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EVALUATION OF PAVEMENT PERFORMANCE ON JALAN RANCAPURUT SUMEDANG USING THE CORE DRILL METHOD

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ABSTRACT

This research aims to comprehensively analyze the current condition and performance of Rancapurut Road in Sumedang, Indonesia. The analysis is conducted to identify areas requiring repair and evaluate the effectiveness of current maintenance and rehabilitation methods. It is crucial to ensure that the region's road infrastructure meets expected safety and comfort standards and to provide recommendations for future improvements. The research employs an exploratory quantitative approach, collecting empirical data directly from the field. The research population includes segments of Rancapurut Road in Sumedang, with samples selected randomly or based on critical areas representing the whole. Primary data collection utilizes core drill techniques, extracting core samples of concrete or asphalt for thickness, composition, and pavement layer condition analysis. Secondary data, such as road maintenance records, is also gathered. The results of the research indicate that the overall condition of the Rancaputu Road pavement is good. The average thickness of the pavement at location 1 is 4.7 cm, location 2 is 4.3 cm, and location 3 is 4.55 cm. However, some points of measurement show lower thicknesses, such as the second measurement point at location 1 (3.25 cm) and the fourth measurement point at location 3 (3.08 cm). The reduction in pavement thickness can be caused by various factors, such as heavy traffic loads, inadequate subgrade conditions, or poor pavement material quality. The research findings are expected to be useful for road managers and engineers in Sumedang and other regions with similar conditions. The findings can be used to improve the planning and implementation of pavement maintenance and rehabilitation programs.

1. Introduction

At the international level, the focus in road paving engineering is primarily on sustainable development. This includes the production of new, durable materials for pavement construction, the use of more sustainable materials (such as the use of waste materials), better pavement management, and innovative maintenance and rehabilitation techniques. Developing pavement that can produce energy is also an important part of greener road infrastructure. _In the context of road infrastructure development, evaluating pavement conditions is an important aspect that determines the sustainability and safety of roads. Pavement Condition Index (PCI) and core drill data are two methods that are often used to assess road conditions. PCI provides an overview of the quality of the pavement based on visual observations and the level of damage found, while core drilling allows further analysis of the composition and quality of the pavement material. These two methods have an important role in determining road maintenance and repair strategies, thus contributing directly to the efficiency and safety of road infrastructure.

Indonesia faces challenges in maintaining and improving the quality of national roads. The Directorate General of Highways noted that the national road network in Indonesia reached 47,017 kilometers with a stability level of 92.2%. National roads have an important role in connecting connectivity between transportation modes throughout the country. However, there are challenges in maintaining and improving the quality of this road so that it can support the need for efficient mobility and connectivity throughout the country. _The application of high-density polyethylene (HDPE) fiber to strengthen expansive subgrade can be an important solution in overcoming the challenges of maintaining and improving the quality of national roads. In particular, in areas with expansive subgrade that are susceptible to damage due to changes in volume, this technology can improve road durability and safety, which is a crucial aspect in ensuring efficient connectivity between transportation modes throughout Indonesia. This approach can help achieve the national road stability targets set by the Directorate General of Highways.

At the regional level, especially in the West Java region where Sumedang is located, the main issue is related to the implementation of road pavement quality standards. Studies show that although there is increased investment in national and provincial roads, this is not necessarily followed by an even increase in road quality in various regions. This problem can be caused by various factors, including practices in implementing quality standards that are not by procedures or road damage that occurs before the expected service period. This demands the need for a more in-depth evaluation regarding the implementation of road pavement quality standards to ensure optimal road performance. There have been significant efforts by the local government to improve the condition of road infrastructure in Sumedang Regency. In 2023, good road conditions will increase to 63% of the total length of district roads, which shows a significant improvement compared to conditions in 2018. In addition, the government's efforts in handling various road sections have shown results that exceed the targets set in 2018. previous year. This shows the strong commitment of the local government to improving the condition of road infrastructure in Sumedang.

One of the areas experiencing significant road infrastructure improvements is the Jalan Mayor Abdurrachman protocol route to the Sumedang Square area, which shows the government's efforts to improve road conditions in the area. Apart from that, there are several routes in Sumedang which are known as "death routes" due to the high number of accidents, such as the Cadas Pangeran road and the Cirebon-Bandung road in the area around Tanjakan Nyalindung. Steps have been taken, such as the installation of warning signs, to reduce the risk of accidents on these routes. These areas can become focal points in your research to assess the effectiveness of road improvements and safety measures implemented.

The purpose of this research is to conduct a comprehensive analysis of the current conditions and performance of the road pavement. This is done to identify areas that require improvement, as well as evaluate the effectiveness of methods currently used in road maintenance and repair. This research is important to ensure that road infrastructure in the region meets expected safety and comfort standards, as well as providing recommendations for future improvements.

The context of this research refers to current practices and the latest technology in the field of road pavement performance evaluation. This includes the use of technology such as Core Drill, which allows for a more in-depth evaluation of the structure of the pavement and its underlying layers. This method provides more accurate data about road conditions, including identification of damaged areas, extent of damage, and potential causes of damage. By understanding this state-of-the-art, your research will contribute to improving practices in road infrastructure management in Sumedang, as well as providing valuable insights that can be applied in other areas with similar conditions.

2. Literature Review

2.1 Core Drill Methodology and Applications

The Core Drill method in road paving is used to obtain concrete or asphalt core samples from existing pavement. This process allows for in-depth analysis of the composition, thickness, and condition of the pavement layer. This information is critical in evaluating the current condition of the road and planning maintenance or repair activities. By understanding the structure and quality of pavement materials, this method helps in determining the interventions needed to maintain or improve road conditions. [4]The Core Drill method is used not only for structural analysis, but also to support the study of representative volume elements (RVE) in the correlation between non-destructive electromagnetic (EM) measurements with conventional asphalt pavement quality control measurements. Pavement core measurements obtained from the same location as the Ground Penetrating Radar (GPR) measurements support these experiments, providing important data for evaluating asphalt quality based on properties such as density and dielectric constant.

It was noted in the research that the Core Drill method was proven to be very effective in testing the compressive strength of concrete, providing results that met quality requirements. Tests using Core Drill on spun piles FC 45 and FC 50 produced a high average compressive strength, showing the reliability of this method in assessing the quality of hardened concrete structures. In the theory of concrete compressive strength testing, a comparison between the hammer test and Core Drill methods shows that there is a significant correlation between the two. The Core Drill method, in particular, is known to provide more accurate results in compressive strength measurements, as evidenced by the development of the equation and the high coefficient of determination (R^2) values in the study. In addition, the accuracy of data from Core Drill in assessing the compressive strength of concrete makes an important contribution to determining the structural feasibility of buildings, especially in the process of reconditioning or upgrading buildings.

In another theoretical context, the core drill method is an effective asphalt sampling procedure for laboratory analysis of specific gravity. A specific gravity ratio that exceeds 98% compared to solid asphalt indicates that the compaction on a particular road segment has met the specified standards, making it suitable for use. This approach is crucial in efforts to ensure the quality of road infrastructure, which directly affects the safety and comfort aspects of road users. Traditional core drill methods in asphalt pavement thickness detection have limitations in meeting the increasing detection demands, especially in terms of speed and efficiency. As a sampling method, core drilling relies on a slower destructive approach and requires further analysis in the laboratory to obtain accurate results. The core drill method is described as a destructive way to control the degree of compaction of asphalt mixtures, which is important for evaluating the quality and suitability of the final layer in road construction. This method, which involves taking core samples from the finished road layer, allows accurate determination of the degree of compaction, which is a key factor in determining the quality and longevity of asphalt roads.

2.2 Road Pavement Performance

In pavement management theory, pavement performance is considered a critical indicator that influences the safety and efficiency of vehicle traffic, measured through variable parameters that fluctuate according to climatic conditions and traffic load. Changes in parameters such as pavement roughness and unevenness, which are important in evaluating road conditions, can be identified through field studies or analysis of historical data. Methodologies such as Accelerated Pavement Testing (APT), developed at the University of Zilina, allow simulating changes in these parameters, providing a basis for economic and technical analysis of specific road segments in the context of pavement management. Road pavement is the layer that is between the subgrade layer and the vehicle wheels so that it directly interacts with the vehicle. The main function of this layer is to provide services to traffic and bear the burden of daily recurring traffic. Therefore, it is very important that during use, the road pavement remains in good condition and does not experience damage that could reduce the quality of traffic services.

Road pavement performance tends to decrease as road age and traffic load increase. To study the pattern of pavement performance degradation, this research considers the impact of the relationship between pavement structure and traffic load on pavement performance, by introducing the concept of the "structure-traffic index". In this analysis, a performance degradation relationship is established by considering the "structure - traffic index", road surface evenness, pavement structural strength, and pavement anti-slip ability, which is then used to develop a prediction model for routine highway maintenance costs. Road pavement performance is a critical aspect in maintaining highway infrastructure, and this research identifies two main approaches, namely traditional modeling methods which are good at combining temporal and spatial aspects but require improved model interpretation based on machine learning techniques, and adaptive modeling methods which can describe behavior. pavement damage more accurately but needs to improve the setting of renewal conditions and evaluation of renewal effects. Recommendations for future studies are also provided to further improve understanding and maintenance of pavement performance.

The importance of road pavement maintenance is currently more focused on the performance of the asphalt surface, but structural damage within the pavement is often overlooked. It was noted in the research, that using non-destructive tests to measure performance, deflection parameters, and structural damage in asphalt pavements, and then using factor analysis to identify common factors among all these indicators. This approach helps in a more comprehensive performance assessment and provides more objective weighting, thereby providing better guidance for determining the timing of road pavement maintenance. the importance of considering emissions produced by road users in evaluating pavement performance, apart from aspects of construction, maintenance, and demolition. This shows that road pavement performance is not only determined by the physical factors of the pavement itself but is also influenced by road users and climate change. By considering road user emissions and climate change impacts in pavement performance analysis, we can gain a more comprehensive understanding of the factors that influence the sustainability of road pavements.

Abroad, there is long-term pavement performance monitoring (Long-term pavement performance/LTPP), this is a program that has been carried out for more than 20 years, such as in Australia with funding from Austroads which represents various road agencies. The program measures pavement performance by monitoring defects such as grooves, roughness, cracks, and deflections, and has developed deterministic models to predict surface damage and loss of traffic load capacity. In addition, this program also includes long-term pavement performance maintenance (LTPPM) monitoring to assess the impact of surface treatment on pavement conditions and the effect of treatment on road damage. These models have now been integrated into pavement management systems (PMS) for more efficient maintenance allocation, and the program is routinely evaluated to ensure observational data relevant to environmental conditions, traffic, and new pavement materials.

2.3 *Core Drill* Method and Road Pavement Performance

In road pavement performance evaluation, the core drill method is used as part of the testing to assess quality and compliance with technical specifications. The use of core drills is mainly focused on testing pavement thickness and density, which are important factors in determining road quality and stability. The results of this evaluation, including testing with core drills, assist the Indonesian government in planning and improving future road projects, taking into account the increase in the number of core drill samples in testing. Others The core drill method plays an important role in evaluating road pavement performance by providing direct data from the internal structure of the pavement. This technique allows for in-depth analysis of the depth, density, and integrity of the pavement material, which is essential in determining the quality and durability of the road. With core drilling, assessment of road pavement performance becomes more accurate, allowing identification of areas of damage and determining appropriate repair steps.

In the context of research that uses non-destructive testing methods such as Falling Weight Deflectometer (FWD) and Portable Seismic Property Analyzer (PSPA) for asphalt pavement evaluation, the core drill method is not directly involved. However, in practice, core drilling can be used as a complementary method to obtain physical samples of pavement, allowing further analysis related to material properties and validation of data obtained from non-destructive testing. Thus, the use of core drills in road pavement performance provides useful additional information to strengthen the results obtained from testing techniques such as FWD and PSPA, especially in determining layer modulus and evaluating structural damage. The core drill method is not explicitly related to the focus of this research, which concentrates on the characterization of interlayer adhesive materials using an interfacial cohesive zone model. However, in a general context, core drills can be used to collect samples from various layers of pavement, including interlayer adhesive materials, for further analysis regarding the properties and performance of those materials. Thus, core drilling provides important insights into the structural integrity and performance of road pavements, particularly in the context of interlayer cohesion and material interactions within the pavement structure.

In other contexts, the core drill method plays an important role in validating and verifying the quality of the asphalt mixture after construction. Core drilling allows physical sampling of constructed pavement to evaluate compliance of aggregate gradations with design specifications, which is critical to pavement performance. Thus, core drills provide practical feedback on the effectiveness of gradation control during the construction process and its impact on the final performance of the road pavement. Additionally, the core drill method can be used to assess the homogeneity of the asphalt mixture along the pavement, allowing the identification of areas with high gradation variability that may affect road performance. Analysis of samples taken with a core drill also helps in understanding the relationship between aggregate size distribution in an asphalt mixture and characteristics such as density, strength, and durability of the pavement.

3. Method

This research uses an exploratory quantitative approach to collect empirical data directly from the field. The population of this study includes segments of Jalan Rancaputu in Sumedang, with samples selected randomly or based on representative critical areas. Primary data collection is carried out through the core drill technique, where core samples of concrete or asphalt are taken and analyzed for information about the thickness, composition, and condition of the pavement layer. Secondary data such as road maintenance records were also collected. Data analysis follows existing pavement performance evaluation models, using statistical techniques to evaluate pavement conditions and projected service life. This research aims to produce a comprehensive evaluation of the condition of the Rancaputu Road pavement and assist in planning future road maintenance or rehabilitation.

4. Results and Discussion

4.1 Core Drill Method Lab Results

This research records and analyzes the thickness of road pavement at specific locations, identified by specific coordinates and positions (right, center, left) on the road. The data shows four thickness measurements at each location, providing a detailed picture of pavement thickness variance at those measurement points. This information is very useful for identifying areas on the road that may experience more significant thickness reduction, which could indicate pavement damage or wear. By calculating the average value of these thickness measurements, the study provides a more stable estimate of pavement thickness at each location.

Table 1 Results of Lab Test Analysis for Improvement of the Kebon Kalapa Axis Road

No.	Location (Sta)	Position	Thickness (cm)				Average Thickness (cm)	Distance from Edge (cm)	Road Width (cm)
1	0+025	KA	4.7	4.7	4.8	4.6	4.70	180	256
2	0+074	US	4.3	4.2	4.4	4.3	4.30	140	253
3	0+985	KI	4.6	4.6	4.4	4.6	4.55	60	250
							4.52		
1	0+020	US	3.6	3	3.1	3.3	3.25	100	250
2	0+041	KA	2.5	3.2	3.2	2.5	2.85	170	245
							3.05		
1	0+012	KA	7.2	6.8	7.2	7	7.05	180	260
2	0+062	US	4.1	4.1	4.2	4.2	4.15	185	280
							5.6		
1	0+001	KA	2	2	1.8	2	1.95	270	300
2	0+025	US	2.9	2.9	3	3	2.95	40	252
3	0+030	KI	3.2	3.1	3	3.1	3.08	30	250
4	0 + 100	KI	5.3	5.1	5.1	5.4	5.23	30	253
5	0+146	KA	4	4.1	3.9	4	4	296	396
							3.44		

Source: Lab. Putr

4.2 Discussion of Road Pavement Performance

The table shows the results of laboratory test analysis of improvements to the Kebon Kalapa axis road. Tests are carried out to measure the thickness of road pavement at certain locations identified by specific coordinates and positions (right, middle, left) on the road.

The data shows four thickness measurements at each location, providing a detailed picture of pavement thickness variations at those measurement points. This information is very useful for identifying areas on the road that may experience more significant thickness reduction, which could indicate pavement damage or wear. By calculating the average value of these thickness measurements, the study provides a more stable estimate of pavement thickness at each location.

In general, the thickness of the pavement on the Kebon Kalapa axis is quite good. The average pavement thickness at location 1 is 4.7 cm, location 2 is 4.3 cm, and location 3 is 4.55 cm. However, several measurement points show lower thickness, such as the 2nd measurement point at location 1 (3.25 cm) and the 4th measurement point at location 3 (3.08 cm).

A decrease in pavement thickness can be caused by various factors, such as heavy traffic loads, inadequate subgrade conditions, or poor quality of the pavement material. To prevent further damage to the pavement, maintenance and repairs need to be carried out at points where thickness decreases.

5. Conclusion

1. The core drill method is an effective method for measuring road pavement thickness because it can provide a detailed picture of thickness variations, can be used for various types of materials, and the measurement results are accurate.
2. Regular testing of road pavement thickness is important to monitor road pavement performance. This testing can help identify areas of more significant thickness loss, which could indicate pavement damage or wear. A decrease in pavement thickness can be caused by various factors, such as heavy traffic loads, inadequate subgrade conditions, or poor quality of the pavement material. To prevent further damage to the pavement, maintenance and repairs need to be carried out at points where thickness decreases.

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