Civilla: Jurnal Teknik Sipil Universitas Islam Lamongan
Volume 11 Number 1 Year 2026

ISSN (Online) 2620-7222
ISSN (Print) 2503-2399

Available online at
https://jurnalteknik.unisla.ac.id/index.php/CVL

https://doi.org/10.30736/cvl.v2i2

Analysis of the Suitability of Road Signs and Markings for One-Way Traffic on Jalan Kartini, Tegal City

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A R T I C L E I N F O

Article History :
Article entry : 23-07-2025
Article revised : 31-10-2025
Article received : 05-04-2026

Keywords :
Transportation, Road Engineering, One-way traffic, Traffic performance, Road signs, Road markings

IEEE Style in citing this article :
V. W. Aji, R. R. Khairani, F. D. S. Abidin, S. Hadi, and B. P. S. B. R. Ayu, "Analysis of the Suitability of Road Signs and Markings for One-Way Traffic on Jalan Kartini, Tegal City", CVL, vol. 11, no. 1, pp. 23–34, Mar. 2026.

A B S T R A C T

Urban road networks face increasing challenges due to rapid vehicle growth and the complexity of traffic dynamics, especially in medium-sized cities such as Tegal, Indonesia. Jalan Kartini is a vital road segment with high economic and pedestrian activity that often experiences congestion and irregular traffic flow. To address these issues, this study aims to evaluate the traffic performance of Jalan Kartini and to assess the suitability of existing road signs and markings for supporting the implementation of a one-way traffic system on this corridor. A descriptive evaluative method was employed, using field surveys and traffic observations, including traffic volume, vehicle speed, degree of saturation, and road capacity results, as well as the condition of road signs and markings. Results showed that the highest traffic volume is 609 PCU/h, with the score of road capacity is 1288.87 PCU/h and score of degree saturation is 0.37 which is indicating a good service level. The 85th percentile speed was recorded at 49 km/h, which is close to the upper limit of the design speed range for secondary collector roads (30–50 km/h) and exceeds the posted speed limit of 30 km/h on Jalan Kartini. However, significant issues were identified in the physical condition and visibility of traffic signs and road markings, many of which were faded, improperly placed, or did not meet regulatory dimensions. The study concludes that although the traffic performance supports a one-way system, the current infrastructure, including signage and markings must be revitalized to ensure effectiveness and safety. This research contributes to urban traffic management practices by highlighting the critical role of visual infrastructure in supporting directional traffic policy implementation.

1. Introduction

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

Transportation is one of the main elements in supporting community mobility and economic growth of a region. Entering the era of urbanization and rapid growth of motorized vehicles, a well-organized transportation system is a major and important requirement for every city, including Tegal City [1]. Roads as the main component of transportation infrastructure must be equipped with adequate safety facilities, such as signs and road markings to support traffic flow to remain smooth and reduce the potential for accidents [2]. Road signs and markings serve as visual communication instruments between the government and road users, effectively conveying information, warnings, and prohibitions. When properly implemented, this infrastructure can improve driving discipline and road user safety [3].

Jalan Kartini in Tegal City is one of the strategic roads with a large intensity of economic and social activities [4]. This area is known as a culinary center and people's economic center that is active throughout the day. The presence of street vendors (PKL), private vehicles, public transportation, and indiscriminate parking are factors that cause congested and often disorderly roads [5]. A 15% increase in the number of accidents in the last two years on a road section is largely related to the ineffective placement of road signs and markings, as well as user non-compliance [6] These trends indicate that the existing traffic management and safety facilities on Jalan Kartini are not yet effective in controlling vehicle movements and protecting vulnerable road users.

This situation encourages traffic engineering efforts in the form of a policy to implement a one-way traffic system or better known as a one-way system on Jalan Kartini. This change aims to reduce congestion and improve the smooth flow of vehicles in the area. In addition, the risk of accidents due to vehicles going against the direction can be minimized, so that the safety of road users can be maintained. This change in flow also has a direct impact on the accessibility of residents and businesses around the road, which requires more attention in planning and implementation [7]. The implementation of this one-way policy has not fully run optimally because in the field there is still public confusion regarding the direction of travel, placement of signs, and road marking boundaries. The urgency of this evaluation is reinforced by findings showing that signs and markings are not in accordance with technical standards and this is one of the causes of increased accident risk [8].

Although there are several studies that review the importance of complete road safety facilities, in-depth studies of the direct relationship between the presence of signs and markings and the effectiveness of one-way systems, especially in the context of medium-sized cities such as Tegal City, are still limited. Previous studies have focused more on quantitatively evaluating traffic volume or vehicle speed, but have not specifically examined the readiness of visual infrastructure such as signs and markings to support one-way policies. Consequently, there is still a lack of empirical evidence on whether existing visual infrastructure can adequately support the implementation of one-way systems in medium-sized cities such as Tegal [9]. Therefore, it is important to further examine the extent of current road signs and markings to see it is support or not for one-way traffic implementation on Jalan Kartini in Tegal City. Comparative approach method and direct survey on the field is uses for this research, which aims to assess the suitability of existing conditions with applicable government regulations. This evaluation will pay attention to aspects of physical condition, placement, visibility, and distance between elements according to existing guidelines and provisions. The results of the study are expected to be the basis for deciding the application of traffic management that is adaptive to the needs of the community and supports the creation of a safe, comfortable and sustainable transportation system [10] Therefore, this study aims to evaluate traffic performance and examine the compliance of road signs and markings on Jalan Kartini with national standards, in order to assess the technical readiness of this corridor for the implementation of a one-way traffic system.

2. Research Method

This research used a comparison method of field survey results with the provisions of PERMENHUB No. 13 of 2014 concerning Traffic Signs, PERMENHUB No. 67 of 2018 concerning of Road Markings, and Indonesian Road Capacity Guidelines (PKJI). This method was used to describe and analyze the existing condition of road signs and markings as a basis for assessing one-way system implementation on Jalan Kartini in Tegal City. Ensuring the suitability of field conditions with applicable technical standards and regulations, so that the implementation of a one-way system is in accordance with the regulations and management set by the government.

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

2.1 Data Collection Techniques and Steps

Collecting primary data by conducting direct observations and measurements in the field, including traffic volume data, speed data, and road inventory data. In addition, a *traffic counting* survey was also conducted for 1 day on Thursday, 29 May 2025 which was divided into morning, afternoon, and evening with a total time span of 9 hours. The time division was carried out at 07.00-10.00 WIB for the morning, 12.00-15.00 WIB for the afternoon, and 16.00-19.00 WIB for the evening. This was done to get volume data and find out the busy time on the Kartini road section. After obtaining the results of vehicle data, a vehicle speed survey was carried out during the morning, afternoon, and evening *peak hours*. The average speed data was obtained by manual method of measuring the distance along 100m and to get the speed, the calculation of distance divided by time was carried out, then converted into units of km/hour.

Secondary data in this study was obtained by literature study and reference to official documents that support the analysis, such as the Transportation Regulation from Minister of Transportation, the Manual of Road Signs and Markings Specifications from Directorate of Transportation, and the Indonesian Road Capacity Guidelines (PKJI) in 2023.

2.2 Data Processing and Analysis Techniques

Analysis is carried out by comparing actual conditions in the field with applicable technical standards, and is carried out qualitatively by processing data obtained through field surveys. Data analysis is carried out in several stages, the traffic counting data obtained is processed to determine the average daily volume, peak traffic hours, and vehicle type distribution. This data processing technique uses volume tabulation based on time intervals to determine the level of road density using PKJI 2023. Existing speed data is obtained through data analysis of vehicle speed measurement results in the field processed using statistical formulas, such as average speed and 85th percentile speed (V85). Data on road signs and markings are analyzed qualitatively by comparing existing conditions in the field to technical standards as stated in the PERMENHUB No. 13 of 2014 concerning Traffic Signs and PERMENHUB No. 67 of 2018 concerning of Road Markings. This analysis technique includes checklists, visual documentation, and scoring of traffic facility completeness. The three types of data are integrated in the evaluation stage to determine whether a road section is technically and operationally ready to implement a one-way system. The research method is using research procedure and technique, and among one study and another, the processes and techniques can be different.

3. Description and Technical

This study analysis compliance of road signs and markings with the implementation of one-way traffic systems, specifically along Jalan Kartini, Kota Tegal. The research was conducted through a combination of field observations, documentation, secondary data analysis, and direct evaluation of existing infrastructure conditions.

The study began with a location survey to identify the existing road markings and sign placements, mapping their alignment with national traffic regulations and standards (such as PP No. 79 of 2013 and PERMENHUB No. 13 of 2014). This survey also recorded the physical condition and visibility of the signage. Subsequently, data collection was carried out through:

a. Measurement of geometric road conditions.
b. Documentation of existing traffic signs and markings.
c. Traffic volume observations.

The collected data were then analysis using a comparative method, assessing the conformity of current signage and markings to the technical guidelines and their effectiveness in supporting the one-way traffic system. Technical evaluation focused on:

a. Visibility, size, and placement of signs.
b. Continuity and clarity of lane markings.
c. Road user comprehension based on field interviews.
d. Alignment with standards from the Indonesian Road Traffic and Transportation System.

The results of the analysis revealed several inconsistencies, including improperly placed signs, missing lane markings, and signs obstructed by physical elements. Based on the findings, several technical improvement measures were identified, including:

a. Repositioning and upgrading traffic signs to meet visibility and placement standards.
b. Repainting or reconstructing road markings.

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ISSN (*Print*) 2503-2399

c. Providing additional directional signs at intersections and decision points.

4. Results and Discussions

4.1 Traffic Volume

The collection of data using traffic counting techniques is differentiated by the type of vehicle passing through the road section according to the vehicle group categories contained in PKJI 2023. Traffic data were collected at the research location at 15-minute intervals over a total duration of 9 hours, covering the morning, midday, and evening periods (07:00–10:00 WIB, 12:00–15:00 WIB, and 16:00–19:00 WIB). The average daily traffic values presented in this study were derived as an estimation based on the 9-hour observation results, under the assumption that the selected time periods adequately represent the daily traffic characteristics of the study road segment.

Table 1. Traffic Flow Data

Time	Number of Vehicles			Vehicles Total	PCU			PCU Total
	MC	LV	HV		MC	LV	HV	
07.00 - 08.00	922	137	0	1059	230,5	137	0	367,5
08.00 - 09.00	962	174	1	1137	240,5	174	1,2	415,7
09.00 - 10.00	1086	231	0	1317	271,5	231	0	502,5
12.00 - 13.00	932	190	0	1122	233	190	0	423
13.00 - 14.00	967	202	1	1170	241,75	202	1,2	444,95
14.00 - 15.00	940	221	0	1161	235	221	0	456
16.00 - 17.00	1410	190	0	1600	352,5	190	0	542,5
17.00 - 18.00	1347	221	3	1571	336,75	221	3,6	561,35
18.00 - 19.00	1580	214	0	1794	395	214	0	609

Source: Analysis Results, 2025

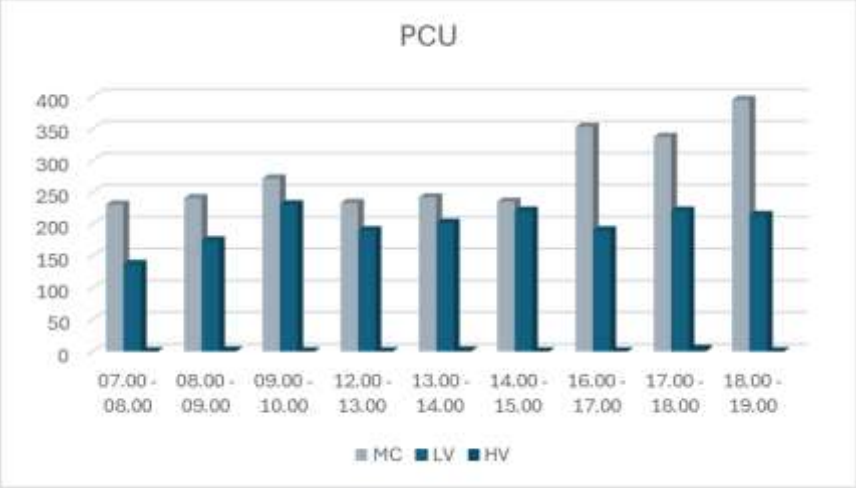

Figure 1. Traffic Counting Data

Traffic counts on Thursday, 29 May 2025 on the Jalan Kartini in Tegal City road section for morning observations obtained peak hours at 09.00-10.00 with a total vehicle volume of 502.5 PCU/hour. The afternoon peak hour was obtained at 13.45-14.45 with a total vehicle volume of 462.75 PCU/hour. In the evening, the peak hour is obtained at 18.00 - 19.00 and the total vehicle volume reached 609 PCU/hour. Therefore, peak hour can be obtained in the evening at 18.00 - 19.00 with the highest of total vehicle volume is 609 PCU/hour.

3.2 ADT Analysis

Conversion of all vehicle types into passenger car units results in Average Daily Traffic (ADT). Finding ADT can be obtained by calculating the total formulation of passing vehicles divided by the length of observation time [11].

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Table 2. Average Daily Traffic (LHR)

ADT (vph)	MC	LV	HV
1325,6667	1127,3333	197,77778	0,5555556

Source: Analysis Results, 2025

The results of the ADT analysis on the Kartini road section were stated at 1325.67 vph. The distribution of the composition of each type of vehicle obtained motorcycles 1127 vph, 197 vph for passenger cars, and medium vehicles 0.56 vph.

3.3 Capacity Analysis and Degree of Saturation

Road capacity (C) is defined as the maximum traffic flow that can be accommodated by a road segment under prevailing geometric, traffic, and environmental conditions. In this study, road capacity analysis was conducted by referring to the PKJI 2023. The capacity calculation adopts the base capacity adjustment approach but applies updated parameter values and adjustment factors as stipulated in PKJI 2023.

The road capacity was calculated using the following equation:

$$C = C_0 \times FCw \times FCsp \times FCsf \times FCcs \quad (1)$$

where C_0 represents the base capacity, FCw is the lane width adjustment factor, FCsp is the directional separation factor, FCsf is the side friction factor, and FCcs is the city size factor. All parameter values and adjustment factors used in this study were determined in accordance with PKJI 2023. Then the value is:

$$C = 1700 \times 1.08 \times 1 \times 0.78 \times 0.9$$
$$= 1288.87 \text{ PCU/hour}$$

Through formulation calculation above, the results is 1288.87 PCU/hour for the road capacity on Jalan Kartini.

The definition degree of saturation is the ratio between traffic volume of vehicles passing a road section in a certain time period and road capacity [12]. This aspect plays an important role to decide the level performance for a road segment. It is can be calculated by dividing the volume (Q) expressed in number of vehicles passing per hour divided by the capacity value (C) which is also expressed in the same unit.

$$Ds = 1288.87 / 483.92$$
$$= 2,663$$

The results of the calculation of the degree of saturation obtained at 0.375 indicate that the traffic flow has not reached a significant density point and the road capacity is still sufficient. This is a strong basis that the implementation of a one-way system will not cause new congestion, it has the potential to increase the efficiency of vehicle flow.

3.4 Analysis of Existing Vehicle Speed

A manual survey at the research location was conducted to determine vehicle speed. Measurements were made by taking samples because of the large number of vehicles passing by. The calculation formula for dividing the number of vehicles from the volume in each morning, afternoon, and evening uses the number of vehicle types divided by the total volume multiplied by one hundred.

Table 3. Data on Number of Vehicles and Minimum, Maximum Speed.

Time	**MC**	**LV**	**HV**	**Minimum Speed**	**Maximum Speed**
Morning	85	15	0	19	59
Noon	82	18	0	20	66
Afternoon	87	13	0	19	58

Source: Analysis Results, 2025

Through **Table 3.** it can be seen for the sample in the morning, motorcycles as many 85 vehicles and passenger cars as many 15 vehicles. The sample in the afternoon was 82 motorcycles and 18 passenger cars. The sample in the afternoon was 87 motorcycles and 13 passenger cars.

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

Through speed surveys in the field using manual methods with simple speed calculations, namely calculating time by determining the distance to be traveled, the minimum and maximum vehicle speed conditions are obtained. The morning sample had the lowest speed of 19 km/h and the highest speed of 59 km/h, for the afternoon sample the lowest speed is 20 km/h and the highest speed is 66 km/h, and the evening sample had the lowest speed of 19 km/h, the highest speed was 58 km/h.

Table 4. Calculation of 85th Percentile

Speed Range (km/h)	Mid point (xi)	Data Total (fi)	Cumulative Total	Data Percentage (%)	Cumulative Percentage (%)	(fi.xi) (3)x(2)	(fi x xi 2)
1	2	3	4	5	6	7	8
19 - 23	21	9	9	0,09	9	189	3969
23 - 27	25	15	24	0,15	24	375	9375
27 - 31	29	19	43	0,19	43	551	15979
31 - 35	33	25	68	0,25	68	825	27225
35 - 39	37	41	109	0,41	109	1517	56129
39 - 43	41	64	173	0,64	173	2624	107584
43 - 47	45	59	232	0,59	232	2655	119475
47 - 51	49	29	261	0,29	261	1421	69629
51 - 55	53	31	292	0,31	292	1643	87079
55 - 59	57	6	298	0,06	298	342	19494
59 - 63	61	1	299	0,01	299	61	3721
63 - 67	65	1	300	0,01	300	65	4225
		300				12268	523884

Source: Analysis Results, 2025

The speed data that has been obtained can be done with the 85th percentile speed calculation method which aims to determine the safe speed limit value on the highway. Through speed analysis of vehicle samples, the average speed of 40 km/h is generated. As for the 85th percentile speed of 49 km/h.

3.5 Design Speed

The speed on each road section is different according to the function of the road. The following is a classification table on urban roads seen based on the design speed.

Table 5. Classification of urban roads by design speed.

Class of Road Function	Design Speed, VR (km/h)
1. Primary Artery Road	50 - 100
2. Primary Collector Road	40 - 80
3. Secondary Artery Road	50 - 80
4. Secondary Collector Road	30 - 50
5. Secondary Local Road	30 - 50

Source: Analysis Results, 2025

The function of Jalan Kartini in Tegal City as a secondary collector road to get the design speed value, which is between 30 - 50 km/h. The following table presents the design speed of the Kartini road section according to the road function according to the guidelines used [13].

Table 6. Design speed (VR) of Kartini road section.

Road Sections	Class of Road Function	Design Speed, VR (km/h)	Placement Distance
Jl. Kartini	Secondary Collector Road	30	Max 50 m

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

Source: Analysis Results, 2025

Source: Analysis Results, 2025

Figure 2. Vehicle speed limit sign for 30 km/h on Kartini road section.

The result of the design speed obtained is 30 km/h in accordance from the existing speed limit signs on the road section with the signs placed 50 m far away from roadside section. This result has been adjusted to the function of Jalan Kartini in Tegal City based on survey data.

3.6 Comparison of 85th Percentile Speed and Design Speed

There are differences in results between each speed value. According to the geometric design guideline, the design speed range for secondary collector roads is 30-50 km/h, while the posted speed limit on Jalan Kartini is 30 km/h as indicated by the existing speed limit sign. The average speed of 40 km/h and the 85th percentile speed of 49 km/h are therefore above the posted speed limit, and the upper tail of the distribution approaches the upper bound of the design speed range, which may increase accident risk, especially in pedestrian activity areas. At certain hours, especially during the day, there are vehicles that reach a maximum speed of up to 66 km/hour. This speed exceeds the upper limit of the design speed and potentially jeopardizes the safety of other road users, especially in school areas or pedestrian activity areas. Through discussion of the results, it can be recommended that the vehicle speed limit on Jalan Kartini is 30 km/h in accordance with the existing speed limit signs.

The readiness to implement a one-way system is closely related to vehicle speed characteristics. One-way traffic requires a smooth, consistent flow of vehicles that is within safe speed limits to avoid traffic conflicts and accident risks, especially in dense areas or near pedestrian activities. It can be seen that the speed aspect of Jalan Kartini in Tegal City has not yet met the readiness criteria for the implementation of a one-way system because it is still found that the existing speed does not match the design speed set in the regulation. Supervision of speed limit violations still needs to be strengthened, such as the provision of speed markings in the form of rumble strips, as well as electronic ticketing-based law enforcement at points prone to traffic violations.

The implementation of rumble strips or corrugated speed markings has been shown to be effective in significantly reducing vehicle speeds, especially near vulnerable zones such as schools and intersections. Research related to the effectiveness of rumble strip installation has shown that *rumble strips* can reduce vehicle speed, for light vehicles it can reduce speed by 5%, motorcycles by 5.2%, and heavy vehicles by 5.1% [14]. Looking through other aspects, law enforcement through ETLE can be carried out with an automatic surveillance camera technology-based approach that can record violations in *real-time*, including speed limit violations, as well as compliance with road markings and traffic signs. ETLE implementation in urban areas is known to be able to reduce speed violations by 31% in the initial three months of implementation [15].

3.7 Analysis of the Conformity of Existing Traffic Signs Based on Guidelines Provisions

Signs that have good physical condition and function meet criteria such as the colour is not faded, the pole is not bent, the leaves are not curved, and the condition of the board is not covered by an object [16]. After collecting data from the sign inventory survey results, an analysis of the placement, distance, and physical condition of the signs is carried out in accordance with the guideline provisions.

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

(1) (2) (3) (4)

Source: Analysis Results, 2025

Figure 3. (1) Intersection warning sign covered with spray paint (2) Speed limit sign obstructed by vegetation (3) Crosswalk sign pole is tilted (4) One-way implementation sign

The results of the traffic sign inventory survey on Jalan Kartini in Tegal City found that the physical condition of most signs requires serious attention. Many signs were damaged, such as faded colors, covered with spray paint, illegal stickers, and bent or tilted poles. For example, the three-sided intersection warning sign at STA 0+061 is covered in spray paint. Meanwhile, signs indicating the location of the hospital at STA 0+154, parking restrictions at STA 0+166 to STA 0+179 have many stickers attached that interfere with visibility. Every traffic sign must be in good condition, not faded, not covered by other objects, and easily visible to the driver from a distance of at least 100 m [16]. Signs that are in a damaged or unreadable condition clearly do not meet the stipulated provisions and have the potential to reduce the effectiveness of information conveyed to road users, as well as the potential for traffic violations [24].

Some signs were found to be placed in inappropriate positions. One of them is the maximum speed limit sign at STA 0+309 which is covered by trees, as well as the sign indicating the location of bus stop facilities at STA 0+323 which is only 25 cm from the road shoulder. This placement is not in accordance with the provisions stating that signs must be located in a location that is easily visible, not obstructed by other objects, and not too close to the vehicle lane so as not to be prone to being hit [16]. In addition, the slope of the sign pole as at STA 0+341 also reduces the effectiveness of conveying information to the driver.

In terms of dimensions, signs were found that did not match the standard size. For example, the right turn prohibition sign at STA 0+139 and the hospital location sign at STA 0+154 only have 50 cm sign leaves. Urban roads with design speeds below 50 km/h should have a minimum sign leaf height of 55 cm with a minimum height of 220 cm from ground level to the bottom edge of the sign leaf. The mismatch causes a decrease in sign visibility for road users. The distance between signs at some points also needs to be re-evaluated. For example, in the segment between STA 0+345 to 0+365 several signs were found to be installed in close proximity. PERMENHUB No. 13 of 2014 concerning Traffic Signs is stipulate that the placement of signs must take into operational visibility and avoid information overload that can confuse drivers.

Overall, the evaluation of the physical condition, placement, size, and spacing of signs on Jalan Kartini in Tegal City showed that most signs required repair and adjustment to comply with applicable technical standards. Improving and standardizing signs according to the guidelines of the applicable provisions, it is expected that the information conveyed is more effective, well read, and can support the smoothness and safety of road users [17]

The results of the analysis of traffic sign inventory data on Jalan Kartini in Tegal City can be concluded that the current conditions do not fully meet the readiness for the implementation of a one-way system. This can be seen from several aspects, namely the physical condition of the signs, the placement that is not ideal, the size that does not meet the standards, and the distance between signs that is not optimal. The one-way implementation system through the aspect of the existence of one-way signs is already available at the starting point of the road section (STA 0+000), and physically meets the standards. However, other supporting signs such as turn restriction signs, entry restrictions, location

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

guidance signs, and warning signs are still found in conditions not in accordance with applicable regulatory guidelines. In addition, there is a factor that the placement of signs is less than ideal, and the distance between signs that are too close together or inconsistent can potentially cause confusion for road users [18].

An area is declared ready to implement a one-way system if all elements of supporting infrastructure, especially signs and markings, have met the standards in terms of number, type, placement, visibility, dimensions, and readability [16].The existing condition of signs on Jalan Kartini in Tegal City cannot be said to be fully ready to support the implementation of a one-way system effectively and safely. It is necessary to revitalize traffic signs using the application of digital-based traffic technology, one of which is electronic signs or Variable Message Sign (VMS). This technology allows real-time display of speed limit information and traffic conditions based on operating hours, weather, or traffic density [19]. Research shows that the implementation of DMS can reduce speed violations by up to 35%, increase road user compliance, and provide more adaptive information flexibility. In addition, automated radar systems integrated with electronic signs can also be used to detect vehicles exceeding the speed limit and display warning messages directly to drivers. Previous research has shown that these systems are effective in reducing potential accidents by up to 20% in urban areas of Indonesia [20].

3.8 Analysis of Existing Road Markings Compliance Based on Guideline Provisions

The category of good markings is markings with physical conditions that can function according to their uses, such as colour clarity and markings visibility [21]. After collecting sign inventory data, it will then be analyzed through physical condition, placement, and distance in accordance with PERMENHUB No.67 of 2018 guidelines.

(1) (2) (3) (4)

Source: Analysis Results, 2025

Figure 4. (1) Faded zebra crossing markings (2) ZOSS markings paint peeling off (3) Faded no-parking markings (4) Faded road shoulder markings

Results of the road markings survey on Jalan Kartini found that most of markings were in a faded physical condition and were not clearly visible to road users. For example, the roadside markings at STA 0+064 had faded, as well as the parking restriction markings at STA 0+154, 0+173, and 0+313 which were all in the form of yellow sinuous lines but no longer looked sharp. Similar conditions were also found on *zebra crossings* at STA 0+339, 0+363, and 0+439 as well as ZOSS markings at STA 0+313 and 0+376 which faded and lost visibility. Referring to PERMENHUB No. 67 of 2018 concerning Road Markings, each marking should have a condition that is clearly visible both day and night and must not fade or be covered by other objects. The existing condition of the markings on the road section can be said to not meet the eligibility standards as required by the regulation.

Most of the parking restriction markings and *zebra crossings* in terms of dimensions have met the technical standards. Parking prohibition markings have a length varying from 9.10 m to 24.10 m, while the *zebra crossing* has a size of 3 m x 0.30 m which is in accordance with the provisions. ZOSS markings also have a length of 15 m which is classified as appropriate. Although in size the markings

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

are close to or meet the standards, the faded physical condition causes the effectiveness of the markings in providing information to be significantly reduced.

The existence of markings on Jalan Kartini is not fully ready to support the implementation of a one-way system. This mismatch can potentially cause accidents due to road users' failure to understand the markings [22]. Although in terms of type and placement some markings are appropriate, such as the existence of zebra cross, parking prohibition markings, and *Zona Selamat Sekolah* (ZOSS) markings, there are various problems that hinder the effectiveness of the one-way system when applied in the current existing conditions, namely the faded condition of the markings. Therefore, revitalization of road markings needs to be done through repainting using reflective *thermoplastic* paint that is durable and clearly visible at night. In addition, active LED markings (road studs) can be installed at crosswalk zones and schools to increase driver awareness [23]. Markings with active light technology can reduce the incidence of pedestrian accidents by 60% [24]. The implementation of electronic signage linked to digital navigation systems such as Google Maps will also be helpful in socializing the one-way pattern in *real-time* to motorists. Such context-based navigation technology has been shown to increase driver understanding by 45% [25].

5. Conclusion and Suggestion

5.1 Conclusion

Final results for this analysis about some of transportation aspects on Jalan Kartini in Tegal City can be concluded that in terms of traffic capacity and performance, this road section has fulfil the technical requirements for a one-way system as indicated by the highest degree of saturation value of only 0.37. The speed aspect has not fulfil the standard because the average speed and 85th percentile speed are not in accordance with the design speed. Monitoring of speed limit violations still needs to be strengthened, such as the provision of speed markings in the form of rumble strips, also as law enforcement based on electronic tickets. In terms of traffic direction infrastructure, road signs, and markings do not meet the technical standards set out in PERMENHUB No. 13 of 2014 concerning Traffic Signs, PERMENHUB No. 67 of 2018 concerning of Road Markings, especially in terms of physical condition, visibility, placement, and completeness. Therefore, before the one-way system is fully implemented, a comprehensive revitalization of signs and markings is needed, including the application of VMS (Variable Message Sign) electronic sign technology and LED active markings to improve the effectiveness of visual communication, road user safety, and the successful implementation of the one-way system in an optimal and sustainable manner.

5.1 Suggestion

To enhance the research on the suitability of road signs and markings for one-way traffic on Jalan Kartini, several advanced methods can be applied. Traffic simulation tools like VISSIM can model the actual flow and reveal the impact of inadequate signage. Including user feedback through surveys or interviews helps uncover real issues not visible in field checks. Identify visibility or behavioral problems, while accident and violation data can link signage issues to actual incidents. Lastly, GIS mapping can visualize problem areas and support clearer analysis. These methods will enrich the study, making it more comprehensive and actionable.

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