

Effect of Traffic Composition on Capacity of Two-Way Two-Lane, Roads under Mix Traffic Condition

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Abstract

Traffic performance of a road section is expressed in terms of Level of Service (LOS). The Highway Capacity Manual (HCM) developed by the Transportation Research Board of the National Academies of Science in the United States provides procedures to determine LOS based on analysis of capacity of a road. It divides the quality of flow into six levels ranging from level A to F. These definitions of quality are based on measures of effectiveness of the road which include speed, travel-time, density and delay.

Road development authorities in Sri Lanka are adopting the methodologies given in the HCM due to the lack of guidelines specific for the country. However, the HCM methodologies may not depict the correct traffic performance of roads owing to the nature of the mix of vehicle types in the traffic stream, the lack of lane discipline and irregular road side activities. This may lead to incorrect decisions in planning, designing, maintenance, rehabilitation, and operation of roads. Therefore, it is necessary to study traffic performance in Sri Lanka, and to evaluate the transferability of methods used in other similar countries in order to develop appropriate and applicable approach to mix traffic Condition. Subsequently, in order to evaluate traffic performance, it is important to study about operational characteristics of traffic stream. In a pilot study under this work, capacity of a road was found to be affected by the traffic composition and control condition. Therefore, characteristics of vehicle composition in different capacities have been considered and study was focused to two way-two lane roads.

Different size, power, and maneuverability performance of vehicles cause significant level of friction to the movement of other vehicles in a mix traffic stream. For an example, in a high traffic volume stream, a large proportion of motorized two wheelers and three wheelers are able to move with speeds closer to their free speeds due to the ability of utilizing smaller gaps in the traffic stream, while the large-size vehicles are subjected to significant speed reduction. Characteristics of fundamental traffic flow parameters (Speed, Density and Flow) in traffic streams with different compositions of vehicles were studied. One-Sample Kolmogorov Smirnov test was performed to check normality of speed of collected data samples under

prevailing conditions and it has shown that speed distribution is significantly deviate from normality ($P\text{-value} \leq 0.05$) under different compositions and traffic volumes. It is observed that speed distribution shows bi-modal distribution in roads which are dominated by two wheelers and three wheelers. One-way analysis of variance (One-way ANOVA) tests was carried for speed characteristics of group of two wheelers, three wheelers and four wheelers. Null hypothesis (H_0) that there will be no significant difference between different groups of vehicle speed sample means was rejected with 95% confidence level ($P\text{-value} \leq 0.05$). Therefore, vehicle composition has described as separate groups of two wheelers, three wheels and four wheelers. Modified continuity equation for heterogeneous driver population was used to calculate densities of traffic streams. Different traffic flow models which were used to model two-lane traffic flow behavior had been tested under prevailing conditions. Greenshield traffic flow model has showed strong correction between flow and speed and it was chosen to develop speed-flow models. Finally, empirical speed – density and speed - flow curves were developed for different compositions of vehicles in order to evaluate the capacity variations under mix traffic condition.

Keywords: Traffic composition, Capacity, Mix traffic condition, Traffic-flow model

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