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FLEXIBLE PAVEMENT WITH REPEATED DISTRESS HISTORY- A CASE STUDY

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Abstract - *Road transportation occupies a very dominant position in the overall transportation system. With increase in traffic, road network in India is overstressed. Building roads require huge investments not only in the initial stages but also adequate funding for their maintenance. For certain reasons some roads deteriorate excessively. This is a matter of grave concern and need to be addressed to save precious resources. Although many studies have been conducted on the distresses that occur on pavements, there is little work on the road stretches that undergo repeated failures. It is important to bring in lime light the factors that lead to repeated failures in a road stretch and investigate the type of rehabilitation work undertaken on the same and check the efficacy of the undertaken rectification works. Detailed investigations need to be undertaken to assess the root cause of failure and for arriving at recommendations for actions to be taken that would prevent recurrence of the phenomenon in future. In this status study analysis was done on few experimental stretches on selected locations (road stretches in Chandigarh city) keeping in view the sub-grade condition, the traffic details, history of failure. Common types of distresses were identified on these selected stretches. From the limited investigation carried out it can be concluded that the failure of the road stretches can be due to one or more reasons since several factors of varying degrees of significance may combine to cause a road to fail or develop defects. Though it is difficult to classify the investigation under clear cut headings, the results drawn from the investigations are useful in finding long term solutions.*

Key words:

Key Words: Flexible pavement, repeated distress, recurrence, maintenance, rectification, rehabilitation, etc.

1. INTRODUCTION

For the improvement of urban road transportation in the cities, there is a need to develop a set of procedures that will provide a systematic evaluation of highway needs, based on sound engineering judgement and expert knowledge and at the same time to determine priorities to decide which road stretches need immediate maintenance and which are the section for which the maintenance operation can be deferred. This paper deals with:

- Identification of pavements that have undergone repeated failures in Chandigarh based on visual inspection and the information obtained from concerned department/consultant.
- Assessment of the type and extent of pavement failures.
- Assessing the effectiveness of the remedial measures already undertaken to rectify the failures.
- An analytical study of road network data (including road class, pavement condition, history, and miscellaneous) and traffic data (traffic volume and growth rates).
- Propose a plan of remedial measure based on the observations and data collected, under broader guidelines of MORTH specifications.

2. IDENTIFICATION OF ROADS

After proper assessment and keeping in view the objectives and time duration of this study, field data collection program was chalked out and preliminary survey was made on the city roads including the roads connecting to the nearby cities. After preliminary survey the stretches which showed more distresses as compared to the normal ageing and wear and tear were identified and there after a detailed visual survey was made on these roads. During visual survey various types of defects were ascertained and the nature and broad extent of each type of defect was also noted. Based on this information few roads were identified that showed more distresses. Further information of these roads was collected from the department/consultants and those roads which were known to have history of repeated failures despite of the overlays being done were identified. The three roads that were selected for this study are:

1. V-3 Road between Sector 46 and Sector 47, UT Chandigarh
2. V-3 Road between Sector 39 and Sector 40, UT Chandigarh

3. Vidya Path dividing Sector 2 & 11 and Sector 11 & 12, UT Chandigarh

Detailed investigation was done on these selected pavements.

3. DATA COLLECTION

The data has been collected from the pre-selected roads that are known to have history of repeated failures. The pavements under investigation are divided into sections and each section is divided into sample units. The type and severity of pavement distress is assessed by making a condition survey that included visual inspection of the pavement sample units. The quantity of the distress is measured and the distress data is found for each sample unit. After this the concerned authority dealing with the construction and maintenance of pavement were approached and the background history of the pavement was enquired. Also for evaluating the strength and the condition of existing pavement and make recommendations for rehabilitation Benkelman Beam test reports were collected from the concerned authorities that performed the test.

4. GENERAL ASSESSMENT OF ROADS UNDER INVESTIGATION

- These roads in Chandigarh were not originally designed to cater to the high intensity of traffic the city is witnessing now-a-days.
- Increase in the magnitude of wheel loads and the number of load repetitions or passage of excessively overloaded commercial values exceeding the design values.
- The pavement structure of modern roads that have been constructed in this city since 1970's have followed some design approach such as CBR method.
- These roads were constructed in early 1970's i.e.; before the guidelines for the design of flexible pavements were finalized (IRC 37).
- At that time boulders were placed at the bottom layer of construction but these don't serve full purpose of transferring the loads. Also uniform compaction of these boulders was not possible.
- There was no provision of drainage at the bottom layers.
- Non uniformity of construction or non-homogeneity of material used in various layers of the pavement existed. Under these conditions, any local weak spot is likely to yield under traffic.
- The roads under investigation showed excessive signs of cracking at the joint between old portion and the widened portion of pavement. At this joint the roads were found to be manifested with defects.
- On inspection it was observed that considerable length of original road (before widening) showed multitude of defects. The defects were reflected on the surface even after an overlay. This shows that the root cause was not addressed, merely placing an overlay is not effective.
- The roads showed severe map pattern or alligator type cracks. Besides the greater width of the cracks, the loop was formed parallel to the line of traffic. These are the characteristics of road surfaces that fail due to weak subgrade.
- It was found during the investigation that in some places cracks had appeared on the patchwork which was laid on the cracked bituminous surface.
- Longitudinal depressions were also observed.
- At later stages these were among the many roads that were widened to accommodate the increased intensity of traffic. The widened portion had different design as compared to the existing road resulting in non-uniform section having differential support.

5. REASONS BEHIND SOME OF THE DEFECTS FOUND COMMON IN THE STRETCHES UNDER INVESTIGATION

i. At the time of laying of these roads, the traffic predominantly consisted of slow moving vehicles that were prevalent during those days.

ii. The magnitude of wheel loads of the vehicles were low, therefore thin sections were laid and most of them were not surfaced,

iii. Road formation was generally laid almost at the same level as the adjoining ground level, therefore water that enters into the subgrade soil could not get drained out under the gravity.

iv. Suitable construction machinery and techniques were not developed. As light compaction standards were adopted at that time, settlement of subgrade continued for several years.

v. The thickness requirements of these road pavements were decided on empirical basis without adopting any design procedure.

vi. Adequate provision was not made for effective drainage of surface and subsurface water.

vii. As the vehicles including heavy commercial vehicles started using these roads, additional granular pavement layers and bituminous surfacing were added in order to strengthen these pavements, but without following any specific design approach.

viii. As the traffic volume increased, widening was done generally with different thickness of pavement component layers in the widened portion. The old roads were widened and strengthened in stages to cater for increasing traffic volume and increase in magnitude of wheel loads. As the magnitude of axle loads of heavy commercial vehicles (HCV) and the

volume started increasing at a rapid rate, excessive failures developed on these weak pavements.

ix. Based on the types of failures that have been occurring on these pavements under investigation, these are grouped as:

Failures emanating due to poor sub-grade
Failures due to inadequate crust thickness
Failure due to non-uniform sections across the width
Failure due to adoption of inappropriate strengthening measures
Total failure of pavement, needing reconstruction or re-carpeting on some stretches.

6. REHABILITATION MEASURES

There are publications available on highway maintenance viz. IRC: 82-1982 "Code of practice for maintenance of bituminous surfaces of highways" and "Specifications for Road and Bridge works" (Fifth Revision) of Ministry of Road Transport & Highways besides a lot of technical papers by a number of learned authors. All these are concerned with the maintenance required to rehabilitate the bituminous pavements.

The following types of distress should be repaired before placement of an overlay on existing bituminous pavement. These measures may be considered in single or combination depending upon the degree of distress and its extent based on critical evaluation of the existing pavement condition. These however preclude profile correction course for reshaping camber and longitudinal profile of existing road section.

Table -1: Rehabilitation Measures for Some Common Distresses

DISTRESS TYPE	REHABILITATION MEASURES
1. ALLIGATOR CRACKING	Removal of soft surface materials and replacement by premixed bituminous materials or base course in high severity areas. Drainage must be carefully examined in all cases.
2. LONGITUDINAL CRACKING	Small areas may be fixed with patch or area repair. Removal of soft surface materials and replacement by premixed bituminous materials or base course in high severity areas. Drainage must be carefully examined in all cases.
3. BLOCK CRACKING	Low severity block cracking may be repaired by a thin wearing course. As the cracking gets more severe, overlays and recycling may be needed. If base problems are found, reclamation or reconstruction may be needed.
4. DEPRESSIONS	Determine the root cause of failure. Depressions should be repaired by removing the affected pavement up to a firm base and replacement of suitable pavement materials to bring it to original level with re-sectioning, if required.
5. POTHOLES	Repair by excavating and rebuilding. Area repairs or reconstruction may be required for extensive potholes
6. PATCHES	Patches are themselves a repair action. The only way they can be removed from a pavement's surface is by a new overlay.
7. CORRUGATION AND SHOVING	A heavily corrugated or shoved pavement should be investigated to determine the root cause of failure. For small localized areas of corrugation or shoving, repair can be done with an overlay or surface milling. For large areas, milling the surface may be required followed by an overlay.

The specifications and construction methods of the rehabilitation measures indicated above will generally be governed by the relevant technical specifications of MoRT&H with modifications, addendum etc. in the contract. In case any contract specification is to be tailored for a particular rehabilitation treatment to suit the site condition, the same shall get the approval from the concerned engineer. The sub-drainage improvement measures, if needed, should also be simultaneously planned along with pre-overlay measures.

7. CONCLUSION

The total road network under the control of the Municipal Corporation Chandigarh is 1250 Kilometers (approx.). The roads will have direct impact due to increase in population, its widening, additional alterations are required in every sector because vehicle population in the city in growing manifolds. At present about 600000 vehicles are plying in city roads of Chandigarh. The average yearly growth rate of vehicle population in the city Chandigarh is about 6%.

- The roads under investigation in this study showed failure primarily because the traffic forecasting failed in their case. At the time of design these roads were constructed to cater to low axle load but with time as the traffic growth increased manifold these roads were subjected to much higher axle loads than what they were designed to cater.
- Also due to the development of areas adjoining the city, the traffic towards these areas plied on these roads which actually were designed as a sector dividing road but the inter-city connectivity via these roads added more to the traffic intensity, this traffic even constituted of heavy vehicles, further adding to the axle load intensity leading to excessive failures on these pavement which aggravated day by day with increase in traffic.
- Without addressing the failures and suggesting treatment measures strengthening was done by laying overlays, with time the earlier defects reflected on the overlaid surface making these roads a case of repeated failures.
- The history of repeated failures of these roads can be gaged if the defects are addressed according to codal recommendations before laying an overlay.
- The strengthening of the pavement should follow a specific design approach. The specifications and construction methods of the rehabilitation measures should be governed by the relevant technical specifications of MoRT&H. If any sub-drainage treatment is needed, it should be simultaneously planned.
- The rehabilitation measures sometimes need to be tailored according to the site condition, its history and forecasting the traffic growth trends.

Keeping these in mind the rehabilitation measures undertaken will work good and for a longer duration. Every road has its own history which needs to be studied before giving any recommendation. The monotonous recommendations should be shredded and case specific recommendations should be suggested for a particular road according to its present condition and background.

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