

SERIES-2, TRANSPORTATION  
VOLUME - 2

# PLANNING FOR **PEDESTRIAN AND CYCLE MOVEMENT**



**INSTITUTE OF TOWN PLANNERS INDIA**  
HARYANA REGIONAL CHAPTER, PANCHKULA



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For  
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**Institute of Town Planners, India  
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## Preface

Rapid urbanization has increased the volume of mobility in towns which has created serious problems of congestion, poor air quality and a wide range of other problems requiring the promotion of alternatives to the growing reliance on automobiles. The planning for Non-Motorized Transport (NMT) which constitutes 40% of the total trips in towns of India has remained a neglected aspect in the physical planning and development. Rapid urbanization has made Indian cities increasingly unfriendly for pedestrians and cyclists, although, pedestrian movement and cycling are among the most sustainable modes of mobility. They have zero dependence on fossil fuels, no emissions, no environmental impact and present many health benefits apart from being an affordable transport option for millions of Indians who cannot afford any form of motorized transport.

The present study encompasses the need, importance, problems, solutions and planning aspects relating to pedestrian and cycle movement with their application to Indian cities. The study is in four parts; the first part covers the introduction, scope, need and importance of walking and cycling. The focus of second part is on problems and basic requirements of cyclist and pedestrians. It also covers the concepts used worldwide to enhance cycling and pedestrian movement. The third part covers the findings and recommendations relating to planning considerations, design considerations, safety and convenience of the pedestrians and cyclist and the fourth part concludes the study.

Ms. Gurpreet Kaur and Ms Rajdeep Kaur, Research Officers, ITPI-HRC have done extensive research for this subject under the able guidance of Sh. Raj Vir Singh. I am thankful to the research team for this valuable work and hope this study will be of useful to the students, teachers and practicing town planners.

Dated: 25-11-2017

(Nadim Akhtar)  
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## ABBREVIATIONS

BRTS- Bus Rapid Transit System

CAI-Asia - Clean Air Initiative for Asian Cities

CMP - Comprehensive Mobility Plan

CSCL - Chandigarh Smart City Limited

EU - European Union

IRC- Indian Road Congress

IUT - Institute of Urban Transport

KSI - Killed or Seriously Injured

LOS - Level of Service

MRTS- Mass Rapid Transit System

MoUD - Ministry of Urban Development

MORTH- Ministry of Road Transport and Highways

NMT - Non Motorized Transport

NMSH - National Mission on Sustainable Habitat

NMVs - Non Motorized Vehicles

NMSH- National Mission on Sustainable Habitat

NUTP- National Urban Transport Policy

OPP - Ottawa Pedestrian Plan

TfL - Transport for London

UCI - International Cycling Union

VRU – Vulnerable Road Users



## CHAPTER-1

### INTRODUCTION

Walking and Cycling, offers multiple benefits including decreased vehicular congestion as well as positive impacts on the public's health and the environment. According to "Planning and Design Guidelines for Cycle Infrastructure"<sup>1</sup> most of the urban residents in India depend upon non motorized transport (NMT), which includes walking, cycling and cycle rickshaws to meet their access needs. Cycle is the most affordable form of transport available to low-income households. NMT provides accessibility in the congested cities. It not only offers environmental advantages but provides a holistic range of benefits to both the individual and the city. This includes health, equity, better air quality road safety, livable cities and equal opportunities to all irrespective of their socio-economic status. Yet, the planning of NMT movement is a neglected aspect in the physical planning of cities in India. Rapid urbanization has made Indian cities increasingly unfriendly for pedestrians and cyclists. In all the cities, vulnerable road users (pedestrians, bicyclists and motorized two wheeler occupants) constitutes more than 80% of all fatalities. Pedestrian fatality share at the national level is 13%.<sup>2</sup>

As per Clean Air Initiative for Asian Cities (CAI-Asia), metropolitan cities like New Delhi, Mangalore and Kolkata have a pedestrian fatality share greater than 40%. As per CAI-Asia in 2011, CO<sub>2</sub> emissions from road transport is increasing at the rate of 7.75% per year. Liquid fuel consumption rate in transport sector is as high as 28% of the total petroleum product consumption in India.<sup>3</sup>

Walking is a key mode of transport and streets are regarded as important community spaces where 'people come first'. To support this, it is necessary to manage private vehicle use and improve the way public transport operates. Walking enhances urbanity, lifestyle, and health. It is a zero-emission mode of transport that needs to be the primary focus of a sustainable

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<sup>1</sup> Velo Quebec, A Technical guide on "Planning and Design for Pedestrians and Cyclists"

<sup>2</sup> Foundation for Innovation and Technology Transfer, Indian Institute of Technology, Delhi (2012), "Planning and Design Guideline for Cycle Infrastructure"

<sup>3</sup> Prof. S. Bhagat Sejal, Er. L.Patel Manoj and Er. S. Shah Palak, (2014),"Pedestrian Priority in Urban Area and Usefulness Towards Community "

habitat. Therefore, walking facilities should be designed and managed to accommodate a wide range of users.

After walk, cycle is the second most important mode of transport for urban poor. Cycling contributes to improving air quality and mitigating climate change, noise reduction, improved physical health and is most economical. As such, an ideal social means of transport which can operate in narrow streets, undulating terrain and difficult areas.<sup>4</sup>

### 1.1 SCOPE

The study covers the need, importance, problems, solutions and planning aspects relating to pedestrian and cycle movement with their application to Indian cities.

### 1.2 NEED AND IMPORTANCE

On an average, 40% of trips in urban India still do not involve a motorized vehicle, out of which 28% are of walking. Pedestrian crashes and the resulting deaths and injuries are a serious problem on our roadways. In urban areas, pedestrian deaths typically represent 25 to 40 percent of traffic fatalities.

Pedestrians and cyclists are most vulnerable as intersections are more difficult to cross, that is when pedestrians encounter wide crossing distances, wide turning radii, multiple turn lanes, or traffic control that is confusing or complex. Other high-risk factors are drug/alcohol use by motorists and pedestrians, lack of nighttime roadway lighting, and the lack of walkways along roads.

**Table 1: Percentage of Pedestrian Accidents in Major Cities (2010)**

Cities	Accidents percentage (%)
Kolkata	14.02
Chennai	38
Delhi	20
Mumbai	64

*Source: Ministry of Road Transport and Highways, 2010*

<sup>4</sup> Ministry of Urban Development (2014), "National Urban Transport Policy", by Government of India.

Cyclists in India are bullied badly by all the other mode of commutation. The cyclists don't even get to know who is coming towards them and from which direction.<sup>5</sup> 35% people of Delhi own cycles, but only 4% of trips are by cycle because it's unsafe and dangerous to use them.<sup>6</sup>

Data obtained from the Chandigarh Police shows that while the number of fatal accidents has declined over the last five years, the percentage of cyclists among the victims has consistently increased from 14.49 in 2010 to 30.77 in 2013.<sup>7</sup>

The National Urban Transport Policy, 2014 (NUTP) and National Mission on Sustainable Habitat, 2014 (NMSH) have stressed the need for an approach that focuses on people and not vehicles. Indian cities have a high latent demand for cycle and walking trips, which can be realized with the introduction of suitable infrastructure, facilities and resources.<sup>8</sup>

The passenger and goods cycle rickshaws (together with cycles referred to as Non Motorized Vehicles or NMVs), form the primary source of mobility and livelihood to a considerable proportion of the population ,but the lack of key information on NMT to city authorities , designers and practitioners is a missing link to create the necessary infrastructure for NMT in India.

Traffic in India is highly heterogeneous in nature. In crossing mid-block section, pedestrian - vehicle interaction is more, this leads to higher risk of accidents and safety problems. Pedestrians are one of the most vulnerable road users at un-signalized midblock sections. Pedestrian road crossing is a serious hazard to pedestrians at uncontrolled midblock crossing locations under mixed traffic flow conditions in India. In the years between 2011 and 2015, about 25,435 cyclists have been killed in India and the total number of pedestrians killed in 2013-2015 is shown in table 2, which depicts that the non-exclusive facility for pedestrian crossing is quite common in Indian condition and it often leads to the fatal accidents.

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<sup>5</sup> Bhatia Anisha (2017), Article on "Cycling in India: Is it worth the risk", NDTV

<sup>6</sup> Delhi Development Authority (2009), "Pedestrian Design Guidelines", UTTIPEC

<sup>7</sup> The Indian Express (July 21, 2014), Article on "Data: Pedestrians, Cyclists Account for 60% Road Deaths"

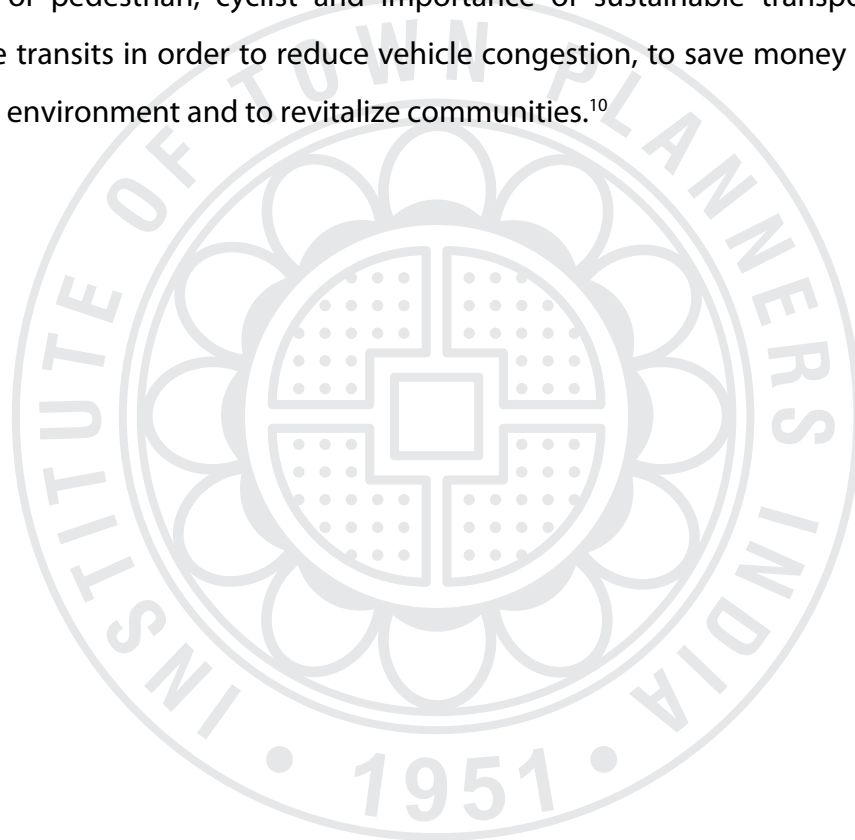
<sup>8</sup> Ministry of Urban Development (2014), "National Urban Transport Policy", by Government of India.

**Table 2: Pedestrians Deaths in India (2013-2015)**

Year	Pedestrians killed
2015	7,088
2014	6,690
2013	12,385

**Source: The Indian Express (December 8, 2016), Article on "Pedestrian deaths in road accidents rise to 7,088 in 2015"**

There is an urgent need to plan for pedestrian and cyclist's movement by understanding the characteristics of pedestrian, cyclist and importance of sustainable transport modes<sup>9</sup> by connecting the transits in order to reduce vehicle congestion, to save money and resources, to improve the environment and to revitalize communities.<sup>10</sup>



<sup>9</sup> The Royal Society for The Prevention of Accidents (2004), "Policy, Planning and Design for Walking and Cycling Local Transport",

<sup>10</sup> NJDOT Local Technical Assistance Program (December 2010), "Bicycle & Pedestrian Plan", City of Hoboken



## CHAPTER-2

### PLANNING FOR PEDESTRIAN AND CYCLE MOVEMENT

In order to successfully design pedestrian and cyclist facilities, one must recognize that pedestrian and cyclist needs are wide-ranging and design approach must be flexible to meet the diversity of needs. One common obstacle in design of pedestrian and cyclist facilities is assuming that one standard can be applied to all journeys and population.

Sometimes there are tensions between pedestrians and cyclists sharing the same pathways. While improved infrastructure (such as better and wider pathways) will assist in many instances, cyclists must always recognize the need to share the off-road space with pedestrians and must give way to pedestrians at all times while riding on shared pathways. Pedestrians must also show greater respect for cyclists.

Pedestrians can also modify their behavior to better accommodate cyclists and must recognize that cyclists are genuine users of shared pathways and use the pedestrian sections of separated paths. It is similarly the responsibility of all pathway users to behave in a safe and sensible manner that does not endanger or diminish the safety and enjoyment of others.<sup>12</sup>

#### 2.1 PEDESTRIAN MOVEMENT

Pedestrians are a diverse group of road users. While many pedestrians may be fit and healthy, have satisfactory eyesight and hearing, pay attention and are not physically hindered, but this is not the case for all pedestrians. While planning for pedestrians impaired section should also be considered. Pedestrians should be placed at, the top of the road user hierarchy, with their needs met by facilities and treatments that provide a high level of safety and access. Pedestrians should be considered at an early stage in planning transport infrastructure as they are at present the most vulnerable lot for accident due to following specific reasons:

- a) Lack of pedestrian facilities: Such as inadequate or no sidewalks or walkways, discouraging or limiting safe pedestrian movement along streets and inadequate lightning system during night.

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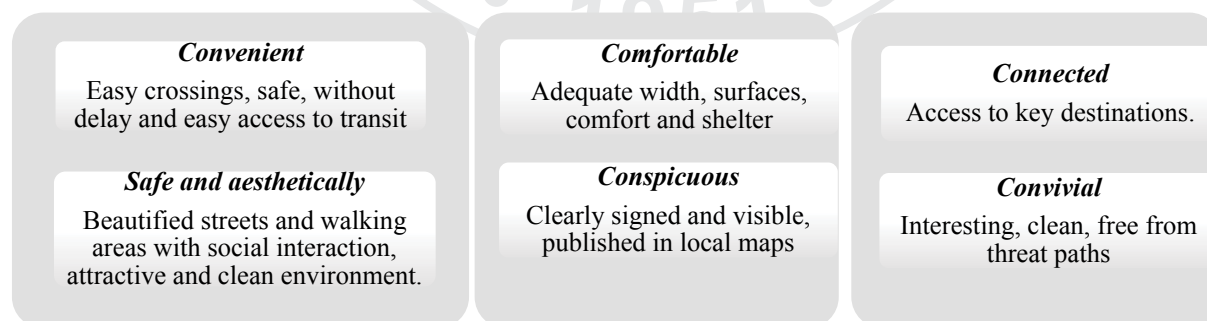
<sup>12</sup> City of Sydney Council, (2007), "Cycle Strategy and Action Plan (2007-2017)", City of Sydney

- b) Lack of safe crossings: High-volume multilane roads with a lack of safe crossing at regular intervals can contribute to pedestrians crossing streets at unsafe locations, particularly those who cannot or will not walk great distances to signalized locations.
- c) Intoxication and drug effects: Alcohol and drugs impair the behavior of pedestrians to the extent that they may be a primary cause of accident.
- d) Pedestrian behavior: Many pedestrian crashes are the result of unsafe motor vehicle driver and pedestrian behaviors.
- e) Roadway designs features: Certain roadway designs features can contribute to unsafe behaviors by pedestrians and motorists. For example, excessively-wide streets encourage higher motorist speeds.
- f) Land use allocations: Land use decisions can also result in areas that are unsafe for pedestrians. For example, separating residential areas from shopping areas with high-volume multilane roads forces some pedestrians to cross streets in places that may not be safe.<sup>13</sup>

Therefore, appropriate levels of pedestrian service should be established and provided across the road hierarchy and path network by also considering the both impaired as well as normal people throughout the entire network.

### 2.1.1 Basic Requirements for Walking

Mainly there are six basic requirements for walking which should be considered while planning for the pedestrians and these are given below in figure 1.



**Figure 1: Basic Requirements for Walking<sup>14</sup>**

<sup>13</sup> The Royal Society for The Prevention of Accidents (2004), "Policy, Planning and Design for Walking and Cycling Local Transport",

<sup>14</sup> New Zealand Transport Agency (2009), "Pedestrian planning and design guide", Government of New Zealand

In the figure 2, the hierarchy of pedestrian facilities has been arranged according to the level of comfort, i.e. first priority has been given to off street pedestrians (independent pedestrian path) followed by multi use pathway, wide sidewalk, buffered sidewalk, paved sidewalk, unpaved sidewalk and paved shoulder. Therefore, while planning green field projects independent pedestrian paths should always be provided.



Figure 2: Pedestrians Facilities by Level of Comfort<sup>15</sup>

### 2.1.2 Type of Pedestrians

A 'pedestrian' is a person on foot or on small wheels or can be an impaired person. This can include an able pedestrian, a person pushing a pram, a person on a skateboard, a person in a wheelchair and a number of other users.<sup>16</sup> There are mainly three types of pedestrians, which encompasses on foot, on small wheel and mobility impaired which can be sub grouped in many as given in the Table 3 given below.

Table 3: Type of Pedestrians

Type of pedestrians	Sub groups
<b>On foot</b>	Able pedestrians
	Runner/ jogger
	Adult and Younger pedestrian
	Impaired pedestrian
	Skateboards and Kick scooters
	Roller skates
	Pedestrian with pram
<b>Mobility impaired</b>	Mobility scooters
	Manual and electric wheelchairs
	Pedestrian with walking frame

Source: <http://exchange.aaa.com/safety/pedestrian-safety/types-pedestrians/#.WTksiGiGNPY>

<sup>15</sup> Urban systems, Region of Peel, Brampton "Pedestrian and Bicycle Facility Design Guidance"

<sup>16</sup> New Zealand Transport Agency (2009), "Pedestrian Planning and Design Guide", Government of New Zealand

However, while planning for pedestrian's mobility and cognitive impairments should also encompass throughout the entire network i.e. for Mobility scooters, Manual wheelchairs, and Electric wheelchairs and the pedestrian with walking frame.

### 2.1.3 Type of Pedestrian Accidents

Pedestrian accidents mostly occur between a car and a pedestrian. These types of accidents can happen while pedestrians are walking, running or standing on the sidewalk. There are many different type of pedestrian accident with different health and legal consequences for the driver and the pedestrian<sup>17</sup>. Typical types of pedestrian accidents are shown in the figure 3.

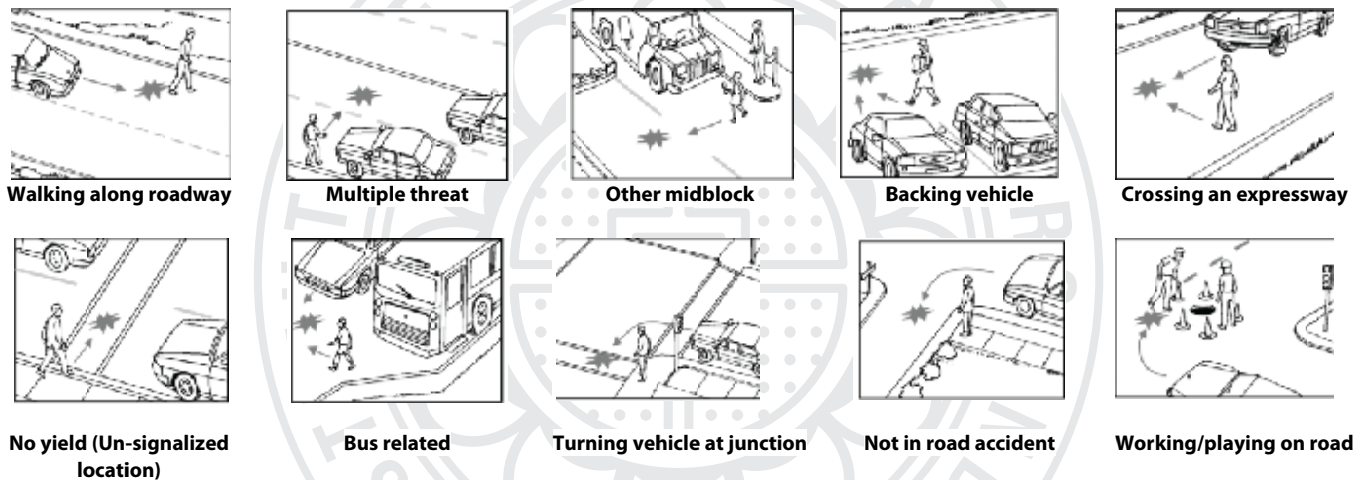


Figure 3: Type of Pedestrian Accidents<sup>18</sup>

### 2.1.4 Concepts

Following are the concepts which can be used to enhance the pedestrian movement and to reduce the pedestrian vulnerabilities. These are some of the concepts being used in different countries worldwide.

#### a) Living Streets

In 'living streets' cars are not excluded, they are so designed that drivers are aware that they are in an area where pedestrian and other users are important as in case of Denver in Colorado.

<sup>17</sup>Allan Goldfarb PA, Miami, Article on "Types of Pedestrian Accidents"

<sup>18</sup>Allan Goldfarb PA, Miami, Article on "Types of Pedestrian Accidents"

A living street encompasses traffic-calming measures, hard and soft landscaping areas, places for social activities; children's play areas and seating and lighting improvements. The living streets concept can be applied to any road (other than a motorway).



**Figure 4: Living Street**<sup>19</sup>

Not all Living Streets look the same, but there are common elements that demonstrate the principles of a Living Street (refer figure 4). There are many advantages and disadvantages of the living streets such as it promotes quality housing, improves social interaction and creates a sustainable environment. It maintains ease of access and creates an aesthetically pleasing environment.<sup>20</sup> The main limitations are the delay in motorized traffic and are costly to create.

#### b) Pedestrian Precincts

'Only pedestrian' oriented areas are created by restricting traffic access or closing roads to traffic (refer figure 5). There are four types of pedestrian precinct:

- i. Modified street precinct: One block is closed for pedestrian-only use.



**Figure 5: Pedestrian Precinct with Event Space, Brisbane**<sup>21</sup>

<sup>19</sup> EPA Smart Growth Implementation Assistance (2009), "Implementing Living Streets: Ideas and Opportunities for the City and County of Denver"

<sup>20</sup> EPA Smart Growth Implementation Assistance (2009), "Implementing Living Streets: Ideas and Opportunities for the City and County of Denver"

<sup>21</sup> EPA Smart Growth Implementation Assistance (2009), "Implementing Living Streets: Ideas and Opportunities for the City and County of Denver"

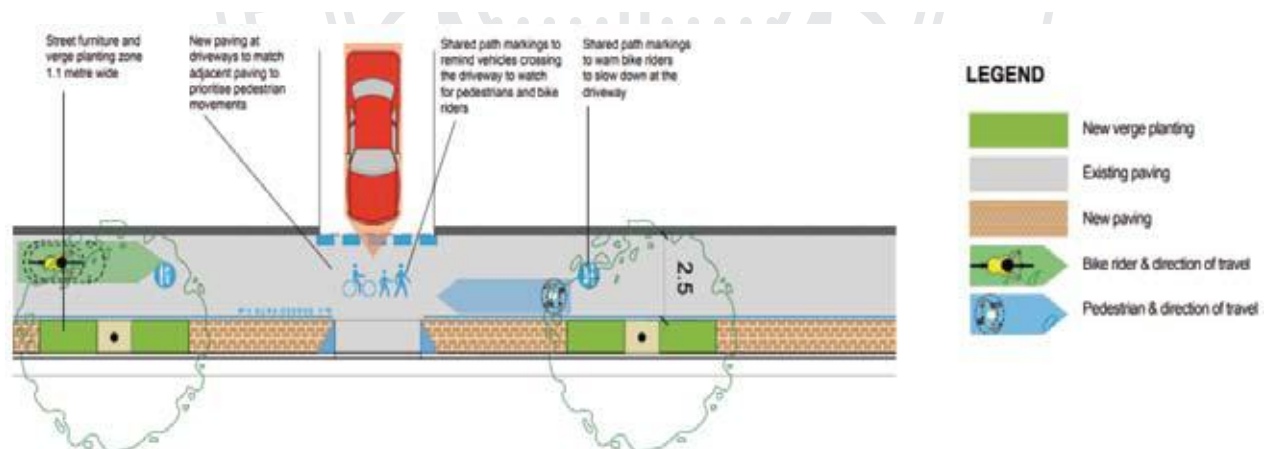
- ii. Plaza: Several blocks are closed but the cross-streets stay open to all traffic.
  - iii. Continuous: Several blocks and the cross-streets are closed.
  - iv. Displaced: Walkways are developed away from the usual roadside footpaths, making use of lanes.
- There are many advantages and disadvantages of the pedestrian precincts such as pedestrian freedom of movement and road safety (refer figure 6). It is having aesthetic, social and economic benefits such as reducing pedestrian congestion and improving air quality and noise levels. On the other hand it results into inconvenience to traffic movement such as diverting bus routes, which can result in longer travel times.



**Figure 6: Home zone, Bristol, United Kingdom**<sup>22</sup>

#### c) Shared Path

A shared path is a footpath shared by pedestrians and bike riders. Pedestrians have the right of way on shared paths and bike riders should slow down and use their bell to warn pedestrians of their approach (refer figure 7).



**Figure 7: Proposed Shared Path, Sydney**<sup>23</sup>

This proposed shared path in Sydney includes:

- i. New paving at driveways to priorities the pedestrian movements.
- ii. Consolidation of the street furniture and verge planting zone to a 1.1 meter width.

<sup>22</sup> EPA Smart Growth Implementation Assistance (2009), "Implementing Living Streets: Ideas and Opportunities for the City and County of Denver"

<sup>23</sup> Sydney (2030) "Concept Design of Bourke Street, Waterloo - Shared Path", City of Sydney

- iii. There will be minimum 2.5 meter wide path for pedestrians and bike riders.
- iv. New verge planting and paving would be there to improve street amenity.<sup>24</sup>

## 2.2 CYCLE MOVEMENT

Bicycle riding has many positive benefits related to health as well as to transportation and the environment, as bicycling can be even more beneficial than walking with respect to physical fitness. It is the responsibility of the cyclist to behave in a safe and sensible manner that does not endanger or diminish the safety and enjoyment of others.<sup>25</sup>

Shifting from a 'footpath only for pedestrians' to a shared footpath for both pedestrians and low speed cycling is not a threat to pedestrians when managed appropriately. Cyclists who obey the law and ride sensibly on a shared footpath are no less threat to pedestrians than a car that runs a red light or does not give way to pedestrians. Traffic speed is a crucial factor in road safety. Many collisions could be avoided if drivers kept to a speed that was safe for the environment they were driving in.

There are many important benefits that support increased cycling as a means of transport and recreation. These are:

- a) **More livable cities:** Cycling is an essential element of a sustainable transport system in one of the world's most livable cities. Cycling can improve access and sociability within communities.
- b) **Health:** Cycling increases physical activity, improving individual health and has shown to reduce the risk of cardiovascular disease, high blood pressure, diabetes, excess weight, obesity etc.
- c) **Congestion:** Bicycles take up less road space than cars and can help in reducing traffic congestion. In congested areas if the time required for parking is also considered the travel-time savings can be even higher. Bicycles require significantly less space for parking - up to ten bikes can be stored in the space needed for one car.
- d) **Economy:** Using a cycle for short trips can eliminate the need for a car in many cases.
- e) **Environment:** Cycling is non-polluting and quiet means of transport. It eliminates greenhouse gas emissions and saves fuel.

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<sup>24</sup> Sydney (2030) "Concept Design of Bourke Street, Waterloo - Shared Path", City of Sydney

<sup>25</sup> C. Lusk Anne and Morency, Patrick (2013) "Bicycle Guidelines and Crash Rates on Cycle Tracks in the United States", American Journal of Public Health

- f) **Social equity:** Cycling provides an affordable form of transport.
- g) **Compatibility:** When used in combination with other forms of public transports cycling can provide the last mile connectivity.

However, the Indian cities are not conducive for large scale cycling. An example of variation can be seen in the average distance covered by cycling are given below:

***In United States:***

The average distance covered by bicycles in the Midwestern and northern regions of the US:<sup>26</sup>

- i) Entertainment, recreation and fitness trips - 30 to 40 km.
- ii) Work and shopping trips - within a range of about 10-20 km.

***Indian context:***

The average distance covered by bicycles in India according to "Institute of Urban Transport Journal"<sup>27</sup> is-

- i) Larger cities with population above 1 million - 7 km.
- ii) Cities (with population 0.5–1.0 million) - 3.5 km.
- iii) Smaller cities (with population less than 0.5 million) - below 3 km.

**2.2.1 Basic Requirements for Cycling**

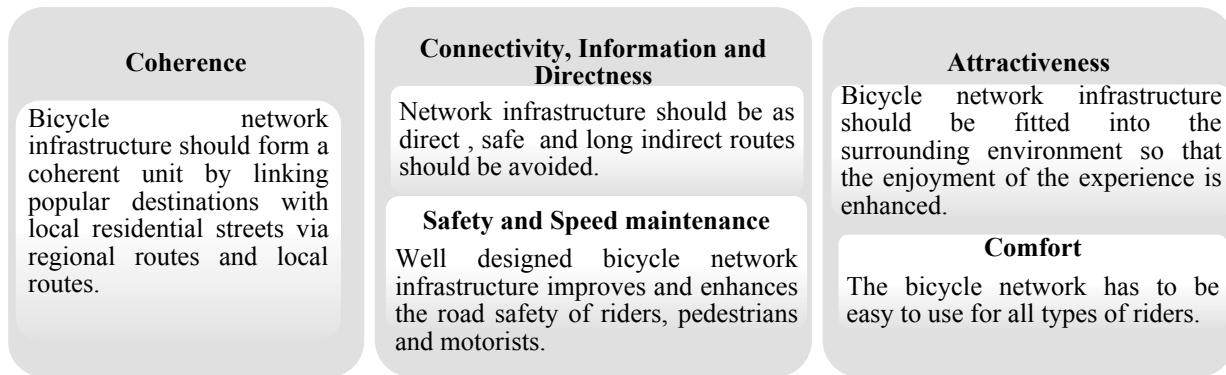
The needs of people cycling are very similar to those of car drivers such as cyclist needs space, direct routes between housing areas and major destinations unobstructed routes and convenient cycle infrastructure in order to make cycling the most pleasant. Mainly there are five basic requirements for cycling which should be considered while planning for the cyclists and these are given below in figure 7:

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<sup>26</sup> Michael Iacono, Kevin Krizek and Ahmed El-Geneidy (2008), Article on "Access to Destinations"

<sup>27</sup> Jain Himani and Dr. Tiwari Geetam, Journal on "Bicycles in Urban India", Institute of Urban Transport"





**Figure 8: Basic Requirements for Cycling**<sup>28</sup>

In the figure 9, the hierarchy of cyclist facilities has been arranged according to the level of comfort, i.e. first priority has been given to off street cycle path (independent cycle path) followed by cycle track, local street bikeway, bicycle lane, shared use lane and shoulder bikeway. In green field areas independent cycle path should to be provided.



**Figure 9: Bicycle Facilities by Level of Comfort**<sup>29</sup>

## 2.2.2 Types of Bicycle Infrastructure

### 1. Off-road

- a) *Bicycle path*: A path for the exclusive use of bicycle riders which will have either designated signage or pavement markings.

<sup>28</sup> New Zealand Transport Agency (2009), "Pedestrian Planning and Design Guide", Government of New Zealand

<sup>29</sup> Urban systems, Region of Peel, Brampton "Pedestrian and Bicycle Facility Design Guidance"



**Figure 10: Bicycle Paths Segregating with Strip Used for Cycle Parking**



**Figure 11: Bicycle Paths Segregating by Plantation Strip<sup>30</sup>**

b) *Shared path*: An area opens to the public (except a separated path) that is designated for use by bicycle riders and pedestrians. A shared path must have either designated signage or pavement markings.

c) *Separated path*: The length of a path where an exclusive bicycle path is complementary to an adjacent footpath. The separation may be visual (painted line) or physical (dividing strip or raised median).



**Figure 12: Shared Paths for Pedestrians and Bicyclists<sup>31</sup>**

## 2. On-road

a) *Bicycle lane*: A lane that is signed posted for use by bicycle riders only and marked with painted lines or a colored surface, without a physical separation from motor vehicles. Riders are required to use these lanes.

b) *Bicycle contra-flow lane*: Some streets permit motorized vehicles to travel in one direction only. Bicycles are permitted in the opposite direction by the use of a bicycle lane.



**Figure 13: Exclusive Bicycle Path Adjacent to The Footpath<sup>32</sup>**

<sup>30</sup> Urban systems, Region of Peel, Brampton "Pedestrian and Bicycle Facility Design Guidance"

<sup>31</sup> Urban systems, Region of Peel, Brampton "Pedestrian and Bicycle Facility Design Guidance"

<sup>32</sup> Urban systems, Region of Peel, Brampton "Pedestrian and Bicycle Facility Design Guidance"



**Figure 14: Bicycle Lanes**



**Figure 15: Bicycle Contra-Flow or Two Way Lanes**

### 2.2.3 Types of Signage

- Regulatory:** This signage can be provided in combination with the regulatory line marking, and defines the type of bicycle facility provided. Regulatory signage is always used to define the start of a facility.
- Warning, guidance and advisory:** This signage alerts riders to changed or potentially hazardous path or road conditions and is generally used on shared paths to assist with the safe use of these facilities.
- Directional:** Located at route decision points to assist users to find their way around the network. It may also indicate distance and/or estimated travel times.
- Interpretive:** Generally aimed at recreational users, interpretive signs provide route context in the form of maps as well as highlighting features or background of the area.<sup>33</sup>

### 2.2.4 Concepts

- Bicycle friendly metro

Copenhagen is one of the most cycle friendly cities in the world; it is the first and the only “bike city”. In order to attract more cyclists, public transport with cycling has been introduced in metro at



**Figure 16: The Bicycle Friendly Metro in Copenhagen, where Bicycle can be Carried on the Metro<sup>34</sup>**

<sup>33</sup> Veysey Michael, (2012), Plan on “How to Prepare a Bike Plan” by Roads and Maritime Services

<sup>34</sup> Ying Liang (2011), “Research on Bicycle Network Planning of Nanjing in China”, Swedish University of Agriculture Science

Copenhagen, where bicycle can be carried on the metro.<sup>35</sup>

#### b) Protected bicycle lanes

Protected bicycle lanes are a simple concept, they're like sidewalks for bicycles. Because they use planters, curbs, parked cars or posts to separate the bicycle and auto traffic on busy streets. Protected lanes are essential to building a full network of bike-friendly routes.

Protected Bike Lanes provide a higher level of protection for the cyclist.

Protected bike lanes separate the cyclists from moving traffic, decreases pedestrian crossing distances, and helps in improving the safety for all road users in order to maintain the existing mobility. Different examples from different cities worldwide showing the protected bike lanes by using parking cars, flex posts and planters which will act as a buffer between cyclists and motorized vehicles are shown in figure 17, 18 and 19.

#### c) Cycle Rental Schemes

Cycle sharing is often confused with a cycle rental systems. Cycle sharing is a technology based self-service system that differs from manual based rental services that are present in many parts of India. In Rental schemes there is a private cycle rental company. Cycles are rented and returned from a single location. Security is guaranteed through personal link or on the deposit of identification documents.



**Figure 17: Chicago, US, Before and After Installation of Protected Bike Lane by Parking Cars**



**Figure 18: Austin, Texas, Before and After Installation of Protected Bike Lane Using Flex Posts**



**Figure 19: Portland, Before and After Installation of Protected Bike Lane Using Planters as a Buffer**

<sup>35</sup> Ying Liang (2011), "Research on Bicycle Network Planning of Nanjing in China", Swedish University of Agriculture Science

d) Cycle sharing concept

Cycle sharing is a flexible form of personal public transport. Cycles are stored in a closely spaced network of stations. With a smart card or other form of identification, a user can check out a cycle from a station, use it for a short ride, and return it to any other station. Cycle sharing stations are often placed near public transport systems to provide last-mile connectivity.

Advantages of cycle sharing concept are that it extends the reach of the city's public transport system by solving the 'last mile' problem. It can help in reducing the congestion and improves air quality by attracting private vehicle users.<sup>36</sup>

**Table 4: Different Types of Cycle Sharing Concepts Have Been Classified Under**

S. No	Name of concept	Components	Characteristics
1	White bikes or free bikes system	Bicycles	Distinct bicycles, unlocked bikes, free of charge and haphazardly located in the area.
2	Coin- deposit system	Bicycles and docking stations	Distinct bicycles, specific locations and bicycles have locks.
3	IT based system	Bicycles, docking stations and IT based kiosks	Distinct bicycles, specific locations, bicycles have locks, smart technology to get access to the bicycle and anti theft efforts such as collect valid ID, verifiable contact details etc.
4	Demand responsive and Multi-modal system	Bicycles, docking stations, kiosks and distribution systems	Distinct bicycles, improved locking system, linked into public transport and a bicycle distribution network. <sup>37</sup>

**Source: Public Bicycle Concepts: Applying the Concepts in the Developing Cities**

### 2.3 CASE STUDIES

Walking and cycling are especially important modes of transportation for children, the elderly, and people who cannot afford to own and maintain a car. According to the 2010 U.S. Census, one-third of all households in the City of Philadelphia, New York are zero-car households. 25% to 80% of urban transport in Asia is by non-motorized vehicles.<sup>38</sup> In the view of this, it is necessary to focus on

<sup>36</sup> Ministry of Urban Development Government of India(2012)" Public Cycle Sharing Systems: A Planning Toolkit for Indian Cities"

<sup>37</sup> Dhingra, Chavvi and Kodukula, Santhish, (2010),"Public bicycle concepts: Applying the concepts in the Developing Cities"

<sup>38</sup> Jain, A.K (2009)"Urban Transport: Planning and Management", A.P.H Publishing Corporation

pedestrian and cycle movement, together with other transport modes. Following are some important practices prevailing on the subject.

### **2.3.1 London, United Kingdom**

Transport for London (TfL) is committed to increasing the number of walking trips in the Capital by a million additional trips a day by 2031. The Road Safety Action Plan for London 2020<sup>39</sup>, was launched in June 2013, and it set a target to reduce killed or seriously injured (KSI) casualties by 40 per cent, from the 2005-2009 baseline period, by 2020. There are six road safety commitments in the publication of 'Safe London streets'.<sup>40</sup>

- a) 40 per cent reduction in the number of people killed or seriously injured on the Capital's roads by 2020.
- b) To prioritize safety of the most vulnerable group's i.e. pedestrians, cyclists and motorcyclists (which make up 80 per cent of serious and fatal collisions).
- c) To provide substantial funding for road safety, invested in the most effective and innovative schemes.
- d) To increase efforts with the police, municipality and enforcement agencies in tackling illegal, dangerous and careless road user behavior that puts people at risk.
- e) To campaign for changes in national and European Union (EU) law to make roads, vehicles and drivers safer.
- f) To work in partnership with area and London's road safety stakeholders to spread best practice and share data and information.<sup>41</sup>

### **2.3.2 Ottawa Pedestrian Plan**

In Ottawa, about 21% trips are shorter than 2 km, but only about 40% of those trips are made by walking. Because a significant number of automobile trips are also short, there is a very real opportunity to replace short automobile trips with pedestrian trips. Recognizing the crucial role that walking plays in creating an attractive, accessible, safe and healthy city, the City has developed this

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<sup>39</sup> Transport for London (2013) 'Safe Streets for London: The Road Safety Action Plan for London 2020'

<sup>40</sup> Transport for London (March 2014) 'Safe London Streets: Our Six Road Safety Commitments'

<sup>41</sup> Transport for London, "Pedestrian Safety Action Plan", Government of U.K

Ottawa Pedestrian Plan (OPP 2013) to firmly place walking at the core of a sustainable transportation system. Walking trips are typically less than 2.5 km long.

- a) **Pedestrian Vision;** It aims to transform Ottawa into a world-class pedestrian city where an equally vibrant and functional pedestrian realm encourages people to walk all year-round. The realization of this vision will create several important dimensions of a more livable Ottawa in order to make the city vibrant and beautiful, an equitable, healthy, sustainable, safe and an integrated city.
- b) **Pedestrian Charter ;** With increasing development pressure and competition for land, the OPP 2009 identified the need to adopt a Pedestrian Charter representing a commitment at the highest level to create a culture where people choose to walk. The International Charter is based on the principles such as increased inclusive mobility, well designed and managed spaces and places for people, improved integration of networks, supportive land use and spatial planning, reduced road danger, less crime, more supportive authorities and a culture of walking.

### **2.3.3 Fort Collins, Colorado, United States**

Through innovation, sustainability, and connections, the City of Fort Collins aspires to create a vibrant, world-class community. The City of Fort Collins is committed to providing leadership and exceptional service to citizens, but recognizes that the entire community must be involved to achieve this vision.

- a) **Pedestrian Vision:** The city's high quality pedestrian network will provide for a safe, easy, and convenient mobility option for people of all ages and abilities. Main Components of Plan which will help in creating flexibility in the Transportation system are:
  - i. Landuses / Transport integration
  - ii. Multiple modes of safe, affordable and convenient travel
  - iii. Innovative travel modes.
- b) **Principles and policies:** To achieve the vision, and acting as a foundation for implementation, seven policy directives are identified including directness, continuity, street crossings, visual interest and amenity, security, education and enforcement, and maintenance.

- c) Level of Service (LOS): The LOS measurement is most commonly used to analyze traffic delay on roadways. However, the City of Fort Collins has LOS standards for each travel mode including motor vehicle, public transit, bicycle, and pedestrian. Level of Service (LOS) is used to analyze effectiveness in transportation infrastructure.<sup>42</sup>

The Pedestrian LOS will retain the five areas of evaluation that were previously developed:

- i. *Directness* - Directness is a measurement of walking trip length.
- ii. *Continuity* - Continuity is the measurement of the completeness of the sidewalk system.
- iii. *Street Crossings (signalized only)* - If pedestrians cannot safely cross a street to get to their destination there is little likelihood that they will be inclined to walk
- iv. *Visual Interest and Amenity* - Visual interest and amenity considers the pedestrian system's attractiveness and features.
- v. *Security* - Security is the measure of a pedestrian's sense of security.<sup>43</sup>

#### **2.3.4 Greater Manchester**

Greater Manchester's vision is of a city fit for the future; a healthy, safe, sustainable city where people want to live, work and visit, and where a well-established cycling culture is integral to the region's health and prosperity. Greater Manchester is aiming for a real cultural shift in cycling across the region through:

- a) A network of high quality dedicated cycle routes, segregated from traffic where possible and which connect to employment centers, schools, leisure opportunities and the regional centre.
- b) Improved cycle parking at rail, metro link and transport interchanges.
- c) Working with educational establishments to increase cycling levels in young people.
- d) Work with Public Health Authorities to develop cycle-focused health and wellbeing initiatives.<sup>44</sup>

The Manchester cycle plan includes components such as cycle tracks, cycle lanes, and Light Segregation, Quiet Streets and Shared Use Footways/Cycle ways.

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<sup>42</sup> Mia Pantzar, (2012), "Pedestrian Level of Service and Trip Generation", University of Melbourne

<sup>43</sup> City of Fort Collins Staff Team, consultant, City Boards and Commissions and Non-Profit Organizations, "Fort Collins Pedestrian Plan"

<sup>44</sup> Transport for Greater Manchester (2014), "Greater Manchester Cycling Strategy"



### 2.3.5 55th Street, Manhattan

Road diet scheme is introduced in Manhattan. A road diet is a lane reduction or road re-channelization technique in transportation planning whereby the number of travel lanes and/or effective width of the road are reduced in order to achieve systemic improvements. A road diet is a traffic engineering technique that reduces the amount of space for motor vehicles, either through eliminating lanes or shrinking the width of lanes, and reallocating that space for other uses.<sup>45</sup>



**Figure 20: Road Diet Concept Followed in Manhattan to Reduce the Road Crossing Time From 66 Feet (19 Seconds) to 32 Feet (9 Seconds)**

<sup>45</sup> Department of Transportation, "Chicago Streets for Cycling Plan 2020"

## CHAPTER- 3

### FINDINGS AND RECOMMENDATIONS

Rapid urbanization of Indian cities, without efficient and dependable public transport system has made them increasingly unfriendly for pedestrians and cyclists. According to data released by the office of the Registrar General of India in 2015, among those who have to travel to work in megacities, one-third walk and 10 per cent cycle to work. Worldwide Fund for Nature Study of 30 Indian cities showed that on an average 40% of trips in urban India still do not involve a motorized vehicle, with 28% walking, 11% cycling and 1% cycle rickshaws etc. India can certainly ease its ever-growing congestion and traffic problem by improving conditions for pedestrians and cyclists.<sup>46</sup>The following table shows the nature of pedestrian fatalities, which is highest at mid-block locations (refer table 5).

**Table 5: Percentage of Pedestrian Fatalities**

S. No	Pedestrian Fatalities	Percentage (%)
1	At mid-block locations	85
2	Related to road crossing	54
3	At mid-block crosswalks	8.3

**Source: Ministry of Road Transport and Highways and Ministry of Urban Development**

The pedestrian and bicycle fatalities in India is 27.4% (MoRTH, 2010) and 19% of the pedestrians are considered responsible for road accidents (MoUD, 2008). The above records indicate that pedestrians are the most vulnerable component of the transportation system in Indian urban road network.<sup>47</sup>

Various kinds of problems faced by pedestrians and cyclists in Indian cities are listed below:

- a) Most of the Indian cities do not have any pedestrian or cycling plan. With the result all kind of fast and slow moving traffic is mixed up resulting in traffic hazards.
- b) Some Development Plans of towns initially included the cycle track and footpaths proposals but they did not reach the implementation level and in some of the plans details of cycle and

<sup>46</sup> India times (2016), "Pedestrians, Cyclists Struggle to Reclaim Indian City Roads Annexed by Vehicular Traffic"

<sup>47</sup> Vinayaraj V.S , Chaudhari A.R. , Arkatkar Shriniwas S. , Joshi Guarang, "Comparative Study of Pedestrian Flow Characteristics at Selected Midblock Crosswalks Sections in India"

pedestrian paths are completely missing.<sup>48</sup> Wherever Master/Development Plans of towns are prepared, very few contain any detailed clauses for the provision of pedestrian / cycling facilities or guidance.<sup>49</sup> Even when there are some proposal/guidelines in town plans, they are not implemented or are changed on site. For example, cycle path was proposed in the sector schemes 6 and 7 of Panchkula but it was not implemented and has been abandoned at places.<sup>50</sup> Subsequently, the pedestrian/cycle tracks were not even planned in the detailed layout plans of Panchkula.

- c) Detailed Mobility Plans for towns have not been prepared. Where ever they are prepared as an afterthought, they are not implemented. For example, in the case of Gurugram the mobility plan was prepared in December, 2010 but it is yet to be implemented. Mobility Plan should start from pedestrian movement to modes of higher order and should invariably be a part of development plan of towns.
- d) Many Detailed Mobility plans lack clarity and are incomplete. The Energy and Resources Institute has evaluated the Comprehensive Mobility Plan's of selected cities such as Kolkatta, Pune, Kochi, Jaipur and Surat. City-specific analysis highlighted some common issues which are generalized as follows.
  - i. Lack of recommendations on provision of supporting facilities for NMT users.
  - ii. Lack of recommendations on integration of hawkers/informal sector in NMT/road proposals.
  - iii. None of the plans suggest establishment of NMT cells to undertake planning and management of NMT.
  - iv. None of the plans suggest any measures to improve security of transport system users, especially that of the vulnerable traveler categories.<sup>51</sup>
- e) In most of the cities either the foot paths are missing or are having insufficient widths i.e. less than 1.5m or are unkept. ( refer figure 21 and 22)

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<sup>48</sup> Chandigarh administration, Ministry of environment and forest (GOI) and United Nations Development Programme, "U.T Chandigarh Action Plan on Climatic Change"

<sup>49</sup> Directorate of Urban Land Transport, Bangalore (2008), "Policy Paper for Pedestrian Movement in the Bangalore Metropolitan Region"

<sup>50</sup> Layout plans of Sector-6 by CTP (P) 599/83 DT: 06.04.83 and Layout plans of Sector-7 CTP (P) 600/83 DT:06.04.83

<sup>51</sup> The Energy and Resources Institute (2011), "Review of Comprehensive Development Plan"



**Figure 21: An Uneven Surface Can Make a Footpath Difficult to Use**



**Figure 22: Footpaths with Proper Surfacing**<sup>52</sup>

- f) Pedestrian paths are not free from obstacles such as high slopes, trees, parked vehicles, uncovered drainage holes, uneven walking surfaces, electrical utilities, and harsh environmental conditions such as direct sun, noise, vehicle fumes and the presence hawker's which act as barriers during walking (refer figure 23 and 24).



**Figure 23: Dangerous Obstruction on the Footpath**



**Figure 24: Footpaths Free From Obstructions**<sup>53</sup>

- g) There is absence of site amenities such as places to sit, shade, trash receptacle, streetlights, bicycle racks and pedestrian signage etc. which need to be provided.
- h) There are no railings or visual obstruction leading to unsafe pedestrian crossing on mid section of roads and there are no pedestrian refuges where they can stand (refer figure 25 and 26).

<sup>52</sup> Advait Jani and Christopher Kost (2013), "Footpath Design", Institute of Transportation and Development Policy

<sup>53</sup> Advait Jani and Christopher Kost (2013), "Footpath Design", Institute of Transportation and Development Policy



**Figure 25: Islands That are Blocked with Fences or Planted With Vegetation are not Accessible to Pedestrians.**



**Figure 26: A Pedestrian Refuge Should be as Wide as the Crossing and Should Allow a High Volume of Pedestrians to Wait Before Crossing.<sup>54</sup>**

- i) Inappropriate curb height and discontinued foot paths encourage pedestrians to use carriage way (refer figure 27 and 28).



**Figure 27: Excessive Heights of Footpaths Forces Pedestrians to Walk in the Carriageway.**



**Figure 28: Footpaths with a Height of Not More than 150 mm are More Likely to be Used.<sup>55</sup>**

- j) Zebra crossing are missing and pedestrian signals or signal actuators are non-accessible (height or location). In the absence of clear demarcation of pedestrian road crossing people tend to cross the road through the moving vehicular traffic (refer figure 29). As per Indian Road Congress (IRC) standards Zebra, crossing should be provided at every 150m distance



**Figure 29: No Clear Demarcation for Pedestrian Road Crossing**

<sup>54</sup> Advait Jani and Christopher Kost (2013), "Footpath Design", Institute of Transportation and Development Policy

<sup>55</sup> Advait Jani and Christopher Kost (2013), "Footpath Design", Institute of Transportation and Development Policy

depending on the surrounding landuse and pedestrian. Pedestrian crossing width should not be less than 3m and can be more as per pedestrian density.

k) There is no Sianage to guide pedestrian and other traffic. The overhead pedestrian signals should be displayed on panels with height ranging from 5-7 m and the letter size should range from 25-30 cm.<sup>56</sup>

l) Fast traffic moves in pedestrian movement areas. On-Street parking and trees act as a buffer between cars and pedestrians (refer figure 30). Reduce speed limits and implementation of other traffic calming techniques such as speed humps, cul-de-sac patterns, rotary, diverters, bollards, one way entry-exit and chokers or narrowing the streets should be implemented.



**Figure 30: Trees act as a Buffer Between Pedestrian Path and Road**

m) There is lack of education and enforcement.

Pedestrians are exposed to over speeding vehicles even at zebra crossings leading to pedestrian accidents (refer figure 31). In such areas the pedestrian crossing can be raised (refer figure 32).



**Figure 31: The Absence of Raised Crossing Allows Vehicles to Drive at High Speeds.**



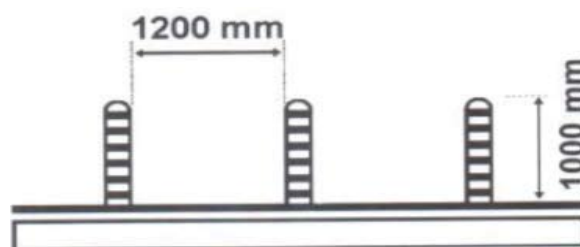
**Figure 32: Raised Crossings Compel Vehicles to Reduce their Speed, thereby Increasing Pedestrian Safety.<sup>57</sup>**

n) Obstacles such as garbage scattered and cars parked on a cycling track make it impossible for cyclists to ride their way through. Clear unobstructed cycling zone at least of width 2m for one way movement and at least 3m for two way movements with vertical clearance of 2.4m should be ensured.

<sup>56</sup> Kadiyali, L.R (2004), 'Traffic Engineering And Transport Planning', by Khanna Publishers.

<sup>57</sup> Advait Jani and Christopher Kost (2013) , "Footpath Design", Institute of Transportation and Development Policy

- o) Bollards should be provided at the start and end of pedestrian/ cycle track to prohibit vehicles entering in the cycling zone. According to the IRC, Bollards on footpaths should be at the height of 1m and gap between two should not be more than 1.2m (refer figure 33). Spacing and height specifications for bollards for cycle tracks are given below in the Table 6.



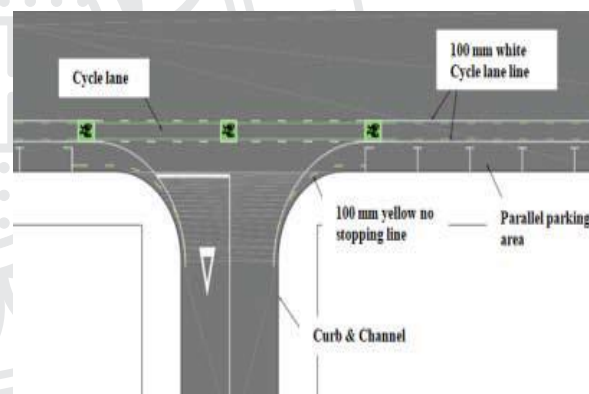
**Figure 33: Height and Gap Between Bollards**

**Table 6: Recommendation for Bollards**

Location	Gap / Spacing	Height
On cycle tracks	0.7m	0.2-0.4m
On streets / refuge islands etc	0.8m	0.9m

*Source: Urban Street Design Guidelines, Pune*

- p) There is lack of continuity of the cycle tracks across road junctions which should be maintained across road junctions, cycle tracks can be merged with the traffic lane before a major junction at minimum possible distance of up to 50m. However, preferably the cycle track should be continuous and rose (refer figure 34).



**Figure 34: Hybrid Cycle Lanes with 2.1-2.5 m Rise Slightly above the Level of the Main Road Surface.**

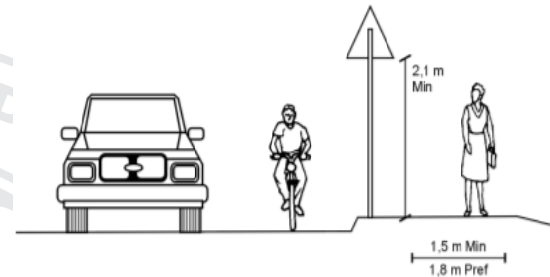
- q) The cycle tracks are not visible at sites. Marked Cycle Lanes fail as vehicles freely drive and park on these cycle lanes due to lack of visibility. Colored surface treatment is recommended to improve the visibility of the bicycle operating area. Cycle tracks should be marked in green or blue color where it is merged at the junction to highlight cyclist priority. A stopping bay for cyclists near the stop line of the junction should be marked.
- r) Lack of physical separation deprives cycles of safety and mixing of modes slows down everyone and creates chaos. At grade cycle tracks segregated from carriageway with curbstones can be considered in highly congested areas at level more than 100 mm from carriageway. Provide hybrid cycle lanes, which are on-road cycle lanes that have some kind of physical demarcation

to provide the feeling of protection that less confident cyclists want (refer figure 35). Fully segregated cycle tracks with 2.5m wide (minimum 2.1 m) on both sides of the road, separated from the main carriageway by at least 1m of green space or by parking the cars, planting trees or by using flex posts<sup>58</sup> can also be provided.



**Figure 35: Fully Segregated Cycle Lanes**

- s) Display boards etc obstruct clear vision. Clear and unobstructed walking zone should have minimum horizontal clearance of 1.5- 1.8 m in residential area and 2.5 to 4.0m in commercial areas with 2.1-2.4m as minimum vertical clearance<sup>59</sup> (refer figure 36).



**Figure 36: Sidewalk Width with Vertical Clearance And Without Obstruction**

- t) Most of the road bridges/flyovers/under passes do not contain independent pedestrian/ cycle paths. With the result the pedestrian and cyclists are forced to come on the main carriageway. While designing the road bridges independent tracks should be provided and in the existing bridges wherever possible the pedestrian and cycle track should be segregated from the automated movement of vehicles.
- u) The pedestrian crossing on busy roads is leading to delays and accidents. Therefore, pedestrian crossings should preferably be at the grade level by elevating road, and if it is not possible suitable ramps with the gradient not more than 1:12 should be provided instead of stairs.<sup>60</sup> Suitable resting place should not exceed 2 m.<sup>61</sup>
- v) Skywalks facilitate easy movement of pedestrian on busy road junctions and are ideal where pedestrian movement is very heavy. But, except in the case of Mumbai, skywalks have not been constructed and they are not properly maintained. In towns like Delhi, it is yet to start although there is dire need at many places.

<sup>58</sup> Cambridge Cycling Campaign (2014), "Making Space for Cycling", Published by Cycle nation, creating a nation of cycle-friendly communities

<sup>59</sup> Department of Transport, Planning and Public Transport Authority, "Guidelines for Planning and Designing for Pedestrians"

<sup>60</sup> Delhi Development Authority (2009), "Pedestrian Design Guidelines", UTTIPEC

<sup>61</sup> Sawyer Ann and Bright Keith "The Access Manual", Blackwell Publishing



- w) There is negligible cycle renting or sharing schemes in India for end to end connectivity. Therefore, there is heavy dependence on automated movement of traffic. The Green Bike (Cycle Feeder & Rental Scheme, Delhi) integrates bus-based transport system with cycling. Introduction of cycle renting facility facilitates visitors to use cycles to visit adjoining area after alighting from buses. Currently, the registered members can hire a bicycle at one place and can return it back at the other place. The unregistered members need to produce an identity proof to hire the bicycle.<sup>62</sup> Similarly the rental scheme of Indore also rents bicycles to familiar people. Chandigarh Smart City Limited (CSCL) has also initiated to promote the use of bicycle<sup>63</sup>. The Bhopal bike sharing system is automated and provides the first and last mile connectivity. Similarly the public bicycle sharing concept of Mysore started with 450 cycles and 48 docking stations works on the operation of swiping cards.
- x) Lack of secure cycle parking's discouraging the cyclists and cycle sharing schemes. Secure Cycle Parking must be provided at all MRTS/ BRTS Stations and shopping complexes. Allocate 100 square meters of space for every 40 cycle's parked (refer figure 37). Lockable parking bays and cycle sharing schemes may not succeed in India until government mitigates the fear of theft or vandalism and has integrated planning, complete network of stations, NMT infrastructure, awareness and efficient operations.



**Figure 37: Cycle Stands to which the Frame can be Locked**

The above is just a problem and solution oriented approach which is not enough to meet the requirement of a comprehensive approach which have been covered in the following as planning considerations, design considerations and as safety and convenience issues. Attempt is made to cover all kind of users and all for further details / specifications IRC and Bureau of Indian Standards can be relied upon.

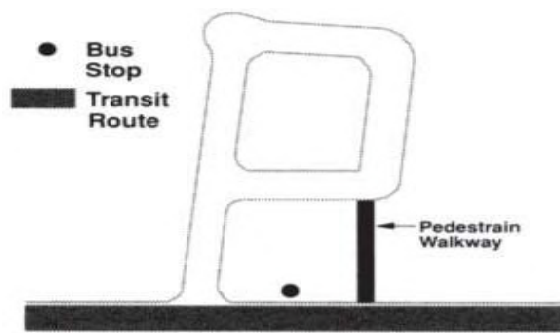
<sup>62</sup> Delhi Integrated Multi-Modal Transit System Limited, "Cycle Feeder & Rental Scheme"

<sup>63</sup>Hindustantimes (Feb 07, 2017), "Smart City Project: Chandigarh to Get Bicycle Sharing System"

### 3.1 PLANNING CONSIDERATIONS

The placement of land uses and their inter connectivity plays a major role in choice of mode of transport and location of path ways.

- a) Transit systems are often not close enough to origins (generators) or destinations (attractors) to make walking / cycling between the uses comfortable. A pathway between adjacent buildings (refer figure 38) can reduce the otherwise lengthy approach and facilitate pedestrian movement (refer figure 39).



**Figure 38 : Shortest Transit Route Should be Opted**

**Figure 39 : Pathways between Adjacent Streets**

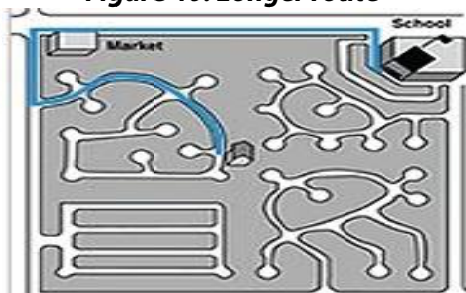
- b) Pedestrian routes should be direct and easily accessible from every corner of the sector. The walking distance in figure 40 is reduced and there are several alternative routes given in figure 41. Similarly the distance given in figures 42 is considerably reduced in figure 43.



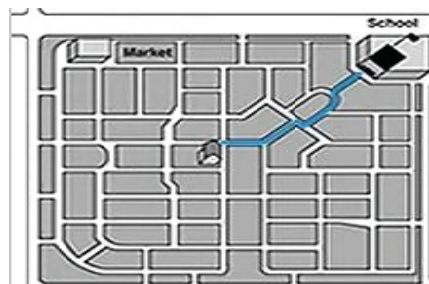
**Figure 40: Longer route**



**Figure 41: Shorter route**

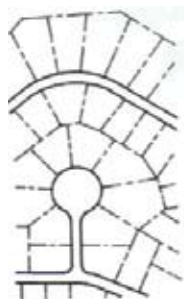


**Figure 42: Longer route**



**Figure 43: Shorter route**

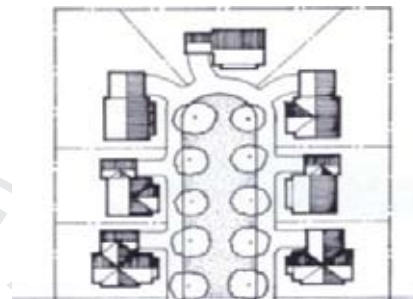
- c) The crescent streets (refer figure 44) and eyebrow streets (refer figure 45) help in slowing down the vehicular traffic in residential areas. This pattern was largely followed in the Model Towns established in the then Punjab immediately after partition of India in 1947. However, now it is largely discarded as it creates irregular plots and wastage of land. It is more suitable for planning small and irregular sites.



**Figure 44: Crescent Streets**

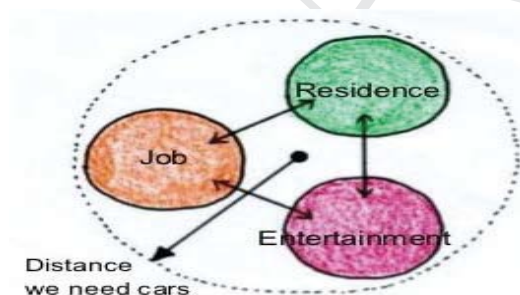


**Figure 45: Eyebrow Street**

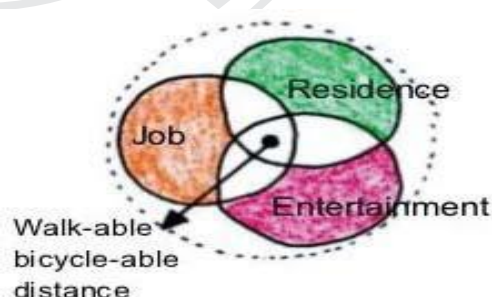


**Figure 46: Loop Lanes**

- d) Loop lanes (refer figure 46) and Cul-de-sac Street patterns helps in avoiding through traffic at the local residential street level and permitting good flow at the collector and arterial levels. The loop lane is an alternative Cul-de sac design in which the standard two-lane road with a circular turn-around 'bulb' is replaced with a loop around a wide central public green space.<sup>64</sup> It can be conceived as a module and repeated over large area.
- e) Compact urban development is best form of development in minimizing travel distances. It brings activities closer together, making them more accessible by foot or by bicycle, without any need to use a car (refer figure 48).



**Figure 47: Scattered Development makes People to Depend on their Private Vehicles<sup>65</sup>**

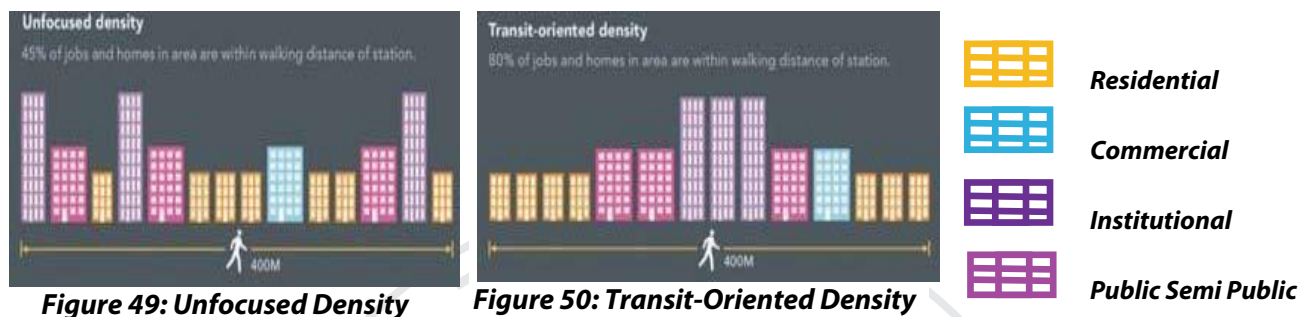


**Figure 48: Compact Development can Reduce Car uses and People can Walk or Use Bicycles**

<sup>64</sup> Microsoft Corporation (2010), "Residential Street Patterns in Bowness and Oak Ridge, Calgary"

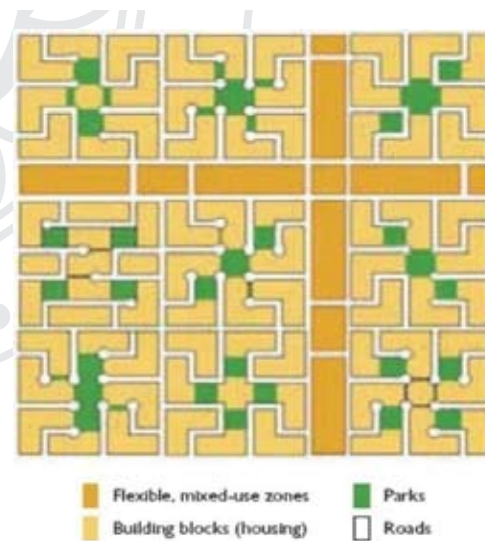
<sup>65</sup> Rogers Richard (1998), "Cities For a Small Planet"

- f) 45% of jobs are within walking distance (refer figure 49) while 80% of the jobs are within walkable distance (refer figure 50). This is attained by rearranging the land uses in a transit oriented development.



- g) Everyday activities, such as housing, work, schools, shops, and other amenities, are all ideally located preferably within walking distance of 800 meters from each other. The aim is to provide a pleasant, comfortable, interesting, and safe environment for pedestrians, and to provide alternatives to car use. This is the concept in transit oriented development in vogue. Ideal walking distance is up to 800m but if it is more than 1.5 km, most people will not walk. Similarly, if the cycling distance is more than 7 km people may not cycle. This needs to be kept in mind while placing land uses so as to make them approachable by foot or by cycling.

- h) The Fused Grid pattern (refer figure 51) can be adopted for planning at neighborhood level as it combines the conventional loops and cul-de-sac pattern with the traditional grid network pattern. This concept avoids the through vehicular connections; these neighborhood footpaths connect all streets, while providing off-road footpaths to maintain full pedestrian and bicycle accessibility.



**Figure 51: The Fused Grid Pattern**

The combination of continuous and discontinuous street grids:

- i. Optimizes the use of land for streets

ii. Secures calm and safe neighborhoods

iii. Increases the potential for social interaction.

iv. Assists district and regional traffic flow.

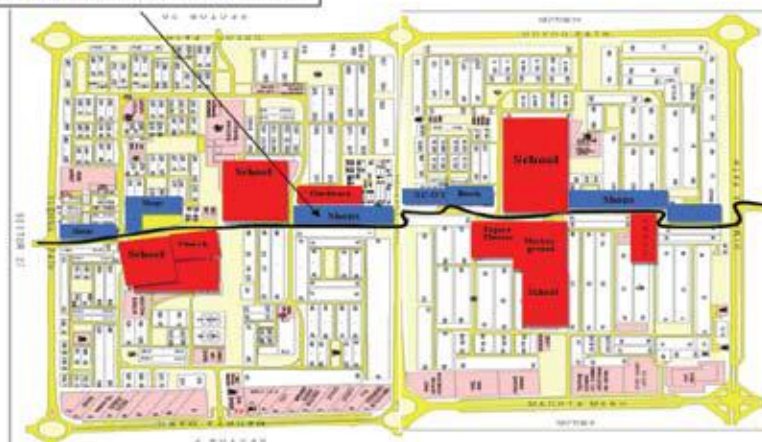
v. Encourages walking while positively discouraging short-distance driving.<sup>66</sup>

i) The extended form of Grid Iron planning evolved by Le Corbusier and C. A. Doxiadas

holds good even today. Le Corbusier used rectangle grids measuring 800-1200 m in the planning of Chandigarh and each rectangle block is called a sector. Each sector is self sufficient to meet day to day requirements. The concept of continuous Indian bazaar is used to place a continuous belt of commercial activities along road cutting through sectors. This is resulting in through traffic which is detrimental for safe pedestrian movement within sector (refer figure 52) similarly, the education, health and other facilities are spread throughout the sector inviting more cross traffic. Therefore, it will be desirable to follow an introvert form of planning in which through traffic is avoided and internal traffic is minimized by the location of education, health, shopping and other facilities towards the centre of the sector as shown in the (refer figure 53)

j) Whatever form of planning is adopted keeping in view the local site conditions, master, zonal and sectoral plans should also encompass the detail of the exclusive pathways for pedestrian and cyclists. Mobility or connectivity for cyclists should be considered in the land use plans as shown in (figure 54).

*Continuous belt of commercial and public semi public activities along road cutting through sectors 18 and 19 of Chandigarh resulting in through traffic.*



**Figure 52: The Combined Layout Plan of Sector 19 and 18**

*Introvert form of planning, as commercial and public semi public is located towards the centre.*



**Figure 53: Introvert Form of Planning**

<sup>66</sup> Canada Mortgage and Housing Corporation, "The Fused Grid - A Neighborhood and District Layout Model"

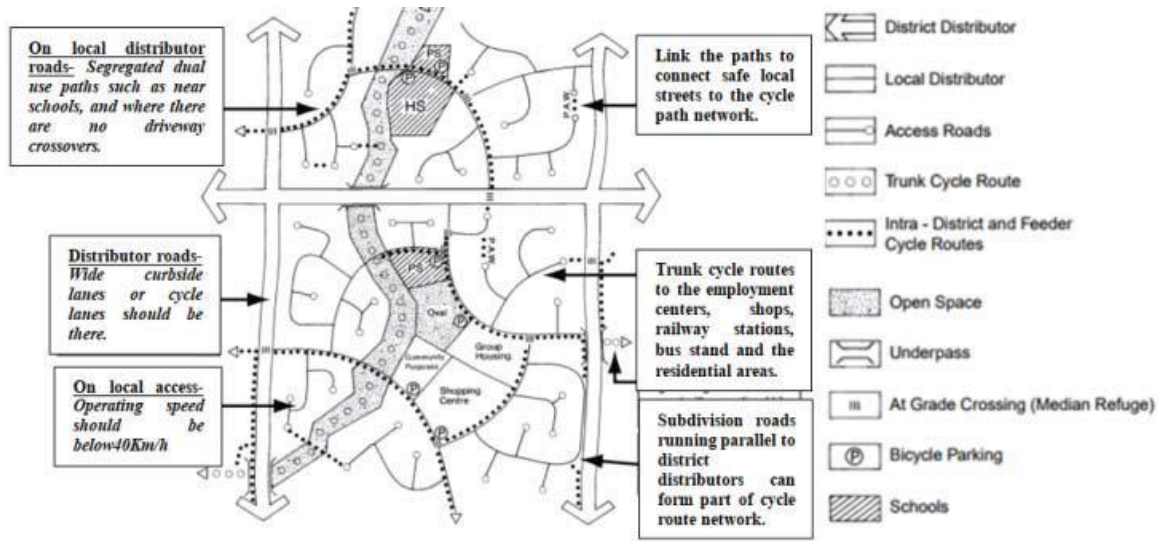


Figure 54: Bicycle Planning

### 3.2 DESIGN CONSIDERATIONS

In the existing developed towns of India, the existing ground realities will dictate the provision of pedestrian and cycle tracks. The extension of towns and new towns can follow the following.

- a) Pedestrian – The width of footpaths depends upon the expected pedestrian traffic and may be fixed with the help of the following norms subject to not being less than 1.8m.in width. The land use adjacent to the road significantly influences the generation of pedestrian traffic and recommended width of footpath along various land uses are given in table 7. However, in places of public assembly such as theaters etc. it should not be less than 6m.<sup>67</sup>

Table 7: Required Width of Footpath as per Adjacent Land Use

Description	Width in meters
Minimum free walkway width in residential/mixed use areas	1.8
Commercial/Mixed Use Areas	2.5
Shopping Frontages	3.5 to 4.5
Bus Stops	3
High Intensity Commercial Areas	4

Source: URDPFI Guidelines, 2015

The width will however, depend upon the volume of the pedestrian who are likely to use the footpath which can be provided as indicated in the table 8:

<sup>67</sup> Town and Country Planning Organization (2015), "Urban and Regional Development Plans Formulation and Implementation (URDPFI) Guidelines", Ministry of Urban Development(Government of India)

**Table 8: Carrying Capacity of Footpath**

Width of side walk (in meters)	Capacity in number of persons per hour	
	All in one direction	In both directions
1.50	1200	800
2.00	2400	1600
2.50	3600	2400
3.00	4800	3200
4.00	6000	4000

Source: *Guidelines for Pedestrian Facilities (2012), IRC*<sup>68</sup>

- b) Cycle – The width of cycle track should not be less than 2m. Connectivity and separation is essential for the cyclist, which could be achieved by providing separated street space and more direct routes. The estimated capacity for a single 1-m to 1.2-m bicycle lane results fell between 2,000 and 3,500 bicycles/hr/lane.<sup>69</sup>
- c) Safety is also one of the consideration for cyclist, which could be achieved by:
- i. Increasing driver awareness of road rules and safety.
  - ii. Higher priority for bicycles at road intersections.
  - iii. Reduce speed limit in busy areas.
- d) Supporting infrastructure is also necessary for a cyclist such as:
- i. Better street lighting.
  - ii. Better connected transit routes.
- e) Road Cross Sections - In new urban developments, standard road cross sections can be applied. According to the URDPFI guidelines (refer table 9) there should be segregated cycle tracks between carriageway or street parking and footpath on either edge of the carriageway on arterial and sub arterial roads, adjacent to the footpath or parking on distributor roads and mixed with motorized vehicular traffic on access roads. It overlooks the need to provide independent pedestrian and cycle tracks which should be first priority in planning.

<sup>68</sup> The Indian Roads Congress (2012), "Guidelines for Pedestrian Facilities", New Delhi

<sup>69</sup> Xu. Cheng, "Estimating Capacity of Bicycle Path on Urban Roads in Hangzhou, China", National Research Council, Washington D.C.

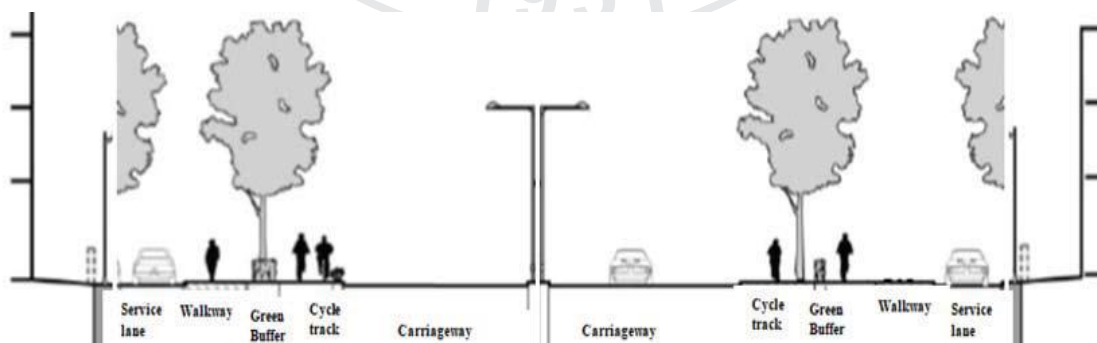
**Table 9: Guidelines for width of Pedestrian and Cycle Path (URDPFI)**

Road hierarchy	Pedestrian path lane width	Minimum Cycle path width	Location of cycle track
<b>Arterial (50-80m)</b>	1.7 to 5.5m	2.5 for a two lane cycle track and 1.9m for a common cycle track and footpath	Segregated track between Carriageway or street parking and footpath on either edge of the carriageway
<b>Sub arterial (30-50m)</b>	1.7 to 5m	2.0 for a two lane cycle track and 1.7m for a common cycle track and footpath	
<b>Distributor (12-30m)</b>	1.5 to 3m	1.5m	Cycle lane on the edge of the carriageway, adjacent to the footpath or parking.
<b>Access (12-15m)</b>	Up to 2.5m	Mixed with motorized vehicular traffic	

*Source: URDPFI guidelines*

- i. Either there should be green buffer between cycle track and footpath or one of them should be at grade in order to segregate the cyclists and pedestrian in areas where pedestrian density is more.
- ii. Vertical barrier can be installed between carriageway and cycle tracks if it is difficult to implement fully segregated cycle tracks.
- iii. Road segregation of cyclist and pedestrian should be done by providing green trees for segregation and for providing shade to the pedestrians. Shared use path is broadly acceptable where pedestrian flows are less than 100 people per hour per meter of width.
- iv. In 60 m wide roads instead of median of greater width green buffer or reserved area should be provided which can be easily utilized for road extension at later stages.

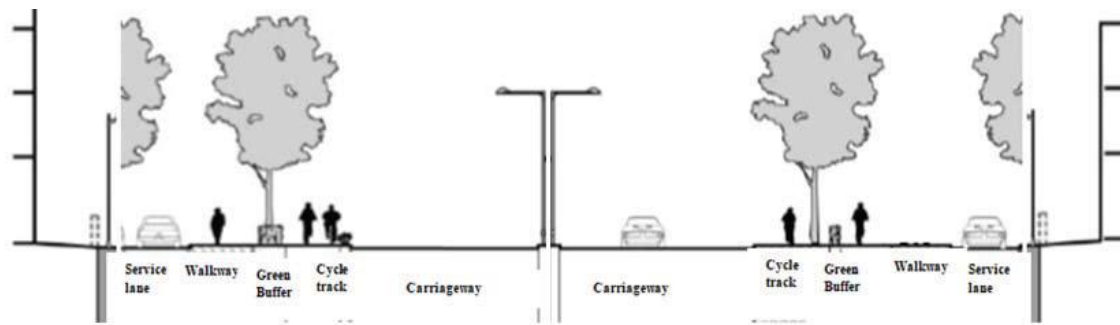
Illustration of road cross sections on the basis of the hierarchy are given as below<sup>70</sup>.



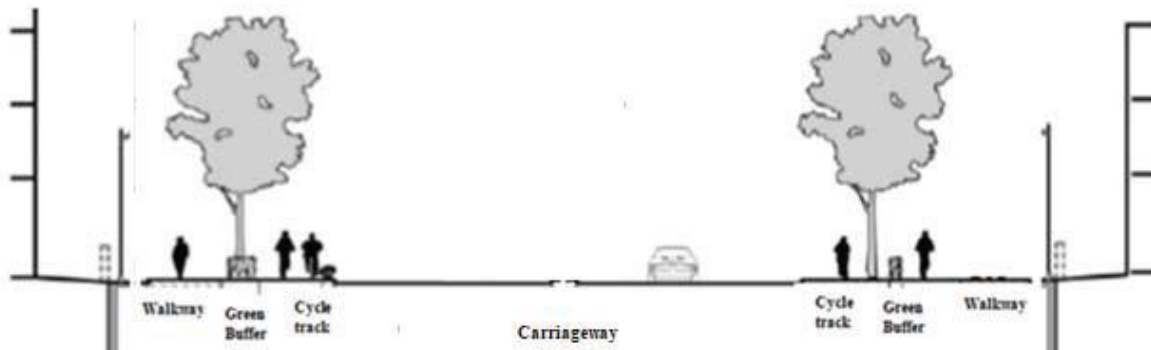
**Figure 55: Arterial Road (50-80m)**

<sup>70</sup> Town and Country Planning Organization (2015), "Urban and Regional Development Plans Formulation and Implementation (URDPFI) Guidelines", Ministry of Urban Development(Government of India)

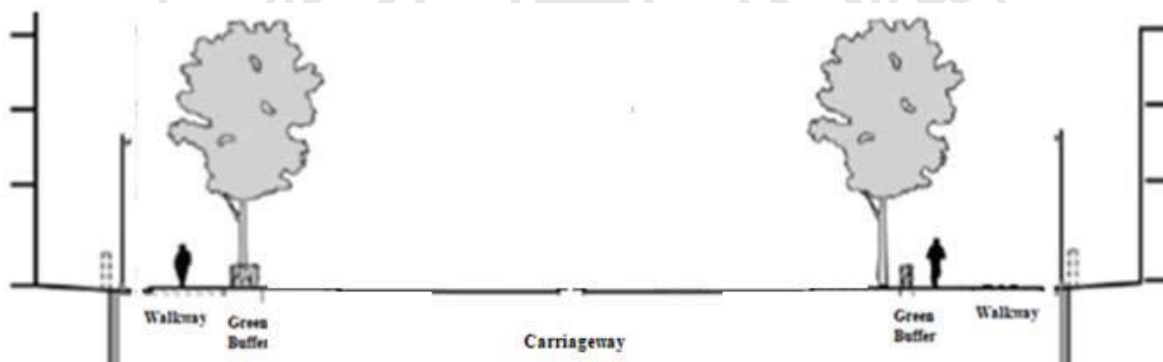




**Figure 56: Sub Arterial Road (30-50m)**



**Figure 57: Distributor Road (12-30m)**



**Figure 58: Access Road (12-15m)**

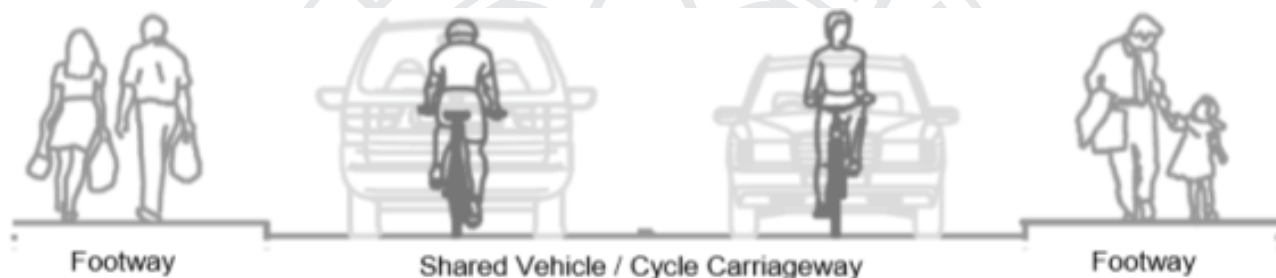
- f) Physically segregated (vertical barrier) from both motorized traffic and pedestrians can also be constructed by reallocation of carriageway space or by new construction (refer figure 59).<sup>71</sup>

<sup>71</sup> Transport for Greater Manchester (2014), "Greater Manchester Cycling Guidelines"



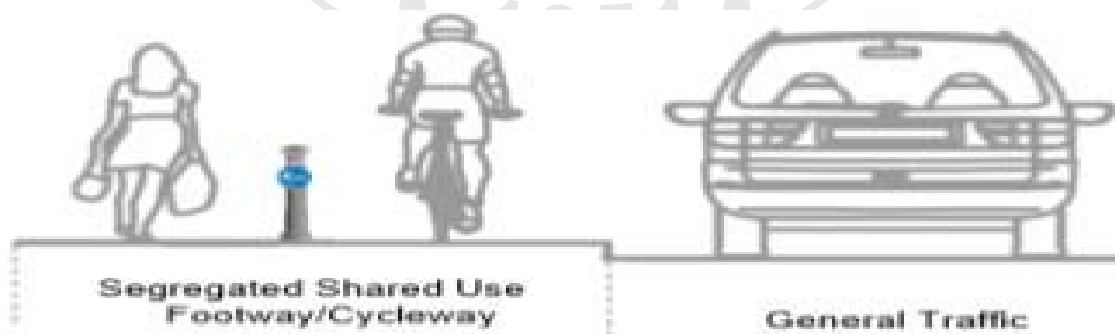
**Figure 59: One-Way Cycle Track**

- g) Quiet Streets with carriageway width of 7m or less will generally be characterized by low traffic flows and speeds and may form part of a wider traffic management strategy to restrict use by motorized traffic and/or to reduce speeds (refer figure 60).



**Figure 60: Cross-Section of Quiet Street**

- h) Shared use routes are designed to accommodate the movement of pedestrians and cyclists. Shared use routes may be segregated or un-segregated, where pedestrians and cyclists are separated by a feature such as a white line, a kerb or some other feature. On an unsegregated route, pedestrians and cyclists mix freely and share the full width of the route (refer figure 61).



**Figure 61: Cross-section of a Segregated Shared Use Footway/Cycle Way**

### 3.3 SAFETY AND CONVENIENCE

For Indian towns, the following are the specific findings and recommendations relating to safety and convenience of pedestrians and cyclists.

- a) According to IRC, lighting must be provided at every 25-30m interval, focusing light on the pedestrian and bicycle lane, not on the motorized vehicle lane (refer table 10).

**Table 10: Recommendations for Street Lights**

Location on street	Spacing between two poles (m)	Height of the light pole (m)	Intensity of light (lux)
On central median	25-30	9-15	30
Between footpath and MV lane	25-30	9-15	30
Between footpath and cycle track	12-16	4.5-6	25
On footpath	15	6.5	20

*Source: International Best Practices & National Street lighting manual*

- b) Provision of median refuge (a safe place to stand in the street) with bold road markings and raised crosswalks whose width should be at least 3 m in order to be accessed by wheelchair user.
- c) Raised crossings compel vehicles to reduce their speed, thereby increasing pedestrian safety; crosswalk should have minimum width of 3m.
- d) As per the DDA Building Bye-laws, 1983, footpath should be above carriageway and separated by curb of maximum height 150 mm above road level(refer table 11).

**Table 11: Recommendations for Curb Height According To Speed Limit**

Design traffic speeds	Curb height
≥ 70km/hr	Crash barriers or fences may be installed (100 mm high or less)
< 50km/hr	Footpath height in such cases could range from 0-150mm.
25-50 km/hr	Fences, hedge-planting or bollards will be installed, wherever required.
< 25 km/hr	Curb less streets are recommended in these areas.

*Source: DDA Building Bye-laws, 1983*

- e) Audible signs should be installed in dangerous areas for the aid of people with visual impairments.
- f) Visibility for elderly and disabled pedestrians can be enhanced through footpaths and curb ramps with tactile paving. Pedestrian path should have a continuous tactile paving and ramps, in order to provide guidance to the handicapped and impaired persons (refer figure 62 and 63). Tactile Pavements at curb cuts to indicate to the visually impaired where the sidewalk ends and the road begins.



**Figure 62: A Footpath that Constantly Changes Levels Discourages Disabled Pedestrians from Using it.**



**Figure 63: Curb Ramps and Footpaths with Tactile Paving**

- g) Difficulty to the visual impairments and handicap pedestrians in crossing roads lead to severe accidents. Make the pedestrian/ bicycle route visible using obvious pavements/pavement treatments, lighting, signage, landscaping etc, so that visual handicap can navigate the area more easily (refer figure 64).



**Figure 64: High Contrast Pavements around Planters and Other Obstructions if They are on the Sidewalk**

## CHAPTER-4

### CONCLUSION

Although 40% of the trips in urban areas in India is in NMT mode with as high as 28% being pedestrians, yet the focus of all planning and development in towns has been on automated movement of traffic in which pedestrian and cyclists are ignored. In 2005, the Ministry of Urban Development launched the Jawaharlal Nehru National Urban Renewal Mission, to improve the quality of life and infrastructure in Indian cities. Instead of allocating those funds towards building cycle tracks, improving sidewalks and public transportation, towns like Delhi used these funds in widening roads and building flyovers.<sup>72</sup>

Indian roads are becoming unsafe day by day for pedestrian and cycle movement due to ever increasing congestion on roads and the lack of consistent effort of the governments to promote pedestrian and cycle movement by making their travel safe and pleasant. In New Delhi, Bangalore and Kolkata, the pedestrian fatality share is greater than 40 per cent. In the case of Bangalore, three pedestrians are killed on roads every two days and more than 10,000 are hospitalized annually. Elderly people and school children carry a large share of the burden with 23 per cent fatalities and 25 per cent injuries (Bhatt et al., 2013).<sup>73</sup>

The Law Commission in its consultation paper on "Legal Reforms to Combat Road Accidents" in 2008 mentions that there are no appropriate legislations to govern the behavior of pedestrians and non-motorized traffic on the roads. But will it be enough to have a legislation defining the appropriate behavior for pedestrians while the laws on protecting pedestrians and pedestrian spaces from motorized vehicles are not being enforced?<sup>74</sup>

Vehicles are now becoming a major source of air pollution in urban India. About 7-8 million vehicles are produced annually in the country today. In India, the number of motor vehicles has grown from

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<sup>72</sup> Shreya Kalra (2016), "Pedestrians, Cyclists Struggle to Reclaim Indian City Roads Annexed by Vehicular Traffic"

<sup>73</sup> Indian Institute for Human Settlement, Paper on "Urban Transport in India: Challenges and Recommendations"

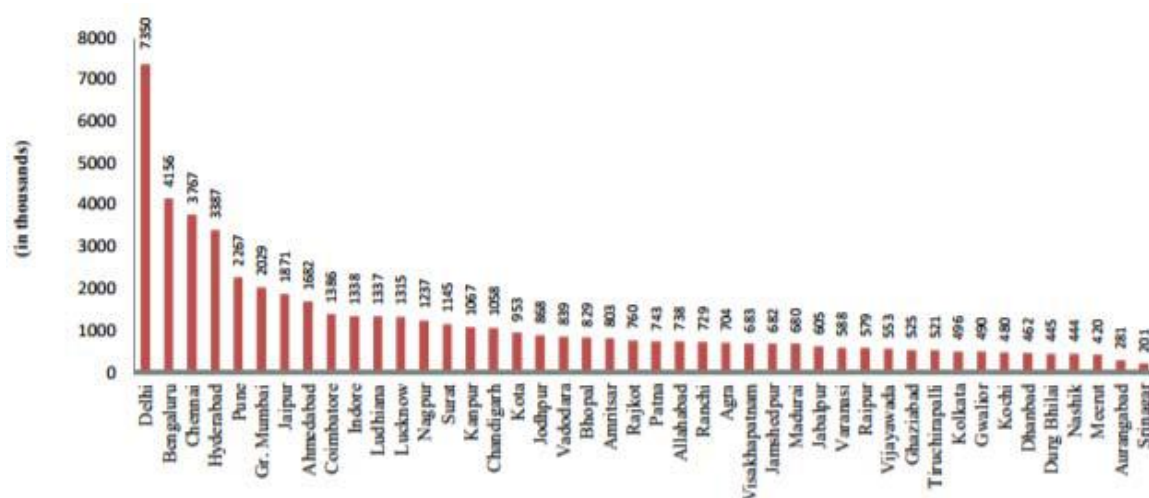
<sup>74</sup> Toshniwal, Roshan, (2012), Article on " Legal Provisions Protecting Pedestrians in India", by WalkabilityAsia.

72.7 million in 2004 to approximately 141.8 million in 2011 (refer table 12).<sup>75</sup> There is marked concentration of vehicles in town and in bigger cities (refer figure 65).<sup>76</sup>

**Table 12: Registered Motor Vehicles in India**

Year	No. of vehicles (in millions)
2004	72.7
2005	81.5
2006	89.6
2007	96.7
2008	105.3
2009	115.0
2010	127.7
2011	141.8

Source: Road Transport year Book, 2012



**Figure 65: Registered Motor Vehicles in Million-Plus Cities, India**

Air pollution in Indian cities is the fifth leading cause of death in India. Annually, about 620,000 premature deaths occur due to air pollution in Indian cities. The fatality rates of vulnerable users are increasing every year; the air quality is worsening day by day. Yet, in Kolkata cyclists are banned on around 175 roads.<sup>77</sup> The examples of developed countries were before the planners and policy makers since long but serious efforts are certainly lacking.

<sup>75</sup> R. K. Shrivastava, Neeta Saxena and Geeta Gautam (2013), Article on "Air Pollution Due to Road Transportation in India: A Review on Assessment and Reduction Strategies"

<sup>76</sup> Ministry of statistics and programme implementation (2016), "Motor Vehicles - Statistical Year Book India 2016", Government of India

<sup>77</sup> Bansal. Ruchita, Article on "Road Design: Why do Indian Cities Never Get it Right"

Private cars need roads for movement and parking space, leading chocking of roads and eventually Mass Rapid Transit System (MRTS) and other modes of public transport systems will have to take over the ever increasing traffic in towns. Only pedestrian and cycle along with other NMT or eco friendly modes of movement will eventually provide last mile connectivity. Therefore, pedestrian and cycle movement should be given due priority in the planning and development of towns instead of focusing on the movement of automated private vehicles.







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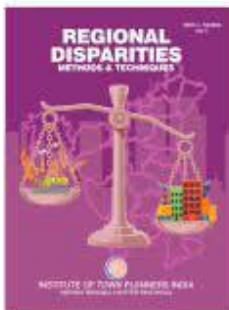
## Other Publications of ITPI HRC.....



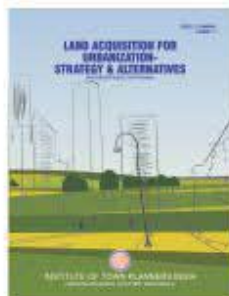
This study aims to understand the intricacies of TOD concept. It also gives specific recommendations vis-à-vis TOD policy of Haryana. The study was released on 19.11.2016.



It is the second study conducted by ITPI HRC and was released on 04.02.2017. The objective of this study is to understand the challenges and solutions of Affordable Housing.

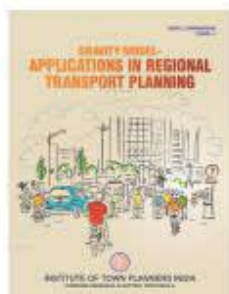


It is third study conducted by ITPI-HRC and was released on 22.04.2017. The study explains the concepts and elaborates the efforts made in attaining balanced development and also pravaills upon the methodology and techniques which can be used to identify the level of development.



### **“Land Acquisition for Urbanization – Strategy and Alternatives (Partnership Model for Haryana)”**

It is the fourth study conducted by ITPI-HRC and was released on 07.10.2017. The objective of this study is to understand the land acquisition alternatives for public purposes in order to suggest a balanced framework which caters to the concerns of both demand side players (mainly public agencies) as well as supply side (mainly farmers).



### **“Gravity Model – Applications in Regional Transport Planning”**

It is the fifth study conducted by ITPI-HRC and was released on 07.10.2017. The objective of this study is to quantify the pattern of interaction between A class (1 Lakh plus) towns of Haryana in terms of road linkage, to identify the traffic load on roads for augmentation purposes and to suggest the inter town public/private transportation requirements/rationale. It also touches upon the need to rationalize the urban form according to the interaction pattern.

## About Us...

The Institute of Town Planners, India (ITPI) was established in July 1951 with the objectives to advance the study of Town Planning, to promote planned, economic, scientific and artistic development of cities and rural areas, to foster the teaching of subjects related to town planning, to hold conferences and meetings on matters relating to Town & Country Planning and to ascertain and notify the law and practice relating to Town & Country Planning. Presently the Institute has 23 Regional Chapters in various states of the Country and have about five thousand registered Town Planners. It is the apex body of Town Planners and guide the Government in Town Planning matters.

Haryana Regional Chapter (HRC) is one of its Regional Chapters which came into existence in the year 2003. The chapter has 230 town planners and it is actively engaged in promoting the objectives of ITPI by undertaking activities such as workshops, conferences, seminars, publications and research studies. The Chapter has published research studies; Transit Oriented Development-Implications and Considerations; Affordable Housing - Challenges and Solutions; Regional Disparities - Methods and Techniques; Land Acquisition for Urbanization - Strategy and Alternatives" (Partnership Model for Haryana) and Applications of Gravity Model in Regional Transport Planning.

This study has been conducted by Ms Rajdeep Kaur and Ms. Gurpreet Kaur, Research Officers, who are B. Tech in Urban and Regional Planning with Masters in Infrastructure Planning under the guidance of Sh. Raj Vir Singh ,M Tech (MRP), LLB,FITP, Ex CTP Haryana Govt., having over 42 years of experience of working in public and private sectors.



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