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Analysis of Road Damage Levels Using the Surface Distress Index Method and Handling Cracked Roads

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ABSTRACT

Analysis of the Level of Road Damage Using the Surface Distress Index Method and Evaluation and Handling of Cracked Roads (Case Study: Jalan Ciherang Cutak-Jalan Suka Mulya, Ciomas District, Bogor Regency. The existence of roads is very necessary to support the rate of agricultural and other economic growth, considering the important benefits So the road construction and maintenance sector is a priority for research and development in planning, implementation and maintenance. The road sections experienced damage which includes several factors such as road sections that are frequently used, poor drainage channels. The aim of this research is to determine the type of damage, evaluate and handle damage to road sections, as well as obtain damage values on Jalan Ciherang Cutak-Jalan Suka Mulya, Ciomas District, Bogor Regency based on the parameters of the Surface Distress Index (SDI) method. The length of the road used in this research is ± 1000m which is divided into 10 segments with The length of each road is ± 100m. In this research the author used the Surface Distress Index (SDI) method and used data on damage dimensions including length, width and depth of damage. Based on the results obtained, there are 4 types of damage found on the Jalan Ciherang Cutak-Jalan Suka Mulya section, Ciomas District, Bogor Regency, namely: pavement edge defects, potholes, alligator cracks, longitudinal cracks and the results of the percentage of SDI values in the average damage. The average is 34, which states that the Jalan Ciherang Cutak-Jalan Suka Mulya section, Ciomas District, Bogor Regency is in good condition, and there is an evaluation and handling of SDI values on the Ciherang Cutak-Jalan Suka Mulya road, the road is in segments 1-4,8-10 with good condition. while 5 and 7 are in moderate condition, but in segment 7 there is a high damage area value, namely 12.2%, so that widespread cracks do not occur, routine and periodic maintenance is needed along the Ciherang Cutak Suka Mulya road so that the damage does not spread.

Keywords: road damage; SDI value; evaluation; handling.

INTRODUCTION

The rapid development of the Bogor Regency area has had an impact on increasing the flow of traffic, people and goods. An increase in traffic flow that is not balanced with an increase in infrastructure will result in congestion, accidents, noise, and a high risk of stress due to inappropriate traffic infrastructure. The existence of highways is very necessary to support the rate of agricultural and other economic growth, considering that the benefits are so important, the road construction and maintenance sector is a priority for research and development in planning, implementation and maintenance. Roads are land transportation infrastructure that is very important in facilitating economic relations activities. Good road conditions will facilitate population mobility in carrying out economic relations and other social activities.

Frequent use of roads can result in road damage to the road pavement layer, so an analysis is needed to determine the type and level of damage to roads in areas with poor drainage and high levels of rain intensity that cause road conditions to become damaged, such as which occurred on the Jalan Ciherang Cutak - Jalan Suka Mulya road, Ciomas District, Bogor Regency. Jalan Ciherang Cutak - Jalan Suka Mulya, Ciomas District, Bogor Regency is a road that connects several sectors, such as the education and tourism sectors.

The aim of this research is: To determine the types of damage that occur on flexible road sections on Jalan Ciherang Cutak - Jalan Suka Mulya, Ciomas District, Bogor Regency, to determine the value of the damage conditions of flexible road pavement on Jalan Ciherang Cutak - Jalan Suka Mulya, Ciomas District. Bogor Regency using the Surface Distress Index (SDI) method. As well as to evaluate and handle flexible road cracks on Jalan Ciherang Cutak-Jalan Suka Mulya, Ciomas District, Bogor Regency.

According to Bina Marga (2011), the surface distress index (SDI) method is a visual check of data on the total area of cracks, average width of cracks, number of holes and depth of vehicle ruts. The value obtained in the examination will then be calculated using the assessment standard. The following calculations use the SDI method.

Determining SDI Value 1 (Crack Area)

SDI 1 Crack Area calculations are carried out at every 100 m interval, so the distance interval is the percentage of the total area of cracks that occur in the pavement layer obtained from field surveys. The total value of the crack area can be seen in equation 1.

$$\%\ crack\ area = \frac{A}{100\ x\ b} \quad \ldots\ldots 1$$

A = total crack area (m2)
b = The width of the road (m)

with:

After getting the crack percentage, then enter the weight as in table 8, below is the SDI 1 calculation

There isn't any

Crack Area <10%, then SDI 1 = 5

Crack area 10-20%, then SDI 1 = 20

Crack area >30%, then SDI 1= 40

Determine the SDI Value (Crack Width)

After obtaining the SDI 1 value, the next step is to find the SDI 2 value by determining the total weight of the crack width as listed in table 7. Then the SDI 1 value is entered into the calculation as listed below, namely:

There isn't any

Crack width <1 mm (fine), then SDI 2 = SDI 1

Crack width 1-5 mm (medium), then SDI 2 = SDI 1

Crack width >5 mm (width). Then SDI 2 = SDI 1 x 2

Determine the SDI 3 value (Number of Holes)

After getting an SDI value of 2 (Crack Width), then SDI 2 is included in the SDI 3 (Number of Holes) calculation. The following is the SDI 3 calculation based on the weights as listed in table 9, namely as follows:

There isn't any

Number of Holes <10/100 m, then SDI 3 = SDI 2 + 15

Number of Holes 10 – 50/100 m, then SDI 3 = SDI 2 + 75

Number of Holes >50/100 m, then SDI 3 = SDI 2 +225

Determine SDI 4 (Wheel Depth)

After getting the SDI value weight 4 as in table 11, then enter the SDI value 3 into the following calculation:

There isn't any

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Wheel Mark Depth <1 cm (X=0.5), then SDI 4 = SDI 3 + 5 x

Wheel rut depth <1-3 cm (X = 2), then SDI 4 = SDI 3 +5 x

Wheel rut depth >3cm (X= 5), then SDI 4 = SDI 3 +20 x

Road comfort is a crucial aspect in ensuring safe and efficient travel for motorized vehicles. Road surface quality is one of the main factors influencing comfort. A smooth road without potholes, cracks, or rough patches is essential. A smooth road surface not only provides a more comfortable driving experience but also reduces wear and tear on the vehicle. In addition, the road surface must have good grip, especially in wet conditions, to avoid the vehicle slipping. An effective drainage system is also needed to prevent water from pooling on the road surface, which can reduce tire grip and increase the risk of accidents (Syaiful S et.al, 2024; Syaiful S et.al, 2024; Syaiful S et.al, 2024).

The geometric design of the road plays an important role in driving comfort. A road that is wide enough allows two vehicles to pass each other safely, while a standard road slope prevents accidents, especially on curves and inclines. Corners with a large enough radius help avoid overly sharp maneuvers, which can be dangerous for the driver. Apart from that, the existence of supporting facilities such as street lighting is very important. Sufficient street lights ensure good visibility at night, reducing the risk of accidents. Clear and easily visible road signs and markings also provide necessary guidance and warnings to motorists, helping them make the right decisions during their journey (Syaiful Set.al, 2022; Syaiful S, Rusfana H, 2022; Syaiful S, Hariyadi D, 2019; Syaiful S et.al, 2020).

Routine road maintenance is very important to ensure road conditions remain optimal. Regular inspections and repairs on road damage need to be carried out as soon as they are detected. This includes cleaning the road from debris, rubbish and other materials that could interfere with driving comfort. Apart from that, road safety aspects must also be considered. Road barriers and guardrails are needed in dangerous locations such as sharp bends and ravines to prevent vehicles from leaving the road. Roadside safety zones are also needed for emergencies, such as temporary parking or stops, which provide enough space for motorists to resolve problems without disrupting traffic (SyaifulS et.al, 2020; Syaiful S et.al, 2021; Syaiful S Fadly A, 2020; Syaiful S, Andana R, 2021; Syaiful S et.al, 2021; Syaiful S, Irbah AF, 2021).

By taking all these factors into account, road comfort and safety can be significantly improved, providing a better driving experience for all road users. The combination of physical quality of roads, good design, supporting facilities, controlled traffic conditions, routine maintenance, as well as technology and innovation, all contribute to the creation of roads that are comfortable and suitable for motorized vehicles to pass on (Syaiful S et.al, 2022; Syaiful S et.al, 2021; Syaiful S et.al, 2022; Syaiful S et.al, 2022).

Technology and innovation in road management can significantly increase comfort. The use of traffic information systems such as electronic information boards provides real-time traffic information to motorists, helping them take the best route. Sensors and cameras installed on roads can monitor road and traffic conditions, and help with faster and more effective management and repairs (Syaiful S et.al, 2023; Mudjanarko SW et.al, 2023; Syaiful S et.al, 2023; Pratama FA et.al, 2023).

The environment and conditions around the road also affect driving comfort. Vegetation management around roads needs to be done to prevent roots from damaging the road surface and to avoid obstructed views. Providing comfortable and safe rest facilities for drivers traveling long distances is also very helpful. This facility allows drivers to rest, reduces fatigue and improves road safety (Syaiful S et.al, 2023; Syaiful S et.al, 2023; Syaiful S, Suherman S, 2024).

RESEARCH METHODS

This research uses the Surface Distress Index (SDI) method. This method is a visual assessment of road conditions through a location survey of road conditions which produces SDI values. The factors that determine the SDI value are the condition of cracks on the road surface with average crack width, total area, number of holes per 100 m as well as depth of ruts/ruttng. The stages in this research are divided into 4 stages, namely literature review, data collection, data analysis and conclusions and suggestions. The following is an explanation of the stages and flow diagram in researching the level of damage to Jalan Ciherang Cutak - Jalan Suka Mulya, Ciomas District, Bogor Regency:

The literature review stage is the collection of sources of information related to the research topic to help facilitate research. In the form of journals, scientific articles, and other sources.

1. The data collection stage is the collection of primary data and secondary data in order to obtain the information needed to achieve the research objectives.
2. The data analysis stage is the stage in obtaining research results after conducting a survey of road damage conditions, in the form of types of road surface damage and values of road pavement conditions.
3. The conclusion and suggestion stage is obtaining a conclusion from the results of data analysis with road condition values in accordance with the Surface Distress Index (SDI) method. Along with suggestions that can be submitted for road maintenance.

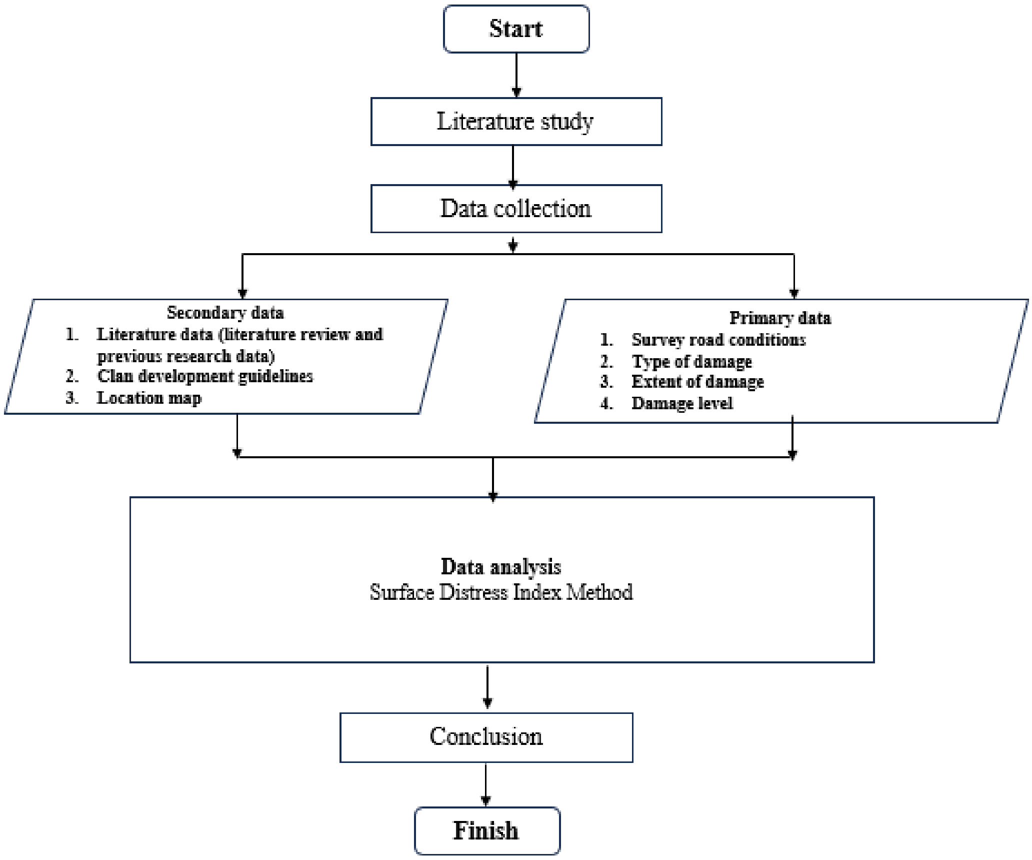

Figure 1. Research Flow

This research is located on Jalan Ciherang Cutak-Jalan Suka Mulya, Ciomas District, Bogor Regency, 1km long, and this road was determined by a letter from the Regent of Bogor Regency with the Dramaga-Ciherang road section with section number 22.01.212 and the length of the road is 3.052km which has a function. Local Primary 1 (LP1). The time for carrying out this research begins in April 2023. The following is a picture of the data collection location.

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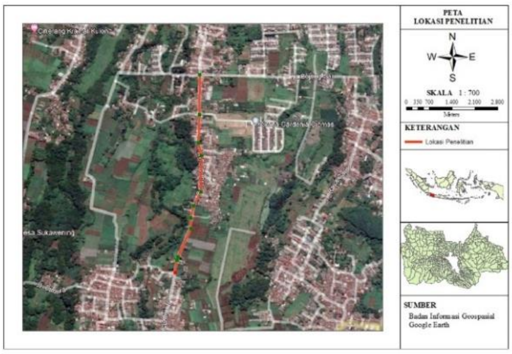

Figure 2. Location of data collection

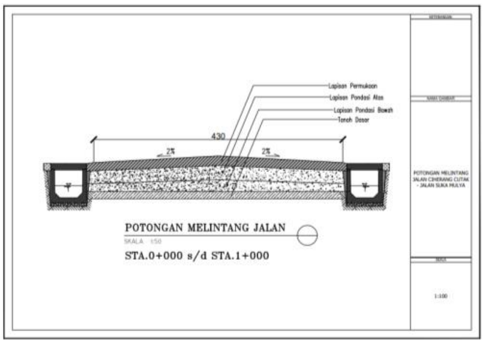

Figure 3. Cross section

RESULTS AND DISCUSSION

Identify the type of road damage

To determine the damage value of Jalan Ciherang Cutak - Jalan Suka Mulya, Ciomas District, Bogor Regency, which is 1km long, this can be done by identifying the condition of the flexible pavement and measuring the damage to the pavement. The following are the types of damage, namely in table 1below.

Table 1. Types of Damage

Location Per STA	Type of Road Damage
0+000 - 0+100	Pavement Edge Defects
0+300 - 0+400	Hole
0+500 - 0+600	Crocodile Crack
0+600 - 0+700	Longitudinal Crack

Based on the description in the table above, the existing types of road pavement damage are one way to make it easier to determine the type of road damage in studying the following discussion. The following are the results of the field survey according to the research location which is along Jalan Ciherang Cutak - Jalan Suka Mulya, Ciomas District, Bogor Regency.

Figure 4. Pavement Edge Defects at Sta 0+100. Source: Research data

Figure 4 is the result of documentation of the types of damage that occurred on the road pavement of Jalan Ciherang Cutak - Jalan Suka Mulya, Ciomas District, Bogor Regency, namely defects in the edge of the pavement surface and the shoulder of the dirt road or on the edge of the shoulder of the asphalt road and the soil around the asphalt.

Figure 5. Holes 0+300 - 0+400. Source: Research data

Figure 5 is the result of documentation of the type of damage that occurred on the pavement of Ciherang Cutak - Jalan Suka Mulya, Ciomas District, Bogor Regency, namely holes causing surface cracks and grain release or both. In this study, cracking then occurred in wide cracks followed by the release of aggregate material at the edge of the crack due to traffic loads.

Figure 6. Crocodile Crack 0+500 - 0+600. Source: Research data

Figure 6 is the result of documentation of the type of damage that occurred on the pavement of Ciherang Cutak - Jalan Suka Mulya, Ciomas District, Bogor Regency, namely that crocodile cracks can occur due to poor pavement materials, poor subgrade, weathering of the ground surface or the pavement below. The surface layer is less stable and the road surface is unable to withstand the weight of traffic vehicles.

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Figure 7. Longitudinal crack 0+600 - 0+700. Source: Research data

Figure 7 is the result of documentation of the type of damage that occurred on the pavement of Ciherang Cutak - Jalan Suka Mulya, Ciomas District, Bogor Regency, namely that longitudinal cracks can occur due to reflection cracks, if the asphalt layer is carried out on a cement foundation layer including soil-cement and with cement stability, The asphalt layer will crack due to reflection.

Pavement Condition Assessment Analysis Using the Surface Distress Index (SDI) Method

The research results obtained were in the form of road condition data using visual survey data collection, namely categories of road damage, size and percentage of road damage using the Surface Distress Index (SDI) method and Surface Distress Index (SDI) data which was taken on the Ciherang Cutak road section. – Suka Mulya Road, Ciomas District, Bogor Regency at STa 0+100 – 0+1000 which shows that most of the damage occurred due to crack damage to the road layer.

The calculation and assessment of the Surface Distress Index (SDI) for segments taking sample units for the Ciherang Cutak - Suka Mulya road, Ciomas District, Bogor Regency at STA 0+500, can be seen in the calculations below:

Table 2. Calculation of Field Results

Calculation of Field Results Data									
Long road			**1000 m**						
The width of the road			**4,3 m**						
Walk Intervals			**100 m**						
STA	**Crack (m)**		**Total Crack Area (m2)**	**Segment Area (m2)**	**Crack Area (m)**	**Total % Crack Area**	**Number of Holes**	**Tire Flow**
	P	L						
0+100	0,81	1,1	0,891	430	0,0021	0,0021	5	0
	1	0,7	0,700					
	0,54	3,8	2,052					
	0,7	1,4	0,980					
	1	0,73	0,730					
0+200	0,65	5,5	3,575	430	0,0083	0,8314	2	0
	0,6	2,2	1,320					
	3,3	1,1	3,630					
	0,74	0,35	0,259					
0+300	2	1,2	2,400	430	0,0056	0,5581	2	0
	4,3	0,9	3,870					

	1,7	0,7	1,190					
0+400	0,5	0,83	0,415	430	0,0010	0,0965	8	0
	0,35	0,3	0,105					
	1,7	1,3	2,210					
	1,1	0,8	0,880					
0+500	3,08	0,6	1,848	430	0,0043	0,4298	14	0
	5,9	0,4	2,360					
	0,43	0,25	0,108					
0+600	3,2	0,1	0,320	430	0,0007	0,07442	1	0
	0,3	0,3	0,090					
	0,3	0,3	0,090					
0+700	2,8	0,75	2,100	430	0,0049	0,4884	0	0
	63,4	0,8	50,720					
0+800	25	0,6	15,000	430	0,0349	3,4884	0	0
0+900	23,8	0,5	11,900	430	0,0277	2,7674	1	0
	5,5	0,55	3,025					
	8	0,5	4,000					
1+000	5,4	0,7	3,780	430	0,0088	0,8791	3	0
	4,9	0,9	4,410					
	2,5	0,7	1,750					
	1,5	1,3	1,950					

Crack Extent
Crack Area 1
Crack Length: 3.08m
Crack Width: 0.6m
Road Width: 4.3 m
Per Segment: 100m
L= p x l
L=(3.08m X 0.6 m)/100m = 0.018 m2
Segment Area
= p x l
= 4.3m x 100m
= 430 m2

Percentage of Crack Area
(Crack Area)/(Segment Area)
= (0.018 m2)/(430 m2) = 0.0000041 m2
= 0.0000041 x 100 %
= 0.0041%
Crack Area 2
Crack Length: 5.9m
Crack Width: 0.4m
Road Width: 4.3 m
Per Segment: 100m
L= p x l
L=(5.9m X 0.4 m)/100m = 0.236 m2
Segment Area
= p x l
= 4.3m x 100m

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= 430 m2
Percentage of Crack Area
(Crack Area)/(Segment Area)
= (0.236 m2)/(430 m2) = 0.00054 m2
= 0.00054 x 100 %
= 0.054%
Crack Area 3
Crack Length: 0.43m
Crack Width: 0.25m
Road Width: 4.3 m
Per Segment: 100m
L= p x l
L=(0.43m X 0.25 m)/100m = 0.00108 m2
Segment Area
= p x l
= 4.3m x 100m
= 430 m2
Percentage of Crack Area
(Crack Area)/(Segment Area)
= (0.00108 m2)/(430 m2) = 0.00000025 m2
= 0.00000025 x 100 %
= 0.00025%
From the results above the sum is 0.0041+0.054+0.00025= 0.05835%
Determine SDI 1 based on crack area:
The crack area presentation at STA 0+500 is 0.05835% based on the table
From road conditions based on 2.12 If less than 10% then the SDI value = 5.
Establish SDI 2 based on average crack width:
Because the crack width is at a medium level, namely <5mm at STA 00+500, namely 10.
Set SDI 3 based on number of holes:
The number of holes in STA 0-500 is 14 if holes are 10-50 then SDI3= SDI2 + 75= 85
Setting SDI 4 based on wheel depth:
Because there are no ruts on STA 0-500, the value of SDI4 = SDI3 where SDI3 is 85 so SDI4 = 85.
From the road conditions based on table 2.12, the SDI value in the 0-500 segment is obtained, namely SDI 50-100, so the road condition is moderate. The following is a calculation table from the analysis of road condition assessments on Jalan Ciherang Cutak-Jalan Suka Mulya, Ciomas sub-district, Bogor Regency using the SDI (surface distress index) method from STA 0-100 to 1-000.

Table 3. Research Analysis Calculation Results

STA	% Crack Area	Crack Width (m2)	Number of Holes	Wheel Marks (m)
0+100	0,012	1,546	5	0
0+200	0,831	2,2875	2	0
0+300	1,735	0,9333	2	0
0+400	0,840	0,8075	8	0
0+500	1,004	0,4167	14	0
0+600	0,116	0,2333	1	0
0+700	12,284	0,775	0	0
0+800	3,488	0,6	0	0
0+900	4,401	0,5167	1	0
1+000	2,765	0,9	3	0

From the road conditions based on table 3, the following is a table of advanced calculations from the analysis of road condition assessments on Ciherang Cutak Road - Suka Mulya Road, Ciomas District, Bogor Regency using the Distress Index (SDI) Survey method from STA 0+100 - 0+1000

Table 4. Results of SDI calculations on Jalan Ciherang Cutak-Jalan Suka Mulya, Ciomas District, Bogor Regency

STA	Segment	SDI 1	SDI 2	SDI 3	SDI 4	SDI Per segment	Road Conditions
		Crack Area	Crack Width	Number of Wheel Holes			
0+100	1	5	10	25	25	25	Good
0+200	2	5	10	25	25	25	Good
0+300	3	5	10	25	25	25	Good
0+400	4	5	10	25	25	25	Good
0+500	5	5	10	85	85	85	Medium
0+600	6	5	10	25	25	25	Good
0+700	7	20	40	55	55	55	Medium
0+800	8	5	10	25	25	25	OK
0+900	9	5	10	25	25	25	OK
1+000	10	5	10	25	25	25	OK
Average						34	Good

From table 4 above, the average surface distress index (SDI) value is 35 with good road conditions. However, there are several damaged segments with moderate conditions at STA 0+500. The following are graphic results of road conditions.

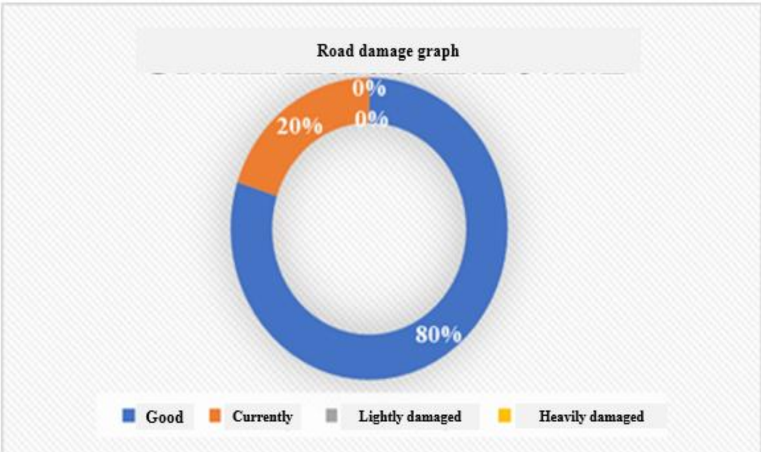

Figure 8. Road Damage Graph

The results of the graph above are the results of dividing the percentage (%) for each condition of damage, namely good condition 80%, moderate 20%, slightly damaged 0% heavily damaged 0%.

Evaluation Results of SDI Values and Handling on Cracked Roads

Based on the relationship between the surface distress index value and the resulting values for the area and width of cracks and handling on the Ciherang Cutak road-Suluyu road, it is presented in table 5.

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Table 5. Evaluation and Treatment of SDI Values on cracked roads

Segment	Number of Cracks	Crack Extent	SDI value 1	Crack Width	SDI value 2	SDI value	Handling
1	5	0,0124	5	1,546	10	25	Routine Maintenance
2	4	0,831	5	2,288	10	25	Routine Maintenance
3	3	1,735	5	0,933	10	25	Routine Maintenance
4	4	0,840	5	0,808	10	25	Routine Maintenance
5	3	1,004	5	0,417	10	85	Periodic Maintenance
6	3	0,116	5	0,233	10	25	Routine Maintenance
7	2	12,284	20	0,775	40	55	Periodic Maintenance
8	1	3,488	5	0,600	10	25	Routine Maintenance
9	3	4,401	5	0,517	10	25	Routine Maintenance
10	4	2,765	5	0,900	10	25	Routine Maintenance

The graph of the number of crack areas from segments 1 to 10 is presented in Figure 9 below.

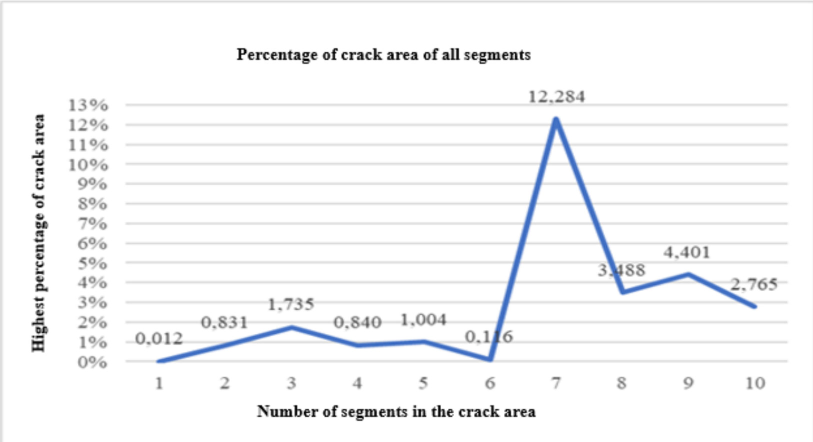

Figure 9. Results graph of crack area in all segments.

The graph above shows the value of the area of cracks on Jalan Ciherang Cutak- Jalan Suka Mulya, showing the large number of crack areas from segments 1 to 10. However, the largest number of crack areas is shown in segment 7 with a crack area value of 12.2%.

CONCLUSION

Based on the analysis that has been carried out in research using the Surface Distress Index (SDI) method on Jalan Ciherang Cutak - Jalan Suka Mulya, Ciomas District, Bogor Regency, it can be concluded as follows: a). There are 4 types of damage on the Ciherang Cutak-Suka Mulya road, namely: pavement edge defects, potholes, crocodile cracks and longitudinal cracks. b). From the results of the percentage of road damage with the average value of the Surface Distress Index (SDI), the condition of the Ciherang Cutak - Suka Mulya road, Ciomas District, Bogor Regency, namely 34, the Ciherang Cutak - Suka Mulya road, Ciomas District, Bogor Regency is in good condition and the results from the graph road conditions with a percentage value (0%) divided into each condition of damage with good condition 80%, moderate 20%, slightly damaged 0%, and heavily damaged 0%. c). From the results of the evaluation and handling of the surface distress index value on Jalan Ciherang Cutak - Jalan Suka Mulya, the road is in segments 1-4.8-10 in good condition. while 5 and 7 indicate moderate conditions, however, to prevent widespread cracking, routine and periodic maintenance is needed along the Ciherang Cutak Suka Mulya road so that the damage does not spread. Meanwhile, for the area of cracks, there are ups and downs per each segment, but in segment 7 there is a high damage area value, namely 12.2%.

REFERENCES

A.Maharani,S.wasono, Perbandingan Perkerasan Kaku Dan Perkerasan Lentur" (Studi Kasus Ruas Jalan Raya Pantai Prigi – Popoh Kab. Tulungagung) *Ge-STRAM: Jurnal Perencanaan dan Rekayasa Sipil*,2018 vol.1 issue 2, pages 89-94.

A.Munandar, 2014. Penelitian Analisa Kondisi Kerusakan Jalan Pada Lapisan Permukaan (Studi kasus : Jalan Adi Sucipto Sungai Raya Kubu Raya), *Jurnal* Universitas Tanjungpura.

Aptarila G, Lubis F, Saleh A,2020. Analisi Kerusakan Jalan Metode SDI Taluk Kuantan-Batas Provinsi Sumatera Barat. *Skripsi* tahun 2020, Universitas Lancang Kuning Jl. Yos Sudarso Km. 8 Pekanbaru.

Keputusan Bupati Bogor, Nomor 620/451/ktps/perUU/2018, Tentang Penetapan Ruas Jalan Menurut Statusnya Sebagai Jalan Kabupaten Bogor.

D.Asri Anugrah, 2021. Analisa Penilaian Kondisi Jalan Raya Dengan Metode Surface Distress Index (SDI) Dan Present Serviceability Index (PSI) Studi Kasus: Duri Kecamatan Mandau. *Skripsi* Tahun 2021, Tekni Sipil UniversitasIslam Riau.

Departemen pekerjaan umum direktorat jenderal bina marga, undang-undang republik Indonesia nomor 38 tahun 2004 tentang jalan, Jakarta

Direktorat Jenderal Bina Marga, 2011. Survei Kondisi Jalan untuk Pemeliharaan Rutin. 2 ed. Jakarta: Kementerian Pekerjaan Umum Direktorat Jenderal Bina Marga.

Manuputty Theodorus Lerich, Vemara Marcha Matitaputty, N. Paulus, Analisis Tebal Perkerasan Lentur Dengan Metode Manual Desain Perkerasan Jalan (MDP 2017) Pada Ruas Jalan Desa Kowatu - Desa Ramberu, Kecamatan Inamosol, Kabupaten Seram Bagian Barat, Skrispsi tahun terbit 2022.

Clarkson H.Oglesby, 1999, Alih Bahasa, Teknik Jalan Raya Jilid 1, Gramedia, Jakarta.

Pekerjaan Umum Departemen, (2011), Manual Konstruksi dan Bangunan Tentang Tata Cara Pemeliharaan Jalan,Direktorat Jendral Bina Marga, Jakarta.

Sukirman. S, 1999, Perkerasan Lentur Jalan Raya, Penerbit Nova, Bandung

Suswandi, Sartono, dan hardiyatmo. 2008. Evaluasi tingkat kerusakan jalan dengan metode PCI untuk menunjang pengambilan keputusan (Studi kasus: Jalan Lingkar Selatan, Yogyakarta.

Udiana I.M, saudale a.r, pah jusuf j.s, 2014, analisa faktor penyebab kerusakan jalan (studi kasus ruas jalan w. j. lalamentik dan ruas jalan gor flobamora) jurnal teknik sipil vol. iii, no. 1 Universitas Undana-Kupang.

Yahya Rafiko, 2019. Analisis Kerusakan Jalan Menggunakan Metode Pavement Condition Indext (PCI) dan Surface Distress Index (SDI).

S Syaiful, P Pratikso, SW Mudjanarko, S Telaumbanua. (2024). EFFECT OF TRAFFIC SPEED ON NOISE GENERATED BY VEHICLES MOTORIZED IN FRONT OF THE KARYA BHAKTI PRATIWI DRAMAGA BOGOR HOSPITAL. ARPN Journal of Engineering and Applied Sciences 19 (2), 114-131.

S Syaiful, P Pratikso, SW Mudjanarko, D Diansyah. (2024). THE EFFECT OF TRAFFIC VOLUME ON THE NOISE CAUSED BY MOTORIZED VEHICLES IN FRONT OF KARYA BHAKTI PRATIWI DRAMAGA HOSPITAL, BOGOR. ARPN Journal of Engineering and Applied Sciences 19 (1), 16-32.

S Syaiful, P Pratikso, SW Mudjanarko, I Iswahyudi. (2024). STUDY ON PUBLIC TRANSPORT AND NON-PUBLIC TRANSPORT VOLUMES ON SUSTAINABLE NOISE. ARPN Journal of Engineering and Applied Sciences 18 (24), 2641-2660.

pISSN 2302-4240
eISSN 2655-2086

Volume 13, Issue 2, June 2024, pp.463-476
DOI: http://dx.doi.org/10.32832/astonjadro.v13i12 http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO

S Syaiful, H Siregar, E Rustiadi, ES Hariyadi. (2022). Model Rekayasa Lalu lintas dalam Sistem Transportasi dengan Pola Kerjasama antar Wilayah Berkelanjutan di Kota Bogor. IPB University.

S Syaiful, H Rusfana. (2022). Rigid Pavement Planning in Traffic: Case Study in Ciherang Road and Pemuda Road, Bogor Regency, Indonesia. Journal of Applied Engineering Science, 1-13.

S Syaiful, Y Pratama. (2019). Sustainable Studies about General Public Transport Performance in the City of Bogor, ARPN Journal of Engineering and Applied Sciences 14 (18), 3241-3247.

S Syaiful, D Hariyadi. (2019). Case Study on Sustainable T-Jungtion Cibinong City Mall (CCM) in Bogor Indonesia, ARPN Journal of Engineering and Applied Sciences 14 (17), 2960-2971.

S Syaiful, H Prayoga, J Akbardin. (2020). Sustainable about the Need of Parking Systems at the Mall RDS Bogor, ARPN Journal of Engineering and Applied Sciences 15 (22), 2620-2626.

S Syaiful, H Siregar, E Rustiadi, ES Hariyadi. (2021). Traffic Improvement Strategy in Transportation System Using AHP Method. ARPN Journal of Engineering and Applied Sciences 16 (22), 2431-2439.

Syaiful, S., & Fadly, A. (2020). ANALYSIS OF THE EFFECTIVENESS OF BUS SERVICES OUTSIDE OF CAMPUS IPB DRAMAGA BOGOR. ASTONJADRO, 9(2), 173–186. https://doi.org/10.32832/astonjadro.v9i2.3597

Syaiful, S., & Andana, R. (2021). PASSENGER CAR SPEED ASSESSMENT RELATIONSHIP TO THE NOISE CAUSED. ASTONJADRO, 10(1), 41–49. https://doi.org/10.32832/astonjadro.v10i1.3494

Syaiful, S., Siregar, H., Rustiadi, E., & Hariyadi, E. S. (2021). ANALYSIS OF MOTORCYCLE TRAFFIC SPEED WHICH CREATES NOISE IN FRONT OF WIYATA MANDALA JUNIOR HIGH SCHOOL DURING THE COVID-19 PANDEMIC. ASTONJADRO, 10(2), 225–236. https://doi.org/10.32832/astonjadro.v10i2.4772

Syaiful, S., & Irbah, A. F. (2021). STUDY OF NOISE ON PASSENGER CAR SPEED. ASTONJADRO, 10(2), 195–203. https://doi.org/10.32832/astonjadro.v10i2.3571

Syaiful, S., Siregar, H., Rustiadi, E., & Hariyadi, E. S. (2022). PERFORMANCE OF THREE ARMS SIGNALIZED INTERSECTION AT SALABENDA IN BOGOR REGENCY. ASTONJADRO, 11(1), 13–29. https://doi.org/10.32832/astonjadro.v11i1.4955

Syaiful, S., Siregar, H., Rustiadi, E., Hariyadi, E. S., Ardila, F. A. D., & Akbar, C. F. R. (2021). TRAFFIC DENSITY DUE TO MOTORCYCLE NOISE DURING THE PANDEMIC COVID-19. ASTONJADRO, 11(1), 151–166. https://doi.org/10.32832/astonjadro.v11i1.5847

Syaiful, S., Prayudyanto, M. N., Rulhendri, R., Lestari, P. A., Nabila, A. N., Damiana, S. L., & Haldiana, H. (2022). VEHICLE TRAFFIC VOLUME ANALYSIS DUE TO SOUND GENERATED IN FRONT OF THE RS. Hermina Bogor. ASTONJADRO, 11(2), 475–489. https://doi.org/10.32832/astonjadro.v11i2.7136

Syaiful, S., Aminda, R. S., Rulhendri, R., & Haldiana, H. (2022). Analysis of traffic volume due to the sound of motor vehicle in front of SMA Taruna Terpadu Boash during Covid-19. ASTONJADRO, 11(3), 588–599. https://doi.org/10.32832/astonjadro.v11i3.7274

Syaiful, S., Aminda, R. S., & Afrianto, Y. (2023). Influence motor cycle density on noise sound at the highway. ASTONJADRO, 12(1), 304–313. https://doi.org/10.32832/astonjadro.v12i1.8782

Mudjanarko, S. W., & Falani, A. Z. (2023). Utilization of digital parking web for the convenience of vehicle users. ASTONJADRO, 12(1), 55–62. https://doi.org/10.32832/astonjadro.v12i1.5879

Syaiful, S., Pratikso, P., & Wiwoho Mudjanarko, S. (2023). Literature Study of the Sustainability Model of Transportation Facilities and Infrastructure in the Management of Public Transportation with the Concept of Inter-Regional Cooperation (Case in the City and District of Bogor). ASTONJADRO, 12(2), 613–634. https://doi.org/10.32832/astonjadro.v12i2.14114

Pratama, F. A., Syaiful, S., & Aminda, R. S. (2023). Paid Parking Performance at Depok Lama Station. ASTONJADRO, 12(3), 934–952. https://doi.org/10.32832/astonjadro.v12i3.15002

Syaiful, S., Zein, A. M., Rulhendri, R., & Aminda, R. S. (2023). Parking Analysis on Bogor Agricultural University Campus. ASTONJADRO, 12(3), 919–933. https://doi.org/10.32832/astonjadro.v12i3.14994

Syaiful, S., Yulianto, M., Murtejo, T., & Rulhendri, R. (2023). Analysis of the Function and Convenience of Pedestrian Public Transport Support the City of Bogor. ASTONJADRO, 12(3), 646–657. https://doi.org/10.32832/astonjadro.v12i3.4341

Syaiful, S., & Suherman, S. (2024). Performance Evaluation of Paid Parking at Cilebut Station. ASTONJADRO, 13(1), 12–22. https://doi.org/10.32832/astonjadro.v13i1.11184