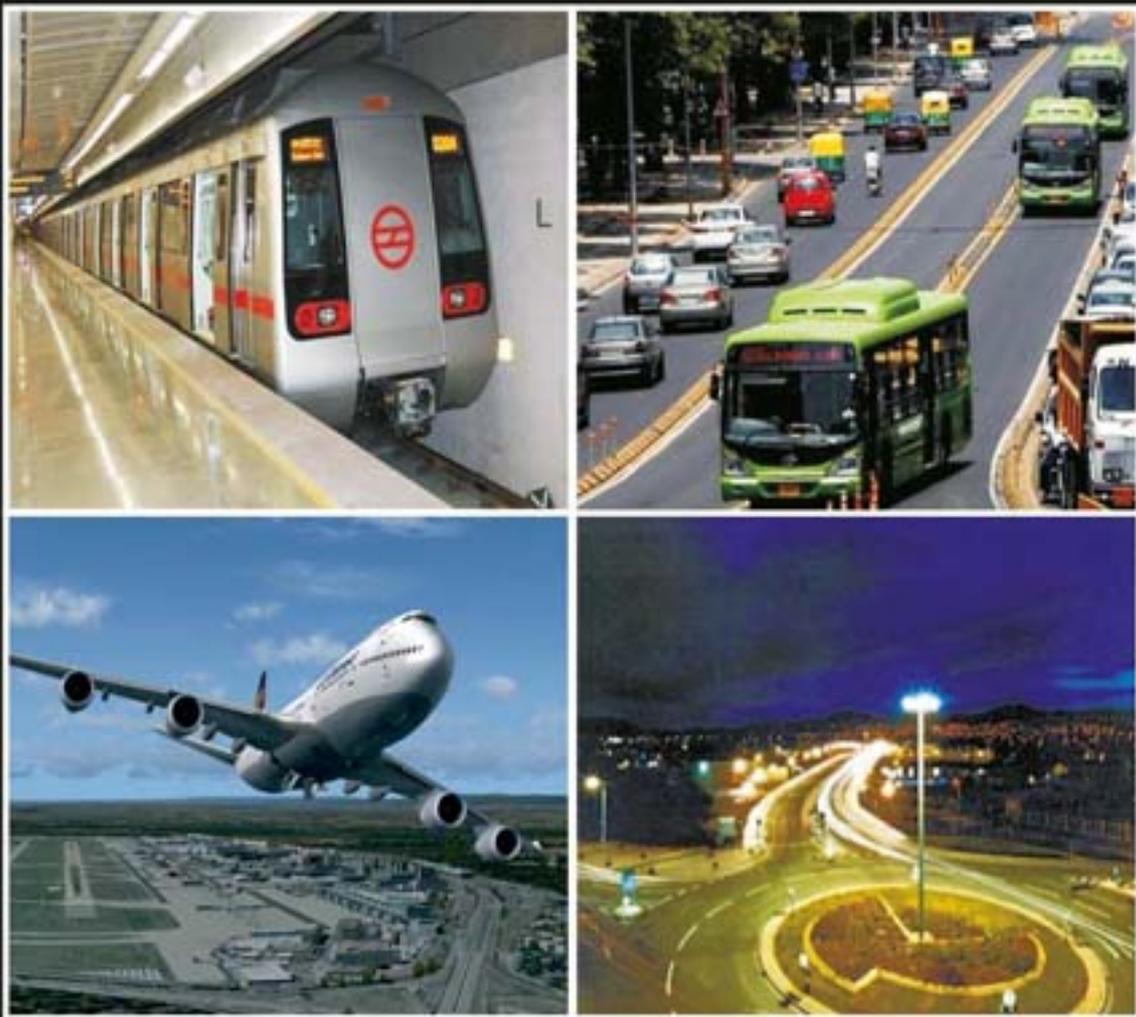


PLANNING, DESIGN & ENGINEERING of
Sustainable
Urban Transport
& Systems

A.K. Jain



KHANNA PUBLISHERS

SUSTAINABLE URBAN TRANSPORT AND SYSTEMS

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Preface

India's three way fast lane of liberalization, privatization and globalization is changing the lifestyles of its people. Increasing production, mobility and consumption are fast changing the patterns of travel and transport. Although transportation is the backbone of economic development, social transformation and urban growth, it suffers from serious problems, severe backlogs and poor planning, implementation and enforcement. The runaway growth of automobiles poses a considerable threat to the society in the form of traffic congestion, road accidents, pollution, noise stress, etc. Traditional solutions to cope up with the demand of increasing traffic have resulted into widening of roads up to the brim and parking spill over on the sidewalks thus eating away the area meant for the pedestrians and cyclists. Various studies indicate that the ownership of the private vehicles in urban areas is growing three to four times the population growth rate. The construction of flyovers, underpasses or grade separators is a temporary solution to congestion on the roads and if not planned carefully public transport may not necessarily reduce the volume of personal vehicles on the roads. The share of cycles, and non motorised vehicles (NMVs) is dwindling in Indian cities, which usually lack dedicated and safe right of way. In Indian cities as transport infrastructure usually guides the land use and planned residential areas along major arteries get converted to commercial and other uses. Parking is emerging as a major problems besides frequent traffic jams. The inadequacy of resources for road construction and poor maintenance add to traffic problems.

Annually more than one lakh lives are lost on Indian roads due to traffic accidents. With less than 1 per cent of the world's vehicle population, India accounts for 6 per cent of world's road accidents and 10 per cent of world's road fatalities. With rapid growth in vehicle ownership, and India having one-sixth of the world's population, the road transport demand is growing very fast; and consequent safety is becoming a major hazard. Apart from the traffic jams, gridlocks and accidents, the greenhouse gas emissions are increasing exponentially with the high end transportation, i.e. car-travel, air travel, etc.

A significant aspect in the context of congestion and pollution, relates to the growth in personalized transport as compared to the availability of public transport. It is estimated that buses, which constitute barely 1.2 per cent of the total number of vehicles, cater to around 60 percent of the total transport load, while personal Vehicles cater to around only 30 percent of the travel demand. Such a huge share of private vehicles, while serving a relatively limited purpose in terms of the transportation modal split, obviously creates tremendous pressure on road space, parking, and pollution. Public transportation must, therefore, drive the society. So far public transport is largely seen as the transport mode for the not so well off and poorer sections of the community, who cannot afford to own/use personal transport. An important element of National Urban Transport Policy is to shift private vehicle users to public transport. Apart from aspects like frequency, inter-modal integration, a possible single ticketing systems, parking policy, the quality of public transport, particularly buses, would need to be significantly upgraded, inter-alia, keeping in view the element of clean and green fuel and traffic calming for sustainable transport.

Transportation policy and planning have dominantly been concerned with moving people by mass transport, modernisation and introduction of new systems of transport. Construction

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of grade separators, bridges, flyovers, widening of roads, metro, etc. have been pursued during the last decades. The net result is to sustain and subsidise inefficient and loosing public transport undertakings, which consequently encourages personal transportation. The paradox of transport policy has been that very ills it must resolve are the consequences of such a policy. This has also relegated para-transport and traditional modes into background. Classical case is of the bicycles in Delhi which declined from 23% in 1970 to 5% in 2010.

A walkable community should provide a fundamental building block in creating a sustainable urban form. The concept of a polycentric urban structure can be evolved in which a city comprises a network of distinct but overlapping communities, each focused on a local centre, within which people can access on foot most of the facilities and services for day-to-day living. Each of these communities is defined by the walking catchment or “ped-shed” around the centre. This is generally taken to be c.800m, equating to a 10-minute walk. Organisation of land use, circulation pattern and decisions regarding density, Floor Area Ratio and other controls should be around the Public Transport System, which reduce the need of personal vehicles and transport. The spatial model should be based upon the principle of “less travel, more energy saving.” As such, a compact development can significantly help in saving fossil fuel consumption, climate change and environment. Critical instruments for this policy option include synergy with public transport, infrastructure development, mixed land use, and e-governance, which reduce the need to travel. Mixed land use creates more accessible urban pattern, which reduces the need of travel.

A successful compact and smart city requires planning around public transport that is, transit oriented development. Examples include: Singapore’s integration with radial and circumferential mass rapid transit, Curitiba’s integration with bus rapid transit on the linear main roads, Freiburg’s integration with light rail transit and environmental commuter pass, and Holland’s A, B, C land use policy based on a differentiated categorisation of locations according to accessibility to public transport.

Although the roads are the lifeline of socio-economic development, the available road capacities are grossly inadequate in the cities. Rapidly increasing demand for transport and the resulting traffic congestion have led to pressures to build new transport infrastructure. Although, as a long-term measure many of these capital-intensive transport systems are justified, the fact remains that most of the cities can ill-afford such expensive solutions. Thus, there is an inescapable need to adopt the approach of sustainable transport. Urban Structure

Sustainable transport implies focusing upon environmentally responsive transport and reduction of energy use. A sustainable society is essentially a walkable community, which means evolving sustainable transportation, reduction in use of fossil fuels, promoting alternative sources of energy and conservation of natural resources. It is necessary to adopt Clean Development Mechanism (CDM) for transport. Walkable community, compact and smart growth with home based offices contribute in making the society low carbon. This requires a transformation of living and mobility patterns. Sustainable mobility should be the basis of planning and growth, alongwith signals enabled investment and technology choice. The pressures of increased land values, urban accessibility, expanding population, globalization of commerce and the locational preferences demand efficient and optimum use of land.

Sustainable and integrated planning of transport and measures such as Transport Demand Management, Transit Oriented Development and promoting non-polluting public transport can bring about a new pattern of urban mobility, settlement structure and lead to

environmental conservation. This will require re-examining the concept of single land use zoning and city structure which should be based on conservation of transport.

Public Transportation should be the basis of design of the future urban space. Networked just-in-time public transportation systems using BRT, hyper buses, light rail, hypertrams could be the least cost solutions with lowest ecological footprint. This can be serviced by a rapid hydrogen-powered public transport network. High speed intercity rail line, air transport and the containerisation with radio tagging of goods enable automated rapid goods movement across different levels of aggregation. Piggybacking on the passenger network should be an integral component of network planning.

A least-cost life-cycle analysis of transportation systems across a range of carriageways and modes (pedestrian, road, light rail, rail, water and air) should be able to establish an optimum long-term mix. A mix of bicycles, people movers, hyper-trams, hyper-buses and waterways can provide a safer, faster and cheaper service than the inefficient personal car. This calls for development of dedicated bus corridors, grade separated parking and property development/land bundling to offset the investments.

Communications provide a viable substitute for transportation. As such, transportation policy is to be linked with telecommunications, electronic mail, video-conferencing, radio-paging, mobile-phones, computer networking, E-mail etc. as the alternatives to physical movement. Likewise there is a need to redesign the system of goods movement. Containers and computers can very effectively avoid unnecessary goods movement.

Road safety problem in India, which has grown to disaster proportions, is not only a socio-technical problem, but has created a serious public health issue. Road Safety Audits are seldom undertaken. The countries which have been able to successfully reverse the trend, tackled it through structured programmes as part of national mission. Multiplicity of modes in transport and low level of education, incompatibility of the road use behaviour make the problem extremely complex, and it requires innovative solutions. A serious effort by thorough scrutiny of the existing and planned road infrastructure, safety audit and strengthening and revamping the institutional framework for targeted levels of road safety is the first step towards ameliorating the situation. A proper accident data record system is a pre-requisite. There is a need for a holistic action plan and implementation of an effective management system to make a breakthrough in such a huge problem. In urban areas it is essential to ensure road safety, streamline road safety by improvement of roads with emphasis on space for pedestrians and through the upgrading of traffic control capability.

Traffic safety issues need to be addressed by a synergy of simulated models of planning and engineering, development of norms and standards, traffic management and enforcement, road safety audits and maintenance practices. The traffic management can be simulated for efficient lane capacity, work zone management, utilities coordination and developing traffic safety. There is a need to evolve various benchmarks, protocols and norms for road planning and development, including the variable traffic information/signage, street furniture, lighting, signals, hoardings, roadside landscape, zebra crossings, pedestrian passages, commuter facilities, etc. To deal with these issues in a coordinated and comprehensive manner, simulation modelling provides a pragmatic tool. Real time computer model enable the extraction of valid inferences on the behaviour of road users/drivers traffic pattern, dynamics and control systems. The Simulation Models assist the designer to arrive at various options and choose the best solution to urban congestion, environment, safety or otherwise.

Strategic and microscopic simulation models provide efficient tools for planning of transport schemes, land use structuring, transport terminals, integration of multi-modal transport, as well as for micro planning, design of road junctions and traffic interactions, bus passenger and pedestrian services/linkages/facilities, dedicated bikeways, signal operation, emergency evacuation, etc. By simulation the aspects of local traffic variations, transport modes, climate, environment, behaviour of the travellers/drivers, etc can be factored in the design. The simulation models open up a new window to synergise urban transport planning and management with the variables of human behaviour, travel habits and variety of needs in the pursuit of safe and sustainable mobility.

The book 'Sustainable Urban Transport and Systems' is a sort of practitioner's manual which provides comprehensive information, concepts and norms for traffic and transportation planning and engineering. This book synthesizes pertinent data and standards and also dwells on planning of various transport infrastructure such as airport, railway stations, metro terminals, multi-level parking, etc. The principles, practices and parameters given in the book are backed and evidenced by empirical data.

While working on Delhi Master Plan-2021, and National Urban Transport Policy, and also teaching the students of Planning, I realized that the professionals especially the younger generation, want to change the world, but grope in the dark when it comes to application of knowledge. This has been the main reason of writing this book. It had been an exciting journey of discovery. It presents a sort of roadmap which provokes a fascinating and complex area of enquiry. I have tried to keep the text as simple as possible and include a large number of illustrations which make it easy to draw out key threads of transportation infrastructure development. A wide range of the concepts have been explained, which should provoke the readers into new ways of thinking and the way transportation infrastructure should be planned and managed. The structure of the book allows the reader to capture the big picture and also to understand working details for further application and development of the urban transport systems. The examples provide reference points for application of the ideas and understanding of the nuts and bolts of transportation infrastructure and how they fit together. The book provides an Indian, as well as a global perspective on the subject.

Although my name appears on the cover of this book, behind the scene many people have contributed a great deal to make it possible. Saying thank you to them seems poor reward for their support and help. Several engineers, transport experts, urban planners, and students, have motivated me to write this book. The information sourced from various publications, as far as possible, has been cited and acknowledged. In case of any corrections and omissions, I shall be grateful if it is pointed out for the future editions.

I have enjoyed a happy relationship with the publishers and am grateful to Mr. V.K. Khanna of Khanna Publishers who is always patient and encouraging. He has been able to convert an unwieldy manuscript into this compact, beautiful book. The people I relied most persistently have been my family-my wife, son and daughter-to whom this book is dedicated with love.

A. K. Jain

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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.

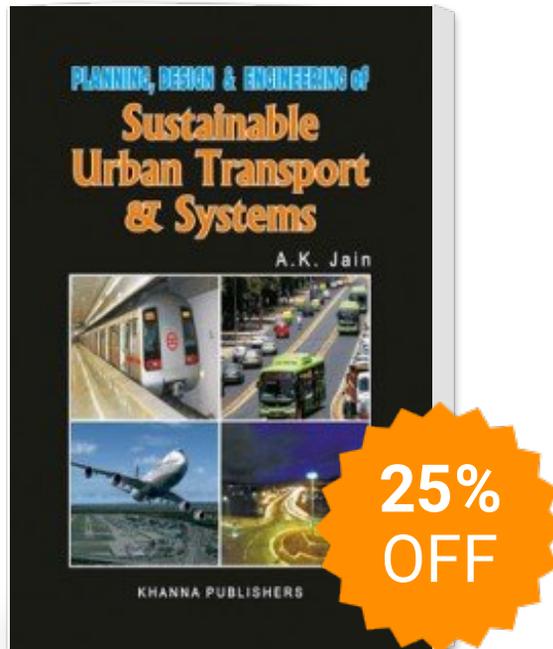
India (population 1210 million) has around 100 million vehicles comprising nearly 70 per cent private vehicles (about 10% cars and 60% two wheelers). During last 40 years the oil consumption increased by 900 per cent at an average annual growth of 20 to 25 per cent. India's highways and urban road networks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

Planning, Design and Engineering of Sustainable Urban Transport & System



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