



## **Pedestrian and Road Safety in Vidisha City (Bus Stand to Ahmadpur)**

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**Abstract:** This study evaluates pedestrian and road safety along the New Bus Stand–Ahmadpur Chauraha corridor in Vidisha, India. Field surveys at four intersections assessed pedestrian/vehicle volumes, spot speeds, road safety audits, and black spots. Two-wheelers dominate traffic (60–61%). New Bus Stand recorded highest vehicle volume (2850 veh/hr) and operates at LOS D (PCU=2490). Pedestrian volumes peaked at 342 persons/hr (New Bus Stand) and 295 persons/hr (SATI Main Gate). Mean speed was 43.8 km/h; 85th percentile speed was 51.4 km/h, exceeding IRC limits. Major deficiencies include missing footpaths, zebra crossings, unregulated parking, encroachments, and poor signage. Five black spots identified; New Bus Stand Entry and Ahmadpur Chauraha are most critical. Recommendations include footpaths, marked crossings, speed calming, parking regulation, signage, lighting, and enforcement.

**Keywords:** Pedestrian Safety, Road Safety, Traffic Volume, Spot Speed, Black Spot

### **I. INTRODUCTION**

In many Indian cities, urban transportation is a significant issue. Congestion, accidents, and pollution are issues that users must deal with despite expenditures in road infrastructure and framework plans for transport development. Particularly when national highways and other roads converge, accidents are a serious issue. A significant amount of time and fuel are frequently lost as a result of traffic congestion. Crossing the road might be inconvenient for pedestrians. Pollution rises as a result of traffic, and it has a negative impact on the health of nearby residents. Urban cities are experiencing a sharp rise in traffic delays and poor traffic management. Effective traffic movement monitoring and management are crucial for ensuring smooth vehicle flow and for overcoming the many obstacles. The substantial volume and makeup of intercity traffic in Vidisha define the city's traffic patterns. Many transportation issues are currently plaguing the city, including traffic congestion, parking issues, narrow roads, heavy delays at junctions, accidents, and poor pedestrian infrastructure. The corridor from New Bus Stand to Ahmadpur is one of the busiest stretches in Vidisha, connecting residential areas, commercial hubs, educational institutions, a railway station, and a hospital. Despite high pedestrian footfall, the corridor lacks basic safety facilities such as footpaths, zebra crossings, and adequate street lighting. This study focuses on pedestrian and road safety conditions along the New Bus Stand–Ahmadpur corridor in Vidisha City by analysing pedestrian facilities, traffic volume, vehicle composition, spot speed, black spots and road safety deficiencies.



**Fig 1: Pedestrian movement on the Bus Stand-Ahmadpur corridor, Vidisha**

## **II. OBJECTIVE OF THE RESEARCH**

The following objectives have been formulated for this study:

1. To assess the existing pedestrian infrastructure and road safety measures along the New Bus Stand–Ahmadpur corridor in Vidisha city, including footpaths, zebra crossings, street lights, speed breakers, signage, and encroachments.
2. To quantify pedestrian and vehicular traffic volumes at selected critical locations, namely New Bus Stand, Railway Station Road, SATI Main Gate and Ahmadpur Chauraha, during morning, afternoon and evening time periods using manual count surveys.
3. To analyze spot speeds of vehicles on the corridor and compare with IRC-recommended speed limits for built-up areas with pedestrian activity.
4. To identify accident-prone locations (black spots) along the corridor and their causative factors through field observations and local inquiry.
5. To recommend engineering, enforcement, and educational measures for improving pedestrian and road safety on the Bus Stand–Ahmadpur corridor.

## **III. METHODOLOGY**

### **3.1 General**

This chapter outlines the methodology employed to evaluate vehicle and pedestrian safety along the New Bus Stand–Ahmadpur route in Vidisha City. The approach encompasses study area selection, traffic and pedestrian surveys, spot speed studies, road safety audits, black spot identification, and data analysis, all conducted in accordance with Indian Roads Congress (IRC) guidelines.

### **3.2 Site Identification and Study Selection**

A systematic approach was adopted to assess traffic and pedestrian safety characteristics along the selected corridor. The methodology comprises literature review, study area selection, field data collection, traffic and pedestrian volume analysis, spot speed studies, road safety audits, black spot identification, and result interpretation.

**Step 1 – Rationale:** The Bus Stand–Ahmadpur stretch experiences significant pedestrian activity due to the presence of a bus stop, railway station, hospital, college, and commercial



establishments. Preliminary investigations revealed accident-prone areas, high vehicle speeds, unmarked crossings, and missing footpaths, necessitating comprehensive safety research.

**Step 2 – Literature Review:** The methodology incorporated a review of relevant literature on pedestrian safety and IRC codes (IRC:103-2012, IRC:86-2018, IRC:112-2018) for sidewalk design, speed limits, lighting, and safety audit procedures. Case studies from similar cities were also consulted.

**Step 3 – Study Area and Data Acquisition:**

*Location Mapping:* The study corridor extends approximately 2.5–3 km from New Bus Stand to Ahmadpur Chauraha in Vidisha, Madhya Pradesh. Four critical intersections were selected for detailed data collection: (1) New Bus Stand, (2) Railway Station Road, (3) SATI Main Gate, and (4) Ahmadpur Chauraha.

*Data Types Collected:*

- **Pedestrian Volume:** Peak hour counts (8–9 AM, 1–2 PM, 5–6 PM) at 15-minute intervals at four intersections
- **Vehicle Volume:** Classified counts of bikes, cars, auto-rickshaws, buses, trucks, and LCVs during peak periods
- **Spot Speed:** Mobile radar speed measurements of 100 randomly selected vehicles under free-flow conditions near SATI College
- **Physical Geometry:** Road width, footpath conditions, zebra crossings, speed breakers, lighting, signage, encroachments, and parking
- **Accident-Prone Locations:** Identified through local inquiry and ranked using a severity index

*Data Collection Protocols:* Field surveys were conducted manually with volunteer assistance. Pedestrians crossing in both directions were counted, and vehicles were categorized into five classes. Spot speed measurements used a mobile radar application. Accident-prone locations were identified through unstructured interviews with local informants, with responses cross-verified. Photographic documentation was performed at all intersections and black spots.

**3.3 Road Safety Audit**

A comprehensive road safety audit assessed the existing infrastructure for deficiencies in:

- **Footpath Conditions:** Presence, continuity, width, surface quality, and encroachments
- **Zebra Crossings:** Existence, condition of markings, and presence of signals/refuge islands
- **Street Lighting:** Pole type, height, spacing, and illumination levels
- **Speed Breakers:** Position, design parameters (width, height, slope), and effectiveness
- **Signage:** Type, position, visibility, and condition of traffic signs
- **Encroachments:** Mapping of roadside encroachments and effective width reduction
- **Parking Conditions:** Occupancy rates, patterns, and impacts on pedestrian movement

**3.4 Spot Speed Study**

A spot speed study was conducted on a straight section near SATI College under free-flow conditions (11 AM–1 PM) using the Speed Gun mobile radar application. A sample of 100

randomly selected vehicles across all categories was measured. The following statistics were computed: minimum, maximum, mean, median, standard deviation, and 85th percentile speed. Results were compared with the IRC:86-2018 recommended speed limit of 40 km/h for built-up areas.

### 3.5 Level of Service (LOS) Analysis

LOS analysis was performed to assess junction operational performance:

- **PCU Calculation:** Raw vehicle counts converted to Passenger Car Units using IRC:106-1990 factors (Bike: 0.5, Car: 1.0, Auto: 1.2, Bus: 3.0, Truck/LCV: 3.0)
- **V/C Ratio:** Calculated as Traffic Volume (PCU/hr) / Practical Capacity (3200 PCU/hr for two-lane urban roadways)
- **LOS Determination:** Based on V/C ratio criteria (A–F), with detailed analysis for major junctions

### 3.6 Data Processing and Analysis

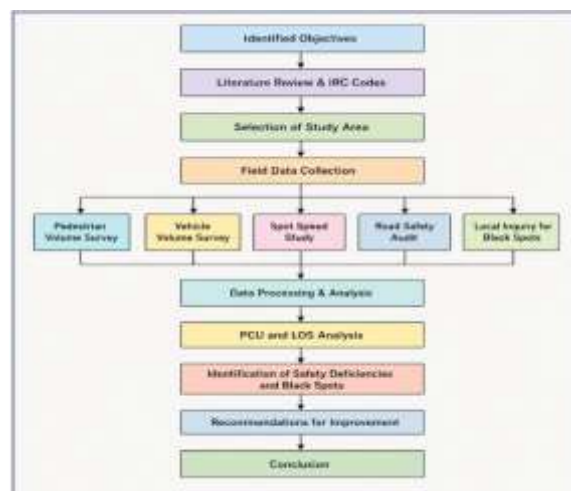
- **Volume Processing:** Hourly volumes calculated from 15-minute count data
- **PCU and LOS Analysis:** Computed using IRC conversion factors
- **Spot Speed Analysis:** Descriptive statistics and histogram generated using Excel
- **Black Spot Severity Index:** Ranking of accident-prone locations using  $SI = (Frequency\ Score + Severity\ Score) / (Maximum\ Possible\ Score) \times 100$
- **Road Safety Audit Compilation:** Deficiencies compiled for each audit aspect and mapped to identified black spots

### 3.7 Limitations

The study acknowledges limitations including: surveys conducted only on weekdays, potential manual counting errors, limited sample size for speed analysis, reliance on local memory for accident data, and qualitative rather than quantitative lighting assessment.

### 3.8 Study Flow Chart

The step-by-step methodology is summarized in Fig. 2, beginning with problem identification and literature review, proceeding through data collection, processing, deficiency identification, recommendations, and conclusions.



**Fig 2: Flow chart of the study**



## **IV. PROBLEM IDENTIFICATION**

### **4.1 General**

Pedestrian safety is a critical concern in urban corridors with mixed traffic, rising vehicle ownership, and inadequate pedestrian infrastructure. The New Bus Stand–Ahmadpur Chauraha corridor in Vidisha, Madhya Pradesh, was selected for this study due to its mixed land use—encompassing residential, institutional, commercial, and transport hubs—resulting in continuous pedestrian–vehicle interactions throughout the day. Problem identification was carried out through field reconnaissance, photographic documentation, local inquiry, and a preliminary road safety audit, laying the groundwork for the quantitative analyses presented in Chapter 5.

### **4.2 Case Study Area and Corridor Description**

Vidisha, located ~56 km east of Bhopal, is a growing city experiencing increased traffic pressure. The selected corridor spans approximately 2.5–3.0 km from the New Bus Stand to Ahmadpur Chauraha, passing through key activity nodes: Railway Station Road, SATI Main Gate, Durga Nagar, Bypass Junction, and Mandi Road Junction. The corridor exhibits mixed land use, with high pedestrian generation near transport (Bus Stand, Railway Station), educational (SATI College), commercial, and residential areas.

### **4.3 Observed Road Safety Deficiencies**

Field observations and photographic documentation revealed the following critical deficiencies along the corridor:

- **Absence of continuous footpaths**, forcing pedestrians to walk on the carriageway.
- **Lack of marked zebra crossings** and pedestrian signals, leading to random, unsafe crossings.
- **Unregulated on-street parking** and **roadside encroachments** (vendors, temporary structures), reducing effective road width and obstructing visibility.
- **Inadequate traffic signage**, poor road markings, and insufficient street lighting.
- **Chaotic mixed traffic flow** with poor lane discipline, informal bus/auto-rickshaw stops, and turning conflicts at intersections.

While all identified locations exhibited these deficiencies, the severity varied. New Bus Stand Entry and SATI Main Gate showed exceptionally high pedestrian crossing demands, whereas Bypass Junction and Mandi Road Junction suffered from speeding and turning conflicts.

### **4.4 Black Spot Identification**

Local inquiry (interviews with vendors, auto-drivers, and residents), combined with field observations, identified five accident-prone locations. A Severity Index (0–100 scale) was computed based on accident frequency and perceived severity to rank these spots.

**New Bus Stand Entry** and **Ahmadpur Chauraha** emerged as the most critical black spots, requiring immediate safety interventions.



Table 1: Black Spot Severity Index

Location	Severity Index
New Bus Stand Entry	95
Ahmadpur Chauraha	88
Durga Nagar Chauraha	79
Bypass Junction	72
Mandi Road Junction	64

#### 4.5 Summary and Link to Study Objectives

The identified problems directly correlate with the study's objectives. The lack of pedestrian infrastructure, mixed traffic, and poor road discipline collectively exacerbate safety risks. The five black spots identified—particularly the New Bus Stand and Ahmadpur Chauraha—represent priority locations for mitigation. The quantitative data on pedestrian/vehicle volumes, spot speeds, and Level of Service (LOS), along with detailed safety recommendations, will be presented in the subsequent chapters.

## V. RESULT AND DISCUSSION

### 5.1 General

This chapter presents the analysis of field data collected along the New Bus Stand–Ahmadpur Chauraha corridor in Vidisha. Based on the methodology outlined in Chapter 3, the analysis encompasses pedestrian volume counts, classified vehicle volume counts, Passenger Car Unit (PCU) analysis, Level of Service (LOS) evaluation, spot speed study, black spot severity assessment, and district-level accident trend analysis. The findings identify critical safety deficiencies and provide the basis for improvement recommendations.

### 5.2 Pedestrian Volume Analysis

Pedestrian counts were conducted at four major intersections during morning (8–9 AM), afternoon (1–2 PM), and evening (5–6 PM) peak periods.

Table 2: Pedestrian volume at study junctions (persons per hour)

Location	Morning	Afternoon	Evening
New Bus Stand	218	176	342
Railway Station Road	184	151	267
SATI Main Gate	295	122	214
Ahmadpur Chauraha	193	168	286

#### Key Inferences:

- **SATI Main Gate** recorded the highest morning pedestrian flow (295 persons/hr) due to student and staff arrivals.
- **New Bus Stand** showed the highest evening pedestrian volume (342 persons/hr), reflecting passenger movement, return commutes, and commercial activity.



- All locations recorded pedestrian volumes exceeding 200 persons/hr at peak times, indicating **high crossing demand**.
- The absence of designated zebra crossings forces pedestrians to cross at unmarked locations, increasing accident risk, particularly in mixed traffic conditions.

### 5.3 Vehicle Volume Analysis

Classified vehicle counts were conducted at the four intersections to determine traffic composition.

**Table 3: Classified vehicle volume at study junctions (vehicles per hour)**

Vehicle Type	New Bus Stand	Railway Station	SATI Gate	Ahmadpur
Bike	1712	1080	1560	1520
Car	586	420	510	472
Auto	338	260	290	302
Bus	94	45	68	56
Truck/LCV	120	75	95	130
<b>Total</b>	<b>2850</b>	<b>1880</b>	<b>2523</b>	<b>2480</b>

### Key Inferences:

- **Two-wheelers dominate** all locations (60–61% of traffic), typical of medium-sized Indian cities.
- **New Bus Stand** has the highest total vehicle volume (2850 veh/hr), reflecting its role as a major transport hub.
- **Buses** constitute only 2–3% of traffic but have disproportionate safety impact due to size and stopping behavior.
- The presence of mixed traffic (two-wheelers, cars, autos, buses, trucks) creates unpredictable conditions, making pedestrian crossings hazardous.

### 5.4 PCU and Level of Service (LOS) Analysis

Vehicle volumes were converted to Passenger Car Units (PCU) using IRC:106-1990 factors (Bike: 0.5, Car: 1.0, Auto: 1.2, Bus: 3.0, Truck/LCV: 3.0). LOS was determined using a practical capacity of 3200 PCU/hr.

**Table 4: PCU and LOS analysis**

Junction	PCU/hr	V/C Ratio	LOS
New Bus Stand	2490	0.78	D
Railway Station Road	1632	0.51	C
SATI Main Gate	2127	0.66	C
Ahmadpur Chauraha	2152	0.67	C

**Key Inferences:**

- **New Bus Stand** operates at **LOS D** (approaching unstable flow), indicating congestion, reduced speeds, and frequent disruptions—conditions that severely compromise pedestrian safety.
- Other junctions operate at **LOS C** (stable flow with acceptable delays), but pedestrian risk remains high due to lack of crossing facilities and mixed traffic.
- The analysis confirms that **traffic volume alone does not determine pedestrian risk**; infrastructure deficiencies and traffic composition are equally critical.

**5.5 Spot Speed Analysis**

Spot speed measurements were conducted on a straight section near SATI College under free-flow conditions (n = 100 vehicles).

**Table 5.4: Spot speed statistics**

Parameter	Value
Minimum Speed	28 km/h
Maximum Speed	63 km/h
Mean Speed	43.8 km/h
Median Speed	44 km/h
Standard Deviation	6.1 km/h
<b>85th Percentile Speed</b>	<b>51.4 km/h</b>

**Speed Distribution:**

Speed Range (km/h)	Vehicles	%
25–30	2	2
31–35	7	7
36–40	20	20
41–45	36	36
46–50	17	17
51–55	16	16
56–60	1	1
61–65	1	1

**Key Inferences:**

- The **mean speed (43.8 km/h)** exceeds the IRC:86-2018 recommended limit of **40 km/h** for built-up areas with pedestrian activity.
- The **85th percentile speed (51.4 km/h)** is particularly concerning, as pedestrian fatality risk increases sharply at impact speeds above 50 km/h.
- **36% of vehicles** traveled in the 41–45 km/h range, indicating widespread non-compliance with speed limits.

- Speed control measures (speed breakers, rumble strips, signage, enforcement) are urgently needed, especially near SATI Main Gate, New Bus Stand, and Ahmadpur Chauraha.

### 5.6 Black Spot Identification and Severity Analysis

Five accident-prone locations were identified through local inquiry and field observation. A Severity Index (0–100) was computed based on accident frequency and perceived severity.

**Table 5.5: Black spot severity ranking**

Rank	Location	Severity Index	Risk Level
1	New Bus Stand Entry	95	Very High
2	Ahmadpur Chauraha	88	Very High
3	Durga Nagar Chauraha	79	High
4	Bypass Junction	72	High
5	Mandi Road Junction	64	Moderate–High

#### Key Inferences:

- **New Bus Stand Entry (SI = 95)** is the most critical black spot, characterized by high bus traffic, pedestrian crossing demand, uncontrolled auto-rickshaw movement, and lack of pedestrian facilities.
- **Ahmadpur Chauraha (SI = 88)** ranks second due to turning conflicts, merging traffic, and inadequate crossing facilities at this major junction.
- The black spot analysis identifies priority locations for immediate safety interventions.

### 5.7 District-Level Accident Trend Analysis

Secondary data on reported road accidents in Vidisha district (2022–2024) was analyzed to provide broader context.

**Table 5.6: Reported road accidents in Vidisha district**

Year	Reported Accidents
2022	793
2023	906
2024	783

#### Key Inferences:

- Accidents peaked in **2023 (906)** and declined in **2024 (783)**, but over **750 accidents annually** indicate that road safety remains a serious concern.
- The district-level trend supports the need for **site-specific, corridor-level interventions** rather than relying solely on general enforcement measures.

### 5.8 Summary of Key Findings

1. **High Pedestrian Demand:** All four study locations recorded peak pedestrian volumes exceeding 200 persons/hr, with New Bus Stand (342 persons/hr) and SATI Main Gate (295 persons/hr) being the busiest.



2. **Mixed Traffic Dominance:** Two-wheelers constitute 60–61% of traffic, but the presence of buses, autos, and commercial vehicles creates unpredictable traffic behavior.
3. **Operational Stress:** New Bus Stand operates at LOS D ( $V/C = 0.78$ ), while other junctions operate at LOS C. However, pedestrian risk is high at all locations due to infrastructure deficiencies.
4. **Excessive Speeds:** Mean speed (43.8 km/h) exceeds the 40 km/h limit, and the 85th percentile speed (51.4 km/h) indicates significant speeding, increasing pedestrian fatality risk.
5. **Priority Black Spots:** New Bus Stand Entry ( $SI = 95$ ) and Ahmadpur Chauraha ( $SI = 88$ ) require immediate safety improvements.
6. **District-Level Context:** Over 750 annual accidents in Vidisha district underscore the urgency of targeted safety interventions.

### **5.9 Link to Recommendations**

The findings presented in this chapter directly inform the safety recommendations (Chapter 6), which include:

- Provision of continuous footpaths and marked zebra crossings
- Installation of speed control measures (speed breakers, rumble strips)
- Improved signage, road markings, and street lighting
- Regulation of on-street parking and removal of encroachments
- Implementation of traffic calming at black spots (New Bus Stand, Ahmadpur Chauraha)

## **VI. CONCLUSION AND FUTURE SCOPE**

### **6.1 Conclusion**

This research evaluated pedestrian safety conditions along the New Bus Stand–Ahmadpur Chauraha corridor in Vidisha, a critical urban stretch connecting commercial, residential, institutional, and public transportation zones. The study reveals persistent pedestrian–vehicle conflicts arising from inadequate infrastructure and mixed traffic conditions.

#### **Key findings from the investigation include:**

- **Infrastructure Deficiencies:** The corridor suffers from a lack of continuous footpaths, unmarked zebra crossings, roadside encroachments, uncontrolled on-street parking, poor road markings, inadequate street lighting, and chaotic mixed traffic movement. These deficiencies force pedestrians to walk on carriageways and cross at hazardous locations.
- **Pedestrian Volume:** Pedestrian movement varies significantly by location and time. SATI Main Gate recorded the highest morning volume (295 persons/hr) due to institutional activity, while New Bus Stand recorded the highest evening volume (342 persons/hr) due to passenger movement and commercial activity. All study locations exhibited pedestrian volumes exceeding 200 persons/hr, demonstrating substantial crossing demand.



- **Vehicle Composition:** Two-wheelers dominate traffic (60–61%) at all locations. New Bus Stand recorded the highest total vehicle volume (2850 veh/hr), followed by SATI Main Gate (2523 veh/hr) and Ahmadpur Chauraha (2480 veh/hr). The presence of mixed traffic—bikes, cars, autos, buses, and commercial vehicles—creates unpredictable conditions that compromise pedestrian safety.
- **Operational Performance:** PCU analysis revealed New Bus Stand operates at LOS D ( $V/C = 0.78$ , 2490 PCU/hr), indicating approaching unstable flow. Other junctions operate at LOS C, but pedestrian safety remains compromised due to infrastructure deficiencies rather than traffic volume alone.
- **Speed Environment:** Spot speed analysis showed a mean speed of 43.8 km/h and an 85th percentile speed of 51.4 km/h, exceeding the IRC-recommended 40 km/h limit for built-up areas. Higher speeds reduce driver reaction time and increase pedestrian injury severity, necessitating immediate speed control measures.
- **Black Spot Identification:** Five accident-prone locations were identified. New Bus Stand Entry (Severity Index = 95) and Ahmadpur Chauraha (Severity Index = 88) emerged as the most critical black spots, requiring priority interventions.
- **District-Level Context:** Vidisha district recorded 783–906 annual accidents between 2022–2024, confirming road safety as a persistent concern requiring site-specific, corridor-level improvements.

**Overall Conclusion:** Pedestrian safety along the New Bus Stand–Ahmadpur Chauraha corridor is compromised by a combination of inadequate infrastructure, mixed traffic, high pedestrian demand, uncontrolled parking, encroachments, and insufficient traffic control. An integrated approach combining engineering measures (footpaths, zebra crossings, speed breakers, signage, lighting), enforcement (speed limits, parking regulations), and awareness campaigns is essential. Priority attention should be given to New Bus Stand Entry, SATI Main Gate, and Ahmadpur Chauraha due to their high pedestrian activity and elevated safety risk.

## **6.2 Future Scope**

While this study provides a comprehensive assessment of pedestrian safety along the selected corridor, several avenues for future research remain:

1. **Expanded Spatial Coverage:** Future studies may extend the analysis to Vidisha's broader urban road network to understand pedestrian safety at a metropolitan scale.
2. **Extended Temporal Analysis:** Incorporating full-day surveys, weekend counts, and seasonal variations would provide a more comprehensive understanding of traffic and pedestrian movement patterns.
3. **Enhanced Black Spot Identification:** Utilizing official police accident records, hospital injury data, and georeferenced accident mapping would improve the accuracy of black spot identification.
4. **Simulation-Based Analysis:** Future research may employ traffic simulation software (e.g., VISSIM, SUMO) to evaluate the effectiveness of proposed interventions (zebra crossings, refuge islands, signal control, speed calming) prior to implementation.



- 5. Pedestrian Perception Surveys:** Conducting detailed perception surveys across different demographic groups—women, students, elderly, public transport users, and residents—would provide valuable insights into user-specific safety concerns.
- 6. Intelligent Transportation Systems (ITS):** Investigating the effectiveness of ITS interventions such as speed cameras, smart signals, CCTV-based monitoring, and real-time traffic control could enhance safety at critical junctions.
- 7. Economic Assessment:** Cost-benefit analysis of proposed safety measures would aid in prioritizing investments based on available budgets and expected safety benefits.
- 8. Integrated Urban Planning:** Future studies should examine how parking management, encroachment control, and public transport design collectively contribute to improved pedestrian safety and reduced traffic conflicts in Vidisha's urban corridors.

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