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Analysis Traffic Volume of Rigid Pavement Damage on Roads Badami Karawang

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Abstract

The road was a means of land transport is very important to the social relations and economic goods and services, and with a population that is increasing in every year to year, increasing the number of vehicles passing on the road that there is, therefore, in need planning a safe way according to the function, volume, and nature of traffic. Road repairs cost a lot and this action is felt not quite right because remedies can not survive by age plans and in kutif of IDN Times in 2019 that the condition damages the highway in the district of Karawang based on data from the Department of Public Works and Spatial Planning (PUPR) Khanewal district, along with the road status 1937.53 kilometers of district roads in poor condition. (IDN Times, 2019). This study was conducted to assess how much influence the volume of vehicles to the damage occurred on roads Badami karawang at STA 0 + 000-0 + 500 and STA 2 + 250-2 + 750, to examine the above problems by analyzing data from LHR and road damage the method of Highways, then further by looking at the correlation between the volume of vehicles on the road destruction by using SPSS and to increase the strength of rigid pavement using cement concrete road pavement planning 2003 is an additional layer (overlay) using the rigid pavement. From the analysis and discussion get Simultaneous Effect Hypothesis Test results that the Sig. (0,000) <α (0.05) and f count (35.671)> F table (3.89) H0 is rejected. It can be concluded that the simultaneous effect of the Light vehicle road damage of 33.8%, the simultaneous effect of the Heavy vehicle road damage amounted to 47.7%, Motorcycles simultaneous effect on road damage by 12.1% and the simultaneous effect of Motor Vehicles not to road damage by 14.2%, the result of the identification of the type and class of road damage indicates that the need for administration of additional layer (overlay) as a treatment for damage to roads, based on the analysis of the design used road repair method with a design life of 10 years, namely: (Overlay) Rigid Pavement (Rigid Pavement) as thick as 18 cm .and of analysts earn fees at cost (overlay) Rigid Pavement (Rigid Pavement) Rp. 9,114,626,20 / segments.

Keywords
Analysis of traffic volume, pavement overlay rigid, correlation rigid traffic volume against damage.

1. Introduction

According to (IDN Times, 2019) Damage highway in the district of Karawang based on data from the Department of Public Works and Spatial Planning (PUPR) Karawang, along the road status 1937.53 kilometers of district roads in poor condition.

Damage to roads in the Falkirk area often become the public spotlight, usually people often submit complaints road damage through the social media accounts of his, so that the Department PUPR Karawang more serious in addressing the problem because the construction of the road was immediately felt by the people and for the district government pay more attention to quality improvement roads are often damaged before the age of the specified path. (IDN Times, 2019).

Therefore it is very important to perform preventive maintenance and assuming the above background, so I took the title of this thesis with the title Analysis of the volume of traffic on the road destruction rigid in Badami karawang roads.

Source: radar karawang 2019
Figure 1. Damage to roads roads bedami karawang

Highway Badami is a street located in the district Telukjambe West, the road is an alternative way to Bekasi and connecting roads Subdistrict Telukjambe West sub-district base, it causes high levels of mobilization on the road section, and make the construction of pavement rigid damaged before age plan determined by keluahuhan citizens and road users that often lead to accidents, especially for two-wheeler riders (radar karawang, 2019).

Damage in general is the increased volume of traffic load, poor drainage systems, poor material properties pavement construction, climate, soil conditions are unstable, the planning of pavement is very thin, a job that does not deserve a process to the specification, this has happened because of the number of passing vehicles exceeding road capacity. Results damage reduction factor in the quality and age.

This study aims to Know the kind of damage that existed at the surface layer rigid in the streets Badami, determine the effect of the volume of vehicles with the level of damage to roads, know the methods of repair and how much it costs is needed, increase knowledge about the causes of road damage rigid due to the number of vehicles increasing increased. As well as provide new reference materials for civil engineering students and researchers, in order to increase knowledge about the causes of road damage caused by the increasing number of vehicles and can be used as a medium of teaching.

2. Methodology

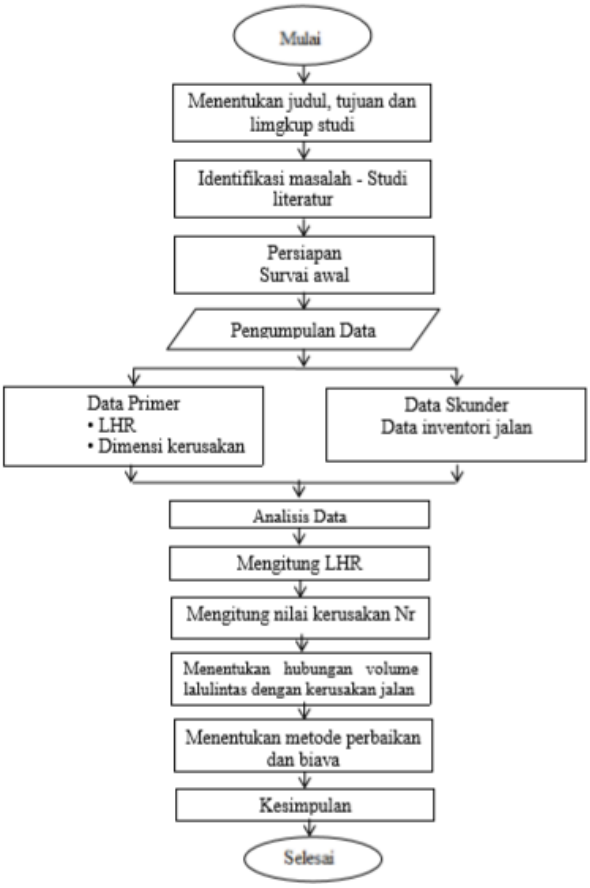
Metodologogi research Overall research activities can be described as follows.

Method of collecting data.

1. Secondary data among other data required length and width of the road, the number of segments, the median, the number of lanes of the road and completeness.
2. Primary data volume of data traffic, road damage data

The analytical method used among others

1. Methods of analysis the volume of vehicles and Methods Using the Damage value of Highways.
2. Regression analysis method to obtain vehicle volume relationship patterns with the level of damage to roads.
3. Road repair method using cement concrete road pavement planning in 2003 to calculate the cement concrete slab thickness.
4. The cost of repair method, technique Hint unit price cost analysis of district road of 1995 to determine the total cost of road handling.



3. Result

A. Traffic volume

To capture data in the field within a week at peak hours beginning at 6:00 to 09:00 pm and 16:00 to 19:00 pm, while the vehicle is observed light vehicle (LV), heavy vehicles (HV), Motorcycle (MC), vehicles are not motorized (UM).

Table 1. The volume of vehicle (veh / day)

No.	Nama Jalan	Jalur	Kendaraan Ringan (Kend/Hari)	Kendaraan Berat (Kend/Hari)	Sepeda Motor (Kend/Hari)	Kendaraa n Tdk Bermotor (Kend/Ha ri)
			(LV))	(HV)	(MC)	(UM)
1	badami - loji STA . 0+100 - 0 + 500	Barat - Timur	2580	1811	14194	9
		Timur - Barat	1843	830	12631	6
2	badami - loji STA .2 + 250 - 2+ 750	Barat - Timur	2480	1615	13650	7
		Timur - Barat	1432	930	11050	5

Source: Data Analyst

B. Assess the damage

From the observation or field observations obtained some kind of damage can occur: longitudinal cracks, transverse cracks, corner cracks, slippery Aggregates, Hole

Table 2. Sta 0 + 000-0 + 500 Directions West - East

No.	jenis kerusakan jalan	luas kerusakan jalan (m2)	luas jalan (m2)	Nq %	Np	Nj	Nq	Kategori
1	Aspal beton	0	1750	0,0000	0	2	0	
2	Penetrasi	0	1750	0,0000	0	3	0	
3	Tambalan	44,00	1750	2,5143	2	4	8	
4	Retak	3,07	1750	0,1756	2	5	10	
5	Lepas	0,20	1750	0,0114	3	5,5	16,5	
6	Lubang	0,93	1750	0,0531	2	6	12	
7	Alur	0	1750	0,0000	0	6	0	
8	Gelombang	17,50	1750	1,0000	2	6,6	13,2	
9	Amblas	0	1750	0,0000	0	7	0	
10	Belahan	91,50	1750	5,2286	2	7	14	
	Nr							73,7

(Sumber : Hasil Analis Data)

Table 3. Sta 0 + 000-0 + 500 Directions East - West

No.	jenis kerusakan jalan	luas kerusakan jalan (m2)	luas jalan (m2)	Nq %	Np	Nj	Nq	Kategori
1	Aspal beton	0	1750	0,0000	0	2	0	
2	Penetrasi	0	1750	0,0000	0	3	0	
3	Tambalan	11,00	1750	0,6286	2	4	8	
4	Retak	5,60	1750	0,3200	2	5	10	
5	Lepas	0,10	1750	0,0057	2	5,5	11	
6	Lubang	1,14	1750	0,0651	2	6	12	
7	Alur	0	1750	0,0000	0	6	0	
8	Gelombang	17,50	1750	1,0000	2	6,6	13,2	
9	Amblas	0	1750	0,0000	0	7	0	
10	Belahan	27,75	1750	1,5857	2	7	14	
	Nr							68,2

(Sumber : Hasil Analis Data)

Table 4. Sta 2 + 250-2 + 750 Directions West – East

No.	jenis kerusakan jalan	luas kerusakan jalan (m2)	luas jalan (m2)	Nq %	Np	Nj	Nq	Kategori
1	Aspal beton	0	1750	0,0000	0	2	0	
2	Penetrasi	0	1750	0,0000	0	3	0	
3	Tambalan	27,65	1750	1,5800	2	4	8	
4	Retak	9,00	1750	0,5143	2	5	10	
5	Lepas	0,25	1750	0,0143	2	5,5	11	
6	Lubang	1,29	1750	0,0734	2	6	12	
7	Alur	0	1750	0,0000	0	6	0	
8	Gelombang	-	1750	0,0000	0	6,6	0	
9	Amblas	0	1750	0,0000	0	7	0	
10	Belahan	19,00	1750	1,0857	2	7	14	
	Nr							55

(Sumber : Hasil Analis Data)

Table 5. Sta 2 + 250-2 + 750 Directions East - West

No.	jenis kerusakan jalan	luas kerusakan jalan (m2)	luas jalan (m2)	Nq %	Np	Nj	Nq	Kategori
1	Aspal beton	0	1750	0,0000	0	2	0	
2	Penetrasi	0	1750	0,0000	0	3	0	
3	Tambalan	10,00	1750	0,5714	2	4	8	
4	Retak	40,00	1750	2,2857	2	5	10	
5	Lepas	0,10	1750	0,0057	2	5,5	11	
6	Lubang	1,14	1750	0,0651	2	6	12	
7	Alur	0	1750	0,0000	0	6	0	
8	Gelombang	0	1750	0,0000	0	6,6	0	
9	Amblas	0	1750	0,0000	0	7	0	
10	Belahan	0	1750	0,0000	0	7	0	
	Nr							41

(Sumber : Hasil Analis Data)

C. Determine the correlation of the volume of vehicles on the road destruction

Analyzes were performed using SPSS. Recapitulation X1, X2, X3, X4 and Y. kendaraa volume and road damage were analyzed with SPSS non-linear regression. Variables that are used can be seen from the table below.

Table 6. Summary of variables X and Y

Nilai Kerusakan Jalan (Nr) (Y)	Kendaraan Ringan (Kend/Hari) (X1)	Kendaraan Berat (Kend/Hari) (X2)	Sepeda Motor (Kend/Hari) (X3)	Kendaraa n Tdk Bermotor (Kend/Ha ri)(X4)
73,7	2580	1811	14194	9
68,2	1792	830	12631	6
55	2480	1615	13650	7
41	1432	930	11050	5

Source: Data Analyst

Table 7.Result of data processing SPSS 16 Obtained coefficient for each variable track

Pengaruh Secara Parsial Variabel Bebas (X) Terhadap Variabel Terikat (Y)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta	B	Std. Error
1	(Constant)	20.286	3.479		5.831	.108
	X_1	.028	.003	.582	9.452	.067
	X_2	.124	.015	.691	8.413	.075
	X_3	.001	.000	.348	3.476	.178
	X_4	.311	.027	.377	11.572	.055

Source: Data Analyst

The effect can be concluded partial determination coefficient analysis of traffic volume mempegaruhi role in Karawang Badami road damage by light vehicles 33.8%, 47.7% Heavy Vehicles, Motorcycles 12.1%, 14.2% of non-motorized vehicles.

Table 8. Results of Testing the overall path analysis

Koefisien Determinasi

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.997(a)	.893	.965	1.85797

Source: Data Analyst

According to the table above shows that the coefficient of determination volume of vehicles on road damage 0.893 then this volume of vehicles has contributed damage 0.893 Street.

Table 9. Effect of Simultaneous Hypothesis Testing The volume of vehicles on the road destruction

Structural	Sig.	A	F hitung	F tabel	Kesimpulan
$\rho y\, x_1x_2$	0,000	0,05	35,671	3,89	H_0 ditolak

Source: Data Analyst

According to the table above can be explained that the Sig. (0,000) <α (0.05) and f count (35.671)> F table (3.89) H0 is rejected. Thus dapatdisimpulkan that simultaneously affect traffic volume on road damage.

D. Improved methods and costs

1. Methods repair repair methods in use namely Structural Repair additional coating, the method of Highways ie additional coating rigid pavement with a design life of 10 years.

To calculate how thick the need for an additional layer by calculating:

a. calculate LHR
b. Analysts vehicle axis
c. Calculation repetition occurring axis
d. Calculation of the concrete slab thickness

a) Counting LHR

In view of the value of the vehicle on a volume o b sta 0 + 000-0 + 500 is greater than the 2 + 250 -2 + 750 can be seen in the table above, the sta 0 + 000-0 + 500 to reference data to calculate how thick overlay (overlay) as a way of handling damage.

Light vehicle 2 ton = 4,372 veh / day / 2-way
Bus 8 ton = 420 veh / day / 2-way
Truck 2 as 13 tonne = 1,201 veh / day / 2-way
Truck 3 as 20 ton = 1,020 veh / day / 2-way

b) Analysts vehicle axis

For step - step analysis of the number of axes calculation is as follows. Determine the configuration of the load, determine the number of vehicles, determine the number of axes per vehicle, specify the number of axis = number of vehicles X amount perkendaraan axis, determines the value of BS (axle) and JS (number of axes).

Table 10. Calculation of Total Axis By Type and His burden

Jenis Kend	Konfigurasi beban sumbu (ton)				Jml Kend (bh)	Jml Sumbu per Kend (bh)	Jml Sumbu (bh)	STRT		STRG		STdRG	
	RD	RB	RGD	RGB				BS (ton)	JS (bh)	BS (ton)	JS (bh)	BS (ton)	JS (bh)
(1)	(2)				(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
MP	1	1	-	-	4372	-	-	-	-	-	-	-	-
Bus 8 ton	3	5	-	-	420	2	840	3	420	5	420	-	-
Truk 2 as	5	8	-	-	1201	2	2402	5	1201	8	1201	-	-
Truk 3 as	6	14	-	-	1020	2	2040	6	1020	-	-	14	1020
Total							5282		2641		1621		1020

Source: Data Analyst

JSKN = 365 x JSKNH x Rx C
C = 0.5
JSKN plan = 365 x JSKNH x R x C
= 365 x 5282 x 13.18 x 0.5
= 12,392,530.68 fruit.

c) Calculation repetition occurring axis

Table 11. Repetition Axes Calculation Plan

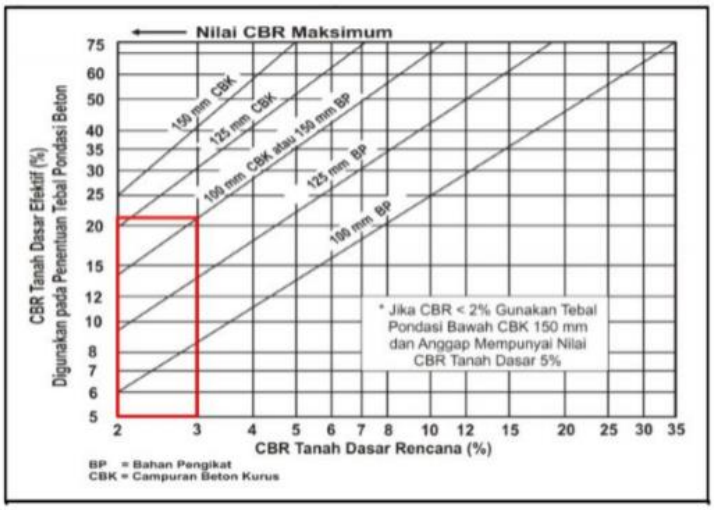
Jenis Sumbu	Beban Sumbu (ton)	Jumlah Sumbu	Proporsi Beban	Proporsi Sumbu	Lalu lintas Rencana	Repetisi yang Terjadi
-1	-2	-3	-4	-5	-6	(7) = (4) x (5) x (6)
STRT	6	2040	0,39	0,67	12.392.530,68	3.190.806,84
	5	2402	0,45	0,67	12.392.530,68	3.757.018,64
	3	840	0,16	0,67	12.392.530,68	1.313.861,64
Total		5282	1,00			
STRG	8	1201	0,74	0,20	12.392.530,68	1.878.509,32
	5	420	0,26	0,20	12.392.530,68	656.930,82
Total		1621	1,00			
STdRG	14	1020	1	0,13	12.392.530,68	1.595.403,42
Total		1020	1			
Kumulatif						12.392.530,68

Source: Data Analyst

d) Calculation of the concrete slab thickness

The data - the data used in the calculation of the concrete slab

1. = 10 year design life.
2. Repetition is happening = 12,392,530.68 fruit
3. Load safety factor = 1.1
4. Flexural tensile strength (f'cf) = 4 Mpa
5. Subgrade CBR = 3.02%.
6. Effective CBR = 21.05% (obtained from the graph)
7. Estimates thick concrete = 25 cm



Source: Data Analyst

Figure 2. Relationship Graph graphic CBR CBR Effective Basic Land Basic Land Plan

After determining the thickness of the estimates on can then continue with the Table Voltage Equivalent and Voltage Erosion and in Table thick sleb 250 and values .cbr effective 20 in view the value of STRT, Strg, STRdRG then the value is applied to the graph TE (Voltage Equivalent) and FE (Erosion factor) To determine the estimated thick concrete slab if it is safe or not.

Table 12. Fatigue Analysis and Erosion with estimates Thick Plates 25 cm

Jenis Sumbu	Beban Sumbu (ton ke kN)		Beban Rencana Per Roda (kN)	Repetisi yang Terjadi	Faktor Tegangan dari Erosi	Analisa Fatik		Analisa Erosi	
						Repetisi Ijin	Persen Rusak (%)	Repetisi Ijin	Persen Rusak (%)
-1	-2		(3) = (2)*FKB / jml roda	-4	-5	-6	(7) = (4)*100/(6)	-8	(9) = (4)*100/(8)
STRT	6	60	33	3.190.806,84	TE = 0,65	TT	0	TT	0
	5	50	27,5	3.757.018,64	FRT = 0,16	TT	0	TT	0
	3	30	16,5	1.313.861,64	FE = 1,53	TT	0	TT	0
STRG	8	80	22	1.878.509,32	TE = 1,02	TT	0	TT	0
	5	50	13,75	656.930,82	FRT = 0,26	TT	0	TT	0
	-	-	-	-	FE = 2,13	-	-	-	-
STdRG	14	140	19,25	1.595.403,42	TE = 0,87	TT	0	2,00,E+07	0,08
	-	-	-	-	FRT = 0,22	-	-	-	-
	-	-	-	-	FE = 2,23	-	-	-	-
Total						**0 < 100 %**		**0,08 < 100 %**	

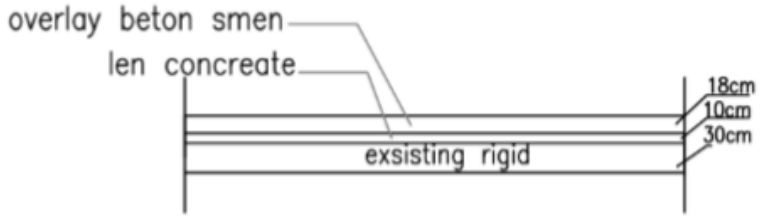
Source: Data Analyst

Because the percentage of fatigue damage and erosion damage percentage to 0.08 and smaller than 100%, the plate thickness used is 25 cm due to already meet the requirements of a strong and safe to use.

Determining the required thick layer added to the equation:
a. Determining thick layer immediately added:
Thick layers of added directly required (Tr) Tr = 1.4 √ (T 1.4 -Cs.T0 1.4)
With known: T = thick layers needed = 25 cm
T0 = 30 cm
Cs = 0.35
Then Tr = 1.4√ {(25) 1.4 - 0.35 (30) 1.4} = 8.81 cm.

b. Determining the layer thickness plus a separator:
Tr = √ (T 2 - Cs.T0 2)
With note: T0 = 30 cm
Cs = 0.35 (fatherly broken pavement conditions strruktur)
Then Tr = √ {(25) from 2 to 0.35 (30) 2} = 17.6cm

Taken thick layer added Tr = 17.6 cm> Tr minimum = 8.81 cm
Then take a thick layer added ≠ Tr = 17.6 cm 18 cm



Source: Data Analyst

2. Repair Cost
A. The volume of work
B. Calculation of cost analysis of rigid pavement work
C. Total cost of road repairs per segment

A. The volume of work

a. The width of the track = 2 x 3.5 m
= 7 m.
b. Long road = 1000 m.
c. The width of the segment = 3.5 m.
d. Segment length = 5 m
e. Plate thickness = 0.18 m.
f. Cast Volume 1 segment = LxWxH
= 5 x 3.5 x 0.18
= 3.15 m3.
g .Volume Lean Wet Concrete = LxWxH
= 5 x 3.5 x 0.1
= 1.75 m3
h. The number of segments required = (road length / segment length) x 2
= (1000/5) x 2
= 400 segments

B. calculation of rigid pavement overlay HSP analyst

a. Wet = 10 year design life.
b. HSP Wet Lean Concrete = Rp. 827,947.67
c. HSP casting plate = Rp. 2,443,085.01
d. Biaya Lean Concrete = volume x unit price
= 1.75, x Rp. 827,947.67
= Rp. 1,448,908.42
e. Slab casting costs street = volume x unit price
= 3.15 x Rp. 2,443,085.01
= Rp. 7.695.717.78

C. Total cost of road repairs per segment

a. Cost Lean Wet Concrete = Rp. 1,448,908.42
b. Cost casting plate = Rp. 7,695,717.78 + amount
= Rp. 9,114,626.20

So the total cost required to repair roads using additional layers of rigid pavement is Rp. 9,114,626.20 / segments

4. Conclussion

After analysis and discussion, it can be concluded:

1. Based on the results of Simultaneous Effect Hypothesis that the Sig. (0,000) <α (0.05) and f count (35.671)> F table (3.89) H0 is rejected. It can be concluded that the simultaneous effect of the Light Vehicle Damage to Roads of 33.8%, the simultaneous effect of the Heavy Vehicle Road Damage amounted to 47.7%, Motorcycles simultaneous effect against 12.1% Damage Roads and Motor Vehicles no simultaneous effect against Road damage by 14.2% ..
2. Based on analysis of the design used road repair method with a design life of 10 years, namely: Rigid Pavement Overlay (Rigid Pavement) as thick as 18 cm.
3. Based on analysis of the cost calculation of the fees obtained by the third method of repair is equal to: the cost of Rigid Pavement Overlay (Rigid Pavement) Rp. 9,114,626.20 / segments.

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