ASSESSMENT AND POLICY INTERVENTIONS FOR NEIGHBORHOOD WALKABILITY IMPROVEMENT

Thesis Submitted in Partial Fulfilment of the requirements
for the award of the degree of

MASTERS IN URBAN & REGIONAL PLANNING

By
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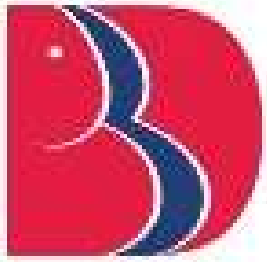

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EXECUTIVE SUMMARY

One of the most common forms of physical activity is walking which is the mother of all the modes of transport which provides inexpensive and equal transportation options to improve residents' health and quality of life. Due to several associated advantages such as wellbeing of residents and improving health, reducing air pollution, traffic congestion and decreasing energy consumption, walking has become an interesting topic for researchers. To have modern cities with highly efficient transportation facilities which support walking, cities and neighbourhoods are trying to promote a pedestrian-friendly environment. As a result, walkability is a sustainable concept to improve the liveability of growing cities that describes the level of capability of the built environments to support walking for multiple purposes including transport, leisure and exercise purposes.

Although measurement of walkability includes several methods and approaches, this research has emphasized on the walkability index as well as neighbourhoods features that influence the willingness of people to walk. Since Lucknow is not considered a walkable city, it is valuable to investigate how this city has tackled this issue. Therefore, for better interpretation, one such neighbourhood in Lucknow was selected to examine the level of walkability and the factors affect that.

This study has several limitations and due to time and resource constraints, the sample size that was selected for the survey in each neighbourhood is limited. Therefore, the low response rate may influence the final results. The model outcomes were validated not only using the individual's perception determined from questionnaire survey but also utilizing mixed methods of GIS analysis in objective parameters of walkability. What makes this research unique is that all aspects of neighbourhoods such as physical, social and safety characteristics have been considered objectively and subjectively. The results of this study can assist policymakers and professionals to give more public space to walking and improve the quality of neighbourhoods' environments.

In conclusion, the overall result implies that due to defining indexes such as population density, mixed-use and connectivity for walkability, some aspects of neighbourhoods' features were recognized significant in this study. Among all of the physical aspects variables of neighbourhoods, accessibility is the most important factors influence walkability, however, the quality of built environment significantly affect people's perceptions as well and in social aspects of neighbourhoods, social interactions and liveliness of streets seem to be significant in walkability. Also, from safety aspects view, the most important factors were a sense of security and sense of safety that affect the walkability. The incredible outcome that was explored in this study is that the physical environment influence the social and safety aspects of neighbourhoods and social aspects influence the safety aspects of neighbourhoods. Therefore, there is an interrelationship between independent variables that can influence the willingness of people to walk.

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(Ar. Kirti Saxena)

UNDERTAKING

I, Ms. Kirti Saxena, the author of the thesis titled "**ASSESSMENT AND POLICY INTERVENTIONS FOR NEIGHBORHOOD WALKABILITY IMPROVEMENT**", hereby declare that this is an independent work of mine, carried out towards fulfilment of the requirements for the award of the Masters in Urban & Regional Planning at the Department of Architecture and Planning, BBDU, Lucknow. The work has not been submitted to any other organization / institution for the award of any Degree/Diploma.

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1. INTRODUCTION

1.1.BACKGROUND

One of the key global challenges is population growth and rapid urbanization that increases the vulnerability of environment and health of people and influence the quality of life of citizens. It is estimated that the total population of world cities grow from "3.3 billion people in 2007 to 6.4 billion by 2050" (Mitchell, Enemark et al. 2015). Increasing the urban population and tendency for a better quality of living and the expansion of car ownership encourages people to live in suburban areas and develop urban sprawl and city congestion. Such sprawling neighbourhoods also cause more air pollution per person and suffer from more traffic congestions. Unfortunately, this has also changed the travel pattern from the traditional mode of transportation to automobile mode of transportation and walking as the oldest and the most basic form of transportation is now being forgotten. To address numerous problems of human development, resource consumption and environmental footprints, different theories, and approaches were proposed such as sustainable urban development, new urbanism and smart growth in which walkability has been proposed as a key principle to improve the quality of life and reduce the negative environmental consequences of car dependency (Wey, Hsu 2014). The "Congress for the New Urbanism" was created in 1993 in order to "while protecting the natural environment, provides a high quality of life for all communities by making buildings, neighbourhoods and regions." It is an approach to promote walkable and pedestrian-friendly neighbourhoods providing easy accessibility to public transportation and workplaces. Moreover, a significant goal of New Urbanism is supporting diversity and mixed-use in neighbourhoods and liveable communities with various types of housing, building densities and land use (Wey, Hsu 2014). Similar to "New Urbanism", "Smart Growth" focus is in improving the walkable, compact urban centers and avoiding urban sprawl. Bicycle-friendly, transit-oriented, walkable land use and mixed-use development with various kinds of housing choices, also have been emphasised in this approach (Wey, Hsu 2014). Sustainable Urban development is a multidisciplinary approach that is identified by three foundations of environmental protection, social development and economic development. Much consideration of sustainability has been given to environmental aspects and social and economic aspects have been mentioned as the least described pillars. They, also, depend upon each other in specific

ways and one of them does not have reason to exist without others. “The foundation of the sustainable city” is walking which provides environmental, social and economic advantages. The variety of positive effects of walkability on these pillars are worth to be considered (Rogers, Gardner et al. 2013).

1.2.ISSUE OF CONCERNS`

Nowadays, population growth and rapid urban expansion have increased urban sprawl and use of motorized vehicles for daily basis activities which leads to greenhouse gas emission, air pollution and several negative impacts on the environment. Also, after industrial revolution and invention of the automobile, increasing car-dependency, lack of physical activity and sedentary lifestyle which are recognized as determinants of obesity-related health issues such as cardiovascular disease, diabetes and cancer. The concept of walkability is a multi-dimension approach that connecting urban design and planning to a wide range of issues related to climate change, economic growth and productivity, social cohesion and public health (Dovey, Pafka). It has received increasing attention from urban planners, sociologist, advocates, practitioners, and professionals related to health issues. To deal with the issues of urban sprawl, it is important for policymakers to know about nature and the extent of these problems. Due to popularity, accessibility and affordability of walking, it has been recommended as a holistic solution to a variety of urban issues.

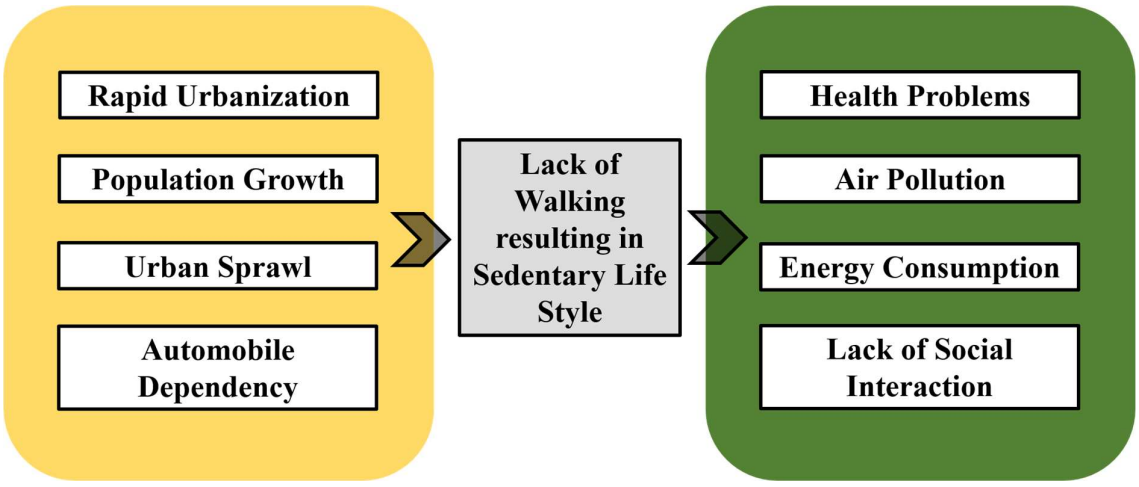


Figure 1 Cause & Effect of Urbanization

Furthermore, to improve the liveability of the urban environment, walkability is proposed as a solution that can provide lively and sociable places, more human-scaled, happier and healthier

areas for communities (Forsyth 2015). Therefore, in the field of urban design and planning, it is necessary to take into consideration that built environment components are properly available to make the place suitable for walking. In addition, beyond the physical factors, it is significant to consider policies and programs which can support walking as a basic way of transportation. For instance, increasing the driving expenses and allocating higher taxes and restricting the number of parking lots are some policies that reduce the tendency of using the car.

Supporting walkability has positive effects on several areas such as health, environment, social equity and economy and there is a growing body of evidence that many cities in the world are promoting walking and cycling instead of using a car. Although, the inequality in the level of walkability in the neighbourhoods are quite obvious, in total, it is assumed as a pedestrian friendly city. Thus, by measuring the level of walkability in Lucknow's neighbourhoods, a critical understanding could be obtained that contribute not only to realise physical, social and safety aspects influence the walkability in neighbourhoods, but also to compare the feasibility of walkability in other cities.

1.3. RESEARCH OBJECTIVES

The previous large scale studies have demonstrated the association between the physical environment and the level of walkability. However, there is still limited literature about the association of social and safety aspects of urban design and walkability. This study is an endeavour to describe the impact of physical, social and safety features on walkability neighbourhoods, looking at objective and subjective measures, and at associations with health, environmental sustainability, economic productivity, and social ties. More specific, Walkability concept has been recently introduced as the extent to which the urban environment is pedestrian-friendly (Moura, Cambra et al. 2017). By evaluating and measuring the level of the walkability of neighbourhoods, the quality of the pedestrian environment can be addressed by planning professionals, what may facilitate the development towards more sustainable, appealing, integrated and walkable cities. Therefore, the main research objective is to identify "the factors that influence the walkability in neighbourhood of Lucknow."

1.4. PROVISIONAL RESEARCH QUESTIONS

According to the problem statement the main research question is: “To what extent do physical, social and safety aspects influence the walkability of neighbourhoods in Lucknow?” Furthermore, sub-research questions to support the main question are: 1-How do physical, social and safety aspects influence walkability of the neighbourhood in Lucknow? 2-To what extent does physical aspects influence the walkability of neighbourhood in Lucknow? 3-To what extent does social aspects influence the walkability of neighbourhood in Lucknow? 4-To what extent does safety aspects influence the walkability of neighbourhood in Lucknow?

1.5.NEED OF THE STUDY

Walking is green and low carbon traveling mode which does not pollute the environment and does not consume natural resources. Also, walking is the most common form of daily physical activity which is regarded as an efficient and beneficial activity for health and control weight of individuals. Walkability provides social equity components and environmental preservation of sustainable urban development which reduces energy consumption and provides the opportunity for disadvantaged people who cannot use cars for reasons like income, age or disability. Higher advantages of walkability at the community level is providing social and spatial interactions what has been given more attention in many countries. Firstly, walkability contributes positively to develop a pedestrian-friendly environment which is the principal of the smart growth approach. Secondly, walking as basic mobility, reduces transport costs, provides liveability to communities and improve public health. Finally, the main objective is to find out how access to basic infrastructure such as school, children playgrounds, hospital, shopping centers influence the walkability of neighbourhoods.

1.6.SCOPE & LIMITATIONS

As mentioned before, the purpose of this study is to demonstrate the influence of social and safety and physical aspects of neighbourhoods on walkability, regarding objective and subjective measures, and relations to build environment, safety, health, and social networks. Several limitations, like every other study, are identified in this study. However, the results of this research cannot be generalized to all the cities and neighbourhoods around the world. Second, for some of the objective measures, a reliable existing data were available from the secondary data of the municipality for all the neighbourhoods of Lucknow that have been used

for explaining the triangulation between these data and information gathered from survey about objective aspects of build environment, social and safety features and walkability of neighbourhoods. However, there is a limitation in the generalization of findings for all the neighbourhoods of Lucknow, because primary data with a limited sample are collected only from “One such neighbourhood of Lucknow” and other neighbourhoods are excluded. Third, the influence of climate and weather conditions are not included in this study. While it is known that wind direction is one of the major factors that discourage people from walking. Finally, although the sample size calculation shows a higher number of respondents, because of “resource and time constraints” of the study, the sample size has been limited to 40 respondents in each neighbourhood.

2. LITERATURE REVIEW

This chapter explains concepts, theories, and perspectives that are used to understand the features of liveable and walkable cities and the factors that influence the walkability. Although, there are several theories and concepts about the association of built environment and walkability in prior studies or researches, this study emphasizes the physical, social and safety characteristics of neighbourhoods that influence walkability concept in order to explain the importance of pedestrian-friendly environments in improving the quality of human life. This research also emphasizes the benefits of walkability, such as: impacts of walking on health conditions, social capitals, and environmental issues as dimensions of sustainable development. The conceptual framework of this research will be explained at the end of this chapter.

2.1.CONCEPT OF THE STUDY

Urban sprawl or suburban sprawl is a geographical extent of cities that occurs when population growth and rapid urbanization induce people to move to suburbs and surrounded areas to enjoy a lifestyle. Urban development which has not been properly designed or planed lead to sprawl and Sometimes, economic growth encourages people for having a better living condition scape from congestion, crime and noise of cities and live in suburb areas. Sprawl leads to low-density land-use patterns and single-use zoning and reduce transportation options and public spaces and community center for social cohesion. This dispersed urban expansion increases the automobile dependency which imposes unnecessary infrastructure costs, produces traffic congestions and pollutes the environment. In this situations, walking as the oldest and the most common form of transportation is now being forgotten. All of these issues contribute to the transition into the “smart growth” approach, which avoids sprawl and focuses on growth in compact, walkable and mixed-use communities. This theory is one of the main paradigms of a sustainable city which is convenient, prosperous, liveable and safe. For the realization of a sustainable city, three theories such as “new urbanism”, “smart growth”, “compact city” have been proposed, which have common principles on walkable neighbourhoods (Wey, Hsu 2014).

New urbanism agendas to overcome the development issues include protecting the environment, promoting pedestrian-friendly and walkable neighbourhoods, preserving historical buildings, increasing the diversity, density and mixed-use in neighbourhoods with a

variety types of households and family sizes, incomes, ages, and cultures (Wey, Hsu 2014). Smart growth policy concentrates on motivating communities to support pedestrian-friendly, compact, mixed-use and ecologically development of existing communities to promote the liveability, well-being, inclusion and happiness of the inhabitants. The smart growth strategies are to increase accessibility by creating network of interconnected streets and proximity to various users and provide streets with higher safety and attraction with walking-based land use to reduce car travels per person (Wey, Hsu 2014). Therefore, both alternative approaches of New Urbanism and Smart growth provide a high quality of life for citizens, while enhancing urban sustainability and address the negative impacts of sprawl on social, economic and environmental aspects. These two approaches, introduce walkable, mixed-use, high-density neighbourhoods to respond to several environmental concerns. These two movements in urban development have a lot of overlaps The influence of physical, social and safety aspects on walkability in neighbourhood of Lucknow. Their main difference is in origin and scope. New urbanism is more concerned with function and ethics of the construction environment and more influenced by architects and physical planners, while smart growth was started from a citizen groups, community of environmentalists, policymakers and transportation planners to alleviate sprawl management and regional planning (Wey, Hsu 2014).

2.2. WALKING AND IT'S IMPORTANCE

Walking is a physical activity which is done for several purposes that each has specific characteristics and need special considerations: • Health: walking as an exercise to lose weight • Recreation: walk for leisure, for example, meeting a friend or talking to the neighbour • Transportation: travel to another destination, for example, shopping, school, work Although walking can be done for different purposes, sometimes these purposes mixed or have often considerable overlap- for example, people may walk to the shop, because they enjoy it or walking for exercise and leisure maybe done not only for reducing stress, losing weight and increasing fitness, but also getting out of the house, meeting a friend or a neighbour and enjoy the beauty of a green park (Forsyth 2015). The relationship between neighbourhood environment and walking differed by walking purposes. When walking for transport, directness and connectivity are important and access to amenities and basic infrastructure in five minutes motivate people to walk to their destinations instead of using their cars. For recreational walking, the attractiveness of the journey maybe as important as the destination, although destinations are often still important. The proximity of destinations is a critical factor for

transportation, but for the purpose of exercise, the quality of sidewalks and safety routs are significant. Population density is correlated with both purposes of walking. Recreation walking is positively associated with Hills but in transportation walking, it is negatively correlated. Therefore, it is important to define which kind of walking is going to be measured (Forsyth 2015). In other words, although there are several parameters affect the willingness of individuals to walk, it is also significant to consider walking which is the simplest and the most basic type of mobility, provide a variety of benefits including community liveability, improving health and social equity and reducing external costs and environmental problems. As mentioned, walking is "the foundation of the sustainable city" providing economic, social and environmental benefits. Looking at the environment perspective, due to recent trends towards sustainability, the level of awareness about protection and conservation of the environment is increased. Walking as a green form of travel and the most basic form of daily physical activity is known as a people oriented transportation mode which has the least impact on the environment (Bilyamin, Wahab et al. 2017). It has, also, low level of environmental impacts, energy-conserving without air pollution and decrease traffic congestions of the cities. From the social point of view, walkable neighbourhoods offer social capital as one measure of social sustainability. The definition of social capital is related to "the value of networks and the. Dixon defines social sustainability by 10 dimensions and policy areas: "demographic change (migration, aging and mobility), health and safety, identity, skills and education, employment, empowerment and access, social capital, environmental health and housing, participation and sense of place, ethnicity, social mixing and cohesion, and quality of life, happiness and well-being". Several of these measurements will be realized in the concept of walkable neighbourhoods (Rogers, Gardner et al. 2013). Walking as a physical activity has a positive effect on the health of residents particularly significant for elderly, children, lower-income and disabled people and reduce the risk of obesity and diabetes. These neighbourhoods increase social interactions which affect the quality of life.

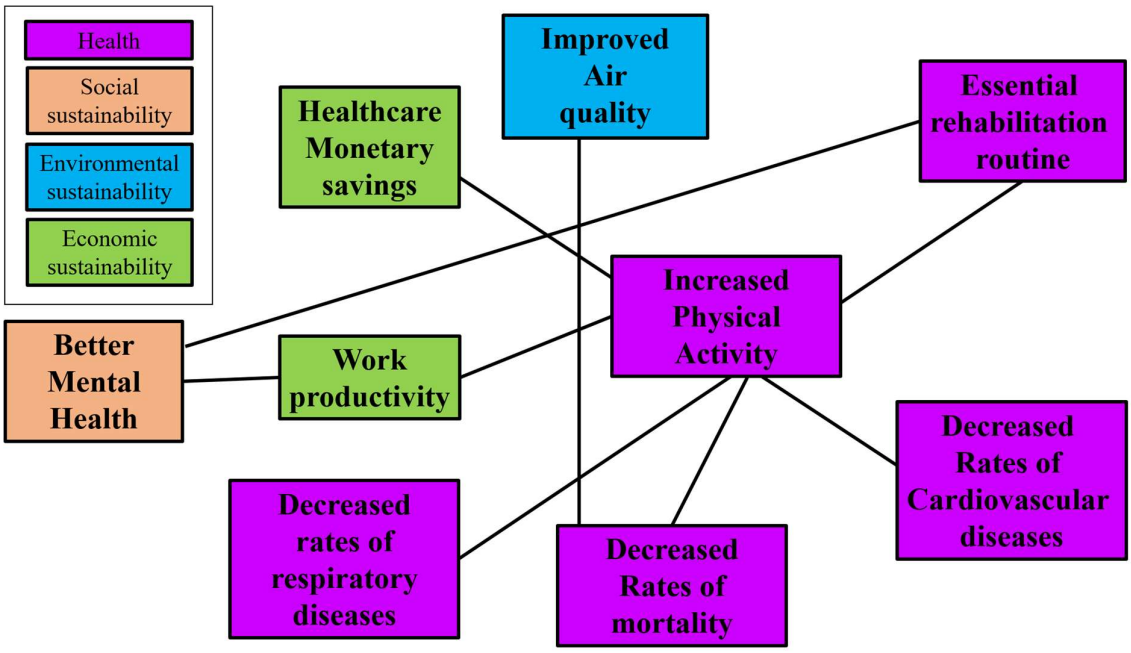


Figure 2 Sustanability Benefits

Walkability can influence economic development in several ways. “Market resources (money, land and labor)” and “none-market resources (clean air, safety, habitat and aesthetic features)” are valuable resources which are included in walkable neighbourhoods. Walking as an affordable, basic transport reduce the expenses associated with owning a car. People who are economically or physically disadvantaged also rely on walking and in this case, it can help social equity and economic opportunity objectives. Walking reduce the various transport external costs such as road, traffic congestion, crash risk, parking facilities, and environmental damages. High-density areas and more walkable neighbourhoods reduce the economic costs of a large amount of land paved for parking and roads. Pedestrian-friendly neighbourhoods tend to increase property values associated with consumers’ willingness to pay and encourage people to live in these areas with immediate access to shopping districts and resort communities, schools and health clinics and support the local business market and increase its • Reduce transportation cost and increase property value. • Reduced land used for roads and parking facilities. • Improve attractiveness and beauty and preserve Open spaces • Reduced air pollution and energy consumption • Increase accessibility for people who are transport disadvantaged. • Walkability can increase employment and local business activity and. • Walkability is the foundation of sustainable city. • Increase physical activity and improve well-being health conditions. • Improve safety and social cohesion. • Improve livability and quality of life. Source: (Litman 2017)

2.3. WHAT IS WALAKABILITY?

Walkability is consisting of two parts “walking” and “ability” which means the human-beings ability to walk. Walkability defined as “the measures of how friendly an area is to walking”. Walkability concept has been recently introduced as “the extent to which the urban environment is pedestrian-friendly”. Many scholars and experts have proposed various definitions and they have proved the possibility of assessing the walkability with developed measurements. According to SouthWorth (2005) walkability means “the quality of built environment that supports and encourages walking and it is easy, convenient, safe and desirable to walk to where every daily-used facilities are accessible with minimum distance and time and providing attractive views in the journey throughout the network”. The significance of evaluating or measuring the walkability is that planning professionals and policymakers could address the issues related to the quality of the walkability in neighbourhoods, what may facilitate the progress towards more unified, attractive and walkable cities with high quality of life and towards more sustainable cities (Bilyamin, Wahab et al. 2017). Walkability is considered as a solution to improve the liveability of urban areas and create lively and sociable places, more human scaled, happier and healthier environments for residents. Walkability has several benefits for human consist of health, environmental and economic and is influenced by the presence or absence and the quality of sidewalks, traffic and road conditions, footpath and other pedestrians right of ways, land use patterns, accessibility, and safety (Moayedi, Zakaria et al. 2013).

2.4. WALAKABLE NEIGHBORHOOD

“Walkable Neighbourhood” is consists of two parts, “walkable” and “neighbourhood” which means “the bounded place that is safe, compact, self-service and physically-enticing with comfortable and interesting streets, sidewalks and paths motivating dwellers to walk and increasing the well-being of its residents” (Forsyth 2015). Choosing walking instead of other modes of transport represents the results of an interaction between the person and the walking environment amongst other factors. Jacobs argued that the ideal neighbourhood is designed to facilitate walkability. People show different reactions to what they perceive within the environment. For example, within the same setting such as street block length and sidewalks widths, one individual may perceive the physical walking environment for connectivity, whereas another person may not. What determines walking behaviour, is the individual’s

perception of walkability. The walkable neighbourhood is a subject which is interested in transportation planners, sustainability advocates, sociologists, urban designers and those in the health and biological fields (Yun 2019).

2.5.DRIVERS & BARRIERS

What makes a city liveable? As more and more people move to cities, the benefits of motivating people to walk become clearer. In order to change the travel pattern from automobile-oriented transportation mode to a sustainable traditional people-oriented mode which is known as walking that has the least negative impacts on the environment and the simple natural and easy way of commuting, it is essential to study the drivers and barrier that affect people's willingness to walk. The first step for encouraging people to walk is to identify which factors influence walking decisions. There has been lots of research to find out what makes a city more attractive to pedestrians and encourage them to walk more. While there is a great deal of current investigation on walkability, this has exposed some deep ambiguities about which factors have more impact on this concept. Several studies have identified the built environment as one of the most important factors that influences walking behaviours. Some studies have identified that walking facilities such as small street blocks, the quality of the pavement, the presence of trees or street furniture affect the willingness of people to walk. Some other studies have referred to the correlation of physical environment to walking such as density, land mixed-use and recreational facilities and public open spaces. A number of studies have also examined the correlations between social factors and walkability. It has been shown that enticing people to walk is not only determined by the physical qualities of the environment but also there's already lots of evidence that people are highly influenced by social dimensions which increase the walkability. However, very few studies have incorporated both the built environment and social factors of the walking environment to examine their relationships and impacts on walking behaviour. Movement of people, also, related to natural characteristics of cities such as "topography, weather conditions, landscape" and "socio-demographic factors" such as "gender, age, culture, income and health condition, accessibility and willingness of residents". For evaluating walkability, it is important to include people who have a walking or physical challenge. For instance, someone with a walker, wheelchair or even a parent pushing a baby stroller (Clark, Scott 2016). Environmental and personal obstacles are considered as barriers that discourage people to walk. One of the key barrier to walking is "lack of safety" because neighbourhoods with higher level of crime and more dangerous streets discourage people from

walking. Also, lack of cleanness and appealing sceneries in neighbourhood make it less desirable for residents to walk. “Extreme temperatures, precipitation, and high winds” discourage people from walking and living in a neighbourhood that is “hilly” or has “steep streets” have been found to decrease walking. Friends and family members who can accompany walking can increase an individual’s willingness for walking due to social experience (Clark, Scott 2016). Upon reviewing the previous literature, there are many factors that influence one’s decision to walk.

2.6. WALKABILITY MEASURE

There are several methods measure the walkability such as Walk Score, Walkability Audit and transportation walkability index.

The **Walk Score (R) index** has become increasingly applied in studies of walking and walkability. Walk Score method relies on detailed spatial data based on five objective measures of environmental attributes such as “residential and population density, number of local destinations, mixed land use, sidewalk availability and distance to amenities and public transportation” that are computed by GIS. Based on the address or postcode given, the range of walkability will be classified into four categories including “walker’s paradise (90-100)”, “very walkable (70-89)”, “somewhat walkable (50-69)”, “car dependency (below 49)”. A systematic review of Scopus (R) and Web of Science was conducted with 42 journal articles eventually being evaluated the validity of Walk Score (R) as a measurement of walkability. These studies partially have reported the association of this method to environmental attributes and have declared safety and social indexes, which are not included in calculations, as the weakness of this method (Carr, Dunsiger et al. 2011).

Walkability Audit is the method used by Eidmann et al. (2011) to evaluate street walkability which consists of numerous criteria. These features are ranked between 1(worst) to 5(best) to quantify the quality of the environment for walking. These factors include aesthetic design, quality of sidewalks, crosswalks, proximity to amenities and safety based on participant observations, citizens survey and GIS to identify the characteristics of the area to be assessed both quantitatively and qualitatively (Szűcs, Lukovics et al. 2017).

Walkability index method is used by the World Bank which conducts a qualitative analysis of the "walking conditions" including "safety and security, convenience and degree of policy support for the pedestrian environment". It is important that these surveys are conducted within local populations to prevent undue bias in results. However, one of the common issues in all of these methods and tools is the arbitrary selection of indicators and unclear structure of evaluation which might not be reprehensive of walkable neighbourhood indicators (Kelly, Tight et al. 2011)

2.7. FACTORS AFFECTING WALKABILITY OF A NEIGHBORHOOD

Walkability is a multidimensional approach related to the community environment and requires multi-disciplinary approaches. Pedestrian movements depend on several factors. This study examined the relationship between subjective and objective measures of the walkability in one such neighbourhood of Lucknow. From the literature review, there are three characteristics of neighbourhoods to be derived from neighbourhood profile of Lucknow City which influence the people's decision to walk.

These three aspects are related to **"physical, social and safety features of the neighbourhood".** Generally, objective walkability factors attempt to measure the urban design and characteristics of urban form by using either existing secondary databases available in GIS or direct observations in the field. For example, features like connectivity, density and proximity can be easily measured with existing databases. While subjective walkability factors or perceptions of inhabitant impact on the cognition of the level of neighbourhood walkability which is influenced by the built environment and usually obtained from Likert scale survey questionnaires which reflect individual's feelings and varied from one person to person. For example, under the same objective measures of walkability, one person will prefer walking who perceived a high level of walkability and another person, will use the private car and may perceive a low level of walkability. For instance, a sense of comfort, a sense of safety, a sense of place, etc. This study tries to deal with both subjective and objective features of one such neighbourhood in Lucknow (Taylor, Fitzsimons et al. 2010). Physical factors that are representative of built environment focus on dimensions include "accessibility of the destinations, sidewalk conditions, aesthetic design, greenery" objectively and people's perceptions in comfortability and interesting features of their neighbourhoods subjectively. Social factors are related to "social interaction, street lively, public places, resting areas and

participation" objectively and "sense of belonging" and "sense of place" subjectively. Safety indexes include "crime reported, traffic lights, street crossing, and street visibility" objectively and "sense of security" about crime and violence and "sense of safety" about car accidents or quality of traffic lights and crossings subjectively. Subjective and objective measures are the measures that completing each other in providing information on neighbourhood's walkability characteristics. "Socio-demographic" attributes such as "gender, age, household income and physiological conditions" are selected as control variables.

2.8. AIM OF THE STUDY

To assess the existing state of neighborhood walkability and propose policy interventions for its improvement in urban areas.

2.9. OBJECTIVES OF THE STUDY

- Conduct an assessment of neighborhood walkability in the study area, considering various physical, social, safety and health factors.
- Identify key factors influencing neighborhood walkability through a combination of quantitative and qualitative data collection techniques.
- Develop policy interventions based on research findings and best practices in urban planning and walkability improvement.
- Evaluate the effectiveness of the proposed policy interventions and provide recommendations for refinement and enhancement.

2.10. CONCEPTUAL FRAMEWORK

A walkable neighbourhood is considered as a measure that determines to what extent a neighbourhood is pedestrian-friendly which includes a number of factors that can be classified into three groups based on "physical, social, safety aspects of neighbourhoods". Most of the past studies have widely adopted physical aspects of neighbourhoods as the most important factors affect the walkability and neglected two other factors. As mentioned, the overall walkability, also include social and safety aspects of neighbourhoods which have been examined only in limited studies. However, the aim of this study is to identify the influence of The influence of physical, social and safety aspects on walkability in one such neighbourhood

of Lucknow, all aspects in both objective and subjective measures and determine if there is a significant correlation between them.

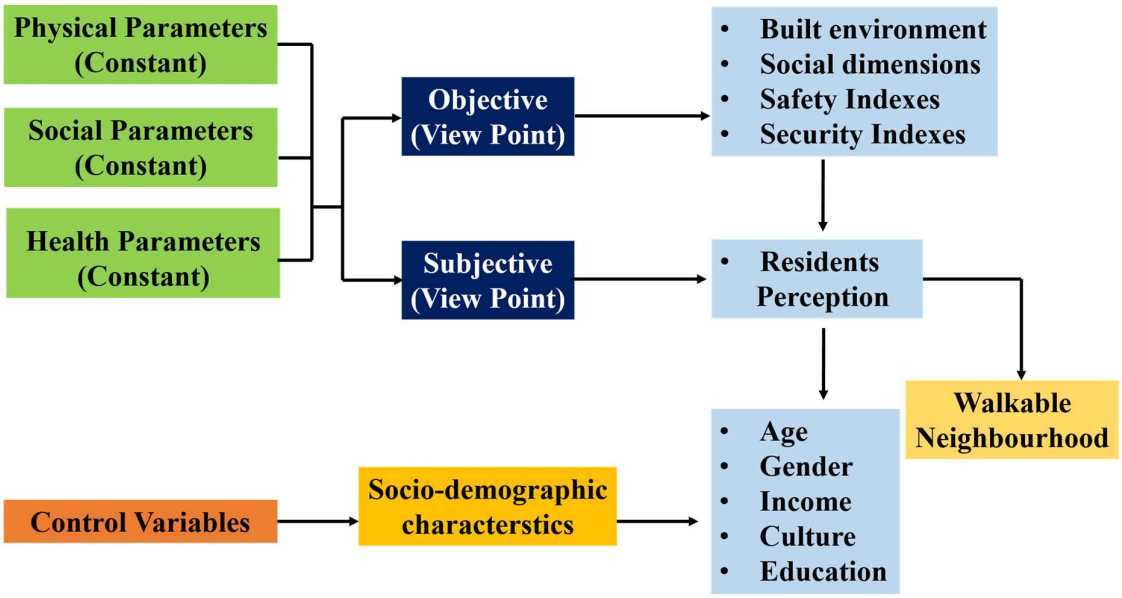


Figure 3 Framework

Physical attributes indicate of spatial characteristics of the built environment such as accessibility of basic amenities, sidewalks conditions, attractive design, and greenery. Accessibility implies the proximity of destinations of basic infrastructure such as groceries, schools, public transportation, restaurants and coffee shops, parks, playgrounds, and recreational centers. Short access networks accelerate pedestrian flows.

Sidewalk conditions is related to pedestrian infrastructures such as well-maintained sidewalks, the quality of pavement, width of paths, slopes of routs, barriers on sidewalks, way-finding signage and weather protections like shelters and shades. What constitutes walkability as an aesthetic design is a quality of built environment design and to what extent it is attractive and pleasant to pedestrians. Picturesque sceneries, attractive architectural design, public arts, sculptures and presence of street furniture encourage people to walk and enjoy the beauty. “Uncleanness and inefficient trash collection, poor drainage systems, presence of dog feces, long bare walls and broken windows made walking unpleasant”. Green elements such as parks, trees, and plants which are features of the natural environment create a pleasant area and motivate people to walk. Sense of comfort as a subjective variable declares the feelings and perceptions of pedestrians about the level of comfortability of sidewalks with variety of

destinations in short distance, provision of facilities such as resting areas, sufficient lights, weather protection and the extent to which streets are calm, welcoming and pedestrian-friendly. Sense of interest is referred to the perception of residents about how enjoyable and interesting a neighbourhood is for walking and the level of attractiveness and pleasantness of the environment in terms of the presence of parks, trees and frontage gardens along with links, appealing views and architectural designs. The influence of physical, social and safety aspects on walkability in one such neighbourhood of Lucknow include social capital which has been influenced by physical characteristics of the built environment and might affect the walkability of neighbourhoods.

Social interactions as a variable related to social networks that create trust among citizens. People who participate in their communities have a high level of interaction that is the other variable of social aspects affect walkability. Also, the presence of public places, resting areas, urban squares and any other area that people can socialize will be the other important factor in increasing walkability. Streets as an important part of public open space constitute of the public realm. People depend on streets for functional, social, and leisure activities. The narrower streets, the less traffic and more pedestrian to walk is an example of a lively street. Sense of place as a subjective variable is referred to the level of satisfaction of people with the atmospheric characteristics of the environment, services and needs provided for by a specific place. What forms these aspects of the sense of place includes both the built environment and the social and cultural relationships. Sense of belonging is the feeling of how people accept themselves as a member of their communities and how they are respected and included in these communities that help people to participate and socialise more within their communities. **Safety aspects** variables are referred to security which is associated with crime and safety which is related to a car accident. Objective variables include crime reported in the neighbourhoods and visibility of the streets that decreases the range of crime. Also, the number of traffic lights and intersections that make it easy for a pedestrian to walk safely. “Sense of security” as a subjective indicator implies the fear of crime that discourages people to walk. Some studies show that perceived sense of security increases in streets with stores, bars, and restaurants which are active most of the time and the presence of street lights. Also, the presence of people increases the “sense of security”. Various other studies have found that the presence of “graffiti, vandalism, litter”, and “poorly maintained streets” negatively affect the “sense of security”. “Sense of safety” is another important factor that affects walking behaviour and related to the fear of a car accident. Various solutions have been suggested to increase the sense of safety such as “separate pedestrians from fast-moving vehicles”, “reducing street

width and speed limits", "introducing traffic calming measures", "trees or plantings to reduce or slow down traffic", "make street-crossing safer for pedestrians" and etc. Walkability indexes include "street connectivity, land use mix, and population density". Street connectivity is an important index in walkability and refers to "the level of directness and availability of alternative routes between home and local destinations". Generally, a high density of intersections often is characterized as a well-connected street network with available short routes to more utilitarian destinations. Population density is defined as "the number of people live in a defined area" and mixed-use is related to the "availability of different land uses in a defined area".

3. RESEARCH DESIGN & METHODS

3.1.ABOUT

This chapter demonstrates detailed information on the research design, data collection and data analysing methods. In order to answer the research questions and obtain the research objectives, firstly, the conceptual framework is operationalized to define variables and indicators.

Secondly, research strategy, data analysis method is described to determine the characteristics of the physical, social and safety aspects that significantly affect the walkability in one such neighbourhood in Lucknow. Finally, the validity and reliability of the collected data have been explained.

3.2.VARIABLES & INDICATORS

Variables and indicators are categorized into three types, based on the conceptual framework and research questions: Independent variables, dependent variables and the control variable Concept: “neighbourhood walkability” Walkable Neighbourhood is a bounded place which is safe, comfortable and interesting to walk with access to basic amenities in minimum time. Dependent variable: “walkability” The term “walkability” used in the study is defined “the street network which connects a variety of land uses in a high populated area”. It is measured by evaluating the level of connectivity, level of mixed land use and the level of population density. Independent variables: “physical, social and safety aspects of neighbourhood” Three aspects of neighbourhood’s “physical, social and safety feathers” are selected as independent variables. These features can be assessed through “objective and subjective measures”. Collected information, for objective features and subjective features was conducted through questionnaire because it is associated with people’s perceptions for conditions of each aspect. According to the problem statement the main research question is: “To what extent do physical, social and safety aspects influence the walkability of one such neighbourhood in Lucknow?” Furthermore, sub-research questions to support the main question are: 1-How do physical, social and safety aspects influence walkability of one such neighbourhood in Lucknow? 2-To what extent does physical aspects influence the walkability of one such neighbourhood in Lucknow? 3-To what extent does social aspects influence the walkability of one such neighbourhood in Lucknow? 4-To what extent does safety aspects influence the walkability of

of one such neighbourhood in Lucknow? The influence of physical, social and safety aspects on walkability in one such neighbourhood of Lucknow. The control variable is associated with socio-demographic characteristics of people who live in selected neighbourhoods. It is important to include all groups of people with different level of income, education, age, gender in the research to have minimum errors.

Sub-question 1: How do physical, social and safety aspects influence the walkability of neighbourhood in Lucknow?

Table 1 Operationalization sub-question 1

concept	variables	sub-variables	definition	indicators
Neighborhoods Walkability	Physical, Social and Safety aspects	Availability of aesthetic design and security in public spaces	How interesting and how secure is the public places to walk	willingness to walk for leisure
		Accessibility to basic amenities and work places with suitable side walks	How close are the facilities in mixed land used with proper access through connected sidewalk .	willingness to walk for transportation
		Acceptability of crosswalks with light, trees and suitable pavement	How suitable are street cross and safe for walking as an exercise	willingness to walk for exercise on a safe walk-way
	Walkability	Mixed land use	"combination of different functions and proximity to various uses"	level of mixed land uses
		Population Density	"Number of people living in a defined area"	person per Hectare
		Street Connectivity	"The directness of links and the density of connections in a transport network"	level of connectivity

Sub-question 2: To what extent does physical aspects influence the walkability of neighbourhood in Lucknow?

Table 2 : Operationalization sub-question 2

concept	variables	sub-variables	definition	indicators
Neighborhoods Walkability	Physical aspects	Accessibility	the distances between people and their destinations that they need access to	level of accessibility
		Sidewalk conditions	the quality of pavement and footpath for walking	level of sidewalk conditions
		Aesthetic design	attractiveness of design and beauty of elements of an area	level of aesthetic
		Greenery	green public spaces, green landscapes and front gardens along the streets	square meter
		Sense of comfort	physical and environmental aspects influence the ability of a person to walk	level of comfortability
		Sense of interest	interesting and attractive features of environment that encourage people to walk	level of attractiveness
	Walkability	Mixed land use	"combination of different functions and proximity to various uses"	level of land uses mixed
		Population Density	"Number of people living in a defined area"	person per Hectare
		Street Connectivity	"The directness of links and the density of connections in a transport network"	level of connectivity

Sub-question 3: To what extent does social aspects influence the walkability of one such neighbourhood in Lucknow?

Table 3 Operationalization sub-question 3

concept	variables	sub-variables	definition	indicators
Neighborhoods Walkability	Social aspects	Social interaction	visiting familiar faces or a friend or a close neighbor when walking and start a conversation	level of social activity
		Street liveliness	streets with the presence of a number of people engaged in social activities	level of street liveliness
		Participation	participation of residents in social activities for improving their communities	level of participation
		Public places	areas for resting with high social interactions	number of public areas
		Sense of place	"relationship with places: emotions, biographies, imagination, stories, personal experiences"	presence or absent
		Sense of belonging	"sense of familiarity in the community"	presence or absent
	Walkability	Mixed land use	"combination of different functions and proximity to various uses"	level of land uses mixed
		Population Density	"Number of people living in a defined area"	person per Hectare
		Street Connectivity	"The directness of links and the density of connections in a transport network"	level of connectivity

Sub-question 4: To what extent does safety aspects influence the walkability of one such neighbourhood in Lucknow?

Table 4 Operationalization sub-question 4

concept	variables	sub-variables	definition	indicators
Neighborhoods Walkability	Safety aspects	Crime reported	the range of burglary, theft, graffiti that was reported to police	level of crime
		Traffic lights	the number of traffic lights support safeties in term of accident	quality of traffic light
		Street intersections	quality of street intersections in term of accident	quality of intersections
		Visibility	equality of the street related to See and be seen in the street	level of visibility
		Sense of security	secure environment from crime	presence or absent
		Sense of safety	The risk of traffic accident	presence or absent
	Walkability	Mixed land use	"combination of different functions and proximity to various uses"	level of land uses mixed
		Population Density	"Number of people living in a defined area"	person per Hectare
		Street Connectivity	"The directness of links and the density of connections in a transport network"	level of connectivity

3.3. RESEARCH STRATEGIES

A mixed-method research is a purposeful combination of methods for data collection, data analysis and interpretation that contributes to achieving a better understanding of connections or contradictions of data in the research and enrich the results of the study.

The mixed-method strategy can be recognized as a triangulation which increases the validation strategy to ensure the quality of the research results. Therefore, this research is an effort to combine survey strategy with spatial analysis by using instruments such as ArcGIS. The influence of physical, social and safety aspects on walkability in one such neighbourhood of Lucknow.

The survey is one of the well-known and large scale research and suitable strategy for deductive research with a high level of standardization that can be applied for several purposes. According to Van Thiel (2014) in order to collect information for a large scale approach with a large group of respondents, the most suitable and efficient strategy is a survey which assists the researcher to collect data about people's opinions, perceptions, feelings and attitudes through the questionnaire or interview and analyses this considerable information with statistical techniques.

Survey tests a certain theory and its main purpose is to explore or describe new information which is opposed to the desk research. In a survey, because of its high external validity, data

can easily be generalized. Therefore, it is important in survey-based research strategy to select a large number of sampling that can be representative of the entire population to reveal a correlation. This research is a combination of explanatory research which is a theory-based and deductive form of research and GIS-based research.

Survey strategy is an efficient method for walkability concept that was conducted in one such neighbourhood of Lucknow based on income, ethnicity and geographical situation to collect primary data.

The secondary data from the database of the municipality of Lucknow and spatial analysis in GIS and Space Syntax were also used to the triangulation of research variables. To achieve the research objective which is to identify physical, social, safety characteristics of neighbourhoods that influence walkability concept, primary data were analysed to describe the association of these factors with walkability concept by statistical analysis.

4. EXISTING WALKABILITY POLICIES IN INDIA

4.1.PEDESTRANISATION OF STREETS

Figure 4 Pedestranisation of Streets

Pedestrianization of streets is a concept that has gained traction in several cities across India. It involves transforming certain streets or areas into pedestrian-only zones, restricting vehicular access to create safe and walkable spaces. Here are a few examples of pedestrianization initiatives in India:

- **Chandni Chowk, Delhi:** One of the most prominent examples of pedestrianization in India is the ongoing redevelopment project of Chandni Chowk in Old Delhi. The project aims to revitalize the historic market area by creating a car-free zone, widening pedestrian walkways, and improving infrastructure.
- **MG Road, Bengaluru: MG Road**, a major commercial street in Bengaluru, has been pedestrianized to some extent. The stretch between Anil Kumble Circle and Brigade Road Junction has limited vehicular access during certain hours, allowing pedestrians to move freely.
- **Pondy Bazaar, Chennai: Pondy Bazaar**, a bustling shopping district in Chennai, has undergone pedestrianization efforts to enhance walkability. Vehicular access has been

restricted during specific hours, creating a safer and more enjoyable environment for pedestrians.

- **Heritage City Development and Augmentation Yojana (HRIDAY):** The HRIDAY scheme, initiated by the Government of India, aims to develop heritage cities and areas. As part of this program, pedestrianization projects have been undertaken in various heritage cities, such as Varanasi, Amritsar, and Ajmer, to preserve the cultural heritage and improve walkability.
- **Smart Cities Mission:** The Smart Cities Mission in India, launched by the government, focuses on transforming cities into sustainable and citizen-friendly urban spaces. Many smart cities under this initiative have implemented pedestrianization projects to promote walkability and reduce congestion, including the creation of pedestrian-only zones and the improvement of pedestrian infrastructure.
- It's important to note that pedestrianization initiatives can vary in scale and scope across different cities and neighborhoods in India. The specific design, implementation, and effectiveness of these projects may also differ. For the latest and most detailed information on pedestrianization initiatives in specific cities or neighborhoods, it is recommended to refer to local government websites, urban development authorities, or related urban planning documents.

4.2.SMART CITY CONCEPT

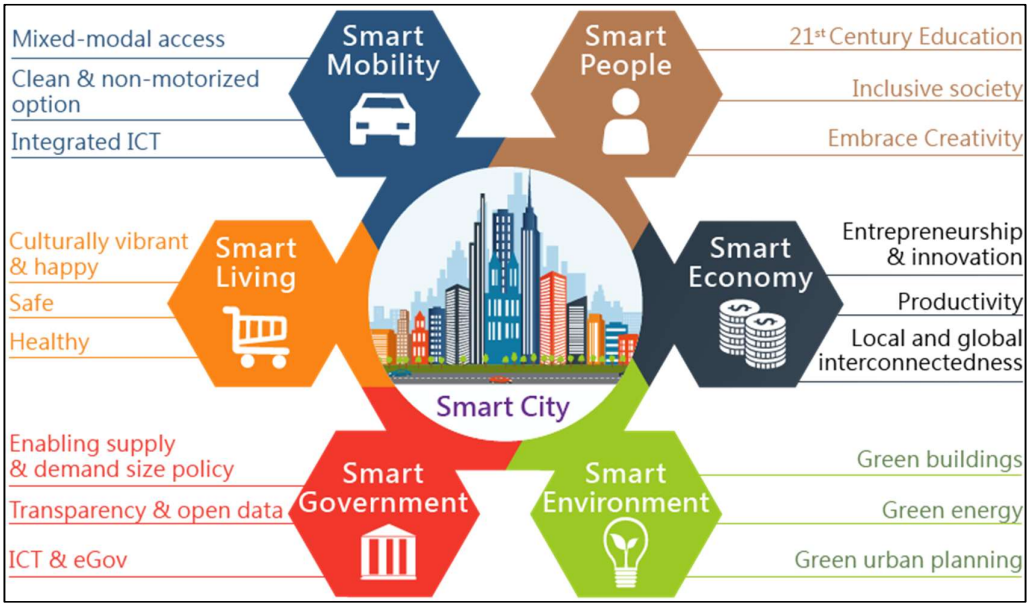


Figure 5 Smart City Concept

The Smart Cities Mission, launched in 2015, aims to develop 100 cities across India with sustainable and inclusive infrastructure. Many of these smart cities emphasize the creation of walkable neighborhoods through measures like improving footpaths, creating pedestrian-friendly streets, and developing non-motorized transport infrastructure.

- **Pedestrian-friendly infrastructure**: Smart cities focus on developing well-designed sidewalks, crosswalks, footpaths, and pedestrian-friendly infrastructure. This includes wider sidewalks, dedicated walking paths, ramps for accessibility, proper lighting, and amenities such as seating areas, water fountains, and shade.
- **Traffic management and safety:** The mission emphasizes improving traffic management to ensure the safety and convenience of pedestrians. This involves implementing intelligent traffic signaling systems, creating pedestrian-only zones or restricted vehicle zones in certain areas, and adopting traffic calming measures such as speed humps, raised crosswalks, and traffic islands to enhance pedestrian safety.
- **Last-mile connectivity:** Smart cities aim to provide efficient last-mile connectivity options to encourage walking. This involves developing integrated transport systems that seamlessly connect public transportation hubs, such as bus stops and metro stations, with pedestrian pathways. Implementing cycle-sharing and pedestrian-friendly transport systems like e-rickshaws can also improve connectivity and encourage walking.
- **Technology-enabled solutions:** The Smart City Mission leverages technology to enhance walkability. This includes implementing smart parking systems that guide drivers to available parking spaces, digital signage to provide real-time information on walking routes, public transportation schedules, and points of interest, and mobile applications to facilitate navigation and safety for pedestrians.
- **Urban planning and design:** Smart cities prioritize urban planning and design that promotes walkability. This involves mixed-use development, where residential, commercial, and recreational spaces are located within close proximity, reducing the need for long-distance travel. The mission also emphasizes creating vibrant public spaces, parks, and green areas, which attract pedestrians and encourage active modes of transportation.
- **Community participation and engagement:** The Smart City Mission encourages community participation and engagement in the planning and implementation process.

4.3.COMPLETE STREETS

Figure 6 Complete Streets

The concept of **"Complete Streets"** is gaining recognition and implementation in various cities across India. Complete Streets are designed to accommodate the needs of all road users, including **pedestrians, cyclists, public transportation users, and motorists, regardless of age or ability.**

The goal is to create inclusive and safe streets that promote mobility, connectivity, and a healthy urban environment. Here are some aspects of the Complete Streets concept in India:

- **Pedestrian Infrastructure:** Complete Streets prioritize pedestrian infrastructure by providing safe and accessible sidewalks, well-marked crosswalks, tactile paving for visually impaired individuals, and adequate street lighting. Efforts are made to enhance walkability, encourage walking as a mode of transportation, and improve pedestrian safety.
- **Cycling Infrastructure:** Complete Streets recognize the importance of cycling as a sustainable mode of transportation. Dedicated cycling lanes, segregated or protected from vehicular traffic, are integrated into street designs. These lanes may include signage, markings, and other measures to ensure cyclist safety. Initiatives like bike-sharing programs and bicycle parking facilities are also encouraged.

- **Public Transportation:** Complete Streets consider the needs of public transportation users. Bus stops are designed to be easily accessible with shelters, seating, and information displays. Transit-oriented development (TOD) concepts are employed to integrate public transport systems seamlessly into the urban fabric, making it convenient for people to access transit stations and services.
- **Traffic Calming Measures:** Complete Streets incorporate traffic calming measures to reduce vehicle speeds, enhance safety, and create a more pleasant environment for all users. Techniques such as speed humps, raised crosswalks, traffic islands, and chicanes are used to slow down vehicular traffic and encourage adherence to speed limits.
- **Accessibility and Universal Design:** Complete Streets strive to be accessible to all individuals, including those with disabilities. Ramps, curb cuts, and tactile features are provided to ensure mobility for people using wheelchairs, mobility aids, or strollers. Accessible pedestrian signals, audio cues, and tactile maps are implemented to assist visually impaired pedestrians.
- **Landscaping and Public Spaces:** Complete Streets focus on creating attractive and green public spaces along road corridors. Landscaping, street furniture, shade trees, and plazas are incorporated to enhance the aesthetics and comfort of the street environment. These elements contribute to creating more vibrant and livable streetscapes.

4.4.METRO STATION & LAST MILE CONNECTIVITY

The concept of **"Metro Station and Last Mile Connectivity"** addresses the challenge of connecting commuters from their origin or destination to the nearest metro station. It recognizes that providing efficient and convenient transportation options for the first and last mile of a person's journey is crucial for the success and accessibility of metro systems. Here's an overview of the concept:

- **Metro Station Infrastructure:** Metro stations are designed to facilitate smooth transfers and connections. They typically provide facilities such as ticketing counters, information kiosks, waiting areas, and platform access for commuters. Additionally, stations often incorporate amenities like elevators, escalators, and ramps to ensure accessibility for people with disabilities or those carrying heavy luggage.
- **Pedestrian Infrastructure:** To promote walkability and pedestrian access, metro stations are designed with safe and convenient pedestrian pathways and crosswalks

connecting to surrounding areas. Adequate footpaths, well-marked crosswalks, and street lighting are provided to encourage walking as a mode of last mile connectivity.

- **Bicycle Integration:** Many metro systems encourage bicycle usage as a mode of last mile connectivity. Metro stations may include bicycle parking facilities, bike-sharing services, or integration with existing cycling infrastructure. This allows commuters to cycle to and from the station, providing a sustainable and healthy transportation option.
- **Feeder Services:** Last mile connectivity is often facilitated through feeder services, which are transportation options that connect commuters from the metro station to their final destination. Feeder services can include bus routes, shuttle services, or shared mobility options like auto-rickshaws or taxis. These services are coordinated to align with metro schedules, ensuring seamless transfers and reducing waiting times.
- **Integrated Mobility Hubs:** Some metro stations are developed as integrated mobility hubs, where multiple transportation modes converge. These hubs connect metro services with other public transport systems such as buses, trains, or suburban rail networks. By integrating various modes of transport, commuters have a wider range of options for their last mile connectivity.

Figure 7 First and Last mile Connectivity

- **Technology Solutions:** Mobile apps, real-time information systems, and smart cards are often utilized to provide commuters with accurate information on metro schedules, routes, and nearby transportation options. These technological solutions help

commuters plan their journeys effectively and choose the most suitable last mile connectivity options.

The implementation of last mile connectivity initiatives varies across different metro systems and cities. Some cities have introduced dedicated feeder bus services, improved pedestrian infrastructure, and integrated bike-sharing programs, while others are exploring innovative solutions like electric rickshaws or ridesharing partnerships. To obtain specific details about last mile connectivity plans and services for a particular metro system or city, it is advisable to refer to the local transit authority's website or official sources.

5. CASE STUDIES

5.1.CHANDNI CHOWK, NEW DELHI, INDIA.

Figure 8 Chandni Chowk (Plan)

Figure 9 Evolution of Chandni Chowk

Historical Evolution

- The street transformed and survived over multiple eras.

Multimodal

- Different kinds of vehicles access it. Two railway stations, four metro stations surround it.

National Scale commercial center

- The area is one-stop shopping center and is a wholesale market with footfall from all around the world.

Figure 10 Existing Scenario

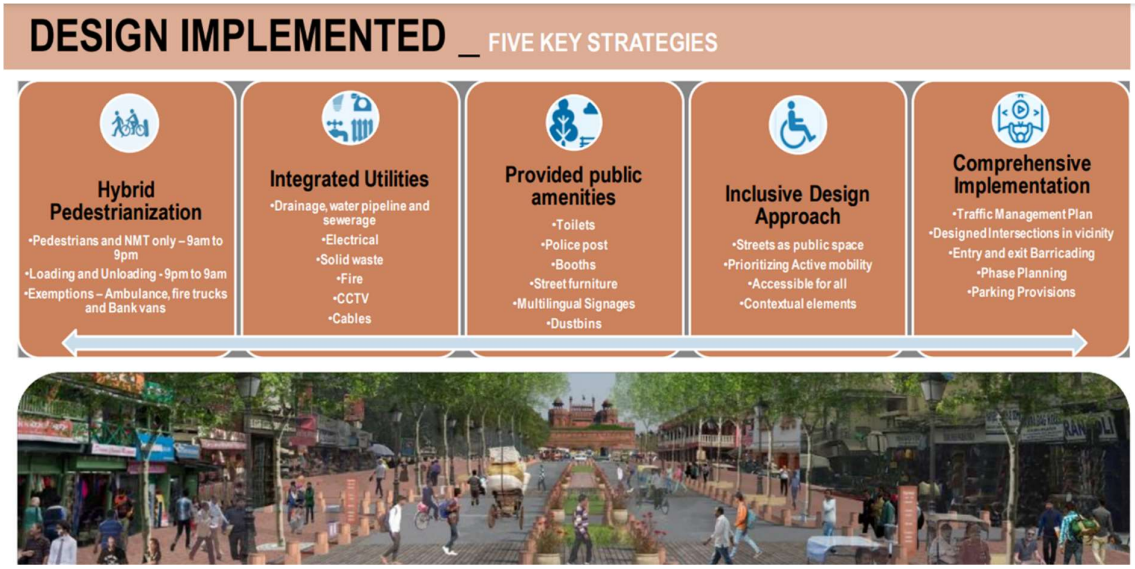


Figure 11 Strategies Implemented

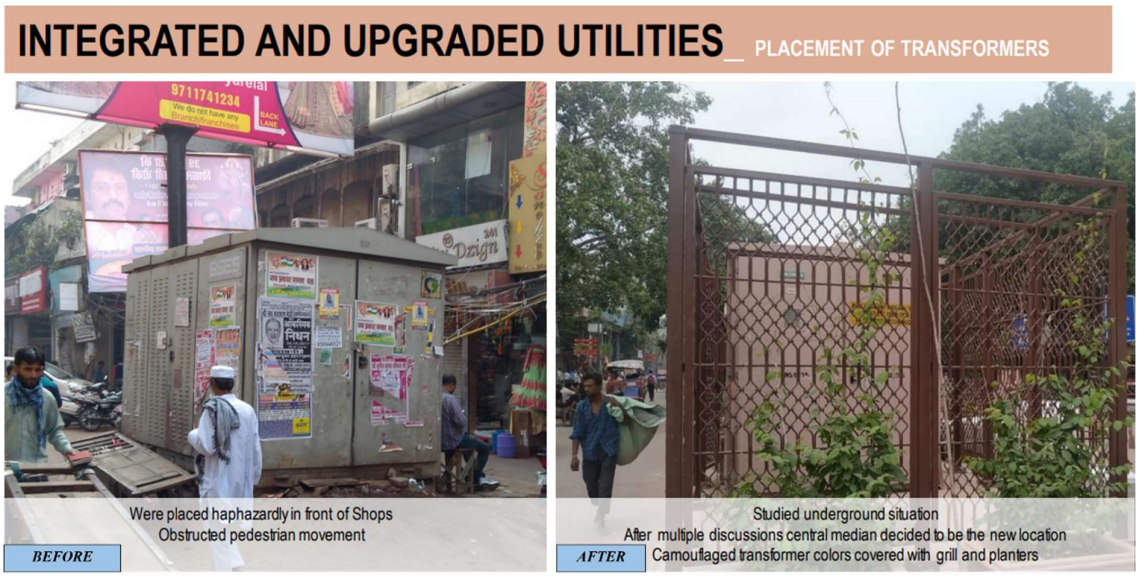


Figure 12 Before & After Scenario

Figure 13 Before & After Scenario

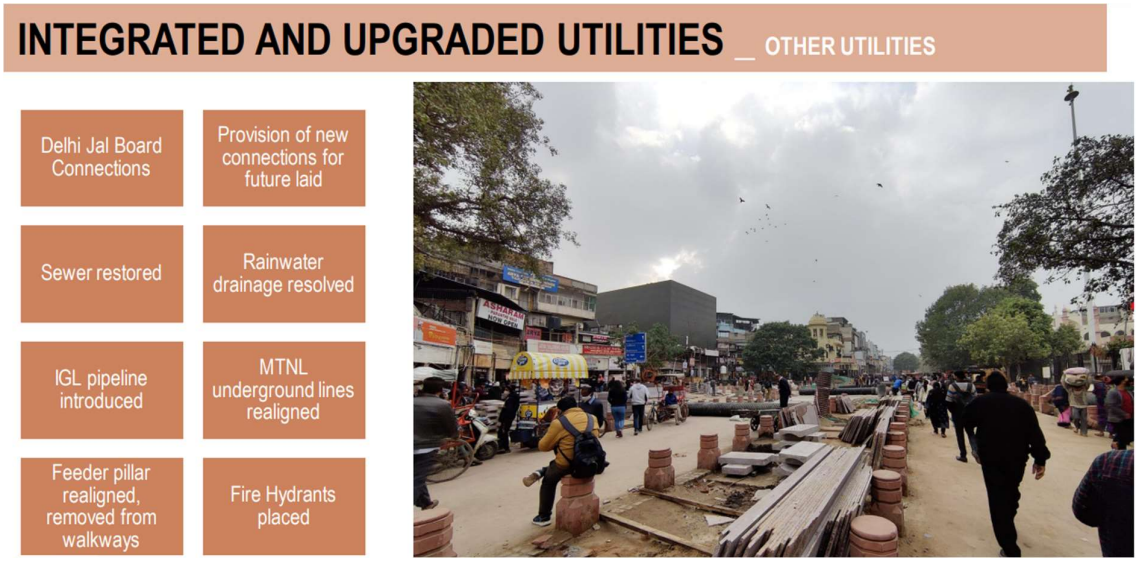


Figure 14 Urgraded Utilities

Figure 15Before & After Transformation

Figure 16 Before & After Transformation

Figure 17 Before & After Transformation

Figure 18 Before & After Transformatio

Figure 19 Conserved areas

Figure 20 Implementation Phases

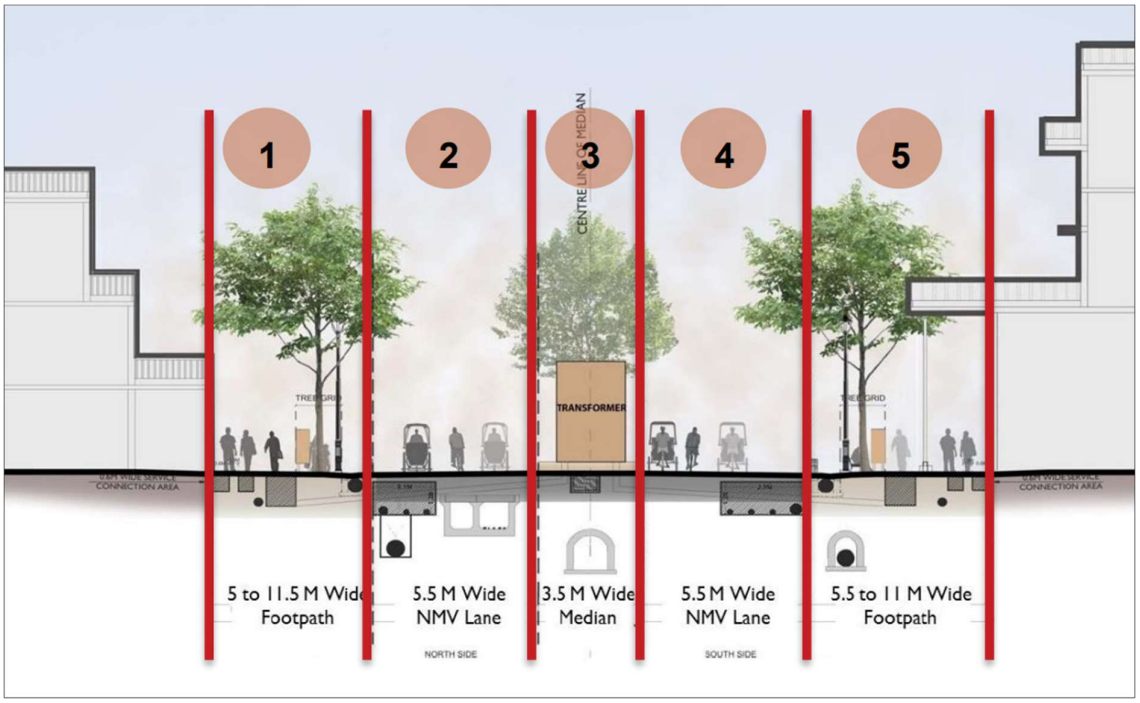


Figure 21 Road Section

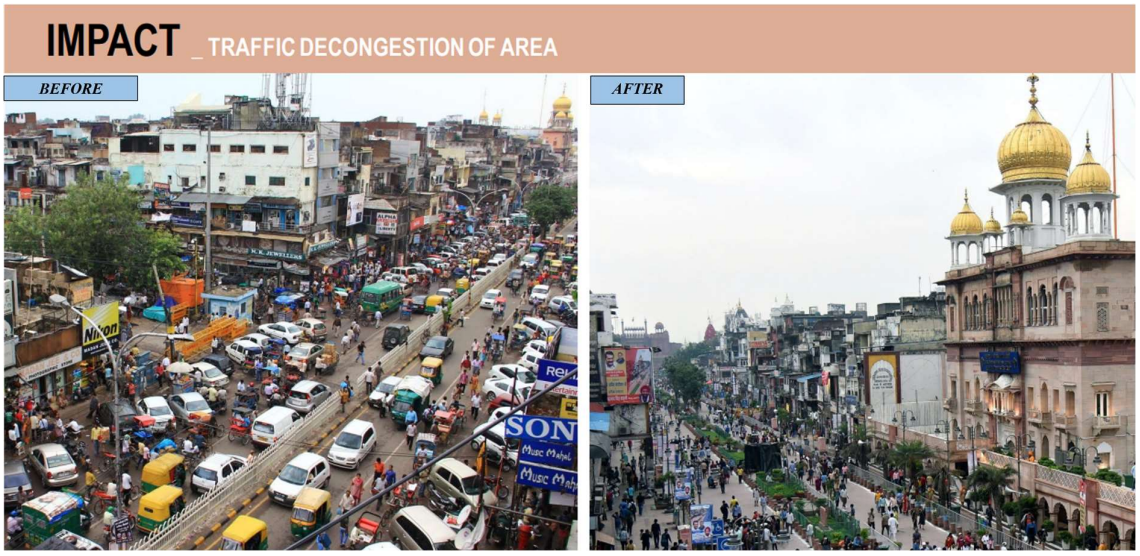


Figure 22 Impact-1

Figure 23 Impact-II

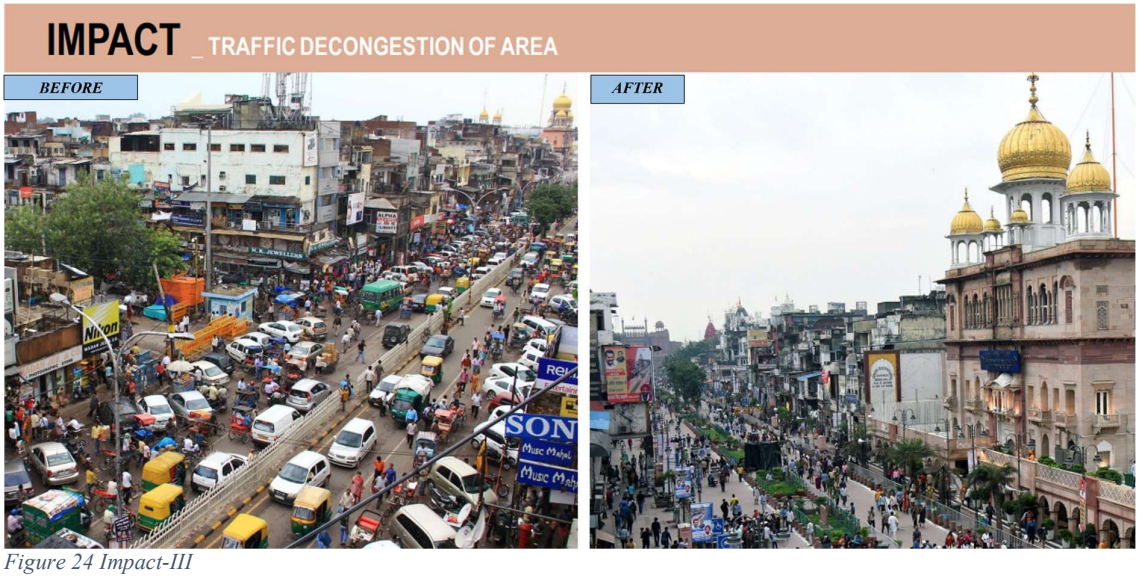


Figure 24 Impact-III

Figure 25 Impact-IV

Figure 26 Impact-V

Walkability policies that were implemented during Redevelopment of Chandni Chowk, New Delhi;

- **Widened Pedestrian Walkways:**

Policies could involve widening existing footpaths or creating new pedestrian walkways to provide ample space for pedestrians to move comfortably. This allows for increased pedestrian safety and encourages walking as a preferred mode of transportation.

- **Traffic Calming Measures:**

Policies may include the implementation of traffic calming measures such as speed limits, raised crosswalks, speed bumps, or traffic circles to reduce vehicle speeds and enhance pedestrian safety.

- **Pedestrian Zones:**

Designating certain areas within Chandni Chowk as pedestrian-only zones or restricting vehicular access during specific hours can prioritize pedestrians and create safe spaces for walking and interacting.

- **Street Furniture and Amenities:**

Policies may focus on providing adequate street furniture and amenities to support pedestrians, such as benches, seating areas, pedestrian-friendly signage, public toilets, water fountains, and trash bins.

- **Enhanced Crosswalks and Signals:**

Policies might involve installing pedestrian-friendly crosswalks and signals at strategic locations to facilitate safe pedestrian crossings. This could include features such as countdown timers, audible signals, and raised crossings.

- **Street Lighting:**

Policies might emphasize the improvement of street lighting to enhance visibility and safety for pedestrians, particularly during the evening and night hours.

- **Accessibility:**

Policies could focus on ensuring accessibility for people with disabilities, such as installing curb ramps, tactile pavings, and accessible facilities to promote inclusive walkability.

5.2.CONNAUGHT PLACE, NEW DELHI, INDIA

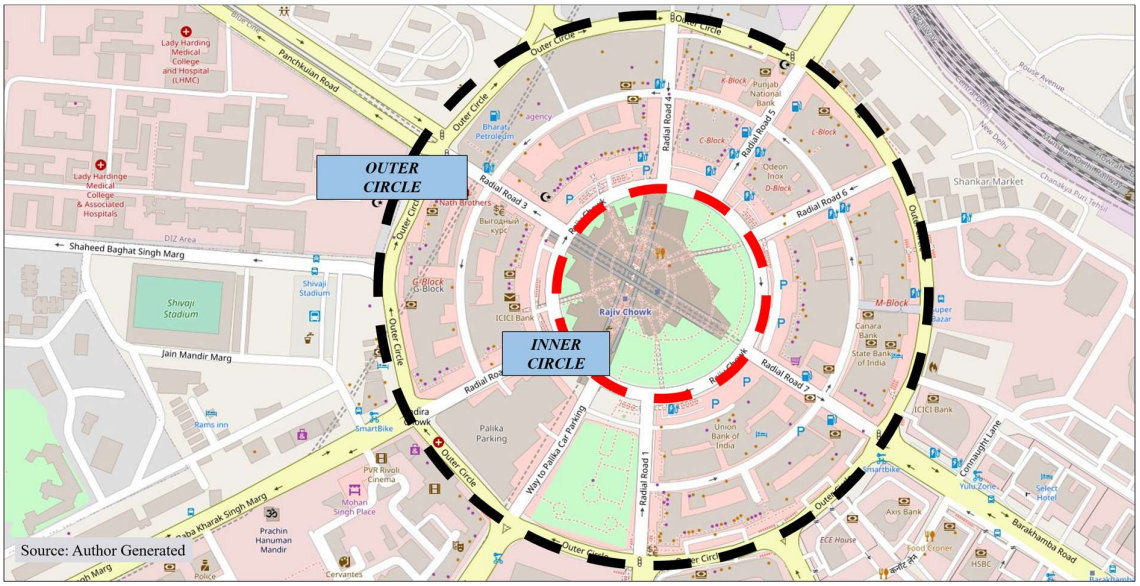


Figure 27 Plan

- **LOCATION :** Atcenter of the city, near Karol bagh
- **YEAR OF COMPLETION :** work began in 1929 and was completed in 1933
- **F.A.R :** 250
- **DESIGNED BY :** Edwin Lutyen
- **PURPOSE :** It was designed as a showpiece of Lutyen's Delhi with a prominent Central Business District.

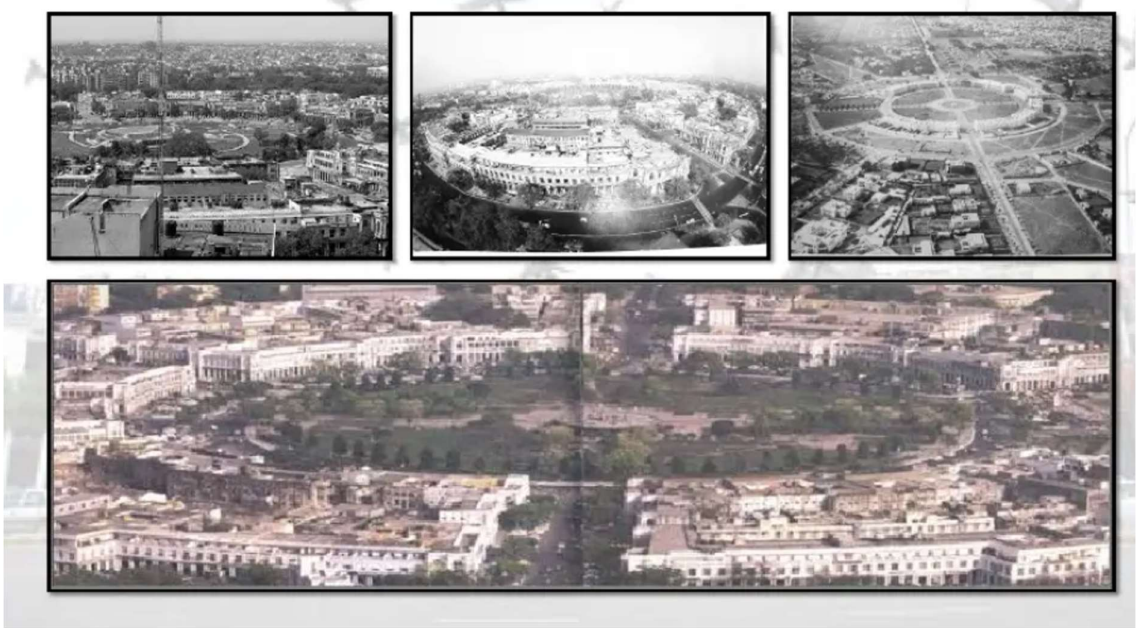


Figure 28 History of Connaught Place

- Connaught Place is one of the largest financial, commercial and business centres in New Delhi. It is often abbreviated to CP.
- It was developed as a showpiece of Lutyen's Delhi with a prominent Central Business District.
- The place was renamed as Rajiv Chowk after the death of great Indian Prime Minister Rajiv Gandhi.
- It is the pride of Delhi having all the major and big names in its perimeter as their head office.
- THE COMMERCIAL HUB Connaught Place was envisaged as a combination of commercial and residential buildings, modelled on the Royal Crescent in Bath, England.
- This was designed in shape of horseshoe to bring good luck to both shoppers as well as business owners as was and still is commercial heart of the Delhi.
- It depicts the style of British architecture which was very planned and well structured.
- The plan was a two-storeyed open colonnaded structure where the ground floor would be taken up by commercial establishments while the floor above would be given over to residents.
- Connaught Place is circular and can easily be covered on foot. It also has about 7 different large roads leading out of it connecting to various parts of the city.
- The entire CP Area, with its roads, lanes and by-lanes is an exotic labyrinth– with tons of shops tucked into nooks and corners, delicious old eating joints and exquisite Indian handicraft and traditional clothes and jewellery shops.

Figure 29 Concept

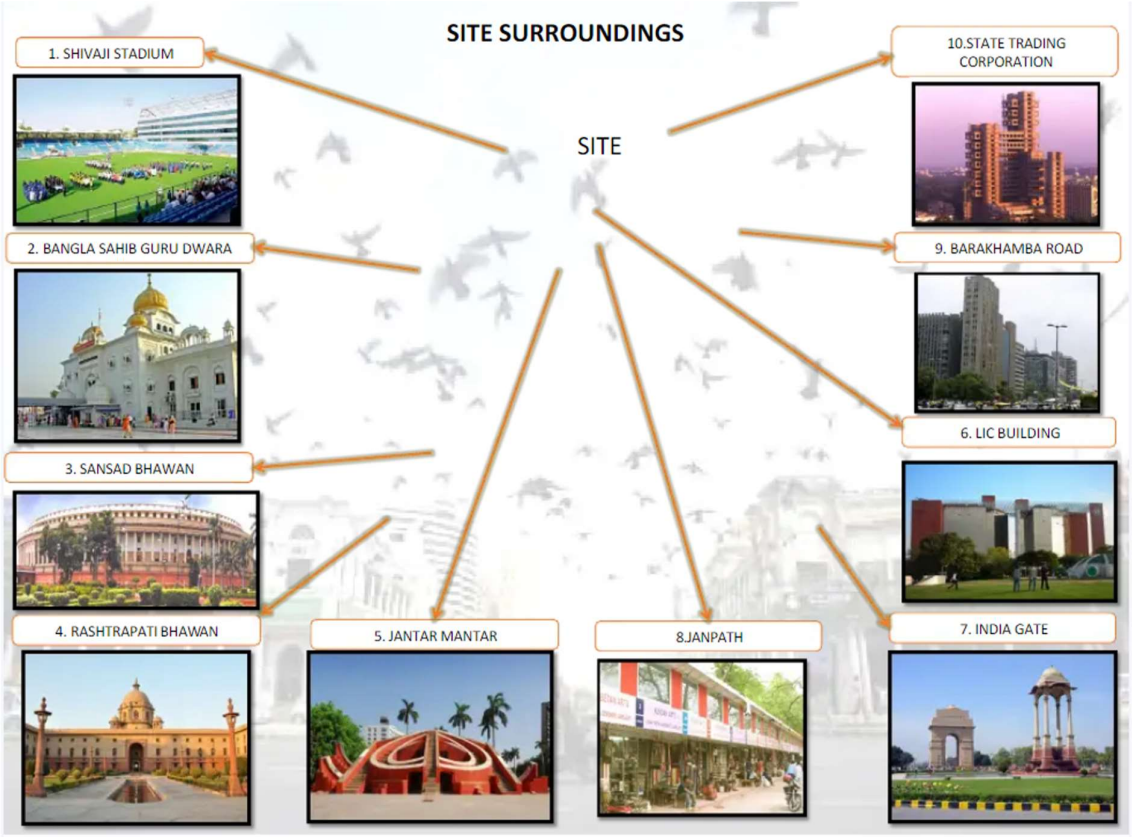


Figure 30 Site Surroundings

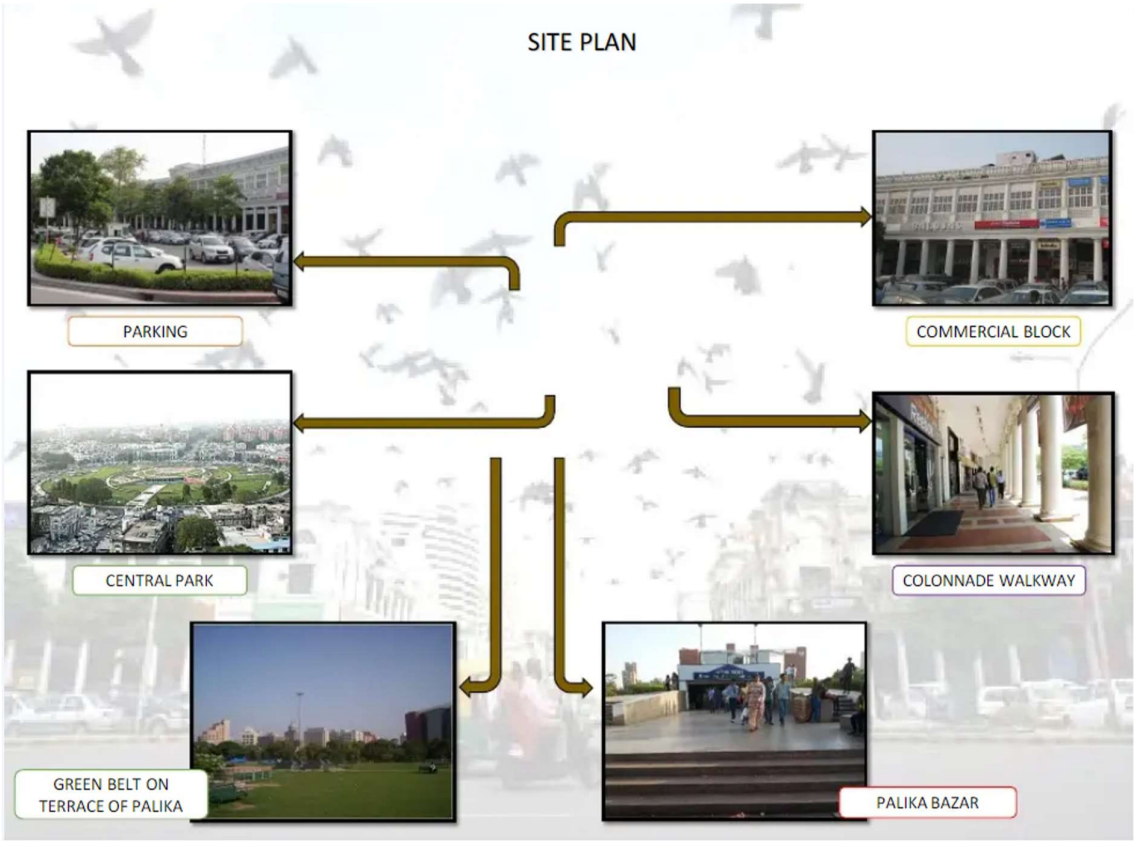


Figure 31 Site Plan

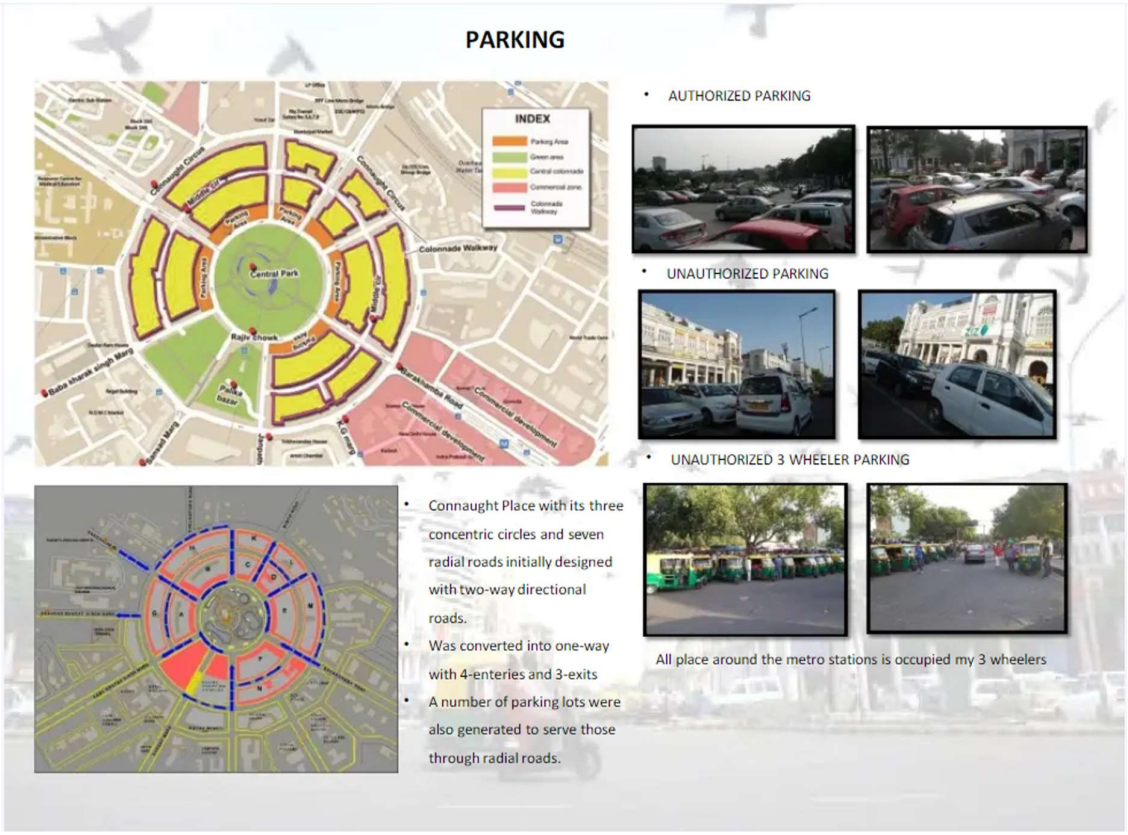


Figure 32Parking Distribution

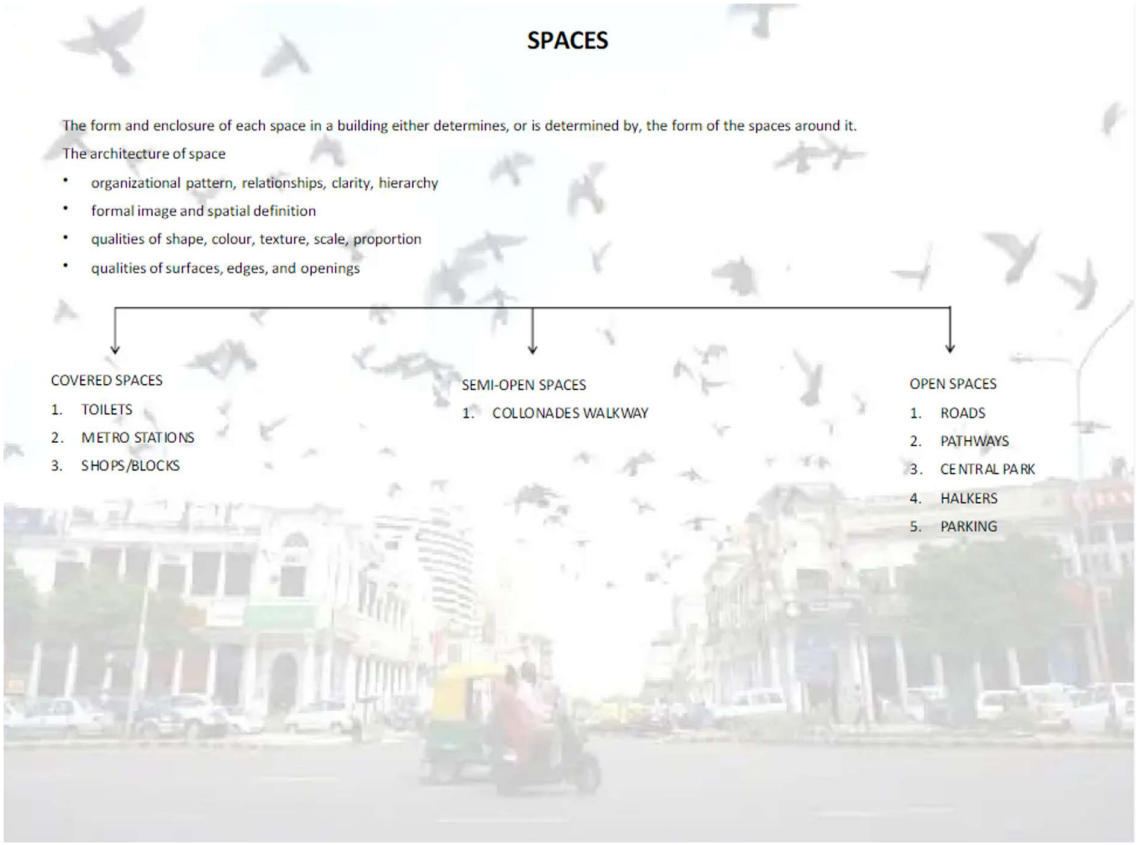


Figure 33 Spaces Allocation

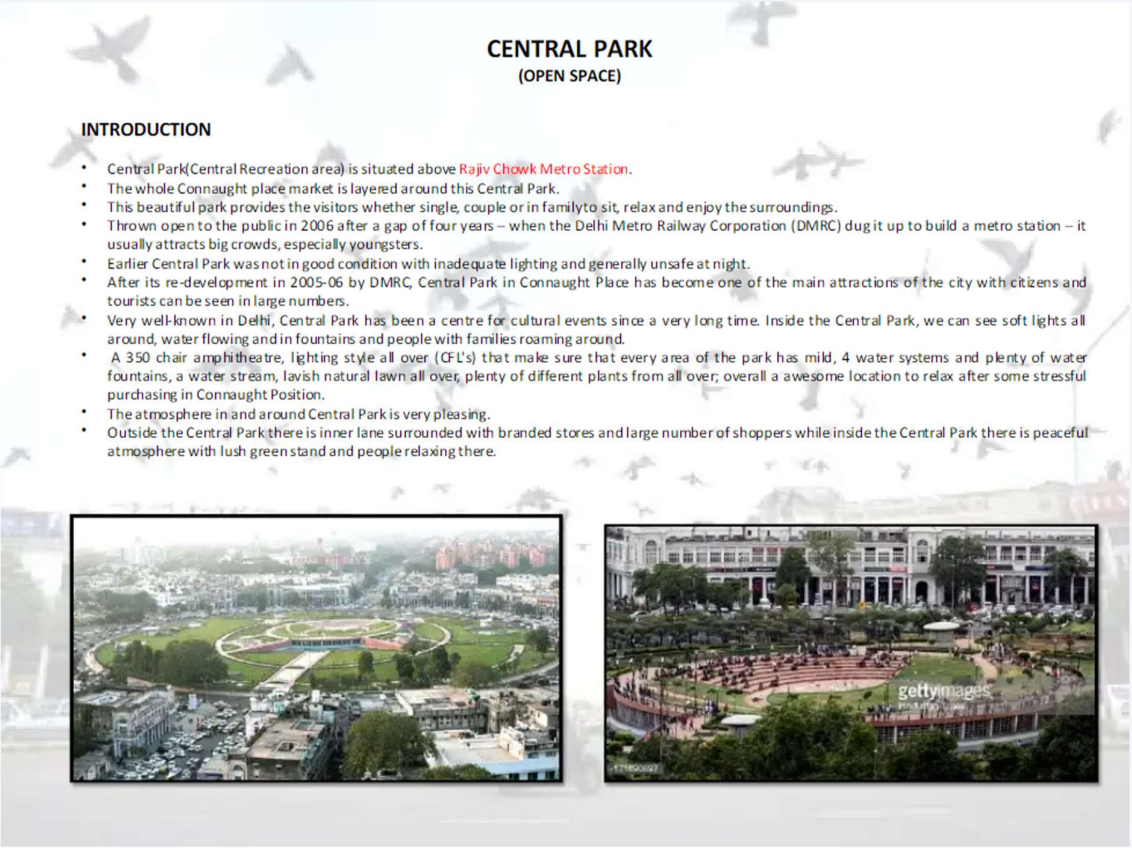


Figure 34 Central Park

Walkability policies that were implemented during Redevelopment of Chandni Chowk, New Delhi;

- **Pedestrianization:**

Connaught Place was transformed into a largely pedestrian-only zone by closing certain inner-circle and outer-circle roads to vehicular traffic. This allowed pedestrians to move around more freely and safely.

- **Widened sidewalks:**

The sidewalks were widened to provide more space for pedestrians, making it easier for people to walk and reducing overcrowding on the footpaths.

- **Improved pedestrian infrastructure:**

The existing sidewalks were refurbished and upgraded with high-quality paving, ensuring a smoother and safer walking surface. Pedestrian amenities such as seating, streetlights, and dustbins were also added to enhance comfort and convenience.

- **Traffic management:**

Various traffic management measures were implemented to regulate vehicular movement and prioritize pedestrian safety. This included the installation of traffic signals, pedestrian crossings, and the enforcement of traffic regulations.

- **Accessibility improvements:**

The redevelopment plan focused on improving accessibility for all individuals, including people with disabilities. Ramps, curb cuts, and tactile paving were introduced to facilitate wheelchair access and assist visually impaired pedestrians.

- **Underground parking:**

As part of the redevelopment, multi-level underground parking facilities were constructed to address the parking needs of visitors. This reduced the presence of vehicles on the surface and helped create a more pedestrian-friendly environment.

- **Green spaces and landscaping:**

The redevelopment plan also emphasized the creation of green spaces and landscaping features to enhance the aesthetic appeal of Connaught Place. Parks, gardens, and tree-lined walkways were introduced, providing a pleasant environment for pedestrians.

5.3.GURGAON CYBER CITY, SKY WALK

WALKABILITY ENHANCING FEATURES:

- Escalators for easy and convenient movement of pedestrians.
- Shading devices for mitigating extreme weather conditions.
- Presence of various plants and shrubs that contribute in the micro climate of the area.
- Convenient walking during night time, due to presence of vertical and horizontal lights.
- Sufficient width of the foot-over bridge.
- Visibility from the street leads to decrease in anti social activities over the bridge.
- Use of sustainable materials to contribute to the environement.
- Presence of lights on the walking area.
- The aesthetics of the bridge encourages users to opt for walking instead of using motorized vehicle.
- Connects various residential blocks increasing accessibility to residential areas & commercial areas.
- Due to the high density flow of traffic, pedestrians could not cross the street earlier, which has become convenient and time saving by the construction of the bridge.
- Decreased road fatalities.

Figure 35Aerial VIew

Figure 36 Sky Walk Images

Figure 37 Lighting Provisions on Sky Walk

5.4.NEW YORK

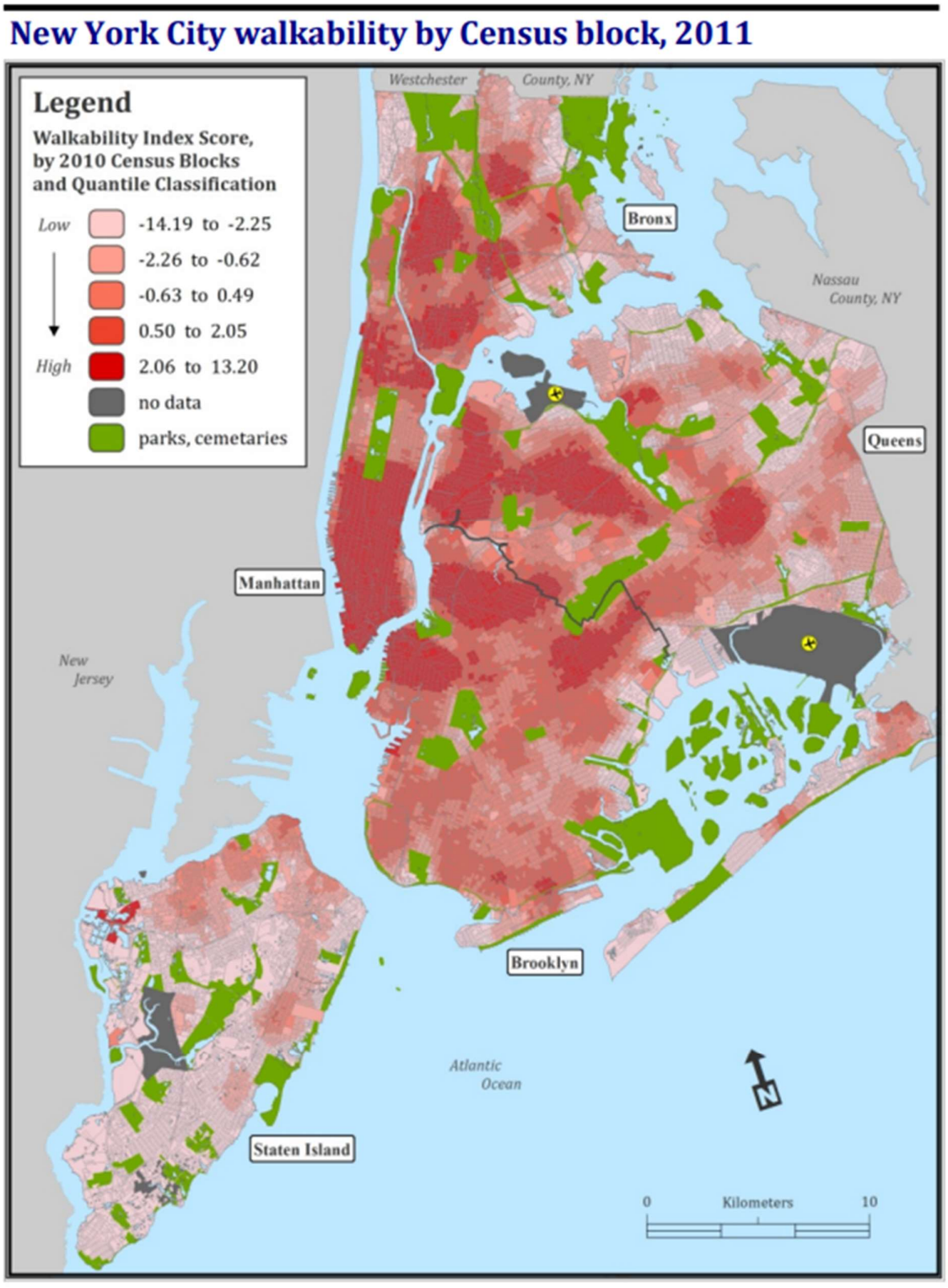


Figure 38 New York City Walkability

Improving neighborhood walkability is one way of promoting physical activity through walking. In 2011, the New York City Department of Health and Mental Hygiene conducted the Physical Activity and Transit (PAT) Survey to understand the patterns of physical activity of adult New Yorkers. Data from the PAT survey were used to evaluate whether neighborhood built environment characteristics are associated with physical activity.

Mean Walkability Index scores of Census blocks, by borough

	(Range -14.19 to 13.19)
New York City	0.05
Brooklyn	0.89
Bronx	0.14
Manhattan	4.23
Queens	-0.58
Staten Island	-3.04

Source: Columbia University Built Environment and Health Research Group

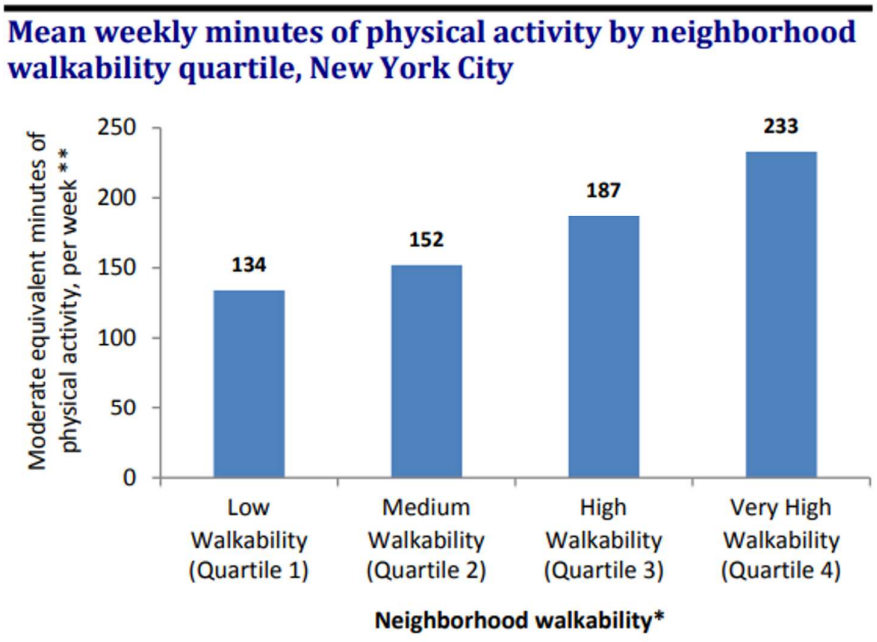


Figure 39Neighborhood Walkability

Neighborhood walkability refers to the extent to which neighborhood design supports walking. This report uses a walkability index developed by Columbia University's Built Environment and Health Research Group to measure neighborhood walkability.

The walkability index includes five components identified in the urban planning literature as promoting walking:

1. Residential density
2. Intersection density
3. Land use mix for five types of land use (residential, office, retail, education and entertainment)
4. Subway stop density
5. The ratio of retail building floor area to retail land area

Walkable neighborhoods have high intersection density; high residential density; a mix of residential, commercial, recreational and institutional land uses; few retail stores set back behind parking lots; and good access to public transit.

- Walk Friendly Communities is a **national recognition program** developed to encourage towns and cities across the U.S. to establish or **recommit to a high priority for supporting safer walking environments**.
- The WFC program recognizes communities that are working to improve a wide range of conditions related to **walking, including safety, mobility, access, and comfort**.

- The WFC assessment tool was developed through the review of relevant programs, guides, and research, collaboration among a diverse group of pedestrian experts, and pilot testing with communities. The development process included the following steps:

i. A review of relevant programs, tools, and research was performed to determine the best **tools and resources for evaluating the walkability of a community.** This review summarized existing community studies, scorings, programs, and community approaches that provide goals and **recognition to cities emphasizing walkable or bike-able communities**.

ii. Two advisory panels were formed to assist in program development. The first panel included ten members of the **Association of Pedestrian and Bicycle Professionals**. The other panel formed was a national review group that **included members representing many different areas of expertise.**

iii. A draft community assessment tool was created to comprehensively evaluate a community's walkability. This rating tool is covers the 5 E's (Engineering, Education, Encouragement, Enforcement, & Evaluation) and **other elements (including planning)** that are needed to help communities set clear goals and plans for achieving those goals. The draft tool provided the foundation for the existing assessment tool.

iv. The assessment tool was then pilot tested in three communities of varying demographics. These communities include a small town **(Cedarburg, WI), a small town with a college and commuter population (Davidson, NC), and a large city (Orlando, FL).** The contributions of these communities helped shape the program. Through their suggestions and feedback, the tool was revised to capture information more accurately and easily.

Figure 40 Walk Friendly Communities

- Walking plays a central role in New York City's transportation system. According to the US Census, two thirds of New York City residents either walk or take transit to work. Fewer than 30 percent of residents in New York City commute by personal vehicle.
- Since first being named a Platinum-level Walk Friendly Communities, New York City DOT has deployed safety counter measures and innovative yet low cost improvements across their 6,300 miles of streets. These improvements are **tracked online** and routinely measured to assess their impact.
- In 2014, New York City was among the first US communities to adopt and implement a **Vision Zero** policy—calling for the elimination of road fatalities. They have been working aggressively to implement their Vision Zero plans, producing annual progress

reports highlighting their achievements. **Maps and data** are provided in public-facing maps and dashboards that allow community members to monitor the City's progress.

- A central part of New York City's Vision Zero program involved the development of a **Pedestrian Safety Action Plan for each of the City's five boroughs**. These plans are tailored to the unique needs and challenges of each borough, laying out a strategy for improving conditions for walking across the City.
- Two other plans released in 2020 – the **Pedestrian Mobility Plan** and the NYC Streets Plan – set a course for continuing improvements for pedestrians and other road users on the City's streets. These plans address needs beyond basic safety and accessibility and to respond equitably to the City's many neighborhoods local needs.
- Left Turn Traffic Calming was pioneered by the New York City DOT and is now a model for addressing severe conflicts stemming from left-turning motor vehicles. The program resulted in a 21 percent decrease in left-turning motor vehicle speeds.
- New York City benefits from the active participation of advocacy organizations and community groups, such as **Transportation Alternatives** and **Families for Safe Streets**. These organizations have elevated road safety as a City priority, and resulting actions have transformed policies on critical issues like speed.
- New York City's Open Streets program launched as a response to the COVID-19 pandemic and evolved into a permanent transformation of key corridors into open space for public use.
- The DOT's **Street Design Manual** guides transportation projects across the City, and lays out a range of design solutions that the City can use to improve safety and walkability. The manual covers topics from roadway geometry to street furniture and lighting.
- New York City has demonstrated a comprehensive approach to improving safety near schools through its **Safe Routes to School** program. The City completes safety projects near schools based on its priority list and has most recently deployed automated speed enforcement to address speeding violations in school zones.

5.5. LONDON

London adopted the Healthy Streets Approach for the following reasons:

- Improving air quality.
- Reducing congestion and help make London's diverse communities greener
- Healthier and more attractive places to live, work, play and do business.

- Improving local environments by providing more space for walking and cycling, and better public spaces where people can interact.
- Prioritizing better and more affordable public transport and safer and more appealing routes for walking and cycling.
- Planning new developments so people can walk or cycle to local shops, schools and workplaces, and have good public transport links for longer journeys.

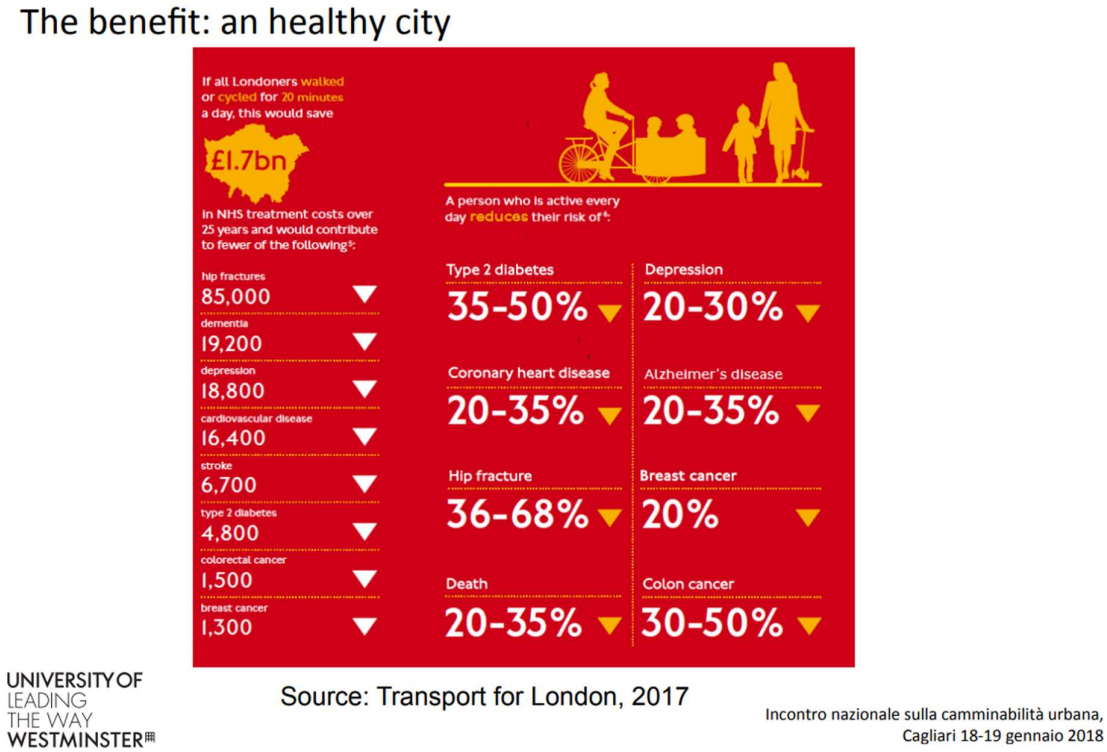


Figure 41 London Healthy City

Re-examining London streets;

- The **transport system has a huge influence on the character of our city**, and the experience of living, working and spending time here.
- London's **streets account for 80 per cent of the city's public space**, yet too often they are dominated by traffic.
- The nature of these places – **public places that belong to us all** – defines what London is like as a city.

The Healthy Streets Approach is a long-term plan for improving Londoners' and visitors' experiences of our streets;

- Street level
- Network level: planning and managing London's transport networks
- Strategic level: policy and planning

Figure 42 Walkability Enhancement

5.6.FLORENCE, ITALY

Figure 43 Florence, Italy

- Firenze is definitely one of the prettiest cities in the world.
- Art and history buffs can rejoice while shoppers will be delighted to walk around the cobblestone streets and bridges to discover local markets and shops.
- It is no secret that Florence often ranks the **highest among most walkable cities** but then, with its historic center being limited to locals with permits, walking is the best option.
- Be delighted to enjoy the open-air museum the city is. Discover the famous cathedral, Santa Maria del Fiore, walk over to Ponte Vecchio to enjoy some shopping, breathe in art from every corner and museum, bite into the most delicious pizzas at the various pizzerias found in the area—the possibilities are endless.

5.7.KOLKATA, INDIA

Figure 44 Kolkata, India

- This might seem like a strange choice but Kolkata is a city where **walking is a way of life for many**.
- While the city has been growing, the **central part of the city is a great walking area**.
- See Victoria Memorial and the Race Course, enjoy the greens of the Maidan, enjoy shopping for clothes and trinkets at the various markets, gorge on local delicacies like puchkas and rolls on the streets, and most definitely take pictures of local life.
- The roads may have traffic but walking and exploring the city will be charming and will give you an insight into the lives of the local people.

Figure 45 Case Study (Comparative Chart)

6. STUDY AREA

6.1.ABOUT

There are various parameters on which the selection of the study area depends, some of them are mentioned below:

- **Mixed use neighborhood**
- **Availability of open spaces for walkability interventions.**
- **Newly developed area would be having ample space for incorporating walkability aspects.**
- **Presence of public transit for convenient mobility of inhabitants.**
- **Presence of open spaces for improvement of quality of life and promoting walkability.**

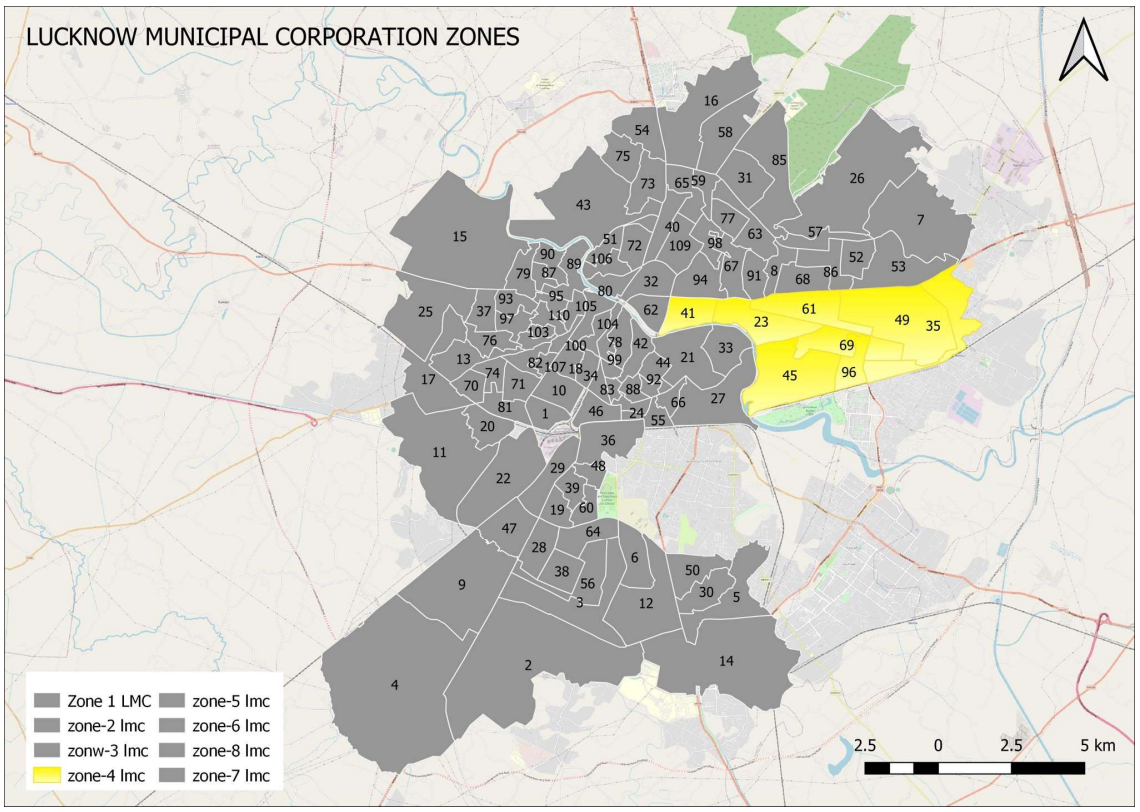


Figure 46 LMC Zones

- I have chosen Gomtinagar as the study area for my master's thesis due to its distinctive characteristics and potential for research in the field of urban planning.
- Situated in Lucknow, the capital city of Uttar Pradesh, India, Gomtinagar stands out as a mixed land-use area that strikes a balance between the historic essence of Lucknow and the rapidly developing new areas of the city. Its unique position presents an excellent opportunity to propose and implement walkability enhancement policies.
- Gomtinagar's mixed land use sets it apart from other areas in Lucknow. Unlike the older parts of the city that predominantly comprise residential neighborhoods or the newly emerging areas dominated by commercial complexes, **Gomtinagar** offers a diverse blend of **residential, commercial, and recreational spaces.** This combination creates an environment where people live, work, and engage in various activities within close proximity, thus fostering a sense of community and reducing dependency on long-distance commuting.

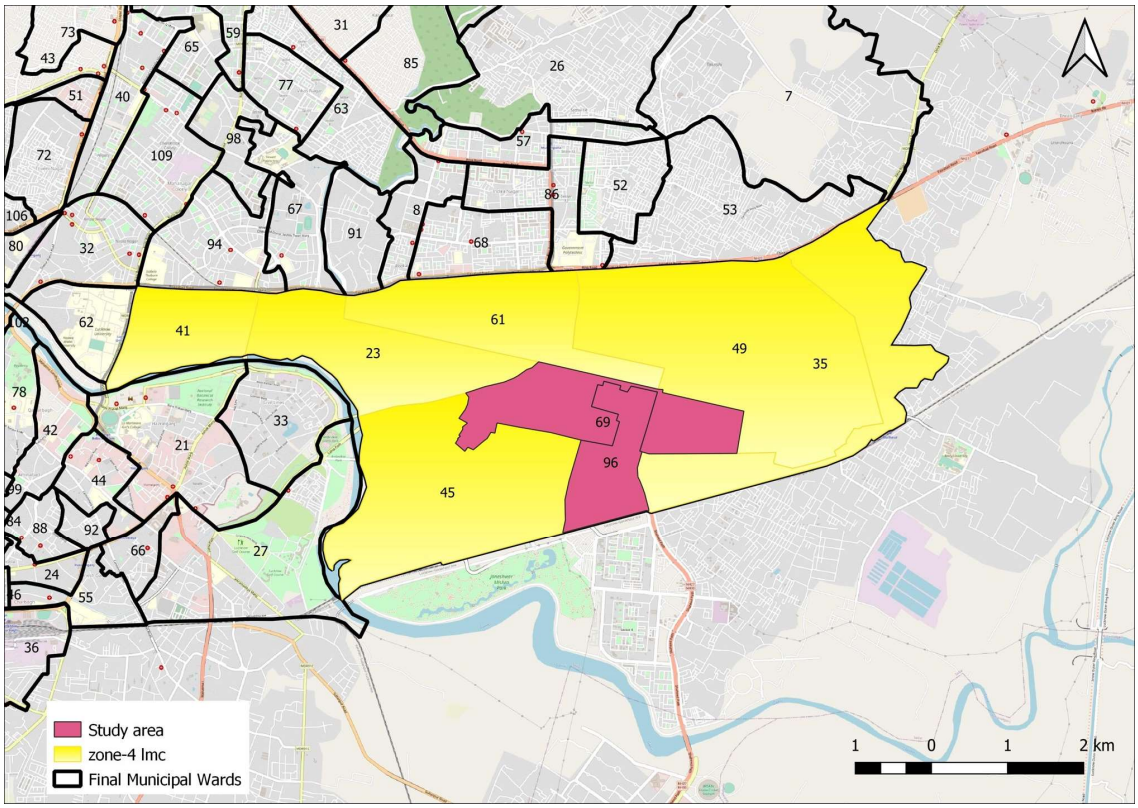


Figure 47 Zone-4

- The intermediate nature of Gomtinagar, being neither too old nor too new, presents an ideal canvas for research. By studying this area, I can gain insights into the dynamics of an evolving urban landscape and analyze the challenges and opportunities it presents. This will enable me to propose effective walkability enhancement policies that cater to the needs of a mixed land-use environment.
- Walkability, the measure of how conducive an area is for pedestrian movement, plays a vital role in fostering sustainable and livable urban spaces. Enhancing walkability in a neighborhood like Gomtinagar has numerous potential benefits, including reducing vehicular congestion, promoting physical activity, improving air quality, and boosting local businesses.
- By identifying the existing walkability issues in Gomtinagar and proposing policy interventions, my thesis aims to contribute to the overall development and livability of the area.
- The proposed walkability enhancement policies can encompass various aspects, such as improving pedestrian infrastructure, enhancing connectivity, ensuring safety, creating green spaces, and promoting mixed-use development. Through comprehensive research and analysis, I intend to identify the specific challenges faced by pedestrians in Gomtinagar and devise tailored strategies to address them effectively.
- By focusing on Gomtinagar, I hope to contribute to the broader field of urban planning and sustainable development. The findings and recommendations from my research can serve as a valuable reference for urban planners, policymakers, and stakeholders interested in creating more walkable and people-friendly neighborhoods. Ultimately, the aim is to create a healthier, more vibrant, and sustainable living environment in Gomtinagar, and potentially inspire similar initiatives in other urban areas facing similar challenges.

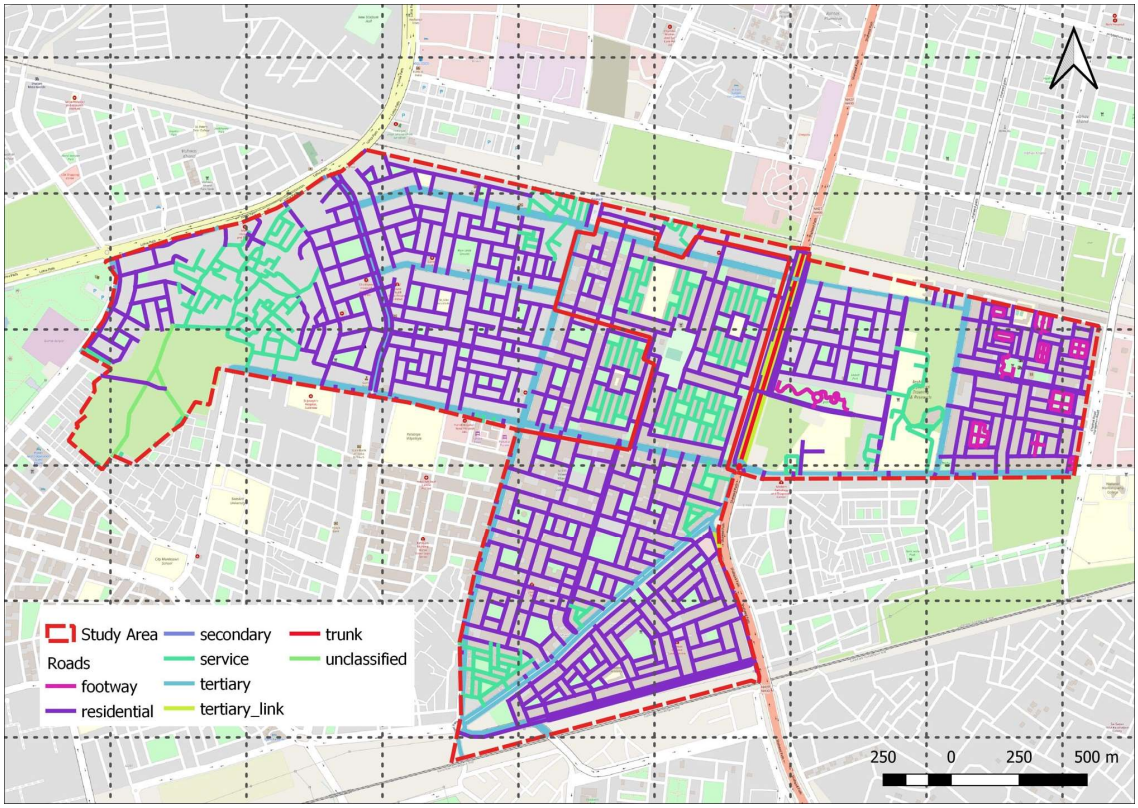


Figure 48 Roads

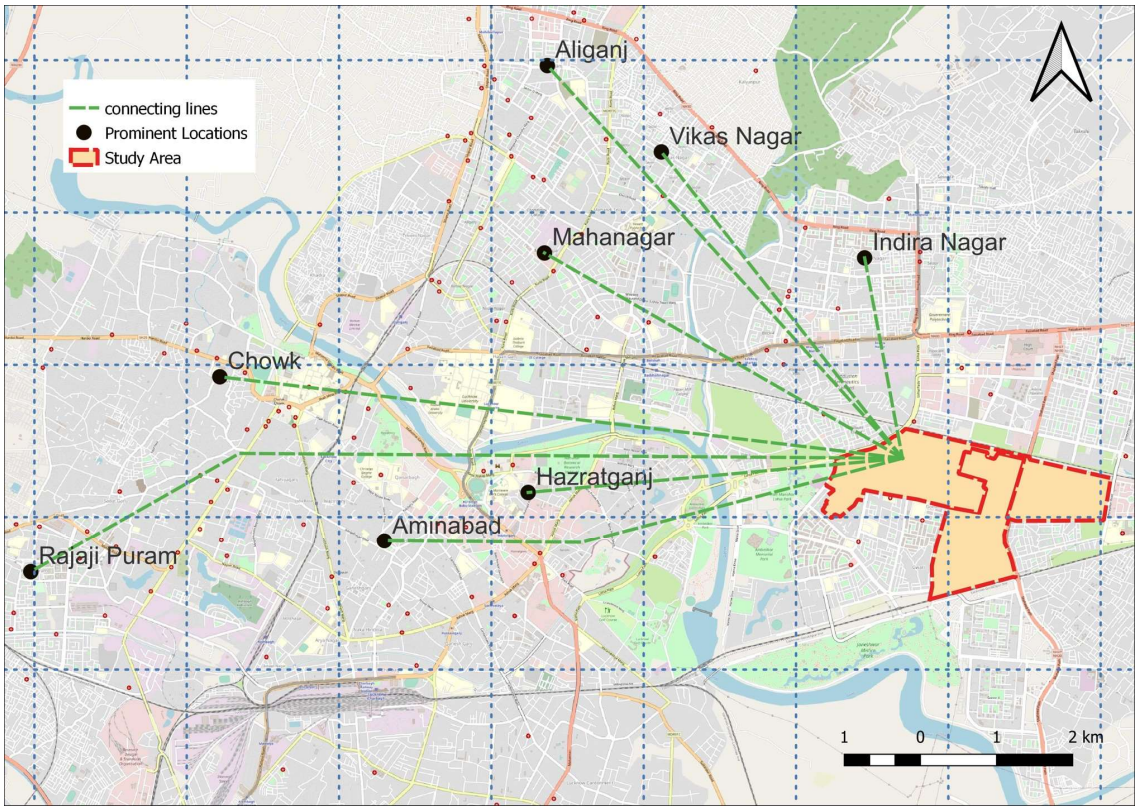


Figure 49 Connectivity to other parts of the city

Gomtinagar, located in Lucknow, is well-connected to various other parts of the city through an extensive transportation network. The neighborhood's strategic location and efficient connectivity have contributed to its popularity and accessibility.

- **Road Network:** Gomtinagar is well-served by a network of well-maintained roads, making it easily accessible from different parts of the city. The **Shaheed Path**, a major arterial road, passes through Gomtinagar and provides seamless connectivity to areas like **Hazratganj, Aliganj, Indira Nagar**, and beyond. The Shaheed Path connects to important roads and highways, such as the **Faizabad Road, Sitapur Road, and Kanpur Road**, enabling smooth travel to different regions of Lucknow and even to other cities.
- **Public Transport:** Gomtinagar is served by an efficient public transport system, including buses and auto-rickshaws**. Lucknow City Transport Services Limited (LCTSL) operates several bus routes** that connect Gomtinagar to various parts of the city. Buses provide an affordable and convenient mode of transportation for daily commuters and visitors alike. Additionally, auto-rickshaws are readily available and offer flexible travel options within and around Gomtinagar.

- **Metro Connectivity:** The Lucknow Metro, which began operations in 2017, has significantly improved connectivity for Gomtinagar residents. The neighborhood is served by two metro stations: **Lekhraj Market and Munshipulia**. These metro stations connect Gomtinagar to key areas like **Hazratganj, Charbagh Railway Station, Alambagh, and the Amausi Airport.** The Lucknow Metro provides a fast and reliable mode of transportation, reducing travel time and enhancing connectivity for residents.
- **Railway Connectivity:** Gomtinagar is located in close proximity to several railway stations, ensuring easy access to rail transportation. The **Gomti Nagar Railway Station**, located within the neighborhood itself, connects Gomtinagar to various parts of Lucknow and neighboring towns. Additionally, the **Charbagh Railway Station, one of the major railway stations in Lucknow**, is just a short distance away.
- **Airport Connectivity:** Gomtinagar benefits from its proximity to the **Chaudhary Charan Singh International Airport, which is approximately 25 kilometers away.** The airport is well-connected to Gomtinagar via road and offers domestic and international flights, providing convenient air travel options for residents and visitors.

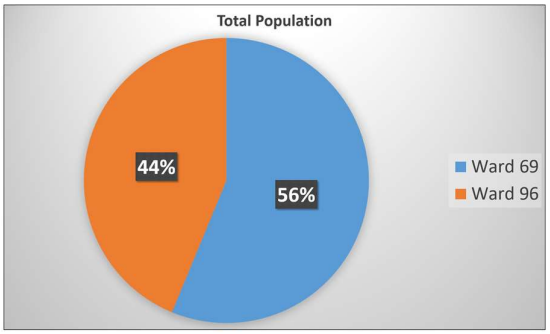
Overall, Gomtinagar enjoys excellent connectivity to different parts of Lucknow through its well-developed road network, public transport system, metro services, railway stations, and airport access. This robust connectivity ensures that residents and visitors can easily commute to and from Gomtinagar, fostering accessibility, economic growth, and the neighborhood's prominence within the city.

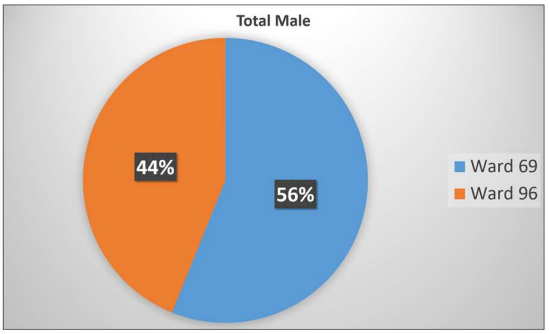
6.2.DEMOGRAPHICS

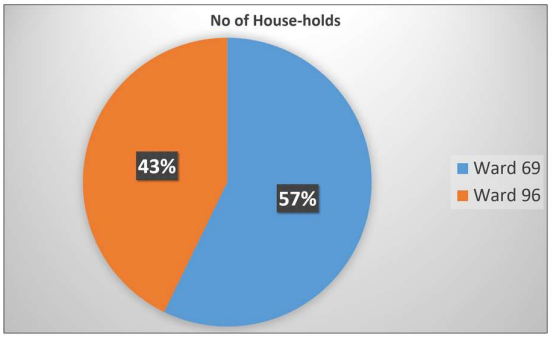
Table 5 Demographics

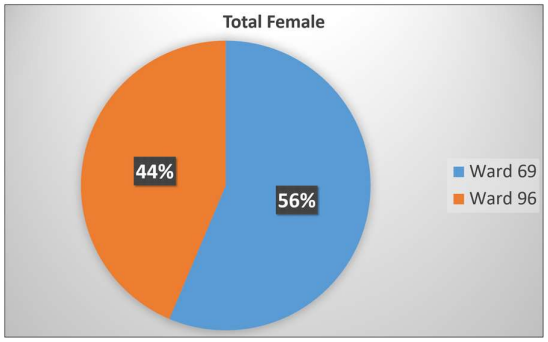
State	District	Subdistt	Ward	Level	Name	TRU	No_HH	TOT_P	TOT_M	TOT_F
09	157	00821	0069	WARD	Lucknow (M Corp.) WARD NO.-0069	Urban	4794	24770	12727	12043
09	157	00821	0096	WARD	Lucknow (M Corp.) WARD NO.-0096	Urban	3586	19274	9950	9324

Table 6 Graphs Demographics









6.3.HISTORY OF GOMTINAGAR

- The history of Gomtinagar, an esteemed area in Lucknow, dates back to the mid-20th century when the development of this neighborhood began. **Prior to its establishment, the region was primarily agricultural land situated on the eastern bank of the Gomti River.**
- The transformation of Gomtinagar started in the **1970s** when the Uttar Pradesh Housing Board (UPHB) initiated a planned development project in response to the growing population and urbanization in Lucknow. **The area was chosen for its strategic location, offering ample space for expansion and the potential to cater to the city's increasing housing demands.**
- The development of Gomtinagar occurred in several stages over the years.
- In the initial phase, the **Uttar Pradesh Housing Board undertook the task of acquiring land, planning the layout, and providing basic infrastructure such as roads, drainage systems, and electricity.**

- The construction of residential colonies commenced, offering affordable housing options to the residents of Lucknow.
- As Gomtinagar's popularity grew, private developers and real estate companies started investing in the area, leading to further expansion and the introduction of modern amenities. The neighborhood witnessed the establishment of commercial complexes, shopping centers, educational institutions, healthcare facilities, and recreational spaces, transforming it into a self-sufficient urban center.
- The 1990s **marked a significant turning point in Gomtinagar's development.** The construction of the iconic Gomti Nagar Railway Station enhanced connectivity, facilitating easy access for residents and fostering economic growth in the area. Additionally, the construction of the **Shaheed Path**, **a major arterial road, further improved accessibility and connectivity to other parts of the city.**
- Gomtinagar's significance in Lucknow lies in its emergence as a prime residential and commercial destination. The area's well-planned layout, modern infrastructure, and diverse land use have attracted people from various socio-economic backgrounds.
- It has become a preferred choice for residents seeking a comfortable and convenient urban lifestyle.
- The neighborhood's strategic location has also contributed to its prominence. Gomtinagar is **situated in close proximity to the city center, government offices, commercial hubs, and major transportation routes**. This advantageous positioning has made it an ideal place for businesses, leading to the establishment of corporate offices, commercial complexes, and shopping centers.
- Furthermore, Gomtinagar's role in Lucknow's development goes beyond its residential and commercial aspects. **The neighborhood is known for its green spaces, parks, and recreational areas, providing residents with opportunities for leisure, physical activity, and community engagement. Its well-maintained public spaces contribute to the city's overall aesthetic appeal and offer a respite from the bustling urban environment.**

In conclusion, **Gomtinagar's journey** from **agricultural land** to a thriving urban center showcases the city's dynamic growth and development. Its establishment in the 1970s, subsequent stages of expansion, and its significance as a mixed-use area have made it a vital part of Lucknow's landscape. Today, **Gomtinagar stands as a testament to urban planning and development**, offering a blend of residential, commercial, and recreational spaces that cater to the needs and aspirations of its residents.

Figure 50 Gomtinagar Evolution

6.4.QUESYIONNAIRE SURVEY

7. CONCLUSION

- It should be noted that this research explored the potential of neighbourhood features in determining walkability.
- It especially focused on not only the physical environment but also social and safety as factors influencing walkability in neighbourhoods.
- By applying the model to Lucknow city and selecting Gomtinagar as a case study it will be possible to compare results and draw a more comprehensive conclusion with higher validity.
- To evaluate walkability in neighbourhoods, walkability indexes (population density, mixed use and connectivity) were adopted as dependent variables, while physical, social and safety aspects of neighbourhoods were selected as independent variables.
- All concepts were measured by written questionnaire survey and facilitated in the development of the conceptual framework, based on which three important relations were observed:

1. The first relation explores the concept of walkability and neighbourhood's factors influence walkability focused on physical aspects, found a significant association between accessibility and walkability. This finding implies that the only important factor for transport purposes is a short distance to basic amenities. Although other physical aspects such as quality of sidewalks, aesthetic design and greenery are significant as well, these factors are related to walking purpose of leisure and exercise. Therefore, the research found a correlation between these factors and sense of comfort and sense of interest which are related to people's feelings and perceptions and subjectively affect walkability.
2. The second relation investigates the association between social aspects of neighbourhoods and walkability. Two important factors were identified as significant and influence the walkability. Social interactions and liveliness of streets were recognized as important factors for this measurement. These objective social aspects affect subjective factors include a sense of place and sense of belonging.
3. The third and final relation analyzed the relation between safety aspects of neighborhoods and walkability. The sense of security and sense of safety was identified as important factors influence walkability.

8. RESEARCH FINDINGS

How do physical, social and safety aspects influence walkability of the neighbourhood in Gomtinagar, Lucknow?

People's walking behaviour depends on their interactions with their living environments. The walking decision is affected not only by individual factors but also by the perception of the physical and social environment. First, this study indicates that the quality of the built environment and physical characteristics of a neighbourhood affect social capitals and safety security perceptions of residents in that neighbourhood. In one hand, Mixed-use designs bring people together for a variety of human activities and create opportunities for people to interact, which provides increased social contact and sense of community. The physical attractiveness of the neighbourhood also has been found to strengthen social cohesion. Therefore, the way that we design our environment has a strong relationship with social interactions and liveliness of the neighbourhoods. Residents living in a mixed-use with high accessibility and well-designed neighbourhoods are more likely to know their neighbours, socializing and trust them. On the other hand, according to (Clark, Scott 2016) lack of security and safety is noticed as an important barrier to walking. Thus, streets with high visibility and adequate light will more likely to increase the sense of security and safety of the residents and motivate them to walk.

To what extent does physical aspects influence the walkability of neighbourhood in Gomtinagar, Lucknow?

- Although socio-economic factors and individual superiority has major influence on walkability, the built environment has also a significant effect on people's walking. (Lee & Moudon 2006)
- Survey results illustrate that due to a large number of respondents that use walking for means of transport, the only important factor was the short distance to diverse land uses such as workplaces, supermarkets, schools and public transports which considered as mixed-use and accessibility.
- As Litman (2011) asserts that walkability refers to the quality of the urban environment which is comfortable, accessible, permeable and well-connected for pedestrians.
- Although, it has not being found qualitative factors of the built environment such as sidewalk conditions, aesthetic design and presence of green areas as significant factors affect walkability, the correlation between these factors and perceptions of people for

a sense of comfort and sense of interest shows that for those people who walk for recreation and exercise, these qualities of the environment are significant as well.

- Therefore, the higher integration of streets means the more presence of people and the more walkable streets which are in line with Hillier (2010).

To what extent does social aspects influence the walkability of neighbourhood in Gomtinagar, Lucknow?

- As Lo (2009) stated walkability is more than physical activity to health term in a physical environment, it also includes "social environment", "perception of the area" and also "comfort of pedestrian".
- Streets are considered public places that provide a social environment for people to interact. Therefore, liveable streets encourage more social interactions among people.
- The level of the liveliness of streets is a significant factor for motivating people to walk (Jane Jacob, 1991). The survey results show that two factors of social interaction and liveliness of streets positively affect the walkability. These factors correlate with population density.
- This implies that compact neighbourhoods with higher population density have higher social interactions among people. This mutual relationship increases the vitality of streets which increase the tendency of people to walk.
- In contrast, in neighbourhoods with lower population density and sprawl characteristics, people have less tendency to walk and empty streets discourage people to walk which is in line with Jane Jacob. It is worth to be considered that in neighbourhoods with higher social interaction, people have more sense of place and can more trust each other.
- A walkable community gives a unique identity to the built environment and make a sense of belonging for the residents and the users as well. Ultimately, the results illustrate that higher participation in community issues, increase the sense of belonging to the community.

To what extent does safety aspects influence the walkability of neighbourhood in Gomtinagar, Lucknow?

- Empirical findings state that the safety aspects of neighbourhood are the most fundamental need of pedestrians that influence the walkability.
- Fear of crime or fear of accidents is considered as significant limitations for walking.

- The negative association between crime reported on the sense of security and quality of traffic lights on the sense of safety indicate that higher sense of security and safety will increase the walkability of neighbourhoods.
- However, the presence of people in the neighbourhood increases social surveillance that leads to increase sense of security.
- In these neighbourhoods, there is no need for the presence of police because people feel secure. As Jane Jacob deemed producing the vitality and "eyes on the street" are the essential issues for the cities (Jacobs, 1991).
- These results are in line with previous studies from Jane Jacobs, when natural surveillance (eyes on the street) disappears, crime, violence and vandalism increase.
- Nevertheless, results indicate that neighbourhoods with wider streets have faster traffic speed, which decreases the sense of safety. So the narrower streets are more pedestrian-friendly and walkable (Southworth and Ben-Joseph, 2003).

9. RECOMMENDATIONS

- This study is an initial effort to clarify the factors influencing walkability in neighbourhoods.
- The main result of this research is that not only the physical environment directly affects the walkability of neighbourhoods, but also social aspects and safety perceptions influence the walkability.
- This result adds to the knowledge of a growing number of studies which have illustrated the impacts of various characteristics of the physical environment on walkability.
- Meanwhile, the results of questionnaires demonstrate that objective variables of all features of neighbourhoods influence the subjective variables.
- For instance, in term of physical aspects, the accessibility and sidewalk conditions affect the sense of comfortability and aesthetic design and green spaces increase the sense of interests in residents.
- Furthermore, the social interaction and liveliness of streets and the presence of public spaces in neighbourhoods create the sense of place in people and higher participation in issues of neighbourhood lead to the sense of belonging to the community.

- On the other hand, what influences the sense of security of residence are the crime report, presence of adequate light and visibility of the streets and for increasing the sense of safety, the quality of traffic lights and intersections are the most important factors.
- As this research is an effort to explore the influence of different characteristics of neighbourhoods on walkability, the following recommendations reflect largely on the need for further study to be undertaken to cover other indices that may also influence the concept of walkability.
- First, because walkability is one of the crucial factors in smart cities and the situation of Gomtinagar, Lucknow as the upcoming mixed use hub for future.
- Although, this city has invested a lot in the objective aspects of the built environment and safety by allocating road and footprint paths, slowing traffic speeds and improving the quality of public spaces at an impressive scale to increase the quality of life, happiness and health, there are some neighbourhoods in the city that needs more improvement in social lives and security aspects.
- This research is a small scale study with a limited number of respondents (40 for each neighbourhood) conducted for one such neighbourhood of Lucknow City which supposed a walkable city.
- Therefore, the results are not applicable to other neighbourhoods nor to the entire city of Lucknow.
- For certain results, it is crucial to conduct a study on all the neighbourhoods in lucknow as well as another city with different context and different level of walkability. for example, similar research is recommended to be conducted in developing cities.
- Future research needs to look into assessing the influence of socio-economic status on walkability and the association of these factors on the gentrification of the neighbourhoods.
- The results of the survey show that people in neighbourhoods with higher income population and unmixed ethnic groups show less motivation in walking.
- In these neighbourhoods, higher house prices provide a high demand for those people with higher income.
- Future research should also try to understand differences in perception of security and safety, related to walkability among different ages and genders and find the most significant factors associated with this issue.

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