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EVALUATION OF THE EFFECT OF THE LEVEL OF ROAD DAMAGE ON VEHICLE LOADS ON BALANCED ROADS

(*Evaluasi Pengaruh Tingkat Kerusakan Jalan Terhadap Beban Kendaraan pada Jalan Lentur*)

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Abstract

The amount of load received depends on the weight of the vehicle, the configuration of the axle, the contact area between the wheels and the vehicle and the speed of the vehicle itself. This will give a value of damage to the pavement due to wheel axle loads that pass each time on the road. The weight of the vehicle is transferred to the pavement through the vehicle which is located at the ends of the vehicle axle. Each vehicle has a different axle configuration. The front axle can be a single axle of the wheel, while the rear axle can be a single, double or triple axle. From the background above, the problem formulation in this study is what is the volume of traffic that is traversed by vehicles on the roads studied, especially Siahoni Village and how is the level of damage to the hot mix road in Siahoni Village. The method used in this research is in addition to the survey method, direct observation also uses the PCI method where the data obtained, both secondary data and primary data, will be analyzed based on the PCI method so that the results are in accordance with the problems in the field to solve these problems according to the needs desired by the users or owners who have technical interests. The results showed that The discussion and results of the analysis above can draw conclusions regarding the analysis of road damage as follows: 1. The number of vehicles every day that pass through Siahoni Village with the formula above can be seen that every day the vehicles passing the Batuboy Village road to Siahoni Village are 580 vehicles / day 2. On the road there are fine cracks, collapsed, release of flea and crocodile skin with a density at Sta 08 + 800 = 5.82% in moderate condition, with a Deduct value of around 45, while the total damage is 11.95%.

Keywords: *Evaluation, Flexible Road, Siahoni*

Abstrak

Besarnya beban yang diterima tergantung dari berat kendaraan, konfigurasi poros roda, bidang kontak antara roda dan kendaraan serta kecepatan kendaraan itu sendiri. Hal tersebut akan memberikan nilai kerusakan pada perkerasan jalan akibat beban sumbu roda yang melintas setiap saat di jalan raya. Berat kendaraan dipindahkan ke perkerasan jalan melalui kendaraan yang terletak di ujung poros kendaraan. Setiap kendaraan memiliki konfigurasi gardan yang berbeda. Poros depan dapat berupa poros roda tunggal, sedangkan poros belakang dapat berupa poros tunggal, ganda atau rangkap tiga. Dari latar belakang diatas maka rumusan masalah dalam penelitian ini adalah berapa volume lalu lintas yang dilalui kendaraan pada ruas jalan yang diteliti khususnya Desa Siahoni dan bagaimana tingkat kerusakan jalan hot mix di Desa Siahoni. Metode yang digunakan dalam penelitian ini selain metode survei, observasi langsung juga menggunakan metode PCI dimana data yang diperoleh baik data sekunder maupun data primer akan dianalisa berdasarkan metode PCI sehingga hasilnya sesuai dengan kebutuhan. permasalahan di lapangan untuk menyelesaikan permasalahan tersebut sesuai dengan kebutuhan yang diinginkan oleh pengguna atau pemilik yang memiliki kepentingan teknis. Hasil penelitian menunjukkan bahwa Pembahasan dan hasil analisis diatas dapat menarik kesimpulan mengenai analisis kerusakan jalan sebagai berikut: 1. Jumlah kendaraan setiap hari yang melewati Desa Siahoni dengan rumus diatas dapat diketahui bahwa setiap hari kendaraan yang melintas. Jalan Desa

Batuboy menuju Desa Siahoni sebanyak 580 kendaraan / hari 2. Pada jalan tersebut terdapat retakan halus, roboh, lepasnya kutu dan kulit buaya dengan kepadatan pada Sta 08 + 800 = 5,82% dalam kondisi sedang, dengan nilai Pengurang sebesar sekitar 45, sedangkan kerusakan total 11,95%.
Kata Kunci: *Evaluasi, Jalan Lentur, Siahoni*

INTRODUCTION

The amount of load received depends on the weight of the vehicle, the configuration of the axle, the contact area between the wheels and the vehicle and the speed of the vehicle itself. This will give a value of damage to the pavement due to wheel axle loads that pass each time on the road.

The weight of the vehicle is transferred to the pavement through the vehicle which is located at the ends of the vehicle axle. Each vehicle has a different axle configuration. The front axle can be a single axle of the wheel, while the rear axle can be a single, double or triple axle.

This was then developed in the AASHTO Road Test, which correlates subjective and objective assessments with measurements of roughness, crack damage, patches, and groove depth expressed in the form of equations. The need for good road infrastructure, especially flexible pavements, is a supporting factor for the smooth running of the economy, considering that the current condition of road facilities has been a lot of damage caused by natural factors as well as human factors, in this case vehicles, so it is necessary to carry out repairs and improvements in order to meet need for higher traffic. In the planning process, as the basis for its implementation, it is necessary to pay attention to the comfort factor, environmental safety and other factors that support a solid detailed plan (Aris, at.al, 2015).

According to ASTM D6433 (2007) in calculating the value of road conditions using the Pavement Condition Index (PCI) method, the types of damage to flexible pavement consist of alligator cracking, bleeding, block cracking, protrusions. and bumps and sags, corrugation, depressions, edge cracking, joint reflection cracking, lane / shoulder drop off, longitudinal / transverse cracks (longitudinal / transverse cracking), patching and utility cut patching, polished aggregate, potholes, railroad crossing, rutting, shoving, slip cracks (slippage cracking), swelling, weathering and raveling.

In contrast to rigid pavement construction which uses cement (portland cement) as a binding material. Concrete slabs with or without reinforcement are placed on the subgrade with or without sub-base layers. The traffic load is mostly carried by concrete slabs. If calculated from the point of view of construction costs, roads built with flexible pavement construction require much less funds than roads built with rigid pavement construction. However, the maintenance program is relatively minimal compared to if the road is built with flexible pavement construction.

Pavement performance includes structural (structural performance) and functional (functional performance). Structural pavement performance includes pavement safety or strength, while pavement performance is functionally expressed by the Surface Index (IP) or Present Serviceability Index (PSI) and the Road Condition Index (RCI).

Surface Index (IP) or Present Serviceability Index (PSI) is a concept of the relationship between the opinions of road users and the measurement results of roughness, crack damage, patches, and groove depth. PSI is formulated from an assessment of a group of pavement sections that are assessed by a group of assessors who give a value based on a scale between 0 to 5 indicating very bad - very good scores. In planning a new or overlay road requires several parameters in its planning, the parameters used in the SNI 1973-1989-F

method are actually almost the same as those used in the 1993 AASHTO method which was slightly modified according to environmental and climatic conditions in Indonesia.

Several planning parameters are required in the SNI 1732-1989-F method such as traffic load, subgrade bearing capacity, regional factors, traffic growth, lane distribution factor, vehicle distribution coefficient, surface index and relative strength coefficient. Whereas in 1993 AASTHO the required planning parameters such as traffic load, subgrade bearing capacity, traffic growth, design age factor, reliability, lane distribution factor, vehicle distribution coefficient, drainage coefficient, surface index and relative strength coefficient (Kang, M. 2015).

By knowing precisely the level of ability of a road to accept a traffic load, the thickness of the pavement layer can be determined and the age of the pavement plan will be as planned. Repetition load or repetition load is the load received by the pavement structure from the wheels of vehicles crossing the highway dynamically during the design life. The amount of load received depends on the weight of the vehicle, the configuration of the axle, the contact area between the wheels and the vehicle and the speed of the vehicle itself. This will give a value of damage to the pavement due to wheel axle loads that pass each time on the road.

The weight of the vehicle is transferred to the pavement through the vehicle which is located at the ends of the vehicle axle. Each vehicle has a different axle configuration. The front axle can be a single axle of the wheel, while the rear axle can be a single, double or triple axle.

This was then developed in the AASHTO Road Test, which correlates subjective and objective assessments with measurements of roughness, crack damage, patches, and groove depth expressed in the form of equations.In planning a road pavement structure, the load and volume of traffic that will use the road during the design life are the main references in calculating the pavement structure. (Hardiyatmo, 2011). The pavement structure functions to receive and accept traffic loads without causing significant damage to the road construction. Pavement Condition Index (PCI) is an estimate of road conditions with a rating to represent actual pavement conditions with untrustworthy and objective data. The PCI method was developed in America by the US Army Corp. of Engineers for airport pavements, highways and parking areas, because this method obtains accurate data and estimates of conditions according to conditions in the field. The level of PCI is written in levels 0 - 100. (Sukirman, 2016) According to Shahin (1994) pavement conditions.

Road work in Buru Regency uses a lot of Pertamina oil asphalt so that it can be said that the work is categorized as flexible pavement work (Flexibel Pavement), this work uses a composition of materials according to the gradation, namely crushed stone, 70/80 penetration Pertamina asphalt and other mixed materials. On road works that are always burdened by the volume of traffic by heavy vehicles, light vehicles and those that pass repeatedly and the penetration of rainwater will cause a decrease in road quality. From a technical point of view, most indicators of road damage can result in accidents or damage to vehicles, so we are interested in conducting studies on road damage, especially Hotmix roads (roads made by the main ingredient of HOT ASPHALT). Many of the road damages that have occurred in Buru Regency have not been studied in depth for the specific level of damage so that there is a need for careful handling of the road damage.

From the background above, the problem formulation in this study is what is the volume of traffic that is traversed by vehicles on the roads studied, especially

Siahoni Village and how is the level of damage to the hot mix road in Siahoni Village using the Pavement Condition Index (PCI) method.

RESEARCH METHOD

This study examines vehicle repetition, the effect of road damage and analysis of the amount of damage using the Pavement Condition Index (PCI) method which is carried out in accordance with the explanation in the framework below in order to clarify the research in Siahoni Village, Kec. However, the research approach used in this research is to use direct field surveys in order to obtain data directly to process primary data. In accordance with the description on the background of the problem and the research objectives, this research is aimed at conducting a study of road damage in the Waeapo sub-district, Buru Regency. The research data is divided into two, namely primary data and secondary data. First of all, what is needed is to conduct an initial survey to obtain field data so that the existing conditions can be known (initial). Next, a survey was conducted on the repetition of light and heavy vehicles as well as natural conditions that could affect the condition of the road pavement.

The method used in this research is in addition to the survey method, direct observation also uses the PCI method where the data obtained, both secondary data and primary data, will be analyzed based on the PCI method so that the results are in accordance with the problems in the field to solve these problems according to the needs desired by the users or owners who have technical interests.

DISCUSSION

Traffic Volume Analysis

In the discussion of the pavement, an analysis of road damage in the Village of Batuboy Village up to the Village of Siahoni was carried out with the Stasiner starting from the Sta. 8 + 800 up to the kilometer Sta. 15 + 623. The method used in this scientific research is the Indonesian National Standard (SNI) and Bina Marga method to conduct a survey of average daily traffic (LHR) and the influence of several factors on road damage in the area between Batuboy Village and Siahoni Village. road about 7 meters on flexible pavement or hotmix road.

The number of vehicles passing the Siahoni Village road is on average every 20 30 seconds per vehicle for normal times while the survey for peak times is usually every 5-10 seconds per vehicle so seen from the survey conducted, every time the vehicle always passes the Siahoni Village area which affects road damage. For vehicles that are very influential on road damage are vehicles that have the greatest axle loads including Dumptruk, Turck and Tangkoi Car which contain loads with 3 or 4 axles that have more than four wheels, while the smallest ones are Pickup, Angkot, A 2-axis truck carrying construction materials and goods transported through the Siahoni Village route. For motorbikes and private cars, there is no significant effect on road damage.

From the explanation above, the percentage of the average value of heavy vehicles per day will be calculated. From the survey above, the average vehicle passes every 1.5 minutes, so the total per vehicle per day is:

The number of vehicles every day that pass through Siahoni village with the following formula analysis:

$$\sum \text{Vehicle (LHR)} = \frac{60}{1,5} \times 14,5 \text{ hour / day} = 580 \text{ vehicle / day}$$

From the data above, it can be seen that every day the vehicles passing the road from Batuboy Village to Siahoni Village are 580 vehicles / day. From the survey data for trucks that are categorized as heavy vehicles with a sample of 6 hours, about 39 vehicles are analyzed for 1 day, then 39 x 2 = 78

trucks / day, so the estimated heavy vehicles are as follows:
Formula:

$$\text{percentage of motorized vehicles} = \frac{\text{number of heavy vehi cles}}{\text{number of vehicles}} \times 100\%$$

$$\text{percentage of motorized vehicles} = \frac{78}{580} \times 100\% = 13{,}45\,\%$$

So from this calculation the percentage for heavy vehicles that often pass through Batuboy Village and Siahoni Village is 19.26% while for light vehicles that pass through the area is 80.74%. So from the data above the vehicles that pass through (through) the research area the road damage is not too significant, so it is necessary to study the level of damage other than the vehicle factor that caused the road damage.

Road Damage Level Analysis

The road space between Namlea District and Waeapo District is a very strategic area because it is categorized as a National road that connects the two Regencies. Here, the research conducted only examines the road drain that occurs on one of these roads, namely the Batuboy Village road to Siahoni Village with road stations starting from STA. 08 + 000 to 16 + 000 so this research was conducted by analyzing road damage using the PCI (Pavement Condition Index) method which uses visual observations on the location or object of damage to regional roads from the Batuboy Village area to Siahoni Village. In the survey, the damage that occurred consisted of fine cracks, crocodile cracks, road ambalas, edge cracks, curls, joint cracks, wear, holes, grooves, slip fractures, grained releases, extended cracks but here, the damage was examined with sufficient volume of damage. above average so that the data taken is not too much but specifically for research on road pavement damage only. From the survey results obtained after that do an analysis of the survey results. The results of measurements and calculations at the research location are obtained in the following calculation data:

Calculating the value of damage here, two samples were taken for the area of damage to the area of the Siahoni Village road, as follows:

• A = P x L then

where: 1.2 m x 0.7 m = 0.84 m2 (with hygienic damage conditions)

where: 24 m x 1.7 m = 40.8 m2 (with medium damage condition)

After that, determine the density. Density is the percentage of the area of one type of damage to the area of the road which is measured the damage to the road segment with the complete formula is as follows:

Density (%) = Area of Damage / Pavement Area x 100%.

From the area above the damage data at Sta. = 0.84 m2, then the average road is 700 cm, with a station length of 100 m so that when calculating the pavement area of 0.84 m2 then:

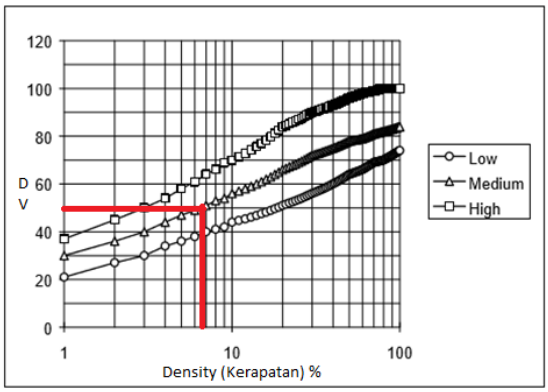
Pavement area = 700 cm x 100 m = 700 m2

Density-1 = (0.84 / 700) x 100% = 0.12%

Density-2 = (40.8 / 700) x 100% = 5.82%

Deduct value (DV) is a value of deduction for each type of damage obtained from the relationship between density and severity. The data is a graph of the types of damage from the data to the next data.

As for the way to determine the DV, namely by entering the density percentage on the graph of each type of damage then drawing a vertical line to cut the level of damage (low, medium, high), then a horizontal line is drawn and a DV (Deduct value) will be obtained in medium conditions, for Sta 09 + 019 with density = 0.12. In the picture from the graph analysis below shows smooth cracks, collapsed and crocodile skin with a density at Sta 08 + 800 = 5.82% in Medium conditions, described in Figure 4.1 below:



Graph figure 4.1. Density value to Deduct value on Siahony Village Road

So the added value of the Deduction value on the graph is = 50 of the total deduction value or the total deduction value obtained in a Sample Unit by adding all individual deduction values.

From the above calculations, we look for the Corrected deduct value (CDV) obtained by entering the TDV value into the CDV graph by drawing a vertical line on the TDV value until the q line command is then drawn a horizontal line. The value of q is the number of inputs with a DV> 2 CDV graph. Calculating the pavement condition value, PCI value or pavement condition value calculated by subtracting the value 100 from the maximum CDV. The complete formula is as follows:

PCI = 100 - CDV PCI = 100 - 50

PCI = 50

PCI = pavement condition value

CDV = Corrected Cut Value

The pavement condition value for each sample unit obtained is then used to determine the handling of damage, namely by prioritizing the handling of damage to pavement that has an older pavement value. To see the total pavement condition value (the road sections under review) is to add up all the pavement condition values for each segment and divide by the total number of segments. The formula used is as follows:

The final results of the PCI analysis for each type of sample unit and the total average PCI value (pavement condition value) on Siahoni and Batuboy can be seen in Table 4.1 below:

Table of measurement results and calculation of road damage in Siahoni Village

NO	STA (M)	KELAS RUSAK	P (M)	L (M)	D mm	A (M2)
1	08 + 800	H	24	1,7		40,8
2	08 + 900	M	18	1		18
3	09 + 019	H	1,2	0,7	10	0,84
4	09 + 030	M	2	0,8		1,6
5	09 + 037	M	1,2	0,7		0,84
6	09 + 075	L	1,1	0,7		0,77
7	09 + 625	M	4,8	6		28,8
8	09 + 950	M	28	3		84
9	10 + 225	H	5,7	1,7		9,69
10	10 + 250	M	5,4	1,4		7,56
11	10 + 275	M	2,2	1,2		2,64
12	11 + 140	H	1,4	0,8	10	1,12
13	11 + 410	H	3,7	0,7		2,59
14	11 + 475	H	1,4	1	10	1,4
15	11 + 520	H	4	1,1	10	4,4
16	11 + 575	H	1,7	1	10	1,7
17	11 + 600	H	2	1,1	10	2,2
18	11 + 875	H	0,8	0,5	10	0,4
19	11 + 880	H	0,8	0,7	11	0,56
20	11 + 975	H	1,4	0,6	10	0,84
21	11 + 985	M	1,5	1,4		2,1
22	12 + 010	M	7,5	2,4		18
23	12 + 150	H	2	1	5	2
24	12 + 156	M	11,5	0,9		10,35
25	12 + 155	M	11,2	1,8		20,16

The analysis shows above that the Deduct value and PCI values are very high above 40% so that there is a need for proper handling so that there is no further damage to the area or area of other roads. This is also used as data for pavement damage damage in areas that need to be treated quickly.

Analysis Reduces the value of the Advanced Path

Next, the deduct value is also calculated at the next stationer (sta) which can provide a comparison with the initial sta so that it provides a clear picture of the existing road conditions. So the calculation of the Deduct value in the graph above is = 50 of the total deduct value or the total deduct value obtained in a Sample Unit by adding all the individual deduct values.

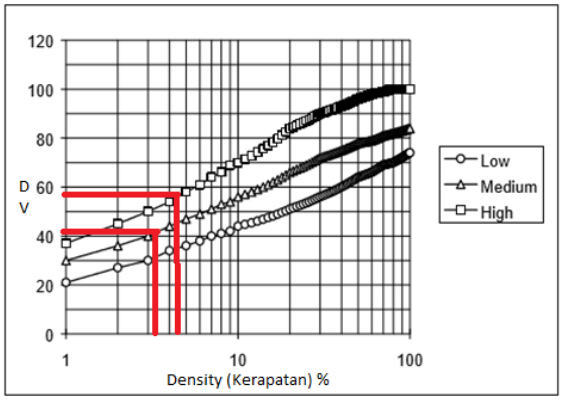
• A = P x L then

where: 11.6 m x 2.7 m = 31.32 m2 (with hygienic damage conditions)

where: 10.5 m x 2.1 m = 22.05 m2 (with medium damage condition)

After that, determine the density. Density is the percentage of the area of one type of

damage to the area of the road which is measured the damage to the road segment with the complete formula is as follows:
Density (%) = Area of Damage / Pavement Area x 100%.
From the area above the damage data at Sta. = 0.84 m2, then the average road is 700 cm, with a station length of 100 m so that when calculating the pavement area of 0.84 m2 then:
Pavement area = 700 cm x 100 m = 700 m2
Density-1 = (31.32 / 700) x 100% = 4.47%
Density-2 = (22.05 / 700) x 100% = 3.15%
Deduct value (DV) is a value of deduction for each type of damage obtained from the relationship between density and severity. The data is a graph of the types of damage from the data to the next data.
As for the way to determine the DV, namely by entering the percentage density on the graph of each type of damage then drawing a vertical line to cut the level of damage (low, medium, high), then a horizontal line is drawn and a DV (Deduct value) will be obtained in Medium conditions, for Sta 15 + 6400 with density = 3.15. In the picture from the graph analysis below shows smooth cracks, collapsed and crocodile skin with a density at Sta 12 + 714 = 4.47% in High conditions, described in the following Graph 4.2:



Graph 4.2. The Density value to the Deduct value on the Siahony Village Road is between high and medium
In the data above, for Sta 15 + 640 with density = 3.15 the value of the Deduct value. in the medium state it is 42, while for Sta 12 + 714 = 4.47% Fine cracks, collapsed and crocodile skin with high density in high conditions, the value of the Deduct value = 57 which includes the image above

Calculating the pavement condition value, PCI value or pavement condition value calculated by subtracting the value 100 from the maximum CDV. The complete formula is as follows:
For Sta. 15 +640 then the PCI, namely:
PCI = 100 - CDV PCI = 100 - 42
PCI = 58
For Sta. 12 +741 then the PCI, namely:
PCI = 100 - CDV PCI = 100 - 57
PCI = 43

The pavement condition value for each sample unit obtained is then used to determine the handling of damage, namely by prioritizing the handling of damage to pavement that has an older pavement value. To see the total pavement condition value (the road sections under review) is to add up all the pavement condition values for each segment and divide by the total number of segments.
The final results of the PCI analysis for each type of Sample Unit and the average PCI value (value of pavement conditions) in total on Jalan Desa Siahoni and Desa Batuboy can be seen in the following table:
4.2. Result of measurement and calculation of road damage in Siahoni Village (Lajutan)

NO	STA (M)	KELAS RUSAK	P (M)	L (M)	D mm	A (M2)
26	12 + 160	L	14,3	1		14,3
27	12 + 175	M	11,7	1,1		12,87
28	12 + 450	M	11	1,8		19,8
29	12 + 500	H	12	2,8		33,6
30	12 + 510	M	7	3,5		24,5
31	12 + 520	M	2,6	1,1		2,86
32	12 + 527	L	10,4	1		10,4
33	12 + 540	M	9,5	0,8		7,6
34	12 + 700	H	9	1		9
35	12 + 714	M	11,6	2,7		31,32
36	12 + 830	H	3,2	3	10	9,6
37	13 + 380	M	10,5	1,1		11,55
38	13 + 380	L	5	0,9		4,5
39	13 + 750	H	2,8	1	12	2,8
40	14 + 475	H	5,8	1,2	5	6,96
41	14 + 550	M	11,8	1		11,8
42	14 + 675	H	6	1,3		7,8
43	15 + 645	M	10,9	2		21,8
44	15 + 640	H	10,5	2,1		22,05
45	15 + 635	M	7	0,8		5,6
46	15 + 630	M	18	1,2		21,6
47	15 + 625	M	10,3	1,4		14,42
48	15 + 623	M	6,6	0,5		3,3

The results of the calculation show that the value of the reduction in value and PCI is very high above 50% so that there is a need for proper handling so that there is no further damage to the area or area of other roads. This is also used as data for road pavement damage in areas that are heavily traversed by traffic vehicles.

PCI calculations can also be calculated by dividing the numbers contained in the number of tables with the value of N as follows:

$$PCI = \frac{\sum PCI(s)}{N}.$$

$$PCI = \frac{573,39}{48} = 11,945\%$$

So the total value of damage for per segment is above 40%, but for the total damage segment, it is in the range of 11.95%. The analysis above shows that there is damage that needs to be handled as soon as possible because if there is no handling it quickly gives another effect due to vehicle loads and unpredictable weather.

CLOSING

The discussion and results of the analysis above can draw conclusions regarding the analysis of road damage as follows: 1. The number of vehicles every day that pass through Siahoni Village with the formula above can be seen that every day the vehicles passing the Batuboy Village road to Siahoni Village are 580 vehicles / day 2. On the road there are fine cracks, collapsed, release of flea and crocodile skin with a density at Sta 08 + 800 = 5.82% in moderate condition, with a Deduct value of around 45, while the total damage is 11.95%. The suggestions that we can convey include: 1. Road maintenance needs to be regularly checked and monitored by a good method or survey. 2. Road handling must create it so that it does not spread to the hardness or other road segments.

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