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**INVESTIGATING THE IMPACT OF MOTORCYCLE
DRIVING PATTERNS ON URBAN TRAFFIC**

S.R.R.G. Wimalasiri

209585U

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Department of Civil Engineering

University of Moratuwa

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S.R.R.G. Wimalasiri

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Thesis submitted in partial fulfilment of the requirements for the degree Master of
Engineering in Civil Engineering

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DECLARATION

I affirm that this thesis is entirely my original work, and I attest that, to the best of my knowledge and belief, it does not include any material that has been previously published or authored by another individual—unless explicitly acknowledged within the text. Furthermore, I confirm that no portion of this thesis has been submitted for academic credit toward any degree or diploma at any other university or higher education institution.

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Name of the supervisor: Dr. H.L.K. Perera

Signature of the supervisor:

Date: 05/06/2024

ABSTRACT

Heterogeneous traffic conditions are prevalent in countries across the South Asian region, setting them apart significantly from many other nations worldwide. Moreover, distinct driving behaviours, a tendency to disregard rules and regulations, and a non-lane following driving style further differentiate traffic in these areas. Motorcycles (MC) are widely used and easily accessible modes of transportation in South Asian countries, experiencing rapid growth in usage over the years. For instance, in Sri Lanka, a South Asian nation, motorcycles now constitute 30% of urban traffic flow, reflecting a substantial increase from 2016 to 2020. This surge is fuelled by a notable 30% rise in registered motorcycles annually, growing at a rate of 8% annually during the mentioned period.

Motorcycles, known for their manoeuvrability, exert significant influences on traffic dynamics, safety, and environmental concerns. According to the World Health Organization (WHO), nearly 30% of road crash fatalities involve motorized two and three-wheeled vehicles, including motorcycles, scooters, and electric bikes, with this statistic trending upward globally. Notably, in the Southeast Asian Region, this figure stands at approximately 43%. In Sri Lanka, motorcycle-related fatalities consistently represent over 40% of total annual fatal crashes, contributing to about 34% of all road accidents in recent years. The country's roads often witness erratic driving behaviour and a lack of lane discipline among motorcycle riders, characterized by zigzag manoeuvres, slow progression at signalized intersections, and disruptions to traffic flow, impacting the movement of other vehicles. Additionally, studies indicate that the high presence of motorcycles on urban roads significantly compromises air quality in these areas. Consequently, close monitoring and regulation of motorcycle behaviour on Sri Lankan roads are imperative to comprehend and address their impacts. This study's primary objective is to assess and quantify the influence of motorcycles on urban traffic flow in Sri Lanka, intending to propose effective measures to mitigate their impact.

This research utilized handheld cameras to gather data from mid-block road segments and signalized intersections. Both manual techniques and software-based methods were employed to ensure accurate data extraction. Various data types, including headway, vehicle types, and vehicle counts, were extracted for subsequent analysis. A key objective was to examine the behaviour of motorcycles across different traffic and roadway conditions, focusing on aspects such as trajectory, lane position, speed, headway, and lane splitting. Additionally, the study aimed to evaluate the impact of motorcycles on urban traffic by assessing variations in Passenger Car Units (PCU) under different traffic and road scenarios. PCU values were determined through the spatial headway approach, with the Road Development Authority (RDA) Design Guideline recommending a PCU of 0.4 for motorcycles, while the Highway Capacity Manual (HCM 2000) did not offer a specified value. The findings indicated that PCU values for motorcycles ranged from 0.35 to 0.60 in areas with low motorcycle compositions (0%-25%) and between 0.40 to 0.75 in areas with high motorcycle compositions (25%-50%) across various traffic flow conditions.

Moreover, the research aimed to assess the influence of motorcycles at signalized intersections, particularly focusing on saturation headway and start-up lost time. The results revealed an average saturation headway of approximately 2.5 seconds at these intersections. Additionally, the presence of motorcycles in the queue was found to significantly affect the achievement of saturation headway. Furthermore, a robust positive correlation was identified between start-up lost time and the number of motorcycles in the queue. Each motorcycle was found to contribute 0.5 seconds to start-up lost time, resulting in a total of 3.9 seconds of lost time in the absence of motorcycle storage, as evidenced by the analysis.

This study aids in comprehending the driving behaviours of motorcycles (MCs) and quantifying their effects on traffic flow at both mid-block road sections and signalized intersections. Furthermore, the findings of this research would enable the establishment of accurate Passenger Car Unit (PCU) factors for motorcycles, tailored to various traffic conditions and compositions of motorcycles. Such insights would assist designers in refining their designs by employing the most appropriate PCU factors for motorcycles, taking into account specific road and traffic attributes. Ultimately, this study sets the stage for future investigations aimed at quantifying the impacts of motorcycles on safety and emissions.

Keywords: Motorcycle, Driving Behaviour, Lane discipline, Headway, PCU

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LIST OF ABBREVIATIONS

Abbreviation	Description
MC	Motorcycle
MCs	Motorcycles
PCU	Passenger Car Units
RDA	Road Development Authority
HCM	Highway Capacity Manual
LHS	Left-Hand Side
RHS	Right-Hand Side
SLT	Start-Up Lost Time
STDV	Standard Deviation
TRL	Transport Research Laboratory
TRRL	Transport and Road Research Laboratory
LT	Light Truck
MT	Medium Truck
HT	Heavy Truck