

# Development of Pavement Maintenance Management System for Chandigarh City Roads

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**Abstract:** This review encapsulates the ongoing research about the defects in flexible pavement and the development of maintenance management system for flexible pavements of Chandigarh City roads. Transport infrastructure plays a leading role in the country's economic growth and development but needs timely maintenance. There is a need for development of Pavement Maintenance Management System (PMMS) for Chandigarh roads for scientific planning of maintenance techniques and judicious allocation of maintenance funds. The road pavement maintenance management system (PMMS) is a systematic way of assessing the condition, planning the maintenance and repair of the roads in order to optimize the pavement condition and to minimize the maintenance cost. Broadly, the activities include the study of pavement maintenance practices adopted by Chandigarh Municipal Corporation, the optimization of the maintenance and rehabilitation (M & R) strategy for Chandigarh city road sections by using Pavement Condition Index (PCI) rating and development of the Pavement Maintenance Management System (PMMS) for Chandigarh city roads.

**Keywords:** Pavement Maintenance Management System (PMMS), Maintenance and Rehabilitation (M&R), Pavement Condition Index (PCI), Chandigarh Municipal Corporation.

## 1. Introduction

The development of modern and efficient transport as a basic infrastructure is a must for any country. Roads play a major role in getting the people and goods reach their destination. Even the well-built and well-constructed roads need periodic maintenance to keep them functional. In order to maintain the road in its originally built state, preserve adjacent resources and user protection, road maintenance is necessary. Roads deteriorate with time, like all structures. Deterioration is mainly due to cumulative vehicle damage, but environmental factors such as frost action, thermal cracking and oxidation also contribute to deterioration. In recent years, road maintenance has gained more importance due to greater travel demand of the general public, impact of roads on development and perhaps due to technological

advancements in automobiles craving to move at higher speeds. Maintenance is the method of maintaining construction components in a stable and functional state. The fundamental purpose should be to maintain the surface of the road and infrastructure in satisfactory quality and to prolong the road life to its design life. Considering the amount of funds consumed over construction and maintenance of highways, an optimization need to be done in a manner that the overall cost of construction and maintenance is minimized.

## 2. Types of defects

Various types of defects have been seen in the flexible pavement and are listed below:

- a) Cracks
  - Alligator cracking
  - Longitudinal cracking
  - Block cracking
  - Edge cracking
  - Centre cracking
- b) Deformation
  - Rutting
  - Shoving
  - Corrugation
  - Shallow depression
- c) Disintegration
  - Pot holes
  - Loss of aggregate
  - Raveling
  - Edge breaking
- d) Surface defects
  - Bleeding
  - Weathering
  - Hungry surface

## 3. Pavement Maintenance Management System

Pavement maintenance management system is considered as a cost effective way to rehabilitate a specific road system. It is a technical or operational methodology for managing and controlling maintenance resources, in a

scientific manner, for optimum benefits. It serves the functions below:

- Identify and prioritize projects in need of Maintenance and Repairs (M&R).
- To identify the type of maintenance needed
- To minimize the maintenance cost
- To maximize benefits
- To make approximate prediction of futuristic pavement performance.

Road maintenance is essential in order to reduce vehicle operation cost, reduce vehicle damage and travel time, minimize accidents, increase useful life of road and to meet designated functional requirements effectively.

Maintenance is divided in the following categories:

- **Routine maintenance**  
This maintenance covers items such as repairing of cracks and patch work, filling of potholes, maintenance of carriageways, maintenance of road signs, maintenance of berms/shoulders and subgrade, cleaning of drains and rectification of corrugations formed.
- **Preventive maintenance**  
This is performed to enhance the functional life of road pavement while in good condition. This may delay the need of periodic maintenance and rehabilitation.
- **Periodic maintenance**  
This includes regular maintenance activities over the existing surface such as applying a renewal coat and is required to be carried out periodically at the specified frequency depending upon the category of road, traffic and climatic conditions.

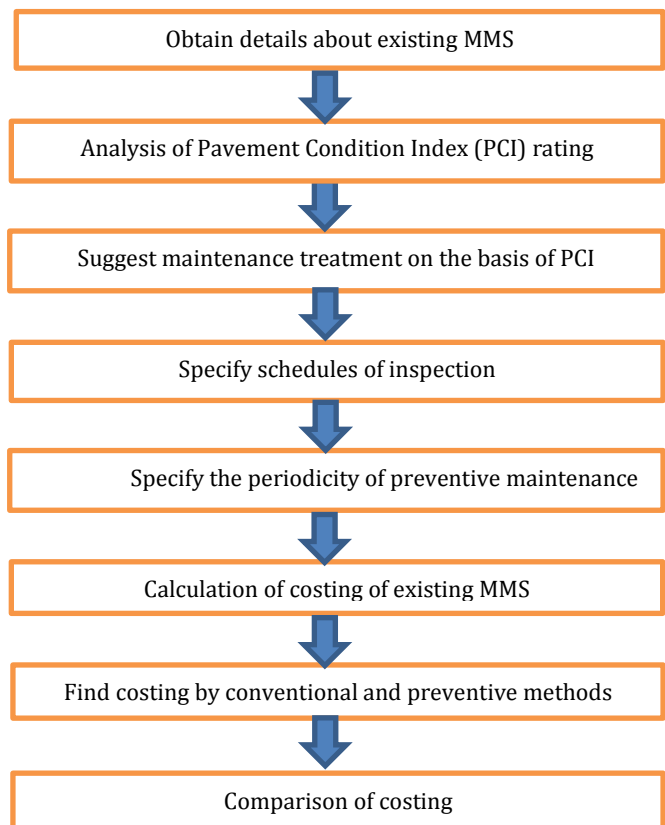
#### 4. Need and scope of the study

There is a need for development of Pavement Maintenance Management System (PMMS) for Chandigarh roads for scientific planning of maintenance techniques and judicious allocation of maintenance funds. The study will focus on developing the Pavement Maintenance Management System for the flexible pavement so as to minimize the maintenance cost and to enhance the life of the pavement. The maintenance plays an essential and integral role in the life of the pavement. It is necessary to develop a proper maintenance management system that will enable the decision makers such as pavement engineers to apply the best methodology at the right time for pavement maintenance and rehabilitation.

#### 5. Objectives

- To study the pavement maintenance practices adopted by Chandigarh Municipal Corporation.
- To develop the Pavement Maintenance Management System (PMMS) for the Chandigarh city roads.
- To optimize maintenance and rehabilitation (M & R) strategy for road sections of Chandigarh city by using Pavement Condition Index (PCI) rating.

#### 6. Methodology



#### 7. Literature review

Sanjiv Aggarwal et al. (2004) [1] conducted a study to explain the implementation of the Pavement Management System (PMS) for the National Highway Network identified in order to facilitate the highway engineers involved for the maintenance of the highway network and the authorities designated for the allocation of highway development funds in providing clear and cost-effective decisions concerning the maintenance and rehabilitation of pavement. This includes the creation of a structured process for evaluating the most cost-effective maintenance plan for a specific section of the pavement and prioritizing those maintenance activities in the event of a restricted

budget. It was concluded that, among a number of pre-defined M&R strategies, the optimal M&R strategy for a pavement section could be computed on the basis of the highest NPV/Cost ratio.

**A Ahmed (2008) [2]** concluded that the creation of cracks in the pavement surface causes various problems such as user irritation, safety reduction, etc. In addition to the above, water infiltration causing lower layer strength to be minimized further as lowering subgrade soil bearing capacity by pumping soil particles through the cracks is also a major issue associated with the pavements.

**Ibraheem Asma T. et al. (2011) [3]** analysis of the condition of pavement maintenance methods in Iraq was carried out with a distinctive reference to versatile pavements. The interviews conducted revealed that maintenance is of secondary importance in Iraq, with no clear budget apparently allocated to such critical works. The study concluded that inadequate and mismanaged maintenance works and operations lead to hindrances and the occurrence of road network failures that involve unusual expenses to overhaul and sustain the accumulated damage. The lack of assets allocated for maintenance work results in the deviation of a large segment of the allocated maintenance fund from the procurement of new or supplementary infrastructure to be used for the building of new roads. The implementation of a planning framework for managing the pavement maintenance of the road network in Iraq and the creation of a clear road failure benchmark in Iraq are strongly suggested.

**Choudhary Sandeep et al. (2013) [4]** conducted a research to establish a strategy for choosing the most suitable activities to be carried out on the various pavement parts of the highway network, taking into account their maintenance priorities. The pavement's maintenance priority was focused on the value of road parts, existing road conditions and potential road conditions. The author concluded from the analysis that the proposed strategy prioritizes the pavement section on the more important section as well as the more significant distress, i.e. if it is to be carried out on the more important section as well as for more significant distress, the section would get higher priority. It was therefore assumed that the alternative methodology was more rational and logical.

**Jain Kunal et al. (2013) [5]** a study involving data collection and the selection of the ideal maintenance and rehabilitation (M&R) strategy was carried out using HDM-4's programmed analysis component for selected road parts. The primary aim of this study was to provide the appropriate pavement maintenance management system with a scientific method to maintain roads with the desired serviceability. HDM-4 was found to be a very effective tool

for developing different features of the pavement maintenance management system, such as forecasting pavement degradation, scheduling maintenance works, lifecycle cost analysis and cost optimization, using HDM-4, Project Analysis portion, the optimal M&R strategy for the different parts of the highway was calculated.

**Hallaq M. A. F. A (2014) [6]** a study was conducted in Gaza City to launch a Pavement Maintenance Management System (PMMS) in which a formal approach of maintaining, updating and operating city pavements and objects are provided to encourage a versatile approach that can allow better, more economical, effective and high-quality operations. As a technique for assessing the condition of the Gaza pavement network, the Pavement Condition Index (PCI) was chosen. It was concluded that by implementing the PMMS based on direct integration between Geo-Media and Micro-Paver, the decision-making process for managing the pavements of the city of Gaza could be facilitated.

**Al-Ajami Hamad (2015) [7]** carried out a study in Riyadh city to evaluate the pavement conditions on the basis of roughness measurement, visual surveying of the pavement condition, skid resistance to assess the state of the pavement. Riyadh municipality assessment procedure concentrated on realizing the type, density and the severity of pavement distress and utilized an index (UDI) Index of Urban Distress to represent the data. It was concluded that Pavement Maintenance Management System (PMMS) is taken into account as additional technique to reinforce the performance of existing pavement and to utilize the allotted funds for projects to best advantage.

**Sarsam Saad (2016) [8]** developed a systematic method for inspection and rating the pavement condition in a given area. The system performed a cost effective analysis of various maintenance and rehabilitation strategies (M&R), then prioritized and recommended pavement maintenance and rehabilitation (M&R) to maximize results within a given budget amount. This work investigated the Pavement Maintenance Management System (PMMS) and its capabilities to help in applying the correct treatment to the right pavement at the correct time in order that the expected service life of the pavement is extended as long as potential with acceptable cost. The deterioration curve was generated based on data and then the most cost effective maintenance strategy was assigned based on condition, surface type, functional classification and available budget. This study concluded that the development of pavement maintenance management system (PMMS) will have a significant impact on the existing road maintenance organization.

**Rashid B. Zulufqar et al. (2017) [9]** analysis was carried out to determine the deficiencies in the highway system's flexible pavements. The parameters that influence the efficiency of flexible pavements have also been established. The faults in the current flexible road pavement were typically categorized during the inspection as road stretches that are functionally defective where pavement distress and failures occur at regular intervals, road stretches that have poor pavement surface condition and are severely undulated leading to poor quality of riding, road stretches that have adequate structural conditions. Such failures typically extend to wider areas, resulting in the entire stretch's total loss. The study concluded that efficient design, periodic inspection and maintenance of the drainage system is of highest concern in maintaining the investment made in the road system and in providing the road user with comfort and protection and maintenance decisions can be made on the basis of the criteria for meeting any or all of the parameters of influence to their maximum acceptable limits.

**Prashant M. Patil et al. (2018) [10]** a research was performed on the different methods of road maintenance implemented using the PCI process. For any maintenance work, careful planning can help to reduce the cost and time needed for the maintenance work. The Road Maintenance Management System leads to decision-making, financial decision-making and assistance by offering a scientific approach to the maintenance of the current road network. It was concluded that it is possible to foresee potential degradation of the road network and prepare a preventive maintenance plan by using the maintenance management framework. The PCI approach encourages the conditions of discomfort in established road bays.

## 8. Expected Outcome

The outcome that is expected from the proposed work is to develop the Pavement Maintenance Management System (PMMS) for the Chandigarh city roads to enhance the life of the pavement by proper maintenance at right time at right place as well as minimizing the maintenance cost.

## 9. Conclusions

Pavement deterioration could be a serious problem for road and traffic sector. In order to develop a systematic approach towards maintenance needs and decision making towards maintenance measures, a comprehensive systematic approach towards measurement of nature and extent of road defects is necessary.

The possible causes of the defects are insufficient strength properties of bituminous mixes, movement of overloaded vehicles, inappropriate inspection and maintenance. The

defects in National Highways and State Highways can be more severe due to heavy load of large vehicles, it is necessary to inspect and rectify the defects on proper time. The defects of city roads are mainly due to improper or no provision of drainage and many more. Only an on-site measurement and evaluation will help to address the problem.

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