



“To study of crack behavior and settlement with remedial measure for bituminous road failure”

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Abstract

It is a known fact throughout the world that the conditions of any road largely depend upon its geotechnical properties. Some samples of soil were collected for laboratory tests in order to analysis some geotechnical properties of road. The results showed that the soil materials used along the road have high and low percentages of clayey and silt/gravel/sand materials respectively (rated as fair to poor materials for road use). The Natural and Optimum Moisture Contents are high for all the Base, Sub-base and Sub-grade courses samples. The Maximum Dry Density (MDD) is quite very lower than the expected specified values for the base, sub-base and sub-grade courses with the exception of few samples. The Plasticity Indices and Liquid limits are very high for both Base and Subbase Courses, while that of Sub-grade course met the required specification values for all samples. Most of California Bearing Ratio (CBR) values for the Base course did not meet specification requirements while that of Sub base and Sub-grade courses did. Conclusively, the pavement failure may not necessarily be due to weak sub base and subgrade except were compaction inadequate. Whereas the materials used for the base course are likely to be poor quality.

Index Terms - Defects, Flexible Pavement, Maintenance, Road, Rutting, Paved Roads

I. INTRODUCTION

A road network system is perhaps one of the most important necessities for the economic development of any country, particularly developing countries. Many of developing countries, therefore, invest huge amount on road construction, while many developing countries appreciate the necessity for huge investment in capital development of roads. Only a few gives due importance to the road maintenance. It is found more glamorous to embark on new construction than to maintain what is already in existence. But unfortunately, pavement structure can be destroyed in a single season due to water penetration. Maintenance activities may be required at intervals throughout the year, but their frequency varies with traffic, topography and climatic conditions, type of roads, grading and repairing pot holes and ruts for paved roads. They include repairing pot holes, surface patching, sealing of cracks and Road surface marking. Transportation contributes to the economic, industrial, social and cultural development of any country. Transportation is vital for the economic development of region since every commodity produced whether it is food, clothing, industrial products or medicine needs transport at production and distribution stages. The inadequate transportation facilities retard the process of socio-economic development of the country.

The adequacy of transportation system of a country indicates its economic and social development. India is a vast country having extreme variation in climatic conditions. North-Eastern region gets very heavy rainfall and annual rainfall as much as 600 cm per year has been recorded, whereas the deserts of Western India get very less rainfall. Evening a particular area, the difference between maximum and minimum temperature of the year may be as high as 420c. North India experiences heavy snowfall during winter at altitudes above 2000m. These climatic conditions have great influence on the type of problems existing on the road as only 47% are surfaced roads, balance being earthen road.

Types of Defects Various defects in flexible pavements have been seen and those are listed below:

- (a) Cracks:
- (b) • Alligator Cracking
- (c) • Longitudinal Cracking
- (d) • Block Cracking

II. OBJECTIVES -

- To carry out investigation of the selected road by performing the laboratory experiments.
- To investigate the cause of road failure.
- To suggest the possible method to prevent further failure of road.

III. SCOPE OF PROJECT –

This study is about the Identification of Defects and Cracks and Maintenance of roads. Case Study on road failure of ODR from pencil chowk to sangha petrol-pump, MIDC, Baramati. In this study the most frequently occurring types of cracks and the defects on road will be considered, by visiting the site and thorough examination will be analyzed. After which, the reasons which cause defects in the pavement are studied.

4.1 To study of crack behavior and settlement with remedial measure for bituminous road failure

4.1.1 Introduction

4.1.2 Stages of Project Work

4.1.3 Selection of road site for failure inspection

4.1.4 Road Inspection

4.1 To study of crack behavior and settlement with remedial measure for bituminous road failure

4.1.1 Introduction-

After discussing the local authorities and making inspection on the site we have worked for finding the reasons of failures and providing its further solution for these failures. Some laboratory experiments are also carried out on the materials that are to be used for the maintenance purpose. First, we made the workplan for this work and accordingly the work was carried out in different stages.

4.1.2 Stages of Project Work

Following are the stages carried out in the project work.

1. Selection of road site
2. Road inspection

4.1.3 Selection of road site for failure inspection

We have selected the 0.5 km portion of other district road (ODR) for our case study of identification of the failures from pencil chowk to sangha petrol-pump, MIDC, Baramati. We had selected this site for inspection because there are many failure occurring in this portion for long time. we are going to carrying out road inspection as well as other laboratory tests forgetting some conclusion for this project work. The selected site as for this work is given in the fig



Fig: Photograph of Selected Site

4.1.4 Road Inspection-

Public opinion was collected by group discussion with peoples to achieve the idea about the causes of failures. Different types of road failures are identified within Pencil Chowk to Sangh Petrol pump, MIDC, Baramati (as shown in fig 3.1) which are given as alligator cracking, block cracking, slippage cracking, longitudinal cracking, transverse cracking, potholes, raveling, water bleeding, corrugation and shoving, depression and rutting. The causes of failures and their maintenance procedures are collected by field investigation, information collection from respective authorities Nagar parishad Corporation and Roads and consideration of public opinion.

a) Traffic volume:

Traffic volume is the one of the main reasons for the failures of road so we did the survey for finding out the traffic volume of selected road.

Definition of Traffic volume:

Traffic Volume is defined as the procedure to determine the volume of traffic or no of vehicles moving on the roads at a particular section during a particular time period.

Methods for Finding the Traffic Volume

- A) By toll Plaza Ticketing
- B) Registration Offices
- C) Statistical Approaches
- D) By Interviewing
- E) By Check Posts
- F) Modern Global Positioning System

We use the method of check post for finding out the traffic volume for this selected site.

The maximum number of vehicles in a lane or a road that can pass a given point in unit time, usually on per lane or roadway.
Unit – Vehicle/hour/lane

b) Traffic Density (K):

We carried out the traffic survey for finding out the traffic density for our selected site for project work. And the observation is also mentioned in the table no 3.2.5 (a) and calculated the traffic density as per the standard formula.

Definition of the Traffic Density:

The average number of vehicles that occupy one mile or one kilometer of road space, expressed in vehicles per mile or per kilometer.

Formula: M/L

M = no of vehicles that occupy in unit length

L = length of selected road

Speed Range Kmph	Mid Speed Kmph	Frequency (f)	Frequency %
0-10	5	12	12/850=1.41
10-20	15	18	2.11
20-30	25	68	8.00
30-40	35	89	10.47
40-50	45	204	24
50-60	55	255	30
60-70	65	119	14
70-80	75	43	5.06
80-90	85	33	3.88
90-100	95	9	1.06
	Σ	850	

Table - A Traffic Observation Table

Traffic density = No of vehicles pass on 1 km road / Length of road
Baramati-Bhighwan road (0.5km)

- 1. No of vehicles pass on 0.5 km highway = 850 in one hour
- 2. Length of highway = 0.5 km

$$\text{Traffic density} = \text{No of vehicles} / \text{Length of road}$$

$$= 850 / 0.5$$

$$K = 1700 \text{ Vehicles/km}$$

As reference to table no (a) we get the different speed at which vehicles are travelling are mentioned by using the graph in fig no (b) . According to the graph the maximum number of vehicles is travelling at the speed of 52-53 and their frequency is about 35 % .

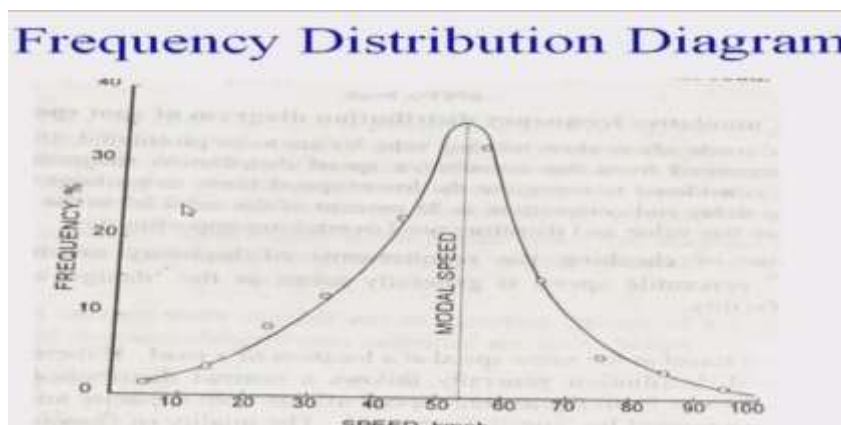


Fig: Frequency Distribution Diagram

c) Types of cracks detected

(A) Alligator Cracking:

Alligator cracking is the type of cracking that is associated with load and structural distresses. Alligator cracks are extensively found at intersections where the vehicles are stopped for a relatively long period because these cracks start to form when the sub-grade and base compress due to the excessive imposed wheel load. It indicates the structural failure that may further deteriorate to a pothole. The causes of this cracking are inadequate structure, poor drainage, etc. Maintenance taken such as carpeting is used for normal alligator cracking, but patching is carried out for effective alligator cracking.

Causes of Alligator Cracking:

1. Weakness in base, surface or sub-grade
2. Thinning of a surface course or base course
3. Poor Drainage System
4. A combination of all of the above

Remedies for Alligator Cracking:

1. Restricting the movement of heavy load vehicles like trucks or semis on the pavement.
2. Designing the concrete pavement as per the expected loads.
3. Improving the drainage of the pavement so that water can flow out of the sub-base.



Fig: Alligator cracking

(B) Pot holes

Small, bowl-shaped depressions in the pavement surface that penetrate all the way through the asphalt layer down to the base course. They generally have sharp edges and vertical sides near the top of the hole. Potholes are the result of moisture infiltration and usually the end result of untreated alligator cracking. As alligator cracking becomes severe, the interconnected cracks create small chunks of pavement, which can be dislodged as vehicles drive over them. The remaining hole after the pavement chunk is dislodged. The fig shows the causes.

Causes of pot holes

1. Pavement fatigue
2. Untreated alligator cracks
3. expansion and contraction of groundwater after the water has entered into the ground under the pavement

Remedies for pot holes

1. Clean the area along the hole with the broom.
2. Trim it vertically to a regular geometrical shape like square or rectangle.
3. Level the bottom of the hole and remove loose aggregate and foreign materials.
4. Apply tack coat on bottom and sides of holes.
5. Now, apply the patching layer and compact it properly by tapping or roller.
6. If the depth of the hole is greater than 7.5cm, Patching layer should be provided in 2 or more layers where each layer should be tamped or rolled properly.



Fig: Pot hole

Block cracking is another type of cracking seen on highway pavements that form a box-like crack on the surface. This type of cracking is associated with the unusual expansion and contraction of concrete. Block cracks look like large interconnected rectangles (roughly).

Block cracking is not load-associated, but generally caused by shrinkage of the asphalt pavement due to an inability of asphalt binder to expand and contract with temperature cycles. This can be because the mix was mixed and placed too dry. Fine aggregate mix with low penetration asphalt & absorptive aggregates, poor choice of asphalt binder in the mix design or aging dried out asphalt. The fig shows the block cracking observed in the selected site.

Causes of Block Cracking:

1. Use of improper mix.
2. Fine aggregates mixed with low penetration asphalt.
3. Poor asphalt binder.
4. Ageing of asphalt.

Remedies of Block Cracking:

1. In case of Block Cracking, the deteriorated pavement must be removed and replaced by an overlay.
2. Sealing method of repair can be used for cracks less than ½ inch or lesser.
3. prevent the ingress of moisture to the subgrade.



Fig: Block cracking

(D) longitudinal cracking

Longitudinal cracking are cracks that are parallel to the pavement's centerline or laydown direction. These can be a result of both pavement fatigue, reflective cracking, and/or poor joint construction. Joints are generally the least dense areas of a pavement. It is caused due to unstable base, poor construction. Surface dressing is used to repair this crack. The cracks observed between selected site as shown in the fig

Causes of Linear Cracking:

1. Pavement fatigue
2. Reflective cracking
3. Poor construction of joints

Remedies for linear cracking:

1. It can be repaired by sealing or replacement.
2. For less severe cracks, sealing of the cracks may be done.
3. For severe cracks, replacement by an overlay may be carried out.



Fig: Linear cracking (longitudinal)

d) Site Visits:

The selected site was investigated / visited time to time for different purposes like identifying the failures, identifying their causes and effects, to perform traffic density, traffic volume ratio etc.

- Selected Location from Belhe Gulanchwadi Road. (3/5/2023)

We were visited the selected location for the inspection of the road. In this visit we collected the data like location of the cracks, what type of vehicles are travelling, and many more was collected.



Schedule for Completion of Project

Stage	Task	Task to be Undertaken	2022				2023			Status
			Aug	Sep	Oct & Nov	Dec	Jan	Feb	Mar	
S T A G E 1	T1	Selection Of Topic and Study of Case Papers								C O M P L E T E D
	T2	Study Of Literature								
	T3	Road Site visit								
S T A G E 2	T4	Tests								Y E T T O W O R K
	T5	Correction Of Errors								
	T6	Results And Discussion								
	T7	Report And Final Presentation								

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