

**COMPARATIVE TRANSPORTATION PROFILE
OF
SELECTED METROPOLITAN CITIES IN INDIA**



सत्यमेव जयते

May, 2003

**TOWN & COUNTRY PLANNING ORGANISATION
MINISTRY OF URBAN DEVELOPMENT & POVERTY ALLEVIATION
GOVERNMENT OF INDIA, NEW DELHI**

Contents

Page No.

Preface

Chapters

1.	Background	1
2.	Population and Land use Characteristics	7
3.	Transportation Characteristics	14
4.	Transport Operations	29
5.	Transportation Systems	38
6	Emerging Issues	42
7	Multiplicity of Organizations	49
8	Transportation Plans & Funding	55
9	Findings and Recommendations	63

Annexure

- I List of Questionnaires
- II List of Contact Departments

List of Tables

	Page No.
1. Registered Number of Vehicles in Metropolitan Cities (1991)	5
2. Demographic Profile of Metropolitan Cities	7
3. Major Land use Distribution in Metropolitan Cities	9
4. Registered Motor Vehicles and Urban Population in India	14
5. Registered Motor Vehicles in Metropolitan Cities- 2000	16
6. Modal Split	17
7. Trips for Different Purpose – 2000	18
8. Transport Networks in Metropolitan Area	19
9. Flyovers and Bridges in Metropolitan Cities	26
10. Traffic Flow in Metropolitan Cities	28
11. Operational Characteristics, Bus Transport	30
12. Bus Transport Logistics	32
13. Number of Employees in Bus Transport Undertakings	33
14. Types of Bus Services Operating	34
15. Bus Ticketing	34
16. Bus Fares Structure	35
17. Goods / Freight Data (Road Based)	36
18. Inter City Commodity Wise Goods Handled By Railways	37
19. Transport Systems	39
20. Road Accident Trends in Metropolitan Cities 1998-2000	43
21. Estimated Vehicular Emission Load in Metro Cities, 2000	44
22. Proposed MRTS Routes	57
23. Proposed Sky Bus Routes	60

List of Maps & Figures

	Page No.
Figures	
1. Methodology	4
2. Land use Distribution in Metropolitan Cities, Pune	10
3. Land use Distribution in Metropolitan Cities, Surat	10
4. Land use Distribution in Metropolitan Cities, Lucknow	11
5. Land use Distribution in Metropolitan Cities, Bhopal	11
6. Land use Distribution in Metropolitan Cities, Kochi	12
7. Land use Distribution in Metropolitan Cities, Varanasi	12

Maps / Drawings

1. Transportation Network of Surat	20
2. Transportation Network of Lucknow	21
3. Transportation Network of Bhopal	22
4. Transportation Network of Kochi	23
5. Transportation Network of Varanasi	24

Preface

Transport is the lifeline of urban centres. It affects their economy and in turn that of the nation. In the recent past, there has been manifold increase in number of motor vehicles and their resultant problems such as pollution, congestion, time and speed delays, accidents and parking problems, etc. The conditions of city transport especially in the metropolitan cities have deteriorated to a large extent, which merits immediate attention.

This study on Comparative Transportation Profile of Selected Metropolitan Cities in India is an attempt to develop a data base and highlight the salient features and traffic and transportation characteristics and present a comparative profile so that basic information is available. TCPO has already brought out a report covering the six mega cities. This study focuses Pune, Surat, Lucknow, Bhopal, Kochi and Varanasi metropolitan cities.

The report will lead to awareness for exchanging data and sharing the experiences on a regular basis amongst development authorities, transport departments and other agencies.

I would like to acknowledge the assistance and cooperation extended by various departments and agencies including Town Planning and Valuation Deptt (Pune), Surat Urban Development Authority (Surat), Town and Country Planning Dept. (Lucknow), Varanasi Development Authority (Varanasi), MP Vikas Pradikaran Sangh,(Bhopal), Greater Cochin Development Authority (Kochi), State Transport Departments, RTOs, Divisional Railways, State Pollution Control Boards for the support provided to TCPO. I would also like to place on record the contributions made by Shri B.K. Arora, Town and Country Planner (Retd.) and Shri Udit Ratna, Associate Town & Country Planner in bringing out the report and Smt. Raj Rani, Research Asst. Smt. Kiran Taneja, Sr. Stenographer, Shri D.M. Nandanwar, Jr. Stenographer and Smt. Saroj Bala, Planning Asstt. for providing technical & secretarial assistance.

May, 2003
New Delhi.


(K.T. Gurumukhi)
Chief Planner

Background

At present, India is characterized by dynamic urban growth. The urban population has gone up by more than 11 times from 25 million in 1901 to 285 million in 2001. The number of urban settlements have gone up by 2.8 times from 1827 to 5161 during the corresponding period. The urban population of India has grown in absolute number from 159 million in 1981 to 217 million in 1991 and 285 million in 2001. Similarly, the number of million plus cities (10 lakh +) has grown from 12 in 1981 to 23 in 1991 and 35 in 2001. The most striking feature is that over 60% of total urban population is concentrated in the towns and cities with over 1 lakh population as per 2001 Census.

The urban population boom puts a severe pressure on the infrastructure and especially on urban transportation. The gap between the demand for and supply of urban services widens, as the user community tends to grow at a geometric progression whereas supply of services does not grow at that rate. In Indian cities, public transport facilities are inadequate. The increase in urban population has resulted in increase in trip demand. Urban transportation is the most important component that shapes urban development and urban living. Urban roads which constitute the lifeline of the urban centers are hardly in a position to accommodate such increasing trip demand, consequent to increase in number of motor vehicles, number of trips, increasing trip length and lack of investment in urban road sector.

Presently, the major cities of India are confronted with severe traffic and transportation problems, increase in personalized modes, unreliable services of public transport systems in terms of quality and quantity, lack of integrated policy, multiplicity of agencies and lack of coordination. Though in the past, various attempts have been made to integrate the land use of different metropolitan cities

with the transport systems, but unfortunately the same has not been achieved to a desired extent. The travel demand in metropolitan cities has increased tremendously. The existing urban transportation system is not able to meet the demand of the growing population. The existing trend of traffic flow reflects poor performance of the urban transport system. The increasing levels of pollution especially vehicular pollution have added to the health hazard. The mounting accident rate and unsafe travel have further added fuel to the fire. Therefore, there is need to address these issues in a comprehensive manner.

This study focuses on presenting a comparative profile of transportation characteristics of selected metropolitan cities in India *viz*: Pune, Surat, Lucknow, Bhopal, Kochi and Varanasi. The main components are demographic profile, land use distribution, modal split, nature of trips, transportation network, traffic flow, transport systems, bus transport logistics, operational characteristics of bus transport, strength of employees in public bus transport undertakings, types of bus services, ticketing and fares, distribution of freight traffic, operational characteristics of suburban rail system, commodity wise goods handled by railways, pollution levels and accident analysis.

Transport, which is a function of land use, plays a crucial role in the national economy. If it is to be sustained in a progressive manner, improved efficiency through sustainable transport policies and effective physical planning are required. There is also need for effective management of transportation systems by adopting short-term and long-term measures leading to overall improvement.

The Government has substantial control on the transport sector. A number of agencies are involved in the provision of transport services and related infrastructure. Some of the features related to these aspects have been analyzed so as to present the status of transport development in these cities and also to focus on the need to collect data in a standardized format on a regular basis.

Objectives, Scope and limitations

The major objectives of the study are:

- i) To assess the transport characteristics of selected metropolitan cities.
- ii) To analyze the existing situation in respect of transport characteristics.
- iii) To study the underlying problems of urban transport sector.
- iv) To disseminate information and data among selected metropolitan cities in order to focus on the need for collection of data in a standard format in a regular time cycle.
- v) To draw the attention of state level agencies dealing with transport for adopting a single window system in respect of transport data for the use of transport planners and policy makers etc.

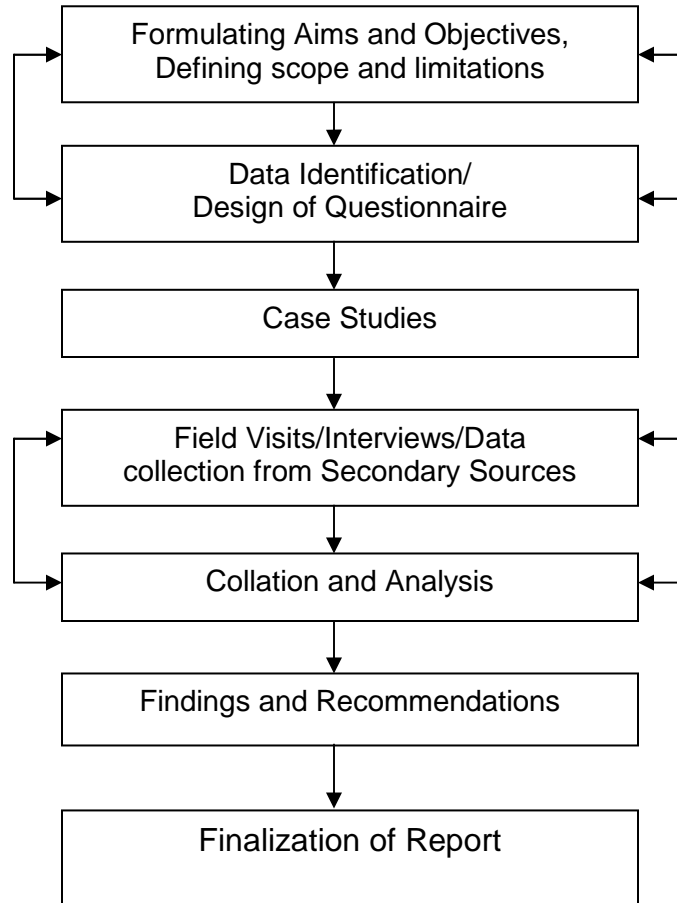
The study is confined to six metropolitan cities. Different components of urban transport such as land use pattern, transport systems, existing transportation network, bus transport logistics, operational characteristics of bus transport/suburban rail system, freight handled by railways, vehicular pollution levels and accident analysis etc., are highlighted with emphasis on problem areas.

Methodology

The study has been taken up by TCPO in house. The questionnaires have been designed and sent to transport departments of the state government, development authorities, divisional railway offices and state pollution control boards, etc. for collection of data / information. A copy of the questionnaire is appended at Annexure-I. The detailed list of contact addresses from whom the data was sought is appended at Annexure-II. Care has also been taken to procure the information from Census of India-2001 (provisional), Motor Transport Statistics of India 1999-2000, Economic Survey Report-2000, Annual Accident Report-1999 and other secondary sources. The officers of the TCPO have also undertaken field visits in order to ascertain the authenticity of data / information.

The missing data was collected and reconciled by specific interviews with the state level officers. The data/ information received from different metropolitan cities and state level agencies has been scrutinized, analyzed and finally presented in the report. The flow chart of the methodology is given in Fig. 1.

Fig 1: Methodology



Case Studies

This is second study following the study on Comparative Transportation Profile of Mega Cities, *i.e.* Mumbai, Kolkata, Delhi, Chennai, Hyderabad and Bangalore. This study brought out the comparative status of different elements of transport and established the need for carrying out this exercise as an on-going

project by including other metros with the help of a specially designed study format which helped to achieve the objective of disseminating information amongst various agencies to help formulate effective policies and strategies. The study also focused on the need of continuity of such studies and also to take up the studies for other cities, especially metro cities, in association with State Governments and other agencies.

The key factors involved in selection of the metropolitan cities for this study are their growth of population during the previous decade and registered number of vehicles. All the 23 Metropolitan cities have been grouped in four categories *i.e.* cities with 4 lakh plus registered vehicles, cities with 3 lakh plus registered vehicles, cities with 2 lakh plus registered vehicles and cities with 1 lakh plus registered vehicles (Refer Table 1). Pune, Surat, Lucknow, Bhopal, Kochi and Varanasi have been selected from the above category. At least one or two metropolitan cities from each group, which also represent north, south, east and west part of the country have been selected.

Table: 1 Registered Number of Vehicles in Metropolitan Cities (1991)

Registered Number of Vehicles (1991)	Metropolitan Cities
4 Lakh and above	Mumbai*, Kolkata*, Delhi*, Chennai*, Bangalore*, Hyderabad* Ahmedabad, Pune, Jaipur
3 Lakh and above	Surat, Indore, Ludhiana, Lucknow
2 Lakh and above	Vadodara, Kanpur, Coimbatore, Bhopal, Patna, Nagpur, Vishakhapatnam
1 Lakh and above	Kochi, Varanasi, Madurai

* Already covered under study on Comparative Transportation Profile of Mega cities.

The metropolitan cities of Pune, Surat, Lucknow, Bhopal, Kochi and Varanasi had population of 24.93 million, 11.40 million, 16.16 million, 10.62 million, 11.40 million and 10.30 million respectively in 1991, which has grown to 37.55 million, 28.11 million, 22.66 million, 14.54 million, 13.55 million and 12.11 million in 2001 thus, they exhibited growth rate of 50.58%, 146.49%, 40.26%,

36.89%, 18.83% and 17.54% respectively during 1991-2001, resulting in tremendous transport problems. These six metropolises account for 11.9% of total urban population of 35 metropolitan cities taken together as per 2001 Census.

Outcome and Utility

The prevailing situation about the transportation problems in the metropolitan cities would give a clue to transport experts, planners, and policy makers etc. to work out strategies for solving the urban transportation problems. Though Pune, Varanasi and Kochi have different number of registered vehicles, but interestingly these cities do come across similar kind of problems, as far as road congestion, parking and road geometrics, etc. are concerned. Varanasi, being an old city, experiences severe traffic problems in terms of congestion because of narrow roads, mixed modes and poor road geometrics. In the same way, in Pune, the population has increased at a galloping pace due to rise in industrial and commercial establishments. This has led to tremendous trip demand and strain on the public transport system. However, traffic management system, short term and long term planning and other remedial measures may be able to cope up with the problems of these cities. Similarly, length of road per sq. km of urban area, length of roads per thousand population, number of vehicles per thousand population, car ownership, etc. may be such indicators, which will help in devising suitable strategies for solving the urban transport problems in these cities. The passengers carried by rail, speed delays congestion and the other indices, which need detailed elaboration may also suggest the future line of action.

Population and Landuse Characteristics

Area and Population

The metropolitan cities selected for study are facing variety of problems, which apparently defy solutions in spite of having development plans and many improvement programmes under operation/ implementation. A large number of people in these cities live in sub-standard conditions housing areas without basic facilities and amenities like public transport, street lighting, sewerage, potable water, poor collection and disposal of solid waste, lack of open spaces, proper access roads. Table 2 reflects the population and area of these metropolitan cities.

Table 2: Demographic Profile of Metropolitan Cities

Particulars	Urban Agglomeration						
	Pune	Surat	Lko	Bhopal	Kochi	Varanasi	
Population (UA) in lakh	24.94	15.18	16.69	10.63	11.41	10.31	
Area in Sq. Km ¹	423.42	120.61	337.50	284.90	373.27	104.82	
Density per Sq. km	5890	12586	4945	3731	3056	9835	
Workers in lakhs ¹	8.84	14.16	4.42	3.28	3.31	2.75	
Participation rate in % (1991) ²	35.44 (1.51)	93.28 (51.16)	26.48 (26.51)	30.86 (29.40)	29.00 (NA)	26.67 (26.73)	
HH Income (in Rs.)	Annum	(income in %)					
	<25000	43.03	N.A	39.0	19.3	N.A	N.A
	25000-40000	38.11	N.A	10.0	39.1	N.A	N.A
	40000-56000	14.86	N.A	19.0	41.6	N.A	N.A
	>56000	4.00	N.A	32.0		N.A	N.A

¹ Pertains to 1991

² Figures in parenthesis show the percentage of workers to the total urban population

Density of Population

The Census areas of the six cities under study range from 104.82 sq. km to 423.42 sq. km. The density of population in these cities ranges from 3056 to 12586 persons per sq. km. Surat has highest density of 12586 persons per sq. km followed by 9835 in Varanasi, 5890 in Pune and 4945 in Lucknow. Some of the old areas in these cities have still higher densities. In terms of workers, Surat being an industrial city recorded 14.16 lakh workers followed by Pune 8.84 lakh. Bhopal had 51% of the households earning more than Rs.40,000 annually recording highest share in higher income bracket. Kochi is next highest with 41.6% and Pune having registered 18.8% is the third in the corresponding income range. In contrast, highest percentage of households i.e. 43.03% is recorded with low income group of Rs. Below 25,000 in Pune (Table 2). Kochi has the lowest share with 19.3% in corresponding income group.

Land Use

In terms of land use, predominant use is residential and sizable undeveloped land is available in all these cities, which to a large extent, is responsible for increasing overhead cost of providing infrastructure. These cities have lower percentage of land under traffic and transportation which creates difficulties especially in the existing built up space in undertaking improvement measures including new transport network and of transport infrastructure. Besides, it is noticed that there is lack of integration of land use and traffic generating nodes.

Hierarchy of transport network is not defined in these cities. Among the six metropolitan cities Pune has the lowest percentage of land under traffic and transportation network i.e. 3.33%, while Bhopal has recorded 14.86% of land under transport, which is highest (Table 3). The area under other uses are 74.7%, 58.5% and 34.5% in Pune, Surat and Kochi respectively, giving ample

scope to bring considerable area under Traffic and Transportation. The break up of land use is shown in Fig.2.

Table 3: Major Landuse Distribution in Metropolitan Cities

Landuse (in hectares)*	Pune (1997)	Surat (2011)	Lucknow (2001)	Bhopal ⁴ (2005)	Kochi (2001)	Varanasi ⁵ (2011)
Residential	22015.07 (16.0)	16727.0 (23.17)	15923.80 (67.24)	8190.0 (46.8)	10588.0 (38.38)	9254.61 (51.62)
Commercial	3234.0 (2.35)	944.0 (1.31)	983.20 (4.15)	650.0 (3.71)	336.0 (1.22)	618.23 (3.45)
Industrial		4483.0 (6.21)	731.00 (3.1)	1389.0 (7.94)	1303.0 (4.72)	656.19 (3.66)
Transportation	4576.25 (3.33)	3212.0 (4.45)	2260.0 (9.54)	2600.0 (14.86)	3123.0 (11.32)	1460.35 (8.14)
Recreational	1449.64 (1.05)	1210.0 (1.67)	1868.50 (7.89)	2925.0 (16.71)	1142.0 (4.14)	984.47 (5.50)
Public & Semi Public	3525.97 (2.56)	3350.0 (4.64)	1537.0 (6.49)	1258.0 (7.19)	1575.0 (5.72)	1309.07 (7.30)
Others	102760.35 (74.70) ¹	42274.0 ² (58.55)	378.50 (1.59)	488.0 (2.79)	9518.0 (34.50)	3644.30 (20.33)
Total Area	137561.28 (100.0)	72200.0 ³ (100.0)	23682.0 (100.0)	17500.0 (100.0)	27585.0 (100.0)	17927.22 (100.0)

- * Landuse for all the metropolitan cities are shown for the horizon year
- 1. Includes water bodies, forest area, defence area, agricultural zone, afforestation
- 2. This includes 40949 hectares of land under non-urbanised area.
- 3. Total urbanise area is 31251 hectares.
- 4. Bhopal Development Plan 2005 published in 1995 by Directorate of Town and Country Planning, M.P.
- 5. Varanasi Master Plan-2011

FIG 2 : Land use Distribution in Metropolitan Cities-Pune

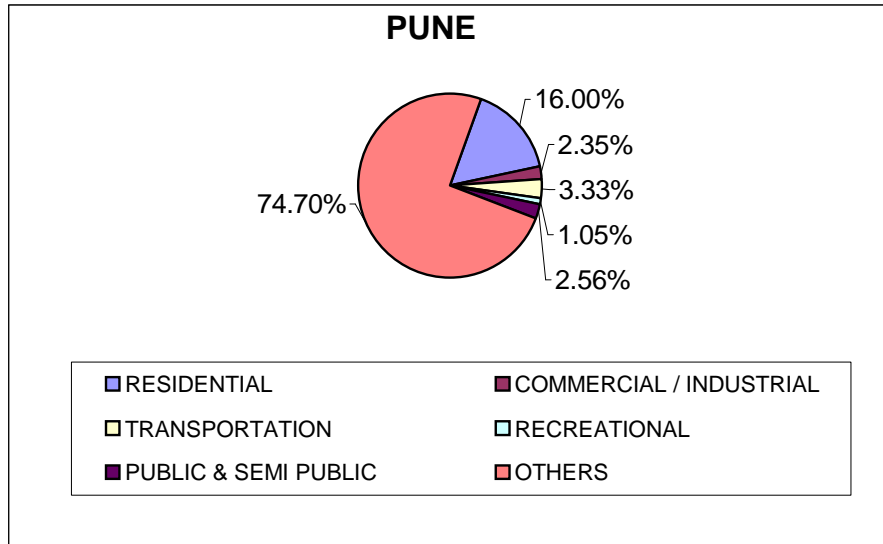


FIG 3 : Land use Distribution in Metropolitan Cities –Surat

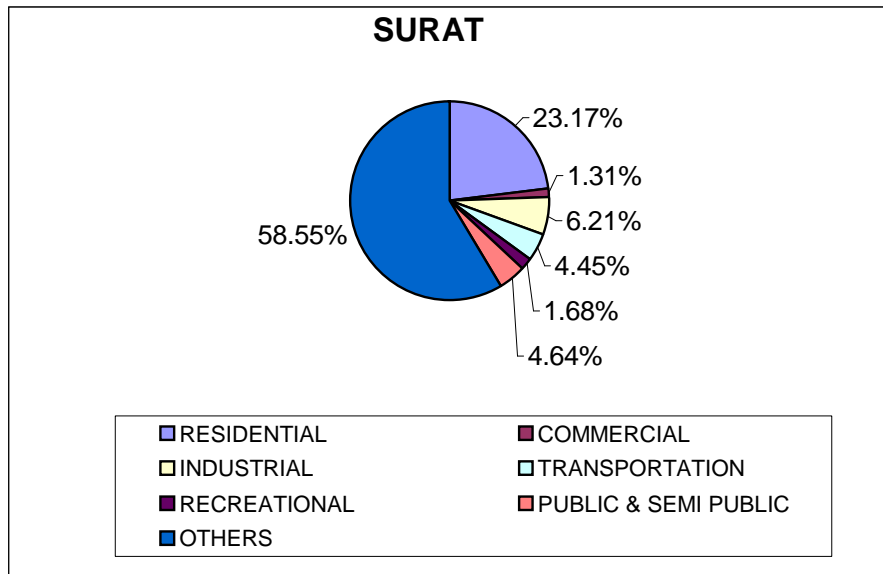


FIG 4: Land use Distribution in Metropolitan Cities-Lucknow

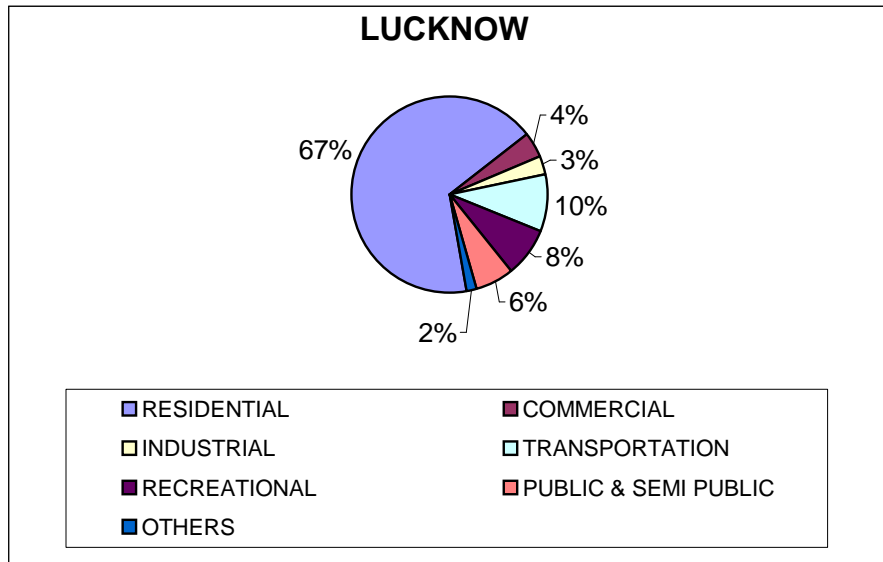


FIG 5 : Land use Distribution in Metropolitan Cities-Bhopal

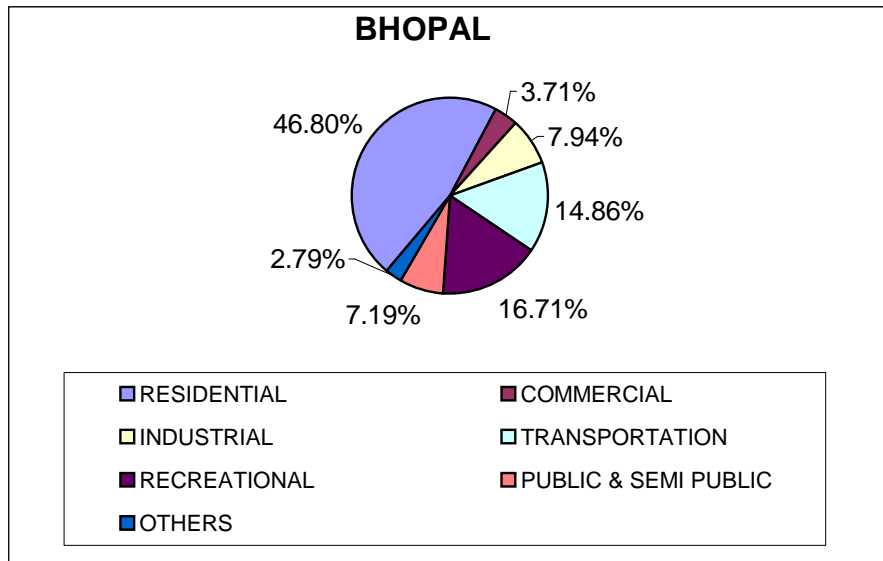


FIG 6: Land use Distribution in Metropolitan Cities-Kochi

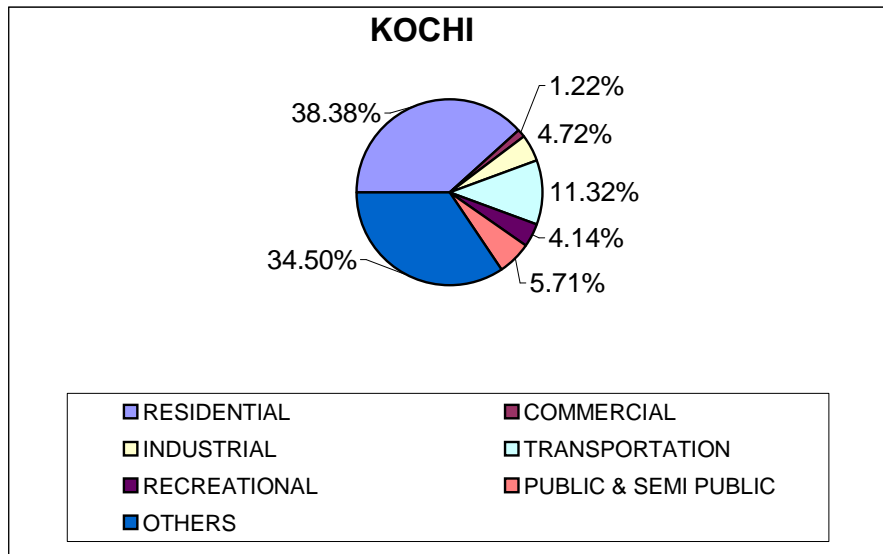
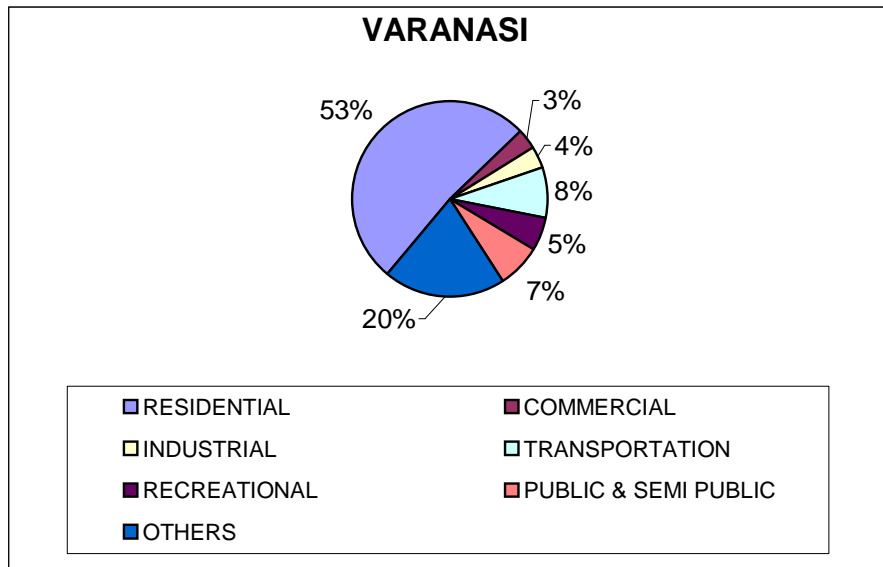


FIG 7 : Land use Distribution in Metropolitan Cities-Varanasi



Land under such use needs to be increased in order to improve circulation pattern in these cities. Varanasi is characterised by narrow and congested lanes. The multi-storied buildings on both sides of the lanes create a hindrance in widening and strengthening of the lanes.

Transportation Characteristics

Although the country has experienced high growth of vehicular population, there is no proportionate increase in length and quality of roads and other transport infrastructure. The country as a whole has got 3.3 million km of total roads, of which national highways constitute only 58112 km account for 1.76 per cent. In 1951 the total length of National Highway was 0.22 lakh km which has increased to 0.31 lakh km in 1991 and 0.58 lakh km in 2001, thus registering an increase of 9000 km of length of National Highways during 1951-91 and 27000 km of length of highways during 1991-2001. This was mainly due to converting the State Highways into National Highways. Transport problems are visible and have multiplied because of increase in travel demand followed by growth in economic and other activities.

Government has wide control on transport sector. Multitude of agencies are involved in the provision of transport services and infrastructure. Some of these features which are visible in these metropolitan cities are discussed with a view to bring out the status of transport development and to disseminate information and data among these metropolitan cities in order to focus the need for collection of data in a standard format on a regular time cycle and share their experiences.

Table 4: Registered Motor vehicles and Urban Population in India.

(In thousand)

Year	Total urban population	Total registered vehicles	Total registered two wheelers
1981	159460	5391	2618
1991	217610	21374	14200
2001	285360	48393*	33913*
% increase (1981-2001)	78.95	897.66	1295.37

Source: Motor Transport Statistics of India 1999-2000

* pertains to year 2000

Growth of Vehicles

The growth of motor vehicles was slow before the eighties; however, since eighties the growth of motor vehicles has experienced phenomenal increase from 5.39 million in 1981 to 48.39 million in 2000 at all India level i.e. just in two decades it has registered nearly nine times increase in total motor vehicles. The growth of vehicles has surpassed the growth of population in the cities by many times. Two wheelers have recorded 13 times increase during the corresponding period (Table 4).

The production of cars has increased manifold. Though the number of buses per lakh population may not be high, buses have recorded a growth of about 235% between 1981-2000. The six metro cities have recorded more than 2.3 million motor vehicles i.e. 4.77% of the total vehicles of the country and more than 14.96% of all the 23 metro cities in the year 2000.

The two-wheeler alone constitutes 84.8% of the total motor vehicles in Surat, followed by 80.2% in Varanasi, 79.5% in Bhopal and 77.9% in Lucknow in 2000. The share of personalized modes of vehicles out of total motor vehicles is as high as 92.9% in Surat followed by 87.6% in Lucknow, 86.2% in Bhopal and 85.1% in Varanasi. Due to inefficient public transport, people prefer to use personalized modes of transport in these cities. The car ownership per thousand of population ranges from 12.9% in Varanasi to 28.9% in Kochi (Table 5). The disheartening feature of transport in metro cities is the high increase of personalized mode and that too of two wheelers without proportionate increase in road capacity. This has resulted into degradation of environment and road safety.

Modal Split

Trips for other purposes like education, recreation, etc., are also increasing along with trips for purposes of work. Modal split (Table 6) indicates that sizable percentage of passenger trips generated in the cities are performed

Table 5: Registered Motor Vehicles in Metropolitan Cities- 2000

Mode	Pune	Surat	Lucknow	Bhopal	Kochi	Varanasi
All Vehicles	593214	487639	442386	284696	226185 ²	274331
Two Wheelers	443266	413775	344268	226634	136219	219750
Light Motor Vehicles (G)	12461	4290	4391	3231	16351	2619
Light Motor Vehicles (P)	41111	22496	8403	8951	12978	4958
Cars	52007	39636	42805	19076	33028	13294
Jeeps	10878	2888	10264	3673	3700	2843
Taxis ¹	3479	690	7140	4420	7247	770
Buses	7827	744	2816	2530	3726	1900
Trucks & Lorries	19222	2544	9212	4003	7769	7045
Tractors	857	77	9424	8555	469	19487
Trailers	702	146	911	3033	985	774
Others	794	353	2752	590	3713	890
% of personalized vehicles	83.52	92.91	87.57	86.21	74.89	85.05
Cars (per 000) population	20.85	25.11	25.65	17.94	28.95	12.89

Source: Motor Transport Statistics of India 1999-2000, Transport Research Wing, Ministry of Road Transport and Highways, Govt. of India, New Delhi.

- 1) Taxis include Multi Taxied/ Articulated Vehicles (89 in Lucknow, 41 in Varanasi, 103 in Bhopal and 233 in Total).
- 2) Relates to 1997.

by walking, cycling etc., as the facilities like education, recreation, offices and employment areas can easily be accessible through these modes in Pune and Bhopal. Nearly two third of the passengers use public bus transport as their mode of transport in Kochi. The people prefer to use personalized modes of vehicles in the cities of Surat and Lucknow because of unreliable services of bus transport. The share of personalized modes of vehicles is as high as 55% in Surat and 29.7% in Lucknow. Another redeeming feature of transport scenario of

Table 6: Modal Split

Mode	% of Trips					
	Pune ¹	Surat	Lucknow	Bhopal	Kochi ³	Varanasi
Bus	22	15	24.2	18.6	66.36	35
Train	01	-	4.2	-	0.39	10
Walk	37	3	2.0	48.5	8.1	5
Car/Jeep	01	20	10.3	1.5	3.62	2
Auto-rickshaw, Cycle Rickshaw	05	22	35.1	2.7	4.56	35
Two Wheelers	16	35	19.4	17.7	5.47	10
Cycle	18	2	4.8	4.3	2.35	3
Others	-	3 ²	-	6.7	9.18 ⁴	-
Total	100	100	100	100	100	100

1 Pertains to 1996

2 includes ferry

3 Pertains to 2000
Essar Ltd.

4 includes Company Buses, Reliance, L&T, Ficco,

these cities is that high percentage of passenger traffic is carried by public transport mode like buses and trains. Increasing share of personalized modes in some of the cities are not necessarily linked with either income or city size but it is often linked with non-availability of dependable public transport system choices especially in the case of Surat, Lucknow and Bhopal. Percentage share of motor cars for Surat which is relatively quite high, is possibly because of high income and availability of company cars.

Trip Purpose

Largest percentage of trips is performed on account of work which is followed by education and other purposes. In case of Surat, Kochi, Pune, Varanasi, Bhopal and Lucknow, work trips account for 60,56,51,50,49 and 40 per cent respectively (Table 7). Work trips in these cities being unidirectional, put serious strain on the transport system specially in high traffic density corridors,

often leading to serious road congestion. Assignment of land use can play very important role in either reducing or increasing number of vehicular trips.

Table 7: Trips for Different Purpose – 2000

Purpose	% of Trips					
	Pune	Surat	Lucknow	Bhopal	Kochi	Varanasi
Work	51	60	40	49.31	56.2	50
Education	35	30	35	27.26	27.52	30
Social & Others	14	10	25	23.43	16.28	20
Total	100	100	100	100	100	100

Hence, shifting of facilities/services in and around residential areas will tend to reduce travel length and may induce shift in vehicular modes. Shift to green modes will help reduce accidents, air and noise pollution. It has been found that the passenger transport in the cities has deteriorated because of lack of necessary investment and lack of sustained policy and weak management of transport department/undertakings. One glaring aspect which can be noticed in the city transport is the less involvement of private sector both in the mass public transport system as well as in the building of roads, rail and waterways. Public-Private participation in the form of BOOT, BOT etc., may help improving public transport system and consequently will carry more passengers for attending to various activities.

Transport Network

All the metropolitan cities are inter connected with one another with the system of National Highways, Rail Networks, Air Routes, etc. The details of transport network for different metropolitan cities are shown at Drawing No. 1-5. The traffic problems in these cities have multiplied several times with increase in number of motor vehicles. The existing ring road in Surat city provide relief to the

commuters approaching to and from walled city area. But discontinuity of ring road often leads to traffic chaos in the western and northern sides of the city. Besides these, many buses are parked along the ring road and near railway station creating traffic congestion during peak hours. Similarly, in Varanasi most of the existing roads are narrow except East-West corridors (G.T. Road, Ramakrishan Marg and Kabir Road) and North South corridors (Vidyapeeth Road, Sarnath Road). The metro cities of Lucknow, Bhopal, Pune and Kochi are characterized by mixed traffic, bottlenecks at intersections and improper design of geometrics, which affect the traffic movement in these cities. Table 8 reflects the length of transport networks in different metro cities. The length of roads varies from 80 km in Surat to 646 km in Pune. The length of roads per 100 sq. km area of Pune, Surat, Lucknow, Bhopal, Kochi and Varanasi are worked out to 152, 54, 110, 44, 95 & 78 km respectively, thus indicating inappropriate road densities in such cities. There is no standard practice for collecting data and also the classifications of roads are not same for each city. This creates difficulty in analysis.










Table 8: Transport Network in Metropolitan Area

Category		(length in kms)					
		Pune	Surat	Lucknow	Bhopal	Kochi	Varanasi
Roads with breakups	30 M	604	33.40	123	38.77	55.5	338.4
	45 M	42 ¹	24.29	87	15.40	34.5	-
	60 M		22.62	99	-	36.0	-
	76 M	-	-	62	27.48		17.3
Total Length		646	80.31	371	81.65	126.0	355.7
Waterways		42	-	-	-	-	110

1. Includes width of 30 m and above

SURAT

LEGEND

-  NATIONAL HIGHWAYS
-  STATE HIGHWAYS
-  MAJOR ROADS
-  S.U.D.A. BOUNDARY
-  S.M.C. BOUNDARY
-  RAILWAY LINE
-  PROPOSED ROADS
-  U.L.C. LIMIT
-  TRANSPORT & COMMUNICATION

TRANSPORT NETWORK



SCALE

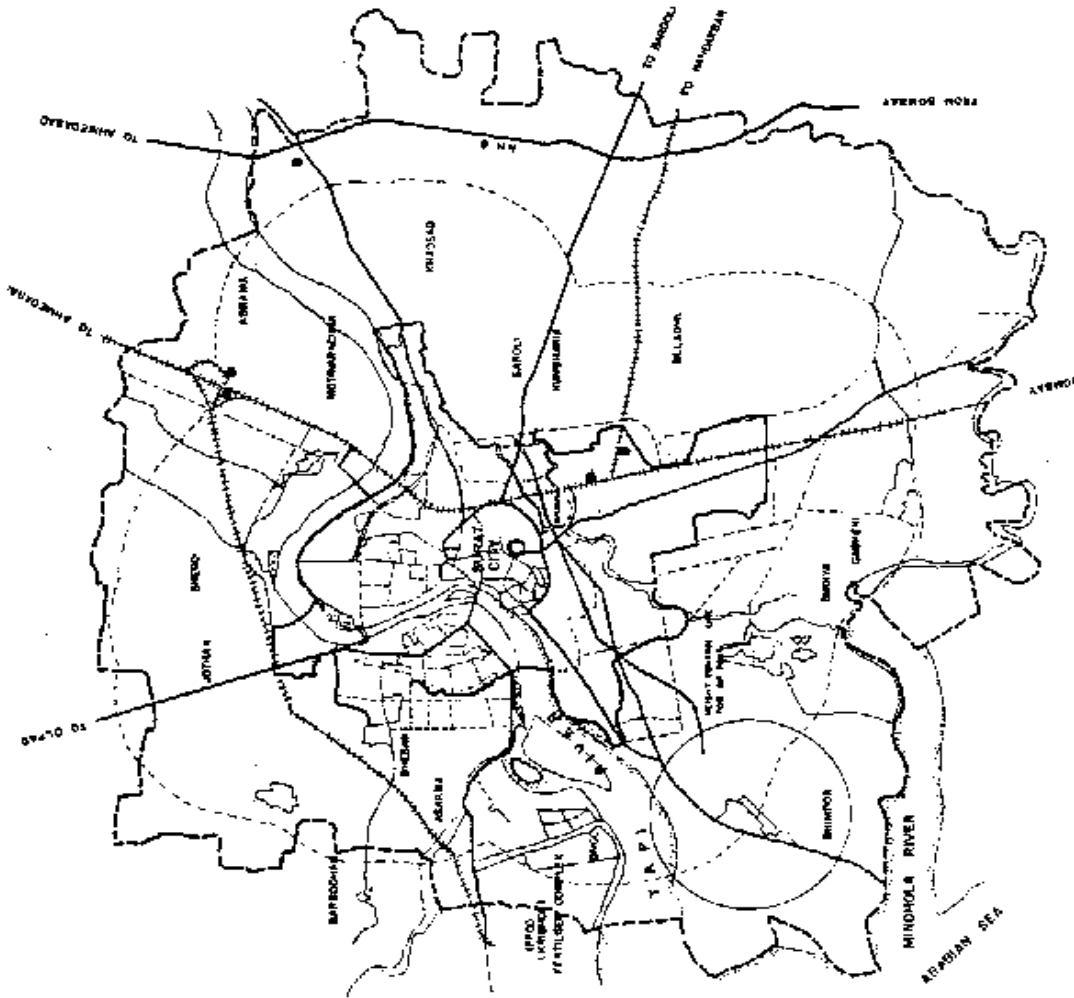
1:50,000

1:38,600

ORG. NO.

1











TOWN & COUNTRY PLANNING ORGANISATION
MINISTRY OF URBAN DEVELOPMENT & P. A.



TRANSPORTATION PROFILE OF METROPOLITAN CITIES IN INDIA

LUCKNOW

LEGEND

-  NATIONAL HIGHWAYS
-  STATE HIGHWAYS
-  MAJOR ROADS
-  MUNICIPAL CORPORATION BOUNDARY
-  BUS TERMINAL / TRUCK TRMNM.
-  TRANSPORT NAGAR
-  RAIL CORRIDORS
-  RAILWAY STATIONS
-  AIR PORT
-  WATER BODY

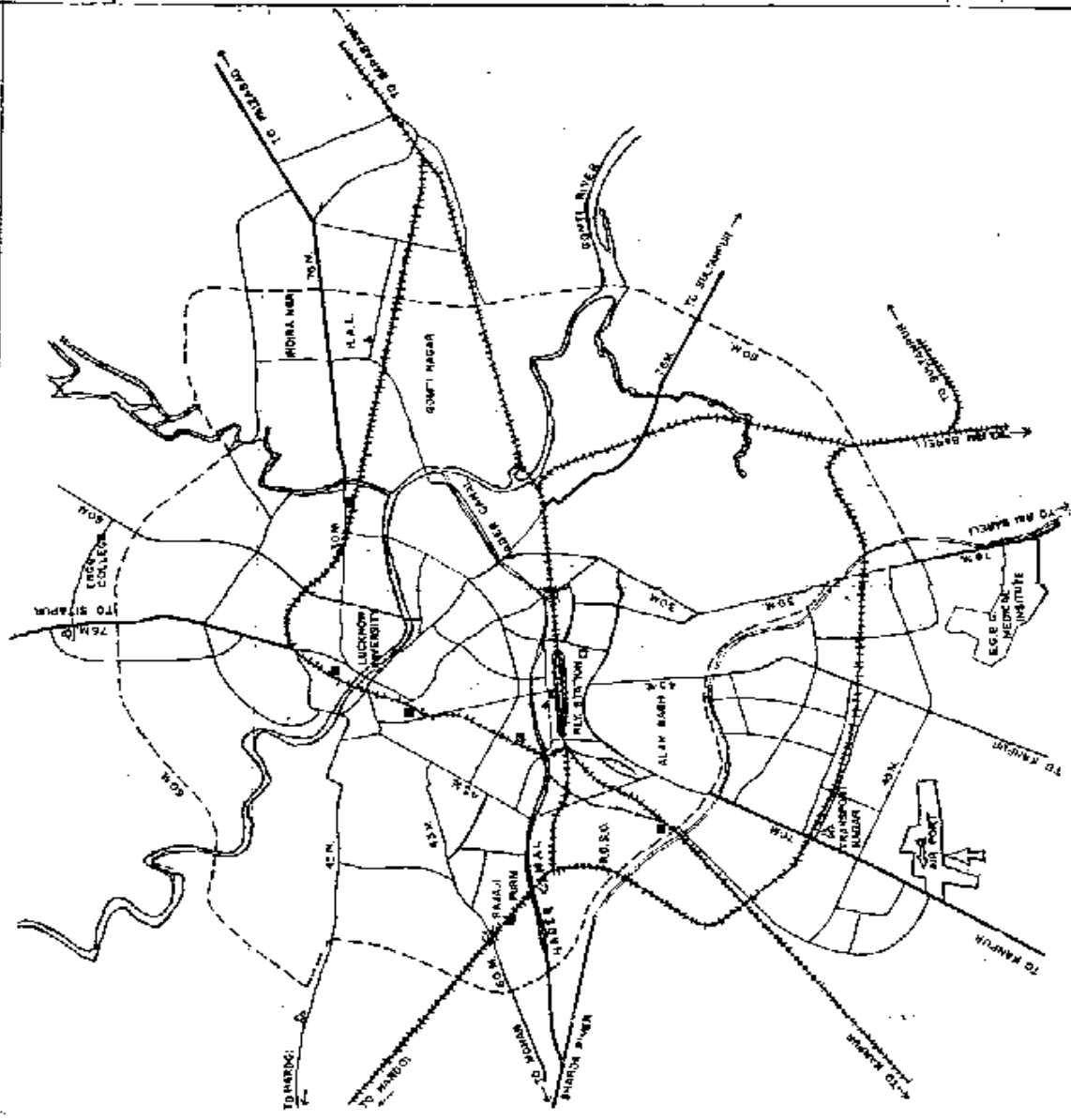
TRANSPORT NETWORK



SCALE 1 : 40,000
6 KM

DRG. NO. 2













TOWN & COUNTRY PLANNING ORGANISATION
MINISTRY OF URBAN DEVELOPMENT & P. A.



TRANSPORTATION PROFILE OF METROPOLITAN CITIES IN INDIA

VARANASI

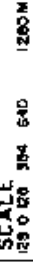
LEGEND

-  NATIONAL HIGHWAYS
-  STATE HIGHWAYS
-  MAJOR ROADS (45-0M WIDE)
-  MAJOR ROADS (30-0M WIDE)
-  PROPOSED ROADS
-  DEVELOPMENT AREA BOUNDARY
-  PLANNING DIVISION BOUNDARY
-  MUNICIPAL CORPORATION BOUNDARY
-  BUS TERMINAL / TRUCK TRMN.
-  TRANSPORT NAGAR
-  RAIL CORRIDORS
-  RAILWAY STATIONS

TRANSPORT NETWORK

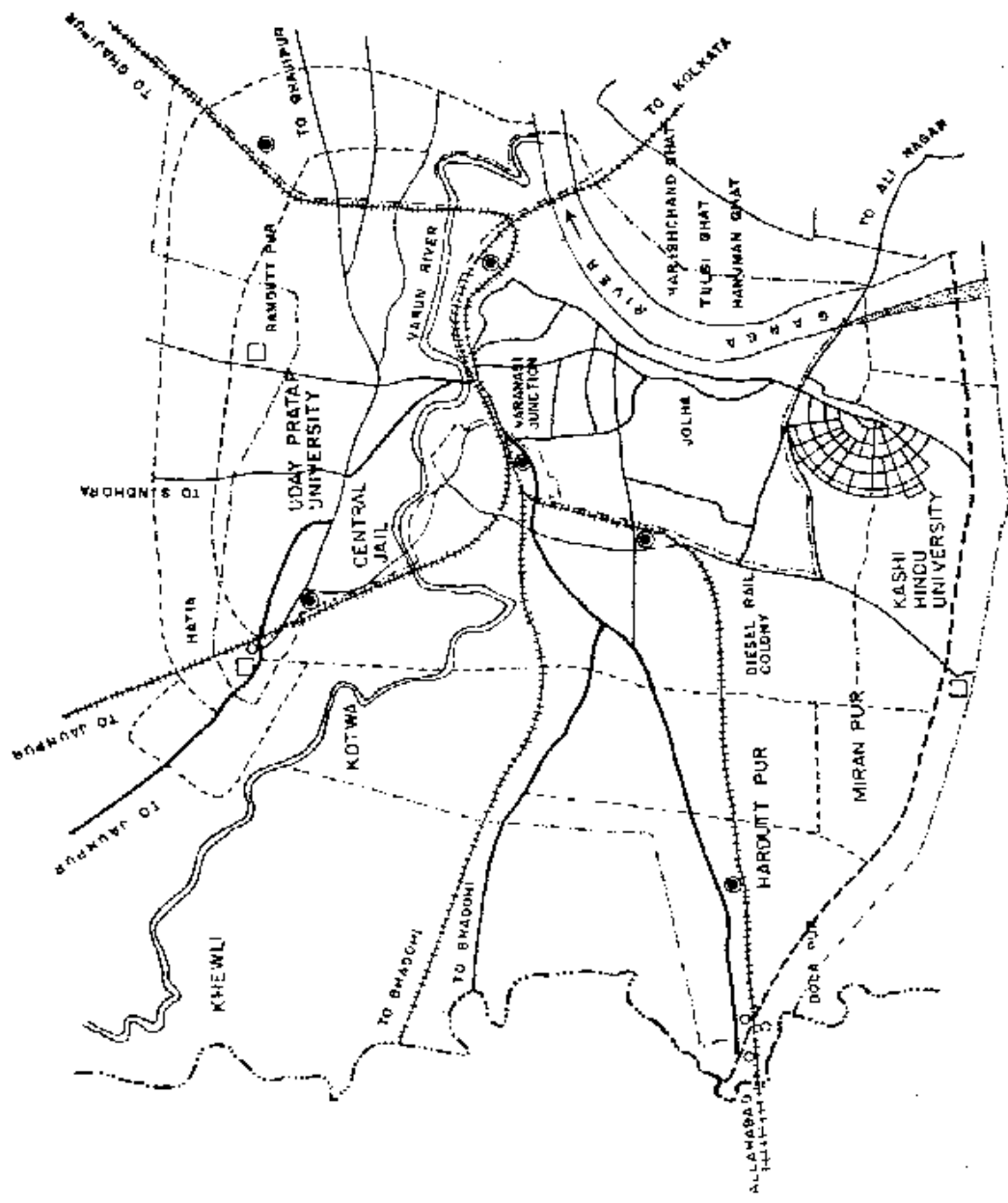


SCALE
1:25,000



DRG. NO.
5

TOWN & COUNTRY PLANNING ORGANISATION
MINISTRY OF URBAN DEVELOPMENT & P. A.



TRANSPORTATION PROFILE OF METROPOLITAN CITIES IN INDIA

Road hierarchy based on types of roads varies considerably for different cities as no uniformity of classification is practiced on the basis of ROW or any other standard. For example, the total road length shown in case of Varanasi may be high but most of the roads are generally narrow and poorly maintained. Large number of arterial/sub-arterial roads will have even less than 12 mt. ROW. Without segregation/median for most road sections, bus routes also create delay and congestion. The congestion is further increased because of sharing the same carriageway by mixed traffic. The sub urban rail networks in all the metropolitan cities are not developed. This is in spite of the fact that India has one of the most extensive railway systems (62660 km). Passenger movements are predominantly road based. However, Kochi happens to be only city among the six metropolitan cities, served by ferry services, which is operated by the Inland Water Transport (IWT) from 10 major terminals. The ferries connect fort Cochin, Mattachery, Wellington Island, Vypeen Islands, Bolgatty Islands, Thevara, Nettor etc. The ferries have good patronage, since the time taken by ferry is much less than to reach the island via road.

All the metropolitan cities are served by railway stations but without adequate parking facilities and modern amenities. Station areas are congested, dirty, without proper signage and without adequate facilities including for handicapped persons, etc. All the metropolitan cities also have airports, which facilitate air movement. Large areas of these towns are used under road and rail networks, airports, depots, terminals and workshops etc. The computerized reservation facilities for inter-city rail travel (to and fro) are available in these cities.

The transport movement in the city is greatly hindered because of traffic snarl and hold up at the intersection points, level crossings, etc., because of lack of adequate grade separators, road under and over passes and also bridges on the rivers etc. Table 9 refers to the number of flyovers, bridges, etc. in

metropolitan cities. Of late, number of bridges in different metropolitan cities are under construction. Kochi has got many bridges on watercourse connecting different parts of city by roads. The railway line divides the city into two parts and is connected by two over bridges leading to tremendous pressure of traffic on the bridges. Ernakulam, the core area was developed around one corridor i.e. M.G. road affect the traffic movement of entire city. But now the situation is improved with emergence of number of bridges. Similarly, Surat is well connected by bridges on river Tapi one of the second largest east flowing rivers in India. The total bridges including on water course number to 31 followed by 20 in Lucknow and 19 in Pune.

Table 9: Flyovers and Bridges in Metropolitan Cities

Category	Numbers					
	Pune	Surat	Lucknow	Bhopal	Kochi	Varanasi
Flyovers	05	2	6	1	-	4
RUB	02	1	8	-	3	2
ROB	01	1	20	3	15	1
Bridges on water Course	19	31	20	8	Many	9
Pedestrian Subways	04	2	Nil	1	-	-
Pedestrian over bridges	-	-	15	-	-	-
Road/ Rail under pass	07	8	-	1	-	-
Number of Level Crossings	06	1	17	8	17	3

The pedestrian sub-ways and road/rail underpass facilitate the safe movement of passengers in Pune, Surat and Bhopal. Surat Municipal Corporation has been able to mobilize the public participation for constructing and maintaining the traffic islands, road dividers and signals etc. It has set a

glaring example in achieving two fold objectives of traffic regulations and saving municipal fund by virtue of public participation. In Bhopal, Lucknow and Varanasi also number of steps have been taken for improvement of traffic problems. However, there is need to make road inventory within the cities and identify those railway crossings which hinder free flow of traffic. These need to be replaced by wider rail over bridges rail over bridges in phase-wise manners. Of late in metropolitan city like Lucknow the steps have been initiated to solve the traffic congestion by constructing the ring road, besides other remedial measures like construction of new bridges, widening of certain bridges in inner core and removal of encroachment, etc. In Surat also the flyover is proposed to be extended in order to ease the traffic problems beyond Textile Market area.

Vehicular Speed / Delay

There is steady deterioration of traffic flow in the metropolitan cities following unprecedented increase of vehicles, encroachments, traffic bottlenecks, improper road geometric, etc. This is further compounded by high volume of pedestrian traffic, hawking activities, indiscriminate digging etc., on footpaths and carriageway. As cities pavements are occupied by hawkers and encroached by shopkeepers, the pedestrian often find it easy to walk on the carriageways thus affecting the capacity of road which in turn seriously affect vehicular traffic flow and safety. Moreover, Indian cities are heterogeneous mixes of different modes of transport, which compete among themselves for the same space of mobility. It has been noted that some of the roads which were once considered motor vehicles owner's pleasure for cruising in relatively high speed has become nightmares. The speed of traffic flow in the central part of the cities is very low for a number of reasons. It has been often seen that passengers alight from the motor vehicles in traffic jam and start walking particularly in the CBD area.

Different studies have indicated different absolute figures of speed possibly because data is collected in different times of the day and during

school/college vacations but their findings/conclusion is same that the vehicular speed in the cities has gone down appreciably over the years.

Table 10: Traffic Flow in Metropolitan Cities

Name of Particular Corridors	Speed in km/hr					
	Pune	Surat	Lucknow	Bhopal	Kochi	Varanasi
Average traffic flow (peak hour)	15- 18	15-20	17-18	15-20	30-32	16-18
Average traffic flow (non-peak hour)	20-24	32	25	30-35	36	32

The studies indicate that traffic flow in Kochi, Bhopal and Surat are in the range of 30-32, 15-20 and 15-20 km/hr respectively during peak hours (Table 10). During non-peak hour, the speed is slightly higher. The speed on high density corridors of these metropolitan cities is expected to be lower which justify the need for introduction of mass rapid transit system.

Transport Operations

Bus Transport

Mass Transit System in the metropolitan cities is yet to be fully developed and it is mostly dependent on low-tech bus transport. The bus and trains will continue to be the main modes of transport for common people.

Bus transport in these cities is quite well developed and people are mainly dependent on this mode as rail transport in intra-city movement of these cities is yet to be developed. Bus transport is provided by public sector transport companies constituted under an Act of Parliament in 1950. Though these transport undertakings are not sound financially because of cumulative debt and poor performance, however, for providing mass transport facilities, under constraints, the situation is bad. There is, however, scope for further improvement if managements are given adequate power and made accountable and inter-departmental co-ordination is achieved. Fixation of fare rate on the basis of cost of living index/inflation or any other suitable formula, needs be devised to compensate undertakings for Government's social policy to charge low fare so as to allow transporters to restrict to higher charge economic fare rate because presently fare rate is unusually low.

Performance of the transport undertakings in the selected cities is not uniform. The average distance travelled per day indicate that the buses run by Private Bus Operators Association, Kochi travel more than 1.87 lakh km followed by 1.61 lakh km per day by Pune Municipal Transport, 1.18 lakh km per day by private bus operators of Varanasi. The performance of G.S.R.T.C, Surat is 0.22 lakh km per day (Table 11). Owing to concentric pattern of development Narrow Street the standard size width buses are not able to ply through all the parts of walled city of Surat.

Table 11: Operational Characteristics, Bus Transport

Characteristics		Pune	Surat	Lko	Bhopal	Kochi	Varanasi
Name of the Operator		PMT ¹	G.S.R.T.C	Pvt.	Pvt.	Pvt.	Pvt.
Avg. Km travelled (lakh/day)		1.61	0.22	0.45	N.A	1.87	1.18
Av. Fleet Utilization (%)		85.89	77.41	75.0	90.0	90.0	91.0
Av. Km cost in Rs.	Operational Cost	16.68	14.80	22.94	6.0	8.46	13.0
	Admin. Cost	-	11.64	Nil	4.00	1.00	Nil
Av. Fare Box Collection per day (in lakh Rs.)		22.04 ²	1.67	8.1	N.A.	26.25	0.46
Passengers travelled in lakh/day	Morning peak hrs.	4.40	9 to 13	0.25	-	-	1.35
	Evening peak hrs.	-	17 to 21	0.25	-	-	1.35
Av. lead (Km)		11.47	N.A	16-25	-	-	-
Passengers carried in peak hrs.		N.A	58290 ³	50000	-	135000	-
Avg. km covered per day by bus		254	N.A	100	N.A	N.A	-
Avg. trips covered per day Gross Km		N.A	N.A	6	NA	N.A	4.36
No. of routes in city operations		185	291	6	49	160	10
Avg. trip length (km)	Longest Trip	15 to 16	17.0	21.6	30	270	27
	Shortest Trip	-	2.0	-	10		

- 1 Pune Municipal Transport
- 2 Includes Ticket Sales of Rs. 2092192
- 3 Includes passengers traveled per day

As a result the share of mass transportation is poor which leads the commuters to use personalized modes. The fleet utilization in these cities recorded is more than 85% except in Lucknow and Surat. The highest average cost per km is recorded in Lucknow followed by PMT, GSRTC and Kochi Private Bus Operators Association. Total passengers traveled per day are highest in Surat followed by Pune. Pune also recorded highest average km per day per

bus i.e. 254 km per day per bus. As far as number of bus routes is concerned, Surat is served by 291 bus routes followed by 185 bus routes in Pune and 160 routes in Kochi. Lucknow has least bus routes i.e. 6 and Varanasi has 10 bus routes. The physical shape of the latter two cities is such that standard size buses cannot ply throughout the city. Alternatively Lucknow and Varanasi are served by three wheeler (9 seater), Tata 407 and Tempos. These modes of transport are able to access even in narrow streets. The average trip length is 30 km in Bhopal followed by 27 km in Kochi. The staff bus ratio which is an indicator of efficiency and better management practice appears to indicate that the transport undertakings are over staffed which may be one of the reasons for higher unit cost of operation. Absenteeism is another major constraint. Pune though is considered to have got efficient bus transport has a high staff bus ratio whereas the lowest is recorded for Lucknow, which is 1.4 per bus. By and large it has been found that bus transport logistics are not commensurate with the number of buses and the passenger demand. Number of depots varies from 1 to 6 (Table 12), which indicates that the number of depots are inadequate. Varanasi and Lucknow have 3 and 6 depots respectively. Along with the less number of depots the buses are expected to ply long distance thus adding more dead mileage thereby adding extra operating cost. In addition, the terminals are not well developed and are without adequate passenger amenities. These places are encroached by hawkers and encourage more encroachments because of lack of planned development of passenger amenities and inadequate enforcements in these areas. Many bus stops are without any shelter for waiting passengers. These are staggered by 0.7 km. to 1.0 km. apart. Thus, it can be safely assumed that city bus transport in the country has not changed much since its initial stage of development. The old aged vehicles, especially in Bhopal required to be modernized in order to give relief to the commuters. It is also very difficult to make contact with or locate the buses on the road in case of emergency or traffic hold ups, etc., for taking corrective action/measures which call for establishing

fast communication by using latest technology for improving operational efficiency.

Table 12: Bus Transport Logistics

Structures		Pune	Surat	Lucknow	Bhopal	Kochi	Varanasi
Depot		6	2	3	2	1	3
Workshops		7	2	2	3	1	4
Terminals		22	11	15	25	30	3
Bus Stations	Inercity	16	11	Nil	2	2	4
	Intracity	-	2	2	3	-	10
Bus Stops	Sheltered	451	20	57	200	2	100
	Unsheltered	824	40	183	-	-	300

It is observed that the fare structure is not based on the cost of operation. In view of increasing travel demand for bus transport due to existing cheap fare rate and increasing urbanization, there is a need for planned programme for increasing the fleet size besides initiating necessary steps to reduce the number of over aged buses. There is also need for increasing co-ordination among different Government department/agencies and the public to improve the bus services in the city.

It has been noted that route rationalization is not undertaken at regular intervals in spite of increasing travel demand due to springing up of new colonies/urban extensions and other developments. The fare box collection per bus also varies from city to city, the lowest being in Varanasi and the highest in Kochi. There is scope for increase in fare box collection per day per bus. These can be increased by route rationalization followed by reduction of average lead, introduction of exclusive bus lanes, improved bus technology, etc. The capacity of bus transport needs to be appreciably increased by constructing dedicated bus

ways. This will also go a long way in increasing the average kilometerage. The efficiently designed urban bus will lead in reducing emission and wastage of energy.

Bus transport offers good employment opportunities (Table 13). Pune has maximum number of employees and Bhopal has the minimum. The city bus transport services are required to cater to the needs of a variety of users. It is necessary that services are made attractive so that patronage from a cross section of the community increases. Also the preferential requirements of various categories of passengers needs to be kept in view for running special types of bus services. Special services exclusively meant for ladies, schools, night service, rail and airport service etc., are required to be promoted. It is also observed that there are no exclusive bus services existing for handicapped people except that few seats are reserved in regular services.

Table 13: Number of Employees in Bus Transport Undertakings

Category	Pune	Surat	Lucknow	Bhopal	Kochi	Varanasi
Total Employees	6867	1181	1800	980	37500	2681
Drivers	2090	428	900	490	750	692
Conductors	2308	456	900	490	1500	730
Administrative Staff	1073	114	Nil	N.A	Nil	102
Others including maintenance staff	1396	183	Nil	N.A	1500	1157
Staff/Bus Ratio	9.16	N.A	1.04	N.A	5.0	5.94

The different types of bus services as available in Metropolitan cities are given in Table 14. Bus ticketing in metropolitan cities is done by conductors manually and the fare structure is based on stages (Table 15).

Table 14: Types of Bus Services Operating

Types	Pune	Surat	Lucknow	Bhopal	Kochi	Varanasi
Bus Services (Ladies Spl, Night Service)	Schedule Bus	Ordinary	Ordin.	Ordinary	Ordin.	Ordinary
Corporate Identity	Red (in middle Yellow)	Red/ Blue	White & route-wise	Green/ Blue	Red	Not specified

Table 15: Bus Ticketing

	Pune	Surat	Lucknow	Bhopal	Kochi	Varanasi
Mode of issue of tickets in the bus	Conductor issues tickets	Stand booking	To Individual	Stand Bookg	Conduct or issues tickets	B.T. Books
Fare structures	Stage Fare	Stage Fare	Km Basis	Km Basis	Km Basis	Homogeneous
Checking System	Boarded, Alighting	Supervise line	Thro' Enforcement	Surprise check	By owners	Thro' Enforcement
Av. Distance of bus stop (in km)	2.0	0.5	1.0	1.0	0.7	0.7

In Lucknow, Bhopal and Kochi it is based on Kilometerage. Traffic inspectors check tickets for correct fare and also discourage/prevent ticket less travel. In privately operated buses, the tickets are checked by private people. Generally there is no air-conditioned city bus service in any metropolitan city. Management of the buses is centralized. The decision making here is not vested with the Undertakings, it vests with the Government. Fare structure is low (Table 16) and it is difficult to revise it without concurrence of the Government. The minimum bus fare is Rs. 2/- in Surat, Lucknow, Varanasi and Kochi.

Table 16: Bus Fares Structure

(in Rs.)

City and Sub Urban Services ¹		Pune	Surat	Lko ²	Bhopal	Kochi ³	Varanasi
Ordinary Bus	Min. Fare	2.50	2.0	2.0	4.0	2.0	2.0
	Max. Fare	23.0	7.0	7.0	N.A	8.0	28.0

1. No figure about Express/ Ltd. Bus Deluxe/Luxury Service or any other special services reported
2. Special Services minimum fare Rs. 5/ and maximum fare 25 /- reported
3. Pertains to year 2002

None of the metropolitan cities under study is provided with sub urban rail facilities. The number of rail alignments passing through these cities facilitate in providing intra city passenger movement. Kochi has more than 46 trains, which either pass through the city or terminate there. It has got sub urban rail route length of 39 km. Pune has 18 sub urban trains making 2 trips on an average daily. The city has the highest length of sub urban rail route i.e. 64 km, connected to 7 railway stations. The cities of Surat, Bhopal, Lucknow and Varanasi have rail services. Bhopal has maximum of 4 depots/yards followed by Pune - 3 depots and 1 workshop and Lucknow - 1 depot and 3 workshops.

Freight movement

In Lucknow, manures alone constitute more than 61% of the total freight handled by rails. The other commodities such as grains, sugar, maida, firewood etc. are also carried by rail. In Lucknow there are 5 freight terminals covering an area of approximately 35 hectares. These terminals are located at Transport Nagar handling miscellaneous items (22 ha.), Charbagh handling miscellaneous items (7 ha.), Pandey Ganj/Rakab Ganj handling grains, Aishbad handling wood and Kanpur Road handling building materials (Table 17). The major commodities handled by roads include cement, fruits, vegetables, fish, building materials, cloth, electric goods and leather items, etc. The building items handled by roads

constitute nearly 81% of the total freight, followed by fruits 9% and vegetables 4.8 per cent. Similarly at Varanasi 3 freight terminal are located at Padam, Lahartara and Pahadiya Subzi Mandi. The earlier two are specialized in building materials and latter in fruits and vegetables.

Table 17: Goods / Freight Data (Road Based)

	Pune	Surat	Lucknow	Bhopal	Kochi	Varanasi
No. of Freight Terminals	NA	NA	5	NA	Nil	3
No. of incoming trucks/day	NA	NA	150	NA	8609	5000
No. of outgoing trucks/day	NA	NA	150	NA	6225	5000
Area of Freight Terminal (in hectares)	NA	NA	35.5	NA	Nil	NA

In Kochi fertilizer is the most important freight in terms of tonnage, which enters the city by rail. Most of the products are being carried from Cochin Harbour Terminus and Ernakulam siding (Table 18). Varanasi city located in Eastern U.P. is the belt of sugarcane and grain production. These are reflected when they are carried by railway.

These two products alone constitute 90.9 % of the total commodities carried by rail. Similarly in Pune sugar and onion, in Surat steam coal, fertilizer and cement, in Bhopal manures, grains and LPG are the major products carried by rail. As far as road based freight in Bhopal is concerned, Krishi Upaj Mandi/ Samiti Mandi are specialized in fruits/vegetables, Azad Market in food grains, Kazi Khem in iron, steel, cement and Gandhi Nagar/Baragarh goods Terminal for mixed items.

Table 18: Inter City Commodity Wise Goods Handled By Railways

(in mt.)

Goods/ Commodity	Pune	Surat	Lucknow	Bhopal	Kochi	Varanasi
Sugar	324108 (77.81)		187650 (5.89)			888 (0.47)
Grain			279817 (8.79)	40000 (2.36)		80701 ⁴ (42.55)
Forest Product			35338 (1.11)			
Sugar Cane			137764 (4.33)			91746 (48.37)
Fodder						2116 (1.11)
Manures			1955590 (61.41)	1570000 (92.57)		4755 (2.51)
Steam coal		463452 (34.86)				
Fertilizer & Cement		865920 (65.14)			826277 ² (24.92)	
Onion	77931 (18.71)					
LPG				29000 (1.71)		
Others	14500 (3.48)		588236 ¹ (18.47)	57000 (3.36)	2489986 ³ (75.08)	9466 ⁵ (4.99)
Total	416539 (100.0)	1329372 (100.0)	3184395 (100.0)	1696000 (100.0)	3316263 (100.0)	189672 (100.0)

Source: Concerned Divisional Railway Offices

- 1 The data includes 275081 MT of maida, 62064 MT Salt, 8100 MT Rice Bran, 21168 MT Paddy Husk, 33220 MT Fire Wood, 76700 MT Timber, and 23660 MT Military Store
- 2 indicates fertilizer o/w from Ernakulam Siding
- 3 includes 363143 MT of different commodity O/W from Cochin Harbour Terminus (CHTS), 272888 MT I/W from Ernakulam goods (shifted to marshaling yard), 1853955 MT o/w from Ernakulam Siding.
- 4 includes 54 MT Oilseeds
- 5 include 41 MT of Mineral Oil

Transportation Systems

The metropolitan cities under study have got different types of transport systems. They are predominantly road based with the exception of Kochi, where ferry services are also operating in addition to the road based transport. Public Transport System is basically the main mode of carrying passengers for intra-city and inter-city trips. The main transportation systems existing in the six metropolitan cities are highlighted below.

Buses

There are no dedicated bus routes in these cities. Private operators in these cities meet the demand of passengers for intra-city movement. There are standard buses in Pune, Bhopal, Varanasi and Surat having capacity of about 65 passengers and above but often passengers number more than 100-125 particularly during the peak hours board these buses. Quality and sizes of the buses vary in these cities as these are designed and built on truck chassis and the bodies built locally. The buses are single deck and run mainly by public transport undertakings. The public transport system is not in a position to cater to the needs of the passengers. In Surat, Lucknow and Varanasi, the passengers are carried by the mini buses also with capacity of 35-40 passengers. The IPT modes such as tempos, taxis and cycle rickshaws have increased in great numbers. They are undependable, over crowded, uncomfortable and have poorly designed layout with an eye to a maximize number of seats and standing capacity with minimum regard to the passenger comforts. Ladies, children, handicapped and elderly persons face serious difficulties in travelling in the buses. Kochi and Lucknow are served by standard buses, but these do not cater to the growing need of commuters.

Because of unreliability of bus schedules, missing link services and poor route planning, IPT modes like cycle rickshaw, taxi, etc., are also playing important role, specially, for short distance travel. It has been noted that some of the corridors even with constraints of free flow of traffic carry bus passengers with high frequency which often rises to more than 15000 – 20000 persons trips per hour per direction (phpd). In Surat especially the commuters prefer to commute by tempos in absence of good bus transport services. Similarly in Bhopal and Kochi auto rickshaw and tempos are prevalent as they are cheaper modes. In Varanasi the travellers use small size buses for intra city movement. The current status of transport system is given in Table 19.

Table 19: Transport Systems

Mode		Pune ¹	Surat	Lucknow ³	Bhopal	Kochi	Varanasi
Standard Buses	Public	4974	158	-	1101	438	Nil
	Private	2685	Nil	248	-	491	750
Mini Buses	Public	N.A	Nil	-	3946	40	Nil
	Private	-	215	123	-	184	Nil
Chartered Buses		N.A	Nil	Nil	-	-	82
Others	Rural service Ordinary	-	1147 ²	-	4467 ⁴	451 ⁵	5200 ⁶

Source: 1 RTO, Pune.

2 Figure pertains to tempo

3. As on 31.10.2000

4. It includes big buses (29), Luxury Buses (388) and Taxi cars (4050).

5. It includes Rural Service Ordinary (410), Big (39) and Mini Express Buses (2).

6. It includes Mini Express Buses (300), Luxury Buses (200), Taxi Cars (1500) and Auto Rickshaw (3200) as on 2002

Pune has the highest of 4974 standard public buses, followed by 1101 in Bhopal and 438 in Varanasi. There are no double decker buses in any of these 6 metropolitan cities under study.

Contract Carriage Buses

As indicated earlier, the transport system in these metropolitan cities is not adequate for providing efficient services to the commuters. There is unauthorized plying of contract buses (also known as Chartered Buses) especially during office hours at a much higher rate on flat fare or on monthly subscription basis. These are quite popular with the office goers because they are more dependable and comfortable. In Varanasi 82 chartered buses are reported to ply on different routes. Diesel Locomotive Workshops in Varanasi, IFFCO, KRIBHCO, GSPC, and ONGC in Surat and BHEL in Bhopal provide contract carriage buses to their employees. Similarly in Lucknow, Kochi, Pune and Bhopal number of contract carriage buses are operating though their official data is not maintained. In view of shortage of proper parking facilities or private depot/terminals, these buses are parked on the roads around the activity nodes thus seriously reducing the road capacity for use of other modes and endangering road safety as well.

Sub Urban Rail

The suburban trains do not operate in any of the six metropolitan cities. However, in addition to public bus transport services, Kochi, Pune and Bhopal have high percentage of intra city passenger movement by rail. The shuttle trains in Pune bring more than 1.0 lakh passengers per day. In Pune, though the number trains per day have increased from time to time to meet the ever growing commuter demand, the constraint on line capacity, physical space and paucity of resources have made it impossible to improve and expand the system adequately. Varanasi, the junction of five railway lines i.e. Allahabad line, Lucknow line via Jaunpur, Lucknow line via Rai Bareli, Gorakhpur line and Mughal Sarai line serves the inter city movement of passengers and good. The suburban stations are located at Maruadih, Cantonment, Varanasi City, Kashi, and Sarnath. Among the five Cantonment /Varanasi junction is the main station. Similarly, in Lucknow and Surat, large number of commuters travel by rail as intra city passenger movement.

Ferry

Kochi is the only city, out of six metropolitan cities to have port handling facilities in terms of traditional as well as non-traditional cargo. The major items of imports are crude oil, food grains, fertilizers, coal, raw cashew nuts, machinery and hardware, newsprint, bauxite, iron and steel etc. In addition to railway connection to important destinations in the country, Kochi is served by National Highway Nos. 47, 17 and 49. With its proximity to the international sea route between the Europe and the Far East and Australia, Kochi can attract a large number of container lines offering immense opportunities. The passenger inflow/outflow at important ferry terminals is very significant. The route between Fort Kochi to Vypeen carries the maximum daily traffic followed by High court to Vypeen route.

Trucks

Number of trucks has been increasing in these cities. Mini trucks (LCV) for intra city goods movement are, however, increasingly being used for easy transferability. Truck movement timings in the cities are regulated. Even though plans have been prepared as a part of development plan for shifting of truck terminals from the congested city centers to the outskirts they are yet to be implemented in the majority of metropolitan cities. Kochi has relatively high percentage of truck and lorries (3.43%) whereas the next highest is Pune (3.24%) followed by Varanasi (2.57%). Trucks and Lorries consist of 2.08% of the total vehicular population in Lucknow. Altogether there are 0.50 lakh trucks in the six metropolitan cities, which constitute 2.16% of the total vehicles (Table 4). Facilities for trucks in the near future will require to be augmented in view of anticipated demand of road based goods movements to these cities. Loading and unloading facilities also need to be improved/provided in these cities in order to provide safe movement of passengers and goods.

Emerging Issues

All the six metropolitan cities are going through a difficult phase in respect of transport by virtue of increase in the use of personalized modes and management of overall transportation system. The effective right of way of roads is not put to use for various users such as pedestrians, motorized traffic and street infrastructure. High growth of vehicles coupled with poor enforcement of traffic management measures including parking has resulted in intractable problems for the citizens as a whole.

Accidents

Though the number of vehicles has been increasing at a fast rate in the country, vehicle ownership per capita is still much less as compared to the developed countries. The number of accidents in the country is very high as compared to countries registering high number of motor vehicles for many reasons, notably poor road worthiness of vehicles; mixed modes of traffic; undefined lane for non-motorised transport; poorly maintained roads; speeding by heavy vehicles specially buses and trucks; poor road geometrics; poor control & regulation of traffic measures; poor street lighting, etc. The total number of road accidents registered was 39,000 in 1960 and 3,91,449 in 2000 at India level, thus registering an increase of 903.71 per cent over a 40 year period.

In these six cities alone, more than 1000 people were killed in road accidents in 1998 (Table 20), which has increased to 1300 in 1999. By the end of year 2000 the total accidents reported were 866 in the six metropolitan cities. It may however be mentioned that all accidents are not reported and recorded. During 1998, 1999, 2000 the number of persons involved in accidents were 7300, 1000 and 8700 respectively in the six metropolitan cities. Lucknow has the dubious distinction of registering the large number of fatal accidents in which

more than 311 persons were killed in road accidents in 2000. Safety of roads is of concern to road users. The number of persons killed in Pune is 369 and 351 respectively in the year 1998 and 1999.

Table 20: Road Accident Trends in Metropolitan Cities 1998-2000

Region/ City	Total Accidents			Persons Killed			Persons Injured		
	1998	1999	2000	1998	1999	2000	1998	1999	2000
Pune ¹	2644	2570	-	369	351	-	2278	2330	NA
Surat ²	1440	1437	1210	152	191	146	1090	1076	970
Lucknow	598	812	878	208	295	311	494	599	583
Kochi	-	2688	2862	-	145	148	-	2543	2823
Bhopal	2264	2194	2383	168	171	162	2476	2332	2556
Varanasi	329	298	137 ³	190	179	99	166	223	69
Total	7275	9999	8706	1087	1332	866	6504	9103	7001

Source: Motor Transport Statistics of India – 1999-2000, MOST, Govt. of India.

1. Pune Municipal Transport, Pune
2. Police Commissioner, Surat
3. Data pertains to June - December, 2002

Pune recorded highest number of fatal accidents possibly because of increase in number of vehicles, speeding, disregard for traffic rules and regulations compared to other metropolitan cities. The economic and social cost of such accidents is enormous. These are often quoted to justify mass rapid transit system. Detailed computer data on standardized format / guidelines for safety throughout the country needs to be collected and exchanged with other cities. Road safety awareness is still quite low among vehicle users and pedestrians inspite of constituting State and National Road Safety Councils. Need for undertaking stringent road safety measures due to vulnerability of the pedestrians, cyclists, etc. hardly requires any emphasis for the metropolitan cities because of higher accident rate and fatality rate.

Pollution

Ambient levels of pollution from vehicular emissions in these metropolitan cities have reached a level of concern. It has been observed that around 65% to 75% of air pollution at the city level is contributed by vehicular emissions

following unprecedented increase of vehicles especially two wheelers during the last decade. Further, the pollution in these cities (Table 21) is varying on the basis of the local microclimate and congestion and number of vehicles, type of vehicles, road corridors, etc.

Table 21: Estimated Vehicular Emission Load in Metro Cities, 2000

City	Vehicular Pollution Load (Tonnes per day)					
	Suspended particulates	Sulphur di Oxide	Oxides of Nitrogen	Hydro Carbons	Carbon Mono Oxide	Total
Pune ¹	0.31	0.12	1.24	-	19.69	21.36 ⁵
Surat	N.A	N.A	N.A	N.A	N.A	N.A
Lucknow ²	0.86	0.88	10.1	71.24	147.13	230.21
Kochi ³	13.6	6.61	122.7	114.4	267.74	525.05
Bhopal	3.83	3.27	46.83	90.02	280.56	424.51
Varanasi ⁴	0.58	0.57	5.25	15.80	36.18	58.38
Total	19.18	11.45	186.12	291.46	751.3	1259.51

1 Source of data Maharashtra Pollution Control Board

2&3 State Pollution Control Board, Thiruvananthapuram

4 Emission load is calculated on the basis of vehicular emission factors given by CPCB Delhi. Average travelled distance for each vehicle is considered as 15 km.

5 Includes HTB, MTV, LTV.

Kochi has recorded the highest level of pollution among all the six metropolitan cities contributing more than 41% of the total emission load in 2000. It has 267 tonnes of carbon monoxide, 114 tonnes of hydrocarbon, 122 tonnes of oxides of nitrogen and 13 tonnes of suspended particulates. Next highest pollution level, as estimated by State Pollution Control Board, is at Bhopal with 280 tonnes of carbon monoxide, 90 tonnes of hydrocarbons, 47 tonnes of oxides of nitrogen and 4 tonnes of suspended particulates. Lucknow stands at third position contributing 18% of the total emission load of the six metropolitan cities. Other cities do have pollution but of varying degree. Pollution level obviously is not same throughout all the six metropolitan cities. Vehicular pollution is highest

at the high-density traffic corridor and at busy crossings when vehicles are in idling conditions.

Parking

Adequate provision of parking in the metro cities has not been made in spite of unprecedented demand for parking space not only in the activity nodes but also in residential area. There is perceptible gap between demand and supply of parking facilities in these metro cities and the problems are very acute especially in the central business districts and in the local and other important centers of activities. These problems have been further aggravated because of use of personalised modes in intra-city movement. All these cities were not planned to accommodate such increase of parking demand. Even today, with few exceptions, it is difficult to discern planned / adequate provision of parking spaces in these metro cities.

Recently multi-storied garages and under ground parking spaces are being considered. However, most of the parking spaces have been provided on the off-street surface parking lots. It has been observed that parking has been provided in places which could be more profitably used for purposes other than parking. There is no well-defined parking policy for the metro cities. Hence, development of parking space is not very spectacular and on-street parking is more common. Even the collection of parking charges for off-street parking is more ad-hoc in nature and municipal parking spaces are auctioned. There is no metered parking in any of the metro cities. Parking problems need to be more seriously addressed and dealt by the city authorities. Also in view of lack of road pricing policy, people tend to bring their motor vehicles to the central part where the demand for parking is the highest and also space for parking is in short supply. As no proper development of parking of vehicles is available, people often park vehicles on the roads thereby reducing capacity of the roads.

This situation has been further aggravated by poor parking regulations and policy of no car zones. In view of lack of parking policy on the parking site, people park vehicles for long hours thus reducing the capacity of parking facilities and scope for others. Moreover, parking charges are not high enough to act as a deterrent for not bringing vehicles to the congested areas. Most of the metro cities do not have adequate parking provision and also do not have any parking norms and standards possibly. No adequate provision for parking as part of the requirements for sanctioning building plans for commercial and recreational buildings, specially, in the central parts has been made. However, if at all certain norms are available for different building uses they are seldom enforced / implemented. It has been seen that parking spaces within the building are being used for purposes other than parking.

Transport Management

The efficiency of traffic operations in the metropolitan centers depends to a very significant extent on the effectiveness of traffic management. It is important to introduce integrated traffic management and control the operation and management of transit systems and goods transports in these metropolitan cities.

The roads on which there is concentration of surface transit routes have not been provided with facilities for speedy movement and loading- unloading of transit vehicles. The regular maintenance and upkeep of such corridors should be given priority so that the journey of passengers becomes more comfortable and safe. The existing transfer points between different modes of passenger transport viz. rail and road (also water in case of Kochi) should be provided with efficient passenger dispersal facilities such as parking areas of surface transit vehicles and other categories of motorized vehicles, exclusive right-of-way for movement of passengers, proper channelisation of vehicular traffic etc. Heavy

encroachments on main roads and lack of pedestrian facilities are also the major issues of concern.

Reduction of slow moving vehicles particularly on arterial roads and deployment of these slow moving vehicles for localized transport demands and provision of well organized bus transport system for providing public transport facilities need to be given stress while considering the issues of transport management.

Environmental Issues

In developing future transport infrastructure, adequate attention has to be given to prevent environmental degradation and to preserve the ecological balance in the metropolitan cities under study. In most of the metropolitan cities the construction of flyovers has been initiated. Since transportation can have adverse environmental impact, care should be taken to prevent or to minimize the same when planning new infrastructure. It is, therefore, necessary to assess the environmental impacts and formulate the suitable strategies to minimize adverse impacts.

Landuse and Development Control

The development efforts would not produce desired results unless measures to control development are taken to prevent the damages likely to be caused to urban environment by uncontrolled development. These measures shall include control of density through rational prescription of floor area ratio and ground coverage, control of construction of high rise buildings by imposing height restrictions, ensuring provision of adequate parking facilities within the premises, ensuring provision of adequate open space at the front, two sides and the rear of the buildings but within the premises wherever possible.

Tree plantation

Trees play an important role in abating pollution and maintaining atmospheric balance. Plantation enhances the aesthetic value of the road network in cities. Selecting the most appropriate species for a particular location profoundly influences the design quality. Preference should always be given to select local plant material. Proper care is needed in selecting route locations and their geometric design so as to preserve the natural beauty. Care should also be taken to protect the environment, as the shrubs and trees are cleared from right-of-way while constructing the roads/railway in an indiscriminate manner.

Multiplicity of Organisations

City transport is run on various transport modes such as bus, sub-urban rail, ferry services, etc. To run such services and operations efficiently, it is imperative to have supporting infrastructure such as roads, bus fleet, rail corridors, depots, terminals associated with affordable fare structure policies. In this context, understanding among various agencies dealing with each of the transport systems becomes inevitable to avoid duplication of services and achieve meaningful co-ordination.

Urban transport is a relatively important component in overall transport system in the country and Ministry of Urban Development, Govt of India is the nodal agency under the business rules and responsible for looking after the interest of urban transport in the country in general and for considering proposal for internal as well as external funding in particular by multilateral agencies like ADB, OECF, World Bank, etc. Transport is basically a state subject and large number of agencies are involved in management of this sector. The list of agencies involved in each of the cities under study are:

1. Pune

- Railways

DRM Central Railway

DRM Western Railway

- Road Transport

Town Planning and Valuation Deptt.

Public Works Department

Pune Municipal Transport

Municipal Corporation

City and Industrial Development Corporation

Brihan Mumbai Electric Supply & Transport
Maharashtra State Road Transport Corporation
Maharashtra Pollution Control Board
Commissioner of Police (Traffic)
Transport Department, Mantralaya, Govt. of Maharashtra

2. Surat

- Railways

DRM Western Railway

- Road transport

Gujarat State Road Transport Corporation
Office of Commissioner of Police
Gujarat State Pollution Control Board
Director General and I.G. of Police
Town Planning and Valuation Department
Private Transport Agencies
Public Works Department
Surat Urban Development Authority
Surat Municipal Corporation

3. Lucknow

- Railways

Divisional Railway Manager
Southern Railway

- Road Transport
Town and Country Planning Department, Lucknow.
Regional Transport Office, Lucknow.
U.P. Pollution Control Board, Lucknow.
Office of Commissioner of Police
Superintendent of Police (Traffic), Lucknow.
Directorate of Local Bodies

Office of Transport Commissioner
U.P. State Road Transport Corporation
Special Urban Development Authority
Lucknow Development Authority
Lucknow City Corporation
Transport Commissioner
State Planning Commission
Local bodies
Private Transport Agencies

4. Bhopal

- Railways

Divisional Railway Manager,
Central Railway, Bhopal.

- Road Transport
MP Vikas Pradikaran Sangh
Directorate of Urban Admn. & Development
Regional Transport Office, Transport Department
MP State Road Transport Corporation
MP State Pollution Control Board
Town and Country Planning Department
Superintendent of Police (Traffic)
Bhopal Development Authority
City Corporation
Public Works Department

5. Kochi

- Railways

Divisional Railway Manager, Southern Railway, Thiruvananthapuram
Konkan Railway, Branch Office, Thiruvananthapuram

- Road Transport

Greater Cochin Development Authority

Municipal Corporation

Town and Country Planning Department

State Transport Department

National Transportation Planning and Research Centre (NATPAC),

Thiruvananthapuram

Kerala State Pollution Control Board

Office of Commissioner of Police

Regional Transport Office

Public Works Department

Kerala State Road Transport Corpn. (KSRTC)

City Police Commissioner

Local Self Government, Govt. of Kerala

Tourism Deptt; Govt. of Kerala

- **Port**

Cochin Port Trust

Cochin

6. Varanasi

- Railways

Divisional Regional Manager

NE Railway, Varanasi.

Station Manager,
Northern Railway, Varanasi.

- Road Transport

Varanasi Development Authority

Town and Country Planning Department

U.P.State Road Transport Corporation

Office of Commissioner of Police

Supdt. of Police, (Traffic)
Regional Transport Officer, Transport Department
U.P. Pollution Control Board, Lucknow.
Municipal Corporation
Public Works Department
Private Transport Agencies

Though State Government has full-fledged transport department looking after licensing, permits and acting, as an overall regulatory body for transport system, planning of transport system in the city is generally not in their hands. Local traffic police is the controlling body for violation of traffic rules. It has been found that these metropolitan cities have multiplicity of agencies responsible for providing transport facilities and management of transport. Railways do not show much interest in urban transport, as there is no specific suburban rail proposal in any of the six cities. PWD and municipalities look after the maintenance and construction of roads. PWD constructs and maintains state highways and national highways passing through the cities whereas municipality constructs and maintains urban roads. Besides Housing Boards/ Development Authority constructs and maintains roads in their jurisdiction. The bus transport is under private as well as public institutional management. Transport system is run by State Transport Undertakings functioning under specific Act whereas private transporters operate the bus services after getting the permit from the State Transport Authority (STA).

Generally there is not much of regulation for non-motorised transport, an important transport system for providing intra-city and neighbourhood mobility. Bicycle does not require licence but cycle rickshaws require licence. It is a well-known fact that there are many unlicensed rickshaws on the roads as compared to licensed ones. Besides, Development Authorities which have been functioning under special act also look after the planning, maintenance as well as construction of roads in the new areas. Central Government also looks after the transport demand by financing research projects and providing monetary support for development of transport systems.

Unified Transport Agencies

Transport being under different agencies, the issue of co-ordination becomes difficult. Therefore, it is not possible to plan and co-ordinate transport development as the other departments' plans and programmes are not known/discussed, thus making preparation of perspective development plan for city transport difficult. Who will prepare transport plans - Development Authority as part of the over all Perspective Urban Development Plan or the Municipality or the Transport Department? It has also been found that interchanges which are being used by various transport systems are under control of different agencies and are not well developed thus making them unfriendly for smooth movement of passengers as well as transshipment of goods. Technology aspect is another area, which needs expertise of different transport system. Besides, sharing of ticket revenue for use in different transport system is another important issue. In view of these, it has been often argued that the metro cities require to have Unified Metropolitan Transport Authority (UMTA). This will help to co-ordinate different functions of different agencies and will have power to integrate programmes and prepare integrated transport development plan and programmes, which will enable provision/generation of funds by borrowings/grants/loans and undertake suitable measures to improve fare box collection or other modes of revenue earning.

Such an organisation may not only borrow money from the market and raise loans and get grants from both State and Central Government but also will be able to create conducive conditions for private- public partnership. Integration and co-ordination are required among different agencies involved with transport development of the metropolitan cities. Such unitary institution will be in a position to work towards that goal. The role of UMTA is very important in view of economic regeneration of the metropolitan cities and undertaking technology improvement and alternative transport system, which are capital intensive. As there is no Act, it is imperative to enact separate Unified Metropolitan Transport Act or Metropolitan Regional Transport Act.

Transportation Plans

All the six metropolitan cities have traffic and transportation plans either as a part of master plan or a separate document or both. Basically traffic and transportation plan is based on one time exercise on the basis of the specific requirements or Government directives or certain crisis situation. These are updated and specific planned designs prepared either departmentally or by engaging consultants. These traffic and transportation programmes and plans are based on studies of the problems and development needs of present and future. However, this effort is construed as simply a technical exercise and is taken up in priority. Funding of projects therefore is very difficult and resources for financing these projects/schemes are very difficult to mobilise. Often, these are not implemented for a long time unless the problems reach crisis point and get politicised. Even resources for the maintenance of transport infrastructure are very meagre. Budgetary expenditure, loans or grants from multi-lateral or bilateral agencies was the main source of funding in the past. The private sector was not involved to the extent it should have been. Due to liberalisation and globalisation, involvement of private sector needs to be exploited specifically in the form of Built Operate and Transfer (BOT), Built, Operate, Own and Transfer (BOOT), Built Operate Lease and Transfer (BOLT), etc.

There are many innovative ways for resource mobilisation in the form of dedicated levy and taxes like surcharge, employer tax, property tax, passenger tax and other measures like property development along transport routes, sale or renting of air space of terminal buildings, depots, offices, etc. raising of loans/grants from multi lateral agencies for bankable projects. Besides, institutional financing, funds for transport programmes with equity participation from the State/Central Government and financial institutions are available. Examples of such institutional framework are found in Lucknow, Pune and Kochi.

There are also good examples of Public participation in Surat, where number of intersections and roads have been constructed by public private participation.

Programmes

PUNE

Pune, the rapidly growing metropolis in the country has a number of problems such as road congestion, absence of proper road hierarchy, absence of adequate road width resulting in long detours of public transport, time and speed delays on account of poor traffic management, uncontrolled intersections, deterioration of road safety levels, unprecedented growth of two wheelers and unplanned parking. Though a lot of efforts have been made earlier to study traffic and transportation problems of the city, very little has been implemented in practice. In the light of above, the Govt. of Maharashtra had a re-look at the city's problems and ultimately a study on "Traffic and Economic Analysis of Road Improvement Project" in Pune has been undertaken by Central Institute of Road Transport, Pune in 2001. The report has highlighted the scenario of existing transport system i.e. gap between transport demand and supply, road and rail network characteristics, different modes of public transport and accident analysis. In doing so, the following major transportation studies in Pune have been reviewed.

- i) Traffic and Transportation Plan for Pune Metropolitan Area – 2001 by Deptt. of Town Planning, Maharashtra, 1984.
- ii) Transport in Pune Region by CIRT, Pune, 1987.
- iii) High Capacity Mass Transit System, Pune - Feasibility study by MTP (Railways), 1988.
- iv) Traffic and Transport Flows for selected Cities in India by CRRI, 1986.

The report also incorporates economic evaluation of road improvement projects. The environmental impact assessment *viz.* air quality assessment, noise assessment, impact evaluation have been analysed in detail. Care has been

taken for prevention of environmental degradation and pollution during construction stage.

Mass Rapid Transit System for Pune

The objective of Mass Rapid Transit System (MRTS) for Pune Metropolitan Area (PMA) is to examine the feasibility of MRTS to serve the forecast travel demand by 2026 AD and to identify cross subsidy schemes to make the project financially viable and implementable. A multi stage travel demand model involving user choice was developed for PMA. The model examines the viability of the project and following six routes in Pune have been proposed (Table 22).

Table 22: Proposed MRTS Routes

Line	Description	Length (in km.)	Proposed year of commencing
1.	Agricultural College to Telco	12.54	2002
2.	Agricultural College to Varje	10.10	2006
3.	Karve Road - Swar Gate – Hadapsar	11.50	2011
4.	Agricultural College to Loni Kand	22.80	2016
5.	Agricultural College to Chinchwad	16.11	2021
6.	Agricultural College to Katraj	12.76	2021

The first two projects are to be implemented in first phase for which the estimated cost has been calculated to the tune of Rs. 14574.1 million (1998 price level). Both the lines together would serve demand of 6.6 lakh passenger trips per day by 2006. The total land requirement for route -1 including motor shed is 102.69 hectare and for route-2 including car shed is 28.49 hectare, whereas land will cost Rs. 1727.7 million and Rs.797.5 million for route 1 & 2 respectively.

Govt. of Maharashtra has also conducted study on Accident for Pune Metropolitan Area in 2000. Road accidents are caused by variety of factors such as vehicles, road users, road geometrics and environmental conditions. The study aimed to analyse various factors responsible for accidents, reasons for accidents and to identify the black spot and suggest possible remedies. One of the findings

of this study is that the maximum number of primary as well as secondary vehicles involved in these accidents are two wheelers. These are more vulnerable to road accidents. If these vehicles are segregated from the other modes of vehicles, the number of accidents can be minimised to a certain extent.

SURAT

Huge number of vehicles are being added every year in Surat adding more transport problems. Surat Municipal Corporation (SMC) has made various attempts to mitigate these problems. Some of the important works done by SMC include management of traffic and transportation, regulation and control of vehicles and pedestrians, providing safe and smooth travel trips, installation of traffic signals at the road junctions, construction of channelisers and road dividers and construction of traffic islands. Above all, SMC has taken a daring step to mobilise the public participation in the transport planning process and traffic management system in the city. This private participation in construction and maintenance of traffic islands has given emergence of beautiful traffic islands in the Surat city. At the same time it has also led to traffic regulations for solving traffic problems. An amount of Rs. 14.40 million has been invested by the public to construct the traffic islands/channelisers and fountains. It has two fold objectives *i.e.* traffic regulations and saving of fund of SMC. Nearly 2 dozens traffic islands/channelisers have already been implemented. Few more are in the pipeline along with widening and construction of municipal roads. The main channelisers taken for construction include Govalak Junction sponsored by Hajoori and Sons for Rs. 1.2 million, Athwagate junction by L&T for Rs. 2.2 million, Elbee Fire Station (Majura) by Aggarwal Samaj for Rs. 0.45 million, Makkai Pool Junction by Surat Peoples Bank for Rs. 1.8 million, Udhna Darwaja by Parag Sarees for Rs. 0.4 million, Gandhi Putla Chowk by Surat Electricity Co. Ltd. for Rs. 1.7 million, Piplod Gam, Surat Dumas Road (3 km) by Indian Oil Corporation Ltd. for Rs. 0.6 million and so on. Similarly, SMC has also implemented road dividers at Surat Dumas Road sponsored by Inderlok Organisers costing Rs. 3.3 million and Ring Road Udhna Darwaja to Mann Darwaja (0.3 km) sponsord by Parag Sarees for Rs.0.8 million and Ring Road from RTO Junction to Flyover (0.18 km) sponsored by Mahavir Cardic Hospital and signals at Delhi Gate sponsored by

Surat Textile Bank for Rs.0.8 million.

Similarly a study has been conducted on “Planning of Traffic & Transportation System for Surat Municipal Area” by Central Road Research Institute, Delhi sponsored by Surat Municipal Corporation in 1988. The study aims to formulate an effective traffic management scheme for the old / fort / walled city of Surat to ease the intensity of traffic congestion and to improve the circulation and safety, to improve the traffic and transport system of Surat Municipality and to suggest a suitable transport system for entire SMC area.

LUCKNOW

Lucknow city is characterised by inadequate Mass Transport System, severe congestion during peak hours, speed delays and parking problems. From time to time studies have been conducted to mitigate these problems. Nevertheless, proposals have not been fully implemented. A few studies carried out for improvement of traffic and transportation systems in Lucknow are listed below:

- i) Lucknow Area Transport Study by S.P.A-1992
- ii) Revised Master Plan by Town & Country Planning Deptt. Lucknow-2001
- iii) Comprehensive Traffic and Transportation Studies by NATPAC-1992
- iv) Physical and Financial Plan for Lucknow Metropolis-2015 by RITES-1993-94
- v) Traffic Management Plan For Central Areas of Lucknow-1999

Traffic Management Plan For Central Areas of Lucknow aims to understand the crux of the existing problems of traffic congestion and on street parking and finally devise suitable short term and low cost measures to ease the general flow of traffic in the area. RITES has suggested certain traffic measures such as restrictions on turning movement, one way street, exclusive bus lanes and closing of side streets. Some of the measures have been already implemented in the city but they are inadequate. Besides, off street parking has been suggested at Old Subzi Mandi near Akbari Gate and on street parking at kerbs on Tulsidass Marg between Aish Bagh Road and Mill Road.

No parking zone has also been suggested on entire Nadan Mahal Road. In the busy Central Business District area, the lane segregation and pedestrian facilities have been proposed. Traffic education propaganda and advertisement along with traffic education by audio-visual programmes have also been suggested.

Keeping in view the transport problems and growing population, Govt. of Uttar Pradesh has assigned Konkan Railway Corporation Ltd., Mumbai, to prepare plan for sky bus metro. The new technological solution will not require land acquisition except for providing for right of way on the existing roadways. Only at the terminal points minimum amount of land in the tune of 2000-4000 sq.mt. of area will be required. The demolition of structures or garden will also be avoided. It will have lowest running cost since the system involved guide ways in the sky, which does not fall into an exact definition of railway. In this system the coaches are suspended from the bogies running overhead and thus are designed for lighter crush loads as compared to normal railway bogies. The proposed six routes in Lucknow are given in Table No 23.

Table 23: Proposed Sky Bus Routes

Sl.No.	Station	Route Length (in km)	Estimated Cost (Million Rs.)
1.	Alam Bagh to Gomati Bridge	6.5	2925
2.	Governor House to Begum Hazrat Mahal Park	2.0	900
3.	Kaisar Bagh to Aminabad	0.80	450
4.	Kaisar Bagh to Char Bagh Rly. Station via Latouche Road	1.80	900
5.	Hotel Clarks Awadh to Bara Immabara	3.00	1350
6.	Chowk to Kaisar Bagh	3.8	1710

The maximum passengers per hour per direction to be carried is estimated to be 15000 to 50000 with average speed of 47 kmph. The bus will be designed to give maximum safety and convenience to the commuters including persons with disabilities.

VARANASI

The new development which is taking place in Varanasi is mainly to the North of Varuna river, West of Maduadih and adjoining to Kashi Hindu Vishwavidyalaya; which creates severe traffic and transportation problems. Some of the glaring problems include parking, encroachment of Gumati, Thela and temporary shops on the roads, poor road geometrics and lack of transport freight terminals and Transport Nagar, etc. The Master Plan for Varanasi –2011 has been prepared which includes proposals for Transport sector. The major proposals include flyover at Maduadih, Kajjakkpura, Ashapur and DLW. Similarly number of bridges on Varuna river have been proposed along with Road widening/construction of new roads, provision of additional bus stand/truck terminals and transport nagar. The scheme of Transport Nagar at Varanasi-Allahabad Road, Varanasi has also been undertaken in 2002 by Varanasi Development Authority, Varanasi. The estimated cost has been worked out to the tune of Rs. 833.90 million. The scheme aims to provide proper loading and unloading facilities for goods transport, parking facilities for truck and heavy goods vehicles, ease out the congested parts of the city for easy traffic flow and relocate different transport agencies of the city for proper and efficient transport management.

BHOPAL

Comprehensive Traffic and Transportation Study in Bhopal has been prepared by Directorate of Urban Administration and Development, Govt. of M.P. in 2000 with estimated cost of Rs. 3.84 million. This aims to improve the transport system for smooth flow of traffic, identify the necessary technical improvements of roads islands and dividers etc., and traffic management system.

The short/medium term plan and long-term measures have been recommended to improve the traffic signals, road geometrics, road widening and removal of encroachments etc. Apart from this Rapid Action Plan for Bhopal Talkies – Zincy Chowk and other junction improvements schemes have been taken up by the Directorate of Urban Administration and Development, Govt. of M.P.

KOCHI

Comprehensive Study for Transport System for Greater Kochi area has been carried out by Transport Dept. Govt. of Kerala in 2000. The task was assigned to RITES in 2000. The Quick Assessment Plan and rapid action plan for traffic system management measures have been adopted. Short term measures suggested include improvements of road corridors, intersections, parking areas and terminal areas, traffic system management measures and other transportation system management measures. Medium term solution includes road network development, i.e. urban bye pass, new roads, missing links etc. Long-term solution includes proposal of urban mass rapid transport system to meet the expected demand and also to carry out of conceptual integration plan for the proposed system with other private and public modes. Other schemes include World Bank aided project of Road Development and Traffic Management at Cochin with estimated cost of Rs. 878.4 million, Elevated High Speed Tram System for Kochi (Kerala) – Feasibility Study, study on Water Transport Routes in Kochi by NATPAC, and Traffic and Transportation Studies for Kochi Corporation in 1990. Apart from these, study on Sky Buses for Kochi is also under consideration by Konkan Railway, which will ease the traffic problems.

Findings and Recommendations

- The transport data pertaining to many components either does not exist or is not maintained in proper shape in the metropolitan cities. Some of the important data like modal split, trip generation, freight of goods and commodities handled by rail and roads, vehicular emission load, number of truck terminals and their percentage in handling the goods etc. are very useful for undertaking transport studies. But, no systematic approach has been adopted to put all the useful data together.
- Time series data is not maintained in many metropolitan cities. There is also no sign of efforts for collection of data periodically. For example, data on current land use pattern is not available in many cities. Proper break up of different categories of uses is also not taken care of. There is no management of data regarding handling of goods and commodities by roads.
- The unprecedented growth of motor vehicles and massive rate of urbanization in the metropolitan cities has caused severe problems such as pollution, congestion, accidents, encroachments, traffic bottlenecks, improper road geometric, parking, and uncertainty of public transport supply, etc. These need to be seen afresh along with sustainable transport policies and effective physical planning measures.
- Increasing demand for urban transportation requires huge financial commitments from variety of funding sources, as investment requirements can no longer be met from public sector alone. However,

access to these sources for funding transport projects is linked with the development and identification of viable projects. It is also important to strengthen the present institutional framework.

- One glaring aspect which can be noticed in the city transport in the metropolitan cities is the less involvement of private sector both in the mass public transport system as well as in the building of roads, rail and waterways. Public-Private participation in the form of BOOT, BOT, BOLT etc., may help improving public transport systems. The public private participation may begin new chapter in the management of urban transportation. The private initiatives will help in injecting new ethos of work culture and sharing in urban infrastructure.
- The attempts have been to prepare the master plans in different metropolitan cities. However, the metropolitan cities need to prepare perspective plan for transport sector in such a way that it should fit into the master plan of the respective metropolitan city. The emphasis should be given to integrate the land-use with transportation.
- A very important point, which emerges, is that all the metropolitan cities have very high percentage of undeveloped land which creates inefficiency and leads to high cost of maintenance and building of lengthy transport networks in the cities. Hierarchy of transport networks is less defined in these cities. Besides, land under traffic and transportation in the six metropolitan cities is very low.
- The disheartening feature of transport in metropolitan cities is the high increase of personalized mode and that too of two wheelers without proportionate increase in road capacity. This has resulted into degradation of environment and road safety. Increasing share of

personalized modes is often linked with non-availability of dependable public transport system. This calls for certain policy measures to discourage the registration of two wheelers/ three wheelers and proper management of transport system.

- Transport being under different agencies in a city makes it difficult for co-ordination and implementation of the projects. Who will prepare the transport plans -Development Authority as part of the over all Perspective Urban Development Plan or the Municipality or the Transport Department? In view of these, it has been often argued that the metro cities are required to have Unified Metropolitan Transport Authority (UMTA). This will help to co-ordinate different functions of different agencies and will have power to integrate programmes and prepare integrated transport development plan and programmes, this will enable provision/generation of funds by borrowing/ grant/ loan and undertake suitable measures to improve fare box collection or other modes of revenue earning.
- Almost all the metropolitan cities are characterized by severe parking problems. They do not have adequate parking provision and also do not have any parking norms and standards possibly. No adequate provision for parking as part of the requirements for sanctioning building plans for commercial and recreational buildings, specially, in the central part has been made. There is need to evolve comprehensive parking policy for these cities.
- Metropolitan cities though have got different types of transport systems; they are predominantly road based with the exception of Kochi, where the passengers are being carried by ferry to some extent. Public Transport System is basically the main mode of

carrying passengers for intra-city and inter-city movement for variety of purposes. There are no dedicated bus routes all through the town. Private operators in these cities mainly meet the demand of passengers for intra-city movement. The possibility of introducing Mass Rapid Transit System in these metropolitan cities need to be explored in order to fetch the public demand. The introduction of sky bus in Kochi and Lucknow is welcome step. However, this needs the adaptability of the administration and political willingness.

Annexure-I

Table 1: Demographic Profile

Name of the City:

Particulars		Urban Agglomeration
Population in Lakhs (1991)		
Area in sq. km (1991)		
Workers in lakh (1991)		
Participation rate (1991)		
Household Income (Specify the year of study with reference population)	Rs./Annum	
	<25000	
	25000-40000	
	40000-56000	
	56000-100000	
	>100 000	

Please specify the year

Table 2: Land use Distribution

Landuse (sq. km) (As per Master Plan /Development Plan)	Existing Year.....	Proposed Year.....
Residential		
Commercial		
Industrial		
Transportation		
Recreational		
Public & Semi Public		
Others (Specify)		
Total Area		

Table 3: Modal Split*

Mode	% of Trips
Bus	
Train	
Walk	
Car	
Auto rickshaw, Cycle Rickshaw, etc.	
Two Wheelers	
Cycle	
Others	

Table 4: Trips for Different Purpose*

City	% of Trips
Work	
Education	
Social & Others	

Table 5: Transport Networks in Metropolitan Area *

Category	Length in Km
Roads (specify the break-up for 30 m & above roads)	
Waterways	

Table 6: Flyovers and Bridges in Metropolitan Area*

Category	Number
Flyovers	
Road Under Bridge (RUB)	
Road Over Bridge (ROB)	
Bridges on water Course	
Pedestrian Subways	
Pedestrian over bridges	
Road/Rail Under pass	
No. of Level Crossings	

Table 7: Traffic Flow*

Specify the name of particular corridors	Speed in Km/hr
Average Traffic flow in km./hr. (Peak Hour)	
Average Traffic flow in km./hr. (Non Peak Hour)	

*(please specify the base year)

Table 8: Goods/ Freight Data (Road Based)

No. of Freight Terminals with location Sketch	
No. of incoming Trucks/day	
No. of outgoing Trucks/day	
Area of Freight Terminal (in hectares)	
Specify types of Terminals Sites e.g. Fruits, Iron and Steel, Cement, etc.)	

Table 9: Traffic Flow

Specify the name of particular corridors	Speed in Km/hr
Average Traffic flow in km./hr. (Peak Hour)	
Average Traffic flow in km./hr. (Non Peak Hour)	

Table 10: Public Transport Systems in UA/Metropolitan Area

Mode		Numbers
Standard Buses	Public	
	Private	
Mini Buses	Public	
	Private	
Double Decker		
Others (specify)		

Table 11: Bus Transport Logistics

Structures		Numbers
Depots		
Workshops		
Terminals		
Bus Stations	Serving Intercity	
	Serving Intra-city	

Table 12: Types of Bus Services Operating

Types of Bus Services (e.g. Ladies Special, Night Service, Express, Ordinary, Ltd., etc.)	Numbers
Corporate Identity	Please specify colour scheme

Table 13: Operational Characteristics, Bus Transport

Characteristics		
Name of the Operator		
Avg. km Travelled (Lakh /day)		
Avg. Fleet Utilisation		
Avg. Km cost in Rs.	Operational Cost	
	Administrative Cost	
Avg. fare Box Collection per day (in Rs)		
Passengers travelled in Lakh/day	Morning Peak hrs. (Specify timings)	
	Evening Peak hrs. (Specify timings)	
Avg. lead (km)		
Passengers carried in peak hrs.		
Avg km. covered per day		
Avg trips covered per day		
Avg mileage/km		
No. of routes in city operations		
Average Trip length (km)		

Table 14: Number of Employees in Public Bus Transport Undertaking

Category	Numbers
Total employees	
Drivers	
Conductors	
Administrative staff	
Others including maintenance staff	
Staff/Bus Ratio	

Table 15: Bus Ticketing

Mode of issue of tickets in the bus	
Fare Structure (Stage fare or kilometre basis)	
Checking System (please specify the method in which ticket less travellers are checked)	
Average distance of Bus stop (in km)	

Table 16: Bus Fares

City Service and Sub urban		Rs.
Ordinary bus	Min. fare	
	Max. fare	
Express/Ltd bus	Min. fare	
	Max. fare	
Deluxe/Luxury Service	Min. fare	
	Max fare	
Any other Special Service		

Table 17: Distribution of Freight Traffic carried by Road (in '000 Tonnes)

Region/City	Originating	Terminating	Total Freight handled

Table 18: Goods/ Freight Data (Road Based)

(Please specify the data year)

No. of Freight Terminals with location Sketch	
No. of incoming Trucks/day	
No. of outgoing Trucks/day	
Area of Freight Terminal (in hectares)	
Specify types of Terminals Sites (eg. Fruits, Iron and Steel, Cement, etc.)	

Table 19: Percentage of goods (Commodity wise) handled by Roads

(Please specify the data year)

City	Goods/Commodity	Quantity in tonnes	Percentage

Table 20: Road Accident data

City	Total Accidents			Persons Killed			Persons Injured		
	1999	2000	2001	1999	2000	2001	1999	2000	2001

Table 21: Estimated Vehicular Emission load (specify data year)

Vehicular Pollution Load (Tonnes per day)					
Suspended Particulates	Sulphur di Oxide	Oxides of Nitrogen	Hydro Carbons	Carbon mono oxide	Total

Note: i) Also name Areas, Specific Locations, in Metropolitan Area where there is more Pollution due to vehicular emissions on map.
 ii) Copy of the annual report to be enclosed.

Annexure-II

List of Contact Departments

Sl.No.	Name of Metropolitan Cities	Contact Departments
1.	Pune	<ul style="list-style-type: none">• Director, Town Planning & Valuation Dept. Govt. of Maharashtra, Central offices, Pune- 411 001• Divisional Railway Manager Western Railway Mumbai• Divisional Railway Manager, Central Railway Pune-400 001• Secretary Transport Mantralaya, Govt. of Maharashtra Mumbai-400032• Chairman Maharashtra State Pollution Control Board Chhatrapati Shivaji Maharaj Municipal Market Building, 4th floor, M.R.Ambedkar Road, Mumbai-400001• Dy. Commissioner of Police (Traffic) Pune• Vice Chairman & Managing Director, City & Industrial Development Corporation of Maharashtra Ltd. 'Nirmal' 2nd Floor, Narimen Point, Mumbai -40 614 (Maharashtra)• Metropolitan Commissioner, Mumbai Metropolitan Reg. Development Authority, Bandra Kurla Complex, Bandra (East) Mumbai 400 051 (Maharashtra)

2.	Surat	<ul style="list-style-type: none"> • Chief Town Planner, Town Planning & Valuation Dept. Govt. of Gujarat, Dr. Jeevraj Mehta Bhawan, Block No. 14 (2nd Floor) Gandhinagar-380 006 • Divisional Railway Manager Central Mumbai Division Mumbai • Divisional Railway Manager, Vadodara Division, Pratap Nagar Vadodara -390 004 • Principal Transport Secretary, Home Department, Govt. of Gujarat, New Sachivalaya Complex Gandhi Nagar-382010 • Vice Chairman Surat Urban Development Authority, 'SUDA Bhawan' Near Collectorate Behind M.S. Building, Nanapura Surat - 395 001 • Dy. Commissioner of Police (Traffic) Surat • Chairman, Gujarat State Pollution Control Board, Paryavaran Bhawan, Sector 10 A, Gandhi Nagar – 382 043 • The Commissioner, Surat Municipal Corporation, Surat • Regional Officer, State Pollution Control Board, Surat • Managing Director Gujarat State Road Transport Devp. Corporation. Surat.
----	-------	--

3	Lucknow	<ul style="list-style-type: none"> • Chief Town and Country Planner, Town and Country Planning Department, 7, Bandaria Bagh, Lucknow-226001 • Divisional Railway Manager, Lucknow Division, Hazrat Ganj, Lucknow-266 001. • Principal Secretary (Transport), Govt. of Uttar Pradesh, Sachivalaya Bhawan Lucknow • Vice Chairman Lucknow Development Authority 6, Jagdish Chandra Bose Marg Lucknow - 220 001 • Managing Director U.P. State Roads Transport Corporation Parivahan Bhawan, Lucknow • Chairman, U.P. State Pollution Control Board, Pickup Bhawan, 3rd Floor, Vibhuti Khand, Gomti Nagar, Lucknow-226 020. • Superintendent of Police (Traffic) Lucknow • Regional Transport Officer, Lucknow.
4.	Varanasi	<ul style="list-style-type: none"> • Divisional Railway Manager, NE Railway, Varanasi -221 001 • Commissioner, Municipal Corporation Varanasi, • Vice Chairman Varanasi Development Authority

		<p>Pannalal Park, Raja Udhay Prathap Marg, Varanasi 221 001</p> <ul style="list-style-type: none"> • Regional Transport Officer, Varanasi. • Superintendent of Police, (Traffic) Varanasi.
5.	Bhopal	<ul style="list-style-type: none"> • Executive Director, MP Vikas Pradikaran Sangh, Bhopal. • Divisional Railway Manager, Central Railway, Bhopal Division, Bhopal-462001 (MP). • Secretary Transport Department, Govt of Madhya Pradesh, Ballabh Bhawan, Bhopal • Deputy Superintendent of Police (Traffic) Bhopal. • Managing Director, MP State Road Transport Corporation, Bhopal. • Vice Chairman Bhopal Development Authority Bhopal • Director, Directorate of Urban Admn. & Devp. Bhopal. • Member Secretary, MP State Pollution Control Board, Bhopal. • Director, Town and Country Planning Department. Bhopal.

6.	Kochi	<ul style="list-style-type: none"> • Regional Transport Officer Transport Department, Govt. of M.P. Bhopal • Chief Town Planner, Town and Country Planning Department, Trivandrum • Director, National Transportation Planning and Research Centre (NATPAC) Trivandrum. • Divisional Railway Manager Southern Railway, Trivandrum. • Secretary Transport Transport (D) Department, Government of Kerala, Thriuvananthapuram • Secretary, Greater Cochin Development Authority, Kochi. • Managing Director, Kerala State Road Transport Corporation Trivendrum 695 023 • Chairman Kerala State Pollution Control Board, Trivandrum. • City Police Commissioner, Kochi. • Regional Transport Officer, Kochi.
----	-------	--