

DESIGN AND MANAGEMENT BASED APPROACH TOWARDS BRT SYSTEM DEVELOPMENT IN DHAKA CITY (A case study of Gabtoli to Sydabad)

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Abstract

Dhaka, the capital city of Bangladesh with huge population pressure has to face different sorts of problems in different sectors. The most significant problem in the Dhaka City is transportation problem with severe traffic congestion, improper planning and inefficient management system, lack of proper integration among different type of modes, insufficient public contribution in this sector and so on. Due to these problems the people of the city have to suffer a lot in terms of time hammering, loss of money, inefficiency in their daily works. In the STP (Strategic Transport Plan) of Dhaka city, some proposal has been reported to solve the problems in which introducing BRT system in Dhaka city seems to be most useful one. But the detail design of BRT and management procedure to operate it has not yet been done. The paper provides a review of the existing transportation system of Dhaka and to carry out the design proposal for Bus Rapid Transit (BRT). It is not only concerned with the design but also to deal with the post implementation works like the operational management and fare collection process as well as the maintenance. The sustainability of the project would very much depend on these issues.

1. Introduction

Dhaka, the capital of Bangladesh, is now a city of about 12 million people, and the population is expected to increase to 18.5 million in the year 2015 (DITS 1994). In an ideal situation, roads and lanes would be constructed on 25 percent of the city's surface area, but in Dhaka it is only 8 percent (DCC 2002), as Dhaka grew from a provincial capital to a national capitol in an unplanned way. Dhaka is perhaps the only city of its size without a well-organized, properly scheduled bus system or any other mass transport system. The transport system in Dhaka is characterized by different types of modes, with both motorized transports (MT) & non-motorized transport (NMT) using the same carriageway. The city transport system is now in a quagmire with traffic congestion, delays, inadequate traffic management, conflict of jurisdictions, poor coordination among

organizations, and increasing air pollution problems. The city's traffic problems have reached a crisis proportion, delays have tripled in the last three years and automobile related air pollution has become a major health problem such that these shortcomings seriously compromise the ability of the transport sector in the Dhaka metropolitan area to sustain economic growth and a reasonable quality of life (DTCB 2004).

A preliminary estimate of vehicular trip demand on the city's 18 major bus routes showed a demand range of 150,000 to 350,000 per day, with peak hour per direction demand in the range of 4,500 to 9,000 per hour (Hossain and Hossain 2003; Hossain et al. 2003). This sort of demand can be comfortably handled by any modern BRT system. Also, considering the affordability of residents and government

financial constraints, BRT could be an ideal choice for Dhaka. The study focuses on four major aspects

1. Detailed design based on uniform criteria
2. Overall management procedure for the BRT system.
3. Providing rational fare collection system.

2. Study Area

In the Strategic Transport Plan (STP) of Dhaka city, 3 routes are proposed for providing BRT system. These are known as “Line 1-The red route”, “Line 2- The blue route” and “Line 3- The yellow route”. The first one is from Uttara to Sydabad, the second one is from Gabtoli to Sydabad and the third one is from International airport to Old Dhaka. The proposed BRT routes of Dhaka city have shown in Fig 1.

For this study the Blue route is selected for the study area but there are certain reason behind this decision which can be stated as follows

1. The length of line 2 is 16 km, whereas the length of Line 1 and Line 3 is 30 km and 35 km respectively. So line 2 is the shortest line and it is easy to make survey and transportation studies in this route.
2. In the STP, the volume of passengers per hour for the three routes is described. The average volume of passenger per hour of Line 1, Line 2 and Line 3 is 51000, 60000 and 33000 respectively. So, maximum people uses Line 2 route for activities. So the importance of this route is greater than the others.
3. The number of intersection in Line 2 is approximately 26, whereas in Line 1 and Line 2 it is approximately 10 and 20 respectively. Large number of intersection is better in this sense that it will helpful for carry out the transportation studies.
4. In line 2, percentage of bus share is larger than the others. Moreover line 2 connects two major bus stations of Dhaka city (Gabtoli- Sydabad). This two major bus

station are used for the inflow and outflow of people.

5. To conduct the study it is necessary to avail sufficient data for proper design of BRT system. A lot of studies are already carried out about Mirpur road. So it is helpful for the designing of the BRT system.

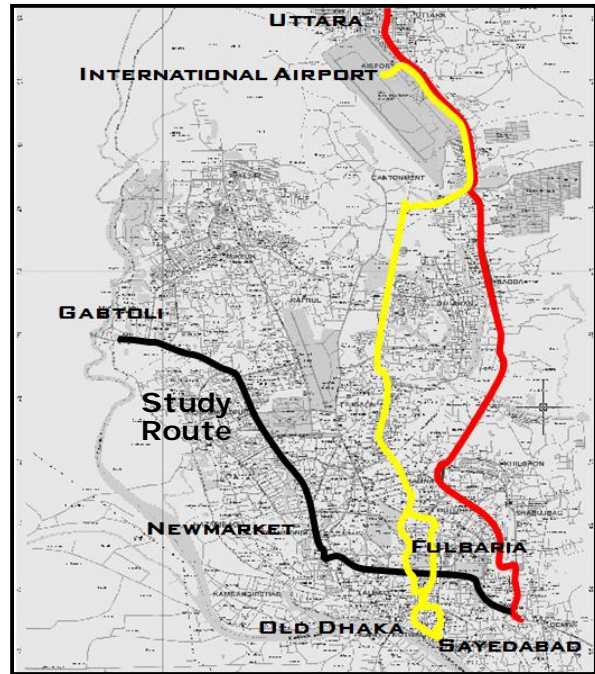


Fig 1: Proposed BRT routes of Dhaka City

Study area at a glance

The overall information of the study area have described as follows:

Length	16 km
No. of intersection	26 (Approximate)
Average distance between intersections	200m- 500m
Maximum Right Of Way (ROW)	42m (In the link road from Sohrawardy intersection to Bangabhaban intersectin)
Minimum Right Of Way (ROW)	16.5 m(In the link road from Nomtoli to Bongobazar)

3. BRT design

3.1 Lane selection

Bus rapid transit indicates a high-capacity rail transport system with its exclusive right of way. But it is always debatable that in which alignment BRT should be introduced whether in median lane or curb lane. There are some definite reasons for which BRT is proposed on median lane instead of curb lane through out the whole route except one special condition.

1. For ensuring pedestrian safety BRT is provided in the median lane. If the BRT is provided at curb lane 50% of total pedestrian will fall in great danger while crossing all the lane of a carriageway for reaching the BRT station.
2. Commuter comfort can be ensured by providing BRT station within 20m walking distance from the intersection which is not possible in curb side.

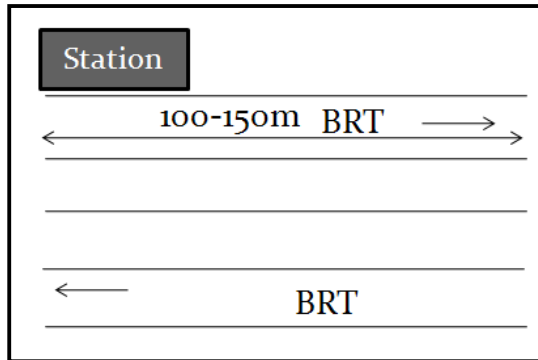


Fig 2: Less commuter comfort when BRT is in curb side

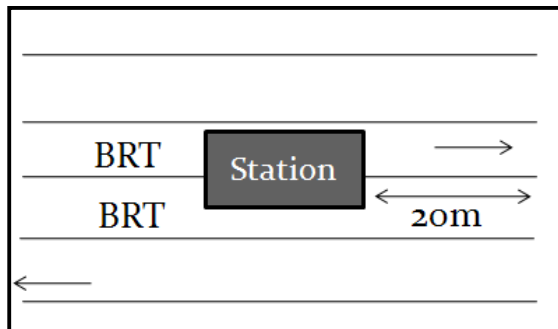


Fig 3: Better commuter comfort as BRT is in median lane

3. Existing median or other features can be used while providing BRT in the median lane.
4. Generally slow vehicle are run on the left side of the carriageway in case of right hand driving. But if the BRT is provided in the curb lane slow moving vehicle will be at the right side of the carriageway which reduces the efficiency of a traffic system. To increase this traffic efficiency BRT is provided in the median lane.

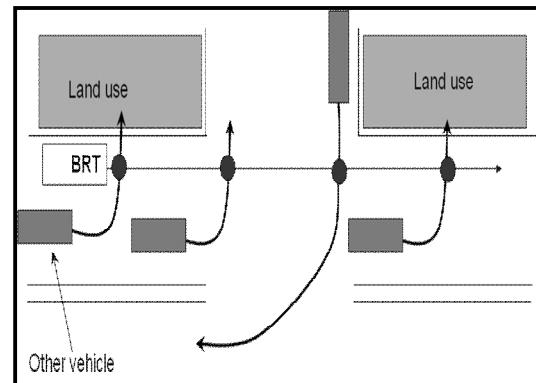


Fig 4: Conflict between BRT vehicle and other vehicle when BRT is in curb lane

Considering all those facts it is justified to design BRT in the median lane.

3.2 Design consideration

Before design the primary design consideration were as follows

1. The main consideration was to prioritize public vehicles in the design by introducing BRT in the roads of Dhaka city.
2. Another consideration was to discourage the use of private vehicles in Dhaka city's roads. Introducing BRT will emphasize it by transferring passengers from private cars to BRT.

3. In the design special emphasis was given on non motorized traffic. In this design it was tried to integrate NMV with MV and BRT in a more systematic manner. Which is absent in today's transport planning of Dhaka city.
4. Proper integration among BRT, MV and NMV is ensured to increase the sustainability in transport system of Dhaka city.

3.3 Design Standards

Design standards have been developed for designing BRT routes in Dhaka city after an extensive study. These standards have been obtained from the previous study, strategic transport plan for Dhaka and also from international case studies which are applicable to the context of Bangladesh. The design standards for various elements of BRT are described below.

Table 1: Standards for designing BRT

Station	Width	2 meter (For one direction)
	Length	40 meter (For 2 buses)
	Distance from intersection	20 meter
	Distance between two stations	610-1350 meter
BRT Lanes	Location	Median
	Width	3.25 to 3.5 meter
MV Lanes	Location	Between BRT and NMV lane
	Width	2.5 to 3.5 meter
NMV Lanes	Location	At curb side
	Width	2 - 2.5 meter

Median and separator

Median or central reservation and the segregation between different lanes are the important element of any urban transport design. There must be a 0.5m median in the whole design of this section, but it can be increased up to 1.5m depending on the ROW of that link. There should have a physical barrier of concrete between MV lane and NMV lane. The width of this physical segregation will be 0.15m and the height will be 0.3m. In case of more than one MV lane the lane segregation will provide by proper lane marking. But there should have no physical segregation between BRT lane and MV lane. In this case rumble strips of 0.3m with a height of 5cm will be used as separator.

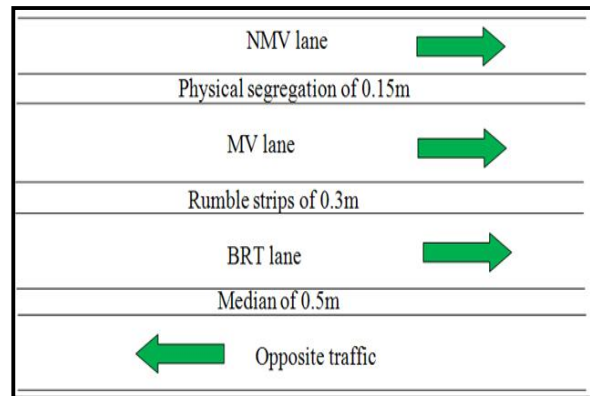


Fig 5: Median and segregation

Bus station

Bus station are the most significant thing to identify there location in terms of many factors. First one has to examine the demand as well as the accessibility and mobility. The distance between the two BRT stations should be in such a way which does not hamper the main characteristics of BRT that is mobility, with maximum coverage of total generated trip on the particular area. Another thing is that the station should be within the walking distance of the people. Considering all this facts the proposed BRT station of the whole route is shown in the following Table 2.

Table 2: Bus shelters of whole BRT route

BRT station	Distance from preceding station (In meter)	Location of station
Gabtoli	-----	Intersection
Technical	810	Intersection
Kalayanpur	1040	Intersection
Shishumela-College gate	980	Midblock
Asad gate	1350	Intersection
Panthopath	1180	Intersection
Science lab	1320	Intersection
New market	910	Intersection
Azimpur	610	Intersection
Bakshibazar-Chankarpul	1270	Midblock
Fulbaria	1270	Intersection
Ittefaque	1010	Intersection
Sydabad	1057	Intersection

In the above Table it is very clear that BRT station are provide both in intersection and in the link that is midblock. In intersection one station is provided for one direction. But in case of midblock station design, one station is provided for both directions. This is done to increase the operational efficiency & ensure pedestrian safety and to reduce the delay. The minimum width of the BRT station is 2m, but if it is serves traffic for both directions, the minimum width should be 4m. When the BRT stations are near intersection there must be a clear distance of 20m from the edge of the intersection. Sometimes this distance can be extended up to 30 m depending on the particular situation. The spatial location of BRT stations of the whole route are shown in Fig 6.

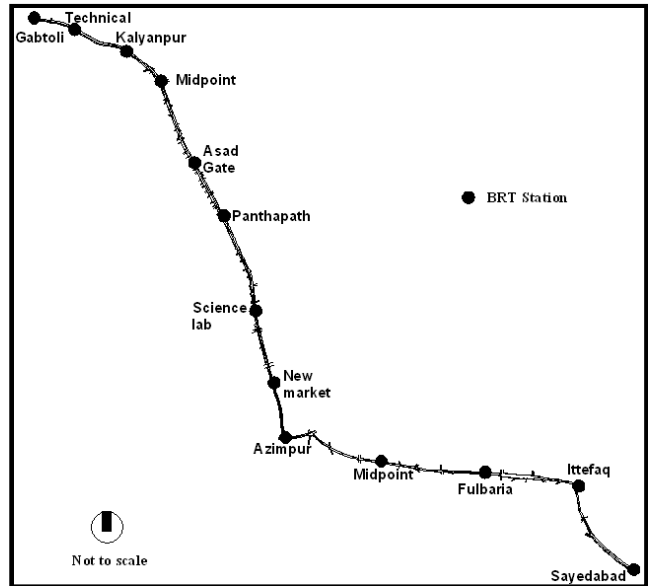


Fig 6: Spatial location of all BRT station

Vehicle

There should be two types of BRT buses

- Local service
- Express service

Bus providing local service have to stop all the station in the Table 2, but express service providing buses should start from Gabtoli and stop at Asad gate, Azimpur, Fulbaria before reaching Sydabad and vice versa. . The system can be explained by the Fig 7.

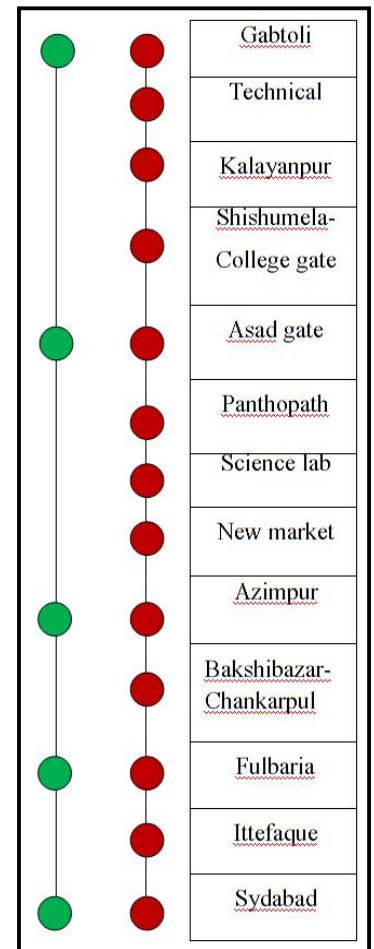
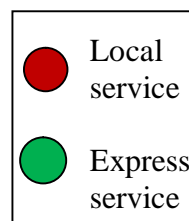


Fig 7: The stoppages of local and express services

3.3 Prioritization

Prioritization is very important in the design of BRT route especially in city like Dhaka, because the basic characteristic of Dhaka is huge volume with low ROW.

Table 3: Prioritization for space allocation on the right of way

At link other than Bus shelter	Near bus shelter
Priority 1: Provide 3.5m wide bus lanes in each direction (depending on the availability of space).	Priority 1: Provide at least 3.25m wide segregated bus lanes. There must be a provision of overtaking. For overtaking purpose a 3.25m bus bay should provide.
Priority 2: Provide sidewalk of a uniform width of 1.5m.	Priority 2: Provide sidewalk of a uniform width of 1.5m.
Priority 3: Provide 2.5m NMV lane depending on the availability of space.	Priority 3: Provide 2m of BRT station for each direction. But in case of both direction the minimum width should be 4m
Priority 4: Provide 1 lanes of motorized vehicle and the minimum width of the MV lane should be 2.5m.	Priority 4: Provide 2.5m NMV lane depending on the availability of space.
Priority 5: Provide 2.5m NMV lane	Priority 5: Provide 1 lanes of motorized vehicle and the minimum width of the MV lane should be 2.5m.
Priority 6: Provide 1-2 lanes of motorized vehicle.	Priority 6: Provide 2.5m NMV lane, depending upon the availability of space.
	Priority 7: Provide 1-2 lanes of motorized vehicle.

Apart from the Table 3 when it is very difficult to provide segregated lane for NMV and MV then mixed traffic is encouraged.

Based on the above design standards and prioritization, detail design of some intersection and link of the whole route is given below.

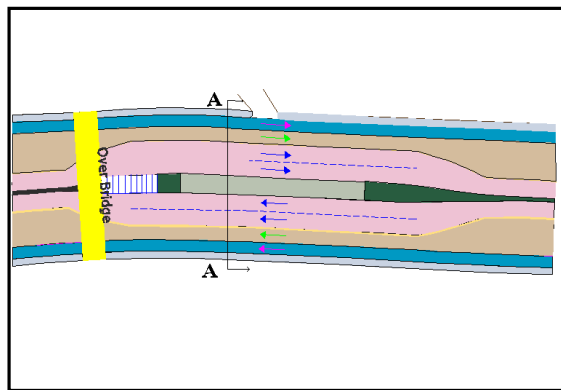


Fig 8: Detail design of Kalayanpur intersection

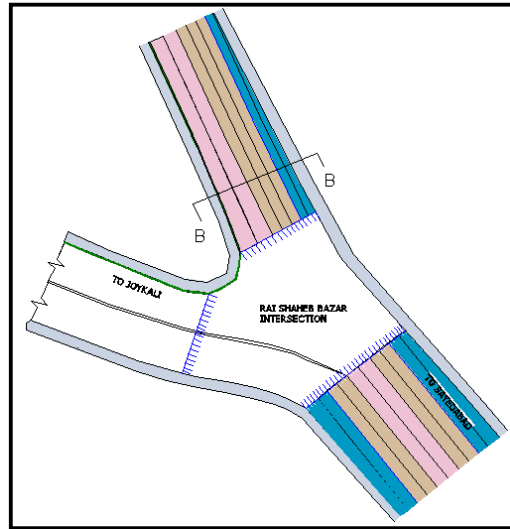


Fig 9: Detail design of Rai Saheb Bazar intersection

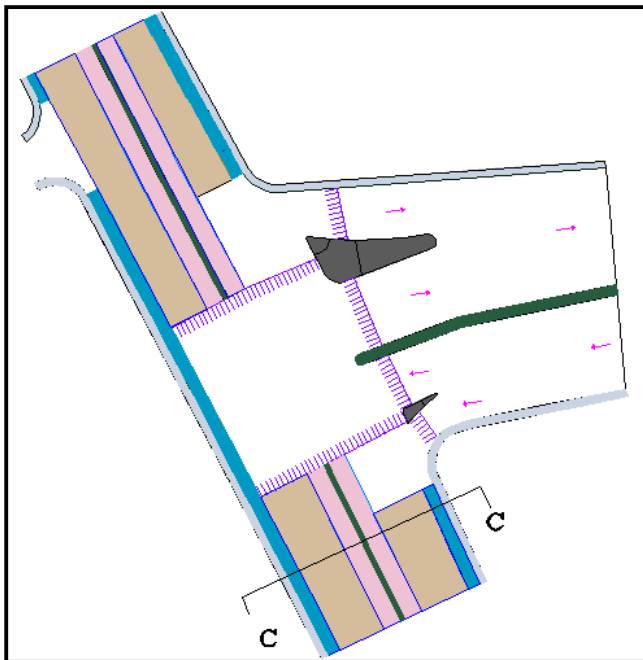


Fig 10: Detail design of Manik Mia Avenue intersection

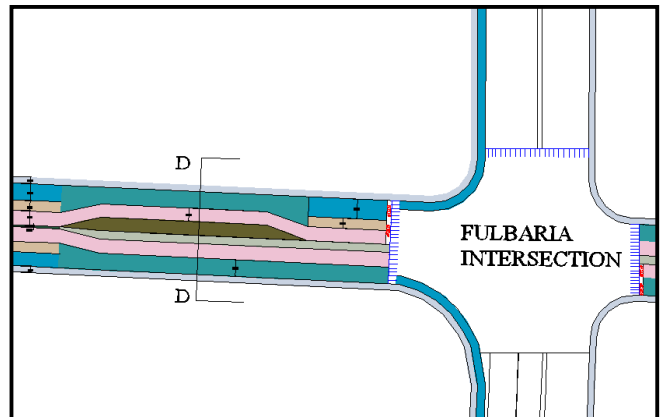
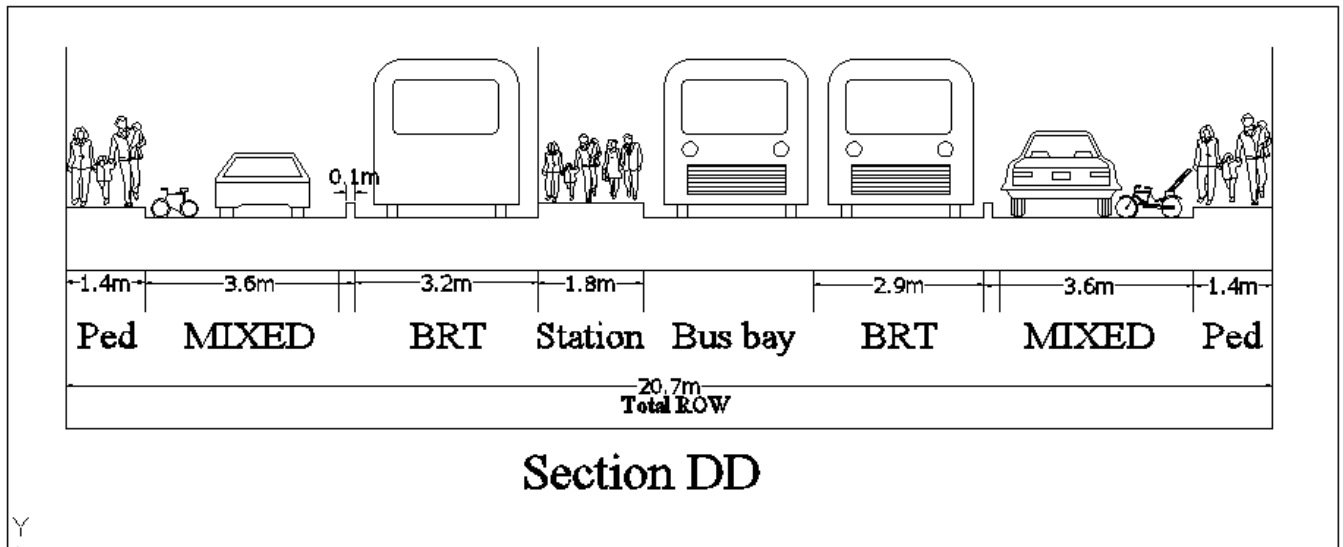
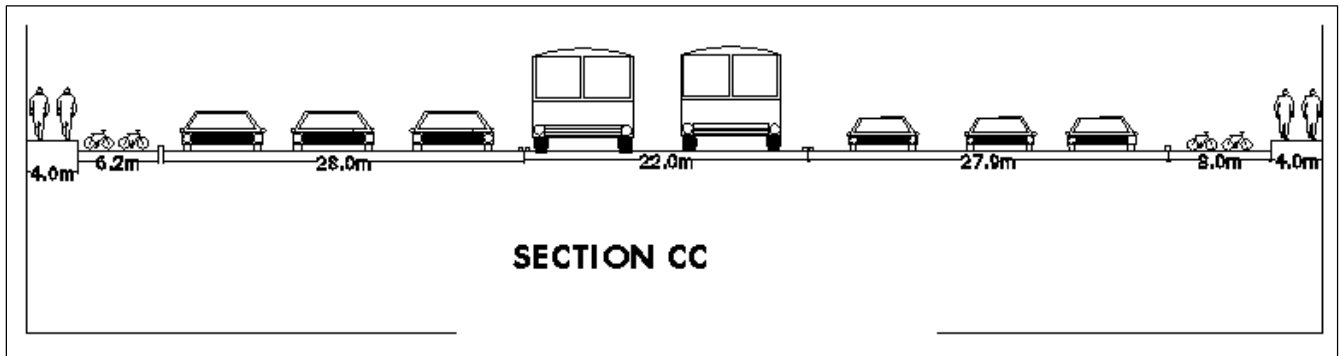
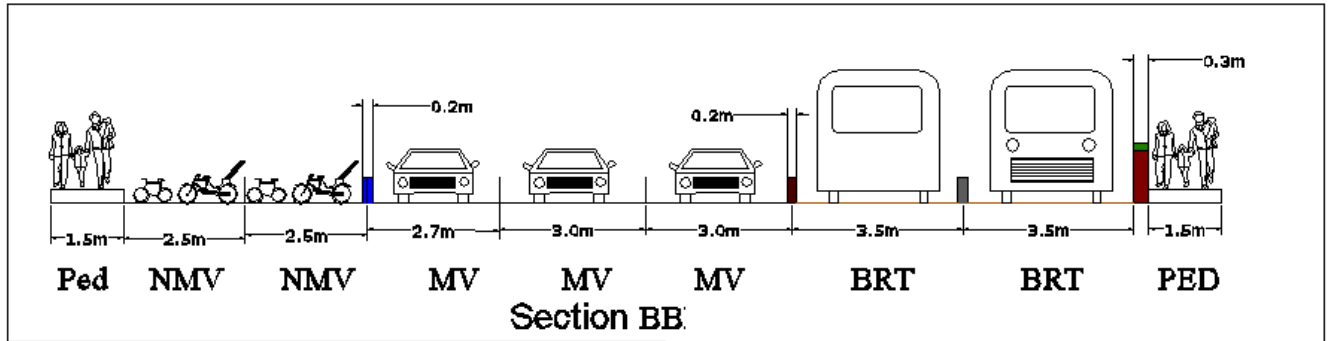
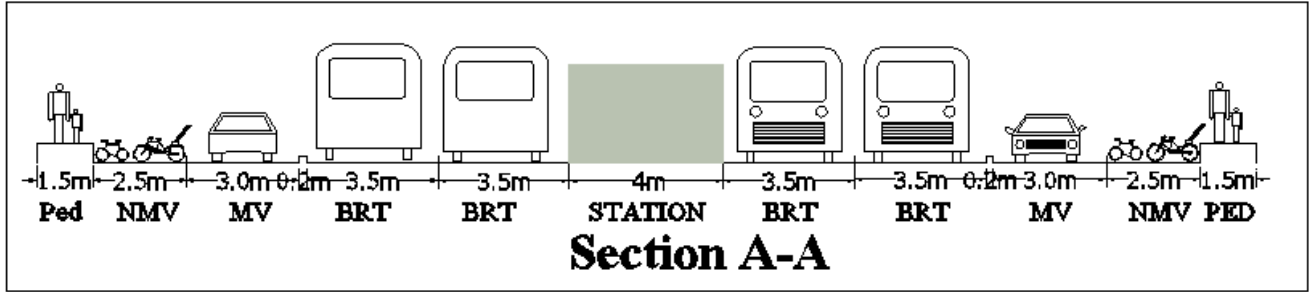


Fig 11: Detail design of Fulbaria intersection

LEGENDS		Station	
Footpath		NMV Lane	
Mixed Traffic		Zebra Crossing	
BRT lane		Bus Bay	
Median		MV lane	
Over Bridge		Round about	



Y

4. Management System

For a transportation system like BRT which has diversified issues to be addressed, a proper implementation and management plan should be drawn up. Various types of policies and procedures have been followed for this purpose. But for Bangladesh there should be special measure for this in order to make it compatible with the existing system.

BOT and related arrangements (e.g. BOOT Build Own Operate Transfer and BOO Build Own Operate) have been very successful in opening up public infrastructure to the private sector finance, and they have a number of advantages. They bring private sector disciplines to the project development and design process, and the public sector is far less exposed to risks of cost overruns or below expected performance. By enabling focus on a particular facility they can be more readily financed and do not impose a burden on public funds, and have thus probably helped encourage financial flows. It is suitable mainly to the Developing country.

To gain a complete and efficient management system not only the private organizations but also the government authorized institutions need to be enough efficient, systematic and helpful to the private organizations and the people.

In Bangladesh, the main public authority which related with transportation Sectors, these are:

RHD- Roads and Highway Department

LGED-Local Government Engineering Department

DCC- Dhaka City Corporation

DMP- Dhaka Metropolitan Police

BRTC- Bangladesh Road Transport Corporation

BRTA- Bangladesh Road Transport Authority

4.1 Proposed Management System

BOT (Build-Operate-Transfer) approach is followed for the management system of the proposed BRT service. The organizations which

are involved in this system and their responsibilities are illustrated below:

Build

In this project, the government and private sector both will share the responsibilities of this “BUILD” phase. Under this phase, the government will provide the infrastructural facilities and the Private organization will be responsible for importing the Articulated buses. There may be 7-8 (assumption) private companies under the private organization.

A new independent government cell (BRTDA-Bus Rapid Transit Development Authority) will be established

Operate

To make a systematic and efficient approach the responsibility of operation should be shared by government and private authorities. The private organization will be entrusted for the operation and maintenance of buses and fare collection system and BRTDA will be responsible for the monitoring and management of the overall system. To ensure the quality of services the private organization is involved in operation and maintenance and to preserve the right of users government sector is involved in monitoring and management.

In this phase the major share of collected fare will be received by the private organization.

Transfer

After 15-20 years (assumption) the ownership of the buses will be transferred to the government cell (BRTDA), because the infrastructures of transport sectors are national asset. Now, the BRTDA will be the owner of the whole system. But still the maintenance and operation of buses and fare collection will be done by private organization.

At this stage, the share (fare collection) of government cell (BRTDA) will be increased.

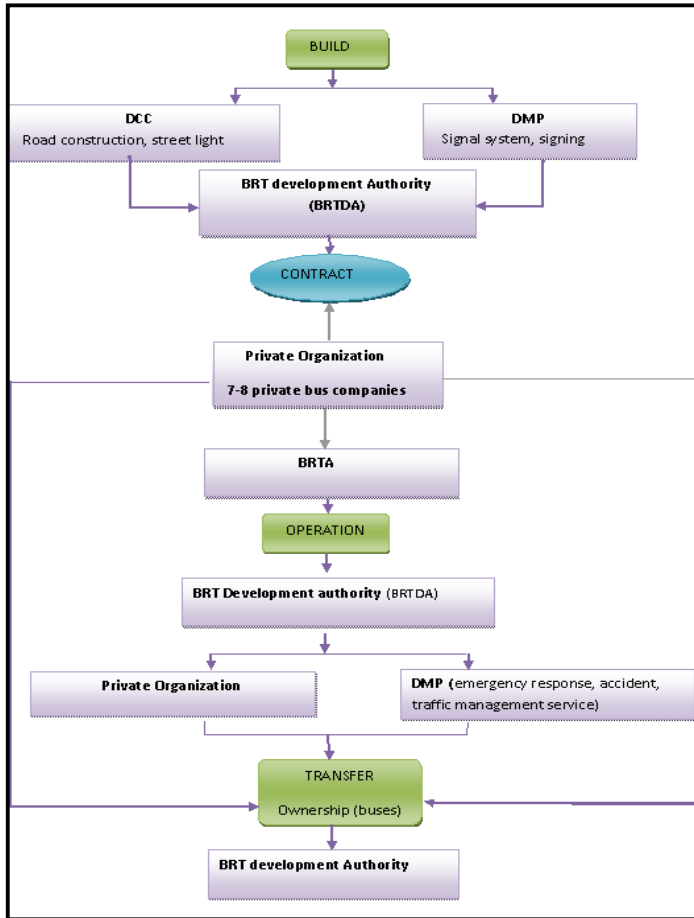


Fig12: Organogram relating various functions of different authorities

5. Fare collection process

The fair collection system of the proposed BRT route will be the combination of manual and automatic system. This will be a off- bus fare collection system. The general layout of the proposed system has shown in the Fig 9.

5.1 Process for entry

In this process, cashiers booth will be situated in the space between pedestrian crossing and station. The main function of this booth is to receiving money from the passengers and providing ticket to them. When a passenger enters to the space from the pedestrian crossing, he/ she will buy a colored plastic ticket card from the cashier by cash payment according to his/ her destination. Then the passenger will

punch the card in a ticket vending or validating machine and if it allows him/ her to go then its barrier will be open and the passenger can enter into the station. Then the passenger will collect their ticket from the machine and will keep this safely. From the station, the passenger can move out through the buses to their destination.

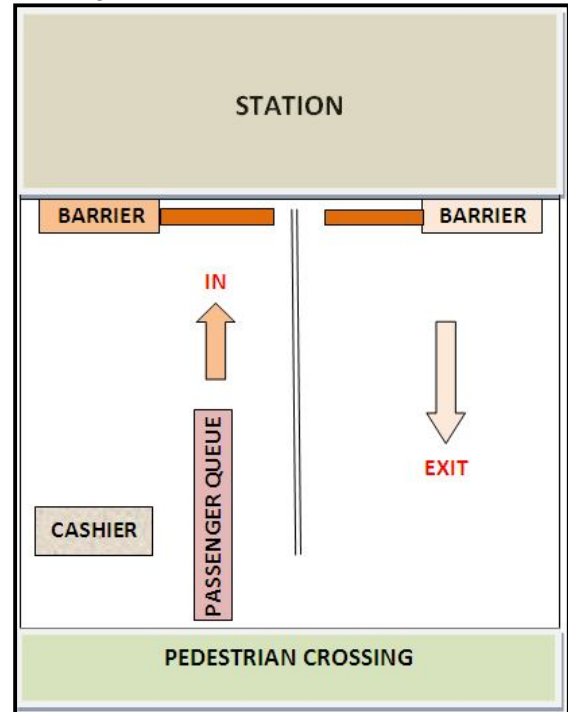


Fig 13: Proposed fare collection system of a station

5.2 Process for exit

When a bus arrive in a station, the passengers who wants to lift off at that station, will be departed from the bus and enter into the station. In the exit point from the station, again there will be a ticket vending or validating machine. The passenger will put the ticket into the machine and if it allow him/ her to go, them they can leave the station.

5.3 Fare transaction media

Fare payment media plays a vital role in the process of fare collection. The fare transaction media for BRT required certain technology and equipment. The more technology use the more fare collection system will be easy and fair. The fair transaction media that used in the proposed fare collection system is a plastic color

card with bar code technology. The main characteristics of the card are as follows.

- The card will be made of plastic.
- The color of the card will be varied according to the destination. For different destination or station the color of the card will be different. But the color of the card for express buses will be same.
- There should be bar code in the card and the bar code will contain the following information.
 - Serial number of the card.
 - Origin- destination information.
 - Manufacturing date
 - Expired date.
 - Price of the card.
 - Manufacture company's name

5.4 Ticket vending/ validating machine

The technology of the ticket validating machine for entrance and exit to and from the station will be different.

Machine for entrance

After receiving ticket card from the cashier, a passenger will punch the card at the entrance ticket validating machine. The machine will be such mechanized that it can identify the color of the card and the information that are coded in the bar code. After recognize the information and color of the card, if it can determine that the card is valid then it will allow the barrier to be opened and the passenger to go in or unless the barrier will be closed.

Machine for exit

The technology of the ticket vending machine at exit point is different. The passenger who wants to leave a station will put their card in the ticket box. This machine also can identify the color of the card and information of the bar card. Moreover it can only identify the subsequent stations ticket cards. For this, no one can travel more than his destination. If it can recognize that the card is valid then it will allow the passenger to leave the station.

The proposed tick validating machine of the fare collection system can be such as the Fig 10.



Fig 14: Ticket vending / validating machines with barrier

5.5 Fare structure

The amount of fare will be varied according to the type of buses. Fare of the passengers of local BRT buses and the express buses will not similar.

- Fare of the local BRT buses i.e. those buses which will be stopped at every stations of a route will be fluctuate according to the station or station. The amount of fare for the passengers on this service depends upon the destination.
- The fare structure of the express buses (which will stop at certain stations) will be flat fare structure i.e. similar fare structure. The amount of fare of the passengers for express buses will be same for all destinations. A passenger who wants to take off at a mid station of a route and the passenger, who wants to take off at the last station of the route, both have to pay same amount of money. People who prefer less time than money will use this type of services.

5.6 Fare collection management

Fare collection management system will have to be such fair that there should be no scope for corruption and no possibility for changing, copying or hampering the system. In the proposed system, ticket will be available not only in the stations but also some other certain places such as shopping centers, traffic junctions, important nodes etc. A cashier will handle selling of ticket cards at the ticket booths. The daily earnings from ticket selling will be deposited to the private company. Moreover the ticket cards that will be deposited in the exit ticket vending box will also be collected daily. Every ticket has a serial number and these tickets are distributed to the ticket booths from the main private company. So they have information about the tickets. All cashiers of the ticket booths will accumulate the serial number at the time of ticket selling.

There should be a linkage among the stations, other ticket booths, BRT vehicles and private company about information sharing. This will help to maintain the time route schedule and to make the fare collection system fair.

Advantages of proposed system

The proposed fare collection system has some advantages which will make it successful in a country like Bangladesh. The advantages are as follows:

Cost

The initial cost of the system is low. Labor cost, equipment costs are also minor. One or two cashier, two security guard can be maintained a station. Moreover cost for plastic ticket card and equipment cost (computer, ticket vending machine etc.) is also not so high.

Simple system

As a great percentage of population of Bangladesh are illiterate, so an easy ticket collecting process is very important for a successful BRT system. The proposed system is very simple.

Fairness

Daily the cash from selling tickets will be collected from all ticket booths and stations. Moreover, the ticket that deposited at a day in the exit ticket vending box will also collected.

The ticket has serial numbers and every ticket has a validity date.

Less harassment

As ticket booths are available in different places, so it will be less harassment for the passengers to buy tickets without station

Free from unwanted people

Only passengers who will actually use the BRT buses can enter into the station. So the station will be free from hopeless people.

Convenience for passengers

The whole system is free from complexity. So it will be convenience for the passenger to obey the rules and make their journey enjoyable.

Flexibility

The system can be adaptable and changeable.

A fair, easy, comprehensible fare collection system of a BRT system will ensure the participation of peoples in that system. Not only the passenger will be benefited from the system but also the administrator or operator of that system will also be benefited. So it is very important that when a BRT system implemented, the fare collection system will also be intelligible.

6. Conclusion

Dhaka Metropolitan Area is expected to become one of the largest cities in the world within the early years of this century. The existing mass transit can not accommodate the current traffic loads properly. The transport problems in Dhaka Metropolitan Area (DMA) are multi-faced and massive, and would need a phased program to solve and improve the situation. Regarding the fact, BRT will certainly be proved as an efficient transport option for greater Dhaka to ensure a Sustainable Transport System. The described design and management based approach towards BRT development has been proved as the ultimate solution to reduce traffic congestion and to provide a liable transport system for Dhaka city. So, effective steps should be taken for a successful implementation of BRT in the Dhaka city on the prescribed routes and provide better options to the future generations.