

**STUDY OF THE PERFORMANCE OF PASSING AND
CLIMBING LANES ALONG COLOMBO –
RATHNAPURA – WELLOWAYA – BATTICOLO ROAD**

Dulmini Madujith Ekneligoda

(158321 U)

Degree of Master of Science in Transportation

Department of Civil Engineering

University of Moratuwa

Sri Lanka

July 2020

**STUDY OF THE PERFORMANCE OF PASSING AND
CLIMBING LANES ALONG COLOMBO –
RATHNAPURA – WELLAWAYA – BATTICOLO ROAD**

Dulmini Madujith Ekneligoda

(158321 U)

Thesis submitted in Partial fulfilment of the requirements for the Degree of Master of
Science in Transportation

Department of Civil Engineering

University of Moratuwa

Sri Lanka

July 2020

DECLARATION OF THE CANDIDATE AND SUPERVISOR

I declare that this is my own work and the thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and believe it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Also, I hereby grant University of Moratuwa the non-exclusive right to reproduce and distribute my thesis, in whole or in part in print, electronic or other medium. I retain the right to use this content in whole or part in future works (such as articles or books).

Signature:

Date:

The above candidate has carried out research for the Master/MPhil/PhD thesis/ Dissertation under my supervision.

Signature of the supervisor:

Date:

ABSTRACT

Study of the Performance of Passing and Climbing Lanes Along Colombo – Rathnapura – Wellawaya – Batticolo Road

Due to increase of population and rapid economic growth, percentage of heavy and recreational vehicles in the traffic stream from Colombo Capital to Central hills have increased causing severe traffic congestions. Specially all essential supplying services including fuel, food, export goods transport using major highways. Applying climbing lane concept on two-lane highways can be a good recommendation to reduce prevailing extreme conditions. “A climbing lane is, in effect, a passing lane added on an upgrade to allow traffic to pass heavy vehicles whose speeds are reduced”. However, application of Passing Climbing Lanes (PCL) are not a common practice in Sri Lanka. Most of steep upgrades on the major trans mountain highways do not have climbing lanes that cause traffic congestion on major highways. Due to the increasing vehicular traffic along the route, there exists an ongoing construction of Passing climbing lane on Colombo- Rathnapura-Wellawaya- Batticolo (CRWB) road near to Rathnapura. This study evaluates the Impact of Passing and Climbing lane on traffic flow on the particular section at CRWB road considering both travel time and delay time using the existing available data from RDA and new traffic survey data. The collected data at particular location before the construction of PCL and after is expected to show the importance of having PCLs at essential places along CRWB. Further, the impact of selected PCL has been analyzed for various traffic volume by a simulation model which was developed for this study. PCL is low cost improvement method rather than replacing extra lane or providing bypass lane, hence study discusses the economic advantages also.

Key Words: Passing Climbing lanes, Two-lane highways, Performance of climbing lane

ACKNOWLEDGEMENT

I would like to express my gratitude to all staff members at Transportation Engineering Division, Department of Civil Engineering, University of Moratuwa, Sri Lanka for giving me the opportunity to follow the MSc. Transportation program.

My special thank goes to my research supervisor Dr. Dimantha De Silva for guiding me with every possible way including commenting on my report and data analysis work. I would like to take this opportunity to thank Road Development Authority – Rathnapura Division providing me the detail drawing and other necessary data for my research work of “**Study of the Performance of Passing and Climbing Lanes Along Colombo – Rathnapura – Wellawaya – Batticolo Road**”.

Lastly, I extend my Gratitude and appreciation to my family, my friends for their support and motivation to complete this study successfully.

TABLE OF CONTENT

Declaration of the Candidate and Supervisor	i
Abstract	ii
Acknowledgement.....	iii
Table of Content.....	iv
List of Figures	vi
List of Tables.....	vii
List of Abbreviations.....	viii
1 Introduction	1
1.1 Background of the Study.....	1
1.2 Research Problem	1
1.3 Justification of the Problem	2
1.4 Research Aims and Objectives	2
1.5 Limitation of the Study	3
1.6 Organization of the Research	4
2 Literature Review.....	5
2.1 Two - Lane Highway	5
2.2 Definitions of Climbing Lanes.....	5
2.3 Performance Measurement of Two-lane Highways in Sri Lanka.....	8
2.4 AASHTO Guideline for Climbing Lane Implementation.....	8
2.5 Warrants on Climbing Lane Designs in Sri Lanka	10
3 Research Methodology	11
3.1 Introduction	11
3.2 Geometry of the Experimental Section.....	11
3.3 Location Photos.....	13
3.4 Traffic Condition in the Climbing Lane	13
3.5 Data Collection Procedure	13

3.6	Simulation	14
3.7	Simulation Model Selection.....	14
3.7.1	Advantages of Microsimulation Modeling (VISSIM).....	15
3.7.2	Climbing lane section for model simulation.....	16
3.7.3	Parameter values on modeling.....	16
3.7.4	Simulation scenarios.....	17
4	Results and Discussion.....	19
4.1	Introduction.....	19
4.2	Total Delay Time	19
4.2.1	Total delay time for different heavy occupancy vehicle percentage	19
4.2.2	Total delay time for different flow rates.....	21
4.3	Average Travel Speed	22
4.4	Average travel speed for different Heavy occupancy vehicle percentages.....	22
4.4.1	Average travel speed for different traffic flow rates.....	23
4.5	Climbing Lane Length	24
4.6	Discussion	26
5	Conclusion and Recommendations	30
5.1	Recommendation	32
6	References	1
	Table A1: Traffic Count Data –Down Direction	2
	Table A2: Traffic Count Data –Climbing Lane	3
	Table A3: Traffic Count Data –Normal lane	4

LIST OF FIGURES

Figure 2.1 Climbing lane in Two-Lane Highway	7
Figure 2.2 Critical lengths of gradient	10
Figure 3.1 Location map	11
Figure 3.2 Site map	11
Figure 3.3 Plan and profile view of the existing climbing lane along CRWB highway	12
Figure 3.4 Climbing lane in CRWB highway	13
Figure 3.5 Climbing lane upstream point	13
Figure 3.6 Sample data collection sheet	14
Figure 3.7 climbing lane section for model simulation	16
Figure 4.1 Total delay time for climbing lane with and without scenarios Vs different heavy occupancy vehicle percentages	20
Figure 4.2 Total delay time for climbing lane with and without scenarios Vs different flow rate	21
Figure 4.3 Average travel speed vs heavy vehicle percentages	22
Figure 4.4 Average travel speed for Climbing lane with and without scenarios Vs flow rate	23
Figure 4.5 Total vehicle delays for climbing lane for different lane lengths flow rates	25
Figure 4.6 Average time speed with different climbing lane lengths for different flow rates	26

LIST OF TABLES

Table 2.1 climbing lane design consideration	9
Table 2.2 Geometric design standard of road development authority in Sri Lanka	10
Table 3.1 Vertical curvature and gradient details of the climbing lane	12
Table 3.2 Parameters and values used for model simulation	17
Table 4.1 Total delay time for climbing lane with and without scenarios for different heavy occupancy vehicle percentages	20
Table 4.2 Ttotal delay time for climbing lane with and without scenarios for different flow rates	21
Table 4.3 Average travel speed for different Heavy vehicle percentages with and without climbing lane	22
Table 4.4 Average travel speed for Climbing lane with and without scenarios for different flow rates	23
Table 4.5 The total delay time for the climbing lane for fixed HOVs for different flow rates	24
Table 4.6 Average travel speed for different climbing lane lengths for different flow rates	25

LIST OF ABBREVIATIONS

Abbreviation	Description
CRWB	Colombo- Rathnapura- Wellawaya- Batticolo highway
PCL	Passing Climbing Lane
HCM	Highway Capacity Manual
LOS	Level of Service
DHV	Design Hourly Volume
RDA	Road Development Authority
USA	United States of America
ASSHTO	American Association of state Highway Transport officials
TRB	Transport Research Board
DHV	Design hourly volume
ATS	Average Travel Speed
PTSF	Percent Time Spent following
PFFS	Percent Free Flow Speed
PCU	Passenger Car Unit
ITS	Intelligent Transport System