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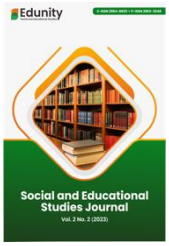

Research of Road Equipment Needs and Safety Management Using the School Safety Zone (ZOSS) Concept on I Gusti Ngurah Rai Road in Palu City

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ABSTRACT

The *School Safety Zone* (ZoSS) is a government-initiated program designed to regulate vehicle speed in school areas through time-based speed zones, ensuring pedestrian safety, particularly for students. The implementation of ZoSS aims to reduce traffic accidents by requiring vehicles to drive at low speeds when entering school zones, anticipating unpredictable pedestrian movements. This research analyzes the need for *School Safety Zone* (ZoSS) facilities along the I Gusti Ngurah Rai Road segment, particularly in the South Tatura Education Area, using the Regulation of the Director General of Land Transportation No: SK.3236/AJ.403/DRJD/2006 as a reference. Data analysis was conducted using normal distribution statistics (Z-test) by comparing the calculated Z-value with the Z-table value for pedestrian behavior, drop-off/pick-up behavior, and vehicle speeds in the area. Additionally, the analysis included the need for drop-off/pick-up zones and pedestrian infrastructure to facilitate safe student activities. The results indicate that the South Tatura Education Area is not yet safe, confirming the need for a ZoSS in the area. The proposed ZoSS design is 2/2UD-25, with a two-lane undivided road (2/2-TT), stopping sight distance of 50–85 meters, school zone speed limit of 25 km/h, and a zone length of 150 meters. The required ZoSS facilities include *School Safety Zone* markings, zebra crossings, traffic signs, yellow zigzag road markings, crossing guides, and additional facilities such as rumble strips.

Keywords: School Safety Zone (ZoSS), Accidents, Pedestrians.

INTRODUCTION

Transportation is a crucial activity in human life that involves the movement of passengers and goods, and is closely linked to social, economic, educational, political, and population mobility (Hussain, 2023; Meyer, 2016; Sumarno, 2020; Vuchic, 2017; Wang et al., 2022; Yoo et al., 2024). Traffic issues often reflect road users' behavior in obeying traffic regulations. In the educational context, transportation has become a routine daily activity, necessitating adequate safety infrastructure in school areas to protect students, who are a vulnerable group of road users.

Traffic accidents are a significant concern that must be addressed by the government to ensure a safe and orderly transportation system (Elvik et al., 2023; Ramadhani et al., 2020; Roshanfekr et al., 2019; Tenenbaum et al., 2019). The lack of

discipline from drivers and road users, particularly in school zones, increases the risk of accidents. The student age group is especially vulnerable, as their school activities are closely situated near traffic. Therefore, efforts to create a safe transportation system require support from the government, parents, and schools through safety management programs.

Upon reviewing the conditions on Jalan I Gusti Ngurah Rai in Palu City, it was observed that three adjacent schools—SDN 1, SDN 2, and SD Inpres 3 Tatura—are located along a road that connects Palu City to Sigi Regency. This road experiences high traffic volume and fast vehicle speeds, posing a danger to students. The absence of safety facilities, such as pedestrian dividers, faded zebra crossings, missing speed signs, and disorganized shuttle management, compounds the problem. Additionally, the lack of a *School Safe Zone* (ZoSS) system and limited safety education are urgent issues to address (Hikmawati, 2022; Kamal et al., 2019; Kordelia & Armizoprades, 2022; Leonard Togatorop et al., 2022; Setyawati et al., 2021).

To address these problems, this research examines the need for road equipment and safety management through the *School Safe Zone* (ZoSS) concept along the I Gusti Ngurah Rai road section, focusing on the three schools. The goal is to develop planning to create a safer school area and reduce traffic accidents involving students. This research draws on previous studies, such as those by Batjo (2023) on Jalan Lahalede, Parepare City, Wulandari (2023) on Jalan Panglima Sudirman, Nganjuk Regency, and Jaya (2024) on Jalan Batas Kota Sukabumi–Gekbrong 1, Sukabumi Regency. Each of these studies provided useful insights for evaluating road conditions, pedestrian behavior, and ZoSS design, with Pratama (2024) additionally examining transportation mode selection and traffic accidents.

The research questions addressed are: (1) What is the current traffic performance on the I Gusti Ngurah Rai road section? (2) What road safety facilities are needed in the area? (3) What is the appropriate design for the implementation of ZoSS at SDN 1, SDN 2, and SD Inpres 3 Tatura? This study aims to answer these questions and produce effective ZoSS planning.

The benefits of this research extend to multiple parties. For researchers, it offers practical insights into traffic safety management in school zones. For academic institutions, especially Tadulako University, the findings contribute to the development of safe transportation studies. For the government and related agencies, the results can inform traffic safety policy-making. Finally, for the community, particularly residents and parents, the research emphasizes the importance of implementing ZoSS as a protective measure for students in educational areas.

RESEARCH METHOD

This research employs a descriptive method with a quantitative approach. The descriptive approach is used to understand various characteristics, activities, changes, as

well as similarities and differences between phenomena related to traffic safety in school areas. The quantitative approach is chosen to solve the problem objectively using numbers, statistical data, and calculation-based data processing techniques.

The research was conducted over two months on Jalan I Gusti Ngurah Rai, South Tatura Village. This road section is predominantly characterized by land use such as residential areas, shops, and educational facilities, particularly elementary schools. Student shuttle activities generally involve private vehicles, such as motorcycles and cars, which are often parked along the road due to limited parking facilities at the schools. This results in reduced road capacity and causes congestion, especially during school hours. The location for this research was selected due to the urgent need to design a better safety and traffic management system around the educational area.

Data collection was carried out using both secondary and primary data relevant to the research needs. Secondary data was obtained from government agencies, including the Palu City Resort Police, the Education Office, and local schools, and included traffic accident data, the number of students, and land use information. Primary data was obtained through field observations, including road and intersection inventories, traffic volume enumeration, vehicle instantaneous speeds, pedestrian behavior, student crossing activities, and student drop-off behavior.

For secondary data, the researcher accessed documents and maps provided by relevant agencies as the main reference for compiling the *School Safe Zone* (ZoSS) plan. Previous literature and research were also used as supporting references. Primary data collection included field surveys that involved observing physical conditions and traffic activities at the research site. Road section inventory surveys recorded elements such as road length, width, shoulders, sidewalks, medians, drainage, signs, markings, and safety facilities. The survey also noted illegal parking and land use characteristics along the road.

The intersection inventory survey was conducted at the intersection of Jalan I Gusti Ngurah Rai and Jalan Emy Saelan to assess the intersection's approach characteristics, radius, control type, and other equipment. This survey was conducted in the morning, before peak hours, to minimize traffic disturbances and ensure surveyor safety. The survey targeted data on the approach type, intersection width, median condition, road shoulder, and the completeness of signs and markings at intersections.

Additionally, a traffic enumeration survey was carried out to gather data on vehicle volume and traffic characteristics at the research site. This survey was conducted for 10 hours, from 06:00 to 16:00 WITA, with 15-minute recording intervals. Two surveyors were stationed at each direction of traffic flow to classify and count vehicles. The collected data on traffic flow and vehicle types will be used to analyze density levels and determine the need for traffic safety facilities in the school area.

RESULT AND DISCUSSION

Performance Analysis of Road Section I Gusti Ngurah Rai

Traffic Volume Analysis

Based on the results of the performance analysis of the I Gusti Ngurah Rai Road section and the results of surveys that have been carried out before school entry time to school hours, namely at 06.00-16.00 WITA, it can be seen that traffic conditions in the South Tatura Education area are congested. This condition is due to the section of I Gusti Ngurah Rai Street located in commercial, office and residential areas.

Implementation of School Safe Zones (ZoSS) in South Tatura Education Zone

From the results of the survey analysis, it shows that there are 3 (three) conditions, namely crossing behavior, ushering behavior, and the speed of vehicles that have not been saved, so that in the South Tatura Education Area, it is necessary to implement the school safe zone (ZoSS) program.

Types of School Safe Zones (ZoSS)

Based on the provisions of the Decree of the Director General of Hubdat No. 3263/AJ.403/DRJD/2006, it can be known that the type of school safe zone (ZoSS) that is in accordance with the existing conditions in the South Tatura Education Area is type 2/2 TT with a 2-lane road type undivided, visibility of 50-85 meters, planned speed limit > 40 km/h, ≤ 60 km/h, speed limit of 25 km/h, The length of the School Safe Zone is 150 meters, the minimum needs are ZoSS markings, zebra crosses, traffic signs, yellow zigzag road markings, crossing guides, while for other additional needs, namely noise tape.

School Safe Zone operating hours

Based on the provisions of the Decree of the Director General of Hubdat No. 3263/AJ.403/DRJD/2006, the operating time of the school safe zone (ZoSS) is recommended to be 2 hours in the morning and 2 hours during the day on school days, between 06.00 – 08.00 in the morning and 13.00 – 15.00 during the day except holidays. This operating time can be adjusted to the needs of each school. Extension of the operating hours of the School Safe Zone is possible if there are a number of students who cross the road regularly throughout the day. The operating hours of the School Safe Zone are stated by additional boards on traffic signs.

Road Equipment Facilities in the School Safe Zone (ZoSS)

The determination of road equipment facilities in the South Tatura Education Area refers to the Decree of the Director General of Land Transportation Number SK. 3528/AJ. 403/DRJD/2018 concerning Technical Guidelines for Prioritizing Pedestrian Safety and Comfort in School Areas Through the Provision of School Safe Zones. The equipment facilities used are as follows:

1. Traffic Signs

Traffic signs as referred to consist of:

a. Warning signs
b. Prohibition signs
c. Signage

2. Road Markings

Traffic markings as intended consist of:

a. Longitudinal marking
b. Cross mark
c. Diagonal mark
d. Lambing mark
e. Other marks in the form of parking prohibition marks
f. Red road markings as a special mark at the beginning and end of ZoSS

3. Control and road safety equipment in the form of noise tape.

4. Pedestrian facilities in the form of sidewalks with their respective sidewalk widths 1.85 meters on the right and left sides.

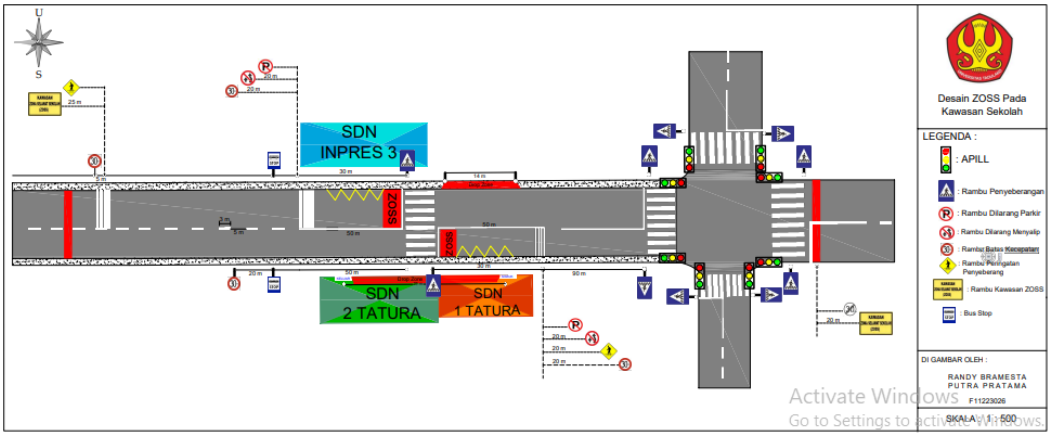

Figure 1. Design of the South Tatura Education Zone School Safe Zone

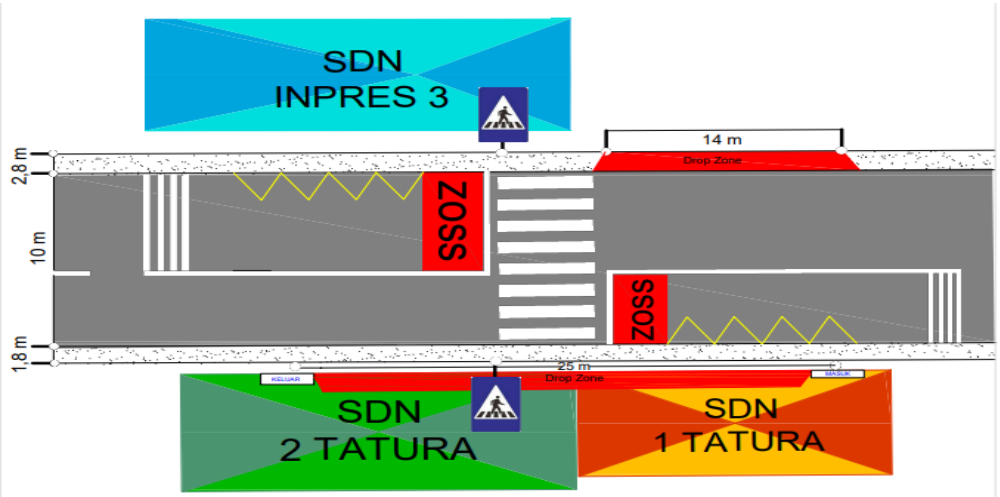

Figure 2. Advanced School Safe Zone Design

Figure 3. Visualization of School Safe Zone Design in South Tatura Education Area

Figure Error! No text of specified style in document.**.** Visualization of School Safe Zone Design Signs in the South Tatura Education Area

It can be seen in the image above showing the visualization of the top view and the design of the proposed School Safe Zone (ZoSS) in the South Tatura Education area, complete with the layout of signs and traffic marks. The implementation of ZoSS in this area has an impact on the performance of road sections, one of which is shown by the decrease in vehicle speed. This is due to the installation of warning signs before entering the area as well as rumble strips. With the decrease in vehicle speed, it is hoped that the potential for traffic accidents involving students can be minimized. As part of efforts to improve safety, proposed pedestrian facilities are also included in the form of sidewalks and zebra crosses. This facility aims to support safe walking activities for students and the community around the area.

Proposed Need for Road Equipment Facilities

Based on the analysis that has been carried out, it is necessary to solve the problem or propose to follow up on the existing problems. For some problems, there are recommendations to solve problems and provide proposals either based on applicable technical standards or with the results of the analysis that have been taken into account so that in the research area it is necessary to implement the School Safe Zone program in the South Tatura education area. The following are his recommendations, namely:

1. Equipping traffic signs in each school to realize student safety management with the ZoSS concept in the South Tatura Education Area.

2. Judging from the number of students who walk along the way, it is necessary to arrange the construction of sidewalks that are safe and comfortable for students.
3. The school, especially SDN 1 and SDN 2 Tatura, widened the main gate of the school which aims to facilitate vehicle access to the drop zone/pick up point area so that the process of picking up and dropping off students becomes more orderly and the school environment becomes more conducive.

CONCLUSION

The analysis of the Safe School Zone (ZoSS) needs in the Tatura Selatan Education Area along Jalan I Gusti Ngurah Rai reveals that the road segment experiences relatively heavy traffic flow with a degree of saturation (DS) of 0.63 and a Level of Service (LOS) of D, indicating near-unstable conditions, although speeds remain manageable. The traffic density is 16,103 pcu/km, with an average vehicle speed of 42.04 km/h. The intersection at Jalan I Gusti Ngurah Rai–Basuki Rahmat–Emy Saelan–Towua has a DS of 0.86, average delay of 42.357 sec/pcu, and a LOS of E, indicating nearing maximum capacity with significant delays. To improve safety, the required road facilities include various traffic signs (warning, prohibitory, and directional), pavement markings, rumble strips, pedestrian facilities such as sidewalks and zebra crossings, and a ZoSS design with two undivided lanes, a 50–85 meter stopping sight distance, and a 25 km/h speed limit. Future research could explore the impact of the ZoSS on traffic flow, accident reduction, and student safety, including the long-term effectiveness of such infrastructure in improving school area safety and traffic management.

REFERENCES

Albatayneh, A., Juaidi, A., Jaradat, M., & Manzano-Agugliaro, F. (2023). Future of Electric and Hydrogen Cars and Trucks: An Overview. *Energies*, *16*(7). https://doi.org/10.3390/en16073230

Bockholt, R., Paschke, S., Heubner, L., Ibarlucea, B., Laupp, A., Janićijević, Ž., Klinghammer, S., Balakin, S., Maitz, M. F., Werner, C., Cuniberti, G., Baraban, L., & Spieth, P. M. (2022). Real-time monitoring of blood parameters in the intensive care unit: State-of-the-art and perspectives. *Journal of Clinical Medicine*, *11*(9). https://doi.org/10.3390/jcm11092408

Ciptomulyono, U. (2024). *Kosep dasar teknik dan terapannya: Pengambilan keputusan multi kriteria*. Itspres.

Eccles, R., Zhang, H., & Hamilton, D. (2019). A review of the effects of climate change on riverine flooding in subtropical and tropical regions. *Journal of Water and Climate Change*, *10*(4), 687–707. https://doi.org/10.2166/wcc.2019.175

Ishaque, W., Mukhtar, M., & Tanvir, R. (2023). Pakistan's water resource management: Ensuring water security for sustainable development. *Frontiers in Environmental Science*, *11*. https://doi.org/10.3389/fenvs.2023.1096747

Keyhanpour, M. J., Musavi Jahromi, S. H., & Ebrahimi, H. (2021). System dynamics model of sustainable water resources management using the Nexus Water-Food-

Energy approach. *Ain Shams Engineering Journal*, *12*(2). https://doi.org/10.1016/j.asej.2020.07.029

Kodoatie, R. J., & Sjarief, R. (2005). *Integrated water resources management*. Andi.

Laili, A. N. (2021). Studi analisis water quality index (WQI) berdasarkan baku mutu kelas II di Sungai Wonokromo Kota Surabaya [Undergraduate thesis, Universitas Islam Negeri Sunan Ampel Surabaya].

Lakshmikantha, V., Hiriyannagowda, A., Manjunath, A., Patted, A., Basavaiah, J., & Anthony, A. A. (2021). IoT-based smart water quality monitoring system. *Global Transitions Proceedings*, *2*(2). https://doi.org/10.1016/j.gltp.2021.08.062

Lindholm-Lehto, P. (2023). Water quality monitoring in recirculating aquaculture systems. *Aquaculture, Fish and Fisheries*, *3*(2). https://doi.org/10.1002/aff2.102

Lowe, M., Qin, R., & Mao, X. (2022). A review on machine learning, artificial intelligence, and smart technology in water treatment and monitoring. *Water (Switzerland)*, *14*(9). https://doi.org/10.3390/w14091384

Miko, T. R., Harsono, T., & Barakbah, A. (2019). Classification and risk-mapping of river water quality in Surabaya with semantic visualization. *EMITTER International Journal of Engineering Technology*, *7*(2). https://doi.org/10.24003/emitter.v7i2.393

Saaty, T. L., & Vargas, L. G. (2006). *Decision making with the analytic network process: Economic, political, social and technological applications with benefits, opportunities, costs and risks*. Springer Science+Business Media.

Said, N. I., Widayat, W., & Nugroho, R. (2020). Peningkatan kualitas air baku dari Sungai Surabaya dengan proses biofiltrasi. *Jurnal Teknologi Lingkungan*, *21*(1).

Satmoko Yudo, & Nusa Idaman Said. (2019). Water quality condition of Surabaya River case study: Improved raw water of PDAM Surabaya. *Jurnal Teknologi Lingkungan*, *20*(1).

Shams, A. K., & Muhammad, N. S. (2022). Toward sustainable water resources management: Critical assessment on the implementation of integrated water resources management and water-energy-food nexus in Afghanistan. *Water Policy*, *24*(1). https://doi.org/10.2166/WP.2021.072

Suwari, R., Riani, E., Pramudya, B., & Djuwita, I. (2010). Profil pencemaran Kali Surabaya dan strategi pengendaliannya. *Buletin Litbang*, *11*(2a).

Yudo, S., & Said, N. I. (2019a). Kondisi kualitas air Sungai Surabaya studi kasus: Peningkatan kualitas air baku PDAM Surabaya. *Jurnal Teknologi Lingkungan*, *20*(1). https://doi.org/10.29122/jtl.v20i1.2547

Yudo, S., & Said, N. I. (2019b). Water quality condition of Surabaya River, case study: Improved raw water of PDAM Surabaya. *Jurnal Teknologi Lingkungan*, *20*(1).

Zhang, C. Y., & Oki, T. (2023). Water pricing reform for sustainable water resources management in China's agricultural sector. *Agricultural Water Management*, *275*. https://doi.org/10.1016/j.agwat.2022.108045