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Evaluation Of Permanent Deformation On Uphill And Downhill Section Of Simpang Ampek - Sasak Road In Pasaman Barat

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Abstract

Roads are a transportation facility that is used by most people. If the road is damaged, it will disturb road users and make them feel uncomfortable when driving. This research method uses the Bina Marga method which determines the average daily traffic and axle load of vehicles that affect road damage on the uphill and downhill sections of the Simpang Ampeik-Sasak road section, West Pasaman Regency, comparing the average daily traffic figures with the determination of the figures according to the class and function of the road. Based on the calculation of the average daily traffic on the uphill and downhill sections, the values exceed the average daily traffic determination in passenger car units, which are worth 2,127 LHR in SMP on the uphill and 2,102 LHR in SMP on the downhill. Regarding the axle load obtained on the road section, vehicles are classified as 6a and 6b, indicating that the road exceeds the truck factor figure, namely 3,583 where the magnitude is 1. The Simpang Ampeik - Sasak road section in West Pasaman Regency experienced an overload, where the type of damage on the ascent and descent is corrugated.

Keywords*: Deformation of ascent and descent, Average Daily Traffic, vehicle axle load*

1. INTRODUCTION

Indonesia, as a country in a state of development, relies heavily on land transportation, making roads a critical factor in infrastructure maintenance. However, road damage often occurs earlier than the intended service period due to various factors, including human and natural influences. Natural factors affecting road quality include

water, temperature fluctuations, weather, and air temperature. Meanwhile, human factors involve excessive heavy vehicle loads and high traffic volume.

The road surface layer deteriorates over time, leading to reduced service levels. This decline is marked by various types of damage, such as potholes, cracks, and fractures, which worsen if left unaddressed. Such damage causes discomfort for drivers and compromises safety. Road design prioritizes the surface layer (asphalt), which must meet roughness standards to ensure safe vehicle handling, especially during turns, sudden stops, or when navigating uphill and downhill sections to prevent accidents.

Road damage stems from excessive traffic loads, temperature extremes, water exposure, and subpar construction materials. Temperature fluctuations directly impact asphalt softness—higher temperatures make it softer, while lower temperatures increase hardness. The Simpang Ampek–Sasak road (Km 278+000–279+500) in West Pasaman Regency, West Sumatra Province, is classified as a provincial road under maintenance authority. This two-lane, two-way road without a median serves diverse vehicle types. Given its heavy usage, this study examines Peirmanein deformation on the uphill and downhill sections of this road segment.

2. METHOD

General Overview

A method is a procedure used in research to solve a problem by studying, collecting, and analyzing the obtained information. In a case study, a method is needed to examine literature and gather the required data. Generally, the data needed in research are primary data and secondary data.

Research Location

This research is located on Simpang Ampeik - Sasak Street in West Pasaman Regency, which is part of the provincial road network in West Sumatra Province. This location was selected as the direct observation area to obtain primary data in the form of average daily traffic data (LHR). The research is limited to a specific road segment, spanning from Km 278+000 to Km 279+500.

Data Collection

In this research, the author uses two types of data collection methods: primary data obtained through direct field observation and secondary data obtained from government agency archives and literature studies related to the research.

Primary Data

The primary data in this research consists of vehicle traffic data (LHR) passing through the Simpang Ampeik – Sasak road in both directions. Data collection was conducted through field observations, covering light and heavy vehicles over 12 hours per day for 7 consecutive days. The observation period for LHR data was set from 06.00 WIB to 18.00 WIB. After data collection, the average daily traffic volume was calculated.

Secondary Data

In this study, secondary data was obtained from literature reviews and related agencies. This includes average daily traffic data for vehicles and vehicle axles passing through the Simpang Ampeik – Sasak road, available from the Bina Marga Service Data, as well as local logistics loading and unloading summary data. This secondary data serves as a reference for primary data collection during observations.

Survey Equipment

The following tools were used to support the research and observation process: a form for recording vehicles passing during observations, writing instruments for noting results, a camera to document the process, and a form adhering to the Bina Marga format.

Survey Implementation Stages

To analyze the problems and complete this research, the researchers required specific data, which was obtained directly through field surveys.

Research Implementation Stage

The research implementation stage involves studying, understanding, analyzing, and solving problems based on collected data and observed phenomena. It is a systematic and lengthy series of interconnected processes.

Data Analysis

The data analysis includes calculating the LHR at the survey location based on vehicle type using the highway configuration, determining the total vehicle weight using the highway method, computing the Equivalent Standard Axle Load (Eisal) value with the highway method, and deriving the truck factor value to assess whether the road is experiencing overloading.

3. RESULTS AND DISCUSSION

Analysis of Bus and Hiace Minibus Passenger Characteristics

The Simpang Ampeik - Sasak road section in West Pasaman Regency is classified according to its handling characteristics. This road section spans 20 km with a width of 5.10 meters per lane, though the study focuses on the segment from Km 278+000 to Km 279+500. The Simpang Ampeik – Sasak road serves as a Collector Road, classified as a Class III B road with a maximum vehicle load capacity of 8 tons. It plays a critical role in transportation, connecting urban centers and tourist attractions. The route accommodates various vehicles, including motorcycles, 2-axle trucks (both medium and light), and school buses.

Average Daily Traffic (ADT) Vehicles in 2023

The traffic volume on the Simpang Ampeik – Sasak road section in West Pasaman Regency for 2023 is detailed in Table 1.

Table 1. Vehicle Traffic Volume

Direction of Vehicle			
Day/Vehicle	**Ampeik - Sasak Intersection (Ascent)**	**Sasak - Ampeik Intersection (Descent)**	**Total**
Monday	3296	3352	6648
Tuesday	3343	3274	6617
Wednesday	3500	3335	6835
Thursday	3170	3334	6504
Friday	3048	3347	6395
Saturday	3689	3210	6899
Sunday	3851	3767	7618

Source: Survey Results

The traffic survey data, collected from a single two-way lane without a median, is further categorized into uphill and downhill directions as in Table 2 and Table 3 below:

Table 2. Average Daily Traffic Survey Data (Uphill)

Daily Vehicle Volume Data				
Time	**MC**	**LV**	**HV**	**Total**
Monday	2498	709	89	3296
Tuesday	2556	708	79	3343
Wednesday	2649	759	92	3500
Thursday	2406	670	94	3170
Friday	2332	643	73	3048
Saturday	2869	710	110	3689
Sunday	3086	675	90	3851
Total Number				**23897**

Source: Survey Results

Table 3. Average Daily Traffic Analysis Data (Uphill)

Vehicle Volume Data Smp/Day				
Time	**MC**	**LV**	**HV**	**Total**
Monday	2498	709	89	3296
Tuesday	2556	708	79	3343
Wednesday	2649	759	92	3500
Thursday	2406	670	94	3170
Friday	2332	643	73	3048
Saturday	2869	710	110	3689
Sunday	3086	675	90	3851
Total Number				**14887.1**
ADT in Junior High School				**2126.72**

Source: Analysis Results

Based on Table 3 the total traffic volume in the uphill direction over one week was 14,887.1 vehicles, averaging 2,126.72 LHR in SMP. The highest traffic occurred on Sunday with 2,335 SMP/day, while the lowest was on Friday with 1,903.9 SMP/day. The downhill traffic analysis is presented in Table 4 and Table 5 below:

Table 4. Vehicle Survey Data (Downhill, One Week)

Daily Vehicle Volume Data				
Time	**MC**	**LV**	**HV**	**Total**
Monday	2614	649	89	3352
Tuesday	2511	668	95	3274
Wednesday	2526	714	95	3335
Thursday	2577	666	91	3334
Friday	2586	665	96	3347
Saturday	2421	686	103	3210
Sunday	2959	730	78	3767
Total Number				**23619**

Source: Survey Results

Table 5. Average Daily Traffic Analysis Data (Downhill)

Vehicle Volume Data Smp/Day				
Time	**MC**	**LV**	**HV**	**Total**
Monday	1307	649	115.7	2071.7
Tuesday	1255.5	668	123.5	2047
Wednesday	1263	714	123.5	2100.5
Thursday	1288.5	666	118.3	2072.8
Friday	1293	665	124.8	2082.8
Saturday	1210.5	686	133.9	2030.4
Sunday	1479.5	730	101.4	2310.9
Total Number				**14716.1**
ADT in Junior High School				**2102.3**

Source: Analysis Results

Table 5. shows a total weekly traffic volume of 14,716 vehicles in the downhill direction, averaging 2,102 LHR in SMP. Sunday recorded the highest volume at 2,310 SMP/day, while Saturday had the lowest at 2,030 SMP/day. The uphill direction peaked on Sunday (2,335 SMP/day) and dipped on Friday (1,903 SMP/day).

The calculated LHR exceeds the permissible limit for a Class III B Collector Road, which mandates an LHR below 2,000 SMP. The uphill direction recorded 2,126 LHR, and the downhill direction 2,103 LHR, indicating overcapacity. Consequently, the Beirgeilombang-type road damage is attributed to excessive LHR relative to its class and function.

Vehicle Axle Weight

Vehicle axle loads on the Simpang Ampeik – Sasak road were surveyed for various cargo types, including corn, palm oil, and sand. Weighbridge data from logistics offices provided sample measurements, summarized below:

1. Normal Load Vehicle Weight

The analysis focused on Groups 6a and 6b (primarily 2-axle trucks, classified as 6b) due to their impact on road damage. The ESAL value for normal loads was 1,088.10. This baseline was compared against overloaded vehicles to assess damage causation.

2. Excessive Load Vehicle Weight

Axle load analysis incorporated empty vehicle weights (per Bina Marga Regulation No. 1/MN/BM/83) and cargo weights from weighbridge data. Overloaded vehicles had an ESAL value of 1,221.92.

3. Vehicle Traffic Factors

The traffic load's damaging effect was evaluated using the Equivalent Standard Axle Load (ESAL) and Truck Factor (TF). A TF > 1 indicates overload-induced damage. The calculation yielded:

$$TF = Total\ ESAL / N = 1221.92320/341 = 3.583$$

The TF value of 3.583 greater than 1, confirms overloading on the Simpang Ampeik - Sasak road.

Types of Road Damage

The case study identified overloading as the primary cause of road damage on the Simpang Ampeik - Sasak section. Primary data revealed wavy damage (Figure 3.1) covering 3.0 m × 5.4 m, with a 7 m slope length. The total observed road area was 38.5 m² (5.5 m × 7 m).

- Damage area: 3.0 m × 5.4 m = 16.2 m²
- Percentage of damage (Np): 42.08%, categorized as "Large" (Np = 7).
- Damage weight (Nj): 6.6 for wavy damage.
- Total damage (Nr): 7 × 6.6 = 46.2, classified as "Many."

Figure 1. Wavy Damage to Flexible Pavement (Researcher)

4. CONCLUSION

The study found that the Simpang Ampeik - Sasak road section in West Pasaman Regency experiences wavy-type damage due to excessive traffic loads. The average daily traffic (LHR) results showed 14,887 vehicles per day uphill and 14,716 vehicles per day downhill, with SMP values of 2,127 LHR and 2,102 LHR respectively. These figures exceed the road's classification capacity of less than 2,000 LHR in SMP for its class and function as a Collector Road. The traffic factor analysis revealed a normal ESAL value of 1088.10 and an overload ESAL value of 1221.92, indicating a difference of 133.82. From the total of 341 weighted vehicles surveyed, the Truck Factor calculation using the overload ESAL value of 1221.92 yielded a result of 3.583, which significantly exceeds the threshold value of 1. This confirms that both the uphill and downhill sections of the Simpang Ampeik - Sasak road are experiencing overload conditions, with the observed wavy road damage being directly attributable to excessive vehicle loads.

Further research should focus on road damage repair methods to address these issues. To control the level of road damage, enhanced field supervision is recommended to monitor and regulate vehicle loads passing through this section. Immediate attention and repairs are needed for the Simpang Ampeik - Sasak road to ensure safer and more comfortable driving conditions for users, while preventing further deterioration of road smoothness and more severe damage in the future.

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