International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 09 Issue: 07 | July -2022 www.irjet.net p-ISSN: 2395-0072

Investigation And Improvement of Road Pavement Section For Rankuva Crossing To Chikhali-Vansda Road

Mr. Bhoya Mehul R.[1], Mr. Shrinath Karli [2]

[1]Student, Dept. of Civil Engineering, Hasmukh Goswami College of Engineering, Gujarat, India,
[2]Professor, Dept. of Civil Engineering, Hasmukh Goswami College of Engineering, Gujarat, India.

Abstract - Highway pavements are deteriorating fast due to lack of timely maintenance, leading to higher vehicle operating costs, increasing number of accidents etc. Thus, timely maintenance of the highway pavement is essential. Because, once pavements start to deteriorate; they deteriorate rapidly beyond the point where maintenance is effective. Thus, there is an urgent need to develop a strategy for maintenance of pavement in a huge highway network. Priority of various maintenance activities to be carried out on pavement sections. Maintenance priority of the pavement is based on importance of the road sections, present road conditions, and future road conditions. In this study, a strategy for maintenance of highway pavement is proposed. In this study consists of detailed analysis of all aspects of pavement condition resulting in the identification of specific problems and their causes. The data type required for analysis range from simple data such as pavement design features and pavement geometrics, to detailed data obtained from destructive testing and non-destructive testing Firstly, failure patterns will classify between Rankuva Crossing To Chikhali-Vansda Highway in existing pavement by visual inspection. Secondly, I will study Visual maintenance and structural maintenance. For structural maintenance, stress and deflection of Rankuva Crossing To Chikhali-Vansda Highway will determine by using the various methods.

Keywords: **Highway, Pavements, Maintenance, Stress.**

1. INTRODUCTION

Gujarat state is one of the most prosperous states in Western India and having a good transportation infrastructure with an extensive road network. The Road & Buildings Department (RBD) of Gujarat government is primarily responsible for construction and maintenance of roads including state highways and panchayat roads in Gujarat. This department is operating through 6 wings geographical spread across the state in 33 districts. There are 1 national Expressway, 17 national highways and more than 300 state highways in Gujarat. The state highways are arterial routes of a state, linking district headquarters and important towns within the state and connecting them with national highways or highways of the neighbouring states. Gujarat is one of the versatile and dynamic states in India. The state has established itself on stronger economic foundation. Over the last decade the name of "Gujarat" has emerged synonymous with progress and vibrancy. Government of Gujarat throughRoads and Buildings Department (R&B) is thriving to deliver better than the best roadinfrastructure for the communities. Gujarat roads, managed by R&B, are known as one of the best in the country. R&B is successfully managing its road assets through various flagship programs ofGovernment of Gujarat, besides multilateral funding and Public Private Participation.

2. OBJECTIVE

- To get the overview of existing traffic flow, surface condition, geometry etc.
- To analyse existing road condition to find out possible causes of road stretchdeterioration
- To prepare a maintenance strategy of the selected pavement section.
- To Prepare the Overlay design for the improvement of the pavement section.

3. LITERATURE REVIEW

In 2020, Andrey Korochkin [1] In this research paper Modern methods of designing road pavements, developed for transport and operational conditions that were relevant 30–50 years ago, do not fully meet the modern requirements and need to be adjusted. Many of the parameters used in the design of road pavements, described in the applicable regulatory documents, have not changed for many years and, as shown by the materials of the studies, are objectively outdated (axle load, increase in traffic intensity, reduction coefficients). Their adjustment requires serious comprehensive research. The conducted studies and the elasticity moduli calculated on their basis have shown that their values will increase over time.Taking into account the trends towards traffic intensity increase on highways, as well as the appearance of an increasing number of heavy-duty vehicles in traffic flows, serious attention should be paid to the construction of highways with rigid road pavements that successfully cope with high loads and extend the durability of highways.

In 2022, Zhuhuan Liu , Romain Balieu, Niki Kringos [2] In this paper Road maintenance is confronted with an increasing challenge of sustainability. In accordance with the perspectives of performance, cost, and sustainability,

different tools and concepts for pavement maintenance effectiveness evaluation and optimization have been identified and categorized. On the one hand, the growing concerns about life cycle cost and life cycle environmental impacts consolidate the systematic scope of pavement maintenance effectiveness; on the other hand, with the complicated immense road infrastructure system, these concerns entangle the evaluation process, especially when it is constructed on an unstandardized maintenance effectiveness evaluation system and embryonic pavement LCA framework. From a more fundamental point of view, this review has indicated the current pavement maintenance effectiveness evaluation is mostly built on many different deterioration models that lack consistencies, making it intractable to compare studies from different regions. Such requirements demand more future pavement vehicle interaction studies to establish the correlations between different deterioration conditions and corresponding environmental impacts and would require an interaction with material models that include long term degradation on the combined environmental and mechanical loading.

In 2013, Arpan Ghosh, Padmarekhab J, Murali Krishnan [3] In this paper For the detailed mechanistic-empirical pavement design of asphalt pavement as per AASHTO, an extensive traffic, weather and material characterization data are required. The traffic data includes number of various classes of truck including hourly and monthly traffic variation, axle load data of various class of vehicle and its distribution. Weather data includes hourly air temperature and other factors that relate pavement temperature to the air temperature. In this investigation, the weather was collected for the Chennai city and the traffic data for an highway near Chennai. It was observed that the rutting response of the bituminous layer exceed the target rutting in less than 3 years. In this design process, the pavement temperature prediction using the design software was carried out using the same Enhanced Integrated Climate Model that was recommended by AASHTO. It is clear that the material characterization greatly influences the design of the flexible pavements. Bituminous pavement design, depending on the rigor required, involves large data. A concerted attempt by all the stakeholders is required to collect rigorous data for a wide range of traffic, climate and bituminous mixtures and binders.

In 2019, Shadi Saadeh, Avinash Ralla , Yazan Al-Zubi , Rongzong Wu, John Harvey [4] This paper presents the research undertaken to build test sections (asphalt and concrete) based on the new design method developed using the mechanistic-empirical design approach by UCPRC at CSULB. Instrumentation of pressure cells and strain gages was performed during construction of test sections in order to collect stress and strain data of both test sections. The collected data from pressure cells and strain gages were analyzed, and graphs were plotted to study the pattern and trend in the data sets. The collected data has revealed that there is a difference in the performance of both test sections. The asphalt test section data results showed high readings of vertical pressure on the top of subgrade when compared with the concrete section. The vertical strain in transverse direction at the bottom of the asphalt surface layer was recorded high in comparison to the concrete test section. The vertical strain in the transverse direction was low when compared to the vertical strain in the longitudinal direction at the bottom of concrete surface layer. The collected data is being used to evaluate the performance of both test sections. Based on the performance evaluation results, it was determined that it is possible to develop and implement the fully permeable pavement design as part of a sustainable transportation for freeways.

In 2021, Sushmita Bhandari, Xiaohua Luo, Feng Wang [5] This paper presents Pavement age plays a vital role in the development of distresses. Rutting and roughness are increasing with time. The use of traffic data in the analysis has been particularly helpful in assessing pavement performance patterns. Rutting and roughness are significantly influenced by heavy vehicle loads.For roughness and alligator cracking, HMAC thickness is statistically significant. Mean roughness index value decreases with the increase of HMAC layer thickness. Meanwhile, alligator cracks are observed more on a thicker HMAC layer. Moreover, the analysis result reveals that HMAC thickness has no significant effect on rutting. Base type is another crucial design factor affecting rutting, roughness, and alligator cracking. The best performance was shown by asphalt treated base with drainage (ATB/PATB). The base types combined with drainage result in lower distresses. Environmental data (temperature and precipitation) also have significant effects on rutting, roughness, and alligator cracking.

In 2022, Mansour Tohidi, Navid Khayat, Abdoulrasoul Telvari [6] This research revealed that the manual method's total pavement thickness varies depending on the project compared to the GA and PSO algorithms. Thus, given the ultimate goal of minimizing pavement thickness design costs, the optimized algorithms combine with the lowest possible costs by varying the layer thicknesses and taking their costs into account. This study demonstrated the effect of the project's location on the preparation of construction materials. Given that the distance traveled by materials to reach the project location can affect the project's final costs, the optimization algorithms choose the layer thicknesses based on material transportation costs to the project location. If the layer's materials are expensive, a thinner layer is chosen. As a result, it can be concluded that the difference or similarity in cost reduction percentages between the GA and PSO techniques and the manual method is determined by the algorithm's searching nature and power.

In 2022, Yaning Qiao , Yaru Guo , Anne M.K. Stoner , Jo˜ao Santos [7] In this paper Climate change induced costs will be inevitable. Road agencies need to plan for additional budgets for climate adaptation regardless of the approach they take. Climate change will have greater impacts on the costs incurred during the maintenance and EOL phases, compared to other phases. User costs are typically a dominating part of LCC, accounting for 76- 85% of the total LCC, even though they are the LCC component least affected by climate change. Climate was found to be a medium sensitive input of pavement LCC. To achieve a more accurate quantification of the climate-induced economic losses/gains, higher sensitive inputs (e.g., gasoline/diesel fuel consumption models) must be predicted with greater accuracy. With passive climate adaptation, pavement LCC are estimated to increase by 0.08-0.21% per ◦C increase in temperature, whereas agency costs are projected to increase 0.41-1.43% for the same temperature increase. Climate change (per ◦C) alone will cause approximately $650-700 million/year of additional agency costs nationwide.

In 2016, Abhay Tawalare, K. Vasudeva Raju[8] The objective of the paper is to develop a Pavement Performance Index for rural roads to assess the performance of these roads. Through expert opinion the various pavement deteriorating parameters like unevenness, skid resistance, CBR, potholes, ravelling, rut depth, camber, carriage width and thickness, drainage conditions, edge break, patching, cracking, condition of shoulder and age were identified specifically for Indian rural roads. To calculate Pavement Performance Index simple formula is suggested which depends on rating and weight age of each deteriorating parameter. The various rating criteria for each parameter are tabulated through literature review and weight age for each parameter was calculated through questionnaire survey. This formula will be very useful to field engineers of PMGSY to calculate the Pavement Performance Index for rural roads. The PPI will be useful to prepare priority list of rural roads for repair and maintenance schedule.

In 2018, Raid R.A. Almuhanna, Hussein Ali Ewadh, Saja J.M. Alasadi [9] Pavement Condition evaluation by PAVER 6.5.7 showed that the current status for the selected zone of roads network in KCC in general have satisfactory condition.

Integrating PAVER 6.5.7 with GIS helps Identifying sections with the specific PCI. This will give easiness to assign the location of best and worst sections. The majority of local sections have low values of PCI and the arterial sections have the best condition. This inducts the maintenance activities uniformly for the network. Systematically, the current maintenance works are not properly managed. The lack of maintenance in the past decades for many sections created severely distressed pavement requiring comprehensive rehabilitation programs. Priority of maintenance can be estimated according to the layout of integrity PAVER & GIS to help decision makers and assure efficient maintenance management. Pavement condition decreases with age of pavement for all stranded sections in a trend agree with other studies.

In 2019, Othman Al Shareedah, Somayeh Nassiri, Zhao Chen, Karl Englund, Hui Li, Osama Fakron [10] In this paper CCFCM elements dispersed well in PC mixture without creating clumps and balls. CCFCM-PC specimens showed comparable 7 and 28-days MR, f't, and f'c with the Control, despite the increase in their porosities. It is anticipated that increasing the CCFCM dosage without reducing aggregate content would further enhance the flexural and tensile strength of PC.The results of the tested cores (extracted from the field) showed that CCFCM-7 section achieved the highest strength compared to other sections. Pavement load testing was conducted using lightweight deflectometer (LWD) test and the results indicated that CCFCM-PC sections showed less deflection than the Control under the same applied load. Further research is needed to quantify the required compaction effort to be applied on fresh PC to achieve the desired mechanical properties.

In 2021, Przemysław Rokitowski, Joanna Bz´owka, Marcin Grygierek [11] In this paper increased moisture that occurs permanently in the road structure, e.g. due to the high GWT level, causes unfavorable working conditions for the pavement under traffic load. As can be seen from the observations in this paper, long-term operation of the pavement in the conditions of GWT occurrence at the level of 30–60 cm below the pavement surface, resulted in a reduction of the unbound base layer moduli by 35%–70%. As a result, in the right wheel track on the road section under observation, despite the rehabilitation works undertaken, the pavement showed characteristic damages after one year of operation. significant observation resulting from the presented research is the importance of the proper pavement diagnostics process. Taking into account not only economic, but also environmental and social considerations, it should be clearly emphasized that the key aspect of the proper maintenance of road pavements is their regular diagnostics. This is especially important in countries with cold climates, where the water retained in the pavement structure thaws each year in the spring, and thus the moisture of the lower layers of the pavement structure increases.

In 2022, Salvatore Cafiso, Alessandro Di Graziano , Valeria Marchetta, Giuseppina Pappalardo [12] In this paper results confirmed the lack of correlation of vibrations in bikes and e-scooter with IRI the most known standard KPI for road pavement surface, how is theoretically expected and experimentally tested in the study. Despite the topic of smartphone and probe vehicles is widely discussed in the literature, in the author knowledge that is one of the few studies that combine bike and e-scooter vehicles with a detailed report of pavement conditions in terms of distress features and road profile characteristics. At the present stage of the research and as reported in the literature, it is not

possible to classify pavement distress at the same level of accuracy (e.g. extension and width of cracking, area and depth of potholes) available from direct measurements like has been done in the present study with ARAN. While outliers are more difficult to be used for detailed classification of distress typology (e.g. potholes vs. humps) and its characteristics (e.g. pothole area and depth). In this perspectives, extension of quality database with different distress typologies and severities, as proposed in the present study, can provide a suitable set of data also to apply advanced artificial intelligence classification techniques.

In 2018, Takahiro Tsubota, Celso Fernando, Toshio Yoshii, Hirotoshi Shirayanagi [13] In this paper This study explored the effect of pavement types and their ages on the accident risk on urban expressway routes. Three pavement types were compared: drainage pavement (DP), dense particle size ascon (DPSA) and dense particle size gap type ascon (DPSGTA). The analysis for dense particle size gap type ascon (DPSGTA) suggests that the risk of accident on tight-curve sections paved with DPSGTA tends to decrease on normal weather condition for the first years. Moreover, the surface of DPSGTA is basically composed by micro-texture, which provides high friction. For sections paved of dense particle size ascon (DPSA), the surface is basically composed of macrotexture. Thus, the decreasing trend of the accident risk along the time on curve sections could be associated with driver's awareness to danger. The macrotexture has a poor friction capacity, and curve sections are known to be accident prone geometry. Therefore drivers would be aware of the danger, and could feel forced to drive with caution.

In 2020, Aditya Singh, Akash Sharma, Tanuj Chopra [14] In this paper This paper deals with the prediction, comparison and analysis of the overlay to be provided over the existing pavement of the National highway in the state of Haryana, India using the salient features of KGPBACK, IITPAVE and HDM-4. In this study, deflection measurements were carried out on the pavement using the established FWD system on the three selected sections classified as H-1, H-2 and H-3 based upon the pavement condition. The accountability of the provided overlay thickness was ensured by the HDM-4 software as it depicted a clear decrease in the cracking, ravelling, rutting and roughness distress values. The improvement in conditions of all pavement sections on modelling the bituminous overlay maintenance strategy suggested that if such strategies are applied on the Indian roads it would increase the lifetime of the Indian Highway Roads.

In 2020, Irina Demyanushko,Vladimir Nadezhdin, Valeriy Stain,Oleg Titov [15] Based on the results of the study, Mobile road pavements made of high-molecular LPP may deform or detach from the ground, therefore, their analysis shall be performed with account for the physical, geometric, and structural nonlinearity of the problem. When a wheel load is applied, out of the four connection options, the preference should be given to the option with two ties in the slab corners. In this case, the maximum slab deflection is relatively small (4.45 cm), the maximum tensile stresses in the slab are equal to 19.78 MPa and do not exceed the yield strength for high-molecular LPP, and the depth of plastic strains' development in the base soil equal to 1 m is almost the same as in the other three connection options. When a tracked load is applied, the optimal solution is to use a structure with two ties in the slab corners. In this case, the maximum slab deflection was 2.62 cm, the maximum tensile stresses were 3.89 MPa, and the maximum depth of plastic strains' development in the base soil was 1.25 m. MRSs made of high-molecular LPP can be recommended for use in the Arctic zone of Russia. However, further research is needed to study their use on frozen soils.

4. CONCLUSION

From This Literature Review find the gap that, the various pavement deteriorating parameters like unevenness, skid resistance, CBR, potholes, ravelling, rut depth, camber, carriage width and thickness, drainage conditions, edge break, patching, cracking, condition of shoulder and age were identified specifically for Indian rural roads. To calculate Pavement Performance Index simple formula is suggested which depends on rating and weight age of each deteriorating parameter. General information of pavement Improvement & management system, development of strategy for road, Pavement performance studies, prioritization of road for improvement are carried out.Priority of various maintenance activities to be carried out on pavement sections. Maintenance priority of the pavement is based on importance of the road sections, present road conditions, and future road conditions. In this study, a strategy for maintenance of highway pavement is proposed. In this study consists of detailed analysis of all aspects of pavement condition resulting in the identification of specific problems and their causes.

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