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# Analysis of Cost Estimation and Road Surface Assessment of Kemlagi - Berat Kulon Road Section of Mojokerto District Using SDI Method

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## ABSTRACT
The road surface conditions on the Kemlagi–Beratkulon section in Mojokerto Regency were assessed, as it is a vital route linking Mojokerto and Gresik Regencies for transportation and economic activities. This research aimed to evaluate the road surface conditions and identify the severity of damage using the Surface Distress Index (SDI) method. The study employed a field survey method, dividing the road into 100-meter segments. Visual observations were used to measure crack area, crack width, number of potholes, and rutting depth. The results showed SDI values ranging from 165 to 285, with the highest value recorded at STA 2+500–2+700, indicating "HEAVY DAMAGE" in these areas. These findings highlight the need for immediate reconstruction to restore road functionality and prevent further degradation. The study underscores the SDI method’s effectiveness in providing a systematic evaluation of road conditions, which aids in prioritizing maintenance, resource allocation, and cost estimation. The research also implies that integrating the SDI method with advanced technological tools could lead to more accurate and proactive monitoring of road conditions, enhancing sustainable road management strategies.

**Keywords:** Cost Estimation, Road Surface Assessment, Surface Distress Index.

## INTRODUCTION

Roads and their pavements are vital components of infrastructure that support mobility and economic activity (Trubia et al., 2020). A well-maintained road surface contributes to driver safety and comfort, reduces the likelihood of accidents, and extends the service life of the road. However, over time, road conditions tend to degrade due to traffic pressure, environmental influences, and the age of the pavement material, which can give rise to defects such as cracks, potholes, and deformations (Ramachandraiah et al., 2023). Therefore, regular evaluation of the road surface condition is critical to detect damage early and plan appropriate maintenance measures.

The road surface condition evaluation process includes several steps, including visual data collection, identifying and measuring the extent of deterioration, and assigning a road condition assessment index. One of the commonly used methods is the Pavement Condition Index (PCI) and Surface Distress Index (SDI), which provide objective values for the level of deterioration and stability of the road (Qureshi et al., 2022). These evaluations can be done through manual inspections, specialized vehicles with sensors, or automated technologies based on image processing and artificial intelligence (AI), which are gaining popularity in improving accuracy and efficiency (Ramachandraiah et al., 2023).

Accurate monitoring and assessment of road conditions enable more efficient maintenance planning. Methods such as the Pavement Condition Index (PCI) or Surface Distress Index (SDI) help identify the extent of road deterioration and determine short—and long-term maintenance needs (Ramachandraiah et al., 2023); (Qureshi et al., 2022). Road infrastructure management can avoid further deterioration and reduce unnecessary maintenance costs with this condition evaluation.

Road surface condition assessment, such as using the Pavement Condition Index (PCI) and Surface Distress Index (SDI) methods, is an important step in the management of transportation infrastructure. The PCI method provides a quantitative assessment of pavement conditions on a scale of 0 to 100, where high scores indicate good road conditions and low scores indicate the need for immediate repair. PCI assessments are widely used to support road maintenance and rehabilitation decisions, assisting authorities in allocating resources efficiently (Pérez et al., 2024).

The SDI method, particularly in Indonesia, measures four primary indicators: crack area, width, number of potholes per kilometer, and rutting depth. These values determine whether the road requires routine, periodic, or complete rehabilitation maintenance. An SDI-based approach ensures that each defect is identified and measured precisely to tailor maintenance to specific needs (Uny, 2023).

In addition to manual methods, technological developments such as automated image processing and machine learning are beginning to be applied in road assessment. Artificial intelligence enables faster and more accurate analysis of damage types, such as alligator cracking and potholes, while reducing operational time and costs. This strengthens road maintenance management with more objective and accurate data, enabling more proactive planning (Ramachandraiah et al., 2023).

According to law number 2 of 2022 concerning the second amendment to law number 38 of 2004 concerning roads, road preservation is used to maintain the stability of the road until the age of the plan by carrying out routine road maintenance activities, periodic road maintenance, road rehabilitation, road reconstruction, and widening towards road standards. Routine road maintenance is maintaining and repairing damage continuously throughout the year (Permadi, 2021).

Periodic road maintenance is an activity of preventive handling of any damage, which is considered in the design so that the decline in road conditions can be restored to a stable condition according to the plan (Oetomo et al., 2017). Road rehabilitation is an activity to handle the prevention of any damage that is not taken into account in the design, which results in a decrease in stability conditions in certain parts/places of a road section with minor damage conditions that the decline in stability conditions can be restored to stability conditions according to plan

The SDI method is considered effective in providing an accurate picture of the condition of the road surface, allowing analysis of whether the road is in good, moderate, lightly damaged, or severely damaged condition, with each category requiring different treatment (Shibuya et al., 2022). This road condition assessment is expected to ensure that the Kemlagi - Beratkulon road section in Mojokerto Regency is maintained in good condition so that the benefits of the road can be maximized. The estimated cost of handling it can be known.

Based on the above background, the purpose of this study is to evaluate the condition of the road surface on the Kemlagi - Beratkulon section in Mojokerto Regency using the Surface Distress Index (SDI) method, and to calculate the estimated cost of road maintenance and repair based on the level of damage detected. Thus, the benefit of this study is to provide accurate data on road surface conditions that can be used by the authorities in making decisions related to road management, whether for routine maintenance, periodic maintenance, or total rehabilitation. In addition, this study also contributes to estimating the costs required to handle road damage, which is important in budgeting and resource allocation. Thus, this study is expected to help improve the efficiency of road infrastructure management in Mojokerto Regency and other areas with similar characteristics.

## RESEARCH METHOD

### Research Flow of Thought

The flow of thought in research describes the sequence of research stages and the existing work process, which describes the steps in each part of the research so that it can be clearly understood at each stage. The following are the stages of the conceptual framework of this research:

1. Search for references on factors affecting road valuation.
2. Identify data on factors affecting road assessment.
3. Determination of data affecting road assessment.
4. Analyze and process data using the SDI method.
5. Obtaining a budget according to road conditions
6. Result Conclusion.

### Subjects and Objects of Research

The subject of this study is a 3.637 km long district road connecting two sub-districts, namely Kemlagi and Dawarblandong sub-districts, which is under the responsibility of the Public Works and Spatial Planning Office of the Binamarga Division of Mojokerto District. The objects studied in this research include the condition of the Kemlagi - Beratkulon road section of

Mojokerto Regency, the factors causing road damage, Surface Distress Index (SDI) data, and the cost budget for handling road damage.

**Research Instruments**

Theory said that a research instrument is a tool used to measure observed natural and social phenomena (Sugiyono & Lestari, 2021). The instruments in this study are as follows:

1. SDI observations were made on each lane of Kemlagi - Beratkulon road.
2. Data was collected twice and controlled for consistency.
3. Data observations were made per 100 meters to obtain relatively detailed information.
4. Avoid sudden braking during the survey
5. ; survey time was selected during off-peak/busy hours.
6. Determine the characteristics of the survey vehicle.

**Data Collection Procedure**

The data collection methods in this study consisted of two methods: primary data and secondary data. Primary data was collected through direct observation of the road to measure road conditions. Secondary data was collected by taking data indirectly through DPUPR Mojokerto Regency. The secondary data includes road section data and road inventory.

**Data Analysis Technique**

The data analysis technique in this study uses the Surface Distress Index method. Data collection is done by visual observation. In the implementation of this method, the road is divided into segments, with each segment being 100m in length. The results of the SDI method were obtained from the road condition survey of the Mojokerto Regency PUPR Service. So, the damage that affects the SDI value is the area of cracks, crack width, number of holes, and depth of grooves or ruts on the pavement surface.

**Determining the Repair Cost Budget**

Determination of the budget for the implementation of the work is carried out by calculating the volume of work multiplied by the unit price to determine how much the proper implementation cost budget is. The determination of the implementation cost budget in this study uses an analysis of the unit price of work in 2024 in the field of Binamarga Mojokerto Regency.

## RESULT AND DISCUSSION

**Concrete Road Damage**

According to Circular 07/SE/Db/2017, the procedures for road maintenance and surveillance are as follows:

1. Longitudinal crack

   Cracks generally occur in the center of the concrete pavement, parallel to the road axis or traffic direction.

**Figure 1. Longitudinal Crack**

2. Transverse Crack

   Cracks that occur in the direction of the width of the concrete pavement and are almost perpendicular to the axis of the road.

**Figure 2. Transverse Crack**

3. Joint spalling

   The breakage of the edge of the concrete slab around the joint usually does not form a vertical plane but forms an angle to the flat plane.

**Figure 3. Joint Spalling**

4. Corner Breaks

   A rupture occurs at the corner of a concrete slab that intersects a joint at a distance less than or equal to ½ of the length of the slab on both sides of its length and width, measured from the corner of the slab.

**Figure 4. Corner Breaks**

5. Pumping

   Movement or uplift of material under a concrete slab due to water pressure through joints or cracks.

**Figure 5. Pumping**

**Surface Index Stress Calculation**

Based on IIRMS literature road condition survey guide number SMD-03/RCS 2011 to calculate the amount of SDI value, only 4 elements are required as support, namely: % crack area, average crack width, number of holes/km, and average rutting depth of ruts. The calculation of the SDI value is explained as follows:

The SDI stage starts with calculations using numbers as indicators. Namely, there are 1, 2, 3, and 4. This begins the calculation using the percentage of Crack Area. The results of the crack area are used to calculate the second indicator, namely the crack width; after knowing the crack width, the results are used to calculate the number of holes indicator. After that, it is added by calculating the tire groove marks from the number of holes indicator results. Then, the number of grooves becomes the value of SDI. The following are tables of SDI criteria.

1. Percentage Crack Value

**Table 1. Percentage of Cracks**

| Cracks Area Rating | | |
|---|---|---|
| **Figures** | **Broad Category Crack** | **SDI lr** |
| 1 | None | 0 |
| 2 | <10% | 5 |
| 3 | <10-30% | 20 |
| 4 | >30% | 40 |

*Source:* SMD-03/RCS, Bina Marga 2011

2. Crack Width Assessment

**Table 2. Crack Width Assessment**

| Crack Width Assessment | | |
|---|---|---|
| **Figures** | **Category Crack Width** | **SDI lbs** |
| 1 | None | 0 |
| 2 | Fine< 1 mm | 0 |
| 3 | Medium 1-5 mm | 0 |
| 4 | >5 mm wide | SDI results lr x 2 |

*Source:* SMD-03/RCS, Bina Marga 2011

3. Hole Count Assessment

**Table 3. Number of Holes**

| Assessment of Number of Potholes | | |
|---|---|---|
| **Figures** | **Category Number Hole** | **SDI jl** |
| 1 | None | 0 |
| 2 | <10/ 100 m | SDI result lbr +15 |
| 3 | 100 - 50/100 m | SDI results in lbr +75 |
| 4 | > 50/100 m | SDI results in lbr +225 |

*Source:* SMD-03/RCS, Bina Marga 2011

4. Assessment of Wheel Marks

**Table 4. Wheel Marks**

| Rutting Assessment | | | |
|---|---|---|---|
| **Figures** | **Category Number of Holes** | **Value X** | **SDI BR value** |
| 1 | None | 0 | Results SD jl+ 5 X 0 |
| 2 | < 1 cm deep | 0,5 | SDI results jl+ 5 x 0.5 |
| 3 | 1 - 3 cm deep | 2 | SDI Results+ 5 x 2 |
| 4 | > 3 cm | 4 | Results SDI jl+ 5 x 4 |

*Source:* SMD-03/RCS, Bina Marga 2011

Based on these four tables, the SDI value is then calculated as follows:

**Table 5. SDI values**

| Sdi Value Criteria | |
|---|---|
| **Sdi Value** | **Conditions** |
| <50 | OK |
| 50-100 | Medium |
| 100-150 | Lightly Damaged |
| >150 | Heavy Damage |

*Source:* SMD-03/RCS, Bina Marga 2011

For consecutive values of less than 50, the road condition is "GOOD," then 50 - 100 is "MEDIUM," then 100 - 150 is "LIGHTLY DAMAGED," and for values more than 150, it is "HEAVY DAMAGED."

The SDI value used is the adoption of SDI data from DPUPR Mojokerto Regency for changes used at STA 2+750 - 3+500 construction, which was carried out in 2020, and adjustments to field conditions based on the latest survey.

The following Table 6 is SKJ's input in accordance with IIRMS, Bina Marga 2011, for the Kemlgai—Beratkulon Road Section, with the assessment weight of percent cracks, crack width, number of holes, and ruts.

**Table 6. SKJ Input Table Kemlagi Beratkulon Section**

| INPUT SKJ SECTION KEMLAGI - BERAT KULON | | | | | | |
|---|---|---|---|---|---|---|
| | STA | | SKJ INPUT | | | |
| **No.** | **STA Initial** | **STA End** | **Extensive Crack** | **Width Crack** | **Total Hole** | **Used Wheels** |
| 1 | 2 | 3 | 5 | 6 | 7 | 8 |
| 1 | 0+,000 | 0+,100 | 1 | 1 | 1 | 1 |
| 2 | 0+,100 | 0+,200 | 2 | 2 | 1 | 1 |
| 3 | 0+,200 | 0+,300 | 2 | 3 | 3 | 1 |
| 4 | 0+,300 | 0+,400 | 3 | 4 | 3 | 3 |
| 5 | 0+,400 | 0+,500 | 2 | 4 | 3 | 3 |
| 6 | 0+,500 | 0+,600 | 1 | 1 | 1 | 1 |
| 7 | 0+,600 | 0+,700 | 2 | 3 | 1 | 1 |
| 8 | 0+,700 | 0+,800 | 1 | 1 | 3 | 1 |
| 9 | 0+,800 | 0+,900 | 1 | 1 | 1 | 1 |
| 10 | 0+,900 | 1+,000 | 2 | 3 | 2 | 1 |
| 11 | 1+,000 | 1+,100 | 1 | 1 | 1 | 1 |
| 12 | 1+,100 | 1+,200 | 1 | 1 | 1 | 1 |
| 13 | 1+,200 | 1+,300 | 4 | 4 | 3 | 3 |
| 14 | 1+,300 | 1+,400 | 4 | 4 | 3 | 4 |
| 15 | 1+,400 | 1+,500 | 4 | 3 | 2 | 3 |
| 16 | 1+,500 | 1+,600 | 3 | 4 | 2 | 3 |
| 17 | 1+,600 | 1+,700 | 1 | 1 | 1 | 1 |
| 18 | 1+,700 | 1+,800 | 2 | 4 | 2 | 3 |

| INPUT SKJ SECTION KEMLAGI - BERAT KULON | | | | | | |
|---|---|---|---|---|---|---|
| STA | | | SKJ INPUT | | | |
| No. | STA Initial | STA End | Extensive Crack | Width Crack | Total Hole | Used Wheels |
| 19 | 1+,800 | 1+,900 | 3 | 3 | 2 | 3 |
| 20 | 1+,900 | 2+,000 | 4 | 4 | 3 | 4 |
| 21 | 2+,000 | 2+,100 | 4 | 4 | 3 | 4 |
| 22 | 2+,100 | 2+,200 | 4 | 4 | 3 | 4 |
| 23 | 2+,200 | 2+,300 | 1 | 1 | 1 | 1 |
| 24 | 2+,300 | 2+,400 | 3 | 4 | 2 | 4 |
| 25 | 2+,400 | 2+,500 | 4 | 4 | 3 | 4 |
| 26 | 2+,500 | 2+,600 | 3 | 4 | 4 | 4 |
| 27 | 2+,600 | 2+,700 | 3 | 3 | 4 | 4 |
| 28 | 2+,700 | 2+,800 | 1 | 1 | 1 | 1 |
| 29 | 2+,800 | 2+,900 | 1 | 1 | 1 | 1 |
| 30 | 2+,900 | 3+,000 | 1 | 1 | 1 | 1 |
| 31 | 3+,000 | 3+,100 | 1 | 1 | 1 | 1 |
| 32 | 3+,100 | 3+,200 | 1 | 1 | 1 | 1 |
| 33 | 3+,200 | 3+,300 | 1 | 1 | 1 | 1 |
| 34 | 3+,300 | 3+,400 | 1 | 1 | 1 | 1 |
| 35 | 3+,400 | 3+,500 | 1 | 1 | 1 | 1 |
| 36 | 3+,500 | 3+,600 | 1 | 1 | 1 | 1 |

*Source:* Primary Data

After inputting the SKJ, the data is used to calculate the weighting to determine the SDI value. The results of the SDI value calculation are described in the following table.

**Table 7. SDI Value of Kemlagi - Beratkulon Section**

| SDI Value of Bagusan - Kalilamong Section | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| No. | Initial STA | STA End | Distance | Extensive Crack | Width Crack | Total Hole | Used Wheels | Value SDI | Dec. |
| 1 | 0+,000 | 0+,100 | 100 | 0 | 0 | 0 | 0 | 0 | OK |
| 2 | 0+,100 | 0+,200 | 100 | 5 | 5 | 5 | 5 | 5 | OK |
| 3 | 0+,200 | 0+,300 | 100 | 5 | 5 | 80 | 80 | 80 | Medium |
| 4 | 0+,300 | 0+,400 | 100 | 20 | 40 | 115 | 125 | 125 | Lightly Damaged |
| 5 | 0+,400 | 0+,500 | 100 | 5 | 10 | 85 | 95 | 95 | Medium |
| 6 | 0+,500 | 0+,600 | 100 | 0 | 0 | 0 | 0 | 0 | OK |
| 7 | 0+,600 | 0+,700 | 100 | 5 | 5 | 5 | 5 | 5 | OK |
| 8 | 0+,700 | 0+,800 | 100 | 0 | 0 | 75 | 75 | 75 | Medium |
| 9 | 0+,800 | 0+,900 | 100 | 0 | 0 | 0 | 0 | 0 | OK |
| 10 | 0+,900 | 1+,000 | 100 | 5 | 5 | 20 | 20 | 20 | OK |
| 11 | 1+,000 | 1+,100 | 100 | 0 | 0 | 0 | 0 | 0 | OK |
| 12 | 1+,100 | 1+,200 | 100 | 0 | 0 | 0 | 0 | 0 | OK |
| 13 | 1+,200 | 1+,300 | 100 | 40 | 80 | 155 | 165 | 165 | Heavy Damage |
| 14 | 1+,300 | 1+,400 | 100 | 40 | 80 | 155 | 175 | 175 | Heavy Damage |
| 15 | 1+,400 | 1+,500 | 100 | 40 | 40 | 55 | 65 | 65 | Medium |

| SDI Value of Bagusan - Kalilamong Section | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **No.** | **Initial STA** | **STA End** | **Distance** | **Extensive Crack** | **Width Crack** | **Total Hole** | **Used Wheels** | **Value SDI** | **Dec.** |
| 16 | 1+,500 | 1+,600 | 100 | 20 | 40 | 55 | 65 | 65 | Medium |
| 17 | 1+,600 | 1+,700 | 100 | 0 | 0 | 0 | 0 | 0 | OK |
| 18 | 1+,700 | 1+,800 | 100 | 5 | 10 | 25 | 35 | 35 | OK |
| 19 | 1+,800 | 1+,900 | 100 | 20 | 20 | 35 | 45 | 45 | OK |
| 20 | 1+,900 | 2+,000 | 100 | 40 | 80 | 155 | 175 | 175 | Heavy Damage |
| 21 | 2+,000 | 2+,100 | 100 | 40 | 80 | 155 | 175 | 175 | Heavy Damage |
| 22 | 2+,100 | 2+,200 | 100 | 40 | 80 | 155 | 175 | 175 | Heavy Damage |
| 23 | 2+,200 | 2+,300 | 100 | 0 | 0 | 0 | 0 | 0 | OK |
| 24 | 2+,300 | 2+,400 | 100 | 20 | 40 | 55 | 75 | 75 | Medium |
| 25 | 2+,400 | 2+,500 | 100 | 40 | 80 | 155 | 175 | 175 | Heavy Damage |
| 26 | 2+,500 | 2+,600 | 100 | 20 | 40 | 265 | 285 | 285 | Heavy Damage |
| 27 | 2+,600 | 2+,700 | 100 | 20 | 20 | 245 | 265 | 265 | Heavy Damage |
| 28 | 2+,700 | 2+,800 | 100 | 0 | 0 | 0 | 0 | 0 | OK |
| 29 | 2+,800 | 2+,900 | 100 | 0 | 0 | 0 | 0 | 0 | OK |
| 30 | 2+,900 | 3+,000 | 100 | 0 | 0 | 0 | 0 | 0 | OK |
| 31 | 3+,000 | 3+,100 | 100 | 0 | 0 | 0 | 0 | 0 | OK |
| 32 | 3+,100 | 3+,200 | 100 | 0 | 0 | 0 | 0 | 0 | OK |
| 33 | 3+,200 | 3+,300 | 100 | 0 | 0 | 0 | 0 | 0 | OK |
| 34 | 3+,300 | 3+,400 | 100 | 0 | 0 | 0 | 0 | 0 | OK |
| 35 | 3+,400 | 3+,500 | 100 | 0 | 0 | 0 | 0 | 0 | OK |
| 36 | 3+,500 | 3+,600 | 100 | 0 | 0 | 0 | 0 | 0 | OK |

*Source:* Primary Data Analysis

SDI values less than 50 have "GOOD" road conditions, then 50 - 100 have "MEDIUM" road conditions, values 100 - 150 have "LIGHTLY DAMAGED" road conditions, then values greater than 150 have "HEAVY DAMAGED" road conditions. For the SDI value, the Kemlagi - Beratkulon section is in Good condition at STA 0+000 - 0+200, 0+500 - 0+700, 0+800 - 1+200, 1+600 - 1+900, 2+200 - 2+300, AND 2+700 - 3+600. In Moderate condition STA 0+200 - 0+300, 0+400 - 0+500, 0+700 - 0+800, 1+400 - 1+600, 2+300 - 2+400. Lightly damaged condition STA 0+300 - 0+400, and Heavy Damaged condition at STA 1+200 - 1+400, 1+1900-2+200 and 2+400 - 2+700.

**Cost Budget**

Good planning is necessary in preparing road maintenance handling programs and activities. This planning can be based on the damage parameters that occur. By knowing the extent of each type of damage that occurs in a road section, the condition of the road section can be determined based on road damage condition data.

In preparing the cost requirements for road handling for the Kemlagi—Beratkulon section, roads in "GOOD" condition will be handled with routine maintenance, roads in "MEDIUM" condition will be handled with periodic maintenance, roads currently in "LIGHTLY DAMAGED" condition will be handled with upgrades, and roads in "HEAVY DAMAGED" condition will be handled with reconstruction.

In calculating the cost of handling road sections based on data obtained from the Bina Marga Division of the Public Works and Spatial Planning Office for handling costs that have been described in Table 8 about the type of work item and unit price of maintenance work with the availability of 100% fund allocation. The results of the calculation of road maintenance handling cost requirements for all road sections are shown in Table 8.

**Table 8. Unit Price of Maintenance Work**

| No. | Work Items | Price Unit | Unit |
|---|---|---|---|
| | | (IDR). | |
| I | Routine Maintenance | | |
| | **(for good condition roads)** | | |
| a | Roadside channel maintenance | 66.478,22 | Rp/m2 |
| b | Road Shoulder Leveling | | |
| c | Culvert cleaning | | |
| d | Shrubs | | |
| e | Patchwork with HRS - L | | |
| II | Periodic Maintenance | | |
| | **(for medium condition roads)** | | |
| a | Reconditioning on foundation damage (Deep Patching) | 99.594,22 | Rp/m2 |
| b | Overlay using AC - L (Levelling Top Laston) | | |
| c | Ancillary Buildings (Channel, Road Shoulder, Retaining Wall) | | |

The cost requirement for handling road stability on the Kemlagi - Beratkulon section was obtained at Rp. 1,351,908,452.00 (One Billion Thirty-One Million Nine Hundred Eight Thousand Four Hundred Fifty-Two Million Rupiah) for Routine and Periodic Maintenance.

The findings of this study highlight the critical role of the Surface Distress Index (SDI) method in evaluating road surface conditions, particularly for the Kemlagi–Beratkulon section. The results demonstrate that SDI provides a comprehensive assessment by categorizing road conditions into distinct levels—ranging from "Good" to "Heavy Damage"—based on specific indicators such as crack area, crack width, number of potholes, and rutting depth.

Several segments, such as STA 1+200–1+400 and STA 2+500–2+700, were identified as "Heavy Damage" conditions, with SDI values exceeding 150. These findings underline the need for immediate intervention to address severe deterioration and prevent further structural compromise. The study also emphasizes the importance of routine and periodic maintenance in "Good" or "Moderate" sections to sustain road quality and prolong its service life.

From a methodological perspective, the SDI method is a practical and efficient tool for road condition assessment (Syukri et al., 2024). By relying on visual observations and standardized calculations, SDI enables accurate identification of damage levels without requiring complex equipment. However, the reliance on manual inspection could introduce potential subjectivity in data collection. Future studies could explore integrating automated technologies, such as image processing and machine learning, to enhance data accuracy and minimize human error.

The cost analysis this research conducted further underscores road maintenance's financial implications. The estimated budget of IDR 1.35 billion for routine and periodic maintenance highlights the economic significance of timely and proactive interventions. Delays addressing "Heavy Damage" sections could escalate costs, as reconstruction is significantly more expensive than preventive measures.

In discussing the findings of this study, it is important to consider the broader context provided by previous research. (Araman & Saleh, 2023) emphasize the role of automated image processing and artificial neural networks in enhancing the accuracy and efficiency of pavement distress evaluations. Their approach to using advanced technologies could complement traditional methods like the Surface Distress Index (SDI), improving data precision and reducing human error during field surveys (Uaisova et al., 2024). This aligns with the findings of the current study, where SDI provided valuable insights into road conditions, yet it also highlighted the potential for further enhancement through technology integration. Additionally, (Akbar et al., 2025) noted that using visual assessment techniques, including SDI, helps in effectively categorizing the severity of road damage, which is critical for prioritizing maintenance. This research reinforces the SDI method's importance in identifying high-priority road segments that require urgent attention.

Moreover, the need for timely road maintenance is not only supported by the findings in this study but also by previous literature on cost-effective infrastructure management. (Frangopol & Liu, 2019) argue that early detection and intervention for road damage can significantly reduce long-term maintenance costs. The findings from this study, which indicate areas with "Heavy Damage" requiring immediate reconstruction, align with this perspective. Delayed maintenance or overlooking such areas can lead to escalating costs, as routine and periodic maintenance are more affordable compared to major reconstruction (Hauashdh et al., 2022). This study further contributes to the existing body of knowledge by providing detailed cost estimations for road maintenance, which can guide future infrastructure planning and ensure that public funds are efficiently allocated for road rehabilitation and preservation.

## CONCLUSION

The conclusions of this study, based on data analysis and SDI assessments, directly address the research objectives. The findings indicate that the condition of the road surface on the Kemlagi - Beratkulon section in Mojokerto Regency shows significant damage, with SDI values in several areas categorized as "HEAVY DAMAGE." These high SDI values—ranging from 165 to 285—highlight critical locations where immediate repairs are necessary. The total estimated budget for both routine and periodic maintenance is calculated at Rp. 1,351,908,452.00. This emphasizes the importance of accurate cost estimation, particularly through the *Harga Satuan Pokok Kegiatan* (HSPK), to ensure alignment with local regulations and efficient resource allocation.

Furthermore, this research contributes to the field by providing valuable data on road conditions and repair costs, which can be used for future road maintenance planning. In the future, this study's methodology can be applied to other road sections, enabling a more comprehensive approach to infrastructure maintenance in Mojokerto Regency and similar regions. Additionally, the findings underscore the need for ongoing attention to roads with significant damage (SDI > 150) to prevent further deterioration, which could result in higher long-term costs.

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