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RETHINKING URBAN MOBILITY IN GURUGRAM: INNOVATIVE SOLUTIONS FOR TACKLING TRAFFIC CONGESTION.

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Abstract

The swift growth of urban areas worldwide, particularly in Asia and notably in India, presents concerning challenges. Among Indian cities, Gurugram stands out as a prime example of rapid urban expansion, surpassing even larger metros like Delhi and Mumbai. Over the past two decades, Gurugram has experienced a staggering 200% growth, attracting around three lakh commuters daily for various purposes. This growth, largely reliant on private vehicle transportation, has strained the city's infrastructure, leading to issues such as air pollution, traffic congestion, and rising crime rates, as recognized by the UN, which has labeled Gurugram as one of the most polluted and unsafe cities globally

Recognizing that well-planned and accessible streets are vital components of urban infrastructure, this paper aims to pinpoint specific street segments in Gurugram for in-depth analysis. By comparing these areas against the principles of comprehensive street planning and design, the study seeks to uncover existing shortcomings and challenges. Ultimately, the paper advocates for a structured approach to assess and address these issues, with the goal of creating safer and more accessible streets for all residents.

Introduction

The phenomenon of rapid urbanization worldwide places significant strain on existing urban infrastructure, necessitating immediate action for a more sustainable future. A crucial aspect of building better cities lies in enhancing street networks and connectivity. For nearly half a century, street design prioritized accommodating vehicles, suppressing alternative modes of mobility.

The post-World War II boom in the automobile industry drastically escalated congestion, traffic delays, air pollution, road accidents, and unsafe street conditions. Over the past three decades, many countries, including the United States, Australia, and Europe, have recognized the importance of complete streets—those designed to cater to all users, not just cars. Transport agencies worldwide are increasingly prioritizing safe, accessible, and multi-modal options,

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shifting away from the previous engineer-driven, car-centric approach. The introduction of the complete street mission in North America in 2009 marked a pivotal shift towards prioritizing people over vehicles in street design. This policy emphasizes the inclusion of all user types in street planning and design considerations. Such policies act as guidelines for city network development, ensuring consistency throughout urban areas.

India, experiencing rapid urbanization, with Delhi ranking second globally after Japan, exemplifies this trend. Gurugram, part of the National Capital Region (NCR) and dubbed "The Millennium City," has witnessed explosive population growth, contributing significantly to urbanization trends. Census data shows a population increase of over 200% from 2001 to 2011, with more than two-thirds classified as urban residents. However, this rapid growth has led to severe traffic congestion, waterlogging, and air pollution issues. Many Indian cities have embraced the complete street policy, retrofitting streets to accommodate diverse user needs. Understanding the context, user types, and existing street design elements is crucial before embarking on street design or redesign projects. Streets should be viewed holistically as three-dimensional spaces, not merely transportation corridors, but also as vital community gathering areas. This research paper aims to identify specific street stretches in Gurugram to evaluate the completeness of their planning and design. It seeks to assess urban design elements for pedestrians, striving for safe, accessible, context-sensitive, and multi-modal streets. The paper's scope is delimited to defining study areas and outlining selection criteria for further research endeavors.

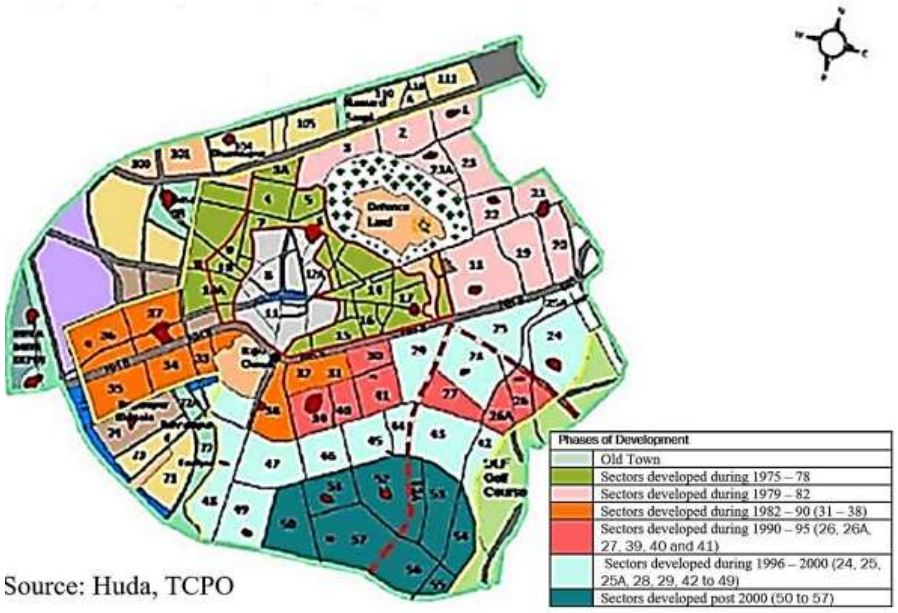

Figure 1: Phase wise development of Gurugram as per TCPO, Haryan

As Gurugram has developed over the years, its transportation network has undergone significant intensification, particularly in terms of street width and hierarchy. Initially, the old town featured narrow streets, which were later widened as new sectors emerged. The evolution of street

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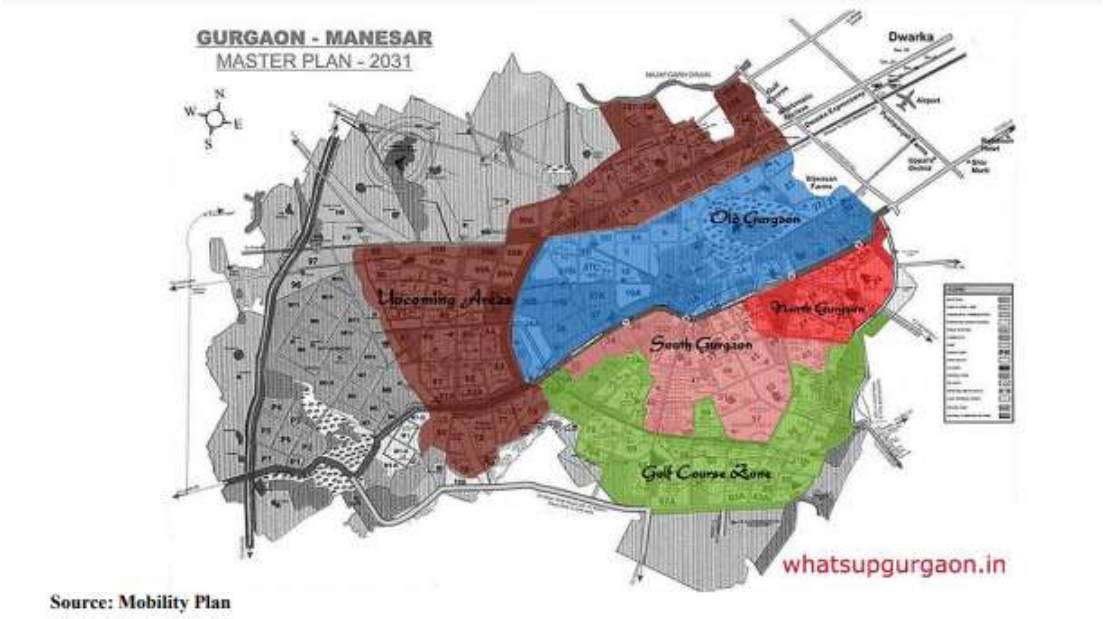
planning in Gurugram began with local streets at 6 meters wide, followed by collector streets at 12 meters wide, which then connected to 30-meter wide arterial roads. However, with time, there have been revisions to these dimensions.

According to the Haryana Urban Development Authority (HUDA), local streets have increased to a minimum of 12 meters wide. The road hierarchy has also evolved, with local streets now ranging from 12 meters to 18 meters wide, connecting to collector streets of 18 meters width, which in turn link to arterial roads of 30 meters and 60 meters width, also known as sector roads. The Master Plan of 2031 for Gurugram indicates further expansions in road width, particularly for sector roads, which are slated to become 60 meters and 75 meters wide. This represents a significant increase from the previous standard of 30 meters wide sector roads in older sectors. Additionally, some areas under development already feature 60-meter wide roads, functioning as collector roads.

In the 1970s, the old town featured local streets at 6 meters wide, collector streets at 9 meters and 12 meters wide, and arterial roads ranging from 18 meters to 30 meters wide. As new sectors emerged in subsequent decades, there were consistent patterns of wider streets being developed, reflecting the city's expanding infrastructure needs. By the 2000s, sectors developed during this period saw local streets ranging from 10 meters to 12 meters wide, collector streets at 18 meters wide, and arterial or sub-arterial roads at 30 meters and 60 meters wide. Looking ahead to the proposed developments in the Master Plan of 2031, sectors from 58 to 100 are slated to have local streets at 12 meters wide, collector streets ranging from 15 meters to 24 meters wide, and arterial or sub-arterial roads at 60 meters and 75 meters wide, signifying a substantial increase in road width compared to previous phases of development.

This evolution in street width and hierarchy reflects the dynamic growth of Gurugram and the continuous adaptation of its infrastructure to meet the demands of a rapidly expanding urban environment.



Source: Mobility Plan

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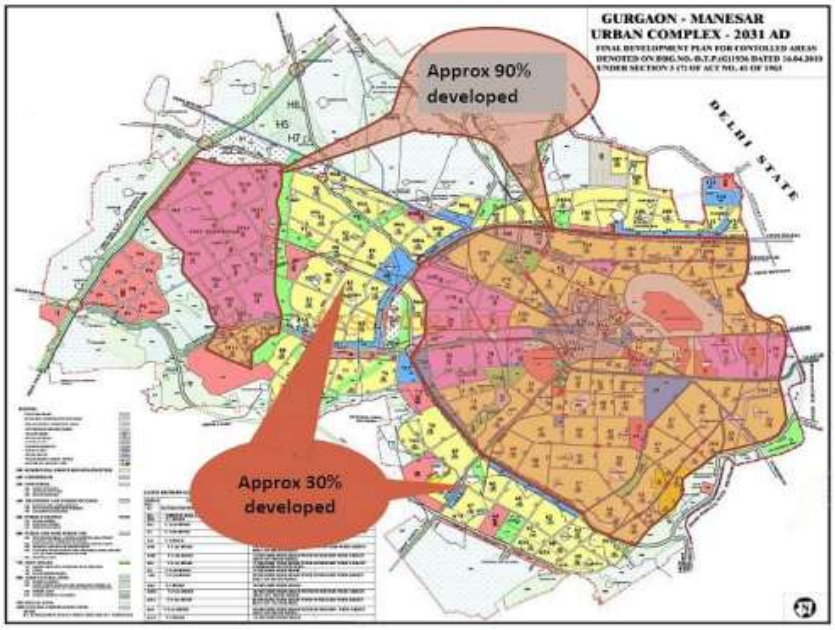
Figure 2: Zonal divisions in Gurugram



Source: GMDA

Figure 3: Development in Gurugram

In the Gurugram Master Plan of 2031, street functions are delineated based on land uses, with particular focus on collector and local streets due to their high accessibility and significant contribution to the total road area. The research scope will primarily encompass these street types, as specified in IRC106 (1990). According to the Integrated Mobility Plan (IMP) of 2008, Gurugram witnessed a daily registration of 250 vehicles, with approximately two-thirds being cars and two-wheelers. Personal usage accounted for around 30% of registered cars and 22% of two-wheelers. However, the city's public transport infrastructure remains limited, reflecting a predominantly car-centric approach as outlined in the IMP report of 2010. This inadequacy in public transport provision has led to a rise in alternative modes of intermediate public transport. Traffic patterns in Gurugram are predominantly characterized by two-wheelers and cars, with public transport playing a significantly smaller role. Data indicates that two-wheelers account for the highest number of trips per day, followed closely by four-wheelers, auto-rickshaws, and then public transport. The dominance of two-wheelers and cars in daily commuting underscores the need for comprehensive transportation planning that addresses the diverse mobility needs of Gurugram's residents while promoting sustainable modes of travel. By focusing on the functions and usage patterns of collector and local streets, the research aims to provide insights into improving urban mobility and enhancing accessibility within the city.

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Motivation for the study

Gurugram, situated approximately 20 kilometers from the international airport and strategically located on NH-8, has emerged as a prominent commercial, real estate, IT, and automobile manufacturing hub. Contributing significantly to India's GDP, Gurugram accounts for about 0.6% of the nation's economic output. Notably, the city boasts a higher vehicle ownership rate compared to Delhi, with 43% of households owning two-wheelers and 33% owning four-wheelers. The vehicle occupancy rate stands at 240 per 1000 persons, reflecting the city's heavy reliance on private transport. Every day, nearly 300,000 people commute to Gurugram, primarily for work and business purposes. However, the city's rapid urbanization has strained its infrastructure, particularly its transportation facilities. Challenges include inadequate and unaffordable public transportation, overcrowded and unreliable buses and autos, insufficient parking facilities, street congestion, poor road conditions, inadequate street lighting, and heightened pollution levels.

Gurugram's pollution woes have earned it the dubious distinction of being ranked as the world's most polluted city by the WHO in 2019, with vehicle emissions and construction activities identified as major contributors. Despite comprising predominantly residential, commercial, institutional, and open space areas, the city's street network primarily consists of four-lane or two-lane streets, with collector and local streets accounting for 53% of the total street length. To address these challenges, a comprehensive study of street completeness will be conducted through extensive surveys of selected street stretches. This analysis will prioritize addressing existing shortcomings and will involve active participation from residents. By developing exemplary street stretches, this initiative aims to serve as a model for improving other streets in Gurugram and potentially in other cities across India, with adaptable variables to suit local contexts. Through such efforts, Gurugram can work towards enhancing its urban infrastructure and fostering more sustainable and livable environments.

In Gurugram, the road network encompasses various types, including highways, arterial, sub-arterial, and collector/local streets. Notably, approximately 53% of the total road network length is dedicated to collector and local street functions, highlighting their significance in urban mobility. According to the Gurugram Master Plan 2031, there are 16 types of roads identified, with four road hierarchies falling under the collector and sub-collector category. These roads vary in width and function, accommodating different levels of traffic and serving diverse purposes within the city.

For instance, V-2 roads, with a width of 60 meters and four lanes, typically function as collector or neighborhood roads, catering to moderate to high vehicular traffic. These roads play a crucial role in connecting various parts of the city and facilitating smoother traffic flow. Conversely, V-4 roads, which are narrower at 24 meters wide with two lanes, primarily serve local neighborhoods with lower traffic volumes. These streets are designed to provide access to residential areas and facilitate local movement within neighborhoods. Furthermore, sector plans complement the Master Plan by delineating roads based on their width and function. These plans include roads ranging from 12 meters to 18 meters wide, serving specific sectors and addressing

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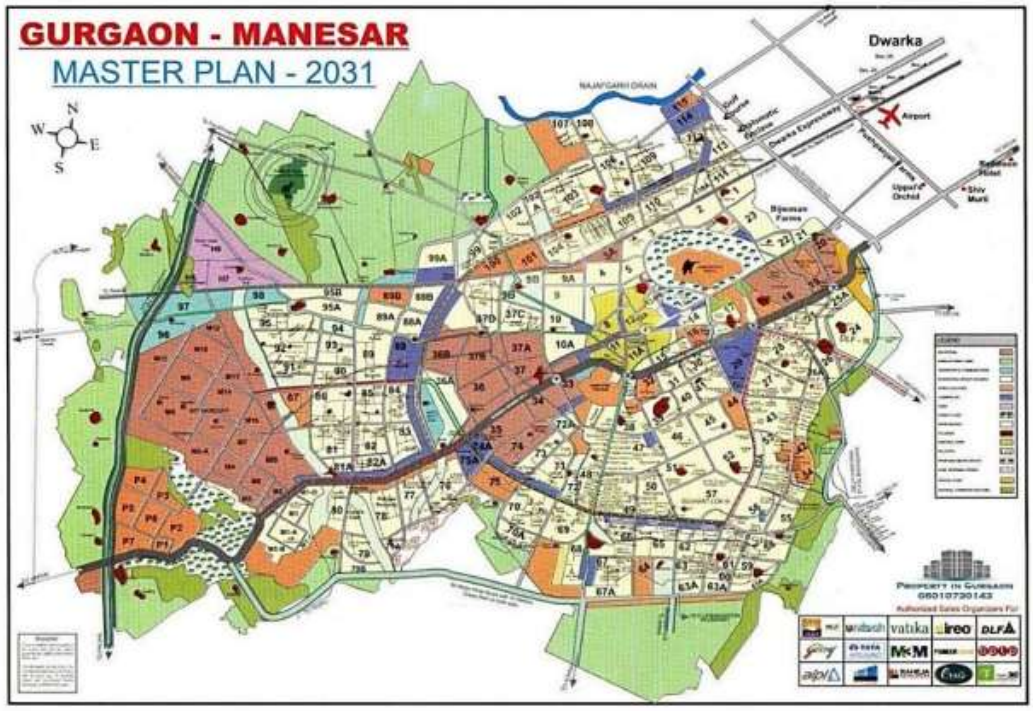
localized traffic needs. The selection process for study areas considers the diverse functions and characteristics of streets, as well as their alignment with land-use patterns. For instance, commercial streets witness high pedestrian activity, while institutional areas may experience lower foot traffic. By understanding these dynamics, researchers can prioritize areas for investigation based on their functional significance and potential impact on safety and accessibility. Ultimately, the selection of study areas involves a comprehensive assessment of street function, land use, and road characteristics. By targeting specific street types and their associated land uses, researchers can gain valuable insights into the effectiveness of existing infrastructure and identify areas for improvement to enhance urban mobility and livability in Gurugram.



Source: TCPO, Gurugram

Figure 4: Master Plan Gurugram 2031

In Gurugram, the intricate relationship between street functions and land uses significantly influences the city's urban fabric and overall quality of life. A comprehensive overview of how different types of streets accommodate various land uses, ranging from residential and commercial to institutional and open spaces. This data underscores the dynamic nature of urban environments, where streets serve as vital connectors between diverse activities and functions. For instance, streets like Badshapur road in Sector 51 and 57 primarily feature residential properties, fostering a sense of community and neighborhood connectivity. On the other hand, thoroughfares like Satyapaul Mittal Marg in Sector 46 and 47 seamlessly blend residential and commercial establishments, reflecting the mixed-use character of modern urban centers.

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Furthermore, the focus on 30-meter wide roads for in-depth study highlights their pivotal role in accommodating a wide range of urban land uses. These roads, predominantly located in established sectors of Gurugram, represent key corridors where residential, commercial, institutional, and open space activities converge. By examining these streets in detail, urban planners and policymakers can gain valuable insights into the complex dynamics of street design, land use integration, and pedestrian experience. Through stakeholder engagement and data-driven analysis, initiatives can be developed to optimize street functionality, enhance accessibility, and promote sustainable urban development. Ultimately, by understanding and leveraging the interplay between street functions and land uses, Gurugram can aspire to create more vibrant, inclusive, and resilient urban spaces for its residents and visitors alike.

Source: Digitized map from Master Plan 2031

Figure 5: 30 mt wide Streets in yellow

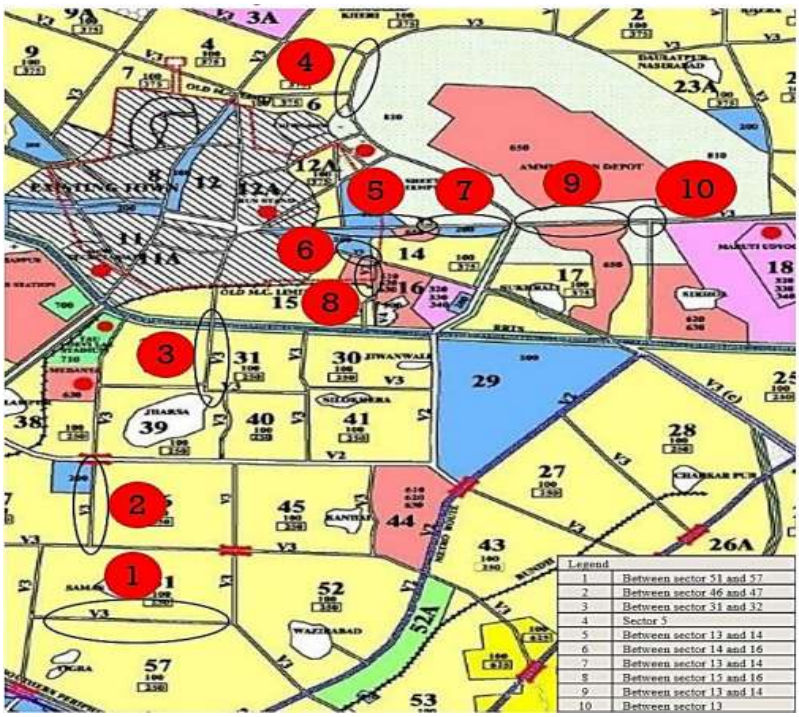

Figure 6: Figure showing the identified study area locations on master plan 2031

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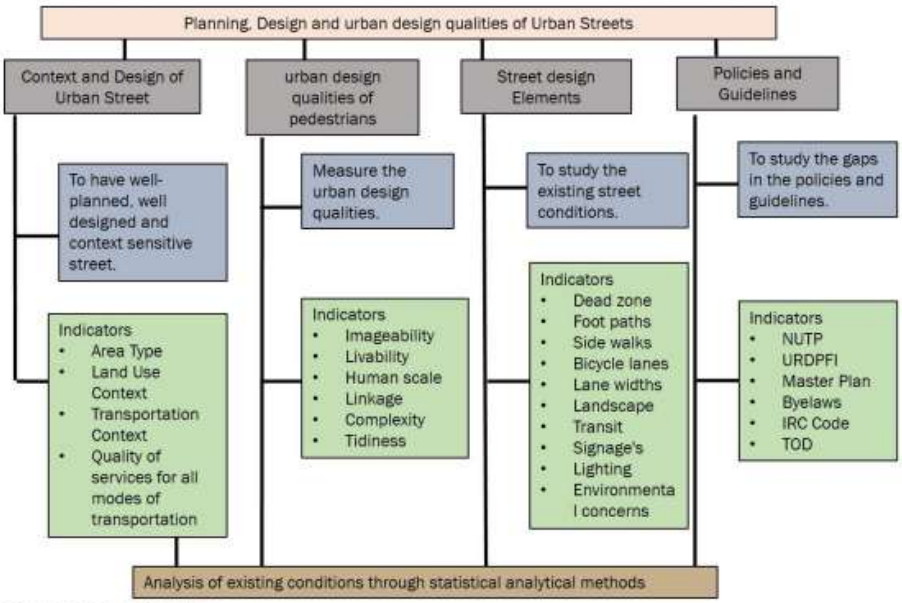

Source: Research work

Figure 7: Methodology adopted to identify the parameters to study completeness of the street

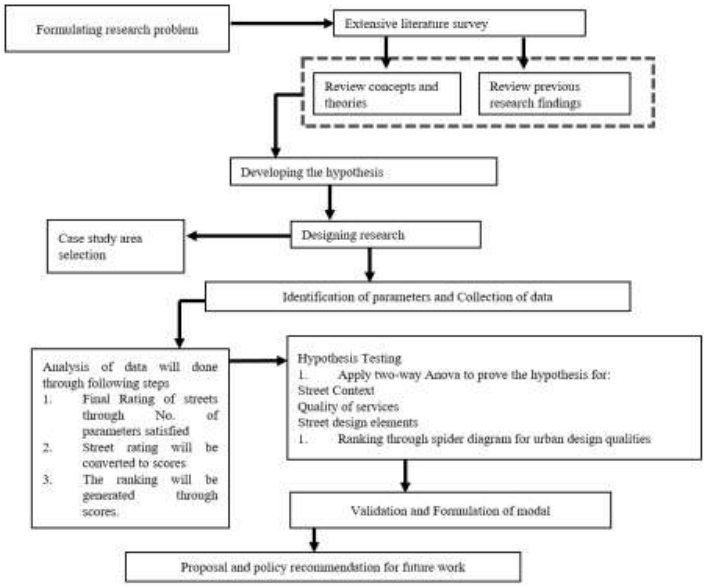

Figure 8: Methodology for further research

The survey was designed to analyze street planning and design at various levels, aiming to provide a comprehensive understanding of urban streetscapes. Firstly, an overall context study of streets was conducted, examining factors such as existing land use, zoning regulations, built mass development, and urban design character. This stage provided insights into the broader environment in which streets operated. Secondly, the overall quality of services provided by streets was assessed, focusing on aspects like street character, function, and design features. These two levels of analysis offered a holistic view of street performance and functionality within the urban landscape.

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Table 1: Overall level of characteristics for street context as per field survey

Street Badshapur Road Stretch	Rating	Existing Land Use and Zoning	Built Mass Development and Urban Design Character	Development Regulations, Existing and Proposed	Street Character and Function	Street Design Features
A	-	1	-	-	-	-
B	1	-	1	1	-	-
C	-	1	-	-	-	1
D	1	1	1	2	2	5
E	-	-	-	2	2	3
Final Rating	D	D	E	E	D	-

Subsequently, the survey delved into more detailed levels of analysis, evaluating specific street planning and designing elements. This included scrutinizing parameters such as street context, quality of services, and street design features for each identified street stretch. Utilizing a rating system ranging from A to E, with A denoting the best and E indicating the worst, streets were assessed based on their performance against each parameter. The final rating awarded to each street stretch was determined by the lowest grade earned among all parameters, ensuring that improvement measures could be prioritized effectively.

Table 2: Cumulative rating for all the identified streets and parameters as per field survey

and Design Parameters	Street Stretches	rs	ur Road	Marg	Marg	Road	ad)	Road)	Old Delhi Gurgaon Road
Street Context	Existing Land Use and Zoning	D	B	C	C	D	D	D	Development Mass Development and Urban Design Character
Quality of Services	Street Zones and Design	D	D	D	D	E	E	E	Design as per Pedestrian
Street Design Elements	Development Zone	C	C	C	D	E	D	C	Side Walks

Additionally, the survey measured urban design qualities for pedestrians, focusing on physical characteristics such as imageability, enclosure, human scale, transparency, and complexity of the street environment. These assessments provided valuable insights into the strengths and weaknesses of Gurugram's street infrastructure, serving as a guideline for future street improvements and urban planning initiatives. Moreover, the data collected was subjected to

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statistical analysis, including two-way ANOVA, to validate hypotheses and inform evidence-based decision-making in urban design and planning processes. Overall, the survey aimed to enhance the understanding of street design and functionality in Gurugram, ultimately contributing to the creation of safer, more accessible, and aesthetically pleasing urban environments.

Conclusion

The conclusions drawn from the study highlight the diverse range of factors influencing street planning and design in the selected case study area. It's evident that the collector streets and local streets, which account for over 50% of Gurugram's street network, play a crucial role in the city's accessibility. Therefore, recommendations formulated based on the analysis of these streets can be extrapolated to improve other streets across the city. The study has identified both strengths and weaknesses within the existing street infrastructure, offering insights into opportunities for enhancement and potential threats that need to be addressed.

Moving forward, further research will be instrumental in gaining deeper insights into each parameter influencing street planning and design. By understanding the nuanced contributions of each parameter, the study aims to prioritize areas requiring improvement in street design and urban planning. Through quantitative evaluation methods, the completeness of streets in Gurugram can be assessed, facilitating targeted interventions to address shortcomings and enhance overall street functionality. Ultimately, the goal is to transform Gurugram into a walkable city characterized by well-connected, well-designed walkways, and comprehensive facilities for non-motorized travel needs.

Moreover, the study's findings will provide valuable guidance to various stakeholders, including statutory bodies, policymakers, planners, and engineers. By identifying gaps in existing policies and planning strategies, the study offers an opportunity to strengthen regulations and promote consistent street design standards throughout the city. This approach aims to create a cohesive and inclusive street network accessible to all types of users, prioritizing safety and accessibility. By integrating the study's recommendations into future urban development initiatives, Gurugram can evolve into a city that prioritizes pedestrian-friendly infrastructure and fosters sustainable modes of transportation. Overall, the insights gleaned from this study will serve as a roadmap for creating vibrant, livable, and resilient urban environments in Gurugram and beyond.

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