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PAVEMENT MAINTANANCE AND PRIORITIZATION USING AHP IN PERINTHALMANNA

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ABSTRACT Any nation's development is dependent on its transportation infrastructure. The nation's road transportation system significantly contributes to economic and social development. delivers significant social advantages for a country as well. Urban roads make up a sizable section of the roadways in India. Urban roads are a crucial component of urban progress in India because they assure shared development by granting access to utilities and infrastructure for the economy and society. However, these roads are being worn down by both traffic and climate conditions. When these roads aren't maintained, degradation quickly advances overtime, making metropolitan areas inaccessible and immobile. People suffer when the time required to reach marketplaces and other social infrastructure increases. It also has an impact on vehicle running costs and road user safety. Many organizations build urban roadways without a long-term maintenance plan in place. A good road network needs meticulous planning, massive money, building techniques, careful quality control, and other associated factors. Due to funding limits, it is not possible to maintain and rehabilitate all roads at the same time. A systematic method for determining effective maintenance and rehabilitation solutions that incorporates all procedures involved in the formation of pavement maintenance plans and programs is required, and the idea of pavement maintenance prioritizing is required.

INTRODUCTION

To prioritize pavement maintenance activities, a number of decision-making methods have been introduced and implemented under Pavement Management System (PMS) study. These methods range from simple ranking to complex optimization. The primary goal of the PMS is to avoid judgmental bias and aid in decision-making by utilizing objective information based on pavement distress and other objective measures. The majority of highway agencies have adopted the practice of expressing the priority of pavement maintenance in the form of a priority index, which is calculated using empirical expression. Although using a mathematical equation is convenient, they frequently lack a clear physical meaning and are incapable of accurately combining multiple factors into a single equation. This invariably leads to an overlooking of various contributing effects of actual distress characteristics. Furthermore, not all of the factors and parameters involved can be quantified and measured in compatible units.

OBJECTIVES

The goal of the study being presented is to create an AHP-based network-level pavement repair decision-making procedure. AHP is used in this project to prioritize pavement maintenance work (Analytical Hierarchy Process). Prioritization was done based on important criteria such as benefit-cost and its sub-criteria. The qualitative factors were quantified using some simple scoring rules. The main aim of the study is based on the following factors;

- To identify different factors affecting the rehabilitation of pavements.
- To use Analytical Hierarchy Process (AHP) to facilitate the factors affecting pavement rehabilitation.
- To Prioritize selected roads based on cost-benefit analysis.

SCOPE OF THE STUDY

Pavement maintenance is not carried out on schedule and at the proper intervals, it has a negative effect on the transportation system. By carrying out this project, we can assess the state of the chosen road network and determine the maintenance priorities, which facilitate maintenance in accordance with the resources and requirements.

- Establishing a methodological approach to determine any section's maintenance priority index based on its current state
- We can easily distribute the available funds based on the priorities.
- Can classify the roads according to their various priorities

NEED AND IMPORTANCE OF THE STUDY

Large sums of money are invested in road maintenance to ensure the mobility of people and goods, and it takes a lot of time and money to maintain the roadway infrastructure. In order to rank and rate pavement conditions according to their relative importance and reduce costs while making the best use of available funds, it is important to prioritize maintenance tasks. With the help of pavement maintenance programs, prioritization selects which ones should be completed first in the hierarchy of importance. The importance of a road section, as well as current and future pavement conditions, determine how often the pavement needs to be maintained. Setting priorities is a process that aids in deciding or choosing the preferred project or activity from a variety of workable alternatives. Professional planners can use the prioritization process to choose the best projects, or the leadership can use it to choose the best plans. There are a variety of prioritization techniques, from straightforward to intricate.

LITERATURE REVIEW

1. Chirag R.Bhuva, (2019) "Review on pavement maintenance and prioritization by using analytical hierarchy process" The use of the analytical hierarchy process (AHP) method for ranking pavement repair priorities was reviewed by authors Chirag R. Bhuva, Prof. Bindiya Patel, and Prof. Mayank Kanani. In this study, an AHP method is suggested, in which pairwise comparison values are allocated based on field data gathered from a road network in Rajkot city, comprising of 5 flexible road sections.The primary eight flexible pavement characteristics (Alligator cracks, longitudinal cracks, transverse cracks, Rutting, Raveling, Roughness, Patching, and Potholes) have an impact on how well the pavement performs. For pavement maintenance and prioritizing, were taken into account in the study. In order to pick more prior options, the weighting of the flexible pavement's considered attributes or alternatives was assessed using the AHP approach.

2. Sarfaraz Ahmed, (2017) "Prioritization of pavement maintenance sections using objective- based Analytic Hierarchy Process" **The authors of the report, Sarfaraz Ahmed, P.Vedagiri, and K.V.Krishna Rao, suggested an AHP in which pairwise comparison values are assigned based on field data gathered from a road network in Mumbai city that consists of 28 road sections. The final ranking list of candidate sections takes into account the priority weigh to alternatives that take into account the state of the roads. By taking into account a variety of criteria at various levels of the structure, a hierarchy is established in this study. As modelling factors for the criteria and subcriteria levels, respectively, road type and pavement surfaced is tresses are taken into consideration. Prioritizing pavement care projects often depends on the type of road. The related solution of the road condition index method, a conventional method of pavement maintenance, is compared to the priority ratings solution of the AHP method. The results of this study indicate that the objective-based AHP method is preferable for prioritising road pavement maintenance.**

3. J.R.Sarkar, (2016) "An Approach for Prioritization of State Highways and Its Application" The prioritisation of road sections was examined in this paper by Sudipta Pal, Bhargab Maitra, and J. R. Sarkar with reference to fifteen State Highway sections in the Indian State of West Bengal. The paper offers a chance for policy makers to prioritise and identify numerous areas that may be improved utilising the money acquired from various methods. The weightages for the seven techno-economic elements are determined by applying the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) and RIDIT method to analyse the rating data. The most significant techno-economic criteria were determined to be the number of commercial vehicles perday, volume to capacity ratio, population directly served by each kilometer route, and potential safety issues. The most significant contributing variables of a potential safety threat were discovered to be the existence of major intersections, roadside schools, colleges, and hospitals, as well as built-up and market areas. The prospective safety risk is taken into account as a techno-economic consideration in the prioritisation when there are no usable accident data. Based on the discovered causal factors and their relative weightages, which are obtained through the analysis of expert opinion data using the Analytic Hierarchy Process, the potential safety hazard is evaluated (AHP).

4. Anjali Ashok, (2016) "Pavement Rehabilitation Prioritization Using Analytical Hierarchy Process (AHP)" The analytical hierarchy method (AHP) was utilized in this work by the authors Anjali Ashok, Thasneem K M, and Sony Vincent to make it easier to prioritize different options based on factors that are crucial to pavement repair and are mostly based on cost and benefit considerations. In this study, some

fundamental scoring guidelines were created to translate the qualitative elements into a quantitative scale, and the weighting of each of these factors was determined with the aid of a comparison matrix. Finally, the benefit to cost analysis yields a priority ranking. The zones with the best benefit-to-cost ratio are ranked foremost in terms of priority.

5. Peyman Babashamsi (2016), "Integrated fuzzy analytic hierarchy process and VIKOR method in the prioritization of pavement maintenance activities" The authors Peyman Babashamsi, Amin Golzad far, and NurIzzi Md Yusoff investigated the prioritization of pavement maintenance alternatives by fusing the fuzzy analytic hierarchy process (AHP) with the VIKOR method, which stands for "Vlse Kriterijumska Optimizacija I Kompromisno Resenje," or "Multi-Criteria Optimization and Compromise Solution," for the multi-criteria decision analysis (MCDA The fuzzy AHP is utilized to establish the indices weights. The options are then ordered in order of importance using indices that have been weighted using the VIKOR model. The combination of fuzzy AHP and the VIKOR model can help decision- makers solve MCDA challenges, which is why these two independent approaches were chosen.

6. International Journal of Pavement Research and Technology, **Volume 10, Issue 2, March 2017, Pages 158-170,** The application of Analytic Hierarchy Process (AHP) method for the prioritization of pavement maintenance sections is widespread now-a-days. Although the evaluation of pavement maintenance section through AHP method is simple, where 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', due to the subjectivity in the process. Further, experts base their decisions solely on their experience while 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 pairwise comparison values are assigned based on the collected field data from a road network in Mumbai city, consisting of 28 road sections. The final ranking list of candidate sections takes into consideration the priority weight of alternatives, which reflect the road conditions. The solution of priority ratings of AHP method is compared with the corresponding solution of road condition index method, a traditional pavement maintenance procedure. The findings of the present study suggest that objective based AHP method is more suitable for the prioritization of pavement maintenance of roads.

7. Pavement Maintenance Prioritization Using Analytic Hierarchy Process, J. Farhan and T. F. Fwa cvefwatf@nus.edu.sgView all authors and affiliations, Volume 2093, Issue 1 The prioritization of maintenance activities is commonly applied in pavement maintenance planning. A widely adopted practice is to express maintenance priority in the form of a priority index, computed by means of an empirical mathematical expression. Though convenient to use, empirical mathematical indices often do not have a clear physical meaning and cannot accurately and effectively convey the priority assessment or intention of highway agencies and engineers. In an attempt to overcome this limitation, this study explores the use of an analytic hierarchy process (AHP) for the prioritization of pavement maintenance activities. The main aim is to identify an approach that can reflect the engineering judgment of highway agencies and engineers more closely. Three forms of AHP are examined, namely, the distributive-mode relative AHP, the ideal-mode relative AHP, and the absolute AHP. The applications of the three methods are illustrated by using an example problem, and the results are compared with the priority assessments obtained by a direct assessment method in which the raters make the evaluation by directly comparing all maintenance activities together. The study concludes that the absolute AHP is suitable for the pavement maintenance prioritization process, on the basis of its ability to provide priority assessments for pavement maintenance activities in good agreement with the priority assessments obtained by the direct assessment method and its operational advantage in evaluating a large number of maintenance activities.

8. Pavement Maintenance Prioritization Using Analytic Hierarchy Process, Transportation Research Record Journal of the Transportation Research Board, 2093(2093):12-24 DOI:10.3141/2093-02
The prioritization of maintenance activities is commonly applied in pavement maintenance planning. A widely adopted practice is to express maintenance priority in the form of a priority index,

computed by means of an empirical mathematical expression. Though convenient to use, empirical mathematical indices often do not have a clear physical meaning and cannot accurately and effectively convey the priority assessment or intention of highway agencies and engineers. In an attempt to overcome this limitation, this study explores the use of an analytic hierarchy process (ARP) for the prioritization of pavement maintenance activities. The main aim is to identify an approach that can reflect the engineering judgment of highway agencies and engineers more closely. Three forms of ARP are examined, namely, the distributive-mode relative AHP, the ideal-mode relative AHP, and the absolute AHP. The applications of the three methods are illustrated by using an example problem, and the results are compared with the priority assessments obtained by a direct assessment method in which the raters make the evaluation by directly comparing all maintenance activities together. The study concludes that the absolute AHIP is suitable for the pavement maintenance prioritization process, on the basis of its ability to provide priority assessments for pavement maintenance activities in good agreement with the priority assessments obtained by the direct assessment method and its operational advantage in evaluating a large number of maintenance activities.

9. Pavement maintenance prioritization of urban roads using analytical hierarchy process, International Journal of Pavement Research and Technology, 8(2):112-122 DOI:10.6135/ijprt.org.tw/2015.8(2).112 January 2015 For a highway agency, it is not possible to take up the maintenance requirements for all road sections within a network at a time due to budget constraints. This makes a need for priority ranking model to select and schedule road sections for maintenance treatments according to their maintenance needs. The objective of this study is to use Analytic Hierarchy Process (AHP) for developing a priority ranking model for maintenance of urban roads. The priority model has also been developed using Direct Assessment (DA) method and results were compared with AHP model. In Direct Assessment method, the experts were asked to rate the importance of each parameter affecting the road maintenance, on a scale of 0 to 100 percent whereas in AHP the experts were asked to make a pair-wise comparison between the parameters based on Saaty's scale i.e. 1 to 9. The pair wise comparison matrix was prepared and evaluated for inconsistencies using Expert Choice version 11 software. Statistical tests were performed to show that the collected data exhibited good consistency and repeatability. The developed priority ranking models has been applied to an urban road network of Noida city, near Delhi, consisting of 21 urban road sections.

10. Scientific approach using AHP to prioritize low volume rural roads for pavement maintenance, Akhilesh Nautiyal, Sunil Sharma, Journal of Quality in Maintenance Engineering ISSN: 1355-2511, Article publication date: 26 January 2021 Permissions, Issue publication date: 28 March 2022 A large number of roads have been constructed in the rural areas of India to connect habitations with the nearest major roads. With time, the pavements of these roads have deteriorated and they need some kind of maintenance, although they all do not need maintenance at the same time, as they have all not deteriorated to the same level. Hence, they have to be prioritized for maintenance

11. Current and Future Pavement Maintenance Prioritization Based on Rapid Visual Condition Evaluation,
Authors: N. Bandara and M. Gunaratne
AUTHOR AFFILIATIONS, Publication: Journal of Transportation Engineering, Volume 127, Issue 2, Satisfactory maintenance of its highway network is essential for any nation's economic growth. A pavement management system (PMS) formulated according to specific needs and resources of a particular highway maintenance agency would assure satisfactory pavement performance with minimal maintenance cost. Since the collection of detailed pavement condition data is extremely costly and time-consuming, innovative approaches for rapid data collection is in increasing demand among highway agencies with limited PMS budgets. A time-saving and effective data collection approach based on subjective judgment is introduced by the writers for rating predominant distress types found in asphaltic pavements. Inclusion of both severity and extent ratings of distresses is expected to provide a strong basis for eventual maintenance cost computations. The mathematical techniques of fuzzy sets are used to deal with the subjectivity associated with human judgment of distress severity and extent. In addition, the relative importance of each distress type with respect to maintenance is also utilized in the determination of the combined condition index. Several fuzzy aggregation and ranking approaches are explored and the one with the highest

computational efficiency is employed for ranking pavement sections with respect to rehabilitation needs. Finally, a fuzzy pavement condition forecasting model is also developed by incorporating subjective probability assessments regarding pavement condition deterioration rates, in the Markov transition process. Specific transition probability matrices for different distress types are used in this approach to overcome the deficiencies of the traditional PCI approach. The potential applicability of the methodology is tested on the major pavement network of Sri Lanka and its effectiveness and the execution ease are demonstrated.

12. Developing optimized prioritizing road maintenance Hussein Ali Ewadh1, Raid Almuhanna2 , and Saja Alasadi2 1College of Engineering, University of Babylon, Hilla, Iraq 2 College of Engineering, University of Karbala, Karbala, Iraq Increased demand for efficient maintenance of the existing roadway system needs optimal usage of the allocated funds. The paper demonstrates optimized methods for prioritizing maintenance implementation projects. A selected zone of roadway system in Kerbala city represents the study area to demonstrate the application of the developed prioritization process. Paver system PAVER integrated with GIS is used to estimate and display the pavement condition index PCI, thereby to establish a priority of maintenance. In addition to simple ranking method by PCI produced by the output of PAVER, the paper introduces PCI measure for each section of roadway. The paper introduces ranking by multiple measures investigated through expert knowledge about measures that affect prioritization and their irrespective weights due to a predesigned questionnaire. The maintenance priority index (MPI) is related to cost of suitable proposed maintenance, easiness of proposed maintenance, average daily traffic and functional classification of the roadway in addition to PCI. Further, incremental benefit-cost analysis ranking provide an optimized process due to benefit and cost of maintenance. The paper introduces efficient display of layout and ranking for the selected zone of roadway system based on MPI index and incremental BCR method. Although the two developed methods introduce different layout display for priority, statistical test shows that no significant difference between ranking of all methods of prioritization.

13. Pavement condition and traffic indices for prioritizing road maintenance, Georgios Hadjidemetriou [1], Michalis Tsangaris [2], Symeon Christodoulou [2] 1 University of Cambridge, United Kingdom 2 University of Cyprus, Nicosia, Cyprus Maintenance prioritization is a regular challenge that transportation departments face. They periodically have to choose among many roadway sections the ones that take precedence over others when it comes to the order of rehabilitation. They typically follow methodologies that consider only pavement condition for prioritizing roadways, without considering the number of the users. Presented herein is the way information provided by automated techniques for pavement and traffic evaluation is transformed into a numerical metric that can be utilized for maintenance prioritization purposes. The contribution of the proposed system can be summarized in: (1) the implementation of two entropy-based classification approaches (change-point detection and thresholding) for detecting "distressed pavement" areas; (2) the development of a pavement condition index that is a continuous variable; and (3) the creation of maintenance prioritization index based on both pavement condition and traffic.

14. The Determination of Priority Scale for City Road Management in Banjarmasin Damayanti Damayanti, IphanFitrianRadam, 25 Oct 2018- International Journal of Civil Engineering (SSRG – IJCE)-Vol. 5, Iss: 10 The road management priority is needed by decision makers in serving public necessities in terms of accomplishment of equitable road infrastructure. In this research, the method used did not only have particular regard for non-technical factor which consisted of Development Plan Meeting (Musrenbang), public proposal, and policy, but also for technical factors. Technical factors were reviewed in terms of its management, namely the maintenance and improvement, each of which consisted of Average Daily Traffic (LHR), damage level, road network, land use, road function, and road class. The present research was aimed to obtain the priority rank of road management, by considering the factors that influenced the analysis using the AHP method. Based on the results of the AHP analysis, the factors that influenced the weighting in the AHP method towards the priority rank of road management in the City of Banjarmasin in this research are technical and nontechnical factors. As for technical factors, they have 3(three) times weight (75%) from that of non-technical

factors' (25%). However, in overall, judging from the fulfillment of non-technical indicators, they apparently have a massive weight: the most important factor is shown by Development Plan Meeting with a weight of 14.48%. As for the technical aspects, both for maintenance and improvement, they are shown by severe damage indicator with an interest level of 8.63% in terms of maintenance, and 8.53% for improvement. The usage of the AHP method in determining the priority scale of road management is applicable to the role and commitment of the decision makers.

15. Application of analytic hierarchy process (AHP) for sustainable pavement performance management in Qatar, Okan Sirin, Murat Gunduz, Mohammed E. Shamiyeh, 04 Nov 2021- Engineering, Construction and Architectural Management (Emerald Publishing Limited)-Vol. 28, Iss: 10 Pavement is one of the main elements of the roads network. It is extremely essential to study and understand the factors affecting its performance and highlight the most important ones for decision-makers and pavement experts to consider during the design, construction and maintenance stages. The purpose of this paper was to identify the factors affecting pavement performance and rank them according to their importance using Analytic Hierarchy Process (AHP) for decision-makers and pavement experts to consider during the design, construction and maintenance stages.The research provides help for decision-makers in the construction industry to improve the performance of pavements using a multi-criteria decision-making tool. This paper's outcome would help the pavement management professionals in the construction industry to improve pavement performance and management, increase the pavement's life cycle and reduce maintenance costs.

16. Application of analytic hierarchy process in network level pavement maintenance decision-making Hongmei Li1, Fujian Ni2, Qiao Dong3, Yuqin Zhu2•Institutions (3) 27 Sep 2017- International journal of pavement research and technology (No longer published by Elsevier)-Vol. 11, Iss: 4, This paper proposes an Analytic Hierarchical Process (AHP) theory based method to determine the weight of the decision-making influence factors, considering their relative significance and generating an overall ranking for each road section. A case study on the highway network maintenance priority was conducted to illustrate the proposed procedure. A total of five pavement maintenance decision-making related factors were considered in the study, including pavement performance, pavement structure strength, traffic loads, pavement age and road grade. The weightings of the five factors were quantified through AHP method. Then, the comprehensive ranking index value Ui was determined, which indicated the maintenance priority of a road section in network level decision-making. From the aspect of maintenance cost, the sensitivity analysis results were in accordance with the weightings of different maintenance decision-making factors. The pavement maintenance cost was significantly sensitive to the change of pavement performance. The case study clearly demonstrated the applicability and rationality of the AHP theory based decision-making method and it can be used as a guideline for pavement maintenance agencies.

17. Pavement Maintenance Decision Making Based on Optimization Models, Shitai Bao 1 , Keying Han 1 , Lan Zhang 2 , Xudong Luo 3 and Shunqing Chen 3, Pavement maintenance prioritization considering both quality and cost is an important decision-making problem. In this paper, the actual pavement condition index of city roads was calculated using municipal patrol data. A linear optimization model that maximized maintenance quality with limited maintenance costs and a multi-objective optimization model that maximized maintenance quality while minimizing maintenance costs were developed based on the pavement condition index. These models were subsequently employed in making decisions for actual pavement maintenance using sequential quadratic programming and a genetic algorithm. The results showed that the proposed decision-making models could effectively address actual pavement maintenance issues. Additionally, the results of the single-objective linear optimization model verified that the multiobjective optimization model was accurate. Thus, they could provide optimal pavement maintenance schemes for roads according to actual pavement conditions. The reliability of the models was investigated by analyzing their assumptions and validating their optimization results. Furthermore, their applicability in pavement operation-related decision making and preventive maintenance for roads of different grades was confirmed.

18. Prioritization of Pavement Maintenance Sections Using Objective Based Analytic Hierarchy Process, International Journal of Pavement Research and Technology 10(2), January 2017DOI:10.1016/j.ijprt.2017.01.001 The application of Analytic Hierarchy Process (AHP) method for the prioritization of pavement maintenance sections is widespread now-a-days. Although the evaluation of pavement maintenance section through AHP method is simple, where 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', due to the subjectivity in the process. Further, experts base their decisions solely on their experience while 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 pairwise comparison values are assigned based on the collected field data from a road network in Mumbai city, consisting of 28 road sections. The final ranking list of candidate sections takes into consideration the priority weight of alternatives, which reflect the road conditions. The solution of priority ratings of AHP method is compared with the corresponding solution of road condition index method, a traditional pavement maintenance procedure. The findings of the present study suggest that objective based AHP method is more suitable for the prioritization of pavement maintenance of roads.

19. Pavement maintenance management systems, Hamad Al-Ajami Member of Training Authority ,Public Authority for Applied Education and Training, Kuwait E-mail of the corresponding author: h.alasidan@hotmail.com ABSTRACT: Many countries have implemented a pavement maintenance management system(PMMS), in which this system will help the decision makers such as pavement engineers to apply the best technique for pavement rehabilitation at perfect time, so the maximal use of available funds were done. Each system requires a procedure to prioritize maintenance processes, in which the effectiveness of each prioritization will direct affect the obtainable funds efficiency. The analysis of priority concentrated on establishing the most appropriate list of road section ranking for rehabilitation depending on multiple factors .The Riyadh city pavement maintenance management system (PMMS) performs an inclusive assessment procedure of pavement situation for the whole road network before implementing any program of pavement maintenance. The main factors that this assessment process depends on are distress kinds, severity and their density. The evaluation process of the pavement condition is considered as a key part due to its ability to realize the effectiveness of the PMMS components

20. "Review on pavement maintenance and prioritization by using analytical hierarchy process" Chirag R. Bhuva, (2019) The use of the analytical hierarchy process (AHP) method for ranking pavement repair priorities was reviewed by authors Chirag R. Bhuva, Prof. Bindiya Patel, and Prof. Mayank Kanani. In this study, an AHP method is suggested, in which pairwise comparison values are allocated based on field data gathered from a road network in Rajkot city, comprising of 5 flexible road sections. The primary eight flexible pavement characteristics (Alligator cracks, longitudinal cracks, transverse cracks, Rutting, Raveling, Roughness, Patching, and Potholes) have an impact on how well the pavement performs. For pavement maintenance and prioritizing, were taken into account in the study. In order to pick more prior options, the weighting of the flexible pavement's considered attributes or alternatives was assessed using the AHP approach.

21. "Prioritization of pavement maintenance sections using objectivebased Analytic Hierarchy Process" Sarfaraz Ahmed, (2017) The authors of the report, Sarfaraz Ahmed, P. Vedagiri, and K.V. Krishna Rao, suggested an AHP in which pairwise comparison values are assigned based on field data gathered from a road network in Mumbai city that consists of 28 road sections. The final ranking list of candidate sections takes into account the priority weight of alternatives that take into account the state of the roads. By taking into account a variety of criteria at various levels of the structure, a hierarchy is established in this study. As modelling factors for the criteria and subcriteria levels, respectively, road type and pavement surface distresses are taken into consideration. Prioritizing pavement care projects often depends on the type of road. The related solution of the road condition index method, a conventional method of pavement maintenance, is compared to the priority ratings solution of the AHP method. The results of this study indicate that the objective-based AHP method is preferable for prioritising road pavement maintenance.

22. An Approach for Prioritization of State Highways and Its Application" J. R. Sarkar, (2016) " The prioritisation of road sections was examined in this paper by Sudipta Pal1, Bhargab Maitra, and J. R. Sarkar with reference to fifteen State Highway sections in the Indian State of West Bengal. The paper offers a chance for policymakers to prioritise and identify numerous areas that may be improved utilising the money acquired from various methods. The weightages for the seven techno-economic elements are determined by applying the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) and RIDIT method to analyse the rating data. The most significant techno-economic criteria were determined to be the number of commercial vehicles per day, volume to capacity ratio, population directly served by each kilometre route, and potential safety issues. The most significant contributing variables of a potential safety threat were discovered to be the existence of major intersections, roadside schools, colleges, and hospitals, as well as built-up and market areas. The prospective safety risk is taken into account as a technoeconomic consideration in the prioritisation when there are no usable accident data. Based on the discovered causal factors and their relative weightages, which are obtained through the analysisof expert opinion data using the Analytic Hierarchy Process, the potential safety hazard is evaluated (AHP).

23. "Pavement Rehabilitation Prioritization Using Analytical Hierarchy Process (AHP)" Anjali Ashok, (2016) The analytical hierarchy method (AHP) was utilized in this work by the authors Anjali Ashok, Thasneem K M, and Sony Vincent to make it easier to prioritize different options based on factors that are crucial to pavement repair and are mostly based on cost and benefit considerations. In this study, some fundamental scoring guidelines were created to translate the qualitative elements into a quantitative scale, and the weighting of each of these factors was determined with the aid of a comparison matrix. Finally, the benefit to cost analysis yields a priority ranking. The zones with the best benefit-to-cost ratio are ranked foremost in terms of priority.

24. Integrated fuzzy analytic hierarchy process and VIKOR method in the prioritization of pavement maintenance activities" Peyman Babashamsi (2016)," The authors Peyman Babashamsi, Amin Golzadfar, and Nur Izzi Md Yusoff investigated the prioritisation of pavement maintenance alternatives by fusing the fuzzy analytic hierarchy process (AHP) with the VIKOR method, which stands for "VlseKriterijumskaOptimizacija I KompromisnoResenje," or "Multi-Criteria Optimization and Compromise Solution," for the multi-criteria decision analysis (MCDA The fuzzy AHP is utilized to establish the indices' weights. The options are then ordered in order of importance using indices that have been weighted using the VIKOR model. The combination of fuzzy AHP and the VIKOR model can help decisionmakers solve MCDA challenges, which is why these two independent approaches were chosen.

25. Prioritization and Optimization of Pavement Preservation Treatments J. J. HAJEK AND W. A. PHANG This paper describes a framework for selecting the best pavement preservation treatments for an available pavement preservation budget. It includes formulation of project-specific strategies, evaluation of funding requirements, and setting of priorities. The technology is illustrated using data for 75 sections from the Stratford district. The key component of this framework is an action plan that recommends preferred and fall-back pavement preservation strategies for all individual pavement management sections. The task of preparing action plans is assigned to experienced regional staff. The action plan documents the existing pavement condition, integrates all major pavement maintenance and rehabilitation efforts into a unified preservation plan, and coordinates pavement preservation functions of different offices within the Ontario Ministry of Transportation. Linear programming is used to allocate pavement investments in a manner that yields maximum benefits to the total pavement network. The linear programming solution considers all section-specific strategies listed in the action plans. Sensitivity analyses are used to evaluate the effect on the linear programming solution of using different optimization goals and different budget constraints. While the objective function used only maximizes the technical benefits of pavement investments, it can be modified to include societal benefits

26. GSTF Journal of Engineering Technology (JET) ***M. Fakhri, Reza ShahniDezfoulian*** Nowadays, the pavement maintenance programming and preservation are considered as a necessity in road agencies. In other words, the road agencies have

realized that using the decision support system such as pavement management system (PMS), which assists them to find cost-effective maintenance solutions, could be useful for managing pavement networks. Budget limitation compels road agencies to prioritize the maintenance of pavements. Actually, maintenance prioritization, which depends on various factors like pavement conditions, traffic volume, performance standards and financial constraints, is a necessity for the optimal use of the resources and selection of the better choices. The pavement management system, as a strategic tool, has been organized by collecting and retaining large amounts of data. The Geographical information system (GIS), as a practical tool, can be appropriate for data integrating, collecting, managing, analyzing and output presenting in PMS. Factors such as the significant cost of data collection, the lack of long-term pavement performance data and the lack of developed and calibrated pavement deterioration models, are important reasons that can affect the implementation of pavement management system and the pavement maintenance prioritization. In the absence of these main needs, providing a new and simple approach can be used as a short-term management decisions for pavement maintenance management. This paper, develops a short-term maintenance management approach in 2 scenarios (with and without budget limitation) at the network level, wherein prioritization is based mainly on pavement condition, treatment cost, importance of road performance and communication role (connectivity) and traffic range in the GIS environment. Furthermore, crack sealing, patching, and thin overlay have been chosen as maintenance activities. To check the results of the proposed method, the surface distress of flexible pavements in Ilam province, Iran, were investigated in 2013 through rapid visual evaluations. Moreover the geographical information system (GIS), as a strategic asset management tool, has been used to display pavement section distress and the result of prioritization.

27. Multi Criteria Model in Prioritization of Road Maintenance between the Competing Needs - Case Study in Tanzania 1 Vitalis Ndume, 2 Ephatar L. Mlavi 1Dar es salaam Institute of Technology 2Tanzania National Roads Agency, Dar es Salaam This paper present the model developed to solve the maintenance funds allocation challenges by developing a dynamic Multi Criteria Analysis model to support decision making on funds allocations. The Model incorporates social-economic benefits in prioritization. The main question in this paper is "How to maximize Tax payer services in roads investment in a given limited funds?" The result is a list of seven factors, the corresponding weight of each factor and a formula that combine the score in each factor into a single score.

28. Prioritization of pavement maintenance sections using objective based Analytic Hierarchy Process Sarfaraz Ahme, P. Vedagiri, K.V. Krishna Rao Department of Civil Engineering, Indian Institute of Technology Bombay, Powai, Mumbai 400076, India Received 5 October 2016; received in revised form 31 December 2016; accepted 3 January 2017Available online 12 January 2017 The application of Analytic Hierarchy Process (AHP) method for the prioritization of pavement maintenance sections is wide spread now-a-days. Although the evaluation of pavement maintenance section through AHP method is simple, where 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', due to the subjectivity in the process. Further, experts base their decisions solely on their experience while 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 pairwise comparison values are assigned based on the collected field data from a road network in Mumbai city, consisting of 28 road sections. The final ranking list of candidate sections takes into consideration the priority weight of alternatives, which reflect the road conditions. The solution of priority ratings of AHP method is compared with the corresponding solution of road condition index method, a traditional pavement maintenance procedure. The findings of the present study suggest that objective based AHP method is more suitable for the prioritization of pavement maintenance of roads.

29. Analytical of Multi-Criteria Approach for Identifying the weight and factor of Rural Road Maintenance Prioritization Pawarotorn Chaipetch, Chisanu Amprayn, Paijit Pawan,Vatanavongs Ratanavaraha The annual budget prioritization for road maintenance at the Department of Rural Roads (DRR) is now based on a

comparison of the benefits of reduced road user costs and maintenance costs, which is primarily based on two factors: traffic volume and the international roughness index (IRI). As a result, the budget allocation for a low-traffic road may be inadequate. The purpose is to improve budget prioritizing by the DRR's strategic plan. Economic, engineering, and social factors are grouped into three categories. The Analytic Hierarchy Process has been used to determine the weight of each factor and the priority value of each strategic driving plan (AHP). The logistic and integrated transport systems, reducing traffic congestion in urban areas, developing transportation to strengthen competitiveness and rural economic development, and tourism are the priority values of DRR's strategic plan (in order of priority). Because it reflects the value of an investment, the economic factor is the most significant. The Engineer analyzed the priority value for IRI, V/C ratio, traffic volume, heavy truck volume, lifeline network, and connectivity to other road networks. The result of the engineering factor indicated that connecting to other road networks is a key aspect of every strategy. In the tourist strategy, IRI is the only aspect that is prioritized. Population density, tourist attractions, and business hub are all characteristics that every strategy focuses on when it comes to social factors. As a result, priority factors should be investigated the road hierarchy is consistent and appropriate budget allocation.

30. The evaluation and prioritization of unpaved road maintenance in developing areas A.T. Pienaar, P.A. & Visser Published Online:1 Feb 1992 Road departments in developing areas are responsible for the maintenance of extensive rural road networks, consisting largely of unpaved roads in poor condition. The increase in traffic and the limited funds available have contributed to a need to formalize the identification and prioritization of regravelling and betterment projects of the lower category roads in particular. A method based on the visual evaluation of relevant aspects of unpaved roads is presented. This visual assessment method is incorporated into an algorithm to produce regravelling and betterment maintenance indices. Consistency of results was verified in a validation of the methodology by a panel of engineers and senior personnel involved with road maintenance. Finally, to generalize the algorithm, tranic volumes are taken into account in calculating the priority indices. Guidance is given for the general implementation of this method and algorithm.

31. Prioritizing Rural Infrastructure Needs Authors: Jolanda Prozzi Rob Harrison Project 0-4169: Managing Rural Truck Traffic in Texas A number of Texas Department of Transportation (TxDOT) districts interviewed during the course of this research (Research Project 4169: Managing Rural Truck Traffic in Texas) have expressed concern about a lack of resources — both funding and personnel — to maintain and modernize the existing urban and rural road infrastructure under their jurisdictions. These districts are concerned about the widening gap between infrastructure needs and available budgets to maintain the system. This document is structured to provide a brief overview of the factors that have contributed to increased demand on the rural road network in Texas and the current condition of pavements in rural Texas before discussing the allocation of available funding among the twenty five TxDOT districts, and how a number of districts are currently prioritizing rural needs. Finally, the researchers propose a number of additional parameters and criteria that can be considered in the prioritizing of rural infrastructure needs, and highlight a number of strategies that TxDOT districts can consider in meeting unforeseen and unmet rural transportation needs.

32. Development of a Multi Criteria Decision Analysis Model for Pavement Maintenance at the Network Level: Application of the MACBETH Approach Pedro Marcelino1* Maria de Lurdes Antunes2 Eduardo Fortunato1 Marta Castilho Gomes3 National Laboratory for Civil Engineering, Transportation Department, Lisbon, Portugal This paper proposes the application of the MACBETH approach for the development of a multi criteria value model to enable the prioritization of maintenance and rehabilitation interventions in the pavements of road networks according to technical, economic, and social aspects. A case-study design considering the Portuguese network was undertaken to illustrate the proposed approach. Using an interactive structuring process developed with the decision-maker, a set of five evaluation criteria related to maintenance costs, traffic, pavement condition, safety, and social equity were defined. The MACBETH approach was then used to build value functions and establish relative weights for the criteria. An application of the resulting model was made to a portfolio of possible intervention projects,

prioritizing them according to the principle of benefit/cost maximization. The case-study demonstrated the application of the MACBETH approach and its suitability to solve the decision-making problem, thus proving the usefulness of this approach for road agencies with pavement management responsibilities.

33. Expert Choice-Based Approach on Analytical Hierarchy Process for Pavement Maintenance Priority Rating Using Super Decision Software in Addis Ababa City, Ethiopia E. Quezon Untimely maintenance activities resulting from budget fluctuations and improper prioritization can lead to further pavement deterioration. Selecting the most cost-effective maintenance activities to control and minimize road users' risk under current budget constraints is necessary. The study tried to fill the gap that decision-makers in Addis Ababa City Road Authority often performed pavement repair and maintenance without considering a systematic procedure. Ten road sections selected that are planned for pavement maintenance in the study area. The most dominant distresses ranked in Decision Analysis Module in Excel, including road class, weights for each criterion, and sub-criteria obtained using the Analytical Hierarchy Process approach and calculated in Super Decision Software for maintenance prioritization. Results indicated that the developed analytical hierarchy process model works sufficiently and yields adequate output for providing accurate decisions. Hence, considering the multi-criteria to prioritize the pavement sections for maintenance, this model can give affirmative action for the decision-maker.

34. Evaluation of prioritization methods for effective pavement maintenance of urban roads Yogesh U. Shah,S.S. Jain & Manoranjan Parida Priority analysis is a multi-criteria process that determines the best ranking list of candidate sections for maintenance based on several factors. In this paper, two methods for priority ranking of road maintenance, viz. (a) ranking based on subjective rating and (b) ranking based on economic indicator, are evaluated. The subjective ranking was done using maintenance priority index which is a function of road condition index, traffic volume factor, special factor and drainage factor. The second ranking method was based on economic indicator in which NPV/Cost ratio was calculated for each pavement section using the HDM-4 software.

35. Prioritisation of Pavement Maintenance based on Pavement Condition Index Bharath Boyapati and R. Prasanna Kumar The main objective of this study is to determine the Pavement Condition Index (PCI) through field data collection and analysis to prioritize the maintenance of pavements. Distress data such as cracks, patches, potholes, ruts etc. was collected along the identified sections of pavements selected based on severity of distress. Corrected deduct values were obtained by assigning weightages to different types of distress and PCI obtained. It was found from the analysis of data that a thin overlay was required as a rehabilitation measure for one of the study stretches. The road authorities of this location also came out with the same remedy thorough their own study, there by establishing one of the findings of this study. Suitable remedial measures for rehabilitating the pavement to different study locations were suggested

METHODOLOGY

Prioritization is a process that selects the pavement repair initiatives that should be completed first in accordance with their importance. The process of prioritization aids in choosing the preferred project or activity from a range of workable options. In this project, the Perinthalmanna municipality's roads are prioritized by utilizing AHP by segmenting the territory into various zones. The following are the project's key steps:

General

Fig. 3.1- Methodology flow chart

Divide the selected area into different zones

The first step of the project was to divide the area considered into different zones. The divisions were done after studying the area and observing the land use pattern, economic importance, etc.

Data collection

Data required for the work were collected by visiting the site, and from internet. The information like pavement conditions are noted by travelling through the proposed route and traffic volume counted manually during peak hours. Environmental factors like geology, ecology, culture heritage, vegetation etc. are collected by direct observation.

Identification of factors affecting rehabilitation of pavement priority

In this project, perceptions were considered to find out significant criteria affecting the maintenance priority, PMS experts perceptions were considered to find our significant criteria affecting the maintenance priority. For this various criteria are selected for ranking the roads like pavement condition, traffic volume, road type, environmental factor, engineering factors, etc. Then the criteria are classified into two based on the benefit point of view and cost point of view since benefit-cost ratio is used for the prioritization of pavements.

Scoring of factors

In order to obtain the final results, the qualitative factors need to be quantified with the help of scoring rules. Scoring rules developed by analysing each criterion and the data available. By using the scoring rules as the reference scoring each zone. Corresponding to each criterion every zone getting scores, which represent the existing condition of the respective road sections

Calculation of weightage of factors

In this rating approach pair wise comparisons between criteria and sub criteria were done by considering importance of factors. Pairwise comparisons capturing the expert's perceptions towards the importance of factors affecting the maintenance between the factors were obtained by priority. Each of the respondent has to compare the relative importance between the two items under special designed questionnaire. Relative weights of criteria, sub criteria and inconsistency rate in each pair wise comparison matrix were calculated using AHP-Khaskia Software. The final weights for all criteria and sub criteria obtained were used to calculate the maintenance priority index for various zones in the case study.

Calculation of final scores

Obtained final score for each zone by multiplying the relative scores and weights given for each criterion.

Benefit to cost analysis

Benefit to cost analysis calculated the priority index for various zones in the case study. For the zone having highest benefit cost ratio getting the first priority for the maintenance work.

SCORING RULES

This is the method of quantifying the qualitative factors by assigning a respective range of scores on the basis of conditions they depend. The scoring rules of the criterion are as follows:

Scoring rules for benefit criteria.

***(i)* Possibility of enhancing traffic quality.**

Quality reflects how well a road works. It refers to how easily and smoothly traffic can go along that particular road, and it largely depends on the extent of the damage. This component is scored on a scale from 0 to 10, with the value changing linearly with the degree of damage in each zone.

(ii) Possibility of increasing pavement capacity.

The extent of damage to the individual road segments heavily influences the route's capacity. A score of 0 to 10 is also provided here, and the scores change linearly with the severity of the damages. When performing maintenance, linear variations are chosen to give severely deteriorated roads a lot of attention.

(iii) Local accessibility and a useful service location.

This component illustrates how local access has improved and how much more land is served by the road network following the rehabilitation effort. As a result, a score between 0 and 10 is assigned, and the scores change linearly with the zones' effective areas.

(iv) Zones with high populations, public amenities, and economic relevance

The number of vehicles using a particular road increases once it has been rehabilitated. Public spaces, offices, etc. will grow along with the population, increasing the zone's economic significance. As a result, this component is dependent on each zone's population, and a score from 0 to 10 is provided that

changes linearly with the population.

(v) Safety

Safety is based on the road's current state, or how much damage it has sustained. If the damaged road is fixed, then more safety is attained. Therefore, the score will be greater for roads with more damage. A score of 0 to 10 is also taken into account here.

Scoring rule for cost criteria

(i) Repair costs

There is less chance of maintenance if the repair costs are significant. The type of road, pavement width, the current state of the road, extent of the damage, type of repairs needed, etc. all play a major role in the cost of repairs. Depending on the type of road that needs repair and the construction method, the cost varies greatly. Therefore, the methodology used to score this criterion is based on the type of road network, such as a national highway, state highway, district road, or municipal road. Given that tiny road networks will have the lowest costs, major road networks will have the highest scores**.**

Table no 3.1 Scoring rule for repair cost

Type of Road	Scores
Major Roads	10
Minor Roads	6
Streets	3

(ii) Effect on traffic

The term "traffic impact" refers to the danger to traffic flow that results from rehabilitation-related maintenance activities. When there are no alternate routes, the maintenance activities worsen traffic congestion. The main roads' traffic flow is mostly impacted by the traffic impact.

(iii) Time for completion.

This refers to the length of time needed to finish the repairs. The extent of the damage is a factor. The maximum score is awarded to severely damaged roads, with a scoring range of 0 to 10.

(iv) Sensitivity of the environment to dust, noise, and gases

The public's presence is the key determinant of this component. The difficulties brought on by noise, dust, and gases produced during maintenance operations grow along with the population. High-population locations receive the maximum score out of a possible ten, with a score range of 0 to 10.

(v) Impact on Residence and Commerce

It shows how maintenance actions affect both residential and business locations. Road traffic increases along with population growth, driving up maintenance costs. The issues brought on by the noise, dust, and gases caused by maintenance activities are less of a concern when the roads that need repair are located in a remote region. As a result, a scale of 0 to 10 is used to assign scores, with the highest values going to locations with the highest population.

OBSERVATIONS & DISCUSSIONS

GENERAL DETAILS OF THE STUDY AREA

Study Area

Perinthalmanna is a major town and municipality in the Malappuram district, of Kerala, India. It serves as the headquarters of the Perinthalmanna Taluk, and a block and a Revenue Division by the same name. It was formerly the headquarters of Valluvanad Taluk, which was one of the two Taluks in the Malappuram District. It is one of the major commercial centers in the Malappuram district but is not a part of the Malappuram metropolitan area. The town is home to several medical institutions and one of the three branches of Aligarh Muslim University in India, which is popularly known as AMU Malappuram Campus. Perinthalmanna is also known as the city of hospitals. There are 4 super specialty hospital including a medical college and so many other medium and small-sized hospitals and clinics.

Geography

Perinthalmanna is crossed by Thuthapuzha, a branch of Bharathappuzha (Ponnani River), Kerala's longest river, and another tributary. East of Perinthalmanna is the beginning of the Western Ghats mountain range. The Kodikuthimala hill station is situated in Perinthalmanna Taluk's Thazhekode village, which also shares a border with Perinthalmanna Municipality. The Nilgiri Biosphere Reserve includes the village of Melattur in the Perinthalmanna Taluk.

About two kilometers (1.2 miles) west of the Perinthalmanna town center is the Angadipuram Laterite, which has been designated a National Geo-heritage Monument.

Transportation

(i) Road

The National Highway 966 connecting Kozhikode, Malappuram, and Palakkad passes through Perinthalmanna. In Perinthalmanna, further noteworthy roads include:

- Pattambi Road, Cherpulassery Road, Valanchery Road, Nilambur Road, Kozhikode Road, Palakkad Road, and Ooty Road
- hornur Perinthalmanna State Highway 23 ends by joining National Highway 966 at Perinthalmanna
- Perumbilavu Nilambur State Highway 39
- State Highway 53 connects Palakkad to Perinthalmanna via Cherpulassery Valanchery
- Nilambur State Highway 73

A KSRTC Sub Depot and three private bus stops serve the town.

(ii) Rail

Three stations on the Nilambur-Shoranur line are located close to Perinthalmanna: Angadipuram, a main station 2.5 kilometres (1.6 miles) to the west of the town, and Pattikkad and Cherukara, two minor stations. From here, trains run to Kottayam, Kochuveli, Palakkad, Nilambur, and Shornur.

(iii) Air

The nearest airport to Perintalmanna is Karipur Airport, 45 km (28 mi) from Kondotty.

DETAILS OF ZONES

Zone 1

Zone 1 includes Kakkooth, Manathumangalam, and Cherattamanna desom covering an area of 6.19 sq. km.

Zone 2

Zone 2 includes Ponniyakurussi and Pathaikkara desom covering an area of 9.51 sq. km.

Zone 3

Zone 3 includes Perinthalmanna desom covering an area of 5.36 sq.km.

Zone 4

Zone 4 includes Kunnappally desom covering an area of 5.69 sq. km.

Zone 5

Zone 5 includes Cherukara and Eravimangalam desom covering an area of 7.65 sq. km.

Figure no 4.1 Zones of Perinthalmanna municipality

FACTORS AFFECTING THE REHABILITATION OF PAVEMENT

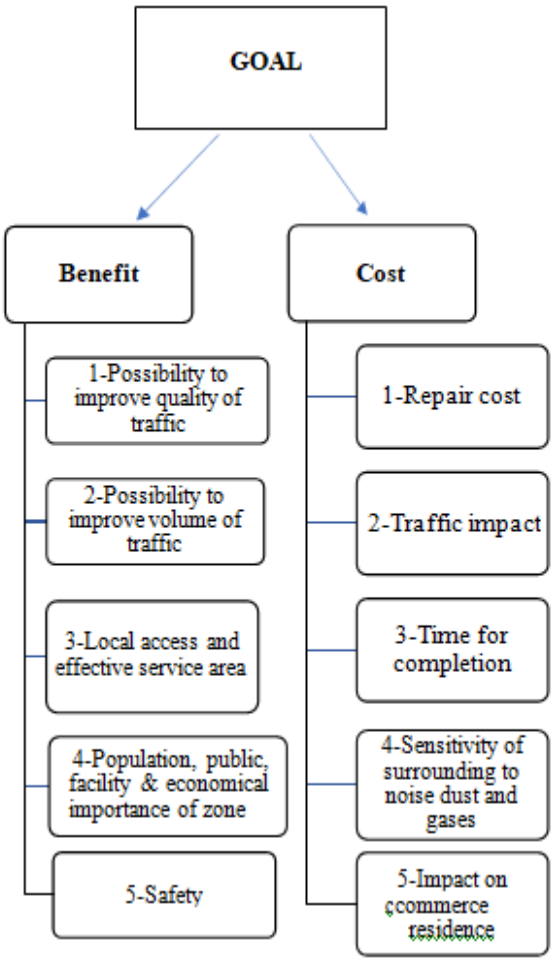

Figure no. 4.2 Factors affecting rehabilitation of pavement

The rehabilitation of pavement is impacted by

numerous elements. Ten variables or standards were found. The opinions of PMS experts were taken into consideration in order to identify important factors influencing maintenance priority. For this reason, a variety of criteria are chosen to rank the roads, including engineering characteristics, traffic volume, pavement quality, and road type. These parameters are split into two categories for the benefit-cost analysis, one based on benefit and the other on cost. The potential for increased traffic quality, the potential for increased pavement capacity, local access and effective service area population, public facility and economic significance of the zone, and safety are the factors listed under benefits

CONCLUSION

All portions that require rehabilitation do not obtain adequate funding due to the restricted budget allotted for maintenance and rehabilitation operations, and as a result, they do not all undergo the annual maintenance programme. Prioritization is therefore very important. Managers would be able to prioritize the maintenance of impairedportionsbaseduponthe irconditionsusingthemain tenancepriorityindex. That will creates in this study. The effectiveness of budget allocation will be ensured by this methodical selection**.**

In this analysis, the benefit-cost ratios of the zones will determine. Based on the priority poor pavement conditions, receives first priority.

In this project we considered a small area for case study, i.e. Perinthalmanna municipality and divided it into 5 zones. priority index will form by using AHP method. And will use benefit cost analysis for prioritization using few criteria. This method can be effectively used in all major engineering projects for proper budget allocation.

On phase II, work to be done are:

- Data collection
- Data analysis
- Result analysis
- Conclusions

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