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Comparison of Rigid Pavement Planning Using PD T-14-2003 and NAASRA 1987 Methods in Industrial Areas

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Abstract

As vital infrastructure, roads are a means of transportation access and function as a distribution route for goods and services. Road pavement plays a crucial role in highway construction, necessitating proper planning according to Indonesian standards and planning criteria to ensure smooth land transportation and provide comfort and safety for its users. This study aims to provide information on road conditions, drainage dimensions, and construction costs. Planning is crucial in every road construction design, particularly for rigid pavement, based on survey data collected from the road section. Numerous methods exist for calculating the design value of rigid pavement. We use the Pd T-14-2003 method and the NAASRA 1987 method (National Association of Australian State Road Authorities) to plan rigid pavement thickness in the industrial area of PT. Bukit Muria Jaya Kudus. The Pd T-14-2003 method yielded a JSKN of 4x107 and a CBR of 35% for the subgrade, resulting in a plate thickness of 150 mm. While the Naasra 1987 planning method achieved a JSKN of 6x107 and a CBR of 35% for the base soil, a plate thickness of 160 mm was obtained with a value of K = 80 kPa/mm. The reinforcement planning using the Pd T-14-2003 and Naasra 1987 methods involves longitudinal reinforcement D10 mm at a distance of 150 mm and transverse reinforcement D10 mm at 250 mm. The drainage dimensions at the cross-section location are width x height (1 m x 1 m), and the guard's height is 0.2 m.

Keywords: *Rigid Pavement, SNI Pd T-14-2003 Method, NAASRA 1987 Method.*

1. Introduction

Roads play a crucial role in supporting the rate of industrial development. As vital infrastructure, roads are a means of transportation access and function as a distribution route for goods and services [1] [2] [3]. Given the numerous activities that rely on smooth traffic, the absence of adequate road infrastructure will hinder industrial growth. The availability of sufficient roads will support the company's operational efficiency, accelerate product delivery, and increase the industry's competitiveness in the market. However, various problems with the current road conditions disrupt smooth traffic flow [4]. Many paved roads are damaged, while some road sections also look bumpy. The damage intensifies during the rainy season, as puddles frequently obstruct traffic flow [5] [6]. This situation not only diminishes driver comfort but also increases the risk of accidents, which can significantly affect industrial productivity [7]. Therefore, the maintenance and repair of road infrastructure require serious attention. In the development plan, the planned road is 433 meters long with a width of 16 meters and consists of three one-way lanes. We expect this design to accommodate high traffic volumes, particularly in industrial areas. We anticipate smooth traffic supporting industrial activities through improved planning and road quality. This will improve the local and regional economies and provide long-term benefits for the community and business actors [8] [9].
Humans build a highway on the earth's surface, designing it in various shapes, sizes, and construction types to facilitate traffic. People, animals, and vehicles use this road to transport goods efficiently and quickly from one location to another [10] [11]. The existence of highways is crucial in supporting mobility and accessibility, directly impacting various aspects of people's lives, including economic, social, and cultural. Highways link urban and rural areas and enable efficient distribution of goods and services [7]. Good road infrastructure facilitates smoother travel, reduces travel time, and lowers transportation costs [12] [13]. This benefits individuals and companies and the economic growth of a region as a whole. In addition, highway planning and construction must consider various factors, such as geographical conditions, the environment, and the community's needs. A well-designed road will be able to meet the increasing traffic demand and maintain road users' safety [14] [15]. Therefore, investment in developing highway infrastructure is essential to ensure the future smoothness and sustainability of transportation. The primary purpose of building road pavement on the subgrade is to support traffic loads.

Construction of road pavement is crucial as it serves as a layer that ensures stability and strength, enabling safe vehicle passage. Without proper pavement, the pressure and loads from passing vehicles can quickly cause damage to the roads [9]. In general, there are three types of road pavement construction: flexible pavement, rigid pavement, and composite pavement, which combine both flexible and inflexible pavement elements. Asphalt typically forms flexible pavement, enabling it to adapt to the movement of the ground beneath it. Rigid pavement, conversely, generally consists of concrete and is more rigid, offering greater strength and bearing capacity but less adaptability to ground movement. A combination of flexible and rigid pavement, or composite pavement, combines the advantages of both types to provide better performance under certain conditions. The right kind of pavement selection depends on traffic types, climate, and soil conditions at the construction site. Understanding the characteristics of each type of pavement enables more effective planning for road construction and maintenance [16] [17].

Pavement design aims to safely and comfortably carry traffic loads while ensuring no significant damage occurs during the design life [18]. To fulfill this function, cement concrete pavements must meet two essential criteria. Firstly, the pavement needs to decrease the stress on the subgrade resulting from traffic loads to a level the subgrade can still support [19] [20]. This is crucial to prevent any discrepancies in settlement or deflection, which could compromise the pavement's integrity. Second, cement concrete pavements need to be resilient to external factors like shrinkage, reduced subgrade strength, and fluctuations in weather and environmental conditions [21] [22]. These effects can cause shifts or cracks in the road surface if not appropriately handled. Therefore, we must carefully select the pavement's design and materials to ensure their resistance to changing environmental conditions. The cement concrete pavement is a structure made up of interconnected cement concrete slabs, which may or may not have reinforcement or be continuous with reinforcement. This structure rests on a subbase layer or subgrade and can incorporate an asphalt surface layer. With the right design, cement concrete pavement will provide optimal performance in supporting traffic and have a long life without significant damage [23].

2. Research Method

Primary data is obtained directly from sources at the research location. This data type can include various collection methods, such as individual or group interviews. Additionally, primary data encompasses the outcomes of observations of physical objects, events, or activities pertinent to the research. The primary data category also includes field testing to obtain technical data and provide accurate information about the conditions under study. Secondary data is a source of research data obtained indirectly through intermediary media. Other parties typically record and compile this data, preventing researchers from directly collecting it. Archives store evidence, records, and historical reports as examples of secondary data. Researchers need this secondary data to provide additional context and support in their analysis and to gain a broader understanding of the topic under study. The research preparation involved conducting the California Bearing Ratio (CBR) test to determine the bearing capacity of the original soil at the research location. We commonly use this CBR test to evaluate the strength and stability of soil as a foundation for road pavement. We conducted the test using the field CBR, which enables direct sampling and measurement on the site. We will process and analyze the test data using PD T 14-2003 regulations and Naasra 1987. This method ensures that the planned pavement design meets the required safety and performance standards.

3. Result And Discussions

Road pavement is an essential element in transportation infrastructure that affects the smoothness of traffic in road planning in the industrial area of PT. Bukit Muria Jaya Kudus, two types of pavement are proposed: concrete roads and paved roads. We chose concrete roads due to their ability to withstand heavy loads and their superior durability over other materials. On the other hand, paving roads were chosen because they provide ease of maintenance and repair and can reduce downtime when repairs are needed. The design of this project takes into account the relatively dense traffic conditions in the industrial area, ensuring it can accommodate a variety of vehicle types and sustain the industry's smooth operation. This road project, measuring 16 meters wide and 433 meters long, is designed to meet the demands of a relatively high traffic flow. In this planning, there is no road shoulder, an essential consideration for efficient use of space and maximizing the area available for paving. A road shoulder can usually narrow the road and increase costs, so in this project, the main focus is optimizing the use of existing space. The decision not to build a road shoulder also considers the characteristics of a dense industrial area, where every meter of space is precious. We divide the road into three sections to optimize the construction process and better manage traffic. The design of each section, measuring 5.3 meters long and 3 meters wide, facilitates the implementation of the work. This division aims to minimize disruption to the ongoing traffic flow so that road users can continue to pass safely and comfortably. This strategy seeks to efficiently carry out road construction without disrupting existing industrial activities, ensuring the safety of road users throughout the construction process. The planned traffic flow consists of three lanes in one direction. We designed this arrangement to enhance efficiency and safety on the road, considering the high vehicle volumes often encountered in industrial areas. We hope that the availability of three lanes will facilitate smoother vehicle movement and reduce the likelihood of traffic jams. Maintaining the smooth running of economic activities in the area is crucial, as it allows industry players to carry out their operations without significant obstacles. There are plans to implement road pavement casting in two separate places. This strategy aims to keep traffic flowing despite ongoing construction activities. By dividing the casting area, vehicles can still pass on one side of the road, while the other will undergo the casting process. We expect this approach to minimize disruption to road user mobility and ensure safety during construction.

Additionally, this arrangement can ensure comfort for road users crossing the project area, preventing any discomfort that could disrupt their daily activities. Road pavement planning prioritizes efficiency and safety in its design. Selecting the correct type of pavement, dividing sections, arranging traffic flow, and carefully casting implementation strategies are critical steps in creating adequate road infrastructure. We hope this project will facilitate the smooth operation of industrial activities and yield long-term benefits for the surrounding community. Implementing good planning will contribute to the development of infrastructure supporting regional economic growth and improving the surrounding community's quality of life. Based on the calculations to determine the thickness of the rigid pavement, there is a significant comparison between the two methods used, namely the PD T-14-2003 and Naasra 1987 methods. The PD T-14-2003 method produces a concrete slab thickness of 150 mm with a 100 mm-thick subbase using a binder. This method's number of JSKN (Number of Quality Units N) reaches 4 x 10^7. This indicates that the method offers a suitable solution for typical traffic conditions and has a relatively high soil bearing capacity.

On the other hand, the Naasra 1987 method produces a larger concrete slab thickness, namely 160 mm, with the same sub-base, namely 100 mm. This method also uses a binder with more JSKN, 6 x 10^7. This method's increased concrete slab thickness suggests that Naasra 1987 could be better suited for heavier traffic conditions or situations requiring further strengthening of the soil-bearing capacity. In other words, if the project faces high traffic volumes and significant loads, this method can provide additional safety. The difference in concrete slab thickness between the two methods reflects the structural capacity and can impact the cost and implementation time. Therefore, the choice between the two methods must be considered thoroughly. Analysis of field conditions and the intended use of the road is crucial in making this decision.

Furthermore, accurately calculating the subbase is essential to guarantee the road's capacity to bear the loads during its design life, thereby minimizing the potential for future damage. In this context, involving an experienced engineering team in thoroughly evaluating field conditions, including soil testing and traffic analysis, is essential. The results of this evaluation will be the basis for determining which pavement method is most appropriate. We hope that selecting the proper pavement method, with a careful and data-based approach, can produce efficient, durable road infrastructure that can meet existing traffic needs.

The reinforcement of jointed concrete pavement plays a crucial role in this planning. Based on the two applied methods, the reinforcement specifications include longitudinal reinforcement with a diameter of D10 mm at a distance of 150 mm and transverse reinforcement with a diameter of D10 mm at 250 mm. The design places longitudinal reinforcement closer than transverse reinforcement, ensuring optimal structural support for the concrete slab. Denser longitudinal reinforcement is crucial in mitigating the impact of high traffic loads by distributing the load more evenly throughout the slab. With a distance of 150 mm, this longitudinal reinforcement strengthens the concrete in dealing with possible tensile and compressive forces, thereby increasing the resistance of the slab to cracking and damage.

On the other hand, the less frequent transverse reinforcement (250 mm) still plays a vital role in maintaining the structure's overall stability and providing the flexibility needed to adjust the movement of the concrete. In addition, using reinforcement that meets quality standards, such as BJTD 24 for steel reinforcement, ensures that the materials used have excellent resistance to tensile loads. High steel quality is essential to ensure the pavement structure can withstand long-term stress, especially in industrial environments that often face pressure from heavy vehicles. Thus, the combination of reinforcement specifications and the selection of appropriate materials significantly contribute to the success of this jointed concrete pavement design. Overall, careful planning in the placement and type of reinforcement will provide a solid foundation for road pavements in industrial areas. Given the heavy traffic conditions, ensuring the proper design and installation of all structural elements, including reinforcement, is crucial. This will not only support the reliability of the road infrastructure but also extend the pavement's service life, thereby providing long-term benefits to road users and surrounding industrial activities.

Additionally, the placement of 25 mm diameter Dowels at 300 mm spacing and 450 mm length, along with the installation of 19 mm diameter Tie bars at 600 mm spacing and 600 mm length, demonstrates a careful effort to optimize the pavement's structural integrity. Dowels act as a connector between the connected concrete slabs, helping to ensure that they remain connected and can distribute the load evenly throughout the structure. Correct placement of Dowels can control the relative movement between the slabs, reducing the risk of cracking due to temperature changes. On the other hand, the presence of tie bars plays an essential role in overcoming the movement of the slabs that may occur during the operational load cycle. Tie bars help to tie the concrete slabs horizontally, thereby reducing the possibility of separation or shifting between the slabs. The strategic positioning of tie bars at 600 mm intervals optimizes the tensile strength, bolstering resistance against traffic-generated dynamic loads. Both of these elements, Dowels and tie bars, significantly improve the long-term performance of rigid pavements. We expect the road pavement to withstand high traffic loads and exhibit good resistance to external factors such as weather and other environmental influences, provided we use the correct specifications and installation techniques. Addressing heavy vehicle movements and high traffic frequencies is crucial in the context of roads in industrial areas. Overall, the integration of dowels and tie bars in pavement design shows serious attention to the safety and sustainability aspects of infrastructure. We expect this project to provide optimal performance, reduce maintenance costs, and increase the road's service life by selecting suitable materials and methods. Thus, the road pavement will be ready to support industrial activities with high efficiency and safety.

Overall, selecting the correct calculation method and reinforcement specifications in a rigid pavement design is crucial to ensuring road durability and safety. The analysis methods, such as PD T-14-2003 and Naasra 1987, offer clear guidance in determining the appropriate thickness of the concrete slab and sub-base for soil conditions and traffic flow. By comparing the thickness of the concrete slab and the sub-base and the details of the reinforcement used, it is expected that this road pavement will be able to withstand heavy loads and overcome the movement and stress generated by heavy traffic. Details of reinforcement specifications, including the use of longitudinal and transverse reinforcement, as well as the placement of Dowels and tie bars, also contribute to the structural strength of the pavement. We expect the road pavement, designed carefully, to meet current traffic needs and withstand future traffic volume developments. In addition, a well-planned road structure will provide long-term benefits for road users, including reduced maintenance costs and increased driving comfort. We expect the road pavement project in the industrial area to demonstrate effective and efficient civil engineering techniques by considering all these factors. The emphasis on safety and durability in pavement design will ensure that this infrastructure meets current needs and functions well in the long term. Thus, this project not only supports industrial activities but also positively contributes to the development of transportation infrastructure in the area.

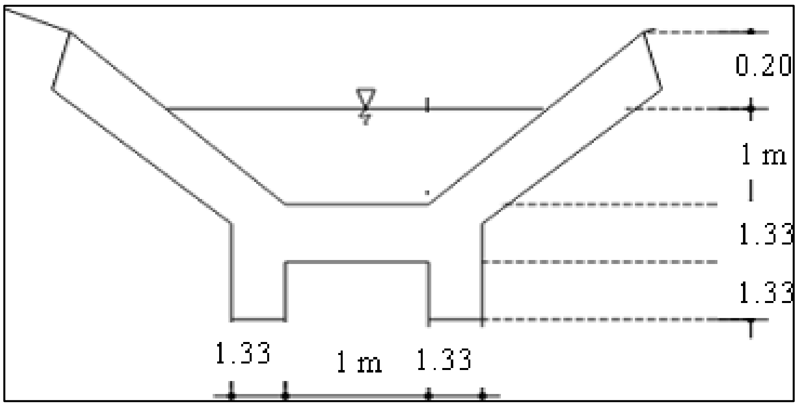

Fig 1. Drainage Channel

To support the building design at the specified location, the dimensions of the channel used have a square shape with a width and water height of 1 meter each. This size allows the channel to drain water effectively, ensuring the accommodated water volume does not surpass the planned capacity. The guard height of 0.2 meters is an essential factor in the design of this channel because it provides additional boundaries to prevent water overflow, which could cause problems such as flooding or damage to surrounding structures. This guard height also functions to maintain the stability of the water flow in the channel so that it remains controlled and can reduce the risk of flooding in the surrounding area. Planning a channel system requires consideration of various factors, including the channel's slope, the material type, and the potential load the channel will bear. This channel can handle water flow well by using dimensions of 1 m x 1 m. Still, it is necessary to ensure that the design is appropriate to the area's environmental conditions and water flow capacity. Therefore, it is essential to carry out hydrological and drainage analyses to determine whether the dimensions of the channel are adequate to handle possible rainfall and to ensure that the channel can function optimally during the period of use. The overall design of the channel must consider safety and sustainability to function as an effective supporting structure at the specified location.

We have analyzed two methods for calculating the cost of rigid pavement: the PD T-14-2003 method and the Naasra 1987 method. Results The calculation shows that the cost for rigid pavement using the PD T-14-2003 method is Rp. 4,562,100,000. This figure encompasses all cost components necessary for project implementation, including materials, labor wages, and other operational costs. Meanwhile, the cost of rigid pavement using the Naasra 1987 method is slightly higher, amounting to Rp. 4,659,780,000. This cost difference could be attributed to variations in material selection, construction techniques, and technical specifications applied in each method. Therefore, it is important to consider the advantages and disadvantages of each method in the context of cost efficiency and quality of the final result. The cost and other factors, such as durability, pavement life, and environmental impact, should be considered when choosing the right method. The PD T-14-2003 method may offer lower costs, while the Naasra 1987 can provide stronger and more durable results.

Further analysis of long-term costs and maintenance potential is also necessary to ensure the feasibility of both methods. This aims to determine the best option that meets the budget and provides expected performance over a more extended period. Overall, the cost calculation results for both rigid pavement methods indicate that careful planning and analysis are essential in determining the construction method that best suits the project needs and available budget.

4. Conclusion

There are two types of road pavement, namely concrete roads and paving roads; the road width is 16 meters, and the length is 433 meters; there is no shoulder; the planning is divided into three sections with dimensions of 5.3 meters long and 3 meters wide; the traffic flow is three lanes and one direction; and the casting implementation is divided into two areas to keep traffic still running. The calculation of each method yielded a comparison of the rigid pavement thickness. The Pd T-14-2003 method uses a concrete slab thickness of 150 mm and a lower foundation thickness of 100 mm, using a binder with several JSKN 4 x 107. In comparison, the Naasra 1987 method uses a concrete slab thickness of 160 mm, a lower foundation thickness of 100 mm, and a binder with many JSKN 6 x 107. The Pd T-14-2003 and Naasra 1987 methods connect the longitudinal reinforcement D10 mm - 150 mm and transverse reinforcement D10 mm - 250 mm with a Dowel diameter of 25 distance of 300 mm length of 450 mm and a Tie bar diameter of 19 distance of 600 mm length of 600 mm. The channel at the location supports buildings with square dimensions of 1 m x 1 m in width and 0.2 m in guard height. The cost calculation for rigid pavement with the Pd T-14-2003 method is Rp. 4,562,100,000, And the cost for rigid pavement with the Naasra 1987 method is Rp. 4,659,780,000.

References

[1] Y. Bai, X. Du, P.-S. Lin, W.-C. Ping, E. Zhai, and Y. Huang, "CHALLENGES AND ADVANCES IN SUSTAINABLE TRANSPORTATION SYSTEMS: PLAN, DESIGN, BUILD, MANAGE, AND MAINTAIN," in *Seminars in Oncology Nursing*, 2013, vol. 29, no. 3.

[2] M. Refiyanni and C. Chaira, "Characteristics of Mixed Porus Asphalt with Combination of LDPE, CPO and PEN 60/70," *Int. J. Eng. Sci. Inf. Technol.*, vol. 1, no. 4, 2021, doi: 10.52088/ijesty.v1i4.146.

[3] M. Ayung Tama, M. I. Setiawan, and S. Budi Wasono, "Analysis Of The Performance East Circle Road Of Sidoarjo," *Int. J. Eng. Sci. Inf. Technol.*, vol. 1, no. 2, 2021, doi: 10.52088/ijesty.v1i2.53.

[4] I. Maghfiroh, E. Puspitasari, and R. M. Jannah, "KAJIAN PERBANDINGAN KELAYAKAN EKONOMI PADA PERENCANAAN TEBAL PERKERASAN LENTUR DAN PERKERASAN KAKU," *Rev. Civ. Eng.*, vol. 5, no. 2, 2021, doi: 10.31002/rice.v5i2.4822.

[5] K. Ainiyah and K. Hadi Putra, "Perencanaan Peningkatan Perkerasan Kaku Dengan Menggunakan Metode Mdpj 2017, Pdt 14 2003,

Dan Aastho 1993 Pada Jalan Pabean –Wadungasri, Sidoarjo," *Etn. J. Ekon. dan Tek.*, vol. 2, no. 8, 2023, doi: 10.54543/etnik.v2i8.231.
[6] W. Ma, R. Q. Grafton, and A. Renwick, "Smartphone use and income growth in rural China: empirical results and policy implications," *Electron. Commer. Res.*, vol. 20, no. 4, 2020, doi: 10.1007/s10660-018-9323-x.
[7] S. Lelepadang, R. Nuhun, N. Nasrul, and S. N. Ahmad, "ANALISIS PERBANDINGAN BIAYA KONSTRUKSI PERKERASAN KAKU (RIGID PAVEMENT) DAN PERKERASAN LENTUR (FLEXIBLE PAVEMENT) (Studi Kasus : Jalan Prof. M. Yamin, Kelurahan Puuwatu, Kota Kendari)," *STABILITA || J. Ilm. Tek. Sipil*, vol. 8, no. 3, 2020, doi: 10.55679/jts.v8i3.16192.
[8] J. K. Roehrich, M. A. Lewis, and G. George, "Are public-private partnerships a healthy option? A systematic literature review," *Soc. Sci. Med.*, vol. 113, 2014, doi: 10.1016/j.socscimed.2014.03.037.
[9] S. Jalalul Akbar, M. Maizuar, K. Yusuf, and J. Arfiandi, "Monitoring the Dynamic Behavior of PCI Bridges Using Short Period Seismograph and CSI Bridge Modeling," *Int. J. Eng. Sci. Inf. Technol.*, vol. 1, no. 4, 2021, doi: 10.52088/ijesty.v1i4.168.
[10] C. Martín-Gámez, M. del C. Acebal, and T. Prieto, "Developing the Concept of 'Ecosystem' through Inquiry-Based Learning: a Study of Pre-service Primary Teachers," *J. Biol. Educ.*, vol. 54, no. 2, pp. 147–161, 2020, doi: 10.1080/00219266.2018.1554596.
[11] A. M. Boulay *et al.*, "The WULCA consensus characterization model for water scarcity footprints: assessing impacts of water consumption based on available water remaining (AWARE)," *Int. J. Life Cycle Assess.*, vol. 23, no. 2, 2018, doi: 10.1007/s11367-017-1333-8.
[12] S. G., H. A., and M. B., "The Characteristics of Asphalt Concrete Binder Course (AC-BC) Mixture with Bottom Ash as Aggregate Substitute," *Civ. Eng. Dimens.*, vol. 17, no. 1, 2015, doi: 10.9744/ced.17.1.29-37.
[13] V. M. Illayaraja Muthaiyaa, G. Elatharasan, and A. Krishnamoorthy, "National Conference on Green Engineering and Technologies for Sustainable Future-2014 Copper Slag," *JCHPS Spec. Issue*, 2014.
[14] I. S. Wong, S. Popkin, and S. Folkard, "Working Time Society consensus statements: A multi-level approach to managing occupational sleep-related fatigue," *Ind. Health*, vol. 57, no. 2, pp. 228–244, 2019.
[15] J. E. Ball *et al.*, "Post-operative mortality, missed care and nurse staffing in nine countries: A cross-sectional study," *Int. J. Nurs. Stud.*, 2018, doi: 10.1016/j.ijnurstu.2017.08.004.
[16] R. Widyo Kisworo and F. Sri Handayani, "Analisis Percepatan Proyek Menggunakan Metode Time Cost Trade Off Dengan Penambahan Jam Kerja Lembur Dan Jumlah Alat," *e-Jurnal Matriks Tek. Sipil*, no. September 2017, 2017.
[17] J. Meil, *A life cycle perspective on concrete and asphalt roadways : embodied primary energy and global warming potential*, no. September. 2006.
[18] J. Krishnaswamy, D. Abdullah, and T. C. Wen, "An empirical study on residents' place image and perceived impacts on support for tourism development in Penang, Malaysia," *Int. J. Acad. Res. Bus. Soc. Sci.*, 2018, doi: 10.6007/IJARBSS/v8-i16/5127.
[19] G. Popov and N. Vaysfel'd, "The torsion of the conical layered elastic cone," *Acta Mech.*, vol. 225, no. 1, 2014, doi: 10.1007/s00707-013-0957-4.
[20] S. Ali Rafsanjani, F. E. Rooslan Santosa, and R. Durrotun Nasihien, "Analysis of Planning for Clean Water Needs at Grand Sagara West Surabaya Hotel With the Green Buillding Concept," *Int. J. Eng. Sci. Inf. Technol.*, vol. 1, no. 2, 2021, doi: 10.52088/ijesty.v1i2.55.
[21] G. Browder, S. Ozment, I. Rehberger Bescos, T. Gartner, and G.-M. Lange, "Integrating Green and Gray: Creating Next Generation Infrastructure," *World Resour. Inst.*, 2019, doi: 10.46830/wrirpt.18.00028.
[22] B. Idrizi and M. Kurteshi, "Web System for Online and Onsite Usage of Geoinformation by Surveying Sector in Kosovo. Case Study: Ferizaj Municipality," *Geosfera Indones.*, vol. 4, no. 3, 2019, doi: 10.19184/geosi.v4i3.13469.
[23] R. U. Khan, J. Yin, F. S. Mustafa, and H. Liu, "Risk assessment and decision support for sustainable traffic safety in Hong Kong waters," *IEEE Access*, vol. 8, pp. 72893–72909, 2020.