iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** X **Month of publication:** October 2023

DOI: https://doi.org/10.22214/ijraset.2023.56151

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue X Oct 2023- Available at www.ijraset.com

Study and Analysis of Highway Failure and Their Maintenance

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Abstract: ***Maintaining highways is crucial to ensure road surfaces are safe and smooth for drivers, ultimately loading to efficient and cost-effective transportation. Regular maintenance helps prevent accidents and reduces theoverall cost of road repairs in the long run. The investigation found that the authority of RCC performs their maintenance work in one year when allocated funds are available. Many types of road failures oc, such as cracks, pot-holes, ravelling, water bleeding, corrugation and showing, depression, and rutting. The possible causes of flexible pavement failures are improper bituminous mixes with poor quality materials, heavy traffic loads,heavy rainfall, and bad drainage on pavement. The failures are gradually raised due to a lack of proper planning, inspection,and treatment. These failures create different types of disadvantages like traffic jams, discomfort to the passengers aswell as drivers, increasing vehicle operating, maintenance costs, etc***

I. INTRODUCTION

The development of a country depends upon a transportation system and the transportation system should be well-developed in roads, railways, waterways, and airways. A well- developed transportation system, encompassing roads, railways, waterways, and airways, plays a crucial role in the development of a country. It facilitates the efficient movement of goods and people, reduces communication costs, and ensures the timely arrival of essential commodities. This infrastructure is a cornerstone of economic and social progress. Indeed, road transportation plays a crucial role in connecting people and communities, providing access to goods and services, and facilitating various aspects of daily life in a complexsociety. It's often the most accessible and versatile mode of transportation, especially in remote areas. That's correct, roads can still experience failures despite careful construction.

Factors like weather, heavy traffic, and maintenance play a role in road durability. Maintenance is crucial to extend the road's lifespan, reduce vehicle operating costs, and ensure it remains in a serviceablecondition. Road pavements are generally divided intotwo main types based on their structural and design purpose: flexible pavement and rigid pavement. Flexible Pavement: This type of pavementis constructed using multiple layers of materials, withthe top layer being asphalt concrete. Flexible pavements are designed to distribute the load from traffic over a broader area, allowing for some flexibility and deformation. This makes them well- suited for roads that experience heavytraffic and need to withstand varying weather conditions. Rigid Pavement: Rigid pavements are typically made of concrete and are designed to be stiff and unyielding. They distribute the load more effectively than flexiblepavements, making them suitable for areas with heavytraffic loads, such as highways and airports. Rigid pavements tend to be more durable but are less forgiving when it comes to temperature- related expansion and contraction. The choice between flexible and rigid pavement depends on various factors, including traffic volume, environmental conditions, and budget constraints. Each type has its advantages and disadvantages, and engineers select the appropriate pavement design based on the specific requirements of the road or highway project..

II. LITERATURE

The term pavement ordinarily means the surfacinglayer only. But in highway design, it means the total thickness of pavement that includes surface, base, and sub-base What you're describing sounds like a road or pavement. Roads are constructed with material layers to provide a stable and even surface for vehicles while distributing the load to the natural soil subgrade. Flexible pavements, such as asphalt roads, are more prone to various types of failures like cracking, rutting, and potholes due to changing weather conditions and heavy traffic loads. Regular maintenance is essential to extendtheir lifespan and ensure safe and smooth travel. may include patching, resurfacing, and seal coating, depending on the specific issues that arise. The flexible pavement layers reflect the deformation of the lower layers on the surface of the layer.

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Development typically goes Highway through severalstages, from planning and design to construction andmaintenance. These stages may vary in detail and order depending on the specific project and location,but here is a general overview of the stages involvedin highway development:

A. Planning and Feasibility Study

1) Identifying the need for a new highway orimprovements to an existing one.
2) Conducting traffic studies andenvironmental assessments.
3) Evaluating various alignment options and potentialroutes.
4) Assessing the economic and social benefits of theproject.
5) Securing funding and approvals.

B. Design

1) Developing detailed engineering plans andspecifications.
2) Creating a geometric design that includes road alignment, cross- sections, and lane configurations.
3) Designing drainage, bridges, interchanges, and othernecessary structures.
4) Ensuring compliance with environmental regulationsand safetystandards

C. Land Acquisition

1) Acquiring the necessary land and right-of- way for the project. - Negotiating with property owners and resolving any disputes.

D. Environmental Impact Assessment

1) Conducting comprehensive environmental impactassessments and obtaining required permits.
2) Mitigating and addressing environmental concerns.

E. Bidding and Contract Award

1) Preparing bid documents and soliciting bids fromconstruction companies.
2) Evaluating bids and awarding contracts to theselected contractors.

F. Construction

1) Building the highway according to the approved plans and specifications.
2) Managing construction activities, including grading, paving, bridge construction, and signageinstallation.
3) Ensuring compliance with safety and qualitystandards.
4) Managing traffic during constructionto minimize disruptions..

G. Quality Control and Inspection

1) Regularly inspecting construction work to ensure it meets design and quality standards.
2) Conducting material testing and quality controlmeasures.

H. Project Management

1) Overseeing the project schedule, budget, andresources. Addressing any unexpected issuesor delays and safety standards

I. Project Management

1) Overseeing the project schedule, budget, and resources.
2) Addressing anyunexpected issues or delays.

J. Completion and Opening: Finalizing construction and conducting safety inspections.

1) Opening the highway to traffic.

K. And Operation

1) Implementing a maintenance plan to ensure the long-term functionality andsafety of the highway.

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2) Regularly inspecting and repairing the roads, bridges, and other infrastructure.
3) Managing traffic flow, toll collection(if applicable), and addressing emergencies.

L. Expansion and Upgrades (if needed):
1) Evaluating the need for future expansion or improvements based on traffic growth and changing needs.
2) Repeating some of the earlier stages of expansionprojects.

Highway development is a complex and lengthy process that involves collaboration among various stakeholders, including government agencies, engineers, environmental experts, and construction companies. It's important to note that each project may have unique requirements and considerations, and local regulations and practices can vary significantly.

a) Types of Distresses / Failures andDefinitions

- *Longitudinal Cracking:* Fatigue cracking, also known as alligator cracking, is a common type of distress that occurs in asphalt pavements due to repeated traffic loadings and the resulting cyclical stresses on the pavement.It is called "alligator cracking" because the pattern of cracksresembles the scales on an alligator's skin or the interlockingmesh of chicken wire.



Fig: Longitudinal Cracking

- *Fatigue Cracking:* Cracks in asphalt layers that are caused by repeated traffic loadings.The cracks indicate fatigue failure of the asphalt layer. When cracking is characterized by interconnected cracks, the cracking pattern resembles that of an alligator'sskin or chicken wire. Therefore, it is also referred to as alligator cracking.



Fig: Fatigue Cracking

- *Block cracking:* Block cracking is a common type of distress that occurs in asphalt pavements. Itis a pattern of interconnected cracks that divide thepavement surface into rectangular or polygonal blocks, resembling the appearance of a shattered piece of glass or a jigsaw puzzle. Block cracking is a distress that can affect both flexible and rigid pavements, but it is more commonly associated with flexible asphalt pavements.



Fig:- Block cracking

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- *Edge Cracking:* Crescent-shaped cracks or fairly continuous cracks that intersect the pavement edge andare located within 2 feet of the pavement edge, adjacentto the unpaved shoulder. Includes longitudinal cracks outside of the wheel path and within 2 feet of the pavement edge .



Fig:- Edge Cracking

- *Rutting:* Rutting is a longitudinal surface depression or groove in the wheel path. If the rutting is accompanied by adjacent bulging, it may be sign of subgrade movement. This phenomenon takes place when either pavement thickness is inadequate or there isheavy channelized traffic



Fig:- Rutting

- *Transverse Cracking:* Cracks that are predominately perpendicular to pavement centreline andare not located over Portland cement concrete joints. Thermal cracking is typically in this category Transverse cracking can be detrimental to pavement performance and safety, as it can lead to the infiltration of water, further deterioration, and reduced ride quality. Addressing transverse cracks typically involves various maintenance and rehabilitation strategies.



Fig:- Transverse Cracking

- *Reflection Cracking:* Reflection cracking is a common challenge when rehabilitating or overlaying existing pavements, especially in areas with significant temperature variations and heavy traffic loads. Proper engineering and construction practices, along with the use of suitable materials and techniques, can help manage and reduce the occurrence of reflection cracking and extend the life of the pavement overlay.

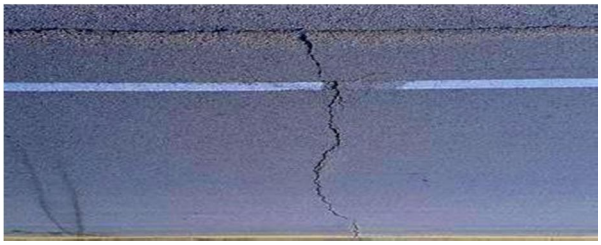


Fig:- Reflection Cracking

- *Corrugation:* The formation of periodic,transverse ripples on unpaved road Surfaces.



Fig:- Corrugation

- *Pot Holes:* The weight of vehicles passing over the weakened pavement can accelerate the development of potholes. As vehicles drive overthe damaged area, they can dislodge piecesof pavement, making the hole larger.



Fig:- Pot Holes

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- *Segregation:* Aggregate segregation is a phenomenon that occurs in the construction of concreteand asphalt mixtures when the individual particles of aggregate (such as sand, gravel, or crushed stone) separate and become unevenly distributed within the mixture. This segregation can lead to undesirable variations in the composition and properties of the final product, which can compromise its quality and performance.



Fig:- Segregation

III. HIGHWAY MAINTENANCE

Highway (road) maintenance is defined as preserving and keeping the serviceable conditions highway as normal as possible and practicable. The main objectives of road maintenance men are the allocation of available maintenance resources according to actual needs and priorities.

A. Surface Maintenance

1) Preventive Maintenance: Preventive maintenance involves proactive measures to address minor issues before they escalate into major problems. This may include sealing cracks, applying surface treatments, andpatching small potholes.

2) Repairs: When road surfaces developsignificant damage, repairs are necessary. This can involve patching or resurfacing sections of theroad to restore its integrity and smoothness.

B. Traffic Service

1) *Traffic Management:* This involves monitoring and controlling traffic flow through various means, including traffic signals, signs, and variable message signs (VMS). Traffic management aims to reduce congestion, prevent accidents, and improve overall road safety andefficiency.

2) *Traffic Signals:* Traffic signal systems are used to control the right-of-way at intersections and along roadways. They help regulatetraffic flow, reduce conflicts, and improve safety.

3) *Traffic Enforcement:* Law enforcement agencies play a critical role in enforcing traffic laws and regulations. This includes issuingcitations for speeding, reckless driving, and other violations to promote safedriving behavior.

C. Roadside and Drainage

1) Ditch Maintenance Cleaning and reshaping roadside ditches to allow for proper drainage of rainwater and prevent flooding.

2) Shoulder Maintenance: Roadside shoulders provide a buffer zone between the road and adjacent areas. Regular maintenance of shoulders involves clearing debris, controlling vegetation, and ensuring proper grading to prevent erosion and provide a safe area for drivers to pullover in emergencies

3) Wildlife Management: In some areas, wildlife can pose a hazard to drivers. Implementing measures like wildlife fences and warningsigns can help mitigate these risks.

D. Shoulder & Approach

1) Emergency Stopping: One of the primary functions of the road shoulder is to provide a safe area for drivers to pull over in case ofemergencies, such as

2) Pedestrian and Cyclist Use: In some areas, roadshoulders may be designated for use by pedestrians and cyclists, providing a

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separated space for nonmotorized transportation.

3) Parking and Overtaking: In some cases, road shoulders may be used for temporary parking, overtaking slower vehicles, or as a transition area for vehicles entering or exiting the road.

E. Bridge

1) Bridges require regular inspection and maintenance to ensure their safety and functionality

2) Maintenance activities may include painting, deck resurfacing, structural repairs, and corrosion prevention.

Environmental Considerations: The construction and maintenance of bridges can have environmental impacts, such as altering water flow patterns or affecting wildlife habitats. These factors are considered in the planning and design stages.

IV. CONCLUSION

1) Engineers have been always with open mind to adopt any material available to them for its use for the construction purposes.

2) It is logical to see that the purpose of highway construction is to provide a firm and even surface for the carriageway or the pavement, which could stand the stress caused due to number of load applications.

3) Life of the road should be increased.

4) Safety of road user.

5) Road surface free from the distress.

6) Avoid the accidental cases.

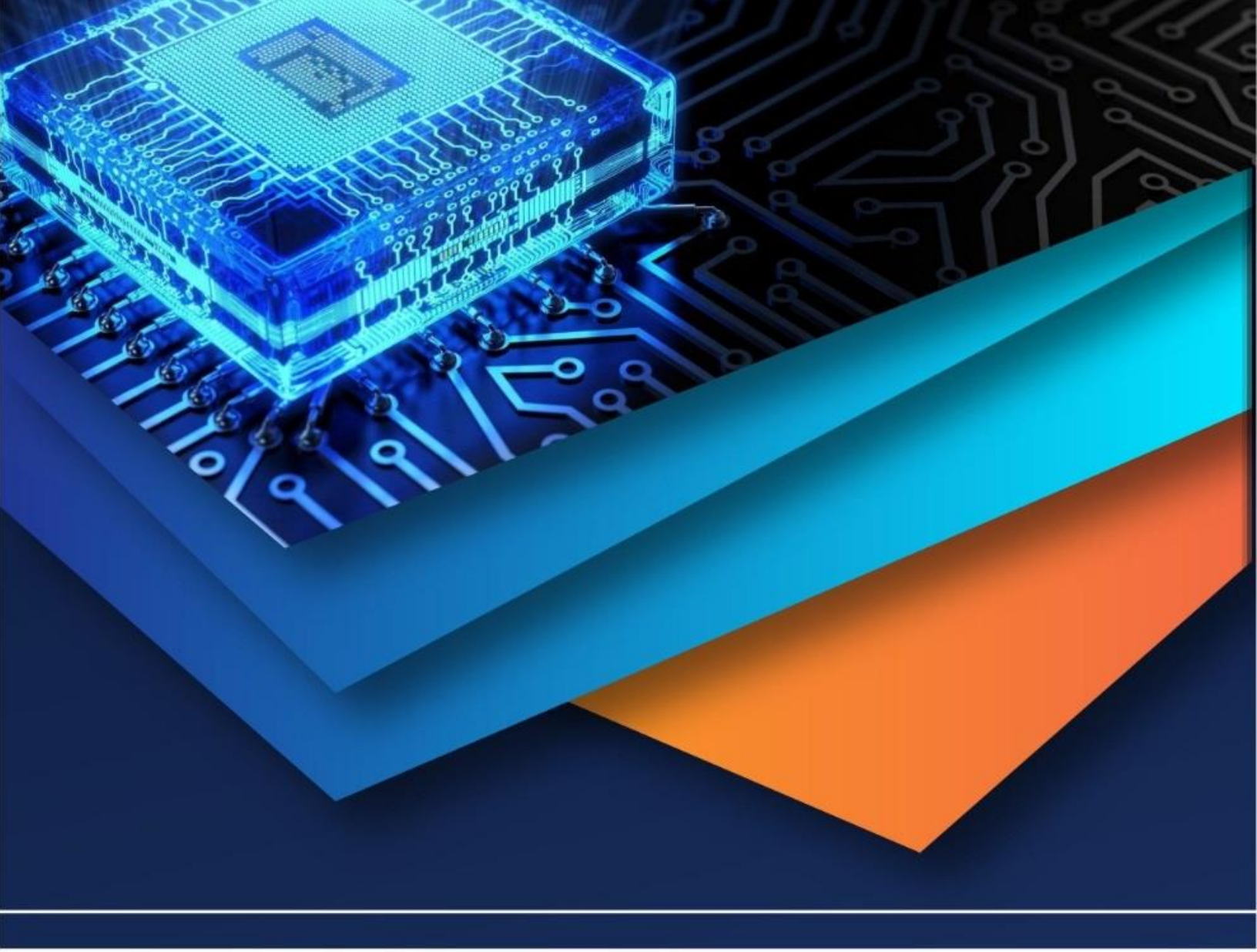
7) Road surface prepared to fast moving traffic.

8) Coir Geotextile and Polygaurd provide crack free surface.

9) Road construction and maintenance phenomena are cost effective.

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