

BRTC INTERNATIONAL BUS TERMINAL

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ABSTRACT

Dhaka is very small city, with ever growing population and shortage of space. Proper planning of transport is a big problem in Bangladesh. So proper urban planning of transport along with efficient use of space is very necessary in Bangladesh.

The project proposal by Bangladesh Road transport Corporation (BRTC) is such a step towards urban & transport planning which would help facilitate commuter service, international travel by bus, along with efficient use of land .BRTC (Bangladesh Road Transport Corporation) International Bus terminal currently is very much under facilitated & unorganized, with no proper traffic management. More over there is no proper passenger facility, or proper arrival and departure bays & the terminal does not portray a good image of Bangladesh to international passenger. The site is opposite Kamlapur Rail station, so both together it creates additional problem in traffic flow of the area. The proposal of the project is to design the international bus terminal at Motijheel with proper passenger facility, a bus service facility, which is able to handle more buses per hour and can accommodate more bus parking, along with a commercial building. In the proposal number of destinations is going increased to 9 inter-district routes and 5 international routes from 5 and 3 respectively. So the aim of this project is to design a bus terminal structure which caters to both inter-district and international buses and passenger and solve traffic flow problem of that area. This dissertation will describe the proposal of the terminal with elaboration of the background and proposed design consideration.

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Introduction

Dhaka is an overpopulated city, with scarcity of land and disorganized transport planning. So cohesive planning of land use, transport and road network is very necessary for the proper development of the city.

Bus transportation is very important mode of transportation of a city. A bus terminal is defined as an area way from the general flow of road vehicle, which gives buses and coaches the freedom of movement to set down and pick up passengers in safety and comfort. Intercity, inter-district and sometimes international buses use this structure for the pickup and drop off of passengers. The terminal may be intended as a terminal station for a number of routes, or as a transfer station where routes continue. The number of bays for arrival and departure, number of bus parking all depends on the number of buses that terminal is serving and the per hour departure and arrival rate. Bus terminal platforms may be assigned to fixed bus lines, or variables in combination with a dynamic passenger information system. Sometimes this structure comes along with other commercial facilities which serve as a revenue generating source.

This dissertation is a source of the ideas for the development of the International bus terminal in Motijheel area and development of the area as a whole.

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I.1 Background of the project

Bangladesh Road Transport Corporation (BRTC) is a semi-autonomous corporation under the Ministry of Communication. BRTC provides both passenger and cargo transport services. BRTC operates three international bus lines (Dhaka to Kolkata, Agartala, and Siliguri in India). Inside Bangladesh, it operates inter-district bus services through its bus depots in Chittagong, Bogra, Comilla, Pabna, Rangpur, Barisal, and Sylhet. It also operates intra-city bus services in many major cities of the country.

It has four bus depots in Dhaka -

- a. Double Decker Bus Depot
- b. Kallyanpur Bus Depot.
- c. international bus terminal at Motijheel
- d. Joarshahara Bus Depot.

The proposal of the project is to design the international bus terminal at Motijheel with proper passenger facility, a bus terminal facility, which is able to handle more buses per hour and can accommodate more bus parking, along with a commercial building. Presently the bus depot only has inter-district buses travelling to 5 destination and international buses travelling to three destinations. Due to shortage of space and buses the depot could not host buses travelling to more place. More over there is no proper passenger facility, or proper arrival and departure bays. Buses pickup and drop off passenger on main road. Recently BRTC is importing new Korean buses, after which buses are going to travel to 9 inter-district routes and five international routes. So the aim of this project is to design a bus terminal structure which caters to both inter-district and international buses and passenger.

1.2 Project specification

Name : International Bus Terminal at Motijheel

Client : Bangladesh road Transport Corporation(BRTC)

Site area : 5.2 acre

Site location : Motijheel Bus depot, Opposite Kamlapur Rail Station, Motijheel, Dhaka, Bangladesh

1.3 Objectives of the project

- To establish a transport system which will have smooth circulation and reduce traffic congestion occurs due to the buses of the terminal.
- To design a terminal with facilities for increased number of proposed buses and passenger (both inter-district & international)
- To create a structure that serves as an iconic landmark for both the city and the country.
- To design a commercial building along with terminal with BRTC offices and other commercial facility.

1.4 Site

Location : Motijheel, Opposite Kamlapur Rail station , Dhaka , Bangladesh.

Site area : 5.2 acre



Fig 01 : Satellite image site Location map
Source: www.googleearth.com



Map 01: Location map
Source: www.mappia.com

1.5 Reasons for choosing the project

In Bangladesh traffic problem and public bus transportation problem is very severe. In the existing bus terminal there is no proper traffic circulation pattern, no designated bus arrival and departure bay, and international facilities are also not adequate.

This particular site in Motijheel is very interesting since it is opposite Kamlapur Rail station, so there is an opportunity to combine them as an interchange facility. More over there is no public space in this area and through this project there is an opportunity to work on urban scale here and give some back for the development of this area.

1.6 Given / proposed program

- Parking of 140 buses
- CNG station
- Repair station
- Commercial building accommodating administration, technical support finance
& traffic departments of BRTC
- International passenger facilities
- Inter-district passenger facilities
- Restaurant
- Shops
- Car parking

CHAPTER 02: Site Appraisal

2.1 Site appraisal

The site is located at the south eastern part of Dhaka city, opposite Kamlapur Rail Station, in Motijheel. The site is situated at the intersection of Kamlapur Road and Station Road, thus very accessible from other parts of the city.

2.1.1 Location Map



Map 02: Site Location map
Source: www.mappia.com

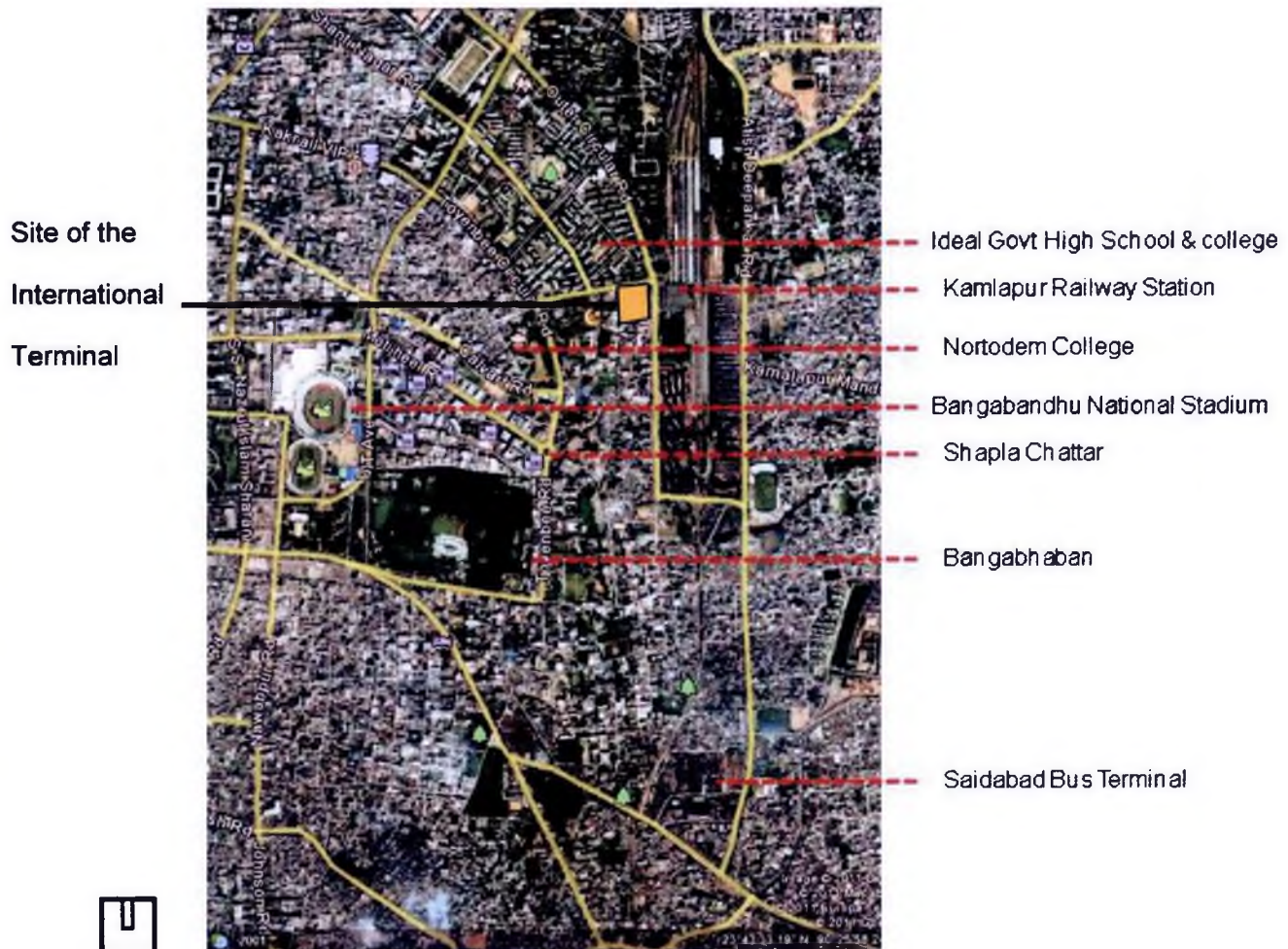
2.2 Environmental considerations

The site has some issues related to environment. As it located adjacent to two major roads, huge traffic moves around the site and has a great impact on the site. The front side of the site is mostly residential, and backside is also mostly residential use along with some commercial and mixed use development, which has to be considered while designing. More over there is sound pollution due to the trains arriving in Kamlapur Rail Station and the traffic flow of Kamlapur rail station also has great impact on the site.

2.3 Site and surrounding plan

The site is located at the prime location of Dhaka and is very Near to some of the important structures and government organization.

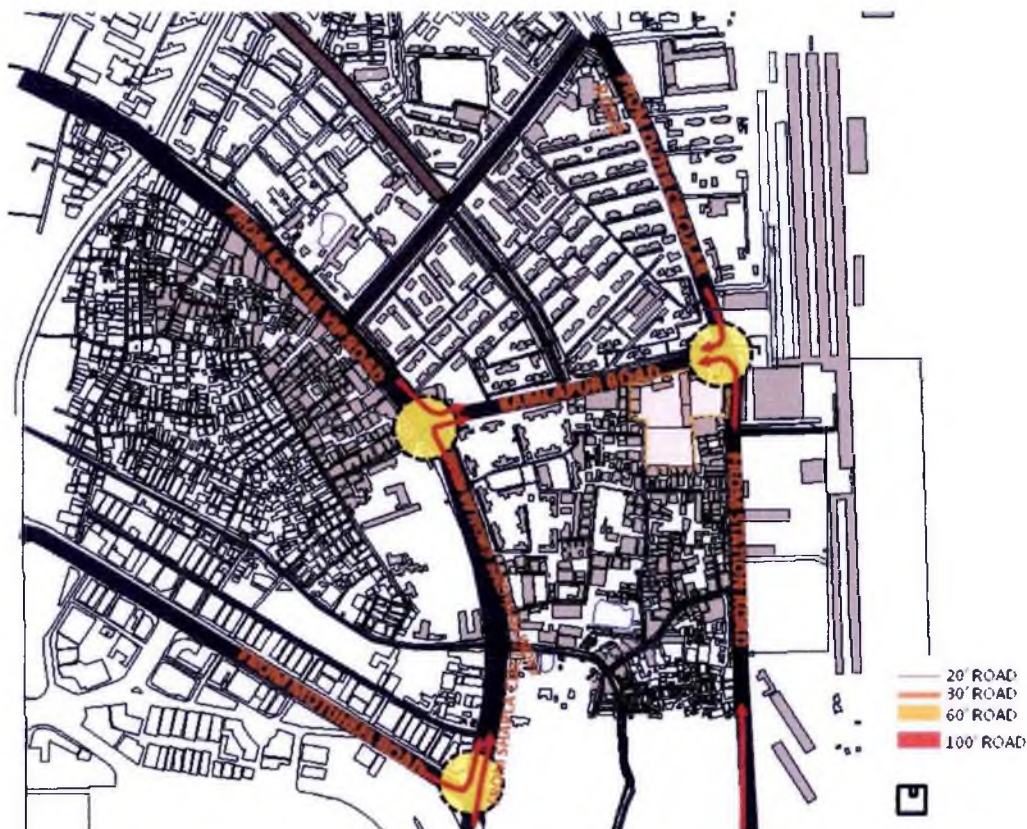
The satellite view of the area is given below (Map: 03) to indicate the important site surrounding and the exact location of the site.



Map 03: Satellite View of location
Source: Google Earth, 2009

2.3.1 Surrounding Road Network

The Site located at the intersection of Station road and Kamlapur road, and is connected by many important road networks. The site is accessible from Atish Depankar road, Shapla chattar and Kakrail Vip road. So the vehicular movement is quite congested.



Map 04: Surrounding road Network
Source: Hoque, 2011



Fig 02: Station road vehicular movement
Source: Hoque, 2011



Fig 03: Kamlapur road vehicular movement
Source: Hoque, 2011

2.3.2 Surrounding Structures

2.3.2.1 Land Use Pattern

The site's land use pattern shows that it is most residential use, with a majority of transport facility, and some commercial and mixed use facility. Although the building beside the main roads have commercial facility on the ground floor and residential use on the upper floors.





Fig 04: Commercial Activity
Source: Hoque, 2011



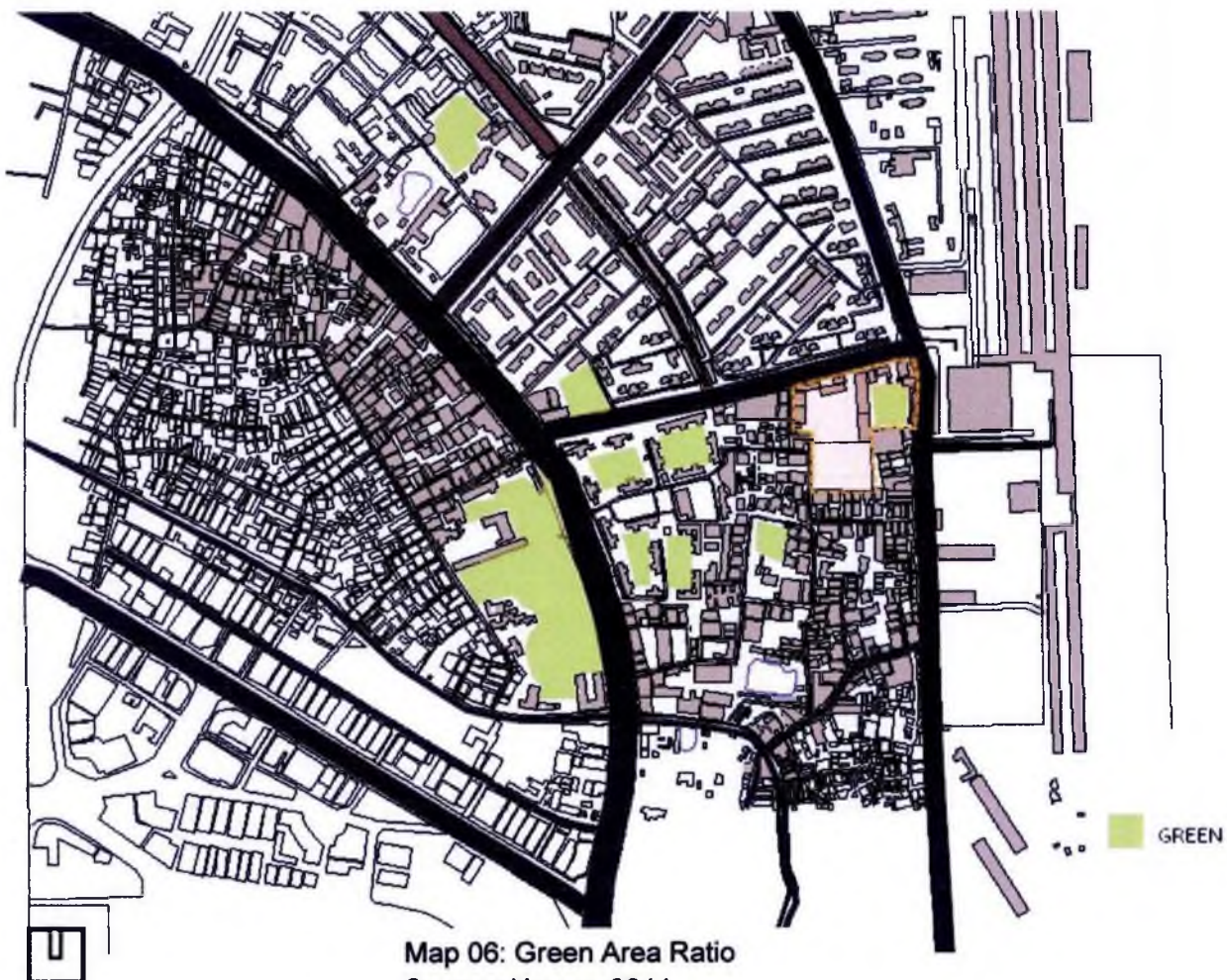
Fig 05: Institution opposite site
Source: Hoque, 2011



Fig 06: Residential use around site
Source: Hoque, 2011

2.3.2.2 Green Area Ratio

The site at a very busy location, beside CBD, so there is almost no green area. The only green area nearby is Notordam Colleges's field.



Map 06: Green Area Ratio
Source: Hoque, 2011

2.3.2.3 Solid Void Ratio

The West and south part of the site is very densely built, whereas due Government quarter on the north side there the built area density is low. More over on the east side the land belongs to railway department, used for the station and container storage, so the built area is also very less there.



Map 07: Solid Void Ratio
Source: Hoque, 2011

2.3.2.4 Surrounding Building Heights



Map 08: Surrounding Building Height
Source: Hoque, 2011

2.4 Topography

The site is almost flat and at the same level as the road. There is an imbalance of green and grey area and there is almost no plantation in the site. The site has low and flat topography as the city. The site does not have a proper drainage system, so water logging happens in times of heavy rainfall.

2.5 Existing Bus terminal Condition & Routes

2.5.1 The inter-district route

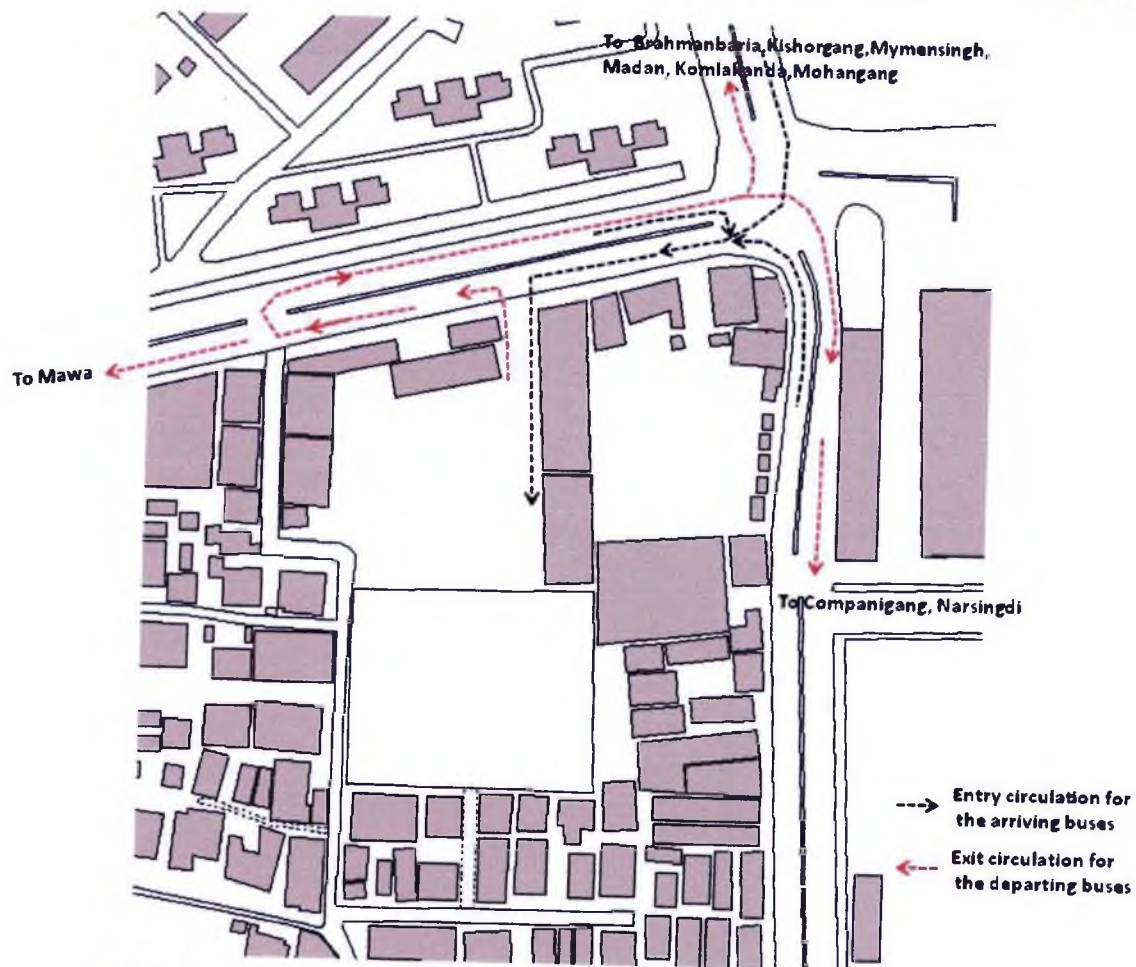
Presently there are only six interdistrict routes running from the bus terminal, which are Komlakanda, Mohangang, Madan, Mymensingh, Narsingdi, and Munsigang.



Map 09: Existing Inter-district Route
Source: Hoque, 2011

2.5.1.1 Circulation Pattern of inter-district buses

The interdistrict buses currently run using three main routes, one towards north using outer circular road, one towards south using Dhaka- Chittagong highway via, Atish depankar road.



Map 10: Existing Inter-district circulation pattern
Source: Hoque, 2011

2.5.2 International Bus route

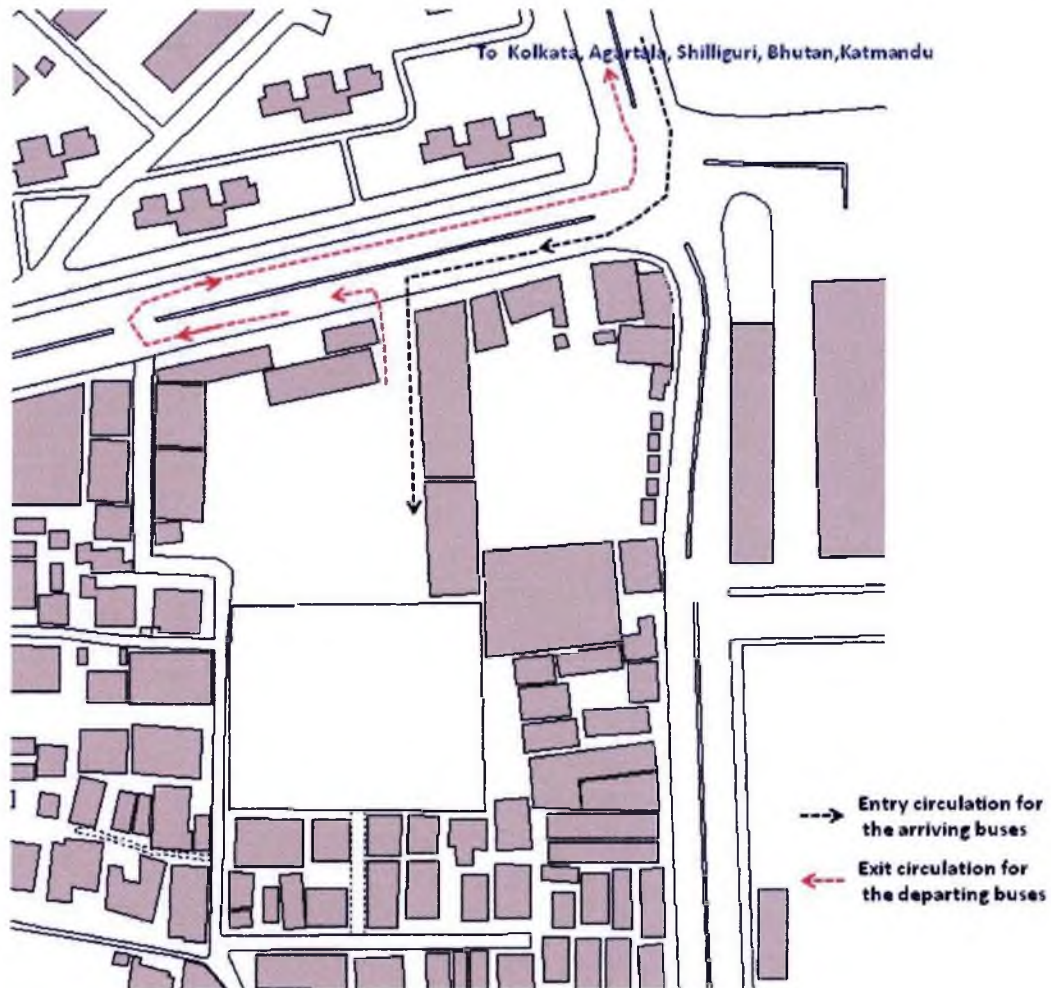
The buses from BRTC bus terminal currently goes to three international destinations, Shilliguri, Agartala and Kolkata



Map 11: existing International Bus Routes
Source: Hoque, 2011

2.5.2.1 International Bus circulation routes

All the international buses use one route, i.e. the outer circular road and goes towards north.



Map12: Existing International Bus Routes
Source: Hoque, 2011

2.6 Existing Site Condition

The circulation and parking is not distinguished in the existing situation. The passenger pickup and drop is done on street. There is no proper bus bay for arrival and departure. The on Street parking causes congestion on the road.

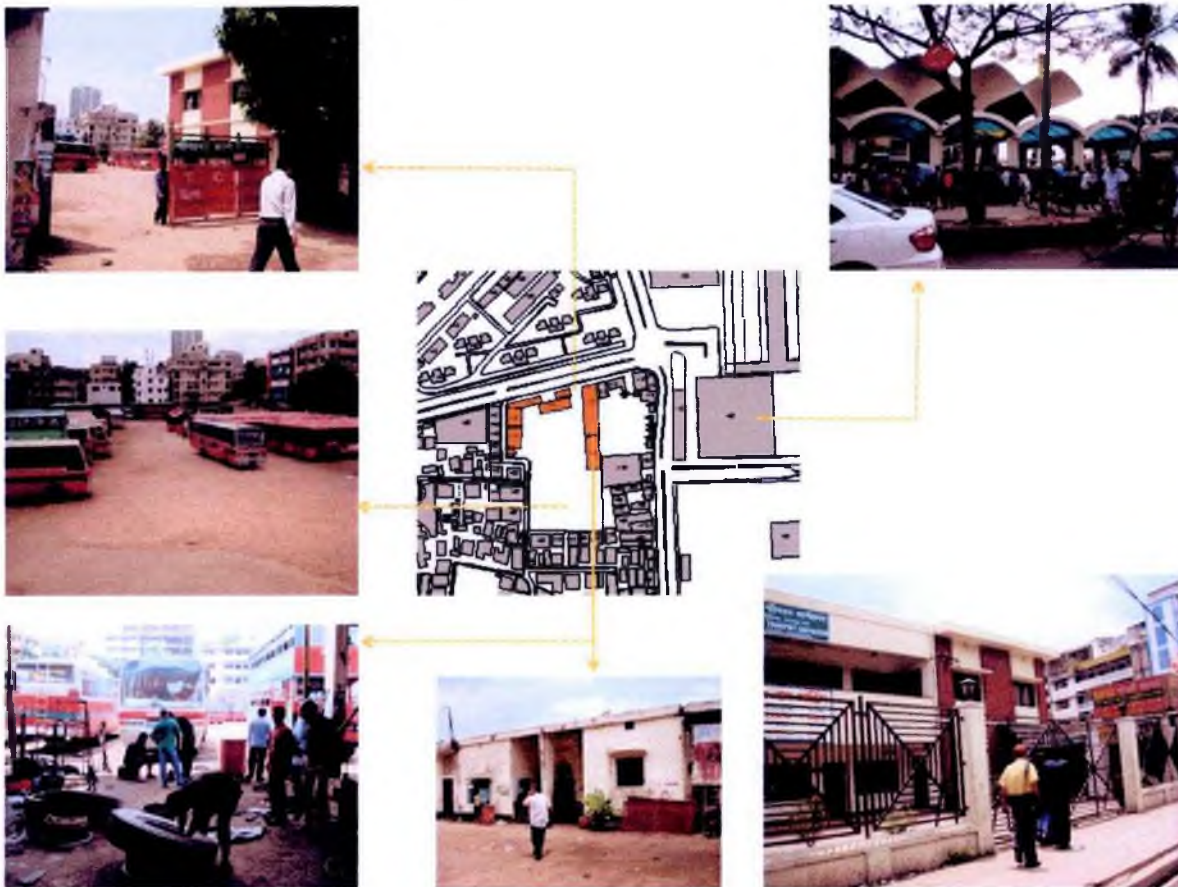


Fig 09: Existing location of Functions pictures
Source: Hoque, 2011

The terminal does not have enough public toilet facility and those that are there are also not maintained properly.



Fig 10: Existing Toilet facility
Source: Hoque, 2011

Fig 11 : Existing Ticket Counter Facility
Source: Hoque, 2011

There is no CNG station facility there, and there is only 1 diesel pump, which is not adequate for the buses. The repairing and cng facility is also not adequate and not maintained.



Fig 12 : Existing Repair Shop
Source: Hoque, 2011



Fig 13: Existing Diesel Pump
Source: Hoque, 2011



Map 14 : Analysis of existing terminal problems
Source: Hoque, 2011

The current terminal also houses BRTC Office which includes four departments – administration, accounts, traffic and technical. The employee facilities are also not adequate and they do not have any cafeteria facility. The drivers and conductors also do not have restroom facility. The international passenger facility is also not up to the standard, as there are no proper baggage checking and offices to handle them.



Fig 14: Existing Office
Source: Hoque, 2011



Fig 15: Existing international waiting
Source: Hoque, 2011



Fig 16: Existing International ticket counter
Source: Hoque, 2011

2.7 SWOT Analysis

2.7.1 Strenght

- The site is in Motijheel ,which is very easily accessible from any part of the city
- The site is adjacent Kamlapur Rail Station making, a transport interchange system.
- The site has two main roads on its two side.

2.7.2 Weakness

- No traffic circulation plan for the movement of buses
- No marked parking layover for the buses and the transport which is used for coming to the terminal.

- Not enough public toilet facility for the passengers.
- There is no restaurant and restrooms for the passengers and the terminal employees.
- On street pickup and drop off of passenger.
- The public access, passenger lounge time table information or destination of buses is not clearly defined.
- No CNG facility
- International facility not adequate

2.6.3 Opportunity

- AS it will be the first international bus terminal of Dhaka, it can be an iconic structure of the area and represent our country in positive way.
- It can be a urban meeting point and it will have some commercial facilities also which will cater to the area as a whole.
- The site is adjacent to Kamalapur railway, so travelling in inter-district route is facilitated.
- It can be the breather space of the area.

2.6.4 Threat

- The ratio of green and grey area is in imbalance.
- Due to movement of traffic and train there is sound pollution
- The site is mostly surrounded by residential area, which might not be an ideal location for a bus terminal.
- The site is too close to CBD area.

CHAPTER 3- LITERATURE REVIEW

3.1 Bus Terminal

Bus station is defined as an area away from the general flow of road vehicles, which gives buses and coaches the freedom of movement to set down and pick up passengers in safety and comfort. Locations are either near shopping centers or other transport terminals, thereby affording the best interchange.

(Transport terminal & Modal Interchanges, 2009)

It is larger than a bus stop. Bus stop is something which is usually simply a place on the sidewalk, where buses can stop. But a terminal is something which may have broader issues, regarding departing & arrival of passengers.

3.2 Types of Bus Terminal

3.2.1 Intercity Bus Terminal

The intercity terminal is usually found in the downtown core and is accessible directly by local transit, taxi, and auto . It differs from other terminal types in that it includes long haul service in excess of several hundred miles and provides for a much greater number of bus movements. Land costs normally dictate vertical expansion capability in the denser city areas. More elaborate "package express" facilities are provided in the intercity terminal and a greater amount of concession and rental space is provided to defray higher terminal construction. (pg- 984, time savers standard for all building types)

3.2.2 Suburban Interstate Terminal

The suburban interstate terminal is a peripheral type designed to avoid the traffic congestion and heavy investment associated with central city and/or airport terminal facilities. The terminal is usually located adjacent to interstate highway connections with major cities or regional airports and in many instances serves the increasing outlying "urban sprawl" areas. In an increasing number of cases terminals of this type serve a commuter-type function where the daily journey to work in the central city may take as long as 2 hours . Sometimes referred to as "park and ride" terminals, because access is primarily by auto, these facilities are provided with open, paved parking spaces. Investment in waiting-room and bus-berthing facilities is minimal. The terminal is usually a one-story building of simple construction. (Pg- 984, time savers standard for all building types)

3.3 Factors affecting size of bus terminal

Stations will vary in size governed by the following basic points, apart from the obvious physical constraints of the site:

- **The number of bays to be incorporated** (the term 'bay' is used in connection with stations instead of the term 'bus stop'), determined by the number of bus and coach services to be operated from the station, and by how practical

it is, related to the local timetable, to use an individual bay for a variety of service routes.

■ the vehicle manoeuvre selected to approach the bays - Three basic types of manoeuvre are used, namely 'shunting', 'drive-through' and 'sawtooth'.

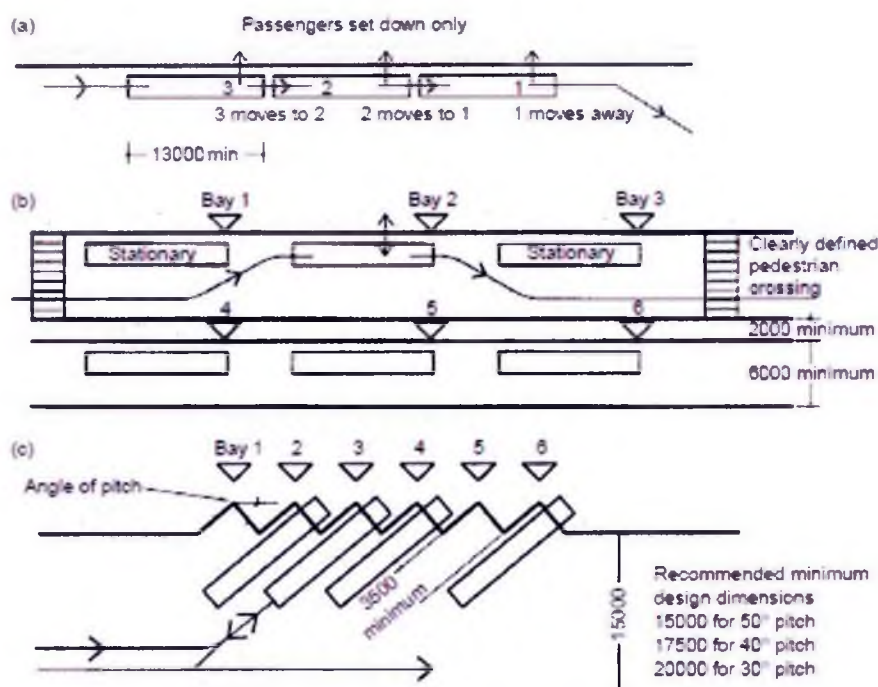


Fig17: Vehicle manoeuvres used in approaching parking bays
Source: Transport terminal & Modal Interchanges, 2009

Vehicle maneuvers used in approaching parking bays.

(a) Shunting is 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. This maneuver avoids waiting to occupy a predetermined bay and effectively reduces journey time.

(b) Drive-through bays are fixed bay positions for setting down and/or collecting passengers. They are in a line, so a vehicle often has to 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' layouts 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. In practice, however, 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

The choice of manoeuvre will be influenced by the size and proportions of the site available, the bus operators' present and anticipated needs, and in particular the preference of their staff. Some will accept the sawtooth arrangement while others prefer the drive-through. The area of the site is further added to by the requirement of 'layover'. This is where vehicles were having set down their passengers, but which are not required to collect passengers, are parked on the station until needed again. The layout for this should be based on the requirement for parking, but preferably in such a manner that no vehicle is boxed in by another, and of course positioned so as not to interfere with other bus movements. In some cases economy of space can be achieved, again dependent upon local timetables, by using spare bays for layover purposes.

■ **The facilities to be provided for passengers** - Provision for passengers will depend entirely upon anticipated intensity of use and the multi-modal nature of the interchange. If, for example, there are already public toilets, a bus and coach information centre and cafés nearby, then these may not be required on the station concourse. However, waiting room facilities will probably be required, with someone on hand to give information and supervision. In more comprehensive schemes, in addition to a waiting room, a buffet and public toilets, one may plan for kiosks and enquiry, booking, left luggage and lost property offices.

■ **The facilities to be provided for staff** -There will invariably be an inspector or inspectors in a station who, as well as assisting passengers, are primarily concerned with supervising the comings and goings of vehicles, their drivers and conductors. If there is a depot near to the station then most staff facilities will be provided there. However, if the depot is some distance away, it will be necessary to provide canteen and toilets for them on the station site, so that during breaks and between working shifts they do not need to get back to the depot until they return their vehicle for long-term parking. Should the depot be even more remote, it will be necessary to provide all facilities at the station site and only basic amenities at the depot. In this case, as well as the canteen and toilets, a recreation area, locker rooms and 'pay-in' facilities should be provided. The latter is an office area where drivers/conductors check, then hand over monies taken as fares, which in turn are checked and accounted for by clerical staff.

■ **Facilities for bus maintenance** - It will be appreciated that the proper inspection, repair and servicing of buses and coaches is an integral part of a bus operator's

responsibility. Normally, such work would be carried out at a local depot, with a repair workshop together with fuelling, washing and garaging facilities. The provision of some or all of these facilities within a station complex is unusual, but by no means unique.

3.4 Standard layout & dimension for buses

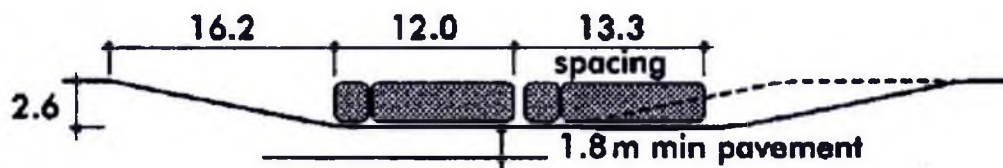


Fig17a: Typical lay-by dimensions for buses/ coaches
Source: Transport terminal & Modal Interchanges, 2009

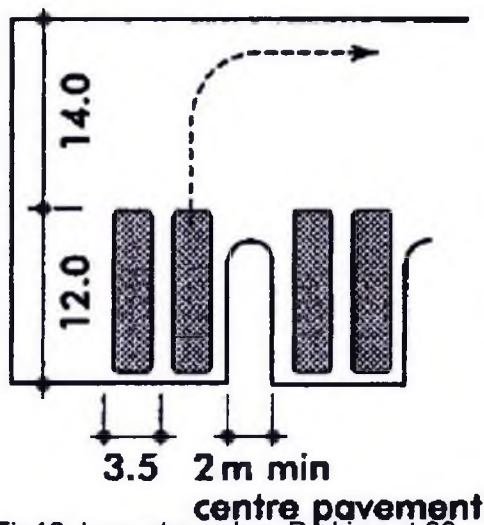


Fig18: buses/ coaches Parking at 90
Source: the architects handbook, 2007

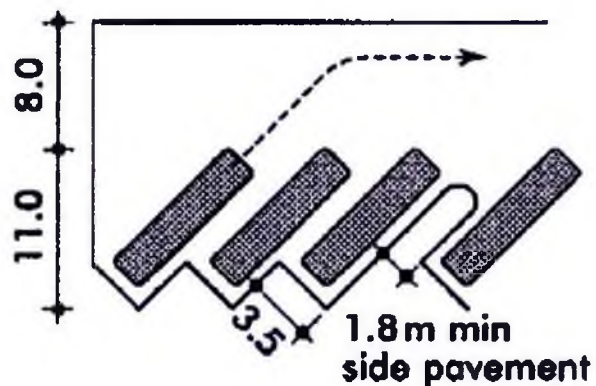


Fig19: buses/ coaches parking at 45
Source: the architects handbook, 2007

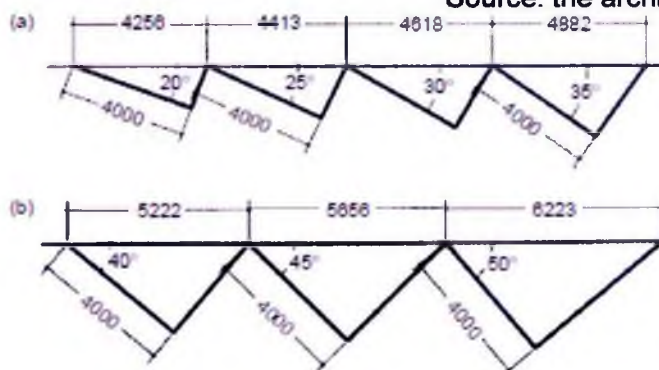


Fig20: The angle of pitch in sawtooth bays increases
Source: the architects handbook, 2007

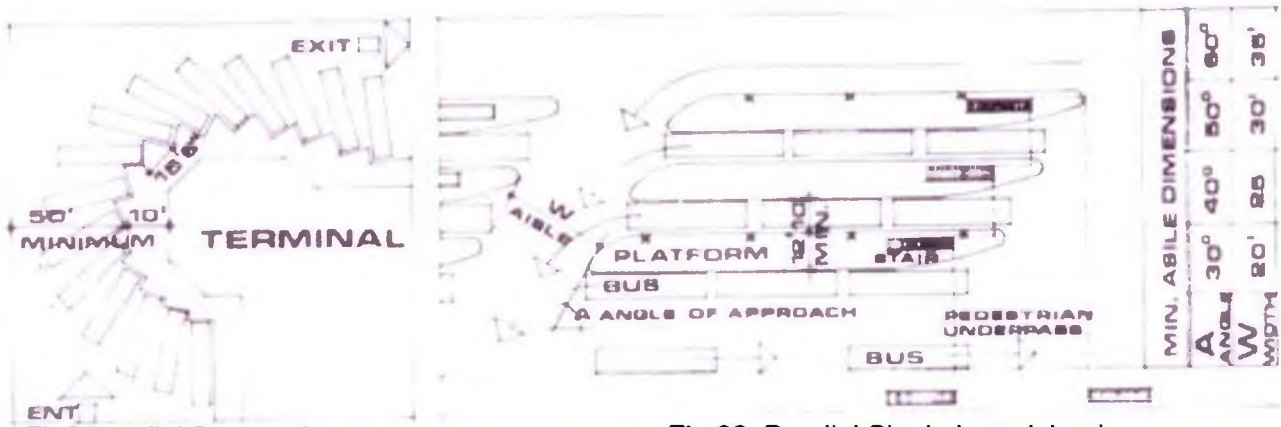


Fig21: radial Saw tooth

Fig 22: Parallel Single Lane Island

Source: Times saver's Standard for building types Source: Times saver's Standard for building types

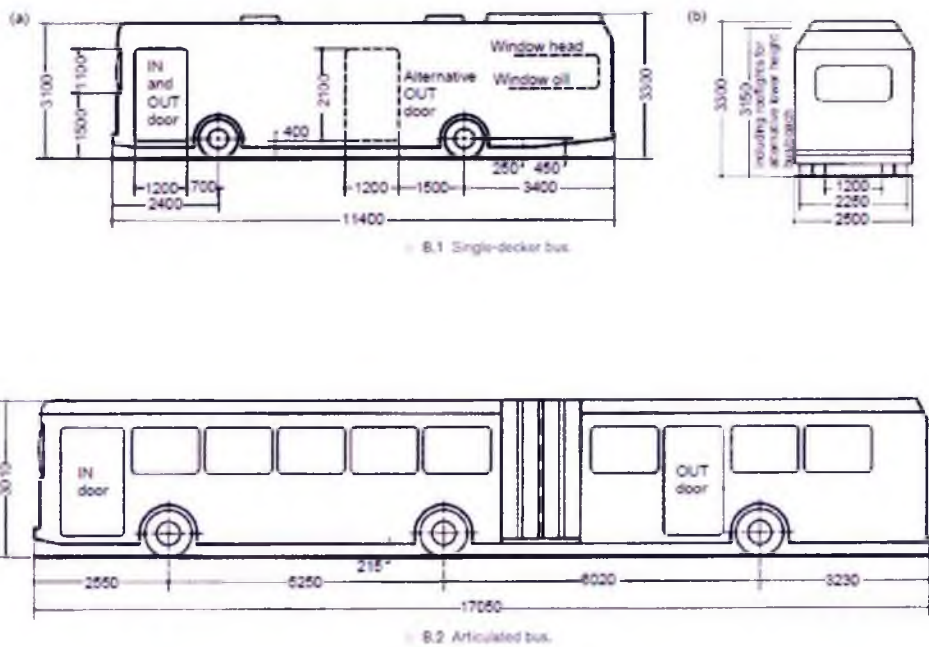


Fig23: Bus Specifications

Source: Transport terminal & Modal Interchanges, 2009

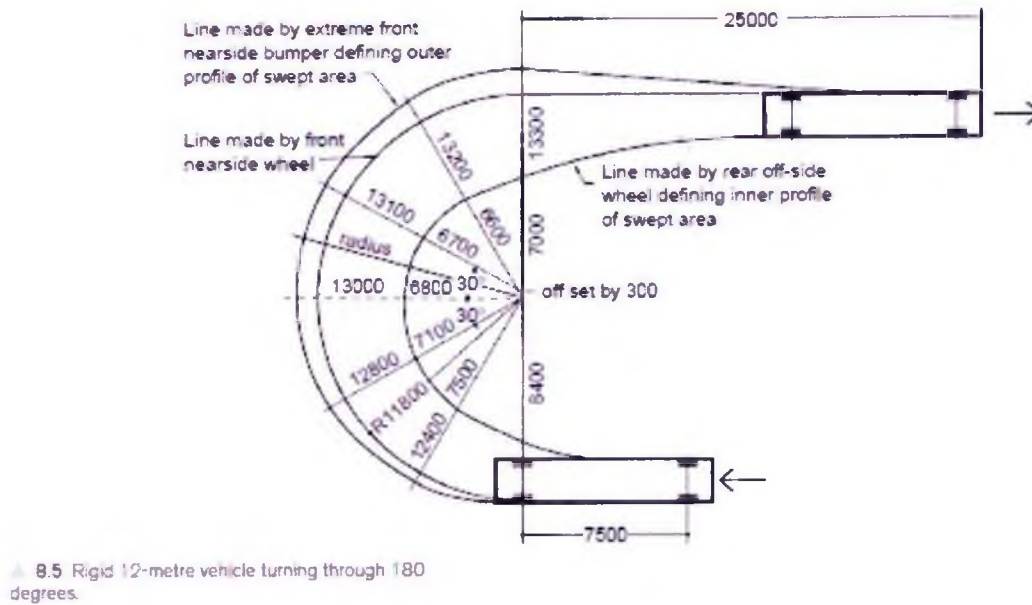


Fig 24: 180 bus turning radius

Source : Times saver's Standard for building types

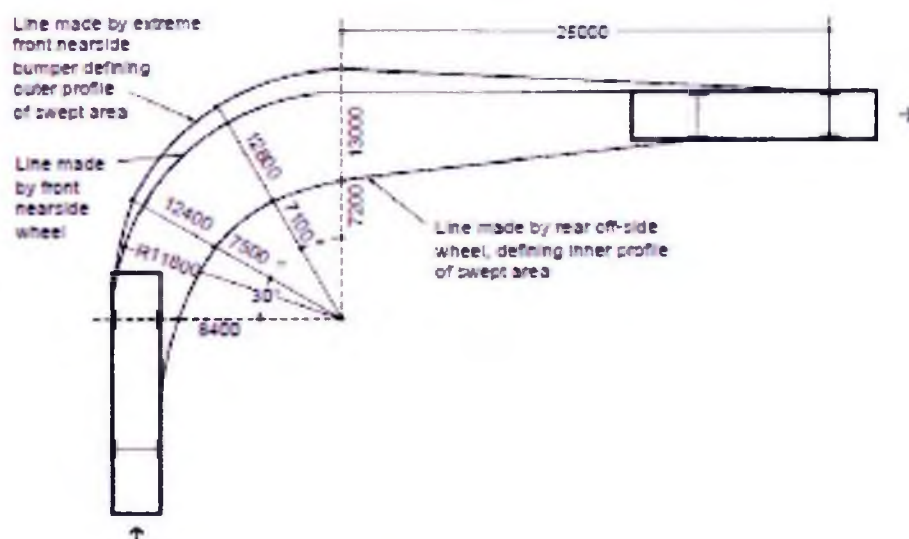


Fig 25: 90 bus turning radius

Source : Times saver's Standard for building types, 2nd edition, 1987

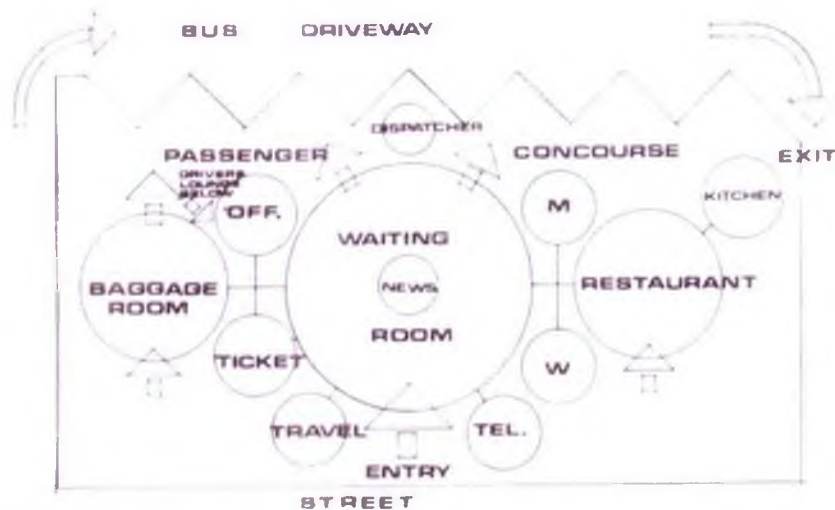


Fig 26: Flow chart of Bus terminal

Source : Times saver's Standard for building types, 2nd edition, 1987

3.5 Standard dimensions for petrol pump

Planning- The size of facilities is determined by location, ease of access, typical traffic flows and competitors. Entrance and exits must allow easy steering onto the site and space is needed for cars to queue while waiting for a vacant pump; it should also be easy to steer away from the pump, with no obstruction of exits and good visibility when pulling out onto the road. Provide good entry/exit sight-lines. Access may be by one-way flow onto the site or combined in-and-out routes, depending on the location (e.g. approaching a roundabout).

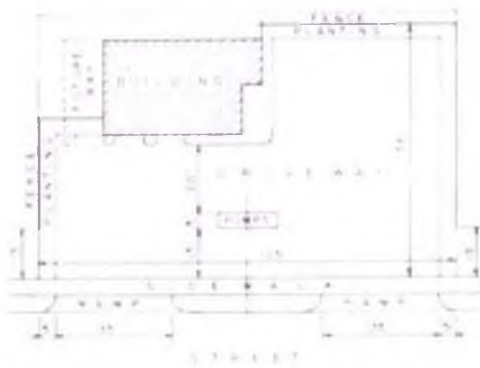


Fig. 2. Plan of service station with one pump island, midblock location

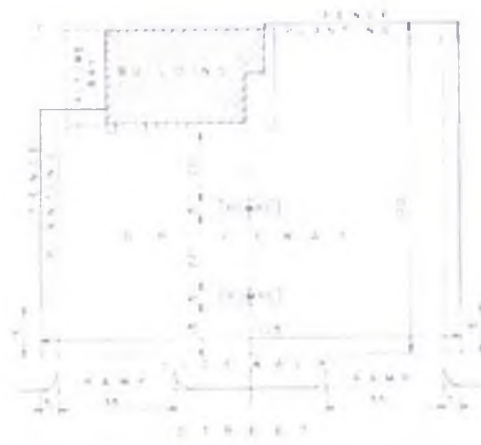


Fig. 3. Plan of service station with two pump islands, midblock location

Fig 27: Single & Double pump Planning

Source : Times saver's Standard for building types, 2nd edition, 1987

CHAPTER 04: Case Study

4.1 Case Study 1 : Rosa Parks Transit Center

Architects: FTL Design Engineering Studio

Location: Detroit, USA (United States of America)

Project Architect: Parson Brikerhoff

Project area: 4,645 sqm

Budget: \$22.5 Million USD

Project year: 2009

Fabric: PTFE glass (Polytetrafluoroethylene)

Photographs: FTL Design Engineering Studio



Fig 28: View from top
Source: www.archdaily.com

FTL created a single sustainable skin to define space, washed with day lighting and harvesting rain water. Transcending infrastructure to sculpture.

The new Rosa Parks Transit Center includes a passenger terminal and roof canopy covering a drop off and outdoor waiting area which will play a pivotal role in providing alternate means of public transportation to the greater Detroit area. The project brief was simple: a permanent roof structure, to withstand harsh weathers, durable, easy to maintain, inexpensive and unique.

4.1.1 Planning

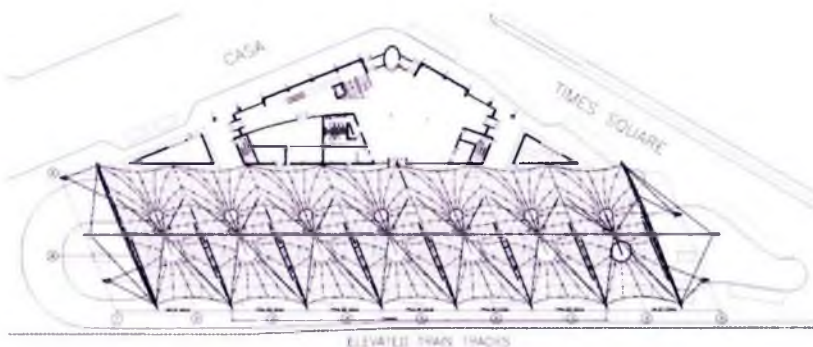


Fig 29: Top View Plan
Source: www.archdaily.com



Fig 30: 2nd floor Plan
Source: www.archdaily.com

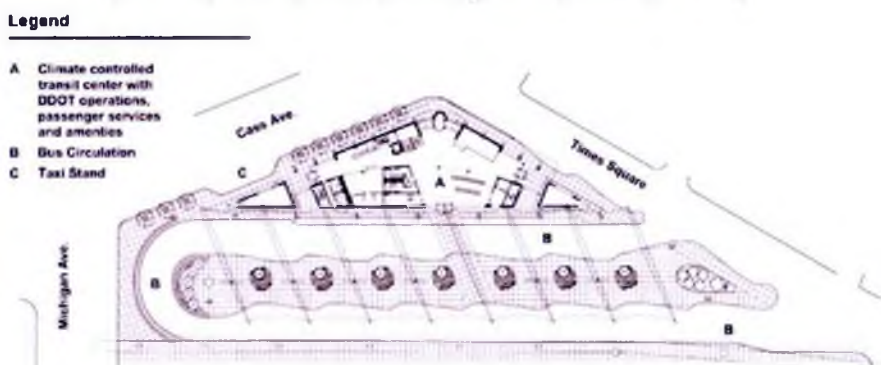


Fig 31: 1st floor Plan
Source: www.archdaily.com

To create rhythm, the proposed scheme was broken down into seven repetitive bays, each approximately 110' long and 50 ft wide. Each bay is comprised of two trusses, an A frame and fabric which is pulled down, transforming the roof into a wall and encompassing a courtyard.

The front canopy structure works as the passenger concourse and has bus bays. Whereas the structure behind accommodates passenger seating, driver's rest room, retail outlets, building services, office, taxi stand and some other ancillary facility for the bus terminal.

4.1.2 Structure

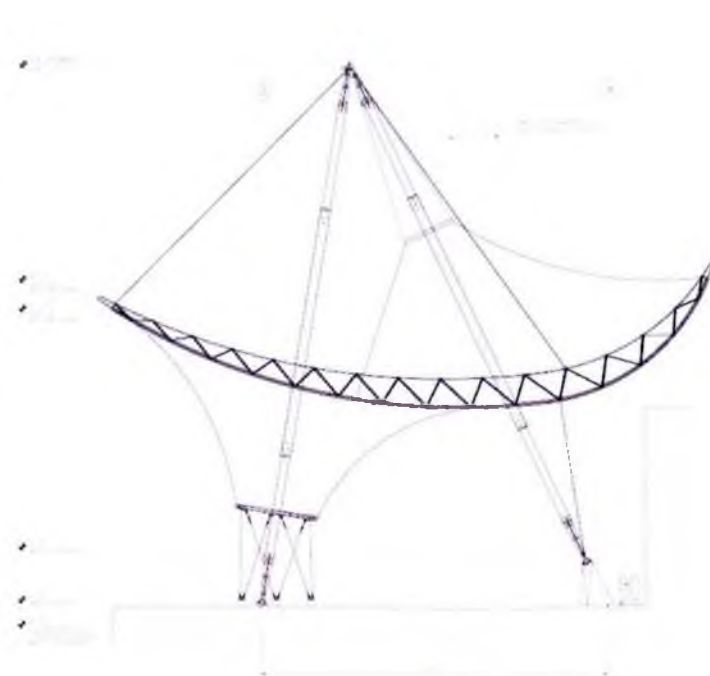


Fig 32: section showing structure
Source: www.archdaily.com



Fig 33: Structural Detail
Source: www.archdaily.com

FTL developed a design approach that uses flowing canopies to create an active visual space and naturally day light space which challenges the conventional notion of roof

where the membrane both hovers 50 ft in space, and in other areas brought to ground and to act as a giant water collector.

The PTFE fabric is supported on steel truss and tension cord.



Fig 34: Different views of the canopy structure
Source: www.archdaily.com

4.1.3 Material

- Structural system: Reinforced concrete Steel frame
- Exterior cladding Metal/glass curtain wall: Vistawall
- Concrete: St. Mary's Cement
- Roofing Elastomeric: Carlisle
- Metal: Firestone
- Windows Aluminum: Vista Wall
- Glazing Glass: PPG Industries
- Fire Glass: Safti
- Skylights: Action Bullet Resistant

4.1.4 Findings

- It has a simple functional flow in systematic way

- The bus terminal has separate layovers for departing & arriving buses
- Terminal uses most of the time glasses as partition to achieve clarity between the spaces.
- To create ventilation for openness the bus terminals is shaded by the use of canopy which creates a dynamic shaded space.
- The ticket counters is in the building adjacent to passenger course.
- The circulation pattern for buses entry and exit follows one-way rule
- There is no provision for overnight parking.
- There is waiting & resting facilities to ensure the passenger comfort.
- The public vehicle facilities like taxi, auto-stand, and private car are is present to facilitate the passengers in terminal.

4.2 Case Study 2: Transbay Transit Terminal

Location : **San Francisco**

Architect : **Pelli Clarke Pelli Architects**

AREA : **5.4 acre**

Budget : **\$170 million** given by the Transportation Infrastructure Finance and Innovation

Act Completion date : **2014**



Fig 35: View of Transbay terminal

Source: www.archdaily.com

The Transbay terminal concept design is forward-looking and generous, responding to emerging modes of living and working while allowing room for growth and change that cannot be fully anticipated. It envisions a terminal that will serve the whole Bay

region, and the growing network of public transportation services, with a building that expresses the importance of the public's arrival in one of the world's great cosmopolitan cities.

The terminal will include wind turbines, geothermal heating methods and a gray water recycling system. The hub will be a strong message that green technology can successfully be combined with modern transportation

4.2.1 Planning

By 2010, the Transbay Terminal will have become a marketplace of public transportation, the place to get anywhere, anytime. New high-rise, mixed-income housing in the surrounding neighborhood, the possibility of new office space, a major new hotel and downtown conference and educational facilities will draw an 18-hour population into the terminal to use its services, enjoy its retail and restaurants, and carry on the commerce of a great city.



Fig 36: Location map of transbay terminal
Source: www.archdaily.com

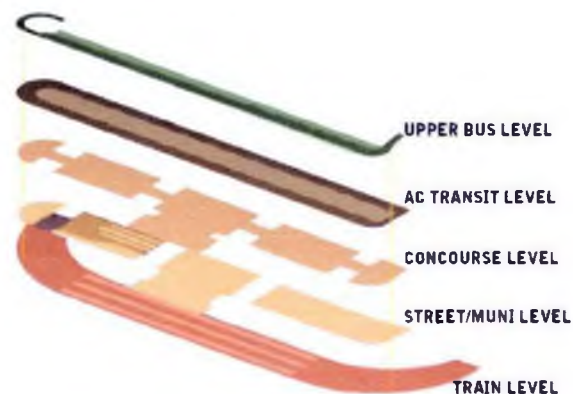


Fig. 5 Transbay Terminal levels

Fig 37: Sectional Zoning
Source: www.archdaily.com

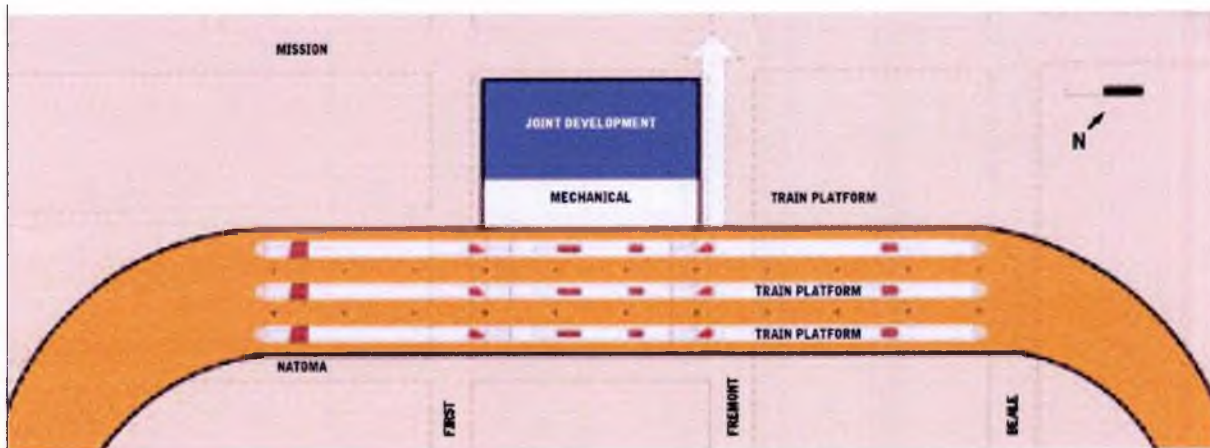


Fig 40: Plan at -30'
Source: www.archdaily.com



Fig 41: Plan at +40'
Source: www.archdaily.com

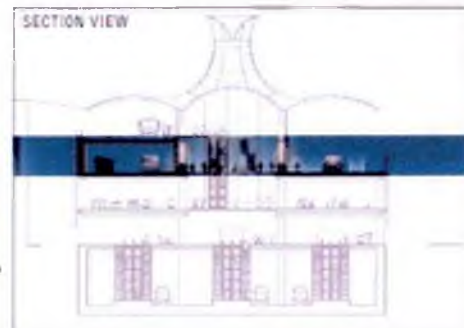


Fig 42: Section Showing bus terminal Level
Source: www.archdaily.com

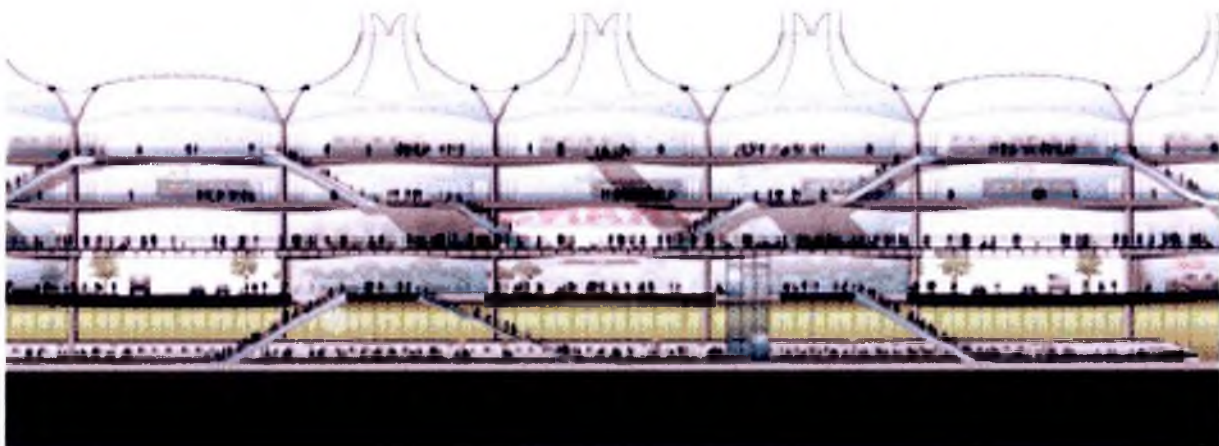


Fig 43: Section looking toward north
Source: www.archdaily.com

4.2.2 Structure & Environmental Consideration

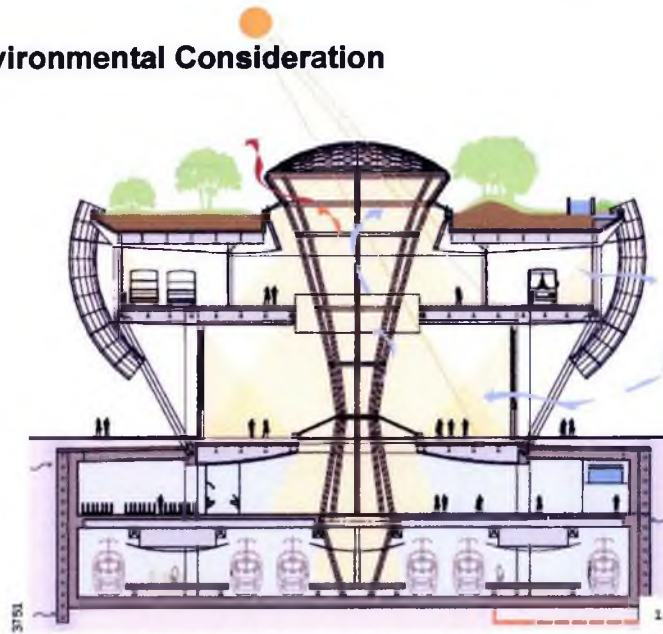


Fig 44: Section looking toward west

Source: www.archdaily.com

Structure : Steel, reinforced concrete

Environmental section : Daylight, natural ventilation, geothermal energy, green roof and water reuse are integrated into the building.

Water reuse strategies : The proposed strategy achieves a 54% reduction in domestic, mechanical, and irrigation water use. The roof park is designed to biologically filter greywater, storm water is captured and reused for toilet flushing.

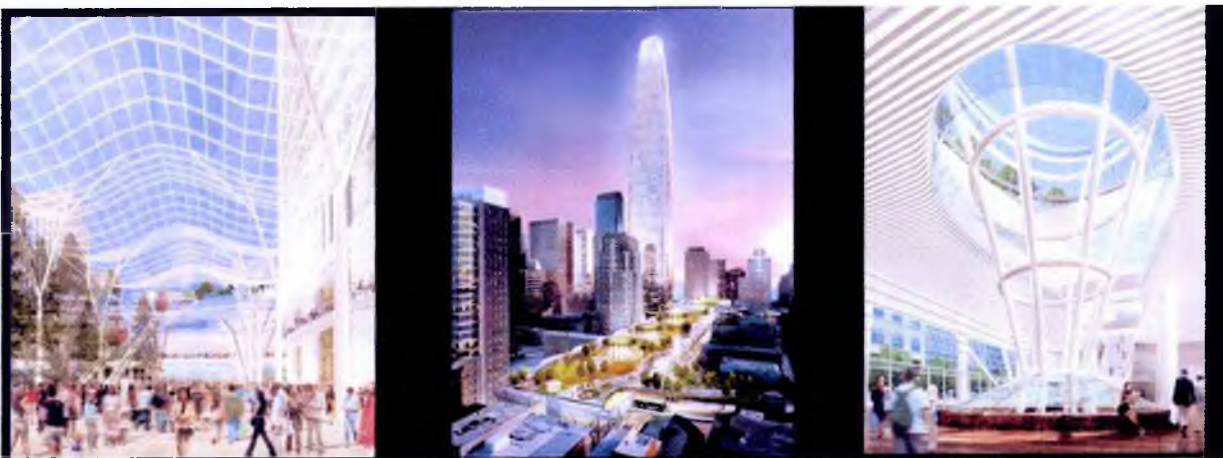


Fig 45: Different views of the structure

Source: www.archdaily.com

4.2.3 Findings

- It is integrated transport system containing subway and bus terminal
- The building has public function like shops & other commercial facilities.
- The bus terminal has separate layovers for departing & arriving buses
- The terminal building is highly energy efficient as it has Daylight, natural ventilation; geothermal energy, green roof and water reuse are integrated into the building.
- The entire terminal is landscaped on the roof, which provides public space for the entire community.
- The Terminal uses as partition to achieve clarity between the spaces.
- The circulation pattern for buses entry and exit follows one-way rule
- There is no provision for overnight parking.
- There is waiting & resting facilities to ensure the passenger comfort .
- The public vehicle facilities like taxi, auto-stand, and private car are is present to facilitate the passengers in terminal.

4.3 Case Study 3: Mohakhali Bus Terminal

Location : Mohakhali, Dhaka, Bangladesh

Client : Dhaka City Corporation



Fig 46: Mohakhali Bus terminal
Source: Afrose, 2009

Mohakhali Bus terminal is situated at the prime location of Dhaka, adjacent to the Mohakhali Rail crossing and flyover. It is a well maintained bus terminal among the terminals situated in Dhaka. It has proper circulation pattern and well guided management for which the terminal works very well among the other terminals. It has other facilities like shops, mosque etc which a terminal requires.

4.3.1 Planning

- The circulation planning of Mohakhali bus terminal is properly designed
- There are separate ticket counter & departure shed divided according to districts.
- There are separate entry & exit points for the terminal buses

- There is separate drop for the passenger vehicle, coming via car, rickshaw or auto-rikshaw.



Fig 47: Plan of Mohakhali Bus terminal
Source: Mohakhali bus terminal authority.



Fig 48: Passenger waiting lounge
Source: Afrose,2009

Fig 49: Bus parking
Source: Afrose,2009

- the long distance buses have facility for overnight parking
- the waiting lounge & public toilet is not maintained properly, but is in better state than other terminals of the city.
- there is a auto-rikshaw terminal which helps passenger to find connecting vehicle after getting down from the bus easily



Fig 50: Bus parking under canopy
Source: www.panoramio.com



Fig 51: Vaulted Structure
Source: Afrose, 2009

4.3.2 Structure & Material

Structural system : Concrete column & beams

Canopy Material : Vaults are made of concrete but vertically covered by ceramic bricks

Mohakhali bus terminal has vaulted sheds for the departing and arriving buses and passengers. This acts as the canopy for shed.

4.3.3 Findings

The observations made from the study of the projects are

- Every bus terminal has a simple functional flow in systematic way
- The bus terminal has divided layovers for departing & arriving buses
- To create ventilation & openness maximum numbers of bus terminals are shaded by the use of vaulted structure canopy.
- The ticket counters are adjacent to the lounge and bus departure space.

- The circulation pattern for buses entry and exit follows one-way rule
- There are facilities for overnight parking is present.
- There are waiting & resting facilities to ensure the passenger comfort.
- The public vehicle facility like auto stand is present in the terminal.
- The public toilet is not maintained properly
- Shops & ancillary commercial facilities are needed with the terminal.

CHAPTER 5: Program & Development

5.1 Program and Development

i. Inter – district bus Service.....	16968 sft
ii. International Bus Service.....	5100 sft
iii. Common facilities.....	116300 sft
Total area.....	157200 sft

5.2 Program Rationale

5.2.1 Bus Parking Rationale

Buses from Motijheel International goes to interdistrict & international routes.

Currently buses from terminal goes to seven inter-district routes, which are Narsinghdi, Narangang, Komlakanda, Mymensingh, Madan, Mahangang, Munsigang. but the proposed route are Dhaka- Narsinghdi, Madan, Mahangang, Narangang, Komlakanda, Mymensingh, Mawa, Companigang, Kishorgang.



Map 15: Proposed Inter-district Route

Source: Hoque, 2011

Departure from	Destination	Proposed No of busses	Travelling time (hrs)
Dhaka	Narsinghdi	20	2
Dhaka	Komlakanda	10	6
Dhaka	Mymensingh	20	5
Dhaka	Madan	5	6
Dhaka	Mahangang (via Netrokana)	10	6
Dhaka	Comilla-Kompanigang	20	6
Dhaka	Gulistan-Mawa	10	2
Dhaka	Brahmanbaria	25	6
Dhaka	Kishorgang(via Pubail)	20	5

Table 01: Proposed no of buses going to each International Route
Source: Sm Faisal Alam, Brtc, director (admin & operation)

The proposed international routes from the terminal are Shilliguri, Agartala, Koltata, Timbu(Bhutan), Katmandu (Nepal).



Map 16: Proposed International Route
Source: Hoque, 2011

INTERNATIONAL BUS SERVICES			
Departure from	Destination	Proposed No of busses	Travelling time (hrs)
Dhaka	KOLKATA	4	12
Dhaka	Agartala	4	10
Dhaka	Shilliguri	4	12
Dhaka	Katmandu(Nepal)	4	15
Dhaka	Thimpur(Bhutan)	4	12

Table 02: Proposed no of buses going to each International Route
Source: Sm Faisal Alam, Brtc, director (admin & operation)

Everyday around two hundred buses will arrive and depart from the terminal. According to the new proposal number of buses going north is. The table below shows per hour arrival and departure of buses which will form the basis of the program calculation of the terminal.

Time	Arrival	Departure	No of bus parking	Arrival + Departure of buses per hour
5:00-6:00			160	0
6:00 – 7:00	2	19+5	138	26
7:00– 8:00	3	18+5	118	26
8:00 –9:00	5	18	105	23
9:00– 10:00	5	18	92	23

Time	Arrival	Departure	No of bus parking	Arrival + Departure of buses per hour
9:00–10:00	5	18	92	23
10:00–11:00	5	16	81	21
11:00 – 12:00	5	8	78	13
12:00 – 13:00	24	13	89	37
13:00–14:00	22	22	89	44
14:00 – 15:00	21	22	88	43
15:00 – 16:00	21	22+2	85	69
16:00 – 17:00	8	23+3	67	34
17:00–18:00	10	23	54	33
18:00 – 19:00	17		71	17
19:00-20:00	17+4		92	21
20:00–21:00	12+4		108	16
21:00 – 22:00	12+2		122	14
22:00 – 23:00	12		134	12
23:00 – 24:00	8		142	8

Table 03: Proposed arrival & departure of buses According to time
Source: Sm Faisal Alam, Brtc, director (admin & operation)

A count of buses in the terminal premises indicates that on average there are around 140 buses parked inside the terminal in an hour. According to the count of table 03, it indicates that in peak hour between 15:00-16:00, the terminal accommodates around 154 buses among them 69 are in active operation, as they either arrive or depart in that hour. The rest of 85 buses are inactive, sitting idle or getting serviced. That is why separate parking lot is required for the buses, along with separate arrival & departure bays.

Design capacity for bus parking:

Peak hour (15:00-16:00) active bus parking :per hour 70

Bus waiting time:15 mins

So,Bus Standing in every 15 mins in departing and arriving lots:20

Space Needed for 20 buses: $(45' \times 13') \times 20 = 11700 \text{ sft}$

Space needed for 140 buses : $(45' \times 13') \times 140 = 81900 \text{ sqft} = 81900 \text{ sft}$

5.2.2 Passenger Lounge Demand

- Passenger lounge Demand (Inter-district)**

Peak Departing passenger : $(23 \times 52) = 1196 \text{ person}$

Average no. of passenger arriving anytime : $(12.75 \times 52) = 663$

No of passenger departing & arriving in peak hr = $(1196 + 663) = 1859 \text{ person}$

Passenger lounge facility = $1/3 \text{ of peak hour departing}$

Space needed = $1/3 \times 1196 \times 10 \text{ sft} = 3987 = 4000 \text{ sft}$

- **Passenger lounge Demand (International)**

Peak Departing passenger : $(2 \times 40) = 120 \text{ person}$

Average no. of passenger arriving anytime : $(3 \times 40) = 120$

No of passenger departing & arriving in peak hr = $(120 + 120) = 240 \text{ person}$

Passenger lounge facility = $1/3 \text{ of peak hour departing}$

Space needed = $1/3 \times 120 \times 10 \text{ sft} = 400 \text{ sft}$

5.2.3 Restaurant

- **Restaurant facility (Inter-district) = $1/4$ of peak hour departing passengers.**

$$= 1/4 (1196 \times 12 \text{ sft}) = 3600 \text{ sft}$$

Kitchen (Inter-district) = $1/3$ Of restaurant

$$= 1/3 \times 3600 = 1200 \text{ sft}$$

- **Restaurant facility (International) = $1/4$ of peak hour departing passengers.**

$$= 1/4 (120 \times 12 \text{ sft}) = 360 \text{ sft}$$

Kitchen (International) = $1/3$ Of restaurant

$$= 1/3 \times 360 = 120 \text{ sft}$$

- **Restaurant facility for crew : $100 \times 12 \text{ sft} = 1200 \text{ sft}$**

Kitchen = $1/3$ Of restaurant = $1/3 \times 1200$

$$= 400 \text{ sft}$$

5.2.4 Washroom Facility

According to standard hourly one toilet is needed in every 40 passenger

Inter-district

So, peak hour toilet needed : $1196/40 = 30$ toilets

Toilet ratio, male : female = 60:40

Gents' toilet = $60\% \times 30 = 18$

Female toilet = $40\% \times 30 = 12$

Space needed for 30 toilets = $30 \times 28\text{sft} = 840\text{ sft} = 900\text{sft}$

International

So, peak hour toilet needed : $120/40 = 3$ toilets

Toilet ratio, male : female = 60:40

Gents' toilet = 2

Female toilet = 2

Space needed for 4 toilets = $4 \times 28\text{sft} = 112\text{sft}$

5.2.5 Ratio of different modes of transport to the terminal

Car parking : 10% of peak departure = $10/100 (1196+120) = 132$

3 person for each car = $132/3 = 44$ cars

Space needed for 44 cars = $44 \times (16' \times 8') = 5632\text{sft}$

Auto rickshaw parking : 30% passenger of total passenger in peak hour

$$= 30/100 \times (1196+120) = 395$$

1 for 15 person, therefore autorickshaw needed = $395/15 = 26$

Space for parking = $26 \times (6' \times 8') = 1248\text{ sft}$

Rickshaw stand : 25% of total peak passenger =329

1 for 10 person per hour= $329/10= 33$ rickshaw

Space for parking = $33 \times (4' \times 7') = 924$ sft

5.2.6 Ticket Counter

Total area for interdistrict = $11 \times 50\text{sft} = 550$ sft

Total area for international= $3 \times 50\text{sft} = 150$ sft

5.3 Detail Program

Detail Program

Inter-district

Function	No of person	No of quantity	Area(sft)	Total area(sft)
Information booth		1	144	144
Ticket counter		11	50	550
Ticket collector room		1	200	200
Passenger lounge	400	1	10	4000
restaurant	300	1	12	3600
Kitchen(1/3 OF restaurant)		1	1200	1200
store		1		100
Security room		1	300	300
Passenger toilet	1/40pas/hr	30	28	840
Cloak room		1		1150
CONCOURSE for passenger	1196		4	4784
Newspaper stand			100	100
Total Area				16968

Function	No of person	No of quantity	Area(sft)	Total area(sft)
Information booth		1	144	144
Ticket counter		5	50	250
Ticket collector room		1	200	200
Passenger lounge	40	1	10	400
Café/restaurent	30	1	12	360
kitchen		1	120+100	220
Passenger toilet		4	28	112
Security room		1	150	150
Luggage check point & baggage collection			350	350
Cloak room			350	350
Rest rooms		10	180	1800
Office for handling international passenger		1	200	200
Tourist center		2	50	100
Passenger concourse	120		4	480
Total Area				5116

Office

Function	No of person	No of quantity	Area(sft)	Total area(sft)
Technical department	10			1000
Accounts department	8			800
Traffic department	8			800
Administration	8			800
Recruiting room		1	300	300
Meeting room	15		150	300
Control room		1	500	500
toilet		6	28	168
Training facilities		1	600	600
Circulation 30%				1580
Total Area				6848

Parking & Common bus facilities

Function	No of person	No of quantity	Area(sft)	Total area(sft)
Parking for buses		140	45x13	81900
Arriving & departing lot		20	45x13	11700
Car parking		44	16x8	5632
CNG station				4500
workshop		7	585+300	885
Spare parts storage		1	200	200
Auto parking		26	6x8	1248
Rickshaw parking		33	4x7	924
Restaurent facility for crew	60	1	12	720
kitchen		1		240
Resting p ace for driver & conductor		1	300	300
washroom		6	28	168
Total Area				108417

Common facilities

Function	No of person	No of quantity	Area(sft)	Total area(sft)
Medical room		1	500	500
Ansar camp		1	600	600
Prayer space	100	1	8	800
ATM		3	50	150
Shops		10	200	2000
		10	100	1000
Generator Room		1	500	500
Wasa pump area		1	500	500
Circulation 30%				1815
Total Area				7865

Function	No of person	No of quantity	Area(sft)	Total area(sft)
Average area of high rise facilities				12000
Grand total				157214

Table 04: Table showing detail program
Source: Hoque,2011

5.4 Program Development

5.4.1 Basic connections of the program

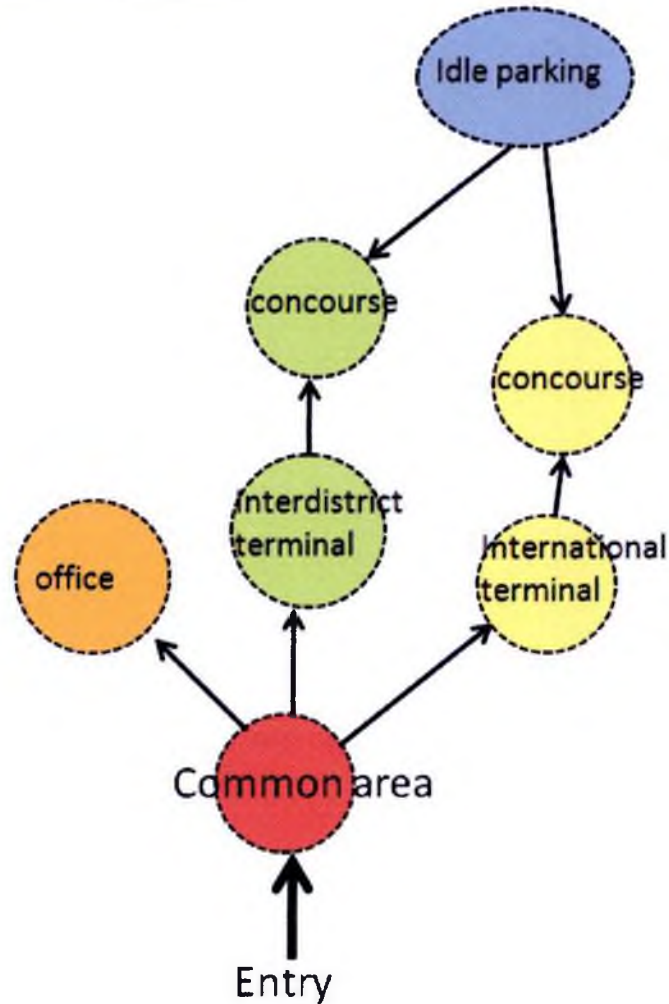


Fig52: Bubble diagram of international bus terminal
Source: Hoque,2011

The main functions for the project are the public concourse, bus concourse area and all these functions are connected by the above program flow diagram.

5.4.2 Functional flow of the project

The bus termination has an amalgamation of various functions, like separate spaces for arrival and departure, for both international and inter-district passenger, separated facilities for crew, and many more function. Thus it has to be ensured that any function doesn't disrupt the flow of any other function. The following diagram shows the functional flow diagram of the project.

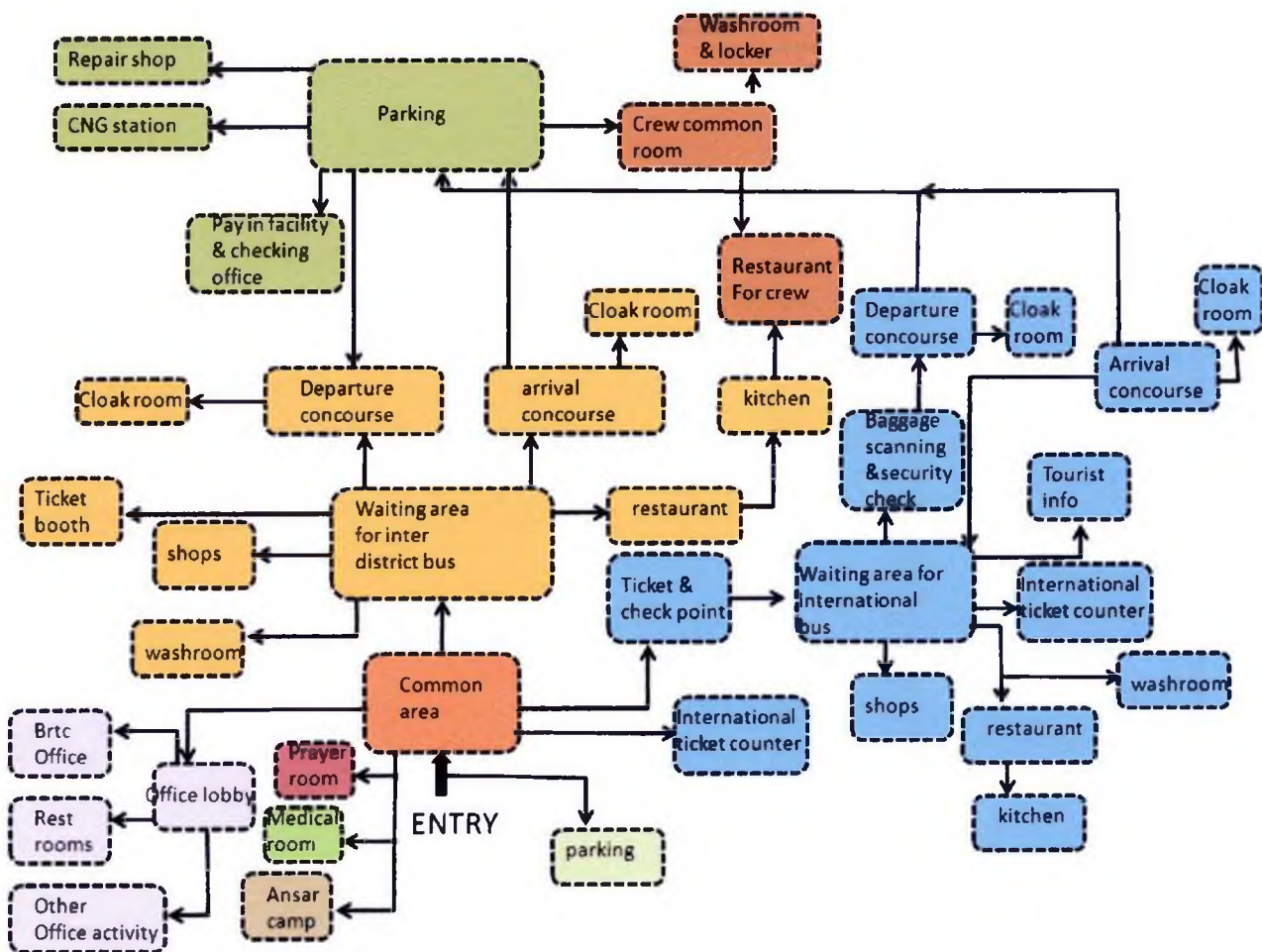


Fig 53: Functional flow diagram
Source: Hoque, 2011

CHAPTER 06

6.1 Conceptual stage

6.1.1 Zoning

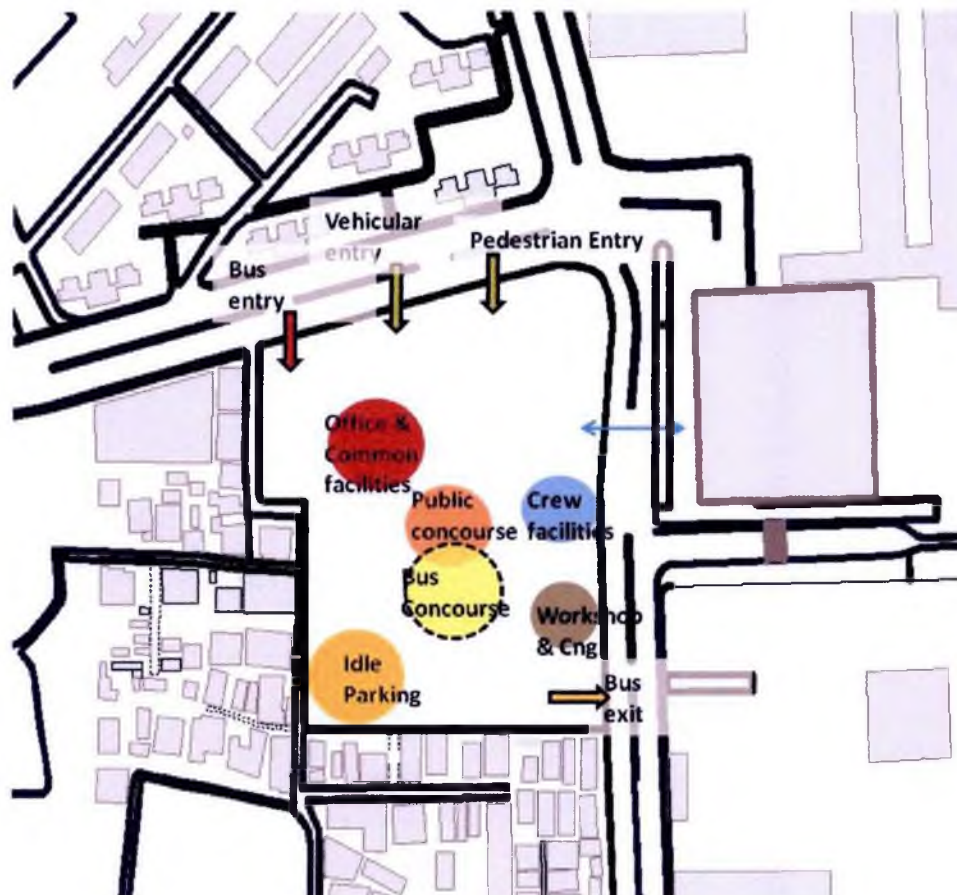


Fig 54 : Functional Zoning in the Site

Source: Hoque, 2011

6.2 Concept

BRTC International Bus Terminal is proposed in Motijheel, and this particular site in Motijheel is very interesting since it is opposite Kamalapur rail station, so there is an opportunity to combine them as an interchange facility. More over there is no public space in this area and

through this project there is an opportunity to work on urban scale and give something back for the development of this area.

6.2.1 Design Development, Phase I – Circulation of arriving & departing Buses

At the beginning of the project I analyzed government proposal for the future development of the area and developed road network pattern. The road on both sides of the site was proposed to be 100' and the station road was proposed to be joined to Gulistan Saidabad highway directly.



Map 17: Proposed Road Network
Source: Hoque, 2011

Then the percentage of buses going to each direction was calculated, and several combinations of possible arrival & departure points from the site, were experimented with.



Fig 55: Percentage of buses going in each direction

Source: Hoque, 2011

Fig 56: Conceptual Sketch

Source: Hoque, 2011

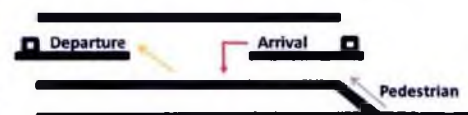


The below diagram shows initially both the arrival and departure of the buses was planned to be on same level, and arrival and departure to be from the same point on station road.



Fig 57: Proposed arrival & departure point 1

Fig 58: Conceptual section 1

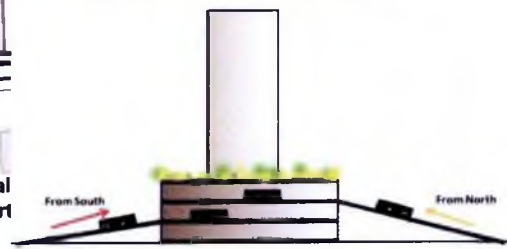


Then due to shortage of space in the site, the bus terminal was divided into tiers. Initially the tier was divided according to the direction buses were coming from, ie, north and south. A flyover was also thought off from north due higher number of buses travelling to and from that direction. The following diagrams illustrate this condition.



Fig 59: Proposed arrival & departure point 2

Fig 60: Conceptual section 2



The last circulation pattern did not solve the problem, thus the bus terminal tier was divided according to arrival and departure levels with entrance of the buses from north Kamlapur Road and departure to east Station Road. The following diagrams illustrate this condition.



Fig 61: Proposed arrival & departure point 2
Source: Hoque, 2011

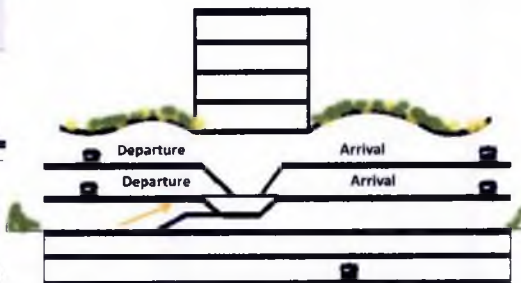


Fig 62: Conceptual section 3
Source: Hoque, 2011



Fig 63: Further development of circulation
Source: Hoque, 2011

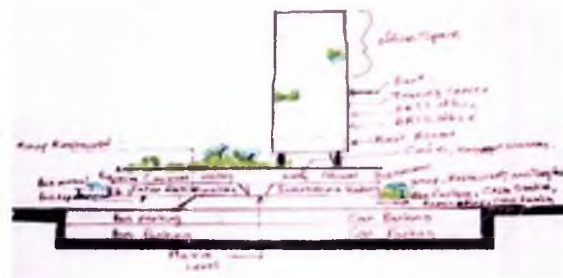


Fig 64: Conceptual section 4
Source: Hoque, 2011

6.2.2 Design Development, Phase II – Circulation, public Concourse & form development

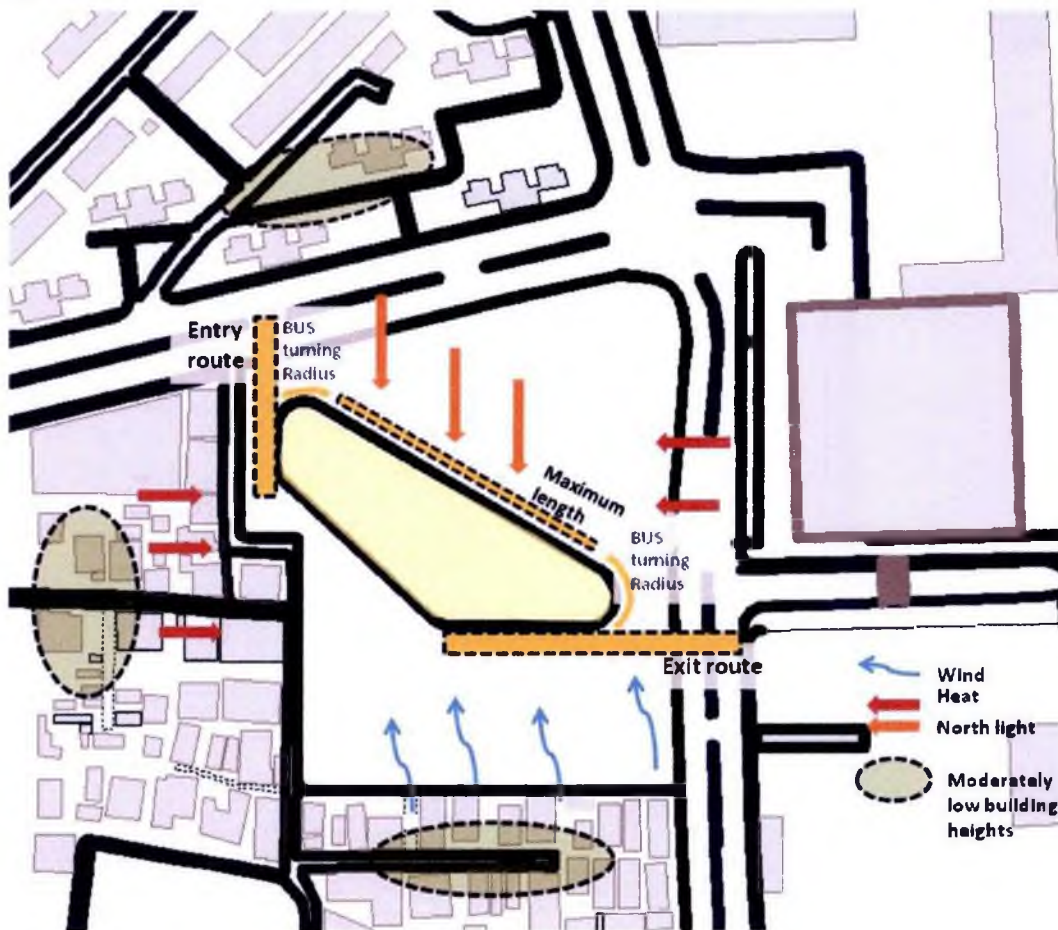


Fig 65: Site Analysis & form derivation
Source: Hoque, 2011

The final conceptual zoning of the bus terminal is shown in the following diagram.

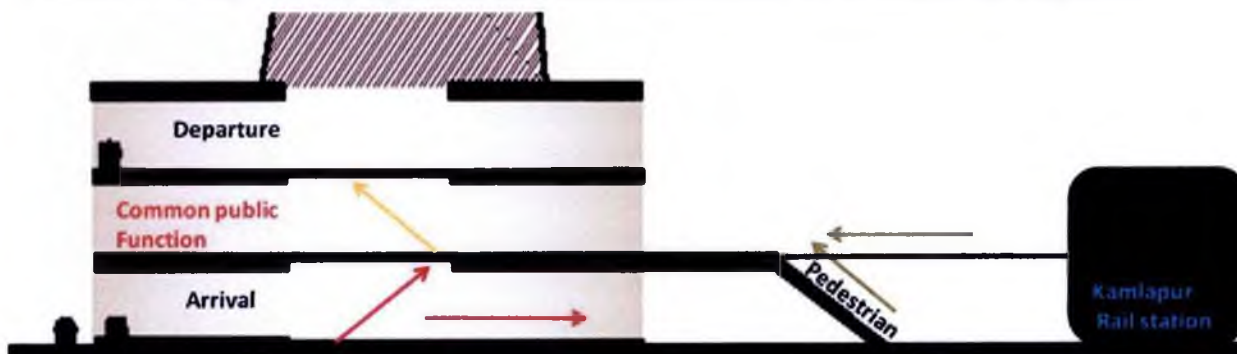
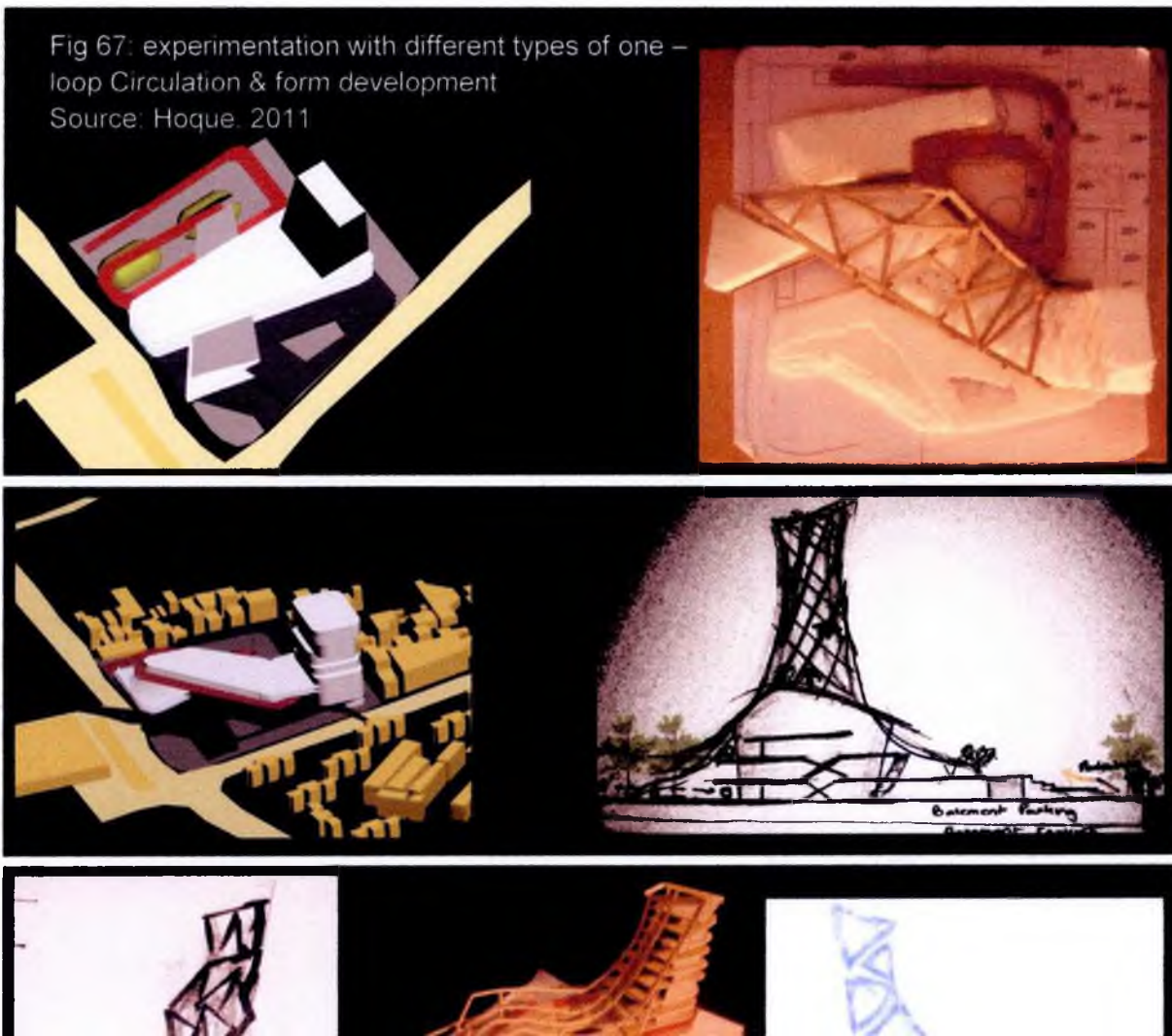


Fig66: Conceptual section 5
Source: Hoque, 2011

For a bus terminal it is very important that circulation of different modes of transportation is designated clearly & separately, and the arrival and departure bays are distinctive. So my idea was to do the zoning of the terminal in such a way that the arrival is on the ground floor and departure is on the second floor, both of which are connected by a common floor containing restaurants, shops, serving to people both coming to arrival & departure.

Fig 67: experimentation with different types of one – loop Circulation & form development
Source: Hoque, 2011



6.2.3 Design Development, Phase III – Creation of a iconic form & Structure development.

The form was thought of in such a way that it should be an iconic structure and reflect Bangladesh in a positive manner to rest of the world. Since the proposal was first of its kind in Bangladesh the form was thought as something innovative and ahead of its time. In the bus terminal, the terminal, the high-rise, the plaza was thought of as one. The form was thought of as “building as landscape”- amalgamating all its function and merging with its surrounding.

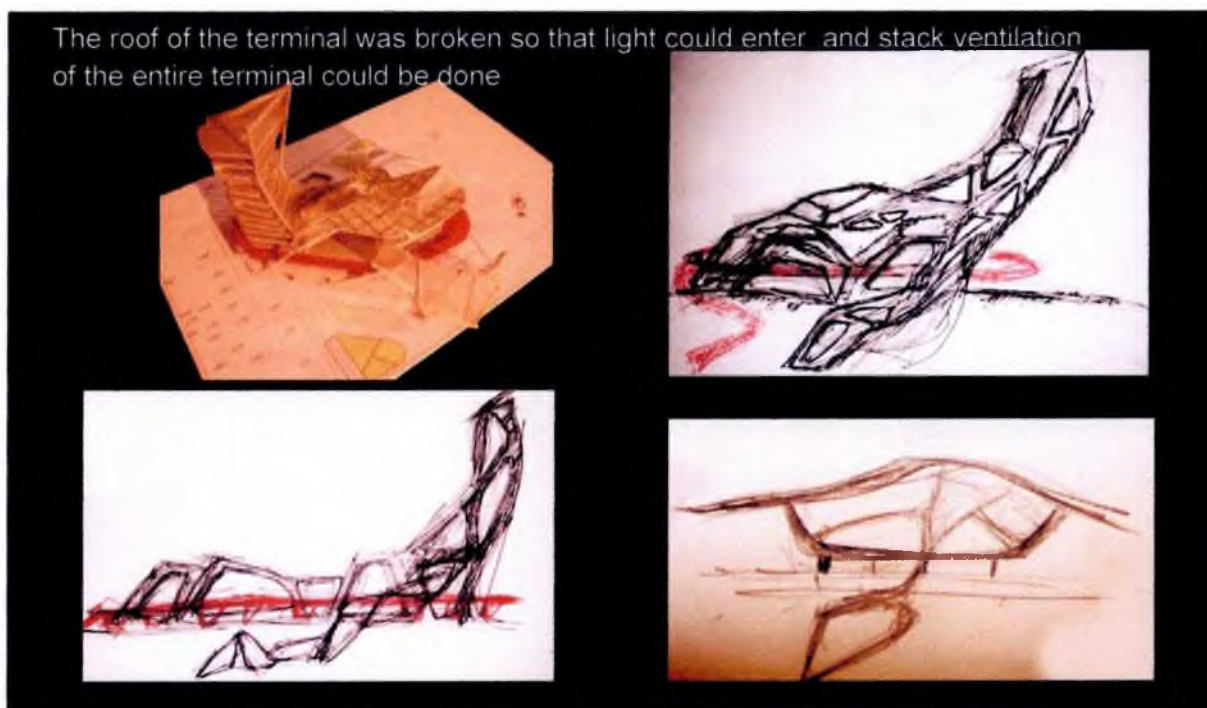


Fig 68: Development of form and structure of building
Source: Hoque, 2011

The structure was thought of as semi-monocogue, exoskeleton structure, where the building is supported form structures placed outside, connected with core to support the entire building.

CHAPTER 07: Proposed Design



Fig 70: Top view of proposed Design
Source: Hoque, 2011



Fig 71: Ground Floor Plan
Source: Hoque, 2011



Fig 72: Plan at 14'
Source: Hoque, 2011

Fig 73: Plan at 24' (Plaza floor Plan)
Source: Hoque, 2011

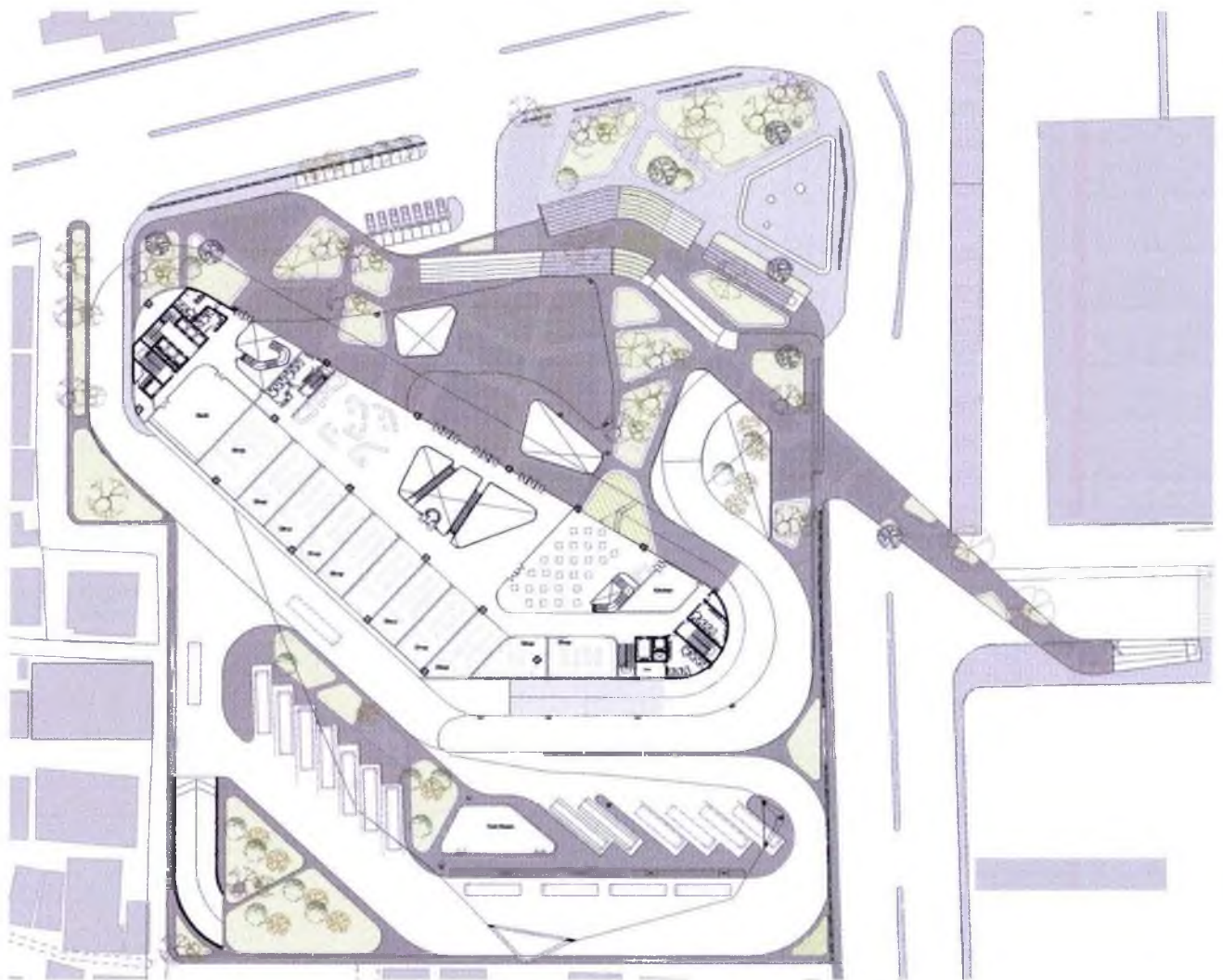




Fig 75: Plan at 60'
Source: Hoque, 2011

Fig 76: Typical Basement Floor Plan
Source: Hoque, 2011

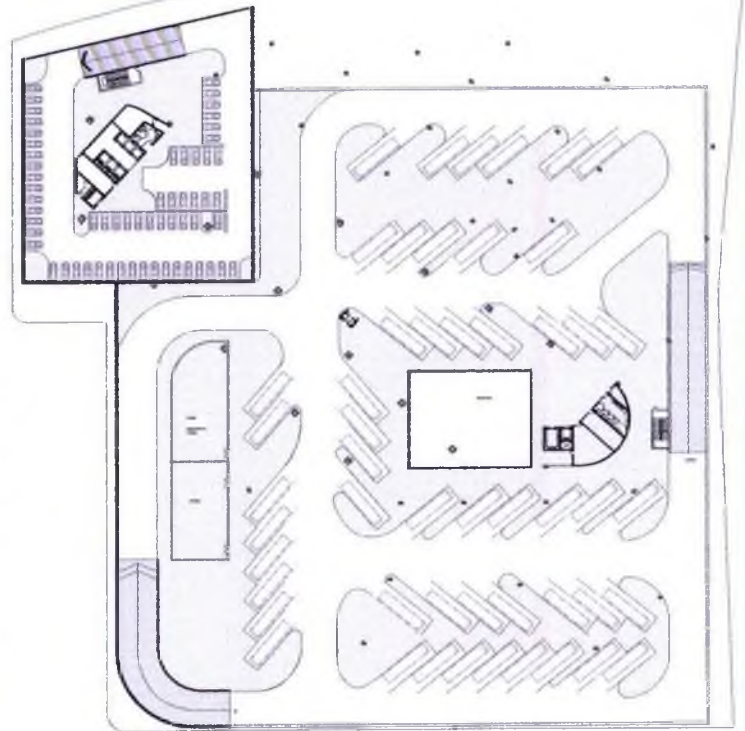
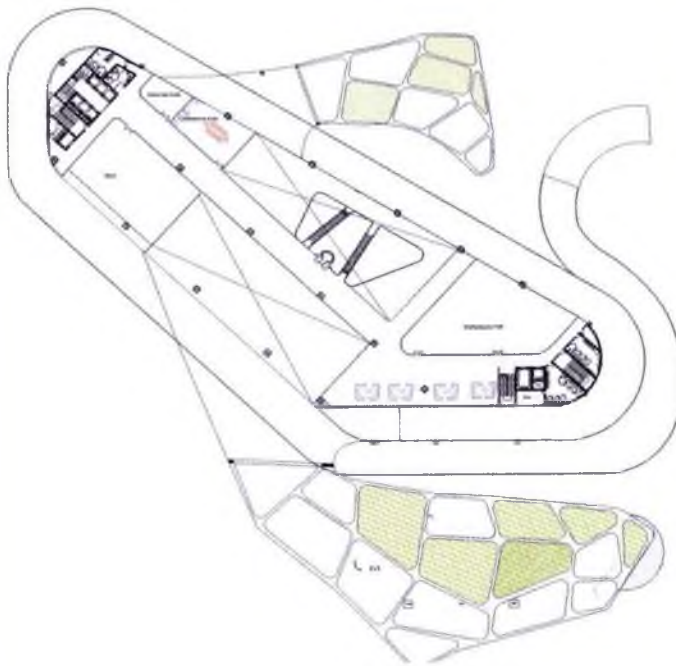


Fig 77: Circulation of buses Illustration
Source: Hoque, 2011

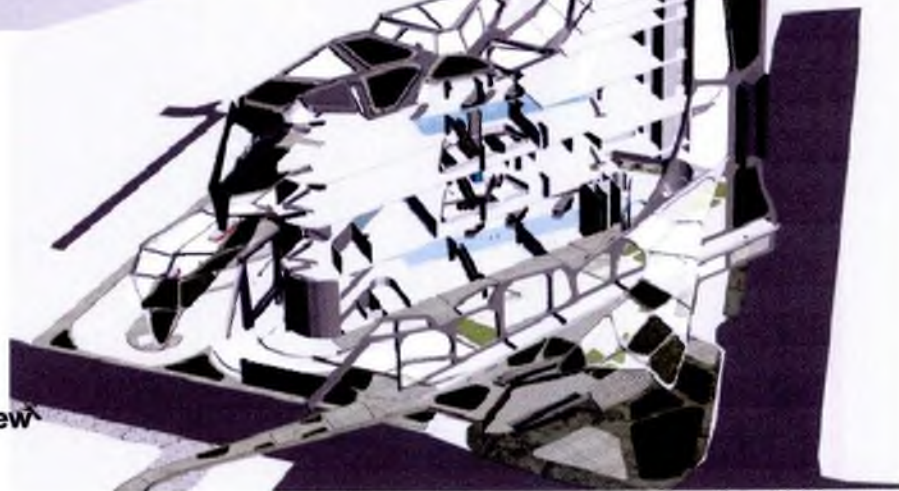
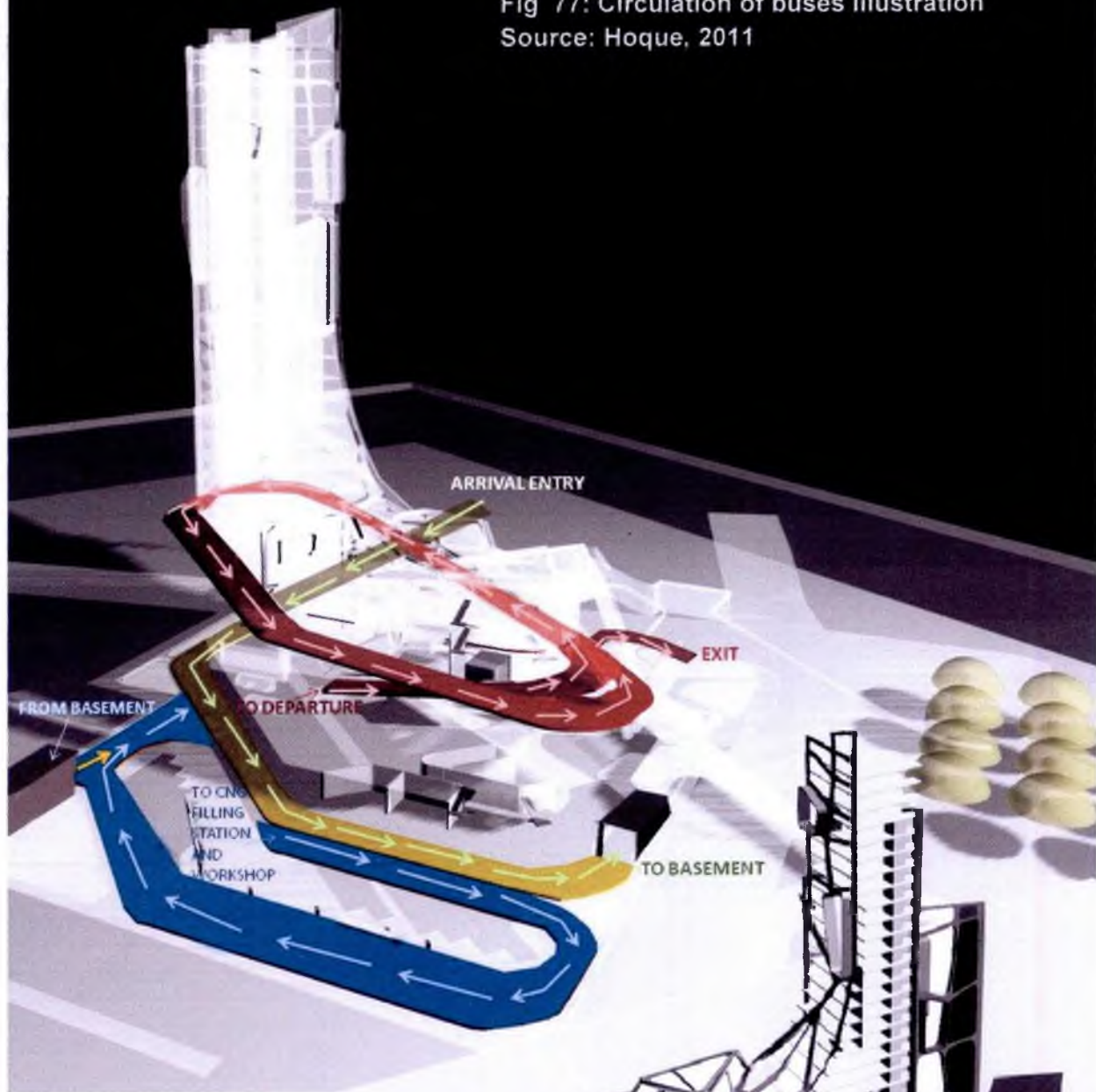
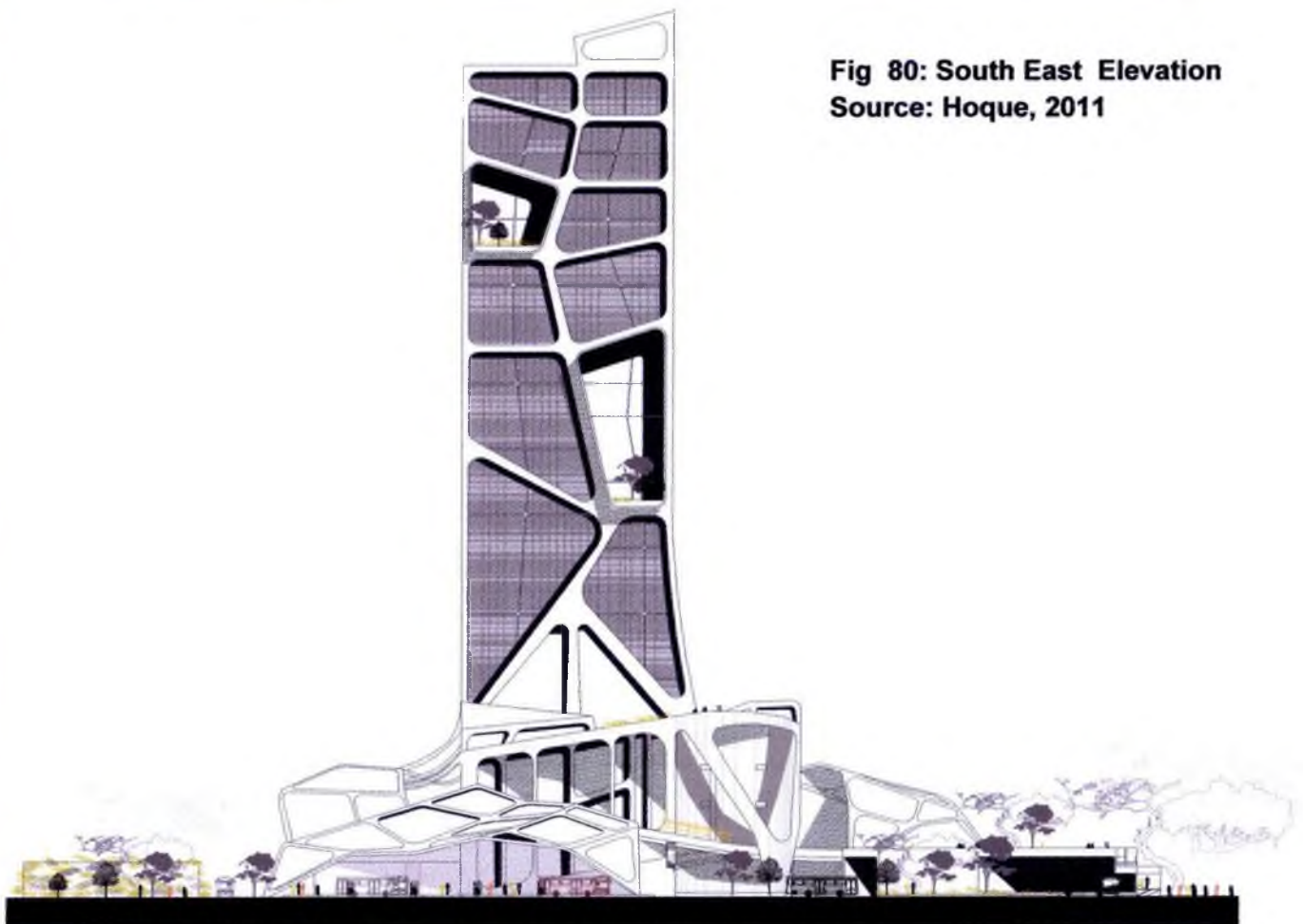


Fig 78: Axonometric view
Source: Hoque, 2011

Fig 79: North East Elevation
Source: Hoque, 2011



Fig 80: South East Elevation
Source: Hoque, 2011



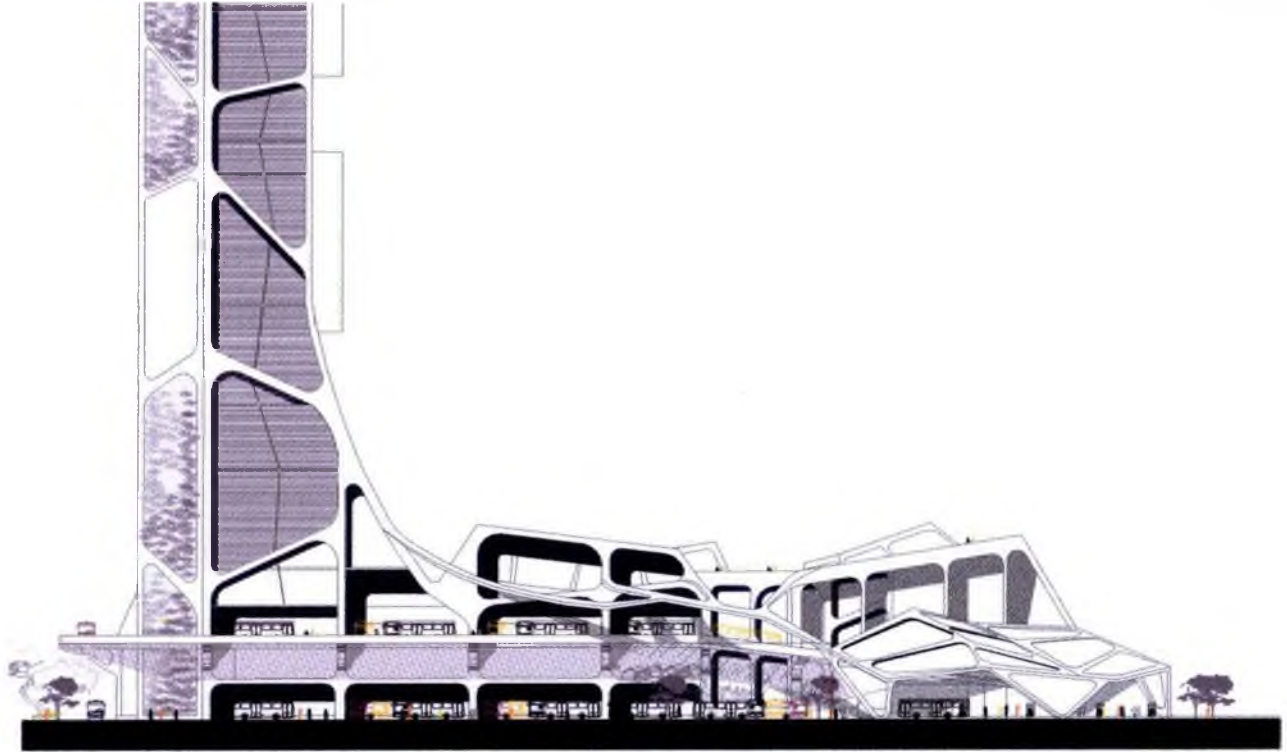


Fig 82: North West Elevation
Source: Hoque, 2011





Key Plan

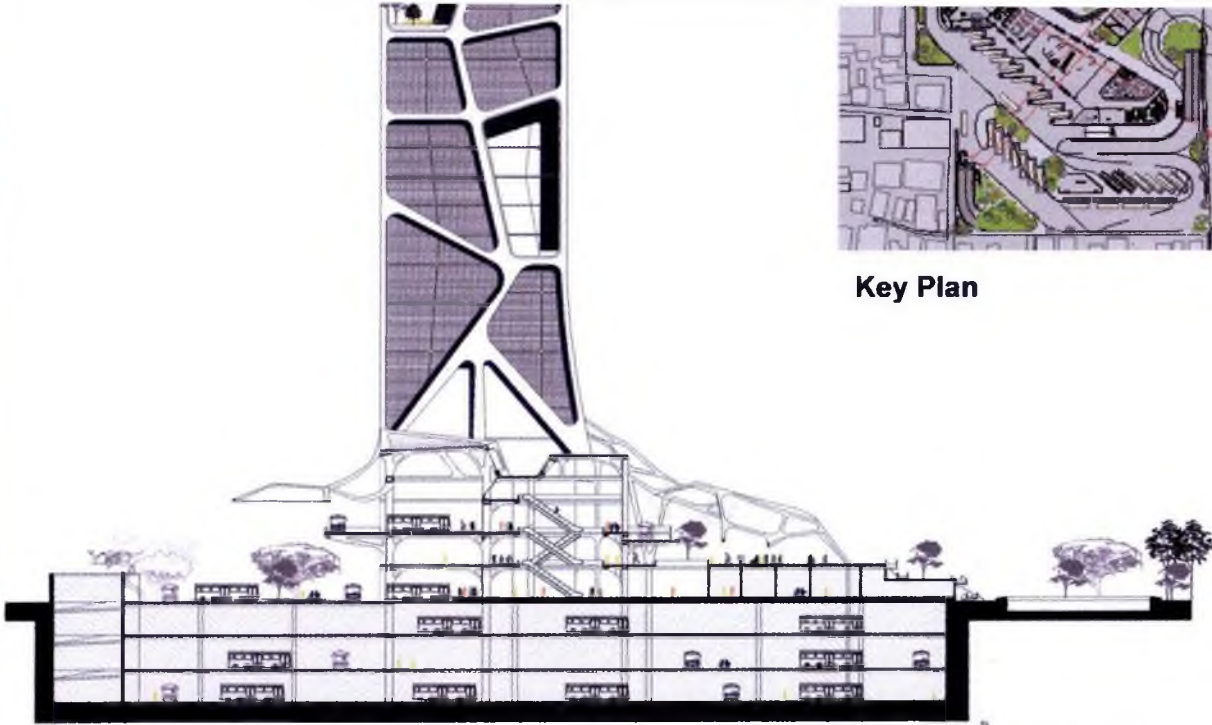
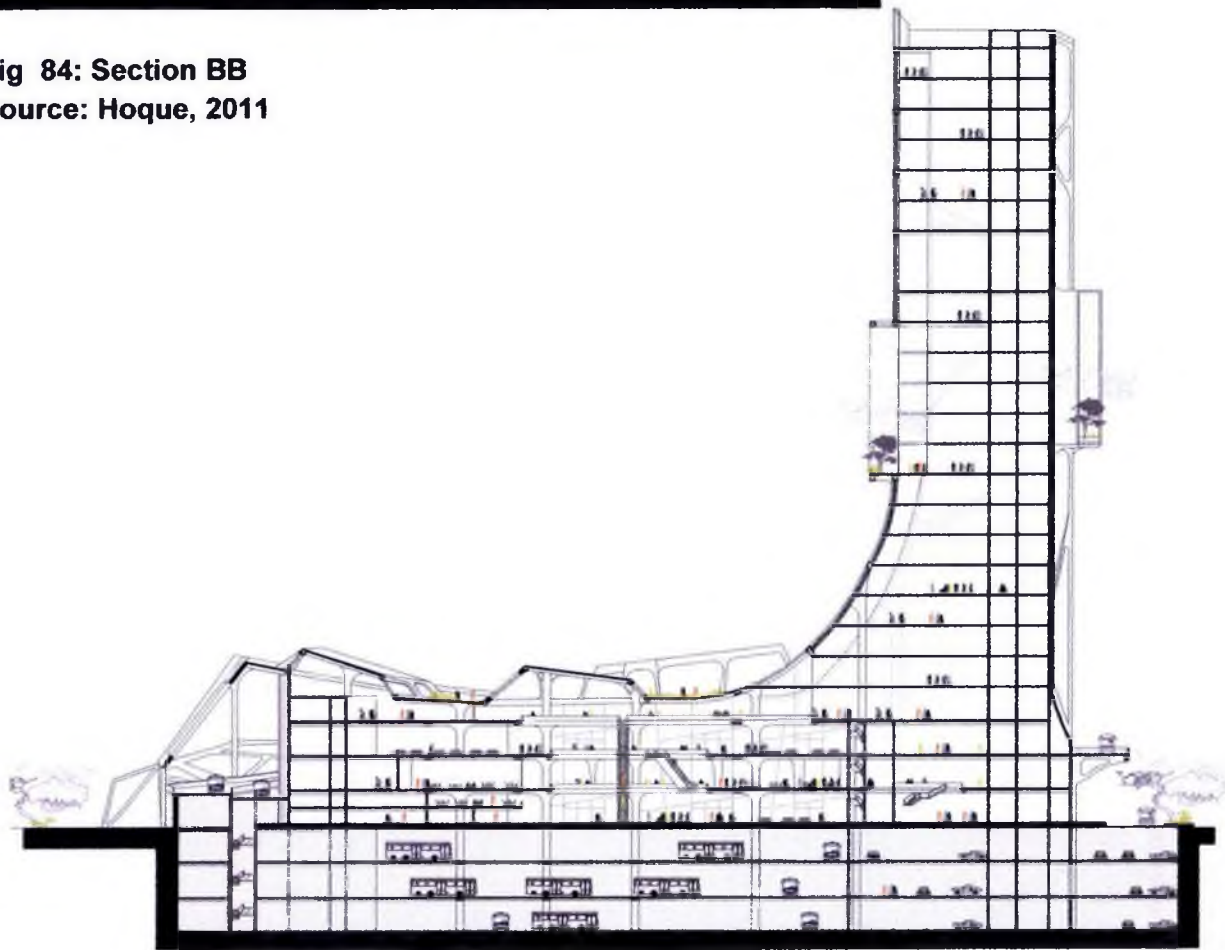
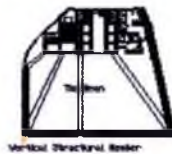


Fig 84: Section BB
Source: Hoque, 2011

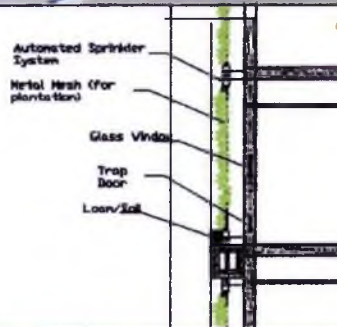
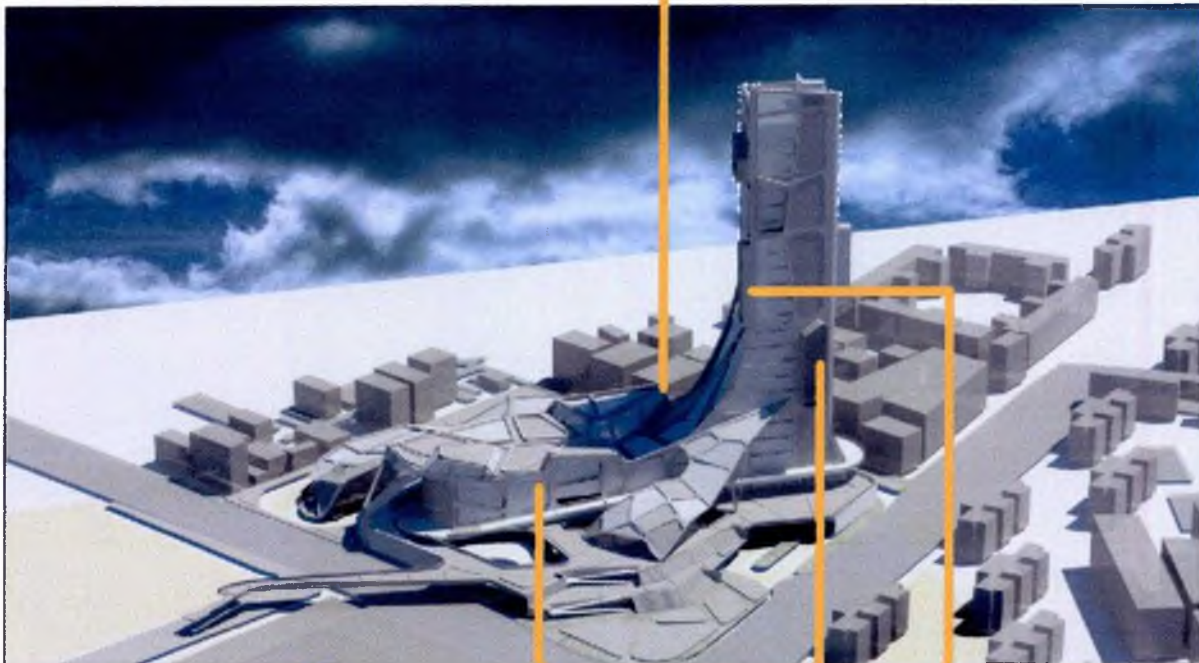
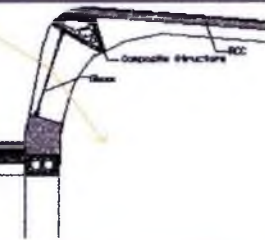
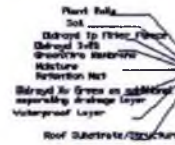




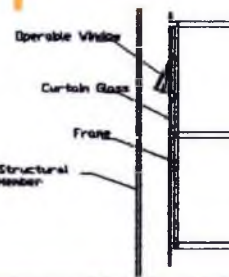
The structure of the International Convention Center is a semi-shell structure where the entire major part of the building is carried by the structure outside and the core.



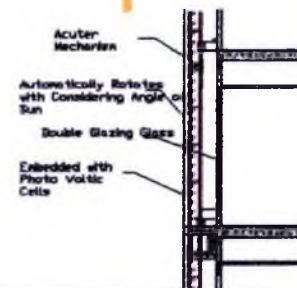
Vertical Structural Member



Green Facade detail



Terminal Facade detail



Highrise Facade Detail



Typical Floor Plan of office

Scale: 1/32" = 1'-0"



Typical Structural Member Section



Canopy Structure Detail

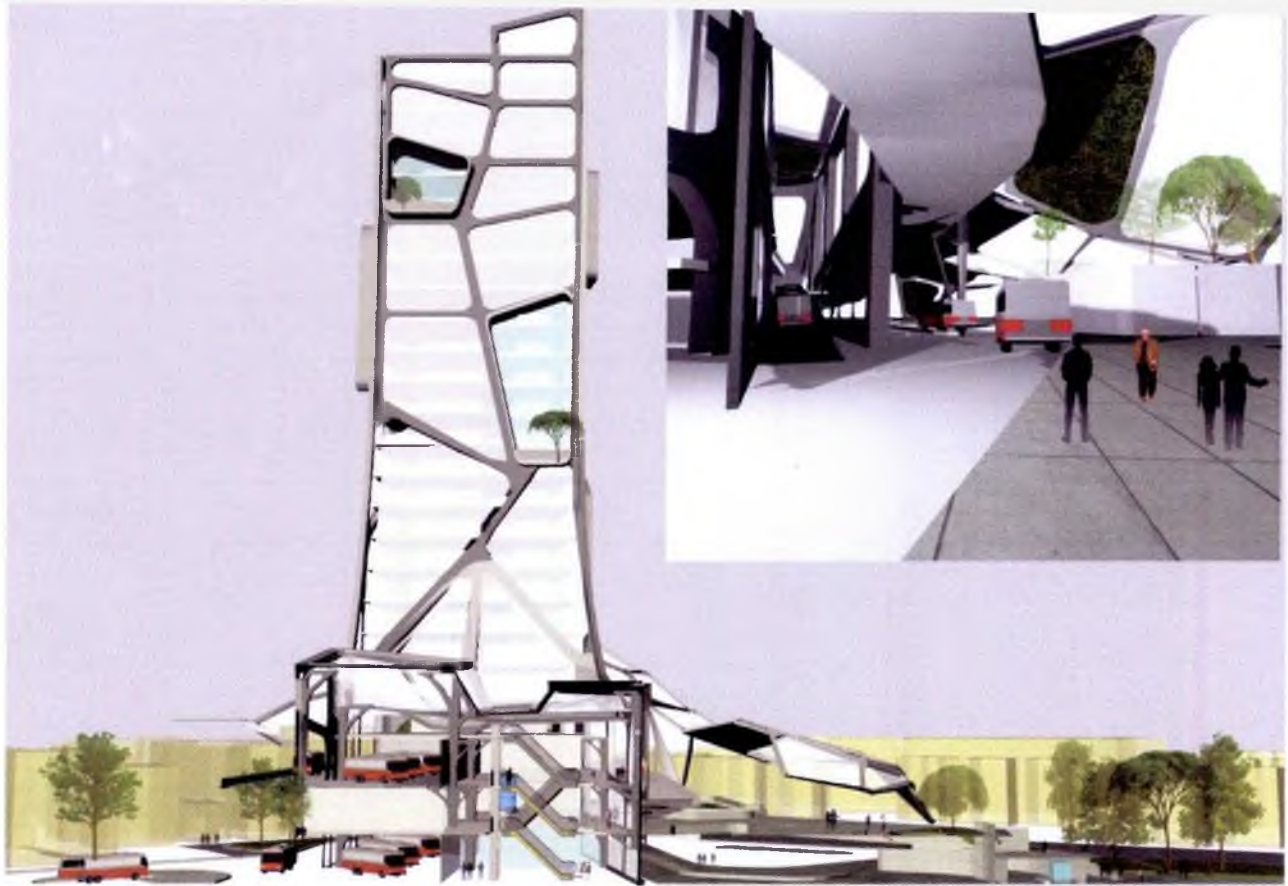


Fig 86: Sectional perspective cc
Source: Hoque, 2011

Fig 87: 3-d Night View
Source: Hoque, 2011



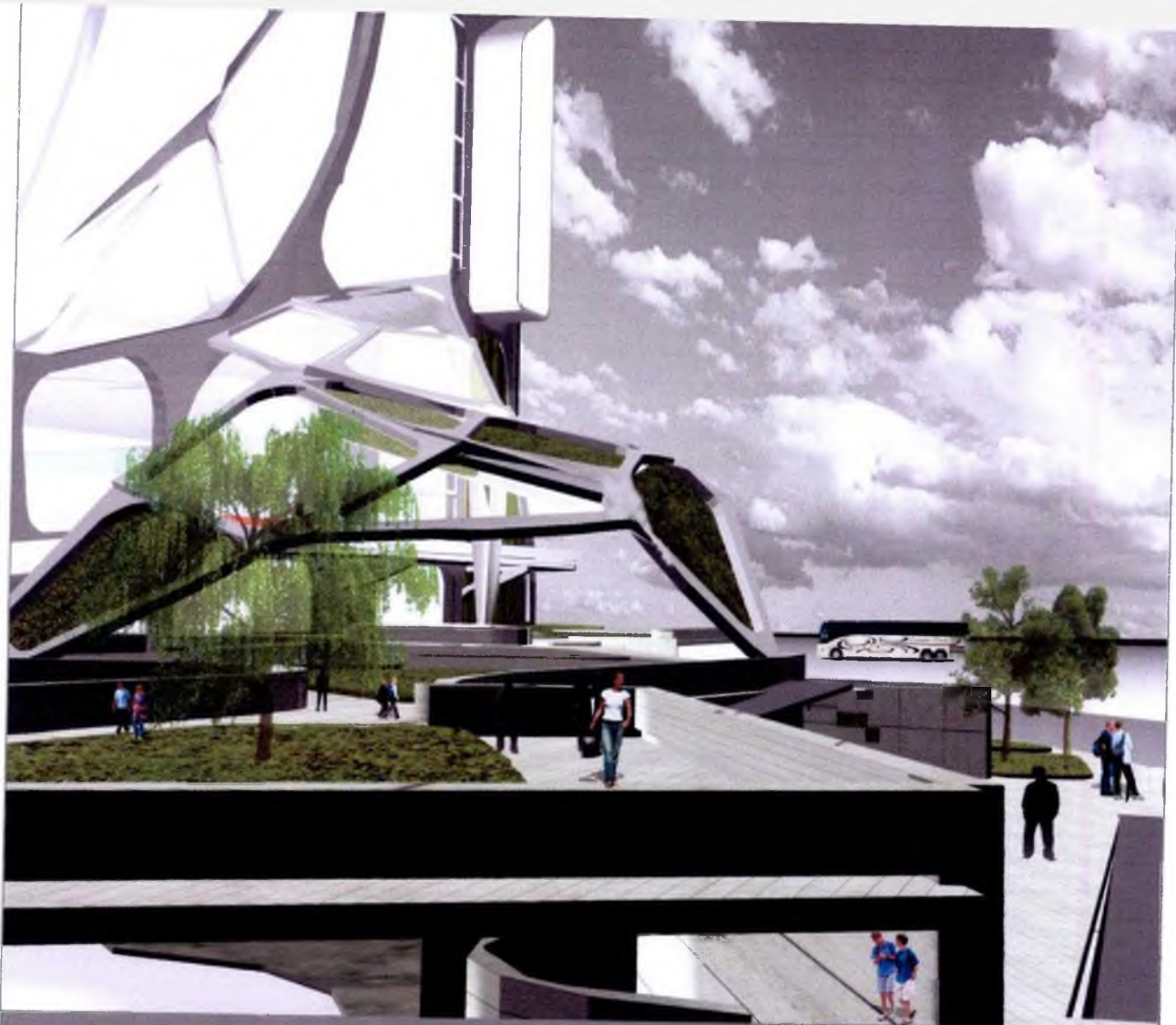


Fig 88: 3-d View of Plaza
Source: Hoque, 2011

Fig 89: Model of Terminal & surrounding
Source: Hoque, 2011

Fig 90: 3d view of Terminal & surround
Source: Hoque, 2011

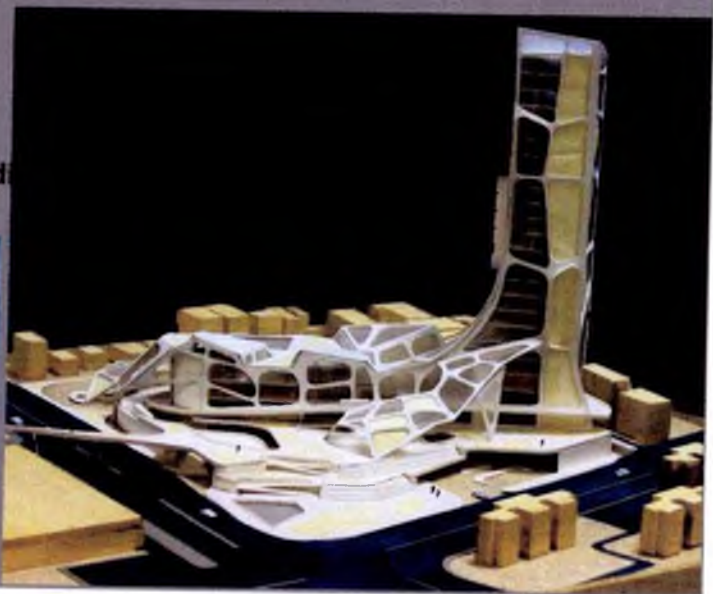




Fig 91: 3-d View ground floor entrance
Source: Hoque, 2011



Fig 92: 3-d View CNG Station
Source: Hoque, 2011



Fig 93: 3-d View From west side
Source: Hoque, 2011

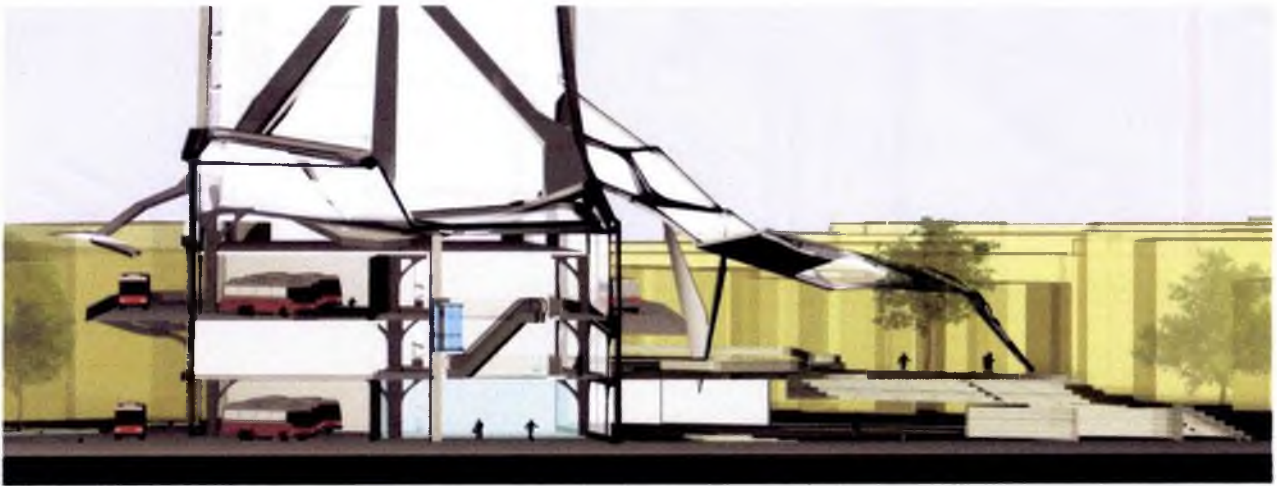


Fig 94: Sectional Perspective
Source: Hoque, 2011

Fig 95: 3-d View of Termianl with plaza
Source: Hoque, 2011



CONCLUSION

BRTC international bus terminal would be such a place which would help mass public of the city (especially south eastern part) for commuter service to nearby district and also to other countries. This design proposal is one of a kind in Bangladesh since, such project has never been implemented, and has given me the opportunity to work for the mass public of the area. The main intention behind the project was to create a good environment for the bus terminal, easy circulation for the public & buses, and an iconic structure which would represent our country in a positive manner. In my design I have tried to incorporate all the necessary functions and also give a big public plaza for the area, which was much needed for the recreational purpose of the area. I also tried to connect Kamlapur Raistation and the bus terminal with walkway so that passenger transit is easier. This dissertation is a source of the ideas for the development of the International bus terminal and development of the area as a whole.

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- Goni Bangla,Urban planner, Bangladesh.

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 ,Bangladesh road Transport corporation(**BRTC**)
- **Major Kazi Golam,Chairman,(traffic)**, Bangladesh road Transport
 corporation(**BRTC**)