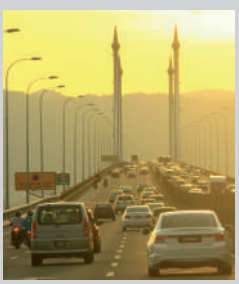
MRR No. 347



Research Report

Relationship Land Use Operation Hour and Time of Road Crashes

Azzuhana Roslan
Rohayu Sarani
Nusayba Megat Johari
Sharifah Allyana Syed Mohamed Rahim
Nur Fazzillah Mohamed Noordin

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Published by:
Malaysian Institute of Road Safety Research (MIROS)
Lot 125-135, Jalan TKS 1, Taman Kajang Sentral,
43000 Kajang, Selangor Darul Ehsan, Malaysia.

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

Azzuhana Roslan
Relationship Land Use Operation Hour and Time of Road Crashes/
Azzuhana Roslan, Rohayu Sarani, Nusayba Megat Johari, Sharifah Allyana
Syed Mohamed Rahim, Nur Fazzillah Mohamed Noordin.
(Research Report; MRR No. 347)
ISBN 978-967-2078-89-0
1. Traffic accidents--Research--Malaysia--Selangor.
2. Traffic accident investigation--Research--Malaysia--Selangor.
3. Traffic safety--Research--Malaysia.
4. Government publications--Malaysia
I. Rohayu Sarani. II. Nusayba Megat Johari.
III. Sharifah Allyana Syed Mohamed Rahim.
IV. Nur Fazzillah Mohamed Noordin.
V. Title. VI. Series.
363.125650720595

Printed by:
VISUAL PRINT SDN BHD (186281-A)
No 47, 47-1, Jalan Damai Raya 1,
Alam Damai, 56000 Cheras,
Kuala Lumpur.

Typeface: Calibri
Size: 11 pt.

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Acknowledgements

The authors/committee would like to express their appreciation to the previous Director-General of the Malaysian Institute of Road Safety Research (MIROS), Professor Dr Wong Shaw Voon and the previous Director of Road Engineering and Environmental Research Centre, Dr Jamilah Mohamad Marjan for providing the grant to conduct this project title Relationship Land Use Operation Hour and Time of Road Crashes (No. Grant: RE103043) and extending their support to produce this report. Their gratitude also goes out to all the stakeholders involved, partners, reviewers, relevant agencies/companies, and research participants. Malaysian Town Planning Department (JPBD) who have worked hard, contributed their invaluable ideas, input, energy and time towards the production of this report. The authors would also like to express special thanks to the team members and research assistants for their help and contribution in completing the project:

Ahmad Sharil Mohd Yusof
Noriah Saniran
Siti Nazura Mohd Salleh
Siti Nurhidayah Musa

Abstract

This report highlights the relationship between land use operation hours and time of fatal and serious injury road crashes. The outcomes of this study provide recommendations to the decision-maker to consider land-use types in future development.

846 location of fatal and serious injury road crashes occur in Selangor was re-identifying base on observation on the site. Survey and interview identify land use operation hours, while other variables, such as the number of lane and types of carriageways, also are collected.

To plan land-uses, detail of crash location can support making a decision. PDRM classifies location of crashes area by 7 categories compared to JPBD 13 categories. Different types of land use generate and attract a different number of trips and traffic volume, which in turn have the potential to cause road accidents. In other words, each type of land use is reasonable may generate road accidents.

Most of the land use activities usually start between 0730 and 0830 and end between 1630 and 2000. However, several land use with the same categories of operation several hours, e.g. some industries areas operating between 0800 to 1800 hours, and some were operating between 0800 to 2000 hours. There are also operating for 24 hours. Land use categories by transportation refer to the road network which considers operating for 24 hours and transport facilities, e.g. bus terminal, bus station, and rail station, operating between 0600 to 2400 hours. Results found that 86.41% of fatal and serious road crashes occur during land-use operating hours.

Carriageway and lane width indicates the room for manoeuvres by the road users. 33.81% of fatal road crashes during land-use operating hours occur at two lanes of roadways. In terms of the carriageway, 50.83% occur at double carriageway.

1. Introduction

Road crashes cost approximately 1 to 3 per cent of a country's annual Gross National Product (GNP). These are resources that no country can afford to lose, especially those countries which still fall under developing economies list. The estimated loss by developing countries is in the region of $100 billion every year. It is almost twice as much as the total development assistance received worldwide by the developing countries. These losses undoubtedly inhibit the economic and social development of developing countries.

Malaysia, as a progressing from middle income to high-income country, lost almost 3% of its GDP due to road crashes (Nuura et al., 2010). Rapid infrastructure development, together with an increasing number of population and vehicles on the road, contribute to the positive mobility of people and businesses. More townships develop to cater to the need of people for housing, education, amenities, and to conduct businesses. These townships should plan to balance mobility, safety and at the same time, maintains the greenery. Land use planning is essential to keep all three elements interact and functions well. Road planning and infrastructure should plan to minimise the possibility of road crashes. For example, schools should be accessible through a service road, and not directly from the main road. In the short run, it may add cost to the township development, but it benefits the society in the long run.

There are many causes of road crashes. It could be possibly due to the careless driver, poor road condition, or vehicle ageing. However, if one is to consider the environment factor, land usage is another element that impacted road safety. Considering it is one of the indirect element in the causes of road crashes, land-use activities are also a defining factor in the level of severity of crashes. Land use does not contribute directly towards road accidents, but its' activities influence the level of traffic flow, speed and safety.

Land use factors can significantly affect travel and associate in road safety which gives impacts and effects with each other. Different types of land use activities generate and attract a different number of trip and traffic, which in turn have the potential to cause road accidents. It is the main reason to coordinate transportation and land use planning decisions which complementary rather than contradictory.

In managing land use, detail of crash location must support making a decision. PDRM classify the location of crashes area by 7 categories compared to JPBD 13 categories. The motivation behind the research is to obtain the land use types of fatal and serious injury road crashes to identify land use operation hours and look at the relationship between operational hours and time of the crash.

Figure 1 below shows the number of fatal and serious injury road crashes in Malaysia from the year 2007 to the year 2011. The record shows the highest numbers of crashes occur in other areas followed by residential and office area. Acknowledging the issue, therefore this study refers to the location of crash information and re-identify the land use during observation on the site.

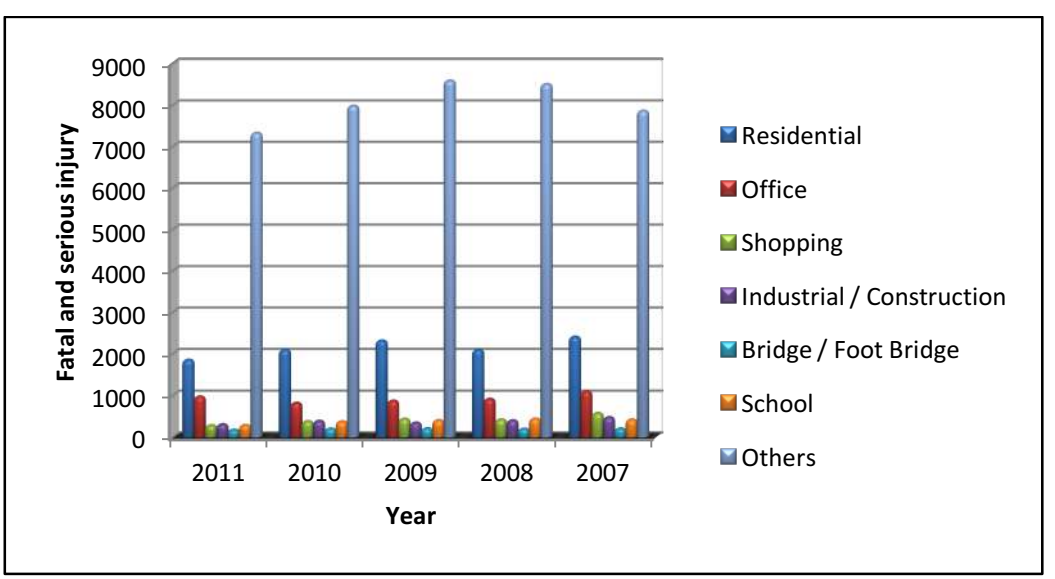

Figure 1 Number of fatal and serious injury of road crashes from the year 2011 – 2007

1.1 Objective of the Study

The main objective of this study is to identify the land use characteristic for all fatal and serious injuries road crashes in Selangor and to test of whether the time of road crashes associates with land use operational hours.

1.2 Scope of the Study

The site of the study is in Selangor (Figure 2). Of all crashes happened in the state, this research focus on fatal and serious injuries road crashes occurred in the year 2011.

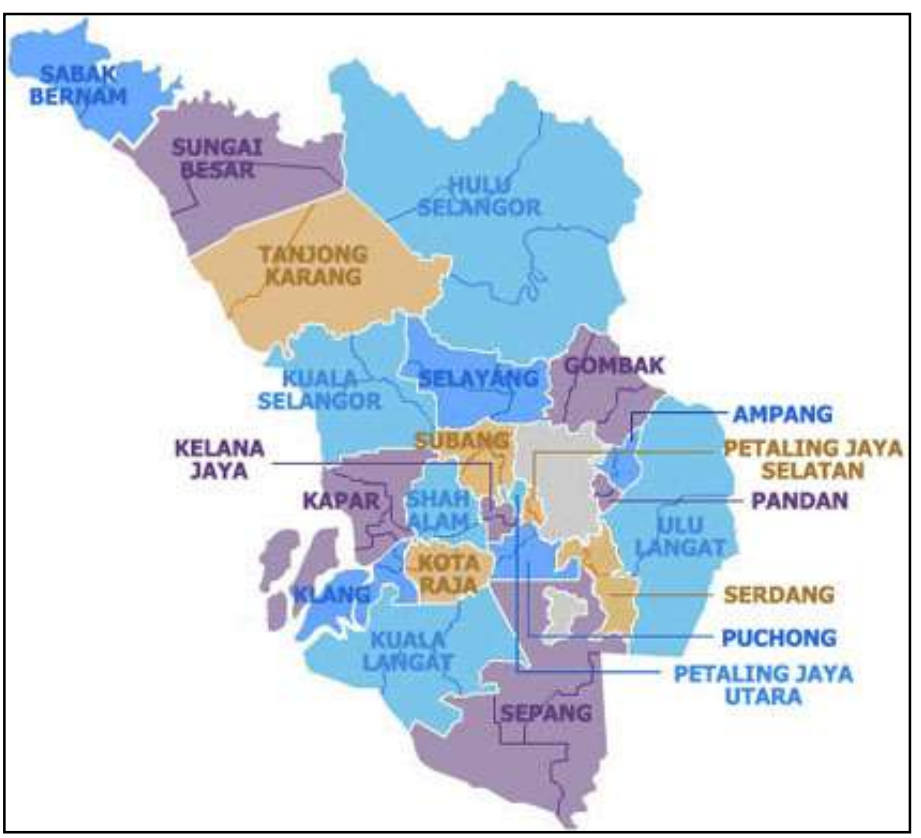

Figure 2 Study area district in Selangor, Malaysia

2. Literature Review

Land use factors can significantly affect travel and associate in road safety which gives impacts and effects with each other. Different types of land use activities generate and attract a different number of trip and traffic, which in turn have the potential to cause road accidents (Wedagama, 2007). It is the main reason to coordinate transportation and land use planning decisions which is complementary rather than contradictory. In other words, each type of land use may generate road accidents.

Land use refers to human use of the earth's surface. Land use involves the management and modification of natural environment or wilderness into the built environment including building, infrastructure, transportation and open space. Land use patterns can have diverse economic, social and environmental impacts (Litman, 2012).

Land use is a trip determinant as it has a strong correlation with both trip generations and attractions. Both are the main factors that influence some road environment variables such as traffic flow, speed limit and road user activities (Dissanayake et al., 2009). Un-planned land use development could lead to traffic conflict and thus contribute to road accidents. Different land use can generate a different amount of traffic. Planners should control the development activities by taking into consideration the possible impact of traffic that might generate from the development.

Hanson and Susan stated that the connection between transportation and land use is a fundamental concept in transportation. Everything that happens to the land use activities has relation to transportation activities, and every transportation affects land use. A lot of new and integrated transport policies have developed to meet the challenges to mitigate traffic congestion and encourage economic growth.

According to Wegener and Furst (1999), the distribution of land use over the urban area such as residential, industrial or commercial determines the locations of human

activities such as living, working, education and leisure; The distribution of human activities in space requires spatial interactions or transport service that leads to trips in the traffic system to overcome the distance between the locations of activities.

Planning decisions regarding transport, land use, and road networks have significant effects on public health. They affect the amount of air pollution by vehicle, the degree of physical exercise undertaken by individuals, and the volume of road traffic crashes and injuries (WHO).

There were various efforts taken to address the accident rate involving road accidents. The authorities are always on the lookout to make roadways safer either by improving engineering measurements or by traffic monitoring. However, the reason accidents do not occur uniformly, and characteristics of roadways vary significantly. It could be geography area, demography area, funds allocation or combination of these (Alind Saxena et al.).

According to the theory of urban safety management, land use is one of the policies used to present & reduce accidents. Many aspects of road safety analysis are also associated with land use activities (D. M. Priyantha Wedagama, 2007).

Part 10.6, The Handbook of Road Safety Measures explains the relationship between land usage, the traffic volume and the number of accidents. Different type of land use may generate and attracts different trips, and that it may be possible, therefore, to model the occurrence of accidents in term of land use without explicit reference to traffic flows.

A study conducted by Edwin and Rodney found 48% of traffic was coming from the high-density housing area and 20% coming from a regional mall, shopping centre and apartments.

However, it might be a useful approach if policymakers can make a decision about land use activities before it generates traffic, rather than manage the traffic problem it generates after developing the land.

Record from POL 27 (PDRM) shown that 40.34% of road crashes occurred in active land use which generates and attract more traffic and consequently causes road accidents. This percentage includes 19.56% of crashes occurred in residential areas, and 7.62% in office areas. 4.70% at shopping centre areas, 3.41% in industrial areas, 3.51% at school areas and 1.53% occurred at bridge/footbridges (Azzuhana R. et al., 2011).

For crash analysis by motorcyclists' age, utilising MIROS Road Accident Database System (MROADS), with focus on the age of rider and the pillion who involved in fatal crashes, the median age for rider is 29, while pillion is 21 years old (Rohayu S. et al., 2011). Median age is the 50% cut off point for the age. In other words, 50% of riders involved are aged 29 and below.

Risk in road traffic arises out of a need to travel – to have access to work, for instance, or education or leisure pursuits. A range of factors determines who uses different parts of the transport system, how it used and why, and at what times (WHO).

During 2.5 or 3 hours every morning and afternoon, people use more public transport, bicycle or walking. At the core of the new model is a severe restriction of automobile use, with total restriction of cars and commercial vehicle during 5 or 6 peak hours every day.

The Royal Society for the Prevention of Accidents (2011) highlight road crashes by tired drivers are most likely to happen between 2.00 am to 6.00 am, after long working hours or on journeys home after long shifts especially night shifts.

Accidents are higher between 07.45 and 08.30, the morning rush hour; and between 16.30 and 17.00, the early evening rush hour. It is unsurprising as these are times of most considerable traffic movement. Of perhaps greater interest is to look at how these temporal patterns have changed over time, focusing on the hours between 07.00 and 19.00. It shows an apparent reduction in the number of accidents occurring across all times of the day. However, what is interesting is that the peak between 16.30 and 17.00 has declined rapidly, but now there seem to be two distinct afternoon peaks, the first at about 15.00 and the second at 17.30 (Simon et al., 2011).

More single vehicle crashes occurred during night time (18:00 to 05:59) with 53.3% compared to during daytime (0600:17:59) with 46.7%. In terms of part of the week, weekends (considered as Friday, Saturday and Sunday) and weekdays have similar trend for fatal single-vehicle crash occurrence (50.4% and 49.6%) (Z. A. Ahmad Noor Syukri et al., 2010).

Thus, this study aims to test the relation between times of road crashes with land use activities. This report looks into how land-use activities impact time of road crashes.

3. Materials and Methodology

To correctly identify problems and monitor performance, there needs to be reliable and accurate data at each stage of road safety management. Data is the cornerstone of all road safety activity and is essential for the diagnosis of the road crash problem and monitoring of road safety efforts. Relevant data are collected every day, but for these data to be useful for informing road safety practice, they must be adequately coded and visualised, processed and analysed systematically.

Figure 3 shows the process flow of data preparation and analysis. The data used in this study is obtained from the Royal Malaysian Police (PDRM) and analysed using the MIROS Road Accidents Database System (MROADS). All information provided on the crash report such as district, road number, location including referring to latitude and longitude information. Observations are on-site to recognise the land use operation hours. All information is recorded and analysed.

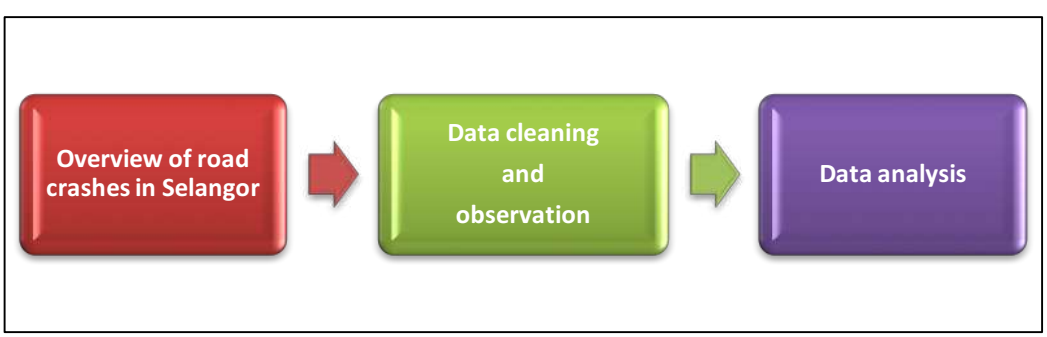

Figure 3 Data preparation flow

3.1 Overview of Road Crashes in Selangor

The data used in this study is from the Royal Malaysian Police (PDRM). This study focused on the year 2011 fatal and serious crashes occurred in Selangor involving all types of vehicles. The record shows 1,070 fatal and 566 serious injuries in road crashes occur on that year — all fatal and serious crash data presented by districts in Selangor with a total of 12 districts. Figure 4 below shows the proportion of fatal and serious injuries by the districts in Selangor. The red bar represents the number of fatal crashes, while yellow represents serious injury crashes. The result shows a higher number of fatal crashes occurred in Klang district (153) followed by Subang Jaya (129). On the other hand, the number of serious injury crashes show are higher at Sabak Bernam (116) followed by Petaling Jaya (98) and Klang (93) district.

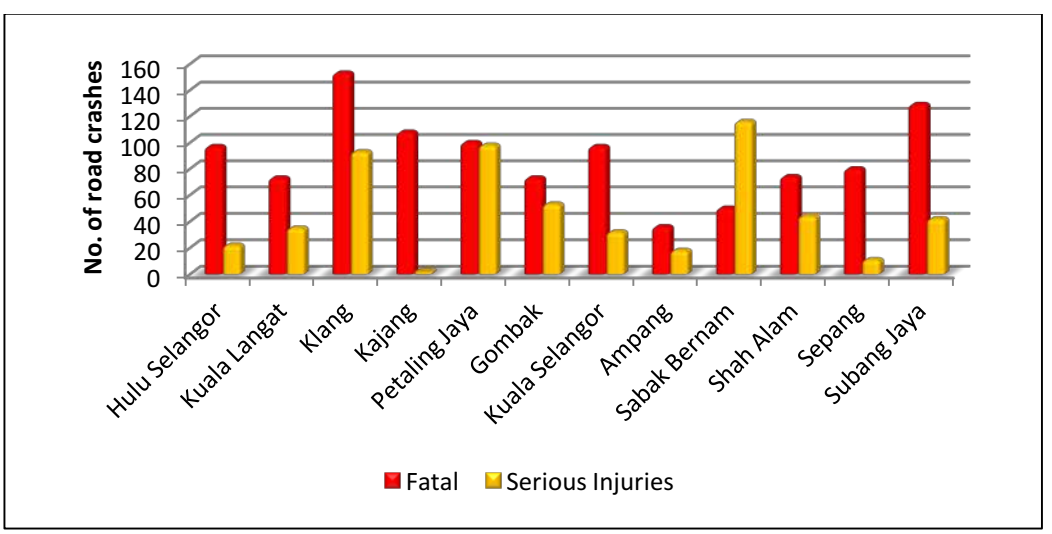

Figure 4 The number of fatal and serious injury crashes by the districts in Selangor

Furthermore, detail data of fatal and serious injuries were obtained from PDRM and analysed using MIROS Road Accidents Database System (MROADS).

3.2 Data Cleaning and Observation

There were 1,636 fatal and serious injury road crashes recorded in Selangor for 2011. Locations of crashes information; latitude, longitude, road name, road number or other information regarding crash location are the main variable in this study. Base on this information, survey and observation to obtain land use activities operating hours. The exclusion of this study is the records without this information.

Figure 5 below shows the proportion of data by districts which obtained before and after the data cleaning process. Total of 846 locations records used in this study. Thus, the result should be used with care as the number of records limits the study.

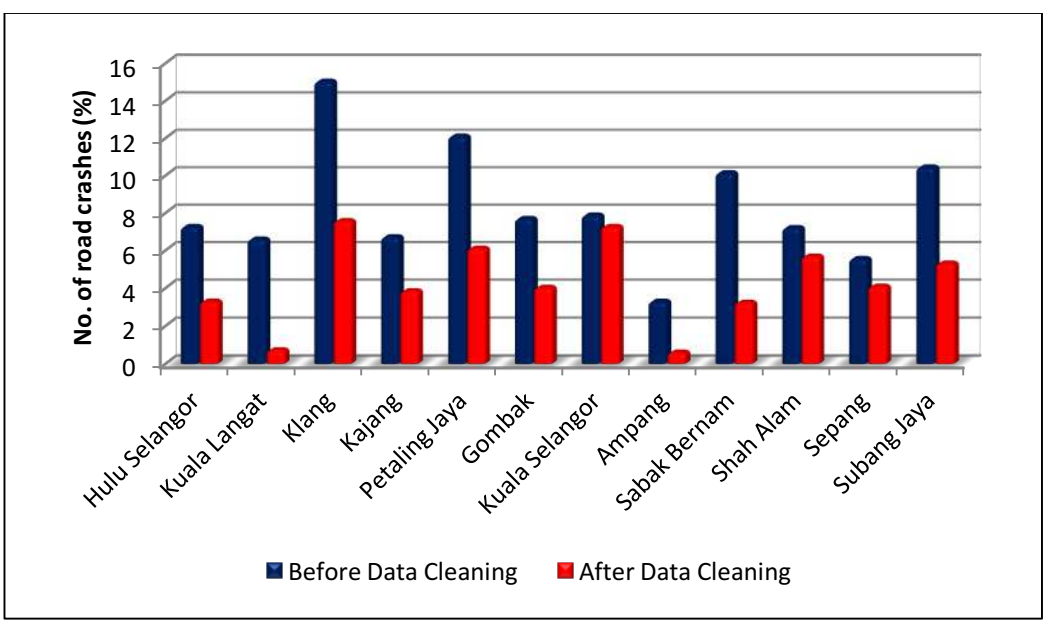

Figure 5 The percentage of fatal and serious injury data before and after data cleaning

Other data are collected as well, such as the number of lane and types of carriageways. All data tabled using forms which develop for data collection purpose (Figure 8). Figure 6 and 7 show one of the crash location at Kajang and Subang Jaya.

Figure 6 Crash location at Kajang

Figure 7 Crash location at Subang Jaya

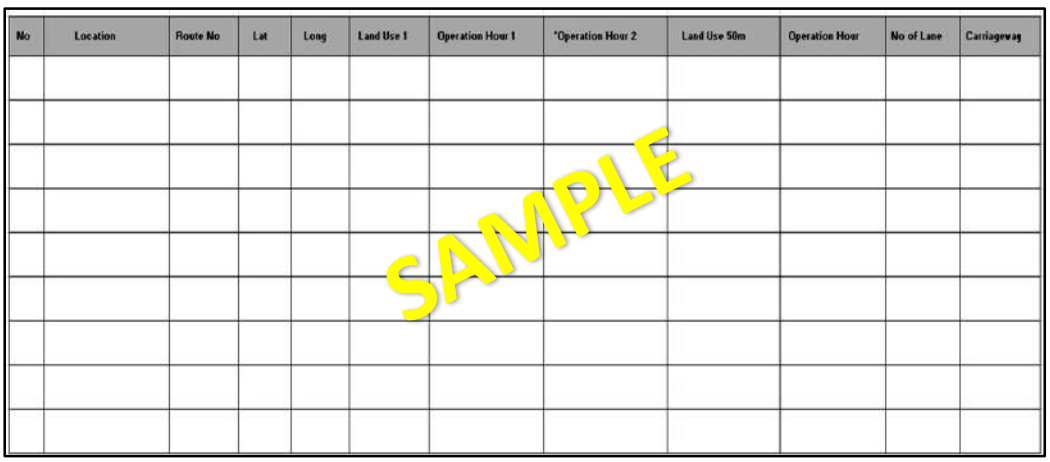

Figure 8 Data collection form

3.3 Data Analysis

PDRM group crash location by 7 categories; however, Town Planning Department (JPBD) Classification and Land Use Coding (amended Dec 2008), classify land use into 13 categories. Table 1 below shows the different groups of land use types classified by PDRM and JPBD. Even though there are differences between land use categories by PDRM and JPBD, the definition of land usage is similar for specific categories. For example, school land-use class by PDRM and institution land-use class by JPBD. These land-use classes both refer to educational. For shopping and office, PDRM separates this into two different categories, which is similar to business and service refer to shop lot area, petrol pump, mall, office and business area, and hotel. However, for this type, there are no specific land use categories definition by PDRM.

Based on data collected during observation, the team reclassified the land use of crash location and their respective operational hours were determined.

Table 1 Group of land use types by PDRM and JPBD

No.	Land use by PDRM	Land use by JPBD	Land use definition by JPBD
1	Residential	Residential	All types of housing areas Terrace, village etc.
2	Industrial/ Construction	Industry	All types of industries area include small and heavy industries.
3	Shopping	Business and service	Includes shop lot, petrol pump, office, business area, shopping mall, food court, hotel.
4	School	Institution and public amenities	All relate to education and government use; school, universities, college, hospital, police station, army etc. welfare and religious.
5	Bridge/Foot bridge	Open space and recreation	Playground, field, sport centre etc.
6	Office	Wasteland	A land which is free of buildings or human activities, including unutilised areas.
7	Others	Transportation	Includes expressway, railway and other transport facilities such as bus station, terminal, port hub etc.
8		Infrastructure and utilities	Includes power plant, substations, gas, IT, cellular, antenna, telecommunication etc.
9		Agriculture	All related to the cultivation.
10		Livestock and aquaculture	Farming, and others related.
11		Forest	
12		Water body	
13		Beach	

4. Results and Discussions

Observations made at 846 different locations which cover 12 districts in Selangor. Figure 9 below shows the distribution of fatal and serious injury road crashes in Selangor.

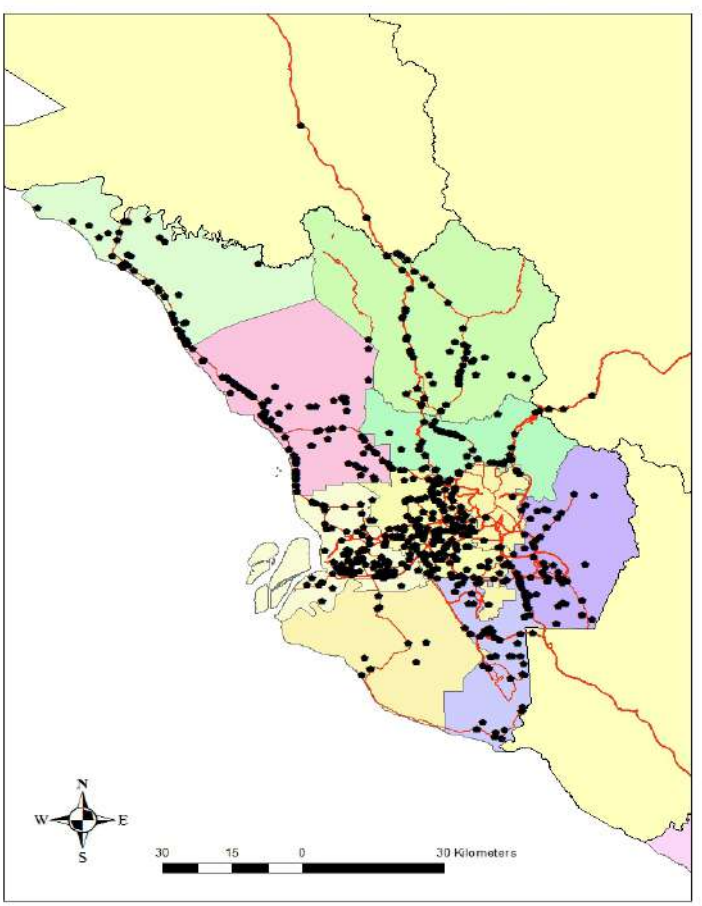

Figure 9 Fatal and serious injury road crashes in Selangor

Spatially, this study did not observe any evidence of population related to road crashes. However, Figure 10 shows a higher spatial correlation between crashes and district close to high-density areas such as Kuala Lumpur.

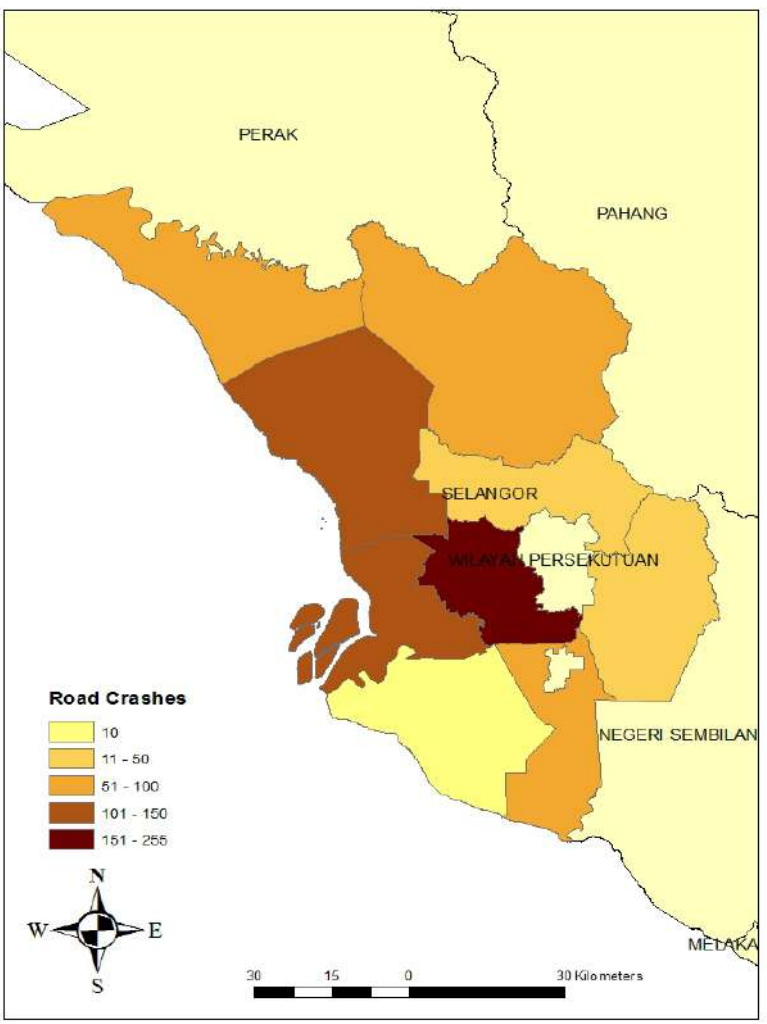

Figure 10 Spatial clustering of fatal and serious injury road crashes by district in Selangor

Figure 11 below shows the proportion of fatal and serious injury by land-use type's base on JPBD land-use class which was re-identify during survey and observation on crash locations. Result show business and services area posed higher percentage of fatal and serious injury crashes with 32% as compared to other area types such as residential (23%), transportation (20%) and industries (11%). It might be due to the different traffic composition in those locations. Detailed analysis of fatal and serious injury crashes based on the operation hour of the location types is further discussed in the next section.

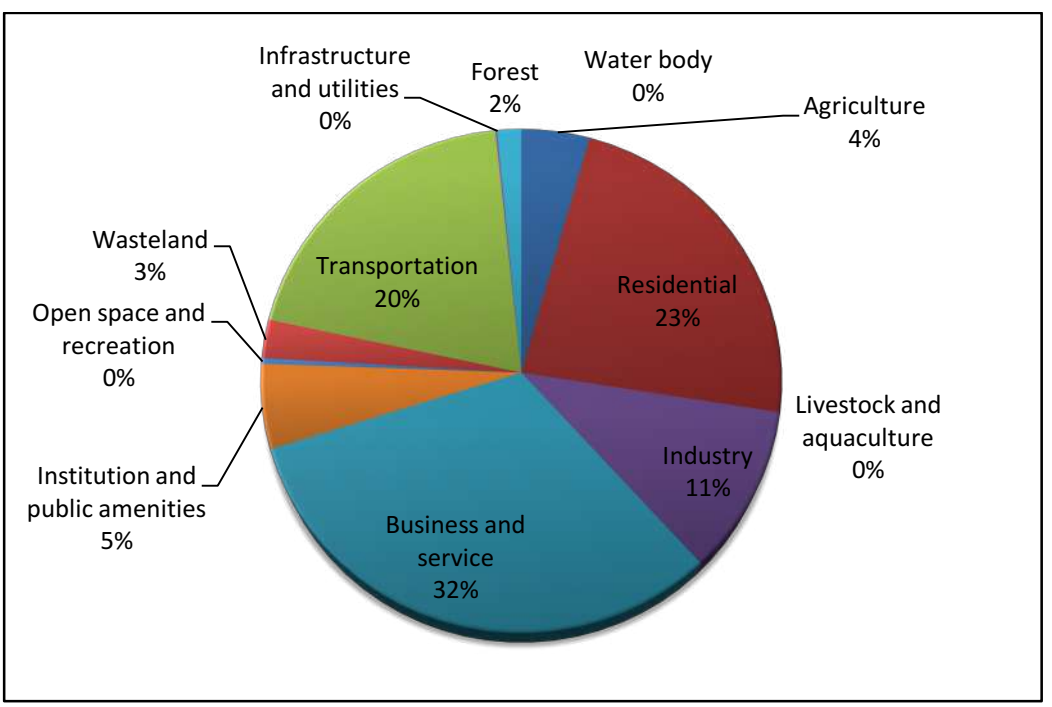

Figure 11 The percentage of fatal and serious injuries by location types based on JPDB land-use class

4.1 Daily Trend

Figure 12 shows the percentage of fatal and serious injuries by day of the week. The result shows a high number of crashes occurred on Thursday (16.5%), followed by Friday (15.78%) and Sunday (14.46%). However, this number more decreases on Monday (11.33%). Meanwhile, the linear line show number of crashes is slightly increased during midweek from Tuesday to Thursday. It is quite surprising that Thursday has the highest number of crashes, as Selangor working days are Monday to Friday.

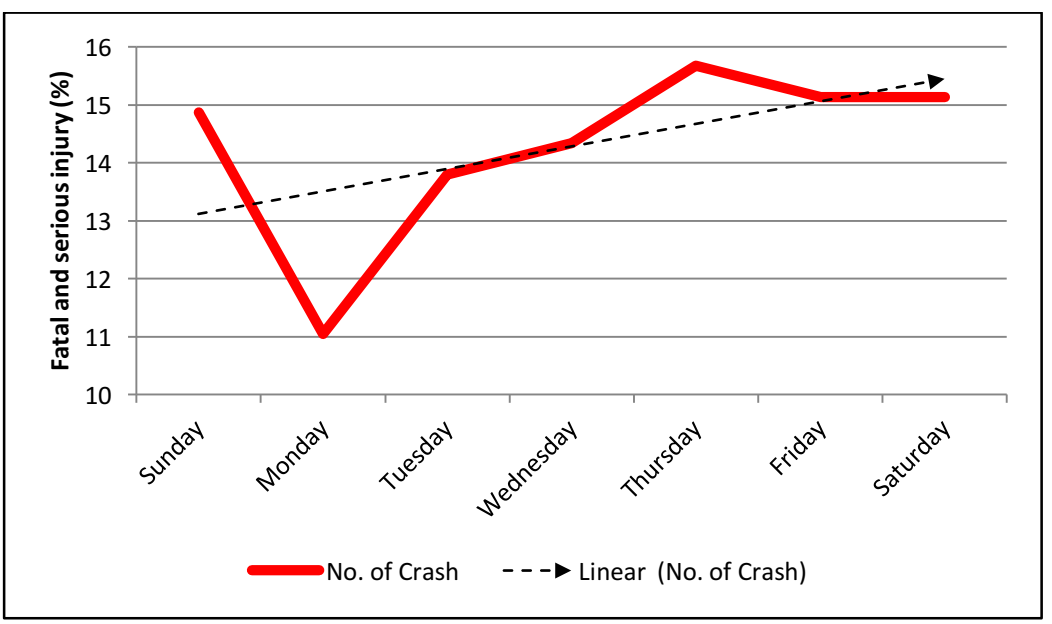

Figure 12 The percentage of fatal and serious injuries by day of the week

Figure 13 shows the percentage of crashes by time of the day. The result shows that there is a slight increase in the linear line number of crashes, as the time of the day increases. There are two clear peaks; one between 0801 and 0900 (6.43%), the morning rush hour; and a second larger one between 1701 and 1800 (6.80%), the early evening rush hour. Result also shows an apparent reduction in the number of accidents occurring between 0900 and 1100 hour. The linear line for the number of crashes slightly increased towards midnight.

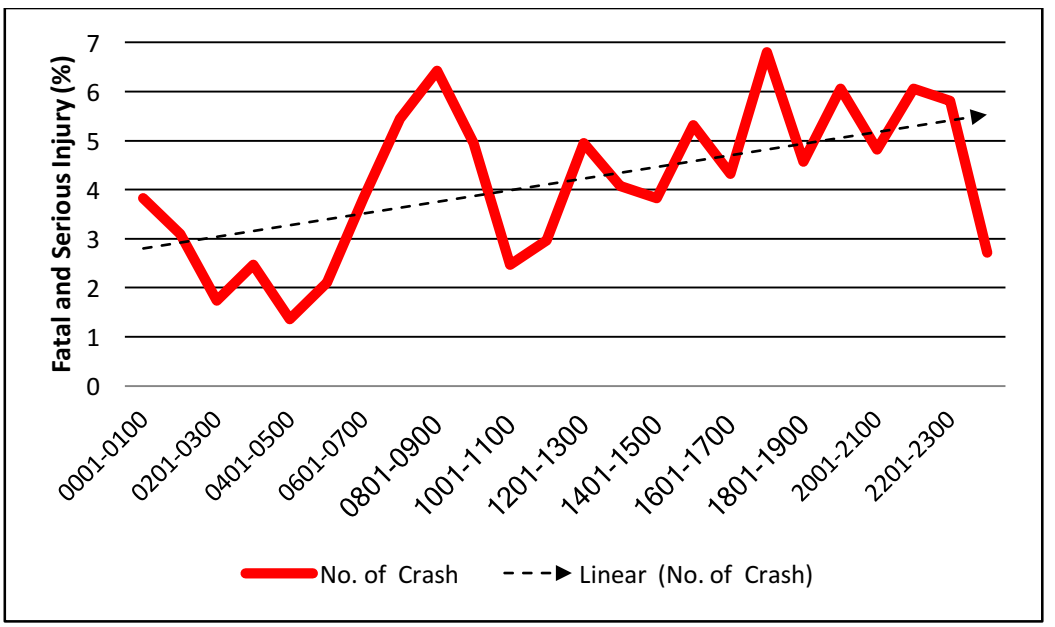

Figure 13 The percentage of crashes by time of the day

Land use operating hours of the crash location identified based on-site survey and a face-to-face interview with a responsible person; such as school staff for gain information regarding school hour, which conducted by RA's during the observation on crash locations. Several land-use types have a similar time of operation hours. As the aim of this study was to identify the impact of land use operation hour and road crashes, it was, therefore, essential to differentiate between land use term and non-term time. Two omissions in the analysis were public holidays and weekends.

Table 2 below show of the time of land use activities obtained during observation. It should also note that most of the land use activities usually start between 0730 and 0830 and end between 1630 and 2000. However, several land use with the same categories of operation several hours, e.g. some industries areas operating between 0800 to 1800 hours, and some were operating between 0800 to 2000 hours. There are also operating for 24 hours.

Land use categories by transportation refer to the road network which considers operating for 24 hours and transport facilities, e.g. bus terminal, bus station, rail station, which operate between 0600 to 2400 hours.

Table 2 Operating hours of land use activities

No.	Land use by JPBD	Operating hours
1	Residential	0000 – 2400
2	Industry	0800 – 1800 0800 – 2000 0000 – 2400
3	Business and service	0800 – 2000 0800 – 2200
4	Institution and public amenities	0730 – 1300 0730 – 1830
5	Open space and recreation	0000 – 2400
6	Wasteland	0000 – 2400
7	Transportation	0600 – 2400 0000 – 2400
8	Infrastructure and utilities	0000 – 2400
9	Agriculture	0000 – 2400
10	Livestock and aquaculture	0000 – 2400
11	Forest	0000 – 2400
12	Water body	0000 – 2400
13	Beach	0000 – 2400

Based on time of land use activities period, result show 86.41% of fatal and serious crashes occur during the time of land use activities operating hours (Figure 14). However, only 13.59% occur out of land use activities operating hours.

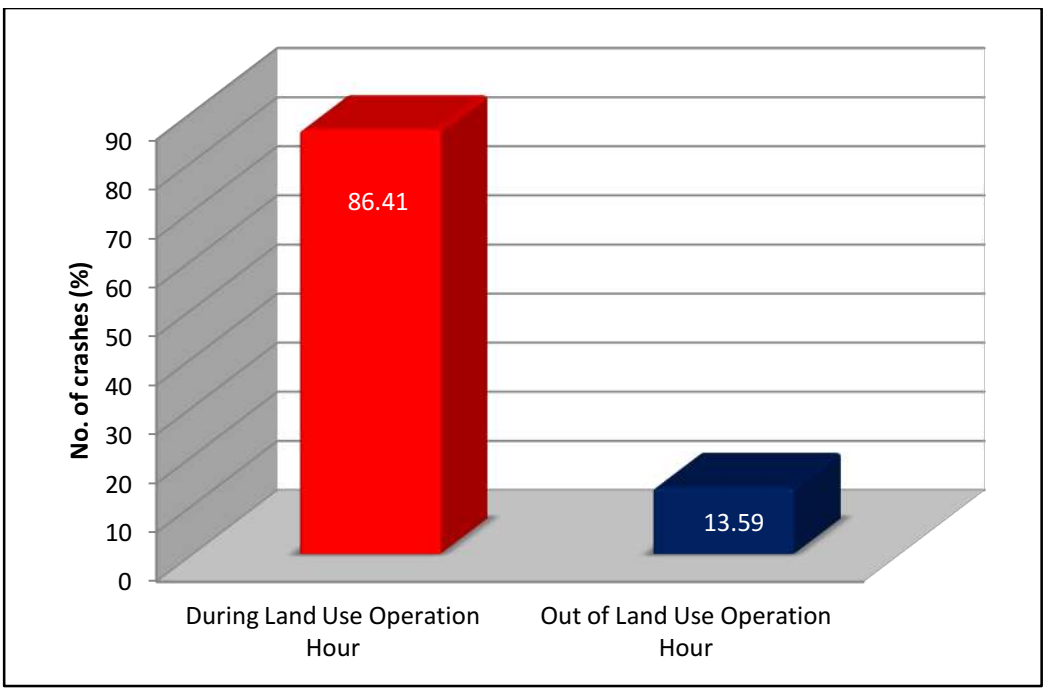

Figure 14 Percentage of road crashes occur in and out of operation hour

Out of total number fatal and serious injury crashes occur during land-use activities operation hours, Figure 15 below shows that 22.93% occur at residential areas and closely followed by business and services areas 22.10%. Transportation area (include roadway, terminal, bus station, rail station and other transportation facilities) contribute 19.86% and industry 9.69%. Nevertheless, fatal and serious injury crashes occur out of land use activities operating hours higher at business and services areas 9.93%. It followed by institutions and public amenities area 2.25% and industry area 1.06%.

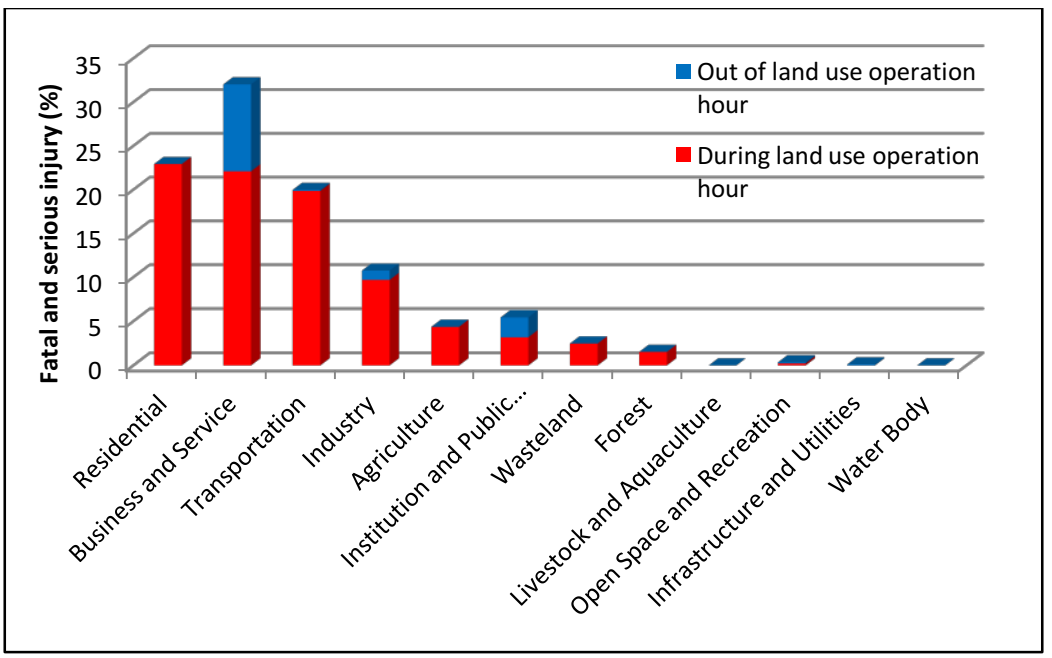

Figure 15 Percentage of road crashes occur during land-use activities operation hours by land use types

Figure 16 below shows the relation between land use operation hours and road crashes. Result show 63.83% of fatal and serious road crashes occur in residential and transport areas which mostly activities on that area operation 24 hours per day, 24.47% occur on areas which are active 14 hours per day and 5.79% occur at area active 12 hours per day. Base on the linear line, a more extended period of the land use activities, contribute the higher number of fatal and serious injury road crashes.

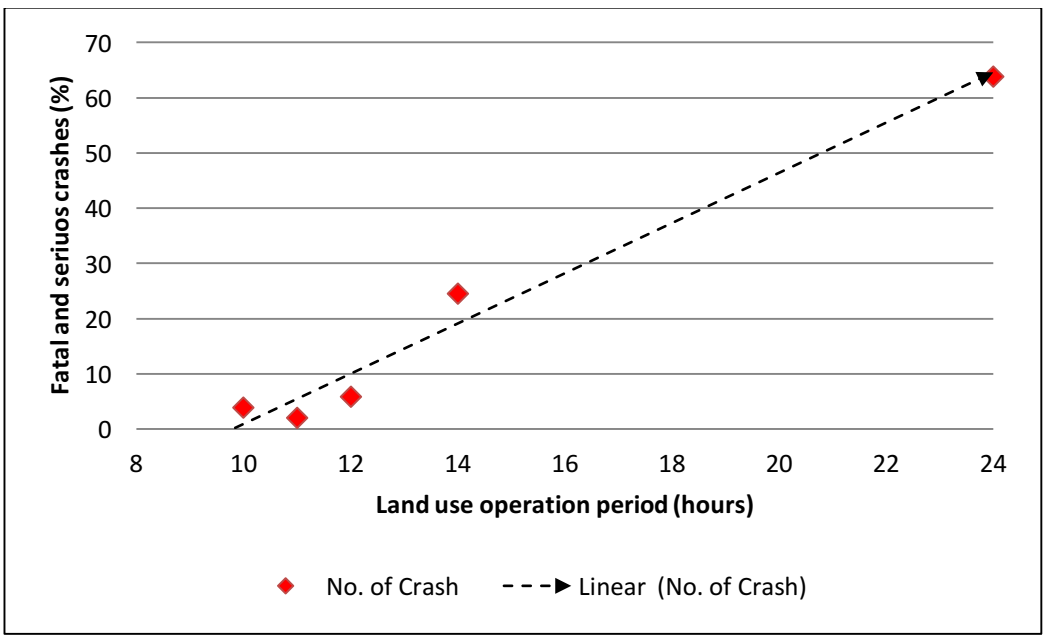

Figure 16 Relationship between the period of land use operation hours and road crashes

4.2 Number of Lane and Types of Carriageway

Other variables recorded during observation is the number of road lane and types of the carriageway; while dividing any of the parallel strips into which the carriageway of a major road or motorway. Carriageway and lane width indicates the room for manoeuvres by the road users. Most accidents occur on the rural single carriageway (Kevin & Janet, 2005).

Figure 17 shows the relationship between the land-use activities operation hours and the number of road lanes. The result shows a higher number of road crashes occur at two (2) lane roadway 59.67% with proportion 33.81% fatal and 17.61% serious road crashes occur during land-use operation hours. These followed by road with three (3) lane which 13.00% fatal and 7.21% serious road crashes occur during land-use operation hours. 17.97% occur at roads with a single (1) lane.

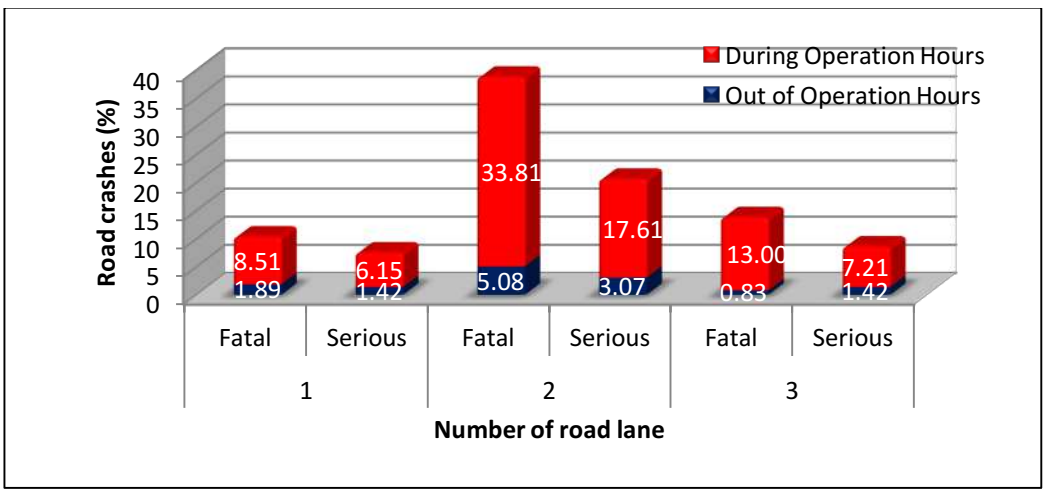

Figure 17 Relationship land use operation hours and number of road lane

In terms of types of the carriageway, fatal and serious injury road crashes occur in operation hour contribute higher at dual carriageway road (50.83%) compared at single carriageway (35.46%). Figure 18 below shows the comparison between the number of fatal and serious injury road crashes occur at single and dual carriageway by during and out of operation hours.

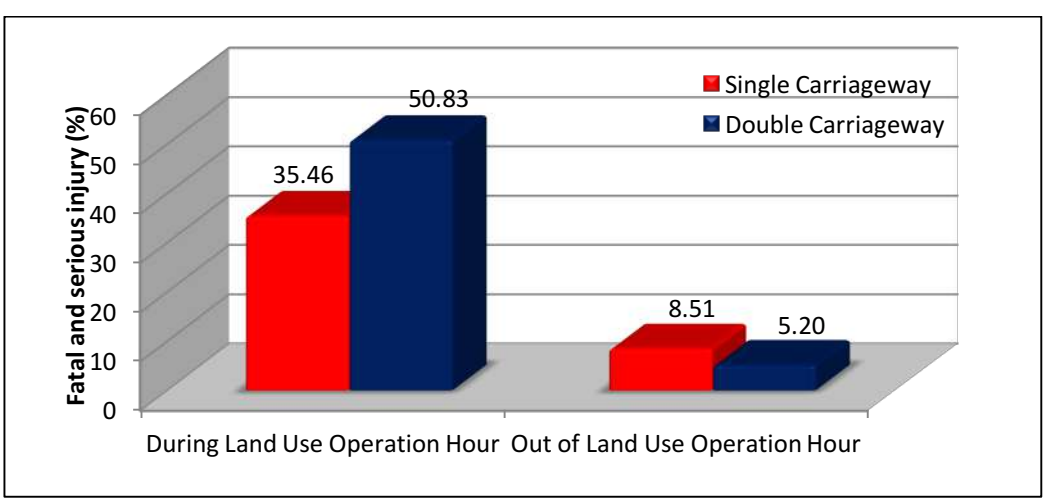

Figure 18 Relationship land use operation hours and types of carriageway

4.3 Relation of All Variables

Different land-use types with a different number of lane and type of carriageway may affect the pattern of fatal and serious injury road crashes. Some study show, comparing dual and single carriageways, single carriageway accidents tend to be more severe; 16.0% of casualties on single carriageways were killed or seriously injured compared with 12.1% on dual carriageways. Single vehicle accidents are more likely on dual carriageways than on single carriageways (NA).

Table 3 below shows the summary (%) of fatal and serious injury road crashes which obtained during observation. The number of lane and types of carriageway also highlight. A higher percentage of fatal and serious injury crashes occurred at each land use types by each road lane highlight by red.

Findings at single carriageway (Table 3) road found, 46.77% of fatal and serious injury crashes occur at 2 lane roadway during lane use operation hours. Out of this number, 17.47% occur at residential area followed by business and services areas 13.17% and industry areas 4.84%. This trend is similar to fatal and serious injury crashes occurring at single-lane roadway with 33.33% Out of this number, 15.05% occur at residential area followed by residential 8.06% and industry areas 4.84%. Around 1% occurs at 3 lane roadway.

The number of fatal and serious injury road crashes occurred out of land use operation hours show lower, whereby 9.68% occur at 2 lane roadway followed by 7.53% occur at the single lane. Crashes at 3 lane roadway remain lower for fatal and serious injuries which occur out of land use operation hour. 5.65% of crashes occurred out of operation hour at business and service area with 1, and 2 lane roadways and other land-use types contribute less than 5% of crashes.

Table 3 Percentage of fatal and serious injury road crashes by land use and number of lanes at single carriageway

Land use	Single carriageway					
	In operation hours (%)			Out of operation hours (%)		
No. of lane	1	2	3	1	2	3
Business and service	8.06	13.17	0.27	5.65	5.38	2.15
Residential	15.05	17.47	0.00	0.00	0.00	0.00
Transportation	0.00	1.08	0.00	0.00	0.27	0.00
Industry	4.84	4.84	0.27	0.27	1.61	0.00
Institution and public amenities	0.81	2.42	0.27	1.61	1.88	0.27
Agriculture	2.96	3.76	0.27	0.00	0.00	0.00
Wasteland	0.81	2.15	0.00	0.00	0.00	0.00
Forest	0.81	1.61	0.00	0.00	0.00	0.00
Open space and recreation	0.00	0.27	0.00	0.00	0.27	0.00
Infrastructure and utilities	0.00	0.00	0.00	0.00	0.27	0.00
Sub total	33.33	46.77	1.08	7.53	9.68	2.42

However, this trend is different for the number of fatal and serious injuries crashes at land-use types with dual carriageway (Table 4). Result remains that a higher number of crashes occurred at land use type with 2 lane roadway (55.06%) during operation hour. However, crashes at 3 lanes dual carriageway (35.23%) are higher than single carriageway during land-use operation hour. This trend is also similar for crashes occurred out of land use activities operating hours which crashes at land use with 2 lanes (6.96%) are higher than land use with 3 lanes (2.11%).

In terms of land-use types, the fatal and serious injury occurred during land-use activities operation hour is higher at transportation areas with 3 lane roadway (23.21%). Crashes at land use with 2 lanes also show higher. Business and service area show 16.24%,

residential 13.50% and transportation 11.39%. Most expressways in Malaysia were dual carriageway. It might be the reason for a higher contribution number of fatal and serious injury crashes occurred in the transportation area.

Business and service area remains as the higher contributor to the number of crashes that occurred out of all land use activities operation hours (5.70%).

Table 4 Percentage of fatal and serious injury road crashes by land use and number of lanes at the dual carriageway

Dual carriageway						
Land use	**In operation hours (%)**			**Out of operation hours (%)**		
No. of lane	**1**	**2**	**3**	**1**	**2**	**3**
Business and service	0.00	16.24	6.33	0.00	5.70	1.69
Residential	0.00	13.50	2.11	0.00	0.00	0.00
Transportation	0.00	11.39	23.21	0.00	0.00	0.00
Industry	0.00	7.59	1.90	0.00	0.42	0.00
Institution and public amenities	0.00	2.32	0.63	0.00	0.63	0.42
Agriculture	0.00	1.69	0.63	0.00	0.00	0.00
Wasteland	0.00	1.48	0.42	0.00	0.21	0.00
Forest	0.00	0.84	0.00	0.00	0.00	0.00
Open space and recreation	0.00	0.00	0.00	0.00	0.00	0.00
Infrastructure and utilities	0.00	0.00	0.00	0.00	0.00	0.00
Sub total	0.00	55.06	35.23	0.00	6.96	2.11

5. Conclusion

The main objectives of the study are to test the relationship between land use operational hours and time of fatal and serious injury road crashes. This study also identifies the effect of land use with regards to road characteristics such as the number of lane and types of carriageways.

An observation of a total of 846 locations of fatal and serious injury road crashes and its land-use types, operational hours, number of lane and types of carriageways were identified on-site and recorded using a particular form. The regrouping of these land-use types basing on JPBD land-use class found that there were 13 groups of land use compared to only 7 land-use groups provide by PDRM.

Different type of land use with a different type of road characteristic may contribute to differences in trends of fatal and serious injury road crashes. Observations found that over 50% of fatal and serious injury road crashes occur at 2 lane roadway and double carriageway.

Result also shows a high number of fatal and serious injury road crashes occurred at business and services areas (33%) followed by residential (23%) and transport (20%). Out of a total number of fatal and serious injury road crashes, 86.41% occur during land-use operation hours. Result also shows that 63.83% of fatal and serious road crashes occurred in land-use types which operate 24 hours per day (such as industrial and residential). Based on the result, it can conclude the longer active period of the land use, contribute the higher number of fatal and serious injury road crashes.

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Research Report

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Designed by: MIROS

MIROS
MALAYSIAN INSTITUTE OF ROAD SAFETY RESEARCH
ASEAN ROAD SAFETY CENTRE

Malaysian Institute of Road Safety Research
Lot 125-135, Jalan TKS 1, Taman Kajang Sentral
43000 Kajang, Selangor Darul Ehsan
Tel: +603 8924 9200 **Fax:** +603 8733 2005
Website: www.miros.gov.my **E-mail:** dg@miros.gov.my

ISBN 978-967-2078-89-0
9 789672 078890