

A Review on a Study of Cement Treated Base and Sub-Base in Flexible Pavement

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Abstract - Countries all over the world are developing rapidly and infrastructure sector plays a vital role in the development of nations. Transportation is the main constituent of infrastructure sector. Most of the countries are dependent on the roads and highways for transportation of all kinds, as compare to waterways, railways, airways etc. In many developing countries, crushed rock and murrum is used as a base material for road pavement. These materials are required in large quantities and are not easily available in many regions. Government of India is concentrating on the development of National Highways and State Highways for the fast transportation and conveyance. Hence the requirement of the construction materials is very huge. The material used for base layers in pavements is costly as it requires production cost i.e. drilling, blasting, crushing, transportation etc. Although this material is fails under heavy traffic load as well as heavy rainfall. Also it is not easily available in city areas. This report consists of the study of reasons of failure of the flexible pavements, the materials used for the pavement construction in traditional method, the problems associated with these materials. This study explains the mechanism of Cement Treated Base and Sub-base. The quantity of the cementitious material required to be added for stabilization process. The requirements of cement treated base/sub-base are also studied in this report. The construction process is explained in details. This material is beneficial because it minimizes the crust thickness and hence saves the material required for construction. The cement treated base and sub-base is tested for the unconfined compressive strength and the results are obtained. It proves that, this material gives better strength as per requirement and performance also better as compare to the traditional materials. The construction cost, quantity of material, transportation charges for material, machine requirement, machinery fuel cost are analyzed and compared for the cement treated sub-base and traditional material. The result shows the saving in the construction cost for CTB and CTSB method is more. This report shows how it is beneficial to use cement treated base and sub-base to replace the traditional base material used for construction of highways.

Key Words: Cement Treated Sub base (CTSB), Cement Treated Base (CTB), Flexible pavement, Performance Analysis

1. INTRODUCTION

Today, many big highway projects are going on all over country and in future it will increase. The Government of

India has planned Rs. 5.35 Lakh Crore of road projects under the Bharatmala Pariyojna to meet the target of 83,677 Km highway construction in the period of 2017 to 2022. This Bharatmala will significantly boost highway infrastructure. It raises the 6 NC corridors to 50 corridors, 40% freight to 80% freight on National Highways, it also raises district connectivity from 300 district to 550 district connected by minimum 4 lane. The Government of Maharashtra also planned the most prestigious road project i.e. Samruddhi expressway it will connect 700 km long going through ten districts with the whopping budget of 48,000 corer. This sector contributes 6% of total GDP out of which 70% shares comes from the road sector. The construction of road pavement costs about 50% of the total cost of construction of the road. Now with these two big ambitious projects the material requirement for construction of pavement is very high. Cost of the required material should be within budget and should be easily available. If the material required will be not available locally then it requires to be borrowed from the other site it will affect the cost of project.

2. LITERATURE REVIEW

Saket Prasad (2016)[1], have done "Feasibility study on Cement Treated Base and Sub Base Layers of Service Road- A case study on Khed Sinnar NH 50 Project." And this research paper published in International Research Journal of Engineering and Technology (IRJET), Volume 03, Issue 09. It is found that from cost comparison for convention and CTB/CTSB method the CTB/CTSB method is more economical from conventional one and the material consumption also less than conventional one. The author concluded the following things:

1. Reduction of the bitumen consumption due to strong sub base.
2. Less local traffic due to fast construction of the road.
3. Uniform distribution of load in cement treated service road as compared to conventional road.
4. Best for laying in the most Water logged area.

Pranshu Sahu, Ritesh Kamble (2017) [2] have done study in Experimental Study on design of flexible pavement using CBR method" and this research was published in the International Journal of Mechanical and Production Engineering Volume- 5, Issue-11, Nov.-2017.

It is the purpose of this paper to point out the problems associated with flexible pavements, to summarize the research that the Joint Highway Research Project has done in

this field, and to outline present endeavors. In so doing, it must be recognized, first of all that flexible- pavement research, or the general problem of flexible-pavement design, consists of two parts. One of these is the material design of competent layers of the flexible pavement, such as the sub base, base, or surface course. In addition to the strength characteristics of such layers, factors of durability also must be recognized in establishing their design. The second part of the problem is concerned with the thickness design of the component layers, wherein it is required that sufficient strength be built up to carry the imposed loads. In this connection the problem must be viewed as one in which the subgrade soil is required to carry the load, but that in order to do so it must be reinforced to the extent that stress applied to it will be so distributed as not to cause failure.

Harshavardhan N. Shinde (2018)[3] studied “Minimal Cost Approach for Selecting the Flexible Pavement Type to Minimize the Construction Cost of Road” and this research published in the International Journal of Latest Technology in Engineering, Management & Applied Science (IJLTEMAS) Volume VII, Issue VI, June 2018

In this study the included the some alternate material crusts for the road construction of having traffic more than 2 msa. The following alternate methods are used

- a. Granular Base and Granular Subbase.(GB and GSB)
- b. Cementitious Base and Cementitious Subbase of aggregate interlayer for crack relief. (CB and CSB)
- c. Cementitious base and subbase with SAMI at the interface of base and the bituminous layer. (CB and CSB with SAMI)
- d. Foamed bitumen/bitumen emulsion treated RAP or fresh aggregates over 250 mm cementitious subbase.(RAP)
- e. Cementitious base and granular subbase with crack relief layer of aggregate layer above the cementitious base (CB and GSB with crack relief layer)

For this above methods the authors has done direct cost analysis for the all methods and the strength of the sub grade for various crust material for various CBR was done.

Ravi Kumar T, Sai Krishna K (2017)[4] have done “study on the Design of the soil cement road” and this research published in International Journal of Civil Engineering and Technology (IJCIET) Volume 8, Issue 5, May 2017, pp. 199–205

In this study the types of the soil cement mixture is considered according to the percentage of the cement to be added to the soil. For the stabilization of the soil the following steps carried out.

- a. Evaluating the properties of field soil where we want to do stabilization
- b. Checking the suitability of that soil for the cement stabilization

- c. Designing the stabilized soil-cement mix by conducting strength tests
- d. Considering the construction procedure by adequately compacting the stabilized layers and laying in the road.

After this process was done the various tests on the stabilized base are conducted and from all above this research the author concluded that as India has very low road densities we can apply the stabilization method for laying the roads at some of the places by following the standard code provisions.

Indian Road Congress (2012)[5], publishes the “Tentative guidelines for the design of flexible pavements (IRC: 37-2012) and Code of practice for maintenance of bituminous surface of highways (IRC: 82-1982).” In the above said manual design criteria for flexible pavements, different layers and their requirements, material used for those layers, procedure of the works to be carried out etc. is explained in details. The second is code about the maintenance works to be carried out for flexible pavements in different types of failures. The general failure types and the preventive and curing measures to be taken for those is explained in details.

Ministry of Roads, Highways and Transport, 5th revision (2013)[6], published by the “Government of India.” This is the guide manual for all the works to be carried out in the highway project. The section wise manual is available for all types of pavements, their requirements, materials and their requirements, procedure to be followed for different works, their measurements etc. is included in this manual. For the study of CTSB/CTB the clause no. 403 is useful. Also for the maintenance work for flexible pavements the clause no. 3000 is helpful.

3. Gap Identification

After going through the above literature review and the research papers it is seen that the most of the work was carried out on the feasibility study of the cement treated base and sub base as well as the design of soil cement road. There is no study or research done on the behavior of the cement treated base and sub base pavement after pavement opening to the traffic. Also the most of researcher used the empirical method for design of the flexible pavement which is not useful for the extensive data to be used for the design. For the accurate load design calculation the mechanistic-empirical method is most useful which was not taken into account for previous research.

4. Problem Statement

The construction of roads, highways is a big investment. This expenditure can be minimized by using the best suitable and economical materials as well as new methods. The real root cause for introducing CTB and CTSB is the bad health conditions of highways. It is seen that the pavement with the conventional method are more liable to failure. So it is very important to use alternate method of the pavement construction and also to evaluate the method with its

performance of pavement after opening to traffic with the economical impact on the construction cost of highway.

5. Scope of Study

The comparison of the flexible pavement by using the Cement treated Base and the Sub base and with conventional method will be done. The design of pavement with empirical-mechanistic method will be study. Also the performance of the both method of flexible pavement will be checked for the fatigue and rutting criteria. The overall cost comparison analysis for both the methods for certain length will be calculated.

6. CONCLUSION

From studying the above available literature review it is seen that the most of the work previously done on the feasibility study of the cement treated base and sub base instead of the conventional method. And also on base stabilization of the roads with the cement. There is also work carried out regarding the minimization of the construction cost of roads by reducing the thickness of the pavement by using cement treated base and sub base. But it is observed that there is no study or research done on the behavior of cement treated base and sub-base pavement after opening to the traffic. The pavement evaluation survey to be required to carry out for checking the performance of the pavement.

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