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Strategic Perspectives of Performance of Rural Roads

Engineering

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ABSTRACT

The broad objective of the present study is to carry out the pavement performance study on the rural road sections constructed under different rural road schemes and to develop combined pavement condition prediction models. The scope of the study also consists of suggesting the optimum maintenance strategies for rural roads, based upon the developed pavement performance models. The road network and inventory data for each of the identified rural road section has been collected from the construction and maintenance records of the concerned highway division's in-charge of the maintenance of these roads as well as by carrying out the actual field studies. Present Condition Index (PCI), an index reflecting the composite effects of varying distress types, severity level and extent upon the overall condition of pavement has been calculated for each rural road section in all categories.

INTRODUCTION

The ability of a road to satisfy the demands of traffic and environment over its design life is referred to as performance. The concepts of pavement performance developed in the late 1950s in association with the AASHTO Road Test provided the necessary system output function for Pavement Management System (PMS). The serviceability performance concept is defined as "the history of deterioration of the ride quality or serviceability provided to the user. However, the performance concept is so generic that in normal understanding, it can include roughness, distress, skid resistance, and structural adequacy.

Two aspects of information on pavement performance are used in decision making process: information on current performance, which is obtained through field inspection and information on future performance, which is predicted using deterioration models. Functional behavior of the pavement is defined as the ability to provide a smooth, comfortable, and safe ride. It requires development of a rating method to characterize these attributes, which depend on the user's perception of the pavement condition. Thus, user's opinion must be measured in order to rate the serviceability of the pavement.

LITERATURE REVEIW

Sharma (1986) used data of 56 road sections to develop present serviceability index model and roughness model. Cracking, patching, surface distress area, rut depth and roughness, Benkelman beam rebound deflection, Present Serviceability Rating, structural adequacy and age of renewal etc. were used to develop the present serviceability index model and roughness model. These models related the functional and structural parameters of pavements and provided the relationships among the various measured and estimated parameters.

Results of this study indicate that Present Serviceability Rating (PSR) technique is a powerful tool for highway engineers for the comparative evaluation of pavement condition of different roads; in priority fixation of maintenance programmes and determine the level of serviceability of road. Roughness is highly correlated with pavement rebound deflection; with the increase of rebound deflection roughness gets increased.

Bhatia (1990) developed the linear regression equations between characteristic deflection and rut depth for the various categories of roads. It has concluded that as the thickness of the overlay increases, both deflection as well as rut depth decrease. For hilly terrain, the rut depth were found to be much higher as compared to the plains.

Rastogi (1991) analyzed the data of certain overlaid flexible pavements to assess the variation of various parameters with time. Nine sections in the states of U.P. and H.P. with varying conditions of the subgrade soil, terrain conditions, pavement materials and traffic intensity were selected for this study. A general model was developed which predicts life of overlays of different materials and thickness. The various parameters considered in the model were characteristic deflection, rut depth, crack length, pavement thickness, overlay thickness and traffic volume. Since the properties of the subgrade soil affect the performance of pavement considerably, therefore models were also developed for each type of subgrade for predicting life of an overlay with a fair degree of accuracy.

It has been concluded that the deflection, rut depth, cracking and maintenance cost varies with time exponentially i.e. increase with time rapidly in the absence of maintenance and rehabilitation work. It has been observed that the deflection is dependent upon rutting and cracking. The relationship has been developed considering the data before and after the overlay.

Shahin et. al. (1994) compared performance of different group of roads. They selected roads having similar deterioration characteristics and put it in a group. They use family curve technique for comparing pavement performances.

Jain et al. (2005) calibrated the HDM-4 pavement deterioration models for a National Highway network. The data were collected for cracking, raveling, potholing and roughness, and used for calibration of the HDM-4 pavement deterioration model. The model is used for prediction of distress and development of maintenance management strategies for developing countries with similar traffic, soil type, climatic conditions, terrain type and pavement composition.

The validity of these models was checked by comparing the distress predictions made by the calibrated deterioration models with those actually observed on the selected pavement sections.

Thube (2006) calibrated HDM-4 for local conditions of rural roads in plain rolling and mountainous terrains of India. Also developed the Artificial Neural Network (ANN) based deterioration models for the prediction of progression of cracking, raveling, rut depth and roughness of rural roads in different terrains. Present Serviceability Index (PSI) and Pavement condition index (PCI) has calculated for each road section. It has concluded that ANN models give better prediction that of HDM-4 models. Priority index based methodology is suggested for maintenance of rural roads at the network levels. And the rate of cracking and

raveling progression was found lower for rural roads in all types of terrains, while rate of edge break progression was slower for plain and rolling terrain and faster for mountainous terrain.

Jain et al. (2007), calibrated HDM-4 pavement deterioration models for rural roads by using the "window" monitoring techniques which consists of reconstructing the distress performance curve of a specific road category starting with similar characteristics but of different ages. Pavement condition data of 61 identified in-service rural road section was collected for 3 years period for model calibration. The result of the study was used for deciding the optimal maintenance strategies for rural roads. The variables used in the study were climate, traffic, terrain, age for calibration of HDM-4.

Isaac et al. (2007) carried out a study on "development of pavement performance models for rural roads" to identify the causes of distress of rural roads and developed the pavement deterioration models for rural road using Regression technique. Eight roads were selected for the study. Data collected in the test section include pavement history data, structural condition data, and functional condition data. Using regression average value of drainage rating, raveling, potholes, roughness and edge failure for each road was predicted and it was compared with actual data by inputting to the model the average value of each independent variable.

IIT Roorkee & NRRDA, New Delhi, (2007) studied the Performance and to determine the rate of deterioration. 20 sections in the states of Uttarakhand and U.P. with varying conditions of the subgrade soil, Pavement materials, traffic, terrain and environment were selected. The data have been collected for deflection using Benkelman beam and for roughness by Merlin. The deterioration Prediction using Artificial Neural Network (ANN) and linear regression. The independent variables used in developing these models are age of the pavement, traffic, CBR and thickness of pavement. Pavement Serviceability Rating (PCR) and Riding Comfort Index (RCI) are given based on visual inspection of test sections.

Mathew et. al. (2008) selected eight rural roads in Thiruvananthapuram district. Detailed data collected included pavement age, pavement thickness, subgrade strength and severity of different distress. The main distresses observed on these roads were raveling, pothole and edge failure. The models were developed for raveling, Pothole and roughness progression and edge failure using neural network and regression techniques. The variation in Pavement Condition Index values for all these roads were determined with age. ANN models were compared with the available regression models. The ANN models were found to be more suitable to the rural roads than the conventional empirical statistical models.

NEED OF STUDY

Detailed literature review has been done for deterioration Characteristics, Pavement Condition Index (PCI), ANN models etc. Pavement evaluation studies have been carried out. The different parameters affecting the pavement performance can be identified. The data regarding pavement for various states: M.P., Maharashtra, Gujrat, Uttaranchal, West Bengal, Rajasthan, Odisha, Southern states etc. can be used for analysis and development of models. Data are in form of different types of surfaces and soil, rainfall, temperature and type of adjoining land, surface drainage rating, MERLIN roughness, DCP of shoulder, sub-grade, sub-base and sub-grade moisture content, rut depth, longitudinal depression, cracking, patching, edge drop and different types of vehicles commercial etc. Analysis of data can do for development of various models. The deterioration models will be useful for forecasting the performance of pavement. The deterioration models can be developed for prediction of different distress.

Family curve technique can be used to analyze the data of all states. Family curve technique is a method of predicting pavement condition accurately and determining the consequences of different maintenance & rehabilitation. The family curve technique relies on the concept that similarly constructed pavements, subjected to comparable traffic and climate, deteriorate at very similar rates. Some software tools i.e. ANN/Neuro solutions can also be used for prediction & validation of deterioration models.

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