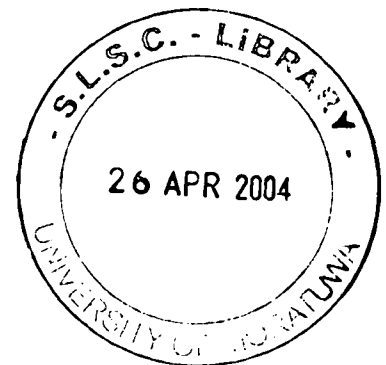


LB/DON/29/03

DETERMINATION OF DEFINITIONS FOR ACCIDENT BLACK SPOTS IN SRI LANKA

THESIS SUBMITTED TO THE DEPARTMENT OF CIVIL
ENGINEERING IN FULFILLMENT OF THE REQUIREMENT
FOR THE DEGREE OF

Master of Science



G.P De Silva
(Msc/C/01/2001)

Supervised by
Dr. (Mrs.) C. Jayasinghe
Prof. L. L. Ratnayake

624 "03"

656.081(512.7)

DEPARTMENT OF CIVIL ENGINEERING

UNIVERSITY OF MORATUWA

University of Moratuwa



77715

SRI LANKA

January 2003

77715

UM Thesis coll

77715



DECLARATION

I, Gayathri Pushpika De Silva, hereby declare that the content of this thesis is the output of original research work carried out over a period of 15 months at the Department of Civil Engineering, University of Moratuwa. Whenever the work done by others was used, it was mentioned appropriately as a reference.



University of Moratuwa, Sri Lanka
Electronic Theses & Dissertations
www.lib.mrt.ac.lk



Table of Contents

Acknowledgement	i
Abstract	ii
Chapter 1	
Introduction	
1.1 General	1
1.2 Objectives	2
1.3 Methodology	2
1.4 Arrangement of Report	3
Chapter 2	
Literature Survey	
2.1 General	5
2.2 Definitions for Accident Black spots derived in other Countries and Sri Lanka	6
2.3 Causes for Road accidents at Black Spots	7
2.3.1 Classification of Accidents According to causes	8
2.3.2 Speeds as a factor for road accidents	9
2.4 Identification and Raking of Hazardous Locations	9
2.4.1 Accident frequency method	9
2.4.2 Accident rate method	10
2.4.3 Quality Control Method	10
2.4.4 Accident Severity Method	11
2.4.5 Combined Method	11
2.5 Counter measures done in other countries at Black Spots	12
2.5.1 Pedestrian facilities	13
2.5.1.1 Pedestrian facilities	13
2.5.1.2 Problem-Vehicles turning at high speed at T-Junction posed danger to pedestrian crossing the road	14

2.5.2 Bridge guard rail	15
2.5.3 Mast Arm	15
2.5.4 Road Humps	16
2.5.5 Speed cushion	16
2.5.6 Pinch point	17
2.5.7 Roundabout	17
2.5.8 Raised Junction	18
2.6 Summary	19

Chapter 3

Accident Analysis

3.1 General	20
3.1.1 Accident Distribution	20
3.2 Trends of Accident in Sri Lanka	21
3.2.1 Growth in road accident in Sri Lanka	21
3.2.2 Fatality rate per 1000,000 population	22
3.2.3 Fatalities per 10,000 operational vehicles	24
3.2.4 Percentage of vehicle involvement in traffic accidents	26
3.3 Accident data for Identified Black spots	27
3.3.1 Average Accident Variation at Black spots	27
3.4 Summary	29

Chapter 4

Field study results and analysis

General	30
4.2 Field survey data	32
4.2.1. Thihariya to Kalegedihena	32
4.2.1.1 Problem related to accidents at Thihariya to Kalegedihena	32
4.2.1.2 Survey Data Analysis	33
4.2.2 Havelock Road Thummulla Junction	34
4.2.2.1 Problem related to accidents at Havelock Road	35

4.2.2.2 Survey Data Analysis	36
4.2.3 Koongaha Junction (Kaluthara North)	37
4.2.3.1 Problem related to accidents at Koongaha Junction	37
4.2.3.2 Survey Data Analysis	38
4.2.4 Korallawella (Moratuwa)	39
4.2.4.1 Problem related to accidents at Korallawella	40
4.2.4.2 Survey Data Analysis	41
4.2.5 Nalluruwa (Panadura)	42
4.2.5.1 Problem related to accidents at Nalluruwa Junction	42
4.2.5.2 Survey Data Analysis	44
4.2.6 Nittabuwa Junction	45
4.2.6.1 Problem related to accidents at Nittabuwa	46
4.2.6.2 Survey Data Analysis	47
4.2.7 James Peries (Opposite Navaloka)	48
4.2.7.1 Problem related to accidents at James Peries (Opposite Navaloka), Sri Lanka	49
4.2.7.2 Survey Data Analysis	50
4.2.8 Rawathawatta Junction (Moratuwa)	51
4.2.8.1 Problem related to accidents at Rawathawatta Junction (Moratuwa)	51
4.2.8.2 Survey Data Analysis	52
4.2.9 Wadiyamankada Junction	53
4.2.9.1 Problem related to accidents at Wadiyamanka Junction	54
4.2.9.2 Survey Data Analysis	55
4.2.10 Yakkala Junction	56
4.2.10.1 Problem related to accidents at Yakkala Junction	57
4.2.10.2 Survey Data Analysis	58
4.3 Summary of Survey data	59
4.4 Summary	60

Chapter 5

Ranking method of accident black spots	62
5.1 General	62
5.2 Equivalent accident number	62
5.2.1 Accident Cost	62
5.2.2 Definition of EAN vale (Equivalent Accident Number)	64
5.3 Collision type- Weighted number of Accidents	67
5.3.1 Analysis of collision type	68
5.3.1.1 Collision type analysis for Fatal Accidents	68
5.3.1.2 Collision type analysis for Grievous Accidents	69
5.3.1.3 Collision type analysis for non grievous Accidents	70
5.3.1.4 Collision type analysis for Damage only Accidents	71
5.3.2 Severity Factor	72
5.3.2.1 Definition of Severity factor for each collision type	72
5.3.2.2 Definition of Cost per Accident	72
5.3.2.3 Severity factors for 2001 for different Collision types	75
5.3.2.4 Average Severity factors	76
5.3.2.5 Average severity factor for collision types	76
5.3.3 Weighted number of accidents	77
5.3.3.1 Definition of weighted number of accident	77
5.3.3.2 Variation of Weighted number of Accidents at black spots	79
5.4 Accident rate method	81
5.4.1 Definition of AR value (Accident Rate)	81
5.5 Comparison of Ranking method of accident black spots	83



5.5.1 Relationship between EAN value and Number of accidents	84
5.5.2 EAN value, Number accidents and Weighted number of accidents at black spots	85
5.5.3 Comparison of EAN value and AR value black spots	86
5.5.4 Comparison of EAN value , weighted number of accidents and AR value at Black spots	87
5.6 Identifying accident black spots and ranking them using EAN EAN value method	88
5.6.1 Defining accident black spots EAN value method	88
5.6.2 Ranking of highest priority accident black spots using Measure of Severity method	89
5.7 Priliminary safety improvements at Black spots using Collision type analysis	91
5.7.1 Wennapuwa Town to Tabarawilla	91
5.7.2 Nalluruwa Panadura	92
5.7.3 Muddukattuwa to Soysarama pansala	94
5.8 Summary	96
 Chapter 6	
Conclusion	97
References	99
 Appendix A	A-1
Appendix B	A-2
Appendix C	A-11



List of Tables

Table 3.1	Annual Distribution of Road Accidents	20
Table 3.2	Annual Distribution of Road Casualties	20
Table 3.3	Fatalities Due to Road Accidents in Sri Lanka	23
Table 3.4	Fatality distribution With Vehicle Population	25
Table 3.5	Average Road Accidents at Black spots (from 1998 to 2000)	28
Table 4.1	Accidents and Traffic volumes at Selected Black spots	59
Table 4.2	Summary of Survey Data	61
Table 5.1	Annual cost of road accidents	63
Table 5.2	Total annual accident cost for year 1997 to year 2001	63
Table 5.3	Equivalent accident number calculation	64
Table 5.4	EAN values and Total accidents at black spots for year 1998 to 2000	65
Table 5.5	Cost per Accident	73
Table 5.6	Severity factor for approaching collision type (Year 2001)	74
Table 5.7	Cost of accident and Severity factor for year 2001	75
Table 5.8	Average Severity factor for collision type	76
Table 5.9	Number of accidents according to collision types	78
Table 5.10	Weighted number of accidents	79
Table 5.11	Weighted number of accidents at Black spots	80
Table 5.12	Accident Rate for selected Black spots	83
Table 5.13	Defining accident Black spots Using EAN Value Method	88
Table 5.14	Ranking Accident Black Spots	89
Table 5.15	Accident at Wennapuwa town to Tabarawila	91
Table 5.16	Accident Data At Nalluruwa Panadura	92
Table 5.17	Accident data Along Mudukaettuwa to Soysarama pansala	94

List of Figures

Figure 2.1	Clarification of Accidents According to causes	8
Figure 2.2	Pedestrian signals	13
Figure 2.3	Raised Pedestrian Crossings	14
Figure 2.4	Raised medians at Pedestrian crossing	14
Figure 2.5	Bridge Guardrail	15
Figure 2.6	Mast arm	15
Figure 2.7	Round Top humps	16
Figure 2.8	Flat top humps	16
Figure 2.9	Speed cushions	16
Figure 2.10	Pinch points	17
Figure 2.11	Roundabout	17
Figure 2.12	Raised Junction	18
Figure 2.13	Summery of literature review	19
Figure 3.1	Annual Road Fatalities per Million People in Africa, America Asia and European Countries	23
Figure 3.2	Annual Road Fatalities per 10,000 operational vehicles in Africa, America ,Asia and European Countries	25
Figure 4.1	Land use study at Thihariya to Kalegedihena	32
Figure 4.2	Land use study at Havelock road Thummulla Junction	34
Figure 4.3	Land use study at Koongaha Junction	37
Figure 4.4	Land use study at Korallawella	39
Figure 4.5	Land use study at Nalluuwa (Panadura)	42
Figure 4.6	Land use study at Nittabuwa Junction	45
Figure 4.7	Land use study at James Peries (Opposite Nawalika)	48
Figure 4.8	Land use study at Rawattawatta Junction	51
Figure 4.9	Land use study at Wadiyamankada Junction	53
Figure 4.10	Land use study at Yakkala Junction	56

Acknowledgement

First and foremost I would like to give my sincere thanks to Senate Research Committee University of Moratuwa for giving me this invaluable opportunity of doing Msc. on transportation.

I wish to thank Prof. L.L Ratnayake for giving his kind support to finish this research successfully.

I would like to convey my special thanks to Dr. (Mrs) C. Jayasinghe my supervisor for encouraging me to do this study and giving all the valuable advisers to finish this study successfully.

I would like to thank specially for Prof. (Mrs) N Ratnayake & Dr. M.T.R Jayasinghe for giving their kind support to finish this research successfully.

I would like to thank Mr. Kurt Fahleson Swedish National Road consultancy AB for giving financial support to do the field study successfully as well as the valuable ideas for the research. I wish to thank Mr. Lars Persson and Mr. Robert Ortergran from Swedish National Road Administration for giving me all their support to finish field studied successfully.

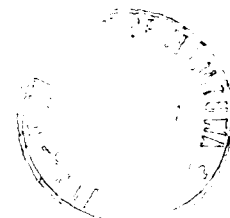
I would like to thank Mrs . Senanayake, Former Director Road safety secretariat and the staff giving me all the identified black spots for Sri Lanka without any hesitation.

I would like give my sincere thanks to Mr. C.M Sandars (ASP) (OIC, IT division Police HQ) & Ms. Nishanthi Costha for giving their kind support to collection of accident data whenever I need them.

I would like to give my special thanks to Mr. Prematilaka (OIC, Statistical Division Police HQ) and the staff giving there kind support more than a month very patiently for collection of accident data for three years.

My special thanks goes to Mr. Damith Dishantha, Ms. R.K. M Priyanvada, Ms. Vasana Jayasena, Mr. Asitha Jayawardhana, Mr. Manoj Fernando, Mr. Ranil Sugathadasa Ms. Taranga Fenando & Crishantha Malnayake who are my friends with me and spent there voluble time and energy for finishing the field studies successfully.

At last not least I would like to thank my mother, father and brother who are always behind me, giving their loving support and encouragement throughout this study.



ABSTRACT

Ever increasing road traffic accidents and traffic flow is a heavy burden to the developing country like Sri Lanka. The rate of increase in road accidents is 7% per year in Sri Lanka. Increasing in vehicle population is 11% per year.

The analysis of past accident data has clearly shown that in Sri Lanka about 50,000 accidents occurs annually on average out of which 2000 were fatal accidents and 15,000 were injury accidents. This is a heavy economic burden to the country. In year 2001 the accident cost has been evaluated as Rs.10.25 billion and the year 2001 Gross domestic product is Rs.1400 billion. Therefore, the accident cost is about 1% of the country's GDP (Gross Domestic Product). It clearly implies that there should be a cost effective method of reducing accidents throughout the country. There are several methods of reducing accidents, but most effective way of reducing accidents is to identify accident-prone locations throughout the country and treat them in a cost effective manner.

This research has been focused on determining a suitable mechanism to identify accident black spots. Mechanisms considered are Equivalent accident number method, Accident rate method, weighted number of accident method and combined method.

Accident rate can be used to identify accident black spots. Accident rate gives the number of accidents with the traffic volume. Therefore, accident rate can be recommended as a better tool to identify accident black spots over the accident frequency method, which is presently used in Sri Lanka to identify accident black spots.

When prioritizing the accident black spots it has been recommended that the Measure of severity method which is derived from Equivalent accident number method can be considered as a better mechanism over the others. However, the weighted number of accident method could emphasis the types of collisions commonly occur at black spots. This can be useful in a stage of determining countermeasures at black spots.