TRANSIT OASIS:
A MULTIMODAL TRANSPORTATION HUB

By

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A thesis submitted to the Department of Architecture in partial fulfilment of the requirements for the degree of
Bachelor of Architecture

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TRANSIT OASIS

Declaration

It is hereby declared that

1. The thesis submitted is my own original work while completing degree at Brac University.
2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. I have acknowledged all main sources of help.

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Approval

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Abstract

The Government of Bangladesh, DTCA (Dhaka Transport Coordination Authority) and JICA (Japanese International Coordination Authority) have proposed the construction of multiple (21) multimodal terminals in Dhaka including Gabtoli at the current location of the Inter-District Bus Terminal. With future proposals for mass rapid transit routes- MRT 2 in the site, and the inclusiveness of Intra-City routes, the design of the Multimodal hub has been generated.

The hub aims to facilitate the interchange between different modes of transport through establishment of park amenities, multiplex and accommodation. The unification of the surrounding green and vegetation and opening the ground for the pedestrians act as the source of form development.

Amidst the chaotic city atmosphere, with numerous functions, the concept is mainly to prioritize pedestrians and provide a mingling spot for the local bystanders, acting as the connection point that connects Dhaka to the North and South of Bangladesh.

Keywords: Multimodal; Transportation Hub; Transit

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List of Acronyms

DTCA	Dhaka Transport Coordination Authority
JICA	Japan International Cooperation Agency
RSTP	Revised Strategic Transport Policy
RHD	The Roads and Highways Department
BRT	Bus Rapid Transit
MRT	Mass Rapid Transit
DNCC	Dhaka North City Corporation
DSCC	Dhaka South City Corporation
BRTA	Bangladesh Road Transport Authority
TOD	Transit Oriented Development
PPPA	Public Private Partnership Authority Bangladesh
NIMTP	National Integrated Multimodal Transport Policy
BITWA	Bangladesh Inland Water Transport Authority

1. Introduction

Dhaka, being one of the most densely inhabited cities in the world has a teeming appearance with buildings, people and vehicles jostling over one another and always in a state of motion. Amidst the chaos, the absence of public breathing spaces is very prominent and only about 0.13 acres per 1000 persons (Kim, 2015). With its population of over 18 million in 2016, and a density of 23,234 people per square kilometre within a total area of 300 square kilometres (World Population Review), it is one of the densely populated cities in the world. The vibrant culture and the presence of thousands of businesses, international corporations, educational institutions, trade and commerce has contributed to migration from all over the country. However, like many other metropolises in the world, the population outgrowth has led to an increase in pollution, congestion and poverty. Although it is the capital and an economical hub, there is an insufficiency of efficient infrastructure and transportation system, which results in severe traffic congestions all throughout the city.

Robert Moses, an American public official, believed that "Cities are created by, and for traffic". A study of DTCA (Dhaka Transport Coordination Authority) shows that the public transport (PT) mode share in Dhaka ranges between 60-80%, depending on the corridor and time of the day; which is abundant considering how Asian cities thrive for only 10% PT modal share. Hence, there lies a potential for improvement of Dhaka's transport system at a reduced cost with subsidiary facilities.

For large urban areas such as Dhaka, a high quality of public transport system developed in effective integration with urban development in an only way to meet the transport demand. Multiple considerations are required for a public- transport oriented city. A core network composed of MRT, BRT and feeder bus services will stimulate socio- economic activities. Adequate role sharing with private transport including cars,

motorcycles, bicycles etc. and a long- term commitment with consistent policies and people's support will improve experiences of the city dwellers. These will nonetheless indicate that mass transit networks serve as urban structure of successful cities when merged with urban land-use and development enriching the public realm.

The land surface roadway system is mostly used for urban transport in Dhaka. Train network are used primarily for inter-city connections and water transports are mostly used by people from the Southern districts. Inter-city and Intra- City bus transportation are operated by the Road Transport Corporation and a major mode of transport for the working population.

Transportation is regarded an index of economic, social and commercial progress of a country. The Government of Bangladesh wants such a transport system that meets the needs of people and businesses at an affordable cost, creating a better environment. The rapid urbanization in Dhaka caused the Government to consider an implementing agency, DTCA, an executing agency, JICA, to formulate a preparatory survey on Dhaka Urban Transport Network Development. Based on the study, the 'National Integrated Multimodal Transport Policy' was approved in 2014 in an aim to reduce congestion, improve cities and encourage vitality (RSTP, 2015).

1.1. Background of the project

The JICA study team has identified 21 transportation hubs throughout Dhaka and its suburbs amongst which include Dhaka International Airport, Kamalapur Station, Mohakhali Bus Terminal, Jatra Bari Bus terminal, Gabtoli Bus Terminal, Gabtoli circular waterway station and Sadarghat Boat terminal. Multimodal Transportation hubs serve multiple transit operators/modes like combined bus, rail and waterway stations. These are an interference between different

transportation systems. Also, known as mixed- mode commuting has a goal to combine the strengths and offset the weaknesses of various transport modes. Benefits include enhancing and supporting transit usage and facilitating transfer between modes efficiently.

The project is to design a ‘Multimodal Transportation Hub’ at Gabtoli at the current Gabtoli Bus Terminal.

1.2. Problem Statement

The dependence of people on the automobiles as a major mode of ground transportation results in congestion and there is minimized usage of public transport facilities.

1.3. Project Specifications

CLIENT	-GOB (Government of Bangladesh) -DTCA (Dhaka Transport Coordination Authority) -JICA -The Roads and Highways Department (RHD)
SITE	-Gabtoli Bus Terminal & Gabtoli Circular Waterway Station
SITE AREA	-12.40 acres (5,40,000 sft)
OWNERSHIP	-DTCA (Dhaka Transport Coordination Authority)

1.4. Aims and Objectives of the project

The idea of this project includes development of public- transportation- oriented urban areas to ensure people's mobility and to promote an environment friendly society which showcases Bangladesh's culture through design experiences. Correspondingly, transport-oriented developments, like infrastructure development, creation of new urban centres for job opportunities, education and housing are desired. Providing a faster commuting time and reducing the ground traffic and increasing the dependency on public transport will also serve the goal for visioning a 'Jam-free' Dhaka.

1.5. Project rationale

Rapid urbanisation needs to be supported by increased people's mobility and ability to commute in the fastest possible time. Multimodal terminals are less time consuming and cost effective, allowing the user group to choose his desired mode of transport.

Gabtoli has a potential to become the Western transportation terminal with MRT Line 5, MRT Line 2 and existing bus terminal (RSTP, 2015). Being the former large municipality and the current neighbourhood of Dhaka, Gabtoli Inter District Bus Terminal is located on the North side of Dhaka- Aricha road with the Turag river, of width approximately 100m between Amin Bazar and Gabtoli stations.

1.6. Methodology of Study

The study is to be carried out using a mixed method process, through the interview of stakeholders. Primarily, a general idea is to be developed about peak hours, age and economic factors and questionnaire is to be formed. Secondly, data collection is to be carried out. Observation and visual documentation i.e. photographs will be taken that

aid in understanding the spatial characteristics of the spaces and available facilities in these locations and how they affect the usability of different gender and age group.

1.7. Functions of the Transportation Hub

General functions of the MRT station and Inter-district Bus Terminal-

1.7.1. Public Areas

Public area including information booths, ticket counters, passenger lounges, concourse halls, baggage carousals, cafeteria and washroom facilities.

1.7.2. Administration

The admin area consists of the general offices, admin offices, supervisor's room, security, surveillance and control rooms, duty officer's rooms and washroom facilities.

1.7.3. Parking Areas

Parking facilities for buses, and other transit vehicles including private cars, CNG, Rickshaw, motorbikes etc.

1.7.4. Staff facilities

*I*ncluding staff quarter with resting rooms, dining areas and washrooms.

1.7.5. Other facilities

Other functions include medical facilities, prayer halls, guard's room, garbage room, electro-mechanical facilities, florist/ gift shops, cafeteria, indoor-outdoor restaurants, newspaper stalls, vendors and banking facilities.

2. Literature Review

'Megacity' evolved its concept by the end of the 20th century to describe large urban agglomerations of the world. Literature shows a few discrepancies regarding the population threshold to define a megacity. The most widely accepted definition is a city with over 10 million inhabitants (UN, 2013); however, others include a population density of 2000 per square kilometres or a population of 8 million in urban areas as a megacity.

Cities in the Global North experienced slow growth between 2007 and 2011, compared to cities in the Global South. One example is India, which has 5 megacities (Delhi, Mumbai, Kolkata, Bangalore, Chennai and Hyderabad) and expected to have another addition by 2020. The concentration of population is visible in these megacities and gives an idea of population growth of developing countries. About a decade ago, in 2008, about 50 percent of the world's total population lived in urban areas, which has a projection to be 72 percent by 2050 according to the United Nations (UN), where the major proportion of the population will be in the less developed areas of the urban area. Dhaka city is the fastest growing megacity in the world which could surpass Mexico City, Shanghai and Beijing by 2025.

2.1. Dhaka city, people and thorough fares

There are five urban elements that forms a city according to Kevin Lynch. Those are path, edge, nodes, landmark and district. Paths, being the most dominant element of urban space must be identifiable and continuous. The clear destinations and directions of the paths help tie the city together through nodes and landmarks. "In general, it is impossible to create a clear city image while its paths remain confused and disordered" (Wenhao Yue, 2014).

With the congested living environment in Dhaka, roads are the only available voids. Street widening and building of flyovers aren't the solution to the lack of proper road networks in the city. Illegal occupation of streets by vendors and neglected garbage on the streets reduces the comfort of pedestrians and thereby promoting the occupants to travel in motor vehicles. Dhaka's street design requires safety, mobility, pedestrian accessibility, liveability, sensitivity to the context and creativity in street design.

Economic reasons and effects of globalisation motivate most people to migrate to Dhaka. Besides, poverty, major migration challenges are overcrowding, pollution and traffic congestion. Dhaka's horrible situation of traffic, which deteriorates daily results because of inadequacy of road network and inefficient traffic management. The percentage of public transport, buses and minibuses has grown at a very insignificant rate from 2003 to 2018 despite the increasing demand for public transport services. Whereas, private vehicles, particularly the number of cars and motorcycles, have almost tripled. Motorcycles and cars constitute around 54 percent and 26 percent of total motorised vehicles respectively (Alam, 2019).

Being one of the few megacities without a proper public transport system, the available bus transit operations are considered unreliable, uncomfortable, unsafe and time- consuming. Dhaka's roads are dominated by various vehicles with different speeds, comfort, accessibility and size. These include:

- Non- motorised vehicles: rickshaws, cycle, school van
- Motorcycle
- Auto rickshaw
- Leguna
- Private motorised vehicles- Cars, Taxi, Microbus
- Bus / Minibus

- Trucks and Others

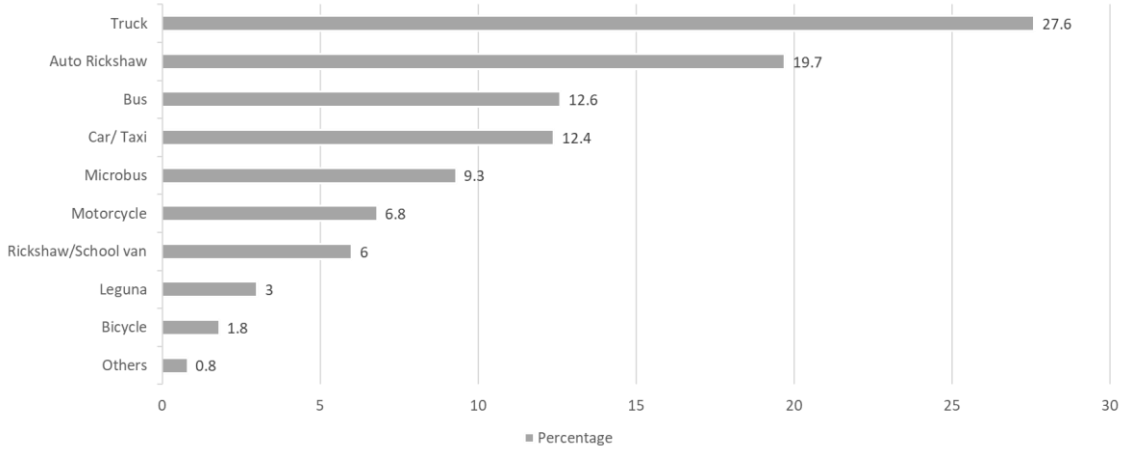


Figure 1 Modal Share of the Vehicular Traffic across the Inner Cordon Line

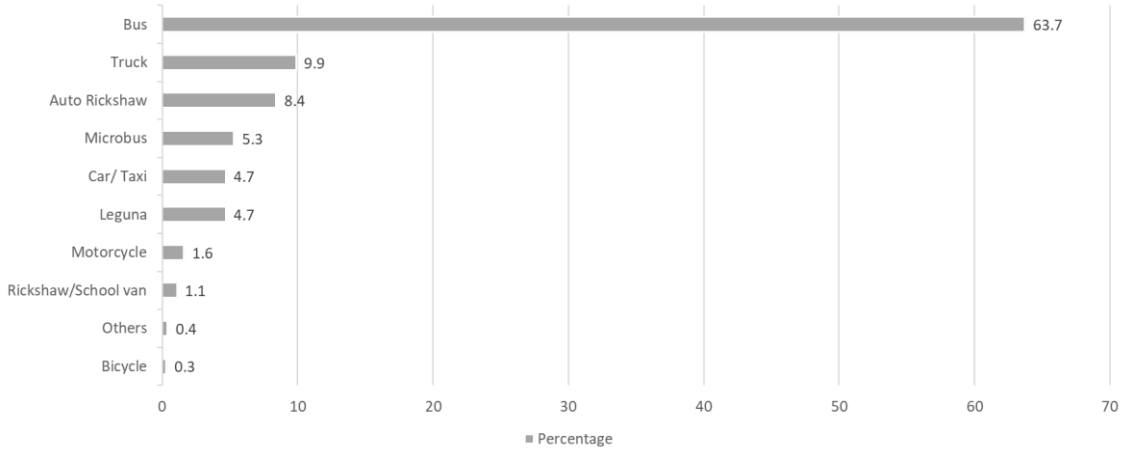


Figure 2 Modal Share of the Passenger Trips across the Inner Cordon Line

Source: Cordon Line survey, 2014, JICA Study team

To improve the recent situation and reorganise the existing traffic system methodically, the government prepared the Revised Strategic Transport Plan, RSTP since 2015, which is a package of comprehensive programmes for the development of transport infrastructure over a 20-year period. This strategy includes various types of development agendas, such as three Bus Rapid Transit (BRT) and Mass Rapid Transit (MRT) routes, more than 50 highway projects, expressways, flyovers, etc.

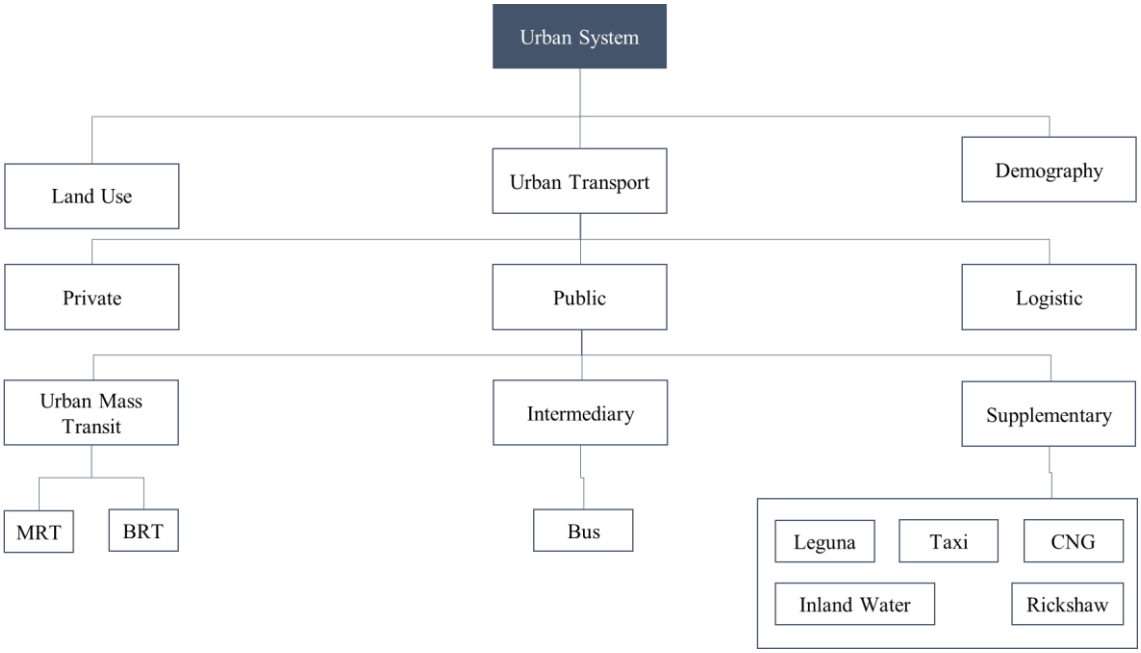


Figure 3 Components of proposed Transportation System for Dhaka

Source: JICA, 2015

2.2. Types of Transport Terminal

Terminals are any locations where freight and passengers either originates, terminates, or is handled in the transportation process. These are central and intermediate locations in the movements of passengers and freight and are usually points of interchange within the same modal system and which ensure the continuity of the flow of movement. The importance of transport terminal is often a function of its size. The major attributes linked with importance and performance of terminals include location, accessibility and infrastructure. The types of various transport terminals include:

- Bus Terminal, a bus station
- Airport Terminal, a building at an airport
- Terminal Station, a station at the end of a railway line
- Marine Terminal, a seaport or a dock

- Freight Terminal, a freight station
- Ferry Terminal, a docking facility for passenger, train and/ or auto ferries
- Container Terminal, a facility which handles shipping containers and cargo

2.2.1. Bus Terminal

A bus terminal is a designated place where a bus or coach starts or ends in its scheduled route. It is an area from the general flow of vehicles, from where buses pick up and drop passengers in safety and comfort with considerations regarding arrival and departure of passengers.

Size of the Terminal

For operational reasons and passenger routes to be their bus garage, where the legal terminus is outside or nearby. For integration of multiple transport modes, such terminal may be located at an interchange station. It may also be a bus stop or loop by the street.

Operational Considerations

While it may be of prime importance to the passenger, the location of the bus terminal doesn't always focus on passengers' convenience. For separate bus operators and bus station owners, it is easier to seclude services outside the station to reduce their costs. Competitive factors may result in usage of a different locations as intermediate terminus.

Turning

A factor in the location of a terminus is how to turn the bus around to start the route in the other direction, which may be difficult in areas where road space is

an issue, or the road layout prevents U-turns. Termini in bus stations will often include reversing/run-around space, negating the turning issue.

Layover

Another consideration about the location of a terminus is the need to layover before resuming in service. To allow layover at a terminus, many routes run through busy centres terminating either side in quiet termini, where a bus can lay over without causing an obstruction. Layover time is time built into a schedule between arrival at the end of a route and the departure for the return trip, used for the recovery of delays and preparation for the return trip.

Driver Change

Terminus location may be positioned to allow driver changes. Centrally located termini may be more convenient for driver changes. Some operators operate pool cars to allow drivers to drive to and wait at a quiet terminus, swapping the car with the bus when it arrives.

There are different types of bus terminals.

- Intercity Bus Terminal- Intercity bus terminals are those which are in the core and accessible directly by local transit, taxi and automated vehicles. It differs from other terminal types in which it includes long haul stretching several hundred miles.
- Sub- Urban Interstate Terminal- This type of terminal is a peripheral type of terminal which functions with avoiding traffic congestion and heavy investment associated with the central city. This type if terminal is usually located adjacent to interstate highway connections with major cities or regional airports which mostly serves the increasing outlying urban sprawl.

- One- Stop- This type of terminal is designated as a one stop, with the buses starting and finishing in the same orientation. This is often necessary for cities with one- way traffic solutions. It may be built run around a bus turnout, which allows the buses to change directions by simply entering and leaving the turnout.
- Two- Stop- The routes that need to change the direction at the terminal starts and ends at different stops, and the pair of stop locations forms the terminus.

There are three major inter- district bus terminals in Dhaka- Sayedabad, Mohakhali and Gabtoli. Apart from these buses also depart from Gulistan, Fakirapul, Kalabagan, Kallayanpur and Abdullapur.

Table 1 Summary of Inter-District Bus Terminals

Source: DNCC, DSCC, BRTA

Name	Area/ sqm	Capacity	Daily Trips	No. of routes
Sayedabad	40,500	500	2000	87
Mohakhali	36,400	300	800	60
Gabtoli	123,400	700	2200	61

Table 2 Fare of Bus and Minibus in Dhaka

Source: BRTA

Type	Minimum Fare/ Taka	Fare/ Km
Bus	7.00	1.70 Taka/ Km
Minibus	5.00	1.50 Taka/ Km

2.2.2. Mass Rapid Transit

Rapid Transit or Mass Rapid Transit (MRT) is a type of urban transport for urban areas. Unlike buses or trams, rapid transit systems are electric railways that operate on an exclusive right- of- way, cannot be accessed by pedestrians or any other vehicles. The grade is usually separated using tunnels or elevated railways. The stations typically have high platforms, without steps inside the trains, which requires custom-made trains in order to minimize gaps between train and platform. They are normally integrated with other public transport and often operated by the same public transport authorities. Rapid transit is used in cities and metropolitan areas to transport large numbers of people often short distances frequently ensuring the safety and security of the passengers.

Each rapid transit system consists of one or more lines, or circuits. Each line is overhauled by at least one specific route with trains stopping at all or some of the stations along the lines. Most systems operate several routes, and distinguished using colours, names, numbering, or a combination thereof. Rapid transit types are determined by many considerations, including geographical barriers, existing or expected travel patterns, construction costs, politics, and historical constraints. A transit system is expected to serve an *area* of land with a set of *lines*, which consist of shapes summarized as "I", "U", "S", and "O" shapes or loops.

The Dhaka Metro is an approved metro rail system under construction in Dhaka, Bangladesh. Together with a separate BRT (Bus Rapid Transit) system it is anticipated to solve the extreme amount of traffic jams and congestion that occur throughout the entire city daily.

Dhaka Metro Rail Lines consist of multiple elevated and underground stations with electricity powered light rail tracks. Construction began on 26 June 2016 and the civil work is being done by the Italian- Thai Development Public Company Limited and Sinohydro Corporation Limited JV and a Tokyo based construction company, is developing the depot’s land.

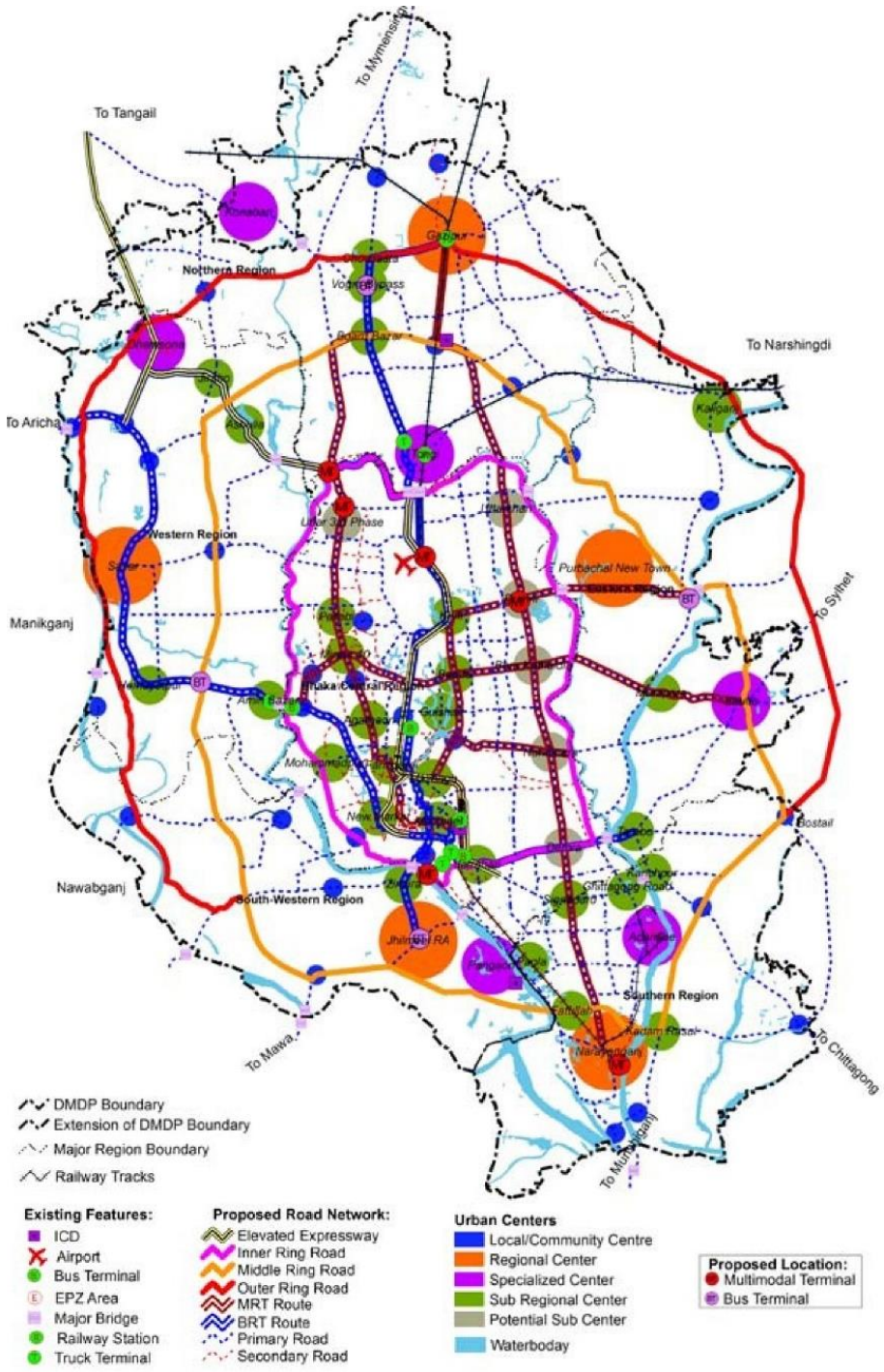


Figure 4 Dhaka Structure plan showing the proposed Road Network

Source: Dhaka Structure Plan (2016-2035)

Table 3 Summary of MRT/ BRT System Plan

Source: JICA Study team, 2014

	Section	Proposed System	Length/ Km	Notes
Line 1	Gazipur- Airport- Kamalapur- Jhilmil- Purbachal- Khilkhet	MRT	52	
Line 2	Ashulia- Savar- Gabtoli- Dhaka University- DSCC- Kamalapur	MRT	40	
Line 3	Gazipur- International Airport- Jhilmil	BRT	42	On-going
Line 4	Kamalapur- Narayanganj	MRT	16	
Line 5	Bulta- Badda- Mirpur Rd.- Mirpur 1- Gabtoli Bus Terminal- Dhanmondi- Bashundhara City- Hatir Jheel Link Rd.	MRT	35	
Line 6	Ashulia- Uttara North- Pallabi- Tejgaon- Motijheel- Kamalapur	MRT	41.8	On-going
Line 7	Eastern Fringe Area	BRT	36	

Gabtoli has a potential to become the Western transportation terminal with MRT Line 5, MRT Line 2 and existing bus terminal (RSTP, 2015)

- *MRT Line 2:*

  It is a 40km long MRT that will serve the Western suburbs of Dhaka via CBD including Gabtoli Bus Terminal which will be operational from 2035. This line has been expected to have passenger demands with nearly 1.1 million passengers per day and 23,020 PPHPD (Passenger Per Hour Per Day) in 2035. There are 3 multimodal stations including the major interchange facilities at Circular Waterway (Gabtoli) and

Kamalapur Station. The Depot is to be situated at the Eastern part of Savar or Ashulia.

- *MRT Line 5:*

  The study team has addressed the Line 5 to provide a 'bypass' public transportation service for the city's suburban areas and provide good connectivity between suburban zones. It is a 35km long East-West corridor from Hemayetpur to Vatara via multiple stations, serving the suburbs and crossing through cantonment area. The line is forecasted to have high passenger demands up to 1.5 million passengers per day and 28.340 PPHPD in 2035. There are 9 multimodal stations including major interchange facilities at Gabtoli Bus Terminal and Circular Waterway (Gabtoli).

  The station has 2 platforms, 4 tracks, 3 underground floors and Island type of platform with a three- storied structure in accordance with longitudinal alignment.

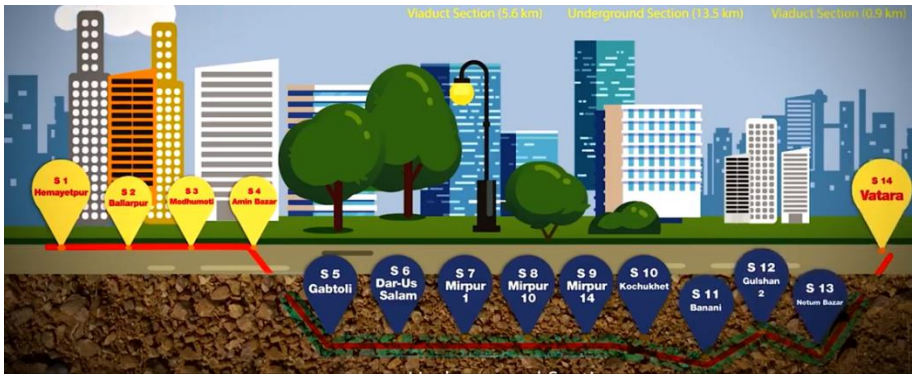


Figure 5 Diagram showing MRT 5 route plan

2.3. Mixed- mode communication

Passenger transport has always been intermodal. From the 19th century, people living in inlands switched from train to seas for overseas travel, people switched from

carriages to ferries at the edge of rivers. Also known as mixed- mode commuting, which involves using two or more modes of transportation for the journey. Mixed-mode commuting combines the strengths and offsets the weaknesses of various transport modes. This form of commuting often centres on one type of rapid transit, usually rail to which low- speed options (bus, tram, bicycles) are appended at the beginning or end of the journey.

Multimodal transport is a form of mixed- mode commuting. It is the articulation between different modes of transport in order to move rapidly and effectively. These serve multiple transit operators/modes like combined bus, rail and waterway stations. Benefits include enhancing and supporting transit usage and facilitating transfer between modes efficiently. It has become the key platform in enabling exports and imports of a country. Transportation is regarded an index of economic, social and commercial progress of a country. Multimodal terminals are time saving and cost effective and user group can have options to choose his desired mode of transport. Integrated urban development with the transport hubs, adequate role sharing with private transportation and long-term commitment aid in creating effective public-transportation oriented city. The resolution to adopt multimodal transport was accepted by the ASEAN in October 2000 (Goh, De Souza, Garg, Gupta, Lei, 2008).

2.4. Vision of DTCA

In the early 1990s, a comprehensive transport study named, Dhaka Integrated Transport Study (DITS) was conducted under the funding of International Development Assistance (IDA). This was followed by Dhaka Urban Transport Project (DUTP) in 1999, and Dhaka Transport Coordination Board (DTCB) in 2001, as a part of Roads and Highways Department (RHD), under the DTCB Act (Act No. 19 of

2001). Later, for greater efficiency, Dhaka Transport Coordination Authority (DTCA) came into existence in 2012 under (Rule-8 of 2012).

Their main aim is to coordinate with transport related agencies in Dhaka to provide a more efficient integrated, cost- effective and sustainable transport network through encouraging commuters to choose the most appropriate mass transportation mode. This is carried out through implementations of STP Requirements and following Public Transport Policies for Traffic Management Planning and Monitoring.

2.4.1. Requirements and Aims

The vision stands upon three pillars- *Liveability, Functionality* and *Resilience.* It also has two conditions- *respect towards local socio- cultural fabric* and *environmental sustainability*. The pillars look forward to allowing the nature as a driving force for the plan. *"The pillars are the accelerator that gives speed, the conditions are the brakes and steering wheel that guide and control that speed."*

Parameters that are deemed for liveability include accessibility to services and facilities, affordability of housing and transportation, meaningful employment opportunities, safety and security, cleanliness and hygiene, social equity and justice, sense of community, availability of quality education and health facilities, attractive and adequate public spaces, walkability, healthy natural environment, interesting cultural activities and opportunities for public participation.

Functionality is related to the efficiency of the components of an urban system operation. The key systems for functionality are transport, drainage, social services like health and education, utility systems, economy, energy, natural environment and ecosystem and governance.

Resilience of the Metropolitan Region from natural and anthropogenic hazards, economic downturn and impacts of climate change is to be done through preventive and curative aspects.

In RSTP (2016-2035), vision for Dhaka and strategies are interlinked with the fact that as the capital city heads towards future growth, it has plenty of 'water' and 'greeneries' in the city plan to ensure Dhaka's identity is developed sustainably and enhanced as "Green Dhaka with Blue River and Green Urban"(RSTP, 2015).

The strategies to be implemented include:

- *Strategy 1*- Develop public- transport oriented urban areas to ensure people's mobility and promote an environment- friendly society.
- *Strategy 2*- Upgrade and revitalise existing built- up areas in the city centres and urban fringe areas.
- *Strategy 3*- Develop modern and competitive new urban centres to attract diversified quality investments that will generate employment opportunities.
- *Strategy 4*- Develop efficient infrastructure and services to ensure convenient and competitive socio- economic activities and affordable services.
- *Strategy 5*- Prepare effective disaster prevention measures to protect against natural and man- induced disasters
- Strategy 6- Strengthen institutions for effective urban management and capacity building.

In order to enhance the development effects of MRT/ BRT Projects, construction of urban facilities at and around the stations for the improvement

of inter- modal connectivity is important. **Transit oriented development (TOD)** is a compact area of mixed- use and commercial area designed to maximise access to public transport, also promoting transit ridership. It is generally at a radius of 400 to 800m from a transit stop, or 600m in average as a comfortable walking distance. The Government policies on TOD emphasise on (I) Introduction of tickets for a complete trip by passengers; (ii) Better facilities at interchanges; (iii) Better connection and coordination between different services; (iv) Wider availability and provision of information on time table, route planning and fares; (v) Introduction of a national public transport information system.

2.4.2. Policies and Legislation

Long-term policy framework of Dhaka Structure Plan in defined through 8 policies:

- Promote a liveable city in Dhaka Metropolitan Region (DMR)
- Establish and operationalise zones and centres
- Gear- up the economy in DMR
- Provide better public facilities and preserve natural environment
- Preserve Natural Environment
- Well-connected transportation network
- Affordable Housing for city Dwellers
- Putting the plan in practice

Transport sector administration consists of National Integrated Multimodal Transport Policy (NIMTP) and Dhaka Transport Coordination Authority (DTCA). Other concerning legislations consist of RHD, BBA, BRTA, DMTC,

BRTC, MOR, BR, MOLGRD & C, LGED, DNCC, DSCC, MOHPW, RAJUK, MOHA, DMP and PPPA.

2.5. Project Specifications

2.5.1. Bus terminal

The design of the bus terminal will consider the bus dimensions and turning radii as per the Times Saver Standards and BNBC Rules and Regulations as shown below.

- *BNBC Requirements*

  i. For any plot (Assembly Building), with front road width above 24metres, Floor Area Ratio= 7.00, Maximum Ground Coverage= 50%

  ii. Entry Road Required for Terminal minimum 30m or 100ft

  iii. Internal Road required for terminal Minimum 23ft, and roads should be one-way1 Car Parking For each 200m^2 floor area

  iv. Parking Dimension Required

  a. CAR 8 ft x 16 ft

  b. BUS 12 ft x 32 ft

  v. Ramp Slope Ratio for vehicles 1:8

  vi. Ramp Slope Ratio for passengers 1:12

  a. Staircase Minimum Width for Terminal 1.5 m or 5 Ft

  vii. Fire stairs Required Every 75ft Radius

2.5.2. Metro station

The following Tables and Figures show the proposed design standards for MRT Lines. JICA Study Team has developed a proposal through Dhaka Transport Coordination Authority's Revised Strategic Transport Plan (RSTP, 2016-2035).

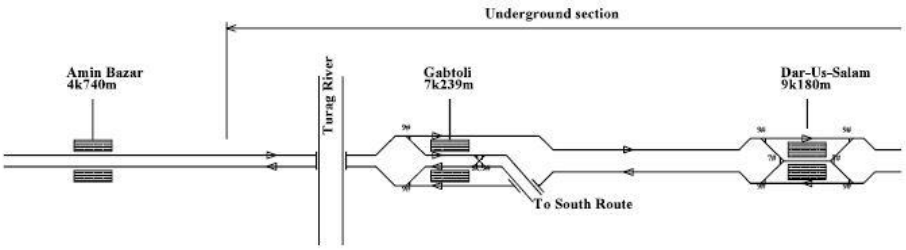


Figure 6 Track layout of MRT Line 5 through Gabtoli

Source: JICA, 2015

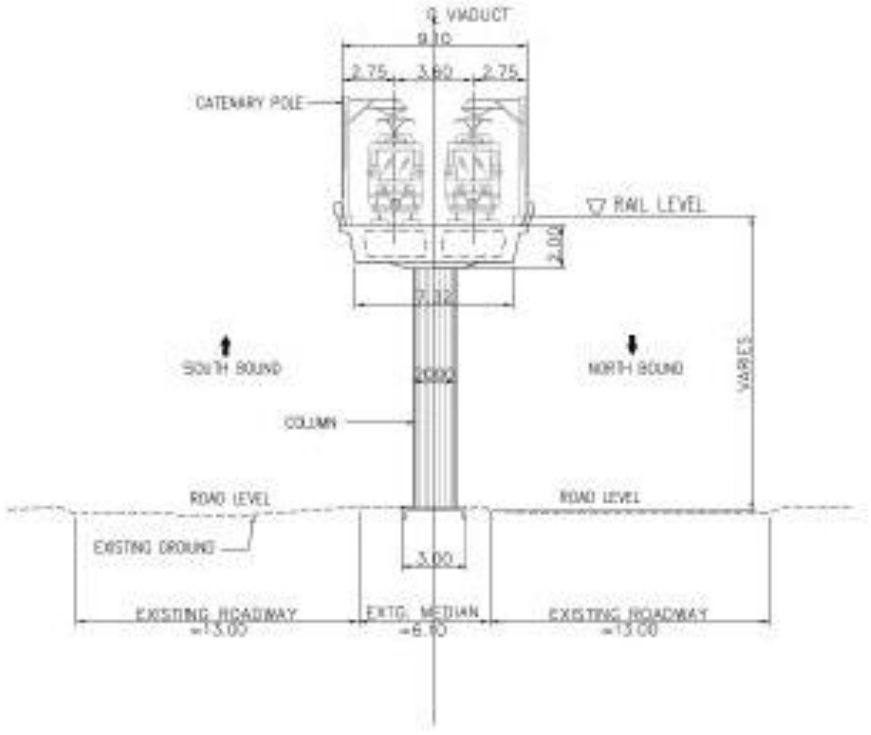


Figure 7 Cross Section of Metro Line

Source: JICA, 2015

Table 4 Specification required for alignment planning

Source: JICA, 2014

Item		Standard	Remarks
Maximum Operation Speed		100 km/h	
Maximum Design Speed		110 km/h	
Minimum Curve Radius	Main Line	200 m	Desirable 400m o more
	Along Platform	600 m	
	Siding	200 m	Including Depot Alignment
Maximum Gradient		35%	
Minimum Gradient	Elevated Section	0%	
	Underground Section	2%	0% in Station Yard
Platform Length		170 m	For 8 cars

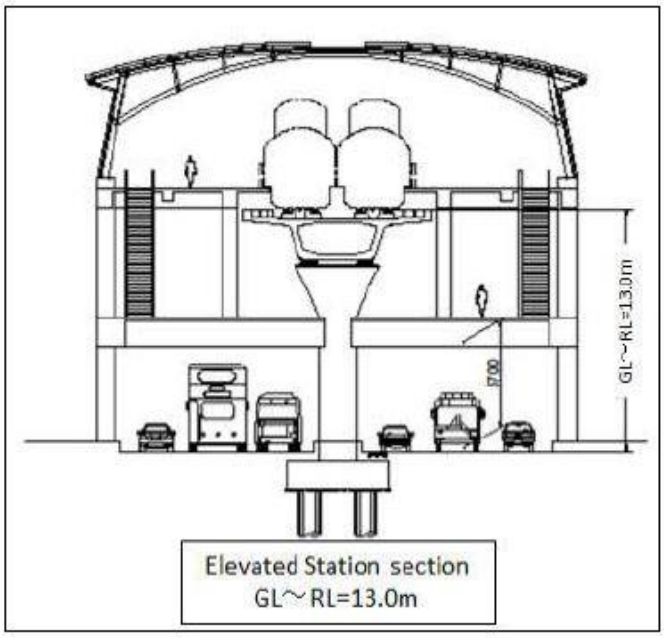


Figure 8 Required Height at Elevated Section

Source: JICA, 2014

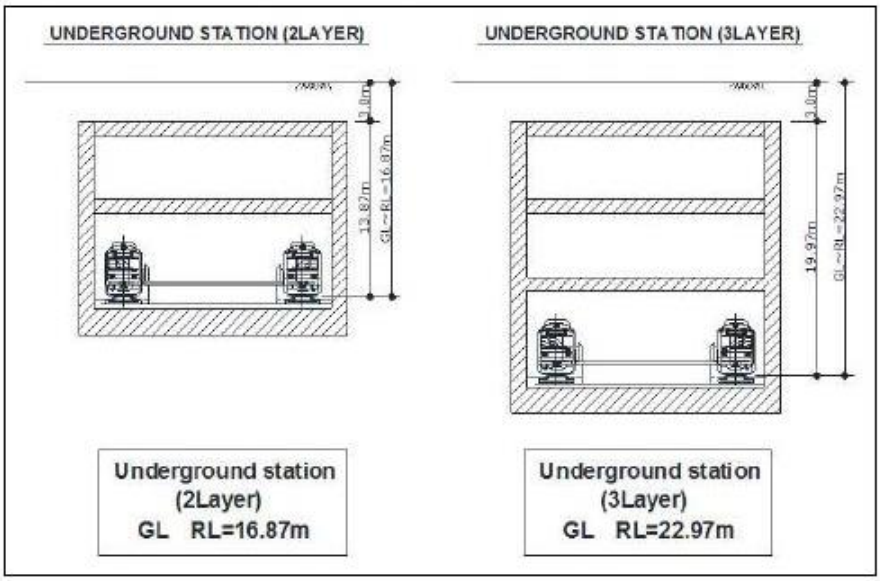


Figure 9 Required Height at Underground Section

Source: JICA, 2014

The underground section (Rail Level) varies from 16.87- 36.85 meters and its width is approximately 38m. The elevated section varies from 13.0- 22.2 meters. The tunnel is planned to run under nearby Turag River with depth more than 1.5D is secured from riverbed.

Table 5 Salient features of Project

Source JICA, 2014

Salient features of the Project are described below:		
Route Length	:	22 km
Underground	:	13.5 km
Elevated (Kamalapur- Purbachal)	:	6.5 km
Total Station	:	14
Underground Station	:	9
Elevated	:	5
Design Speed	:	110 km/h
Maximum Train Operating Speed		
At elevated section	:	100 km/h
At underground section	:	90 km/h
Capacity		
6 car formation 3M3T seated with 160% congestion rate	:	1546 persons
8 car formation 4M4T seated with 160% congestion rate	:	2074 persons
Rolling Stock Required (6 car configuration)	:	Total 30 train set, 180 cars by 2028
Signalling and Train Control	:	Communication based Train Control, Automatic train control
Fare Collection	:	Automated fare collection system
Depot Location	:	North side of Hemayetpur station
Train Operation	:	18 hrs of the day (6am- 12am)
Headway	:	Peak 3’30” (2028 6 cars), 3’00” (2035 6 cars), 3’00” (2058 8 cars)
	:	Off- peak 4’00” (2025 6 cars), 5’00” (2025 8 cars), 4’00” (2035 8 cars)
Platform	:	Length: 170m
	:	Side: 7-10m
	:	Island: 11m
PSD (Platform Screen Door)	:	Full Height PSD (Underground)
	:	Half Height PSD (Elevated)
Design PHPDT	:	Year 2028: 26,460 persons
	:	Year 2035: 57330 persons
Project Cost	:	BDT 299 billion

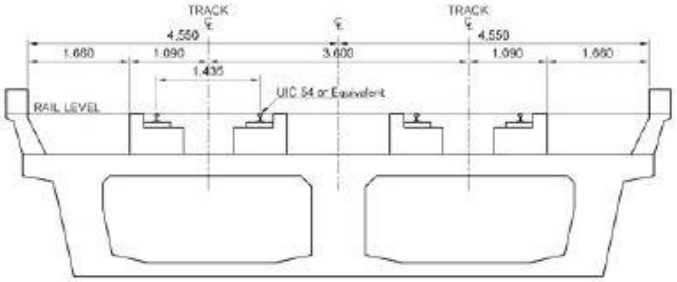


Figure 10 Typical Cross- Section of Double Track

Source: GTZ, 2005, World Bank, 2001-2002

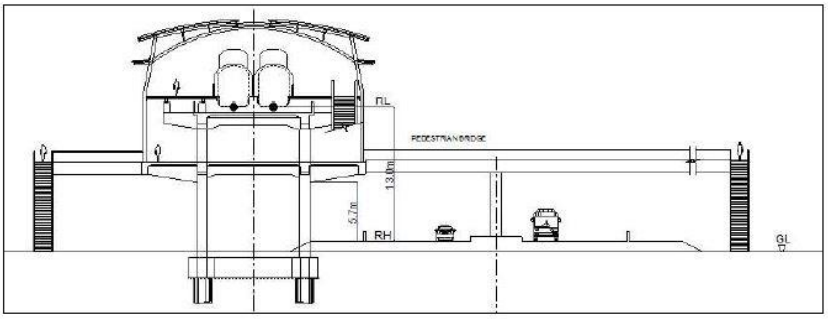


Figure 11 Control Point in Parallel Section with Access Control Toll Road

Source JICA, 2014

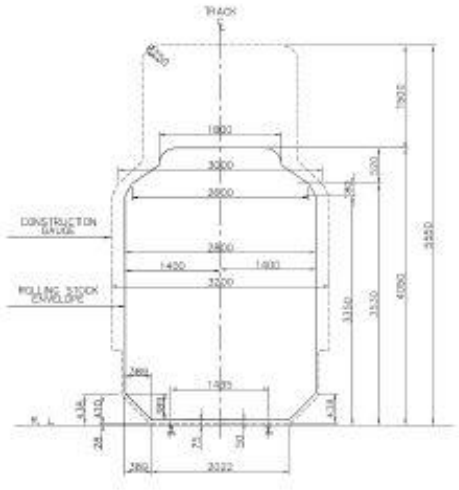


Figure 12 Rolling Stock Envelope and Construction Gauge

Source: GTZ, 2005, World Bank, 2001-2002

Table 6 Rolling Stock Design Criteria

Source: JICA, 2014

Item	Description	Specification
Requirements	Average per Train (approx.)	4.2 MW
Maximum Current	-	4000 Amp
Traction Motor	3- phase induction motor 140-200 KW (Estimated)	-
	Maximum rated Voltage	1,100 V
	Battery Charging Circuit	110 VDC
Lighting	Level in Saloon	>200 Lux
	Level in driving Cab	>100 Lux
Air Conditioning	Self-Contained package type	-
	Saloon Interior Temperature	24°c
	Saloon interior relative humidity	60%
Ventilation	Fan capacity	13 cubic metre/ min
Air Compressor	Three phase 380 VAC motor driven unit	-
	Capacity (Estimated)	2,000 litres/ min
Train Information System	On board Information for the train driver and on- board diagnostics for maintenance	-

Table 7 JICA Design Criteria

Source: JICA, 2014

Item		Description
Basic Spec.	Earthquake	Seismic design
	Operation in case of fire	Non- stop between stations (Train shall be driven to nearest station)
	Rail gauge	Std. gauge: 1435 mm
	Car gauge (clearance)	Widening at curve section
	Construction gauge	Widening at curve section
Alignment	Min radius	600m(normal), 200m(unavoidable), 200m (Depot area)
	Min radium (Station)	600m (the track along the platform)
	Gradient	35%- 40% (between stations), Level for stations but 10% will be allowed for unavoidable case
	Transition curve	Cubic parabola curve or Clothoide
	Min length of tangent line between transition curve	20m but two transition curves will be allowed in case of unavoidable
	Min length of curve section	20m but two transition curves will be allowed in case of unavoidable
	Distance between rail centre	3.6m (main tracks)
Rail Structure	Rail	UIC (54kg/m (main track), 50kg/m (side-track and depot) CWR in curvature larger than 400m, to provide expansion joints at both ends.
	Rail fastener	Basically, Torsion Type
	Turnout	No. 10 for main track, No. 8 or No. 10 for side-track and depot
Station	Platform length	Train length+ 10m, train length +5m with ATS/ ATO
	Platform width	No structures are allowed within 2m from the end of the platform Min 5m for Island Type Platform Min 4m for Lateral Type Platform (exception case; 4m for Island Type and 2m for Separate Type)
	Consideration of people handicapped	Universal Design, Barrier Free (Lift, Escalator, Tactile road tile for blind, slope etc.)
Power	Electric Power	Overhead Catenary Type, DC 1,500 V

2.6. Spatial characteristics of multimodal terminals and surroundings

The MRT Lines will leave big impacts on socio- economic activities and land-use along the corridors. For the Lines to efficiently manage the planning process, the clear definition of influence area is essential. Depending on the purpose and scope of activities, the diagram below shows the spatial relation of station influence area with MRT/ BRT Stations.

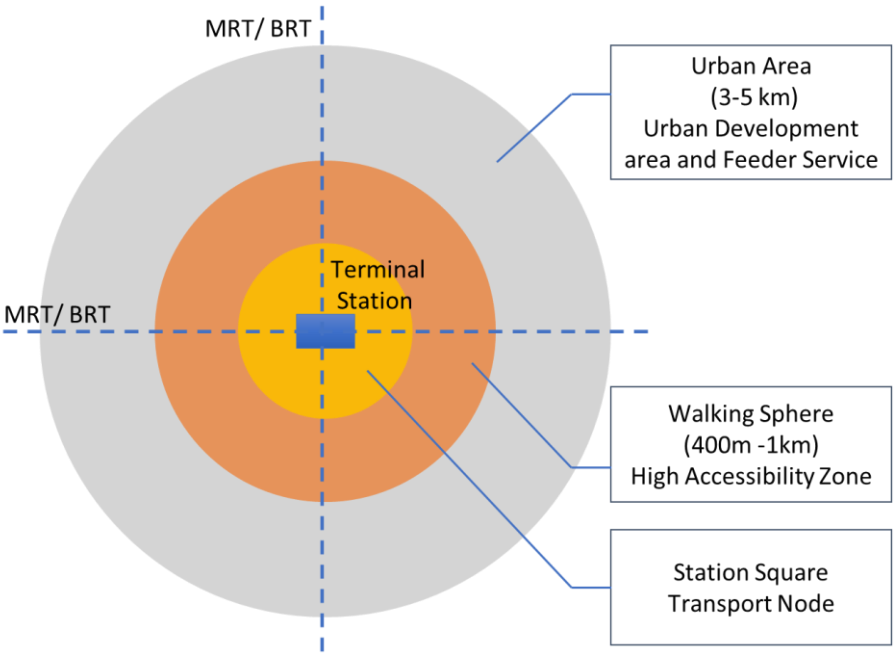


Figure 13 Spatial Relation of Station Influence Area with MRT/ BRT Station

Source: Author, adapted from RSTP (2015)

2.6.1. Level 1 Project Influence Area: City/ District

The influence area is spread up to a large part of existing urbanised and expanding areas of Dhaka. The provision of feeder bus service and usage of public transport will be important as well.

2.6.2. Level 2 Project Influence Area: Area within walking distance

With regards to the perspective of railway use as a part of daily life, the catchment area can be regarded as a walking distance covering about 1,000 m radius of the station.

2.6.3. Level 3 Project Influence Area: Area at and around MRT/ BRT Stations

The mass transit does not act as a transport facility only, but also act as a multi- functional facility which responds to various economic and commercial needs and public services.

Multimodal Transport Hubs are sites for place making and community development. These public transport nodes are natural gathering points which provides social services and information to people. Keeping a moto for "Pedestrians first" through properly designed pedestrians' ways, provision for the disabled, children, women and designed bicycle routes, keeping in mind the pollution prevention help generate prominent urban spaces.

Place making focuses on developing public spaces into places that have meaning for people, give them pleasure to be in, and that resonate with feeling and memory (Yencken, 1995). In order to achieve improved civic engagement, peoples' participatory processes will assist in developing the public and cultural life of the community. The combination of a poorly designed transit environment, the presence of uncivilised people, the lack of evident security measures, and negative media exposure heavily influences passengers with insecurities when travelling (Kennedy's Study, 2008). Studies have shown many users to have a dislike towards stations that make them feel enclosed, entrapped, or vulnerable to danger. Commuters tend to feel unsafe when they must wait at platforms for long durations, there is a shortage of proper waiting and toilet facilities and unclear route directions at interchanges.

3. Site Appraisal

Figure 14 Location of Gabtoli in Dhaka and site marked in Gabtoli map

Source: Author, 2019

Gabtoli is a former large municipality and the current neighbourhood of Dhaka, the capital city of Bangladesh with latitude and longitude coordinates: **23.783726, 90.344246. and GPS** coordinates of 23° 47' 1.4136" N and 90° 20' 39.2856" E**.**

One of the major transportation terminals of the country is located here- Gabtoli Inter- District Bus Terminal, which is under the ownership of Dhaka Transport Coordination Authority (DTCA). Besides this, the cattle yard, brick yard, coal yard, and sweeper's colony exist in the area. Presently, it is an expanding and developing area, with growing residential areas. It is a place with modal interfaces (Interaction and coordination that involves the deliberate assembly

of modal movement units i.e., vessel, vehicle, or rail car) of different activities such as communication, commercial, residential, community service, workshops, trading and hotels.

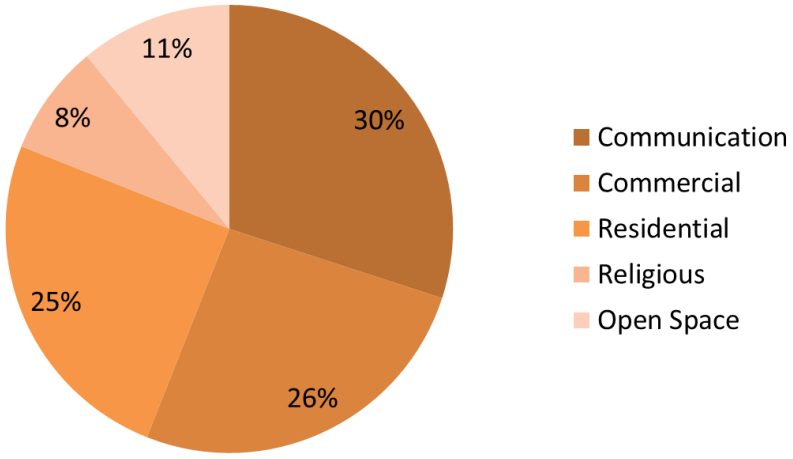


Figure 15 Land-Use pattern and the percentile

Source: Author (2019), adapted from Haque, 2014

Gabtoli district is perfect for the middle-income group since the dwelling facilities are not expensive there, but the living standards are relatively high. The total population of the district is estimated to be close to 25 thousand people.

3.1. Morphology

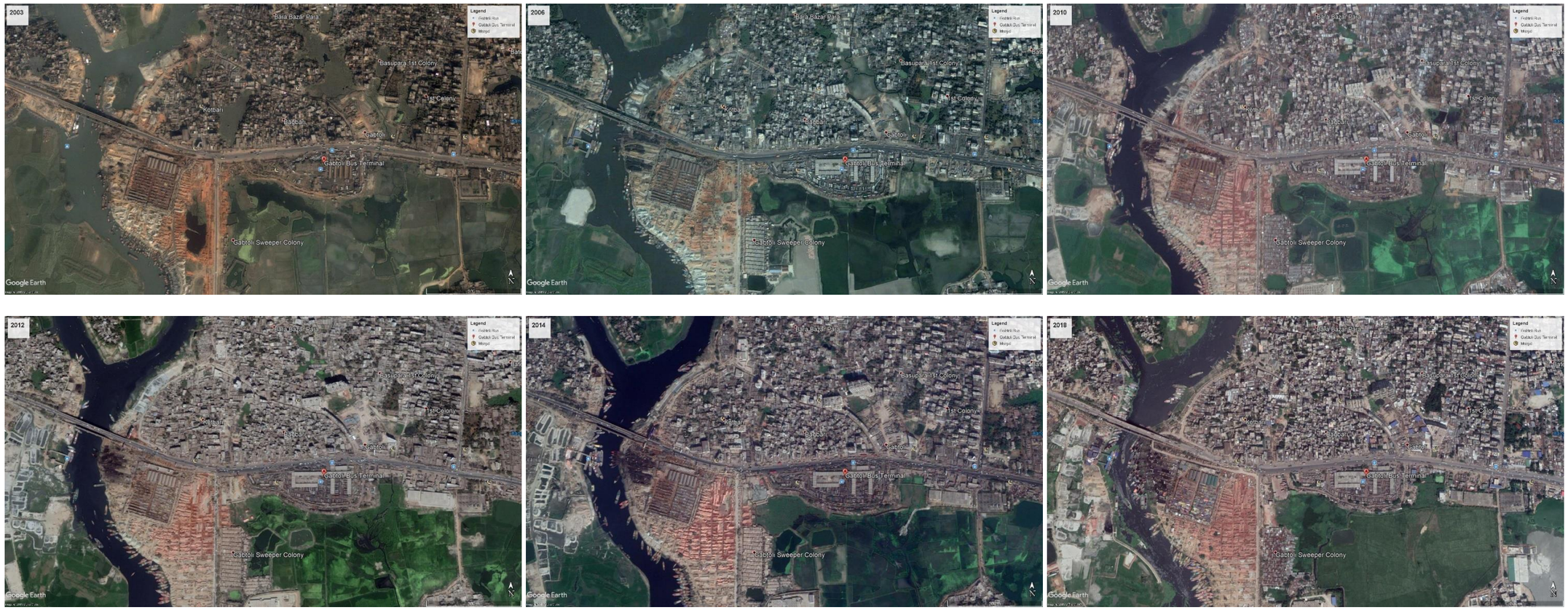


Figure 16 Morphology Map

Source: Google Earth

The morphology map shows that there in an increase in land use and a reduction in the green areas. Also, the Turag river has narrowed down over the time span with an increase in water vehicles. There has been prominent development on the Eastern side of the Turag river.

3.2. Site Location

The site is Gabtoli Inter District Bus Terminal (632,555 ft², 14.5 acres) is located on the North side of Dhaka- Aricha road.

Figure 17 Site location

Source: Author, 2019 (Base Map: Google)

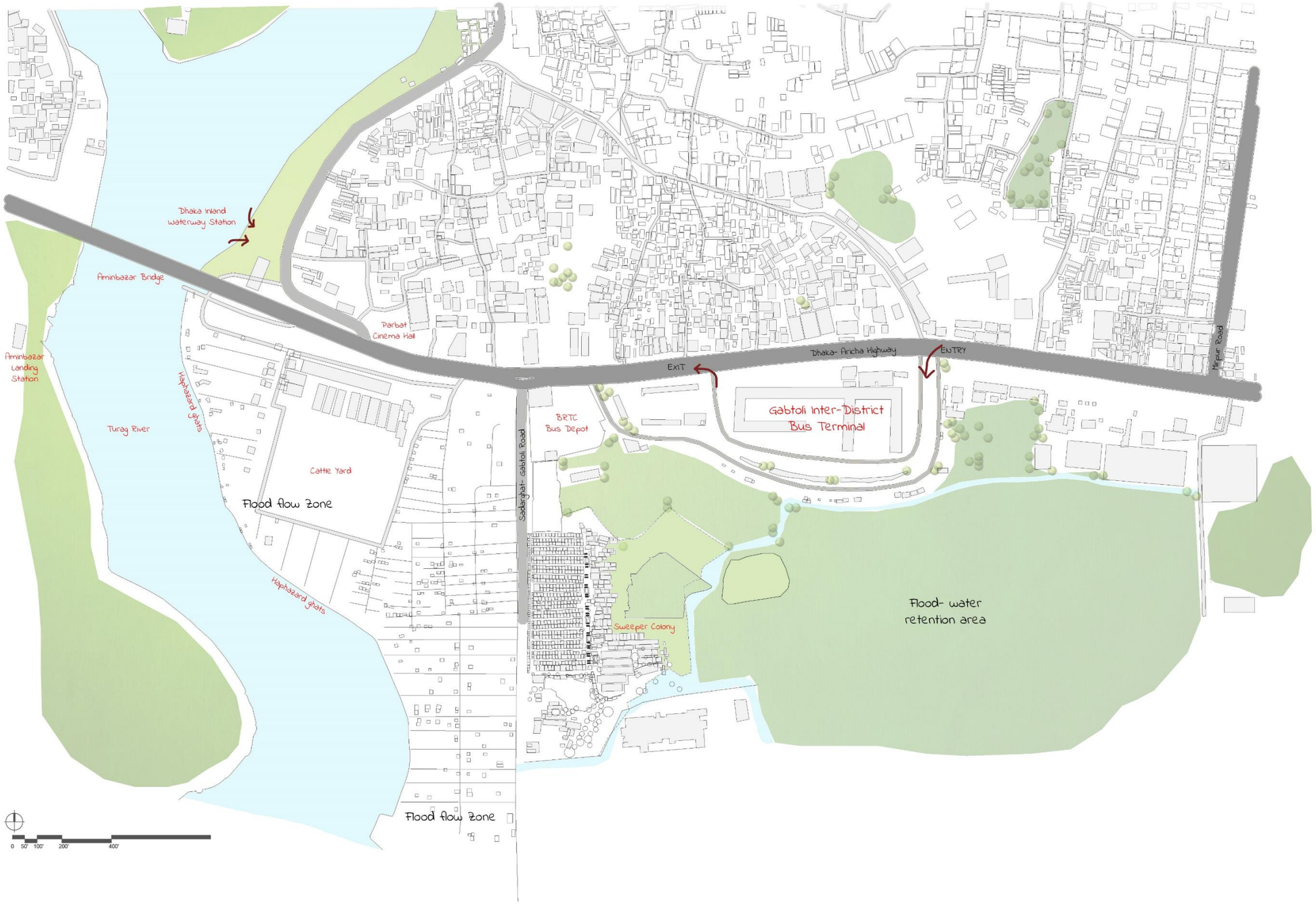


Figure 18 Site and surroundings

Source: Author, 2019

Source: Author

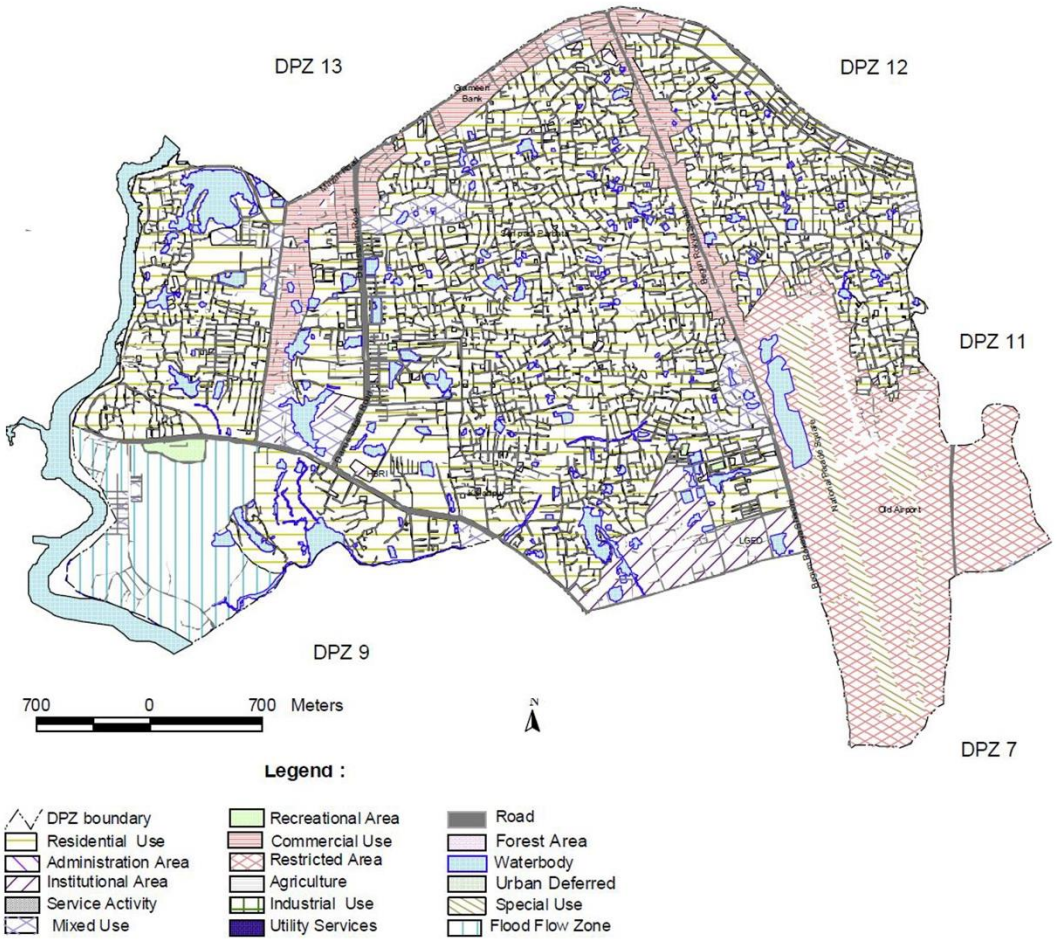


Figure 19 Proposed land- use by RAJUK DAP

Source: RAJUK DAP

The population of DPZ-10 was 10,49,696 with a density of 275 in 2015. The prominent localities of this DPZ are: Agargaon, Shyamoly, Senpara Parbata, Shewrapara, Bishil, Tolarbagh, Kafrul, Ibrahimpur, Gabtoli, Gaider Tek, Dar-Us-Salam, Ananda Nagar, Kotbari, Baghbari, Golartek, Diabari, Kallyanpur, Paikpara, Bangla College, Staff Quarter, Pirer bagh, etc. The far western part of DPZ-10 has number of water bodies. It consists of unplanned and haphazard built up area with mostly residential development except Old Airport Area and sub-flood flow zone near

Gabtoli along Turag River. A review of the existing land use pattern of this area shows that the residential development is the mostly dominant (52%). Restricted areas together with sub-flood flow zone shares 20% of the land. The other types land uses are insignificant. The land dedicated for road network is only 8% which clearly displays the acute shortage of circulation spaces.

Water- logging is a major problem in the western skirt, due to its land-filled low- lying nature and clogged canals.

DAP visions certain opportunities for the DPZ. The patches of rural land in Gaider Tek below Dar-Us-Salam, and behind Gabtoli Bus Terminal which can be declared future government Reserve Land or Land Bank for government. The location of Gabtoli Cattle Market, Inter District Bus Terminal being nearby should provide scope for effective development management mechanisms effective to maintain the flood plain in the west as well as control the activities of the private developers encompassing the above development.

Few land-use proposals of Rajuk DAP include allowing mixed-use on both sides of Mirpur Road up to Gabtoli with proper service roads on both sides.

3.3. Environmental Aspects

3.3.1. Climatic conditions

Climate is the average condition of the atmosphere near the earth's surface over a long period of time, considering temperature, precipitation, humidity, wind, cloud, barometric pressure, etc. Bangladesh is widely characterized by wide seasonal variations in rainfall, high temperatures and humidity with a subtropical monsoon climate. Three distinct seasons in Bangladesh: a hot, humid summer from March to June; a cool, rainy monsoon season from June to

October; and a cool, dry winter from October to March are predominant. Generally, the maximum summer temperatures range between 30°C and 40°C, April being the warmest month in most parts of the country and January being the coldest when the average temperatures for most of the country about 10°C.

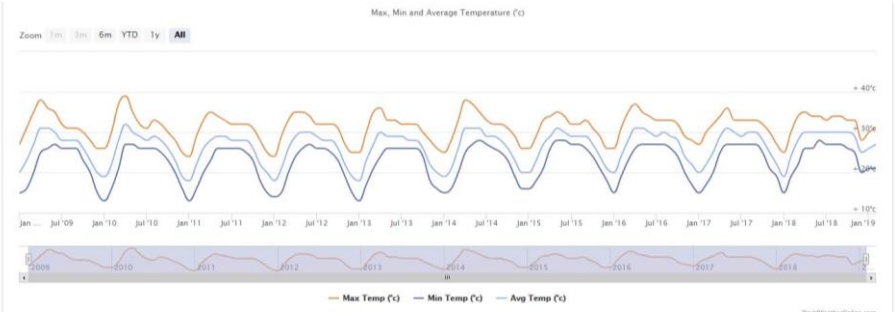


Figure 20 Average temperature over time in Dhaka

Source: Banglapedia

There is a distinct seasonal pattern in the annual cycle of rainfall, which is much more pronounced than the annual cycle of temperature. Heavy rainfall is a distinguishing feature of Bangladesh. Rajshahi is the relatively dry western region, where the annual rainfall is about 1600 mm; whereas, other parts of the country receive at least 2000 mm of rainfall per year. Because of its location just south of the foothills of the Himalayas, where monsoon winds turn west and northwest, the regions in north-eastern Bangladesh receives the greatest average precipitation, sometimes over 4000 mm per year. About 80 percent of Bangladesh's rain falls during the monsoon season (Banglapedia).

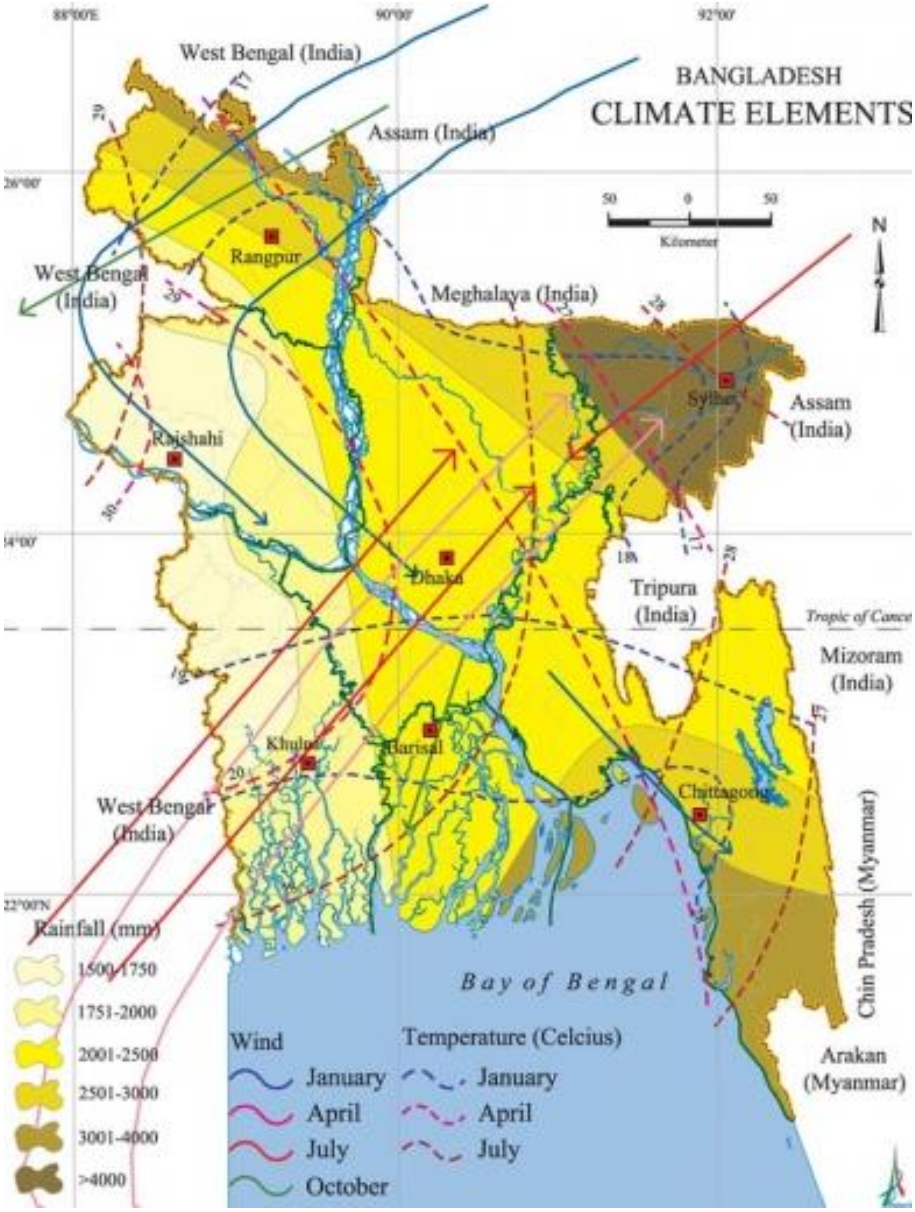


Figure 21 Climatic elements in Bangladesh

Source: Banglapedia

3.3.2. Sunshine, wind and humidity

The sun in Bangladesh shines regularly in the dry season, while in the monsoon season, from June to September, it is rarely seen. Here are the average daily sunshine hours in Dhaka.

Table 8 Daily Average sunshine hours in Dhaka

Source: www.climatestotravel.com

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hours	9	8	7	6	5	3	2	2	3	6	8	9

Atmospheric pressure and winds are characterised by seasonal reversals between summer and winter in Bangladesh. During winter, a centre of high pressure lies over the north-western part of India and the stream of cold air flows eastward from this high-pressure region to the country through its north-east corner by changing its course clockwise, almost right-angle. This wind is the part of the winter monsoon circulation of the South Asian subcontinent. On the other hand, during summer, a centre of low pressure develops over the west-central part of India because of intense surface heat which causes the stream of warm and moist air from the Bay of Bengal to flow towards the above-mentioned low pressure through Bangladesh. This wind is the part of the summer monsoon circulation of the sub-continent. Generally, winds are stronger in summer (8-16 km/hr) than in winter (3-6 km/hr). However, wind directions during the transition seasons (in spring and autumn) are variable. The mean pressure is 1,020 millibars in January and 1,005 millibars during March through September.

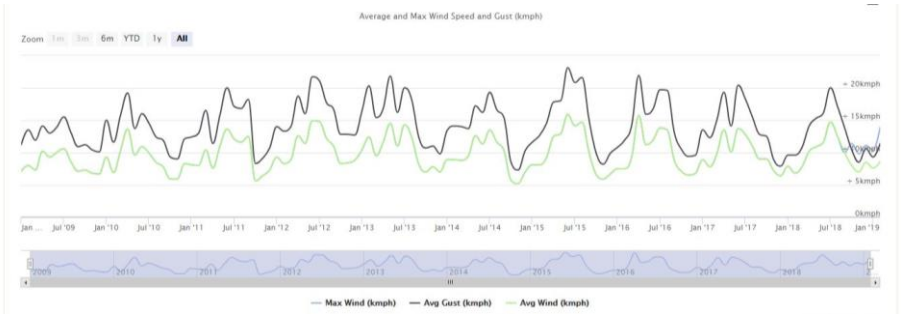


Figure 22 Average wind and gust in Dhaka

Source: www.worldweatheronline.com

March and April are the least humid months over most of the western part of the country. The least humid months in the eastern areas are January to March. The relative humidity is everywhere over 80% during June through September.

3.3.3. Hydrological characteristics- Rainfall, flood and river water- level

Rainfall is the single most dominant element of the climate of Bangladesh. Because of the country's location in the tropical monsoon region, the amount of rainfall is very high. The dry winter season accounts for only 2%-4% of the total annual rainfall. Rainfall during this season varies from less than 2 cm in the west and south to slightly over 4 cm in the northeast. The amount is slightly enhanced in the north-eastern part due to the additional uplifting of moist air provided by the Meghalaya Plateau. As the pre-monsoon hot season progresses, rainfall increases due to intense surface heat and the influx of moisture from the Bay of Bengal. Rainfall during this season accounts for 10%-25% of the total annual rainfall which is caused by the thunderstorms (*Kalbaishakhi jhar*). The amount of rainfall in this season varies from about 20 cm in the west central part to slightly over 80 cm in the northeast. Higher amount of rainfall in the northeast is caused by additional uplifting (by the Meghalaya Plateau) of the moist air.

Rainfall during the rainy season is caused by the tropical depressions that enter the country from the Bay of Bengal. These account for 70% of the annual total in the eastern part, 80% in the southwest, and slightly over 85% in the north-western part of Bangladesh. The amount of rainfall in this season varies from 100 cm in the west central part to over 200 cm in the south and north-east. Average rainy days during the season vary from 60 in the west-central part to 95 days in the south-eastern and over 100 days in the north-eastern part. The geographic distribution of annual rainfall shows a variation from 150 cm in the west-central part of the country to more than 400 cm in the north-eastern and south-eastern parts.

The Typhoon season begins in August and lasts to end November which are often followed by catastrophic effects that causes flooding (Banglapedia).

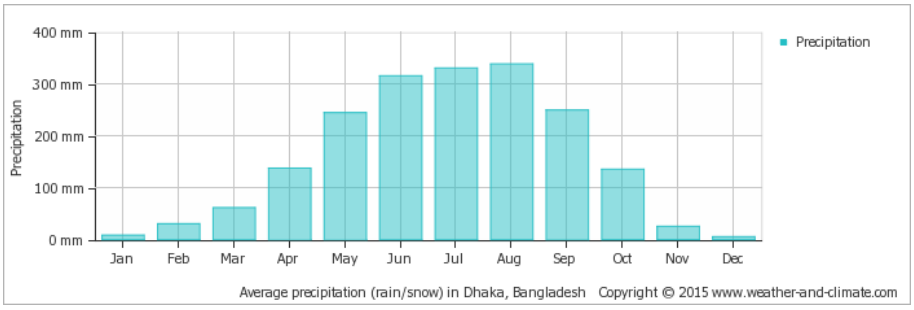


Figure 23 Average precipitation in Dhaka

Source: www.weather-and-climate.com

Dhaka is surrounded by tributaries and branches of three major rivers- *Turag*, *Buriganga* on the east and *Balu* river, *Shitalakhya* river on the west. Water levels of these rivers vary in sync with the water level of the major rivers and rise to 5-6 metres in the rainy season and up to 1-2 metres in the dry season. Turag river runs along Gabtoli (RSTP, 2015).

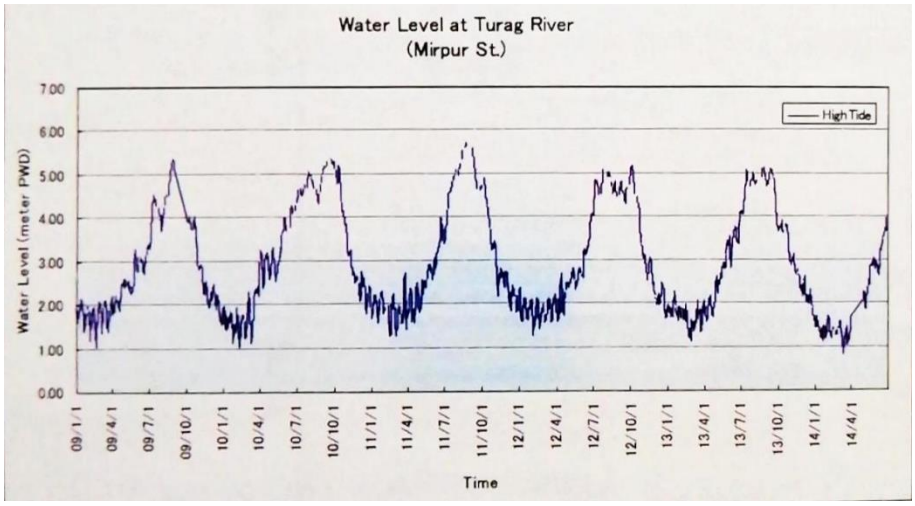
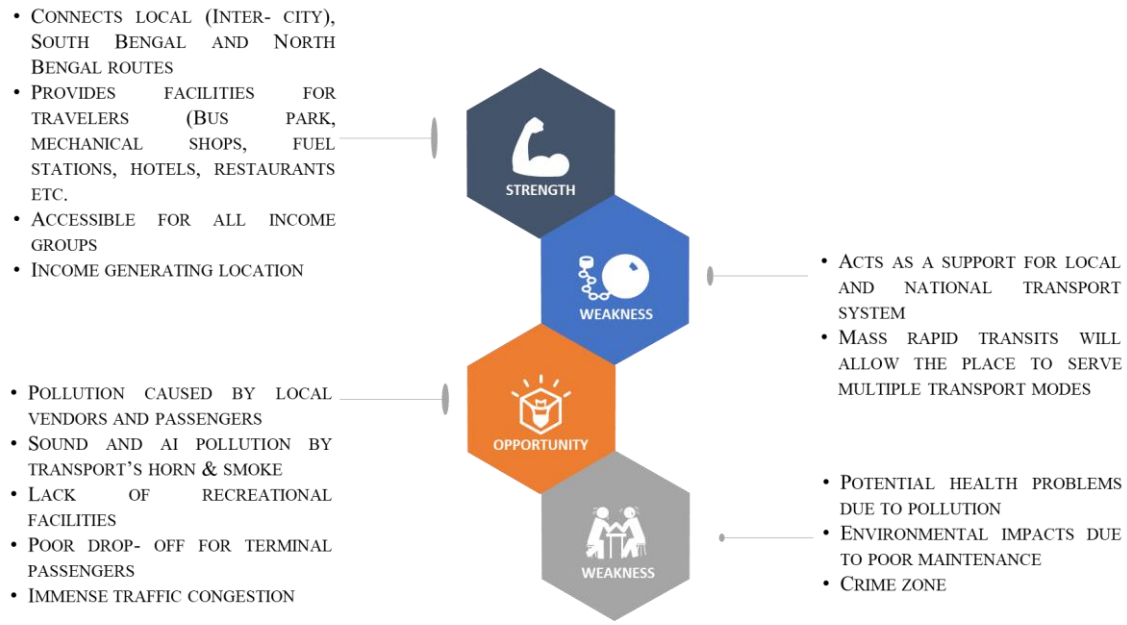


Figure 24 Water Level at Turag River

Source: RSTP, 2015

With yearly precipitation of Dhaka of about 1,400 to 2,400 mm, the river levels rise during the rainy seasons resulting in floods consequently to the poor drainage systems in the city.

3.4. SWOT Analysis



Source: Author, 2019

3.5. Existing Scenario

The prevailing **Inter- District Bus terminal** was influenced by the international style of designing a terminal which acts as a landmark to the city. It has the typical feature of platforms which are perpendicular to the building. This allows the direct access of passengers to all platforms without the need of crossing. The functions of this terminal include:

- Administration facilities with manager's room, station master and platform masters' rooms and general offices
- Traffic Control facilities with TXR's room, switch room, relay room, emergency power room and computer room.
- Crew facilities and running staff offices with restrooms, reporting rooms and offices.
- Passenger service facilities with booking counter, waiting rooms, clock room, refreshment room, retiring room, left luggage and lavatories.
- Other functions include post office, shops, telephone, telegram booths, prayer room and security control rooms.

The terminal consists of a 2-storied building with stationery shops, engineering and metal workshops etc. the conflict of pedestrian movement results from the segregation of arrival and departure buses.

The advantage of this terminal is that it has separate serve and service roads and passenger can board on the bus without crossing vehicular roads.

The lack of proper signage confuses passengers. The waiting areas and toilet facilities are poorly maintained.

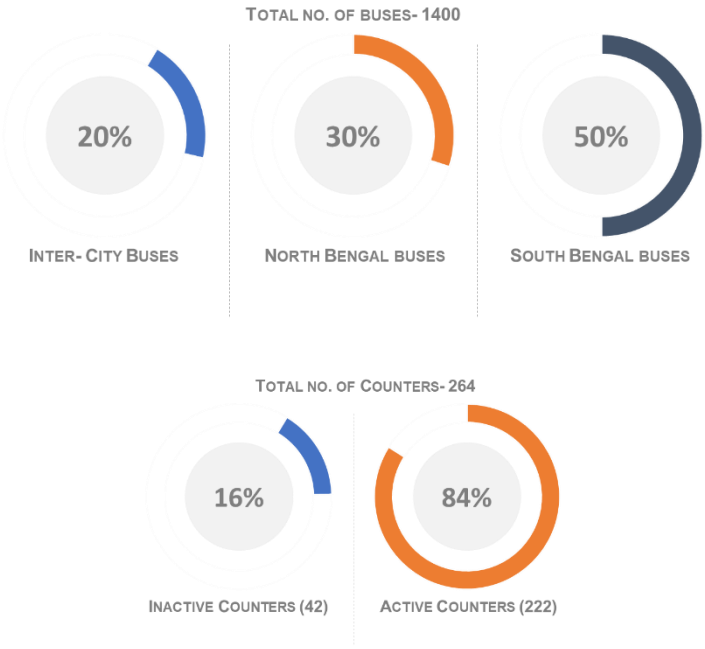


Figure 25 Facilities at the terminal

Source: Author, 2019

Figure 26 Routes from Gabtoli Terminal

Source: Illustration by Author,2019 (Info: Gabtoli Bus Malik Shomiti)

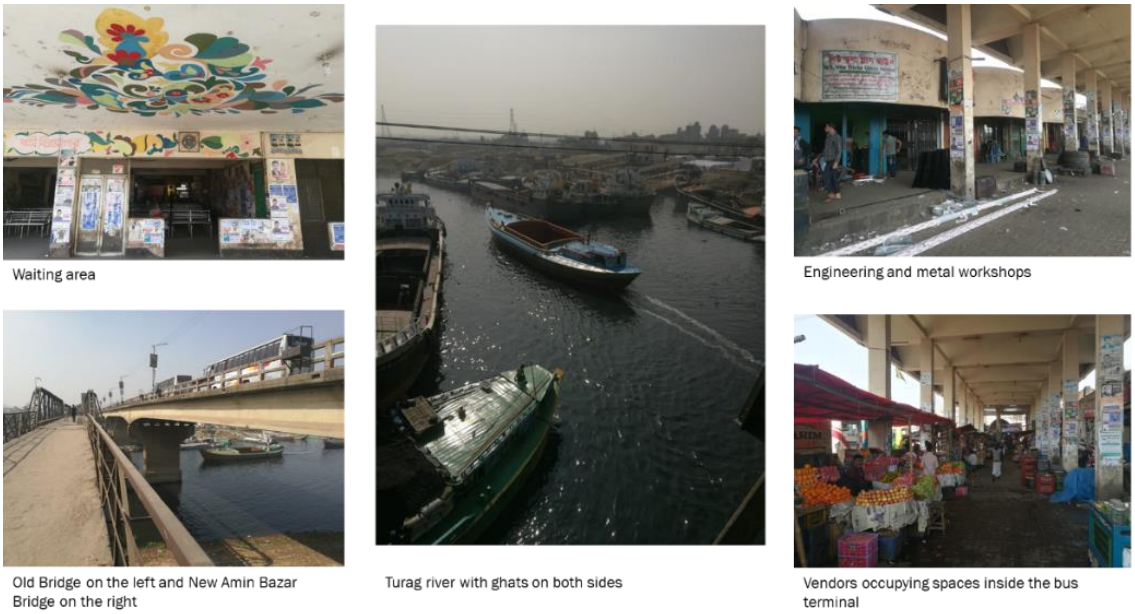


Figure 27 Images from site and surroundings

Source: Author, 2019

The main road, which is also the Dhaka- Aricha Highway has three-lane roads on each side including roadside bus stoppages. Vehicles on the main roads include bus, private cars, jeep, taxi, *tempo*, *leguna*, motorbikes, bicycles, CNG etc.

Surroundings include cattle market, brick yard, stone yard, coal yard and sand yard which unload at the Aminbazar landing station. Haphazard placement of g*hats* along the Turag river and an inactive waterway taxi station is evident.

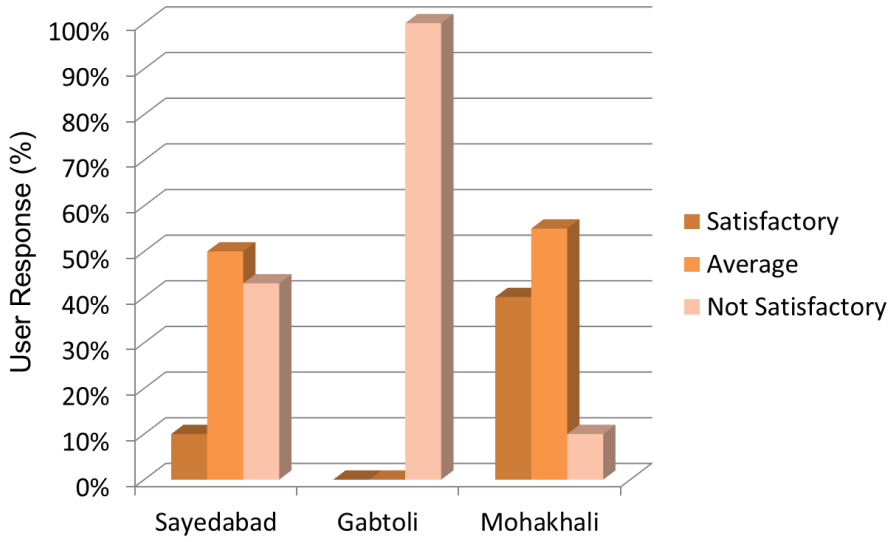


Figure 28 User Satisfaction Level regarding Passenger Waiting rooms

Source: ResearchGate

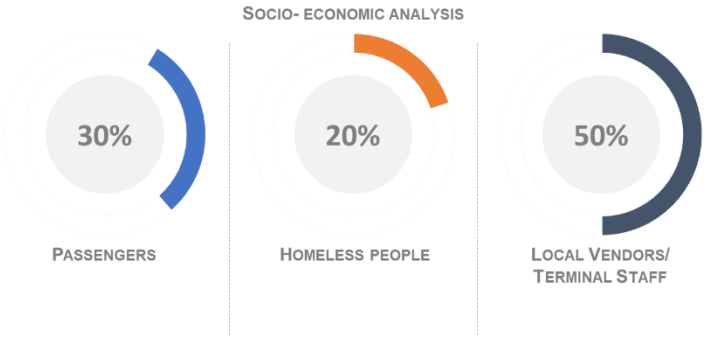


Figure 29 Socio Economic analysis at terminal

Source: Author, 2019

Besides, there are prevalence of settlements and residences areas nearby. Filling stations consist of Converted Natural Gas Stations (Shohag Filling Station, Intraco Filling Station, Nesa and Sons Filling Station) and Petrol/ Diesel/ Octane Stations (S.S. Filling Station, Rujina Filling Station, Trade Consortium Filling Station).

3.5.1. Solid- void relationship

Figure 30 Figure Ground Map

Source: Author, 2019

The figure- ground map shows that there is an unplanned dense residential development around the site surroundings. Although the sides of the river have been left for flood water flowing, there has been riverside developments both commercial and residential.

3.5.2. Road Network

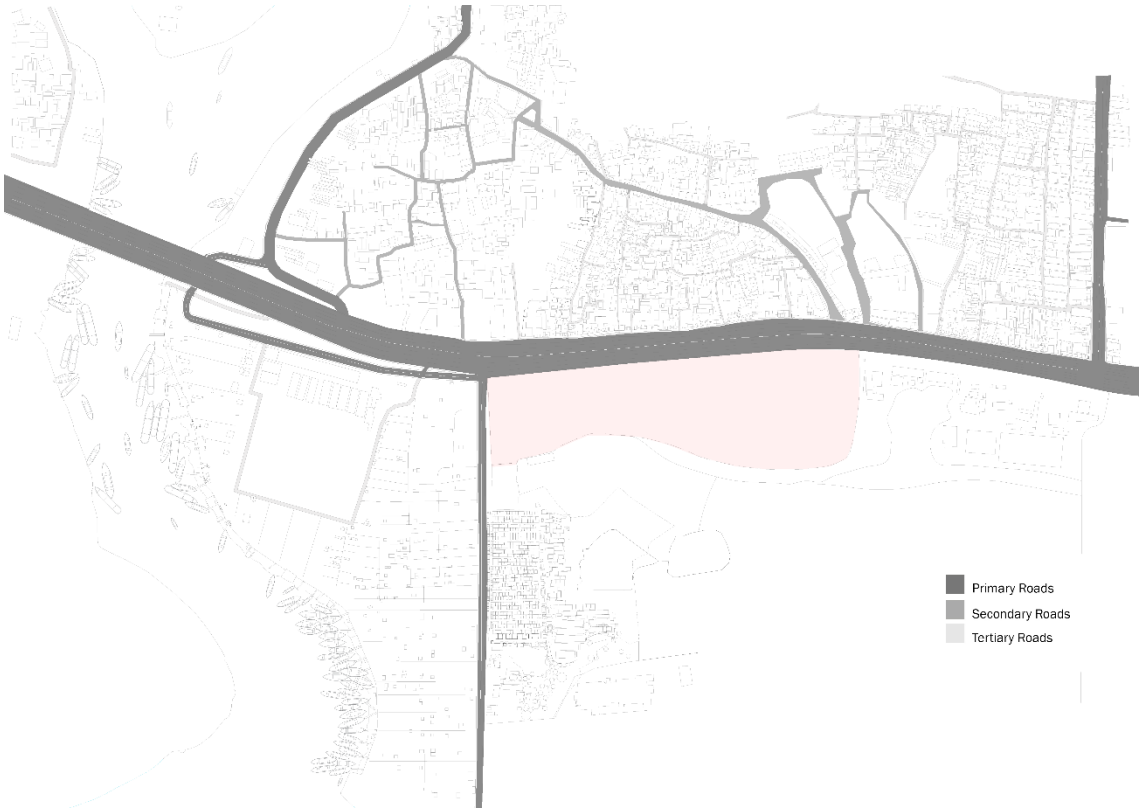


Figure 31 Road Network Map

Source: Author, 2019

Dhaka- Aricha Highway acts as the primary road which is linked with the Aminbazar Bridge. The secondary roads like the Mirpur road and Sadarghat-Gabtoli road also exist.

3.5.3. Existing green

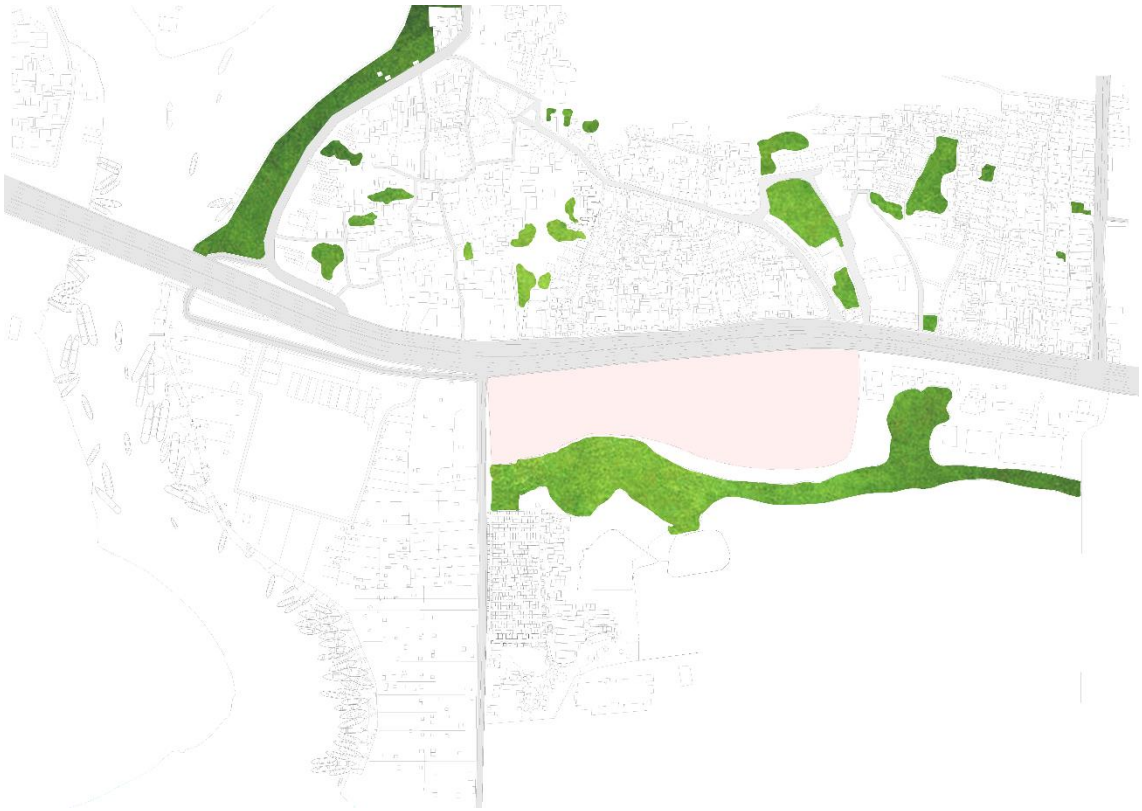


Figure 32 Vegetation Map

Source: Author, 2019

The existing green areas have reduced overtime as shown in the morphology map. However, the south side of the Gabtoli Bus Terminal, potential multimodal hub, has a portion of solid green low land which is left for flood retention.

3.5.4. Waterbody map

Figure 33 Waterbody Map

Source: Author, 2019

Turag River is a narrow river channel that meets the *Buriganga* river, massive loading/ unloading occurs after freight vehicles reach the landing station. Trucks carry the supplies directly at the construction sites. Waterway taxi connects the Inland passenger terminal from *Badamtali*.

3.5.5. Height map

Figure 34 Height Map

Source: Author, 2019

The surroundings do not have any high-rise structures along the site, mostly three to five storied buildings lengthwise to the Dhaka- Aricha Highway. The houses of the Sweeper Colony are mostly one-storied with a few that are two- storied.

3.5.6. Land-use map

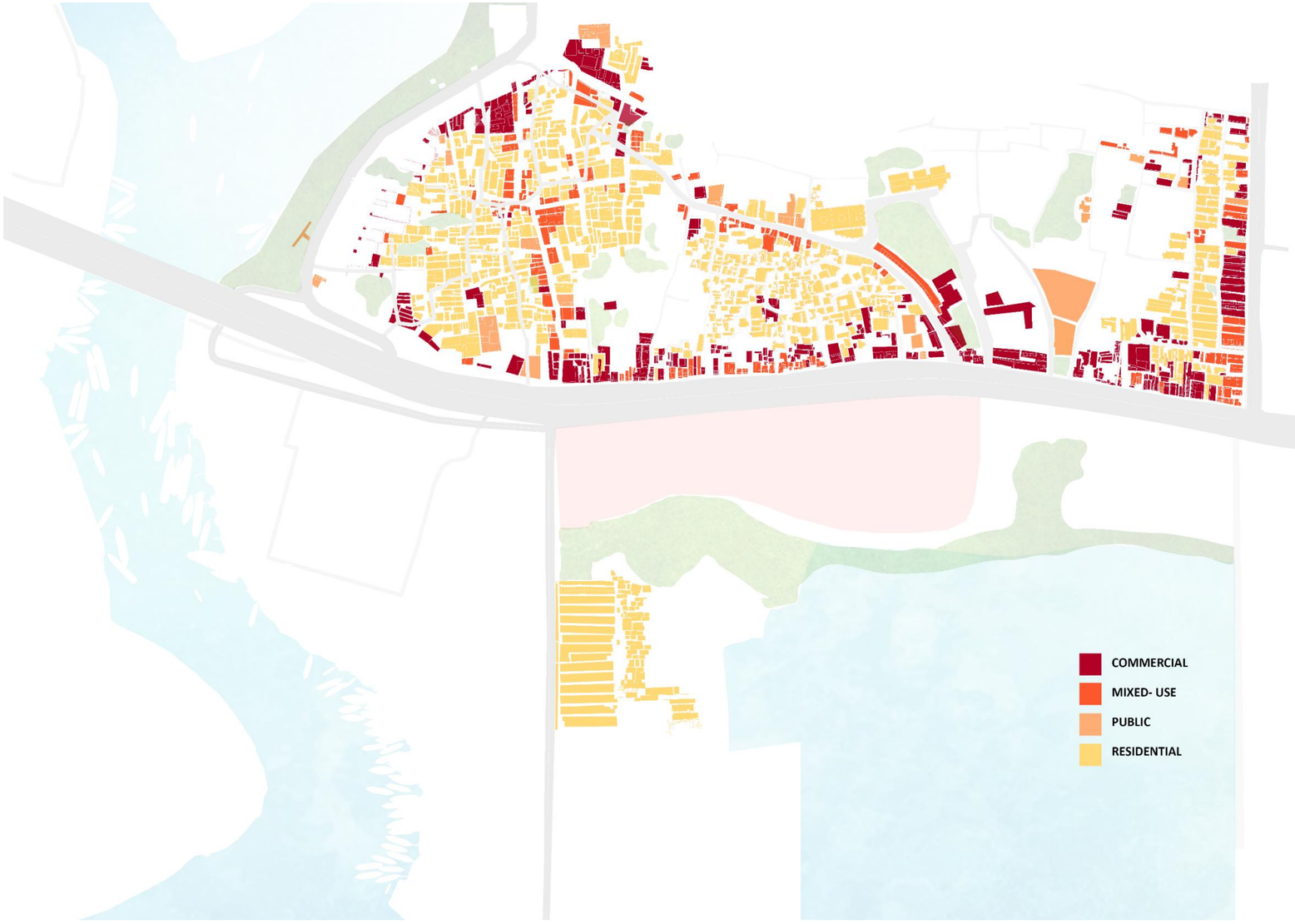


Figure 35 Land-Use Map

Source: Author, 2019

The land-use map of Gabtoli clearly displays the prominence of commercial and mixed- use activity through the roadside growths. These consist of offices, workshops, bus counters and depo, hotels, restaurants, fuel pumps etc.

3.5.7. Vendor map

Figure 36 Vendor Location Map

Source: Author, 2019

The Gabtoli terminal itself is a mixed- use commercial centre. It is composed of various vendors, shops, and other mechanics shops which add to the economy of the terminal.

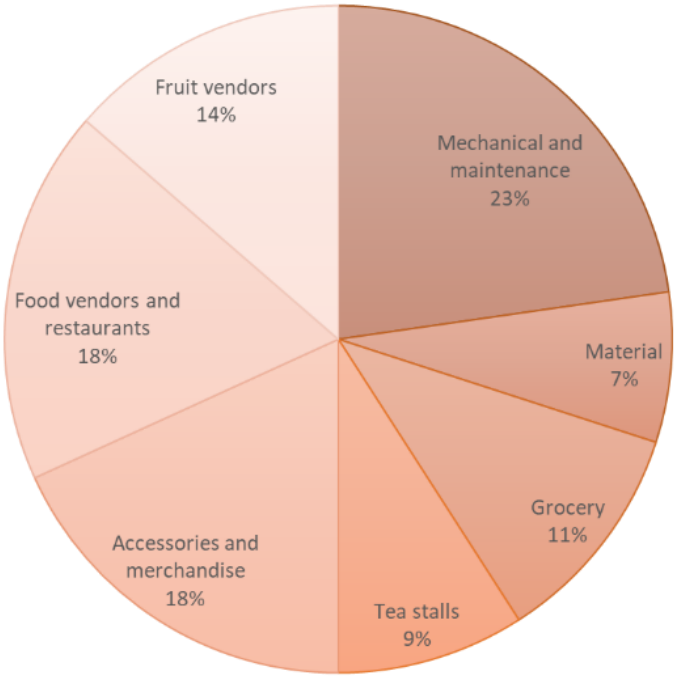


Figure 37 Percentage of vending items at the terminal

Source: Author, 2019

3.5.8. Vehicular pattern

- *Daily Vehicular Traffic volume*

Table 9 Daily Vehicular Traffic Volume and Vehicle Type

	Non- Motorised Vehicles				Motorised Vehicles															
Survey Station	Bicycle	Rickshaw	School Van	Total	Motor-bike	CNG/ Mishuk/ Auto	Car	Taxi	Tempo/ Leguna/ Maxi	Micro-bus/ Jeep	Bus/ Mini bus	AC Bus	Staff Bus	School/ college/ uni. Bus	3-axle/ truck/ trailer	Tanker/Tank/ Lorry	2- axle Truck	Pick-Up/ small Van	Others	Total	Grand Total
Dhaka- Aricha Highway	315	1032	23	1370	2149	1647	4370	45	1224	2869	6131	313	258	65	101	118	6163	3655	212	29320	30690

Source: Cordon Line Survey, JICA, 2014

- *Average Vehicle Occupancy*

Table 10 Average Vehicular Occupancy and vehicle type

	Non- Motorised Vehicles			Motorised Vehicles													
Survey Station	Bicycle	Rickshaw	School Van	Motor-bike	CNG/ Mishuk/ Auto	Car	Taxi	Tempo/ Leguna/ Maxi	Micro-bus/ Jeep	Bus/ Mini bus	AC Bus	Staff Bus	School/ college/ uni. Bus	3- axle/ truck/ trailer	Tanker/ Tank/ Lorry	2- axle Truck	Pick-Up/ small Van	Others
Dhaka- Aricha Highway	1.03	2.15	7.33	1.46	2.97	3.01	3.15	10.11	6.44	39.01	41.79	19.19	30.08	2.53	2.26	3.02	2.27	4.11

Source: Cordon Line Survey, JICA, 2014

- *Hourly Vehicular traffic volume*

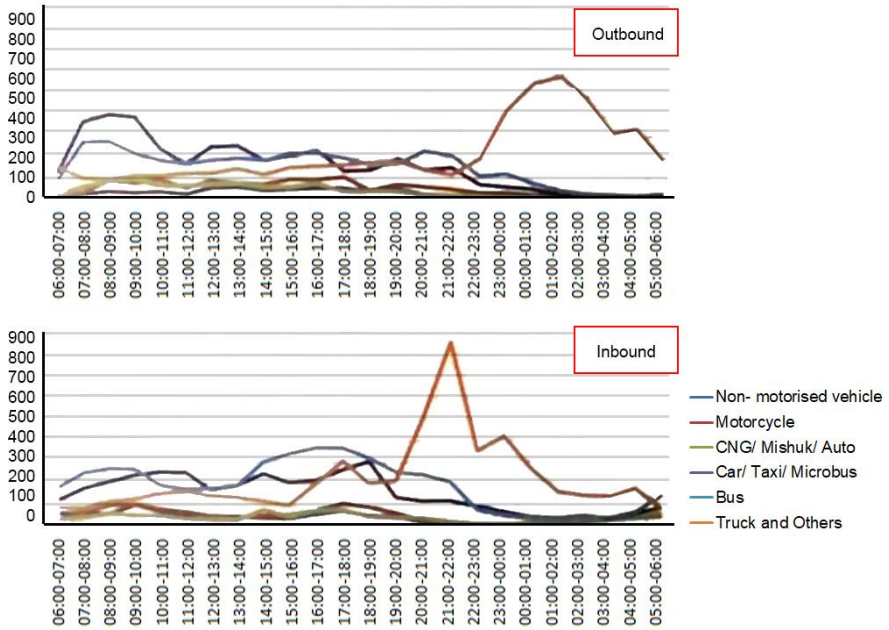


Figure 38 Hourly Vehicular traffic volume at Dhaka- Aricha Highway

Source: Cordon Line Survey, JICA, 2014

4. Case Study

The proposed project is a combination of a Bus Teminal and an MRT Interchange Station. In order to understand how these functions, it is crucial to understand each of the functions individually. Hence, the case studies were carried out in such a way that covers a local context, a sub-continental context and a European context. Also, it shows the studies of a Bus Terminal, an MRT Station and a multimodal terminal.

4.1. Mohakhali Inter- District Bus Terminal- Dhaka, Bangladesh

4.1.1. Background and location

Mohakhali Bus Terminal is one of three main inter-city bus stations in Dhaka. It was opened in 1984, renovated in 2005 and is situated in Dhaka's prime location, adjacent to Mohakhali flyover and rail crossing. It is relatively new compared to Gabtoli Bus Terminal. It serves the North and North- east region of Dhaka.

The 36,400-square-metre (9.0-acre) site accommodates 300 buses. As of 2015, companies operate 800 daily trips from the terminal, on 60 different routes.

Figure 39 Mohakhali Bus Terminal

Source: dailystar.net

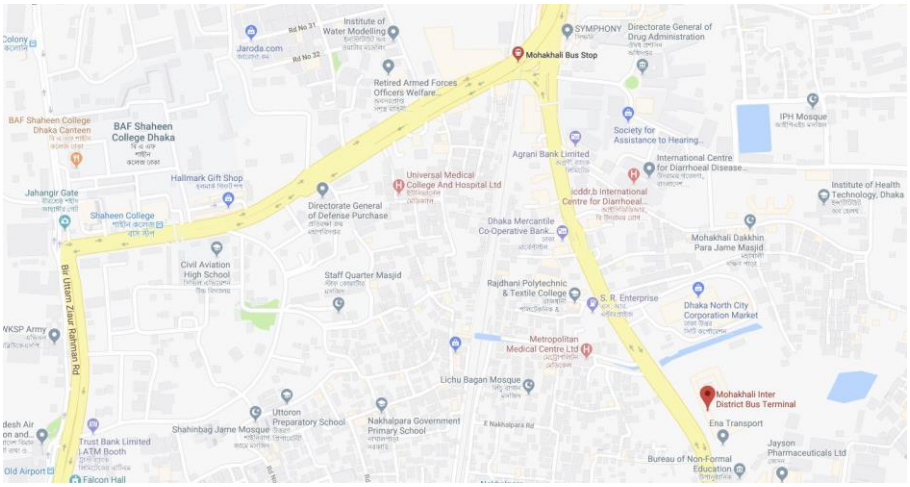


Figure 40 Mohakhali Bus Terminal map

Source: Google Earth

4.1.2. Understanding Transport Network

Being located in the Mohakhali neighbourhood, it primarily serves destinations in northern Bangladesh including Tangail, Netrokona, Mymensingh, Jamalpur, Sherpur, Kishoreganj and Bogra.

However, there are no luxury buses to serve the north- bound people. Heavy traffic develops since the terminal circulation is connected to the Moghbazar-Banani road. One of the dominant transportations to the terminal is bus, cycle, rickshaw, auto rickshaw, tempo, etc. Passenger car parking facilities is very poor, and it is deprived of any street parking facilities.

This terminal also serves the local buses. And most people who use the local buses use the nearby bus stoppage as their drop- off point.

4.1.3. Characteristics and architectural features

It is one of the well-maintained terminals in Dhaka with proper circulation and good management system. The terminal has arched roofs.

Maximum ticket counters are inside the main terminal building and the administration and union offices are on the second floor of the building. Functions include ticket counters, waiting area, dressing rooms control areas, offices, toilets and other facilities including restaurants etc. Other facilities in it that include shops, mosque etc.

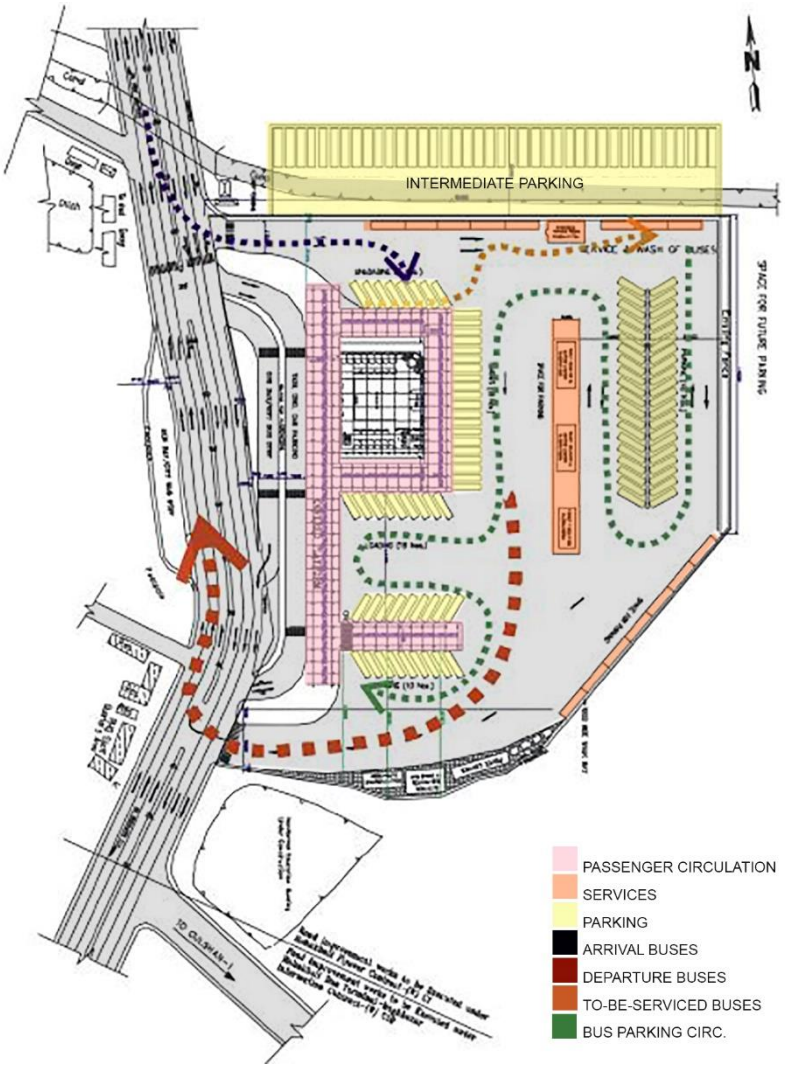


Figure 41 Schematic Plan of Mohakhali Inter- District Terminal

Source: Author, 2019

4.1.4. Projection

The bus routes are well defined and circulates well. Although the terminal might seem chaotic and poorly maintained, it is one of the most well- organised terminals. These circulation patterns (passenger and vehicular) will assist while designing the Bus terminal at Gabtoli. With proper parking facilities and separate service zones. The design at Gabtoli involves the arrival and departure of various transport modes like buses, auto rickshaws and private vehicles and portrays a similar scenario as the Mohakhali terminal. Hence, it would provide

a knowledge to make the effectively circulate vehicles at Gabtoli, overcoming the deficiency that exist here.

4.2. Formosa Boulevard MRT Station - Kaohsiung, Taiwan

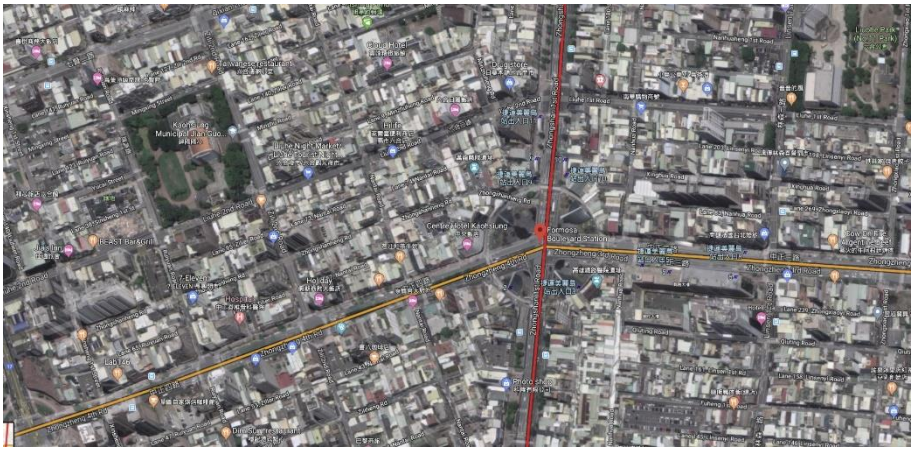


Figure 42 Location of MRT Station

Source: Google Map

4.2.1. Background and location

Formosa Boulevard is an interchange station of Kaohsiung MRT located in Sinsing District, Kaohsiung, Taiwan. The station is named after the Formosa Boulevard project, a remodeling of Kaohsiung's Jhongshan Road in preparation for the 2009 World Games (Wikipedia). The surroundings include Liuhe Night Market, Kaohsiung General Post Office, Sinsing Market, Nanhua Shopping Street, Kaohsiung Police Department, Sinsing Branch, Jhongshan and Jhongjheng Road Wedding Street.

Figure 43 Formosa Boulevard MRT Station with entry/ exits

Source: livingnomads.com

4.2.2. *Understanding transport network*

Transferring from the Red line to the Orange line (or vice versa) takes roughly 4 minutes.

Figure 44 Routes to and from the Station

Source: npust.edu

4.2.3. *Characteristics and architectural features*

The station is a three-level, underground station with an island pattern platform and two side platforms and third under construction. It is located at the junction

of Jhongjheng and Jhongshan Road consisting of 11 exits. The Orange Line station is 334m long, while the Red Line station is 209m long.

Figure 45 Interior of the Station

Source: Wikipedia

In addition to be the interchange station of Red and Orange subway lines, the station is also world known for its biggest public art installation- "Dome of Light", which is featured on the upper part of the station. The artist, Narcissus Quagliata put together the dome in a little less than four years, which includes shipping art pieces of coloured glass directly from Germany. The amazing art piece spans a 30-meter diameter and covers an area of 2,180 square meters. It is made up of 4,500 glass panels and will be offered as venues for weddings.

Formosa Boulevard Station was also the site of the Kaohsiung Incident, a major turning point in Taiwan's pro-democracy movement. The design of the station was based on the concept of prayer. The entrance to the station is partitioned by a four-layer glass curtain wall which represents the people who came from all over to pray for peace. The word Formosa is a Portuguese word meaning

“beautiful island”. Over the course of many years Formosa Boulevard Station has become a symbol for long-awaited freedom and democracy.

Visitors walk around with views of story of human life through panels, transitioning from the section that represents **water**, the womb of life, to **earth**, which embodies the act of growing and prospering are to be seen. There are also sections on **light** and **fire**, the latter representing on the one hand destruction and on the latter rebirth. The main message that pervades the dome, however, is one of love and tolerance.

The entrance/ exit is designed as public art “Prayer”. The concourse hall consists of information desk, automatic ticket dispensing machines, one-way faregates, restrooms etc. the transit zone connects the platforms with stairs and escalators.

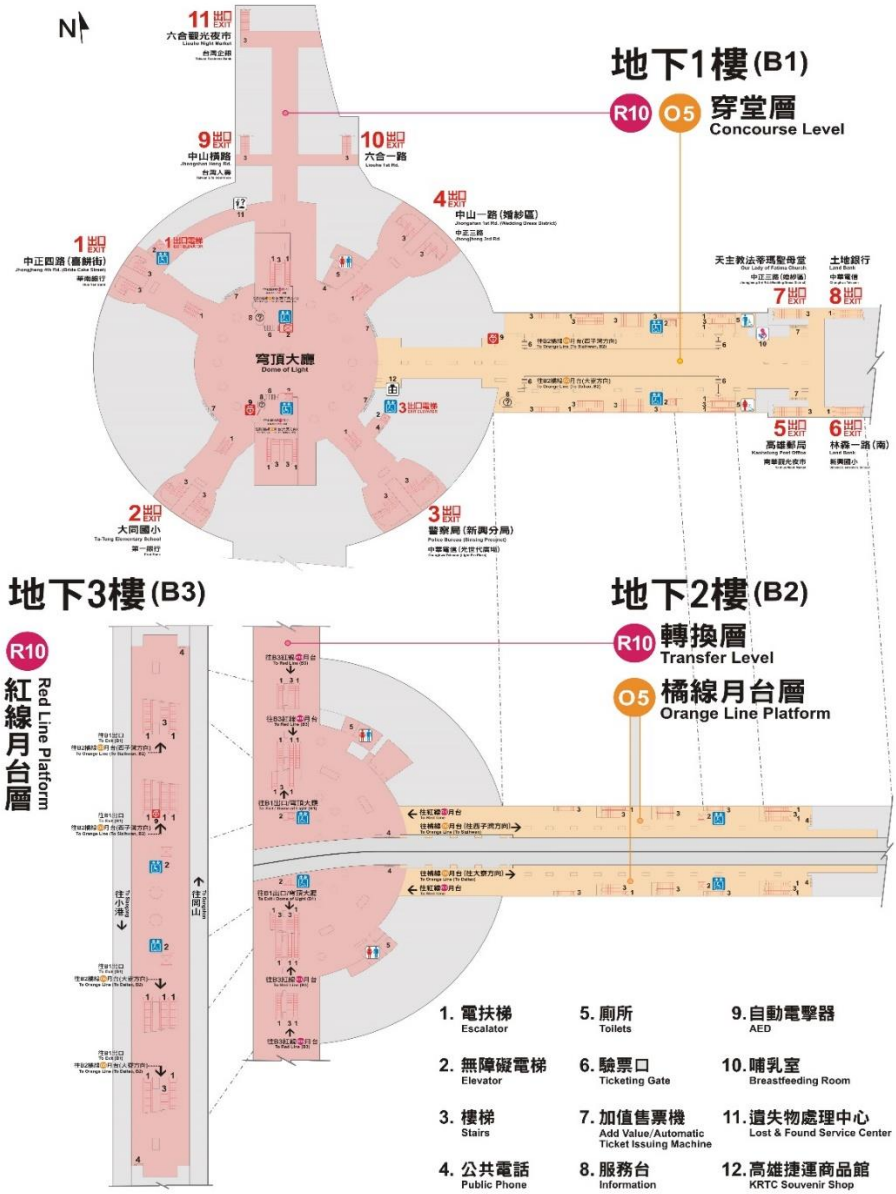


Figure 46 Plan of MRT Station

4.2.4. Projection

Artwork in underground stations prevent visitors from feeling claustrophobic. Also, the multipurpose use of the MRT Station with public facilities like wedding venues make it diverse. With visually attractive public plaza and MRT

Station, the ground level is left free for aesthetics and ease of movement making the station unique.

4.3. Stockholm Central Station- Stockholm, Sweden

Figure 47 Stockholm Central Station

Source: visitstockholm.com

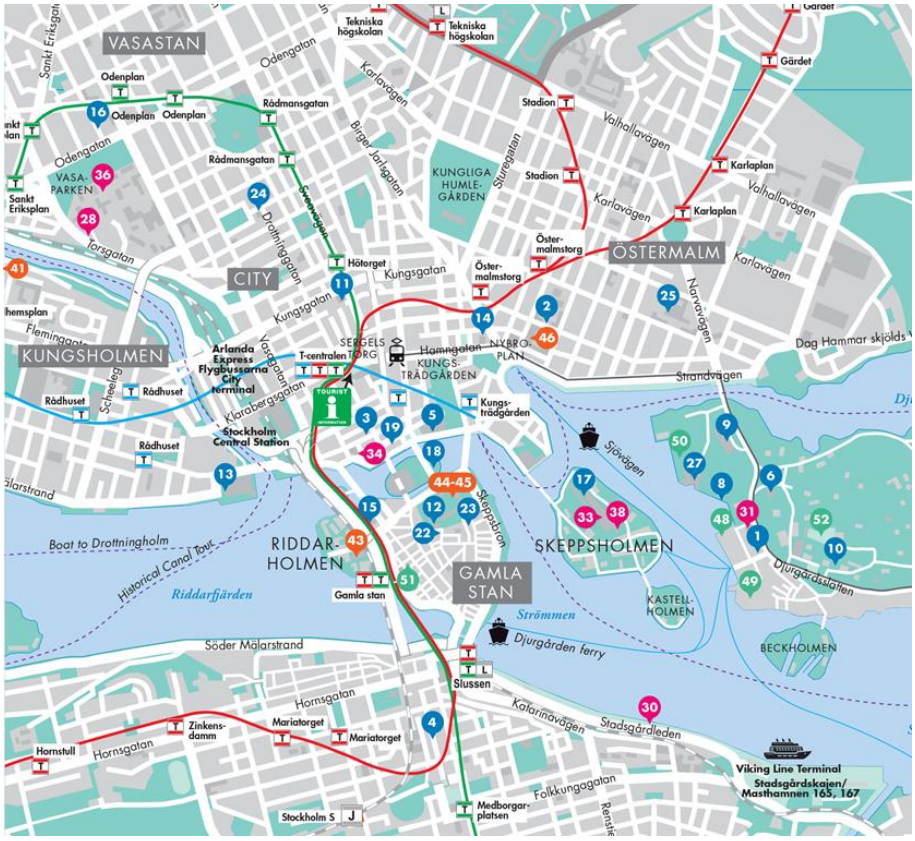


Figure 48 Location of Stockholm Central Station on map

Source: Google Map

4.3.1. Background and location

The station was built between 1867 and 1871 with Adolf W. Edelsvard as the architect. Up until 1925 the tracks directed towards the station, but during a renovation between 1925-1927, the tracks were moved to the west and the previous track hall was converted into a 119-meter-long, 28-meter-wide and 13-meter-high waiting hall. The station was extended to the south through the construction of the southern pavilion, which currently houses a conference facility. The Royal waiting hall next to the conference facility is where the Royal Family waits when travelling by train.

The facade towards Vasagatan was changed and given a more simplified look in 1951 and an underground passage to T- Centralen was opened in 1958. In

2017 the commuter trains were moved to a separate station, which is one kilometer away- The Stockholm Central Station. In 2011, a real estate company in Stockholm, found a way to channel the body heat from the commuters passing through Stockholm's Central Station to warm another building across the road.

The historically significant Stockholm Central Station has been preserved through highlighting the building's fine qualities, while at the same time creating a modern travel centre. It allows travellers and visitors to perceive the station as a safe and pleasing environment. The station comprises of a gross floor area of 25,000 sqm and establishes an extensive facility for passenger environment, with improved commercial space, improved services, a wider range of concessions, and new restaurants, accessibility and comfort.

4.3.2. Understanding transport network

Stockholm Central Station, also known as T-Centralen consists of a *metro station* that forms the heart of the Stockholm and the only station where all three of the system's lines meet and well known for its decoration known as longest art gallery in the world. Its central location, Norrmalm Borough of Stockholm, and its connections with other modes of transport make it the busiest station in the system. The station is located 26–32 meters below ground, has one platform and 2 entrances. There are 4 lines, Green (3 routes, 49 stations: 12 subterranean, 37 above ground), Red (2 routes, 36 stations: 20 subterranean,1 elevated), Blue (2 routes, 20 stations: 19 subterranean and one elevated station), Yellow and a recent addition- the Pink line. There are 100 stations in use in the Stockholm metro (of which 47% are underground).

Stockholm City commuter Rail station is located below the metro station, with direct escalators to the metro platforms.

It includes a *City Bus Terminal.*

Arlanda express connects the station to the *Arlanda Airport* via a train route.

Several major *ferry lines* serve the countries around the Baltic Sea, and Stockholm's harbours are centrally located.

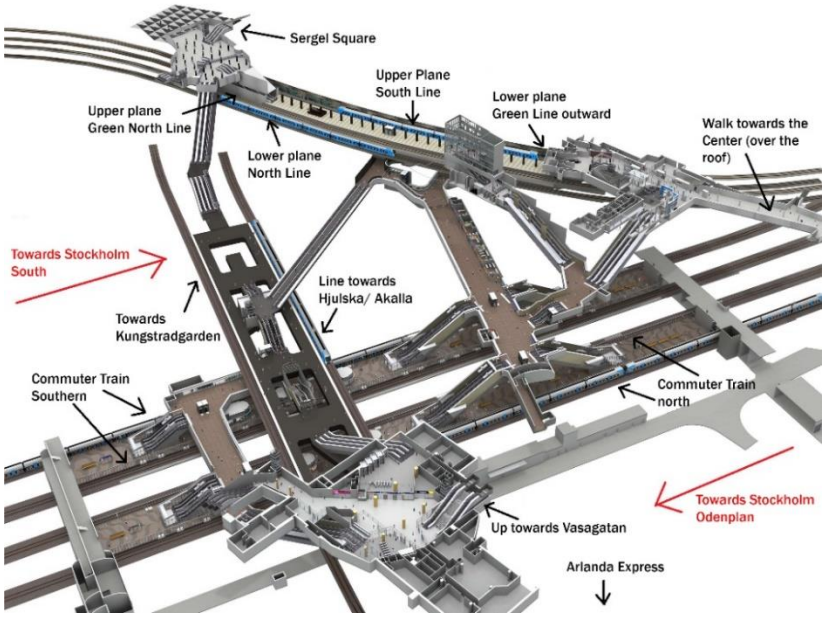


Figure 49 Stockholm Central Station Routes

Source: reddit.com

4.3.3. Characteristics and architectural features

Figure 50 Interior of the Station

Source: visitstockholm.com

Stockholm's Central Station is Sweden's busiest train station with over 250,000 passengers a day commuting through this major transport hub (2005). It consists of tourist information centres, public toilets, meeting points, taxi, metro, tickets, luggage locker, waiting areas, restaurants, shopping stores etc. It is well known for its decoration of the stations and has been called the longest art gallery in the world.

4.3.4. Projection

The location of hotels nearby the Station makes it easier for travellers. Along with the easily distinguishable spaces and well thought our placement of functions, the station purposes better. The characteristic interior that showcases art and extensive waiting areas, food court is pleasing for the tiresome mind of travellers. There is availability of Shop- on- the- go facilities like shopping stores and supermarket and tourist information centres that help in commuting. Besides, conference facility also adds up to peoples' convenience. Parking for cyclists is easy to passengers who frequently use cycling as a mode of transport to and from the terminal. Overall, the experience favours the commuters and encourages them to use the station recurrently.

4.4. Brief Overview

The three of the above- mentioned case studies bring out different qualities of a transport terminal. The Mohakhali Inter-District Bus Terminal shows a zoning with services on the rear and the main passenger area at the roadside with good circulation system. The Formosa Boulevard MRT Station - Kaohsiung, Taiwan shows that through artwork and multipurpose use, a terminal can be diversified. Stockholm Central Station which connects to many parts of the city has a well- circulated planning, amenities

located in the vicinity of the station, shopping options, visual representation of culture through art provide comfortable passenger flow.

5. Program Development

Program development requires a list of programs or functions as a guideline. For an urban project like this, contextual analysis is necessary for generation of programs. Defining the requirements of the occupants including identifying problems and needs, providing the right amount and type of space, equipment, and furniture needed to function efficiently is necessary for programming.

Function can be divided into two separate identities- **events**, the atmosphere which results through peoples' interaction and **program**, which gives comfort to the occupants of the space.

A multi- modal terminal will be considered as a non- place, since it refers to spaces of transience where the human beings remain anonymous. A dialogue is to be created with the place and people considering all factors while dealing with a non-place.

The programs of this project can be classified into two. One- the existing programs of the place, and second- the proposed programs for future development of the vicinity.

5.1. Proposed projects on site

The proposed projects on the site include-

- Bus Terminal
- MRT Interchange Station
- River Port

5.2. Requirements of site and surroundings

Site and surroundings have an impact on the programs to be placed. These include-

- Pedestrian facilities along with Bus Terminal and proposed MRT interchange station.
- Amenity facilities for residential neighbourhood (TOD opportunities)

- Facility for staff who serve the terminal- staff room, toilets, day-care facility, café etc.
- Stoppages for drop- off (Auto rickshaw, cycle, taxi, car, service vehicle)
- Spaces for Vendors
- Urban recreational facilities
- Cultural facilities and social gathering spaces
- Parking areas
- Toilets (Male/ Female)

5.3. Bus Terminal Architectural Design Requirements

The existing programs and proposed programs for the Gabtoli Inter-District Bus terminal are shown in the table below.

Table 11 Comparison of existing and proposed programs

Source: Author,2019

EXISTING		PROPOSED		
Entry/ exit	Main entry	**Entry/ Exit**	Main entry	
	Service entry		Service entry	
Administration	Manager's Room	**Administration**	Manager's Room	
	Station Master's room		Station Master's room	
	Platform Master's room		Platform Master's room	
	General Offices		General Offices	
Traffic Control Facilities	TXR's room	**Traffic Control Facilities**	TXR's room	CCTV Control room
	Switch Room		Switch Room	Security personnel room
	Relay Room		Relay Room	Dog Squad+ others
	Emergency Power Room		Emergency Power Room	

	Control room		Control room	
Crew facilities room	Staff office	**Crew facilities room**	Staff office	Accommodation area
	Washrooms		Washrooms	Waiting area
	Reporting rooms		Reporting rooms	Staff kitchen+ Dining
Passenger Service Facilities	Booking Counter	**Passenger Service Facilities**	Booking Counter	Security check-in facilities
	Waiting Room		Waiting Room	Arrival Hall
	Clock Room		Clock Room	Baggage drop- off area
	Refreshment room		Refreshment room	Smoking Zone
	Retiring room		Retiring room	Breastfeeding room
	Left luggage		Left luggage	Food Court
	Public Toilet		Public Toilet	
			Boarding pass collection counter	
			Luggage handling	
Others	Post Office	**Others**	Post Office	Guard Room
	Shops		Shops	ATM Booth
	Telephone booth		Telephone booth	Rent- a- car
	Telegram booths		Telegram booths	Souvenir Shops
	Prayer room		Prayer room	Medical Centre
	Security Control rooms		Security Control rooms	Vendors
		Parking	Surface parking	Idle Bus parking
Services	Carwash	**Services**	Carwash	Electro-mechanical rooms
	Workshop		Workshop	
			Fuelling station	

5.4. Metro Station Architectural Design Requirements

5.4.1. Condition of Station Planning

Passenger stations are planned considering demand forecast, car numbers, alignment, civil structure, mechanical and electrical facilities, O&M planning, city planning and intermodal access.

Table 12 The number of Daily passenger and transit passenger

Source: JICA, 2015

Transit stations	2028			2035		
	Daily passenger (person)	Transit passenger (person)	Transit passenger ratio (%)	Daily passenger (person)	Transit passenger (person)	Transit passenger ratio (%)
Natun Bazar station (MRT Line 1)	186,000	101,300	54%	171,000	92,400	54%
Gabtoli station (MRT Line 2)	-	-		221,000	97,300	44%
Mirpur10station (MRT Line 6)	206,000	98,200	47%	206,000	104,200	51%

5.4.2. Station Size

Station size is fundamentally defined as per the following criteria-

- Concourse floor length to be designed in consideration of accumulated dimension of minimum concourse length + station office + E/M rooms + station and tunnel ventilation rooms.
- Platform length to be designed in consideration of number of future train sets (8 cars) +5m clear spaces at both ends of the platform.
- Platform width is an accumulation of minimum stairway width + Escalator + wall + reasonable width between stairway walls to Platform Screen Door (PSD) (Minimum 1.5m)

Station size such as platforms, concourse, stairs, and ticket gate numbers are basically demarcated to keep passengers' safety, comfort and serviceability at peak hours. In MRT Line 5, PSD are planned to be installed in every station.

5.4.3. Ticket Gates and Security Check Gates Planning

There are four main access routes from the street level to the B1 concourse level designated at both sides of public area with two ticket gates at both sides of paid

concourse located at centre of the station. In addition to normal ticket gates, security check gates are to be installed at entrance. There will be separate entrance and exits. Based on the demand forecast, the number of ticket gates to be calculated for each station. The width of ticket gates is planned based on MRT 6 station plan. Security check gates to have area of 2.5 m×3.5 m each, to arrange check gate itself plus security staff table, baggage check table. Basically, two check gates should be provided at each entrance and there should be wide space not only in front of ticket gates, but also at security check gates for expected long queues in front of the gates. Automatic Fare Collection System is proposed for MRT Line-6 with ticket Vending Machine (Capacity: about 300 tickets/hr.), automatic gate (Capacity: Maximum about 60 Pax / min.), fare adjustment machine (Capacity: about 140 times/hr.).

5.4.4. Station Office and Ticket Selling

Station office area is planned based on MRT Line 6 station plan. There are control room, station office, station master room, security guards' room, maintenance room, staff mess, prayer room, first aid room, staff toilet, and storage etc. Size of the area is estimated to be 450 sqm including corridors.

5.4.5. Public Toilet

Passenger toilets shall be provided in paid concourse in every station. Men's toilets, Women's' toilets and multipurpose toilets for physically challenged people are to be provided.

5.4.6. Elevators and Escalators

Escalators shall be provided in every station from the ground level to the concourse level, on either side of the street. At least one set of up-down

escalators shall be provided from concourse level to platform level with speed is about 30m/min - 40m/min. At least one elevator shall be provided from ground level to concourse level and concourse level to platform level for physically challenged people. As a basic policy, for stations with large numbers of passengers and for transfer stations, more escalators and elevators are to be provided. And the numbers to be determined by the passenger demand. Width of elevator door: 90cm and above.

5.4.7. Barrier Free/ Universal Design

Stations, as part of public transportation system, need to be more disabled-friendly by means of installing facilities that will provide easier access to passengers with physical and visual disabilities. The design primarily should be performed in accordance with Bangladesh code; and the design can be further improved by applying advanced design concept, referring "Barrier free guideline (Passenger facilities edition)" by Ministry of Land, Infrastructure, Transportation, and Tourism of Japan. Related include Automatic Escalator 3 Flat Steps, Guiding/ Warning Blocks, 2 Levels Handrail, See-Through Elevators, Platform Screen Door, Low Counter at Ticket Gate, 2 Levels Bench and Multi-Purpose Toilets (EQMS, 2017).

5.5. Functional Relationship Diagram

The functional relationship diagram shown below shows the relationship between different functions.

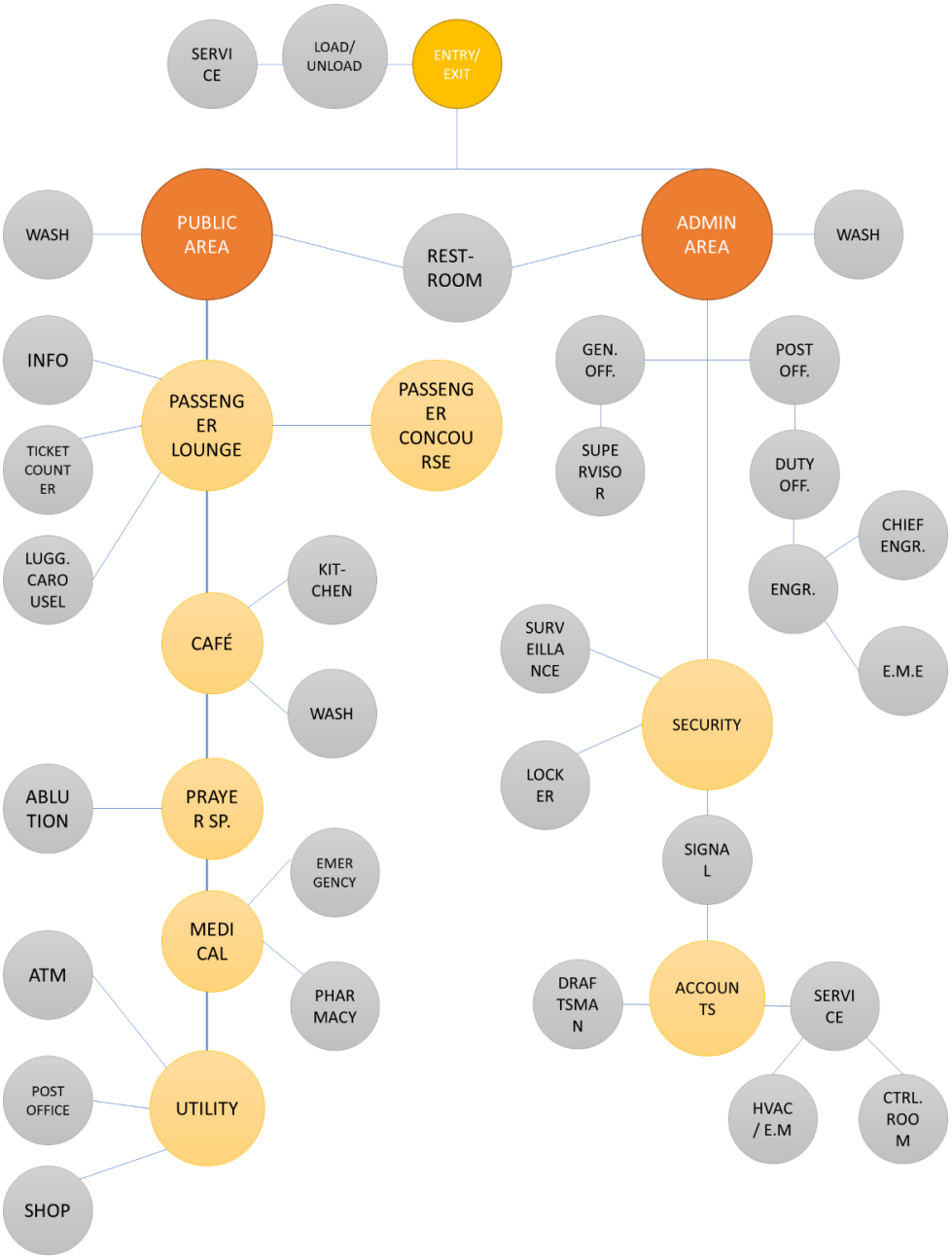


Figure 51 Functional Relationship Diagram of Terminal

Source: Author, 2019

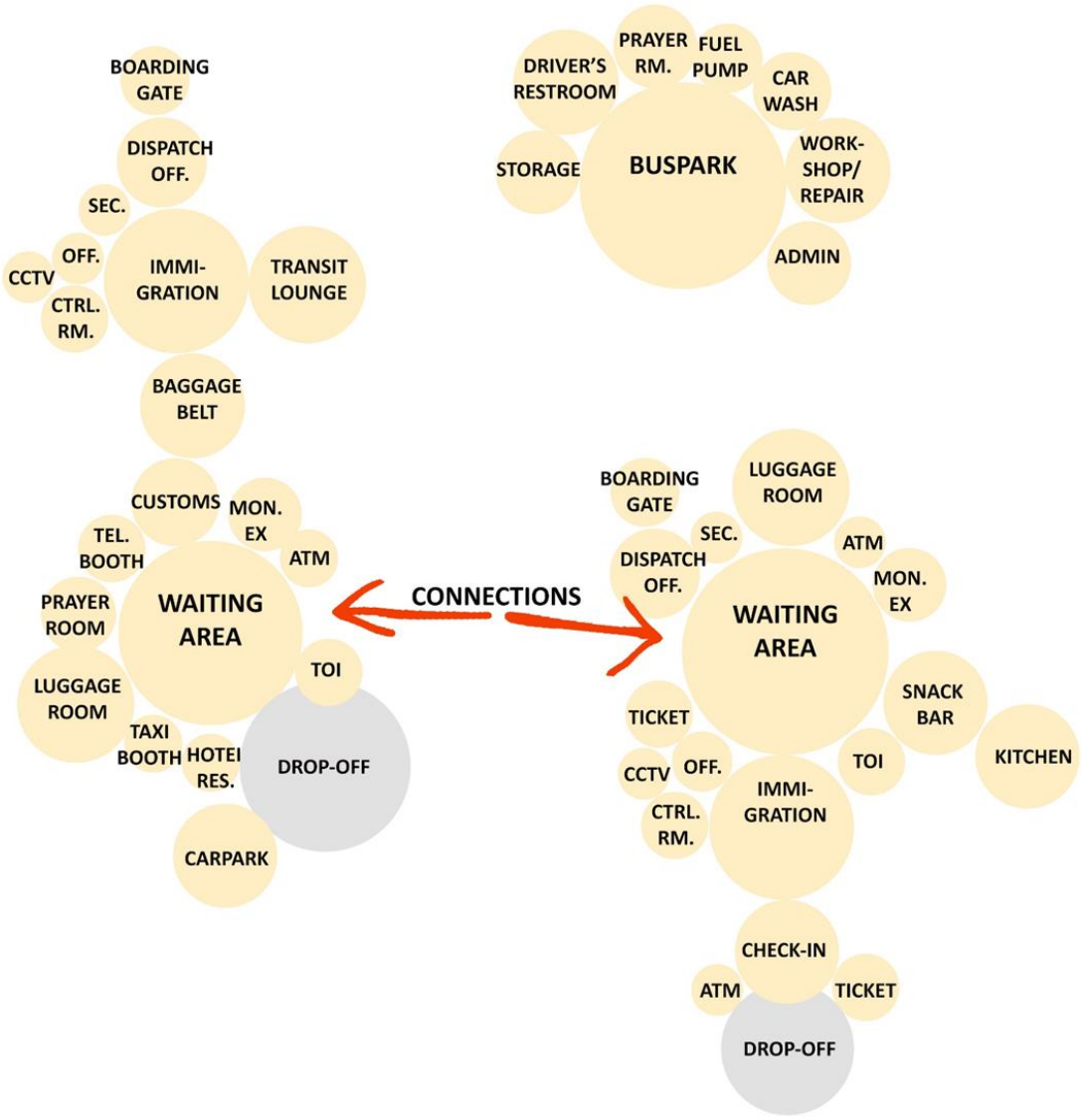


Figure 52 Functional Flow of Bus Terminal

Source: Author, 2019

5.6. Proposed Programs

Table 13 Table showing the space requirements for the Transport Hub

Function		Description	Quantity	sft/ quantity	No. of Users	sft/ person	Total sft
PUBLIC AREA							
	Info. Booth		1	400			400
	Ticket counter	1 counter for 25-30 people	280	80			22,400
	Ticket collector & collector's room				2	350	700
	Passenger's lounge (1/3rd at peak)	(14,000 passengers at peak hour)14,000/3= 4667			46,670	10	466,700
	Food Court (1/4th of passengers)	221,000/4= 55,250			55,250	10	552,500
	Kitchen (1/3rd of restaurant)						184,166.67
	Passenger's concourse (1/3rd at peak)	14,000/3= 4667			46,670	6	280,020
	Baggage room	50sft for each loading berth	102	50			5,100
	Newspaper Booth		3	150			450
	Telephone Booth		12	20			240
	Security		1	400			400
	Toilet	1:40 passengers			350	28	9,800
	Total						**1,522,877**
ADMINISTRATION							
	General office		2	1000			2,000
	Station Manager's room		1	200			200
	Supervisor's room		1	200			200
	Control room		1	600			600
	Paribahan Shamity room		1	1000			1,000
	Dispatch office		6	150			900
	Director room		1	200			200
	Engineering section		1	500			500
	Owner Union office		1	200			200
	Leader office		1	200			200
	Admin office		1	500			500
	Meeting room		1	200			200
	Toilet	(4 Male+3 Female)			7	40	280
	Total						**6,980**
STAFF							
	Staff Accommodation	50% crew of parked bus (1400/2=700)			700	10	7,000
	Staff common room	50% crew of parked bus (1400/2=700)			700	10	7,000
	Locker room		1	400			400
	Staff Kitchen		1	500			500
	Staff Dining/ Café	(1/4th of crew of parked bus)			350	10	3,500
	Washroom	1/3rd of restaurant					1,167
	Total						**19,567**
OTHERS							
	Guard's room		3	325			975
	Rest room		1	1,000			1000
	Medical center		1	1,200			1200
	Security and police control		1	3,000			3000
	Post office		1	1,500			1500
	Prayer space				350	8	2,800
	Shops		60	100			6000
	Vendors		80	25			2,000
	ATM Booth		8	10			80
	Bank		1	4,000			4,000
	Cyber Café		1	10	30		300
	Generator room		1	500			500
	WASA pump area		1	1,000			1,000
	CNG/ Petrol pump		1	25,000			25,000
	Electromechanical facilities		1	3,250			3,250
	Total						**52,605**

HOTEL							
	Accommodation (Deluxe)	(2-4 people)	22	384			8,448
	Accommodation (Dorm)	6 people	4	768			3,072
	Back of House	Main Kitchen	1	1,000			1,000
		Main Kitchen Storage	1	500			500
		Staff Area (Locker/ Toi etc.)	3	1,000			3,000
		Storage	4	500			2,000
		Engineer's Office	1	150			150
		General Manager's room	1	150			150
		Meeting Room	1	300			300
		Housekeping	1	2,600			2,600
		Laundry	1	3,000			3,000
	Front of House	Lobby	1	400			400
		Reception	1	400			400
		Restaurant	1	2,500			2,500
		Fire Control Room	2	60			120
	Toilet	(4 Male+3 Female)			7	40	280
	Total						**27,920**
MULTIPLEX							
	Cinema Hall		6	3,200			19,200
	Food Court		1	3,000		10	3,000
	Ticket counter		4	250			1,000
	Total						**63,020**
PARKING AREA							
	Car parking	8'*16'= 128	100	128			12,800
	Bus parking	12'*32'= 384	1400	384			537,600
	Workshop etc.						20,000
	Total						**570,400**
	NET TOTAL						**2,263,368**
	Circulation (30%)						**1,131,684.17**
							3,395,052.50

Source: Author, 2019

The program is developed with the use of Architectural standards like Time Savers, Neufart, RAJUK, BNBC etc. and proposals which are given in the Strategic Transport Plan by JICA and DTCA. And passenger numbers are used from data's which project a population number for the future use.

6. Design Development

6.1. Concept Development

The project was conceptualised from the contextual analysis of the site and surroundings and the existing pedestrian movements around the area. Therefore, such a futuristic and human-centred design intervention requires an understanding of the vehicular, pedestrian and contextual challenges.

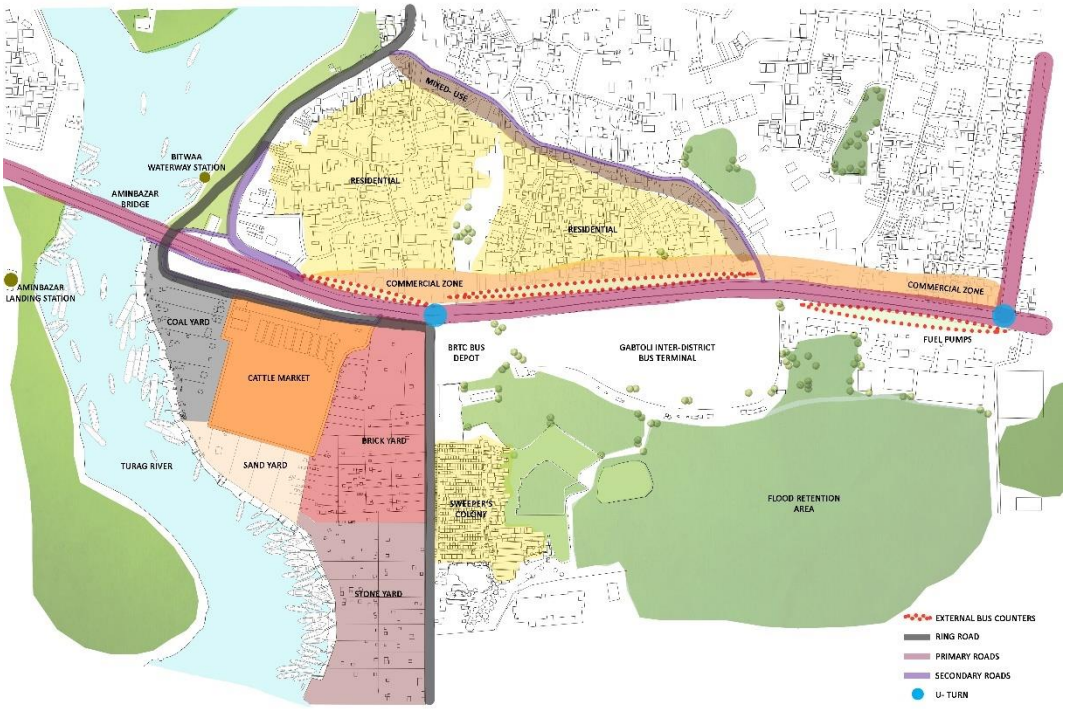


Figure 53 Contextual Analysis of Site

Source: Author, 2019

The unplanned development of residential zones in the surrounding area demands proper playground and open spaces for its residents. The project, therefore, seeks to provide park and common facilities that serve the neighbourhood along with the provision of a terminal that connects multiple modes of transport.

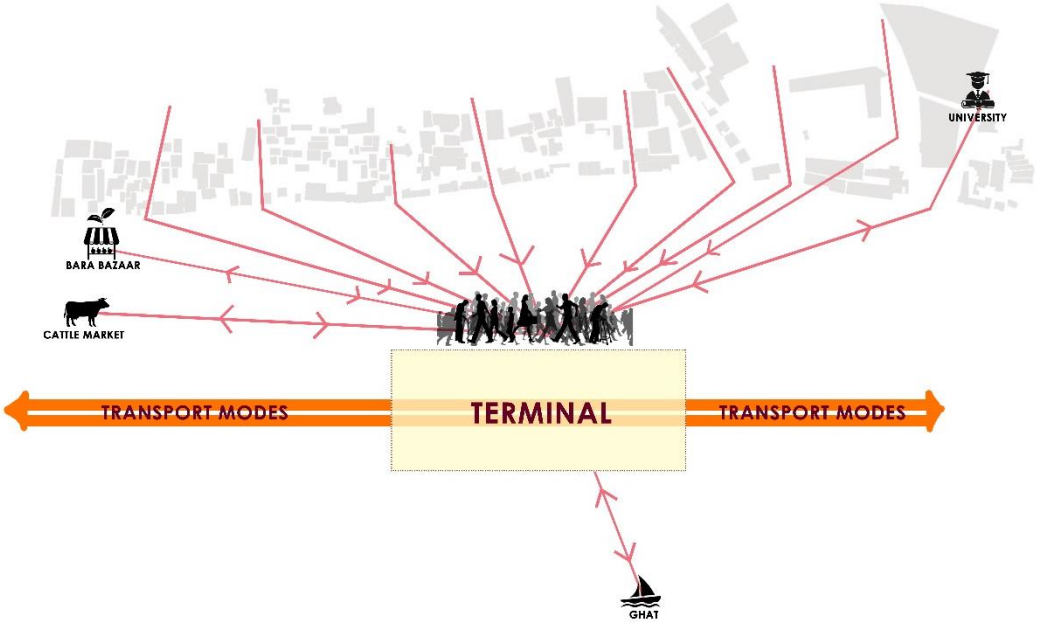


Figure 54 Concept Diagram 1

Source: Author, 2019

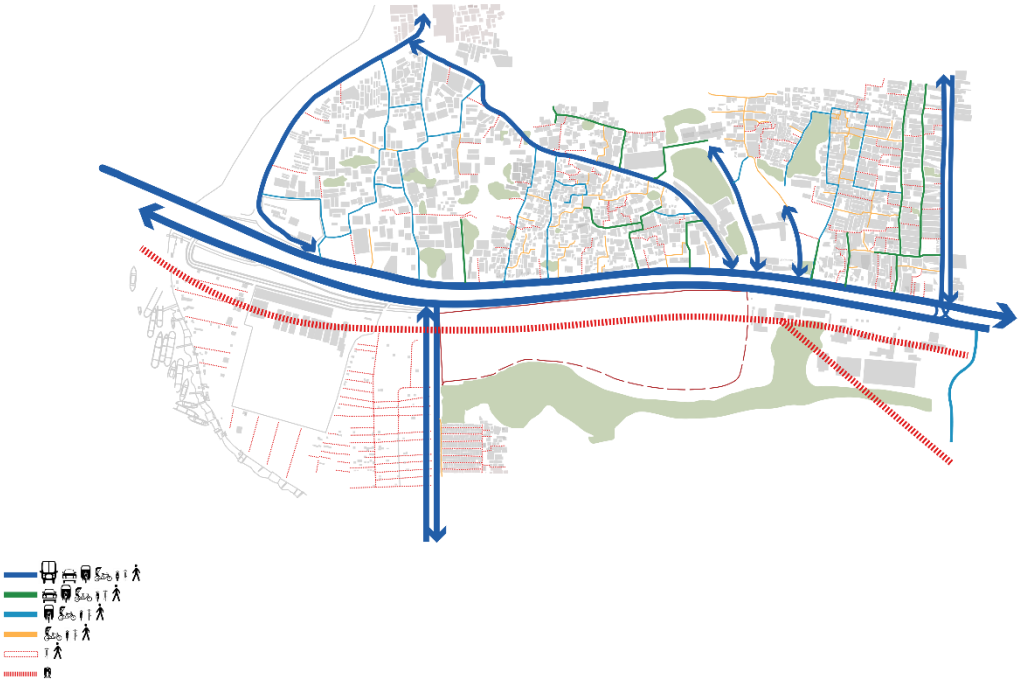


Figure 55 Accessibility Map

Source: Author, 2019

The accessibility map creates an understanding of the primary, secondary and tertiary road networks based on the approachability of different vehicles through them.

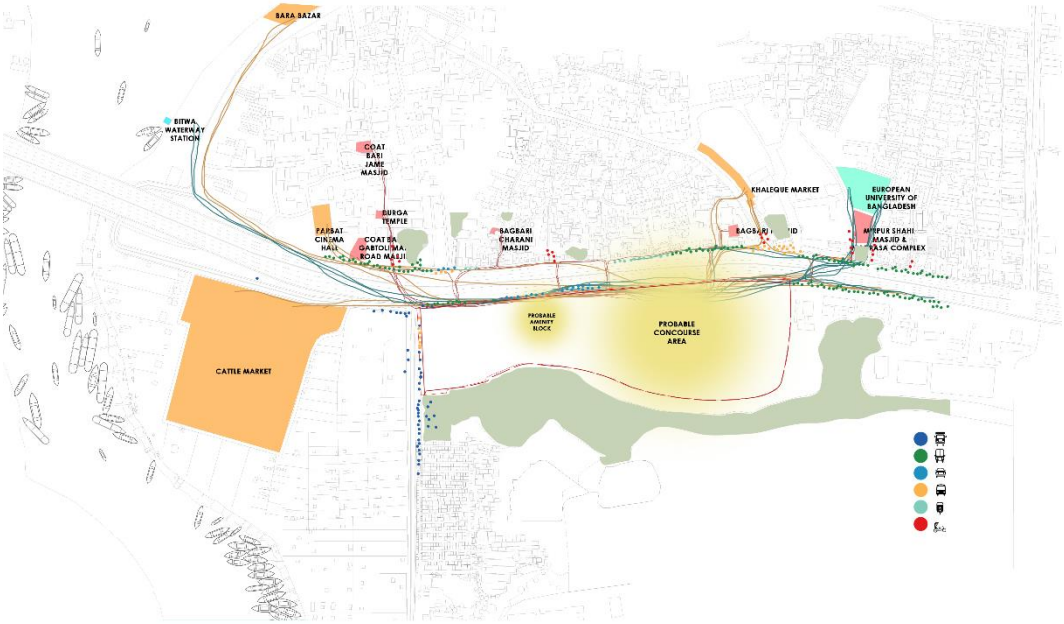


Figure 56 Pedestrian Movement Pattern and Vehicular Stoppage Map

Source: Author, 2019

The map shows the movement of pedestrians based on the public generating functions that persist in site surroundings. The vehicular stoppages on the roadsides originate pedestrian nodes which guides the project through a probable concourse area for the transport terminal. Frequent stoppage of Intra-City buses on the roadsides disables secure pedestrian movement and crossing.

Figure 57 Green Map Analysis

Source: Author, 2019

The analysis of the green map indicates the absence of green in the residential areas (Grey area depicts the dwellings that do not enjoy park/ playground facilities). According to standards, a communal open space is required within 50m of each dwelling served. Playgrounds and parks must be at a walking distance from homes and a minimum of 0.3 acres is expected to serve 1,000 population. Furthermore, neighbourhood parks with an area of 3.5 acres is mandatory for 5,000 population.

Nevertheless, the neighbourhood contains only an insufficient area of 3.13 acres for 1.14 million residents. Thereby, the project aims to serve as an interchange point of multiple facilities through the provision of park, playground, amenities, multiplex and accommodation besides ensuring proper means of transport facilities.

Figure 58 Concept Diagram 2

Source: Author, 2019

The blending in of the surrounding green and vegetation and opening the ground for the pedestrians act as the key concept. Amidst the chaotic city atmosphere with numerous functions, the idea is mainly to prioritize pedestrians through the generation of mingling spots for the local bystanders that allow the passengers to enjoy their transit.

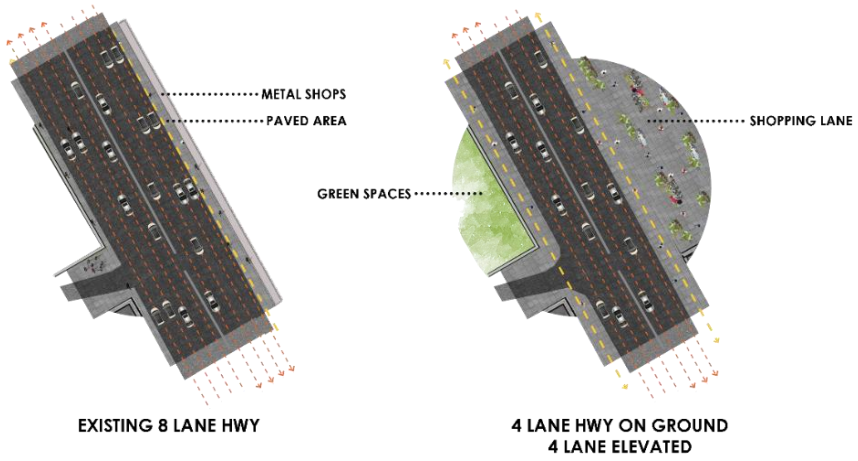


Figure 59 Concept Diagram 3

Source: Author, 2019

An 8-lane Dhaka-Aricha highway parts the site with the neighbourhood residential zone, university and mosques. Narrow pavements run alongside the workshops, metal shops, other variety stores and restaurants. Subsequently, a bypass of the highway has been designed that segregates the local transport vehicles with highway transport vehicles creating an ease of movement for the vehicles and pedestrians by establishing green and shopping lane next to shops.

6.2. Form Development

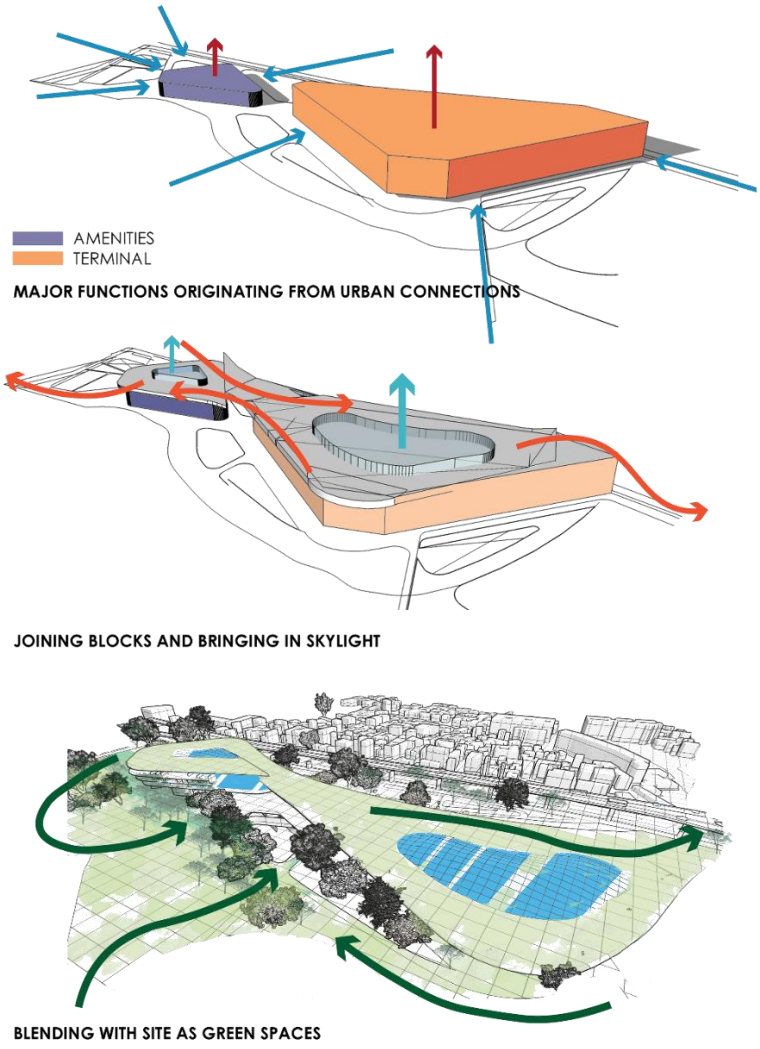


Figure 60 Form Development Diagram

Source: Author, 2019

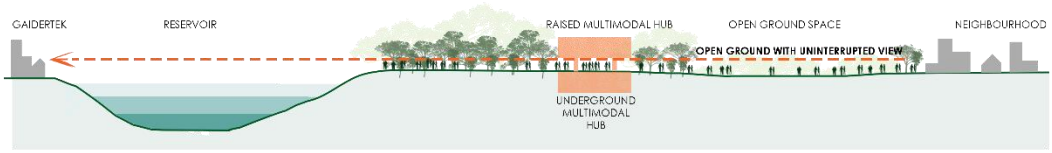


Figure 61 Conceptual Section

Source: Author, 2019

The form has been generated through the functions, which initially commenced off with two separate blocks: the terminal block and the amenity block. The urban paths have been identified, and the green has been blended out with the surroundings accordingly. The roof of the terminal block itself acts as an intermingling zone that allows people from all age groups to enjoy the city and water view. Light wells have been introduced in multiple places for ambient light to perforate through to the underground layers. Ghats or boat decks have been provided to permit communities from the other side to enjoy the facilities. Additionally, parking spaces for leguna and auto-rickshaws have been integrated through the design along with a green belt has that acts as a bio-filter zone. The glass roofs are specially designed photosensitive glass panels that refrain the entry of direct sunlight.

6.3. Functions and spatial characteristics

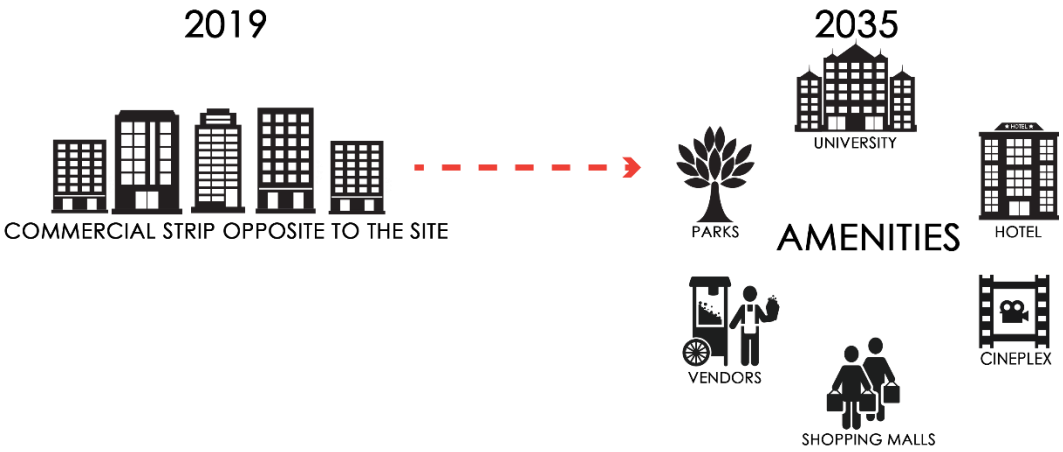


Figure 62 Concept Diagram 4

Source: Author, 2019

The functions of the project have been generated to focus on the demands of the context and people. Considerations of future strategies have been kept in mind and accordingly the issues have been referred.

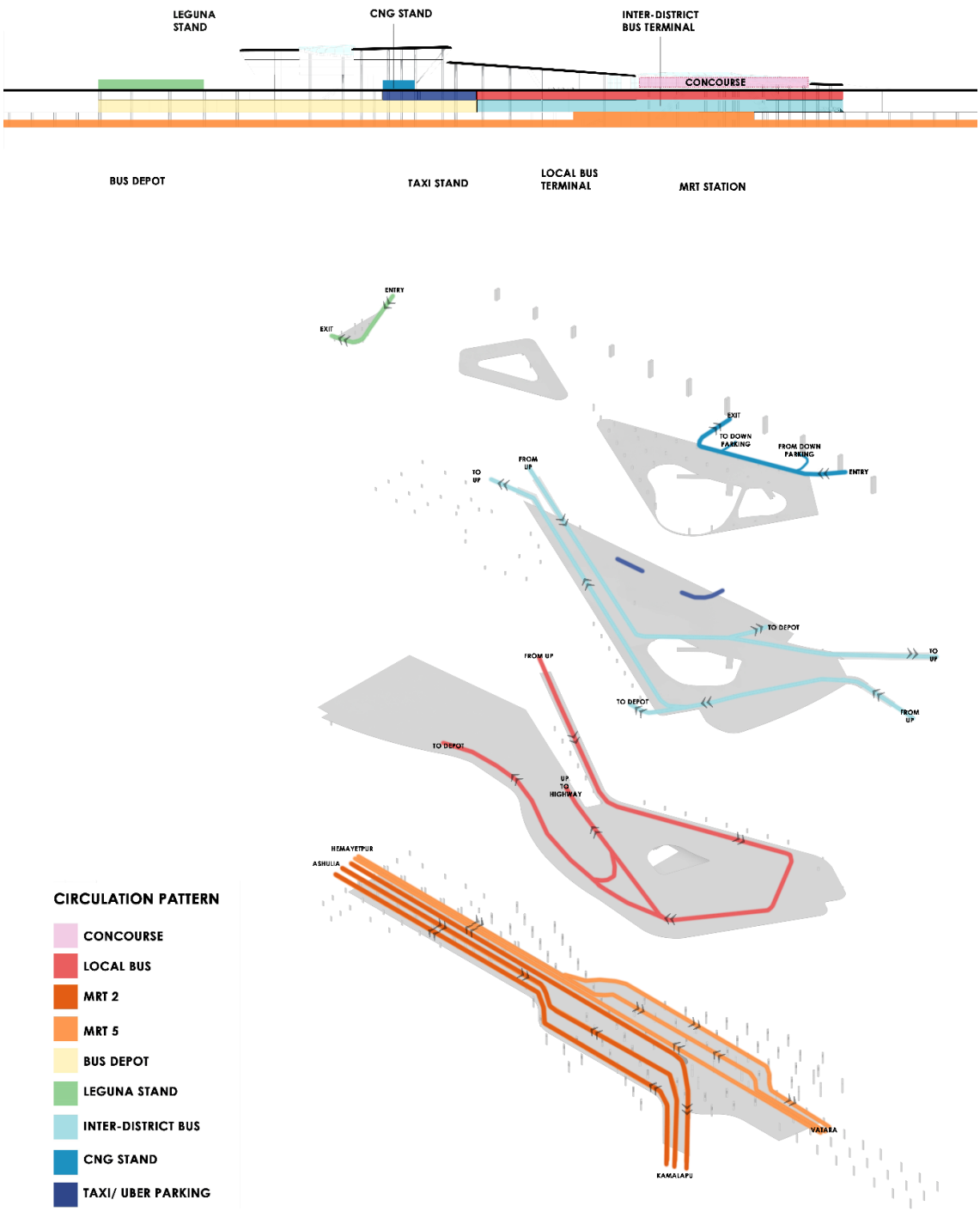


Figure 63 Functional Zoning

Source: Author, 2019

The functional zoning has been depicted through different colours that shows the placement of all transport modes including Inter-City bus, Intra-City bus, MRT Lines, Leguna, Auto Rickshaw (CNG), Taxi/ Uber etc.

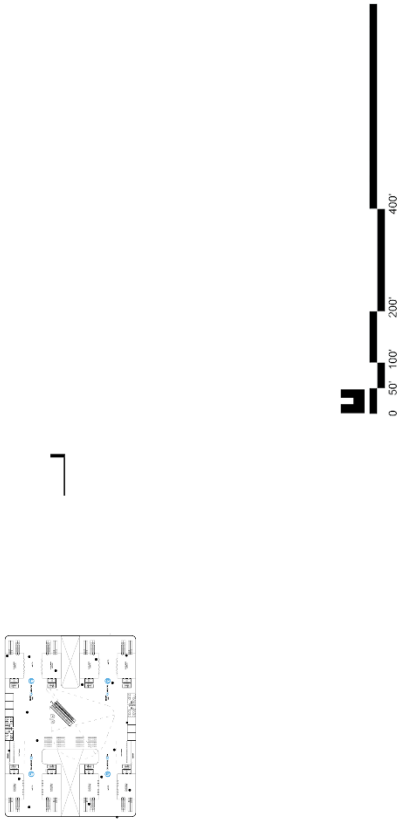
6.4. Drawings (Plans, Section, Elevations)

Figure 64 Site Plan

Figure 65 Ground Floor Plan

Figure 66 Plan at -20'-0"

Figure 67 Plan at -45'-0"



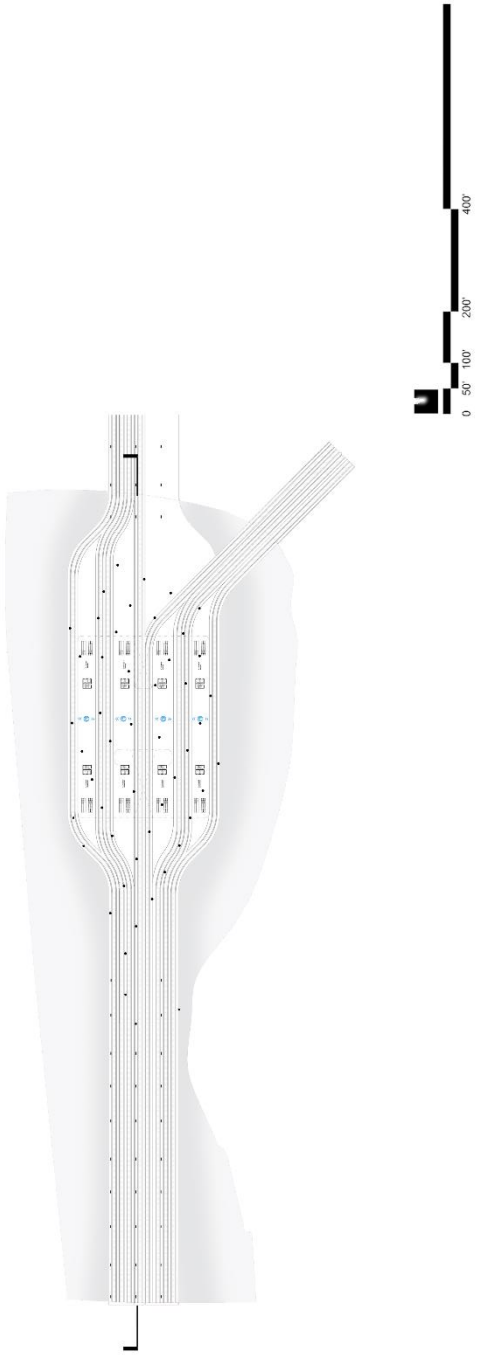


Figure 68 Mezzanine plan at -60'-0"

Figure 69 Plan at -75'-0"

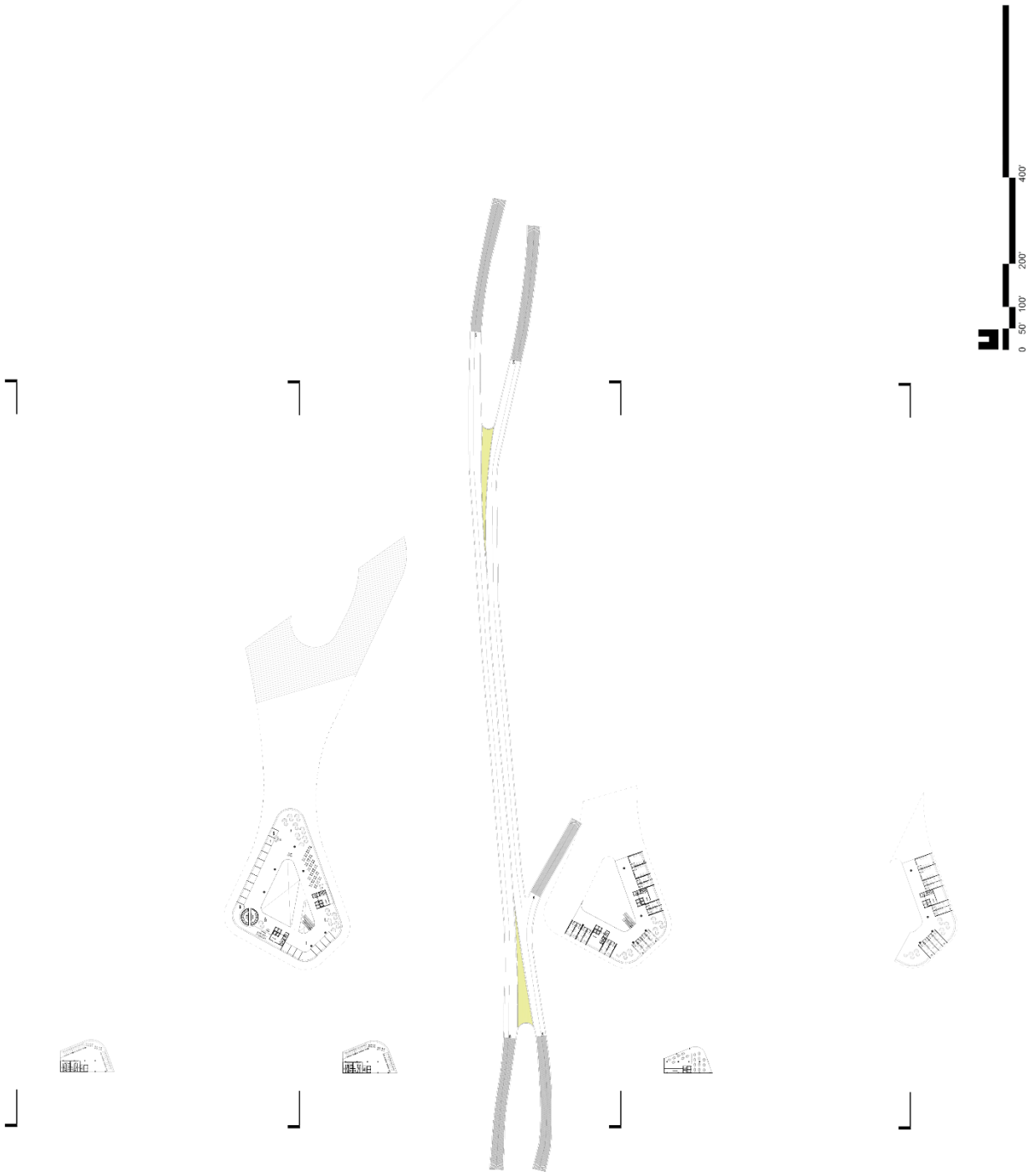


Figure 71 Plan at +15'-0"

Figure 70 Plan at +30'-0"

Figure 72 Plan at +45'-0"

Figure 73 Plan at +60'-0"

Figure 76 Longitudinal Section

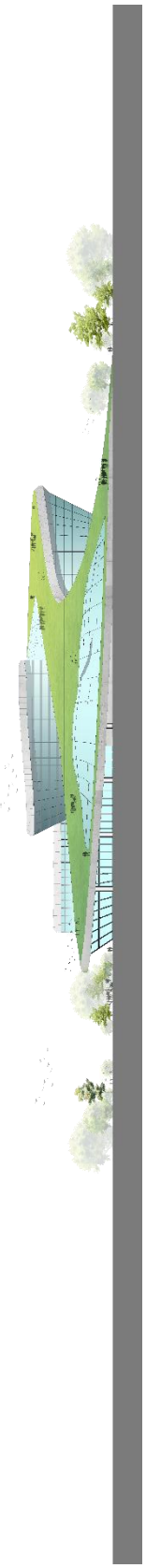


Figure 74 East Elevation

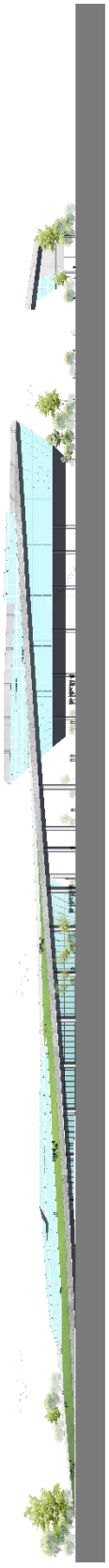


Figure 75 North Elevation

6.5. Perspectives

Figure 77 Perspective of Concourse Area

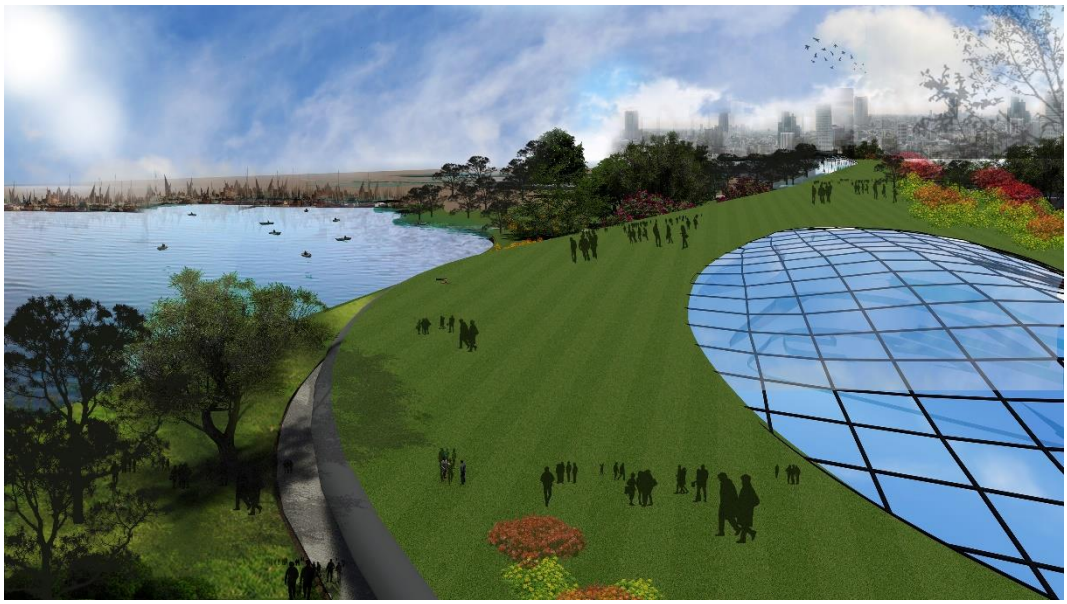


Figure 78 Aerial View of Terminal Roof

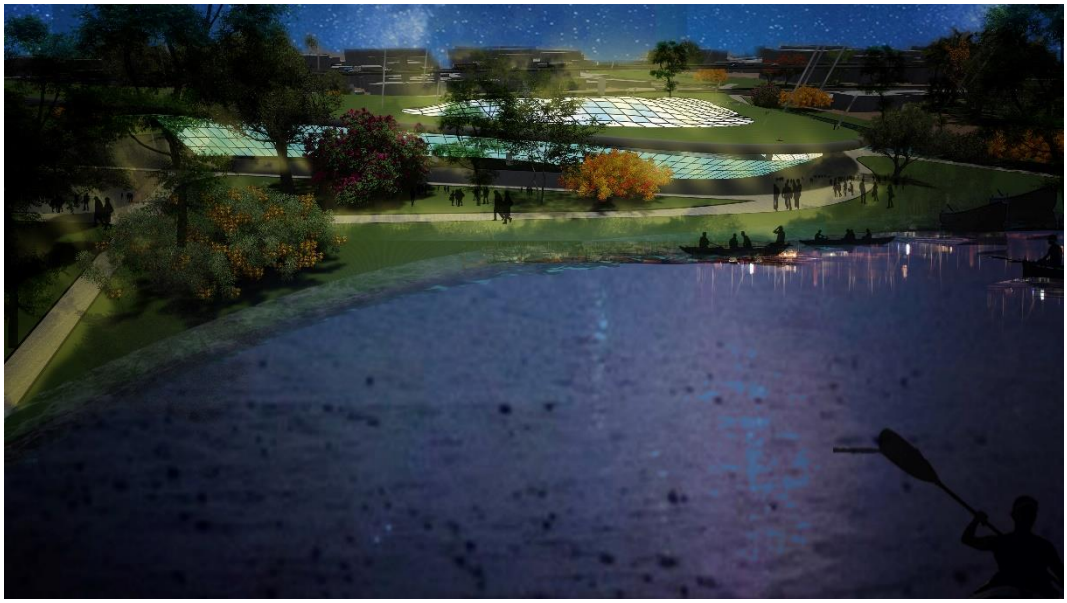


Figure 79 Aerial View of Boat Deck

Figure 80 Perspective of Food Court

6.6. Model Photographs

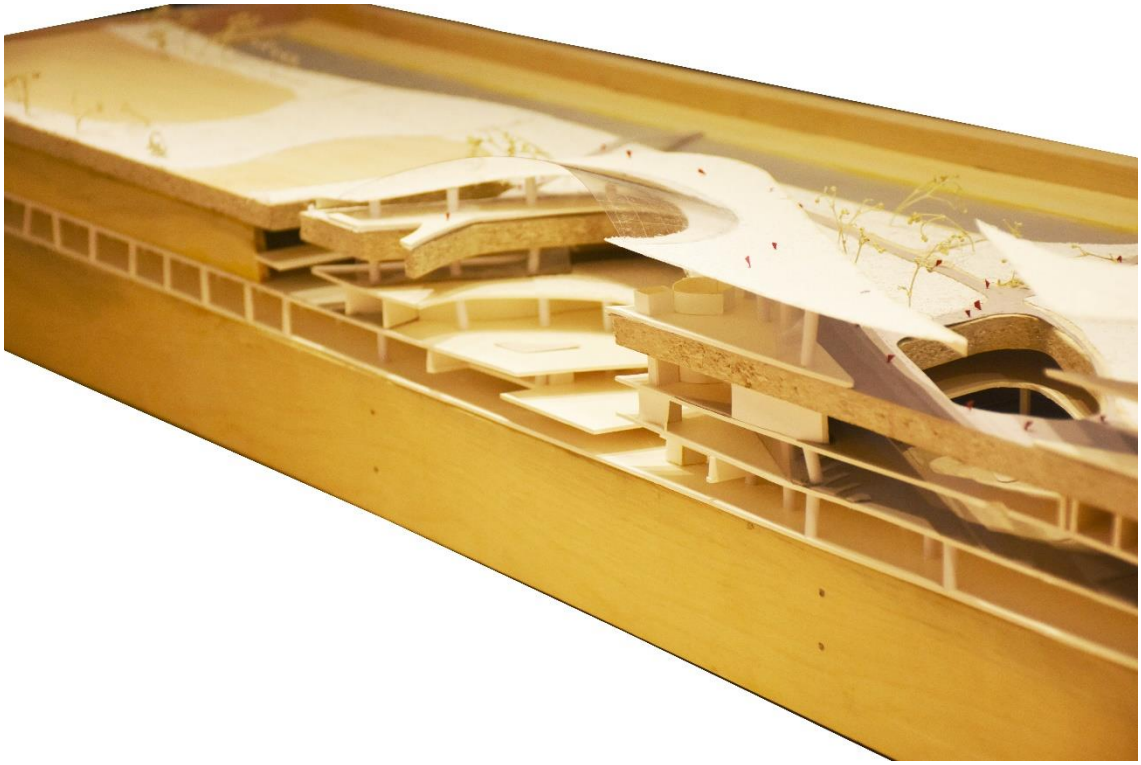


Figure 81 Model Images

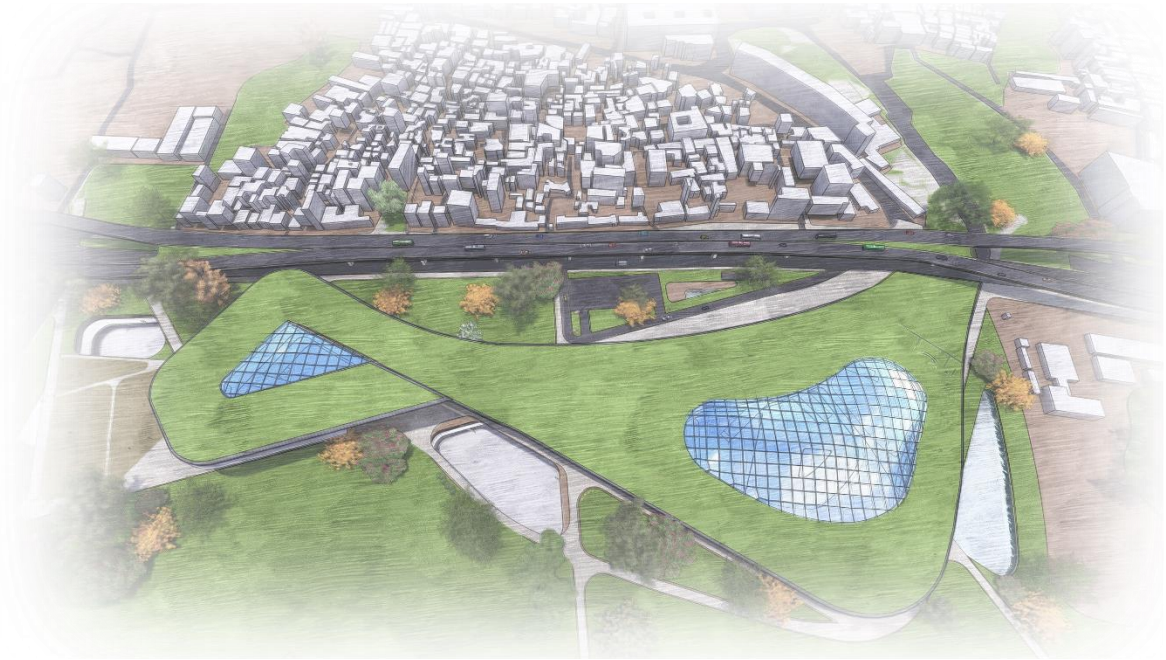
7. Conclusion

In Gabtoli, with the outgrowing commercial and residential zones, pertains lack of active green open spaces. The residents of the city are mostly reliant on private vehicles as a major mode of ground transportation. As a result, traffic jam builds up on the main road intersections and highway routes. Due to the poor availability of public transport facilities and interchange systems, people tend to have difficulty in changing the modes of transport with no safe and secure waiting areas or dwellings.

The project's design process has been carried out through intending to fulfil numerous amenities that are currently absent in the place. Functions like cinemas and food court, offer entertainment services to enable the passengers to get rid of their weariness from the journey. Resting lodge for passengers are also ensured for longer waiting hours.

Furthermore, to address the existing problems, and offer an aesthetic and contextual perspective through activating the dying green and open spaces of the city, the project has been devised accordingly.

"Transit Oasis" allows different modal interfaces of transport and humanitarian activities to take place at the ground level without the disruptions caused to ingoing and outgoing vehicles to and from Dhaka.



Appendix

A. Bus Terminal

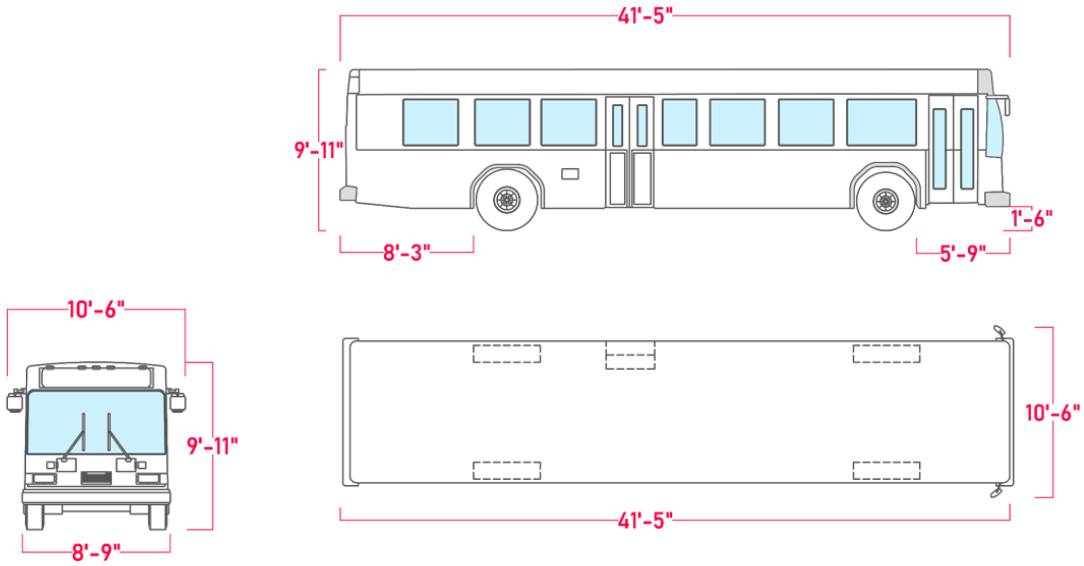


Figure 82 Typical Bus Dimensions

- Turning Radius of Buses

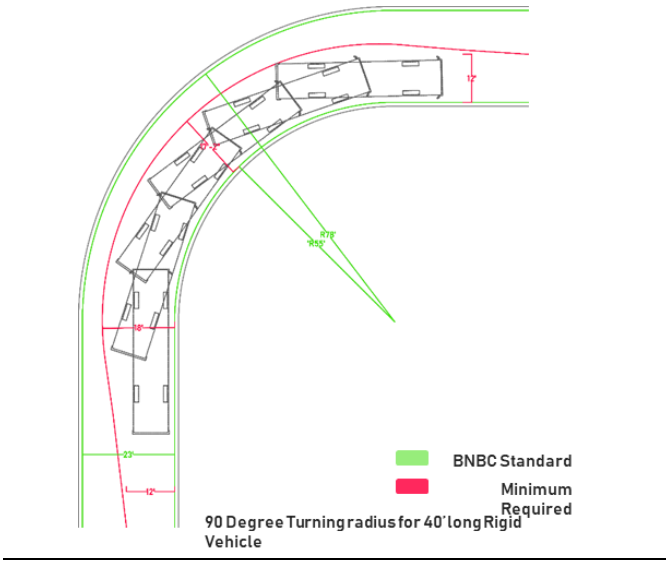
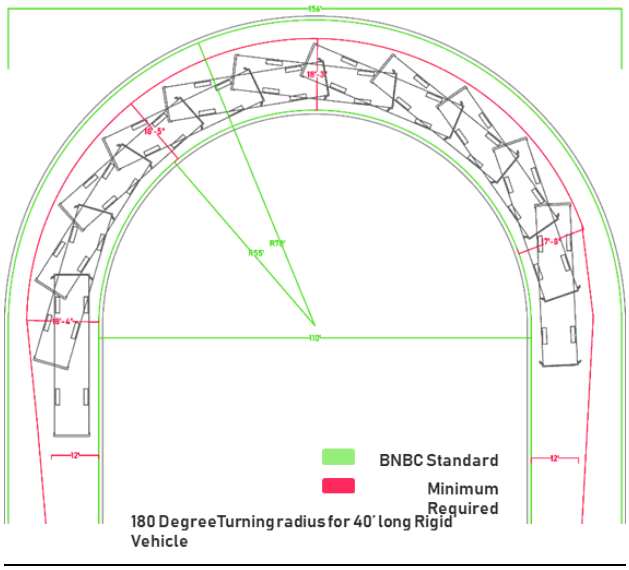


Figure 83 Turning Radius as per Times Saver Std. and BNBC



180 Degree Turning radius for 40' long Rigid Vehicle

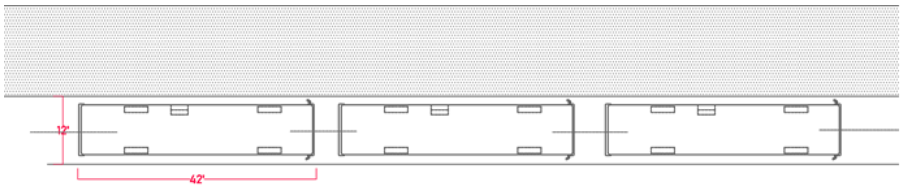
- Types of Bus Bays

  (a) *Shunting bays* are used where a vehicle only sets down passengers on to their concourse before moving away to park or to a bay position for collecting passengers

  (b) *Drive-through bays* are fixed bay positions for setting down and/or collecting passengers. They are in a line, so a vehicle often must approach the bay between two stationary vehicles. In practice, it is often necessary to have isolated islands for additional bays with the additional conflict of passenger and vehicle circulation.

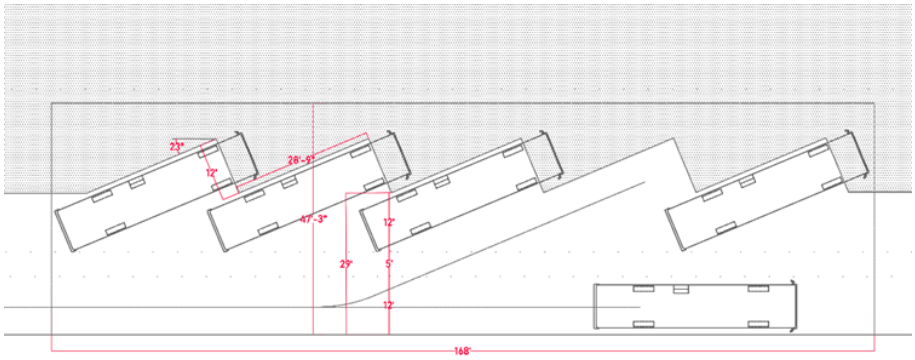
  (c) *Saw tooth bays* have fixed bay positions for setting down and/or collecting passengers with the profile of the concourse made into a saw tooth (sometimes referred to as echelon) pattern. In theory, the angle of pitch between the vehicle front and the axis of the concourse can be anything from 1 to 90 degrees. However, in practice, it usually falls between 20 and 50 degrees. The vehicle arrives coming forward and departs going backwards, thus reducing the conflict

between passenger and vehicle, but demanding extra care to be taken when reversing out of the bays.

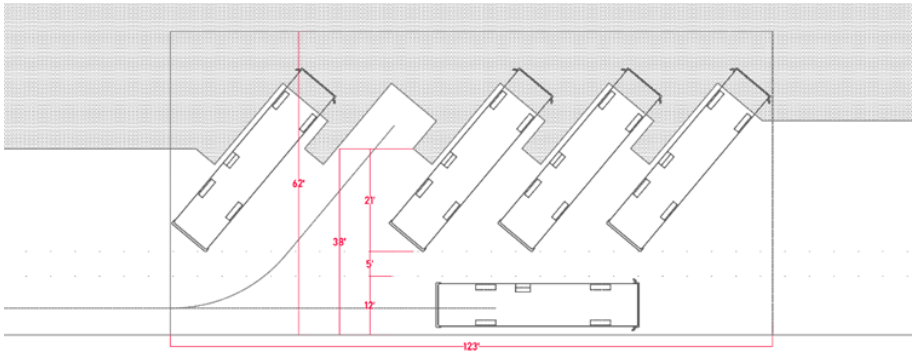


SHUNTING BAY

Where a vehicle only sets down passengers on the concourse before mobbing off to park or pick up more passengers. This avoids waiting to occupy a pre-determined bay, and reduces effective journey time.



23° SAWTOOTH BAYS



50° SAWTOOTH BAYS

SAWTOOTH BAYS

Sawtooth layouts have fixed bay positions for setting down and/or collecting passengers with the profile of the concourse made into an echelon or sawtooth pattern. In theory the angle of pitch between the vehicle front and the axis of the concourse can be anything from 1° to 90°; in practice it lies between 20° to 50°. The vehicle arrives coming forward, and leaves in reverse, thus reducing the conflicts between vehicle and passenger circulation but demands extra care in reversing.

Figure 84 Types of Bus Bays

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