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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 maintenance operations. Along with the maintenance techniques there are various methods for pavement preservation which will help in enhancing the life of pavement and delaying of its failure. The purpose of this study was to evaluate the possible causes of pavement distresses, and to recommend remedies to minimize distress of the pavement. 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. A comprehensive literature concerning the factors of road deterioration, common road defects and their causes were reviewed. The investigation involved field survey and laboratory testing on those projects to examine the existing pavement conditions. 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. Based on the results, recommendations were provided to help highway engineers in selecting the most effective repair techniques for specific kinds of distresses.***

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).

A. Flexible (Bituminous Pavements)

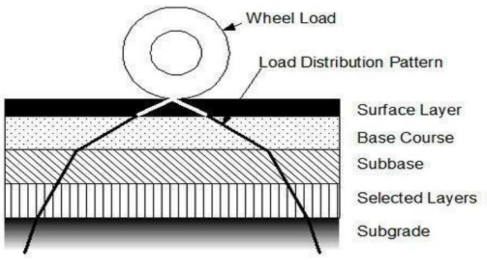

Fig 1. Load distribution of Flexible Pavement

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Flexible pavements are constructed of several layers of natural granular material covered with one or more waterproof bituminous surface layers, and as the name imply, is considered to be flexible. A flexible pavement will flex (bend) under the load of a tyre. The objective with the design of a flexible pavement is to avoid the excessive flexing of any layer, failure to achieve this will result in the over stressing of a layer, which ultimately will cause the pavement to fail. In flexible pavements, the load distribution pattern changes from one layer to another, because the strength of each layer is different. The strongest material (least flexible) is in the top layer and the weakest material (most flexible) is in the lowest layer. The reason for this is that at the surface the wheel load is applied to a small area, the result is high stress levels, deeper down in the pavement, the wheel load is applied to larger area, the result is lower stress levels thus enabling the use of weaker materials.

B. Rigid (Concrete) Pavement

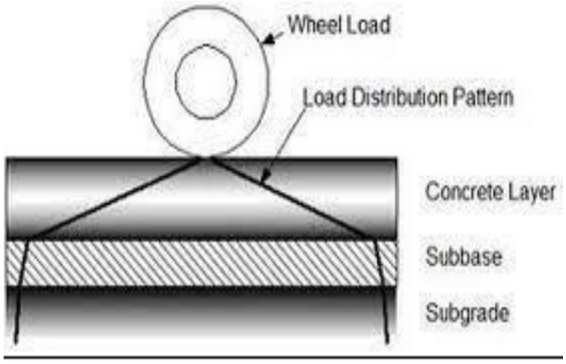

Fig 2. Load distribution of rigid pavement

Rigid pavements are composed of a PCC surface course. Such pavements are substantially "stiffer" than flexible pavements due to the high modulus of elasticity of the PCC material. Further, these pavements can have reinforcing steel, which is generally used to reduce or eliminate joints. The increased rigidity of concrete allows the concrete surface layer to bridge small weak areas in the supporting layer through what is known as beam action. This allows the placement of rigid pavements on relatively weak supporting layers, as long as the supporting layer material particles will not be carried away by water forced up by the pumping action of wheel loads.

C. Objectives

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

D. Problem Statement

A highway which is either flexible or rigid can get deteriorated in its level of serviceability due to various causes. These factors are:

1) Traffic loading
2) Environmental Factors
3) Quality of the material
4) Drainage

According to IRC, a pavement is designed for its design period of 10 years. After its design period pavement is likely to fail and needs maintenance operations to extend its life further. But sometimes it may fail earlier to its design period because of low quality of material or may by other factors.

E. Scope of the Project Work

1) The special attention will be given to the areas having high severity level.
2) Future road performance will be assessed and forecasted.
3) Control of surface water or infiltration is needed by providing adequate drainage.
4) Adequate road markings to save it from collision of vehicles should be provided.
5) All the above parameters affect the allocation of funds for maintenance option for different stretches of the road

II. METHODOLOGY

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 deterioration with number of cracks, potholes, ruts etc

Hence the quality and level of service is dropped down drastically as the road users are increased but maintenance is overlooked

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

Table 4.1. Table for type of failure, its maintenance type, machinery use in Maintenance

Water Bleeding	Routine	Back hoe, Dump truck, Tractor, Water sprinkler, Bitumen distributor, Asphalt
		mixing plant, Road sweeping vehicle etc.
Rutting	Routine	Hoes, Bitumen distributor, Dump truck, Smooth roller

III. CONCLUSIONS

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.

7) 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.

8) Funds required for proper and timely maintenance of roads should be provided to the organizations concerned.

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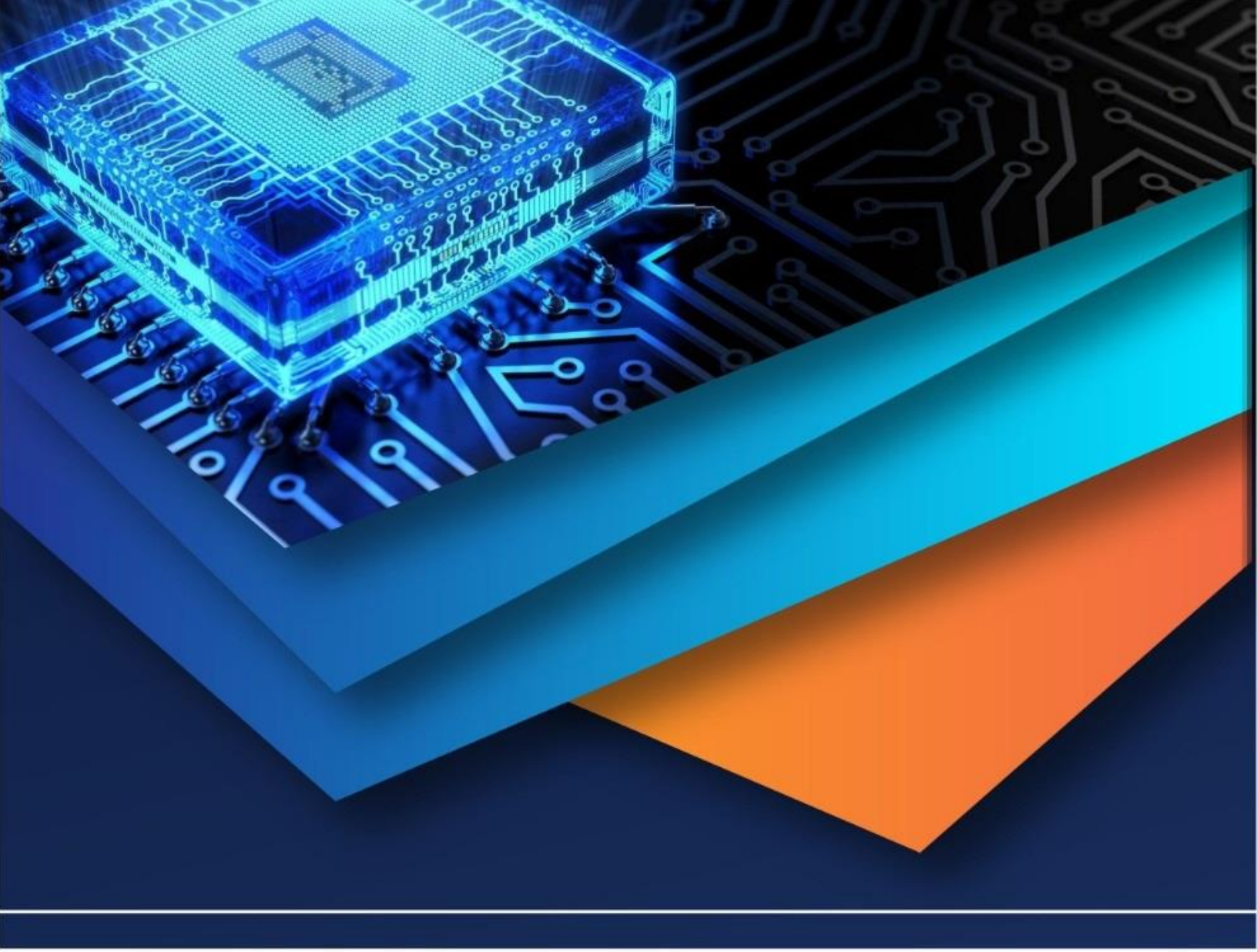

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