# The Impact of Load Traffic of Road Deterioration in Urban Areas: Case Study Jalan KH Abdul Halim Majalengka

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| ARTICLE INFO | ABSTRACT |
|---|---|
| | *Pavement road kingdom damage frequently becomes into a serious issue. Due to the possibility that it will increase maintenance costs, lower the quality of transportation, and increase the danger of accidents. Next, cross. Findings from research This anticipation may provide additional light on the mechanisms underlying the repercussions and cross-road load of damaged pavement. It may serve as a foundation for the creation of maintenance plans that are more successful. The primary thoroughfare with heavy traffic in Majalengka, Jalan KH Abdul Halim, served as the research location. The Importance Performance Analysis (IPA) approach, which is employed in Cartesian with four quadrants, is employed in this study. Data from the results questionnaire were used to determine the significance of road pavement degradation. Driving safety was the greatest indicator, scoring 4.81, while the frequency of maintenance and repairs received the lowest score of 4.57. Temporary satisfaction with road pavement damage, with a score of 2.43 for value data from the greatest indicator impacts on vehicles, and a score of 2.11 for value data lowest, which relates to the frequency of maintenance and repairs. Based on the aforementioned statistics, the average interest value is 4.71, the average satisfaction value is 2.26, and the average gap value is -2.45. According to the data research findings, road and pavement damage received an average relevance score of 4.71. Temporary, that is, the average satisfaction score of 2.26 indicates that the interest mark is taller than the satisfaction mark, resulting in an average gap value of -2.45; the negative sign indicates that the user's road to lighting satisfaction Not just yet can be satisfied, given that the respondents anticipate that the KH Abdul Halim Street road's damaged pavement will be repaired.* |

## 1. Introduction

Especially in heavily populated urban regions, road infrastructure is essential for maintaining both regional economic growth and mobility. Every country needs to develop its transportation infrastructure in order to move people and goods in a timely, cost-effective, safe, and environmentally responsible manner. This affects the regional economic structure and the nation's geographical cohesion (Polyzos, 2020). Road pavement damage is a serious problem since it can increase

maintenance costs, reduce the quality of transportation, and increase the likelihood of traffic accidents. Moreover, poor road performance can make it more difficult for the road to function smoothly (Wincent, 2022). Traffic accidents have three major causes: human behavioral factors, vehicle mechanical factors, and driving environmental factors (Tsubota, 2018). Excessive traffic load is one of the primary causes of road pavement deterioration, as it compromises the road's structural integrity and longevity.

Humans depend heavily on transportation, particularly highways, to go about their daily activities (Isradi et al., 2020). Numerous factors, including cracks, potholes, and permanent deformation, can accelerate road deterioration caused by high traffic volumes, especially from large vehicles like buses and trucks. Globalization's increased use of cars also affects mobility, which leads to vehicle volume loads exceeding authorized road class limitations and deteriorating pavement age and quality (Isradi et al., 2021). The need for greater public understanding of the value of public transit guidance is one of the elements thought to be contributing to the suspected increase in the number of vehicles (Sidiq, 2022). One example of a road in an urban region that frequently sees heavy traffic volumes every day is Jalan KH Abdul Halim in Majalengka. The state of this situation makes it difficult to maintain and fix suitable roadways. It is necessary to conduct business to maintain the quality of road service in order for the road to continue meeting the needs of traffic with a certain level of service. One of these activities is evaluating the condition of good roads, which should have thickness and quality that will not be harmed by load vehicles (Isradi et al., 2020).

When designing a pavement structure to meet its service life, consideration is given to the quality of the materials used, environmental factors such as the amount of rainfall that is anticipated and the pavement's (in this case, the drainage channel's) ability to lessen or eliminate the threat of environmental factors, and the size of the anticipated load (Hatmoko, 2019). This study is to investigate how traffic volume affects deterioration to the road surface in Jalan KH Abdul Halim. This study will gather information about the physical state of the road, the quantity and kind of cars that travel on it, as well as environmental elements that may have an impact on pavement damage, utilizing both primary and secondary data. This data's analysis will assist in determining damage patterns and how they relate to actual traffic loads.

The research approach includes field surveys, road condition mapping, and statistical analysis to relate the available data. This case study will also review the maintenance strategies that have been implemented and evaluate their effectiveness in reducing road damage. Even though they are more expensive to build and maintain, paved roads have the advantage of providing a high-speed surface and convenient transit. These are characteristics that are crucial in the contemporary, fast-paced world we live in (Shtayat, 2020). As a result, this research gives suggestions for future advancements in addition to a summary of the current situation.

The results of this study will lay the groundwork for the development of more effective maintenance programs and advance our knowledge of the mechanisms driving traffic-related road surface deterioration. It is therefore essential to understand the distribution of pavement damage given the high percentage of road maintenance and the prompt and effective detection of such damage given the continually rising length of roads (Ren, 2023). Local governments and authorities in Majalengka will be able to develop and maintain road infrastructure more efficiently with the support of the research findings and recommendations, which will lower damage and improve the community's standard of road services.

## 2. Literature Review
## 2.1 Effect of Traffic Load on Road Pavement Damage

Because it enables them to move about quickly and maximizes time efficiency, people with access to transportation are more productive (Andika, 2022). Road surface erosion is mostly caused by high traffic volumes, especially when those levels are generated by huge trucks. The traffic flow metric of vehicle volume represents the total number of vehicles on the road over an extended period of time (Assalam, The Effectiveness Analysis of Frontage Road on Jalan Margonda Raya, Depok, 2022). Heavy vehicles like trucks and buses repeatedly put a lot of stress on the layers of road surface. The pavement material is permanently deformed by this pressure, and over time, these fractures and holes appear. A practical and realistic prediction of pavement performance over the design lifetime requires a precise assessment of the mechanical response fields (stress, strain, and deformation fields) of the pavement (Assogba, 2020). Compared to roads used only by light cars, roads with heavy traffic loads experience the material fatigue process more quickly, leading to degradation more swiftly.

In addition to the road surface layer, traffic loads also affect the sub-foundation and foundation layers. Regularly carrying large loads can erode the foundation of the road, causing shifting and uneven surface settling. The performance, longevity, and length of service period of the pavement are determined by the amount of bitumen that can be bonded and adhered to the aggregate surface under different conditions (Omar, 2020). Furthermore, the study demonstrated that a high frequency of large cars accelerates the road's structural deterioration, making it more susceptible to major damage and requiring more frequent and expensive repairs. The enhancement of community facilities and infrastructure is one way that regional development can be a reflection of the health of the local economy (Rifai, 2021).

Severe traffic jams are caused by the uneven distribution of vehicle traffic compared to the breadth and size of Indonesian roadways, as well as the poor design of signalized intersections and roundabouts (Immanuel, 2022). sheer traffic loads are frequently a more serious issue in urban areas because of the sheer number of vehicles around all day long. As the automobile industry has grown, the number of people owning cars has increased annually. As a result, high-quality pavements are required to handle the demands of heavy traffic (Liu, 2020). This puts more strain on the road infrastructure, which might require regular updates or redesign to handle such heavy volumes. The remaining fatigue life of the present asphalt layer is also necessary in pavement rehabilitation design, which involves placing a new structural layer over the old one (Cheng, 2021). Consequently, improved maintenance practices and infrastructure design depend on an understanding of how traffic loads affect road pavement deterioration. The number of people who ride motorcycles and drive cars is rising quickly in many emerging nations. Simultaneously, there are few possibilities to obtain thorough driving training and knowledge about road safety (Assalam, The Effectiveness Analysis of Frontage Road on Jalan Margonda Raya, Depok, 2022).

## 2.2 Factors Affecting Road Damage

Road deterioration is influenced by a number of interrelated factors besides traffic loads. The quality of the material used to pave roads is a major factor. Low-quality materials are more vulnerable to wear and damage when there are large loads and bad weather. When poor mixing techniques or non-compliant materials are used, the road may have severe structural issues. However, the road ages and deteriorates with time due to a variety of factors, including weather, age, traffic volume, engineering decisions, and the materials used in construction. Because of this, knowing how much

deterioration there is is crucial for doing cost-effective maintenance that keeps the road in excellent and safe condition (Arya et al. learning-based road damage detection and classification for multiple countries, 2021).

A significant contributing element to the acceleration of road deterioration, aside from material quality, is weather. Precipitation is the primary source of road surface water that can permeate joints, voids, cracks, and the borders of the road, allowing it to seep into the internal structure of asphalt pavement (Wang, 2019). Pavement materials can expand and compress as a result of prolonged precipitation, exposure to strong sunlight, and sharp temperature changes, which can cause cracking and breaking. For example, in warmer climates, asphalt that is subjected to heavy loads tends to soften and deform more quickly. However, in colder climates, the water in the pavement may undergo significant breaking due to freezing and thawing cycles.

The durability of the road pavement is also significantly influenced by the building technology employed. Poor compaction or uneven asphalt application are two examples of improper construction procedures that can lead to weak places in the road structure that are prone to failing too soon. Life cycle assessment (LCA) is one method used under the auspices of sustainable development to examine the building of road infrastructure (Nascimento, 2020). both conventional and modern building methods and technologies to guarantee the best possible road quality and longevity.

## 2.3  Case Studies in Various Urban Areas

Case studies carried out in various urban zones offer a better knowledge of the impact of traffic loads on road degradation. One major problem is the sheer volume of heavy vehicles on urban roadways. The road A. Rozak / Patal Pusri / Mongosidi is the main route and is vital since it travels through ports, densely inhabited districts, and the Pusri pure fertilizer industrial hub. Road W is located in the city of Palembang. (Oktorine, 2019). Large vehicles such as freight trucks and buses exert extra pressure on the road's pavement, speeding up the deterioration process and causing material fatigue.

Inadequate planning for the infrastructure and insufficient money for upkeep exacerbate this problem. It demands regular assessment of the state of the roads, which is frequently carried out independently by several government authorities (Arya et al., 2020). The study found that both abrupt increases in traffic loads and a lack of routine maintenance led to faster and more severe road degradation. However, the road ages and deteriorates due to a variety of factors, including weather, traffic volume, age, engineering choices, and the materials used in construction. In order to preserve the road's good and safe condition, it is necessary to determine the extent of the deterioration through effective and inexpensive maintenance (Arya et al. learning-based road damage detection for different nations, 2020).

Similar patterns can be observed in numerous case studies from developing countries, where high traffic volumes and sporadic maintenance lead to significant road degradation. For example, as a result of urbanization and economic growth, heavy vehicle traffic volumes have increased considerably in Brazil's main cities, seriously deteriorating the nation's road infrastructure. The Brazilian National Traffic Council conducted a road quality assessment study (CNT (2018)) and found that 37.0% of the roads were classified as "Regular," 9.5% as "Bad," and 4.4% as "Poor" (Rateke, 2021). These studies emphasize the need for better planning and investments in more robust road infrastructure to address the problems caused by high traffic loads in urban areas.

## 3. Method

This study aims to investigate the effects of traffic loads on the state of the road surface in Jalan KH Abdul Halim, Majalengka. Among the methods used are field surveys, data collection, data processing, and result interpretation. This study used the Importance Performance Analysis (IPA) approach, which makes use of four quadrant Cartesian quadrants. To sustain its performance, it is recommended to keep the variables in Quadrant 1 (High Interest and High Satisfaction) constant. Quadrant 2 exhibits overperformance (Low Interest and High Satisfaction). Quadrant 3 (Low Interest and Low Satisfaction) indicates low priority. Quadrant 4 (High Interest and Low Satisfaction) indicates that more concentration is needed (Sumantri, 2022). The primary thoroughfare with heavy traffic in Majalengka, Jalan KH Abdul Halim, served as the research location.
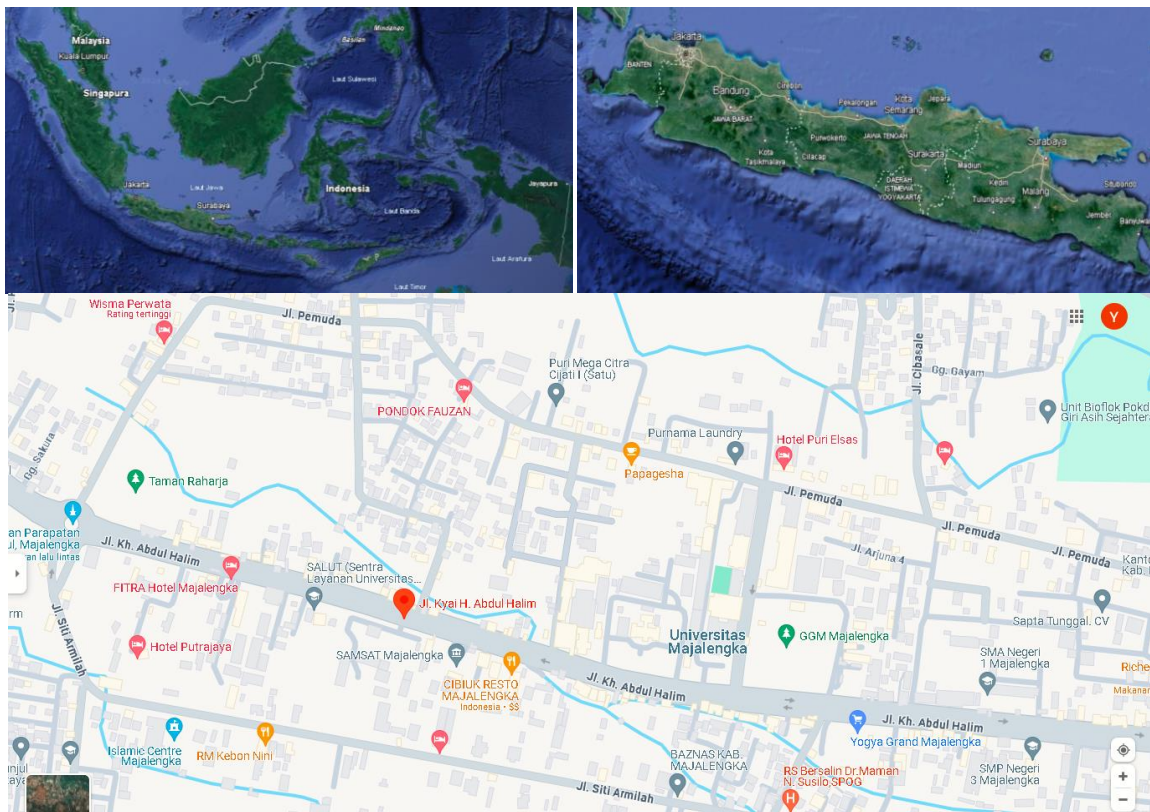


Figure 1Location Plan

A questionnaire measuring satisfaction and interest in road damage to pavement on Jalan KH Abdul Halim, Majalengka, was used to gather ata from the opinions of 50 respondents. It is very significant to very unimportant and very unsatisfied to very satisfied on a scale of 1 to 5. The damage to the road pavement at Jalan KH Abdul Halim, Majalengka, is the subject of this study, which was conducted via questionnaires and on-site direct observation. The answers of a questionnaire given to people who use Jalan KH Abdul Halim in Majalengka as well as observations made of the road constitute primary data.

| | |
|---|---|
| How critical is the condition of the road for the comfort of road users? | A1 |
| How important are road conditions for driving safety? | A2 |
| How critical is the condition of the road in reducing your vehicle maintenance costs? | A3 |

| How critical is the condition of the road in terms of the frequency of maintenance and repairs? | A4 |
|---|---|
| How significant is road damage to government involvement in road maintenance? | A5 |

*Table 2 Indicators of Importance*

| How significant is road damage to government involvement in road maintenance? | B1 |
|---|---|
| How satisfied are you with safety on this road? | B2 |
| How satisfied are you with vehicle maintenance costs due to these road conditions? | B3 |
| How satisfied are you with the maintenance and repair of this road? | B4 |
| How satisfied are you with the government's involvement in maintaining this road? | B5 |

*Table 3 Satisfaction Level Indicators*
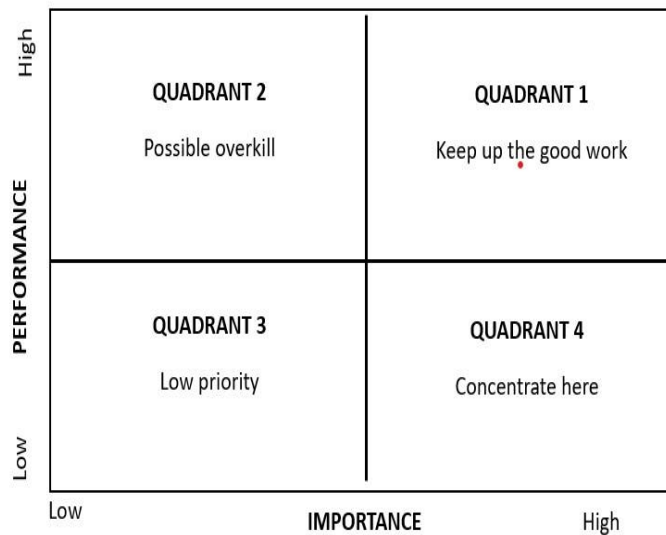


*Figure 4 The IPA Method Quadrant*

## 4. Result and Discussion

| Indicator | Importance | Performance | Gap |
|---|---|---|---|
| Driving Comfort | 4.75 | 2.31 | -2.44 |
| Safety ride | 4.81 | 2.28 | -2.53 |
| Impact on vehicles | 4.64 | 2.43 | -2.21 |
| Maintenance and Repair Frequency | 4.57 | 2.11 | -2.46 |
| Government involvement in road maintenance | 4.79 | 2.18 | -2.61 |

*Questionnaire Data on the Importance and Satisfaction of Road Pavement Damage KH Abdul Halim*

According to the data above, which was derived from the questionnaire's answers about the significance of damage to road pavement, driving safety has the highest indicator value (4.81), while the frequency of maintenance and repairs has the lowest data value (4.57). In the meantime, the impact on vehicles has the highest value data for the indication of satisfaction with damage to road pavement, scoring 2.43, while the frequency of maintenance and repairs has the lowest value data, scoring 2.11. Based on the aforementioned statistics, the average interest value is 4.71, the average satisfaction value is 2.26, and the average gap value is -2.45.
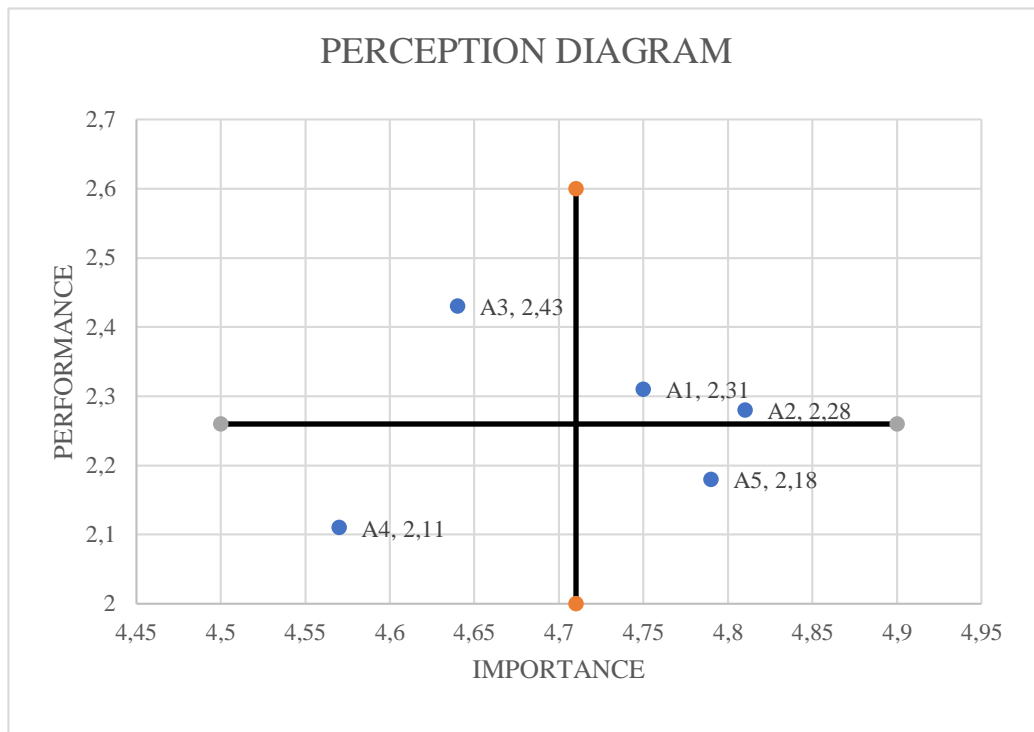


*IPA Method Diagram Image*

The relevance and value of each individual quadrant's level of satisfaction are displayed in the table above. Maintaining Quadrant I is necessary since it has a high degree of value and satisfaction. Two in particular, A1 and A2. Low importance and a low degree of satisfaction height characterize Quadrant II. This is over the top; A3 is the only indicator that is presented. The same low degree of satisfaction and prioritized interests are found in Quadrant III. Quadrant III contains one indicator, which is A4. The quadrant with the same low degree of interest and satisfaction is called Quadrant IV. Quadrant IV contains one indicator, which is A5.

## 5. Conclusion

Based on the data gathered from studies on pavement deterioration, an average importance score of 4.71 was determined. The average gap value is -2.45, a negative indicator that suggests that road user contentment with lighting has not been met, while the average satisfaction value is 2.26, showing that the value of importance is larger than the value of satisfaction. Respondents anticipate that repairs may thereby deteriorate Jalan KH Abdul Halim's road pavement. This involves lowering the possibility of mishaps. Other than that, driving safety is one of the factors with the highest relevance value, and the impact on the vehicle has the highest satisfaction value.

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