

April 2019

Making Connaught Place (New Delhi, India) Bicycle And Pedestrian Friendly

Surabhi Jain

Follow this and additional works at: https://digitalcommons.lsu.edu/gradschool_theses



Part of the [Landscape Architecture Commons](#)

Recommended Citation

Jain, Surabhi, "Making Connaught Place (New Delhi, India) Bicycle And Pedestrian Friendly" (2019). *LSU Master's Theses*. 4917.

https://digitalcommons.lsu.edu/gradschool_theses/4917

This Thesis is brought to you for free and open access by the Graduate School at LSU Digital Commons. It has been accepted for inclusion in LSU Master's Theses by an authorized graduate school editor of LSU Digital Commons. For more information, please contact gradetd@lsu.edu.

MAKING CONNAUGHT PLACE (NEW DELHI, INDIA) BICYCLE AND PEDESTRIAN FRIENDLY

A Thesis

Submitted to the Graduate Faculty of the
Louisiana State University and
Agriculture and Mechanical College
In partial fulfillment of the
requirements for the degree of
Master of Landscape Architecture

In

The School of Landscape Architecture

by

Surabhi Jain

B. Architecture, Rajasthan Technical University, Aayojan School of Architecture, 2015
May 2019

ACKNOWLEDGEMENTS

Towards the end of thesis project, I would like to express my gratitude to all the people who have helped me in completing my thesis successfully. First and foremost, I would like to thank my thesis committee chair Professor Bruce Sharky for motivating me to achieve higher and giving me the right direction when I was going wrong. Having also taken two other classes with him before, I have had a great learning experience with him as my teacher and guide. I am grateful to Professor Lake Douglas for guiding our class towards developing our thesis ideas during thesis preparation classes and further providing invaluable inputs as my thesis committee member during this whole design process. I would like to thank Professor Traci Birch for helping me out at different stages of this thesis project. I am thankful to the all the faculty members of Robert Reich School of Landscape Architecture for giving me priceless education in Landscape Architecture.

I have been very lucky to have my parents by my side with their immense support and help throughout this project. Taking up a project in India, from Louisiana State University has been possible because of their continuous help and encouragement. Without their support and help, I would not have been able to successfully complete this project.

I am also grateful to Ashwani Rai for constant support during this project and my friends at LSU and India for being available to me whenever I wanted to discuss nitty-gritties of the project and knowing if I was heading in the right direction.

Table of Contents

Acknowledgements.....	ii
List of Tables.....	iv
List of Figures.....	v
Abstract.....	viii
Chapter 1. Introduction.....	1
1.1. Inspiration for this project.....	8
1.2. The project site- Connaught Place	10
1.3. Site Selection criterion- Why New Delhi, Connaught Place?.....	13
1.4. Previous work done at Connaught Place	15
1.5. Scope of project.....	16
1.6. Problems, Issues and Opportunities.....	17
1.7. Objectives.....	19
Notes.....	20
Chapter 2. Literature Review.....	21
2.1. History, Culture and People – Connaught Place and New Delhi.....	21
2.2. Pedestrian and bicycle friendly paths- Complete Streets.....	27
2.3. NACTO guidelines.....	30
Notes.....	33
Chapter 3. Methodology.....	34
3.1. Analyzing the site- Mapping, site visits and observations.....	35
3.2. Precedent studies.....	45
Chapter 4. Design Proposal.....	53
4.1. Proposal highlights.....	42
Chapter 5. Conclusion.....	57
5.1. Future prospects.....	57
Bibliography.....	58
Vita.....	61

LIST OF TABLES

Table 3.1. Conclusions of site observation data.....	44
Table 3.2. Traffic circle precedent studies.....	45

LIST OF FIGURES

Figure 1.1. Delhi location (Source: Maps of India).....	1
Figure 1.2. Connaught Place (Central park)- pollution. Credits: Author.....	2
Figure 1.3. Connaught Place -pollution. Credits: Author.....	2
Figure 1.4. Connaught Place- vehicular congestion. Credits: Author.....	2
Figure 1.5. Connaught Place- vehicular congestion. Credits: Author.....	2
Figure 1.6. Connaught Place- “Raahgiri” Day.....	4
Figure 1.7. Pedestrian walking on a regular basis.....	4
Figure 1.8. MG Road- Sikkim. Source: Alvexo lifestyle- Sikkim cleanest state in India...5	
Figure 1.9. MG Road- Sikkim. Source: Alvexo lifestyle- Sikkim cleanest state in India...5	
Figure 1.10. Bangalore street photo (presence of sidewalk, good surroundings).....	8
Figure 1.11. Bangalore street photo (presence of sidewalk, shade).....	8
Figure 1.12. Layout of Connaught Place.....	10
Figure 1.13. Weekend street market in Connaught Place.....	10
Figure 1.14. Looking at Regal cinemas building at Connaught Place.....	10
Figure 1.15. Vehicles on road (i to v)	12
Figure 1.16. CBRE’s list of most expensive business spaces to rent around the world.13	
Figure 1.17. Delhi Metro map. Connaught place highlighted in red point.....	14
Figure 1.18. Perspective rendering of DUAC proposal.....	15
Figure 1.19. Scope of the project: Outer and Inner circle.....	16
Figure 1.20. No sitting spaces. Credits: Author.....	17
Figure 1.21. Parking encroached upon by vehicles. Credits: Author.....	18
Figure 1.22. Congestion on roads. Credits: Author.....	18
Figure 1.23. Pedestrians crossing the road, no crosswalks. Credits: Author.....	18

Figure 1.24. Narrow and insufficient parking space. Credits: Author.....	19
Figure 1.25. Middle circle traffic. Credits: Author.....	19
Figure 2.1. Map showing the shift of capital from Kolkata to Delhi in 1911.....	21
Figure 2.2. Map showing Old Delhi and site for New Delhi (1924).....	21
Figure 2.3. Viceroy's House views to Moghul mosque and Old Fort.....	22
Figure 2.4. Triangular spatial organization Viceroy's House- (S-W), India Gate- (S-E) Connaught Place- (N).....	23
Figure 2.5. Old photo of Connaught Place.....	25
Figure 2.6. Old photo of Connaught Place.....	25
Figure 2.7. Historical development- Delhi.....	26
Figure 2.8. Public comfort levels for paths with and without physical barriers.....	30
Figure 2.9. Bicycle boxes.....	31
Figure 2.10. Intersection design guideline.....	31
Figure 2.11. Visibility for 10-20 ft at corners.....	31
Figure 2.12. Intersection example- existing situation(i) and after design situation(ii).....	32
Figure 2.13. Organization of street- existing confusing situation (i) and situation after improvements (ii).	32
Figure 3.1. Thesis Methodology diagram.....	34
Figure 3.2. Parking spaces and building footprint- Connaught Place.....	36
Figure 3.3. "SmartBike" a bicycle rental program established by government at Connaught Place.	36
Figure 3.4. Paved surface vs greenery.....	37
Figure 3.5. Topography.....	37
Figure 3.6. Temperature data for Delhi.....	38
Figure 3.7. Average monthly rainfall.....	38

Figure 3.8. Figure ground.....	38
Figure 3.9. Land Use.....	39
Figure 3.10. Connaught Place- site observation intersections.....	40
Figure 3.11. Graph of number of vehicles passing through point A in a minute.....	41
Figure 3.12. Graph of number of vehicles passing through point B in a minute.....	41
Figure 3.13. Graph of number of vehicles passing through point C in a minute.....	42
Figure 3.14. Graph of number of vehicles passing through point D in a minute.....	42
Figure 3.15. Income section zones in Delhi.....	43
Figure 3.16. Bike friendly design elements- (i) to (vii).....	47
Figure 3.17. Times Square before and after street transformation.....	49
Figure 3.18. Before and After street transformation in Stroget, Copenhagen.....	50
Figure 3.19. Before and After street transformation in Antwerp, Belgium.....	50
Figure 3.20. Before and After street transformation in Vienna, Austria- (i) and (ii).....	51
Figure 4.1. Existing condition.....	53
Figure 4.2. Location where the section drawing is taken.....	53
Figure 4.3. Before and After street design.....	54
Figure 4.4. Existing condition at Parking lot (i), After design improvements rendering (ii).....	55
Figure 4.5. Existing condition at Middle circle (i), After street design improvements rendering (ii).....	56

ABSTRACT

India is a place where people have walked miles since ancient times for basic day-to-day needs like water, food, education, shopping, entertainment, tourism, and shelter. However, the rapid growth in population and urbanization is changing the way people live and commute. The urban sprawl is pushing people to the outskirts of the city core because of which personal automobiles is becoming the main source of transportation. This is leading to congestion on roads for most times of the day. The objective of this thesis is to explore and examine how to improve pedestrian and bicycle facilities in a prominent commercial and retail center in New Delhi, India and to identify design strategies to alleviate the problems of air pollution and traffic congestion. Due to rapid urbanization and globalization, the number of motorized vehicles between 2008 and 2018 has increased by 17% in New Delhi (According to Delhi Traffic Police). The population rise within the same time has been 55% as per the census of India. Government organizations have identified polluting emissions from vehicles as a dominant source of high air pollution levels in Delhi. There is an urgent need to plan for non-motorized transport (NMT) as pedestrian facilities and green infrastructure can help to enhance the environment of the capital city. The concern is less about the willingness of people to use NMT and more about the absence of proper facilities. Connaught Place in New Delhi is a good example because increase in automobile traffic has adversely impacted the physical environment around the area. It is a major business and economic hub of great historical importance for the city. This thesis aims to propose a planned layout to accommodate the users and make the busy circle pedestrian and bicycle friendly.

CHAPTER 1. INTRODUCTION



Figure 1.1. Delhi location (Source: Maps of India)

New Delhi the capital city of India is located in North India (Figure 1.1). The city is witnessing rapid growth in population from 1980s onwards. Since then, the city has struggled to timely provide its people with proper infrastructural facilities. For example, the metro system for commuting within the city of Delhi opened as late as 2002, when already the population pressure was beyond control. Further, by the time infrastructure is created for, say X number of users, the actual number of users rises to many times of X . The inability to timely provide such infrastructure to people, reduces the positive impact that these facilities have on city. After installation of the metro rail transit system, there was some relief in traffic congestion on roads, but the use of cars still increased because affluent members of the upper middle class own multiple cars per family. Once again, the problem of traffic congestion on roads has built up and is reaching a tipping point. We

need to be one step ahead to provide solutions for such city problems rather than catching up and lagging behind.

The air quality in the capital city Delhi (as well as many other cities in India) has degraded substantially due to an increased number of vehicles on the roads, owned by the city's comparatively smaller but very affluent population. The Central Pollution Control Board (CPCB) and the National Environmental Engineering Research Institute (NEERI) have identified polluting emissions from vehicles as a dominant source of high air pollution levels in Delhi.¹ CSE (Center for Science and Environment) conducted a research on 13 arterial Delhi roads over a period of 1 year. They found that roads in Delhi were congested



Figure 1.2. Connaught Place (Central park)- pollution. Credits: Author



Figure 1.3. Connaught Place -pollution. Credits: Author



Figure 1.4. Connaught Place- vehicular congestion. Credits: Author



Figure 1.5. Connaught Place- vehicular congestion. Credits: Author

throughout the day and that there was no such difference between peak and non-peak hours. The research concludes that air pollution increases with congestion. When average morning peak hour speed of 17 miles/hour drops to 15.5 miles/hour (figures converted from kilometer per hour to miles per hour) during evening peak because of congestion, nitrogen dioxide levels increase by 38 per cent.² Another problem that arises with heavy dependence on vehicles is the road fatalities. Statistics indicate that 35% of road fatalities involve pedestrians in India.³ As per the numbers by Delhi Traffic Police, 1604 people were killed, and 1510 people were injured in Delhi in the year 2018.⁴

Some measures have been tried to bring changes and reduce air pollution in Delhi. For example, permission to use odd and even car number plates on alternate days, following the Beijing example. Because of political reasons, this reform was heavily berated, and ultimately failed because people ended up buying two cars – one with odd and other with even number plates. As the air pollution levels are increasing, and the emission from the vehicles is a major cause, there is an urgent need to plan for non-motorized transport in Delhi to reduce the dependency on automobiles for everyday commute. Because of negligence to provide wholistic solution, these issues have become serious and need to be acted upon immediately.

Commercial markets are a typical transit problem scenario in Delhi. Most of them struggle to be safe and comfortable zone for pedestrians. Markets such as Khan Market, Sarojini Nagar Market and Karol Bagh Market see a huge daily foot traffic but, are a challenge to navigate through for pedestrians and vehicles. Connaught Place is one such huge urban commercial center which is visited by thousands of people every day for work, shopping, visiting, and hanging out with friends and by the employees who run the retail

spaces in the circle. Connaught Place is an attractive piece of architecture and is an expansive urban recreational space that was built in 1933 when the British moved their capital from Kolkata to New Delhi in 1911. More information on Connaught Place is given further in the report. Over the years, with increasing traffic congestion, Connaught Place has transformed from being an urban open leisure space to merely a vehicular commuting space. Several steps to restrict entry of cars in few places and imposing penalties on parking on roads, have been taken in several market places in India. Limiting the use of cars will only provide a short-term solution to the problem, a long-term sustainable solution needs to be developed. Proper pedestrian and bicycle-friendly infrastructure is required to encourage people to leave their cars behind and commute by using public modes of transportation. There are several reasons why such infrastructure is a beneficial strategy.



Figure 1.6. Connaught Place- “Raahgiri” Day
Source: <https://lbb.in/delhi/a-day-spent-at-raahgiri/>



Figure 1.7. Pedestrian walking on a regular basis. Source: Shutterstock video clip Indian Street Mumbai November, 14, 2014.

Firstly, people have walked in India since ancient times for their basic needs such as water, food, shelter, education, entertainment and recreation, but, because of increasing usage of vehicles, pedestrians are being pushed out of the urban picture. Programs such as “Raahgiri Day”, a day when selected streets in Delhi, and other cities

in India, become pedestrian only zones, have become a famous fun community activity where people take to the streets to participate in a number of planned programs. Other city roads in India such as MG Road in Sikkim in India are pedestrian streets where automobiles are not allowed. These street programs and their results help to establish importance of pedestrians in urban realm and encourage the idea of pedestrianization of streets. However, instead of exclusive pedestrians' day or pedestrian streets, the streets should be designed to accommodate each kind of user to offer everybody a positive urban experience. A concept of shared "complete" street is still missing from the conversation. Being a famous destination for foreigners and local visitors in Delhi, Connaught Place offers a good opportunity to develop a strong pedestrian and bicycle friendly infrastructure that will help alleviate the traffic problems and degradation of air quality



Figure 1.8. MG Road- Sikkim.
Source: Alvexo lifestyle- Sikkim cleanest state in India



Figure 1.9. MG Road- Sikkim.
Source: Alvexo lifestyle- Sikkim cleanest state in India

Secondly, with the emergence of new millennial population and changing paradigms, non-motorized modes of transportation are becoming more desirable among members of the younger generation, because they are cheaper and quicker way to get to places. A recent research by Morgan Stanley indicated that the Indian millennial population (400 million) is the largest in the world.⁵ Millennial is the term that is used to

refer to population born between 1983 and 2000 (age 18 to 35) and are currently a major working force of the country. Millennials are different from the previous generation in their lifestyle and thinking. They are more inclined towards sharing assets than owning them, they thrive on technology and a growing trend towards well-being and social good. About 36% of Indian millennials have fitness apps installed on their phones.⁶ As a result of the mindset of sharing assets, the usage of taxi sharing service is more common than personal automobiles. Hence to keep up with the needs of this emerging population who is less dependent on personal automobiles, provision of pedestrian and bicycle friendly facilities is a logical solution.

Thirdly, the social strata of New Delhi is such that a large segment of the population still does not own cars, and, as a consequence these people are heavily dependent on public modes of transportation for their daily commutes. Pew research center is a not-for-profit research organization that informs the public about the issues and trends shaping the world. They conduct public opinion polling, demographic research, content analysis and other data-driven social science research.⁷ According to their research on car ownership and bicycle ownership posted in 2015, only 6% of households in India own cars whereas 67% own bicycles. In United States, 88% of households own cars and only 53% of households own bicycles. In Europe equal number of households own cars and bicycles. As this research indicates that the number households that own bicycles in India are much more than the number of households that own cars, it becomes more imperative that Indian cities need to provide proper bicycle and pedestrian friendly infrastructure to its citizens. Other countries that have such high number of bicycle users, are providing with such facilities. A concept of complete shared streets that allows different modes of

transportation to coexist is a beneficial strategy to accommodate different users. This thesis explores of ways to incorporate complete streets concepts within an already established open urban space.

While people in major cities throughout the world are advocating for provision of more pedestrian friendly spaces, very few steps have been taken to address the issue in Indian cities. We, in India, need to be actively involved with the worldwide trend of providing bicycle and pedestrian greenways for the public, for environmental-friendly and sustainable growth of our cities. This thesis can serve as a starting point for addressing these problems and suggesting solutions. The model proposed at Connaught Place can be replicated in other urban spaces thereby creating a uniform transportation network system throughout the city.

The thesis is structured to allow, the reader to understand an unfamiliar site, concepts associated to pedestrianization and bicycle friendly infrastructure and the design proposal. The first chapter introduces the topic in depth. It narrates the inspiration behind this thesis project, outlines the main features of Connaught Place. This chapter also provides a rationale for choosing such this site for study and defines the scope, issues and objectives of this project. The second chapter is the literature review and introduces the capital city of New Delhi and Connaught Place, it's history, culture and people to the reader and discusses the concepts associated with pedestrian and bicycle-friendly infrastructure, namely. The chapter also lists various guidelines by NACTO (National Association of City Transportation Officials) for street design. Moving further in this research project, the next chapter elaborates on the research methodology adopted to carry out the proposed project and analysis mapping and site observation data.

Chapter 4 leads the reader into proposal design highlights. Finally, Chapter 5 summarizes the topic and briefly suggests future prospects of the proposed design interventions in an urban realm in India.

1.1. Inspiration for this project

As I begin to write my thesis, I have come quite far from where I began graduate studies leading me to rethink the experiences that inspired me to pursue this topic. Two experiences of walking while working in Bangalore (India) led me to pursue this topic enthusiastically. The first experience was good, and the second experience was not. Yet both made me realize the importance of pedestrian facilities in the urban realm.

In 2015, I moved to Bangalore in Southern India for a work opportunity. In 1990s, because with globalization, many companies had set up offices in Bangalore. Among many other reasons for doing so, one good reason was the pleasant weather almost year around. Bangalore has seen huge growth and is referred to as the Silicon Valley of India. The population of Bangalore grew from 4 million in 1990s to 11.8 million in 2018. With the development and continuous influx of people, congestion increased. The traffic conditions grew worse, with negative influences on the city's climate.



Figure 1.10. Bangalore street photo (presence of sidewalk, good surroundings)
Source: Google Earth



Figure 1.11. Bangalore street photo (presence of sidewalk, shade. Source:

My place of work was only 1.3 miles, a twenty-minute walk, from where I lived. I had become accustomed to the certainty of my routine because I was independent of traffic problems. I was always on time to work. Besides this, I enjoyed walking the route. Even though the sidewalk was broken at a few places but for the most part, the sidewalk was continuous and decently maintained. I never realized that I walked for twenty minutes. The street was well shaded with trees and just because the walk was interesting, I didn't mind the occasional broken portions of sidewalk. Every day I felt there was something new to look at. The reasons for this, I came to understand later after reading Jane Jacobs's *Death and Life of American Cities*, were the continuous on-going activities on street, which were a part of street's "daily ballet".⁸ Where I walked was lined by commercial outlets, malls, small shops, restaurants, offices, hostels and single-family bungalows rented out for young professionals. The activities on the street started early in the morning and the hustle and bustle went on till the night.

This walk routine went on for a year before my office moved to a new location 4 miles away. The bus connection for half the route was very good, but the bus that took all the way was not frequent. I tried to adjust to the times of the bus, but because of traffic, the arrival time always varied. By the time it was evening, the bus times became very unpredictable because of traffic congestion. At times, I even had to wait for 45-60 minutes for the bus. For a few weeks, I tried to take the more frequent bus for half way and walk the other half, but the walking conditions were poor. For the most part, a proper pedestrian path was lacking, road edges were dangerous and dusty to walk on, and the road was not shaded. I ended up buying a 2-wheeler scooter so that I had some regularity to get from home to work. Now, I did not spend so much time waiting for ride, but I did spend

considerable amount of time stuck in traffic. I had to leave early from home and consider time allowances if I got stuck in traffic to reach office, and sometimes I was even late. All this made me frustrated. I missed the independence from traffic that came with walking. What I observed from this experience was a loss of the level of peace and content with the shift from walking to riding. When an opportunity opened to work on a thesis project, I was sure that I wanted to address the issue of a lack of proper pedestrian amenities. I chose New Delhi as my site for this project where the magnitude of the problem was much higher than Bangalore.

1.2. The Project site - Connaught Place



Figure 1.12. Layout of Connaught Place. Credits: Google maps + Author



Figure 1.13. Weekend street market in Connaught Place. Credits: Author



Figure 1.14. Looking at Regal cinemas building at Connaught Place. Credits:

Connaught Place is an urban commercial place located in the center of colonial sector of Delhi. Connaught Place extends over to 2000ft (0.4miles) in diameter and 1.2 miles in circumference. The built-up of Connaught Place market is in 2 concentric circle and forming 3 roads- called as inner, middle and outer circle. Through the circle, 9 main roads extend outwards into the city that provides connectivity to different areas in the city, as shown in the Figure 1.12.

The inner and outer circle are meant to be the main business retail areas of Connaught Place. The outer circle road serves some the shops opening to outer circle and is also used to commute to other parts of Delhi. Hence traffic at outer circle is mixed- people who have some work in outer circle and others who are just passing by. In contrast, the inner circle is mainly used by people who want to be in Connaught Place. For example, business owner, employees and young people who are hanging out with friends are the main users of inner circle. Middle circle was meant for providing service to the shops. However, now, many offices and shops like banks and restaurants have created their entrances from middle circle. The middle circle is now starting to build up traffic. Connaught Place houses many administrative buildings and the headquarters of many national and international companies. It is one of the most commonly visited site in New Delhi, because of its economic importance and its architectural grandeur and vastness.

The structure of Connaught Place was designed by Robert Tor Russell, who at that time was the Chief Architect with Public Works Department in the British-led Government of India. The idea for Connaught Place was conceived in 1911 in master plan prepared by Sir Edwin Lutyens, a famous British architect who was part of the town

planning committee of Delhi. Connaught Place was opened in 1933. While designing Connaught Place, Russell was inspired by the Royal Crescent at Bath and he laid out the built structure with the colonnaded walkways, similar to Bath's Royal Crescent, for shoppers to be protected from sun and rain.⁹ Russell designed the building keeping with the aspirations of Edwin Lutyens who wanted a neo-classical style for the building. A more detailed explanation of New Delhi and the developments in Connaught Place since 1930s to now, is included in Chapter 2.

As already established, vehicular congestion is a major problem at Connaught Place. To provide a comprehensive design strategy for an information on the type of vehicles that exit in the transportation system is very necessary.

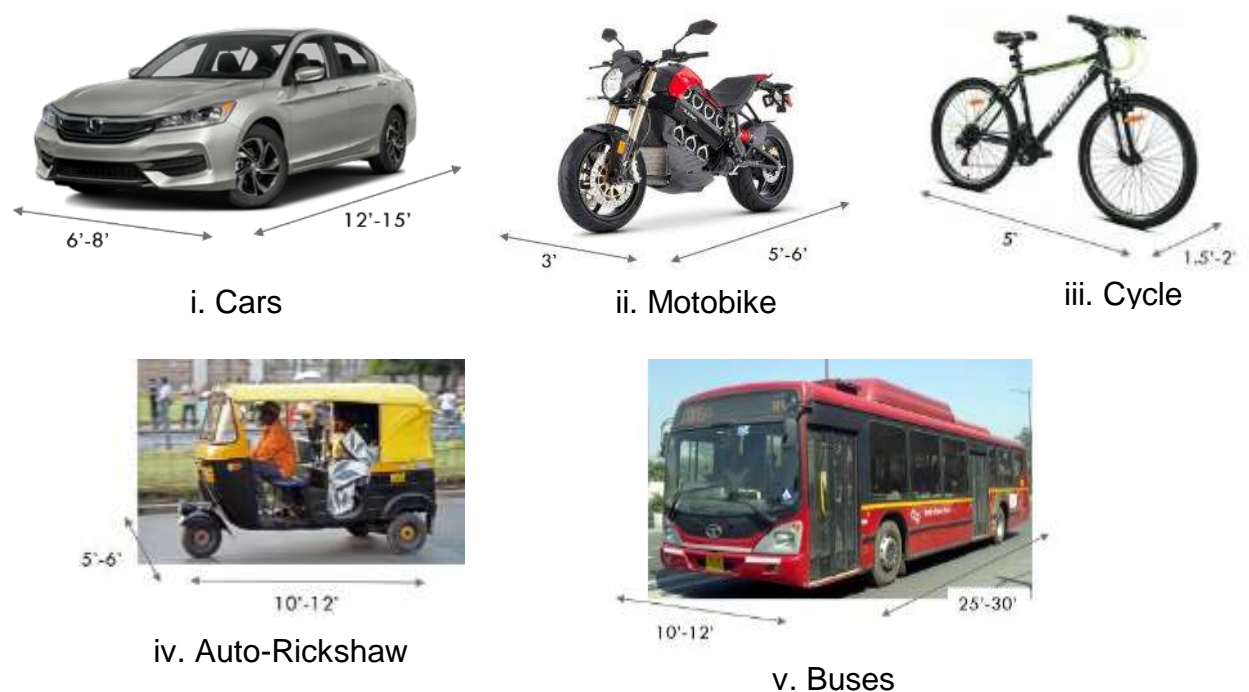


Figure 1.15. Vehicles on road (i to v)

1.3. Site selection criterion- Why New Delhi, Connaught Place?

There are many areas in India that lack well developed pedestrian friendly infrastructure. I chose Connaught Place for four main reasons listed below:

1. Historical significance: The first and foremost reason for choosing this site is that, Connaught Place is a historically important site as it is a part of city plan proposed by Edwin Lutyens in what years. The place is celebrated for its bold geometric layout and its grandeur that comes with its architectural qualities and that is where many important government offices are located.
2. Important economic center: Connaught Place is one of the most expensive market places not only in India, but in the world. CBRE Group Inc. is an American based commercial property and real estate services and consulting firm. As shown in Figure

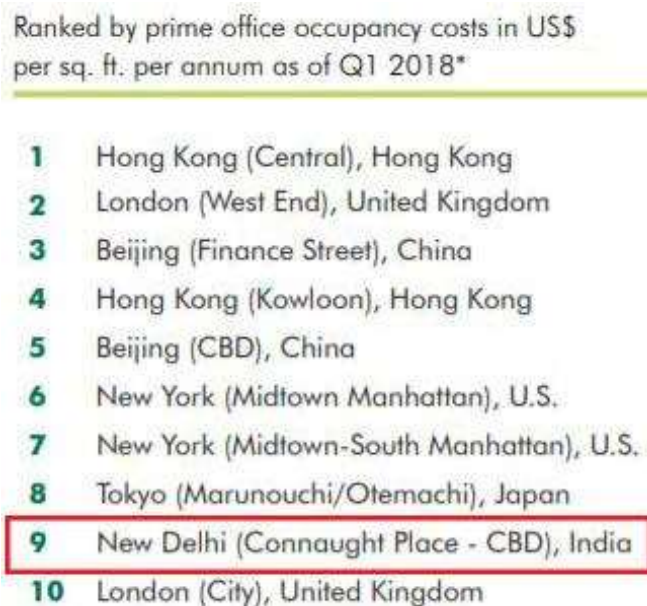


Figure 1.16. CBRE's list of most expensive business spaces to rent around the world. Source: <https://www.cbre.com/about/media-center/hong-kong-central-remains-most-expensive-office-market-in-the-world>

1.9, according to CBRE's report on cost of renting business spaces, Connaught Place ranks 9th amongst the most expensive places to own businesses around the world.¹⁰

The place is not the geographic center of Delhi anymore, but because of Parliament, foreign embassies and government administrative and private companys' headquarters all located nearby, Connaught Place is an economic center of Delhi.

3. Good existing transportation system: Pedestrian and bicycle friendly infrastructure are heavily dependent on the availability of good public modes of transportation. Delhi's metro rail system established in 2002 is running successfully and is being heavily used. The Central park of Connaught Place has an important underground metro station called Rajiv Chowk. As shown in Figure 1.10, the metro station highlighted in red circle, Rajiv Chowk connects N-S and E-W running metro lines and serves as an important junction point. Therefore, my proposal has a solid foundation upon which to build. A successful pedestrian program in Connaught Place will have a large impact and demonstration value and high chances of replication in other such commercial markets in New Delhi.

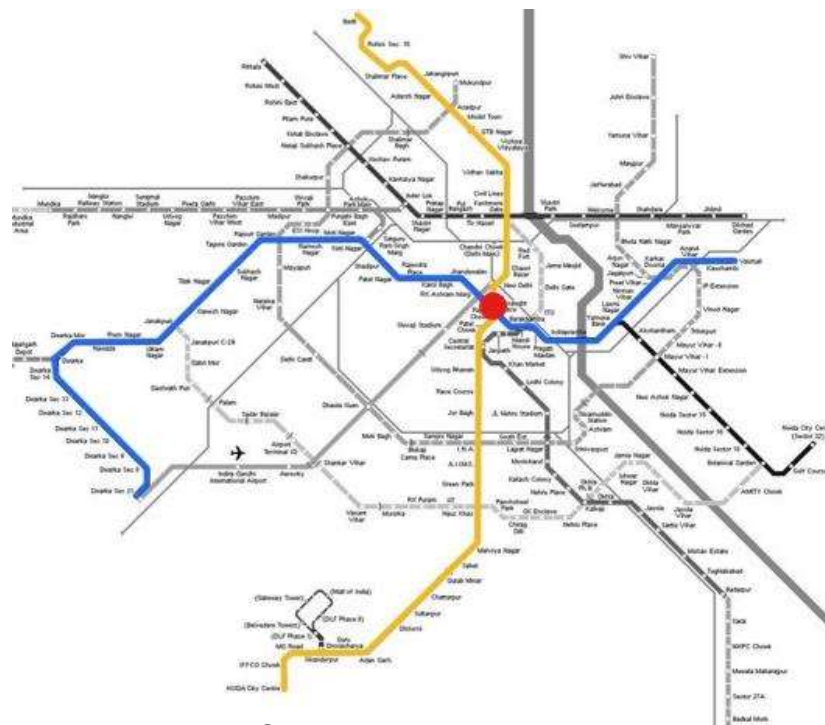


Figure 1.17. Delhi Metro map. Connaught place highlighted in red point. Source: Delhi Metro corporation

4. Geographic advantage: Delhi, being close to my hometown, it was convenient to carry site-related visits during my visits to family and friends in India. I was able to use the visits to advantage and personally explore on foot and get the feel of the area and understand the issues prevalent on site. I first explored the area in Summer 2018, and second in December 2018.

Considering all these important aspects, Connaught Place is an ideal location to consider strategies for incorporating pedestrian and bicycle supportive design.

1.4. Previous work done at Connaught Place

Half way through my research, I happened upon a proposal released by Delhi Urban Arts Commission (DUAC) with National Development Municipal Council (NDMC) in January 2018 which aimed to make the inner circle, a complete pedestrian zone by removing vehicular accessibility. It was a comprehensive study with stakeholders being the City, the Police Department and the Connaught Place Traders' Association. The



Figure 1.18. Perspective rendering of DUAC proposal. Source:

proposal provides vehicular access only up to the outer and middle circle and radial roads and converts the inner circle roads into public pedestrian open space. For easy mobility, the proposal introduces shared battery-operated shuttles service for public, so that traveling from one end to the other end of Connaught Place is less cumbersome and easy for shoppers and other people. This expansive plaza is interspaced with landscape zones like- outdoor dining/sitting areas, kids play areas with different landscape elements like pergolas, tree courts and fountains. Although this thesis project is based on the outer circle, this proposal by New Delhi Municipal Corporation helps to bring conversations pertaining to pedestrian and bicycle friendly spaces to the public and provides them an opportunity to think of advantages of such provisions.

1.5. Scope of Project

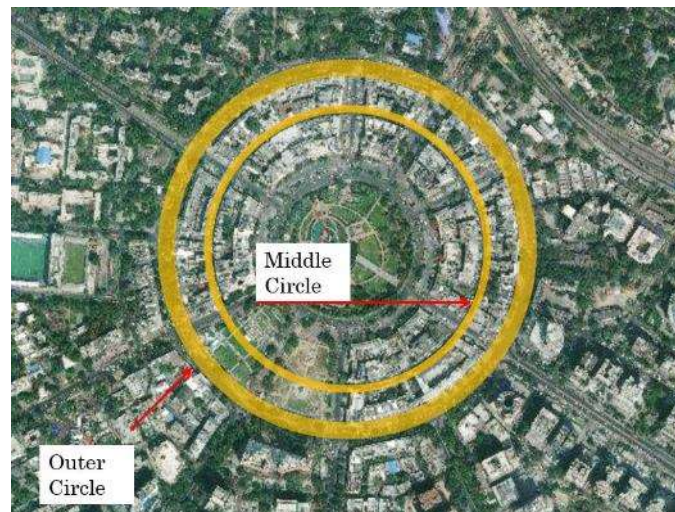


Figure 1.19. Scope of the project: Outer and Inner circle. Credits: Google earth +Author

As most of the vehicular traffic congestion in Connaught Place occurs in the outer circle, the scope of this project is to look at solutions that can be proposed within the outer circle. The middle circle is also taken into consideration, as it is beginning to face

congestion problems now when several businesses have created entrances from middle circle. The limitation posed by this site is my limited ability to travel to the site multiple times for on-site data collection. Since the site is continents away, there is a limitation of on-site data collection and the strategies proposed will be based on the data collected until December 2018 site visit.

1.6. Problems, Issues and Opportunities

After visiting the site three times, I noted several issues which offer opportunities to be addressed in my design strategies.

1. Lack of sitting spaces: As shown in Figure 1.20, an important shortcoming of this area is a lack of sitting spaces for visitors. There are seat walls located sporadically across Connaught Place, but the absence of street furniture at majority of places compels people to spend less time in this urban space than one might expect of such an important commercial center.



Figure 1.20. No sitting spaces. Credits: Author

2. Footpaths encroached by vehicles: At number of places on outer circle, the width of footpath is as less as 3'- 3.5'. Places where the parking and footpath are at same level, the footpath is encroached upon by parked vehicles.



Figure 1.21. Parking encroached upon by vehicles. Credits: Author

3. Congestion by vehicles: Due to dependence on vehicles, there is constant congestion on roads because of vehicles. Congestion combined with honking by these vehicles creates a disturbing and uncomfortable environment for visitors. (Figure 1.22)



Figure 1.22. Congestion on roads. Credits: Author



Figure 1.23. Pedestrians crossing the road, no crosswalks. Credits: Author

4. Insufficient and safe crossings: Since Connaught Place is a big commercial center, people require easy road crossings to comfortably move from one commercial space to another. Because there is continuous fast-moving traffic on road, it becomes difficult for people and many times they risk their life by running and crossing the road. (Figure 1.23)

5. Spread out small parking areas: The parking spaces for employees are provided in-front of each commercial block. As there is limited space in-front of the commercial block and these parking lots end up being very narrow. This forces car-users to encroach on sidewalks and park cars haphazardly.



Figure 1.24. Narrow and insufficient parking space. Credits: Author



Figure 1.25. Middle circle traffic. Credits: Author

6. Middle circle traffic: As number of businesses have created entrances from middle circle, it has started to become congested with vehicles. (Figure 1.25)

1.7. Objectives

Due the problems listed about, following are the objectives of this project.

1. To propose a workable network of pedestrian and bicycle-friendly paths so that it is easier for pedestrians to move within the circle with safety, comfort and freedom.
2. To also provide well-placed and comfortable sitting spaces.
3. To reduce the speed of cars to enable people to cross roads easily.
4. To provide proper parking facilities.
5. To pedestrianize the middle circle to avoid congestion problem.

All these strategies are proposed such that the design works with the existing vehicular movement of the circle.

Notes

[1] TNN. "Top 8 main causes of air pollution in Delhi". *Times Of India*. November 15, 2017. <https://timesofindia.indiatimes.com/life-style/health-fitness/health-news/top-8-main-causes-for-air-pollution-in-delhi/articleshow/61626744.cms>

[2] "Congestion on Delhi roads has worsened – says new analysis by CSE of latest Google map data". *Center for Science and Environment*. July 10, 2017. <https://www.cseindia.org/congestion-on-delhi-roads-has-worsened--6994>

[3] Patel, Tanvi. *The Better India*. January 9, 2018
<https://www.thebetterindia.com/127110/pedestrian-friendly-india-safe/>

[4] "Over 1500 killed in road accidents in 2018". *The Hindu*. January 12, 2019.
<https://www.thehindu.com/news/cities/Delhi/over-1500-killed-in-road-accidents-in-2018/article25975001.ece>

[5] "India's Millennials to Recast Economy in Own Tech Savvy Image". *Morgan Stanley Research*. March 17, 2017. <https://www.morganstanley.com/ideas/india-millennials-makeover-disruption-growth>

[6] Jain, Harshita. "What the millennial Indian wants: Not cars & houses, just fun & convenience". *Economic Times*. November 2, 2017.
<https://economictimes.indiatimes.com/markets/stocks/news/what-the-millennial-indian-wants-not-cars-houses-just-fun-convenience/articleshow/61452052.cms>

[7] Pew Research center. "Car, bike or motorcycle? Depends on where you live",
<http://www.pewresearch.org/fact-tank/2015/04/16/car-bike-or-motorcycle-depends-on-where-you-live/>

[8] Death and life of Great American cities- Jane Jacobs. Pg 54

[9] Roy, Sidhartha. "CP's blueprint: Bath's Crescent". *Hindustan Times*, Aug 29, 2011.
<https://www.hindustantimes.com/delhi-news/cp-s-blueprint-bath-s-crescent/story-gJCuSSrHKqa0hRILoMPiPK.html>

[10] CBRE's report on Global Prime office occupancy costs- June 2018
<https://www.cbre.com/about/media-center/hong-kong-central-remains-most-expensive-office-market-in-the-world>

CHAPTER 2. LITERATURE REVIEW

This chapter provides literature insights to some of the associated topics with this thesis. The first topic discussed is historical, cultural and social developments of New Delhi and Connaught Place. The second topic is literature on pedestrian and bicycle friendly networks which entails walkability and dialogue on complete street theories. The third topic sheds light on research, findings and guidelines developed by NACTO (National Associated of City Transportation Officials, USA) in their publication- Global Street Design Guide.

2.1. History, Culture and People - Connaught Place and New Delhi, the capital city

Starting from 1200s dynasties both Indian and Islamic had come and ruled in the country before the establishment of Mughal rule in 1500s. During these 300 years, Indian and Islamic art and architecture style flourished in India. When Moghuls came in 1500s they continued the trend and for most kingdoms Delhi was the capital city.

Conceived under the British rule in India, the idea of New Delhi to be the capital of



Figure 2.1. Map showing the shift of capital from Kolkata to Delhi in 1911. Source- Map of India

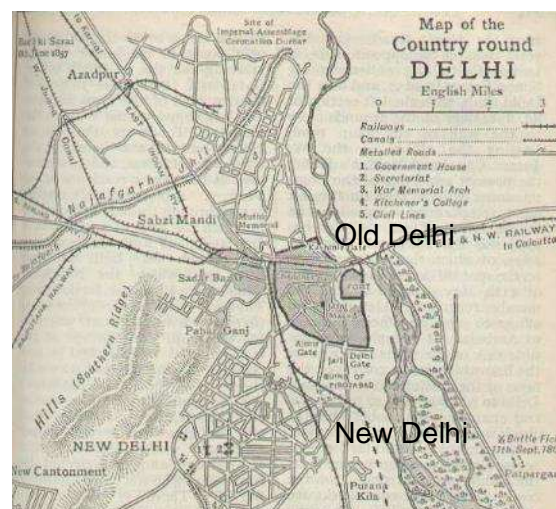


Figure 2.2. Map showing Old Delhi and site for New Delhi (1924). Source. <http://homepages.rootsweb.com/~poyntz/India/maps.html>

India was announced by Emperor George V in December 1911, when his government decided to shift the capital from Calcutta (now called Kolkata) to Delhi because of political unrest in Calcutta. Delhi had always been the administrative center for different empires that have ruled in the India before Britishers¹

During this shift of capital, Charles Hardinge, who was the Viceroy and Governor-general of British-led India knew the importance of city planning and created a town-planning committee that would be responsible for the planning, design and organization of the new capital city, New Delhi. The first two members to be appointed were John Brodie, an engineer from Liverpool and George Swinton, Chairman of London County Council. After much thought and deliberation, Edwin Lutyens, the famous British architect

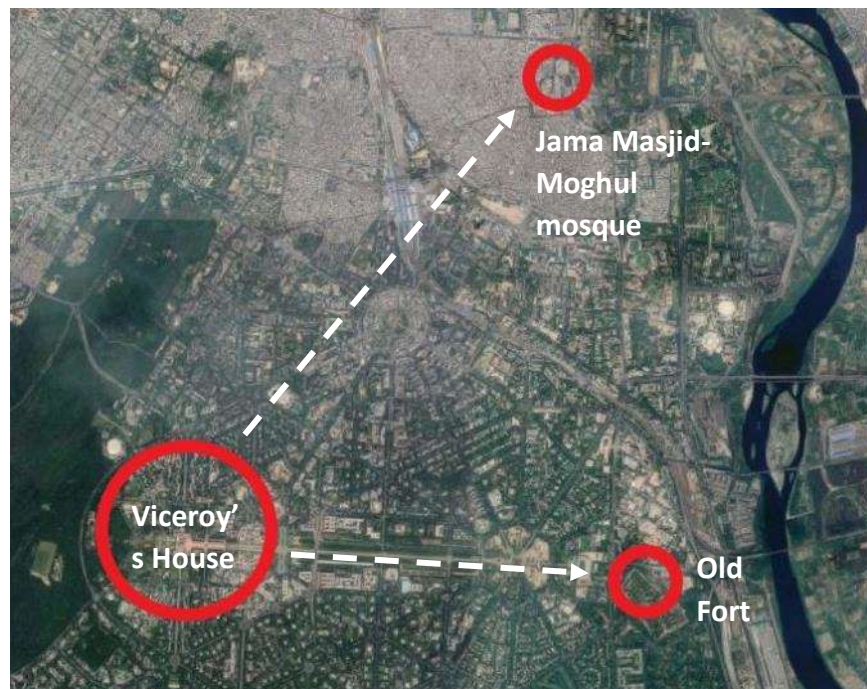


Figure 2.3. Viceroy's House views to Moghul mosque and Old Fort
Credits: Author, Base map from Google Earth

was appointed for this project. However, Hardinge was skeptical at first because he wanted someone with more experience in town planning and Lutyens had experience with mostly country-houses².

Wilhide in her book "Sir Edwin Lutyens- Designing in the English Tradition" describes how Lutyens had perceived the project of planning Delhi as a way to prosper in his field-

"Lutyens had been hoping to secure the project of planning Delhi, a project of monumental proportions that would give him the opportunity to set his seal in posterity. Little did he know that it would occupy much of the next eighteen years, almost the rest of his productive life; that it would bring immense frustrations and disappointments as well as acclaim; or that his grand design, carefully envisaged to last three hundred years, would have a direct political relevance for less than two decades. In a trite sense, Delhi proved a perfect example of the old warnings: be careful what you wish for, for it might come true".³

Due to the political unrest in Kolkata, Hardinge wanted the new capital in Delhi to "give Indians greater stake at the empire" and wanted an "Indian look" for the city. Lutyens was unimpressed by Hindu and Mughal style of architecture and thought there was no order in the intricate designs of motifs and patterns. This difference of opinion was problematic for Lutyens as he found it hard to impress his client, which he was good at when he designed country-houses for individual clients⁴. Lutyens was to also design the Viceroy's house and the work of designing the Secretariat buildings was commissioned to Sir Herbert Baker, another famous architect from England. Baker and Lutyens were good friends, but even that didn't end very well when Lutyens felt that the Secretariat buildings will overshadow the visibility of Viceroy's house because of natural land gradient.

A suitable site for the city was chosen for the new capital city which was south of older Moghul settlements in Delhi. The new capital city was to be called New Delhi. Hardinge wanted the Parliament to be aligned to Old fort- Purana Qila and Moghul mosque- Jama Masjid (shown in Figure 2.3). Lutyens in a speech in 1933 acknowledges that these required axes gave rise to triangular and hexagonal geometry in master plan⁵. Lutyens was also inspired by other capital cities like Washington and Paris, and the way important government buildings and monuments were located along the ceremonial avenue. “Lutyens found major historic monuments useful to terminate the main axes and to provide strong visual accents emphasizing his street patterns”⁶. The framework of the



Figure 2.4. Triangular spatial organization Viceroy's House- (S-W), India Gate- (S-E), Connaught Place- (N) Credits: Author + Google Earth

city was formed by an equilateral triangle with Viceroy's residence, Secretariat and Parliament at the south-west vertex, a world war memorial – India Gate at the south-east vertex and Connaught Place at the north vertex (refer Figure 2.4).

Connaught Place was conceived in 1911 as a place for shopping for colonial elites. It was earmarked as the retail and entertainment hub of the new city as a one-stop-shopping destination, where everything would be available at one place for people to buy. This commercial hub added exuberance to the city. The built up was supposed to be



Figure 2.5. Old photo of Connaught Place Source: <https://www.youthkiawaaz.com/2014/07/photos-delhi-now-look-back/>



Figure 2.6. Old photo of Connaught Place Source: <http://www.dssc.co/delhi/2018/04/07/connaught-place-legends-that-survived-the-tide-of-time/>

circular and the central part was supposed to become an inter-city railway station. Due to financial limitations, the railway station was shifted to the North of Connaught Place and the central space became an expansive green leisure space. Since the famous architects, Edwin Lutyens and Herbert Baker, were in charge of designing the more important administrative buildings, the charge of designing this commercial center came to Public Works Department. Chief Architect, WH Nicholls of Public Works Department gave the initial designs but the details of the designs were given by Robert Tor Russell who was the next Chief Architect with Public Works Department. The construction began in 1929 and went on till 1933.

Swapna Liddle in her book “Connaught Place and the making of New Delhi” explains how Connaught Place developed over the years from when it was built to current times. She says that Connaught Place was a quiet place when it was just built because the population of the city was low. World War II brought many changes to the place. Many government officials stayed in Delhi as it had become the supply hub of war. Journalists came from around the world and stayed in Delhi and people from British allies, mainly Americans were stationed in Delhi. The population grew because of these reasons and Connaught Place had become a lively place during the war. Cinemas, restaurants, bookstores and many other kinds of shops opened in Connaught Place. Soon after, in 1947, when the Independence movement was on its high, things changed again. After gaining Independence on 15 August 1947 and due to partition from Pakistan, Connaught Place saw a huge influx of refugee population who opened shops in vacant places of Connaught Place.⁷

New Delhi, as a result of the urban sprawl, extended in all directions but extensively in southern and south- eastern directions (Figure 2.7). Even though Connaught Place

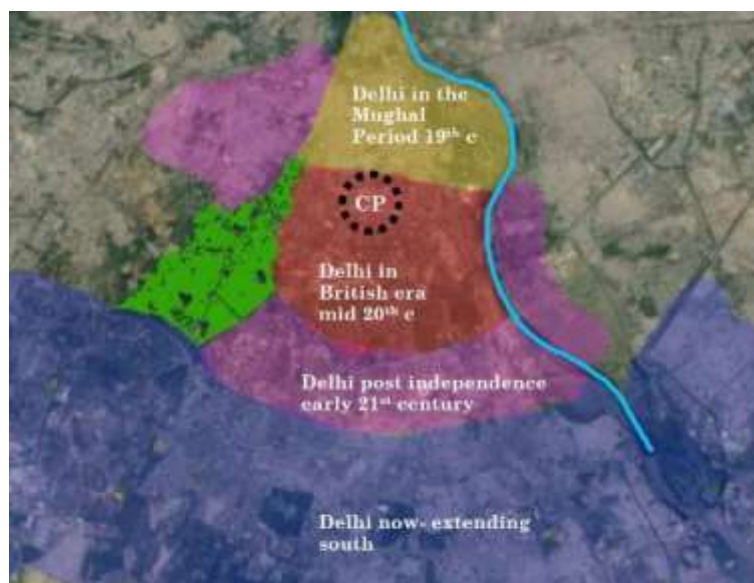


Figure 2.7. Historical development- Delhi

was no more the physical center of New Delhi, it maintained its importance among people because most of government and administrative offices and institutions and business headquarters were around Connaught Place. Connaught Place remained an administrative center of the city and managed to preserve its identity through the years.

Connaught Place experienced a period of decline in 80's and the 90's. When intra-city metro rail transit systems opened in 2002, and an important underground metro station was built under the central lawn of Connaught Place, it started to gain importance⁸. The metro station called as "Rajiv Chowk" was an important link connecting the main N-S and E-W metro lines of Delhi (refer to photo 1.9). This led to an increase in the number of visitors for Connaught Place. Connaught Place today has not faced competition from modern day malls, because it is a unique urban space in the center of the city.

2.2. Pedestrian and Bicycle paths- Complete streets

A complete street, as the name suggests is a street which accommodates all types of users- pedestrians, bicycle riders, motorists, automobiles, buses. The Complete Streets Policy was formulated in 2010 by National Complete Streets Coalition. Some benefits of complete streets are safety, equity and access, economic development, environmental sustainability, livability and health.⁹ Walkable environments are also beneficial because these streets serve as vital social urban environments for public interaction.

Another associated term with such concept is 'Livable streets' which was first proposed by Donald Appleyard in 1980. He had studied residential neighborhoods and analyzed how streets could become more livable for residents. Author Mark Francis, a Professor Emeritus and past Chair of Landscape Architecture in University of California

at Davis, in his essay in book 'Public Streets for Public Use' builds on the idea of Livable Streets and coins the word 'Democratic Street' to describe a livable street that is meant for public use. He says the democratic street does not exclude automobilist but provides space for vehicles by striking a more equitable balance with other street` users, namely, pedestrians and cyclists.¹⁰ Published first in 1987, this idea is very similar to Complete Streets.

Many scholars have worked on such developing concepts of walkable neighborhoods. Elbert Peets and Werner Hegemann were one of them whose work on city planning in 1920s were used to develop concepts of New Urbanism. Elbert Peets was a landscape architect and city planner and Werner Hegemann was a well-known city planner. New Urbanism is an urban design concept that advocates for mixed-use walkable neighborhoods.

People are slowly becoming more conscious of walkable and bicycle friendly streets and its advantages. As Michael Southworth Professor Emeritus at University of California at Berkley College of Environmental Design, points out that it is a socially equitable mode of transport that is available to a majority of the population, across classes, including children and seniors.¹¹ According to a nationwide survey by the National Association of Realtors and Portland State University in 2016, "The most requested neighborhood characteristic of all buyers is walkability," real estate broker Andrea Evers recently told a reporter for The Washington Post. She said that Millennials prefer urban amenities more than their predecessors.¹²

Walkability index is a criterion which helps to calculate whether a street is walkable or not. The index also assigns a number that indicates how walkable the street is. Some

of the main factors that the index considers are building heights, sidewalk widths, presence of street furniture and presence of different land-uses on the site. Hence to make a street desirable and walkable, only provision of sidewalk is not enough. Some transportation planners acknowledge that micro design qualities such as landscape, path design or street furniture might be important factors affecting pedestrian behavior. Susan Handy, Chair of Transportation Technology and Policy at University of California at Davis Institute of Transportation Studies, states that “because the pedestrian sees, hears, smells, and feels such of the surrounding environment, urban form is likely to play a greater role in the choice to walk”¹³

Further, Shige Oishe, a psychology professor at University of Virginia lays emphasis on the experience of walkability by saying that walkability should be more about leisure, not commuting.¹⁴ WE CAN (Walkable Eugene Citizens Advisory Network) is an ad-hoc group of home owners, renters and property owners in Oregon, Portland who supports walkable neighborhoods and make efforts for its citizens to live in walkable neighborhoods. They list out important criterion from user’s perspective in making walking and cycling experience more comfortable and safer. They point out that structure of the space is an important criterion. People prefer walking where buildings are neither too tall nor too short, where sunlight reaches their shoulders..¹⁵

To provide safer walking and cycling experience, providing underpasses or bridges is not a solution. Roger Trancik in book ‘Finding Lost Spaces’ points out that people have found totally enclosed pedestrian environments and underpasses or bridges rather uncomfortable, disorienting and alienating, preferring usually to remain at ground level- people friendly towns.¹⁶ Hence even though people are advocating for walkable streets

and neighborhoods, the quality of experience is a key factor that ultimately decides whether a walkable street is well used or not.

2.3. NACTO (National Association of City Transportation Officials) guidelines

NACTO is an association of 68 major North American cities and 11 transit agencies formed to exchange transportation ideas, insights, and practices and cooperatively approach national transportation issues. NACTO's mission is to build cities as places for people, with safe, sustainable, accessible and equitable transportation choices that support a strong economy and vibrant quality of life.¹⁷ It was founded in 1996 with headquarters in New York City.

1. According to research done by NACTO on Global urban street design, they mention the comfort levels depending on how bicycle lanes are located next to vehicular lanes. They conclude that the bicyclists are most comfortable when a physical barrier exists between bicycle and vehicle lanes.

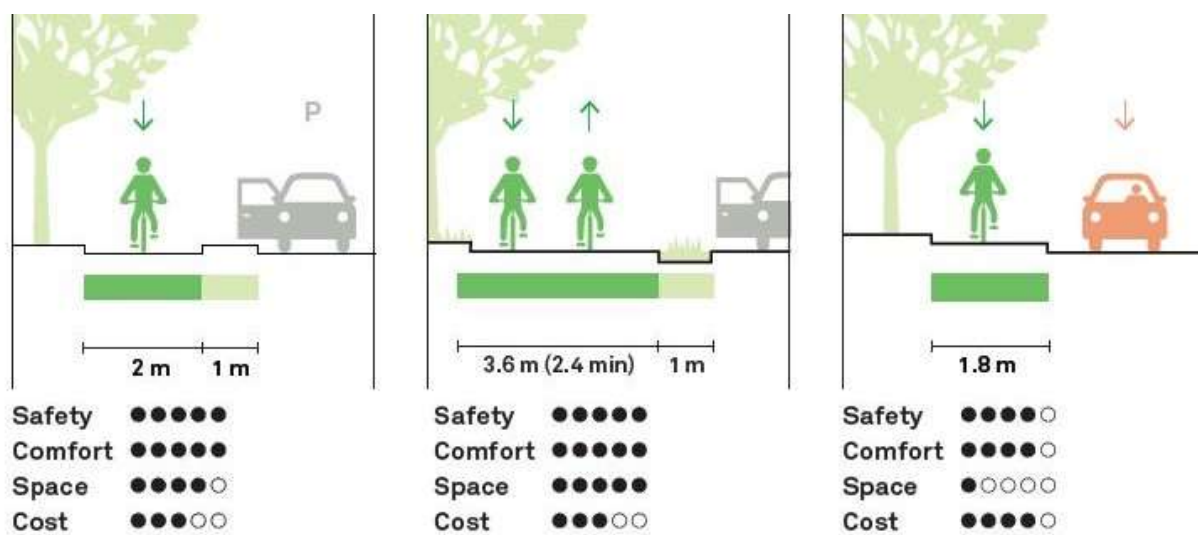


Figure 2.8. Public comfort levels for paths with and without physical barriers

Source: Global street design manual

2. Bicycle boxes- At a traffic circle, the stopping line for cars is shifted ahead to make space for bicycle. It offers cars proper visibility of bicycle and gives them a head-start from cars.

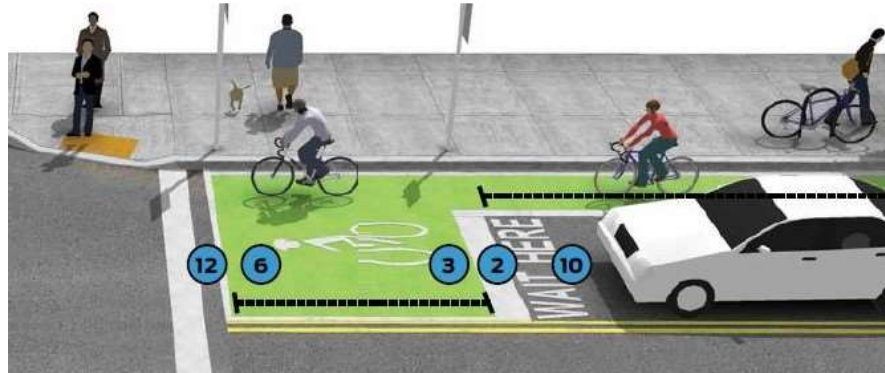


Figure 2.9. Bicycle boxes.

Source: Global street design manual

3. The most important rule that NACTO advocates is to reduce the width of intersections so as to reduce exposure time and increase visibility. The guidelines also mention that at the corners, the visibility should be up to 10-20 ft, as shown in figure 2.10

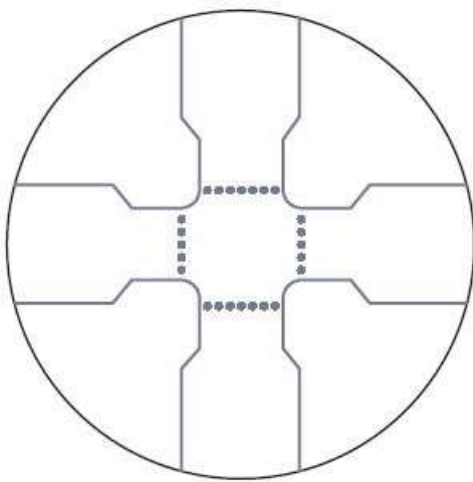


Figure 2.10. Intersection design guideline

Source: Global street design manual

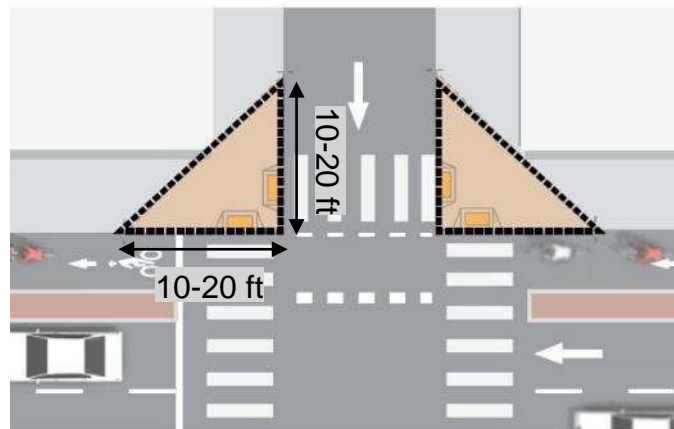
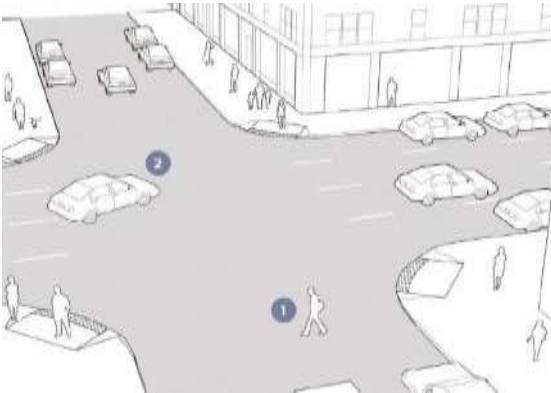


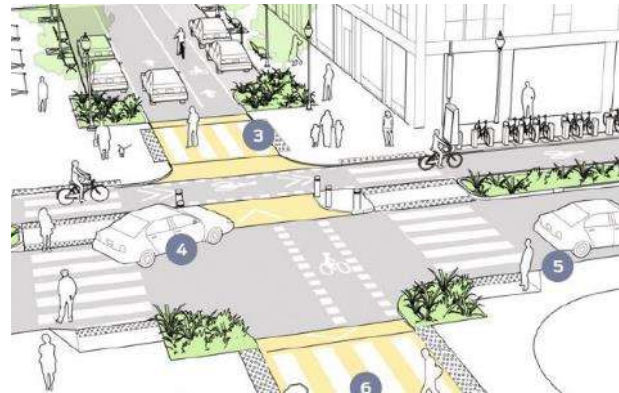
Figure 2.11. Visibility for 10-20 ft at corners

Source: Global street design manual

An example of technique is provided below-



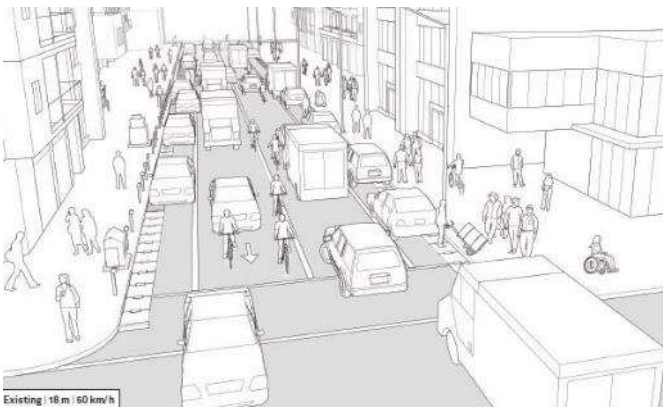
(i)



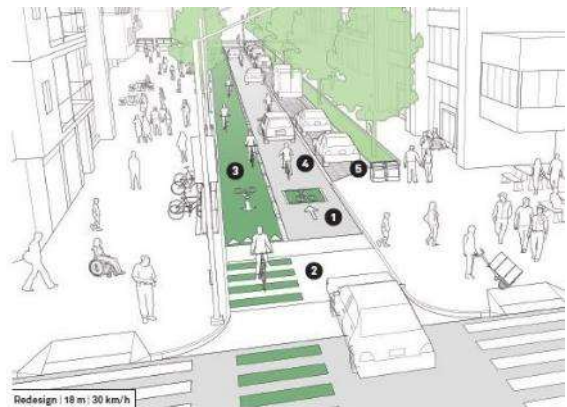
(ii)

Figure 2.12. Intersection example- existing situation(i) and after design situation(ii). Source: Global street design manual

4. Street organization and dedicated lanes help to reduce traffic speed and conflicts. The example below from NACTO shows that such organization can lead to a speed reduction of 30km/hr.



(i)



(ii)

Figure 2.13. Organization of street- existing confusing situation (i) and situation after improvements (ii). Source: Global street design manual

Notes

- [1] https://en.wikipedia.org/wiki/New_Delhi
- [2] Liddle Swapna, Connaught Place and the making of New Delhi, Page 16
- [3] Wilhide, Sir Edwin Lutyens, Designing in the English Tradition Page, 40
- [4] Wilhide, Page 40
- [5] Liddle, Page 59
- [6] Irving, Indian Summer: Lutyens, Baker and Imperial Delhi Page, 80
- [7] Liddle, Page 110
- [8] Delhi Metropolitan: The Making of an Unlikely city- by Ranjhana Sengupta Page 216.
- [9] Complete Streets Manual
- [10] Public Streets for Public Use, Mark Francis, Page 28
- [11] Designing Walkable City- Michael Southworth
- [12] Why we can't afford walkable neighborhoods, Washington post
- [13] Designing Walkable City- Michael Southworth
- [14] The Washington Post
- [15] WECAN, walkability
- [16] Roger Trancik, Finding Lost Spaces
- [17] National Association for City Transportation Officials, <https://nacto.org/about/>

CHAPTER 3. METHODOLOGY

Identifying the methodical process of research helps in keeping the thought process logical during the whole study period. A flow diagram was created to identify important steps and an appropriate sequence in which they should occur in the research. The diagram below (Figure 3.1) shows these important steps. After collecting literature data related to the subject, the next step was to collect site-specific data (which includes map data and data from site observation) and carry out precedents study that where such infrastructure of pedestrian and bicycle friendly network has been successfully integrated in the transport systems. The chapter presents these site-specific data and the precedent studies.

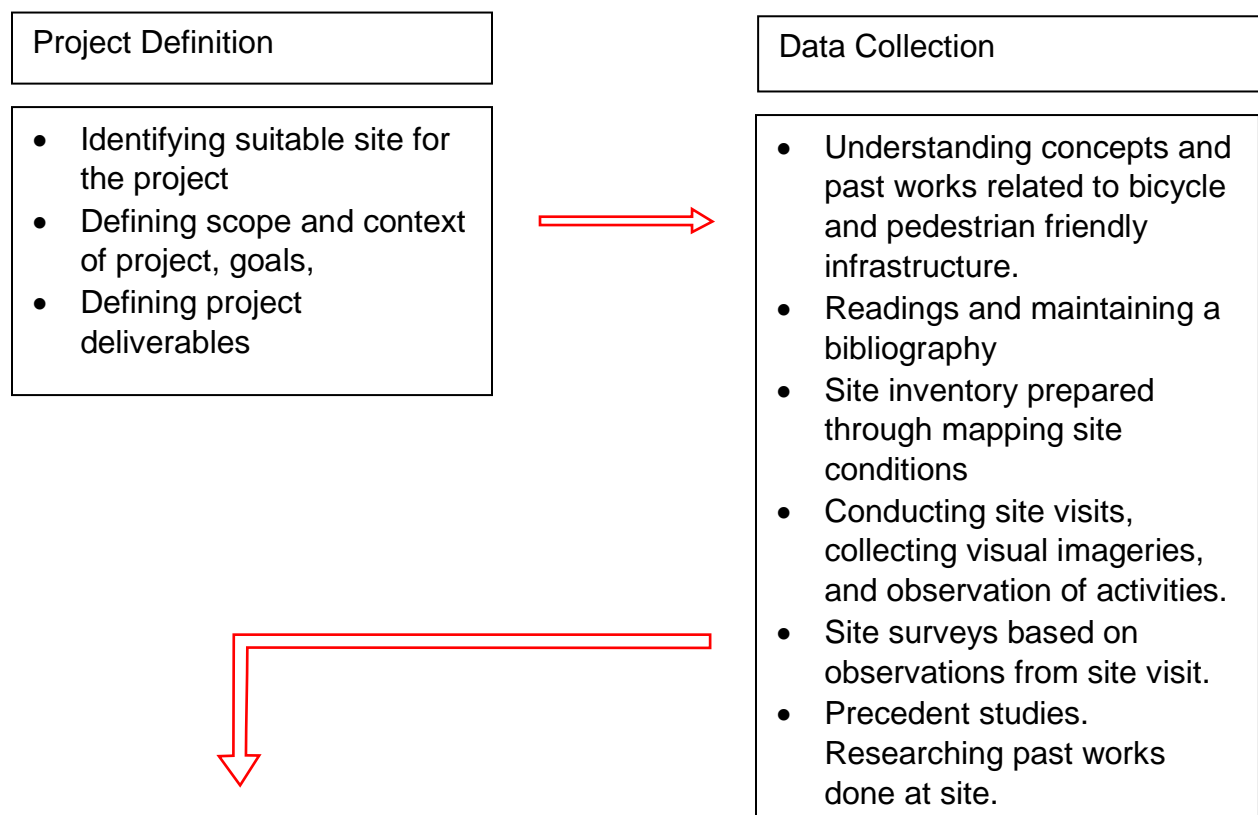


Figure 3.1. Thesis Methodology diagram (fig. cont'd.)

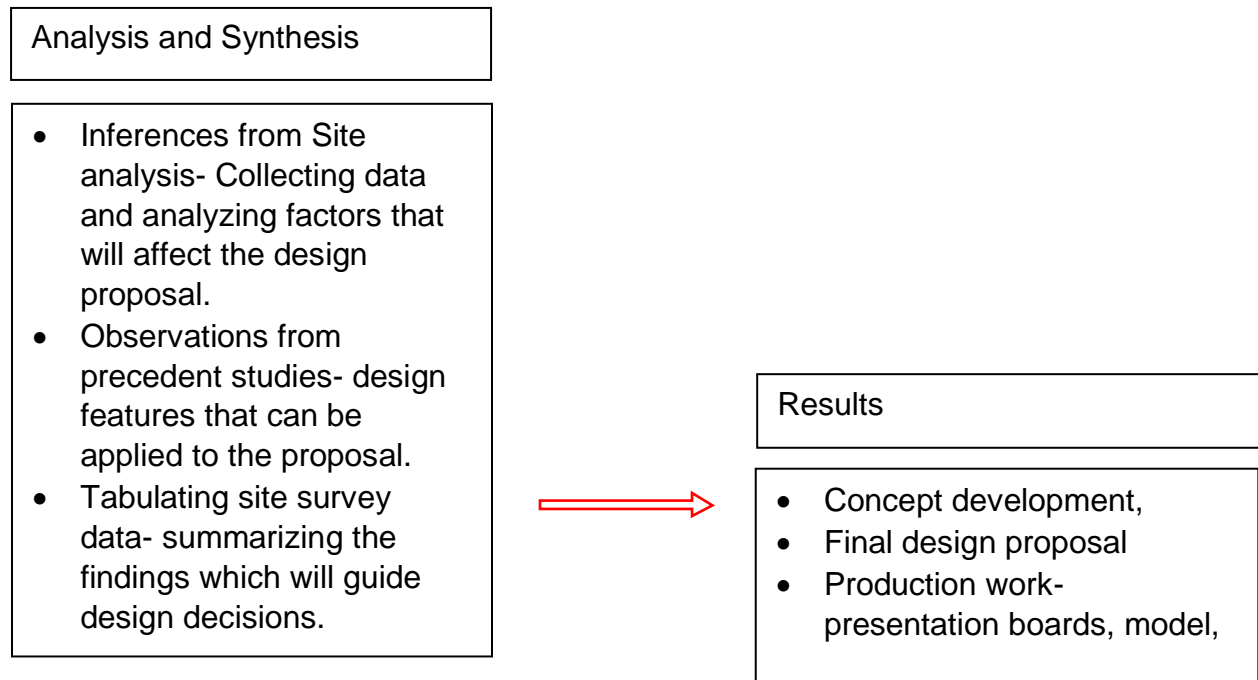


Figure 3.1. Thesis Methodology diagram
Credits: Author

3.1. Site Analysis- Mapping, site visits and surveys

Following an understanding of basic site conditions and concepts related to the providing bicycle and pedestrian friendly infrastructure, a detailed site analysis is the next step in the development of a workable design proposal. These datasets have been identified as significant studies towards this design process:

1. Parking spaces and building footprint

The present condition, as shown in Figure 3.2, is that a considerable amount of space (area colored in yellow) is allotted to parking. This is surface parking situated on the streets in front of the building (shown in pink color) and is generally reserved for employees. The space for parking is limited here which leads to vehicles parking haphazardly. Recently bicycle rental program called “Smartbike” was also installed by New Delhi Municipal Corporation in Connaught Place where bicycles can be rented through app. These bicycle rental locations are shown in blue dots in Figure 3.2.

Inference: To organize parking systematically, parking lots can be clustered together to provide adequate space. As some parking lots will get eliminated this way, the vacant space can be utilized to provide landscape sitting facilities.

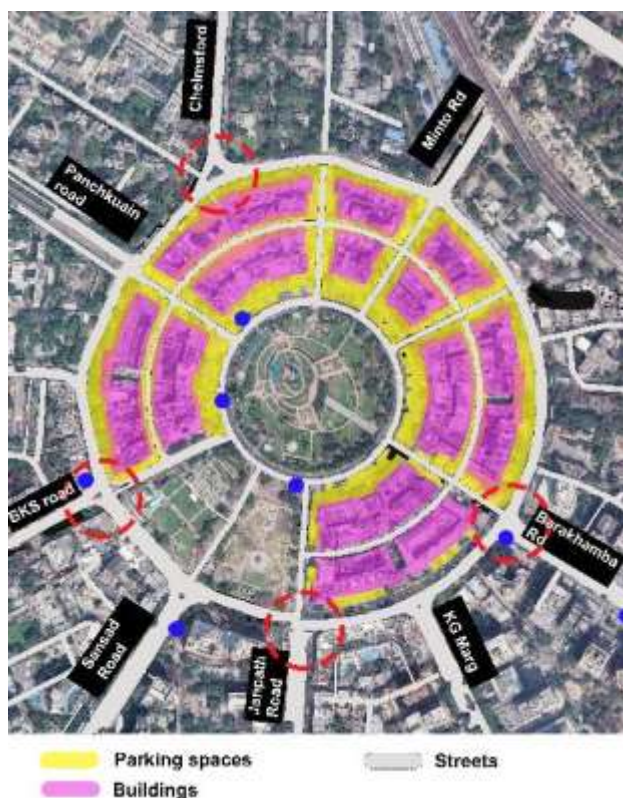


Figure 3.2. Parking spaces and building footprint- Connaught Place. Credits: Author



Figure 3.3. “SmartBike” a bicycle rental program established by government at Connaught Place. Credits: Author

2. Paved surfaces versus greenery at Connaught Place



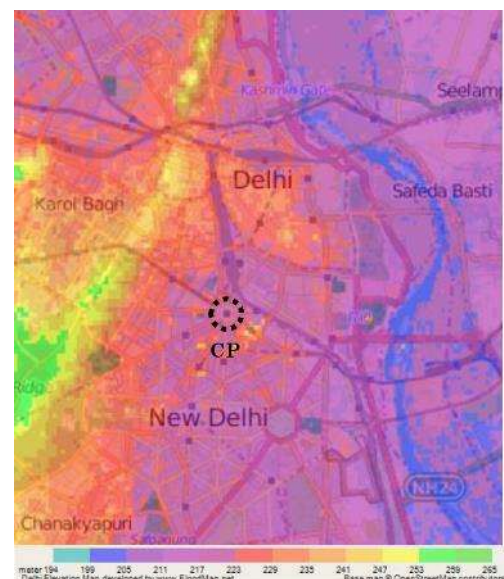
Figure 3.4. Paved surface vs greenery. Credits: Author

Figure 3.4 shows the comparison between paved surfaces and greenery within the Connaught Place and the surrounding context. The greenery in the surrounding context area is mainly because of trees alongside the roads and understory plants.

Inference: The greenery reduces on the radial roads and middle circle in the Connaught Place. The design improvements for middle circle can be aimed at increasing the greenery at Connaught Place.

3. Topography: As shown in Figure 3.5, much of the land around Connaught Place is flat. This eliminates complexity that could have arisen because of gradient change. However, land will have to be graded carefully to drain surface water efficiently.

Figure 3.5. Topography, Source:
<http://www.floodmap.net/Elevation/ElevationMap/?gi=1261481>



3. Weather conditions

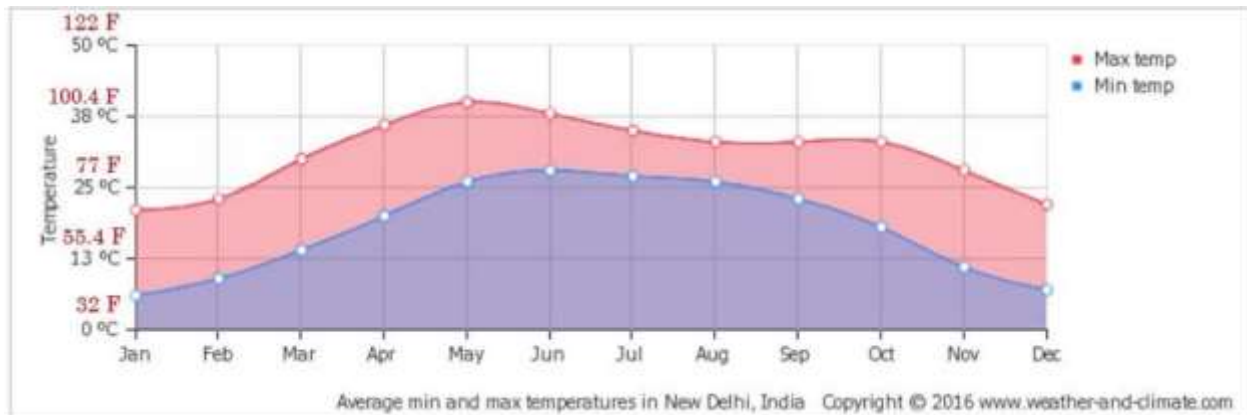


Figure 3.6. Temperature data for Delhi. Source: <https://weather-and-climate.com/average-monthly-min-max-Temperature,New-Delhi,India>

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Annual Rainfall mm (inch)	19 (0.75)	20 (0.79)	15 (0.59)	21 (0.83)	25 (0.98)	70 (2.76)	237 (9.33)	235 (9.25)	113 (4.45)	17 (0.67)	9 (0.35)	9 (0.35)

Figure 3.7. Average monthly rainfall. Source: Wikipedia

Inference: Delhi faces two extreme weather conditions in a year. The summer months are extremely hot with maximum temperature of 100 to 103F and winter months are extremely cold with minimum temperatures around 35F. Hence the design should address the extremities of summer and provide for shade for summer. Also, the average annual monthly rainfall data shows that Delhi receives intensive rains in July and August.

4. Figure ground: Figure ground helps to grasp the spatial organization of buildings around Connaught Place and formulate an idea of vacant spaces around the circle that can be used while proposing strategies. For example, relocating some parking spaces.



Figure 3.8. Figure ground. Credits: Author

4. Land use

Similar to standard land use colors- red shows commercial buildings, yellow stands for residential and blue indicates governmental institutions. As the map indicates, the areas around Connaught Place are being used for variety of different uses. Many different national and state level government offices, company's headquarters and retail spaces exist around Connaught Place.

Inference: As the area around Connaught Place is diverse in uses, Connaught Place is being visited by different user groups. For example, business owners, employees, young generation who come to spend time with friends and shoppers. This offers an opportunities for us to plan multiple activities for different groups of people.

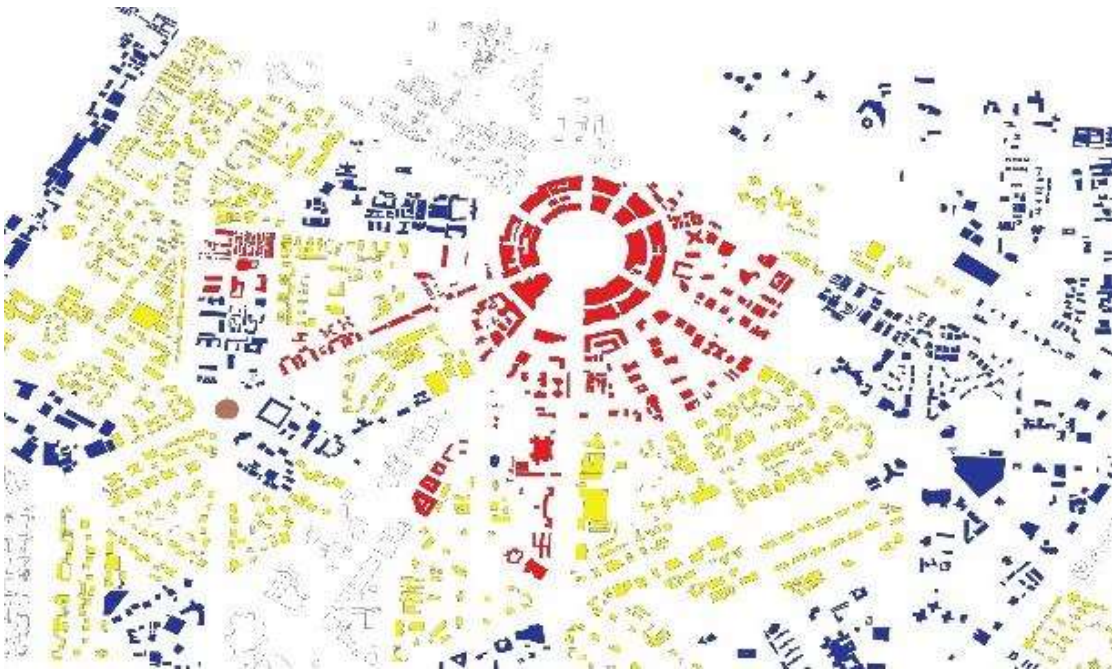


Figure 3.9. Land Use, Credits: Author

7. Site observations and income data

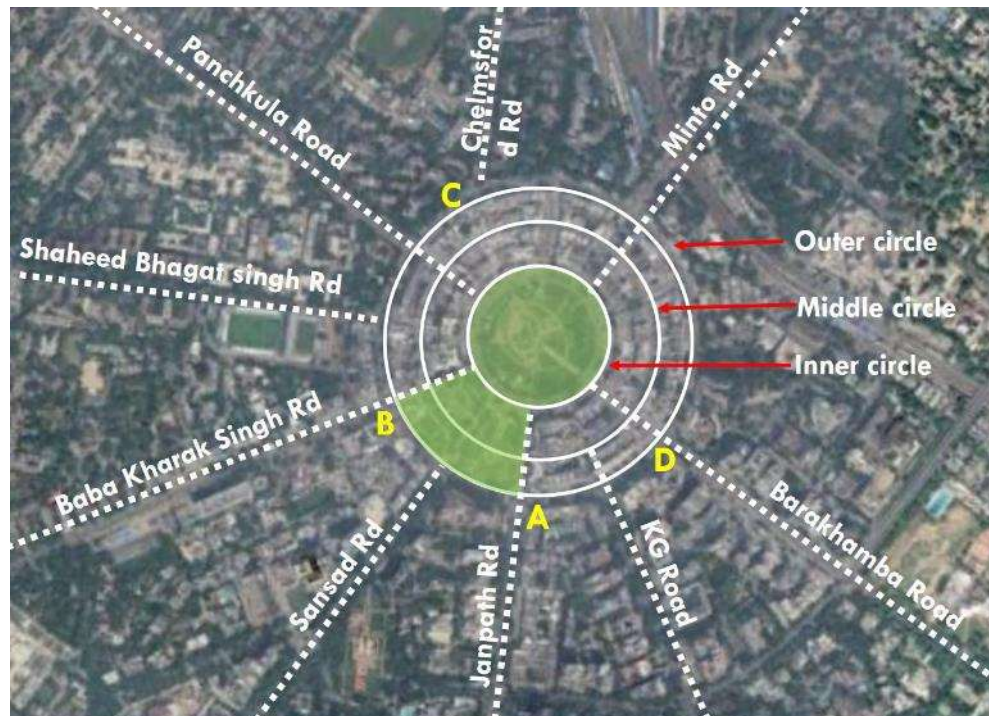


Figure 3.10. Connaught Place- site observation intersections. Credits: Author

During site visit done in December 2018, I observed that the intensity of traffic coming into the outer circle and leaving the outer circle differed at different road intersections. Hence, I observed and identified 4 nodes where the traffic congestion was most indicated them as points A, B, C and D. I took note of number of vehicles passing through a point in a minute. These numbers were recorded for morning (9am to 11am), afternoon (2pm to 4pm) and evening (6pm to 8pm) times. I also differentiated them based on what type of vehicles. For example- motorbikes, cycles and cars etc. The figure graphs of vehicles on weekends and week days. There are limitations to this data. For example, the numbers are counted for the particular side when the traffic light turns green. Hence the numerical data is dependent on which side the numbers are counted for. Another constraint is that these numbers are not averaged. Because the site was visited two times, the data

presented is raw data and not an average number across different days, weather conditions or times of the year. However, this data provides a starting point for proposing pedestrian friendly design solutions. Future design processes can be based on more detailed data collection process.

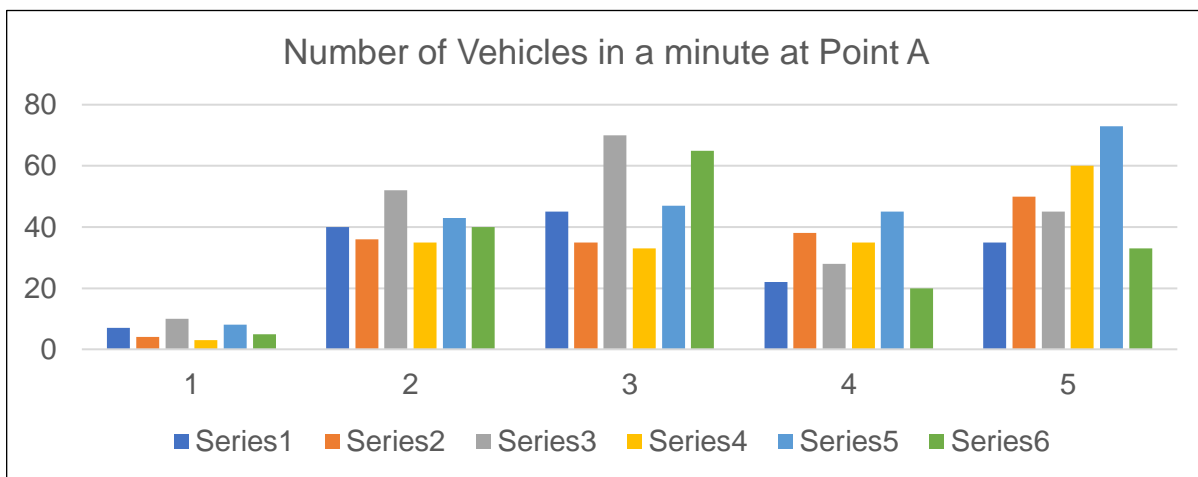


Figure 3.11. Graph of number of vehicles passing through point A in a

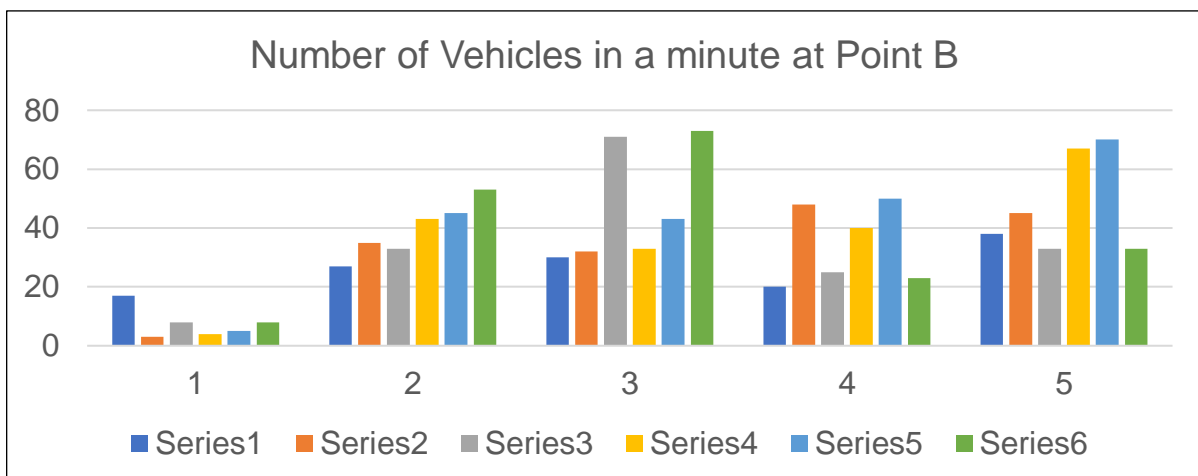


Figure 3.12. Graph of number of vehicles passing through point B in a

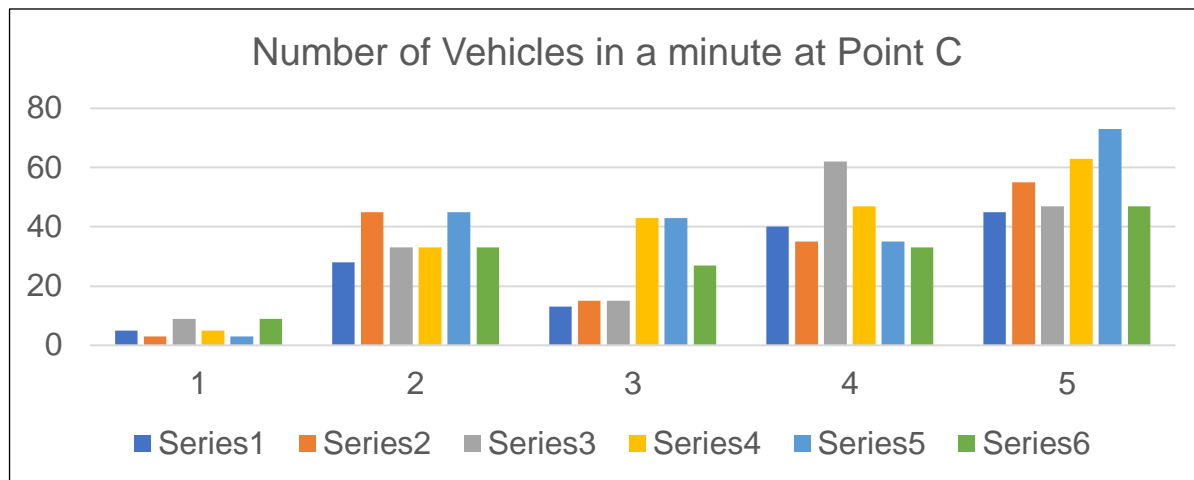


Figure 3.13. Graph of number of vehicles passing through point C in a minute.

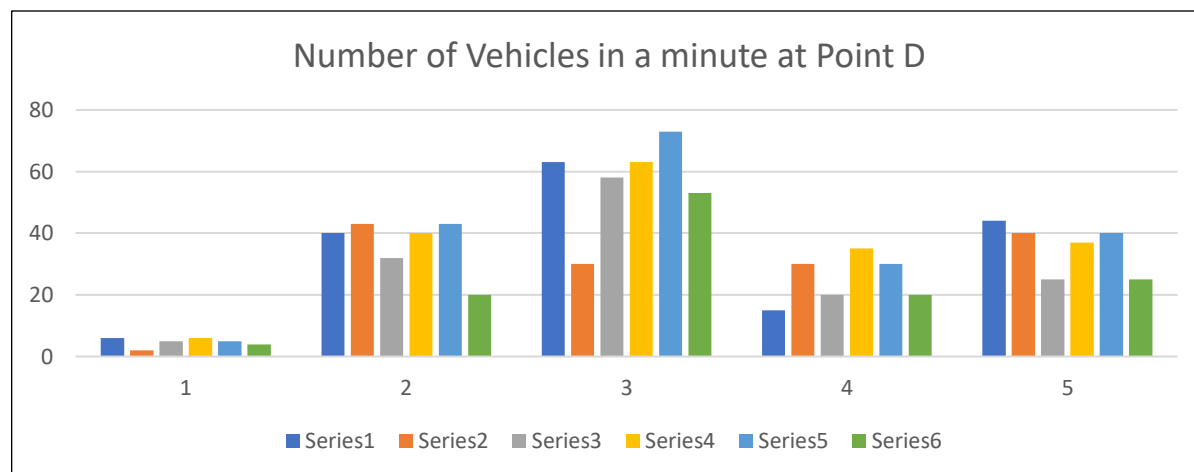


Figure 3.14. Graph of number of vehicles passing through point D in a minute.
Credits: Author

The number of vehicles from these points, compelled me to look at reasons of why certain type of number increased and decreased. I looked at income data of different zones in Delhi. These income zones however are not state defined. Since zonal income data is not released by the Government of India, this map is created based on general understanding of these areas and the look and feel of neighborhoods in New Delhi. Nonetheless, the map provides sufficient information to reason the different vehicle usage at different intersections. Overlapping income map with data collection intersections, the income zones helped to analyze why certain roads coming into Connaught place brought in certain kind of traffic. Table 3.1 summarizes the conclusions of each intersection based on site observation and income data.

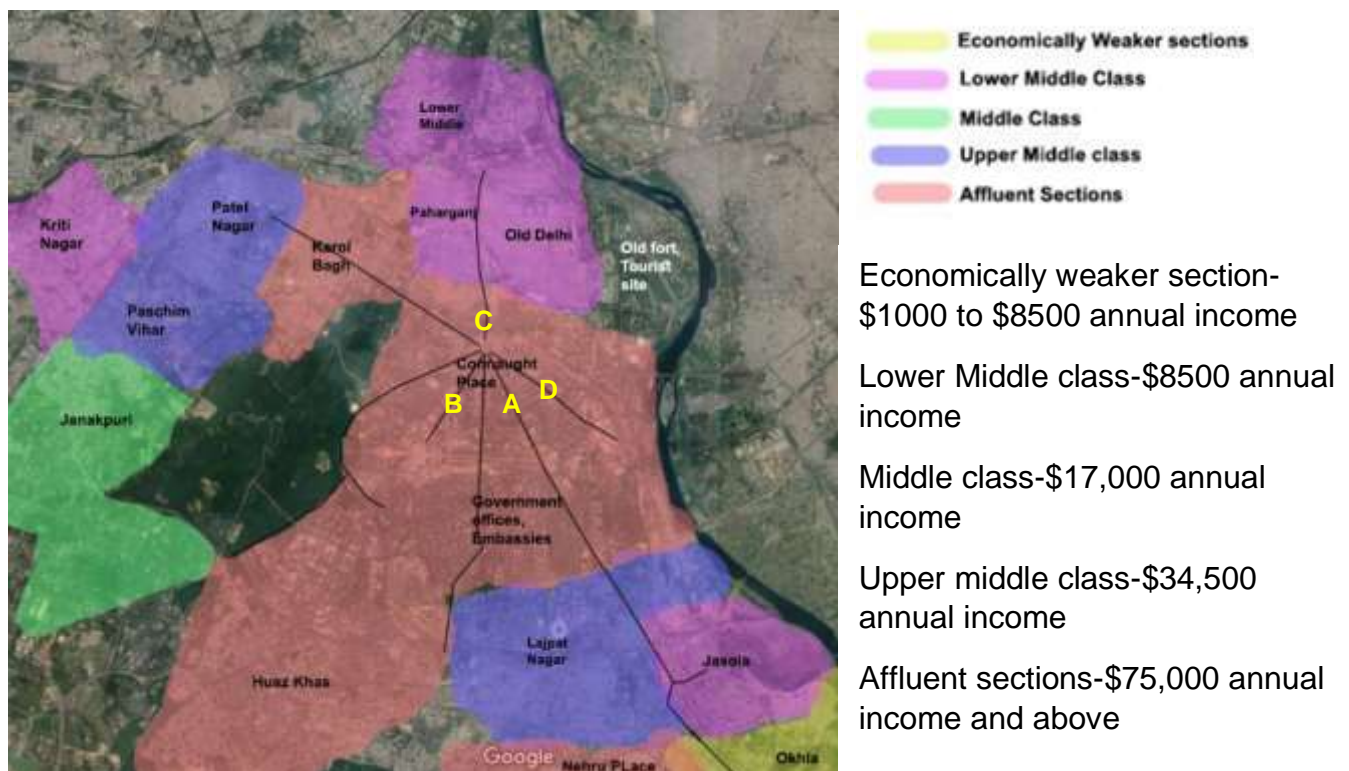

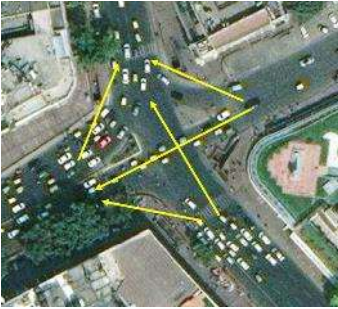




Figure 3.15. Income section zones in Delhi. Source: Author

Table 3.1. Conclusions of site observation data. Credits: Author

	Road Layout	Conclusions from site observation
A		<ul style="list-style-type: none"> • Government offices located along the connecting road, hence more cars. • Many weekend markets held along this road. Hence, maybe the increased numbers of 3-wheelers on weekend afternoon
B		<ul style="list-style-type: none"> • More cars and incoming traffic into the circle. • The road leads to parliament and other government offices, hence a greater number of cars.
C		<ul style="list-style-type: none"> • Vehicles are coming from lower middle-class areas of New Delhi, hence number of 2-wheelers and autos are more than private cars and taxis. • Lot of incoming traffic into the circle from this point.
D		<ul style="list-style-type: none"> • Private cars increased, 2 wheelers and taxi cars decreased. The road connects Non-Capital Region (satellite areas) to Connaught Place. Hence maybe more cars.

3.2. Precedent studies

Precedent studies were carried out to understand how other circular thoroughfares have been changed to make them more easily accessible to pedestrians. Secondly, there have been cities, like Amsterdam and Copenhagen that have been innovatively designed streets to make them bicycle friendly. Last but not the least, several streets around the world have been successfully made pedestrian friendly. Some examples of such transformations are Times Square in New York, streets in Vienna, Copenhagen etc. Photographs and diagrams are presented in this chapter to interpret designs from such examples.

1. Traffic Circles

To understand in more detail how traffic circles can be transformed, a study of traffic circles around the world is important. For this study, prominent traffic circles that are present in major urban cities around the world were chosen. Trafalgar square in London, Plaza de Bastille in Paris and Columbus Circle in New York are few circles that are recognized majorly in the metropolitan cities where they are present.

Table 3.2. Traffic circles precedent studies.

	Trafalgar	Plaza de bastille	Columbus circle
Place	London	Paris	New York
No. of visitors	75,000 pedestrians	-	1,35,000 visitors (60,000 cars)
Size of space	110ft X110ft	220 feet dia	377 feet dia

(table cont'd.)




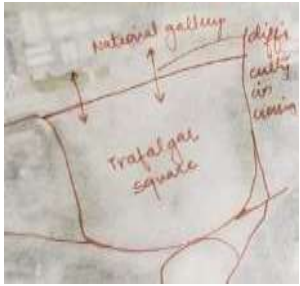





	Trafalgar	Plaza de bastille	Columbus circle
Access	Underground stations rail and 17 buses routes	Underground stations rail buses	Underground subway (7 lines) and 11 buses routes
Problems	<ul style="list-style-type: none"> Traffic roundabout that impeded safe pedestrian travel. Struggle to cross surrounding wide busy street. 	<ul style="list-style-type: none"> No direct pedestrian crossing. Half of square given to cars Cars speeding and trying to find exits 	<ul style="list-style-type: none"> Motorbikes would park in the central island. Not safe for pedestrians
Photograph			
Situation "Before"			
Situation "After"			
Observations	<ul style="list-style-type: none"> Closed off one street- East bound road on North side. Narrowed the roads on all sides 	<ul style="list-style-type: none"> Closed off one street for pedestrians. Extended plaza to connect canal to circle 	<ul style="list-style-type: none"> Widened pedestrian crossing from circle towards the edge. Created taxi waiting areas

Table 3.2. Traffic circles precedent studies.

2. Bicycle Friendly Elements

Mention below are some of the design solutions being followed across the world to make streets bicycle friendly. Amsterdam and Copenhagen rank number one in the world for their bicycle friendly infrastructure.



i. Colored bicycles path, Washington, DC



ii. Stopping line for bicycles ahead cars at traffic signal, Copenhagen



iii. Continuous bicycle path at intersection, Amsterdam



iv. Separate bicycle path, different paving material, Japan



v. Hand and footrests at signals, Copenhagen



vi. Bicycle ramps, Copenhagen



vii. Tilted dustbins, Copenhagen

Figure 3.16. Bike friendly design elements- (i) to (vii)

Source: <https://road.cc/content/news/126192-get-cyclists-pavement-build-better-bike-lanes-washington-dc-finds>

<http://www.copenhagenize.com/2016/12/top-ten-design-elements-that-make.html>

<http://www.tokyobybike.com/2014/09/tokyo-bicycale-lane-designs.html>

<https://bicycledutch.wordpress.com/2011/04/07/state-of-the-art-bikeway-design-or-is-it/>

3. Pedestrian friendly

Below are some photographs of before and after street transformations, after providing good pedestrian and bicycle friendly network. Below are some photographs of successful famous examples.

1. Times square, New York

Snøhetta is an integrated design office based in New York who worked on Times Square in New York city, to make it more pedestrian friendly. Their design reimaged the stretch of Broadway from 42nd to 47th streets, replacing the existing streets with a continuous hardscape connecting building front to building front. They also provided new seating options, including ten 50-foot long granite benches, allow pedestrians to occupy the space at a relaxed pace.¹



Figure 3.17. Times Square before and after street transformation.

Source: <https://www.archdaily.com/869685/times-square-celebrates-grand-opening-of-snohetta-designed-transformation>

2. Stroget, Copenhagen



Figure 3.18. Before and After street transformation in Stroget, Copenhagen.

Source: <https://globaldesigningcities.org/publication/global-street-design-guide/streets/pedestrian-priority-spaces/pedestrian-only-streets/pedestrian-streets-case-study-stroget-copenhagen/>

The street in Stroget converted to pedestrian zone in 1962. The project was a huge success that made businesses realize that traffic-free streets increased their revenue tremendously.²

3. Antwerp, Belgium



Figure 3.19. Before and After street transformation in Antwerp, Belgium.

Source: <https://www.citylab.com/solutions/2015/09/a-before-and-after-photo-archive-of-the-worlds-best-street-designs/405424/>

This corner showed in photograph in Antwerp Belgium, was transformed from being a vehicular space predominantly in 2009 to a “lush, café-filled micro park with bike lanes.”³

4. Vienna, Austria



(i)



(ii)

Figure 3.20. Before and After street transformation in Vienna, Austria- (i) and (ii)
Source: <https://www.viennacouver.com/2015/10/transforming-a-street-before-after-images-of-viennas-mariahilferstrasse/>

Examples of Vienna streets show that shared space areas empower pedestrians (and cyclists) by forcing cars to slow down and interact with other road users. More opportunities to sit were the biggest request from citizens during the comprehensive public engagement process.⁴

Notes

- [1] <https://www.archdaily.com/869685/times-square-celebrates-grand-opening-of-snohetta-designed-transformation>
- [2] <https://globaldesigningcities.org/publication/global-street-design-guide/streets/pedestrian-priority-spaces/pedestrian-only-streets/pedestrian-streets-case-study-stroget-copenhagen/>
- [3] <https://www.citylab.com/solutions/2015/09/a-before-and-after-photo-archive-of-the-worlds-best-street-designs/405424/>
- [4] <https://www.viennncouver.com/2015/10/transforming-a-street-before-after-images-of-viennas-mariahilferstrasse/>

CHAPTER 4. DESIGN PROPOSAL

This chapter illustrates some design improvements that are proposed at Connaught Place following various studies that have been done during the research phase.

4.1 Proposal highlights

After understanding concepts on making streets more pedestrian and bicycle friendly, one important conclusion is the need to slow the traffic down. Looking at ways to slow down traffic, an example of existing condition is taken at Connaught Place. Figure 4.1 shows the existing condition of road near point A shown in Figure 4.2. Reducing road width and adding street furniture is a good way to reduce the speed of cars on that road. The road width is 48ft wide at this point which is reduced to 15ft. Bicycle path, street furniture-sitting spaces, parking edge is added to make it safer for pedestrians to move on peacefully on the road.



Figure 4.1. Existing condition



Figure 4.2. Location where the section drawing is taken

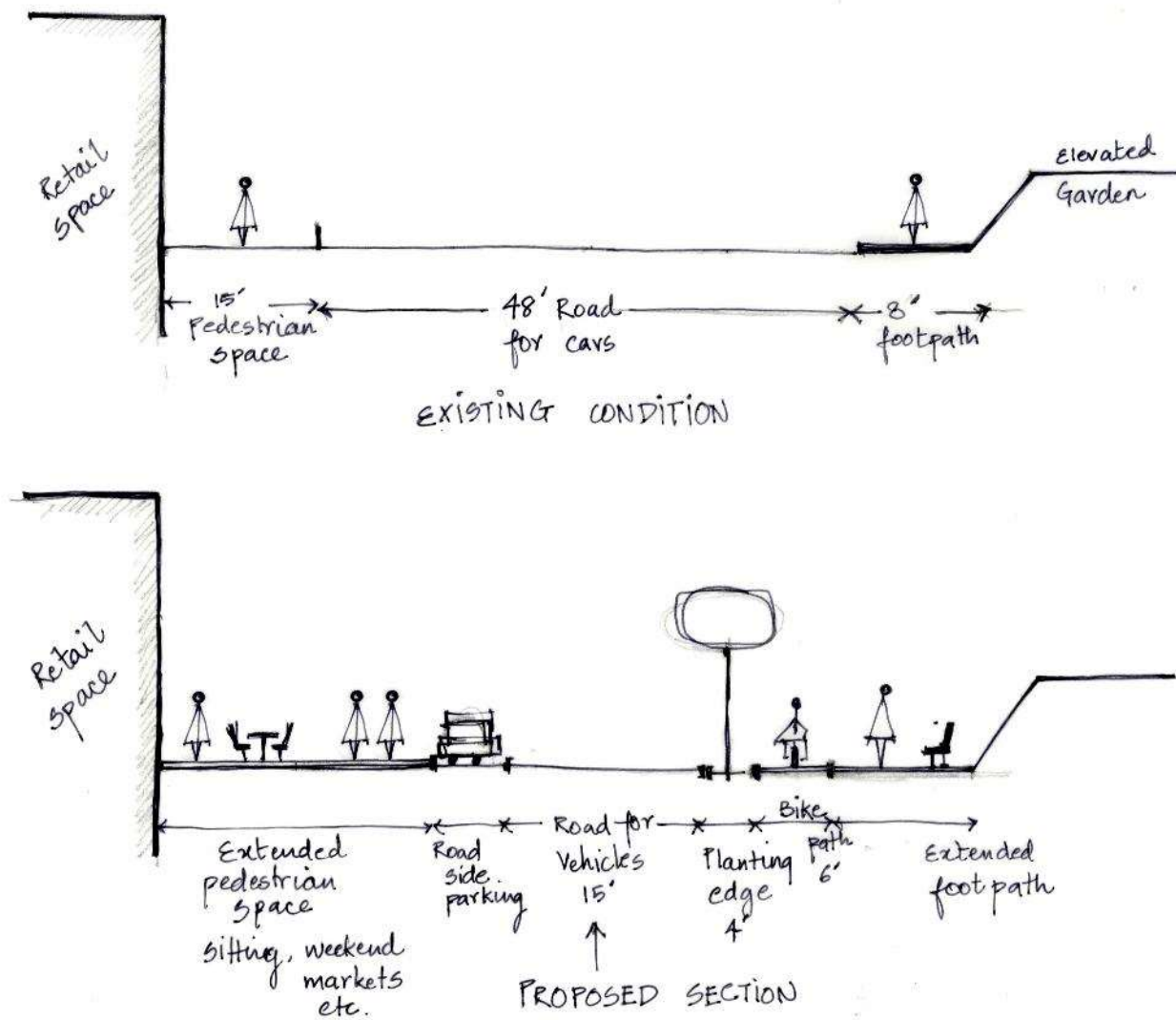


Figure 4.3. Before and After street design.

Parking Space:

Few of parking lots are insufficient in terms of space to allow proper car parking.

Converting such non- efficient parking lots for public sitting furniture is a beneficial change. Parking lots can be provided in front of other buildings where enough space is available.



(i)



(ii)

Figure 4.4. Existing condition at Parking lot (i), After design improvements rendering (ii)

Middle Circle:

Strategies in transforming middle circle include- restricting vehicular access to middle circle, adding roadside trees, changing paving material to a softer and more permeable one that looks appealing and allows rainwater to percolate, and adding landscape sitting furniture.



(i)



(ii)

Figure 4.5. Existing condition at Middle circle (i), After street design improvements rendering (ii)

CHAPTER 5. CONCLUSIONS

This project of providing pedestrian and bicycle friendly infrastructure has tremendous potential as many cities are facing different problems because of absence of walking and cycling facilities. City officials and residents around the world are actively looking to provide non-motorized modes to transit to its people. The millennial population has brought a shift in lifestyle, and they are asking for such facilities for commute that are bicycle and pedestrian friendly. Promoting citizens to use bicycles to move around is dependable long-lasting and sustainable way of growth of cities. City transportation officials need to take an active step in engaging the audience in this conversation as most of the people still do not know about such concepts. As we learn from examples, the problem is less about public will and interest and more about absence of infrastructure.

5.1. Future prospects

The current administration in India, is proposing many new 'smart cities'. This offers a golden opportunity to plan the cities with sustainable means of transportation from the start. In Delhi specifically, I hope that more such commercial retail hubs get developed into pedestrians' dominant zones. Organically. It takes time to people to react to the changes and start accepting them.

Once the commercial markets are developed into pedestrian zones, these zones can be linked together with better public transportation modes like metro rails and buses so that there is a definite hierarchy of transportation modes in cities.

.

BIBLIOGRAPHY

- Appleyard, D., M.S. Gerson, and M. Lintell. *Livable Streets*. University of California Press, 1981.
- Bicycle Dutch. "State of the Art Bikeway Design, or is it?".
<https://bicycledutch.wordpress.com/2011/04/07/state-of-the-art-bikeway-design-or-is-it/>
- CBRE Group Inc. "Hong Kong Central Remains Most Expensive Office Market In The World, According To CBRE". *Global Prime Office Occupancy Costs report*. Los Angeles, June 2018. Accessed August 2018. <https://www.cbre.com/about/media-center/hong-kong-central-remains-most-expensive-office-market-in-the-world>
- Center for Planning Excellence. Complete Streets Policy Manual.
- Center for Science and Environment. "Congestion on Delhi roads has worsened – says new analysis by CSE of latest Google map data". Last Modified July 2017. Accessed February 2019. <https://www.cseindia.org/congestion-on-delhi-roads>
- Copenhagenize.com. Top Ten Design Elements That Make Copenhagen Bicycle-Friendly. December 8, 2016. Accessed February 2019.
<http://www.copenhagenize.com/2016/12/top-ten-design-elements-that-make.html>
- Delhi Urban Arts Commission. "Pedestrianisation Of Connaught Place, Movement and Design". Delhi, India. January 2018. Accessed September 2019
http://www.duac.org/site_content/attachments/Pedestrianisation%20of%20Connaught%20Place.pdf
- Global Designing Cities Initiative. Pedestrian Only Streets: Case Study | Stroget, Copenhagen. Accessed February 2019.
- Foster + Partners. Trafalgar Square, London 2003.
<https://www.fosterandpartners.com/projects/trafalgar-square/>
- Irving, Robert.G. *Indian Summer: Lutyens, Baker, and Imperial Delhi*. Yale University Press, 1981.
- Jacobs, Jane. *The Death and Life of Great American Cities*. Vintage Books, 1992.
- Jain, Harshita. Economic Times. "What the millennial Indian wants: Not cars & houses, just fun & convenience". November 2, 2017. Accessed March 2019.
<https://economictimes.indiatimes.com/markets/stocks/news/what-the-millennial-indian-wants-not-cars-houses-just-fun-convenience/articleshow/61452052.cms>
- Liddle, Swapna. *Connaught Place and the Making of New Delhi*. Speaking Tiger Books, 2018.

- Lynch, Patrick. Arch Daily. Times Square Celebrates Grand Opening of Snøhetta-Designed Transformation. April 20, 2017. Accessed February 2019.
<https://www.archdaily.com/869685/times-square-celebrates-grand-opening-of-snohetta-designed-transformation>
- Patel, Tanvi. The Better India. January 9, 2018. Accessed March 2019.
<https://www.thebetterindia.com/127110/pedestrian-friendly-india-safe/>
- Pew Research center. "Car, bike or motorcycle? Depends on where you live". Last Modified April 2015. Accessed December 2018.
<http://www.pewresearch.org/fact-tank/2015/04/16/car-bike-or-motorcycle-depends-on-where-you-live/>
- Moudon, A.V. *Public Streets for Public Use*. Columbia University Press, 1991.
- Morgan Stanley Research. "India's Millennials to Recast Economy in Own Tech Savvy Image". March 17, 2017. Accessed March 2019.
<https://www.morganstanley.com/ideas/india-millennials-makeover-disruption-growth>
- National Association of City Transportation Officials, "*Global Streets Design Guide*". Island Press, New York, October 2016. Accessed February 2019
- Oberklaid, Sarah. *The Urbanist*. "Closing Trafalgar Square to traffic", August 31, 2015. Accessed February 2019. <https://www.theurbanist.org/2015/08/31/closing-traffic-square-to-traffic/>
- Roy, Sidhartha. "CP's blueprint: Bath's Crescent". *Hindustan Times*, Last Modified August 2011. Accessed January 2019. <https://www.hindustantimes.com/delhi-news/cp-s-blueprint-bath-s-crescent/story-gJCuSSrHKqa0hRILoMPiPK.html>
- Rudy Bruner Award. Columbus Circle Public Plaza.
<http://www.rudybruneraward.org/wp-content/uploads/2016/08/05-Columbus-Circle-Public-Plaza.pdf>
- Sengupta, Ranjana. *Delhi Metropolitan: The Making of an Unlikely City*. Penguin Books, 2007.
- Southworth, Michael. "Designing the Walkable City." *Journal of Urban Planning and Development* 131, no. 4 (2005): 246-57.
- Sullivan, Feargus O'. *City Lab*. A Before-and-After Photo Archive of the World's Best Street Designs. September 15, 2015. Accessed February 2019.
<https://www.citylab.com/solutions/2015/09/a-before-and-after-photo-archive-of-the-worlds-best-street-designs/405424/>
- Sullivan, Feargus O'. *City Lab*. Paris Is Making 7 Iconic Squares More Pedestrian-Friendly. June 23, 2015. Accessed February 2019.

<https://www.citylab.com/transportation/2015/06/paris-is-making-7-iconic-squares-more-pedestrian-friendly/396575/>

Stevenson, John. *Road.cc*. "To get cyclists off the pavement, build better bike lanes, Washington DC finds". August 8, 2014. Accessed February 2019.
<https://road.cc/content/news/126192-get-cyclists-pavement-build-better-bike-lanes-washington-dc-finds>

TNN. "Top 8 main causes of air pollution in Delhi". *Times Of India*, Nov 17, 2017. Accessed November 2018. <https://timesofindia.indiatimes.com/life-style/health-fitness/health-news/top-8-main-causes-for-air-pollution-in-delhi/articleshow/61626744.cms>

The Hindu. "Over 1500 killed in road accidents in 2018". January 12, 2019. Accessed March 2019. <https://www.thehindu.com/news/cities/Delhi/over-1500-killed-in-road-accidents-in-2018/article25975001.ece>

The Local. "Revealed: What the future Place de la Bastille will look like". November 20, 2017. Accessed February 2019. <https://www.thelocal.fr/20171120/revealed-what-place-de-la-bastille-will-look-like-in-future>

Tibbalds, Francis. *Making People-Friendly Towns: Improving the Public Environment in Towns and Cities*. Taylor & Francis, 2012.

Trancik, Roger. *Finding Lost Space: Theories of Urban Design*. John Wiley & Sons, 1986.

Vienncouver. Transforming a street: Before-After images of Vienna's Mariahilferstrasse. October 15, 2015. Accessed February 2019.
<https://www.vienncouver.com/2015/10/transforming-a-street-before-after-images-of-viennas-mariahilferstrasse/>

Walkable Eugene Citizens Advisory Network (WE CAN), "*Walkability*", 2016, Accessed February 2019.

Wilhide, Elizabeth. *Sir Edwin Lutyens: Designing in the English Tradition*. Pavilion Books, 2012.

VITA

Surabhi Jain has studied Architecture for her undergraduate studies in Jaipur, India. She participated and won Landscape design trophy for zonal competition of NASA (National association for students in Architecture). Unsure of what prospects in landscape architecture are, she went to work in a landscape architecture firm in Bangalore, India, to learn more about in and outs of the field. Determined to pursue a career in landscape architecture, she came to LSU in 2017 for gaining advanced and technical education in this field. Surabhi wants to gain experience in public-use, community-development oriented projects which are designed with ecological and sustainable approach.