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# Evaluation of Road Damage on Flexible Pavement Using the Bina Marga Method (Case Study; Leuwiseeng Village Road, Majalengka)

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*ABSTRACT*

Leuwiseeng village road is one of the connecting roads between villages and is the route passed when heading to the district highway. Roads are the most common transportation infrastructure people use for their daily activities. The condition of this road has several damages, including cracks and holes, as a result of which community activities are disrupted. Therefore, researchers are interested in writing a journal entitled Evaluation of Road Damage on Flexural Pavement Using the Bina Marga Method (Case Study: Leuwiseeng Village Road, Majalengka). This evaluation is used to identify the type and level of damage and provide appropriate repair and maintenance recommendations. Road damage can be caused by various factors, including the quality of materials used, inadequate construction design, and vehicle loads that exceed road capacity. Counting traffic volume: The manual method involves recording the number of vehicles passing through at specific intervals, such as 15 minutes or 1 hour. Routine maintenance involves cleaning the road, checking it, and making minor repairs to the road surface to prevent further damage. Leuwiseeng Village Road is located in Majalengka Regency; the road length studied is 1.2 km. This road is a village road with a road width of 5 meters and a two-way, one-lane road. The data collected are road geometric data, average daily traffic (LHR) data, and road damage types and levels. After the data is processed, the road repair and maintenance are analyzed. The LHR of the Leuwiseeng village road, with a length of 1.2 km, is class 3. The types of damage on this road are alligator cracks, patches, holes, grooves, and wear. Where alligator cracking has the highest percentage of other types of damage, with a value of (14%). The Order of Priority (UP) is 8 with a category> 7, so the handling is carried out with a routine maintenance program every year.

## 1. Introduction

Infrastructure impacts the development of human, social, and cultural capital; chances to create economic projects and draw in outside funding; chances to modernize the expansion of agricultural output; chances to raise the standard of living for the populace; and chances to create multipurpose and sustainable rural development (Prus, 2021). The condition of transportation infrastructure, especially roads, contributes significantly to the growth of the world economy. Mobility refers to the physical travel of people to obtain goods or services or to take part in activities for their daily lives (Yu, 2021). Roads affect mobility, from transportation to the global economy affect mobility, from transportation to the global economy. Around the world, the quality of roads is an infrastructure that must be considered because of the importance of good infrastructure for the country's survival. Many countries in the world do not have good quality road infrastructure; on the one hand, countries that do not have good quality roads are caused by the country's economy or developing countries. At the same time, public infrastructure, such as roads, is a good investment for mobility activities and connectivity in developing

countries. Numerous methodologies have been used to examine the connection between economic growth and public infrastructure (Batool, 2021).

In the Southeast Asian region, road infrastructure is one of the priorities for development to support economic integration. Road transportation is critical to a country's economic development (Aryan, 2023). Many countries in Southeast Asia still face the problem of damaged roads. Most ASEAN countries lag in infrastructure development (Shen, 2023). Damaged roads disrupt connectivity and mobility in a country, which in turn hampers the economy. Improving roads in the region is essential to increase economic competitiveness and connectivity between regions.

As the largest country with several large islands, Indonesia has more than 500,000 km of road length (Nihayah, 2021). ). In Indonesia, flexible pavement is usually used for local roads, while rigid pavement is widely used on highways. Flexural pavement is still widely used. Multiple layers of granular foundations support the asphalt concrete layers that make up flexural pavement (Beskou, 2023). Road infrastructure in Indonesia has many damaged roads, especially in remote areas. The government's lack of attention to infrastructure in remote areas causes uneven development, so road construction does not meet standardsRepaving and resurfacing old roads is part of road maintenance, which is frequently defended as a public benefit expenditure to boost employment and the economy (Gertler, 2024). Roads that are not up to standard will quickly deteriorate.

In West Java, road infrastructure plays a vital role in supporting the community's economy in mobility with transportation modes to each region. To support the expansion of urban areas, a city must have access to high-quality roads (Suraharta, 2021). West Java is a province that has developed quite well in terms of economy, but there are still many inadequate infrastructures. One of them is village road infrastructure, which often receives less attention. As a result, the quality of roads is poor, and they do not meet standards. Road quality is important, especially in rural areas where most poor households are located (Wahyuni, 2022). Road damage that is not immediately repaired will disrupt community mobility.

Leuwiseeng village road is one of the connecting roads between villages and is the route passed when heading to the district highway. Roads are the most common transportation infrastructure people use for daily activities (Sinambela, 2024). The condition of this road has experienced several. Damage includes cracks and potholes, which disrupt community activities. Damaged roads hamper the flow of transportation of goods and people (Setiaputri, 2021). Therefore, researchers are interested in writing a journal entitled Evaluation of Road Damage on Flexural Pavement Using the Bina Marga Method (Case Study: Leuwiseeng Village Road, Majalengka). This evaluation is used to identify the type and level of damage and provide appropriate repair and maintenance recommendations.

## 2. Literature Review

### 2.1 Type of Road Damage

Road damage is a common problem in many urban and rural areas. Among the many things that can lead to road damage is the caliber of the materials employed, inadequate construction design, and vehicle loads that exceed road capacity. Several factors, including overloading, climate change, and environmental conditions, can cause road damage. These inadequate drainage systems result in high traffic volumes, waterlogging, and poor planning, an implementation that does not follow current plans and a failure to keep an eye on road condition (Isradi M. A., 2021). The damages caused by road defects, For road users, issues including traffic accidents, lengthy travel times, and traffic congestion are serious (Manurung, 2022). This combination of vehicle stress and environmental influences often leads to cracks, potholes, and road surface deformation. Cracks are one of the most common types of road damage. Cracks can appear due to the influence of continuous traffic loads or due to soil movement beneath the road surface.

Potholes are surface defects and a significant problem in neighborhoods as they are apparent defects (Kanoungo, 2021). Potholes result from releasing surface materials caused by high humidity and vehicle pressure and vehicle vehicle pressure. Poor quality asphalt mixes and inappropriate construction methods often accelerate pothole formation. In addition, persistent waterlogging weakens the binding force of the pavement layer, making it easier for materials to detach. This happens when the asphalt layer is not stable enough to withstand the pressure of heavy traffic for a long time. This deformation often results from using materials with low stability or inadequate compaction during construction.

Vehicle loads that surpass the road's intended capacity are also a significant cause of premature failure—sudden increases in traffic and dynamically loading huge loads trucks (Assogba, 2021). The gross vehicle weight of trucks and axle configurations, pavement structure, and damage thresholds for rehabilitation affect permit costs (Misaghi, 2021). Roads are often not designed to withstand overloaded vehicles. As a result, repeated stresses on the road structure accelerate the deterioration of the base and surface layers. The continuous increase in vehicle volume with large vehicle loads also makes the load carried by the road unable to withstand it, so road deterioration will continue to occur. Most road departments and/or highway authorities adopt pavement surface condition assessment (Isradi M. A., 2022).

## 2.2 Traffic Volume

To determine how many cars pass a place or lane segment in a specific amount of time, the Highway Capacity Manual typically makes a distinction between volume and flow rate (Macioszek, 2021). High traffic volumes indicate intensive road utilization, which can affect overall transportation. Traffic volume measurements are taken. The activity patterns of the community strongly influence traffic volumes. Commercial and residential developments, for example, can cause spikes in traffic volumes on the surrounding road system. Factors that influence traffic volume include land use characteristics, economic activities, travel patterns of the population, and availability of public transportation facilities.

Calculating traffic volumes is an important step in transportation analysis to assess road usage levels, identify infrastructure needs, and evaluate traffic performance. This process can be done through manual observation or automated tools. The manual method involves recording the number of vehicles traveling in a specific interval, such as 15 minutes or 1 hour. The automated method uses magnetic induction sensors, video cameras, or GPS-based tools to record vehicle counts more efficiently. To obtain more detailed data, Traffic volume counts are often accompanied by vehicle classifications, such as private cars, motorcycles, buses, and trucks. This data can be used to calculate average daily volumes.

Traffic volume is often associated with the concept of road capacity. Road capacity is the highest volume of traffic that a piece of road can handle under specific circumstances without lowering driving comfort or speed. Traffic congestion and accidents are increasing in Indonesia due to high population density(Reta, 2024). When traffic volumes approach road capacity, congestion starts to occur, increasing travel time. People are still doing various activities, whether going to/from work, going to/from school or other activities(Purnama, 2022). People's life activities generate a high volume of vehicles. This contributes to traffic congestion and chaos (Firmansyah, 2022). Traffic volume and road damage have the same relationship; when traffic volume increases, road damage also occurs. This is because the more transportation passes on the road, the more load the road receives. Road designs not designed with high loads, especially on rural roads, are often damaged due to inappropriate design.

## 2.3 Road Maintenance and Repair

Road maintenance and repair are important aspects of the transportation infrastructure system, and they aim to maintain quality and sustainability. Routine and periodic maintenance are the two primary types of road maintenance.. Routine maintenance involves cleaning the road, checking it, and making minor repairs to the road surface to prevent further damage. On the other hand, periodic maintenance involves more significant activities, such as repairing or replacing the asphalt layer and upgrading the road structure. To maintain and preserve the condition of the road and make it usable, the road authority must perform proper maintenance (Albar, 2024).

Road repair activities are usually carried out when road damage is severe enough to affect the comfort and safety of road users. Pavement assessment justifies the development and operation of expected modes of pavement maintenance (Isradi M. A., 2024). Roads with structural or significant damage to the road network also require full reconstruction (Nurhasanah, 2024). Road repairs may include repaving, repairing cracks, or replacing damaged structural elements. The main factors that cause road damage include heavy vehicle loads, extreme weather, and the quality of materials used. Technology and innovation also play an important role in road maintenance. Sound management systems, such as using data for Planning maintenance priorities based on the level of damage, can optimize the allocation of limited costs.

In addition to weather factors and the materials used, high traffic volumes are also one of the leading causes of road damage. Roads continuously traveled by heavy vehicles or logistics trucks will experience faster wear and tear than roads only traveled by light vehicles. Therefore, traffic volume analysis is an important part of road maintenance planning. The importance of well-planned road maintenance can also be seen in traffic safety. Poorly maintained roads cause vehicle damage and risk increasing the number of accidents. Damage, such as potholes or cracks in the road surface, can cause drivers to lose control. The safety of road users is paramount to reduce the risk of traffic accidents. Roads need upkeep in order to be comfortable to use and have a long, ideal service life (Muatan, 2022).

## 3. Method

Leuwiseeng Village Road is located in Majalengka Regency; the length of the road section studied is 1,2 km. This road is a village road with a road width of 5 meters and a two-way one-lane road. The following is a location map of this research.

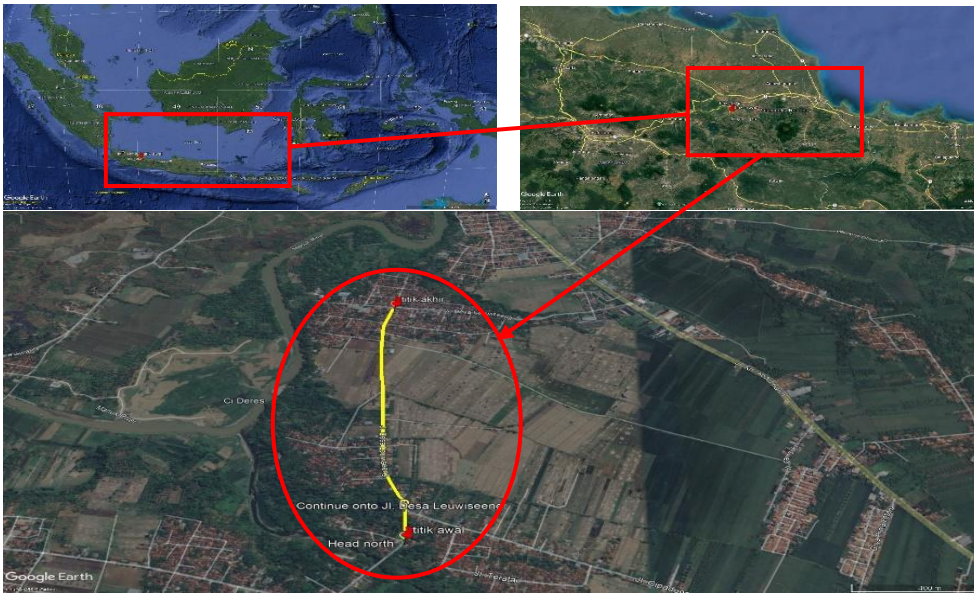


Figure 1. Location
Source: Google Earth Pro

Data collection is done by observation or direct observation of the location. Data collection is done by observation or direct observation of the location. Data collection was carried out for 3 days, namely Monday, Wednesday, and Friday, with meter tools and notebooks used to measure the area of road damage. The data collected are road geometric data, average daily traffic (LHR) data, and types and levels of road damage. After the data is processed, the repair and maintenance of the road will be analyzed for 3 days, namely Monday, Wednesday, and Friday, with meter tools and notebooks used to measure the area of road damage. Data was collected in the form of road geometric data, average daily traffic (LHR) data, and types and levels of road damage. After the data is processed, the road repair and maintenance are analyzed.

## 4. Result and Discussion

### 4.1 Traffic Volume

The data used to calculate traffic volume is the Average Daily Traffic (LHR) data surveyed in the field. The survey was conducted for 3 days. For the survey time, the researchers conducted the surveys at 06.00 - 07.00 WIB and 16.00 - 17.00 WIB, which is the peak hour of traffic. Vehicle types are divided into 3, namely:

a. HV Truck, Dump Truck, and others.
b. LV Private cars, public transportation, pick-up trucks, etc.
c. MC= Motorcycle

Of the three classes of vehicles above, the Passenger Car Unit (SMP) value has a value of HV= 1.3, LV= 1.0, MC= 0.5. The following are the results of the Average Daily Traffic (LHR) survey calculation.

Table 1. LHR Calculation Results

| Day | Vehicle Class | | | Volume (smp/day) |
|---|---|---|---|---|
| | HV= 1,3 | LV = 1,0 | MC = 0,5 | |
| Monday | 29 | 47 | 193 | 186.6 |
| Wednesday | 41 | 44 | 146 | 171.2 |
| Friday | 24 | 63 | 205 | 208.4 |

Source: Calculation Result

Based on Table 1 above, the highest LHR is on Friday with 208.4 smp / day, and then the class value is 3.

### 4.2 Pavement Damage Type

According to the Bina Marga Method, several categories of pavement damage include cracks, grooves, patches, holes, and surface roughness. The following table below is based on research on the Leuwiseeng Village road section.

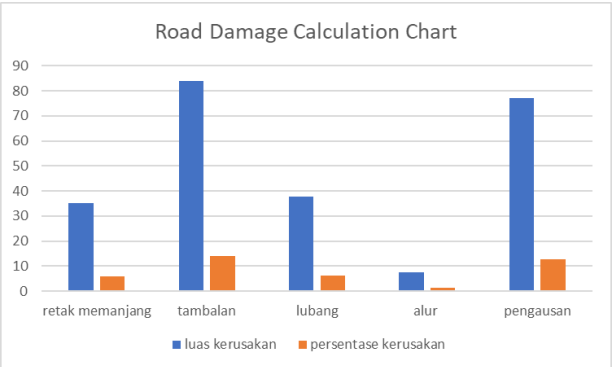


Figure 2. Road Damage Calculation Chart
Source: Calculation Result

In Figure 2. above, the highest percentage value of the damage is patches with a percentage of (14%), Wear 12.83%), holes 6.27%), longitudinal cracks (5.82%), and the lowest grooves with a value of (1.25%)

After calculating the percentage of damage types, the calculation of damage numbers is carried out as shown in Table 3 below.

Table 3. Road Deterioration Rate Condition

| Type of Damage | Damage Rate |
|---|---|
| Crocodile crack | 5 |
| Patches | 1 |
| Hole | 0 |
| Flow | 7 |
| Polished Aggregate | 4 |
| **Total** | **17** |

Source: Calculation Results

Based on the damage number condition table above, according to Bina Marga's 1990, the total road damage number 17 is in the damage range 16-18. So, the road condition value of Leuwiseeng Village is 6.

To calculate the Order of Priority (UP), it is calculated using the following formula.

UP = 17 - (LHR Class+ Road Condition Value)

= 17 - (3+ 6)

= 8

According to Bina Marga, the following is the handling priority order in the table below.

Table 4. Handling Priority Order

| Priority Order | Handling Taken |
|---|---|
| 0 – 3 | Improvement program |
| 4 – 6 | Program berkala |
| > 7 | Program pemeliharaan rutin |

Source: Direktorat Jendral Bina Marga 1990

The result of the Priority Order is 8, which is in UP> 7 according to the table above, the treatment taken is a routine maintenance program. The routine maintenance program is an annual repair of the road surface aimed at improving driving comfort. Repairs can be done by patching with patching holes in asphalt pavement.

## 5. Conclusion

From the results of the discussion using the Bina Marga LHR method, the Leuwiseeng village road with a length of 1.2 km is class 3. The types of damage on this road are crocodile cracks, patches, holes, grooves, and wear. Where crocodile cracks have the highest percentage of other types of damage, with a value of (14%). The Order of Priority (UP) is 8 with a category> 7, so the handling is carried out with a routine maintenance program every year. Damaged roads can be repaired by patching holes or patching on asphalt pavement.

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