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# IMPACT OF ROADSIDE FRICTION ELEMENTS ON AVERAGE TRAVEL SPEED AND LOS OF URBAN TWO LANE STREETS IN INDIA

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***Abstract*** **- Each year the Government is spending huge amount of money to improve the infrastructure by improving the Road Connectivity and conditions, at different level of organizations be it National, State or rural roads.. Even after these efforts the conditions have not seen a considerable improvement due to Socio economic factors deciding the quality. The most common events undermining the improvement are Pedestrians moving haphazardly, parked vehicles at undesignated places and road side vendors etc. These elements causing Side Friction are effecting vehicular movements and also its maximum flow and level of services (LOS). The randomness and scarce presence makes it less interesting for the researchers to study the causes and effects though they make a major factor for developing countries, whereas it is commonly experienced in daily life. Though, an initiative has been taken to quantify the result of roadside friction elements on Average Travel Speed and Level of services of Rural Highways**

## I. INTRODUCTION

The daily traffic density of urban streets is increasing with the growth in Urbanization. . As per records are taken into account, the 1901 Census gives the data that only 25.5 million individuals grouping to almost 11.5 percent of the said population lived in Urban colonies in the country. Crossing an entire century, a twelve time increment has been seen in the population and stands at 286 million which turns out to be 28.53 of population. India is lagging behind in the Urban Trasnport System in comparision to other developing countries around the globe.

*A) Objective*

- To determine the average travel speed a vehicle operates on at different study sections and segments at different time periods of the day.
- From the evaluation of the average travel speed and later the free flow speed the level of service of the roads is to be determined.
- After assigning different weights corresponding to different Road side Friction Elements at different positions within the carriageway all the friction components are combined in one unit of measure named as RSFI.
- The main objective is to identify if friction factors explained any variation in mean vehicles speeds and capacity on the different studied roads.

*B) Scope*

Average travel speed can be improved by removing road side friction elements.

By taking side friction elements into account while designing, proper parking facilities can provided.

Inclusion of variety of facalities as mentioned: Roundabouts, Different Terrains, Ramps and Intersections.

## II. LITERATURE REVIEW

Works and studies which has been done previously on this topic are been discussed in this section. A huge amount of funds are been invested in road transport in rapidly developing & densely populated countries in asia as it is seen to be a crucial sector in development effort. Procedures are needed to estimate the traffic performance if best utilisation is to made of the resources spent for maintenance and construction while designing new roads & upgrading and maintaining existing ones.

Over the years for meeting the demands various tools are been developed internationally:

a)HCM(Highway capacity manual)-It originates regarding traffic engineering profession and various traffic performing measures like speed, delay etc as functions of traffic control features, geometric design and traffic interaction are predicted using this.

b)HDM(Highway design and maintenance models)-this emanates from highway engineering profession. By comparing highway costs and road user costs for different treatment and pavements the selection of pavement management is primarily done by it.Free flow speed which normally excludes congestion effects is been predicted on the basis of these calculation.

The Indonesian HCM (1993)[1] classifies side friction to high and low levels and considers side friction correction factors to be incorporated in the calculation of free flow, saturation flow and capacity.

Ahmed Munawar (2011)[2] studied comparative analysis between predicted speed by IHCM formula and actually observed speed .From this study it is concluded that, when side friction is high ,there is a significant difference between the speed predicted by IHCM and actual speed.

Sherin George, Sudipta Pal & Sudip Roy(2014) [3 & 4] had proposed interaction among fast moving vehicles, pedestrian, and non-motorized vehicles.

Karl L. Bang(1995) [5] selected two types of roads for data collection viz. urban roads and interurban roads. For urban roads side friction parameters are flow of pedestrians along the highway (ped/h), pedestrians across the highway (ped/h/km), vehicle stopping is differentiated according to whether stop was on the shoulder or the carriageway, parking or un-parking of vehicles (veh/h/km), vehicles entering or exiting road facilities. For interurban roads parameter are no. of pedestrians walking along and crossing the road (ped/h/km), no. of stopping and parking manoeuvre (veh/h/km), no. of vehicles entering and leaving road facilities, the flow of slow moving vehicles (veh/h).

Daisa and Peers( 1997) [6] observed that the average speed decreases around 13 Kmph with every 100 veh/km increase inm parking density.

Hidayati et al.(2012) [7] and Bansalet al.(2014) identified ‘parked and stopped vehicles’ as the most important side friction element on urban road causing the maximum impact on the regular traffic flow as compared to other factors like pedestrian movements, NMVs etc.

## III CALCULATION OF RSFI

Various friction elements will have different impact on through traffic based on their physical dimension and their position within the carriageway. Weight factors were calculated based on projected area of respective friction element and their distance from carriageway edge. Impact of Side Friction was considered as combined effect of physical dimension of friction element and their position on carriageway.

| S. No. | Friction Element | Edge Strip | Mid Strip | Crossing |
|---|---|---|---|---|
| 1 | Pedestrians | 0.544 | 1.044 | 2.044 |
| 2 | Cars | 1 | 1.5 | 2.5 |
| 3 | Two wheeler | 0.63 | 1.13 | 2.13 |
| 4 | Truck | 2.04 | 2.54 | 3.54 |
| 5 | Mini Bus | 1.825 | 2.325 | 3.325 |
| 6 | Full Bus | 2.745 | 3.245 | 4.245 |
| 7 | Cycle | 0.575 | 1.075 | 2.075 |
| 8 | Auto Rickshaw | 0.785 | 1.285 | 2.285 |
| 9 | Carts | 0.725 | 1.225 | 2.225 |

**Table I**
Scaled Weight Factors Considering Cars at Edge Strip as Unit

| **Left Edge Strip** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pedestrians | cars | Two Wheelers | Truck | Mini Bus | Full Bus | Cycle | Auto Rickshaw | Carts |
| **W.F** | 0.544 | 1 | 0.63 | 2.04 | 1.825 | 2.745 | 0.575 | 0.785 | 0.725 |
| **No.** | 14 | 52 | 7 | 0 | 0 | 0 | 8 | 12 | 2 |
| **RSFI** | 7.616 | 52 | 4.41 | 0 | 0 | 0 | 4.6 | 9.42 | 2.57 |
| | | | | | | | | Total | 80.62 |
| | | | | | | | | | |
| **Mid Strip** | | | | | | | | | |
| **W.F** | 1.044 | 1.5 | 1.13 | 2.54 | 2.325 | 3.245 | 1.075 | 1.285 | 1.225 |
| **N.o** | 8 | 6 | 2 | 2 | 2 | 0 | 0 | 1 | 0 |
| **RSFI** | 8.325 | 9 | 2.26 | 5.08 | 4.47 | 0 | 0 | 1.285 | 0 |
| | | | | | | | | Total | 30.45 |
| | | | | | | | | | |
| **Crossing** | | | | | | | | | |
| **W.F** | 2.044 | 2.5 | 2.13 | 3.54 | 3.325 | 4.245 | 2.075 | 2.285 | 2.225 |
| **N.o** | 12 | 4 | 3 | 0 | 0 | 0 | 1 | 2 | 0 |
| **RSFI** | 24.528 | 10 | 6.39 | 0 | 0 | 0 | 2.075 | 4.57 | 0 |
| | | | | | | | | Total | 47.56 |

Table 2 Typical Calculation of RSFI

Total RSFI for: Segment 1/ Run No.1/ Peak Evening/ East Bound Direction:80.62 + 30.45 + 47.56 = 158.62 per 3.2 k.m and 3.8 m mid Section

**Road side friction index (RSFI) = ∑niWi** where, niis the number of ith type friction elements in stretch and Wi is the Scaled Weight factorfor a particular type of element. So, for 1 k.m and 5m standard mid section : RSFI = [ (158.62/3.2) x (5/3.80) ] = 65.22

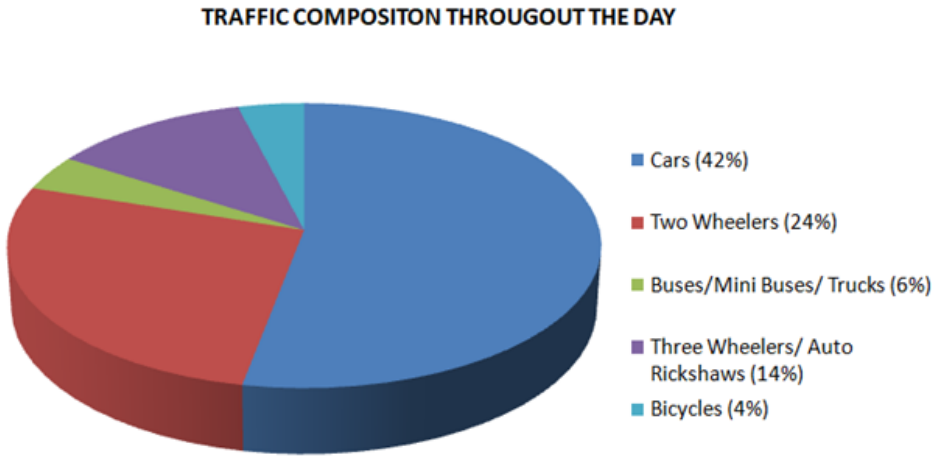


Fig 1 Mixed Traffic Composition for Site 1 Throughout the Day

| Vehicle Category | Conversion Factor |
|---|---|
| **Car** | 1 |
| **Bus** | 3 |
| **LCV** | 1.5 |
| **Two wheeler** | 0.5 |
| **Three Wheeler** | 1 |
| **Truck** | 4.5 |

Table 5.1 PCU Conversion Factors for Different Vehicle Categories

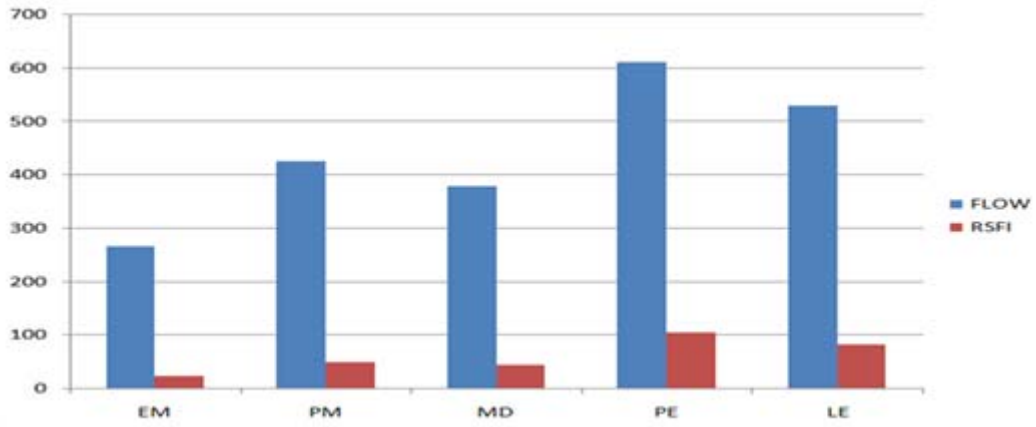


Fig 2 Mixed Traffic Composition for Site 2 Throughout the Day

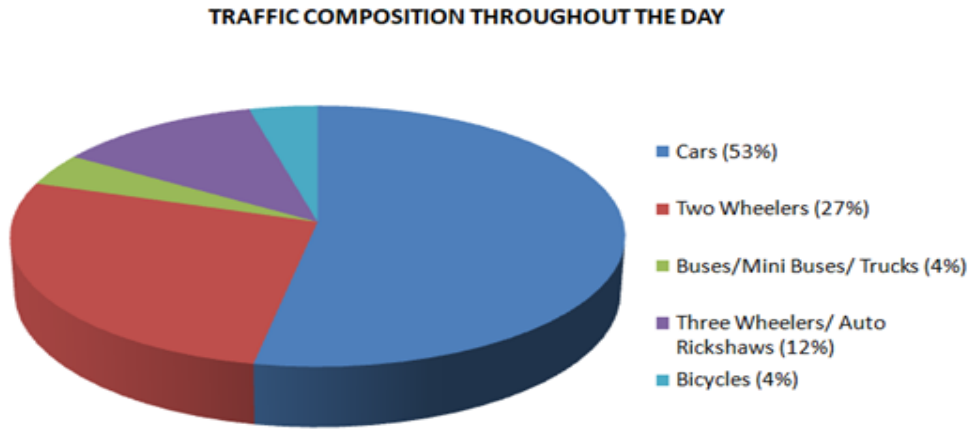


Fig 3 Mixed Traffic Composition for Site 2 Throughout the Day

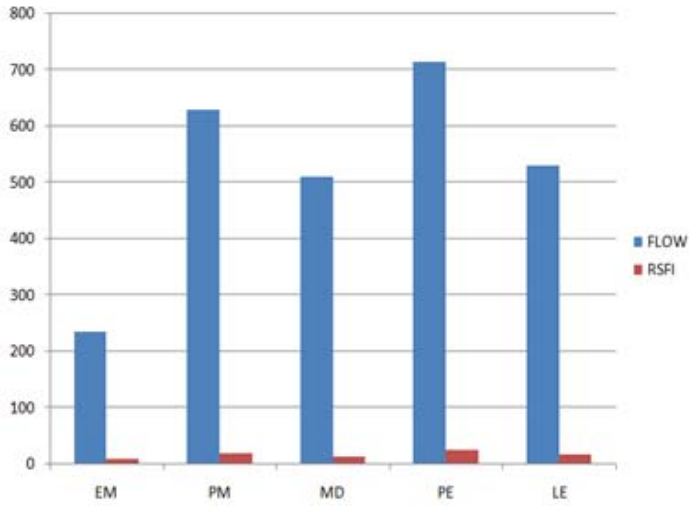


Fig. 4 Flow and RSFI Variation Throughout the Day

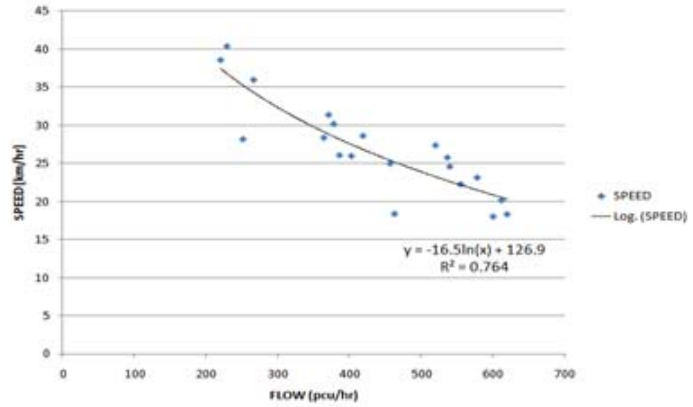


Fig. 5 Speed- Flow Plot For Segment 1

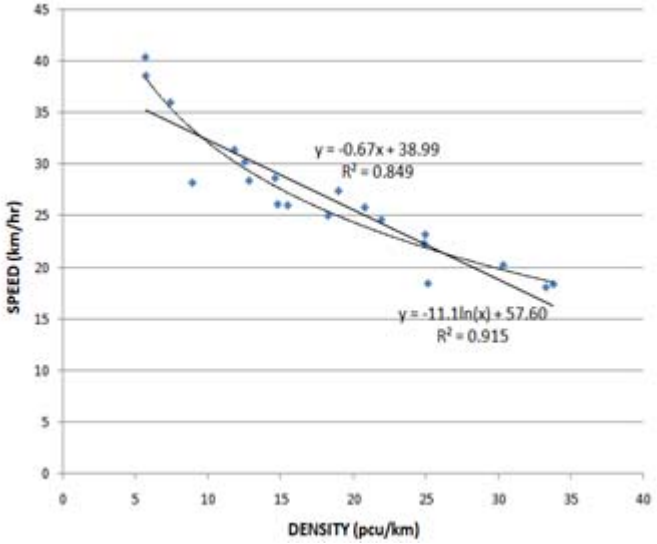


Fig. 6 Speed- Density Plot for Segment 1

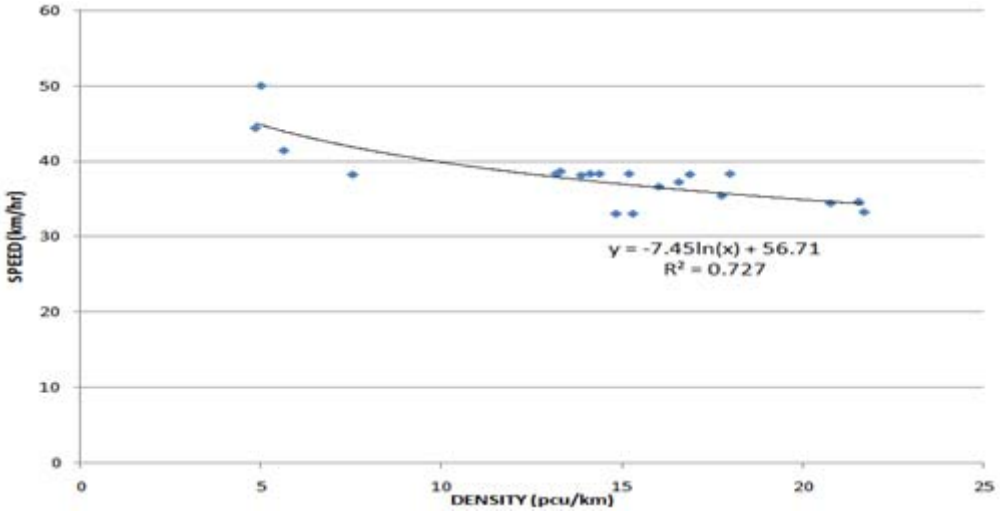


Fig. 7 Speed- Density Plot for Segment 2

| Time period | RSFI Ranges | Speed Ranges (km/hr) |
|---|---|---|
| EM | 10-130 | 30-46 |
| PM | 20-240 | 18-36 |
| MD | 30-260 | 16-38 |
| PE | 70-350 | Aug-36 |
| LE | 70-300 | Oct-38 |

Table 3 Temporal Variations in Density and Speeds

| Time Period | Density Ranges (pcu/km) | Speed Ranges (km/hr) |
|---|---|---|
| EM | 4 to 10 | 28 to 47 |
| PM | 10 to 25 | 17 to 34 |
| MD | 10 to 35 | 17 to 38 |
| PE | 20 to 100 | 8 to34 |
| LE | 10 to 60 | 12 to 68 |

Table 4 Speed and Density Variations at Different RSFI

| Friction Level | Range of Density (pcu/km) | Range of Speed (km/hr) |
|---|---|---|
| Low | 0-30 | 24-41 |
| Medium | 0-40 | 15-35 |
| High | 10-100 | Aug-24 |

Table 5 Speed and RSFI Ranges at Different Time Periods

| Road Type | Site | R square values | |
|---|---|---|---|
| | | Model with RSFI | Model without RSFI |
| 2 – lane | Section 1 | 0.81 | 0.127 |
| 2- lane | Section 2 | 0.913 | 0.555 |
| 2- lane | Both section 1 and section 2 | 0.806 | 0.329 |

Table 6 R Square Values With and Without RSFI

| Section | Avg Travel Speed (km/hr) | | Independent T –Test | |
|---|---|---|---|---|
| | Low RSFI | High RSFI | Sig Level = 0.05 | Impact |
| Sec 1 | 38.268 | 22.2927 | 0 | Significant |
| Sec 2 | 26.86 | 13.133 | 0 | Significant |
| Sec 1 + Sec 2 | 36.22 | 14.44 | 0 | Significant |

Table 7 T Test Results for Different Sites

## CONCLUSIONS

The quality of travel is largely impacted by the lesser known factors which are side friction causing elements which are not given as importance as they deserve. The effects and range of these side friction activities are such that it must be taken into account properly while calculating speed and capacity of road links in many developing countries such as India. It is also reinforced that impacts of such factors like Side friction on roads must be taken into account in Payment management analysis as well as Geometric Design Analysis primarily in India.

It is proved that travel speeds in India are effected by the factor above mentioned for example in Jaipur City also, where study shows major effects like other general factors in Capacity Analysis. This gives us the conclusion to incorporate in Highway Capacity Studeis, variable in different suitable circumstances.0

Proper parking spaces and more importantly the proper enforcement of parking laws should be imparted. Areas with parking problems should be paid more emphasis at periods when the effect of side friction is the greatest.

Hence, it is preached to undertake detailed analysis of the impact of road side friction elements on travel speed as per the given methodology. It is further conveyed to undertake research on a global scale taking under consideration much wider set of all frictional variation in the Criterion Variable. Furthermore, huge scale study will ascertain to take inclusion of variety of facalities as mentioned: Roundabouts, Different Terrains, Ramps and Intersections. The fact that Different friction factors will vary for different facilities and different terrains will be reinforced.

## REFERENCES

[1] Indonesian Highway Capacity Manual (1997), Directorate General of Highways, Republic Indonesia, Jakarta

[2] Ahmed Munawar ,"Speed Direct (june 2011)[9] Aronsson ,Karin F.M," Influence on vehicle speed profiles of interactions with other road user Macro & Micro '".

[3] Sherin George, "Effect of side friction on traffic characteristics of urban arterial", www.civil.iitb.ac.in (2014)

[4] Sudipta Pal &Sudip Roy "Impact of roadside friction on travel speed and LOS of rural highways in India, "Regression model, Springer (Nov 2015).

[5]Karl L. Bang, "Impact of side friction on speed-flow relationship for rural & urban highway ", Regression model, HDM4 report (July 1995).

[6] Daisa ,J.M ,Peers .J.B ,1997.Narrow residential streets :Do they really slow down speeds ?67th annual meeting of Institute of Transportation Engineers ,pp.546-551.

[7] DC. Hidayati, N.: Liu, R.: Montgomery, F. 2012. The Impact of School Safety Zone and Roadside Activities on Speed Behaviour: the Indonesian Case, Procedia-Social and Behavioral Sciences 54: 1339-1349.