CHAPTER 10.0

VIJAYAWADA BRT SYSTEM

10.1 Why BRT System?

Productivity of an urban bus system is affected by

- low bus speeds along the route
- high bus stop boarding and alighting times
- large delays at intersections
- inefficient scheduling (wheel turning hours)
- poor image due to technological obsolescence

The BRT System overcomes these problems through

- Dedicated right-of-way increasing operating speeds, priority at intersections reducing delays, etc which all cumulatively add to increase in the number of bus trips per day and hence improved carrying capacity and revenues
- Improved bus design (high capacity, low floors, wide doors, etc), better bus stop designs and innovative fare collection systems (smart card) that reduce dwell time at bus stops
- Scientific planning and scheduling of services to increase wheel turning hours
- Continuous monitoring of operations and communication of real time information to passengers that would increase convenience to the users
- Use of modern buses with Intelligent Transport Systems that would enhance the efficiency and image of the system

Success of the BRT System depends on the quality of system designs and services, sustained interest, backing and facilitation by political, administrative and technical authorities and the interest, acceptance and the support of the traveling public.

To provide a high level of service to the people and improve the productivity and image of the bus system, Bus Rapid Transit System is proposed to be developed and operated in Vijayawada.

10.2 BRTS Corridors

Based on the potential public transport passenger demand levels, the following corridors are identified for introduction and operation of BRTS (**Figure 10.1**).

Green Corridor: Mahatma Gandhi Road (Bandar road) (from Bus stand upto Kanuru) (Length: 12 km)
Red Corridor: Eluru Road (from Bus stand upto Ramavarppadu junction) (Length: 6.8 km)

Blue Corridor : G S Raju Road (from Bus stand upto Payakapuram) (Length: 12 km)
Orange Corridor : S N Puram Road (from Bus Stand to Machavaram Hanuman Temple) (Length: 5.5 km)
Yellow Corridor : Route No. 5 Road (from Bus Stand to JRD Tata Industrial Estate) (Length: 6.15 km)

10.3 Corridor Description

Green Corridor : Mahatma Gandhi Road (Bandar Road)

This is an important arterial road of the city. Its ROW is 30 mts and is presently of 4 lane divided carriageway. The road runs parallel to Bandar Canal. A number of important offices, hotels and commercial activities are fast developing along this road.

The important intersections along the road are:

- Police Control Room Junction
- Governerpet Junction
- Vangaveeti Ranga Statue Junction
- Indira Gandhi Municipal Stadium Junction
- Veterinary Hospital Junction
- Benz Circle
- NTR Statue Junction
- Autonagar Junction

Mahatma Gandhi road in its extension beyond Benz Circle as NH-9, connects to the newly developing areas like Kanuru where a large size of future population and activities are proposed to be located. NH-9 in continuation connects Machilipatnam.

Red Corridor : Eluru Road

Eluru road is a major arterial corridor. Its ROW is 30 m and is presently of 4 lane divided carriageway. It starts from Police Control Room and runs parallel to Ryves Canal. In its continuation as Karl Marx road, it meets Kolkata road (NH-5) at Ramavarapupadu intersection. NH-5 runs in continuation and connects to Gannavaran airport and areas beyond.

High intensity commercial activity takes place all along the road. BSNL office, Mary Mata Church (Gundala Hill), etc. are major landmarks along the corridor.

The important intersections along the corridor are:

- Swarna Palace Hotel Junction
- Apsara Theater Junction
- Vijaya Talkies Junction
- Seetarampuram Junction

- Chuttugunata Junction
- Ramavarapupadu Junction

Blue Corridor: G S Raju Road

This corridor starts from Government General Hospital and runs along G S Raju road along Eluru canal upto Government press, and then turns northwards to run along Ajit Singh Nagar – Payakapuram road upto the proposed Payakapuram Nodal terminal. Beyond this regular services can extend upto Nezvidu.

The ROW of the road is generally 27 m, the carriageway is 4 lane undivided. High density residential areas are all along this road.

The corridor crosses Eluru Canal, Budameru, and Kolkata rail line. Bridges with adequate capacity need to be constructed. C K Reddy road runs parallel to G S Raju road on the other side of Eluru canal and provides opportunity for diverting some of the other modes onto it.

Important intersections along the corridor are:

- Government Hospital Junction
- Gandhi Center Junction
- Gymkhana Ground Junction
- Cement Factory Junction
- Government Press Junction
- Pipula Road Junction

Orange Corridor: SN Puram Marg

This is a new road being formed along the abandoned rail track corridor. It provides good opportunity for developing as a major BRTS corridor.

It starts from Government General Hospital and runs along the road in front of Vijayawada railway station and turns eastwards to run along the new road being formed. At its eastern end it links up with the Eluru road corridor at Machavaram Hanuman Temple.

High density residential development is along the corridor.

The corridor provides connection to Vijayawada railway station, a major traffic generator.

Along its stretch the corridor crosses Eluru Canal and Ryves canal. Bridges with adequate capacity need to be provided.

Important intersections along the corridor are:

- Goods Shed Junction
- Vijayawada Railway Station
- Pezzoi Pet Junction
- Old SN Puram Railway Station
- Madhura Nagar Road

Yellow Corridor: Route No. 5 Road

This is an important bus route corridor. It is a narrow road of 2-lane carriageway width.

The corridor starts from JRD Tata industrial Estate in the east, runs through Auto Nagar, LIC Colony, Prajasaktinagar, Governorpet and meets Eluru road (Gopalareddy road) at Old Bus Stand.

The corridor needs to be exclusively reserved for buses. All other modes need to be diverted along other roads.

As there are a large number of intersections, they needs to be properly designed, controlled and managed to give priority to bus movement.

Important intersections along the corridor are:

- Eluru road Junction
- Swarna Palace Hotel Junction
- Besant Road Junction
- Dornakal Road Junction
- Madhu Kalyanamandapam Junction
- Siddartha Arts College Junction
- Sunnam Battilu Junction
- Executive Club Junction
- Gurunanak Colony Road Junction
- Auto Nagar Junction

10.4 Development Plan

The development and operation of BRTS services would involve the following steps.

- Topographic survey of the corridors and preparation of base maps to suitable scale showing all surface features
- Survey and plotting, on corridor base maps, all utilities and services on, under and over the corridor
- Finlisation of corridor cross-section details and elements for entire length of the corridor. This would include plans and designs for intersection geometrics and control system

- Engineering designs and specifications for the pavement and other component elements of the corridor
- Engineering planning and design of all bridges, flyovers, interchanges that may be necessitated
- Land acquisition
- Re-engineering of the roads through appropriate resource mobilization, budget, tendering and implementation.
- Selection and introduction of buses of appropriate design and specifications. High capacity, low Floor, wide doors, suitable acceleration and deceleration capability, environment friendly fuel base, fitted with ITS components for vehicle monitoring, communication etc, attractive colour and other features. Provision for air conditioning or air cooling or any other arrangement needs to be carefully considered and decided.
- Design of bus stops which are attractive and convenient
- Development of nodal bus terminals
- Finalisation of fare policy
- Resource Mobilization including private sector participation (BOT) and/or PPP)
- Institutional arrangements for planning, development, operation and management of the BRT System

Redesign of Road Cross-sections

The essence of the BRTS is high speed with minimum delays. This can be achieved only with a segregated right-of-way and priority at intersections. The roads in Vijayawada have limited right of way of 30 m or less. All efforts need to be made to acquire land to increase the right of way of the selected corridors to atleast 45 m. However, in the present instance the following re-ordering of the road cross section is proposed. **Figure 10.2** presents the proposed road cross-section.

The bus way is proposed in the centre as it would conserve road space. 2 lanes (7.0 m) are proposed for the busway. 3 lane (9.0 m) carriageway on either side are proposed for other modes. This would include cycle lanes of 2 m wide on either side with lane marking and surface texture variation. Footpaths of 2.0 m wide on both sides, over road side drainage channels to be provided. Narrow median strips of 0.5 m wide with well designed railings are proposed between busway and general carriageway.

Bus stops are proposed near the intersections. The median strips would need to be widened to about 2.5 m for bus stop shelters.

Pavement

The pavements need to be designed for the expected loadings.

Design Standard

The following general design standard for different elements of BRTS are proposed:

Sr. No.	Description	Design Standards
	Right Of Way (ROW)	
1.	*ROW*	40 - 60m
	Design Speed	
2.	*Design Speed*	50 kmph
	Geometric Design	
3.	*Cross-sectional elements*	
	i. Lane widths	
	a. Median Bus Lanes	7.0m
	b. Carriageway	7.0m
	c. Parking For Trucks (where provided)	3.0m
	d. Parking For Cars (where provided)	2.25m
	e. Service Lane (where provided)	6.0m
	f. Cycle Path	2.5/2.0m
	g. Pedestrian Pathway	2.0m
	ii. Cross Slope	
	a. Median Bus Lanes	2.0%
	b. Carriageway	2.0%
	c. Parking For Trucks	2.0%
	d. Parking	1.5%
	e. Service Lane	1.5%
	f. Cycle Path	1.5%
	g. Pedestrian Pathway	1.5%
4.	*Safe Stopping Sight distance*	60m
5.	*Median*	
	i. Width of Median at Bus Shelter (raised)	2.5m
	ii. Transition in Median	1 in 15 to 1 in 20
	Pavement Design (at CBR 5 % & MSA 5)	
6.	For BRT Bus lanes & Carriageway	Thickness
	a. Bituminous Concrete (BC) or AC	25mm
	b. Dense Graded Bituminous Macadam (DBM)	50mm
	c. Wet Mix Macadam (WMM)	250mm
	d. Granular Subbase (GSB)	250mm
	e. Subgrade (SG)	500mm (min)
	Intersection Design	
7.	*Intersections*	
	i. Length of storage lane (including 50m taper) for right turning	130m
	ii. Minimum length of acceleration lane (including 80m taper)	180m
	iii. Minimum length of deceleration lane (including 80m taper)	120m
	iv. Maximum radius for left turn	30m
	v. Minimum radius for right turn	15m
	vi. Width of turning lane (inner radius of 30 m)	5.5m
	vii. Rate of taper (minimum)	1 in 15
	viii. Minimum size of channelising island	4.5sqm
	ix. Offset of island from vehicle path	0.3 – 0.6m
	x. Desirable angle of intersection arm	60 – 90 degrees

Bus Stops

The planning and design of all elements of the road corridor, including the bus lanes, would need to be in accordance with the manuals and guidelines of Indian Roads Congress and other authorities.

Bus stop and Bus Shelter designs need careful consideration. The average spacing of the bus stops to be 600-800 m. The bus stops are to be located near the signalized intersections with provision of pedestrian phase for safe crossing of the roadway by the passengers. The level of bus station platform to be in level with the floor level of BRTS buses to enable smooth and fast boarding and alighting. All physical elements to be friendly to physically challenged. Atleast two boarding/alighting platforms per stop to be provided. Atleast 2 Bus boxes of 3 m x 12 m to be marked at each bus stop (**Figure 10.3**).

Access to Bus Stops

Access to bus stops to be made safe and convenient. Where bus stops are at intersection, pedestrian phase to be of sufficient duration to enable the passengers to cross the roadway. Where bus stops are at mid block, pedestrian actuated signals (pelican signals) to be provided.

At high volume bus stops, grade separated pedestrian facility may be provided.

All pedestrian crossing facilities to be well marked and provided with appropriate signages.

Lighting

Lighting of the streets, including the BRT Corridor and pedestrian crossings to be adequate and proper. Average illumination of 35 lux for traffic lanes and 25 lux for footpaths to be provided.

Street Furniture

The BRT corridors need to be developed as model road corridors. Provision of well designed road furniture is important. They are:

- Traffic signs
- Road Markings
- Traffic signals
- Railways
- Channelisers
- Planters
- Tree guards
- Landscaping
- Roadside public amenities
- IPT stands

- Dhallaos (Garbage Dumps)

System Operation

Careful planning of the operation of the services is important. Initially the bus capacity may be 60-70. However as patronage increases high capacity buses of 100 and 120 seats need to be introduced. The average journey speeds to be 22-25 kmph to reduce travel time to passengers and increase vehicle productivity. Frequency of service to be high to attract passengers.

BRT System would be either 'closed' or 'open' (**Figure 10.4**). In the first case the buses operate only along the identified corridor from end to end. In the second case buses may enter and exit the corridor in the run of their route. This needs to be carefully considered and decided at the time of detail planning of the system. However in the first instance 'closed' system of operation, between the central and nodal terminals of the corridors, is recommended. However mofussil services to immediate regional nodes can enter and use the corridors.

A variety of Services – normal, local, express, ladies special, AC etc – could be provided to attract passengers and derive higher revenues.

Fare Policy

Fare policy needs to be carefully decided. It includes fare level, fare structure and concessions. Fare policy needs to be integrated with other modes of public transport. It also needs to be in the framework of the affordability of the potential patrons.

Fare Collection

Generally fare is collected on board. Off-board collection system with smart cards needs to be introduced to minimize stop dwell times. However in the initial phase 'hybrid' system may be adopted.

Infrastructure

Provision of required infrastructure comprising bus depots, workshops, terminals, stops, etc is important for the efficiency of the system.

ITS Technology

The BRTS is to be supported by ITS technologies. They include Automatic Vehicle Location (AVL), Automated Scheduling and Dispatch (ASD), Transit Signal Priority (TSP), etc. All traffic signals along the corridor need to be linked. In the later phase other modern ITS technologies like on board transponders etc. can be adopted to further improve the efficiency of the system.

Integration

The BRTS services need to be integrated with other public transport services like the regular bus services, IPT services and any potential new PMT technologies that may be introduced.

Traffic Management

Intensive traffic management along BRTS corridors and other links of the road network is critical to maintain the efficiency of the system in particular and overall traffic in general. As the carriageway capacity is limited, no parking on street along the corridor should be permitted. This calls for appropriate parking management including identification of alternate parking areas, pricing, etc. Management of traffic flows at intersections is important to enable smooth entry and exit of buses into and out of BRT lanes and safe movement of pedestrians. Regular highway patrolling, quick removal of break down vehicles, incident management etc. are important. The Traffic Police need to be equipped with necessary manpower and logistics.

Improvement of the Loop

All the identified corridors meet at the vertex near Police Control Room junction. From here they need to reach the bus stand located on the southern side of Bandar Canal. The Canal road from Police Control Room upto Prakasan barrage is highly congested. There is a need to develop and upgrade a loop road system. It would include upgrading of Canal road from Police Control Room upto VMC bridge across Bandar Canal near VMC office, widening of link road running by side of Rajeev Park, from bridge to NH-9, widening of road south of Bandar Canal from NH-9 to bridge and widening of bridge and road leading to Police Control Room junction. One way traffic for all modes on this loop needs to be enforced. If necessary the loop may be partly on elevated roadway.

The inter-city and intra-city bus terminals (Pandit Nehru Bus Stand) need to be integrated and reorganized to enable smooth movement of buses.

Parking Facilities

With the development of BRT system along the identified corridors on-street parking on these roads need to be strictly prohibited. This would necessitate provision of parking facilities at other locations along the corridor. About 150 to 200 equivalent can spaces need to be created for every kilometre of BRT corridor. On-street parking on all streets around the corridors needs to be reorganized. Open spaces need to be identified and parking facilities developed.

Private sector participation in provision of parking facilities needs to be encouraged.

Mechanized parking facilities to be promoted to conserve space.

Parking facilities could be designed as multi-use complexes to generate revenue and self sustain.

A comprehensive Parking Policy at city level needs to be adopted and Local Area Parking Plans to be prepared and implemented.

Differential pricing needs to be adopted.