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Research Article

AHP Method System for Determining Road Repair Priorities in Dadimulyo Sub-District

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ABSTRACT

Improving road infrastructure plays a vital role in enhancing community mobility and fostering economic development within a region. In Dadimulyo Sub-district, one of the main challenges in infrastructure development lies in determining road repair priorities, especially under the constraints of limited budgets and available resources. This study proposes the development of a Decision Support System (DSS) utilizing the Analytical Hierarchy Process (AHP) method to facilitate more objective, transparent, and systematic decision-making. The AHP method enables the analysis of multiple criteria, such as current road conditions, traffic volume, accessibility, and community demand to assign weighted priorities for road repairs. The system is developed using the PHP programming language and MySQL as the database management system, ensuring both functionality and ease of data management. Based on the AHP calculations, Waterpas Road was identified as the highest-priority road for repair, receiving a final score of 0.227. The results of this study demonstrate that the integration of the AHP method into the decision-making process allows for more accurate prioritization and effective resource allocation. With this DSS, the government of Dadimulyo Sub-district is better equipped to optimize infrastructure planning, improve transparency, and ensure that limited budgets are directed toward areas with the greatest need and impact.

Keywords: DSS; Road Repair; Infrastructure; AHP; Dadimulyo Sub-district

1. INTRODUCTION

The development of information technology has brought a major revolution in various fields, including strategic decision-making in the infrastructure development sector (Aulia et al., 2023). Information technology enables complex data processing to become more structured and accessible in real-time (Aulawi & Firmansyah, 2024). In the context of development, the implementation of technology-based systems can help the government and policymakers make more effective and efficient decisions (Meisella Kristania et al., 2021). Dadimulyo Subdistrict is one of the areas with a relatively large population, approximately 4,875 people, with high activity levels, making adequate infrastructure, especially roads, essential. As the main connector for community activities, the roads in this area face increasing pressure from the growing use of both private vehicles and public transportation (Hidayat et al., 2020). Geographic conditions and usage intensity often accelerate road damage, requiring special attention in its management (Kusnadi & Warnars, 2021).

This study refers to related research titled "Determining Road Repair Priorities in Gawan Village Using the Analytical Hierarchy Process Algorithm." It discusses that a Decision Support System (DSS) is an innovative solution designed to assist policymakers in solving complex and multi-criteria problems (Lehot et al., 2024). DSS uses specific algorithms to provide objective recommendations (Prawira & Amin, 2022). In the context of road repairs, DSS enables an analysis of various factors, such as the level of damage, frequency of use, and socio-economic benefits (Rozi & Heriyanto, 2023). With DSS, decisions regarding road repair priorities can be made in a measurable way based on valid data, reducing the potential for errors or inefficiencies in implementation (Simare Mare & Yana, 2022).

Roads play a strategic role as the primary infrastructure supporting human and goods mobility (Sumarno & Mustafa Harahap, 2022). Roads not only function as connectors between regions but also as main routes that facilitate social, economic, and cultural interactions (Alfiza et al., n.d.). High-quality roads positively impact a region's economy, improve public accessibility, and streamline the distribution of goods and services. Conversely, poor road conditions can create

significant obstacles in various aspects of community life (Nelfiyanti et al., 2024). Additionally, adequate road quality is an essential factor in supporting local economic growth by facilitating access to markets, public service centers, and other facilities (Kisal Filalba et al., n.d.). Therefore, planning and implementing road repairs should be a top priority for local governments. The following is data on roads requiring repairs in Dadimulyo Subdistrict.

Tabel 1. Road Data Requiring Repairs in Dadimulyo Sub-district

No	Road Name	Neighborhood
1	Rimbas Road	1
2	Linggis Road	1
3	Skrap Road	2
4	Raskam Road	2
5	Kikir Road	3
6	Batu Asah Road	6
7	Pahat Road	7
8	Waterpass Road	7
9	Lingkara Road	7

Source: (Dadimulyo Sub-district, 2025)

This damage not only causes inconvenience but also increases the risk of accidents and transportation costs. Second, the government often struggles to determine which roads should be prioritized for repairs, mainly due to budget and resource limitations (Heriyantoro R. Didik, n.d.). Third, there is no established method or system that provides measurable and valid data, making road repair planning tend to be subjective. This often results in inefficient resource allocation and can disadvantage the community as a whole (Amnur & Sisma Putri, 2022). The Analytical Hierarchy Process (AHP) method is an effective mathematical approach to solving multi-criteria problems (Akbar et al., 2023). This method works by comparing various factors or criteria in pairs to determine the most relevant priority weights. With a clear hierarchical structure, AHP allows decision-makers to evaluate different options based on their level of importance (Gede Iwan Sudipa et al., n.d.). In the context of road repairs, this method can be used to analyze criteria such as road conditions, traffic volume, accessibility, and community demand to produce objective priorities (Tul Uhro Ibnah, 2023). Based on these issues, developing a system based on the AHP method to assist the government of Dadimulyo Subdistrict in determining road repair priorities is a feasible solution. This system is designed to systematically process data, provide transparent analytical results, and generate data-driven recommendations (Purnamawati et al., 2023).

Several road sections in Dadimulyo Subdistrict suffer from significant damage, disrupting the smooth mobility of the community (Pakpahan & Fa'atulo Halawa, 2020). The subdistrict faces difficulties in prioritizing which roads should be repaired first. The absence of a supporting method for decision-making in determining road repair priorities often makes this process ineffective and subjective. This research focuses on roads requiring repairs in Dadimulyo Subdistrict and employs the Analytical Hierarchy Process (AHP) method to determine repair priorities. Assessment is conducted on key criteria, including road conditions, traffic volume, accessibility, and community demand, in determining road repair priorities. The system is developed using PHP programming language with a MySQL database.

Infrastructure development, particularly road maintenance, plays a critical role in supporting economic growth, transportation efficiency, and public safety. In many regions, the lack of an objective and data-driven approach in determining road repair priorities often leads to inefficient allocation of resources and delayed responses to urgent needs. highlight the effectiveness of decision support systems in infrastructure planning, especially when integrated with Multi-criteria decision-making methods like the Analytical Hierarchy Process (AHP) (Ilham et al., 2021). These approaches have proven to improve transparency, consistency, and efficiency in decision-making processes, particularly in public sector projects. Therefore, implementing a structured and systematic method for prioritizing road repairs is not only timely but essential for optimizing development outcomes at the local level. This research aims to implement the Analytical Hierarchy Process (AHP) method to improve accuracy and efficiency in determining road repair priorities in Dadimulyo Subdistrict. Additionally, it seeks to design a structured decision support system to assist in prioritizing road repairs based on established criteria. Lastly, the study involves implementing a web-based decision support system that can help determine road repair priorities in Dadimulyo Subdistrict using PHP programming language and MySQL as the database (Bara Jonathan Rihi Hina et al., 2024).

2. RESEARCH METHOD

The research methodology is a series of systematic steps or procedures used in a study to achieve goals and answer research questions. The methodology chosen must be in accordance with the research objectives and types of data needed. The selection of appropriate methodology ensures research can be carried out systematically and produce valid findings.

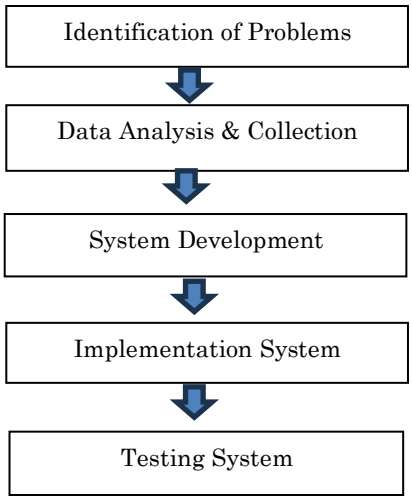

Figure 1. Research Frameworks

Problem identification involves observing and understanding existing issues in a phenomenon, both theoretically and practically. Based on problem identification, it is evident that there is no system in place to assist Dadimulyo Subdistrict in determining road repair priorities. The expectation is that such a system would help reduce the time required for the selection process (Zalukhu et al., 2023).

2.1 Data Collection Techniques

The data collection techniques used in this study are as follows:

1. Field Research
   Field research is a type of study conducted by directly visiting the location or environment where the required data or information can be obtained, such as visiting Dadimulyo Subdistrict.
2. Interviews
3. Interviews are a data collection method conducted through direct interaction between the interviewer and the respondents by asking several questions related to road repair priorities in Dadimulyo Subdistrict. This method helps gather information, insights, or experiences regarding the topic.
4. Observation
5. In this study, the researcher conducted direct observations of the research object related to determining road repair priorities in Dadimulyo Subdistrict.
6. Literature Review
7. Literature review is a research method conducted by collecting, reading, analyzing, and summarizing data or information obtained from various written sources. These sources may include books, scientific journals, articles, official documents, research reports, or other written materials related to the research and study topic.

2.2 Research Time and Location

The location of this research is conducted at the office of the Head of Dadimulyo Subdistrict, located at Jalan Meteran, Lingkungan V, Kisaran Barat District, Asahan Regency, North Sumatra. The data analysis technique used in this study is

the *Analytical Hierarchy Process* (AHP), a quantitative approach designed to determine priorities based on multiple criteria through pairwise comparisons. The analysis begins by structuring the problem into a hierarchy consisting of the main goal, criteria, and alternatives. A pairwise comparison matrix is then developed, where each element is assigned a weight based on its relative importance. These weights are calculated using the eigenvector method to produce priority values. A consistency check is conducted to ensure that the comparisons are logically coherent and not random. The final output of the AHP analysis is a ranked list of priorities, which serves as a data-driven foundation for decision-making in determining the most urgent road repairs.

3. RESULTS AND DISCUSSION

3.1 System Analysis

System analysis is the activity of identifying and evaluating an existing system to identify problems and design more optimal solutions. In this study, the analyzed system is the process of determining road repair priorities in Dadimulyo Subdistrict. Currently, the decision-making process for road repairs is still conducted subjectively without a supporting system that can assist in determining priorities objectively. This results in a lack of transparency in selecting which roads should be repaired first, as well as the potential for inaccuracies in the allocation of budgets and available resources (Rizky et al., 2023).

3.2 Process Analysis

3.2.1 Determining Criteria Data and Alternatives

The criteria are determined based on the results of interviews with the head of Dadimulyo Subdistrict. The criteria required in this study.

Table 1. Criteria Data

No	Criteria Code	Criteria Name
1	K01	Road Condition
2	K02	Traffic Volume
3	K03	Accessibility
4	K04	Community Demand

The alternatives used are obtained from the Dadimulyo Subdistrict office, consisting of the names of roads that require repairs.

Table 2. Alternative Data

No	Road Name	Neighborhood	Code
1	Rimbas Road	1	A1
2	Linggis Road	1	A2
3	Skrap Road	2	A3
4	Raskam Road	2	A4
5	Kikir Road	3	A5
6	Batu Asah Road	6	A6
7	Pahat Road	7	A7
8	Waterpass Road	7	A8
9	Lingkaran Road	7	A9

3.2.2 Creating a System Hierarchy

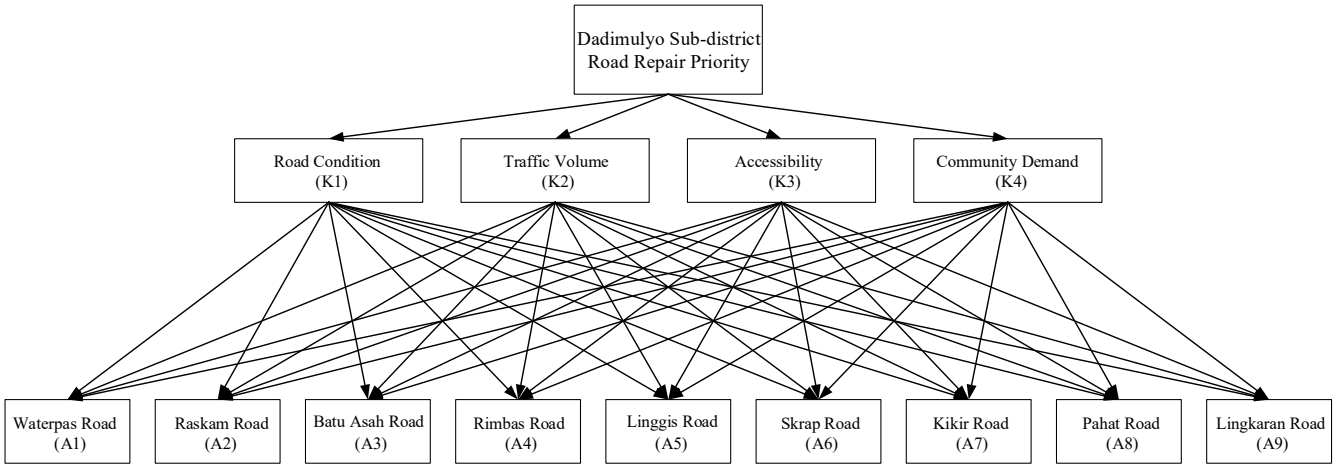

Figure 2. Hierarchy Structure of Road Repair Prioritization in Dadimulyo Sub-district

The image above illustrates the hierarchy of the system for prioritizing road repairs in the Dadimulyo sub-district.

3.2.3 Determination of Criteria Priority Weights and Consistency Ratio

The comparison results of each criterion will be represented by numbers ranging from 1 to 9, indicating the confidence level in comparing one element to another. The following is the pairwise comparison of the four evaluation criteria based on an interview with the Head of Dadimulyo Subdistrict.

Table 3. Pairwise Comparison of Criteria

Criteria	K1	K2	K3	K4
K1	1,00	1,00	5,00	0,20
K2	1,00	1,00	5,00	0,20
K3	0,20	0,20	1,00	0,11
K4	5,00	5,00	9,00	1,00
Total	7,20	7,20	20,00	1,51

The criterion value matrix is obtained by dividing the criterion comparison values by the total comparison of each column, as shown in the table above.

$$K1 = \frac{1,00}{7,20} = 0,139$$

$$K2 = \frac{1,00}{7,20} = 0,139$$

$$K3 = \frac{0,20}{7,20} = 0,028$$

$$K4 = \frac{5,00}{7,20} = 0,694$$

Follow the same procedure for the second column (K2) and the subsequent columns. As a result, the matrix values for each row are obtained and displayed in the **Table 4**.

Table 4. Criteria Value Matrix

Criteria	K1	K2	K3	K4
K1	0,139	0,139	0,250	0,132
K2	0,139	0,139	0,250	0,132
K3	0,028	0,028	0,050	0,074
K4	0,694	0,694	0,450	0,662
Total	1,000	1,000	1,000	1,000

After obtaining the matrix values, the next step is to calculate the priority value for each criterion by summing the matrix values of each row and dividing by the total number of criteria, which is four. Then, the calculation for determining the global priority value is performed by multiplying the priority value of each alternative by the priority value of each criterion, and then summing the results. The global priority values can be seen in the **Table 5**.

Table 5. Global Priority Value of Each Road

Alternative	K1	K2	K3	K4	Bobot Total	Rank
Waterpas Road	0.006	0.013	0.003	0.205	0.227	1
Raskam Road	0.036	0.022	0.005	0.093	0.155	2
Batu Asah Road	0.025	0.035	0.009	0.042	0.112	5
Rimbas Road	0.009	0.006	0.001	0.024	0.040	8
Linggis Road	0.004	0.004	0.001	0.133	0.142	3
Skrap Road	0.051	0.058	0.015	0.012	0.136	4
Kikir Road	0.013	0.010	0.002	0.066	0.090	6
Pahat Road	0.018	0.014	0.003	0.033	0.068	7
Lingkaran Road	0.003	0.003	0.007	0.016	0.029	9

Based on the global priority values, the highest value was obtained as the road prioritized for repair, which is Alternative 1, Waterpas Road, with a score of 0.227, ranking first.

3.3 System Implementation

System implementation is a procedure that must be carried out to complete the system design outlined in the approved system design document, as well as to test, install, and initiate the use of the new system. In general, the purpose of this implementation is to conduct trials on the system development concept that has been designed. In this case, the focus is on researching whether the designed concept can be executed correctly or not. The output produced in this phase is a trial recommendation based on research findings during the testing period over a certain duration. The main page of the decision support system for determining road repair priorities in Dadimulyo Sub-district using the AHP method features nine menus: home, scale, criteria, alternatives, comparison, calculation, results, change password, and logout. Each menu has its own function for processing data to generate information. Below is the main page display of the decision support system for determining road repair priorities in Dadimulyo Sub-district.

Figure 3. Main Page Display Of The Decision Support System For Determining Road Repair

The login form of the decision support system for determining road repair priorities in Dadimulyo Sub-district using the AHP method consists of two text fields: username and password, along with a single button labeled "Login." Below is the login form display of the decision support system for determining road repair priorities in Dadimulyo Sub-district.
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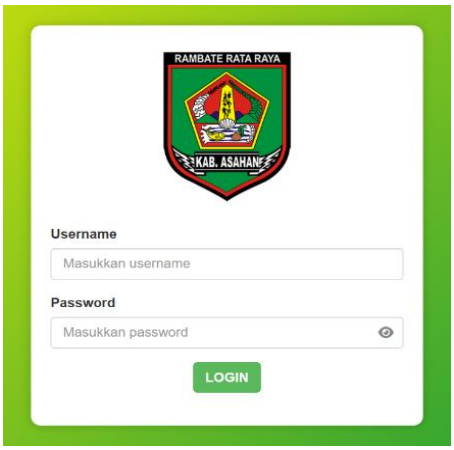


Figure 4. Administrator login form

The criteria form in the decision support system for determining road repair priorities in Dadimulyo Sub-district using the AHP method includes three buttons: add, edit, and delete. Below is the criteria form display of the decision support system for determining road repair priorities in Dadimulyo Village.

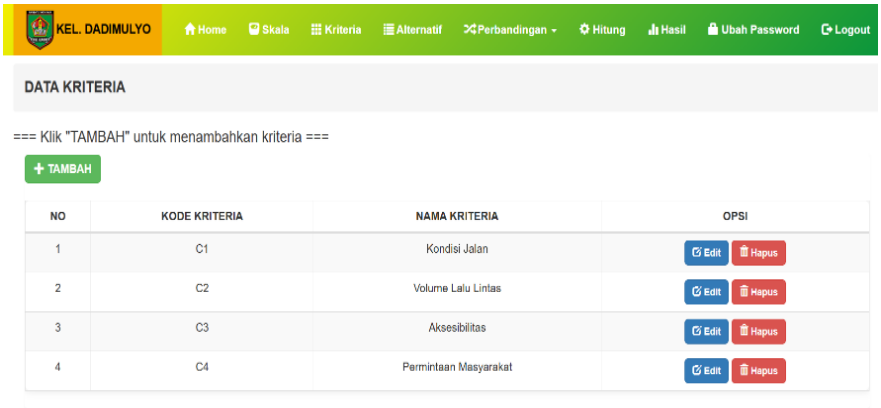


Figure 5. Criteria Data

The alternative form in the decision support system for determining road repair priorities in Dadimulyo Sub-district using the AHP method includes three buttons: add, edit, and delete. Below is the alternative form display of the decision support system for determining road repair priorities in Dadimulyo Village.

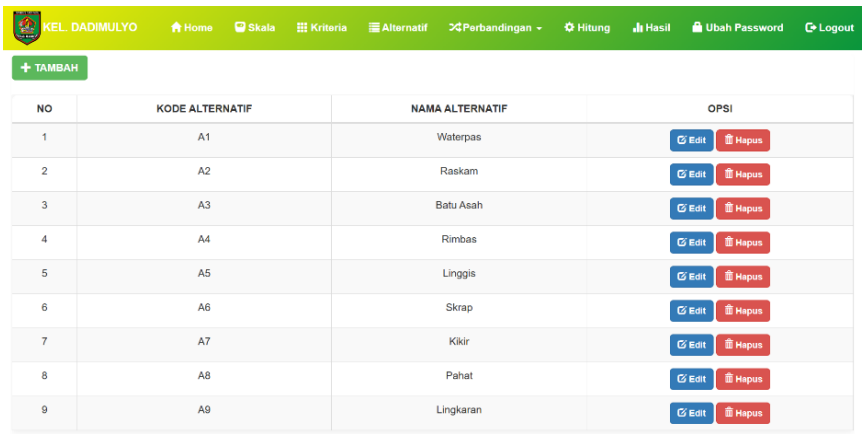
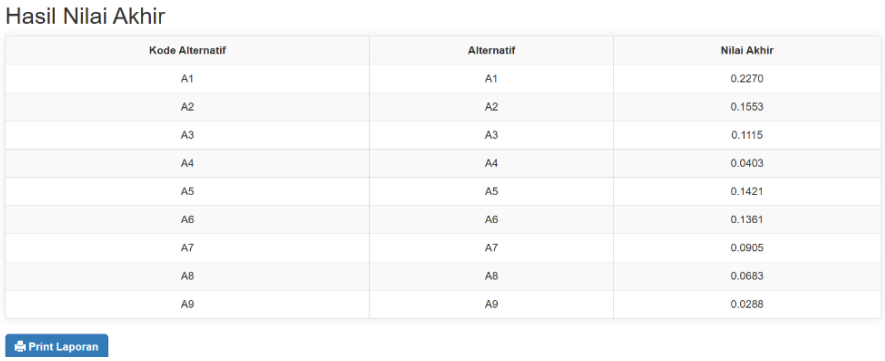


Figure 6. Alternative Data

The calculation form in the decision support system for determining road repair priorities in Dadimulyo Sub-district using the AHP method includes a print report button, which is used to print the AHP calculation report from criteria comparisons to the final value. Below is the calculation form display of the decision support system for determining road repair priorities in Dadimulyo Sub-district.


Hasil Nilai Akhir

Kode Alternatif	Alternatif	Nilai Akhir
A1	A1	0.2270
A2	A2	0.1553
A3	A3	0.1115
A4	A4	0.0403
A5	A5	0.1421
A6	A6	0.1361
A7	A7	0.0905
A8	A8	0.0683
A9	A9	0.0288

Print Laporan

Figure 7. Calculation Display

The result form in the decision support system for determining road repair priorities in Dadimulyo Sub-district using the AHP method includes a print report button, which is used to print the ranking results of alternatives using the AHP method. Below is the result form display of the decision support system for determining road repair priorities in Dadimulyo Village.

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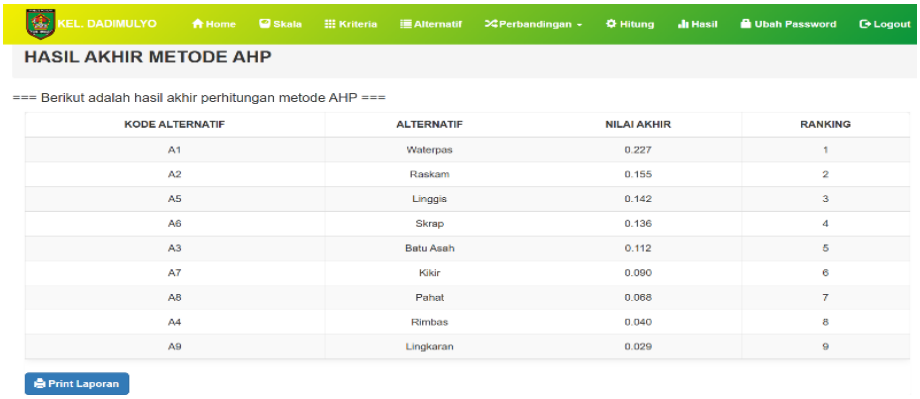

Figure 8. Result Display

3.4. System Testing

This research supports the use of black box testing as an effective method for validating the functional accuracy of a developed system without requiring insight into its internal code structure. This approach is in line with Pressman (2010) and Beizer (1995), who highlight black box testing's strength in detecting errors related to input/output handling and interface functionality. It is particularly useful in ensuring the system meets user requirements, as also supported by Myers (2011), who states that black box testing reflects how end-users interact with the software. However, some studies, such as those by Kaner et al. (2002), argue that black box testing has limitations in identifying internal logic or structural issues within the software, which are better addressed through white box testing. Therefore, while black box testing is highly beneficial for ensuring functional compliance and user-oriented performance, it should be complemented with white box techniques to achieve comprehensive system validation. Its main advantages include simplicity, user-focus, and the ability to test without code knowledge, but its disadvantages lie in limited code coverage and reduced effectiveness in uncovering hidden logic flaws.

4. CONCLUSION

Based on the previous chapter's discussion, several key points can be observed regarding the decision support system for determining road repair priorities in Dadimulyo Sub-district using the AHP method, as follows is the decision support system for determining road repair priorities in Dadimulyo Sub-district is still carried out manually, where road repairs

are determined solely based on the most damaged roads. The development of this information system is highly needed by Dadimulyo Sub-district to improve the accuracy of road repair prioritization using the AHP method, ensuring a more targeted approach. Additionally, the processes of data collection, calculations, report generation, and information presentation required for decision-making can be processed more quickly and reduce the potential for human error. This research serves as a reference for further studies to implement the system using the Visual Studio Code programming language and MySQL.

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