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Analysis of Construction Costs on the Improvement of the Dupak Road Section in Surabaya City

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ABSTRACT

The rapid growth of traffic in urban areas, especially on the *Jalan Raya Dupak* Surabaya section, has a significant impact on the decreasing lifespan of road pavement plans and increases the need for construction costs. This research aims to analyze and calculate the estimated cost of improving the Dupak road section in Surabaya City. The methods include analysis of average daily traffic data (LHR), calculation of single axle equivalent load (ESAL), and rigid pavement structure design, considering the underlying soil conditions and projected traffic load over the design life of 40 years. The results of the research show that a traffic growth rate of 5.6% per year leads to a significant decrease in the design life if it is not addressed with an appropriate pavement design. The estimated cost of road improvement reaches Rp 11,513,568,000.00. It is hoped that this research will assist in planning the improvement of urban arterial roads to maintain the sustainability and efficiency of transportation infrastructure.

Keywords: *design life, rigid pavement, road improvement costs, traffic growth*

INTRODUCTION

Roads are an important component of road transport infrastructure, which includes all segments of highways, as well as other complementary structures that may be located on the surface or underground, and waterways, with the exception of railways and cable routes (*NUMBER 38 OF 2004*, 2004). Roads function as vital transportation infrastructure that facilitates human mobility, thereby promoting economic progress, increasing social and cultural interactions, ensuring national stability, and contributing to the equitable distribution of development (Rangkuti, 2022). Roads are a crucial element of transportation infrastructure that can significantly affect the economic, social, cultural, and political development of a given region. To ensure comfort and safety for drivers, it is imperative that the road is supported by high-quality pavement. Pavement refers to a construction layer placed on the foundation of a road, particularly on a highway, designed to bear and withstand the direct loads imposed by vehicular traffic (Saodang, 2005).

According to Afan and Moh. Michol (2020), road infrastructure is a critical necessity because it facilitates various sectors within a region, including economic, social, cultural, and tourism dimensions. As a result, the government continues to advance knowledge related to the demand for the road network. In 2024, the Directorate General of Highways within the Ministry of Public Works disseminated a new set of guidelines to serve as a framework for road construction: the *Road Pavement Design Manual Number 03/M/BM/2024*. The provisions outlined in this manual adequately address issues related to vehicle loads, temperature variations on pavement, and sliding soil. In practical application, the 2024 road pavement design manual is still governed by established guidelines (*AASHTO Guide for Design of Pavement Structures*, 2004) and Austroads AGPT02-17. However, when complying with previous regulations, it is imperative that the planning process aligns with the provisions of the 2024 guidelines, which require consideration of factors such as potential road damage, projected road life (design duration), substructure road design, and anticipated vehicle loads. During the pavement design phase, it is important for planners to have a comprehensive understanding of field conditions. After reviewing this discourse, this text will use *Regulation Number 03/M/BM/2024* as a reference point in determining the design of rigid pavement. With this planning, it is hoped that transportation facilities can operate effectively, as transportation is the lifeblood of society and the economy.

In order for road construction to be carried out effectively and efficiently, the process must follow certain stages. It starts with formulating project requirements, which are part of project management, and ends at the supervision and maintenance stage. Basically, the stages of road construction are determined by the class of road, its function, or its size. Considerable effort is required given limited infrastructure resources. Increased classification or street function correlates with increased complexity of operational phases. In addition, major highways typically have significant impacts on pre-existing transportation networks and can substantially affect land use patterns, which in turn alter adjacent environments. Thus, careful road planning is crucial and must be implemented in practice.

Road damage is an event that causes road pavement to deviate from its original geometric configuration, potentially resulting in pavement degradation such as potholes, cracks, wrinkles, and other forms of distress. Road pavement surfaces often suffer damage or failure before reaching the anticipated service life. The assessment of road pavement conditions can be categorized into structural and functional deficiencies. Structural damage occurs when the road structure is compromised, either partially or entirely, such that the pavement cannot withstand imposed loads. To address this problem, it is very important to improve the pavement structure through resurfacing (*overlay*) and rehabilitation with rigid pavement. In line with the *Road Pavement Design Manual*, six classifications of road damage are described in document No. 04/SE/DB/2017, which include cracks, distortions, load-related defects, wear, oily surface properties, and damage associated with prior utility installations. The following statement will explain each category of damage identified (Road Pavement Manual, 2017).

Rigid pavement, also known as cement concrete pavement, is a pavement structure made of aggregate and cement as the bonding material (Aly, 2004). In pavement construction, traffic loads consist of three components: vertical forces from the vehicle load, horizontal forces from braking, and vibrational forces generated by wheel rotation. Due to force distribution, the load received by the lower pavement layers decreases progressively. Therefore, the surface layer must be able to withstand vertical forces and vibrations simultaneously, while the subgrade is assumed to withstand only vertical forces. Compared to flexible pavement, rigid pavement tends to be more expensive for light to medium traffic, especially in urban and rural areas where construction disturbances are minimal. However, for city streets with heavy vehicle restrictions, rigid pavement can be a more economical option. Additionally, in locations with limited workspace, the construction process of rigid pavement is usually faster and more practical than flexible pavement.

According to Waluyo et al. (2008), one of the important processes in construction projects is activity cost estimation. This is conducted to answer the question, "How much money should be allocated for a building?" In most cases, construction work involves substantial costs. Stakeholders will suffer consequences from inaccuracies in budgeting. RAB (*Rencana Anggaran Biaya*) is a calculation of the cost requirements for workers, wages, and materials related to the work performed. The following formula can describe the cost budget plan of a project:

RAB = ∑ (Volume × Unit work price)

The unit prices of materials and labor wages differ by region. When calculating and budgeting project costs, it is crucial to consider these variations. Accurate cost estimation requires a comprehensive understanding of the construction process, including the types and necessity of tools, as these factors directly influence overall construction expenditures. Cost budgets can also be affected by productivity, material availability, weather conditions, contract types, and management control systems.

The rapid growth of urban traffic, particularly on arterial roads like *Jalan Raya Dupak* in Surabaya, has led to accelerated pavement deterioration and increased construction costs, posing significant challenges for infrastructure sustainability. Despite the availability of pavement design manuals such as the *2024 Road Pavement Design Manual*, there remains a gap in localized studies integrating traffic growth analysis, soil conditions, and cost estimation tailored to specific urban contexts. Existing research often focuses on flexible pavements or theoretical models, leaving a need for empirical studies on rigid pavement applications in high-traffic urban areas, especially in developing regions like Indonesia. This research addresses this gap by providing a comprehensive analysis of rigid pavement design and cost estimation for the Dupak road section, offering practical insights for similar urban arterial roads.

The urgency of this research is underscored by the critical role of *Jalan Raya Dupak* as a key transportation artery in Surabaya, where traffic growth of 5.6% annually exacerbates pavement damage and disrupts economic and social activities. Delayed or inadequate road improvements could lead to higher long-term maintenance costs and reduced road safety, impacting urban mobility and regional development. By analyzing traffic data, soil conditions, and pavement design, this research provides timely solutions to mitigate these issues, ensuring the road's longevity and functionality. The findings are particularly relevant for policymakers and urban planners seeking cost-effective strategies to maintain infrastructure amid rapid urbanization and increasing vehicular loads.

This research introduces novelty by combining traffic growth projections, equivalent single axle load (ESAL) calculations, and rigid pavement design under the 2024 guidelines, offering a holistic approach to urban road improvement. Unlike previous studies, it emphasizes the economic feasibility of rigid pavement in high-traffic urban settings, supported by detailed cost analysis and volume calculations. The objectives include determining the optimal pavement thickness, estimating construction costs, and evaluating the project's cost-benefit ratio. The benefits extend beyond Surabaya, serving as a model for other cities facing similar challenges, while contributing to academic discourse on sustainable infrastructure development. Ultimately, this research aims to enhance transportation efficiency, reduce long-term maintenance expenses, and support equitable urban growth.

METHOD

Quantitative methods based on secondary data were used in this research. Interested agencies gathered for this research include the Planning Consultant and the Surabaya City Water Resources and Highways Office. Required secondary data include the unit price of work, the current type of pavement, DCP field CBR test results, and average daily traffic volume (*LHR*) data. To collect primary data, road tracking is carried out to collect data on the physical condition of the road. The inspection was carried out by collecting visual data on road conditions during the survey. The current width of the road in meters, field documentation, the current type of pavement, and the location of the damage are all data obtained from this research.

The data from the survey results that have been obtained from the field are then combined with data obtained from related agencies to identify the type of road damage and determine the appropriate repair design. After getting the desired pavement design, it can be continued with an analysis of the calculation of the cost of road improvement construction. Data analysis can be done through the following stages:

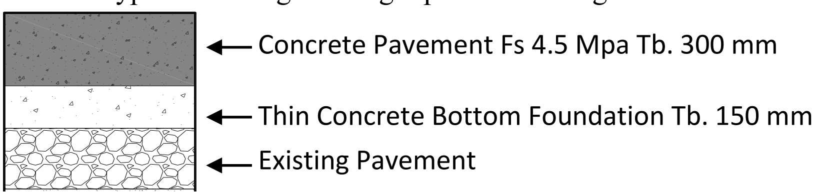
1. Preliminary survey.
2. Traffic Growth Analysis according to *LHR* 2023 data and *LHR* 2025 data.
3. Identify and calculate excessive vehicle load on the Dupak Highway in Surabaya City.
4. Analysis of the Age of the Pavement Plan.
5. The CESA value is calculated using equivalent numbers for each vehicle type.
6. Using the JSKN value comparison plan.
7. Road Capacity Analysis.
8. Thickness Analysis of Rigid Pavement.
9. Cost analysis.

RESULTS AND DISCUSSION

Rigid Pavement Design

From the results of the analysis of Fatigue Damage and Erositebal Damage to concrete that can withstand loads. The traffic for rigid pavement designs is 300 mm.

Here are typical drawings for Rigid pavement designs:



Calculation of Work Volume

The calculation of the volume of work is used to assess labor, materials, and road improvement costs on the Dupak road section of Surabaya City. Volume Calculation on each work item on STA 1+000 – STA 1+025 =

Excavation of Soil with Heavy Equipment

Long = 25 meters
Wide = 10 meters
Thick = 0.45 meters
Account = Length x width x height
= 25 x 10 x 0.45
= 90 m3

Soil Reclamation for Construction
Long = 25 meters
Wide = 0.20 meters
Thick = 0.32 meters
Account = Length x width x height
= 25 x 0.20 x 0.32
= 1.60 m3

Soil Leveling and Compacting
Long = 25 meters
Wide = 8 meters
Account = Length x width x height
= 25 x 8
= 200 m2

Aggregate of Class A Upper Foundation Layer (LPA) Using Tools
Long = 25 meters
Wide = 8 meters
Thick = 0.05 meters
Account = Length x width x height
= 25 x 8 x 0.05
= 10 m3

Scrapping Aspal (Coal Milling)
Long = 25 meters
Wide = 8 meters
Thick = 0.04 meters
Account = Length x width x height
= 25 x 8 x 0.04
= 8 m3

Lean Mix Concrete (LMC) Work f'c=10 MPa
Long = 25 meters
Wide = 8 meters
Thick = 0,10 meter
Account = Length x width x height
= 25 x 8 x 0.10
= 20 m3

Cement Concrete Pavement with M10-Single Layer Wiremesh (tool)
Panjang = 25 meters
Wide = 8 meters
Thick = 0.30 meter

Account = Length x width x height
= 25 x 8 x 0.30
= 60 m3
Asphalt Cutting Jobs)
Long = 25 meters
Number of sides = 8 meters
Account = Length x Number of Sides
= 25 x 2
= 50 m1
Pas. Kerb / Curbing type B uk. 20x30x50 ; f'c 30 Mpa
Panjang = 25 meters
Account = Length
= 25
= 25 m1
Spent 1 PC : 2 Ps T=3cm
Long = 25 meters
Wide = 0.20 meters
Account = Length x Width
= 25 x 0.20
= 5 m2
Work Non - Woven Geotextile Coating Type UNW 250
Long = 25 meters
Wide = 8 meters
Account = Length x Width
= 25 x 8
= 200 m2
Installation of Polythene Coating
Panjang = 25 meters
Wide = 8 meters
Account = Length x Width
= 25 x 8

The following are the results of the recapitulation of the volume of work on the Dupak road section of Surabaya City:

Table 1. Volume of Preliminary Work

NO.	WORK DESCRIPTION	VOLUME	UNIT
I	**PRELIMINARY WORK**		
1	Preparation and Rent of Site Office	1.00	Ls
2	Project Name Board Manufacturing	1.00	Bh
3	Preparation (Mobilization & Demobilization)	1.00	Ls
4	Setting Out with Theodolite	1.00	Ls
5	Bouwplank Construction	38.00	Point
6	Rent of Project Site Security Fence (300 m1)	1.00	M1
7	Construction Occupational Safety and Health Management System (SMK3)		
	RKK Preparation	1.00	Ls
	Socialization, Promotion and Training	1.00	Ls

	Work Protective Equipment (APK) & Personal Protective Equipment (APD)	1.00	Ls
	Insurance and Licensing	1.00	Ls
	Construction K3 Personnel	1.00	Ls
	Facilities, Infrastructure, and Health Equipment	1.00	Ls
	Necessary Signs	1.00	Ls
	Equipment Related to Construction Safety Risk Control	1.00	Ls

Source: Calculation Results, 2025

Table 2. Volume of Excavation and Concrete Work

NO.	WORK DESCRIPTION	VOLUME	UNIT
II	**EXCAVATION & EARTHWORK**		
1	Soil Excavation with Heavy Equipment	3,494.43	M3
2	Soil Backfilling for Construction	60.80	M3
3	Soil Transport Out of Project Site	3,433.63	M3
4	Soil Leveling and Compaction	7,600.00	M2
5	Class A Upper Base Course Aggregate (LPA) Using Equipment	501.22	M3
6	Asphalt Scrapping (Coal Milling)	35.95	M3
7	Gravel Backfilling (COMPACTED)	45.17	M3
III	**CONCRETE ROAD WORK**		
1	Lean Mix Concrete (LMC) Work fc=10 MPa	760.00	M3
2	Cement Concrete Pavement with Wiremesh M10-Single Layer (equipment)	2,308.40	M3
3	Asphalt Cutting Work	1,975.00	M1
4	Kerb / Curbing Installation Type B size 20x30x50 ; fc 30 Mpa	950.00	M1
5	Mortar 1 Cement : 2 Sand T=3cm	190.00	M2
6	Asphalt Concrete Laston (AC) Surface Layer Paving tb. 4 cm	45.86	M2
7	ATB Paving tb. 6 cm	6.33	Ton
8	Non-Woven Geotextile Layer Installation Type UNW 250	1,900.00	M2
9	Polythene Layer	15,200.00	M2
IV	**OTHER WORKS**		
1	Site Cleaning	1.00	Ls

Source: Calculation Results, 2025

Calculating Work Unit Analysis

The calculation of this AHSP multiplies the value of the coefficient by the unit price of materials or labor. The decree of the mayor of Surabaya determines the unit price for labor, materials, equipment, and equipment rental. Calculation analysis for Excavation of Soil with Heavy Equipment items is presented here

Table 3. Analysis of Soil Excavation Unit Prices with Heavy Equipment

Type of Work = Soil Excavation with Heavy Equipment				**HSPK Surabaya City No. 24.01.02.12**	
Unit of Payment = M3					
No.	ACTIVITY DESCRIPTION	UNIT	COEFFICIENT	UNIT PRICE (Rp.)	TOTAL (Rp.)
1	2	3	4.0000	5	6=4×5
1	Foreman	Man-Day	0.0070	198,900.00	1,392.30
2	Assistant Worker	Man-Day	0.2260	168,900.00	38,171.40
3	Excavator Rental 6 m3	Hour	0.0670	160,000.00	10,720.00
				GENERAL COSTS	
				PROFIT COSTS	
				UNIT PRICE OF WORK	**50,283.70**
				ROUNDED	**50,284.00**

Source: Calculation Results, 2025

Developing a Cost Budget Plan

Once the volume and AHSP calculations are complete, the next step is to compile the RAB. This is done by multiplying the volume that has been calculated in the BOQ by the Job analysis:

Table 4. RAB Calculation Results

NO.	Job Description	Volume	SAT.	Unit Price	TOTAL PRICE
1	2	3	4	5	6 = 3 x 5
I	**PRELIMINARY WORK**				
1	Preparation and Hiring of Keet Board of Directors	1,00	Ls	6.054.500,00	6.054.500,00
2	Project Nameplate Creation	1,00	Bh	422.802,00	422.802,00
3	Preparation (Mobilization & Demobilization)	1,00	Ls	3.000.000,00	3.000.000,00
4	E.g. Theodolit	1,00	Ls	2.165.100,00	2.165.100,00
5	Building Board Construction	38,00	Titik	121.914,00	4.632.732,00
6	Rent Security Fence Project Site (300 m1)	1,00	M1	5.000.000,00	5.000.000,00
7	Construction Occupational Safety and Health Management System (SMK3)				
	RKK Setup	1,00	Ls	100.000,00	100.000,00
	Socialization, Promotion and Training	1,00	Ls	900.000,00	900.000,00
	Work Protective Equipment (APK) & Personal Protective Equipment (PPE)	1,00	Ls	2.275.000,00	2.275.000,00
	Insurance and Licensing	1,00	Ls	12.454.991,00	12.454.991,00
	K3 Construction Personnel	1,00	Ls	4.400.000,00	4.400.000,00
	Facilities, Facilities, Infrastructure and Medical Devices	1,00	Ls	500.000,00	500.000,00
	Required signs	1,00	Ls	1.550.000,00	1.550.000,00
	Equipment Related to Construction Safety Risk Control	1,00	Ls	500.000,00	500.000,00
				SUB TOTAL I	**43.955.125,00**
II	**MINING & SOIL JOBS**				
1	Excavation of Soil with Heavy Equipment	3.494,43	M3	50.284,00	175.713.666,70
2	Soil Reclamation for Construction	60,80	M3	21.007,00	1.277.225,60
3	Transporting Land Out of the Project	3.433,63	M3	59.725,00	205.073.253,13
4	Soil Leveling and Compacting	7.600,00	M2	26.813,00	203.778.800,00
5	Aggregate of Class A Upper Foundation Layer (LPA) Using Tools	501,22	M3	276.073,00	138.374.516,88
6	Scrapping Aspal (Coal Milling)	35,95	M3	472.171,00	16.975.350,14
7	Sirtu Erosion (SOLID)	45,17	M3	270.958,00	12.238.834,16
				SUB TOTAL II	**753.431.646,61**

III	**CONCRETE ROAD WORKS**				
1	Lean Mix Concrete (LMC) Work f'c=10 MPa	760,00	M3	1.041.636,00	791.643.360,00
2	Cement Concrete Pavement with M10-Single Layer Wiremesh (tool)	2.308,40	M3	3.589.649,00	8.286.345.751,60
3	Asphalt Cutting Jobs	1.975,00	M1	18.513,00	36.563.175,00
4	Pas. Kerb / Curbing type B uk. 20x30x50 ; f'c 30 Mpa	950,00	M1	198.345,00	188.427.750,00
5	Spent 1 PC : 2 Ps T=3cm	190,00	M2	73.228,00	13.913.320,00
6	Asphalt Surface Laying of Laston Concrete (AC) tb. 4 cm	45,86	M2	129.116,00	5.921.259,76
7	Spread of ATB tb. 6 cm	6,33	Tone	1.443.556,00	9.135.803,99
8	Installation of Non - Woven Geotextile Coating Type UNW 250	1.900,00	M2	34.770,00	66.063.000,00
9	Lapisan Polythene	15.200,00	M2	11.566,00	175.803.200,00
				SUB TOTAL III	**9.573.816.620,35**
IV	**MISCELLANEOUS WORK**				
1	Location Cleaning	1,00	Ls	1.381.200,00	1.381.200,00
				SUB TOTAL IV	**1.381.200,00**

Source: Calculation Results, 2025

Table 5. RAB Recapitulation

No. Divided	**Description**	**Price Work (Rp.)**
I	PRELIMINARY WORK	43.955.125,00
II	MINING & SOIL JOBS	753.431.646,61
III	CONCRETE ROAD WORKS	9.573.816.620,35
IV	MISCELLANEOUS WORK	1.381.200,00
(A)	Total Job Price	10.372.584.591,95
(B)	Value Added Tax (VAT) 11%	1.140.984.305,11
(C)	TOTAL AMOUNT OF WORK PRICE	11.513.568.897,07
	ROUNDED	**11.513.568.000,00**
Notable :	**Eleven Billion Five Hundred Thirteen Million Five Hundred Sixty-Eight Thousand Rupees**	

Source : Calculation Results, 2025

Based on the design of rigid pavement (Rigid Pavement), the total cost of upgrading the Dupak road STA 0+933 – STA 1+883 is Rp. 11,513,568,000.

Discussion

The analysis of traffic growth on the Dupak road section revealed an annual increase of 5.6%, significantly impacting pavement deterioration rates. This finding aligns with studies by Wirnanda et al. (2018), who observed similar traffic-induced damage on urban roads in Indonesia, emphasizing the correlation between rising vehicle loads and accelerated pavement wear. The data was derived from average daily traffic (LHR) measurements and equivalent single axle load (ESAL) calculations, which provided a quantitative basis for projecting future infrastructure demands. By contextualizing these figures within the 2024 Road Pavement Design Manual guidelines, the study highlights the necessity of adaptive design strategies to accommodate dynamic traffic conditions. This underscores the importance of integrating real-time traffic data into pavement planning to ensure long-term durability and cost efficiency.

The rigid pavement design proposed in this study, featuring a 300 mm concrete layer and a 150 mm thin concrete bottom foundation, was optimized to withstand the projected traffic loads over a 40-year lifespan. This design contrasts with flexible pavement solutions often recommended for lighter traffic, as noted by Risman (2017), who compared both pavement types in Bandung's industrial areas. The structural analysis accounted for subsoil conditions and fatigue resistance, ensuring the pavement could endure repetitive stress without premature failure. Such an approach is supported by Shinta et al. (2017), who demonstrated the influence of soil CBR values and concrete quality on rigid pavement performance. The findings validate the suitability of rigid pavement for high-traffic urban corridors, where durability outweighs initial cost considerations.

Cost estimation revealed a total project budget of Rp 11.5 billion, with concrete road works constituting the largest expense (Rp 9.57 billion). This aligns with Pamungkas et al. (2024), who identified material and labor costs as dominant factors in urban road projects. The detailed breakdown of unit prices and work volumes provided transparency, enabling stakeholders to assess cost drivers and allocate resources efficiently. Notably, the study's cost model incorporated localized wage and material rates, addressing a gap in generic cost studies that often overlook regional variations. By comparing these figures with similar projects, such as those analyzed by Purwanto et al. (2025), the research demonstrates the economic viability of rigid pavement in high-traffic settings, despite higher upfront costs.

A critical finding was the reduction in planned pavement lifespan due to unmitigated traffic growth, echoing concerns raised by Krisnanda (2023) in Central Lampung. Without proper design interventions, the road's functional lifespan could decrease by 30–40%, leading to frequent repairs and higher lifecycle costs. This aligns with the AASHTO (2004) framework, which emphasizes the need for traffic-adjusted design criteria. The study's solution—integrating traffic growth projections into pavement thickness calculations—offers a proactive approach to extend service life. This strategy is particularly relevant for cities like Surabaya, where rapid urbanization exacerbates infrastructure strain, as noted by de Rozari and Wibowo (2015) in their analysis of Surabaya's traffic congestion.

The discussion also highlights the role of geotextile and polythene coatings in enhancing pavement stability, a technique supported by Road Pavement Manual (2017) guidelines. These materials mitigate subgrade moisture infiltration, a common cause of structural failure in tropical climates. The study's empirical data on their installation costs and benefits provides actionable insights for engineers, bridging the gap between theoretical recommendations and practical implementation. This complements research by Alfikri (2017), who advocated for material innovations in pavement design but lacked detailed cost-benefit analyses. By quantifying these advantages, the study strengthens the case for incorporating advanced materials in urban road projects.

Comparisons with previous research revealed discrepancies in cost assumptions, particularly regarding labor productivity and equipment efficiency. For instance, Putra (2018) estimated lower costs for rigid pavement in Kuantan Bay, but his model did not account for urban wage premiums or traffic disruption expenses. The current study addresses these limitations by incorporating real-world constraints, such as project site accessibility and safety regulations. This refinement enhances the accuracy of cost forecasts, aiding budget planning for municipal authorities. The findings resonate with Sukirman's (2016) emphasis on contextual factors in construction economics, underscoring the need for localized data in infrastructure planning.

Theoretical implications of the study are grounded in the Bina Marga design methodology, which prioritizes traffic load distribution and soil-structure interaction. This framework aligns with Austroads AGPT02-17 standards, as referenced in the 2024 Road Pavement Design Manual, but adapts them to Indonesia's unique conditions. The research advances this theory by validating its application in Surabaya's high-growth context, addressing a gap identified by Maharani et al. (2018). Their comparative study of rigid and flexible pavements called for more case-specific evaluations, which this study delivers through its detailed traffic and cost analyses.

Practical implications include recommendations for phased construction to minimize traffic disruption, a strategy supported by PM No. 96 (2015) on traffic management during infrastructure projects. The study's cost model also aids in securing funding by demonstrating long-term savings from reduced maintenance, a point emphasized by Akbar et al. (2024) in their benefit-cost ratio analysis. Municipalities can leverage these insights to justify investments in rigid pavement, particularly in economically strategic corridors like Dupak Road. Additionally, the research underscores the need for periodic traffic monitoring to update design parameters, ensuring infrastructure resilience amid changing urban dynamics.

The study's limitations include its reliance on secondary traffic data and assumptions about consistent growth rates, which may not capture sudden economic or demographic shifts. Future research could incorporate real-time traffic sensors or scenario-based modeling to enhance predictive accuracy. Despite this, the findings offer a robust foundation for urban road planning, combining empirical data with theoretical rigor. By addressing gaps in cost estimation and design adaptability, the study contributes to sustainable infrastructure development in rapidly growing cities. Its methodology and conclusions provide a replicable model for other regions facing similar challenges, advancing both academic discourse and practical infrastructure solutions.

CONCLUSION

Based on the construction cost analysis for the improvement of the Dupak road section in Surabaya City, with a traffic growth rate of 5.6%, the rigid pavement design consists of a 150 mm Thin Concrete Bottom Foundation Layer and a 300 mm Cement Concrete Pavement layer for the section between STA 0+933 and STA 1+883. The total estimated cost for this road improvement project amounts to Rp 11,513,568,000.00. Future research is suggested to explore the long-term performance and maintenance costs of this rigid pavement design under varying traffic and environmental conditions, as well as to investigate alternative sustainable materials and construction techniques to optimize cost efficiency and durability.

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