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Case Study on Pavement Failures & Its Maintenance

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Abstract: ***A robust transportation infrastructure is critical to the nation's industrial, social, and cultural advancement. Humans have evolved three forms of transportation: air, sea, and land as a result of this requirement. From 4 lakh km in 1947 to 20 lakh km in 1993 and approximately 62 lakh km by March 31, 2020, the road network has grown. In India, the total length of all roads paved and unpaved is less than 5.13 km per 1000 inhabitants. Before we get into the maintenance section, we will try to concentrate on various defects and their causes. The research indicates that the definition of flexible pavement defects and their causes is the reduction in serviceability brought on by the development of various types of deterioration on the flexible pavement, such as cracks, surface defects, disintegration, etc. The breakdown of bituminous pavement can have numerous causes.***

Keywords: Pavement failure, Maintenance, Types of failure.

I. INTRODUCTION

As a result, a large number of emerging countries invest heavily in the construction of roads, while many developing countries recognize the necessity of making large investments in the capital development of roads. Few few gave road maintenance their full attention. Starting a new construction is perceived as more attractive than maintaining what presently exists. However, water penetration can unfortunately damage pavement structures in a single season. Throughout the year, maintenance tasks might be necessary, but how frequently they are needed depends on a variety of factors, including traffic volume, topography, climate, road type, and pothole and rut repair for paved roads.

II. LITERATURE REVIEWS

A. Ayush Tiwari et.al (2023)

Snow and ice exacerbate the difficulties of road maintenance in areas that experience severe winter weather. Dan Empey, Aaron Steinfield, and Benedicte Bougler emphasize how important snow removal is to reducing winter-related risks and maintaining traffic flow. Despite the significant challenges presented by bad weather, proper snow removal techniques are essential for maintaining the integrity of the pavement and protecting road users. Steinfield, Bougler, and Empey emphasize the value of adaptive methods in addressing seasonal fluctuations and boosting roadway resilience by giving priority to winter maintenance activities.

B. Pathave & Landge (2023)

The thesis's emphasis on upkeep as a foundation for expanding. The longevity of road surfaces is admirable. By examining the several reasons why pavement fails The thesis adds to the body of information intended to improve the longevity and safety of roadways by examining rigid pavements and talking about maintenance strategies utilizing a variety of materials. All things considered, this paper provides insightful analysis and useful suggestions for maximizing the longevity and performance of rigid pavement infrastructure in India.

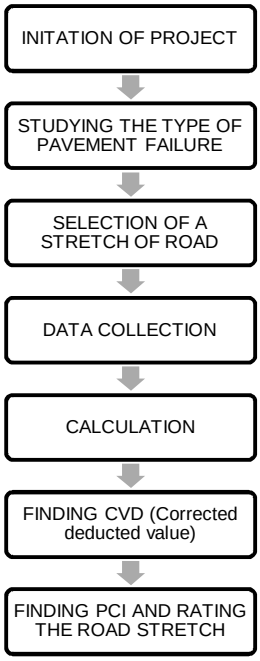
C. Mehedi Hasan (2020)

The surface course, base course, sub-base course, and natural soil subgrade are the four layers that make up a conventional flexible pavement system. The surface course serves as the vehicle's driving surface, the base course provides structural support, the sub-base course improves load distribution, and the natural soil subgrade acts as the pavement's overall foundation. Each layer of the pavement has a specific function in supporting and distributing loads.

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D. Boyapati & MNS (2020)

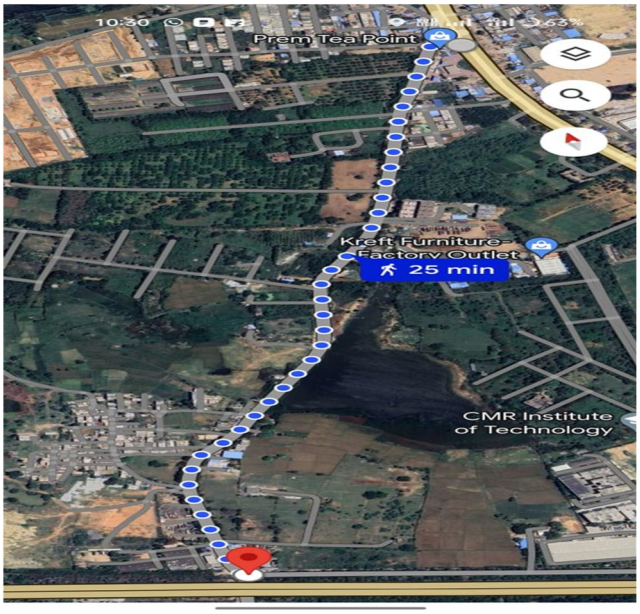
In many nations, streets are unquestionably important open spaces that support transportation networks and foster key linkages between local communities. For drivers, the installation of street improvements results in instant and frequently substantial benefits. These benefits range from increased comfort, safety, and speed during driving to better access to hospitals, schools, and marketplaces. Furthermore, these improvements help to reduce the cost of operating vehicles, which increases their beneficial effects on both people and economies. However, a carefully thought-out maintenance program is essential to guarantee the durability of these advantages and optimize the return on investment.



III. METHODOLOGY

A. Study Area

We consider the stretch of road from Medchal Check Post to Kandla Koya village which is 1.7 kilometer long. And with heavy traffic On the road due to Its connection Between the NH44 and the service road of outer ring road



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IV. DATA COLLECTION

Select the stretch of the road and find the total length of the road Using aerial mapping. Identify the different types of failures on the road visually. And start taking the measurements of the failures one by one and include the data in the table which is taken from the code book of pavement condition index.

Distress quantity relates to measurement, measurement unit and total quantities on survey form.

No	Type of Damage	Unit
1	Alligator Cracking	m2
2	Bleeding	m2
3	Block Cracking	m2
4	Bumps and Sags	m
5	Corrugation	m2
6	Depression	m2
7	Edge Cracking	m
8	Reflection Cracking	m
9	Lane Shoulder Drop Off	m
10	Long. & Trans. Cracking	m
11	Patching & Utility Patching	m2
12	Polished Aggregate	m2
13	Potholes	number
14	Rail Road Crossing	m2
15	Rutting	m2
16	Shoving	m2
17	Slippage Cracking	m2
18	Swell	m2
19	Weathering / Ravelling	m2

Distress severity	**Quantity**						**Total**	**Density%**	**Deduct value**
10M	16.8	14.3					31.1	1.8%	14
7H	16.2						16.2	0.9%	8
1M	4	1.9					5.9	0.34%	14
13L	0.36	0.68	0.44				1.48	0.08%	18
6L	0.04	0.07					0.11	0.006%	5

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A. Filled data sheet with measurements required for the process.

Calculation of Pavement condition index

we need to find out the density percentage of the recorded quantities using the formula from the code book(ASTM D 6433 – 07) of the pavement condition index.

ASPHALT SURFACED ROADS AND PARKING LOTS
CONDITION SURVEY DATA SHEET
FOR SAMPLE UNIT

SKETCH:

BRANCH_____ SECTION_____ SAMPLE UNIT_____
SURVEYED BY_____ DATE_____ SAMPLE AREA_____

1. Alligator Cracking	6. Depression	11. Patching & Util Cut Patching	16. Shoving
2. Bleeding	7. Edge Cracking	12. Polished Aggregate	17. Slippage Cracking
3. Block Cracking	8. Jt. Reflection Cracking	13. Potholes	18. Swell
4. Bumps and Sags	9. Lane/Shoulder Drop Off	14. Railroad Crossing	19. Weathering/Raveling
5. Corrugation	10. Long & Trans Cracking	15. Rutting	

DISTRESS SEVERITY	QUANTITY										TOTAL	DENSITY %	DEDUCT VALUE

B. Finding the density for the Quantities

Density%= (Total distress quantity/Length of the stretch)*100

Long. & Trans. Cracking(10 M) = (31.1/1700)*100 = 1.8%

Edge Cracking (7 M) = (16.2/1700)*100 = 0.9%

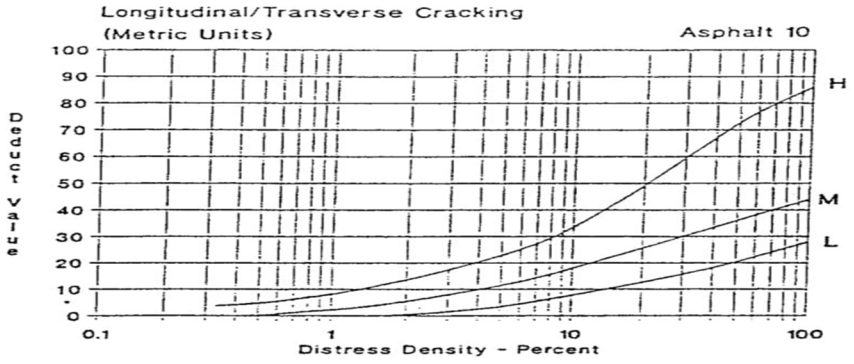
Alligator Cracking(1 M) = (5.9/1700)*100 =0.34%

Potholes(13 L) = (1.48/1700)*100 =0.08%

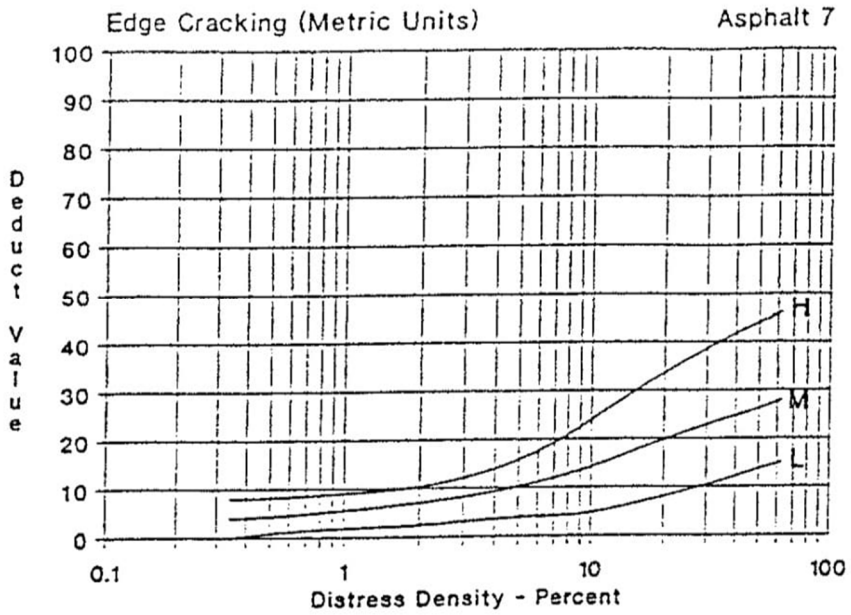
Depression(6 L) = (0.11/1700)*100 =0.006%.

C. Finding the deduct values using graphs

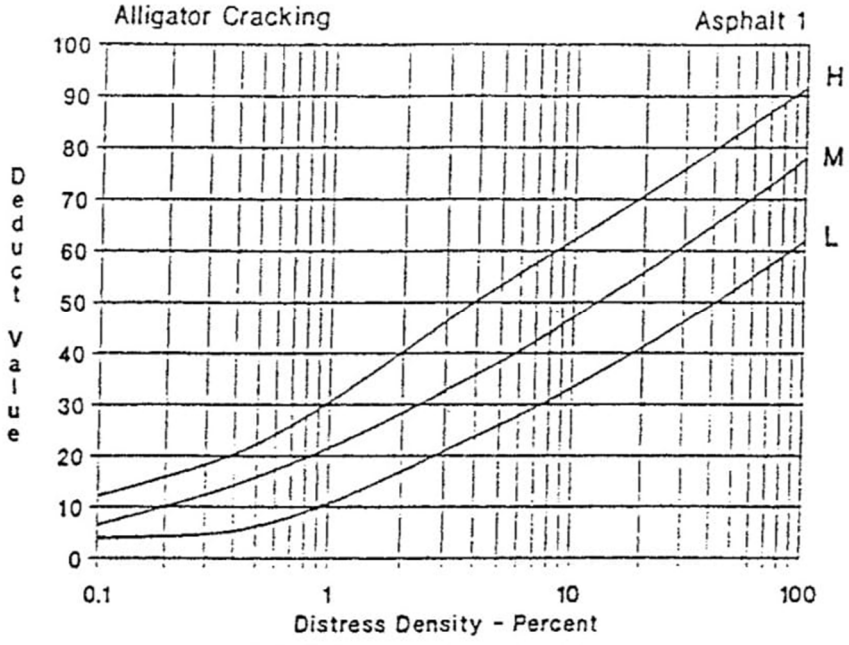
Long. & Trans. Cracking:



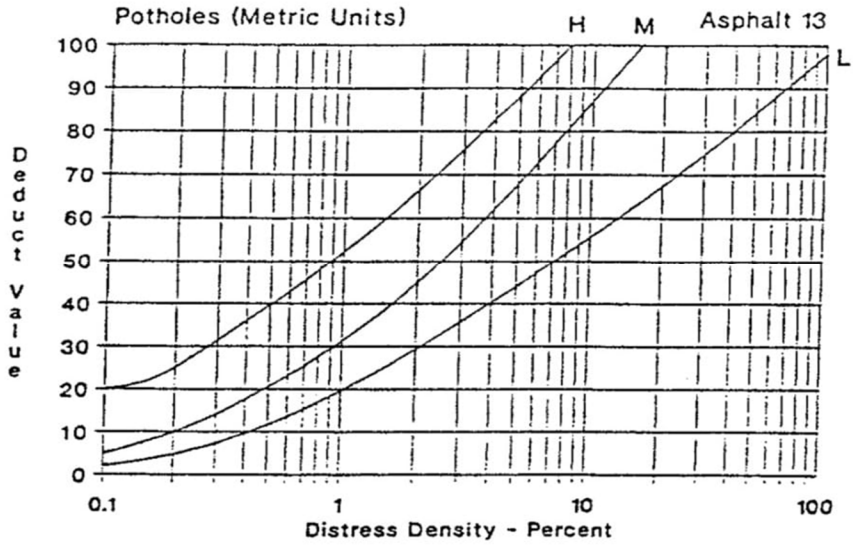
D. Edge Cracking



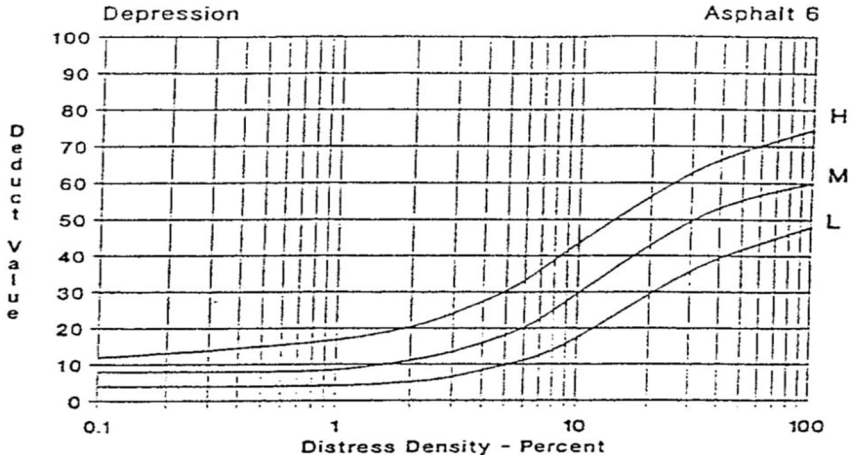
E. Alligator Cracking



F. Potholes



G. Depression



V. ANALYSIS WITH THE STANDARD TEST AND VALUES

Highest deduct value(m)
m=1+(9/98) X (100-18)
m=8.530
m Maximum allowable number of deducts including fraction
m value is nearly 8 to 9
number of deductive values are 5
Deductive values in descending order
18, 14, 14, 8, 5
Reduce the smallest individual deduct value greater 2 to "2"
Determine the maximum corrected deduct value (CDV). The procedure for determining maximum CDV from individual DVs is identical for both AC and PCC pavement.
The following procedure must be used to determine the maximum CDV

A. Deduct Value Table

S.NO						Total deduct value	q	CVD
1	18	14	14	8	5	**59**	5	30
2	18	14	14	8	2	56	4	31
3	18	14	14	2	2	50	3	30
4	18	14	2	2	2	38	2	27
5	18	2	2	2	2	26	1	26

VI. FINDING PCI USING MAXIMUM CVD VALUE

Maximum CVD (corrected deduct value)=31
PCI =100-CVD
=100-31
=69
Standard pavement condition index
Rating scale
Yellow color (Fair)

VII. CONCLUSION

S.No	Type Of Failure	Solution
1	Long & Trans Cracking:	➢ To tackle long and transverse cracking, conduct a thorough assessment to determine the underlying causes such as traffic volume and pavement quality. ➢ Apply appropriate crack sealing techniques to prevent moisture intrusion and inhibit further deterioration. ➢ Implement a proactive maintenance strategy and monitor the pavement condition regularly to address any emerging cracks promptly, ensuring the longevity of the pavement structure.
2	Edge Cracking	➢ To mitigate edge cracking, improve the support and drainage at the pavement edges to reduce stress concentrations. ➢ Utilize proper edge treatments such as asphalt widening or shoulder construction to distribute loads more effectively. ➢ Implement regular maintenance practices including crack sealing and edge repairs to prevent water infiltration and limit the progression of cracks.

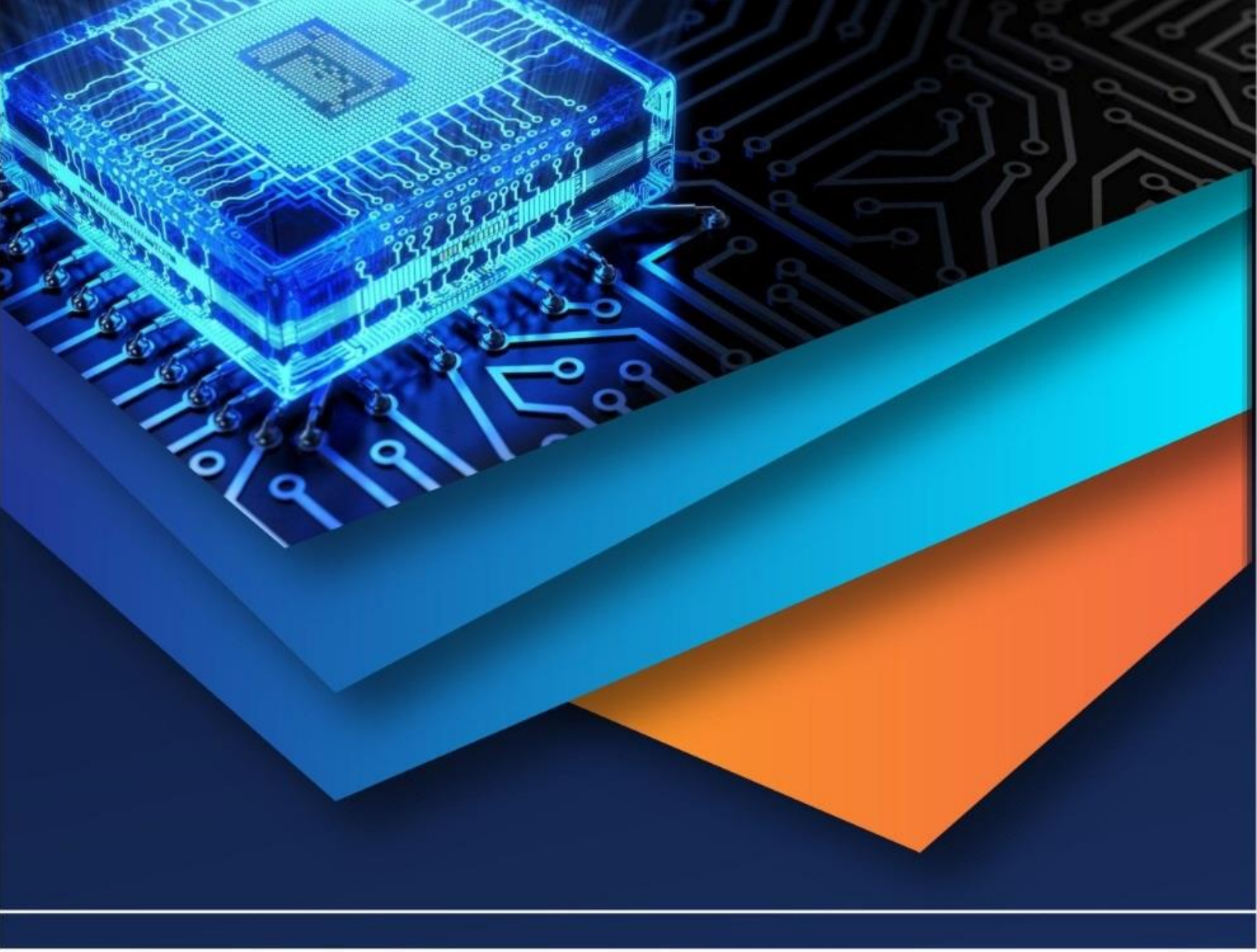
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3	Block Cracking	➢ To address block cracking, apply asphalt rejuvenators or sealers to restore flexibility and cohesion to the pavement surface. ➢ Conduct thorough surface preparation, including cleaning and repairing any existing cracks, before applying appropriate surface treatments like sealcoating. ➢ Implement regular pavement maintenance and monitoring to identify and treat block cracking early, preventing further deterioration and extending the pavement's lifespan.
4	Potholes	➢ To repair potholes, first, clean out debris and loose material from the affected area. ➢ Then, fill the pothole with a suitable asphalt or cold patch material, compacting it to ensure proper bonding with the surrounding pavement. ➢ Finally, apply a sealant or surface treatment to prevent water infiltration and future deterioration, ensuring the longevity of the repair.
5	Depression	➢ To remedy depressions in the pavement, identify the underlying cause, which could include poor drainage or structural issues. ➢ Correct drainage problems by improving surface grading or installing drainage systems. ➢ Fill the depression with appropriate materials such as asphalt patching mix or concrete, compacting it thoroughly to restore the pavement's smoothness and integrity.

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