JOURNAL OF SOCIAL SCIENCE
Printed ISSN: 2720-9938
Electronic ISSN: 2721-5202
jsss.co.id

Road Damage Analysis on Brigjend Katamso Road - Berbek Road – Wadung Asri Road with Sdi Method

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KEYWORDS

Road;,Road Damage; Surface Distress Index method; Handling Road Damage

ABSTRACT

Roads are a component that plays a role in improving the community's economy and population which results in an increase in traffic volume which can result in a decrease in road quality and affect safety, comfort and smoothness of traffic. In this research, an analysis of road damage was carried out on the Jalan Brigjend Katamso – Jalan Raya Berbek – Jalan Raya Wadung Asri (STA. 0+000 – 5+000) section located in Sidoarjo Regency. Analysis of road damage in this research uses the SDI method. The SDI method is a method that produces SDI values to determine road conditions and the form of maintenance required. The SDI value is obtained from the percentage of crack area, crack width, number of holes per 100 m, and depth of ruts or grooves. From this research, it was found that the types of road damage that occurred on the Jalan Brigjend Katamso – Jalan Raya Berbek – Jalan Raya Wadung Asri (STA 0+000 – 5+000) section were 0.49% potholes, 3.73% ruts (grooves), 87.62% cracks, 2.31% bleeding , 3.42% grain peeling, 2.07% patches, and 0.35% thumb. Assessment of road conditions using the SDI method shows that 98% are in good condition and 2% are in slightly damaged condition. Treatment that must be carried out immediately on the Jalan Brigjend Katamso – Jalan Raya Berbek – Jalan Raya Wadung Asri (STA 0+000 – 5+000) section is asphalt resurfacing, sealing, patching holes, overlaying, and re-marking.

INTRODUCTION

Roads are an important component for society because they act as the main means of transportation on land and can facilitate the economy and culture between regions in Indonesia. Roads can make it easier for people to carry out other social activities if the condition of the road is good and meets appropriateness standards. With the increase in the economy of the people in a city, the population of the city will also increase and result in an increase in traffic volume which will continuously affect the condition of road construction, and this will result in a decrease in the quality of the road, which will affect safety, comfort and smoothness. traffic in the city (Setyawati, 2022).

Sidoarjo Regency borders Surabaya City, which is also the city that produces the most MSMEs. Not only that, Sidoarjo Regency is also a buffer for Surabaya City which is part of the Gerbangkertasusila area (Setyawati, 2022). With a population of 2,064,168 people according to

BPS Sidoarjo Regency from data from the 2022 population census and experiencing an increase in the number of motorized vehicles every year according to BPS data for East Java Province for 2018 - 2020 as presented in table 1 as follows (Zuliasari & Rachmawati, 2021).

Table 1
Sidoarjo Regency Motor Vehicle Data 2018 – 2020 (BPS East Java Province)

Year	Car	Bus	Truck	Motorcycle	Heavy equipment	Total
2018	172.223	2,392	47,343	1,413,942	132	1,636,032
2019	187,816	2,573	50,687	1,509,222	147	1,750,445
2020	194,598	2,641	52,718	1,558,650	147	1,808,754

This makes Sidoarjo Regency not far from the problem of traffic jams at every point on the road. Sidoarjo Regency is a suburban area which makes it a special attraction for building housing, opening businesses and looking for work. This is what causes traffic jams at several road points in Sidoarjo Regency (Setyawati, 2022).

In this case, an analysis of road damage was carried out on the Jalan Brigjend Katamso - Jalan Raya Berbek - Jalan Raya Wadung Asri section which is located in Waru District, Sidoarjo Regency. Jalan Brigjend Katamso – Jalan Raya Berbek – Jalan Raya Wadung Asri is included in the district road that connects Jalan Raya Waru with Jalan Raya Taman Asri, and is one of the access roads to Rungkut District, Surabaya City (Purwahono & Solichin, 2023). Jalan Brigjend Katamso – Jalan Raya Berbek – Jalan Raya Wadung Asri is a road that is frequently passed by large vehicles and there are also frequent traffic jams on this section of road so that there is a lot of road damage in the form of cracks, holes and grooves on the road section.

Analysis of road damage on the Jalan Brigjend Katamso – Jalan Raya Berbek – Jalan Raya Wadung Asri section was carried out to determine the type of repairs that must be carried out immediately so that the road performance can return to its original state so as to create comfort, smoothness and safety of traffic on this road section (Girsang, 2020).

Based on these problems, damage analysis was carried out using the SDI method. The SDI method has several advantages over other road damage analysis methods (Ibnu & Nugroho, 2017). In this case, several advantages of the SDI method will be exemplified when compared with the 1990 Bina Marga method, IRI (International Roughness Index), and PCI (Pavement Condition Index) which are presented in table 2 as follows (Nugraha, 2021).

Table 2
Advantages of the SDI Method (Comparative results of road damage analysis methods)

SDI method	**Bina Marga Methods 1990**
It requires a shorter time to implement because it only requires road damage data.	It takes longer to implement because it requires road damage data and LHR data.
The SDI method is more effective and efficient in assessing and calculating the costs of maintaining road damage (Yusup, CM, 2020).	The Bina Marga method is less effective and less efficient in assessing and calculating the costs of maintaining road damage (Yusup, CM, 2020).
SDI method	**IRI method**
It has more accurate results when compared to the IRI method because it is done by visually assessing the damage that occurs in the field (Suwandi, A., 2021).	It has less accurate results when compared to the SDI method because the assessment relies on a roughmeter measuring instrument (Suwandi, A., 2021).
SDI method	**PCI method**

The type of damage is more generalized so that identification of damage is much easier (Nugraha, D., 2021).	It is too risky when collecting data because there are too many types of damage, so identifying each damage will be prone to errors (Nugraha, D., 2021).

The purpose of this research is to determine the types of road damage that occur, to determine the value of road conditions after analyzing road damage using the SDI method, and to identify forms of treatment that must be carried out immediately on the Jalan Brigjend Katamso - Jalan Raya Berbek - Jalan Raya Wadung Asri (STA 0+000 – 5+000) after analysis (Wang, Wu, Yang, & Wang, 2018).

METHOD

Road damage analysis was carried out on the Jalan Brigjend Katamso – Jalan Raya Berbek – Jalan Raya Wadung Asri (STA 0+000 – 5+000) section using the SDI (Surface Distress Index) method. The SDI method is a road condition survey method issued by the Directorate General of Highways in 2011 . The SDI (Surface Distress Index) method is a scale. The SDI method is a road performance scale obtained from visually observing road damage in the field (Yastawan, Wedagama, & Ariawan, 2021).

The SDI method produces SDI values to determine road conditions and the form of maintenance required. In the SDI method, road damage that needs to be considered is the crack area, crack width, number of holes per 100 m, and rut depth (Arya et al., 2020). Several assessment categories required in determining road condition values according to the SDI method are:

1. The assessment of crack area categories is presented in table 3 as follows.

Table 3
Crack Extent Category Assessment (Bina Marga 2011)

No	Broad Category of Cracks	SDI value a
1	There isn't any	-
2	<10%	5
3	10% – 30%	20
4	>30%	40

2. The assessment of crack width categories is presented in table 4 as follows.

Table 4
Crack Width Category Assessment (Bina Marga 2011)

No	Crack Width Category	SDI value b
1	There isn't any	-
2	Fine <1 mm	-
3	Medium 1 mm – 3 mm	-
4	Width >3 mm	SDI value a x 2

3. The assessment of the number of holes categories is presented in table 5 as follows.

Table 5
Assessment of Number of Holes Category (Bina Marga 2011)

No	Category Number of Holes	SDI value c
1	There isn't any	-

2	<10 per 100 m	SDI value b + 15
3	10 – 50 per 100 m	SDI value b + 75
4	>50 per 100 m	SDI value b + 225

4. The assessment of wheel rut categories is presented in table 6 as follows.

Table 6
Scoring of Wheels Category (Bina Marga 2011)

No	Wheel Worn Category	SDI value d
1	There isn't any	-
2	<1 cm deep	SDI value c + 5 x 0.5
3	1 – 3 cm deep	SDI value c + 5 x 2
4	>3 cm deep	SDI value c + 5 x 4

5. Assessment of road conditions according to the SDI method is presented in table 7 as follows.

Table 6
Road Condition Assessment According to the SDI Method (Bina Marga 2011)

Road Conditions	SDI value
Good	<50
Currently	50 – 100
Light Damage	100 – 150
Heavy Damaged	>150

The SDI value is obtained from the largest value of the four values (SDI a, SDI b, SDI c, and SDI d). Then an assessment of road conditions is carried out based on table 7 (Suwandi, 2021).

For the type of treatment based on the SDI method following Road Preservation Management for Regional Road Network Management in 2011, see table 8 as follows (Ichsan & Isya, 2014)(Sinaga, 2011).

Table 7
Handling Types Based on the SDI Method (Road Preservation Management for Regional Road Network Management in 2011)

Handling Type	SDI value
Routine Maintenance	<50
Routine Maintenance	50 – 100
Periodic Maintenance	100 – 150
Road Improvement or Road Rehabilitation	>150

The things that must be done when calculating road damage analysis using the SDI method are:

1. Table the survey results according to the types of damage that need to be considered in the SDI.
2. Determine the SDI value.
3. Determine road conditions and the form of handling that must be carried out.

The tools needed to analyze road damage using the SDI method are as follows.

1. Meter for measuring the dimensions of small-scale damage.
2. Thrust meter to divide segments on roads and measure the dimensions of large-scale damage.
3. Vernier caliper to measure crack width.
4. *Pilox* to mark segment boundaries.
5. Stationery to record the results of road damage surveys.

RESULTS AND DISCUSSION

The types of damage that occurred based on the results of visual observations on the Jalan Brigjend Katamso – Jalan Raya Berbek – Jalan Raya Wadung Asri at STA 0+000 – 5+000 were pothole damage, rut damage (grooves), crack damage, obesity (bleeding). , grain peeling, patch damage, and toe damage (7 types of road damage). Examples of the damage that occurred are presented in figures 1 to 3 as follows.

Figure 1. Examples of Whole Damage at Research Locations (Observation Results)

Figure 2. Examples of Flow Damage at Research Locations (Observation Results)

Figure 3. Examples of Crack Damage at Research Locations (Observation Results)

The percentage of damage that occurred on the Jalan Brigjend Katamso – Jalan Raya Berbek – Jalan Raya Wadung Asri STA 0+000 – 5+000 section is presented in Figure 4 as follows.

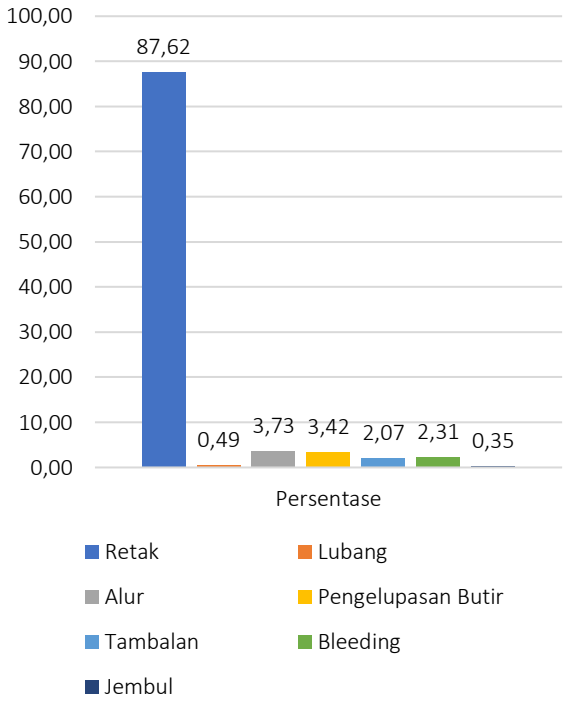

Figure 4. Percentage of Road Damage (Results of data analysis)

It can be seen from Figure 4 that the most dominant damage is crack damage. This makes crack damage the most influential damage to the calculation of road condition values.
The results of the SDI values for each segment are presented in table 9 as follows.

Table 8
Results of SDI Values for Each Segment (Results of data analysis)

Segment	STA	SDI value a	SDI value b	SDI value c	SDI value d	SDI Value Per STA	Road Conditions
1	0+000 - 0+100	0	0	15	15	15	Good
	0+100 - 0+200	5	10	25	25	25	Good
	0+200 - 0+300	5	10	25	25	25	Good

Segment	STA	SDI value a	SDI value b	SDI value c	SDI value d	SDI Value Per STA	Road Conditions
	0+300 - 0+400	5	10	10	10	10	Good
	0+400 - 0+500	5	10	10	10	10	Good
	0+500 - 0+600	5	10	25	25	25	Good
	0+600 - 0+700	5	10	10	10	10	Good
	0+700 - 0+800	5	10	10	10	10	Good
	0+800 - 0+900	5	10	10	20	20	Good
	0+900 - 1+000	5	10	10	10	10	Good
	1+000 - 1+100	5	10	10	10	10	Good
2	1+100 - 1+200	5	10	10	10	10	Good
	1+200 - 1+300	5	10	25	45	45	Good
	1+300 - 1+400	5	10	10	10	10	Good
	1+400 - 1+500	5	10	25	25	25	Good
	1+500 - 1+600	5	10	10	10	10	Good
2	1+600 - 1+700	5	10	10	10	10	Good
	1+700 - 1+800	5	10	10	10	10	Good
	1+800 - 1+900	5	10	10	10	10	Good
	1+900 - 2+000	5	10	10	10	10	Good
	2+000 - 2+100	5	10	10	10	10	Good
	2+100 - 2+200	5	10	25	25	25	Good
	2+200 - 2+300	5	10	10	10	10	Good
	2+300 - 2+400	5	10	10	20	20	Good
	2+400 - 2+500	5	5	5	5	5	Good
3	2+500 - 2+600	5	10	10	10	10	Good
	2+600 - 2+700	5	5	5	5	5	Good
	2+700 - 2+800	5	10	10	10	10	Good
	2+800 - 2+900	5	10	25	25	25	Good
	2+900 - 3+000	5	10	25	25	25	Good
	3+000 - 3+100	5	10	10	10	10	Good
	3+100 - 3+200	5	10	25	25	25	Good
	3+200 - 3+300	5	10	10	10	10	Good
	3+300 - 3+400	5	10	25	25	25	Good
	3+400 - 3+500	5	10	25	25	25	Good
4	3+500 - 3+600	20	40	40	40	40	Good
	3+600 - 3+700	5	10	10	10	10	Good
	3+700 - 3+800	5	10	25	25	25	Good
	3+800 - 3+900	20	40	40	40	40	Good
	3+900 - 4+000	5	10	10	10	10	Good
	4+000 - 4+100	5	10	85	105	105	Lightly damaged
5	4+100 - 4+200	5	10	25	25	25	Good
	4+200 - 4+300	5	10	10	20	20	Good
	4+300 - 4+400	5	10	25	27.5	27.5	Good

Segment	STA	SDI value a	SDI value b	SDI value c	SDI value d	SDI Value Per STA	Road Conditions
	4+400 - 4+500	5	10	25	27.5	27.5	Good
	4+500 - 4+600	5	10	25	25	25	Good
	4+600 - 4+700	5	10	25	25	25	Good
	4+700 - 4+800	5	10	25	27.5	27.5	Good
	4+800 - 4+900	5	10	25	27.5	27.5	Good
	4+900 - 5+000	5	10	10	10	10	Good

From table 9 it can be determined that the road condition on the Jalan Brigjend Katamso – Jalan Raya Berbek – Jalan Raya Wadung Asri STA 0+000 – 5+000 49 STA section is in good condition because it produces an SDI value of less than 50 (based on table 7) and only 1 The STA experienced mild damage because it produced an SDI value between 100 – 150 (based on table 7). And according to table 9, it can be seen that the roads that experienced light damage were at STA 4+000 – 4+100.

The SDI values in segment 1 are presented in Figure 5 as follows.

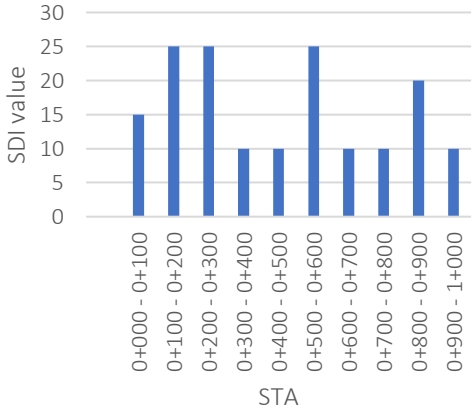

Figure 5. SDI Value in Segment 1 (Results of data analysis)

From Figure 5 it can be seen that the SDI values in segment 1 are all below 50 (in good condition) and the highest damage conditions are at STA 0+100 – 0+300 and STA 0+500 – 0+600 which have an SDI value of 25.

The SDI values in segment 2 are presented in Figure 6 as follows.

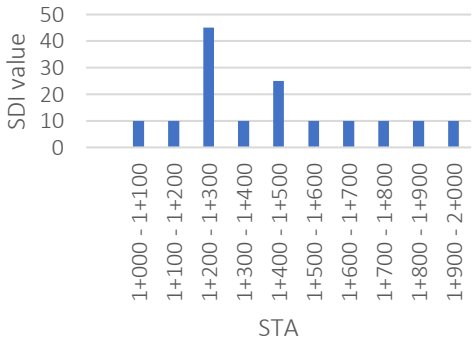

Figure 6. SDI Value in Segment 2 (Results of data analysis)

From Figure 6 it can be seen that the SDI values in segment 2 are all below 50 (in good condition) and the highest condition of damage is located at STA 1+200 – 1+300 which has an SDI value of 45 (almost reaching medium condition). The SDI values in segment 3 are presented in Figure 7 as follows.

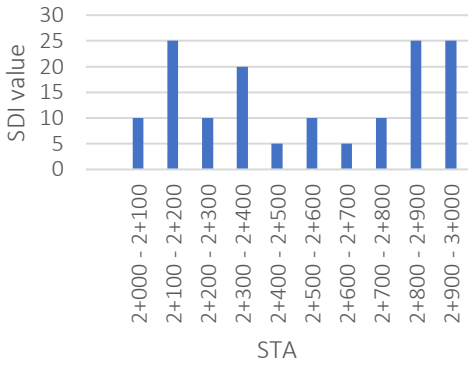

Figure 7. SDI Value in Segment 3 (Results of data analysis)

From Figure 7 it can be seen that the SDI values in segment 1 are all below 50 (in good condition) and the highest damage conditions are located at STA 2+100 – 2+200 and STA 2+800 – 3+000 which have an SDI value of 25.

The SDI values in segment 4 are presented in Figure 8 as follows.

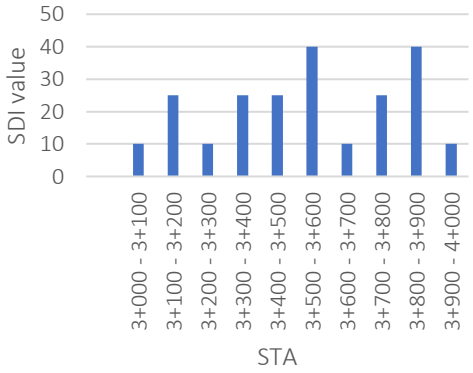

Figure 8. SDI Value in Segment 4 (Results of data analysis)

From Figure 8 it can be seen that the SDI values in segment 4 are all below 50 (in good condition) and the highest condition of damage is at STA 3+500 – 3+600 and STA 3+800 – 3+900 which have an SDI value of 40 (almost reaches medium condition).

The differences in SDI values in segment 5 are presented in Figure 9 as follows.

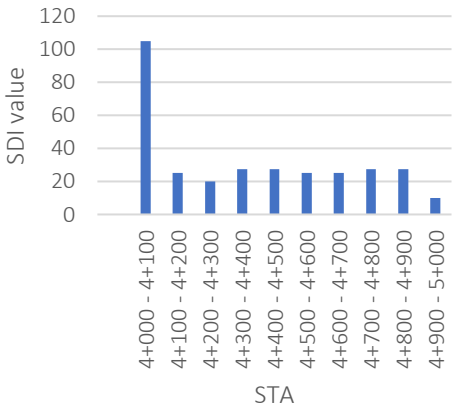

Figure 9. SDI Value in Segment 5 (Results of data analysis)

From Figure 9, it can be seen that almost all of the SDI values in segment 5 are below 50 (in good condition). Only one STA has the number 105 (in slightly damaged condition), namely STA 4+000 – 4+100.

The form of treatment required for the Jalan Brigjend Katamso – Jalan Raya Berbek – Jalan Raya Wadung Asri STA 0+000 – 5+000 section according to the SDI method (table 8) is routine maintenance and periodic maintenance. Routine maintenance is carried out on roads that are in good condition, namely on STA 0+000 – 4+000 and STA 4+100 – 5+000 (based on table 9). Meanwhile, periodic maintenance is carried out on roads that are in a slightly damaged condition, namely at STA 4+000 – 4+100 (based on table 9)(Yusup, 2020).

The form of handling routine maintenance and periodic maintenance according to Minister of Public Works Regulation No. 13 of 2011 which is adapted to the form of road damage that occurs on the Jalan Brigjend Katamso - Jalan Raya Berbek - Jalan Raya Wadung Asri section is presented in table 10 as follows (Umum, 2011).

Table 9
Forms of Treatment Required (Results of data analysis)

STA	Road Conditions	Type of Treatment	Damage Occurred	Form of Treatment
0+000 – 4+000 And 4+100 – 5+000	Good	Routine Maintenance	Hole	Hole patching
			Channel Crack width <2 mm Grain flaking Patch *Bleeding* Thumb	Asphalt coating
			Crack width >2 mm	*Sealing*
4+000 – 4+100	Light Damage	Periodic Maintenance	Hole Crack width >2mm Channel Grain peeling	*Overlays* Remarking

CONCLUSION

The conclusions obtained from the results of data analysis and discussion in this research are as follows. 1) The types of road damage that occurred on the Jalan Brigjend Katamso – Jalan Raya Berbek – Jalan Raya Wadung Asri (STA 0+000 – 5+000) section were 0.49% damage to potholes, 3.73% damage to ruts (grooves), 87.62% crack damage, 2.31% obesity damage (bleeding), 3.42% grain peeling damage, 2.07% patch damage, and 0.35% crest damage. 2) The road condition value is 98% indicating good condition, namely at STA 0+000 – 4+000 and STA 4+100 – 5+000 because it produces an SDI value of less than 50 (classified as a road in good condition) and 2% indicates good condition. lightly damaged, namely at STA 4+000 – 4+100 because it produces an SDI value of 105 (classified as a road with a slightly damaged condition). 3) Treatment that must be carried out immediately is for roads in good condition that require treatment in the form of asphalt coating, sealing and patching holes. Meanwhile, roads with mild damage require treatment in the form of overlays and re-marking.

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