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## Chapter 2 Overview of Phase I Report



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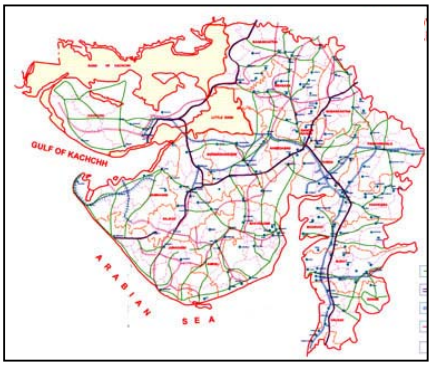
# CHAPTER 1.0
# Introduction

## 1.1 Preamble




The State of Gujarat, on the west coast of India, endowed with rich natural resources, has vast skilled manpower and is having most developed industrial infrastructure. Gujarat has become one of the most preferred locations for industrial investment in the country and the State contributes significantly to the economic development of the nation.

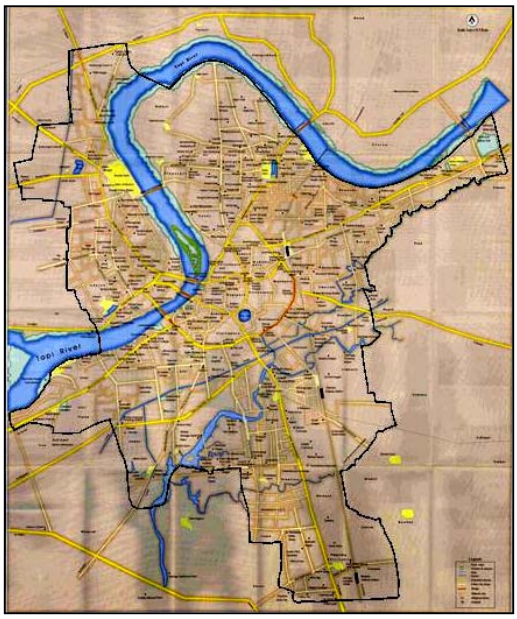
According to the population distribution, the city of Surat stands next to Ahmedabad. It is the biggest city in the region of south Gujarat. Surat is one of the most dynamic cities of India with one of the fastest growth rates due to immigration from various parts of Gujarat and other states of India. Surat occupies a pivotal position along the 225.10 km long industrial belt, with a canal irrigated agriculture hinterland.

Surat is one of the cleanest cities of India and is also known by several other names like *The Silk City, The Diamond City, The Green City*, etc. It has a most vibrant present and an equally varied heritage of the past.

Surat city is one of the most important cities on the industrial map of the country with many large industries developed over here. It has a broad, multi functional economic base comprising cultural, educational, business, trade, commerce, industry sectors and activities. Surat contributes about:

- 28% of the Nation's total man made fiber production.
- 18% of the Nation's total man made fiber export.
- 40% of the Nation's total man made fabric production.
- 12% of the Nation's total fabric production.
- 70% of the Nation's total rough diamond cutting and polishing.
- 42% of the World's total rough diamond cutting and polishing.
- 40% of the Nation's total diamond exports.

Still today, Surat continues the same tradition as people from all around the country flock in for business and jobs. Surat has practically zero percent unemployment rate and jobs are easier to get here due to very fast development of various industries in and around Surat City.




Surat is well known as the hub for Diamond Business, not only in India, but also in entire World. Surat has specialty in polishing and shaping rough diamond. From entire World lots of diamond comes to Surat for cutting, polishing and shaping. Surat is the one and only flourishing diamond business centers in India. On the other hand Surat city is equally popular for its textile industry. Thousands of textile industries processing various stages of textile material are located in and around Surat. These industries are ranging from small scale to very large process houses. Many other industries are grown in the nearby areas of Surat. Hazira and nearby industrial areas are developing very rapidly. The development and expansion of Surat city is due to this rapid growth of Industry and Trade.

## 1.2 Need for the Study

Surat city, which is hub of commercial activities in Gujarat State, needs very good transport infrastructure to sustain the growth. In the past, SMC have carried out several studies for improvement of the transport infrastructure in Surat area and these studies came out with various recommendations to ease the traffic congestion, improve the accessibility & mobility and overall environment. Most of the recommendations of earlier studies have been successfully implemented by the concerned authorities.

Surat city has good road network. However, the road network in the *Walled City* is congested due to insufficient road widths. The road based public transport system is Bus operated by Gujarat State Road Transport Corporation (GSRTC). At present there are only about 75 city buses in Surat. The share of mass transportation in Surat is very poor. This in turn prompted the people to go in for private transport (personalised modes).

In general, an efficient, affordable and environmental friendly public transport system reduces the increasing usage of private vehicles and results in saving in travel time and vehicle operating cost (VOC) as well as improvement in environment. To provide an efficient

and environment friendly mass transportation system for Surat, Government of Gujarat initiated a study on Integrated Public Transit System for the city of Surat.

Consulting Engineering Services (I) Private Limited have been appointed as Consultant to carry out the necessary studies for Integrated Public Transit System for Surat City. The study was initiated in August 2005 and the Inception Report was submitted in September 2005. Consultants submitted various reports including Draft Final Report (Phase I), Report on Household Travel Survey and Phase I Report. The Phase I Report included development of baseline data, situational analysis of existing public transport system, various surveys and studies & their analysis, development of travel demand models and the traffic forecast for various horizon years. The present report is the *Phase II Report* which includes amongst others, travel demand forecast for various scenarios, assessment of demand supply gap, corridor analysis and various short term, medium term and long term improvement plans including bus and rail based public transit systems.

## 1.3 Study Objectives

The overall objectives of the present study are as follows:

- To provide appropriate solution for Integrated Public Transit System considering socio-economic conditions, technical capability, institutional systems and financial conditions.
- To review the existing public transport system vis-à-vis current and future demand for public transport services to determine the optimal mix of public transport modes.
- To review the possibilities of exploiting Western Railway services of Ahmedabad-Surat-Mumbai and Bhestan - Hazira Gothan tracks to render short-term solution for the Mass Transport.
- To formulate a short-term traffic and transportation improvement plan for alleviating the traffic problem of the city in the short term and to suggest methods of implementing the same
- To formulate long-term development plan and medium term action plan for the public transport system which will include a prioritised implementation strategy for environmentally sustainable and efficient Integrated Public Transit System
- To recommend the appropriate implementation scheme for the projects i.e. through public investments keeping in mind the budgetary allocations of the concerned agency or Private Sector Participation (PSP) keeping in mind the financial viability of the project

## 1.4 Scope of the Study

The present study is comprehensive in nature, which includes all the sub-components of transport system, such as road, rail, public and private transport, traffic management, institutional framework, private sector involvement etc. The major phases of the study are as follows:

Phase I : Identification of the Problems
Phase II : Public Transport System Plan
Phase III : Detailed Study of Selected System

## 1.5 Methodology in Brief

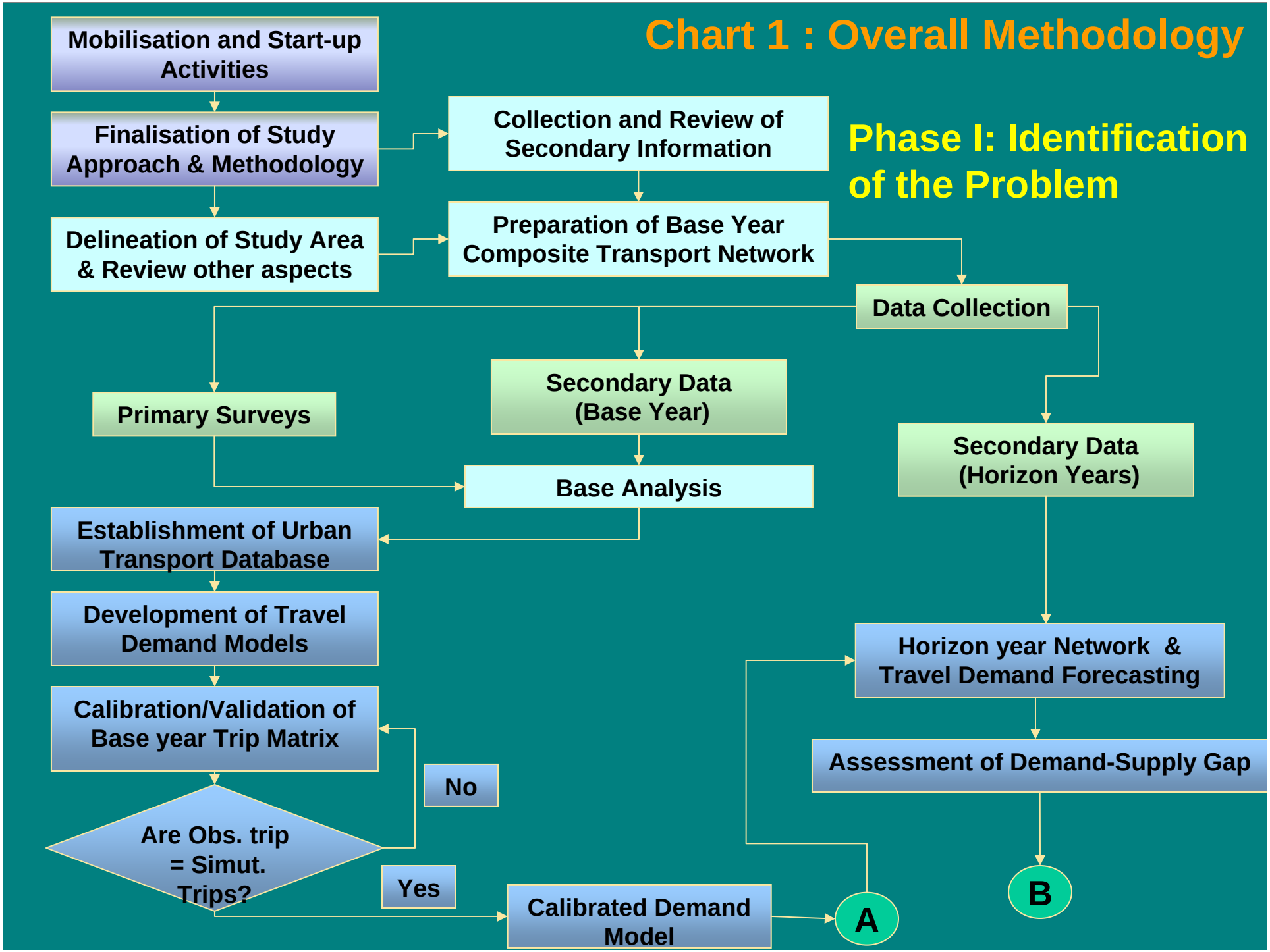
The overall work approach and methodology is summarized in **Chart 1**. The different activities have been grouped into six main activities. The various tasks of the methodology are listed below; detailed description of each task has already been presented in the previous Reports.

- Traffic & Transportation Studies
- Development of Demand Forecasting Models
- Short Term Improvement Plan
- Medium & Long Term Public Transport Plan
- Detailed Study for Selected Public Transport System
- Public Consultation

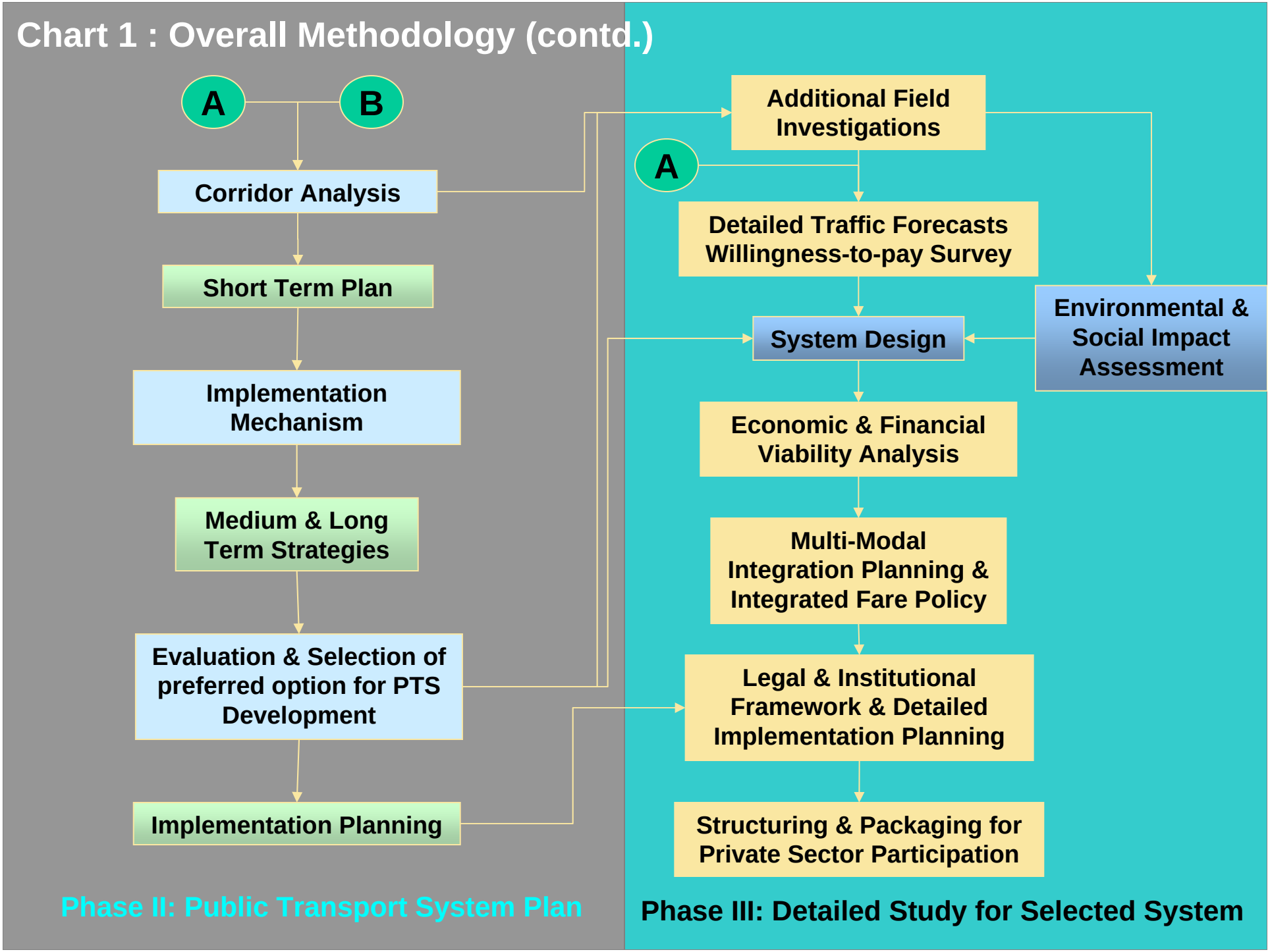
## 1.6 Report Structure

The present report is organized in 7 Chapters. In *Chapter 1*, study background, need for the study, objectives, scope of the study and brief study methodology are presented. An overview of the Phase I Report submitted in October 2006 is given in *Chapter 2*. *Chapter 3* details the development of travel demand models & traffic forecast for various scenarios, loadings on various alternative mass transit systems and corridor analysis. The road based improvement proposals based on the traffic forecast are presented in *Chapter 4. Chapter 5* includes the IPTS based improvement proposals. *Chapter 6* includes the proposed phasing and the block cost estimate. The suggested institutional framework and implementation strategy are presented in *Chapter 7*.

# Chart 1 : Overall Methodology



# Chart 1 : Overall Methodology (contd.)



# CHAPTER 2.0
# Overview of Phase I Report

## 2.1 Preamble

The main objective of the present study is to provide appropriate solution for Integrated Public Transit System considering socio-economic conditions, technical capability, institutional systems and financial conditions. The reports submitted by the Consultants include Inception Report, Report on Household Travel Survey and Final Report - Phase I. The Phase I Report included amongst others appraisal of existing situation, development of baseline data, situational analysis of existing public transport system, various surveys and studies including household travel survey carried out as part of the present study & their analysis, development of travel demand models & traffic forecast for various horizon years and assessment of demand & supply gap. A brief review of the Phase I report submitted in October 2006 is presented in this Chapter.

## 2.2 Study Area Characteristics

### 2.2.1 Study Area

The study area is *Surat Urban Development Authority (SUDA),* which covers an area of 722.0 sq. km. The study area includes areas within Surat Municipal Corporation (SMC) and 130 villages in the peripheral area. For the purpose of analysis, the study area is divided into three parts:

i) Walled City
ii) SMC area excluding Walled City
iii) SUDA Area (excluding SMC area)

The existing land use pattern of SMC area shows that the entire Walled City is concentrated with mixed land use of household industries, especially the power looms, jari, diamond and intensive commercial activities. Northern portion of Katargam is developed into industrial estate within the SMC area limit.

### 2.2.2 Demographic Pattern

***Surat Municipal Corporation Area***

Surat Municipal Corporation (SMC) area is spread over an area of 112.28 sq. km and had a total population of 14.99 lakhs in 1991. The Walled City covers an area of 8.22 sq km. As per 2001 Census, the SMC population was about 24.34 lakhs with an average gross density of 21676 persons/ sq. km. Demographic profile and decadal variation of population of Surat City are presented in **Table 2.1.**

**Table 2.1 Population Growth in Surat City**

| Census Year | Status | Area in Sq. Km. | Total Population | Decadal Population Growth | Density (Person / Sq.km.) |
|---|---|---|---|---|---|
| 1901 | M | 8.18 | 119306 | | 14,585 |
| 1911 | M | 8.18 | 114868 | -4% | 14,042 |
| 1921 | M | 8.18 | 117434 | 2% | 14,356 |
| 1931 | M | 8.18 | 98936 | -16% | 12,094 |
| 1941 | M | 8.18 | 171443 | 73% | 20,958 |
| 1951 | M | 8.18 | 223182 | 30% | 27,283 |
| 1961 | M | 8.18 | 288026 | 29% | 35,211 |
| 1971 | MC | 33.85 | 471656 | 64% | 13,933 |
| 1981 | MC | 55.56 | 776583 | 65% | 13,977 |
| 1991 | MC | 111.16 | 1498817 | 93% | 13,483 |
| 2001 | MC | 112.28 | 2433835 | 62% | 21,676 |

*M = Municipality; MC = Municipal Corporation*

Recently in the year 2006, Surat Municipal Corporation has increased its area by merging eight SUDA villages (Nagar Palikas) into SMC limits. These villages are adjoining the SMC boundary. List of these villages and their demography are presented in **Table 2.2**. With the extension of Surat City Limit, the total population of SMC area (148.67 sq km). is 27,29,482 (2001).

**Table 2.2 Newly Added Areas in SMC**

| Name of Area | Area in Sq. km | Population |
|---|---|---|
| Amroli | 0.42 | 17138 |
| Chhapara Bhata | 2.96 | 23415 |
| Godadara | 2.97 | 23234 |
| Parvat | 2.12 | 20693 |
| Bamroli | 6.90 | 34592 |

| Name of Area | Area in Sq. km | Population |
|---|---|---|
| Puna | 7.37 | 119092 |
| Unn | 4.12 | 28820 |
| Kosad | 9.53 | 28663 |
| **Total** | **36.39** | **295647** |

***Surat Urban Development Authority (SUDA) Area***

SUDA area covers an extent of 722.0 sq. km, which includes areas within Surat Municipal Corporation (SMC) and 130 villages in the peripheral area.

The population of Surat Urban Development Authority area (Refer **Table 2.3**) (excluding Surat Municipal Corporation) in the year 1971 was 1.49 lakhs, 2.08 lakhs in 1981, 2.87 lakhs in 1991 and 6.57 lakhs in 2001. The total population of SUDA area was 9.85 lakhs in 1981, 17.16 lakhs in 1991 and 30.90 lakhs in 2001. The decadal population growth rate of Surat Urban Development Authority area including Surat Municipal Corporation area during 1991-2001 was 80%. The projected population of SUDA area for the year 2011 is about 42 lakhs.

**Table 2.3 Surat Urban Development Authority – Population**

| Year | SUDA+SMC Population | Decadal Growth Rate% | SMC Population | SUDA Population excluding SMC |
|---|---|---|---|---|
| 1971 | 6,20,573 | - | 4,71,656 | 1,48,917 |
| 1981 | 9,85,370 | 58.78 | 7,76,876 | 2,08,494 |
| 1991 | 17,16,566 | 81.31 | 14,98,817 | 2,87,749 |
| 2001 | 30,90,686 | 72.99 | 24,33,785 | 6,56,901 |

Since the inception of SUDA (Surat Urban Development Authority) in late 70s, the City is growing at a rapid pace; though the development in the peripheral areas was not that rapid until 2001. Decadal population growth rate between 1991and 2001, did not result in the horizontal urban sprawl; on the contrary, it densified the core city areas, which were part of the municipal corporation.

With the municipal area in Surat reaching a density of 21677 persons/sq km, it is envisaged that the future development will take place outside the municipal limits in the urban development authority areas. This demographic fact makes the role of SUDA very crucial in the coming decades of development in the city.

### 2.2.3 Socio-Economic Profile

Surat situated on the Golden Quadrilateral Highway Network of India has emerged as an important economic centre of South Gujarat region. During the last decade Surat has experienced very high growth in economic activities and has earned its name internationally for its textile and diamond business. Along with intensive concentration of trade and commercial activity in the city, the land has been blessed with rich agricultural land.

In the district of Surat, Surat is the only city having industrial development activities. Surat SEZ, which is located in Sachin GIDC, is the main strategic business unit of Diamond and Gem Development Corporation Limited (DGDC).

Surat is known for its textile, manufacturing, trade, diamond cutting and polishing industries, intricate zari works, chemical industries and the gas based industries at Hazira established by leading industry houses. An estimated 4% of GDP is contributed from textile sector. An apparel park has also been planned in the city for production and export facilities to be under one roof and to give a face lift to the textile industry.

### 2.2.4 Regional Transport System

Surat city is well connected by Road, Rail and Air transport. Surat is well connected to one of the busiest inter state trunk routes in the country (National Highway No. 8) which lies at a distance of about 16 km from eastern boundary of Municipal area and other major regional linkages with State Highways.

Being located almost midway on the 500 km long principal rail corridor of Western Railway between Mumbai and Ahmedabad, Surat is provided with 45 pairs of express/ mail/passenger and local trains per day. The state government has also established an air-strip to facilitate smaller aircraft landings, but no domestic air service has started yet.

### 2.2.5 Road Network

Surat city has good road network of radial and ring grid type. Most of the major roads have divided carriageways. However, the road network in the Walled City is congested due to insufficient road widths. Most of the roads do not have sufficient footpath facilities. All the traffic related problems in the city need detailed studies on assessment of future requirement of transport infrastructure facilities.

***Ring Road:***

One of the most significant major roads in the Surat city is Ring Road, which facilitates the bypassable traffic from the congested streets in the Walled City area. The mid-block peak hour traffic on the Ring Road is more than 10,000 PCU/ hour. A long flyover on the Ring Road covers a number of junctions. Another multi-level flyover is under construction from Udhana Darwaja to Majura Gate on this road to cover other major junctions

***Radial Roads:***

The important radial roads in the Surat Urban Agglomeration are given below. The regional bus trips from all these corridors enter the city area near Railway Station.

- Bathena Aanjana Road
- Lambe Hanuman Road
- Aswani Kumar Road
- Ved Road
- Katargam Road
- Althan Bhatar Road
- Headgover Road
- Dindoli Main Road
- Ghoddod Road
- Adajan Hazira Road
- Athwa Dumas Road
- Udhana Magdalla Road
- Udhana Navsari Road
- Bardoli Road
- Varachha Main Road
- Katargam Amroli Road
- Rander Olpad Road

At present there are 37 major and minor bridges and two underpass ways in the city. Of them eight bridges are across River Tapi at various locations. One of them is a weir cum causeway and another is a railway bridge.

There are three fly over bridges in the Surat city. Of these, two fly over bridges are on the Ring road, one at Athwa gate junction and another from Nan Darwaja junction to Sahara Darwaja. Another fly over bridge is on Varachha road. There is one overbridge above L.C.No. 146 on Sumul Dairy Road. At present one fly over bridge at Majura Gate Junction on Ring Road and one road over bridge above Railway

Culver No. 436 at Dindoli are under construction. Two major bridges across the River Tapi are planned to be constructed within a span of three years each.

In SUDA area there are two major bridges across river Tapi and 15 bridges across various creeks.

### 2.2.6 Registered Motor Vehicles

The total number of registered vehicles in Surat RTO area during 1994-2005, collected from Surat RTO, is presented in **Table 2.4**. The annual average growth rate of registered vehicles in Surat during 1994-2005 is 11.89%. The composition of registered vehicles in Surat is shown in **Figure 2.1.**

**Table 2.4 Registered Motor Vehicles in Surat**

| Year | Total Vehicles | % of Growth |
|---|---|---|
| 1994 | 400419 | |
| 1995 | 444264 | 10.95% |
| 1996 | 486743 | 9.56% |
| 1997 | 529879 | 8.86% |
| 1998 | 582442 | 9.92% |
| 1999 | 642293 | 10.28% |
| 2000 | 708323 | 10.28% |
| 2001 | 761650 | 7.53% |
| 2002 | 818883 | 7.51% |
| 2003 | 896844 | 9.52% |
| 2004 | 982713 | 9.57% |
| 2005 | 1089689 | 10.89% |

*Source: RTO, Government of Gujarat, 2005*

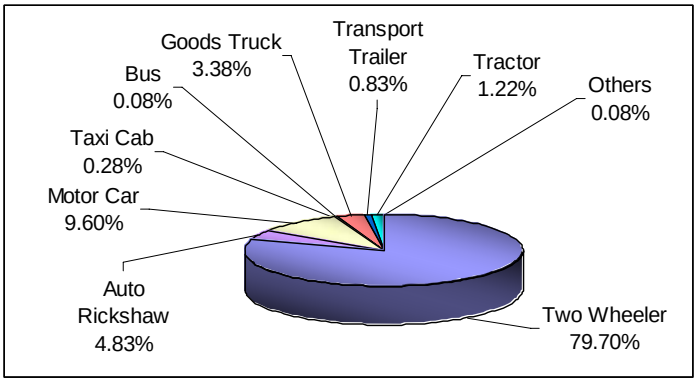



**Figure 2.1 Composition of Registered Motor Vehicles**

## 2.3 Traffic and Transportation Characteristics

Assessment of traffic characteristics of an urban area is important to appreciate the traffic related problems in the area and understanding the need for organizing the same in an efficient and economical manner. Traffic characteristics help in appreciating the spatial and temporal features of travel within the study area, relationship of traffic intensity with network capacity and prevailing level of service on various corridors of the area. This appreciation and understanding is essential for identifying the present conditions and constraints, eliciting proper policies and strategies, selecting relevant transport systems and designing the individual components of the system**.**

To assess the traffic characteristics in the study area, classified traffic volume counts, Origin-Destination surveys were carried out at a number of locations identified along outer cordon, inner cordon and screen lines. Road Network Inventory Survey, Speed and Delay Survey, PT & IPT User and Operator Survey were also conducted. In addition, household travel survey covering about 12000 households was conducted in the study area. A detailed analysis of these surveys was presented in the Phase I Report. This section briefly highlights the major findings of the analysis of these surveys.

### 2.3.1 Passenger Car Units

In the present context PCU factors recommended for urban areas would be applicable. Thus the PCU values recommended for urban conditions have been used in the present analysis. The passenger car unit factors are presented in **Table 2.5**.

**Table 2.5 Passenger Car Unit Factors**

| Vehicle Type | PCU Factor |
|---|---|
| Two Wheeler | 0.50 |
| Auto Rickshaw | 0.75 |
| Car/Jeep/ Van | 1.00 |
| Tempo/ LCV | 1.50 |
| Mini Bus | 2.00 |
| Bus/2 Axle & 3 Axle Trucks | 3.00 |
| Multi Axle Vehicles | 4.50 |
| Ag. Tractor & Tractor Trailer | 4.00 |
| Animal/Hand Drawn | 4.50 |
| Bicycle | 0.50 |

### 2.3.2 Average Daily Traffic (ADT)

An assessment of average daily traffic provides an insight into following aspects.

- ❖ Intensity of traffic on various corridors in the study area.
- ❖ Temporal and spatial characteristics of traffic movement in and out of city, which is important from planning point of view.

The traffic characteristics have been studied at five levels a) Outer cordon b) Inner cordon c) Screen Line 1 d) Screen Line 2 and e) Screen Line 3. Following sections briefly describe traffic characteristics at these levels.

***Outer Cordon***

On an average 1,33,028 Vehicles (1,56,835 PCUs) are entering and leaving SUDA area every day as observed at the outer cordon locations. **Table 2.6** presents the average daily traffic intensity at the outer cordon locations. Bardoli Road (Bardoli Road & NH8 Crossing), Surat-Kamrej Road (Kamrej Road & NH8 crossing) and Hazira Road (near Ichhapore Village) account for 55.6% of the total entering and leaving traffic. Among the 10 (ten) radial roads, Bardoli Road carries maximum traffic (20.00%) followed by Surat Kamrej Road (19.19%).

No major imbalance in directional distribution has been observed across different outer cordon locations. Overall the directional distribution for all the locations put together is 49.25% in favour of incoming vehicles.

**Table 2.6 Daily Traffic Observed at Outer Cordon Locations**

| Sl. No. | Road Name | Location Name | Vehicles | PCUs | Share in Total (%) | Directional Split | |
|---|---|---|---|---|---|---|---|
| | | | | | | In | Out |
| 1 | Barbodhan Village Road* | Near Segvachhama Village | 2615 | 2865 | 1.83% | 54% | 56% |
| 2 | Dandi Road* | Near Kunkani/ Ambheta Village | 4652 | 4203 | 2.68% | 46% | 54% |
| 3 | Vasvari Village Road* | Near Vasvari Village | 10766 | 11185 | 7.13% | 47% | 53% |
| 4 | Kathor Village Road* | Near Abrama Village | 5793 | 7087 | 4.52% | 48% | 52% |
| 5 | Olpad State Highway | Near Talad Village | 9779 | 11104 | 7.08% | 47% | 53% |

| Sl. No. | Road Name | Location Name | Vehicles | PCUs | Share in Total (%) | Directional Split | |
|---|---|---|---|---|---|---|---|
| | | | | | | In | Out |
| 6 | Surat Kamrej Road | Near Kamrej Road & NH8 Crossing | 26368 | 30092 | 19.19% | 47% | 53% |
| 7 | Palsana Road | Near Palsana Road & NH8 Crossing | 11708 | 18841 | 12.01% | 52% | 48% |
| 8 | Surat Hazira Road | Near Ichhapore Village | 19663 | 25758 | 16.42% | 50% | 50% |
| 9 | Bardoli Road | Near Bardoli Road & NH8 Crossing | 26811 | 31360 | 20.00% | 50% | 50% |
| 10 | Navsari Road | Near Sachin Village | 14874 | 14339 | 9.14% | 46% | 54% |

** 24 hr traffic is estimated from 16 hr traffic using conversion factor.*

***Inner Cordon***

SMC area boundary has been considered as Inner Cordon of the study area. 16 hour Classified Traffic Volume Count has been carried out at all eleven locations on Inner Cordon. All count stations are near to octroi posts of SMC. On an average about 3,37,072 Vehicles (2,71,098 PCUs) are entering and leaving SMC area every day (16 hrs) as observed at the inner cordon locations. The traffic intensity (16 hour) at the inner cordon locations is presented in **Table 2.7**. Puna Octroi and Sarthana Octroi count stations account for 37.23% of the total entering and leaving traffic. Among the eleven octroi count posts, Puna Octroi location carries maximum traffic (20.14%) followed by Sarthana Octroi (17.09%).

**Table 2.7 Traffic at Inner Cordon Count Locations**

| Sl. No. | Road Name | Location Name | 16-hr Traffic | | Share in Total (%) | Directional Split | |
|---|---|---|---|---|---|---|---|
| | | | Vehicles | PCUs | | In | Out |
| 1 | Athva Dumas Road | Rundh Octroi | 34893 | 26974 | 9.9% | 45% | 55% |
| 2 | Magdalla Road | Magdalla Octroi | 14394 | 12922 | 4.8% | 46% | 54% |
| 3 | Amroli Road | Amroli Octroi | 63786 | 39843 | 14.7% | 56% | 44% |
| 4 | Pisav Variyav Road | Variyav Octroi | 7445 | 6097 | 2.2% | 37% | 63% |
| 5 | Rander Olpad Road | Saroli Octroi | 10365 | 8829 | 3.3% | 53% | 47% |
| 6 | Palanpore Road | Palanpore Octroi | 15544 | 9147 | 3.4% | 45% | 55% |
| 7 | Adajan Hazira Road | Pal Octroi | 14140 | 14471 | 5.3% | 64% | 36% |

| Sl. No. | Road Name | Location Name | 16-hr Traffic | | Share in Total (%) | Directional Split | |
|---|---|---|---|---|---|---|---|
| | | | Vehicles | PCUs | | In | Out |
| 8 | Bardoli Road | Puna Octroi | 54232 | 54610 | 20.1% | 48% | 52% |
| 9 | Varachha Road | Sarthana Octroi | 53004 | 46319 | 17.1% | 38% | 62% |
| 10 | Dindoli Main Road | Dindoli Octroi | 20257 | 13607 | 5.0% | 48% | 52% |
| 11 | Udhana-Navsari Road | Unn Octroi | 49012 | 38280 | 14.1% | 48% | 52% |

***Screen Lines***

***Screen Line 1***

An imaginary line running North-South along the railway line and passing through the Surat city has been taken as *Screen Line 1* for understanding traffic movement pattern in the City. 16 hours classified traffic count survey has been conducted at the five screen line points of *Screen Line 1*.

On an average 3,73,901 Vehicles (2,51,238 PCUs) cross the *Screen Line 1*. Among all count locations on *Screen Line 1*, Sahara Darwaja underpass alone accounts for 36.53% followed by Suryapur Gate underpass with 29.64% traffic. Out of the 5 screen line points, traffic at Aswini Kumar crematorium underpass is the lowest with only 21,972 vehicles (5.84%). Traffic observed at *Screen Line 1* count stations is presented in **Table 2.8**.

**Table 2.8 Traffic Observed at Screen Line 1**

| Sl. No. | Location Name | 16hr Traffic | | Share in Total (%) | Directional Split | |
|---|---|---|---|---|---|---|
| | | Vehicles | PCUs | | In | Out |
| 1 | Sumul Dairy ROB | 73429 | 42776 | 17.0% | 55.13% | 44.87% |
| 2 | Sahara Darwaja | 122683 | 91786 | 36.5% | 47.70% | 52.30% |
| 3 | Suryapur Gate Underpass | 116188 | 74475 | 29.6% | 54.46% | 45.54% |
| 4 | Lambey Hanuman Road Underpass | 38880 | 27219 | 10.8% | 64.18% | 35.82% |
| 5 | Aswini Kumar Crematorium Underpass | 22721 | 14982 | 6.0% | 40.80% | 59.20% |

***Screen Line 2***

*Screen Line 2* is an imaginary line running parallel to the Tapi River. Classified traffic volume count survey has been conducted at all six locations of Screen Line 2. 16-

hour traffic count has been carried out at all locations except at Rander Causeway, Magdalla Bridge and Savji Korat Bridge where 12 hour traffic count has been done. The summary of findings from the volume count survey analysis is presented in **Table 2.9**. Total traffic crossing *Screen Line 2* is 3,04,015 Vehicles (2,01,959 PCU). Maximum traffic on *Screen Line 2* has been observed at Sardar Bridge (34.56%) followed by Nehru Bridge (27.88%).

**Table 2.9 Traffic Observed at Screen Line 2**

| Sl. No. | Location Name | 16hr Traffic | | Share in Total (%) | Directional Split | |
|---|---|---|---|---|---|---|
| | | Vehicles | PCUs | | In | Out |
| 1 | Nehru Bridge | 91831 | 56301 | 27.9% | 54.93% | 45.07% |
| 2 | Savji Korat Bridge * | 17903 | 12882 | 6.4% | 42.81% | 34.11% |
| 3 | Magdalla Bridge * | 10688 | 13787 | 6.8% | 35.10% | 41.82% |
| 4 | Rander Causeway * | 29547 | 17327 | 8.6% | 41.83% | 35.09% |
| 5 | Vivekananda Bridge | 49307 | 31861 | 15.8% | 48.70% | 51.30% |
| 6 | Sardar Bridge | 104739 | 69801 | 34.6% | 50.31% | 49.69% |

** 16 hr traffic is estimated from 12 hr traffic using conversion factor.*

***Screen Line 3***

*Screen Line 3* is an imaginary line running parallel to the Ring Road. Classified traffic volume count survey has been conducted at all four locations for 16 hours on this screen line. The summary of findings from the volume count survey analysis is presented in **Table 2.10**. The total traffic (16 hours) crossing *Screen Line 3* is 3,92,524 Vehicles (2,69,531 PCU). Maximum traffic was observed at Athwa Gate (34.41%) followed by Udhana Darwaja (31.91 %).

**Table 2.10 Traffic Observed at Screen Line 3**

| Sl. No | Location Name | 16hr Traffic | | Share in Total (%) | Directional Split | |
|---|---|---|---|---|---|---|
| | | Vehicles | PCUs | | In | Out |
| 1 | Katargam Gate | 65851 | 48258 | 17.9% | 56.76% | 43.91% |
| 2 | Athwa Gate | 144641 | 92741 | 34.4% | 54.60% | 45.85% |
| 3 | Ved Road | 69153 | 42536 | 15.8% | 59.60% | 41.06% |
| 4 | Udhana Darwaja | 112879 | 85995 | 31.9% | 66.46% | 33.54% |

### 2.3.3 Traffic Movement Pattern

In order to understand pattern of the traffic entering/leaving the study area, Consultants have conducted Origin-Destination surveys for 24 hours simultaneously with the Classified Traffic Volume Count survey at 6 outer cordon locations. In this section, travel desire characteristics, purpose of travel, loading pattern of freight vehicles etc. observed at outer cordon locations are discussed.

#### 2.3.3.1 Travel Pattern of Passenger Vehicles

Travel pattern varies largely amongst different locations. **Table 2.11** presents the location wise travel pattern of passenger traffic at the outer cordon. As can be observed from the table, through traffic is more predominant on Palsana Road (27.67%), Hazira Road (14.12%) and Olpad State Highway (7.17%).

Over all the surveyed locations, average share of Internal to External, External to Internal and External to External traffic was observed to be 47.44%, 44.49% and 7.78% respectively. Proportion of through passenger traffic observed at various locations of outer cordon is shown in **Figure 2.2**. Comparatively high percentage of through passenger traffic was observed on Palsana Road (27.67%) and Surat Hazira Road (14.12%). The desire line diagrams for public transport (including IPT) and private vehicles are presented in **Figure 2.3** and **2.4** respectively.

**Table 2.11 Travel Pattern of Passenger Vehicles at Outer Cordon**

| Location Name | Internal - External | External - Internal | External - External |
|---|---|---|---|
| Olpad State Highway | 38.68% | 54.15% | 7.17% |
| Surat Kamrej Road | 56.97% | 40.80% | 2.22% |
| Palsana Road | 37.26% | 35.07% | 27.67% |
| Surat Hazira Road | 46.04% | 39.84% | 14.12% |
| Bardoli Road | 47.43% | 45.03% | 7.54% |
| Navsari Road | 41.04% | 52.05% | 6.91% |

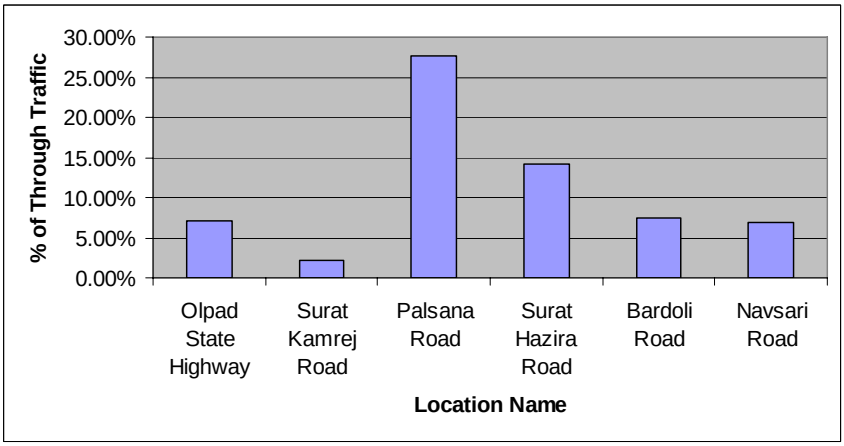



**Figure 2.2 Proportion of Through Passenger Traffic at Outer Cordon Locations**

### 2.3.3.2 Travel Pattern of Freight Vehicles

***Travel Pattern***

Data collected from Origin-Destination survey has been analysed to study the travel pattern of freight vehicles at the outer cordon. **Table 2.12** present the movement pattern of freight vehicles. Proportion of through freight vehicle traffic observed at various locations of outer cordon is shown in **Figure 2.5.** Desire Line diagram for commercial vehicles is shown in **Figure 2.6.**

**Table 2.12 Location wise Travel Pattern of Freight Vehicles**

| Location Name | Internal - External | External - Internal | External - External |
|---|---|---|---|
| Olpad State Highway | 29.34% | 27.41% | 43.24% |
| Surat Kamrej Road | 43.13% | 52.20% | 4.67% |
| Palsana Road | 21.50% | 26.30% | 52.21% |
| Surat Hazira Road | 16.74% | 17.89% | 65.37% |
| Bardoli Road | 29.76% | 34.41% | 35.83% |
| Navsari Road | 31.22% | 51.85% | 16.93% |

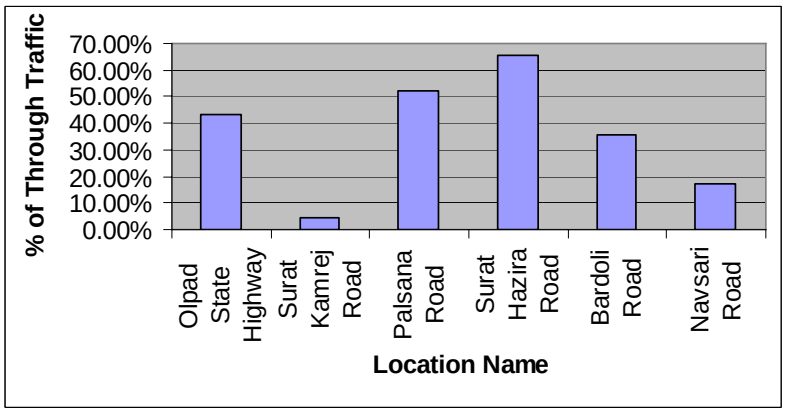



**Figure 2.5 Proportion of Through Freight Traffic at Outer Cordon Count Locations**

On analysing the percentage through traffic, the following inferences have been made:

- Usually, on regional roads, the major traffic composition is truck traffic and most of this traffic is usually through traffic. It can be observed from the table that the through traffic component at all locations range from 4.67% to 65.37%. Maximum through traffic was observed on Hazira Road (65.37%) and minimum on Kamrej NH8 crossing (4.67%). Through traffic share was more because most of the traffic coming from Olpad or National Highway is destined to the Hazira Industrial area, which is located outside study area.
- The average composition of External to External, External to Internal and Internal to External freight traffic at all the cordon locations was 38.04%, 33.50% and 28.46% respectively.

Mode-wise Travel pattern of freight vehicles is presented in **Table 2.13**. The average share of 2 Axle (33.17%) and Multi Axle Trucks (77.78%) was maximum in through traffic (External-External).

**Table 2.13 Mode-wise Travel Pattern of Freight Vehicles at Outer Cordon**

| Location Name | Internal - External | External - Internal | External - External |
|---|---|---|---|
| LCV | 38.96% | 43.31% | 17.73% |
| 2 Axle Truck | 28.40% | 38.43% | 33.17% |
| 3 Axle Truck | 19.66% | 14.83% | 65.52% |
| Multi Axle Truck | 15.08% | 7.14% | 77.78% |
| Tractor | 59.09% | 22.73% | 18.18% |

### 2.3.4 Speed and Delay Characteristics

For the present study all major and important minor roads of road network in the study area were identified for carrying out the Speed and Delay study. The survey was carried out during peak and off peak periods using Moving Car Observed Method. The data collected was analysed to assess the speed characteristics along the identified road network and identified locations of delay and extent of delay. A detailed analysis of the speed and delay survey including the spatial speed profile of the study area was made and presented in the Phase I Report. The results of these speed and delay survey along with the network inventory survey were used in preparing the composite transport network of the study area.

## 2.4 Household Travel Survey

An appreciation of the demographic, socio-economic and travel characteristics of the city is essential to understand the travel needs of the people, their propensity to travel, preferences for travel modes, ability and willingness to pay for travel and their desire for travel within this area. To obtain the required information for the study area, household travel surveys were conducted. The necessary details were collected by engaging trained investigators and through pre-designed survey questionnaire. The following details were derived from the survey data.

- Household characteristics, including vehicle ownership details, income and expenditure pattern
- Personal characteristics of the trip maker
- Trip characteristics
- Opinion Survey on Existing Transport System
- Willingness-to-Pay

**Data Analysis**

Household survey data analysis gives an appreciation of the demographic, socio-economic and travel characteristics of residents of the study area. It is important to understand the travel needs of the people, their propensity to travel, preferences for travel modes, ability to pay for travel and their desires of travel within the area. Such an understanding helps in rational policy formulation, decision making and in identification of relevant transport system to serve the area.

For the present study, household travel survey was carried out for 12000 households, spread over 154 Traffic Analysis Zones to gather necessary socio-economic and travel characteristics. The household data collected as a part of the field surveys, has been analysed under the following heads:

i) Socio-economic characteristics
ii) Personal characteristics, and
iii) Trip characteristics

In order to appreciate the socio-economic and travel characteristics at a micro level the data has been analysed at four spatial levels within the study area. These are:

1. Walled City
2. SMC area (including Walled City)
3. SUDA Area (excluding SMC area)
4. Study Area

In addition, characteristics at the zonal level have also been analysed.

### 2.4.1 Household Socio-Economic Characteristics

**Household Size**

Average household size in the study area was observed to be 4.43. The distribution of households by size, at the three spatial levels and the study area is shown graphically in **Figure 2.7**. It can be observed that 78.02 percent of households have household size between 3 and 6.

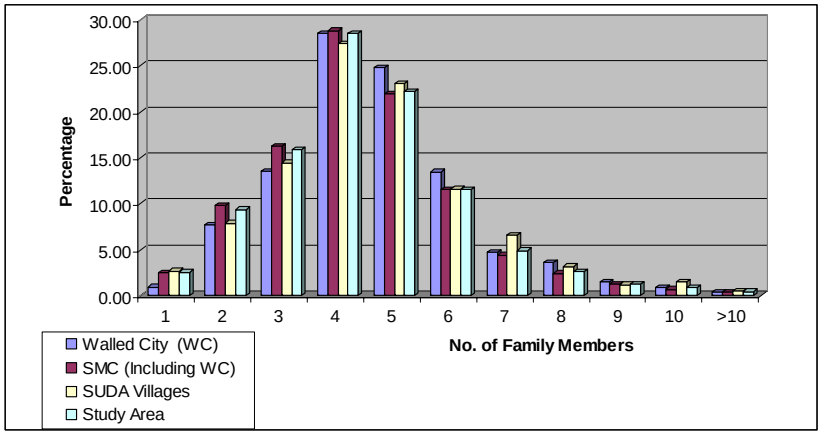



**Figure 2.7 Distribution of Households by Size**

### Household Income

Average household income in the study area was found to be Rs. 8182 per month. The distributions of households under various income groups reveal that majority of the households (43.27%) fall within an income range of Rs. 5001-10000 per month.

The distribution of households under different income groups. Indicate that SMC (Including Walled City) area exhibit higher incomes compared to SUDA Village area. Average Per Capita Income (PCI) in Walled City, SMC (Including Walled City), SUDA Village areas were observed to be Rs. 8487, Rs. 8342 and Rs.7649 per month respectively.

It is observed that Walled City has fewer low-income households and more middle-income households, while SUDA villages have more of low-income households than other areas. Further, SUDA villages have fewer middle-income households than other areas.

### Vehicle Ownership

Average vehicle ownership rate in the study area was observed to be 0.65 vehicles per household in case of motorized vehicles (two wheelers and car/jeep) and 1.06 vehicles per household when bicycles are also taken into consideration**.** The Car ownership rates are much lower in comparison to two wheeler and cycle ownership.

**Household Monthly Expenditure Pattern**

Household expenditure analysis gives an idea on relative priority a household of certain income category attaches to the expenditure on transport vis-à-vis expenditure on other activities.

Household expenditure in the study area shows that expenditure on food accounts for the maximum proportion (54.11%) of total household expenditure followed by others (16.31%) and transport (13.22%). It was also observed that on an average a household in the study area spends about Rs. 589 per month on transport, which is nearly 13.2 percent of total household expenditure. Nearly 37.2 percent of households spend between Rs. 300 and Rs. 800 on traveling.

In terms of transport expenditure SUDA villages spend 15.10% of household expenditure on transport while SMC spends 12.71% only. Thus SUDA villages have lesser income, but more Transport Expenditure.

As regards the variation in monthly travel expenditure with respect to monthly household income, the average expenditure on travel increases with increase in income in absolute terms i.e. Rs 265 with income upto Rs 3000 and Rs 1481 with income exceeding Rs 20,000. However, percentage share of household income, for travel decreases with increase in income levels.

### 2.4.2 Personal Characteristics

**Age Structure**

Population distribution under different age groups reveals that majority of the population (46.85 percent) in the study area is in the age group of 18-40 years. Population under working age group (18 - 60 years) constitutes about 64.75 percent within the total population. **Figure 2.8** shows the population distribution under different age groups in the study area.

It is observed that population below 5 years of age constitute about 8.41 percent, whereas population over 60 years comprise about 3.89 percent of the total population within study area.

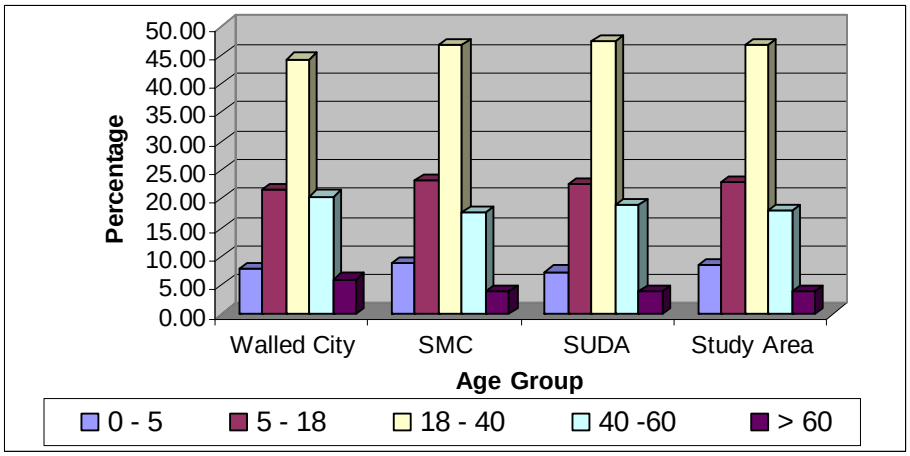



**Figure 2.8 Age Structure of the Study Area**

### 2.4.3 Travel Characteristics

Data on trip information has been analysed with a view to assess the travel characteristics and trip pattern in the study area. The travel and socio-economic characteristics will form the basis for developing the travel demand model for the study area.

**Total Trips**

An estimated 62,545 trips were preformed on an average day by 12000 households, out of which contribution of Walled City, SMC (Including Walled City), and SUDA Villages was 15.9 percent, 76.2 percent and 23.8 percent respectively. Out of all the trips, home based trips accounted for 85% while non-home based trips accounted for the rest 15%.

**Per Capita Trip Rate**

The overall per capita trip rate (PCTR) observed in the study area was 1.13 while the PCTR excluding walk trips was 0.73. This trip rate is based on the total trips performed by the residents of the Study Area. Spatial Analysis of PCTR reveals that highest PCTR was observed in SMC (Including Walled City) (1.15), followed by Walled City (1.09). SUDA village area recorded the lowest PCTR of 1.06 indicating the prevalence of low-income and low mobility level population. The overall PCTR does not vary significantly over spatial entities of the study area. The spatial variation of PCTR across the study area is shown in **Figure 2.9**.

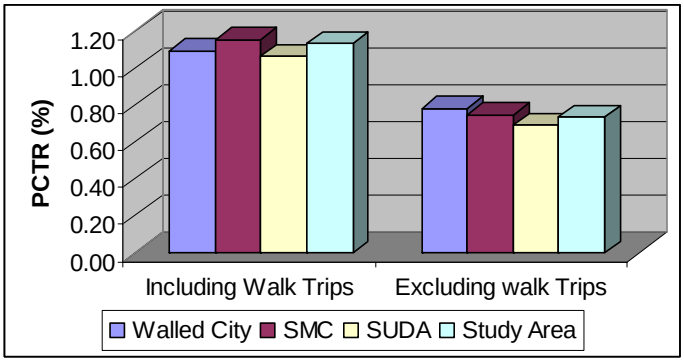



**Figure 2.9 Per Capita Trip Rate**

### Mode of Travel

The distribution of trips amongst different modes is presented in the **Table 2.14** and **Figure 2.10**. Walk trips constitute about 35.28 percent of total trips in the study area. The share of walk trips in total trips is highest in SMC area (35.66%) followed by SUDA Villages (34.09%). Public transport trips are lowest at 0.48 percent in SMC area largely due to absence of public transport bus service.

**Table 2.14 Mode wise Distribution of Trips**

(%)

| Area | Walk | Cycle | Scooter / MC | IPT | Car / Jeep | PT | Other | Total |
|---|---|---|---|---|---|---|---|---|
| **Walled City** | 30.34 | 8.46 | 34.90 | 22.68 | 1.16 | 0.57 | 1.89 | **100.00** |
| **SMC** | 35.66 | 9.70 | 30.12 | 20.42 | 1.26 | 0.48 | 2.36 | **100.00** |
| **SUDA Villages** | 34.09 | 10.47 | 26.71 | 22.74 | 2.15 | 1.96 | 1.88 | **100.00** |
| **Total** | 1 | 9.88 | 29.30 | 20.98 | 1.47 | 0.84 | 2.25 | **100.00** |

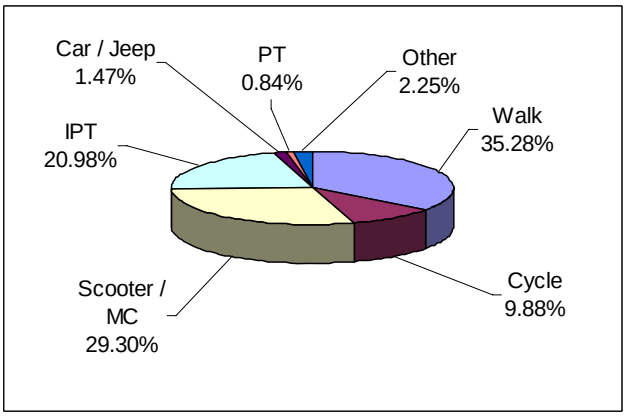



**Figure 2.10 Mode wise Distribution of Trips in Study Area**

### Purpose of Travel

Trip distribution by purpose of travel (**Figure 2.11**) shows that work, education and business trips account for 16.54 percent, 15.51 percent and 13.17 percent of the total trips made in the study area respectively. Shopping trips account for 3.97 percent.

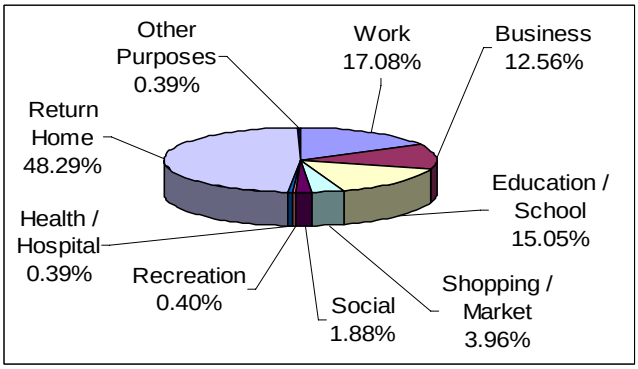



**Figure 2.11 Purpose-wise Distribution of Trips**

### Trip Length

The average trip lengths observed in the study area are 4.11 km and 5.33 km including and excluding walk trips respectively. Trip length frequency distribution (TLFD) shows that majority of the vehicular trips have trip lengths between 1 and 3 km (34.34 percent), followed by 3 to 5 km (25.49 percent). The distribution of trips by trip length is shown graphically in **Figure 2.12**.

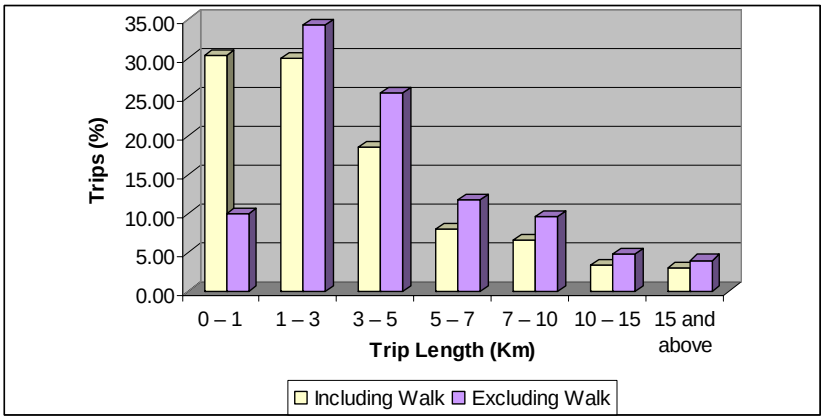



**Figure 2.12 Length-wise Distribution of Trips**

There is a variation in the distribution pattern of trip lengths in SUDA villages and the rest of the study areas. The average trip length (excluding Walk) increases from 4.45 km in Walled City to 7.22 km in SUDA area.

**Purpose and Mode of Travel**

The mode-wise trip distribution of trips by purpose indicates that while walk trips are mainly for education purpose, cycle trips are used for work purpose. Most of the cycle trips are for work purpose and private motorised vehicle trips are mainly for work purpose and business.

The purpose wise distribution of trips across modes reveals that majority of work and business trips (37.89 percent and 50.07 percent respectively) are performed by private motorised vehicles, while 55.19 percent of education trips are performed by walk. The major modes for shopping trips are walk (47.00 percent), PT/IPT (29.96 percent) and private motorised vehicles (19.70 percent).

**Purpose and Trip Length Relationship**

The distribution of trips by purpose and trip length reveals that 81.01 percent of work trips and 84.60 percent of business trips are confined upto a distance of 5 km while 91.62 percent of the education trips are within a distance of 5 km.

## 2.5 Other Surveys

In addition to the above surveys, public transport and IPT operators & users survey, including rail passenger survey were conducted. The analysis of these surveys was presented in the Phase I Report.

# CHAPTER 3.0
# Travel Demand Modelling and Forecasting

## 3.1 Preamble

One of the principal steps in the Urban Transport Planning System (UTPS) is the establishment of quantifiable relationship between movement (transport) and landuse pattern. In order to establish such a relationship Conventional Urban Transport Planning System is used to simulate the travel behaviour pattern of the residents of study area. Consultants used CUBE (TRIPS) – an advanced transport planning software to develop the conventional four-stage transport planning system.

Consultants have constructed and validated travel demand models and forecasted the traffic using the projected planning variables and the validated models. The forecast had been made for two horizon years 2016 & 2026. The details regarding generation of base year trip matrices based on various traffic surveys carried out and the secondary data were presented in detail in the Phase I Report (October 2006). The trip generation, distribution and traffic assignment models developed for the present study were also covered under Phase I Report. This chapter presents a brief summary of the travel demand models developed as well as the travel demand forecast for the identified scenarios and the assessment of demand-supply gap and corridor analysis.

## 3.2 Study Area and Delineation

The study area is *Surat Urban Development Authority (SUDA),* which covers an area of about 722.0 sq. km. The study area includes areas within Surat Municipal Corporation (SMC) and 130 villages in the peripheral area. Surat Municipal Corporation (SMC) area is spread over an area of 112.28 sq. km and had a total population of 24.34 lakhs in 2001. The population of Surat Urban Development Authority area (excluding Surat Municipal Corporation) in the year 2001 was 6.57 lakhs and the total population of study area in 2001 was 30.90 lakhs

For better understanding of the travel pattern, a total of 160 zones called Traffic Analysis Zones (TAZs) were identified in the Study Area. Of these, 154 zones are within the study area and the rest 6 are external zones covering rest of Gujarat and India. For ease of understanding the travel behavior of traffic entering and leaving Surat urban area, the study area (160 TAZs) was grouped into three parts.

| | |
|---|---|
| SMC Area | 102 TAZs |
| SUDA Area (excluding SMC area) | 52 TAZs |
| External Traffic Zones | 6 TAZs |

For the purpose of this study, year 2006 was taken as the base year. Two horizon years viz. 2016 & 2026 were considered for which all the travel demand forecasting was carried out.

## 3.3 Transport Network

### 3.3.1 Base Year Transport Network

The base year transport network was prepared using the network inventory survey and other secondary data. The traffic management measures like one-way road links, restrictions to truck movement were collected and used in developing the composite transport network. The different types of links in the study area network and their characteristics along with their capacity, speed at free flow & at capacity and parameters of speed-flow function were presented in Phase I Report.

The speed-flow relationship considered for the present study has the following functional form:

$$V = V_f(1-\alpha(e^{\beta \ln(q/c)}))$$

Where,

V Speed at iteration *i*
$V_f$ Free Flow Speed
c Link Capacity
$\alpha$, $\beta$ Speed-flow Parameters
q Flow at iteration i

Public Transport Network includes all roads on which public transport buses operate as well as the local rail network. In addition, in this study, auto rickshaw was considered as a part of public transport and was made available on all the road links by suitably marking the routes for the mode. The base year transport network is shown in **Figure 3.1**.

### 3.3.2 Horizon Year Transport Network

The composite transport network for the future years was prepared by incorporating the additional links (roads) that were proposed by various planning authorities. Major road network improvements proposed by SMC and SUDA viz. bridges across river Tapi, ROBs and flyovers were considered in the horizon years' transport network. The horizon years' network included:

- Bridge between Ved-Jahangirpura on River Tapi
- Bridge between Atwalines – Adajan on river Tapi
- Bridge between Ved – Variav
- Bridge on River Tapi near Valak (part of Outer Ring Road)
- Flyover on Delhi Gate Junction on Ring Road
- Flyover on Gujarat Gas circle, Adajan Road
- Flyover on Parle Point junction
- Flyover on Canal Road near Puna Kumbharia Octroi naka
- Flyover on Canal Road at Kharwarnagar near Surat – Navsari Road junction
- Flyover near Nana Varachha
- Flyover near City Lights Road Junction
- ROB at Sachin, Kosad and Gothan (part of Outer Ring Road)

As proposed in the Development Plan, completion of Outer Ring Road of 66 km length was considered in the horizon years' network. Out of the 66 km, 44 km is already existing and considered in the base year transport network. The improvement of this existing road section to 4-lane road was also considered in the horizon year network

A road of about 8.9 km along the Canal within SMC limits from Udhna Magdalla Road to Puna Jakat Naka is proposed to be developed as a high quality cement concrete road with all street furniture, including improvement of intersections along the major linkage roads. This Canal Road is considered in the horizon years' transport network. **Figure 3.2** shows the horizon year transport network for the study area.

## 3.4 Generation of Trip Matrices

Various primary traffic and transportation surveys, including household travel surveys, were conducted to assess the base year traffic and travel characteristics in the study area. Home Interview (Household Travel) Survey was conducted to obtain the socio-economic and travel characteristics of resident population. Outer cordon O-D surveys were conducted to assess the intercity travel demand and its characteristics. Opinion surveys were conducted to understand the mode choice preferences of the travelling

public. The details of these primary surveys and their analysis were detailed in Phase I Report.

Household Travel Survey provides the basic information on the household demographic and socio-economic characteristics, individual trip-information and stated preference regarding the existing transport system. The details of the analysis of household travel survey were presented in detail in Phase I Report. Using the zonal expansion factors, the sample trip matrices were expanded to reflect the trip distributions of the zonal population. Data of O-D surveys carried out at outer cordon locations was used in strengthening the trip matrices, particularly the internal-external and external-external trips. The trips performed by non-residents, entering/ leaving the study area by train were included in the base year passenger trip matrix based on the rail passenger survey conducted at Surat Railway Station.

The summary of base year travel pattern is presented in **Table 3.1.** A total of **46,07,637** trips are generated in a day in the study area, out of which about 16.50 lakh trips are intra-zonal. The modal share of base year travel (excluding intra zonal trips) is shown in **Figure 3.3**. It may be observed from Figure 3.3 that the maximum proportion of passenger trips are performed by two wheelers (35%) followed by IPT (23.9%). The proportion of trips made by Bus is about 6.5%. This proportion includes inter-city trips which are about 60% of the total bus trips. The intra-city bus trips include GSRTC buses, school buses, buses operated by private agencies, etc.

**Table 3.1 Base Year Travel Pattern (Person Trips)**

***Including Intra-Zonal Trips***

| | Walk | Car | Two Wheeler | IPT | Bus | Cycle | Total |
|---|---|---|---|---|---|---|---|
| I-I | 1544148 | 80080 | 1241191 | 887966 | 105699 | 423617 | 4282700 |
| I-E | | 51662 | 38332 | 19339 | 50742 | | 160075 |
| E-I | | 33625 | 37311 | 20668 | 54983 | | 146587 |
| E-E | | 4714 | 3320 | 2126 | 8116 | | 18275 |
| **Total** | **1544148** | **170081** | **1320153** | **930098** | **219540** | **423617** | **4607637** |

***Excluding Intra-Zonal Trips***

| | Walk | Car | Two Wheeler | IPT | Bus | Cycle | Total |
|---|---|---|---|---|---|---|---|
| **I-I** | 577352 | 59062 | 955056 | 664270 | 79060 | 298042 | 2632842 |
| **I-E** | | 51662 | 38332 | 19339 | 50742 | | 160075 |
| **E-I** | | 33625 | 37311 | 20668 | 54983 | | 146587 |
| **E-E** | | 4714 | 3320 | 2126 | 8116 | | 18275 |
| **Total** | **577352** | **149062** | **1034018** | **706403** | **192901** | **298042** | **2957779** |

*I-I - Internal to Internal, I-E - Internal to External, E-E- External to External*

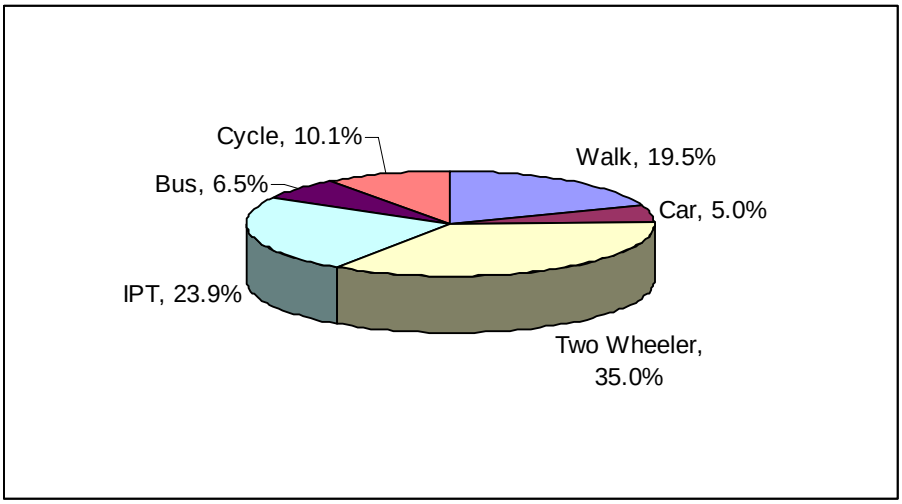



**Figure 3.3 Modal Share of Base Year Travel**

## Commercial Vehicle Matrix Estimation

Base year CV matrix was estimated from link counts. Daily directional volumes of commercial vehicles were available on 15 links within the study area and eleven links at the inner cordon (from the primary traffic surveys). These links were spread all over the study area. Using the matrix estimation module of CUBE (TRIPS) package, which works on the principle of entropy maximization, a reasonable estimate of the daily CV matrix was obtained. The total number of daily commercial vehicle traffic for the base year thus obtained for the entire study area is 167016 PCUs. The future CV matrices were obtained by applying appropriate growth factors and by furnessing. The estimated total commercial vehicle traffic for the horizon years 2016 and 2026 is 2,84,890 PCUs and 4,42,374 PCUs respectively.

## 3.5 Population and Employment Forecast

The population estimates made by the National Commission on Population have been used as the basis for projecting the future population of the study area. The forecasted population was tested for consistency of growth rates and the shares are adjusted to ensure consistency. The estimated population for SMC and SUDA are 34.83 lakhs and 14.46 lakhs respectively for the year 2016.The estimated population in the study area for the horizon year 2026 is 62.45 lakhs.

In absence of the trend data for employment, the household survey carried out as part of the present study was used to estimate total employment and distribution across various sectors. The estimated employment in the study area is 18.06 lakhs and 21.85 lakhs for the horizon years 2016 & 2026 respectively. The detailed procedure adopted for the population and employment forecast was presented in Phase I Report.

## 3.6 Travel Demand Models

For the present study, four stage sequential modelling approach consisting of trip generation, trip distribution, modal split and traffic assignment modules has been adopted.

Trip end models viz. trip production and trip attraction models were developed utilizing the trip ends derived from the base year mode wise trip matrices and the base year planning variables using Multiple Linear Regression Technique. The trip generation equations developed for various geographical areas of the study area (SMC, SUDA, SMC+SUDA) were presented in the Phase I Report.

In the study area, as the modal choice is mostly influenced by household income, a pre-distribution stage modal split was felt appropriate and the same was adopted.

At pre-distribution stage, separate trip generation equation for different modes are adopted. It is also called the Trip End Modal Split Model. It assumes that the major determinants of public transport patronage are socio-economic characteristics of trip makers and does not consider transport system characteristics.

This model is more appropriate in case where public transport is inadequate and trip makers are captive. It is usually relevant in small and medium size towns.

The observed modal share in the base year is as under:

| | |
|---|---|
| Cycle | : 13 % |
| Private Modes | : 50 % |
| Public Mass Transport (including IPTs) | : 38 % |

Considering rapid growth in household income, change in vehicle ownership pattern, and availability adequate public transport system in the study area, it has been assumed that, there will be considerable shift from cycle & personal vehicles to public transport and cycle to personal vehicles in the horizon year.

Adopted modal shift in the Horizon years is as under:

*Horizon year 2016*

15% of person trips by Cycle shift to Public Transport
15% of person trips by Private Vehicles shift to Public Transport

*Horizon year 2026*

15% of person trips by Cycle shift to Public Transport
20% of person trips by Private Vehicles shift to Public Transport

The above aspects were considered while forecasting the horizon years' mode-wise trip matrices.

A gravity type trip distribution model was calibrated for the intra city trips performed by the residents of the study area for synthesizing the trip interchanges. Generalised cost/time (fare/vehicle operating cost and time cost of passengers) was considered as the deterrence parameter for the calibration of gravity model. The calibrated gravity model was used in distributing the mode-wise future travel demand.

Regarding the traffic assignment, a capacity restrained assignment technique was used. The sequence of steps involve in this technique is:

1) Minimum path trees were constructed for all origin zones based on travel times computed from average speeds under typical urban conditions.
2) Interzonal volumes were assigned to the minimum path tree on all or nothing basis.

3) Link travel times were recalculated using the speed flow curves.
4) New minimum path trees were constructed using the new travel times calculated in the previous step.
5) Inter-zonal trips were then assigned on all or nothing basis to new minimum path trees.
6) Return to step 3, until equilibrium occurred or until some predetermined cut off point was reached.

Conversion of passenger trip matrix into peak hour vehicular trip matrix was done by using the average occupancy for each passenger mode and the peak hour traffic as a percentage of total traffic. Capacity restrained assignment technique using CUBE software was adopted for the present study. The unit VOT and VOC values were based on the DPR study for Ahmedabad Metro carried out in 2005 by M/s Delhi Metro Rail Corporation (DMRC).

### 3.6.1 Model Validation

The model will be termed as validated once the traffic loadings on to the network match with the observed traffic at the selected check points termed as screen lines on the road network. Classified traffic volume counts were carried out at these locations. The traffic assignment was carried out in the following sequence:

- Commercial Vehicles
- Public Transport Trips
- Private Vehicles Trips

After assignment of each mode matrix, the network speeds have been updated. After assigning of all modes on to the network, the assigned traffic streams were compared with those observed on ground along the screen lines. The model depicted or reflected the traffic pattern on the city's road network accurately.

## 3.7 Forecasting of Trip Matrices

The details of forecasting process are reported in the following sub-sections.

### 3.7.1 Forecasting of O-D Matrices

The calibrated trip end equations for the daily person trips made within the study area were applied on the projected planning variables for the horizon years (2016 and 2026) to get the future trip ends of intra-city trips. These future year trip ends were distributed by applying the calibrated gravity distribution model with the previous cost skims available for the initial run (i.e., the base year cost skims were used for estimating travel pattern of 2016). Public transport matrix included person trips made by bus, IPT train, cycle and walk modes.

The daily travel demand by person trips (excluding Walk) estimated using the trip generation equations and the future planning variables is presented below:

Horizon Year 2016

| | |
|---|---|
| Total person trips per day | : 37,91,315 |
| Total person trips per day (PT&IPT) | : 13,70,308 |
| Total person trips per day (PV) | : 17,88,641 |
| Total person trips per day (Cycle) | : 6,32,366 |

Horizon Year 2026

| | |
|---|---|
| Total person trips per day | : 51,72,162 |
| Total person trips per day (PT&IPT) | : 19,19,291 |
| Total person trips per day (PV) | : 24,03,233 |
| Total person trips per day (Cycle) | : 8,49,638 |

### 3.7.2 Forecasting of Inter-City Trips

All the trips except the intra-city trips were modelled using mode-wise growth factors. The mode-wise growth rates were obtained based on past traffic data and other secondary data. The mode-wise growth rates are presented in **Table 3.2.**

**Table 3.2 Growth Rates for Inter City Traffic**

(%)

| Period | 2 Wheeler | Auto | Car | Bus | Truck |
|---|---|---|---|---|---|
| 2006-2011 | 5.0% | 4.0% | 5.0% | 4.0% | 6.0% |
| 2012-2016 | 5.0% | 4.0% | 4.5% | 4.0% | 5.5% |
| 2017-2021 | 4.0% | 3.0% | 4.0% | 3.0% | 5.0% |
| 2022-2026 | 3.0% | 3.0% | 3.0% | 3.0% | 4.0% |

Truck O-D matrix and mode-wise external PV and PT&IPT trips (inter-city trips) were forecasted using zonal growth factors and by furnessing. The cost skims used in gravity distribution model were revised using the ones obtained by assigning the public transport trips and highway trips on to their respective networks. The cost/time skims obtained using the final stabilized link cost information was used to get the final mode wise O-D matrices of person trips.

The travel pattern including intra-city and inter city trips for various horizon years is reported in **Table 3.3**.

**Table 3.3 Estimated Future Trips**

| Mode | 2016 | 2026 |
|---|---|---|
| PV (PCUs) | 543522 | 683877 |
| PT&IPT (Passengers) | 1615697 | 2281184 |
| Cycle (PCUs) | 237139 | 318615 |
| CV (PCUs) | 284890 | 442374 |

The flow chart in **Figure 3.4** shows the methodology adopted for traffic forecast for various horizon years.

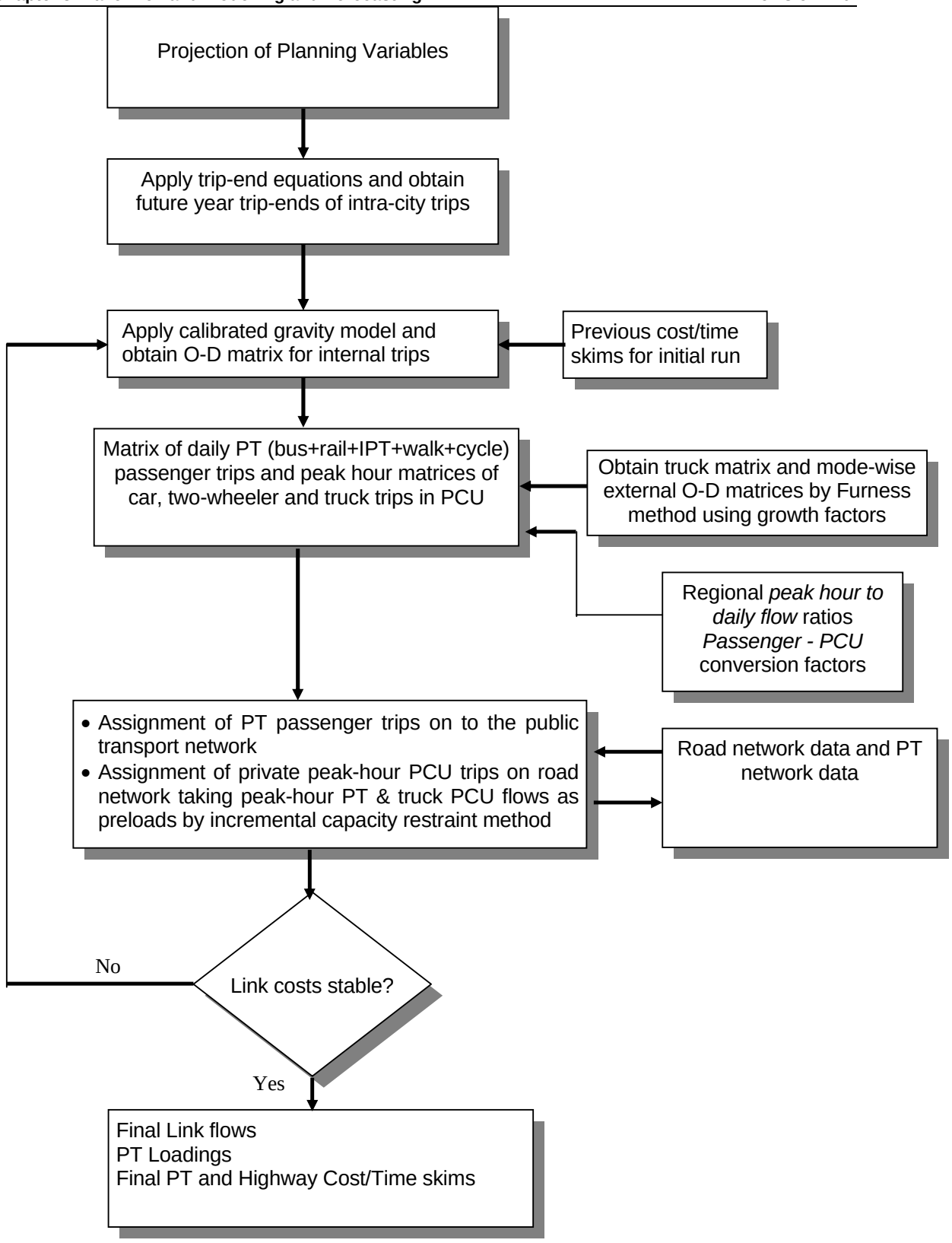



**Figure 3.4 Forecasting of Traffic**

## 3.8 Travel Demand Forecast

The future trip matrices of year 2016 and 2026 were assigned to the horizon year networks using capacity constraint technique in an incremental fashion. The trips between two OD pairs are assigned on to the alternate paths between them based on the generalised time/ cost of travel along the paths. The generalised cost is taken as sum of time cost (both in-vehicle and out-vehicle travel time costs), direct travel cost (fare in case of public transport and IPT, and vehicle operating cost for private and commercial vehicles). The traffic assignment was carried out and the travel demand forecast was made for the horizon years 2016 and 2026.

The details of forecasting process are reported in the following sub-sections.

***Traffic Assignment: Public Transport Assignment***

The peak hour O-D matrix of public transport passenger trips was assigned on to the public transport network. The public transport network consists of all the road links coded with appropriate characteristics like length, speed, etc. Besides, the existing GSRTC bus service, to meet the future demand, the assignment has been done for various public transport modes and network scenarios.

Scenario I: Only GSRTC bus system in operation, without any proposed public transport (Do Nothing)
Scenario II: Bus Mass Transit routes proposed by Surat Municipal Corporation
Scenario III: Bus Mass Transit routes proposed by Consultants
Scenario IV: Bus Mass Transit routes proposed by Consultants along with BRTS/LRTS along North-South and East-West corridors

*Scenario I: Only GSRTC bus system in operation, without any proposed public transport (Do Nothing)*

This is a *Do Nothing* scenario. In the travel demand modeling, only existing GSRTC bus system in operation has been considered. No improved public transit systems are considered.

*Scenario II: Bus Mass Transit routes proposed by Surat Municipal Corporation*

Recently Surat Municipal Corporation has planned to introduce Bus Mass Transit System (BMTS) on 42 routes with in SMC limits. In this scenario Consultants assessed the passenger demand on all these routes for various horizon years.

*Scenario III: Bus Mass Transit routes proposed by Consultants*

Consultants proposed Bus Mass Transit System on 35 routes inline with SMC proposal. The variation between SMC's and Consultants proposal is mainly routing and segregation of non potential and potential corridors. Some of the routes are extended upto SUDA limits. These routes are planned to serve all the directions of the city. Four major terminal points viz. Surat Railway Station, Chowk, Adajan Patia and Near Udhna Darwaja are identified for these routes.

*Scenario IV: Bus Mass Transit routes proposed by Consultants, along with BRTS/LRTS along North-South and East-West corridors*

In this Scenario, Consultants considered Bus Mass Transit routes as taken in the Scenario II along with Bus Rapid Transit System and Light Rail Transit System. These systems are proposed along North-South & East-West corridors based on the passenger demand for various horizon years. The North-South corridor is between Ved Gam on north side & Unn on south side and East-West corridor is between Kosmada on east side & Rundh on west side.

Different headways, distance based fare structures have been adopted for proposed public transport modes. The proposed public transport (BMTS, BRTS and LRTS) and IPT routes were defined by specifying the links on which these modes traverse. Each route and mode is characterised by its frequency, capacity, crush load, fare table etc. As explained earlier, the public transport assignment was done based on generalised time approach. For initial assignment the network with average speeds as observed in base year was used. The bus passenger link loadings and IPT passenger link loadings obtained after public transport assignment were transferred on to the road network as peak hour PCU flows by employing appropriate passenger-PCU conversion factors.

Public transport assignment was been carried out for the four public transport network scenarios. The assigned peak hour passenger flows and route wise PHPD for Scenario IV for the horizon years 2016 and 2026 are presented in **Table 3.4** and **Table 3.5** respectively.

**Table 3.4 Hourly Passenger Loading (Scenario IV)**

| Route No. | BMTS Corridor | Passenger Loading | |
|---|---|---|---|
| | | 2016 | 2026 |
| 1 | Railway Station to Navayug College, Housing Board, Rander, Jahangirpura | 6548 | 8901 |

| Route No. | BMTS Corridor | Passenger Loading | |
|---|---|---|---|
| | | 2016 | 2026 |
| 2 | Railway Station to Chowk – Ichahanath | 2117 | 2730 |
| 3 | (Surat Stn.)Wadi Faliya to Uan Patiya | 2703 | 3756 |
| 4 | Station to Virkavi Narmad (South Gujarat) University | 2182 | 2860 |
| 5 | Udhna Station to Virkavi Narmad University | 2502 | 3285 |
| 6 | Railway Station to Gujarat Housing board Pandesara | 3254 | 4805 |
| 7 | Railway Station to Katargam - Vedroad | 1311 | 1614 |
| 8 | Railway Station to Katargam - Vedroad-Chowk | 1804 | 2588 |
| 9 | Railway Station to Varachha -Sarthana | 7630 | 10616 |
| 10 | Railway Station to Fulpada, Katargam,Gotalawadi, Laldarwaja | 1628 | 2241 |
| 11 | Railway Station to Fulpada, Katargam,Wadifalia | 4072 | 5343 |
| 12 | Railway Station to Makkaipul-Adajan | 2093 | 2848 |
| 13 | Railway Station to Nani Ved | 4685 | 6308 |
| 14 | Adajan Patia to Palanpur Jakatnaka | 2798 | 3755 |
| 15 | Ghoddad Road | 2856 | 3586 |
| 16 | Railway Station to Godadra | 4110 | 6436 |
| 17 | Railway Station to Udhana Dindoli | 6156 | 9067 |
| 18 | Railway Station to Lambe Hanuman | 1886 | 2418 |
| 19 | Railway Station to Puna- Kumbharia | 1986 | 3074 |
| 20 | East side of the station to Punagam to & fro | 2513 | 3400 |
| 21 | Ring road -station Chowk-(Circular Bus both sides) | 3479 | 4429 |
| 22 | Railway Station to Saraswati Vidyalaya-Hirabag circle - Railway Station | 3171 | 4037 |
| 23 | Adajan to Bhesan | 2809 | 4330 |
| 24 | Jahangiripura-Palanpura Patia-Saradar Circle-Athwagate-Ichhanath -Dumas | 3298 | 4338 |
| 25 | Rander Bus stand- SVR college- Dumas- Langar | 3212 | 4272 |
| 26 | Chowk to Bahuchharaji- Moti Buchharaji,Nani Ved | 1822 | 2383 |
| 27 | Chowk to Katargam, Kanteshwar Mahadev, Amroli | 3519 | 5027 |
| 28 | Chowk to Althan | 2302 | 3004 |
| 29 | Chowk to Unn- Sachin (via Ring Road) | 2735 | 3753 |
| 30 | Canal Road | 1096 | 1742 |
| 31 | Adajan to Dandi | 609 | 874 |
| 32 | Chowk to Kosad | 5163 | 8416 |
| 33 | Adajan to Hazira Side | 2886 | 4243 |
| 34 | North South Corridor (BRTS/MRTS) | 32427 | 44469 |
| 35 | East West Corridor (BRTS/MRTS) | 20379 | 31279 |

**Table 3.5 Peak Hour Passenger Flow (Scenario IV)**

| Route No. | LRTS | PHPD | |
|---|---|---|---|
| | | Year 2016 | Year 2026 |
| 36 | N-S corridor (from Ved Gam to Udhna Navasari Road upto Sachin) | 13690 | 18820 |
| 37 | E-W corridor Puna to upto ORR Magdalla | 8029 | 11685 |

Peak hour passenger loadings on various routes are shown in **Figure 3.5** and **Figure 3.6** for the year 2016 and 2026 respectively. Based on the peak hour loadings and PHPD, Consultants proposed suitable public transit systems. The choice of the system viz. bus system, BRTS, LRTS and MRTS is based on the PHPD in the horizon years. The detailed proposals for public transit systems are discussed in **Chapter 5**.

*Assignment of Private Vehicle Trips*

The daily matrices of car and two-wheeler person trips were converted to peak hour O-D matrices in passenger car units (PCU) by applying peak hour to daily flow ratios and passenger to PCU conversion factors. On similar lines the daily truck matrix was also converted into peak hour PCU matrix. First the network was pre-loaded with the bus and IPT PCU flows as explained above. Then the truck peak hour PCU matrix was loaded on to the preloaded network. The car and two-wheeler peak hour PCU matrix was then loaded using incremental capacity restraint procedure. A network with modified speeds was produced for use in the next iteration of public transport assignment.

Assignment of private vehicle trips has been carried out for the four public transport network scenarios. The assigned peak hour traffic flows (PCUs/hr) on some of the important links in the study area for the horizon years 2016 and 2026 are presented in **Table 3.6**.

## Table 3.6 Assigned Peak Hour Traffic Flows

| Road Names | Link Number | | Year 2006 | Year 2016 | | | | Year 2026 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Scenario-I | Scenario-I | Scenario-II | Scenario-III | Scenario-IV | Scenario-I | Scenario-II | Scenario-III | Scenario-IV |
| Inner Ring Road | 566 | 644 | 9351 | 10643 | 7865 | 7910 | 8634 | 13672 | 10056 | 10100 | 9107 |
| Outer Ring Road – E | 858 | 855 | 0 | 6767 | 6717 | 6703 | 6712 | 10267 | 10180 | 10183 | 10071 |
| Outer Ring Road – W | 240 | 251 | 1442 | 2597 | 2721 | 2629 | 2772 | 3784 | 3910 | 3790 | 4163 |
| Outer Ring Road – N | 840 | 867 | 0 | 4623 | 4567 | 4558 | 4590 | 7026 | 6984 | 6969 | 6951 |
| Bathena Aanjana Road | 708 | 743 | 1841 | 2964 | 3041 | 3186 | 2922 | 3884 | 4099 | 4313 | 4127 |
| Lambe Hanuman Road | 674 | 720 | 2297 | 7760 | 5637 | 5597 | 6959 | 9405 | 6835 | 6765 | 6668 |
| Ved Road | 538 | 529 | 3889 | 9560 | 5893 | 5870 | 5654 | 12449 | 7426 | 7452 | 6165 |
| Katargam Road | 565 | 601 | 5584 | 9648 | 5694 | 5682 | 8021 | 13338 | 7686 | 7670 | 7511 |
| Althan Bhatar Road | 470 | 464 | 3772 | 3549 | 2807 | 2829 | 3546 | 4647 | 3657 | 3678 | 3535 |
| Headgover Road | 564 | 572 | 2717 | 5826 | 3537 | 3536 | 4210 | 8227 | 4920 | 4913 | 4652 |
| Ghoddod Road | 943 | 504 | 2241 | 2386 | 1187 | 1159 | 1694 | 3026 | 1443 | 1403 | 1256 |
| Adajan Hazira Road | 418 | 410 | 4559 | 5604 | 3571 | 3417 | 3967 | 7639 | 4863 | 4584 | 4521 |
| Athwa Dumas Road | 465 | 462 | 8105 | 8027 | 4825 | 4904 | 4713 | 10169 | 6199 | 6323 | 5883 |
| Udhana Magdalla Road | 568 | 540 | 3414 | 6048 | 3426 | 3473 | 4118 | 8147 | 4649 | 4687 | 4428 |
| Udhana Navsari Road | 611 | 642 | 13528 | 18608 | 9482 | 9367 | 9854 | 24450 | 12321 | 12210 | 10810 |
| Bardoli Road | 795 | 831 | 5643 | 7573 | 7656 | 7456 | 7446 | 6233 | 8365 | 8457 | 8236 |
| Varachha Main Road | 779 | 766 | 6289 | 8300 | 5474 | 5463 | 5948 | 11145 | 6386 | 6362 | 6146 |
| Rander Olpad Road | 380 | 384 | 6178 | 6192 | 3506 | 3495 | 3786 | 8237 | 4663 | 4652 | 4587 |
| Anandmahal Road | 392 | 404 | 1800 | 5537 | 3169 | 3157 | 3797 | 6960 | 4414 | 4336 | 4208 |
| ***Walled City Roads*** | | | | | | | | | | | |
| Chowk Main Road – W | 532 | 567 | 4757 | 4099 | 2832 | 2895 | 4271 | 5152 | 3437 | 3512 | 5022 |
| Chowk Main Road – E | 567 | 581 | 3168 | 4099 | 2832 | 2895 | 4271 | 5152 | 3437 | 3512 | 5022 |
| Nanpura Main Road – S | 952 | 508 | 6204 | 6730 | 4485 | 4515 | 4498 | 8505 | 5749 | 5768 | 5020 |

| Road Names | Link Number | | Year 2006 | Year 2016 | | | | Year 2026 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Scenario-I | Scenario-I | Scenario-II | Scenario-III | Scenario-IV | Scenario-I | Scenario-II | Scenario-III | Scenario-IV |
| Nanpura Main Road – N | 511 | 531 | 5353 | 8582 | 4744 | 4699 | 6187 | 11200 | 6044 | 6068 | 5251 |
| Link Between Udhna Darwaja-Bhagal Chowk-Ved Road - N | 567 | 542 | 2706 | 4355 | 3100 | 3229 | 1532 | 5435 | 3619 | 3831 | 1859 |
| Link Between Udhna Darwaja-Bhagal Chowk-Ved Road - S | 546 | 562 | 5762 | 10259 | 7387 | 7525 | 3178 | 13227 | 9378 | 9602 | 4652 |
| Link Between Vivekananda Bridge - Junction near Gopi Lake | 535 | 546 | 4603 | 7589 | 5334 | 5459 | 4552 | 10022 | 6994 | 7193 | 7330 |
| ***Major Existing Bridges*** | | | | | | | | | | | |
| Magdalla Bridge | 264 | 251 | 1442 | 2597 | 2721 | 2629 | 2772 | 3784 | 3910 | 3790 | 4163 |
| Sardar Bridge | 465 | 439 | 5718 | 5765 | 4729 | 4824 | 4840 | 7510 | 6316 | 6419 | 6063 |
| Vivekananda Bridge | 492 | 440 | 2980 | 4645 | 1865 | 2087 | 1984 | 6206 | 2296 | 2655 | 2560 |
| Nehru Bridge | 511 | 444 | 4822 | 6429 | 2966 | 3167 | 3711 | 8416 | 3907 | 4191 | 4151 |
| Weir cum Causeway | 460 | 422 | 1592 | 2209 | 1905 | 1888 | 1806 | 2725 | 2356 | 2356 | 2371 |
| Amroli Bridge | 682 | 769 | 4182 | 7275 | 4401 | 3184 | 3770 | 11411 | 6750 | 4745 | 4732 |
| Savjibhai Korat Bridge | 843 | 845 | 1142 | 985 | 905 | 893 | 1554 | 1626 | 1458 | 1430 | 2301 |
| ***Proposed Bridges*** | | | | | | | | | | | |
| Ved-Jahangirpura Bridge | 427 | 379 | 0 | 2561 | 2266 | 2210 | 1480 | 3555 | 3091 | 3033 | 3325 |
| Atwaline-Adajan Bridge | 430 | 382 | 0 | 2596 | 1914 | 1943 | 2160 | 3838 | 2855 | 2916 | 2981 |
| Ved-Variyav Bridge | 516 | 518 | 0 | 1842 | 1818 | 1888 | 1811 | 2860 | 2802 | 2905 | 2904 |
| Bridge Near Valak of Outer Ring Road | 867 | 840 | 0 | 4623 | 4567 | 4558 | 4590 | 7026 | 6984 | 6969 | 6951 |

## 3.9 Assessment of Demand Supply Gap and Corridor Analysis

The Travel Demand Models calibrated for the study area were used to assess the demand supply gap. Demand Supply gap is established based on the volume – capacity ratio in case of road links and intensity of overcrowding of passenger trips in case of Public Transport System. **Table 3.7** shows the V/C ratio and Level of Service for various Scenarios on important corridors in the study area for the horizon years 2016 and 2026.

Link loadings have been estimated for the following four scenarios

| | |
|---|---|
| Scenario I: | Only GSRTC bus system in operation, without any proposed public transport (Do Nothing) |
| Scenario II: | Bus Mass Transit routes proposed by Surat Municipal Corporation |
| Scenario III: | Bus Mass Transit routes proposed by Consultants |
| Scenario IV: | Bus Mass Transit routes proposed by Consultants along with BRTS/LRTS along North-South and East-West corridors |

Based on the link loadings for various scenarios, corridor wise analysis has been carried out. The traffic loading on various major links in the Scenario IV would reduce by about 30% to 35% as compared to *Do Nothing* scenario (Scenario I). Even after improving the road network, the volume to capacity ratios on the major radial corridors, sub arterial radial and ring roads are exceeding existing capacities levels.

Based on the maximum section loadings, peak hour intersection volumes and functional requirement of the corridors, road based infrastructure improvement proposals for short term, medium term and long term in line with integrated public transit system are proposed and the same are presented in **Chapter 4**.

## Table 3.7 V/C and Level of Service for Various Scenarios

| S. No | Road Names | 2006 | | Scenario - A06 2006 | | Scenario - A16 2016 | | Scenario - B16 2016 | | Scenario - C16 2016 | | Scenario - D16 2016 | | Scenario - A26 2026 | | Scenario - B26 2026 | | Scenario - C26 2026 | | Scenario - D26 2026 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Existing Lane Configuration | Capacity | V/C | LOS | V/C | LOS | V/C | LOS | V/C | LOS | V/C | LOS | V/C | LOS | V/C | LOS | V/C | LOS | V/C | LOS |
| | **SMC Roads (Excluding Walled City)** | | | | | | | | | | | | | | | | | | | | |
| 1 | Inner Ring Road | 8-Lane Divided (Two-Way) | 7200 | 1.30 | LOS E | 1.48 | LOS E | 1.09 | LOS E | 1.10 | LOS E | 1.20 | LOS E | 1.90 | LOS E | 1.40 | LOS E | 1.40 | LOS E | 1.26 | LOS E |
| 2 | Outer Ring Road - E | 4-Lane Divided (Two-Way) | 3600 | 0.00 | LOS A | 1.88 | LOS E | 1.87 | LOS E | 1.86 | LOS E | 1.86 | LOS E | 2.85 | LOS E | 2.83 | LOS E | 2.83 | LOS E | 2.80 | LOS E |
| 3 | Outer Ring Road - W | 4-Lane Divided (Two-Way) | 3600 | 0.40 | LOS A | 0.72 | LOS C | 0.76 | LOS C | 0.73 | LOS C | 0.77 | LOS C | 1.05 | LOS E | 1.09 | LOS E | 1.05 | LOS E | 1.16 | LOS E |
| 4 | Outer Ring Road - N | 4-Lane Divided (Two-Way) | 3600 | 0.00 | LOS A | 1.28 | LOS E | 1.27 | LOS E | 1.27 | LOS E | 1.28 | LOS E | 1.95 | LOS E | 1.94 | LOS E | 1.94 | LOS E | 1.93 | LOS E |
| 5 | Bathena Aanjana Road | 4-Lane Divided (Two-Way) | 3600 | 0.51 | LOS A | 0.82 | LOS D | 0.84 | LOS D | 0.89 | LOS D | 0.81 | LOS D | 1.08 | LOS E | 1.14 | LOS E | 1.20 | LOS E | 1.15 | LOS E |
| 6 | Lambe Hanuman Road | 4-Lane Divided (Two-Way) | 3600 | 0.64 | LOS B | 2.16 | LOS E | 1.57 | LOS E | 1.55 | LOS E | 1.93 | LOS E | 2.61 | LOS E | 1.90 | LOS E | 1.88 | LOS E | 1.85 | LOS E |
| 7 | Ved Road | 4-Lane Divided (Two-Way) | 3600 | 1.08 | LOS E | 2.66 | LOS E | 1.64 | LOS E | 1.63 | LOS E | 1.57 | LOS E | 3.46 | LOS E | 2.06 | LOS E | 2.07 | LOS E | 1.71 | LOS E |
| 8 | Katargam Road | 4-Lane Divided (Two-Way) | 3600 | 1.55 | LOS E | 2.68 | LOS E | 1.58 | LOS E | 1.58 | LOS E | 2.23 | LOS E | 3.71 | LOS E | 2.14 | LOS E | 2.13 | LOS E | 2.09 | LOS E |
| 9 | Althan Bhatar Road | 4-Lane Divided (Two-Way) | 3600 | 1.05 | LOS E | 0.99 | LOS E | 0.78 | LOS C | 0.79 | LOS C | 0.99 | LOS E | 1.29 | LOS E | 1.02 | LOS E | 1.02 | LOS E | 0.98 | LOS E |
| 10 | Headgover Road | 4-Lane Divided (Two-Way) | 3600 | 0.75 | LOS C | 1.62 | LOS E | 0.98 | LOS E | 0.98 | LOS E | 1.17 | LOS E | 2.29 | LOS E | 1.37 | LOS E | 1.36 | LOS E | 1.29 | LOS E |
| 11 | Ghoddod Road | 4-Lane Divided (Two-Way) | 3600 | 0.62 | LOS B | 0.66 | LOS B | 0.33 | LOS A | 0.32 | LOS A | 0.47 | LOS A | 0.84 | LOS D | 0.40 | LOS A | 0.39 | LOS A | 0.35 | LOS A |
| 12 | Adajan Hazira Road | 6-Lane Divided (Two-Way) | 5400 | 0.84 | LOS D | 1.04 | LOS E | 0.66 | LOS B | 0.63 | LOS B | 0.73 | LOS C | 1.41 | LOS E | 0.90 | LOS E | 0.85 | LOS D | 0.84 | LOS D |
| 13 | Athwa Dumas Road | 6-Lane Divided (Two-Way) | 5400 | 1.50 | LOS E | 1.49 | LOS E | 0.89 | LOS D | 0.91 | LOS E | 0.87 | LOS D | 1.88 | LOS E | 1.15 | LOS E | 1.17 | LOS E | 1.09 | LOS E |
| 14 | Udhana Magdalla Road | 6-Lane Divided (Two-Way) | 5400 | 0.63 | LOS B | 1.12 | LOS E | 0.63 | LOS B | 0.64 | LOS B | 0.76 | LOS C | 1.51 | LOS E | 0.86 | LOS D | 0.87 | LOS D | 0.82 | LOS D |
| 15 | Udhana Navsari Road | 6-Lane Divided (Two-Way) | 5400 | 2.51 | LOS E | 3.45 | LOS E | 1.76 | LOS E | 1.73 | LOS E | 1.82 | LOS E | 4.53 | LOS E | 2.28 | LOS E | 2.26 | LOS E | 2.00 | LOS E |
| 16 | Bardoli Road | 6-Lane Divided (Two-Way) | 5400 | 1.05 | LOS E | 1.40 | LOS E | 1.42 | LOS E | 1.38 | LOS E | 1.38 | LOS E | 2.27 | LOS E | 2.22 | LOS E | 2.16 | LOS E | 2.15 | LOS E |
| 17 | Varachha Main Road | 6-Lane Divided (Two-Way) | 5400 | 1.16 | LOS E | 1.54 | LOS E | 1.01 | LOS E | 1.01 | LOS E | 1.10 | LOS E | 2.06 | LOS E | 1.18 | LOS E | 1.18 | LOS E | 1.14 | LOS E |
| 18 | Rander Olpad Road | 4-Lane Divided (Two-Way) | 3600 | 1.72 | LOS E | 1.72 | LOS E | 0.97 | LOS E | 0.97 | LOS E | 1.05 | LOS E | 2.29 | LOS E | 1.30 | LOS E | 1.29 | LOS E | 1.27 | LOS E |
| 19 | Anandmahal Road | 4-Lane Divided (Two-Way) | 3600 | 0.50 | LOS A | 1.54 | LOS E | 0.88 | LOS D | 0.88 | LOS D | 1.05 | LOS E | 1.93 | LOS E | 1.23 | LOS E | 1.20 | LOS E | 1.17 | LOS E |
| | ***Walled City Roads*** | | | | | | | | | | | | | | | | | | | | |
| 20 | Chowk Main Road – W | 3-Lane Undivided (Two-Way) | 2250 | 2.11 | LOS E | 1.82 | LOS E | 1.26 | LOS E | 1.29 | LOS E | 1.90 | LOS E | 2.29 | LOS E | 1.53 | LOS E | 1.56 | LOS E | 2.23 | LOS E |
| 21 | Chowk Main Road – E | 3-Lane Undivided (Two-Way) | 2250 | 1.41 | LOS E | 1.82 | LOS E | 1.26 | LOS E | 1.29 | LOS E | 1.90 | LOS E | 2.29 | LOS E | 1.53 | LOS E | 1.56 | LOS E | 2.23 | LOS E |
| 22 | Nanpura Main Road - S | 3-Lane Undivided (Two-Way) | 2250 | 2.76 | LOS E | 2.99 | LOS E | 1.99 | LOS E | 2.01 | LOS E | 2.00 | LOS E | 3.78 | LOS E | 2.56 | LOS E | 2.56 | LOS E | 2.23 | LOS E |
| 23 | Nanpura Main Road - N | 3-Lane Undivided (Two-Way) | 2250 | 2.38 | LOS E | 3.81 | LOS E | 2.11 | LOS E | 2.09 | LOS E | 2.75 | LOS E | 4.98 | LOS E | 2.69 | LOS E | 2.70 | LOS E | 2.33 | LOS E |
| 24 | Link Between Udhna Darwaja-Bhagal Chowk-Ved Road - N | 2-Lane Undivided (Two-Way) | 1500 | 1.80 | LOS E | 2.90 | LOS E | 2.07 | LOS E | 2.15 | LOS E | 1.02 | LOS E | 3.62 | LOS E | 2.41 | LOS E | 2.55 | LOS E | 1.24 | LOS E |
| 25 | Link Between Udhna Darwaja-Bhagal Chowk-Ved Road - S | 4-Lane Divided (Two-Way) | 3600 | 1.60 | LOS E | 2.85 | LOS E | 2.05 | LOS E | 2.09 | LOS E | 0.88 | LOS D | 3.67 | LOS E | 2.61 | LOS E | 2.67 | LOS E | 1.29 | LOS E |
| 26 | Link Between Vivekananda Bridge - Junction near Gopi Lake | 4-Lane Divided (Two-Way) | 3600 | 1.28 | LOS E | 2.11 | LOS E | 1.48 | LOS E | 1.52 | LOS E | 1.26 | LOS E | 2.78 | LOS E | 1.94 | LOS E | 2.00 | LOS E | 2.04 | LOS E |
| | ***Major Existing Bridges*** | | | | | | | | | | | | | | | | | | | | |
| 27 | Magdalla Bridge | 2-Lane Undivided (Two-Way) | 1500 | 0.96 | LOS E | 1.73 | LOS E | 1.81 | LOS E | 1.75 | LOS E | 1.85 | LOS E | 2.52 | LOS E | 2.61 | LOS E | 2.53 | LOS E | 2.78 | LOS E |
| 28 | Sardar Bridge | 4-Lane Divided (Two-Way) | 3600 | 1.59 | LOS E | 1.60 | LOS E | 1.31 | LOS E | 1.34 | LOS E | 1.34 | LOS E | 2.09 | LOS E | 1.75 | LOS E | 1.78 | LOS E | 1.68 | LOS E |
| 29 | Vivekananda Bridge | 4-Lane Divided (Two-Way) | 3600 | 0.83 | LOS D | 1.29 | LOS E | 0.52 | LOS A | 0.58 | LOS A | 0.55 | LOS A | 1.72 | LOS E | 0.64 | LOS B | 0.74 | LOS C | 0.71 | LOS C |
| 30 | Nehru Bridge | 2-Lane Undivided (Two-Way) | 1500 | 3.21 | LOS E | 4.29 | LOS E | 1.98 | LOS E | 2.11 | LOS E | 2.47 | LOS E | 5.61 | LOS E | 2.60 | LOS E | 2.79 | LOS E | 2.77 | LOS E |
| 31 | Weir cum Causeway | 2-Lane Undivided (Two-Way) | 1500 | 1.06 | LOS E | 1.47 | LOS E | 1.27 | LOS E | 1.26 | LOS E | 1.20 | LOS E | 1.82 | LOS E | 1.57 | LOS E | 1.57 | LOS E | 1.58 | LOS E |
| 32 | Amroli Bridge | 2-Lane Undivided (Two-Way) | 1500 | 2.79 | LOS E | 4.85 | LOS E | 2.93 | LOS E | 2.12 | LOS E | 2.51 | LOS E | 7.61 | LOS E | 4.50 | LOS E | 3.16 | LOS E | 3.15 | LOS E |
| 33 | Savjibhai Korat Bridge | 2-Lane Undivided (Two-Way) | 1500 | 0.76 | LOS C | 0.66 | LOS B | 0.60 | LOS B | 0.60 | LOS A | 1.04 | LOS E | 1.08 | LOS E | 0.97 | LOS E | 0.95 | LOS E | 1.53 | LOS E |
| | ***Proposed Bridges*** | | | | | | | | | | | | | | | | | | | | |
| 34 | Ved-Jahangirpura Bridge | 4-Lane Divided (Two-Way) | 3600 | 0.00 | LOS A | 0.71 | LOS C | 0.63 | LOS B | 0.61 | LOS B | 0.41 | LOS A | 0.99 | LOS E | 0.86 | LOS D | 0.84 | LOS D | 0.92 | LOS E |
| 35 | Atwaline-Adajan Bridge | 4-Lane Divided (Two-Way) | 3600 | 0.00 | LOS A | 0.72 | LOS C | 0.53 | LOS A | 0.54 | LOS A | 0.60 | LOS A | 1.07 | LOS E | 0.79 | LOS C | 0.81 | LOS D | 0.83 | LOS D |
| 36 | Ved-Variyav Bridge | 4-Lane Divided (Two-Way) | 3600 | 0.00 | LOS A | 0.51 | LOS A | 0.51 | LOS A | 0.52 | LOS A | 0.50 | LOS A | 0.79 | LOS C | 0.78 | LOS C | 0.81 | LOS D | 0.81 | LOS D |
| 37 | Bridge Near Valak of Outer Ring Road | 4-Lane Divided (Two-Way) | 3600 | 0.00 | LOS A | 1.28 | LOS E | 1.27 | LOS E | 1.27 | LOS E | 1.28 | LOS E | 1.95 | LOS E | 1.94 | LOS E | 1.94 | LOS E | 1.93 | LOS E |

# CHAPTER 4.0
# Transport System Development Programme - Road Based Improvements

## 4.1 Introduction

In the framework of objectives postulated, strategies identified, the transport system development programme for Surat has been developed. It contains a number of components, important of them being the road network system, the public transport system, the terminal complexes, traffic management measures and the organizational structure for planning development, operation and co-ordination of the transport system.

In Chapter 3, traffic projections, in terms of PCU for different horizon years was presented separately for (i) current modal split (where IPT modes and private vehicles dominate) (ii) with road based IPTS in the form of Bus and (iii) with bus and rail based system. The demand in terms of PCU/peak hour varies for each of the postulation and therefore the requirement/extent of road widening and improvement also varies. As the introduction of IPTS was the most desired option, the same is considered as basis for phase-wise development.

A comprehensive list of improvement measures are grouped into two complimentary development phases, viz.

- Development 1: Road Based Proposals (in line with IPTS)
- Development 2: Bus and Rail based IPTS

## 4.2 Development 1: Road Based Proposals (in line with IPTS)

Efficient functioning of any public transport system mainly depends on the adequacy and potentiality of the available road network and transport system management measures. In order to obtain the best use of the existing road network through effective design, maintenance and management, a comprehensive study is undertaken to suggest sustainable improvements at appropriate locations.

### 4.2.1 Prelude to Recommendations

In general, the road network within the study area is fairly well developed, especially in the SMC area. However, significant road based impediments do exist which

potentially affect the efficiency of the Public Transport System. Specific among them are

- Absence of a consistent road network hierarchy
- Inefficient design of intersections
- Imbalances in the supply and demand of infrastructure and road network facilities
- Absence of any integrated traffic management system with minimal provisions to deal with congestion effects, traffic emergencies, mode separation or lane disciplines.
- Existence of several bottlenecks that constrict the smooth flow of Private Transport System.

Comprehensive list of Improvement proposals considered under Development 1 are as follows:

- Development of consistent and efficient road classification system
- Full development of corridors (where ROW is available) with Service Roads, On-Street Parking, Footpaths and Bicycle lanes etc.
- Corridor Improvements including widening of existing roads and new links.
- Improvement of Important Intersections
- Developing comprehensive Parking Regulation Policy
- Developing comprehensive Pedestrian Facilities
- Development and Integration of Para-Transit and Private Bus infrastructure facilities like Auto Stands, Bays.
- Implementation of an efficient Traffic Management System including One way Movements, Turning Movement Restrictions, Modal Restrictive/Access control measures, Public Transport/IPT Movement and their Terminals, Flexi Hours, Signs and Markings etc. along with Co-ordinated traffic signals on radial roads
- Framing of Institutional strengthening measures

## 4.3 Surat Road Classification System (SRCS)

Road classification or grouping of roads based on similar functions improves transportation planning, road infrastructure design, maintenance and managing traffic operations. Consultants have devised a road hierarchy followed all over the world consisting four distinct road types.

1. Major Arterials (including Expressway portions of NH & SH)
2. Minor Arterials

3. Collectors
4. Local Streets

The criteria adopted to establish such a road classification system for Surat are as tabulated in **Table 4.1.** Based on this criteria, the important roads in the study area are categorised into Ring Roads, Radial arterial roads, radial sub-arterial roads and sub-arterial roads and the same are presented in **Table 4.2** and shown in **Figure 4.1**.

**Table 4.1 Criteria for Road Classification**

| Characteristics | Locals | Collectors | Minor Arterials | Major Arterials | National & State Highways |
|---|---|---|---|---|---|
| Traffic Movement versus property access | Property access primary function | Traffic Movement and property access of equal importance | Traffic Movement primary consideration and some property access control | Traffic Movement primary consideration subject to property access control | Traffic Movement primary consideration and no property access |
| Typical daily motor vehicle traffic volume (both directions) (Veh/PCU) | ≤2,500 | 2,500-8,000 | 8,000-20,000 | >20,000 | >40,000 |
| Minimum number of peak period lanes (excluding bicycle lane) | One (one way streets) or two | One (one way streets) or two | Two | Four | Four |
| Desirable Connections | Locals, Collectors | Locals, Collectors, arterials | Collectors, arterials | Collectors, arterials, expressways | Major Arterials, Highways |
| Flow Characteristics | Interrupted Flow | Interrupted Flow | Un interrupted except at signals and zebra crossings | Un interrupted except at signals and zebra crossings | Free flow (grade separated) |
| Legal speed limit, km/h | 20-30 | 40-50 | 40-60 | 50-60 | 80-100 |
| Accommodation of Pedestrians | Footpath on one or both sides | Footpath on both sides | Footpath on both sides | Footpath on both sides | Pedestrians prohibited |
| Accommodation of Cyclists | Special facilities as required | Special facilities as required | Wide curb lane or special facilities desired | Wide curb lane or special facilities desired | Cyclists prohibited or conform to hard shoulders |
| Surface Transit | Generally not provided | Permitted | Preferred | Preferred | Express Buses only. |
| Surface Transit daily passengers | Not applicable | ≤1,500 | 1,500-5,000 | >5,000 | Not applicable |
| Heavy truck restrictions (e.g. seasonal or night time) | Restrictions preferred | Restrictions permitted | Generally no restrictions | Generally no restrictions | No restrictions |
| Typical spacing between traffic control devices (m) | 0-150 | 215-400 | 215-400 | 215-400 | Not applicable |

| Characteristics | Locals | Collectors | Minor Arterials | Major Arterials | National & State Highways |
|---|---|---|---|---|---|
| Typical right of way width (m) | 15-22 | 20-27 | 20-30 | 20-45 | >45 |

**Table 4.2 Classification of Important Roads in Surat**

| SL No. | Road Names |
|---|---|
| **A** | **Ring Roads** |
| 1 | Inner Ring Road |
| 2 | Outer Ring Road – W |
| 3 | Outer Ring Road – E |
| 4 | Outer Ring Road – N |
| 5 | Partial Mid Ring Road (MRR-1) |
| 6 | Partial Second Mid Ring Road (MRR-2) |
| **B** | **Radial Arterial Roads** |
| 1 | Ved Road |
| 2 | Katargam Road |
| 3 | Adajan Hazira Road |
| 4 | Athwa Dumas Road |
| 5 | Udhana Magdalla Road |
| 6 | Udhana Navsari Road |
| 7 | Bardoli Road |
| 8 | Varachha Main Road |
| 9 | Rander Olpad Road |
| **C** | **Radial Sub-Arterial Roads** |
| 1 | Anandmahal Road |
| 2 | Althan Bhatar Road |
| 3 | Headgover Road |
| 4 | Bathena Aanjana Road |
| 5 | Lambe Hanuman Road |
| **D** | **Sub-Arterial Roads** |
| 1 | Chowk Main Road – W |
| 2 | Chowk Main Road – E |
| 3 | Nanpura Main Road – S |
| 4 | Nanpura Main Road – N |
| 5 | Link Between Udhna Darwaja-Bhagal Chowk to Ved Road – N |
| 6 | Link Between Udhna Darwaja-Bhagal Chowk to Ved Road – S |
| 7 | Link Between Vivekananda Bridge to Junction near Gopi Lake |
| 8 | Ghoddod Road |

## 4.4 Corridor Improvement

The road improvement proposals are studied for the following four alternative scenarios.

Scenario I: Only GSRTC bus system in operation, without any proposed public transport (Do Nothing)

Scenario II: Bus Mass Transit routes proposed by Surat Municipal Corporation

Scenario III: Bus Mass Transit routes proposed by Consultants

Scenario IV: Bus Mass Transit routes proposed by Consultants along with BRTS/LRTS along North-South and East-West corridors

From the above four scenarios, Consultants selected best suited scenario and the detailed proposals are recommended for this scenario. The roads proposed for widening, their required lane configuration and required ROW for the horizon years 2016 and 2026 are presented in **Table 4.3**.

**Table 4.3 Proposed Road Widening**

| S. No | Roads | Existing Lane Configuration | Existing ROW (M) | DP (ROW) | Required Lane Configuration & ROW | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Year 2016 | | Year 2026 | |
| | | | | | Lane Config. | ROW (M) | Lane config. | ROW (M) |
| | **Major Corridors in SMC excluding Walled City** | | | | | | | |
| 1 | Inner Ring Road | 8-Lane Divided | 30-35 | 60 | 5+5 | 49 | 5+5 | 49 |
| 2 | Outer Ring Road – E | 4-Lane Divided | 15-20 | 60 | 4+4 | 39 | 6+6 | 59 |
| 3 | Outer Ring Road – W | 4-Lane Divided | 15-20 | 60 | 2+2 | 19 | 3+3 | 29 |
| 4 | Outer Ring Road – N | 4-Lane Divided | 15-20 | 60 | 3+3 | 29 | 4+4 | 39 |
| 5 | Bathena Aanjana Road | 4-Lane Divided | 15-20 | 24 | 2+2 | 19 | 3+3 | 29 |
| 6 | Lambe Hanuman Road | 4-Lane Divided | 15-20 | 24 | 3+3 | 29 | 4+4 | 39 |
| 7 | Ved Road | 4-Lane Divided | 15-20 | 24-36 | 4+4 | 39 | 4+4 | 39 |
| 8 | Katargam Road | 4-Lane Divided | 15-20 | 24 | 3+3 | 29 | 4+4 | 39 |
| 9 | Althan Bhatar Road | 4-Lane Divided | 15-20 | 24 | 2+2 | 19 | 2+2 | 19 |
| 10 | Headgover Road | 4-Lane Divided | 15-20 | 24 | 2+2 | 19 | 3+3 | 29 |
| 11 | Ghoddod Road | 4-Lane Divided | 15-20 | 24 | 2 | 10 | 2 | 10 |
| 12 | Adajan Hazira Road | 6-Lane Divided | 20-25 | 60 | 2+2 | 19 | 3+3 | 29 |
| 13 | Athwa Dumas Road | 6-Lane Divided | 20-25 | 60 | 3+3 | 29 | 4+4 | 39 |
| 14 | Udhana Magdalla Road | 6-Lane Divided | 20-25 | 60 | 2+2 | 19 | 3+3 | 29 |
| 15 | Udhana Navsari Road | 6-Lane Divided | 20-25 | 60 | 5+5 | 49 | 6+6 | 59 |
| 16 | Bardoli Road | 6-Lane Divided | 20-25 | 60 | 4+4 | 39 | 5+5 | 69 |
| 17 | Varachha Main Road | 6-Lane Divided | 20-25 | 45-60 | 3+3 | 29 | 4+4 | 39 |
| 18 | Rander Olpad Road | 4-Lane Divided | 15-20 | 45 | 2+2 | 19 | 3+3 | 29 |
| 19 | Anand Mahal Road | 4-Lane Divided | 15-20 | 24 | 2+2 | 19 | 3+3 | 29 |

| S. No | Roads | Existing Lane Configuration | Existing ROW (M) | DP (ROW) | Required Lane Configuration & ROW | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Year 2016 | | Year 2026 | |
| | | | | | Lane Config. | ROW (M) | Lane config. | ROW (M) |
| | ***Walled City Roads*** | | | | | | | |
| 1 | Chowk Main Road – W | 3-Lane Undivided | 10-15 | 18 | 2+2 | 19 | 3+3 | 29 |
| 2 | Chowk Main Road – E | 3-Lane Undivided | 10-15 | 18-24 | 2+2 | 19 | 3+3 | 29 |
| 3 | Chowk Main Road – E | 3-Lane Undivided | 10-15 | 18-24 | 2+2 | 19 | 3+3 | 29 |
| 4 | Nanpura Main Road – S | 3-Lane Undivided | 10-15 | 18-24 | 3+3 | 29 | 3+3 | 29 |
| 5 | Nanpura Main Road – N | 3-Lane Undivided | 10-15 | 18-24 | 3+3 | 29 | 3+3 | 29 |
| 6 | Link Between Udhna Darwaja-Bhagal Chowk-Ved Road – N | 2-Lane Undivided | 6-10 | 10 | 2+2 | 19 | 2 | 10 |
| 7 | Link Between Udhna Darwaja-Bhagal Chowk-Ved Road – S | 4-Lane Divided | 15-20 | 18 | 4+4 | 39 | 3+3 | 29 |
| 8 | Link Between Vivekananda Bridge - Junction near Gopi Lake | 4-Lane Divided | 15-20 | 18 | 3+3 | 29 | 4+4 | 39 |
| | ***Major Existing Bridges*** | | | | | | | |
| 1 | Magdalla Bridge | 2-Lane Undivided | 10 | 10 | 2+2 | 19 | 3+3 | 29 |
| 2 | Sardar Bridge | 4-Lane Divided | 20 | 20 | 3+3 | 29 | 4+4 | 39 |
| 3 | Vivekananda Bridge | 4-Lane Divided | 20 | 20 | 2 | 10 | 2+2 | 19 |
| 4 | Nehru Bridge | 2-Lane Undivided | 10 | 10 | 2+2 | 19 | 3+3 | 29 |
| 5 | Weir cum Causeway | 2-Lane Undivided | 10 | 10 | 2+2 | 19 | 2+2 | 19 |
| 6 | Amroli Bridge | 2-Lane Undivided | 10 | 10 | 2+2 | 19 | 3+3 | 29 |
| 7 | Savjibhai Korat Bridge | 2-Lane Undivided | 10 | 10 | 2 | 10 | 2+2 | 19 |
| | ***Proposed Bridges*** | | | | | | | |
| 1 | Ved-Jahangirpura Bridge | -- | 20 | 20 | 2+2 | 19 | 2+2 | 19 |
| 2 | Atwaline-Adajan Bridge | -- | 20 | 20 | 2 | 10 | 2+2 | 19 |
| 3 | Ved-Variyav Bridge | -- | 20 | 20 | 2 | 10 | 2+2 | 19 |
| 4 | Bridge Near Valak of Outer Ring Road | -- | 20 | 20 | 3+3 | 29 | 4+4 | 39 |

### 4.4.1 Development of Corridors

Link analysis is done for each corridor to assess the V/C ratio under various considerations. Full development of corridors include

- Development of service roads
- Development of Cycle tracks
- Pedestrian walk ways (footpaths)
- Medians for traffic segregation
- Loading and unloading facilities (bays)

The existing radial roads are proposed to be upgraded in terms of ROW, capacity and other geometrics. They are to be designed for a higher level of service from the entry into Surat Urban Area to their meeting point with the Walled City (CBD) orbital road. The corridors considered for improvement are:

1. Varachha Road
2. Bardoli Road
3. Udhna-Navsari Road
4. Udhna – Magdalla Road
5. Dumas Road
6. Ved Road
7. Adajan Hazira Road
8. Rander Olpad Road
9. Katargam

The existing features of the above mentioned corridors are discussed below.

#### *(i) Varachha Road*

This is a radial road passing near Surat Railway Station and connecting Nana Varachha in SMC and various villages in SUDA area and Kamrej. It is a six lane divided road with fairly good road surface. Major Diamond processing activities are located along this corridor. A long flyover on this road was recently built which covers a number of junctions. The long flyover is a four-lane divided catering to the through traffic. The low-level road below the flyover has 3-lane wide carriageway on each side. Road-side vegetable market occupies majority of the carriageway. A pay and park facility is developed below the flyover. These substantially reduce the effective road width available for movement of traffic. The average speed on this section below the flyover is approximately 25 kmph. Most of the minor junctions on this road

are uncontrolled and major junctions are controlled by traffic signals. The geometry of majority of the junctions on this corridor is very poor.

**Traffic Forecast**

The traffic forecast for the horizon years 2016 and 2026 is as follows (in PCUs)

| Corridor | Peak Hour PCUs (2016) | Peak Hour PCUs (2026) |
|---|---|---|
| Varachha Road | 5585 | 6146 |

**Improvement Proposal**

Traffic forecast suggest 8-lane divided carriageway for this road section to cater to the future traffic demand. This requires widening of existing road by additional 4 lanes on either side of the existing carriageway. Developments of service roads, Cycle tracks, Pedestrian walk-ways (footpaths) are suggested.

***(ii) Bardoli Road***

Bardoli Road is another major radial road, which connects the central area at Sahara Darwaja on Ring Road to Dumbhal in SMC & various villages in SUDA area (i.e., Magob, Parvat etc.) and further leads to Bardoli. This road is recently concretised (6-lane). Unauthorised auto rickshaw stand and operation of inter-city private buses takes place near Sahara Darwaja junction. This road section at Sahara Darwaja is very congested leading to long queues. APMC market, road-side vegetable market and New Bombay textile market are located along this road. The market activities usually encroach the carriageway resulting in loss of road space for traffic. Most of the junctions on this road have roundabouts or uncontrolled. In SUDA area, the section is a four lane divided, bitumen road with good quality road surface.

**Traffic Forecast**

The traffic forecast for the horizon years 2016 and 2026 is as follows (in PCUs)

| Corridor | Peak Hour PCUs (2016) | Peak Hour PCUs (2026) |
|---|---|---|
| Bardoli Road | 7455 | 8135 |

**Improvement Proposal**

Traffic forecast suggest 10 lane divided carriageway for this road section to cater to the future traffic demand. Developments of service roads, Cycle tracks, Pedestrian walk ways (footpaths) are suggested.

***(iii) Udhana Navsari Road***

Udhana Navsari Road is also a major radial road which connects central area at Udhana Darwaja on Ring Road to Pandesara GIDC, Bhestan in SMC & Sachin GIDC and various villages in SUDA area i.e., Unn, Pardi Kande, Kansa, etc and Navsari. It is a four lane divided carriageway near the Ring Road. Then the road becomes a six lane divided carriageway, which is under concretisation. During the peak hours the intensity of traffic is very high as it is the main connector to Pandesara GIDC in SMC area and Sachin GIDC in SUDA area. Un-organised on-street parking on both sides of the road has been observed. Most of the junctions on this road have roundabouts or uncontrolled. After SMC limits, it becomes a two lane divided bitumen road of good road surface quality.

**Traffic Forecast**

The traffic forecast for the horizon years 2016 and 2026 is as follows (in PCUs)

| Corridor | Peak Hour PCUs (2016) | Peak Hour PCUs (2026) |
|---|---|---|
| Udhna Navsari Road | 9359 | 10779 |

**Improvement Proposal**

Traffic forecast suggest 12-lane divided carriageway for this road section to cater to the future traffic demand. Developments of service roads, Cycle tracks, Pedestrian walkways (footpaths) are suggested.

***iv) Udhana Magdalla Road***

Udhana Magdalla Road is also called as Hasmukbhai Hoziwal Road, which starts from Udhana Navsari Road (near Udhana Darwaja) connects Bhatar, Althan areas in SMC and Magdalla & other villages in SUDA area. This road is parallel to the Canal Road with six lane divided carriageway and has a fairly good road surface. Essential street furniture elements are missing and there are no proper pedestrian facilities like

foot path, pedestrian road crossing facilities etc. During the peak hours, the traffic demand is very high. Due to a number of textile mills located along this corridor, bi-cycle traffic is very high as workers in these mills usually commute by bicycles. All the junctions on this corridor have roundabouts. High rise-high income residential development is taking place along this corridor. This road is a two-lane divided bitumen road of good road surface.

**Traffic Forecast**

The traffic forecast for the horizon years 2016 and 2026 is as follows (in PCUs)

| Corridor | Peak Hour PCUs (2016) | Peak Hour PCUs (2026) |
|---|---|---|
| Udhna – Magdalla Road | 3468 | 4437 |

**Improvement Proposal**

Traffic forecast suggest 6 lane divided carriageway for this road section to cater to the future traffic demand. Developments of service roads, Cycle tracks, Pedestrian walk ways (footpaths) are suggested. As significant bicycle traffic was observed on this corridor, a bicycle track is suggested.

***v) Dumas Road***

Athwa Dumas Road, once a centre for ship building activities, is the one of the major radial roads that connects central area at Ring Road to Parle Point, Piplod, SVNIT and various villages in SUDA area i.e., Gaviar, Dumas etc. It also connects Surat Airport at Gaviar with Surat city. This road is six lane divided cement concrete road of fairly good road surface. Essential street furniture elements are not present, nor are there any proper pedestrian facilities like footpath, pedestrian road crossing facilities etc. During the peak hours, this road caters to very high traffic. There is irregular on-street parking on both sides of the road thereby reducing the effective road width available for movement of traffic. From SVNIT, this road becomes four lane divided road with raised footpath and service lanes on both sides. Parking is mostly observed on the service road. Most of the junctions on this road have roundabouts except one, i.e. Parle Point junction which is signalised. Beyond SMC limits, the road is four lane divided bitumen road of good road surface.

**Traffic Forecast**

The traffic forecast for the horizon years 2016 and 2026 is as follows (in PCUs)

| Corridor | Peak Hour PCUs (2016) | Peak Hour PCUs (2026) |
|---|---|---|
| Dumas Road | 4898 | 5882 |

**Improvement Proposal**

Traffic forecast suggest 8-lane divided carriageway for this road section to cater to the future traffic demand. Therefore no further widening is required. Developments of service roads, Cycle tracks, Pedestrian walk ways (footpaths) may be provided.

***vi) Adajan Hazira Road***

Adajan Hazira Road is also a major radial road on west side of Surat city. This road starts from Adajan Patia and leads to Pal in SUDA area and Hazira. It is an eight lane divided road of fairly good road surface. During the peak hours, this road caters to very high traffic since this is the only link to Hazira, an industrial area. Two major junctions are present on this road i.e. Gujarat Gas Junction and Bulka Bhavan Junction. A flyover connecting Gujarat Gas Junction and Bulka Bhavan Junction is being planned to relieve traffic congestion. Beyond SMC limits, the road is a two lane divided bitumen road.

**Traffic Forecast**

The traffic forecast for the horizon years 2016 and 2026 is as follows (in PCUs)

| Corridor | Peak Hour PCUs (2016) | Peak Hour PCUs (2026) |
|---|---|---|
| Adajan Hazira Road | 3425 | 4529 |

**Improvement Proposal**

Traffic forecast suggest 6 lane divided carriageway for this road section to cater to the future traffic demand. Developments of service roads, Cycle tracks, Pedestrian walk ways (footpaths) are also proposed.

### *vii) Rander Olpad Road*

Rander Road is a major radial road on west side of the Surat city across Tapi river. This road starts from Adajan Patia and leads to three other major roads i.e., Bhestan Road, Dandi Road and Olpad State Highway. It is a six-lane divided concrete road (recently concretised). During the peak hours, this road caters to very high traffic. There is irregular on-street parking on both sides of the road. Most of the junctions on this road have roundabouts or uncontrolled.

**Traffic Forecast**

The traffic forecast for the horizon years 2016 and 2026 is as follows (in PCUs)

| Corridor | Peak Hour PCUs (2016) | Peak Hour PCUs (2026) |
|---|---|---|
| Rander – Olpad Road | 3474 | 4595 |

**Improvement Proposal**

Traffic forecast suggest 6 lane divided carriageway for this road section to cater to the future traffic demand. Developments of service roads, Cycle tracks, Pedestrian walk ways (footpaths) are proposed.

### *viii) Katargam Road*

Katargam-Amroli Road is a major radial road connecting central area at Dhastipura to Katargam GIDC in SMC & various villages in SUDA area i.e., Amroli, Kosad etc. It is a four lane divided road with fairly good road surface. During the peak hours this road caters to high traffic with significant bicycle traffic as it is the main connector to Katargam GIDC. There is irregular on-street parking on both sides of the road. Most of the junctions on this road are roundabouts and uncontrolled junctions. Beyond SMC limits, the road is a two lane divided bitumen road.

**Traffic Forecast**

The traffic forecast for the horizon years 2016 and 2026 is as follows (in PCUs).

| Corridor | Peak Hour PCUs (2016) | Peak Hour PCUs (2026) |
|---|---|---|
| Katargam Road | 5596 | 7515 |

**Improvement Proposal**

Traffic forecast suggest 8-lane divided carriageway for this road section to cater to the future traffic demand. Developments of service roads, Cycle tracks, Pedestrian walk ways (footpaths) are suggested.

***ix) Ved Road***

Ved Road is a radial road, which starts at Dhastipura and connects Ved Gam in SMC. This road ends within SMC limits only. It is a four-lane divided road with fairly good road surface. Traffic intensity is medium on this road. Most of the junctions on this road are roundabouts. Textile mills activity is high along this corridor.

**Traffic Forecast**

The traffic forecast for the horizon years 2016 and 2026 is as follows (in PCUs)

| Corridor | Peak Hour PCUs (2016) | Peak Hour PCUs (2026) |
|---|---|---|
| Ved Road | 6059 | 6271 |

**Improvement Proposal**

Traffic forecast suggest 8 lane divided carriageway for this road section to cater to the future traffic demand. Developments of service roads, Cycle tracks, Pedestrian walk ways (footpaths) are proposed.

### 4.4.2 New Links / Missing Links

Surat city has well defined and developed inner ring road around the old walled city area. However, this link needs to be made complete by constructing a missing

portion from New Bridge connecting Adajan to Ved Junction through Island including a bridge over river Tapi. This length is approximately 2.7 Km (Approx). This link will help divert traffic from other bridges and relieve some of the traffic on old city roads and rest of inner ring road. The construction may involve some relocation at city end.

The SUDA master plan has proposed outer ring road, major portion of which will pass through outer areas beyond SMC limits. There is a need to develop another ring known as mid-ring road which will help divert the traffic among the radials and give great relief to inner ring road, walled city roads, and some existing bridges. The mid-ring road do exists in parts, though some missing portion needs to be constructed and some radial roads to be widened. The proposed ROW will be between 30-45 m. The mid ring road will involve constructing 2 bridges across river Tapi : One near Rander Village and other near Adajan – Bhatar.

A partial second mid ring road is also proposed connecting radial routes of Nana Varachha, Bardoli, Navsari and Dumas. The identified missing links and the forecasted peak hour traffic for the horizon years 2016 and 2026 are presented in **Table 4.4**.

**Table 4.4 Estimated Traffic on the Missing Links**

| Name of Link | Peak Hour PCUs (2016) | Peak Hour PCUs (2026) |
|---|---|---|
| Full First Mid ring Road | 5789 | 7524 |
| Second Mid Ring Road (Partial) | 2214 | 3456 |
| Outer Ring Road – E | 6703 | 10069 |
| Outer Ring Road – N | 2625 | 4163 |
| Outer Ring Road – W | 4556 | 6951 |

**Improvement Proposal**

The suggested carriageway configurations for the missing links based on the traffic are presented in **Table 4.5**.

**Table 4.5 Suggested Lane Configuration – Missing Links**

| Name of Link | Lane Requirement - 2016 | Lane Requirement - 2026 |
|---|---|---|
| First Mid ring Road | 3+3 | 4+4 |

| Name of Link | Lane Requirement - 2016 | Lane Requirement - 2026 |
|---|---|---|
| Second Mid Ring Road (Partial) | 2 | 2+2 |
| Outer Ring Road – E | 4+4 | 6+6 |
| Outer Ring Road – N | 2+2 | 3+3 |
| Outer Ring Road - W | 3+3 | 4+4 |

### 4.4.3 River Bridges – Widening/New

At present there are 7 Major road bridges and 1 Rail Bridge across the Tapi River. Some of these bridges have crossed their road capacity and warrant widening. The projected traffic on the existing bridges and the proposed new bridges for the horizon years 2016 and 2026 are presented in **Table 4.6**:

**Table 4.6 Forecasted Traffic on River Bridges**

| Bridge Name | Peak Hour PCUs (2016) | Peak Hour PCUs (2026) |
|---|---|---|
| **Existing River Bridges** | | |
| Magdalla Bridge | 2625 | 4163 |
| Sardar Bridge | 4798 | 6078 |
| Vivekananda Bridge | 2094 | 2572 |
| Nehru Bridge | 3175 | 4124 |
| Weir cum Causeway | 1903 | 2381 |
| Amroli Bridge | 3176 | 4733 |
| Savjibhai Korat Bridge | 894 | 2320 |
| **New River Bridges** | | |
| Ved-Jahangirpura Bridge | 2242 | 3395 |
| Atwaline-Adajan Bridge | 1936 | 2972 |
| Ved-Variyav Bridge | 1897 | 2898 |
| Bridge Near Valak of Outer Ring Road | 4556 | 6951 |
| New Bridge connecting Adajan to Ved Junction Through Island | 3200 | 5300 |

**Improvement Proposal**

The suggested carriageway configuration for the existing and proposed river bridges are presented in **Table 4.7**. The existing and proposed river bridges are shown in **Figure 4.2**.

**Table 4.7 Suggested Lane Configuration – River Bridges**

| Bridge Name | Lane 2016 | Lane 2026 |
|---|---|---|
| ***Existing River Bridges (Widening)*** | | |
| Magdalla Bridge | 2+2 | 3+3 |
| Sardar Bridge | 3+3 | 4+4 |
| Vivekananda Bridge | 2 | 2+2 |
| Nehru Bridge | 2+2 | 3+3 |
| Weir cum Causeway | 2+2 | 2+2 |
| Amroli Bridge | 2+2 | 3+3 |
| Savjibhai Korat Bridge | 2 | 2+2 |
| ***New River Bridges*** | | |
| Ved-Jahangirpura Bridge | 2+2 | 2+2 |
| Atwaline-Adajan Bridge | 2 | 2+2 |
| Ved-Variyav Bridge | 2 | 2+2 |
| Bridge Near Valak of Outer Ring Road | 3+3 | 4+4 |
| New Bridge connecting Adajan to Ved Junction Through Island | 2+2 | 3+3 |

## 4.5 Intersections Improvement

Generally, efficiency of transport is interpreted in terms of operating speeds prevailing on the road section and capacities they attain, with high level of safety and economy. Often they are more governed by the performance of the individual intersections and at times as a whole.

The on going Traffic & Transportation study of Surat city by CRRI has considered 31 critical intersections for improvement. The proposed improvements include geometric improvements, signalization and grade separation.

In light of this, the Consultants have identified 10 critical intersections in discussion with SMC officials other than the intersections considered by CRRI for the short-term

improvement. **Figure 4.3 (Table 4.8)** shows the locations of the intersections identified in the present IPTS study.

**Table 4.8 Identified Intersections for Improvement**

| S. No | Junction Name | Remarks |
|---|---|---|
| 1 | Prithviraj Chouhan Chowk | Topographic Survey is carried out at all the ten intersections and geometric Improvements are proposed. |
| 2 | Mina Bazar Teen Rasta Chowk | |
| 3 | Amroli Chowk | |
| 4 | Kapodara Junction | |
| 5 | Gamatal Nana Varachha Junction | |
| 6 | Puna Jakat Naka Chowk | |
| 7 | GIDC Naka | |
| 8 | Jahangirpura Junction | |
| 9 | Palanpur Jakat Naka Junction | |
| 10 | Vesu Patia Junction | |

The existing features of the above mentioned junctions are discussed below.

**Prithviraj Chouhan Chowk**

This is a very important 4-armed, unsignalized junction on Udhna Road and Althan - Majura Gate Road, the minor arms of this intersection connect to Majura Gate and Althan. The landuse near the junction is mainly a mix of residential and commercial. Two/Three timber marts are located on East- South corner of the junction. Both the intersecting roads i.e. Udhna Road and Althan - Majura Gate Road carry high volume of traffic throughout the day. Sufficient land is not available within the right of way on both the minor roads. The peak hour traffic volume observed at this junction is 14512 PCUs

**Mina Bazar Teen Rasta Chowk**

This is a three-armed signalized intersection on Varachha Road, however the signals are not in operation. The abutting land use mainly consists of high rise buildings with commercial use. The northern arm leads to Mini Bazar. No open space is available for land acquisition for improvement of geometry. The observed peak hour traffic volume at this junction is 10744 PCUs

**Amroli Chowk**

This is a very important unsignalized four-arm junction, which connects the central part of the city with Amroli Bridge over Tapi River. One arm connecting to Amroli Bridge has very high volume of bicycle traffic. The volume of auto rickshaws and personalized modes are also high on this road. The abutting land use at this junction is residential and commercial with high number of hawkers and vendors. The observed peak hour traffic volume at this junction is 9851 PCUs.

**Kapodara Junction**

This is a staggered four armed intersection on Varachha Road. The abutting land use mainly consists of high rise buildings with commercial use. The southern arm leads to Rachna Society Road and northern arm leads to Sunrise Complex. No open space is available for improvement of geometry. The observed peak hour traffic volume at this junction is 9289 PCUs

**Gamatal Nana Varachha Junction**

This is a staggered 5-armed unsignalized intersection on Varachha Road. One arm towards north is very Narrow Street. The abutting land use is mainly residential. The composition of the junction traffic volume consists of high proportion of trucks. The peak hour traffic volume observed at this junction is 8809 PCUs.

**Puna Jakat Naka Chowk**

This is a five armed unsignalized intersection near Puna Octrio Naka. Two arms are divided by Canal running through north-east to south-west and other two arms are main roads of the junction i.e. Sahara Gate- Dhulia Road. Major share of the traffic composition is heavy commercial vehicles. Truck movement is mostly observed on Dhulia -Sahara Gate Road. The observed peak hour traffic volume at this junction is 8334 PCUs

**GIDC Naka**

This is a three armed unsignalized intersection on SH Road called Sachin-Magdhalla Road. The traffic mainly consists of High Commercial Vehicle to/ from Navasari and Hazira Road. The peak hour traffic volume observed at this junction is 5427 PCUs

**Jahangirpura Junction**

This is an intersection of Olpad Road and Ashram Road. The Ashram Road is a small street leading to Asaram Bapu Ashram, ISCON Temple and a small residential slum area. The turning traffic from/ to Ashram road to Olpad Road would be high during certain period of the year due to presence of Asaram Bapu Ashram. The observed peak hour traffic volume at this junction is 3954 PCUs

**Palanpur Jakat Naka Junction**

This is an uncontrolled intersection of Palanpur Main Road and Honey Park Road. The surrounding locality of these two roads mainly consists of low-rise residential building. The peak hour is observed during morning hours, due to the gathering of daily wages workers at this junction, which affects the smooth flow of turning traffic. The peak hour traffic volume observed at this junction is 2540 PCUs

**Vesu Patia Junction**

This is a four-armed intersection. The abutting land use at this junction is open area. Three educational institutions are located in the vicinity which is generating heavy pedestrian traffic especially school children and mini buses. The peak hour traffic volume observed at this junction is 1688 PCUs.

## 4.6 Projected Intersection Volumes

Projected traffic for the identified junctions in the study area is presented in **Table 4.9**.

**Table 4.9 Peak Hour Intersection Volumes**

| S. No | Name of Intersection | Peak Hour Volume (PCUs) | | | | |
|---|---|---|---|---|---|---|
| | | 2006 | 2011 | 2016 | 2021 | 2026 |
| 1 | Prithviraj Chouhan Chowk | 14512 | 17656 | 21481 | 24903 | 28869 |
| 2 | Mina Bazar Teen Rasta Chowk | 10744 | 13072 | 15904 | 18437 | 21373 |
| 3 | Amroli Chowk | 9851 | 11985 | 14582 | 16904 | 19597 |
| 4 | Kapodara Junction | 9289 | 11301 | 13750 | 15940 | 18479 |
| 5 | Gamatal Nana Varachha Junction | 8809 | 10717 | 13039 | 15116 | 17524 |
| 6 | Puna Jakat Naka Chowk | 8334 | 10140 | 12336 | 14301 | 16579 |

| S. No | Name of Intersection | Peak Hour Volume (PCUs) | | | | |
|---|---|---|---|---|---|---|
| | | 2006 | 2011 | 2016 | 2021 | 2026 |
| 1 | Prithviraj Chouhan Chowk | 14512 | 17656 | 21481 | 24903 | 28869 |
| 2 | Mina Bazar Teen Rasta Chowk | 10744 | 13072 | 15904 | 18437 | 21373 |
| 3 | Amroli Chowk | 9851 | 11985 | 14582 | 16904 | 19597 |
| 4 | Kapodara Junction | 9289 | 11301 | 13750 | 15940 | 18479 |
| 7 | GIDC Naka | 5427 | 6603 | 8033 | 9313 | 10796 |
| 8 | Jahangirpura Junction | 3954 | 4811 | 5853 | 6785 | 7866 |
| 9 | Palanpur Jakat Naka Junction | 2540 | 3090 | 3760 | 4359 | 5053 |
| 10 | Vesu Patia Junction | 1688 | 2054 | 2499 | 2897 | 3358 |

### 4.6.1 Intersection Improvement Proposals

Since an intersection involves two or more intersecting roads, there can be conflicting streams of vehicles at intersections. The improvements possible to have a smooth traffic flow are

- Geometric Improvements
- Control improvements like Rotary, Signalization
- Grade separation for through traffic / major movement

It is recommended that all the major intersections are signalized. Grade separators/Flyovers may be built based on traffic intensity, site conditions and environmental acceptability. The important intersections where signalization and grade separators based on traffic intensity are suggested and presented in **Table 4.10**.

**Table 4.10 Required Intersection Control**

| S. No | Name of Intersection | 2006 | 2011 | 2016 | 2021 | 2026 |
|---|---|---|---|---|---|---|
| 1 | Prithviraj Chouhan Chowk | GI + F | TSM | TSM | TSM | TSM |
| 2 | Mina Bazar Teen Rasta Chowk | GI + F | TSM | TSM | TSM | TSM |
| 3 | Amroli Chowk | GI + S | F | TSM | TSM | TSM |
| 4 | Kapodara Junction | GI + S | F | TSM | TSM | TSM |

| S. No | Name of Intersection | 2006 | 2011 | 2016 | 2021 | 2026 |
|---|---|---|---|---|---|---|
| 5 | Gamatal Nana Varachha Junction | GI + S | F | TSM | TSM | TSM |
| 6 | Puna Jakat Naka Chowk | GI + S | F | TSM | TSM | TSM |
| 7 | GIDC Naka | GI + S | S | - | - | F |
| 8 | Jahangirpura Junction | GI + S | S | - | - | - |
| 9 | Palanpur Jakat Naka Junction | GI | S | - | - | - |
| 10 | Vesu Patia Junction | GI | - | - | - | S |

*GI – Geometric Improvements, S – Signalization, F – Flyover*
*TSM – Transport System Management Measures*

All the 10 intersections considered require geometric improvements immediately. 6 intersections are proposed to be signalized and two intersections to be grade separated for the present traffic.

### 4.6.2 Intersection Geometric Improvements

For systematic design of at-grade Intersection it is necessary to study the existing conditions with respect to carriageway, foot path/shoulder, approach widths, flaring, islands, if any, and constraints in the form of physical features, their nature and scope for acquisition of land.

At present, about 10 intersections have been designed. In each case the following aspects have been considered.

- Free path without obstructions for vehicular flow in each direction.
- Adequate turning radii and visibility.
- Minimisation of conflict area with traffic islands.
- Bending of flow path wherever necessary for minimum relative speeds
- Provision of footpath.
- Paint marking for pedestrian crossings; stop line, Centre line and lane markings, obstruction marking and kerb marking.

The problem identification and improvement proposals are presented in the **Table 4.11**.

**Table 4.11 Problem Identification & Improvement Proposals**

| Name of Intersection | Problems | Improvements |
|---|---|---|
| Prithviraj Chouhan Chowk (Bhatar Junction) | - Improper channelization leading to vehicular conflicts on North-South road of the junction.<br>- No facilities for pedestrian<br>- Absence of road signs, markings.<br>- Improper shape of rotary<br>- High intensity of traffic<br>- Huge gathering of daily wages workers in morning hours | - Shifting of median towards backwards on North-South road<br>- Geometric improvements of rotary<br>- Improvement of median on East-West road<br>- Land acquisition at East- West corner of junction |
| Mina Bazar Teen Rasta Chowk | - High intensity of traffic during peak hour<br>- Presence of hawkers on Kamrej- Surat Road reducing the effective width of carriageway for vehicular traffic<br>- Road marking, traffic signs<br>- High turning traffic from/ towards Sardar Vallabhai Statue Road | - Land acquisition at North-East corner of junction<br>- Provision of channeliser for left turning traffic at North-East corner<br>- Provision of median at approach towards Sardar Vallabhai Statue Road<br>- Provisions of road signs at appropriate places and road markings |
| Amroli Circle | - High traffic intensity<br>- Presence of hawkers on all the roads reducing the effective width of carriageway for vehicular traffic<br>- No pedestrian and parking facilities<br>- High turning movement from/ to Chhapra Bhata Road and Utran Road | - Proposed geometric rotary<br>- Land acquisition at all four corners of junction<br>- Proper replacement of all medians<br>- Provision of pedestrian facilities and integration of pedestrian phase for crossing at intersection |
| Kapodara Junction | - High intensity of traffic at peak hour<br>- Presence hawkers on Kamrej-Surat Road reducing the effective width of carriageway for vehicular traffic<br>- No parking facilities for private and IPT mode | - Provision of minimum turning radius at the corners<br>- Provision of footpath, road marking, signs and pedestrian facilities<br>- Relocation of existing median and provide new median at North- South road<br>- Relocation of electric poles |
| Gamatal Nana Varachha Junction | - Considerable intensity of traffic<br>- No facilities for pedestrian<br>- Absence of road signs, markings<br>- High commercial vehicle movement | - Provision of footpath, pedestrian crossing at all four roads<br>- Provisions of medians<br>- Shifting of electric poles<br>- Provision of minimum turning radius at corners |
| Puna Jakat Naka Chowk | - High commercial vehicular movement | - Provision of proper medians, islands<br>- Geometric improvement of existing |

| Name of Intersection | Problems | Improvements |
|---|---|---|
| | - Insufficient sight distance<br>- No pedestrian, footpath facilities<br>- Improper channelisation<br>- Heavy hawkers and vendors activity<br>- Huge gathering of daily wages workers in morning hours | island<br>- Provision of footpath, road marking, road crossing facilities<br>- Land acquisition at West- South corner of the junction<br>- Shifting of existing median backwards at Sahara Gate road and extension of median at Dhulia Road towards junction |
| GIDC Naka | - Absence of footpath, road markings<br>- Absence of pedestrian facilities<br>- Heavy commercial movement<br>- Insufficient capacity of bypass road | - Provision of footpath<br>- Provision of road marking, road crossing facilities<br>- Shifting of median backwards on Navasari Road |
| Jahangirpura Junction | - Absence of median on all roads<br>- Improper geometric shape of the junction<br>- Insufficient road width from all the approaches<br>- Absence of pedestrian, footpath facilities | - Provision of channelisers for left turning movement at Olpad Road<br>- Provision of footpath, pedestrian crossing<br>- Land acquisition at North-West and North-South corners of junction for island and widening of road width |
| Palanpor Jakat Naka Junction | - High intensity of traffic during peak hour<br>- Poor geometrics of the junction especially sight distance<br>- At present, carries low vehicular traffic and expected to grow fast in future years<br>- Presence of street vendors resulting in narrow carriageway | - Land acquisition at Palanpur Road and North- East, East- South corner of junction<br>- Provision of median<br>- Provision of road marking, footpath<br>- Shifting of electric polls<br>- Organized on-street parking facilities away from intersection |
| Vesu Patia Junction | - Considerable traffic movement<br>- Mini buses are more due to presence of many schools in the vicinity<br>- No pedestrian facility, road marking and signs<br>- Medians are absent | - Land acquisition at all corners<br>- Provision of medians, road markings and signs<br>- Provisions of footpath<br>- Shifting of electric poles |

The detailed intersection designs with proposed improvement for all the 10 identified intersections are shown in **Figure 4.4 to 4.13**.

### 4.6.3 Intersection Grade Separation

Grade separation improves the flow by eliminating some conflicts thereby minimizing intersection waiting time and provides adequate space for the vehicle maneuverability under it.

Based on the traffic volumes at various important intersections in Surat, the following intersections are identified for various types of improvement, viz. signalisation, and grade separation (**Figure 4.14**).

*Mina Bazaar Teen Rasta Junction:* Though there is a long flyover at this intersection, traffic below flyover is very high. To maintain smooth flow of traffic, it is required to improve the geometry of intersection (at-grade) and provide signal.

*Prithviraj Chowhan Chowk:* Flyover is required at this junction immediately along with geometric improvements

*Puna Jakat Naka Chowk, Gamatal Nanav Junction, Kapodara Junction, Amroli Chowk:* As per traffic volume these junctions immediately require geometric improvements & signalling, and to be grade separated in next 5 years.

*Palanpur Jakat Naka Junction, Jahangirpura Junction, GIDC Naka:* These junctions require geometric improvements and signalisation

## 4.7 Comprehensive Parking Facilities

The parking problem is generally dealt in two ways.

- Regulation of On-Street Parking
- Development of Off-Street Parking

Since finding adequate vacant space for off-street parking is difficult and costly in the Walled City Area, an attempt has been made towards more rationalised and efficient parking regulation policies with regard to the on-street parking.

So far there are very few legal parking spaces in the Study Area. From the secondary sources, it is estimated that the demand (covering 16 identified corridors) for car parking is 1150 spaces, 7000 spaces for Two Wheeler, 900 spaces for Auto Rickshaw and 2400 spaces for bicycles. No attempt has been made at present to provide parking lots for bicycle parking on any road section in the study area. This has created a tendency to park their cycles on footpaths and other restricted areas

like the near side of intersection. Also Surat being an industrial town the parking demands for LCV, HCV, Luggage Auto and Hand Cart are also significantly high.

### 4.7.1 Alternative Parking Management Strategies for Study Area

For arriving at a suitable and appropriate parking strategy, it may be necessary to consider and analyse a set of alternative policies for parking management in the study area. Accordingly four different policies have been studied which are discussed in detail.

**Strategy - I**

Allow only curb car-parking in the CBD, but charge heavily so as to discourage long duration parking. Provide some parking facilities on the boundaries of CBD at cheaper rates. Also restrict parking on the other roads of CBD where volume has exceeded the capacity of roads. Provide suitable off-street parking facilities (in the core) for all the two wheelers that will be entering the core of CBD and charge for the parked vehicles.

**Strategy – II**

Allow the curb parking of all the vehicles in the CBD but restrict the long term parking with traffic wardens or parking meters and suitably charge for the parked vehicles depending upon the type of vehicle, to discourage long duration parking.

As the priority will be given for the parking of two wheelers, provide suitable on-street parking facilities in the core area itself. For the car parkers, provide parking lots along the boundaries of core. On all the roads where volume has exceeded the capacity, parking is to be strictly prohibited.

**Strategy – III**

Ban the curb-car parking in the core and other roads of the CBD where volume has exceeded the capacity and provide off-street facilities in core itself or along its boundaries, leaving the on-street parking for scooters and cycles.

**Strategy - IV**

Totally ban the parking in the core of CBD, and provide Off- Street parking facilities for all the vehicles on the boundary and provide mass transportation facility for the parkers in to the core and to reach their places of activity.

**Selection of Suitable Policy**

Of all the policies proposed, it is implicit that the Strategy - II is suitable for CBD in Surat town for immediate implementation. This policy of allowing curb parking with suitable time restrictions may be selected for implementation. At the same time suitable off-street parking facilities need to be provided like surface car parking, for long term parkers.

### 4.7.2 On-Street Parking Facilities

The on-street parking, which is presently very dis-organised, needs to be rationalised and organised. It also needs to be laid out in the framework of proposed circulation system. Typical on-street parking plans have been shown in **Figure 4.15 (a) & Figure 4.15 (b)**.

With the introduction of one-way circulation system on certain links of the Central Area network, and other SMC areas there is a possibility of even increasing on-street parking spaces. The recommended guidelines with reference to width of road and traffic circulation are presented in **Table 4.12**.

**Table 4.12 Guidelines for Traffic Circulation and Parking Organisation**

| Circulation Type | Parking Organisation |
|---|---|
| Traffic one-way, road width ≤ 5 meter | No on-street parking |
| Traffic one-way, road width between 5 and 11m | On-street parking on one side only, alternatively on either side on odd and even dates.<br>Parking type to be perpendicular for 2-wheelers and parallel for other modes. |
| Traffic one-way, road width > 11 m | On-street parking on both sides |

- No on street parking upto 15 meters from an intersection edge on all arms.
- No parking near entry to public utility buildings, hospitals, schools etc.

- No parking near entry gates to properties.
- No parking near bus stops, upto 15 m on either side.

On-street parking within Central Area is intense and omnipresent. The predominant modes are 2-wheelers and cycles. Appreciable efforts are being made by SMC to organize on-street parking. This needs to be continued and supported by other measures.

Organised on-street parking needs to be provided within the central area to prevent traffic congestion on narrow stretches and to allow smooth movement of traffic. Parking mainly consists of two wheelers, including appreciable number of cycles and cars. Organized on-street parking will serve the purpose for a short period of time and development of off-street facilities should be taken up in the long run. Following regulatory measures (**Table 4.13**) have been recommended for parking in the Central Area:

**Table 4.13 Parking Regulatory Measures**

| Road Name | Present Scenario | Proposed Scenario |
|---|---|---|
| Inner Ring Road | One side 2W / 4W parking between Lal Darwaja Chowk to Delhi Gate Chowk | There is a proposal of flyover at Delhi Gate junction. After the construction of this flyover parking near Delhi Gate area can be shifted below the flyover. Off street parking would be required near Textile Market |
| | One side 2W / 4W parking between Delhi Gate Chowk to Sahara Darwaja Chowk | |
| | One side 2W / 4W parking between Sahara Darwaja Chowk to Somolai Hanuman Chowk | Multi level flyover construction is under progress along this stretch. After completion of the flyover this parking can be shifted below the flyover |
| | One side 2W / 4W parking between Bamroli Chowk to Majura Gate Chowk | |
| Athwa -Dumas Road | Both side 2W / 4W parking between Athwa Gate Chowk to Parle Point (Eiffel Tower) | Parking demand is very high along this corridor. To meet this demand it is required to identify space for off street parking near Athwa gate |
| Ved Road | One side 2W / 4W parking between Wadinath to Pandle | Parking demand is very high along this corridor. To meet this demand it is required to identify space for off street parking near Athwa gate |

| Road Name | Present Scenario | Proposed Scenario |
|---|---|---|
| Varachha Road | One side 2W / 4W parking between Hirabaug Circle to Vaishali Chowk | Along Varachha Road there is a long flyover, parking on this corridor can be shifted below the flyover. It is also required to identify space for off street parking lot near Mini Bazar. |
| Katargam Road | Both side 2W / 4W parking between Sardar Chowk to Dhanwantri Chowk | Katargam area is mainly industrial and commercial area. Parking demand is very high along this corridor. To meet the demand it is required to identify space for off street parking area on Katargam Road. |
| Udhna-Bhagal Road | Both side 2W / 4W parking between Udhna Darwaja to Putti Chowk | Restrict on street parking. |
| Nanpura Main Road | One side 2W / 4W parking between Nanpura Chowk to Talavedi Chowk | One side parking be allowed. |
| Bhagal area from Delhi Gate to Chowk Bazar | Both side Parking | Restrict on street parking (Kanskiwad Bus Stand area can be used as off-street parking lot) |
| Salasar Hanuman Gate to Sai Darshan Market | On street parking | Restrict on street parking |
| Arround Textile market area | Un-organised parking on the street | One lane parking on both sides. |
| RTO | Both side parking | One side parking be allowed. |

The Ring Road and Varachha Roads have long flyovers. In this area there is great demand for parking. It is suggested that the space below flyovers be suitably utilized for parking. It is recommended that pay & park schemes be introduced to be operated by private operators. Generally long duration parking (>1 Hour) be allowed under the flyover.

## 4.8 Comprehensive Pedestrian Facilities

Segregation of vehicular and pedestrian movement both along and across the traffic flow improves the capacity of the road with increased safety of pedestrians.

The main objective of pedestrian crossing facilities is to enhance the safety of pedestrians who cross the road in between the moving vehicles, at locations of

higher pedestrian concentration. Safety of school children and handicapped is to be given top priority for provision of these facilities.

Consultants recommend pedestrian crossing facilities like mid block zebra crossing, zebra crossing with speed breakers, guard rails at Intersections and mid blocks, pedestrian signals at mid blocks, intersection signals with pedestrian phase and deployment of traffic police in critical locations.

**Pedestrian Facilities (at level) without structural element**

- Footpaths along the corridor with raised guard rails
- Zebra crossings at Median openings
- Zebra crossing at Intersection approaches (with / without pedestrian phase)
- Zebra crossing with Mid-block signals (pelican Signals)

**Pedestrian Facilities with Grade Separation**

- Pedestrian Subways / Pedestrian + Light Vehicle Subways
- FOB /Deck
- Low Level Flyover

### 4.8.1 Provision of Footpaths

All arterial & sub-arterials have to be provided with footpaths (minimum of 1.5 m extending up to 2.5 m) with 1.2 m high raised guard rails.

The following action plan is proposed for providing the footpath facilities:

- Removal of all encroachments from the footpaths, wherever applicable
- Providing adequate footpath/ footpath space delineated either with kerb stones only or kerb stones & guard rails depending upon the vehicular and pedestrian traffic. The Consultants have developed guidelines to select the requirement of delineation of footpath space and carriageway either by kerb stone or kerb stone with guard rails. These guidelines are presented in **Table 4.14** and the same are followed in proposing the footpath facilities for the identified roads and junctions, which need improvements immediately.

**Table 4.14 Guidelines for Proposed Footpath Facilities**

| Traffic Volume on the Road | Pedestrian Volume along the roads | Delineation of carriageway and footpath/ footpath space by |
|---|---|---|
| **Road with existing footpaths** | | |
| High | Low | Sufficient footpath facility only |
| High | *High* | Sufficient footpath facility with guard rails |
| Low | Low | Sufficient footpath facility only |
| Low | High | Sufficient footpath facility with guard rails |
| **Road without existing footpaths** | | |
| High | Low | Kerb stone only |
| High | High | Kerb stone with guard rails |
| Low | Low | Kerb stone only |
| Low | High | Kerb stone with guard rails |

### 4.8.2 Controlled Pedestrian Crossings at Intersections (Pedestrian Phase)

Controlled pedestrian crossing facilities like pedestrian signals at following important intersection have been proposed and the control for pedestrian crossing at these intersections is to be integrated with traffic signals.

- Mina Bazar Teen Rasta Chowk
- Puna Jakat Naka Chowk
- Prithviraj Chouhan Chowk
- Kapodara Junction
- Gamatal Nanav Junction
- Jahangirpura Junction
- GIDC Naka
- Amroli Chowk
- Suryapur Circle
- RTO
- Saraswati Vidyalaya
- Katargaon
- Singanpur Chowk
- Ramji Nagar
- Delhi Gate
- Sahara Darwaza
- New Lucky Market

### 4.8.3 Controlled Pedestrian Crossings at Mid-block locations (Pelican signals)

Mid-block signal are required to be provided at major pedestrian activity areas across the major radial corridors. This pelican signals improve the safety of the pedestrian crossings. Pelican signal are required on the following corridors.

- Varachha Road at Mini Bazar
- Bardoli Road at New Bombay Market and APMC Market
- Navsari Road
- Udhna – Magdalla Road
- Dumas Road
- Adajan Hazira Road
- Rander Olpad Road
- Katargam-Amroli Road

### 4.8.4 Pedestrian Grade Separators

***Pedestrian Subways***

The important locations where the pedestrian subways are proposed are listed below. However, the engineering feasibility is to be examined before finalizing the locations.

- Athwa Gate
- Gujarat Gas Circle / Anand Mahal Road on Adajan – Pal Road
- Mini Heera Bazar Road
- Udhna Gate
- Delhi Darwaja
- Sahara Darwaja

***Pedestrian FOB***

Following tentative locations are proposed for provision of pedestrian cross movement facilities through FOB

- Surat Railway Station
- Peoples Bank on Katargam Road
- New Bombay / Fruit Market on Bardoli Road
- Ramnagar on Rander Road
- Saraswati Vidyalaya on Ashwani Kumar Road
- Kapodara Fire Junction
- Sargam Shopping Centre

- Majura Gate / RTO Junction
- Ambika Niketan / Parle Point
- Bhatar Char Rasta
- Udhna Gam Tal on Navsari Road
- Bhestan on Navsari Road
- SMC Hospital / College on Bardoli Road
- APMC on Bardoli Road
- Adajan Patia
- Navyug College
- Palanpur Patia on Rander Road
- Chowk
- Socio Circle
- Vanita Vishram on Dumas Road
- Rangila Park on Goddod Road

## 4.9 Develop and Integrate Para-Transit and Private Bus infrastructure facilities

Para transit includes auto rickshaws (Three seater, Six seater), taxis and private busses operated by private parties. About 55,000 auto rickshaws ply in Surat city at present which brings out the importance of the regulation in issues like fares, over loads, auto stands, observance of traffic rules, parking and route fixation etc. Private busses currently operate only as intercity services.

### Para Transit Systems

In the context of growing travel demand within urban areas, the multi-dimensions of trips performed and the constraints on public resources, it is important to recognize the role of para transit and incorporate them in the planning and development process. Basically para transit system plays all the three roles –Basic, Supplementary & Complementary. In the case of Surat, presently the para transit system, in the absence of a regular public transport system, is performing the basic role. However it is proposed that during the course of time, when Surat does get a regular public transport system as envisaged, the para transit's role would become more of supplementing the system on major corridors in the peak hours and to complement the public transport by acting as feeders for collection and distribution to and from public transport in the peripheral areas. However they would continue to perform the basic role in central area, particularly around activity nodes.

Since the para transit system would continue to perform a major role in the mobility of Surat city in the future also, it is recommended that various promotional measures needs to be implemented for a proper and integrated development of para transit

system. Some of these are:-

*1. Planning Measures*

There is a need to incorporate the role of para transit system in the transport planning process and allocate needed infrastructure at appropriate locations to make their operation efficient. Future Planning should forsake the bias against them and enable an integrated and coordinated operation of these modes.

*2. Monetary and Fiscal Measures*

There is a need to provide for institutional finance and make its access easy and simple for promoting the growth of para transit system.

*3. Technology Upgradation Measures*

There is a need to review the present rules and regulations in order to make the growth and operation of para transit modes more rational

*4. Education Measures*

There is a need to impart education programmes to the operators of para transit system to instill a sense of responsibility amongst them and to make their operations safer.

### 4.9.1 Privatized Stands for Para Transit modes

In the integrated transport network concept, para transit stands are very important components as they enable integration between the different modes of the system. A large number of autos, taxis presently seen parked on carriageway will go off-street in defined fashion. The objective is to organize the para transit vehicles in a hierarchy and locate them at proper places.

**Auto Stands**

- For every 2 km one Auto stand be provided along each major radial corridor with a standing capacity of 30 autos along with proper flaring for in & out operations and other facilities.

- As Ring Road acts as major traffic distributor/transfer corridor between radial corridors and central area, auto stand be provided at every major junction with minimum interference with the junction traffic.

- The locations where auto stands are in operation and enough space is available need to be fully developed. Identified such spaces are: Auto stand near Chowk, near Railway Station, Sahara Darwaja, Adajan Patia and Udhna Darwaja.

## 4.10 Transport System Management Measures

With the concentration of activities within the central area and along corridors, coupled with inadequate capacity of the road network to meet the growing parking demands, there is a need to balance between the traffic needs and capacity. Preparation and implementation of Traffic Management Plan (TMP) offers the best strategy.

It is recommended that TMP be prepared on area basis and corridor basis. The TMP should include the circulation system, segregation and minimizing of conflicting movements, priority for high occupancy vehicles, appropriate geometric design and installation of control systems at intersections, identification and provision of facilities for pedestrians, identification and allocation of parking areas, provision of traffic signs, lane markings etc. and a concerted program of enforcement and education.

The existing traffic management measures and the additional recommendations are elaborated in the following sections.

### 4.10.1 One Way Movements

**Prevailing One Way Movements**

Presently some of the roads operate as one-way streets in the walled city. The list of roads and direction of one- way movements are presented in **Table 4.15**.

**Table 4.15 Prevailing One Way Movements**

| Direction | Road Name/Area | Existing One-Way Movement |
|---|---|---|
| N – S | Road Section between Ved Junction and Bhagal Chowk | From Darga to Bhagal Chowk |
| W – E | Chowk Main Road | From Bhagal Chowk to Delhi Gate Junction W-E movement is made one way for only 4 Wheelers. |
| N – S | Walled City Area | From Gopi Lake Junction to Udhna Darwaja. |
| S – N | Walled City Area | From Udhna Darwaja to Gopi Lake Junction. |

Though in general the network pattern in Surat is ring and radial, there are grid pattern formed in each sub zone bound by more or less parallel arterial and sub-arterial roads. The one way system be introduced on each of such parallel road pairs, which are not divided. This will increase the speed; makes better utilisation of available lanes, provide for parking & facilitate junction output as few turns are eliminated.

### 4.10.2 Turning Movement Restrictions

Number of lower order roads (like collector roads and sub-arterial roads) meets the ring road and radial roads forming 'T' or cross intersections. The turning movements especially right turns complicate the signal phasing schemes and cause delays. It is suggested that right turns be restricted alternatively at all such junctions.

In case of the provision of service roads along the radial arterial roads, the restriction on right turning movement need not be considered.

### 4.10.3 Modal Restrictive / Access Control Measures

**Existing Measures**

- At present Chakadas are completely banned from the SMC. They mainly operate from SMC boundary connecting the surrounding SUDA villages.

**Proposed Measures**

- Plying of heavy goods vehicles be completely restricted in walled city area between 8.00 AM to 12.00 noon and 4.00 PM to 9.00 PM.
- Four wheeler Private cars be discouraged on wall city main roads by banning on-street parking between 8.00 AM to 3.00 PM.
- Animal drawn vehicles and hand cart should be banned on Ring Road, Radial Arterial Roads (approximately 2 km radially along, from Ring Road) during morning and evening peak hours.
- Loading/Unloading for wholesale trade be restricted during morning/evening peak hours in front of major market areas.

### 4.10.4 Public Transport / Intermediate Public Transport

**Intercity Bus Movement**

The main operators of road based Intercity Public Transport is GSRTC and Private operators. The major intercity movements are either towards north connecting Ahmedabad or towards south connecting Mumbai. Sahara Darwaja and Intercity Bus Terminal near Railway Station have become major terminal points for intercity traffic.

The GSRTC buses originate and terminate at Intercity Bus Terminal located at Surat Railway Station and private bus operators are concentrated at Sahara Darwaja. Generally these buses pick up and drop from this location.

The south side moving traffic will enter Surat from Bardoli Road or Navsari Road and disperse back along the same routes. And north side moving traffic will take Varacha Road and traces back along the same road.

Apart from this, contract buses operate from Adajan Patia to Hazira, which serve the Hazira industrial employees.

**Intra-city Auto (3-Seater) Movement**

The major IPT stands are located near Chowk, Sahara Darwaja, Udhna Darwaja, Adajan Patia and Station. The autos cover all the routes in the SMC area. Most of the autos operate on CNG fuel making cost of operation cheaper. Most of the autos operate with shared system without any permit route schemes.

Some of the important sections are presented below.

- Station to Adajan
- Station to Bhatar
- Station to Varacha
- Station to Chowk
- Adajan to Rander
- Adajan to Beyond Bulka Bhavan
- Udhna to Navasari side
- Chowk to Katargam

**Intracity Chakada (6-Seater) Movement**

- Operates from SUDA villages to periphery of SMC

### 4.10.5 Need of Flexi Hours

The main job centres are Industrial Area, Textile Mills, Diamond cutting, various wholesale markets, govt./semi-govt. offices, private offices etc. Most of these centres are widely distributed and there is no unduly concentration. The peak hour traffic flow percentage is also not very high. Thus there is no need & scope for adopting staggering working hours.

### 4.10.6 Co-ordinated traffic signals on radial roads

Numbers of major intersections are located on the radial roads some of which are signalised and some of which are uncontrolled. These have become bottleneck points causing delays and hardships to inter-zonal & external traffic. It is recommended that all major intersections be provided with signal control which should by co-ordinated ensuring smooth flow in major direction. However, a detailed feasibility study is required for implementing the co-ordinated traffic signal system in Surat.

### 4.10.7 Traffic Signs and Markings

A number of traffic signs i.e., informatory, mandatory and warning signs are suggested at various locations in the central area for easy understanding of the regulations by the road users and for strict enforcement of the proposed traffic and parking regulations. **Figure 4.16** shows the various types of traffic signs to be located in the study area.

Road signs such as “No entry”, “One Way”, “No parking”, “ODD/Even parking”, ”No right turn”, “Pay and Park”, “No U Turn”, ”Speed Limits” etc. will be erected at all

appropriate locations. Similarly, all the roads particularly sub-arterial and arterials to be provided with pavement marking such as lane marking, turning arrows, stop lines, zebra crossings etc.

# Chapter 5.0
# Transport System Development Programme - IPTS Based Developments

## 5.1 General

In view of accelerated growth of Surat in terms of population, size, activity concentration, increase in trip rates due to economic development, the city will experience high traffic demand. Supply based improvements are impossible due to constraints of limited resources, energy shortages and deterioration in environment quality. Therefore the policy on public transport and its system planning, operation and management becomes the backbone of the transport system plan.

For Surat Municipal Corporation area, with the growing traffic demand, the introduction of Bus Mass Transit System is considered to be first step of transport system plan. With further increase in demand in the horizon year, Rapid transit systems like Bus Rapid Transit System (BRTS) and/or Light Rail Transit System (LRTS) are considered for augmenting the public transport system.

The corridors that are suitable for the each system, requirements of terminal, depot and stop/station facilities are detailed in this chapter. Chronological phasing of each is derived and presented in Chapter 6.

Mass Transport System Improvements proposed in this chapter are complimentary to road based improvements proposed in Chapter 4 and can be considered simultaneously. IPTS is a stand alone development alternative which can be considered either without or after the completion of road infrastructure improvements.

## 5.2 System Selection

### 5.2.1 Public Transport System

A well planned, intra-urban public transport arrangement in a city should cater to traffic requirement of different corridors and all modes of transport like buses, light rail transit, light rail medium capacity rapid transit (LRV) and mass rail rapid transit system (MRTS). The light rail rapid vehicles (LRVs) and mass rapid transit cars (MRTS) would connect the central business districts and commercial centres from different parts of the city. Light rail rapid transit should be planned for corridors with peak traffic demand of 15,000 to 30,000 PHPD and mass rapid transit systems (MRTS) for 30,000 PHPD and above.

The traffic assessment on different corridors is the starting point of planning of a public transit system and should be made over a span of 20 years. Based on the growth of traffic and the traffic demand in the horizon year and the proposed route alignment, transit system is selected. But the infrastructure like viaducts, track structures, station buildings and platforms, signaling system, power supply and current collection system, maintenance facilities can be built up in stages. The design and characteristics of rolling stock and the operating policy have an important bearing on the overall system design of not only the infrastructure but also on the recurring operating cost especially the energy cost and maintenance cost. These factors finally determine the fare structure and government subsidy.

### 5.2.2 Criteria for System Selection

Major considerations for selection of appropriate public transport system are:

1. Peak hour demand on major corridors
2. Demand in non peak direction
3. Geographical spread of the city
4. Average trip length & trip length frequency
5. Trip generating land use distribution – concentration of CBD, Residential area, Industrial areas, recreational centres, shopping malls, rail terminal, etc.
6. Network characteristics in terms of ROW, carriageway width, horizontal curves, gradients.
7. Affordability of the general users
8. Value of time/comfort for residents
9. Intercity connectivity
10. Institutional / organisational capacity

### 5.2.3 Travel Demand Characteristics

SUDA area has unique job potentials. It has the traditional industrial units like textiles, engineering, small scales, Diamond cutting etc. Over the years the trading activities is on the rise and many malls, complexes dealing exclusively in diamond, jewellery, textiles, electronic goods have come up. Due to proximity to Hazira Port, the export import based industries are being set up in the vicinity of Surat. The city also accommodates major educational institutions including south Gujarat University.

The economic prosperity of the city is evident in newly developed high income high rise apartments. Most of the major land use activities have concentrated in certain

selected locations spread all over. This is evident in the well-defined trip patterns which are amenable for Public Mass Transport System.

Surat is fortunate to have a network of wide roads. The ROW of major arterial roads is about 45 to 60 m. Recently many flyovers have been added. Enough vacant lands are available in the outskirts of Surat for locating terminals, depot etc.

The travel demand on public transport system by 2026 is estimated at 22.8 Lakhs of trips per day with almost equal (48:52) share by PT & IPT modes. The increase in demand by public transport stresses the need for concerted efforts in planning and developing the system.

The peak hour passenger boarding on the proposed mass transit system in the horizon years 2016 and 2026 have been estimated as under.

***Year 2016 (Scenario III)***

BMTS & BRTS : 1,52,815

***Year 2026 (Scenario IV)***

BMTS & BRTS : 2,14,966

The various available Mass Public Transit Systems are reviewed and their suitability to Surat is studied and appropriate systems with efficient and effective performance are identified. The details are presented in the following sections.

### 5.2.4 Alternative Public Mass Transit Systems (PMTS)

A good and efficient multimodal, integrated PMTS is the answer for promoting mobility of all the sections of the people in an economical, affordable and sustained means. PMTS is also important to conserve resources, promote safety, protect and enhance environment quality to ensure sustainable development of the city. PMTS reduces the increasing usage of private vehicles and results in saving in travel time and vehicle operating cost (VOC).

**Spectrum of Choice of PMTS**

There is a spectrum of choice of different technologies of PMTS available for selection. System selection needs to be made with care and due deliberation. The factors to be considered are:

- capacity
- costs (initial and life cycle)
- impacts
- safety
- reliability
- comfort
- environment friendliness
- efficiency
- attractiveness
- accessibility to physically challenged

**Technology Alternatives**

Presence of diverse socio-economic groups in the city of Surat is reflected in the diverse modes of transport present on all roads. Public transport must be seen not as poor person's option but as an instrument to meet the deferential needs of the different classes of people residing in the city. Residences and work places should ideally be planned along transport corridors where public transport is given priority over private transport. The technologies generally suitable for cities like Surat are Bus Mass Transit System, Bus Rapid Transit System and the Light Rail Transit System.

**Figure 5.1** presents the suitability of different technologies related to demand levels.

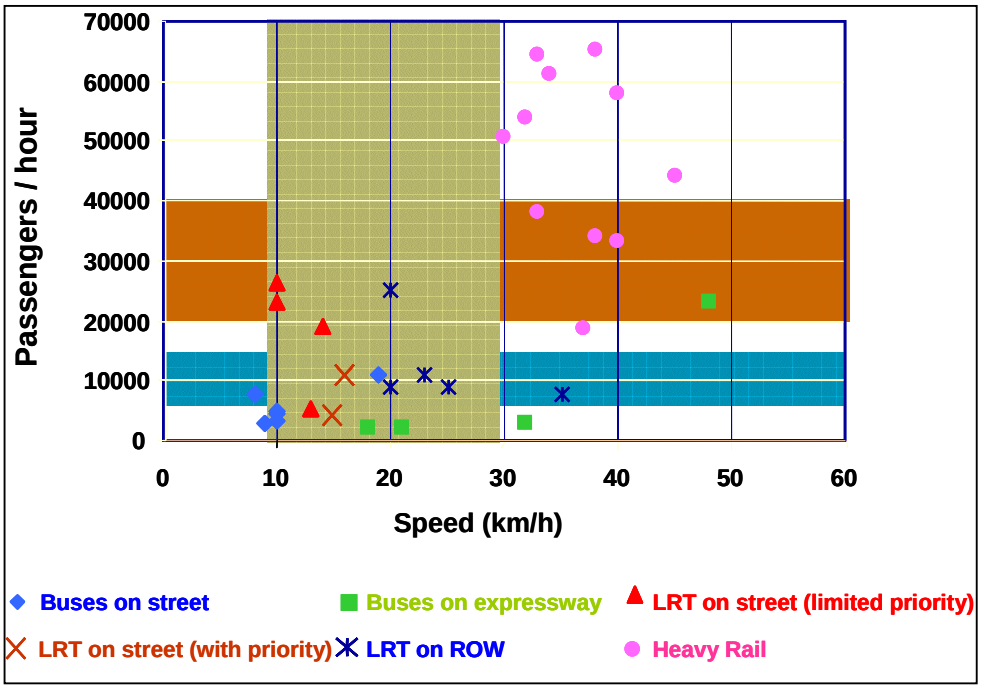



**Figure 5.1 Suitability of System and Passenger Loads**

### 5.2.5 Bus Mass Transit System (Mixed with Normal Traffic)

A bus transit system consists of motor buses or trolley buses. Their routes, frequencies, fares, and stopping places are generally prescribed and are subjected to various levels of government regulations. Fares may be uniform flat fares or based on zones or distances, and are usually collected on board the vehicles by conductors.

Trolley bus systems, however, lack the flexibility of conventional bus transit because they are constrained by their overhead power transmission system, and involve considerably higher costs. The trolley buses can be considered as a low cost, non polluting solution for high volume corridors. With the development of hybrid buses, which can operate with and without over headlines, this option is likely to get more attractive. The introduction of hybrid buses will make the bus based option very flexible also.

***Physical Characteristics of Bus System***

A bus based transit system can operate under three environments:

1. Under Mixed Traffic

2. Bus Lanes
3. Exclusive Bus Lanes

**1. Under Mixed Traffic**

In mixed traffic conditions, buses share the same road space with other vehicles. Their speed, capacity, reliability and quality of service are largely influenced by other vehicles. This environment has the limiting factors like the amount of stopping space for boarding and alighting and terminal facilities. Journey speeds under mixed traffic conditions is likely to be in the region of 12 km/hr.

**2. Bus Lanes**

Bus lanes are reserved spaces allocating priority to buses over other forms of transportation through the use of painted lines and signs. Private vehicles may use the lanes during non peak hours only. However due to lack of hard barriers, the bus lanes are susceptible to private traffic. Journey speeds under these conditions is in the region of 20 km/hr.

**3. Exclusive Bus Lanes**

These are bus expressways physically separating buses from other traffic flow through the use of median strips and barriers, with grade separation or priority at intersections. In general, off-line stations with terminals are provided with multiple platforms for boarding and alighting. Average journey speeds under these conditions is about 30 km/hr.

### 5.2.6 Bus Rapid Transit System

Bus Rapid Transit system can provide high quality, metro like transit service at a fraction of cost of other options. BRT is proved as high quality customer oriented transit that delivers fast comfortable and cost effective urban mobility. It incorporates most of the high quality aspects of underground metro system without the high costs. BRT systems are thus also known as “surface metro” systems in many parts of the World.

The experience of Latin – American cities like Curitiba, Bogota, etc. have catapulted the ubiquitous road based bus system into the forefront of PMTS technologies. The bus system, with conventional buses of low and medium capacity, operating in highly congested mixed traffic is subject to many constraints resulting in poor performance,

low productivity, inefficient service, reducing patronage and continual losses. Curitiba and other cities have transformed their performance and changed the perception. They have demonstrated that given a BRTS system, a dedicated right-of-way and innovative operational and management practices can efficiently cater larger volumes of demand, up to 20,000 person per hour per direction (PHPD) at lower costs and equivalent levels of service as compared to rail based technologies.

The essential features of a BRT are:

- Large capacity buses. Low floor. Wide doors
- Dedicated bus ways
- Traffic signal priority
- Convenient and rapid fare collection (Preferably off board)
- Limited stops
- Improved stations and shelters
- Intelligent Transportation System Technologies
- Cleaner and quieter vehicles
- Higher Flexibility (than Light Rail)
- Ability for phased development (Incremental development)
- Potential as an interim system

The benefits of BRT system identified are as under

- Attracts Higher Ridership and revenues
- The system is Cost Effective
- Increases Operating Efficiency in serving transit passengers.
- Transit-Supportive Land Development and increase in value of properties
- Results in Improved Environmental Quality
- The ability to attract riders from the automobile can help reduce or limit the growth in congestion.
- Improves economic productivity
- Providing mobility alternatives and improving transit-supportive development can improve the quality of life of a city.
- Providing additional mobility choices can enhance the pool of employment opportunities a regional population can pursue and reduce costs associated with more expensive modes. Retail establishments and other businesses benefit from increased sales and labour force availability.
- Transit investment has direct positive impacts on employment for the construction, planning and design of the facilities.

### 5.2.7 Need and Choice for a Mass Rapid Transit System

Mass transit system is the backbone of any city transport system as the absence of such a system forces people to use low capacity vehicles which require considerable road space, cause road congestion, are not energy efficient, burn liquid fuels (mostly imported) and cause air pollution. In Mumbai the suburban network of Central & Western railway has become the *lifeline* of the city and carries around 6.5 million passengers on a working day. The system also provides an affordable transport for the daily commuters.

Road based mass transit system is generally suitable for demand levels upto 10,000 PHPD. When the demand exceeds 5000 PHPD and is expected to increase beyond 10,000, planning for rail based alternative should be started. For demand levels exceeding 25000-30000 PHPD the Heavy Rail Metro system is generally considered more appropriate. For demands between 5000 and 25000, Light Rail Transit (LRT) system becomes relevant. The mode of mass transit system has to be decided by the current demand and the future demand with possibility of up-gradation in future, if necessary. The Right of Way should be kept reserved keeping in view the future requirements so that the up-gradation/ augmentation can be done when necessary.

Urban transport demand consists of intercity, suburban and intracity demands. This demand has to be met by different modes in an integrated manner (integration between various modes of public transport, between public and personal transport, between urban and intercity transport etc.). Interchange should involve least physical effort and time penalty. Attention has also to be given to approaches to the MRT stations so that commuters need not spend long time in gaining access to MRTS.

Rail based transit systems use rails for both support and guidance and may be broadly classified into two main categories;

- Light Rail Transit
- Mass Rail Rapid Transit

Light rail transit systems are widely used for intra-urban transit and may be further divided into the following types.

1. Tramway: Simple trams or street cars on fixed grooved rails embedded in the ground flush with the road and usually operating as single units in mixed traffic.

2. Light Rail: Light rail articulated low floor vehicles generally operating in consists of two or three Tram (LRT) units on street at grade or segregated right-of-way.
3. Light Rail: Light rail articulated vehicles operating in consists of three or four units on exclusive right of Rapid Transit way either on surface, on viaduct or in underground tunnels and provide fast and efficient (LRV) medium capacity transit service.

### 1. Tramways

Tramways generally operate in single units along streets in mixed traffic with minimum headway of one minute and are able to carry 6000 to 7000 passengers per hour per track. Journey speeds are about 12 km/h. This capacity can be increased to 10,000 passengers if the vehicles are larger in size or carry a trailer and run on segregated right of way. In the past, Delhi, Mumbai, Chennai had the tram cars plying on the roads but now Kolkata is the only city which has the tramways. In congested down town areas the performance is very poor and rows of trams laid up at peak traffic hours can be seen but on wider streets with less interference from other traffic it provides a good and fairly fast service. However, they are not considered suitable in view of limited capacity under mixed traffic and higher capital investment in infrastructure (compared to buses).

### 2. LRT System

Light Rail Transit System, is a modern rail based, medium capacity urban transit system with technological features. It can operate on surface with mixed traffic, on elevated viaducts and in underground tunnels. It can negotiate sharp curves and steep gradients and hence can fit into the existing road network pattern. It offers a large range of capacity. It has the advantage of being environment friendly. It promotes urban form and structure in desired directions. Though initially costs are high, life cycle costs are low as compared to bus system. It doesn't consume road

capacity at the cost of other modes as in the case of BRT. It is a widely operated system in many cities and has rich operational experience. The technology is being adopted and developed in many cities of developing countries like Bangkok.

LRT system usually operates on tracks along streets and has a segregated right-of-way over all part of their routes. They may be given priority signals at inter-sections or grade separated. The vehicles have low floor and passenger board at stops either from road level or from low level platforms. Running on exclusive street track with grade separated inter-sections, LRT can provide a capacity of 15,000 to 20,000 passengers per hour in one direction. Journey speeds of 25 km/h may be achieved.
The main features of a Light Rail Transit System are:

- Metropolitan – electric railway system
- Can operate in a variety of environments (on street, elevated structures, in subways)
- High capacity of cars
- Capacity of train can be varied (2/3/4/6 cars)
- High visibility
- Environment Friendly
- Impact on city form and structure
- Can negotiate steep gradients and sharp curves
- High initial capital costs. Low life cycle costs
- Operating costs comparable to BRT

### 3. Light Rail Medium Capacity Rapid Transit System (LRV)

LRVs have a very wide application and generally operate on surface and on viaducts with exclusive right-of-way, but may go underground in tunnel while passing through down town area or in front of historical buildings/monuments. The vehicles consist of two cars with three bogies and a single articulation of three cars with four bogies and double articulation. Three or four vehicles are coupled to form a train. A 29m long 2.65m wide LRV with a single articulation has a capacity of 300 passengers (20% seated) under dense crush loading of 8 passengers per square metre. A train of 4 vehicles running at headway of two minutes could provide a maximum traffic capacity of about 36,000 passengers per hour in one direction.

Light weight car construction and its smaller size enable considerable reduction in its tare weight and the load per axle is limited to a maximum of 10 tonnes. Therefore, the viaduct superstructure is lighter and it can be supported on a single column in the middle of the road leaving adequate spaces for road vehicles. The articulation

permits the LRV to negotiate sharp curves and, therefore, they can follow street alignments. The vehicles are designed for maximum speed of 80 km/h and can achieve scheduled journey speeds of 33 km/h to 35 km/h with an average station distance of 1 km. The LRV transit system generally meets the traffic requirement of cities with a population of upto 6 million.

### 4. Mass Rail Rapid Transit System (MRTS)

Mass rail rapid transit is usually designed for mass transit with peak hour capacity of 30,000 passengers in one direction and above. The cars are of larger size and have two bogies. A 22 m long, 3.2 m wide car can accommodate about 360 passengers (20% seated) under dense crush loading and are coupled to operate in trains of eight cars or more. With headway of two minutes-they can cater for a capacity of about 70,000 to 80,000 PHPD. However, the MRTS cars are heavy with maximum axle loading of 15 to 16 tonnes and therefore do not fit into urban environment and elevated structures with sharp curves. The MRTS invariably run in tunnels involving heavy expenditure. The cars are designed for a maximum speed of 80 km/h and operate at a scheduled speed of 33 km/h to 35 km/h.

### 5. Design of Light Rail Rapid Transit Vehicles (LRV)

LRVs run in congested areas mostly on elevated structures and follow street alignments. Very often sharp curves are provided to avoid dismantling of nearby fixed installations or to provide adequate clearances. The viaduct structure should be light so that the deck can be supported on a single column leaving enough space on the street for pedestrians and other street vehicles. The LRV design takes into account these aspects. LRVs generally comprise two cars supported on two bogies at the ends and one in the middle with an articulation joint which enables rotation at curves with radius as sharp as 25m. The vehicle end overhang is normally of the order of 4 to 4.5 m with tapered profile to provide adequate clearance from line side installations. The individual car length is decided to limit the body throw in the middle and the bogie centre distance is limited to 10m. LRVs of optimum length of 28.5 m to 30m and width of 2.65 m and the height of 3.4m will have a passenger capacity of 300 passengers (20% seated) under dense crush loading. Wider cars may be desirable from the point of passenger capacity but would increase the viaduct width and increase the loading on the column.

One essential requirement of LRVs is light weight construction to achieve economy in construction of guide way especially elevated guide way structure to minimize infrastructure cost and economy in energy consumption. LRV of above size will have

a tare weight of about 40 tonnes and maximum axle loading not exceeding 10 tonnes. The floor height is above 1 m in order to accommodate the equipment below the under frame so as to release space to accommodate more number of passengers. Mounting of equipment on the roof is not desirable to avoid direct heat from sun's rays.

**6. Mass Rail Rapid Transit Cars (MRTS)**

Mass rail transit caters for heavy traffic levels above 30,000 passengers per hour. The cars are, therefore, longer and heavier and cannot be run on alignments with sharp curves. Generally, the curve radius is more than 200 m. MRTS cars have an optimum size of 22m in length 3.2 m wide x 3.6 m in height with a floor height of 1.1m and are also constructed with light weight materials. Tare weight is of the order of 40 tonnes and each car carries about 360 passengers (20% seated) under dense loading and the axle load will be of the order of 15 to 16 tonnes.

### 5.2.8 Systems Evaluation

Initially Standard Bus System is proposed in major passenger demand routes, which further enhanced by adding additional busses along medium demand corridors with regard to social concerns.

The capital costs that involve in bus system are much lower than the rail based system, makes this development a viable even though the ridership is insufficient in some of the social routes.

The maximum PHPD, a system can serve is presented in **Table 5.1.**

**Table 5.1 Criteria for System Selection**

| S.No | System | Maximum PHPD | |
|---|---|---|---|
| 1 | BMTS with mixed traffic condition | 1000 | 5000 |
| 2 | Surface BRTS | 5000 | 10000 |
| 3 | Surface LRTS | 10000 | 12000 |
| 4 | Elevated LRTS | 12000 | 30000 |

Peak hour total passenger loadings on various corridors are presented in **Table 5.2.**

**Table 5.2 Corridor wise Passenger Loadings (Boardings)**

| Route No | IPTS Corridor | Peak Hour Passenger Boardings | |
|---|---|---|---|
| | | 2016 | 2026 |
| **High Demand Corridors** | | | |
| 1 | North South Corridor (Unn to Ved Gam) | 33726 | 46187 |
| 2 | East West Corridor (Magdalla to Kosmada) | 20426 | 31359 |
| **Potential Corridors** | | | |
| 1 | Railway Station to Navayug College, Housing Board,Rander,Jahangirpura | 6560 | 8923 |
| 2 | Railway Station to Varachha –Sarthana | 7609 | 10595 |
| 3 | Chowk to Kosad | 5187 | 8449 |
| 4 | Adajan Patia to Palanpur Jakatnaka | 2797 | 3753 |
| 5 | Railway Station to Udhana Dindoli | 6397 | 9379 |
| 6 | Ring road - Station – Chowk (Circular Bus both sides) | 3713 | 4724 |
| 7 | Railway Station to Godadra | 4145 | 6484 |
| 8 | Railway Station to Makkaipul-Adajan | 2088 | 2840 |
| 9 | Railway Station to Gujarat Housing board Pandesara | 3391 | 4985 |
| 10 | Ghoddad Road | 2871 | 3606 |
| 11 | Station to Virkavi Narmad (South Gujarat) University | 2185 | 2864 |
| 12 | Adajan to Bhesan | 2807 | 4328 |
| 13 | East side of the station to Punagam to & fro | 2511 | 3395 |
| 14 | Railway Station to Chowk – Ichahanath | 2122 | 2736 |
| 15 | Railway Station to Nani Ved | 4859 | 6547 |
| 16 | Railway Station to Lambe Hanuman | 1882 | 2415 |
| 17 | Railway Station to Fulpada, Katargam,Wadifalia | 4077 | 5350 |
| 18 | Railway Station to Saraswati Vidyalaya-Hirabag circle –Railway Station | 3161 | 4030 |
| 19 | Adajan to Hazira Side | 2886 | 4243 |
| 20 | Rander Bus stand- SVR college- Dumas- Langar | 3182 | 4230 |
| 21 | Railway Station to Puna- Kumbharia | 1989 | 3076 |
| 22 | Chowk to Katargam, Kanteshwar Mahadev, Amroli | 3542 | 5057 |
| **Medium Demand Corridors** | | | |
| 1 | Chowk to Unn- Sachin (via Ring Road) | 1496 | 2097 |
| 2 | Canal Road | 1097 | 1742 |
| 3 | (Surat Stn.)Wadi Faliya to Uan Patiya | 1471 | 2101 |
| 4 | Udhana Station to Virkavi Narmad University | 2589 | 3395 |
| 5 | Chowk to Althan | 2341 | 3055 |

| Route No | IPTS Corridor | Peak Hour Passenger Boardings | |
|---|---|---|---|
| | | 2016 | 2026 |
| 6 | Jahangiripura-Palanpura Patia-Saradar Circle-Athwagate-Ichhanath -Dumas | 3330 | 4381 |
| 7 | Railway Station to Katargam – Ved Road | 1446 | 1769 |
| 8 | Railway Station to Fulpada, Katargam, Gotalawadi, Lal Darwaja | 1634 | 2267 |
| 9 | Chowk to Bahuchharaji- Moti Buchharaji,Nani Ved | 1172 | 1548 |
| 10 | Railway Station to Katargam – Ved Road-Chowk | 1518 | 2183 |
| 11 | Adajan to Dandi | 609 | 874 |

Based on the peak hour passenger loadings, PHPD and criteria for system selection, consultants have identified suitable system for various corridors. The corridor wise system selection is presented in **Table 5.3.**

**Table 5.3 Corridor Wise System Selection**

| S. No | Corridor | 2016 | | 2026 | |
|---|---|---|---|---|---|
| | | PHPD | Proposed System | PHPD | Proposed System |
| **High Demand Corridors** | | | | | |
| 1 | North South Corridor (Unn to Ved Gam) | 13690 | Elevated LRTS | 18820 | Elevated LRTS |
| 2 | East West Corridor (Magdalla to Kosmada) | 8029 | Surface BRTS | 11993 | Surface BRTS |
| **Potential Corridors** | | | | | |
| 1 | Railway Station to Navayug College, Housing Board, Rander, Jahangirpura | 3849 | BMTS with mixed traffic condition | 5227 | Surface BRTS |
| 2 | Railway Station to Varachha -Sarthana | 2967 | BMTS with mixed traffic condition | 4167 | BMTS with mixed traffic condition |
| 3 | Chowk to Kosad | 2437 | BMTS with mixed traffic condition | 3804 | BMTS with mixed traffic condition |
| 4 | Adajan Patia to Palanpur Jakatnaka | 2417 | BMTS with mixed traffic condition | 3252 | BMTS with mixed traffic |

| S. No | Corridor | 2016 | | 2026 | |
|---|---|---|---|---|---|
| | | PHPD | Proposed System | PHPD | Proposed System |
| | | | | | condition |
| 5 | Railway Station to Udhana Dindoli | 2315 | BMTS with mixed traffic condition | 3208 | BMTS with mixed traffic condition |
| 6 | Ring road -station - chowk-(circular Bus both sides) | 2215 | BMTS with mixed traffic condition | 2823 | BMTS with mixed traffic condition |
| 7 | Railway Station to Godadra | 2052 | BMTS with mixed traffic condition | 3232 | BMTS with mixed traffic condition |
| 8 | Railway Station to Makkaipul-Adajan | 1836 | BMTS with mixed traffic condition | 2375 | BMTS with mixed traffic condition |
| 9 | Railway Station to Gujarat Housing board Pandesara | 1763 | BMTS with mixed traffic condition | 2678 | BMTS with mixed traffic condition |
| 10 | Ghoddad Road | 1702 | BMTS with mixed traffic condition | 2133 | BMTS with mixed traffic condition |
| 11 | Station to Virkavi Narmad (South Gujarat) University | 1610 | BMTS with mixed traffic condition | 1845 | BMTS with mixed traffic condition |
| 12 | Adajan to Bhesan | 1567 | BMTS with mixed traffic condition | 2392 | BMTS with mixed traffic condition |
| 13 | East side of the station to Punagam to & fro | 1566 | BMTS with mixed traffic condition | 1954 | BMTS with mixed traffic condition |
| 14 | Rlyway Station to Chowk - Ichahanath | 1498 | BMTS with mixed traffic condition | 1615 | BMTS with mixed traffic condition |
| 15 | Railway Station to Nani Ved | 1403 | BMTS with mixed traffic condition | 1897 | BMTS with mixed traffic condition |
| 16 | Railway Station to Lambe Hanuman | 1386 | BMTS with mixed traffic condition | 1716 | BMTS with mixed traffic condition |

| S. No | Corridor | 2016 | | 2026 | |
|---|---|---|---|---|---|
| | | PHPD | Proposed System | PHPD | Proposed System |
| 17 | Railway Station to Fulpada, Katargam,Wadifalia | 1297 | BMTS with mixed traffic condition | 1715 | BMTS with mixed traffic condition |
| 18 | Railway Station to Saraswati Vidyalaya-Hirabag circle -Rlyway station | 1203 | BMTS with mixed traffic condition | 1545 | BMTS with mixed traffic condition |
| 19 | Adajan to Hazira Side | 1190 | BMTS with mixed traffic condition | 1730 | BMTS with mixed traffic condition |
| 20 | Rander Bus stand- SVR college- Dumas- Langar | 1119 | BMTS with mixed traffic condition | 1512 | BMTS with mixed traffic condition |
| 21 | Railway Station to Puna-Kumbharia | 1102 | BMTS with mixed traffic condition | 1705 | BMTS with mixed traffic condition |
| 22 | Chowk to Katargam, Kanteshwar Mahadev, Amroli | 1074 | BMTS with mixed traffic condition | 1557 | BMTS with mixed traffic condition |
| **Medium Demand Corridors** | | | | | |
| 1 | Chowk to Unn- Sachin (via Ring Road) | 952 | BMTS with mixed traffic condition | 952 | BMTS with mixed traffic condition |
| 2 | Canal Road | 944 | BMTS with mixed traffic condition | 965 | BMTS with mixed traffic condition |
| 3 | (Surat Stn.)Wadi Faliya to Uan Patiya | 936 | BMTS with mixed traffic condition | 936 | BMTS with mixed traffic condition |
| 4 | Udhana Station to Virkavi Narmad University | 932 | BMTS with mixed traffic condition | 1201 | BMTS with mixed traffic condition |
| 5 | Chowk to Althan | 878 | BMTS with mixed traffic condition | 1149 | BMTS with mixed traffic condition |
| 6 | Jahangiripura – Palanpura | 778 | BMTS with mixed | 1002 | BMTS with |

| S. No | Corridor | 2016 | | 2026 | |
|---|---|---|---|---|---|
| | | PHPD | Proposed System | PHPD | Proposed System |
| | Patia – Saradar Circle – Athwagate – Ichhanath – Dumas | | traffic condition | | mixed traffic condition |
| 7 | Railway Station to Katargam - Vedroad | 777 | BMTS with mixed traffic condition | 809 | BMTS with mixed traffic condition |
| 8 | Railway Station to Fulpada, Katargam,Gotalawadi, Laldarwaja | 762 | BMTS with mixed traffic condition | 784 | BMTS with mixed traffic condition |
| 9 | Chowk to Bahuchharaji-Moti Buchharaji,Nani Ved | 716 | BMTS with mixed traffic condition | 916 | BMTS with mixed traffic condition |
| 10 | Railway Station to Katargam - Vedroad-Chowk | 625 | BMTS with mixed traffic condition | 625 | BMTS with mixed traffic condition |
| 11 | Adajan to Dandi | 282 | BMTS with mixed traffic condition | 408 | BMTS with mixed traffic condition |

On the whole, three systems BMTS, BRTS and LRTS are identified for different corridors based on the maximum demand it can cater to in various horizon years. Each system is dealt in detail and its various components / requirements are enumerated further.

## 5.3 Bus Mass Transport System (BMTS)

The planning for public transport starts with the recognition that public transport is more efficient than personalized transport in the utilization of available road spaces and is less polluting.

It must cover areas where there is no optimum load capacity as well as areas where there is full load. It must differentiate between needs of those who need concession and those who do not. It must cater to the needs of the various cross sections of people depending on their paying capacity. It must integrate with a multi-modal transport system and must have the technological capability to upgrade systems quickly after taking account of obsolescence.

The peak hour passenger Boardings on the BMT System in 2016 and 2026 have been estimated as under.

***Year 2016***

Direct Service (BMTS) : 98,663

***Year 2026***

Direct Service (BMTS) : 1,37,419

Therefore, BMTS as an efficient public transport system, meeting the demand in cost-effective and environment friendly manner, with control on future development pattern, is considered as introductory public transit system for Surat.

### 5.3.1 BMTS Corridors & Fleet Size

Based on the peak hour peak direction passenger flow and total corridor loading, Consultants have proposed two categories of corridors:

- Potential Demand Corridors
- Medium Demand Corridors

Based on passenger loading, BMTS fleet size for each corridor is estimated for various horizon years considering standard size busses with 40 as seating capacity and 60 as crush capacity. The estimated bus fleet size required to meet the demand in the horizon year 2016 and 2026 is about 1176 and 1548 respectively.

It is proposed to consider potential corridors on priority for implementation and then medium demand corridors

### 5.3.2 Intra-city Bus Terminals – BMTS

Terminals are important elements of the bus system. They provide the interface between the system and the users, as well as non-users. They are critical to enable easy and efficient transfer within the system amongst different routes in the case of the proposed route network system. They are also important physical elements in the urbanscape of the city affecting the visual image of the city. They need to be conveniently located, sensitively designed and efficiently managed.

In order to regulate the terminal concentration in single area and create a balanced service situation, decentralized terminals are proposed as follows (**Table 5.4**). The proposed intra-city bus terminals are shown in **Figure 5.2**.

**Table 5.4 Proposed BMTS Terminals**

| Terminals | Service Areas |
|---|---|
| Railway station | Eastern Zone |
| Chowk | Central Zone, North Zone |
| Adajan Patia | West Zone |
| Near Udhana | South Zone |

In addition it is recommended that sub-nodal bus terminals at every Community Centre serving a population of about a lakh of people may be developed. This would mean about 36 sub nodal terminals to be developed in the city.

### 5.3.3 Interchange Bus Terminals – BMTS

In order to optimize the bus route frequencies so as to match with the passenger demand, from some common locations to various nearby destinations it is proposed to develop interchange terminals at following locations. These will offer exchange points for commuters coming from different directions.

In order to segregate the small distance, long distance and commuter traffic with optimum trip length in approaching the destinations the following interchange terminals are proposed **(Table 5.5)**. These terminals could be upgraded as multi-modal transport terminals considering the future growth.

**Table 5.5 Proposed BMTS Interchange Terminals**

| Interchange Terminals | Service Areas |
|---|---|
| Magdalla | South-West Zone |
| Puna | East Zone |
| Kosmada | North-East Zone |
| Unn | South Zone |
| Ved | North Zone |

### 5.3.4 BMTS Depots

In order to accommodate the proposed fleet size of 1176 busses, there is a requirement of 8 to 10 depots with a service range of 100 to 150 vehicles per depot. The bus depots need to be located judiciously, to minimise dead-kilometerage. Location at or near about the intersection of radial arterial roads and the ring road are preferred. Each bus depot would require a land area of about two hectares. A workshop of about five hectares in extent may be located in the industrial area. It is proposed to develop Depots at the following locations **(Table 5.6)**:

**Table 5.6 Proposed BMTS Depots**

| S.No | Location of Depot | Service Areas |
|---|---|---|
| 1 | On Lambe Hanuman Road Near Surat Railway station | North & Eastern Zones |
| 2 | Near Adajan Patia | West Zone |
| 3 | On Udhana Magdalla Road Near Bhatar | South Zone |
| 4 | Magdalla | South-West Zone |
| 5 | Puna | East Zone |
| 6 | Kosmada | North-East Zone |
| 7 | Unn | South Zone |
| 8 | Ved | North Zone |

### 5.3.5 BMTS Stops and Stations (Corridor wise)

Bus stops are important to facilitate easy, convenient and safe access to the service. They must be within the walking distance of the passenger. On an average the bus stops may be located at a spacing of 500-600 meters. The bus shelters need to be sensitively designed so that they add to the aesthetic quality of the streetscape. The easy accessibility of the bus stops promotes better usage of the public transport system.

The bus terminals and stops may be made bankable/self-financing projects through a combination of commercial floor space and advertisement rights.

Based on the passengers per hour and the surrounding land use following number of locations are tentatively identified for the bus stop locations **(Table 5.7)**.

**Table 5.7 Proposed BMTS Bus Stops**

| S.No | BMTS Corridor | No of Bus Stops |
|---|---|---|
| | **Potential Corridors** | |
| 1 | Railway Station to Navayug College, Housing Board,Rander,Jahangirpura | 20 |
| 2 | Railway Station to Varachha -Sarthana | 12 |
| 3 | Chowk to Kosad | 8 |
| 4 | Adajan Patia to Palanpur Jakatnaka | 10 |
| 5 | Railway Station to Udhana Dindoli | 8 |
| 6 | Ring Road -Station – Chowk (Circular Bus both sides) | 25 |
| 7 | Railway Station to Godadra | 9 |
| 8 | Railway Station to Makkaipul-Adajan | 15 |
| 9 | Railway Station to Gujarat Housing board Pandesara | 7 |
| 10 | Ghoddad Road | 12 |
| 11 | Station to Virkavi Narmad (South Gujarat) University | 6 |
| 12 | Adajan to Bhesan | 9 |
| 13 | East side of the station to Punagam | 6 |
| 14 | Railway Station to Chowk - Ichahanath | 9 |
| 15 | Railway Station to Nani Ved | 16 |
| 16 | Railway Station to Lambe Hanuman | 5 |
| 17 | Railway Station to Fulpada, Katargam,Wadifalia | 17 |
| 18 | Railway Station to Saraswati Vidyalaya-Hirabag circle -Railway station | 10 |
| 19 | Adajan to Hazira Side | 5 |
| 20 | Rander Bus stand- SVR college- Dumas- Langar | 22 |
| 21 | Railway Station to Puna- Kumbharia | 9 |
| 22 | Chowk to Katargam, Kanteshwar Mahadev, Amroli | 16 |
| | **Medium Demand Corridors** | |
| 1 | Chowk to Unn- Sachin (via Ring Road) | 14 |
| 2 | Canal Road | 12 |
| 3 | (Surat Stn.)Wadi Faliya to Uan Patiya | 11 |
| 4 | Udhana Station to Virkavi Narmad University | 10 |
| 5 | Chowk to Althan | 14 |
| 6 | Jahangiripura-Palanpura Patia-Saradar Circle-Athwagate-Ichhanath –Dumas | 16 |
| 7 | Railway Station to Katargam – Ved Road | 20 |
| 8 | Railway Station to Fulpada, Katargam,Gotalawadi, Laldarwaja | 16 |

| S.No | BMTS Corridor | No of Bus Stops |
|---|---|---|
| 9 | Chowk to Bahuchharaji- Moti Buchharaji,Nani Ved | 11 |
| 10 | Railway Station to Katargam - Vedroad-Chowk | 13 |
| 11 | Adajan to Dandi | 8 |

The locations proposed are purely on section demands and proposed land use. Permanent bus shelter locations may need revision with practical future developments and usage demands.

### 5.3.6 BMTS Feeder Services

Surrounding the high demand corridors at important areas of land use, para transit feeder services have been considered. The para transit services considered are mostly 3-seater, 6-seater auto rickshaws and regular taxis. The provision of new bus routes along these feeder routes be considered with the possible impact on these feeder services.

### 5.3.7 Ownership Regulation & Enforcement

There is a high potential for development of competitive bus transport market through contracting or franchising arrangement. However this requires a policy framework which specifies the role of the market and government. The cities like Surat should develop their own regulatory and enforcement capabilities to promote bus service competition and put in place an independent fare setting mechanism that will ensure financial viability of such operation. According to the World Bank report on 'India's Transport Sector, The Challenges Ahead (2002)', cities with population more than one million should have urban bus transport corporation that owns 30 percent of its own buses and contracts 70 percent of buses from private contractors and operators.

## 5.4 Bus Rapid Transit System (BRTS)

The BRT system is a stand alone development alternative which can be considered along the major demand routes with a demand over 5000 PHPD. **Table 5.8** shows the corridors PHPD and the proposed mass transit system for various horizon years.

**Table 5.8 Proposed Mass Transit System**

| S.No | Corridor | 2011 | | 2016 | | 2026 | |
|---|---|---|---|---|---|---|---|
| | | PHPD | Proposed System | PHPD | Proposed System | PHPD | Proposed System |
| 1 | North South Corridor (Unn to Ved Gam) | 11521 | Surface BRTS | 13690 | Elevated LRTS | 18820 | Elevated LRTS |
| 2 | East West Corridor (Magdalla to Kosmada) | 6757 | Surface BRTS | 8029 | Surface BRTS | 11993 | Surface BRTS |

Also, as it is proposed to convert the BRTS on North – South corridor into LRTS, the proposed Bus Stations be planned so that they can be converted to LRT stations in the year 2016.

### 5.4.1 BRTS Corridors

Based on the estimated peak hour passenger demand and PHPD, two corridors i.e, North – South and East – West corridors are identified for the introduction of Bus Rapid Transit System by year 2011. **Figure 5.3** shows the proposed BRTS corridors. This system will continue on East-West corridor upto 2026, where as North-South corridor requires an upgradation to LRT system by horizon year 2016.

The peak hour passenger boardings on the BRT System in 2011 are estimated as under.

***Year 2011***

Direct Service (BRTS) : 45,595
Direct Service (BMTS) : 83,071

**Unn to Ved Gam (North – South Corridor)**

The North – South corridor provides connectivity to residential areas like Ved Gam, Karada, Dabholi, Singanpor Gam, Rajdheep Nagar, Sneha Nagar, Gopinath, Nithayana Society, Laximikath Society, Saritha Society, Katargam, Kantheshwari Society, Lamxi Nagar, Bhari Matha, Tunki Nagar, Pandol, Kubher Nagar, Rampura,

Sayad Pura, Mahidar Pura, Salbhad Pura, Gopi Pura, Wadi Fhaliya, Rudhar Pura, Rusthum Pura, Sagram Pura, Anjana, Sanjeev Nagar, Udhyog Nagar, Udhana Gam, Postal Society, Hari Nagar, Katri Nagar, Sonala Society, Pandesara, Bhedwad, shanty Estate etc., and passes through major Industrial areas like Diamond industry, textile mills at walled city, textile market near Udhana Darwaja, textile mills at Bhestan Gam, Pandesara GIDC, Batliboy, Navin Florin & Sachin GIDC.

Also this corridor closely connects various educational institutions, governmental offices market areas religious places

The length of the corridor is approx. 18.3 Km. Eleven major stations along the corridor have been identified at the following locations:

1. Unn
2. Bhestan
3. Pandesara 1
4. Pandesara 2
5. Hari nagar
6. Udhana Interchange Point
7. Bhagal Chowk
8. Sastipura (Ved Katartgam junction)
9. Rajdeep Nagar (Katargam)
10. Raghunandhgan
11. Ved Gam

**Magdalla to Kosmada (East-West Corridor)**

The East – West corridor provides connectivity to residential, educational and market places of Kosmada, Khadsad, Simada, Saniahemed, Saroli, Puna, Magob, Parvat, Dhambhol, Anjana, Udhana market area, Majura, Bhatar, Althan, Bhimrad, Agricultural University, Bhatar textile industry, Piplod, Vesu, Rundh, Magdha, etc.,

The length of the corridor is about 18.4 Kilometers. Initially upto 2011, this corridor is proposed for operation between Magdalla to Puna Octroi (11.8 Km) and further extended up to Kosmada. Eleven major stations along the corridor have been identified at the following locations:

1. Magdalla
2. Udhana
3. Magdalla, Bhatar, Agriculture University

4. Majura (Kapadia Health Club)
5. Majura (Petrol Pump)
6. Udhana Interchange Point
7. Aanjan
8. Bhetena Anjaneya
9. Puna Octroi
10. Saniahemed
11. Kosmada

### 5.4.2 BRT Section and Section Loads

The forecasted section loads on the proposed BRTS corridors are shown in **Table 5.9** and **Table 5.10.**

**Table 5.9 Section Loads - North-South BRT Corridor**

| Section | | Peak Hour Section Load (Year 2011) |
|---|---|---|
| From | To | |
| Unn | Bhestan | 7803 |
| Bhestan | Pandesara 1 | 10303 |
| Pandesara 1 | Pandesara 2 | 10303 |
| Pandesara 2 | Hari nagar | 12783 |
| Hari nagar | Udhana Interchange Point | 15981 |
| Udhana Interchange Point | Bhagal Chowk | 18965 |
| Bhagal Chowk | Sastipura (Ved Katartgoan junction) | 10773 |
| Sastipura (Ved Katartgoan junction) | Rajdeep Nagar (Khatargam) | 5317 |
| Rajdeep Nagar (Khatargam) | Raghunandhgan | 3451 |

**Table 5.10 Section Loads – East – West BRT Corridor**

| Section | | Peak Hour Section Load (Year 2011) |
|---|---|---|
| From | To | |
| Magdalla | Althan | 1747 |
| Althan | Magdalla, Bhatar, Agriculture University | 3498 |
| Magdalla, Bhatar, Agriculture University | Majura (Kapadia Health Club) | 4495 |

| Section | | Peak Hour Section Load (Year 2011) |
|---|---|---|
| From | To | |
| Majura (Kapadia Health Club) | Majura (Petrol Pump) | 5970 |
| Majura (Petrol Pump) | Udhana Interchange Point | 5911 |
| Udhana Interchange Point | Aanjana | 10649 |
| Aanjan | Bhetena Anjana | 9630 |
| Bhetena Anjaneya | Puna Octrai | 9113 |
| Puna Octrai | Saniahemed | 6809 |
| Saniahemed | Kosmada | 3563 |

### 5.4.3 BRT Fleet Size

The fleet size for BRTS is estimated considering 100 crush capacity per bus and average corridor speed of 35 kmph. Estimated fleet size for different horizon years is presented in **Table 5.11.**

**Table 5.11 BRT Fleet Size**

| S.No | BRTS Corridor | Fleet Size | | |
|---|---|---|---|---|
| | | 2011 | 2016 | 2026 |
| 1 | Unn to Ved Gam (North-South Corridor) | 118 | * | * |
| 2 a | Magdalla to Puna Octroi (East-West Corridor) | 61 | -- | -- |
| 2 b | Magdalla to Kosmada (East-West Corridor) | -- | 112 | 168 |

** System Needs Upgradation to LRTS*

As the North –South corridor is proposed / required to be converted to LRTS, in 2016 horizon year, the existing fleet of 118 busses can be utilised properly by extending the East – West corridor from Puna to Kosmada.

### 5.4.4 BRT Terminals

Terminals act as peripheral, multimodal Interchange terminals and will be able to accommodate, collect, disperse and transfer passenger trips among various modes including Rail, Auto Rickshaws, Urban Transit Buses or Long distance GSRTC and Private buses.

The recommendations for developing such terminals are based on comprehensive analysis of the traffic data and modeling of the current and future travel pattern.

Assignment of various internally and externally generated travel trips indicated that travel supply and demand are well balanced when measures are taken to separate and reorient the local commuter and long distance travel from the city center.
Various rail and bus corridors defined would need to coordinate their services from such terminals. Five end terminals at the ends of the both the corridors are identified and presented in **Table 5.12.**

**Table 5.12 Proposed BRT Terminals**

| Terminals | Corridor | Service Areas |
|---|---|---|
| Magdalla | Magdalla to Kosmada | West |
| Kosmada | Magdalla to Kosmada | East |
| Puna | Magdalla to Kosmada | Central |
| Unn | Unn to Ved Gam | South |
| Ved | Unn to Ved Gam | North |

### 5.4.5 BRT Interchange Terminals

The proposed BRTS enables interchange of modes between BRTS and BMTS and para transit vehicles, Inter-city bus stations and railway station. The following interchange station is identified **(Table 5.13)**:

**Table 5.13 Proposed BRT Interchange Terminals**

| Interchange Terminals | Corridor | Service Areas |
|---|---|---|
| Udhana | Unn to Ved Gam & Magdalla to Kosmada | Central |

### 5.4.6 BRT Depots

In order to accommodate the proposed fleet size of 179 BRT busses, there is a requirement of minimum 2 depots along each BRT corridor at the edges.

Therefore it is proposed to develop Depots at the following locations **(Table 5.14)**. **Figure 5.4** shows the proposed BRTS terminals, interchange points and depots.

**Table 5.14 Proposed BRTS Depots**

| S.No | Location of Depot | Corridor |
|---|---|---|
| 1 | Magdalla | Magdalla to Kosmada |
| 2 | Puna | Magdalla to Kosmada |
| 3 | Unn | Unn to Ved Gam |
| 4 | Ved | Unn to Ved Gam |

### 5.4.7 BRT Feeder Services

Both BMT System and the Para Transit System act as feeder services for the BRT System. The details of feeder services would be addressed in the Phase – III Report (Detailed Study of Selected System).

## 5.5 Light Rail Transit System

The BRT system is a stand alone development alternative which can be considered along the major demand routes on which demand is about 12000 PHPD. It is proposed to upgrade the BRT System on North – South corridor to LRT System in the year 2016. **Table 5.15** presents the PHPD of the LRT System.

**Table 5.15 PHPD of Proposed LRT Corridor**

| S.No | Corridor | 2016 | | 2026 | |
|---|---|---|---|---|---|
| | | PHPD | Proposed System | PHPD | Proposed System |
| 1 | North South Corridor | 13690 | Elevated LRTS | 18820 | Elevated LRTS |

### 5.5.1 LRT Corridors

As mentioned above, two corridors i.e, North-South and East-West corridors are identified initially for the introduction of Bus Rapid Transit System by year 2011. However, based on the estimated peak hour passenger demand and PHPD for the horizon year 2016, the North-South corridor requires an upgradation to LRT system.

The peak hour passenger Boardings on the LRT System in year 2016 and 2026 are estimated as under.

*Year 2016*

Direct Service (BRTS, LRTS) : 54,152
Direct Service (BMTS) : 98,663

*Year 2026*

Direct Service (BRTS, LRTS) : 77,546
Direct Service (BMTS) : 1,37,419

**Unn to Ved Gam (North-South LRT Corridor)**

The length of the corridor is about 18.3 Km. **Figure 5.5** shows the proposed LRT Corridor. Eleven major stations along the corridor have been identified and the same are presented below:

1. Unn
2. Bhestan
3. Pandesara 1
4. Pandesara 2
5. Hari nagar
6. Ring road (near Udhana Darwaja)
7. Bhagal Chowk
8. Sastipura(Ved Katartgoam junction)
9. Rajdeep Nagar (Khatargoam)
10. Raghunandhgan
11. Ved Gam

### 5.5.2 LRT Section and Section Loads

The section loads on each of the link of the North – South Corridor are presented in **Table 5.16.**

**Table 5.16 Section Loads - North-South LRT Corridor**

| Section | | Peak Hour Section Load (Year 2016) |
|---|---|---|
| From | To | |
| Unn | Bhestan | 9267 |
| Bhestan | Pandesara 1 | 12236 |
| Pandesara 1 | Pandesara 2 | 12236 |
| Pandesara 2 | Hari nagar | 15182 |
| Hari nagar | Udhana Interchange Point | 18980 |
| Udhana Interchange Point | Bhagal Chowk | 22525 |
| Bhagal Chowk | Sastipura (Ved Katargam junction) | 12795 |
| Sastipura (Ved Katargam junction) | Rajdeep Nagar (Khatargam) | 6315 |
| Rajdeep Nagar (Khatargam) | Raghunandhgan | 4098 |

### 5.5.3 Rolling Stock

The number of rakes required has been worked out on the basis of four car consist, dense loading of coaches of 225 passenger per coach (at 8 person per sq.m.) (i.e. 675 passenger per rake of 3 coaches) a directional split of 60:40 and a scheduled speed of 32 kmph. **Table 5.17** shows the corridor wise coach requirement.

**Table 5.17 Coach Requirement**

| LRTS Corridor | Year | PHPD | No of rakes needed |
|---|---|---|---|
| Unn to Ved Gam (North-South Corridor) | 2016 | 13690 | 9 |
| | 2026 | 18820 | 13 |

In addition four spare rakes are required as under:

- one as operation stand by
- one under petty repairs
- one under heavy repairs
- one under POH

The total requirement of rakes thus works out to 9 rakes in 2016 and 13 rakes in 2026.

### 5.5.4 LRT Terminal & Depot

For the North –South corridor the terminal can be located at Udhana. In order to accommodate the proposed rakes, there is a requirement of a depot along LRT corridor. It is proposed to develop Depots at Unn. **Figure 5.6** shows the proposed LRTS terminals, interchange points and depots.

### 5.5.5 LRT Feeder Services

Both BMT System and the Para Transit System act as feeder services for the LRT System. The details of feeder services would be addressed in the Phase – III Report (Detailed Study of Selected System).

## 5.6 Passenger Information Systems & ITS

The transit systems are proposed to have a modern operation system. Buses are proposed to be provided with two way radio communication system for communicating with operation control centres. GPS linked Automatic Vehicle Tracking (AVT) system to provide accurate details on spatial locations of the bus may also be provided. Computerized system for operation planning, scheduling and routing is proposed to be adopted. Since BRT/LRT is proposed to operate on exclusive ways, punctuality and regularity of the services can be maintained and proper information to passengers in the form of time tables as well as real time notice boards can be provided to the commuters at the stops/stations.

## 5.7 Corridor Oriented Land Use Development

It is anticipated that during the detailed feasibility study for selected corridors certain land use policies supporting and enhancing the proposed IPTS will have to be identified and defined.

## 5.8 Regional Bus Transport System

***Existing Intercity Bus Terminals in Surat***

Two types of services are operating for intercity bus system

1. Busses operated by State Road Transport Undertaking (GSRTC)
2. Busses operated by private bus operators

1. *State Transport Service:* These are operated mainly by Gujarat State Road Transport Corporation. The buses from other neighbouring sate corporations also operate on selected routes on reciprocal buses. The GSRTC buses connect Surat with all other district & regional centres of Gujarat. Whereas other state RTC operate services mainly to state capital and other important cities and religious centres of their state.

2. *Private Bus Operations:* The private bus operations run the services under contract carriage provision. The busses are luxury, A/c and /or super deluxe and connect to important cities of Gujarat and other states. The buses to Mumbai are particularly more popular. The pick up points of these buses are spread over the city near the hotel complexes on Inner Ring Road. However majority of them congregate near Sahara Darwaja.

**Inter-State Bus Terminal**

Large number of inter – state buses terminate at Surat. Even the through buses originating from other major cities like Ahmedabad, Baroda passes through Surat. The intercity operations are carried out by State Road Transport Corporation of Rajasthan, MP, Maharashtra, Andhra Pradesh as well as private operators. The ridership and clientele on these routes is high since they provide air conditioned and comfortable travel.

At present most of the intercity buses operated by private agencies park their vehicles on roads. It is therefore recommended to develop an interstate Bus Terminal preferably near Sahara Gate on Ring Road. This ISBT will have facilities for Bus parking (only for pick up), passenger amenities, minor repairs and small offices of agencies. Presently there are two terminals in Surat **(Table 5.18).**

**Table 5.18 Existing Intercity Bus Terminals**

| S. No | Terminal | Proposed Improvements |
|---|---|---|
| 1 | Intercity Bus Terminal at Railway Station | This is located close to the Railway Station near the Ring Road out side the Walled City Area. |
| 2 | Intercity Bus Terminal at Adajan Patia *(not in operation)* | This is located in the western part of the Tapi River where high density of residential population resides. |

***Proposed Inter City Bus Terminals in Surat for GSRTC***

With the introduction of public bus transport system, it is necessary to integrate the intercity bus services with city services. In addition to the existing terminal it will be necessary to decentralize them along the radial routes & near the BMTS Bus station.

As part of BMTS proposals following intercity terminals are proposed which must be developed / upgraded for intercity and intra city loading and unloading operations **(Table 5.19)**.

**Table 5.19 Proposed Intercity Bus Terminals**

| Interchange Terminals | Service Areas |
|---|---|
| Magdalla | South-West Zone |
| Puna | East Zone |
| Kosmada | North-East Zone |
| Unn | South Zone |
| Ved | North Zone |

## 5.9 Regional Rail Transport System

***Existing Intercity Rail Terminals in Surat***

Surat is a junction on the Mumbai-Delhi main line. It is well connected by long distance and short distance trains with important cities. Udhana (4 km), Bhestan (9 km), and Sachin (14 km) stations are within the SUDA boundary limit on Mumbai side. Daily passengers commute to Surat as far as from Navsari and Maroli. Utran (3 km), Kosad (7 km) and Gothangam (10 km) lie within the SUDA limit.

Other than Mumbai – Ahmedabad railway line, there is a single line to Bhusaval. Niol (8 km) and Chalthan (15 Km) stations come under SUDA limit on this corridor. Daily two passenger trains in the morning and evening are running on this line. There is a line between Gothangam and Hazira. This railway line is basically a freight line and at present no passenger trains are operated.

Four passenger trains and four MEMU trains run on the Mumbai-Surat-Ahmedabad line and four passenger trains run on Surat Bhusaval line. Presently there are three terminals in Surat **(Table 5.20)**

**Table 5.20 Existing Intercity Rail Terminals**

| S. No | Terminal | Area |
|---|---|---|
| 1 | Surat Railway Station Near Inner Ring Road | This is located close to Ring Road towards east side out side the Walled City Area. |
| 2 | Udhana Railway Station | This is located in the southern side which is currently under utilized. |
| 3 | Bhestan Railway Station | This is located still in southern side in Bhestan |

Large number of commuters, workers travels to Surat from nearby towns daily. It is recommended that intercity bus services and most particularly intra city bus services are properly connected with these terminals to facilitate long distance passengers as well daily commuters travelling by rail.

# Chapter 6
# Implementation Plan

## 6.1 Introduction

In the framework of objectives postulated, policies formulated and strategies identified the Transport System Development Programme for Surat has been developed. The transport development programme has a spectrum of action programmes from re-design of road intersections to development of road/rail based mass transport systems. A general program, including phasing, is suggested to meet the immediate problems and fit into long range needs. The phasing has been developed on an appreciation of inter-sectoral priorities under overall policy framework for development of Surat and its urban transport system. The sections below presents a general phasing programme recommended for Surat.

With a view to identify relatively easy but urgent schemes, it is proposed to group these measures into three categories:

a) Short Term Improvement Proposals ( 0 - 5 years)

The proposals which need immediate attention without any further delay in meeting the traffic demands.

b) Medium Term Improvement Proposals (5 - 10 years)

Such proposals which need to be developed between 5-10 years, are somewhat less complex and may not involve acquisition of built up properties.

c) Long Term Improvement Programme (10 – 20 years)

These will include such proposals which are complex, costly and may involve acquisition of lands/properties.

## 6.2 Plan Implementation Phasing

The development period (2007-2026) is divided into three phases:

| Phase | Time Period |
|---|---|
| I | 2007-2011 (Short Term Improvement) |
| II | 2012-2016 (Medium Term Improvement) |
| III | 2017-2026 (Long Term Improvement) |

***Phase I (2007 – 2011) – Short Term Improvement Measures***

1. Carriageway Improvements for the selected links
    - Traffic signs
    - Road Markings
    - Enforcement of Parking Regulations
    - Construction of raised footpaths along with 1.2 m high guard rails
    - Clearing of Hawkers
    - Removal of encroachments
2. Intersection geometry Improvements
    - Prithviraj Chouhan Chowk
    - Mina Bazar Teen Rasta Chowk
    - Amroli Chowk
    - Kapodara Junction
    - Gamatal Nana Varachha Junction
    - Puna Jakat Naka Chowk
    - GIDC Naka
    - Jahangirpura Junction
    - Palanpur Jakat Naka Junction
    - Vasu Patia Junction
3. Intersection Signalization/upgradation
    - Amroli Chowk
    - Kapodara Junction
    - Gamatal Nana Varachha Junction
    - Puna Jakat Naka Chowk
    - GIDC Naka
    - Jahangirpura Junction
4. Pedestrian mid block signalization
5. On-street parking improvements
6. Clearance of Hawkers and Encroachments and provision of hawker zones.
7. Terminal Improvements
8. Remedial Measures for Bottlenecks
9. Setting up of Transport Development Fund

10. Improvement in logistics support to Traffic Police.
11. Conduct of Techno – Economic and Engineering Studies and preparation of functional plans and design for
    - Improvement of Arterial Roads
    - ROB/RUB's
    - Pedestrian subways
    - Terminals, depots and workshops
    - Parking facilities
12. Engineering study of Pedestrian Subways
13. Preparation of Traffic Management Plan (TMP) for other areas and their implementation
14. Formulation and implementation of traffic education and enforcement measures.
15. Bus Mass Trasnsit System Development
    - Inroduction of initial fleet size of 772 buses of BMTS on potential routes
    - Development of bus infrastructure like bus stops with proper bus bays
    - Development of intra-city bus terminals and depots
    - Bus Route Network planning and scheduling to be taken up on a scientific and comprehensive manner.
16. Bus Rapid Trasnsit System Development along N-S and E-W (Upto Puna Octroi) Corridors
    - Inroduction of initial fleet size of 97 buses of BRTS
    - Development of BRTS infrastructure like bus stations with proper bus bays
    - Development of BRT terminals and depots
17. Preparation of detailed project reports.

***Phase II (2012 – 2016) – Medium Term Improvement Measures***

1. Improvement of the critical corridors by widening
    - Inner Ring Road
    - Outer Ring Road – W
    - Ved Road
    - Katargam Road
    - Udhana Navsari Road
    - Bardoli Road
    - Lambe Hanuman Road
    - Chowk Main Road – E
    - Nanpura Main Road – S
    - Nanpura Main Road – N

- Link Between Udhna Darwaja-Bhagal Chowk-Ved Road – N
- Link Between Udhna Darwaja-Bhagal Chowk-Ved Road – S
- Link Betweeen Vivekananda Bridge - Junction near Gopi Lake

2. Construction of missing road links
   - Middle Ring Road - 1
   - Middle Ring Road - 2
   - Outer Ring Road – E
   - Outer Ring Road – N
3. Construction of Proposed River Bridges
   - Ved-Jahangirpura Bridge
   - Atwaline-Adajan Bridge
   - Ved-Variyav Bridge
   - Bridge Near Valak of Outter Ring Road
   - Island Bridge (Adajan Patia to Ved Katargam Junction)
4. Construction/Widening of Flyover
   - Mina Bazar Teen Rasta Chowk
   - Prithviraj Chouhan Chowk
   - Gamatal Nanav Junction
   - Amroli Chowk
5. Pedestrian FOB
   - Surat Railway Station
   - Peoples Bank on Katargam Road
   - New Bombay / Fruit Market on Bardoli Road
   - Ramnagar on Rander Road
   - Saraswati Vidyalaya on Ashwani Kumar Road
   - Kapodara Fire Junction
   - Sargam Shopping Centre
   - Majura Gate / RTO Junction
   - Ambika Niketan / Parle Point
   - Bhatar Char Rasta
   - Udhna Gam Tal on Navsari Road
   - Bhestan on Navsari Road
   - SMC Hospital / College on Bardoli Road
   - APMC on Bardoli Road
   - Adajan Patia
   - Navyug College
   - Palanpur Patia on Rander Road
   - Chowk
   - Socio Circle

- Vanita Vishram on Dumas Road
- Rangila Park on Goddod Road

6. Construction of pedestrian subways
   - Athwa Gate
   - Gujarat Gas Circle / Anand Mahel Road on Adajan – Pal Road
   - Mini Heera Bazar Road
   - Udhna Gate
   - Delhi Darwaja
   - Sahara Darwaja
7. Development of Off-Street Parking facilities.
8. Bus Mass Trasnsit System Development
   - Increase of BMTS buses fleet size to 1176 buses on potential and medium demand routes
   - Development of bus infrastructure like bus stops with proper bus bays
9. Bus Rapid Trasnsit System Development along E-W (Extension upto Kosmada) corridor
   - Development of BRTS infrastructure like bus stations with proper bus bays
10. Light Rail Trasnsit System Development along N- S Corridor
    - Procurment of 27 Rolling Stock coaches
    - Development of LRTS infrastructure like LRT stations
    - Development of LRT interchange terminal and depot
11. Institutional arrangement for promotion of IPTS

***Phase III (2017 – 2026) – Long Term Improvement Measures***

1. Completion of all road developments
   - Outer Ring Road – W
   - Katargam Road
   - Adajan Hazira Road
   - Athwa Dumas Road
   - Udhana Magdalla Road
   - Bardoli Road
   - Rander Olpad Road
   - Althan Bhatar Road
   - Headgover Road
   - Bathena Aanjana Road
   - Ghoddod Road
   - Anandmahal Road
   - Walled City Roads

- Chowk Main Road – W
- Chowk Main Road – E
- Nanpura Main Road – N
- Link Betweeen Vivekananda Bridge - Junction near Gopi Lake
- Middle Ring Road - 1
- Middle Ring Road - 2
- Outer Ring Road – E
- Outer Ring Road – N

2. Widening/New Construction of River Bridges
   - Magdalla Bridge
   - Sardar Bridge
   - Nehru Bridge
   - Amroli Bridge
   - Savjibhai Korat Bridge
3. Construction/Widening of Flyover/ROB
   - Near Unn on Udhna-Navsai Raod
4. Bus Mass Trasnsit System Development
   - Increase of BMTS buses fleet size to 1548 buses
   - Development of bus infrastructure like bus stops with proper bus bays
5. Light Rail Trasnsit System Development along N-S corridors
   - Procurment of 57 Rolling Stock coaches
   - Development of LRT infrastructure like LRT stations

## 6.3 Block Cost Estimate

The total cost of the proposed Surat Transportation Development Plan (Phase I, II & III) is estimated to be of the order of Rs **3950** Crores at current prices. The general break up of cost by major components is given in **Table 6.1.** The system based development cost under each phase is presented in **Table 6.2**.

## Table 6.1 Phase Wise Transport Investment Programme

*(Rs. Lakhs)*

| S. No. | Item | Phase I | Phase II | Phase III |
|---|---|---|---|---|
| | ***Phase I (2007 – 2011) – Short Term Improvement Measures*** | | | |
| | ***Road Based Improvements*** | | | |
| 1 | **Carriageway Improvements for the selected links** | 5458.76 | | |
| | *Traffic signs* | | | |
| | *Road Markings* | | | |
| | *Enforcement of Parking Regulations* | | | |
| | *Construction of raised footpaths along with 1.2 m high guard rails* | | | |
| | *Clearing of Hawkers* | | | |
| | *Removal of encroachments* | | | |
| | *On-Street Parking Improvements* | | | |
| 2 | **Intersection Geometry Improvements and Signalization (No. 10)** | 70.90 | | |
| 3 | **Pedestrian Mid Block Signalization (No. 8)** | 24.00 | | |
| 4 | **Setting up of Transport Development Fund** | 100.00 | | |
| 5 | **Improvement in logistics support to Traffic Police** | 100.00 | | |
| 6 | **Preparation of Traffic Management Plans (TMP) and their implementation** | 100.00 | | |
| 7 | **Formulation and implementation of traffic education and enforcement measures** | 100.00 | | |
| | ***IPTS Based Improvements*** | | | |
| 8 | **Bus Mass Transit System Development** | | | |
| | *Introduction of BMT buses (No. 772)* | 11580.00 | | |
| | *Development of intra-city bus terminals (No. 2)* | 400.00 | | |
| | *Development of intra-city bus Interchange terminals (Bus Intra to Bus Inter) (No. 4)* | 480.00 | | |
| | *Bus stops with proper bus bays (No. 256)* | 2560.00 | | |
| | *Development of intra-city bus depots (No. 4)* | 800.00 | | |
| | *Bus Route Network planning and scheduling to be taken up on a scientific and comprehensive manner.* | 100.00 | | |
| 9 | **Bus Rapid Transit System Development along NS and EW (Upto Puna Octroi) corridors** | | | |
| | *Introduction of BRT buses (No. 97)* | 3876.07 | | |
| | *BRT Stations (No. 22)* | 1100.00 | | |
| | *BRT Corridor Development (Length 30 Km)* | 7525.00 | | |
| | *Development of BRT terminals (No. 4)* | 2000.00 | | |
| | *Development of Interchange terminal (BRT to BRT) (No. 1)* | 500.00 | | |
| | *Development of BRT bus depots (No. 1)* | 200.00 | | |
| | *Intelligent Transport System (ITS) (LS)* | 2000.00 | | |
| | *Logistics to Traffic Police* | 800.00 | | |

| S. No. | Item | Phase I | Phase II | Phase III |
|---|---|---|---|---|
| | *Surveys and Studies (LS)* | 200.00 | | |
| 10 | **Preparation of detailed project reports.** | 100.00 | | |
| | ***Phase I - Sub Total*** | **40174.73** | **0.00** | **0.00** |
| | ***Phase II (2012 – 2016) – Medium Term Improvement Measures*** | | | |
| | ***Road Based Improvements*** | | | |
| 11 | **Improvement of the critical corridors by widening** | | 20831.51 | |
| 12 | **Construction of Missing Road Links** | | 40379.90 | |
| 13 | **Construction of River Bridges (No. 5)** | | 26799.53 | |
| 14 | **Construction of Flyovers (No. 4)** | | 1467.73 | |
| 15 | **Widening of ROB (No. 1)** | | 3582.70 | |
| 16 | **Pedestrian FOB (No. 21)** | | 4200.00 | |
| 17 | **Construction of pedestrian subways (No. 6)** | | 1200.00 | |
| 18 | **Development of Off-Street Parking facilities (No. 4)** | | 400.00 | |
| 19 | **Para transit Stands** | | 19.20 | |
| | ***IPTS Based Improvements*** | | | |
| 20 | **Bus Mass Transit System Development** | | | |
| | *Introduction of BMT buses (No. 404)* | | 6060.00 | |
| | *Development of intra-city bus terminals (No. 2)* | | 400.00 | |
| | *Development of intra-city bus Interchange terminals (Bus Intra to Bus Inter) (No. 2)* | | 240.00 | |
| | *Bus stops with proper bus bays (No. 120)* | | 1200.00 | |
| | *Development of intra-city bus depots (No. 2)* | | 400.00 | |
| | *Bus Route Network planning and scheduling to be taken up on a scientific and comprehensive manner.* | | 100.00 | |
| 21 | **Bus Rapid Transit System Development along EW (Extension upto Kosmada) Corridor** | | | |
| | *Introduction of BRT buses (No. 0)* | | 0.00 | |
| | *BRT Stations (No. 0)* | | 0.00 | |
| | *BRT Corridor Development (Length 6.6 Km)* | | 1650.00 | |
| | *Development of BRT terminals (No. 1)* | | 500.00 | |
| | *Development of Interchange terminal (BRT to BRT) (No. 0)* | | 0.00 | |
| | *Development of BRT bus depots (No. 0)* | | 0.00 | |
| | *Intelligent Transport System (ITS) (LS)* | | 500.00 | |
| | *Logistics to Traffic Police* | | 200.00 | |
| | *Surveys and Studies (LS)* | | 20.00 | |
| 22 | **Light Rail Transit System Development along NS corridors with 9 Rolling stock** | | | |
| | *Cost of fixed structures (civil, electrical, signal etc.) (Km 18)* | | 128100.00 | |
| | *Cost of the rolling stock coach (No. 27)* | | 27000.00 | |
| | *Cost of the rolling stock coach (Standby)(No. 4)* | | 4000.00 | |

| S. No. | Item | Phase I | Phase II | Phase III |
|---|---|---|---|---|
| | *Maintenance facility* | | 15000.00 | |
| 23 | **Institutional arrangement for promotion of IPTS** | | 100.00 | |
| | ***Phase II - Sub Total*** | **0.00** | **284350.57** | **0.00** |
| | ***Phase III (2017 – 2026) – Long Term Improvement Measures*** | | | |
| | ***Road Based Improvements*** | | | |
| 24 | **Improvement of the critical corridors by widening** | | | 22037.80 |
| 25 | **Construction of New Major Roads** | | | 17459.16 |
| 26 | **Construction of River Bridges (No. 7)** | | | 9628.50 |
| 27 | **Construction of Flyovers (No. 1)** | | | 0.00 |
| | ***IPTS Based Improvements*** | | | |
| 28 | **Bus Mass Transit System Development** | | | |
| | *Introduction of BMT buses (No. 372)* | | | 5580.00 |
| | *Development of intra-city bus terminals (No. 0)* | | | 0.00 |
| | *Development of intra-city bus Interchange terminals (Bus Intra to Bus Inter) (No. 0)* | | | 0.00 |
| | *Bus stops with proper bus bays (No. 25)* | | | 250.00 |
| | *Development of intra-city bus depots (No. 2)* | | | 400.00 |
| | *Bus Route Network planning and scheduling to be taken up on a scientific and comprehensive manner.* | | | 100.00 |
| 29 | **Bus Rapid Transit System Development along EW corridors** | | | |
| | *Introduction of BRT buses (No. 74)* | | | 2960.00 |
| | *BRT Stations (No. 0)* | | | 0.00 |
| | *BRT Corridor Development (Length 0 Km)* | | | 0.00 |
| | *Development of BRT terminals (No. 1)* | | | 0.00 |
| | *Development of Interchange terminal (BRT to BRT) (No. 0)* | | | 0.00 |
| | *Development of BRT bus depots (No. 0)* | | | 0.00 |
| | *Intelligent Transport System (ITS) (LS)* | | | 0.00 |
| | *Logistics to Traffic Police* | | | 0.00 |
| | *Surveys and Studies (LS)* | | | 100.00 |
| 30 | **Light Rail Transit System Development along NS corridors with 13 Rolling stock** | | | |
| | *Cost of fixed structures (civil, electrical, signal etc.)* | | | 0.00 |
| | *Cost of the rolling stock coach (No. 12)* | | | 12000.00 |
| | *Cost of the rolling stock coach (Standby)* | | | 0.00 |
| | *Maintenance facility* | | | 0.00 |
| | ***Phase III - Sub Total*** | **0.00** | **0.00** | **70515.47** |
| **Grand Total (Rs. Lakhs)** | | **40174.73** | **284350.57** | **70515.47** |
| **Grand Total (Rs. Crores)** | | **401.75** | **2843.51** | **705.15** |
| **Total Surat Transport System Development Cost (Rs. Crores)** | | **3950** | | |

** The above cost do not include cost of land acquisition and R&R cost*

## Table 6.2 System Based Development Cost

*(Rs. Lakhs)*

| S. No. | Item | Phase I | Phase II | Phase III | Total |
|---|---|---|---|---|---|
| 1. | **Road Based Improvements** | 5953.66 | 98880.57 | 49125.47 | 153959.70 |
| 2. | **Bus Mass Transit System Development** | 15920.00 | 8400.00 | 6330.00 | 30650.00 |
| 3. | **Bus Rapid Transit System Development along E-W and N-S Corridors** | 18301.07 | 2870.00 | 3060.00 | 24231.07 |
| 4. | **Light Rail Transit System Development along N-S Corridor** | 0.00 | 174200.00 | 12000.00 | 186200.00 |
| **Total** | | **40174** | **284350** | **70515** | **395040** |
| **Grand Total (Rs. Crores)** | | **3950** | | | |

# CHAPTER 7.0
# Institutional Framework and Implementation Strategy

## 7.1 General

Implementation of an IPTS Plan is an opportunity to identify and strengthen the institutions responsible for planning, development, operation and management of the city transport system and build capacity in them to take up the programmes under the short term, medium term and long term plan through public institutions and/or private sector participation.

### 7.1.1 Institutional Framework for Public Institutions (i.e. SMC)

The Surat Municipal Corporation (SMC) has been envisaged as the most important institution responsible for the planning, development and maintenance of the city transport system particularly of its road network system, bus transport system, Light Rail Transit System (LRTS), Terminals, parking areas, etc. While it is not contemplated to restructure SMC under the IPTS Plan, the following proposals are recommended to enable SMC to undertake and monitor IPTS Plan:

#### (1) Establish Traffic Engineering and Management Unit in SMC

Immediately a Traffic Engineering and Management Unit (TEMU) as one of the functional technical departments of SMC should be established. It shall be headed by a Transport Planner/Traffic Engineer with necessary professional qualification and adequate experience. He shall be of the rank of at least Dy. City Engineer and be responsible to the Commissioner of the Surat Municipal Corporation. The responsibilities of TEMU are:

- to assist in the development and implementation of local transport policies
- to plan, design and implement public transport and general traffic improvement schemes;
- to draw up and implement traffic regulations concerning the utilization of road space by different vehicle types and pedestrians;
- to maintain traffic signs, carriageway markings and traffic control devices;
- to monitor vehicle and pedestrian movements;
- to develop traffic schemes of a temporary or experimental nature;
- to coordinate the planning and design of traffic and transport plans.

The TEMU will be structured to comprise four sections as under:

(i) a **planning and design section**

- Responsible for conducting strategic transport studies and evaluating alternative proposals
- Responsible for the planning and implementation of short term traffic improvement measures

(ii) a **research and monitoring section**

- Responsible for policy studies and the conceptual planning improvement measures and schemes of an experimental nature.
- Responsible for conducting surveys, carrying out traffic counts and analyzing traffic and accident data;

(iii) a **maintenance and traffic signal section**

- Responsible for traffic signs, carriageway markings and other traffic control devices;
- Responsible for the design, implementation and maintenance of traffic control equipment;

(iv) a **parking section** responsible for the administration and supervision of on and off-street parking;

**(2) Establish Surat Transport Development Fund**

To overcome the resource constraints and to ensure availability of money at the right time it is recommended that SMC may set up a Surat Transport Development Fund (STDF). The annual budgetary allocations towards city transport system development and maintenance and other related loans and grants-in-aid received from state and central governments is to be credited to STDF. The fund shall be non-lapsable. In addition special effort to be made to generate resources through innovative measure like market borrowings, entry fees, road pricing, user charge, cess on sale of petrol, cess on sale and registration of vehicles, parking compounding fees, development cess, etc and credit these to the STDF. The fund shall be managed by TEMU under a set of guidelines.

### (3) Promote Private Sector Participation

The TEMU shall endeavor to invite, encourage and facilitate private sector participation in the IPTS Plan. Surat being the industrial and trade capital of the state, attracting private sector interest, capital and expertise should not be a difficult task. However it is important to build confidence and promote a facilitating environment.

### (4) Provide Logistics Support to Traffic Police

Another important institution for the enforcement and management of traffic is the City Traffic Police of the Police Department. The Traffic Police are making strenuous efforts to enforce, regulate and manage the city traffic. However, they are severely handicapped in terms of sufficient manpower and adequate logistic facilities. The City Traffic Police is headed by the Asst. Commissioner of Police, under the overall charge of the Commissioner of Police.

The manpower restructuring of the City Police Department is linked with that of the state. Hence no recommendations are made in this respect. However it is suggested that efforts be made to raise a Traffic Volunteer Force (TVF) comprising students and civic minded people and suitably train and use their service to supplement the traffic police personnel in the enforcement and management of traffic.

It is of immediate importance to equip the City Traffic Police with adequate logistic hardware to discharge their functions. These would include personnel communication systems, CCTVs, mobikes, jeeps, towing vehicles, interceptors (as used in Delhi), ambulance vehicles, etc. A serious effort should be made to equip the traffic police with these equipments.

It is also recommended that a few hospitals in different parts of the city be identified as Accident Trauma Centres and suitably equipped to attend on an emergency basis all road traffic accident victims.

### (5) Education and Training

To meet the needs of professionals, in all branches, over the next twenty years, it is necessary to select young professionals with necessary basic qualification and depute them for higher levels of education to reputed

institutions within the country. The education should cover all aspects of planning, development, operation and management of urban and regional transport systems.

In addition a number of short term training programmes on different aspects would need to be designed and delivered to upgrade the skills of the existing personnel and update the new entrees on a regular basis. For this purpose the local institutions, in particular the Sardar Vallabhbhai National Institute of Technology (SVNIT), Surat, may be identified as the nodal training centre and supported with necessary financial support to run the training programmes on a regular and continuous basis.

## 7.2 Implementation Strategy

To prepare and implement the Transport System Development Plan on a coordinated, comprehensive and continuous basis, a proper institutional arrangement is very important. Following two options are suggested :

**Option 1 :**

To set up Surat Municipal Transport Undertaking (SMTU) (on the lines of BEST of MCGM) under the chairmanship of Mayor of Surat, with Municipal Commissioner as Vice-Chairman. The proposed TEMU in Surat Municipal Corporation is to provide the technical services to the SMTU. The head of TEMU is to be the Member - Secretary of SMTU.

Other members of the SMN will be nominated / elected from among the elected Corporators of SMC.

**Option 2 :**

To set up a separate traffic & Transportations planning / co-ordination Department in SUDA headed by the Transportation Engineer/ Planer in the grade of Chief Engineer. The department should include professional experts representing urban transport planning, urban finance, public mass transport & law. The department will function under the directive of SUDA which will take all policy decisions & accord Administrative approvals. (MMRDA, Mumbai pattern)

The proposed functions of SMTU or T&T Department of SUDA are:

- Formulate city level transport policy in the framework of national/state polices
- Coordinate with city planning Authority in the preparation of city Master/Development Plan providing professional inputs as related to city transport sector
- Prepare integrated multi-modal transport plan
- Mobilize resources and allocate to different components of the transport system on a rational equitable and transparent basis
- Manage City Transport Development Fund
- Facilitate participation of private sector
- Formulate fare policy for the integrated public transport system and function as Tariff Regulatory Authority
- Prepare Transport System Management Plans on an area or corridor basis and facilitate their implementation
- Promote technological modernisation
- Maintain and disseminate city level urban transport
- information system
- Coordinate the working of all component participant agencies

### 7.2.1 Identification and Ranking of Potential BOT/Toll Road Projects

In order to make a preliminary determination of which projects are suitable for implementation through BOT processes, a simple financial analysis has to be performed for general ranking of projects with a preliminary indication of each project's financial feasibility.

The analysis would involve the following steps:

- Preliminary identification of individual projects that require improvements and which could be financed through the collection of user charges based on preliminary cost, traffic and revenue estimates; and
- Ranking of projects based on order of magnitude estimates of financial feasibility.

After ranking potential projects, the most promising projects should be subjected to more detailed engineering, financial and economic analysis.

### 7.2.2 Packaging of BOT Projects

In case of IPTS Plan project, SUDA/SMC should set the user charges and the concession period which is the deciding factor – the concession will be won by the bidder offering the shorter concession period (under this policy the most profitable concessions would normally have the shortest periods).

Upon expiration of the concession, the project is handed over to SUDA/SMC for maintenance. It may actually be in the best interest of the SUDA/SMC to have longer concession periods, and therefore have the concessionaire maintain the projects for a longer period of time.

One way to do this is to create packages of BOT projects in which some of the less profitable projects would be linked with the most profitable ones, thus requiring bidders to offer longer concession periods

These bigger BOT packages would have advantages for the concessionaires, since they would be able to take advantage of economies of scale in construction, maintenance, operations, user fee collection, financing and other project aspects. These large BOT packages should attract only those contractors that are well organized and are capable of managing the projects efficiently.

### 7.2.3 Options for Executing BOT Projects

There are numerous options available to the SUDA/SMC for the execution of BOT projects. Each of these options depends upon the viability of a particular project. Options that can be adopted by the SUDA/SMC include:

- Awarding bids to private parties to build the projects and collect revenues before transferring them to SUDA/SMC. These bids can be awarded in three ways:
  - on the basis of the shortest transfer period;
  - on the basis of the minimum transfer fee (in cases where the transfer period is fixed); or
  - on the basis of minimum user fee levied if the transfer period or the transfer fee is fixed
- Awarding contracts to joint ventures (“Special Purpose Vehicle”) formed between state agencies and domestic financial institutions for the execution of the project;

- Awarding contracts to joint ventures between domestic financial institutions for the execution of the project.
- Different approach may be needed to execute the different sub systems of IPTS depending upon estimated FIRR, EIRR, total cost, etc.
  For example possible options would be
  i) Bus Mass Transit System – Execute through operators on franchise basis
  ii) Bus Rapid Transit System – Execution by in-house
  iii) Light Rail Transit System – Execution on BOT or BOOT basis

## 7.3 Institutional Framework for Private Sector Participation on Build, Operate & Transfer (BOT) Basis

The primary relationship in BOT structure is between a government agency (i.e. SMC/SUDA) and a private party. The private promoter subsequently enters into other contractual relationships for design, construction, financing, operation and maintenance. The execution of this concept is based on contractual relationships, with each party having recourse to the project for its returns

The chart hereunder (**Figure 7.1**) provides a diagrammatic representation of the institutional framework for project implementation on BOT Basis.

### 7.3.1 *Special Purpose Vehicle (SPV)*

The BOT projects are conventionally set-up as separate legal/corporate entities to facilitate the independent execution of the project. The SPV format enables the project to access sector investors and lenders. The lenders can collateralize the cash flows of the project for recovery of their financial exposure to the Project.

The Integrated Transport Company of Surat Ltd. (ITCS) as a Special Purpose Vehicle (SPV) is proposed to be incorporated by Private Promoters (Concessionaire) for promoting, developing, financing, operating and implementing the IPTS Plan.

The Board of Directors of ITCS will be responsible for the operations of the Company. The ITCS Board will have representatives from Government of Gujarat, GIDB, SUDA & SMC, besides the Private Promoters.

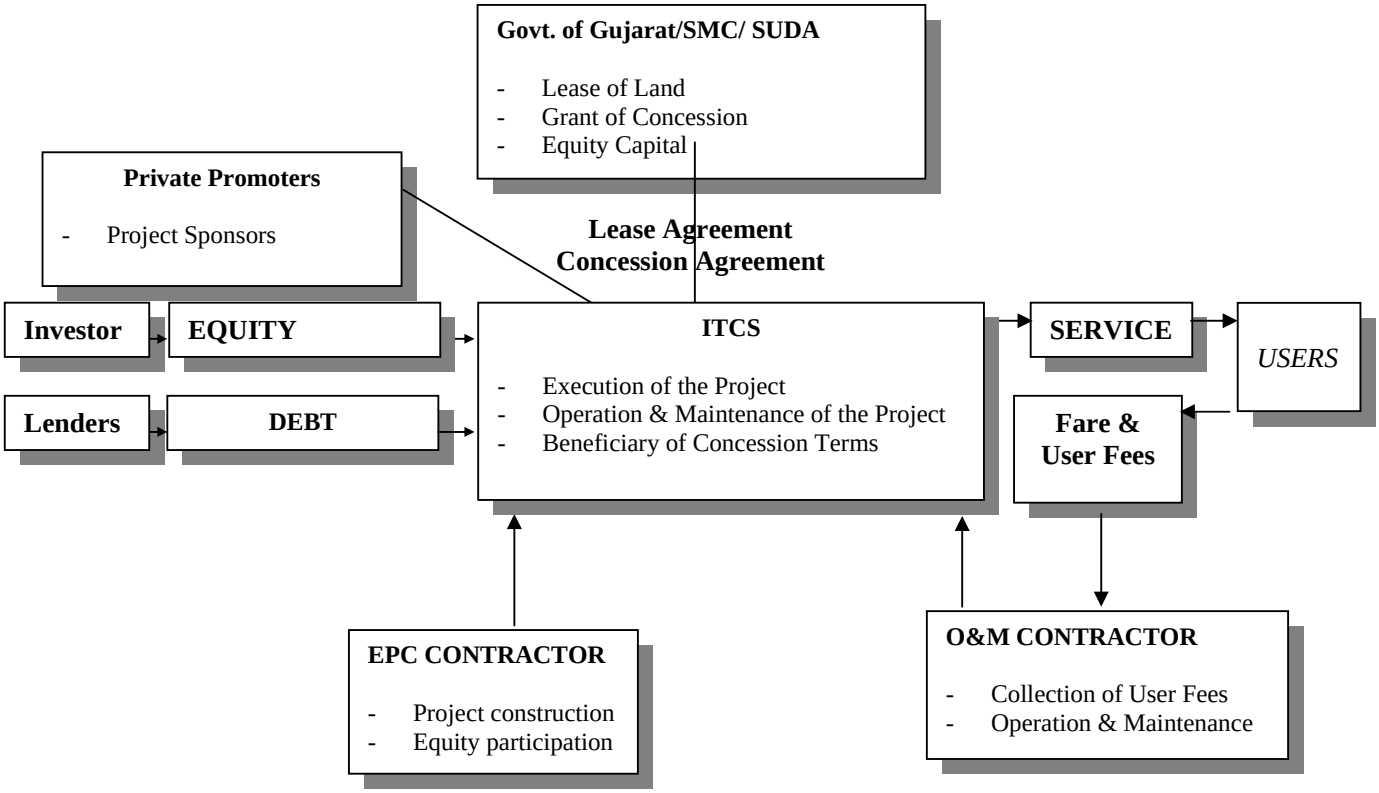



**Figure 7.1**

#### 7.3.1.1 *Project Sponsors / Private Promoters*

The Private Promoters, the successful bidder selected on the basis of National Level Competitive Bidding (NCB), will be the project sponsors.

A Memorandum of Agreement is to be signed between Govt. of Gujarat (Gujarat Infrastructure Development Board/SUDA/SMC and ITCS to undertake the development and implementation of IPTS Plan on commercial format.

### 7.3.2 Project Concept and Cost Estimates

The estimated cost of the IPTS Plan includes costs associated with civil constructions, Environmental Management Plan, Rehabilitation and resettlement costs, operation & maintenance cost etc.

Based on the construction cost of the project, the landed costs are to be arrived at by incorporating the establishment & pre-operative expenses, Insurance, legal & Mortgage fees, project management fees, mobilization and other financial charges, physical contingencies, interest during construction, etc.

Establishment and pre-operative expenses relate to the miscellaneous expenses that are being incurred during project development phase. These include SPV incorporation, registration fees, stamp duties payable, pre-operative expenses incurred by project co-sponsors, administrative overheads, etc.

### 7.3.3 Project Implementation Activities

The project development activities will be initiated by SMC.

Based on the IPTS Plan, Request for Qualification (RFQ) and thereafter Request for Proposal would be issued to the bidders for their bids on Construction and Operation & Maintenance of the project. The salient features of the bidding process would include the following:-

(1) Provide detailed designs to the bidder by way of the detailed feasibility report.
(2) The bidder shall have an option to suggest alternate or modified designs
(3) Certain parameters such as width of carriageway, Right of Way, shall be fixed and Bidder will not be allowed to vary these parameters even in his alternate designs
(4) The Construction Contract shall be a lumpsum fixed price contract. Since, the bidder will be submitting the bids based on his designs, the design risk will pass on to him
(5) An O&M price shall be quoted by Contractor for base year and would be paid upon escalation formulae. The O&M price shall be in four parts:-
    - ◊ Routine Maintenance
    - ◊ Major Maintenance
    - ◊ User Fee/ Bus Fare/ LRTS fare
    - ◊ Operations

### 7.3.4 *Project Management and Supervision*

**Project Engineer** - for the purposes of ensuring compliance of technical standards and specifications, the SPV would be appointing a Project Engineer (PE)

**Independent Engineer** - In addition to the Project Engineer who would basically represent the Concessionaire, the Project Lenders, Concessionaire and SMC will appoint an independent, internationally reputed firm of engineers to act as an Independent Engineer (IE). The IE would be responsible for determining and ensuring compliance with technical standards, specification and costs during the construction period. The IE would also have additional responsibilities during the operation phase including review of operations, submission of monthly reports, etc. The IE, however, will not be involved with day to day implementation and maintenance of the project

**Independent Auditor** - The Lenders, the Concessionaire and SMC would jointly appoint an Independent Auditor (IA) for the entire length of the Concession Agreement. The IA would approve the format for maintenance of accounts, the accounting standards and the method of cost accounting to be followed by the Concessionaire. The IA would audit and certify the books of accounts of the Concessionaire and shall also certify the project cost. In addition, the IA would also furnish requisite data to the Project Oversight Board at the request of the Concessionaire