Study on Vechicle Speed Reduction Due to Side Friction on Sh216 at Gudlavalleru

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ABSTRACT

This study analyzes the impact of side friction on vehicle speed reduction along SH-216 at Gudlavalleru. Side friction elements such as pedestrian movement, roadside activities, parked vehicles, and non-motorized traffic interrupt the smooth flow of traffic, leading to speed variations and safety concerns. Data was collected using video graphic techniques and analyzed for different vehicle categories including two-wheelers, three-wheelers, light commercial vehicles, and heavy commercial vehicles. The study shows that side friction significantly reduces vehicle speed, with an average reduction of about 38.65% at Location-1. The results highlight the need for proper traffic management strategies such as controlled parking, pedestrian facilities, and regulation of roadside activities to improve safety and traffic efficiency.

Index terms:side friction, vehicle speed reduction, rural areas, pedestri movement, traffic flow, speed analysis.

INTRODUCTION:

Traffic flow on highways is influenced by several factors, among which side friction plays a significant role. Side friction refers to disturbances caused by roadside activities such as pedestrian movement, parked vehicles, vendors, and vehicles entering or leaving the roadway. These disturbances interrupt smooth traffic flow and reduce speed, capacity, and efficiency. In developing countries like India, mixed traffic conditions with different vehicle types further complicate traffic behavior. Each vehicle responds differently depending on its size and maneuverability.
The study at Gudlavalleru focuses on understanding how these roadside activities affect vehicle speeds. It is important to evaluate these impacts for realistic traffic analysis and better highway design. Understanding speed reduction due to side friction helps improve road safety, optimize traffic flow, and support effective planning.

LITERATURE REVIEW:

1. Arya V.S. et al. (2020a)

This study examined the impact of roadside activities on vehicle speed in urban roads similar to Indian cities. Activities such as pedestrian movement, roadside parking, and local traffic were identified as major contributors to side friction. The authors introduced the Road Side Friction Index (RSFI) and Percentage Speed Reduction (PSR) for evaluation. Field data indicated that increased side friction leads to a noticeable reduction in vehicle speed and deteriorates the level of service (LOS). The study highlights the need for regulating roadside activities in congested urban environments.

2. Arya V.S. et al. (2020b)

This research provided a detailed assessment of various side friction elements commonly observed in Indian urban areas, including pedestrian crossings, street vendors, and slow- moving vehicles. The study found that unregulated roadside activities cause frequent interruptions in traffic flow. Results emphasized that proper traffic control measures and road design improvements are essential to minimize these disturbances in developing regions.

3. Arasan V.T. & Koshy R.Z. (2005)

This study focused on modeling heterogeneous traffic conditions, which are typical in India. It highlighted the presence of mixed traffic such as two-wheelers, auto-rickshaws, and heavy vehicles moving at different speeds. The research showed that traditional homogeneous traffic models are not suitable for Indian roads. Advanced simulation techniques were recommended for accurate traffic analysis.

4. Biswas S. et al. (2021)

The study investigated the effect of side friction on urban road capacity in India. It identified pedestrian activity, roadside vendors, and parked vehicles as dominant friction factors. Findings revealed that high side friction significantly reduces road capacity and leads to congestion, especially during peak hours. The study recommends incorporating side friction parameters into capacity estimation models.

5. Chandra S. & Kumar U. (2003)

This research analyzed the influence of lane width on traffic capacity under mixed traffic conditions. It showed that narrower lanes combined with roadside disturbances further reduce

road efficiency. The findings are highly relevant to Indian roads where space constraints and side friction are common.

6. **Chandra S. et al. (2009)**

This study proposed a method for estimating the capacity of two-lane roads under mixed traffic conditions. It considered factors such as vehicle composition and roadside disturbances. Results confirmed that side friction significantly affects road capacity. The methodology is suitable for analyzing traffic conditions in developing countries like India.

7. **Chauhan P. & Gupta P. (2025)**

This paper reviewed the impact of pedestrians and non-motorized transport, which are common in Indian cities. The study found that bicycles, handcarts, and pedestrian movements contribute significantly to traffic interruptions. It also suggested sustainable planning approaches to manage roadside friction effectively.

8. **Highway Capacity Manual (2016)**

This manual provides standard procedures for evaluating road capacity and level of service. Although developed for international conditions, it recognizes side friction as a key factor affecting traffic performance. It serves as a benchmark for comparing Indian traffic conditions.

9. **Indo-HCM Project Team (2017)**

This project developed capacity guidelines specifically for Indian traffic conditions. It considered heterogeneous traffic and high roadside activity levels. The study emphasized the importance of side friction in capacity estimation and provided practical models suitable for Indian roads**.**

10. **Indian Roads Congress (1990)**

These guidelines focus on rural road capacity in India. They recognize the influence of roadside activities such as local traffic and pedestrian movement The document provides standard methods for capacity estimation under varying conditions.

11. **Indian Roads Congress (2018)**

This updated guideline addresses urban road capacity in India. It highlights the role of side friction, including pedestrian crossings and roadside parking. The document is useful for evaluating level of service in Indian cities.

12. **Kadiyali L.R. (2013)**

This book explains fundamental concepts of traffic engineering with relevance to Indian conditions. It discusses traffic flow, capacity, and the impact of roadside activities. It is widely used as a reference for understanding real-world traffic behavior.

13. **Khanna S.K. & Justo C.E.G. (2011)**

This textbook provides detailed knowledge of highway engineering and traffic management. It highlights how roadside activities affect traffic flow and road capacity, particularly in developing countries like India.

14. **Pal S. & Roy S.K. (2019)**

This study analyzed side friction effects on rural highways in India. It found that pedestrian movement and local roadside activities significantly reduce vehicle speed and increase travel time. The study emphasizes improved roadside management.

15. Rahman M.M. & Nakamura F. (2005)

This research focused on passenger car equivalents (PCE) under mixed traffic conditions. It highlighted the complexity of heterogeneous traffic systems, which is highly applicable to Indian roads.

16. Reddy K.S. et al. (2020)

This study examined side friction under heterogeneous traffic conditions in Indian urban areas. It showed that increased roadside disturbances reduce speed and increase accident risk. Proper traffic management strategies were recommended.

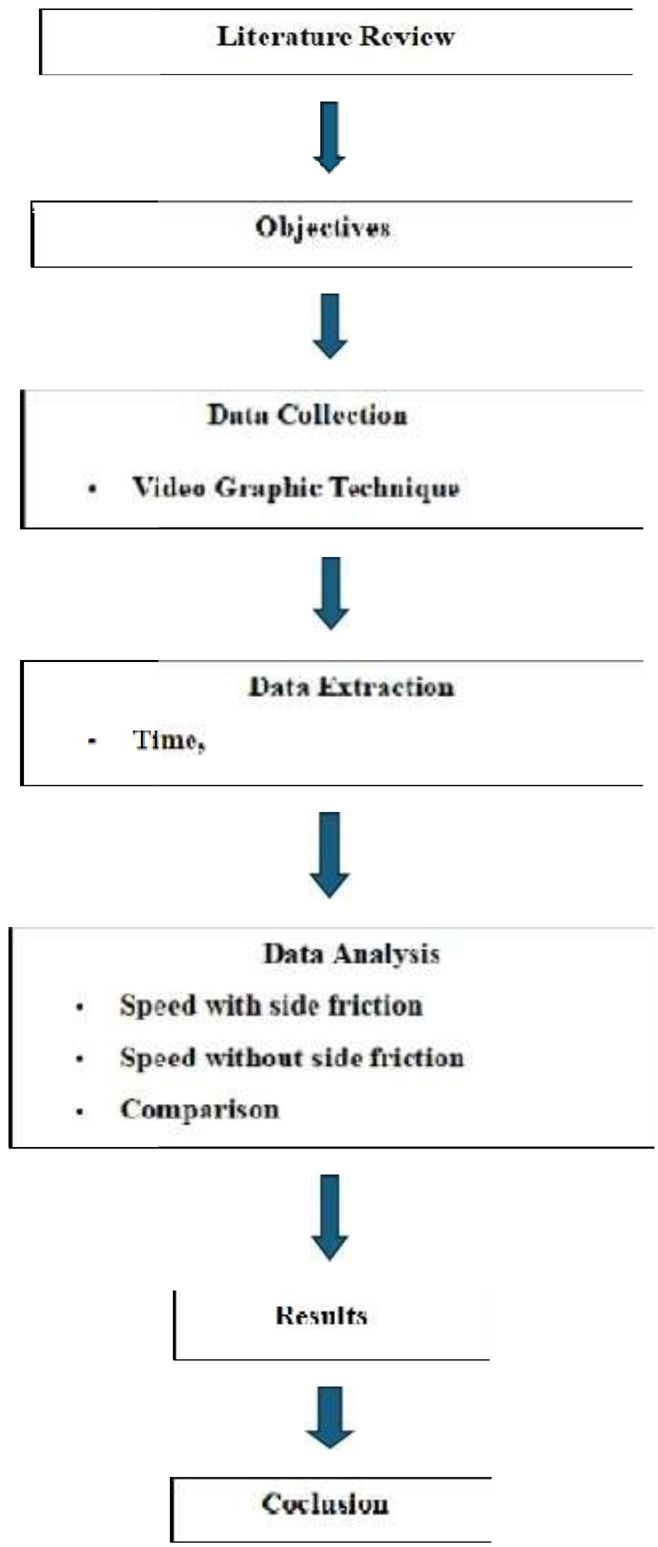
17. Tripathi A. & Sharma P. (2022)

This paper evaluated the impact of side friction on urban highways. Results indicated reduced traffic efficiency and lower level of service due to roadside activities. The study suggests improvements in road design and regulation**.**

18. Vasudevan V. & Mathew T.V. (2013)

This study analyzed roadside activities such as parking, pedestrian movement, and street vending. It found that these factors reduce speed, increase delays, and create safety concerns. The findings are relevant for urban traffic planning in Indian cities

METHODOLOGY:



Data Collection Overview

For the both side friction and without side friction road study, the distance between two reference points was set to 20 meters, and the speed of each vehicle was calculated using the recorded time stamps.

The data was collected using video recordings at two locations:

- Location 1 (with road side activities): Speed data was collected for different vehicle types with and without side friction.
- Location 2 (without Road side activities): Speed data was separately recorded for vehicles moving in both directions, with and without side friction.

Speed data was analyzed for the following vehicle categories:

- Two-Wheelers (2W)
- Three-Wheelers (3W)
- Four-Wheelers (4W)
- Buses (BUS)
- Heavy Commercial Vehicles (HCV)
- Light Commercial Vehicles (LCV)

The average speeds for each vehicle type with and without chicanes were calculated, and the percentage reduction in speed was determined.

Location -1 Road Speed Analysis

Average Speed with and without Side friction

Two scenarios were considered: one with side friction and one without. The following graphs illustrate the average speed of different vehicle types.

AVERAGE SPEED VALUES

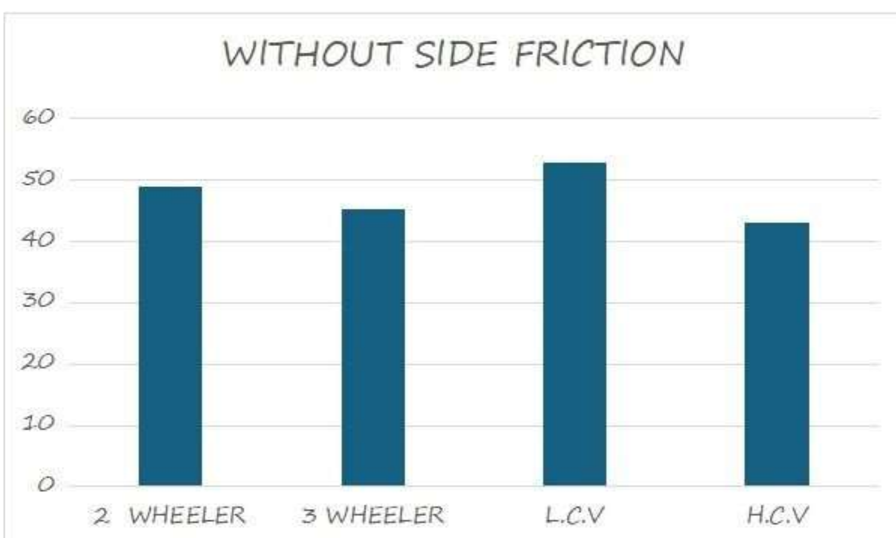


Figure Average Speed of Vehicles Without side friction

• The graph represents the average speed of different vehicle types at a 20m distance without side friction. Higher speeds are observed due to the absence of physical obstacles.

AVERAGE SPEED VALUES

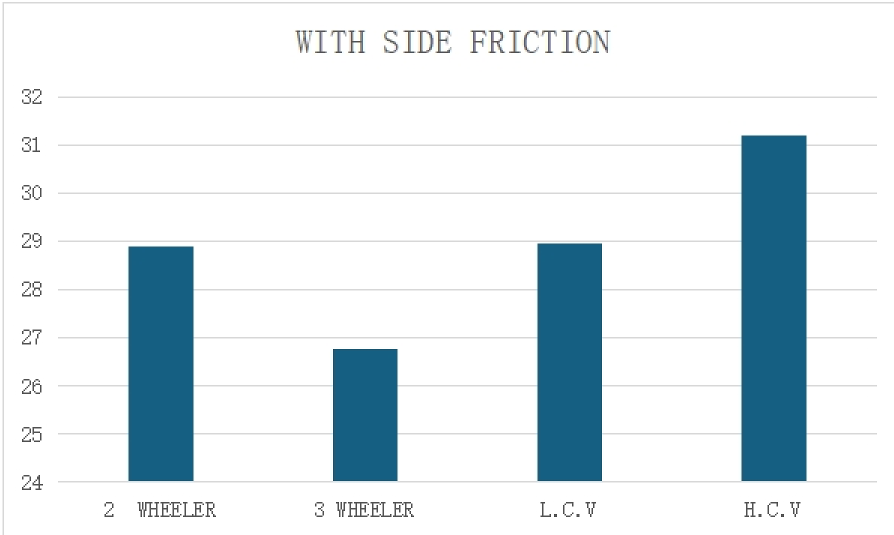


Figure Average Speed of Vehicles With side friction

The graph represents the average speed of different vehicle types at a 20m distance without side friction. Higher speeds are observed due to the absence of physical obstacles**.**

AVERAGE SPEED VALUES

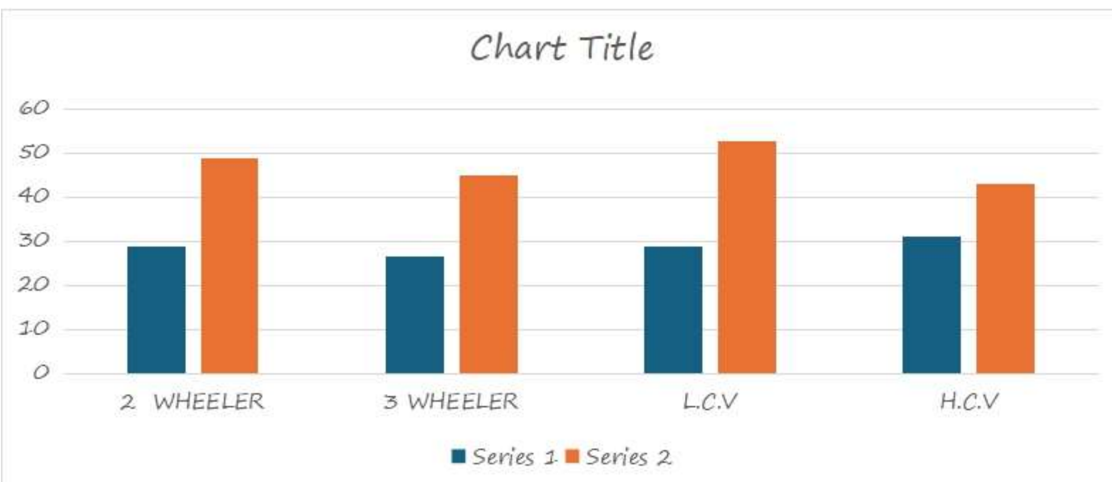


Figure Comparison of Average Speed Reduction on with and without side friction Percentage Speed Reduction on Location -1

A comparative analysis is performed by calculating the percentage reduction in speeds. The speed reduction effect on location -1 road was analyzed by comparing vehicle speeds with and without side friction. The table below presents the percentage speed reduction for each vehicle type.

Table : Percentage Speed Reduction on Location -1

VEHICLE TYPE	AVERAGE SPEED WITH SIDE FRICTION	AVERAGE SPEED WITHOUT SIDE FRICTION	PERCENTAGE SPEED REDUTION
2 WHEELER	28.88	48.86	40.88
3 WHEELER	26.77	45.19	40.75
L.C.V	28.95	52.94	45.30
H.C.V	31.19	43.13	27.66

The table shows a comparison of vehicle speeds with and without side friction. It is observed that speeds are lower when side friction is present. All vehicle types experience a reduction in

speed due to roadside disturbances. Light Commercial Vehicles (LCV) show the highest speed reduction, while Heavy Commercial Vehicles (HCV) show less impact. Overall, side friction negatively affects traffic flow and reduces vehicle speed.

Results

Average speed of each vehicle type on location -1 with side friction (right to left & left to right).

1. Average speed of Two-Wheelers (2W): 28.88 kmph
2. Average speed of Three-Wheelers (3W): 26.77kmph
3. Average speed of Heavy Commercial Vehicles (HCV): 31.19 kmph
4. Average speed of Light Commercial Vehicles (LCV): 28.95 kmph
5. Average speed for all vehicle types: 92.41kmph.

Average speed of each vehicle type on location -1 without side friction (right to left & left to right).

1. Average speed of Two-Wheelers (2W): 48.86 kmph
2. Average speed of Three-Wheelers (3W): 45.19kmph
3. Average speed of Heavy Commercial Vehicles (HCV): 43.13 kmph
4. Average speed of Light Commercial Vehicles (LCV): 52.94 kmph
5. Average speed for all vehicle types: 157.78kmph.

Percentage speed reduction of each vehicle type on location -1 (right to left & left to right).

1. Average speed of Two-Wheelers (2W): 40.88kmph
2. Average speed of Three-Wheelers (3W): 40.15kmph

3. Average speed of Heavy Commercial Vehicles (HCV):38.65 kmph
4. Average speed of Light Commercial Vehicles (LCV):45.30 kmph
5. Average speed for all vehicle types: 38.65kmph.

Conclusion

• Side friction causes a significant reduction in traffic performance across all cases.

• The average reduction is 38.65% (Location-1), 27.37%, confirming its strong negative impact.

• Mean values clearly decrease under side friction conditions.

• Average values reduce from 47.53 to 28.95 (Location -1).

• Vehicle-wise variation indicates different sensitivity levels.

• Maximum reduction is observed in LCV (45.31%) in (Location -1).

• Impact of side friction depends on traffic and roadside conditions.

• Higher reduction in Location -1 indicates heavy roadside interference.

• Side friction significantly affects roadway capacity and operational efficiency.

• Therefore, incorporating these quantified reductions is essential for accurate traffic analysis, design, and planning of highways.

• Side friction plays a major role in reducing traffic efficiency and capacity.

• Ignoring it can lead to incorrect estimation of speed, flow, and overall road performance.

• Incorporating side friction is essential for proper road design and planning.

• Engineers must consider it to improve safety, manage traffic flow, and ensure realistic highway desig

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