet	Small Jet	Propeller	Total
Peak Hour Landing (A)	2.6	5.5	1.4	9.5
Spot Occupancy Time (Min) (T)	75	60	50	
Spot Requirements	4	7	2	13
Contingency (S)	-	2	-	2
Total	4	9	2	15

b) Night Stay Parking Spots for International Flights by Foreign Airlines

When planning the requirements of apron spots in an airport, it is necessary to consider night stay apron.

Approximately 80 % of international flights were operated by foreign airlines according to flight schedule of Yangon Airport in April 2015. It is assumed this share will be kept in the future. Among the international flights by foreign airlines, only 1 aircraft, which is operated in Bangkok-Yangon route, stayed in Yangon Airport. So it is reasonable to assume only a few foreign airlines' aircraft will stay at HIA. Considering number of available spots for international flight by foreign airlines, a few night stay aircraft can use loading spots so that additional parking sports for night stay by foreign airlines is not necessary.

c) Night Stay Parking Spots for International Flights by Domestic Airlines

Required night stay spots for domestic airlines in international routes are calculated from required number of aircraft operated in international route. The flowing figure shows the calculation flow.

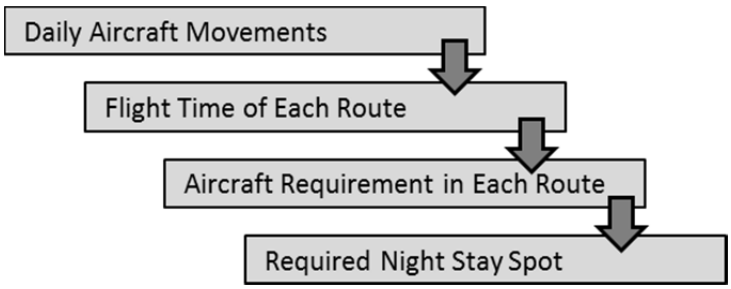


Figure 2.7.3 Calculation flow of night stay spots

Domestic airline will operate approximately 20 % of international flights if current market share will remain the same. The table below shows peak day aircraft movements by domestic airlines.

Table 2.7.22 Peak Day Aircraft Movements by Domestic Airlines in International Routes

(12 mppa)

	Large Jet	Middle Jet	Small Jet	Propeller	Total
ASEAN	3	1	28	3	35
Northeast Asia	7	2	12	0	21
Middle East	2	0	0	0	2
Europe	2	0	0	0	2
Oceania	1	0	0	0	1
Total	15	3	40	3	61

(30 mppa)

	Large Jet	Middle Jet	Small Jet	Propeller	Total
ASEAN	9	2	19	4	34
Northeast Asia	20	4	22	0	46

Central Asia	0	1	1	0	2
Southwest Asia	4	1	5	0	10
Middle East	8	1	0	0	9
Europe	9	1	0	0	10
Oceania	2	0	0	0	2
Africa	0	1	0	0	1
Total	52	11	47	4	114

(60 mppa)

	Large Jet	Middle Jet	Small Jet	Propeller	Total
ASEAN	15	3	32	6	56
Northeast Asia	35	7	37	0	79
Central Asia	0	1	1	0	2
Southwest Asia	8	2	8	0	18
Middle East	13	1	0	0	14
Europe	15	1	0	0	16
Oceania	4	1	0	0	5
Africa	1	1	0	0	2
Total	91	17	78	6	192

To calculate number of aircraft operated in each region, major cities were selected as representing city, and flying time from Yangon is adopted as shown in the table below:

Table 2.7.23 Route Flight Time

Area	Representing City	Flight Time	Remarks
ASEAN Jet Aircraft	Hanoi	2:15	
ASEAN Propeller	Bangkok	1:45	
Northeast Asia	Tokyo	7:00	
Central Asia	Almaty	6:40	*1
Southwest Asia	Mumbai	4:30	*1
Middle East	Doha	6:50	
Europe	London	12:50	*1
Oceania	Sydney	9:20	*1
Africa	Nairobi	8:50	*1

*1: Flight time is from Bangkok since there is no direct flight from Yangon

Flight time of one round trip consists of two flight times and two spot occupancy times. Round trip of each route is calculated from the above flight time plus spot occupancy time in Table 2.7.19 as shown in the table below:

Table 2.7.24 Round Trip Duration (Hour)

Area	Large Jet	Middle Jet	Small Jet	Propeller
ASEAN	8.34	8.00	8.00	5.50
Northeast Asia	17.84	17.50	17.50	-
Central Asia		16.84	16.84	
Southwest Asia	12.84	12.50	12.50	
Middle East	17.50	17.16		-
Europe	29.50	29.16		-
Oceania	22.50	22.16		-
Africa	21.50	21.16		

Considering 20 hours operation of international flights by jet aircraft, number of round trips by an aircraft is calculated from dividing the above round trip durations with 20 hours. For ASEAN propeller route, operation hour of 16 hours are assumed.

Table 2.7.25 Number of Daily Round Trip

Area	Large Jet	Middle Jet	Small Jet	Propeller
ASEAN	2.40	2.50	2.50	2.91
Northeast Asia	1.12	1.14	1.14	
Central Asia	1.16	1.19	1.19	
Southwest Asia	1.56	1.60	1.60	
Middle East	1.14	1.17		
Europe	0.68	0.69	0.69	
Oceania	0.89	0.90		
Africa	0.93	0.95		

Since number of takeoff and landing of one aircraft is twice of the above table, number of required aircraft is calculated by dividing peak day aircraft movements in Table 2.7.22 by doubled number of daily round trip in above table and the results are shown in the table blow.

Table 2.7.26 Required Aircraft in International Route by Domestic Airlines
(12 mppa)

	Large Jet	Middle Jet	Small Jet	Propeller	Total
ASEAN	1	1	6	1	9
Northeast Asia	3	1	5		9
Middle East	1	0	0		1
Europe	2	0	0		2
Oceania	1	0	0		1
Total	8	2	11	1	22

(30 mppa)

	Large Jet	Middle Jet	Small Jet	Propeller	Total
ASEAN	2	1	4	1	8
Northeast Asia	9	2	10	0	21
Central Asia	0	1	0	0	1
Southwest Asia	2	1	2	0	5
Middle East	4	1	0	0	5
Europe	7	1	0	0	8
Oceania	1	0	0	0	1
Total	23	6	14	1	44

(60 mppa)

	Large Jet	Middle Jet	Small Jet	Propeller	Total
ASEAN	4	1	7	2	14
Northeast Asia	15	3	16	0	34
Central Asia	0	1	1	0	2
Southwest Asia	3	1	3	0	7
Middle East	6	1	0	0	7
Europe	12	1	0	0	13
Oceania	2	1	0	0	3
Africa	1	1	0	0	2
Total	43	10	27	2	82

It is assumed that above required number of aircraft will be stationed in the new airport but half of the aircraft will stay overnight. Also, in general 2/3 of the night stay spot can be shared with other parking spots. Table below summarized required number of night stay spots for international flights by domestic airlines.

Table 2.7.27 Summary Required Number of Night Stay Spots for Domestic Airline of International Flight

(12 mppa)

	Large Jet	Middle Jet	Small Jet	Propeller	Total
Night Stay Aircraft	4	1	6	1	12
Loading Spots	7	1	17	1	26
Night Stay Spots	0	0	0	0	0

(30 mppa)

	Large Jet	Middle Jet	Small Jet	Propeller	Total
Night Stay Aircraft	13	4	8	1	26
Loading Spots	20	3	17	1	41
Night Stay Spots	0	2	0	0	2

(60 mppa)

	Large Jet	Middle Jet	Small Jet	Propeller	Total
Night Stay Aircraft	22	5	14	1	42
Loading Spots	28	5	23	1	57
Night Stay Spots	1	2	0	0	3

d) Night Stay Parking Spots for Domestic Flights

According to the results of air traffic demand forecast, peak day aircraft movements for domestic flights are 20 when annual passenger is 12 mppa. It is assumed that aircraft used in domestic routes can operate 3.75 flights per day, considering day time flights are operated for 15 hours from 5:00 to 20:00 and one flight takes about 4 hours (2 x 60 minutes turn around and 2 x 60 minutes flights) round trip. Based on this assumption, 20 flights can be operated with 3 aircraft (20 flights are equal to 10 round trip and 10 round trip can be made with 3 aircraft (10 / 3.75 = 2.7). If 2 aircraft is stationed in the airport, 2 parking spot for night stay is required. As required number of spots for peak hour movements are 4 and there is no operation during night, no night stay spot is required. Future ratio of two in thirds for loading spots, which can be used for domestic night stay apron, is adopted.

Same calculation is made for 30 and 60 mppa traffic as shown in the table below.

Table 2.7.28 Required Number of Night Stay Spots for Domestic Flight

(12 mppa)

	Large Jet	Small Jet	Propeller	Total
Peak Day Aircraft Movements	0	20	0	20
Flight time per day (hour)	4	4	4	
Number of flights per day (15 hours)	3.75	3.75	3.75	
Required number of aircraft	0	3	0	2
Night stay aircraft	0	2	0	1
Loading spots	0	4	0	4
Night stay spots	0	0	0	0

(30 mppa)

	Large Jet	Small Jet	Propeller	Total
Peak Day Aircraft Movements	14	34	8	56
Flight time per day (hour)	4	4	4	
Number of flights per day (15 hours)	3.75	3.75	3.75	
Required number of aircraft	2	5	1	8
Night stay aircraft	1	3	1	5
Loading spots	2	6	1	9
Night stay spots	0	0	0	0

(60 mppa)

	Large Jet	Small Jet	Propeller	Total
Peak Day Aircraft Movements	72	150	38	260
Flight time of one return flight (hour)	4	4	4	
Number of flights per day (15 hours)	3.75	3.75	3.75	
Required number of aircraft	10	20	5	35
Night stay aircraft	5	10	3	18
Loading spots	4	9	2	15
Night stay spots	2	4	2	8

e) Summary

Required number of aircraft parking spots is summarized in the table below.

Table 2.7.29 Summary Required Number of Spots

Traffic	Spot Type	Flight Type	Large Jet	Medium Jet	Small Jet	Propeller	Total
(12 mppa)	Loading	International	7	1	17	1	26
		Domestic	0	0	4	0	4
		Total	7	1	21	1	30
	Night Stay	International	0	0	0	0	0
		Domestic	0	0	0	0	0
		Total	0	0	0	0	0
	Total		7	1	21	1	30
(30 mppa)	Loading	International	20	3	17	1	41
		Domestic	2	0	6	1	9
		Total	22	3	23	2	50
	Night Stay	International	0	2	0	0	2
		Domestic	0	0	0	0	0
		Total	0	2	0	0	2
	Total		22	5	23	2	52
(60 mppa)	Loading	International	31	5	26	1	63
		Domestic	4	0	9	2	15
		Total	35	5	35	3	78
	Night Stay	International	1	2	0	0	3
		Domestic	2	0	4	2	8
		Total	3	2	4	2	11
	Total		38	7	39	5	89

f) Required aircraft parking spots by Code Letter

Table below shows apron clearance by ICAO Code Letter. Typical aircraft type in the category is also presented below.

Table 2.7.30 Apron Clearance

ICAO Code Letter	Wing Span Range	Minimum Clearance between Aircraft	Aircraft stand taxilane center line to object	Aircraft Type
A	Less than 15 m	3 m	12.0 m	
B	15m to 24 m	3 m	16.5 m	
C	24 m to 36 m	4.5 m	24.5 m	ATR42, ATR42, E1 90, B737, A320
D	36 m to 52 m	7.5 m	36.0 m	B767, A300, A310
E	52 m to 65 m	7.5 m	42.5 m	B777, B747, B787, A340, A330
F	65 m to 80 m	7.5 m	50.5 m	A380, B747-8

Considering current aircraft fleet in Yangon Airport and trend of aircraft type in the region, all propeller aircraft in the new airport will be fallen into category of Code Letter C. It is also presumed that all medium size aircraft in the new airport will be B787 series. Required number of spot by ICAO Code Letter is shown below.

Table 2.7.31 Summary Required Number of Spots by ICAO Code Letter

Traffic	Spot Type	Flight Type	Code E	Code C	Total
(12 mppa)	Loading	International	8	18	26
		Domestic	0	4	4
		Total	8	22	30
	Night Stay	International	0	0	0
		Domestic	0	0	0
		Total	0	0	0
	Total		8	22	30
(30 mppa)	Loading	International	23	18	41
		Domestic	2	7	9
		Total	25	25	50
	Night Stay	International	2	0	2
		Domestic	0	0	0
		Total	2	0	2
	Total		27	25	52
(60 mppa)	Loading	International	36	27	63
		Domestic	4	11	15
		Total	40	38	78
	Night Stay	International	3	0	3
		Domestic	2	6	8
		Total	5	6	11
	Total		45	44	89

g) Required aircraft parking spots for Freighter

In general, freighter is operated during night; it arrives midnight and leaves early morning to avoid busy hours. To consider this characteristic, it is presumed all freighters will operate in

the same time. Required number of parking spots for freighter is the same as half of daily movements and one spot for each aircraft type is allocated as contingency. The table below shows required number of spots for freighter.

Table 2.7.32 Required Parking Spots for Freighter

	12 mppa		30 mppa		60 mppa	
	Large Jet	Middle Jet	Large Jet	Middle Jet	Large Jet	Middle Jet
Daily movements	3	0	5	1	8	2
Daily landing	1.5	0	2.5	0.5	4	1.0
Parking spots	2	0	3	1	4	1
Contingency	1	0	1	0	1	0
Total spots	3	0	4	1	5	1

(5) Airport Roads and Car Parks

a) Airport roads

One direction with 2 lanes roads and 2 directions with 4 lanes roads are planned as same as the airport access roads.

b) Car Parks

Ratio of vehicle per peak hour passengers of 0.8 is adopted from the value used in Japan for planning car parks are adopted. Area of 35 m2 per vehicle is adopted.

Table 2.7.33 Required Car Parks

	Peak Hour Passenger	Vehicle / Passengers	Number of Car Park Slots	Area (m2)/ Vehicle	Area (m2)
12 mppa	3,060	0.8	2,448	35	85,650
30 mppa	5,800	0.8	4,540	35	162,400
60 mppa	10,580	0.8	8,680	35	303.800

2.7.3 Air Navigation Facilities

Air navigation facilities consist of communication, navigation, surveillance, air traffic control, aerodrome meteorological observation, and aeronautical ground lights. Basic plan of air navigation facilities will be planned by the following concept.

a) Basic Concept

- The specifications of air navigation equipment should meet the ICAO Annex's requirement as a minimum for precision approach runway, category-I.
- The equipment to be planned in Phase-1 should be considered the latest products because the technological changes of air navigation equipment are remarkable.
- Because the air navigation facilities located widely in the airport are easy to suffer damage from lightning, suitable lightning protection system should be considered.
- The equipment to be considered prevention maintenance concept should be planned because the safety operation of the aircrafts and maintain scheduled flights will be affected by the malfunctions of the equipment. The equipment should also be planned

a main and hot standby configuration.
- An adequate space of equipment room should be planned to avoid influence on the operation of the existing equipment during replacement works.

b) Communication Facility

The location of the antennas of VHF ground to air communication facility should be considered to keep maximum communication coverage, but the distance between antenna and equipment should be minimized with the following siting conditions.
- No antenna penetrates approach surface, transit surface, and horizontal surface.
- The distance between VHF antenna and ASR antenna shall be kept more than 15m to avoid fading by ASR antenna.
- The distance between VHF antennas should be kept more than 3m.

The equipment for Automatic Terminal Information Service (ATIS), which broadcasts to aircrafts the airport information such as approach procedure, landing runway, airport weather information, status of air navigation equipment, and so on, should be planned.

The communication equipment should be able to control remotely through the airport data network. Because air navigation facilities are located on the airport widely, the airport data network should be established to transmit the remote control and status data of the equipment.
The network equipment to be planned should meet European Organization for Civil Aviation Equipment (EUROCAE) ED137B and an optic fiber cable, which is withstood against lightning damage, should be planned for network transmission lines

c) Navigation Facilities

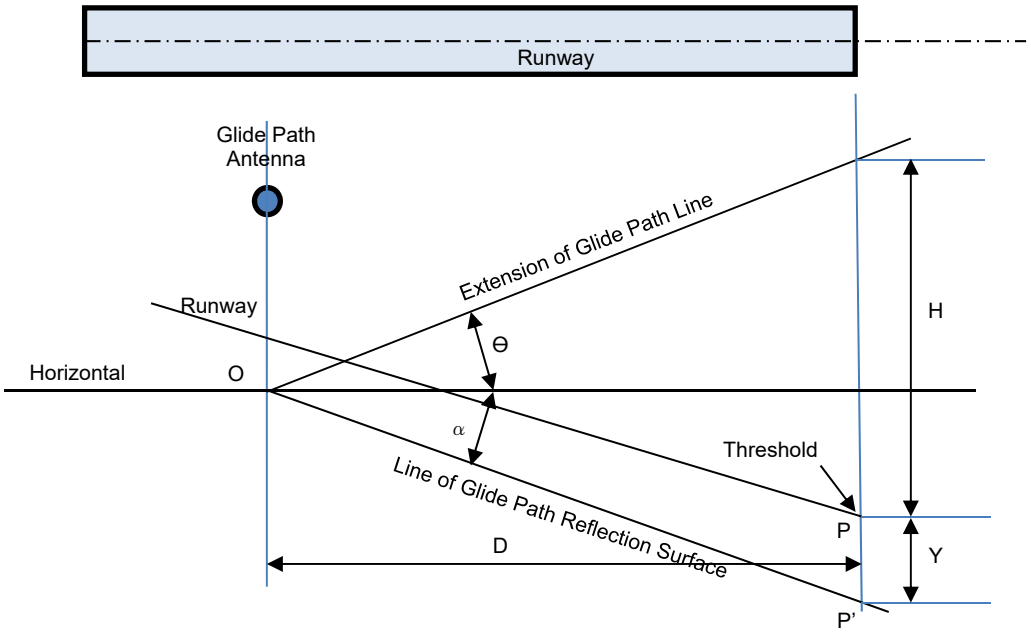
Installation of ILS should be planned for both sides of runway in order to ensure a safe landing. Instead of outer marker and middle marker which are constitutive part of ILS, DME to be collocated with glide path will be considered for simplifying the maintenance. ILS is, therefore, comprised of localizer (LLZ), glide path (GP), and distance measuring equipment (DME). The following siting conditions should be applied to LLZ.
- The LLZ antennas shall be placed on the extension of the runway center line and at right angles to the runway center line.
- No antenna penetrate approach surface of 1/50.
- The antenna radiating element shall be on line of sight with the Threshold Crossing Height (TCH: between15m to 18m) at the approach end of the runway.
- The antenna system should be placed more than 300m from threshold.
- Chapter 12.3.4, described below, of ICAO Annex 14 Attachment A should be considered:

  Where an ILS localizer is installed within the light plane boundaries, it is recognized that the localizer, or screen if used, must extend above the light plane. In such cases the height of these structures should be held to a minimum and they should be located as far from the threshold as possible. In general the rule regarding permissible heights is 15 cm for each 30 m the structure is located from the threshold. As an example, if the localizer is located 300 m from the threshold, the screen will be permitted to extend above the plane of the approach lighting system by 10 × 15 = 150 cm maximum, but preferably should be kept as low as possible consistent with proper operation of the ILS.

The location of GP should be calculated by the following formula. Figure 2.7.3-a shows the location of GP antenna.

$$D = (H + Y) / \tan (\Theta + \alpha)$$

Where D: horizontal distance between O and P
H: threshold crossing height
Y: vertical height between P' and P at the threshold
Θ: ILS glide path angle
α: longitudinal negative slope of glide path reflection surface



Source: Aviation Radio Facilities Design Handbook

Figure 2.7.3-a Location of GP Antenna

According to ICAO Annex 10, any large reflecting objects, including vehicles or fixed objects such as structures within the radiated signal coverage, will potentially cause multipath interference to the ILS course and path structure. For the purposes of developing protective zoning criteria, these areas can be divided into two types, i.e. critical areas and sensitive areas:

- The ILS critical area: An area of defined dimensions about the localizer and glide path antennas where vehicles including aircraft, are excluded during all ILS operations. The critical area is protected because the presence of vehicles and/or aircraft inside its boundaries will cause unacceptable disturbance to the ILS signal-in-space;

- The ILS sensitive area: An area extending beyond the critical area where the parking and/or movement of vehicles, including aircraft, is controlled to prevent the possibility of unacceptable interference to the ILS signal during ILS operations. The sensitive area is protected against interference caused by large moving objects outside the critical area.

Figure 2.7.3-b and 2.7.3-c show localizer and glide path critical and sensitive areas of Category I for B747 respectively.

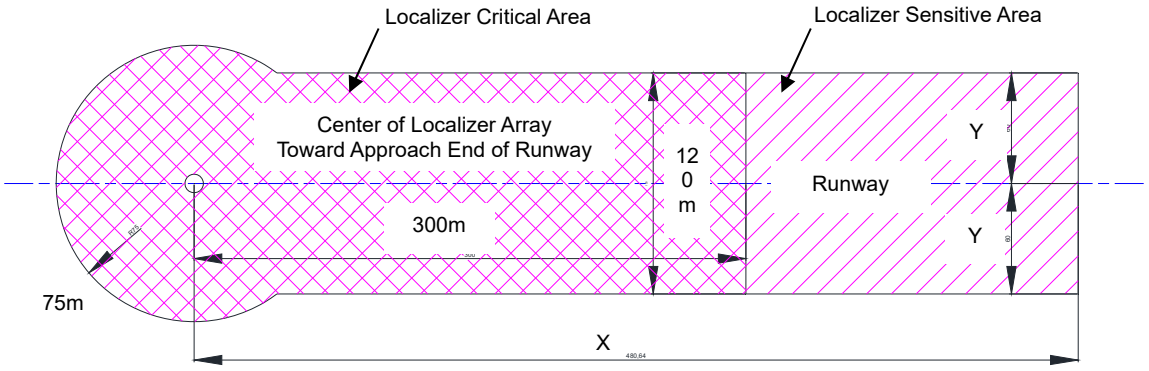


Figure 2.7.3-b Localizer Critical and Sensitive Areas

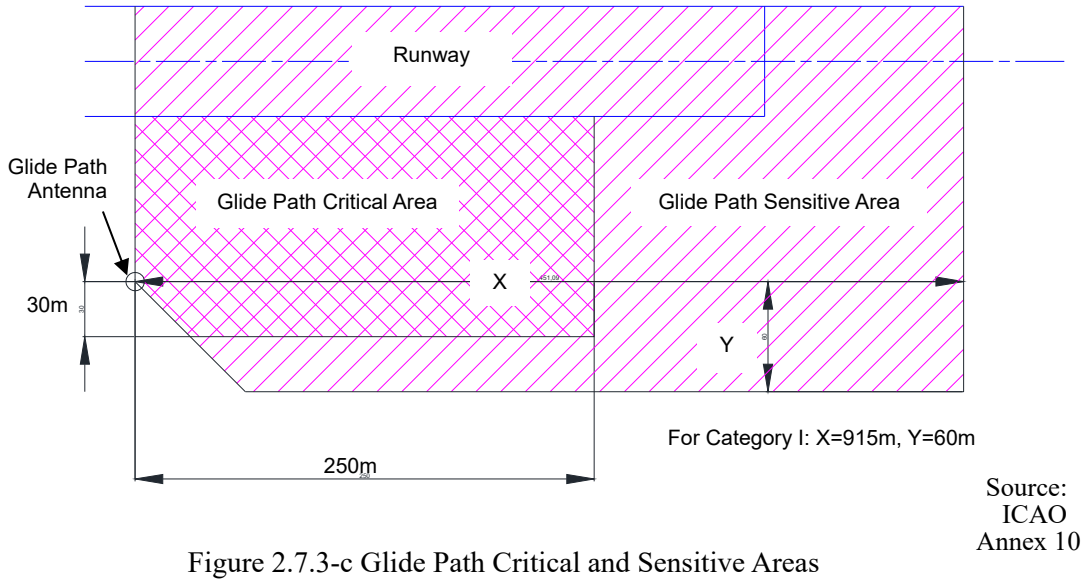
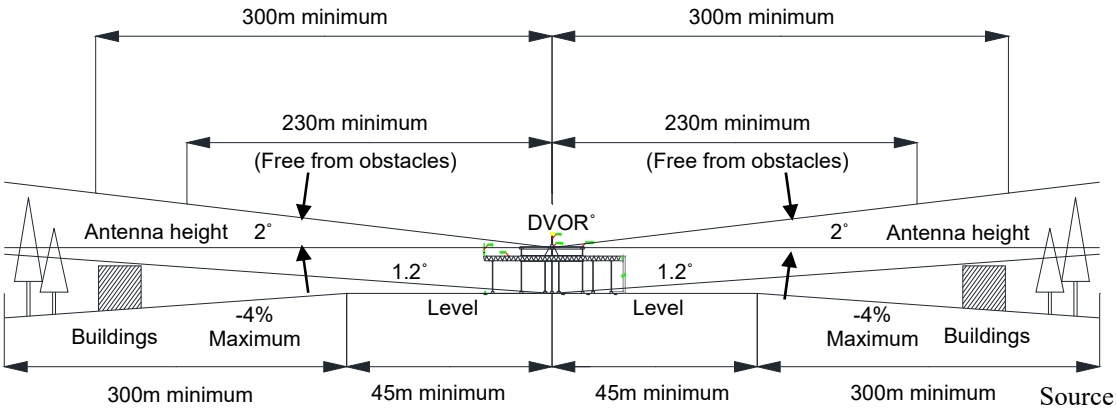


Figure 2.7.3-c Glide Path Critical and Sensitive Areas

Installation of DVOR/DME which are providing direction and distance information up to the airport should be planned with the following conditions.

- At least 45m radius of the DVOR area should be leveled.
- There is downslope, minus 4% maximum, from 45m to 345m conically.
- There is no tree within 300m, and no tree penetrates beyond 300m from 2˚ elevation angle at antenna height.
- There is no obstacle within 230m, and no obstacle penetrates beyond 230m from 1.2˚ elevation angle at ground level.

Figure 2.7.3-d shows summarized conditions around DVOR site.



Source: Aviation Radio Facilities Design Handbook

Figure 2.7.3-d Conditions around DVOR Site

The location of the DVOR should be planned on an extension line of the runway centerline so that an aircraft faces to the runway at the early stage of the approach.

d) Surveillance Facilities

Installation of airport surveillance radar/secondary surveillance radar (ASR/SSR) should be planned in order to safe takeoffs and landings of the aircraft at regular time intervals. SSR should be planned with mode-S in order to achieve data communication.
Installation of ADS-B will be considered as a back-up system of ASR/SSR.
The following siting conditions should be applied to ASR/SSR

- No antenna penetrates approach surface, transit surface, and horizontal surface.
- 0.5 NM away from runway threshold.
- 750m, at least, away from ILS and VOR to avoid mutual interference.
- More than 450m away from the obstacles such as hunger, control tower, terminal building, and apron.

Figure 2.7.3-e shows the siting area of ASR/SSR.

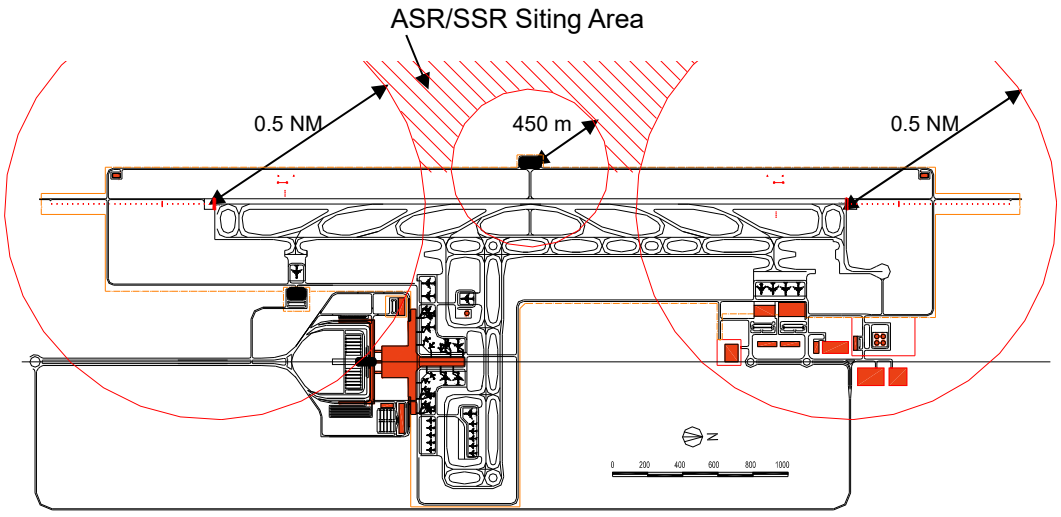


Figure 2.7.3-e ASR/SSR Siting Area

e) Air Traffic Control (ATC) Facilities

To realize the voice communication with a controller and the pilot for maintaining of the orderly air traffic flow, ATC consoles in consideration of human machine interface (HMI) should be planned. For the approach control, DCA will establish Yangon Air Traffic Management System (YATMS) center, and HIA approach and departure will be controlled from YATMS center.

f) Aerodrome Meteorological Observation Facilities

The system for automatically measuring and deliver meteorological information required for the precision approach category 1 runway in accordance with Annex 3 to the Convention on International Civil Aviation of International Civil Aviation Organization (ICAO) should be planned.

Aeronautical meteorological stations and observations:

- Aeronautical meteorological stations shall make routine observations at fixed intervals.
- At aerodrome, the routine observations shall be supplemented by special observations whenever specified changes occur in respect of surface wind, visibility, runway visual range, present weather, clouds and/or air temperature.

- At HIA with runway intended for Category I instrument approach and landing operations, automated equipment for measuring, including monitoring and remote indicating of surface wind, visibility, runway visual range, height of cloud base, air and dew-point temperatures and atmospheric pressure will be planned. These devices are integrated automatic systems for acquisition, processing, dissemination and display in real time of the meteorological parameters affecting landing and take-off operations.

Layout of Major Component

- Wind sensor:
  Wind sensor will be planned to measure the wind direction and speed. The location of wind sensors will be planned in the Met field of both runway ends.

- Runway Visual Range (RVR) sensor:
  RVR sensor will be planned to assess the touchdown zone of the runway intended for Category I precision approach runway operations. The location of RVR sensors will be planned in the Met field of both runway ends.

- Ceilometer:
  Ceilometer will be planned to measure cloud base height and vertical visibility. The location of ceilometer will be planned on the extended center line of the runway extending the distance of 950m from the threshold of runway.

- Air temperature sensor and humidity sensor:
  Air temperature sensor and humidity will be planned to measure air temperature and dew-point temperature. The location of sensors will be planned in the Met field middle which is located around center of runway.

- Rain gauge:
  Rain gauge will be planned to measure precipitation for reporting present weather. The location of rain gauge will be planned in the Met field middle.

- Air pressure sensor:
  Air pressure sensor will be planned to measure atmospheric pressure to compute QNH and QFE. The location of sensor will be planned in the Met field middle.

- Automated Weather Observing Systems (AWOS):
  AWOS will be planned to report meteorological information of METAR and SPECI. The location of main components will be planned in the Meteorological room of the control tower ground floor. The system should be designed in accordance with Manual on Automatic Meteorological Observing Systems at Aerodromes (Doc 9837) of ICAO.

g) Aeronautical Ground Lights

The aeronautical ground lights required for the precision approach category 1 runway in accordance with Annex 14 to the Convention on International Civil Aviation of International Civil Aviation Organization (ICAO) should be planned. As for the lamp of aeronautical ground lights, the LED should be examined in consideration of reduction of the environmental load.

The major components of Aeronautical Ground Lights (AGL) are as follows:

- Wind Direction Indicator:
  A wind direction indicator shall be located so as to be visible from aircraft in flight of on the movement area and in such a way as to be free from the effects of air disturbances caused by nearby objects. Illuminated wind direction indicator should be provided at an aerodrome intended for use at night.

- Aerodrome Beacon:
  An aerodrome beacon shall be provided at an aerodrome intended for use at night. The aerodrome beacon shall be located on or adjacent to the aerodrome in an area of low ambient background lighting.

- Category-I Precision Approach Lighting System:
  A category-I precision approach lighting system shall consist of a row of lights on the extended center line of the runway extending over a distance of 900m from the runway threshold with a row of lights forming a crossbar 30m in length at a distance of 300m from the runway threshold.

- Precision Approach Path Indicators (PAPI):
  The PAPI system shall consist of a wing bar of 4 sharp transition multi-lamp units equally spaced. The system shall be located on the left side of the runway unless it is physically impracticable to do so.

- Runway Threshold and End Lights:
  The threshold and end lights shall be placed in a row at right angles to the runway axis as near to the extremity of the runway as possible and, in any case, not more than 3m outside the extremity.

- Runway Edge Lights:
  Runway edge lights shall be placed along the full length of the runway and shall be in two parallel rows equidistant from the center line.

- Runway Center Line Lights:
  Runway center line lights shall be located along the center line of the runway.

- Runway Touchdown Zone Lights:
  Touchdown zone lights shall extend from the threshold for a longitudinal distance of 900m. The pattern shall be formed by pairs of barrettes symmetrically located about the runway center line.

- Runway Guard Lights and Stop Bars:
  Runway guard lights should be provided at each taxiway/runway intersection associated with a runway.
  The provision of stop bars at runway-holding positions can form part of effective runway incursion prevention measures.

- Taxiway Center Line Lights:
  Taxiway center line lights should be provided on complex taxiway intersections and exit taxiways.

- Taxiway Edge Lights:
  Taxiway edge lights on a straight section of a taxiway should be spaced at uniform longitudinal intervals of not more than 60m. The lights on a curve should be spaced at intervals less than 60m so that a clear indication of the curve is provided.

- Mandatory Instruction and information Signs:
  Signs shall be provided to convey a mandatory instruction, information on a specific location or destination on a movement area.

- Apron Floodlighting:
  Apron floodlights should be located so as to provide adequate illumination on all apron service areas, with a minimum of glare to pilots of aircraft in flight and on the ground, aerodrome and apron controllers, and personnel on the apron. The arrangement and aiming of floodlights should be such that an aircraft stand receives light from two or more directions to minimize shadows.

- Visual Docking Guidance System (VDGS):
  VDGS include those systems shall be provided to indicate, by a visual aid, the precise positioning of an aircraft on an aircraft stand.

- Aircraft Stand Identification Signs:
  An aircraft stand identification sign should be located so as to be clearly visible from the cockpit of an aircraft prior to entering the aircraft stand.

- Power supply equipment, and remote control and monitoring system for AGL:
  At least two circuits, interleaved, shall be considered for approach and runway lighting systems. AGL shall be controlled and monitored from Tower CAB, AGLCC-1 and AGLCC-2.

h) The major air navigation equipment to be planned is shown in Table 2.7.34.

Table 2.7.34 List of Major Air Navigation Equipment

Facility	Major Equipment
a) Communication Facility	・VHF ground to air transmitters and receivers ・D-ATIS ・Data network for air navigation facilities
b) Navigation Facility	・ILS ・D-VOR/DME・
c) Surveillance Facility	・ASR/SSR ・ADS-B
d) Air Traffic Control Facility	・Consoles for Tower control ・Consoles for Radar control ・Voice Communication Control System (VCCS) for consoles
e) Aerodrome Meteorological Observation Facility	・Meteorological observing sensors ・Automated Weather Observing System (AWOS)
f) Aeronautical Ground Lights (AGL)	・Illuminated Wind Direction Indicator ・Aerodrome Beacon ・Category-1 Precision Approach Lighting System ・Precision Approach Path Indicators ・Runway Threshold and End Lights ・Runway Edge Lights ・Runway Center Line Lights ・Runway Touchdown Zone Lights ・Runway Guard Lights and Stop Bars ・Taxiway Center Line Lights ・Taxiway Edge Lights ・Mandatory Instruction and Information Signs ・Apron Floodlighting ・Visual Docking Guidance System ・Aircraft Stand Identification Signs ・Power supply equipment, and remote control and monitoring system for AGL

2.7.4 Buildings

(1) Definition of Designed Capacity

a) Passenger Terminal Building
Based on the air traffic demand forecast, designed capacity of the passenger terminal on phase 1 is 1.2 mppa for international and 0.6 mppa for domestic.

b) Cargo Handling Facilities
Based on the air traffic demand forecast, designed capacity of the cargo handling facilities on phase 1 is annual 63,000 ton for international and 6,000 ton for domestic.

(2) Sizing of each Facilities

a) Passenger Terminal Building

The scale of each passenger processing facilities has been determined according to the peak hour passenger traffic presented by the air traffic demand forecast. The calculation is based on the IATA Airport Development Reference Manual 10th edition. The values of service level B mentioned in the IATA Airport Development Reference Manual 9th Edition are also used to define the units space and the time required for check-in, immigration procedures and security inspection etc. The total floor area is calculated by the standard ratio of commercial facilities, offices and traffic space, etc. . The results are as shown in Table 2.7.35 and Table 2.7.36.

Table 2.7.35 The area of each passenger processing facilities

Facilities	Position	Area
INTERNATIONAL		
Self-Service Kiosks	15	105 m^2
Baggage Drop Facility	16	270 m^2
Check-in Desks	56	865 m^2
Departure Passport Control Facility	26	595 m^2
Departure Security Checkpoint Facility	14	990 m^2
Area of the Gate Lounge for Code E aircraft	4	2,040 m^2
Area of the Gate Lounge for Code C aircraft	12	3,180 m^2
Area of the Bus Gate Lounge for Code C aircraft	6	1,590 m^2
Arrival Passport Control Facility	38	800 m^2
Baggage claim	5	2,095 m^2
Primary Inspection Booth at Custom	7	515 m^2
X-ray Facility at Custom	2	70 m^2
Arrival Hall	-	1,425 m^2
DOMESTIC		
Self-Service Kiosks	5	30 m2
Baggage Drop Facility	5	85 m2
Check-in Desks	16	250 m2
Departure Security Checkpoint Facility	5	335 m2
Area of the Bus Gate Lounge for Code C aircraft	6	1,590 m^2
Baggage claim	1	325 m2
Arrival Hall	-	245 m2
Total		17,400 m2

Table 2.7.36 The total floor area of passenger terminal building

Facilities	Ratio	Area	Example A	Example B
Passenger Processing Facilities	10%	17,400 m^2	9%	10%
Traffic space, Washrooms, etc.	45%	78,300 m^2	42%	41%
Commercial Facilities	10%	17,400 m^2	10%	7%
Offices	10%	17,400 m^2	14%	8%
Machine rooms, Service space, etc.	25%	43,500 m^2	25%	34%
Total	100%	174,000 m^2	100%	100%

b) Cargo Handling Facilities

The size of Cargo Handling Facilities is calculated based on the designed capacity. The calculation follows the methods that are used in the planning of Japanese airports. The results are as shown in Table 2.7.37 and Table 2.7.38.

Table 2.7.37 The size of Cargo Terminal facilities - International

Facilities	Gross Floor Area
Airlines shed	4,200 m^2
Agency shed	2,100 m^2

* International Cargo Demand : 63,000 ton
Layout type : Handling over 10,000 ton → Separate type
Calculation per unit : Handling over 50,000 ton → 15.0 ton/m^2
Area of airlines shed : 63,000 ton ÷ 15.0 ton/m^2 = 4,200 m^2
Ratio of agency shed : 0.5
Area of agency shed = 4,200 m^2 × 0.5 = 2,100m^2

Table 2.7.38 The size of Cargo Terminal facilities - Domestic

Facilities	Gross Floor Area
Airlines shed	770 m^2
Agency shed	385 m^2

* Domestic Cargo Demand : 6,000 ton
Layout type : Handling less than 10,000 ton → Unit type or Separate type
Calculation per unit : Handling less than 10,000 ton
→ $0.0096X^{0.77}$ ton/m^2 = 7.8 ton/m^2
X : Cargo Demand
Area of airlines shed : 6,000 ton ÷ 7.8 ton/m^2 = 770 m^2
Ratio of agency shed : 0.5
Area of agency shed = 770 m^2 × 0.5 = 385m^2

c) Other Facilities

The size of Control Tower, Operations and Administrative Building, Aircraft Rescue & Fire Fighting Station, VVIP Terminal, GSE Maintenance Shop, Flight Kitchen Centre, MRO and other Offices are presented in Table 2.7. 39.

Table 2.7.39 The size of Other facilities

Facilities	Gross Floor Area
Control Tower	2,700 m^2
Operations and Administrative Building	19,000 m^2
Aircraft Rescue & Fire Fighting Station	3,200 m^2
VVIP Terminal	2,500 m^2
GSE Maintenance Shop	3,500 m^2
Hotel	20,000 m^2
Flight Kitchen Centre	15,000 m^2
Maintenance Repair and Overhaul (MRO)	15,000 m^2
Offices 1	15,000 m^2
Offices 2	15,000 m^2
Offices 3	5,000 m^2

(3) Planning of facility location

a) Passenger Terminal Building

Passenger Terminal Building is designed as the centralized terminal as required by DCA on RFP, with the following reasons: 1) since the international demand is the majority, the aggregated CIQ facilities is desirable in the operation and the facility planning, and 2) since there is no airline that has the predominantly large share, the possibility of construction of dedicated terminals for airline is unlikely.

The shape of the building is planned in consideration to the required facility scale, the phased development, the connection between the runway and the spot, and the moving distance of passenger.

In the internal facility location planning, the multi-layer type which suits a large-scale terminal is adopted, 1st floor of building is for arrival facilities, 2nd floor is for arrival and transit facilities, 3rd floor is for departure facilities and 4th floor is for lounge etc. The departure forecourt is located at 3rd floor level, and the arrival forecourt is located at 1st floor level. The Centralized check-in system which is chosen by most terminals and becomes almost standard recently is adopted. The Centralized security screening for passenger is planned considering safety and high efficiency of staffs and equipment. Inspection of checked baggage, is planned with in-line screening system by reason of safety and the convenience of passengers. Domestic facilities are placed adjacent to the international facilities in the same building, considering the convenience of transfer. LCC is planned to operate in the same facility.

For more information, refer to 2.11 Conceptual Design.

b) Cargo Handling Facilities

Based on the master plan, Cargo Handling Facilities are located in the cargo area at the north of airport site.

c) Control Tower

Control Tower is located in the airside of almost center of the site in consideration to the visibility over runway, taxiway, apron, approach and takeoff path of aircraft and airfield traffic pattern, the visibility obstruction by other facility and the cooperation with operation building.

Its height is approximately 80 meters, to avoid the obstruction by passenger terminal of visibility of around the south end of 2nd runway.

d) Operation Building

In consideration to the cooperation with the Control Tower and the Passenger Terminal Building, Operation Building is located next to the Passenger Terminal Building.

e) Fire Station

In consideration to the required time for arriving to the aircraft on fire, 1st Fire Station is located near the center of the 1st runway.

f) VVIP Terminal

In consideration to the access and security, VVIP terminal is located near the passenger terminal area.

2.7.5 Utilities

(1) Sizing of each Facilities

a) Substation

Electric power capacity is calculated as shown in Table 2.7.40.

Table 2.7.40 Electric Power Capacity

Facilities	Gross Floor Area(m^2)	Unit(W/m^2)	Capacity(W)
Control Tower	2,700	50	135,000
Operations and Administrative Building	19,000	90	1,710,000
Aircraft Rescue & Fire Fighting Station	3,200	50	160,000
Passenger Terminal Building	174,000	90	15,660,000
VVIP Terminal	2,500	90	2,250,000
GSE Maintenance Shop	3,500	50	175,000
Hotel	20,000	90	1,800,000
Cargo Handling Facility	8,000	50	400,000
Flight Kitchen Centre	15,000	50	750,000
Maintenance Repair and Overhaul (MRO)	15,000	50	750,000
Offices 1	15,000	90	1,350,000
Offices 2	15,000	90	1,350,000
Offices 3	5,000	90	450,000
Air Navigation Facilities			1,500,000
		Subtotal	26,415,000
Utilities		Subtotal x 5%	1,320,750
		Total	27,735,750
			≒28MW

b) Water Treatment Plant

Water demand is estimated based on the number of passengers for a peak day in the new terminal. The following assumptions for the water demand are made;

・Demand rate per average daily passenger is estimated at 30 litres.
・Demand rate per employee per shift is estimated at 120 litres.
・Water consumption for cooling towers is about 4.5 m^3/h/MW cooling.

The estimated total potable and non-potable water demand for the Passenger Terminal Building and ancillary buildings is 3,000m^3/day.

c) Sewage Treatment Plant

The sewage treatment is carried out for the water except a coolant for cooling towers from quantity of water supply demand.
The filthy water throughput is 1,500 m^3/ day.

(2) Planning of facility location

The utility area is located in the north of the airport site for connection with the infrastructure. Substation, water treatment facility, sewage treatment facility, and waste disposal facility are located in the utility area.

Based on the above sections, the outline of the major airport facilities are summarized in the Table 2.7.41.

Table 2.7.41 Outline of the Major Airport Facilities at each Phase

	12 mppa	30 mppa	60 mppa
Runway - Number - Length and Width	 1 3,600 m x 60 m	 1 3,600 m x 60 m	 2 3,600 m x 60 m
Apron - Large Jet - Medium Jet - Small Jet - Propeller - Total	 7 1 21 1 30	 22 4 25 4 55	 39 7 43 6 95
Passenger Terminal Building (m2)	174,000	381,000	543,000
Cargo Terminal Building (m2)	7,455	23,000	46,000
Control Tower (m2)	2,700	2,700	2,700
Operations and Administrative Building (m2)	19,000	19,000	19,000
Aircraft Rescue & Fire Fighting Station (m2)	3,200	3,200	6,400
VVIP Terminal (m2)	2,500	2,500	2,500
Car Parks Area (m2)	85,650	177,520	321,720

2.8 Specification of Surrounding Infrastructure

2.8.1 Transport Infrastructure

(1) Transportation Projects Related to HIA

a) Myanmar National Transport Master Plan (MYT-Plan)

MYT-Plan was submitted to MOT from JICA Study team in September 2014 and was approved by cabinet. In the master plan, national level transportation network was proposed. The new expressway that connects the existing expressway with Thilawa port via HIA is proposed. Sea cargo and Air cargo can be transported to inner Myanmar by using the expressway. Also, airport link which connects HIA with YIA is proposed.

Projects related to the HIA are summarized as follows:

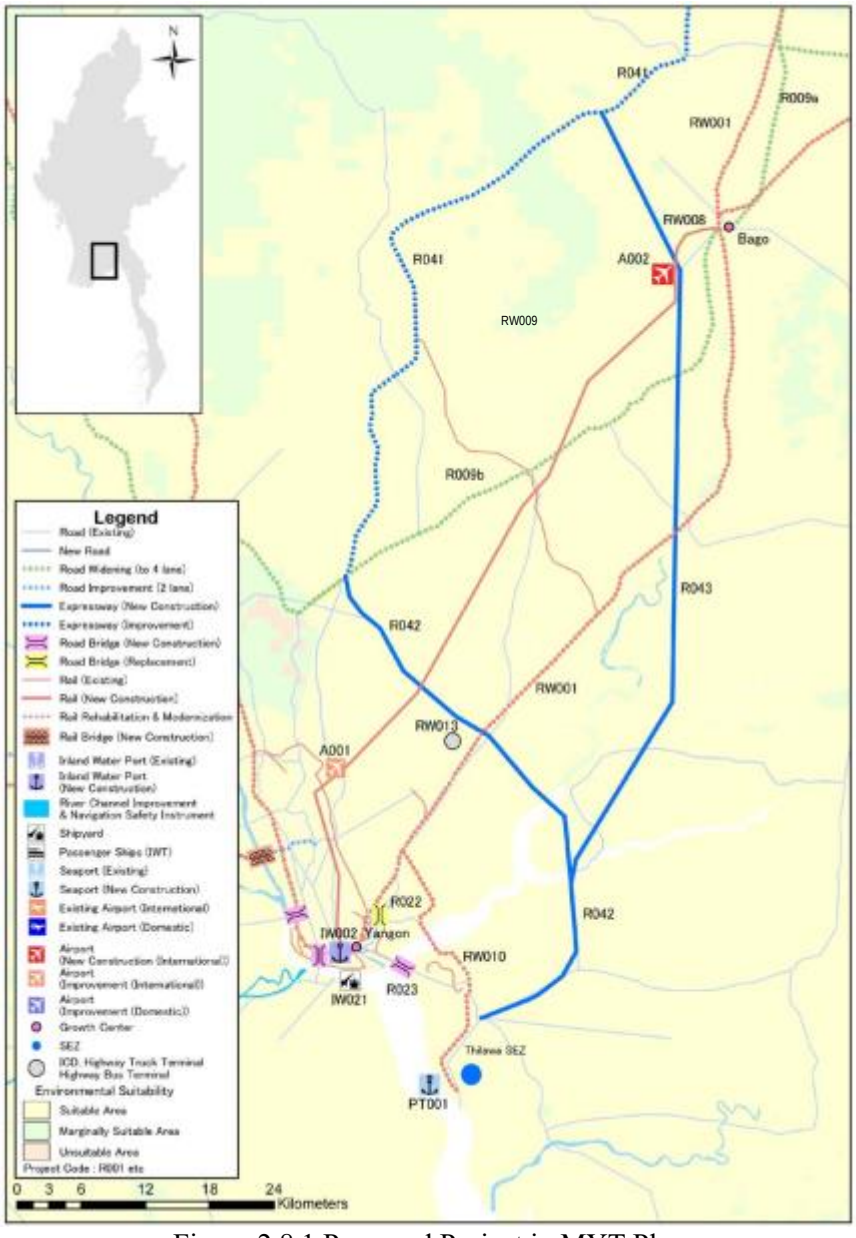


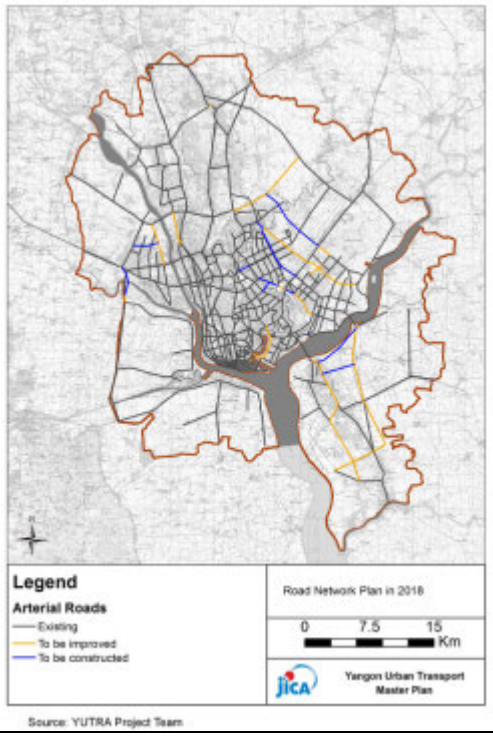
Figure 2.8.1 Proposed Project in MYT-Plan

Table 2.8.1 Proposed Projects in MYT-Plan

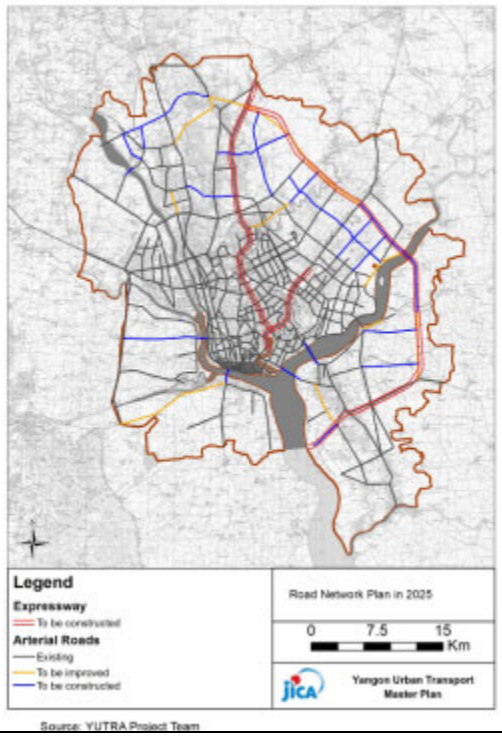
Project (ID)	Length (km)	No. of Lanes	Contents	Project Cost (Bil. MMK)	Implementation Schedule
New Expressway Construction (Yangon City – Hanthawaddy – Existing Expressway (R043)	80	4 lanes single carriageway	New Construction	338	2021 – 2025
New Expressway Construction (Yangon City – Thilawa Port (R042)	50	4 lanes single carriageway	New Construction	243	2016 – 2020
Improvement of Yangon – Mandalay Expressway (R041)	580	4 lanes single carriageway	Improvement (alignment, surface, safety facility, etc.)	676	2016 – 2020
Improvement of Yangon – Bago Road (NH1) (R009b)	50	4 lanes single carriageway	Improvement (roughness, pavement, shoulder, etc.)	84	2021 – 2023
Yangon-Mandalay Railway Rehabilitation and Modernization Project [4] (RW001)	620	Double Tracks	Rehabilitation and Modernization	N/A	Yangon – Taung Oo Open Year: 2021 Taung Oo – Yamethin Open Year: 2022 Yamethin – Mandalay Open Year: 2023
Bago - Hanthawaddy Airport Railway Branch Line Construction Project (RW008)[5]	10	Single Track	Construction of New Railway Line	29	2020 – 2026
New Airport Railway Access Project (Yangon – Hanthawaddy) (RW009)[6]	70	Double Tracks	Construction of New Railway Line	N/A	2022 – 2030

b) Comprehensive Urban Transport Plan of the Greater Yangon (YUTRA)
In this master plan, comprehensive transportation network for greater Yangon region was proposed. The inner urban circular expressways with some extension sections are proposed. The elevated expressway connects Yangon downtown area with Yangon – Mandalay expressway. Also, MRT line that connects Yangon station with YIA is proposed.
Projects related to the HIA are summarized as follows:

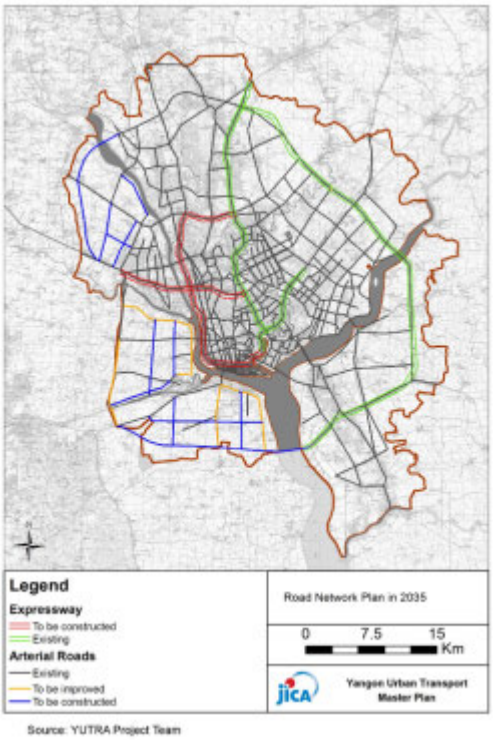
[4] Operation plan will be changed after construction and installation works for all phases are completed.
[5] This project is not included in RW001.
[6] MR mentioned that MR requested to Korea Eximbank to conduct F/S for airport railway access project.



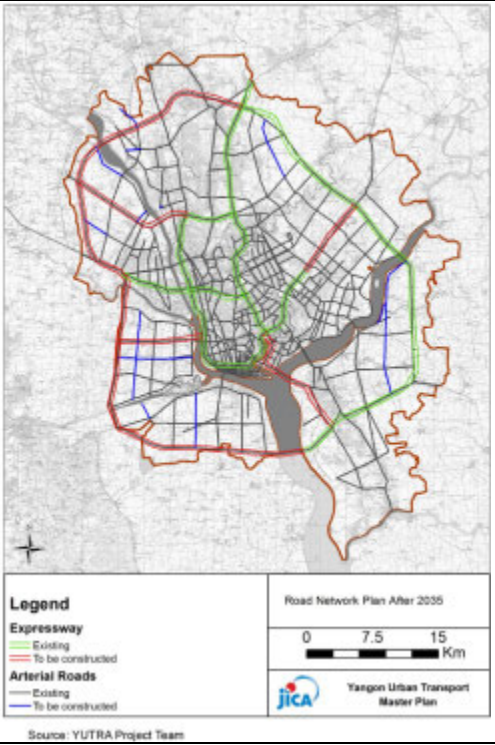
Road Network in 2018



Road Network in 2026



Road Network in 2035



Road Network after 2035

Figure 2.8.12 Proposed Road Development Plan in YUTRA

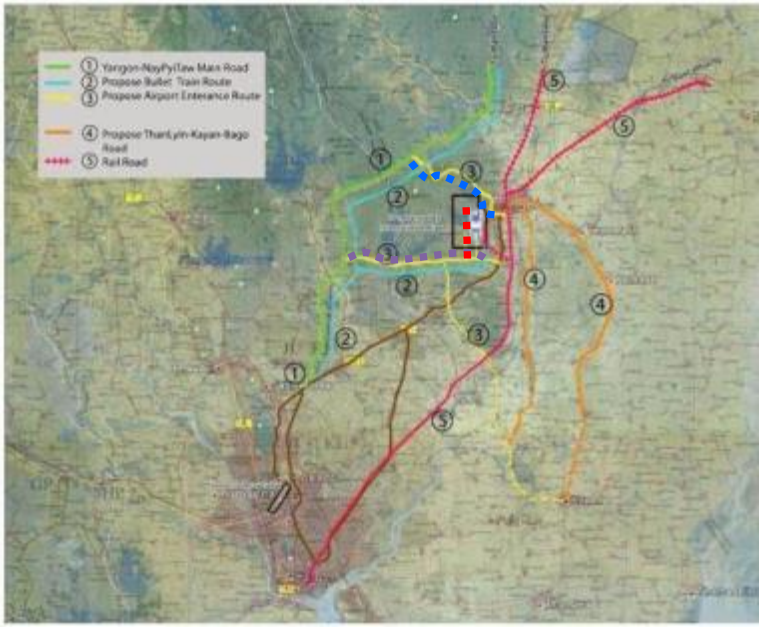
Table 2.8.12 Proposed Projects in YUTRA

Project	Length	No. of Lanes	Contents	Project Cost	Implementation Schedule
Construction of Yangon Urban Expressway (Inner Ring Section) (Phase-1: Waiza Yan Thar Rd.) (RD-7)	15km	4 lanes expressway + 6 lanes arterial roads	Construction of Elevated Expressway	620 Mil. USD	2015 – 2021
Construction of Yangon Urban Expressway (Inner Ring Section) (Phase-2: Kyee Myindaing Kanner Rd.) (RD-8)	7.5km	4 lane elevated expressway + 6 lanes arterial roads	Construction of Elevated Expressway	315 Mil. USD	2018 – 2023
Construction of Yangon Urban Expressway (North Radial Section: No.3 Main Rd.) (RD-6)	17km	4 lanes elevated expressway + 6 lanes arterial roads	Construction of Elevated Expressway	252 Mil. USD	2014 – 2019
Construction of Yangon Urban Expressway (East Radial Section: No.2 Main Rd.) (RD-9)	9.5km	4 lanes elevated expressway + 6 lanes arterial roads	Construction of Elevated Expressway	403 Mil. USD	2020 – 2025
Construction of Arterial Roads of Outer Ring Road (along Road No.7) (RD-5)	18km	4 lanes arterial roads	Construction of arterial roads	140 Mil. USD	2014 – 2019
UMRT Line1 Construction Project (North- South Line) (RL27)	21.8km	Double Tracks (UG:10.5km, EV:11.3km)	Construction of New MRT Line	2,253 mil USD	2015 – 2025

c) DCA

In the RFP, DCA planned access transportation system for HIA as below.

As for access road system from Yangon, Ngyn Inn Road (Purple dot line in following figure), northern road (Red dot line) and access roads from NH1 (Blue dot line) is proposed. Also, bullet train and spur line from Yangon – Mandalay railway is proposed. However, there are no tangible plans for airport access railway and roads at this moment based on the Myanma Railway and MOC.



Source: DCA

Figure 2.8.13 Public Road Map

d) Feasibility Study for Urban Expressway (North – South Corridor)
Korean Yooshin Consortium conducted the feasibility study for the urban expressway in Yangon which is one of the proposed projects in YUTRA. In the study, the elevated expressway is proposed from Yangon CBD to YIA as phase 1 project. The expressway from YIA to the 0 mile point of existing expressway is proposed with at grade road is proposed as phase 2.

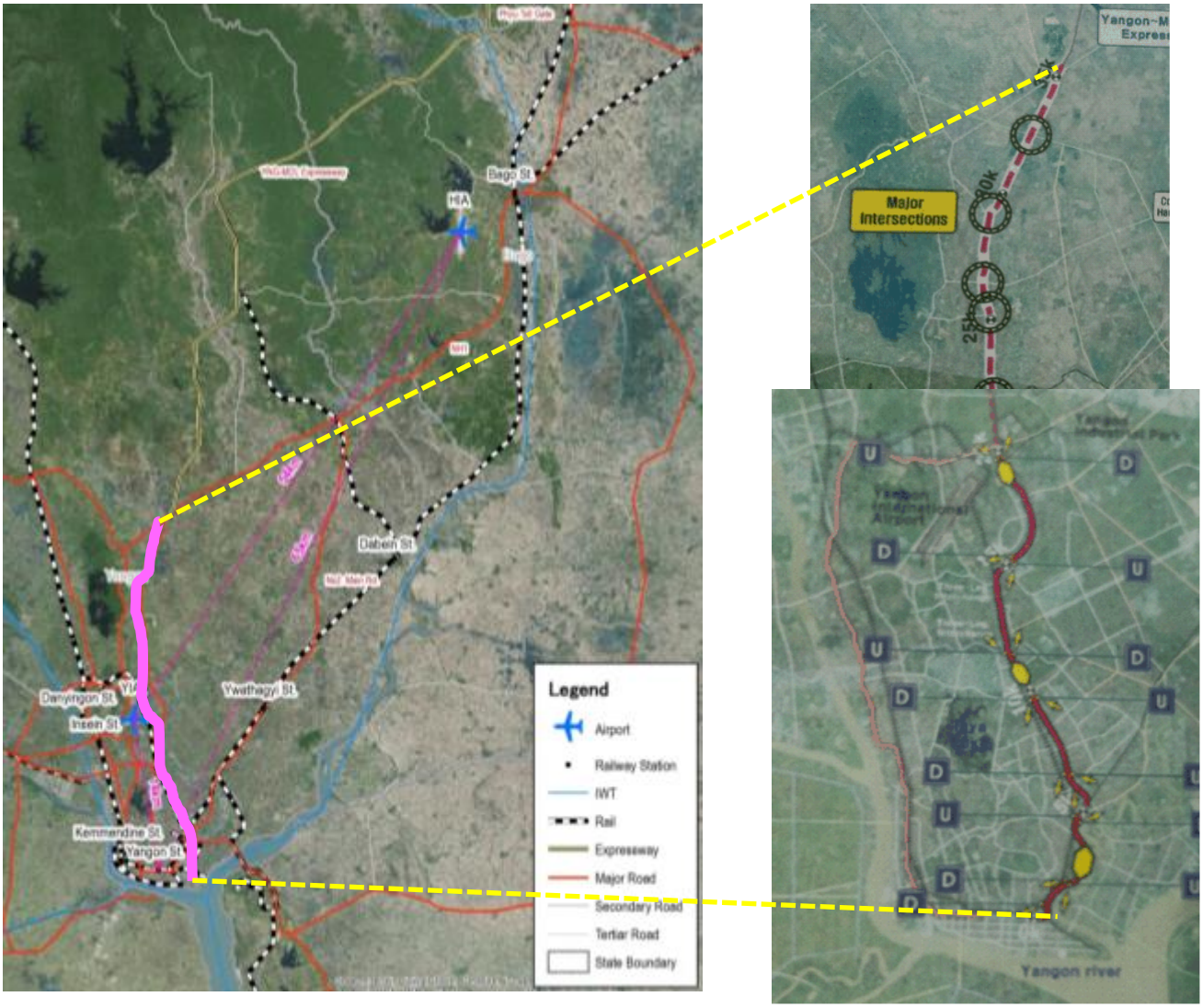


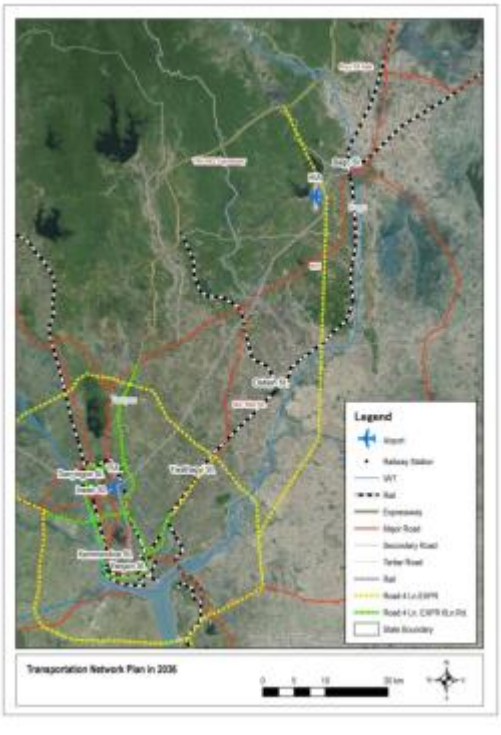
Figure 2.8.14 Inner-ring Road East Section and Extension

e) Summary of Future Transportation Network
Future transportation plan in MYT-Plan and YUTRA is summarized as shown in Figure 2.8.15.

Transportation Network in 2022

Transportation Network in 2025

Transportation Network in 2030



Transport Network after 2030

Figure 2.8.15 Transportation Network Plan proposed YUTRA and MYT-Plan

(2) Target Level of Service

Considering the service level of access transport for international airports in surrounding countries and related projects, the target level of service for HIA is studied in this section.

a) Cross-country Study for Access Transportation to International Airport

As shown in "1.2.6" in this report and following tables, the service level for access transportation to HIA airport is quite poor comparing with other airports. The travel time from CBD to HIA is almost double of journey time of Narita airport even the distance from CBD to Narita airport is similar to the distance between CBD to HIA, approximately 65 kilometers.

In addition, multi-modal transportation service is provided to those other airports. It is quite important for airport access from the view point of redundancy. At present, there are no railway access between YIA and HIA.

Table 2.8.13 Journey Time from CBD to International Airport

Airport	Distance (km)	Travel Time(min)	
		Car	Rail
Haneda	15	24	28
Changi	20	25	27
Suvarnabhumi	27	40	22
Incheon	50	65	43
Narita	67	65	53
Hanthawaddy	**65**	**138**	**144**
Yangon	14	45	N/A

Source: JICA Study Team

Table 2.8.14 Journey Time from Hub Airport to other Airport

Hun Airport	Other Airport	Distance	Travel Time(min)	
		(km)	Car	Rail
Suvarnabhumi	Domuwan	30	48	N/A
Incheon	Kinmpo	32	40	38
Narita	Haneda	60	74	90
Hanthawaddy	**Yangon**	**54**	**93**	**N/A**

Source: JICA Study Team

b) Target Level of Service

HIA is planned to be opened by 2022. It is assumed that the traffic demand for HIA will be increased gradually. Considering the necessary procedure and budget to construct access transport infrastructures, it is proposed that the transport infrastructures should be developed in stages. Proposed target level of access transportation service in each phase is below:

- Phase 1(Opening Year): Reliable Access Road Network Development
- Phase 2(2025): Expressway Network Development
- Phase 3(2030): Airport Access Link Development

Table 2.8.15 Target Service Performance

Indicators	Present (Year 2015)	Phase 1 (Year 2022)	Phase 2 (Year 2025)	Phase 3 (After Year 2030)
Travel Time From YIA (min)	93	70	60	30
Travel Time From CBD (min)	138	85	85	60
No. of Access Route	1	More than 2	More than 3	More than 2
Mode of Access Transportation	Car	Car/Bus	Car/Bus/Rail[7]	Car/Bus/Rail

(3) Access Transportation Development Strategy

Considering required service level by target year, the following development strategy is proposed for access transportation system for HIA. The travel distance and time to HIA is shown in Figure 2.8.6 and Figure 2.8.7, respectively.

a) Phase 1 (Opening Year)

The reliable access road network is minimum conditions for air passengers. If access road is closed due to traffic accident or natural disasters repeatedly, air passengers have to considering extra time every trip.

By the year 2022, the 4 lanes roads with asphalt concrete pavement that connects Yangon city with HIA should be developed. Also, there should be an alternative access route. Considering existing road network, following two projects is proposed as phase 1 project:

i. Improvement of Ngyn Inn Road
ii. Construction of Access Road (NH1 – HIA)

Also, following three projects which is conducted / going to conducted by Myanmar government should be implemented by 2022.

iii. NH1 Widening
iv. Traffic Control of NH1: Strengthening regulation for illegal parking and benders
v. Improvement of Yangon – Mandalay Expressway

The proposed access route is shown in Figure 2.8.8.

b) Phase 2

To provide the punctual and high speed transport service, expressway network that

[7] The access route from YIA to HIA doesn't include rail transport.

connects Yangon city with HIA should be developed. The expressway should be full-access controlled.
Considering existing road network and future plans, airport access expressway project is proposed as phase 2 project.
The Bago - Hanthawaddy airport railway branch line construction project is also proposed considering the improvement project of Yangon-Mandalay railway will be completed by phase 2.
The proposed access route with expressway is shown in Figure 2.8.9.

c) Phase 3
To provide more punctual and higher speed public transportation service, airport link railway that connects Yangon city with HIA via YIA should be developed.
The proposed access railway is shown in Figure 2.8.10.

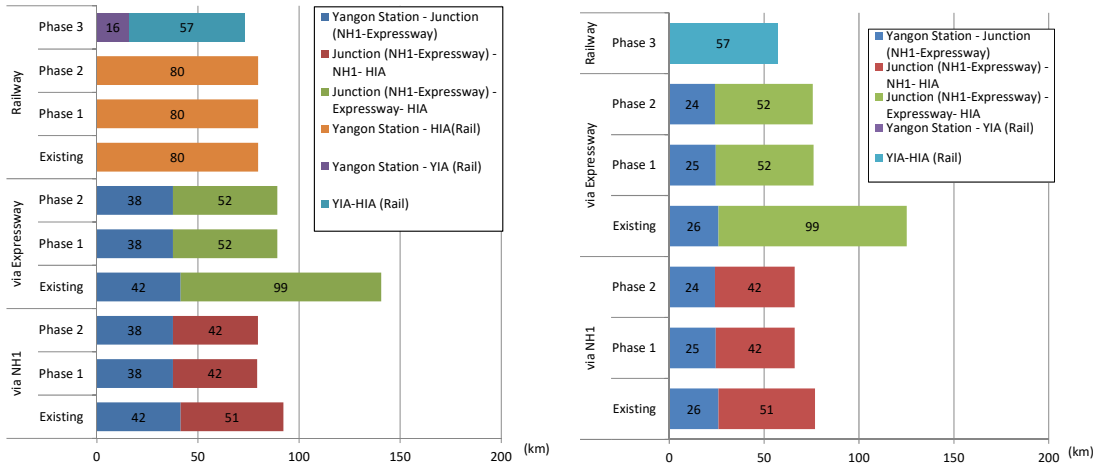


Figure 2.8.16 Travel Distance to HIA for each stage (Left: YNG CBD-HIA, Right: YIA-HIA)

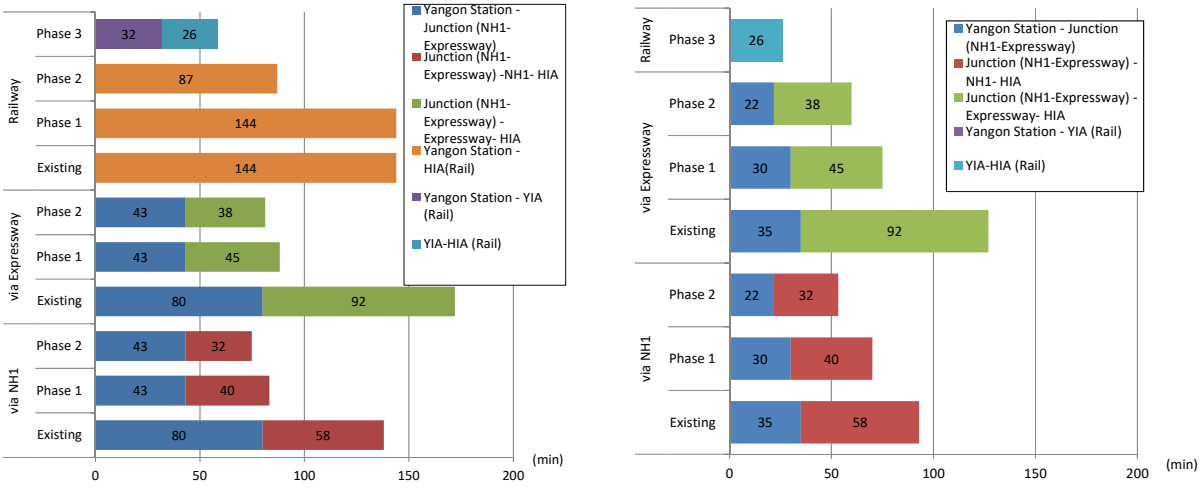


Figure 2.8.17 Travel Time to HIA for each stage (Left: YNG CBD-HIA, Right: YIA-HIA)[8]

[8] Travel speed on existing road is assumed as same speed as current speed. The travel speed on new arterial road, expressway, MRT and airport railway line is assumed 60km/h, 80km/h, 30km/h and 130km/h, respectively. The travel time using expressway is assumed as expressway is constructed on NH1 and Nygn Inn road.

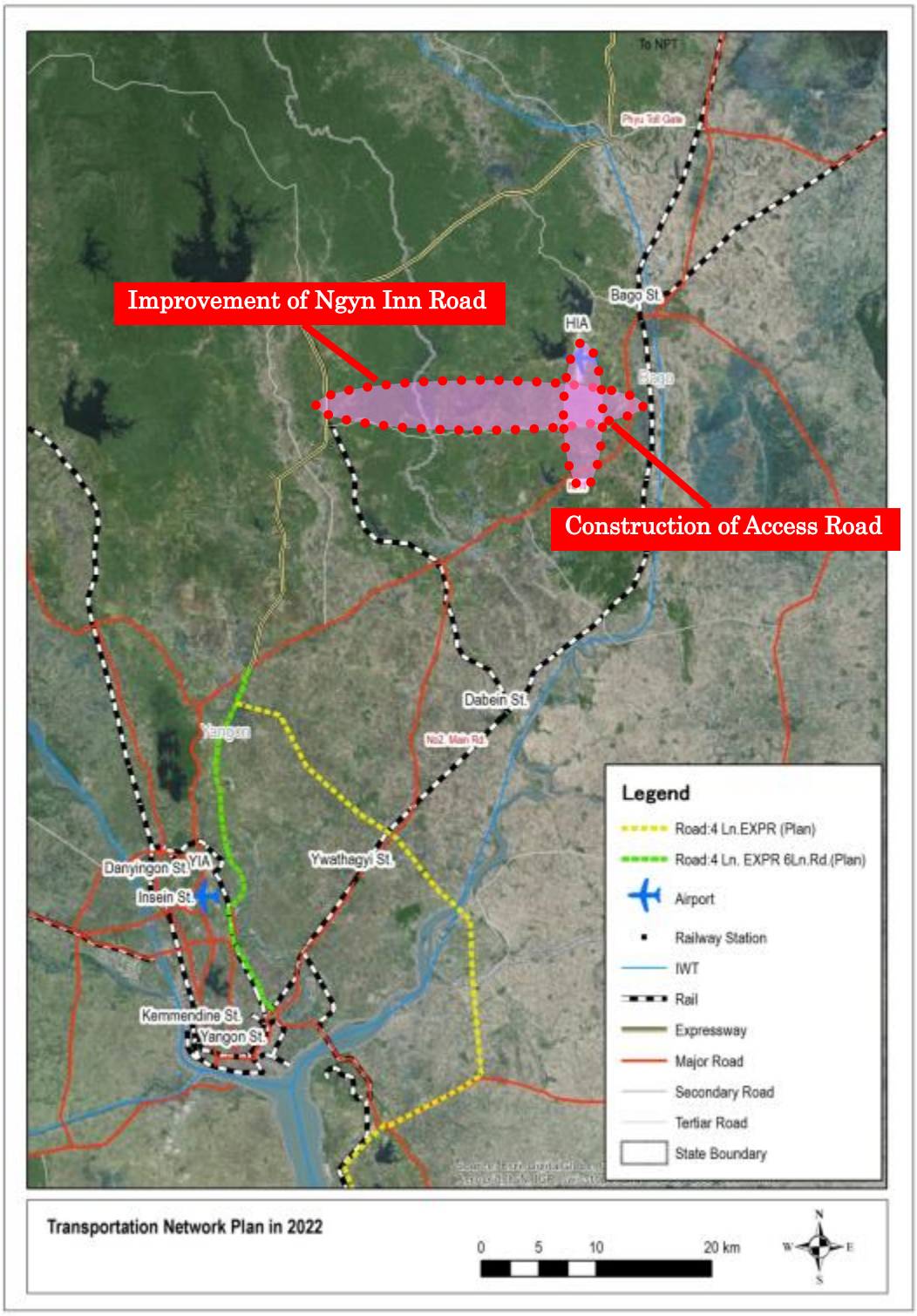


Figure 2.8.18 Airport Access Route and Proposed Projects in Phase1

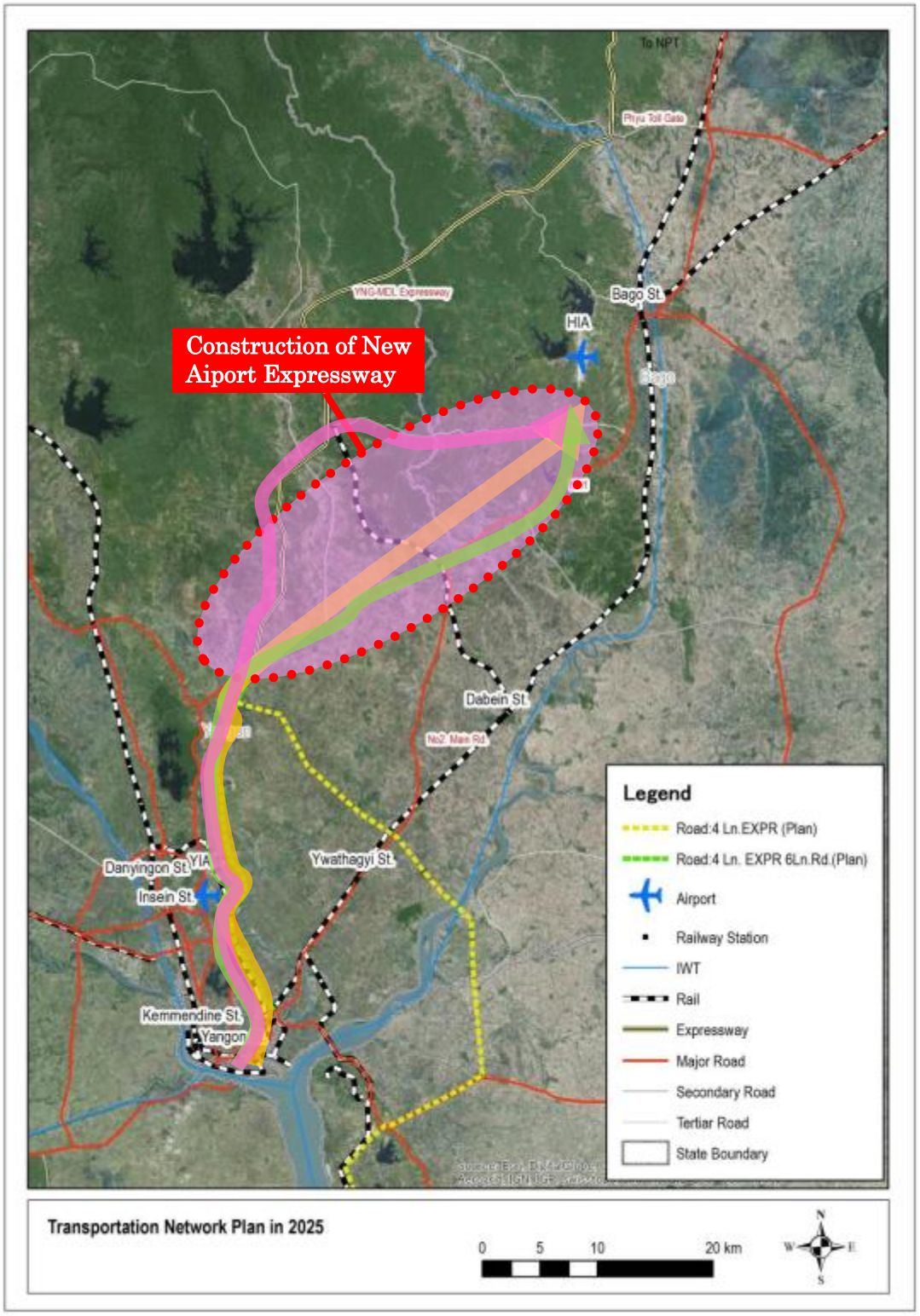


Figure 2.8.19 Airport Access Route and Proposed Projects in Phase2

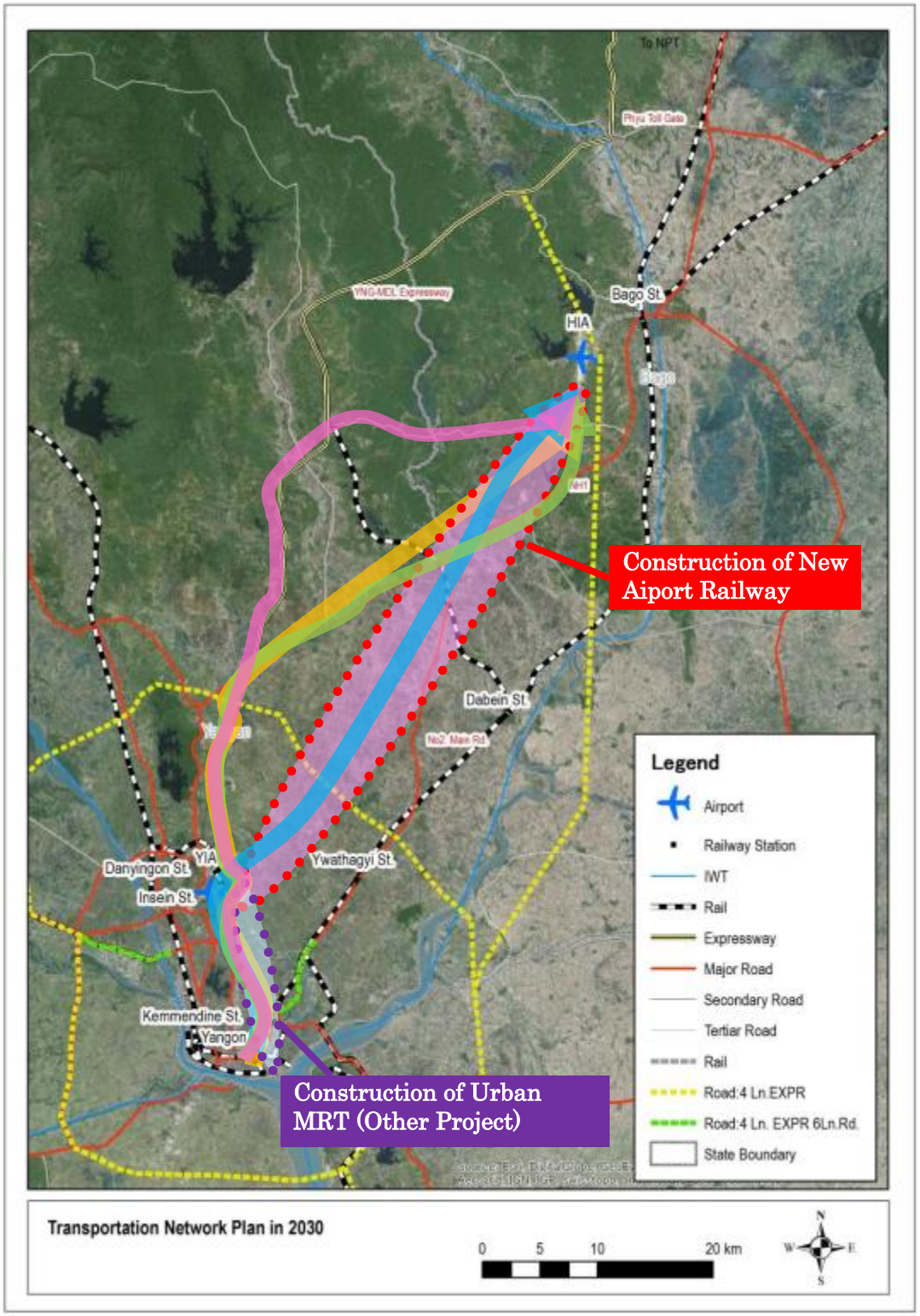


Figure 2.8.110 Airport Access Route and Proposed Projects in Phase3

(4) Airport Access Traffic Forecast

a) Peak Hour Traffic

Access traffic volume is forecasted based on the forecasted daily visitors in Chapter 2.8.8 with peak ratio shown in table 2.2.17, the average peak ratio of departure and arrival.
The number of visitors for HIA is estimated 4,700 persons per hours in 2022, 23,000 persons per hours in 2050.

Table 2.8.16 Daily Airport Visitors

Unit: Passengers / day

	2022	2025	2030	2040	2050
Daily Passengers	30,440	39,000	56,510	114,080	189,450
Daily Well-wisher	12,180	15,600	22,600	45,630	75,780
Daily Airport Staff	2,130	2,730	3,960	7,990	13,260
Total	44,750	57,330	83,070	167,700	278,490

Table 2.8.17 Airport Visitors in Peak Hour

Unit: Passengers / peak-hour

	2022	2025	2030	2040	2050
Daily Passengers	2,892	3,276	4,408	8,328	13,451
Daily Well-wisher	1,157	1,310	1,763	3,331	5,380
Daily Airport Staff	639	819	1,188	2,397	3,978
Total	4,688	5,405	7,359	14,056	22,809

b) Modal Split

Modal share for airport access is estimated using the modal split model with explanatory variables as travel time and travel cost which was developed in MYT-Plan and “Detailed Design for Yangon- Mandalay Railway Improvement Project Phase I” (YMDD).

i. Modal Split Model

Multi-nominal logit model is developed in the MYT-Plan and YMDD based on the stated preference survey to public transport passengers such as bus and railway.
The proportion of trips between any two points, i and j that choose mode k out of the set of four choices is given as:

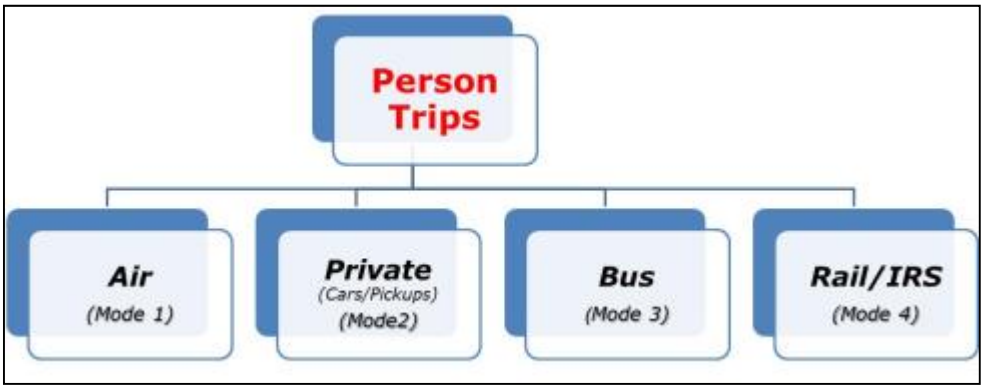
$$P_{ijk}=\frac{\exp U_{ijk}}{\sum_{k=1}^{n}\exp U_{ijk}}$$

Where:
Uijk is the utility function of travel between zone, i and j on mode k defined as: a*Tijk+ b*Cijk;
Tijk is the travel time on mode k between any two TAZ’s i and j;
Cijk the cost of travel in units of 1,000 Kyat on mode k between any two zones i and j; and a and b equation constants which was estimated by income level. In this study, the constants for high income are adapted.

Table 2.8.18 Modal Choice Scale Parameters

Calibration Parameters		Statistical Results		
		ρ^2	t-value for each Parameter	
A	b		A	b
-0.01169	-0.07192	0.20	-37.643	-42.9869

Source: Interim Report for YMDD



Source: Interim Report for YMDD

Figure 2.8.11 Modal Split Hierarchy

ii. Modal Split

It assumed that most of the airport visitors come from Yangon CBD area due to the lack of OD data for airport visitors. It is also assumed that airport access expressway is developed on Nygn Inn road by 2022 and airport access railway is developed by 2030. Travel time by railway will be shortened since Yangon – Mandalay railway is supposed to be rehabilitated and modernized by 2023. However, the railway access to HIA isn't considered in 2025 since the average headway is planned quite long as 42 minutes in 2025.

Table 2.8.19 Forecasted Modal Share for Airport Visitors

	2022	2025	2030	2040	2050
Car	51%	51%	32%	32%	32%
Bus	49%	49%	31%	31%	31%
Rail	-	-	37%	37%	37%

Table 2.8.10 Forecasted Number of Airport Visitors by Access Transportation Mode

Unit: Passengers / peak-hour

Passenger / hour	2022	2025	2030	2040	2050
Car	2,401	2,762	2,362	4,511	7,321
Bus	2,287	2,643	2,261	4,318	7,007
Rail			2,736	5,227	8,481

Table 2.8.11 Forecasted Traffic Volume by Airport Visitors

Unit: PCU / peak-hour

PCU / hour	2022	2025	2030	2040	2050
PCU	1,108	1,276	1,091	2,084	3,382

The average number of person in a car and a bus is assumed as 2.55 persons and 24 persons based on transportation survey in YUTRA. PCU factor for car and bus is assumed 1.0 and 1.75.

Traffic capacity for each lane for more than 2 lane roads is indicated 2,200 PCU / hour / two-way in “Highway Capacity Manual”.
Based on the capacity, the expressway should be 4 lanes between 2040 and 2050.

(5) Transport Infrastructure Project

a) Improvement of Ngyn Inn Road

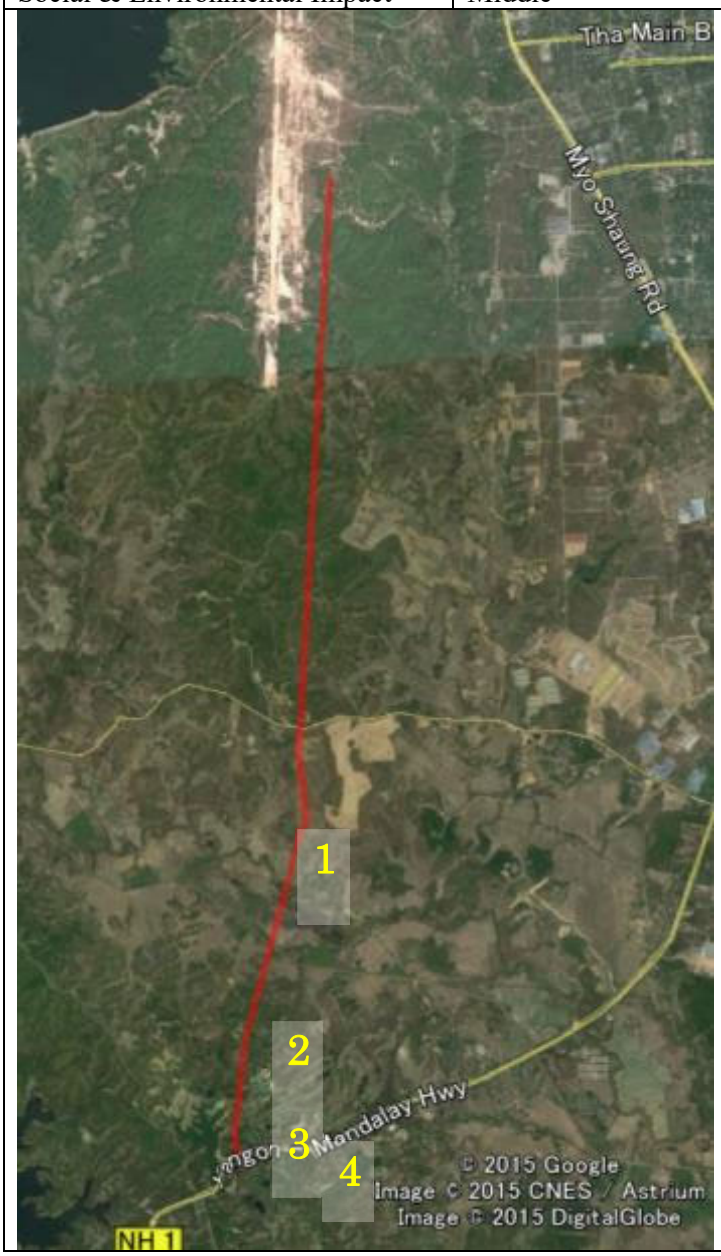
The Ngyn Inn Road which connects existing expressway and NH1 should be widen and improved alignment by 2020, opening year of HIA. The traffic demand from Yangon to HIA is forecasted as 1,108 PCU per peak hour in 2022 as above mentioned. The traffic should be assigned with new access road which is mentioned below. Then, the induced traffic volume by HIA for Nygn Inn road is assumed as 554 PUC per peak hour. However, 4 lanes road is proposed considering redundancy and travel time saving.

Description	Widening to 4-lane road with asphalt concrete pavement Improvement of alignment		
Length	27km	Project Cost	Approximately 68mil. USD
Environmental & Social Impact	Low		

b) Construction of Access Road (NH1 – HIA)

The new access road connecting NH1 and HIA should be constructed by 2020, opening year of HIA.

Description	Constriction 4-lane road with asphalt concrete pavement		
Length	8km	Project Cost	Approximately 27mil USD
Social & Environmental Impact	Middle		



1.Existing Road

2. Existing Crossing Road

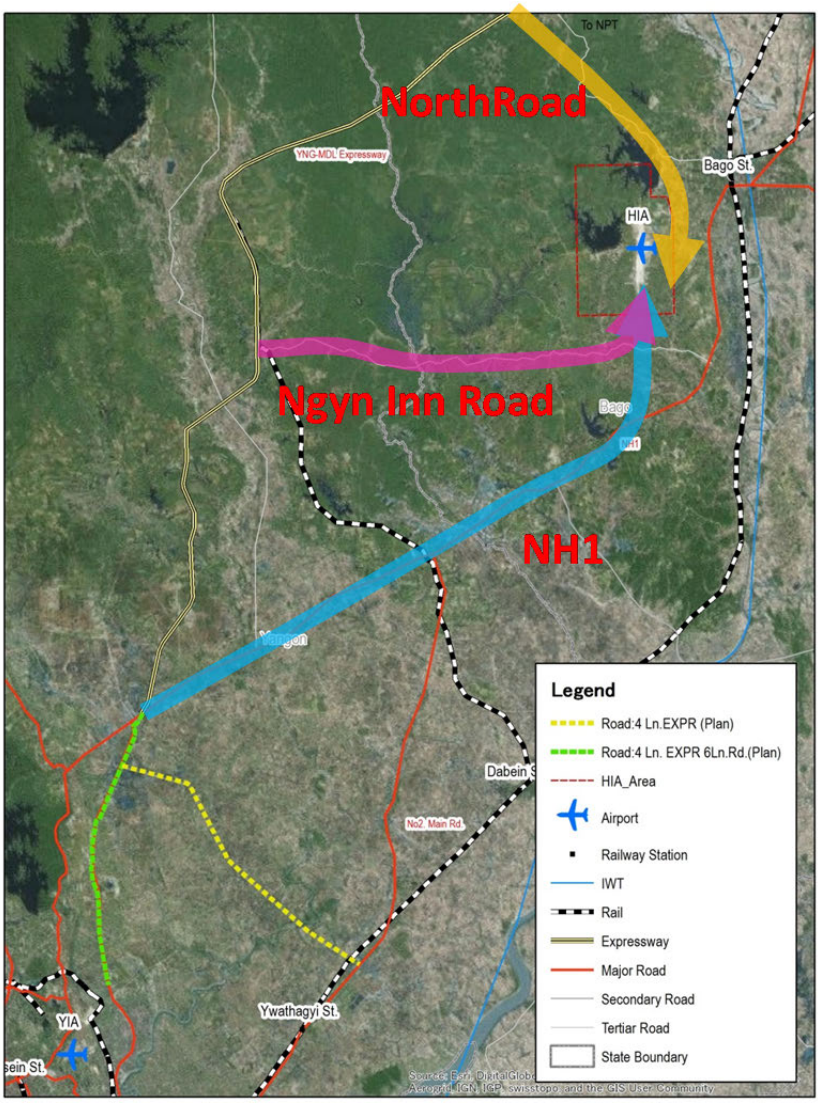
3. Monastery

4. Hanthawaddy Golf Course

d) Construction of New Airport Expressway

New expressway should be constructed between existing expressway and HIA in phase 2 project. The following alternative routes are proposed considering existing expressway and proposed expressway projects in previous studies.

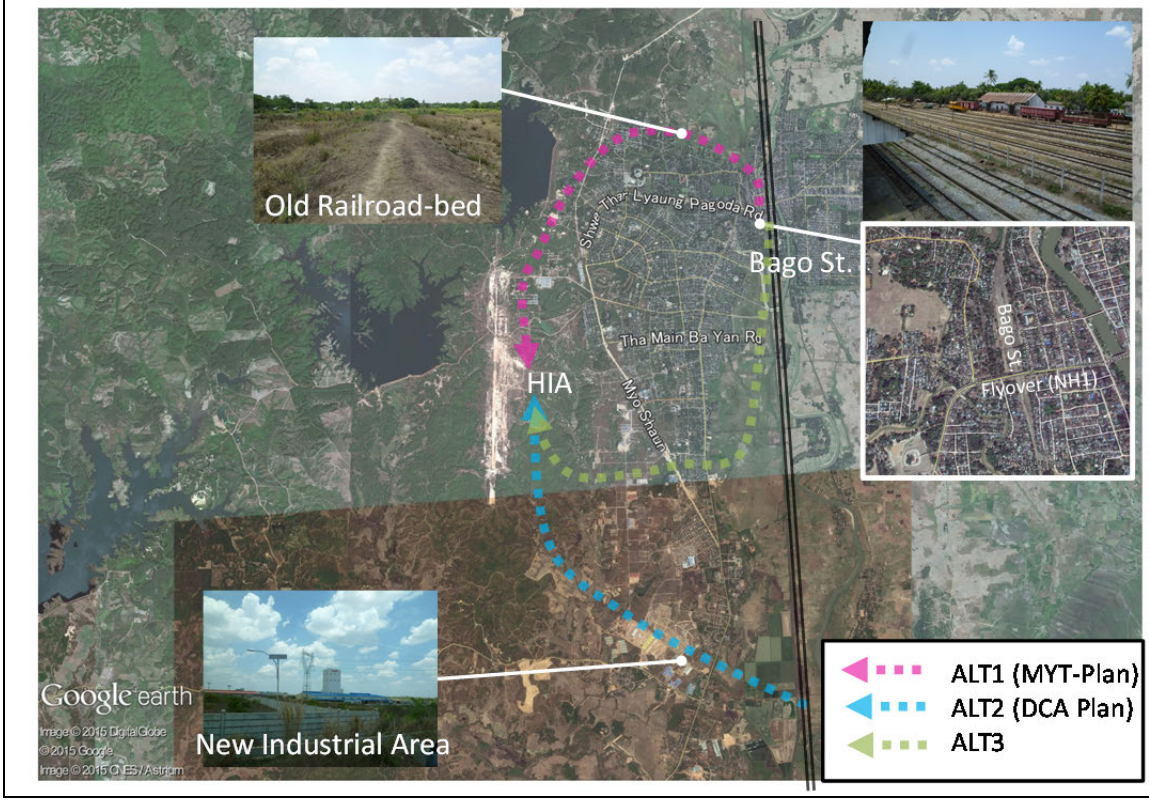
ALT	Description	Length (km)	Project Cost (mil. USD)	Service Level (YIA-HIA)	
				Distance (km)	Time (min)
NH1	Construction of 4 lanes elevated expressway (Urban area) and at grade expressway	42	1,113	68	51
Ngyn Inn Road	Construction of 4 lanes at grade expressway on Ngyn Inn Road	27	90	77	57
North Road	Construction of 4 lanes at grade expressway from 40 miles point of existing expressway	18	60	99	73



e) Construction of Bago - Hanthawaddy Airport Railway Branch Line

The construction of Bago – Hanthawaddy airport railway branch line is also proposed in phase 2 project. The following alternative routes are proposed considering proposed projects in previous studies. However, future detailed study is required to implement the project.

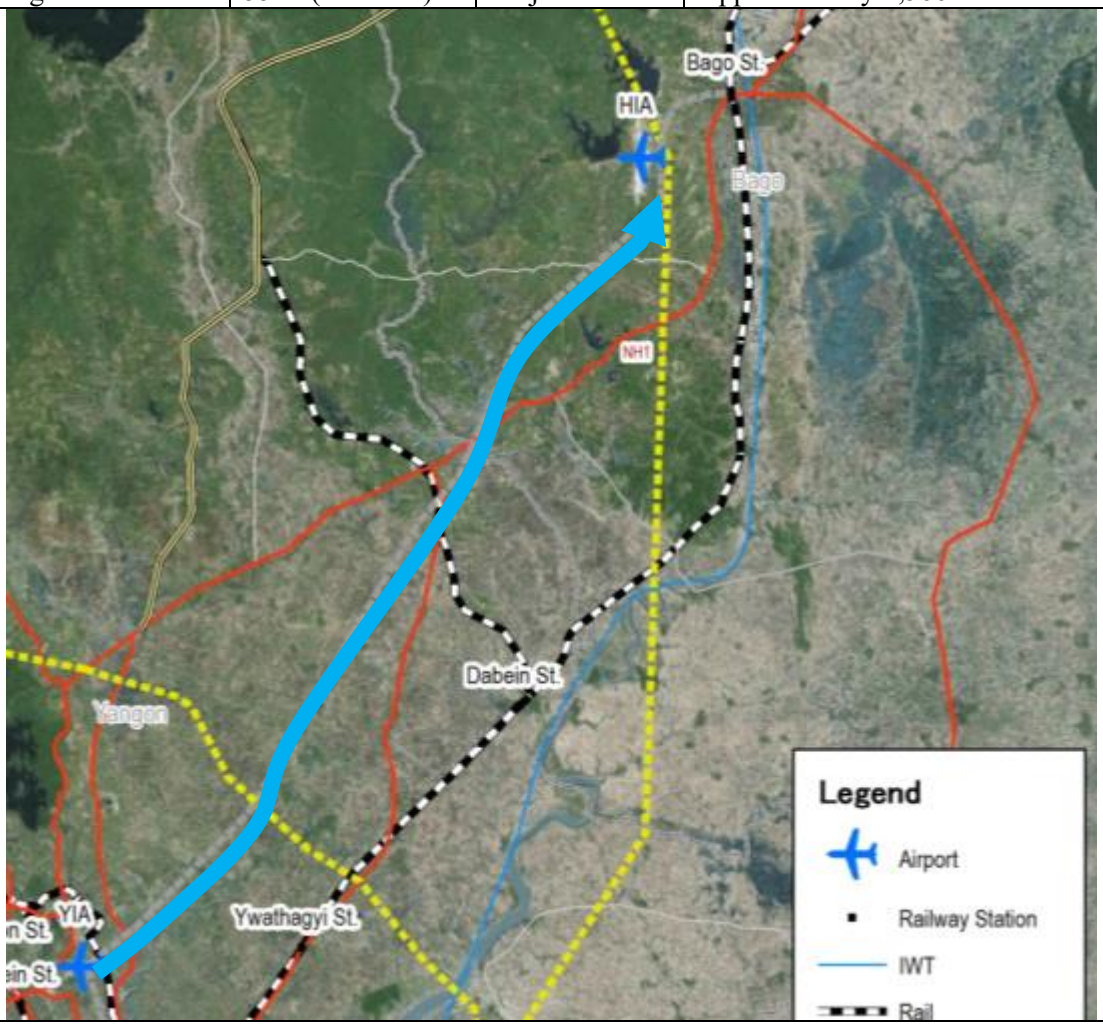
ALT	Description
ALT1	The alignment is the proposed alignment in MYT-Plan. The line starts from Bago station and goes to HIA via northern area of Bago city where old railroad-bed exists. The location of new HIA station should be decided considering that the terminal building of HIA is planed facing south.
ALT2	The alignment is the proposed alignment in RFP for HIA project by DCA. The railway branches from Yangon – Mandalay railway at the southern section of Bago station. Elevated structure is required since the railway runs through industrial area. The branch line operation should be considered that the number of trains bound for Mandalay will reach to the line capacity.
ALT3	The railway starts from southern area of Bago station and goes to HIA via southern area of Bago city. The section within urban area of Bago city should be elevated structure. The Bago station of the branch line should be constructed on the south side of flyover bridge of NH1. Therefore, the transfer passengers are required to walk between existing Bago station and the new Bago station of branch line.



f) Airport Link Railway

New airport link railway should be constructed in phase 3. Following alignment plan is proposed in MYT-Plan.[9]

Description	Construction of New Airport Link Railway（YIA-HIA）		
Length	55km(Elevated)	Project Cost	Approximately 1,566mil.USD



[9] Project cost is re-estimated in this study since some railway section is duplicated in MYT-Plan and YUTRA

2.8.2 Utility

(1) Current Situation of Utility

a) Current Situation of Electric Power

Bago Division, Ministry of Electric Power is responsible for electric power supply in the region where the airport project site locates. A map of transmission line in Bago region is shown in the figure 2.8.12. The national grid line with 220/33/11kV runs from north to south in the region. The primary substation with 220/33/11KV, 100MVA, locates in the south of the map, connects to the national grid, and the electric power is supplied through the secondary substations in the township.

The proportion of hydraulic power generation accounts for more than 70% of the national power generation in Myanmar. The past maximum power supply was about 1,500MW within which the supply for Yangon region is about 700MW.

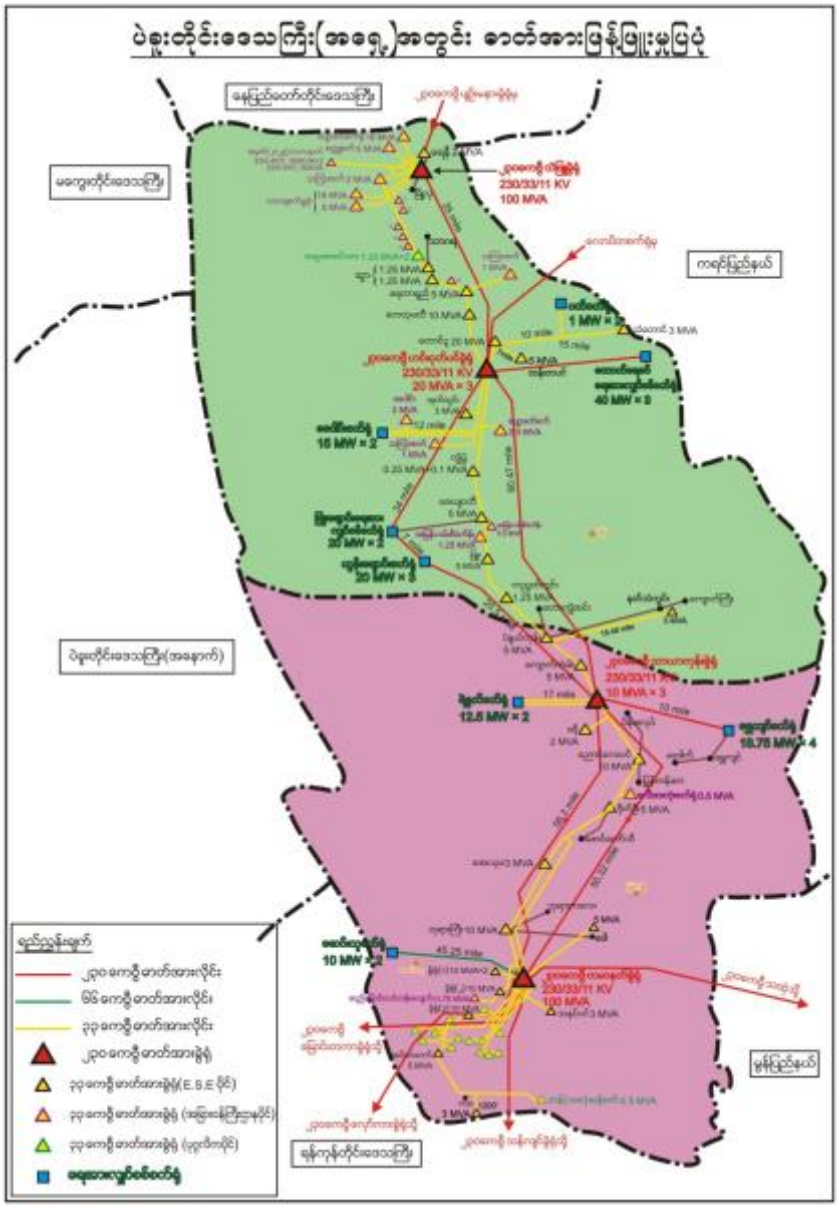
The national grid for the south reaches to Yangon region. There are thermal power stations in Yangon, however, there is no power station in Bago. The electric power in Bago is supplied from hydraulic dams locates in the north of the country. Therefore power failure occurs frequently in the end of the dry season, when the water level at the hydraulic dams is the lowest.

The electric power rate is shown in the table 2.8.12. The rates are divided into residential and industrial usages. Industrial rate will be applied for airports.

Table 2.8.12 New Electric Power Rate applied from April 1, 2014

No.	Type of Usage	Unit	New Rate (MMK)
1.	Residential	1 ～ 100	35
		101 ～ 200	40
		201 <	50
2.	Industrial	1 ～ 500	75
		501 ～ 10000	100
		10001 ～ 50000	125
		50001 ～ 200000	150
		200001 ～ 300000	125
		300001 <	100

Source: Bago Division, Ministry of Electric Power



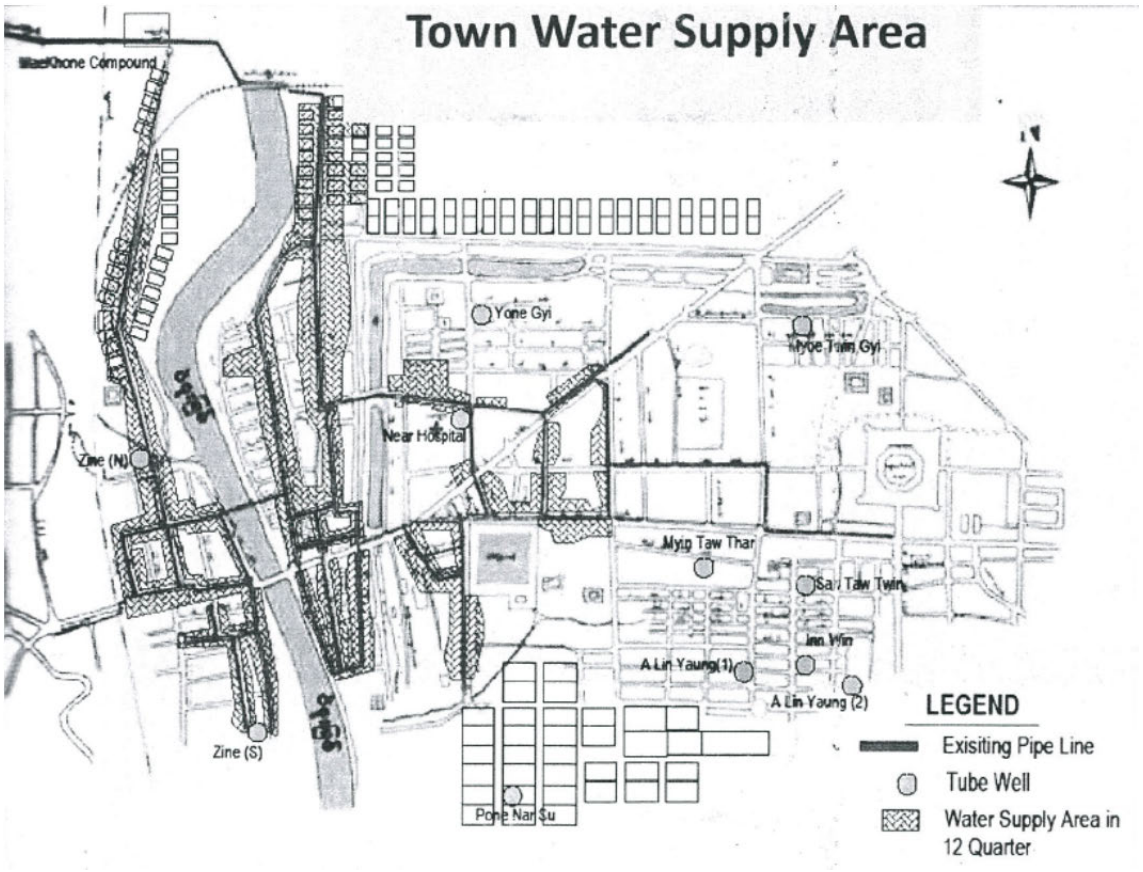
Source: Bago Division, Ministry of Electric Power

Figure 2.8.12 Electricity Distribution in Bago Division (East)

b) Current Situation of Water Supply

i. Present Water Supply System

Current water supply system in Bago township consists of the following; 1) reservoir water supply based on gravity system round the clock since 1924, and 2) ground water supply by direct pumping system from the tube wells since 1960.



Source: Bago Township Development Committee

Figure 2.8.13 Water Supply Area

1) Reservoir Water Supply

KanDawGyi reservoir, located in the north of the township, is a water source for reservoir water supply system, which supplies 12 quarters out of 31 quarters in total in Bago township. The rate for 1 water tap is 4000 Kyats/month except for religious and public taps, which are free of charge.

Due to the lack of water treatment plant in the supply system, the raw water without treatment is supplied. An ongoing JICA loan project supports an improvement for the current water supply system in Bago, which covers development of water treatment plant, and improvement and extension of the system.

There are 1455 taps under the reservoir water supply system in total. These types and the number are shown in the table 2.8.13.

Table 2.8.1 Types and Number of Taps

Type	No. of Tap	Remarks
Household	1,360	
Religion	27	Free of charge
Public	24	Free of charge
Government	44	
Total	1,455	

Number of taps, coverage households and population by quarter are shown in the table 2.8.14.

Table 2.8.14 Number of Taps and Coverage from Reservoir Water Supply

No.	Quarter	Household	Population	No. of Water Tap	Coverage (%)		Remarks
1	Yone Gyi	582	3348	115	19.7	26.4	Household Tap
				20	3.4		Government Tap
				4	0.7		Religion Building
				1	2.6		Public Tap
2	Lake Pyar Kan	850	4985	62	7.3	8.6	Household Tap
				6	0.7		Government Tap
				5	0.6		Religion Building
3	Shin Saw Pu	1644	7074	45	2.7	3.8	Household Tap
				2	0.1		Government Tap
				1	1		Public Tap
4	Zay Paing	940	4800	217	23	24	Household Tap
				6	0.6		Government Tap
				4	0.4		Religion Building
5	Pan Hlaing	1224	6977	192	15.7	18.7	Household Tap
				5	0.4		Government Tap
				2	2.4		Public Tap
				2	0.2		Religion Building
6	Thom Ba Yar	1125	6468	130	11.5	16.8	Household Tap
				4	5.3		Public Tap
7	Nyaung Wine (South)	1036	4815	169	16.3	16.4	Household Tap
				1	0.1		Bagoda
8	Nyaung Wine (North)	778	4407	107	13.7	14	Household Tap
				1	0.13		Government Tap
				1	0.13		Bagoda
9	Ywar Thit	1036	4815	134	13	21.8	Household Tap
				6	8.7		Public Tap
				1	0.1		Religion Building

10	Kyauk Gyi Su	905	5285	65	7.2	14.9	Household Tap
				4	0.4		Government Tap
				4	6.6		Public Tap
				6	0.7		Religion Building
11	Zine Ga Naing (South)	1224	6977	32	2.7	2.7	Household Tap
12	Zine Ga Naing (North)	940	4790	92	9.8	19.7	Household Tap
				6	9.6		Public Tap
				3	0.3		Religion Building
	Total	12284	64741	1455			

2) Ground Water Supply（Tube Well）

There are 20 tube wells at present. Three (3) tube wells support to the reservoir water supply line. Remaining 17 tube wells do not have taps, and supplies to public water tanks, which everyone can use it for free of charge.

ii. Water Source

1) Ground Water

Nine (9) tube wells out of 20 are out of services now. Quality of ground water is not suitable for tap water because the water contains iron and saline. Therefore water from dam/reservoir is expected for the water source for water supply expansion in the future.

2) KanDawGyi Reservoir

KanDawGyi reservoir, locates in the northern part of the airport project site, is utilized as the water source for the current water supply system. The water source for the ongoing JICA loan project is KanDawGyi reservoir as well.

Table 2.8.15 Data of KanDawGyi Reservoir

Daily Water Supply	690,000 gallons
Water Storage Area	141 acres
Storage Volume	422.7 million gallons
Length of Dam	750 ft
Height of Dam	95 ft (RL.)
Height of Intake Structure	97 ft (RL.)
Height of Spillway Crest	89 ft (RL.)
Length of Spillway	60 ft

Figure 2.8.14 Location of Reservoir and Dams

3) Mazin Dam and Zaletaw Dam

Mazin dam and Zaletaw dam were constructed and completed in 2000 and 1999, respectively, for the purpose of irrigation, water supply and flood control. The basic information of these dams are presented in the table below.

Table 2.8.16 Data of Mazin Dam and Zaletaw Dam

	Mazin Dam	Zaletaw Dam
Type of Dam	Earth Filled Dam	Earth Filled Dam
Water Spread Area at F.T.L	1525 acres	1380 acres
Storage Capacity	28800 Acre-ft	18000 Acre-ft
Length of Dam	4100 ft	4565 ft
Height of Dam	60 ft (RL.)	50 ft (RL.)
Irrigable Area	650 Acre	2000 Acre

These dams are managed by irrigation department, Bago division, Ministry of Agriculture and Irrigation. Currently there are used only for the irrigation but not for water supply, although these dams were constructed for the both purposes. The use records in the last 5 years of both dams are shown in the table 2.8.17.
Irrigated areas of both dams are decreased year by year, because 1) rice price fell recently, 2) farmers for cultivation abandonment are increasing, and 3) sold farmlands with the progress of urbanization are increasing.

Table 2.8.17 Irrigation Water Use (Irrigated area base)

Name of Dam	Irrigable Area		Storage Capacity (Acre-ft)	Summer Paddy (Acre)				
	Plan	Actual		2010 -11	2011 -12	2012 -13	2013 -14	2014 -15
Mazin Dam	650	635	28800	710	584	353	161	90
Zaletaw Dam	2000	1790	18000	1021	848	772	657	310

Table 2.8.18 Yearly Statement of Water Supply Utilization (Mazin Dam)

Year	Inflow (Ac-ft)	In Acre Feet						Rain Fall (in)
		Utilization			Wastage & Loss		Storage Balance	
		Irrigation Supply	Domestic Supply		Evaporation & Other Loss	Spilled		
			Other	Industrial Use				
2010	40687	7682	8963	-	11908	10579	-	89.31
2011	78081	5544	14771	-	14302	45726	-	116.5
2012	73815	10608	-	-	22522	41392	-	105.87
2013	67596	10460	-	-	24382	29643	-	97.13
2014	69811	10536	-	-	19022	40960	-	109.05

Table 2.8.19 Yearly Statement of Water Supply Utilization (Zaletaw Dam)

Year	Inflow (Ac-ft)	In Acre Feet						Rain Fall (in)
		Utilization			Wastage & Loss		Storage Balance	
		Irrigation Supply	Domestic Supply		Evaporation & Other Loss	Spilled		
			Other	Industrial Use				
2010	28213	7564	12259	-	8805	-	-	85.68
2011	50601	5712	21464	-	10488	10392	-	117.82
2012	47775	5920	-	-	38200	6620	-	75.33
2013	34890	4472	-	-	17834	10519	-	63.48
2014	34525	9600	-	-	18464	13895	-	90.85

c) Current Situation of Waste Drainage

There is no sewerage system in Bago township, but instead a waste collecting system. There is a waste treatment plant near the land fill site located in the southeast of the east part of the township. There is no tariff system for collection and treatment. The rate is calculated and set upon discharge amount and distance for each case.
There is no environmental standard for effluent. Ministry of Environmental Conservation and Forestry is currently preparing a draft of standards.

(2)Utility Plan

a) Electric Power

JICA Preparatory Survey on Power Distribution System Improvement Project in Major Cities in Myanmar, which covers Bago township, is ongoing now. If JICA loan is funded, deteriorated transmission line with much loss will be improved by the project.
According to Request for Proposal (RFP) issued by DCA, the airport substation is stipulated for 11kV with 15-20MVA and 30MVA in Phase 1 and 2, respectively.
According to the interview from Bago division, Ministry of Electric Power, 30MW for the airport power demand has been already allocated by the Ministry headquarter. In addition, an airport substation is required to be built in case such demand to be received. Currently,

the Bago division is considering the development plan for the airport substation and the transmission line. The following figure 2.8.15 is the development plan, so far. According to this plan, the transmission line to the airport substation is connected from the national grid cable in the southern part of the township.

In addition, according to the Bago division, the power supply to the airport, as an important facility, is planned to be supplied with higher priority without power failure as other important facilities is e.g. hospitals are supplied uninterruptable even in the power shortage season.

Ministry of Electric Power will be the executing agency and examine and finalize the location of the airport substation and the route of the transmission line. The airport substation including the transmission line shall be developed with the capacity of 30MW and uninterrupted supply priority.

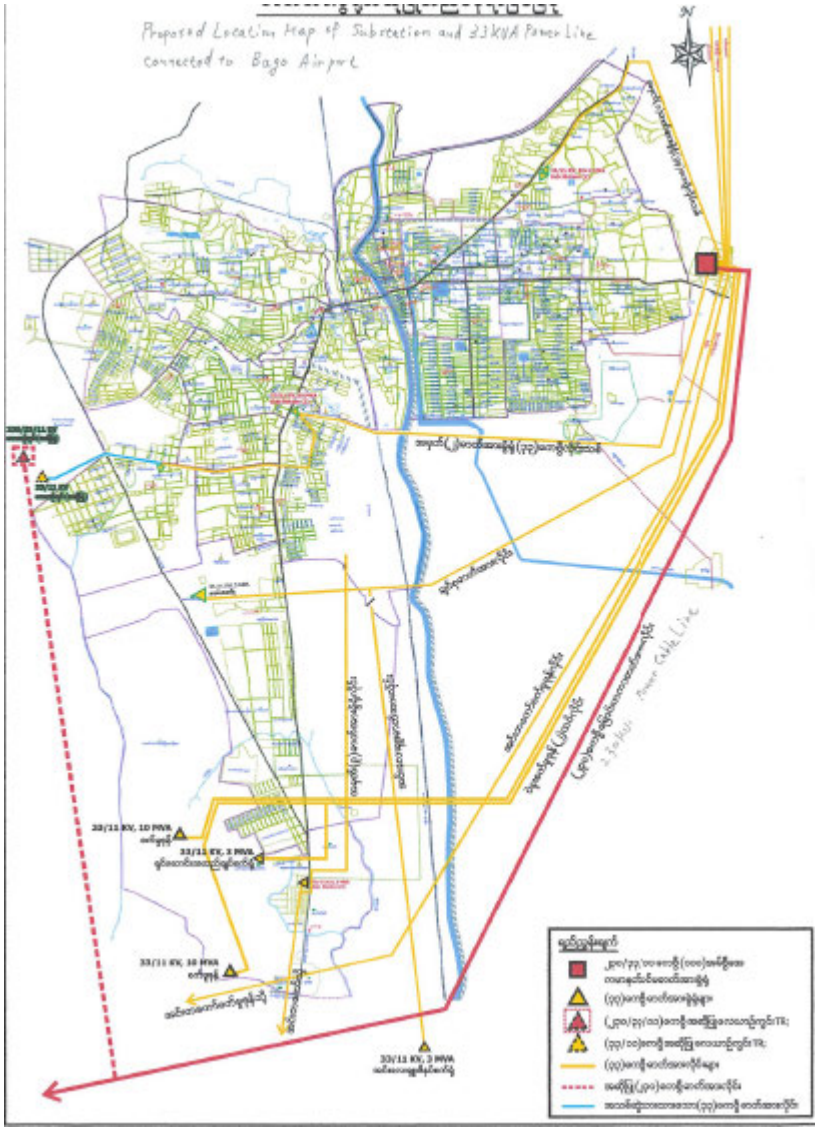


Figure 2.8.15 Location Map of Airport Substation and Transmission Line

b) Water Supply

There are three (3) water supply development plans related to the airport project.

i. JICA Loan Project Phase 1

Poverty Reduction Rural Development Project and Capacity Building (Phase 1) in Myanmar is a JICA loan project which the loan agreement (L/A) was made in 2013 with JPY 1.7 billion. The project covers 7 regions and 7 stats, and consists of 79 subprojects in 3 sectors, namely road/bridge, electric power and water supply. The implementation schedule is set out from June 2013 to June 2016, in total 37 months.

One of the 79 subprojects is a water supply subproject in Bago township, which aims to improve the current water supply system (replacement of water pipe and installation of water treatment plant).

The tender process has been completed, and the construction will be commenced around 3rd quarter in 2015 and completed in 2016-2017.

However the subproject covers only the center of the township and does not cover the airport demand.

ii. JIC Loan Project Phase 2

A JICA preparatory study of Phase 2 of JICA loan project above is expected to be conducted from July 2015 to June 2016.

A water supply subproject in Bago is expected to be included in the Phase 2 project, and Bago Township Development Committee is preparing and planning for Phase 2.

The subproject in Phase 2 is a new water supply system supplied from Mazin dam as a water source. The subproject covers mainly western side (eastside of the airport) of the township. The preliminary plan so far does not cover the airport demand,.

iii. BOT Water Supply Project

Currently two (2) private companies in Thailand and Myanmar are planning a water supply project in Bago township. This plan is a new water supply system to take water from Mazin dam and to cover western side of Bago township including the airport surrounding area and industrial parks.

This project plan is proposed by these companies and submitted to Bago Township Development Committee. The project plan will be finalized through the discussion between Bago Township Development Committee and these companies. The project is assumed to be a BOT project although the detail of the project is unknown so far.

It is supposed to take time to finalize the plan due to a negotiation of contract condition, tariff setting, etc. Therefore it is not clear if this system can supply water to the airport by the commencement of the airport operation.

iv. Other Water Supply Project

Development of water supply system for the airport demand is required by the projects above and/or expanding to these projects. If water volume of KanDawGyi Reservoir and Mazin Dam as water sources for them is insufficient, development of water supply system from Zaletaw Dam, which is not used for water supply currently, is required.

c) Waste Drainage

In addition to the situation that there is no sewerage system in Bago, RFP states to install sewage treatment system in the airport project site to treat waste water from the airside and the landside. In addition, RFP states to install oxidation ditch system, trickling filter system or equivalent to comply with Environment Protection Law in Myanmar or reputable regulation of an industrial country to discharge. According to Bago Township

Development Committee, it plans to develop a drainage canal discharged from the west side of the airport project site and join a river flown from Zaletaw dam, locates in the west of the airport project site. An executing agency for the development is not decided so far.

Figure 2.8.16 Location of Drainage Canal

2.8.3 Further Issue

Expected plan of the surrounding infrastructure is described in section 2.8.1 and 2.8.2. To promote these Project forward, implementation of conceptual design, budget allocation, identification of execution agency, environmental and social considerations including land acquisition are required.

It has not been the time for related ministries/agencies to plan formally these surrounding infrastructures because Myanmar government has not submitted the official ODA application for the HIA Project to GoJ, so far. Therefore some plans have not been finalized even though plans are under consideration. Hence the process of land acquisition and environmental and social considerations has not been implemented, and the budget for these processes has not been allocated. Regarding executing agencies, it is not sure whether Bago regional government or related ministries to be in charge.

2.9 Project scope and business scheme

2.9.1 Outline of the business

In Myanmar, international air traffic demand increases rapidly with the economic growth around Yangon International Airport. Therefore, establishment of an adequate airport (Hanthawaddy International Airport) for Yangon Metropolitan Area is an important and urgent issue not only for the air transportation sector in Myanmar but also for the sustainable growth of the Myanmar's economy.

The Business (Project) is for planning, design, procurement and construction, operation and maintenance of Hanthawaddy International Airport by Public and Private Partnership (PPP) scheme. The Special Purpose Company (SPC) will be given 30-year concession right (with twice 10-year extension) by DCA, and performs the Project under Built, Operation and Transfer (BOT) contract.

2.9.2 Phased approach and passenger capacity (DCA's Requirements)

Phased development approach of the Hanthawaddy International Airport is requested by DCA as follows.
The scope of the study is carried out the phase 1 considering the expansion of the phase 2.

Table 2.9.1 Phased approach (DCA's Requirements)

		Phase 1	Phase 2
Terminal Capacity	Domestic		6 mppa
	International	12 mppa	24 mppa
	Total	12 mppa	30 mppa
Cargo Terminal capacity		100,000 tons/year	-

(Source: DCA, from RFP)

2.9.3 Outline of the Scope of the work and the services (DCA's Requirements)

Regarding the scope of the work and the services described in the Request for proposal issued by DCA are as follows.

(1) Outline of work
   a) Master planning including design criteria
   b) Preliminary and detailed design
   c) Construction of control tower and operation building, terminal building(s), runway, taxiway, parking apron and storm drainage system
   d) Installation of communication, navigation and surveillance (CNS) systems and airfield lighting system
   e) Fire station and fire fighting vehicles
   f) Water supply and sewage treatment plant
   g) Electric power supply system
   h) Fuel storage and distribution system including fuel hydrant system
   i) Security system
   j) Environmental Impact Study (EIS)
   k) Social and Cultural Impact Study (SIS, CIS)
   l) Access road and railway access and car parking
   m) Cargo terminal, hotel and other ancillary infrastructure
   n) Management, operation and maintenance of the Airport

(2) Outline of the services

a) Design work
All design necessary investigation and examination etc. for construction of the subject facilities including civil facilities.

b) Construction work
Selection of contractors, order of the construction and construction supervision.

c) Maintenance work
Inspection, examination, maintenance, rehabilitation and cleaning of the subject facilities.

d) Operation of the facilities
Passenger processing, renting the facilities and building to air carriers and concessionaire, security of them and management of landside area including parking space.

2.9.4 Outline of the Scope of the facilities (DCA's Requirements)

Regarding the subject facilities described in the Request for proposal issued by DCA are as follows.

(1) Civil Works

No	Item	Description
1	Runway	1) Runway 2) Runway Shoulders 3) Runway Strip 4) Runway-end Safety Area 5) Marking
2	Taxiway	1) Taxiway 2) Rapid Exit Taxiway 3) Taxiway Shoulder 4) Taxiway Strip 5) Marking
3	Apron	1) Passenger Apron 2) Maintenance and Night Stay Apron 3) Cargo Apron 4) Apron Shoulder 5) Compass Apron 6) Marking 7) Blast Fence
4	GSE Road	1) GSE Road 2) GSE Parking Area 3) Perimeter Road 4) Service Road 5) Marking 6) Boundary Fence and Gate
5	Access Road	1) Road of Airport 2) Access Road 3) Curbside (Dispatcher) 4) Road for Cargo Terminal 5) Road for Maintenance Area 6) Road for Operation Building and Control

		Tower Area 7) Road for Utilities Area 8) Sign and Road Marking
6	Car Parking Lot	1) Parking Lot for Passenger 2) Parking Lot for Employee 3) Bus Pool and Taxi Pool 4) Walkway 5) Fence and Gate, Landscaping
7	Storm Drainage	

(2) Building Works

No.	Item	Description
1	Passenger Terminal	
2	Airport Hotel	
3	Cargo Terminal	
4	Catering Center	
5	Control Tower	
6	Fire Station	
7	GA Terminal	
8	LCC Terminal	
9	Maintenance Shop	
10	Operation Building	
11	VVIP Terminal	
12	Passenger Terminal Equipment	1) Baggage Handling System (BHS) 2) Passenger Boarding Bridge (PBB) 3) Flight Information Display System (FIDS) 4) Commonly Used Terminal Equipment (CUTE) 5) Visual Dicking Guidance System (VDGS) 6) Elevator (EV) 7) Escalator (ES) 8) Moving Side Walk (MSW) 9) Dumbwaiters (DW) 10) Immigration Equipment (IE) 11) Customs Equipment (CE)
13	Electrical Works	
14	Mechanical Works	

(3) CNS

No.	Item	Description
1	CNS: Communication	1) Air-to-Ground Communication 2) AFTN/AMHS and AIS Terminal 3) VCCS an Voice Recorder 4) D-ATIS 5) PDC 6) Telecommunication Link
2	CNS: Navigation	1) ILS 2) GBAS 3) DVOR/DME 4) PBN
3	CNS: Surveillance	1) PSR/MSSR Mode-S 2) ADS-B Ground Station

(4) Utilities

No.	Item	Description
1	Power Supply System	
2	Distribution System	
3	Motor Control System	
4	Back-up Generator System	
5	Grounding / Lightning Protection System	
6	Structured Cabling / Telephone System	
7	Water Intake and Transmission System	
8	Water Supply System	
9	Sewage Treatment System	
10	Solid Waste Disposal System	
11	Jet Fuel Supply System	1) Tank Farm 2) Fuel Supply Station 3) Fuel Transmission System 4) Fuel Hydrant System 5) Fire Protection System
12	Aeronautical Ground Lights	
13	Apron Flood Lighting	
14	ITV for Apron Surveillance	
15	Utility Tunnel	

2.9.5 Division of roles between Public and Private sector and out of scope

(1) Division of roles between Public and Private sector (Fund source)

From the aspect of the fund source, the Project can be divided into two parts. One is a part which is carried out using ODA Loan (referred to as Public part, or ODA Project Part). The other is a part which is implemented by SPC's direct investment and financing (referred as to Private Lenders part, or PSIF Project Part). In addition, Private part is comprised of the part which SPC carries out directly and the part which SPC grants the business right (Re-concession) to the 3rd party.

The Public-Private division in the Project makes it a principal in the following. Detailed division of roles will be discussed and determined by ODA Loan guidelines after cost estimation of the Project.

Category 1: Public nature + Private company is hard to enter (Public part)
To provide the facilities by ODA Loans, DCA or Myanmar Government directly operate the facilities which include runway, taxiway, ATC (air traffic control), fire station, etc. so-called "airside" facilities.

Category 2: Public nature + Private company is possible to enter (Public part)
To provide the facilities by ODA Loans, SPC operates the facilities which include utilities supply facilities, landside road, etc..

Category 3a: Private nature + Private company is possible to enter (Private part)
To provide the facilities by SPC's finance. SPC operates the facilities which include passenger terminal, car parking, etc. so-called "landside" facilities.

Category 3b: Private nature + Private company is possible to enter (Private part)
To provide the facilities by SPC or the 3rd party's finance. SPC or the 3rd party operates the facilities which include jet fuel supply system, cargo terminal, MRO facilities (maintenance shop, inc. hanger), etc.

(2) Out of scope of the Project

The scope of the Project is an airport and the associated facilities inside of aerodrome (airport site). Therefore, the following facilities are not included in the Project, which are planned, designed, constructed and operated by related authorities of Myanmar Government.

a) Land Acquisition, Site Clearance
b) Surrounding Infrastructure
   - ➢ Airport Access (Road, Railway, etc.)
   - ➢ Facilities outside of the airport site
     - Power
     - Communication
     - Water
     - Sewage Treatment
     - Solid Waste Disposal, etc.

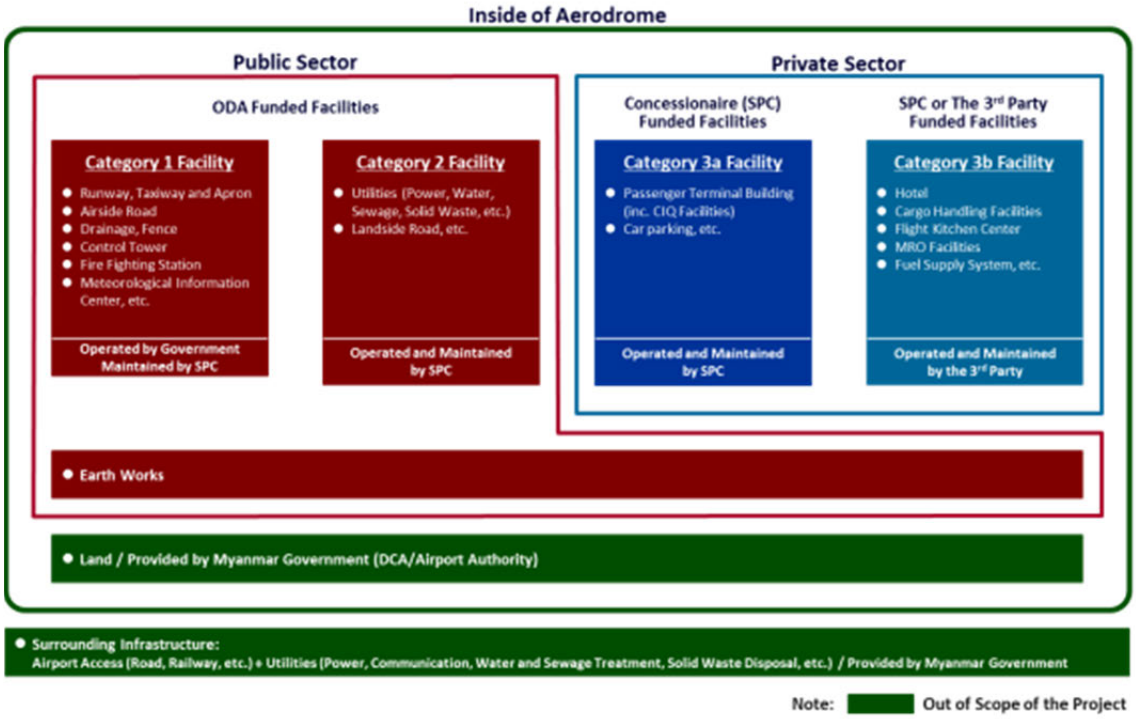


Figure 2.9.1 Definition of Project Scope (Tentative)

2.10 Specification of Design Conditions as PPP Project

2.10.1 Civil Works

This section briefs design conditions as PPP project. The implementation organization, DCA, stipulates the conditions in the "Request for Proposal" (RFP) in most of discipline areas, which designers are obliged to comply with.

1. Civil Works
   (1) Runway
   (2) Taxiway
   (3) Apron
   (4) GSE Road
   (5) Access Road
   (6) Car Parking Lot
   (7) Storm Drainage

2. Building Works
   (1) Passenger Terminal
   (2) Control Tower
   (3) Aircraft Rescue and Fire Fighting Station
   (4) Operations and Administrative Building
   (5) VVIP Terminal
   (6) Terminal Equipment
   (7) Electrical Works
   (8) Mechanical Works
   (9) Utility Works

The following tables show summary. Refer to Appendix for full list of design condition.

(1) Runway

Item		Description	Remarks
General notes:		ICAO Code 4F precision approach runway ICAO Annex14 compliant for geometry, sloping, and all others	
Runway			
	Layout	Length : 3,600m Width : 60m	Code letter : F
	Pavement	Design practices by FAA	Code letter : E
Runway Shoulders			
	Layout	Width : 7.5m	Code letter : F
	Pavement	Design practices by FAA	Code letter : E
Runway strip			
	Layout	Width of Runway strip : 300m Length of Runway strip : 3,720m	Code letter : F
Runway-end Safety Area			

Item		Description	Remarks
	Layout	Width : 120m (60m from Runway center line on both sides) Length : 4,200m (240m from the end of Runway strip on both ends)	Code letter : F
Marking			
ICAO Annex14 and Aerodrome Design Manual Part4			

(2) Taxiway

Item		Description	Remarks
General notes:		ICAO Code 4F taxiway system ICAO Annex14 compliant for geometry, sloping, and all others	
Taxiway			
	Layout	Minimum separation distance between Runway and parallel taxiway ≥ 190m Two parallel taxiways ≥ 97.5m Width of taxiway ≥ 25m	Code letter : F
	Pavement	Design practices by FAA	Code letter : E
Rapid Exit Taxiway			
	Layout	Exit speed under wet conditions ≥ 93km/h Radius of turn-off curve at the least : 550m	Code letter : F
	Pavement	Design practices by FAA	Code letter : E
Taxiway Shoulder			
	Layout	Width : 17.5m	Code letter : F
	Pavement	Design practices by FAA	Code letter : E
Taxiway strip			
	Layout	Width of Taxiway strip : 115m	Code letter : F
Marking			
ICAO Annex14 and Aerodrome Design Manual Part4			

(3) Apron

Item		Description	Remarks
General notes:		ICAO Annex14 compliant for geometry, sloping, and all others	
Passenger Apron			
	Layout	Code letter E : 10 (W=72.5m, L=135.0m) Code letter C : 19 (W=72.5m, L=90.0m)	

Item		Description	Remarks
	Pavement	Design practices by FAA	
Maintenance and Night Stay Apron			
	Layout	Code letter E : 5 (W=72.5m, L=135.0m) Code letter C : 7 (W=40.5m,L= 90.0m)	
	Pavement	Design practices by FAA	
Cargo Apron			
	Layout	Code letter D : 8 (W=59.5m, L=110.0m)	
	Pavement	Design practices by FAA	
Apron Shoulder			
	Layout	Width : 17.5m ; 60m (including Taxiway)	
	Pavement	Design practices by FAA	
Compass Apron			
	Layout	As proposed by the Tenderer	
Marking			
ICAO Annex14 and Aerodrome Design Manual Part4			

(4) GSE Road

Item		Description	Remarks
GSE Road			
	Layout	As proposed by the Tenderer Front of Passenger Terminal : W= 30m GSE Lane : W= 10m, GES Parking : W= 10m, Underground Pipes : W= 10m Other Area : W= 10m	
	Slope	Transverse Slopes ≤ 1.5%	
	Pavement	Design practices by FAA	
GSE Parking Area			
	Layout	As proposed by the Tenderer	
	Slope	Transverse Slopes ≤ 1.5%	
	Pavement	Design practices by FAA	
Perimeter Road			
	Layout	Width : 5.5m Design Speed : 40km/h ~ 20km/h	
	Slope	Transverse Slopes ≤ 1.5%	
	Pavement	CBR > 8.0% or K Value > 50 MN/m^3	
Service Road			
	Layout	Width : 4.0m Design Speed : 40km/h ~ 20km/h	
	Slope	Transverse Slopes ≤ 1.5%	

Item		Description	Remarks
	Pavement	CBR > 8.0% or K Value > 50 MN/m^3 Traffic volume (No/day/lane) : 100 ~ 250 Category of Equipment : Vehicle	
Marking			
	Layout	Stop Marking for Objects Area of Runway	
Boundary Fence			
	Layout	to be located to separate the aircraft movement area	
Gate			
	Layout	at the Entrance and Exit of the aerodrome	

(4) Access Road

Item		Description	Remarks
Road of Airport			
	Layout	Target vehicle : Vehicle and bus	
	Pavement	CBR > 8.0% or K Value > 50 MN/m^3 Traffic volume (No/day/lane) : 1000	
Access Road			
	Layout	Target vehicle : Vehicle, bus, and trailer Design speed : 70km/h Lane more than 2 lanes Lane width larger than 3.0m per lane	
	Pavement	CBR > 8.0% or K Value > 50 MN/m^3 Traffic volume (No/day/lane) : 1000	
Curbside (Departure)			
	Layout	Target vehicle : Vehicle and bus Design Speed : 40km/h ~ 20km/h Number of lane for public transport vehicles more than 1, Number of lane for vehicles of passengers more than 1	
	Pavement	CBR > 8.0% or K Value > 50 MN/m^3 Traffic volume (No/day/lane) : 1000	
Road for Cargo Terminal			
	Layout	Target vehicle : Vehicle and trailer Design Speed : 20km/h Number of lane more than 2 Lane width larger than 5.0m per lane	
	Pavement	CBR > 8.0% or K Value > 50 MN/m^3 Traffic volume (No/day/lane) : 100	
Road for Maintenance Area			
	Layout	Target vehicle : Vehicle and trailer Design Speed : 20km/h Number of lane more than 2 Lane width larger than 3.0m per lane	

Item		Description	Remarks
	Pavement	CBR > 8.0% or K Value > 50 MN/m^3 Traffic volume (No/day/lane) : 100	
Road for Operation Building and Control Tower area			
	Layout	Target vehicle : Vehicle Design Speed : 20km/h Number of lane more than 2 Lane width larger than 3.0m per lane	
	Pavement	CBR > 8.0% or K Value > 50 MN/m^3 Traffic volume (No/day/lane) : 100	
Road for Utilities Area			
	Layout	Target vehicle : Vehicle, bus and trailer	
	Pavement	CBR > 8.0% or K Value > 50 MN/m^3 Traffic volume (No/day/lane) : 100	
Sign			
	Layout	to be designed to guide drivers to their destination without failure	
Road Marking			
	Layout	to be placed in consideration of road capacity, visibility and safety	

(6) Car Parking Lot

Item		Description	Remarks
Parking Lot for Passenger			
	Layout	As proposed by the Tenderer Target vehicle : Vehicle	
	Pavement	CBR > 8.0% or K Value > 50 MN/m^3 Traffic volume (No/day/lane) : 100 ~ 250	
Parking Lot for Employees			
	Layout	As proposed by the Tenderer Target vehicle : Vehicle	
	Pavement	CBR > 8.0% or K Value > 50 MN/m^3 Traffic volume (No/day/lane) : 100 ~ 250	
Bus Pool			
	Layout	As proposed by the Tenderer Target vehicle : Bus	
	Pavement	CBR > 8.0% or K Value > 50 MN/m^3 Traffic volume (No/day/lane) : 100 ~ 250	
Taxi Pool			
	Layout	As proposed by the Tenderer Target vehicle : Taxi	
	Pavement	CBR > 8.0% or K Value > 50 MN/m^3 Traffic volume (No/day/lane) : 100 ~ 250	

Item		Description	Remarks
Walkway			
	Layout	to be arranged to facilitate easy access to the Parking lot from Passenger terminal, Cargo terminal, Operation Building and others	
	Pavement	CBR > 8.0% or K Value > 50 MN/m^3 Rated for pedestrians	
Fence and Gate			
	Layout	The fence to be located so as to separate the movement area and other facilities. The Gate on boundary fence to be located from public access at the Entrance and Exit with Security.	
Landscaping			
	Design	Landscape design concept to be consistent with that of Passenger Terminal.	

(7) Storm Drainage

Item	Description	Remarks
Drainage system to be designed and constructed catchment area by catchment area delineated by the land formation and various structures of the		
Rainfall Intensity	Return period : 10-years Intensity formula: I = 100 (mm/hr) Where ; I : rainfall intensity	
Concentration time	Coefficient of surface friction : pavement: 0.02, rubble: 0.07	
Discharge Volume	Runoff coefficient : Pavement: 0.95, Building : 0.90, Grass or rubble: 0.50	
Water Velocity	Maximum and minimum velocities of drainage water not to be larger and smaller than 3.6 m/s and 0.4 m/s, il	
Drainage Structure Slope	bottom slope ≤ 0.15% (except for U-ditch)	

2.10.2 Building Works

(1) Passenger Terminal

Item	Description
Section 1 Conditions for Design	
Scope of Design	
General "World Class" passenger terminal	
Forecasted number of annual passengers	12,000,000
Location of Passenger Terminal	As proposed by the Tenderer
Transitional surface	not to encroach upon transitional surface.
CIQ facility CIQ facility inside Passenger Terminal.	
Architectural Design Concept	
Main gateway to the country	
National identity	
Harmony with natural setting	
Section 2 Quality and Performance	
Function and Safety	
General Level B service as defined by IATA comprehensive and effective security system	
Floor planning	
General quality service of truly international grade utmost attention to integrate security	
Departure lobby	
Baggage handling system	
Baggage handling in-line-baggage screening system	
Security inspection system	
CIQ facility	
Departure concourse and lounge	
Boarding bridge to be furnished with GPU (Ground Power Unit).	
Arrival concourse	
Arrival lobby	
Airline office	
Concession most enjoyable place in the terminal building	
Building service system	

Item	Description
General Myanmar Fire Protection Code two trunk lines for 24-hour operation	
Car park for airport employees	
Other facility	
Security and safety	
Maintenance durable, sturdy and maintenance-free type of equipment and materials for low maintenance cost.	
Convenience and Comfort	
General Universal design (design for all, inclusive design)	
Provisions for Reasonable User Charge	
General in a spirit of "better service with lower charge"	
Efforts to reduce cost	
Life-cycle cost reducing the life cycle cost to be substantiated	
Environmental Impact	
Environmental impact	
Eco-material to minimize environmental load.	
Energy saving and natural resources saving	
Use of renewable energy	
Recycling rain and waste	
Landscaping	
Landscaping	
Greenery	
General "Green Airport".	

(2) Control Tower

Item	Description
Section 1 Basis for Design	
Scope of Design	
ASR radar room Radar room for ASR (Airport Surveillance Radar) to be arranged either on the ground floor of the Control Tower or in Operation Building.	
UPS system UPS (Uninterrupted Power Supply) system to its full capacity	

Item	Description
	Transitional surface Control Tower not to encroach upon transitional surface imposed by runway
General	
	Architectural design Provision provide for Passenger Terminal to be applied here wherever pertinent.
Section 2 Quality and Performance	
Welfare of Air Traffic Controller	
	Break room
	Bed room
	Locker room
Training of Air Traffic Controller	
	Training room
	Briefing room
Landscaping	

(3) Aircraft Rescue and Fire Fighting Station

Item	Description
Section 1 Basis for Design	
General	
	Reference documents ICAO Airport Services Manual Part 1 Rescue and Fire Fighting
	Aerodrome category Category 10 as defined by ICAO
Section 2 Quality and Performance	
Functional and Efficient Arrangement of Rooms	
Welfare of Air Traffic Controller	
	Bed room
	Multi-purpose room
Landscaping	

(4) Operations and Administrative Building

Item	Description
Section 1 Basis for Design	
	General to be occupied by SPC on his own or rented out
Section 2 Quality and Performance	

Item		Description
	General ・Meteorological information Centre ・CIQ office ・Local police office ・UPS system room ・Director's room ・Employee's canteen ・Bed rooms with shower rooms ・Conference rooms ・Convenience shop etc.	
	Connection with Control Tower	
Functional and Efficient Arrangement of Rooms		
	Access floor to be provided with free-access floor	
Landscaping		

(5) VVIP Terminal

Item		Description
Section 1 Basis for Design		
	Function VVIP Terminal to serve foreign royals, dignitaries, high ranking government officers, celebrities and the like.	
	Location VVIP Terminal to be separated from Passenger Terminal.	
Section 2 Quality and Performance		
Basic Feature of Terminal		High quality Solemn, dignified but gorgeous in exterior and interior design
Approach to Building		Long breezeway or deep awning at entrances both on landside and airside
Landscaping		

(6) Terminal Equipment

Item		Description
	Baggage Handling System (BHS)	1,760 peak hour international passengers.
		Departure counter: 4 islands each 2 rows, 96 check in counters
		Transfer System (Hold Baggage Screen System)

Item		Description
		Arriving System: 7 Claim lines international
	Passenger Boarding Bridge (PBB)	20 numbers of complete PBB Systems
		Pre-Conditioned Air Supply System (PCA)
		400 Hz Ground Power Supply System (400 Hz GPU) to some of PBBs as appropriate
		To be connected with AODB, MC, BMS, and VDGS
	Flight Information Display System (FIDS)	The Airport Operational Database System (AODB) to be supplied by a local specialist company
		The hardware and software of the FIDS and Commonly Used Terminal Equipment (CUTE)
	Commonly Used Terminal Equipment (CUTE)	Design and supply of hardware and software, test and commission the CUTE system in compliance with IATA recommendation No. 1797
	Visual Docking Guidance System (VDGS)	20 numbers of VDGS and Aircraft Stand Identification Sign (ASIS)
	Elevator (EV) Escalator (ES) Moving Side Walk (MSW) Dumbwaiters (DW) Immigration Equipment (IE) Customs Equipment (CE)	

(7) Electrical Works

Item		Description
	Distribution System (DS)	from the substation to local lighting panel and motor control panel Voltage: 380/220 V AC Maximum voltage drop : 3% for lighting / 5% for general supply Frequency: 50Hz ± 0.25 Hz
	Motor Control System (MCS)	for all pumps, and motorized equipment and facilities
	Grounding / Lightning Protection System (GLPS)	to be installed in all large and tall buildings
	Lighting and Socket Outlet System (LSOS)	Internal Lighting / Socket Outlet System
	External Lighting / Socket Outlet System (ELSS)	External Lighting / Socket Outlet System Protection level : IP65

Item		Description
		Lighting fixture : metal halide lamp
	Master Clock System (MC)	Global Positioning System receiver slave clock at all offices Time Synchronization with other systems
	Closed Circuit TV System (CCTV)	Coverage : Passenger Terminal Building Cargo Terminal building Aircraft Parking Apron, Utility area, Access road, Service road, and Car Parking area To be connected with other systems
	Public Address System (PAS)	Coverage : in Passenger Terminal Building in public areas
	Public TV / Information System (PTV)	Coverage : at departure lobby, departure concourse, gate lounge, and VIP/CIP lounges, and one TV socket outlet in office / staff room etc.
	Information Multimedia Kiosks System (IMKS)	for departure and arrival passengers in the passenger terminal
	Radio Communication System (RCS)	2000 numbers of mobile radio stations and 500 numbers of car radios
	Wireless LAN System (WLAN)	to provide a complete and fully operational system
	Fire Alarm / Detection system (FADS)	Smoke detectors Heat detectors Manual fire alarm stations
	Access Control System (ACS)	ACS Supervisor and Administrator located in the Operation Building full coordination with CCTV and FADS
	Building Management System (BMS)	
	Structured Cabling / Telephone System (SCTS)	

(8) Mechanical Works

Item		Description
Air-conditioning and Ventilation System		
	Air-conditioning Main System (ACMS)	air conditioning system to be built independently in each building

Item		Description
		water heaters to be installed individually
	Air Conditioning and Ventilating System (ACVS)	Design Conditions Temperature : 25°, Humidity : 50% Air Conditioning System Passenger Terminal Building, Public Areas : single-duct Air Conditioning Unit (ACU), Other Areas / other buildings to be furnished with individual fan coil unit (FCU) Mechanical Smoke Exhaust System
	Automatic Control / Monitoring System	for the Ventilating and Air Conditioning system fully integrated with BMS
	Rainwater Drainage System	from the roof of each building down spout pipes of heavy duty PVC
	Fire Fighting System	The outdoor firefighting system of fire hydrants along the internal roads / near a building

(9) Utility Works

Item			Description
Utility Works - 1 CNS Works			
Communication, Navigation, and Surveillance for Aviation (CNS)			
	Communication		
		Air-to-Ground Communication AFTN/AMHS (Automatic Message Handling System) and AIS Terminal VCCS (Voice Communication Control System) and Voice Recorder D-ATIS (Automatic Terminal Information Service) PDC (Pre-Departure Clearance) Telecommunication Link	
	Navigation		
		ILS (Instrument Landing System) GBAS (Ground-Based Augmentation System) DVOR/DME (Doppler VHF Omni-directional Radio Range/Distance Measuring Equipment) PBN (Performance Based Navigation)	
	Surveillance		
		PSR/MSSR (primary and secondary surveillance radars) Mode-S ADS-B Ground Station (Automatic Dependent Surveillance -Broadcast)	
Air Traffic Management System (ATM)			

Item		Description
Utility Works - 1 CNS Works		
	ATC-Aerodrome Control	
	ATC- Terminal Radar Control	
Meteorological Observation System (MET)		
Utility Works - 2 Utilities		
	Power Supply System (PSS)	A 11kV power supply underground cable line system is extended from a Circuit Breaker Station to the city substation located at 12km from the airport boundary in Bago city.
		The secondary voltage of the main substation of the Airport to be 11 kV, and electric power capacity to be 15 MVA ~ 20MVA .
		The 11kV electrical power supply system is medium-voltage underground system with two lines in a ring main.
		Each substation to have two transformers 10kV/0.4KV and located at the following places:
	Distribution System (DS) Motor Control System (MCS) Back-up Generator System (EGS) Grounding / Lightning Protection System (GLPS) Structured Cabling / Telephone System (SCTS)	
Water Supply System		
	Water Intake and Transmission System Water intake existing adjacent to the north boundary of the aerodrome Water volume not less than 20,000m^3/day Water Supply System Water treatment plant to a potable level recommended by WHO	
	Sewage Treatment System Sewage from airport facility plus sewage from airplane Reduction of the BOD by the Environment Protection Law of Myanmar Treatment system to be either oxidation ditch system, trickling filter system or equivalent Solid Waste Disposal System Solid waste from the airport facility plus waste from airplane Solid waste disposal system to be a garbage incinerator	

2.11 Preliminary Design (not disclosed)

2.12 Construction Plan (not disclosed)

2.13 Project Cost Outline (not disclosed)

2.14 Development of Project Implementation Schedule (not disclosed)

Chapter 3

Clarification of Division of Roles between Public and Private Sectors

Chapter 3 Clarification of Division of Roles between Public and Private Sectors (not disclosed)

Chapter 4

Organization for Implementation for ODA Project

Chapter 4 Organization for Implementation for ODA Project

4.1 Implementation System for ODA and O&M project

4.1.1 Prospective implementation process for HIA project

In general case of construction work by the Yen loan in ODA projects the implementation unit will follow this process:

- Deciding project scale and budget roughly in accordance with F/S
- Signing Loan Agreement with JICA and disbursing funds
- Implementing Detailed Design
- Preparing bid documents, receiving approval, and tendering
- Monitoring construction work
- Implementing payment and managing budget

The Hanthawaddy International Airport (hereinafter refereed as HIA) project consists of not only construction work by the Yen loan but also Operation and Maintenance (hereinafter refereed as O&M) work during the concession period. This means that the implementation organization will play a role in both construction and O&M. The government of Myanmar (hereinafter refereed as GoM) must handle the following work that the implementation organization will be in charge of.

(Before airport opening)

- Concession agreement
- Land Acquisition and Resettlement
- Procuring and installing the ATC System
- Preparing other government side operational systems (CIQ, police, etc.)
- Operation Readiness and Training (ORAT)

(After airport opening)

- Operating air navigation
- Handing airport O&M (CIQ, police, etc.)
- Supporting airport promotion

4.1.2 Need strong commitment in implementation from the government of Myanmar

To synchronize public and private works during the preparation phase, GoM will establish a project management unit (hereinafter refereed as PMU) responsible for a wider role and made up of a variety of specialists.

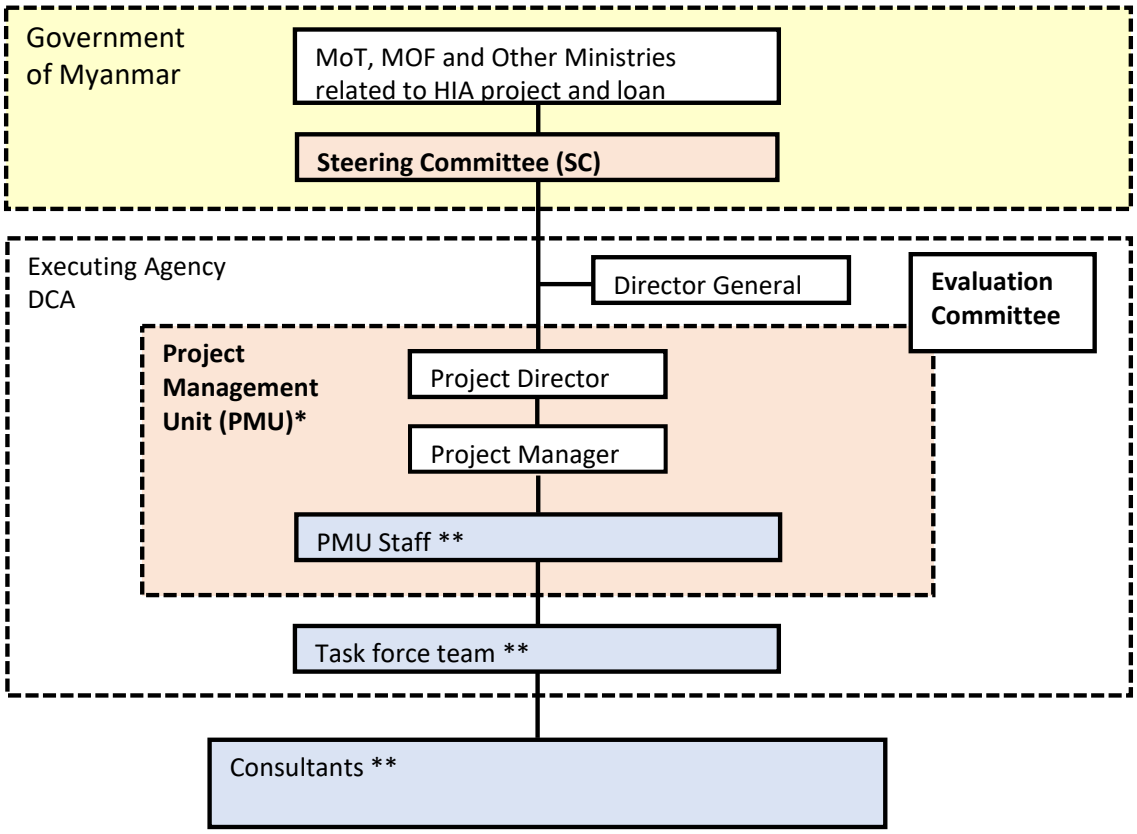
Because GoM, as well as DCA, has not received foreign public finance such as ODA for over 20 years except for humanitarian assistance, DCA officials are not familiar with implementation process of the Yen loan. On the other hand, JICA guidelines set out detailed procedures for bidding, monitoring and payment. Therefore, GoM must commit more strongly at the implementation stage. The implementation process will be successful if there is support from the consultant and good teamwork is established with the consultant. Reviewing existing cases that receive ODA in Myanmar, a strong commitment from GoM is the key to success.

4.2 Proposed structure of implementation organization

The GoM should make a decision on the implementation system for the Project as soon as possible and define the roles of the implementation organization involved in the Project.

- The lending agency will be more comfortable if the Ministry of Transportation (MoT), acting on behalf of GoM, is responsible for repayment.
- The Department of Civil Aviation (DCA) will be an executing agency with the necessary experience and human resources relevant to the implementation of the airport project.

In order to launch the project on schedule, JICA will ask GoM to set up a Steering Committee (SC) and PMU in GoM.



- PMU members will be hired as full-time employees

** Staff, team members, and consultants will be assigned to each experts as follows

1. Project Management (task management between public side and private side)
2. Airport Engineering and procurement
   (civil engineering, construction, electrical, mechanical, communications, etc.)
1. Finance and Accounting (for payments)
2. Legal and Contract
3. Airport Operations (airside operations and terminal/landside operations)
4. Environmental Management

Source: JICA Study Team

Figure 4.2.1 Proposed structure of implementation organization

4.2.1 Establishment of SC

For the purpose of launching infrastructure projects related to the HIA project, such as high-speed rail and highways etc., in coordination with all related ministries and local governments, it is imperative to establish a high-level body. A Steering Committee (SC) will be established exclusively for the HIA project.

The SC will handle the following issue:
- Coordination with related ministries and local governments
- Decision-making to launch related projects
- Monitoring progress of the related projects
- Resolving issues in implementing these projects at the national policy level
- Assessing prospective new projects

In order to solve inter-ministerial issues, the chairman of the SC shall be the deputy prime minister. Members of the SC shall be deputy ministers in each ministry and at the same level for local states. Members will be named in the loan agreement, but potential members will be listed in the working group (hereinafter refereed as WG) that has already been held for the HIA project.
SC members will share existing roles and tasks that each member is responsible for. Members will serve part-time so they can attend official meetings. As a rule, official meetings will be held once a month, but eventually can also be held when necessary.

Table 4.2.1 Potential SC Members

No.	Name	Title	Ministry
1.	HE. Nyan Htun Aung	Union Minister	Ministry of Transport
2.	HE. U Zin Yaw	Deputy Union Minister	Ministry of Transport
3.	HE. U Myint Thein	Deputy Union Minister	Ministry of Railway
4.	HE. Daw Khin Saw Oo	Vice Chairman	Central Bank of Myanmar
5.	HE. U Aung Khin	Yangon Regional Government	Regional Minister (Transport)
6.	HE. U Tun Wai	Regional Minister (Transport)	Bago Regional Government
7.	U Win Swe Tun	Permanent Secretary	Ministry of Transport
8.	U Nay Aye	Director General	Ministry of Environmental Conservation and Forestry
9.	U Myint Aung	Managing Director	Ministry of Electrical Power
10.	U Tin Myint	Deputy Director General	Ministry of Home Affairs
11.	Daw Si Si Pyone	Deputy Director General	Ministry of Finance
12.	U Min Lwin	Deputy Director General(DCA)	Ministry of Transport
13.	U Thein Zaw	Deputy Director General	Ministry of Construction
14.	U Than Hlaing	Deputy Chief Engineer	Ministry of Communications and IT
15.	U Myo Min Oo	Assistant Permanent Secretary	Ministry of Transport
16.	U Kyaw Myo	Honorable Advisor(DCA)	Ministry of Transport
17.	To be named	Consultant(DCA)	Foreign Consultant
18.	U Kyaw Soe	Director(DCA)	Ministry of Transport
19.	U Hla Phone Zaw	Deputy Director (DCA)	Ministry of Transport
20.	U Tet Tin Htut	Executive Engineer(DCA)	Ministry of Transport

Source: Meeting Attendance List for HIA Implementation on 28th May 2015 at MOT.

4.2.2 Establishment of PMU

For successful implementation of the HIA project, a Project Management Unit (PMU) will be established exclusively for this HIA project. JICA will require GoM to set the PMU up as an independent organization to implement of all tasks related to disbursing the loan.
The PMU will handle the following issues:

- Overall project management, monitoring timeline of each sub-project
- Creating detailed designs and plans
- Preparing tender documents and bidding (procurement)
- Making a contract with winner of bidding
- Monitoring construction work, progress, and controlling quality
- Paying contractors and managing disbursement of loan
- Managing environmental and social considerations
- Writing a report to JICA and submitting quarterly progress reports
- Submitting audit reports to the Office of the Auditor General of the Union

The PMU will be formed as soon as possible after ODA loan application. Preparation work in GoM will be done starting with the early stage of this project.
A Project Director (PD) will be appointed as the representative of PMU and will be responsible for supervising the project implementation timeline and resolving critical issues between the private and public sectors. The PD will have the authority to implement the Project, including approval of all technical and financial matters within the Project framework. The PD will report directly to the Director General of the DCA on the SC. A Project Manager (PM) will be appointed as a deputy to the PD or as head of technical matters, to differentiate him from the PD who is responsible for operational and financial matters.

4.2.3 Specialists must be appointed for each concession contract

In the case of ODA projects in general, most specialists on the government side are engineers and accountants. However, this project includes not only construction work but also O&M work in the concession contract, so other specialists for legal, operation, maintenance, and overall project management will be needed. A list of members by field of specialization follows the next table.
At the implementation stage, the number of staff would be about 25 persons to cover each field. Once construction work starts, the number of staff will have to be increased because of the need for monitoring. However, the number of staff needed will be estimated based on the number of contract items, individual work items, and frequency of monitoring. And at the operation stage, the number of engineers and accountants can be reduced. Therefore, the number of PMU staff in the list is an example and can be revised.

Table 4.2.2 Specialists and Number of PMU Staff (Proposed)

Specialists	Stage	Num. of staff		
		Implemention	Construction	O&M
		Detailed Design Sign loan agreement Concession Agreement	Monitoring construction work Managing budget and payment Preparing O&M	Monitoring O&M services Revise contract
		2017-2018	2019-2022	2023-
Project Management		2	2	1
Engineers	civil	10	30	2
	electrical, lightning			
	mechanical and vehicle			
	aircraft handling, towing			
	fuel supply			
	water and sewage			
	terminal building			
	air navigation			
	IT & Communications			
	transportation			
Accountants	account management	3	10	1
	budgeting			
	finance procurement			
	payment			
Legal	contract	4	3	3
	monitoring			
O&M	airside	3	8	3
	landside/terminal			
	surrounding area			
Environment		3	3	-
Land settlement				
Total		25	56	10

Source: JICA Study Team

4.2.4 A full-time officer will be appointed to set up an independent division

As the HIA project will be the biggest of all the ODA projects in Myanmar and needs a wide range of specialized knowledge for implementation, it will be necessary to appoint a full-time specialist as a PMU member. PMU staff may be appointed not only from among current officials but new staff should also be recruited from outside the government when GoM cannot obtain specialists internally. In particular, legal, management, and O&M specialists should be found in the private sector.
As counterparts to full-time officers, a consultant team will be set up for general ODA projects. Specialists will be assigned according to the specialties of each PMU Member. Specialists in various fields–engineering, accounting, legal, O&M, airport management and environment will be also assigned as consultant. The number of consultants will be estimated according to the budget described in the next section.
GoM should support all of the activities of the team of consultants. GoM will arrange shared office space for PMU and consultants and recruit consultants who are knowledgeable about airport projects.

4.2.5 Evaluation committee

In order to select consultants, GoM will establish an evaluation committee (hereinafter refereed as EC) temporarily. The EC will be responsible for setting evaluation criteria and evaluate proposals to comply with JICA guidelines. Similarly to recent cases of ODA in Myanmar, the ministries responsible, MOT in the case of HIA, will establish EC.
The members of the EC will consist of higher-level officers in MOT and DCA only. The

Chairman will be the deputy minister and directors or deputy directors of the DCA and MOT departments concerned will be the members.
In other cases, only the main member and/or chairman continued as members of SC or PMU, because SC members should be selected widely from the ministries concerned and members of the PMU should be chosen by ability in their specialties.

4.2.6 Dispute Board (DB)

During the implementation stage of the Project, use of dispute board (DB) should be considered in the contract involving the package of civil, architectural and engineering works procured through international biddings/selection, however the package of ICT and equipment supply and installation works is regarded not necessary for use of DB due to less concern of conflict occurrence.
Member of DB should be tree (3) engineers, adjudicators or lawyers acquainted with airport development. Standing-3 members of DB during the construction period including Defects Notification Period (DNP) shall be adopted to the package which exceed the expected contract amount of 10 billion yen or more.
The relevant cost should be estimated and included within the Japanese ODA loan amount.

4.2.7 Locate work site in HIA and office in Yangon

During the construction period, technical staff should monitor daily progress of construction work at the work site, so a work office will be located at the HIA site. On the other hand, other staff will be in charge of desk work to produce documentation in coordination with the agencies responsible, obtain approvals, and handle different issues. Therefore, another office for non-technical staff will be located near DCA in Yangon. Because it takes over one hour to travel between HIA and Yangon during the implementation period, having two offices will be more efficient to do the work. In other cases, the location of the office is decided based on the type of project.

Table 4.2.3 Examples of consultant offices and PMU in other cases

Case	1. Thilawa port	2. Y-M railway	3. Poverty Reduction
Work site	Tilawa port only	Section of work in 1st phase 270km	Spread to over 70 sites all over Myanmar
Position of PMU member	Full-time/independent	Full-time/independent	Part-time/shares work
Office of Consultant	Near responsible agency	(Same as office of PMU)	Nay Pyi Taw (Near responsible agency
Office of PMU (plan)	Work site (Thilawa port)	Work sites: 3 points between 270km Office : In responsible agency	Office : in each responsible agency (Nay Pyi Taw or Yangon) Work site : Monitoring by local government

Source: JICA Study Team

4.3 Function of proposed organization and role of consultant

The PMU will perform the following tasks for implementation of the project.

4.3.1 Planning overall implementation schedule

Planning tasks, including elaborating an overall plan and detailed annual and quarterly plans for the project implementation. The types of plans are as follows:

- Loan disbursement plan
- Disbursement plan for construction cost
- Bidding plan

To design these plans, PMU will be in charge of management of the implementation schedule and completion deadline for each task. The overall plan will be prepared by PMU in advance and approved by SC. Detailed plans will be elaborated based on the agreement with JICA and submitted to MoT for approval. These annual plans ensure timely implementation of payment according to the agreement with JICA.

4.3.2 Completion of preparation works

PMU, as a representative of GoM, will complete the first preparatory work of the implementation stage as follows,

- Resettlement of inhabitants
- Ground clearance
- Environmental and social impact assessment

These works must comply not only with Myanmar regulations but also with JICA guidelines.

4.3.3 Bidding and contract management

Bidding and contract management are critical tasks of PMU. Bidding will be assigned by MoT, as the project owner, in accordance with Myanmar bidding law and JICA guidelines. The PMU will manage progress of the bidding procedure and performance of construction work.

4.3.4 Financial and asset management and disbursement

Financial and asset management and disbursement are also important tasks of PMU. PMU will perform financial and asset management and carry out procedures for disbursement in accordance with Myanmar law and JICA guidelines.

4.3.5 Administrative and documentation tasks

Administrative tasks will be carried out by PMU, which has an office and personnel for managing PMU members and will set up an information system and storage for all documents. All documentation concerning benefits and effects of the HIA project must be submitted. Auditing, inspection, and advertising documents will also be prepared by PMU.

4.3.6 Monitoring progress of works

PMU must also periodically conduct monitoring and evaluation. This includes organizing monitoring and assessment of project implementation, including reporting, and sharing and supplying information by submitting all information on the HIA project from SC. Progress reports will be submitted not only to DCA and MoT but also to MoF and other ministries concerned.

4.3.7 Transferring assets to operator smoothly

In the final stage of construction, construction work and financial settlement of programs will be turned over to the airport operator. PMU will prepare a report on completion of works and financial settlement stated in the loan agreement with JICA.

PMU will be in charge of these tasks at the implementation stage but cannot launch them by itself. Support from the consultant will be necessary to make progress in each part of the work.

4.4 Issues of human resources development and know-how transfers

As this is almost first time for GoM officials to implement an ODA loan in the last decades, the government does not have any know-how for implementing and approving ODA loan project. In the case of HIA, officials and the consultant will work together so that officials can learn from the consultant how to implement loans. As HIA will hire full-time staff, it will be necessary for the consultant and PMU staff to work together so that the latter can acquire know-how from the consultant.
As a whole, the technical level of implementation officers is currently low, but their ability will improve at the end of the implementation period if GoM accepts carrying out the following steps:

4.4.1 Know-how transfer for preparing documents in accordance with JICA guidelines

In other cases, the consultant has drafted documents such as detailed designs, quotations, tendering documents, and monitoring reports. That is why officials are not familiar with the JICA guidelines, so the consultant has to do most of the work. This structure is efficient for both of them.
This will be the first time for DCA to use ODA in the last decades, so it will be necessary to support the work done entirely by the consultant. However, this is a rare case for Myanmar, and Myanmar officials will have to obtain know-how and do it by themselves in the next ODA project. In order for DCA to acquire know-how, the following training system has been effective in other projects.

- Preliminary training course on JICA guidelines
- Hands-on process (with examples of documentation prepared by the consultant)

4.4.2 Restore know-how for managing international contracts

Myanmar officials believe they need to learn how to manage the implementation process under public finance by international donors. They also want to know how to manage contracts under international standards, because they only know the domestic system of the Myanmar government.
In the poverty reduction project under Japanese ODA, the consultant adopted a new “two envelope scheme,” meaning that evaluation of technical and financial proposals are placed in two envelopes separately. In Myanmar, the usual situation is that only financial proposals are evaluated, so they felt it was difficult to implement this system. At first, they would forget to evaluate the technical proposal, but the consultant explained that this is a common system in worldwide bidding so they intend to comply with the proposed system.
In the HIA project, the same problem would occur many times. But in the field of airport management, officials seek to learn about international standards, so this project will be a good opportunity for them.

4.4.3 Monitor construction work to maintain high quality of specifications

JICA guidelines describe a higher quality level for construction in accordance with international standards. But in previous projects, officials could not meet the requirement for high quality, so they tended to endorse the existing specifications that they know. For example, in road construction, concrete is the usual paving material in Myanmar, but the guidelines specify the use of asphalt for better surface durability.
In the case of ODA, the consultant needs to encourage contractors or officials to comply with JICA guidelines and change the construction methods in the proposed specifications. It is

important to be aware of the differences in thinking.
The consultant also generally introduces progress charts for construction work for monitoring, but this is a new concept for officials in Myanmar. Because it is usual for government officers to carry out construction work by themselves, not only do they not know how to monitor but they also do not think about it. That is the point of transferring know-how for PMU engineers and is an important role of the consultant.

4.4.4 Install e-government to ease the internal decision-making process

In order to move actions to the next stage, speedy approval is important. Since decision-making is concentrated at the top levels of the government, such as ministers, they are too busy and the approval process generally takes too long. Time management is the most critical factor in the implementation stage, in order to complete the project on time. Officials used to obtain approval from top government ministers but failed to do so when they could not meet with them.
GoM will introduce an e-government system using a paperless online approval system. It is expected to introduce this system but it will take a long time. It is an effective system for reducing implementation costs.

4.5 Issues of financial arrangements

To establish PMU and hire full-time officials and a consultant team, JICA will require GoM to secure a counterpart fund as a non-eligible cost in general. Those will be the terms of the loan agreement. The following issues are critical for GoM.

4.5.1 Additional budget for capital budget

In the budget system in Myanmar, there are two accounts, the current budget as an annual budget, and a capital budget for construction and investment. If DCA assigns members of PMU by relocating them from another division, no additional human resources costs occur, so the human resources cost will be estimated under the current budget.
But since the plan is to recruit specialists outside of the government, establish a specific new division for PMU, and secure office cost and so on, a new budget for this project should be secured in the capital budget. Costs are mainly for human resources for construction work, so this budget should be secured under the construction accounting item.
The implementation period will be for six years from 2017 to 2022, so DCA will offer the budget needed to last until the end of the construction period.

4.5.2 Rough estimate of implementation cost to set up PMU

As GoM should recruit external specialists for legal and O&M, they should offer a higher salary than for regular officials. If the average salary is set at 3,500USD per person, the yearly total will be 175,000USD for 25 persons including double fringe benefits. Around 1 million USD will be needed for 6 years. In addition to personnel costs, the cost for two offices must be added to this PMU cost.

4.5.3 Timing of offering additional budget

In the regular budget cycle in the government of Myanmar, the finance department fixes the budget for the next fiscal year in the first half of the fiscal year, between April and September. If DCA prepares to set up a PMU in 2017, DCA should request an additional budget in the first half of fiscal 2016. That means costs should be estimated as soon as possible and DCA should prepare to submit the estimate to get funding.

4.5.4 Strict management system of annual payment account

The budget system in the Myanmar government is managed strictly. For example, accounts payable are settled by the accounting division every fiscal year, but if the department responsible does not use the total amount of budget, surplus funds must be returned at the end of the fiscal year. So in the last several months of the fiscal year, officials have to project whether individual construction work will be completed and whether payment items will be closed or not. That system forces PMU and consultants to calculate every project very carefully for a certain amount. This is why more PMU members and consultants need to be assigned than in other countries.

4.5.5 Government audit process

GoM has an independent unit for auditing called the Office of the Auditor General of the Union. This body is used to audit in the same detail as auditing by JICA. If the PMU can prepare a detailed audit report in accordance with JICA guidelines, additional work for the Office of the Auditor General of the Union is not necessary, but a detailed report needs to be produced, which means a heavy workload.

4.6 Case study of implementation organizations in ODA projects in Myanmar

Restarting GoM use of ODA loans from the Japanese government, three projects will establish implementation organizations. Suggestions in this report have come from ideas and lessons from these projects.

Table 4.6.1 Comparison of implementation organization in ODA projects

	Case	1. Thilawa Port	2. Y-M Railway	3. Poverty Reduction
Project outline	Project objective	To construct berths, pier, loading machines in part of Thilawa port	To upgrade railway system for a high-speed connection between Yangon and Mandalay	To build basic infrastructure in disadvantaged regions
	Facilities to be constructed	2 berths for Phase1	270km railway for Phase 1	Small roads, electricity, water supply in a total of over 70 sites
	Schedule (Past only)	2012 Feasibility study 2013 Loan agreement, DD 2015 LA, Bidding	2012 Feasibility study 2014 Loan agreement 2015 DD	2012 Feasibility study 2013 Loan agreement 2014 Select consultant 2015 Start construction
	Construction cost	Around 25 bil. JPY	Around 70 bil. JPY	Around 17 bil. JPY
	Ministry responsible	MPA (Ministry of Port Authority)	MoT (Ministry of Transportation) MR (Myanmar Railways)	FERD (Prime), MoC (Roads), MoE (Electricity), DRD (Water)
EC	Establishment	(Yes)	(Yes)	-
	Chairman	Deputy minister	Deputy minister	-
SC	Establishment	-	-	(Yes)
PMU	Establishment	(Yes)	(Yes)	(Yes)
	Frequency of MTG	Weekly	-	Monthly
PMU members	Class	DGM/GM	DGM/GM	
	Origin	MPA only	MR only	
	Position	Part-time/share work	Full-time/independent	Part-time/share work
	Main specialties	Engineer/Accountant	Engineer/Accountant	Engineer/Accountant
	Implementation	20 persons	10 persons maximum	-
	Construction	-	100 persons (HQ 40, each station 20×3)	9 persons (63 persons, including shared staff)
Consultants	Implementation	10 persons	-	-
	Construction	30-50 persons	170 persons	Around 50 persons
	Work site	Thilawa port only	270 km section of work in Phase 1	On 70 sites all over Myanmar
Budget	Additional Budget	(None)	(Yes)	(None)
	Human resources cost of PMU	(Included)	(Not included)	(Included)
	Hired consultant	-	0.3 bil. JPY per year	1.7 bil. JPY
Office	of Consultant	Near responsible agency	(Same as office of PMU)	Nay Pyi Taw (Near responsible agency
	of PMU	Work site (Thilawa Port)	Work site: 3 points along the 270 km section Office: In the respective responsible agencies	Office: each responsible agency (Nay Pyi Taw or Yangon) Work site: Monitored by local government

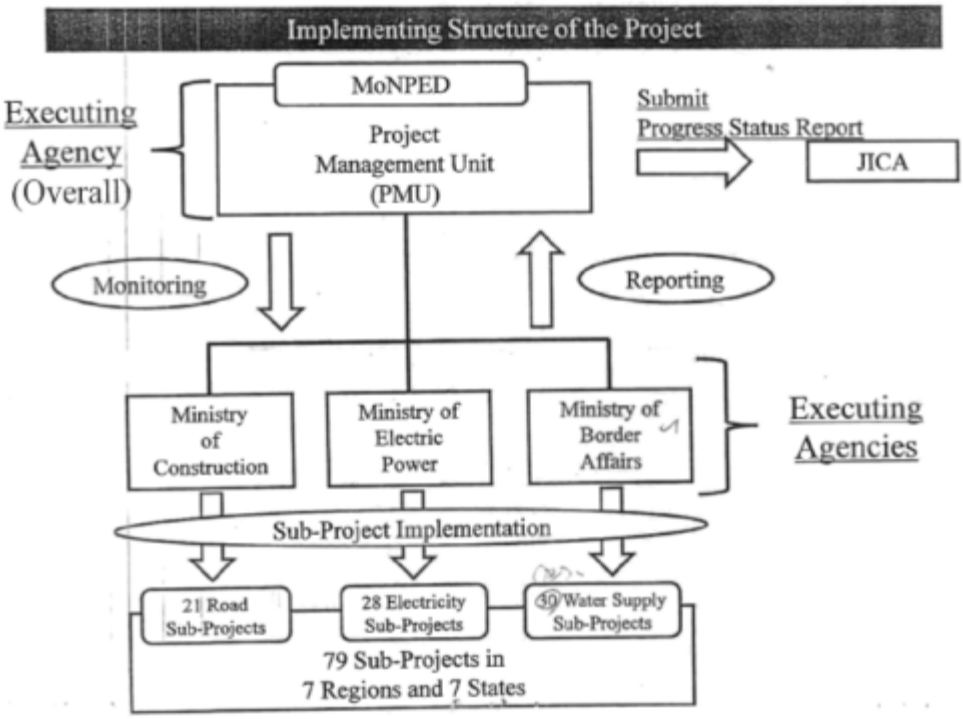


Figure 4.6.1 Structure of PMU for "Poverty Reduction" project

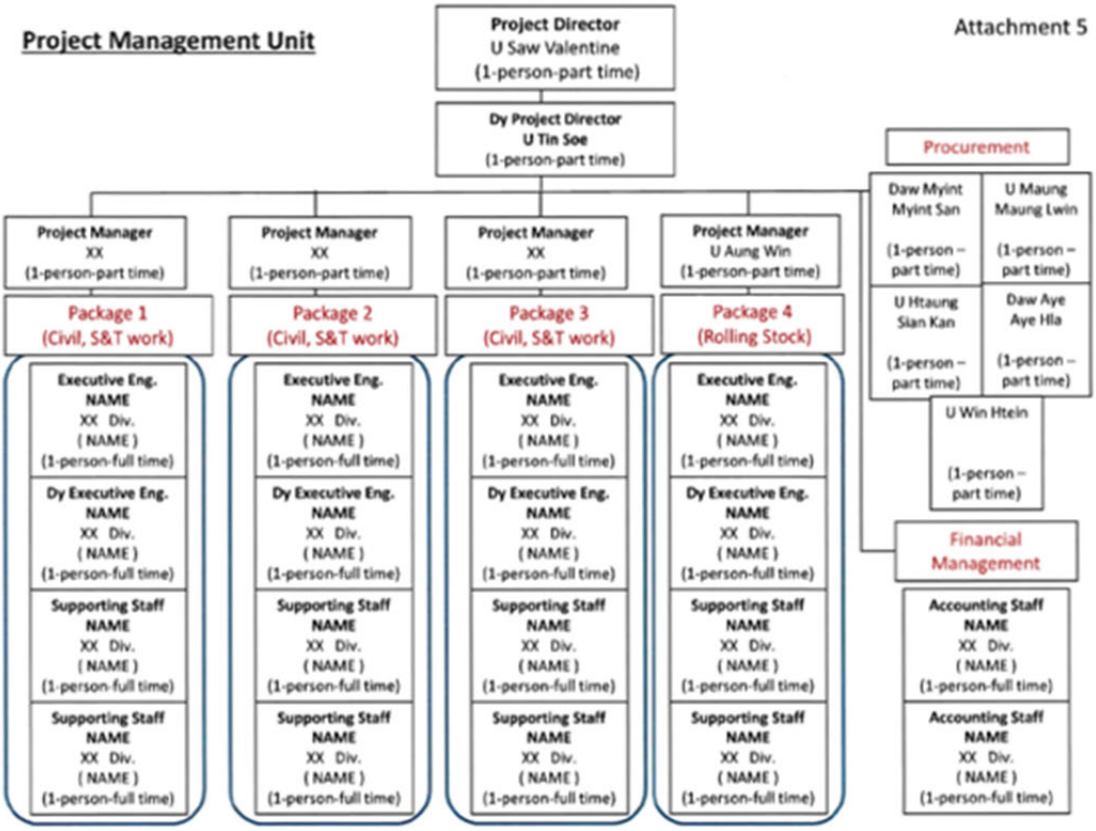


Figure 4.6.2 Structure of PMU for "Y-M Railway" project

4.7 Climate Change Adaptation Programmes

4.7.1 Typical Climate Change related Issues for the Airport Development

The Projects under Japanese ODA Loans have been requested not only to reduce the vulnerability of human or natural systems to the impacts of climate change and climate- related risks, but also are designed to maintain or increase adaptive capacity and resilience against the impacts of climate change.

Therefore, the adaptation measures are necessary that the Project should be planned and designed in consideration of increased external forces stemming from climate change to moderate potential damage, to take advantage of opportunities or to cope with consequences.

Typical climate change related issues for the airport development are as follows:

Increasing precipitation (flooding of runway and access roads, damage to facilities)

Cloud amount (reduction of visibility)

Wind speed (stability of aircrafts)

Change in the bird ecosystem (increasing bird-strikes)

These conditions may adversely affect the safety of flight operations, especially during take-off and landing, and cause damage to the airport operations as well as increasing the safety risks of surrounding communities.

4.7.2 Vulnerability Assessment

Prior to formulate the adaptation measures, the following information for vulnerability assessment should be obtained in Yangon and Bago regions:

(1) Collecting past meteorological data.

Projecting future meteorological conditions (weather conditions in the planned base year using the analysis results of climate change projection for the target year)

Studying past damage by weather conditions and restrictions in plane take-off / landing at YIA.

Studying availability of alternative transportation and risk management capacity of regulatory authorities (access to Yangon, Nay Pyi Taw and Mandalay).

Evaluating DCA’s activities and budgets for facility maintenance and disaster recovery.

Confirming availability of research institutions or units for aviation and airport operations.

4.7.3 Measures to be Adopted

Based on the above data and studies, the following measures are adopted to ensure the safe take-off / landing of planes and the safety of structures, mainly through the improvement of airport facilities:

(1) Surface water drainage systems to be flexible and expandable enough to cope with the increase of precipitation.

(2) Increase in the permeability of pavement and surface of the airport where possible.

(3) Installing navigation system and approach lighting system (ALS) for safety air control even cloudy day and bad weather.

(4) Secure expandability of runway.

(5) Installation of wind breaking fence.

(6) Establishing bird patrol system.

(7) Installation of bird detection radar.

(8) Strategical landscape planning for groundcovers, shrubs and trees for bird habitation and seeds preference.

4.8 Construction Safety Programmes

4.8.1 General Procedures

Prior to issuing any approval of works for the commencement to the Contractor, the Consultant has to make sure that the Contractor had taken the necessary safety precautions and measures in relevant to the works to be executed.

In this regard, the Contractor is requested to prepare and submit a Safety Management Plan (SMP) for the review and acceptance by the Consultant and the Employer (DCA), and necessary measures for construction safety are considered to be taken by the Contractor in the entire period of implementation of the Project.

The Consultant will review and study the proposed SMP to ensure compliance with regulations of the Governmental Departments and Agencies concerned prior to approval and to advise them of any necessary corrections in the contents of SMP:

(1) DCA

(2) Bago Reginal Government

(3) Traffic Department

(4) Water Authority

(5) Electrical Company

(6) Telecommunication Company

(7) Others where required

Close communication between the Contractor and DCA is also one of the factors for better Safety Management. It is intended to reinforce the understanding of the Consultant as well as the Contractor and DCA involved with construction that they may have and how they can assess their performance in the Safety Management.

Daily monitoring by site staff to make sure that Contractor keeps all measures in working satisfactory conditions according to SMP.

The organization of Safety Management in the Project should be set up to take into account the scale of the construction site, diversity and schedule of construction activities and social and cultural customs of the Myanmar concerned. In this regard, the Contractor's organization for the construction safety including the organization chart and responsible person(s), communication network / contact procedures, responsible persons for respective works in the Project should be submitted.

Specific activities for Safety Management consist of daily safety checks, monthly safety inspections and safety reviews every 3 months are necessary. In each activity, the comments, indications, confirmed items and concerned matters should be recorded and kept in the daily report and job monitoring report filed by the Contractor.

4.8.2 Accident Reporting

When an accident occurs at the construction site, it should be reported immediately to persons concerned (including the person in charge of JICA Myanmar office) and necessary actions to be taken. In case of human injuries the injured persons should be first aided and sent at once to the nearest medical centre.

Then an investigation into the causes of the accident should be launched, countermeasures prepared against reoccurrence and an accident report (in the specified format) should be prepared. Safety and special precaution measures based on this investigation should be implemented around the incident area, depending on the nature and type of the emergency case.

Emergency Contact Network Flow of initial information on occurrence of an accident should be prepared and maintained to allow immediate contact with DCA, the Contractor, the Consultant, hospital and police and related organizations (JICA, Japanese embassy, etc.) in case of an accident.

The Contractor should primarily be responsible for the investigations into causes of accidents. The Consultant carries out the investigations and examines countermeasures separately. The Consultant should give advice to the Contractor regarding the accident report proposed by the Contractor based on the Consultant's own investigations.

The Consultant will submit the Contractor's accident report to DCA and JICA, including the countermeasures proposed by the Contractor and reviewed by the Consultant.

It is also very important to control the media in order to avoid harmful rumours to spread anonymously and thus, the communication mechanism should be established that any information related to the accident should be informed to the external entities by the authorised personnel.

4.8.3 Check List for Safety Management

The basic check items related to the safety management to be implemented by the Consultant are summarized in the following table.

Table 4.8.1 Check List of Safety Management

		Check Items	
1	Basic items	1	Do the Contractor, Supervisor and DCA hold a common consciousness of safety?
		2	Has a Safety Management Plan been submitted by the Contractor?
		3	Is the SMP based on the laws regarding safety of the Myanmar?
		4	Has the Contractor assigned a licensed Safety Manager and authorized him to manage the safety?
2	Safety Management Plan	1	Has the SMP been checked by the Consultant with any modifications or additions agreed to between the Consultant and the Contractor?
		2	Has the SMP, which was submitted by the Contractor been approved by DCA and agreed to by the Consultant?
		3	Has the Consultant given instructions to the Contractor regarding any necessary modifications to the SMP, in accordance with a change of the construction method? Are these modifications agreed to by the Contractor and approved by DCA?
3	Safety Management Activities by the Contractor	1	Are the Safety Education and Training for construction workers and the safety patrols being carried out periodically?
		2	Are the Safety Manager and the Foreman of the Contractor inspecting the site conditions and instructing the involved personnel regarding the safety works in accordance with the SMP?
		3	Is the Safety Manager of the Contractor periodically confirming that safety equipment is arranged and operated properly?
		4	Is the Consultant checking the safety records (safety patrol records, minutes of safety meetings, improvement and rectification records, etc.) confirmed to have been submitted by the Contractor?
4	Safety Management Activities by the Consultant	1	Has a competent person to be responsible for Safety Management been selected?
		2	Does the Consultant conduct the daily safety checks, monthly safety inspections and every 3 monthly safety reviews?
		3	Do the Contractor and DCA attend the Consultant's safety patrols?
		4	Does the Consultant record and keep check lists, minutes of meetings, etc. for safety works?
		5	Are the records related to the instructions for safety works agreed to and approved by the Contractor, and are these records with DCA?
		6	Is the emergency contact network (between DCA, the Contractor, the Consultant and related organizations), updated periodically?
		7	Are the Safety Education and Training for construction supervisors being carried out?

4.8.4 Safety Measures

Various safety measures should be taken by the Contractor depending on the type of work, location of work and time of work. The following safety measures should be checked on-site:

(1) The Contractor should erect boundary fence around the whole construction site with adequate number of gates and perimeter lightings and enough guards (for 24 hours) to control the entrances and exits of the construction site.

(2) Guards should always have the "Emergency Phone Numbers" such as Ambulance, Civil Defence and Rescue Police and should know the basic fire-fighting skills.

(3) All site staff & workers and visitors should wear safety helmets and safety boots in the construction site.

(4) Written official approval to Traffic Department should be issued prior to closing any particular section of the street.

(5) Maintaining continuous coordination with the services departments :

a) Water Authority

b) Electrical company

c) Telecom company

(6) Detours for vehicles should be in accordance with the requirements of concerned authorities.

(7) Warning tapes and temporary fence surrounding the work area should be installed to control entry and exit to the construction site.

(8) Proper, suitable, and sufficient warning signs around working areas, should be fixed with indications such as, “work is in progress”, “no entrance is allowed,” “be aware of construction equipment,” etc.

(9) Red flag wavers wherever and whenever needed.

(10) Proper, suitable and sufficient temporary stepping walkways across the excavated areas for pedestrians.

(11) Proper, suitable and sufficient guardrails whenever & wherever needed and as instructed by the Consultant.

(12) Proper, suitable and sufficient street ramp-parts to slow down vehicles’ speed and as instructed by traffic dept.

(13) Provide sufficient First Aid Kits.

(14) Other measures required by concerned authorities and departments and as instructed by the Consultant.

(15) Provide perimeter warning safety lights.

(16) Construction traffic control (trucks, concrete mixers, heavy equipment, etc.).

(17) Provision of fire extinguishers close to the welding area.

(18) Provision of temporary warning signs around welding area to prevent entry of non-concerned persons.

(19) Temporary stable protective fences should be installed around borders of high areas to prevent and control falling off accidents.

(20) Proper safe scaffolding system should be used.

(21) Anti-snake serums and anti-insects bites drugs are recommended to be available at site if possible.

(22) Proper drainage of storm water should be directed away from working area, but not affecting or damaging the surrounding properties.

(23) Provision of waterproof covering sheets against rains whenever required to protect executed works.

(24) Provision of water pumps for emergency cases to discharge any seeping water from excavated pits.

(25) Provision of suitable and sufficient light sources (projectors, flood light) for activities in the dark.

(26) Warning safety lights and reflective warning tapes to be illuminated in the night around the working areas and especially around excavations.

4.9 Gender Considerations

4.9.1 International Treaties and Government Plans and Activities for Gender Equality

Myanmar has acceded to the Convention of Elimination of All Forms of Discrimination Against Women (CEDAW) in 1997, based on the adoption of the Beijing Declaration and Platform for Action in 1995 (BDPFA) which is the United Nations agenda for women's empowerment. Through the National Strategic Plan for the Advancement of Women (NSPAW) 2013–2022, is now put in place in Myanmar in line with BDPFA and for the advancement of women outlines a comprehensive approach for improving the situation of women and girls in the country by the creation of enabling systems, structures and practices.

The NSPAW, was developed over three years and supported by UNDP along with other UN and CSO partners (an open platform) contributed technical and financial inputs for the process of preparation and consultations, identified the following twelve critical areas to strive to combat violence against and empower women and girls which are fully aligned with CEDAW and BDPFA:

(1) Livelihoods and Poverty Reduction: reduction of persistent and increasing burden of poverty on women.

(2) Education and Training: initiatives to improve access to education and training for women and girls.

(3) Health Care: provide equal and adequate access to health care and related services for women and girls.

(4) Violence against Women: enforce laws to eliminate gender-based violence against women.

(5) Emergencies: alleviate effects of armed or other kinds of conflict on women.

(6) Economy: enhance equality in economic structures and policies, in all forms of productive activities and in access to resources.

(7) Decision Making: increase women's political leadership to involve in the sharing of power and decision- making at all levels.

(8) Institutional Mechanisms: provide sufficient mechanisms at all levels to promote the advancement of women.

(9) Human Rights: policies to promote equal rights to jobs and adequate promotion and protection of the human rights of women.

(10) Media: harness the media to reduce gender stereotyping and enhance equality in women's access to and participation in all communication systems.

(11) Environment: enhance gender equalities in the management of natural resources and in the safeguarding of the environment.

(12) The girl child: eliminate persistent discrimination against and violation of the rights of the girl child.

It is expected that in each of these critical areas the Myanmar Government and its civil society partners will develop specific plan of actions to achieve concrete and measurable results for Myanmar women and Girls.

The Myanmar National Committee for Women's Affairs (MNCWA) identified five critical areas (Education, Health, Economy, Violence against Women and Girl Child) and added another area namely culture that were considered to be most relevant for the advancement of Myanmar women in response to the above twelve critical areas of concern to women around the world described in NSPAW. For implementation of the activities, respective sub-committees were formed for each activity.

The Government has also designated the Ministry of Social Welfare, Relief and Resettlement, which is leading reforms to enhance gender equality and empowerment and it is cooperating with other government agencies, civil society, academia, and the international community, as the National Focal point for Women's Affairs.

MNCWA laid down the policy guidelines for the advancement of women, especially those living in the far reaching remote border areas. The Myanmar National Working Committee for Women's Affairs was subsequently formed to carry out the activities for advancement of women. Both Committees comprise high-level personnel from government ministries, NGOs and INGOs responsible for women's advancement.

The Government's cooperation with such organizations as the Myanmar Women's Affairs Federation and Myanmar Women Entrepreneurs Association has contributed to promoting the policies to address the needs of women and their protection from gender based violence. Thus, there is increasing momentum within civil society networks and organisations to promote programming and advocacy for women's rights and gender equality in Myanmar.

4.9.2 Gender Consideration in the Project

While the labour market remains precarious for both men and women in Myanmar, women are often found in work that is both unregulated and isolated, which makes women workers particularly vulnerable to abuse. Greater equality of opportunity and remuneration are needed to change this.

Concerning the women situation in workplace such as working under this Project, the Constitution of Myanmar guarantees the legal equality of all citizens, and prohibits discrimination on the basis of gender. Although the Constitution also ensures equal opportunities in public employment, occupation, trade and business, and matters related to technology and science, and provides for equal pay for equal work, working in the construction site is a male dominated workplace in Myanmar.

A gendered division of labour is prominent especially in the construction industry. The domains of work for men and women are typically positioned in opposition to each other (men in construction managerial and engineering related works, while women in office administration and simple labour works). This norm established based on a man's perceived strength, bravery and tenacity that is held up against the perception that a woman lacks these qualities. The idea that women should focus on reproductive work is largely taken for granted in Myanmar.

However, labour laws could also prohibit dismissal on account of marital status, pregnancy and maternity, and require employers to provide paid parental leave for a reasonable period after the birth of a child. Anti‐discrimination laws protecting the conditions of work should include penalties for sexual harassment in the workplace, including physical, mental, and verbal forms of harassment, and exposure to sexually explicit visual materials. They should also provide for the establishment of appropriate tribunals through which women can seek remedies.

Although above considerations are provided, women's increased income earning should not automatically be assumed to be emancipatory, with poor and hazardous working conditions without proper protections, firm glass ceilings to promotion or advancement, and the double burden of domestic and works in the construction site, as reasons for concern.

It is therefore important to address such practices through regulations, guidelines and policies, with monitoring for compliance and sanctions if employers in the Project continue to discriminate.

Based on the above, the following measures should be taken by the employers such as the Contractors, Consultants and Suppliers during the implementation of the Project:

(1) Ensure labour laws and policies include provisions of equal opportunities for employment and guarantee of equal pay for work of equal value (regardless of sex, gender identity, age or marital status). Provide sanctions for employers who do not live up to these standards.

(2) Improve workers' rights and conditions in the Project, bearing in mind the largely young and female workforce, the unhealthy work conditions, safety at work concerns, and lack of security of employment.

(3) Provide childcare facilities to ensure women who carry out the majority of reproductive works.

(4) Provide transportation for women working in the Project who live in Bago and Yangon Regions rather than establishing the accommodation camp on-site.

(5) Prohibit overtime works, if no transportations are available for women.

(6) Special measures to increase women's participation in male‐dominated activities, if practically applicable.

(7) Prohibition of refusal to hire and dismissal because of marital status, pregnancy or maternity.

(8) Provide paid parental leave according to law.

(9) Prohibition of workplace sexual harassment in mentally, physically and verbally.

(10) Set-up labour tribunal to deal with discrimination cases.

4.10 HIV / AIDS Prevention Programme

4.10.1 HIV Prevalence in Myanmar and in relation to the Project

In 2011, HIV prevalence was expected to have decreased to 0.43% by 2015 that reduced HIV prevalence since the peak in 2004 (0.67%) in Myanmar. It has been on a steady decline in the general adult population for many years and is calculated at 0.5% in 2013, down from 0.6% in 2010. In other words, the number of people living with HIV in Myanmar was estimated at around 189,000 in 2013, of which 37% were female[10].

However, HIV prevalence remains relatively high among key populations such as 18.7% among people who inject drugs (PWID), 10.4% among men who have sex with men (MSM) and 8.1% among female sex workers (FSW) and their clients in 2013.

The mid-term review of Myanmar's National Strategic Plan on HIV and AIDS (2011-2015) highlighted the need for a defined "prevention package" to standardise prevention interventions and ensure access to a minimum level of quality services.

Since the Project will employ a large number of labourers, engineers and office administration staff for 36 months who are more likely to be young, active and mobile which may create potential risk for HIV infection.

Therefore, it is important to implement a programme to prevent HIV/AIDS among the staff and workers who will be engaged in the construction and clerical works related to the Project. On the other hand, the construction project can be used as a channel to disseminate information and behavioural change to prevent HIV as part of the national effort to prevent HIV/AIDS.

In order to certainly implement the HIV/AIDS prevention programme, the Conditions of Contract for the Contractor should include a clause of HIV/AIDS prevention by employing an approved service provider (SP) who will design and implement the HIV/AIDS prevention programme. The Contractor should be entitled to be reimbursed by the Employer for any eligible payments related to the implementation of HIV/AIDS prevention programme.

4.10.2 Obligations of the Contractor

The Contractor through SP is responsible for managing the implementation of all activities and deliver outputs for the HIV/AIDS prevention programme, commencing as soon as practicable after the Contractor's employees arrive at the site in conjunction with occupational health staff of the Contractor and the local health authorities involved in HIV/AIDS prevention, to reduce the impact of HIV/AIDS on the labourers, engineers and office administration staff in the construction project as well as local community.

The Contractor is required to instruct the Contractor's employees to participate in the HIV/AIDS Prevention Programme in the course of their employment and during their normal working hours or any period of overtime provided for in the relevant employment contracts.

4.10.3 Targets and Duration of the HIV/AIDS Prevention Programme

(1) Managerial Staff and Engineers (briefing only)

(2) Administrative personnel (briefing only)

[10] HIV Estimates and Projections, Asian Epidemiological Model, Myanmar 2010–2015, SI and M&E TWG, 2011.

(3) Skilled and Unskilled labourers (educational activity)

The HIV/AIDS Prevention Programme should be implemented for the duration of 36 months.

4.10.4 Components of HIV/AIDS Prevention Programme

Component 1:Assessment
Component 2:Support Creation and Institutional Capacity Building
Component 3:Establishing Implementing Structure
Component 4:HIV/AIDS Education Activity
Component 5:Condom Promotion
Component 6:Referral to local health facilities
Component 7:Monitoring, Reporting and Evaluation

(1) Component 1: Assessment

Specific measures and strategies for each target and stakeholder to implement an effective HIV/AIDS prevention identified and identifying the knowledge, attitude and behaviour gaps and access to and needs of HIV/AIDS of employees and workers of the Project and to assess their HIV vulnerabilities. At the same time, identifying the knowledge, attitude and behaviour and to measure the level of leadership support and commitment of the Management should be evaluated.

It is also important to clarify the level of interest and support, and roles of key stakeholders in the HIV/AIDS programme; i.e, PMU, Consultants, Contractors and local entities such as government agencies, other donors, local hospitals and health centres, etc. based on the understanding the nature of the Project and organizational setting including staffing structure and existing mechanism on health and safety issues in Myanmar.

(2) Component 2: Support Creation and Institutional Capacity Building

Institutional Support for the HIV/AIDS prevention from the project management and appropriate coordinating mechanism among all stakeholders including local institutions ensured.

Conducting an awareness and sensitisation session for the Project Management (PMU, Consultants, Contractors) on HIV/AIDS and the workplace HIV/AIDS Programme.

Conducting an orientation workshop on the HIV/AIDS Prevention Programme inviting all project representatives and local institutions including local AIDS Commission, Health Department and hospital and health centres, etc.

Agreeing on no-discriminatory environment concerning the issues related to HIV/AIDS during the Workshop. The agreement including the following issues should be documented and, if appropriately signed by representatives of PMU, Consultants and Contractors.

- Recognizing HIV/AIDS as a workplace issue.
- Recognizing HIV/AIDS as a Health and Safety issue of staff and workers.
- Non-discrimination on recruitment and continuation of employment of HIV infected persons.

- Voluntary HIV testing (No compulsory testing).
- Confidentiality of HIV and other health issues of staff and workers.
- Support for HIV/AIDS prevention.
- Care and Support for people living with HIV/AIDS, etc.

(3) Component 3: Establishing Implementation Structure

Implementation and coordination structure on HIV/AIDS Prevention Programme to carry out regular reporting on the progress and to discuss lessons and remedial measure to improve the Programme established.

Forming a HIV/AIDS Programme Management Committee (PMC) among the responsible officers of the Contractor such as the Head of the Safety Officer, the Site Operation Manager, the Personnel Manager, etc., and the members of the service provider; meeting bi-monthly or quarterly.

Forming a Technical Advisory Committee (TAC) consisting of PMC (Contractors and the service provider), PMU-DCA, Consultants and the local organizations for technical advice and networking, should hold periodicals meeting during the implementation of the Programme.

(4) Component 4: Education Activities

Awareness of the staff and workers on HIV, Sexually Transmitted Diseases (STD) and Sexually Transmitted Infections (STI) to create positive behaviour change for prevention of HIV/AIDS raised.

Reproduction (if possible and appropriate, development) of education materials such as leaflets, posters, flipcharts and banners should be developed and these education materials during Safety Meeting, small talk, peer education, etc. should be used and distributed

HIV/AIDS education sessions integrated in existing occupational health and safety, e.g. once a month in the regular Safety Meeting should be conducted. The target of the activity will be all staff and workers of the Project. The contents of this activity will be more general due to the time limitation and the larger groups.

Small group talks, discussion, video shows in a meeting room in the project site after work and/or during rest time should be conducted. The target will be workers of the Project. The contents of this activity can be more detailed and personal.

Peer Educator training twice a year, including refresher training should also be conducted. Selection can be done in consultation with an immediate supervisor of a group of workers and training of peer educators will be carried out after work or during off days.

The information of the above activities can include the following topics:

- Basic fact of HIV/AIDS.
- HIV Infection and Risk Behaviour.
- HIV Prevention (including A-Abstinence, B-Be Faithful, C-Consistent Condom use-ABC approach) (the message should also include moral aspects).

- HIV and Sexually Transmitted Infection.
- HIV and Alcohol, Drug use.
- HIV Counselling and Testing.
- Living with HIV (Care and Treatment).
- Discrimination and Stigma.

(5) Component 5: Condom Promotion

Increase of availability and access of the prevention measure for HIV and STI can be improved by the use of Condoms.

Condoms should be provided after effective and satisfactory awareness and education activities on HIV infection, risk behaviours and proper condom use are made. The strategy to provide condoms will be Silent Approach (those who need condoms can approach to the service provider) and at the later stage, the provision during peer education or group talk can be considered as well.

(6) Component 6: Referral to Local Health Facilities

Accessing the counselling, testing, treatment of HIV and STI among the Project staff and workers should be ensured.

The linkage and networking with health institutes should be established. The service provider may already have an established linkage with these facilities.

A confidential referral system should also be ensured in place in the Project and providing information on health institutions to those who need such services as HIV and STI counselling, testing and treatment.

STI and VCT (HIV Voluntary Counselling and Testing) and Antiretroviral Therapy (ART) service should be provided by local health facilities if required. The registration fee and other costs may need to be borne by patients. The service provider should provide detailed information regarding those services.

(7) Component 7: Monitoring, Reporting and Evaluation

In order to measure the outcome of the Programme, monitoring, reporting and evaluation system should be set up and implemented to track on the progress and deficiencies.

Monitoring and evaluation indicators should be developed in conjunction with monthly monitoring, mid-term review reporting (depending on requirement in the Project).

Pre and Post Evaluation of education activities should be measured on the knowledge level of participates by using a simple one page format (could be in selected activities) and evaluation of quality of training and education activity (group or individual assessment) after each activity by using a simple one page format (could be in selected activities) should be conducted. End line survey should be held by using the same set of questions with the baseline survey to evaluate the result of HIV/AIDS Prevention Programme.

4.11 Cost Reduction Programmes (not disclosed)

Chapter 5

Proposed Organization of Airport Operator

Chapter 5 Proposed Organization of Airport Operator (not disclosed)

Chapter 6

Key Considerations for ODA Project

Chapter 6 Key Considerations for ODA Project (not disclosed)

Chapter 7

Consulting Services for ODA Project

Chapter 7 Consulting Services for ODA Project (not disclosed)

Chapter 8

Review of Project Implementation Scheme and Financing Arrangement, Cash-flow Analysis

Chapter 8 Review of Project Implementation Scheme and Financing Arrangement, Cash-flow Analysis (not disclosed)

Chapter 9

Risk Analysis and Mitigation

Chapter 9 Risk Analysis and Mitigation (not disclosed)

Chapter 10

Effect of HIA Project

Chapter 10 Effect of HIA Project (not disclosed)

Chapter 11

Environmental and Social Considerations

Chapter 11 Environmental and Social Considerations

11.1 Overview of environment

11.1.1 Location of the Project Site

(1) Airport

Hanthawaddy International Airport is proposed for the City of Bago, a capital of Bago region, about 70km northeast from Yangon, a commercial center of Myanmar. Total population of the City is around 300,000 (Figure 11.1.1), and the proposed airport site is about 12m above sea level. Japanese imperial army tried to construct a runway during the World War II at the proposed site.

Figure 11.1.1 Project Site for Hanthawaddy International Airport

(2) Associated Facility

An access road to the airport will be constructed outside of the proposed site as a facility associated with it. Bifurcation of the existing roads is under consideration as the access road, and there are following two options.

a) Bifurcation from East-West Road, which connects the City of Bago with a highway,

b) Bifurcation from the National Road No.1.

To secure the access to the airport in case an accident or natural disaster leads to closure of one road, at least two access roads will be necessary. Therefore, the connection with National Road is under consideration additionally.

Boundary Coordinates		
Point Name	Northern	Eastern
A	17° 16'10.36"	96° 23'46.26"
B	17° 16'14.42"	96° 26'45.46"
C	17° 19'07.12"	96° 26'43.32"
D	17° 19'43.54"	96° 26'32.92"
E	17° 19'42.86"	96° 26'01.96"
F	17° 20'42.25"	96° 26'01.07"
G	17° 20'38.98"	96° 23'41.26"

Figure 11.1.2 Proposed Site for Hanthawaddy International Airport

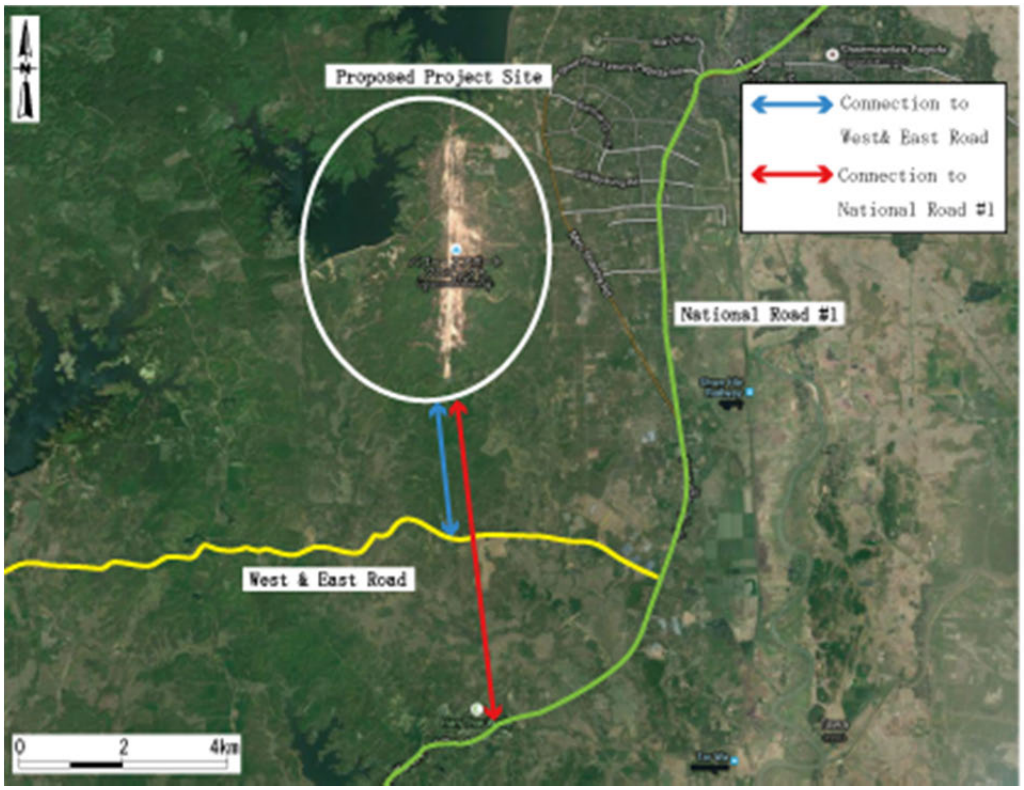


Figure 11.1.3 Proposed Access Road

JICA regards a facility as an integral part of the project, when “this associated facility would not be constructed if there were no such project, and this facility is essential for the project”. Thus, the access road from the existing road to be constructed for the project is deemed to be an integral part of the project. As for an integral facility of the project, it is required to confirm that an environmental and social consideration document has been produced on the basis of its potential impacts in accordance with JICA Guidelines for Environmental and Social Considerations. We will conduct Environmental Impact Assessment on this access road in our survey.

11.1.2 Natural Environment of the Proposed Project Area

(1) Climate

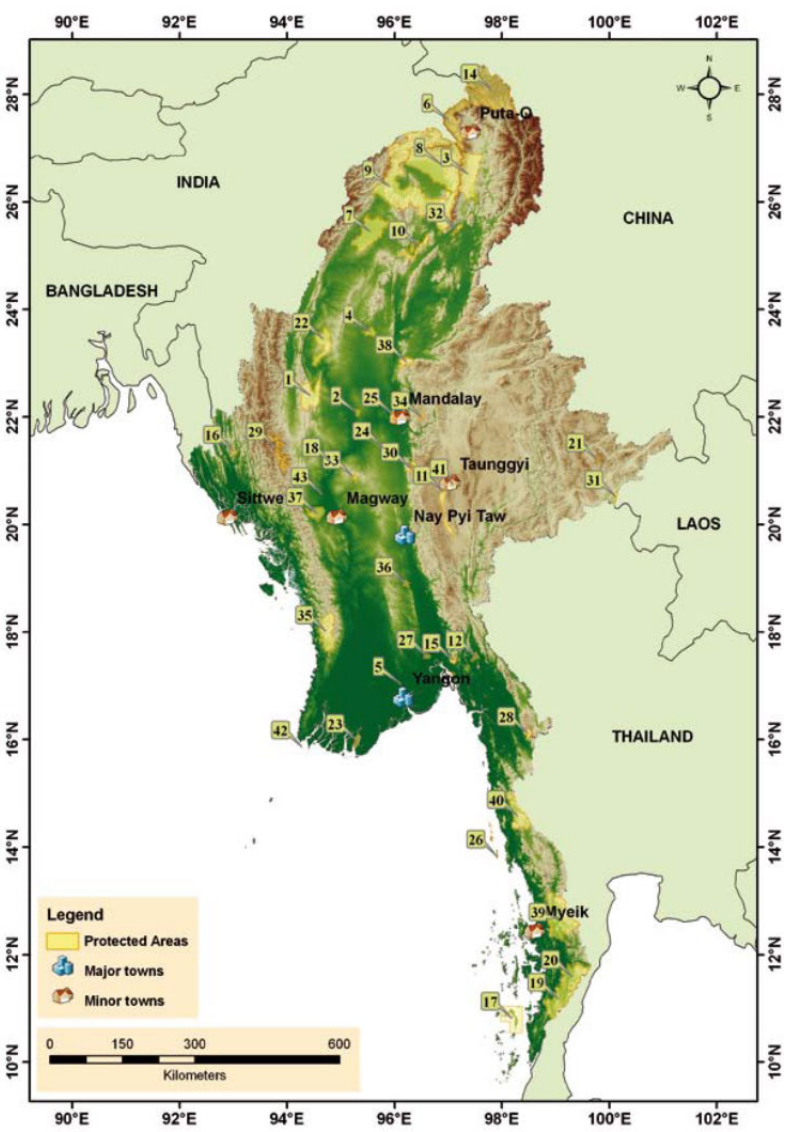
The proposed project area is under the tropical monsoon climate.

Its annual average temperature is about 28 degree Celsius, and April is the hottest month of a year with its monthly average temperature of approximately 31 degree Celsius. The coldest month of a year is January with its average temperature of approximately 24 degree Celsius.

Most of rain falls during the southwest monsoon season, or May to October, and there will be less rainfall during the northwest monsoon season, or December to March. From April to May, strong cyclones sometimes hit the coast of Myanmar. Its annual average precipitation is around 3,530mm, with the heaviest rainfall of approximately 960mm in July and the least rainfall of only 2mm in December.

(2) Natural Parks and Protected Areas

Myanmar enacted Wildlife and Nature Conservation Law in 1994, and 40 protected areas, such as the wildlife conservation areas, bird sanctuaries, national parks, and nature conservation areas have been designated (Figure 11.1.4). Among them, Moyingyi Wetland Wildlife Sanctuary is closest to the proposed project site, and it is located about 20km north to the site (Figure 11.1.5).



	Site Name	Designation	Status	Establishment	Area (km²)
1	Alaungdaw Kathapa	National Park	Designated	1989	1597.62
2	Bawditatsaung	Nature Reserve	Applied	2008	272.52
3	Bumhpabum	Wildlife Reserve	Designated	2004	1854.43
4	Chatthin	Wildlife Reserve	Designated	1941	269.36
5	Hlawga	Wildlife Park	Designated	1989	56.24
6	Hpoukanazi	Wildlife Reserve	Designated	2003	2703.95
7	Htamanthi	Wildlife Reserve	Designated	1974	2150.73
8	Hukaung Valley	Wildlife Reserve	Designated	2004	6371.37
9	Hukaung Valley Additional	Wildlife Reserve	Designated	2004	15431.16
10	Indawgyi Lake	Wildlife Reserve	Designated	2004	814.99
11	Inlay Lake	Wildlife Reserve	Designated	1985	641.90
12	Kabilu	Wildlife Reserve	Designated	1928	160.56
13	Kelatha	Wildlife Reserve	Designated	1942	23.93
14	Khakaborazi	National Park	Designated	1998	3812.46
15	Kyaikhtayoe	Wildlife Reserve	Designated	2001	156.23
16	Kyauk-Pan-Taung	Wildlife Reserve	Applied	2001	132.61
17	Lampi Island	Marine National Park	Designated	1996	204.84
18	Lawkananda	Wildlife Reserve	Designated	1995	0.47
19	Lenya	National Park	Applied	2002	1761.19
20	Lenya Additional	National Park	Applied	2004	1398.59
21	Loimwe	Protected Area	Designated	1996	42.84
22	Mahamyaing	Wildlife Reserve	Applied	2002	1180.39
23	Maunmahla Kyun	Wildlife Reserve	Designated	1993	136.69
24	Minsontaung	Wildlife Reserve	Designated	2001	22.60
25	Minwuntaung	Wildlife Reserve	Designated	1972	205.88
26	Moscos Island	Wildlife Reserve	Designated	1927	49.19
27	Moyingyi Wetland	Bird Sanctuary	Designated	1988	103.60
28	Mulayit	Wildlife Reserve	Designated	1936	138.54
29	Natma Taung	National Park	Applied	1997	722.61
30	Panlaung-Pyadalin Cave	Wildlife Reserve	Designated	2002	333.80
31	Parasar (Par Sar)	Protected Area	Designated	1996	77.02
32	Pidaung	Wildlife Reserve	Designated	1918	122.08
33	Popa	Mountain Park	Designated	1989	128.54
34	Pyin-O-Lwin	Bird Sanctuary	Designated	1918	127.25
35	Rakhine Yoma Elephant Range	Wildlife Reserve	Designated	2002	1755.70
36	Shanpinkyeithauk	Wildlife Reserve	Applied	2006	3671.90
37	Shwesettaw	Wildlife Reserve	Designated	1940	552.70
38	Shwe-U-Daung	Wildlife Reserve	Designated	1918	325.95
39	Tanintharyi	National Park	Applied	2002	2071.81
40	Tanintharyi	Nature Reserve	Designated	2005	1699.99
41	Taunggyi	Bird Sanctuary	Designated	1930	16.06
42	Thamihla Kyun	Wildlife Reserve	Designated	1970	0.88
43	Wenthukan	Bird Sanctuary	Designated	1939	4.40

Source: http://www.oecc.or.jp/pdf/kaiho/OECC67/67p4.pdf

Figure 11.1.4 Locations of natural parks and protected areas in Myanmar

a) Moyingyi Wetland Wildlife Sanctuary

This Sanctuary was designated in 1988 to protect birds. It was registered as Ramsar Wetland in 2005. A lake in the Sanctuary provides a key foraging site to the resident and migratory birds, and harvesting of lilies there creates job opportunities to local people.

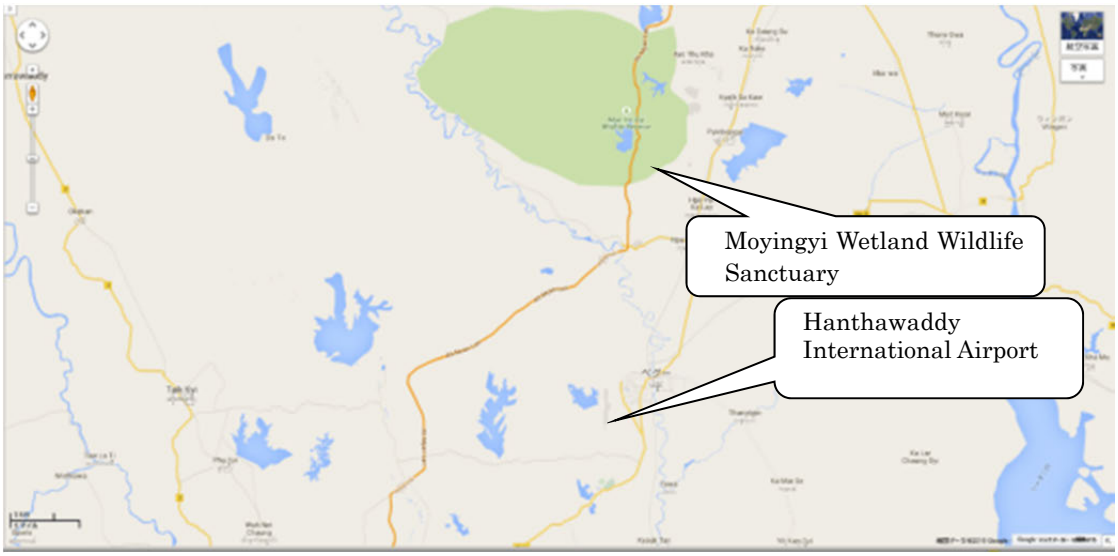


Figure 11.1.5 Locations of Moyingyi Wetland Wildlife Sanctuary and the proposed Hanthawaddy International Airport

(1) Topography

The eastern side of the proposed airport site, where major facilities will be constructed, is a small hill. The proposed runway will be highest in the airport and 40 to 45m above sea level. The proposed site is generally not flat and it is rather undulating. Only during the rainy season, there flow small rivers. The eastern side of the site is 25 to 30m above sea level, while its western side is 30 to 40m above sea level. The eastern side is generally lower.

(2) Land and Water Uses

DCA owns the proposed airport site. The land use within the proposed airport site can be largely categorized into idle land, agricultural land, and two ponds (Zaletaw pond and Mazin pond). Several military buildings and pagodas exist in the proposed site. There are residents make a living of agriculture within the proposed airport site. Moreover, although Zaltaw pond and Mazin pond are not used for drinking water, some residents fish in there and make a living of it.

Rubber plantation largely covers the surrounding area and so do idle land and paddy field. Population centers around the airport are on the eastern and southern sides to its proposed site, and there is a small community west to the site. People in this community currently go across the site to go to the downtown Bago. This access will not be available anymore when construction of the proposed airport commences, and according to the City of Bago, the City will construct an alternative road for them to go around the northern site of the airport. As for the details, they are unplanned yet.

(3) Vegetation

The proposed airport site was previously used as farmlands, and there is no large-scale natural forest although herbs and shrubs could be found. Especially, the proposed runway is almost free from herbs and shrubs.

11.1.3 Land acquisition attempted previously for the project (not disclosed)

11.2 Overview of Legislation for Environmental and Social Considerations in Myanmar

11.2.1 Laws and Regulations for Environmental and Social Considerations in Myanmar

(1) Government Agency

In Myanmar, there are 31 ministries and agencies under the President's Office. Mainly in charge of environmental and social consideration is the Department of Environmental Conservation of the Ministry of Environmental Conservation and Forestry (MOECAF)[11] created in September 2011.

(2) Major Relevant Legislation

Below is the major legislation relevant to environmental and social considerations in Myanmar.

- Forestry Law (1992)
- Protection of Wildlife and Conservation of Natural Areas Law (1994)
- Public Health Law (1972)
- Factory Act (1951)
- Minerals Law (1994)
- Freshwater Fisheries Law (1991)
- Law on Aquaculture (1989)
- Irrigation Laws and Regulations (1982)
- Conservation of Water Resources and Rivers Law (2006)
- Environmental Conservation Law (2012)
- Environmental Conservation Rules (2014)
- Environmental Impact Assessment Procedures (2015)

Followings provide overview of the especially major laws among the above;

a) Protection of Wildlife and Conservation of Natural Areas Law (1994)

Ministry of Environmental Conservation and Forestry implements this Law. The Law provides protection of wildlife and conservation of natural environment, and also implementation of policies and development of researches by the government for these.

b) Conservation of Water Resources and Rivers Law (2006)

This Law provides not only conservation of water resources and rivers themselves but also protection of water resources and river systems for utilization of water in watersheds, for contribution of water resources to the development of national economy. Ministry of Transportation is in charge of implementation of this Law, and its emphasis is on the safe navigation and the development for it.

[11] MOECAF was renamed "Ministry of Natural Resources and Environmental Conservation, MONREC) in April, 2016.

c) Environmental Conservation Law (2012)

Although Environmental Conservation Law was published on April 1, 2012, it does not provide mechanisms and operations for environmental conservation in details, and it rather presents a fundamental framework for them.

Specific regulations were provided by Environmental Conservation Rules (ECR) in 2014 under Environmental Conservation Law.

Environmental Conservation Law and ECR established Environmental Impact Assessment system in Myanmar. Project proponents who undertake Environmental Impact Assessment need to refer to the followings issued under the Law and ECR.

- Environmental Impact Assessment Procedures (2015)
- It establishes the requirements concerning the environmental impact assessment procedure.
- Environmental Impact Assessment Guidelines (2014)
- They provide the guidance concerning, for example, the contents to be described in the Environmental Impact Assessment report.
- National Environmental Quality (Emission) Guidelines (2015)
- They establish the ambient standards and emission standards for each sector.

(3) Major Relevant Policies

Below are the major policies relevant to environmental and social consideration in Myanmar;

- National Environmental Policy (1994)
- National Forest Policy (1995)
- National Sustainable Development Strategy (2009)

Followings provide overview of the major policies;

a) National Environmental Policy (1994)

This Policy was established to introduce the environmental management into Myanmar. It declares commitment by Myanmar Government on the principles for sustainable development.

b) National Forest Policy (1995)

This Policy was established to ensure the sustainable development of forest resources, protect wildlife, and enhance life of people.

c) National Sustainable Development Strategy (2009)

National Sustainable Development Strategy was produced to establish a long-term strategy for the sustainable development. National Commission for Environmental Affairs played a leading role in its establishment.

11.2.2 Environmental Impact Assessment in Myanmar

(1) Procedure of Environmental Impact Assessment

As for Environmental Impact Assessment (EIA) in Myanmar, MOECAF has established the basic framework on EIA by Chapter 11 (Articles 51 to 61) of Environmental Conservation Rules (ECR), and MOECAF established the Environmental Impact Assessment Procedures (hereinafter referred to as "EIA Procedures) in December 2015.
Notification of commencement of the EIA procedure for Hanthawaddy International Airport Project was submitted in May 2015 to Myanmar Environmental Conservation Department (ECD) prior to the establishment of the EIA Procedure. Nevertheless, it was confirmed with ECD that the EIA procedure for the project need to follow the provisions of the EIA Procedure.

Detailed EIA Guidelines were established in 2014.

Under the EIA Procedures, screening will be conducted to determine either simplified Initial Environmental Examination (IEE) or detailed EIA is required for a project, depending on its size and siting.

The minimum size to require IEE or EIA for each category of projects is indicated in Annex to EIA Procedures. The minimum size to require IEE or EIA is shown for airports and roads, or the main and associated components of the present project in Table 11.2.1 below.

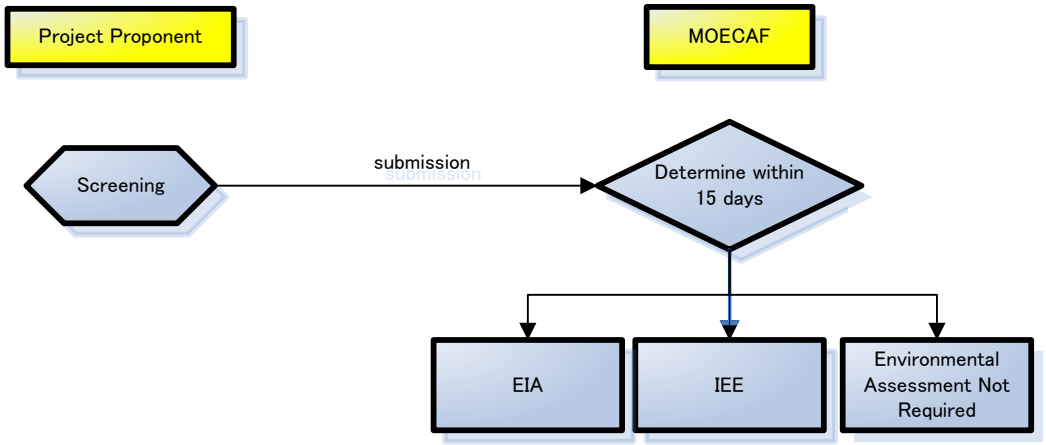
The proposed runway for the present project is 3,600m long and subject to EIA, while its access road requires IEE.

Table 11.2.1 Minimum Size to Require IEE or EIA for Airports and Roads

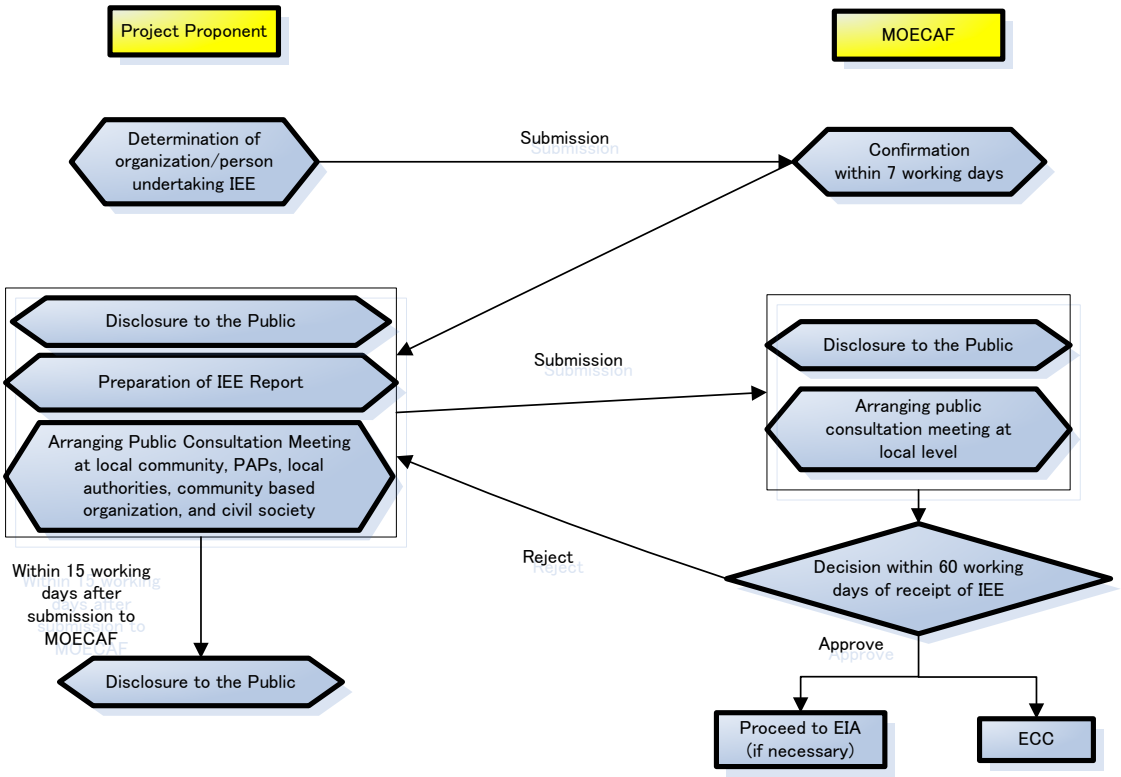
Category	Size	IEE or EIA required
Airports	Runway less than 2,100m	IEE
	Runway no less than 2,100m	EIA
Roads	No less than 1km but less 50km	IEE
	No less than 50km	EIA

Processes to obtain an environmental approval under EIA Procedures are presented in Figure 11.2.1.

(Screening)



(IEE: Initial Environmental Examination)

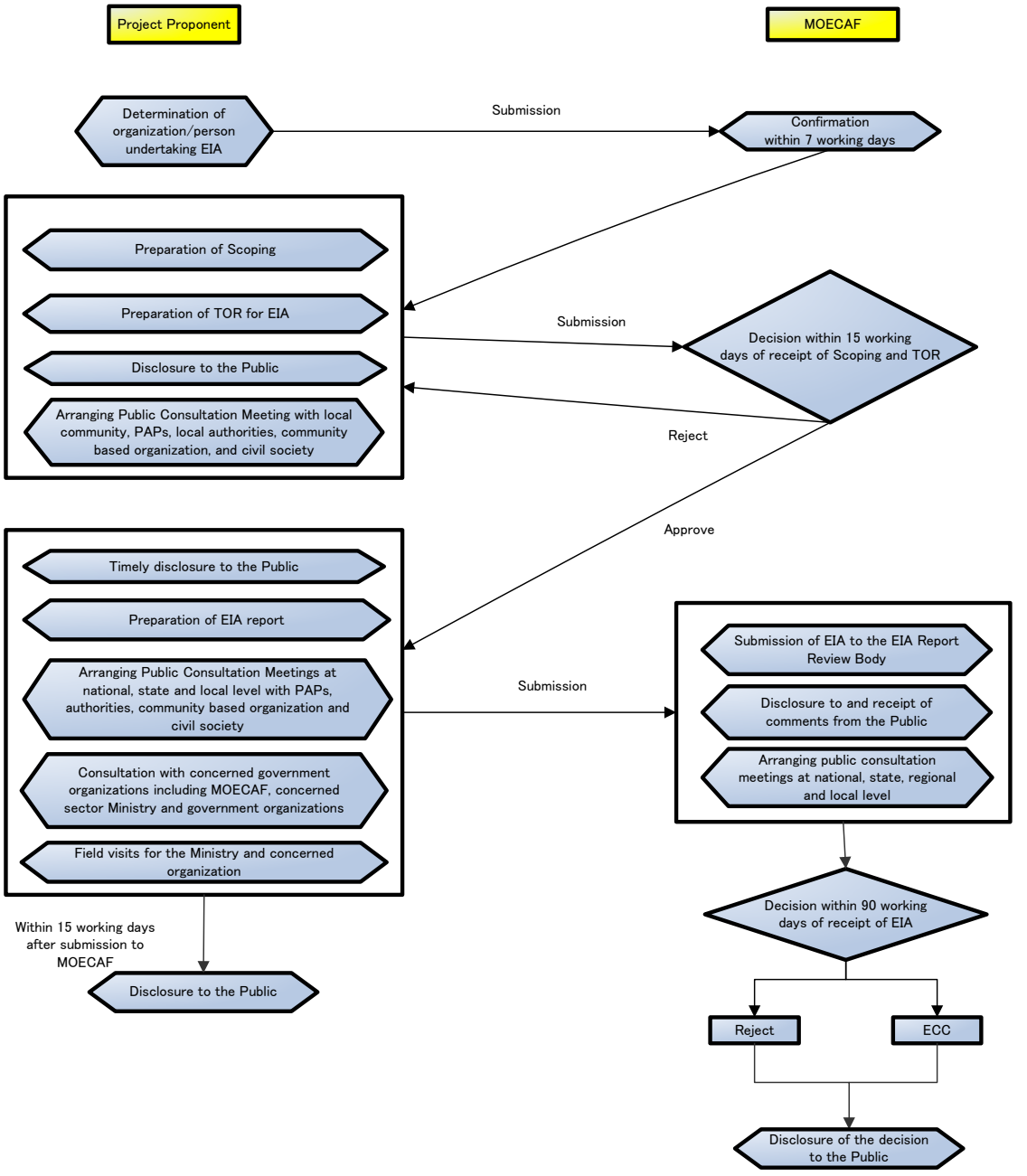


ECC: Environmental Compliance Certificate

Source: Environmental Impact Assessment Procedures (2015)

Figure 11.2.1 Environmental Approval Process and EIA Procedures (1)

(Environmental Impact Assessment)



ECC: Environmental Compliance Certificate

Source: Environmental Impact Assessment Procedures (2015)

Figure 11.2.2 Environmental Approval Process and EIA Procedures (2)

(2) Differences betweeen EIAs under JICA Guidelines for Environmental and Social Considerations and EIA in Myanmar

Table 11.2.2 below presents differences in contents of EIS between JICA Guidelines for Environmental and Social Considerations and Myanmar EIA Guidelines.

Table 11.2.2 Differences in Contents of EIS between JICA Guidelines for Environmental and Social Considerations and Myanmar EIA Guidelines

Content	JICA Guidelines for Environmental and Social Considerations	Myanmar EIA Guidelines	Gaps between JICA Guidelines for Environmental and Social Considerations and Myanmar EIA Guidelines
Preface	Not required	Not required	No gap
Executive Summary	Key findings and recommended actions shall be briefly described.	Overview of the project and summary of the key findings (including economical evaluation), recommended actions, alternatives, and environmental management plans shall be described.	No gap
Policy, legal and administrative framework	Policy, legal and administrative framework for EIA shall be described.	Present framework of policies, legislation and administration on the environmental and social considerations shall be described. International treaties on EIA shall be also mentioned. It shall be further stated whether the project is subject to the environmental and social policies, codes or guidelines of the donor or other organization.	No gap
Proposed project	Proposed project and its geographical, ecological, social and historical background shall be briefly described. All of investments required outside of the project site (ex., pipelines, access roads, power plant, water supply, accommodation, and storage for raw material and products, for the project) shall be included. It shall be clearly mentioned whether a resettlement action plan, program for indigenous people, and social development program are required or not. Maps to indicate the project area and the area with potential impacts from the project are usually required.	Outcomes from scoping (i.e., major physical, biological, economic, social, cultural, and visual impacts of the project) and major concerns of the project-affected people or community shall be briefly described. Relevant information (i.e., previous technical, economic, environmental, social, and cultural surveys) shall be also mentioned. Maps to indicate the project area and the areas vulnerable to the project shall be included. Infrastructures associated with the project (including temporary ones) shall be also stated. It shall be mentioned whether a resettlement action plan or socio-economic surveys are required or not, and, if they are, their overview shall be included.	A program for indigenous people is not mentioned in Myanmar EIA Guidelines.

Content	JICA Guidelines for Environmental and Social Considerations	Myanmar EIA Guidelines	Gaps between JICA Guidelines for Environmental and Social Considerations and Myanmar EIA Guidelines
Baseline	The project area shall be characterized and its physical, biological and socio-economic conditions shall be described. Its changes foreseen before the project shall be included. On-going or proposed development activities within the project area, which are not directly related to the project, shall be among these changes. Information provided here shall have relevance to decisions on siting, design, operation and mitigation measures of the project. Accuracy and reliability of data shall be stated here together with their information sources.	Physical, biological, economic, social, cultural and visual conditions of the survey area shall be described. Components with potential direct or indirect impacts on the project shall be included. The project proponent shall survey the proposed site with the latest method, and this method shall be described. Secondary data shall be obtained from sources such as governments, and these information sources shall be clearly mentioned.	Changes foreseen before the project are not mentioned in Myanmar EIA Guidelines.
Environmental Impacts	Positive and negative potential impacts shall be predicted quantitatively as much as possible, and they shall be evaluated. Mitigation measures and all of the negative potential environmental impacts without mitigation measures need to be identified. Opportunities to enhance environmental quality shall be sought. Available information and its quality, important lack of information, and uncertainty associated with predicted values shall be recognized and evaluated. Issues which do not require further consideration also need to be identified.	Subjective concrete and reproducible methods shall be used as much as possible to predict and evaluate potential impacts for their description. Positive and negative, direct and indirect, multiple and synergetic, and reversible and irreversible potential impacts shall be identified as much as possible. Actions, infrastructures and modifications of the project to mitigate potential impacts shall be described. Quantitative risk assessment shall be conducted as required for its description. Levels of influence of uncertainty on the impact assessment, and the possibility of impacts shall be also described as required.	No gap

Content	JICA Guidelines for Environmental and Social Considerations	Myanmar EIA Guidelines	Gaps between JICA Guidelines for Environmental and Social Considerations and Myanmar EIA Guidelines
Analyses of Alternatives	Available alternatives for the location, technology, design, and operation of the project (including "no project" option) shall be compared systematically, in terms of their potential impacts on environment, mitigation potential against these impacts, initial and operating cost, applicability to the local situation, and required institutions, training and monitoring. Potential impacts shall be quantified as much as possible for each alternative, and its economic evaluation shall accompany if available. Selection of the specific project alternative shall be clearly justified, and its desirable impact levels and the appropriateness of measures to prevent or reduce pollution.	Realistic alternatives to accomplish development by the project shall be described. Alternatives analyzed at the scoping stage shall be also mentioned. All of the potential impacts on environment, economy, society, health, culture and landscape shall be described for alternatives. At least, 2 alternatives and "no project" option shall be presented. Comparisons between alternatives shall be based on evaluations of their quantitative data, as much as possible, for environmental, social, technical and economic factors. The selected alternative shall be described in details.	No gap
Environmental Management Plan (EMP)	EMP shall cover mitigation measures to remove, off-set or reduce negative impacts during construction and operation periods, and strengthen of monitoring and institution.	It is essential to produce EMP under EIA procedure. EMP covers measures to mitigate negative impacts and to enhance positive impacts, during the life cycle of the project (including monitoring). EMP shall be produced separately from EIS.	No gap
Consultation	Records of consultations (their dates and venues, participants, proceedings, comments by the major local stakeholders and the responses of the project proponent to them) shall be provided. Included among them shall be records of those conducted to collect opinions of PAPs, local NGOs and regulatory authorities, which they have obtained after disclosure of relevant information.	Described in the main text shall be the mode of consultations and their outcomes (ex., comments of stakeholders and the responses of the project proponent to them). Details of consultations (including the participant list) shall be attached as an Appendix document.	No gap

Content	JICA Guidelines for Environmental and Social Considerations	Myanmar EIA Guidelines	Gaps between JICA Guidelines for Environmental and Social Considerations and Myanmar EIA Guidelines
Attachments	N/A	Details of consultations shall be attached. Overview of the project. Modes of notification of the consultations. Detailed agenda and the minutes of meeting of the consultations. List of participants.	N/A

Source: JICA Guidelines for Environmental and Social Considerations (2010), Myanmar EIA Guidelines (2014)

11.2.3 Environmental Regulations in Myanmar

In Myanmar, "National Environmental Quality (Emission) Guidelines" was established in December 2015 which provides the basis for regulation and control of noise and vibration, air emissions, and liquid discharges from various sources in order to prevent pollution for purposes of protection of human and ecosystem health, under financial and technical assistance from the Asian Development Bank.
These Guidelines apply to any project subject to EIA Procedure.

(1) Air Quality

a) Ambient Standards

Table 11.2.3 shows the ambient standards concerning air quality applicable to the project.
National Environmental Quality (Emission) Guidelines requires that "emissions do not result in concentrations that reach or exceed national ambient quality guidelines and standards, or in their absence current World Health Organization (WHO) Air Quality Guidelines". As national ambient quality guidelines and standards have not been established as of November 2016, the standards required to be met in Myanmar is equivalent to the values set in WHO Air Quality Guidelines.
National Environmental Quality (Emission) Guidelines also require that contribution concentration of emissions from each project does not exceed 25 percent of the applicable air quality standards.[12]

Table 11.2.3 Air Quality Standard

Parameter	Unit	Averaging period	National Guideline*	IFC/WB General EHS Guidelines (2007)
Nitrogen dioxide	µg/m^3	11-year	40	Guideline value: 40
		1-hour	200	Guideline value: 200
Ozone	µg/m^3	8-hour daily maximum	100	Interim target 1: 160 Guideline value: 100
Particulate Matter PM_{10}	µg/m^3	1-year	20	Interim target 1: 70 Interim target 2: 50 Interim target 3: 30 Guideline value: 20
		24-hour	50	Interim target 1: 150 Interim target 2: 100 Interim target 3: 75 Guideline value: 50
Particulate Matter $PM_{2.5}$	µg/m^3	1-year	10	Interim target 1: 35 Interim target 2: 25 Interim target 3: 15 Guideline value: 10
		24-hour	25	Interim target 1: 75 Interim target 2: 50 Interim target 3: 37.5 Guideline value: 25
Sulfur dioxide	µg/m^3	24-hour	20	Interim target 1: 125 Interim target 2: 50 Guideline value: 20
		10-minute	500	Guideline value: 500

* National Environmental Quality (Emission) Guidelines（2015）

[12] During the EIA preparation, the predicted contribution concentration will be calculated with a simulation model and the obtained results will be compared with the amount equivaling 25 percent of the applicable air quality standard.

b) Air Emission Standards

Two types of air emission standards applied to this project. One is standards for incineration of general waste and industrial waste and the other is ones for emission associated with cargo handling and maintenance of aircraft.

The air emission standards for incineration of general waste and industrial waste are established by the national guidelines as described below.

Table 11.2.4 Air emissions standards for incineration of general waste and industrial waste

Parameter	Unit	Averaging period	National Guideline*	IFC/WB EHS guidelines for Waste Management Facilities
Cadmium	mg/m^3	0.5-8hour	0.05-0.1	0.05-0.1
Carbon monoxide	mg/m^3	-	50-150	50-150
Hydrochloric acid	mg/m^3	-	10	10
Hydrogen fluoride	mg/m^3	-	1	1
Mercury	mg/m^3	0.5-8hour	0.05-0.1	0.05-0.1
Nitrogen oxide	mg/m^3	24 hour	200-400	200-400
Polychlorinated dibenzodioxin and dibenzofuran	ng TEQ**/m^3	-	0.1	-
		6-8 hour	-	0.1***
Sulfur dioxide	mg/m^3	24 hour	50	50
Total metals	mg/m^3	0.5-8 hour	0.5-1	0.5-1
Total suspended particulates	mg/m^3	24 hour	10	10

* National Environmental Quality (Emission) Guidelines (2015)
** Toxicity equivalence factor (toxicity of compound of dioxins)
*** Dioxins and furan

The air emission standards associated with cargo handling and maintenance of aircraft (both for passenger and for cargo) are regulated by the national guidelines as described below. It should be noted here that a large maintenance building, which needs to follow these standards, will not be installed in this airport.

Table 11.2.5 The air emission standard associated with cargo handling and maintenance of aircraft

Parameter	Unit	National guideline value*	IFC/WB EHS guidelines for Airlines ****
Ammonia	mg/Nm^3	50	50
Hydrogen chloride	mg/Nm^3	10	10
Nitrogen oxides	mg/Nm^3	350	350
Particulate matter PM_{10} (metal surface treatments)	mg/Nm^3	5	5
Particulate matter PM_{10} (plastic processing)	mg/Nm^3	3	3
Total organic carbon (rubber vulcanization)	mg/Nm^3	80	80
Volatile halogenated hydrocarbons (metal surface treatments)	mg/Nm^3	20	20
Volatile organic compounds (metal and plastic coating)	mg/Nm^3	100 (up to 15 tons/year solvent consumption)	100 (up to 15 tons/year solvent consumption)
		75 (more than 15 tons/year solvent consumption)	75 (more than 15 tons/year solvent consumption)
		50 (drying processes)	50 (drying processes)
Volatile organic compounds (rubber conversion)	mg/Nm^3	20**	20**
Volatile organic compounds (surface cleaning)	mg/Nm^3	20-75***	20-75***

* National Environmental Quality (Emission) Guidelines（2015）

** Facilities with solvent consumption greater than 15 tons/year

*** 20 mg/Nm^3 for waste gases from surface cleaning using volatile organic compounds classified as carcinogenic, mutagenic or toxic to reproduction; 75 mg/Nm^3 for waste gases from other surface cleaning

**** IFC EHS guidelines for Airlines require referring to IFC EHS Guidelines for Metal, Plastic, and Rubber Products Manufacturing.

(2) Water Quality

Direct discharge of rainwater and drainage generated during each of construction and operation phase of the airport into rivers is regulated by the effluent standards shown in Table 11.2.6.

Table 11.2.6 Effluent standards for effluent associated with the construction and operation of the airport

Parameter	Unit	National standard*	IFC/WB General EHS Guidelines
Biological oxygen demand	mg/l	30	30
Chemical oxygen demand	mg/l	125	125
Oil and grease	mg/l	10	10
pH	-	6-9	6-9
Total coliform bacteria	100 ml	400	400
Total nitrogen	mg/l	10	10
Total phosphorus	mg/l	2	2
Total suspended solids	mg/l	50	50

* National Environmental Quality (Emission) Guidelines

The effluent generated by cargo handling and maintenance concerning aircraft (both for passenger and for cargo) is regulated by the effluent standards shown in Table 11.2.7

Table 11.2.7 Effluent standards for large-scale maitenance facility

Parameter	Unit	National standard*	IFC/WB EHS guidelines for Airlines**
Aluminum	mg/l	3	3
Ammonia	mg/l	10	10
		20 (electroplating)	20 (electroplating)
Arsenic	mg/l	0.1	0.1
Cadmium	mg/l	0.1	0.1
Chemical oxygen demand	mg/l	250	250
Chromium (hexavalent)	mg/l	0.1	0.1
Chromium (total)	mg/l	0.5	0.5
Copper	mg/l	0.5	0.5
Cyanides (free)	mg/l	0.2	0.2
Cyanides (total)	mg/l	1	1
Fluorides	mg/l	20	20
Iron	mg/l	3	3
Lead	mg/l	0.2	0.2
Mercury	mg/l	0.01	0.01
Nickel	mg/l	0.5	0.5
Oil and grease	mg/l	10	10
pH	-	6-9	6-9
Phenols	mg/l	0.5	0.5
Silver	mg/l	0.2	0.2
Sulfide	mg/l	1	1
Temperature increase	℃	< 3	< 3
Tin	mg/l	2	2
Total nitrogen	mg/l	15	15
Total phosphorus	mg/l	5	5
Total suspended solids	mg/l	50	50
		25 (electroplating)	25 (electroplating)
Volatile organic halogens	mg/l	0.1	0.1
Zinc	mg/l	2	2

* National Environmental Quality (Emission) Guidelines
** IFC EHS guidelines for Airlines require referring to IFC EHS Guidelines for Metal, Plastic, and Rubber Products Manufacturing.

The leachate generated from landfill of general waste and industrial waste is regulated by the effluent standards shown in Table 11.2.8 and Table 11.2.9 below, respectively. Bottom ash and the solid residue of industrial hazardous waste in the incinerator are required to be treated as hazardous waste unless proved non-hazardous.
It should be noted here that landfill disposal of waste is not planned in this airport.

Table 11.2.8 Effluent Standard for leachate from landfill of general waste

Parameter	Unit	National standard*		IFC/WB EHS guidelines for Waste Management Facilities	
		Daily max.	Monthly average	Daily max.	Monthly average
5-day Biochemical oxygen demand	mg/l	140	37	140	37
Ammonia	mg/l	10	4.9	10	4.9
Aniline	mg/l	-	-	-	-
Arsenic	mg/l	-	-	-	-
α-Terpineol	mg/l	0.033	0.016	0.033	0.016
Benzoic acid	mg/l	0.12	0.071	0.12	0.071
Chromium (total)	mg/l	-	-	-	-
Naphthalene	mg/l	-	-	-	-
p-Cresol	mg/l	0.025	0.014	0.025	0.014
pH	-	6-9	6-9	6-9	6-9
Phenol	mg/l	0.026	0.015	0.026	0.015
Pyridine	mg/l	-	-	-	-
Total suspended solids	mg/l	88	27	88	27
Zinc	mg/l	0.2	0.11	0.2	0.11

* National Environmental Quality (Emission) Guidelines (2015)

Table 11.2.9 Effluent Standard for leachate from landfill of hazardous waste

Parameter	Unit	National standard*		IFC/WB EHS guidelines for Waste Management Facilities	
		Daily max.	Monthly average	Daily max.	Monthly average
5-day Biochemical oxygen demand	mg/l	220	56	220	56
Ammonia	mg/l	10	4.9	10	4.9
Aniline	mg/l	0.024	0.015	0.024	0.015
Arsenic	mg/l	1.1	0.54	1.1	0.54
α-Terpineol	mg/l	0.042	0.019	0.042	0.019
Benzoic acid	mg/l	0.119	0.073	0.119	0.073
Chromium (total)	mg/l	1.1	0.46	1.1	0.46
Naphthalene	mg/l	0.059	0.022	0.059	0.022
p-Cresol	mg/l	0.024	0.015	0.024	0.015
pH	-	6-9	6-9	6-9	6-9
Phenol	mg/l	0.048	0.029	0.048	0.029
Pyridine	mg/l	0.072	0.025	0.072	0.025
Total suspended solids	mg/l	88	27	88	27
Zinc	mg/l	0.535	0.296	0.535	0.296

* National Environmental Quality (Emission) Guidelines (2015)

(3) Waste

Sludge generated at the waste water treatment facility is dehydrated and landfilled or incinerated. Sludge is regulated by the effluent standards shown in Table 11.2.10 below.

Table 11.2.10 Effluent standards for sludge

Parameter	Unit	National standard*	IFC/WB EHS Guidelines**
Arsenic	mg/kg	75	---
Cadmium	mg/kg	85	---
Chromium (total)	mg/kg	3,000	---
Copper	mg/kg	4,300	---
Lead	mg/kg	840	---
Mercury	mg/kg	57	---
Molybdenum	mg/kg	75	---
Nickel	mg/kg	420	---
Selenium	mg/kg	100	---
Total coliform bacteria	g	1,000	---
Zinc	mg/l	7,500	---

* National Environmental Quality (Emission) Guidelines (2015) (Refer to "Use and disposal of sewage sludge. 2006. 40CFR Part 503, USEPA")

** The relevant standard values are not established in the IFC Guidelines

(4) Noise and Vibration

The noise level is regulated by the national environmental standards for each receptor as shown inTable 11.2.11. Noise concerning the project shall be controlled to be below these standard values, or so that the increase from the existing noise level is within 3dB at the receptor nearest to the project site.

Table 11.2.11 Noise Level Standard

Receptor	Unit	National standard*		IFC/WB General EHS Guidelines	
		Daytime 7:00-22:00 (10:00-22:00 for Public holidays)	Nighttime 22:00-7:00 (10:00-22:00 for Public holidays)	Daytime 7:00-22:00	Night time 22:00-7:00
Residential, institutional, educational,	dBA	55	45	55	45
Industrial commercial	dBA	70	70	70	70

* National Environmental Quality (Emission) Guidelines (2015)

11.3 Consideration of Alternative Proposals (not disclosed)
11.4 Potential Impacts (Scoping) (not disclosed)
11.5 Environmental and Social Baseline Study Results (not disclosed)
11.6 Evaluation of Potential Environmental Impacts (not disclosed)
11.7 Environmental Management Plan (not disclosed)
11.8 Monitoring Plan (not disclosed)
11.9 Consultation with Stakeholders (not disclosed)
11.10 Land Acquisition and Resettlement (not disclosed)
11.11 Proposed Monitoring Form (not disclosed)
11.12 Environmental Checklist (not disclosed)