

Global Road Infratech Summit & Expo 2026

Impact of Low-Cost School-Zone Countermeasures on Driver Behaviour and Pedestrian Safety: Evidence from a Three-Phase Evaluation

Presented by:

Bhavna Katoch
Research Scholar, IIT Roorkee

Co-Authored by

Prof. Indrajit Ghosh
Professor, Civil Engineering Department,
IIT Roorkee

Prof. Satish Chandra
Professor, Civil Engineering Department,
IIT Roorkee



Introduction



- Almost **43 children** die in road accidents across the country each day in India.
- **30% of kids** have witnessed a road crash while travelling to school, and 6% of them were involved in such accidents (SaveLife Foundation, 2021).
- **7.4%** (987 out of 13,396) of road accidents have occurred near **schools, and other educational institutions** as per Accidental Deaths & Suicides in India (2021) Report.

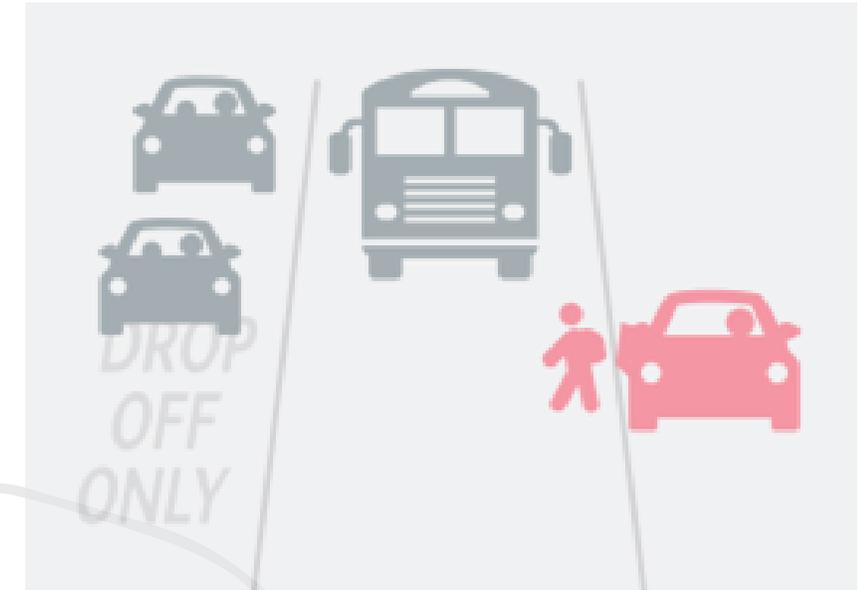


Source: Google Images

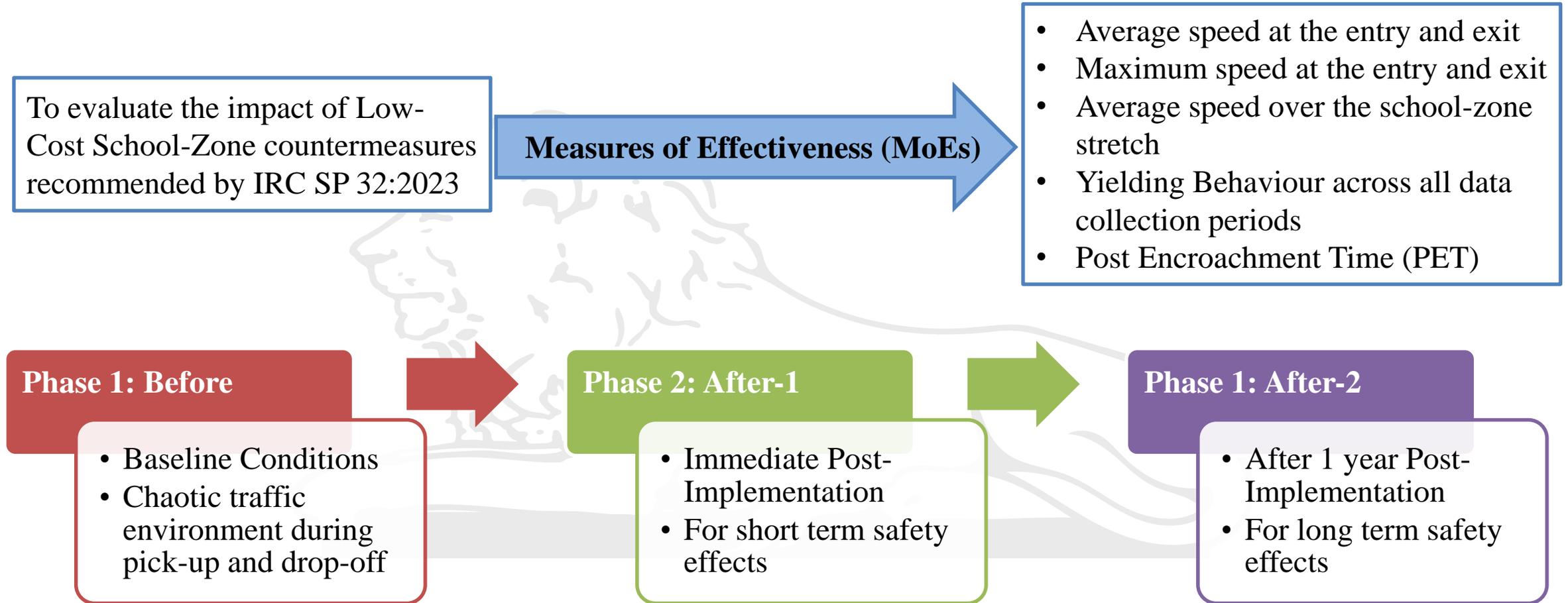
Need for study



- **Children** remain among the most vulnerable road users, especially near schools.
- Indian school zones often exhibit unsafe operational conditions: **obstructions, chaotic traffic flow, and poor compliance.**
- **Surrogate safety measures** allow early, proactive evaluation of safety improvements.



Methodology: A three-phase safety evaluation



Study Site

- Hill Grange Preparatory School, Dehradun
- Near Urban road section

**Before
Implementation**



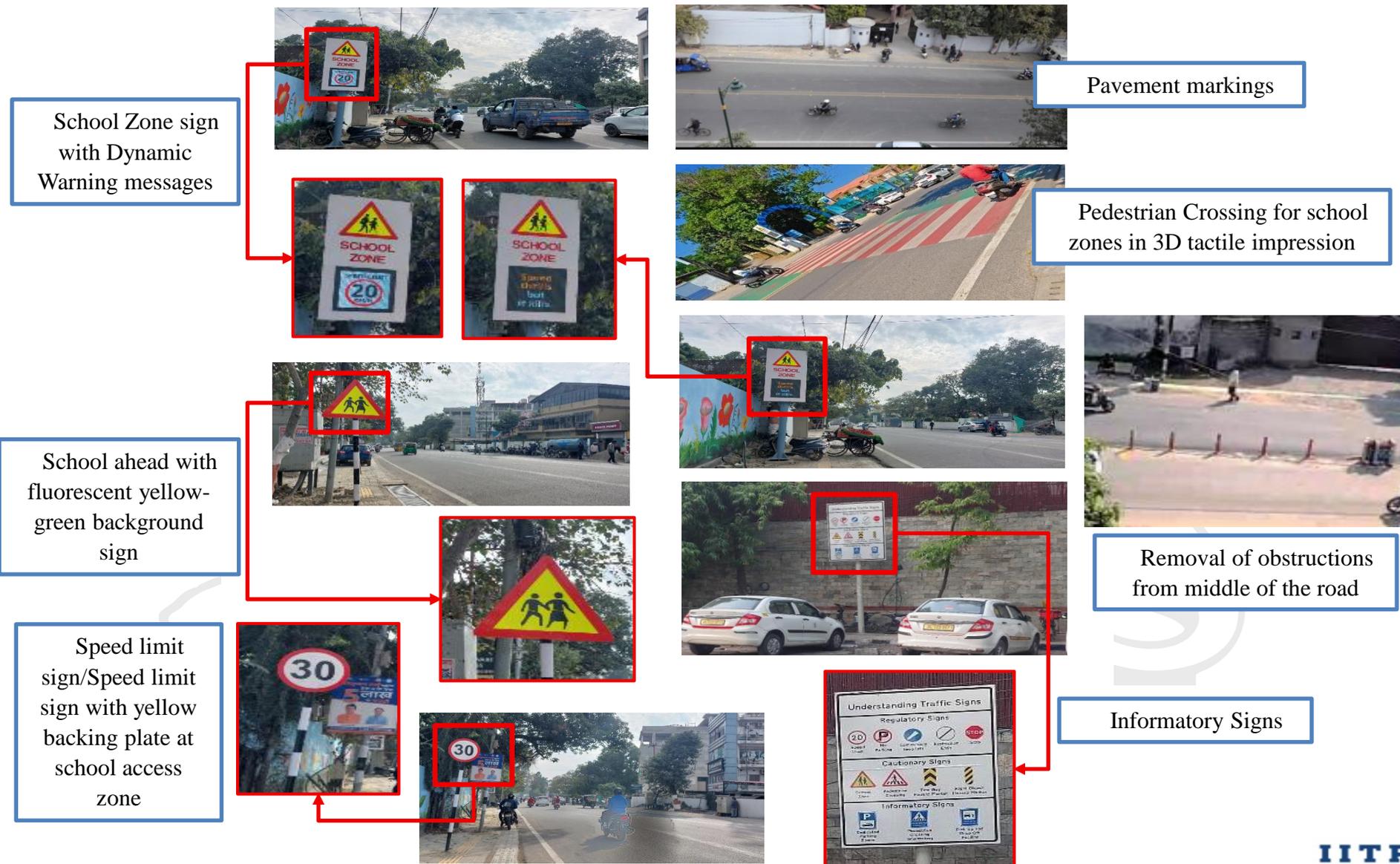
- Removal of mid-road bollards & poles
- New edge & centerline markings
- Transverse Bar Markings (TBMs)
- Dynamic speed-limit sign with safety messages

- **Data Collected** using high-resolution video camera installed opposite the school entrance.
- Data recorded during both **morning and afternoon** School gate opening periods.
- Morning data collection duration: **7:00 to 9:00 AM**
- Afternoon data collection duration: **12 to 2:30 PM**
- **Data Extraction** using DataFromSky Software

**After
Implementation**



Control Devices installed- IRC:SP:32-2023



Spot speeds at the entry and exit points

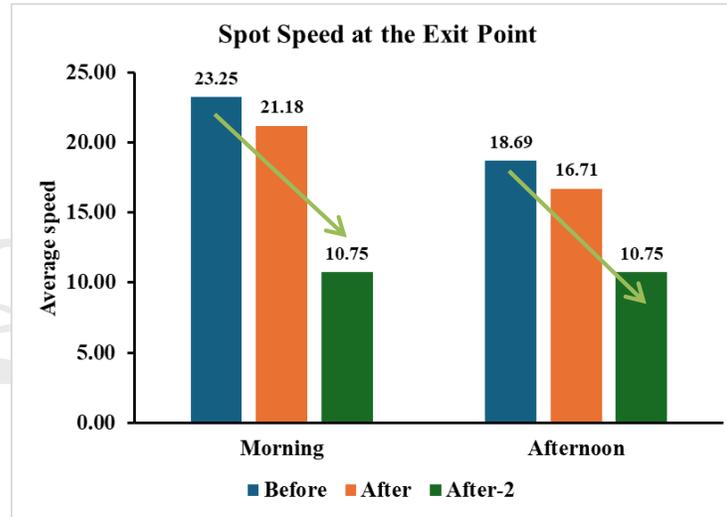
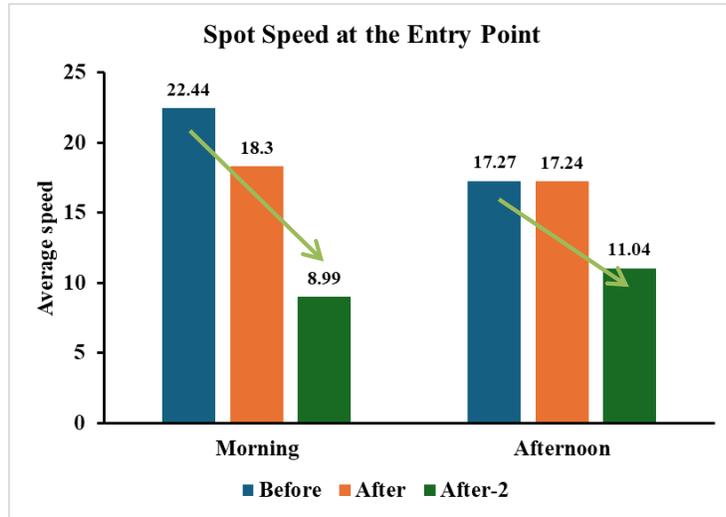


Fig. Average Vehicle speed at the Entry and Exit points

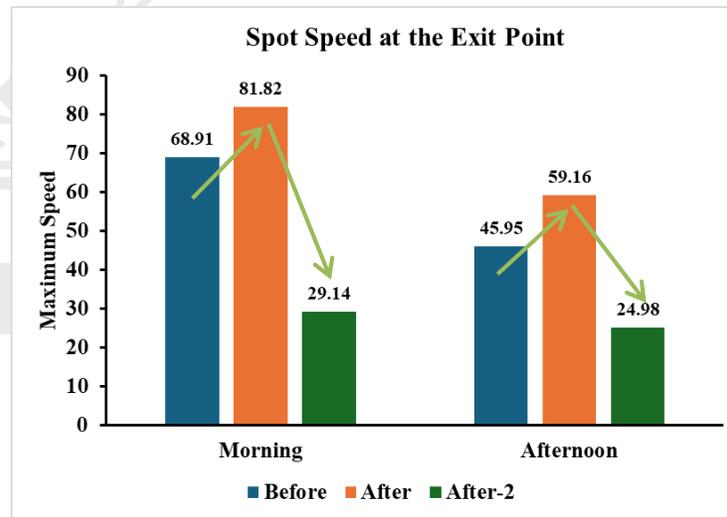
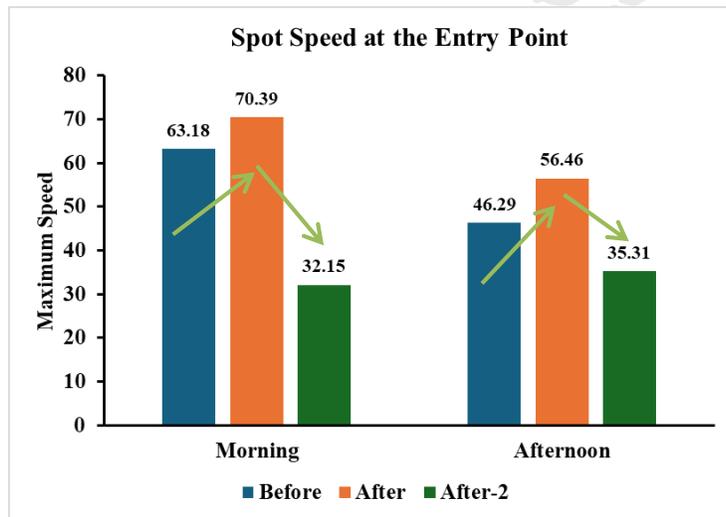


Fig. Maximum Vehicle speed at the Entry and Exit points

Table 1: 85th percentile speeds

| Data Collection Period | Morning | Afternoon |
|------------------------|---------|-----------|
| Before | 33.83 | 27.04 |
| After-1 | 31.09 | 25.65 |
| After-2 | 16.62 | 15.81 |

Yielding Behaviour

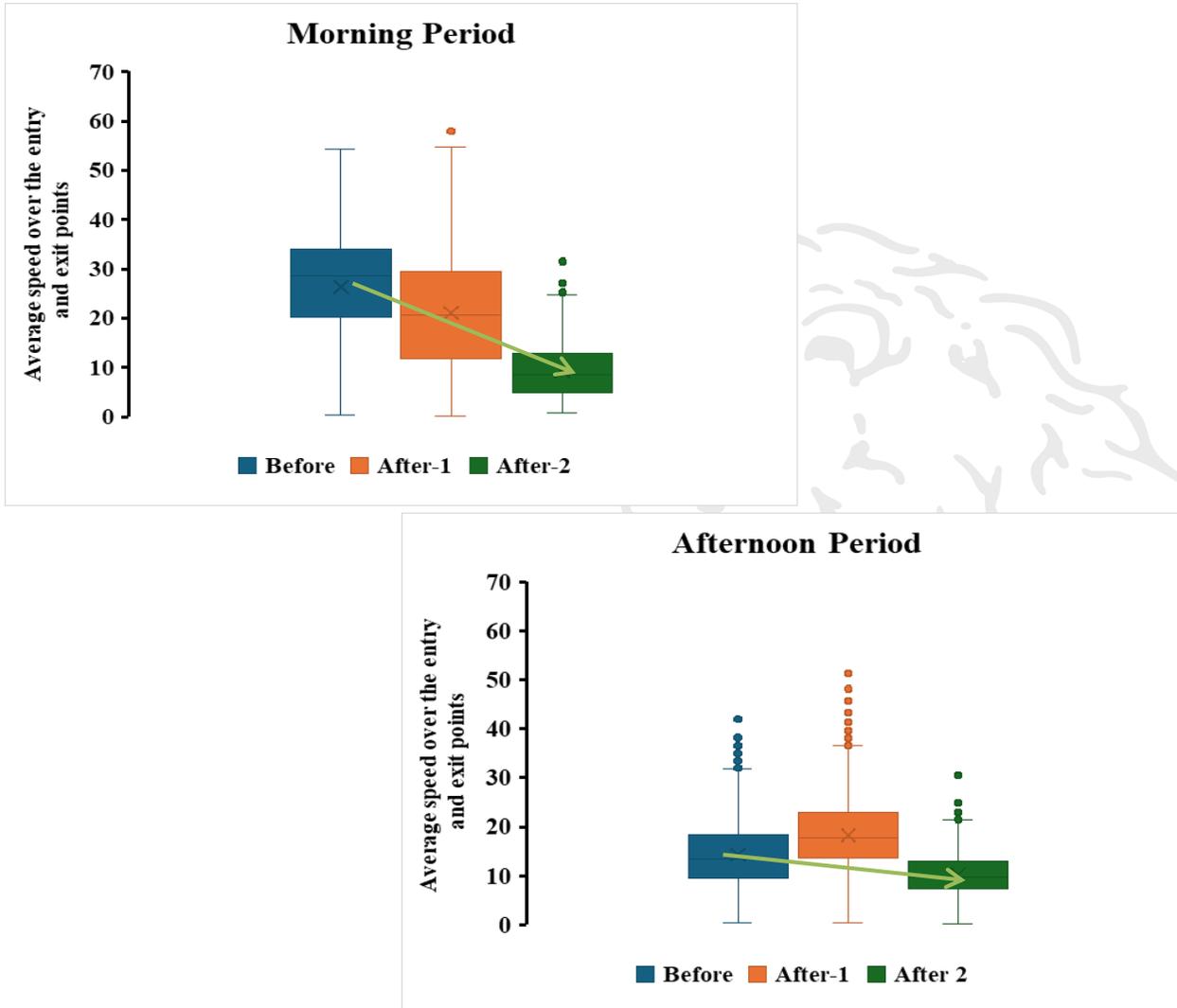


Table 2. Yielding Behaviour across all data collection periods

| Vehicles Yielded (%) | Before | After-1 | After-2 |
|-------------------------|--------|---------|---------|
| Morning Period | | | |
| Motorcycle | 42.55 | 50.98 | 54.29 |
| Car | 46.61 | 57.895 | 60.71 |
| Total | 43.87 | 55.556 | 56.36 |
| Afternoon Period | | | |
| Motorcycle | 44.92 | 47.11 | 51.98 |
| Car | 44.44 | 50.25 | 53.81 |
| Total | 43.99 | 48.11 | 52.71 |

Fig. Average Vehicle Speeds Over the Entire Section

Statistical Validation

Statistical analysis using the Analysis of Variance (ANOVA) test

H0: $\mu_{\text{before}} = \mu_{\text{after-1}} = \mu_{\text{after-2}}$

H1: $\mu_i \neq \mu_j$

Table 3. ANOVA test results

| Scenario | Section | Mean Speeds | | | F Stat | p-value (Two-Tailed) | F Critical | Conclusion |
|-----------------------|-----------|-------------|---------|---------|---------|-------------------------|------------|-----------------------|
| | | Before | After-1 | After-2 | | | | |
| Entry Speed | Morning | 22.44 | 18.30 | 10.61 | 1007.82 | 0 | 2.997 | Significant reduction |
| | Afternoon | 17.31 | 17.26 | 10.90 | 1059.50 | 0 | 2.996 | Significant reduction |
| Exit Speed | Morning | 23.43 | 21.23 | 10.72 | 1673.16 | 0 | 2.997 | Significant reduction |
| | Afternoon | 18.72 | 16.72 | 11.52 | 1228.35 | 0 | 2.996 | Significant reduction |
| Average Section Speed | Morning | 26.32 | 21.06 | 9.32 | 15.84 | 0 | 2.997 | Significant reduction |
| | Afternoon | 21.73 | 18.32 | 10.31 | 19.6 | 0 | 2.996 | Significant reduction |

All F-statistics exceeded critical values with p-values < 0.05 , confirming with statistical certainty that the safety improvements were caused by the interventions, not by random variation.

Post Encroachment Time

Post-Encroachment Time (PET) measures the time difference between a pedestrian leaving a zone and a vehicle arriving.

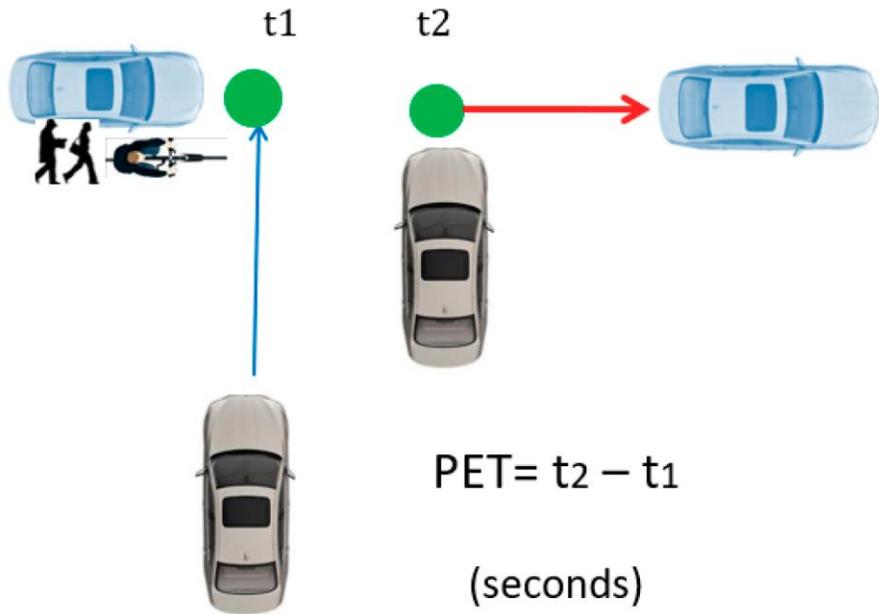


Table 4. Result of Conflict Analysis

| Total number of conflicts | | |
|---------------------------|---------|-----------|
| | Morning | Afternoon |
| Before | 321 | 921 |
| After-1 | 190 | 905 |
| After-2 | 57 | 531 |

**82%
Reduction**

**43%
Reduction**

Overall Reduction in critical conflicts indicates Elimination of High-Risk Pedestrian-Vehicle Interactions

Conclusions



Speed:

~50%+ reduction in maximum speeds;
85th percentile speeds nearly halved.



Compliance:

~12% absolute increase in driver
yielding rates.



Safety:

~82% drop in morning vehicle-
pedestrian conflicts (PET).



Cost:

Achieved entirely via low-cost
signage, paint, and rumble strips.

- The IRC:SP:32-2023 guidelines were found effective in moderating speed and reducing conflicts.
- Improvements were sustained and even deepened over time (After-2), proving the viability of these measures for long-term safety.
- Wider adoption of these low-cost treatments is a viable, high-impact strategy for resource-constrained settings to protect vulnerable road users in school zones.

Limitations and Future Scope

- Limited observation window (With two peak periods).
- Unable to isolate individual effects of specific TCD components.
- Single-site pilot study.
- Application across varied urban contexts to generalize findings, validate consistency, and guide state-wide safety policy.



Acknowledgements



SAFETRIP LAB
Department of Civil Engineering,
IIT Roorkee

A dark blue rectangular box containing a white shield-shaped logo with a winding path, a 'T' in a triangle, and a 'P' in a square. Below the logo, the text 'SAFETRIP LAB' is written in white, followed by 'Department of Civil Engineering,' and 'IIT Roorkee' in a smaller white font.

3M
India Limited

The 3M logo is in red, with '3M' in a large, bold font and 'India Limited' in a smaller, bold font below it.

DATA FROM SKY

The logo for Data From Sky, featuring a blue cloud icon with a white eye-like shape inside, followed by the text 'DATA FROM SKY' in a bold, blue, sans-serif font.

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Thank You

