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ANALYSIS OF THE EFFECTS OF OVERLOADING ON THE AGE OF THE TOLL ROAD CASE STUDY TANGERANG-MERAK KM 72 S/D KM 77

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ABSTRACT

Economic growth that occurred in Indonesia requires adequate infrastructure. The large number of infrastructure which found in Indonesia is not accompanied by the compliance level of infrastructure users, the number of violations that occur causes a decrease in the life of a road. Overloading does not only causes road damage but also impacts on the lack of road safety. Therefore, research and analysis are carried out to find out how much influence is given by the overload on a road, in this case the age of the plan. The method which used to find out how big the impact of a normal charge is with remaining life, which is to compare the age of a normal load plan with overload. By this method it is necessary to know the Vehicle Damage Factor (VDF) which will later be used to find the cumulative ESAL of each vehicle condition, then with the cumulative ESAL that occurs can know the remaining life of a road. From the conducted analysis result, it was found that each vehicles had an increase in vehicle damage factor (VDF), as well as the cumulative ESAL that was previously planned to receive cumulative ESAL in the amount of 20.602.172 with the cumulative overloading of ESAL received to 284.426.068, due to the charge causing a decrease in remaining life is 4 years 9 months or decreased by 24%.

Keywords : *Overload, ESAL, Remaining Life*

INTRODUCTION

Indonesia as one of the countries with the highest economic growth. The Central Statistics Agency said Indonesia's economic growth was at 5.07%, with the amount of economic growth having to be supported by adequate infrastructure, one of the important infrastructures was roads.

Roads are a very important infrastructure for mobilizing in land transportation, roads are also one of the driving forces of the economy and also as an infrastructure of community activities in various development sectors of the economic, social, political, cultural and security sectors. In addition, the road also provides a good solution for the smooth flow of traffic which has an impact on the smooth delivery of one region to another.

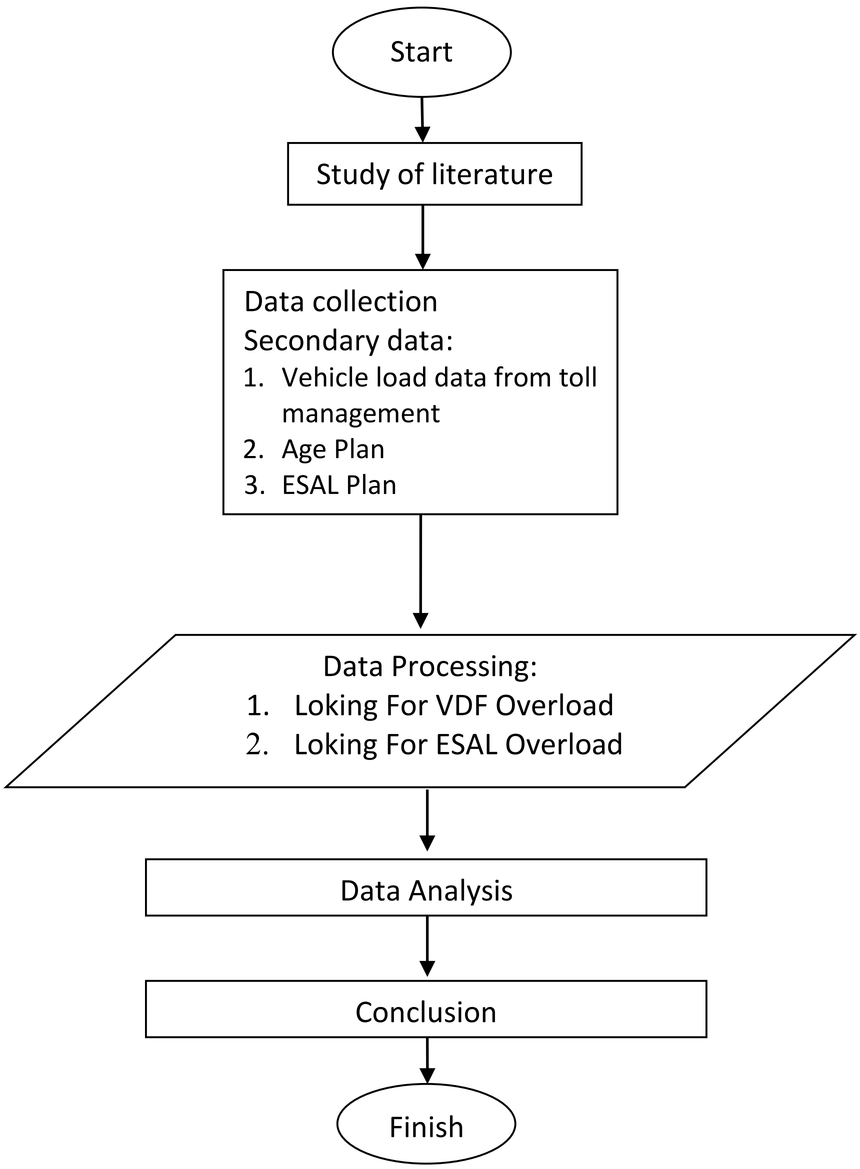
Large-scale road construction by the government is not followed by compliance with logistical transport providers, many logistical transport service providers carry loads exceeding the load limits set by the government. Director General of Land Transportation of the Ministry of Transportation (Kemenhub), Budi Setiyadi, said the number of violators reached 81.07%. The figure was recorded during the 14-day supervision period of July 8-22 2019 in 21 Implementing Vehicle Weighing Unit (UPPKB) or weighbridge.

PT. Jasa Marga TBK said that it suffered a loss of around 1.5 trillion Rupiah as a result of vehicles carrying overloads and over-dimensions. These losses include road repair costs, consisting of 40% routine repairs and 60% road reconstruction. Other effects of overloading include reduced levels of driving safety, congestion and faster damage to vehicle parts. Basically the road will experience a decrease in structural quality in accordance with the increase in the life of the road, especially if it is passed by vehicles exceeding the provisions, with the number of vehicles overloading very influential in reducing the age of pavement services (Ojha, 2018).

Likewise, the Tangerang-Merak Toll Road, which is the only toll road that connects the Jabodetabek area with the Merak Port, is inseparable from the violation of the vehicle's cargo. Therefore PT. Marga Mandala Sakti as the manager of the Tangerang-Merak Toll Road placed Weight In Motion (WIM) tools on some of their toll gates, the function of Weight In Motion (WIM) is to measure the load of vehicles that will enter the Tangerang-Merak Toll Road section. Road pavement damage that occurs is a combination of several interrelated factors. By considering the current conditions, the author wants to conduct research under the title "ANALYSIS OF THE EFFECTS OF OVERLOADING ON THE AGE OF THE TOLL ROAD CASE STUDY TANGERANG-MERAK KM 72 S/D KM 77"

RESEARCH METHODOLOGY

The method of data analysis in this study refers to the AASHTO Method by calculating the reduction in the percentage of age in each year so that a comparison between plans and actual conditions is found.



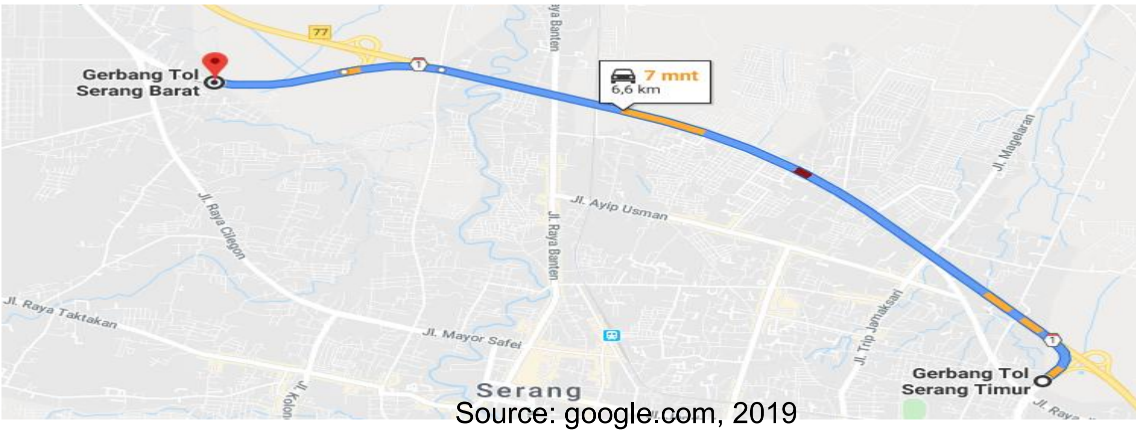
The order of analysis as follows:

1. Single Axle Load
   At this stage the primary data in the form of traffic data is converted to an equivalent number using the standard source load equation.
2. Vehicle Damage Factor
   At this stage, single axle load become vehicle damage factor by adding up all the single axle load numbers of each vehicle.
3. Equivalent Single Axle Load
   Then the number of vehicle damage factor is entered ESAL equation, so that it can be ESAL for the year.
4. Look for Influence *Overload*
   At this stage, the ESAL obtained is compared with the ESAL of the planned load, so that the effect of the overload on the life of the plan is found.
5. Conclusion
   At this stage the authors provide conclusions from the results of the analysis carried out so that conclusions are found, then the authors also provide the necessary advice.

Research Site

The research site reviewed was the Tangerang toll road section to Merak. Precisely on the Section of the Road between the West Serang Toll Gate to the East Serang Toll Gate.

Figure 1. Research Site



Source: google.com, 2019

At this toll gate, the Weight In Motoin (WIM) engine was located, which used as a tool to measure the vehicle load that will be used to search for ESALs from every vehicle that passes.

RESULTS AND DISCUSSIONS

Data

Supporting data in this final project is the Average Daily Cross (LHR) data and the Load data of each vehicle taken from the Weight In Motion (WIM) equipment located at the Serang Barat Toll Gate.

Average Daily Trafic

The results of the average daily traffic of Serang Timur to Serang Barat toll gates, can be seen in the table below:

Table 1. Average Daily Trafic of Serang Barat and Serang Timur toll gates

Class of Vehicle	Years		
	2017	2018	2019
Gol 1	29,273	29,830	29,956
Gol 2	7,348	7,569	6,760
Gol 3	5,723	5,845	5,425
Gol 4	1,188	1,287	1,136
Gol 5	1,235	1,400	1,221

source : PT. Marga Mandala Sakti, 2019

Load Vehicle

For vehicle overloaded data, it can be seen in the table below:

Table 2. The number of vehicle overload and vehicle load

Configuration	Overload Vehicle	Vehicle Load (ton)
1-1	2890	4,25
1-2	641	24,2
1-2.2	1362	32,72
1.2-2.2	935	36
1.2.2-2.2	836	54,5
1-2.2-2.2.2	952	53.6

source : PT. Marga Mandala Sakti, 2019

Vehicle Damage Factor (VDF)

Vehicle Damage Factor can be seen in the tables below:

Table 3. VDF Normal Load Vehicle

Configuration	Load	VDF
1-1	2	0.0004511
1-2	18,3	0.70300735
1-2.2	25	2.74157251
1.2-2.2	31,4	3.90832713
1.2.2-2.2	40	4.13321645
1.2.2-2.2.2	46	4.51761419

Source: Data in research, 2020

Table 4. VDF Overload Vehicle

Configuration	Load	VDF
1-1	4,25	0,0092
1-2	24,2	2,1499
1-2.2	32,72	8,0444
1.2-2.2	36	6,7528
1.2.2-2.2	54,5	11,7252
1.2.2-2.2.2	53,6	8,3279

Source: Data in research, 2020

Cumulative ESAL

The cumulative ESAL is sought by adding up the ESALs received by a road every year so that it will be known that ESALs are received by a road in the planned time unit.

a. Cumulative Normal Load

For Cumulative Normal Load, it can be seen in the tables below:

Table 5. Cumulative ESAL Normal Load

Year Line	Year	ESAL	Cumulative ESAL
0	2019	0	0
1	2020	8.229.766	8.229.766
2	2021	8.388.355	16.618.121
3	2022	8.552.415	25.170.536
4	2023	8.722.223	33.892.759
5	2024	8.898.072	42.790.831
6	2025	9.080.274	51.871.105
7	2026	9.269.157	61.140.262
8	2027	9.465.069	70.605.331
9	2028	9.668.378	80.273.709
10	2029	9.879.476	90.153.185
11	2030	10.098.776	100.251.961
12	2031	10.326.717	110.578.678
13	2032	10.563.763	121.142.441
14	2033	10.810.407	131.952.848
15	2034	11.067.170	143.020.018
16	2035	11.334.607	154.354.625
17	2036	11.613.303	165.967.928
18	2037	11.903.881	177.871.809
19	2038	12.207.001	190.078.810
20	2039	12.523.362	202.602.172

Source: Data in research, 2020

b. Cumulative Overload

Cumulative Overload can be seen in the table below:

Table 6. Cumulative ESAL Overload

Year Line	Year	ESAL	Cumulative ESAL
0	2019	0	0
1	2020	11.165.330	11.165.330
2	2021	11.415.050	22.580.380
3	2022	11.674.245	34.254.625
4	2023	11.943.405	46.198.030
5	2024	12.223.043	58.421.073
6	2025	12.513.705	70.934.778
7	2026	12.815.965	83.750.743
8	2027	13.130.435	96.881.178
9	2028	13.457.760	110.338.938
10	2029	13.798.621	124.137.559
11	2030	14.153.746	138.291.305
12	2031	14.523.896	152.815.201
13	2032	14.909.881	167.725.082
14	2033	15.312.565	183.037.647
15	2034	15.732.855	198.770.502
16	2035	16.171.712	214.942.214
17	2036	16.630.162	231.572.376
18	2037	17.109.282	248.681.658
19	2038	17.610.219	266.291.877
20	2039	18.134.191	284.426.068

Source: Data in research, 2020

Remaining Life

a. Remaining Life Normal Load

The results of the cumulative ESAL that have been obtained then will be changed in the form of a percentage that shows a reduction in the remaining life of the road, for a decrease in the percentage of planned life can be seen in the table below:

Tabel 7. Remaining Life Normal Load

Year Line	Year	ESAL	Cumulative ESAL	Remaining Life (%)
0	2019	0	0	100
1	2020	8.229.766	8.229.766	95,938
2	2021	8.388.355	16.618.121	91,798
3	2022	8.552.415	25.170.536	87,576
4	2023	8.722.223	33.892.759	83,271
5	2024	8.898.072	42.790.831	78,879
6	2025	9.080.274	51.871.105	74,398
7	2026	9.269.157	61.140.262	69,823
8	2027	9.465.069	70.605.331	65,151
9	2028	9.668.378	80.273.709	60,379
10	2029	9.879.476	90.153.185	55,502
11	2030	10.098.776	100.251.961	50,518
12	2031	10.326.717	110.578.678	45,421
13	2032	10.563.763	121.142.441	40,207

Year Line	Year	ESAL	Cumulative ESAL	Remaining Life (%)
14	2033	10.810.407	131.952.848	34,871
15	2034	11.067.170	143.020.018	29,408
16	2035	11.334.607	154.354.625	23,814
17	2036	11.613.303	165.967.928	18,082
18	2037	11.903.881	177.871.809	12,206
19	2038	12.207.001	190.078.810	6,181
20	2039	12.523.362	202.602.172	0,000

Source: Data in research, 2020

a. Remaining Life Overload

For the reduction in planned life, in this analysis the overload is used and compared with the remaining normal plan life, that it will be known how much influence of the overload on the Tangerang-Merak Toll Road. For the table of age reduction plans with overloading can be seen in the table below:

Tabel 3.7 Remaining Life Normal Load and Overload

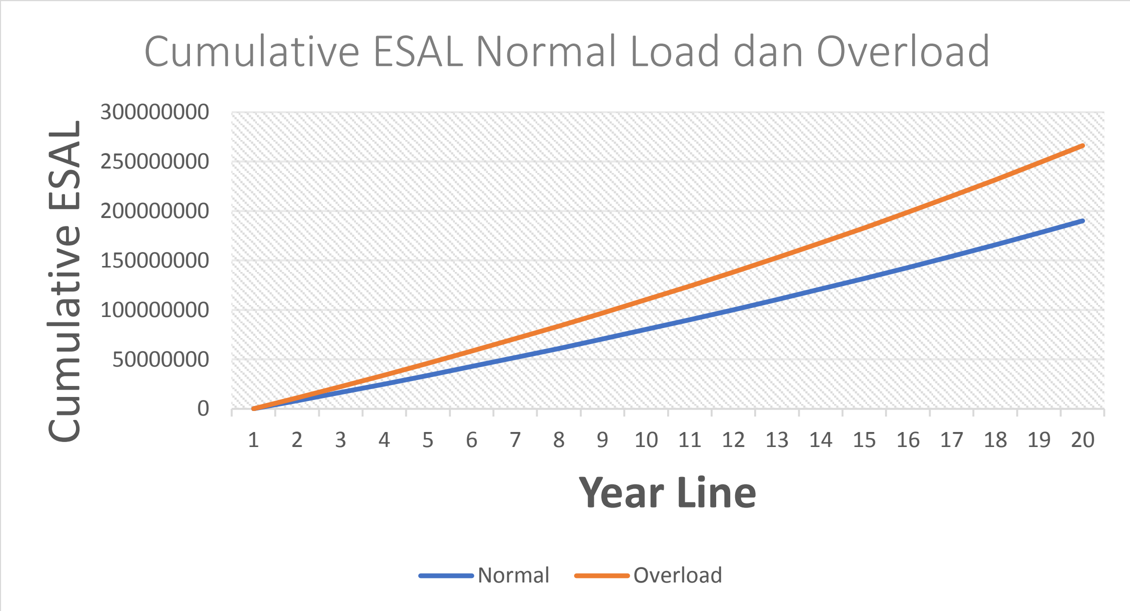
Year Line	Year	ESAL Overload	Cumulative ESAL Overload	Cumulative ESAL Normal Load	Remaining LIfe (%)
0	2019	0	0	0	100
1	2020	11.165.330	11.165.330	8.229.766	94,49
2	2021	11.415.050	22.580.380	16.618.121	88,85
3	2022	11.674.245	34.254.625	25.170.536	83,09
4	2023	11.943.405	46.198.030	33.892.759	77,20
5	2024	12.223.043	58.421.073	42.790.831	71,16
6	2025	12.513.705	70.934.778	51.871.105	64,99
7	2026	12.815.965	83.750.743	61.140.262	58,66
8	2027	13.130.435	96.881.178	70.605.331	52,18
9	2028	13.457.760	110.338.938	80.273.709	45,54
10	2029	13.798.621	124.137.559	90.153.185	38,73
11	2030	14.153.746	138.291.305	100.251.961	31,74
12	2031	14.523.896	152.815.201	110.578.678	24,57
13	2032	14.909.881	167.725.082	121.142.441	17,21
14	2033	15.312.565	183.037.647	131.952.848	9,66
15	2034	15.732.855	198.770.502	143.020.018	1,89
16	2035	16.171.712	214.942.214	154.354.625	-6,09
17	2036	16.630.162	231.572.376	165.967.928	-14,299
18	2037	17.109.282	248.681.658	177.871.809	-22,74
19	2038	17.610.219	266.291.877	190.078.810	-31,435
20	2039	18.134.191	284.426.068	202.602.172	-40,38

Source: Data in research, 2020

Comparison of Remaining Life

After knowing the decrease in the plan, both normal and overload, we can find out the difference between overload and not, we can present it in graphical form, the graph will show the difference. Firstly we look how much the increase that occurs each year, to find a graph of ESAL increase in both normal and overloads, can be seen in the graph below:

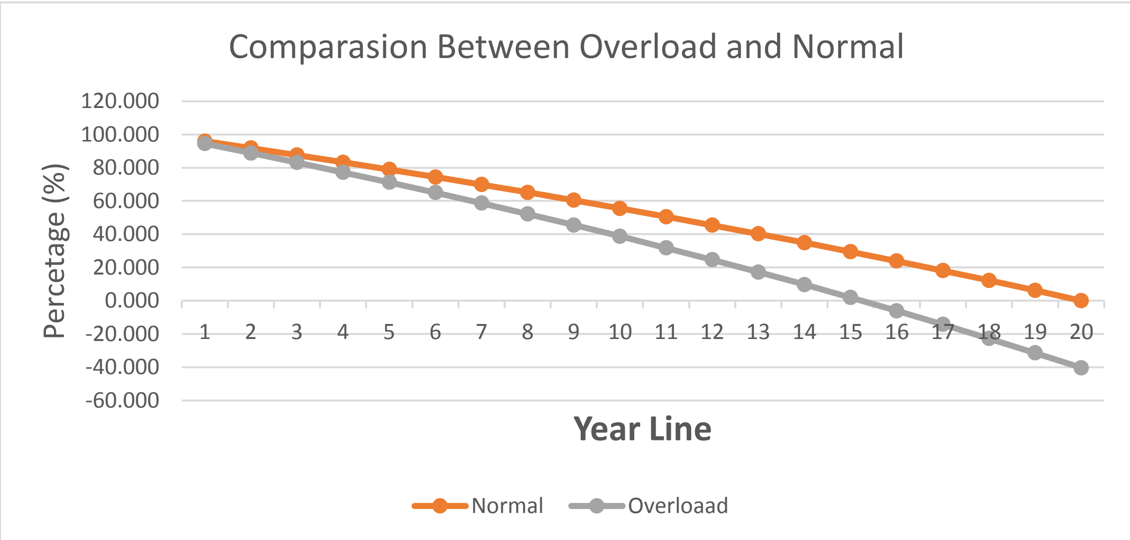
Figure 2. ESAL Cumulative Graph of Normal and Overload



Source: Data in research, 2020

To find out how far the decline in plan life, we can use a decrease graph, so we can know the difference and how far the changes that occur are caused by overloading, to find out can be seen in the graph below:

Figure 3. Comparison Graph Between Overload and Normal



Source: Data in research, 2020

CONCLUSION

Based on the result of calculations and the analysis that have been described about the effect of overload on the age of the plan, it can be concluded as follows:

a. From the analysis results of Vehicle Equivalent Numbers with overloading per configuration found an increase, namely for configurations 1-1 to 0.0092, configurations 1-2 to 2.1499, configurations 1-2.2 to 8.0444, configurations 1.2-2.2 to 6.7528 , configuration 1.2.2-2.2 becomes 11.7252, configuration 1.2.2-2.2.2 becomes 8,3279.

b. Based on the cumulative ESAL that was originally planned to receive a cumulative ESAL value of 202.602,172 in the 20th year, with the existence of overloaded vehicles the value can be achieved in the 15th year of the road life, the planned age has decreased the design life of the plan by 4 years 9 months that is, if it is used as a percentage, the overload that occurs on the Tangerang-Merak Toll Road KM 72 to KM 77 has decreased by 24%.

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