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Review on Study of Pavement Conditions and Proposing Maintenance Strategies

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Abstract: The attempt of this paper is to highlight that defect in flexible pavement is a significant issue and emphasize the urgent need systematic documentation of problems and rectifying them. The challenges associated with defects in flexible pavements are manifold and complex. The exponential increase in vehicular traffic coupled with the rapid expansion of the road network has exaggerated these defects. Adding to complications of the situation is inaccessibility of suitable technology, material, equipment, and skilled labor, along with poor funds provision. In this review paper, various methods for diagnosing pavement quality are examined in order to provide a comprehensive understanding of the problem. These methods include visual inspections, non-destructive testing, etc. By operating these diagnostic tools, the aim is to gain insights into the condition and performance of the pavements, allowing for more precise identification and characterization of defects. The paper focuses on identifying the common defects of flexible pavements and investigates potential causes there off. By analyzing these factors, the paper proposes appropriate remedial measures to mitigate the identified issues competently. These recommendations will contribute to the development of strategies intended at improving the overall quality, durability, and safety of flexible pavements.

Index Terms – **Flexible pavements, defects, pavement quality, maintenance strategies.**

I. INTRODUCTION

In contemporary transportation, pavements serve as crucial civic infrastructures that facilitate the movement of automobiles and people. They form the foundation of transportation networks, enabling efficient and safe travel. Pavements provide a dedicated surface for vehicles to traverse, connecting communities, cities, and countries. Whether it's highways, city streets, or rural roads, pavements play a vital role in accommodating the diverse needs of transportation. They provide a smooth and stable surface that allows vehicles to travel at higher speeds, reducing travel times and improving connectivity. Moreover, pavements enhance road safety by offering better traction and stability, reducing the risk of accidents and ensuring the well-being of road users. Additionally, pavements have a significant economic impact as they facilitate the movement of goods and services, supporting industries, commerce, and trade. The importance of pavements in contemporary transportation cannot be overstated, as they are instrumental in connecting people, fostering economic growth, and enabling efficient mobility for societies around the world.

The construction of road networks stands as one of the most significant economic activities in modern advanced countries, demanding substantial government investment. These networks serve as the lifelines of transportation infrastructure, connecting cities, towns, and regions, and facilitating economic growth and social development. However, to safeguard this substantial investment, a considerable amount of money is required to maintain and preserve the road networks in excellent condition.

Maintaining road networks is essential for several reasons. Firstly, regular maintenance activities help prevent the deterioration of roads, ensuring their longevity and extending their service life. By addressing issues such as cracks, potholes, and pavement distresses promptly, maintenance efforts prevent minor defects from escalating into more severe problems that require costly repairs or even complete reconstruction. Furthermore, maintaining road networks in excellent condition enhances road safety. Well-maintained pavements offer better skid resistance, reduced braking distances, and improved visibility, reducing the likelihood of accidents and minimizing their severity. This, in turn, promotes the well-being of road users and reduces the economic and social costs associated with road traffic accidents.

Given the importance of maintaining road networks, an immense amount of money is required to uphold their excellent condition. These funds are utilized for routine maintenance activities, such as crack sealing, pothole repairs, and surface treatments, as well as for larger-scale rehabilitation projects when necessary. Additionally, investments are made in technologies and equipment for efficient maintenance operations, as well as the training and development of skilled personnel.

The systematic maintenance with regular inspection preventive repair is effective to enhance the life period of the pavement.
An essential element of any Pavement Maintenance Management System is a reliable and accurate way to predict pavement performance. A typical way to predict the performance of the pavement is by developing pavement performance models, which can

be used to determine the future maintenance needs and the required maintenance budget and to set maintenance priorities based on the available budget [Abdullah Al-Mansoor et al. in 2022].

Pavement conditions can be determined through performance indicators such as pavement distresses, riding quality, structural adequacy, and skid resistance. These performance indicators can be combined into one index, e.g., the pavement condition index (PCI) has been widely utilized to allocate pavement maintenance strategies [U. Shah et al. in 2013].

II. TYPES OF PAVEMENT DISTRESSES

The pavement distress labeling and quantification in term of type, severity, and extension are the first steps for a road maintenance assessment. This phase is often crucial because of a lack of standardization in the distress definition that could lead to the inconsistency of the classification [Antonella Ragnoli et al. in 2018].

Following are the types of pavement distresses in flexible pavement:

Alligator cracking:

Alligator cracking is a type of distress that occurs on the surface of asphalt pavements. It appears as a series of interconnected cracks like the skin of an alligator, hence the name. Several factors can contribute to the development of alligator cracking.

Transverse Cracking:

Transverse cracks run in the perpendicular direction of traffic flow. They can begin at the curb or shoulder, be confined in only one lane, or spread completely across the roadway. These cracks can likewise start in the middle of a lane or at the centreline

Longitudinal Cracking:

Longitudinal cracks occur in parallel direction of traffic flow. Longitudinal cracks might appear along the centreline, in mid-lane, in the wheel tracks and along the edges. Cracks can be comparatively short in span or run the complete length of a pavement segment.

Pothole:

Considered as flaw on the surface of the bitumen roads. Potholes are small concave depressions on the pavement surface/base course, typically fewer than one meter in length. They generally have sharp boundaries and vertical sides near the top of the hole. Their development is accelerated by free water assembling inside the hole. Potholes are replicated when traffic grazes small pieces of pavement surface. The pavement then continues to collapse due to poor surface quality, frail spots in the base or sub grade, or because of severe alligator cracking. When depression is created by high-severity alligator cracking, they should be identified as potholes.

Rutting/Deformation:

Rutting is categorized by longitudinal depressions in the pavement surface which occur in the wheel paths of a street.

Bleeding:

Bleeding is a film of bituminous material that tops the pavement exterior and that creates a glossy, crystal-like presence. It happens when asphalt fills the void of the mix during hot weather and then migrates to the pavement surface.

III. METHODOLOGY OF THE PAVEMENT INSPECTION

The objective of pavement inspection is to quantitatively evaluate the condition of the pavement. The goal is to obtain results that are objective enough to make informed judgments regarding the urgency of repairs, forecast the development of defects, and study the causes behind these defects. Several types of defects are particularly significant when considering the serviceability of the pavement, including its useful life, road safety, and drivers' comfort.

Cracks in the pavement are a common defect that can indicate underlying structural issues or aging of materials. The size, type, and distribution of cracks provide valuable insights into the condition of the pavement and can help determine the appropriate repair or maintenance measures.

By focusing on the key types of defects, pavement inspections aim to provide a comprehensive understanding of the pavement's condition and performance. Quantitative assessment methods, such as PCI, are employed to obtain objective results. These results serve as the basis for making informed decisions regarding the urgency of repairs, predicting the development of defects, and investigating the underlying causes.

3.1 PCI

PCI is an index, which shows the current condition of pavement as per synchronous assessment. The Pavement Condition Index was found to deliver a measure of pavement integrity and surface operational condition by a scale, where 100 gives the perfect conditions and 0 the failed one. The technique is based on visual survey: the degree of weakening is a function of distress type, distress severity, and the quantity or density on the specific sample unit [Antonella Rangoli et al. in 2018].

The PCI is a method of evaluation based on inspection and observation. It is not a complex or time-consuming exercise. Well-informed public works officials drive the road network and estimate its condition in an appropriate manner. The observations are put into a database for evaluation and use. The PCI should be conducted yearly so that variations in road condition can be seen.

PCI is calculated as follows, using the detailed type, severity, and extent data:

1. An equation alters the severity and extent of each n every distress into a “deduct value”. Different deduct equations are used for the various distress types.
2. All the deduct values found across all the distress types are then added and subtracted from 100.
3. The resultant PCI is on a scale of 0 to 100.

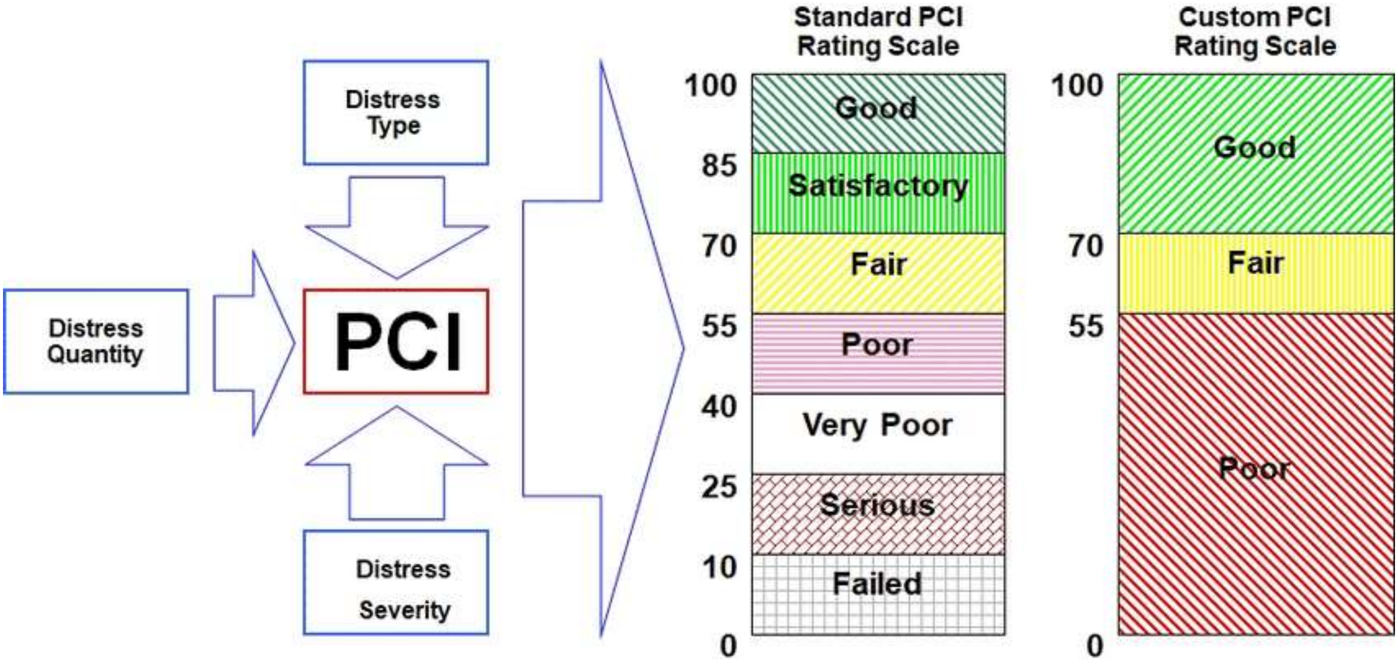

Fig. 1. Range scale of the pavement condition index

The use of PCI offers numerous benefits in pavement management. It enables the identification of immediate maintenance and rehabilitation needs, supports the development of preventive maintenance strategies, monitors pavement condition over time, and facilitates the evaluation of pavement materials and designs. By leveraging PCI as an extensive assessment tool, agencies can make data-driven decisions, optimize resource allocation, and ensure the long-term sustainability and performance of their pavement networks.

The Pavement Condition Index is a useful tool but it has its boundaries. While most people would settle on which roads are rated as excellent and which ones are rated as poor, deciding on whether a road is in reasonable condition or good condition is more difficult. Being too tolerant may mean that important maintenance work is overdue. Being too harsh may mean spending money on fixing a problem before it really needs to be done.

It deals with surface conditions only. Surface conditions are symptoms of underlying problems and need to be properly diagnosed. In the worst-case situation, there can be severe distresses below the pavement with no visual signs of distress. Other testing and inspection methods should be used to quantify specific pavement conditions.

3.2 Visual Inspection

A Pavement Condition Index (PCI) is typically developed based on a visual inspection and observation, often referred to as a "windshield inspection." This process involves two individuals working together to conduct the inspection. One person drives the vehicle while the other takes notes and both evaluate the pavement condition as they proceed.

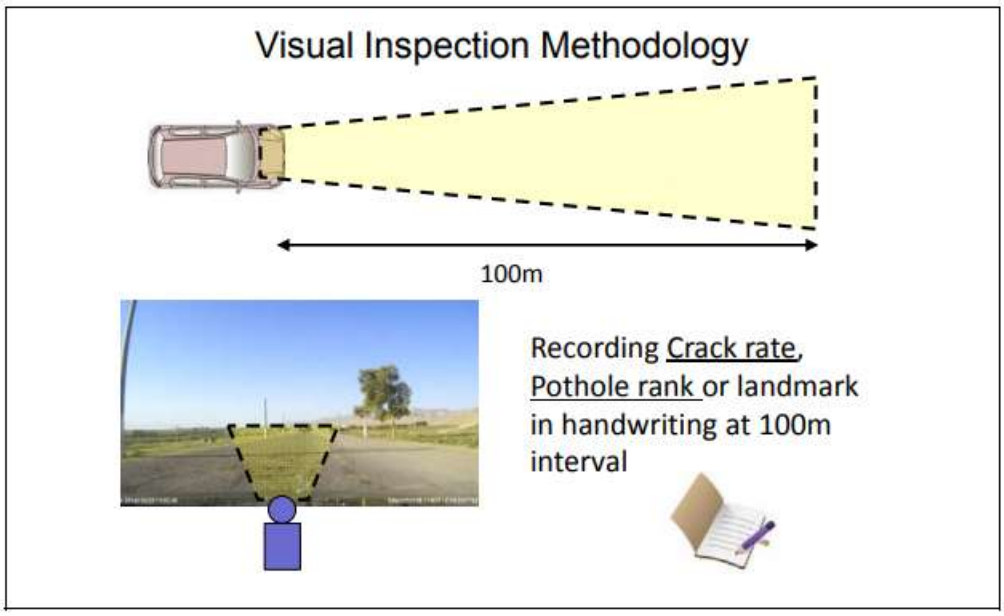

Fig. 2. General Outline on Visual Inspection

The inspection begins by driving along the road section at the posted speed in one direction. This allows the inspectors to assess the ride comfort of the pavement. They pay attention to any noticeable bumps, vibrations, or unevenness that may affect the driving experience.
Following this, a repeat drive-through is conducted at a lower speed, typically around 48 kilometers per hour. During this slower drive, the inspectors thoroughly examine the full width of the road, carefully looking for any surface defects or distresses. These can include cracks, potholes, ruts, unevenness, or any other signs of deterioration. The inspectors use a checklist to record the frequency and severity of these specific defects.
In addition to assessing the surface defects, the inspectors also make observations regarding the overall functionality of the road section. They consider whether it is meeting its intended purpose and evaluate its performance compared to other roads in terms of ride quality, safety, and functionality.
To complement the inspection data, a digital photograph is taken of each section of roadway. These photographs serve as a permanent record of the pavement condition, providing visual evidence to support the assessment and aid in future comparisons and analysis.
By conducting a thorough windshield inspection using the described methodology, agencies can gather valuable information about the condition of the pavement network. This data forms the basis for developing a Pavement Condition Index, which quantifies the overall condition of the road section and aids in decision-making for maintenance, repairs, and future investments in the pavement infrastructure.

In order to ensure accurate pavement inspection, it is crucial to identify the exact locations of observed irregularities or defects on the pavement surface. This information plays a significant role in effectively addressing and repairing the identified issues. There are several key elements involved in identifying the locations of irregularities during pavement inspection.
Firstly, establishing a clear start point and end point for the inspection is essential. This allows the inspection team to systematically evaluate the entire section of pavement under consideration. By defining the starting and ending points, inspectors can ensure comprehensive coverage and avoid missing any potential defects.
Additionally, utilizing landmarks or reference points along the pavement section is important for providing locational information. These landmarks can include physical features such as intersections, utility poles, road signs, or distinctive structures. By referencing these landmarks, inspection engineers can accurately pinpoint the locations of observed irregularities and record their positions for future reference.
During the inspection process, inspectors often use various tools and technologies to aid in identifying and documenting the locations of defects. For instance, they may use handheld GPS devices to record precise coordinates of each observed irregularity. This allows for accurate geolocation data and ensures that the repair or maintenance efforts are targeted to the specific areas requiring attention.
Accurately identifying the locations of observed irregularities is crucial for efficient and effective pavement repair. It minimizes the chances of misinterpreting or missing defect locations, thereby facilitating targeted and timely interventions. By precisely documenting the positions of irregularities using start and end points, landmarks, GPS coordinates, or visual markings, inspection engineers can ensure that repair efforts are focused on the correct areas, leading to improved pavement condition and overall infrastructure performance.

3.3 Aggregate Testing

Flexible pavements are commonly constructed using hot mix asphalt (HMA). Hot mix asphalt is a mixture of aggregate (such as crushed stone, gravel, or sand) and asphalt binder, which is a petroleum-based material that acts as a binding agent. This mixture is produced at high temperatures (typically between 150 to 180 degrees Celsius) in specialized asphalt plants. Hot mix asphalt is widely used in the construction of flexible pavements due to its flexibility, durability, excellent compaction characteristics, skid resistance, and relative ease of construction. Additionally, hot mix asphalt allows for relatively quick construction and repair. The mixture can be manufactured and transported to the construction site in a short period. Once placed and compacted, the asphalt cools down and hardens rapidly, enabling the roadway to be opened to traffic soon after construction or repairs are completed.
It is worth noting that the specific design of the hot mix asphalt depends on various factors, including traffic loads, climate conditions, and desired pavement performance. The mix design involves determining the appropriate combination of aggregate sizes, asphalt binder content, and additives, if required, to meet the project requirements and achieve the desired pavement properties. The proper selection and application of hot mix asphalt contribute to the development of high-quality and long-lasting flexible pavements that can effectively support the transportation needs of communities.

Aggregate is a collective term for the mineral materials such as sand, gravel, and crushed stone that are used with a binding medium (such as water, bitumen, Portland cement, lime, etc.) to form compound materials (such as bituminous concrete and Portland cement concrete) [Ermias Ketema Kate in 2019]. Aggregates constitute 94-95 percent by weight of the hot mix asphalt (HMA) mixtures. Therefore, the properties of coarse and fine aggregate are very important to the performance of the pavement system in which the HMA is used. Often pavement distress, such as rutting, stripping, surface popouts, and lack of adequate surface frictional resistance is traced directly to improper aggregate selection and use. Clearly, aggregate selection based on the results of proper aggregate tests is necessary for attaining desired performance. Many of the current aggregate tests were developed to empirically characterize aggregate properties without, necessarily, strong relationships to the performance of final products (such as HMA) incorporating an aggregate. [Prithvi S. Kandhal et al].

Tests on Aggregates	Reference to test methods
Aggregate Crushing Value (ACV)	IS: 2386 (Part IV) - 1963
Aggregate Impact Value (AIV)	IS: 2386 (Part IV) - 1963
Los Angeles Abrasion Test (LAA)	IS: 2386 (Part IV) - 1963

Table 1: Laboratory tests on Aggregates

3.3.1 Aggregate Crushing Value

According to [IS: 2386 (Part IV) - 1963] the 'aggregate crushing value' gives a relative measure of the resistance of an aggregate to crushing under a gradually applied compressive load. With aggregate of 'aggregate crushing value' 30 or higher, the result may be anomalous.

It determines the ability of aggregates to resist crushing under gradually applied compressive loads. The test provides an indication of the aggregate's ability to withstand heavy loads and stresses experienced in the pavement structure. Aggregates with higher crushing values may be susceptible to deformation and degradation, potentially leading to premature pavement failure.

3.3.2 Aggregate Impact Value

The 'aggregate impact value' gives a relative measure of the resistance of an aggregate to sudden shock or impact, which in some aggregates differs from its resistance to a slow compressive load [IS: 2386 (Part IV) - 1963].

The Aggregate Crushing Test (ACT) measures the strength and mechanical properties of aggregates. It determines the ability of aggregates to resist crushing under gradually applied compressive loads. The test provides an indication of the aggregate's ability to withstand heavy loads and stresses experienced in the pavement structure. Aggregates with higher crushing values may be susceptible to deformation and degradation, potentially leading to premature pavement failure.

3.3.3 Los Angeles Abrasion Value (LAAV) Test:

The Los Angeles Abrasion Value (LAAV) test evaluates the resistance of aggregates to abrasion and wear caused by rubbing and grinding action during traffic loads. This test helps assess the aggregate's ability to withstand repeated impacts and abrasion, simulating the conditions it will experience in the pavement. Aggregates with lower LAAV values indicate higher resistance to abrasion and are typically preferred for constructing durable and long-lasting pavements.

3.4 Bitumen Testing

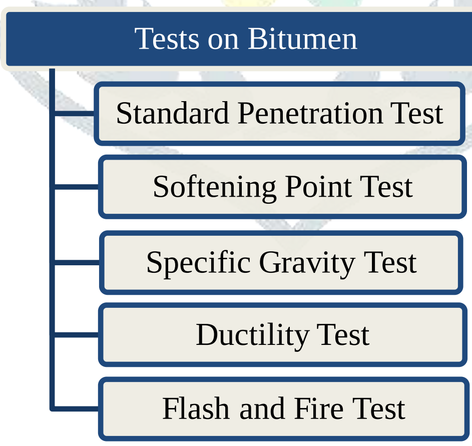

Fig. 1.6.1 Test on Bitumen

3.4.1 Standard Penetration Test

In this test we inspect the uniformity of a sample of bitumen by determining the distance in tenths of a millimetre that a normal needle vertically enters the bitumen specimen under known situations of loading, time, and temperature. This is the most extensively used method of measuring the consistency of a bituminous material at a specified temperature. It is a means of classification rather than a measure of quality.

3.4.2 Softening Point Test

The softening point of bitumen or tar is the temperature at which the material achieves specific degree of softening. It is the temperature in ºC at which a typical ball passes through a sample of bitumen in a mould and falls from a height of 2.5 cm, when heated under water or glycerine at specific conditions of test. The binder should have enough fluidity before its applications in road uses.

3.4.3 Specific Gravity Test

It is frequently required to know the specific gravity of straight run and cut-back bitumen for determinations of calculating rates of spread, asphaltic concrete mix properties etc. The standard specific gravity test is carried out at a temperature of 250C. But, if cooling services are not available, a temperature of 350C may be used, while this must be clearly specified in the result. For some reason the specific gravity at elevated temperatures is mandatory, as it is not possible to measure this directly an estimated value may be found by calculation using the value determined at a lower temperature.

3.4.4 Ductility Test

The property of bitumen which allows it to undergo deformation or elongation is called ductility of bitumen. The ductility of bitumen is calculated by the distance in cm to which the bitumen sample will elongate before breaking when it is dragged by standard specimen at specific speed and temperature.

3.4.5 Flash and Fire Test

At high temperatures depending on the grades of bitumen materials exclude volatiles. And these volatiles catch fire which is very dangerous and hence it is essential to qualify this temperature for each bitumen grade. BIS has defined the flash point as the temperature at which the vapour of bitumen shortly catches fire in the form of flash under specific test conditions. The fire point is defined as the lowest temperature under specific test conditions at which the bituminous material gets ignited and burns.

IV. MAINTENANCE STRATEGIES FOR DISTRESSED PAVEMENTS

Selecting the appropriate maintenance treatment for a road can indeed be a complex process. Several factors need to be considered to ensure an effective and cost-efficient maintenance strategy. These factors include the cause of the distress, expected treatment life, cost-effectiveness, and the function of the road.

Understanding the underlying cause of a specific distress or pavement issue is crucial. Different types of distress, such as cracks, potholes, rutting, or surface deterioration, can result from various factors like traffic loads, climate conditions, material quality, or construction practices. Identifying the root cause helps in selecting the most suitable treatment that addresses the specific problem effectively.

The expected life of different maintenance treatments is another significant factor. Some treatments may offer short-term fixes, while others provide long-lasting solutions. It is essential to assess the anticipated durability of each treatment option and choose the one that aligns with the desired service life of the road. Considering the future maintenance needs and expected deterioration rates can assist in making informed decisions.

Cost is a critical aspect to consider when selecting a maintenance treatment. Evaluating the cost-effectiveness of various options involves considering not only the initial investment but also the long-term benefits. Cost/benefit analysis helps determine the value of the treatment relative to its expected performance and the benefits it provides, such as extended pavement life, improved ride quality, or reduced future maintenance expenses. It is crucial to strike a balance between upfront costs and long-term benefits to make economically sound decisions.

The function of the road also plays a role in selecting the appropriate treatment. Roads serve different purposes, such as arterial routes, residential streets, or highways. The selection of maintenance treatments should consider the traffic volume, speed, and functional requirements of the road. For example, a heavily trafficked highway may require more durable and long-lasting treatments compared to a low-volume residential street.

Surface Treatment	Good Condition (PCI=80)	Fair Condition (PCI=60)	Poor Condition (PCI=40)
Fog Seal	3-5	1-3	1-2
Chip Seal/Slurry	7-10	3-5	1-3
Overlay 3-5”	10-12	5-7	2-4
Reconstruction			20

Fig. 3. Estimated Life Extension (Years)

In general, maintenance options for roads can be categorized into three main ranges: preventative maintenance, corrective maintenance (rehabilitation), and reconstruction. Each of these options serves a specific purpose in preserving and improving the condition of the road network.

1. Preventative Maintenance: Preventative maintenance aims to proactively address potential issues and prevent the deterioration of the road surface. This type of maintenance includes routine activities such as crack sealing, seal coating, pavement resurfacing, and periodic maintenance treatments. By performing preventative maintenance, road authorities can extend the service life of the pavement, minimize the occurrence of distresses, and reduce the need for more extensive and costly repairs in the future.

2. Corrective Maintenance (Rehabilitation): Corrective maintenance, also known as rehabilitation, involves repairing specific areas or sections of the road that have deteriorated or experienced significant distresses. This includes activities like patching potholes, repairing cracks, restoring localized pavement failures, and addressing drainage issues. Corrective maintenance focuses on restoring the structural integrity and functionality of the affected areas, improving ride quality, and ensuring the safety of road users. It is typically performed when preventative maintenance is no longer sufficient to address the extent of the damage.

3. Reconstruction: Reconstruction involves the complete removal and replacement of the existing pavement structure. It is considered the most extensive and costly form of maintenance. Reconstruction is typically undertaken when the existing road has

experienced severe distresses, significant structural deficiencies, or has reached the end of its service life. It involves the complete redesign and rebuilding of the road, including excavation, base layer construction, and application of new pavement materials. Reconstruction provides an opportunity to address underlying issues and upgrade the road to meet current design standards and traffic demands.

The selection of the appropriate maintenance option depends on several factors such as the condition of the road, available budget, expected service life, traffic volume, and long-term objectives. A well-planned and executed maintenance strategy combines preventative measures to minimize deterioration, timely corrective actions to address localized issues, and occasional reconstruction to ensure the long-term viability of the road network.
With proper maintenance applications, the life expectancy of a road can be extended by a number of years, as seen in the following table.

4.1 Prioritization for Road Maintenance

Prioritizing road maintenance is a crucial aspect of effectively managing limited resources and ensuring the optimal condition and functionality of road networks. Road authorities need to assess the condition of their roads and prioritize maintenance activities based on various factors.

4.1.1 Criteria for Prioritization

One key factor in prioritization is the level of deterioration and distress of the road. Roads with severe distresses, such as potholes, deep cracks, or pavement failures, require immediate attention to prevent further damage and ensure the safety of road users. These roads are typically given high priority for maintenance to address critical issues promptly.
Another factor to consider is the traffic volume and importance of the road. High-traffic roads that serve as major transportation corridors or connect important economic centers should receive priority attention as their deterioration can significantly impact regional or national mobility and economic activities. Roads with high strategic value, such as highways, expressways, or major arterial routes, often take precedence in maintenance planning.
Additionally, prioritization can be influenced by the functional classification of roads. Roads that serve as vital links for emergency services, schools, hospitals, or other essential facilities may require prioritized maintenance to ensure uninterrupted access and reliable transportation for emergency situations or critical services.
The available budget and resources play a significant role in prioritizing maintenance activities. Road authorities must allocate their limited funds effectively, considering the cost-effectiveness of different maintenance interventions. Prioritization may involve identifying the most cost-effective treatments that provide the greatest benefits in terms of extending pavement life, improving ride quality, and reducing future maintenance needs.
Furthermore, public feedback and community concerns can influence prioritization decisions. Soliciting input from road users, residents, and stakeholders helps to identify areas with high public demand or areas that may have safety concerns. Engaging the public in the decision-making process promotes transparency and ensures that maintenance priorities align with community needs and expectations.

4.2 Factors Considered

When selecting the specific section for repair work on a road, it is important to consider various site conditions to ensure that the chosen area addresses the most critical needs and provides the greatest benefit. Here are some factors to consider:

1. Roadside land use: The land use along the roadside can influence the priority of repair work. Areas with high-density residential or commercial developments, schools, hospitals, or other important facilities may require immediate attention to ensure smooth traffic flow and accessibility.
2. Environmental impact: Environmental considerations are crucial in selecting the repair site. Areas near sensitive ecosystems, protected areas, or water bodies may require special attention to minimize any potential negative impact during repair activities, such as erosion control measures or pollution prevention measures.
3. Road alignment: The alignment of the road, including curves, gradients, and intersections, should be taken into account. Sections with sharp curves, steep gradients, or complex intersections may pose safety risks and require repairs or modifications to enhance traffic flow and ensure safe driving conditions.
4. Traffic speed: The speed at which vehicles travel on the road is an important factor. Sections with high traffic speeds may experience greater wear and tear, leading to faster deterioration. Repairing areas with high-speed traffic is essential to maintain safety and prevent further damage.
5. Traffic accident history: Sections of the road with a history of traffic accidents should be given priority. Repairing these areas can help address potential design deficiencies, improve road safety, and reduce the risk of future accidents.
6. Other strategic reasons: Strategic considerations may include factors such as the road's significance as a transportation corridor, its connection to important economic centers, or its role in supporting regional or national mobility. Repairing sections that have strategic importance ensures the efficient functioning of the overall transportation network.

By considering these site conditions, identification of the sections that require immediate repair or maintenance and prioritize their efforts accordingly can be done. This approach ensures that repair work is focused on areas that will have the most significant impact in terms of safety, functionality, and overall improvement of the road network.

V. RESULTS AND DISCUSSION:

After a thorough analysis of the previous research conducted by the mentioned authors, it is apparent that noteworthy efforts have been made to employ automation tools for evaluating pavement conditions. However, it is critical to study several other factors, like composition of pavement materials including aggregates and bitumen, temperature, roadside land use, environmental impact, and more, in order to precisely identify road distress. Hence, there is a prospect to establish a relationship between these factors and pavement indicators, specifically the Pavement Condition Index (PCI). Future studies focusing on this connection between PCI and certain factors will enable the determination of the maintenance strategies and prioritization of maintenance and rehabilitation on different segments of road network.

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