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Evaluation of Road Pavement Conditions Using The Surface Distress Index (SDI) as A Basis for Determining Maintenance Priorities (Case Study: Guru Bangkol Road, Mataram City)

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Abstract

The condition of road pavement that continues to experience degradation due to traffic loads and environmental factors requires regular evaluation to determine appropriate maintenance priorities. This study aims to evaluate the pavement condition of Jalan Guru Bangkol, Mataram City, using the Surface Distress Index (SDI) method as a basis for determining road maintenance priorities. The study used a descriptive quantitative approach through a visual survey of the road surface condition. The 1.25 km road section was divided into 13 observation segments with 100-meter intervals. Primary data were obtained through direct observation of the parameters of crack area, crack width, number of potholes, and wheel groove depth (rutting), then analyzed based on the SDI guidelines of the Directorate General of Highways. The results showed that of the 13 observed segments, 10 segments (76.92%) were in good condition, 1 segment (7.69%) was in moderate condition, and 2 segments (15.39%) were in a condition of slight damage, while no segments were found with severe damage. Based on the SDI value classification, most road sections are recommended for routine maintenance, while one segment requires periodic maintenance and two segments require road rehabilitation. The research results show that the SDI method is able to provide a systematic evaluation of pavement conditions and supports the determination of more objective and effective maintenance priorities as a basis for decision making in urban road infrastructure management.

INTRODUCTION

Roads are a strategic transportation infrastructure that plays a key role in supporting public mobility, the distribution of goods and services, and the economic growth of a region. Good road pavement conditions improve road service levels, user safety, and reduce vehicle operational costs. Conversely, improperly maintained road damage can reduce driving comfort, increase the risk of accidents, and accelerate the decline in pavement performance (Vikram, 2025). Therefore, regular pavement condition evaluation is a crucial component of a road asset management system to support the development of an effective and sustainable maintenance program. Amri et al. (2020) explain that road condition assessment is a key component of road network management because the evaluation results form the basis for determining maintenance priorities and budget allocation.

Road pavement damage is influenced by various factors, including increased traffic volume, excessive vehicle loads, poor drainage conditions, and the influence of tropical climates that accelerate the weathering process of pavement materials (Tifa, 2024). Common forms of damage include longitudinal cracks, alligator cracking, potholes, rutting, and raveling (Oktopianto, 2024). Dewayani and Rachmi (2025) showed that surface damage that is not immediately addressed will develop into more complex damage, requiring greater rehabilitation costs than routine maintenance. Therefore, early identification of the type and extent of damage is an important step in determining the appropriate treatment strategy.

Various methods have been developed to evaluate road pavement conditions, including the International Roughness Index (IRI), Pavement Condition Index (PCI), and Surface Distress Index (SDI) (Salmani, 2021). The SDI method is widely used in Indonesia because it refers to the Directorate General of Highways guidelines and is based on visual observation of road surface damage, such as crack area, crack width, number of potholes, and wheel groove depth (Alimin, 2025). Hidayatulloh et al. (2026) stated that the SDI method has advantages in conducting field surveys because it is relatively simple, quick to implement, and able to provide a classification of road conditions that can be used as a basis for developing maintenance programs.

Several previous studies have demonstrated the effectiveness of the SDI method in evaluating road pavement conditions. Brahmana et al. (2024) reported that the simultaneous use of the SDI and PCI methods can provide more comprehensive information on national road conditions than using either method alone. Firmandari, (2024) and Faisal, (2024) also showed that the combination of the PCI and SDI methods can produce more precise treatment recommendations based on the level of damage in each road segment. In addition, Ananda Putri et al. (2026) stated that the SDI method is effective for identifying variations in pavement conditions through parameters such as cracks, potholes, and surface deformation, thus supporting decision-making in road maintenance programs.

Although numerous studies have been conducted on road condition evaluation using the SDI method, most studies still focus on comparing the SDI method with PCI or IRI and are applied to national and provincial roads (Jatmiko & Widayanti, 2024; Hadi, 2026). Studies that specifically evaluate urban road conditions as a basis for establishing maintenance priorities at the road segment level are still relatively limited. Furthermore, there are not many studies that apply the SDI method to urban roads in Mataram City by directly linking the results of road condition assessments to recommended treatment types according to the Directorate General of Highways classification. This situation indicates that there is still a research opportunity to generate more specific road condition information as a basis for maintenance decision-making (Majidifard, 2020; Jha, 2023).

Jalan Guru Bangkol is one of the urban roads in Mataram City that plays a crucial role in supporting residential, commercial, educational, and public service activities. The high traffic intensity on this road section has the potential to cause pavement deterioration if not accompanied by an appropriate maintenance program. Therefore, road condition evaluation using the SDI method is necessary to identify the level of damage in each segment and determine treatment priorities based on actual conditions in the field. This approach is expected to provide more objective information for road management agencies in developing effective and efficient maintenance programs (Huang et al. 2024; Piryonesi et al. 2020; Sassani et al. 2021; Sodikov et al. 2015).

The research gap identified presents significant urgency. Jalan Guru Bangkol serves as one of Mataram City's critical urban roads, supporting residential, commercial, educational, and public service activities with high traffic intensity. The road's strategic role in the urban transportation network makes it essential to implement a systematic condition evaluation program. Without regular assessment, pavement deterioration may progress undetected until reaching severe damage levels, resulting in expensive rehabilitation costs and disruptions to community activities. Therefore, immediate condition evaluation using the SDI method is necessary to identify damage levels in each segment and determine appropriate treatment priorities based on actual field conditions.

This study introduces novelty through its specific focus on evaluating the Jalan Guru Bangkol urban road section using the SDI method, with direct application of Directorate General of Highways (2011) guidelines for determining treatment priorities at the segment level. Unlike previous studies that primarily focused on method comparisons, this research produces detailed segment-specific SDI values and corresponding maintenance recommendations for an urban road that serves diverse community functions. The integration of field observations with systematic SDI calculations provides practical insights for local road management agencies. Ananda Putri et al. (2026) emphasized that SDI evaluation can support decision-making in road maintenance programs through damage parameters such as cracks, potholes, and surface deformation.

Based on the description, this study aims to evaluate the pavement condition of Jalan Guru Bangkol, Mataram City using the Surface Distress Index (SDI) method, identify the level of damage in each road segment, and determine maintenance priorities based on the SDI value obtained. The results of the study are expected to be a reference for local governments in preparing condition -based road maintenance programs while enriching studies on the application of the SDI method to urban road networks.

METHOD

Research Design

This study used a descriptive quantitative approach with a field survey method *to* evaluate the condition of road pavement surfaces using *the Surface Distress Index* (SDI). This approach was chosen because it is able to describe the actual condition of the road pavement based on visual observations of the type, level, and dimensions of damage that occurs. Furthermore, the results of the SDI assessment are used as a basis for determining road maintenance priorities according to the Directorate General of Highways' Road Condition Survey Guidelines (2011).

Research Location

The research was conducted on Jalan Guru Bangkol, Mataram District, Mataram City, West Nusa Tenggara Province, the research location can be seen in Figure 1. This road section is one of the urban roads that serves residential, commercial, educational, and office activities so that it has a fairly high traffic intensity. The road section that is the object of the research has a length of approximately 1.25 km and is divided into 13 segments, each 100 meters long to facilitate the process of identifying damage and calculating SDI values in each observation segment. The division of segments follows the road condition survey procedure recommended by the Directorate General of Highways.

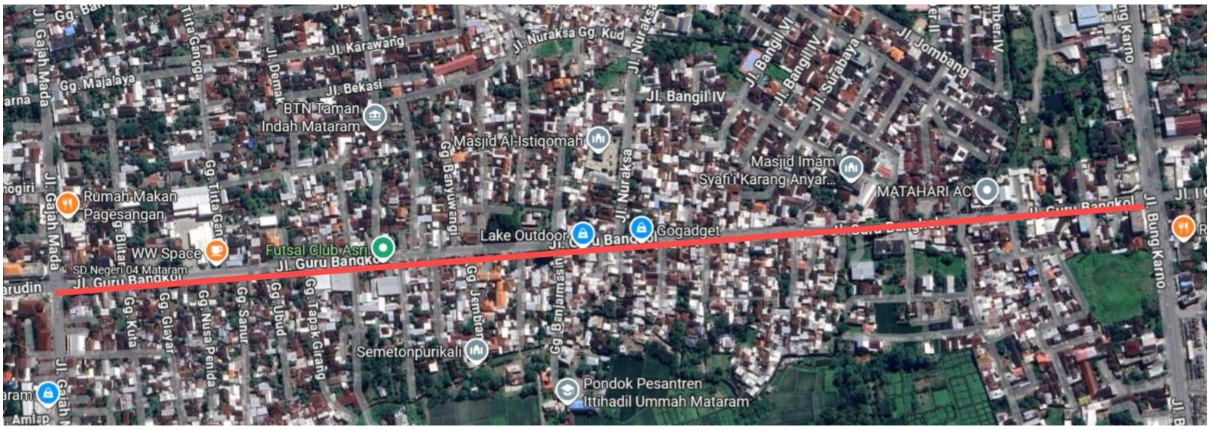

Figure 1. Research Location

Research Data

The research uses two types of data, namely primary data and secondary data.

a. Primary Data

Primary data was obtained through direct field surveys to identify road surface conditions. The data collected included:

- types of pavement damage,
- crack area,
- crack width,
- number of holes,
- wheel groove depth (*rutting*),
- visual documentation of damage,
- geometric dimensions of the road.

Data collection was carried out using SDI survey forms, roll meters, measuring rulers, mobile phone cameras, and stationery.

b. Secondary Data

Secondary data was obtained from relevant agencies, including the Mataram City Public Works Department and other relevant agencies. The data collected includes:

- road network map,
- regional administration data,
- road section status,
- other supporting documents.

Research Equipment

The equipment used is listed in Table 1 below.

Table 1. Research Equipment and Functions

No	Equipment	Function
1	Roll meter	Measuring the dimensions of the damage
2	Steel ruler	Measuring crack width and groove depth
3	Smartphone camera	Damage documentation
4	SDI survey form	Recording observation results
5	stationery	Field data recording
6	GPS/Google Maps	Determining STA and survey location

Research Stages

The research stages consist of five stages.

Stage 1. Literature Study

Literature studies were conducted by reviewing various references regarding:

- *Surface Distress Index* (SDI) method,
- road maintenance management,
- types of flexible pavement damage,
- Highways guidelines.

Stage 2. Preliminary Survey

A preliminary survey was conducted to:

- determine road section boundaries,
- determine the starting point of the STA,
- identify general road conditions,
- determine survey equipment requirements.

Stage 3. Road Condition Survey

Road condition surveys were conducted using visual observation methods on each 100-meter segment.

The parameters observed include:

- crack area,
- crack width,
- number of holes,
- wheel groove depth (*rutting*).

All damage is measured, recorded on an SDI form, and documented using a camera.

Stage 4. Calculation of SDI Value

The SDI value is calculated in stages based on the Directorate General of Highways Guidelines (2011), taking into account:

- crack area,
- crack width,
- number of holes,
- wheel groove depth.

Each parameter has an assessment weight which is then accumulated into an SDI value for each road segment.

Stage 5. Determining Handling Priorities

Handling priorities are determined based on the SDI value classification as shown in Table 2 below.

Table 2. Determination of Handling Priorities

SDI Value	Road Conditions	Type of Handling
< 50	Good	Routine Maintenance
50–100	Currently	Periodic Maintenance
100–150	Minor Damage	Rehabilitation
>150	Seriously Damaged	Reconstruction

This classification is used to determine maintenance priorities for each road segment.

Data Analysis

Data analysis was carried out descriptively quantitatively with the following stages.

1. Identify the type of damage on each road segment.
2. Calculate SDI values based on field survey results.
3. Classify road conditions into good, moderate, lightly damaged, or heavily damaged categories.
4. Determine the appropriate type of treatment based on the SDI value.
5. Arrange maintenance priorities for the Jalan Guru Bangkol section based on the level of damage in each segment.

The results of the analysis are then presented in the form of tables, graphs, and visual documentation to provide a comprehensive picture of road conditions.

The SDI value can be obtained by carrying out an accumulative calculation of the road damage that occurs to obtain the quality of road conditions based on Table 3 below.

Table 3. Road Condition Ratings

SDI Value	Condition
<50	Good
50-100	Currently
100-150	Minor Damage
>150	Seriously Damaged

The following calculation of SDI values for damage categories based on Bina Marga (2011) can be seen in Table 4, Table 5, Table 6 and Table 7 below.

Table 4. Location Area Category Values

Number	Crack Area	SDI value [1]
1	There isn't any	0
2	<10%	5
3	10-30%	20
4	>30%	40

Table 5. Location Width Category Values

Number	**Crack Width**	**SDI value ^{2}**
1	There isn't any	0
2	Fine <1 mm	0
3	Medium 1-3 mm	0
4	Width >3 mm	SDI ^{1} x 2 Results

Table 6. Number of Categories Number of Holes

Number	**Number of Holes**	**SDI value ^{3}**
1	There isn't any	0
2	<10/100 m	SDI ^{2} + 15 Results
3	10-50/100 m	SDI ^{2} + 75 Results
4	>50/100 m	SDI ^{2} + 225 Results

Table 7. Wheel Rim Category Values

Number	**Wheel Marks**	**SDI value ^{4}**
1	There isn't any	0
2	<1 cm in	SDI ^{3} + 2.5 results
3	1-3 cm deep	SDI ^{3} + 10 Results
4	>3 cm deep	SDI ^{3} + 20 Results

The following research flow diagram is presented in Figure 2 below.

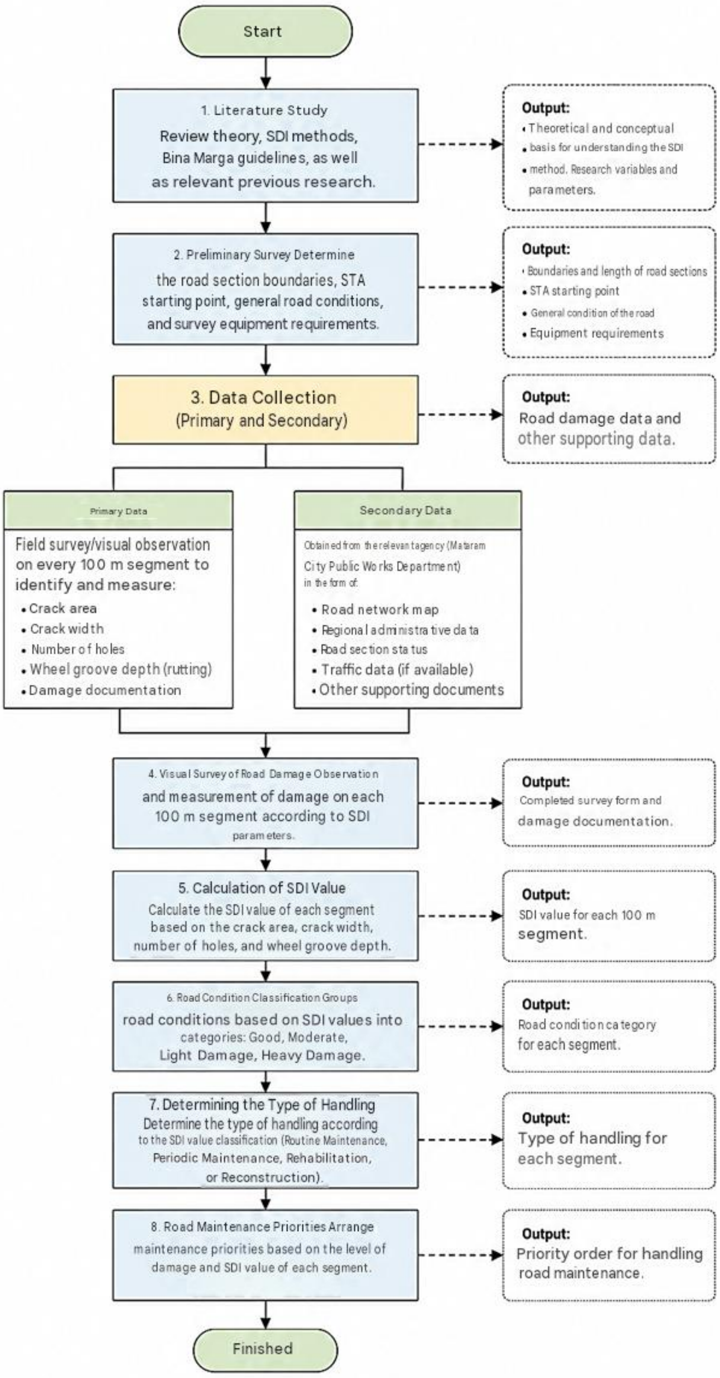

Figure 2. Research Flowchart

RESULTS AND DISCUSSION

Characteristics of the Research Road Section

The study was conducted on Jalan Guru Bangkol, Mataram District, Mataram City, with a length of approximately 1.25 km. The road condition survey was conducted using the *Surface Distress Index* (SDI) method through visual observation of each 100-meter segment. Observed parameters included crack area, crack width, number of potholes, and rutting depth *in* accordance with the guidelines of the Directorate General of Highways.

Road Damage Identification Results

The survey results show that the damage found on Jalan Guru Bangkol consists of surface cracks, potholes, and wheel grooves with varying degrees of damage in each segment. The summary of the assessment results for each parameter in Table 8 is used as the basis for calculating the SDI value to determine the road condition.

Table 8. Surface Distress Index (SDI) Assessment Results

STA	Crack Area	Crack Width	Number of Holes	Wheel Marks	SDI Value	Condition
0+000–0+100	5	10	25	0	40	Good
0+100–0+200	20	40	0	0	60	Currently
0+200–0+300	5	10	0	0	15	Good
0+300–0+400	5	10	0	0	15	Good
0+400–0+500	5	10	0	0	15	Good
0+500–0+600	20	40	55	0	115	Minor Damage
0+600–0+700	5	10	25	0	40	Good
0+700–0+800	5	10	0	0	15	Good
0+800–0+900	5	10	0	0	15	Good
0+900–1+000	5	10	25	0	40	Good
1+000–1+100	5	10	25	0	15	Good
1+100–1+200	5	10	25	0	40	Good
1+200–1+250	20	40	55	0	115	Minor Damage

Source: Results of research analysis.

Distribution of Road Conditions Based on SDI Values

Based on the SDI calculations, the condition of Jalan Guru Bangkol is divided into three categories: good, moderate, and slightly damaged. Most segments are in the good category, while several segments show moderate and slightly damaged conditions. The road condition results are presented in Table 9 and Figure 3 below.

Table 9. Distribution of Road Conditions Based on SDI

Road Conditions	Number of Segments	Percentage (%)
Good	10	76.92
Currently	1	7.69
Minor Damage	2	15.39
Seriously Damaged	0	0.00
Total	13	100

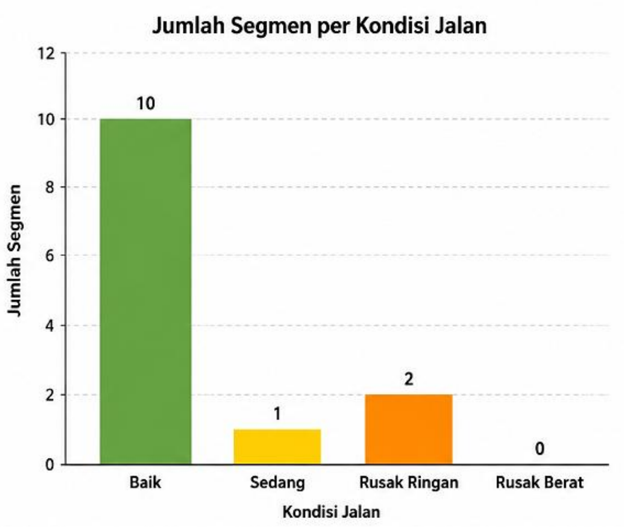

Figure 3. Distribution of conditions of Jalan Guru Bangkol based on evaluation results

Types of Road Handling

The type of treatment is determined based on the SDI value classification for each segment. The results in Table 10 indicate that most road sections require routine maintenance, while some segments require periodic maintenance and rehabilitation.

Table 10. Determination of Road Handling Type

STA	SDI Value	Condition	Type of Handling
0+000–0+100	40	Good	Routine Maintenance
0+100–0+200	60	Currently	Periodic Maintenance
0+200–0+300	15	Good	Routine Maintenance
0+300–0+400	15	Good	Routine Maintenance
0+400–0+500	15	Good	Routine Maintenance
0+500–0+600	115	Minor Damage	Rehabilitation
0+600–0+700	40	Good	Routine Maintenance
0+700–0+800	15	Good	Routine Maintenance
0+800–0+900	15	Good	Routine Maintenance
0+900–1+000	40	Good	Routine Maintenance
1+000–1+100	15	Good	Routine Maintenance
1+100–1+200	40	Good	Routine Maintenance
1+200–1+250	115	Minor Damage	Rehabilitation

Road Condition Documentation

Field observations show variations in road surface conditions across several survey segments. Field documentation reveals segments in moderate condition characterized by surface cracks and localized damage, as well as segments in good condition that still have a relatively intact pavement surface. This visual documentation supports the classification of road conditions based on SDI values, as shown in Figure 4. Road conditions at STA 0+500 to 0+600 and STA 1+200 to 1+250 are in a state of minor damage.

Figure 4. Condition of Minor Damage

Meanwhile, several STAs, such as STAs 0+100 to 0+200, are in moderately damaged condition, as seen in Figure 5 below.

Figure 5. Moderately Damaged Condition

However, most of the roads on Jalan Guru Bangkol Mataram are in good condition as seen at STA 0+000 to 0+100, 0+200 to 0+300, 0+300 to 0+400, 0+400 to 0+500 and 0+600 to 0+700 to STA 1+100 to 1+200 as shown in Figure 6 below.

Figure 6. Good Condition

Road Pavement Conditions Based on *the Surface Distress Index* (SDI) Method

The evaluation results show that the pavement condition of Jalan Guru Bangkol is generally still in the good category, with 10 of 13 segments (76.92%) having an SDI value of less than 50. In addition, there is 1 segment (7.69%) in moderate condition and 2 segments (15.39%) in light damage. No segments were found in the heavy damage category. This condition indicates that most of the road sections are still able to provide a good level of service to road users, although there are several locations that are starting to experience a decline in surface conditions so that appropriate maintenance measures are required. This percentage is obtained from the results of calculating the SDI value for each segment along Jalan Guru Bangkol.

The predominance of segments in good condition indicates that the pavement structure is generally still functioning as intended. However, the presence of several segments in moderate and light damage indicates that pavement degradation has begun in certain locations. This type of condition requires attention in a road asset management system, as localized damage can develop into structural damage if not promptly addressed through an appropriate maintenance program.

Characteristics of Road Pavement Damage

The assessment using the SDI method shows that the most dominant damage on Jalan Guru Bangkol is surface cracks, potholes, and wheel grooves (rutting). These three types of damage are the main parameters in calculating the SDI value and directly affect the classification of road conditions. Based on the survey results, the STA 0+500–0+600 and 1+200–1+250 segments obtained an SDI value of 115, so they are categorized as lightly damaged and recommended for road rehabilitation. Meanwhile, the STA 0+100–0+200 segment obtained an SDI value of 60 which is categorized as moderate and requires regular maintenance.

Technically, the high SDI scores in both segments are due to a combination of larger crack areas, relatively large crack widths, and the presence of potholes in the road surface. The combination of multiple damage types in a single segment causes the accumulated SDI score to increase, shifting the road condition category from good to light damage.

Determining Road Maintenance Priorities

One of the advantages of the SDI method is its ability to link road surface conditions with the type of treatment required. Based on the research results, most segments of Jalan Guru Bangkol are recommended for routine maintenance, while one segment requires periodic maintenance and two segments require road rehabilitation. No segments require reconstruction because no SDI value exceeds 150.

These findings indicate that preventive maintenance programs can still maintain the condition of most road sections. Addressing damage at an early stage is a more efficient strategy than waiting for it to progress to severe damage, which requires more expensive rehabilitation or reconstruction. Therefore, the SDI evaluation results can serve as a basis for local governments in determining maintenance priorities based on the level of damage in each road segment.

Implications of Research on Road Maintenance Management

This study provides information on the actual condition of Jalan Guru Bangkol, which can be used as a basis for developing a road maintenance program in Mataram City. The SDI value information for each segment allows road management agencies to prioritize maintenance more objectively based on field conditions, allowing for more effective and efficient maintenance budget allocation.

Furthermore, the SDI method simplifies routine surveys, requiring only visual observation and simple measurements. Therefore, this method can be applied periodically to monitor changes in road pavement conditions and support the implementation of a condition-based road asset management system.

CONCLUSION

This study successfully evaluated the pavement condition of Guru Bangkol Road, Mataram City using the Surface Distress Index (SDI) method as a basis for determining road maintenance priorities. The evaluation results showed that of the 13 segments observed along the road, 10 segments (76.92%) were in good condition, 1 segment (7.69%) was in moderate condition, and 2 segments (15.39%) were in light damage, while no segments were found with severe damage. The dominant damage was in the form of surface cracks, potholes, and wheel grooves (rutting), which directly affected the SDI value in each segment. Based on the SDI value classification, most sections of Jalan Guru Bangkol are recommended for routine maintenance, while segments STA 0+100–0+200 require periodic maintenance, and segments STA 0+500–0+600 and 1+200–1+250 require road rehabilitation. These findings indicate that the SDI method is able to provide systematic and objective pavement condition information so that it can be used as a basis for preparing more effective and efficient road maintenance priorities. This research provides practical contributions for road management agencies, particularly in supporting decision-making based on actual pavement conditions. For further research, it is recommended that road condition evaluation be conducted on a wider road network by combining the Surface Distress Index (SDI) method with other assessment methods such as the Pavement Condition Index (PCI) or the International Roughness Index (IRI), and integrating traffic volume data, pavement age, and Geographic Information Systems (GIS) to determine maintenance priorities more comprehensively.

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