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A Traffic Volume Study of an Unsignalized Intersection to Determine Its Level of Service at Bindu Chowk, Kolhapur

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Abstract -*Understanding how traffic moves through urban intersections is key to improving road safety and efficiency. This study focuses on Bindu Chowk, a prominent yet unsignalized intersection in Kolhapur, to evaluate its current traffic conditions and determine its Level of Service (LOS). As the city continues to grow, Bindu Chowk experiences increasing traffic pressure, especially during peak hours. Using systematic traffic volume counts during both morning and evening peak periods, we analyzed vehicle flow patterns, composition, and delays. The collected data was then used to assess the intersection's performance using standard methodologies recommended by the Highway Capacity Manual (HCM) and Indian Road Congress (IRC). The study reveals how effectively—or inefficiently—the intersection operates and identifies the point at which traffic conditions begin to deteriorate. Based on the LOS evaluation, we provide insights into whether the intersection meets acceptable traffic service standards and suggest practical recommendations to enhance its performance. This research aims to support better traffic management strategies in Kolhapur and contribute to a smoother, safer urban commute.*

Key Words: **Traffic volume, Unsignalized intersection, Level of service, Bindu Chowk, Kolhapur, Traffic engineering**

1.INTRODUCTION

Urban areas around the world are facing growing traffic congestion, and Indian cities like Kolhapur are no exception. As population and vehicle ownership rise, the existing road infrastructure struggles to keep up, especially during peak hours. The result is frequent delays, higher fuel consumption, and increased stress for commuters. Among the most affected parts of a city's traffic network are intersections, where multiple traffic streams converge and often create bottlenecks.

Unsignalized intersections, in particular, require closer attention. Unlike signalized junctions that regulate vehicle movement through traffic lights, these intersections depend on driver judgment and right-of-way rules. This makes them more vulnerable to congestion, delays, and even accidents—especially during high-volume periods. Despite their common presence in smaller cities, unsignalized intersections are often overlooked in traffic studies.

This study focuses on Bindu Chowk in Kolhapur, a major unsignalized intersection that experiences heavy traffic daily. The **objectives** of this study are to collect and analyze traffic volume data, determine the intersection's Level of Service (LOS), and identify problem areas that hinder smooth traffic flow.

The scope of the study is limited to Bindu Chowk during typical peak hours, using established traffic engineering methods for data collection and analysis. However, its significance extends beyond this single intersection—it offers valuable insights that can inform broader urban traffic planning, helping Kolhapur move toward a more efficient and safer road network.

Traffic volume studies are essential for understanding how roads are used and where problems like congestion or safety risks arise. By counting and analyzing vehicles over time, planners can design better traffic signals, improve road layouts, and prepare for future growth. Around the world, cities face serious traffic challenges—drivers in places like New York and London lose nearly 100 hours a year in traffic. In India, the issue is even more pressing, with high accident rates and over 11% of global road deaths. Poor infrastructure and weak enforcement in urban areas make the need for smart traffic planning even more urgent.

2.STUDY AREA DESCRIPTION

Bindu Chowk, located in the heart of Kolhapur, Maharashtra, is a key intersection that connects several busy parts of the city. Just 1.27 kilometers from Kolhapur Railway Station and about 700 meters from the famous Mahalaxmi Temple, it plays a central role in the city's traffic network. The junction is a three-legged, unsignalized intersection where major roads like Takala Road converge, carrying a diverse mix of vehicles—two-wheelers, cars, rickshaws, and buses. There is also a government pay-and-park facility nearby, adding to the activity in the area.

Surrounding land use is a lively mix of commercial, residential, and institutional spaces, which creates fluctuating traffic volumes throughout the day. Shops, schools, banks, and homes all contribute to the area's dynamic environment. However, the absence of traffic signals or lane channelization makes the intersection prone to confusion and congestion, especially during peak hours. Drivers rely solely on mutual understanding to navigate the crossing, which often compromises safety and efficiency.

Recognizing these issues, the Kolhapur Municipal Corporation is planning to introduce traffic signals at Bindu Chowk. A detailed study involving field observations, traffic volume analysis, and capacity assessments is being used to guide this much-needed improvement.

3.DATA COLLECTION AND DATA ANALYSIS

To get a clear picture of traffic patterns, data was collected over seven days and then averaged. This helped account for daily changes between weekdays and weekends, giving a more accurate view of typical traffic flow. It allowed us to understand real-world conditions and how the intersection normally functions.Traffic data collected over a continuous seven-day period was averaged to ensure consistency and account for daily fluctuations. This approach provided a representative dataset for evaluating flow characteristics, volume trends, and intersection performance across typical operating conditions.

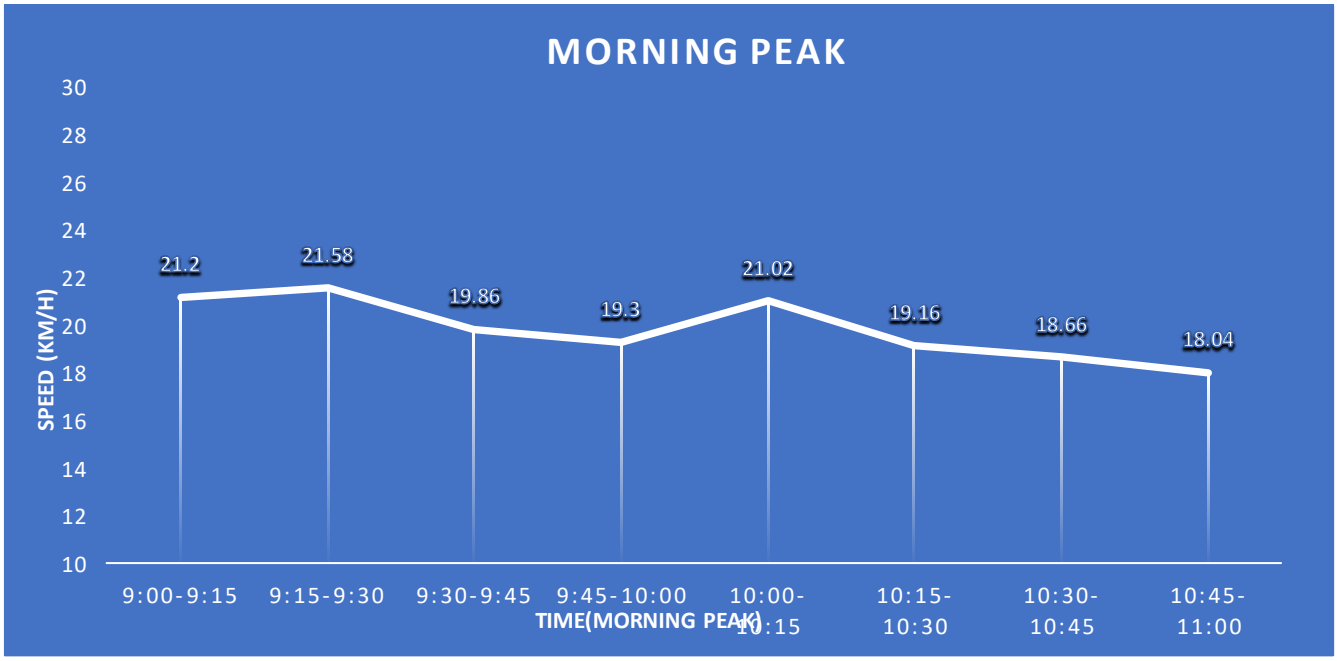
- **Travel Speed Analysis:**

Vehicle speeds were calculated by analysing the video recordings captured during peak hours. For each approach, the time taken by vehicles to travel between two fixed reference points was noted.

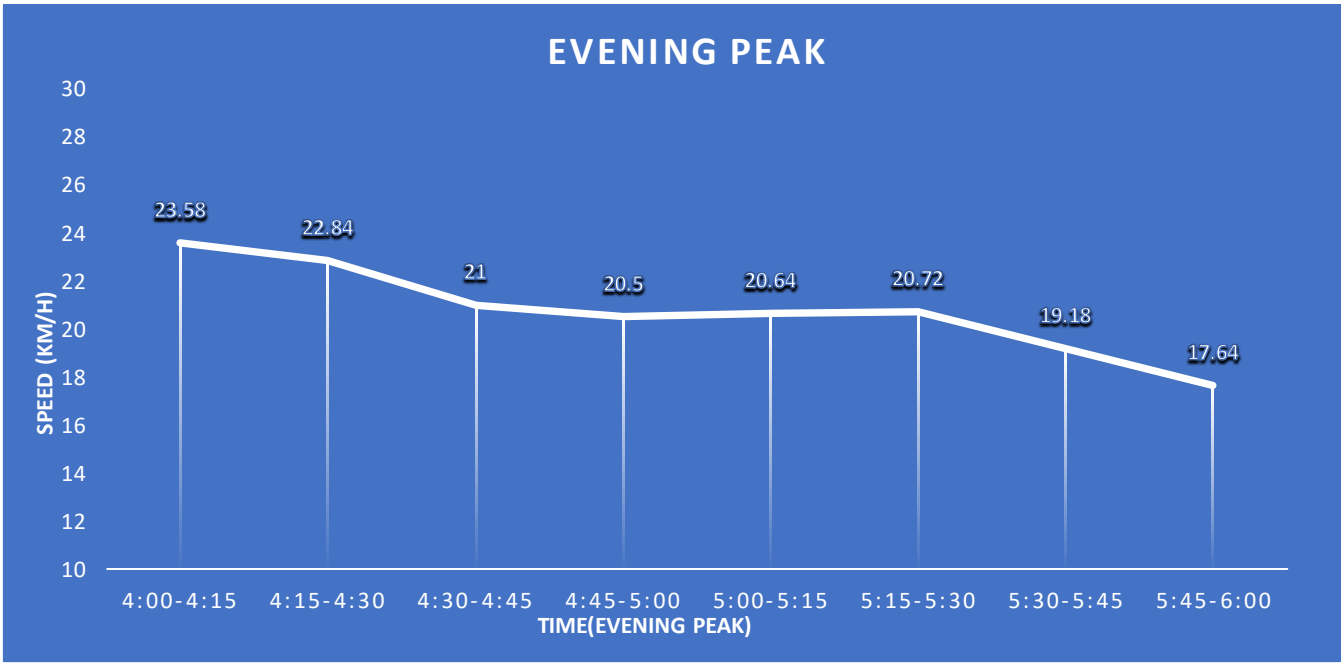
The following formula was used:

$$Speed\ (km/h) = \left(\frac{Distance\ (m)}{Time\ (sec)}\right) \times 3.6$$

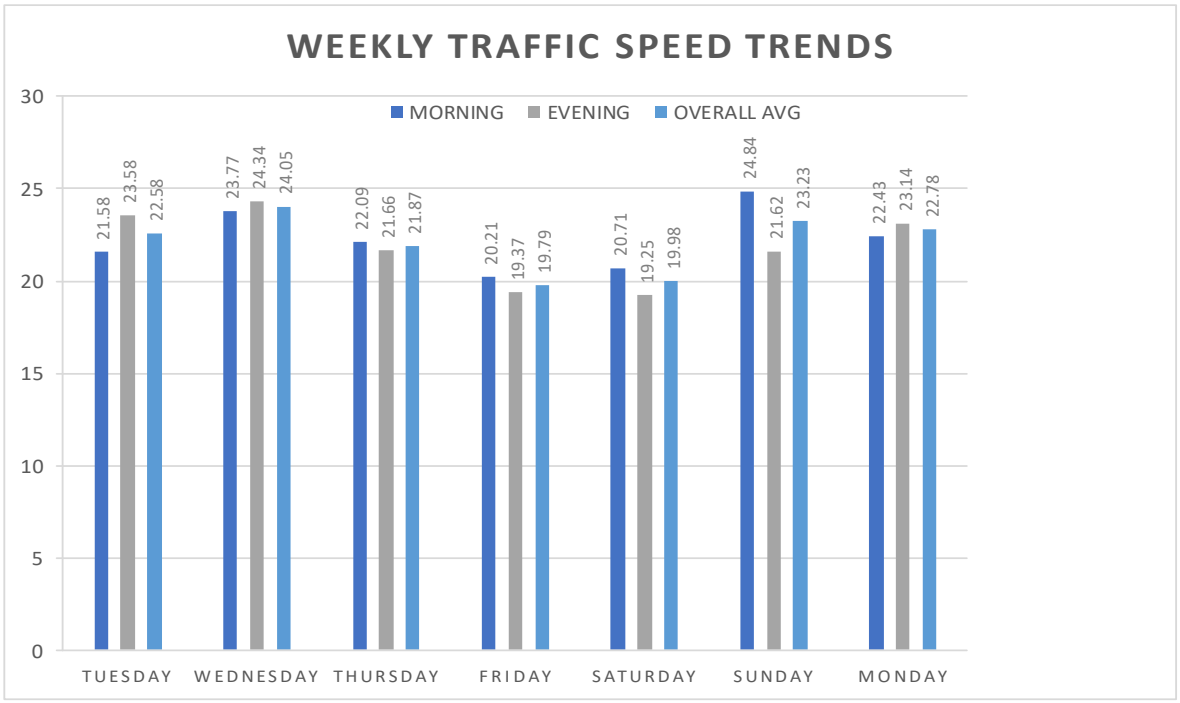
This method offers a practical and on-site observable way to estimate speeds using real traffic conditions. While not as precise as sensor-based tracking, it provides sufficiently reliable speed data when executed with careful observation and consistent timing points.



(fig 3.1 -Traffic Speed Trends During Morning Peak Hours)



(fig3.2 -Traffic Speed Trends During Evening Peak Hours)



(Fig3.3 - Traffic Speed Patterns Over the Week.)

- **Peak Hour Factor (PHF):**

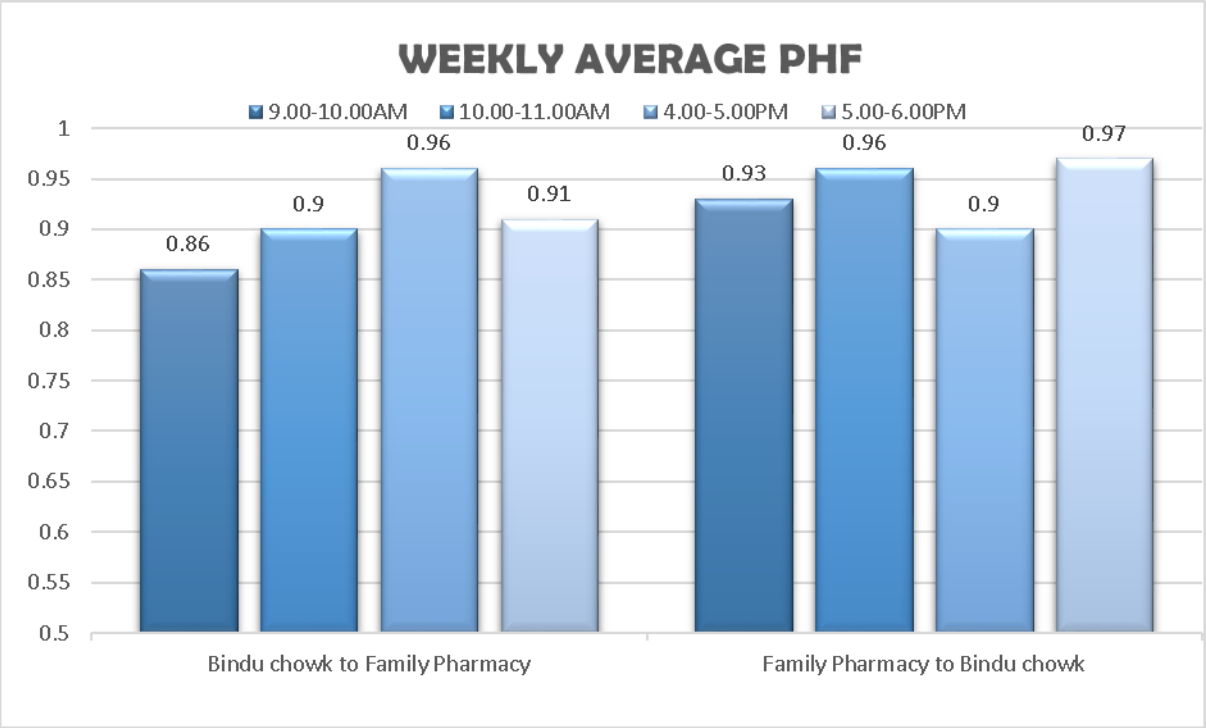
The Peak Hour Factor (PHF) is a critical indicator in traffic engineering used to assess the distribution consistency of traffic volume during the peak hour. It quantifies the level of demand fluctuation by comparing the total hourly volume to the highest traffic volume recorded during any 15-minute interval within the same hour. This measure helps in identifying peaking characteristics and assessing the operational efficiency of a facility under peak load conditions.

The PHF is defined by the following equation:

$$PHF = \frac{Hourly\ Volume}{4 \times Peak\ 15-minute\ Volume}$$

Where:

- Hourly Volume is the total Passenger Car Units (PCUs) observed during the peak hour.
- Peak 15-minute Volume is the highest volume recorded in any 15-minute subinterval within that hour.
- The factor 4 represents the number of 15-minute intervals in one hour



(fig3.4 weekly average Peak hour factor)

➢ **Level of Service (LOS) Measurement:**

The Level of Service (LOS) represents the overall efficiency and operational performance of each approach. It was determined by calculating the volume-to-capacity (V/C) ratio, which compares actual traffic volume to the designed capacity of the roadway segment, as per applicable standards

Table 3.1-Level of Service Classification Based on Volume-to-Capacity Ratio

Level of service (LOS)	V/C Ratio	Operational Description
A	0.00 – 0.60	Free-flowing conditions with minimal delay
B	0.61 – 0.70	Good flow with limited interruptions
C	0.71 – 0.80	Stable operations, occasional slowing
D	0.81 – 0.90	Approaching capacity; acceptable performance
E	0.91 – 1.00	Unstable flow; high delay and reduced comfort
F	Greater than 1.00	Oversaturated; breakdown in movement

This classification helped in understanding how efficiently each approach was performing. It made it easier to spot where traffic was moving smoothly and where there were signs of congestion or breakdown. Using this standard method ensured a fair and consistent way to assess traffic flow across all conditions.

Table 3.2- LOS Assessment: Bindu chowk to Family Pharmacy

BINDU CHOWK TO FAMILY PHARMACY						
	Time	**Total no. of vehicle**	**Total PCU**	**Capacity of road Qc / C**	**V/C**	**Observed LOS**
Morning	9.00 – 10.00 am	2101	1839	1500	1.26	F
	10.00 –11.00am	2399	2154.4		1.43	F
Evening	4.00 – 5.00 pm	1967	1812.35		1.20	F
	5.00 – 6.00 pm	2039	1884.35		1.25	F

Table 3.3- LOS Assessment: Family Pharmacy to Bindu chowk

FAMILY PHARMACY TO BINDU CHOWK						
	Time	**Total no. of vehicle**	**Total PCU**	**Capacity of road Qc / C**	**V/C**	**Observed LOS**
Morning	9.00 – 10.00 am	1626	1609.8	2400	0.67	B
	10.00 –11.00am	2111	2148.45		0.89	D
Evening	4.00 – 5.00 pm	1619	1583		0.65	B
	5.00 – 6.00 pm	2229	2311.85		0.96	E

4. CONCLUSIONS AND RECOMMENDATIONS:

4.1 Identifying and Addressing Roadside Element Issues for Better Traffic Flow

Overview: This assessment identifies critical roadside elements disrupting traffic flow and safety at Bindu chowk. Through field observations and alignment with IRC guidelines and statutory norms, key issues such as bus stop and rickshaw stand placement, illegal parking, hoarding obstructions, misaligned light poles, road surface defects, and vendor encroachments were analysed. Each element was evaluated for its impact on congestion, visibility, and pedestrian movement. The proposed interventions focused on relocation, clearance, and regulatory enforcement aim to restore intersection efficiency, enhance safety, and support future-ready urban mobility planning.

Issue 1: There is a lack of clear and visible road signs.

(fig 4.1 confusing road signs for tourists)

Tourists visiting the area often struggle with navigation due to the lack of clear and visible road signs. Without proper guidance, they can easily get confused, take wrong turns, or unknowingly break traffic rules, which affects both safety and traffic flow. To address this, installing well-placed, reflective, and bilingual road signs as per IRC:67-2012 standards is essential. These signs should be maintained regularly and positioned to help unfamiliar drivers find their way easily. Doing so will not only improve the experience for visitors but also reduce accidents, ensure smoother traffic movement, and make the roads safer for everyone—locals and tourists alike.

Issue 2: Lack of lane discipline

(*fig 4.2 lack of lane discipline at the intersection)*

At Bindu Chowk, two-wheelers often ignore lane discipline, weaving through traffic and creating chaos at the already unsignalized intersection. This not only leads to congestion but also increases the risk of accidents. To address this, clear lane markings, visible road signs like "Stay in Lane," and speed-calming measures such as rumble strips are recommended. Deploying traffic police during peak hours and running awareness campaigns can further encourage safer behavior. If feasible, adding a traffic signal could bring much-needed order. Together, these steps would guide two-wheelers to follow lanes, reduce risky maneuvers, and make the intersection safer and more manageable for all road users.

Issue 3: Roadside Parking at the Intersection

(fig 4.3 Top View of Roadside Parking)

(fig 4.4- Roadside Parking on at turning point in front of shops)

The intersection is near Mahalaxmi Temple in Kolhapur, which is also close to D.R.K During the Navratri festival, the area around the college and shops near Mahalaxmi Temple faces major congestion due to unchecked roadside parking. With visitors, students, and shoppers all competing for space, illegally parked vehicles often block lanes and reduce visibility—making the roads unsafe for both drivers and pedestrians. Emergency and delivery vehicles also struggle to get through. To ease this, clear no-parking zones, off-street parking facilities, and better pedestrian infrastructure are urgently needed. Boosting traffic enforcement and using adaptive traffic systems during peak hours can help manage flow more effectively, ensuring safer, smoother movement for everyone during the busy festival season.

Issue 4: Auto-Rickshaw Stop at the Intersection

(fig 4.5- Auto-Rickshaw Stop at the Intersection)

The auto rickshaw stop at Bindu Chowk creates serious traffic problems by blocking lanes and pedestrian paths, especially during busy hours. Parked rickshaws reduce visibility,cause jams, and even delay emergency vehicles. To fix this, the stop should be moved slightly away from the intersection to a wider area with marked parking bays. Regulating pick-up and drop-off times, adding crosswalks, and using cones or barricades can help maintain order. Smart parking tools and more traffic police presence would also improve flow. These steps will reduce congestion, improve safety for both drivers and pedestrians, and make traffic smoother and more manageable.

Issue 5: Disorganized pedestrian flow

(fig 4.6- Pedestrians walking on middle of the road)

During the Navratri festival, Bindu Chowk sees a surge in pedestrian activity that overwhelms the area's limited walkways, forcing people onto the road and causing traffic chaos. This unorganized movement slows down vehicles, increases accident risks, and creates confusion at intersections. To manage this, wider, continuous footpaths and clearly marked crossings with pedestrian signals are essential. Temporary barricades and traffic marshals can guide crowds safely, while pedestrian-only zones during peak hours can ease pressure on roads. These simple yet effective steps will keep pedestrians safe, reduce vehicle-pedestrian conflicts, and ensure smoother traffic flow during high-traffic festival periods like Navratri.

4.2 Strategic Traffic Signage and Road Marking Plan for Bindu chowk intersection

At Bindu Chowk, a busy intersection with high traffic volumes, clear and effective signage is crucial for improving safety and traffic flow. The proposed regulatory signs, such as "No Parking," "One Way," and "Stop," will be strategically placed to prevent congestion and guide vehicles more smoothly. For example, the "Left Turn Only" sign before the intersection will direct drivers, while the "Speed Limit" sign 30-100 meters away will help control speed and reduce accidents. A "One-Way" sign near the pharmacy area will manage vehicle access, and "No Entry" signs will prevent wrong-way driving.

In addition to regulatory signs, warning signs like "Pedestrian Crossing Ahead" and "Speed Breaker Ahead" will alert drivers of potential hazards. These signs, placed at appropriate distances, will enhance safety, especially in pedestrian-heavy areas like near schools and markets. To further guide tourists and reduce confusion, informatory signs will be installed to provide directions to key landmarks, parking, and public facilities.

All signs will be bilingual (Marathi and English), with clear, reflective, weather-resistant materials to ensure visibility. These measures will improve traffic discipline, enhance pedestrian safety, and ensure smoother navigation through this high-traffic area.

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