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Study of Traffic Management at Selected Roadway Intersections in Pune

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Abstract
Pune's rapid expansion, driven by growth of its information technology sector, has placed the city's road network under intense pressure, with urban intersections emerging as the most critical points of conflict and delay. This paper presents a field-based study of traffic management conditions at six strategically important intersections in the western corridor of Pune: Kokane Chowk, Panchratna Chowk, Kasturi Chowk, Ganraj Chowk, Sakharam Waghmare Chowk, and Infosys Circle Phase 1. The study combines peak-hour classified traffic volume surveys with a systematic qualitative assessment of ten physical infrastructure parameters at each site, benchmarked against Indian Roads Congress (IRC) standards. Results show that every intersection studied has at least one significant infrastructure deficiency, with the complete absence of traffic signal control at three locations identified as the most urgent concern. Ganraj Chowk recorded the highest peak-hour volume, at approximately 8,296 vehicles, while Panchratna Chowk exhibited the most severe combination of high volume and infrastructural neglect. Based on the field evidence and applicable IRC guidelines, this paper proposes a phased, prioritized set of engineering interventions, including signal installation, channelization, pedestrian facility development, drainage improvement, and corridor-level signal coordination, to improve operational performance and safety at the studied locations.
Keywords: *Traffic management, urban intersections, traffic signal, channelization, Indian Roads Congress (IRC), level of service, Pune, pedestrian safety.*

I. Introduction

India's urban population grew by more than 200 million between 2001 and 2021, driving an explosion in private vehicle ownership and placing unprecedented pressure on city road networks. At the heart of this challenge are urban intersections, the points where competing traffic streams must share space and negotiate right of way, and which most often determine the performance of the entire network.

Pune, once known primarily as an educational city, has undergone a dramatic transformation since the 1990s driven by growth in its information technology and manufacturing sectors. The Hinjewadi Rajiv Gandhi Infotech Park alone employs more than three lakh professionals, and the western corridor of the city—Hinjewadi, Wakad, Pimple Saudagar, and Baner—has grown from semi-urban fringe into one of Maharashtra's most densely developed zones in a short span of time. Road infrastructure in this region has not kept pace with this growth: signal timing plans remain outdated, channelization is frequently absent, and pedestrian infrastructure has been squeezed by encroachment. In the 2023 TomTom Traffic Index, Pune ranked as the second most congested city in India and the seventh most congested city globally.

This research is motivated by the recognition that meaningful improvement does not require futuristic technology, but rather the systematic application of established traffic engineering principles already codified in IRC guidelines. This paper presents an evidence-based assessment of six key intersections in Pune's western region, identifies the deficiencies relative to IRC standards, and proposes targeted, practically implementable interventions.

The specific objectives of this study are: (1) to document traffic volume characteristics at six selected intersections, covering all approaches and vehicle categories; (2) to evaluate physical infrastructure against IRC standards; (3) to analyze the relationship between observed deficiencies and operational performance; (4) to propose targeted, cost-effective improvement measures; and (5) to develop a prioritized, phased implementation plan.

II. Literature Review

Traffic behavior at intersections differs fundamentally from mid-block flow because vehicles must periodically stop, yield, or slow to negotiate shared space. The saturation flow rate—the maximum discharge rate during continuous green—is the central parameter in intersection capacity analysis. Arasan and Koshy [1] found that mixed Indian traffic conditions produce saturation flow rates significantly different from Western references such as the Highway Capacity Manual, necessitating locally calibrated values.

Indian urban traffic is markedly heterogeneous: two-wheelers, which typically account for 50–70% of vehicle volumes, exhibit short headways and high maneuverability that standard saturation-flow models do not capture. Chandra and Kumar [2] developed Passenger Car Unit (PCU) equivalency factors for Indian mixed traffic—0.5 for two-wheelers, 0.75 for three-wheelers, 1.0 for cars, and 3.0–3.7 for heavy vehicles—that remain the basis for converting mixed traffic volumes into comparable units.

Channelization, using raised or painted islands to guide vehicles into defined paths, is among the most effective geometric tools for separating conflicting movements and reducing vehicle speeds at conflict points. IRC: SP: 41 provides detailed guidance on channelizing and central island design [4]. Ponnuswamy and Johnson [7] documented reductions in through-vehicle delay of 15–35% following the introduction of dedicated right-turn lanes at high-volume Indian intersections.

Webster [3] established the foundational formula for optimal signal cycle length, minimizing total vehicle delay as a function of approach volumes and saturation flow. IRC:93 [5] provides India-specific guidance on signal design and recommends that timing plans be reviewed at intervals of not more than three years—a recommendation frequently unmet in Indian cities. Adaptive control systems such as SCATS and SCOOT, deployed in cities including Bengaluru and Hyderabad, have reported travel-time reductions of 15–25%.

Pedestrian safety research indicates that properly marked zebra crossings at signalized intersections reduce pedestrian–vehicle conflicts by 40–60%, with the greatest benefit when combined with a protected pedestrian signal phase. Level of Service (LOS), as defined by the Highway Capacity Manual [8], is the standard qualitative measure of intersection performance based on average control delay; LOS C is generally regarded as the acceptable design target for urban arterials in the Indian context, though many of Pune's busiest intersections are estimated to operate at LOS D or E during peak periods.

While the literature establishes robust analytical methods and design standards, it does not substitute for site-specific field observation, since every intersection has a unique combination of geometry, control, demand, and land-use context. This study addresses that gap through direct field measurement at six representative intersections in Pune's western corridor.

III. Research Design and Methodology

This study adopts a mixed-methods approach combining quantitative peak-hour traffic volume surveys with systematic qualitative infrastructure assessment, interpreted through the lens of IRC guidelines.

A. Study Locations

Six intersections were selected from Pune's western corridor based on congestion level, strategic connectivity, diversity of control type, and accessibility: Kokane Chowk (unsignalized, six-lane), Panchratna Chowk (signalized, four-lane), Kasturi Chowk (signalized, four-lane), Ganraj Chowk (signalized, four-lane), Sakharam Waghmare Chowk (unsignalized, four-lane), and Infosys Circle Phase 1 (unsignalized, four-lane).

B. Traffic Volume Survey

Manual classified counts were conducted at each approach by four observers recording light vehicles (LV), heavy vehicles (HV), and two-wheelers (TW) separately for right, straight, and left movements at 15-minute intervals. Peak-hour volume was derived from the four consecutive 15-minute intervals with the highest combined volume; the Peak Hour Factor (PHF), computed as peak-hour volume divided by four times the maximum 15-minute volume, ranged from 0.82 to 0.94 across the study sites.

C. Qualitative Infrastructure Assessment

Ten physical parameters were assessed at each intersection: divisional islands, centralized islands, channelized islands, zebra crossings, footpaths, pavement type, drainage, signage, road markings, and presence of signalization. Site photographs were taken to support visual analysis.

D. Analytical Framework

Field data were compared against IRC standards, including IRC: SP:41 for at-grade intersection geometry, IRC:93 for signal design, IRC:35 for road markings, and IRC:67 for road signage, to identify specific deficiencies and to formulate engineering recommendations.

IV. Results and Analysis

Table I summarizes the peak-hour traffic volumes recorded at the six study intersections, and Table II summarizes the qualitative infrastructure assessment.

Table I: Peak-Hour Traffic Volume Summary

Intersection	Control	Lanes	Peak-Hr Volume (veh/hr)
Kokane Chowk	Unsignalized	6	4,426
Panchratna Chowk	Signalized	4	6,315
Kasturi Chowk	Signalized	4	6,190
Ganraj Chowk	Signalized	4	8,296
Sakharam Waghmare Chowk	Unsignalized	4	3,974
Infosys Circle Phase 1	Unsignalized	4	4,243

Table II: Qualitative Infrastructure Assessment (P = Present, A = Absent)

Intersection	Signal	Div. Isl.	Cent. Isl.	Chan. Isl.	Zebra	Footpath	Drain.	Markings
Kokane Chowk	A	P	P	P	P	P	P	P
Panchratna Chowk	P	P	A	A	A	A	A	A
Kasturi Chowk	P	P	P	A	P	P	A	P

Ganraj Chowk	P	P	A	A	P	P	P	P
Sakharam Waghmare	A	P	A	P	P	P	P	P
Infosys Circle Ph.1	A	P	P	A	P	P	P	P

A. Volume Characteristics

Ganraj Chowk recorded the highest peak-hour volume in the study at 8,296 vehicles, driven by a dominant east approach carrying a combined 2,523 vehicles per hour, characteristic of a major arterial corridor serving the Baner and Balewadi catchments. Panchratna Chowk and Kasturi Chowk followed closely at 6,315 and 6,190 vehicles per hour respectively, both situated within the high-demand Hinjewadi IT corridor. Two-wheelers constituted 46–48% of total volume at the busiest sites, consistent with the cost-conscious, predominantly young IT commuter demographic, while heavy vehicles ranged from approximately 3% to 5% of volume.

B. Infrastructure Deficiencies

Three intersections—Kokane Chowk, Sakharam Waghmare Chowk, and Infosys Circle Phase 1—operate entirely without traffic signal control despite carrying peak-hour volumes of approximately 4,000–4,400 vehicles, levels at which IRC and HCM guidance both indicate that signalization is warranted. Panchratna Chowk, the highest-demand intersection in the Hinjewadi corridor, lacks centralized islands, channelized islands, zebra crossings, footpaths, and drainage—the most deficient infrastructure profile of any site studied, despite carrying the second-highest volume overall. Ganraj Chowk and Kasturi Chowk, while signalized and otherwise reasonably equipped, both lack channelized islands, leaving turning movements ungoverned at high-volume conflict points.

C. Proposed Interventions

Based on field evidence and applicable IRC guidelines, this study recommends: (1) signal installation at Kokane Chowk, Sakharam Waghmare Chowk, and Infosys Circle Phase 1; (2) construction of channelized and central islands at Panchratna Chowk, Ganraj Chowk, and Kasturi Chowk; (3) complete pedestrian facility development—footpaths, zebra crossings, and protected signal phases—at Panchratna Chowk as the highest-priority safety intervention; (4) drainage improvement at Panchratna Chowk and Kasturi Chowk ahead of the monsoon season; (5) periodic review and optimization of existing signal timing plans at Panchratna, Kasturi, and Ganraj Chowks; and (6) an area-wide signal coordination strategy across the Hinjewadi corridor, estimated to reduce total corridor travel time by 15–20% even prior to physical infrastructure upgrades.

Table III: Priority Ranking of Key Interventions

Rank	Intervention	Location(s)	Timeframe
1	Signal installation	Kokane, Sakharam, Infosys	0–12 months
2	Pedestrian facilities	Panchratna (full); others (refresh)	0–12 months
3	Signal timing update	Panchratna, Kasturi, Ganraj	0–6 months
4	Channelization	Panchratna, Ganraj, Kasturi	12–36 months
5	Drainage works	Panchratna, Kasturi	12–24 months
6	Corridor signal coordination	Hinjewadi corridor	36–60 months

V. Conclusion

This study demonstrates that infrastructure deficiency, rather than traffic volume alone, is the primary determinant of poor intersection performance in Pune's western corridor. Every one of the six intersections studied was found to violate at least one applicable IRC standard, with absence of signal control at three high-volume locations identified as the single most urgent and cost-effective intervention available to authorities. Pedestrian infrastructure has been systematically neglected, most severely at Panchratna Chowk, the busiest intersection in the study. Because three of the six intersections lie within the same Hinjewadi corridor, an integrated, network-level signal coordination strategy offers substantial additional benefit beyond isolated, intersection-by-intersection improvements. The findings reinforce that addressing Pune's traffic congestion does not require novel technology, but the disciplined, evidence-based application of established IRC engineering principles, phased according to urgency and resource availability.

Future work should incorporate micro-simulation modeling to quantify expected delay reductions, a formal cost–benefit analysis of proposed interventions, pedestrian and cyclist volume counts, before–after evaluation once improvements are implemented, and consideration of emerging mobility trends such as electric two-wheelers and ride-hailing growth.

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