



Analysis of Blackspot on National Roads in West Java Province

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KEYWORDS

Accident Equivalent Number, ArcGIS, Blackspot, National Road, Traffic Accident

ABSTRACT

Traffic accidents are a serious challenge for the transportation system in Indonesia, especially in West Java, due to high population density and high vehicle volume, which have a significant impact on road user safety. Identification of Blackspots is done based on the number of accidents and the severity of victims, so that it can be used as a basis for planning more effective transportation policies. This research analyzes the distribution of blackspots on the national roads of Java Province using a quantitative approach with secondary data from the West Java Police Traffic Directorate for the period 2022 - 2024. The accident data was identified in accordance with the Guidelines for Handling Traffic Accident Prone Locations (Pd T-09-2004-B), with 133 blackspots. Then it was analyzed using the Accident Equivalent Number (AEK) method to determine the weighting value of the accident location and determine the severity of the accident at each location. To calculate the accident rate limit, calculations are carried out using the Upper Control Limit (UCL) method. Locations with AEK values > UCL values amounted to 48 blackspots spread across national roads, West Java Province. The highest blackspot is on Cipularang Toll Road, located in Sukajaya, Sukatani Sub-district, Indonesia. The analysis identified the 10 highest blackspot locations, which were then presented in the form of a map showing the distribution of blackspots on national roads in West Java Province. Recommendations were also made for handling the highest blackspots according to the most common types of accidents. With this map, authorities can focus more on the most urgent mitigation measures.

ARTICLE HISTORY

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1. INTRODUCTION

Traffic accidents are a complex global issue with significant social impacts. WHO data from 2024 reveals that road accidents are currently the eighth leading cause of death worldwide, and are projected to become the seventh leading cause of death by 2030 [1].

Road safety, especially on the national road network, is a fundamental pillar for connectivity and economic distribution in Indonesia. [2]. However, despite various efforts, the high frequency and fatality rate of traffic accidents on these roads pose a serious challenge that requires serious attention. Data indicates that traffic accidents not only cause significant material losses but also have widespread social and economic impacts, including severe injuries and deaths, which collectively affect productivity and the quality of life for communities. Therefore, comprehensive identification and

analysis of blackspots (often referred to as blackspots or accident-prone areas) are essential for formulating effective and preventive mitigation strategies.

West Java Province, as one of the regions with the highest traffic density and complex movement dynamics, often records substantial traffic accident rates on its national road network. This phenomenon indicates the existence of specific patterns that need to be thoroughly understood in order to implement precise interventions. Previous studies have extensively discussed the identification of blackspots using various methods and variables; however, updated data and contextual analysis specific to the conditions of national roads in West Java remain a critical need.

Based on Law No. 22 of 2009 concerning road traffic and transportation, a traffic accident is an unexpected and unintentional event on the road involving a vehicle with or

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without other road users, resulting in human casualties and/or property damage [3]. In Indonesia, particularly in West Java, traffic accidents remain a serious concern. The frequent occurrence of accidents not only leads to significant financial losses but also claims lives and causes injuries. [4]

Given the importance of this issue, this study focuses on analyzing the distribution of blackspots on national roads in West Java Province. The primary objective is to identify and map critical points that require priority attention using a systematic approach that integrates valid accident data and criteria for blackspots based on guidelines issued by the Department of Settlement and Regional Infrastructure (Pd. T-09-2004-B), blackspots are defined as areas where incidents frequently occur, with recurring events within similar timeframes and areas, all caused by specific conditions. Therefore, the identification of blackspots involves determining locations (such as intersections, bridges, or road sections) that have experienced two or more traffic accidents within a one-year period. [5].

National roads are arterial roads and collector roads in the primary road network system, generally classified based on their function in connecting various regions. In general, national roads serve as connectors between provinces, major cities, and important economic centers. The focus is on connectivity and large-scale transportation efficiency. [6].

According to the 2023 West Java Province Transportation Statistics book, traffic accidents increased by an average of 6.10% annually over a five-year period (2019–2023). With the province having the highest population density, this is an issue that must be addressed immediately. [7].

This study focuses on blackspots on national roads, which are known as areas with traffic accident rates that continue to increase every year. To identify blackspots, the analysis applies the Accident Equivalent Number (AEK) and Upper Control Limit (UCL) methods. Furthermore [8], the distribution of these locations is visualized using the ArcGIS application. [9].

The methodology to be applied includes the identification and diagnosis of blackspot locations through the collection of accident reports over a three-year period (2022-2024) from the West Java Regional Police Traffic Directorate, followed by an analysis of accident patterns and their contributing factors. This study is expected to provide significant contributions to authorities in designing more targeted and data-driven road safety policies and programs, and serve as an important reference for road safety studies in other regions, ultimately reducing accident rates and enhancing the safety and comfort of road users in West Java Province.

2. RESEARCH METHODOLOGY

The following is a flowchart diagram of the research process conducted in this study is shown in Figure 1. The research location was a national road in West Java Province.

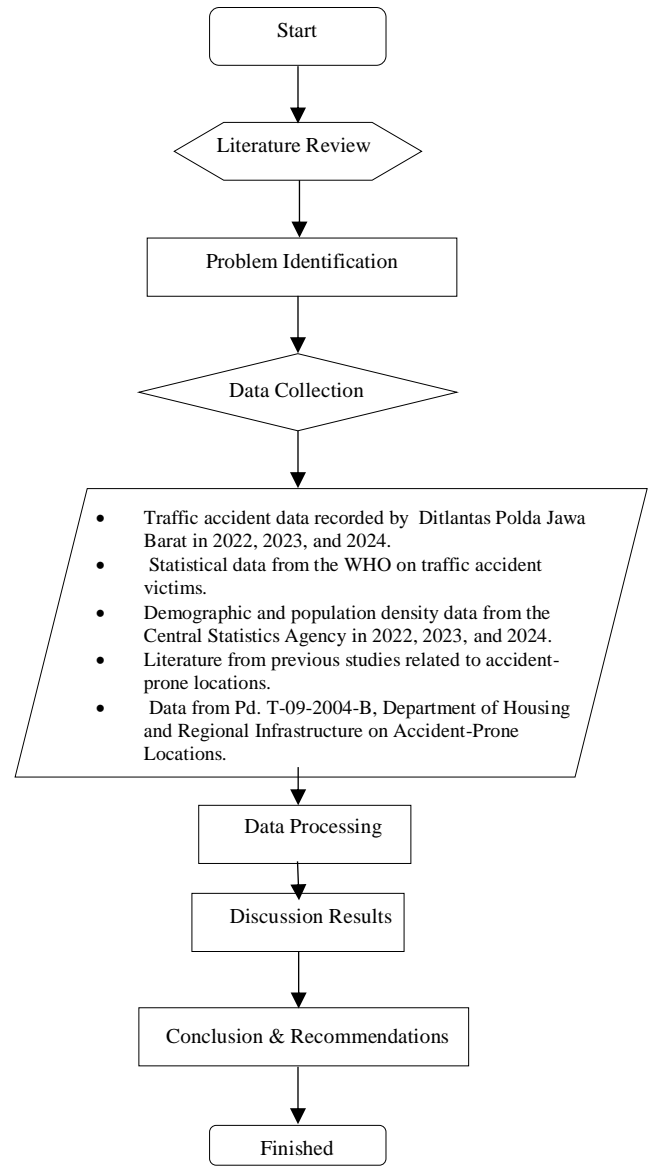


Fig.1. Research Flow Chart

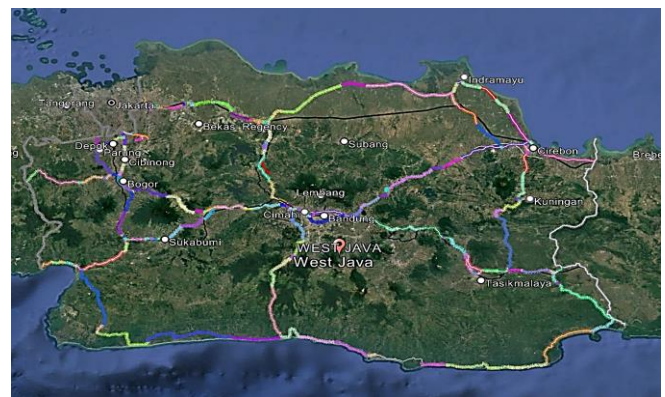


Fig. 2. Map of National Roads in West Java Province (Google Earth, 2025)

2.1 Data Collection Techniques

This study uses the Accident Equivalent Number (AEK) method and the Upper Control Limit (UCL) method, which then produces a map of the distribution of blackspots on national roads in West Java Province, using accident data for the 2022–2024 period from the West Java Regional Police Traffic Directorate, the data does not include weather condition data.

3. RESULT AND DISCUSSION

The screening of blackspot that experienced two or more traffic accidents within a three-year period resulted in a total of 354 incidents in 133 blackspots for the period 2022-2024. The details are as follows:

Table 1. Number of black spots and victims of traffic accidents on national roads in West Java Province 2022-2023 (Ditlantas Polda Jawa Barat)

Year	Blackspot	Number of Accidents
		Based on Pd T-09-2004-B, Screening ≥ 2 incidents
2022	61	154
2023	22	61
2024	50	139
Total	133	354

Based on the characteristics of accidents on national roads in West Java Province, with a total of 133 blackspots, the characteristics of accident victims can be identified, namely:

- MD = Death
- LB = Serious injury
- LR = Minor injury

3.1 Characteristics of Accident Victims

Table 2. Number of Traffic Accident Victims on National Roads in West Java Province 2022-2024 Based on Characteristics (Ditlantas Polda Jawa Barat)

Year	Victim (Person)		
	MD	LB	LR
2022	69	13	394
2023	27	0	123
2024	57	1	288
Total	153	14	805

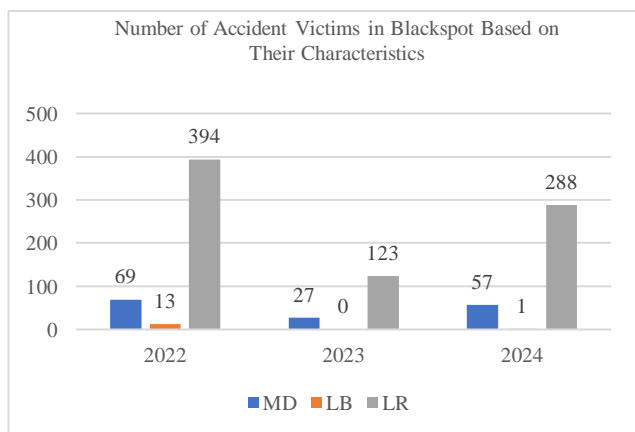


Fig. 3. Diagram of the number of traffic accident victims at blackspot on national roads in West Java Province 2022-2024 based on characteristics (Polda Jawa Barat).

3.2 Analysis Using the Accident Equivalent Method

Then, weighting calculations were performed using the accident equivalent number method with weighting values in the Blackspot Determination and Assessment Guidelines book established by the Traffic Corps. The weighting values for traffic accidents vary based on the severity of the victims [10], namely:

- a. Accidents that result in the death of the victim are weighted at 10.
- b. Accidents in which the victim suffers serious injuries are weighted at 5, and
- c. Accidents in which the victim suffers minor injuries are weighted at 1.

The following is the calculation of the accident equivalent number:

1. Data Processing of Accident Equivalent Numbers each Location

Calculations are performed for each location to determine the severity of each blackspot by weighting the accident equivalent number (AEK). Here is an example of the calculation:

- a. In 2022, the Purwakarta Police Department recorded 7 traffic accidents on the Cipularang Toll Road, from KM 97B to KM 88A, located in Sukajaya, Sukatani District, Purwakarta Regency, West Java 41167, Indonesia. As an example of the calculation for one of these incidents: The incident occurred on January 6, 2022, resulting in 1 fatality, 0 seriously injured, and 10 slightly injured. The AEK weighting value for this incident is 20. The AEK weighting at this location reached 85, derived from the accumulation of seven traffic accidents.
2. Calculating the Equivalent Number of Accidents per Year Here is an example of AEK calculation per year:
 - a. In 2022, there were 69 fatalities, 13 people suffered serious injuries, and 394 people suffered minor injuries. Therefore, the AEK weighting value obtained is 1149.

The results are as follows:

Table 3. Accident Rates or AEK Per Year on National Roads in West Java Province.

Year	Victim (Person)			Accident Equivalent Number (AEK)	Blackspot
	10	5	1	$AEK = 10MD + 5LB + 1LR$	
2022	69	13	394	1149	61
2023	27	0	123	393	22
2024	57	1	288	863	50
Total	153	14	805	2405	133

3.3 Analysis Using the Upper Control Limit Method (UCL)

After calculating the weighting of accident locations, calculations were then performed using the Upper Control Limit (UCL) method to identify or determine the priority of handling blackspots. The calculation of the AEK accident rate uses data from the 2022, 2023, and 2024 periods.

The calculation used are as follows:

$$UCL = \lambda + \psi \times \sqrt{\left(\left(\frac{\lambda}{m} \right) + \left(\frac{0,829}{m} \right) + \left(\frac{1/2}{m} \right) \right)} \tag{1}$$

By first determining the average AEK accident rate (λ).

$$\lambda = \frac{\text{Total AEK All Segments}}{\text{Total Number of Segments Reviewed}} \quad (2)$$

The average AEK accident rate over 3 years is 18 and the probability value is 2.576 [11]. To obtain the UCL value, one example is as follows:

- a. In 2022, the number of AEK accidents or the m value is 1149, for an average value (λ) of 18. So, the control limit value obtained with the UCL method in 2022 for all segments is 18 accidents.

b. **Table 4.** UCL Figures Each Year on National Roads in West Java Province

Year	Accident Equivalent Number (AEK)	UCL
2022	1149	18
2023	393	19
2024	863	18

Based on the ranking conducted on 133 Blackspot, 48 Blackspot were found to have accident analysis values above the UCL value. This number was selected using typical locations [12]. There were 155 traffic accidents, consisting of 109 fatalities, 11 serious injuries, and 368 minor injuries. To focus the analysis and visualization through a distribution map of Blackspot on national roads in West Java Province in the most critical areas, the top 10 Blackspot with the highest values will be selected from the total of 48 identified Blackspot. The selection of the top Blackspot is based on the accident analysis value (AEK) exceeding the highest UCL value [13]. The 10 Blackspot are as follows:

Table 5. Ranking Results of 10 Blackspot in the Most Critical Areas on National Roads in West Java Province

Rangking	District Police	Street Name	AEK Weighting Amount
1.	Purwakarta	Cipularang Toll Road Km 97B – Km 88A, Sukajaya, Sukatani District, Purwakarta Regency, West Java 41167, Indonesia.	85
2.	Subang	Cikopo - Palimanan Toll Road, Marengmang, Kalijati District, Subang Regency, West Java 41271, Indonesia.	80
3.	Indramayu	Cikopo - Palimanan Toll Road, Cikawung, Terisi District, Indramayu Regency, West Java 45262, Indonesia.	61
4.	Indramayu	Cikopo - Palimanan Toll Road, Mekarjaya, Kertajati District, Majalengka Regency, West Java 45457, Indonesia.	48
5.	Indramayu	Jatibarang Village Public Road.	46
6.	Subang	Cikopo - Palimanan Toll Road, Cipeundeuy District, Subang Regency, West Java 41272, Indonesia.	43
7.	Indramayu	Cipali Toll Road.	42

8.	Indramayu	General Road of Larangan Village.	39
9.	Purwakarta	Purbaleunyi Toll Road, Cibodas, Sukatani District, Purwakarta Regency, West Java 41167, Indonesia.	38
10.	Indramayu	Pamayahan Village Public Road.	38

3.4 Characteristics of the Most Common Types of Blackspot Accidents

Based on the results obtained, the highest Blackspot on the national road in West Java Province can be addressed through accident prevention measures based on the type of accident on the Cipularang Toll Road, from KM 97B to KM 88A, located in Sukajaya, Sukatani District, Purwakarta Regency, West Java 41167, Indonesia. The following are the characteristics of the highest LRK accident type:

Table 6. Characteristics of the Most Common Types of Blackspot Accidents

Number of Accident Victim	Highest Type of Accident at Blackspot
25	rear-end collision
2	Vehicle Out of Control Veers Off Road to the Right

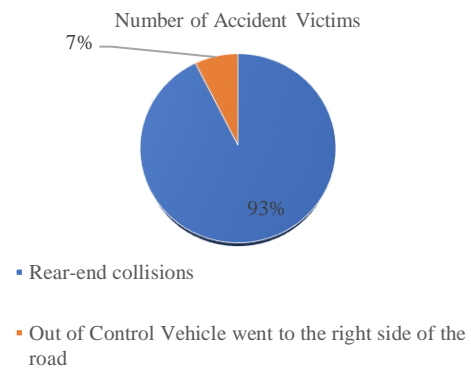


Fig. 4. Percentage of Characteristics of Accident Types with the Highest Blackspot

3.5 Map of Blackspot

Based on the results of the Accident Equivalent Number (AEK) and Upper Control Limit (UCL) calculations, 10 Blackspots were identified on the national road network in West Java Province. To facilitate visualization and analysis, these findings are presented in the form of a map showing the distribution of Blackspot on national roads in West Java Province as in Figure 5.

3.6 Accident Level Handling Recommendations

The recommendations focus on the highest ranking and are based on the type of collision, in accordance with the analysis of Blackspot [14]. The highest number of accidents on national roads in West Java Province, specifically on the Cipularang Toll Road from KM 97B to KM 88A, located in Sukajaya, Sukatani District, Purwakarta Regency, West Java 41167, Indonesia, is dominated by rear-end collisions. Table 8 shows the recommendations for handling accident rates.

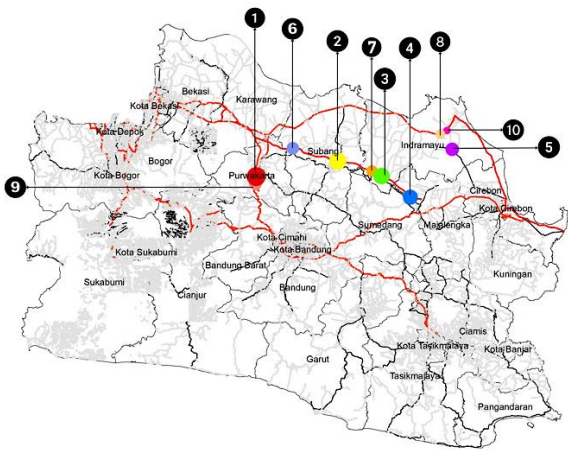


Fig. 5. Ranking of Distribution Map of 10 Accident-Prone Locations on National Roads in West Java Province

Table 8. Recommendations for Handling Accident Rates

Location	Jl. Tol Cipularang KM 97B – KM 88A, Sukajaya, Kec. Sukatani, Kabupaten Purwakarta, Jawa Barat 41167, Indonesia
Accident Type	Dominated by rear-end collisions
Recommendations	<ol style="list-style-type: none"> 1. Front-Rear Collision, quoted from Module 3 of the 2016 PUPR Traffic Accident Data [15], the recommendations for handling are: <ol style="list-style-type: none"> a. Installing road signs and markings continuously according to the needs at the location. b. Installing special chevron signs to provide directions on bends. c. Widening the intersection to provide a special lane for right turns. d. Repairing road construction to eliminate potholes and restore the normal slope of the collapsed road. 2. Based on Hanafi’s research (2019) [16], regarding the analysis of the safety level of the Cipularang Toll Road, optimization of traffic markings and signs is highly recommended. Proposed improvements include the installation of larger, clearer, and repeated "Keep a Safe Distance" and "Reduce Speed" warning signs along the slope. In addition, the addition of road markings such as rumble strips (rumble strips or shock markings) is proposed to provide warnings in the form of vibrations and sounds to drivers. It is also important to optimize traffic signs and warning message signs through repainting and regular inspections to ensure that nothing is obstructed. 3. Punishment Imposing penalties on traffic violators to enforce driving order is one effective way to promote driving safety. This can also be done by setting up surveillance posts by the police or using traffic CCTV. 4. Education Road safety education can be optimized through digital media, utilizing platforms for information dissemination. Navigation applications and websites allow for the delivery of real-time warnings and geographic data of blackspots. Meanwhile, social media facilitates awareness campaigns that reach diverse demographics through engaging visual and narrative content. Integration of research data on road geometric profiles and the dominance of specific accident types, such as rear-end collisions, can be articulated into infographics, simulation videos, or tutorials. These materials can explain the

importance of speed management, safe distances, braking system maintenance, and the use of engine brakes on road segments with steep slopes.

4. CONCLUSION

This study analyzes the distribution of blackspots on national roads in West Java Province using a quantitative approach with secondary data from the West Java Regional Police Traffic Directorate for the period 2022-2024. The accident data was identified based on the Guidelines for Handling Traffic blackspots (Pd T-09-2004-B), with 133 blackspots. Which was then analyzed using the Accident Equivalent Number (AEK) method to determine the weighting value per location of the accident incident and determine the severity of the accident at each location. To calculate the accident number limit, calculations were carried out using the Upper Control Limit (UCL) method. Locations with AEK values > UCL values totaled 48 blackspots spread across national roads in West Java Province, with 10 of the highest blackspots. Then it produces a map of the distribution of blackspots on national roads in West Java Province. With this map, authorities can focus more on the most urgent mitigation measures.

This study maps the distribution of blackspots on national roads in West Java Province using the ArcGIS application. The distribution map shows the spatial distribution of blackspots, which can be used as a basis for planning and decision-making related to improving traffic safety in West Java.

The recommendations for handling from this study are based on the type of accident, optimization of improving traffic markings and signs, education and law enforcement against traffic violations.

REFERENCES

- [1] WHO, "World Health Organization," url: <https://www.who.int/data/gho/data/themes/topics/topic-details/GHO/road-traffic-mortality>
- [2] W. K. N. N. H. D. S. S. Gagah Hikmah Pradana, "Identifikasi Black Spot Pada Ruas Jalan Nasional Di Jember," Paduraksa, Vol. 9, No. 1, Pp. 51-60, 2020, doi: <https://doi.org/10.22225/pd.9.1.1558.51-60>
- [3] D. RI, Undang - Undang Tentang Lalu Lintas Dan Angkutan Jalan - UU RI No. 22 Tahun 2009, Indonesia: DPR RI & Presiden RI, 009. url: <https://peraturan.bpk.go.id/details/38654/uu-no-22-tahun-2009>
- [4] S. Novriani, "Blackspot Identification Using Aek And Bka Methods On National Road In Java Island," International Journal Of Civil Engineering And Infrastructure, Vol. 1, No. 2, Pp. 17-23, 2021, doi: <https://doi.org/10.24853/ijcei.1.2.17-23>
- [5] D. P. D. P. Wilayah, Pd T-09-2004-B, Penanganan Lokasi Rawan Kecelakaan Lalu Lintas, Jawa Barat: Direktorat Jendral Bina Marga Kementerian Pekerjaan Umum, 2021, url: <https://binamarga.pu.go.id/index.php/nspk/detail/pedoman-penanganan-lokasi-rawan-kecelakaan-lalu-lintas>
- [6] B. P. D. P. H. P. K. N. B. P. Keuangan, Peraturan Pemerintah (PP) Nomor 34 Tahun 2006 Tentang Jalan, Indonesia: Pemerintahan Pusat Indonesia, 2006, url: <https://peraturan.bpk.go.id/details/49132/pp-no-34-tahun-2006>
- [7] B. P. J. B. B. -. S. O. J. B. Province, Statistik Transportasi Provinsi Jawa Barat 2023, Jawa Barat: BPS Provinsi Jawa Barat/ BPS - Statistics of Jawa Barat Province, 2024, url: <https://jabar.bps.go.id/id/publication/2024/12/31/af0e8eed2221174d38119041/statistik-transportasi-provinsi-jawa-barat-2023.html>
- [8] I. E. R. Siti Aziza Kurnia, "Analisis Kecelakaan Dan Alternatif Penanggulangannya Pada Jalan Rta Milono Dengan Metode Aek Dan Ucl," Jurnal Teknika, Vol. 6, No. 49-55, P. 1, 2022, doi: <https://doi.org/10.52868/jt.v6i1.7742>

- [9] N. H. R. M. E. H. G. Laode Muhamad Irsan, "Pemetaan Lokasi Rawan Kecelakaan Lalu Lintas Menggunakan Sistem Informasi Geografis," *Journal of Geographical Sciences And Education* , Vol. 2, No. 2, Pp. 73-81, 2024, doi: <https://doi.org/10.69606/geography.v2i2.113>
- [10] K. L. L. Polri, *Pedoman Penentuan Dan Pengkajian Black Spot, Indonesia: Korps Lalu Lintas Polri*, 2016, url: <https://www.scribd.com/document/436432881/buku-blackspot>
- [11] R. Chandra, *Analisis Kecelakaan Lalu Lintas Di Jalan Raya Kota Padangsidimpuan Sumatera Utara, Sumatra Utara: Universitas Muhammadiyah Sumatera Utara* , 2024, url: <http://repository.umsu.ac.id/xmli/bitstream/handle/123456789/25725/skripsi%20rifqi%20chandra.pdf?sequence=1&isallowed=y>
- [12] B. H. Susilo And L. W. Cahyadi, "Prioritas Penanganan Lokasi Rawan Kecelakaan (Lrk) Di Provinsi Sumatera Utara," *Teknik Sipil*, Vol. Xiv, No. 1, Pp. 1-104, 2018, doi: <https://doi.org/10.28932/jts.v14i1.1446>
- [13] A. F. Gito Sugiyanto, " Identifikasi Lokasi Rawan Kecelakaan Lalu Lintas (Black Spot) Di Kabupaten Purbalingga," *Jurnal Teknik Sipil & Perencanaan*, Vol. 2, No. 19, Pp. 128-135, 2017, doi: <http://dx.doi.org/10.15294/jtsp.v19i2.10768>
- [14] D. J. P. Darat, *Pedoman Operasi Accident Blackspot Investigation Unit / Unit Penelitian Kecelakaan Lalu Lintas (Abiu/Upk)*, Jakarta: Direktorat Keselamatan Transportasi Darat, 2007, url: <https://www.scribd.com/document/54404672/2007-pedoman-operasi-investigasi-blackspot-hubdat>
- [15] D. J. Berkeselamatan, *Modul 3 : Data Kecelakaan Lalu Lintas 2016, Indonesia: Kementrian Pekerjaan Umum Dan Perumahan Rakyat*, 2016, url: https://simantu.pu.go.id/epel/edok/38073_3data_kecelakaan_lalu_lintas__ra_.pdf
- [16] F. R. R. P. D. M. R. H. Hanafi, *Analisis Tingkat Keselamatan Jalan Tol Berdasarkan Metode Pembobotan Korlantas (Studi Kasus: Jalan Tol Cipularang)*, Cimahi, 2019, doi: <https://doi.org/10.26874/jt.vol18no2.106>