CHAPTER 129

Study of Traffic Management at Road Intersection in Pune

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ABSTRACT

Pune, is a rapidly growing tier-two city in India, faces severe traffic congestion due to its booming population and inadequate road infrastructure. With a projected population of 12.5 million in 2024 and over 4.3 million registered vehicles, the city's roads struggle to meet demand. A 2023 report ranked Pune as the second most congested city in India and seventh globally. While the city has extensive road networks, poorly planned intersections create bottlenecks. Pedestrians face additional challenges, with limited crossing times at signals. The study focuses on addressing the traffic congestion challenges at intersections in Pune, a rapidly growing city in India. The research identifies intersections as critical points contributing to urban traffic bottlenecks and aims to assess their conditions comprehensively. The city's road network, despite its extensive reach, faces limitations due to poor intersection designs and lack of adherence to Indian Road Congress (IRC) standards. Through both qualitative and quantitative methodologies, the study evaluates various intersections across Pune, identifying key deficiencies such as inadequate lane markings, absence of stop lines, and non-engineered junctions. Drawing insights from literature and practical observations, the research emphasizes improving intersection management. Recommendations include implementing rational designs that prioritize pedestrian and cyclist safety, optimizing traffic signals, and integrating channelization measures to streamline vehicle flow. Additionally, the study suggests leveraging modern technologies like intelligent transportation systems to enhance traffic efficiency.

Keywords: Traffic congestion; Bottlenecks; Indian standards and research; Poor intersection design; Indian road congress (IRC); Qualitative and quantitative methodology.

1.0 Introduction

Urbanization and population growth have significantly impacted traffic conditions in cities worldwide, and Pune, a rapidly expanding tier-two city in India, is no exception. With increasing vehicle ownership and inadequate road infrastructure, traffic congestion has become a critical issue, particularly at intersections.

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These intersections serve as crucial nodes in the road network, and inefficient traffic management at these points often results in delays, road safety hazards, and poor commuting experience. The current road infrastructure struggles to accommodate the growing number of vehicles, leading to congestion, increased travel time, and higher fuel consumption. Addressing these issues requires a systematic approach to traffic management, focusing on improving intersection design, optimizing signal coordination, and integrating intelligent traffic control measures. Pune is the ninth most populated city in India and serves as a major educational, industrial, and IT hub.

As the city continues to expand, the demand for transportation increases, putting immense pressure on its existing road network. According to recent traffic studies, Pune ranks among the most congested cities in India, with several key intersections experiencing severe traffic delays. The lack of efficient traffic signal coordination, improper lane markings, absence of pedestrian crossings, and encroachments further contribute to intersection inefficiencies. Pedestrians often struggle to crossroads safely due to short signal durations, while non-motorized transport users face challenges due to inadequate infrastructure. These issues highlight the urgent need for a comprehensive study to assess and improve intersection management strategies in Pune.

This research aims to analyze traffic flow at selected roadway intersections in Pune, identifying key congestion points and assessing their compliance with Indian Roads Congress (IRC) guidelines. The study involves data collection on vehicle movement, pedestrian flow, and intersection design using field surveys, video analysis, and other observational techniques. By evaluating these parameters, the research seeks to propose effective solutions, such as signal optimization, geometric modifications, and implementation of intelligent traffic management systems (ITMS), to enhance overall traffic efficiency. With cities like Pune continuing to expand, sustainable traffic management solutions are essential for ensuring smooth urban mobility. This study contributes to the growing body of research aimed at developing data-driven, technology-integrated, and sustainable traffic management strategies. By adopting innovative approaches and adhering to best practices in urban planning, Pune can significantly enhance its transportation infrastructure and improve the overall commuting experience for residents and visitors alike.

2.0 Literature Review

Widianty & Hasyim (2023) examined intersection traffic management through simulation-based modeling, identifying alternative routing and congestion mitigation strategies. Similarly, Chen & Xu (2020) introduced a connected-vehicle system for managing non-signalized intersections. This system organizes vehicles into virtual platoons and employs distributed control mechanisms to ensure smooth and conflict-free movement. Cheng & Zu (2018) studied spatial and temporal crash analysis, identifying accident-prone areas and

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proposing data-driven intersection safety measures. Recent research highlights the increasing role of artificial intelligence (AI) and intelligent transportation systems (ITS) in traffic control. Ozioko & Kunkel (2022) explored the integration of autonomous and human-driven vehicles, identifying challenges related to mixed-traffic behavior. Vasirani & Ossowski (2012) emphasized the effectiveness of multi-agent systems in ITS, allowing decentralized control for better traffic regulation. Gholamhosseinian & Seitz (2022) investigated Vehicle-to-Everything (V2X) technology, which enhances communication between vehicles and traffic infrastructure, ensuring real-time adaptive traffic control.

Non-motorized transport (NMT) is crucial for sustainable urban mobility. Beura & Bhuyan (2018) developed a Bicycle Level of Service (BLOS) model to assess urban cycling conditions, emphasizing the need for safer intersection designs for cyclists. Alkhatib & Maria (2022) introduced an Urban Traffic Control (UTC) system, which leverages real-time vehicle density analysis to optimize traffic light timings and lane prioritization, reducing wait times and congestion. Afrin & Yodo (2020) explored self-organizing traffic signal systems, which adjust dynamically based on real-time traffic demands, significantly enhancing intersection efficiency.

Several studies focus on smart intersection designs. Gupta (2018) and Singh & Akhtar (2015) analyzed adaptive traffic signal control systems, which use real-time data to regulate signal phases and improve flow efficiency. These systems reduce congestion by automatically adjusting to traffic variations. Additionally, Indhiradevi *et al.* (2020) investigated mixed-traffic congestion modeling, particularly in developing countries where lane discipline is weak. The literature highlights the growing role of AI-based traffic management, real-time signal adaptation, and sustainable transport planning in improving urban mobility. However, there is a lack of research on localized solutions for fast-growing Indian cities like Pune, where rapid urbanization and diverse traffic patterns pose unique challenges. Addressing this gap through intersection-specific improvements, better NMT integration, and AI-driven traffic regulation could significantly enhance Pune's traffic conditions.

3.0 Methodology

In this study, various road intersections were identified and examined to assess traffic management challenges. During the field visits, several key variables influencing traffic flow and congestion were observed. These variables were categorized into two types: quantitative and qualitative parameters. Quantitative parameters include measurable factors such as traffic volume, vehicle composition, intersection geometry, al timing, and average vehicle delay. These parameters provide numerical data essential for statistical analysis and traffic modeling. Qualitative parameters, on the other hand, focus on non-measurable factors that influence traffic conditions, such as road surface conditions, visibility at intersections, pedestrian movement patterns, driver behavior, and enforcement of traffic rules. These factors play a crucial role in understanding the practical challenges faced by road users.

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3.1 Study location

The six intersections in Pune Western Region were identified as having many bottlenecks in various city areas. The major focus areas are in Wakad, Hinjewadi and Baner, which are highly populated and face a lot of traffic problems during day and evening time. The locations identified are Kokane Chowk and Sakharam Waghmare Chowk in Wakad, Infosys Circle Phase 1, Kasturi Chowk, Panchratna Chowk in Hinjewdi and Ganraj Chowk at Baner.

3.2 Data collection methods

A survey was carried out at each selected intersection, and the gathered data was classified into categories, including quantitative and qualitative parameters. The quantitative parameters include factors such as traffic volume, signal timing and average vehicle delay. The qualitative parameters will be focusing on factors such as traffic condition, road surface condition, pedestrian movement pattern, and driver behavior.

4.0 Data Analysis and Interpretation

4.1 Traffic data analysis and observation

4.1.1 Kokane Chowk

Kokane Chowk, situated in Pune's Pimple Saudagar area, is a key intersection linking Rahatani, Pimple Saudagar, and Nashik Phata. Due to its strategic location and heavy traffic during peak hours, congestion is a frequent issue. Although the intersection lacks traffic signals, it includes divisional, centralized, and channelized islands. Pedestrian facilities such as zebra crossings and footpaths are available, while the road features flexible pavement with a drainage system. Additionally, road markings and signage help guide traffic movement. The intersection's traffic flow data is detailed in the table below.

Table 1: Traffic Data Collection at Kokane Chowk (Hourly)

Directions	**Right**			**Straight**			**Left**		
Traffic from approach road	**LV**	**HV**	**TW**	**LV**	**HV**	**TW**	**LV**	**HV**	**TW**
North	115	10	200	150	25	190	220	30	190
South	280	25	195	130	15	100	180	14	150
East	150	15	230	240	5	180	100	15	160
West	140	10	210	160	17	130	250	25	170
Total	**685**	**60**	**835**	**680**	**62**	**600**	**750**	**84**	**670**
Total Vehicles from all Sides	**4426**								

4.1.2 Panchratna Chowk

Panchratna Chowk, located in Pune's Hinjawadi area, is a key intersection in a rapidly developing region. The area's growth, driven by IT parks, residential complexes, and commercial hubs, has led to infrastructure improvements.

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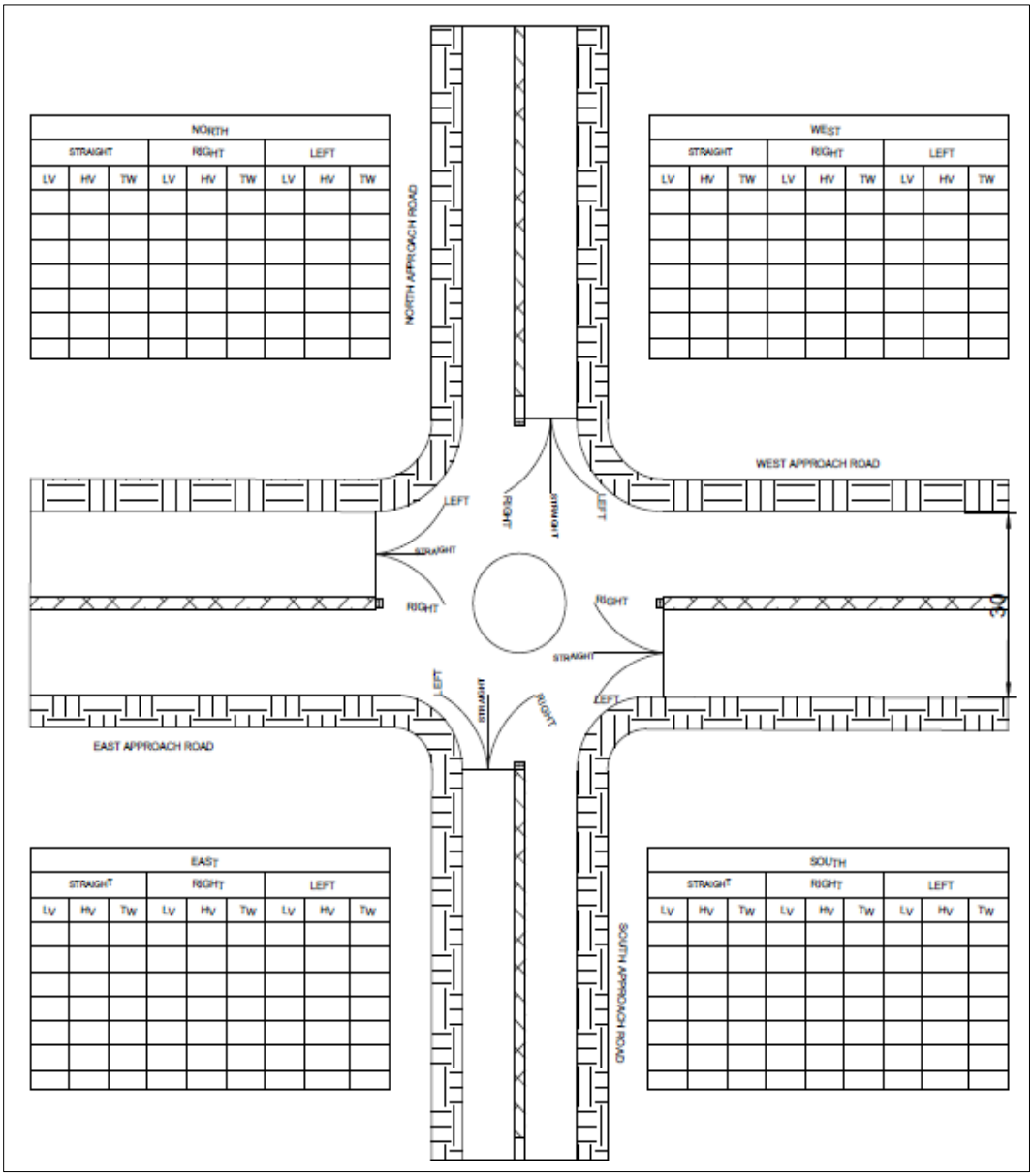
Figure 1: Traffic Data Collection Sheet



This signalized intersection features divisional islands but lacks zebra crossings and footpaths. The road consists of flexible pavement without a drainage system, while road markings and signage are in place to assist traffic movement.

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Figure 2: Existing and Proposed Intersection at Kokane Chowk

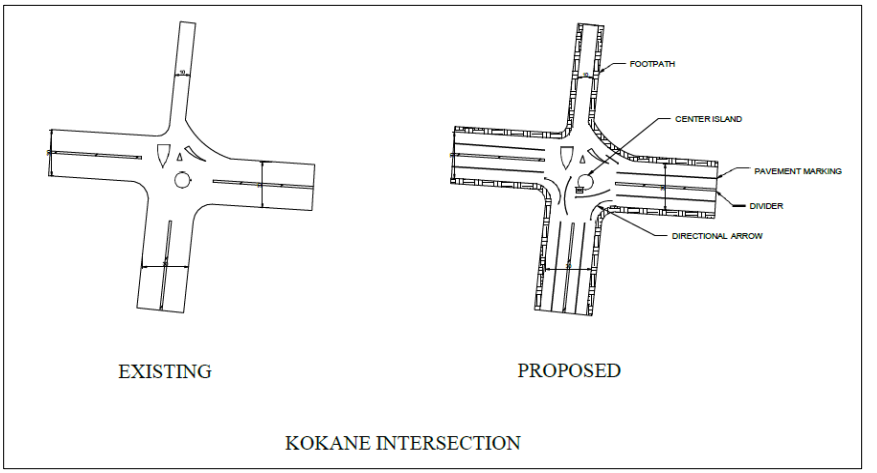
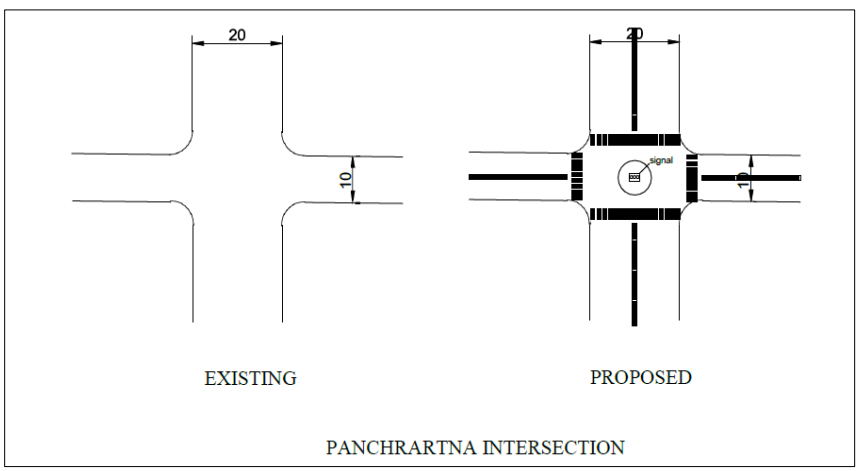


Table 2: Traffic Data Collection at Panchratna Chowk (Hourly)

Directions	**Right**			**Straight**			**Left**		
Traffic from approach road	**LV**	**HV**	**TW**	**LV**	**HV**	**TW**	**LV**	**HV**	**TW**
North	300	19	350	209	10	310	268	25	295
South	197	10	267	240	15	188	350	18	235
East	150	5	249	390	25	321	180	12	239
West	215	13	312	210	14	280	190	24	180
Total	**862**	**47**	**1178**	**1049**	**64**	**1099**	**988**	**79**	**949**
Total Vehicles from all Sides	**6315**								

Figure 3: Existing and Proposed Intersection at Panchratna Chowk



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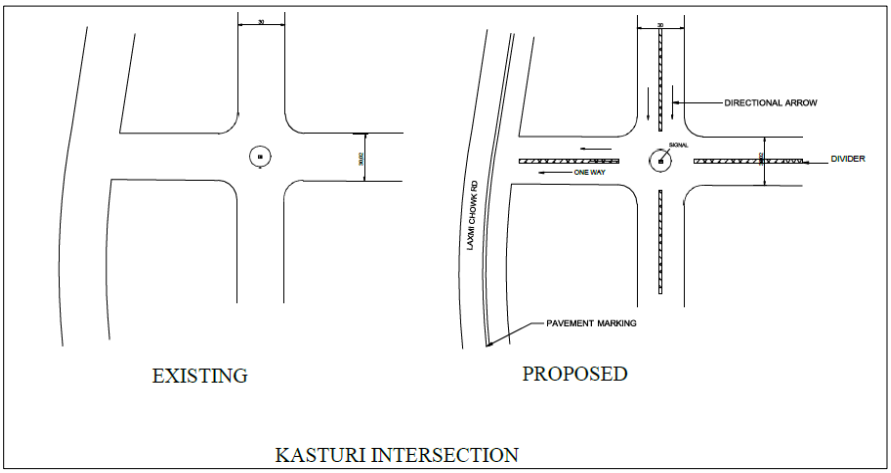
4.1.3 Kasturi Chowk

Kasturi Chowk, located in Pune's Wakad area, is a crucial intersection that ensures smooth connectivity to nearby regions, benefiting both commuters and residents. Designed to enhance traffic flow and minimize congestion during peak hours, this signalized intersection includes divisional and centralized islands. It features zebra crossings, footpaths, and rigid pavement with a drainage system, while road markings and signage aid in traffic management.

Table 3: Traffic Data Collection at Kasturi Chowk (Hourly)

Directions	**Right**			**Straight**			**Left**		
Traffic from approach road	**LV**	**HV**	**TW**	**LV**	**HV**	**TW**	**LV**	**HV**	**TW**
North	200	25	250	180	11	236	205	19	288
South	197	16	316	209	15	281	319	18	349
East	216	21	250	309	26	319	251	25	267
West	180	11	210	291	29	250	211	12	188
Total	**793**	**73**	**1026**	**989**	**71**	**1086**	**986**	**71**	**1092**
Total Vehicles from all Sides	**6190**								

Figure 4: Existing and Proposed Intersection at Kasturi Chowk



4.1.4 Ganraj Chowk

Ganraj Chowk, situated in Pune's Baner area, is a key intersection that facilitates smooth connectivity to nearby regions, benefiting both commuters and residents. Its location near major roads ensures easy access to essential services. This signalized intersection includes divisional islands, zebra crossings, and footpaths. The road features rigid pavement with a drainage system, while road markings and signage support traffic regulation.

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Table 4: Traffic Data Collection at Ganraj Chowk (Hourly)

Directions	Right			Straight			Left		
Traffic from approach road	LV	HV	TW	LV	HV	TW	LV	HV	TW
North	349	17	291	180	30	200	230	4	257
South	276	5	310	197	10	225	246	6	261
East	480	29	370	450	40	550	324	10	270
West	409	10	340	490	15	514	450	10	441
Total	**1514**	**61**	**1311**	**1317**	**95**	**1489**	**1250**	**30**	**1229**
Total Vehicles from all Sides	**8296**								

Figure 5: Existing and Proposed Intersection at Ganraj Chowk

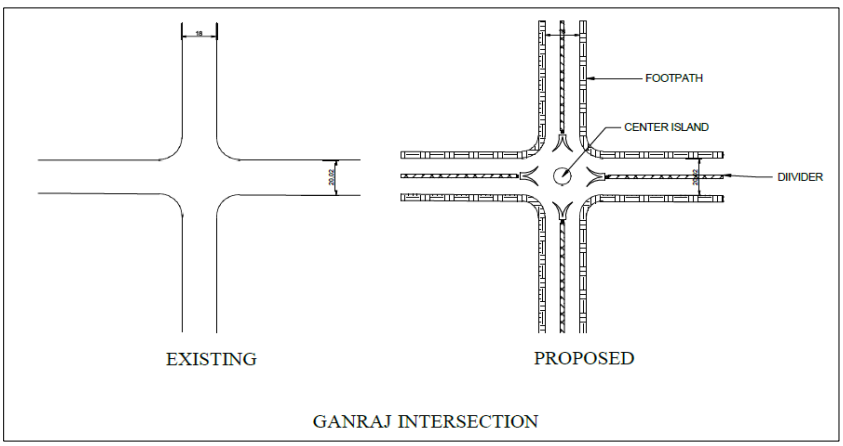

Table 5: Traffic Data Collection at Sakharam Waghmare Chowk (Hourly)

Directions	Right			Straight			Left		
Traffic from approach road	LV	HV	TW	LV	HV	TW	LV	HV	TW
North	187	10	165	120	7	135	145	15	160
South	198	17	170	105	3	120	160	7	75
East	230	5	30	240	5	100	210	10	240
West	260	10	60	260	10	100	180	5	220
Total	**875**	**42**	**425**	**725**	**25**	**455**	**695**	**37**	**695**
Total Vehicles from all Sides	**3974**								

4.1.5 Sakhram Waghmare chowk

Sakharam Waghmare Chowk, located in Pune's Wakad area, is a key intersection designed to improve traffic flow and reduce congestion during peak hours. Its accessibility to

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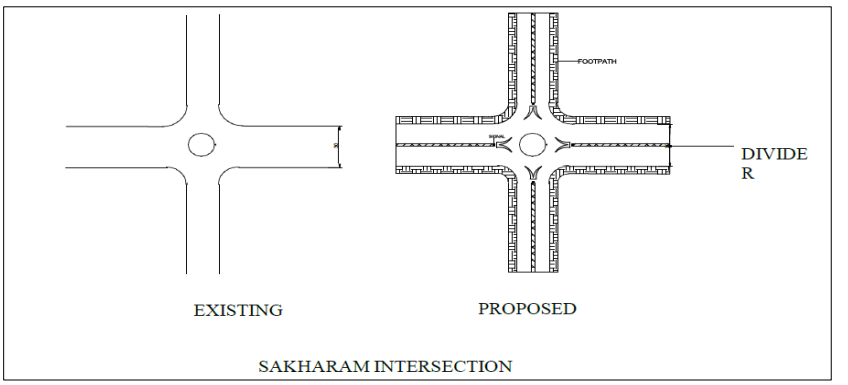
major roads enhances connectivity to essential services and amenities. Although the intersection lacks traffic signals, it includes divisional islands, zebra crossings, and footpaths. The road features rigid pavement with a drainage system, while road markings and signage assist in traffic management.

Figure 6: Existing and Proposed Intersection at Sakharam Waghmare Chowk



4.1.6 Infosys circle phase 1

Infosys Circle, located in Hinjawadi, Pune, is a major intersection near the Infosys Phase 1 campus within the Rajiv Gandhi Infotech Park, a key IT hub with numerous multinational companies. Although traffic signals are absent, the junction includes divisional and centralized islands, zebra crossings, and footpaths. It features flexible pavement with a drainage system, while road markings and signage aid in traffic management.

Table 6: Traffic Data Collection at Infosys Circle Phase 1 (Hourly)

Directions	**Right**			**Straight**			**Left**		
Traffic from approach road	**LV**	**HV**	**TW**	**LV**	**HV**	**TW**	**LV**	**HV**	**TW**
North	196	19	174	167	15	190	96	5	40
South	160	10	140	180	8	210	110	4	45
East	200	18	220	140	5	180	200	5	240
West	210	5	240	190	14	170	220	7	210
Total	**766**	**52**	**774**	**677**	**42**	**750**	**626**	**21**	**535**
Total Vehicles from all Sides	**4243**								

5.0 Conclusion

This study examines key traffic management challenges at selected roadway intersections in Pune, highlighting issues such as congestion, inefficient signal coordination, lack of pedestrian infrastructure, and inconsistent road markings. Peak-hour traffic analysis reveals that the absence of synchronized signal timing and poor lane discipline further contribute to delays and safety risks.

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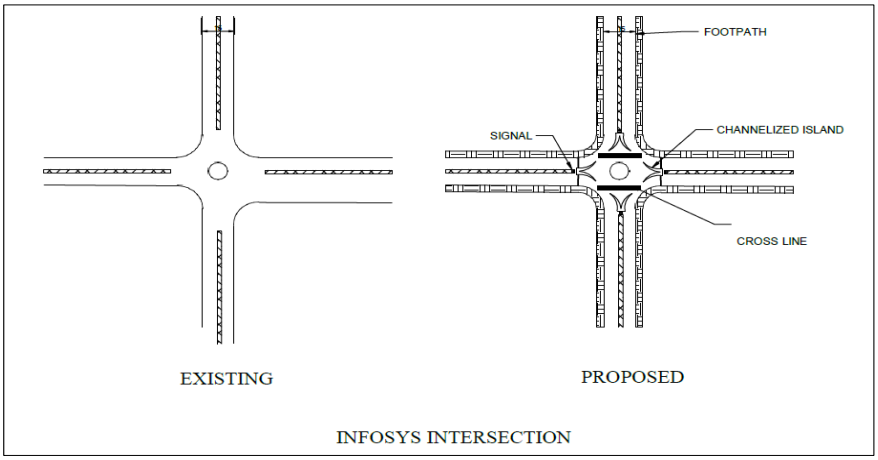
Figure 7: Existing and Proposed Intersection at Infosys Circle Phase 1



Addressing these problems is crucial for improving urban mobility and road safety. The study offers recommendations for multiple stakeholders, including government agencies, traffic police, urban planners, public transport authorities, and commuters. Implementing measures such as optimized signal coordination, enhanced road markings, channelized islands, and pedestrian-friendly infrastructure can significantly improve traffic efficiency and safety. Additionally, integrating intelligent traffic management systems (ITMS) can help regulate vehicle movement more effectively. Future research should focus on AI-driven traffic control, real-time simulation models, and sustainable transport solutions to enhance urban mobility. Expanding the study to a city-wide level and assessing the impact of non-motorized transport (NMT) can provide deeper insights into long-term traffic management strategies. Overall, traffic congestion at intersections is a pressing challenge that affects daily life and urban productivity. Addressing these issues requires a collaborative approach between urban planners, government bodies, and the public. Implementing data-driven solutions and advanced traffic management strategies will be essential in creating a safer, more efficient, and sustainable transport system for Pune.

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