Defects in Flexible Pavement and its Maintenance

Zulufqar Bin Rashid, \textsuperscript{a}Dr. Rakesh Gupta

\textsuperscript{a}M.Tech Scholar, Civil Department, SRMIET, Bhurewala, Haryana, India

\textsuperscript{b}Associate Professor and Director, Civil Engineering Department, SRMIET, Bhurewala, Haryana, India

Abstract
This paper summarizes the ongoing researches about the defects in flexible pavement and the maintenance in flexible pavements. In the past, lots of researchers have already studied the defects and problems of maintaining the flexible pavements all over the world. Efforts have been made to refer some of the publications related to this topic. Various defects in flexible pavements have been identified since the existence of flexible pavement. Pavement structure can be destroyed in a single season due to water penetration. Defects in flexible pavements is a problem of multiple dimensions, phenomenal growth of vehicular traffic (in terms of no. of axle loading of commercial vehicles), the rapid expansion in the road network, non-availability of suitable technology, material, equipment, skilled labor and poor funds allocation have all added complexities to the problem flexible pavements. Maintenance is set of activities directed towards keeping a structure in a serviceable state during its design life. Maintenance of a road network involves a variety of operations, i.e., identification of deficiencies and planning, programming and scheduling for actual implementation in the field and monitoring. The essential objective should be to keep the road surface and appurtenances in good condition and to extend the life of the road assets to its design life. Broadly, the activities include identification of defects and the possible cause thereof, determination of appropriate remedial measures; implement these in the field and monitoring of the results.

Keywords
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 give 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 any 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. The most demanding fact is that this country needs to provide road links both for major proportions of villages and marked centers like significant important roads, important buildings, destinations of schools and hospitals, etc. India has got second largest road network in the world. The road network has expanded from 4 lakh km in 1947 to 20 lakh km in 1993 and almost 55 lakh kms as on 31 March, 2015. India has less than 3.8 kms of road per 1000 people; including all its paved and unpaved roads. In terms of quality, all season, 4 or more lane highways; India has less than 0.07 kms of highway per 1000 people as of 2010. Construction of roads involves substantial investment and therefore proper maintenance of these assets is of paramount importance. The road user cost, comfort and safety are influenced to a large extent by its state of maintenance. The quality of roads is a critical indicator of a nation’s economic vitality because a poor road transport system can constrain the location of economic activity, hamper the integration of economic markets, limit the gains from specialization and eventually become a major barrier to growth and competitiveness. In India large road networks built at great expense, have been inadequately maintained and used more heavily than the design values. The main deficiencies affecting our highway system apart from inadequate capacity and insufficient pavement thickness include poor riding quality, weak and distressed bridges/culverts, congested sections, excessive axle loading, and lack of wayside amenities and enforcement. Among various modes, roads and road transport has come to occupy a dominant position in the transportation system. Factors that contributed in this direction are flexibility, door to door service, reliability and speed. India has second largest road network across the world at 4.7 million km. This road network transports more than 60 per cent of all goods in the country and 85 per cent of India’s total passenger traffic. The Indian roads carry almost 90% of the country’s passenger traffic and around 65% of its freight. Maintenance of roads is a problem of multiple dimensions, phenomenal growth of vehicular traffic (in terms of no. of axle loading of commercial vehicles), the rapid expansion in the road network, non-availability of suitable technology, material, equipment, skilled labour and poor funds allocation have all added complexities to the problem of the maintenance of roads. The maintenance of existing roads tends to get neglected at the cost of new construction and financial constraints. 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. Even in a particular area the difference between maximum and minimum temperature of the year may be as high as 420\textdegree. North India experiences heavy snowfall during winter at altitudes above 2000 m. These climatic conditions have great influence on the type of
problems existing on the road as only 47% are surfaced roads, balance being earthen roads.

II. Types of Defects
Various defects in flexible pavements have been seen and those are listed below:
(a) Cracks:
• Alligator Cracking
• Longitudinal Cracking
• Block Cracking
• Edge Cracking
• Centre Cracking
(b) Rutting and Shoving:
• Rutting Classification
• Shoving
(c) Pot Holes and Patching:
• Pot Holes
• Patch Deterioration and Repairs
(d) Bleeding, Reveling and Weathering:
• Bleeding
• Reveling and Weathering
(e) Miscellaneous Type of Defects:
• Polished Aggregates
• Corruggations

III. Problems Faced During Road Maintenance
The various types of problems faced during maintenance of roads in general have been discussed in brief below:
I. Problem of drainage system-Efficient drainage is a must for any highway system/road network, especially in heavy rainfall mountainous and low lying areas; all drainage structures must be well designed and adequately maintained.
II. Geological problem-In India, we experience frequent landslides, flash folds etc. in hilly regions and shifting sand dunes in deserts of western region cause lot of problems to highway engineers. Similarly snow clearance and road maintenance in high altitude snow bound areas is a challenging task to field engineers, the extreme and adverse climatic conditions reduce the efficiency of man and machine.
III. Shortage of equipment skilled labour, lack of modern technology and non-existence of updated guideline standards and norms for maintenance of roads.
IV. Damage to subgrade due to seepage of water into the subgrade.
V. Poor quality control during initial construction stage and inadequate thickness of pavement, excessive overloading adds to the maintenance enforcement problems.
VI. Stability of subgrade and top layers is decreased under adverse moisture conditions, frost action and temperature variation.

IV. Classification of Maintenance Activities
Engineering maintenance as far as the road is concerned should be taken as comprising several small scale engineering activities that are carried out at varying intervals, depending upon climate, terrain, traffic and design standards of the roads. All the operations described here are aimed at keeping or restoring the road to a state of preservation and acceptable standards for its current and intended uses. These operations can be classified as routine, recurrent, periodic and urgent. The routine activities are likely to be required, irrespective of the engineering characteristics of the road or the density of traffic it carries. Cost activities include grass cutting, cleaning of ditches, culverts and bridges and road sign maintenance.

Maintenance of highway is classified under the following categories:
• Routine Maintenance
• Periodic Maintenance
• Special Maintenance

1. Routine Maintenance
Activities involved in routine maintenance are irrespective of the engineering characteristic of road and density of traffic carried by it. These are required to be carried out throughout the year. The works to be attended under this category are as follows:
• Upkeep of carriageway.
• Road sign maintenance.
• Maintenance of berms/shoulder and subgrade.
• Repair to pot holes, cracks and other minor defects.
• Cleaning of drains and clearing of choked culverts.
• Rectification of corrugations formed.
• Minor repair of culverts/bridges.

2. Periodic Maintenance
It is nothing but periodic renewals of existing surface. In this type of maintenance a surfacing layer over the pavement at regular intervals of time so as to preserve the characteristics of the pavement and offset the wear and tear caused by traffic, weathering, etc. and thereby prolongs the life of pavement. The various types of periodic maintenance are as follows:-
(a) For unpaved roads:
• Gravelling.
(b) For paved roads:
• Surface dressing
• Thin premix carpet
• Thin mix seal surfacing
• Improving drains
• Road surface marking

3. Special Repairs
The type, frequency and degree of maintenance of pavements can influence performance and time at which major rehabilitation such as overlay is required. Pavement rehabilitation is performed due to following two reasons:
1. To correct existing distress and improve riding quality.
2. To increase the structural capacity of pavement.
In order to increase the service life of an existing road, the works to be carried out are widening, overlays, removing old surfaces and constructing new pavements, improving drains, culverts, bridges, repairing walls and stabilization of soils.
Overlay is necessary when pavement section cross their maximum acceptable limits of deflection, rut depth, roughness and cracking and there is increase in traffic intensity. Overlay is generally laid when Characteristic Deflection (DC), Rut Depth Index (RDI), Crack Index (CI) and Roughness Index (RI) reach acceptable limits. Classification of Rut Depth Index and Crack Index is given in Table.
Table: Classification Of Rut Depth Index And Crack Index

<table>
<thead>
<tr>
<th>Transverse Deformation under a 3 m long straight edge</th>
<th>Degree of Cracking</th>
<th>Visible cracking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classification</td>
<td>Deformation (mm)</td>
<td>RDI</td>
</tr>
<tr>
<td>D1</td>
<td>&lt; 10</td>
<td>1</td>
</tr>
<tr>
<td>D2</td>
<td>10-15</td>
<td>2</td>
</tr>
<tr>
<td>D3</td>
<td>15-20</td>
<td>3</td>
</tr>
<tr>
<td>D4</td>
<td>20-25</td>
<td>4</td>
</tr>
<tr>
<td>D5</td>
<td>&gt; 25</td>
<td>5</td>
</tr>
</tbody>
</table>

V. Status of Ongoing Researches
HninEiEiKhaing and Dr. Tin TinHtwe (2014), in their study the major purpose was to improve the pavement of Magway Yangon Highway in order to provide a satisfactory surface over which the vehicles could move safely. In this study failure patterns were classified between every five miles for the existing pavements by visual inspection. The stress and deflection of above mentioned highway was determined by using the method of soil mechanics of three layered system. The required overlay thickness was evaluated in accordance with Indian Road Congress Formula (IRC). From this study it was concluded that maximum overlay thickness was 6 inches and the minimum was 4.5 inches; whereas maximum granular overlay thickness was 12 inches and minimum was 9 inches.

Mr. EtkalaNagaraju (2015), in this study the major focus was on rehabilitation of pavement and its maintenance. As the road networks are subjected to severe deterioration leading to premature failure of the pavements. From this study it is concluded that significant savings could be obtained by choosing various rehabilitation strategies that include recycled materials in new layers.

Magdi M.E. Zumrawi (2015), the objective of this study was to visually inspect and evaluate flexible pavement failures for maintenance planning. It is very important to identify and then examine the causes of failed pavements and further to select proper treatment option. This study consists of two tasks in which first part covers the visual inspection of existing pavement failures whereas the second task was to investigate the actual causes of these failures. In this study, Obed Khaitim Road was selected for investigation. The damaged pavement sections suffered from severe cracking and rutting failures. The damage to existing roads could be due to poor drainage conditions, inadequate design and improper pavement materials used.

Aggarwal et al. (2005), has given an overall picture of the problems of road networks in developing countries, which are rapid traffic growth, inadequate funding for maintenance and upkeep, lack of skilled man power, attitude towards maintenance etc.

V. Conclusion
After going through number of researches I conclude that defects in flexible pavement is a problem since long time and there is a need of identification of problems and rectifying them. Thus it is concluded that a research needs to be done so as to see the various alternatives which can be adopted. The research should mainly have the objectives as:-

(a) To identify type and classification of common defects in flexible pavements.
(b) To identify the causes of these defects and suggest remedial measures.
(c) To identify the deficiencies in existing pavement maintenance practices.
(d) To rectify the identified defects for smooth movement of traffic flow.

References:


