

**6th UNDERGRADUATE  
SEMINAR ON BUILT  
ENVIRONMENT  
AND TECHNOLOGY  
(USBET) 2023**

**SUSTAINABLE BUILT  
ENVIRONMENT**

**25 - 27 SEPTEMBER 2023**

**E-PROCEEDING**

**USBET 2023**



# e-Proceeding

**6th UNDERGRADUATE  
SEMINAR ON BUILT  
ENVIRONMENT  
AND TECHNOLOGY  
(USBET) 2023  
SUSTAINABLE BUILT  
ENVIRONMENT**

**Published by,**

Department Of Built Environment Studies And Technology  
Faculty Of Architecture, Planning & Surveying  
Universiti Teknologi MARA Perak Branch, Seri Iskandar Campus  
*usbet.fspuperak@gmail.com*

Copyright @ 2023

Department Of Built Environment Studies And Technology  
Faculty Of Architecture, Planning & Surveying  
Universiti Teknologi MARA Perak Branch, Seri Iskandar Campus

This work is subject to copyright. All rights are reserved by the Publisher. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording or any information storage and retrieval system without permission in writing from the copyright owners.

eISSN 2821-3076



02 October 2023 | Perak, Malaysia  
Universiti Teknologi MARA, Perak Branch, Seri Iskandar Campus

## **EDITORIAL BOARD**

### **Editors-in-Chief**

SR. NORAZURA MIZAL AZZMI (BS)

NADIRA AHZAHAR (BS)

### **Editors**

TS. ZURAIHANA AHMAD ZAWAWI (BS)

SR. NAZHATULZALKIS JAMALUDIN (BS)

SR. SITI ZUBAIDAH HASHIM (BS)

NURHIDAYAH SAMSUL RIZAL (BS)

SR DR. NURUL FADZILA ZAHARI (BS)

NUR FADHILAH BAHARDIN (BS)

SR TS. DR. ALIA ABDULLAH SALLEH (BS)

SR TS. DR. SURIANI NGAH WAHAB (BS)

SR TS. DR. HASNAN HASHIM (BS)

SR NOORAZLINA KAMARUZZAMAN (BS)

SR MARIATY MOHD BAHARI (BS)

SR AIDA AFFINA ABDUL GHANI (BS)

DR. NOR DIANA AZIZ (BS)

SR AMIR FASHA MAT ISA (BS)

SR DR. NOR AMIN MOHD RADZUAN (BS)

PROF. MADYA SR DR. MOHD FADZIL YASSIN (BS)

SR TS. KHAIRUL AMRI RAMLY (BS)

SR. MOHD ASRUL HASIN (BS)

SR TS. MOHD KHAZLI ASWAD KHALID (BS)

SR MOHD DZULKARNAEN SUDIRMAN (BS)

SR DR. IRWAN MOHAMAD ALI (BS)

SR DR. MOHAMMAD HASZIRUL MOHD HASHIM (BS)

DR NURHASYIMAH BT AHMAD ZAMRI (BCT)

DR. PUTERI YULIANA SAMSUDIN (TP)

*Editors-in-Chief*

*6th Undergraduate Seminar on Built Environment and Technology 2023*

***- E- Proceedings-***

*Organized by,*

*College of Built Environment (KAB) UiTM Perak Branch*





# A STUDY OF USERS' PERCEPTION TOWARDS ROAD MAINTENANCE ON THE KOTA KINABALU-KENINGAU FEDERAL ROAD

Nurhanana Nadzihah<sup>1</sup>, Robiah Abdul Rashid<sup>1\*</sup>  
Nurul Fadzila Zahari<sup>2</sup>, Wan Zuriea Wan Ismail<sup>1</sup>, Hikmah Kamarudin<sup>1</sup>

<sup>1</sup>School of Real Estate and Building Surveying,  
College of Built Environment, Universiti Teknologi MARA,  
40450 Shah Alam, Selangor, Malaysia.

<sup>2</sup>Department of Built Environment Studies and Technology,  
College of Built Environment,  
Universiti Teknologi MARA Perak Branch,  
Seri Iskandar Campus,  
32610, Seri Iskandar, Perak, Malaysia.

[2020866078@student.uitm.edu.my](mailto:2020866078@student.uitm.edu.my), [\\*rubeilza@uitm.edu.my](mailto:*rubeilza@uitm.edu.my)

## ABSTRACT

*Roads play a crucial role in a nation's transportation network and are vital for economic development. Efficient and well-maintained roads facilitate the smooth flow of people and goods, contributing to the nation's economy. However, despite annual budget allocations for road maintenance and agreements between the government and concession companies responsible for maintenance, poor road conditions still persist. This research aims to understand the importance of road maintenance, evaluate user satisfaction levels with maintenance efforts, and propose strategies to address road maintenance issues on the Kota Kinabalu-Keningau federal road. The findings revealed that road users were dissatisfied with the implemented road maintenance, while their assessment of the road conditions was neutral. However, certain aspects related to road conditions, such as safety, road surface condition, and road furniture and amenities, received poor ratings. To address these issues, several strategies were recommended on federal road and incorporating site observations as an additional method for the study.*

**Keywords:** Road maintenance, federal road, users' perception

© 2023 USBET, JABT, UiTM Perak Branch, All rights reserved

## **INTRODUCTION**

Malaysia has experienced rapid development and has constructed various structures, including buildings, infrastructure, and facilities. These structures serve different purposes and are crucial for the country's growth. Maintaining these structures is essential to ensure their optimal functionality and longevity. Roads are a vital part of a nation's transportation network, as highlighted by Maw et al. (2007) and Rogers & Enright (2016) and play a significant role in economic development (Ghani et al., 2017). Well-designed and properly maintained roads facilitate the smooth flow of people and goods, contributing to economic growth. They provide reliable means of travel over long distances, connecting cities and states regardless of weather conditions or time of day (Burningham & Stankevich, 2005). Therefore, prioritizing road maintenance is crucial for ensuring the nation's well-being and the safety of road users. Effective road maintenance practices are necessary because roads, like any other asset, require routine maintenance to remain functional and fulfil their purpose.

## **PROBLEM STATEMENT**

Road transportation is crucial for providing access to jobs, resources, education, and healthcare in Malaysia (Kamarudin et al., 2018). However, traffic accidents caused by poor road conditions have become a significant concern (Touahmia, 2018). Despite budget allocations (Lim, 2021) and the involvement of concession companies responsible for maintenance (Shafii et al., 2021), issues such as potholes, inadequate signage, drainage problems, faulty signals, and poorly maintained bridges persist (Levin, 2014 ; Mohammad, 2020). These problems not only lead to traffic congestion and delays but also increase the risk of accidents (New Straits Times, 2019). Drivers have expressed frustration with the state of federal roads and their negative impact on driving experiences (Shafii et al., 2021). Social media platforms have been used by users to voice their opinions about the quality of road maintenance, highlighting the importance of ensuring user safety and comfort.

## **RESEARCH OBJECTIVES**

The objectives of this research are to (1) understand the importance of road maintenance, (2) evaluate users' satisfaction level with the maintenance of the Kota Kinabalu-Keningau federal road and (3) suggest strategies to overcome the issues of road maintenance on the Kota Kinabalu-Keningau federal road.

## **SCOPE AND LIMITATIONS OF THE RESEARCH**

This study examines the maintenance of the R500 Kota Kinabalu-Keningau federal road, with a specific focus on the Keningau-Apin-Apin Town route. Data was gathered through questionnaires distributed to road users and interviews with the road maintenance concession.

## Statement of Significance

This study needs to be implemented as there have been no previous studies conducted on road maintenance in the specified area. The findings and data gathered from this study can be valuable for various stakeholders involved in road maintenance. Both the public and private sectors can benefit from this study by gaining insights and implementing strategies for more effective planning of maintenance work. Future researchers can also benefit from the information and findings to address related inquiries.

## LITERATURE REVIEW

Roads serve as essential pathways for travel and transportation, enabling efficient movement and connectivity between regions (Sukirman, 1994; Ali, 2011). Maintenance activities, including preservation, restoration, and repair, are crucial to uphold the functionality, safety, and longevity of roads (Sjafri et al., 2018; Wong & Hamidun, 2018). Road deterioration occurs over time due to factors like traffic and the environment, making regular maintenance necessary to prevent further damage (Paterson, 1987; Alaamri et al., 2017). Understanding road deterioration helps in implementing proactive measures for safer and longer-lasting roads (Deme, 2020). Effective maintenance practices not only save costs but also promote road user safety and comfort (Zawawi et al., 2016).

## Types of Road Maintenance in Malaysia

Generally, road maintenance activities can be categorised into three main areas, as outlined by the Malaysian Ministry of Public Works (n.d.):

- **Routine works**

Maintenance work follows a planned schedule based on policies, equipment lifespan, and inspections. It aims to ensure road safety and prevent rapid deterioration (Universiti Teknologi Malaysia, n.d.). This includes regular minor repairs in response to reported issues, usually done weekly or more frequently. Activities involve fixing potholes, maintaining road shoulders, tending to roadside items, managing drainage systems, inspecting and maintaining bridges and culverts, and cutting grass (Ministry of Works, n.d.).

- **Periodic works**

Periodic maintenance refers to occasional maintenance tasks performed after a significant period of time, as noted by Imen (2018) and Burningham & Stankevich (2005). These activities are extensive, requiring specialized equipment and skilled workers. They involve careful planning and preparation due to their costliness. The Ministry of Works (n.d.) categorizes periodic works into

pavement and non-pavement maintenance. Examples of these works, as outlined by Malaysian Government (2022) in the "Garis Panduan Tatacara Pengurusan Pemberian Penyelenggaraan Jalan Negeri 3.0", include repaving and repairing road pavement structures, replacing street furniture, road painting, drainage system replacement, slope repairs, bridge and culvert repairs, maintenance of roadside trees, intersection maintenance, road endurance tests, maintenance of streetlights and traffic lights, and road sweeping for state roads to keep them clean.

- **Special / Emergency works**

Emergency road maintenance involves immediate actions taken to address sudden road blockages caused by natural disasters, as defined by Sapkota (2016). The main goal is to quickly reopen the affected road, restore normal traffic flow, and prevent further damage. The frequency of such maintenance is unpredictable, as it depends on emergencies. Prompt response is crucial in these situations, as emphasized by Burningham & Stankevich (2005). Examples of incidents requiring emergency maintenance include fallen trees, soil or slope collapse, road settlement, rampart failure, sewer and drain collapse, floods, and hazardous material spills that endanger road user safety (Malaysian Government, 2022).

## **Types of Road Failure/Defects**

- **Road surface**

According to the study by Wada (2016), there are various types of failures and defects can occur on road surfaces, requiring proper maintenance to ensure optimal conditions. Cracking is a common issue, including fatigue cracking, longitudinal cracking, and transverse cracking, caused by weaknesses or failures in pavement layers induced by vehicular movement. Surface deformation, such as rutting, corrugations, and depressions, can significantly reduce the service life of pavements and are important considerations for maintenance (Fan et al., 2020). Disintegration refers to the gradual fragmentation of the pavement, resulting in the formation of potholes and patches. Surface defects, such as ravelling, bleeding, polishing, and delamination, primarily affect the top layer of the pavement and are often caused by inadequate bitumen quality or quantity.

- **Road furniture**

Road furniture, which includes design elements and equipment on the road, can also experience failures and deficiencies that impact road safety. Faded road markings reduce visibility and can make it challenging for drivers to navigate



safely, especially at night (Bradshaw, 2018). Damaged road signage, including signs with faded colors, physical damage, or vandalism, compromises their effectiveness in providing crucial information and instructions to drivers (McGee, 2010; Khalilikhah & Heaslip, 2016). Broken kerbs, which separate roads from sidewalks or medians, can lead to structural problems and pavement damage due to excessive moisture infiltration (Momotaz et al., 2022). Insufficient or malfunctioning streetlights diminish visibility and increase the risk of accidents (Ali et al., 2016; The Royal Society for the Prevention of Accidents, 2020). Overgrown vegetation on the roadside obstructs visibility, conceals hazards, and poses risks to road users (Will, 2022; Eck & McGee, 2008). It is important to address these failures and deficiencies to maintain road safety and optimal road conditions.

## **Users' Satisfaction on Road Maintenance**

The level of satisfaction often arises from the quality of services provided by road infrastructure and how users react to these services (Hasan et al., 2020). In this research, road users refer to drivers, motorcyclists, pedestrians, cyclists, and public transport users. Cardozo (1995) explained that satisfaction is a measure of how satisfied a customer feels when they compare their perceived service experience to their expectations. It's crucial for customers to communicate their expectations to service providers. Providers must then respond in a way that exceeds these expectations. This emphasizes the importance of understanding what road users expect to deliver the highest level of service (Walker & Baker, 2000). Various aspects of road services impact road user satisfaction. Some of these factors have a significant influence on satisfaction levels. For example, comfort, emergency services, and safety aspects play a crucial role in satisfaction (Hasan et al., 2020). In a separate study by Akakpo (2017), a proposed framework suggests that user satisfaction is influenced by two main types of service quality: technical and functional. Technical elements include road safety, road surface condition, roadside amenities, and cleanliness. Functional dimensions like responsiveness, assurance, and reliability also contribute to user satisfaction.

## **Strategies on Maintaining Road Conditions**

To enhance user satisfaction with road maintenance, effective strategies are crucial. Prioritizing maintenance planning is essential for infrastructure longevity and safety (Wong & Hamidun, 2018). A comprehensive assessment of the road network is the foundation of informed decisions (Rajesh, 2015). Gathering data on conditions, traffic, and historical maintenance records enables prioritization based on factors like usage and safety (Mikler, 2015). Regular checks on critical components, addressing issues before they escalate, and efficient resource allocation are vital (Trout, n.d.).

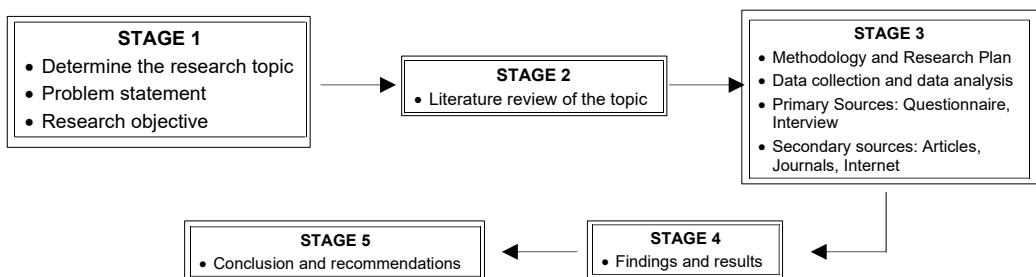
Next, enhancing road maintenance quality is crucial to minimize road defects and optimize benefits. Improved maintenance extends road lifespan, reduces repair frequency, and enhances user experiences. Material quality is pivotal, as substandard materials risk catastrophic failures and safety hazards (Mather, 1958; Taimoor et al., 2022). Balancing material expectations and performance is key for effective highway construction and innovation adoption (Shafii et al., 2021). Training programs are vital, enhancing maintenance personnel skills and adherence to industry best practices (Herrity, 2023). These enhancements elevate productivity, efficiency, and profitability. A commitment to continuous advancement aligns with enhancing road maintenance quality for safer, more reliable transportation networks (Rajesh, 2015).

Furthermore, establishing a direct channel for road users to voice complaints is valuable for swift issue resolution. Utilizing customer satisfaction surveys helps track trends and target improvements (Lodeni, 2011). Mobile apps provide a versatile means for users to provide feedback on road performance (Mohd, 2020). This accelerates communication between users and management, ensuring prompt action to address concerns. Addressing road defects promptly is cost-effective compared to neglected repairs necessitating expensive reconstruction (Burningham & Stankevich, 2005).

Lastly, closely monitoring maintenance activities is vital to assess road condition performance. Safe road infrastructure requires consistent monitoring across planning, design, implementation, and maintenance (Masirin et al., 2016). Periodic road safety audits, adhering to Jabatan Kerja Raya (JKR) standards, are essential in this process (Masirin et al., 2016). These audits involve thorough scrutiny of various aspects, ranging from project planning and design to operational features. The goal is to identify potential safety hazards that could impact road users (Abas, 2017). Evaluating designs' alignment with guidelines ensures safety throughout planning to operation (Michael, 2020). This prevents safety shortcomings and disruptions during development (Masirin et al., 2016).

## **RESEARCH METHODOLOGY**

The study's methodology outlines its process and workflow. To analyze user perceptions of road maintenance (Figure 1), planned steps were taken. Primary and secondary data were collected. Quantitative data came from road user questionnaires along the Kota Kinabalu-Keningau Federal Road, while qualitative insights were gained through interviews with road operators. Secondary data, sourced from various outlets such as journal articles, books, newspapers, research papers, and online searches, supplemented the study.



**Figure 1: Research Methodology Flow**

## Sampling

The research focused on road users who have used the Kota Kinabalu-Keningau federal road, specifically the road between Keningau and Apin-Apin Town. Around 100 to 250 road users were estimated to travel this route per hour during peak times. To gather data, approximately 60 respondents were randomly selected from different categories of road users, including drivers, motorcyclists, pedestrians, cyclists, and public transport users. The selection was done at various locations like restaurants, rest areas, bus stations, gas stations, residential areas, and school areas.

## Case Study

This study focused on a federal road in Sabah, specifically the R500 Kota Kinabalu-Keningau-Tenom federal road. The specific area of interest was the road between Keningau City and Apin-Apin Town. This road was designated as a main federal road on December 13, 2000, and it spans a total length of 163.7 km. This area was chosen because it is a crucial transportation route for rural residents, who need to travel to the city center.

## Data Collection

- **Primary data**

a) Questionnaire: An online survey gathered perceptions of road maintenance on the Kota Kinabalu-Keningau federal road. The questionnaire is divided into six sections: Section A: respondent's background; Section B: general information about road maintenance; Section C: the level of satisfaction; Section D: common road issues on observed; Section E: effects of road deterioration on road users; and Section F: recommendations for overcoming road condition issues. A total of 60 respondents were randomly chosen (10%-20% of the total road users within a one-hour peak period). The survey employed two methods: (1) The researcher distributed questionnaires along the road – rest areas, residential

areas, schools, and supermarkets. Some declined due to inconvenience, causing an extension of the data collection period. (2) Alternatively, the survey was shared on social media platforms (WhatsApp, Telegram, Instagram, Twitter) for users familiar with the route. Some respondents did not provide feedback, resulting in a low response rate and a delay in reaching the target.

b) Interview: Individual interviews were conducted to gather comprehensive insights into road maintenance practices implemented by the responsible road management company, and to establish comparisons with questionnaire findings. Semi-structured online interviews were held via Google Meet with Lintasan Resources Sdn. Bhd., the organization responsible for road management from Keningau to Apin-Apin Town. Face-to-face interviews were not feasible due to time constraints and unforeseen circumstances, resulting in multiple rescheduled online meetings due to urgent management commitments, which at times disrupted the interview process.

- **Secondary data**

Secondary data refers to information obtained from analyses conducted by other parties, such as journal articles, books, newspapers, research papers, internet searches, and other publications. The majority of information on the topic was derived from secondary data sources.

## **DATA ANALYSIS**

In this study, responses from Sections A, B, D, E, and F of the questionnaire were examined using frequency distribution. This involved analyzing the percentage of each answer for every question and presenting the results through bar charts and pie charts to depict frequencies as percentages. To calculate these percentages, the number of respondents for each answer was divided by the total number of respondents and then multiplied by 100%.

For Section C of the questionnaire, participants were asked to rate their satisfaction with road maintenance and road condition on a scale of 1 to 5. A score of 1 indicated strong dissatisfaction or extremely poor condition, while a score of 5 indicated strong satisfaction or excellent condition. Data analysis involved computing the mean score by adding up all values in a dataset and dividing by the number of values. This average score provided an overall grasp of participants' agreement regarding road maintenance and condition. The calculated value determined different satisfaction categories, as outlined in Table 1.



**Table 1: Mean Range for the Level of Satisfaction with the Road Condition**

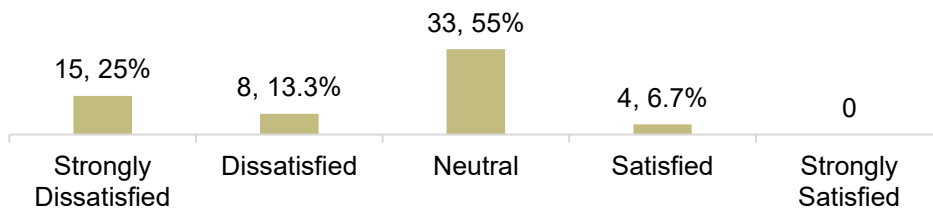
Scale	Strongly Dissatisfied / Poor (1)	Dissatisfied / Poor (2)	Neutral (3)	Satisfied / Good (4)	Strongly Satisfied / Excellent (5)
Mean Value	1.00-1.80	1.81-2.60	2.61-3.40	3.41-4.20	4.21-5.0

## RESULTS AND DISCUSSION

### The Importance of Road Maintenance

The study aimed to understand the importance of road maintenance. The majority of respondents (98.3%) agreed that road maintenance is crucial for ensuring safe and efficient transportation. They highlighted that well-maintained roads contribute to a smoother flow of traffic, reduce the risk of accidents, and improve the overall driving experience as mentioned in the study studies conducted by Sjafrri et al. (2018) and Wong & Hamidun (2018). Additionally, respondents emphasized that proper road maintenance enhances the durability of the roads, leading to cost savings in the long run, a perspective also aligned with the study by Deme (2020) and Zawawi et al. (2016), which emphasizes that effective maintenance practices not only save costs but also enhance road user safety and comfort. The World Road Association (2019) estimates that the annual cost of maintaining a major paved road is only 2-3% of its initial cost, while the cost of maintaining an unpaved rural road is 5-6%. Therefore, it is important to invest in regular road maintenance to avoid costly repairs in the future.

### User Satisfaction with Road Maintenance



**Figure 2: The Satisfaction Level of the Implemented Maintenance**

The study evaluated user satisfaction levels with the maintenance efforts on the Kota Kinabalu-Keningau federal road. The findings from Figure 2 revealed that the majority of respondents (55%) expressed neutral opinions about the implemented road maintenance, while 38.3% expressed dissatisfaction, and only 6.7% reported satisfaction. Dissatisfaction primarily stemmed from poor road maintenance quality, encompassing inadequate repairs, delayed issue responses, and insufficient safety efforts, categorized as functional service quality (Akakpo, 2017). Respondents were

frustrated by issues like potholes, lacking signs, and poorly maintained road features, aligning with technical service quality (Akakpo, 2017). This aligns with the study by Amir & Naharudin (2021) in Shah Alam, identifying potholes and cracks as prevalent issues. Potholes, posing risks to users, were also highlighted by Halim et al. (2022), underscoring lives lost due to them. Urgent measures are essential to address and mitigate pothole-related safety concerns, enhancing road infrastructure for a safer environment that promotes user satisfaction and road safety.

## Road Conditions

**Table 2: The Satisfaction Level of Road Users with the Road Condition**

Category of Road Condition	Frequency					Mean Score	Category
	1	2	3	4	5		
Road surface condition	7	22	27	4	0	2.47	Poor
Road shoulder condition	7	14	34	5	0	2.62	Neutral
Drainage condition	7	13	33	7	0	2.67	Neutral
Road furniture and amenities condition	7	19	25	9	0	2.60	Poor
Plants/Grass condition	4	9	33	14	0	2.95	Neutral
Comfort	7	15	30	8	0	2.65	Neutral
Safety	11	12	30	7	0	2.55	Poor
<b>Average Mean</b>						<b>2.64</b>	<b>Neutral</b>

To evaluate road conditions on the Kota Kinabalu-Keningau federal road, respondents were asked to rate various aspects like safety, road surface, and amenities (Table 2). The overall road conditions received a neutral assessment, indicating neither strong agreement nor disagreement. However, specific aspects had lower ratings. Notably, 38.3% expressed dissatisfaction with safety due to factors like inadequate lighting, unclear markings, and insufficient signs, contributing to perceived hazards. Emphasizing proper infrastructure is important for road safety (Babić et al., 2020). Road surface satisfaction was 6.7%, while 48.3% were dissatisfied. This discrepancy underscores the significant room for improvement in maintaining road surfaces to minimize hazards and discomfort for road users. For amenities, 43.3% were dissatisfied, highlighting faded markings, malfunctioning lights, and damaged signs. Faded markings reduce visibility and clarity, potentially causing confusion (Babić et al., 2020). Malfunctioning lights risk users during low visibility (Wood, 2020). These findings emphasize addressing these areas for safer roads, as dissatisfaction with safety, surface, and amenities signals targeted improvements for enhanced safety and user-friendly road environment.

## **Strategies to Address Road Maintenance Issues**

Based on the findings and discussions with Lintasan Resources, the appointed maintenance management concessionaire for the Kota Kinabalu-Keningau federal road, several strategies were recommended to address road maintenance issues. These strategies include:

**Prioritizing proper planning and scheduling for maintenance:** It is crucial to develop a comprehensive maintenance plan that takes into account the condition of the road, traffic volume, and user feedback. Regular inspections should be conducted to identify maintenance needs and prioritize repairs based on urgency and impact on road users. Macorig et al. (2020) stated that implementing an effective maintenance programme can ensure that the pavement retains its desired functional and structural qualities throughout its entire lifespan. This is supported by studies conducted by Tavakoli et al. (1992), which highlight the significance of proper maintenance in preventing the future escalation of maintenance costs for a city's transportation system.

**Improving the quality of work to minimize road defects:** Emphasizing the use of high-quality materials and proper construction techniques can help minimize road defects and improve the longevity of repairs. Training and certification programs should be implemented to enhance the skills of maintenance personnel and ensure adherence to best practices. This approach not only ensures the overall quality of the highways but also plays a significant role in safeguarding people's lives and safety (Zhou et al., 2022).

**Establishing a direct channel for road users to lodge complaints:** A dedicated platform or hotline should be established to allow road users to report poor road conditions and maintenance issues (Belsky, 2021). This would facilitate prompt response and action from the maintenance management concessionaire (Mohd, 2020).

**Closely monitoring the maintenance activities:** Regular monitoring and evaluation of maintenance activities are essential to ensure compliance with maintenance standards and contractual obligations. This can be done through periodic audits and inspections (Abas, 2017) to assess the quality of work and identify areas for improvement.

## **CONCLUSION**

As a conclusion, the entire objective of this study was achieved. Based on the results of the study it can be concluded that the road users were dissatisfied with the implemented road maintenance along the Kota Kinabalu-Keningau federal road, while their assessment of the road conditions was neutral. However, certain aspects related to road conditions such as safety, road surface, and amenities receive lower ratings. Addressing these concerns is vital for maintaining the road's good and safe

condition. To overcome these road issues, the study suggests implementing strategies such as prioritizing proper planning and scheduling of maintenance, improving work quality, establishing a direct channel for road user complaints, and enhancing monitoring of maintenance activities. These recommendations aim to enhance user satisfaction and ensure the effective upkeep of the road infrastructure by the road concessionaire.

## **RECOMMENDATIONS**

Based on the research findings, the researchers propose the following suggestions and recommendations to enhance the quality of future studies, aiming for more refined and precise outcomes:

a) To address the current focus solely on a single case study, the Kota Kinabalu-Keningau federal road, further research is recommended to explore road users' satisfaction with maintenance on other federal roads. Additionally, conducting a study in two diverse locations and subsequently performing a comparative analysis of road maintenance activities in each site would provide a more comprehensive understanding of road users' perceptions across various maintenance contexts.

b) To overcome the methodological limitations of this study, which are confined to questionnaires and interviews, future research can incorporate a combination of methods, including surveys, interviews, and on-site observations. This approach will help gather more accurate and reliable information by cross-verifying the data.

c) Given the questionnaire's limited sample size of only 60 respondents, the resulting findings might not accurately represent the satisfaction of all road users. To address this limitation, future researchers are encouraged to increase the number of respondents in future studies, aiming for a larger and more diverse sample. This approach would enhance the generalizability of findings and strengthen the statistical significance of the results.

## **ACKNOWLEDGEMENT**

Special thanks are extended to all the respondents, including road users and Lintasan Resources Sdn. Bhd., for their generous participation in this study.



## REFERENCES

- Abas, J. (2017). Road Safety Audit at Expressway: Upgrading Pasir Gudang Expressway (F17) Johor Baharu. *Engineering (Civil) Universiti Teknologi Malaysia (UTM)*.  
<http://eprints.utm.my/id/eprint/78599/1/JalaluddinAbasMFKA2017.pdf>
- Akakpo, S., Ayarkwa, J., & Agyekum, K. (2017). A Conceptual Framework to Evaluate Road Users' satisfaction of George Walker Bush Highway, Ghana. *International Conference on Infrastructure Development in Africa*.
- Alaamri, R. S. N., Kattiparuthi, R. A., & Koya, A. M. (2017). Evaluation of Flexible Pavement Failures-A Case Study on Izki Road. *International Journal of Advanced Engineering, Management and Science*, 3(7), 741–749.
- Ali, F., Suri, M. A., Khan, S. U., Khan, S. U., & Rehman, T. U. (2016). The Role of Current Technology in Street Light System. *International Journal of Computer Engineering and Information Technology*, 8(8), 141–145.
- Ali Zaltuom, A. M. (2011). *Evaluation Pavement Distresses Using Pavement Condition Index*, University of Dipomegoro.
- Amir, M. H. M., & Naharudin, N. (2021). Geospatial Analysis on the Impact of Road Defects on Motorcycle Accidents. *IOP Conference Series: Earth and Environmental Science*, 767(1), 012002.
- Babić, D., Fiolić, M., Babić, D., & Gates, T. (2020). Road Markings and Their Impact on Driver Behaviour and Road Safety: A Systematic Review of Current Findings. *Journal of Advanced Transportation*, 2020, 1–19.
- Belsky, Weinberg & Horowitz. (2021). *Solutions to Poor Road Conditions*.
- Bradshaw, L. (2018). *The Importance of Highly Visible Pavement Markings*. Sure Seal Pavement.
- Burningham, S., & Stankevich, N. (2005). *Why Road Maintenance is Important and How to Get it Done*.
- Cardozo, R.N. 1965. An Experimental Study of Consumer Effort, Expectation and Satisfaction. *Journal of Marketing Research*. 2, 244-249.

- Deme, D. (2020). A Review on Effect of Pavement Surface Failure on Road Traffic Accident. *American International Journal of Sciences and Engineering Research*, 3(1).
- Eck, R. W., & McGee, H. W. (2008). *Vegetation Control for Safety: A Guide for Local Highway and Street Maintenance Personnel*. U.S. Department of Transportation Federal Highway Administration.
- Fan, Z., Li, C., Chen, Y., Wei, J., Loprencipe, G., Chen, X., & Di Mascio, P. (2020). Automatic Crack Detection on Road Pavements Using Encoder-Decoder Architecture. *Materials*, 13(13), 2960. <https://doi.org/10.3390/ma13132960>
- Ghani, A., Lazim, H. M., Lamsali, H., & Salleh, M. N. (2017). Highway Maintenance Management: A Review of Some Practices in Malaysia. *Journal of Technology and Operations Management*, 49–58.
- Halim, M. H. B. M., Ibrahim, A. Bin, Osman, M. K., Kader, M. M. M. A., Termizi, M. F. A., & Abu, A. E. M. (2022). Detection of pothole for repair works of asphalt flexible pavement optimization using YOLO.
- Hasan, M., Alam, A., Mim, A. & Das, A. (2020). Identifying User Satisfaction Level of Road services: A Focus on Rajshahi City Bypass Road, Bangladesh. *Transportation Research Procedia*. 48. 3132-3152.
- Herrity, J. (2023). *The Importance of Training Employees: 11 Benefits*. Indeed.
- Imen, B. H. (2018). The Construction and Maintenance of Rural Roads. *PIARC*.
- Kamarudin, M. K. A., Abd Wahab, N., Umar, R., Mohd Saudi, A. S., Md Saad, M. H., Nik Rosdi, N. R., Abdul Razak, S. A., Merzuki, M. M., Abdullah, A. S., Siti Amirah, & Mohd Ridzuan, A. (2018). Road Traffic Accident in Malaysia: Trends, Selected Underlying, Determinants and Status Intervention. *International Journal of Engineering & Technology*, 7(4.34), 112–117.
- Khalilikhah, M., & Heaslip, K. (2016). The effects of damage on sign visibility: An assist in traffic sign replacement. *Journal of Traffic and Transportation Engineering (English Edition)*, 3(6), 571–581.
- Levin, G. (2014). Can I Sue after an Accident caused by Poor Road Design or Maintenance, *The Levin Firm*.
- Lim, A. (2021). RMK-12: Poor Road Maintenance – Lack of Resources, Corrective rather than Scheduled Maintenance Cited. *Paultan*.

- Lodenijs, E. (2011). Customer satisfaction measurement within the road sector-further development of customer feedback systems and a public input model. *Department of Civil and Environmental Engineering*.
- Macorig, D., Ristori, C., & Bertoli, V. (2020). Development of a method to evaluate the priorities of intervention on the road network of the Province of Pisa. *Transportation Research Procedia*, 45, 103–110.
- Malaysian Government. (2022). *Garis Panduan Tatacara Pengurusan Pemberian Penyenggaraan Jalan Negeri 3.0*.
- Masirin, M., Mohamad, N. & Samsuddin, N. (2016). Analysis of Road Infrastructural Audits along Jalan Batu Pahat-Kluang Malaysia: A Case Study. *ARPN Journal of Engineering and Applied Sciences*. 11. 14101-14105.
- Mather, B. (1958). *Quality Materials for Highway Construction*.
- Maw, A. A., Nakamura, F., & Okamura, T. (2007). A Study on Highway Project Procurement Through Evaluation of Alternative Public-Private Partnership Approaches. *In Proceedings of the Eastern Asia Society for Transportation Studies*, 6, 63–63.
- McGee, H. W. (2010). *Maintenance of Signs and Sign Supports: A Guide for Local Highway and Street Maintenance Personnel*. No. FHWA-SA-09-025 VHB/Vanasse Hangen Brustlin, Inc.
- Michael, A. (2020). An Introduction to Road Safety Audit. *IPM Professional Services*.
- Mikler, J. (2015). *On Improvement of Maintenance Function: A Reference Model and Improvement Methodology*. KTH Royal Institute of Technology.
- Ministry of Public Works. (n.d.). *Penyenggaraan Jalan Persekutuan*.
- Ministry of Works. (n.d.). *Maklumat Jalan Persekutuan*.
- Mohd Jamail, N., A. G., A., & Mohd Jamail, N. (2020). Development of intelligent road maintenance system mobile apps for a highway. *Bulletin of Electrical Engineering and Informatics*, 9(6), 2350-2357.
- Mohammad, N. (2020). Making Malaysians safe drivers. *Bernama*.
- Momotaz, H., Rahman, M. M., Karim, M. R., Iqbal, A., Zhuge, Y., Ma, X., & Levett, P. (2022). A Review of Current Design and Construction Practice for Road Kerbs and a Sustainability Analysis. *Sustainability*, 14(3), 1230.

- New Straits Times. (2019). *Potholes, Bad Roads Still a Bane*.
- Paterson, W. D. O. (1987). *Road Deterioration and Maintenance Effects*. The Johns Hopkins University Press Baltimore and London.
- Rajesh, B. (2015). *Rural Road Maintenance Training Modules for Field Engineers*. International Labour Organization.
- Rogers, M., & Enright, B. (2016). *Highway Engineering* (4th edition). John Wiley & Sons.
- Sapkota, R. K. (2016). *Road Maintenance Group (RMG)*. Government of Nepal.
- Shafii, H., Abd Halid, M. A. H., Md Yassin, A., Masram, H., & Sarpin, N. (2021). Kajian Terhadap Kualiti Penyelenggaraan Jalan Persekutuan di Johor Bahru: Dari Perspektif Pengguna. *Research in Management of Technology and Business*, 2(1), 678–689.
- Sjafri, F. S., Abdul Maulud, K. N., Wan Mohd Jaafar, W. S., Arif, F., Ab Rahman, A. A., & Mukhlisin, M. (2018). Development of Road Maintenance Inventory in UKM by Using Aerial Images. *Jurnal Kejuruteraan, SI 1(2)*, 73–78.
- Sukirman, S. (1994). *Dasar - Dasar Perencanaan Geometrik Jalan (Third)*. Nova.
- Taimoor, N., Ali, S., & Zahid, U. (2022). *Importance of good quality materials in construction industry*. Graana.com.
- Tavakoli, A., Lapin, M. S., & Figueroa, J. L. (1992). PMSC: Pavement Management System for Small Communities. *Journal of Transportation Engineering*, 118(2), 270–280.
- The Royal Society for the Prevention of Accidents. (2020). Road Safety Information.
- Touahmia, M. (2018). Identification of Risk Factors Influencing Road Traffic Accidents. *Engineering, Technology & Applied Science Research*, 8(1), 2417–2421.
- Trout, J. (n.d.). Maintenance Management: An Overview. *Reliable Plant*.
- Universiti Teknologi Malaysia. (n.d.). Kepentingan Penyelenggaraan.
- Wada, S. A. (2016). Bituminous Pavement Failures. In *Journal of Engineering Research and Applications www.ijera.com (Vol. 6, Issue 2)*.

- Walker, J. and Baker, J. 2000. An Exploratory Study of a Multi-Expectation Framework for Services. *Journal of Services Marketing*. 14/5, 411-431.
- Will, C. (2022). Pihak Konsesi digesa Selesaikan Masalah Rumput Panjang di Tepi Jalan. *Borneo Daily Bulletin*.
- Wong, R., & Hamidun, R. (2018). Road Maintenancee in Malaysia.
- Wood, J. M. (2020). Nighttime driving: visual, lighting and visibility challenges. *Ophthalmic and Physiological Optics*, 40(2), 187–201.
- Zawawi, Z. A., Khalid, M. K. A., Ahmad, N. A., Zahari, N. F., & Agus Salim, N. A. (2016). Operation And Maintenance in Facilities Management Practices: A Gap Analysis in Malaysia. *MATEC Web of Conferences*, 66.
- Zhou, Y., Guo, X., Hou, F., & Wu, J. (2022). Review of Intelligent Road Defects Detection Technology. *Sustainability*, 14(10), 63

Surat kami : 700-KPK (PRP.UP.1/20/1)

Tarikh : 20 Januari 2023

Prof. Madya Dr. Nur Hisham Ibrahim  
Rektor  
Universiti Teknologi MARA  
Cawangan Perak



Tuan,

**PERMOHONAN KELULUSAN MEMUAT NAIK PENERBITAN UiTM CAWANGAN PERAK  
MELALUI REPOSITORI INSTITUSI UiTM (IR)**

Perkara di atas adalah dirujuk.

2. Adalah dimaklumkan bahawa pihak kami ingin memohon kelulusan tuan untuk mengimbas (*digitize*) dan memuat naik semua jenis penerbitan di bawah UiTM Cawangan Perak melalui Repositori Institusi UiTM, PTAR.

3. Tujuan permohonan ini adalah bagi membolehkan akses yang lebih meluas oleh pengguna perpustakaan terhadap semua maklumat yang terkandung di dalam penerbitan melalui laman Web PTAR UiTM Cawangan Perak.

Kelulusan daripada pihak tuan dalam perkara ini amat dihargai.

Sekian, terima kasih.

“BERKHIDMAT UNTUK NEGARA”

Saya yang menjalankan amanah,

**SITI BASRIYAH SHAIK BAHARUDIN**  
Timbalan Ketua Pustakawan

*nar*

*Setuju.*

*27.1.2023*

PROF. MADYA DR. NUR HISHAM IBRAHIM  
REKTOR  
UNIVERSITI TEKNOLOGI MARA  
CAWANGAN PERAK  
KAMPUS SERI ISKANDAR