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Rehabilitation of The Pedestrian Bridge at Simpang Kuda, Sei Panas

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ABSTRACT

Transportation plays a crucial role in global development, and as transportation systems improve, so do development activities and the economy. However, with the growth of transportation and the number of vehicles on the road, the risk of accidents also increases. Governments are constructing pedestrian facilities to reduce the likelihood of pedestrian accidents. Pedestrian bridges are designed to improve pedestrian safety and convenience. Nevertheless, some pedestrian bridges built by the government, like the one located at Simpang Kuda, Sei Panas, experience low utilization due to various factors. These factors include inadequate placement, inconvenient staircases that result in longer journeys, and unsafe bridge conditions. Consequently, pedestrians often cross the road directly rather than using the pedestrian bridge. This study focuses on evaluating the condition of the pedestrian bridge at Simpang Kuda, Sei Panas, and identifying necessary measures for rehabilitation and maintenance. The research incorporates two types of data; primary data is gathered through observation, while literature review methods are used to collect secondary data. Observations and visual inspections identify common issues such as concrete cracks, absence of handrails, steel corrosion, and overgrown vegetation. Recommendations to address these problems involve repairing cracks, installing handrails, protecting against corrosion, managing vegetation growth, and implementing regular maintenance. The research findings offer valuable guidance to local authorities, enabling them to prioritize pedestrian safety and ensure the bridge's sustained functionality. Adequate allocation of resources and the local government's commitment are essential in implementing these recommendations and enhancing the well-being of pedestrians in urban areas.

1. Introduction

Transportation plays a significant role in world development, as it is the basis for community development and economic growth. Along with the development of transportation, development activities, and the economy will also increase. Transportation involves moving or shifting people or goods from one place to another [13]. The development of urbanization creates new transportation demands and encourages the development of transportation, which changes the spatial form of urban areas and affects the development of the transportation industry. Transportation is a service activity. Transportation services are needed to support activities in other sectors. Therefore, transportation services are called derived demand, where transportation demand increases as demand increases from economic, industrial, and development activities. With the increase in transportation and vehicles, the risk of accidents for both motorists and pedestrians will also increase. According to the Indonesian Central Bureau of Statistics, the number of traffic accident cases in Indonesia from 2015-2019 increased by 20,178. Unsafe road crossings have been identified as the leading cause of pedestrian accidents. To minimize the risk of pedestrian accidents, the government is building pedestrian facilities such as sidewalks and pedestrian bridges so that pedestrians do not disrupt the flow of vehicles [2].

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Pedestrian bridges are public facilities designed as safety or special lanes for pedestrians in urban areas. Pedestrian bridges are facilities for crossing traffic, not on plots, because they are designed to minimize traffic conflicts at crossings [3]. In urban areas, transportation facilities and infrastructure are essential to supporting community activities [33] [34]. As Batam's transportation system develops rapidly, it is also necessary to build pedestrian bridges. The Batam City government made road-crossing bridge facilities in a few areas to ensure safety, comfort, smoothness, and security for pedestrians crossing the road. However, many pedestrian bridge facilities the government has designed are not used by pedestrians for several reasons. The reasons include the improper location of the bridge, the long walk due to the stairs, and the condition of the bridge, which is uncomfortable and unsafe for pedestrians. Safety, security, convenience, smoothness, system integration, comfort, and attractiveness must be prioritized in designing it. In urban development, pedestrian facilities are often overlooked, while motorized vehicles are prioritized [6]. This condition can be found on many pedestrian bridges in Batam City. There needs to be maintenance on the bridge, making pedestrians feel unsafe when using the pedestrian facilities.

Safety for pedestrians in urban traffic is a complex but significant issue [7]. It is common for pedestrians to choose the quickest way to reach their destination without considering their safety. This phenomenon can be seen on the pedestrian bridge at Simpang Kuda, Sei Panas. The pedestrian bridge is located near Public Elementary School 001 Batam Kota, where many pedestrians are children and parents walking home. However, they are reluctant to use the pedestrian bridge to cross the road because they feel unsafe using the pedestrian bridges due to the conditions of the bridge, such as concrete spalling, steel corrosion, and broken handrail. Therefore, they prefer to cross the road directly. The pedestrian bridge is also near the Bengkong Area, which has good road performance. As a result of this situation, pedestrians will be at risk as well as traffic will be disrupted.

Based on the problems that have been stated above, research was carried out to assess the pedestrian bridge condition at Simpang Kuda, Sei Panas. This research aims to determine how to rehabilitate and maintain the bridge condition so that pedestrians will feel safe using the pedestrian bridge in the long term.

2. Literature Review

2.1 Pedestrian

Pedestrian movement is still a significant component of today's urban transportation networks as it has always been an essential mode of transportation. Pedestrians are those who travel on foot from one place to another. In the transportation field, pedestrians are people who walk on pedestrian paths, whether on roadsides, sidewalks, or specific pedestrian paths or crossings [37]. Pedestrians are expected to enjoy the atmosphere and facilities while moving from one place to another [48].

2.1.1 Pedestrian Accident

Over 120 years ago, a British woman named Bridget Driscoll became the first pedestrian fatality recorded in history. Over the next few decades, motorized vehicles developed globally. Today we have countries labelled as motorized and less motorized. A reduction in pedestrian accidents and fatalities has been reported in more motorized countries, and the rate of traffic fatalities has stabilized [10].

Traffic fatalities in low-income countries continue to rise, while pedestrian fatalities remain high. Low and middle-income countries are the less motorized countries. Most motorized countries have reported a decrease in road traffic fatalities, but less motorized countries report an increase. Over half of pedestrian deaths occur in low-income countries. Traffic fatalities continue to rise in low-income

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countries, and pedestrian fatalities have remained high worldwide. Over 400,000 pedestrians die yearly from pedestrian crashes, over half in low-income countries.

2.2 Pedestrian Bridge

Pedestrian bridges are essential in urban areas, providing a safe passage for pedestrians over land or water. Originally, pedestrian bridges were designed to meet the needs of urban traffic, but they have since evolved to provide more than just a safe passage for pedestrians. Today, pedestrian bridges are often used to connect areas of high traffic to bridge gaps between roads, plazas, and railway systems. The primary function of a pedestrian bridge is to provide a safe separation between pedestrians and vehicles. They can also offer a direct route for pedestrians to access different parts of the city, allowing them to avoid areas of high traffic. Pedestrian bridges are essential to urban infrastructure, providing a safe passage for pedestrians and promoting a more sustainable urban environment [11]

Pedestrian bridges can be used decoratively to connect two distinct areas or serve to sign a transaction. The construction of a pedestrian bridge will eliminate conflicts between pedestrians and motor vehicles. Although pedestrian bridges are primarily designed for and by humans, they entail a multiplicity of interactions responsive to in-situ environmental change. It is important to note that a pedestrian bridge is one of the infrastructure facilities for pedestrians to ensure their safety so they can cross the road safely. The pedestrian bridge facility is intended for pedestrians who will not use a level crossing to cross the road (Dermawan et al., 2022). It is usually the case that pedestrian facilities are needed primarily in urban areas, due to the high level of social dynamics, especially in crowded places such as trade centres, stations, terminals, schools, and others, where there are a large number of pedestrians.

2.3 Rehabilitation and Maintenance

In general, rehabilitation is defined as a set of civil works intended to restore or upgrade structural design parameters [12]. There are five stages to rehabilitating damaged reinforced concrete bridges and their subsequent safe operation. The first stage is regular inspection of the construction's technical condition. This activity is to detect significant defects and deterioration of the bridge. The second stage of rehabilitation is logistical preparation for the construction rehabilitation, followed by the third stage, designing a renovation project.

After the overall bridge rehabilitation project is completed, renovation works are carried out. Minor and major repairs are performed to restore a bridge to its original serviceability. After the rehabilitation of the bridge, improvements to its serviceability are implemented, taking into account existing traffic conditions and the environment. Monitoring the construction technical condition will follow the post-rehabilitation. To restore the bridge's original serviceability, repair works are implemented to repair its defects. At the same time, improvements are being made to improve bridge serviceability, considering traffic and environmental conditions. Routine maintenance is carried out to prevent further deterioration.

3. Method

Data is one of the major forces in the development of scientific research and modeling. However, large data sets are only meaningful if correctly interpreted and translated into accurate predictions [31] [32] [33] [34] [35]. The data used in this research can be divided into two types of data primary and secondary. Primary data is obtained by observing the performance conditions at the actual site. Observation is used to collect primary data, and literary methods are used to collect secondary data in this study. The observation method is a technique that collects data by observing and recording the physical condition of objects, and the literature method is a technique that collects library data and

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identifies and processes the obtained written data. This data collection is the next step in the preparatory stage before conducting this study. The data obtained correspond precisely and reasonably to the research plan. The data was collected from the pedestrian bridge at Simpang Kuda, Sei Panas, Batam, Kepulauan Riau, Indonesia. This research was conducted on 18th May 2023 from 10.00-10.30 A.M

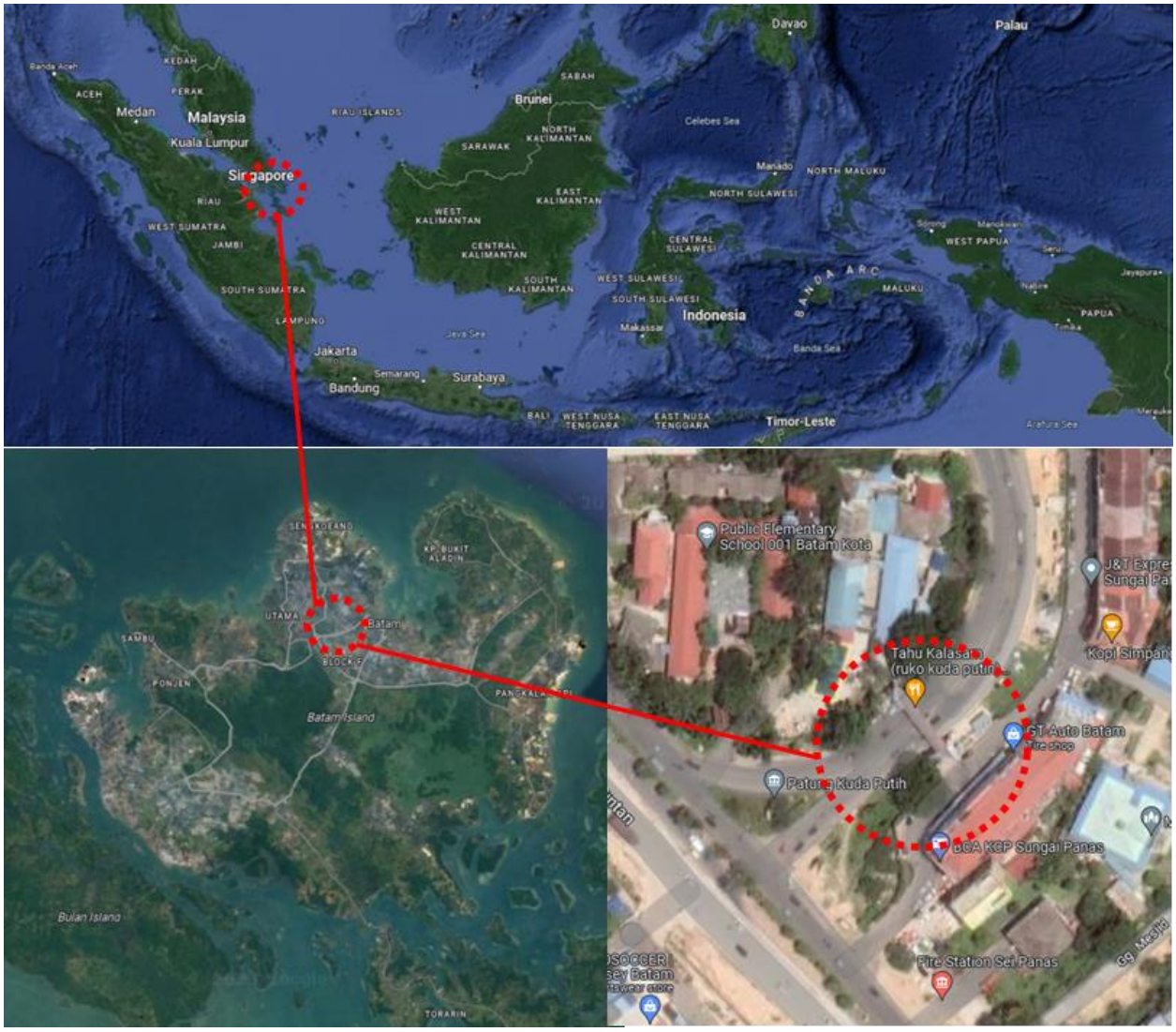

Figure 1. Location of research

4. Result and Discussion

4.1 Deteriorations

The pedestrian bridge located at Sei Panas has experienced damage and deterioration. However, efforts have yet to be made to repair or maintain the bridge. Certain damages have rendered the bridge unsafe for pedestrians to utilize. Vertical cracks, with a width of less than 2 mm and of moderate intensity, are present in the central column of the bridge, as shown in Figure 2a. Cracks are also found in the stair column, as depicted in Figure 2b. The cracks in the first stair column are 1 mm wide and have a light intensity level. However, Figure 2c reveals that the second stair column exhibits cracks and partially destroyed concrete, posing a hazardous condition.

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Figure 2. Deterioration of pedestrian bridge the first stair column

The absence of handrails along the edge of the bridge poses a significant safety risk for its users. Figure 3 shows that the road connecting the bridge to the school lacks handrails, prompting the school to close the road due to safety concerns, especially for the children who frequently use it. Additionally, Figure 6 highlights the lack of handrails on the stairs leading to the bridge, further jeopardizing the safety of the bridge users.

Figure 3. Lack of handrails on the stairs

Figure 4 shows that the steel deck of the bridge is undergoing corrosion. This rusting is commonly attributed to prolonged exposure to air and water. However, maintenance and preservation efforts have yet to be undertaken to alleviate the rust-related issue.

Figure 4. Corrosion on the steel deck

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Figures 5 show a significant growth of small plants and moss on the bridge stairs. Maintaining open airspace around the bridge is recommended without any plants or vegetation. The presence of plants and vegetation can cause the bridge structure to absorb moisture and accelerate its deterioration.

Figure 5. Weeds growing on the staircase

4.2 Rehabilitation and Maintenance

The damage occurring on the pedestrian bridge at Sei Panas can be addressed using various methods suitable for the specific type and extent of the damage. Prioritizing the safety of workers during the repair process, it is essential first to handle the cracks found in the central column and stair columns before proceeding with repairs and maintenance on other areas.

The cracks observed on the central column in Figure 2 and the stair columns in Figure 3 can be effectively treated through crack injection and filling. Crack filling involves cleaning the surface of the cracked concrete, applying sealant, and injecting epoxy adhesive using specialized tools to restore structural integrity. In Figure 4, addressing the cracks on the stair columns requires the removal of damaged concrete, followed by thorough cleaning and applying new concrete adhesive and densely installed concrete material.

After the column repairs, the subsequent step involves mitigating the corrosion on the steel deck. This process initiates with removing rust from the steel surface using a water jet and promptly applying a protective coating. Finally, the steel is coated with galvanized steel paint. To enhance safety and comfort, particularly for school children who utilize the pedestrian bridge, it is recommended to install railings in bridge sections lacking such features as stair sections and connecting parts. The growth of plants and moss can accelerate bridge deterioration, necessitating their removal through mowing or weeding. Also, a water jet can effectively clean roads and stairs filled with dirt and dust.

5. Conclusion

After conducting a visual inspection and observing the pedestrian bridge at Simpang Kuda, Sei Panas, it is evident that immediate attention is needed to address various issues, such as damages, neglect, and safety hazards. The presence of cracks in the primary and staircase columns, the lack of railings, corrosion on the steel deck, and vegetation growth all contribute to its deterioration. Recommended methods to rectify these problems include repairing the cracks, installing railings, cleaning, and protecting the steel deck, managing vegetation growth, and establishing a regular maintenance program. This research is a valuable reference for local authorities to address the issues identified in the pedestrian bridge at Simpang Kuda, Sei Panas. The findings and recommendations can guide them in implementing necessary measures, such as repairs, railings installation, corrosion protection,

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vegetation control, and regular maintenance. By utilizing this research as a reference, local authorities can prioritize the safety and well-being of pedestrians and ensure the longevity and functionality of the bridge. The allocation of sufficient resources and the prioritization of these efforts by the local government and authorities are essential to ensure the safety and well-being of pedestrians in urban areas like Simpang Kuda, Sei Panas.

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