Prevention of Pavement Materials

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\section{I. INTRODUCTION}

Pavements are an essential part of our life. We use them as roads, runways, parking lots, and driveways. Pavements are engineered structures and are important for our everyday life, commerce and trade, and defense. Surface transportation is the most widely used mode of transportation in the world, and a country’s development is often measured in terms of its total paved road mileage. The construction of roads is and will continue to be a major industry in developing countries, and as the infrastructure matures, it will be a major industry in developed countries as well. Preventive maintenance techniques are considered useful in extending the life of a pavement if applied at the right time. Maintenance treatments addressed include only crack seals, fog seals, slurry seals, microsurfacing, chip seals, thin asphalt concrete overlays, and other thin surface treatments.

Development of a country depends on the connectivity of various places with adequate road network. The pavement is the crucial part of any road project and needs to withstand traffic load without deteriorating or deforming to the extent that it becomes unusable during the design life period. The pavement’s primary purpose is to provide a functional surface for a specific transportation need.

The basic function is to withstand load, under different seasonal environmental conditions, without deforming or cracking, since either of these distress conditions would reduce the functionality of the pavement. The function of the different layers in the pavement is to spread out the load on the surface and reduce its intensity with depth. In the past, gravel road surfaces, cobbled stone and granite setts were extensively used, but these surfaces have mostly been replaced by asphalt or concrete laid on a compacted base course.

The objective of this paper is to address how the materials get affected by many reasons like high temperature, flexible pavement preventive maintenance.

Two types of pavement maintenance are generally recognized preventive and corrective (or reactive). Preventive maintenance is used to arrest minor deterioration, retard progressive failures, and reduce the need for corrective maintenance.

It is performed before the pavement shows significant distress to provide a more uniform performing pavement system. Corrective maintenance is performed after a deficiency occurs in the pavement; i.e., loss of friction, moderate to severe rutting, or extensive cracking.

In this paper, the problems related to pavements like crash severity, extension of asphalt pavement, and the structural design of asphalt pavement is considered with their preventive methods like for crash severity in two-lane and multilane highways the model named RPSUNB is used for minimizing it.

For extension of asphalt pavement, the GRCS is used to minimize the temperature in pavement and prevent from the failure (rutting, fatigue, potholes) and the structural analysis of asphalt pavement is done by considering the factors during construction are like geometric, functional and drainage aspects.

\section{II. REVIEW}

Safety impacts of pavement surface roughness at two-lane and multi-lane highways:

This paper throws light on how the pavement condition affects the two lane and multi lane highways crash severity and also the impact of pavement condition on highway safety, and to discern whether there is any difference in the magnitude and direction of such impacts across multi-lane and two-lane highways.

Multilane highway means one that has at least two lanes in each direction but excludes freeways and expressways; A two lane highway has only one lane in each direction.

This paper shows that estimated model named Random parameters seemingly-unrelated negative binomial regression (RPSUNB) model used for accounting the correlation at different types of crash severity. It also evaluate the safety impact of pavement condition across multilane and two lane highway.

The pavement condition of multilane highways have more impact on crash severity than that of two lane highway.

In model the crash severity levels are: Fatal, Injury, No injury.
The problems of crashes occurs in two lane highways are mainly limited space for driving and in case of emergency situation. These crashes are caused by a number of factors related to the vehicle, the driver, the natural or built-up environment, the road pavement and geometrics, policy and legislation, or a combination of these factors. There are more chances or possibility of head-on crashes.

The results given by this model are that the multiline highways are more fit than the two lane highways.

The results indicate that the strength of influence of the pavement condition on highway safety differs across the two highway classes (multi-lane and two-lane): poor pavement condition was found to increase crashes at multi-lane sections but no significant effects at two-lane highways. Reason is awareness of drivers at two lane highways.

There results give the three potential options to reduce the chances of injury and no injury crashes such as: Widening the lane, Widening the outside shoulder, improving the pavement condition.

Distresses like potholing, skid number, rutting will be prevent by some methods like patching techniques, leveling of deeper ruts etc.

**Structural Design of Asphalt Pavements:**

**Principle and Practices**

A pavement’s primary purpose is to provide a functional surface for a specific transportation need. The basic function is to withstand load, under different seasonal environmental conditions, without deforming or cracking. An asphalt pavement is made up of multiple layers, namely sub grade, sub-base, base, surfacing and wearing course.

This Paper shows the there are design considerations involved in a pavement from the geometric, functional and drainage aspects, the composition of the materials for road pavement are done by mix design. An asphalt concrete surface will generally be constructed for high-volume primary highways having an average annual daily traffic load greater than 1200 vehicles per day. Advantages of asphalt roadways include relatively low noise, relatively low cost compared with other paving methods, and perceived ease of repair.

Different methods are used at different part of time. According to their mechanistic - empirical method that different pavement structures (that is, pavements with different thicknesses), a same level of distress would occur at different number of repetitions.

They give views on use of new asphalt layer on pavement, which two design variables and two distress (fatigue and rutting) are considered. It is also observed that design of asphalt thickness is also increases when traffic repetitions.

There is need of switching over to high performance/new/alternate materials and technologies that are applicable to flexible pavements and are able to provide sustainable solutions, bitumen bound layers are normally used in wearing, surfacing, base and binder courses. They may be thick or thin, hot or cold, plant-mixed or site-mixed cementitious layer with marginal aggregates as base/sub-base and so on, making of new pavement materials the mix design of materials should be done carefully.

The benefit of a mechanistic - empirical approach is its ability to accurately characterize in situ material (including sub-grade and existing pavement structure).

This allows for a more realistic design for the given conditions.

Pavement failure is caused by a number of variables including, water intrusion, stress from heavy vehicles, expansion and contraction from seasonal temperature changes, and sun exposure. It is important to keep up with proper maintenance like crack and asphalt sealing to prevent cracks from spreading or forming.

Pavements may deteriorate only at the surface with time, and hence rehabilitation work will be far less than that in pavements with different materials.

**Extension of Asphalt Pavement Life by Reduction of Temperature**

Pavements, like all other materials expand as they rise in temperature and contract as they fall in temperature. Flexible as well as rigid pavement suffers more cracks as a result of a excessive contraction in cold weather.

In this paper, the GRCS (Geosynthetic reinforced chip seal) is used to overcome the problem of extension of pavement. There are two factors which helps to reduce the temperature from top surface to bottom surfaces are (i) the higher reflectivity of aggregates and (ii) the insulation by the asphalt binder.

This type of problem generally seems during the summer months, the problems occurs in this period are like rutting, fatigue etc., these occur due to temperature variation in asphalt binder and aggregates. the rehabilitation of these failures are uneconomical and time consuming.

This paper gives the solution for problem of extension in asphalt is feasibility of lowering of pavement temperatures. It reduces the temperature of asphalt in pavement.
Layers in the pavement from top to deeper area are High reflectivity aggregates, Geosynthetic insulation layer with low heat conductivity, Asphalt Binder with low heat conductive, HMA layers.

This paper shows the effective results of GRCS with the variation in temperature.

The benefits of GRCS were maximum with increase in temperature. This indicates that as the air temperature increases, the effectiveness of the GRCS in lowering the temperature also increases. At depth of 12.5mm for the HMA layer and GRCS layer ,at the maximum temperature GRCS has lower regression coefficient than HMA . In higher temperatures ,this absorb the temperature and give the effective results for number of consecutive days .

In GRCS high albedo aggregates (made from igneous rocks such as granite ,rhyolite etc.) used , availability of their rocks in different regions of country is also considered , if it is not available at time ,then it will affects the cost of the project,

The good quality control is needed during the construction for asphalt binder,

The effect of winters on this surface in not mentioned in this paper, aggregates doesn’t shows any effects during to winter seasons.

The actual benefits of GRCS are shown in the high temperature areas (close to 40 celsius) , in maximum temperature area the maximum temperature will be absorbed by this and reduces the failure ,

III. Summary

Preventive maintenance techniques are considered useful in extending the life of a pavement if applied at the right time. This paper presents a framework for selecting the most appropriate maintenance techniques for correcting various distress types in asphalt pavements.

Planning and scheduling of preventive maintenance activities are important functions that need to be effectively managed. This is important because of two reasons. First, there is never enough funding for rehabilitation of all of the roads in a network at the same time, and secondly, different roads deteriorate at different rates and hence are in different conditions at a specific time. This process of keeping an inventory of condition and selecting pavements for rehabilitation/reconstruction is called pavement management.

The basic function of pavement is to withstand load, under different seasonal environmental conditions, without deforming or cracking, since either of these distress conditions would reduce the functionality of the pavement. When pavement is in service, the traffic loads and environment would deteriorate it.

Types of distress considered include roughness, rutting, fatigue cracking, longitudinal cracking, raveling, weathering, and bleeding. Pavements are exposed to the environment, a very important factor in the design of pavements is the consideration of water. The function of the different layers in the pavement is to spread out the load on the surface and reduce its intensity with depth.

The paper assesses preventive maintenance techniques should be scheduled to maximize safety, maintainibility, and the cost-effectiveness of pavement preservation efforts. The problem like crashes in two-lane and multilane highways models like RPSUNB are there this results as evaluation of the safety impacts of past or anticipated projects that improve in pavement condition, and assessing the safety consequences of delayed pavement rehabilitation.

Different seasonal conditions like variation in temperatures (high and low) affects the pavement layer material and reduces the stability and strength ,using of GRCS in pavements , the temperature affects the stiffness of the asphalt layer and the moisture content affects the stiffness of the unbound granular layer and the subgrade. GRCS depends on two factors—the higher reflectivity of the chips or aggregates and the insulation provided by the asphalt binder saturated geosynthetic layer.GRCS extends the life of layers at maximum air temperature .

The composition of a pavement material is finalized through appropriate mix design, so that the desirable levels of various engineering properties of the material are achieved. Economic analysis is generally used to choose the best design . A pavement gradually deteriorates due to its exposure to environment and traffic. Overlaying is one of the maintenance measures, where additional asphalt layer thickness is provided to the existing pavement. A pavement design problem (for new pavement as well as overlay) is expected to have multiple design solutions and repair of area of overlay to provide an even platform for the new pavement because a smooth surface with good skid resistance ,free from rutting ,fatigue, potholing etc is safe travel by the people .

REFERENCES


[2] Extension of Asphalt Pavement Life by Reduction of Temperature Rajib B. Mallick, Dharamveer Singh , A. Veeraragavan Received: 20 September 2015 / Accepted: 21 March 2016 / Published online: 2 April 2016, Springer International Publishing Switzerland 2016

