1 Accessible City

Life is motion, moving, mobile and dynamic. Death is still and static. Accessibility and mobility are the basic characteristics of lively, dynamic space. Transportation is the lifeline of economic development, social transformation and growth. It is a trigger of urbanisation and employment generation. However, many Indian cities are becoming traffic jam cities rather than transit cities. This has arisen as a result of the society having embraced motor car as a status symbol and as the pillar of the economy. The battle between economic growth and sustainability is becoming a major issue in urban transport.

India (population 1210 million) has around 100 million vehicles comprising nearly 70 per cent private vehicles (about 10% cars and 60% two wheelers). During last 40 years the oil consumption increased by 900 per cent at an average annual growth of 20 to 25 per cent. India's highways and urban road networks (670,000 km) fail to cope up with the increasing traffic.

Urban transport is a complex system involving various modes of transport, technologies and institutions. The volume and nature of demand for urban transport are derived from the overall pattern of socio-economic activities and their interactions within an area. Urban transport shapes the growth pattern of urban development and vice-versa. The scale of urban growth in India is unprecedented, largely due to motorization of transport and emergence of public mass transit. Urban transport has emerged as one of the most important components of economy. Inefficient urban transport negatively impacts the competitiveness of the economy by adversely affecting the labour market and by increasing the commuting time for goods and passengers. The urban transport sector can be seen as comprising four basic elements: modes of transport (public and private), transport infrastructure (e g. urban roads), transport service providers and transport management (institutions, planning, design, finance, implementation, and enforcement).

Emerging Trends

Rapid motorisation, private car ownership and heavy volume of traffic in the cities impose large economic, social and environmental costs, including increased traffic congestion, increasing road and parking facility costs, increased consumer costs, more crashes, increased energy consumption, increased pollution, emissions, sprawled and single land use, reduced mobility and reduced public health hazard.

Some of the key trends are (Replogle, 2008):

- Rising motorisation: Increasing individual wealth results not only in higher car ownership, but also more sprawling settlements as people move to larger and higher quality residences that require more frequent and longer travel. This makes private car use more attractive and public transport less convenient.
- Growing traffic congestion: Increasing traffic congestion may result in dispersion and relocation of businesses to the urban edge. Declining accessibility to businesses and public institutions reduce not only quality of life but also the economic performance of cities.

Motor Vehicles

According to the Society of Indian Automobile Manufactures there are around 100 million vehicles on Indian roads (2010):

- 60 million two wheelers,
- 10 million cars,
- 10 million taxis/autos (three wheelers),
- 8 million buses,
- 4 million goods vehicles,
- 8 million other vehicles (government, military, emergency, etc.)

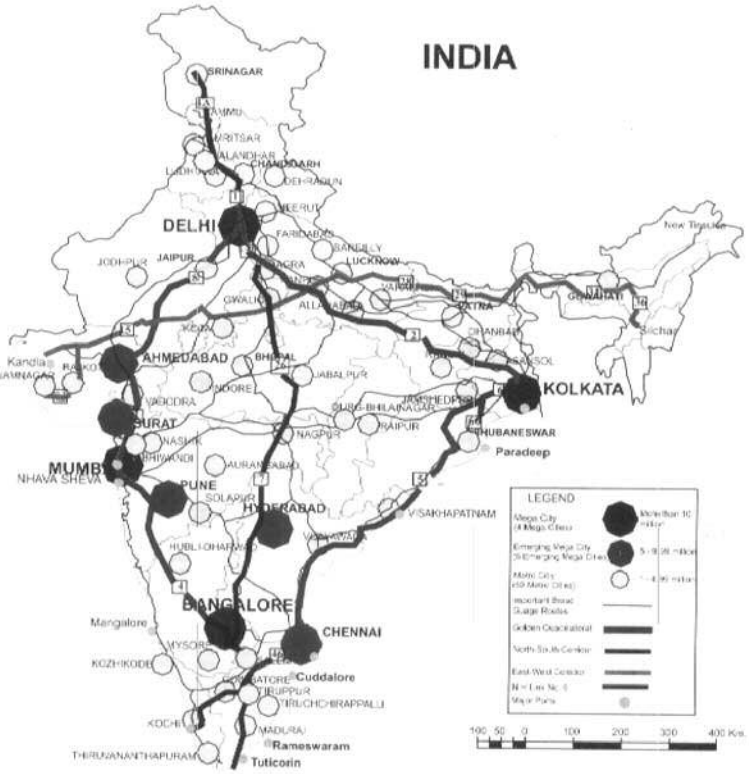


Fig. 1.1: Linkages among major cities of India (2021)

- Declining economic competitiveness: As economic activities shift to the service sector, travel patterns become more dispersed, i.e. the peak demand decreases and the number of origins and destinations of journeys increase, resulting in lower economic feasibility of public transport.
- Public health and safety: More vehicles moving at higher speeds lead to more frequent and severe accidents and fatalities. High concentration of vehicle emissions, particularly particulate matter from diesel combustion, are related to increasing cases of asthma and pulmonary disorders. Lifestyle changes resulting from more time spent in cars lead to higher rates of obesity.
- Social segregation: The gap between high income, high mobility citizens and others tends to grow with increasing motorisation. As lower income citizens loose access to jobs, goods, and services, mobility become a matter of social equity.
- Climate change: Motorisation and sprawling growth result in more fuel consumption and vehicle emissions which contribute to global warming.

Emerging trends that need to be addressed are the following:

- High growth rate of vehicles and heavy vehicular volume on roads causing congestion, delay, safety, pollution, and social and economic overheads.
- Ineffective utilization of road space - on street parking, encroachments, lack of pedestrian facilities.
- Improper road design - No consideration for disabled and pedestrians on road.
- Inadequate, unaffordable and inefficient public transport.

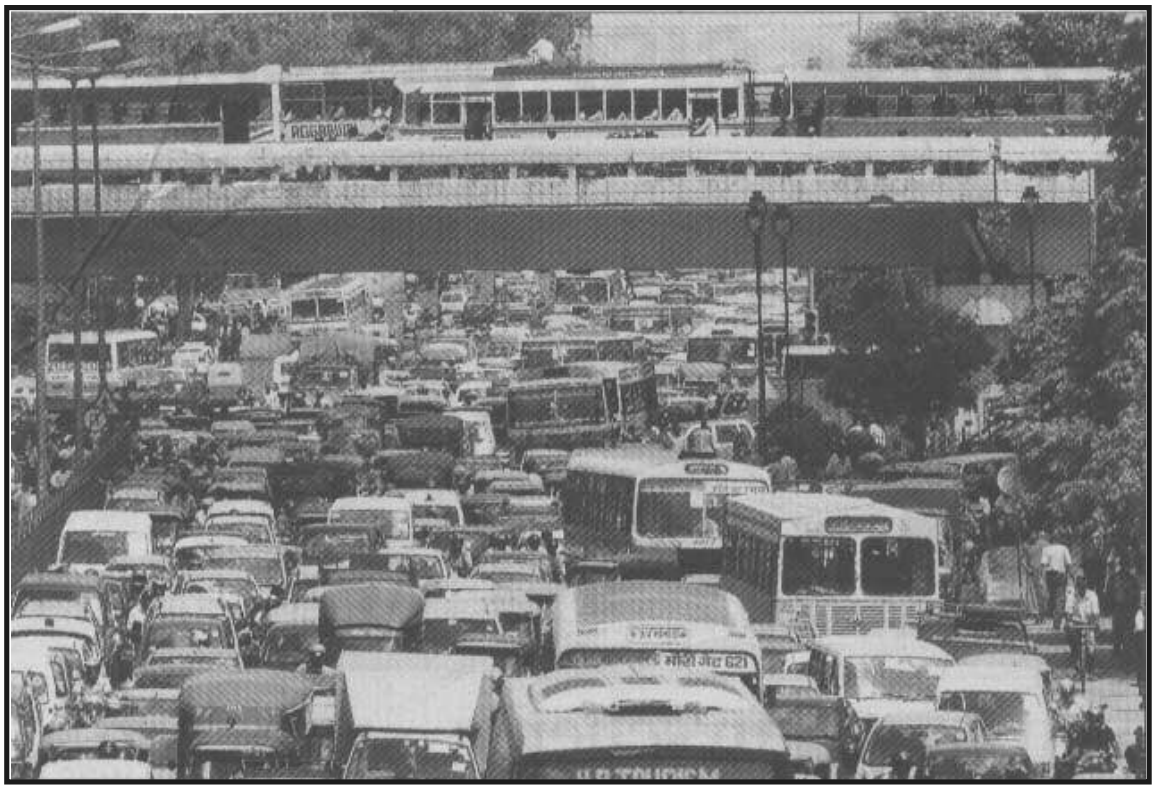


Fig 1.2: Traffic congestion, Vikas Marg, New Delhi

- Lack of integration of land use – transport system.
- Erosion of environment friendly modes like cycles and cycle rickshaws.
- Inadequate parking.
- Intermixing of local and regional passenger and goods traffic, slow and fast vehicles.
- Lack of coordination among the implementation agencies.
- Lack of user system interface and transport information.
- Lack of adequate enforcement and implementation.

Motorization in India

Motorization in India is mainly of a two-wheeler variety (i.e., scooters, motorcycles), although a recent roll out of an inexpensive, small car may change this. The growth of motorized two-wheelers has had major negative impacts on the performance and patronage of the hitherto dominant mix of walking, cycling and public transport modes.

Table 1.1: Motorisation- Autos (Four-wheelers and Two-wheelers)

City	*Autos per 1000 populatoin.*	*Autos + 2-wheelers per 1000 population*
Kanpur	7.3	87.0
Pune	12.0	108.6
Ahmedabad	14.1	118.6
Bangalore	22.6	143.9
Hyderabad	13.8	109.9
Chennai	23.7	109.9
Delhi	57.1	224.7
Kolkata	17.9	38.3
Mumbai	14.9	34.5

Source: Reports of various cities (2005-08)

Accessibility deals with the movement of people and goods that emphasises the outcomes and performance of the transport system. Policy, planning and engineering aiming at improving access, envisage wide variety of transport related strategies, programs and investments. However, the fast pace of growth of the transportation sector is a cause of growing and intractable carbon emissions. Urbanization and related transport development in the developing world and transition economies are impacting land use in rural areas and subsequent loss of agricultural and natural land areas. The government's policy to promote the motor industry and real estate sector has led to extensive urbanization, through the transformation of agricultural land. This has led to increased traffic congestion, increasing demand for fuels, roads and parking, increased costs, more accidents and increased energy consumption. This is evident in extensive suburban townships around almost all the metropolitan cities such as Mumbai, Delhi, Kolkata, Chennai, etc. Around Mumbai 7 new towns have come up within a radius of 50 km from old city. Around Delhi, new urban centres include Gurgaon, Manesar, Kondli, NOIDA, Greater NOIDA, Ghaziabad, Faridabad, etc which have come up around 20 to 50 km radius and are contiguous to Delhi. Around Kolkata new city developments, such as Salt Lake City, Jadavpur, Rajarhat,

have come up around 20 to 40 km radius from the mainland. With a shift to new suburbs, both the number of private vehicles and trips length are increasing. The poor who cannot afford private transport are adversely affected, who resort to informal motorised transport in absence of efficient public transport, which means more money and time spent in commuting. As a consequence the gap between private vehicle owners, *i.e.,* high mobility citizens and low income groups with restricted mobility is widening, both in economic and social terms, and potential advantages of city life are not accessible to poor.

It is well realised that accessibility acts as a powerful tool that enables spatial inclusion and social sustainability. In most of the cities, majority of people are engaged in managing their basic needs, i.e. (*i*) survival (livelihood, jobs, economic growth, safety and security), (*ii*) access to supports (basic services, education, healthcare, etc.), (*iii*) transformational needs (social and economic growth), and (*iv*) empowerment, education, healthcare, goods and services. The public policy by and large determines the transport choices and land use pattern. Transport projects have also been a major cause of forced evictions in several cities, with detrimental effects on the urban poor's access to affordable housing and employment. Urban transport can be a powerful tool towards the destination of access to survival, supportive and transformational needs of the poor and for the empowerment of the civil society. To incorporate these needs in urban transport policy and programs in a local context, it is necessary to resort to participatory planning and give voice to relevant stakeholders through the process of community driven social audit. In this regard the roles of transport departments, planners and other concerned institutions are crucial, who need to consider transport and mobility as a human right. This is important, particularly with regard to public transport and informal modes, where women's dignity and security are at risk. Public transport and city planning are the two major areas of public policy that can direct the society along a sustainable and inclusive path.

Public transport: Public transport is primarily in government ownership, and provides affordable and often low-level services. However, privatisation is being introduced in public transport which is often weakly regulated. Informal modes are ubiquitous and dominate in smaller and medium sized cities. It is estimated that the buses, which are generally 1 to 2 per cent of the total number of vehicles, cater to around 50 to 60 per cent of the total vehicular trips demand. Public transport is largely seen as the transport mode for the poorer sections of the community, who cannot afford to own/use personal transport. The buses usually lack dedicated right of way and the aspects like frequency, inter-modal integration, development of parking and infrastructure are not given due attention. In Indian cities where most of the users are poor, public transport is often subsidised. Wherever private buses operate, they tend to choose the profit making routes and are usually overloaded and unsafe. The availability of public buses is irregular and limited. The private buses and mini bus tend to apply the "fill and run" principle, taking over the profitable part of the transport business while the government is left with the task to uphold a costly service.

Out of 5161 cities/towns in India only about 100 cities have a public transport system run by the State (or City) Transport Undertakings (STUs). Due to poor return and subsidies involved, bus fleets with the government run transport undertakings have been declining and private operators are being licensed to supplement bus operation to meet the growing demand. An estimated 62 per cent of the commuting trips in Delhi are made by buses, which are less than one per cent of the total motorized vehicles. Cars (1.8 million) and two wheelers (3.72 million) represent 90 per cent of the total motorized vehicles (5.86 million). Delhi has one of the largest CNG bus fleet in the world comprising 46,000 buses (including public, private, school,

company, chartered and inter-state), covering a road network of 31,200 km, running about 13 million km per day and transporting nearly 6 million passengers per day. It is interesting to note that private modes carry 31% of vehicular trips, and are responsible for 90% of emissions, while CNG powered buses carry 62% of trips and emit less than 4% of pollutants.

Table1.2: Transport Modes in Delhi vis-a vis Emissions (2009)

S.No	*Mode*	*No. of Vehicles*	*Vehicle km Travelled (VKT) Million km / day*	*Percentage of Trips*	*Emissions[1] Tonnes / day*
1.	Private	5,526,000	123 (73%)	31	500.0 (90%)
1.1	Cars	1,805,000	68 (40%)	10.0	280.0
1.2	Scooters/motor cycles	3,721,000	55 (33%)	21.0	220.0
2.	Public		43.7(27%)		53.0 (10%)
2.1	3 Wheelers/Auto	76,000	19.6 (12%)	3.0	6.0
2.2	Taxi	28,000	0.6 (0.4)	0.1	2.0
2.3	Buses[2]	46,000	13.0 (8%)	62.0	15.0
2.4	Goods Vehicles	158,500	6.0 (3.6)	—	30.0
2.5	Metro (Electric)	186 km	4.5 (3.0)	3.9	NA
	Total	5,866,000	166.7	100.0	553.0

[1]Comprising CO/CO_2 (60%), Hydro-carbons (20%), NOx (15%), Particulate and others (5%)

[2]Includes public, school, company, chartered, private and inter-state buses. All buses, taxies and auto-rickshaws in Delhi run on CNG fuel.

Note: Figures for NMT not available, however rough estimates give a total of 6.3 million km travel per day.

Sources : Kayinda, R. et.al, 2010, (Central Road Research Institute), Vehicular Emission Norms vs Vehicular Pollution Load in Delhi, Paper presented in Transect 2010 Conference April, New Delhi.

Bhandari, M. et.al, 2010, CRRI, Environmental Implications and Passenger Mobility in Delhi, Paper presented in Transect 2010 Conference April, New Delhi.

Government of Delhi, 2010, www.transport.delhigovt.nic.in

In some metropolitan cities in India, the alternatives such as surface railway for intra-city transport, metro and LRT are working or being taken up. Although about 55% of the railway passengers in major Indian cities comprise of its suburban services, no further contribution is being made by the Railways in improving the intra-city railway services. In the recent some of the metropolitan cities have embarked upon multi-modal transport comprising of integrated road/Bus Rapid Transit System and metro/LRT system. Most of the funding for these is given by the Central Government under Jawaharlal Nehru National Urban Renewal Mission and during last five years Bus Rapid Transit (BRT) corridors have been developed in several cities which include Indore, Ahmedabad, Surat, Rajkot, Hyderabad, Bangalore and Delhi. Delhi Government plans to build 26 BRT corridors in Delhi, covering a total length of 310 km by 2020, of

which one BRT corridors has been completed and is operational since 2008. The experience of Delhi BRTS indicates that it can be quickly built utilising existing road network and at a fraction of the cost of metro rail systems. It can increase the average bus speed by twice, from normal 10-12 km per hour to 20-25 km per hour, thus enhancing the bus service efficiency without additional bus fleet. Along with BRT, dedicated corridors have been developed for pedestrians and bicyclists. The BRT lane also provides undisturbed corridor for emergency vehicles like police, ambulances and fire brigade. However, allocation of existing lanes for BRT has caused traffic congestion and invited severe criticism from car users and media. Careful selection of BRT Corridor is necessary so that other traffic can avail escape route. Bus Rapid Transport Systems (BRTS) have been taken up in Delhi, Jaipur, Chennai, Mumbai, Hyderabad, Bangalore and Indore, which provide some valuable lessons.

In Ahmedabad 48.8 km of BRT corridor has been developed at an average cost of Rs 1.60 million per kilometre. 50% of investment were borne by the Ahmedabad Municipal Corporation, 35% by Central Government and 15 % by State Government of Gujarat. The financing of rolling stock and operations are based on public-private partnerships. It is claimed by marginal investment in dedicated corridor development for buses, the speed and delivery of each bus enhanced by double. This provides 'factor 4' gains, that is obtaining twice the benefit by investing half the funds, thus saving enormous investments.

The ICTSL (Indore City Transport Services Ltd.) structured a PPP model for urban bus services. The investment in the urban bus transport system was shared between ICTSL, private operators and service providers. Broadly cost of common infrastructure like bus stops, bus depot terminal and office space was borne by the ICTSL, and the investment in the rolling stock by the private bus operators. The contractual arrangement between the ICTSL and the bus operators was based on a franchise arrangement, by way of competitive tendering process. The contract between the successful bidder and the ICTSL for tenure of five years is based on the following conditions:

- The operator would pay a fixed monthly premium to the ICTSL for the right of plying the buses on selected routes and for using the shared infrastructure.
- The operation and maintenance cost, daily running costs, and other costs of operating the service will be borne by the bus operator. The operator's share of revenue comprises the following.
  (*i*) Entire fare box collections
  (*ii*) 60% of the revenue from sale of advertising rights
  (*iii*) 80% of the revenue from sale of monthly passes
- The operator will comply with the performance and maintenance standards issued by the ICTSL.
- The fare collected from the passengers would be based on tariffs prescribed by ICTSL.

The performance parameters for the private entities prescribed by ICTSL include:

- Technical specifications for the rolling stock; standards for bus, pollution check, fuel, etc.
- Specifications and standards for operations of buses, numbers, frequency, trips timings, maintenance, etc.
- Specifications for the operating staff and their code of conduct
- Standards for support services, GIS, and PIS, for monitoring the performance of services and adherence to defined routes, fares and the specifications.

The ICTSL involved private parties for BRT corridor retrofitting and maintenance which includes sidewalks, cycle tracks, bus stops, etc, and for provision of supporting services like advertising, selling bus passes and installing and operating GIS (geographical information system) /PIS (passenger information system) in the buses. The PPP model also covered 100 taxis which are accessible through a 24×7 call centre. The experience of last four years of PPP indicates an improved ridership on buses (to an extent of 30 to 40 %), together with a more reliable, efficient and comfortable service.

It may be necessary to look at public transport from a basic human right and social service perspective, as mobility helps the poor sections in access to employment, education, healthcare and other basic amenities. In some cases a part of financing is being sourced from value capture by real estate development by the public transport agency, however, still government support and soft loans are necessary. In order to make a public transit system sustainable and inclusive, its synergy with land use needs to be considered along with improving its operational efficiency. There is ample scope to improve the vehicle efficiency and transit operations (consistent dwell times and driving practices, regular dispatch, control of the bus intervals along the route). Improving fuel efficiency and quality, fleet management systems, using GIS for automatic vehicle location and online supervision, help to make public transit operations sustainable and reliable. The public transport system cannot be considered in isolation, but has to work in conjunction with other modes, such as 2 wheelers, cars and NMTs. Well developed road infrastructure, along with terminals, workshops, depots and parking space, are necessary for a city wide public transit system. The viability of public transport largely depends upon the urban structure and land uses around the routes, so as to enables walking from stop to reach the destination within a maximum time of 8 to 10 minutes (about 500m). To make the public transit system attractive to the passengers, proper design of public transport vehicles, terminals and bus stops is necessary.

It would be naive to think that public transport can act as an alternative to private motorised vehicles. Even in cities with reasonably good and subsidised public transport, private motorised transport remains popular as it provides door to door, just in time, quick, convenient and safer travel. Private motor vehicles as compared to public transport, are being increasingly used for longer trip lengths as the users try to balance between the fuel price and time gain. It is necessary to consider how private motorised transport can link up with public transport and non-motorised transport. Cars have been commonly used on pool basis to ferry school children. Taking hint from this, car sharing by office goers is catching up in large cities. The Government of Delhi (Transport Department) has recently started a ‘mega car pool scheme’ that facilitates sharing a car ride which can be requisitioned on mobile phone on credit/exchange basis from a car registered under the scheme.

The benefits and costs of public transport planning and investment are often uneven and gender insensitive, resulting in policies and investments inappropriate to the differentiated needs of women and children. Public transport system is one of the areas which have bearing on women in terms of treatment in buses and on bus stops, besides their accessibility and mobility. Deprivation in terms of access to affordable transport is accentuated by gender and age. In cities where privacy and modesty have special significance for women they face an additional challenge. Eve teasing and pushing women in crowded public transport are common in many cities. Keeping in view that as per surveys about 43% of women commuters in Delhi face sexual harassment while using public transport, Delhi metro has reserved a coach for women passengers, besides installing CCTV and deploying women marshals.

Sustainability Issues

In the major Indian cities motorised urban transport on an average contributes more than half of air pollution, mainly by use of fossil fuels. Motorization has contributed to an increase in transportation energy intensity and consumption of fossil fuels. The impacts of oil-based transport energy on the natural environment (energy and mineral extraction and use, hydrological cycle and water quality effects, consumption of agricultural land and natural habitats through urban sprawl, air pollution, etc.) and the built environment (noise, pollution, traffic accidents, community severance) are significant. The impact of climate change on urban transport is severe in terms of infrastructure damage, cost of delays and lost trips, especially in Indian cities where transport infrastructure is often poor and is inadequately maintained.

In India fast pace of production, mobility and consumption are enhancing carbon emissions and climate change. Models predict an average increase in temperature of 2.3 to 4.8°c in India for the benchmark doubling of carbon dioxide scenario within next 20 years. Per capita emissions in India vary from 0.82 mt (Bangalore) to 2.80 mt (Patna), and overall average is pegged at 1.2 mt per year.

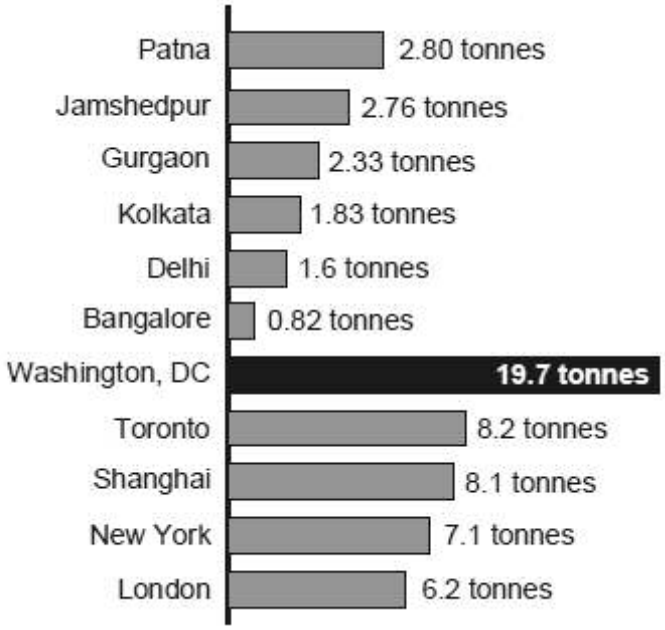


Fig 1.3: Per capita GHG/Carbon emissions in selected cities in India as compared to some cities across the world (2007-08)

Source : UNFCCC, WRI. 2009

Emissions vary widely as per the mode, which is as high as 4.5 mt per capita for those using private motorised transport, which are predicted to double within next 10 years, if private motorised travel continues to grow at present pace of 8 to 10 per cent per year if mitigation measures are not initiated. Studies show that to transport one ton of cargo per kilometer, road transportation needs 4 to 5 times the energy that is needed by a train. The energy used by a car to carry a passenger over one kilometer is 3 to 4 times that of a bus.

Critical environmental parameters and greenhouse gas emissions with respect to sustainability of different modes of urban transport (Tables 1.3 and 1.4) show that broadly per passenger the emission of public transport (bus, rail and trams) is about one-twelfth of car. Although NMTs (including walking) are ideal from emissions point of view, in terms of kilometre travel, these cover only 1 to 2 per cent of the total VKT, even if the proportion of trips are as high as 40 to 50 per cent, as in Delhi and other megacities.

Table1.3: Environmental Sustainability of Different Modes of Transport

	Air Pollution	*Noise*	*Ugliness*	*Unsafe*
Walking	5	5	5	3
Cycling	5	5	4	2
Car	1	2	2	2
Tram	5	3	3	3
Light Rail (LR) Surface	5	3	3	4
Rapid Rail (RR) Surface	5	2	2	4
Rapil Rail (RR), Elevated	5	1-2	2	5
Rapid Ral, Tube	5	5	5	5
Bus, Mixed Traffice	1-2	3	4	3
Bus, Reserved Lane	3	3	4	3

Legend: 1 = very bad, 2 = bad, 3 = average, 4 = good, 5 = very good

Source: Vuchic, R.V (1981)

Table1.4: Typical greenhouse gas emissions

Activity	*Metric Tonnes (mt) per capita per year*
Bus, Rail, Trams	0.1
Car	1.2
Air Travel	1.8
Other direct Emissions	0.6

Source: Goodall, Christ, (2007) How to Live a Low Carbon Life, Earthscan, London

The Central Pollution Control Board (CPCB) data indicates that more than half of India's 5000 odd cities have critical levels of pollution, largely due to transport emissions. (Fig. 1.5). Fig 1.6 depicts the co-relation between particulate matter and carbon dioxide emissions. Some of these are higher for larger cities, mainly due to increased travel, although part of these may be a result of other sources such as, industry, thermal power plant and distant sources in the region.

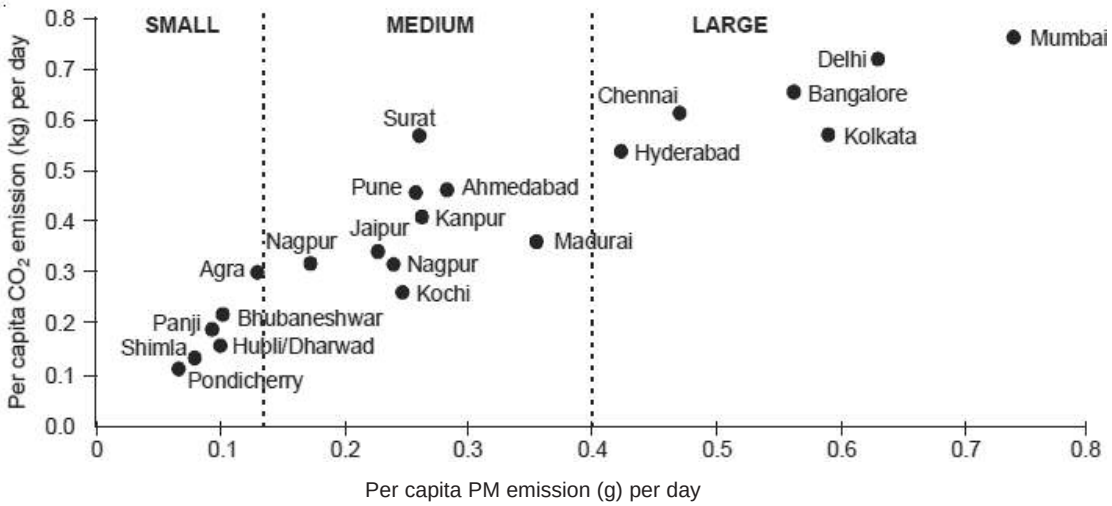


Fig 1.4: Levels of Pollution in Indian Cities More than half of cities have critical pollution levels

Source : Computed from data of Central Pollution Control Board, India (2008)

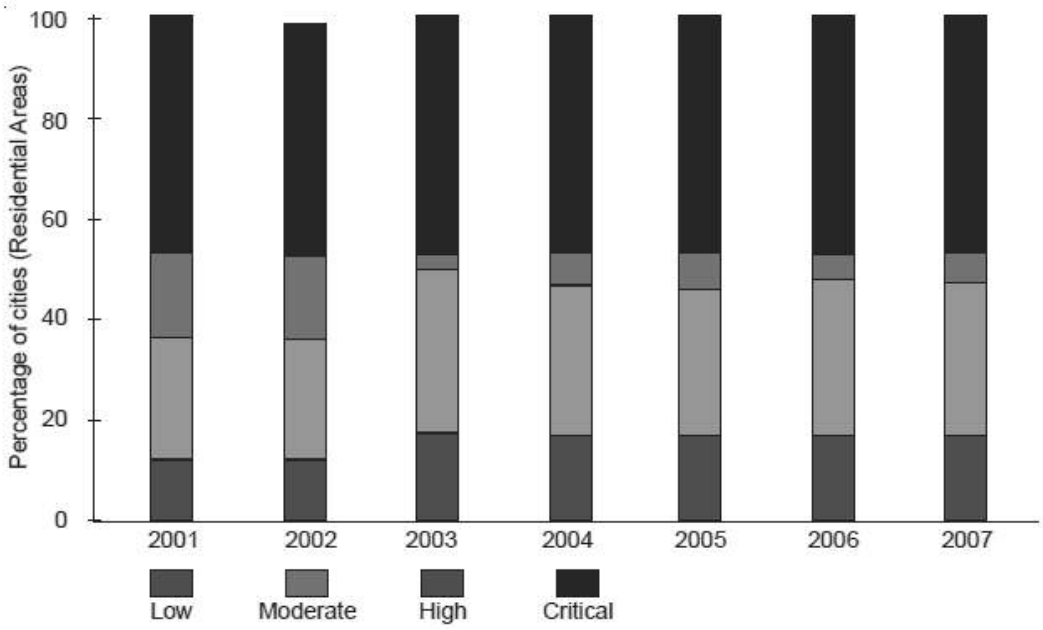


Fig 1.5 : CO_2 and Particulate matter (PM) emissions in Indian Cities.
Indian cities show strong correlation between CO_2 and Particulate matter (PM) emissions both of which increase proportionately with the city size

Source: CAI Asia, & CPCB, 2008

Various policy initiatives have been taken by governments to deal with the environmental sustainability of transport. These mainly cover (*i*) improving the environmental efficiency of

vehicles, such as engine/performance, (*ii*) fuel type and quality, introducing low pollution fuels, (*iii*) improving emissions and environmental regulations, (*iv*) improving the quality of road infrastructure and public transport. In Mumbai, Delhi and other cities in India, air quality improvement efforts include adopting CNG, LPG and other cleaner fuels, improving engine standards for fuel efficiency and standards, vehicle and road maintenance, strengthening of public transport (BRT, Metro, etc.), mandatory replacement of two stroke engine, vehicle pollution checks and traffic reforms.

Recent empirical data, however indicates that pollution loads in Delhi are reducing, largely due to vehicular technology in term of emission norms (such as BS II and BS III norms), and by use of CNG and LPG. The pollution loads in Delhi, as compared to 2002 significantly reduced in 2009, by 37 per cent for CO (264.55 tons per day), 31 per cent for HC (127.54 T/day), 25 per cent for NOX (82.53 tons per day) and PM by 23 per cent (9.81 t/day) However, gains tend to be nullified by increasing volume of vehicles and idling due to congestion on roads. Besides engine norms and fuel policy, it is necessary to reduce the Vehicle Kilometer Travel (VKT) and trip length by travel demand management, land use and transport synergy, car pooling and integrating public-private modes of urban transport. Besides emissions, environmental footprints of private motor vehicle also include the amount of resources (including embedded energy) used in their production, amount of waste produced by its disposal, and continued use of fossil fuels. Electric car is being promoted through the government subsidies, however, the production of thermal energy is still a large producer of carbon emissions.

Besides emphasis on the transportation hardware such as roads, grade separators, fuels, engine efficiency and reduction of energy use, it is also necessary to focus upon the software of transport, such as promoting walkability, mixed land use, higher density, compact and smart growth, which reduce the demand to travel. The popular solutions like widening of roads, construction of flyovers/grade separators and mega transport terminals often prove to be short term and sometimes even worsen the situation.

Integrity between transport and urban planning, along with transport demand management, transportation mode and technology choice are crucial factors in transport sustainability. It implies a change in perspective as public transport and NMTs are usually seen as the mode for the not so well off section of the community, who cannot afford to own/use personal transport. To change this perception the public transport and NMTs have to be reinvented. In Agra state of art designer rickshaws made them prestigious for the users besides being more efficient, less polluting and more comfortable. Car and taxi pooling, dedicated buses/metro and train coaches for women and students and such other measures can be of direct benefit to vulnerable users of urban transport. Apart from aspects like reliability, frequency, inter-modal integration and single ticketing systems, the quality of public transport would need to be significantly upgraded, inter-alia, keeping in view the elements of clean and non-carbon (green) fuels and traffic calming. This way a reduction in use of fossil fuels and resulting pollution control is linked with public transport sustainability, efficiency and performance. Some cities in India (Indore, Ahmadabad, Delhi, etc.) have recently adopted Clean Development Mechanism (CDM) protocols, performance standards and IT based traffic management and passenger information systems for public transport, which can be evaluated and adapted more widely.

Non-motorised and Informal Transport

In Indian cities about 40 types of vehicles ply on the roads, and about half of them are NMTs and informal modes, which are dominant transport modes of poor. The non-motorised

transport (NMTs) are low investment, economical, non-polluting, need minimal space and no fuels. People have developed and retrofitted indigenous models of cycle and rickshaw for vending, transporting school children, goods, garbage and to provide many day to day services. As such, in spite of frequent strikes, non-availability of diesel/petrol and traffic jams, the city continues to function. For most of the users the NMTs are the means of lifecycle and livelihood, which provide cheap mobility being independent of fossil fuel. Almost every city is regularly served by a variety of NMTs, such as bicycle, thela, tricycle and carts which provide doorstep services and goods like fruits and vegetables, bread and biscuit, incense, flowers, balloons, toys, ice-cream, food, savouries, newspaper and magazines, knife sharpening, stove repair, utensil repair and polishing, readymade clothes, knick-knack items, presswala (ironing clothes), etc. Hawkers using NMTs are the eyes on the streets and their presence results in reduction in crimes. Most of NMT trips are for short distances (0.5 to 3 km) or last mile/feeder trips. In terms of vehicle kilometre travelled, though there are no comprehensive surveys, it is estimated that although in Delhi non-motorised transport covered 42 % of trips (of a total of 15 million trips in 2008), these covered only 6.3 million km per day , as compared to 166.7 million VKT by vehicular modes.

Varying from 17 to 60 per cent, people in South Asian cities use various modes of non-motorised transport (Table1.5):

Table1.5 : Modal Split in Some South Asian Cities

Cities	*Total Trips*		
	Private Transport (%)	*Public Transport (%)*	*Non-motorized Transport (%)*
Lahore	24	16	60
Karachi	27	23	50
Delhi	18	40	42
Mumbai	18	60	22
Kolkata	5	78	17

Note: Above table does not categorise separately informal motorized transport, which presumably is included under private and public transport.

Sources: Traffic Engineering and Transport Planning Agency (TEPA) and Japan International Cooperation Agency (JICA), 1992 (Lahore); Malik 2004 (Karachi); World Bank 2002 (other Indian cities).

In effort to faster movement of traffic, many cities are abandoning or banning the use of manual, animal driven carts and tricycles in favour of standard motorised passenger and goods transport. With tremendous competition for space and speed, cyclist and pedestrians are losing out. Public finance is hardly earmarked for NMTs and for dedicated facilities and infrastructure for them. Although NMTs as the feeder service sustain and compliment the public transport system, these are seldom integrated with it. The media regularly reports on the achievements of automobile industry (cars and two wheelers), BRT, MRT, etc., with no coverage on hard work being done in the urban backyard by the NMTs.

The informal transport and NMTs provide much?needed mobility and informal services, jobs or vending options to the poor whose livelihoods depend upon reaching early to procure jobs, markets or the customers. Women make up the majority of the users of informal trans-

port, such as mini bus, vans, three wheelers etc. which also connect the peri-urban and congested neighbourhoods that are inaccessible or remain unserved by buses. In India and some other countries motorised tri-cycles are being extensively used for hauling of small loads, which require frequent stops urban deliveries. As compared to small truck, the rickshaw trailers are substantially cheaper, which by multiple trips could deliver as much as a 5-ton truck in a day. Courier services, perishables, such as milk, vegetables, fruits, groceries and other short-haul deliveries are increasingly being made by autorickshaw, van or tricycle, where public authorities do not allow trucks/public carriers during day time and also during frequent VVIP visits, processions, ceremonies, etc. During the XIX Commonwealth Games (October 2010) in Delhi, the movement of trucks was almost banned for three weeks and the people were wondering whether they will get their daily supplies of fresh fruits and vegetables, milk, bread, vegetables, newspaper, laundry, grocery, soft drinks, water, etc. It was a mystery that in spite of almost no trucks, the supplies were almost normal. Credit goes mainly to informal goods transport- that is motorised three wheelers, trailers, etc. which regularly delivered bulk of the daily supplies of fruits and vegetables (3600 mt) and many other items of daily consumption. The informal carriers and goods services have developed their own informal indigenous logistics. They often work on the principle of relay race and area-wide trip chains link various transport nodes-railway stations, bus terminals, truck terminals, wholesale markets of grains, fruits and vegetables, etc., milk production centres with the retail markets, street vendors and consumers. Informal transport services tend to bridge the void left by formal public transport operators and satisfy escalating demands for transport and goods movement. Although competitive and affordable, low fares preclude service improvements. Informal transport provides employment for hundreds of thousands of unskilled, young men, estimated at about 15 percent of total employment in transport sector. In Dhaka, Bangladesh the figure is close to 30 percent.

Goods Transport

Besides the movement of people, transportation involves the transfer of the goods from one location to another. The delivery and collection of the goods is necessary component of urban living, and the economic and social sustainability of an urban area is dependent on an effective, efficient, affordable and safe transport of the goods. Historically many cities in the Indian sub-continent grew up as market towns (Mandi) for transfer of agricultural produce of rural areas or as distribution centre for industrial production, exports and imports. Almost every city has specific for wholesale areas markets of fruits and vegetables, grains, edible oils, sugar and spices, fodder, cotton, etc., which are usually found along the highways or adjacent to transport node (railway station, bus terminal, etc.). However, with the passage of time, population growth and congestion, most of the wholesale markets and warehousing areas in inner city have become non-conforming and are unable to cater to the increasing demands of parking, traffic and related infrastructure. The effects of globalisation, industrialisation and consumerism are visible and cities are emerging as the new centres of transfer of goods. This is manifested by emerging variety of goods transport-air, container, railways, trucks, pickup vans, trailers, maritime, ropeways, pipelines, etc., co-existing with non-motorised thela, rehri, cycle rickshaw, head loading, animal powered cart, etc. Surveys in Delhi reveal that for every truck, there are about 5 feeder informal motorised goods vehicles, 5 non-motorised vehicles and 5 to 10 head-loaders. As such goods transport is a major generator of business and employment and helps in achieving the goal of poverty alleviation. Deficient logistics and poor goods transport can be major drag on the economy and social change.

The ecological implications of fossil fuel and road based freight industry, need to be re-

viewed and alternatives such as rail based goods transport, non-polluting NMTs, ropeways, pipelines and maritime transport. While India has 12 major ports, 140 minor ports, 14,500 km of navigable rivers and canals, the inland water transport potential is grossly underutilised, largely due to lack of interconnected logistics, infrastructure facilities, markets and feeder transport system. Civil aviation is another sector which offers several benefits for cargo movement in terms of time and logistics. It needs supporting facilities like warehousing, markets and feeder services. It is also important to factor in the issues of health and safety of transport workers, environmental justice and safe disposal of toxic wastes, for which closing the loop and recycling need to be adopted.

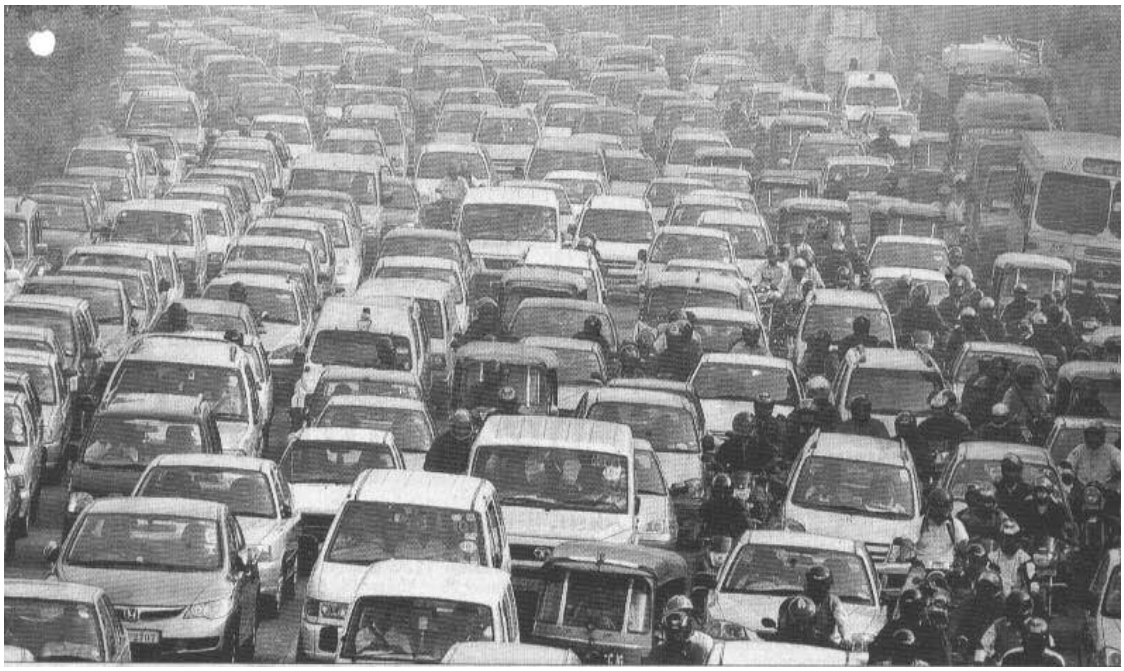


Fig. 1.6 Traffic jams are a common sight in large cities, like New Delhi.

Accessibility Barriers and Critical Issues

The Indian cities suffer from various barriers of accessibility and mobility:

Infrastructure Supply : Infrastructure is often in poor supply and repair.

- Urban roads, parking, sidewalks and paths are often congested and crowded.
- Streets and sidewalks serve many functions and users (walking, talking, retail businesses, sleeping, begging, etc.)
- Streets not well designed for heavy motor vehicle traffic

Vehicle Supply: Low automobile ownership among general population.

- Medium to high automobile ownership among middle-income and wealthy households.
- High bicycle ownership in some regions.
- Medium to high supply of public transit and taxi vehicles.

Personal Mobility: Large variations in mobility between different income groups:

- Low mobility among the general population and high mobility among wealthier groups.

Transportation Diversity: Considerable diversity (walking, cycling, animal carts, public transit, private automobile).

- Conditions of alternative modes, such as walking, cycling and public transit are often inferior (slow, uncomfortable, unsafe and unconnected).

Institutional Capacity: Many cities have poor civil institutions to plan, implement and enforce traffic improvement. Sometimes poor cooperation exists between different levels of government. Most decision- makers are relatively wealthy using personal car and tend to favour automobile-oriented improvements. Many Indian cities are either slow to move or rely on least-resistance actions to provide temporary relief. This is characterized by the enthusiastic buildings of flyovers suggesting that neither urban development nor transport institutions are up to the daunting challenges cities face, in terms of staffing, funds, concepts or instruments associated with the urbanization and motorization before them.

Policy Response

At the national level, the Government of India has adopted National Urban Transport Policy (2006). It has set up of an urban infrastructure development fund and National Transport Revolving Fund. Under the JNNURM public transport is a major component of urban renewal. The Expert Group on Commercialization of Infrastructure Policy Reforms underline the need for greater commercialization of urban transport infrastructure along with the promotion of public-private partnerships. The National Urban Transport Policy (NUTP) aims to promote sustainable public transport by giving financial assistance to all state capitals and cities with a population of more than one million for high capacity public transport systems through the Special Purpose Vehicle (SPV) mechanism:

- By providing 50% of the cost of preparing city transport plans and detailed projects.
- Viability Gap Funding to the extent of 30% of the total capital cost
- By offering 50% of project capital cost whenever projects are to be financed through PPP.

The Government has proposed Rs.50,000 million National Transport Revolving Fund (NTRF) for the Metro Rail Transit Systems (MRTS) in various metro cities in India for attracting private investors. Funds are also earmarked for sustainable public transport, which support appropriate fare regulation, pricing control and modal shift from private transport.

Under the NUTP financed public transport schemes, Indore, Ahmedabad, Bangalore, Rajkot, Nashik, Surat, Delhi and some other cities have developed PPP models to operate urban bus services. These are accompanied by several financial and institutional reforms, corporate initiatives and differentiated public transport services. The subsidies in the form of use of public transport infrastructure, tax concessions, etc. have brought forward the private sector in urban public transport.

The mass of the urban poor people in Indian cities (estimated to be approximately 50-60 per cent of population) calls for a much more balanced approach the hitherto attempted. Enthusiasm for investing in large-scale roads and public transport systems is in sharp contrast to the poor level of basic amenities for pedestrian and bicycles, on-street public transport services, and generally a low traffic management effort. Instead of accommodating the narrow interests of

sub-sectors and their institutions, the consolidation of decision making with a composite framework would help to address the critical urban transport issues, as given below, in a long range perspective:

Government costs: Limited funds for transportation infrastructure and services.

Consumer costs: Many households spend a large portion of income on transport.

Traffic safety: High casualties per motor vehicle.

• High risk to vulnerable road users (pedestrians, cyclists, animal carts, etc.).

Comfort: Low comfort levels for non-motorised travel (walking, cycling, animal carts, etc.).

- Low comfort levels for most public transit.
- Medium to high comfort for private automobile and taxi travel.

Environment: High pollution concentration in urban areas.

- Pavement of green space (farmlands and wildlife habitat) in some areas.

Land Use: Medium to high accessibility of urban core area , where many destinations can be reached by walking, cycling and public transit.

- Poor and declining accessibility in most suburbs and new communities.
- In some areas limited land available for new transportation infrastructure.

Economic development: High dependence on imported transportation goods (vehicles, parts and fuel) is often leading to subsidies and deficit financing.

To cope up with increasing volume of traffic, the urban areas require proper road networks. New roads attract more traffic and reduce the viability of public transport and the benefits are offset by growing congestion. As such the question remains how to reduce traffic congestion, minimise its adverse effects on the environment or public health, and to generate additional revenue to improve public transport. The impacts of resulting urban congestion include:

- loss of time, and increased vehicle operating costs,
- more pollution than would be the case with smoothly flowing traffic,
- significant negative impacts on the viability of more efficient modes of public transport, walking, and cycling,
- dispersal of journeys to outlying city areas increasing thereby VKT /trip length.

There are tremendous challenges and opportunities for institutional reorganization, capacity building and streamlining of the procedures, including review of overall mandates, roles, and functions of existing institutions. A visible priority is the establishment of a citywide unified urban transport agency, which also recognises and promotes the NMTs and non- transport (walking, e-governance, etc). A major task of unified transport agency is to promote a more professional approach to transport planning. Other vital areas which need to be strengthened are streamlining of PPP procedures, updating legal framework, driving license and safety procedures, working out norms and standard operating procedures. Participation of citizen groups, transport cooperatives, media, education and training institutions in urban transport policy, plans and practices need to be institutionalised for public oriented priorities and services. Social

audit, disclosure policy and accounting procedures are effective tools to achieve better value of public funds. The process of social audit of urban transport projects will ensure creation of an equitable gender sensitive, accessible urban transport environment. Efficiency gains would accrue from consistent policies that address to overall economic and social concerns (such as safety and gender/women's dignity in public transport), role of NMTs, traffic calming, etc. A unified framework of strategic functions can be developed according to geographic and sectoral division of work (Table 1.6).

Table1.6: Allocation of Strategic Functions

Strategy level	Function	Agency	Comments
"For the city"	National roads Public enterprises, Tax levels intergovernmental transfer, Regulation and competition policy Vehicle registration and safety	Ministry of Construction Ministry of Economy Treasury, Ministry of Transport/ Urban development, etc.	Private sector construction, sometimes municipal. May be function of a quasi-independent commission
"Of the city"	Urban structure planning, Strategic transport planning, Local road management, Public transport planning and procurement, Traffic management, Law enforcement, Road safety	Planning department, Transport department, Roads department, Public transport agency, Traffic Department, Police Department, Interdeparmental unit.	Direct responsibility of mayor, sometimes national, state government
"In the city"	Public transport operations, Road construction and maintenance, Local facility consultation	Private companies, NGOs and individuals, franchised or contracted	Sometimes under SPV and Regulatory authority

Note : NGO - Non-Government Organisation
Source : Adapted from World Bank (2002), Cities on the Move.

The experience indicates that involvement of the private sector in urban public transport in bringing in additional resources had been fraught with several problems, such as high costs, low profits and long gestation periods. Therefore to attract the private sector, the governments participate in their equity and provide certain concessions/ benefits such as provision of interest free/low interest subordinate debt, tax holiday, incentives for property development, sharing of advertisement income, etc. In order to obviate the high cost of land acquisition for widening of urban roads, the tool of using land for commercial activities (such as hotel, offices, shopping, etc.) and enhanced Floor Space Index (FSI), also known as Floor Area Ratio (FAR), have been used. In Hyderabad, a massive road widening programme has been taken up, whereby the land owners are incentivised to surrender their lands for road widening free of cost, against the benefits of relaxation of zoning and building rules and allocation of extra Floor Space Index (FSI) against the surrendered land. Hyderabad Municipal Corporation rebuilds the demolished compound walls and structures affected due to land surrender or pays compensation. If there is

no scope for going vertical, the land owner has a choice to avail Transferable Development Rights for using the FSI elsewhere or sell it. Wherever necessary, non-residential use (commercial/institutional) is permitted to induce landowners to part with their portion of land.

New Mumbai has experimented with selling air-rights to private sector over railway terminals for part financing of the development of transport nodes. Other methods which have been adopted for making urban transport projects financially viable include land bundling, betterment charges, generating international funding, issue of bonds for mass transport projects, excess condemnation for construction of highways/public transport corridors/terminals; passenger/vehicle tax; leasing of urban road, etc. An innovative method which has been adopted in Delhi is by diversion of the part of the excise duty levied on the hard liquor, and levy on petrol and diesel for financing of urban transport projects. The Delhi Tourism and Transport Development Corporation, Delhi State Industrial and Infrastructure Development Corporation and Delhi Integrated Multi-modal Transport Services Ltd. have been constituted by Delhi Government as self-financing special purpose vehicles, who invest in urban transport infrastructure, mainly by combining resources through levies, excise duty, Centre and State Government plan funds and by way of PPP. The experience indicates that property/land development can offset only a part of the capita investments of the large transport projects (like metro, terminals, railways, BRT, etc) and these still need budgetary support and soft loans from the Central/ State/Local governments. However, transport investments cannot be and should not be evaluated in segments, but as a part of the whole transport system. While doing so, it is important to keep in view that urban transport is a powerful tool for poverty reduction, social inclusion, gender equity and empowerment. When viewed in this perspective the focus and priorities shift from mega and high investment transport projects to smaller actions which are more relevant for the common man, like the provision of sidewalks (90% Indian roads do not have them), signage, road markings, drainage, better bus stops, public urinals, removal of roadside encroachments, and bringing the informal motorised transport and NMTs in the urban mainstream by improving the facilities, norms and micro-financing.

DELHI-HOW PEOPLE MOVE

- 40% of total road length in city has no sidewalks
- Even available sidewalks lack quality in terms of surface, width and geometrics
- 34% of city's population undertakes walk-only trips for daily commute. Only 14% Delhites drive cars
- 58% of the differently-abled found ramps difficult to negotiate
- 45% of the elderly found steps and ramps daunting
- 20% had trouble with uneven, narrow sidewalks
- Engineering guidelines for people with disabilities are not implemented.

Source : RITES Study, 2008 and

Components of Accessible City

Transportation planning, policy and engineering too often focus on ways to improve the transport system to increase vehicles volumes and speeds. That is, the emphasis of transport investments is on moving more vehicles, more quickly. This produces the car-dominated cities. By focusing on vehicles, mobility planning puts vehicles in conflict with non-motorised modes, while accessibility planning tends to create synergies.

The vital components of an accessible city are :

- City Structure. that supports walkability, cycling, public transport and sustainability.
- Public Transit system.
- Transport (Travel) Demand Management (TDM)
- Transit Oriented Development (TOD)

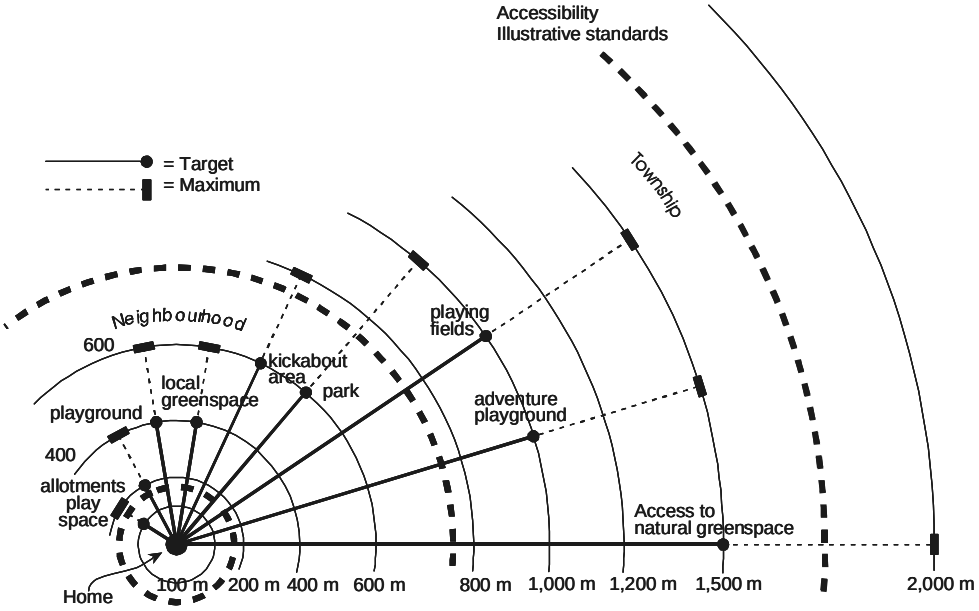


Fig.1.7: The urban hierarchy is worked out on modular basis and accessibility to various functions so that community, especially children, women and aged can walk to their places of education, recreation, shopping or work. As the distance increases, the public transport should provide access to the place of destination.

Sources: Barton H.etal. (2003). Shaping Neighbourhoods, Spon Press, London

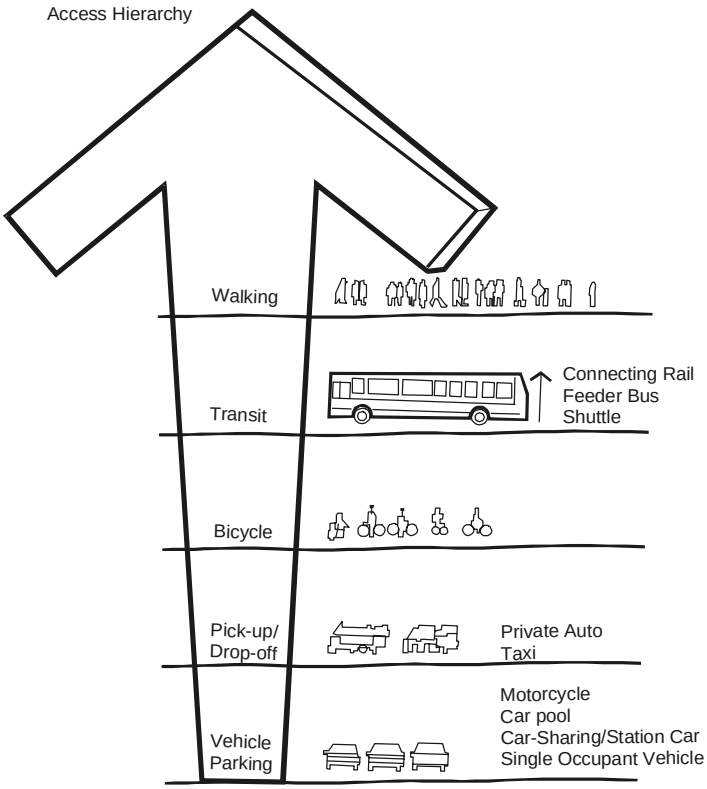


Fig. 1.8. Access is directly related with distance, time and mode of travel. As such the places of frequent visit should be located closest to the place of residence, aiming at a walkable, sustainable transit system.

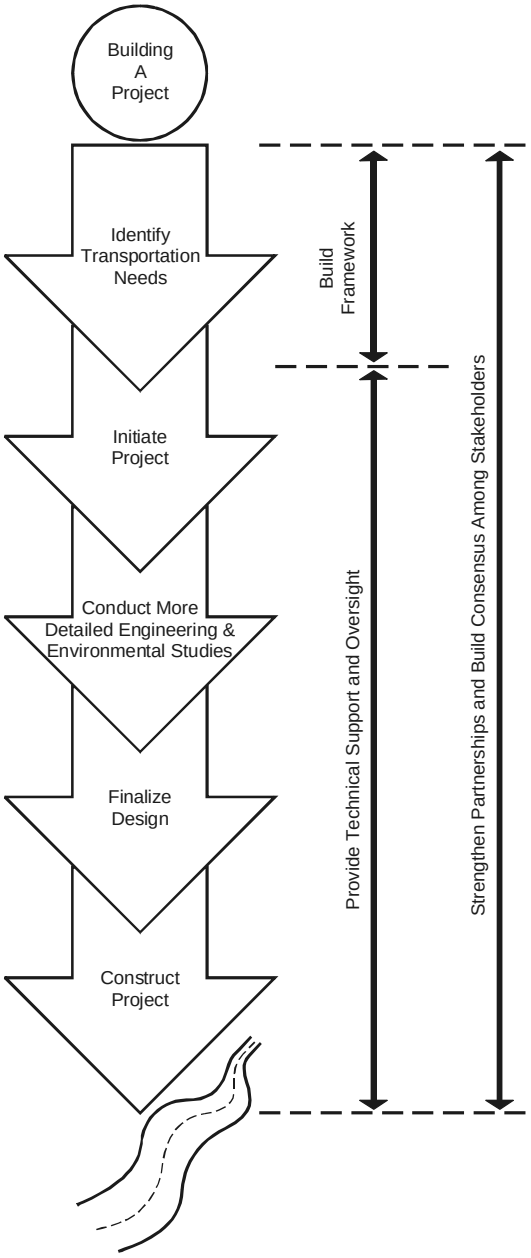


Fig. 1.9: Transport Planning Process

City Structure

Liveable neighbourhoods are compact, well-designed, sustainable communities designed to enhance local identity, provide diverse housing options, increases land use efficiency increase local employment and support alternative travel modes. Liveable neighbourhoods are defined by a convenient 5-minute (400 to 500 meter) walking, with a highly interconnected network of

streets and compatible mixed land use. Cul-de-sacs are less frequent, with paths that provide connections for walking and cycling. Where a site is of sufficient size, neighbourhoods are clustered together around a town center.

Major roads called neighbourhood connectors, form the spine of the neighbourhoods and towns, than the edges. Neighbourhood and town centres are located at the junctions of these streets. All streets, including arterials and neighbourhood connectors, have an important role in the urban structure by accommodating all modes to travel, including walking, cycling, public transit and driving, and by supporting active land uses. The emphasis is on connectivity, amenity and integration to achieve a safe, efficient and attractive road network. Streets are designed to comfortably accommodate non-vehicular users and support adjacent land uses, with generous footpaths and street trees. Buildings are located directly onto streets fronts (rather than set back, behind parking). On busier streets, passive and video surveillance of public spaces increases personal safety. Streets, service roads and lanes are used to provide with on-street parking.

New Urbanism and Land Use Reforms

New Urbanism (also called Smart Growth, New Community Design, Neo-traditional Design, Traditional Neighbourhood Development, Location Efficient Development and Transit Oriented Development) is a set of development practises to create more attractive, efficient and liveable communities. These can significantly improve accessibility and reduce per-capita automobile travel. Specific design features are listed below.

- The community has a discernible activity centre. This is often a plaza, square or green, and sometimes a busy or memorable intersection. A transit stop should be located at this centre.
- Special attention is paid to protecting the public realm and creating quality public spaces, including sidewalks and paths, parks, streetscapes and public buildings. This helps create more community identity and cohesion, leading to stronger and healthier communities.
- Buildings at the centre are placed close to the sidewalk and to each other, creating an urban sense of spatial definition. Buildings towards the edges are placed further away and further apart from each other, creating a more rural environment.
- Most dwellings are within a five-minute walk (400-500 m) from the transport node. Streets are designed for walking and cycling, with sidewalks on both sides, bike lanes where needed, good crossings, traffic calming features used to control motor vehicle traffic speeds, and other features to encourage non-motorized travel.
- There are a variety of dwelling types. These take the form of houses, row houses, and apartments, such that younger and older, singles and families, the poorer and the wealthier can find places to live.
- There are places to work within and adjacent to the neighbourhood, including shops, office buildings, and live-work units.
- There are shops sufficiently varied to meet common household needs, such as conveniences stores, a post office, a bank machine (ATM) and a gym.
- A small ancillary building should be permitted within the backyard of houses. It may be used as a rental apartment, or as a place to work.

- There should be a primary school close enough so that most children can walk from their dwelling. This distance should not be more than one kilometer.
- There are parks, trails and playgrounds near every dwelling. This distance should not be more than one kilometre.
- Networks of highly connected roads and paths provide multiple routes between destinations, increasing accessibility and reducing problems if one route is closed. Access points into neighbourhoods may be highlighted with a gateway or signs.
- Thoroughfares are relatively narrow and shaded by rows of trees that slow traffic and create an appropriate environment for pedestrian and bicyclist.
- Parking lots and garage doors rarely end of front the thoroughfares. Parking is relegated to the rear of the buildings and usually accessed by alleys or lanes.
- Certain prominent sites are reserved for public buildings. A building must be provided at the centre for neighbourhood meetings.
- The neighbourhood should be self-governing, deciding on matters of maintenance, security, and physical evolution.

The land use reforms can be implemented at various geographic scales. New Urbanism and Transit Oriented Development reflect neighbourhood and local level planning, while Access Management, Location-Efficient Development and Clustering reflect similar principles at the site and block level, and Smart Growth reflects these principles at the city level. New Urbanism has gained increasing attention among development professionals and the general public, particularly in regions experiencing growth-related conflicts. Many see the New Urbanism as a way to accommodate growth while enhancing community and environmental objectives.

New Urbanism does not exclude automobile travel, but it increases transportation options, emphasizes high quality transit services and stations, and sometimes gives priority to walking, cycling and transit. New Urbanism supports development of a more connected street network, often using a modified grid pattern. This provides multiple routes and more direct travel between destinations compared with a disconnected street network with many dead-end roads result in more circuitous routes, and funnel traffic onto a few roadways. Increased street connectivity has been showed to reduce per capita vehicle travel, and reduce traffic volumes on major roads. It also reduces risks for emergency access if a particular route is blocked.

Some designers suggest that streetscapes provide a sense of enclosure. As a general rule they recommend that urban street be no more than six times as wide across as the height of the buildings that line it, from the building front or row of trees on one side of the street to those on the other. Urban centres should be designed with amenities that are oriented to pedestrians, not just motorists.

How much difference do these factors make? If you live in highly automobile dependent neighbourhood, virtually every trip you make requires driving. If you live in a new urban neighbourhood you can conveniently go shopping and perform other personal by walking and cycling, and your children can walk to school and parks. Common destinations such as stores, schools, recreation centres and commercial center are closer together, so your car trips are shorter. The result is an increase in transportation option, and a reduction in total mileage and vehicle costs.

New Urbanism can give people better options for where they live and work. For example, many people want to “age in place”, rather than moving to a specialized retirement community.

For this to be possible their community must have accessible land use patterns, with shops and other public services nearby, and diverse transportation services for people with various needs and abilities, including good walking facilities that accommodate mobility aids and wheelchairs, and various types of transit services. Although many well-known projects are "master planned communities," meaning large urban-fringe developments as a unit, these concepts can also be incorporated into existing urban communities and even in communities that have highways with heavy traffic through their Commercial Center. Existing residential and commercial areas are incorporating New Urbanist design features as part of redevelopment efforts. For example, older neighborhoods can implement Traffic Calming and Pedestrian Improvements, Reallocate Road Space, Use Parking Management, Encourage Location Efficient Development, and work to Create A Design Identity.

Many current planning regulations and development practices are in conflict with Smart Growth Policy Reforms. For example, zoning codes often require more parking and wider streets than considered appropriate. Zoning codes also discourage commercial activities and secondary living units in residential areas, and require large setbacks for homes and businesses that reduce densities and land use mix. Another barrier is that the real estate industry is highly segmented by land use category (such as single-family housing, multi-family housing, retail, office and warehouse). Each category has its own practices, markets, trade associations, and financing sources, which requires a more integrated approach to development.

Although most individual design features have modest impacts on total travel, their effects are cumulative, resulting in significant total reductions in vehicle use. Residents in well-designed neighbourhood with good walkability, mixed land use, connected streets, and local services tend to drive 20-30% less than residents in automobile dependent areas, and even greater vehicle travel reduction may be possible if urbanism is coordinated with other TDM strategies, such as transit improvements, car sharing, road pricing, parking, management and commuter trip reduction programs. This can provide a variety of economic, social and environment benefits:

- More housing and commercial options for consumers.
- Increased property values.
- Improved transport and access for non-drivers, and support Universal Design.
- More affordable housing (location efficient development). It can reduce automobile dependency and use, providing consumer cost savings and reductions in automobile travel that provide social benefits (such as reduced traffic congestion, parking costs, accident risk, pollution and urban sprawl).
- It can significantly improve liveability, interaction and cohesion.
- Increased traffic safety due to narrower streets and slower traffic (Traffic Calming).
- Improved public health due to increased walking and cycling.

The dense, centralised urban form of rapidly developing and motorizing cities is generally well suited to public transport systems, despite the fact that many such settlements do not have good public transport systems to support their urban form. Kenworthy observes that such densities are typically associated with more mixed land use thereby making these environments more conductive to non-motorised movement, making the on-going threat to walking and cycling by increased motorization very problematic indeed. He also observes that many lower cities "have strong corridors of development where densities and mixed land use are

highest" and that these are ideal for public transport, despite the fact that most such settlements do not have dedicated public transport right-of-way (ROW) and the high quality public transport services needed to support them. This aggravates the already heavily traffic jammed corridors, substantiating the belief that the mismatch between urban form and transport infrastructure support is a root cause of the chaotic transport patterns in human settlements.

Design Standards to Improve Accessibility

Providing convenient connections is key to inclusive access. Connectivity can be increased during roadway and pathway planning, by adopting street connectivity standards or goals, by pedestrian connecting destinations, by using shorter streets and smaller blocks, and by applying Traffic Calming rather than traffic restrictions. Typical street connectivity standards or goals include the features listed below. Such standards must be flexible to accommodate specific conditions, such as geographic barriers.

- Encourage average intersection spacing for local streets to be 90 to 120 m.
- Limit maximum intersection spacing for local streets to be 200 m.
- Limit maximum intersection spacing for arterial streets to about 300 m.
- Limit maximum spacing between pedestrian/bicycle connections to about 100 m (that is, it creates mid-block paths and pedestrian shortcuts).
- Reduce street pavement widths to 8 to 12 m.
- Limit maximum block size to 5 Ha.
- Limit or discourage cul-de-sacs.
- Limit the maximum length of cul-de-sacs to 60 to 120 m.
- Limit or discourage gated communities and other restricted access roads.
- Require multiple access connections between a development and arterial streets.
- Require or create incentives for a minimum connectivity index.
- Specifically favour pedestrian and cycling connections.

Design of Junctions/Crossings

- Avoid right hand turning traffic by provision of U-turns and round about. Keep left hand turn free with sufficient width, that reduces accumulating of traffic and the junctions can to be controlled by traffic signals.
- A round about ensures uninterrupted flow of traffic through the main crossing.
- A raised pedestrian speed breaker, provided at the termination of all roads into the junction, ensures pedestrian and cyclist's safety and slow vehicular speed at the junction.
- The junction may be raised to match the level of the speed breaker to ensure slow traffic movement along the roundabout.
- At the junction side curves may be made to slope, assisting heavy vehicles such as trolley etc. to negotiate the bends comfortably.
- For arterial road a pedestrian island (median) and a divided channeliser ensure pedestrian safety in the middle of the road.
- Street lights to be provided at the junction, the median and the footpaths to ensure a

well lit junction, roads and walkways.

- Sculpture and landmarks assist in beautifying the junction and the orientation of road users.

All housing and mixed use developments should be within easy walking distance of good public transport services that give access to the main centres of urban activity. A common standard of railway/metro bus access is 500 m. Beyond that distance, the proportion of people willing to walk declines progressively and car dependence increases. The 500 m criterion needs to be applied with care. It is the distance people on average actually walk if routes are indirect the straight-line distance may be much less. Access is also influenced by gradients (especially for older people) and psychological barriers such as Foot Over bridges (FOB), subways or intimidation by road traffic. The redensification exercise is aimed at readjustment of the growth and to make it more efficient and viable.

Accessible City Structure

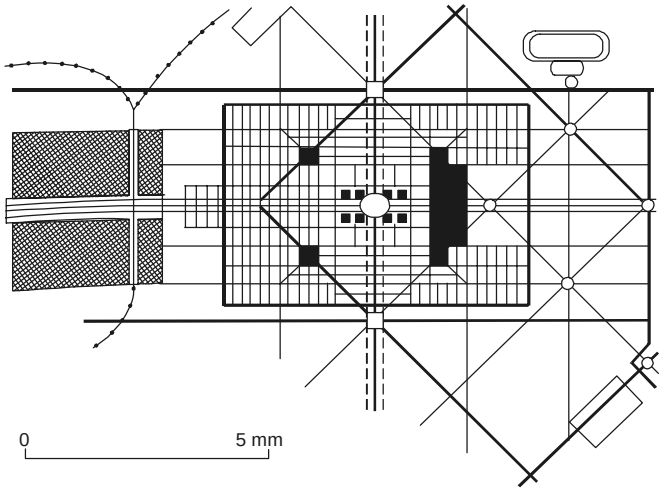


Fig. 1.10: Accessible City Structure: Plan by Le Corbusier (1933). The urban structure is derived on the basis of roads, railways and communication networks, which in turn determine the land use and intensity of development.

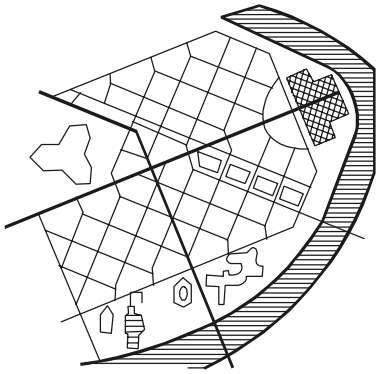


Fig. 1.11: A city needs at least 15 to 20 per cent of area under roads/transportation which should be based on the projected traffic growth for next 50 years.

Source : Boesiger, W.(Ed.) (1935/1999), Le Corbusier-Complete Works, Birkhauser Publishers, Basel.

Fig. 1.12: The growth of large cities had been usually concentric, leading to congestion in the central areas and numerous intersections. The development of the Ring Roads, imposing 'congestion charges', building flyover/grade separators provide only temporary relief to the perennial congestion. Often it is not possible to restructure the city completely, but mixed land use, compact and smart development controls, transit oriented development, car, pools, efficient public transport and taxies, improving road capacity and using Intelligent Transport Systems Management can provide solutions to the problems.

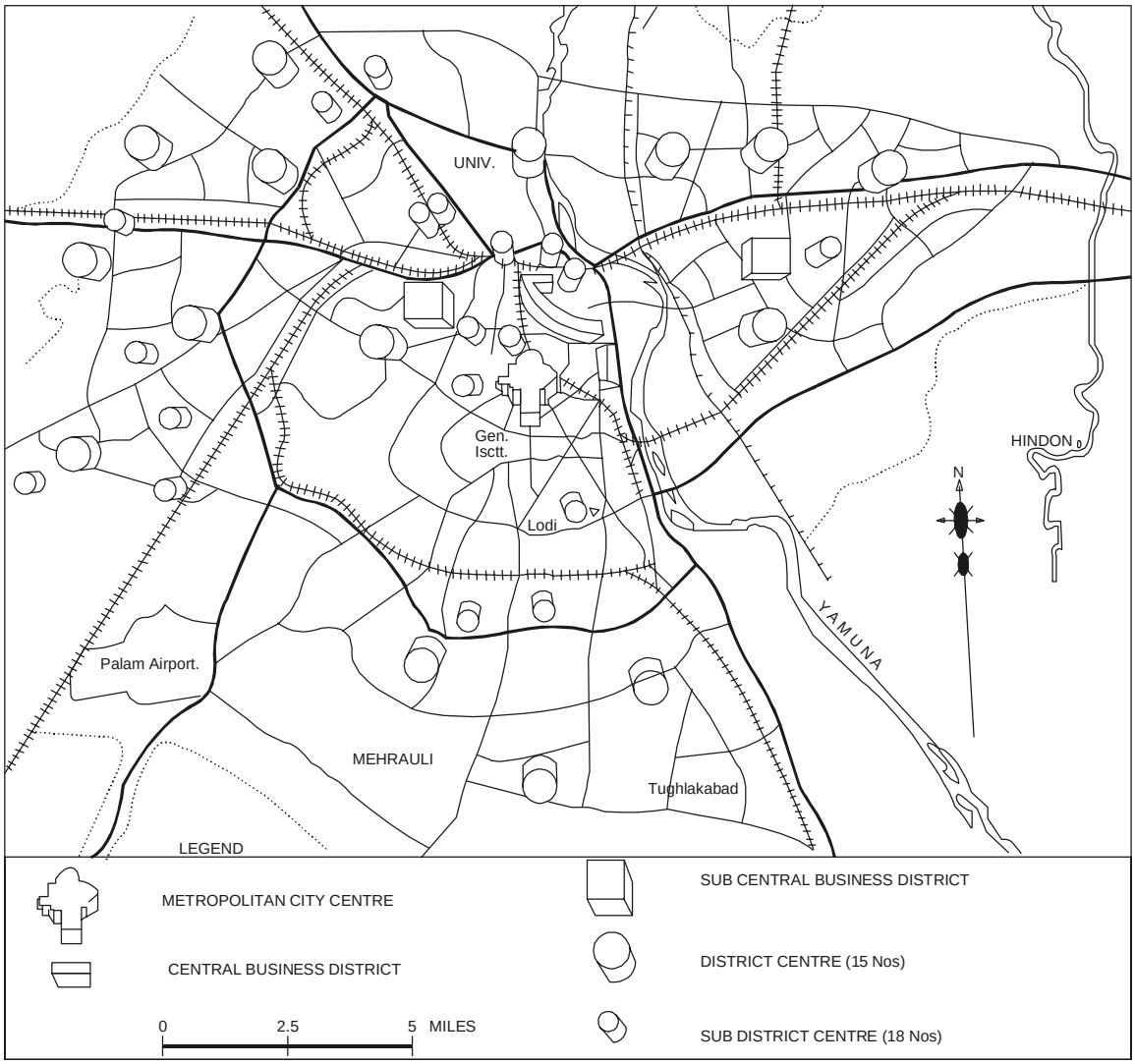
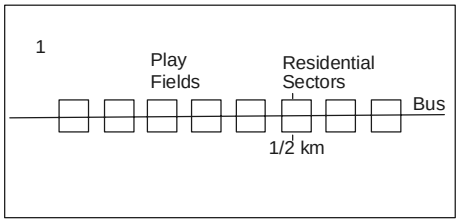


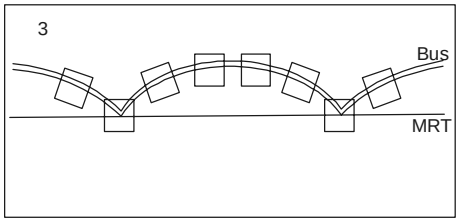
Fig. 1.13. The commercial centres in the Master Plan of Delhi are based on segregated land use by way of polynodal, polynuclear concept with a theoretical organisation of Districts, Communities and Neighbourhood. In actual practice this had been a cause of centrifugal, centripetal transport network with gridlocks all over.

Evolving New Bombay Plan on Rail Based Network

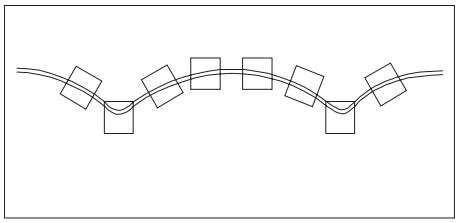


1. A series of sectors (some exclusively residential, others mixed residential-employment ares, depending on need) growing along a bus line (secondary MRT). The fact that the system is linear—as opposed to a grid—makes for a corridor of medium density demand and thus for an efficient bus system

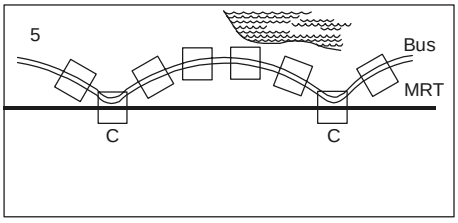
2. However, with the intensification of densities, the traffic grows and a primary MRT becomes necessary by acquiring developed load, knocking down buildings, etc. or reserving this land from the beginning. This is difficult because of squatters, and secondly, because it would leave no-man's land in the middle of the town.



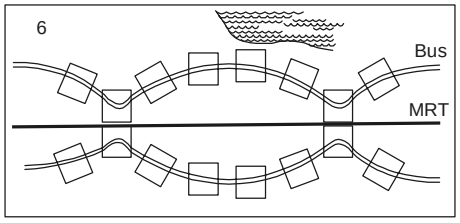
3. Why not reverse the pattern, *i.e.* start with a bus line which meanders; later on, when the train is installed, its alignment is direct. This pattern more clearly reflects the alignment constaints of the system



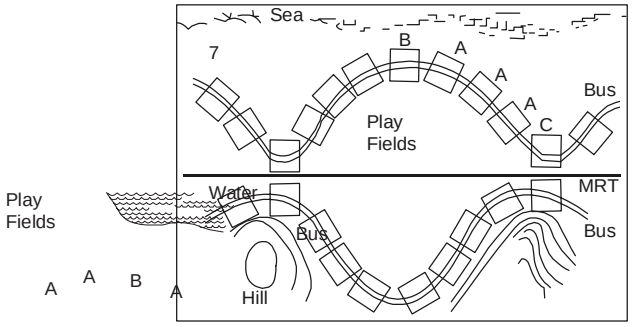
4. How the system grows. We start with a bus line (secondary MRT) generating a series of sectors of approximately equal importance. Let's call it type B.



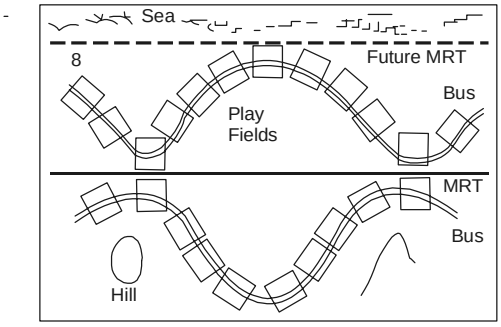
5. As the traffic grows and the primary MRT is installed, the interchanges generate additional activity, upgrading these particular sectors (type C)



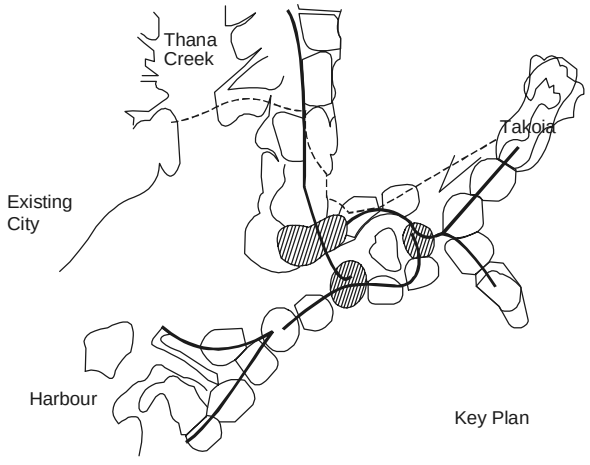
6. With time, a second bus line can be installed opening up a whole new section of the hinterland.



7. The system shown diagramatically on the new Bombay site (which runs between hills and water).



8. In future, in case densities and traffic grow beyond expectation, an additional primary MRT can be installed. This upgrades the importance of some type 'A' sectors (which now provide an opportunity for locating new social infrastructure and other facilities for additional population).



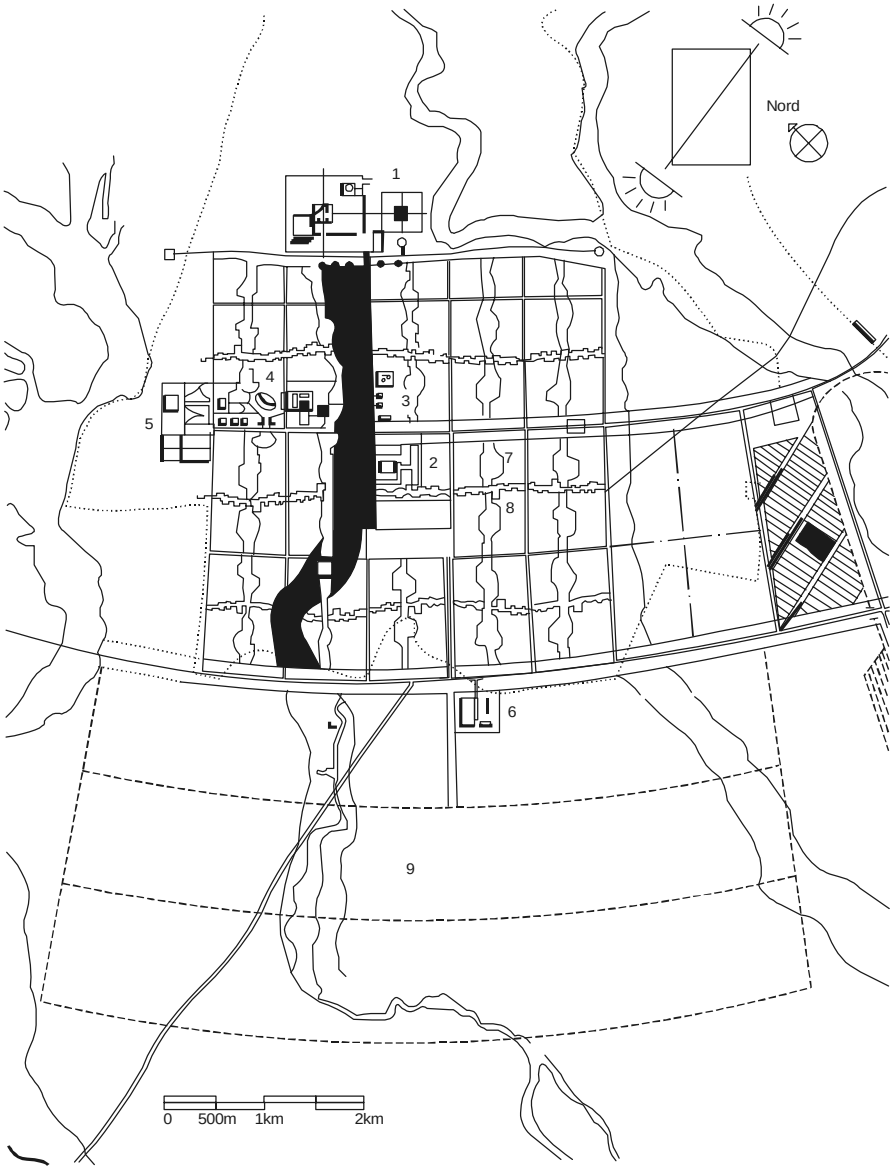
9. The basic structural plan for new Bomaby: three such linar spines arranged in a pin-wheel around the CBD. Each spine is hooked into the CBD at one end and into the regional transport network at the other, thus relating out CBD to the region around.

Transport Node cum-CBD

Fig. 1.14: The concept of New Bombay (Mumbai) developed by Charles Correa is based on 'beads in a string' pattern, the string being the MRT corridor tying up the nodes, that is, new cities in the region.

Source: Frampton, Kenneth (1996), Charles Correa, Perennial Press, Mumbai

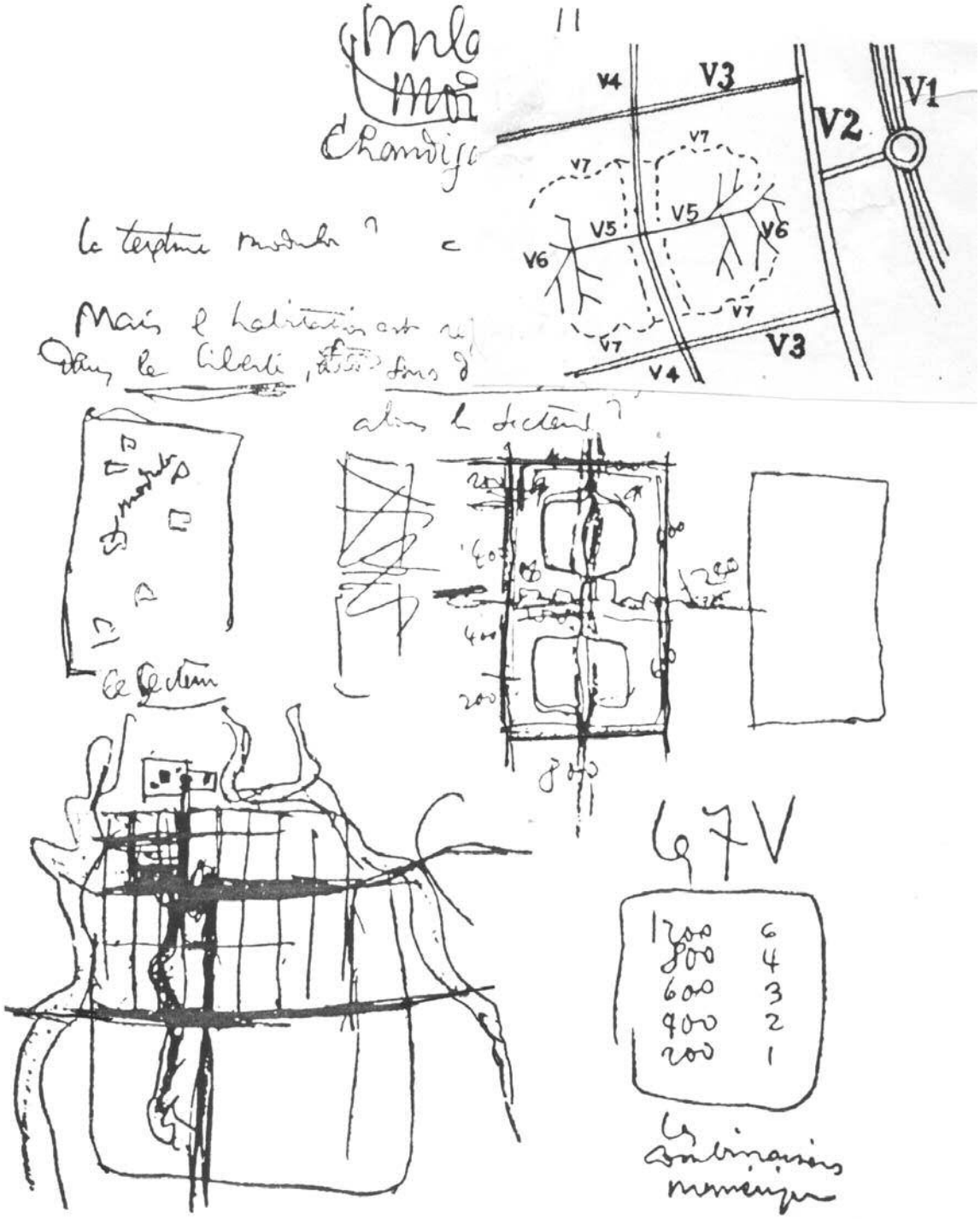
Le Corbusier: Master Plan for Chandigarh, 1951



1. Capital complex
2. Central business district
3. Hotels, restaurant and visitors centre
4. Museums and stadium
5. University
6. Wholesale market
7. Park bands extending through residential areas
8. Shopping street (V4)
9. Area for further expansion of the city for a population of 5,00,000

Fig. 1.15: The starting point of planning of Chandigarh was organisation of a transport network based on V-7 hierarchy of road network and sectors (800 × 1200 m) with an interconnected green corridor, cycle tracks and pathways.

Source : Boesiger, W. (Ed.) (1999) Le Corbusier - Complete Works, Birkhauser Publishers, Besel.



Source : Boesiger, W. (Ed.) (1999) Le Corbusier - Complete Works, Birkhauser Publishers, Besel.

Fig. 1.17: Studies by Le Corbusier in 1951 for Chandigarh showing the 7V system. Schematic design of a residential sector to be surrounded by streets carrying through traffic (V3) and bisected by a neighbourhood shopping street (V4 and V5). Loop roads would distribute local traffic, while a band of park land would extend through the sector providing sites for schools

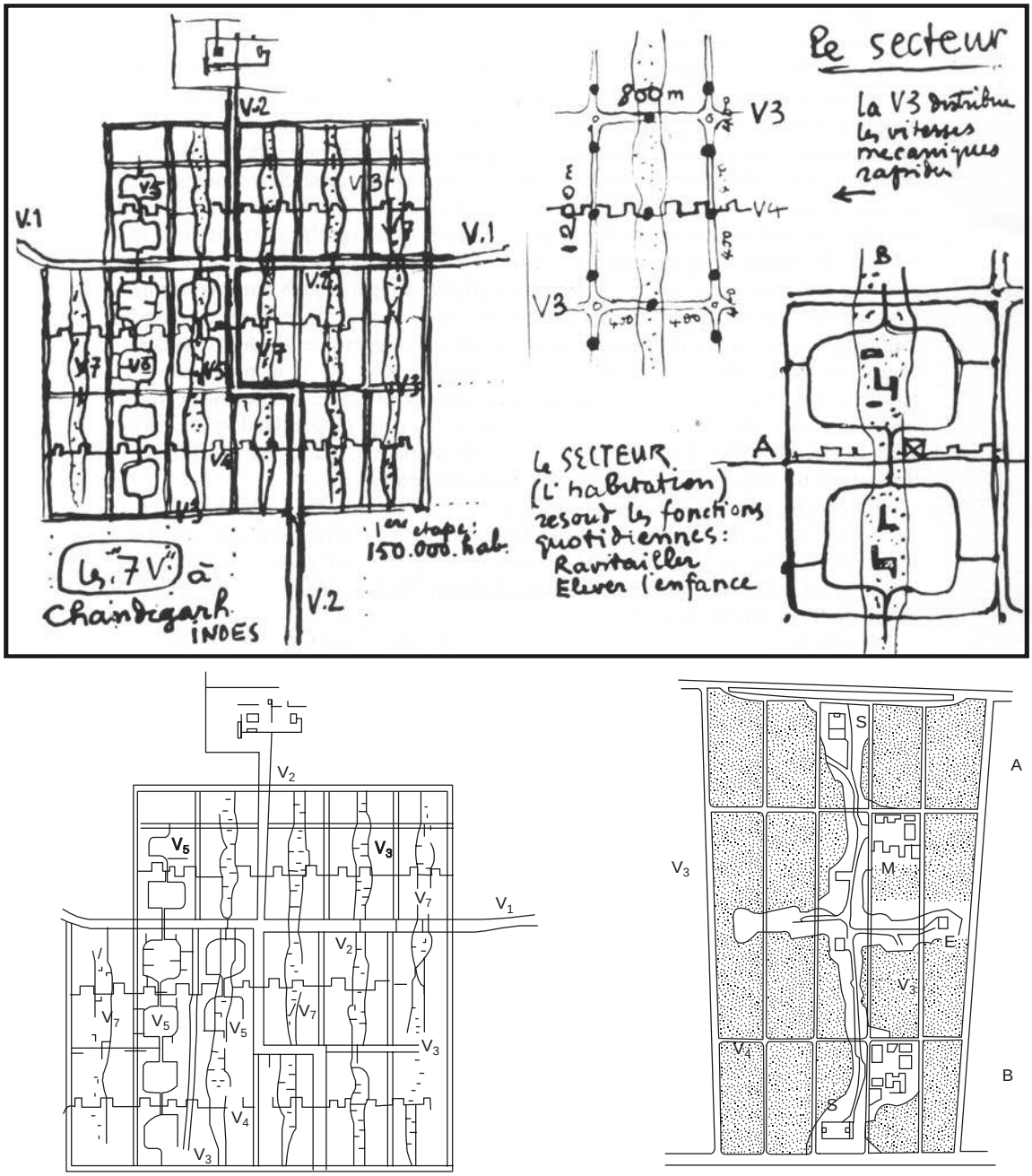


Fig. 1.18: Le Corbusier's road classification. V1 cross country: V2 branch to city: V3 sector divide: V4 sector connectors: V5 local spine: V6 to buildings: V7 pedestrians

Source : Boesiger, W. (Ed.) (1999) Le Corbusier - Complete Works, Birkhauser Publishers, Besel.

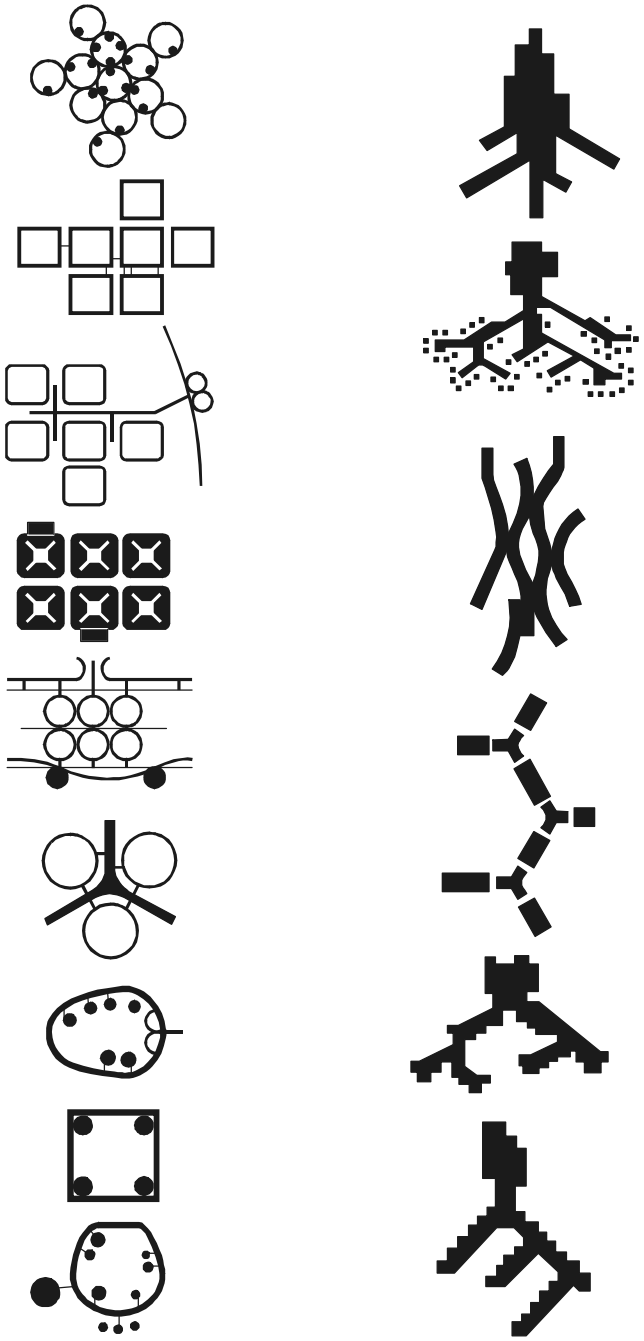


Fig 1.19: . Various forms of city structure can be developed for walkability, efficient public transport, as well as for organisation of community module, greens and social infrastructure. The basic principles of city structure for sustainable transport are (*i*) creating a walkable city, (*ii*) a smart and compact city, (*iii*) controlling urban sprawl (*iv*) promoting mixed land use (*v*) promoting public transport by travel demand management/transit oriented development and corridor planning. Usually arterial roads (60 m and above) should be spaced at 500 m, collector/sub arterial roads (30 to 60 m) at 300 m and local streets (up to 40 m) at 150 m. Accordingly a module/sector can be designed, for example 800 m × 1200 m in Chandigarh. The industry, warehousing and truck terminals should be located outside in the urban periphery.

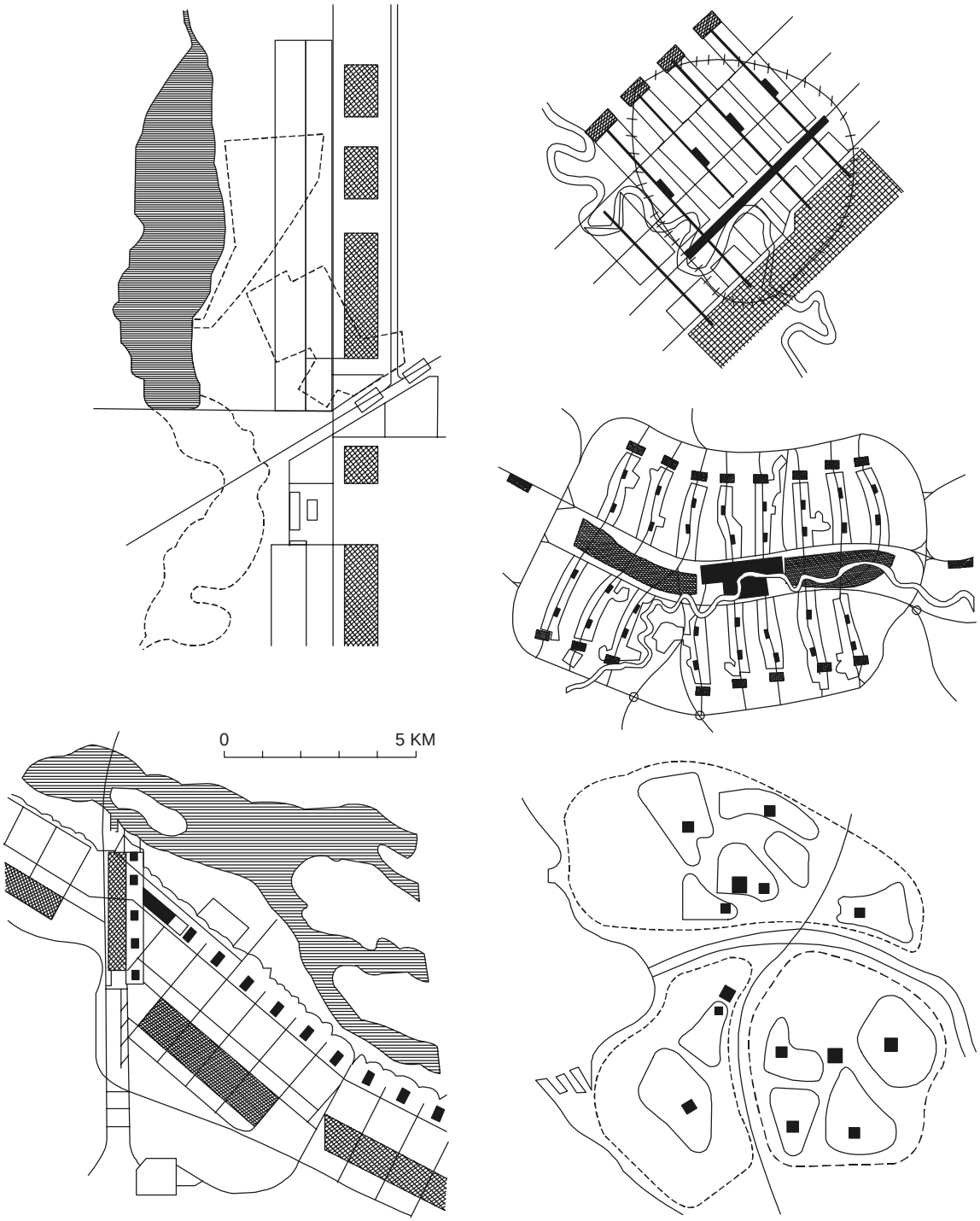


Fig. 1.20: Public transport as a determinant of city structure envisages linear networks, multimodal transport system, walkable neighbourhoods, development of commercial / institutional corridors along mass transport corridors, with compact and high density development to control urban sprawl.

Fig. 1.21: Plan of a linear city by Le Corbusier (1922) : The city develops along a central spine served by public transport. The central spine is primarily a commercial / industrial / institutional zone which is flanked by residential neighbourhood, accessible by pedestrian corridors as well as by private vehicles

Source : Boesiger, W. (Ed.) (1999) Le Corbusier - Complete Works, Birkhauser Publishers, Besel.

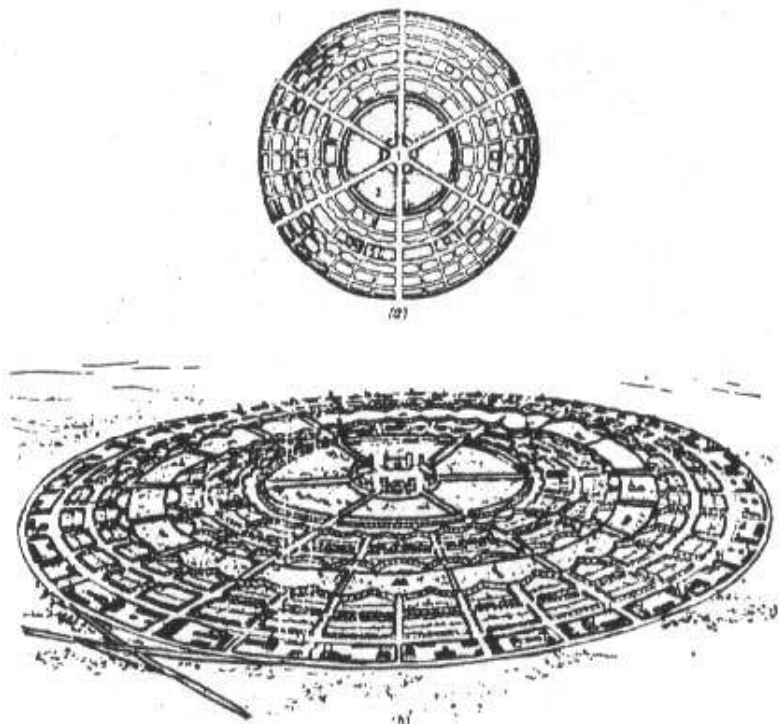


Fig. 1.22: Ebenzer Howard's Garden City, (*a*) Plan, (*b*) Panoramic view (*a*) : 1 - central park with public buildings - theatre, museum, concert hall, library, hospital; 2 - crystal gallery for walking ;
3 - housing zone 4 - school 5 - church; 6 - industries

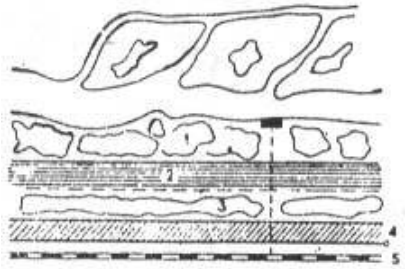


Fig. 1.23. N. Milyutin Functional - linear zoning of urban territory.
1 - park area 2-housing zone 3-protective green belt; 4 - industrial area; 5-railroad terminal

Fig. 1.24. N. Ladovsky D loping town 1-residential area;
2-i political

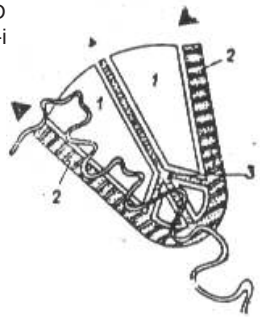


Fig: 1.25: Plan of Islamabad (Pakistan) by Doxiadis
1. Rawalpindi town, 2. Residential districts, 3. Dynamic developing centre–public shopping and commercial centre, 4. Military zone, 5. Embassies, 6. Airport, 7. Old city, 8, bus terminal, 9. Green space, 10. Industrial area, 11. Railway area. Arrows show direction in which the city grows.

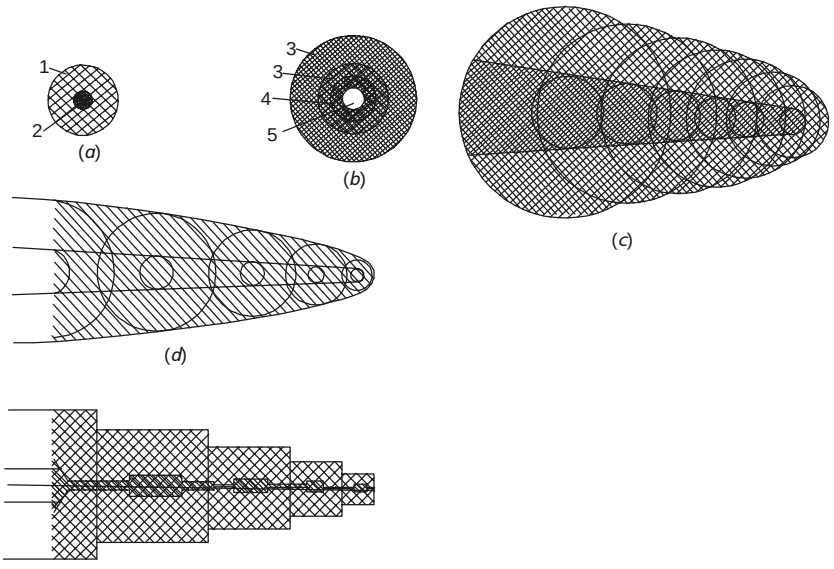


Fig 1.26.: Concept of Evolving city by Doxiadis adopted in Islamabad

Source: Doxiadis,C. (1965), 'Islamabad, the Creation of a New Capital', Town Planning Review, 36(1).

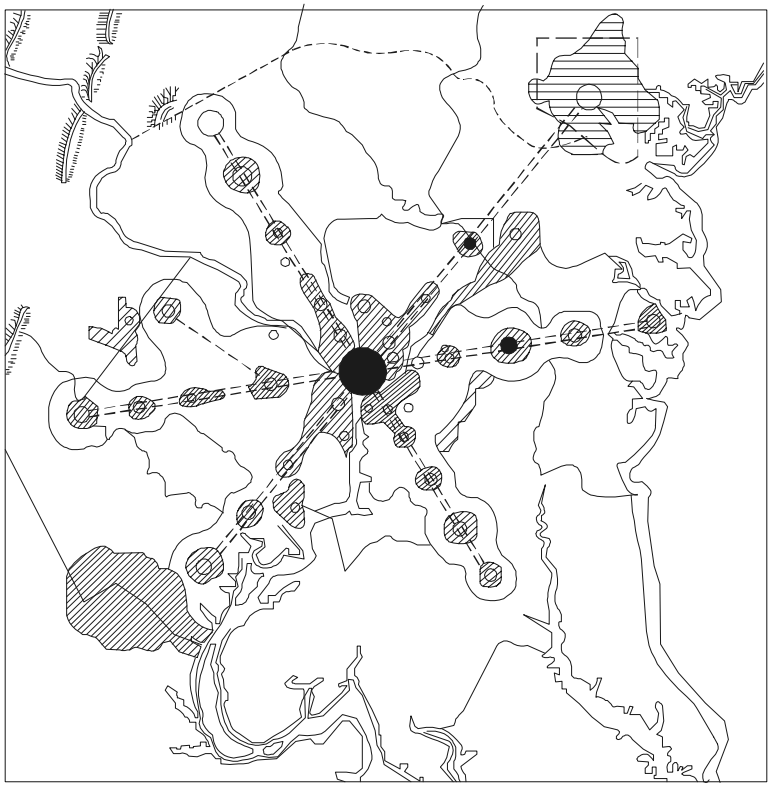


Fig. 1.27: Washington Region: Radial Corridor Plan, 1961. The plan has a “palm and fingers” structure, which is suitable for public transit systems (BRT, metro, railways, etc.) and walkability (max. 800 m from Public Transit stop).

Source: National Capital Planning Commission, Washington DC. American Planning Association & Emina Sendich, 2006, Planning and Urban Design Standards, John Wiley, New Jersey (USA).

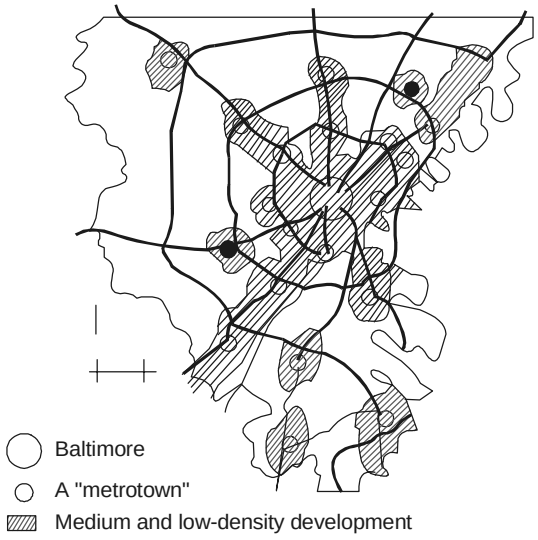


Fig. 1.28:. A proposal for “Metro towns” around Baltimore. Plan for Washington proposes intense corridors of settlements which are supplemented by wedges of open space penetrating the centre of the city to ensure the presence of natural open space

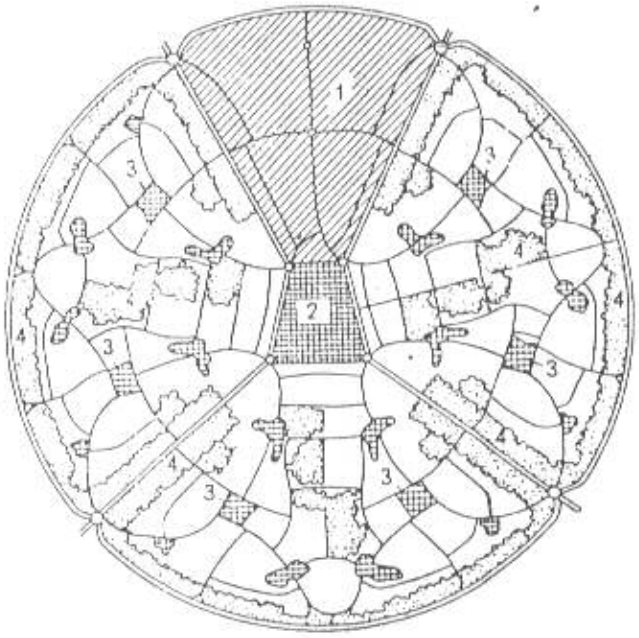


Fig. 1.29: Diagrammatic plan of town of 60 thousand inhabitants, by L. Kiblow
1-industrial area; 2-public centre; 3-local centres; 4-green spaces with sports grounds and pre-school facilities

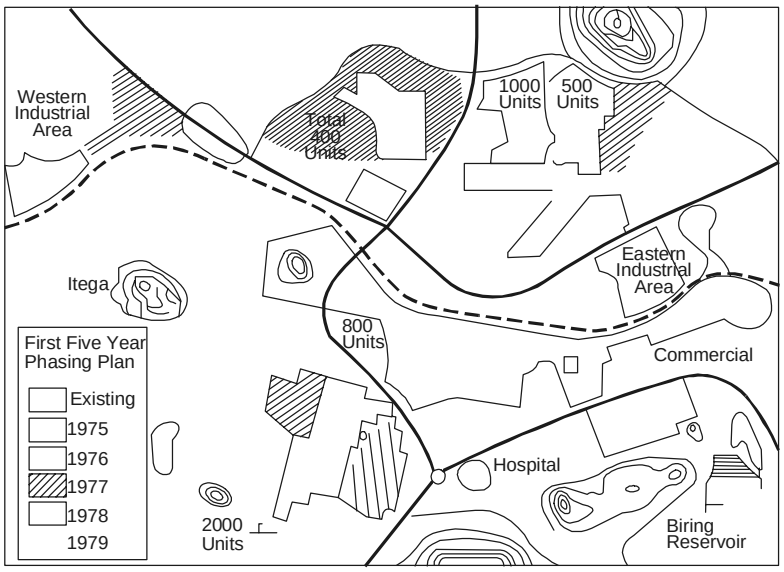


Fig. 1.30: Plan of existing Dodma and the new areas surrounding the old town

Source: Capital Development Authority, Dodma, 1976

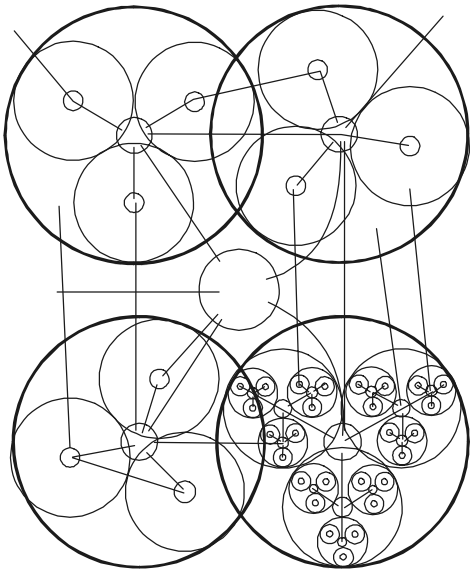


Fig. 1.31: Diagram of Egli's proposal for Furttal near Zurich, Switzerland. The proposal follows Egli's description of Bardet's concept of urban hierarchy. Egli shows a hierarchy of family, neighbourhood, group, district, town and city.

Source: Egli, E. Geschichte des Stadtebaus Erlenbach-Zurich, Eugen Rentsch Verlag, 1967

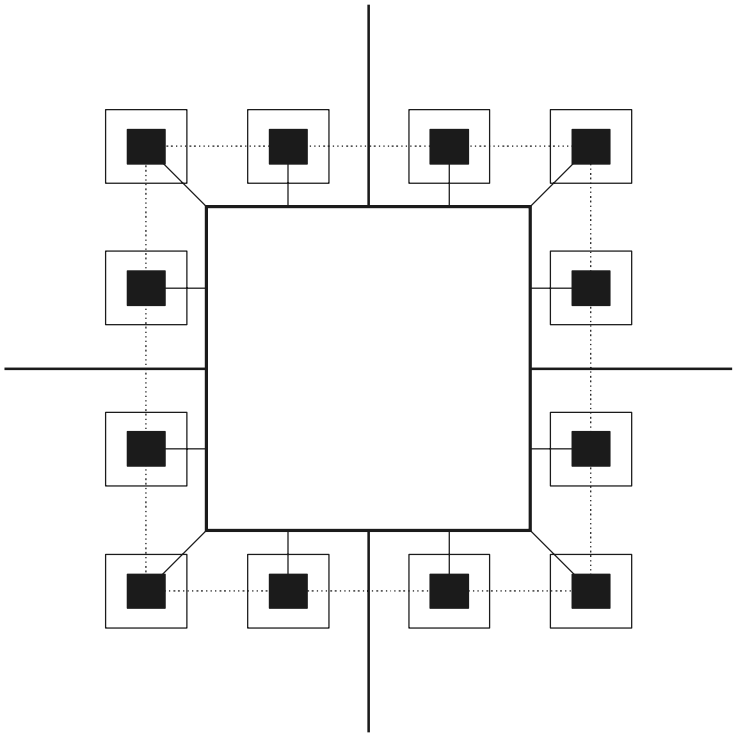


Fig. 1.32: Diagram showing a 'Mencian' approach towards arranging twelve balanced communities, their public transport circuit and their road links to each other and a national road network. The 'Mencian' centre typically contains symbols of national unity and culture.

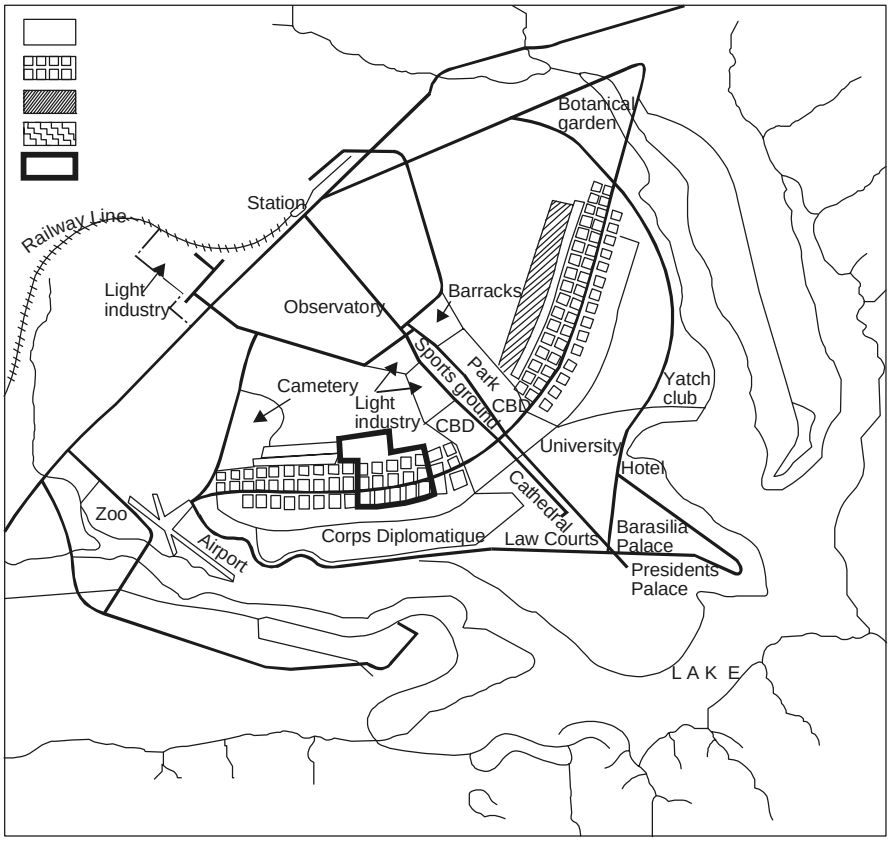


Fig. 1.33: Brasilia, the new capital of Brazil, had been planned by Lucio Costa in the shape of a cross, as was used in the ancient city of Alexandria. This form provides an efficient pattern of transportation, segregating residential and non-residential traffic to a large extent

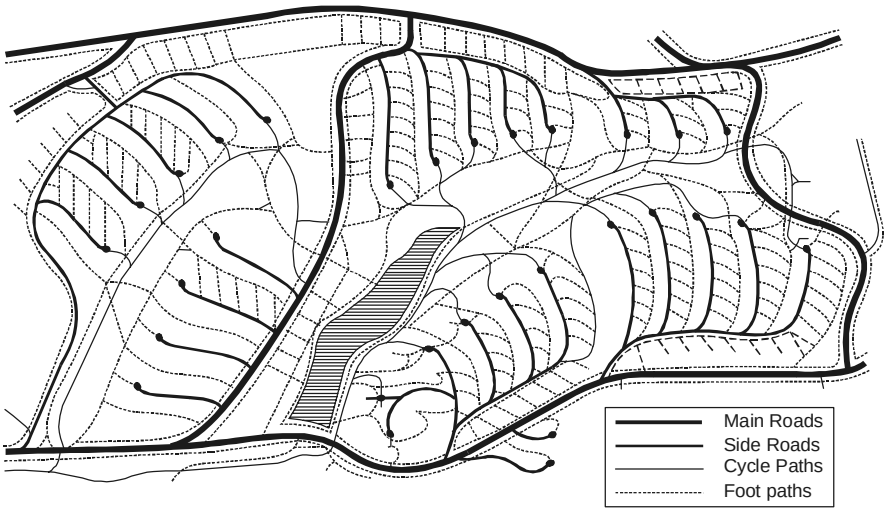


Fig. 1.34: Traffic plan for Leverkusen-Steinbuchel (near Cologne): at first the layout appears to be haphazard, but a clear organic leaf vein-like pattern can be discerned (H. B. Reichow, Die Auto-genechte Stadt).

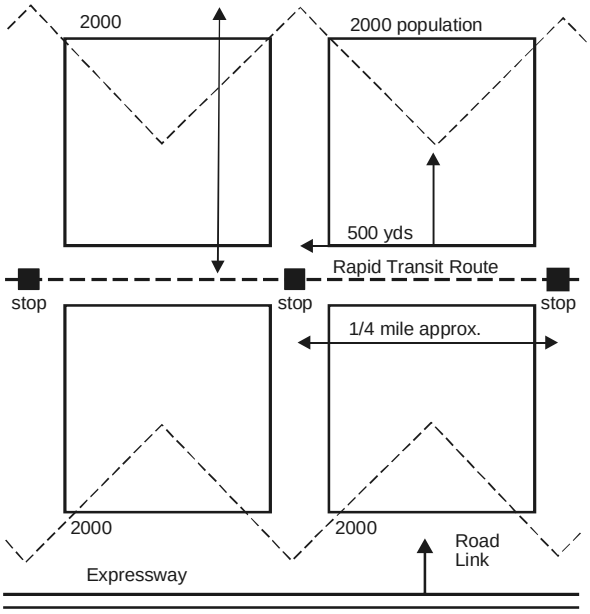


Fig. 1.35: Runcorn New Town- the plan evolves on the basis of module of neighbourhoods accessed by rapid public transit route.

Source: Ling, A. Runcorn New Town: Master Plan, Runcorn Development Corporation, 1967.

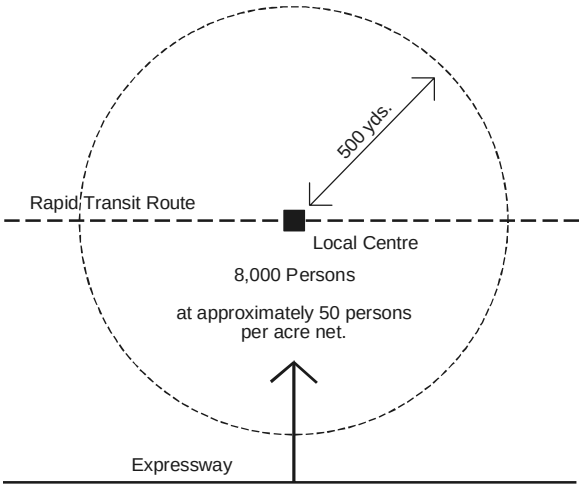


Fig.1.36: Population Related to Walking Distance

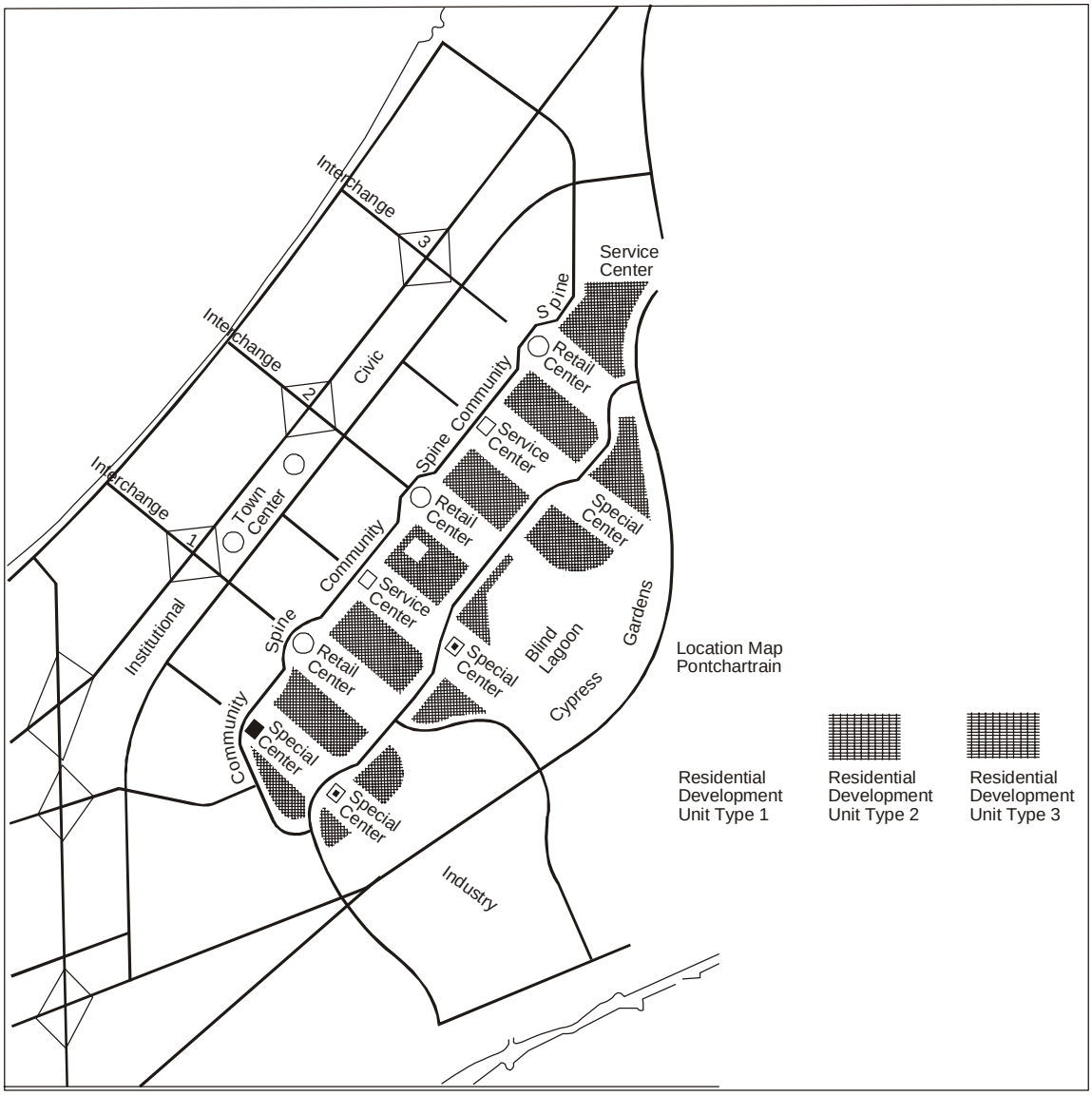


Fig. 1.39: Pontcharian New Town - planned for an efficient, linear system of public transport and Transit Oriented Development by locating major work centres, institutions and community spine along public transit corridors

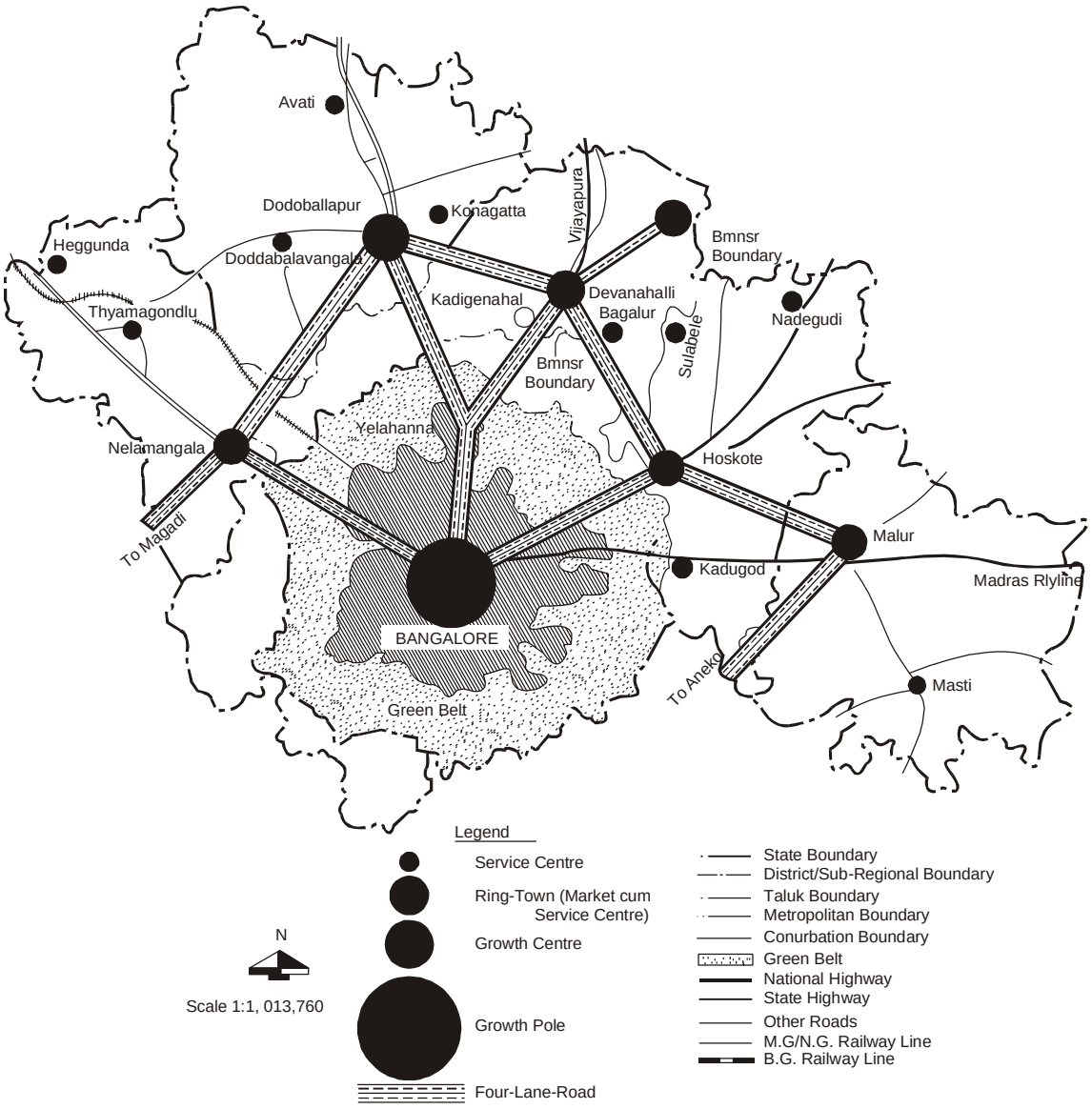


Fig. 1.40: Structure Plan for Bangalore Metropolitan Sub-Region-Northern, Proposed Growth Centres and Four-lane-roads (2001).
The Sub-Regional Plan of Bangalore seeks to decentralise and disperse the concentration of population (hence traffic) to suburban towns connected by four lane roads, expressways and railways.

Source: Bangalore Development Authority

Public Transit System

The objectives of public transport system are:

- To deliver an effective transport network that is integrated, efficient, cost-effective and sustainable.
- To plan, develop and manage transport system to meet the needs, enabling growth; inclusion of the poor.
- To develop and implement policies to encourage commuters to choose the most appropriate mode of transport.

The attributes of an efficient public transport system are the following:

- Public transport system service: reducing the growth rate of car travel, improving efficiency of public transport systems, reinventing the bus, mass rapid transit expansion and introduction of a new generation train and development of a metropolitan rail system.
- Road network and services linking existing and proposed growth centres to work centres, major industrial areas, airport, road and rail terminals, highways, and other corridors.
- Multi- modal passenger and freight systems including improved rail road integration and coordination.
- Integrated transport and land use planning interfacing employment and business areas and public transport.
- Environmental sustainability and demand management.

As such the determinants of an efficient Public Transit System are the following:

- High capacity
- High speed
- Low pollution
- Uses little urban space
- Cost effective
- Flexibility
- Safety and comfort
- State of the Art technology and fuel/energy efficiency

The basic idea is to establish an approach that integrates supply and demand side management strategies and delivers a “World-Class Transport System”. This approach guarantees that all relevant aspects of transportation are considered, that synergies of supply and demand side measures can be reaped, and that long-term planning is facilitated. Various model options are available, which can be considered in combination or separately depending upon the context, traffic volume, sustainability (social, economic and environmental), costs and feasibility (Table 1.7)

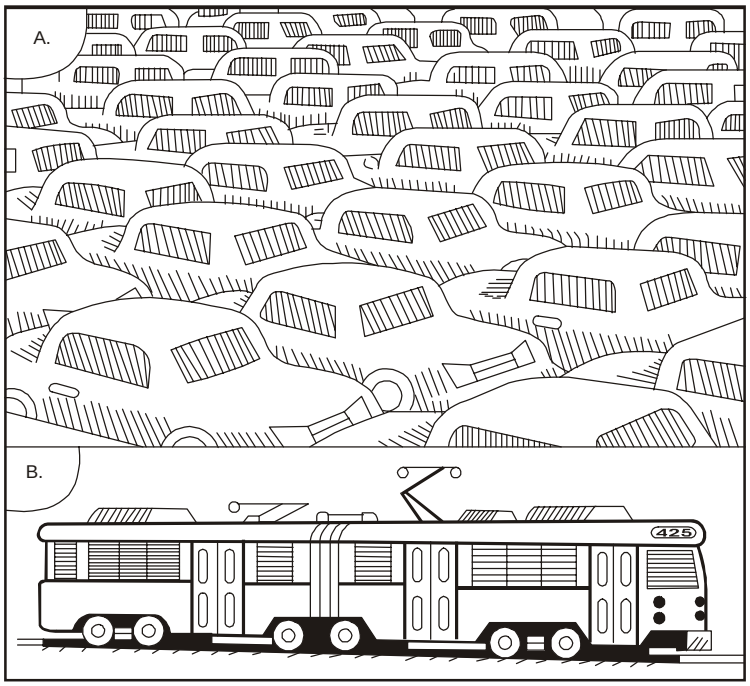


Fig. 1.41: What is the most efficient way for fifty people to get to work?

Table 1.7: Transport Modes and their Characteristics

Transportation Type	*Performance Characteristics*	*Continuous Right of way*	*Flexible Route Location*	*Integration with other Modes*	*Integration with Adjacent Land-use*
Walking	Speed : 2-3 MPH Capacity : N/A	2	3	3	3
Pedestrian Assister,	Speed :1-5 MPH Capacity: 7,200 Pass./Hour	3	3	3	3
Vertical Motion Devices	Speed : 1-2 MPH Capacity :7,200 Pass./Hour	3	3	3	3
Two-Wheel Vehicle	Speed:10-25 MPH Capacity : N/A	2	3	3	3
Monorail	Speed : 10-35 MPH Capacity: 5,000 - 16,000 Pass./Hour	3	3	2	3
Express Bus	Speed:25-40 MPH Capacity: 8,000 - 30,000 Pass./Hour	2	2	2	2
Rail Low Speed:	Speed 20-40MPH Capacity: 10,000 - 40,000 Pass./Hour	2	2	2	2

Rail High Speed	Speed 80-100 MPH Capacity 10,000-40,000 Pass./Hr.				
Watercraft	Speed : 15-35 MPH Capacity : N/A	3	1	1	1
Rotary Wing Aircraft	Speed : 45-70 MPH Capacity : N/A	3	3	1	1
Fixed Wing Aircraft	Speed : 100-600 MPH Capacity : N/A	3	3	1	1
Street Transit	Speed : 10-50 MPH Capacity: 300 - 8,000 Pass./Hour	2	3	3	2
Automobile	Speed : 10-60 MPH Capacity: 300 - 1,000 Pass./Hour	1	2	2	1

1 - Substantial Environmental Problems

2 - Significant Environmental Problems

3 - Limited Environmental Problems.

Source : Kenworthy, 2011

Operational Characteristics of Different Public Transport Modes

Public transport is to be planned keeping in view the operational characteristics of different modes and their optimum efficiency/ridership.

- **Buses :** Regular bus systems in lower income cities typically do not exceed 30 km/h, and an average bus speed of only 18 km/h.
- **Minibus :** achieve average speeds of 17 km/h. However, minibuses offering limited stops average between 37 and 40 km/h.
- **Trams and LRT :** Trams are characterised by their very low speeds (average 15.5 km/h), typically due to the inner, denser areas where they operate and their lack of reserved rights-of-way. Manila's LRT, with an average speed of 30 km/h, is an exception as it operates on a dedicated ROW.
- **Metros :** Metro systems are more common than trams and LRT with average speed of operation at 32 km/h.
- **Suburban rail :** Suburban rail systems are clearly the best performing public transport modes which operates over longer distances with wider spaced stops. They achieve an average operating speed of 36 km/h.
- **Ferries :** Ferries are very slow modes and quite uncommon in cities. They average only 12 km/h or close to a typical bicycle speed in cities, and provide very direct critical links across cities where road bridges are not feasible.
- **Speed-competitiveness of public transport :** The overall average speed of public transport in only exceeds that of the private vehicles, where dedicated corridors are available, like BRT.

Sources : Adapted from Kenworthy, 2011

However, a transit facility cannot be planned in isolation, but need to be complimented by various strategies as given below:

- Integrate land use and transport planning by forming a unified transport authority through the merger of various entities, such as, state transport department, public transit corporations, public works department, etc.
- Develop a comprehensive and efficient road network along with sidewalks.
- Improve public transport through multi-modal transit projects, commuter and traffic facilities.
- Manage the demand for road space through vehicle ownership and usage measures, such as, electronic road pricing schemes, vehicle registration and licensing, differentiated vehicle taxation, vehicle entry permits and toll payments.The economic instruments play a central role in demand side management, which include Electronic Road Pricing (ERP), Vehicle Quota System (VQS), Vehicle Entry Permits and Tolls.

Land Use and Transport Planning in Curitiba

Curitiba had been able to successfully integrate land use and transport planning. Land development in Curitiba has been guided along five linear axes from the city centre, each axis being served by dedicated bus lanes. These radial routes, built in the 1970s as part of an urban development package aimed at regulating the growth of the city, has in each route three separate roads running in parallel. The middle one has an exclusive two-lane bus ways flanked on either side by a single direction service road. The two outer roads are single direction multilane roads. High capacity buses operate on bus way trunk lines linking downtown terminals to upstream feeding stations. They operate in a hierarchical system of interconnected services, from express to inter-district to feeding stations. They are also aided by priority status at signalised intersections. Other features of the bus system include automatic fare collection and extensive use of articulated buses.

Curitiba's land use plan emphasizes control on both the type and density of land use. Higher building density ratios are allowed along the designated public transport axis rather than in areas remote from these axis. In other words, the density of development has been controlled so that transport demand is limited to the capacity of the public transport system. These controls encourage matched development of commercial and high density residential buildings in areas outside the city centre with consequent restraint on trips generated between the outer and inner urban areas.

Key Planning Principles for Efficient Public Transport

- Directness: provide direct routes between points of primary attraction—*e.g.* town centres
- Speed/reliability : use bus-only lanes, junction priority and other measures to ensure that public transport vehicles are not unduly delayed by other traffic.
- Linearity : shape neighbourhoods so that journeys are naturally funnel with little need for lateral trips, increasing linear demand and service quality.
- Density : grade densities so that the higher-density housing is close to steps, minimising the average walk distance.

- Clustering : locate along the route those activities that generate local trips, reinforcing visibility and potential for dual-purpose trips.
- Environment : ensure that the environment of the stops and main pedestrian access route is pleasant and safe, avoiding physical or psychological barriers.
- Bus shelter/information : provide attractive bus/tram shelters with passenger information available.

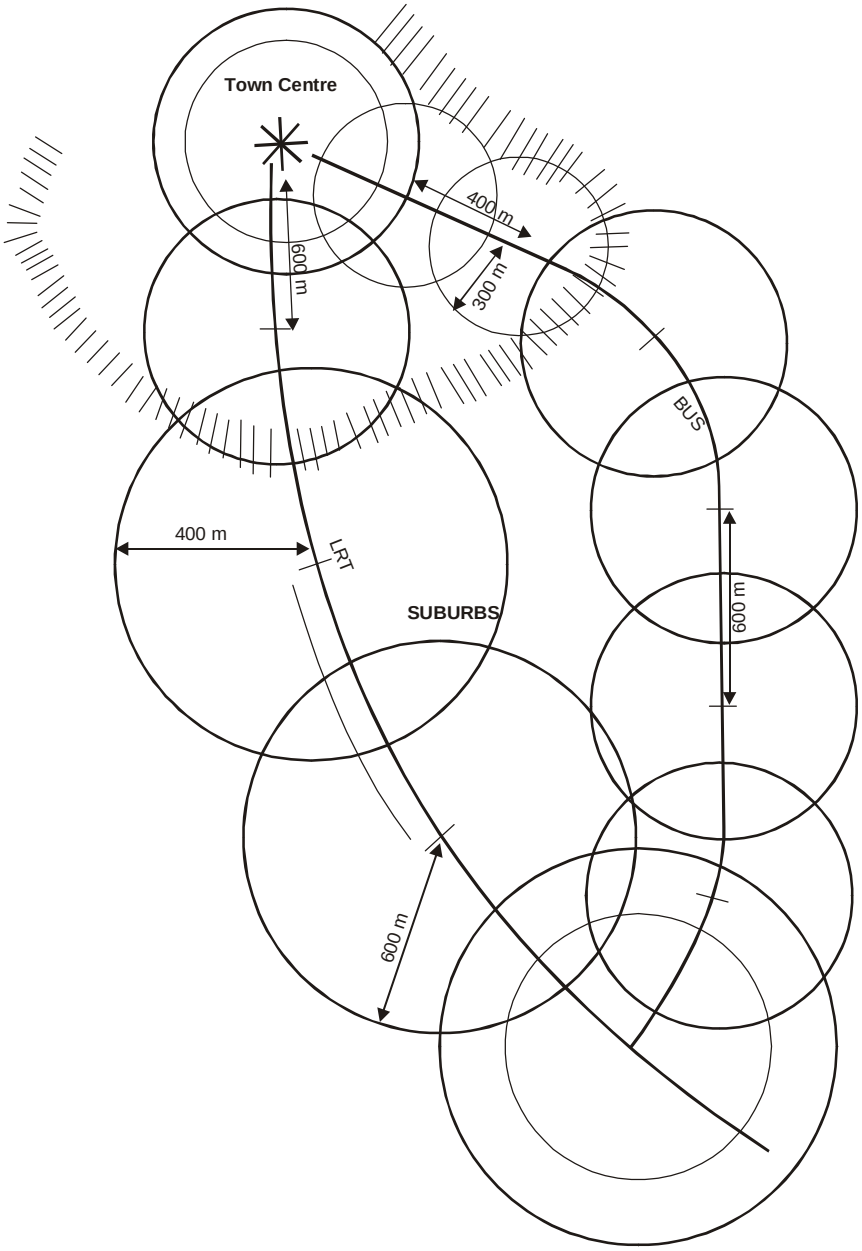


Fig. 1.42: Public Transit Stops are planned to have a catchment of 400 to 600 m to promote walkability and cycling/ rickshaws as a feeder service to public transport system.

Source : Barton H., M.Grant & R. Guise (2003) Shaping Neigbbourhoods, Spon Press, London

• Access to stops and stations: All housing development should be within easy walking distance of good public transport services that give access to the main centres of urban activity. A common standard for bus access is 400 to 600 m.

• Taming Private Cars: The key to a healthy transport strategy is taming vehicular traffic. The capacity of the road system should not normally be increased, because it simply encourages extra trips by car and compounds problems of air pollution and (sometimes) accidents, undermining the inclination to walk, cycle or use the bus. On the contrary, road capacity may be progressively reduced (allowing time for behavioural adjustment) as a direct consequence of positive planning for pedestrians, cyclists and public transport. At the same time, traffic speeds (the prime factor in accidents) should be held low by design, and parking policy used to deter unnecessary car trips.

• Road Networks: Hierarchical road networks are compatible with sustainability because they can help keep heavy traffic out of residential areas, and well-managed main roads with limited access reduce accidents.

The secondary or distributor roads act as the natural focuses of activity within or between neighbourhoods, and should be traffic-calmed and integrated into the town-scape, with local facilities clustered on them. The minor roads should not be a serious of culs-de-sac but a network giving good vehicle, bike and pedestrian permeability through the area, yet subtly discouraging rat runs. The bus routes should normally follow the main distributors, so the disposition of those routes to maximise bus accessibility is critical.

The planners can significantly affect the viability of public transport and the route network in new areas by arranging roads, footpaths and land uses. The quality of bus and train services can be higher where the maximum number of people can reach their destination by the minimum number of routes. Linearity is therefore a key feature. The points where routes cross (nodes) then become the prime locations for local jobs and services and the focus for pedestrian and cycling routes. Public transport accessibility needs to be considered not therefore as an after thought (left to the market) but as the starting-point for neighbourhood planning, with land uses attached to the public transport network.

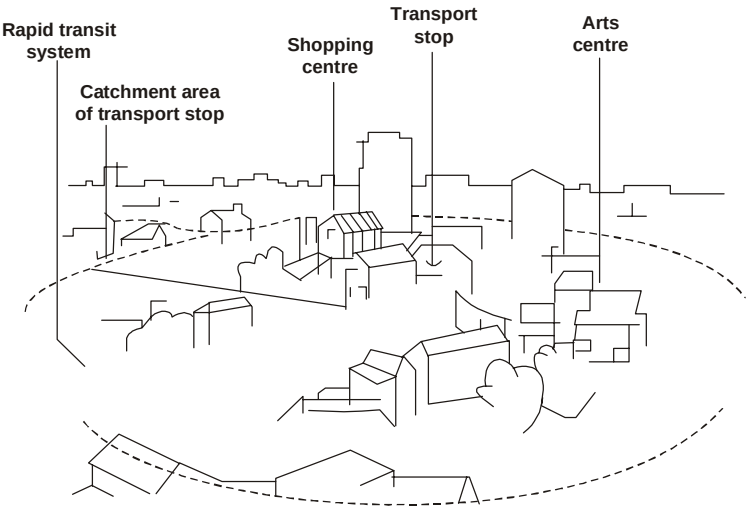


Fig.1.43: Public transport magnets

Source : Barton H., M.Grant & R. Guise (2003) Shaping Neigbbourhoods, Spon Press, London

New retail, employment and leisure facilities in town/district centres can be clustered close around public transport nodes so as to benefit customers and underpin public transport viability.

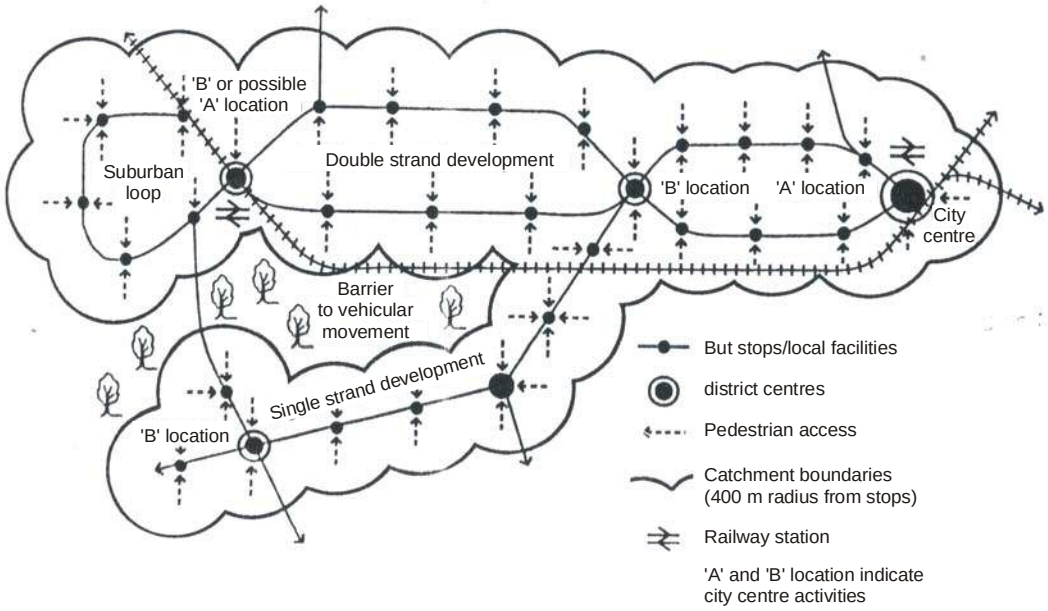


Fig. 1.44: Principles of public transport planning illustrating :
• Linear catchment zones • magnets and nodes • limited lateral movement • fast and stopping services.

Source : Barton H., M.Grant & R. Guise (2003) Shaping Neigbbourhoods, Spon Press, London

Measures to Improve Public Transport Services

General categories of transit improvement:

- Increased service (more transit vehicle-km)
- Improved services (more comfortable, convenient, reliable etc.).
- Incentives to use transit (lower fares, commuter financial incentives, marketing, etc.).
- Transit oriented development (land use patterns designed to support transit, including more compact, walkable, mixed development around transit stations and corridors).

Specific measures that grow transit ridership:

- Additional routes, expanded coverage, increased services frequency, and longer hours of operation.
- HOV Priority (HOV lanes, bus ways, queue jumper lanes, bus-priority traffic signals, and other measures that reduce delay to trustee vehicles). Grade separate transit lines, so they are not delayed by cross-streets and traffic congestion.
- Reallocate Road Space to transit and walking.
- Comfort improvements, including bus shelters and better seats.
- Lower and more convenient fares (such as discounts for frequent users).

- More convenient fare payment using electronic “smart card”.
- Improved rider information and marketing programs, including real-time information on transit vehicles.

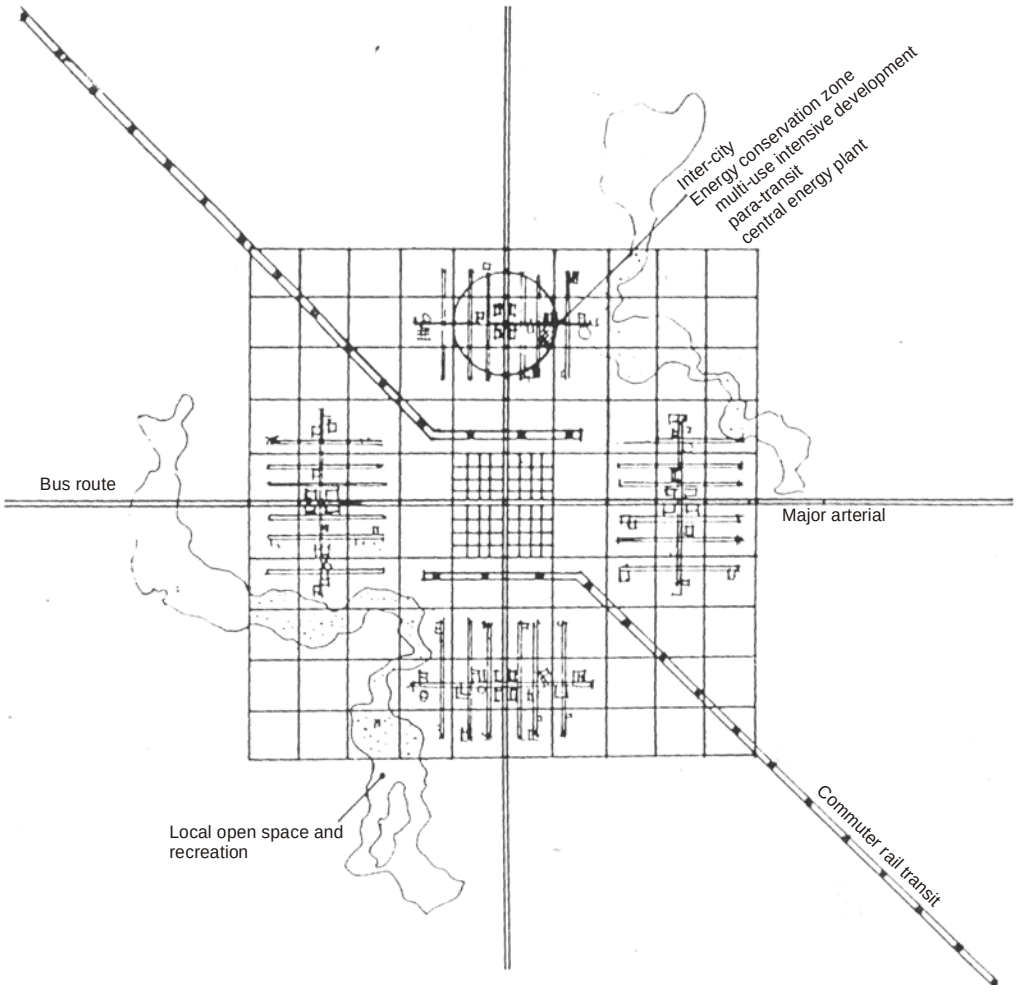


Fig. 1.45: Inter-modal Transport Centre

Synergy between transport and land use should be the basis of sustainable city planning

- Transit Oriented Development and Smart Growth, which result in land use patterns more suitable for transit transportation.
- Pedestrian and Cycling Improvements that improve access around transit stops.
- Bike and Transit Integration (bike racks on buses, bike routes and Bicycle Parking near transit stops).
- Universal Design of vehicle, stations, and pedestrian facilities to accommodate people with disabilities and special needs.
- Park and Ride facilities

- Improved Security for transit users and pedestrians.
- Create a Multi-Modal Access Guide, which includes maps, schedules, contact number and other information on how to reach a particular destination by public transport.
- Improved coordination of transit modes and networks to increase rider convenience and access to information.
- Services targeting particular travel needs, such as express commuter buses, Special Event services, and various types of Shuttle Services.

ABC Zoning Policy of Amsterdam

In Amsterdam, the change in transportation behaviour and travel pattern has been pursued through zoning regulations and land use control. The ABC land use code, in conjunction with transportation investments has resulted in business location decision. The ABC code classifies businesses according to their travel needs, as follows:

- a business that must be highly accessible to transit to succeed, e.g., commercial office space. This classification also states that private auto usage should be highly discouraged. Thus, the most parking spaces a business can have in this category is one private parking space per ten workers.
- a business that needs to be highly accessible to both private car and transit to succeed, e.g., a retail shopping centre. The most space for private parking is one per five workers.
- a business that needs to be accessible by private car or truck if it is to successful. There are no parking limits for a business in this category.

The ABC code is designed to promote the land use that will support the public investment. It redirects the existing growth of the city and attempts to place it at transit stations, in major suburban office centres, and at urban villages. Each of these areas must have a significant rail option for commuters, shoppers, and residents.

Transportation Demand Management (TDM)

Transportation(or travel) Demand Management (TDM) aims to maximize the efficiency of the urban transport system by discouraging unnecessary private vehicle use and promoting more effective, healthy and environment-friendly modes of transport, in general being public transport and non-motorised transport. Its objectives are:

- Congestion reduction
- Parking savings
- Improved mobility options
- Energy conservation
- Efficient land use
- Road cost savings
- Consumer savings
- Road safety
- Emission reductions
- Public fitness and health

TDM is often the most cost effective overall transportation improvement strategy and can be affordable for cities with limited financial resources. Experience has shown that various TDM options and measures should be designed and implemented in a comprehensive manner to make sure that the maximum benefits can be achieved. A three-pronged approach, involves, (1) Improve Mobility Options, (2). Economic measures, and (3). Smart Growth to manage demand and create a resilient and efficient transport system.

TDM strategies and programs can minimise transportation investments and avoid the problems of excessive motorisation that chokes many cities with traffic congestion and pollution. Against the prevailing practice of structural solutions, such as construction of grade separators, bye-pass/ring roads, etc., the TDM measures are usually non-invasive, non-structural, such as congestion pricing, vehicle use restriction, clustered mixed land use, and flexible work hours.

Table 1.8 Protocols for deciding whether transportation projects will significantly affect land use and development.

Sources of Information	Field visit/evaluation of study area. Note existing land use in the corridor amount of vacant land by plan designation within half mile of the project, Capacity of vacant land in the study area in terms of population and employment. Project description, preliminary traffic analysis, Local plans and policies: land use, water and sewer transportation. Interviews with local government staff, realtors, developers, and others with knowledge of the study areas. Ask how they think the improvement will affect land use in the areas.				
How big is the transportation improvement?,	(*a*) Aggregate change in travel time (absolute and relative)				
	Little change				Considerable change
	1	2	3	4	5
	(*b*) Estimated project cost				
	Lower				Higher
	1	2	3	4	5
	(*c*) Length				
	Shorter, more localized				Longer
	1	2	3	4	5
	(*d*) Number of vehicles/trips affected				
	Lower				Higher
	1	2	3	4	5
	(*e*) Capacity of project relative to existing capacity in the study area. (Project may have a small relative impact in a developed downtown,, the urban fringe may have a large one.)				
	Small percentage				Large percentage
	1	2	3	4	5
What do local land-use water/sewer and transportation plans tell us?	(*a*) Do the policies support the project?				
	No support for project				Policies expect project
	1	2	3	4	5

(*b*) Are services (water, sewer, electricity, telecommunication) available in the project area?

No services are available — All services are available

1 2 3 4 5

(*c*) Strength of market demand for development around the project

Weak — Strong

1 2 3 4 5

(*d*) Opinions of local government staff, realtors, developers, and other with knowledge of the study area regarding how the improvement will affect land use in the area.

Little impact — Considerable impact

1 2 3 4 5

Potential magnitude of indirect land-use impacts

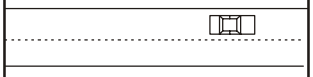
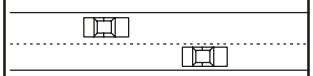
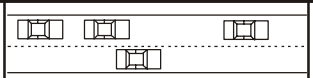
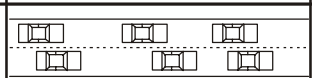
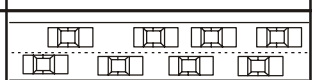
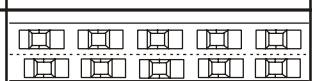
Given the response to the items above, how big are the potential indirect land-use impacts? Factors include the size, type, configuration, and location of the transportation improvement the market forces, and the public policy (land-use plans and public facility, capacity).

Little impact — Considerable impact

1 2 3 4 5

Source : ECONorthwest, with Portland State University, A Guidebook for Evaluating the Indirect Land Use and Growth Impact of Highway Improvements, Oregon Department of Transportation, 2001.

Table 1.9: Level of Service Assessment

	Level of Service	*Description*
A		Free flow : Low volumes and no delays
B		Stable flow : Speeds restricted by travel conditions, minor delays
C		Stable flow : Speeds and maneuverability closely controlled due to higher volumes.
D		Stable flow : Speeds considerably affect by change in opening conditions. High-density traffic restricts maneuverability, volume near capacity
E		Unstable flow : Low speed, considerable delay; volume at slightly over capacity
F		Forced flow : Very low speeds; volumes exceed capacity; log delays with stop and go traffic.

Source : Bucher, Willis and Ratliff Corporation, APA, 2006, Planning and Urban Design Standards, John Wiley, NJ, USA

Transportation Demand Management can provide significant savings to consumers and society by reducing and deferring roadway capacity expansion costs. It is often the least cost solution. Since the majority of travel is by automobile in most communities, you might assume that the best way to improve transport is to increase roadway capacity. But the existing roadway system provides a relatively high level of services, and there are diminishing marginal benefits from additional roadway investments. Motorists can travel to most destinations with reasonable speed, comfort and safety, except under urban-peak travel conditions. These are the conditions in which TDM tends to be effective, due to concentrated travel demand. The major transportation problems facing most communities (traffic and parking congestion, inadequate mobility for non-drivers, and external costs from traffic), are the types of problems that TDM can effectively address.

Individual TDM strategies tend to provide modest but multiple benefits, and so are not usually considered the best solution to any single objective. Conventional transportation evaluation practices that focus on individual problems tend to undervalue TDM solutions. They tend to favour technical solutions are effective at reducing one or two problems, although they often exacerbate others due to Rebound Effects. For example, adding capacity may reduce traffic congestion on a particular highway, but it can increase downstream traffic congestion, parking problems, crashes, environmental impacts, and urban sprawl. Conversely, fuel efficiency standards and alternative fuels that reduce vehicle operating costs encourage increased driving, which can increase traffic congestion, road and parking facility costs, crashes, sprawl and even types of pollution.

TDM can help achieve equity objectives. For example, TDM strategies can:

- Increase horizontal equity (fairness) by creating more neutral planning and investment practices.
- Increase horizontal equity by making transportation prices more accurately reflect costs.
- Benefit lower-income people by providing direct financial savings and improving affordable transport choices.
- Benefit transportation disadvantaged people by improving transport choices and reducing the automobile external costs they must bear (such as road and parking subsidies, and uncompensated crash risk and pollution costs).
- Improve basic access by increasing transport choices and giving priority to higher value trips.

Although some TDM programs require subsidies, these can only by considered unfair if they are greater than subsidies for comparable automobile travel. Expenditures on alternative modes may simply represent an alternative way for non-drivers to receive their share of transportation resources. Even if subsidies are greater than that of automobile travel per passenger-mile, non-drivers only travel about a third as much as distance as motorists each year, and so per capita annual subsidies tend to be smaller. Total annual per capita transportation external costs and subsidies tend to be much greater for motorists than for transit riders.

Automobile-oriented strategies to achieve transportation equity objectives often create new problems. Since annual vehicle travel tends to increase significantly with income, higher income people tend to receive the greatest per capita transportation subsidies. For example, free parking and low road users changes, which are often justified on the grounds that they make driving more affordable for lower-income households that do not own an automobile to

high-income households that, drive more than average. It would be fairer to charge users the full costs of their road and parking costs and provide a targeted subsidy to lower-income households. TDM strategies can result in better transportation choices to people who are transportation disadvantaged, and a fairer distribution of public resources.

The equity benefits of TDM can be particularly large for comprehensive TDM programs that reduce market distortions, increase transportation choices, and create more balanced transportation and land use systems. This can provide significant financial savings that particularly benefit lower-income households and people who are transportation disadvantaged. Many TDM strategies help achieve equity objectives in addition to economic and social objectives. Implementing such "no regrets" solutions helps achieve more Sustainable Transportation.

Table. 1.10 Trends and Demand Management Strategies in Transport Sector

Trends in transport sector	Transport demand management strategies
• Vehicle ownership ↑	• Promote convenient efficient public transportation to take private vehicles from roads
• Vehicle use ↑	• Reduce/avoid need to travel, to move goods
• Larger vehicle ↑	• Shift to environmentally friendly modes
• Sprawl ↑	• Promote compact growth patterns
• Increase in number of accidents ↑	• Capture full cost of driving from users
• Local air quality ↓	• Promote mixed use
• Traffic congestion ↑	
• Noise ↑	
• Burdens on the poor ↑	
• Capital funds ↓	
• Operating funds ↓	• Promote sustainable development
• Non-motorised transport (NMT) marginaliszed ↑	• Promote carbon dioxide (CO_2) reduction technologies
• Fuel consumption ↑	• Improve system efficiency
• Transport supply ↑	• Promote zero polluting, non-fossil fuels for vehicles
• CO_2 emissions and Climate change ↑	

Table. 1.11: Example of transport demand management measures

Increase Supply	*Demand Management*
Add roads and road lanes	Road/Congestion pricing
More bus service	Fuel pricing
More light rail service	Parking policies and pricing
More commuter rail service	Vehicle use restriction
More frequent bus service	Road space reallocation
Dedicated bus or tram corridors	Priority for bus and non-motorised modes
Bike lanes and bike parking	Clustered land uses
Sidewalks and crosswalks	Flexible work hours and telecommuting
Bridges and tunnels for bicyclists and pedestrians	Travel planning information

Transport Demand Management principles can be illustrated in the form of 9 pillars as given below:

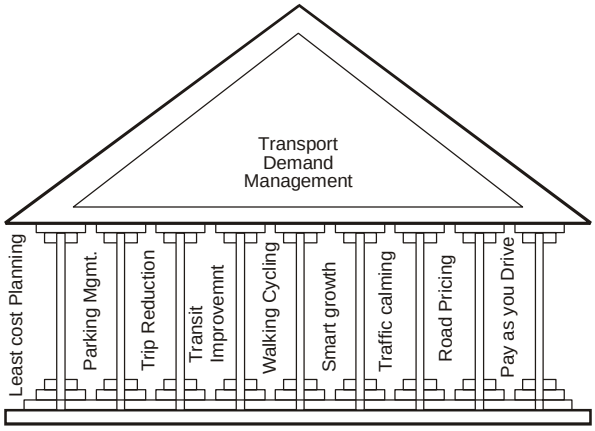


Fig. 1.46: The structure of Transport Demand Management is supported by 9 pillars

1. **Least Cost Planning:** Least-cost planning, or Integrated Planning considers demand management solutions. It involves the public in developing and evaluating alternatives, such as using roadway expansion funding for transit improvements, rideshare programmes or mobility management programmes.
2. **Parking Management:** Parking management entails efficient use of existing parking facilities-shared parking, flexible minimum parking requirements, and user charges.
3. **Commute Trip Reduction:** Commute Trip Reduction programmes encourage people to reduce car trips. Typically they use a variety of incentives and support to reduce peak-period driving, including better cycling facilities and flexible working hours.
4. **Transit Improvements:** There are many ways to improve public transit, including

better vehicles and stations, more frequent services, reduced crowding, improved walking conditions to transit stations, and Priority for High Occupant Vehicle (H$OV buses, vanpools and carpools) priority over general traffic, so public transit travel is faster and more efficient.

5. **Walking and Cycling Improvements:** Walking and Cycling travel can substitute for some motor vehicle trips. Communities with good walking and cycling conditions drive less.
6. **Smart Growth Land Use Policies:** Smart Growth Land use policies encourage the development of more compact, mixed, walkable, transit-oriented communities.
7. **Traffic Calming and Management:** Traffic calming reduces speeds and volumes on specific roads. Typical strategies include traffic circles at intersections, raised crosswalks, and partial street closures to discourage, short-cut traffic through residential neighbourhoods.
8. **Road Pricing:** Road pricing means that motorists pay directly for driving on a particular roadway or in a particular area. Transportation economists have long advocated road pricing as a way to fund transportation improvements and to reduce congestion.
9. **Pay-As-You-Drive Pricing:** Pay-As-You-Drive (PAYD) pricing means that vehicle insurance premiums and other fees are based directly on how much it the vehicle is driven. This provides a significant financial incentive to reduce driving, while making these charges fairer and affordable.

Table. 1.12 : Summary of good practices

City	*Country*	*Good practice*
Singapore	Singapore	An integrated land and transport policy
		Emphasis on public transport (particularly bus transport) with supporting measures to restrain car use and maximize efficiency of taxis
		Independent regulator for buses
		Performance measurement of services
		Customer satisfaction surveys
Auckland	New Zealand	Integrated sustainable transport plan with actions and targets and timelines clearly charted out
Curitiba	Brazil	Integrated land use and transport planning
		Dedicated bus corridor
		Strong political will to promote public transport
Bogota	Columbia	City municipality empowered to handle transport function
		Dedicated bus corridors in the city
		Quality of public transport matching with personal travel
Melbourne	Victoria	Dedicated public transport division to plan, manage, and monitor public transport
		Conducting customer satisfaction surveys

		Publishing of performance reports
		Citizens' charter for public transport services
Indore	India	Development of a PPP model to operate urban bus services
		Involvement of all city actors
Bangalore	India	Institutional reforms for improving services
		Differentiated public transport services
		Corporate initiatives to shift its employees to public transport

PPP - Public Private Partnership

Source : Ministry of Urban Development, GOI, 2009

Transit Oriented Development (TOD)

Transit Oriented Development (TOD) is defined as higher density, mixed use development that is located in or around transit facilities (train/metro station, bus station etc.). TOD aims at more efficient use of land and synergy between land uses and public transport infrastructure. TOD focuses upon a mix of land-uses such as residential, office, shopping, civic uses and entertainment, within easy walking distance from a transit station (0.5 km, 5-10 minutes). As such the idea is to make the public transit system viable and to develop a walkable city, thus reducing the dependency on private vehicle. New housing, major public facilities and commercial development must therefore be located where they can be accessed, or are likely soon to be accessed by public transport. This applies as much to brown-field as to green-field development, and is the bottomline of sustainable development.

New retail, employment and leisure facilities can be clustered close around public transport nodes so as to benefit customer and underpin public transport viability. Transport Oriented Planning can significantly affect the viability of public transport and the route networks in new areas by arranging roads, footpaths, and land uses. The quality of bus and train services can be higher where the maximum number of people can reach their destination by the minimum number maximum number of people can reach their destination by the minimum number of routes. The nodes where various routes cross and public transport estimated starts become the prime locations for local jobs and services and the focus for pedestrian and cycling routes. Public transport accessibility needs to be considered as the starting point for planning, with land uses attached to the public transport network.

All housing and mixed use developments should be within easy walking distance of good public transport services that give access to the main centres of urban activity. A common standard for railway/metro bus access is 500 m. Beyond that distance, the proportion of people willing to walk declines progressively and car dependence increases. The 500 m criterion needs to be applied with care. It is the distance people on average actually walk if routes are indirect the straight-line distance may be much less. Access is also influenced by gradients (especially for older people) and psychological barriers such as Foot Over bridges (FOB), subways or intimidation by road traffic. The redensification exercise is aimed at readjustment of the growth and to make it more efficient and viable.

Advantages of TOD:

- Due to increased activity in the vicinity of station, the ridership on the MRTS/BRT/ Local Train systems would increase making the operation more viable.
- Since more of the trips generated in the station area would be catered by the Public Transit systems, the traffic on the surrounding network would be less.
- The parking demand generated for the redensified areas would be very small as most of the passengers would prefer to use MRTS and other modes of Public Transportation.
- The redensification of urban area with higher intensity of development near stations would check the urban sprawl and increasing mean trip length and traffic.
- The beneficiaries could be charged conversion fees and other charges which could be used by the concerned agencies for argumentation of services.
- Transit Oriented Development reduce transportation costs and externalities, increased travel choice, and reduced land paved per capita.
- Properties located near transit stations have higher property values and local bodies get increased tax revenue.
- TOD can lower annual household rates of driving by 20 per cent for those living, working, and or shopping near transit stations.
- Vibrant communities that include pedestrians, increases customers.
- Old areas can be revitalized through transit-oriented development.
- TOD may reduce parking requirement by almost 20%
- TOD may reduce automobile travel by 20-25%
- TOD may reduce by upto 20 per cent of infrastructure costs of water, sewage and roads.
- TOD may reduce rates of greenhouse gas emissions by 2.5 to 3.7 tons per year for each household.
- Possible reduction in car accidents and injuries.

Urban Restructuring along Major Transport Corridors

Actioning Land use and Transport Integration is a major challenge which needs establishing an incentive based regime along with a unified strategy bringing together multiple agencies. Master Plan for Delhi 2021 envisages restructuring of about 500 m belt along the metro corridors, highways and transport nodes with incentives of higher Floor Area Ratio (FAR) and mixed land use. The concept of linear 'facility corridors' all along metro/ public transport networks envisages high intensity development of work centres, educational, healthcare and other public facilities so as to strengthen activity relationship with mobility (public transport), pedestrians, cycles, etc. It aims at non-invasive and non-structural solutions to traffic concentration and its dispersal towards achieving a sustainable volume/ capacity ratio. The Plan recognises that public transport system is closely dependent upon physical characteristics of land use, intensity of development and density of population. As such, it encourages compact, dense and smart growth. It is realised that to an extent, in a growing economy, the objective of shift from private transport to public transport is an illusion. Delhi has a 186 km long metro system with a ridership of 850,000 to a million per day. It claimed that about 29,000 car owners and 28,000 two wheelers/three wheeler commuters shifted to metro during last one year (2009). The shift was attributed to traffic jams (23 percent), parking problem (5 percent), speed (17 percent) and 24 percent for safer, comfortable journey. However, on the other hand, there is a continuous shift of about 200,000 to 300,000 commuters per year from public to private transport, which nullifies the shift of private vehicle owners to public transport. As such, integrated land use and

transport planning along with transit oriented development and travel demand management appears a more pragmatic approach than expecting the public transit to reduce the private vehicles from roads. The restructuring of land use in synergy with public transit systems, involves a series of complimentary actions, as given below:

(*i*) Preparation and operationalisation of an integrated and complementary multi-modal transportation plan comprising the Road, Rail and Metro network, so that work centers / residences are within a walkable distance.

(*ii*) The multimodal system has to be integrated with facilities for pedestrians, bicyclists, disabled persons and Intelligent Transport System (ITS) enabled taxis and three-wheeler scooter rickshaws (TSR).

(*iii*) Optimal development of the existing road network by removing impediments in smooth and safe flow of buses and non-motorised transport.

(*iv*) Expansion and restructuring of the existing network and creating alternative networks to promote use of public transport.

(*v*) Integration between the bus, rail and metro-system to provide seamless multi-modal transport, through provision of additional stations, park and ride facilities and introduction of single multi-modal ticketing. The multimodal public transport system to be based on comparative cost-effectiveness analysis for judicious use of public funds.

(*vi*) Planning and development of goods transport and transport terminals (air, railways, container depots, freight complexes, warehousing and wholesale markets) and influence areas around them to be based on the principle of decentralisation in a regional framework and towards the urban periphery, linked with railways, highways and metro network, together with feeder services.

(*vii*) Development of a comprehensive parking policy including measures for linking new vehicle registration with owner parking facilities

(*viii*) Bicycle/ Cycle-Rickshaw to be promoted for short and medium trip lengths, together with enhanced facilities for the pedestrians with street furniture, signage and landscaping.

(*ix*) A major consideration in mobility planning and space design is that people with disability, older persons and people in wheel chairs could move safely in the city. This requires that:

(*a*) Paths and pavements shall be flat, uniform, slip-free and free from obstacles.

(*b*) Orientation points and guide routes may be provided for visually disabled people.

(*c*) Information and warning signs must be understandable, clear and well lit

(*d*) Provisions for the physically challenged should be made to overcome curb height, rain water gratings and other barriers. Parking spaces close to the entrance should be reserved for physically challenged. Public transport shall be designed for easy access by wheelchair users.

(*x*) Exclusive parking bays be provided near major intersections for parking of mobile repair vans, PCR vans, ambulances, cranes, fire tenders and other public utility vehicles.

(*xi*) Safety of road users shall be a prime consideration while planning transport infrastructure. The aspects of licensing, registration and training of transport operators/ drivers are important elements in traffic safety. Appropriate road signage and markings help in traffic safety.

The MRTS system and other modes of public transport have not only provided relief to the overstrained transport system in Delhi, but has also opened a redevelopment opportunities along its corridors. The Master Plan for Delhi 2021 (MPD-2021) provides enhanced FARs along its route, linked with the preparation of Redevelopment Plans. Funds for Infrastructure development along the corridor are to be derived through conversion fees and enhanced FAR charges to be recovered from the beneficiaries/property owners. The MPD-2021 states the following:

"Growth of Delhi over the years has been on the ring and radial pattern with reliance on road based public transport. The development envisaged by the previous Plans was poly nodal with hierarchy of Commercial Centres located either on ring or radial roads. The proposed MRTS network will bring sizable urban area within waling distance from the purposed stations. This will have an impact on the existing structure of the city and consequently its development. This changed scenario provides opportunities for city restructuring and optimum utilization of the land along the MRTS corridors. In this process, a sizable proportion of the additional population with requisite facilities and employment can be absorbed along these corridors."

Influence Zone along the MRTS Corridor is envisaged as intensive development zone. The scheme for Redevelopment of Influence Zone shall be prepared on the basis of the following:-

- Maximum upto 500 m wide belt on both sides of centre line of the MRTS / Major Transport Corridor (to be identified in consultation with GNCTD) will be designated as Influence Zone which will be identified in the respective Zonal Development Plans.
- Entire approved layout plan of a scheme will be included in the zone if more than 70% of the plan area falls inside the influence zone. In case of large schemes, block / pocket boundary should be considered as one schemes for this purpose.
- The approval of schemes will be granted only after commencement of execution of the respective phase of MRTS.
- Development Controls applicable will be as permissible for the respective use zone / use premises.
- Higher FAR and height can be availed of through the preparation and approval of comprehensive integrated schemes.
- In the proposed Urban Extension areas the land uses will be integrated with the proposed movement corridors at planning stages only.
- The following areas shall be excluded from the enhancement of FAR:-
  - — Lutyens' Bungalow Zone, Chanakyapuri, DIZ Areas and Mata Sundari Area
  - — Civil Lines Bungalow Area.
  - — Monument Regulated Zone (as per ASI guidelines)
  - — Property development of DMRC
  - — Comprehensive commercial schemes.

The grant of higher FAR should be allowed on the basis of comprehensive / integrated schemes (not on individual plotted development) corresponding to mandatory provision of social housing and against the reservation of greens / facilities (to be handed over to the Govt./ DDA). The schemes can be prepared by the private sector according to the stipulated mode, guidelines and Regulations. The policy regarding maintaining Right of Way and Coverage to be followed on the plot affected in the Road widening shall be against equivalent FAR, and on the principle of Transferable Development Right (TDR) and Accommodation Reservation. Under

the provision of Transferable Development Rights (TDR), the development potential of a plot / land partly or fully reserved for a public purpose can be made available by way of TDR in the form of Floor Area Ratio (FAR).

The utilisation of TDR Certificate shall conform to the Master Plan / Zonal Plan / approved Redevelopment Plan. An additional ground coverage upto 50% of that prescribed in the Master Plan and Building Bye laws, can be allowed on Master Plan Roads (30 m wide and above), provided other requirements are met.

Transit Oriented Development for Urban Extensions

Besides redensification and intensive redevelopment of Influence Zone along MRTS Corridor, MPD-2021 also envisages transit oriented development in the Urban Extensions. MPD-2021 gives the concept of facility belts / corridors in urban extensions. "For the zonal Development Plans in Urban Extension, the facility belts/corridors shall be detailed out in layout plans". The concept is based on the fact that about 50% of the land is required for city level facilities/ utilities, transport corridors and greens, land for which is to be provided mainly by the Government/DDA. This is based on the Transport-Land use synergy (Transit Oriented Development).

As per the Master Plan for Delhi 2021 about 50 percent of the area taken up for development is required for city level infrastructure, in the form of transportation, public and semi-public facilities, industrial and commercial complexes, which are, by and large developed by the DDA/Government agencies. These activities are proposed to be provided in Facility Corridors along MRTS route/major Roads (30 meters and above). The remaining area which, in terms of the Master Plan, can be seen as gross residential use zone comprising housing and related internal roads, utilities, parks/green areas, local commercial areas and community facilities, can be developed to a large extent through the private sector, including the land owners. The lands falling within the facility corridors are proposed to be developed on priority, as roads services will open up the area for development.

The lands along the facility corridors will be planned on the basis of the modules of community (1 lakh population - 200 to 225 Ha.), Neighbourhoods (10,000 population/18 to 20 Ha.), and Housing Area (5000 population/8-10 Ha.). These areas will be available for development in a composite manner by Developers/ Owners, on the basis of a layout plan within the framework of the approved Structure Plan/ Zonal Plan. Such schemes can also be taken up by a Developer, who may assemble the land and seek permission from the DDA to carry out development, management and construction as per approved plans.

Since the development of major roads is the starting point for laying of services, the principle of "Excess condemnation", *i.e.* the Road Corridor and Influence zone along the roads must be planned and developed together. Keeping in view that the MPD 2021 envisages a composite development, the Facility Corridors could be treated as 'White Use Zones', and specific land uses at premises level may be worked out on the basis of the land policy, local needs and local plans, including the policy for regularization of existing unauthorized colonies. The transformation of rural areas to urban areas should be gradual and voluntary, and the existing rural land holdings can be given option for change of land use, on the basis of overall Layout Plan, subject to payment of conversion changes and reservations for facilities, roads, green and obligatory social housing component.

Performance Indicators for TOD

In order to make public transportation more effective, TOD envisages that the public transport system is complimented by land use restructuring and optimum utilization of the land along the public transport nodes and corridors. Higher density and mixed use developments in or around transit facilities (train/metro stations, bus stations, etc.) aim at more efficient use of land and public infrastructure, and also make public transportation more viable with enhanced ridership. Overall Level of Service (LOS) is measured as a combination of the following sequential attributes of TOD:

- Plotting of Public Transport corridors and nodes.
- Preparation of TOD Guidelines including delineation criteria, development controls, preparation of schemes, conversion changes and application procedure etc.
- Availability of parking, pedestrian and cycle facilities at Public Transport Corridors and Nodes.
- Preparation and approval of TOD Plans and Redevelopment Schemes to facilitate higher percentage of land use under work centers (Mixed use, Public and Semi Public facilities Government and industry).

Table 1.13: Level of Service/Performance Indicators

LOS	Attribute	Indicator
1	Map of Public Transport Corridors/Bus/Local, Trains/Metro Routes and Nodes	1 Available 2 Not available
2	Guidelines and Plans of Influence Zones around Transit Corridors/Nodes (upto 400m)	1 Available 2. Not available
3	(*a*) Availability of public parking at Public Transport Nodes,	1 Available 2 Party available 3 Not available
	(*b*) Availability of dedicated cycle routes along TOD corridors and Rental Cycles / Cycle parking at Bus terminals. Railway Stations and Metro Stations	1 Available 2 Party available 3 Not available
	(*c*) Availability of pedestrian facilities/walkways in the influence Zone (TOD corridor),	1 Available 2 Party available 3 Not available
4	Land use break-up: Percentage of area under mixed use, centre,	Above 33%.....1
	Public & Semi-Public facilities within 400 m radius of Transit	20% > 33%.....6
	Corridor/Nodes,	<20% 12

Note: Overall Land use break up shall include Residential,, Work Centers (Commercial/mixed use, Industry, Government use and Public & Semi-Public facilities), Recreational, Transportation and Utilities.

Overall LOS is evaluated and measured as a sum of the assigned indicators, divided by six, which will provide an indicator ranging from 1 to 6.

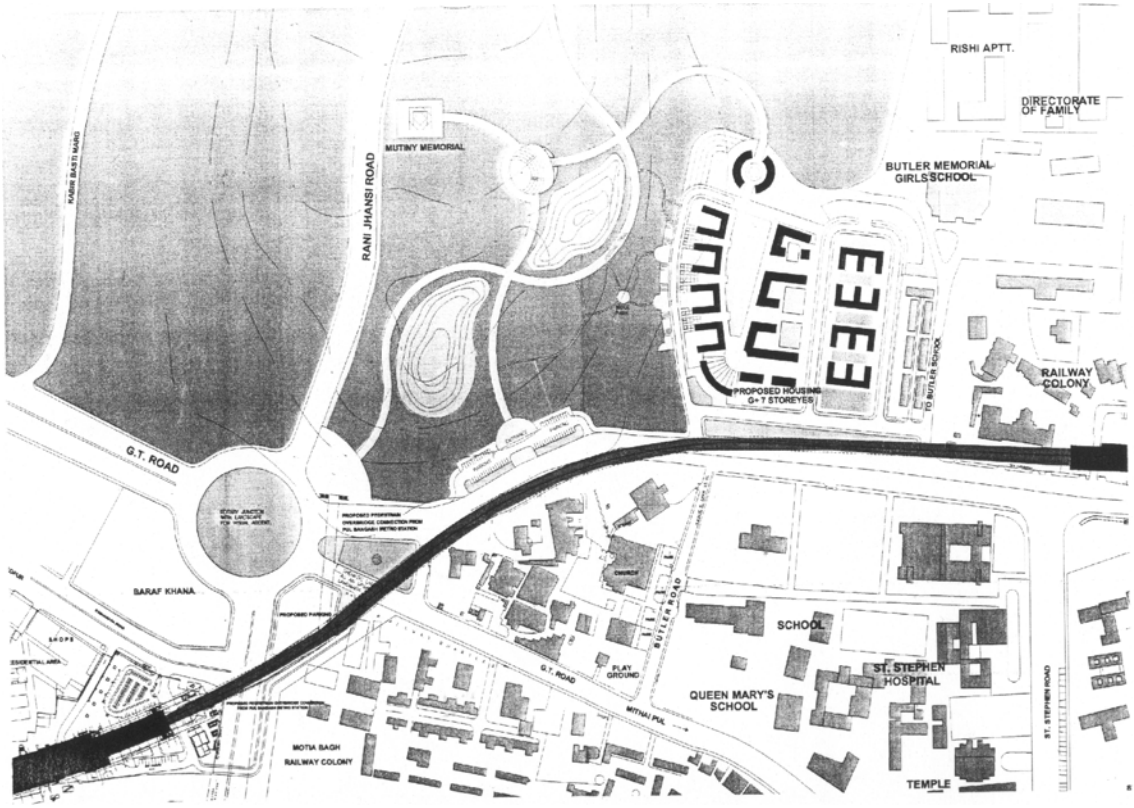


Fig. 1.47. Proposed Redevelopment of Influence Zone along metro corridor (Kashmere Gate)
Source : S.K. Das & Associates, 2005

Pilot-Transit Oriented Redevelopment of Kashmiri Gate-Tis Hazari-Pul-bangash Metro Corridor

As a pilot project the Delhi Development Authority and the Delhi Metro Rail Corporation sponsored a case study for a Transit Oriented Redevelopment of the area along the Metro line connecting Kashmiri Gate, Tis Hazari, Pul Bangash, Architect/Planner S.K Das & Associates were engaged for the study. The planning exercise focuses on the redevelopment and restructuring of the influence area along the Metro Corridor (500 m on both sides) as defined in the Master Plan for Delhi 2021. The scheme covers an area of 190.70 Ha., which is mostly comprised of government railways, institutional lands (45 Ha.), residential (48 Ha.), recreational (44 Ha.), and transport/circulation (52 Ha.). The area provides an excellent potential for redevelopment and TOD. The proposal has been worked out in three phase of development as given below:

Phase I

1. Improvement of circulation network
2. Landscaping along main Circulation Corridors.
3. Tourist Zone
4. Notification for change in Land use for Phase II

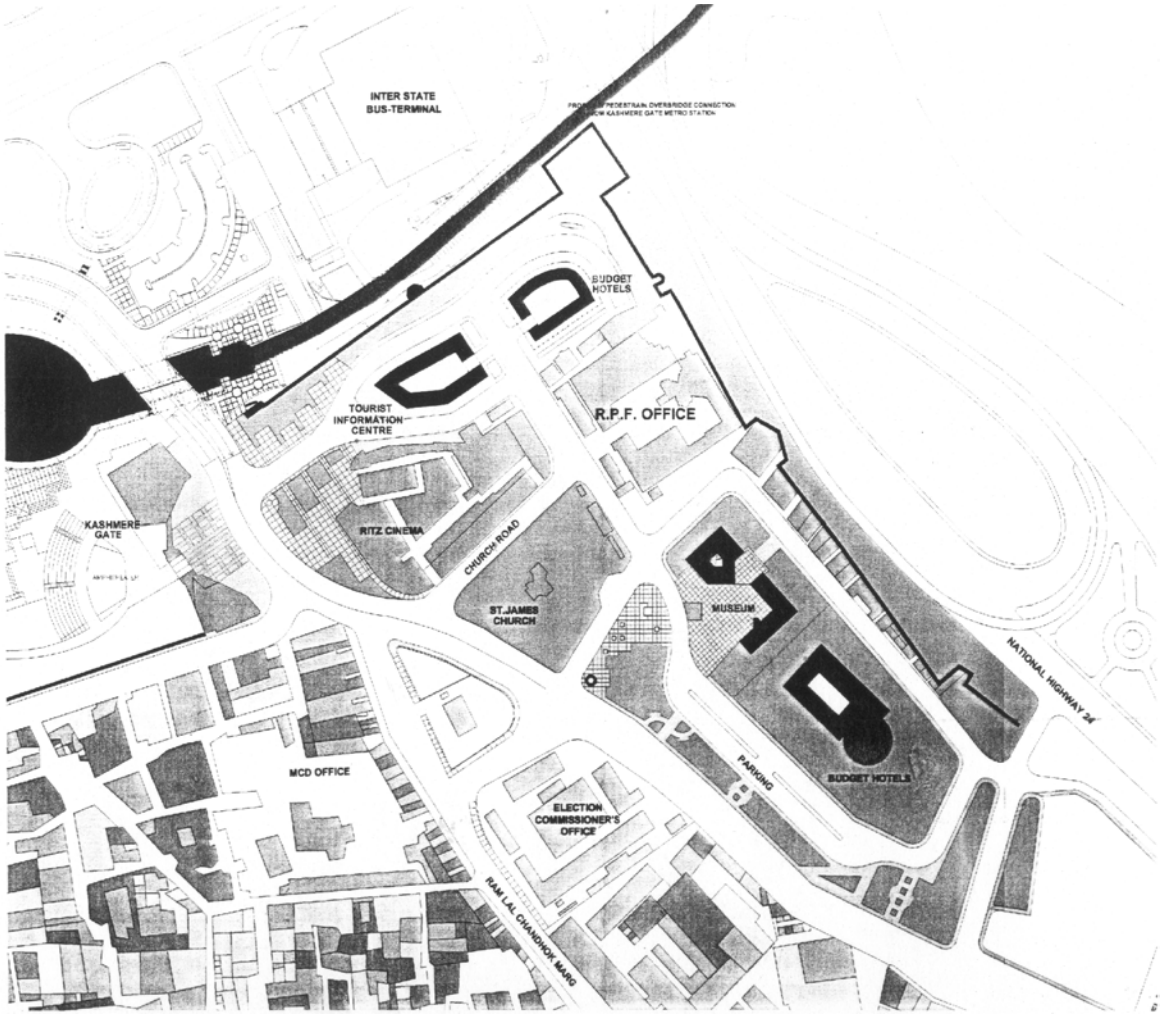


Fig. 1.48. Redevelopment Plan of Kashmere Gate area along Metro.

Source : S.K. Das & bAssociates, 2005

Phase II

1. Mixed Use development
2. Informal Sector
3. Redevelopment of Gokhale Market
4. Reconstruction & Rehabilitation

Phase III

General guidelines and redevelopment strategy.

The project attempts transit oriented development and recreating a continuity of the landscape and the green areas as a continuous flow between the ridge and the river and as a connecting element between different functional zones. The extent of greens generated exceeds the

existing quantum. The redundant and defeat areas falling under renewal are proposed for redevelopment and for heritage and tourism promotion. The city wall and its vicinity are proposed to be made a tourist attraction. Mixed-use developments are proposed taking into account the opportunities extending due to introduction of Metro. The circulation and pedestrian links are proposed to be improved, and the new links will be developed as stated below:

- Improvement of the road geometry at the junction between Rani Jhansi Road, GT Road and Boulevard Road.
- Elevated pedestrian connection from the Pul Bangash Metro Station to the proposed development adjacent to the ridge.
- Extending the flyover from Shahdara on Boulevard Road beyond the Alipur Road - Boulevard Road crossing to ease of vehicular movement.
- A strong pedestrian connection starting from the Riverside development across the Ring Road to the ISBT Terminal and Kashmiri Gate Metro Station.
- Entry from National Highway 24 to the Lothian Road in the Walled City. This road is proposed to be widened.

The TOD approach will integrate physical fragments and revive the pedestrian realm that has got completely lost to the ever increasing vehicular population. The following are the highlights of the landscape proposals:

- Beautification of Boulevard Road section with regard to street lighting, side walk ways etc.
- The landscaping along the Boulevard Road and the Lothian Road.
  - Area around Kashmiri Gate station
  - Area to the East of St. James Church
  - Area in front of Nicolson Cemetery, Qudsia Bagh, Maharaja Aggarsen Park.
- Landscaping of the junction between Rani Jhansi Road, GT Road and Boulevard Road.
- Development of open space at:
  - Area of the Northern Ridge, broadening Boulevard Road.
  - Stretch bordering Tis Hazari and the open space created in front of the Police Headquarters and proposed commercial complexes.
  - MCD Park behind Kashmiri Gate Metro Station to be developed as a Heritage Park.
  - Open space adjacent to the Nicolson cemetery.

The bank of river Yamuna to the east of Ring Road is an important part of the proposal, which will link the population with the river front. The area along the city wall, including its east, where the Delhi College of Engineering exists and is earmarked for urban renewal in the Zonal Plan is proposed to be developed as a Heritage and Tourist zone. The proposal includes development of heritage walks/trail, a city museum, Tourist Information Centre, guest houses and budget hotels. Part of the area is earmarked for reconstruction and rehabilitation. This includes a proposal for high rise, high density housing (5.4 Ha.) and social rehabilitation housing (2 Ha.) to be developed on the basis of additional FAR of 50% available under MPD 2021.

Public transport and land use are inherently linked, which is reflected in Delhi and all other cities in India by massive non-conforming commercial activity along transport nodes and corridors. It is time to recognize this uterine relationship and embrace the concept of Transit Oriented Development in the Indian cities. Land use and transport synergy provides viable

substitutes for private transportation and could make the cities walkable, safe and people friendly. Transit Oriented Development reduces transportation costs and encourages wider travel choices. Properties located near Public Transit Corridors have higher property values and local bodies get increased tax revenue. TOD can reduce the demands of driving, parking and also the green house gas emissions. Further, it will yield substantial reduction in accidents and injuries.

Accessible Transport Design

Many disabled people are dependent on their vehicles and careful consideration must be given to the parking needs of disabled drivers and passengers. The following standards are therefore applied:-

- 3% of spaces provided in any car park should be reserved for disabled users, with a minimum of 2 spaces where the development would generate a total of 50-99 spaces and 1 space where development would generate 20-49 spaces. For developments generating less than 20 spaces, there is no specific requirement to allocate a space for disabled users, although provision should be made wherever possible, and particularly at those locations where they are most likely to be needed, such as doctors, surgeries, schools or theatres.
- Where possible, reserved parking spaces should be provided close to an accessible entrance on level ground.
- If possible, covered spaces should be provided, as transfer between car and wheel chair can take time.
- Where access to a public building is via a pedestrain area, reserved parking should be provided within 50 metres if the pedestrian area is not covered, and within 100 metres if the area is covered.

Signing of Parking Bays

- Spaces reserved for disabled people should be clearly marked and should display the “Disabled” symbol both at eye level and on the ground.
- The location of the reserved parking bays should be clearly signposted at the carpark entrance.
- The route from the parking bays to the building entrance should be clearly signed, level and well-lit.

Design of Space

- Parking spaces for disabled users should be a minimum of 3200 mm wide to enable the car door to be fully opened within the bay.
- Alternatively, standard spaces with transfer zones can be provided with a 1200 mm zone for transfer from car
- to wheelchair.
- Transfer zones should either serve two bays or be positioned in the corner of a parking area to avoid being used by other drivers.
- Kerbside spaces for disabled users should be provided with a dropped kerb access to the footway.

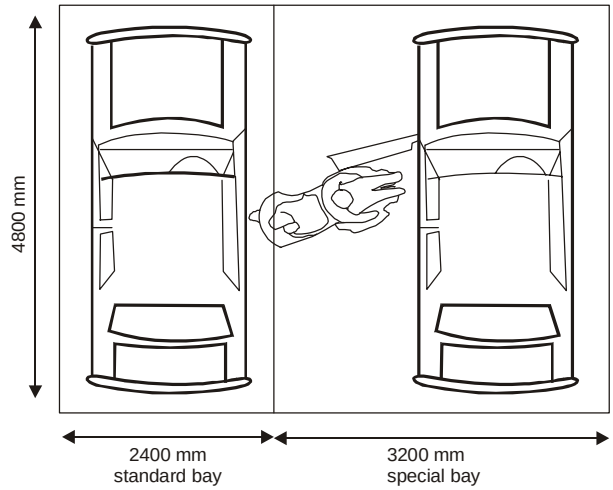


Fig 1.49: Car Parking for Disabled

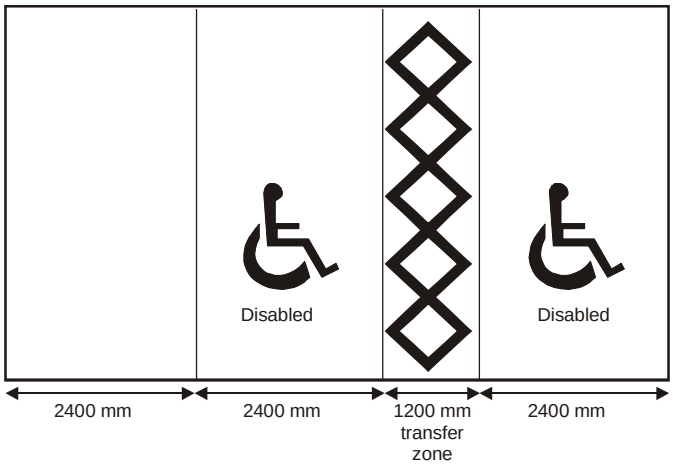


Fig 1.50: Car Parking Layout

Source : Samarthyam, New Delhi

Footways and Footpaths

- Footways adjacent to the carriageway, as well as footpaths where there is no contiguous carriageway, should be as level as possible without camber, and constructed o stable, firm, non-slip materials. External surfaces should be well laid and maintained. Cracked, uneven surfaces can be treacherous for disabled people and able-bodied alike.
- Ground surfaces should not deaden sounds and echoes which blind people depend on to gain direction guidance.
- Edges of footways and footpaths should be well-defined.
- Footways and footpaths should have a minimum width of 2000 mm to allow wheelchairs, prams and push chairs to pass each other.
- Changes of colour texture and lighting help to denote potential hazards, and can assist partially sighted people.

- Railings should be designed to have low rails for detection by blind people using canes.
- Handrails should extend beyond changes of level.
- The minimum width between obstacles should be 900 mm.

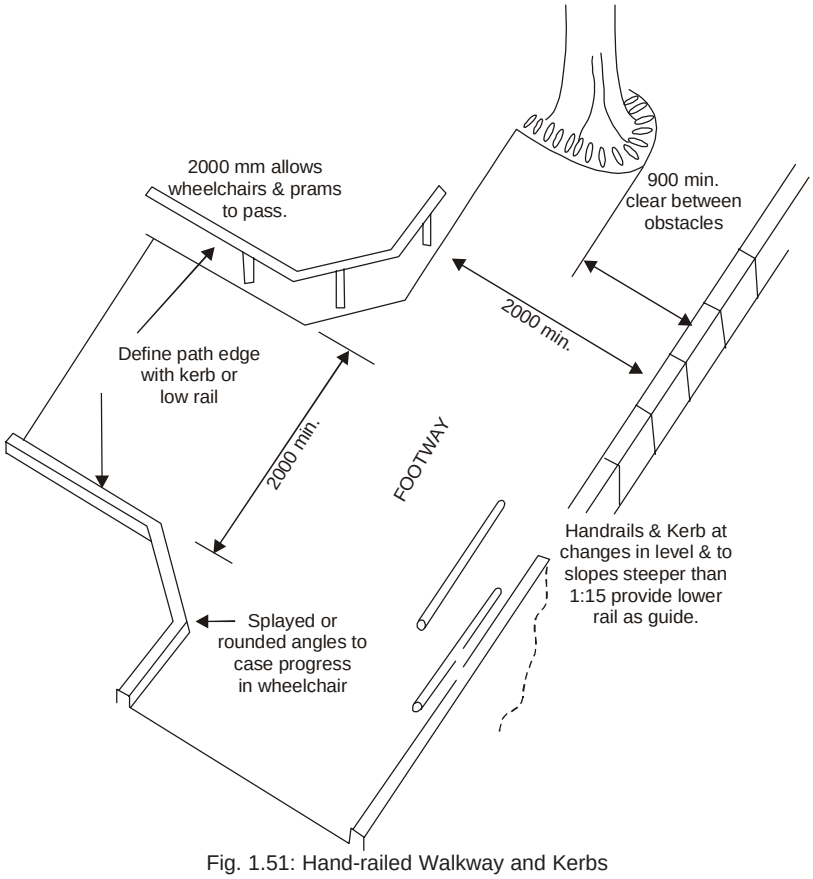


Fig. 1.51: Hand-railed Walkway and Kerbs

Kerbs and Dropped Kerbs

- Kerbs should be ramped at all crossing points, including road junctions. The gradient should be as gentle as possible with the maximum desirable gradient being 1:12.
- Special consideration should to given to crossing facilities in locations where they are most likely to be used by people with disabilities and, in particular, to crossings close to shops, clinics, public facilities and old people's homes.
- Kerbs should be at least 100 mm high and no more than 125 mm high.
- Dropped kerbs should be marked with a distinctive colour.
- A textured strip should be provided on the approach to the dropped kerb to alert blind people and their dogs.
- A minimum width of 900 mm should be provided behind the ramp to allow safe passage along the pavement.
- Dropped kerbs should be flush with the road surface, with no up stand.
- Dropped kerbs and ramps on either side of a vehicular route should be directly opposite one another. This is particularly important for guide dogs which are trained to cross at right angles.

Travel Reduction by e-governance

E-governance refers to the use of information technologies (such as Wide Area Networks, the Internet, and mobile computing) that have the ability to transform relations with citizens, businesses, and other arms of government. These technologies can serve a variety of different ends: better delivery of government services to citizens, improved interactions with business and industry, citizen empowerment through access to information, or more efficient government management. The resulting benefits can be less corruption, increased transparency, greater convenience, revenue growth, and/or cost reductions.

E-governance is about changing how governments work, share information, and deliver services to external and internal clients. It harnesses information and communications technology to transform relationships with citizens and businesses, and between arms of government. Benefits can include reduced need to travel, less corruption, increased transparency, greater convenience, higher revenues, and lower costs. But these benefits do not result solely from the use of information and communications technology. Instead, e-government initiatives should be part of broader reforms to improve public sector performance. Good governance and sustainable development is not attainable without sound land administration or - more broadly - sound land management.

Knowledge Management is an integrated approach to managing the information assets of an organisation/enterprise. These information assets may include databases, documents, policies, procedures, or just knowledge stored in the individual's heads. Knowledge Management, this way, is just common sense. However, in reality, the state of knowing or having access to the right knowledge at the right time is a real and important business advantage.

However, in relation to e-Governance, knowledge management is basically about designing and implementing suitable spatial data infrastructures or, more particularly, it is about designing and implementing a suitable IT-architecture for organising spatial information that can improve the communications. There are several impressive success stories as illustrated below:

- A Kolkata based hospital leverages e-Governance for tropical medicine. The telemedicine enables the local doctor in the panchayat, to contact a doctor at the hospital for tropical medicine via a voice & data connection, to secure the benefit of being treated by a hospital specialist without the patient having to travel.
- The Karnataka government's computerized 'Bhoomi' project of land records, while doing away with the corruption-ridden system that involved bribing village accountants to procure land records, records of right, tenancy and cultivation certificates (RTCs), is expected to benefit seventy lakh villagers in 30,000 villages.
- The Karnataka Road Transport Corporation (KSRTC) was the first to introduce a computerized passenger seat reservation system and deploy palmtop electronic ticketing machines.
- In Gujarat there are websites where citizens log on and get access to the concerned government department on issues such as land, water and taxes.
- Ahmedabad Municipal Corporation is using appropriate e-Governance solutions to increase revenue generation by a phenomenal 125%.
- In Hyderabad, through e-Seva, citizens can view and pay bills for water, electricity and telephones, besides municipal taxes. They can also avail of birth/death registration certificates, passport applications, permits / licences, transport department services, reservations, Internet and B2C services, among other things.

- e-Chopal, ITC's unique web-based initiative, offers farmers the information, products and services they need to enhance productivity, improve farm-gate price realisation, and cut transaction costs. Farmers can access the latest local and global information on weather, scientific farming practices, as well as market prices through the web portal.
- The Coimbatore Municipal Corporation (CMC) has used e-Governance for "Anytime, Anywhere" governance. This has helped CMC in making their administrative processes transparent, efficient and productive, besides saving visits to CMC offices by customers/citizens.