

Transportation : A Strategic Perspective

11.1 Introduction

- 11.1.1** Transport infrastructure is of key importance in determining the land use patterns. Efficient transport provides mobility to citizens that is essential for development of skilled urban labour market. Historically the sea port and the railways have been the most important inputs to the phenomenal growth of Mumbai. As this sector is very sensitive to technological developments and behavioural changes a long term end state plan cannot be meaningfully prepared. What is necessary is to identify a broad strategy within which detailed short term investment programmes could be developed.

11.2 Regional Plan - 1973

- 11.2.1** Prior to formulation of Regional Plan a detailed road transport plan was prepared by an American transport Consultant in 1962 for Greater Mumbai. The Wilbur Smith proposals included elaborate network of freeways mainly for private road transport in accordance with the then prevailing state of the art. The proposals did not take into account the importance of public transport and did not examine the possibilities of changing the land use pattern to manage the travel demand. In order to supplement the Wilbur Smith study the traffic cell of the Town Planning Department (Govt. of Maharashtra) undertook a study of Mass Transportation in Mumbai Metropolitan Region in 1967-68. The study noted the possibilities of augmenting mass transportation capacities within the metropolitan area by

1. augmenting the carrying capacity of the existing surface transport system;
2. providing the additional links to the surface system; and
3. provision of a new rapid transit system in the form of an underground railway, mono rail etc.

The measures in group 1) which later came to be called as 'optimisation' and included remodeling of Chhatrapati Shivaji Terminus Station, improved signaling, replacement of level crossings and running of 12 coach trains. The measures in group 2) essentially involved a sixth corridor of railway from a third suburban terminal at Ballard Estate or Fort Market going along the Harbour Branch extended along the Western Railway from Bandra to Goregaon and also from Ravli to Bhandup. The group 3) projects involved an under ground seventh corridor with loop connecting CST and Churchgate and extended up to Santacruz airport and Kurla.

- 11.2.2** The Regional Plan - 1973, did not do a rigorous analysis of transport demand but listed all the transport projects that were under consideration at that time in various fora. It divided its recommendations into "Inter regional", "Intra regional" and "Intra city" transport projects. It however sounded a note of caution regarding capital intensive projects like the freeways recommended by the Wilbur Smith and Associates or the

underground seventh rail corridor. The plan observed that these projects will become necessary if the southernly concentration of economic activities continues and is accentuated by the development of Backbay reclamation. The Plan therefore reemphasised the need for development of Bandra Kurla Complex and of Metro Centre (later came to be called Navi Mumbai) on account of transport efficiency. The recommendations of the Regional Plan, 1973 and their present status is summarised in Table-11.1 (BMRPB, 1974)).

- 11.2.3** It would be seen from Table 11.1 that most of the projects mentioned in the Regional Plan - 1973 are still being debated. Although it is true that lack of adequate resources and institutional framework dedicated to metropolitan transport has prevented desired level of investment. It painfully brings out the need for rigorous cost benefit analysis and prioritisation of projects; followed by resource mobilisation efforts instead of having a long shopping list of projects.

11.3 Road Transport Plan - 1983

- 11.3.1** After coming onto force of the Regional Plan, 1973, the Central Road Research Institute (CRRI) was commissioned to prepare a comprehensive road transport plan in 1978.

Regional Plan-1973:Recommendations regarding Transport and their present status		
Sr. No.	Regional Plan Recommendation	Present Status
I	Inter Regional	
1	Construction of new 4 lane expressway to Pune, from Sion to Panvel via Thane Creek Bridge, 4 lane road from Khopoli to Lonawala through the ghats and by passes to Panvel and Pune.	The recommendation only partly implemented. Feasibility study of new expressway alignment completed in 1993. Panvel bypass is planned to be implemented as BOT Project.
2	Third ghat rail line connecting Kalyan to Dhond-Manmad section between Rahuri and Ahmednagar.	
3	Development of Nhava Sheva Port	Implemented. Port began functioning in 1989
4	Though not explicitly recommended the plan expected wider application of hovercrafts and waterbus services for transport between Mumbai and nearby coastal belt.	Expectation has not materialised except for some experimental runs of hovercraft between Mumbai and Navi Mumbai in 1994.
5	Second international airport at Rewas Mandwa then outside the Region was mentioned.	Rewas Mandwa is part of the Region since 1975 and the location of second airport at Rewas Mandwa has been confirmed by the International Airport Authority of India. But investment decision is yet to be taken.
II.	Intra regional	
1.0	Railways	
1.1	Diva-Bassein or Diva-Vangaon railway mainly with a view to open up new areas like Dahanu Palghar and Bhiwandi.	Diva-Vasai railway completed mainly as goods line. In the absence impact of opening up of Bhiwandi for development has not yet accrued.
1.2	Improvement of Diva Urban Section	

Table 11.1 (Contd.)

Regional Plan-1973:Recommendations regarding Transport and their present status

Sr. No.	Regional Plan Recommendation	Present Status
1.3	A passenger cum goods railway in the Trans Thana Creek area to serve industrial and commuter traffic.	Panvel Uran section not yet improved though a separate siding provided for JNPort.
1.4	Kurla Karjat railway to shorten the distance to Pune.	Kalwa Turbhe goods line partly financed by MMRDA completed mainly to serve the agricultural produce markets relocation from Mumbai. Commuter Services are being proposed.
1.5	Extension of Diva Apte line as Konkan Railway.	Kura Mankhurd Belapur railway completed for suburban services with 66% of the finances provided by the state Govt. Belapur Panvel is under construction by CIDCO. Panvel Karjat has been included in the Railway Programme.
2.0	Roads	
2.1	Bypasses to Kalyan and Bhiwandi	Bhiwandi bypass completed. Kalyan bypass in planning stage.
2.2	Additional northern Thane creek bridge	CIDCO has commenced construction of Airoli bridge in 1994.
2.3	Bridge across Panvel creek in continuation of Thane Belapur Road.	Bridge completed by CIDCO in early 70s. Second bridge is being proposed to cater to the JN Port traffic.
2.4	Additional link from Mumbai to mainland either a bridge from Pir Pau to Nhava or a bridge or a tunnel from Gateway of India to Uran, but with a higher priority for development of the mainland.	Feasibility study of the former carried out and that of the later is under MMRDA's consideration.
2.5	Replacement of Kahseli and Kalwa bridges.	New bridge built as part of Bhiwandi bypass of NH3. Second Kalwa bridge is proposed to be built by the TMC.
2.6	Improvement of Kalyan Badlapur Neral Karjat road to highway standard with extension to Khopoli.	Not yet implemented.
2.7	Improvement of Kalyan Shil Mahape Road to highway standard.	Now proposed in conjunction with Airoli bridge.
2.8	Improvement of Panvel Uran Road to highway standard.	Partly implemented to serve JN Port.
2.9	Improvement of Thane Ghodbundar Road to highway standard.	Recommended again in Atkins study, 1994
2.10	Improvement of link between Bombay Pune road and Bombay Goa road via Rasayani.	
2.11	New road link between Achole and Bhiwandi.	

Table 11.1 (Contd.)

Regional Plan-1973: Recommendations regarding Transport and their present status

Sr. No.	Regional Plan Recommendation	Present Status
2.12	Study of road link from Chowk Karjat road to southern face of Matheran.	Not yet carried out.
2.13	A direct road link between Virar, Nala Sopara, Bassein Road and Bassein.	Planned as apart of overall road network of Development Plan by CIDCO.
2.14	Completion of road link through Malshej ghat.	Completed.
2.15	A new road connecting Bassein and Naigaon railway station and its continuation to Ahmedabad highway.	Not built, but planned as part of Development Plan road network.
III.	Intra City	
3.0	Road network	
3.1	Wilbur Smith and Associates had suggested an elaborate programme of freeways in 1962 to support the land use pattern then envisaged. The Regional Plan observed that with the policy of centralisation advocated by the Plan and development of Bandra Kurla Complex, proposals of Wilbur Smith can be deferred and reassessed.	A few fly overs have been built but freeway proposals have remained unimplemented. The optimism of the Plan of early development of Bandra Kurla complex has not also come true.
4.0	Mass Transport	
4.1	Optimisation of existing capacity of railways by adding rolling stock, adopting 12 coach trains on Central Railway and completeing quadruplication of lines between Grant Road and Churchgate.	Partly completed. Further scope of reducing the headway to 3 minutes still exists, and proposed to be part MUTP II.
4.2	Quadruplicating Borivali Virar Railway.	Recommended by the Atkins study 1994.
4.3	Developing thrid terminal at Bellard Estate or connect CST and Churchgate by an underground loop.	The underground loop recommended by the Atkins study, 1994.
4.4	If present trend of development continues a separate grade seperated rapid transit will be necessary.	Rapid transit practically given up being extremely expensive.
4.5	Improving efficiency of the bus services.	Addressed during MUTP I.

Table 11.1 (Conclld.)

The plan prepared in 1983 recommended a strategy comprising (CRRI, 1983);

1. Road development plan
2. Traffic management strategies and
3. Land use planning

The road development plan consists of a hierarchy of roads as given below;

Freeways

1. Western freeway from Kalanagar to Nariman Point.
2. Eastern freeway from the junction of Andheri Ghatkopar link road with Eastern Express Highway to SP Mukherjee Chowk.

Mumbai Mainland Links

1. Thane Creek bridge II to the south of present bridge
2. Sewree Nhava Sheva Link

Expressways

1. Dr. Ambedkar Road
2. Mathuradas Vasanji Road
3. Western Express Highway
4. Eastern Express Highway
5. Thane Bhiwandi Road along the new bridge (NH 3)
6. Thane Belapur Road up to Turbhe
7. Sion Panvel Highway
8. Belapur Uran Highway
9. Kalyan Dombivali Shil crossing of Thane Belapur Expressway
10. Bhiwandi Kalyan Ambernath Highway
11. Panvel Uran Highway

Major Arterials

1. Madame Cama Road
2. Sardar Vallabhai Patel Road
3. Drainage Channel Road - Acharya Donde Marg
4. Samrat Ashok Road
5. Santa Cruz - Chembur Link Road
6. Jogeshwari - Vikroli Link Road
7. Senapati Bapat Marg
8. Relief Road
9. Swami Vivekanand Road
10. Lal Bahadur Shastri Marg
11. Ghodbunder Road
12. Agashi - Vasai Road
13. Vasai - NH8 link Road
14. Agashi - NH8 Link Road
15. NH8 (Dahisar Vaitarna)
16. NH3 (Thane Kasheli Bridge)

17. NH4 (Thane Panvel)
18. NH4 (Panvel Khopoli)
19. NH17 (Panvel Pen)
20. Proposed Roads in Navi Mumbai viz. Taloje to Pargan and Nhava to Jasai

District Roads

Certain important roads which were only one lane wide but required to be widened to two lanes by 2001 were identified as the District Roads.

Linking Roads

These roads were identified from the accessibility considerations particularly to industrial and recreational areas.

A three phase programme of implementation by 2001 was also recommended.

Roads :

1. The alignment of Mumbai : Ahmedabad Expressway passing through villages Mira-Navghar, Sasu Navghar, Sarjamori, Juchandra, Gokhiware, Bilopada, Dhanvi, Pelhar, Kaner, Tokare, Dahisar, Koshimbe, Rajavali shall be modified as shown on the plan
2. The alignment of Mumbai : Nasik Expressway passing through villages Vadpe, Borivali Turh Sonale, Vahuli, Kurund, Arjumali, Padgha, Borivali Turf Rahur, Devali, Kumbharshiv, Bhokari, Talavali Turf Rahur, Kasane shall be modified as shown on the plan.
3. The new link road between Bhiwandi : Wada Road and Mumbai Nashik National Highway passing through villages Zidke, Dalonde, Khariwali, Gondarval, Jambivali Turf Kambale, Shedgaon, DabhadeKushivali, Dakepada, Kurund, Vahuli, Sape and Kukse shall be added as shown on the Plan.
4. The alignment of Mumbai : Pune Expressway passing through villages Nandgaon, Kudare, Palaspe, Deravali, Ariwali, Ashte, Kasalkhand, Bhatan, Khanavale, Talegaon, Bhokarpada, Rees, Lodhivali, Sarang, Kopari shall be modified as shown on the plan.
5. The alignment of Mumbai : Sawantwadi Expressway passing through villages Walpikhar, Bori BK, Jai, Koproli, Kalambusare, Kelvani, Dighati, Sai, Rave, Dadar, Hanumanpada, Tambadshet, Johe, Waredi, Kane, Borge, Odhango, Washi, Shinganwat, Kolave, Vadkhal, Shahbaj, DehenKoni shall be modified as shown on the plan.
6. The alignment of Mumbai : Trans Harbour Link from Sewree in Mumbai to Jasai in Navi Mumbai shall be modified as shown on the plan.
7. The lignment of West Island Freeway shall be as shown on the plan.
8. The lignment of East Island Freeway shall be as shown on the plan.

11.3.3 Traffic Management Strategies

A comprehensive traffic management plan for the Island City was recommended. However such traffic measures were seen to be of short term significance till adequate road capacities are developed.

For developing and implementing the traffic management plan creation of traffic engineering cell in MCGM was also recommended.

11.3.4 Land Use Planning

CRRRI recognised the importance of land use planning in minimising the travel demand but emphasised that avoidance of costly solutions like freeways and expressways is not possible. It further cautioned that their postponement may result in more expenditure than providing them. Nevertheless the report recommended support to the decentralisation of south Mumbai.

11.4 Mumbai Urban Transport Project (MUTP)

- 11.4.1** MUTP-I was implemented during 1978 to 1984 with the financial assistance of US \$ 25 million from the World Bank. The project supported investments in improving the road system, augmenting the bus fleet, developing the bus depots and a workshop. The project also supported traffic management and signal improvements. In the bus services component of BEST, a total of 700 buses including 235 double deck buses were procured along with adequate spare parts and put into regular service. The BEST works also included review of bus operations and management practices and training of staff. 3 new bus depots, a workshop and 11 bus shelters and termini were constructed and improvements were carried out in 2 existing bus depots. In the traffic circulation component of MCGM 5 fly-overs, 2 pedestrian bridges and 3 tunnels were constructed, channelisation works for 9 roads, and road, bridge widening and extension works in 5 cases were carried out. Modernisation and improvement works for signal system at 77 junctions were also carried out. The project also included technical assistance and training to MCGM staff.

11.5 Paranjape Committee

- 11.5.1** In 1988 the Government of Maharashtra appointed a Committee under the chairmanship of its then Chief Secretary, Shri K.G.Paranjape to review various road transport projects then under consideration and prepare a time bound programme of implementing the high priority projects. The Committee recommended an immediate programme for 1988-89 and 1989-90, a short term stage I programme for 1989-90 to 1992-93 and a short term stage II programme to be completed by 1994-95. The short term programme included traffic management measures and improvement of existing roads. The short term programme included investment in new facilities. With the notable exception of low level fly over on the Senapati Bapat Marg at Dadar and fly overs at Amar Mahal, Chembur; Kalanagar and Thane financed by MMRDA not much progress has been achieved till 1995. This has once again brought out the need for resource mobilisation and careful investment programming. Details of recommendations of the Committee and the present status of their proposals is given in Annexure-A.11.1.

Recommendations of Paranjpe Committee (1989-90)		
Sr. No.	Name of the Project and agencies concerned	Status
1	Immediate Measures	
1.1	<p>Traffic Management Schemes The schemes proposed mainly included controls on car entry, one-way traffic, parking restrictions, provisions and pricing, improvement in traffic signals, providing special facilities for buses, right-turning restrictions, heavy penalties for traffic violations, and road traffic management of areas in and around Mb.P.T.</p> <p>The agencies mainly concerned were MCGM and the Traffic Police. Other agencies concerned were MMRDA, GOM and Mb.PT for certain schemes</p>	Proposals related to car entry and staggering of office timings were not accepted by the Govt. Action on one-way traffic proposal was deferred till road concretisation of main arteries was completed. or imposing penalties present practice was continued. For Mb.PT Traffic Management a plan is to be prepared. For all other schemes recommendations W.S. Atkins study were awaited for carrying out further detailed studies
1.2	<p>Improvement of existing roads. The proposals included construction of a road, a ramp, upgradation and improvement of 5 roads, widening of 3 roads, controls on access, parking and removal of encroachments on certain roads</p> <p>The agency concerned was MCGB</p>	Construction of a ramp, a low level fly-over bridge, and certain improvement works such as cement concreting, signals, street-lighting and some road widening works have been completed. However some improvement works have not been taken due to encroachments
2	Short Term Measures	
2.1	<p>Stage-I</p> <p>Those included improvements to Senapati Bapat Marg, construction of two ROB's in lieu of level crossing on Western Railway, pedestrian subways at V.T., construction of 6 link roads, construction of a fly-over and 16 pedestrian sub-ways and foot -over bridges</p> <p>The agencies concerned were MCGB, PWD, W.Rly., MMRDA</p>	Except for construction of low level flyover at Dadar and partial completion of some link road work and the Andheri subway all other works are at the investigation stage.
2.2	<p>Stage-II</p> <p>These included construction of 3 new link roads, 5 ROB's in lieu of level crossing, widening of 2 ROB's including approaches, construction of 6 flyovers and interchanges and station area improvement plans for 11 stations</p> <p>The agencies concerned were PWD, MCGB and Railways</p>	Except for ROB between Kandivili and Borivali and Flyover works which are in progress, most other works are in the initial stages only.

Annexure 11.1

11.6 Comprehensive Transportation Study

- 11.6.1** MMRDA, after the successful completion of the World Bank assisted Mumbai Urban Transport Project in 1984, began the preparatory work for the Mumbai Urban Transport Project II (MUTP-II) in 1988. This project was conceived to be more comprehensive and included road development, traffic management, bus transport, water transport and rail transport. While considering the request for financial assistance for this project

the World Bank advised that comprehensive strategic transportation study be carried out. The World Bank then with the grant fund of Japanese government also arranged to commission WS Atkins International with Operations Research Group, Baroda and Kirloskar Consultants, Pune to carry out such a study. The consultants prepared a number of technical reports and submitted a draft of the "Preliminary Report of Findings" in April 1994. The succeeding paragraphs are largely based on this report (WS Atkins International, 1994).

11.6.2

Vehicle ownership

Vehicle registration data are presented in Table-11.2. Between 1976 and 1991 vehicle registration in MMR increased by a factor of 3.25. While truck and bus registration

Vehicle Registrations in MMR				
Sr No.	Class of vehicle	MMR		
		1971	1981	1991
1	Motor Cycles+Scooters	24,786	93,080	343,707
2	Cars,Jeeps,Station Wagons	83,360	159,365	291,465
	Total (Pvt.vehicles)	108,146	252,445	635,172
3	Taxi Cabs	15,951	30,039	35,285
4	Autorickshaws	7	9,426	48,107
6	Contract Carriages	+	1,518	3,571
7	Trucks,Lorries, Delivery Vans			
7a	Private carriers	9,817	17,937	21,266
7b	Public Carriers	14,387	31,533	61,742
8	Ambulances	211	521	1,162
9	School Buses	352	439	672
10	Private Service Vehicles	443	1,336	2,259
11	Trailors	475	1,153	2,235
12	Tractors	396	1,350	1,976
13	Others	332	1,003	2,467
14	Total Vehicles	152,082	351,796	820,828
15	Total Population	7,777,531	11,078,029	14,534,364
16	Work Place Employment	1,800,154	2,791,052	3,396,089
17	BEST Passenger Trips(In Lakhs)	23.48	42.95	41.20

Note : + included in Stage carriages

Table-11.2

increased by 2.22 times, private vehicle registration increase by 3.45 times mainly as a result of increase in scooter and motor cycle ownership. The growth of vehicles is graphically shown in Figure-11.1 & 11.2.

Private vehicle registration in 2011 is expected to more than double the 1991 levels. Number of private vehicles per 1000 persons is expected to increase from 49 in 1991 to 61.1 by 2011. The detailed forecast is given in Table-11.3

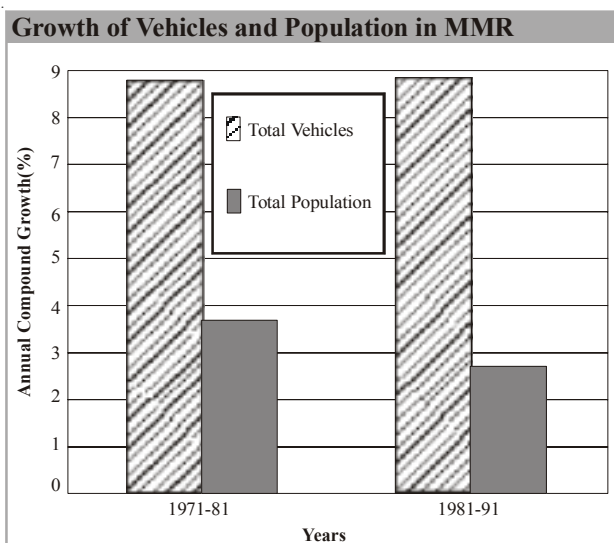


Figure-11.1

Private Vehicle Ownership Forecast for MMR				
	1991 (Actual)	Model Forecast	Global Forecast	
		2011(income growth 2.5% per Annum)	2011 Low	2011 High
Population				
Greater Mumbai	9,925,891	14,000,000	14,000,000	14,000,000
Rest of Region	4,608,473	8,200,000	8,200,000	8,200,000
MMR	14,534,364	22,200,000	22,200,000	22,200,000
Private Vehicles (Excluding Autorikshaws & taxis)				
Greater Mumbai	590,351	943,676	1,214,220	1,723,820
Rest of Region	128,213	412,822	451,115	711,186
MMR	718,564	1,356,498	1,665,335	2,435,006
Private Vehicles/1000				
Greater Mumbai	59.5	67.4	86.7	123.1
Rest of Region	27.8	50.3	55.0	86.7
MMR	49.4	61.1	75.0	109.7

Table-11.3

Passenger travel demand and modal split

the total number of peak period passenger trips in 1993 is estimated to be 21,54,860. Out of these trips 88 % were performed by public transport, 7 % by private vehicles and 5 % by taxis. In 2011 the total peak period passenger trips are expected to increase to 32,60,431 with percentage of trips by public transport reducing to 85 %. Perhaps because of the decentralised pattern of development the average trip length is expected to reduce for public transport from 15.06 km. in 1993 to 12.36 in 2011. The detailed forecast is given in Table-11.4 and is graphically shown in Figure-11.3.

Growth of Vehicles and Population in MMR

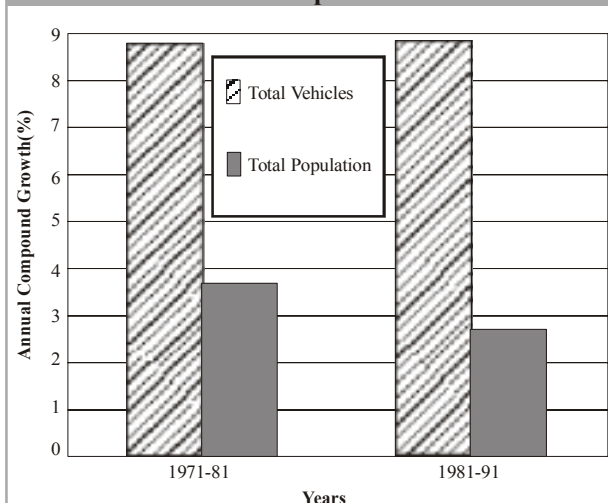


Figure-11.2

Total Travel Demand in MMR

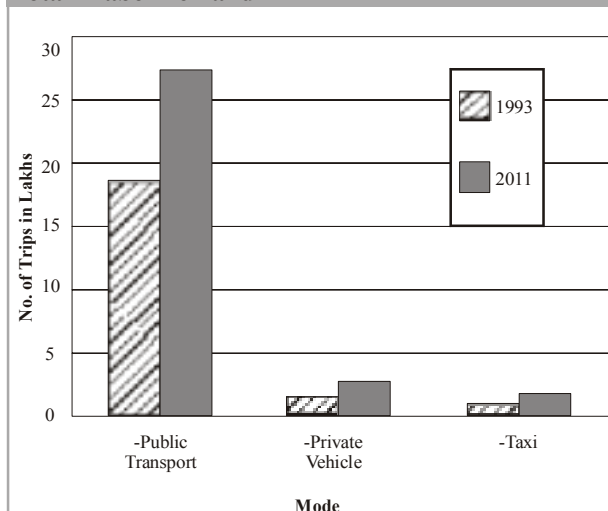


Figure-11.3

Overall Forecast of Total Travel Demands, Modal, Split and Average Trip Lengths				
	1993		2011	
Total Trips (peak period)	2,154,860		3,260,431	
- Public Transport	1,893,751	(88%)	2,770,691	(85%)
- Private Vehicles	148,167	(7%)	289,516	(9%)
- Taxi	112,942	(5%)	200,224	(6%)
Average Trip Length (Kms.)				
- PT		15.06		12.36
- Bus		4.67		4.67
- Rail		22.15		17.72
- PV		14.17		12.1
- Taxi		5.77		3.99
Average Road Speed (kph)		22.2		20

Note: Average PT trip lengths are estimated, and exclude walking distance

Table-11.4

11.6.3 Transport Supply

Road Network

The road network has developed in a predominantly north-south direction. Extensive development over much of the peninsula has led to the major traffic movements being concentrated into three main corridors; western, central and eastern. The western corridor generally provides higher level of service than central and eastern corridors. The central corridor, especially in the south Island area, is severely congested with high pedestrian movements and bus traffic. The eastern corridor which runs adjacent to the port, carries large volume of truck traffic and suffers badly from long term parking and informal roadside vehicle maintaining activities. The network is shown in Figure-11.4.

East- west movement is constrained by the Western and Central Railway tracks which also run majority of the length of the Island City. Consequently major traffic movements are concentrated on relatively few roads, resulting in major points of congestion where east-west movements intersect the north-south corridors.

To the north of Mumbai Island, east-west movements are further restricted by the limited number of crossing points on the Mithi river. This lack of good link between places like Santacruz and Chembur often results in considerable detours via Sion and the Western and Eastern Express Highways.

The roads of Mumbai serve not only as a means of transport provision but also function as parking areas for vehicles, sites for hawkers and other commercial activities, and extended footways. In some places notably on the Western Expressway, part of the right of way has been encroached upon by slums. These other functions, together with frequent disruption due to service provision and maintenance, severely reduce the traffic capacity of highways.

The road network has developed piecemeal and this has resulted in some junctions acting as a focus for a large number of intersecting streets. These tend to be

Road and Rail Network

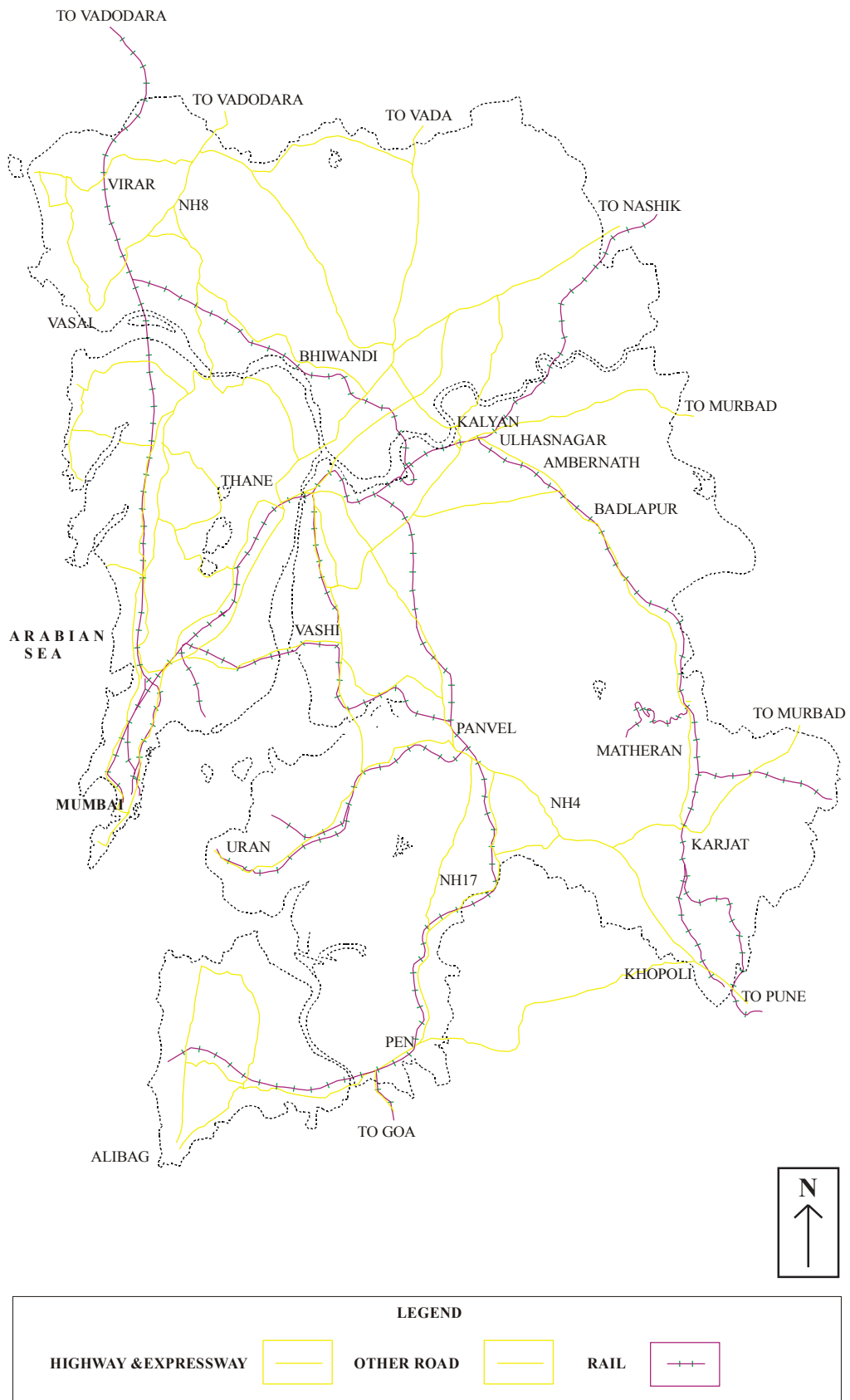


Figure-11.4

controlled by traffic signals which have long cycle times to accommodate the large turning movements at the junctions. Delays to traffic are considerable and may be exacerbated where large number of pedestrians compete with vehicular traffic for the limited road space.

When these junctions are located in close proximity, which is the case in many areas in Mumbai CBD, severe traffic congestion occurs, resulting in low average journey speeds of less than 15 kmph. The areas around Churchgate and Mumbai Central railway stations are particularly congested during the morning and evening peak periods. However traffic speeds on the eastern and Western Express Highways and on the main corridors in the Island City have remained reasonable due to active traffic management and control by the police.

1. Existing Regional Road Network

The Region is well connected by 4 National Highways (to Pune, Nasik, Goa and Ahmedabad) and 19 designated State Highways for the inter-regional passenger and goods traffic. Besides, 600 km. of road length fall under major district roads and other district roads which are maintained by PWD and Zilla Parishads.

2. Existing Freight Movement

At present freight movement is concentrated around Masjid Bunder, the port areas, Byculla and Mazgaon in Island City, and Ghatkopar, Kurla, Vikhroli and Bhandup in the suburbs. In 1993, approximately 30,116 trucks are observed to enter Greater Mumbai. Of these, approximately half are destined to the Island City. A third of the trips originate from the north (Gujarat) and 42% from the north-east (north Maharashtra, Delhi, Calcutta). Less than 25% come from southern Maharashtra or other south Indian States.

De-centralisation policies have led to the relocation of various following markets from Masjid Bunder area to Turbhe near Vashi in the early 1990s :

- Onion and Potato Market;
- Grain, rice, oil seeds market, and
- Condiment, spices, sugar, jaggery and dried fruits markets.

Iron and Steel stockholding sites and wholesaling markets were shifted to Kalamboli in Navi Mumbai.

Due to the above shifting, it is observed that the commercial vehicular traffic is slowly declining in the City areas while the traffic on Express Highways and National Highways is growing.

3. Inland Water Transport

The passenger traffic is handled by Ferry Launches at some ports and by sailing vessels at some ports. Manori and Versova handle the maximum passengers by ferry launches, whereas Dativare, Alibag, Karanja and Rewas handle maximum passengers by sailing vessels. Approximately, 65.6 lakhs and 20.17 lakhs passengers were handled by ferry launches and sailing vessels respectively in 1992.

4. Air Transport

Mumbai Airport is one of the busiest Airports in India and handles approximately 46.9% of the total passenger traffic in the Country. During 1972-92, the international passenger traffic increased from 18.37 lakhs to 40.38 lakhs whereas the domestic traffic increased from 12.38 lakhs to 42.15 lakhs.

Mumbai Airport is basically a single runway airport and cannot be provided with a parallel runway to increase its capacity due to rapid urbanisation of areas adjoining its boundaries.

To meet the requirement of increased passenger traffic a new international passenger terminal complex with a design capacity of 7.5 million annual passenger has been proposed in 3 Phases of 2.5 million each. The first two phases have been commissioned providing for a 5 million annual capacity. The feasibility report of phase III has been submitted for Government's sanction.

5. Inland Water Transport Services

In 1982, an Expert Group was appointed under the chairmanship of Vice Admiral N.P.Dutta, (I.N.Retd), to examine the feasibility of establishing PWT services in Mumbai water to help solve the problem of commuters. The Group had recommended that year-round PWT services should be provided along the cross-Harbour routes between Colaba and Navi Mumbai and North-South route on the east coast of Mumbai. However, the group had opined that conventional North-South ferry services along West Coast may not be feasible due to inadequate draft and inclement weather.

The detailed feasibility study carried out by CIDCO through M/s. Kirloskar Consultants for the proposed ferry services between Colaba and Belapur and Vashi established the overall techno-economic feasibility of the services and the potential financial viability of the project at affordable fares.

M/s. W.S.Atkins, the consultants for CTS have also recommended fast ferry services across Mumbai harbour to Navi Mumbai as a part of overall public transport strategy. It is suggested by the consultants that the ferry services should be integrated with bus, taxi services and provision of drop off facilities in Navi Mumbai and Mumbai as well. Full-fledged hover craft services between Mumbai and Belapur are being commissioned.

The inland east-west water links joining Dharamtar and Karanja can also be thought of for freight movement between Mumbai and areas like Uran, Alibag and other parts of Raigad Districts.

6. Air Traffic Projects

According to International Airports Authority of India (IAAI)'s Preliminary Report on "Increasing Airport Capacities at Bombay", the air Passenger Traffic is likely to grow to 22.3 million by the year 2000 and 44.76 million by 2010 at a growth rate of 6% p.a. for international and 8% p.a. for domestic respectively. The air cargo traffic is expected to rise from 181.3 thousand tonnes in 1988 to 1475.7 thousands

by 2010 at an expected growth rate of 10%. In order to meet the future demand, a second international airport was recommended by IAAI at Mandva-Rewas in the south east region of the mainland.

In view of the proposed site for 2nd international airport and subsequent development of regional significance, industrial development in Raigad district, justification for the Southern Trans harbour link connecting Colaba and Uran has improved. Detailed feasibility needs to be carried out to establish this link.

7. Truck Terminal

The Wadala Truck Terminal is being developed by MMRDA on 80 hectares of land to move the existing freight distribution centre from the Masjid Bunder area. This is designed for a capacity of 3000 trucks at a time with all infrastructure facilities like offices and godowns of transport companies, loading/unloading facilities, parking and idle trucks, banks, restaurants, dormitories, etc. The truck terminal will have free access to Eastern Express Highway and Anik-Panjarpol link which forms the part of East Island Freeway. As the Centre of gravity of economic activities gradually moves north from the island city, the potential advantage of Wadala Truck Terminal in terms of its location will improve efficiency of freight distribution.

Bus Transport

Public stage carriage bus services are provided by BEST in MCGB area (and 20 km beyond the municipal boundary), TMT in Thane and MSRTC elsewhere.

With over 3030 buses, BEST is by far the largest provider of bus services in MMR carrying approximately 4.5 million passengers every day. All routes within Mumbai are provided by BEST. These include radial routes to and from main centres, trunk routes linking main centres and feeder services linking to the trunk routes and to railway stations. Additionally, some routes operate on a limited stop basis providing slightly faster journey times on the trunk routes between the Mumbai City area and outlying parts of Greater Mumbai.

Bus routes from Mumbai City to Navi Mumbai are provided by BEST and MSRTC. Routes from other points in Greater Mumbai to Navi Mumbai and Thane are provided by BEST, MSRTC and TMT.

The distribution of rail passengers from the main railway terminals to their final destinations in Mumbai CBD such as Fort, Ballard Estate, Colaba, or Nariman Point is at present carried out primarily by the bus system. Shared taxi routes are also operated, whilst a large number people make this final stage of the journey on foot. In the morning peak these movements involve 30,000-40,000 passengers per hour from each terminus. BEST operates an “on demand” service policy for morning peak hour feeder services between Churchgate and Nariman Point, and between CST and Colaba.

Railways

The main skeleton of the rail network in Mumbai was laid down over 100 years

ago, initially to link Mumbai and adjacent townships. This network grew rapidly to become the Mumbai termini of two great trunk railways interlacing the sub continent.

Today Mumbai is served by two zonal railways. Western and Central. The Western Railway line runs northward from Churchgate terminus station in Mumbai CBD parallel to the west coast of the island towards northern and western India and Delhi. Suburban operations extend upto 60 km northward up to Virar. The Central Railway runs from Victoria Terminus situated on the eastern side of the Island and serves a large part of Central India. Suburban services extend from Mumbai CST as far as Kasara to the north east (120 km) and Karjat to the south east (100 km). The Central Railway is also responsible for services on the “harbour line” which runs from CST along the east side of Mumbai Island to Rawli Junction where the line splits. One branch goes to north west to join the western railway main line at Bandra, with other line continuing northward to Kurla, before turning east wards to serve Chembur and Mankhurd and cross the new Thane Creek bridge to access the developing city of new Mumbai. The railway right-of-way has been encroached upon by the squatters very close to the railway line in the Chembur Govandi area resulting in speed restrictions having to be imposed on the trains for safety. At Wadala the Mumbai Port Trust rail line joins the harbour line and north of Wadala the harbour lines are shared with freight traffic to and from the Mumbai docks. Within the Mumbai area both railways carry a combination of suburban, long distance and freight traffic. Within Mumbai many stations are less than 1.5 km apart and in some cases less than 1 km. Such close stations are characteristic of a metropolitan urban railway rather than a suburban system. Mumbai rail network is diagrammatically shown in Figure-11.5

In addition to the lines radiating from Mumbai there is a single track connection between Vasai Road on the Western Railway and Diva on the Central Railway. This allows long distance north south trains to bypass Mumbai. The branch from Diva junction to Roha provides a link to the Konkan railway which is under construction.

All railway lines within the Mumbai suburban area are Indian Broad Gauge (1.672 m) and electrified using the 1500 volt d.c. overhead system. In some areas tracks are prone to flooding during monsoon season due to drainage system shortcomings. Suburban services are formed of electric multiple units (EMU's) predominantly formed as 9 car rakes. A multiple aspect colour high lighting system is used. EMU's are being fitted with an Auxiliary Warning System (AWS) which prevents motormen from exceeding a speed of 38 kmph when running under single yellow (caution) signal and makes an emergency brake application if a red (danger) signal is passed. AWS installation is complete on the Western Railway and Harbour lines, and is planned for installation on the Central Railway in due course.

Western Railway Suburban Operations

In May 1993 the Western Railway operated 923 suburban services per weekday. This required 59 nine car rakes and one twelve car rake to be in service out of total fleet of 68 rakes.

MMR Rail System

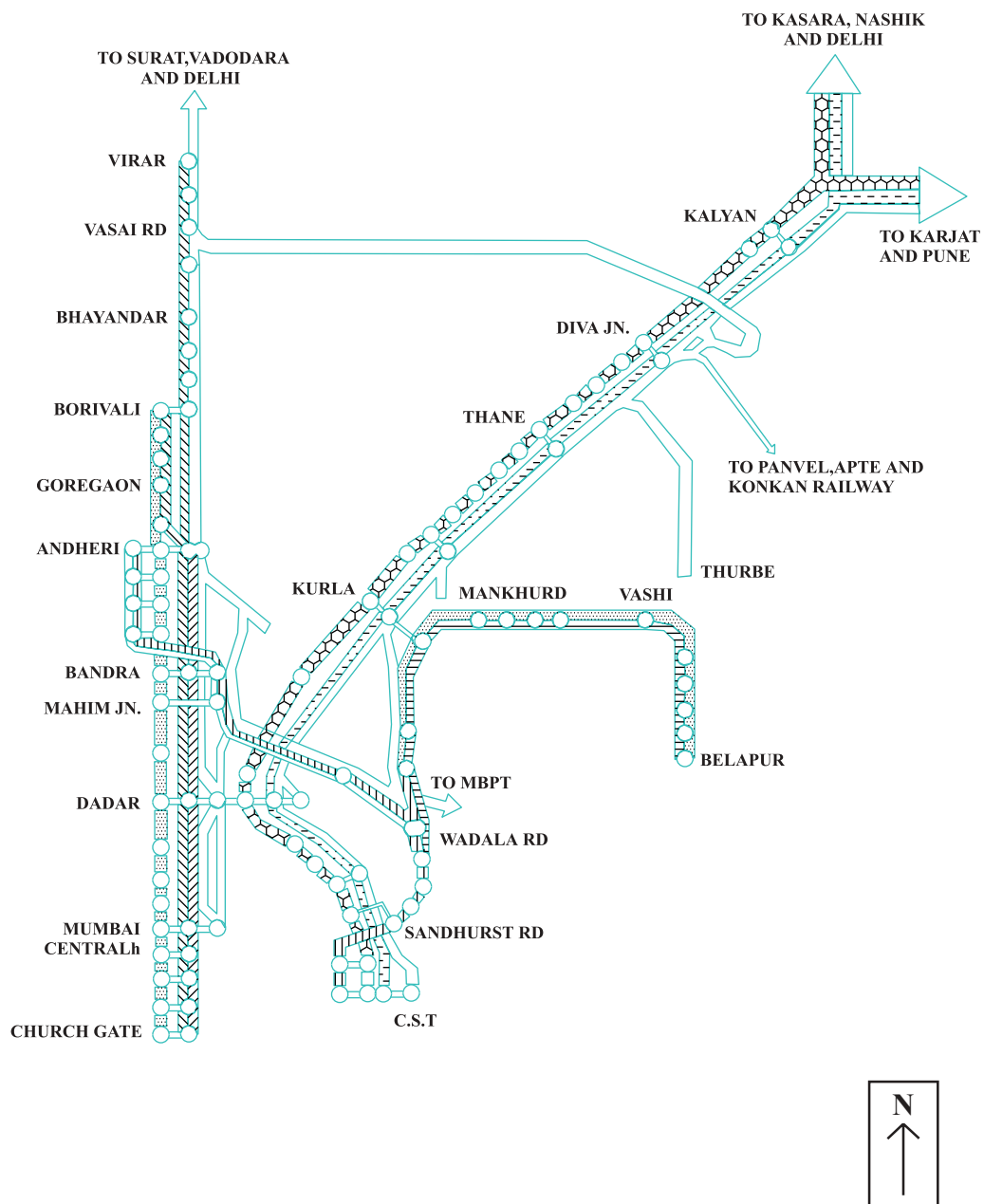


Figure-11.5

The morning period is most intense for the railways. Between 08.30 am and 11.30 am 99 trains arrive at Churchgate. During this period there are also five south bound long distance trains and one additional suburban 12 car train which terminate at Mumbai Central and Dadar respectively. There are also harbour line trains running between Mahim and Andheri.

Passenger counts show that approximately 118,000 persons arrive at Churchgate between 09.00 am and 11.00 am, an average of 1850 per train. With only four terminating lines, capacity at Churchgate is severely restricted. Dispatch of trains within 2 or 3 minutes of arrival is achieved by means of double discharge platforms.

1993 estimated peak hour passenger loadings are shown in Table-11.5 Over the most densely trafficked sections the average occupancy of each 9 car rake is above 4000 passengers. This occurs in the section between Bhayandar and Bandra with a slight drop between Bandra and Dadar. At Dadar occupancy drops by approximately 25 %, partly because of passengers transferring to the Central Railway.

The off peak average train occupancy is approximately 1400 per train at Churchgate increasing to about 2500 between Dadar and Andheri. North of Borivali where significantly less trains operate (due to availability of only one corridor) the average occupancy ranges from 2500 to 3100 per train which is super dense crush load.

Central Railway Suburban Operations

In May 1993 the Central Railway operated 1072 suburban services each weekday (658 on the main line and 414 on the harbour line). This required a total of 76 EMU rakes out of a total fleet of 95 rakes. 71 EMU rakes arrive at CST between 09.00 am and 11.00 am bringing about 126,000 passengers at a rate of about 1800 passengers per train. However due to availability of 7 platforms after the recent remodeling of Mumbai CST, the intensity of services is less as compared to that at Churchgate. The peak period passenger flows on the Central Railway's main line are shown in Table-11.6. The passenger loadings are very high from Dombivali to Dadar and north bound loads are about 75 % of the south bound loads.

Western Railway Southbound Morning Peak-hour Passengers(1993)		
From	To	No.of Passengers
Virar	Nallasopara	9,826
Nallasopara	Vasai Road	16,895
Vasai Road	Naigaon	21,337
Naigaon	Bhayander	21,938
Bhayander	Mira Road	37,719
Mira Road	Dahisar	38,867
Dahisar	Borivali	45,191
Borivali	Kandivili	91,232
Kandivili	Malad	99,288
Malad	Goregaon	108,446
Goregaon	Jogeshwari	115,149
Jogeshwari	Andheri	120,884
Andheri	Vile Parle	136,471

Vile Parle	Santacruz	130,347
Santacruz	Khar Rd	134,231
Khar Rd	Bandra	136,564
Bandra	Mahim	139,241
Mahim	Matunga Rd	137,257
Matunga Rd	Dadar	132,973
Dadar	Elphinstone Rd	111,056
Elphinstone Rd	Lower Parel	107,585
Lower Parel	Mahalaxmi	99,950
Mahalaxmi	Mumbai Central	98,588
Mumbai Central	Grant Rd	81,092
Grant Rd	Charni Rd.	73,564
Charni Rd.	Marine Lines	69,523
Marine Lines	Churchgate	61,601

Table-11.5

During the off peak period an average of 12 trains per hour run from CST to terminate at Kurla (10%), Thane (45%) and Kalyan (35%). A few suburban services run beyond Kalyan to Karjat and Kasara. Off peak services running out of CST on the harbour line average about seven trains per hour of which three run to Bandra or Andheri with the remainder terminating at Mankhurd, Vashi or Badlapur.

Suburban Train Capacity

Each 9 car rake contains 852 to 900 seats. Design passenger capacity varies from 1728 to 1752 per rake. Allowing for standing passengers at a maximum desirable density of 7 per sq.m. in designated standing areas and baggage areas result in a total maximum capacity of 2600 passengers per rake. However during peak period the actual occupancy is in excess of 4000 passengers per rake.

The present trend is to augment the combined EMU fleet at the rate of 4 or

Central Railway Mainline Southbound Morning Peak-hour Passengers (1993)		
From	To	No.of Passengers
Beyond Khadvali	Khadavali	1,401
Khadavali	Titwala	1,509
Titwala	Ambivili	2,265
Ambivili	Shadad	3,669
Shadad	Kalyan	6,112
Kalyan	Dombivili	29,013
Dombivili	Diva Jn.	49,075
Diva Jn.	Mumbra	49,121
Mumbra	Kalwa	51,163
Kalwa	Thane	52,112
Thane	Mulund	70,716
Mulund	Bhandup	76,950

Bhandup	Kanjur Marg	87,419
Kanjur Marg	Vikhroli	85,231
Vikhroli	Ghatkopar	86,337
Ghatkopar	Vidyavihar	100,721
Vidyavihar	Kurla	96,190
Kurla	Sion	108,866
Sion	Matunga	102,194
Matunga	Dadar Jn.	95,615
Dadar Jn.	Parel	90,946
Parel	Currey Rd.	88,012
Currey Rd.	Chinchpokli	86,023
Chinchpokli	Byculla	83,882
Byculla	Sandhurst Rd.	71,265
Sandhurst Rd.	Masjid	76,488
Masjid	C.S.T	70,743

5 rakes per year (3%). Track capacity improvements have been very gradual over the last ten years with signaling and power supply to enable train running at closer headways on both Western and Central Railways. Additional track works by way of 5th line on Western Railway and extension of harbour line from Bandra to Andheri have also been carried out. The main capacity bottlenecks are the level crossings on both the railways which now effectively preclude the full exploitation of the reduced headways even if rolling stock was available. On the Western Railway it seems likely that many level crossings would remain in use due to property developments in the vicinity, squatter resettlement or financial constraints. Continued presence of these level crossings will prevent the introduction of extra peak period trains and may result in a cutback in the EMU fleet augmentation programme. With these constraints there may be an increase of only 4% capacity between Andheri and Borivali. North of Borivali the increase could be 14%. In contrast, however, the increase in demand is likely to be 80% to 130% by the year 2011. Between Bandra and Andheri, with the opening of sixth corridor the capacity would increase by 23%. On the Central Railway main lines north of Kurla the capacity is likely to increase by 12.5% against the increase in demand of 17% to 29%. At Thane capacity could be increased by 35% as against the likely demand increase of 4% to 32%. At Mankhurd with the introduction of the reversing facility at Wadala for connection to Andheri the capacity would double. But with the population increase anticipated in the east of Mankhurd the demand may increase by 120% to 150%. The demand on Mahim screen line is likely to increase by only 7% subject to full development of Bandra Kurla Complex and the Oshiware District Centre.

The capacity shortfall even at the super dense loading of 4000 passengers per 9 car rake would be as given below;

The current trends of investment are inadequate to deal with these shortfalls. The future prospect for the rail system is therefore one of worsening shortages in the suburbs and continuing intense pressure on the whole of the network. Potential rail passengers will increasingly be forced to use other modes which

would be buses or private vehicles thus significantly worsening road congestion in the suburban road corridors too.

Non-motorised Transport

Non-motorised vehicles and walking is an important mode of transport for small distance trips and is environment friendly. Such traffic in the form of bicycle users or pedestrians however find it increasingly difficult to share the reducing amount of road space due to increasing number of motor vehicles which get the priority and stationary encroachments. Lack of adequate facilities and increasing risk of accidents would discourage use of non-motorised vehicles even for short trips. These modes deserve more attention of the policy makers than has been received in the past (World Bank, 1994).

Section	Shortfall
Bhayandar-Andheri	22,000 passengers/hr
Mankhurd-Kurla	20,000 passengers/hr
Kurla-Dadar	7,000 passengers/hr
Bandra-Kurla	14,000 passengers/hr

11.7 Strategy for Transport Development

11.7.1 Transport infrastructure which effectively meets the needs of the business and industry and improves mobility of the population to their work places is a critical input for enhancing economic productivity and growth. Growing incomes of the population is however accompanied by increasing vehicle ownership, congestion and high levels of localised air pollution. This calls for environmentally more acceptable approaches to enhancing efficiency of transport services. Investments in transport infrastructure should also yield adequate returns for sustaining economic growth and should be affordable to the investor and to the users (World Bank, 1994).

The objectives of the transport strategy therefore include the following;

1. to ensure adequate levels of accessibility in the expanding urban areas;
2. to assist the economic development of the region; and
3. to improve the safety record of the transport system.

These objectives are to be achieved with due consideration of environmental and social aspects and availability of resources.

11.7.2 Upgrading road network has been the dominant strategy so far. According to this strategy following long standing major road improvements will be necessary;

1. East and West island freeways providing a highway ring around the island city
2. a trans harbour road link to connect the City directly to south Navi Mumbai and proposed new airport site.

3. a new International Airport at Rewas-Mandwa; and
4. major new highways in the suburbs of Mumbai and in the outer region.

Such a system would focus on vehicular access to Island City. It would substitute road based public transport (buses, trolley buses or trams) for railways to an increasing extent. It would be expensive in terms of capital and operating costs. The analysis has shown that the bus operating costs per passenger are significantly higher than the equivalent rail costs and that new systems such as light rail transit have very high capital cost per passenger. Revenues from tolls within affordable limits - though well above present levels - would be unlikely to bear the costs. As a strategy it would be directed toward a very small part of the overall problem and would be swamped by the increase in private vehicle travel that it would encourage with consequent parking and attendant road congestion problems in many parts of the Island City and the major suburban centres. Overall it would do little to solve the current transportation problem in the region.

11.7.3 On this background six alternative transportation strategies can be envisaged.

1. Enhancement of rail services in existing corridors to the extent needed to carry all demands at present conditions of crowding with Bandra Kurla east west link. Option 1a;
2. Further optimisation of rail services as above with extra rolling stock and greater frequency to reduce peak train loading to 2600 passengers per 9 car rake. Option 1b;
3. Construction of new rail corridors plus optimisation of existing services to carry demand at present level of crowding, Option 2a;
4. Further optimisation of 3. above with greater frequencies, longer trains and additional rolling stock to reduce the peak train load to 2600. Option 2b;
5. A moderate level investment in highways consistent with the levels of investment shown to be affordable by 2001. Option 3;
6. A higher level of investment in highways including some schemes which may be possible as Build Operate and Transfer (BOT) options. Option 4.

The economic analysis of these options is presented in Table-11.7.

11.7.4 **The Proposed Strategy**

Public transport is the only solution to providing adequate accessibility for a region where a large number of households will not own a car in foreseeable future. The suburban rail network can provide the core of the transportation system for the enlarged conurbation by using the linear urban form to advantage. The economic analysis shows that the aggregate economic return is the highest for a strategy with substantial investment in metropolitan railway system and a modest investment in the road system. This strategy is also beneficial from an environmental stand point.

The strategy for rail system development must address the present acute overcrowding with substantial increase in capacity. Rail system capacity needs to be doubled north of Andheri on the western railway and north of Kurla on the central railway. The capacity increase requires full integration of the two existing suburban railway systems and optimisation of services including;

- elimination of all level crossings and replacement with road overbridges on both the western and central railways;
- introduction of new rolling stock of a radically improved design;
- longer trains running at 3 minute headway on the western fast lines and central mainline to the fullest extent subject to unavoidable long distance trains and platform capacity;
- power supply and signaling enhancement to sustain the three minute services on both railways;

Economic Returns of the strategies				
Strategies	Economic Returns *			
	PVC (Rs. in Mill)	PVB (Rs. in Mill)	NPV (Rs. in Mill)	IRR (%)
Strategy 1a	6,561	11,408	+4,848	+19%
Strategy 1b	17,121	6,584	-10,537	+3%
Strategy 2a	10,614	8,343	-2,270	+10%
Strategy 2b	*16,714	4,863	-11,852	+1%
Strategy 3	1,996	3,807	+1,811	+18%
Strategy 4	4,829	7,459	+2,629	+17%

*At 12% discount rate

Note: Figures do not total due to rounding

Table-11.7

- construction of the 5th line from SantaCruz to Borivali on the western railway;
- construction of an additional corridor from Borivali to Virar (quadruplicating);
- possible construction of an additional corridor from Kurla to Thane.

East-West Link

Developing the Bandra Kurla commercial complex is one of the key elements of the overall planning strategy. For this centre to succeed a rail link is a must. Bandra Kurla rail link apart from serving the commercial complex, would cater for an existing substantial demand for east west travel. One corridor seems immediately justifiable. Its capacity may have to be augmented depending upon the nature of actual development in the Bandra Kurla complex.

The railway system development strategy should also support and to some extent lead the overall planning strategy for the region. In this context expansion of rail services in Navi Mumbai and their connection with rest of the system is of critical importance.

Mumbai CBD will continue to be the main centre for commercial, entertainment and tourism activities. In the long run therefore provisions must be made for rail services to fully penetrate the CBD.

The Highway Network

The strategy for development of highway network is focussed on the suburbs and the outer region where the majority of the population will be located during the next two decades.

Within Greater Mumbai following eight projects deserve high priority;

- Anik to Panjrapol expressway. This will relieve the heavily congested Sion junction and the Eastern Express Highway Chembur to Sion section. It will also access the Wadala Truck Terminal site;
- Completion of the Wadala road-over-bridge and link to the east to connect with Anik to Panjrapol link;
- The eastern freeway extension as far south as Cotton Green. This would link with the Anik to Panjrapol highway and provide links to the eastern corridor and to the Port;
- Two east-west links between the Eastern Express Highway and the Western Express Highway viz.
- Jogeshwari to Vikroli link road where land clearance has been achieved
- Santa Cruz to Chembur for which there is heavy demand. However the route of this link passes through a large area of slums and hutments at its eastern end and would require a major resettlement programme to precede the road.
- Completion of the Western Relief Road (WRR) from Malad to Dahisar and junction improvements on WRR between Malad and Santa Cruz. This will serve the western suburbs and could allow bus priority developed on Swami Vivekanand Road;
- Airoli bridge project crossing Thane Creek connecting the north eastern suburbs with Navi Mumbai at Airoli. This needs to be developed as a toll road.
- Widening of Tilak Bridge at Dadar.

In the outer region the strategy should be to fully utilise the NH Expressways connecting Mumbai with its hinterland in Maharashtra and Western India and to limb together the various sub regions of MMR without the need for traffic to transit through Mumbai. The strategy is illustrated in Figure-11.6 and the details are given below.

- Roads to connect the NH8 Expressway (Mumbai - Vadodara) to Thane, Kalyan and the north-eastern sub region;
- improvements of the connection from Vasai-Virar to Bhiwandi and Kalyan;
- improvements to Kalwa Bridge at Thane which could be a toll bridge;
- improvement of the Thane-Bhiwandi road possibly as a BOT project;
- Panvel bypass as BOT project;

Proposed Road Network

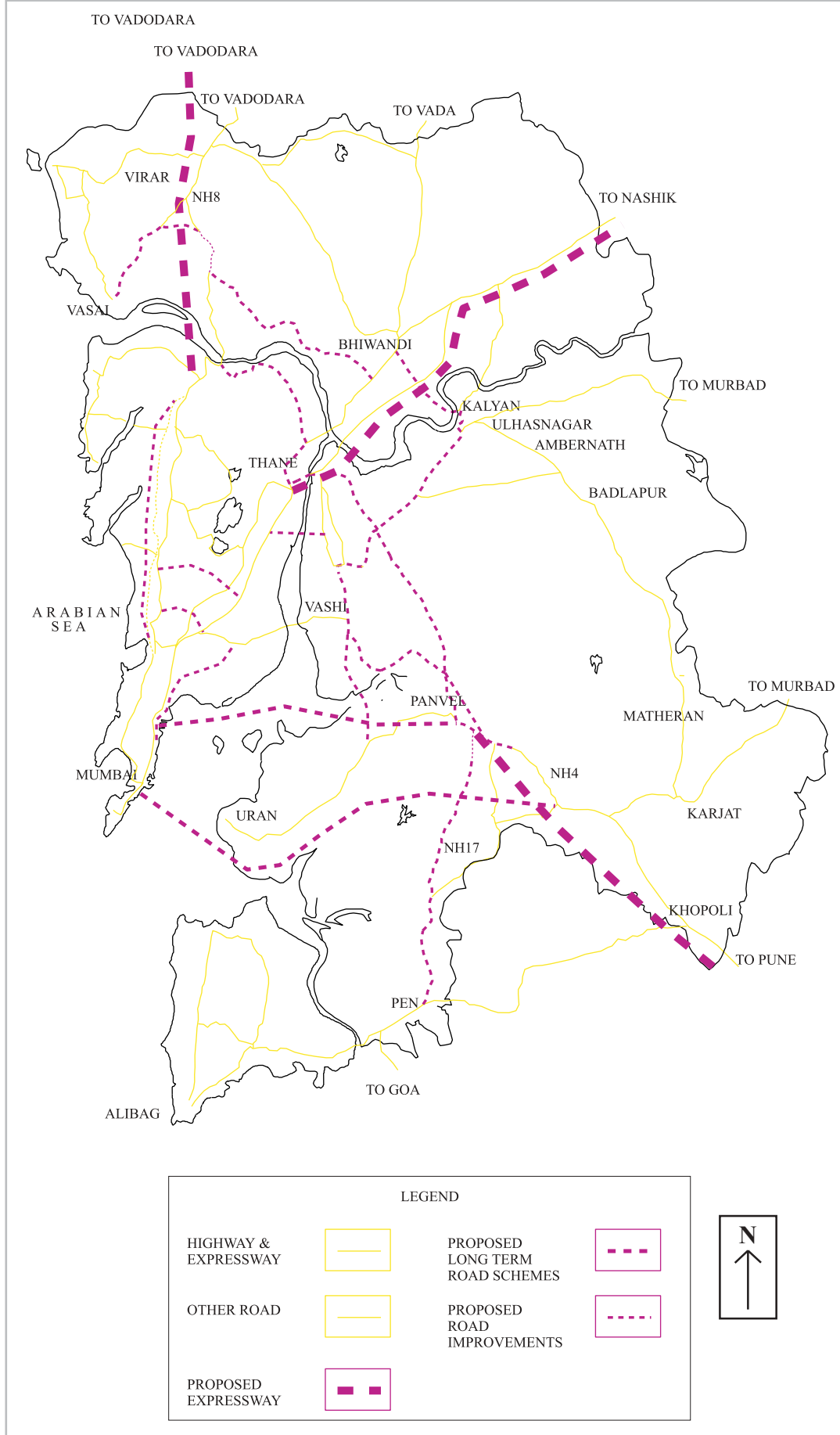


Figure-11.6

- improvement to the Turbhe - Belapur - Panvel road to link Thane Creek bridge with the Panvel bypass and NH4 expressway;
- improvement to NH17 between Panvel to Pen;
- duplication of Panvel creek bridge to serve the traffic originating from Jawaharlal Nehru Port; and
- BTHL and connection to NH4 Expressway as a long term BOT project.

Within the Island City the case for major road improvements is weak. Despite the high cost of such measures the terminal capacity to accommodate ever increasing number of private vehicles cannot realistically be achieved in the south island destinations. Furthermore as most of the major proposals parallel existing roads, the economic and financial feasibility of carrying out these projects as BOT is unsound.

More economically attractive alternative is to optimise the capacity of the existing road system by traffic engineering and traffic control system. Road network capacity can be increased by up to 25% by traffic engineering and installation of urban traffic control system. This represents a highly cost effective method of network enhancement.

However such extra capacity achieved through traffic engineering and urban traffic control will be limited and cannot balance the demand expected to be generated by the rising vehicle ownership.

Demand Management

It is therefore necessary to contain the demand by restraint or management of the demand. The objectives would be;

- to restrain inefficient use of private vehicles,
- to conserve scarce financial resources and fuel, and
- to limit the adverse environmental impacts.

Management of demand will also mitigate the adverse effects of road congestion on causing delays and unreliability in the bus service, in turn causing an increase in costs and loss of passengers thereby further increasing unit costs and contribution to deficits. The consequent fare increases or service cuts would further exacerbate the problem.

Parking Control

The control of on - street parking is a prerequisite of demand management. By levying parking fees for use of road space for parking purposes and providing off street parking on commercial basis conditions can be improved for pedestrian as well as vehicular traffic particularly the buses.

The Development Control Regulations require minimum level of off street parking provision. There has been a tendency to stipulate increasingly higher level of such parking. However in commercial areas like Mumbai CBD and Bandra Kurla Complex the alternative of prescribing the maximum level of off street parking

with a view to ensuring that planning authorities retain control of majority of parking needs serious consideration.

Cordon Pricing

Introduction of an hourly fee for all kerb side parking as well as all public off street parking throughout the CBD is strongly recommended as a regulatory measure. However parking charges alone will not effectively restrain car entry because of the presence of large amount of privately owned off street parking.

Cordon pricing is the only effective means by which demand could be managed. A simulation study indicates that a Rs. 50 charge per car entry through a cordon covering area north of Colaba up to Mumbai Central and Mazagaon Dock can bring about 10% to 27% reduction in traffic across various screen lines in the Island City.

It would be necessary to introduce reliable bus service of standards acceptable to car owners, from the peripheral parking areas to the CBD. Depending upon the location of the cordon and the amount of charge levied about 5000 - 6000 passengers per hour will have to be carried by the bus service. As the standard of the bus service will have to be higher, different fares can be charged. This service could also be privatised with advantage.

Bus Strategy

The emphasis should change away from large municipally owned bus companies running all stage carriage services in their area into enabling undertakings, whose role would be to specify service requirements and agree with the Regional Transport Officer (RTO) the licensing conditions under which the private sector companies can provide the required service. The enabling undertaking should own and operate certain central bus stations and depot facilities which the bus service providers should be required to use. With appropriate management this would enable the authorities to maintain a minimum necessary level of control data through which to monitor operations and enable them to plan extensions and modifications to route plans and services.

Navi Mumbai is an obvious area for initiating this system of publicly managed private bus service provision. However certain sections of Mumbai commuters could also be considered for this type of development as the requirements in the suburbs expand and new bus depots and bus services become necessary. It may also be possible to deregulate bus service provision in Thane.

The bus strategy will have to respond to the demand of growing number of middle class households for higher standard of bus service. Standard in terms of vehicle design and fittings, comfort levels, limited stops giving higher speeds and perhaps air conditioning. The objective should be to avoid these middle class individuals to opt for their private vehicle as that would disturb the very stability of the road network in Mumbai. Given the right type of terms and conditions the private sector operators are most likely to positively respond to this demand.

The investment required to implement the desired strategy during 1995-2000 is estimated to be Rs. 2,059 crores with a railway component of Rs. 1,328 crores at 1992-93 prices. Resources for such investments will have to be augmented through more efficient use of traditional financing mechanisms such as fares, local taxation, user charges, domestic and external borrowing and through encouraging private investments in this sector (World Bank, 1994).

11.8 The Future Scenario

11.8.1 The above strategy indicates the policy and programme priorities for the next 10 to 20 years. However as transport investments have long term impacts on the patterns of regional developments, it is also useful to envisage the long term scenario to ensure that the current programme is not inconsistent with the likely future scenario. According to the present trend of the land use pattern it is seen that apart from the Fort and Nariman Point areas in south Mumbai the emerging centres of development in MMR are going to be Bandra Kurla Complex, Vashi, Belapur - Ulwe CBD of New Mumbai and Jawaharlal Nehru Port. This would be further strengthened if Mumbai Port Trust areas are redeveloped for office and commercial purposes. Such a poly centric pattern of central cities can then support a large metropolitan growth in the surrounding region. This pattern of growth is like a large pentagon as described in the Chapter-13. The pattern of transport infrastructure also needs to be in tune with this pattern of land use development. Some of the transport provisions that are of critical importance in this regard are;

1. CST, Kurla, Vashi, Belapur existing Rail Corridor; with Belapur, Jawaharlal Nehru Port, Uran proposed rail corridor in New Mumbai and the probable rail corridor linking CST to Uran by the Trans Harbour Link.
2. The underground rail corridor connecting CST to Churchgate via Fort Market, Stock Exchange and Nariman Point, thereby providing a circular loop between CST, Churchgate, Bandra and Kurla.
3. These two loops can be supported by three other peripheral loops viz. Bandra, Vasai, Diva, Kurla; Kurla, Diva, Karjat, Panvel and Diva, Kalwa, Turbhe, Belapur, Panvel.

This is shown in a diagrammatic form in Figure-11.7. The future mass transport corridors are shown in Figure-11.8.

It is however very likely that investment in urban rail will be the key to meeting the challenges of future metropolitan growth and its structure.

11.9 Environmental Considerations

11.9.1 Vehicular emissions are found to be a major cause of air pollution particularly at locations with higher traffic intensity. Transportation is also a source of noise pollution. Measurement of air pollution however does not adequately capture the vehicle related pollution. Improved monitoring is therefore necessary to understand the relationship between traffic flows, vehicle characteristics, micro meteorology and the ambient air quality. Location specific air pollution caused by vehicles could be

MMR Rail System

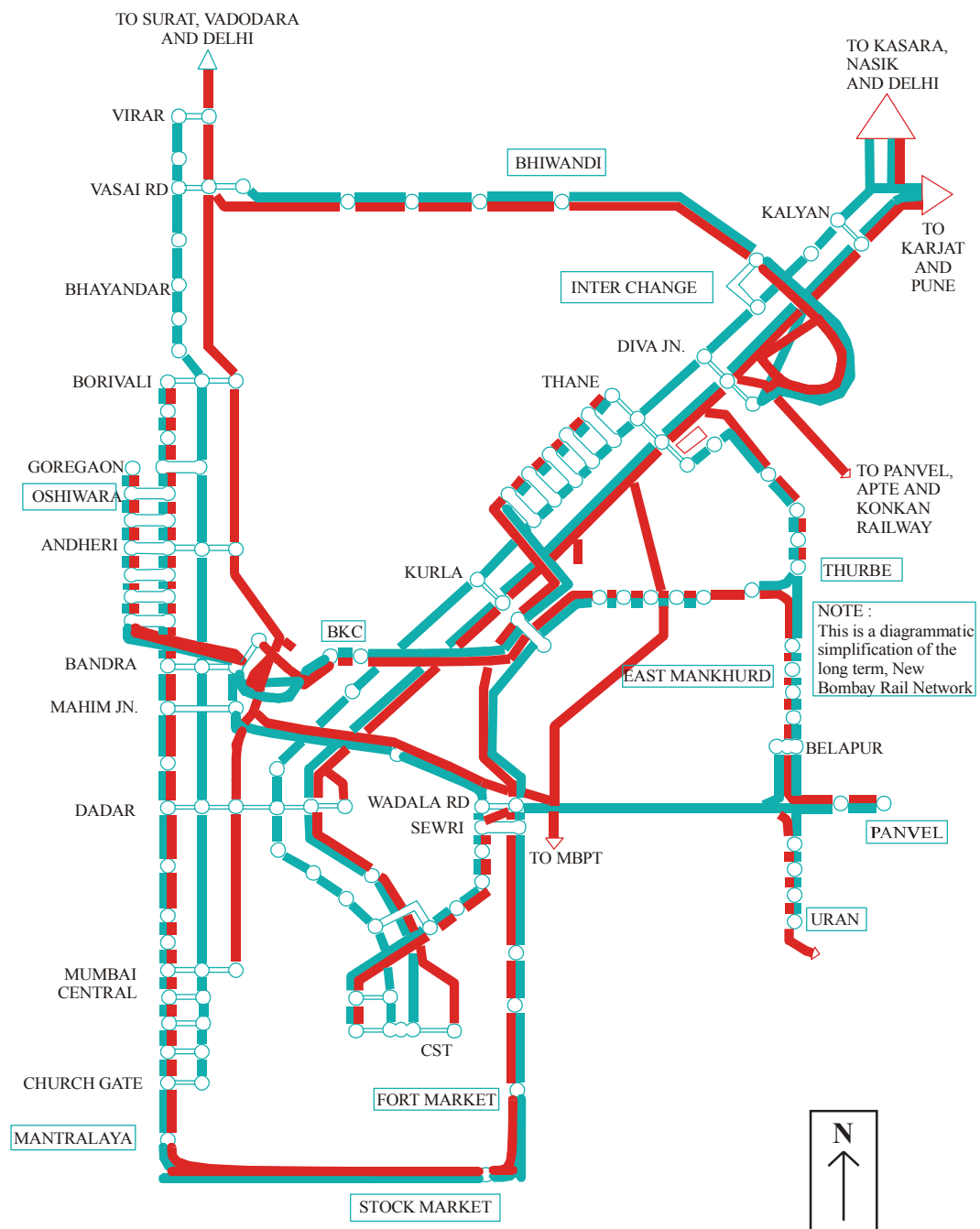


Figure-11.7

Future Mass Transport Corridors

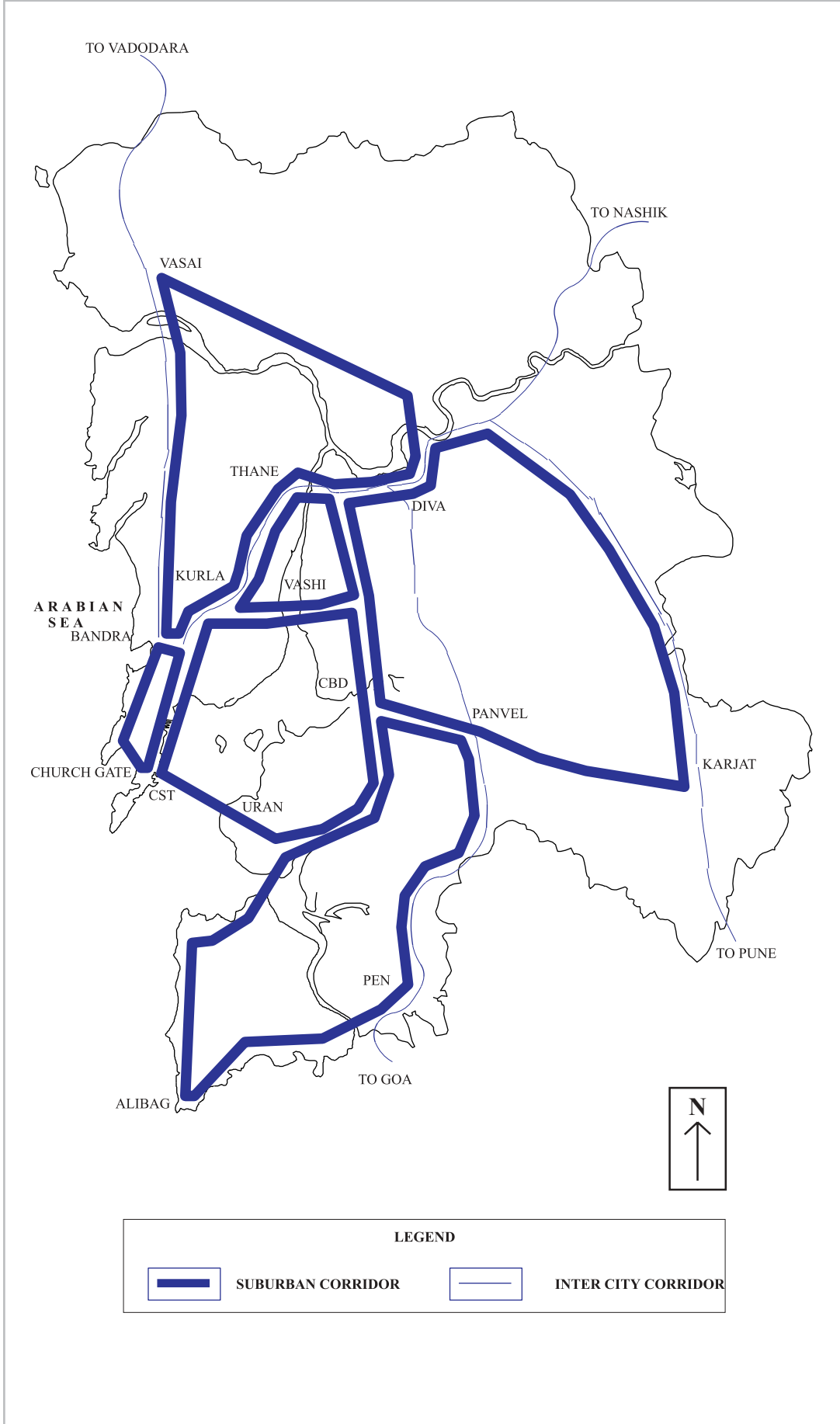


Figure-11.8

reduced by controlling the vehicular traffic intensity in congested areas through demand management. New roads providing alternative routes could also help divert the traffic from congested routes.

- 11.9.2** Measures could also be adopted to check actual vehicle emissions. Use of alternate or improved fuel e.g. CNG and lead free petrol, changes in engine design and use of catalytic converters should help reduce harmful emissions. A study of Environmental Assessment proposed to be undertaken for MUTP II will carry out sectoral environmental assessment of the proposed strategy.

11.10 Institutional Issues

Integrated suburban railway planning and operations is of critical importance to effective long-term transportation management in MMR. An Urban Metropolitan Transport Authority could be established in the long run and UMTA could eventually come up for inter modal coordination if required. Such a step at the present stage may however complicate the issues and add to delays. MMRDA as a regional level authority could play the role of planning, coordinating and investment programming agency.