A REVIEW PAPER ON ASSESSMENT OF TRAFFIC SAFETY PERFORMANCE AT UNSIGNALIZED INTERSECTION

ANAND SAMIR[1] ,SANKET THORAT[2]

[12](*Department of Civil Engineering, GHRCE, Nagpur/RTMNU, 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. In this paper various methods to analyze and reduce conflicts at un-signalized intersections have been reviewed.

Keywords: PET, Safety, Surrogate Safety Measures (SSMs), 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.

II.   LITERATURE REVIEW

Surrogate Safety Measures (SSMs)

These measures are based on the idea that accidents occur due to confliction among vehicles, a situation caused due to higher chances of collisions. The various safety indicators are; Time to Collision (TTC) - it is the expected time of collision between two vehicles if they do not change their present speed on the same path.

Gap Time (GT) - it is the time lapse between the completion of encroachment by turning vehicle and the arrival time of crossing vehicle if they continue with same speed and the path.

Encroachment Time (ET) – it is the time duration during which the turning vehicle infringes upon the ROW (Right Of Way) of through vehicle.

Deceleration Rate (DR) – it is the rate at which crossing vehicle must decelerate in order to avoid the anticipated collision.

Proportion of Stopping Distance (PSD) – it is the ratio of distance available for maneuvering to the distance remaining to the projected location of the collision.

Post Encroachment Time (PET) – it is the time gap between two vehicles when first vehicle exits and another vehicle enters the common spatial collision zone.

Time to collision (TTC) and Post Encroachment Time (PET) are the most frequently used SSMs. PET is the most commonly used proximal indicators in the road safety analysis, and is chosen to evaluate the safety situation at un-signalized intersection.

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.

 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.

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.

Sayed et al, (1993) used the TSC-Sim to generate simulation models for T and 4-legged intersections. These models were then be used to study the traffic conflicts as critical-event traffic simulations. The effects of various conditions such as driver characteristics, waiting time etc on conflict were studied. The results of simulation correlate reasonably well with actual conflict observations and thus can be used for assessing safety performance and feasible solutions for enhancing safety at the intersections.

III.   NEED 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.   FUTURE SCOPE

The methods mentioned in this paper have proven records to increase the safety at un-signalized intersections. So by using these methods we aim to propose safety measures at an un-signalized intersection in Nagpur city. The various types of data collected for selected intersection will be analyzed using micro-simulation tools and new safety measures will be identified based on results produced by the micro-simulation tools.

VII.   CONCLUSION

Above studies focused on present conditions of safety at un-signalized intersections in Indian context. Various researchers implemented different methods to increase the safety in such conditions. Based on their studies following conclusions can be drawn:

- Potential conflict zone can be identified by using Post Encroachment Time method.

- The PET values obtained manual analyses 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.

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.