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ANALYSIS OF THE CAUSES OF ROAD DAMAGE

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ABSTRACT

The background of this research is the existence of roads is needed to support the rate of economic growth, agriculture, social, cultural and other sectors. While in reality, the condition of road construction is often not followed by good maintenance, causing various kinds of problems. There are alternative solutions to repair road pavements which can be classified into 2 types, namely functional repairs and structural repairs.

This research is a qualitative descriptive research on secondary data collection, which aims to study the literature through the collection, comparison and inventory of previous studies on road pavement damage, the aspects that cause it, and effective countermeasures to overcome it and provide an overview of road pavement damage and aspects that cause the limitations of several areas that are the object of research.

The result of this research is that the damage to the road pavement is dominated by cracks and surface defects due to several main factors, namely drainage maintenance is not carried out optimally and correctly so that garbage clogs the drainage. and around drainage for growing crops.

1. Introduction

Road infrastructure is the lifeline of the transportation system and plays an important role in every aspect of our lives, so it must always be in good condition in order to continue to contribute to the improvement of optimal service through repairs and maintenance. Judging by the concentration of road users, roads are the most used transportation infrastructure[1][2], road maintenance and construction must be of good quality, and innovative updates of road infrastructure are required from time to time. You need to do. [2][3]

Speaking of roads, highways themselves are a means of land transportation, especially in the transport sector, in the process of sustainable distribution of goods and services, and in



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the process of passenger transport, which is considered to be the most efficient and costly. It plays a very important role. -effective. The presence of highways is needed to support economic growth, agriculture, social welfare, culture and other sectors. This is because recent developments in global and domestic economic conditions pose challenges to efforts to achieve and maintain stable economic growth in Indonesia. [4]. Therefore, the current government wishes to develop infrastructure, especially the road to improve the road, and to improve their happiness. However, the construction of the street often causes various types of problems that correct maintenance continues. Road damage is a complex issue in almost all regions. Road damage was discovered before the end of the roadside plan, and generally there were various damage that was not only factor, but it was combined with the side of the cause relied on it. Therefore, it can be confused after light damage to difficult damage. Based on the results of Adzim et al. Based on the analysis performed, road damage is known to be dominated by crack damage and surface imperfections. Second, the main reason for road damage is sewer maintenance, which is not done regularly and properly, with lots of garbage clogging and lots of vegetation around the platform. Therefore, roadbeds and other well-maintained pavement supplemental structures indicate the nature, severity, and extent of significant pavement damage that triggers the repair process. [5]

Damage caused by road damage, such as traffic accidents, long travel times, and traffic jams, is especially serious for road users. Personal losses can be a measure of the region's global economic loss. In addition, if road damage is left unattended, maintenance costs may increase, so the road infrastructure development budget is mainly used for maintenance activities. On the other hand, the government's ability to raise funds for road infrastructure is declining and so limited that road maintenance activities, especially new road construction, are ignored. So far, repairing road damage has not been optimally refurbished, maintained or improved. All the efforts made due to the damage seem to be chasing each other. This can happen because maintenance is only performed for physical damage without further evaluation of the causative aspect and it is necessary to take action to prevent the pavement from being damaged as before. .. The quality and durability of the pavement structure is inseparable from the state of the substructure. A good foundation for pavement construction is one of the local sites or other site fills compressed to a specific density, with load bearing capacity to accommodate changes in volume over the service life. There are differences in the environment. Conditions and soil local types [6]

Therefore, in this case, many aspects of road damage and damage in many parts of Indonesia are explained according to the results of previous surveys. It then draws conclusions from the data it collects, captures the main and early damage-causing aspects, and proposes effective measures to address the problems that arise. However, the letter is limited to damage to flexible roads. The flexible pavement is a pavement that uses asphalt as a binder where the pavement construction includes a pavement layer that is spread over the subgrade after compaction. A pavement layer that is responsible for carrying and spreading traffic loads to the subgrade. Layers against flexible pavement include

- 2.1. Surface course, covering the wearing course and the binder course.
- 2.2. Layers of the top foundation (Base Course).
- 2.3. Layers of sub-base course
- 2.4 Layers of subgrade (Subgrade)

According to the picture below:



Source: Director General of Highways of the Republic of Indonesia (2012)

Figure 1. Road Pavement Layer

Figure 1 shows that roads are the most important structure that drives a country's economic growth. The road structure to be built is determined by traffic requirements, local climatic conditions, terrain and more. Road structures need to withstand wear, and climatic and terrain conditions need to undergo new surface coatings. Maintenance must be performed throughout the planning process to maintain the performance of the pavement and provide safety and comfort to road users. The design life of the new flexible pavement structure complies with the laws of the Highway Director General No. 22.2 / KPTS / Db / 2012 of the Road Pavement Design Manual. This is 20 years, but the road pavement design life is improved by 10 years. The era of road paving planning was created by Bina Marga. He believes that the design era of more than 20 years is no longer economical in terms of the construction stage: road maintenance, planning, or implementation. The condition of road pavement services can be classified as critical, steady, and unstable pavements. The categories are defined and explained, among others:

2.1. Great Service Condition

This is a service condition from the construction is still new to the service condition to the stability limit and the decrease in the fair stability value as calculated. For example on the road to moderate and good conditions.

2.2. Unstable Service Conditions

This is a state of service that lies in the stability limit to the critical limit. An example in this case is a road that is in poor or damaged condition.

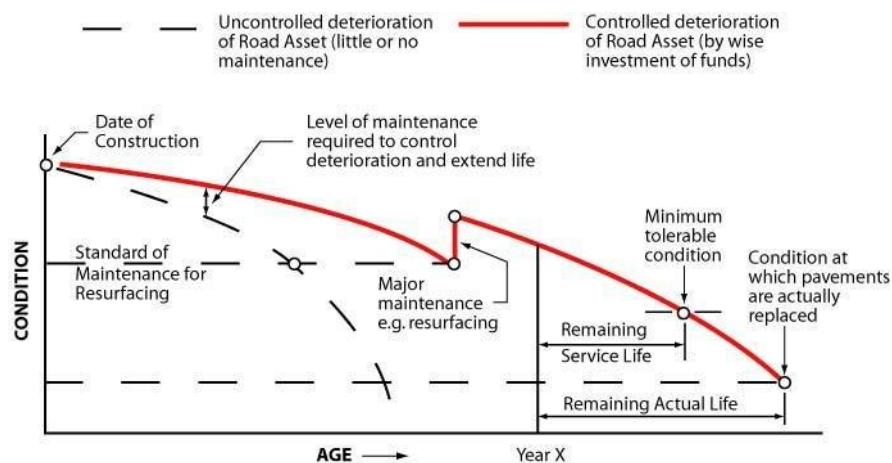
2.3. Critical Conditions

The condition of service to the stability value begins with a critical limit until it can no longer be measured, where this condition results in a decrease in road capability. An example in this case is a road that is in bad condition or heavily damaged.

Nowadays, severe meteorological events are always more frequent all over the world. This causes a strong impact on the environment such as numerous landslides, especially in rural areas. Rural roads are exposed to an increased risk for geotechnical instability [7]. In China, Traffic loading causes the rotation of principal stress axis and generates a heart-shaped stress path in the deviatoric stress space. Using dynamic hollow cylinder apparatus (DHCA), a series of cyclic heart-shaped and cyclic triaxial undrained tests were performed on Shanghai clay through simultaneously varying the torsional shear stress and the normal stresses. Experimental results show that the accumulated undrained responses of clay at different stress levels can be described by the shakedown approach. The permanent strain and energy dissipation were used to classify the accumulated deformation patterns, including plastic shakedown, cyclic plastic creep and ratcheting (incremental instability). For the plastic shakedown, the IPC (increment per cycle) of permanent axial strain becomes negligible and the IPC (area of hysteretic loop per cycle) of energy dissipation tends to reach a low constant level after cycling. For the cyclic plastic creep, the IPC of permanent axial strain (plastic strain increment per cycle) and the IPC

of energy dissipation become nearly constant after a large number of cycles [8]. On the other hand, pavement agencies generally face large-scale pavement networks. The complexity of the proposed stochastic model increases exponentially with the number of network sections and scenarios. The problem is solved using the Progressive Hedging Algorithm (PHA), which is suitable for large-scale stochastic programming problems, by achieving an effective decomposition over scenarios [9].

The decrease in road pavement performance can occur in tandem with the increasing age of the road. The decline in road health during service time and its relation to maintenance needs can be seen below.



Source : Ministry Of Rural Development (MRD) (2015) [10]

Figure 2. Relationship between Road Conditions during Service Period and Maintenance

As shown in Figure 2, planned routine and periodic maintenance has a significant impact in achieving a longer service life of a road. Periodic maintenance, eg. resurfacing, is equally important, but on a different time scale with longer cycles in terms of years than months. Depending on the performance of the pavement, there may be several cycles of periodic maintenance work on the road before its service life is over. To maintain the performance of the pavement so that it is able to provide services until the end of the previously planned life, it is necessary to make a number of efforts to repair damage in the form of road maintenance. This is a road handling action that includes maintenance, rehabilitation, support, and improvement.

There are also types of road maintenance that are seen based on the implementation time in accordance with the Regulation of the Minister of Public Works No. 13/PRT/M/2011 regarding the ownership and maintenance procedures for roads as quoted by [11] in his book are as follows :

- 2.1. Routine maintenance is a handling action that is given only to the surface layer which is designed to improve riding quality, by increasing structural strength, and is carried out throughout the year.
- 2.2. Periodic maintenance is maintenance carried out on certain roads (not continuously throughout the year) and their character increases structural strength.
- 2.3. Road improvement is the handling of roads in order to improve road services in the form of structural or geometric improvements to obtain the planned level of service.

To improve the road pavement thus can be classified into 2 types, namely functional repair and structural repair. Functional repairs can be carried out through standard repair methods based

on the Routine Maintenance Manual for National Roads and Provincial Roads, Ministry of Public Works Number 002/T/Bt/1995.

As for the types of road damage, according to Shahin's opinion in his book, there are 19 types of pavement damage, namely: raveling, weathering, swell, slippage cracking, shoving, rutting, railroad crossings, potholes, polished aggregate, patching and utility. cut patching, longitudinal and transverse cracking, lane/shoulder drop off, joint reflection, edge cracking, depression, corrugation, bumps and sags, block cracking, bleeding, and alligator cracking.

2. Research Method

The writing method used in this paper is descriptive qualitative on secondary data collection, namely by studying literature through collecting, comparing and conducting an inventory of previous studies on road pavement damage, the aspects that cause it, and how to deal with it effectively to overcome these damages, especially to areas in Indonesia. In addition to this, the researcher uses a number of other sources, namely theses, theses, and others that serve as a guide for researchers in making a literature review related to the writing of this journal.

In accordance with the writing method used, thus the writing of this journal is only limited to studies that have been carried out previously. Thus, the description of road pavement damage and the aspects that cause it is limited to the area that is the object of the research. Apart from this, the road referred to in this case is a road with flexible pavement.

3. Results and Discussions

3.1. Analysis of Road Pavement Damage and Management Measures

The most prominent flexural pavement damage is determined according to a significant presentation, frequency of occurrence, or based on the highest position in a type of damage than other types of damage based on data from previous research in several areas that have a high level of damage in the form of cracks and surface defects. continuously occurs in each area observed and has a very prominent percentage of damage levels than other types of damage. This is reinforced by the views of experts who consider that surface cracks and defects are the dominant aspects of pavement damage to provincial and national roads, namely Melawi Regency, West Kalimantan, Banggai Regency, Archipelago Prov. Central Sulawesi, Kendari, Southeast Sulawesi Province, and Kab. Fort Prov. West Kalimantan. Such as:

3.1.1. From the data from the BPS (Central Bureau of Statistics) of West Kalimantan Province in West Kalimantan in Figures in 2014 it can be seen that the total length of roads in this province is 5,209.22 km or 37.64% in unstable condition, while the steady condition is the cumulative condition good and moderate amounted to 8,630.69 km or 62.36%. Of the total road conditions that are not stable, which is 91.28% or 4,755.20 km are Regency/City roads, it means that the condition of Regency/City roads is very decisive on the overall road conditions in West Kalimantan Province. [12].

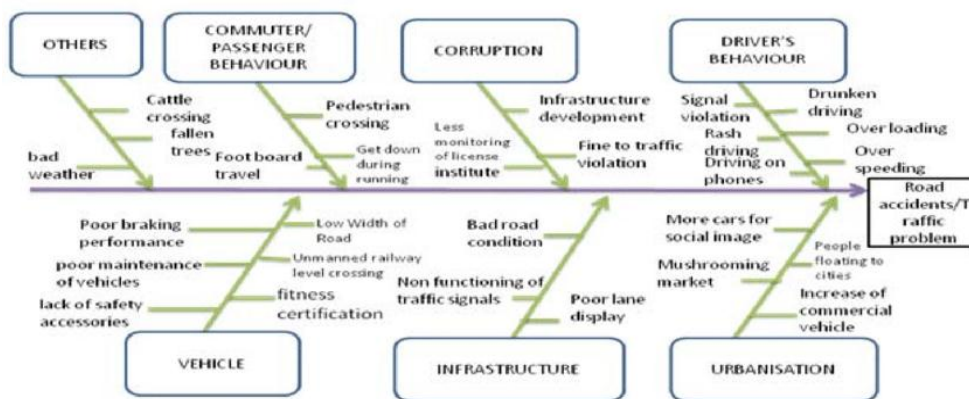
3.1.2. Based on the results of the evaluation with vehicle data, the ideal width of the lane and shoulder according to the determination of the width of the lane and the shoulder of the road is 6.0m and 1.0m. While the results of the evaluation of the design speed, based on the equation that has been determined for stopping visibility with the design speed 28.83m to 35.61m. and by looking at the results of the actual measurement of the width of the lane on the vertical alignment according to and even exceeding the predetermined ideal width of 6.40m but not yet having a shoulder, the slope value of 10% is not in accordance with the rules, which is a

maximum of 9% but is still categorized as safe. Therefore, there must be additional traffic signs on the Timbong village road, Banggai Tengah District, Banggai Laut Regency because of the 10% slope, this is so that road users are more careful to anticipate accidents even though the road is still categorized as safe. [13].

3.1.3. From the results of research on 10 (ten) provincial roads in Kendari City, it shows that the condition of provincial roads is in good and moderate (steady) condition by 55.60% where the minimum service standard is 60% while the value of road connectivity is 89.40% with a minimum service standard of 100% and according to the perception of road users, the level of service for road conditions is 49.25% and the level of connectivity in Kendari City is 81.2%. [14]

Previously, an analysis of road pavement damage was carried out which was very prominent in the form of cracks and surface defects. Then the aspects that cause the two types of damage are explained to identify the aspects that cause the most dominant damage so that it can be anticipated and the two types of damage can be reduced or eliminated.

In accordance with the results of research on Melawi Regency, West Kalimantan, Banggai Islands Regency, Central Sulawesi Province, Kendari Prov. Southeast Sulawesi, Kab. Fort Prov. West Kalimantan, and others, thus the aspects that cause road damage can be interpreted through the fishbone diagram technique as shown in the image below. Fishbone diagrams are commonly known as Ishikawa diagrams.



Source : Prabhuram, et all (2010) [15].

Figure 3. Fishbone Diagram Causes of Pavement Damage

Figure 3 illustrates that there are three main factors that cause accidents, namely humans, vehicles, and roads and the environment. These three factors can combine to cause accidents. Sleepy drivers can combine bad weather, damaged pavement conditions and waterlogged, hazardous roadside environments or limited visibility into fatal accidents.

3.2. Factors Causing Road Damage

The factor causing road damage in some areas is poor drainage maintenance. This is supported by the opinion of experts who mention the same thing that causes initial damage to road pavement during maintenance. This is reinforced according to the results of research from [16] that the type of pavement suitable for pavement repair on Mercedes Benz Street, Gunung Putri District, Bogor Regency, West Java is Rigid Pavement due to thinner construction thickness, cost cheaper construction, and lower maintenance costs. So that the rigid pavement is very suitable for pavement repairs on Mercedes Benz Road.

Seeing how important the drainage function is in road pavement performance, thus the drainage needs to be made through careful planning, good maintenance, and proper implementation. Then so that the drainage can run effectively based on the purpose, thus the drainage must be maintained properly based on the terms and conditions that apply. There are 4 types of drainage maintenance work including:

- 3.2.1. Routine maintenance, is drainage maintenance that is always carried out periodically at a certain time, for example, picking up trash drifting in the canal and removing weeds, can be carried out every day.
- 3.2.2. Periodic maintenance, which is maintenance that is carried out within a certain time, for example in the removal of sediment in the channel, can be carried out annually, weekly, or once a month.
- 3.2.3. Special maintenance, is drainage maintenance that can be carried out if the channel is damaged suddenly.
- 3.2.4. Rehabilitation, carried out if the channel is damaged so that the flow is no longer suitable for flood discharge

Detailed and complete information on drainage and its maintenance can be read and viewed in Appendix III of the Regulation of the Minister of Public Works No 12/PRT/M/2014 concerning the Implementation of Urban Drainage Systems.

In addition to the four maintenance works, according to the opinion of [17], it is necessary to evaluate drainages that are not running effectively in identifying trends, so that drainage re-planning is necessary. Re-planning of surface drainage can be carried out if the road segment is in accordance with the following factors:

- 3.2.1. Section of the road against a very heavy level of damage
- 3.2.2. The road to the frequency of flooding with a high category which is known as the category always and often
- 3.2.3. Roads to flood inundation area above 10%
- 3.2.4. Vehicle load is high or low. However, the priority is on low vehicle loads. This is due to the high road and vehicle loads, the aspect that causes this is the vehicle load, not due to the influence of water

The aspect that causes damage to roads that are in the second position after drainage that does not run effectively is the composition of materials that do not meet the specified provisions and requirements. The composition of the material on the road pavement should be considered first in obtaining a good pavement throughout the service life of the road which is generally carried out by carrying out a laboratory test process. However, sometimes errors are found in the process of determining the composition of the material in the mixture, either intentionally or unintentionally.

The material composition error that is often experienced is the low asphalt content used. In accordance with the opinion of [18], good maintenance of road bodies and other road pavement complementary buildings will be able to reduce the total road handling costs that must be incurred because the type, severity and amount of damage that occurs determine the costs incurred. must be borne for maintenance activities. The more significant the type, severity and amount of pavement damage, the greater the costs. This can result in holes, grain release, or cracks, peeling due to the oxidation stage of the asphalt. Oxidation is experienced at the 5 micron layer, thus the asphalt used for the pavement should be above 5 micron thick.

However, it must be noted that the asphalt content should not be too high because it can cause the road surface to become slippery and damage can occur in the form of holes,

waves, obesity (bleeding), or corrugation. Thus the asphalt composition needs to be calculated in an appropriate way and implemented effectively.

However, in addition to the minimal asphalt content in the mixture, it can also be experienced that there are very many fine grains used in the mixture. In accordance with [19] the fine grain used in the asphalt mixture should be around 15%. If the grain used is more than the specified, then it can cause the asphalt and the granules to not bond with each other because the grains of sand have a slippery surface which can break the bonds between the aggregates and cause waves.

This is in line with the results of research conducted by [20] regarding the use of carbide waste at a variation of 60% which is the most effective mixture according to the General Specifications Division 6: 2016 Asphalt Pavement, with the best composition in the form of a mixture of 0% carbide waste. stability value is 871.13 kg, VFWA 75.18 kg, VMA 22.55 kg, VIM 7.01 kg, flow 3.80 mm, MQ 229.29. variation 40% stability value is 629.20 kg, VFWA 65.69 kg, VMA 25.09 kg, VIM 10.05 kg, flow 2.85 mm, MQ 226.52. variation of 50% stability value is 1011.76 kg, VFWA 72.75 kg, VMA 23.15 kg, VIM 7.72 kg, flow 2.50 mm, MQ 410.00. variation 60% stability value is 1291.26 kg, VFWA 71.67 kg, VMA 23.41 kg, VIM 8.04 kg, flow 2.30 mm, MQ value 562.35. Thus, the road construction, especially the standard quality of road asphalt that meets all Marshall parameters in the 30 minute immersion test is variation 2: stability value 803.38 kg, Flow 3.13 mm, VIM 4.17%, VMA 15.80%, VFB 73 .59%, MQ 256.71 kg/mm. Meanwhile, the stability value at 24-hour immersion did not meet the requirements for both variations so that the impact on the durability value did not meet the 90% requirement. The durability value for variation 1 is 66% and variation 2 is 69%, this indicates that the AC-WC mixture with CPO substitution is not durable. [21].

4. Conclusion and Suggestion

4.1. Conclusion

Based on the analysis carried out by the author on data from various sources that have been collected in this paper, the author can draw the conclusion that the damage to the road pavement is dominated by cracks and damage to surface defects due to several main factors, namely drainage maintenance is not carried out optimally and properly so that garbage clogs drainage. and around the drainage to grow plants.

4.2. Suggestions

Maintenance is needed not only to focus on physical maintenance of the road pavement, but maintenance on other factors that cause damage, namely drainage maintenance.

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