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# REVIEW ON PAVEMENT MAINTENANCE AND PRIORITIZATION BY USING ANALYTICAL HIERARCHY PROCESS

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***Abstract - This paper studies review of the application of Analytic Hierarchy Process (AHP) method for the prioritization of pavement maintenance. For a highway agency it is not possible to take up the maintenance requirements for all road sections within a road network at a time due to budget constraints. This makes a need for priority ranking model to select and schedule road sections for maintenance treatment according to their maintenance needs. The analytic hierarchy process (AHP) method for prioritization of pavement maintenance is wide spread now a day. In AHP method the relative importance assigned between scales 1 to 9 (on Saaty's scale) to each parameters in hierarchy by the experts opinion (transportation professionals). The pair wise comparison matrix was prepared between each parameter. Normalized the matrix for determine weightage of parameter or alternative. Final priority Ranking was given to parameters or alternatives based on their weightage value. The parameter or alternative was ranked first which has highest weightage value and it was more prior than other so, considered first for the maintenance work.***

***Keywords - Analytic Hierarchy Process (AHP); Maintenance Prioritization; Priority ranking.***

## I. INTRODUCTION

Excessive road deterioration, due in part to improper and irregular maintenance, results in increased Vehicle Operating Costs (VOC), increased number of accidents and in general reduced reliability of transport services. The function of pavement maintenance is to diminish pavement deterioration and extend the life of a pavement. Pavement maintenance, if not done at appropriate times in a pre planned manner, negatively impacts the transport system. Prioritization is executed in a sequential manner, beginning with Enlisting of the pavement maintenance projects required to be implemented. Based on their relative perceived urgency of need for repair, engineers and managers are able to prioritize and schedule the maintenance of pavement sections. To prioritize pavement maintenance activities, a number of decision making methods have been introduced and implemented under Pavement Management System (PMS) study. These methods vary from simple ranking to complex optimization. The main objective of the PMS is to avoid the bias derived from judgment and help in the decision-making by using objective information based on pavement distress and other objective measures. Most of the highway agencies have adopted a practice of expressing the pavement maintenance priority in the form of priority index, which is computed by means of empirical expression. Although using a mathematical equation is convenient, often they do not have a clear physical meaning and cannot accurately combine different factors into a single equation. This inevitably leads to overlooking of various contributing effects of actual characteristics of distress. Furthermore, not all the factors and parameters involved can be expressed quantitatively and measured in compatible units. In view of these shortcomings and constraints, Analytic Hierarchy Process (AHP) is the most suitable choice for the prioritization of pavement sections for maintenance at network level. Although the evaluation of the pavement maintenance section through AHP method is simple, but the relative importance (on Saaty's scale) assigned to each parameter in the hierarchy varies between the experts (transportation professionals) consulted, which leads to discrepancies in the final rankings of the sections. Hence the process can be termed subjective. Further, experts base their decisions solely on their experience while due consideration is not given to the actual quantitative physical condition of the roads. To overcome these difficulties an objective based AHP method is proposed in this study, where pair wise comparison values are assigned based on the collected field data from a road network in Rajkot city, consisting of 5 flexible road sections.

## II. LITERATURE REVIEW

**Sarfaraz Ahmed, P. Vedagiri, K.V. Krishna Rao (2017)** The 28 road sections of Mumbai city were considered for the study. The 5 distress of flexible pavement (Alligator cracks, Patching, Pothole, Ravelling, and Rutting) was considered in study. The selected road sections and distresses were prioritized by AHP method and RCI method. It was seen that, According to results of AHP method 'road section 27' has highest weightage value = 1 with priority ranked 1st and 'Ravelling' has highest weightage value = 0.563. According to results of RCI method 'road section 23' has highest RCI value = 8.67 with ranked 1st and 'cracks' has highest weightage value = 0.355.

**Hongmei Li, Fujian Ni, Qiao Dong, Yuqin Zhu (2017)** The weightage of 5 parameters (pavement performance, structural strength, traffic load, pavement age, & road grade) are calculated by using AHP method and also sensitivity

analysis is performed for analysis of pavement maintenance cost. From the study, it was found that the pavement performance has higher weightage value (0.5860) and also pavement maintenance cost is very sensitive to the change of pavement performance.

**Dr. Asma Th. Ibraheem & Noor S. Atia (2016)** A local road of university of Baghdad is divided into 15 sections as named (D, C, F, SC, SL, CH, MS, M, CP, HP, TC, TH, PA, O, RE) and 7 distresses are selected for study (Edge Cracking, Block Cracking, Transverse Cracking, Longitudinal Cracking, Alligator Cracking, Pothole, Ravelling) and weighted by AHP method. It was seen that 'AC' (Alligator Cracks) has valuable weightage (0.5396) and the section 'TH' is most valuable with average priority of 0.2063.

**Abhay Tawalare, K. Vasudeva Raju (2016)** The 14 major distress parameters are selected that affects the performance of rural roads from the opinion of 5 experienced experts. In second stage the questionnaire was prepared to decide the weightage for severity of each selected parameters. Questionnaires were mailed to all district offices of PMGSY and among them 117 responses are received. The weightage of each distress were evaluated by using AHP and the rating was provided to each distress according to its severity. And from that pavement performance index was calculated. It was seen that "bearing capacity" has highest weightage value = 0.0892 and "drainage characteristics" has weightage value = 0.0876 and followed by other.

**Anjali Ashok, Thasneem K M, Sony Vincent (2016)** In this study, the study area perinthalmanna municipality was divided into 6 zones according to their land use. The inventory data, distress data, & traffic volume (at major junctions, for 3 peak hours) data were collected. From the distress data percentage damaged were calculated. The weightage of 6 parameters of benefits and 6 parameters of cost were evaluated by using AHP method. It was seen that the parameter of benefit "possibility to improve quality" of traffic has highest weightage value = 0.326 and parameter of cost " repair cost" has highest weightage value = 0.358 & Among the 6 zones residential zones have highest priority ranking 1 & 2 due to it gets largest percentage damage 38.76%.

**Akash C. Prakasan, Devesh Tiwari, Dr. Yogesh U. Shah, and Manoranjan Parida (2015)** The 21 urban road sections (A1 – A21) of noida city are studied under 8 parameters (riding quality, PSR, structural adequacy, safety, TV, importance to community, drainage condition, road class) by using AHP & DA. It was seen that, riding quality has highest weightage (0.158 & 0.178) in both methods. And road section A12 has highest weightage (0.7055 & 0.7496) in both methods with priority rank 1st.

**Vivek S. Hokam, Dr. V. S. Landge (2015)** The fifteen road sections of MIDC were selected for the study and prioritized by MPI method on the basis of 5 distress (cracking, ravelling, rutting, potholes, edge break) data and traffic volume & composition. In the first stage the RCI value for each selected road sections was calculated from distress data and in second stage the RUF value is calculated from traffic volume & composition. And from RCI and RUF values the MPI is evaluated. It was seen that the road A & road B has higher MPI value = 60 and followed by road in R & C zone and BPCL with MPI value 40 and next other. I.e the road A & B are more prior than other roads.

**Bharath Boyapati and R. Prasanna Kumar (2015)** The study was carried out on road-1 of length 7 km (thanjavur – ayyampetai) and road-2 of length 4 km (sathamagalam – keelapur) of thanjavur city of tamilnadu. The road-1 was studied under 7 stretches of length 1 km and Road-2 was studied under 4 stretches of length 1 km. The distress data (cracks, patch, potholes, ruts), traffic volume data, rider comfort were collected. In second stage weightage of each distress were evaluated according to its presence and severity. It was seen that, for road-1 & road-2 'potholes' has highest avg. weightage value 0.976 and 0.798 respectively. For road-1, stretche-1 (PCI=24) more prior than other & for road-2, stretch-4 (PCI=40) more prior than other.

**M. Asad Abdurrahman, Lawalenna Samang, Sakti A. Adisasmita, M. Isran Ramli (2015)** The study conducted on 5 roads funded by govt. of Makassar city of Indonesia. Those five roads are studied on the basis of 4 parameters (Traffic characteristics, Land zone, Pavement condition, Preferences).By using AHP method. The results of AHP were compared with the results of expert choice software. It was seen that parameter 'pavement condition' has highest priority weightage value in AHP & expert choice analysis (0.36 & 0.331 respectively). And also road section-4 (antang raya) has the highest priority value (0.261) which expresses the most recommended road to be maintained. Followed by road - 1, 3, 2, and 5.

**Rezqallah H. Ramadhan, Hamad I. Al-Abdul Wahhab, Salih O. Duffuaa (2012)** In this method, the 7 parameters (Road class, Pavement condition, Operating traffic, Riding quality, Safety condition, maintenance cost, importance) are considered for the study purpose. The weightage of these parameters are evaluated by AHP method for find out more prior parameter for the pavement. It was concluded that 'pavement condition' was more prior factor for the pavement with weightage value of 0.205.

**Dr. Yogesh U. Shah, S. S. Jain & Manoranjan Parida (2012)** The 21 road sections (A1 – A21) are studied on the basis of 5 distresses (patching, rutting, ravelling, potholes, and cracks) by using MPI method and HDM-4. By the expert opinion survey, it was found that a cracking has a highest weightage (0.355) & patching has lowest weightage (0.080). According to MPI method, road section A9 has 1st priority ranking with (RCI = 11.20 & MPI = 504) and according to HDM-4 analysis, road section A1 has 1st ranking.

**Danial Moazami, Ratnasamy Muniandy, Hussain Hamid and Zainuddin Md. Yusoff (2011)** The number of streets in district no.6 of Tehran municipality were selected and divided into 131 sections and prioritized on the basis of 3 criteria (PCI, TV & Road Type) by using AHP method. It was found that, street of branch 5, section 17 (mirzaye shirazi north to south at sarv intersection) should be maintained prior first (priority weightage = 0.799) to with street of branch 7, section 3 (karim khane zand east to west at kheradmand intersection) (priority weightage = 0.317).

## III. CONCLUSION

The major eight parameters of flexible pavement (Alligator cracks, longitudinal cracks, transverse cracks, Rutting, Ravelling, Roughness, Patching, and Potholes) affect the function of pavement. Those were considered in the study for pavement maintenance and prioritization. It was seen that AHP method of prioritization used commonly in pavement maintenance prioritization. The weightage of considered parameters or alternatives of flexible pavement were evaluated by AHP method to select more prior alternatives. Also the results of AHP were compared with the other methods of prioritization for the validation purpose.

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