An Energy Saving Pavement Management (ESPM) for Urban Roads in Madhya Pradesh

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Abstract - *Highway Road agencies use the Pavement management systems (PMS) for setting up the best probable network level maintenance and renewal work programs for the road network. PMS also help in establishing the funding levels required to meet agency desired pavement performance or level of service goals. Pavement management systems embrace the classification of most advantageous maintenance strategies at different administration levels. It aims to determine the most efficient maintenance program that yields maximum benefit for the public funds expended. However, the PMS generated maintenance programs can vary significantly based on underlying variables, decision trees, models and overall rationale exercised by pavement management engineers. The objectives of this paper to implement Energy Saving Pavement Management system (ESPM) in small to medium sized cities of Madhya Pradesh and to gain knowledge of pavement management practice at the regional level all over Madhya Pradesh and aimed to establish what type of energy savings could be achieved by using 'low energy' materials.*

*Key Words***:** E*nergy Savings, Pavement , Road Agencies, Decision Making, Construction*

1.INTRODUCTION

However, as a very large categorization, our roads still suffer from a litany of ills. They are capacity embarrassed, slow, insecure, environmentally unfriendly, non-maintainable and patchily administered. For now, efforts to get better the situation are in a weak position by belated clearances, various overlapping authorities and jurisdictions, normally varying rules of commitment with the private sector, immovable land laws, and expertise shortages. In excess of the subsequently 20 years, India's roads must deal with these issues to contain an economy that will both be significantly better, and structurally diverse in financially viable, societal and demographic terms.

Conservation of accessible roads and lane system has turn into a most important activity for all levels of administration. There is a deficiency of resources to uphold the street system at the state level. Worsening metropolitan roads and reduced financial support are also a most important crisis for the local governments. Resources that have been elected for pavements must consequently be used as efficiently as possible. One verified technique to attain highest worth of available funds is during the utilize of a PMS. Important effort is now underneath manner at state and local government levels for rising and implementing PMS. In response to the engage, expansion of low price, microcomputer based, and effortlessly maintained and operated PMS at the metropolitan level was necessary. The University of Texas developed a pavement management which is Urban Roadway Management system (URMS). Implementation of such a system can save capital for together the organization and the consumer and get better not only the effectiveness but also the usefulness of decision making concerned in managing pavements.

1.1 Pavement Management System

Pavement management involves the classification of most favorable strategies at different supervision levels as well as the execution of these strategies. It is the procedure of scheduling, budgeting, financial support, scheming, constructing, Invigilating, estimating, and preserving the pavement system to make available most benefits for obtainable funds. A Pavement Management System is a set of tools or techniques that help out decision makers in finding best possible policies for providing and preserving pavements in a practical condition in excess of a given time period. Without a sufficient schedule pavement continuation plan, roads need more recurrent renovation, in that way costing the state and local administration millions of additional money. The role of a PMS is to get better the efficiency of judgment making, give feedback on the consequences of decisions, ease the synchronization of actions within the organization, and make certain stability of decisions made at diverse supervision levels within the similar organization. The whole decision making procedure is based on information from PMS attached with manufacturing skill, financial plan constraints, setting up parameters, management privilege, public effort, supporting considerations, and scheduling and programming factors [7,8,9].

PMS can afford a number of benefits at both the network and the scheme levels.

Organization wide programs of new creation, protection or analysis having the least total cost, or maximum benefits, over the chosen investigation period, are developed at the network level.

At the scheme level, complete consideration is specified to substitute plan, building, and preservation or analysis actions for a particular part or project inside the overall curriculum which will offer the preferred benefits or service levels at the slightest total cost over the analysis phase [10].

1.2 Utilize of Pavement Management System

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The following objects briefly explain the major areas where a PMS is useful and the benefits attain from each:

(a) Street Catalog

The main instant utilize of the PMS is in having a absolute and readily available record of country's road system together with up-to-date situation. This information is commonly extremely precious for day-to-day use in tracking upholding work and for orientation in preparing information or studies.

(b) Developing Maintenance financial plan

Rather than setting up the distinctive 1-year maintenance funds, a PMS allocates a country to get ready a sequence of finances. These finances can be in the type of a multi-year plan, classifying not only short-term requirements, but delineation needs over the way of several years. Further, alternatives can be organized and accessible to the funds decision makers.

(c) Prioritization

A Pavement Management System permits for the prioritization of upholding projects based on expenditure and situation ratings and additional aspects such as traffic. It further can be used for choosing and ranking of projects for the forthcoming budget year, as well as for long term economic planning.

1.3 Pavement Management System (PMS) Software Components

The different mechanism of a PMS are-

(a) Road Catalog

This factor identifies the physical uniqueness for every road; stored in road catalog files in the PMS record. Each road is separated into controllable sections called "road segments".

(b) Condition inspection

This is a way of windshield investigation of all section of road.

(c) Decision formation Data

In addition to record and circumstance data, decision making information is necessary and contains patch up strategies, renovate alternatives, renovate expenses and decision trees.

(d) Data Analysis

The Pavement Management System software includes investigation tools that recognize possible repair alternatives for each section compute the associated predictable renovate costs; choose the most cost-effective result for each road section and priorities probable projects for budgeting.

(e) Reports

This module has variety of layouts including pie charts, bar charts and tables.

2. REVIEW OF PREVIOUS STUDIES

2.1 PMGSY(PradhanMantri Gramin Sadak Yojna)

At the season of dispatch of the PMGSY in 2000, there were around 347,000 homes without an all-climate street association. The goal of the PMGSY is to give all residences a populace of more than 500 with all-climate rustic street network. On account of slopes, deserts and tribal regions, the edge is casual and covers all groups with a populace of 250 tenants. As of August 2014, the estimation of works endorsed is Rs. 1835 billion covering both new development and redesigning, profiting a sum of 145,000 homes through overhauling 198,000 km of existing streets and building 360,000 km giving new availability [1, 2]. The PMGSY program began development exercises around thirteen years back. There are more than 100,000 km that have completed the 5-year support contracts and the principal streets are presently due for occasional upkeep. In the years to come, greater quality provincial streets should be received into a very much oversaw upkeep framework keeping in mind the end goal to ensure Past country street works Rural streets have been worked under different rustic advancement programs [3]. Genuine endeavors through these projects likewise couldn't give all-climate availability to the greater part of the towns in the nation. Then again, numerous streets which have been fabricated couldn't be maintained. Cautious examination of these has uncovered that most endeavors have not been successful because of the way that in those projects, the streets were not comprehended to be building structures. These non-built structures without reinforcement frameworks and offices to support them with building contributions for repair and upkeep have vanished in the

blink of an eye. A significant number of the specialized parts of street building were never given due significance in provincial streets; e.g. satisfactory compaction of sub-review, waste, required cross seepage and a large group of others. There must not be any restraints about the specialized points of interest that are required to be comprehended for provincial streets; these are required to be embraced fundamentally. Be that as it may, none of these are difficult to embrace for nearby organizations and specialists by any methods. Besides there are a lot of proper advancements for country street development and upkeep utilizing locally accessible materials and also nearby rural executes. From the Rural Roads Manual, Indian Roads Congress 2012 Managing Maintenance of Rural Roads in India 24 these speculations and in this way support the advantages of this new era of provincial streets [4, 11].

2.2 PMS in South Africa

In South Africa (SA), numerous streets were built over fifty years prior and have been subjected to unexpected increments in the weights and the quantities of the vehicles utilizing them (National Department of Transport 1998). These increments have happened amid a period when governments at all levels have confronted, and are confronting, raising requests on their budgetary assets (McQueen 2001). It is not astounding that the accentuation today is to arrange and spending plan for their support and recovery [6]. This can be accomplished by utilizing current administration and designing systems (McQueen 2001).

The requirement for having a PMS in South Africa (SA) was distinguished by the South African Roads Board (SARB) through the South African Roads Agency Limited (SANRAL) (National Department of Transport 1996). SANRAL, as ordered by SARB, built up a PMS arrange and the point of the arrangement was to furnish PMS Managers with the rules in regards to the necessities of the PMS. Guided by the PMS arrange, distinctive street support experts (nearby, metropolitan and common) took a command of creating and dealing with their PMS.

2.3. PMS in Australia, as in different nations over the world, is overseen at the area and state level, as it were. It was produced as an in-house programming to fill in as a choice bolster apparatus for the street resource support approach and system at the state and area levels. Different states utilize industrially accessible programming for this reason. All states utilize asphalt information gathering frameworks. Information assembled incorporates, yet is not constrained to unpleasantness, rutting, quality, surface, breaking, slide resistance and seal coat age (Anderson et al. 1994).

2.4. PMS in China:

In China there are 1,900,000 km roads had been constructed by 2005, among them 47% expressways road. By 2010 there are 15,000 expressways would have been raised (Liu, 2006). The 85,000 expressways would be completed with national highway network by 2020. So clearly, A Pavement management arrangement needed by China to address future and past pavements [5]. China has been developed a pavement management system in 1984 but it has less focus and acceptance because the China's most transportation departments are focused on construction rather than road maintenance (Liu 2006).

3. OVERALL OBJECTIVES

The main aim of the study was to develop a pavement management system for Madhya Pradesh road network maintenance to provide as a decision sustain tool to assist to get better the effectiveness of making assessment, provide feedback as to the consequences of these decisions, make sure uniformity of decisions made at diverse levels and get better the efficiency of all decisions in terms of effectiveness of results.

a) To recognize the most important contributing issues in the worsening of the road,

b) Make proposal based on these factors to build up best execution appliance,

4. PROPOSED METHODOLOGY

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In order to attain the overall goal of developing a pavement management system for road network preservation to provide as a decision support tool to assist to pick up the competence of making decisions; the subsequent procedure was followed.

4.1. Literature assessment

Literature survey was performed to obtain data regarding the Pavement Management system. Documents and report available on and related to pavement management system were reviewed. Such documents and reports were obtained from different resource including libraries, the network, books, magazines and manuscript. The data gain integrated the past and presentation of existing PMS that are being supervised by various road preservation authorities in the nation and all over the world. The features and inadequacy of such PMS were also investigated.

4.2 Information gathering

In this study, three techniques were used to gather statistics. The techniques used were,

(a) Visual Condition Assessments (VCA),

(b) Non-destructive testing

(c) Semi-destructive testing.

On the other hand, ahead of these techniques were engaged to gather data, the valuation of the surroundings of the learning region was undertaken to establish the promising effects the location might have on the road.

4.3 Data Analysis

Data was analyzed through five steps namely –

1. Data managing,

2. Roadway situation investigation,

3. Action commendation,
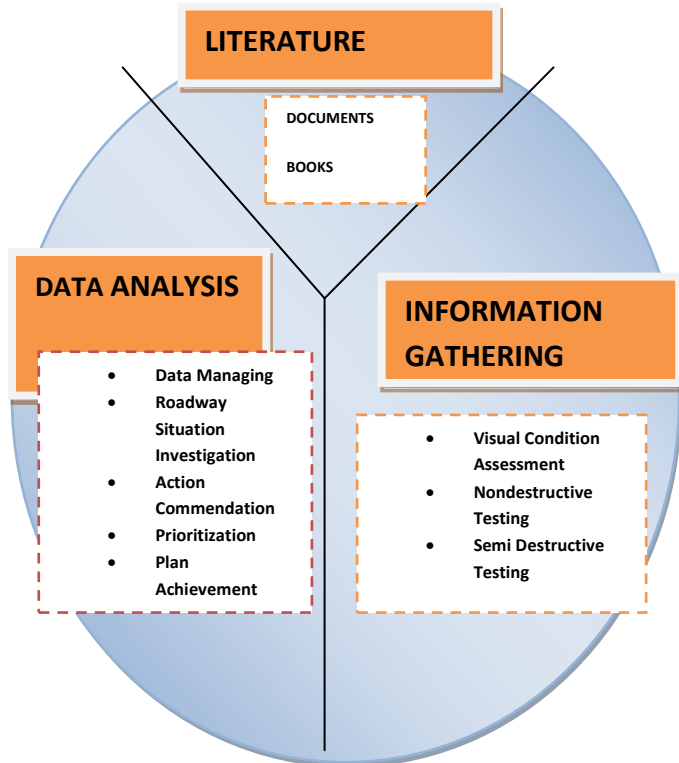
4. Prioritization

5. Plan achievement

Fig- 1: decision support tool for ESPM

5. ENERGY ESTIMATE OF ROAD SUPPLIES

The work for this element of the project involved giving an energy value to the various work items carried out in road maintenance. These work items are the actions necessary to produce, i.e. manufacture, the road pavement materials and also to place them on the road. Energy values have been applied to both currently used road pavement materials and new "low energy" road pavement materials. This allows for accurate comparison between the energy used in manufacture and placement of existing road material and new "low energy" road pavement materials that are used in road maintenance. In order to calculate and represent these energy values in the clearest manner, a spreadsheet has been produced. This spreadsheet is a result of consultation with project partners for inputs on the material types, the material mixes (both currently used and new low energy), the density of materials, the construction plant, the transport of material, the placement practices etc. Site visits were made in order to collect data. Four different carriageway types have been examined: single carriageway, wide single carriageway, dual carriageway and motorway. Energy values are calculated for each road type. The spreadsheet produced is capable of calculating the energy values for each work item that is required for manufacture and placement of current and new road pavement materials. The spreadsheet was produced in order to calculate and represent these energy values in the clearest manner. Each layer of the road has been assigned a number of current material mixes and new material mixes. Each material mix is assigned a 'total energy to produce and place' value in the spreadsheet. By assessing the energy values for each material mix, one can evaluate which mix is most energy efficient for each layer in the carriageway.

Methodology for Energy estimate:

1. A worksheet was developed which estimate the energy supplies of performing preservation works on a road.

2. The user can choose the highway category:

(a) Single carriageway (b) Wide (c) Dual carriageway or motorway.

3. A catalog of resources is provided for every layer of the highway: (a) Base/regulating (b) Binder (c) Surface (d) Tack coat.

4. The user can choose the resources for all layers from a inventory which includes existing generally used materials and also original low energy

5. The user should also input the amounts of material, filler, bitumen and aggregates necessary per mix per kilo miter.

Fig- 2: Method for Energy Evaluation

6. EXPECTED RESULT

The pavement should be improved to facilitate the road to purpose to the necessary level of service. It would also assist to renovate the pavement and enhance its life span. Implementation of ESPM-Pavement Management system was carried out at two levels.

A. at the Beginning level, the Metropolitan city of Madhya Pradesh were directly assisted and the project team worked intimately with the city on accomplishment.

B. at the second level all other cities, which showed significant attention in achievement, were accessible assistance via telephone

7. CONCLUSION

The major aim of the study was to build up a pavement management system for Madhya Pradesh road network maintenance to serve as a decision support tool to help out to improve the effectiveness of making decisions, provide feedback as to the consequences of these decisions, make sure uniformity of conclusions made at various levels and get better the efficiency of all decisions in terms of efficiency of results. The specific objectives were to identify the main contributory factors in the road deterioration, use these factors to develop best implementation applications and develop an effective pavement management system to be used as a decision support tool.

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