Investigating the Impact of Motorcycles on Urban Traffic

Ruwantha Wimalasiri[1], Nalin Jayarathne[2], Loshaka Perera[3]

Abstract

In many countries in the South Asian region, the traffic is significantly different, including aspects such as the variety of vehicles, driving behaviours and traffic volumes from that of many other countries. The Motorcycle (MC) is one of the widely used and accessible forms of transportation in those countries and has shown rapid growth over the years. As a south Asian country, the MC composition in Sri Lankan urban traffic flow has surged to 30%, driven by a notable 30% increase in registered MCs at an annual growth rate of 8% over the past few years, according to data from the Department of Motor Traffic. MCs, with their high manoeuvrability, have significant impacts on traffic, safety, and the environment. According to the World Health Organization (WHO), almost 30% of road accident fatalities involve powered two and three-wheeled vehicles, such as MCs, scooters, and electric bikes, and these numbers are going up in the world. Additionally, in the Southeast Asian Region, this percentage is at around 43%. In Sri Lanka, MC-related fatalities have consistently accounted for over 40% of total annual fatal accidents, contributing to approximately 34% of all road accidents in recent years. Sri Lankan roads often witness erratic driving behaviour and a lack of lane discipline among MC riders. These riders frequently engage in zigzag manoeuvres, slow progression to the front at intersections, and disrupt traffic flow, affecting the start of other vehicles. Additionally, as per some studies, the prevalence of a high number of MCs on urban roads significantly contributes to emissions in these areas. Therefore, it is crucial to closely monitor and regulate MC behaviour on Sri Lankan roads. From these various types of impacts, this research's main focus is to assess and quantify the traffic impacts of MCs on urban traffic flow in Sri Lanka. In this research, Camera devices are used to collect data at mid-block road sections and signalized intersections. The sites were selected considering several crucial parameters such as MC composition, Average daily traffic and less disturbance from other unrelated factors. A total of seven urban mid-block road sections and five signalized junctions were carefully selected for videography, conducted during good weather conditions, specifically during peak traffic hours. Both manual and software-based methods were employed for accurate data extraction. One primary objective of this research is to investigate the dynamics of MCs under different traffic and roadway conditions, analysing aspects such as trajectory, lane position, speed, headway, and overtaking manoeuvres. Additionally, the research aims to assess the traffic impact of MCs on urban traffic by considering variations in Passenger Car Units (PCUs) under different traffic and road conditions. The PCU values were determined using the spatial headway methodology. Using this approach, the PCU of MCs were assessed through three distinct methods, determined by the positioning of the MCs in relation to passenger cars. Generally, the Road Development Authority (RDA) Design Guideline recommends a PCU of 0.4 for MCs, while the Highway Capacity Manual (HCM 2000) does not provide a specific value. This study reveals that PCU values for MCs range from 0.35 to 0.60 in low MC compositions (0%-25%) and between 0.40 to 0.75 in high MC compositions (25%-50%) under varying traffic flow conditions. Furthermore, the study focused on assessing the traffic impact of MCs at signalized intersections, particularly considering saturation headway and start-up lost time. The research revealed that the average

saturation headway at these intersections is approximately 2.5 seconds. Moreover, the results show that the presence of MCs in the queue significantly affects the attainment of saturation headway with an associated delay of approximately 5.7 seconds. Additionally, by considering the Pearson correlation coefficient, a strong positive correlation was observed between Start-Up lost time and the number of MCs in the queue. Furthermore, each MC was found to contribute 0.5103 seconds to Start-Up Lost Time, resulting in 3.9 seconds of lost time in the absence of MC storage, as per the analysis. This study helps to understand the driving behaviours of MCs and quantify their impacts on the traffic flow at the mid-block road sections and signalized intersections. Moreover, the outcomes of this research would facilitate accurate PCU factors for MCs that are related to different traffic conditions and MC compositions. This will help designers to improve their designs using the most suitable PCU factors for MCs, considering the specific road and traffic characteristics. Ultimately, this study would facilitate future studies on quantifying the traffic impacts of MCs on roads with similar characteristics.

Keywords: *Motorcycle, Driving Patterns, Lane Position, Overtaking manoeuvre, Headway, PCU, Road Safety, Saturation headway, Start-up lost time*

Authors Details;

1. Postgraduate Student, Department of Civil Engineering, University of Moratuwa. ruwanthageeshan@gmail.com
2. Research Intern, A*STAR Research Institute, Singapore. nalin.jayaratne@gmail.com
3. Traffic Engineer, City of Rockingham, Australia. perera.loshaka@gmail.com