

Analysis of the Level of Road Damage Due to Vehicle Volume on Rigid Perkerasa on the Pantura Tegal - Pemalang Road in Tegal Regency

Wahidin

Faculty of Engineering, Universitas Muhadi Setiabudi (UMUS) Brebes, Indonesia
Email: wahidinnaures@gmail.com

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ABSTRACT

Traffic volume is one of the factors causing road damage. Rigid pavement is generally used on roads that have fairly heavy traffic. With the increasing number of vehicles it is possible that the road will suffer damage in a relatively short time. The purpose of this study was to determine the effect of the volume of vehicle types with the level of road damage and the relationship of the volume of vehicle types with the level of road damage on rigid pavement. So it can be predicted in advance the value of road damage that will occur. The method used in this research is the method of analyzing vehicle volume and the level of road damage using the regression method. Namely to get the function of the relationship with the value of R^2 (coefficient of determination) which shows the magnitude of the effect of changes in the variation of the volume of vehicle types to changes in the value of road damage. This research was conducted in the Pantura Tegal - Pemalang Lane section. There is a relationship between the volume of vehicle types and the value of road damage. With the result $R^2 = 0,892$ show k of damage roads that influenced the volume type of light vehicles and heavy vehicles have a percentage of 89.2%. With the results of the heavy vehicle equation (X_2) and the value of road damage (Y) that is $Y = 0,27 X_2 + 8,887$. From this equation can be described as follows. Regression coefficient X_2 (a) = 0,27, meaning that heavy vehicles by 100 vehicles / day will increase the level of road damage by 27, constant (c) = If no vehicles pass a road, the road will suffer a road damage of 8,887.

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1. INTRODUCTION

Tegal Regency is a regency located in the northwestern part of Central Java Province. Tegal Regency has a strategic location on the road Semarang - Tegal - Cirebon, and Semarang - Tegal - Purwokerto and Cilacap. With this strategic location, Tegal Regency is crossed by the Pantura Main Line, and also has a main crossing from the north coast to the north coast. That makes Tegal Regency have started to develop in a number of industries and economies. With this development, the flow of vehicles, especially vehicles that have a large tonnage, will also increase. This causes many roads to be damaged because they exceed the load capacity of the previously constructed plan. The road network is also a land transportation infrastructure that plays a very important role in the transportation sector for the distribution of goods and services, so a good road pavement design is a must.

With the population increasing every year and the increasing number of vehicles, the need for road -

transportation facilities is very large. Therefore, optimal road construction planning and technical requirements are needed. according to function, volume and nature of traffic so that the construction can be of maximum use for the development of the surrounding area. Road construction planning without adequate road maintenance, both routine and periodic, will be able to cause substantial damage to the road, so that the road will lose its function faster. Road damage that occurs in various regions today is a very complex problem and the losses suffered are really big, especially for road users, such as the occurrence of long travel times, congestion, traffic accidents, and others. These individual losses will be the accumulation of global economic losses for the area.

Basically the road will experience a decrease in its structural function in accordance with increasing age. Roads are currently experiencing damage in a relatively very short time (early damage) both newly built roads and newly restored roads (overlay).

Cement concrete road or rigid pavement consists of slabs and concrete foundation layers. Pavement is generally used on roads that have fairly heavy traffic, with the increasing number of vehicles it is possible that the road will suffer damage in a relatively short time. But if the rigid pavement is maintained properly and remains in good condition then the cement concrete road will have a longer life. But once this cement concrete road is damaged, the damage will take place very quickly. Therefore it is very important to carry out preventative maintenance. Assuming the background above, I took the title of this thesis writing, "Analysis of the Level of Road Damage Due to the Volume of the Vehicle on Rigid Pavement in the Tegal - Pemalang Pantura Line".

2. METHOD

Metode de research is the work demands that they meet the objectives of research studies that have been determined. Another understanding of methodology is a process, principles, procedures in approaching problems and efforts to find answers. Methodology can also be interpreted as a systematic study in a qualitative or quantitative manner with various methods and techniques. This method can be in the form of scientific analysis, namely qualitative descriptive analysis and quantitative analysis.

According to Sugiyono (2010) explains that research methods are scientific ways to obtain valid data, with the aim to be found, developed and proven, a certain knowledge so that in turn it can be used to understand, solve, and anticipate problems. The research method is basically a scientific way to collect data with specific purposes and uses. The scientific way means that research activities are based on scientific characteristics, namely rational, empirical and systematic.

1. Data source

a. Primary data

Traffic Volume Data. This data is taken only during peak hours, based on vehicle volume data from the Tegal city transportation office. Because the initial traffic volume data is obtained through secondary data (MKJI: 1997).

b. Road Damage Data

This data is taken by measuring and calculating the level of damage to the road under study.

2. Secondary Data

a. Road Inventory Data

This data was obtained from the Tegal Regency Bina Marga Office. Data needed includes the length and width of the road, the number of sections, the median, the number of lane roads and completeness.

b. Traffic Volume Data

Traffic volume data was obtained from the Tegal Regency Transportation Office. This data includes data on the volume of vehicles passing the road per hour. This data is not used for research analysis but rather is used as a reference for primary data collection that is carried out in peak hours (MKJI: 1997).

3. Analysis Method

The analytical method used is:

- a. Method of analysis of vehicle volume and value of Damage in general.
- b. Regression analysis method to get the relationship pattern of vehicle volume with the level of road damage

3. RESULTS AND DISCUSSION

1. Volume ago Linta

Each type of vehicle has different characteristics because of the dimensions, speed, acceleration and maneuverability of each type of vehicle. To find the impact of the required space requirements it is usually stated in passenger car units (smp), while to look for damage to the pavement structure it is usually stated with the Vehicle Damaging Factor (VDF) which is usually calculated by:

$$\text{(Single axis)} = \frac{(\text{Load of a single axis in Kg})^4}{8160}$$

$$\text{(Single axis)} = 0.086 \frac{(\text{Load of a single axis in Kg})^4}{8160}$$

And the magnitude of emp vehicles is in accordance with MKJI (1997) for roads outside the city in flat alignment type. In the traffic survey using vehicles / hours in accordance with the types of vehicles that have been classified as heavy vehicles (trucks, large buses), light vehicles (cars, pick ups, small buses, small trucks), motorcycles and vehicles not motorized. Vehicle volume data on each section can be seen in table 1 below.

Table 1. Volume of Vehicle Type (vehicle /day)

No	Name Street	Pathway	Vehicle	Vehicle	Bike	Vehicle
			Light (kend / day)	Weight (kend / day)	Motorcycle (kend / day)	No Motorized (kend / day)
1	Highway Dampyak	Direction West East	2916	339	13261	29
		Direction East West	3168	442	11067	38
2	Highway Suradadi	Direction West East	4016	456	10379	31
		Direction East West	1663	314	12912	27
3	Highway Kramat	Direction West East	4183	281	12824	12
		Direction East West	2737	214	7079	9

From this data the traffic volume for each road segment is different for each type of vehicle

2. Road damage value

Damage that occurred in each of the roads studied was different - different. Of the various types of damage to the road can be found the value of the damage. Damage value

(Nr). is obtained from the total amount and damage value per each type of damage

(Nq). The assessment of surface conditions first looks for the value of the percentage of damage

(Np). To find the Np value by:

$$Np = \frac{\text{Number of Road Damage Segments}}{\text{Number of Roads}} \times 100\%$$

Table 2. Percentage values of road damage

Percentage	Category	Value
<5%	So little	2
5% - 20%	a little	3
20% - 40%	Is	5
> 40%	Many	7

After Np is obtained to find the damage value (Nq), it remains to be multiplied by the value of the amount of damage (Nj). For the Nj value itself, there is a choice of values based on the type of damage available, the following values are:

Table 3. Value of type of damage

Type of Damage	Value
Asphalt concrete	2
Penetration	3
Patch	4
Cracked	5
Free	5.5
Hole	6
Plot	6
Wave	6.6
Disappear	7
Hemisphere	7

If the value of Np and the value of Nj have been multiplied, then the value can be used to find the value of the amount of road damage (Nq). The method can be classified in the

following table.

Table 4. Percentage values for total road damage

No.	Type of Damage	Percentage of Value Outside the Damage Area			
		≤ 5%	5% - 20%	21% - 40%	≥ 40%
		So little	a little	Is	Many
1	Asphalt concrete	4			
2	Penetration	6			
3	Patch	8	12	20	28
4	Cracked	10	15	25	35
5	Free	11	16.5	27.5	38.5
6	Hole	12	18	30	42
7	Plot	12	18	30	42
8	Wave	13	19.5	32.5	45.5
9	Disappear	17	21	35	49
10	Be land	14	21	35	49

The value of the amount of damage has been obtained so all that remains is added to each type of damage and can be obtained from the damage value (Nr). Because the formula for finding the value of Nr itself is the total number of Nq.

3. Relationship of Light Vehicle Volume, Heavy Vehicle, Motorcycle, Non Motorized Vehicle and Damage Value

The research result kendaraan volume n and the value of the damage was analyzed by non-linear regression. The variables used are the types of vehicles that are grouped into light vehicles as variable X1, heavy vehicles as variable X2, motorcycles as variable X3, non-motorized vehicles as variable X4 and value of road damage as variable Y. Analysis was performed using the SPSS application. Recapitulation of X1, X2, X3, X4 and Y can be seen in the following table.

Table 4.17 Recapitulation of variables Z1, X2, X3, X4, and Y

NO	Street Name	Pathway	Value Damage Road (Nr) (Y)	Vehicle Light (kend / day) (X1)	Vehicle Weight (kend / day) (X2)	Bike Motorcycle (kend / day) (X3)	Vehicle No motorized (kend / day) (X4)
1	Highway	West East	55	2916	339	13261	29
	Dampyak	East West	55	3168	442	11067	38
2	Highway	West East	69	4016	456	10379	31
	Suradadi	East West	41	1663	314	12912	27
3	Highway	West East	33	4183	281	12824	12
	Kramat	East West	33	2737	214	7079	9

From the results of the analysis show the type of vehicle is quite influential on road damage. R2 is indicated by the results of determination coefficient of 89 , 2 %. This indicates that the type of vehicle and affect the level of damage to roads amounted to 89 , 2 %.

Regression analysis was carried out to get the results of the heavy vehicle equation (X2) and the value of road damage (Y), namely $Y = 0,27 X2 + 8,887$. From this equation can be described as follows. Regression coefficient X2 (a) = 0,27, meaning that a heavy vehicle of 100 vehicles / day will increase the level of road damage by 27, constant (c) = If no vehicle crosses a road, the road will experience road damage of 8,887.

4. CONCLUSION

There is a relationship between the volume of vehicle types and the value of road damage. With the results $R^2 = 0,892$ with the results of the equation of heavy vehicles (X2) and the value of road damage (Y) is $Y = 0,27 X2 + 8,887$. From this equation can be described as follows.

Coefficient X2 (a) = 0,27, meaning that a heavy vehicle of 100 vehicles / day will increase the level of road damage by 27, constant (c) = If no vehicle crosses a road, the road will experience road damage of 8,887. The pattern of the relationship is a k of damage path that influenced the volume type of light vehicles and heavy vehicles have a percentage of 89,2 %.

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