TO IMPROVE THE NMT (NON-MOTORIZED TRANSPORTATION) FACILITY IN LUCKNOW, HAZRATGANJ

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by

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CERTIFICATE

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CANDIDATE'S DECLARATION

I hereby declare that the work, which is represented by me in this dissertation, entitled "**To improve the NMT (Non-motorized transportation) facility in Lucknow, Hazratganj",** in partial fulfillment of the requirements for the award of the degree of **Master In Urban And Regional Planning** submitted to the **Department of Architecture and planning, Babu Banarasi Das University Lucknow,** is an authentic record of my own work carried out during the period from July 2021 to June 2022 under the supervision of **Ar. Shalini Diwaker, Ar. Saurabh Verma & Dr. Mohit Agarwal**, Department of Architecture and planning B.B.D. University Lucknow Uttar Pradesh ,India.

The matter embodied in this thesis has not been submitted by me for the award of any other degree of this or any other institute.

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ABSTRACT

Walking is the oldest form of transportation prior to the invention of the wheel, but in our fast-urbanizing cities, walking has slowing lost its significance. Sprawling urban cites, where distances to be travelled for various needs are continuously increasing, people's preference to walking has also reduced. Bicycle as we know is an affordable, low-cost, environment- friendly, and sustainable mode of transport. Their lack of speed has outdated them but with ever rising greenhouse gas emissions and the shift towards sustainable cities calls for their revival of sorts. This study highlights ways in which non- motorized transport can be incorporated in our transport corridors. In 2010 Hazratganj went under revitalization and beatification but there is still room for improvement. This study aims to analyzes the applicability of cycling and tries to improve pedestrianization in Indian CBDs in order to provide them with a cleaner environmentand in turn make them more habitable. Which can be achieve by following the methodology followed is to firstly study cities and countries where pedestrianization and bicycling have been promoted on a large scale. Secondly, to document the present facilities or the lack of them and comparing them standards; studying the present land-use of the area and understanding its relation to trips generated site through various primary and secondary surveys to understand the drawbacks and negative parameters which inhibit people from walking and cycling. Thirdly, to analyze and interpret the data collected and to finally develop a layout plan for movement of walkers and cyclists in the Hazratganj area which takes into consideration the observed restrictions and brings out an integrated circulation pattern for pedestrians and cyclists and their connectivity to public transportation in line with the existing legislative framework and Zonal plans and proposals. The proposals are supported the credible analysis and also the inferences which are jotted from the above said study. These proposals will enhance the operational capability of the full system at both the study sites. the most objective of this study is to procedure followed within the developing of this proposal is further applied to other CBD's and residential sectors. The inculcation of those steps and process of arriving at a layout plan in site planning for various sectors like residential, commercial is additionally possible.

KEYWORDS: Non-motorized transport, PEF (Passenger Equivalent Factor), Central business district, Walking friendly Pedestrian, Hazratganj.

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CHAPTER 1: INTRODUCTION

1.1 Overview

Since earliest times residents lived near their work until the increase of the suburbs, expressways, and shopping malls separated residential from commercial districts. In many cities since that point, there's been a definite lack of streets that invites walking. Walking is a vital mode of transport. Most journeys, whether or not mainly by car, bus or bike, include walking as a component. New and improved pedestrian facilities enable greater access and mobility within our communities. A pedestrian-friendly environment plays a vital role in encouraging walking as a mode of travel, and this has proven health and environmental benefits (NZTA 2011).

The issue entails that the majority of our cities are motorized and pedestrian movement has been given very less consideration if not any. Footpaths are diminished to form room for carriage way. it's too dangerous for cyclists to maneuver on high traffic roads. the auto industry is growing day by day and discouraging people from walking or taking non-motorized means of transportation.

Cities that promote walking are sustainable as they're the healthiest and most prosperous communities; they're designed round the pedal extremity, truly the sole template which will result in pedal sustainability and future community prosperity. Increased walkability also helps improve resource responsibility, safety, condition and social interaction.

Cycling and walking are safer in terms of reduced road accidents They promote exercise and health. Such cities promote social interaction collectively is continually bumping into their neighbors. It relates to the aspect of connecting people, not just connecting

places. These cities are a green concept with lesser fuel emissions thus they're more sustainable. it's economic benefits also, every other day petroleum and diesel prices are hiking and parking also comes with a fee. Walkability may be understood as places where walking is permitted and possible like in places where motorized movement is restricted.

Walkability is linked to the standard of built environment, the urban form and connectivity, safety and desirability to walk and accessibility of infrastructure i.e. it is accustomed 13 measure the connectivity and quality of walkways and sidewalks in cities. Whereas pedestrianization is a trial to induce and encourage walking in area by improving support infrastructure facilities like footpaths, crossings, amenities etc which can go hand in hand with motorized transportation.

The demand for walking employing a standard survey methodology will be wont to generate a walkability index, this could be accustomed compare cities and subsequently help identify areas for improvement that are site-specific.

The walkability survey can raise awareness and generate interest amongst policy makers and city officials and aid them in improving the specified infrastructure (CAl-Asia, 2011). Some of the constraints to pedestrianization are the intense climate which don't favor walking for e.g. in India, the

mindset of individuals since people have gotten too comfortable travelling in cars and other vehicles. so as to bring back the concept of pedestrianization people must be willing to simply accept it. And it can only be introduced in small scales because it isn't comfortable to travel long distances on foot or on cvcles. While significant numbers of individuals do walk. There's an increasing pressure from motorization, urban area, pollution and deteriorating pedestrian infrastructure. Cities have marginalized the wants of the pedestrians and given priority to the requirements of the automobiles; yet our cities were built to be walkable.

Walking is that the simplest urban transport mode for all short-to-medium length travel, and bicycling and bicycle-derived modes play a necessary role in urban transport in most low- and middle-income countries of the planet. For people within the lowest strata of the economic scenario as in India, these modes affect survival, whereas in countries like Netherlands all sections of society use bicycles. In a wholly different dimension -urban air quality, shift to non- motorized modes is usually a net gain. Despite of these reasons, interests of non-motorized travelers tend to be systematically neglected investment, network management and infrastructure maintenance.

Without continuous, good-quality and secure infrastructure networks, people won't shift to walking or bicycle travel. Even today, nearly one third of daily travel trips in Lucknow, and in most other Indian cities folks that commute by walking outnumber those that use their vehicles (MoUD,2008) yet, the pedestrians remain invisible within the ever-increasing motorized traffic that congests our roads. Pedestrians go into extremely unsafe and hostile conditions, they're in constant conflict with motorized traffic and are easy victims to crashes and accidents. Countless people trip over potholes or are grievously hurt by bumping

into numerous obstacles along footpaths. The high share of walking in Indian cities has embark sharply from the nation-wide assessment applied Union ministry of urban development on traffic and transportation policies and techniques in urban areas in 2008. The share of walkers can vary between 16 to 57 per cent reckoning on the character and size of the town (MoUD,2008).

Despite such high share of walk trips our cities today don't seem to be all walkable. Walkability merely reflects the standard of walking facilities and conditions that make walking safe, comfortable and convenient. Typically, during a given city, the pedestrian facilities and network includes sidewalks, path, crosswalk, stairways, curb cuts, ramps and transit stops. These have to be designed, intricately connected so as to assist pedestrians take the shortest direct route to destinations and feel safe.

The MoUD has indexed 30 cities of all sizes on walkability and assessed them supported availability of foot paths on major arterial roads. and overall facility rating by pedestrians themselves.

The perception of pedestrians has also been gauged on availability of footpath and its quality, obstruction, maintenance, lighting, security from crime, safety in crossings etc. a coffee rank indicates inadequate and substandard pedestrian facilities. The national average index is 0.52. the simplest within

the country per this ranking is Chandigarh with 0.9. this is often in sharp contrast to cities like London that score 1.5 to 1.7 and have active policies to encourage foot traffic.

Pedestrians aren't given significant importance in planning approaches; this can be grossly evident from this state of sidewalks that are being gradually obsessed to provide more room for carriageways of motorized traffic. MoUD has found that the proportion of the road with pedestrian footpaths runs hardly in 30 per cent in most cities.

Even people who exist are clogged with hawkers, vendors, urinals and electric transformers in hit or miss manner.

In any typical city the core could just be 2-4 km across and simply walkable within an inexpensive time. Studies have shown that quite 40 to 50 per cent of the daily trips in many of our cities have distances but 5 kilometers (MoUD, 2008). This has enormous potential to convert to non-motorized and particularly walking trips. City cores even in mega cities of Mumbai, Kolkata, and plenty of others have retained a number of the characteristics of high density, mixed-land use and short trip stretches. But these characteristics are fast disappearing as urban sprawls are expanding.

High density, mixed land use, and narrow streets have made walking for work and recreation comfortable, feasible and popular in traditional Indian cities. there's a direct have to measure and improve the state of pedestrian infrastructure in Indian cities because the conventional land-use and transport planning practices in Indian cities pay little attention to walking, and cyclists leaving a spot between the demand and availability of pedestrian facilities. Supporting and promoting the choice to run for brief distances must be made a key objective of national regional and native transport and community plans and likewise integrated with cycling and public transportation network.

1.2 Background Study

Walking is that the oldest style of transportation before the invention of the wheel, it's also the foremost healthy and eco-friendly mode of commuting. But in our fast-urbanizing cities, walking has slowing lost its significance. Sprawling urban cites, where distances to be travelled for various needs are continuously increasing, people's preference to walking has also reduced. Bicycle as we all know is a reasonable low-cost, environment- friendly, and sustainable mode of transport. It's considered a style of non-motorized or transport together with walking. Non-motorized transport is another means of transportation which is ecofriendly and must be encouraged. Their lack of speed has outdated them but with ever rising greenhouse emission emissions and also the shift towards sustainable cities needs their revival of sorts. This study highlights ways within which non-motorized transport will be incorporated in our transport corridors.

There are many studies done on Hazratganj through the years and a few are incorporated but there's still room for improvement. In 2010, Hazratganj underwent a serious face-upliftment where it had been

re-painted; new signs for outlets were put up together with whole revitalization was done but much attention wasn't given to walkers and cyclists.

1.3 Aim of the study

To study and analyse the applicability of cycling and try to improve pedestrianization in Indian CBDs.

1.4 Objectives of the study

- To understand the concept of walkability and non-motorized transportation.
- To Formulate the study methodology to achieve the aim.
- To critically analyze the applicability of NMT and support it with street infrastructure.
- To identify and propose the possible Schemes/Strategies and a layout plan.

1.5 Need Of Study

Walking is under an enormous stress from all sides as policies are leading to urban sprawl, increasing journey distances and making cities less walkable, this is extremely evident in Lucknow. Car-centered infrastructure for congestion-free, signal-free travel through flyovers, expressways and flyovers is deteriorating urban landscape, disrupting direct shortest routes of the walkers and increasing distances and travel time for walkers. The insatiable need for space for motorized vehicles is leading to the arbitrary surrender of walking space in cities. These factors are:

1.0.1 Increase in number of cars: Indian cities are motorizing at a rapid pace, the majority of vehicles registered are in urban areas 33% of Indian vehicles are in the 23 top metropolitan cities as recorded in 1994. According to an annual report of the MoUD, in the next 15 years 53 million two-wheelers and six million cars will be on metropolitan roads. Vehicles registrations have drastically increased from 62.7 million in 2003 to 99 million in 2007. Some researchers expect the vehicle growth to increase at a rate of 8- 12% per year which is almost four times faster than the growth of population (CAI-Asia, 2011).

1.0.2 Fuel consumption: Fuel consumption will likewise increase with increased number of cars. In 2004-2005, liquid fuel consumption in transport sector alone was 28% of India’s total petroleum

products consumption (CAI-Asia, 2011).

1.0.3 Road Accidents: About half of the world's road fatalities i.e. 1.3 million people are pedestrians and cyclists and more than 90% of which occur in developing countries. Although the pedestrian fatality share across India is 13%, it is 40% greater in metropolitan cities like Lucknow, Kolkatta, Bangalore etc. In the case of Bangalore, on an average

3 pedestrians succumb to road accidents every two days and annually approximately 10,000 are hospitalized of which senior citizens and school children havea major share of 23% fatalities and 25% injuries (CAI-Asia, 2011).

1.0.4 Household transport budget: A study conducted by Future Capital Research on 20Indian cities indicated that a large chunk of people's income is spent on transport. People spend more money on travel, about 21.3% than on health (7.6%), education (5.2%) and housing (8%) combined (CAI-Asia, 2011).

1.0.5 Emissions from transport sector: A study done by CAI-Asia indicates that due to sudden increase in motorization, the CO_2emissions from surface transport are expectedto increase at the rate of 7.75% increase per annum. Even if they don't increase, due to the current trend alone CO_2 emissions are expected to increase 2-3 times between2008 and 2025.

1.0.6 Transport system expansion: With an increase in mobility, the need for investment in transport infrastructure also increases. The Mckinsey Study (2010) on urban growthin India indicated that, India needs to build 350 to 400 km of metro lines and subways every year which is approximately 20 times the capacity building achieved by India in the last decade. In addition to this, about 19,000 – 25,000 km of road network must be built every year to accommodate the booming vehicle numbers and urban sprawlrequirements (CAI-Asia, 2011).

1.0.7 Funding: As the transport sector grows likewise the funding requirement to meet these demands also increase. The Rakesh Mohan Committee estimated a total cost of Rs 124770 million (approx USD 2.7 billion, 1996 prices) for urban transport infrastructure over a 10 year period up to 2006. Rail India Technical and Economic Services (RITES) indicated the cost for urban

Cost up to USD 30 billion in the 11th five-year plan and about USD 97 billion over the next 20 years (CAI-Asia, 2011).

Thus, there is an eminent need to find a whole new way of organizing cities to improve the quality of urban life. Providing good walk ways is only the first step towards creating non-motorized space in our cities. It is quite possible for cities to move directly to high end public transport and an urban way of life that is dominated by walking and cycling, if appropriate efforts are made in the right direction. Modern transport infrastructure development is at a take-off stage in our cities, if the infrastructure design gives priority to pedestrians, cycling and public transport the mobility paradigm can be transformed and made more sustainable. This is possible only if the policyunderstanding can be built on the linkage between walking and the sustainable travel options in city.

1.6 Scope of the Study

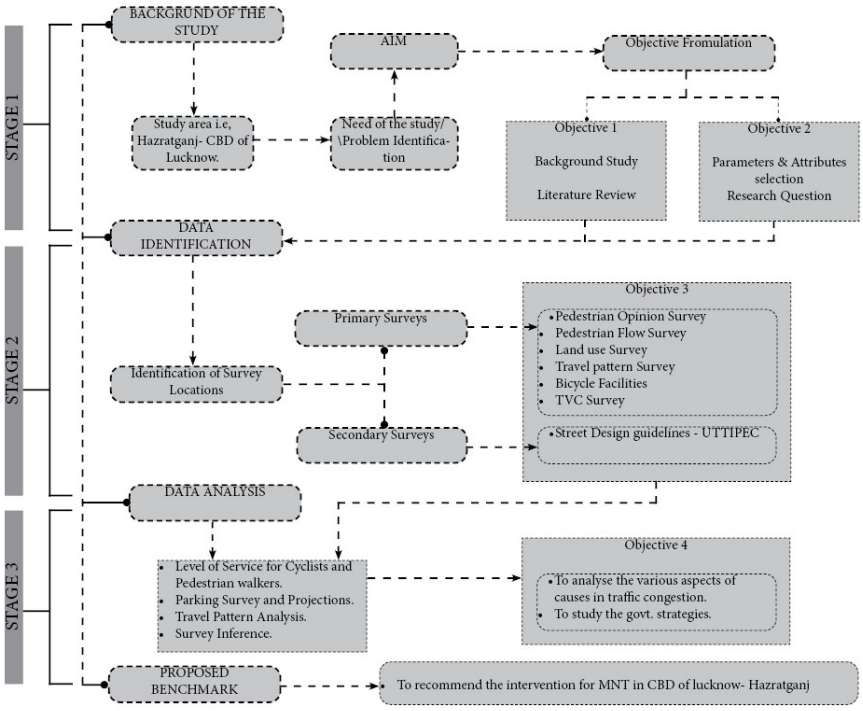
- The concluded results and recommendations of the research might contribute to a better understanding of the use of NMT and its implementation around the metropolitan cities of India.

1.7 Limitation of study

The The study is restricted to Non-Motorized Transportation in the CBD of Lucknow, Hazratganj only. And the concept of walkability is also integrated with inducing non-motorized transportation, which is restricted to cycling and walking alo

1.8 Methodology

The methodology which is followed for the work is as follow.



- The methodology followed is to firstly study cities and countries where pedestrianization and bicycling have been promoted on a large scale i.e., studying the best practices around the world, understanding their approach and methodology strategies in implementing them, interpreting the pros and cons of these approaches to be able to replicate them in the most sustainable way.
- Secondly, to document the present facilities or the lack of them and comparing them standards; studying the present landuse of the area and understanding its relation to trips generated site through various primary and secondary surveys to understand the drawbacks and negative parameters which inhibit people from walking and cycling.
- Thirdly, to analyze and interpret the data collected and to finally develop a layout plan for movement of walkers and cyclists in the Hazratganj area which takes into consideration the observed restrictions and brings out an integrated circulation pattern for pedestrians and cyclists and their connectivity to public transportation in line with the existing legislative framework and Zonal plans and proposals. Sample size for the all surveys was taken as 200 as no data on floating population was available.

CHAPTER 2: LITERATURE REVIEW

2.1 The Global Scenario

According There are many countries around the globe that are gradually shifting from urbansprawls to pedestrian-friendly neighborhoods. Netherlands has a very extensive pro-pedestrian and pro-bicycle legal and infrastructural framework. The Netherland Government has done several studies to understand the history of cycle usage, present infrastructure facilities supporting or discouraging walking and cycling, taken extra measures to ensure bicycle and pedestrian safety. It carried out studies on which age groups use cycles to get to school or recreation centers, workplaces etc and thecomfortable distances people travel to on foot or cycles. They have created bicycle tracks and footpaths in various avenues to encourage people to reduce car usage (NZTA, 2011).

Amsterdam has strenuous space constraints, where people do not have suffice space to park their cars near workplaces or shopping arcades etc. People as a result are compelled to use bicycles simultaneously the traffic and transportation infrastructuredepartment aims to stimulate the use of bicycles for transportation. Extensive funding has been given to it to promote bicycle usage as it is the responsibility of the government to provide a safer and cleaner environment. They developed a bicycle network integrated with pedestrian friendly avenues to induce cycling and walking. Across the world, including India there are cities in which bicycle is used for more than 20% of the trips for example, China, Tanzania, Burkina Faso, Netherlands, Denmark, Germany, Italy, Peru and Cuba. 67 percent of commuters in Latvia, 62 percent in Sweden and 52 percent in the Netherlands either walk, bike or use mass transit.Europeans on average walk 237 miles and cycle 116 miles per year; U.S. residentswalk 87 miles (Pucher et al., 2005).

Sustainable mobility is a ‘hot topic’ at a time when climate change is also a gravematter of concern. The bicycle is the cleanest, most sustainable, healthiest and fastest mode of urban transport. In terms of greenhouse gas emissions, the bicycle is than 100 times more sustainable than the car and much more sustainable than public transport also. Furthermore, a bicycle friendly town (e.g. Houten, Groningen and Zwolle) results ina better quality of urban life. The New Zealand Transport Agency has also taken up policy measures and awareness programs to improve and increase the percentage of cyclists in New Zealand. (NZTA, 2011)

2.2 Case Study – Shenzen, China

2.2.1 Issue:

Although Shenzhen has seen a boom in economic success, it has also been confronted with some severe problems, among which environmental challenge is regarded as one of its critical problems. With an increase in private car ownership, the city has gradually suffered from exhaust emission of vehicles. Air pollution, which is partly caused by the uncontrolled use of cars, has caused suffice emissions that has in turn, blurred the once blue sky of the city. The official data shows that in Shenzhen, there were 177 days with dust haze in the year of 2004, almost ten times more than thatin the 1980s. (GPWA, 2007) Also according to the official resource (STB, 2000-2005), the growth of Shenzhen's car ownership has reached an annual increase of more than 20%, much higher than the growth of road capacity. This explains why today traffic jam has increased greatly in Shenzhen's urban area. If the situation gets worse, Shenzhen will no longer be able to sustain its advantage in efficient urban system (Yuanzhou T et al 2009).

2.2.2 Approach:

In the recent years, with the increased heed being paid to the sustainabilityissues and the rise of 'low carbon' economy, both authorities and people of Shenzhen have become aware of the importance of pedestrian environment. Based on the reconsideration of previous development of Shenzhen, the municipal government decided to launch a study to plan for a city-wide pedestrian system, which aimed to improve the pedestrian environment of Shenzhen in line with the encouragement of a 'people-oriented' principle, the facilitation of low-carbon economic environment, and the promotion of sustainable development. The plan outlines three main sections, including:

A spatial strategy to support a well-organized network connecting different pedestrian units; development control to promote a good pedestrian environment in each unit; and design guidance to encourage comfortable and walkable pedestrian facilities as per general standards for all the units (Yuanzhou T et al 2009).

2.2.3 Target:

The proposed plan sets a clear target for the city in pursuit of an integrated, comprehensive, and feasible pedestrian system. It aims at the establishing a walkable city guided by the pedestrian plan, which is expected to provide safe, convenient, comfortable and beautiful pedestrian environment towards a healthy, clean, sustainable and livable Shenzhen. A planning outline has been structured to organize the stipulationof plan and corresponding policy and guidance, which focus on the improvement of pedestrian environment by various planning methods in order to achieve this aim(Yuanzhou T et al 2009).

2.2.4 Methodology:

By conducting field visits, firstly, some important spatial and local elements can be identified such as natural resources (mountains, riverside, and coastline) in Shenzhen; these can provide long-distance routes for walking and cycling for recreational purposes. Secondly, different places having different pedestrian behavior with regards to their location, land use, built forms, and other such parameters are classified. For instance, pedestrians in residential areas might pay more attention to the quality of landscape rather than those in industrial areas. Thirdly, the advantages and critical issues, to the improvement of pedestrian environment in different areas are also identified and classified. The pros may include the proximity to public transportation andthe attractive natural environment, while the drawbacks might include, lack of facilities for the disabled in public places or a commercial street being too narrow (Yuanzhou T etal 2009).

2.2.5 Action Plan:

First of all, at the city-wide level, several important places within the pedestrian corridors are proposed with detailed schemes, which are expected to initiate the improvement for all corridors. Secondly at the district level, some pedestrian areas are identified for action planning. Some of them are for development or redevelopment, which provide a good opportunity to implement the pedestrian-related development control. Some in the city's central position however, in poor pedestrian condition are in great need of urgent actions to change their negative impression. Thirdly at street level, it is proposed to renew the existing pedestrian facilities in some pivotal completely pedestrian areas and gateway or nodal areas (Yuanzhou T et al 2009).

2.3 Cycling In Netherlands

Cycling is a very popular activity in the Netherlands, but this cannot be interpreted as cycling being prevalent all over the country. In fact for distances up to 7.5 km, the bicycle is the most popular means of transport. In 2007, 34% of all trips up to 7.5 km were made by bicycle (PWWM, 2009).

Netherlands is the only European nation with more bicycles than people. On an average, the Dutch own 1.11 bicycles per person and the number of bicycles sold in theNetherlands is also high: 1.2 million bicycles in 2005, for 16 million residents. In absolute terms, more bicycles are only sold in various European countries with considerably higher populations: 4.9 million bicycles in Germany (for 82 million inhabitants), 3.2 million bicycles sold in France and 2.5 million in Great Britain (both 60 million inhabitants) (PWWM, 2009).

It has been observed that higher the use of bicycles, the safer it is for cyclists. Firstly, higher bicycle use, leads to a modified conduct of all traffic participants, becausecyclists are more dominant in the overall road picture and because more traffic participants have cycling experience. Secondly, higher bicycle use goes hand-in-hand with lower car use, thus reducing the chance of conflict with car traffic. Thirdly, almost every car driver is also a bicyclist (60% of the Dutch cycle at least three times a week, 80% at least once a week) (PWWM, 2009), which implies that car drivers understand the behavior of cyclists. Finally, the policy states that high bicycle use creates a greater support for the bicycle policy, thus more is invested in a safer cycling infrastructure.

The objectives of Bicycle Policy aim at Increasing the accessibility of companies and facilities - directly, by improving the cycling facilities for clients and employees arriving by bicycle and indirectly, by encouraging clients and employees arriving by car to switch to the bicycle or to a combination of bicycle and public transport both to improve accessibility for other car traffic (PWWM, 2009).

Its objectives also include improvement in the quality of the living environment: directly, because many inhabitants value safe and comfortable cycling facilities and indirectly, as bicycles replace short car journeys which produce a relatively large amount of (noise) disturbance. Also, by increasing social safety and traffic safety, both objectively (reducing

the number of traffic accident victims) and subjectively (reducing feelings of danger) (PWWM, 2009).

Also, by improving public health- directly, as bicycle use contributes to a daily exercise regime. And indirectly, the air quality improves if people use the bicycle for short journeys instead of the car. And by increasing development opportunities as manyinhabitants in Amstelveen do not have access to a car. Good and safe bicycle facilities may allow them to participate in activities independently. Disabled people may also depend on the bicycle infrastructure. And indirectly, to promote independence and the development of children, it is important that they can move independently from a young age, and finally to reduce the number of bicycle thefts (PWWM, 2009).

It highlights the main requirements for bicycle-friendly infrastructure i.e. it must bedirect - short and rapid routes from origin to destination. It must be comfortable, have a good surface, generous space and little hindrance from other traffic participants. It must also be attractive and socially safe environment, without smell or noise inconvenience.

These main requirements apply to the entire network of bicycle routes, but also to the facilities at road stretches and intersections. The bicycle network: most municipalities have a network of principal bicycle routes based on bicycle policy; such a network is developed through an analysis of the origin areas and the main destinations for cyclists such as offices, schools and the station (PWWM, 2009).

Some interventions that have been inculcated by them are that the main routes must meet higher quality requirements, for example they must have tarred surfaces, or priority must always be given to the main cycling route. Tackling bottlenecks on themain cycling routes is generally also subject to a higher priority. Simultaneously the cycling network cannot be considered in isolation from the network for vehicle traffic or given lesser importance to the bus network. When main cycling routes coincide with traffic arteries for vehicular traffic, this often has negative consequences for cyclists.Also taking the bicycle parking facilities for cyclists into account, not only do cyclists need a good and safe bicycle route, they also need support facilities to park their bicycles conveniently and safely. In practice, the fear of theft and vandalism leads to lower bicycle use. Good bicycle

parking facilities are not always self-evident; cyclists want to be able to leave their bicycles as near as possible to their destinations (PWWM,2009).

5.2 Pedestrian Design Guidelines

In the Pedestrian Design Guidelines as produced by UTTIPEC, DDA highlights the current laws and guidelines that legislates the "right to walk" and the "right to road space" of Pedestrians. These include the Central Motor Vehicles rules (CMVR) 1989 Safety Rules provide passive protection for pedestrians, stating that motorists cannot enter pedestrian way and are liable to penalty. The Indian Penal Code (sec 283) sec 34 of Delhi Police Act –which states that obstruction in public space, is punishable.

Some of the key design guidelines include avoiding sidewalk interruptions by minimizing kerb cuts i.e. minimizing the number of driveways that cross the sidewalk as a support to the pedestrian safety and to a continuous sidewalk along with removal of allobstructions from the sidewalks, maintaining an even surface and elevation of the pavement at 150 MM from surrounding road level, having consistency in design elements, color and texture, which aid in visual continuity and calm traffic, even at crossings; footpaths and bus stop surfaces should be matt-finish/ anti-skid. Universal accessibility is required for all sidewalks, crossings, parks, public spaces and amenities for people using wheelchairs, strollers, walkers, crutches, handcarts, bicycles, aged people, visually or hearing impaired, and pedestrians with temporary mobilityimpairment or injury (UTTIPEC, 2009).

The use of Traffic calming measures: traffic calming is the management of traffic through a combination of education, enforcement and engineering devices – so thatits negative impacts on residents, pedestrians and schools is minimized. The goal of traffic calming is to reduce vehicle speeds, improve pedestrian and cyclist safety, and enhance quality of life. Signal-free and fast movement of motorized vehicles within city limits (other than Mass Rapid Transit Systems) is to be minimized, as it makes the city extremely unsafe for pedestrians and public transport users and causes fatal accidents (UTTIPEC, 2009).

5.3 Bicycles for rent – London 2012 Olympics

With the onset of the Olympics 2012 to be hosted in London this time, the Transport for London (TfL) has developed The Barclays Cycle Hire, a bicycle hire scheme which aims at providing 6,000 bicycles for rent; as during the Olympics, public transport links and London roads will be congested. This scheme was launched in 2010 is open to visitors as well. It is only open to online registered members on the site (check tfl.gov.uk) who are to pay £3 for a smartcard, they can enter their credit or debit card details, select a bike and make their trips. A £1 a day is charged, for the first halfan hour, rental is free, and any number of 30-minute trips in the day can be made, in case the bike ride lasts longer than 30 minutes, charges start adding up. Bicycles returned after their access time has expired, face a punitive £150 late return charge. If the bike is misplaced, or is damaged by the hirer – or vandals – the hirer will have topay up to £300 to cover the loss (punctures are considered as wear and tear). Bicycles are also available for longer durations of days and weeks; Rentals can be pre-bookedas well (GLA).

Daily:		Weekly:	
1 day:	£20	1 week:	£50
2 days:	£30	2 weeks:	£75
3 days:	£40	Extra weeks:	£20 per week
4 days:	£45		
5 days:	£50		

Table 2.1 Pricing for bicycle rentals

Source: GLA

Since its introduction, the Cycle Hire scheme has seen over 1.5 million journeys, over 100,000 people have now registered for the scheme. Presently there are 400 docking stations. Provisions for free bike parking at all Olympic venues and the OlympicPark are also planned. The bike hiring stations are to be situated near the mainentrances of the venues. All bike hire needs are catered to such as bookings, maps, tour info, advice etc. Bethnal Green, Bow, Canary Wharf, Mile End, North Shoreditch, Poplar, Tower Hamlets and the Olympic Park itself will all gain Cycle Hire docking stations. A total of 2,700 docking stations will be created in the new area, and the existing hire area will also gain 1,500 a dditional stations (GLA).

Fig 2.1 Barclay's cycle

Fig 2.2 Smartcard

Fig 2.3 Docking stations

Photos courtesy: Gothamist

5.4 Indian Examples of Pune and Ahmedabad in context to Cycling

Ahmedabad and Pune are Indian examples of where attempts to consciouslypromote cycling have been made. In Ahmedabad, cycling has 15% of the modal shareas of 2007 with 14.63 lakh of the city's trips on cycles. With a population of more than60 lakh, the city fares better than the national average and other large cities in itscategory whose average is about 11% of trips on cycle (MoUD, 2008). AccordingCensus 2001, 54.43% households in Ahmedabad own one or more cycles. Whileexperts suggests that bicycle use may decline over the years, there will still be a largenumber of non-motorized trips at the rate of 8% modal share by 2021 (MPD-2021).In the city of Pune about 0.75 million trips are estimated to be on cycle every day. (Tiwari G., 2008). The Pune Municipal Corporation is the implementing agency for the project of GEF-SUTP which has proposed sub-components of Pedestrian infrastructure improvements which include reconditioning footpaths by adding to their widths where necessary; and limiting their height where it exceeds the standards, improvements of sections of existing footpath depressed for facilitating driveway access, construction of raised crosswalks and where pedestrian facilities are absent, constructing them de-novo on the length of roads to be meted out with the treatment, sub-way for pedestrian/cycle access, street furniture, lighting and road markings.

(i) Cycle infrastructure improvements include construction of cycle tracks at city level and as feeder network for BRT, bicycle stands on either side of BRT stations, traffic signal priority for cycle users and pedestrians and street furniture, lighting and road marking etc (MoUD, 2009).

5.5 Eco-friendly Rickshaws in India

Under the 'clean Delhi, clean Yamuna' campaign, eco-friendly rickshaws have been launched in Delhi recently by Chief Minister Sheila Dixit for the Common Wealth Games 2010.They have been sponsored by Vodafone Essar priced at 1.5 lakh, the company has so far sponsored 25 vehicles. These are battery operated and have a capacity of travelling 90 km per charging. The main components of the vehicle are fully recyclable polyethylene cabin, a heavy-duty modular steel frame. They have been launched for five routes namely Greater Kailash-II, Saket-Press club road, IIT-SDA market area, Delhi University-North Campus and Chandni Chowk. These can be used by senior citizens who face difficulty in walking short distances and also help protect people from walking in the sun in severe summers.

Features of E-Rickshaws

- The e-rickshaw has a battery which is required to be charged for six to eight hours and an electric motor of 250 W.
- The e-rickshaws are zero-emission means of transport for passengers and are equipped with a remarkable shape, comfortable design and superior technical features.
- The e-rickshaw weighs about 200 kg and is about 1.86 m long
- The e-rickshaw is capable enough to run at the speed of 25km per hr or 15mph.
- These rickshaws also have the facility to be fitted with GPS locator device.
- This shift from rickshaws to e-rickshaws has not affected the fares of these rickshaws. These new rickshaws will charge between Rs. 10 and 15 and pensioners need not pay them. The Government had aimed to start running 4000 e-rickshaws by the time of the Commonwealth Games. (The Economic Times)

Fig 2.4 E-Rickshaw side

Fig 2.5 E-Rickshaw front

Photos courtesy: Press trust of India

CHAPTER 3: TOOLS AND TECHINIQUES

3.1 Approach

Since the study revolves around the use of footpaths and bicycles, it is predominantly based on perception of people towards the facilities provided for pedestrians and cyclists as it is the psychology and mindset of people which encourages/discourages them to use the same.

3.2 Primary Data

3.2.1 Pedestrian Opinion Survey (refer to annex 3)

These surveys are conducted to capture the views and preferences of pedestrians. A short questionnaire on social characteristics and walkability preferences was designed to evaluate current conditions and assess requirements for pedestrian facilities. Opinions of pedestrians on nine parameters were ranked on a 1 - 5 scale, where one indicates the worst and five the best. A low rank indicates inadequate and substandard pedestrian facilities and vice-versa. (MoUD, 2008)

Parameter	Description
1. Walking Path Modal Conflict	The extent of conflict between pedestrians and other modes on the road, such as bicycles, motorcycles and cars
2. Availability of Walking Paths	The need, availability and condition of walking paths.
3. Availability of Crossings	The availability and length of crossings to describe whether pedestrians tend to jaywalk when there are no crossings or when crossings are too far apart
4. Grade Crossing Safety	The exposure to other modes when crossing roads, time spent waiting and crossing the street and the amount of time given to pedestrians to cross intersections with signals
5. Motorist Behavior	The behavior of motorists towards pedestrians as an indication of the kind of pedestrian environment
6. Amenities	The availability of pedestrian amenities, such as benches, street

	lights, public toilets, and trees, which greatly enhance the attractiveness and convenience of the pedestrian environment, and in turn, the surrounding area
7. Disability Infrastructure	The availability of, positioning of and maintenance of infrastructure for the disabled
8. Obstructions	The presence of permanent and temporary obstructions on pedestrian pathways. These ultimately affect the effective widthof the pedestrian pathway and may cause inconvenience to pedestrians
9. Security from Crime	The general feeling of security from crime on a certain stretch ofroad

Source: Walkability Surveys in Asian Cities

Table 3.1 Field Walkability Survey Parameters

3.2.2 Pedestrian Flow Survey

Pedestrian and crowd surveys are carried out in order to capture pedestrian volumes and profiles; origins and destinations; use of modes; and journey objectives. These provide the baseline information for any capacity assessment, design specification or crowd simulation. It has its advantages over direct observation as one can collect data from the video carefully and accurately later in a more leisure environment also trajectories of all pedestrians can be determined from the video data. (NYC DCP, 2006)

For the design of walking infrastructure, a working knowledge of the characteristics of pedestrian flows is required in order to design the infrastructure aswell as to assess its efficiency and safety. In particular, a good understanding of the emergent patterns is required to predict how the flow will behave under different circumstances. In predicting the disutility of walking, a pedestrian value the different attributes characterizing the available options (e.g., risk to collide with another pedestrian, straying from the intended walking path, physical contact with other pedestrians, etc.) differently.

3.2.3 Parking Survey (refer to annex 2)

Parking surveys can be undertaken to provide information on the demand for parking around existing facilities, on-street or off-street, to provide an understanding of the demand for parking, duration of stay and turnover of parking. This information can be used to plan for the expansion of the facility or improvements and redesign of the parking facilities including new parking controls such as parking duration limits, access control etc. The results of surveys at a particular location can also be used as an indicator of parking demands for a similar planned facility (TPSL, 2011).

Parking Accumulation Study: this type of study simply measures the number of vehicles entering or leaving a parking area and thus allows an estimate to be made of the overall parking demand by time of day for the survey period. This type of surely would be applicable to a large off-street car park, say associated with a shopping centre, where the parking area is serviced by a limited number of access roads(TPSL, 2011).

Parking Duration Study: The range of parking durations of vehicles parking withina car park or area can be observed by mapping the parking area to be surveyed and then having an observer note the occupancy of each parking bay at regular intervals. The shorter the time interval between each cycle allows the parking durations to be noted more accurately but of course this additional accuracy will come at an additional cost due to the need for additional staff to allow the additional observations to be made (TPSL, 2011).

3.2.4 Land use Survey

Landuse and Traffic have a direction correlation as both directly affect eachother. Landuse generate traffic and traffic is headed to a particular landuse. The quantum of trip generation also relates to landuse. Thus a landuse survey is imminent.

3.2.5 Travel Pattern Survey (refer to annex 1)

People coming to Hazratganj were asked their average number of trips made to Hazratganj in a week and the purpose for their trip i.e either work or leisure. People were also asked their mode choice for various destinations such as markets, metro stations, hospitals etc to obtain a general understanding of mentalityand use of motorized transportation.

3.2.6 Bicycle Facilities

Design Speed: The range for speed is between 7 to 30 mph but the working speed is taken as 20 mph. Bikeway Width: This depends on the bicycle width maneuvering allowance, clearance space between oncoming and passing by bicycles. There must be at least 2.5 ft of horizontal distance between bicycles and pedestrians. A comfortable distance range is 11-15 ft wide would be required to accommodate both.

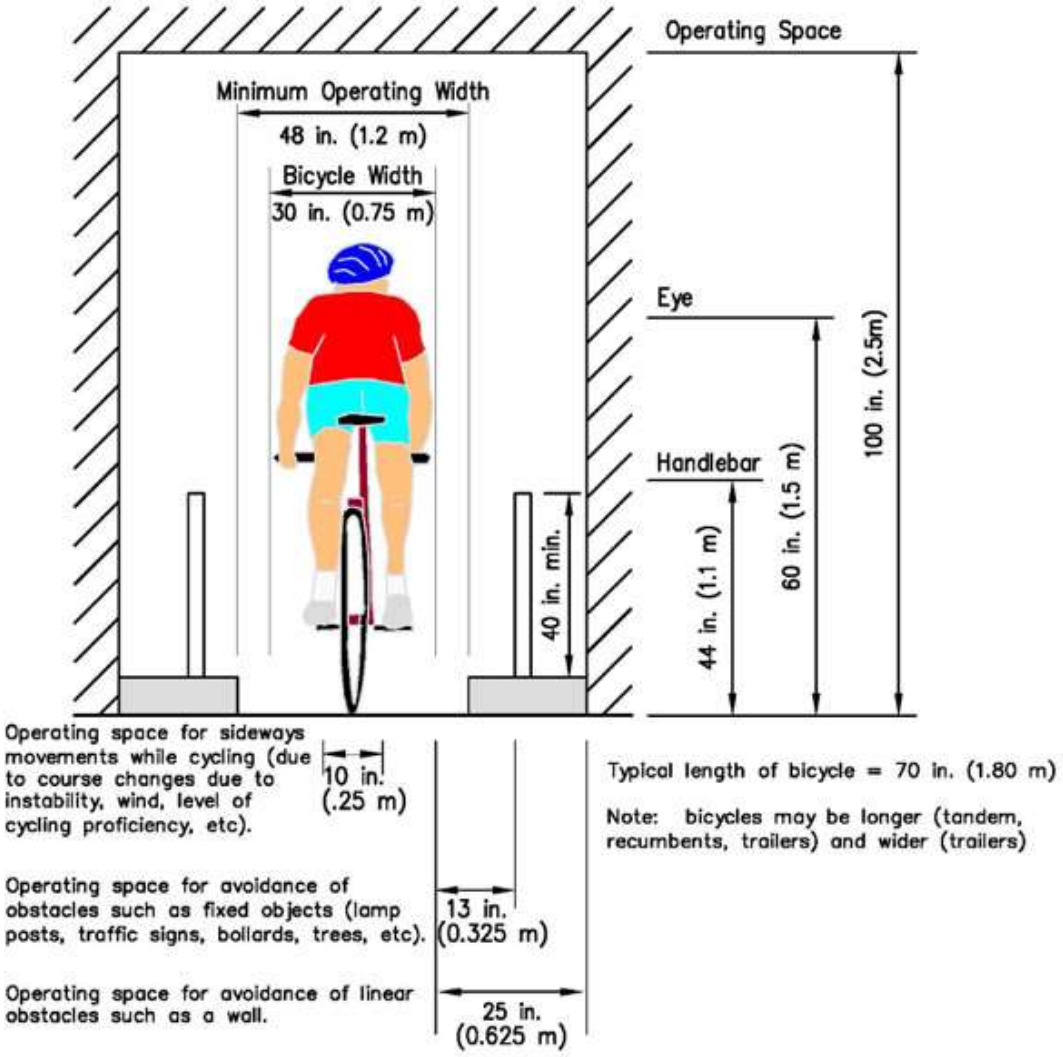


Figure 3.1 Slum population by state

Source: Transportation Engineering: An Introduction

5.6 Secondary Data

3.3.1 Street Design Guidelines

UTTIPEC

Table 3.2 Street Design Guidelines

S no	Component	Sub - Component	Non – negotiable Requirement	Street type
1.0 Walking Zone: Clear Walking Zone should be 1.8 M x 2.4 M High				
	01A	Minimum Clear Walking Zone	1.8 M clear width 2.4 M Clear height (No obstructions allowable within this clear height; Tree branches within this height to bepruned with due permissions; All Advertisement panels, posts, poles, junction boxes, public utility structures etc. to be removed.)	All
	01B	Walking Zone	2.0 M for Residential Areas	All
		Width is provided as per land-use	2.5 M minimum for Commercial/Mixed Use Streets 4.0 M for Commercial Nodes	Commercia l and Mixed-use Streets
			Maximum height of a pavement (including kerb, walking surface, top-of- paving) shall not exceed 150 MM (6”). 100 mm (4”) kerb height is preferable for Arterial Roads.	
			·All walking surfaces should be very	
			rough/ matt-finish/ anti-skid.	
			·Medians should be maximum 150mm	
			high or be replaced by crash barriers.	
	01C	Maximum Kerb	·In case the carriageway finished level is expected to rise during	All

		Height	future re- carpeting, reduction in footpath level to 100 mm or less is acceptable. But under no circumstances is the height of footpath to exceed 150 mm.	
			·Finished top level and kerb height for	
			all bus-stops to be 150 mm.	
			·Only along Segregated Bus ways/	
			BRT corridors, the kerb height of the Bus Stop could match the height of the bus floor.	
			Maximum corner radius of Kerb = 12 M	
			It may be reduced to 6 M in residential	
	01D	Kerb Radius and Slip Road Treatment	areas to slow down turning buses, trucks etc. with the provision of a corner mountable kerb for emergency	As specified.
			vehicles.	
			Slip roads or Free Left Turns should be	
			avoided. For intersections of R/Ws of 30m-30m or lesser, Slip Roads should be removed/ not considered. In cases wherethey already exist for intersections for intersection of 30m- 45m and higher R/Ws, thefollowing Strategies may be employed: Option 1: Slip Road can be removed wherever Pedestrian and NMV volumes are high. Option 2: Reduce Corner Radius of kerb to calm traffic, and signalize the Slip road crossing (full or pelican signal), in order to make them safe for all users. Option 3: Introduce raised table top crossings at slip roads and minimum 20-second pedestrians' signals – to allow pedestrians, cyclistsand physically	

			challenged people to cross the road comfortably at the same level. Option 4: Signalized Turning Pockets may be provided where left-turning volumes are high.	
	01E	Continuous Pavement	Continuous barrier free movement corridor for NMTs and Persons with Disabilities. ·Avoid sidewalk interruptions by minimizing kerb cuts i.e. Minimize the number of driveways that cross the sidewalk – in order to support pedestrian safety and a continuous sidewalk.	All
			·Maintain an even surface and elevation of the pavement at 150 MM or less from surrounding road level. ·At entry points of properties – introduce “raised driveway” or "table- top" details –where pedestrian and cycle lanes continue at their same level, but the motorized vehicles have to move over a gentle ramp to enter the property. ·Remove all obstructions from the sidewalks. ·Consistency of design elements, color and texture, help provide visual continuity and calm traffic, even at crossings.	
	01F	High Albedo Materials	If paving with asphalt, apply a white aggregate as a chip seal layer, or a light colored surface coating such as a zinc-oxide slurry mix.	All
	01G	Permeable Pavement	Paving for large hard surfaced areas like parking lots, driveway curb-cuts, large plazas, hawker zones, pedestrian only streets, etc. should be permeable in order to reduce runoff and heat island effect, and increase ground water infiltration and recharge.	Wherever large paved areas exist;
		Guard-Rail	Not desirable in most instances on	

			urban roads, except near intersections.	
2.0	Frontage Zone or "Dead Width"	· For sidewalks in shopping areas, an extra 1M should beadded to the stipulated 4.00 M width. This extra width is called "Dead Width".		All Commercia land
		·In other situations where sidewalks pass next to buildings and fences, a dead width of 0.5 M can be added. In busy areas like bus stops, railway stations, recreational areas, width of sidewalk should be suitably increased to account for accumulation of pedestrians.		Mixed-use Streets
3.0	Universal Accessibility Features/ Barrier Free Design	Universal Accessibility is required for all sidewalks, crossings, parks, public spaces and amenities.		
	03A	Kerb Ramps	1:12 Minimum Slope at all level change points; 1.2 M Width of Ramp; Tactile warning strip to be provided at curbside edge of the slope..	All
	03B	Raised Table-Top Crossings	All slip road pedestrian crossings; all non-signalized intersections and mid-block intersections should be raised to matchthe level of the connected footpaths (150MM top of Kerb)	All

	03C		All walking surfaces should have Tactile pavers (Guiding and warning path) to guide people with vision impairment Tactile pavers should be provided to lead persons with vision impairments to the lifts, crossings, toilets, bus stops, i.e. all public and road facilities.	All
	03D	Auditory Signals	All traffic signals should have red & green man symbols and auditorysignals.	All
	03E	Accessible Infrastructure	All Signages should be graphic or symbol based, rather than text based.	All
			Lifts should be minimum 1400 x 1400 MM in size. All Lifts to have Braille buttons and audio announcement systems.	Wherever applicable
4.0	Multi-Functional Zone with Planting	Multi-Functional Zones on a Street should be a minimum of 1.8 M Wide, and may locate any or all of the following functions within them: Tree Planting; Planting for Storm Water Management; Auto-rickshaw Stands; Cycle-rickshaw Stands; HawkerZones; Car Parking; Street Furniture; Bus Stops, Street lights/ pedestrian lights. Provision of MFZ is most critical otherwise the aboveuses/ components of streets would encroach uponpedestrian, cyclist or carriageway space. Common Utility Ducts and Duct Banks should not be located under the MFZ as there may be		

		interference due to trees.		
	04A	Essential Planting	Deciduous Trees a must for shadingand comfort of all road users in different seasons.	All Streets above
			Tree Planting and Lighting Plan mustbe prepared in conjunction so as to not obstruct each other. Trees must be pruned up in order tomaintain visual clearance for pedestrians (2.4 M clear vertical zone). Under no circumstances should treesbe placed within the 1.8 M clearhorizontal Walking zone.	All
	04B	Tree Pits and	1.8 M x 1.8 M Tree Pit should be left for	All
		Tree Grates	Tree roots to breathe; Permeable Pavers or Tree Grates should be placed over the pit in busy pedestrian streets so people can walk over the tree pit.	
		Planting	Rain water harvesting is a must	

	04C	with Storm Water Management	on all roads, and all road retrofitting projects.	All
	04D	Aesthetic Planting	Trees themes by color of flowers, foliage, fruit-type, smells, and other aesthetic qualities in order to give a unique experience to road users	As feasible and suitable.
5.0	Bicycle and NMT Infrastructure	Minimum 2.5 M NMT Path made in Cement Concrete andphysically separated from MV Lanes.		
	05A	Segregated Cycle + NMTPaths	Cycle and NMT Path in cement concrete, physically separated fromMotorized vehicle traffic by an open space or barrier within the existing Right–of–Way.	All two-wayStreets above
	05B	Bicycle Parking and Other Infrastructure	Secure Cycle Parking must beprovided at all MRTS/ BRTS Stations. Designated cycle-rickshaw parking is tobe provided near all local and masstransit stops. Cycle parking and cycle rickshaw parking should be accommodated within the Multi- Functional Zone; minimum width required is 1.5 M. The stands should allow at least the frame and ideally both wheels, to be secured to them.	All
		Cycle Track – Capacity	Capacity in number of cycles per day	

		For One way Traffic	Two Lane - 2.5 to 5.0 M Three Lane - Over 5.0 M Four Lane - -------	
		For Two Way Traffic	Two Lane - 2.5 MINIMUM Three Lane - 2000 to 5000 Four Lane - Over 5.0 M	
		Cycle Track – Types	Two types of cycle tracks: 1. Which run parallel to or along a main carriage way. A. Adjoining Cycle Tracks B. Raised Cycle Tracks C. Free Cycle Tracks 2. Which are constructed independent of any carriage way.	
		Cycle Track - Horizontal Curves	It should be so aligned that the radii of the horizontal curves are not less than 10 M (33 ft). Where the track has a gradient steeper than 1 in 40, the radii of the horizontal curves should not be less than 15 M (50 ft). The radii of horizontal curves for independent cycle tracks should be as large as practicable.	

		Cycle Track - Vertical Curves	Vertical curves at changes in grade should have a minimum radius of 200 M (656 ft) for summit curves and 100 M (328 ft) for valley curves.	
		Cycle Track - Gradients	The length of grade should not exceed from 90 M (295 ft) to 500 M (1640 ft) for the gradient of 1 in 30 to 1 in 70,	
			respectively. Gradients steeper than 1 in 30 should generally be avoided. Only in exceptional cases, gradients of 1 in 20 and 1 in 25 may be allowed for lengths not exceeding 20 M (65 ft) and 50 M (164 ft) respectively. Where the gradient of a carriage way is too steep for a parallel cycle track the latter may have to be taken along a detour to satisfy the requirements of this standard.	
		Cycle Track - Sight Distances	Cyclist should have a clear view of not less than 25 M (82 ft). In the case of cycle tracks at gradients of 1 in 40 or steeper, cyclist should have a clear view	

			of not less than 60 M (197 ft).	
		Cycle Track - Lane width	The total width of pavement required for the movement of one cycle is 1.0 M(3 ft 3 in.).	
		Cycle Track - Width of Pavement	The minimum width of pavement for a cycle track should not be less than 2 lanes, i.e., 2.0 M (6 ft 6 in.). If overtaking is to be provided for, the width should be made 3.0 M (9.8 ft). Each additional lane where required should be 1.0 M (3 ft 3 in.) wide.	
		Cycle Track - Clearance	Vertical clearance - The minimum head-room provided should be 2.25 M (7.38 ft). Horizontal clearance - At underpass and similar other situations a side	
			clearance of 25 cm should be allowed on each side. The minimum width of an underpass for a two-lane cycle track would, therefore, be 2.5 M (8.2 ft). In suchsituations it would be desirable toincrease the head-room by another 25 cm so as to provide a total vertical clearance of 2.5 M (8.2 ft).	

		Cycle Track - Cycle tracks on bridges	Full width cycle tracks should be provided over the bridge. The height of the railing or parapet should be kept 15cm higher than required otherwise, when cycle track is located immediately next to bridge railing or parapet.	
		Cycle Track - General	Provided on both sides of a road and should be separated from main carriage way by a verge or a berm. Minimum width of the verge - 1.0M (3ft 3in.) Width of verge may reduced to 50cm (20 in.). For a width of 50cm (20 in.) from the edge of the pavement of the cycletrack, the berms should be maintained so as to be usable by cyclists in an emergency. Cycle tracks should be located beyond the hedge, tree, or footpath. Kerbs should be avoided as far as possible. A clearance of at least 50 cm should be provided near hedges and of 1.0 M from trees or ditches.	

		Cycle Track - Road crossings	Where a cycle track crosses a road,the carriageway should be marked with appropriate road markings.	
		Cycle Track - Riding surface and lighting	Cycle tracks should have riding qualities and lighting standards equalto or better than those of the main carriage way, to attract the cyclists.	
6.0	Crossings	Minimum 3 M wide pedestrian crossing and 2.5 M wide cycle crossing must be provided at all road crossings. A "Set of 3" essentials components are required at each crossing: Universal Accessibility Features (for persons with disabilities, reduced mobility, vision and hearing impairment.) Dustbin Street Directional Signage		All
	06A	At-grade Crossing	Minimum 3 M wide signalized crossings at all intersections and T-junctions. Width of crossing should be increased where higher pedestrian/NMV volumes are expected due to abutting land-uses. Advance stop and yield lines should beconsidered at stop- or signal-controlled marked crossings with limited crossing visibility, poor driver compliance, or	All

			nonstandard geometrics. Stop and yield lines can be used from 1 to 15 M in advance of crossings, depending upon location, roadway	
			configuration, vehicle speeds, and traffic control. Traffic Calming Treatment starting least 25 m before the zebra/ table-top crossing is essential in Delhi due to unruly traffic. Way finding Signage for Pedestrian orientation and directional guidance must be provided at street intersections. Amenities like dustbins are also needed.	
	06B	Mid-Block Crossing	Mid-block crossings must be provided for Blocks longer than 250 M. See Guideline Document for Details. Mid-block crossings must be provided at regular intervals as per the following standards: Residential Areas: Every 80 - 250m and Coordinated with entry points of complexes; location of bus/ train stops, public facilities, etc. Commercial/ Mixed Use Areas: Every 80 - 150m High Intensity Commercial Areas: Make Pedestrian and NMT only, if possible. All non-signalized mid-block crossings are to have auditory pelican signals and table top provisions.	All, except highways
	06C	Raised Crossings	(see 03B)	All, except highways
	06D	Grade Separated	Foot Over-bridges may be considered only on highways and	

			in Special	
		Crossing (Foot Over Bridge)	Conditions where no other solutions for Crossing are possible. All Subways and Foot-over bridges must have a combination of either "Staircase + Ramp" or "Stair Case + Elevator" for universal accessibility.	
	06E	Grade Separated Crossing (Humped Crossing)	Humped Crossings may be considered only on highways. Clear height of Humped crossing is 2.7 M - the road above is raised by 1.5 M and the pedestrian walkway is sunk by 1.2 M. Rainwater harvesting is mandatory and critical.	Only Highways or Special Conditions.
7.0	Medians, Refuge Islands	Medians and Pedestrian Refuge Islands are a must onstreets wider than 24 M.		All Streets above 24 M
	07A	Landscaped Median	Instead of fences, Medians should be landscaped and used for storm water management wherever possible. When street trees are desired, a median should be min. 1.5 M wide, including kerbs.	All Streets above 24 M
	07B	Pedestrian Refuge Island at Median	At-grade Median Refuges allowpedestrians to wait safely for crossingwide streets with long signal rotations. Minimum Width of a Pedestrian RefugeIsland at a Crossing is 1.2 M, enoughto accommodate a wheelchair orstroller. Bollards must be used to prevent vehicular U-turns.	All Streets above 24 M

8.0	Pedestrian Scale Lighting	Mid-Mast Lighting (10-12 M tall) – are appropriate formost Arterial and Sub-Arterial Streets. For Wide Streets with high pedestrian/ commercial activity, Mid-Mast lighting may be combined with Pedestrian Scale lighting to create additional security and comfort.		
	08A	Pedestrian Scale Low - Mast Street Lighting	Height of Light Pole is a function ofStreetWidth. Narrower the StreetWidth, lower can be the Lamp Height. The flux level for the street lighting maybe applied as per BC/IRC standards. Lighting Plan must be prepared in conjunction with Tree Planting Plan.	All
	08B	Full Cut-off Fixtures	Full cut off fixtures which focus light downwards and allow no light towards the night sky, and also do not cause glare – are required for all public streets.	All
9.0	Public Amenities(Toilets, etc), Hawker Zones, Signage			
	09A	Local Bus Stop	Bus Stop must be Universally Accessible and located Clear of the 1.8M Walking Zone; they can be located within the Multi-Functional Zones.	All

	09B	Public Toilets	Public Toilets, one including persons - must with disabilities located every 500 -800 M.	All
	09C	Street-Direction Signage	Vector Way fining Signage is essential at every street corner.	All, as feasible
	09D	Pelican Signals	Auditory Pelican Signals coupled with raised table top crossings must be provided at all T-junctions and non-fully signalized mid-block crossings.	All
	09E	Dustbins	Dustbins with graphic explanation of source separation must be provided at all street intersections and bus-stops.	All
	09F	Hawker Zones	Hawker Zones must be provided within the Multi-functional Zone or other incidental spaces along a pedestrian pathway - within the overall R/W - but must be clear of all minimum walking and cycling rights-of-way.	All

Source: UTTIPEC (2010)

CHAPTER 4: BRIEF PROFILE OF STUDY AREA – HAZRATGANJ WARD NO.17, LUCKNOW

4.1 Overview

There is a significant reduction in non-motorized mode shares over the years - in Lucknow, bicycle trips fell from 36% to 7% of trips by all vehicular modes between the years1957 and 1994. But in the city of Lucknow about 0.9 -1.2 million trips are estimated to be oncycle every day. In Lucknow there are an estimated 0.96 million households (37.6%) owning bicycles in 2001. The average trip length for bicycle in medium and large cities varies from 3.1 to 4.5km. In Lucknow the average trip length of all vehicle's excluding walk is 10.66km and for bicycle is 5.1 km. About 35% of the total vehicular trips are short trips.

Fig 4.1 India Map

Fig 4.2 Lucknow District Map

Fig 4.3 Area Base Map

4.2 Description of Site

- Taken total study area is of Hazratganj ward number 17
- Which comprises of 2.5 km of stretch.
- Which has two major intersection arterial roads were Mahatma Gandhi Marg and Ashok Marg.
- This Arterial Road Plays a Major Role in the city as it crosses via main part of the city as became a major transport transient.

Hazratganj is that the downtown and also the main outlet of Lucknow, the capital and therefore the largest city of the Indian state of Uttar Pradesh. additionally, to bazaars, it also contains shopping complexes, restaurants, hotels, theaters, cafés and lots of offices.

In 2010 to celebrate 200 years of Hazratganj, the then government started a programme for the makeover of the world. the first makeover plan designed by country's noted architect Nasir Munjee several years ago worked because the base for the ultimate plan that entailed an expense of Rs 30 crore. Hoardings from rooftops and encroachments on the road were removed. Buildings were painted during a uniform crème and pink. Same size and colour signages, stone pavements and therefore the Victorian style balustrades, lamp posts, waste-bins, benches, an exterior tiny amphitheatre and vibrant fountains were constructed.

The century-old station was demolished to form way for the fashionable multilevel parking. Lucknow Development Authority (LDA) along with city's administration organizes monthly carnival on the second Sunday of every month in Hazratganj market. On tonight, the market becomes a space with barricades and security services. Various kinds of cultural and entertainment programmes are held for the final public. Lucknow Police watches the gang with the assistance of drone cameras.

"Ganjing" is ambling and shopping within the wide lanes and by lanes of citv's ganj market. Hazratganj could be a major Victorian style shopping area. It houses showrooms, shopping complexes, restaurants, hotels, cafés, theatres, offices and businesses. Hazratganj shops sell the famous Lucknow Chikan material. Gurjari, Handloom Emporium and Gandhi Ashrams are located within the market.

4.3Observations

- NMT Facilities like E-rickshaws, rickshaw, Cycles doesn't have any dedicated crossings and paths or dedicated Stop Points which hinders the pedestrian flow of market visitors along with crossing points.

Figure 4.4 E-rickshaw movement

Figure 4.5 Unauthorized Crossings

- There can be seen a growth of almost six times in the city 's decadal population if focus on the population trend since 1961 to 2011.
- The chart above illustrates the trend in projected population from 2021 to 2041, i.e., the city will undergo a gradual increase in growth rate from 36.14% to 40.94% from 2021 to 2041.
- About 1.07,481 vehicles passthrough the Hazratganj crossing in which about 3,48,291 persons commute in 24 hours. This is about 13.93 per cent of Lucknow's population.
- In certain areas, footpaths are not maintained or built. There are no traffic signals for pedestrians.

Figure 4.6 Footpath Friendly designs missing

- There is no side stand or drop point along the area causes uncontrolled stoppage of e rishaws and rikshaws along with private vehicles.

These factors act as drawbacks which do not facilitate movement of pedestrians and cyclists.

CHAPTER 5: DATA ANALYSIS

5.1 Pedestrian Flow Survey (LOS)

A video survey was conducted 4 days of the week and weekend at peak hours tocompute the density of people at a given studied at the four radial axis roads of Hazratganj. The peak time taken on weekdays was taken as 9-11am and 4-6pm whereason weekend's peak time was taken as 10-12am and 6-8pm (refer to annex 4).

When the flow of pedestrians is heterogeneous (e.g. regarding the walking speeds), changing speed or direction may improve the conditions of an individual, since slower pedestrians with hold back faster ones. Faster pedestrians will overtake only if overtaking will result in a substantially improved situation. When such benefits are not sufficient, that is, when the switching costs are higher than the disutility of staying in the current layer, the pedestrian aiming to walk fast will stay behind the slow pedestrian: thedisutility of not being able to walk at the desired velocity is in this case compensated by the reduced probability of colliding with other pedestrians and the switching cost fromthe current layer to another (caused by e.g., needing to cross through another layer).

For bi-directional flows, user-optimal states are states in which lanes of uniform walking directions. In this case, the system optimal situation would be two regions of pedestrians moving in opposite directions, since this situation yields the least friction between the regions, and thus the smallest collective disutility. This ideal state may not occur due to initial conditions, heterogeneous composition of the flows (with respect to the desired walking speed) combined with overtaking opportunities, etc. This also implies that the number of lanes that are formed will also depend on the density, since the latter determines overtaking opportunities.

As per the data collected the present design speed is 17 ped/min/ft i.e. the present level of service is LOS E. The minimum design level is LOS C for which speed is 7-10 ped/min/ft. Since hawkers take up about 1 m of walking space in a 3 m walking zone if they are relocated, more space will be available for walking and thus improving the level of service as well i.e., more pedestrians can walk faster without bumping into other walkers - lesser congestion.

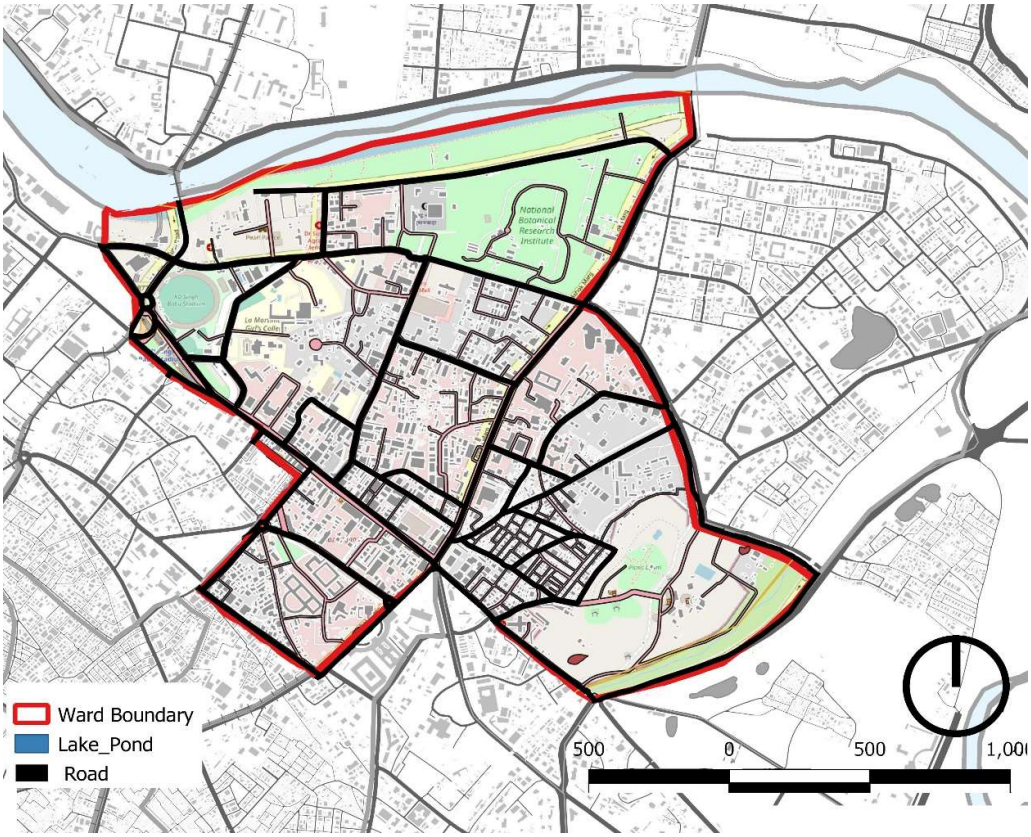


Figure 5.1 Base Map

Source: Author

5.2 Opinion Survey

From the pedestrian opinion survey, it can be understood that people feel that footpaths are available and the footpath width is not very less, there are minimalobstructions as well.

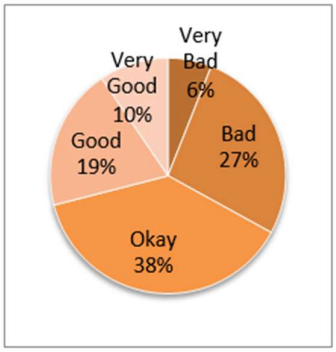


Fig 5.2 Availability of footpath

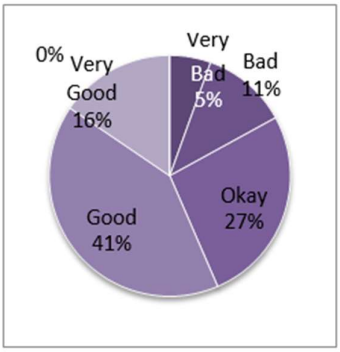


Fig 5.3 footway width

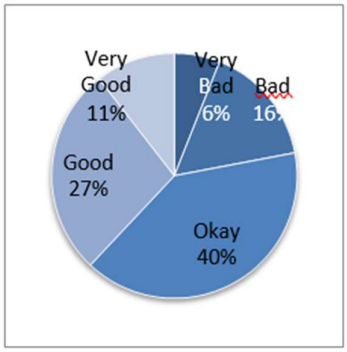


Fig 5.4 Presence of obstruction

Source: Primary survey

The maintenance of footpaths, availability of street furniture and amenities is mediocre whereas safety from crime is good.

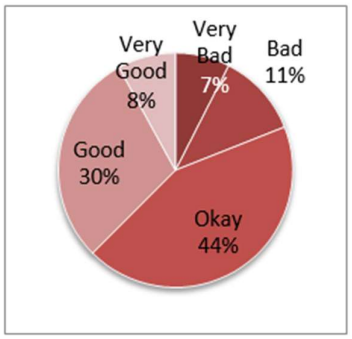


Fig 5.5 Maintainance of footpath

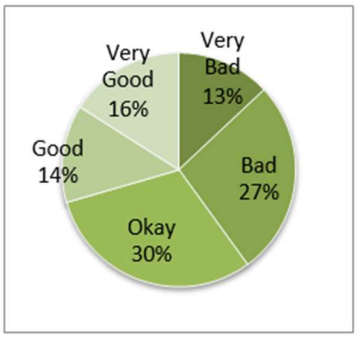


Fig 5.6 Street Furnitures

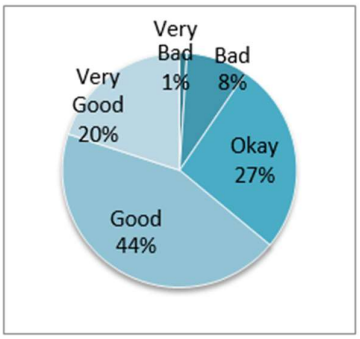


Fig 5.7 Security from Crime

Source: Primary survey

The general perception of people regarding availability and safety in crossing is that it can be improved whereas walking path as not so many in number, it is not inconvenient overall.

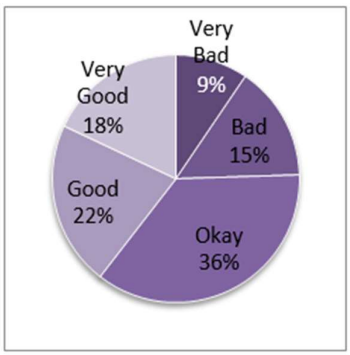


Fig 5.8 Walking path conflict

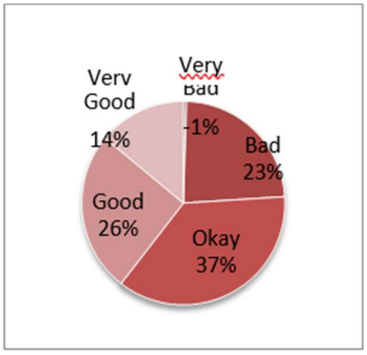


Fig 5.9 Availability of Pedestrian crossing

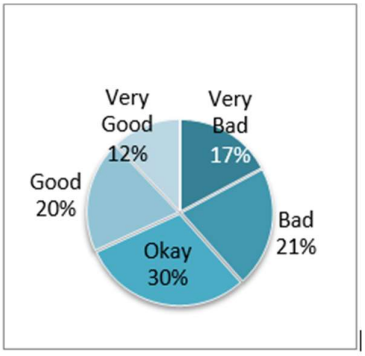
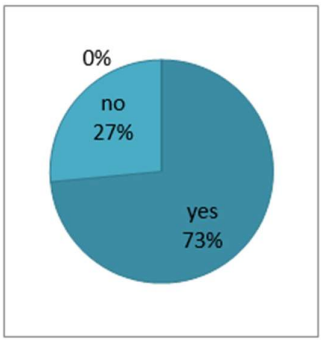


Fig 5.10 Crossing Safety

Source: Primary survey

It can be inferred from the survey that people's preferences are to walk and use bicycles if better facilities were provided, as cycle ownership is not very high, cyclerental systems could flourish.

Fig 5.11 Preference to walk if better facilities were provided



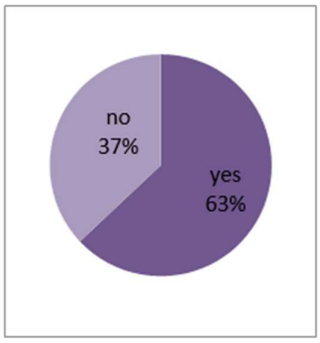


Fig 5.13 Cycle Ownership

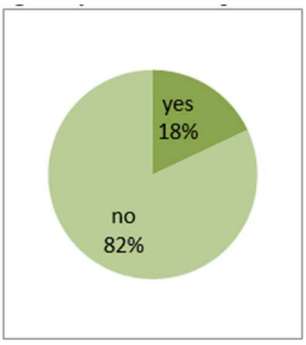


Fig 5.12 Preference to use cycles if better facilities were provided

The inference from these have been related with other factors such as land-use and inference have been drawn

5.3 Average Speed

The average speed of the vehicle coming for different purpose in the study area, slowest speed is in the peak hour in morning in which maximum people are passed through the study area and then a slightly fast speed traffic is of people who comes to their offices.

	COMMERCIAL LAND USE PERCENTAGE	AVERAGE SPEED AS OBSERVED ON MORNING AND EVENING PEAK HOURS					
		MORNING PEAK HOUR			EVENING PEAK HOUR		
		08:00 AM	09:00 AM	10:00 AM	05:00 PM	06:00 PM	07:00 PM
OFFICES	32%	2	2	2.5	1	2	2.5
COMMERCIAL	26%	1	1.5	2	1	2	2.5
RESIDENTIAL	11%	1	1	1	1	1	1
EDUCATION	9%	2	2	1.5	2	2.5	1.5
CIRCULATION	15%	2	2.5	3	2	2.5	3

Source: Primary survey

Table 5.1 Average Speed by Different Categories

5.4 Average Flow Rate

MAIN HAZRATGANJ LANE						
S.No	Width (m)	Av. Speed (m/min)	PEF	Flow Rate (PEF/m)	Av. Space (Sqm/PEF)	Density
1 Min	4	42.7	176	59.9	1.54	1.97
2 Min	4	49.4	86	42	1.03	0.91
3 Min	4	45.5	340	69	0.47	2.9
4 Min	4	45.8	387	86.8	0.44	3.97
5 Min	4	53.6	568	88.2	0.36	3.99
6 Min	4	53.6	570	59.7	0.49	2.68
7 Min	4	52.3	593	38.7	1.43	1.65
8 Min	4	52.4	631	38.4	1.41	1.76
9 Min	4	31.8	59	29.5	1.49	1.74
10 Min	4	37.7	189	51.5	0.56	2.19
11 Min	4	31.6	122	44.5	1.10	1.98
12 Min	4	30.4	158	55.4	0.91	1.34
13 Min	4	30.6	66	25.5	2.5	0.75
14 Min	4	33.4	95	39	1.37	0.92
15 Min	4	25.1	97	80.9	0.39	4.64
		Total PEF	4117			

Table 5.2 Average Flow Rate *Source: Primary survey*

From the compiled 15 min set the Average flow rate (PEF/Min) has been calculated for each time through Vp=PEF/Width. Similarly, **Average Space** has been calculated through **Sp=Vp/Average Weighted Speed** and **density** through **density=1/average space.**

5.5 Traffic column count at major junctions

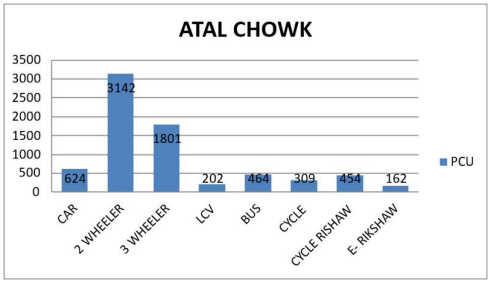


Fig 5.1 PCU count at Atal Chowk

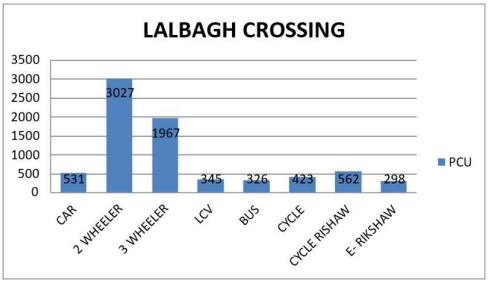


Fig 5.2 PCU count at Lalbagh crossing

Source: Primary survey

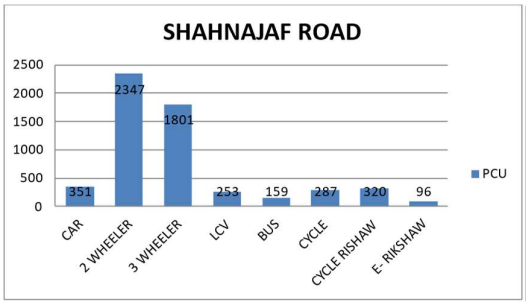


Fig 5.3 PCU count at Shahnaaf Road

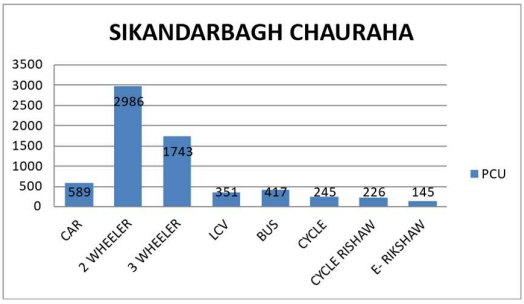


Fig 5.4 PCU count at Sikandarbagh

Source: Primary survey

These charts are of the **TVC** of major crossing in my study area and the pie chart are % of different types of vehicles comes/cross the study area. There are four main crossing in the study area which are Atal chowk, Lalbagh crossing, Shahnajaf road and Sikandarbagh chauraha.

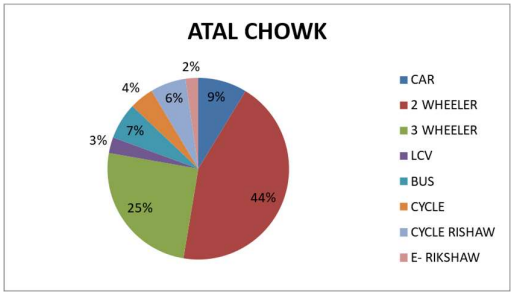


Fig 5.5 % distribution at Atal Chowk

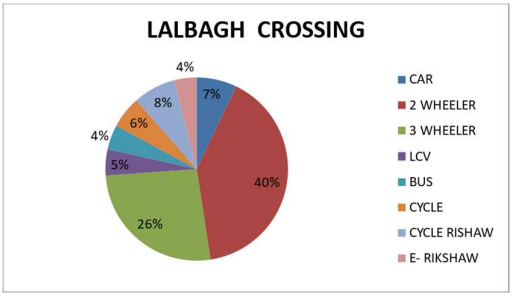


Fig 5.6 % distribution at Lalbagh

Source: Primary survey

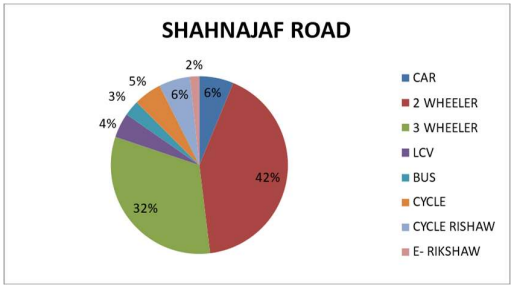


Fig 5.7 % distribution at Shahnajaf Road

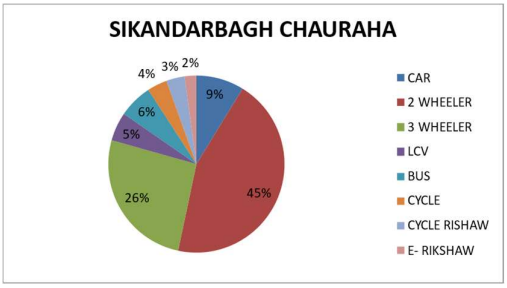


Fig 5.8 % distribution at Sikandarbagh

Source: Primary survey

Atal chowk is the most densed crossing and the shahnajaf road chauraha is least densed in all the 4 main crossing

5.0 Travel Pattern Survey

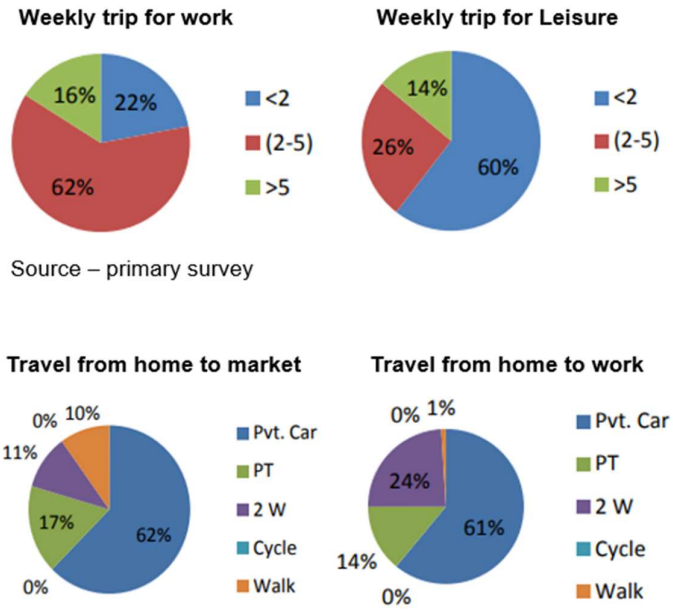


Fig 5.9 Percentage distribution for Different purpose travel

Source: Primary survey

Of the 200 people interviewed, 62% travel to Hazratganj between 2 to 5 times in a week for work whereas they travel less than 2 times a week for leisure i.e., about 60%. Majority of people travel to work and markets by car or motorcycles where as to metro stations, predominantly people primarily use public transport such as buses or autos as compared to personal cars or motorcycles.

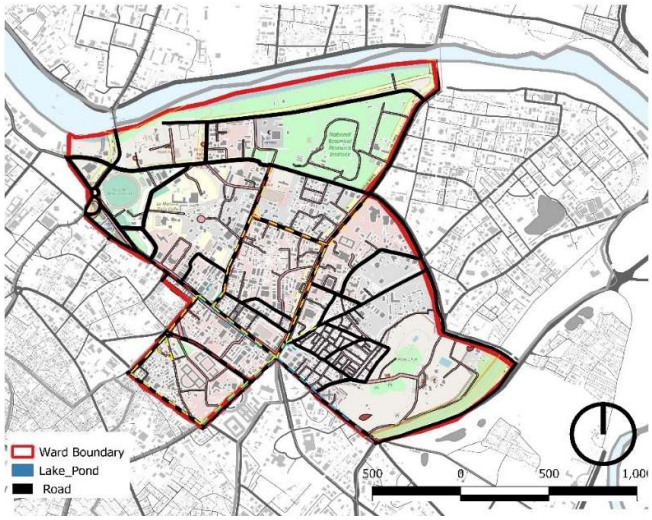


Fig 5.10 Trip pattern by Different Sectors *Source: Author*

CHAPTER 6: PROPOSAL

6.1 Background

Hazratganj crossing is the busiest crossing of Lucknow city. It is situated at 4 confluence of National Highway-24, National Highway-25, National Highway-28 and National Highway24B. The whole area of the crossing falls in Lucknow's Heritage zone.

Hazratganj area is home to very prestigious and old institutions such as St. Francis' College, Seventh Day Adventist Senior Secondary School, La Martiniere Boys' College, La Martiniere Girls' College, Loreto Girls' College, Christ Church College, National P. G. College and St. Joseph's Cathedral. And because of the traffic jams the heritage importance of the city is getting degraded.

A study stated that while the number of buses in the city was declining, the number of cars and auto-rickshaws was increasing, clogging the traffic arteries. And creating an problem for pedestrians to walk and increases the carbon footprint around.

The traffic of the street is managed by with the human effort and the technology. The traffic personnel always check the stopped traffic. And this human effort is helped with the advanced technologies incorporated in the hazratganj.

The Road network plan shows the type of roads which are present. The main ganj street is quite wide and is Arterial Road. From this Arterial Road the road network has developed. Further resulting into smaller road (Collector and Local roads).

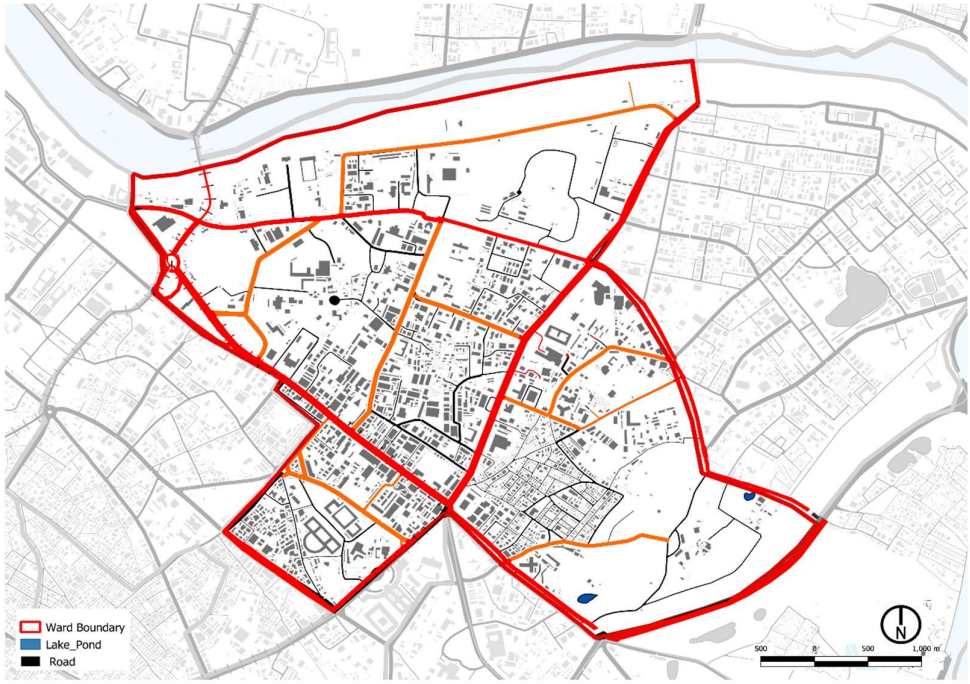
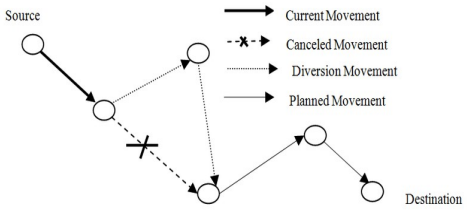


Fig 6.1 Road Division Map *Source: Author*

6.2 Proposal

6.2.1 Circulation Pattern: Proposing Route Diversions From Sikandar Bagh Chauraha for all the LCV's (Light Commercial Vehicles) and coaching/Institutional students through Rana Pratabh Marg Instead of main Hazratganj Road wich is mahatma Gandhi marg with their vehicles.



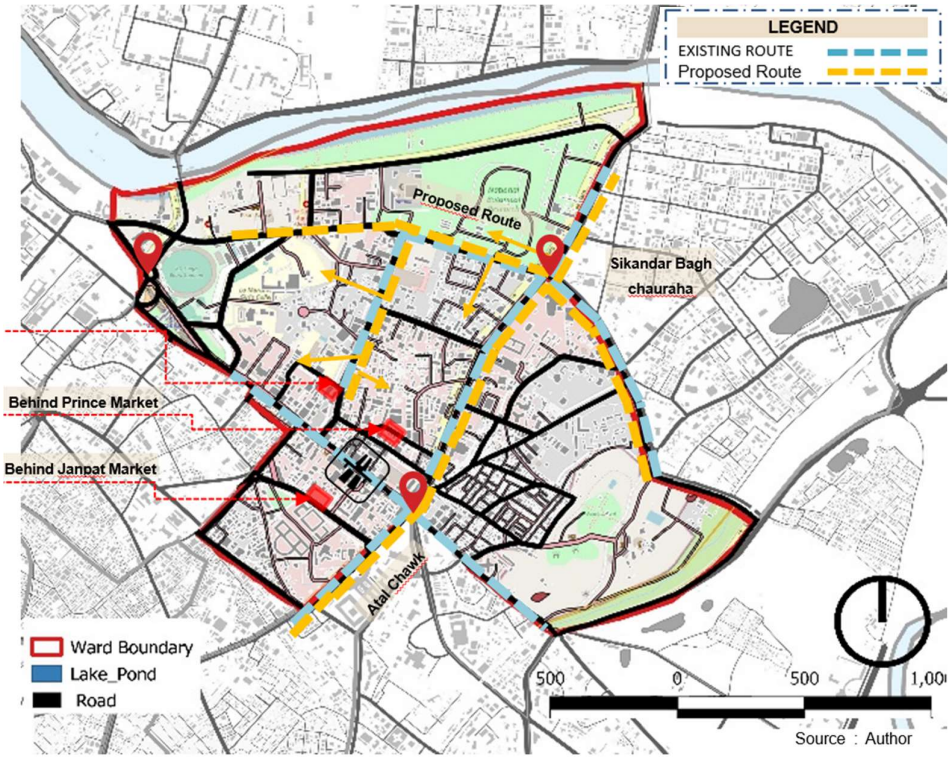


Fig 6.2 Circulation Pattern Map *Source: Author*

Currently mahatma Gandhi the main road of hazratganj is being the shortest and direct route for the LCV and other peoples which slowdowns the traffic during the peak hr of 8 to 11 am and 6 to 8 pm. Which have high density traffic during this hrs but by diverting the LCV and student population through the Rana Prathap Marg via Sikandra Bagh

chauraha approximate 8-12% of the traffic volume will decrease which will help to reduce traffic density on main Hazratganj Street during the peak rs of the day.

6.2.2 Pedestrian Walkways and Footpaths: Proposing walking friendly street elemnts and amenities as Hazratganj's walkability index is high due to daily visitors for shopping, work and education institutes streets needs several elements to make walking more safe and people friendly by using several elements as Tactile Pavings and Raised "Table-Top Crossing because according to UTTIPEC guidelines, walking zone width is provided as per land-use and for commercial spaces it is 2.5m and the proposal adheres to it in all lanes along with walkable friendly design element on pedestrian paths.

Fig 6.3 Pedestrian Walkways and Footpaths *Source: Author*

6.2.3 Amenities: Proposing Stop/Drop Points for running E-rickshaws and rickshaw carts which will also work as an drop/pickup point for private vehicles. Bathrooms of the dimensions 7.3m x 5.5m accommodating 6 persons, 3 maleand 3 female stalls have been provided in each block. UTTIPEC guidelines states bathrooms must be provided at a minimum distance of 500-800m. Street lights are provided at a distance of 3m. Signage at appropriate locations have been proposed regarding restriction of vehicles, speed of rickshaws, bicycle parking, car parking lots, direction of flow etc.

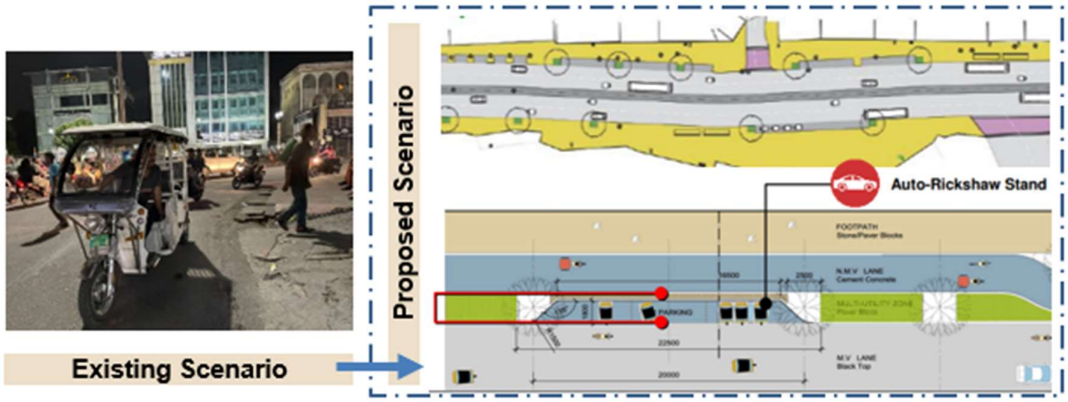


Fig 6.4 Stop/Drop Points For E-rickshaws & rickshaw *Source: Author*

6.2.4 Parking: Proposing Several new Mechanical Multi-level parking's for 2 and 4 wheelers both over some of the old existing parkings in order to reduce road corner unauthorize parking's by several visitors, coaching students and small shop employs.

Fig 6.5 Mechanical Parking *Source: Author*

6.2.5 Proposal to create walkable dominating zones: As Hazratganj Major landuse Comprise of Mix and Commercial and Private offices and Educational Institutes this area has several narrow lanes and Corridors which can be maintained and embrace by restricting 2 Wheelers which can be achieve by creating several walkable dominating zones.

Fig 6.5 Walking Dominating Street Zones *Source: Author*

6.3 Conclusions

The procedure followed in the developing of this proposal can be further applied to other CBD's and residential sectors. The inculcation of these stepsand process of arriving at a layout plan in site planning for various sectors such as residential, commercial is also possible. In our fast-paced world where lesser attentionis paid to walkers and cyclists, this study can aid in promoting them and this can be replicated in various cities across the country. It can also form the basis for policy level strategies in terms of non-motorized transport networks and walkways. Enhancing the support structure provided for cyclists and walkers, incorporating the legislative framework and recommendations of various transport agencies and studying the guidelines followed internationally will greatly contribute to the promotion of this green concept in many cities and towns.

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- Non-motorized Level of Service: Addressing Challenges in Pedestrian and Bicycle Level of Service
- Mobility design as a means of promoting non-motorised travel behaviour? A literature review of concepts and findings on design functions