MRT STATION AND URBAN LINKAGE
AT KHAMABARI - INDIRA ROAD - FARMGATE

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ABSTRACT:

In this project, what was explored is the opportunity matrix or dimension that might change or impact in a dense context of Dhaka if an MRT Station is introduced and the possible opportunities it might represent. Following the current proposal developed by JICA Study Team for Dhaka Urban Transport Network Development Project, the future scenario that might arise after implementation of such a massive intervention project in dense urban context and fortunate urban intervention opportunities it represents such as proper greenery and landscape design for nature and public, accommodation for informal business sector, designed stands for buses, cars as well as tempo and rickshaw, etc.

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1. CHAPTER 01 : BACKGROUND OF THE PROJECT

Bangladesh, a country of nearly 160 million people (The World Factbook, 2011), has a population of over 15 million (Statistical Pocket Book, 2008) living in its capital Dhaka. With a population density of 23,029 (Statistical Pocket Book, 2008) people per square kilometer, the city plays the multi-functional role as the administrative centre, business, trade and commercial centre as well as a traditional cultural centre. Dhaka is one of the fastest growing cities in the world due to rapid urbanization as a result of massive migration from the rural towns and villages due to the recent economic fall in agrarian sector of the nation over the past few years. Functionally it plays the nation's only multifunctional central hub of culture, trade, commerce, business and administration with no massive notion of decentralization planning from its multifunctional role. With the lack of decentralized planning and with rapid urbanization growth rate of nearly 8 percent per annum (Md. Mazharul Hoque, 2005), Dhaka has seen the rise of rapid motorization resulting in massive congestion and pollution problems. It is expected to be the second largest city of the world with a population of 22.8 million by 2015 (UNFPA, 2001).

Greater Dhaka has a total road network of 2450 km of which roughly 25% are classified as primary roads. The typical width of a street normally varies between 6 to 40m. The main roadways are usually 15 to 25m wide, whereas newly built facilities are generally 40m wide. In contrast, streets in the older part of Dhaka are often less than 6 m wide. (ENNO “ED” KOEHN, 2002)

Urban transport in Dhaka mainly utilizes the surface roadway system. The train network is used primarily for inter-city connections and waterways are designed for inter-district freight distribution. Inter-city bus transportation, which uses a fleet of 600 buses, is operated by the Road Transport Corporation. It is estimated that 80% of the residents in Dhaka cannot afford to pay for any type of transportation and travel by foot. The main physical traffic problem is related to this mix of transport modes: rickshaws, bicycles, bullock carts, buses and automobiles. (ENNO “ED” KOEHN, 2002)

With due consideration of this rapid urbanization situation in Dhaka, the Government of Bangladesh (GOB), through Dhaka Transport Coordination Board (DTCB) as the implementing agency, Japan International Cooperation Agency (JICA) as the executing agency, formulated a preparatory survey on Dhaka Urban Transport Network Development Study (Phase 1 Study) from March, 2009 to March 2010. The Phase 1 Study recommended a series of urban transport network development projects and programs. MRT Line 6 project was selected in the Phase 1 Study as the high priority project and it was later conducted further studied in the Phase 2 to confirm the feasibility, technical and economical details. (JICA, October 2011)

1.1 Key aspects of this project:

This project has the scope of incorporating architecture and urban design issues together. It plays with terms and issues regarding Transport Planning, Urban Intervention, Pedestrian Linkage, Urban Regeneration. The fun and the challenge of this project lies on how to address these issues and simplify them into a precise solution.

1.2 Specifications of this Project:

Project Name: Metro Rail Transit Station and Urban Linkage at Farmgate

Site Location: Farmgate, Dhaka, Bangladesh

Owner/Client: Bangladesh Government - Transportation Coordination Board and JICA

Basic Design Criteria (Proposed by JICA Research Team):

	Item	Description
Basic Specifications:	**Rail Gauge**	Standard gauge: 1435mm
	Operation in case of Fire	Nonstop between stations (Train shall be driven to the nearest stations.)
	Earthquake	Seismic Design
Alignment:	**Minimum Radius**	600m (normal case) 200m (unavoidable case) 200m (Depot Area)
	Minimum Radium (Station)	600 m (the track along the platform)
	Gradient	35%-40% (between stations) Level for stations but 10% will be allowed for unavoidable cases
	Transition Curve	Cubic Parabola Curve or Clothoide
	Minimum Length of Tangent Line between Transition Curve	20m but two transition curve will be allowed in case its unavoidable
	Minimum Length of Curve Section	20m but two transition curve will be allowed in case its unavoidable
	Distance between Rail Centre	3.6m (main tracks)
Rail Structure	**Rail**	UIC 54 kg/m (main tracks), 50 kg/m (side track and depot) CWR in curvature larger than 400m, to provide expansions joint 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 Minimum 5m for Island Type Platform Minimum 4m for lateral Type Platform
	Consideration of people with handicapped	Universal Design, Barrier Free (Lift, Escalator, Tactile Road for the Blind, Slope,etc)
Power	**Electric Power**	Overhead Catenary Type DC 1,500V
Rolling Stock		Body Length: 20,000mm (Middle Car) Weight: Tare 28 Ton (Motor Car) Composition: 6 cars Maximum Train Speed: 100 km/ hr, Design Speed: 110 km/ hr Body Light Weight Aluminium Train Control: ATC Amenity: Air- Conditioned

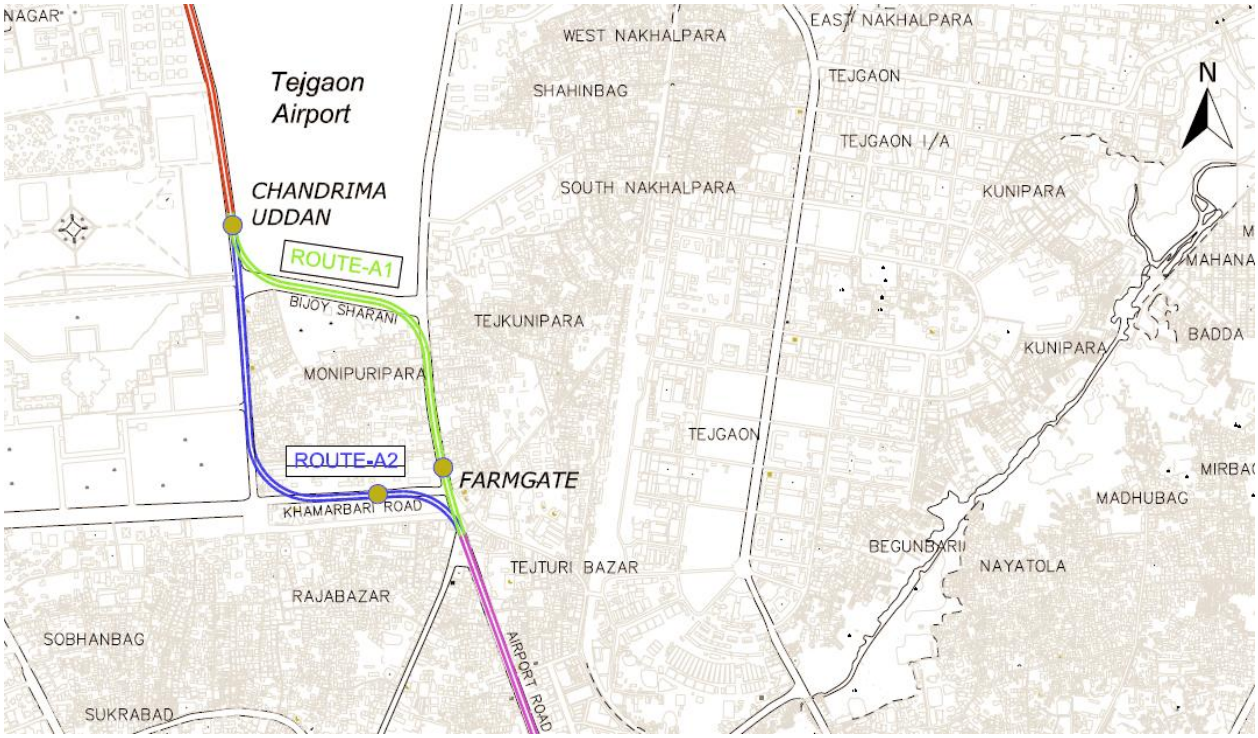


Figure 1 : Two alternative routes proposed for Farmgate by JICA due to height restrictions around the Old Airport

1.3 Site Location:

Farmgate is an important place of Dhaka, the capital of Bangladesh. It is so named because there was a big farm in that area and the gate of the farm was located on the Mymensingh Road (now known as Old Airport Road). This is one of the busiest and most crowded areas of Dhaka city. From the early 1990s, the area has seen massive building and construction boom. Consequently the area has got commercial importance and nowadays it has become one of the major transportation hub of Dhaka from where anyone can travel all other parts of the city as well as throughout the country. Today Farmgate has become a more commercial area than a residential area. Neighboring places of Farmgate are Kawran Bazar, Pantapath, National Parliament, Rajabazar etc.

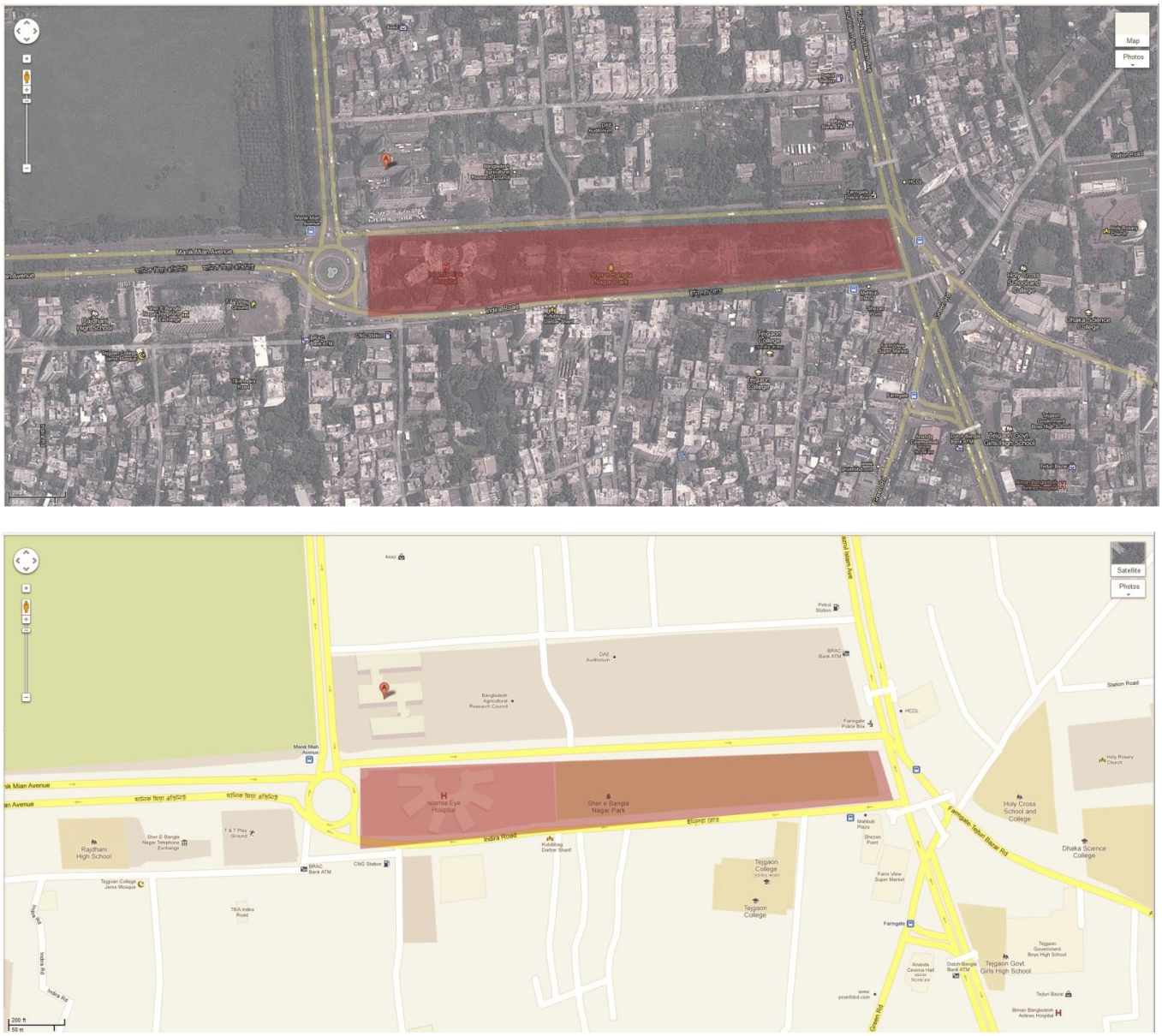


Figure 2 - Google Earth and Google Map Image of the Site Location

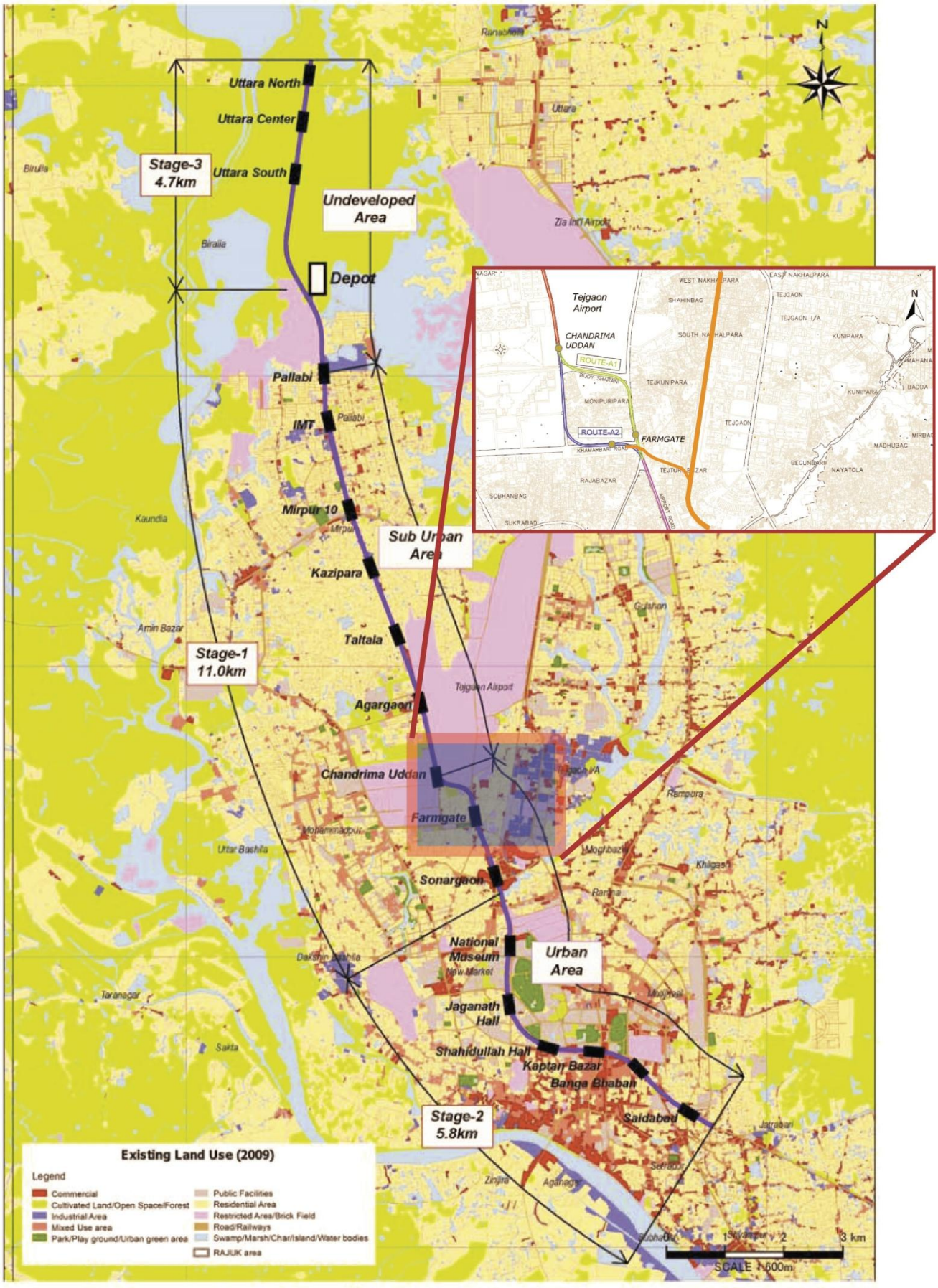


Figure 3 - MRT Route-6 and Station Location in the context of Dhaka Map

1.4 Reason for choosing this Site:

Farmgate has a heritage of its own. It has the oldest church in Dhaka and a Christian community along with it. Its development can be traced back from the Colonial Period. Over the recent it has developed into a major urban transportation hub of Dhaka City. This MRT Station is a major urban intervention in an already hectic hub of the city. With proper designing of a a better built environment, it has the potential to solve major traffic congestion problems, pedestrian connection and safety security issues and introduction of green into this urban environment as well.

1.5 Given Programme

Elevated Railway Station, Bus Station, Ticket Booth, Administration Office, Technical Office, Security Office, Newspaper Shop, Pharmacy, Library, Cyber Café, Restaurant, Grocery, Urban Pedestrian Connection and Recreation Park **Total : 80,780 sft x 30% circulation = 105,014 sft**

Station and facilities:

Proposed Station Program (By JICA Study Team)

Floor	Item	Unit	Intermediate Station	Terminal Station
Elevated Passenger Volume				
	Number of daily passengers	Persons	81,000	124,000
	Number of hourly passengers	Persons	10,000	15,000
2nd (Platform)				
	Scale of Floor (width x length)	m	21.8 x 125	27.3 x 125
	Style of Platform		Lateral Platform	Island Platform
	Number of Platform	Place	2	2
	Width of Platform	m	7.6m x 2	8.6m & 7.0m
	Number of Stairs	Place	4 (= 2 x 2)	4 (= 2 x 2)
	Width of Stair	m	2.5m x 4	2.5m x 4
	Number of Escalators	Place	4 (= 2 x 2)	4 (= 2 x 2)
	Number of Elevators	Place	2 (= 1 x 2)	2 (= 1 x 2)
	Number of Personnel Room	Place		4 (= 2 x 2)
1st (Concourse)				
	Scale of floor (width x length)	m	21.8 x 125	27.3 x 125
	Ticket Vending Machine Room and Counter	m^2	35	35

Ticket Barrier Counter	m^2	5	5
Station office	m^2	125	180
Guard's room	m^2	30	35
Prayer room	m^2	50	50
Passenger's toilet	m^2	75	100
Garbage man's room	m^2	50	50
Restroom for Station Personnel (Tearoom, Lecture room, Napping Room, Toilet and Shower)	m^2	260	310
Napping room for train crew	m^2	-	-
Electricity facilities and others	m^2	300	450
Ground (Entrance)			
Number of Stairs	Place	4 (=2x2)	5 (=2x2+1)
Width of Stairs	m	2.5m x 4	2.5m x 4 + 3m
Number of Elevators	Place	2 (=1x2)	2 (=1x2)

2 CHAPTER 02 : SITE APPRAISAL

Farmgate is the nerve center of Dhaka city. As a major commercial area of Dhaka, Farmgate serves as one of the significant business hubs of the city. Many Governmental, NGO (Non overnment Organisation), educational institutions, commercial and financial institutions are located in Farmgate. The biggest wholesale market of Dhaka, Kawran Bazar is located right beside Farmgate. Furthermore, Ananda cinema hall, one of the city's traditional and crowded cinema hall is located here. Green Road is the main street of this area extending from Farmgate over bridge to the Pantapath. Department of Agricultural Extension, commonly known as Khamarbari is situated in Farmgate. Traffic congestion is a common scene of Farmgate. As a transportation hub of Dhaka, the area is most often remains crowded and thousands of cars, rickshaws, minibus, bus, trucks remain stranded for even hours in the roads and streets of Farmgate. Majority of the inhabitants of Farmgate are servicemen and businessman. Dhaka's largest sanitary market and Green Super Market is here. Another highly crowded market, known as Sezan Market is located right beside the Farmgate over bridge. With numerous markets, offices accompanied with immense traffic jam, one can take a glimpse and find the ambiance of Dhaka.

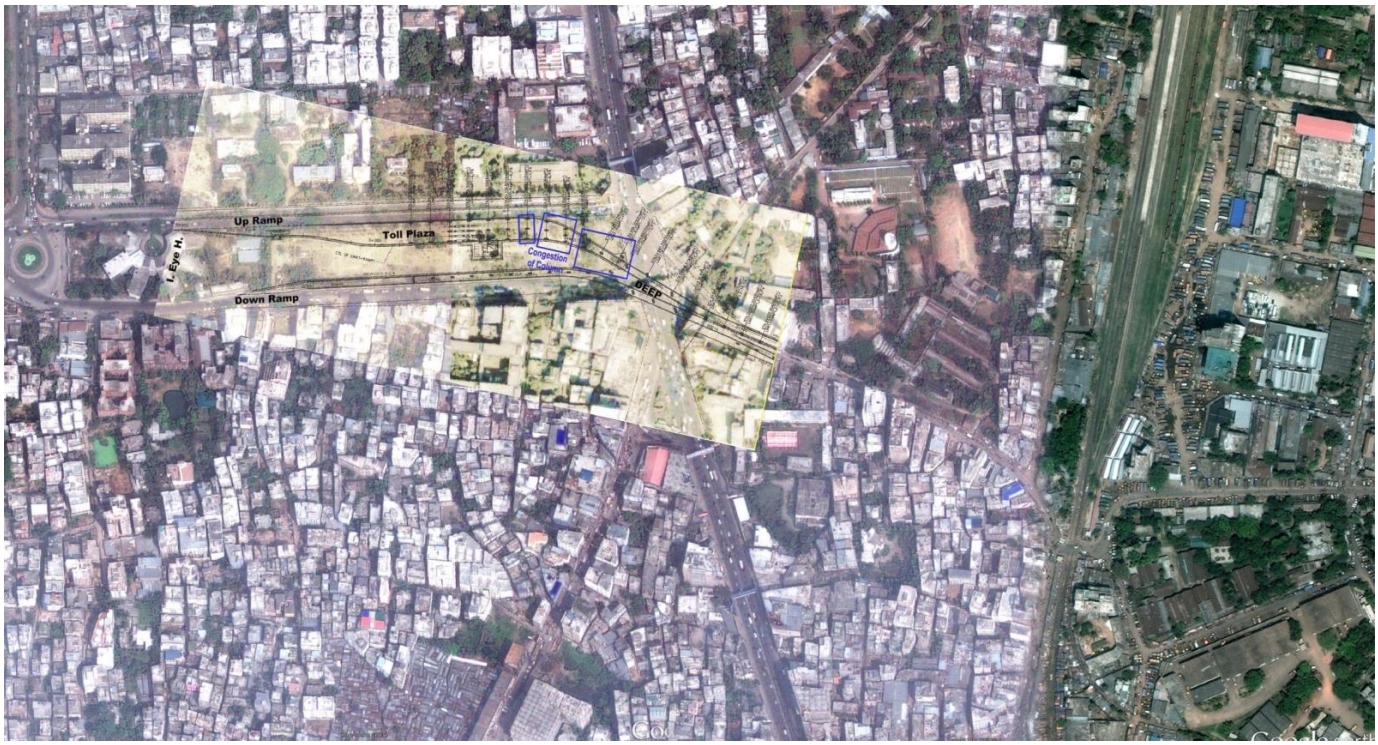
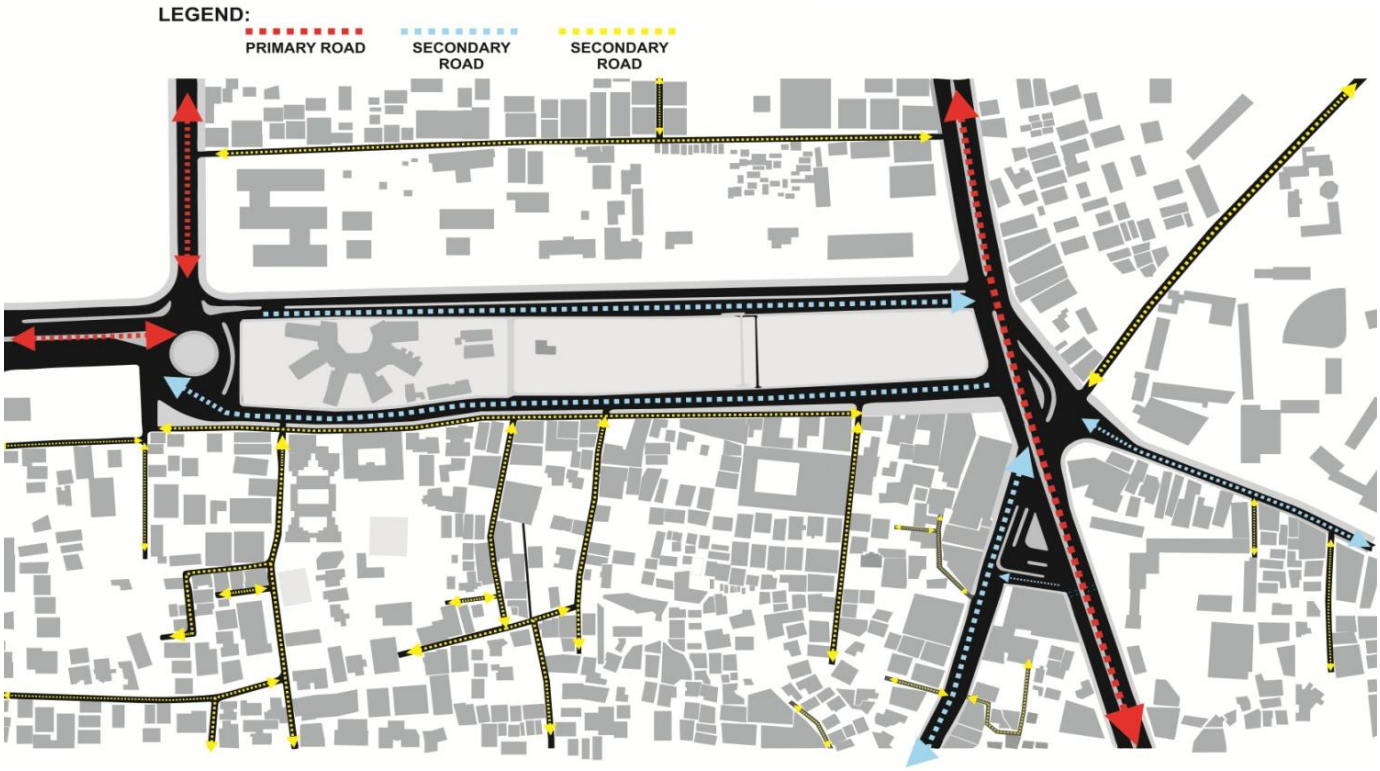


Figure 4 : Site and Surrounding Satellite View with future expressway ramp and toll plaza super imposed

2.1 Existing Road Network

This site links to east and west sectors of Dhaka city. It links to major north to south roads of the city that parellely run side by side each other. On the west end there is the Manik Mia Avenue and Begum Rokaya Sharani and the east end there is the Kazi Nuzrul Islam Avenue (Old Aiport Road).



2.2 Solid-Void Verses Green

There is a dense development at the south end of the site, while many not accessible green at north, east and west end of the site. The only accessible green that mainly occupies the site now will be replaced by the toll plaza and the on and off ramp of the expressway. So it is essential to add vertical green in the design to compensate the accessible that is being removed from the site.

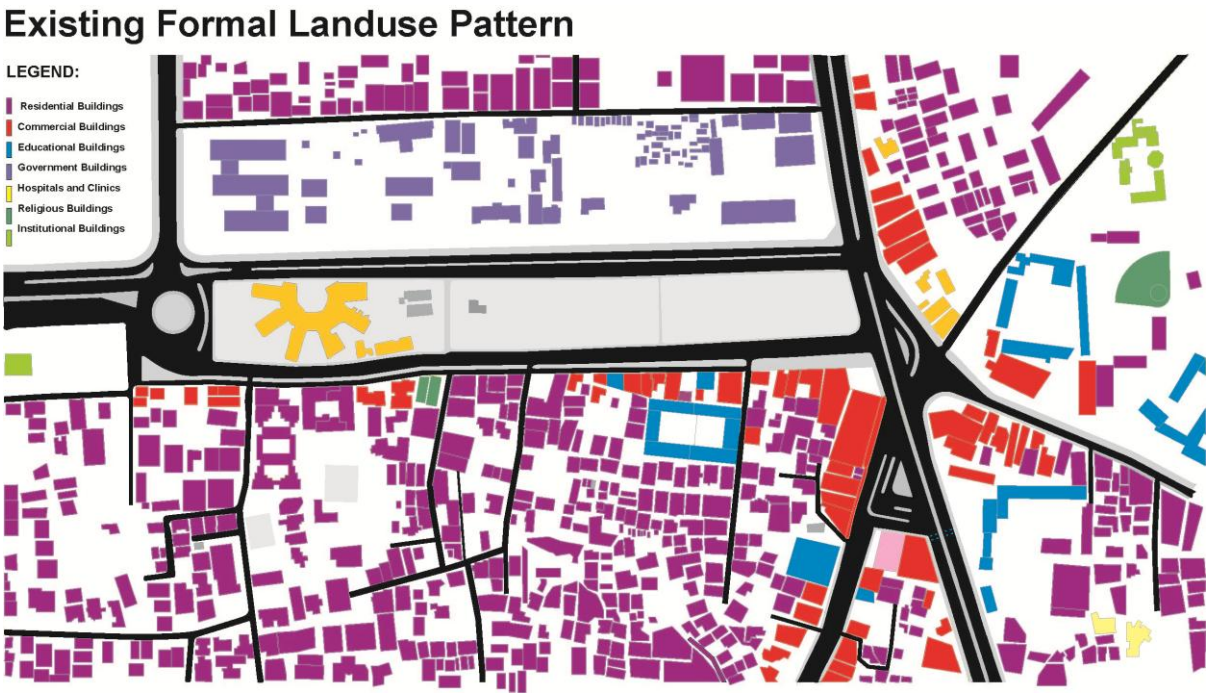
Figure 5 : Green Park on the existing site which will be replaced by on and off ramps from Expressway in future

2.3 Land-use Pattern

Existing Land-use Pattern survey through site visit examination showed that on the north, opposite to the site, there is an establishment of well-known Government Buildings such as Bangladesh Agricultural Research Council (BARC), Bangladesh Veterinarian Institute, Soil Resource Development Institute (SRDI), etc.

Figure 7 - Bangladesh Agricultural Research Council (BARC)

Figure 6 - Soil Resource Development Institute (SRDI)



On the south, in the immediate opposite of the site, there is a gradual development of mixed-use which includes commercial on the podium levels and residential in the upper storey. There are also two garments factories and a multi-storied mosque. Further into south, there is a very dense multi-storied development of residential building with very narrow access roads. There are also educational institutes such as Tejgaon College and Darul Ihsan University in between dense development as well.

Figure 10 - Garments Factory

Figure 9 - Multi-storied Mosque

Figure 8 - Mixed-use Development

One the east end of the site, there is the Parliment Assembly Building of Bangladesh, Dhaka and on the west end, there is a high density of commerical, health and educational Instiututional development.

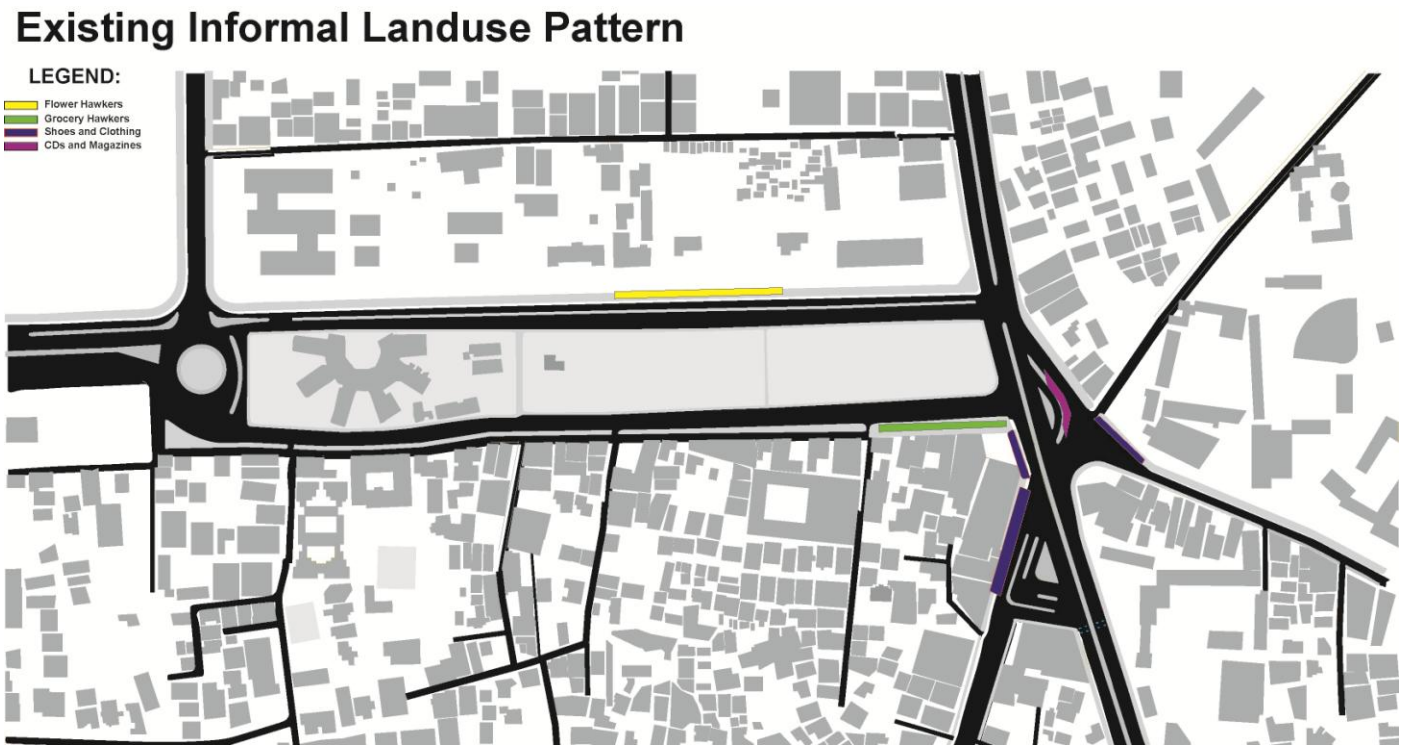


Figure 11 : Flower Hawkers at the Northern footpath of the site

Informal Landuse Pattern plays quite a vital role concerning in the sustainability of this site. Informal bussiness through Hawkers and Vendors thrive in the pedestrian footpath of this area due to the immense pedestrian coming and going on the roads. This sector needs to be properly addressed and designedly allocated along the future pedestrian main stream way.

Figure 12 : Vegetable and Grocery Hawkers at the South-eastern end of the site.

Figure 13 : Clothing and Shoes Hawkers at the eastern end of the site, occupying half the pedestrian footpaths

2.4 Traffic Pattern

Existing Traffic Pattern survey through site visit examination showed that on the north and south of the site there are tempo stands where they wait to take passengers to Mohammodpur, Hazaribagh, Dhanmondi and Lalmatia. On the east end is the main traffic congestion area of Farmgate due to the two bus stand on both sides and the out pour of vehicles from Holy-Cross Road and Green Road.

Figure 14 : Traffic Congestion at Farmgate

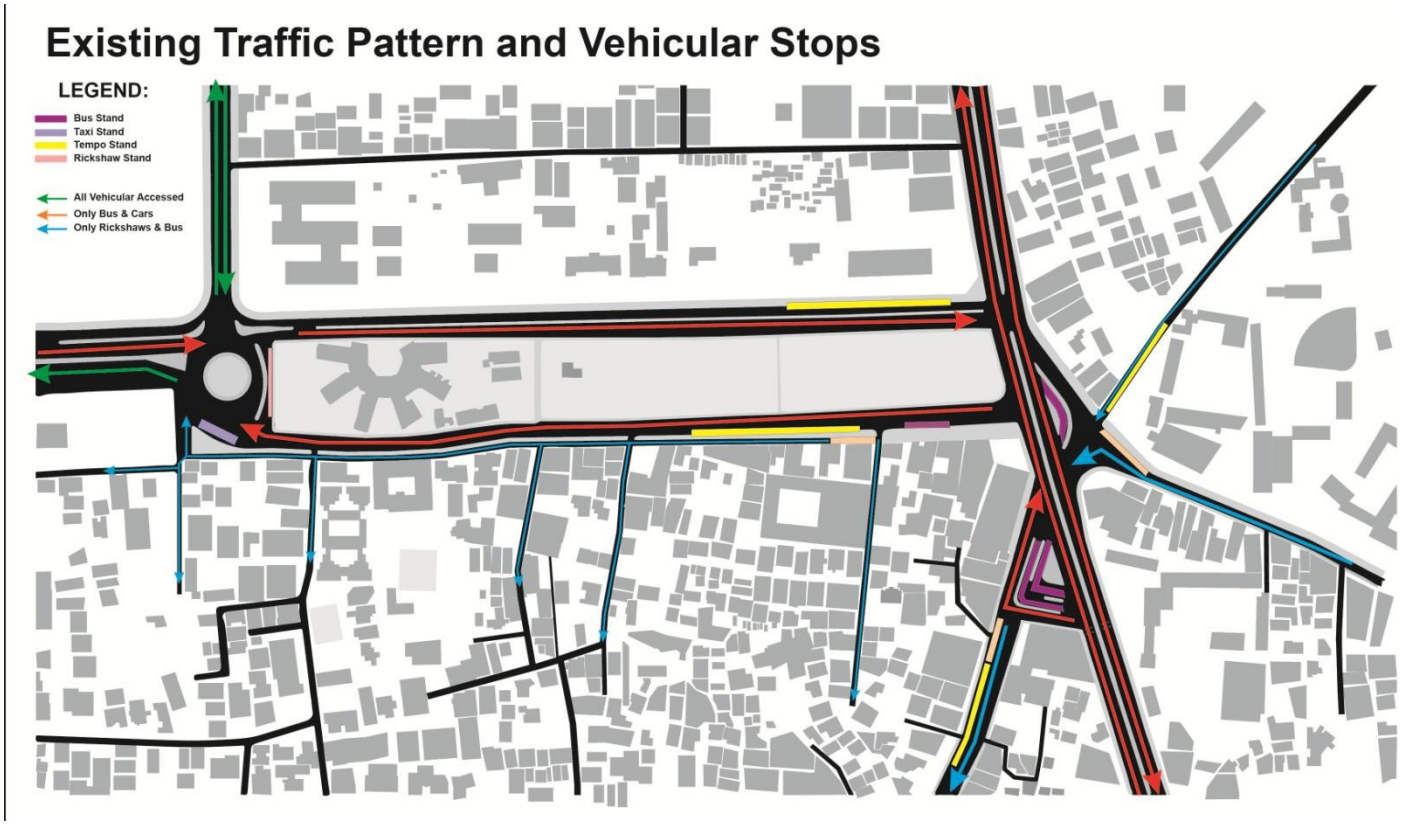
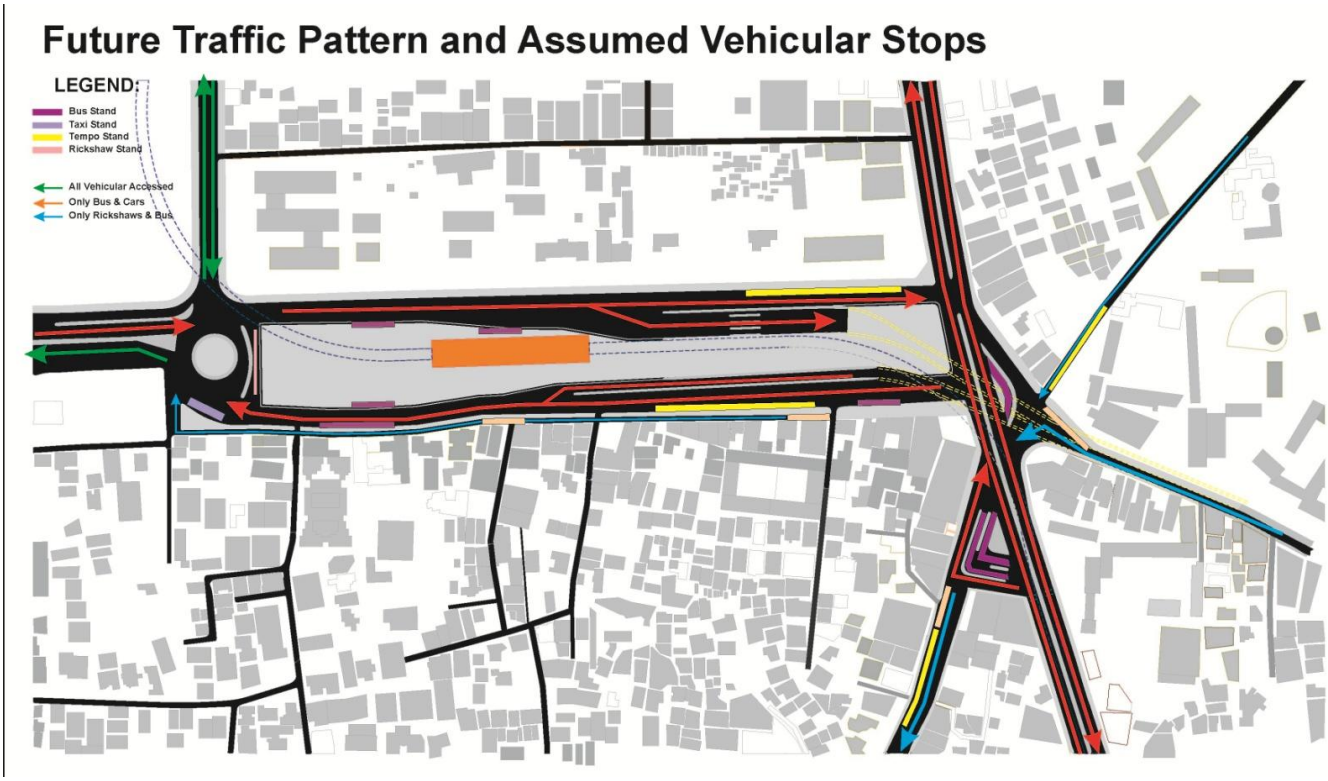


Figure 15 : Farmgate Bus Stand at the eastern end of the site

Figure 16: Rickshaw Standing area at the south of the site

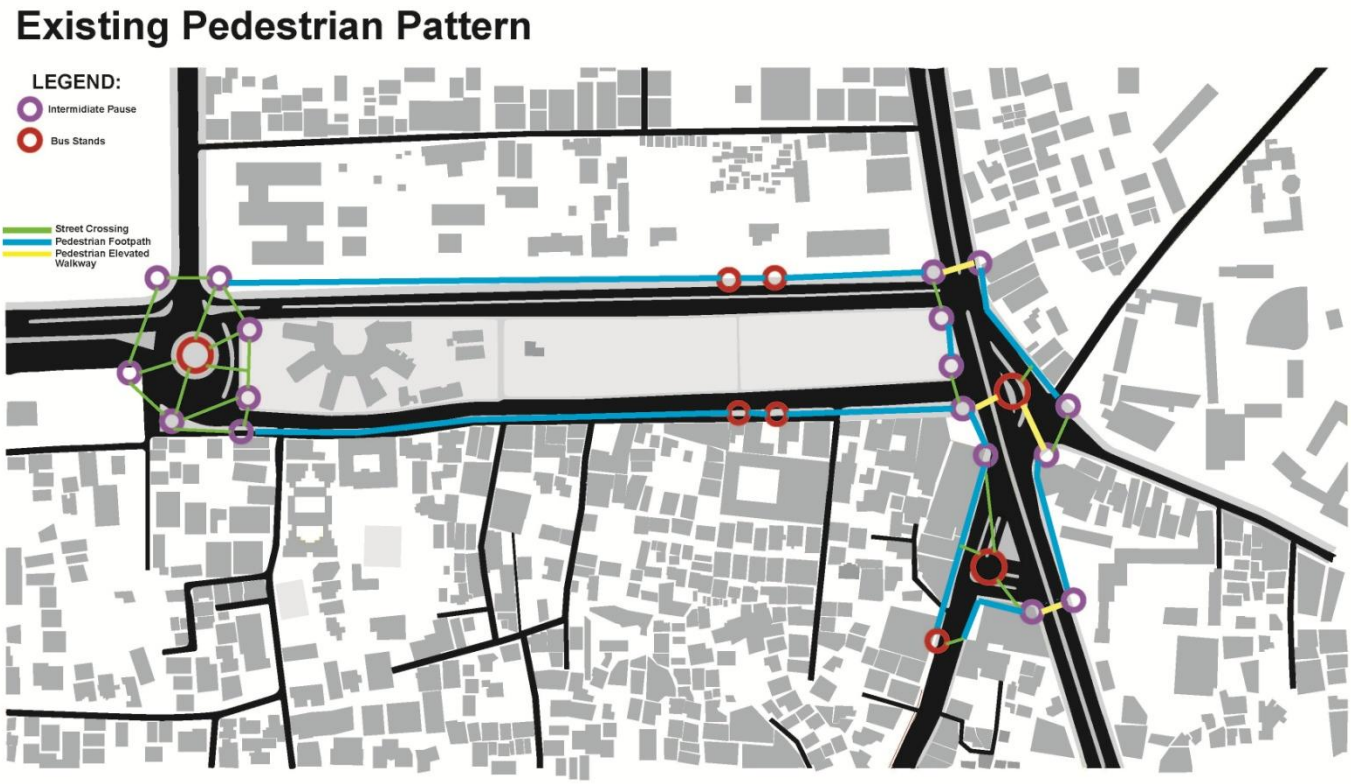
Figure 17 : Tempo Standing area at the south of the site



By reflecting on the current scenario at Mohakhali, Jatrabari and other Fly-over on Dhaka, one can positively assume future traffic congestion occurring at the future entry and exit way of the ramp of expressway where bus will illegally stop to pick up or drop off passengers before buses alight or leave the ramp of the expressway. They will also stop to pick up passenger who have alighted from the MRT station to catch buses to Banani, Uttara and other North-east sectors of Dhaka. Therefore Proper bus stop accommodation needs to be made at base of both on and off ramps of the expressway to avoid further traffic congestion.

2.5 Pedestrian Network

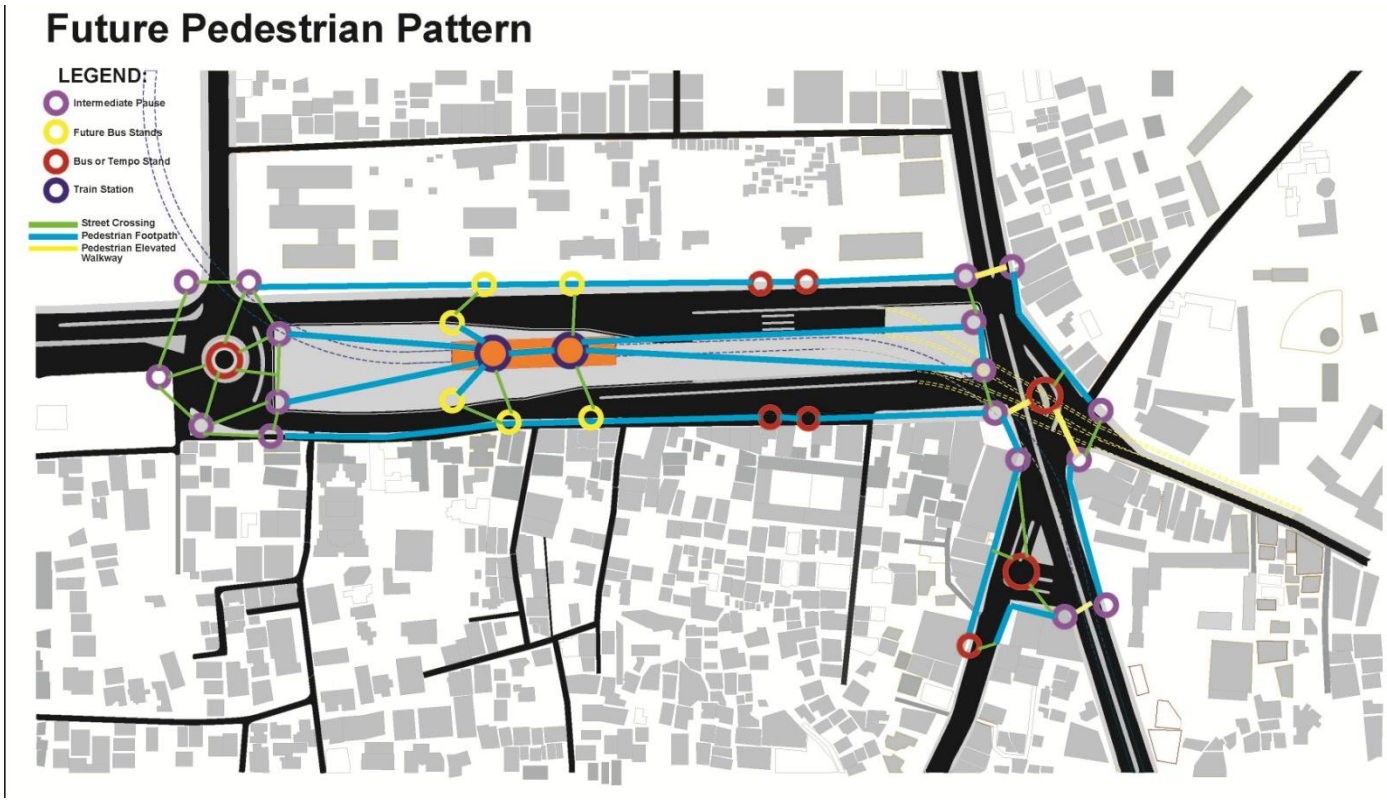
Existing Pedestrian Pattern survey through site visit examination showed that there is a dense pedestrian activity on both the east and west end of the site. The east end consists of two major bus stands serving both ways. There is also modal exchange from rickshaw to bus or tempo that occurs mainly in the east end of the site where passengers coming from neighboring areas alight from rickshaws and then take a bus to other parts of the city. Vice versa passengers coming other parts of the city alight here either to make their way to the neighboring well-known educational institutes or residential zones nearby. There are three foot over pedestrian bridges connecting from one end of the Kazi Nuzrul Islam Avenue to another, which are always under heavy pedestrian utilization since the roads underneath are always under heavy traffic vehicular demand.



On the west end of the site, scenario is quite different. Due to the Parliament Assembly Building, there is green breath of space and people from various parts of city come here for leisurely purpose. Over the years, the green roundabout on the west end has come a very popular hangout area for the neighboring people and becomes very crowded especially during the night.

Figure 18 - Foot-over Pedestrian Bridge across Kazi Nuzrul Islam Avenue

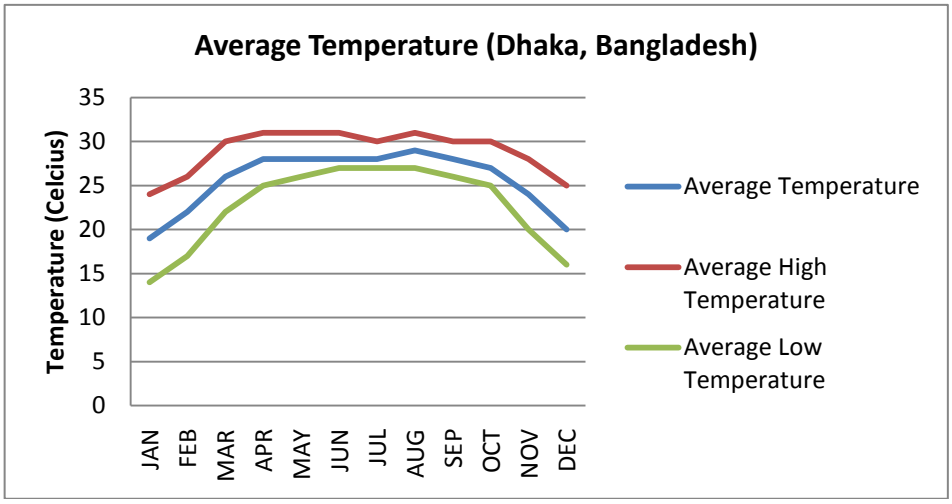
Figure 19 : Green Roundabout that has become a popular neighbourly hangout spot espcially in the evening due to lack of green

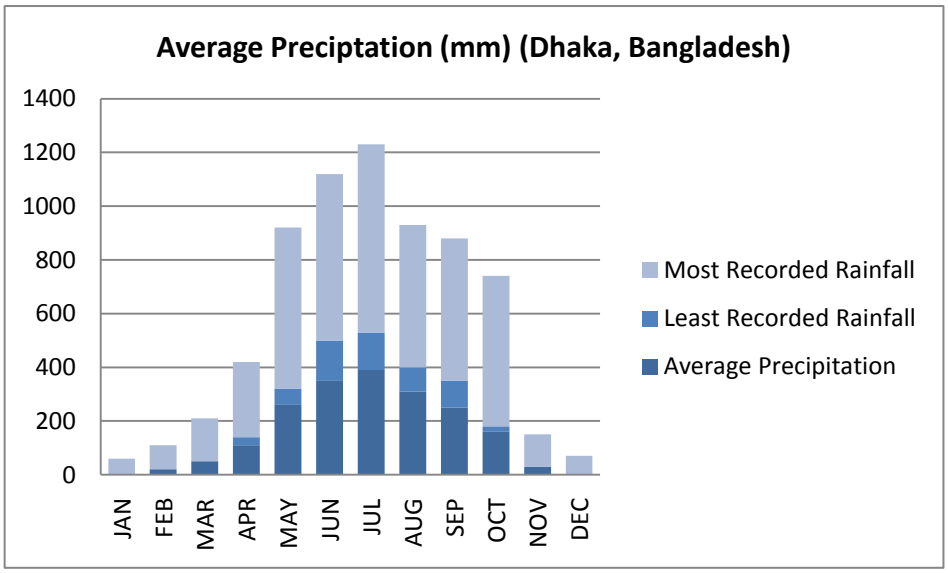


In the future scenario, what is being assumed is that there definitely be an increase of pedestrian density in this area in form of passengers alighting or boarding from the trains. Therefore this will bring a crucial change from the current pedestrian network pattern. Many passengers will alight here to catch buses which towards North-East Sector (Banani, Gulshan, etc) and South-West (Dhanmondi, Mohammodpur) sectors of Dhaka. Therefore proper pedestrian network needs to be design to disperse passengers evenly to their bus stand destinations without intersecting or conflicting with the vehicular circulation of the site.

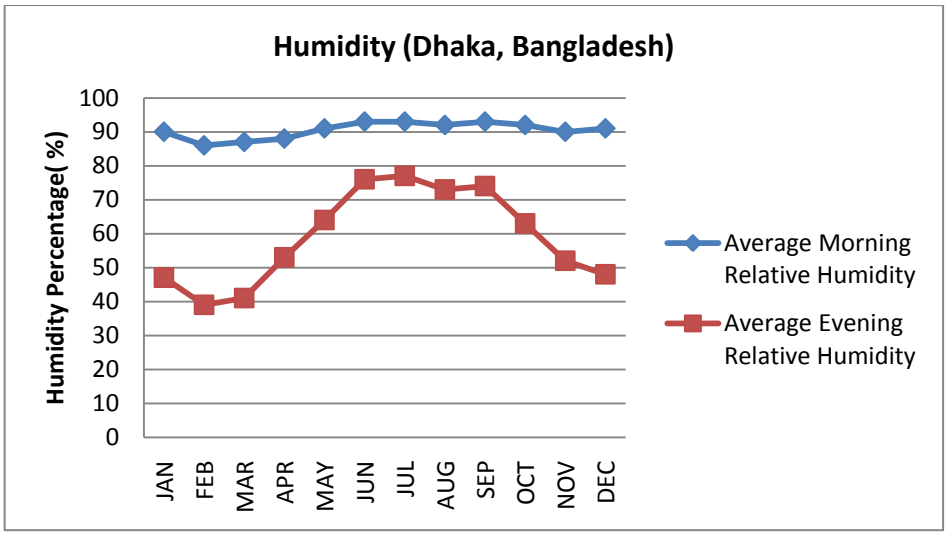
2.6 Environmental Considerations:

The climate of Dhaka experiences a hot, wet and humid tropical climate. Under the Koppen climate classification, Dhaka has a tropical wet and dry climate. The city has a distinct monsoonal season, with an annual average temperature of 25 °C (77 °F) and monthly means varying between 18 °C (64 °F) in January and 29 °C(84 °F) in August.[1] Nearly 80% of the annual average rainfall of 1,854 millimetres (73.0 in) occurs during the monsoon season which last from May till the end of September. Increasing air and water pollution emanating from traffic congestion and industrial waste are serious problems affecting public health and the quality of life in the city. (Climate of Dhaka)

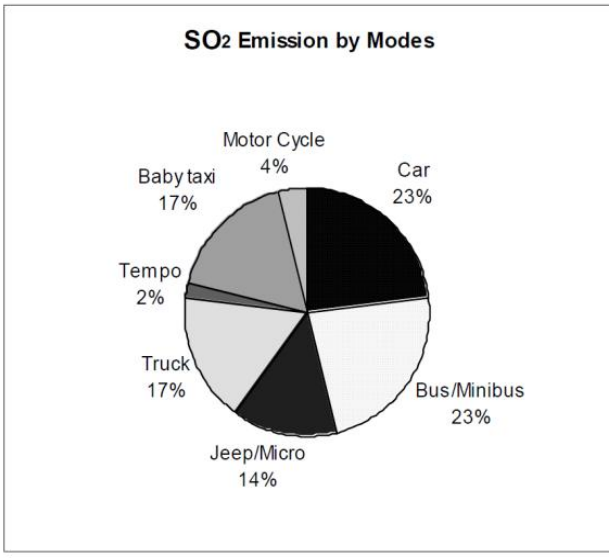


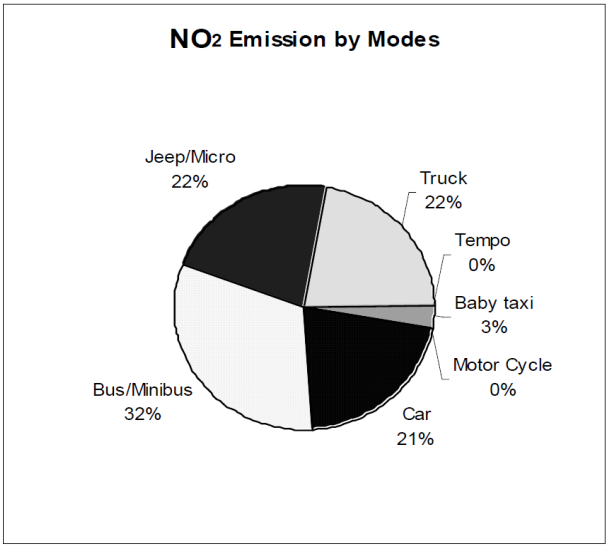


Due to the high humidity and temperature level, it is important to consider proper natural ventilation when designing in Dhaka. Mechanical devices such as escalators and generators need proper protection from the rain and the high urban flooding that occurs in Dhaka .

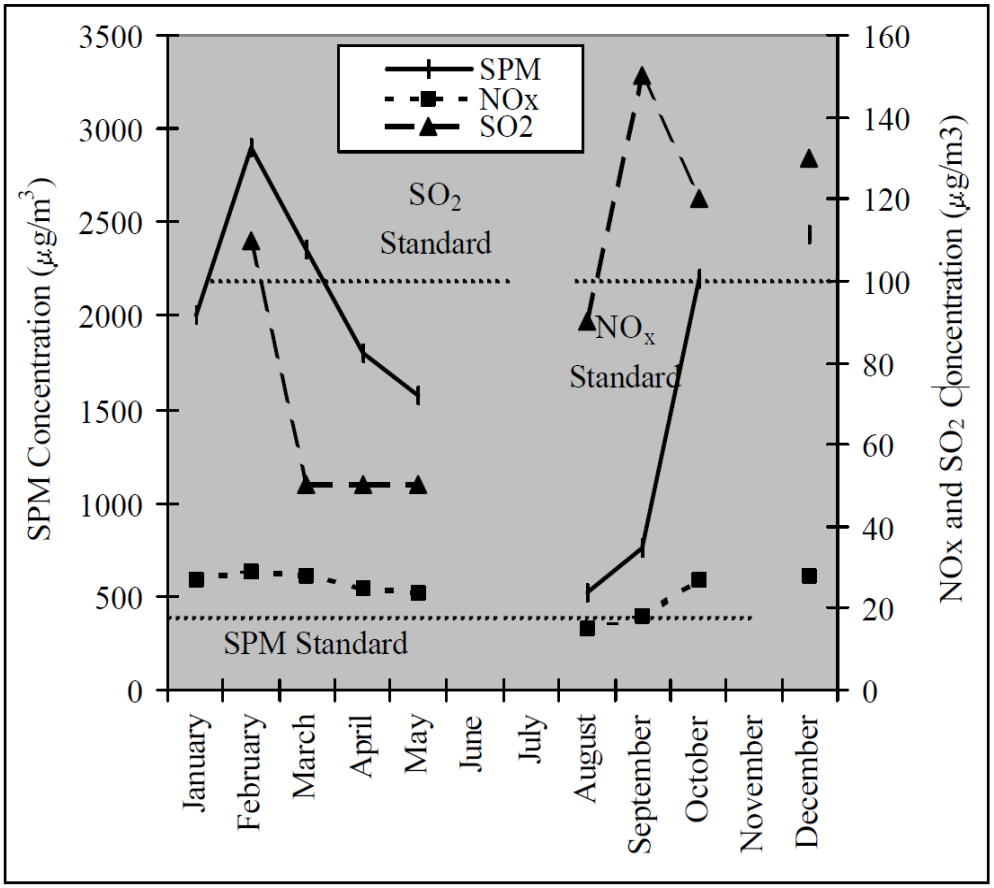


2.7 Atmospheric Pollution Data at Farmgate:





The air quality standards are different for residential, industrial, commercial, and sensitive areas. The worst affected areas in Dhaka city include: Hatkhola, Manik Mia Avenue, Tejgaon, Farmgate, Motijheel, Lalmatia, and Mohakhali. Surveys conducted between January 1990 and December 1999 showed that the concentration of suspended particles goes up to as high as 3,000 micrograms per cubic meter (Police Box, Farmgate, December 1999), although the allowable limit is 400 micrograms per cubic meter. The sulphur dioxide in the air near Farmgate was found to be 385 micrograms per cubic meter, where as the maximum permissible limit is 100 micrograms per cubic meter. (Air Pollution in Dhaka)



2.8 SWOT Analysis

Strength: The strength of the site lies in the busy streets. The mixed land-use pattern and the existence of some important structures model the urban fabric of the site. The institutions (Holy-cross, Tejgaon College, Polytechnic college) act as the backbone of the site while the bus-stops on both sides of the road act as the heart, helping thousands and thousands of people commute from one place to another. Ananda cinema hall used to be a favourite family gathering place before the quality of cinema as well as the crowd deteriorated. Strength of the site is the flea markets which keep the foot-paths alive. One of the six MRT routes has been proposed through this site for its convenience to travel around.

Weakness: The lack of green is a big drawback of the site. The only green existing around is the farm gate park which is not enough for the busy area for sure. There used to be some green pockets in the site which has been taken by the site owners and boundary walls prevent public to use those.

Opportunity: The opportunity of the site lies in the urban activities of the area. Being the most used public transportation hub of the city, the opportunity is there to work with the huge number of commuting people. The existing Ananda cinema hall and the bus stops can be transformed into interesting public spaces and the flea markets can be integrated also to make the public space more active. Adding greenery and landscaping the area can be another opportunity.

Threat: The unplanned and neglected pedestrian is a threat for the area. The unplanned growth of buildings are encroaching the existing green around the area, making it lifeless. The weak structure of the foot over-bridge is a threat to the lives of the large number of people using it. Many lives have been lost in road-crossing in the area.

3 CHAPTER 03 : LITERATURE REVIEW

3.1 Types of MRT Systems and it distinctions

A rapid transit, underground, subway, elevated railway, metro or metropolitan railway system is an electric passenger railway in an urban area with a high capacity and frequency, and grade separation from other traffic. Rapid transit systems are typically located either in underground tunnels or on elevated rails above street level. Outside urban centers, rapid transit lines may run on grade separated ground level tracks. (Rapid transit)

The distinction between MRT concepts is fluid, and many different approaches are commonly used to distinguish the different modes and features of various MRT systems. Traditionally, MRT systems have been categorized according to technology and degree of segregation from traffic. Table-1 summarizes the key features of the MRT options. Some typical MRT systems in developing cities are outlined in Table-2.

Characteristics	Bus Rapid Transit (BRT)	Light Rail Transit (LRT)	Metro	Suburban Rail
Current Applications	Widespread in Latin America & some developing cities	Most European & North American cities	Most Developed cities & few large developing cities	Most European & North American cities
Segregation	At grade	At grade	Mostly elevated or underground	At grade
Space requirement	2-4 lanes from existing road	2-3 lanes from existing road	Little impact on existing road if elevated/underground	-
Impact on Traffic	Depends on policy & design	Depends on policy & design	Reduces congestion	Depends on frequency
Public Transit Integration	Problematic with paratransit	Often difficult	Excellent	Usually existing
Initial cost (US$ million/km)	0.5-15	13-50	15-30 at grade 30-75 elevated 60-180 underground	-
Implementation time	Short	Medium	Long	-
Interaction with land development	Good	Very good	Excellent	Variable
Fuel	Mainly Diesel/CNG/LPG	Electricity	Electricity	Electricity
Air pollution & noise	Considerable	Low	Low	Low
Capacity (pass./hr/direction)	10-35,000	12-30,000	60,000+	30,000
Speed (km/hr)	17-20	20-50	30-80	40-45+
Traffic Accident	Minor	Minor	No	Minor (at level crossing)
System image & passenger attraction	Good	Very Good	Excellent	Variable

Sources: GTZ, 2005 ; World Bank, 2001 & 2002

Metros: Metros, often designated as true heavy rapid transit, use fully segregated, and grade-separated track in central areas, the track may be elevated although the most common international term is for subway or underground. They employ very advanced control systems that allow high-frequency operations, and the trains are made up of multiple units of high-capacity 'heavy' cars. They can provide high levels of service (speeds and frequency) having the highest theoretical capacity, although they are also the most expensive form of MRT system. Metros in developing cities carried about 11 billion journeys in 2000, more than twice the ridership of commuter rail and more than four times the ridership of LRT systems (GTZ, 2005). Metro systems are being developed or expanded in several developing cities, such as Bangkok, Santiago de Chile, Kuala Lumpur, Delhi, Mumbai, Kolkata, Sao Paulo, Buenos Aires, Mexico City, Cairo, Dubai, Ankara, Manila, Beijing, Shanghai, Taipei, Hong Kong and many other parts

Table-2: Performance And Cost Of Various MRT Systems

Example	Caracas (line-4)	Bangkok (BTS)	Mexico City (line-B)	Kuala Lumpur (PUTRA)	Tunis (SMLT)	Recife (Linha sul)	Quito Busway	Bogota (TransMilenio, phase-1)	Porto Alegre Busways	Kolkata (Calcutta Metro)	Delhi (Metro Phase-1)
Category	Rail metro	Rail metro	Rail metro	Light rail	Light rail	Commuter rail	Busway	Busway	Busway	Rail Metro	Rail Metro
Technology	Electric, steel rail	Electric, steel rail	Electric, rubber tyre	Electric, Driverless	Electric, steel rail	Electric, steel rail ,	AC Electric Duo-trolleybus	Articulate Diesel buses	Diesel buses	Electric, steel rail	Electric, steel rail
Length (kms)	12.3	23.1	23.7	29	29.7	14.3	11.2 (+ext 5.0)	41	25	16.45	65.11
Vertical segregation	100% tunnel	100% elevated	20% elevated 55% at grade 25% tunnel	100% elevated	At grade	95% at grade 5% elevated	At grade, Partial signal priority	At grade, Mainly segregated	At grade, No signal priority	Mainly underground	20% tunnel 80% at grade/ elevated
Stop spacing (kms)	1.5	1.0	1.1	1.3	0.9	1.2	0.4	0.7	0.4	0.97	1.17
Capital cost (millions $)	1,110	1,700	970	1,450	435	166	110.3	213	25	365	2,100
Infrastructure/TA/ equipment (millions $)	833	670	560	1,450	268	149	20.0	213	25	365	2,100
Vehicles (millions $)	277	1,030	410	NA	167	18	80	NA	NA	NA	NA
Capital cost/route-km (millions $)	90.25	73.59	40.92	50.0	13.3	11.6	10.3	5.2	1.0	22.2	32.25
Initial (ultimate) vehicles or trains/operation hour/direction	20 (30)	20 (30)	13 (26)	30	NA	8	40	160	NA	7	15
Maximum passenger capacity	32,400	50,000	39,300	30,000	12,000	36,000	15,000	35,000	20,000	18,000	75,000
Average operating speed (km/h)	50	45	45	50	13/20	39	20	20	20	30	80
Revenue/operating cost ratio	n.a	100	20	>100	115	NA	100	100	100	NA	>100
Ownership	Public	Private (BOT)	Public	Private (BOT)	Public	Public	Public (BOT)	Public infrastructure, private vehicles	Public infrastructure, private vehicles	Public	Private (BOT)
Year completed	2004	1999	2000	1998	1998	2002	1995 (ext 2000)	2000	1990	1984	2002

Note: NA means information is not available.
Sources: GTZ, 2005 ; World Bank, 2001; DMRC, 2008; MRK, 2008

of the world. There is extensive metro activity and substantial future activity is under planning or underway in many cities. Figure-2 shows how the number of metro systems worldwide increase over time.

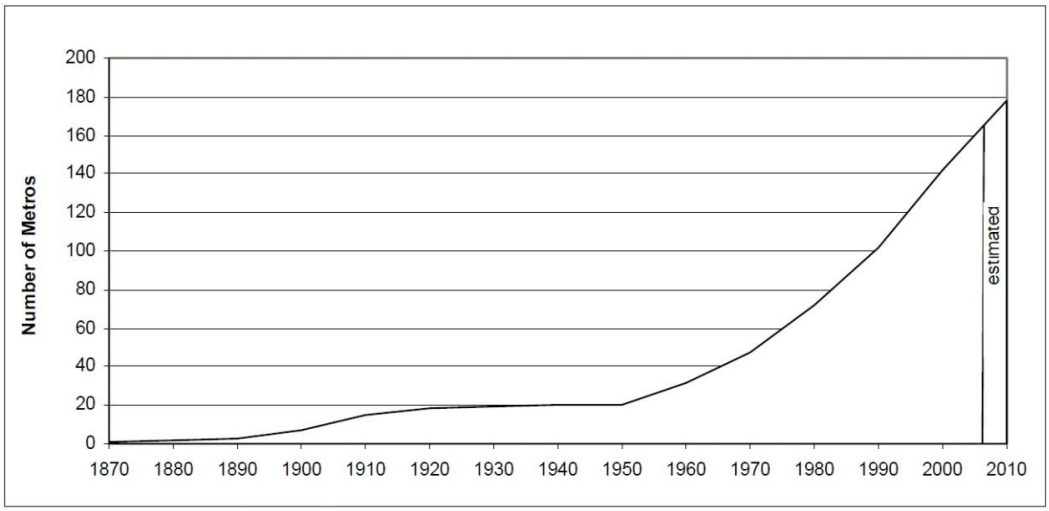


Figure-2: Incremental Growth of Metro Systems worldwide over time
Source: Metro Bits, 2008

Commuter rail: *Suburban or commuter rail* tends to be part of a larger rail network that carries passengers within urban areas or between urban areas and their suburbs, often at grade but separated from road traffic, and differs from Metros and LRT in that the passenger cars generally are heavier, the average trip length are usually longer, and the operations are carried out over tracks that are part of the railroad system in the area. Existing railway needs to be strengthened to introduce a new commuter rail as it often integrates with the existing systems. These systems have to operate within the context of the wider network demands, and are characterized by higher headways and longer station spacing as compared with both Metros and LRT. Suburban railways in developing cities are usually radially oriented into the city center. Although even in relatively well-served cities like Mumbai, Rio de Janeiro, Moscow, Buenos Aires and Johannesburg, they carry less than 10% of trips, they can be important in supporting a transit-friendly city form and maintaining a strong city center.

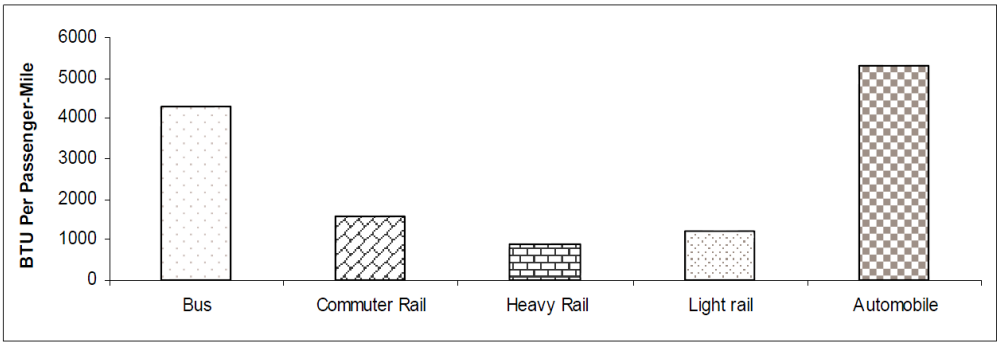


Figure 20 - Transit Energy Consumption - Source - VTPI 2007

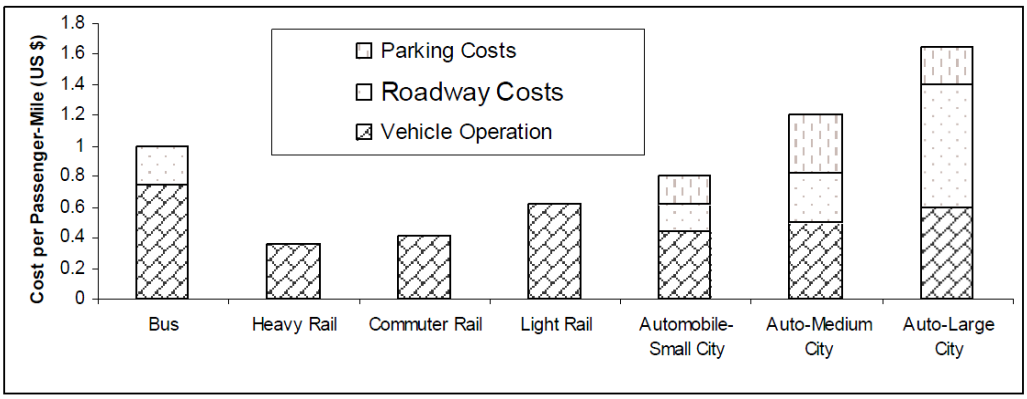


Figure 21 - Average Operating Costs By Transit Modes - Source - VTPI 2007

There are marked differences in the activities of MRT by regions. In Central and

Eastern Europe activity is focused on rehabilitating existing systems, upgrading the tram systems to LRT or heavy systems and exceptionally, developing new metros. There is little systematic development of metro in Africa and the Middle East. South Asia has metro operational only in India (Mumbai, Delhi and Kolkata). East and South-East Asian cities have already extensive metros in operation and also in under planning in many cities. In Latin America there are major busway programs and metro developments and suburban rail concessioning too in some cases. BRT has increasingly become an attractive urban transit alternative in many Asian developing cities especially in China and many other developing large cities of the world due to its cost-effective and flexible implementation. But within a built-in environment of a city like Dhaka where the road space is very limited, it is very difficult to introduce BRT system as it needs space sharing with existing traffic. Rather it may be introduced in newly developed town like Purbachal. (Md. Mazharul Hoque, 2005)

3.2 Dhaka Urban Transport Network Development

With due consideration of rapid urbanization situation in Dhaka, the Government of Bangladesh (GOB), through Dhaka Transport Coordination Board (DTCB) as the implementing agency, formulated the "Strategic Transportation Plan" (STP) in cooperation with the World Bank in 2005. The STP prepared an "Urban Transportation Policy" for the year period from 2004 to 2024 and identified priority issues such as the establishment of an organization to manage project implementation and maintenance/operation, improvement of the mass transit system such as introduction of Bus Rapid Transit (BRT) and Mass Rapid Transit (MRT) and improvement of road network. Under such circumstance, Japan International Cooperation Agency (JICA) conducted formulation study for Dhaka Urban Transport Project in March 2008.

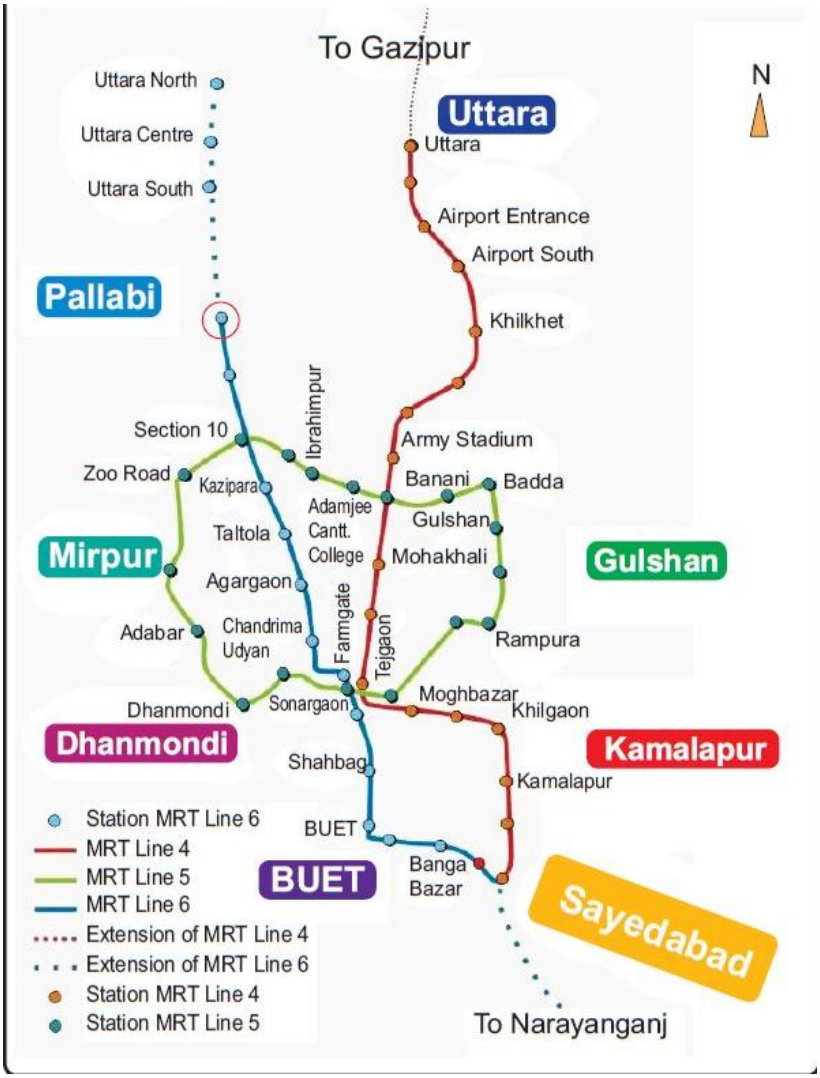


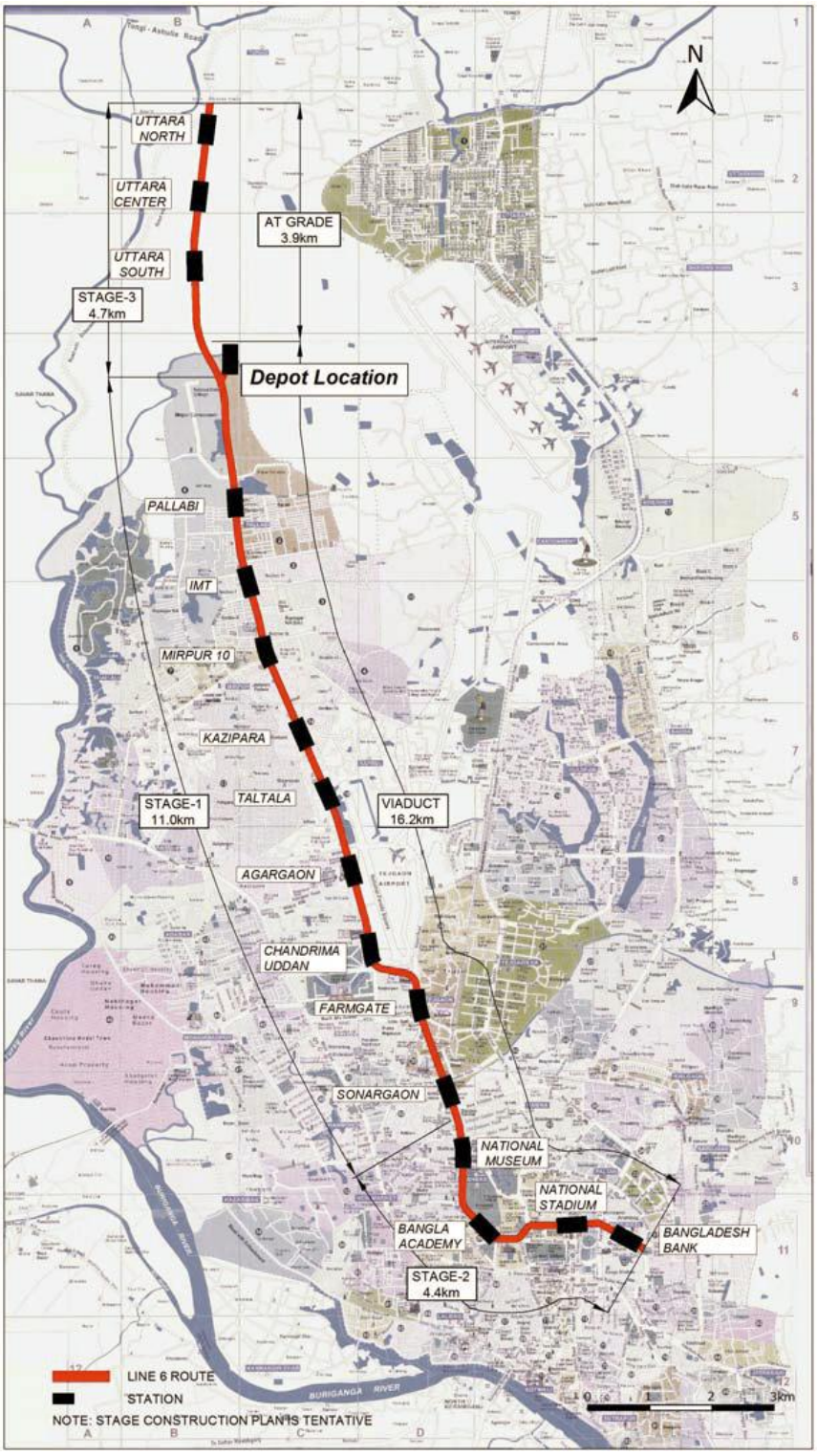
Figure 22 - Proposed Metro Routes in Dhaka, Bangladesh

Source : bdnews24.com

Following this study, JICA conducted preparatory survey on Dhaka Urban Transport Network Development Study (Phase 1 Study) from March, 2009 to March 2010. The Phase 1 Study recommended a series of urban transport network development projects and programs. MRT Line 6 project was selected in the Phase 1 Study as the high priority project and it was

agreed between GOB and JICA that this project will be further studied in the Phase 2 to confirm its feasibility. (JICA, October 2011)

The objectives of the Phase 2 Study are to conduct the feasibility study on MRT Line 6 project by confirming technical, economical and financial viability of the project as well as confirming environmental and social aspect. The following sections 'Technical Design Criteria and Specifications' provides the technical specifications provided by JICA in 'Dhaka Urban Transport Network Development Study- Phase II' and was used as the main technical guideline for the MRT station Design at Khamarbari- Indira Road-Farmgate.



3.3 Technical Design Criteria and Specifications (Proposed by JICA Research Team)

3.3.1 Basic Design Criteria Detail:

	Item	Description
Basic Specifications:	**Rail Gauge**	Standard gauge: 1435mm
	Operation in case of Fire	Nonstop between stations (Train shall be driven to the nearest stations.)
	Earthquake	Seismic Design
Alignment:	**Minimum Radius**	600m (normal case) 200m (unavoidable case) 200m (Depot Area)
	Minimum Radium (Station)	600 m (the track along the platform)
	Gradient	35%-40% (between stations) Level for stations but 10% will be allowed for unavoidable cases
	Transition Curve	Cubic Parabola Curve or Clothoide
	Minimum Length of Tangent Line between Transition Curve	20m but two transition curve will be allowed in case its unavoidable
	Minimum Length of Curve Section	20m but two transition curve will be allowed in case its unavoidable
	Distance between Rail Centre	3.6m (main tracks)
Rail Structure	**Rail**	UIC 54 kg/m (main tracks), 50 kg/m (side track and depot) CWR in curvature larger than 400m, to provide expansions joint 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 Minimum 5m for Island Type Platform Minimum 4m for lateral Type Platform

	Consideration of people with handicapped	Universal Design, Barrier Free (Lift, Escalator, Tactile Road for the Blind, Slope,etc)
Power	**Electric Power**	Overhead Catenary Type DC 1,500V
Rolling Stock		Body Length: 20,000mm (Middle Car) Weight: Tare 28 Ton (Motor Car) Composition: 6 cars Maximum Train Speed: 100 km/ hr, Design Speed: 110 km/ hr Body Light Weight Aluminium Train Control: ATC Amenity: Air- Conditioned

3.3.2 Station and facilities:

Station plan and facilities plan are made for the following typical three stations:

Standard Intermediate Station: Mirpur 10 Station, Farmgate Station

Terminal Stations: Pallabi Stations, Sonargaon Station and Bangladesh Bank Station

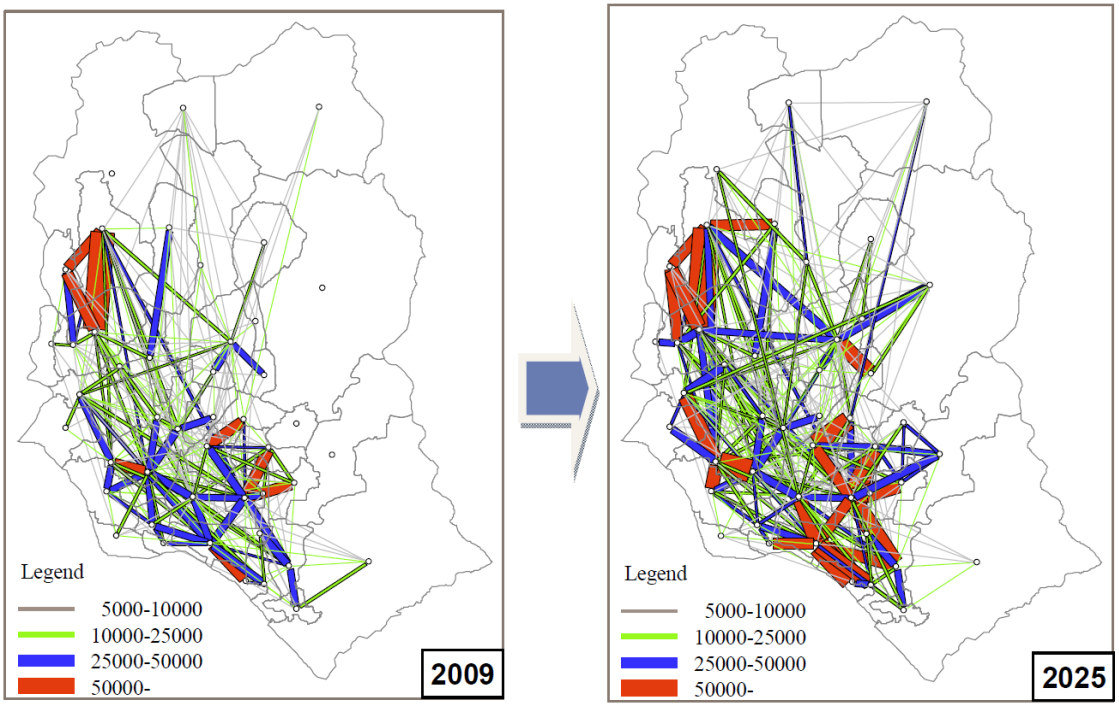
Lateral type platform is proposed for intermediate stations and Island type platform is proposed by terminal stations. The station building has two floors, first floor will be the concourse and second floor will be the platform. The layout of the Station plan and Facilities Plan will be made in consideration of passengers convenience and barrier-free design for handicapped people.

Type	Category	Pros	Cons
A	Lateral Platform	Straight main track without speed limit. High visibility all over the platform. Easy extension of the platform in future.	Less effective utillization of the platform area in commuter stations. Number of elevations and stairs increase compare to Island platform. Therefore, the construction cost will increase.
B	Island Platform I	High visibility all over the platform Effective utilization of the platform area in commuter stations (Difference in passengers on up and down tracks) Construction cost will be reduced compare to Lateral platform because of the required numbers of elevators and stairs are less than Lateral platform.	Curve included in main track requires decrease in train speed. Difficult to extend platform after construction.

C	Island Platform II	Less elevators and stairs Smaller space is required compared to Type B.	Curve included in main track requires decrease in train speed. Same space (road width) as lateral platform type is required. Wide area (road width) is necessary. Limited visibility due to curve. Difficult to extend platform after construction.

3.3.3 Conditions of Train Operation Plan (Proposed by JICA Research Team)

	Item	Condition
	Track Length	9.6km (distance between stations)
	Number of Stations	9 stations
	Average inter-station distance	1.2km
	Minimum curve radius	200 m
	Longitudinal grade	0%
	Number of cars per set	6 cars
	Number of Seats and Straps (Base No of Passengers: BNP)	(Leading cars) 147 persons X 2 + (Intermediate cars) 162 persons X 4 cars = 942 persons
	Target Passenger Number (TPN)	180% of BNP = 1,696 persons
	Station Structure	Intermediate Station: Straight and lateral platform Terminal Station: Island platform
	Track Layout for Terminal Stations	Turn-back at platform
	Required time for turn-back	3-minutes
	Stoppage time at station	40 seconds per station
	Inter-station operation time	Assume 1 minute 30 seconds between station
	Traffic pattern at peak time	The same number of trains for up and down tracks
	Number of passengers in the most congested section	18,250 persons / hour
	Headway	5 minutes 25 seconds



Source: JICA Study Team (the Phase 1 Study)
Note: trips which is less than 5,000 are not displayed

Figure 2.2-2 Desired Lines of Person Trips (All Purpose: 2009 - 2025)

3.3.4 Rolling Stock Data (Proposed by JICA Research Team)

Item	Recommended Specification	Remarks
Car body material	Full-Aluminium-alloy (motor	Recycling car
Composition	6 cars: 3M3T (Tc+M+T+M+Tc)	M: motor T: tralier Tc: train control
Electrical Power Supply	DC 1,500V	
Weight (Tare)	Tc:25t,M:28t,T:22t	
Target Passenger Number	1,696 persons	
Seating Passenger	Long-seat seatings arrangement	
Car dimensions	L 20,110mm x W2,950mm x H 4,100mm	Leading car
	L 20,000mm x W2,950mm x H 3,650mm	Middle car
No. of side entrances	4 doors/car each side	
Entrance dimensions	W 1,300 mm x H 1,850 mm	
Traction motor	1,100 V, 140 A, 200kW (1-hour rating)	
Controller	VVVF Inverter control type	

Brakes		Re-generative electric brake
Electric collection		Single-Arm pantograph type
Operation protection system		Automatic Train Control (ATC)
Maximum running speed		100 km/hr
Car Performance	Acceleration	3.3 km/hr
	Deceleration	Normal 3.5 km/h/s
		Emergency 4.5km/h/s

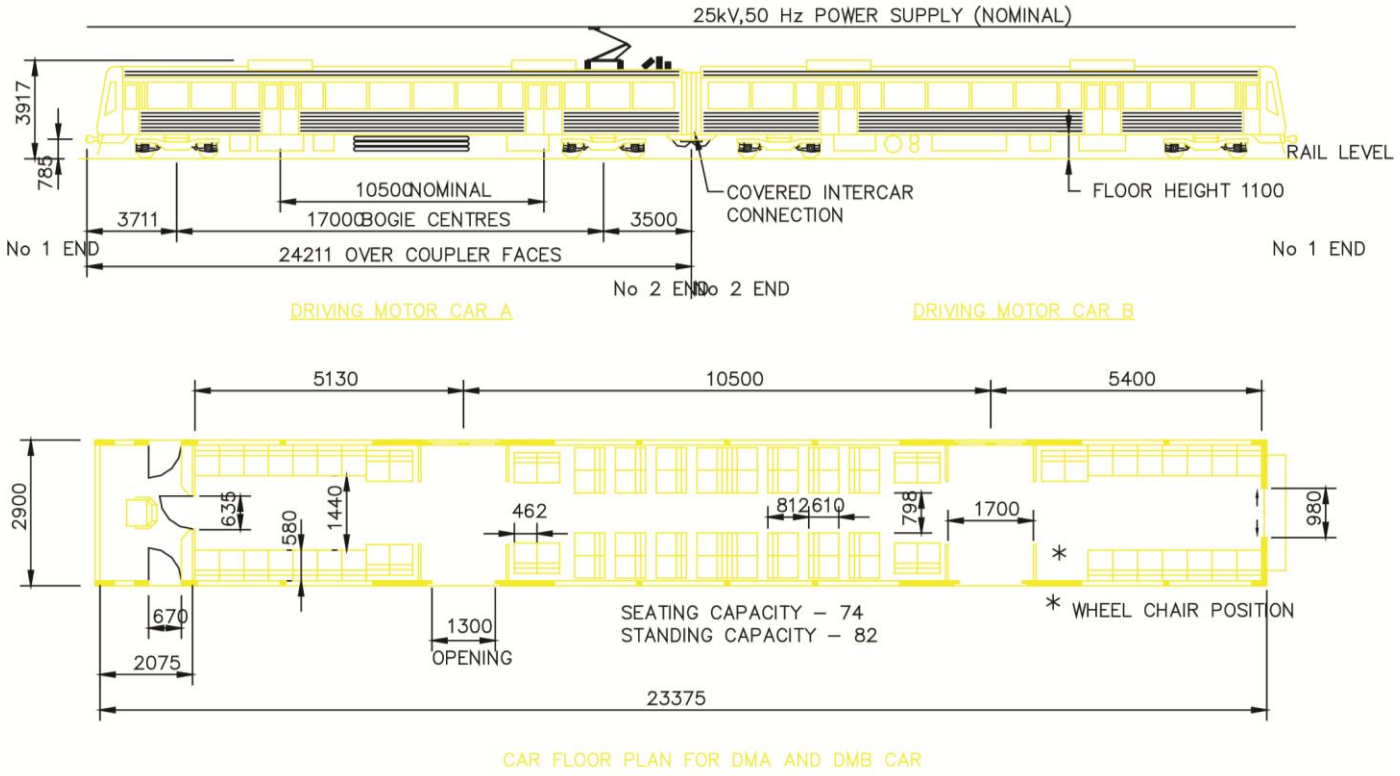


Figure 23 - Detail Specifications of the Rolling Stock

3.3.5 Recommended Technical Systems and Facilities (Proposed by JICA Research Team)

1)	Station Equipment	Ticket System	Automatic Fare Collection System (Ticket Vending Machine, Automatic Gate, Fare Adjustment machine)
		Ticket Type	Contactless IC Ticket
2)	Signal System	Block System	Cab Signalling Block System
		Interlocking Device	Relay Interlocking
		Signal Safety System	ATC
		Operation Control	CTC

3)	Telecommunication System	Telecommunication Facility for Security	Dispatcher Telephone, Wayside Telephone, Crew Radio System, Yard Radio System, Train Radio System (LCX)
		Telecommunication Facility for Passenger Services	Public Address Facility, Passenger Information Display System, Clock System and CCTV Monitoring System
		Information Collection	Rain Gauge, Anemometer, Seismometer, Fire Alarm, Fire Detector and Disaster Prevention System
		Transmission Facility	Optical Fibre Cable and Transmission System
4)	Others	Remote Control and Surveillance System	Supervisory Control and Data Acquisition (SCADA) System

3.3.6 Station Equipment for MRT Line 6 System (Proposed by JICA Study Team)

Equipment	Proposal
Ticket System	Automatic Fare Collection System is proposed for MRT Line-6 Ticket Vending Machine (Capacity: about 300 tickets/hr.) Automatic Gate (Capacity: Maximum about 60 pax / min.) Fare Adjustment Machine (Capacity: about 140 times/hr.)
Type of Ticket	Contactless IC Ticket is proposed for MRT Line-6
Escalator	Escalator is recommended in the station. Speed is about 30m/min - 40m/min.
Elevator	Elevator is recommended between concourse and platform. Main specification is as follows: Width of elevator door: 90cm and above Barrier-free function

Fare Adjustment Machine: The fare adjustment machine is installed inside the ticket gates and used for fare adjustments, such as excess fire. This fare machine reads the ticket information when the ticket is inserted into the machine. At this time, the fare is deducted from the remaining balance on the ticket and any balance due is displayed. After inserted the necessary amount of money, an adjusted-fare ticket will dispensed, with which the passenger can pass through the automatic gate. (JICA, October 2011)

Automatic Ticket Vending Machine: The automatic ticket vending machine is used for ticket selling, and a machine which automatically accepts money and issues and tickets after the passenger chooses the type of ticket. The automatic ticket vending machine is operated by passengers need to be simple and easy to use.

Figure 24 Various Types of Automatic Ticket Vending Machine

Automatic Gate: The automatic gate, which is installed at the ticket gate or the ticket collection gate, is a machine that reads or collects tickets on the behalf of the station staff. The types of automatic gates are for entrance only, exit only; and both entrance and exit (different- able). On entrance, the automatic gate reads the necessary information from the card or ticket and writes the entrance record onto it. On exit, the card again passes over the card reader. At this time, the fare is adjusted and confirmed based on the entrance record. If required information is not obtained on entrance or exit, the gate will close in each case. The automatic gates are installed in order to check tickets swiftly and accurately for many passengers.

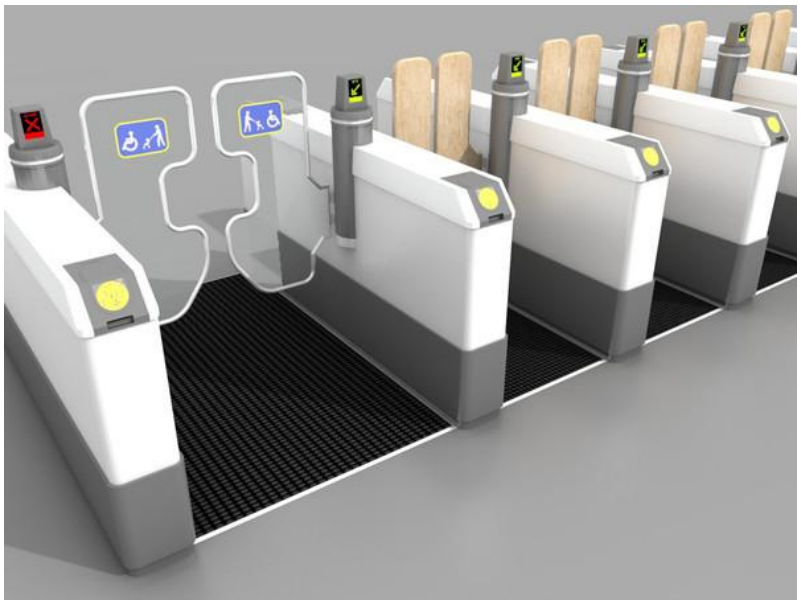


Figure 25 - Automatic Ticket Gate with Fare Adjustment Machine Inside

3.3.7 Height Levels at Farm gate for MRT Line 6 System (Proposed by JICA Study Team)

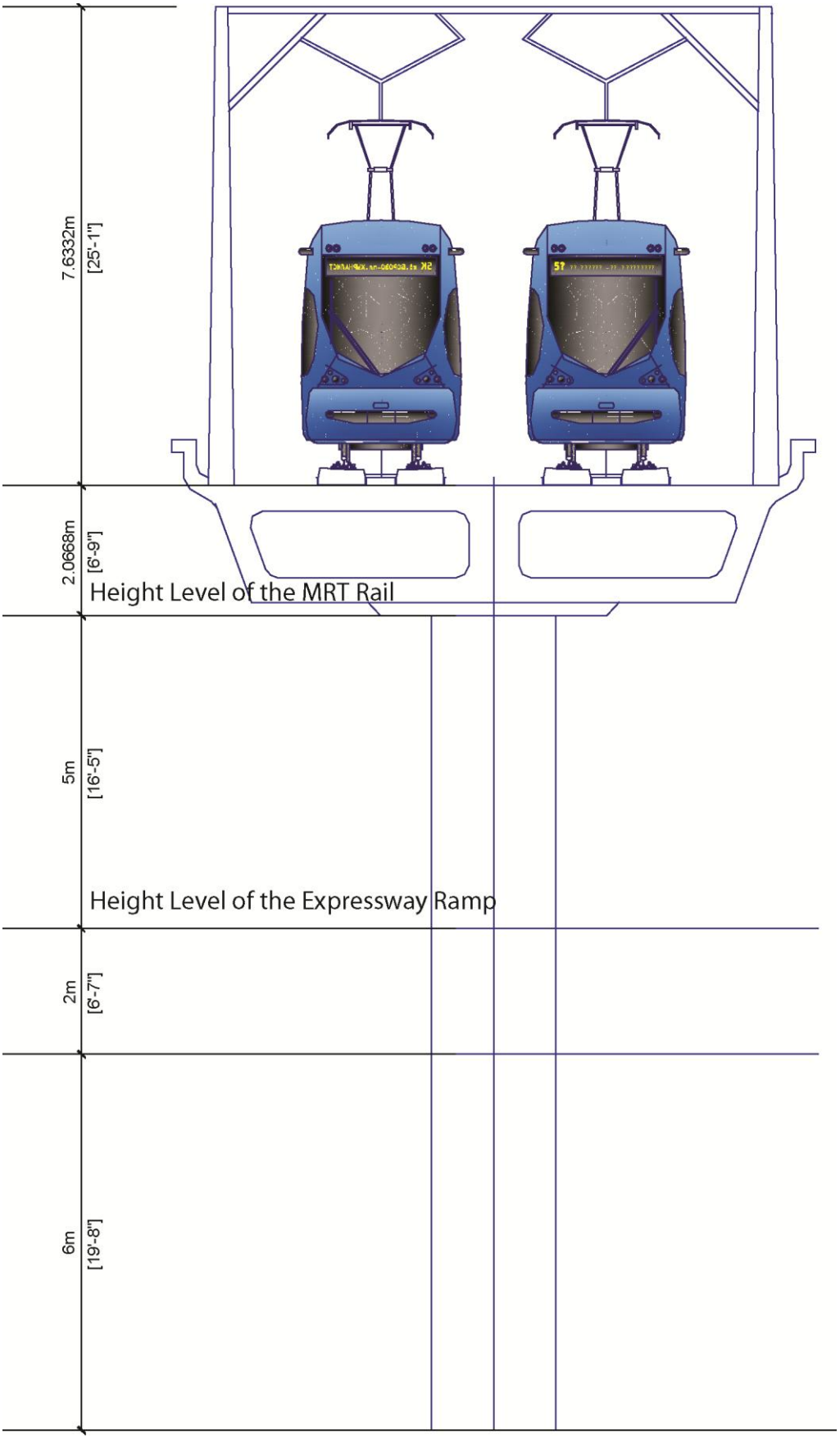
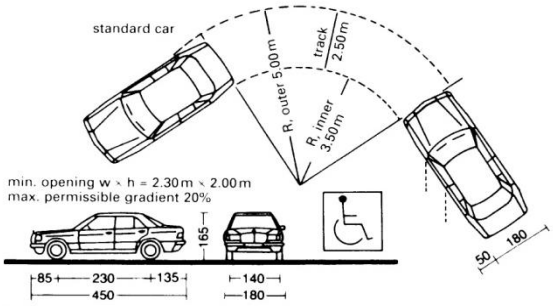
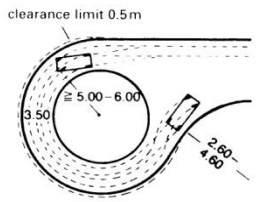


Figure 26 - Height Levels at Farmgate for MRT Line 6 System

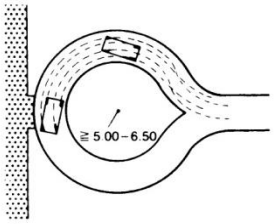
3.4 Bus Stop and Car Drop-off Measurements (Neufert Standards)



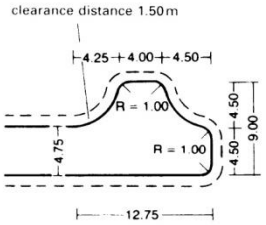
① **Standard car**



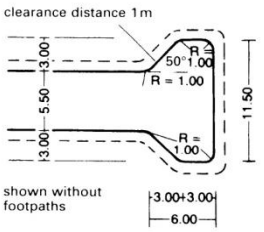
② **Car turning circle**



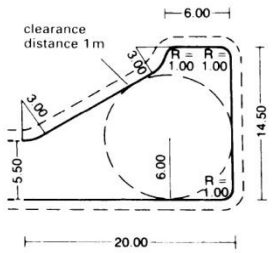
③ **Car turning circle radius for an entrance drive ≥ 5–6.50 m**



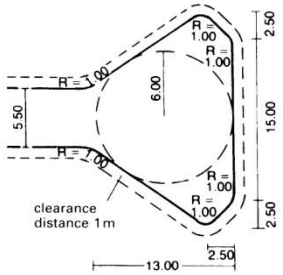
④ **Hammerhead turning place for cars**



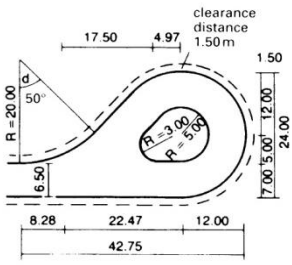
⑤ **Hammerhead turning place for vehicles up to 8 m (refuse collection vehicles, fire tenders, trucks up to 6 t)**



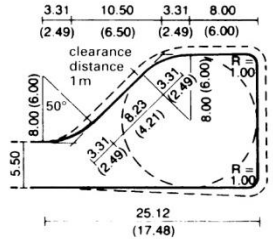
⑥ **Turning area for trucks over 10 m long and 24 t 6 × 4 refuse collection vehicles**



⑦ **As ⑥**



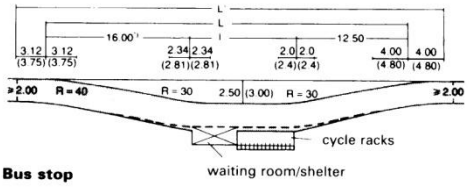
⑧ **Turning loop for articulated trucks and buses**



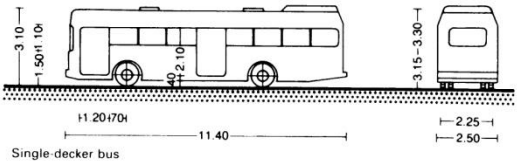
⑨ **Turning circle for 4 × 2 refuse collection vehicles and 6 m long delivery vans**

	l	L	L'
bus	12.00	40.50	47.62 (49.05)
two buses	25.00	53.50	60.62 (62.05)
articulated bus	18.00	46.50	53.62 (55.05)

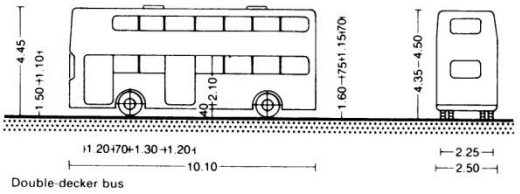
for 3 m wide bus stop bays
*) 25 m for bus stop bays for articulated buses



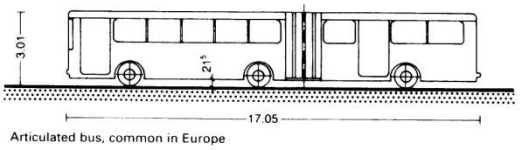
⑧ **Bus stop**



Single-decker bus

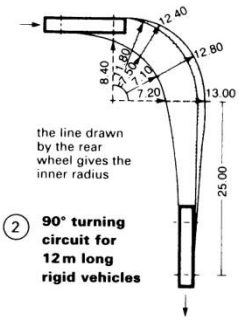


Double-decker bus

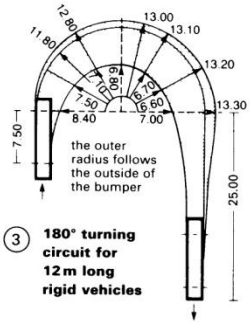


Articulated bus, common in Europe

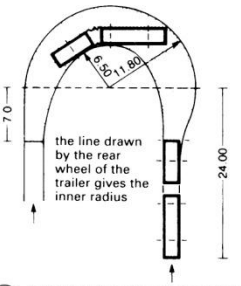
① **Bus dimensions**



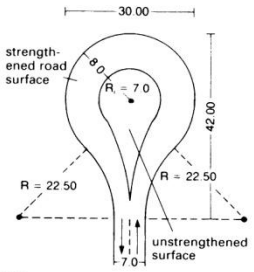
② **90° turning circuit for 12 m long rigid vehicles**



③ **180° turning circuit for 12 m long rigid vehicles**



④ **180° turning circuit for 17 m long articulated vehicles**



⑤ **Turning circuit**

(Neufert)

4 CHAPTER 04 : CASE STUDY

4.1 MRT Stations Projects:

4.1.1 Case Study 01: High Speed Train Station Napoli-Afragola

Architect: Zaha Hadid

Site Size: 30,000 sqm

Program: Train Station for high speed and regional services. Facilities for bus, taxi and car parking retail and civic, police and fire services.

Location: Naples, Italy

Significance : The New High Speed Station Napoli Afragola is a bridge above the tracks. The key challenge of the architectural scheme is to create a well organized transport interchange that can simultaneously serve as a new landmark to announce the approach to Naples – thus a new gateway to the city. The concept of the bridge emerges from the idea of enlarging the overhead concourse, required to access the various platforms, to such a degree that it can become the main passenger concourse itself.

Providing an urbanized public link across the tracks, the task is to give expression to the imposition of a new through-station that can also act as the nucleus of a new proposed business park linking the various surrounding towns. The bridge concept further allows two strips of extended park-land to move openly through the site alongside the tracks opening and connecting the site to the surrounding landscape and business park.

The architectural language proposed, geared towards the articulation of movement, is pursued further within the interior of the building, where the trajectory of the travelers determines the geometry of the space. (Zaha Hadid Architects - High Speed Train Station Napoli-Afragola)

Findings: Zaha Hadid's deconstructive forms and how it emerges from urban fabric and motion can be seen from this project. The atrium space is very inspirational and how circulation functions can be integrated with the atrium space and also bring in light and ventilation into the project. The steel frame details provide the notion of how such dynamic spaces and forms can be perceived through the use of extra skeletal frames. Integration of fenestration such as glass, louvers and steel coverings with the steel frame can also be seen in this project.

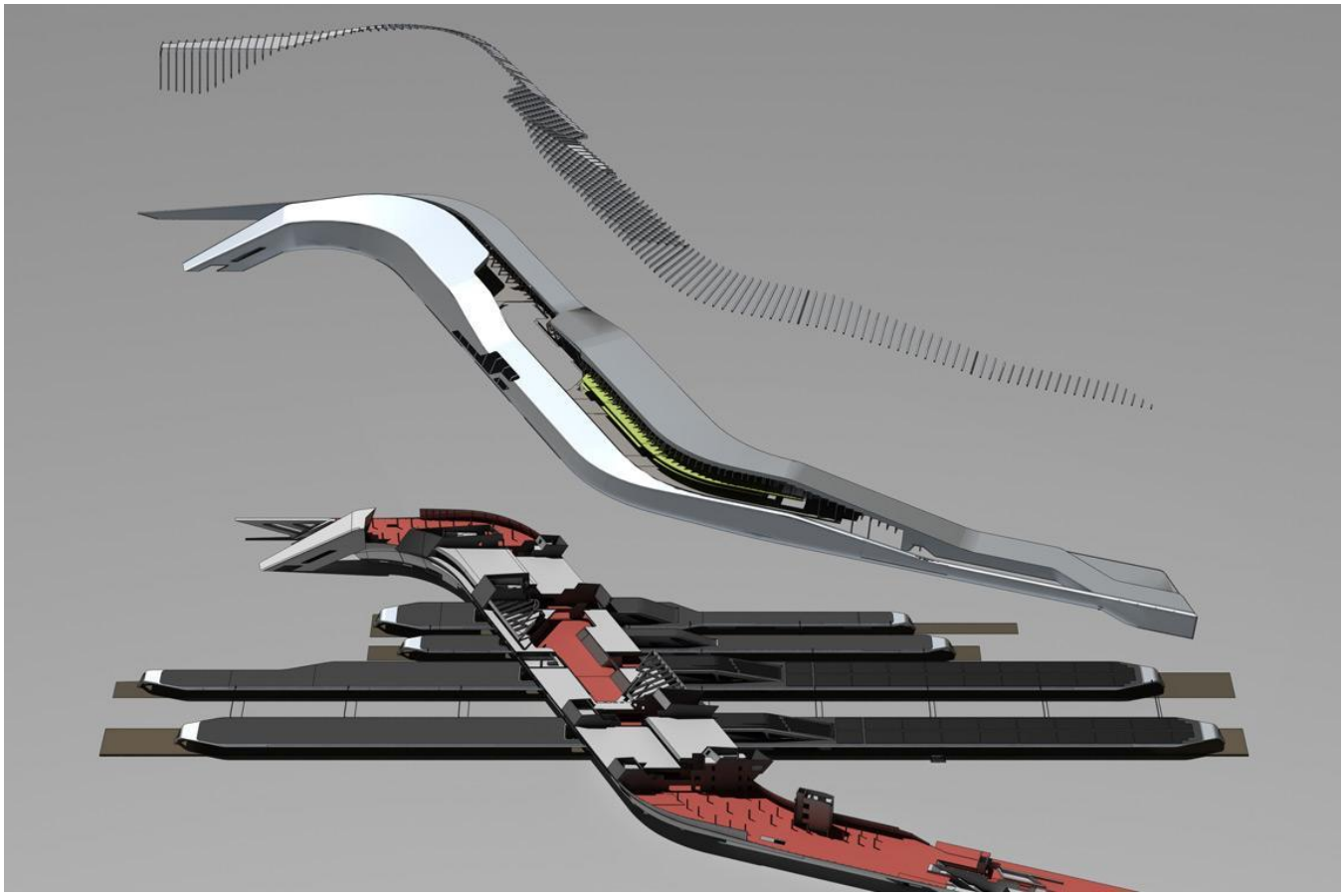


Figure 27 : Axonometric View showing the platform, atrium space and the roofing structural system

Figure 28 : Computer-Generated View of the Station

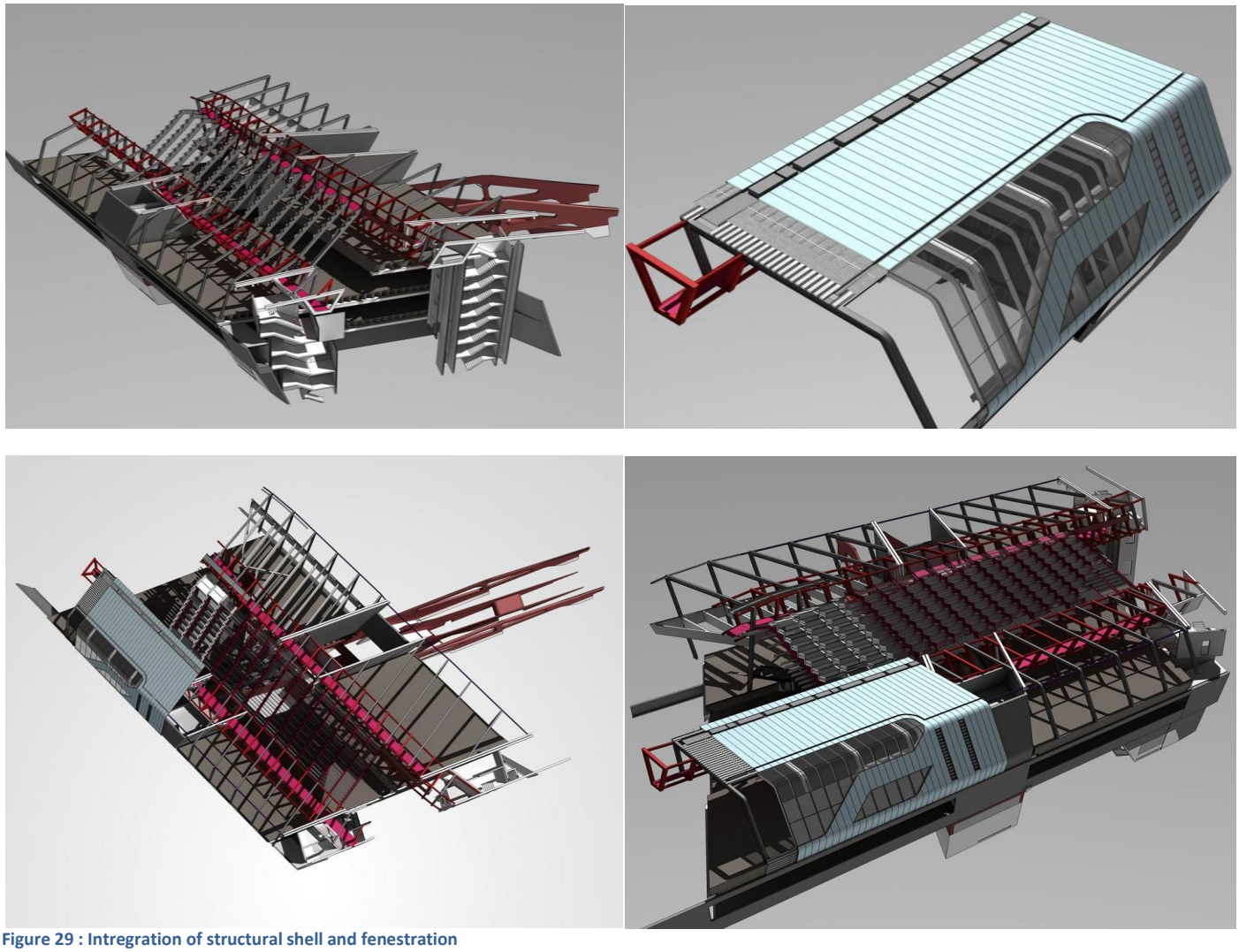


Figure 29 : Intregration of structural shell and fenestration

Figure 30 : Inspirational Atrium Space enlighting and uniting the interior enironment

4.1.2 Case Study 02: Newport Train Station

Architect: Nicolas Grimshaw

Site Size: 1,000 sqm

Client: Network Rail

Program: Train Station for commuter services. Facilities for bus, taxi and car parking and it integration with overall Newport Masterplan Development.

Location: Newport, Wales, England

Significance: Grimshaw, in association with Atkins, are redesigning Newport Station as part of a citywide regeneration masterplan by Newport Unlimited. As Newport is the first city reached by passengers between England and Cardiff, the station is a highly visible structure. Network Rail were keen that the new station should provide a striking civic building that would provide a gateway opportunity not only to Newport, but to Wales herself. Newport is bisected by the railway tracks. As a result, each half of the city has developed its own character. Grimshaw's design embraces this divide, creating two major new concourses. The North Concourse will be on the civic side of the city and focus on the needs of commuters. The South Concourse, on the commercial side, will be for connecting travellers, daytrippers and tourists. Each terminal's function is reflected in the distribution of ancillary facilities around the station.

Ticket facilities and platform access are split equally between the two terminals. All the main facilities at both terminals are housed in continuous ETFE and aluminium clad spirals. The spiral form of the station mirrors the journey taken within and helps to ease traffic flow by guiding the passenger from ground level up to the connecting bridge and back down onto the platforms. The use of an ETFE wrap over a steel structure not only creates a very bright and airy space but also, due to the lightness of the material, means the building requires a minimal support structure. This brightness of space is compounded by the inclusion of an oculus at the peak of each building, which doubles as a compression ring to secure the structure. The terminals and their connecting bridge have been positioned relative to the trains stopping positions, easing access and offering stronger connections to the city. Pedestrian routes surrounding the station are also being upgraded.

Findings: The analytical diagrams of this project showed the functional connections (Platform-Concourse-Public Plaza) in a train station and how it can be solved. Station Personnel, Administration and Technical services offices and their layout in the plan also provides strong design guidances as to how to solve these particular train station functions. The structural diagram shows steel frame detailing which plays quite a crucial in how to create architectural feats with steel.

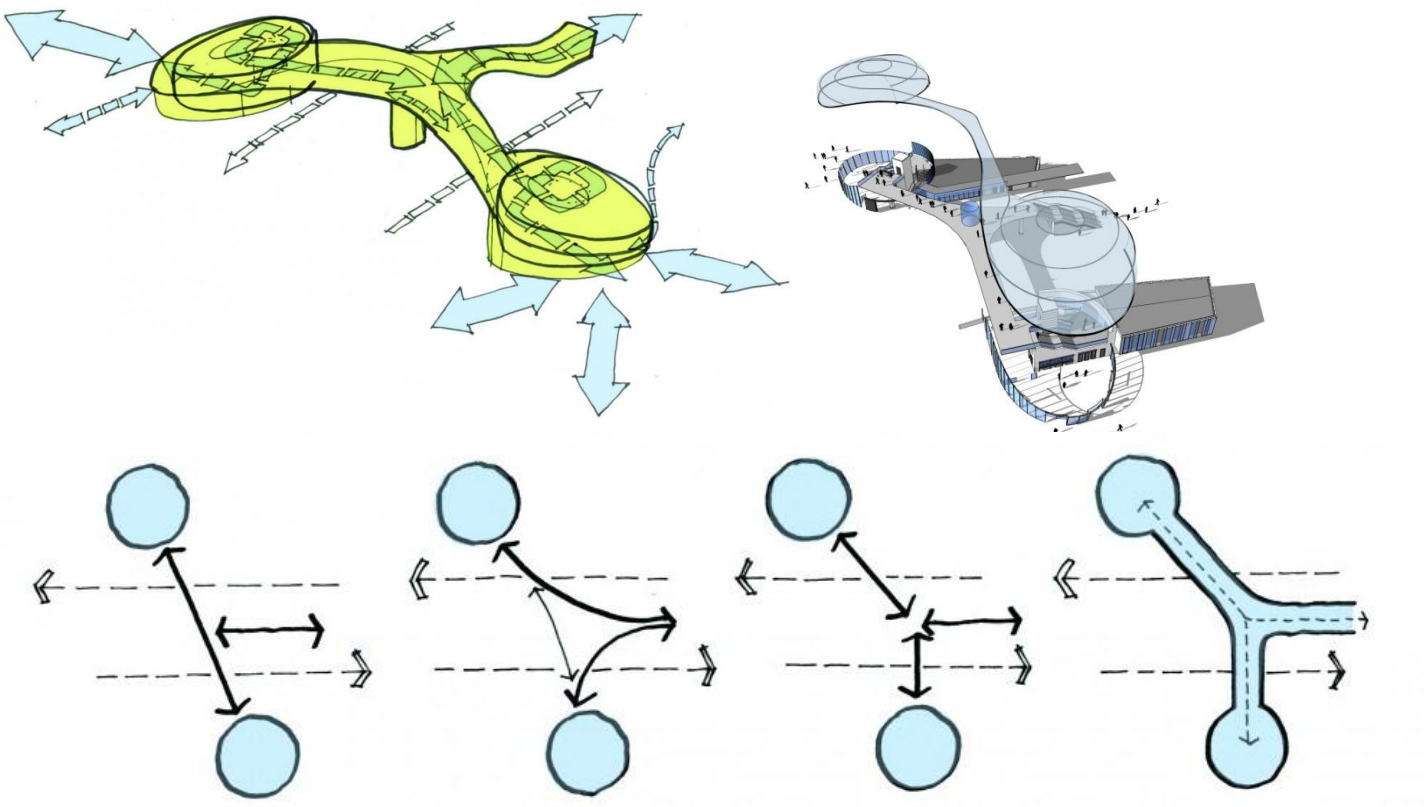


Figure 31 : Pedestrian Circulation Analysis and Conceptual Function Connection Diagram

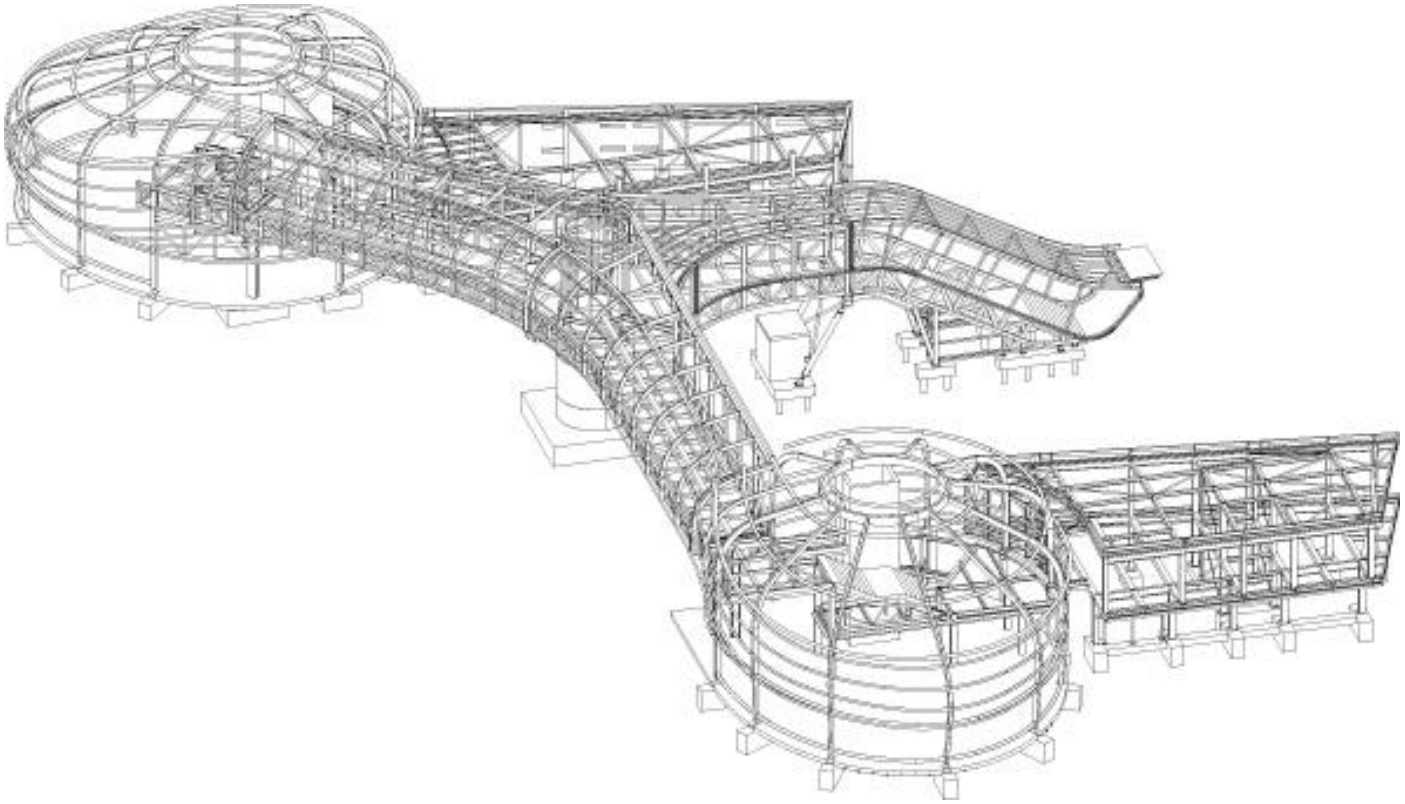


Figure 32 : Structural Diagram of Steel Reinforcement

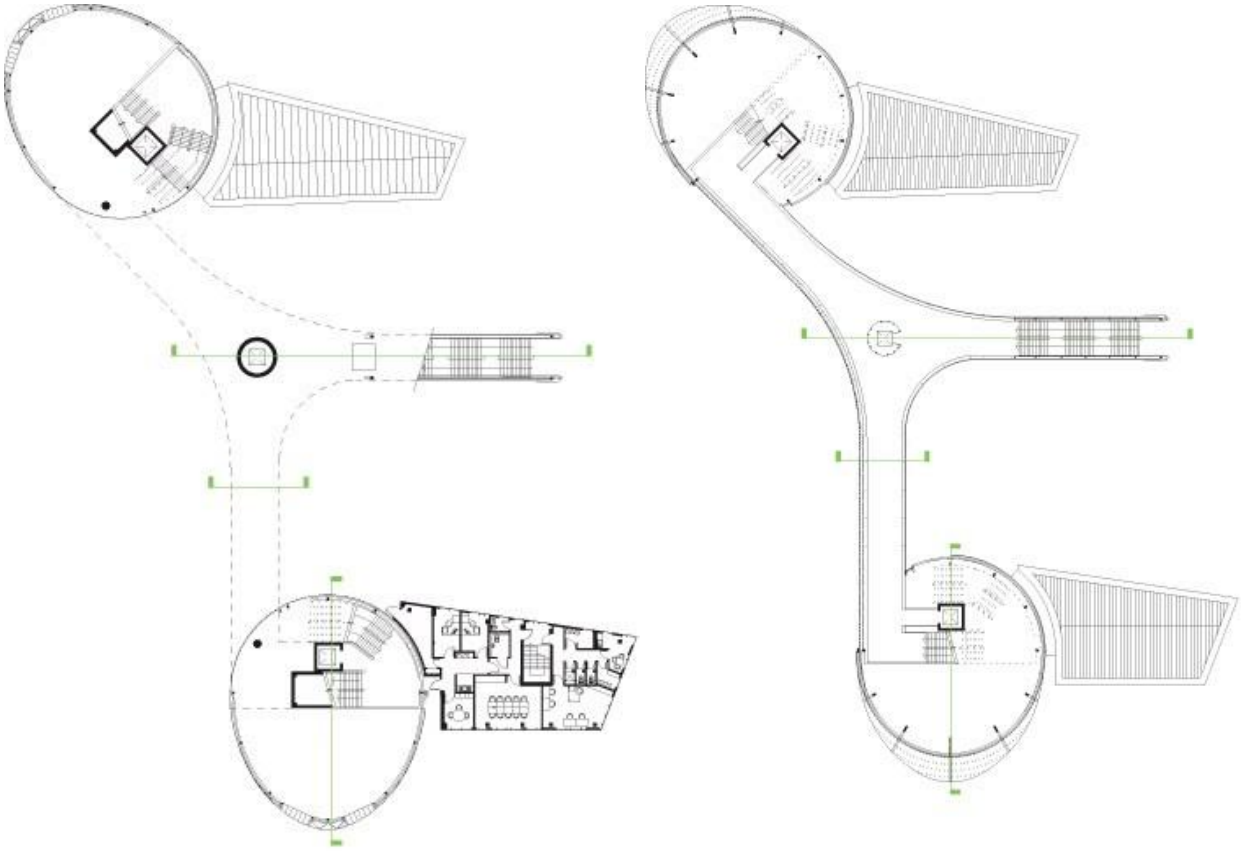


Figure 33: Concourse and Connecting Platform Floor Plans with Station Personnel Functions of Newport Station

Figure 34 : Ground Floor Plan of Newport Station

4.1.3 Case Study 02 : Circular Quay Station

Program: Elevated Train Station for commuter services. Facilities for bus stand, taxi stand, ferry wharf, elevated expressway, retail, restaurants, cafe, civic space and park.

Location: Sydney, Australia

Significance: Circular Quay is a CityRail station located in Sydney, Australia and is situated on the City Circle line. The station is elevated with the elevated Cahill Expressway roadway directly above it, and lies directly behind the Circular Quay ferry terminals from which services operate to a number of locations around Port Jackson (Sydney Harbour). The area is also the terminus for a number of bus services. Circular Quay is the nearest railway station to the Sydney Opera House and The Rocks area of Sydney.

Findings: This project showed the potential of how various transportation systems can be multi-layered and work simultaneously without disrupting urban connectivity. The integration of modal exchange functions and dispersion of commuter passengers to their next modal exchange destination can be seen in this project. How to promote visual connectivity while waiting for trains or ferry to beautiful harbours views can be really enjoyed in this project.

Figure 35 : 360 degree view of the Elevated Platform level and the Harbour Front View from that Level

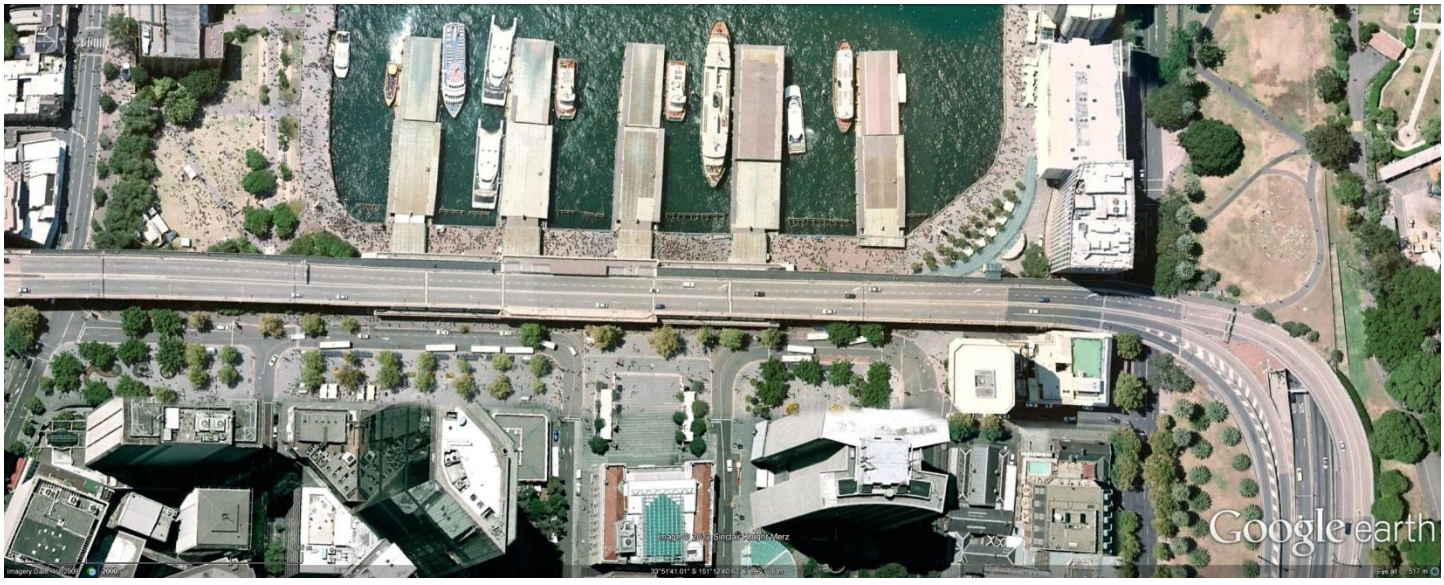


Figure 36 : Google Earth View from the top showing the Elevated Expressway on the top of the station and Ferry Terminal and Bus and Taxi Stand at the Ground Floor Level

Figure 37 : Front View of the Circular Quay Station with Ferry Terminal at the fore front and Sydney Cityscape at the background.

Figure 38 : Concourse Space and Automatic Ticket Barrier Machine

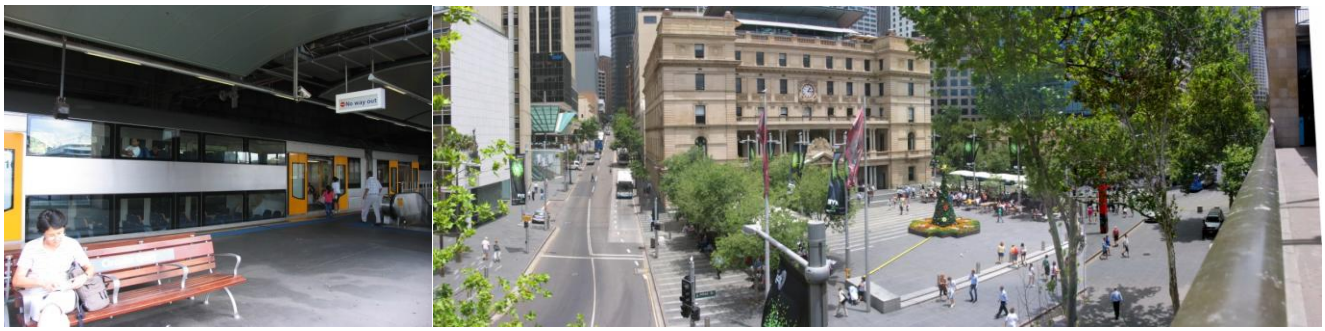


Figure 39: Public Square and Bus Stands at the Ground Floor of the Station

Figure 40 : Interior of the CityRail Train in Sydney

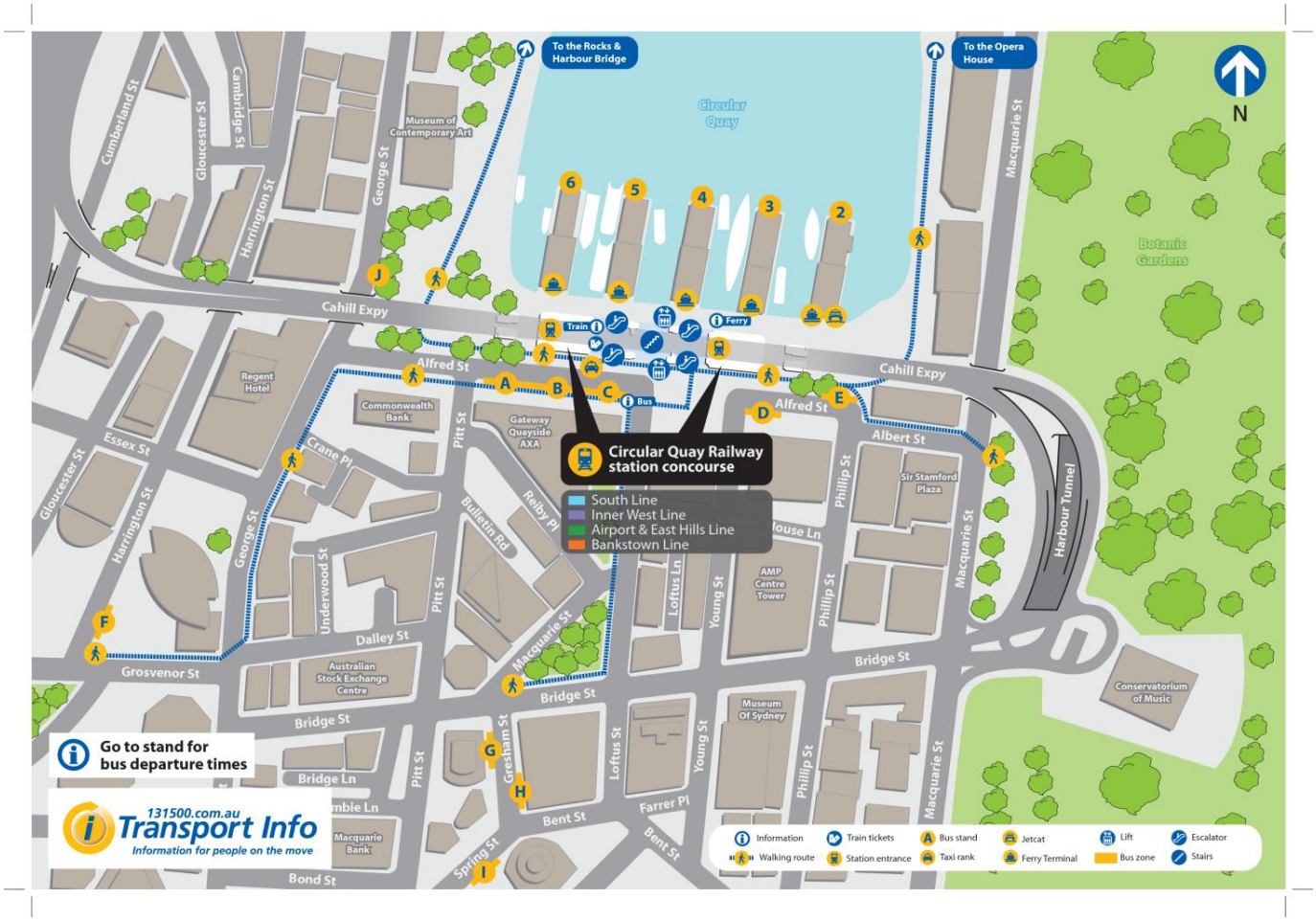


Figure 41 : Tourist Guide Map showing the location of escalators, stairs, ferry terminals, bus stands and taxi stands.

Figure 42 : Ground Floor outer concourse space of the station with Ticket Vending Machines and Ticket-Selling Booths

4.2 Urban Design Projects:

4.2.1 Case Study 01: Perth Link Project

Program: Urban Design and Master planning of Underground Train Station for commuter services and Facilities for bus stand, taxi stand. Development of City Link connection and civic, entertainment and commercial centre for the city.

Location: Perth, Australia

Plot Size 13.5 hectare

Significance: Perth's city centre and Northbridge were divided in 1881 by the Fremantle-Perth-Guildford rail lines. When the gold rush hit in the 1890s, this divide was increased further as the central railway precinct grew, perpetuated by the huge demand for passenger and freight transportation.

Five new cross-city connections will be created by sinking the Wellington Street Bus Station and the Fremantle rail line from Perth Station to Lake Street, as this will prepare the site for redevelopment.

The proposed new connections include the Milligan Street, Queen Street and King-Lake Street extensions, which will provide vehicle access through the area. Paths extending Shafto Lane to Roe Street and connecting William Street will enable pedestrians to cross through the city with ease.

The project's objectives are to:

- Provide a focus for public life, with the creation of an improved and new public realm.
- Optimise the appeal of the city centre and Northbridge and forge a connection of the two areas.
- Create better connectivity and access to public transport.
- Assist in supporting the revitalisation of the Perth Cultural Centre.
- Capitalise on the potential transit-oriented development benefits by its direct relationship with major transit systems.
- Provide opportunity and support for private investment, to create wider-spread economic benefits and drive the continued revitalisation of the city centre.
- Ensure that public investment is designed and implemented holistically to generate the improvement of social, economic, environmental and cultural conditions in the city centre.
- Provide housing with a diversity of dwelling types and sizes, and 10 to 15%affordable dwellings, to increase the opportunity for a variety of family types to live in the city centre.

Findings:

This project provided the opportunity to learn how to analyze and then improve urban linkage in a project when a site divides or breaks linkages in a city. Through the use of directional diagrams showing current vehicular, pedestrian, taxi and bus movements and how it can be improved through the site in future.

PERTH CULTURAL CENTRE
PERTH RAILWAY STATION
BARRACK STREET
FORREST PLACE
PERFORMING ARTS CENTRE
WILLIAM STREET
ONE40 WILLIAM STREET
WILLIAM STREET
JAMES STREET
LAKE STREET
QUEEN STREET
KING STREET
ROE STREET
RUSSELL SQUARE
WELLINGTON STREET
MURRAY STREET
HAY STREET
MILLIGAN STREET
PERTH ARENA
FITZGERALD STREET
MITCHELL FREEWAY
0m
50
100m

Figure 43 : Vehicular Movement Network in the Perth Link Project

Figure 44 : Pedestrian Network in the Perth Link Project

Figure 45 : Bicycle Infrastructure elements

Figure 46 : Bus Access and Movement Network

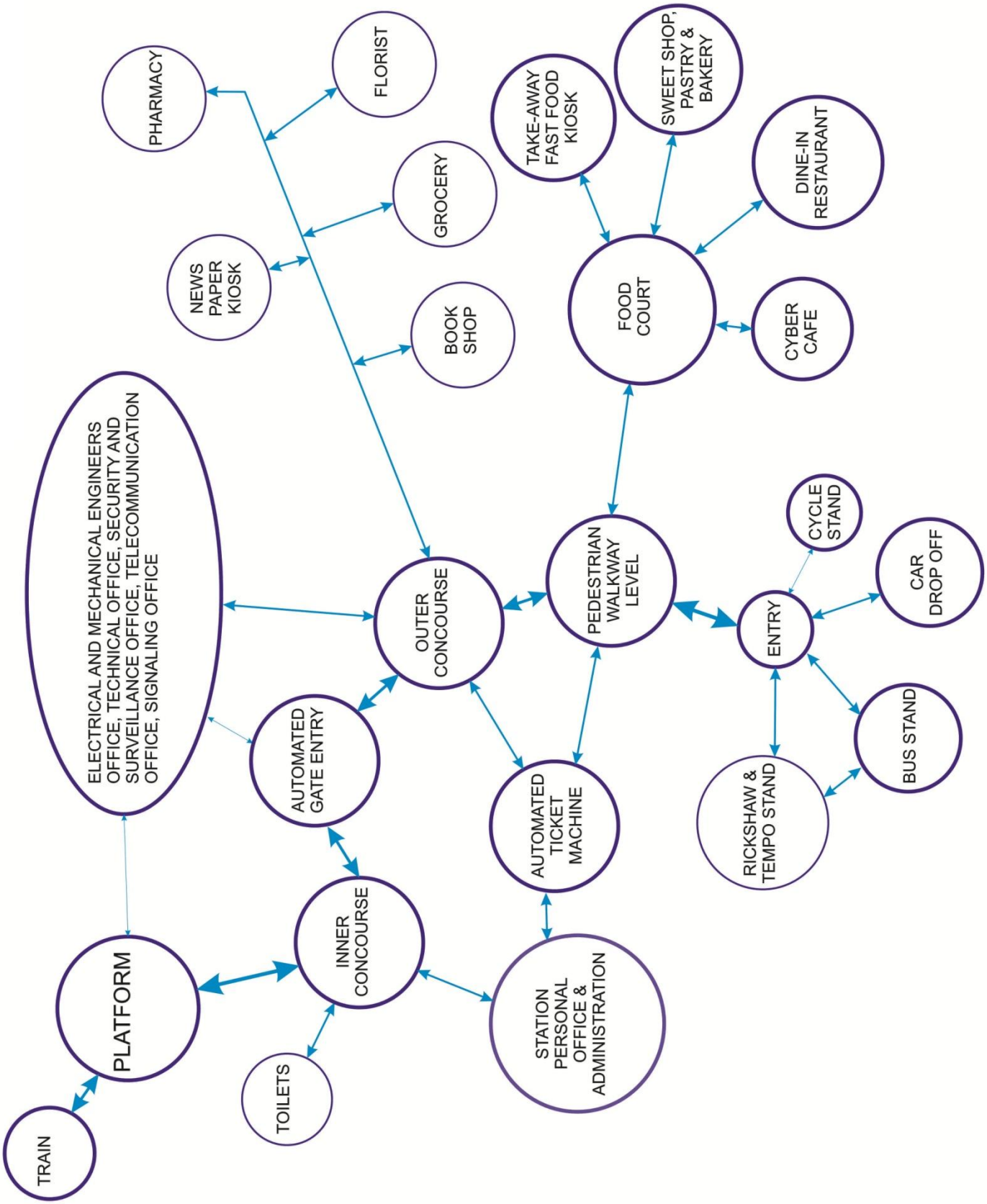
5 CHAPTER 05 : DEVELOPED PROGRAM

Floor	Item	Unit		Intermediate Station	Unit sq ft.
Elevated Passenger Volume					
	Number of daily passengers	Persons		81,000	
	Number of hourly passengers	Persons		10,000	
2nd (Platform) A railway platform is a section of pathway, alongside rail tracks at a train station, metro station or tram stop, at which passengers may board or alight from trains or trams. Almost all stations for rail transport have some form of platforms, with larger stations having multiple platforms. The term platform is most commonly used, in British usage, for designated areas where trains stop.					
	Scale of Floor (width x length)	m		21.8 x 125=2725m^2	29,340
	Style of Platform			Lateral Platform	
	Number of Platform	Place		2	
	Width of Platform	m		7.6m x 2	
	Number of Stairs	Place		4 (= 2 x 2)	
	Width of Stair	m		2.5m x 4	
	Number of Escalators	Place		4 (= 2 x 2)	
	Number of Elevators	Place		2 (= 1 x 2)	
	Number of Personnel Room	Place			
1st (Concourse) The concourse is the main gathering space of the commuting people. The volume of the space depends on the density of people in the road above. It requires at least a double height space to avoid claustrophobic feeling.					
	Scale of floor (width x length)	m		21.8 x 125=2725m^2	29,340
	Ticket Vending Machine Room and Counter	m^2	35	19 x 20	380
	Ticket Barrier Counter	m^2	5	8 x 7	56

Station office Administration Office	m^2	125	36 x 37.5	1350
Guard's room	m^2		25 x 13	325
Prayer room	m^2	30	30 x 18	540
Passenger's toilet	m^2	50	12 x 33.75 x 2	810
Garbage man's room	m^2	75	30 x 18	540
Restroom for Station Personnel (Tearoom, Lecture room, Napping Room, Toilet and Shower)	m^2	50	50 x 56	2800
Electricity facilities and others Mechanical Office Technical Office Security and Surveillance Office Telecommunication Office Signaling Office	m^2	260	65 x 50	3250
Ground (Entrance)- This intermediary floor provides access to passengers to the concourse level above and bus stands below. It contain variety of shops for the commuting passengers and students as well as the local residential community.				
Number of Stairs	Place		4 (=2x2)	
Width of Stairs	m		2.5m x 4	
Number of Elevators	Place		2 (=1x2)	
Newspaper Agency/Stationary Shop- Provision for quick access to newspapers, magazines and stationary needs for commuting and local students and passengers.			30 x 30	750
Pharmacy- Provision for quick access to medications and immediate medical and cosmetics for commuting passengers.			30 x 30	900
Cyber Café- A cafe which also provides the facilities to internet access. Mainly for students to do their after-school research internet.			30 x 30	900

	Take-way Fast Food Shop - Provision for quick access lunch for commuting passengers.	30 x 30	900
	Sweet Shop, Pastry and Bakery- Provision for quick access to desserts and confectionaries for commuting passengers.	25 x 30	750
	Restaurant - A dine-in shop for passengers in waiting and local community.	50 x 76	3800
	Florist & Gift Shop- Provision for quick access to cards, bouquet for commuting passengers.	25 x 30	750
	Grocery- One stop mixed-use needs for surrounding residential zone and commuting passengers.	40 x 45	1800
	Bank- financial institution for the passengers and local neighbourhood to deposit, lend or open accounts for financial transcations	40 x 45	1800
		TOTAL =	71 030 sq.ft
		TOTAL x 30% =	102,993sq.ft

5.1.1 Functional Flow-Chart Diagram:



6 CHAPTER 06 : CONCEPTUAL STAGE AND DESIGN DEVELOPMENT

During design development, two issues - pedestrian and vehicular circulation - where addressed simultaneously through the use of section diagrams and multiple layered diagrams of circulation.

6.1 Master Plan and Circulation Development

6.1.1 Development Phase - I

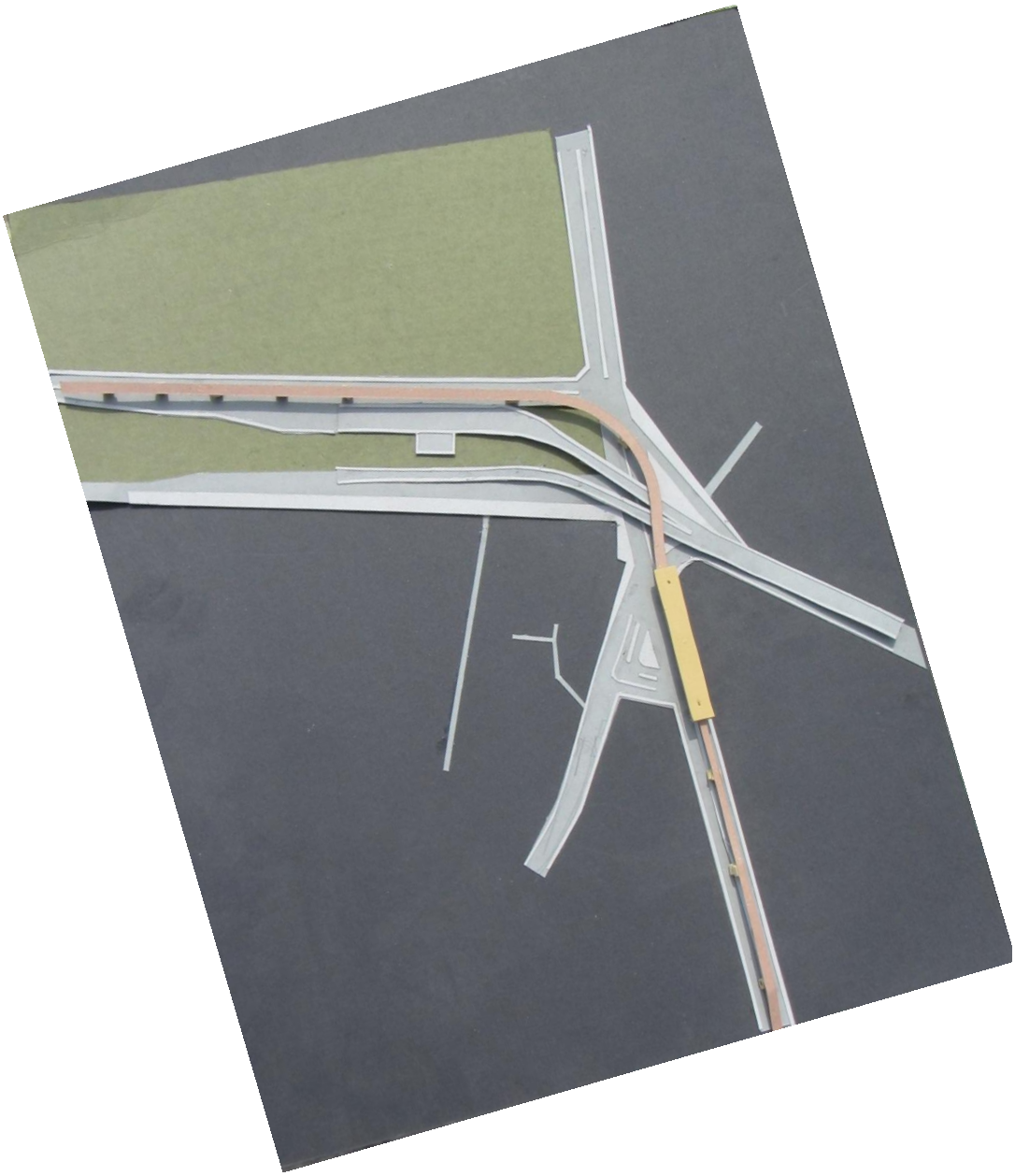


Figure 47 : Site Model Study consisting of the future goverment proposal of the MRT Rail and Expressway Ramp and Toll Plaza

This initial phase consisted of site analysis and model study of what the future scenario of the site would be once the elevated MRT station and rail is introduced as well as the ramps and toll plaza from the elevated expressway is also introduced according to the Government proposal for the site.

6.1.2 Development Phase - II

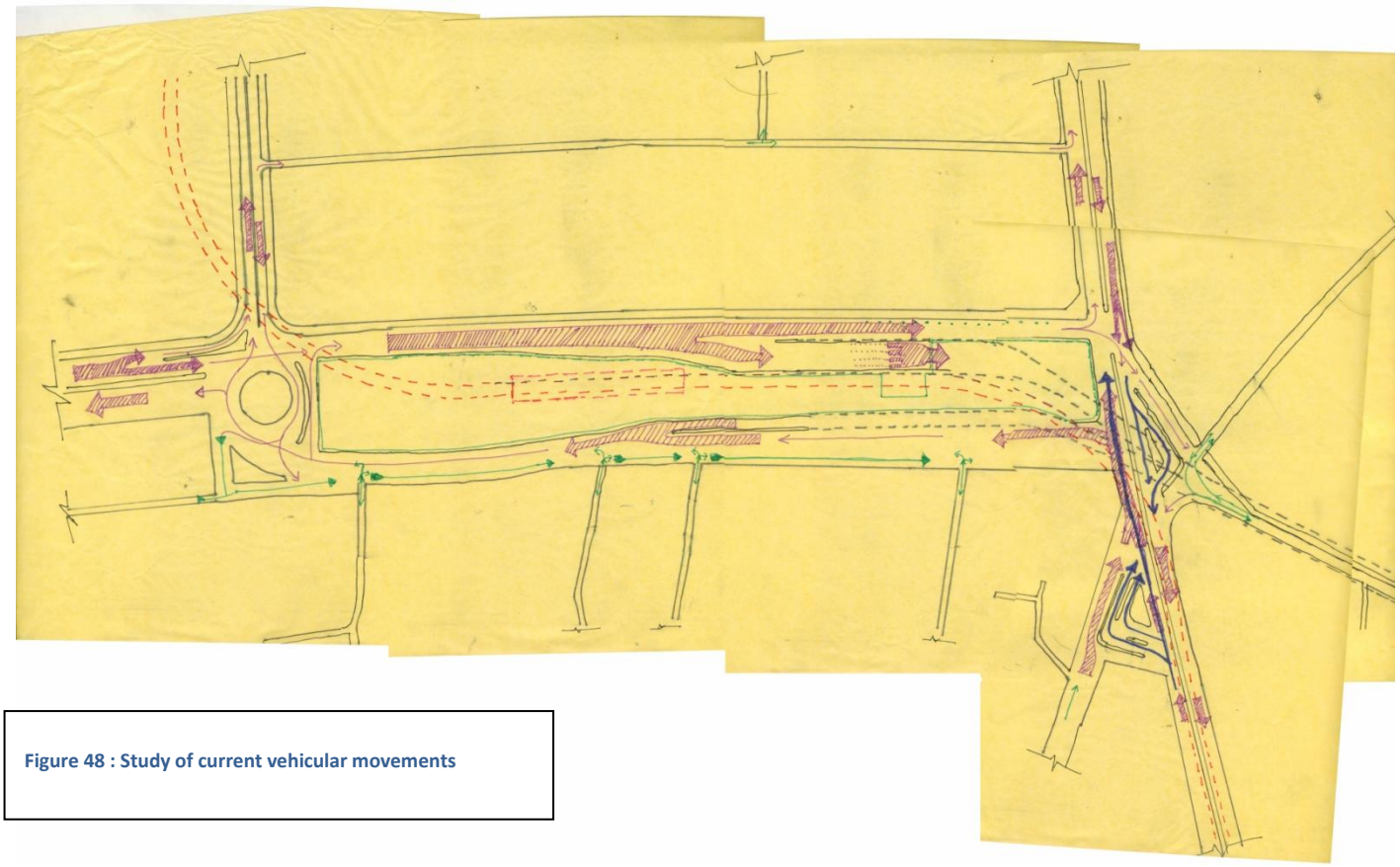


Figure 48 : Study of current vehicular movements

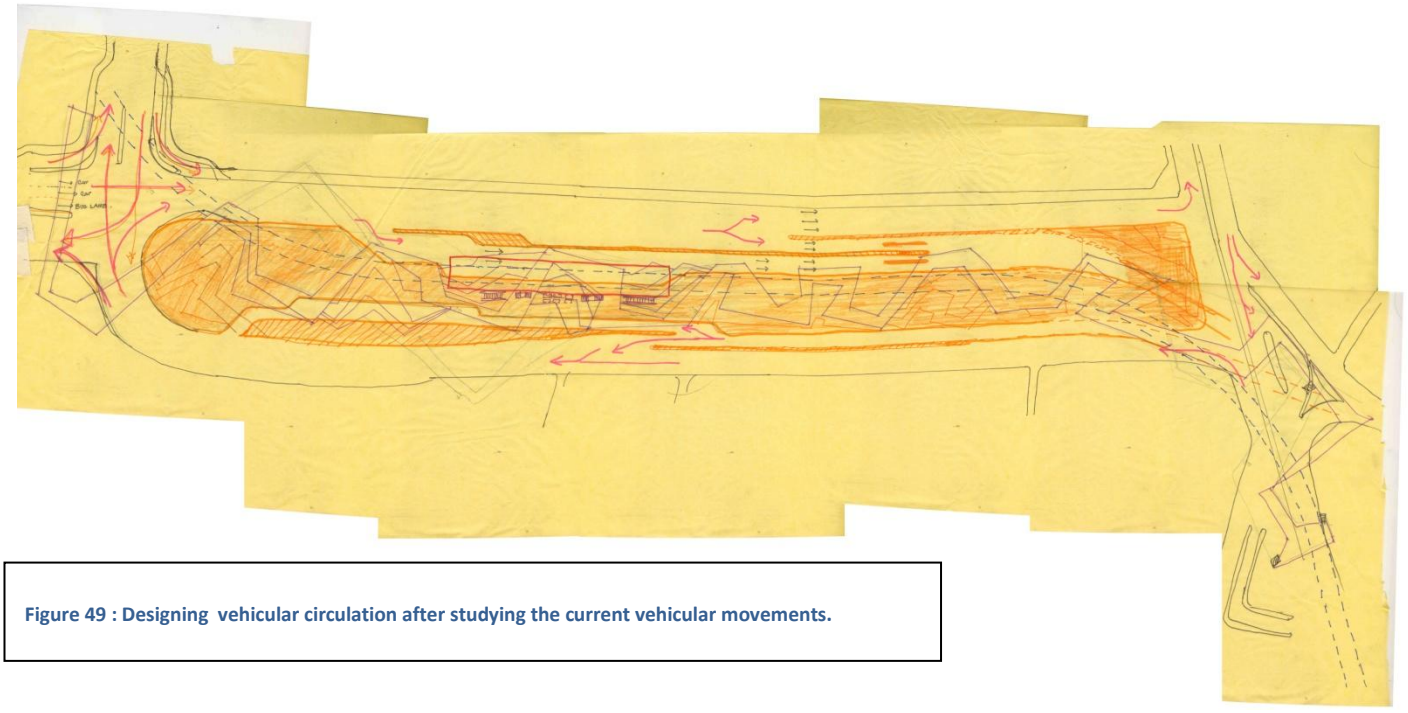


Figure 49 : Designing vehicular circulation after studying the current vehicular movements.

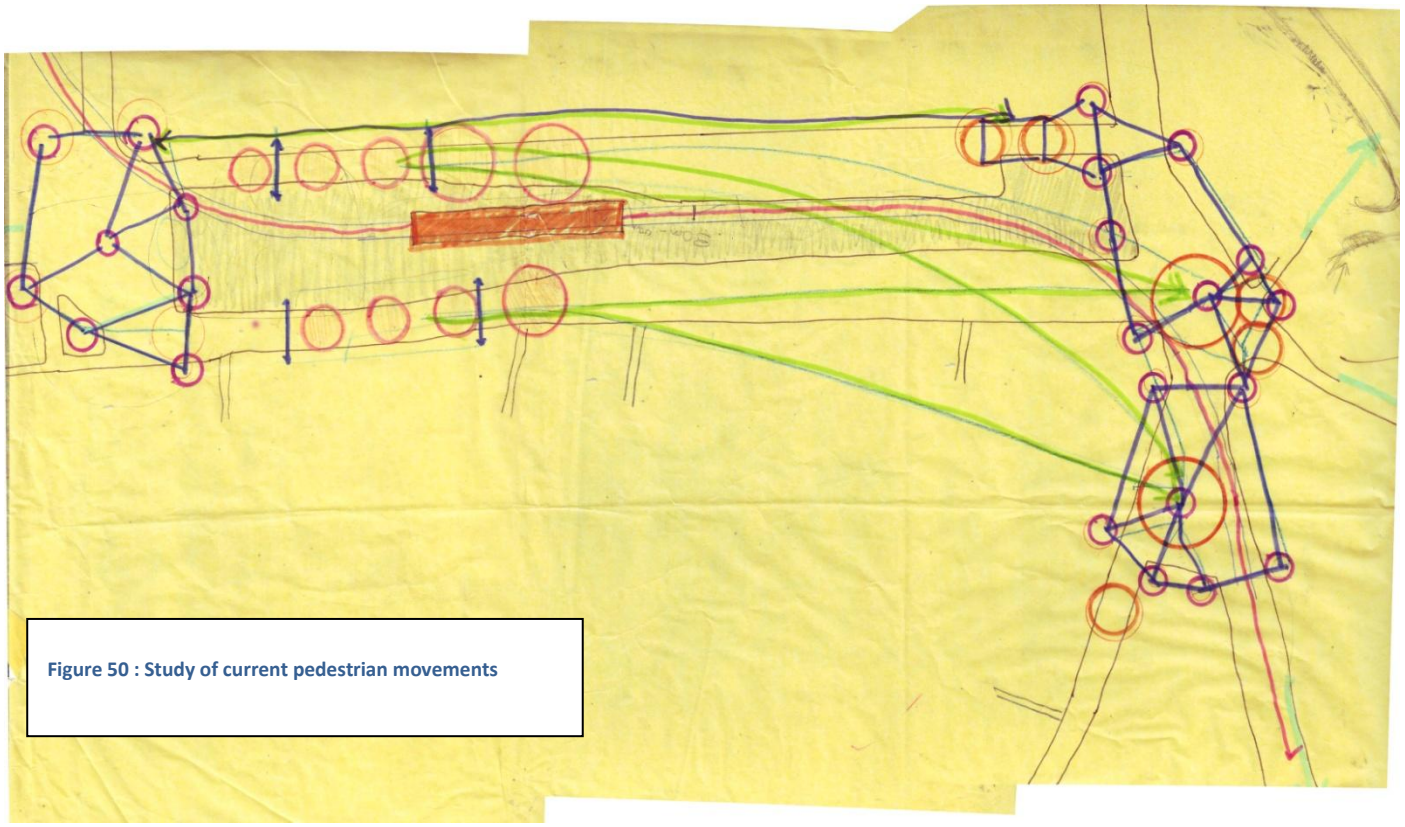


Figure 50 : Study of current pedestrian movements

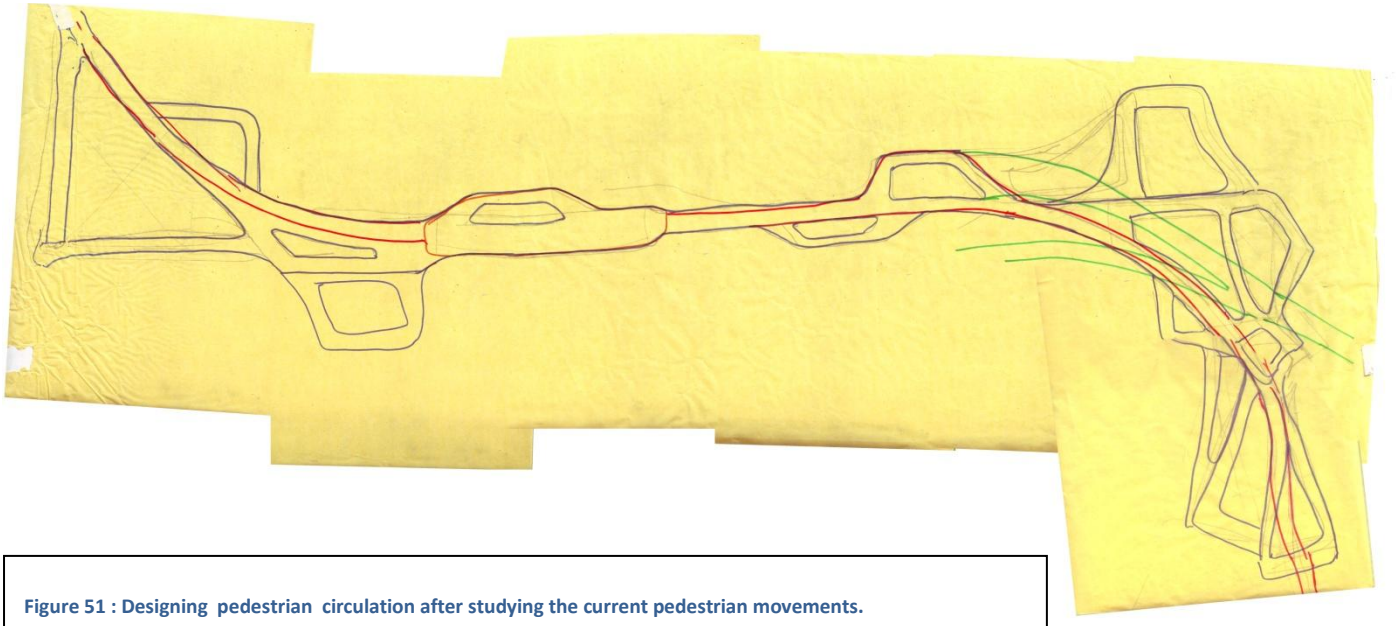


Figure 51 : Designing pedestrian circulation after studying the current pedestrian movements.

In Master Plan Phase-II, the design development on the overall master plan schematics and concentrated on the study of current vehicular and pedestrian movement and how it might change if an MRT station is introduced and therefore the optimum circulation process that can be achieved and the distribution of the commuter passengers to their required modal exchange destination from train whether it be rickshaw, bus, or tempo and vice versa.

6.1.3 Development Phase - III

In Master Plan Phase- III, Detailed Master plan schematics and multi-layered circulation diagram integrating all forms of circulation together including pedestrian, bus, cars, rickshaw, tempo, etc.

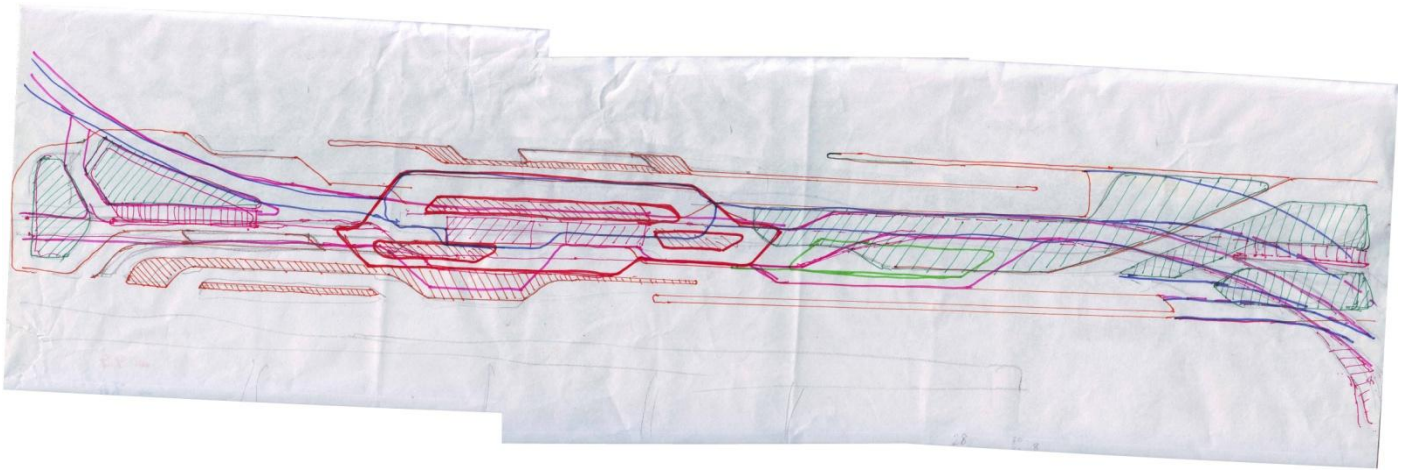
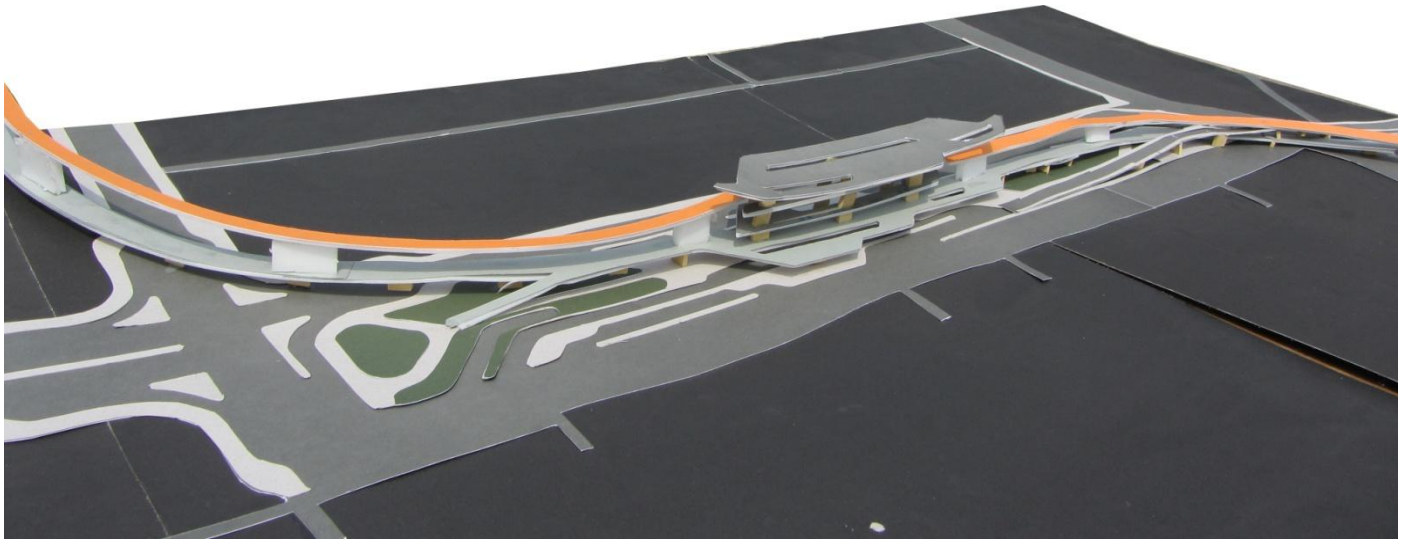


Figure 52 - Multi-layered circulation diagram containing pedestrian, vehicular, MRT rail circulation in different layers



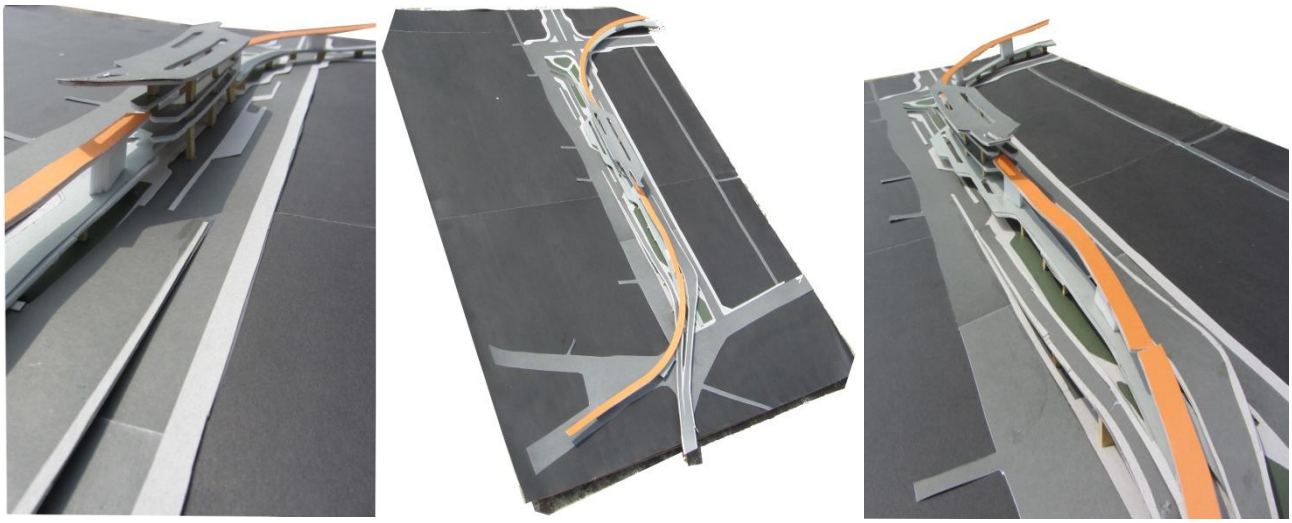
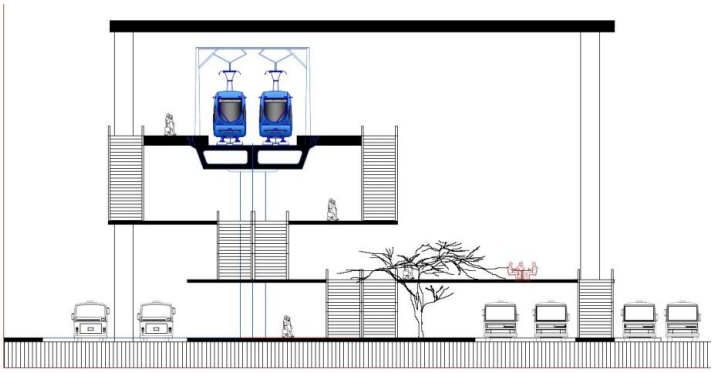


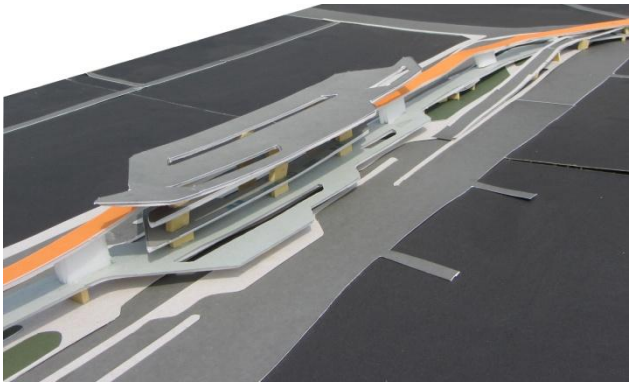
Figure 53 : Model Study consisting of various layers of vehicular and pedestrian circulation distribution

6.2 Sectional and Functional Detail Design Development:

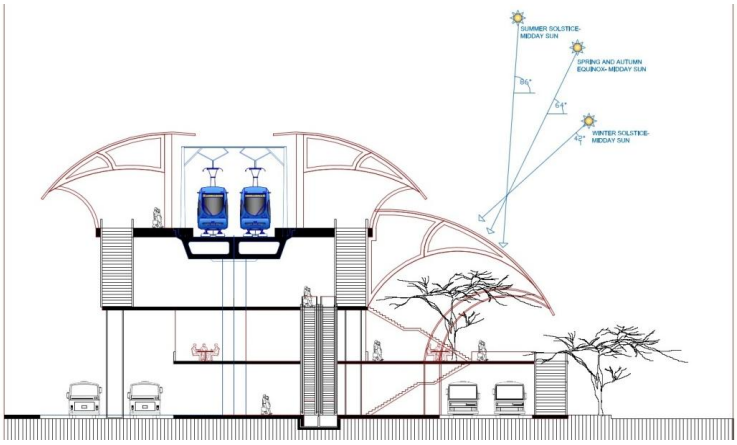
In this next few phases, it was more concentrated on the station and its integrated functions such as platform, concourse, shops, elevated expressway and how spaces could be made interesting by integrating vertical circulations (lift, escalators, stairs) with atriums and double-triple height spaces along with food court, kiosks and other functions. Sectional Diagrams and Models where used to understand the interior spaces in the following design phases.

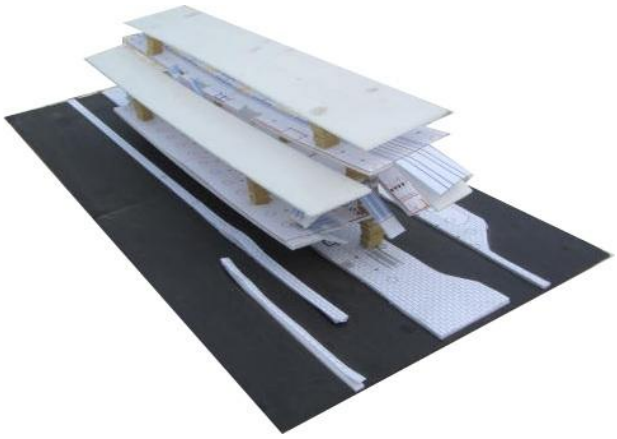
6.2.1 Sectional Development Phase - I



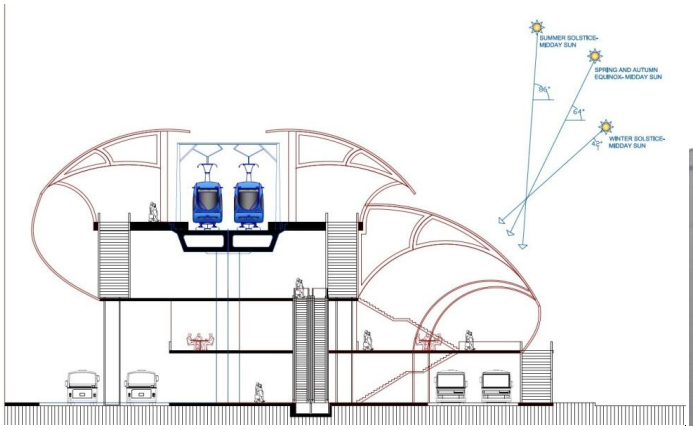


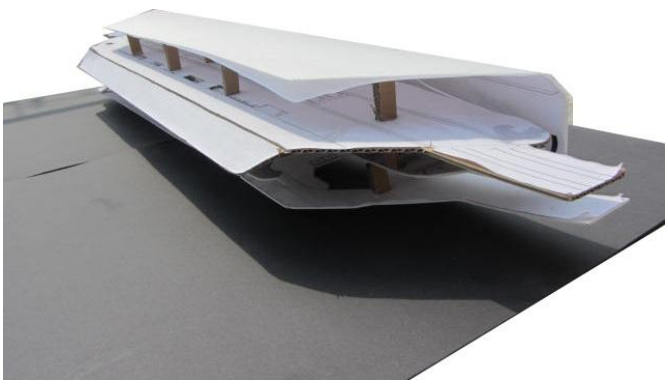
6.2.2 Sectional Development Phase - II





6.2.3 Sectional Development Phase - III

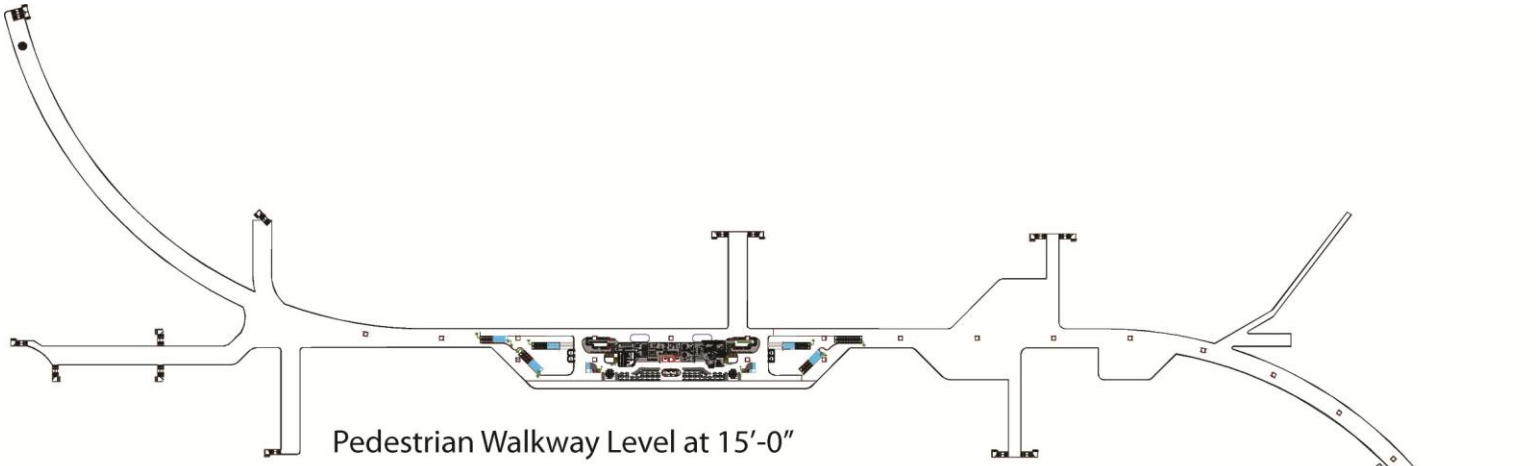




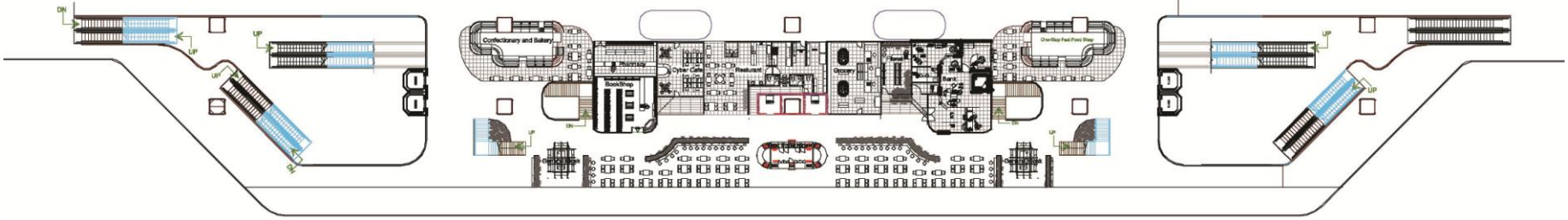
6.3 Design Submission

6.3.1 Floor Plans

Site Plan (Ground Floor) at 0'-0" Level

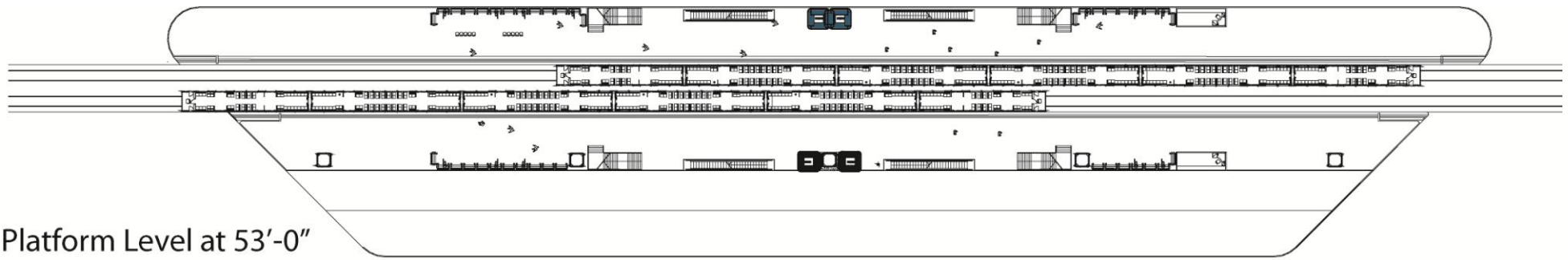


Pedestrian Walkway Level at 15′-0″

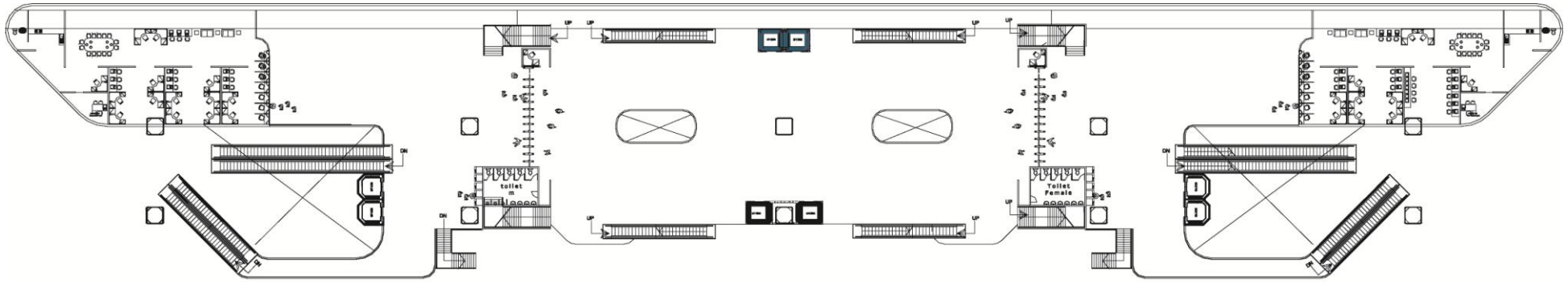


Pedestrian Walkway Level (Detail Plan) at 15′-0″

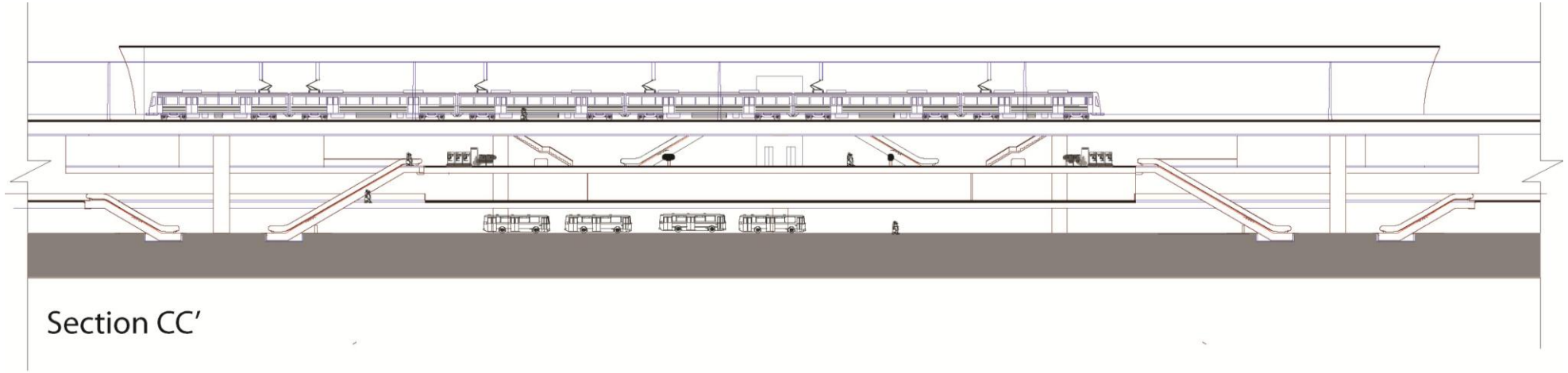
Pedestrian Walkway Level (Shop Plan Detail) at 15′-0″



Platform Level at 53′-0″

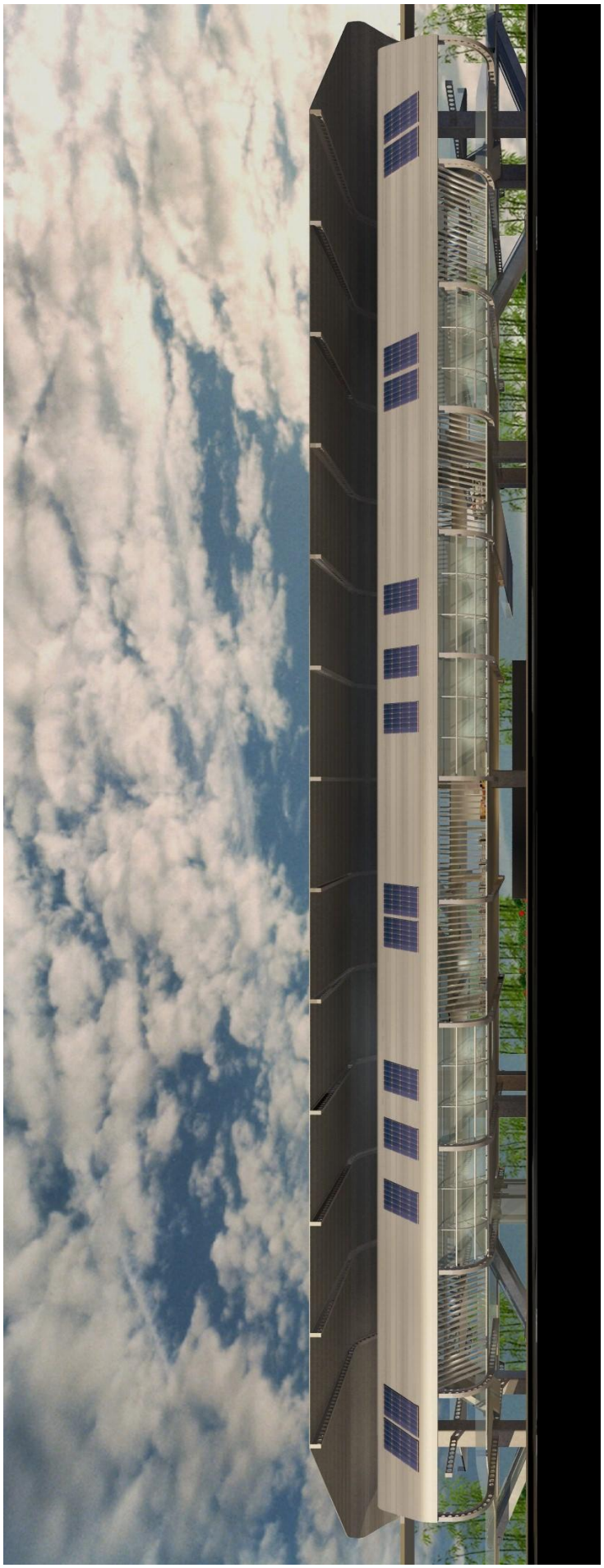


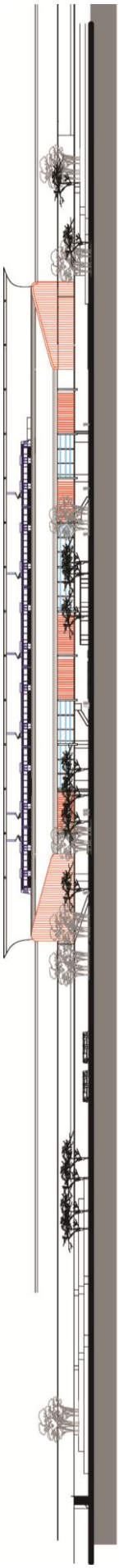
Concourse Level at 30′-0″



Section CC′

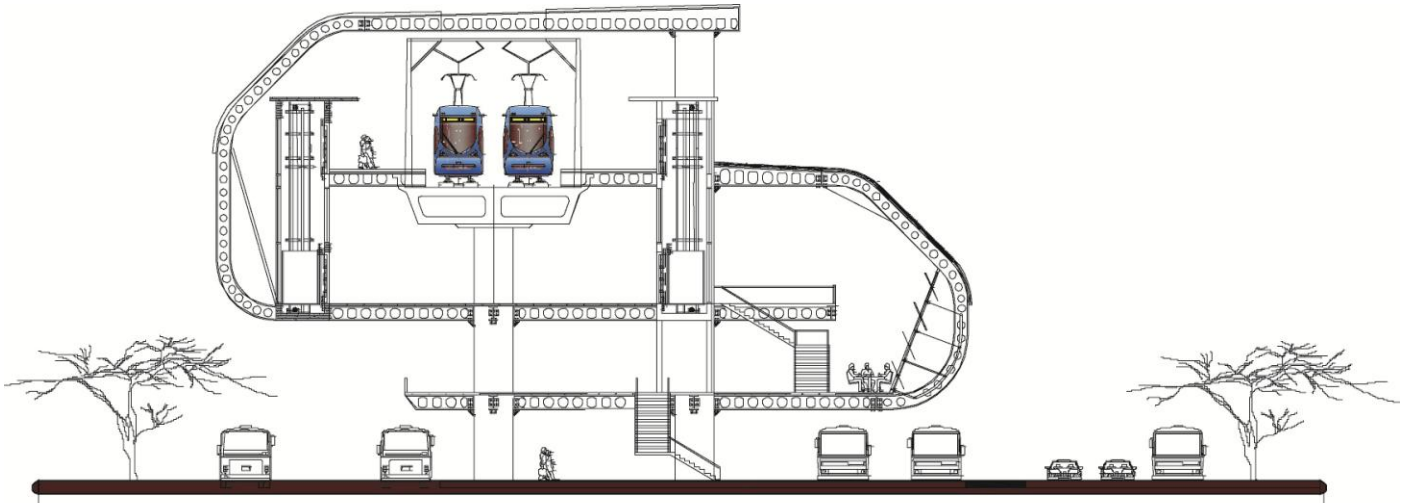
1.1.1. Elevation



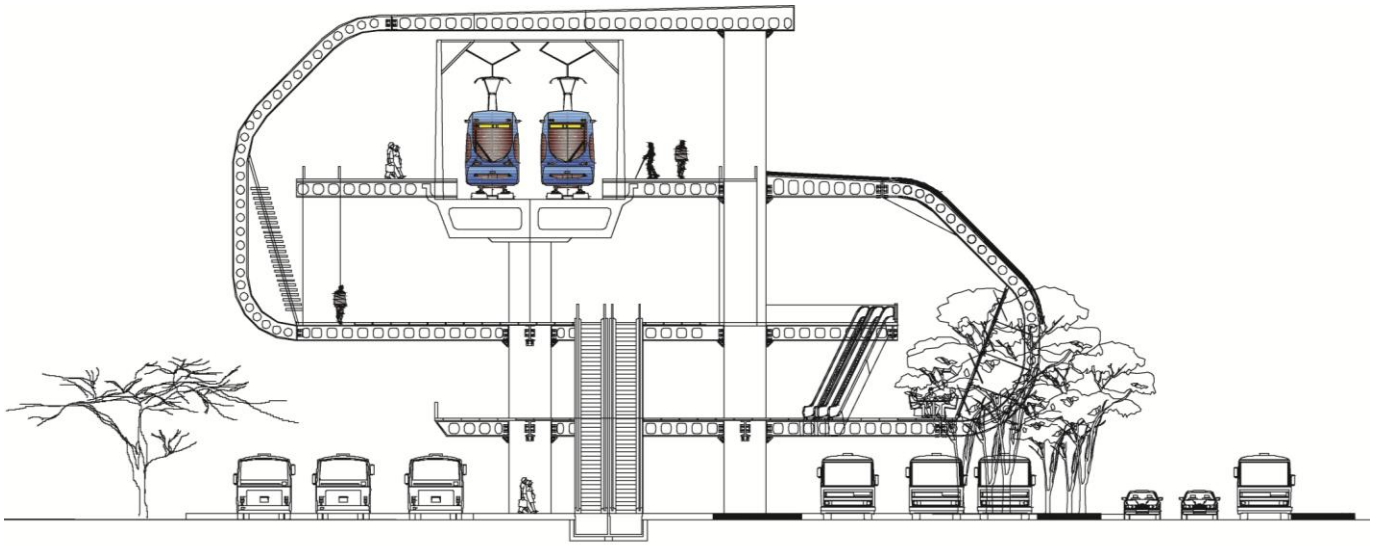


South Elevation

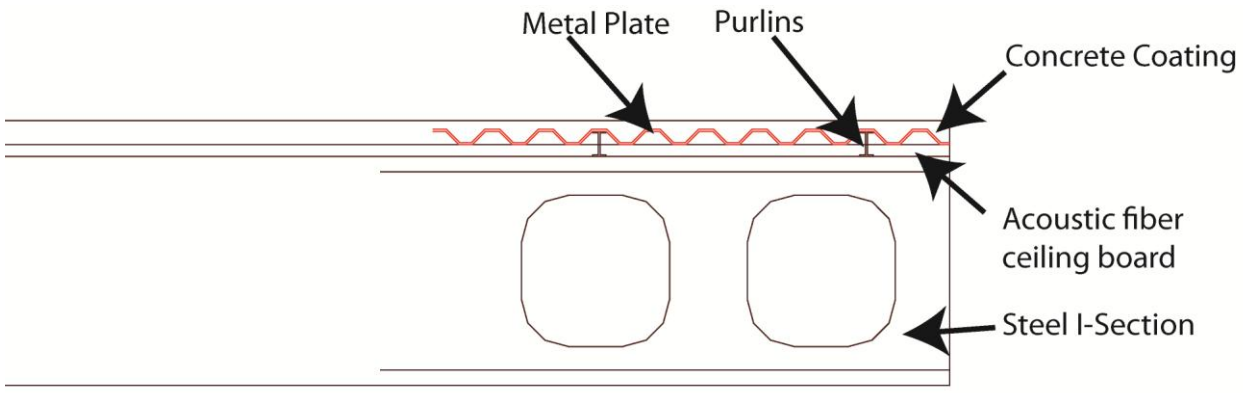
1.1.2. Sections



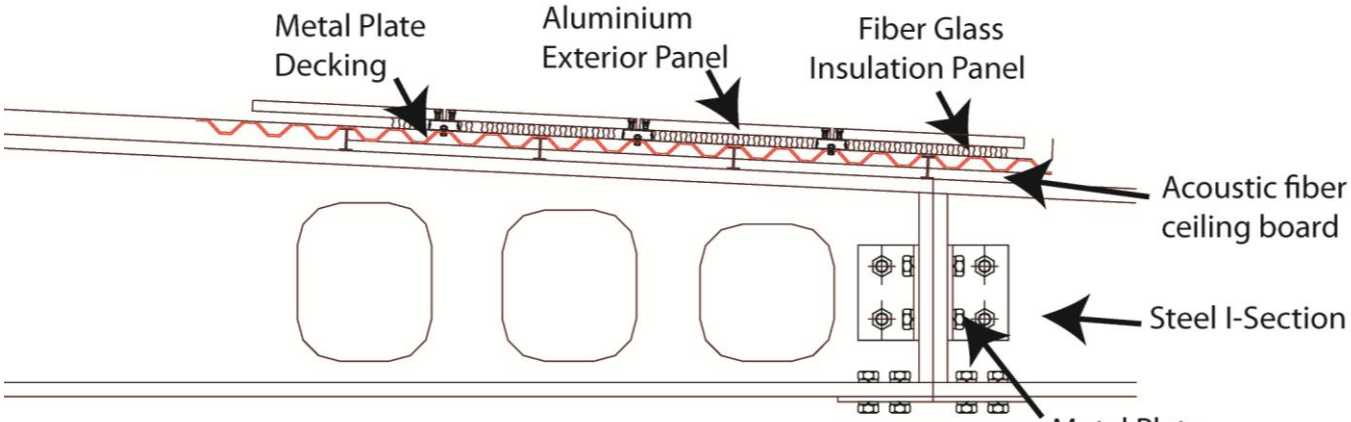
Section AA'



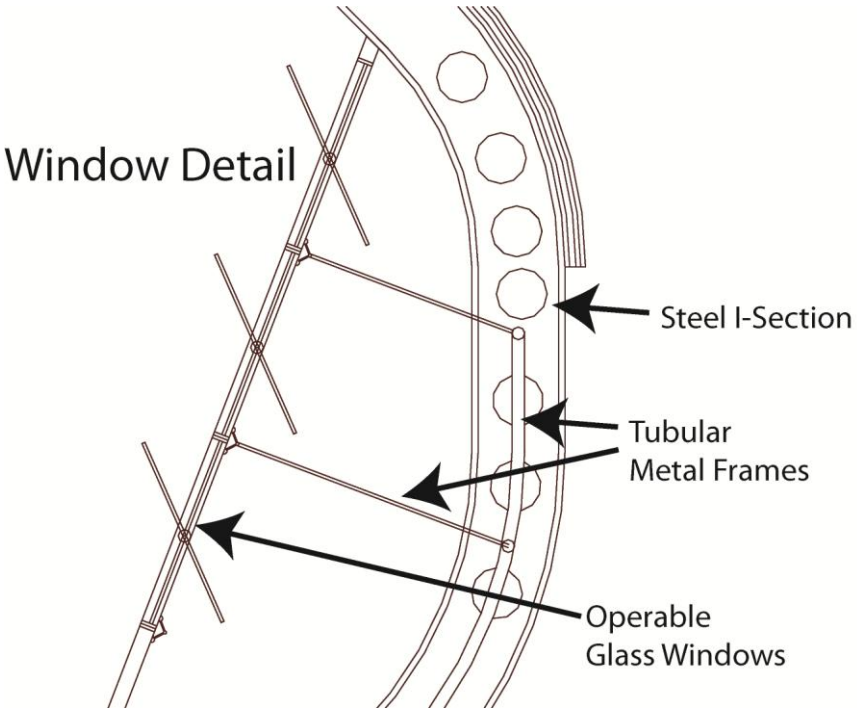
Section BB'



Floor Plate Detail



Roof Plate Detail



6.3.3 3-Dimensional Rendered Images

Figure 54 : Fenestration Details

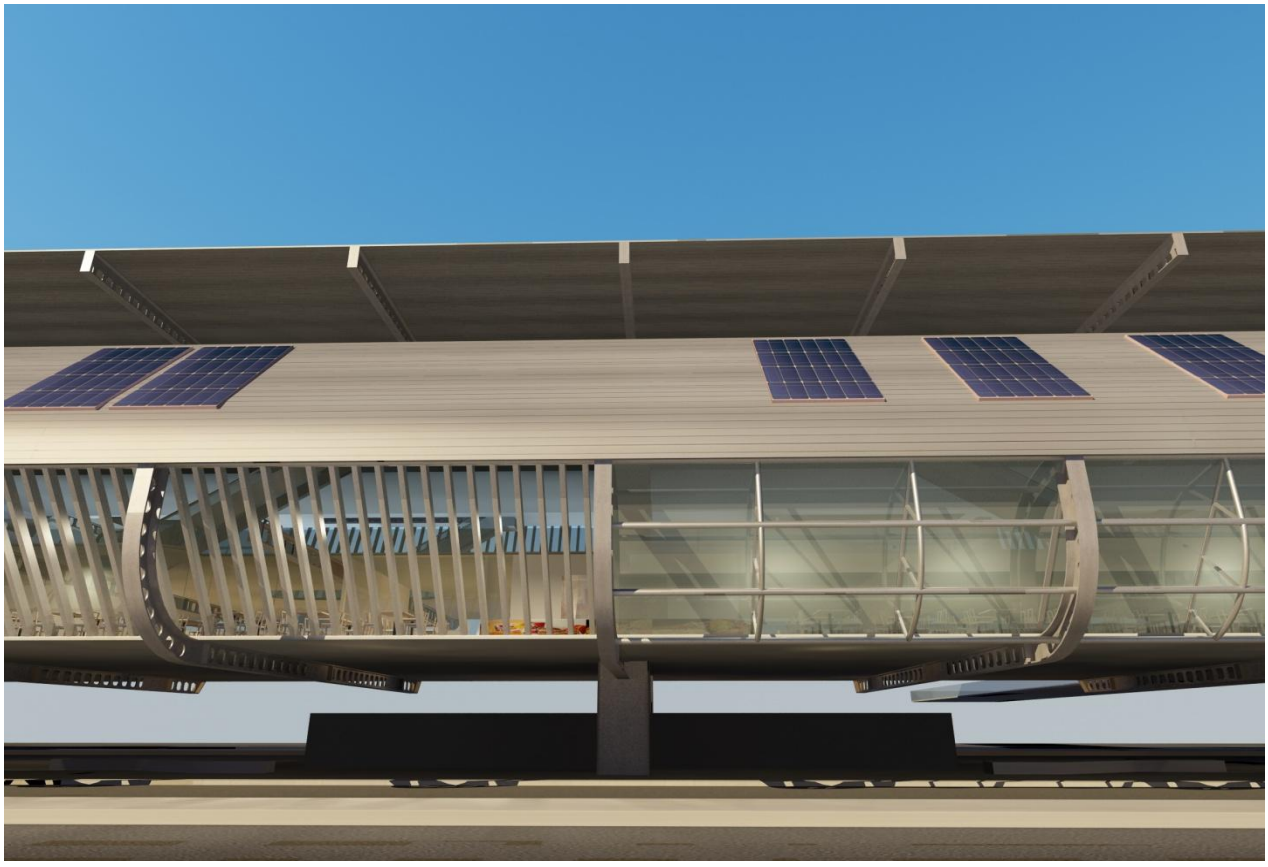


Figure 55 : Solar Panels

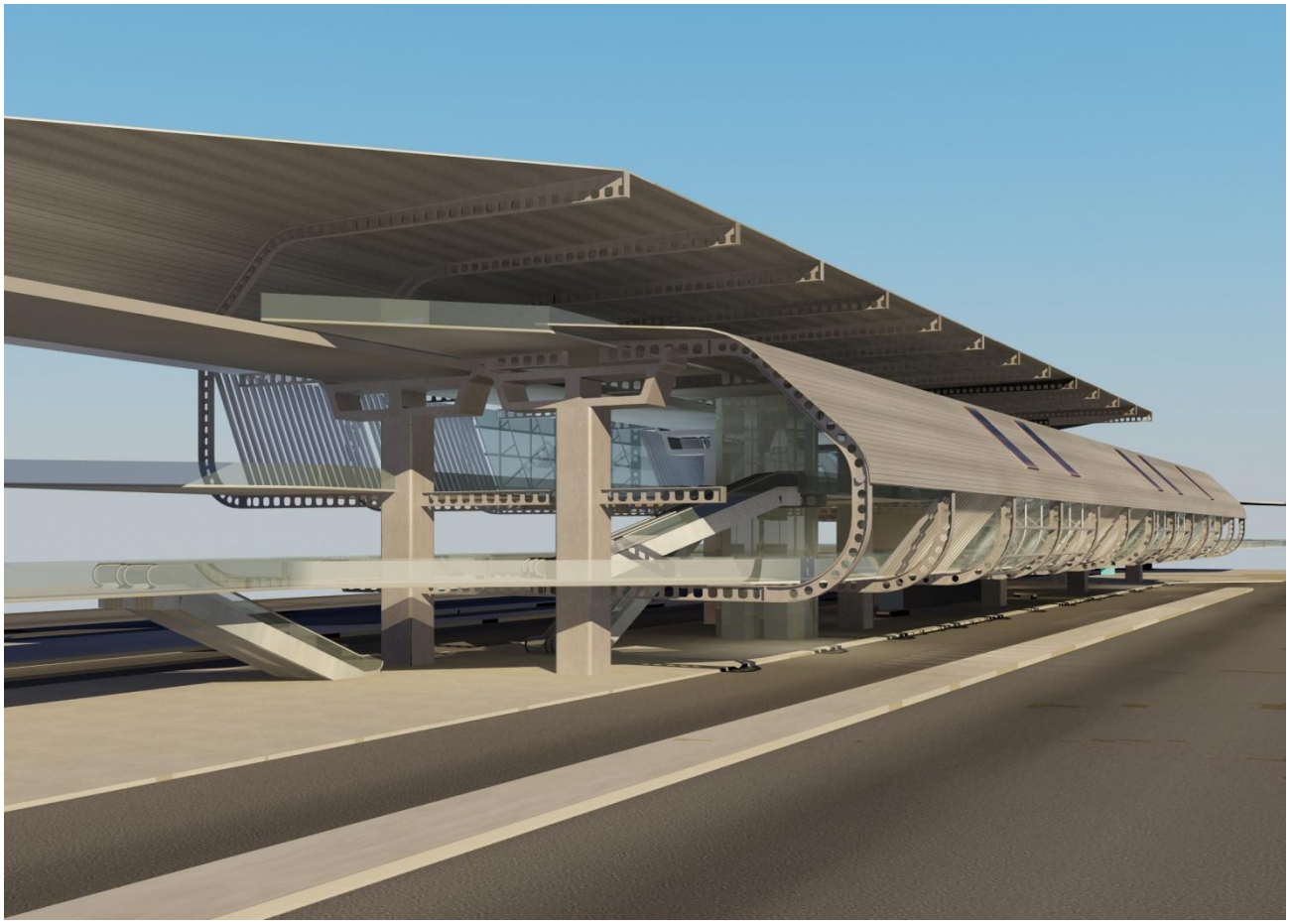


Figure 56 : Exterior Side View

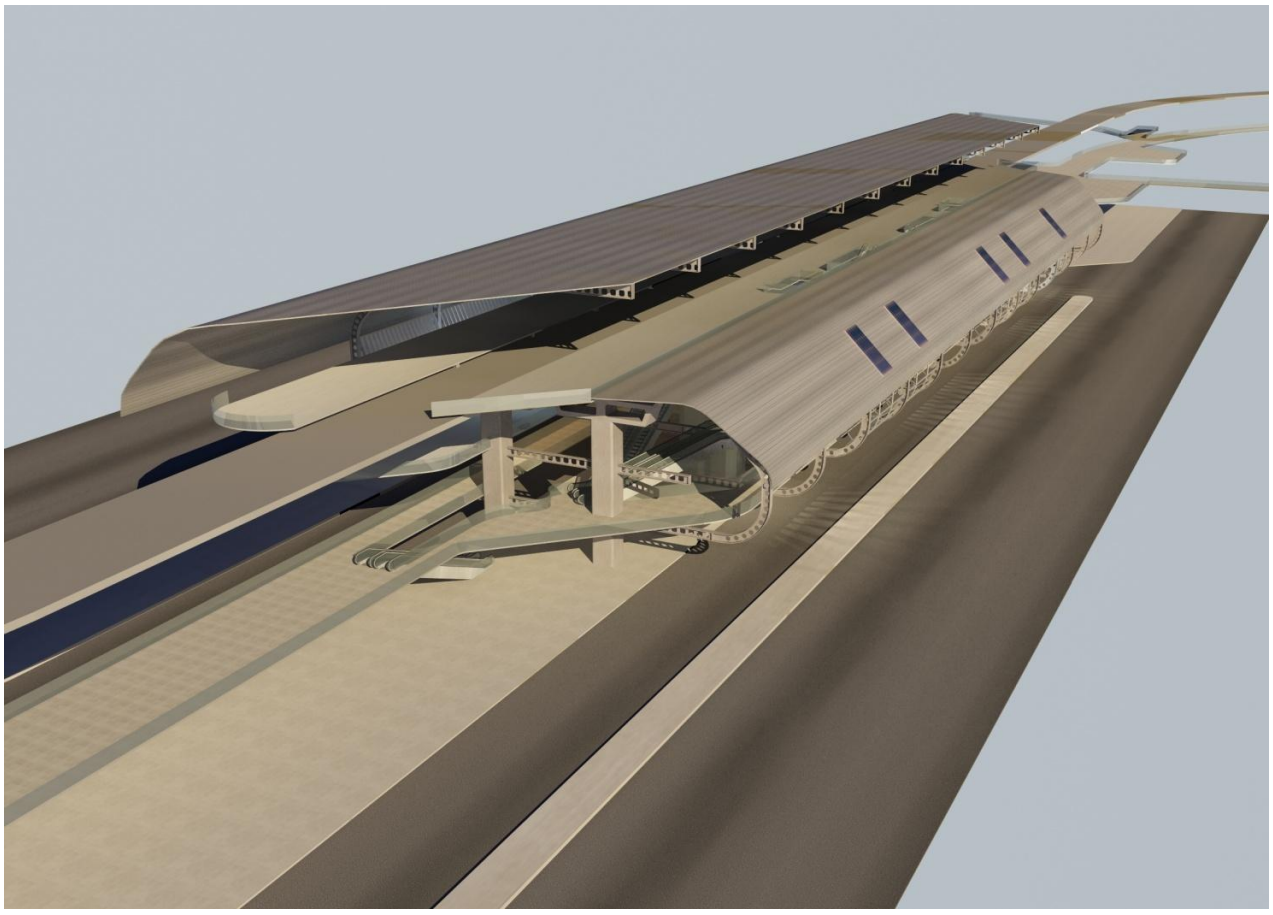


Figure 57 : Exterior Bird's Eye View

Figure 58 : Interior Double-Height Food Court from the West End

Figure 59 : Interior Double-Height Food Court Area from the East End

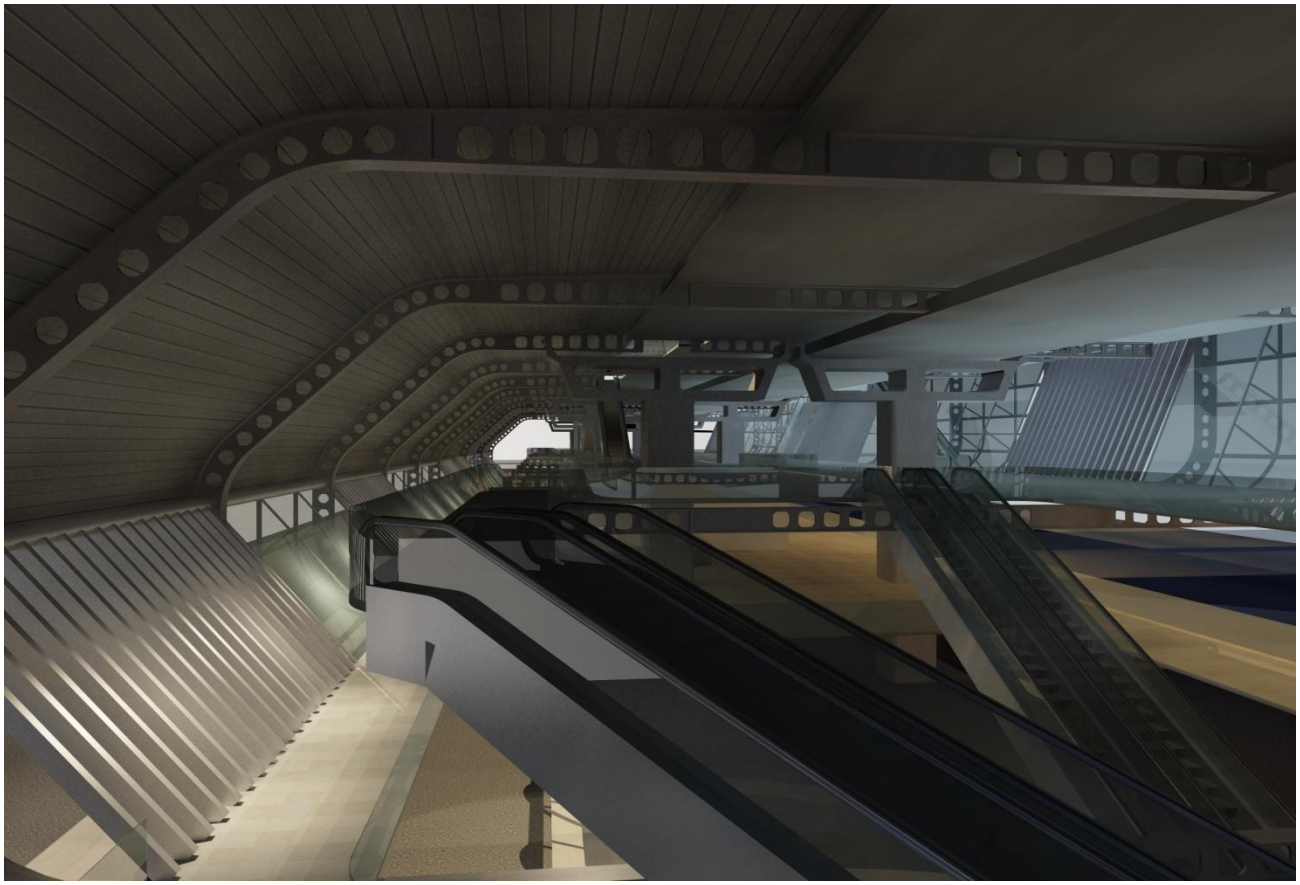


Figure 60 : Circulatory Atrium Space from Concourse Level

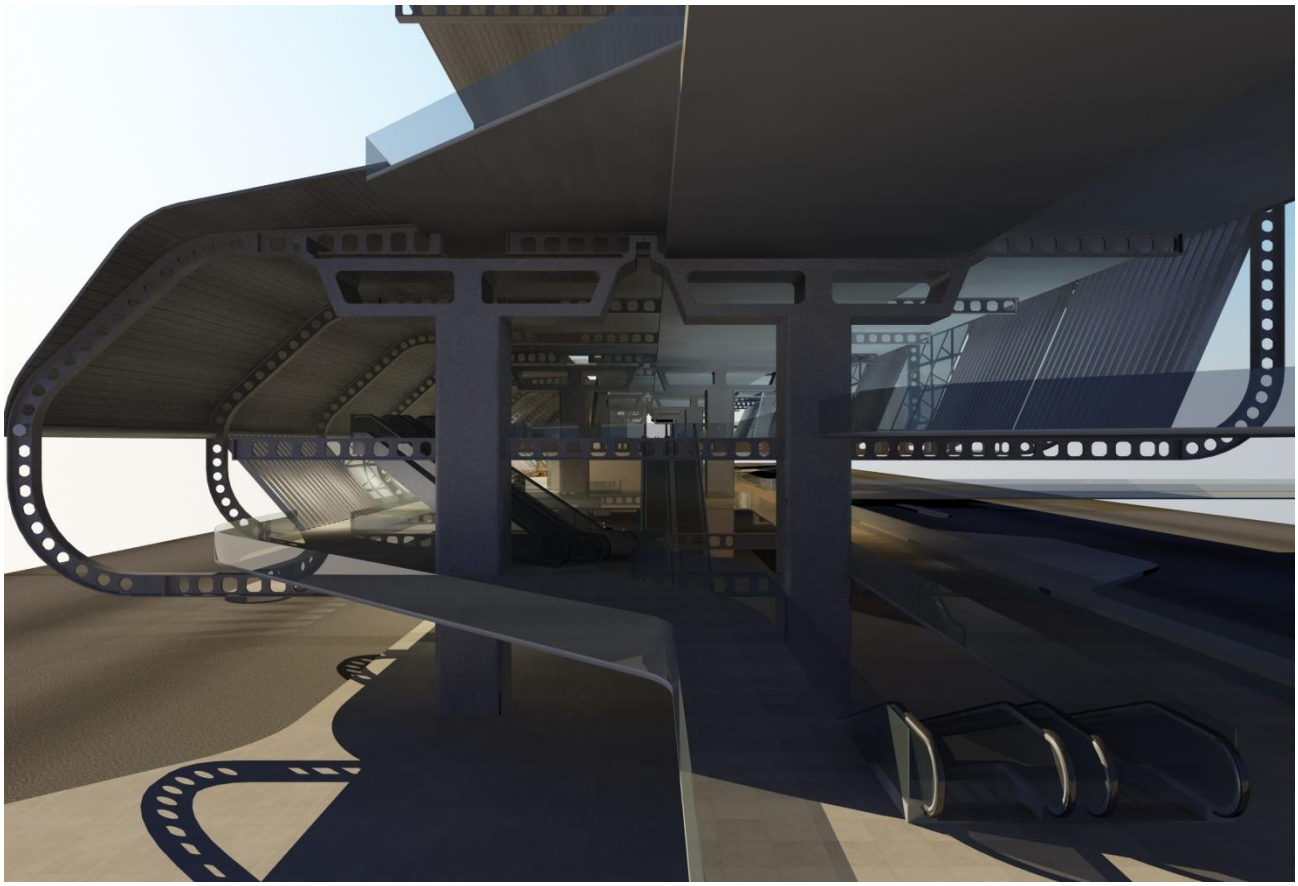
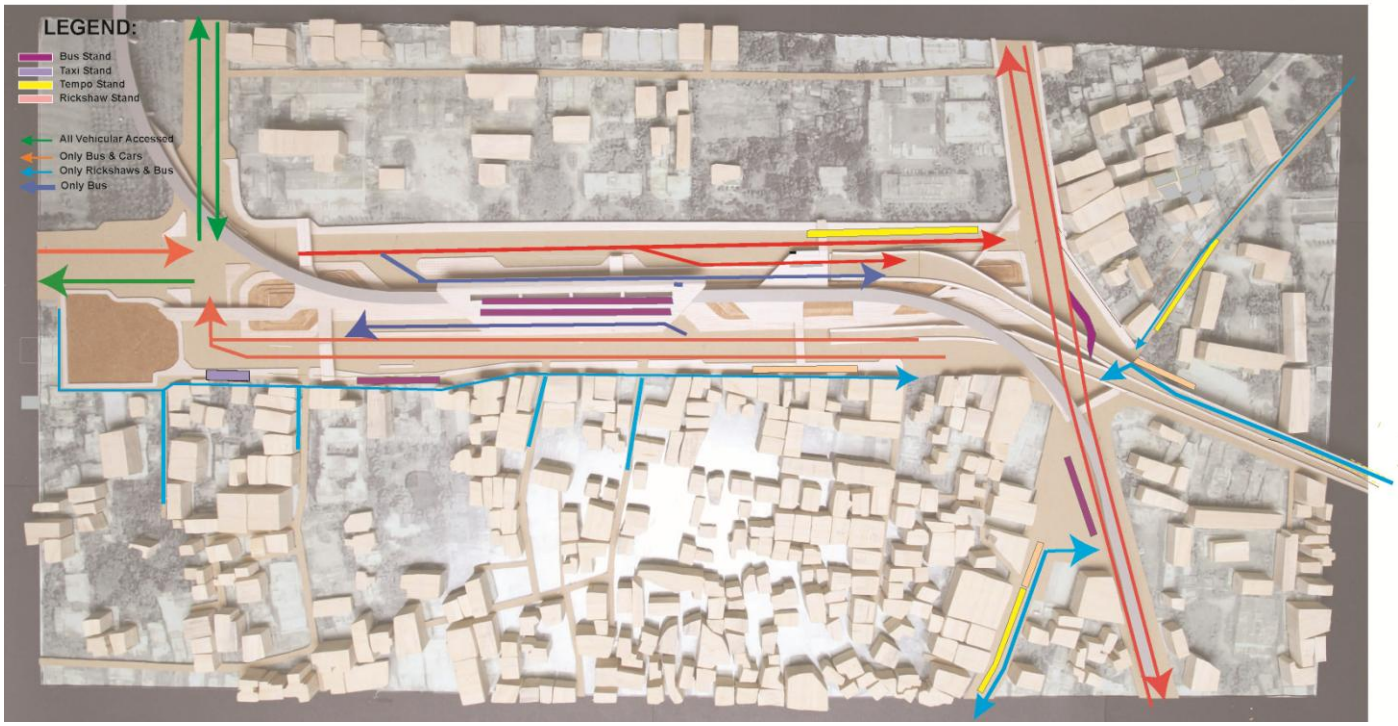
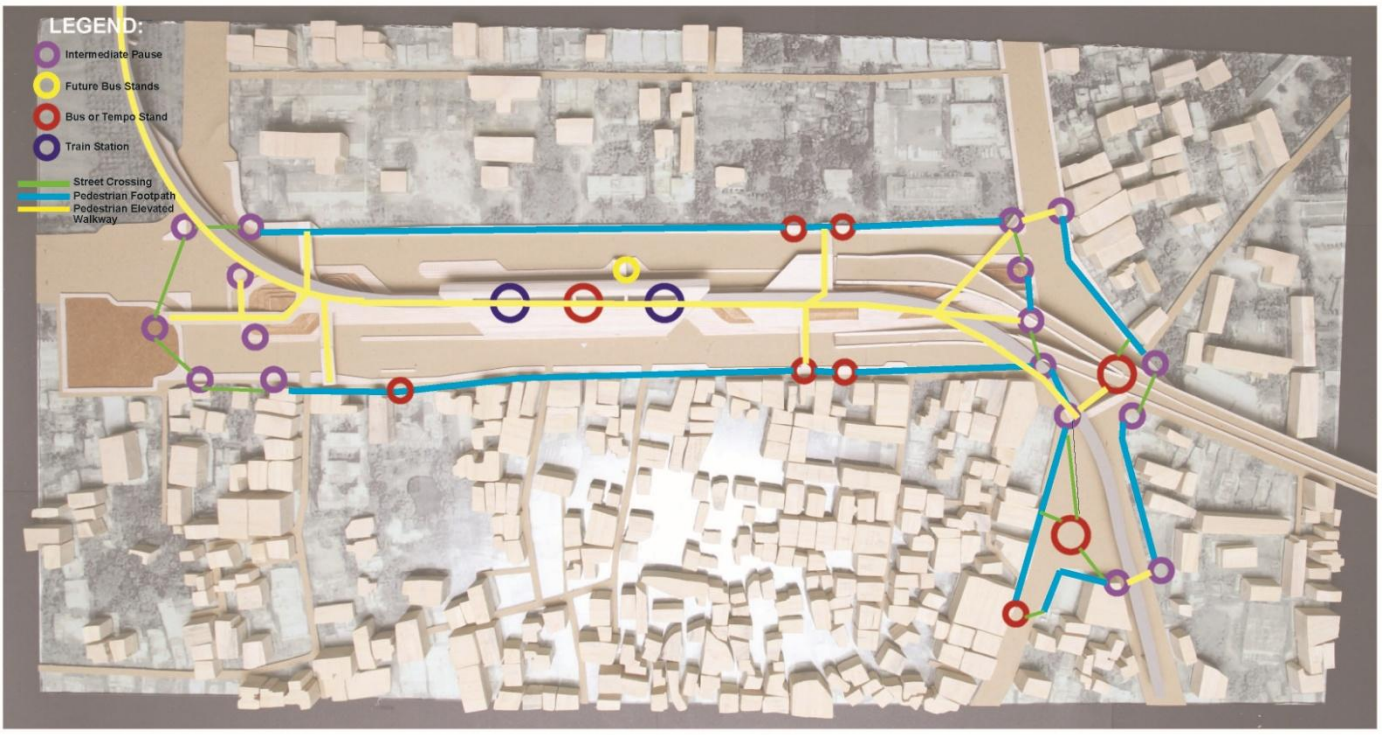


Figure 61 : Circulatory Atrium Space from Pedestrian Walkway Level

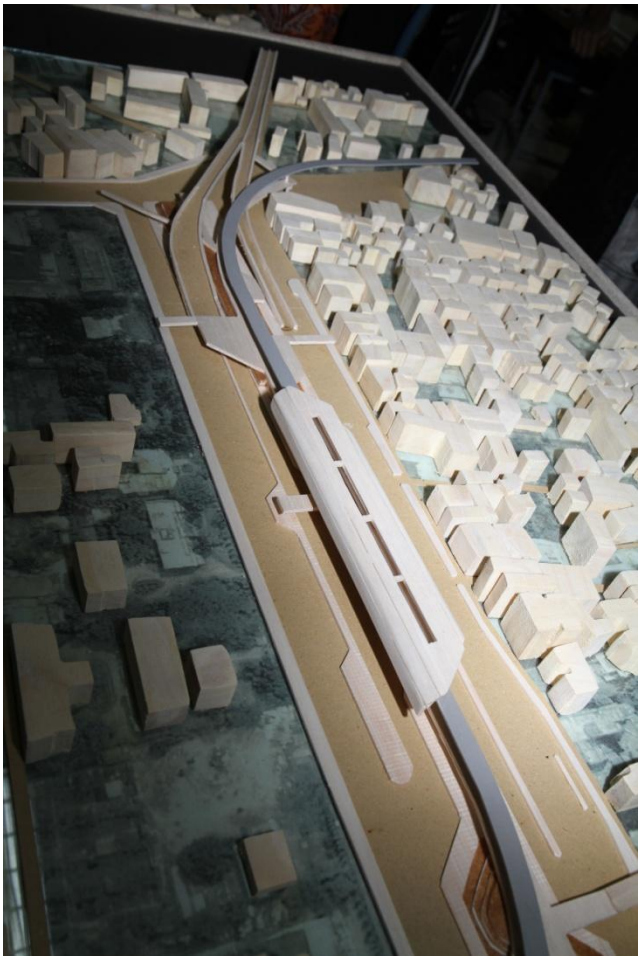
Design Analysis: Traffic Pattern and Vehicular Stops

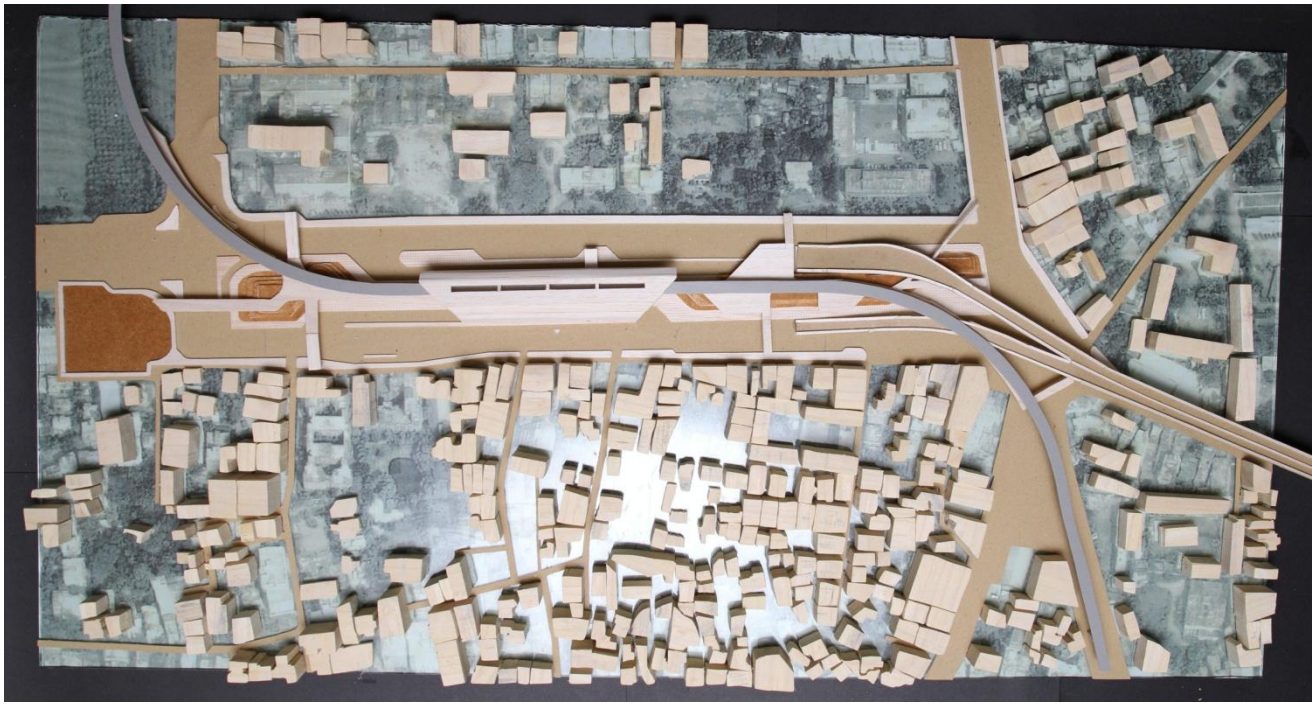


Design Analysis: Pedestrian Pattern

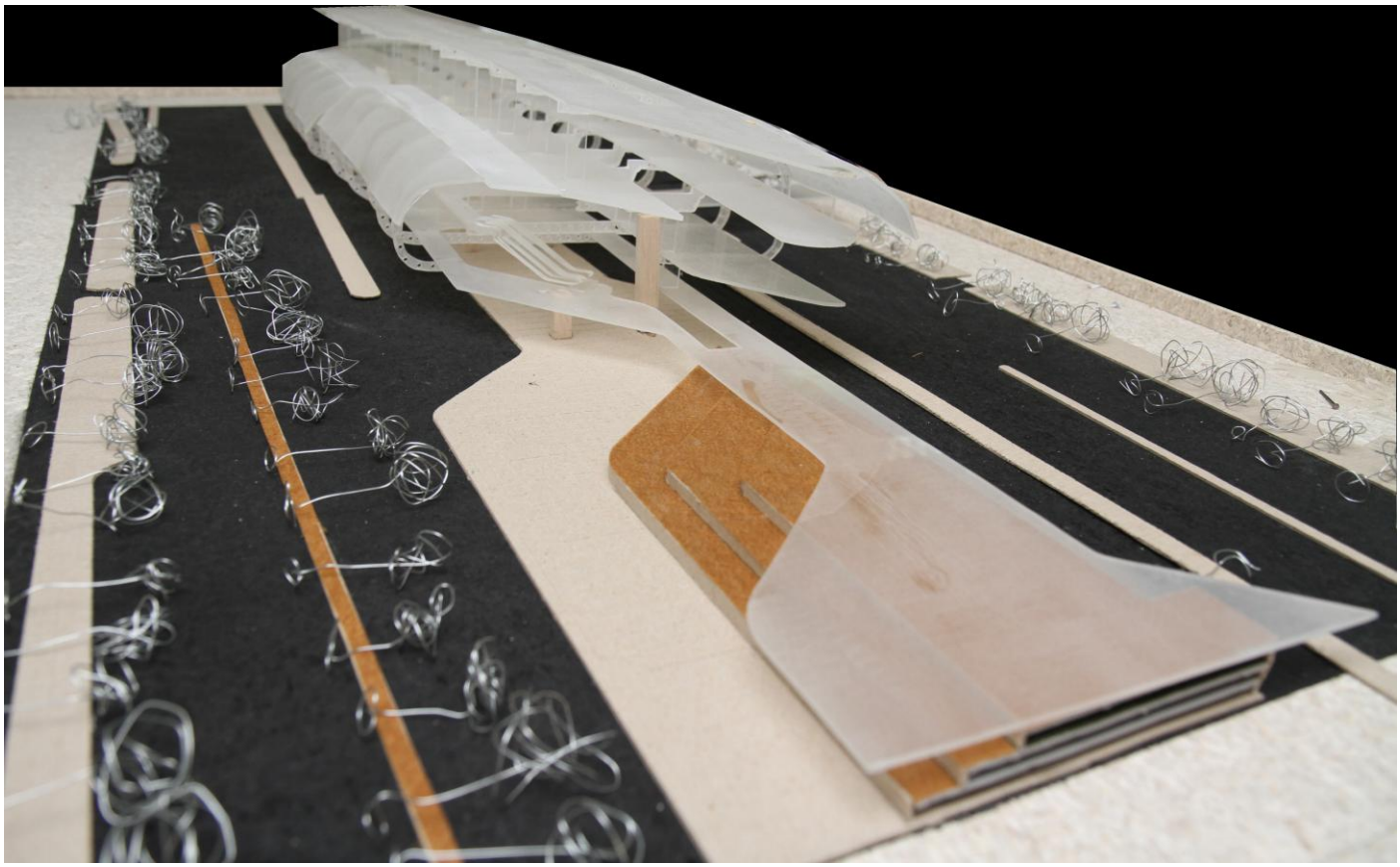


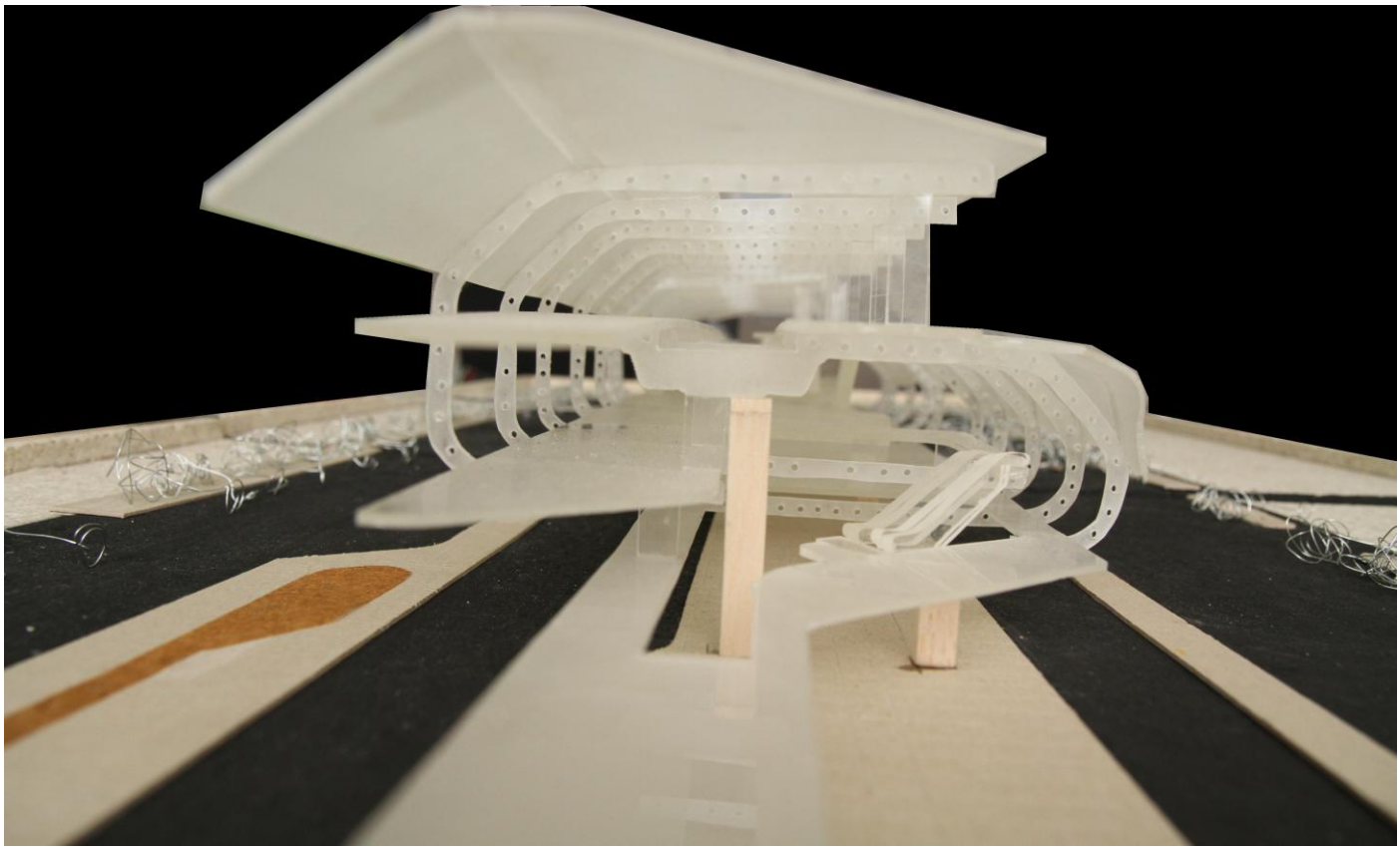
6.3.5 Site Model Photos

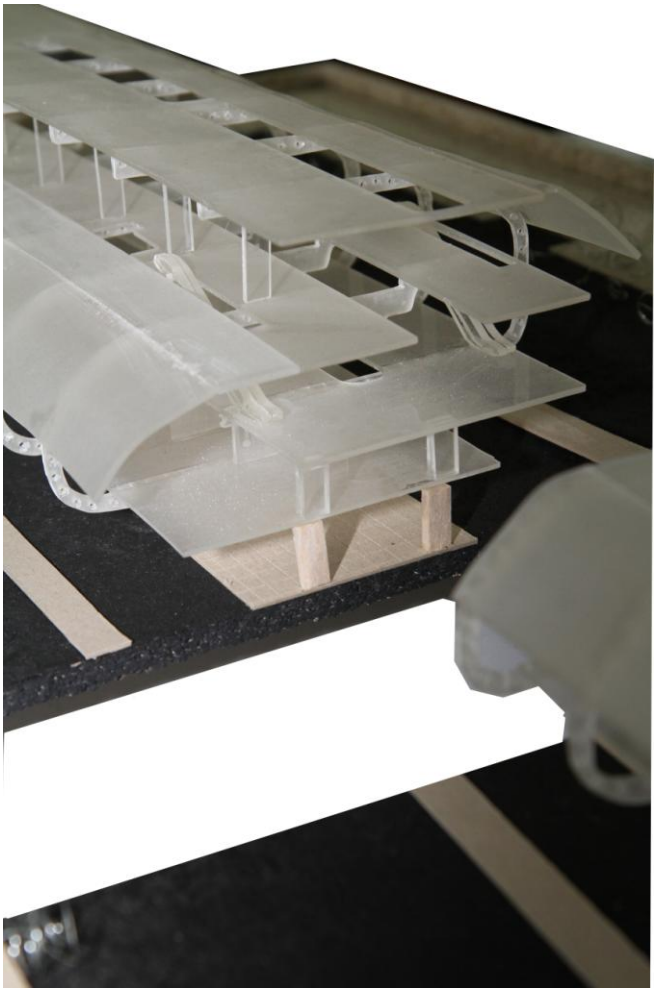


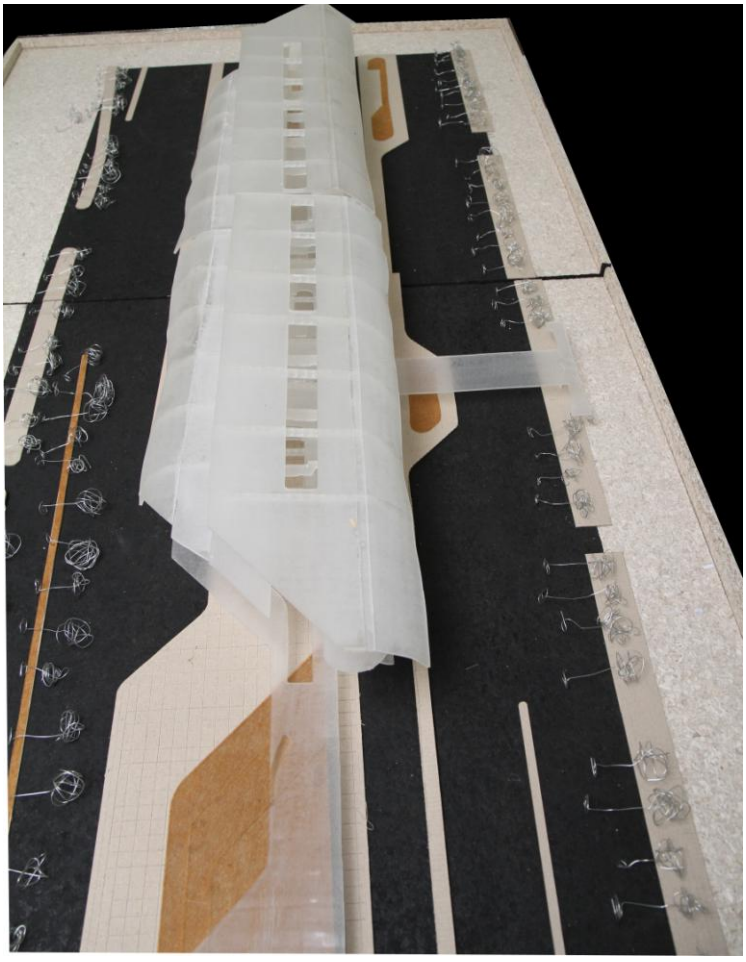


6.3.6 Sectional Model Photos









7 CONCLUSION:

To create a station in a dense developing urban context especially like Dhaka, where informal sector and formal sector of business are integrated and co-exists mutually for economic growth and survival, where various mixed modes of transport - rickshaws, tempo, cars, bus, etc function on the same road, it is important to address and significant them all as they are together part of a society as together serve all sectors and socio-economic backgrounds of a society. Through the use of proper urban linkages and modal exchanges in public transports, socio-economic classes can be integrated, to unite a society, a nation and live symbiotically together and promote sustainable transit-oriented development of a developing city as a whole.

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TABLE OF FIGURES:

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