EVALUATING THE IMPACT OF CONNECTED AND AUTONOMOUS VEHICLES ON AIRPORT ROADWAY OPERATIONS

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Master of Engineering in Highway & Traffic Engineering

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Thesis submitted in partial fulfillment of the requirements for the degree
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DECLARATION

I affirm that this thesis is entirely my original work and does not include any unacknowledged material that has been previously submitted for a degree or diploma at any other university or educational institution. To the best of my knowledge, this thesis does not contain any content that has been previously published or authored by others, except for properly cited references. I reserve the right to utilize this content, either in whole or in part, in future publications such as articles or books.

……..... Date: 05.03.2025

N.P Jayawardhana

The candidate has conducted research for their master's thesis under my guidance. I verify that the statement made by the student above is accurate and truthful.

……..... Date: 18.03.2025

Prof. H. R. Pasindu

DEDICATION

Dedicated to my beloved family, whose unwavering encouragement has been a constant source of strength throughout the significant milestones of my life. I would also like to extend my sincere gratitude to my supervisor, Professor H. R. Pasindu, for the invaluable motivation and dedicated mentorship provided throughout this process.

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ABSTRACT

The introduction of connected and autonomous vehicles (AVs) offers significant potential to improve the capacity and efficiency of modern transportation systems. Although much of the existing research has concentrated on the beneficial effects of AVs on highway traffic flow and capacity, there has been limited exploration of how AVs might influence airport curbside and internal roadway operations. Therefore, this study is designed to examine and predict the effects of AVs on the operations of airport curbside roadways. To conduct this investigation, a microsimulation method was utilized through VISSIM, incorporating the Wiedmann 74 model to simulate car-following behavior. The parameters for autonomous vehicles were calibrated to meet the Level 4 automation standards established by the Society of Automotive Engineers (SAE). A conceptual curbside network was selected for simulation, with separate lanes designated for AVs and Human-Driven Vehicles (HDVs). Six scenarios were simulated, each representing incremental increases in AV penetration rates from 10% to 50%. The study focused on evaluating improvements in traffic flow metrics, including Maximum Queue Length, Vehicle Delay, and Vehicle Travel Time. Findings from this study indicate that discernible enhancements in curbside traffic flow at airports are only observed once AV penetration levels surpass 35%. Specifically, a significant improvement in traffic flow metrics, such as Maximum Queue Length, Vehicle Delay, and Vehicle Travel Time, was noted when AV penetration levels increased from 35% to 40%. The improvement in traffic flow from AVs can be primarily attributed to their ability to mitigate the stop-and-go nature of traffic which is typically observed in HDVs. Based on these findings, this study recommends simulating traffic flow scenarios with AV penetration levels of 35%, 40%, and 50% under mixed traffic conditions, without segregating lanes for AVs and HDVs to identify the exact optimal AV penetration level for curbside operations at airports.

Keywords: Autonomous Vehicles (AVs), Airport Curbside Roadway Operation, Vehicle Penetration, Microsimulation

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LIST OF ABBREVIATIONS

Abbreviation	Description
AVs	Autonomous Vehicles
HDVs	Human Driven Vehicles
SAE	Society of Automotive Engineers
TNCs	Transportation Network Companies
V2V	Vehicle-to-vehicle
SAVs	Shared Automated Vehicles
VTT	Vehicle Travel Time