

INVESTIGATION ON CAUSES OF PAVEMENT FAILURE AND ITS REMEDIAL MEASURES

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ABSTRACT

Pavement failure is defined in terms of decreasing serviceability caused by the development of cracks and ruts. Before going into the maintenance strategies, we must look into the causes of failure of bituminous pavements. Failures of bituminous pavements are caused due to many reasons or combination of reasons. Application of correction in the existing surface will enhance the life of maintenance works as well as that of strengthening layer. It has been seen that only 3 parameters i.e., unevenness index, pavement cracking and rutting are considered while other distresses have been omitted while going for ma. The report describes lessons learnt from pavement failures and problems experienced during the last few years on a number of projects in India. Based on the past experience's various pavement preservation techniques and measures are also discussed which will be helpful in increasing the serviceable life of pavement. The results revealed that the roads investigated experienced severe failures in the forms of cracks, potholes and rutting in the wheel path. The causes of those failures were found mainly linked to poor drainage, traffic overloading, expansive subgrade soils and the use of low-quality materials in construction.

Keyword : - Causes of pavement failure in Nashik city .

I. INTRODUCTION

Pavement deterioration is the process by which distresses develop in pavement under the combined effects of traffic loading and environmental conditions. Deterioration of pavement greatly affects serviceability, safety and riding quality of the road. After construction, roads deteriorate with age as a result of use and therefore, they need to be maintained to ensure that the requirements for safety, efficiency and durability are satisfied. Normally, new paved roads deteriorate very slowly in the first ten to fifteen years of their life, and then go on to deteriorate much more rapidly unless timely maintenance is undertaken. These deteriorations were contributed to many reasons such as excessive loads, climatic changes, poor drainage and low-quality pavement materials. The most common road distresses are cracks, potholes, rutting, ravelling, depressions and damaged edges. These distresses affect the safety and riding quality on the pavement as they may lead to premature failure and traffic hazards. Before going into maintenance strategies, engineers must look into the causes of road deterioration.

That with which anything is paved; a floor or covering of solid material, laid so as to make a hard and convenient surface for travel; a paved road or sidewalk; a decorative interior floor of tiles coloured bricks. Pavements are

typically divided into the following three general categories: flexible, rigid and unpaved (gravel or dirt).

1.2 Objective

To investigate the typical failures of flexible pavement under Nashik City Corporation area. To review the maintenance procedure practice by Nashik City Corporation and public work department.

1.3 Problem Definition

A highway which is either flexible or rigid can get deteriorated in its level of serviceability due to various causes. Design period pavement is likely to fail and needs maintenance operation, but sometimes it may fail earlier to its design period.

II. LITERATURE SURVEY AND PROJECT OVERVIEW

2.1 Literature Survey

A literature review allows one to get an insight into the different aspects of the problem being studied. It explores innovative computational methods, shines light on how to enhance data collecting performance and proposes strategies to maximize data collection and understanding effectiveness. Therefore, reviewing literature is an essential step in the development of the research project. A literature review is a body of text intended to evaluate the key points of existing knowledge including empirical studies as well as theoretical and analytical approaches to a particular subject. Literature reports are secondary sources, which have no current or initial scientific research published.

A. S. Harishchandra 2004, The study was particularly concentrated on identifying the causes of road deterioration. D.Y. Patil Abhijit et.al 2011, Drainage is an important feature in determining the ability of given pavement to withstand the effects of traffic and environment. D.N. Little et.al 1995, This study is aimed to improve the engineering properties of marginal base materials by mechanical stabilization. Currently used techniques for stabilization of marginal base materials are reviewed. K.D. Stuart 1990, This state-of-the-art report is on the moisture susceptibility of asphalt mixtures used in highway pavements. M. Sargious 1975, Pothole is a localized loss of material or depression on road pavement surface. The development of cracks and the formation of potholes on road surface are widespread problems in road construction and maintenance. N. Okigbo 2012, Most of the road networks in the developing countries of Africa are in deplorable conditions. Nigeria being one of these countries is not an exception. The conditions of the roads in Nigeria were examined. N.D. Little et.al 2003, Historically, six contributing mechanisms to moisture damage have been identified: detachment, displacement, spontaneous emulsification, pore pressure-induced damage, hydraulic scour, and the effects of the environment on the aggregate-asphalt system. N.P. Khosla et.al 1999, Most of the roads constructed in Ethiopia fail prematurely before serving the design life due to various causes arising from many factors

III. METHODOLOGY

3.1 The concept and Investigation on various types of failure

1. Generally, it's observed that after opening of newly constructed roads or well-maintained or newly widened roads which is very good in terms of level of services. But it is after some time with the use of heavy traffic volume, constant change in weathers the roads are completely decorated with number of cracks, potholes, ruts etc.
2. Hence the quality and level of service is dropped down drastically as the road users are increased but maintenance is overlooked

3. However, reinforcing the soil with geo-textile is one of the methods which can give technically as well as economically superior solution to improve performance of sub grade soils

3.2 Heavy Traffic

One of the defects caused by heavy traffic on the road is the deformation of the pavement surface due to overloading that is more than the design load. that deterioration of pavements arises from deformation generally associated with cracking under heavy commercial vehicles. The increased traffic loading will then cause failures such as cracks and depressions on the pavement. Road surfaces often wear under the action of traffic, particularly during the very early life of the road. However, the action of traffic continues to wear the surface texture and thus gradually reduces the high-speed skidding resistance. He reported that with the increase of traffic loads (volume and axle loads) the road network was experiencing a deterioration equivalent to a loss of billions of dollars due to road deterioration and vehicle operating cost.

3.3 Climatic Changes

Climatic factors include rainfall and annual variations in temperature are an important consideration in pavement deterioration. Rainfall has a significant influence on the stability and strength of the pavement layers because it affects the moisture content of the subgrade soil. The effect of rain on road pavements can be destructive and detrimental as most pavements are designed based on a certain period of rainfall data. In addition, rainfall is well established as a factor affecting the elevation of the water table, the intensity of erosion, and pumping and infiltration.

3.4 Poor Drainage

The highway drainage system includes the pavement and the water handling system which includes pavement surface, shoulders, drains and culverts. These elements of the drainage system must be properly designed, built, and maintained. When a road fails, inadequate drainage often is a major factor. Poor design can direct water back onto the road or keep it from draining away. Too much water remaining on the surface combine with traffic action may cause potholes, cracks and pavement failure.

Patil Abhijit et al investigated the effect of poor drainage on road pavement condition and found that the increase in moisture content decreases the strength of the pavement. Therefore, poor drainage causes the premature failure of the pavement.

3.5 Construction with low quality materials

The use of low-quality materials for construction adversely affects the performance of the road. This sometimes occurs in the form of the improper grading of aggregates for base or subbase and poor subgrade soil of low bearing strength. The use of marginal or substandard base materials for pavement construction will affect pavement performance. He found that these materials may accelerate deterioration of the pavement and often result in rutting, cracking, shoving, raveling, aggregate abrasion, low skid resistance, low strength, shortened service life, or some combination of these problems.

Osuolale et al investigated the possible causes of highway pavement failure along a road in south western Nigeria. He stated that the materials used as subbase have the geotechnical properties below the specification and this is likely to be responsible for the road failure.

3.6 Expansive subgrade soil

Expansive soil as road subgrade is considered one of the most common causes of pavement distresses. Longitudinal cracking results from the volumetric change of the expansive subgrade, is one of the most common distresses form in low volume roads. This type of cracking is initiated from the drying highly plastic subgrade (PI >35) through the pavement structure during the summer. Other forms include fatigue (alligator) cracking, edge cracking, rutting in the wheel path, shoving, and pop outs.



3.7 Failure causes

Types of Distress	Possible Causes	Remedies
Fatigue Cracking (Alligator)	<ol style="list-style-type: none"> 1. Excessive loading 2. Weak surface, base, or subgrade 3. Thin surface or base 4. Poor drainage 5. Any combination of 1-4 	Full-depth patch
Block Cracking	<ol style="list-style-type: none"> 1. Old and dried out mix 2. Mix was placed too dry 3. Fine aggregate mix with low penetration asphalt & absorptive aggregates 4. Aggravated by low traffic volume 	Any surface treatment or thin overlay
Edge Cracks	<ol style="list-style-type: none"> 1. Lack of lateral support 2. Settlement of underlying material 3. Shrinkage of drying out soil 4. Weak base or subgrade layer 5. Poor drainage 6. Frost heave 7. Heavy traffic or vegetation along edge 	Improve drainage. Remove vegetation close to edge. Fill cracks with asphalt emulsion slurry or emulsified asphalt Crack seal/fill
Longitudinal (Linear) & Transverse Cracking	<ol style="list-style-type: none"> 1. Poorly constructed paving joint crack 2. Shrinkage of the asphalt layer 3. Daily temperature cycling 4. Cracks in an underlying layer that reflect up through the pavement 5. Longitudinal segregation caused by the improper operation of the paver 	Improve drainage by removing the source that traps the water Seal crack or fill with asphalt emulsion slurry or light grade of asphalt mixed with fine sand. Provide side drainage ditches Crack seal/fill
Reflection Cracking	<ol style="list-style-type: none"> 1. Differential movement between the 	Crack seal/fill

- asphalt and concrete layers
- 2. Can deteriorate further under heavy traffic

Applications

1. Provide a reasonably smooth riding surface.
2. Provide accurate surface friction skid resistance.
3. Project the subgrade.
4. Provide waterproofing.

4.1 Conclusion

On the basis of various data collected from different roads construction and maintenance authority, the following conclusions drawn:

1. Most of the road maintenance works are done by on emergency basis. As a result, proper quality control is not always possible. Due to lack of quality control, highway and road needs early and repeated maintenance.
2. Study of data about equipment for highway maintenance owned by different authorities indicates that equipment's are neither sufficient nor well distributed.
3. Road deterioration is an issue of vital concern to road authorities because of the high cost for rehabilitation of existing roads.
4. Pavements deteriorate under traffic loads and climate effects. This fact, together with the weak subgrade soil and poor drainage system, could be major causes of the road's fast deterioration in Sudan.
5. It was pointed out that understanding the causes of pavement deterioration will significantly contribute to the proper selection of effective maintenance technique results in prolonged service life of roads and significant savings for the government.
6. The experience of the investigator is an important factor in correctly diagnosing the pavement failure cause and determining the best rehabilitation treatment.

On the basis of the study, the following recommendations are made:

1. The road maintenance deserves much more importance than is usually placed on it in order to protect the investment that have been made on our road system and maintenance programme should be collected be chalked out by the concerned department well ahead to take up the maintenance work in time on the basis of priority determined in relation to field conditions and available funds.
2. Funds required for proper and timely maintenance of roads should be provided to the organizations concerned.
3. Departments and organizations should have adequate number of professionals, technical and skilled personnel to look after and carry out maintenance work appropriately. Departments and organizations concerned with road maintenance work should take steps to acquire adequate number of equipment's and machineries in order to undertake maintenance work speedily and effectively.

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