



ADVANCED METHODOLOGIES FOR ACCIDENT REDUCTION AT UNSIGNALIZED INTERSECTION

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ABSTRACT

This paper deals with providing safety at unsignalized intersection. Intersections are often the location for traffic accidents. This may be attributed to the layout of an intersection, a location where at least two roadways cross each other and multiple vehicles are turning left, right, crossing-over, etc. ongoing activities that may lend themselves to an increased risk of motor vehicle accidents. Highway intersections are nodes of road networks and accident-prone locations. Majority of intersections in the India are unsignalized. According to documented statistics, intersections are among the most hazardous locations on roadway systems. Many studies have extensively analyzed safety of signalized intersections, but did not put their major focus on the most frequent type of intersections, unsignalized intersections. This paper introduces an approach to evaluate and improve unsignalized intersection safety performance. This method is fully based on the existing conditions of unsignalized intersection, including geometric design, sight distance, pavement surface conditions, traffic control devices, and lighting, etc. This approach needs to go through a field survey to unsignalized intersection to be evaluated. In this approach, a safety index is introduced to give a diagnostic summary of the safety performance degree of unsignalized intersections. Corresponding countermeasures are ranked and recommended based problems identified. In this paper, the approach (called diagnostic approach) is practically applied to evaluate and improve the safety performance of some unsignalized intersections in Maharashtra.

Keywords: Injury, Intersections, Locations, Crossing, Traffic Crashes, Safety, Unsignalized.

I INTRODUCTION

Traffic safety is becoming more and more important for both drivers and the whole society [22]. Crashes often occur at intersections because these are the locations where two or more roads cross each other and activities such as turning left, crossing over, and turning right have the potential for conflicts. Even though intersections constitute only a small proportion of the entire roadway system, a significantly large proportion of crashes occur at intersections. The crossing

and turning maneuvers that occur at intersections create opportunities for vehicle-vehicle, vehicle-pedestrian, and vehicle-bicycle conflicts, which may result in traffic crashes.

The convergence of two or more roads can take the form of an at-grade intersection or a grade-separated interchange. Because an intersection is the point at which multiple pathways directly cross one another, it inherently presents increased opportunities for conflicts between those who traverse it. Intersection collisions are not at all uncommon and often result in severe injuries and fatalities. As depicted below, crashes at or related to intersections have accounted for more than one of every four fatal crashes in the Maharashtra in recent years.

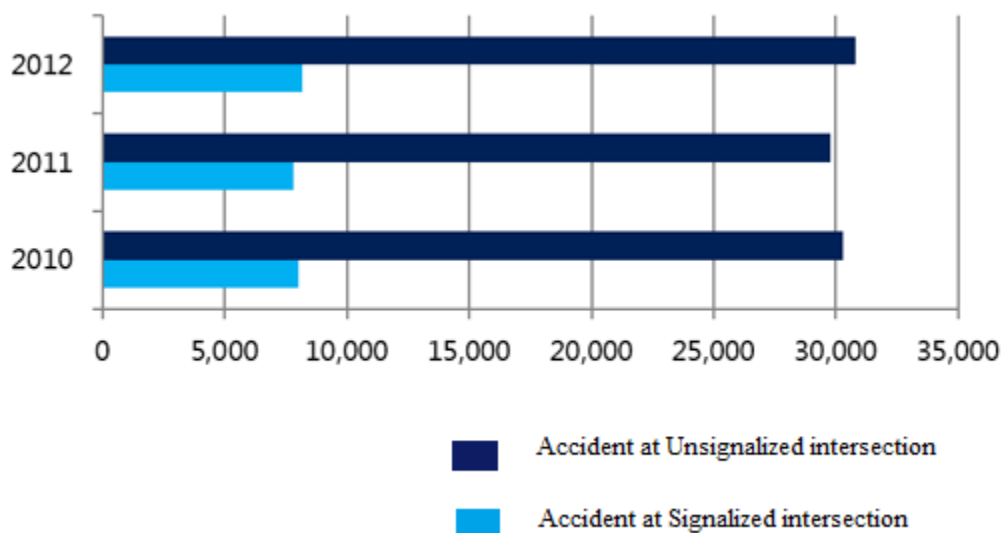


Fig:- Accident at signalized & unsignalized intersection-related Fatal Crashes in Maharashtra (based on query of NHTSA FARS database).

Vehicles stopping or slowing to turn create speed differentials between vehicles travelling in the same direction. This is particularly problematic on two-lane highways. The intersections along low- to moderate volume roads in rural and suburban areas are usually unsignalized. These roadways are generally associated with high-speed travel and relatively lower geometrics than those in more developed suburban and urban areas [2].

II OBJECTIVE AND SCOPE OF PRESENT STUDY

- **Improve management of access near unsignalized intersections** — Driveway access at or near an unsignalized intersection may confuse drivers using the intersection and create vehicle-vehicle conflicts. For good access management, driveways within 250 feet of an intersection should be closed, relocated, or restricted.
- **Reduce the frequency and severity of intersection conflicts through geometric design improvements** — Reducing the frequency and severity of vehicle-vehicle conflicts at intersections can reduce the frequency and



severity of intersection crashes. This can be accomplished by separating through and turning movements at the intersection, restricting or eliminating turning maneuvers, providing acceleration lanes, and closing or relocating intersections.

- **Improve sight distance at unsignalized intersections** — Some collisions at unsignalized intersections occur because of limited sight distance for drivers approaching the intersection or for drivers stopped at an intersection approach. Provision of clear sight triangles in each quadrant of an intersection can minimize the possibility of crashes related to sight obstructions.
- **Improve availability of gaps in traffic and assist drivers in judging gap sizes at unsignalized intersections** — Some collisions at unsignalized intersections occur because drivers have difficulty judging gap sizes before deciding whether to initiate a roadway entry or a turning maneuver. Drivers stopped to wait for the oncoming traffic stream often choose to proceed when oncoming vehicles are close, thus increasing the probability for a collision.

III METHODOLOGY

3.1 Selection Of Evaluation Method

In the research presented in this paper, another approach called diagnostic approach was attempted. To evaluate or assess the safety performance of an intersection, traffic crash analysis is the most popular method and has been used for a long history. However, traffic crash analysis is based on a lot of crash data which needs to be accumulated through a long time period. This approach is purely based on the existing intersection conditions, such as geometric, channelization, sight distance, pavement surface conditions, lighting, approaching traffic speed, etc. Different from the crash-based and conflict-based methods, this approach is a non-crash and non-conflict based analysis method. With such characteristics, this approach could give a relatively fast evaluation to intersection safety performance. The non-accident based approach is based on field survey to the conditions mentioned before. The approach will also result in a safety index to indicate the safety performance degree of the intersection. A safety index is introduced to give a diagnostic summary of the safety performance of an intersection [4]. Meanwhile, corresponding countermeasures are ranked and recommended based on the cost-benefit analysis. Usually, non-crash and non-conflict based evaluation methods can give a safety evaluation to road facility with a relatively short time period and are relatively easy to be implemented in real applications. Particularly, this type of approach has advantages, such as low cost, high efficiency, and less time-consuming. Furthermore, this type of approach can be better used by field safety engineers to find potential safety problems and corresponding countermeasures can be implemented with short time period so that possible traffic safety problems can be prevented [4].

Traffic safety is influenced by lots of factors such as roadway geometric, road surface condition, traffic management and control, weather condition, driver behaviour and so on. Considering data collection and processing, it is not feasible to identify all the factors, where only a few can be easily obtained and analysed to estimate unsignalized intersection safety [1]. Diagnostic approach is used to evaluation unsignalized intersections safety performance which is based on the existing conditions that have direct relationships or impacts to traffic safety at unsignalized intersections [1].



3.2 Selection of Intersection for Safety Evaluation

The process to determine the sites (intersections) in an area or roadway can be based on the past traffic crash history or a preliminary field safety survey. The number of sites for detailed field survey is really based on the budget limitations [4].

3.3 Identification of Safety Problems

Field surveyors need to use the survey form to survey each intersection. The survey items cover all related conditions. The surveyors need to use their field experience to judge the potential safety problems associated with the existing conditions at each intersection; filling in the diagnostic table mainly depend on the researcher's own practical experience, significance and severity evaluation criterions, which are established according on present criterions, guides practical experience and the expert's suggestion, the purpose is to provide a uniform reference of the safety problems to the researchers [9,10].

IV RESULTS AND DISCUSSIONS

Intersections are important connections between two or more roadways and the resulting conflicting traffic movements make intersections crash-prone locations. The safety condition of unsignalized intersections has a great influence on the traffic safety of the road net, and decrease the number of traffic accidents.

This document has primarily focused on specialized treatments that may be considered to reduce crashes at unsignalized intersections on multi-lane, high speed roadways. consideration of proven common treatments should be given the first priority after the contributing causes of the crashes have been identified. The best solution may be a combination of both common treatments and specialized treatments. Many of the specialized treatments presented in this document have not had extensive use thereby providing only limited information regarding the expected crash reduction.

In the research presented in this paper, another approach called diagnostic approach was attempted. In order to evaluate the safety performance of highway intersections more objectively, efficiently, and fast, the existing conditions at Unsignalized intersection could be used as the basis for intersection safety performance evaluation. Non-crash and non-conflict based evaluation method can give a safety evaluation to roadway facility with a relatively short time period and are relatively easy to be implemented in real applications. This research analyzes safety problem and present information on suggest effective, low-cost intersection countermeasures improvement at unsignalized intersections. These low-cost countermeasures can be applied to a large number of unsignalized intersections with a high frequency of crashes.

V CONCLUSION

It is concluded that count data should be classified in terms of geometric and control parameters for effective utilization in accident analysis. Attributes such as road width, locale, lane marking, and traffic control provide the key factors responsible for accident occurrence. A more detailed investigation can be performed by dividing the data with respect to road width for each attribute The results from this study from the different methodological approaches for analyzing



safety at unsignalized intersections can be applicable to diagnose some safety deficiencies identified. It is recommended that localized treatment can be provided to intersections with single lane marking by constructing concrete or grass median in the effective area of the intersection. Another option is to convert the major road into one way facility if the volume is high. Since, provision of Stop sign and/or Stop line greatly reduces the number of accidents occurring at unsignalized intersections. Therefore, all intersections with no control should be furnished with stop signs and stop lines. This will contribute heavily towards their risk reduction. According to guidelines, stop signs should be kept clean, and visible at all times (at day and night). Improper signs should be replaced without delay. Special care should be taken to make sure that trees, shrubs, and other vegetations do not block stop signs.

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REFERENCES

- [1] Colgate, M.G., Tanner, J.C., 1967. Accidents at rural three-way junctions. Road Research Laboratory, Ministry of Transport, RRL Report LR 87.
- [2] Polus, A., 1985. Driver behaviour and accident records at unsignalized urban intersections. Accident Analysis and Prevention 17 (1), 25–32.
- [3] Frith, W.J., Harte, D.S., 1986. The safety implications of some control changes at urban intersections. Accident Analysis and Prevention 18 (3), 183–192.
- [4] Jian Lu, Li Yuan, Guoqiang Zhang, and Qiaojun Xiang, "Diagnostic Approach for Safety Performance Evaluation and Improvements of Highway Intersection ", Journal of Transportation Engineering, TRB, 2007 Annual Meeting CD-Rom.
- [5] Shengxue Zhu, Jian Lu, and Gu Wang," Intersection Safety Evaluation Model ", Journal of Transportation Engineering, ASCE, 2010, pp. 305-311.
- [6] Institute of Transportation Engineers, " Making Intersection Safer : A Toolbox of Engineering Countermeasures to Reduce-Light Running ", U.S. Department of Transportation, Washington, D.C., 2003.
- [7] Bruce Corben, Jennifer Oxley, Sjaanie Koppel, and Ian Johnston, " Cost-Effective Measures to Improve Crash and Injury Risk at Rural Intersections ", Monash University Research Centre, 2008.
- [8] Mace, D., and Pollack, L., " Visual Complexity and Sign Brightness in Detection and Recognition of Traffic Signs", Transportation Research Record, 904, 1983.
- [9] Preston, H., and Schoenecker, T., " Potential Safety Effects of Dynamic Signing at Rural Horizontal Curve ", (Report No. 3-35) , D.C.,USA, National Co-Operative Highway Research Program, 1999.



- [10] Li Yuan, and Jian Lu," Safety Evaluation Method of Roadway Intersection ", Journal of Transportation Engineering, IEEE, 2009, pp. 590-593.
- [11] Federal Highway Administration, "Low Cost Intersection Safety Improvements ", U.S. Department of Transportation, Washington, D.C., 2008.
- [12] Xiaoming Zhong, and Liande Zhong, " Study on the Relationship of Intersection Design and Safety of Urban unSignalized Intersection in China ", Submitted for Presentation and publication Consideration at 3rd Urban Street Symposium of the Transportation Research Board, Washington, 2007.
- [13] Kim, D-G., Lee, Y., Washington, S., Choi, K., 2007. Modeling crash outcome probabilities at rural intersections: Application of hierarchical binomial logistic models. Accident Analysis and Prevention 39, 125–134.
- [14] Harnen, S., Umar, R. S. R., Wong, S. V., Hashim, W. I. W., 2003(a). Motorcycle crash prediction models for non signalized intersections. IATSS RESEARCH 27(2), 58-65.
- [15] Harnen, S., Umar, R. S. R., Wong, S. V., Hashim, W. I. W., 2003(b). Predictive model for motorcycle accidents at three-legged priority junctions. Traffic Injury Prevention 4(4), 363-369.
- [16] Cameron, A.C., Trivedi, P.K., (1998). Regression analysis of count data. Cambridge University Press. ISBN 0-521-63201-3.
- [17] Sayed, T., and Zein, S., " Traffic Conflict Standards for Intersections " , Transportation Planning and Technology, Vol. 22, 1999, pp. 309-323.
- [18] Yuan, L., Lu, J., and Xiang Q.J., " Research on Diagnostic Method of Highway Intersection Safety ", International Road Safety Seminar, Beijing, China, 2005, pp. 348-352.
- [19] Sun, B.Y., Lu, J., and Ma Q.L., " Research on Method for Priorities of Traffic Safety Countermeasures at Highway Intersections " , International Road Safety Seminar, Beijing, China, 2005, pp. 341-344.
- [20] Xiang, Q.J., Lu C., Wu Q., and, Lu J., " Traffic Safety Evaluation on Highway Intersection Based on Severity Division of Traffic Conflict " , Journal of Highway and Transportation Research and Development, 2008, pp. 128-131.