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Safety Performance Evaluation of Yamuna Expressway

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ABSTRACT

The traffic on the Indian highways is heterogeneous in nature. Vehicles with widely varying static and dynamic characteristics occupy the common carriageway space. The speed differentials between the vehicles of the same class and different classes significantly contribute to road crashes on the highways.Statistical modeling approach by Poisson regression and Negative binomial regression were used to assess the safety performance as occurrence of crashes are random events and to identify the influence of the geometric design variables on the crash frequency. Negative binomial regression model was found to be more suitable to identify the variables contributing to road crashes. The study enabled better understanding of the factors related to road geometrics that influence road crash frequency. The study also established that operating speed has a significant contribution to the total number of crashes.The focus of this work is mainly to quantify the relationship between geometric design characteristics and level of safety of intercity highways under heterogeneous traffic conditions.

KEYWORDS:*Crashes; Geometric characteristics; Heterogeneous traffic; Statistical modeling; Poisson regression; Negative binomial.*

1.INTRODUCTION

According to World Health Organization (WHO 2013), over 1.2 million person are killed and 20 to 50 million person are injured annually in road crashes worldwide . As far as developing countries are concerned, 20 to 200 deaths occur per 10,000 motor vehicles, whereas only 2 to 5 deaths happen in the case of developed countries. India is no exception with over 1.3 million people gets killed in over 4.89 mill ion road crashes ever y year.as per the recent statistics, around 0.14 million people die and 0.4 million people get injured due to road crashes every year, with a fatality rate of 11.8 (MORTH, 2015). Approximately half of road crash victims are vulnerable road user's viz. motorcyclists, pedestrians and cyclists. Research works were conducted to evaluate the influence of speed on the safety of roadways. According to AASHTO geometric design of highways and streets (2001), "the safest speed for any highway depends on design features, road conditions, traffic volumes, weather

conditions, roadside development, spacing of intersecting roads, cross-traffic volumes, and other factors". Most of the studies considered the operating speed as the 85th percentile speed of those vehicles travelling on the roadway and found speed-related crashes are more likely to occur at mid-blocks than at intersections (Lamm.et.al., 1990; Liu and Chen, 2009; Lu, 2006). Models were also developed to study the dependence of crash rates on speed and geometric characteristics, which showed that they are not linearly related (Garber and Ehrhart, 2000). Vehicle speed could be related to traffic safety in two ways: (a) greater a vehicle's velocity, lesser the time available for the driver to react to a hazard in the presence of other motorists, bicyclists, or pedestrians. If this relationship exists, it would be expressed in relative incidence of crashes at different speeds and (b) due to the physical relationship of mass and speed to energy, it would be possible to express the relative severity of crashes at different speeds (FHWA, 1998). Most of the studies were carried out on undivided rural highways and a few on divided highways.A pedestrian hybrid beacon (PHB) when used at a midblock pedestrian crossing can overcome this unnecessary delay tomotorists by replacing a designated segment of the solid redball with a flashing red ball. According to the latest version ofMUTCD, PHBs can be installed at locations that do not meettraffic signal warrants or at a location that meets traffic signalwarrants but a decision is made not to install a traffic controlsignal.

2.LITERATURE REVIEW

Praveen Vayalamkuzhi.et al .(2016). In this paper the study was carried out to analyze safety performance of a four-lane divided highway in India, operated under heterogeneous traffic condition. The study was carried out in two sections, viz, development of safety performance functions and also operating speed models. Safety performance functions (SPF's) were developed using GLM approach likes Poisson, Poisson-gamma regression, negative binomial and zero-inflated models where as operating speed models for the mid of curve as well as tangent were developed using multiple linear regression approach. As far as SPF's were considered, geometric design parameters such as gradient, cross slope, operating speed, median opening and annual average daily traffic havesignificant effect on crashes and this variation in turn affects the traffic characteristics thereby decreasing the level of safety leading to more number of crashes. From the models developed based on the goodness of fit test, NB regression model was found to have lower value than that of Poisson regression and Poisson-gamma models, which shows the ability of NB model for predicting crashes.

VeerararavanAmirthalingam.et.al.(2016). In this paper it is concluded that the influence of geometric design characteristics and traffic characteristics on the levelof safety on a four-lane divided rural highway in India, operated under heterogeneous traffic condition was studied. Count data modelling approach was used for developing crash models, because the crash occurrences are rare and random in nature. Geometric characteristics of highway were observed to be varied, which in turn affect the operating speed on the highway, thereby affecting the level of safety. Operating speed (85th percentile speed) of highway, one of the explanatory variables, which has a positive effect on the crash occurrence, was found to be the most influential factor in all

the models developed. It was also found that geometric characteristics of the roadway such as gradient, median opening, access point density, curvature, and traffic volume of preceding and succeeding segments influence the crash occurrence, in addition to the effect of the segment under study. The relationship between contiguous elements was established by developing operating speed models for curve and tangent section and was observed that operating speed of one element is associated with the other element.Developed crash prediction models (CPMs) also gave insight that not only the segment under study have aninfluence on crash, but also preceding and succeeding segments have a significant role in crash occurrence. In thisway, developed models will be really helpful for the transportation engineers in the design of highways operatingunder heterogeneous traffic.

Ranjit Prasad Godavarthy .et al (2016). This study found a significant decrease in unnecessary delay for drivers by comparing PHBs with a signalized treatment at busy midblock pedestrian crossings. An unnecessary delay reduction of 92% was observed for the drivers at the fist PHB location and an unnecessary delay reduction of 94% was observed for the drivers at the second PHB location when compared to the signalized midblock crossing. Further, statistical analysis showed there is a significant reduction in delay by comparing PHB with a signalized treatment at midblock. Though the first PHB location has low volume of vehicles and pedestrians, the results for the first PHB were similar to the results at the second PHB location. Therefore the findings from the two PHB locations can be used for making reliable comparisons with the signalized treatment.

Eugene R. Russell.et al. (2016). In this paper the following points are concluded by them-.After the PHB was included in 2009 version of the MUTCD, the implementation of PHBs in United States increased and there have been numerous studies measuring their safety benefits, and pedestrian and driver compliance rates when installed at intersections, midblocks, and roundabouts. However, not many studies document the benefits of PHB in decreasing the unnecessary delay to the drivers at midblock pedestrian crossings which could potentially improve the traffic flow on streets with high pedestrian activity. While this study also documents pedestrian and driver characteristics at PHB, it was mainly geared to measure the delay benefits by using a PHB instead of signalized treatment at midblock pedestrian crossings with high traffic and pedestrian activity Further, the literature review from this study shows that the cost of installation of PHB was considerably less than a full midblock signal.

V.T. Venkatesh.et al. (2013). In this paper it can be observed that*f*ew recommendations for the better implementation of the same are as follows. Separate provision for pedestrian walkways and safe pedestrian crossings is an effective, affordable and sustainable strategy, supplemented with designation of one-way streets, good street lighting, and traffic calming measures in high-risk areas. Creating public awareness by involving the local residents, schools and school teachers can also be sought. Vehicular standards for the passengertransferrying buses and trucks needs to be regulated as to the maximum passengers allowed, the materials used and about the safety provision to the passengers.

Santijiarakul S.et al.(2015). With increasing motorization, RTIs are on the increase in all Member States of the Region. It is estimated that nearly 300 000 persons die every year in road crashes with the highest numbers reported from India, Indonesia and Bangladesh. More than 10 million people sustain different grades of injury from road traffic crashes. The economic and psychosocial impact of RTIs is huge, though unmeasured. Despite the increasing burden, efforts to address road safety are far from satisfactory in the Region. A limited number of dedicated national lead coordinating agency, in countries, lack of policies and programmes, coordination, funding, commitment for enforcing existing laws, trained human resources are some of the major barriers.

3.CONCLUSION

In this paper we study Safety Performance functions (SPF's) are developed using GLM approach likes Poisson, Poisson-gamma regression, negative binomial and zero-inflated models where as operating speed models for the mid of curve as well as tangent are developed using multiple linear regression approach. As far as SPF's were considered, geometric design parameters such as gradient, cross slope, operating speed, median opening and annual average daily traffic havesignificant effect on crashes and this variation in turn affects the traffic characteristics thereby decreasing the level of safety leading to more number of crashes.Developed crash prediction models (CPMs) also gave insight that not only the segment under study have an influence on crash, but also preceding and succeeding segments have a significant role in crash occurrence. In this way, developed models will be really helpful for the transportation engineers in the design of highways operating under heterogeneous traffic.

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