# Survey on Pavement Maintenance Management System for Indian Roads Using HDM-4

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*Abstract – In recent years, a major emphasis has been put on the maintenance of existing road network of India in an appropriate and systematic way through various major projects such as the Highway Management Capacity Improvement Project (HMCP, 2002), the Road Network Improvement Project (RNIP, 2003), and the Third Road Improvement Project - Implementation of Sector Development Policy (ISDP, 2005). Highway Development and Management System HDM-4 (PIARC, 2001) has been used for strategy and program analyses of the road network under unconstrained and constrained budgets as well as for optimization of pavement maintenance alternatives at project level for a specific road section. Therefore, in this project we are presenting the pavement maintenance management system and its analysis using the HDM-4 software tool by using the Indian roads datasets. So in this paper we present the recent study which is done in past by several authors and we explained there techniques and method which used by researchers. Paper explain the related studies on pavement maintenance management system for India with the use of HDM-4.*

*Keywords— Pavement Maintenance, HDM-4, Indian Roads, Highway Management, Rod Network*

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## 1.    INTRODUCTION

Road Transportation it inhabit a very governing location inside the complete transportation method of India. Enlarge of road traffic within the region liberty space has been absolutely unmatched both in Intellection of goods and passenger traffic. In the year from 1951 to 2001, the vehicular traffic has rising from 3,00,0000 to 4, 300, 0000. But unfortunately, the according to enlarge inside road system have not been matching with the massive enlarging in vehicle driver population; these are the rising from 4,00,0000 km to 33,00,0000 km between the equal duration (Vishwanath, et. al., 2013). without enough and well-timed support, road degenerates enormously, required to bigger vehicle working price, expanding number of accidents and reduces dependability of transport facilities.   And consequently there's necessitates of producing a scientific model to finding the care and renewal demands of pavements. Efforts also are necessary to manufacture road controlling and planning machines to add the present highway network. Those machines are obligatory for estimates the economical requirements, analysis other maintenance scheme and prioritizing the work programs. In hence conditions, implements and application of a well-organized Pavement Management System would allocate compulsory data and purposeful analysis to securely constant and price

efficient choice associated to maintenance of the highway networks (Vishwanath, et. al., 2013) (Choudhary & Agrawal, 2013)

In present years, a large significance has been position on the maintenance of present road pavement system in both developed and developing nation to keeping the big investments in pavements. If the effective and research scheme for preservation are employed, for a larger period of time the pavement system can supplies larger level of service and thus outcomes in saving with respecting to the overall transport costs to community.  In the year of 2003, HDM-4 (Management & Highway Development) are antecedent HDM-III (Maintenance Standards Model & Highway Design) (Watanatada *et al.*, 1987), which were executed via the World Bank and another world wide firms, have been collected as state-of-the-art systems for the examines of road management and investment scheme via many real and innovation project in more than 100 nation across the last 3 decades, because of the below benefits: (1) the internalization of both road user costs and organization cost in a life-cycle cost calculate, (2) the use of normalized parameters for types-based pertinence in various climate and suitable, and (3) the use as an suitable scheme devices for pavements, if correctly graduated, particularly for developing nations, while adoption scheme levels directly from

the scheme description of industry nations (Tsunokawa and Ul-Islam, 2003).

Presently, the HDM0-4 has been utilized in India for PMs by different larger projects thus as the road network improvement project (RNIP, 2004) and the highway management capacity improvement project (HMCP, 2002). Theses research shows the strength and prediction of using developing devices, integrated with the existing devices in the PMS, to initialize the deliberate management scheme for the country road network. Although, how to utilize this approach effectively is still the matter in query. Therefore, this application provides an entire of HDM-4 then represents direction and obstacle of HSM-4 examination, also shows future management in manner to apply HDM-4 efficiently corresponding to the Indian Road suitable.

HDM - 4 software devices produced via the World Wide bank for worldwide programs can be efficiently useful for recognize optimum maintenance way for highway pavements. In this project, optimum pavement maintenance strategy is arrived using HDM - 4 analysis after making due calibration for the local conditions for the urban roads in India.

Generally, pavements are divided mainly into flexible and rigid classes. Flexible pavements contribute most percent of Gaza paved roads. Therefore, focus will be concentrated on flexible pavements analysis. Figure (1.1) shows a typical flexible pavement structure. It is contain of some layer of cautiously choose materials created to graduall1. y spread loads from the surface to the layers below.
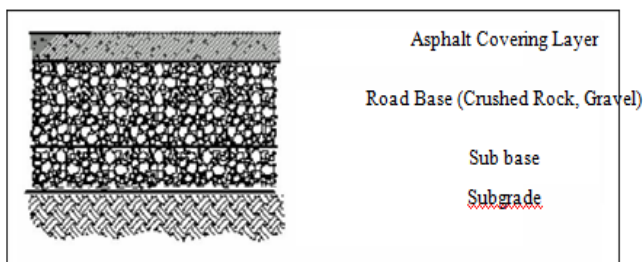


**Fig.1. Typical Flexible Pavement Structure**

## 2. LITERATURE SURVEY

This section presents the study of recent works reported on research title.

Vishwanath G (2013) [1], introducing the examination which was going for drawing out the strategy use in completing the review on the asphalt and for rating of the asphalt (PCI) with the contextual investigations of four critical streets of Rajarajeshwari Zone, Bangalore city and the PCIs of rating of these asphalts at the season of studies actualize to be from extremely poor

to great. Asphalt administration methods have been proposed construct absolutely with respect to the condition rating by creator.

Sandeep Choudhary (2014) [2] proposed new approach for support of thruway asphalt for Indian streets. Inside that situation author included two achieve based procedure. In level I, it was proposed to choose priority of thruway street areas. In arrange II, priority of various upkeep exercises to be carried on various segments might be stern. The technique proposed in this investigation represented with the assistance of example of a couple of speculative interstate systems which incorporate 4 areas.

Amritpal Singh (2015) conducted the study on Patiala city (Punjab, India) road network to supply a Brawny system for the investigation of pavement management and encirclement strategies for the maintenance of the large urban road network. The HDM-4 software was utilized via author for strategy and program analysis of 52 road sections of Patiala city, out of which 5 manageable floor sections on the basis of individualize characteristics are discussed in detail.

Fwa (2006) cantered that thruway the support can widely depict as a move made to keep the street asphalt in a protected and helpful condition. Street support usually rejects redesigning and fortifying of the street segments, yet perhaps done if those appear to be the most cost – viable developments inside the protracted expressions. Upkeep can be crisis, therapeutic and preventive kind. Street support should be overseen, arranged, performed and outline. Masterminding and overseeing are performed with the guide of support administration formats and procedures. From an asphalt and scaffold control frameworks those gadget and methodology are regularly unique. The preventive and supporting developments for these developments can be distinguished the applicable asphalt and scaffold and this is a piece of a street upkeep program. On time upkeep is exceptionally significant.

Dipak (2005) conduct an exploration for streets upkeep at Nepal found that the critical goals of street support is to duty the serviceability of the street organize and less the cost of street transportation, which is included:

1. Agency cost: Capital price of maintenance and establishment of the services over their designing life; and

2. Road User Cost.

Amr A. Elhadidyet.al (2014) the two-target advancement show considered least activity expenses and most extreme condition for used street

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arrange. The creator's approach, Markov-chain models are used to predict the execution of street asphalt and to figure the normal decrease at various timeframes. To understanding the more-target improvement issues built up the hereditary calculation. Essentially in light of the discovering results, the Pareto most helpful arrangements of the two objective streamlining abilities are obtained. From the ideal answers spoke to by methods for cost and condition, a decision creator can without much of a stretch obtain the certainties of the upkeep and recovery sorting out with negligible activity charges and greatest condition. The advanced model has been actualized on a system of streets and demonstrated its capacity to infer the ideal arrangement.

Soomin Woo et.al (2016) the creator's proposed an edge work to improve a versatile audit design inside a peril confine portrayed by black-top state conjecture with development stream data and an all the more negligent crumbling show. The results support the out execution of the enhanced audit more than two standard examination designs – 1-year and 2-year typical evaluation. In like manner the redesigned examination is correspondingly heartier than the reliable surveys with different development circumstances due to the weakness peril taken by general evaluations.

Adman M.S Shiyab et.al (2003) the creator's shows procedure for suspecting Pavement Remaining Service Life (RSL) using disagreeableness data to the extent the IRI (International Roughness Index).The brutality, serviceability and age information partner to more than 400 sections of dark best surfaced black-tops in Dubai Emirate, U.A.E. were accomplished and examined. Models for assessing the Current Serviceability Index (CSI) in show of direct cruelty estimations made and differentiated and the delayed consequences of similar overall examinations. Confine backslide models for both strongly trafficked ways (direct way) and speedy development way are displayed. The made obnoxiousness cruelty and serviceability age models were found extremely pivotal and not amazing. A strong time route for evaluating the RSL for the two ways depends upon the present age of the black-top has been used.

C. Makendran et.al (2015) the creator's delivered desire models to grasp the development of brutality, breaking, and potholes in versatile black-tops exhibited to scarcest or nil routine help. Hopelessness data was assembled from the low volume rural a road covering around 173 expands spread transversely finished Tamil Nadu state in India. In light of that accumulated data, inconvenience desire models have been made using diverse direct backslide examination. Also, the models have been approved different direct backslide examination. It can be contemplated that the models made can serve profitable gadgets for the practicing

engineers keeping up versatile pavements on low volume boulevards.

Adelino Ferreira1 et.al (2012) the creator's illuminate the bleeding edge similar to breaking models. They picked models evaluate the part zone progression for a plan of delegate Portuguese black-tops structures and development conditions. The Indian and HDM-4 breaking down models were believed to be the most reassuring to execute in another Portuguese Maintenance Optimization System, i.e. to give a better than average response for the black-top upkeep organization issue including infrequent help and also typical upkeep (split settling, groove levelling, settling, et cetera.).

## 3. RELATED WORK

This section present the related studies related to research which done in past

| Paper Title | Author name | year | Key Techniques and Methods |
|---|---|---|---|
| Road Network Pavement Maintenance Optimisation Using The Hdm-4 Pavement Performance Prediction Models | Diana Jorge And Adelino Ferreira | 2012 | the creator's shows another help progression structure (MOS), known as the GENEPAV-HDM4, which is produced to organize the black-top organization system (PMS) of the area of Viseu (Portugal). It was moreover created for conceivable application to other existing PMS In the interim and that required a refresh as a result generally Portuguese authorization. This is the position of the PMS used by means of the main Portuguese concessionaire |

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| | | | Estrada's de Portugal, SA. |
| Improvement of Economic Effectiveness of Road Highway Projects | Ing. Radantomek, Msc.,Ing. Stanislav Vitásek | 2016 | the creator's examinations centres around assessment of current techniques for financial valuation, their progressive advancement and on fuse of the LCCA motivation inside the speculation decision strategy. Along these lines, it feature of the conceivable outcomes to improve the productively of each, a financing determination methodology and an acknowledgment area through the recommendation of exceptionally solid measures in light of results of creator's investigations and on experience of unique practice development. |
| Evaluating Life Cycle Costs Of Perpetual Pavements In China Using Operational Pavement Management System | Saud A. Sultan Andzhong yinguo | 2016 | the target of creator's is to again utilize the overall asphalt substances for various intentions, particularly to keep up home grown assets, for example, totals, and to satisfy money related necessities by |

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| | | | method for diminishing the estimation of thruway development and recovery. A top to bottom testing program has been done on reused black-top asphalts substances (RAP) to survey their mechanical and basic qualities to be use for the advancement and recovery of road asphalts. Particular sorts of RAP joins have been settled through Portland concrete to find the greatest fitting one from the perspective of design, environment, economy and development. |
| Evaluating The Performance Of Sustainable Perpetual Pavements Using Recycled Asphalt Pavement In China | Saud A. Sultan, Zhongying uo | 2016 | The vital target of creator's is asphalt design and administration is to build economical asphalt structure with little costs every single through it whole ways of life. There are various vulnerabilities in the technique for asphalt design relating huge numbers of its factors, comprising of future movement |

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| | | | estimation long time conduct of materials, future weights and types of voyaging vehicles, accessibility of value run and so on. Thusly, it is noteworthy to apply asphalt level creation method amid the technique of asphalt format and administration to least the shot related with those vulnerabilities. |
| Application of the Hdm-4 Model on Local Road Network: Case Study of the Herzegovina-Neretva Canton In Bosnia And Herzegovina | B. Čutura A, G. Mladenovićb, B. Mazićc, I. Lovrić | 2016 | the principle challenge is to get HDM-4 input records with confined sources, since normally that task requires substantial examinations. Further to stock certainties, it's required to characterize the state of the activity volume, street organize, movement data, and numerous others. From past examinations and task documentations, the street geometry realities were picked up. The IRI data were taken from the sooner overviews or imagined wherein no records were accessible. Different |

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| | | | parameters were picked up through field tests. Activity records were available from standard system movement checks. |
| Calibration of Hdm-4 for Use in Pavement Management Systems (Pms) | N. K. Mushule | 2009 | the creator's assesses the achievability of utilizing HDM-4 as a help programming and decides level 1 adjustment factors for PMS in Tanzania. The creator's shows the utilization of an aligned HDM-4 to decide the required street administration data in creating nations. |
| Development of Pavement Maintenance Management System (Pmms) Of Urban Road Network Using Hdm-4 Model | Tanujchopraa, Manoranjanparidab, Naveen Kwatrac, Jyotimandhani | 2017 | the fundamental target of creator's is to created Pavement Maintenance Management System (PMMS) for four street segments of urban street organize (Patiala, Punjab, India) utilizing Highway Development and Management (HDM-4) demonstrate. The HDM-4 gives a deterministic approach in information and process information of |

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| | | existing street condition, activity volume and asphalt arrangement to anticipate street crumbling according to the urban street conditions as far as International Roughness Index (IRI) esteem. The creators demonstrates the utilization of HDM-4 show for the calculation of ideal Maintenance and Rehabilitation (M&R) technique for every street segment and near investigation of booked and condition responsive M&R methodologies. |
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## 4.     CONCLUSION AND FUTURE WORK

The training of pavement management is completely depends on the part of highway agencies, mainly in developing nation like India, because of necessity of available maintenance funds. To create simpler operations of development of PMS need, so that the field engineers may be able to understand and use it more productively. Generally perceived HDM-4 structure has been utilized for the development of pavement management program for the National Highway network in the country. The asphalt decay models melded into HDM-4 have been adjusted using the asphalt condition information assembled on the asphalt fragment and alignment factors for various intertwined models, for instance breaking, ravelling, potholing and harshness models have been crated. To confirm the viability of these sorts of models we have been check legitimacy of these models, by differentiating the misery expectation made by the balanced disintegration models with those really saw on the picked asphalt zones. The R2 esteems

acquired for unpleasantness movement (0.97), splitting movement (0.98) and ravelling movement (0.79), display exhibit extraordinary comprehension amongst anticipated and watched values. Along these lines, these models have been use for expectation of bothers and the improvement bolster administration systems for the thruway organize.

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