Improvement of Road Drainage System for Indian Roads

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Abstract— Drainage quality is a necessary parameter that affects the route pavement performance. Excessive water content in the pavement base, sub-base, and sub-grade soils can cause early distress and lead to a structural or purposeful failure of pavement. Thus, when choosing acceptable maintenance methods price|the value|the price} of pavement maintenance has to be compared with the cost of rising the standard of drain. Hence, there is a requirement to quantify the effect of varied forms of drain quality on performance of the pavement. However, very few studies have investigated to what extent quality of drain affects the performance of pavement. Therefore, this study identifies a simple framework for quantification of result of drain quality on structural additionally as purposeful performance of the pavement. The proposed framework presents the structural and purposeful performance of the pavement is foreseen in terms of deflection and roughness severally. It is expected that this study will helpful to cut back the upkeep price of route pavement system and thus are helpful to preserve large route network in India. Drainage of water from pavements has been a necessary thought in building for over 2000 years. However, modern process, handling, and placement of materials frequently result in base courses that don't transmit water or drain; combined with exaggerated traffic volumes and masses, this often leads to pavement distress caused by wet within the structures. Water related damages on the pavement will cause one or a lot of the following styles of deterioration,

Reduction of sub-grade/sub-base strength

Differential swelling in expansive sub-grade soils

Stripping of asphalt in versatile pavement, etc., Free water is that the kind of most concern to the designer because it will decrease the strength of the pavement and is the solely kind of water that may be considerably removed by gravity drain.

Key words: Pavement Performance, Drainage Quality

INTRODUCTION

It is a widely known proven fact that water in pavement systems is one among the principal causes of premature pavement failure. Indian road network at over 3.3 million metric linear unit falls below one of the world's longest road networks. Most of the highways and airfield pavements engineered in our country within the past thirty years about, have very slow exhausting systems, largely as a result of normal style practices emphasizes on density and stability however place very little importance on emptying. Drainage is a key component within the style of pavement systems. However, inadequate drainage continues to be known as a major reason behind pavement distress. Water is a leading think about causing harm to pavements. Extensive field tests and observations have indicated that rates of harm and loss of each rigid and versatile forms of pavements area unit a lot of bigger once structural section contain free water. Quality of drainage is Associate in Nursing vital parameter that affects the performance of the main road pavement. The poor drainage quality on these roads leads to great amount of expensive repairs or replacements long before reaching their style life. Not much importance has been given to this facet in Republic of India. However, the gradation Associate in properties of layer materials seldom allow the layer to be an effective emptying layer, leading to entrapment of water at intervals the pavement inflicting a "bathtub" condition, resulting in premature failures and chronic pavement distresses. Hence, there is a desire to quantify the impact of quality of drainage on pavement performance. However, very few studies have investigated to what extent quality of emptying affects the performance of pavement. Therefore this study presents a framework for the quantification of impact of emptying quality on useful performance of the pavement as well as structural performance of the pavement. The functional performance and structural performance of the pavement is foretold in terms of roughness & deflection severally.

The main objectives of this study are as follows: To gift the necessity of the study of impact of emptying quality on performance of the pavement. To presents a framework for quantification of impact of emptying quality on structural performance of pavement. To presents a framework to assess the effect of emptying quality on useful performance of pavement. This paper consists of five chapters of that this is often the primary one. This section focuses on the basic issues as a result of poor emptying and objectives. The second section presents briefly summary of literature on previous work carried out on main road emptying. The third section briefly presents the impact of poor emptying on pavement performance and varied pavement distresses due to poor emptying. The fourth sections briefly describe want of the study on impact of emptying quality on pavement performance. The section five presents a framework for quantification of impact of emptying quality on structural as well as useful performance of the pavement. The last sections presents the important conclusions drawn primarily based on this study.

LITERATURE REVIEW

To meet the objective of this study, a literature available on highway drainage were reviewed. Literature reviews on highway drainage are briefly summarized as follows:

Rokade S, Et al (2012) “The drainage design criteria used in the past have been based on the assumption that both the flow of water through pavements and the drainage of pavement

layers can be represented with saturated flow assumptions. The detrimental effects of water can be reduced by preventing water from entering the pavement, providing adequate drainage to remove infiltration, or building the pavement strong enough to resist the combined effect of load and water. Pavement service life can be increased by 50% if
infiltrated water can be drained without delay. Similarly, pavement systems incorporating good drainage can be expected to have a design life of two to three times that of un-drained pavement sections" Veeraragavan A. Et al (2010) carried out "sub surface drainage is a key element in the design of pavement system. An optimum performance of a pavement system can be achieved by preventing water entering by means of a well designed subsurface drainage system. G. Shailendra et al (2010) carried out "Inadequate subsurface drainage continues to be identified as a major cause of pavement distress. The entrapment of water within the pavement leads to a "bathtub" condition resulting in premature failures and chronic pavement distresses. This leads to large amount of costly repairs or replacement to the pavements long before they reach their design life. Hence there is need to carry out research work in India to demonstrate and quantify the impact of sub-surface drainage on pavement performance to reduce the future maintenance cost and preserve the road assets."

EFFECT OF POOR DRAINAGE ON PAVEMENT PERFORMANCE

Excessive moisture among a pavement structure will adversely have an effect on pavement performance. A Pavement can be stable at given wet content, but might become unstable if the materials become saturated. High water pressures can develop in saturated soils once subjected to dynamic loading. Subsurface water will freeze, expand, and exert forces of considerable magnitude on a given pavement. Water in motion can transport soil particles and cause a variety of various issues, including impeding of drains, eroding of embankments, and pumping of fines. These circumstances must be recognized and accounted for in the style of a pavement. The detrimental effects of water on the structural support of the pavement system area unit printed by AASHTO (1993), as follows: Water in the asphalt surface can result in wet harm, modulus reduction, and loss of tensile strength. Saturation can cut back the dry modulus of the asphalt by as a lot of as half-hour or additional. It reduces the strength of unbounded granular material and Sub-grade soils. Continues contact with water causes stripping of hydrocarbon mixture. Added wet in unbound mixture base and molding is anticipated to result in a loss of stiffness on the order of fifty or additional. Modulus reduction of up to 30% will be expected for asphalt-treated base and increase erosion status of cement or lime treated bases. Saturated fine-grain roadbed soil might expertise modulus reductions of additional than five hundredth. Surface scour is the loss of surface material caused by the flow of water along and/or over the road. This often leads to appreciable gravel loss as channels area unit withdraw the paved surface either laterally or down the grades. The problem is exacerbated if there's loose material on the surface, for example after a blading operation and before the surface is reconsolidated by traffic. The ability of the surface material to resist erosion depends on the shear strength under that the water flow happens.

Carpenter et al (1981) summarized moisture related bituminous concrete pavement distresses characterized by excessive deflection, cracking, reduced load bearing, raveling, and disintegration.

IV. NEED OF THE STUDY

The important of adequate and economical voidance to the structural integrity of a road is well recognized. Water has a key role when discussing the mechanical performance and lifelong of any traffic infrastructure. The problems caused by associate inadequate or poor drainage or lack of applicable maintenance or defective drainage systems square measure aquaplaning, skidding on ice, Swerving to avoid standing water, flooding and damage to adjacent property and land, erosion and damage to the road structure requiring pricey repairs, nuisance splashing of pedestrians. The fact, known for centuries, is that as long as road structures and sub-grade soil do not have excess water the road will work well. But magnified water content reduces the bearing capability of a soil, which can increase the speed of degradation and shorten the period of the road. In such cases, the road will would like rehabilitation a lot of usually than a well-drained road structure. Thus, when choosing applicable maintenance ways price|the value|the price} of pavement maintenance must be compared with the cost of rising the standard of voidance. Hence, there is a necessity to quantify the impact of quality of drainage on pavement performance and develop an easy methodology for judge the result of drainage quality on pavement performance. However, very few studies have investigated to what extent quality of drainage affects the performance of pavement. We would like to review of road system for a few following reason also: a rise in wet content decrease in strength or stability of a soil mass. Surface water runoff to remove the water from areas of carriageway or footpath where it presence would be harmful or dangerous to users or cause deterioration. The flowing water has capacity to injury the road whereas flowing down the shoulders and aspect slopes. in this process the water cause erosion and once more deposits the fabric inflicting siltation at different purpose each requiring of measures to reduces the injury owing to every. The water which entered into the pavement layers throughout rains from

Loose soil fill in the median
shoulders and
Pervious surface at some locations of the DBM layer
might not drain out through the impervious

GSB layer and thus the entrapped water level magnified among the pavement, saturating the WMM and BM layers. Consequently, the BM layer and part of DBM layers got deteriorated and unsuccessful as results of stripping and weakening of the hydrocarbon combine.

A. Road Drainage Facilities:

Footway Drainage

In general footways should have a crossfall towards the kerb to allow surface water to be collected by the kerb side gullies on the carriageway. The total width of footway and carriageways should be used in determining the drained width.

Where the paved area adjacent to the carriageway is very wide, gullies at a very close spacing along the carriageway may be required. In such case, it may be more appropriate to provide a separate drainage system for the footway. One option for footways in rural area with low

pedestrian volume is to drain surface water to separate open or covered channels at the back of the paved area. *Pedestrian Crossings:*

At pedestrian crossings where there are many pedestrian movements across the kerb side channel, it is worthwhile to spend extra effort in detailing the position of gullies to minimise inconvenience to the pedestrians. It is recommended that:

No gully should be located within the width of any pedestrian crossings;

For roads of longitudinal gradient 0.5% or above, a gully should be located at the upstream end of all pedestrian crossings; and

For roads of longitudinal gradient less than 0.5%, another gully (in addition to that required Should be provided at the downstream end.

Continuous Drainage Channel:

For wide carriageway roads in flat areas or flood prone areas, gullies would need to be provided at very close spacing. For example, a flat 4 lane carriageway with a superelevation of 3% and with both adjacent footways shedding water to a single kerb side channel or a sag point with a large catchment could require gullies at a spacing of less than 5m. In such circumstances, drainage by means of covered continuous channels may be preferable. However, the susceptibility of damage by vehicles and the maintenance effort required should be considered thoroughly if continuous channel is proposed to be used.

Gully Pots:

Untrapped gullies are preferred to the trapped ones because the latter is more susceptible to choking. Trapped gullies should be used when there is the possibility of having sewage discharged into the stormwater drain serving the gullies.

Precast/preformed gully pots should be used instead of in-situ construction except in very special cases where physical or other constraints do not allow their use. The following are some of the advantages of using precast/preformed

CONCLUSIONS

Drainage is a key part within the style of pavement system. However inadequate evacuation leads to major explanation for pavement distress owing to great amount of expensive repairs or replacements long before reaching their style life.

There is an imperative have to be compelled to study the impact of evacuation quality on pavement performance in India and quantify the good thing about the nice drained system with relation to un-drained or poor system. Effective drainage in roads is an important demand for guaranteeing stability and preventing the failure of pavement. This study presents a framework for evaluation of impact of evacuation quality on structural performance of the pavement. This study also presents a framework for quantification of impact of evacuation quality on practical performance of the pavement. It is expected that this study will helpful to quantification of impact of evacuation quality on pavement performance and improve the route system, thus to scale back the upkeep value of route pavement system and thence are helpful to preserve huge highway route network in India

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