LB/DON /131/04

Q. S.

SAFETY IMPROVEMENT AT JUNCTIONS

THIS THESIS WAS SUBMITTED TO THE DEPARTMENT OF CIVIL ENGINEERING OF THE UNIVERSITY OF MORATUWA IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF ENGINEERING





R. A. Sudath (PG / HT / 14 / 2001)

Supervised by Prof. Amal S Kumarage

624 °04." 624 (04.3)

Department of Civil Engineering University of Moratuwa Sri Lanka

October 2004

University of Moratuwa . 82319 82319 um Tresis coll.

82319

Acknowledgement

First and foremost I would like to give my sincere thanks to General Manager Road Development Authority for giving me this invaluable opportunity to follow in M.Eng. course of Highway Engineering.

I wish to thank Professor Amal S Kumarage my supervisor for giving his fullest support to finish this M.Eng. research successfully.

My special thank goes to Prof. J.M.S.J. Bandara course co-coordinator for his valuable suggestion to finish this research successfully.

I would like to convey my special thanks to Mr. D.Ganesan Duputy Director Planning Division of Road Development Authority for encouraging me to do this study giving his valuable suggestions and Mrs. R.A.S.K.Kaluarachche, Deputy Director of Highway Design for his guidance specially on road geometry.



I would like to thank late Mr. M.A.J.P. Dias Enumerator Planning Division, Mrs.V.S. Athale Drawing Office Assistance, Mrs. C.P.Yapa and Miss. R. Apsara of Planning Division for giving their kind support for collection of accidents data, collection of geometry data and drafting work.

I would like to thank Miss. G.De Silva and Miss P.Siriwardena from Sweroad for giving their kind support for collection of research data.

At last I would like to thank my parents and my wife Mrs. Ramya Premaratna Chief Engineer Road Development Authority encouraging me from the commencement to the completion of this M.Eng. research giving their fullest cooperation.

ABSTRACT

Road traffic injuries are a critical public health problem in Sri Lanka. As social and financial costs of traffic injuries are colossal. There is an urgent need to inquire about the number of accidents. A significant number of these accidents are happening at junctions.

This research has been focused on finding the cost effective method of reducing accidents at junctions. Within the Western province where the highest concentration of traffic was observed, a significant number of road accidents have been reported.

For this research project ten junctions which includes four 4 legs junctions: Dehiwala, Yakkala, Talawatugoda, Golumadama, and six 3 legs junctions were selected within the six police divisions; Dehiwala, Moratuwa, Mt. Lavinia, Koswatta, Gampaha.

By comparing the nature of accidents – Rear-end, Head-on, Angle, Side-swipe, Pedestrian with the relevant contributory factors such as Traffic volume, Pedestrian volume, Parking volume and Geometry, five relationship have been derived.

Problem identification and relevant solutions for these junctions are based on these relationships. It has been found that most of the problems are associated with the road geometry, unauthorized parking, road crossing pedestrian and poor visibility.

TABLE OF CONTENTS.

ı.

Acknowledgement Abstract

Chapter 1

Introduction

1.1 General	01
1.2 Objectives	
1.3 Limits of the Study area	
1.4 Methodology	

Chapter 2

Literature Survey

2.1 Accidents	
2.1.1 General	03
2.1.2 Accident at Junctions.	03
2.1.3 Nature of Accidents	04
2.1.4 Elements of an Accidents Record System	
2.2 Traffic	05
2.2.1 General	05
2.2.2 Count of Traffic Volume	05
2.3 Pedestrian	06
2.3.1 General	06
2.3.2 Pedestrian Crossings	06
2.3.3 Median/Refuges	07
2.3.4 Signalized Pedestrian Crossings	07
2.3.5 Overpass/Underpass	07
2.4 Parking	
2.5 Geometry	08

2.5.1 Intersection Types	
2.5.2 Traffic Controlled Devices	09
2.5.3 Conflict Area	11
2.5.4 Lane width	11
2.5.5 Centre Median / Splitter Islands	
2.5.6 Visibility	
2.5.7 Alignment	16

1

Chapter 3

T

** **

lection of Junctions

Chapter 4

Collection of Data
4.1 Accident Data
4.1.1 Type of Conflicting Maneuvers
4.1.2 Source of Data
4.2 Traffic Data
4.2.1 General
4.2.2 Source of Data
4.3 Pedestrian Data 25
4.3.1 General
4.3.2 Source of Data
4.4 Parking Data
4.4.1 General
4.4.2 Source of Data
4.5 Geometry Data
4.5.1 General
4.5.2 Source of Data

	21
Analysis of Data	
5.1 General	
5.2 Analysis of Accident Data	
5.3 Analysis of Traffic Data	
5.3.1 Analysis of Traffic Data for Vehicle Related Accident	s32
5.3.2 Analysis of Traffic Data for Pedestrian Related Accide	ents 33
5.4 Analysis of Pedestrian Data	
5.4.1 Analysis of Pedestrian Data for Pedestrian Related Ac	cidents 35
5.4.2 Analysis of Pedestrian Data for Vehicle Related Accid	dents 36
5.5 Analysis of Parking Data	
5.5.1 Conversion of peak hour Parking Volume to yearly parkin	ig volume
in PCU	
5.5.2 Analysis of Parking data for Vehicle Related Accidents	
5.5.3 Analysis of Parking data for Pedestrian Related Accidents	
5.6 Analysis of Geometry Data could floor the State of Moratuwa, Sri Lanka.	42
5.6.1 General	
5.6.1.1 Analysis of Intersection Type	43
5.6.1.2 Analysis of Traffic Controlled or Uncontrolled	44
5.6.1.3 Analysis of Conflict Area of Junction	45
5.6.1.4 Analysis of Carriageway Data	
5.6.1.5 Analysis of Centre Median Length	
5.6.1.6 Analysis of Visibility of Junctions	
5.6.1.7 Analysis of Alignment of Junctions	49
5.6.1.8 Summary of the Geometry Analysis	51
5.6.2 Analysis of the Geometry data for Vehicle Related Accide	ents 51
5.6.3 Analysis of the Geometry data for Pedestrian Related Acc	cidents 53

Chapter 6

74

8

ĺ

Relationship between Nature of Accidents & Contributory Factors
6.1 General 55
6.2 Relationship for Vehicle Related Accidents
6.2.1 Relationship between rear-end accidents and
Independent Variables
6.2.2 Relationship between Head-on Accidents and
Independent Variables
6.2.3 Relationship between Angle Accidents and
Independent Variables 59
6.2.4 Relationship between Side-Swipe Accidents and
Independent Variables
6.3 Relationship for Pedestrian related Accidents
6.3.1 Relationship Between Pedestrian Accidents and
independent Variables63
University of Moratuwa Sri Lanka
Chapter 7 Electronic Theses & Dissertations
Safety Improvement at Junctions
7.1 General64
7.2 Accident reduction at Selected Junctions
7.2.1 Nature of Accident : Head – on
7.2.2 Nature of Accident : Rear – end
7.2.3 Nature of Accident : Angle
7.2.4 Nature of Accident : Side – Swipe
7.2.5 Nature of Accident : Pedestrian
7.3 Summary of Safety improvement of Junctions

~

Chapter 8

 Conclusion and Recommendations
 83

 8.1 Conclusion
 83

 8.2 Recommendations
 84

 8.2.1 Short term Solution
 84

 8.2.2 Long term Solution
 85

Reference	86
-----------	----

Annexure

Annexure A : Layout of junctions

Annexure B : Geometry data field sheet



LIST OF TABLES

Table 2.2.2	Vehicle Categories and PCV factors	05
Table 3	Provincial Accident Data	19
Table 4.1	Nature of Accident Data for Selected Junctions	22
Table 4.2	Peak hour Vehicle movement data for selected junction	26
Table 4.3	Peak hour Pedestrian movement data for selected Junctions	27
Table 4.4	peak hour Parking volume for selected Junction	29
Table 4.5	Summary of Geometry data for selected Junctions	30
Table 5.2	Nature of accidents per year for selected Junctions	31
Table 5.3.1	Traffic volume for vehicle related accidents for selected Junctions.	32
Table 5.3.2	Traffic volume for pedestrian related accident for	
	selected Junctions	34
Table 5.4.1	Pedestrian volume for pedestrian related accidents	
	for selected junctions	35
Table 5.4.2	Pedestrian volume for vehicle related Accidents for	
	Selected junctions	37
Table 5.5.1(a)	Summary of peak hours parking data in PCU	38
Table5.5.1 b)	Yearly parking volume (PCU) in millions	39
Table 5.5.2	Parking volume for vehicle related accident for	
	Selected junctions	40
Table 5.5.3	Parking volume for pedestrians related accidents	
	for selected junction	42
Table 5.6.1.1	Summary of rating for intersections type for selected junctions	43
Table 5.6.1.2	Summary of rating for traffic controlled or uncontrolled	
	For selected junctions	44
Table 5.6.1.3	Summary of conflict area for selected junctions	45
Table 5.6.1.4	Summary of carriageway width for selected junctions	46
Table5.6.1.5	Summary of centre median (not available) for	
	Selected junction	47
Table5.6.1.6(a	a)Rating scheme for visibility	48
Table 5.6.1.6(b)Summary of visibility for selected junctions	48

٩

Table5.6.17(a)Rating scheme for horizontal alignment 49
Table 5.6.1.7(b)Rating scheme for vertical alignment 50
Table5.6.1.7@	Summary of alignment for selected junctions
Table5.6.1.8	Summary of geometry analysis for selected junctions
Table5.6.2	Summary of geometry factors for vehicle related accidents 52
Table 5.6.3	Summary of geometry factors for pedestrian related accidents 54
Table 7.2.1	Summary of numbers of accident reduction & Percentage
	of accident reduction after treatments for head-on accident
Table 7.2.2	Summary of number of accident reduction & percentage
	Of accident reduction after treatments for rear-end accidents 70
Table 7.2.3	Summary of number of accident reduction & percentage of
	Accident reduction after treatments of angle accidents
Table 7.2.4	Summary of number of accident reduction and percentage of
	Accident reduction after treatments for side-swipe accident
Table 7.2.5	Summary of number of accident reduction & percentage of
	Accident reduction after treatments for pedestrian accident
Table 7.3	Summary of accident reduction percentage
	After treatments
	Eniversity of Marshurz, Sri Lanka

ł

4

} I

÷

.

Electronic Theses & Dissertations www.lib.mrt.ac.lk

LIST OF FIGURES

|

d n

.

_ _

_ _

ł

Fig. 2.5.1 (a)	Conflicting Points at a four way intersection	10
Fig. 2.5.1 (b)	Conflicting points at a three way intersection	10
Fig. 2.5.3 (a)	Reduction of conflict areas by cannalisation	14
Fig. 2.5.3 (b)	Reduction of conflict area by realignment	14
Fig. 2.5.4	Typical cross section of road	15
Fig 2.5.7 (a)	Safe Intersection sight distance	17
Fig. 2.5.7 (b)	Approach grading on side roads	18
Fig. 4.1.1.(a)	Head-on accidents	23
Fig. 4.1.1 (b)	Rea-end accidents	. 23
Fig.4.1.1 (c)	Side-Swipe accidents	23
Fig. 4.1.1 (d)	Angle accidents	24



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