CSID Journal of Sustainable City and Urban Development (2018) Vol. 1 Issue 1: 77-88
ISSN: 2614-8161

DATABASE OF TRAFFIC ACCIDENT FOR HANDLING BLACKSPOT AREA (STUDY CASE NATIONAL ROAD FROM THE BORDER OF PALEMBANG CITY UNTIL THE BORDER OF JAMBI PROVINCE)

Intan Permata Sari*, Joni Arliansyah, Erika Buchari

Master Program in Civil Engineering, Faculty of Engineering, Universitas Sriwijaya, Palembang

ABSTRACT

South Sumatera province has two main routes, which is called East line and central line. East line is the main line with many of heavy vehicles volume and the average daily traffic volume which much higher compared with central line. In South Sumatera Province, there is no systematic data of accident in online platform. Based on this matter, an online database system for accident-prone areas is designed to facilitate the search of accident location prone points, to analyses the causes of accident and how to make a location safer. Research started from problem identification and preliminary study by following as a secondary data collection. Which will be inputted in online database by using WordPress application. The expected output would be the accident rate data, number of victims, number of losses, type of accident, and location map of the incident. The highest crash site would be survey in order to determine the probability, the level of threat of accidents assessed based on the probability of the accident, and the impact of the severity of the victim can be reviewed in the location. So the risk of the accident can calculated. Having obtained the risk value of accident due to deficiency, it can be made a program of action reduction of accident. From the analysis result, it is know that the crash-prone point with the highest equivalent value are in Peninggalan – Sei Lilin (KM135) with AEK 61 and Betung – Batas Kota Palembang (KM 22) with AEK 40. The audit result road safely indicates that some part of the road facilities are in the hazard and or "very dangerous" categories, which must be fixed immediately: (1) pavement aspects, include damage of the road bodies and holes; (2) aspect of the road equipment, include speed light sign, uphill/descending road sign, and road marking.

Keywords: audit, street, accident, safety.

1. INTRODUCTION

The number of traffic accidents in South Sumatera province in 2017 reached 1,182 incidents with death number is 525 people, compared with 2015 the number is higher with 1,606 incidents (South Sumatra Regional Police, Directorate of Traffic Department). Traffic accidents caused by road factors road equipment such as signs, lighting and markers. Accidents occurring in roads, with nearby the location, will from an accident-prone location, which requires observation and research into the cause of the event.

In South Sumatera, there is still no systematic data of incident and accident area, which can be accessed online. Base on this, a database system of accident-prone areas is designed to facilitate the search for the locations of accident-prone points, to then analyze the causes of accidents and how to make the location safer (safer road). The

*Corresponding author: E-mail: intanps_cbn@yahoo.com

research on the handling of this accident-prone area analysis is structured to accommodate the needs of policyholders to create a more salvatory path.
In this research, the formulation of the problem starts from the compilation of the database of accident location on national road in South Sumatra province. To see accident-prone areas with high incidence and fatalities. From the database then analyses how and the handling type that can be given in the location of accident-prone points to reduce the number and the fatality rate of an accident. This study, among others, to:

1. Develop web-based crash database in South Sumatra province
2. Identify accident-prone areas in study area
3. Conduct audit in an effort to handle accident-prone areas

Handling the accident prones areas is one of the action to reduce the number of traffic accidents. Bina Marga as one of the agencies had launched the guideline for handling traffic accident-prone area (Pd T-09-2004-B). The methodology begin with identification of the prone area and then analyzed the accident characteristic.

Mulyono et al. (2009) had mention if the methodology of assessing the probability and the level of accidents treated can be calculated through the probability if accident occurrence due to deficiency, the risk of accident occurrence due to deficiency, and the value of the impact from the victim's severity in the reviewed location.

This method is devoted to the effect of road infrastructure deficiency on accidents (road factors). The measurement was conducted in three aspects of road infrastructure namely geometric, pavement, and traffic harmonization. From the analysis results obtained, risk level due to deficiency of these three aspects, which the level of handling priority adjusted with the risk categories. Types of handling adapted based on aspects/road conditions, which need an improvement.

To determining, the pathway with the highest number of accidents can be done by weighting in accordance with the level of accident fatality. Weighting is a value used to be calculated the accident index based on the invidual characteristic of the accident. The number of human causalities is divided into deaths, serious injuries, and minor injuries. Weight rating the fatalities of accidents can be seen in Table 1. The rate of accident fraction (AEK) is the rate for weighing the accident level. The measurement is connected with the fatalities of accident road and the ammount of accident moment which harm the physical facilities. Dep Kimpraswil had launched the formula for measuring the equvalent fraction, which can be seen in equation 1.

$$AEK = 12DV + 3(SI + LI) + K \quad (1)$$

Remarks :
AEK = Accident Equivalent value
DV = The total of the death victim (person)
SI = Total of serious injures (person)
LI = Total of light injures (person)
K = Total of the accident with losses of material

The higher of AEK value, the higher of the accident rate at a point and it is following the risk of the accident. The presence of danger due to non-fulfillment of road safety standards caused by roads referred to the road safety deficiency.

The basic principle of an audit is to compare the occurrence of the recorded field with an agreed technical standard. In relation to road infrastructure, the audit will focus

on how deviation of the infrastructure performance against its technical standards, which include:

1. Road geometric audit, such as visibility, bend radius, vehicle traffic width, road shoulder width, elevation difference between pavement edge and road shoulder
2. Performance audit of pavement damage, such as pothole areas, rutting, deformation and bleeding
3. Audit of harmonisation of road equipment facilities to road functions, such as speed limit signs and direction, markers, lights, signals, medians, and guard rails

Assesment of the need for a road safety audit is measured against the probability of accident occurrence, the value of the impact of the severity of the accident victim and the value of the risk and the level of importance of the handling. There are 3 (three) quantitative and qualitative analysis acitivities for road safety audit, as follow:

1. Analysis of the probability of accident occurences due to deficiency
2. Analysis of the value of the impact of the severity of the casulaty casualties at the site under study
3. Analyzing the risk value of accidents along with determining the importance of handling deficiency

Table 1. The Deficiency Opportunity of The Safety Road Infrastructure to Occurance The Road Driving Accident Based on The Field Measure Data

The Measurement of Dimensions and Layout of the Road Infrastructure Section	**Qualitative Value**	**Quantitative Value**
The measured different less then 10% from the technical standard	Accident, never happened	1
The measured different is in between 10% - 40% from the technical standard	Accident, happened until 5 times/ year	2
The measured different is in between 40% - 70% from the technical standard	The accident happened 5-10 times/ year	3
The measured different is in between 70% - 100% from the technical standard	The accident happened 10-15 times/ year	4
The measured different is more than 100% from the technical standard	The accident happened more than 15 times per year	5

Source: Mulyono et al., 2009

Table 2. Impact of Severity of The Victims From The Roadside Accidents by Level of Fatalities and Interests Handling

Impact of The Severity of The Victims of Traffic Accidents	Qualitative Value	Quantitative Value
The victim does not suffer any injuries except material loss	Very Light	1
The victim suffered minor injuries and material damage	Light	10
The victim suffered severe injuries and no potentially disabling limbs, as well as any or no material loss	Medium	40
The victim suffered serious injuries and potentially died in the treatment process at a hospital or a healer, as well as any or no material loss	Heavy	70
The victim dies at the scene of the accident, as well as any or no material loss	Very Heavy	100

Sumber : Mulyono, et al., (2008) and Mulyono et al., (2009a;2009b)

Mulyono et al. (2009a, 2009b) states that the risk value for each deficiency that has been found can indicate how urgent the handling response should be. The risk value for each deficiency is the multiplication of the probability value of a deficiency that may contribute to the potential incident of accidents as in Table 1 with the value of the consequences or impacts most likely to be received by the victim if an accident occurs as shown in Table 2. Risk values and categories along with the level of handling infrastructure safety deficiencies way to minimize the incidende of driving accidents, can be seen in Table 3.

Table 3. Risk Value and Categories Along With Level of The Handling Road Safety Deficiency Infrastructure

Risk Analysis		Level of importance of handling
Value of Risk	Risk Category	
<125	No Dangerous (ND)	Routine monitoring with scheduled road safety inspection at potential points of accident occurrence
125-250	Quite Dangerous (QD)	Requires unscheduled technical handling based on road safety inspection results at the scene and surrounding areas
250-375	Dangerous (D)	Technical handling required for a maximum of 2 months from the result of the road safety audit approved
>375	Very Dangerous (VD)	Requires total technical handling with relevant stakeholders up to 2 (two) weeks since the result of the road safety audit is approved

Source : Directorate General of Highway (2007a;2007b) and Mulyono et al., (2009a;2009b)

In making the accident database, the author uses open source application that is WordPress application. WordPress is built with the Personal Home Page (PHP)

programming language and MySQL database. PHP is a server-side script programming language designed for web development. WordPress app is commonly used as a blog application, but can also be used as a CMS because of its ability to be modified and tailored with the needs.

2. METHODOLOGY

Research starts from problem identification and preliminary study. Identification of Problem in accordance with the objectives of this research is to develop traffic accident database, identify accident-prone areas, and conduct road safety audits. Research starts from problem identification and preliminary study. Identification of problems in accordance with the objectives of this research is to develop traffic accident database, identify accident-prone areas, and conduct road safety audits.

Preliminary studies were obtained from several previous studies related to the handling of accident-prone location, road safety audits, and the creation of accident databases using geographic information systems. Secondary data comes from traffic directorate of South Sumatera province and National Road Implementation Center (Area 5) Ministry Of Public Works and People's Housing. Once obtained secondary data needed, then all the data is input in the database based online by using WordPress application.

From these database, the location of crash points will be generated based on the highest accident equivalent score values which will be further analyzed. The location of the accident with the highest vales is the surveyed directly to the field to get a figure of the accident location and accurate measurement related to geometric and road conditions. The results of the field measurements were analyzed to determine the probability and the level of threats of the accidents assessed based on the probability of accident occurrence and the impact of the severity of the victim in the reviewed location, so that the value of accident risk due to deficiency can be calculated. Having obtained the risk value of accidents due to deficiency, it can be made a program of action of accident deficiency reduction. More details of research methods can be seen in Figure 1.

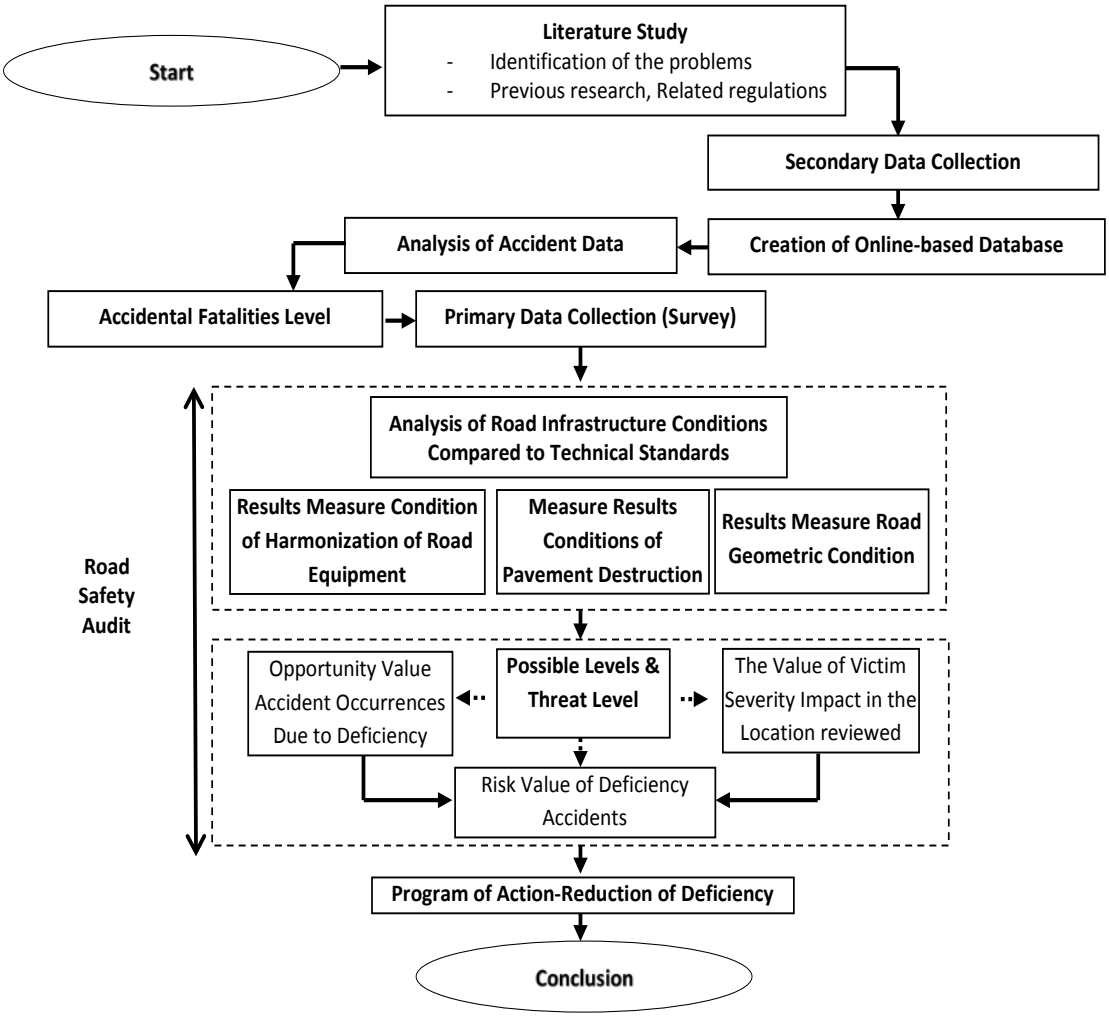


Figure 1. Research Methodology

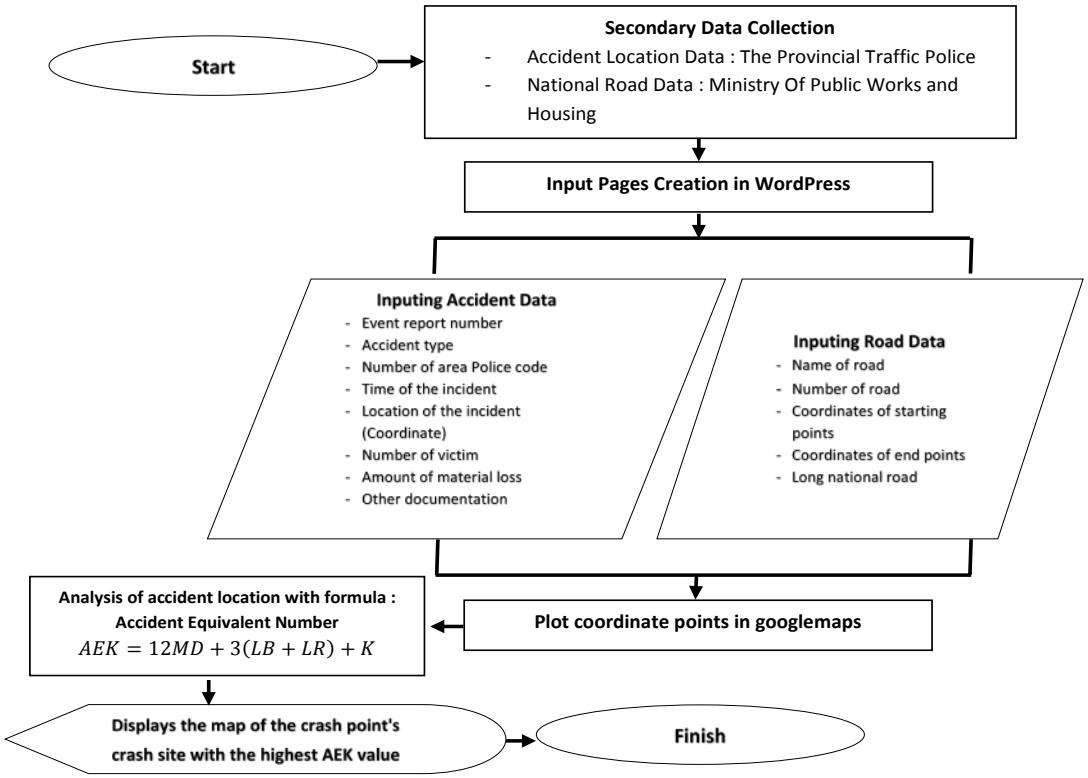


Figure 2. Roadmap of Database

In the database, input data in the form of coordinate points of accident-prone locations as well as the starting and ending points of roads are inputted in the googlemaps map. Database outputs are accident rate data, number of casualties, total loss, accident type, location map as shown in Figure 2.

3. RESULTS

The location of the activities in this study focused on four national roads in the eastern crossroad, as followed:

1. Bts. Prov. Jambi – Peninggalan (90,15 km), it is shown as a blue line in the figure 3
2. Peninggalan – Sei Lilin (33,94 km), it is shown as a red line in the figure 3
3. Sei Lilin – Betung (43,80 km), it is shown as a green line in the figure 3
4. Betung – Bts. Kota Palembang (56,16 km), it is shown as a purple line in the figure 3

Drafting the accident database using a WordPress application with address http://sigblackspot.com. There are two types of data that must be input as accident data consisting of accident report number, accident type, Police areas office number, time of incident, location of incident, number of casualties and losses, while for input of road data consist of name and number of road segment, initial and final coordinate points, and path length. The data is then plotted in a map based on google maps to facilitate users to see the distribution of the location of the accident. In the user map can click the point of accident location to get the information as shown in Figure 3.

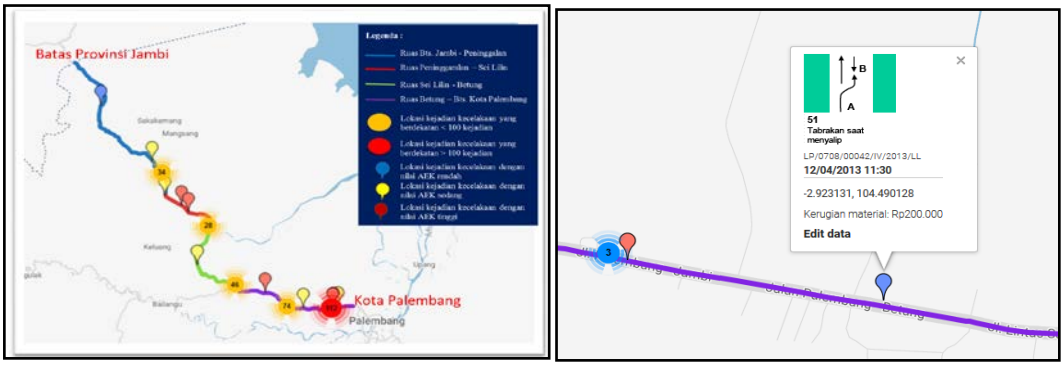
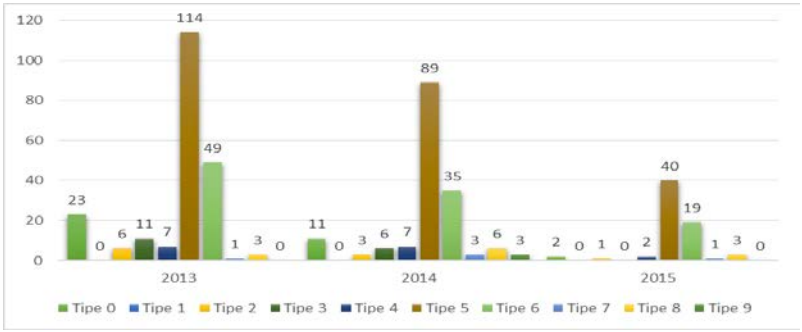


Figure 3. Research Location and Information from The Maps



Note: Type 0: pedestrian crossing without Zebra Crossing; Type 1: pedestrian crossing with Zebra Crossing; Type 2: singe, 1 vehicle; Type 3: single, with an object; Type 4: between vehicle, perpendicular to each other without turns; Type 5: between vehicles, opposite direction; Type 6: between vehicles, direction of turn movement; Type 7: between vehicles in the same direction with either or both turns; Type 8: between vehicles in the opposite direction with either one or the casting is turning; Type 9: between vehicles, collisions perpendicularly between vehicles with either or both turns.

Figure 4. The Accident Base on The Type of The Accident

The outputs of this application include table-shaped databases in PDF and excel formats that can be selected based on the needs. For example, the number of victims, the data based on the type accident as shown in Figure 4, the data based on the time of the accident, as well as data based on the overall accident point, as well as per road segment. From this database, we can analyses the characteristic of accidents based on the number of victims, the type of accident, and the time of the incident at the location of the study. In this application http://sigblackspot.com, it is created the crash site calculation program with the highest AEK value (eq.1), which is found that the location of the incident in KM 135 area (Peninggalan – Sei Lilin) with the highest AEK value.

Road Safety at Peninggalan - Sei Lilin National Street (KM 135)

The accident happened in Km 135, it was happened on 24th December 2015 at 03.00AM. The total of the Death Victim (DV) is 4 people, Serious Injuries (SI) about 3 people, and Light Injuries (LI) is 1 person. The equivalent value is 61. Type of accident that happened is type 51, collision between vehicles in the opposite direction, collision when overtaking. From the type of accident that occurred in this KM 135, which is a collision when the vehicle overtakes the vehicle in front of the front-front accident, there are 2 (two) geometric aspects of the role, such as visibility and stop viewing distance of view, while at 4 (four) other aspects have no effect on the incidence of this

accident. So for the victim's fatality assessment, only on the aspect of stopping visibility and visibility to prepare.

Figure 5. Peninggalan – Sei Lilin National Street (KM 135)

According to the Table 2, the value of the impact of severity of the accident victim on driving for the death number, the quantitative impact value 100. For the geometric aspect of stop visibility and viewing distance, due to the death there are four. The impact values is 100, while in the aspect the other is worth one (unless the bend radius is not counted) as in table 4. From the aspect of stopping visibility and viewing distance, the probability of safety deficiency equal to 2, the impact value of accident victim 100 because the victim died at the scene, then the risk value become 2 x 100 = 200.
According to table 3, the risk value among 125-250 is categorized as Harmful enough (CB) so that the level of priority handling required unscheduled technical handling according to road safety rules. As for the aspect of the width of the traffic lane, the road shoulder elevation, and the shoulder width of the road where the risk value generated by the value of the chance of deficiency multiplied by the impact value, the result of the risk value < 125, can be categorized as "not harmful". Those the results of the road infrastructure safety audit geometric aspect in the category of "fairly dangerous" as shown in Table 5. The probability of accident occurrence from the aspect of pavement damage condition can be seen in Table 6. There is a pothole along the research area of < 150 m^2/km exceeding the technical standard limit so that the deviation is 50%. According to table 1, for the difference in the field measurements between 40-70% against the standard, the probability values is three. In the rutting aspect based on the measurement encountered 75 m^2/km, still in the amount of technical safety is 100 m^2/km, standard deviation. Similarly, from the observation on the pavement, the deformation can be seen in the research location.

Table 4. Result of Measurement and Field Observation of Road Geometric Condition for The Safety Infrastructure Deficiency

Observation and Measurement			Technical Standard for the safety *	End Value after reduction	Deviation (%)	Proba-bility	Fatalities of the victim (person)**			Impact Values
	Aspect	Unit					DV	SI	LI	
a.	Viewing Distance to Stopped	Meter	75	65	13	2	4	3	1	100
b.	Viewing Distance to Through	Meter	350	300		2	4	3	1	100
c.	Radius of Curve	Meter	Min 115	No	-	-				-
d.	Wide Of Lane	Meter	3,5	3,5	1	1				1
e.	Different elevation from shoulder to the pavement edge	Cm	< 1	1 - 2	100	4				1
f.	Wide of Shoulder	Meter	1	1 - 2	100	4				1

* Sumber : Ditjen Bina Marga (2007a;2007b)
** Remarks : Death Victim (DV), Serious Injuries (SI), Light Injuries (LR)

Table 5. Audit Result to The Geometric Condition

No	Audited aspects	Probablity Value	Impact Value	Risk Values	Risk Category	The program for reducing the deficiency
a.	Viewing Distance to Stopped	2	100	200	QD	Requires unscheduled technical handling based on road safety inspection results at the scene and surrounding areas
b.	Viewing Distance to Through	2	100	200	QD	
c.	Radius of Curve	-	-	-	-	-
d.	Wide Of Lane	1	1	1	ND	
e.	Different elevation from shoulder to the pavement edge	4	1	4	ND	Scheduled inspection
f.	Wide of Shoulder	4	1	4	ND	

*) Remarks : ND = Not Dangerous; QD = Quite Dangerous; D = Dangerous; VD = Very Dangerous

From the type of accident when overtaking, rutting, deformation and bleeding aspects not affect the occurrence of accidents. In these three aspects of pavement the quantitative opportunity value is 1. The level of fatality of the victim on the pothole aspect has an impact value of 100 due to the detah toll in accordance with table 1. The pothole aspect according to table 3 falls into the “dangerous” category with a risk value is 3 x 100 = 300.

Table 6. Result of Measurement and Field Observation Pavement Damage to Road Safety Infrastructure Deficiency

Observation and Measurement				Technical Standard for the safety	End Value after reduction	Deviation (%)	Proba-bility	Fatalities of the victim (person)*			Impact Values
	Aspect	Unit						DV	SI	LI	
a.	Pothole >25cm, d>10cm	m2/km	<	100	<150	50	3	4	3	1	100
b.	Rutting	m2/km	<	100	75	-25	1				1
c.	Deformation d>15cm	m2/km	<	100	0	-100	1				1
d.	Bleeding	m2/km	<	200	0	-100	1				1

* Remarks : Death Victim (DV), Serious Injuries (SI), Light Injuries (LR)

Table 7. Result Audit on Deficiency of Pavement Condition of the Side Road

No	Audited aspects	Probablity Value	Impact Value	Risk Values	Risk Category	The program for reducing the deficiency
a.	Pothole >25cm, d>10cm	3	100	300	D	Need the scheduled technical handling, maximum 2 months from audit
b.	Rutting	1	1	1	ND	Scheduled inspection
c.	Deformation, d>15cm	1	1	1	ND	
d.	Bleeding	1	1	1	ND	

*) Remarks : ND = Not Dangerous; QD = Quite Dangerous; D = Dangerous; VD = Very Dangerous

Table 8. Result of The Measurement and Field Observation Condition of The Harmonization of The Road Equipment to Road Safety Deficiency of Infrastructure Road

Observation and Measurement			Technical Standard for the safety *	End Value after reduction	Deviation (%)	Proba-bility	Fatalities of the victim (person)**			Impact Values
	Aspect	Unit					DV	SI	LI	
a.	Speed sign									
	• Amount	Unit	2	0	100	4	4	3	1	100
	• Location	Spot	4	0	100	4				1
	• Condition	%	100	0	100	4				1
b.	Signs direction									
	• Amount	Unit	6	0	100	4	4	3	1	100
	• Location	Spot	6	0	100	4				1
	• Condition	%	100	0	100	4				1
c.	Street Sign									
	• Availability	Y/N	Yes	No	100	4	4	3	1	100
	• Condition	%	100	0	100	4				1
d.	Street lighting									
	• Availability	Y/N	Yes	Yes	0	1				1
	• Distance between lamps	Meter	60	60	0	1				1
	• Position againts the curb	Meter	4	4	0	1				1
e.	Signal light	Y/N	N	N	-					
f.	Median road	Y/N	N	N	-					
g.	Guardrail	Y/N	N	N	-					

Remarks: Deacth Victim (DV), Serious injuries (SI), Light Injuries (LI)

Table 9. Audit Result to The Condition of The Deficiency

No	Aspek yang diaudit	Nilai Peluang	Nilai Dampak	Nilai Resiko	Kat *) Resiko	Program aksi mengurangi defisiensi keselamatan
a.	Speed sign	4	100	400	VD	Install new signs of speed limits and new directions for directions as needed, max 2 weeks from the date the audit is approved
b.	Signs direction	4	100	400	VD	
c.	Street Sign	4	100	400	VD	Conducting road marks max 2 weeks from the date the audit is approved
d.	Street lighting	4	1	4	ND	Scheduled inspection
e.	Signal light	-	-	-	-	-
f.	Median road	-	-	-	-	-
g.	Guardrail	-	-	-	-	-

*) Remarks : ND = Not Dangerous; QD = Quite Dangerous; D = Dangerous; VD = Very Dangerous

The possibility of accident occurrence from the aspect of the condition from the harmonization of the road facility can be seen in Table 8. The speed limit signs, signpost and road markings contributed respective chances of 4 because thew was not found in the study sites so the standard deviation was 100%. From these three aspects,

the impact value of the victim is 100. Furthermore, the risk value from the three aspects is 4x100 = 400, so it is categorized as “very dangerous” as per table 3. The lights in KM 135 is still in the good condition. At the scene there were no signal, median, or guardrail lights. With regard to the area around KM 135 which does not have a sharp turn with traffic that still meets the criteria of the arterial road, these three aspects are not yet needed in the location, so the value of the opportunity and its impact value is not calculated.

4. CONCLUSION

The conclusion from this research as bellows;

1. Web-based crash database in South Sumatra province can be developed and used to obtain the accident characteristic.
2. Result identification of accident prone area obtain the accident location with highest equivalent number in Peninggalan-Sei Lilin road (KM 135) is 61.
3. Based on the result of safety road audit in Peninggalan-Sei Lilin road (KM 135), which is categorized as “very harmful“ is an aspect of pavement and harmonization aspect of road equipment. Therefore, it is necessary to improve road condition in the form of closure of the holes, installation of speed limit signs, vertical curve guide signs, and addition for the road marking to guide the driver.

REFERENCES

Adi, A. P., (2016), The Best Tools for WordPress, PT. Elex Media Komputindo, Jakarta.

Directorate General of Highway, (2007a), Preparation of Road Safety Management System and Guidance in Road Construction Activities, Department Of Public Works, Jakarta.

Directorate General of Highway, (2007b), Training Module for Road Safety Inspection (IKJ) in Road Safety Maintenance, Department Of Public Works,, Jakarta.

Department Of Public Works, (2005), Road Safety Audit Guidelines, Jakarta.

Mulyono, AT., Kushari B., Agustin J., (2008), Monitoring and Evaluating Infrastructure Safety Deficiencies Towards Integrated Road Safety Improvement in Indonesia, Proceeding Australian Road Safety Research, Policing and Education Conference, ISBN 1 876346 56 6.

Mulyono, AT., Berlian, K., Gunawan, H.E., (2009a), Road Safety Infrastructure Audit (Case Study of KM 78-KM79 National Road Java Pantura Line, Batang District), Jurnal Teknik Sipil, Vol. 16, ISSN 0853-2982, Yogyakarta.

Mulyono, A.T., Berlian, K., Gunawan, H.E., (2009b), Preparation of the Road Safety Deficiency Deficit Audit Model to Reduce the Potential of a Car Accident, Competitive Grant Report Research as per National Priority Batch II, LPPM UGM, Yogyakarta.

Noviarty, 2013, Analysis of Causes of Deficiency of Road Safety Infrastructure Case Study of National Road in Palembang City, Univercity Of Sriwijaya, Palembang.

Wedasana, Agus Surya, (2011), Analysis of Accident Prone Area and Preparation of Database Based on Geographic Information System Case Study of Denpasar City, Univercity Of Udayana, Denpasar.