International Journal of Civil and Structural Engineering Research ISSN 2348-7607 (Online)
Vol. 3, Issue 1, pp: (16-19), Month: April 2015 - September 2015, Available at: www.researchpublish.com

Operating Speed Profiling On Horizontal Curves

[1]Bybin Paul, [2]Jaina U N, [3]Linu Joy, [4]Sikha Surendran, [5]Sreeja V,

[1]Asst Professor, [2,3,4,5] B.Tech Scholar, Mar Athanasius College of Engineering, Kothamangalam, Civil Engineering Department, India

Abstract: **The objective of this paper is to develop the 85th percentile operating speed models at mid-curve that can be integrated based on shoulder width, degree of curve, length and radius of simple horizontal curves for the horizontal curve on Kerala two-lane rural highways conditions. The speed data measurement is based on Spot Speed Data at specified points and location manually.. The geometric parameters such as radius of curve, shoulder width, degree of curve and length of curve are used to recognize the effect of operating speed models at the mid-curve. If this 85th percentile operating speed prediction model using multiple linear regression analysis is implemented and enhanced into current guideline and standard in Kerala, it could play an important role in designing or redesigning of the horizontal alignment for two-lane rural highway in Kerala.**

Keywords: **Operating speed model, Design speed, Radius of curvature.**

I. INTRODUCTION

Traditionally design speed has been selected to determine the radii of horizontal curves for roadway design. One of the significant weaknesses of the design speed concept is that it uses the design speed of the most restrictive geometric element within the roadway section, usually the horizontal or the vertical curve of the alignment, as the design speed of the entire road. Therefore, the speeds that motorists travel on tangents are not explicitly taken into consideration in the design speed concept. This leads to potential inconsistencies among successive sections of a road. These inconsistencies might result in a sudden change in three aspects of the roadway environment: the characteristic of the roadway, driver workload, and driver operating speed. A sudden change in the roadway characteristic might surprise motorists, and such sudden changes might violate driver's expectancy. Several studies indicate that horizontal curvature is highly related to crashes. It was reported that the average crash rate for highway segments including horizontal curves is about three times the average accident rate for tangent segments. Hence it is essential to conduct a study two-lane highways for predicting operating speeds and evaluating design consistency on rural.

II. PROBLEM STATEMENTS

The present design practice in Kerala do not consider the ergonomic element in consideration of the human factors for roadway design since approach for design speed concept only applies to horizontal curves independently and also do not take into consideration the tangents between these curves in an integrated manner.

The conventional approach of design in Kerala does not provide any guidance in determining the maximum tangent length. Therefore, the highway designers are not able to control the maximum operating speeds on tangents since longer tangents encourage higher operating speeds and drivers may have to reduce their speeds significantly or make abrupt changes when they are approaching a sharp curve after driving a long and straight road segment. Note that highways in rural areas of the country are generally designed to give road users both accessibility and mobility. There is no in-depth investigation being reported on the model of the 85th percentile operating speed for horizontal alignments on two lane rural highways in Kerala. This research is will be useful in designing or redesigning the horizontal alignments especially for two lane rural highways where the highways convey high traffic speed. So far, the evaluation of the horizontal alignments design is based on the relationship of operating speeds and other elements. Therefore, this research proposes a model for evaluating the speed of 85th percentile operating speed for horizontal alignments on two lane rural highways with the development of an operating speed model is based on data collected.

III. RESEARCH OBJECTIVE

The purpose of the study is to develop the 85th percentile operating speed model at mid-curve that can affect the highway geometry in horizontal alignments by apply simple and multiple linear regression analysis. The model can be used toestimate and predict the operating speed of passenger vehicles. The objective of this research is to develop of the V85 speed model. Finally, the parameters that are highly correlated between driver speed behavior and highway alignment can be justified based on the design standard and can also assist the practitioners towards the best practice in highway geometric design on two lane rural highways conditions in the country.

IV. LITERATURE REVIEW

Although various studies have been conducted for other types of roadways, the methodologies used and the conclusions reached would benefit this study. Some of the findings provide an understanding to driver's behavior on roadway curves, which benefits the site selection of this study.

The term speed is a general term typically used to describe the actual speed of a group of vehicle over a certain section of roadway. Design speed should be a logical one with respect to the topography, anticipated operating speed, the adjacent land use and the functional classification of the highway. The operating speed is the speed at which drivers are observed operating the vehicle during the free flow condition. The 85^{th} percentile of the distribution of observed speed is the most frequently used measure of the operating speed associated with a particular location or geometric features.

Syed Khaira Syed Abbas, Muhammed Akram Adnan,(2011), presented an empirical research and empirical model to predict 85^{th} percentile operating speed model for the horizontal curve. The speed data measure is based on spot speed data at a specified point and location using the instrument called Laser Gun Meter Detector. Multiple linear regression equations were developed to predict the V_{85} of the vehicle on horizontal curves in two lane rural highways. The geometrical parameters such as radius of curvature and speed at the approach tangent line are used to recognize the effect of V_{85} operating speed model at the midcurve.

There are numerous studies in North America(Transportation Research Circular) that presented model to predict 85^{th} percentile free flow speed in terms of the road geometry. Data were collected from a set of curves. In addition, data were collected for different vehicle type including passenger car, pickup van and trucks. Geometric data was also collected at the site. The predictor variable considering operating speed model includes degree of horizontal curve, lane width, length of horizontal curve, shoulder width, super elevation, available sight distance, vertical grade etc. For each curve, speed was measured at three points including point of curvature, midpoint of the curve and the point of tangency. From the studies, it was noted that for the same horizontal curve, there were significant difference between operating speed at point of curvature, point of tangency and midpoint of the curve. This difference increased with the increase of radius of curvature. According to them, curve radius was the only statistically significant independent variable in predicting 85^{th} percentile operating speed for all alignment combination. Operating speed on horizontal curves are very similar to speed on long tangent when the radius is greater than or equal to approximately 800m. Operating speed on horizontal curve drop sharply when the radius of curve is less than 250m.

According to operating speed model for horizontal curve on rural four- lane non –freeway highways, there is a tendency of driver for selecting high speeds. To remedy the potential problems, some conceptual procedure have been proposed such as considering driver's desired speed in design speed selection procedure. In general, design speed are higher than operating speed on high speed roadways, while lower than operating speed on low speed roadways. It was found that 85^{th} percentile operating speed increases with increase of speed limit. Manually operated radar gun was used to collect the speed data. They proposed a model for operating speed prediction. Model was developed using statistical methodologies. It was concluded that the selection of operating speed prediction model had a significant effect on evaluating the design consistency.

In the previous researchs, most of the model developments were based on spot-speed data using equipment radar or laser gun, video camera recording, speed trap recording, stop watch and the latest technology used by Memon et. al (2008) in Pakistan using Global Position System GPS – VBOX equipment at specific location. In Kerala, there is no in-depth investigation that has been reported on the 85th percentile operating speed model for horizontal alignment that reflective on Kerala rural highway condition.

V. METHODOLOGY

For this research, the preliminary operating speed model had been developed to evaluate the 85th percentile operating speed and it can be used to predict the speed that can match the acceptable design speed. The research flow focused on the operating speed for horizontal alignments that includes the field work, data collection, and surveying works.

Site selection:

Kerala has different categories of highways road design. These are in descending order of hierarchy. Roads which function to provide long distance travel, will require higher, design speeds whilst road which serve local traffic, where the effect of speed is less significant can have a lower design speed. Also roads with heavier traffic will be provided with a higher standard. The site selected for the case study areas is in Ernakulam district, Muvattupuzha-Thodupuzha and Muvattupuzha-Perumbavur two-lane rural highways, which have higher accident occurance. The study area have criteria such as the classification of road is National Highway, guidelines that provide high geometric standards and usually serve long to intermediate trip lengths with high to medium travelling speeds. The design speed on that area is 100 km/h and the posted speed on that area is 90 km/h. The speed data were collected for cars, bikes and autorikshaws in traffic stream under free flow conditions. The horizontal site were selected with the following criteria; (i) no intersection being along this site; (ii) no physical features that make an obstruction of operating speed such as speed reducer, or traffic light system along the site; (iii) the road must good dry condition because in wet or rainy condition that make the operating speed become slow.

Geometrical Data:

The geometric information were obtained from construction drawing plans collected from the respective Public Works Kerala State Transport Project (KSTP) offices. For the horizontal curve, the data included; radius of circular curve (RC) and length of circular curve (LC). These geometrical data are needed for the analysis and the model development. Shoulder width was measured from site and degree of curvature was calculated. Super elevation was found to be negligibly small.

Data collection:

Data were collected during off-peak hours. It was realized that there is no significant change in the speed on tangent points and centre of curve. Speed data was collected using radar Speed Gun. Speed data were collected from 30 horizontal curves.

Data reduction:

The data collected was analyzed using SPSS software. Then an appropriate model was developed for finding the 85^{th} percentile speed on horizontal curves using the same.

$$\mathbf{V_{85} = 0.033\ R + 0.002\ L + 1.031\ S - 0.243\ D + 51.868}$$

Where,

R = radius of horizontal curve

L = length of horizontal curve

S = shoulder width

D = degree of curve

VI. DISCUSSION AND CONCLUSION

Stastical software were used to find out 85^{th} percentile speed on horizontal curves. According to this model, the variable radius of curve can be rearranged to get a specific radius of horizontal curve. This model can be used for reducing the accident rates. Also, this model can be used for the proper design of horizontal curves and redesigning.

VII. ACKNOWLEDGEMENT

We would like to thank our guide, Prof. Bybin Paul who gave us constant guidance, support and encouragement throughout our project. The study of SPSS software was conducted at Nirmala College, Muvattupuzha.

REFERENCES

[1] S.K.S Abbas , M K Adnan , I N Endut (2011), "Exploration of 85th percentile operating speed model on horizontal curve: A case study for two lane rural highways" , Procedia Social and Behavioural Sciences, Vol 16, pp 352-363.

[2] Gong, Huafeng,(2007), "Operating speed prediction models for horizontal curves on rural four-lane non-freeway highways" , University of Kentucky Doctoral Dissertations , pp 562.

[3] Salvatore Cafiso , Gianluca Cerni (2011) , " A new approach to define continuous Speed Profile Models for two lane rural roads".

[4] Scott C. Himes, Eric T. Donnell, (R. J.) Porter (2010) , Fourth International Symposium on Highway Geometric Design.