Study on Failure and Maintenance of Flexible Pavement

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Abstract

In India, the large network of existing roads, which are built at huge expanses, has started showing signs of distress failure before the time due to combined effect of inadequate maintenance and structural inadequacies to meet the requirements of increase in traffic intensity and loading. The gap between the minimum requirements and actual allocation of funds for maintenance over the years has resulted in a poor quality of road maintenance. India's many cities like throughout Palestine are facing a monumental challenge in dealing with aging infrastructure. For pavements, in particular, it is found that many streets were built 20 or 30 years ago and they are near the end of their economic life. Other streets have been deteriorated because of misuse, overuse, and mismanagement. Besides, present and future threats affect the hoped mission of these pavements for rapid, safe and comfort movements of people and goods. Moreover, the current management reveals that the system used is not flexible enough to reflect the changing conditions and poor to assist in making decisions. This study aims to initiate a Pavement Maintenance Management System (PMMS) in which it provides a systematic process of maintaining, upgrading and operating the city pavements and tools to facilitate a more flexible approach that can enable to perform tasks better.

Keywords: Distress Failure, Structural Inadequacies, Traffic Intensity, Loading, Mismanagement, Comfort Movements, Road Maintenance

Introduction

There is no doubt that the quality and efficiency of roads affect the quality of life, the health of the social system and the continuity of economic and business activity. Deterioration and catastrophic failure of these roads may occur because of aging, overuse, misuse and/or mismanagement. Therefore, their maintenance and preservation should have a great national interest. Pavement Maintenance Management System (PMMS) is a scientific tool for managing the pavements to make the best possible use of resources available or to maximize the benefit for society. Thus, PMMS can be used in directing and controlling maintenance resources for optimum benefits. A Maintenance Management System of a city is composed of a group of interrelated management tools designed that provide a basis for planning, scheduling, operating and controlling the highway maintenance effort with economy and effectiveness. The use of this system places continuity emphasis on the economic utilization of personnel, equipment and materials, with the available resources. The maintenance activities need to be considered in a more flexible and integrated decision-making framework. The system should be capable of handling the various aspects systematically, because of the changing conditions. There is a strong need to gradually introduce new technologies like Geographic Information System (GIS), Global Positioning System (GPS), work schedules, reports, and inventory management. These will enable the highway agencies to perform tasks better, more economically, effectively and of higher quality.

Reviews on Different Case Studies

Pavement maintenance can be defined as the planned strategy of cost-effective treatments to an existing road-way pavement system that preserves the system, retards future deterioration and maintains or improves the functional conditions of the system without including the structural capacity (does not include reconstruction or other improvements). On the other hand, highway maintenance [10] has more generality and is concerned with the task of preserving, repairing and restoring a system of roadways with it is elements, to it is designed or accepted the configuration. System elements include carriageway surfaces, shoulders, roadsides, drainage facilities, bridges, tunnels, signs, markings, and lighting fixtures.

Figure (1.0) shows a generic deterioration curve and illustrates how the overall condition of the pavement changes as it ages. When first built, the pavement is hopefully in very good condition. Typically, the condition slowly decreases in the first years of service from very good to good condition. As the pavement approaches the end of its service life, the rate of deterioration accelerates.

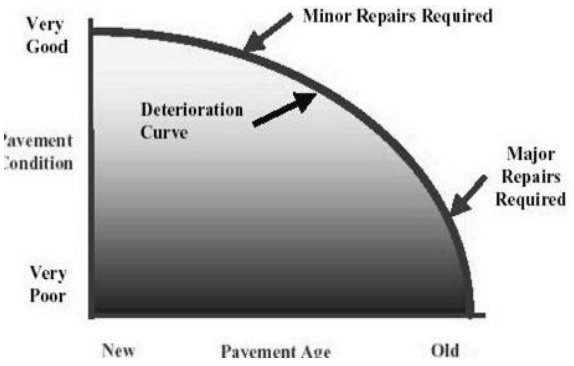

Figure (1.0): General Pavement Deterioration Curve

2.1 Flexible Pavement: The pavements can be classified based on the structural performance into two, flexible pavements and rigid pavements. Inflexible pavements, wheel loads are transferred by grain-to-grain contact of the aggregate through the granular structure. The flexible pavement, having less flexural strength, acts like a flexible sheet (e.g. bituminous road).

Flexible Pavements

Structural components of flexible pavement layer is give below in figure.2

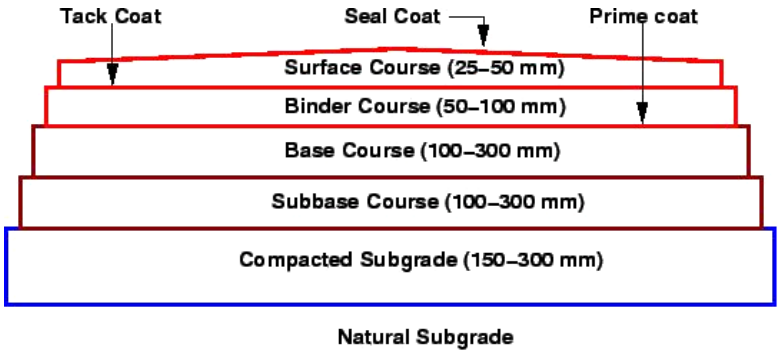

Figure2. The Structural component of flexible Pavement layer

Flexible pavements will transmit wheel load stresses to the lower layers by grain-to-grain transfer through the points of contact in the granular structure **(see Figure 2).**

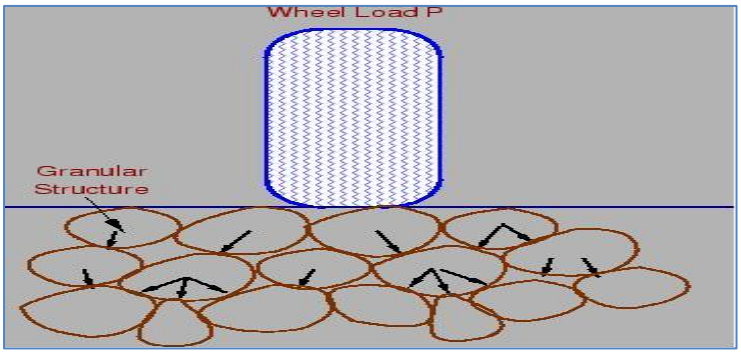

Figure3. Grain-to-grain transfer through the points of contact in the granular structure.

Maintenance Aim

In developing countries (as Palestine) large road networks that built at great expenses have been inadequately maintained and used more heavily than expected. From an economic point of view, it is desirable that adequate maintenance operation be carried out before the existing roads get appreciably deteriorated. The approximate time to carry out maintenance is very crucial. Neglect of short term routine maintenance leads to general deterioration, possibly too serious failure and certainly to major maintenance work. This may cost 10 times of timely preventive maintenance work

Timely maintenance programs of roads serve four main purposes:

1. Reduces the rate of deterioration and prolong the life of roads.

2. Reduces vehicle operating cost by providing better riding quality.

3. Keeps roads more open continually for traffic when the pavement reaches the end of its design life, expensive reconstruction will be necessary. Maintenance type versus pavement condition is shown in figure (1.2).

Table 4.0 Pavement Distress Based Rating for MDR and Rural Roads (ODR and VR)

Defects	**Range of Distress**		
Cracking, (%)	>20	10-20	< 10.0
Ravellling, (%)	>20	10-20	<10
Pothole, (%)	>1.0	0.5 to 1.0	<0.5
Patching, (%)	>20	5-20	<5.0
Settlement and depression , (%)	>5	2 to 5	<2.0
Rating	1	1.1 - 2	2.1 - 3
Condition	Poor	Fair	Good

Discussion on Review

The present study consists of existing Indian pavement management system for the flexible pavement road network. The existing Indian pavement methodology involves six modules which are data collection, pavement condition evaluation, developing urban pavement maintenance management system(UPMMS) using Highway Development and Management(HDM- 4) tool, Urban pavement drainage management system, Urban priority ranking model using Analytic Hierarchy Process(AHP) and Integrating UPMMS WITH Geographical Information System(GIS).

Conclusion

The maintenance management decision systems developed for urban roads in this present existing road pavement maintenance system would be practicing engineers, highways engineers, and consultants in India as well as other developing countries having similar geographical and climatic conditions.

Recommendation

The methodology presented in this study may be extended to include the whole of the existing road network Indian flexible pavement.

The fields engineers may be trained to successfully implement such pavement management systems.

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