(12) PATENT APPLICATION PUBLICATION
(21) Application No.202141007413 A
(19) INDIA
(22) Date of filing of Application :22/02/2021
(43) Publication Date : 26/02/2021

(54) Title of the invention : STRENGTHENING OF EXPANSIVE CLAYEY SUBGRADE PAVEMENT BY USING ADMIXTURE AND GEOSYNTHETIC

(51) International classification	:C04B0028080000, E02D0001020000, E01C0007180000, E02D0003000000, E21B0049000000
(31) Priority Document No	:NA
(32) Priority Date	:NA
(33) Name of priority country	:NA
(86) International Application No	:NA
Filing Date	:NA
(87) International Publication No	: NA
(61) Patent of Addition to Application Number	:NA
Filing Date	:NA
(62) Divisional to Application Number	:NA
Filing Date	:NA

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(57) Abstract :
ABSTRACT The swelling process generates the hydraulic pressure which results in the heaving or lifting of the structure, whereas differential settlement can be caused by the process of shrinkage. Due to the shrinkage and swelling process, many buildings and pavements which are constructed over such soils are often exposed to danger. Thus, the technique of stabilization is made for enhancing the properties of soil to avoid the mentioned risk. This stabilisation increases the load bearing capacities of soil for heavy wheeled vehicle traffic. GGBS, silica fume, rice husk are the basic waste materials used as a waste material, which improves the quality of soil and reduces the cost of pavements. The main objective of the present study is to improve various engineering properties of the soil by using geosynthetic material and admixture. Dynamic cone penetration (DCP) experiment is conducted on site and the corresponding CBR value is calculated. Laboratory experiments are carried out using combinations of geotextile at various heights (H/4, H/2,3H/2 i.e., 43.75mm, 87.5mm and 131.25mm heights respectively from bottom of the mould) and admixture (GGBS: 0% - 40%) to know the consequences when mixed with expansive soils. From the CBR values obtained, the optimum placement of geotextile and GGBS are found to be 9.20 and 30% respectively. The unconfined compressive strength (UCS) value is found to be high i.e., 0.545kg/cm2 when 30% GGBS is added. From the results it is found that, by placing the Geotextile at 131.25mm and addition of GGBS of about 30% has improved the strength of the soil by 60%.

No. of Pages : 16 No. of Claims : 6

FORM - 2

THE PATENTS ACT, 1970

(39 OF 1970)

THE PATENTS RULES, 2003

COMPLETE SPECIFICATION

(Section 10; rule 13)

STRENGTHENING OF EXPANSIVE CLAYEY SUBGRADE PAVEMENT BY USING ADMIXTURE AND GEOSYNTHETIC

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The following specification particularly describes the invention and the manner in which it is to be performed:

STUDY ON THE INFLUENCE OF TERRAZYME AS A STREGTHENING AGENT FOR BLACK COTTON SOIL

Field and background of the invention

Out of these, BC soil is present in large quantities. It occupies about 0.8sq.km which is 20% of total land area and possesses poor drainage and slope conditions. The primary bedrock is Basalt. The depth of these BC soil is about 20m deep. These extend over the states of Maharashtra, Madhya Pradesh, Karnataka, Andhra Pradesh, Tamil Nadu, and Uttar Pradesh. Based on pedagogical studies, the depth of cracks and pattern in this soil vary from place to place. The soil becomes slushy and loses its strength in rainy and hardens in summer. The variation is due to climatic conditions and its shrinkage and expansion varies the depth about 1.5m and the structure constructed over it may undergo settlement. Hence, there is a necessity to stabilize this soil for better serviceability and increasing bearing capacity of pavement. Flexible pavements are preferred these days as it contributes to low initial cost, adaptive to temperature changes and can be easily repaired when compared to rigid pavements.

The strength and stability of soil can be improved by various methods such as Chemical stabilization, Soil Reinforcement, Compaction etc. Out of these, soil reinforcement is adopted as it contributes to greater life than other method and widely used in any civil engineering projects. As the land value is increasing day by day, the demand for stabilizing the poor soil is necessary.

a) Instability of pavement :

Due to moisture variation in different seasons, expansive subgrade is subjected to alternate swelling and shrinkage which leads to disturbance in different layers of pavement. This will cause instability in the pavement.

b) Shear failure in shoulder region:

The shear failure of single lane roads in expansive soil subgrades is common due overtaking of vehicles in rainy season (Patel and Qureshi, 1979).

c) Undulated pavement surface:

The soil gets softened in the edge portions in rainy season. The deformation will be more in edge portions due to wheel tracking on this softened edge portion leading to undulations in pavement surface.

d) Deterioration of pavement:

Sub soil intrusion into softened subgrade takes place in rainy season leading to intermixing of structural layers of pavement with subgrade. This will cause progressive reduction in the thickness of pavement over a period of time and failure under design traffic.

e) Volume instability:

There will be volume instability, sub soil intrusion into overlying structural layers of pavements, softening of subgrade soil during rainy season and penetration of subbase course material into softened subgrade.

f) Large pavement thickness:

In wet condition expansive soils swell more and strength will decrease leading to largepavement thickness. Hence the construction cost will increase.

g) Stripping of Bitumen:

In rainy season, moisture rise from subgrade to surface leads to stripping of bitumen. This stripping of bitumen causes raveling of aggregate

Criteria for determining theflexible pavement:

Vertical compressive strain comes to the subgrade due to the standard axle laden of magnitude 8.17 kN (8170 kg) , if more than this. it causes permanent deformation in form of rutting. The maximum rutting can be accepted in village road as 50 mm before maintenance and the analytical evaluation can be done according to IRC:37. For rigid and semi-rigid pavement tensile stress is taken as the design criteria.

b)Traffic:

As per the IRC:37 design traffic should be 0.1 msa to 2 msa (million standard axles). Weight of commercial vehicle (laden) is considered as 3 tons or more. For design traffic we consider the existing traffic and rate of growth. Traffic study should be done as per the IRC:9.

c) Design life:

The no. of years to be taken until the major reconstruction. Design life depend upon the environmental conditions, materials used ,maintenance etc. For rural roads design life of 10 years is considered. In low volume roads for the thin bituminous surfacing design life of 5 years is considered.

Pavement components:

a) Subgrade:

- To provide support to the pavement as its foundation.
- Top 30 cm of the cutting or embankment at formation level in rural roads is considered as subgrade.
- A minimum of 100% of standard proctor compaction should be attain in subgrade.
- For clayey soil 95% and moisture content of 2% in excess of optimum value.
- Soil below subgrade should be compacted to 97% of standard proctor compaction.

- If CBR less than 2% for 100 mm thickness, then minimum CBR of 10% is to be provided to the sub-base for CBR of 2%.
- If CBR more than 15% , no need to provide sub-base.

b) Sub-base course:

Selected materials are placed on subgrade which is compacted to 98% of IS heavy compaction. Function of sub-base is to distribute the stresses over a wide area of the subgrade imposed by the traffic. Materials selected should be passing through 425 microns IS sieve, have L.L<25 ,P.I<6 and CBR of 15%.

Waste material such as Fly ash, Iron and steel slag, recycled concrete municipal waste are also used. When subgrade is silty or clayey soil and annual rainfall of area is more than 1000 mm, a drainage layer of 100 mm then formation width should be provided.

c) Base course:

With stand high stress concentrations which develop due to traffic under the wearing surface.

Different types of base course used are as follows:

- WBM
- Crusher-run macadam
- Dry lean concrete
- Soft aggregate base course
- Lime-fly ash concrete

d) Surface course:

Thickness of surface course depend upon the traffic volume and type of material used. For gravel roads, extra thickness should be provided because of lost in thickness due to the traffic action. Bituminous wearing courses must be made up of good quality aggregate with aggregate impact value not exceeding 30 % in order to reduce degradation of aggregates by crushing.

Methods for the design of flexible pavement:

There are various methods available for the design of flexible pavement.

- Group index method
- CBR method (IRC: 37-1970 & 1984)
- IRC Method [IRC: 37-2001 (Second Revision)]
- IRC Guidelines for Low Traffic Volume Roads: (IRC: SP: 72-2007 and IRC: SP: 77-2008)
- Boussinesq's (Single Layer) Method
- Burmister's (Two-Layer) Method
- Mechanistic-Empirical Method

For this project the samples are prepared for following proportions.

The common types of soil stabilization are as follows:

- Cement stabilization
- Bitumen stabilization
- Chemical stabilization
- Lime stabilization
- Salt stabilization

Out of different stabilization techniques a particular method is adopted based on the availability and financial considerations. In this method adopted, we use geotextiles and admixture (GGBS) in combinations. Addition of geotextile to soil increases the strength of soil and prevents swelling and shrinking of soil and settlement. The properties such as gradation, density, moisture content ad strength of subgrade varies rapidly and is complicated. The effect of geotextile placed at subgrade, subbase on the results of MDD, OMC, moisture content, CBR is studied.

The geotextiles when used as reinforcement for unpaved roads may degrade as the time passes and stability reduces and there may be increase in layers of geotextiles placed. The field studies indicate that there is formation of rutting after 18months when geotextile is placed and when geotextile is not placed the ruts of depth 5-35mm deep are formed.

Hence laboratory experiments are performed on both soaked and unsoaked geotextile placed on subgrade and geotextile reinforcement when placed at different depths in single layer. The optimum location of geotextile is determined based on CBR and UCS test results. The pavements designed with geotextiles have decreased the thickness of base course and improves the performance with reduced rutting process. The insertion of geotextile has increased the service life of both paved and unpaved roads this is due to the distribution of load to a large area than the contact area of wheel. In design of pavement the number of fines added should be optimum otherwise it leads to deformation due to lack of maintenance. This occurs when the compaction of base course due to traffic loads. The reinforcement using geotextile decreases the amount of shear stress transferred to subgrade due to vertical distribution outwards the loading area and supports the wheel loads.

Geosynthetics:

Geosynthetics are the synthetic products with high tensile strength used in combination with soil of high compressive strength have found to be effective in the design of many civil engineering applications. Many researchers explained the application of Geosynthetics in the field of geotechnical, transportation, hydraulics, and geo-environmental engineering. The materials employed in the manufacture of geosynthetics are primarily artificial materials generally derived from crude oils, rubber, fiberglass etc., The polymeric nature of the products make them more suitable for usage in ground applications where durability of high levels is required. Geosynthetics could be a generic name representing a broad variety of plane merchandise factory-made from compound materials. The term ‘geosynthetics’ has 2 parts: ‘GEO’ and ‘SYNTHETICS’. The term GEO touching on Associate in Nursing finish use related to rising the performance of applied science works involving earth/ground/soil. ‘SYNTHETICS’ touching on the very fact that the materials square measure virtually solely from artificial merchandise. Geosynthetics are available in different forms and materials.

Objective

The main objectives of this study are as follows:

- *To determine the compaction characteristics of soil such as optimum moisturecontent (OMC), maximum dry density (MDD).*
- *To determine the strength of sub-grade soil in terms of California BearingRatio (CBR), test for both unsoaked and soaked condition at optimummoisture content (OMC),*
- To study the impact of Geo-grid and GGBS using California bearing ratio test.
- To study the improvements in strength of soil possessing low bearing capacity.
- To reduce the thickness of the pavement and the cost of the project.

In this study, the nature of geotextile and GGBS in stabilizing the soil is examined. The soil specimen is analysed for its stability by carrying out mainly CBR test on it.

We Claim

1) We Claim that the maximum dry density of 1.83 g/cc is achieved for 18% of water content for the soil with 30% GGBS. The CBR values have increased by 60% when geotextile is placed at a depth of 131.25mm.
2) We Claim that from the CBR values, the optimum placement of geotextile out of 43.75, 87.5 and 131.25 is found as 131.25mm from the base of the mould. The CBR values of geotextile placement at 131.25mm is found to be 9.20 and that of 30% GGBS is found to be 9.20
3) We Claim that CBR value of a combination of Geotextile at 131.25mm height and 30% GGBS is found to be 8.89. The UCS value is found high when 30% GGBS is added and it is equal to 0.545kg/cm^2.
4) We Claim that the values are within the limits i.e. the CBR value should be 3-10 for BC soil used for subgrade and we have increased the CBR from 1.7 to 3.92 which is 2.3 times the original CBR value. The free swell index of the soil is 88which indicates that the soil has high swelling property and can be reduced by chemical stabilization. As the addition of GGBS has increased (0-40 %), there is reduction in swelling property of the soil by 89%.
5) We Claim that addition of geotextile has increased the strength and bearing capacity of the soil samples.
6) We Claim that from the DCP test, based in traffic intensity (N = 8.57msa) and CBR value of 7.21, the thickness of pavement is found to be 553mm

ABSTRACT

The swelling process generates the hydraulic pressure which results in the heaving or lifting of the structure, whereas differential settlement can be caused by the process of shrinkage. Due to the shrinkage and swelling process, many buildings and pavements which are constructed over such soils are often exposed to danger. Thus, the technique of stabilization is made for enhancing the properties of soil to avoid the mentioned risk. This stabilisation increases the load bearing capacities of soil for heavy wheeled vehicle traffic. GGBS, silica fume, rice husk are the basic waste materials used as a waste material, which improves the quality of soil and reduces the cost of pavements.

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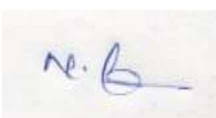
Keywords: Expansive soil, Geotextile, GGBS, CBR, UCS, FSI, DCP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	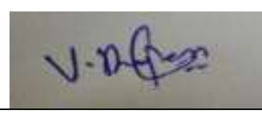	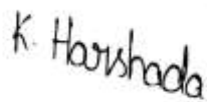	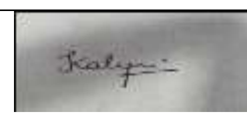
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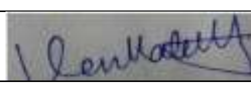			
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