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Feasibility Management and Maintenance in Highway Construction Zone

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ABSTRACT: Efficient transportation infrastructure is fundamental to the economic prosperity of any nation. However, the escalating number of vehicles has led to severe traffic congestion on urban roads, necessitating the development and enhancement of road networks to alleviate bottlenecks. The evaluation of such projects often hinges on metrics like Economic Internal Rate of Returns (EIRR), which measure their economic viability and long-term benefits. Maharashtra, home to major economic hubs like Aurangabad Highway to Kolwadi Road, faces significant traffic challenges, particularly on highways linking these cities. This study focuses on the Pune-Aurangabad section of NH-4, a critical route plagued by congestion due to economic and industrial growth. The project entails the strengthening and widening of this highway to accommodate six lanes, with a flexible pavement design. Through comprehensive analysis, the study aims to assess the impact of these improvements on traffic flow and ascertain their economic feasibility. Initial findings indicate that the proposed enhancements exhibit economic viability, promising substantial benefits in terms of reduced congestion and improved travel efficiency. By addressing the traffic bottlenecks along this corridor, the project is poised to yield significant socio-economic advantages, contributing to regional development and enhancing connectivity between key urban centers. This research underscores the importance of strategic infrastructure investments in fostering sustainable economic growth and improving overall quality of life.

I. INTRODUCTION

Highway construction projects are critical infrastructural developments that play a pivotal role in enhancing connectivity, facilitating economic growth, and improving overall transportation efficiency. However, these projects often entail challenges and complexities, particularly during the construction phase when highways are transformed into active construction zones. Feasibility management and maintenance emerge as crucial aspects during this phase to ensure that construction activities progress smoothly while minimizing disruptions to traffic flow, ensuring safety, and adhering to project timelines and budgets. Feasibility management in highway construction zones encompasses various strategies and methodologies aimed at assessing the practicality and viability of proposed construction activities within the context of prevailing site conditions, regulatory requirements, and resource availability. One of the primary objectives of feasibility management is to optimize resource utilization and minimize construction-related disruptions to traffic flow. Highway construction zones often pose significant challenges to commuters and motorists due to lane closures, detours, and reduced speed limits. Therefore, effective feasibility management strategies prioritize the implementation of construction techniques and traffic management measures that mitigate congestion, minimize travel delays, and ensure the safety of both construction workers and road users.

Moreover, feasibility management encompasses the identification and mitigation of potential environmental impacts associated with highway construction activities. Construction projects in sensitive ecological areas or near water bodies may require additional safeguards to prevent soil erosion, water contamination, and habitat destruction. Hence, feasibility assessments must consider environmental regulations and incorporate mitigation measures such as erosion control, sedimentation ponds, and habitat restoration to minimize ecological disruption and preserve natural resources. Therefore, feasibility assessments must account for regulatory compliance and incorporate measures to address legal obligations, obtain necessary permits, and adhere to industry best practices. In addition to feasibility management, maintenance activities are integral components of highway construction zone management aimed at preserving existing infrastructure, ensuring operational efficiency, and prolonging the lifespan of roadways.

Maintenance encompasses a range of activities such as pavement repair, signage replacement, vegetation management, and drainage system maintenance, all of which contribute to enhancing the safety and usability of highways during the construction phase. Effective maintenance strategies in highway construction zones prioritize proactive inspections, routine upkeep, and timely repairs to address wear and tear resulting from construction activities and environmental factors. Regular maintenance not only prevents deterioration of infrastructure but also minimizes the likelihood of accidents, reduces long-term maintenance costs, and enhances the overall quality and durability of highways. Feasibility management and maintenance are essential aspects of highway construction zone management that are instrumental in ensuring the successful execution of construction projects while minimizing disruptions, ensuring safety, and preserving environmental integrity. By adopting proactive strategies, leveraging advanced technologies, and adhering to regulatory requirements, stakeholders can optimize project outcomes and deliver high-quality infrastructure that meets the needs of communities and enhances transportation networks.

1.1 Highway Construction Zone Overview

Highway construction zones are critical areas where infrastructure development takes place, often resulting in temporary disruptions to regular traffic flow. Feasibility management and maintenance within these zones are essential to ensure smooth project execution while minimizing inconvenience to commuters and maintaining safety standards. Comprehensive planning and evaluation of several variables are required for feasibility management in order to ascertain the construction project's viability as well as practicality within the allocated highway region. This entails assessing the resources that are accessible including labour, materials, and devices, in addition to taking concerns of stakeholders, legal constraints, and impacts on the environment into account. Maintenance within highway construction zones is crucial for preserving the integrity of existing infrastructure and ensuring the safety of both workers and motorists. Regular inspection and upkeep of equipment, signage, barriers, and temporary structures are essential to prevent accidents and minimize disruptions. Additionally, proactive maintenance practices, such as routine repairs and cleaning, help extend the lifespan of construction materials and minimize the need for costly replacements.

Moreover, effective communication and coordination among project stakeholders, including construction crews, transportation authorities, and local communities, are vital for managing feasibility and maintenance activities efficiently. By keeping all parties informed about project timelines, traffic diversions, and safety protocols, potential conflicts and delays can be mitigated, fostering a collaborative approach to highway construction management. In summary, feasibility management and maintenance play integral roles in highway construction zones, ensuring the successful execution of projects while prioritizing safety, efficiency, and minimal disruption to traffic flow. By employing strategic planning, regular maintenance practices, and open communication, construction teams can navigate challenges effectively and deliver high-quality infrastructure that meets the needs of the community.

1.2 Importance of Maintenance Planning

Maintenance planning plays a crucial role in highway construction zones, ensuring the longevity, safety, and efficiency of the infrastructure. Here are some key reasons highlighting the importance of maintenance planning in such contexts: **Safety Assurance:** Highway construction zones are inherently risky environments, with ongoing work, changing traffic patterns, and potential hazards. Maintenance planning helps identify safety risks and implements measures to mitigate them. Regular inspections and upkeep of signage, barriers, and road surfaces minimize the chances of accidents and ensure the safety of both workers and commuters. **Minimization of Disruptions:** Effective maintenance planning aims to minimize disruptions to traffic flow and adjacent communities. By scheduling maintenance activities during off-peak hours or periods of low traffic volume, the impact on commuters is reduced. Proper planning also allows for swift responses to emergencies or unexpected issues, minimizing delays and inconvenience. **Preservation of Infrastructure:** Highways are significant investments, and maintenance planning is essential for preserving this infrastructure over its lifecycle. Regular inspections, routine maintenance, and timely repairs help prevent minor issues from escalating into major structural problems. By addressing issues promptly, the need for costly repairs or reconstruction in the future is mitigated, saving both time and resources.

Optimization of Resources: Maintenance planning involves allocating resources efficiently to address the most critical needs within the construction zone. By prioritizing maintenance tasks based on factors such as traffic volume, wear and tear, and safety concerns, resources such as labor, materials, and equipment are utilized effectively. This optimization ensures that maintenance activities yield maximum benefit in terms of safety and infrastructure longevity. **Compliance with Regulations:** Highway construction zones must adhere to various regulations and standards set forth by governmental bodies. Maintenance planning ensures compliance with these requirements, including regular inspections, documentation of maintenance activities, and adherence to safety protocols. By staying compliant,

highway authorities mitigate the risk of penalties or legal issues while upholding public trust and confidence in the project. In essence, maintenance planning in highway construction zones is not just about fixing problems as they arise but about proactively managing the infrastructure to ensure safety, efficiency, and longevity. By implementing comprehensive maintenance plans, stakeholders can minimize risks, optimize resources, and enhance the overall quality of the highway network.

1.3 Challenges in Construction Zones

In highway construction zones, feasibility management and maintenance present several challenges that need to be addressed for successful project execution. These challenges include: **Traffic Management:** One of the primary concerns in highway construction zones is managing traffic flow while construction activities are ongoing. Feasibility management involves developing strategies to minimize disruptions to traffic, ensuring the safety of both workers and commuters. Maintaining a smooth traffic flow can be particularly challenging during peak hours and in densely populated areas. **Safety Hazards:** Construction zones inherently pose safety hazards for workers and commuters alike. Feasibility management requires implementing stringent safety protocols and ensuring compliance with safety regulations to mitigate the risk of accidents and injuries. Maintenance of safety equipment and regular inspections are essential components of safety management in construction zones. **Environmental Impact:** Highway construction projects can have significant environmental implications, including habitat disruption, soil erosion, and pollution. Feasibility management involves assessing the environmental impact of construction activities and implementing measures to minimize negative consequences. This may include erosion control measures, proper waste disposal, and adherence to environmental regulations.

Resource Management: Efficient management of resources, including labor, materials, and equipment, is crucial for the successful completion of highway construction projects. Feasibility management involves optimizing resource allocation to ensure that construction activities proceed according to schedule and budget constraints. Additionally, maintenance of equipment and infrastructure is necessary to prevent delays and cost overruns. **Stakeholder Coordination:** Highway construction projects often involve multiple stakeholders, including government agencies, contractors, local communities, and businesses. Feasibility management requires effective coordination and communication among these stakeholders to address concerns, resolve conflicts, and ensure project objectives are met. Regular updates and consultation with stakeholders help to maintain transparency and build trust throughout the construction process. Addressing these challenges requires careful planning, proactive risk management, and collaboration among various stakeholders. By effectively managing feasibility and maintenance in highway construction zones, project teams can ensure the timely completion of projects while minimizing disruptions and maximizing safety and environmental sustainability.

II. RELATED WORK

El-Sawah Hany et al. An investigation into This study presents the utilisation of ANNs (artificial neural networks) for preliminary cost estimate. The choice and design of the artificial neural network (ANN) algorithm significantly affect its output along with consequently, the accuracy of the expense projection. Along with regression analysis, the research took into account Back Propagation Neural Networks (BPNN), Probabilistic Neural Networks (PNN), and Generalised Regression Networks (GRNN). Audu, H. A. P. et al. The sensitivity analysis's graphs show that the alternatives' life cycle costs drop when the interest rate rises. The economic assessment of flexible pavement and transit networks depends heavily on these findings. The original investment price and upkeep costs are taken into account, according to Mr. Akhai Mudassar et al. Alternative pavement designs may be chosen with the aid of LCC. This will save costs and provide sufficient serviceability throughout the duration of the roads' design life. The cost will be further decreased by substituting a specified percentage of fly ash for cement. According to Yonas Ketema et al., due of the maintenance expenditures that flexible pavement incurs over the course of its design life, its cost 7.9 million ETB greater per km than pavement with rigidity. It is suggested that Portland Cement Concrete Pavement (PCCP) be used in pavement construction in order to comply with regional construction standards. Pratik Shirole et al. Applying a white topping overlay to an existing bituminous pavement is one potential restoration option in lieu of asphalt overlays. Igor Peško et al. seek to assess the life cycle expenses of rubberized and concrete pavements and recommend a better option among them in this research. The most accurate ANNs attained accuracy of 25.38%, whereas the top SVM demonstrated better precision when predicting expenses, with an average absolute percentage error (MAPE) of 7.06%. Estimating the length of a task has proven to be more challenging. For SVM and ANN, the best MAPEs were 22.77% and 26.26%, respectively. Batouli, Mostafa et al. The findings' sensitivity to several factors, including the price of discounting and the pace of future traffic increase, was also investigated in the research. The level of sensitivity analysis's findings

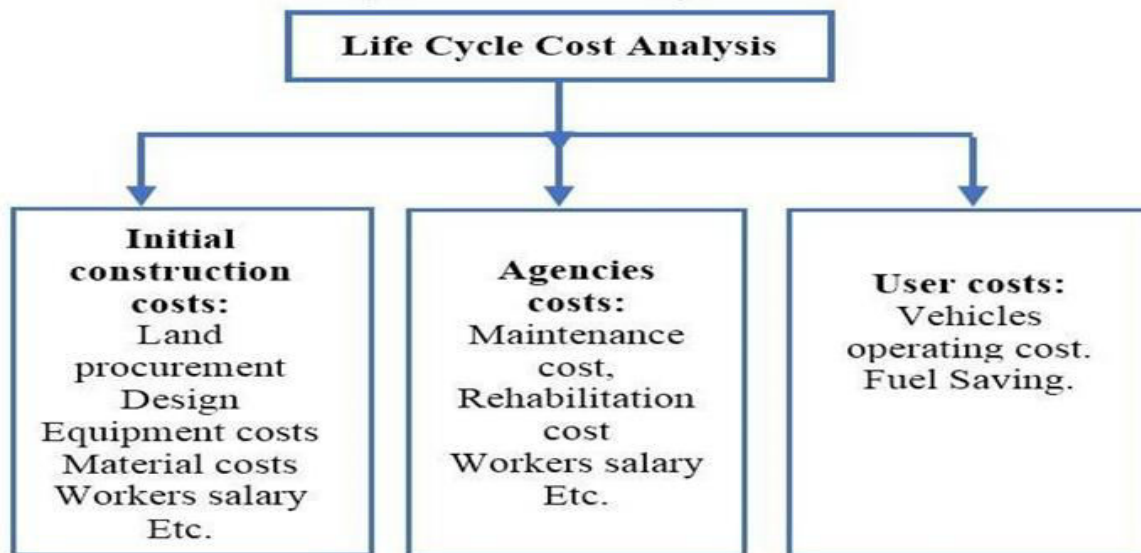
showed that, for discount rates of less than 4%, the movable road design had lower agency fees than rigid pavements. Lower life cycle costs are achieved by stiff concrete for discount rates higher than 4.5%.

Sabeti Sepehr This article addresses the hazardous situations that may be found in highway construction zones, where insufficient anticipatory safety measures resulted in 124 worker fatalities in 2018. This research provides a revolutionary design paradigm that blends augmented reality (AR) with artificial intelligence (AI) to address this issue. Three main pillars are outlined: (1) edge-based AI for distant vehicle detection/classification; (2) real-time wireless communication in work zones; and (3) AR user interface for real-time multimodal notifications. This will enable latency-aware interaction between AI and AR components. **Xinyuan Zhu** Climate change must be included in state highway planning, delivery, and construction processes in order to lower carbon emissions. This need is covered in this article. It introduces the Green Performance Contracting (GPC) framework, which breaks down techniques into categories for materials, equipment efficiency, life cycles, and the production of clean energy. The study examines current contracting practices and provides information on the application of GPC methods by US state Departments of Transportation (DOTs). **Michael J. Markow** This research critically analyses the FHWA's yearly highway maintenance and operations expense index, which was created in 1947 and has been constant ever since. The tasks included a study of the literature, an investigation of state transportation agencies, behaviour analysis of the index, and comparisons with other building and maintenance indices. The research looks at alternatives including keeping the present index, making revisions, developing a new one, or ending it altogether. **MEDICINA ISABEL CANETE** This research The Heart of Illinois Turnpike Feasibility Study, financed by IDOT and FHWA, began in May 1993 and is scheduled to be completed in the spring of 1995. Covering an area of nearly 7,700 km², the study takes into account a variety of locations throughout 10 counties. More than 1,000 km of corridor options were created, arranged into three transit recommendations: north, northeast, and east, with feedback from the community and the Study Advisory Group. The options were reduced by a rigorous three-step screening procedure that included factors including environmental effect, unfavourable travel circumstances, and redundancy.

Ahmed Z. Abdelmohsen Motorway construction zones put workers and traffic at danger, which makes driving tougher and causes delays & gridlock. The state departments of transportation (DOTs) and the FHWA (Federal Highway Administration) are searching for innovative methods to enhance work-zone safety and accessibility. This study presents a unique multiobjective improvement technique that is meant to be employed for the meticulous design and improvement of roadway work-zone layout. Using multiobjective evolutionary algorithms, the model finds a set of Pareto-optimal work-zone layouts that provide the best possible trade-offs between lowering the likelihood of crashes and minimising traffic delays. **Zhu Gaoru** Under the national policy of building a "strong transportation country," one of the main concerns among scholars is the viability of building a highway network, especially in environmentally sensitive areas such as the Sanjiangyuan region on the Qinghai-Tibet plateau. Using a comprehensive methodology, this research assesses nine ecological friendliness and seventeen building need indices. These indicators are given weights using expert scoring techniques and the Analytic Hierarchy Process (AHP). **Ryan Christopher Huebschman** This thorough analysis looks at many traffic control systems intended to alert drivers to changing circumstances while building interstates. Although these systems are good at spreading information, there is frequently little evidence linking them to increased safety. The research, which examined data from sixteen interstate projects in Indiana, finds that accident rates rose by 27.5% while the projects were under development. Fixed panel signs and Variable Message Signs (VMS) were among the experimental signs deployed as part of a pilot project in the renovation of the I-65/US-30 intersection. **Li Zongzhi** This study examines work zones health auditing procedures worldwide, investigates expert viewpoints on highway work region security in the US, and offers a framework for putting them into practice. By combining a study of the literature with experts polls and questionnaires, the research determines the main root causes of work zone safety challenges, workable solutions, relevant projects for inspection, squad composition, finance sources, audit roles, tools, and staff safety training. **Al-Jalil Ahmed Bayati** This research examines data from the Fatality Assessment and Control Evaluation (FACE) Programme in order to address the concerning rates of deaths and injuries in street and highway maintenance work zones in the United States. The research highlights the vital role that Internal Traffic Control Plans (ITCPs) play in work zone safety, with a focus on internal-source occurrences and vehicle incursion incidents. Notably, it is determined that ITCPs are not required, and as a result, OSHA is advised to compel their usage by means of the general-duty provision.

III. METHODOLOGY

A. Life Cycle Cost Analysis Procedure



4. ANALYTICAL STUDY



Figure No.1 Road view



Figure No.2 Stone Aggregate Grey



Figure No.3 Preparation and placing of Premix.



Figure No.4 –Bitumen Sprayer

Study Area Google Map
Study Aurangabad Highway to Kolwadi Road

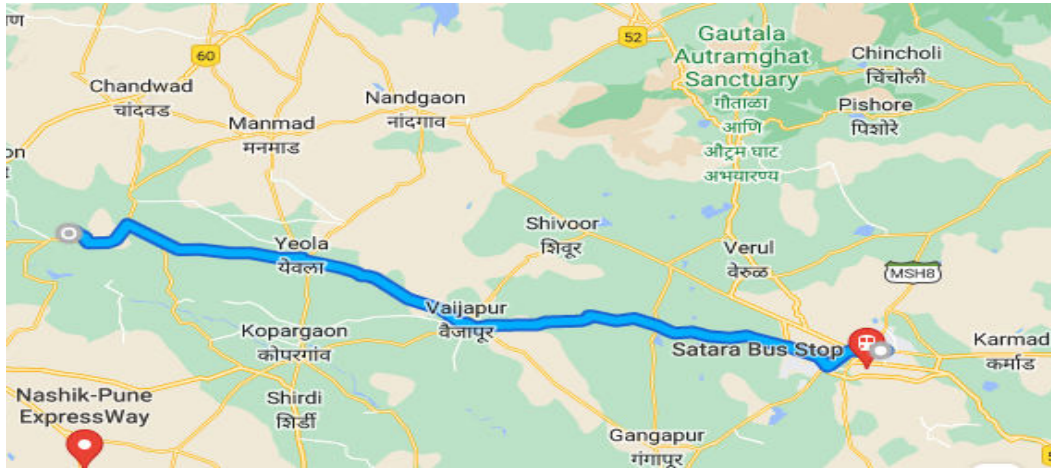


Figure No.5 Study Area Google Map

In order to forecast future expenses related to maintenance, the current case study's ANN input annual maintenance cost was necessary. Data spanning the last 20 years was collected from Stup Consultant's billing engineer, Mr. Amol Garole.

4.1 For Rigid Pavement

Improvement of Package-I in the state of Maharashtra from km 0+000 to km 47+800 to 2 lanes with paved shoulders.

Table 1 General Abstract of Cost for Rigid Pavement

| GENERAL ABSTRACT OF COST | | | |
|-------------------------------|--|-------------------|-----------------|
| Length of Project -(47.80 Km) | | | |
| Bill No | Item of works | Amount (Rs. Crs.) | % of Total Cost |
| 1 | Site clearance and dismantling | 2.13 | 0.95% |
| 2 | Earth work | 41.80 | 18.70% |
| 3 | Granular sub-base | 24.51 | 10.96% |
| 5 | Concrete pavement | 87.47 | 39.13% |
| 6 | Slab, box and pipe culverts and underpass | 18.10 | 8.10% |
| 7 | Major and minor bridges | 8.03 | 3.59% |
| 8 | Drainage and protection works | 15.85 | 7.09% |
| 9 | Traffic signs, marking and other appurtenances | 1.81 | 0.81% |
| 10 | BUS BAY and TRUCK LAY BAY | 1.88 | 0.84% |
| 11 | MISCELLANEOUS (Median work and Utilities across the highway) | 5.58 | 2.50% |
| 12 | Toll plaza | 3.98 | 1.78% |
| 13 | Major and minor junctions | 8.17 | 3.65% |
| | TOTAL | 223.54 | |
| | Total project Cost Per Km (Rs. Crs.) | 5.67 | |



4.2 For Flexible Pavement

Up gradation of, Package-I from Km. 0+000 to Km. 47+800 to 2 lane with paved shoulder configuration in the state of Maharashtra

Table 2 General Abstract of Cost for Flexible Pavement

| GENERAL ABSTRACT OF COST | | | |
|-------------------------------|--|-------------------|-----------------|
| Length of Project -(47.80 Km) | | | |
| Bill No | Item of works | Amount (Rs. Crs.) | % of Total Cost |
| 1 | Site clearance and dismantling | 2.13 | 1.05% |
| 2 | Earth work | 41.80 | 20.59% |
| 3 | Granular sub-base | 24.51 | 12.07% |
| 5 | Pavement | 98.00 | 48.26% |
| 6 | Slab, box and pipe culverts and underpass | 18.10 | 8.91% |
| 7 | Major and minor bridges | 8.03 | 3.96% |
| 8 | Drainage and protection works | 15.85 | 7.80% |
| 9 | Traffic signs, marking and other appurtenances | 1.81 | 0.89% |
| 10 | BUS BAY and TRUCK LAY BAY | 1.88 | 0.92% |
| 11 | MISCELLANEOUS (Median work and Utilities across the highway) | 5.58 | 2.75% |
| 12 | Toll plaza | 3.98 | 1.96% |
| 13 | Major and minor junctions | 8.17 | 4.02% |
| | TOTAL | 203.06 | |
| K | Total project Cost Per Km (Rs. Crs.) | 5.19 | |

4.3 Life Cycle Cost Analysis

a) For Rigid Pavement

Table 3 For Rigid Pavement

| Year | Construction Item | Cost (Crores Rs) | Cost After Inflation (at 5%) | Discounted Cost (at 12%) | Cum Net Present Value(Crores Rs) | Inflation Factor | Discount Rate Factor |
|------|--|------------------|------------------------------|--------------------------|----------------------------------|------------------|----------------------|
| | Cost of civil works excluding cent ages | | | 223.54 | crores | | |
| | annual routine maintenance for joint repair @ 0.1% of civil cost | | | 0.224 | crores | 105% | 112% |
| 2017 | 1 st year const | 22.354 | 22.35 | 22.35 | 22.35 | 1.000 | 1.000 |
| 2018 | 2 st year const | 67.062 | 70.42 | 62.87 | 85.22 | 1.050 | 1.120 |
| 2019 | 3 st year const | 134.124 | 147.87 | 117.88 | 203.11 | 1.103 | 1.254 |



| | | | | | | | |
|------|-------------------------|-------|------|------|--------|-------|--------|
| 2020 | Annual maintenance (AM) | 0.224 | 0.26 | 0.18 | 203.29 | 1.158 | 1.405 |
| 2021 | AM | 0.224 | 0.27 | 0.17 | 203.46 | 1.216 | 1.574 |
| 2022 | AM | 0.224 | 0.29 | 0.16 | 203.63 | 1.276 | 1.762 |
| 2023 | AM | 0.224 | 0.30 | 0.15 | 203.78 | 1.340 | 1.974 |
| 2024 | AM | 0.224 | 0.31 | 0.14 | 203.92 | 1.407 | 2.211 |
| 2025 | AM | 0.224 | 0.33 | 0.13 | 204.05 | 1.477 | 2.476 |
| 2026 | AM | 0.224 | 0.35 | 0.13 | 204.18 | 1.551 | 2.773 |
| 2027 | AM | 0.224 | 0.36 | 0.12 | 204.30 | 1.629 | 3.106 |
| 2028 | AM | 0.224 | 0.38 | 0.11 | 204.41 | 1.710 | 3.479 |
| 2029 | AM | 0.224 | 0.40 | 0.10 | 204.51 | 1.796 | 3.896 |
| 2030 | AM | 0.224 | 0.42 | 0.10 | 204.61 | 1.886 | 4.363 |
| 2031 | AM | 0.224 | 0.44 | 0.09 | 204.70 | 1.980 | 4.887 |
| 2032 | AM | 0.224 | 0.46 | 0.08 | 204.78 | 2.079 | 5.474 |
| 2033 | AM | 0.224 | 0.49 | 0.08 | 204.86 | 2.183 | 6.130 |
| 2034 | AM | 0.224 | 0.51 | 0.07 | 204.93 | 2.292 | 6.866 |
| 2035 | AM | 0.224 | 0.54 | 0.07 | 205.00 | 2.407 | 7.690 |
| 2036 | AM | 0.224 | 0.56 | 0.07 | 205.07 | 2.527 | 8.613 |
| 2037 | AM | 0.224 | 0.59 | 0.06 | 205.13 | 2.653 | 9.646 |
| 2038 | AM | 0.224 | 0.62 | 0.06 | 205.19 | 2.786 | 10.804 |
| 2039 | AM | 0.224 | 0.65 | 0.05 | 205.24 | 2.925 | 12.100 |
| 2040 | AM | 0.224 | 0.69 | 0.05 | 205.29 | 3.072 | 13.552 |
| 2041 | AM | 0.224 | 0.72 | 0.05 | 205.34 | 3.225 | 15.179 |
| 2042 | AM | 0.224 | 0.76 | 0.04 | 205.39 | 3.386 | 17.000 |
| 2043 | AM | 0.224 | 0.79 | 0.04 | 205.43 | 3.556 | 19.040 |
| 2044 | AM | 0.224 | 0.83 | 0.04 | 205.47 | 3.733 | 21.325 |



| | | | | | | | |
|------|----|-------|------|------|--------|-------|--------|
| 2045 | AM | 0.224 | 0.88 | 0.04 | 205.50 | 3.920 | 23.884 |
| 2046 | AM | 0.224 | 0.92 | 0.03 | 205.54 | 4.116 | 26.750 |
| 2047 | AM | 0.224 | 0.97 | 0.03 | 205.57 | 4.322 | 29.960 |
| 2048 | AM | 0.224 | 0.22 | 0.22 | 205.79 | 1.000 | 1.000 |
| 2049 | AM | 0.224 | 0.22 | 0.22 | 206.02 | 1.000 | 1.000 |

(b) For Flexible Pavement

Table 4 for Flexible Pavements

| | Cost of civil works excluding cent ages | | | 203.06 | crores | | |
|------|--|------------------|------------------------------|--------------------------|----------------------------------|------------------|----------------------|
| | Annual routine maintenance for shoulder rain cut repair, potholes etc. @ 0.25% of civil cost | | | 0.51 | crores | 105% | 112% |
| Year | Construction Item | Cost (Crores Rs) | Cost After Inflation (at 5%) | Discounted Cost (at 12%) | Cum Net Present Value(Crores Rs) | Inflation Factor | Discount Rate Factor |
| 2017 | 1 st year const | 20.31 | 20.31 | 20.31 | 20.31 | 1.000 | 1.000 |
| 2018 | 2 st year const | 60.92 | 63.97 | 57.11 | 77.42 | 1.050 | 1.120 |
| 2019 | 3 st year const | 121.84 | 134.33 | 107.08 | 184.50 | 1.103 | 1.254 |
| 2020 | AM | 0.51 | 0.59 | 0.42 | 184.92 | 1.158 | 1.405 |
| 2021 | AM | 0.51 | 0.62 | 0.39 | 185.31 | 1.216 | 1.574 |
| 2022 | AM | 0.51 | 0.65 | 0.37 | 185.68 | 1.276 | 1.762 |
| 2023 | AM | 0.51 | 0.68 | 0.34 | 186.03 | 1.340 | 1.974 |
| 2024 | AM | 15.16 | 21.33 | 9.65 | 195.67 | 1.407 | 2.211 |
| 2025 | AM | 0.51 | 0.75 | 0.30 | 195.98 | 1.477 | 2.476 |
| 2026 | AM | 0.51 | 0.79 | 0.28 | 196.26 | 1.551 | 2.773 |
| 2027 | AM | 0.51 | 0.83 | 0.27 | 196.53 | 1.629 | 3.106 |
| 2028 | AM | 0.51 | 0.87 | 0.25 | 196.77 | 1.710 | 3.479 |
| 2029 | AM | 15.16 | 27.22 | 6.99 | 203.76 | 1.796 | 3.896 |
| 2030 | AM | 0.51 | 0.96 | 0.22 | 203.98 | 1.886 | 4.363 |
| 2031 | AM | 0.51 | 1.01 | 0.21 | 204.19 | 1.980 | 4.887 |

| | | | | | | | |
|------|----|-------|--------|-------|---------------|-------|--------|
| 2032 | AM | 0.51 | 1.06 | 0.19 | 204.38 | 2.079 | 5.474 |
| 2033 | AM | 0.51 | 1.11 | 0.18 | 204.56 | 2.183 | 6.130 |
| 2034 | AM | 48.66 | 111.52 | 16.24 | 220.80 | 2.292 | 6.866 |
| 2035 | AM | 0.51 | 1.22 | 0.16 | 220.96 | 2.407 | 7.690 |
| 2036 | AM | 0.51 | 1.28 | 0.15 | 221.11 | 2.527 | 8.613 |
| 2037 | AM | 0.51 | 1.35 | 0.14 | 221.25 | 2.653 | 9.646 |
| 2038 | AM | 0.51 | 1.41 | 0.13 | 221.38 | 2.786 | 10.804 |
| 2039 | AM | 18.14 | 53.08 | 4.39 | 225.77 | 2.925 | 12.100 |
| 2040 | AM | 0.51 | 1.56 | 0.12 | 225.88 | 3.072 | 13.552 |
| 2041 | AM | 0.51 | 1.64 | 0.11 | 225.99 | 3.225 | 15.179 |
| 2042 | AM | 0.51 | 1.72 | 0.10 | 226.09 | 3.386 | 17.000 |
| 2043 | AM | 0.51 | 1.81 | 0.09 | 226.19 | 3.556 | 19.040 |
| 2044 | AM | 18.14 | 67.74 | 3.18 | 229.36 | 3.733 | 21.325 |
| 2045 | AM | 0.51 | 1.99 | 0.08 | 229.45 | 3.920 | 23.884 |
| 2046 | AM | 0.51 | 2.09 | 0.08 | 229.52 | 4.116 | 26.750 |
| 2047 | AM | 0.51 | 2.19 | 0.07 | 229.60 | 4.322 | 29.960 |
| 2048 | AM | 0.51 | 2.30 | 0.07 | 229.67 | 4.538 | 33.555 |
| 2049 | AM | 18.14 | 86.46 | 2.30 | 231.97 | 4.765 | 37.582 |

V. CONCLUSION

Concrete is a more advantageous solution when compared to bituminous pavements using Life Cycle Cost Analysis (LCCA), with concrete overlays providing efficient rehabilitation for bituminous surfaces that are already in place. Rigid pavements show lower life cycle costs over 40 years, saving 64 million ETB per km compared to flexible pavements, despite higher initial construction costs (10.08% more). In comparison to rigid pavements, flexible pavements need a 7.3 million ETB increase for construction and maintenance over a three-decade period due to routine maintenance expenditures that are 1.1 times more than original construction costs. Based on the results of this research investigation, it has been shown that stiff pavement lasts longer than flexible pavement. After forty (40) years of analytics, the stiff pavement cover has a life cycle cost that is one kilometre lower than the flexible pavement cover, for a total of 64 million ETB (Existing-To-Bank). For three decades, the cost of routine and regular maintenance for a one-kilometer stretch of flexible pavement is 1.1 times more than the cost of building inspections. The construction and maintenance costs of flexible pavement are also higher than those of rigid pavement, costing an additional \$7,3 million. Rigid pavement has an initial construction cost that is 10.08 percent higher.

Congestion may be reduced and developed and maintained quickly using flexible pavement. These pavements, which are typically black in color, provide a significant reduction in road surface clearance and aid in the formation of line markings. In contrast to rigid pavement, these surfaces are sturdy, secure, and long-lasting. Using rigid and flexible pavements, the life cycle cost assessments for the road are finished in this study and carried out using MATLAB

programmer over a distance of one km. According to the LCCA research study on roads with rigid and flexible pavement, initial construction costs for roads with flexible pavement are 40–45% more than those for roads with rigid pavement.

similarly, the output findings of the MATLAB analysis show that the roads with stiff sidewalk have an accuracy of 99.5%, but the roads using flexible asphalt have an accuracy of 99.94%. According to those results, stiff pavement is more affordable than malleable asphalt. To achieve the optimal potential compromise involving highway project investment and repair, LCCA should be used. Choosing the optimal option to achieve a project goal is one of the many uses for LCCA. Beyond costs and LCCA, such as geological conditions, the feasibility study on road selection takes into account other factors such as construction time, environmental effect, availability of technology, constructability, ecological considerations, and political implications. To guarantee the best cost efficiency throughout the course of the road's life, it is helpful to conduct an LCCA of the various choices involved for each projected major repair in order to adequately plan for future repairs or regular maintenance.

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