

UNIVERSITI TEKNOLOGI MARA

**SPATIAL RELATIONSHIP
BETWEEN ROAD
CHARACTERISTICS AND
ENVIRONMENTAL FACTORS
TOWARDS ROAD ACCIDENT
PATTERN IN KEDAH**

NUR FATMA FADILAH BT YAACOB

Thesis submitted in fulfillment
of the requirements for the degree of
**Master of Sciences
(Built Environment)**

Faculty of Architecture, Planning and Surveying

May 2019

ABSTRACT

Road accidents are major world economic and social problem as the statistics of fatality keep increasing globally and locally. However, not much work has been done to address the road characteristics and environmental factors contributing to accident cases. Therefore, this study aims to investigate the relationship between; accident cases with road characteristics and environmental factors. Overall, there are six (6) parameters investigated which are the type of lane, level of services (LOS), slope, rainfall, temperature and wind. All of these data were obtained from *Ibu Pejabat Polis Kontinjen* (IPK) Alor Setar, *Jabatan Kerja Raya* (JKR) Alor Setar, and the Meteorology Department. Then, it was processed in ArcGIS and geospatial database of accident cases with road characteristics and environmental parameters created. Based on the analysis, Alor Setar and Sungai Petani were identified as hotspot areas for accidents and the spatial pattern of accident cases in Kedah can be classified as a clustered pattern. Accident cases were also mostly found on two-lane type of lane; but less on four-lane roads. Meanwhile, LOS, slope and rainfall negatively correlated with accident cases, which indicates higher value of level flow, slope or rainfall contributing to less number of accidents. The study also found temperature is positively correlated with accident cases during cool days ($R^2=0.78$), but negatively correlated with warm temperature ($R^2=0.79$). It shows that the number of road accident cases occurring during warm days decreased when the temperature was nearly 30°C . Also, the number of accident cases also reduced with the increase of the wind speed ($R^2=0.22$). Lastly, by using the ordinary least square (OLS) method, among the six parameters (6), it has been found that LOS is the most contributing parameter to road accidents from the year 2013-2015. In conclusion, the output of this study should able to aid the local authority such as Traffic Police in decision-making wise especially in developing related strategies to reduce accidents.

ACKNOWLEDGEMENT

Firstly, I wish to thank God for giving me the opportunity to embark on my Master and for completing this long and challenging journey successfully. My gratitude and thanks go to my supervisor Sr. Sharifah Norashikin Binti Bohari, and co-supervisor, Gs. Dr. Noradila Binti Rusli. Thank you for the support, patience and ideas in assisting me with this project. I would like to express my gratitude to the staff of the Ibu Pejabat Polis Kontinjen (IPK) Alor Setar, Jabatan Kerja Raya (JKR) Alor Setar and Malaysian Meteorology Department (MMD) for providing the data, knowledge and assistance.

My appreciation goes to the crewmembers of the FSPU who provided the facilities and assistance during this study. Special thanks to my colleagues and friends for helping me with this project.

Finally, this thesis is dedicated to the loving memory of my very dear late father and mother for the vision and determination to educate me. This piece of victory is dedicated to both of you. Alhamdulillah.

TABLE OF CONTENT

	Page
CONFIRMATION BY PANEL OF EXAMINERS	ii
AUTHOR'S DECLARATION	iii
ABSTRACT	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENT	vi
LIST OF TABLES	x
LIST OF FIGURES	xii
LIST OF PLATES	xvii
LIST OF SYMBOLS	xviii
LIST OF ABBREVIATIONS	xx
CHAPTER ONE: INTRODUCTION	1
1.1 Introduction	1
1.2 Research Background	1
1.3 Problem Statement	3
1.4 Research Gap	5
1.5 Aim	9
1.6 Objectives	9
1.7 Research Questions	9
1.8 Conceptual Framework of Accident Factors	10
1.9 General Methodology	12
1.9.1 Study Area	13
1.10 Scope and Limitation	14
1.11 Thesis Organization	15
CHAPTER TWO: LITERATURE REVIEW	16
2.1 Introduction	16
2.2 Definition of Road Accident	16
2.3 Road Accident Statistics Worldwide and in Malaysia	17

2.4	Characteristics of Rural and Urban Road Accident	19
2.5	Types of Vehicles Involved in Road Accidents	23
2.6	Factors Affecting Road Accidents	27
2.7	Human Behaviour Factor Influences Road Accidents	30
2.8	Road Characteristics Effect on Road Accidents	33
	2.8.1 Type of Road Involved in Road Accidents	33
	2.8.2 Lane Characteristics Affecting Road Accident Cases	36
	2.8.3 Level of Services (LOS) of Road	38
	2.8.4 Traffic Congestion	40
	2.8.5 Road Surface Condition	42
2.9	Environment Factor toward Road Accident	45
	2.9.1 Rainfall Effect toward Road Accidents	46
	2.9.2 Wind Effect toward Road Accident	50
	2.9.3 Temperature Effect toward Road Accident	53
	2.9.4 Monsoon Effect on Environmental Factor	56
2.10	Geographical Information System	58
2.11	GIS Application in Analysis of Road Accidents	59
2.12	Regression Analysis in Road Accident	61
2.13	Spatial Pattern	65
	2.13.1 Hotspot Analysis	66
	2.13.2 Kernel Density Analysis	68
	2.13.3 Inverse Distance Weighted (IDW) Analysis	70
	2.13.4 Spatial Autocorrelation Analysis	72
	2.13.5 Ordinary Least Square (OLS)	75
2.14	Summary	76
CHAPTER THREE: RESEARCH METHODOLOGY		77
3.1	Introduction	77
3.2	Detail Methodology	77
3.3	Description of Study Area	79
	3.3.1 Accident Distribution in Kedah	80
3.4	Data Acquisition	85
	3.4.1 Kedah's Districts	85
	3.4.2 Road Accident Data of Kedah 2013 – 2015	86