International Journal Of Core Engineering & Management
Volume-3, Issue-8, November-2016, ISSN No: 2348-9510

PERCENT TIME SPENT FOLLOWING (PTSF) AS PERFORMANCE MEASURE FOR TWO-LANE HIGHWAYS

Vivek
Assistant Professor, JNGEC, SUNDERNAGAR

Shubham Sharma,Chandni,Priyanka Thakur, Akriti Rana
Students of 4th year Civil Engineering, JNGEC, SUNDERNAGAR

Abstract

This study concentrated on estimating the percent-time-spent-following (PTSF) on two lane highways. Percent-time-spent-following (PTSF) is a key estimate of level-of-service in traffic engineering applications. However, to measure PTSF directly is complicated in the field. Because of this complication, estimation of PTSF has been based on analytical procedure which uses equations derived from simulations and field observations at given location based on surrogate measure; as the percent of vehicles traveling with headway less than 3 seconds (3 s). Findings from existential studies confirmed that analytical procedures used by HCM in evaluating PTSF yield results that are irreconcilable with the 3 s surrogate measure and mostly overestimate the indicator. In this study queuing analogy is used to measure PTSF by measuring the headways inside and outside platoons on the two lane highways of J&K. In this analysis, middle or average range will be that where number of headways inside and outside the platoon will be equal. The difference in range of PTSF increases as volume increases. The range of PTSF estimated is lesser than that given in the HCM. The main difference for the range of PTSF between current study and HCM is that using queuing analogy LOS "A" has a PTSF value less than 17% while for HCM it is 35%. The proposed method of estimating PTSF can be used as a powerful tool to provide reasonable estimates of various measures for LOS that would otherwise be very difficult to estimate.

I. INTRODUCTION

The study of percent time spent following (PTSF) is implemented by the Highway Capacity Manual (HCM) as key service measure to evaluate the level of service of two-lane highways. Flow of traffic on two-lane highways is dissimilar from that on other type of road mainly because vehicles travelling on either lane are facing oncoming traffic in the opposite lane and they may be subject to dawdling because of their incapability to pass slow moving vehicles moving on highway. Two lane highway also characterized by vehicular interactions in the traffic stream; not only in the same direction of travel but also in the opposite one. As the traffic flow in both direction increases, the effect of these interactions generally strengthens. This, in turn, create the formation of platoons as for a fast moving vehicle to safely pass a slow moving one; it needs the use of opposite lane which depends upon sufficient sight distance and permissible gap in the opposing lane of highway. Utilization of

PTSF by HCM as service measure for two-lane highways faces denunciation from numerous researchers not because of its paucity as performance indicator; simply because, it is complicated to measure directly in the field. Also, the two approaches for evaluating PTSF; analytical procedures and use of 3 s surrogate measure for field observations were corroborate to produce inconsistent results. In fact, the analytical procedures notably overestimate PTSF as juxtapose to field values. The point here is not about questioning the criterion of using 3 s as a surrogate measure for field estimation of PTSF as the cut-off headway has been widely judged satisfactory, but it is about the procedure used in applying the criterion. For the fact that PTSF is a segment related measure, the authors contend its observation at representative point and its applicability over a long section of two-lane road. A queuing model is developed to estimate flow characteristics on two-lane rural highways. Three parameters are developed and evaluated using Queuing model. The first of these parameters is the flow that is related to density and is a main indicator of driving attributes. The second parameter, one that measures the quality of flow, is "traffic intensity". It is another dimension of the driving conditions on two-lane highways and represents freedom of manoeuvre during driving. The third, but hardly the least, important parameter is a measure of "freedom of flow" which is a ratio between free travel time when driving between platoons and the delay time of the second vehicle travelling behind the impeding vehicle when searching for an acceptable passing gap. The proposed weighted-average method seems more appropriate when the traffic mix involves a relatively large proportion of heavy vehicles which normally constitute the vast majority of slow-moving vehicles. In this sense, the weighted-average approach has an inherent limitation. Namely, as the percentage of heavy vehicles becomes small, the accuracy of the PTSF estimation using the weighted-average approach may become an issue.

II. EVALUATION OF HCM MEASURES: STUDY CHRONICLE

Several studies (Luttinen, 2001; Harwood et al., 2003; Pollatschek & Polus, 2005) reported that the method suggested by HCM to determine PTSF overestimates the values. Luttinen (2001) proposed various models to estimate PTSF based on the percentage of no-passing zones, total flow and directional distribution of traffic. These models gave lower value of PTSF than that estimated by HCM. Based on a study conducted on unpredictability in the operational analysis of two-lane highways, Luttinen (2002) showed there were restraints in the accuracy of the analysis procedures which cause errors and lessen the usefulness of the LOS concept[6]. According to Dixon et al. (2002) the HCM 2000 two-lane highway analysis procedures using the TWOPAS simulation model and field data collected from northern Idaho. The PTSF values of one-directional procedure were discern to be overestimated by both simulation models: it was about 10 % overestimation and about 30 % overestimation in the field data. He found the values of two-way procedure were observed to be more accurate as compared to those of one-directional method. Subsequent to this research, Harwood et al. (2003) supervised the National Cooperative Highway Research Program Study on the HCM's two-lane road analysis methodology and prudent an overestimation of PTSF by HCM[3]. Accordingly, there was formulation of revised set of curves to estimate PTSF. Based on an analysis of drivers' restiveness on two-lane rural highways, Pollatschek and Polus (2005) flourished theoretical models for turning down the critical passing gap with longer delays prior to the passing maneuver. The impatience of the driver may cause willingness to accept more precariousness because delay increases, which eventually reduces PTSF. This could be one major reason for overestimating the PTSF parameter by HCM [8]. In a paper on the German experience, Brilon and Weiser (2006) reported that, in Germany, the PTSF has never been imprudent a substantial measure of effectiveness as it does not directly convey the degree of efficiency of traffic operation. Polus and Cohen (2009) evolved a queuing model to evaluated PTSF from the field data. This was used in a study supervised on 15 two-lane rural highway sections in northern Israel, and the actual PTSF values acquired from the study were also observed to be considerably lower than the corresponding HCM values[10]. In another study, Cohen and Polus (2011) found similar lower values of PTSF and provided ameliorate relationship between PTSF and two-way flow by pertinent the new estimates by means of the least-squares method. Bessajr and Setti (2011) recalibrated the HCM 2000 ATS and PTSF functions for Brazilian roads using a genetic algorithm[4]. These new models were able to better represent the behaviour of traffic streams.

III. METHODOLOGY

In this study queuing analogy is used to measure PTSF by measuring the headways inside and outside platoons on the two lane, two way highways of Jammu and Kashmir, India. A 3 second surrogate measure is to be used for field measurement of PTSF.Thus by using simple count of headways inside and outside the platoons; two important parameters can be calculated. Using these two intermediate parameters in the queuing theory, we can estimate new range of PTSF. It is possible to consider each platoon as a one-server queuing system, in which ''service time'' is the time interval spent by the fast vehicle in the first position just behind the impeding vehicle. M/M/1 queuing model is used to analyze the traffic patterns, its interaction and growth.

IV. RESULTS AND DISCUSSIONS

The data analysis of various traffic characteristics such as traffic volume, traffic intensity, average speed of vehicles, number of headways inside and outside the platoons, platoon formation and estimation of Percent-Time-Spent-Following to propose its new range for various levels of Service to measure the performance of a highway facility. The values of Percent-Time-Spent-Following obtained in this study
are validated on four highway sections by using Weighted Approach method.

V. RESULTS COMPARISON

The range of PTSF obtained through this study is compared with that given in HCM 2010 and with the study done by Polus and Cohen . In the study, vehicles were only considered inside platoon when their headway is less than 3 seconds, else they are outside platoon.

International Journal Of Core Engineering & Management
Volume-3, Issue-8, November-2016, ISSN No: 2348-9510

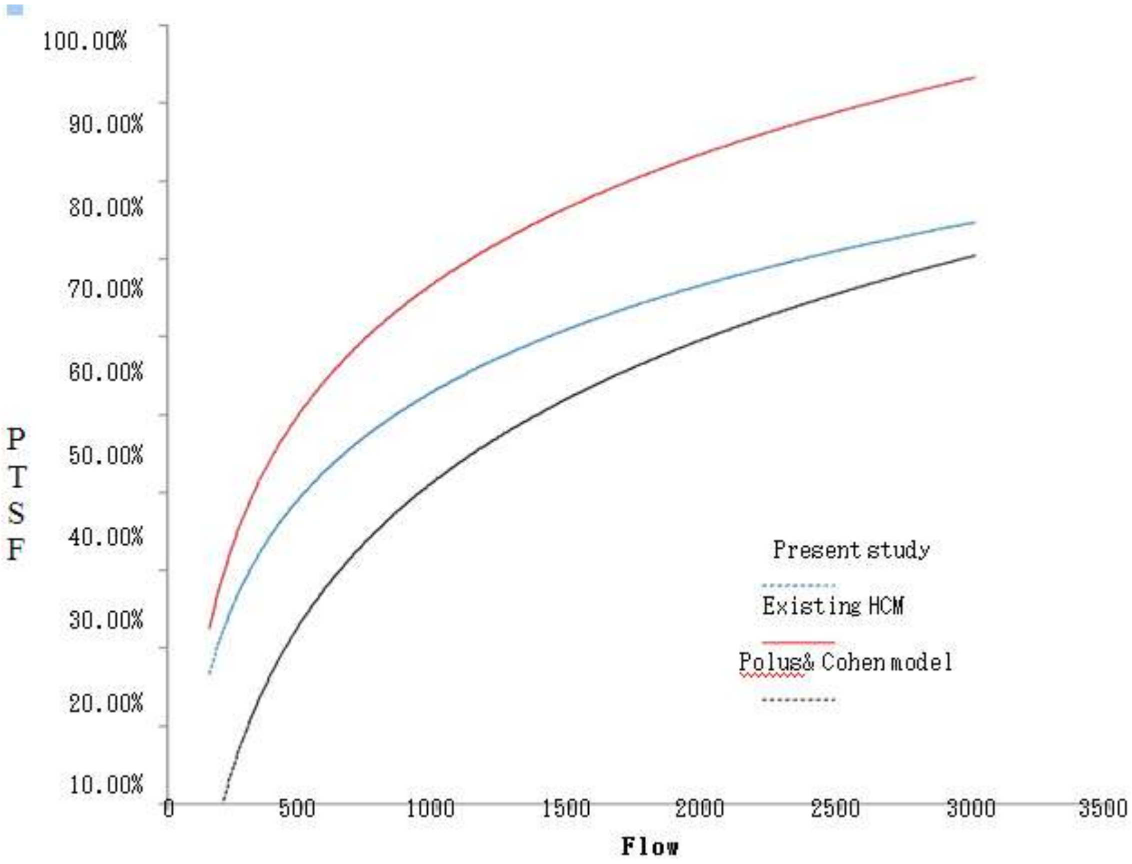

Fig 1: Comparison between present model, HCM model and Polus& Cohen study model.

VI. CONCLUSION

The data analysis of various traffic characteristics such as traffic volume, traffic intensity, average speed of vehicles, number of headways inside and outside the platoons, platoon formation and estimation of Percent-Time-Spent-Following propose its new range for various levels of Service to measure the performance of a highway facility. The values of Percent-Time-Spent-Following obtained in this study are validated on highway sections by using

Weighted Approach method. The results obtained in the present study are more than as pers Polus and Cohen study but are less than as given in HCM 2000.

REFERENCES

[1] Chauhan, Shriya., et.al (2016).”Percent Time Spent Following as Performance Measure for Two-Lane Highways.” International Journal of Core Engineering & Management (iJCEM),3(23489517): 47-60.

[2] Cohen, M., and Polus, A.,”Estimating percent-time-spent-following on two-lane rural highways.” Transportation Research Part C, 19 (2011),: 1319-1325.

[3] Harwood. D., May,A., Anderson, I., Leiman,L., Archilla, A., (1999).” Capacity and quality of service of two-lane highways. Tech, rep., NCHRP Project 3,55(3).

[4] Jose Elievam Bessa, Jr., Jose Reynaldo Setti.,(2011).”Derivation of ATS and PTSF Functions For Two-Lane Rural Highways in Brazil.” Procedia Social and Behavioral Sciences,16(2011),: 282-292.

[5] Laval, Jorge A., (2006).”A Macroscopic Theory of two-lanerural roads.” Transportation Research Part B,(69518): 1-11.

[6] Luttinen , R. T. (2002). “Uncertainity in operational analysis of two-lane highways.” Transportation Research Record . 1776(01-2730), Transportation Research Board, Washington, D.C.,: 52-59.

[7]Luttinen, R.T.,Dixon, M., and Washburn, S., (2005).“two –lane highway analysis in HCM 2000.” Transportation Research Board.

[8] M. A. Pollatschek and A. Polus: Modeling Impatience of Drivers in Passing Maneuvers, Transportation and Traffic Theory ISTTT16, H. S. Mahmassani, ed., Elsevier Science and Pergamon, Amsterdam, the Netherlands (2005), 267-280.

[9]Morrall, J. F., and Werner , A. (1990). “Measuring level of service of two-lane highways by overtaking.” Transportation Research Record. 1287 , Transportation Research Board ,Washington , D.C., 62-69.

[10] Polus, Abishai., and Cohen, Moshe., (2009).”Theoretical and Empirical Relationship for the Quality of Flow and for a New Level of Service on Two-Lane Highways.” Journal of Transportation Engineering,135(6): 380-385.