Maintenance and Rehabilitation of Flexible Pavement (Kosmadi Patia to Sevni Village, Kamrej District)

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Abstract— For the evaluation of a functional behaviour or performance analysis, information is needed on the history of riding quality of the pavement stretch. In condition survey, pavement surface condition is measured and which types of the distress is observed. For the sub grade evaluation soil sample is taken at required locations on road stretch. In the structural evaluation of flexible pavement the pavement deflection is measured by the Benkelman Beam. It is possible to measure the rebound and residual deflections of the pavement structure. While the rebound deflection is one related to pavement performance, the residual deflection may be due to non-recoverable deflection of the pavement or because of the influence of the deflection bowl on the front legs of the beam. Rebound deflection is used for overlay design. A detailed pavement condition survey is done on Kosmadi Patia to Sevni village, Kamrej district and the road condition is evaluated structurally.

Key words: Maintenance, Rehabilitation, Pavement Evaluation, Deflection

I. INTRODUCTION

Transportation infrastructure plays a lead role in economic growth and development of country. India has the second largest highway and road networks system on the world. They carry almost 90 percent of the country’s passenger traffic and 65 percent of its freight. However, most highways in India are narrow and congested with poor surface quality. Also most of India’s villages do not have access to all weather roads.

All civil infrastructures have a definite life span. In other words, all structures are designed to fail at some point but the life of structure is extended by the maintenance and rehabilitation activities. The maintenance and rehabilitation activities of pavement structures become increasingly important as pavements deteriorate with time and traffic. The combined effects of traffic loading and the environment will cause every pavement, no matter how well-designed/ constructed to deteriorate over a period of time.

Quality of the road surface, stiffness and thickness of pavement layers are important parameters which influences the performance and efficiency of roads. Pavement evaluation plays a very important role in repair and rehabilitation of existing roads and quality control of new roads.

Flexible pavement is made with different layers with different material. It is important to design all layers carefully. It transmits the load by grain to grain contact.

The aim of the thesis is Maintenance and Rehabilitation of flexible pavement and special focus on the performance of the pavement, find out the different aspect of deterioration of roadway, therefore suggest the suitable measure for the improvement of the selected road as per IS standard.

II. TYPES OF FAILURES IN FLEXIBLE PAVEMENT

As stated above, the localized settlement of any one component layer of the flexible pavement structure could be enough to cause pavement failure. This demands that each one of the layers should be carefully designed and laid. Thus to maintain the stability of the pavement structure as a whole, each layer should be stable within itself and thereby making the total pavement maintain its stability. One of the major challenges facing pavement engineers is how to select the optimal repair strategy for a flexible pavement that is aging and exhibiting distress. This selection process can be relatively straightforward if the cause of the pavement distress is known. Unfortunately, finding the cause of the distress is often complex.

The different types of distress/failure in flexible pavement are tabulated in Table 1.

<table>
<thead>
<tr>
<th>No.</th>
<th>Type of Failure</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Fatigue (alligator) Cracking</td>
<td>Series of interconnected cracks caused by fatigue failure under repeated traffic loading</td>
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<tr>
<td>2</td>
<td>Bleeding</td>
<td>Film of asphalt binder on the pavement surface</td>
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<tr>
<td>3</td>
<td>Block Cracking</td>
<td>Interconnected cracks that divide the pavement up into rectangular blocks (approx. 0.1 m2 to 9 m2)</td>
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<tr>
<td>4</td>
<td>Corrugation and Shoving</td>
<td>A form of plastic movement typified by ripples(corrugation) or an abrupt wave (shoving) across the pavement surface</td>
</tr>
<tr>
<td>5</td>
<td>Depression</td>
<td>Localized pavement surface areas with slightly lower elevations than the surrounding pavement</td>
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<tr>
<td>6</td>
<td>Joint reflection cracking</td>
<td>Cracks in a flexible overlay of a rigid pavement which occur directly over the underlying rigid pavement joints</td>
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<tr>
<td>7</td>
<td>Longitudinal Cracking</td>
<td>Cracks parallel to the pavement's centreline or laydown direction (a type of fatigue cracking)</td>
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<td>8</td>
<td>Patching</td>
<td>An area of pavement that has been replaced with new material to repair the existing pavement</td>
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<td>9</td>
<td>Polished Aggregate</td>
<td>Areas where the portion of aggregate extending above the</td>
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Asphalt binder is either very small or angular particles.

**10** Potholes
Small, bowl-shaped depressions in the pavement surface that penetrate all the way through the HMA layer down to the base Course.

**11** Ravelling
The progressive disintegration of an HMA layer from the surface downward as a result of the dislodgement of aggregate particles.

**12** Rutting
Surface depression in the wheel Path.

**13** Slippage Cracking
Crescent or half-moon shaped cracks generally having two ends pointed into the direction of traffic.

**14** Stripping
The loss of bond between aggregates and asphalt binder that typically begins at the bottom of the HMA layer and progresses upward.

**15** Transverse (thermal) cracking
Cracks perpendicular to the pavement's centreline or lay down direction is usually a type of thermal cracking.

**16** Water bleeding and pumping
Water bleeding occurs when water seeps out of joints or cracks or through an excessively porous HMA layer. Pumping occurs when water and fine material is ejected from underlying layers through cracks in the HMA layer under moving loads.

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Table 1: Types of Distresses in Flexible Pavement

**III. OBJECTIVE OF STUDY**

Objectives for the present studies are as follows:

1) To identify the different aspect of deterioration of roadway.
2) To suggest the suitable measure for the improvement of the selected stretch.

**IV. NEED OF THE STUDY**

A good road management is necessary, and maintenance and rehabilitation actions must be taken with good timing. Pavement rehabilitation activities, though not as spectacular as the construction ones, are of major importance for protecting the initial important investments made for development of transportation infrastructure. Major economic losses will continue unless improved capabilities for rehabilitation design are provided to meet today's highway traffic needs, as most projects today include rehabilitation design. Improved rehabilitation designs will lead to longer lasting and more cost-effective rehabilitated pavement.

**V. PAVEMENT EVALUATION**

Pavement evaluations are conducted to determine functional and structural conditions of a highway section either for purposes of routine monitoring or planned corrective action. Functional condition is primarily concerned with the ride quality or surface texture of a highway section. Structural condition is concerned with the structural capacity of the pavement as measured by deflection, layer thickness, and material properties.

**VI. LITERATURE REVIEW**

Prof. A.A.Patel, Dhaval V. Lad (2015) had discussed about the highways, pavements, bridges, parking garages and other exposed structures are becoming functionally obsolete or deteriorating due to repeated application of vehicular loads and due to the effect of climatic parameters. Non-destructive structural evaluation of pavements is an important part of the pavement management. In the structural evaluation of flexible pavement the pavement deflection is measured by the Benkelman Beam. Rebound deflection is used for overlay design. A detailed pavement condition survey is done on State Highway 158 (Waghodiya crossing to Limda) and the road condition is evaluated structurally.

Neero Gumsar Sorum, Thangmuansang Guite, Nungleppam Martina (2014), in this study, the observation showed that the most commonly found pavement distresses in the highway were pot holes, alligator cracks followed by raveling and edge failure. All the distresses found have values exceeding maximum limits. The most required probable treatments for surveyed distresses are overlay, patching and shoulder improvement. It was also observed that the side drainages were not maintained, cleaned and even absent in some places of the NH-52A.

G.Bhatt Mayank, Prof. Amit Vankar, Dr L.B. Zala (2013), he mentioned that the evaluation of a functional behaviour or performance analysis, information is needed on the history of riding quality of the pavement stretch. In condition survey, pavement surface condition is measured and which types of the distress is observed. For the sub grade evaluation soil sample is taken at required locations on road stretch. In the structural evaluation of flexible pavement the pavement deflection is measured by the Benkelman Beam. It is possible to measure the rebound and residual deflections of the pavement structure. While the rebound deflection is one related to pavement performance, the residual deflection may be due to non-recoverable deflection of the pavement or because of the influence of the deflection bowl on the front legs of the beam, Rebound deflection is used for overlay design. A detailed pavement condition survey is done on State Highway 188 (Sarsa Junction to Vasad Junction) and the road condition is evaluated structurally.

Saurabh Jain, Dr. Y. P. Joshi, S. S. Goliya (2013), he reviewed as, Flexible pavement are preferred over cement concrete roads as they have a great advantage that these can be strengthened and improved in stages with the growth of traffic and also their surfaces can be milled and recycled for rehabilitation. The flexible pavements are less expensive also with regard to initial investment and maintenance. Although Rigid pavement is expensive but have less maintenance and having good design period. The economic part are carried out for the design pavement of a section by using the result obtain by design method and their corresponding component layer thickness. It can be done by drawing comparisons with the standard way and practical way.
Kunal Jain, Sukhvir Singh Jain, Mahipal Singh Chauhan (2013) has studied about maintenance and rehabilitation (M&R) requirements of roads depend upon the extent of damage and strengthening of the existing roads. The limited funds available should be used scientifically to have maximum benefit. For this, an investment strategy is needed to be developed to meet the requirements for the maintenance and rehabilitation of roads. The decision is to be made, at which sections; it is ‘best’ or ‘optimal’ to take the maintenance and rehabilitation within the available funds.

Yogesh U.Shah, S.S. Jain, Devesh Tiwari, M.K. Jain (2013), he present that pavements are major assets of highway infrastructure. Maintenance and rehabilitation of these pavements to the desired level of serviceability is one of the challenging problems faced by pavement engineers and administration in the highway sector. The evaluation of pavement performance using pavement condition indicators is a basic component of any Pavement Management System. Various indicators like Pavement Condition Index (PCI), Present Serviceability Rating (PSR), Roughness Index (RI), etc. have been commonly used to assign a maintenance strategy for the existing pavements. The present paper is an effort in the similar direction, to develop a combined OPCI for the selected network of Noida urban roads.

Agarwal, P. K, Singh, A. P. (2011), he studied about the highlights some basic issues for sustainable maintenance of rural roads. This study also identifies some strategies for rational uses of limited resources available for maintenance, strategies to provide required level of funding, strategies to strengthen the institutional measures and strategies for developing data base for sustainable maintenance of rural road network in India. A basic framework is also presented that can be used for developing a maintenance management system for rural roads in India. It is expected that the finding of this study will be useful to preserve the benefits of huge rural road assets created recently in India.

Rokade S, Agarwal P K, Shrivastava R (2010), he mentioned that the evaluation of riding quality of pavement involves a study of the functional behaviour of a stretch of road pavement in its entirety. For a functional behaviour or performance analysis, information is needed on the history of riding quality of the pavement stretch. In condition survey, pavement surface condition is measured at a given time. The riding quality of a pavement can be measured by a Bump Integrator which qualifies in to physical terms, the overall surface condition of the pavement. It is necessary for the pavement maintenance engineer to evaluate functional condition of a pavement surface from time to time. Unevenness is normally measured with response type measuring equipment, which is relatively fast and inexpensive. The towed fifth wheel Bump Integrator is one such instrument. The unevenness measured by these devices is generally expressed in terms of cumulative humps and depressions (mm/km) or slope variance. In the structural evaluation of flexible pavement the pavement deflection is measured by the Benkelman Beam. It is possible to measure the rebound and residual deflections of the pavement structure. Rebound deflection is used for overlay design.

**VII. STUDY AREA PROFILE**

Study area is Kosmadi Patia to Sevni village, Kamrej district. Map of site shown below. Total length of stretch is 11 km, nearby area is developing rapidly in last few years. In this stretch, there is a college route to Vidhyabharti Campus and many residential projects are going on, so that the traffic volume should be increased further days. There are many college buses and private vehicles like cars, bikes, vans and loaded trucks travel on the road. So that the pavement condition become rough, unsafe for road users.

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**Fig. 2: Study Area Location**

The salient features of the Road Section are:
(Kosmadi Patia to Sevni village, Kamrej district)
- Length of the stretch: 11 km.
- Type of Pavement: Bituminous.
- No. of lanes: 2 lane.
- Divided/Undivided: Undivided.
- Type of Shoulder: Rough Shoulder.
- Surrounding Environment: Rural.
- Type of traffic: Mixed traffic.

**VIII. VISUAL SURVEY**

This survey is done on the basis of vision. Condition surveys cover aspects of both functional and structural pavement condition, but generally serve as a qualitative indicator of overall condition.

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**Fig. 3: Raveling**

**Fig. 4: Patching**
Fig. 5: Total failure of pavement.

Fig. 6: Rutting

Fig. 7: Hungry Surface on Pavement

Fig. 8: Alligator Cracking

Fig. 9: Pothole

IX. CONCLUSION

- The visual observation for rutting, patch work, potholes and cracks can identify weak spots of pavement.
- The Benkelman beam study should be carried out in the study area Kosmadi Patia to Sevni village.
- The overlay thickness on existing flexible pavement in terms of bituminous macadam should be calculated.
- The visual observation and Benkelman beam deflection should be correlated with each other as per the IRC-81 1997 guideline.

REFERENCES


