Journal of Social Research
P-ISSN: 2827-9832
E-ISSN: 2828-335x
http://ijsr.internationaljournallabs.com/index.php/ijsr

Analysis of Road Condition Assessment Using The Surface Distress Index (SDI) Method and Estimation of Road Maintenance Costs For The Durenan-Prigi Road Section (Link 006)

Muhammad Fareza Akbar, Risma Marleno, Wateno Oetomo
Universitas 17 Agustus 1945 Surabaya, Indonesia
fareza.akbar94@gmail.com, rismamar@untag-sby.ac.id, wateno@untag-sby.ac.id

ABSTRACT

The Durenan - Prigi road section is a 30.4 km long road that is authorized by the East Java Provincial Government, this road is one of the access roads to Prigi Beach, Mutiara Beach and other tourist attractions in Trenggalek Regency. The road that is the access to the tour certainly requires care and maintenance to always be in steady condition and does not reduce the comfort of road users. Factors that cause damage include traffic load factors, soil condition factors, weather, rain, drainage channel factors and so on. In monitoring road conditions, there is a road condition assessment, namely the Surface Distress Index (SDI) method. The objective of this research is to evaluate the condition of the Durenan-Prigi road section using the Surface Distress Index (SDI) method to assess its current state, determine necessary maintenance actions, and estimate the required budget for its upkeep. The SDI method is a method of assessing the condition of the road surface by making visual observations. The SDI method has four types of damage in assessing road conditions with four categories of road condition assessment results. The Durenan - Prigi road section has an average SDI value of 11.89 with an assessment of "Good" condition. Nevertheless, maintenance is still required with an estimated budget of Rp2,596,960,786.27. The budget includes three main components, namely type 3 emulsified asphalt coating (CQS-1h) amounting to Rp2,392,020,512.39, repairing the cold-applied asbuton mixture amounting to Rp160,955,321.83, and closing type 1 cracks (crack width 0.20-0.50 cm) amounting to Rp43,984,952.06.

Keywords: *SDI, handling plan, road condition*

INTRODUCTION

Roads are crucial land infrastructure for the development of a region. The mobility of people today is highly dependent on road conditions, which directly affects their ability to carry out social activities. The importance of road maintenance is because every road has a limited service life. Road damage is often caused by various factors such as weather, temperature, water, construction materials, high vehicle volumes, and others. (Sandyna, Elfichra, Aqilla, Novaldi, & Adiman, 2022).

Roads are vital infrastructure, serving as the main route connecting one region or area to another. In the context of the land transportation sector, roads have a very important role in ensuring the smooth distribution of goods and services, which must run continuously without obstacles (Hasrudin & Maha, 2024). In addition, roads also have a significant impact on economic progress and social development in an area. The continuity of economic and social activities is highly dependent on the smooth flow of traffic, which can be well realized through adequate road infrastructure. However, when roads are damaged or disrupted, it can cause serious problems, such as hampering economic and social activities. Not only that, road damage

can also potentially cause traffic accidents that endanger the safety of motorists and other road users. Therefore, road maintenance and repair is essential to maintain the smoothness and safety of all activities that depend on land transportation (Arianto & Suprapto, 2018).

Road conditions must be maintained because each road has a certain period of service so that preservation must be carried out. Poor road conditions or so-called road damage are caused by various factors, namely weather, temperature changes, water, pavement construction materials, increased vehicle volumes that exceed the initial planning, poor compaction process, unstable subgrade and many others. Therefore, road damage can interfere with regional or inter-regional mobility, hindering important social activities that support the progress of the country. Thus, it is necessary to evaluate the problems that must be resolved so that road conditions can survive and remain in prime condition, one of which is the management and improvement of road infrastructure. The management and improvement of road infrastructure functions as an activity to maintain road conditions so that they remain good and comfortable to use, which is carried out efficiently and effectively so that the road can still be used according to the service life (Hermawati & Putri, 2024).

Road infrastructure that is burdened by high and repetitive traffic volumes will cause a decline in road quality. An indicator of this is the condition of the road surface, both structural and functional, which is damaged. (Suswandi & Sartono, 2008) In addition, the quality of materials used in road construction greatly affects its durability. Low-quality materials or construction processes that do not meet standards often cause roads to deteriorate faster. Unstable subgrade soils and poor drainage systems can also result in water accumulation, which exacerbates road deterioration. Therefore, periodic maintenance such as crack repair, resurfacing, and full reconstruction is essential to maintain the safety and comfort of road users.

Factors such as construction quality, weather and poor drainage play a significant role in road deterioration, indicating the need for regular maintenance. Extreme weather conditions, such as flooding, often cause inundation and erosion of the road's coating, accelerating the onset of potholes and cracks. In addition, without an effective drainage system, water will be retained on the road surface, worsening its structural condition. This poor drainage, together with high traffic loads, accelerates the deterioration of the road, resulting in rapid deterioration if left untreated (Nugroho & Marleno, 2020).

Road surface condition assessment is one of the stages to determine the type of revaluation program that needs to be carried out. One of the steps in evaluating the condition of the road surface is to assess the condition of the road surface layer (Gusnilawati, Chrisnawati, & Maryunani, 2021). The development of the road system, in line with the evolution of human history, requires optimal pavement design to meet transportation needs. Road deterioration, especially on flexible pavements, can significantly affect traffic flow and requires condition evaluation using methods such as Surface Distress Index (SDI). (Wibowo, Atmajayani, & Widodo, 2023).

In the context of maintenance, the Surface Distress Index (SDI) method is one of the tools used to assess the level of road deterioration. The SDI method provides an objective assessment of the physical condition of the road, which can help in determining the type of repairs required. For example, roads with low SDI values indicate severe deterioration, requiring full reconstruction, while roads with higher SDI values may only require minor overlays or patches. This method helps the government allocate budgets appropriately, avoiding waste on unnecessary repairs (Anugrah, 2021).

Another relevant study by Anugrah (2021) applied SDI to roads in Mandau District, Riau, with the result that roads with low SDI values require full reconstruction while roads with high SDI only require light maintenance. These results show the benefits of SDI as an objective method in evaluating and allocating budgets as needed.

Another study on analyzing road maintenance costs based on the SDI method was

conducted by Ghoni & Alawi, (2021) who used SDI to assess damage and calculate maintenance costs on road sections in Semarang. The results showed that the utilization of SDI helped streamline the budget by determining specific repair needs for minor to severe damage. This research supports the application of SDI as an objective evaluation method that can provide data for long-term planning and ongoing maintenance of road infrastructure.

This research topic aims to analyze road condition assessment using the Surface Distress Index (SDI) method as well as Maintenance Cost Estimation on the Durenan-Prigi Road Section (Link 006). Through the use of the Surface Distress Index (SDI) method, damage to roads can be classified more easily, enabling more accurate and targeted maintenance cost planning according to the level of damage identified (Sujarwo & Oetomo, 2022). Thus, SDI allows road managers to intervene according to the level of damage, be it minor or major repairs, which contributes to more effective budget management. This can provide more complete information for policy makers in planning road repairs or maintenance, so that budget allocations can be made more precisely and efficiently. The research focus on the Durenan-Prigi road section (Link 006) is particularly relevant, given that this road is an important route that connects various regions, including tourist destinations. By ensuring the road is in good condition, the quality of road services can be maintained, which will certainly increase comfort and safety for both local communities and tourists. In addition, optimal road maintenance also has a positive impact on the local economy, as it improves the smooth transportation of goods and people, which in turn can support economic sectors that depend on road accessibility. Therefore, this research is crucial not only to ensure good quality road infrastructure, but also to support wiser budget allocations that benefit the wider community.

Literature Review

Previous Research

In this study the authors took references from previous research that had been carried out related to road condition assessment research and calculation of road maintenance costs.

A study in Sukabumi District (Cisaat-Situgunung) by Cucup Muhammad Yusup, Tahadjudin, and Nia Kartika (2019) analyzed road maintenance costs using the SDI method. This study identified several types of damage such as patches, splice cracks, edge cracks, and potholes. The results of SDI show the lowest value of 10 and the highest of 310, with an average SDI value of 111.45. The cost budget plan for maintaining this road reaches Rp. 744,057,000.00 with a damage area of 10.99%.

A study in Sorong Regency (2023) by Murni, Asriadi, and Ahmad Badrul Ali Mustofa used the SDI method for road damage mapping. This study identified defects such as potholes, sinkholes, surface layer peeling, and longitudinal and transverse cracks. Based on the SDI results, road conditions are divided into four categories: 66% of roads are in good condition, 23% are in moderate condition, 3% are lightly damaged, and 4% are severely damaged (Murni, Asriadi, & Mustofa, 2024).

A study in Sidoarjo (Mayjen Bambang Yuwono Road) by Ukhti Sukma Azhari, Nurani Hartatik, and Laily Endah Fatmawati (2024) found that most road defects consisted of crocodile skin cracks, longitudinal cracks, and potholes. Of the total road segments studied, 70% were in good condition, 27% were moderate, and 3% had minor damage. More intensive maintenance is required on the segments with moderate damage.

Comparison of SDI and PCI Methods on Gresik-Paciran Road by Shaafiyah Zahroo Khairunnisa and Cahya Buana (2023) shows a comparison between SDI, PCI, and recommendations for road handling with patching and reconstruction methods. This study compares the level of damage using both methods to determine the appropriate treatment.

Definition of Road

Based on Law No.38 of 2004, Road is a land transportation infrastructure that includes all parts of the Road, including connecting buildings, complementary buildings and equipment

intended for traffic, which is on the ground surface, above the ground surface, below the ground surface, and / or water, as well as above the water surface, except rail roads, lorry roads, and cable roads. Roads are infrastructure that is needed in the transportation system to connect one place to another in order to fulfill economic, social and cultural needs

Based on Government Regulation No. 34 of 2006, public roads are classified as follows:

1. National Road
2. Provincial Road
3. District Road
4. City Road; and
5. Village Road

Provincial roads consist of several classifications based on the following:

1. Primary collector roads that connect provincial capitals with regency/city capitals
2. Primary collector roads that connect the capital of the regency or city
3. Provincial Strategic Roads; and
4. Roads in the Special Capital Region of Jakarta

Surface Distress Index

Surface Distress Index (SDI) is a method used to evaluate road conditions through visual inspection that includes total crack area, crack width, average crack size, number of potholes, and depth of vehicle ruts (Yusup & Kartika, 2019). The assessment using the SDI method is in accordance with the 2011 Road Condition Survey Guide, as follows:

a. SDI1 Total area of cracks

- None
- < 10% = SDI1 5
- 10 % - 30 % = SDI1 20%
- >30% = SDI1 40

b. SDI2 Average Crack Widts

- None
- Fine < 1mm SDI2= SDI1
- Med 1-5mm SDI2= SDI1
- Wide > 5 mm SDI2= SDI1 x 2

c. SDI3 Total of Potholes

- None
- Number of Holes < 1/100 M SDI3= SDI2+15
- Number of Holes 2-5/100 M SDI3= SDI2+75
- Number of Holes >5/100 M SDI3= SDI2 +225

d. SDI4 based on vehicle ruts (Average Depth of Wheel Rutting)

- None
- Rutting depth < 1 cm... X = 0.5 SDI = SDI + 5*X
- Rutting Depth 1-3 cm...X = 2 SDI = SDI + 5*X
- Rutting depth > 3 cm...X = 5 SDI= SDI +20

The SDI assessment was carried out by summing up the damage values encountered and categorized according to Table 1.

Table 1. SDI value

ROAD CONDITIONS	SDI
OK	<50
MEDIUM	50-100
LIGHTLY DAMAGED	100-150
HEAVY DAMAGE	>150

Source: *Bina Marga (2011)*

Based on this table, the road condition category on each segment can be known based on the accumulated SDI value.

Cost Budget Plan

The cost budget plan is calculated based on the type of handling of each damage encountered, the calculation of the cost budget plan uses the analysis of the unit price of the Ministry of PUPR work by using the unit price of the district area. Trenggal

Despite the widespread application of the Surface Distress Index (SDI) method in assessing road conditions, there is limited research focusing on its integration with maintenance cost estimation for roads serving as primary access to tourism destinations. Most existing studies emphasize general road conditions or urban settings, neglecting the unique challenges of maintaining roads in rural or high-traffic tourist areas, such as the Durenan-Prigi road section. This study addresses this gap by analyzing SDI alongside budget planning specific to such critical infrastructure.

With the Durenan-Prigi road section being a crucial access point to prominent tourist destinations in Trenggalek Regency, maintaining its "Good" condition is essential to ensure the comfort and safety of road users. The road's deterioration could hinder tourism-driven economic growth, disrupt local mobility, and increase the risk of accidents. This study's urgency lies in its potential to provide data-driven insights into effective road maintenance strategies, contributing to sustainable infrastructure that supports regional development and economic stability.

This research introduces a novel approach by combining the SDI method with a detailed estimation of maintenance costs tailored to the unique needs of a high-traffic tourist route. It highlights the application of targeted repair strategies, such as emulsified asphalt coating and crack sealing, based on specific types and extents of road damage. The study also provides a case-specific model that can guide policymakers and engineers in optimizing budget allocation for similar road infrastructures in rural and tourism-focused areas.

The main objectives of this research are to evaluate the road condition of the Durenan-Prigi section using the SDI method, identify specific types of damage, and estimate the required maintenance budget. The study also aims to propose cost-effective maintenance strategies that align with the road's role as a vital access route for tourism.

This study offers practical benefits for local governments and policymakers by providing a framework for prioritizing maintenance activities and optimizing budget allocation. It also contributes to academic research by expanding the application of the SDI method in budget planning for rural and tourism-centric roads. For the community, the findings support the development of safer and more reliable transportation infrastructure, enhancing economic activities and improving overall accessibility to key tourist destinations.

METHOD

Research Location

The location of this research is on the Durenan - Prigi Road Section (Link 006) with a length of 30.4 Km with the following details:

- Location : Road Section Durenan - Prigi (Link 006)
- Road Length : 30.4 (Thirty point four) Km
- Km. Sbaya : 171+000 to 201+400
- Road Status : East Java Provincial Road

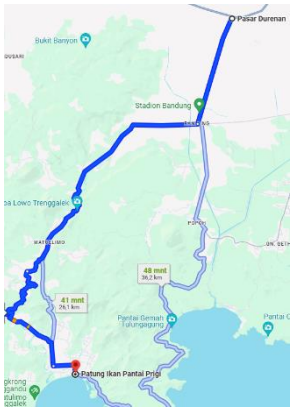

Figure 1. Durenan - Prigi Road Section (Link 006)

The Durenan - Prigi road section passes through 2 (two) districts, namely Trenggalek Regency and Tulungagung Regency and passes through 3 sub-districts, namely Durenan District (Trennggalek Regency), Bandung District (Tulungagung Regency) and Watulimo District (Trenggalek Regency).

Data

The data in this study includes primary and secondary data. The data is described as follows.

a. Primary data, data obtained by direct field or direct data collection, in this case primary data collection is carried out on the Durenan - Prigi Road Section (Link 006).
b. Secondary data, data obtained indirectly, including data from related agencies, journals, books and other scientific works.

Survey Method

The survey method carried out is directly in the field through visual observations, before the survey is carried out it is necessary to prepare a variety of both equipment and data - the data needed so that implementation can run smoothly. Survey equipment includes the following.

1. 4 Wheel Vehicle
2. Camera with good resolution for recording Road conditions
3. Road damage record form
4. Tensile Meter
5. GPS
6. Smartphone

Then, the survey was conducted as follows.

1. Observations were made from inside a 4-wheeled vehicle running slowly at a speed of 15-20 km/h and filling in the prepared form.
2. Observations were carried out from the beginning of Km Sbaya section 171+000 to the end of Section 201+400.
3. If necessary, direct measurements are taken on the road section.
4. Conduct damage documentation and survey implementation documentation

Handling Planning

Handling recommendations are based on the type of damage encountered and the quantity of damage, the damage will be categorized into the type of handling plan, namely:

a. Routine Maintenance
b. Periodic Maintenance
c. Rehabilitation/Reconstruction

Improved

RESULTS AND DISCUSSION

Road Condition Analysis Using the Surface Distress Index (SDI) Method

Based on the data obtained, the next step is to analyze using the SDI method, here is an example of calculations using the *Surface Distress Index* (SDI) method at STA 001+000 to 001+100:

a. SDI Value Calculation 1

Crack Length : 30 Meters
Crack Width : 2 Meters
Crack Area : 30 x 2 = 60 M2
Segment Area : P x L
: 100 x 5 Meters
: 500 m^2
Percentage : $\frac{60}{500}$ x 100% = 12%

Since the percentage value is between 10% - 30%, the SDI 1 value is 20.

b. SDI Value Calculation 2

Based on the observation, the crack has a crack width between 1-5 mm so that it has an SDI value of 2 = SDI value 1, namely 20

c. SDI Value Calculation 3

SDI Value Calculation 3 Based on the number of existing holes
Number of Holes : 2
So using the formula SDI 3 = SDI 2 +75
SDI 3 = 20+75
SDI 3 = 95

d. SDI Value Calculation 4

The SDI 4 value calculation is based on the depth of the ruts, in this case the depth of the ruts = 0, so the SDI 4 value is 95.

Based on this calculation, the SDI value of 20 has a road condition category of "Moderate". Then, the SDI results also show that the majority of roads are in "Good" condition.

Table 2. Recapitulation of SDI Value

No.	STA			SDI VALUE	Category	No.	STA			SDI VALUE	Category
1	000+000	sd	000+100	75	Medium	153	015+200	sd	015+300	80	Medium
2	000+100	sd	000+200	0	Good	154	015+300	sd	015+400	20	Good
3	000+200	sd	000+300	0	Good	155	015+400	sd	015+500	40	Good
4	000+300	sd	000+400	0	Good	156	015+500	sd	015+600	40	Good
5	000+400	sd	000+500	0	Good	157	015+600	sd	015+700	5	Good

6	000+500	sd	000+600	5	Good	158	015+700	sd	015+800	0	Good
7	000+600	sd	000+700	5	Good	159	015+800	sd	015+900	0	Good
8	000+700	sd	000+800	0	Good	160	015+900	sd	016+000	0	Good
9	000+800	sd	000+900	0	Good	161	016+000	sd	016+100	0	Good
10	000+900	sd	001+000	20	Good	162	016+100	sd	016+200	0	Good
11	001+000	sd	001+100	95	Medium	163	016+200	sd	016+300	95	Medium
12	001+100	sd	001+200	5	Good	164	016+300	sd	016+400	0	Good
13	001+200	sd	001+300	0	Good	165	016+400	sd	016+500	35	Good
14	001+300	sd	001+400	0	Good	166	016+500	sd	016+600	0	Good
15	001+400	sd	001+500	0	Good	167	016+600	sd	016+700	0	Good
16	001+500	sd	001+600	0	Good	168	016+700	sd	016+800	0	Good
17	001+600	sd	001+700	0	Good	169	016+800	sd	016+900	5	Good
18	001+700	sd	001+800	0	Good	170	016+900	sd	017+000	5	Good
19	001+800	sd	001+900	0	Good	171	017+000	sd	017+100	0	Good
20	001+900	sd	002+000	0	Good	172	017+100	sd	017+200	0	Good
21	002+000	sd	002+100	0	Good	173	017+200	sd	017+300	75	Medium
22	002+100	sd	002+200	0	Good	174	017+300	sd	017+400	15	Good
23	002+200	sd	002+300	0	Good	175	017+400	sd	017+500	15	Good
24	002+300	sd	002+400	0	Good	176	017+500	sd	017+600	75	Medium
25	002+400	sd	002+500	0	Good	177	017+600	sd	017+700	75	Medium
26	002+500	sd	002+600	0	Good	178	017+700	sd	017+800	0	Good
27	002+600	sd	002+700	0	Good	179	017+800	sd	017+900	75	Medium
28	002+700	sd	002+800	0	Good	180	017+900	sd	018+000	20	Good
29	002+800	sd	002+900	0	Good	181	018+000	sd	018+100	15	Good
30	002+900	sd	003+000	0	Good	182	018+100	sd	018+200	0	Good
31	003+000	sd	003+100	0	Good	183	018+200	sd	018+300	0	Good
32	003+100	sd	003+200	0	Good	184	018+300	sd	018+400	0	Good
33	003+200	sd	003+300	0	Good	185	018+400	sd	018+500	0	Good
34	003+300	sd	003+400	0	Good	186	018+500	sd	018+600	0	Good
35	003+400	sd	003+500	0	Good	187	018+600	sd	018+700	0	Good
36	003+500	sd	003+600	0	Good	188	018+700	sd	018+800	5	Good
37	003+600	sd	003+700	0	Good	189	018+800	sd	018+900	5	Good
38	003+700	sd	003+800	0	Good	190	018+900	sd	019+000	0	Good
39	003+800	sd	003+900	0	Good	191	019+000	sd	019+100	0	Good
40	003+900	sd	004+000	0	Good	192	019+100	sd	019+200	0	Good
41	004+000	sd	004+100	0	Good	193	019+200	sd	019+300	0	Good
42	004+100	sd	004+200	0	Good	194	019+300	sd	019+400	0	Good
43	004+200	sd	004+300	0	Good	195	019+400	sd	019+500	0	Good
44	004+300	sd	004+400	15	Good	196	019+500	sd	019+600	75	Medium
45	004+400	sd	004+500	0	Good	197	019+600	sd	019+700	0	Good
46	004+500	sd	004+600	0	Good	198	019+700	sd	019+800	75	Medium
47	004+600	sd	004+700	0	Good	199	019+800	sd	019+900	0	Good
48	004+700	sd	004+800	20	Good	200	019+900	sd	020+000	0	Good
49	004+800	sd	004+900	20	Good	201	020+000	sd	020+100	0	Good

50	004+900	sd	005+000	75	Medium	202	020+100	sd	020+200	0	Good
51	005+000	sd	005+100	0	Good	203	020+200	sd	020+300	0	Good
52	005+100	sd	005+200	0	Good	204	020+300	sd	020+400	0	Good
53	005+200	sd	005+300	0	Good	205	020+400	sd	020+500	0	Good
54	005+300	sd	005+400	75	Medium	206	020+500	sd	020+600	0	Good
55	005+400	sd	005+500	5	Good	207	020+600	sd	020+700	0	Good
56	005+500	sd	005+600	20	Good	208	020+700	sd	020+800	0	Good
57	005+600	sd	005+700	0	Good	209	020+800	sd	020+900	0	Good
58	005+700	sd	005+800	5	Good	210	020+900	sd	021+000	75	Medium
59	005+800	sd	005+900	75	Medium	211	021+000	sd	021+100	0	Good
60	005+900	sd	006+000	0	Good	212	021+100	sd	021+200	0	Good
61	006+000	sd	006+100	0	Good	213	021+200	sd	021+300	15	Good
62	006+100	sd	006+200	15	Good	214	021+300	sd	021+400	0	Good
63	006+200	sd	006+300	0	Good	215	021+400	sd	021+500	0	Good
64	006+300	sd	006+400	75	Medium	216	021+500	sd	021+600	15	Good
65	006+400	sd	006+500	0	Good	217	021+600	sd	021+700	0	Good
66	006+500	sd	006+600	0	Good	218	021+700	sd	021+800	0	Good
67	006+600	sd	006+700	0	Good	219	021+800	sd	021+900	0	Good
68	006+700	sd	006+800	75	Medium	220	021+900	sd	022+000	0	Good
69	006+800	sd	006+900	0	Good	221	022+000	sd	022+100	0	Good
70	006+900	sd	007+000	0	Good	222	022+100	sd	022+200	75	Medium
71	007+000	sd	007+100	0	Good	223	022+200	sd	022+300	0	Good
72	007+100	sd	007+200	0	Good	224	022+300	sd	022+400	0	Good
73	007+200	sd	007+300	0	Good	225	022+400	sd	022+500	0	Good
74	007+300	sd	007+400	0	Good	226	022+500	sd	022+600	0	Good
75	007+400	sd	007+500	0	Good	227	022+600	sd	022+700	0	Good
76	007+500	sd	007+600	0	Good	228	022+700	sd	022+800	0	Good
77	007+600	sd	007+700	0	Good	229	022+800	sd	022+900	15	Good
78	007+700	sd	007+800	0	Good	230	022+900	sd	023+000	75	Medium
79	007+800	sd	007+900	20	Good	231	023+000	sd	023+100	80	Medium
80	007+900	sd	008+000	5	Good	232	023+100	sd	023+200	75	Medium
81	008+000	sd	008+100	20	Good	233	023+200	sd	023+300	0	Good
82	008+100	sd	008+200	20	Good	234	023+300	sd	023+400	0	Good
83	008+200	sd	008+300	20	Good	235	023+400	sd	023+500	0	Good
84	008+300	sd	008+400	15	Good	236	023+500	sd	023+600	0	Good
85	008+400	sd	008+500	80	Medium	237	023+600	sd	023+700	0	Good
86	008+500	sd	008+600	20	Good	238	023+700	sd	023+800	0	Good
87	008+600	sd	008+700	0	Good	239	023+800	sd	023+900	0	Good
88	008+700	sd	008+800	0	Good	240	023+900	sd	024+000	0	Good
89	008+800	sd	008+900	75	Medium	241	024+000	sd	024+100	75	Medium
90	008+900	sd	009+000	0	Good	242	024+100	sd	024+200	0	Good
91	009+000	sd	009+100	0	Good	243	024+200	sd	024+300	75	Medium
92	009+100	sd	009+200	0	Good	244	024+300	sd	024+400	0	Good
93	009+200	sd	009+300	0	Good	245	024+400	sd	024+500	0	Good

94	009+300	sd	009+400	0	Good	246	024+500	sd	024+600	20	Good
95	009+400	sd	009+500	0	Good	247	024+600	sd	024+700	0	Good
96	009+500	sd	009+600	0	Good	248	024+700	sd	024+800	15	Good
97	009+600	sd	009+700	0	Good	249	024+800	sd	024+900	0	Good
98	009+700	sd	009+800	0	Good	250	024+900	sd	025+000	0	Good
99	009+800	sd	009+900	0	Good	251	025+000	sd	025+100	0	Good
100	009+900	sd	010+000	0	Good	252	025+100	sd	025+200	0	Good
101	010+000	sd	010+100	0	Good	253	025+200	sd	025+300	0	Good
102	010+100	sd	010+200	0	Good	254	025+300	sd	025+400	0	Good
103	010+200	sd	010+300	0	Good	255	025+400	sd	025+500	0	Good
104	010+300	sd	010+400	0	Good	256	025+500	sd	025+600	20	Good
105	010+400	sd	010+500	0	Good	257	025+600	sd	025+700	0	Good
106	010+500	sd	010+600	0	Good	258	025+700	sd	025+800	0	Good
107	010+600	sd	010+700	0	Good	259	025+800	sd	025+900	0	Good
108	010+700	sd	010+800	0	Good	260	025+900	sd	026+000	0	Good
109	010+800	sd	010+900	0	Good	261	026+000	sd	026+100	0	Good
110	010+900	sd	011+000	75	Medium	262	026+100	sd	026+200	0	Good
111	011+000	sd	011+100	0	Good	263	026+200	sd	026+300	0	Good
112	011+100	sd	011+200	0	Good	264	026+300	sd	026+400	0	Good
113	011+200	sd	011+300	5	Good	265	026+400	sd	026+500	0	Good
114	011+300	sd	011+400	0	Good	266	026+500	sd	026+600	80	Medium
115	011+400	sd	011+500	95	Medium	267	026+600	sd	026+700	0	Good
116	011+500	sd	011+600	0	Good	268	026+700	sd	026+800	0	Good
117	011+600	sd	011+700	75	Medium	269	026+800	sd	026+900	0	Good
118	011+700	sd	011+800	0	Good	270	026+900	sd	027+000	0	Good
119	011+800	sd	011+900	5	Good	271	027+000	sd	027+100	0	Good
120	011+900	sd	012+000	0	Good	272	027+100	sd	027+200	0	Good
121	012+000	sd	012+100	0	Good	273	027+200	sd	027+300	0	Good
122	012+100	sd	012+200	5	Good	274	027+300	sd	027+400	0	Good
123	012+200	sd	012+300	5	Good	275	027+400	sd	027+500	0	Good
124	012+300	sd	012+400	80	Medium	276	027+500	sd	027+600	5	Good
125	012+400	sd	012+500	5	Good	277	027+600	sd	027+700	0	Good
126	012+500	sd	012+600	0	Good	278	027+700	sd	027+800	0	Good
127	012+600	sd	012+700	0	Good	279	027+800	sd	027+900	0	Good
128	012+700	sd	012+800	5	Good	280	027+900	sd	028+000	75	Medium
129	012+800	sd	012+900	5	Good	281	028+000	sd	028+100	0	Severely Damaged
130	012+900	sd	013+000	80	Medium	282	028+100	sd	028+200	0	Good
131		sd	013+100	95	Medium	283	028+200	sd	028+300	0	Good
132	013+100	sd	013+200	80	Medium	284	028+300	sd	028+400	0	Good
133	013+200	sd	013+300	0	Good	285	028+400	sd	028+500	0	Good
134	013+300	sd	013+400	0	Good	286	028+500	sd	028+600	0	Good
135	013+400	sd	013+500	0	Good	287	028+600	sd	028+700	0	Good
136	013+500	sd	013+600	0	Good	288	028+700	sd	028+800	0	Good
137	013+600	sd	013+700	0	Good	289	028+800	sd	028+900	0	Good

138	013+700	sd	013+800	0	Good	290	028+900	sd	029+000	0	Good
139	013+800	sd	013+900	0	Good	291	029+000	sd	029+100	0	Good
140	013+900	sd	014+000	0	Good	292	029+100	sd	029+200	0	Good
141	014+000	sd	014+100	0	Good	293	029+200	sd	029+300	0	Good
142	014+100	sd	014+200	0	Good	294	029+300	sd	029+400	0	Good
143	014+200	sd	014+300	75	Medium	295	029+400	sd	029+500	0	Good
144	014+300	sd	014+400	80	Medium	296	029+500	sd	029+600	0	Good
145	014+400	sd	014+500	15	Good	297	029+600	sd	029+700	0	Good
146	014+500	sd	014+600	0	Good	298	029+700	sd	029+800	0	Good
147	014+600	sd	014+700	20	Good	299	029+800	sd	029+900	0	Good
148	014+700	sd	014+800	5	Good	300	029+900	sd	030+000	0	Good
149	014+800	sd	014+900	20	Good	301	030+000	sd	030+100	0	Good
150	014+900	sd	015+000	75	Medium	302	030+100	sd	030+200	0	Good
151	015+000	sd	015+100	20	Good	303	030+200	sd	030+300	0	Good
152	015+100	sd	015+200	95	Medium	304	030+300	sd	030+400	0	Good

Budget Plan for Handling Costs

Based on the budget recapitulation above, the following cost calculation is planned:

Table 3. Handling Cost Plan

No.	Jobs	Volume	Unit Price	Maintenance Type
	Division 4 Preventive Work			
1	Asphalt emulsion slurry cover layer type 3, CQS-1h	33,719.00	70,939.84	2,392,020,512.39
	Total Division 4			2,392,020,512.39
	Division 10 Performance Maintenance Work			
1	Improvement of Cold-Heated Hot Mix Asphalt	36.54	4,404,521.82	160,955,321.83
2	Sealing Type 1 (Cracks 0.20 - 0.50 cm)	1,730.00	25,424.83	43,984,952.06
	Total Division 10			204,940,273.88
	Total			**2,596,960,786.27**

The unit price is based on the analysis of the Ministry of Public Works and the East Java Province Bina Marga Public Works Office which has been adjusted to the price of local wages and materials. Based on the table above, it is known that the maintenance cost of the Durenan - Prigi Road Section (Link 006) is Rp. 2,596,960,786.27 (Two billion five hundred ninety-six million nine hundred sixty thousand seven hundred eighty-six rupiah twenty-seven cents).

Discussion

The analysis using the Surface Distress Index (SDI) method on the Durenan-Prigi road section revealed that the overall condition of the road is categorized as "Good," with an average SDI value of 11.89. This finding indicates that most segments of the road have minimal damage but still require routine maintenance to preserve their optimal condition. These results align with prior studies by Yusup and Kartika (2019), which emphasized the importance of maintenance even for roads that are not yet classified as severely damaged, to prevent further deterioration.

The Role of the SDI Method in Budget Planning

The SDI method has proven to be an effective tool for providing an objective assessment of road conditions through a structured visual inspection approach. This method facilitates the identification and classification of damage, such as cracks, potholes, and surface deformations, based on severity. Consequently, it supports more efficient budget allocation by identifying the specific types and locations of damage that require prioritized attention. For example, the findings from this study highlight that the dominant types of damage include crocodile skin cracks, block cracks, and longitudinal cracks, which can be addressed through type-3 asphalt emulsion overlays, cold mix asphalt repairs, and crack sealing for specified widths.

Implications for Maintenance Costs

The cost estimation for maintaining the Durenan-Prigi road section amounts to IDR 2,596,960,786.27. This includes IDR 2,392,020,512.39 for asphalt emulsion overlays, IDR 160,955,321.83 for cold mix asphalt repairs, and IDR 43,984,952.06 for crack sealing. This budget reflects a significant investment but is justified by the need to maintain the road's "Good" condition. These findings are consistent with research by Ghoni and Alawi (2021), which demonstrated that the SDI method enables budget planning based on the actual condition of road damage, thereby avoiding unnecessary expenses.

Limitations and Challenges

However, the study also identified limitations, such as the absence of adequate drainage systems along some segments of the road. Standing water during the rainy season poses a significant risk of accelerating damage, including the formation of potholes and larger cracks. These observations support the findings of Nugroho and Marleno (2020), who stressed the critical role of drainage infrastructure in mitigating road deterioration.

Relevance to the Local Context

As a primary route to key tourist destinations in Trenggalek Regency, maintaining the road in optimal condition directly impacts user comfort and facilitates economic mobility in the region. Therefore, in addition to addressing physical damage, improving supporting infrastructure, such as drainage systems, should be prioritized in road management planning.

Recommendations for Future Research

Future studies could explore the comparative effectiveness of the SDI method against other evaluation approaches, such as the Pavement Condition Index (PCI) or the International Roughness Index (IRI), to gain a broader perspective on road assessment methodologies. Additionally, the influence of environmental factors, such as rainfall and traffic volume, on the rate of road deterioration warrants further investigation to develop more proactive maintenance strategies.

CONCLUSION

Based on the analysis that has been calculated, the conclusions that can be drawn are the types of damage that occur on the Durenan - Prigi Road Section are Crocodile Skin Cracks (alligator cracks), Overweight, Block Cracks, Curling, Curb Cracks, Longitudinal or vertical cracks, Patches, Aggregate Scouring, and Potholes, based on the calculation of the road condition value using the SDI method has an average SDI value of 11.89 so that it has a "GOOD" category.

The Budget Plan for the repair of the Durenan - Prigi road section is Rp. 2,596,960,786.27 (Two billion five hundred ninety-six million nine hundred sixty thousand seven hundred eighty-six rupiah twenty-seven cents), with details of the Work of Overlaying Type 3 emulsion asphalt slurry cover layer, CQS-1h amounting to Rp. 2,392,020,512.39, Repair Work of Hot Mix Asphalt Cold Rp. 160,955,321.83 and Sealing Type 1 (Cracks 0.20 - 0.50 cm) amounting to Rp. 43,984,952.06.

REFERENCES

Anugrah, Dewi Asri. (2021). *Analisa Penilaian Kondisi Jalan Raya Dengan Metode Surface Distress Index (Sdi) Dan Present Serviceability Index (Psi) Studi Kasus: Duri Kecamatan Mandau*. Universitas Islam Riau.

Arianto, T., & Suprapto, M. (2018). Pavement Condition Assessment Using Iri From Roadroid And Surface Distress Index Method On National Road In Sumenep Regency. *Iop Conference Series: Materials Science And Engineering*, *333*(1), 12091. Iop Publishing.

Azhari, Ukhti Sukma, Hartatik, Nurani, & Fatmawati, Laily Endah. (2024). Analisis Kerusakan Perkerasan Jalan Menggunakan Metode Surface Distress Index (Sdi)(Studi Kasus Jalan Mayjen Bambang Yuwono, Balongbendo, Sidoarjo). *Journal Of Scientech Research And Development*, *6*(1), 598–605.

Ghoni, Mohammad Affan Abdul, & Alawi, Muhammad Watsiq. (2021). *Analisis Perbandingan Penggunaan Dinding Penahan Tanah Tipe Kantiliver Dan Tipe Gravitasi Menggunakan Aplikasi Plaxis V. 8.6 Dan Perhitungan Manual*. Universitas Islam Sultan Agung.

Gusnilawati, Anisa, Chrisnawati, Yusfita, & Maryunani, Woro Partini. (2021). Analisis Penilaian Faktor Kerusakan Jalan Dengan Perbandingan Metode Bina Marga, Metode Pci (Pavement Condition Index), Dan Metode Sdi (Surface Distress Index). *Jurnal Rekayasa Infrastruktur Sipil*, *2*(1), 15.

Hasrudin, La, & Maha, Indra. (2024). Analisis Penilaian Kondisi Perkerasan Jalan Dengan Metode Pci (Pavement Condition Index), Sdi (Surface Distress Index) Dan Iri (International Roughness Index). *Syntax Idea*, *6*(4), 1881–1898.

Hermawati, Putu, & Putri, Npas. (2024). Assessment Of Road Pavement Conditions Using Surface Distress Index (Sdi) And Pavement Condition Index (Pci) Methods. *Iop Conference Series: Earth And Environmental Science*, *1294*(1), 12030. Iop Publishing.

Khairunnisa, Shaafiyah Zahroo, & Buana, Cahya. (2023). Analisis Kondisi Dan Perbaikan Perkerasan Pada Ruas Jalan Gresik–Paciran Km Sby 28 Sampai Dengan Km Sby 38 Dengan Menggunakan Metode Pci Dan Sdi. *Jurnal Teknik Its*, *12*(1), E39–E45.

Murni, Murni, Asriadi, Asriadi, & Mustofa, Ahmad Badrul Ali. (2024). Analisis Pemetaan Kerusakan Jalan Kabupaten Sorong Dengan Metode Sdi (Surface Distress Index). *Journal Peqguruang: Conference Series*, *5*(1), 32–38.

Nugroho, Dandy, & Marleno, Risma. (2020). *Optimasi Waktu Dan Biaya Proyek Revitalisasi Pasar Kraton Kota Tegal Dengan Metode Time Cost Trade Off*. Untag Surabaya.

Sandyna, Aisyah Nurfakhirah, Elfichra, Ayu, Aqilla, Azzahra, Novaldi, Kevin, & Adiman, Edi Yusuf. (2022). Analisis Perbandingan Tingkat Kerusakan Jalan Pada Perkerasan Lentur Dengan Metode Pci Dan Metode Sdi (Studi Kasus: Jalan As-Shofa Pekanbaru). *Journal Of Infrastructure And Civil Engineering*, *2*(2), 95–105.

Sujarwo, Aris, & Oetomo, Wateno. (2022). Analisis Waktu Dan Biaya Pembangunan Gedung Ikfm, Ips, Ipl Dan Parkir Kendaraan Karyawan. *Jurnal Kacapuri: Jurnal Keilmuan Teknik Sipil*, *5*(1), 269–278.

Suswandi, Agus, & Sartono, Wardhani. (2008). Evaluasi Tingkat Kerusakan Jalan Dengan Methode Pavement Condition Index (Pci) Untuk Menunjang Pengambilan Keputusan (Studi Kasus: Jalan Lingkar Selatan, Yogyakarta). *Civil Engineering Forum Teknik Sipil*, *18*(3), 934–946.

Wibowo, Alfino, Atmajayani, Risma Dwi, & Widodo, Trisno. (2023). Perbandingan Metode Pci Dan Sdi (Studi Kasus Jalan Penghubung Desa Kademanagan-Darungan). *Journal Of Science Nusantara*, *3*(3), 122–134.

Yusup, Cucup Muhammad, & Kartika, Nia. (2019). Analisis Biaya Pemeliharaan Terhadap Tingkat Kerusakan Jalan Menggunakan Metode Surface Distress Index (Sdi). *Santika Is A Scientific Journal Of Science And Technology*, *9*(2), 943–951.