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MRT in Surabaya without Land Acquisition by Utilizing the River Routes and the Existing Single Track Railroad

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ABSTRACT

Traffic congestion that occur between the city of Surabaya and the surrounding buffer cities which are 30 to 50 kilometers away are caused by the increasing use of private vehicles and the decreasing use of public transportation because it is considered that the process will be complicated and travel ineffective. This will cause an imbalance between the capacity of the highway and the number of vehicles, resulting in traffic congestion, especially during peak hours. To overcome this problem, improvements are made to sustainable and community liveability in the form of optimal utilization of existing properties in the city, including rivers and existing railroad. With the background above, this paper will present the idea of a solution to overcome traffic congestion by utilizing the drainage channel or rivers and the single tracks railroad to become MRT lanes. This transportation system innovation will be proposed as an evaluation of the Indonesian Railroad Master Plan (2018 to 2030), specifically to be implemented in the city of Surabaya and surrounding.

Keywords: green infrastructure, MRT, traffic congestion

1. Introduction

The rise of Mass Rapid Transportation (MRT) systems has become a significant symbol of urban modernization and development in cities worldwide. However, development decisions regarding transportation infrastructure are often made based on symbolic importance rather than efficiency, leading to significant financial waste [1]. It is important to note that the impact of infrastructure projects on traffic flow is typically short-lived, with improvements lasting only 4 to 6 years before traffic congestion returns to previous levels [2]. This phenomenon underlines the need for more sustainable, long-term solutions to urban transportation issues [3].

In Surabaya, the growing urbanization of surrounding cities like Sidoarjo, Gresik, and Bangkalan has created a situation where traffic congestion has reached critical levels, particularly during peak hours [4]. This congestion extends into nearby cities such as Mojokerto, Lamongan, and Pasuruan, with traffic jams regularly occurring from early morning until late at night. As shown in Figure 1, the A.Yani Street in Surabaya

experiences heavy traffic, particularly during peak hours, contributing to daily inefficiencies and environmental concerns. Furthermore, escalating land prices in Surabaya make traditional urban development solutions, such as new roads or tolls, increasingly unfeasible. As noted by Eri Cahyadi, the Head of the Surabaya City Development Planning Board, land prices in Surabaya can sometimes triple, further exacerbating the challenges of expansion and urbanization [5].

Figure 1. Traffic condition in A.Yani Street Surabaya on peak hour.

Another crucial factor contributing to traffic congestion in Surabaya is the imbalance between road capacity and the increasing number of private vehicles. In 2018, the total length of roads in Surabaya was recorded at 1,703.83 kilometers, while the number of private vehicles had reached over 5 million units [6]. Table 1 highlights the growing disparity between road capacity and vehicle numbers from 2014 to 2018, illustrating the worsening problem of traffic congestion in the city [7].

Table 1. Number of private vehicles, populations, and length of the roads at 2014 - 2018.

Year	2014	2015	2016	2017	2018
Number of Private Vehicles	4.327.725	4.499.427	4.664.553	4.811.001	5.015.001
Number of Population	2.853.661	3.272.955	3.307.300	3.327.474	3.345.775
Length of The Roads (km)	1.679,14	1.682,02	1.686,38	1.699,63	1.703,83

Several potential solutions have been proposed to address this issue, including the development of MRT systems, monorails, trams, and double-track railways [8]. However, many of these solutions tend to focus on symbolic gestures rather than practical, efficient alternatives. There is a need for innovative breakthroughs in transportation planning, financial systems, and managerial strategies to provide a lasting solution [9]. This paper proposes an alternative approach: the utilization of existing infrastructure, specifically the drainage channels and single-track railroads, to create an MRT system that avoids the need for land acquisition and capital-intensive construction [10].

In 2014, a polemic arose in Surabaya when the local government and the central government disagreed over the construction of a flyover toll road. While the central government supported this infrastructure project, Surabaya's Mayor Tri Rismaharini opposed it for several reasons: it would exclude certain people, worsen social inequality, and increase the risk of property value loss under the elevated road, as well as potential environmental impacts from disrupted water flows [11]. Instead, the city explored alternative solutions, including the construction of new roads over existing rivers using box culverts, as shown in Figures 2 and 3

[12]. However, these solutions have faced criticism due to their environmental impact, particularly in terms of disrupting the natural hydroecological functions of the rivers [13].

Despite these challenges, Surabaya is known for the resilience and collective spirit of its citizens. The "City of Heroes", as it is known, has always been able to unite people for a common cause, and this spirit could prove essential in developing an effective and efficient mass transportation system [14]. This paper presents a solution to the ongoing traffic congestion by proposing the use of existing river routes and single-track railroads to develop a sustainable MRT system. By utilizing existing land and infrastructure, this solution can help address Surabaya's transportation issues without the need for costly land acquisition [15].

Figure 2. The box culvert development project in Jemur Ngawinan street, Surabaya [3].

Figure 3. Highway on the box culvert, Jemur Ngawinan street, Surabaya [4].

2. Method

This study employs a combination of site observations and secondary data analysis to assess the feasibility of utilizing existing river routes and single-track railroads for the development of a Mass Rapid Transportation (MRT) system in Surabaya. The primary aim of this approach is to evaluate the spatial distribution and potential of the transportation infrastructure in Surabaya, which can be leveraged for this MRT project.

Site and location observations were conducted to identify potential routes for the MRT system, focusing specifically on areas where river channels and existing railroads are located. The observations began in the vicinity of the Suramadu Bridge valley, proceeding along the river or drainage channel on Kedung Cowek Road. The evaluation continued through various roads, including Karang Asem Road, Tambang Boyo Road, Jalan Raya Menur, Jalan Raya Manyar, Jalan Raya Nginden, Jalan Raya Prapen, and Jalan Raya Jemursari. These routes were chosen because they provide accessibility and are already integrated into Surabaya's urban landscape. After traveling westward for 800 meters along Jalan Raya Jemursari, the river channel meets the single-track railway line, offering an opportunity to continue the MRT line along this established route. To

ensure the accuracy of the proposed routes, the observations were cross-checked with Google Maps and existing secondary data. This data validation process ensured that the proposed routes align with urban planning frameworks and transportation infrastructure already in place, further confirming the feasibility of the route. The integration of primary site observations with secondary data provides a comprehensive understanding of the proposed MRT system's potential.

The typology diagram of the MRT route, shown in Figure 4, illustrates the spatial division of the proposed MRT line, which consists of two main track typologies. The first portion follows river or drainage channels, spanning approximately 55 kilometers. These river routes were chosen due to their accessibility and minimal disruption to existing urban infrastructure, offering an environmentally friendly and cost-effective option for transportation development. The second portion of the route switches to the existing single-track railway line along Jalan Raya A. Yani Surabaya for a distance of 3 kilometers. This track continues across Sidoarjo for an additional 22 kilometers and extends further for another 11 kilometers to the Bangil Pasuruan station. By using existing rail infrastructure, the project can significantly reduce the need for new land acquisition and large-scale construction, making it a more cost-effective and efficient solution.

In conclusion, the methodology emphasizes utilizing existing infrastructure to create a continuous MRT line that requires minimal new construction, thus addressing one of the major challenges of MRT development—land acquisition. The proposed route, as shown in Figure 4, integrates these existing channels and railroads into a cohesive system that addresses Surabaya's traffic congestion while minimizing environmental and financial impacts.

Figure 4. Typology diagram and division of MRT line distance in Surabaya without land acquisition by utilizing the river routes and the existing single track railroad

3. Result and Discussion

The proposed solution to address the traffic congestion issue in Surabaya involves utilizing existing river routes and single-track railroads to create a Mass Rapid Transportation (MRT) system, a strategy that directly addresses the high land prices in the city. Surabaya's growing urban sprawl has resulted in increasingly dense traffic, with congestion extending from the city into neighboring buffer cities, such as Sidoarjo, Gresik, Bangkalan, Mojokerto, Lamongan, and Pasuruan. Given the escalating costs of land acquisition, this study proposes leveraging existing infrastructure to avoid the need for expensive land purchases.

The proposed river route, beginning at the mouth of the Kedung Cowek River near the Suramadu Bridge, heads southward toward Jalan Jemursari, where it intersects with an existing railway line on Jalan A. Yani. The rivers in Surabaya that can be utilized for the construction of the MRT lane are wide enough—at least 7 meters in width—and can be directly connected to the existing railway line, extending the MRT system southward to Bangil Pasuruan. Figure 5 illustrates the existing river and railroad lines that have the potential to serve as MRT lanes. These existing pathways represent an efficient, cost-effective method for extending the MRT without the need for new land acquisition.

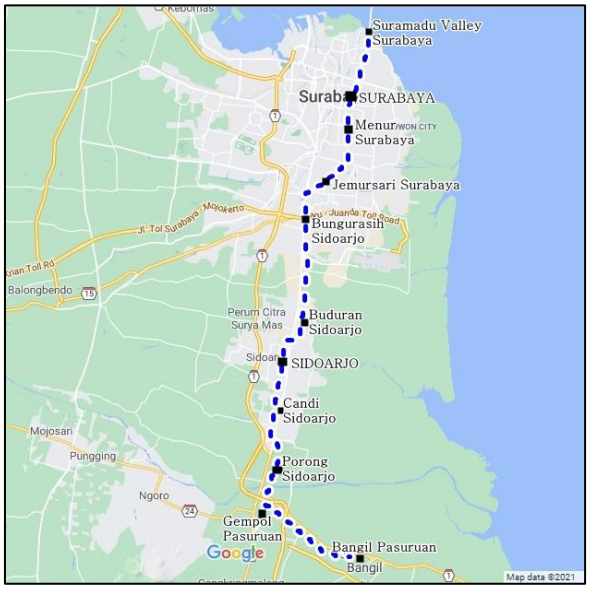

Figure 5. The existing river and railroad lines that potential to serve as MRT lanes

The route begins at Kedung Cowek, as shown in Figure 6, where the river serves as the initial alignment for the MRT track. This river, as shown in Figure 7, stretches north to south and serves as the ideal location for the first leg of the proposed MRT system. The Jemursari River also presents an opportunity for connection to the railway network, as depicted in Figure 8. The MRT system could then follow these established routes through urban areas that are already developed, ensuring minimal disruption to the surrounding environment and existing infrastructure.

Figure 6. Existing image of the Suramadu Bridge valley

Figure 7. The existing river stretching north-south on Kedung Cowek Street Surabaya as the start of the MRT route

Figure 8. Existing image of the river along the Jemursari road Surabaya

Further along the route, Figure 9 and Figure 10 show the existing Sidoarjo Railway Station and its connectivity with the proposed MRT system. The alignment continues through Sidoarjo, where the MRT line can seamlessly transition to the single-track railroad along Jalan Raya A. Yani. This section of the route, as shown in Figure 11, illustrates the existing railroad bridge across the Porong River, which serves as an integral part of the MRT line's infrastructure. This bridge can be modified and integrated into the MRT system to ensure continuity along the route.

Figure 9. Existing image of the Sidoarjo Railway Station (1)

Figure 10. Existing image of the Sidoarjo Railway Station (2)

Figure 11. Existing image of the railroad bridge across the Porong River

Finally, the MRT line would continue through Bangil, as shown in Figures 12 and 13, where the line would terminate at the Bangil Pasuruan Station. The inclusion of existing infrastructure in these areas not only reduces costs but also minimizes the need for extensive construction or land acquisition, both of which are typically the most costly aspects of building transportation systems.

The results indicate that using existing river routes and railroads provides an efficient and economically viable solution to Surabaya's transportation challenges. These proposed routes, illustrated through the various figures, ensure a continuous and accessible MRT system while leveraging already available land. By utilizing these pre-existing infrastructures, the city can bypass the high costs associated with land acquisition, a major obstacle in traditional MRT development. The final system is not only cost-effective but also environmentally sustainable, as it repurposes existing waterways and rail corridors that are already integrated into the city's urban fabric.

Figure 12. Existing image of the Bangil (Pasuruan) Railway Station (1)

Figure 13. Existing image of the Bangil (Pasuruan) Railway Station (2)

4. Conclussion

The development of a Mass Rapid Transportation (MRT) system in Surabaya, utilizing existing infrastructure such as river routes and single-track railroads, presents a sustainable and cost-effective solution to the city's ongoing traffic congestion issues. With increasing urbanization and the growing population in Surabaya and its surrounding areas, traditional methods of expanding road networks through land acquisition have proven to be both expensive and inefficient. The proposed approach of repurposing existing waterways and rail corridors offers a practical alternative that minimizes the need for new land, significantly reducing both financial and environmental costs.

By utilizing medium-wide rivers such as the Kedung Cowek River and Jemursari River, alongside the single-track rail network along Jalan A. Yani and extending to Bangil Pasuruan, the proposed MRT system can connect key areas in Surabaya and its surrounding cities. This strategic use of existing infrastructure addresses the challenges of traffic density while avoiding the complications associated with land acquisition. The integration of the MRT with existing rail lines and waterways enhances the overall urban mobility network, promoting environmental sustainability and reducing urban sprawl.

Figures 5 through 13 illustrate the specific routes that have been identified for the MRT system, emphasizing the potential of Surabaya's rivers and railroads for efficient urban transport. The careful planning of these routes ensures that the system will not only be feasible but also optimally integrated into the city's existing infrastructure, providing a long-term solution to traffic congestion.

In conclusion, this study demonstrates that by utilizing green infrastructure and existing transport corridors, Surabaya can build a modern and efficient MRT system without the need for costly land acquisition. This approach not only provides a practical solution to Surabaya's transportation challenges but also offers a model for other cities facing similar issues. The involvement of the local community in the planning and implementation phases further ensures that the system reflects the values and needs of Surabaya's citizens, aligning with the city's historical spirit of collaboration and resilience. The proposed MRT system thus represents a forward-thinking, cost-effective, and environmentally responsible transportation solution for Surabaya's future.

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6. Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper. The research was conducted with the highest standards of academic integrity and without any external influence or financial gain. All findings and recommendations presented in this paper are the result of the authors' independent analysis and evaluation of the data.

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