ASSESSMENT OF TRAFFIC SAFETY PERFORMANCE AT UNSIGNALIZED T-INTERSECTION UNDER MIXED TRAFFIC CONDITION

Anand Samir[1] , Sanket Thorat[2], Buddharatna Godboley[3]

[1] *4th SEM M.TECH. Transportation Engineering, GHRCE, Nagpur (India)*

[2, 3] *Assistant Proffesor, Department Of Civil Engineering, GHRCE, Nagpur (India)*

ABSTRACT

Safe movement of vehicle through the various roads is an issue of National concern. Accident causes a lot of damages to both the public health in the form of injuries or causalities and material damages to vehicle, causes loss of productivity. Every year the density of vehicles is increasing and so the flow of vehicles on the roads and previously designed road network may not be able to cope with it due to the increasing demand of traffic across the country. Assessment of traffic safety is generally based on the use of historical accidental data records, which are reactive in nature it is like waiting for the accidents to occur and then applying their countermeasures. These days researchers have proposed a new method for the assessment of collisions at non-signalized intersections called Proactive model based on the Surrogate Safety Measures (SSMs). The main advantage of this method is that they occur more frequently than accidents, thereby implying an efficient and more reliable proximal measure of traffic safety.

Keywords: PET, Safety, Unsignalized Intersection.

I INTRODUCTION

Safety on road is of the utmost priority for any country. Since India is a developing country and we are having heterogeneous traffic system comprising wide range of vehicles of static and dynamic characteristics. Generally lane discipline is violated in Indian driving context. Millions of accidents are being registered every year in India. In urban areas mainly accidents occurs at un-signalized intersections. More than 50% accidents occur at such intersections. At least 14 people die every hour in road accidents in India. Total number of deaths due to road accidents is close to 1,35,000 mark. India has the worst road traffic accident rate worldwide. Intersections are being constructed in order to make movement of traffic smooth and comfortable with some special safety arrangements such as signals. Also accidents occur due to the unsafe driver actions and maneuvers. The confliction between vehicles at the intersections is usually due to the merging, crossing and diverging of vehicles, abrupt change in speed and unexpected lane change. Bicyclists and two wheelers are supposed to be the most collision causing elements at such uncontrolled intersection as they claim almost 40% of fatalaties from total fatalaties recorded so far.

II LITERATURE REVIEW

Pirdavani et al (2010) Presented a safety evaluation of un-signalized intersections using micro-simulation and proximal safety indicators, they have applied a micro-simulator (S-Paramics) to investigate whether changing speed limits under different traffic conditions will affect traffic safety as measured by PET. The results of the simulation show that increasing the traffic volume conditions will affect traffic safety as measured by PET. The results of the simulation showed that increasing the traffic volume on both major and minor roadways will lead to decrease of mean PET values. In other words, as long as there is no traffic congestion, the level of safety will become worsen by increasing the traffic volume.

Songchitruksa and Tarko (2006) proposed a novel application of the extreme value theory to estimate safety. They evaluated the proposed method by applying it to right-angle collisions at TB signalized intersections. Evaluation results indicated a promising relationship between safety estimate and historical crash data. Crash estimates at seven out of twelve sites remained within the range of Poisson-based confidence intervals established using historical data.

Klunder et al (2004), developed a new micro-simulation model for intersection traffic, which can generate accurate SSMs and which represents driver behavior on intersections more accurately. The vehicles in the simulation were designed using dynamics models in Simulink the control (i.e. the driver model) of these vehicles is performed by a number of higher level controllers programmed in java. A series of experiments were set up and the smallest Time to Collision (TTC) was recorded for each different setting of the critical gap value. The result show that as the critical gap value decreases, increasingly unsafe situations can occur at the intersection. TTC values below 1.5 seconds are generally deemed unsafe.

III CALL FOR STUDY

In 2010, a total of 4,99,628 road accidents were registered, which claimed a total death of 1,34,513 people and 5,27,512 injured (Road accident Report, India 2010). In 2011 total number of accidents were 4,97,686 which resulted in death of 1,42,485 people and 5,11,394 injured, however the number of fatalities increased by 5.9% in 2011. The total loss to the Indian economy due to fatalities and accident injuries at 3% of GDP in 1999-2000 is particularly severe as 51.9% of road accident victims were in the age group of 25 to 65 years in 2010, claiming pedestrian, bicyclists and two wheelers, who are supposed to be the most unprotected road users. Above furnished data clearly indicates that the driving practice is one of the most important root causes for accidents.

IV DIFFICULTIES FACED AT UNSIGNALIZED INTERSECTION

The Indian traffic is of mixed type. All types of vehicle moves on the same lane, as very rarely dedicated lanes for a single type of vehicular movement have been designed. At un-signalized intersections vehicles are free to move in any of the directions. Usually people avoid waiting too long and thus try to make entry even in small gaps found. Such practices results in several problems such as traffic congestion, sudden accidents as a result of collision between two or more vehicles. Maximum road accidents are being recorded at un-signalized intersections. As compared to signalized intersection it is relatively difficult for pedestrians to cross the road and accidents as well.

V STUDY METHODOLOGY

The roads Historical accidental data were being used for analysis of accidents. Such practices are reactive in nature. Researchers have proposed a new method for the analysis of accidents which is more practical and gives such a result which restricts future collision between vehicles. This is "Proactive Method". In this approach a significant number of crashes must occur before a problem is identified and corresponding corrective measures can be implemented. This method does not completely rely on the historical accident data but use of other measures such as safety indicators and predictive models. Application of safety indicators is more reliable and efficient alternative for the safety assessment of traffic accidents. PET calculation is supposed to be the best method for the assessment of traffic collision at un-signalized intersections. Generally PET is calculated by forming grids on the road. If *t1* is the time when a vehicle exits and *t2* is the time when another vehicle enters the same common spatial collision zone, then PET =*t2-t1*. Smaller the value of PET greater will be chance of collision and vice-versa. Total numbers of collisions will be determined and that value will be compared with the results obtained from the application of simulation software.

VI DATA ASSORTMENT AND ANALYSIS

The research work was executed at a typical unrestrained T-intersection (CRPF Gate No.-3, Hingna, S.H- 255) of Nagpur city. The site is next to our institution and easily accessible. This cross section of road witnesses around 6000 PCU at its peak hour duration, because of its proximity to MIDC (Maharashtra Industrial Development Corporation) and many educational institution. The traffic at this stretch is of mixed nature. It constitutes heavy vehicles, farming vehicles, 2&3 wheelers, excavators, school buses, LCV, bicycles, etc. First of all peak hour period has been decided by carrying out seven days traffic volume count. From this result it has been established that peak hour is from 09:45am to 10:45am. So we have carried out video recording from 09:45am to 10:45am. This T-intersection is being divided into square grid of 3.0m×3.0m using AUTO CAD 2007 software, and grids are designated in a proper naming order for effortless calculation of PET values. An apparent image of grids has been made with the help of Maya 3D software. Now this apparent image of grid have been overlaid on recorded video and has been run using Corel Video Studio Pro X8 software at a frame rate of 6 frames per seconds, and thus PET values have been premeditated at an accuracy of 0.01 seconds. PET values can be premeditated by noting down the time t1 and t2, and difference off t2-t1 gives PET values. t2 is the time when right of way vehicle makes its entry in the potential conflict zone and t1 is the time when right turning vehicle exits the same confliction zone. PET value calculated manually is tabulated below.

Table-1

Class Limits	Mid Point	Frequency	Percentage Relative Frequency	Cumulative Percentage Frequency
0.005-5.005	2.505	661	64.931	64.931
5.005-10.005	7.505	167	16.405	81.336
10.005-15.005	12.505	119	11.690	93.026

15.005-20.005	17.505	58	5.697	98.723
20.005-25.005	22.505	7	0.688	99.411
25.005-30.005	27.505	4	0.393	99.804
30.005-35.005	32.505	2	0.196	100

PET Values from Simulation: Vissim 7.0 has been used for modeling. A road network has been framed with the existing condition of road network. Road network has been extracted from Google map. Exact dimension and channelization of road has been obtained and applied in the modeling. Vissim has certain inbuilt features such as, it follows Poisson's distribution for the arrival process with exponential inter arrival times. Road network created has been calibrated by assigning vehicle inputs from three directions. Spot speed survey has been conducted. Considering 10 vehicles of each class has been examined and average spot speed has been considered. Speed restricted zones has been identified and implemented in modeling. Total 6 types of vehicles have been considered for this study, because the intersection which has been selected for the study is having wide range of vehicle composition. Squared shape of nodes has been place exactly at the same position as in the manual method of PET calculation and then simulation is carried out. The obtained values have been tabulated below.

Table-2

Class Limits	Mid Point	Frequency	Percentage Relative Frequency	Cumulative Percentage Frequency
0.005-5.005	2.505	623	61.078	61.078
5.005-10.005	7.505	189	18.529	79.607
10.005-15.005	12.505	112	10.98	90.587
15.005-20.005	17.505	79	7.745	98.332
20.005-25.005	22.505	11	1.078	99.419
25.005-30.005	27.505	6	0.588	100
30.005-35.005	32.505	0	0.000	100

Now both obtained results has been compared by plotting graph of relative frequency and cumulative frequency curve. It has been observed that both results are approximately same.

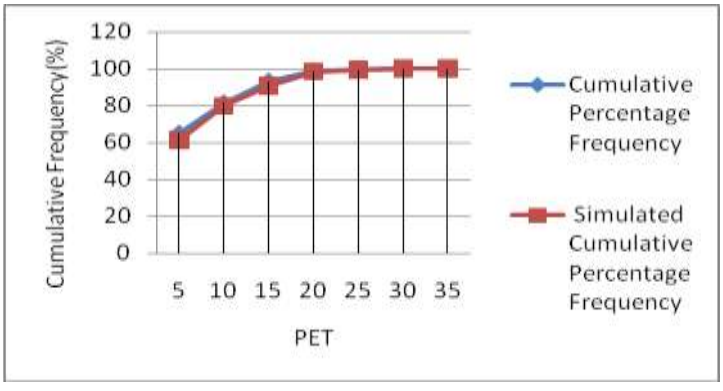

Fig-1

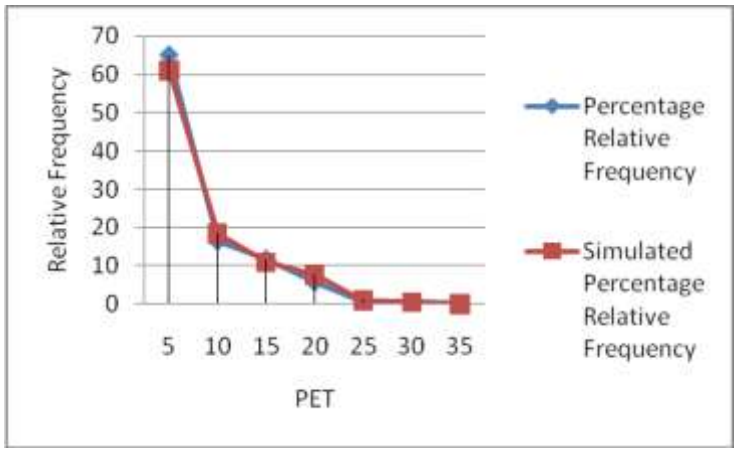

Fig-2

V CONCLUSION

Above studies focused on present conditions of safety at un-signalized intersections in Indian context. Collision severity has been drawn from this study and based on that the following conclusion is withdrawn:

- Prospective conflict zone can be identified by using Post Encroachment Time method.
- The PET values obtained by manual method are nearly equal to the PET values obtained by using Micro-simulation tool. Hence micro-simulation tools can be considered reliable for assessment of traffic safety.
- The study of on effect of traffic volume indicates that the increase in traffic volume in major as well as minor road will result in decrease in the mean PET values.
- Speed enforcement measures can be used to minimize chances of crashes at intersections.
- Since PCU Value at this stretch is quite high during peak hour period, therefore signal can be installed at this junction.

REFERENCES

[1] Killi D V. et.al., Vedagiri P., (2014) "Proactive Evaluation of Traffic Safety at An Unsignalized Intersection Using Micro- Simulation" , Journal of traffic And Logistics Engineering Vol. 2, No. 2, June 2014

[2] Pirdavani, A., Brijis, T., Bellemans, T., and Wets, G., 2010. Evaluation of traffic safety at un-signalised intersections using microsimulation: a utilisation of proximal safety indicators. Advances in Transportation Studies an international Journal, Section A22, 43-50.

[3] Gerdien Klunder, G., Arshad, A., Immers,. B., 2004. Development of a micro-simulation model to predict road traffic safety on intersections with surrogate safety measures, TNO Build Environment and Geo Sciences. 1-25

[4] Songchitruksa, P., Tarko, AP., 2006. The extreme value theory approach to safety estimation, *Accident Analysis and prevention, 26,5,593-607.*

[5] Sayed, T., Brown,G., Navin, F., 1994. Simulation of traffic conflicts at unsignalised intersection with TSC-Sim, *Accident analysis and prevention,26,5,593-607.*

[6] J. Archer, "Indicators for traffic safety assessment and prediction and their application in micro-simulation modeling: A study of urban and suburban intersections," Ph.D. dissertation, Dept. of Infrastructure, Royal Institute of Technology, Stockholm, Sweden, 2005.

[7] L.R Kadiyali, Traffic Engineering and Transport Planning, Khanna Publishers, India

[8] Reports on Road Accidents in India, 2010 and 2011, Government of India, Ministry of Road Transport Researrch Wing, New Delhi.