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THE EFFECT OF TRAFFIC LOADS ON PAVEMENT DAMAGE ROAD SEGMENT: ROAD GOVERNOR SARKAWI CITY OF BANJARBARU

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ABSTRACT

Currently, population growth is increasingly rapid, and of course this will be directly proportional to the growth in transportation needs. At the same time, it is necessary to ensure that the infrastructure supporting the use of transportation is in good condition, otherwise the activities of transportation users will be destroyed. The aim of this research is to obtain traffic volume on Jalan Governor Sarkawi, know value of road damage on Jalan Governor Sarkawi, analyzed The influence of traffic volume on road damage on Jalan Governor Sarkawi, analyzed The influence of CESA on road damage on Jalan Governor Sarkawi. The method used in this research is the Bina Marga method using regression and correlation analysis, so as to obtain this relationship with the r value and $Pvalue$which shows the magnitude of the influence between the level of road damage and traffic volume and traffic load. This research was conducted on Jl. Governor Sarkawi. There is a relationship between traffic volume and road damage, the relationship between traffic volume (pcu/hour) and road damage **, and** the relationship between standard load (CESA) and damage. Where the magnitude of the relationship between traffic volume and the value of road damage that is most influential is obtained, namely the r value obtained of 0.6436 with $Pvalue$a value of 0.001 and an r value of 0.7432 with *a P value* of 0.007. Meanwhile, for the relationship between LHR (pcu/hour) and road damage, the r value was 0.8787 and for the relationship between CESA and road damage, the r value was 0.7263 . From this analysis, the results obtained are that the relationship between variables x and y to find the relationship between vehicle volume and road damage values, or the relationship between traffic load and road damage values influence each other. Because the greater the correlation results, the greater the influence of variable x on variable y.

Keywords : Road Damage Value, Traffic, Standard Load, Regression, Correlation

ABSTRACT

Currently, population growth is increasing rapidly, and of course it will be directly proportional to the growth in transportation needs. At the same time, it is necessary to ensure that the infrastructure supporting the use of transportation is in good condition, otherwise the activities of transportation users will be destroyed. The purpose of this research is to get traffic volume on the Jalan Governor Sarkawi section, knowing the value of road damage on the Jalan Governor Sarkawi section, analyzing the effect of traffic volume on road damage on the Jalan Governor Sarkawi section, analyzing the effect of CESA on road damage on the Jalan Governor Sarkawi section. The method used in this study is the Bina Marga method using regression and correlation analysis, so as to obtain the relationship with the value of r and which shows the magnitude of the influence between the level of road damage with traffic volume and traffic load. This research was conducted in the Jl. Governor Sarkawi. There is a relationship between traffic volume and road damage, traffic volume relationship (pcu/hour) to road damage **,** *standard load relationship (CESA) to damage. Where is the magnitude of the relationship between traffic volume and the value of road damage that affects the most, namely the value of r of 0.6436 with a value of 0.001 and an r-value of 0.7432 with a P-value of 0.007. While the relationship between LHR (pcu/hour) on road damage obtained an r value of 0.8787 and for CESA relationship to road damage an r value of 0.7263 was obtained. From this analysis, the results obtained if the relationship between the variables x and y to find the relationship between vehicle volume and the value of road damage, or the relationship between traffic load and the value of road damage, influence each other. Because the greater the correlation, the greater the influence of the x variable on the y variable.*

Keywords *: Road Damage Value, Traffic, Standard Load, Regression, Correlation*

1. INTRODUCTION

This research was conducted on Jalan Governor Sarkawi which is located in the city of Banjarbaru. The research carried out on this road was divided into 8 segments with segments divided according to road damage. A sketch of the location can be seen in Figure 1 below.

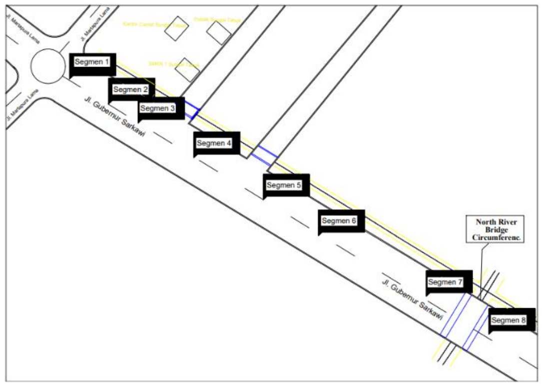


Figure 1. Research Location

Population growth coupled with developments in transportation needs will cause an increase in two-wheeled, four-wheeled or other traffic. The impact of this increase resulted in a lot of damage to roads. This is mainly due to the fact that this road is an alternative area from Banjarbaru to Banjarmasin apart from being an alternative road, the Governor Sarkawi Road is a connecting road between South Kalimantan and Central Kalimantan. Therefore, there is a lot of activity from heavy vehicles passing by to transport materials. The impact of this activity results in the possibility that the load received by the road exceeds the planned load (overloading) (Alya Nabillah & Fitrian Radam, 2019) .

The road itself has meaning according to Republic of Indonesia Law no. 38 of 2004 Article 1 paragraph (4) explains that roads are land transportation infrastructure which includes all parts of the road, including complementary buildings and equipment intended for traffic, which are on the ground surface, above the ground surface, below the ground surface and/ or water, as well as above the water surface, except for railways, lorry roads and cable roads. The type of road that is often used is the highway, because all types of land transportation can be carried out via this road (UU No. 38, 2004) . According to (Presidential Decree, 2006) road parts are given 3 special names, namely Road Use Space (RUMAJA), Road Owned Space (RUMIJA) and Road Monitoring Space (RUWASJA).

According to (Sukirman, 1999) There are 3 types of pavement construction, namely, flexible pavement construction, rigid pavement construction and composite pavment construction . According to (MKJI, 1997) vehicle types are divided into 4 , namely: light vehicles (LV), heavy vehicles (HV), motorbikes (MC) and non-motorized vehicles (UM) .

According to (Shahin, 2005) there are several types of road damage, namely crocodile skin cracks, curling, sinking, pavement edge defects, decreased shoulders on the road, longitudinal and transverse cracks, patches, holes, grooves, slumping, asphalt coming out of the road surface, block cracks. and shifting cracks. Road maintenance will depend on the existing priority order values. This road condition value will later be used as a reference to determine the type of procedure that must be carried out, be it repair procedures, periodic maintenance or routine maintenance (Bolla, 2019) . The purpose of this research is to determine and analyze the factors causing damaged roads on the Governor Sarkawi road, both by traffic volume and by standard load (CESA).

2. RESEARCH METHODOLOGY

In this research, the road used as a place to conduct research was divided into 8 segments according to the type of damage present. The method used is the clan development method. The data collection itself is carried out directly in the field. The first step in this research is problem identification. Then take traffic volume data and road damage data. Traffic volume data is taken for 24 hours in one segment and then used as a benchmark for segments where data is taken for 1 hour. Traffic volume is used to determine traffic classes, which traffic classes can be seen in table 1.

Table 1. Traffic Class Table for Maintenance Work

Traffic Class	**LHR (junior/day)**
0	<20
1	20 -50
2	50 – 200
3	200 – 500
4	500 – 2,000
5	2,000 – 5,000
6	5,000 – 20,000
7	20,000 – 50,000
8	>50,000

Source: (Ministry of Public Works, 2011)

Next, take road damage data, the parameters used can be seen in table 2.

Table 2. Table of Road Condition Values Based on Damage Type

Cracks (Cracking)

Type	**Number**
Crocodile	5
Random	4
Transverse	3
Elongated	1
There isn't any	1
Wide	**Number**
>2mm	3
1 – 2 mm	2
<1mm	1
There isn't any	0
Extent of Damage	**Number**
>30%	3
10 – 30%	2
<10%	1
There isn't any	0
Channel	
Depth	Number
>20mm	7
11 – 20 mm	5
6 – 10 mm	3
0 – 5 mm	1
Depth	**Number**
There isn't any	0
Patches and Holes	
Wide	**Number**
>30%	3
20 -30%	2
10 – 20%	1

<10%	0
Surface Roughness	
Type	**Number**
Disintegration	4
Grain Release	3
Rough	2
Fatty	1
Close Texture	0
Sink	
Depth	**Number**
>5/100 m	4
2 – 5/10 m	2
0 – 2/100 m	1
There isn't any	0

Source: (Ministry of Public Works, 2011)

From table 2, the total number of road damage can be calculated which will later be used to determine the value of road conditions which can be seen in table 3.

Table 3. Table of Road Condition Values Based on Damage Numbers

Total Damage Figures	**Assess Road Conditions**
26 - 29	9
22 - 25	8
19 - 21	7
16 - 18	6
13 - 15	5
10 - 12	4
7 - 9	3
4 - 6	2
0 - 3	1

Source: (Directorate General of Highways, 1990)

After knowing the road class, the next step is to group the survey results and group the data according to the type of road damage at the research location. To calculate damage parameters and assess road damage, see table 2. The final step is to add up the numbers for the types of damage and determine the road condition value according to table 3. After that, calculate the road priority order value using the following equation:

$$\text{Priority Order} = 17 - (\text{LHR Class} + \text{Road Condition Value})$$

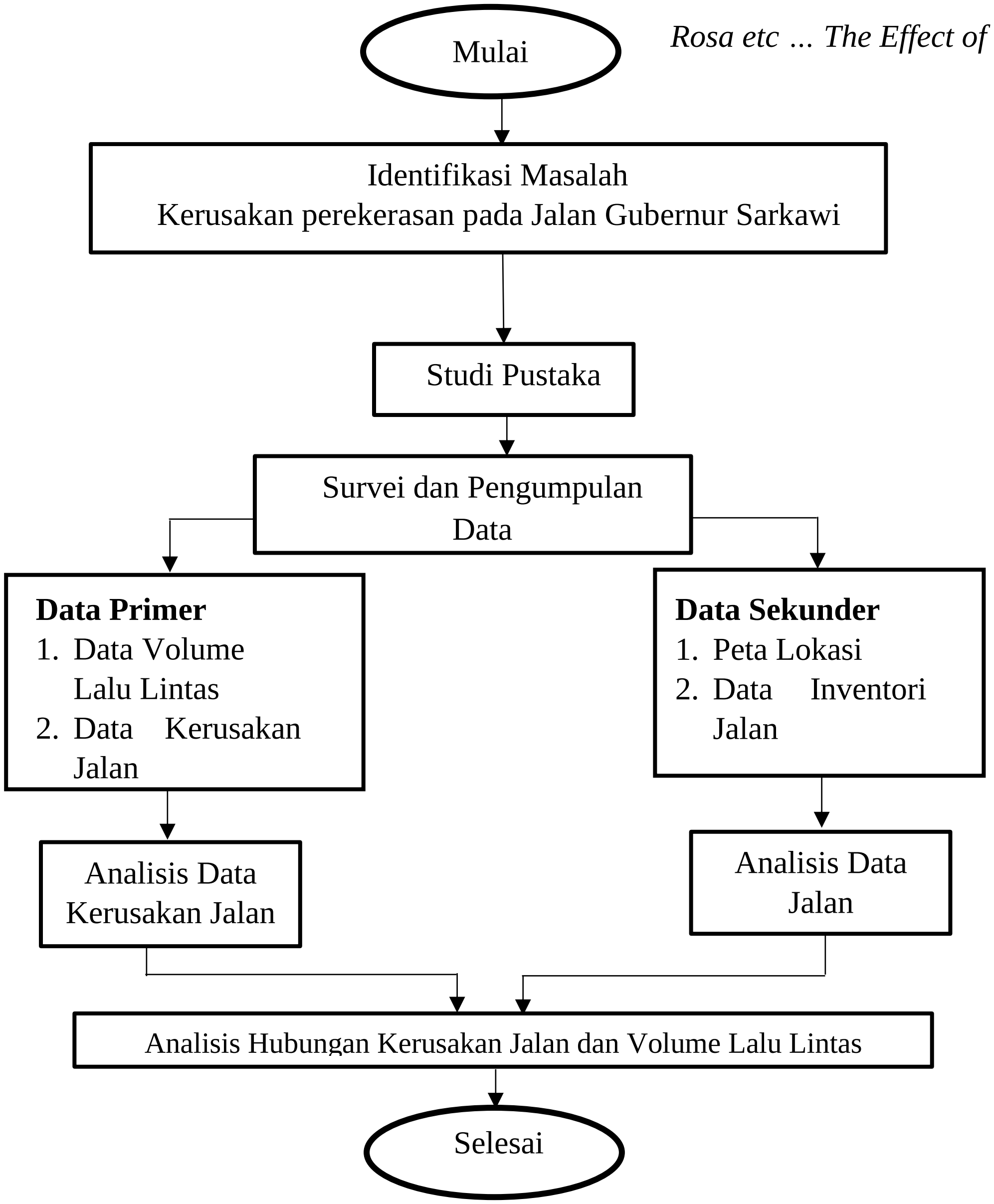
This research also uses a regression method where variable Y is the dependent variable and variable X is the independent variable. For a significance test < 0.05, the independent variable has an effect on the dependent variable, but if the significance test value is > 0.05 then the independent variable has no effect on the dependent variable.

Table 4. Interpretation of R Values Based on Correlation Coefficient

R^2 Value	Absolute Value of Coelation Coefficient (IrI)	Interpretation
<0.04	0.00 – 0.199	Slight correlation, almost negligible relationship
0.04	0.20 – 0.399	Low correlation, little relationship
0.16	0.40 – 0.699	Moderate correlation, substantial relationship
0.49	0.70 – 0.899	Strong correlation, marked relationship
0.81	0.90 – 1,000	Very strong correlation, very reliable relationship

Source: (F. Radam et al., 2015)

So the analysis of the research carried out can be seen briefly in the transfer chart below.



3. Results and Discussion

3.1 Traffic Volume Data

From the LHR survey that has been carried out in the field and from the analysis that has been carried out, it can be seen that the results obtained can be seen in table 5.

Table 1. Total City Traffic Volume in All Segments

Vehicle Name	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8
Sedan	293	331	234	358	256	191	147	221
Public transportation	2	0	0	0	0	0	0	0
Small Bus	6	5	0	0	0	0	0	0
Big Bus	14	0	0	14	0	3	0	0
Pickups	350	335	237	217	215	335	115	87

Truck 2 axles 4 wheels	78	32	187	0	254	0	130	12
Truck 2 axles 6 wheels	1190	1085	721	59	64	609	99	1707
Truck 3 axles	227	354	672	581	1568	1547	2061	150
Truck 4 axles	13	0	0	100	0	17	0	0
Trailers	39	0	26	22	0	8	0	23
Motorcycle	4962	1309	2562	875	1919	1730	2230	1939
Bentor/ken.roda 3	2	0	0	0	0	0	0	0
Bicycle/rickshaw/cart	53	17	38	0	0	0	0	0
Total	7229	3468	4676	2226	4274	4439	4780	4138

Source: (Analysis Results, 2021)

From the existing table it can be seen that the highest vehicle volume is in segment 1. Next, table 6 is a recapitulation of two-way vehicle volume.

Table 2. Recapitulation of Total Traffic Volumes Entering the City (pcu/hour)

Segment	LHRtotal Vehicles/hour (pcu/hour)
1	5139
2	3228
3	3769
4	1801
5	3805
6	4229
7	4313
8	3732

Source: (Analysis Results, 2021)

After getting the traffic volume calculation, then look for the standard load acting on that road section using the Equivalent Load Factor (VDF). To determine the ESA5 values according to the planned age, see the 2017 MDP. For the steps for determining the ESA5 values, see the calculations below.

For ESA5 calculations, the plan age is 20 years using the ESA formula as follows.

$$\boldsymbol{ESA_{TH-1}} = (\mathbf{\Sigma LHRJK\ x\ VDFJK})\ \mathbf{x\ 365\ x\ DD\ x\ DL\ x\ R})$$

Work steps

The first step to take is to calculate the growth rate factor (i) which can be seen in the cumulative traffic growth multiplier table using the following formula.

$$\boldsymbol{R} = \frac{(\mathbf{1} + \mathbf{0,01}\ \boldsymbol{i})^{\boldsymbol{UR-1}}}{\mathbf{0,01}\ \boldsymbol{i}}$$

Table 3. Traffic Growth Rate Factor (i)

	Java	Sumatra	Kalimantan	Indonesian average
Arterial and Urban	4.80	4.83	5.14	4.75
Rural Collector	3.50	3.50	3.50	3.50
Village Road	1.00	1.00	1.00	1.00

Source: (Directorate General of Highways, 2017)

With UR equal to 3 and 17 years respectively, it is obtained

$$\boldsymbol{R}_{(2021-2024)} = \frac{(1+0{,}01\ 5{,}14)^3-1}{0{,}01\ (5{,}14)} = 3.157$$

$$\boldsymbol{R}_{(2025-2041)} = \frac{(1+0{,}01\ 5{,}14)^{17}-1}{0{,}01\ (5{,}14)} = 26.158$$

The next step is to determine the LHR data used, namely data from a survey conducted in the field for 24 hours and the data can be seen in the table below.

Group	Vehicle Type	2021 average LHR
2	Passenger cars and other light vehicles	339
5B	Big bus	10
6A	2 axle 4 wheel truck	46
6B	2 axle 6 wheel truck	581
7A1	3 axle truck	100
7A2	tandem 3 axle truck	0
7C1	4 axle truck	11
7C2A	tandem 5 axle truck	16
7C2B	5 triple axle truck	0
7C3	6 axle truck	0

Source: (Analysis Results, 2021)

From the table above you can calculate the VDF value. The VDF value was taken on the island of Kalimantan because the road studied was on the island of Kalimantan. The VDF table is in the table below.

Table 4. VDF Value for Each Type of Commercial Vehicle

Jenis kenderaan	Sumatera				Jawa				Kalimantan				Sulawesi				Bali, Nusa Tenggara, Maluku dan Papua			
	Beban aktual		Normal		Beban aktual		Normal		Beban aktual		Normal		Beban aktual		Normal		Beban aktual		Normal	
	VDF 4	VDF 5	VDF 4	VDF 5	VDF 4	VDF 5	VDF 4	VDF 5	VDF 4	VDF 5	VDF 4	VDF 5	VDF 4	VDF 5	VDF 4	VDF 5	VDF 4	VDF 5	VDF 4	VDF 5
5B	1.0	1,0	1,0	1,0	1,0	1,0	1.0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
6A	0.55	0.5	0.55	0.5	0.55	0.5	0.55	0.5	0.55	0.5	0.55	0.5	0.55	0.5	0.55	0.5	0.55	0.5	0.55	0.5
6B	4,5	7,4	3,4	4,6	5,3	9,2	4,0	5,1	4,8	8,5	3,4	4,7	4,9	9,0	2,9	4,0	3,0	4,0	2,5	3,0
7A1	10,1	18,4	5,4	7,4	8,2	14,4	4,7	6,4	9,9	18,3	4,1	5,3	7,2	11,4	4,9	6,7	-	-	-	-
7A2	10,5	20,0	4,3	5,6	10,2	19,0	4,3	5,6	9,6	17,7	4,2	5,4	9,4	19,1	3,8	4,8	4,9	9,7	3,9	6,0
7B1	-	-	-	-	11,8	18,2	9,4	13,0	-	-	-	-	-	-	-	-	-	-	-	-
7B2	-	-	-	-	13,7	21,8	12,6	17,8	-	-	-	-	-	-	-	-	-	-	-	-
7C1	15,9	29,5	7.0	9,6	11,0	19,8	7,4	9,7	11,7	20,4	7,0	10,2	13,2	25,5	6,5	8,8	14,0	11,9	10,2	8,0
7C2A	19,8	39,0	6,1	8,1	17,7	33,0	7,6	10,2	8,2	14,7	4,0	5,2	20,2	42,0	6,6	8,5	-	-	-	-
7C2B	20,7	42,8	6,1	8,0	13,4	24,2	6,5	8,5	-	-	-	-	17,0	28,8	9,3	13,5	-	-	-	-
7C3	24,5	51,7	6,4	8,0	18,1	34,4	6,1	7,7	13,5	22,9	9,8	15,0	28,7	59,6	6,9	8,8	-	-	-	-

Source: (Directorate General of Highways, 2017)

Next is to determine the two-way road distribution factor usually taking 0.50.

Table 5. Directional Distribution Factor (DD)

Untuk jalan dua arah, faktor distribusi arah (DD) umumnya diambil 0,50 kecuali pada lokasi-lokasi yang jumlah kendaraan niaga cenderung lebih tinggi pada satu arah tertentu.

Source : (Directorate General of Highways, 2017)

Then determine the distribution factor which is taken as 100 because the number of lanes in each direction is only one and can be seen in the following table.

Table 6. Lane Distribution Factor (DL)

Jumlah Lajur setiap arah	Kendaraan niaga **pada lajur desain** (% terhadap populasi kendaraan niaga)
1	100
2	80
3	60
4	50

Source: (Directorate General of Highways, 2017)

From the calculations that have been carried out, the results of these calculations are obtained, the recapitulation of which can be seen in the following table:

Table 7. Recapitulation of CESA Values for each segment

Segment	CESA5 Directions to enter the city	CESA5 Directions Out of City
1	109674299	116299014
2	102483337	102516312
3	99150058	129134530
4	140593144	3815799
5	154740832	127329978
6	253724600	107679505
7	184491385	185343333
8	163550243	163550243

Source: (Analysis Results, 2021)

Road Damage Data

Road damage data is the primary data needed in this research. To calculate the road damage data itself, use the road damage classification based on the Procedures for Preparing City Road Maintenance Programs Number 018/T/BNKT/1990. The overall road damage value can be seen in the table.

Table 8. Assessment of Road Damage in Each Segment

Segment	Total LHR	LHR Class	Damage Score	Condition Value	Order of Priority
1	5139	6	26	9	2
2	3228	5	25	8	4
3	3769	5	11	4	8
4	1801	4	13	5	8
5	3805	5	21	6	6
6	4229	5	28	9	3
7	4313	5	19	7	5
8	3732	5	12	4	8

Source: (Analysis Results, 2021)

Relationship between Traffic Volume (pcu/hour) and Road Damage

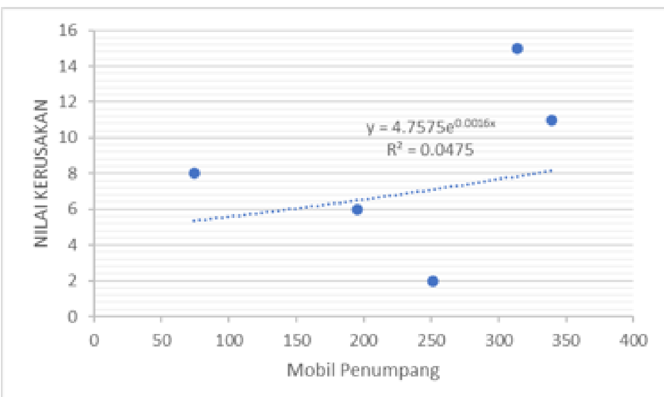
From previous calculations because the values obtained are not suitable for all segments. So a conclusion will be made that the segments to be analyzed are segments 1, 8, 9, 12 and 15 which are calculated using scatter charts and SPSS. In this calculation, traffic volume and traffic load are used as variables X and for variable Y is the value of road damage. In this case the variable X is divided into 11.

Table 18. Recapitulation of Variables X and Y

Segment	Damage Score	Passenger Cars and other light vehicles	5B	6A	6B	7A1	7A2	7C1	7C2A	7C2B	7C3	LHR
1	11	339	10	46	581	100	0	11	16	0	0	1317
8	6	195	0	12	620	150	0	0	0	0	0	1208
9	15	314	4	32	609	127	0	2	23	0	0	1340
12	2	251	4	0	25	0	0	0	0	0	0	289
15	8	74.2	0	85	34	1044	0	0	0	0	0	1560

Source: (Analysis Results, 2021)

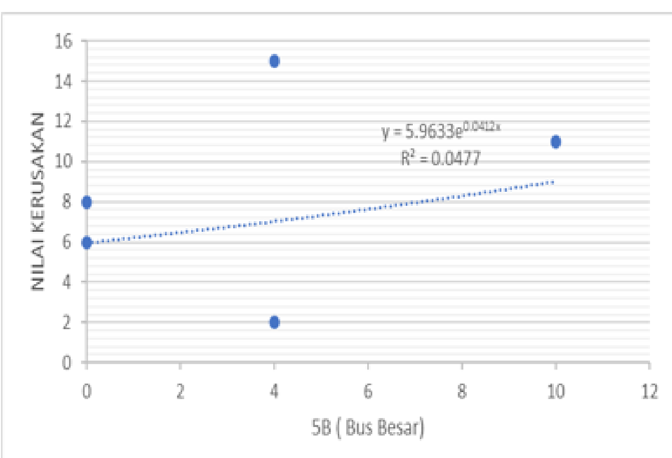
From the survey and calculations that have been carried out, the results obtained can be seen in the table and the relationship between variable X and variable Y is presented in graphical form as in the image below.



R^2 Value	Nilai Absolut Koefisien Koelasi (|r|)	Interpretasi
<0,04	0,00 – 0,199	Korelasi sedikit, hubungan yang nyaris diabaikam
0,04	0,20 – 0,399	Korelasi rendah, hubungan kecil
0,16	0,40 – 0,699	Korelasi sedang, hubungan substansial
0,49	0,70 – 0,899	Korelasi kuat, hubungan yang ditandai
0,81	0,90 – 1,000	Korelasi yang sangat kuat, hubungan yang sangat bisa diandalkan

Figure 2. Relationship of Passenger Cars to damage

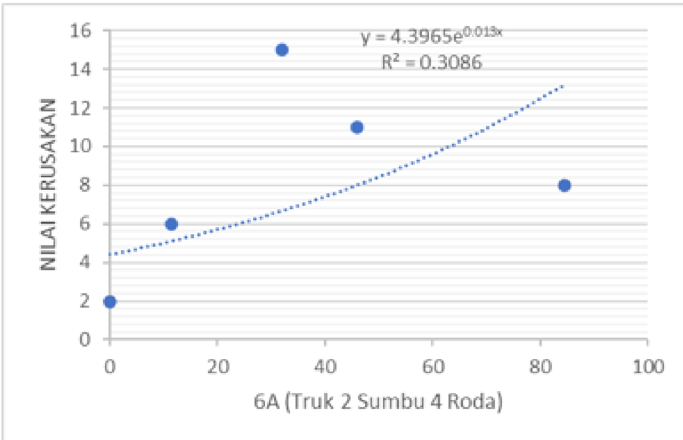
Source: (Analysis Results, 2021)



R^2 Value	Nilai Absolut Koefisien Koelasi (|r|)	Interpretasi
<0,04	0,00 – 0,199	Korelasi sedikit, hubungan yang nyaris diabaikam
0,04	0,20 – 0,399	Korelasi rendah, hubungan kecil
0,16	0,40 – 0,699	Korelasi sedang, hubungan substansial
0,49	0,70 – 0,899	Korelasi kuat, hubungan yang ditandai
0,81	0,90 – 1,000	Korelasi yang sangat kuat, hubungan yang sangat bisa diandalkan

Gambar 3. Hubungan 5B terhadap Kerusakan

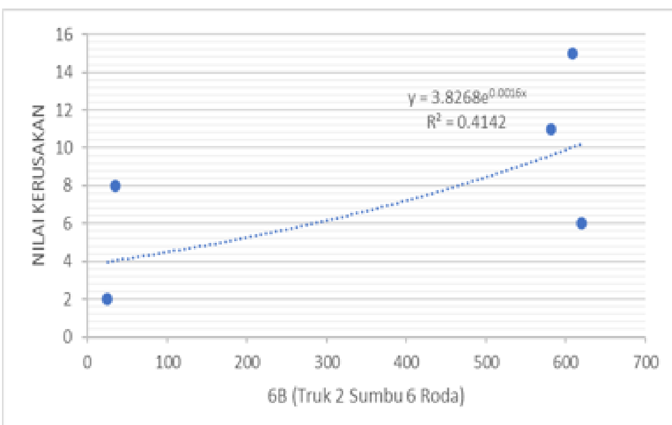
Sumber : (Hasil Analisis, 2021)



R^2 Value	Nilai Absolut Koefisien Koelasi (|r|)	Interpretasi
<0,04	0,00 – 0,199	Korelasi sedikit, hubungan yang nyaris diabaikam
0,04	0,20 – 0,399	Korelasi rendah, hubungan kecil
0,16	0,40 – 0,699	Korelasi sedang, hubungan substansial
0,49	0,70 – 0,899	Korelasi kuat, hubungan yang ditandai
0,81	0,90 – 1,000	Korelasi yang sangat kuat, hubungan yang sangat bisa diandalkan

Figure 4. Relationship of 6A to Damage

Source: (Analysis Results, 2021)



R^2 Value	Nilai Absolut Koefisien Koelasi (|r|)	Interpretasi
<0,04	0,00 – 0,199	Korelasi sedikit, hubungan yang nyaris diabaikam
0,04	0,20 – 0,399	Korelasi rendah, hubungan kecil
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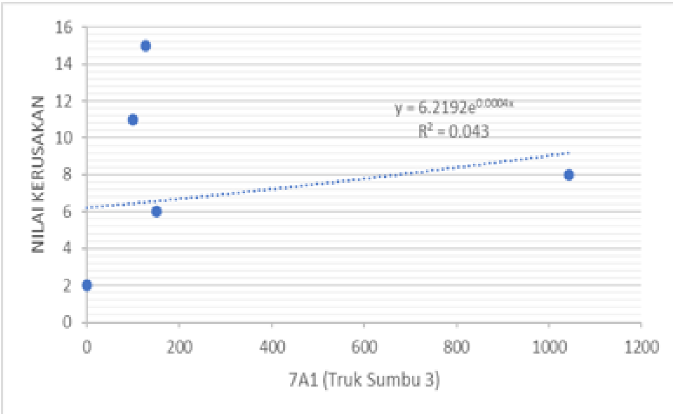
0,49	0,70 – 0,899	Korelasi kuat, hubungan yang ditandai
0,81	0,90 – 1,000	Korelasi yang sangat kuat, hubungan yang sangat bisa diandalkan

Figure 5. Relationship of 6B to Damage

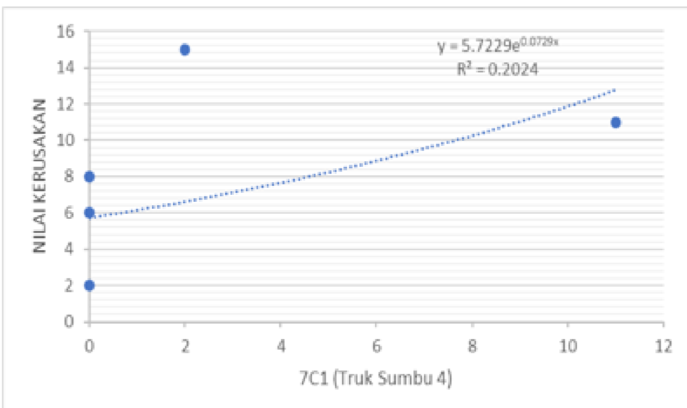
Source: (Analysis Results, 2021)



R² Value	Nilai Absolut Koefisien Koelasi (|r|)	Interpretasi
<0,04	0,00 – 0,199	Korelasi sedikit, hubungan yang nyaris diabaikam
0,04	0,20 – 0,399	Korelasi rendah, hubungan kecil
0,16	0,40 – 0,699	Korelasi sedang, hubungan substansial
0,49	0,70 – 0,899	Korelasi kuat, hubungan yang ditandai
0,81	0,90 – 1,000	Korelasi yang sangat kuat, hubungan yang sangat bisa diandalkan

Figure 6. Relationship of 7A1 to Damage

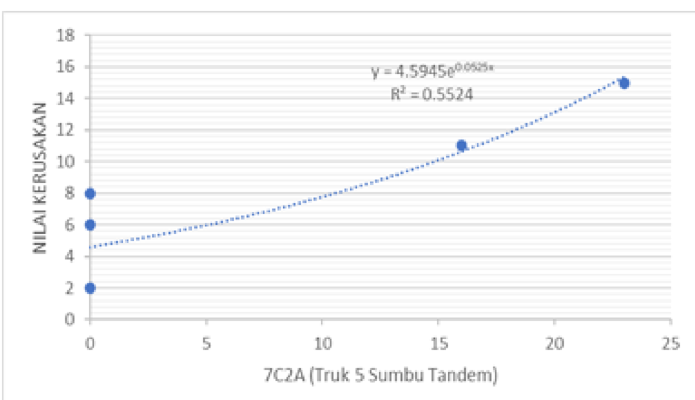
Source: (Analysis Results, 2021)



R² Value	Nilai Absolut Koefisien Koelasi (|r|)	Interpretasi
<0,04	0,00 – 0,199	Korelasi sedikit, hubungan yang nyaris diabaikam
0,04	0,20 – 0,399	Korelasi rendah, hubungan kecil
0,16	0,40 – 0,699	Korelasi sedang, hubungan substansial
0,49	0,70 – 0,899	Korelasi kuat, hubungan yang ditandai
0,81	0,90 – 1,000	Korelasi yang sangat kuat, hubungan yang sangat bisa diandalkan

Figure 7. Relationship of 7C1 to Damage

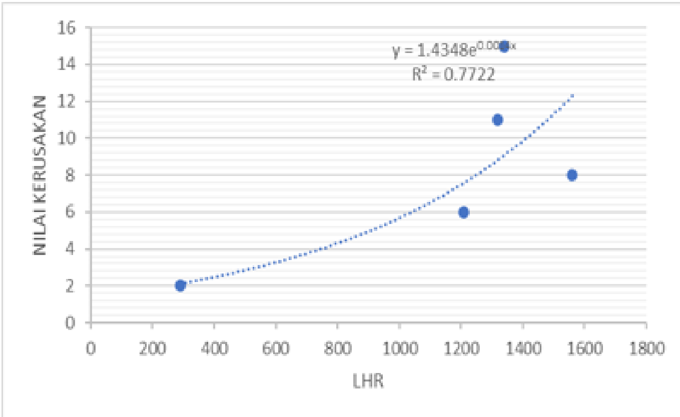
Source: (Analysis Results, 2021)



R² Value	Nilai Absolut Koefisien Koelasi (|r|)	Interpretasi
<0,04	0,00 – 0,199	Korelasi sedikit, hubungan yang nyaris diabaikam
0,04	0,20 – 0,399	Korelasi rendah, hubungan kecil
0,16	0,40 – 0,699	Korelasi sedang, hubungan substansial
0,49	0,70 – 0,899	Korelasi kuat, hubungan yang ditandai
0,81	0,90 – 1,000	Korelasi yang sangat kuat, hubungan yang sangat bisa diandalkan

Figure 8. Relationship of 7C2A to Damage

Source: (Analysis Results, 2021)



R^2 Value	Nilai Absolut Koefisien Koelasi (|r|)	Interpretasi
<0,04	0,00 – 0,199	Korelasi sedikit, hubungan yang nyaris diabaikam
0,04	0,20 – 0,399	Korelasi rendah, hubungan kecil
0,16	0,40 – 0,699	Korelasi sedang, hubungan substansial
0,49	0,70 – 0,899	Korelasi kuat, hubungan yang ditandai
0,81	0,90 – 1,000	Korelasi yang sangat kuat, hubungan yang sangat bisa diandalkan

Figure 9. Relationship between LHR and Damage

Source: (Analysis Results, 2021)

LHR Relationship (pcu/hour) on damage can also be calculated using SPSS. In this case variable X is LHR (pcu/hour) which in this data is obtained from calculations (LV and HV) and road damage value as variable Y. The equation using linear regression can be seen in table 19.

Table 19. Equation of the Relationship between Variables X and Y

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.817[a]	.668	.289	3.269

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	150.628	8	18.828	1.762	.235[b]
	Residual	74.810	7	10.687		
	Total	225.437	15			

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Kerusakan	9.995	15	.000	9.688	7.62	11.75
Mobil Penumpang dan Kendaraan Ringan Lain	11.579	15	.000	245.938	200.67	291.21
Bus Besar	2.250	15	.040	1.958	.10	3.81
Truk 2 sumbu 4 roda	2.619	15	.019	43.203	8.05	78.36
Truk 2 sumbu 6 roda	4.104	15	.001	345.888	166.23	525.54
Truk 3 sumbu	4.004	15	.001	441.750	206.61	676.89
Truck 4 sumbu	1.298	15	.214	8.104	-5.20	21.41
Truck 5 sumbu tandem	3.118	15	.007	7.375	2.33	12.42
LHR	13.400	15	.000	1328.260	1116.98	1539.54

Source: (Analysis Results, 2021)

From calculations using SPSS which uses linear regression analysis, the determination efficiency results for the eight variables are R^2 of 0.5524, so that a correlation is obtained of 0.7432, which means the correlation between variable X and variable Y is strongly related. This value is then connected to the P *value* , the result of which is 0.007<0.05, which is taken from the 7C2A vehicle type and has a large influence on road damage due to repeated loads.

Relationship of Standard Load (CESA) to Road Damage

The relationship between road damage and standard loads uses a scatter chart, where variable X is ESA and variable Y is the damage value. For ESA values, use segment data 1, 8, 9, 12 and 15, the same as

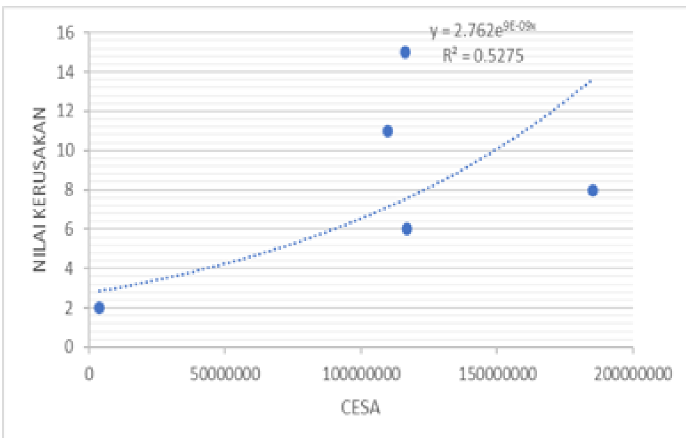
LHR calculations (junior/hour). The following is a recapitulation table between variable X and variable Y which can be seen in table 4.43.

Table 20. Recapitulation between Variables X and Y

Segment	Damage Score	CESA5
1	11	109674299
8	6	116922311
9	15	116299014
12	2	3815799
15	8	185343333

Source: (Analysis Results, 2021)

The relationship between variables X and Y can be seen in the following scatter chart.



R^2 Value	Nilai Absolut Koefisien Koelasi (|r|)	Interpretasi
<0,04	0,00 – 0,199	Korelasi sedikit, hubungan yang nyaris diabaikam
0,04	0,20 – 0,399	Korelasi rendah, hubungan kecil
0,16	0,40 – 0,699	Korelasi sedang, hubungan substansial
0,49	0,70 – 0,899	Korelasi kuat, hubungan yang ditandai
0,81	0,90 – 1,000	Korelasi yang sangat kuat, hubungan yang sangat bisa diandalkan

Figure 10. Relationship between CESA and Road Damage

Source: (Analysis Results, 2021)

From the graph above, the R2 value is 0.5275, so the r value is 0.7263, which means the relationship between CESA and road damage is strong.

4. Conclusion

At locations where research was carried out on the age, classification and handling of road maintenance, it was shown that the level of damage that occurred on the road was influenced by the vehicles that used the road. From the analysis carried out, it was found that vehicle 7C2A has a strong correlation (0.7432) forming an exponential y = $4.5945e^{0.0525x}$. This type of vehicle is more influential because the P-value is less than 0.05 and this vehicle passes this road repeatedly.

Based on standard load analysis (CESA), the road damage value obtained a strong correlation value. However, the vehicle that is most affected by road damage is the 7C2A vehicle type (5 axle tandem truck). So it can be concluded that the road damage that occurred on Jalan Governor Sarkawi was caused by repeated traffic loads.

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