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Review of Use of RBI 81 Along with Coir Fiber for Stabilisation of Expansive Soil

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Abstract- Expansive soil is considered one of the most common causes of pavement distresses. Depending upon the moisture level, expansive soils will experience changes in volume due to moisture fluctuations from seasonal variations. During periods of high moisture expansive will "swell" underneath pavement structure. Conversely during periods of falling soil moisture, expansive soil will "shrink" and can result in significant deformation. These cycles of swell and/or shrinkage can also lead to pavement cracking. Puppala et al. (2006) implied that expansive soils encountered in various districts particularly in northern Texas are the primary causes of pavement failures. Expansive soils located in regions where cool and wet periods followed by hot dry periods are more prone to such problems.

Index Terms- Coarse Aggregate, Design Mix, Plastisizer, Steel Slag, Sand, Slump value, workability

I. INTRODUCTION

Expansive Soil" is reviewed in this chapter. Some papers dealing with related to the above topic are discussed in the present chapter. The literature review search has been performed for relevant publications using many Web based search engines and databases. The search was purposely restricted to articles published in refereed journals and containing the terms: Compressive strength, Rice Husk Ash, Black Cotton soil & coir Fiber etc. Any research paper with the key terms as mentioned above has been considered here and included in the database of this research. Thus the literature review provides a basic background and the ideas for the present work and is relevant for the present study.

II. REVIEW OF SOME IMPORTANT LITERATURE

S.Gangadhara et.al. (2023) in this research, an attempt is made to understand the impact on strength characteristics of expansive soil treated with Road Building International Grade-81 (RBI-Grade-81) stabilizer. This stabilizer has a wide response spectrum range. A broad range of studies, such as Atterberg limit, Compaction, Unconfined compressive strength (UCS), and California bearing ratio (CBR) measures, are demonstrated on expansive soil and it is treated with percentages varying between 2 and 10% of RBI-Grade-81. Due to the creation of new cement materials, which is apparent in the SEM research micrographs, the improvement in intensity is achieved. The results suggest that considered stabilizer is effective in enhancing the engineering properties of expansive soil.

Kumar and Khatri (2023) This study presents and analyzes the results of a series of Atterberg's limit tests, Proctor compaction tests, California bearing ratio tests and Unconfined 17 Compressive Strength tests performed on Black cotton soil treated with mixture of various Lime and Road Building International (RBI) Grade 81 contents and compacted under the optimum Proctor conditions. These test results show that the geotechnical parameters values are concordant and confirm the bearing capacity improvement of this natural clay, which is translated by a significant increase in soil strength. However, the best performances are obtained for a mix treatment corresponding to 6% Lime and 5% RBI Grade 81 contents. Using 6% Lime we can save up to 25% & using 5% RBI Grade 81 we can save up to 18% pavement cost.

Bernadette et.al (2022) the present study investigates the effect of reinforcing the sub grade soils with RBI 81 material. A soil nearby was collected and preliminary tests were conducted to classify the soil and it was found from the results that the sample collected was a poorly graded clay. Subsequently Tests such as Proctor Compaction, CBR, and UCC were conducted to study the various engineering properties of the identified soil. In addition to the above tests were also conducted on the soil by reinforcing with varying percentages of RBI 81. From the analysis of test results it was found that this material (RBI 81) will significantly improve the CBR value of the soil.

Shiva and Darga (2022) the present study deals with the efect of Road Building International Grade 81 (RBI Grade 81) on strength characteristics of the clayey subgrade. A wide range of tests was conducted on various percentages of RBI Grade 81 subgrade mixtures such as Atterberg limits, compaction characteristics, California Bearing Ratio (CBR) and Unconfned Compression Strength tests (UCS). It can be noticed that the CBR of clayey subgrade has increased signifcantly with the addition of RBI Grade 81. Similarly, the maximum dry density (MDD) has decreased and the optimum moisture content (OMC) has increased with RBI Grade 81 addition to subgrade. The strength of clay subgrade at 8% of RBI Grade 81 has improved 3–3.5 times as compared to the natural clayey subgrade. Overall, it can be concluded that RBI Grade 81 is suggested as a potential stabilizing agent especially for clayey subgrades. 18 Figure 2.1: Variation of OMC and MDD with RBI Grade 81

Kumar and Solanki (2022), in the present study, an attempt is made to modify the engineering properties of the expansive soil available in SVNIT campus of Surat city, Gujarat by stabilizing it with RBI Grade 81. The effect of adding this chemical stabilizer in expansive soil are characterized through various laboratory tests to determine Consistency Limits, Compaction Characteristics, Free Swell Index, Unconfined Compressive Strength, and California Bearing Ratio. The laboratory investigations indicate that RBI Grade 81 with up to 5% optimizes the engineering properties of expansive soil to be used as sub-grade.

K. Prashanth and M. Kumar (2021) the present study deals with prophecy of plate load test response from theory of elasticity solution as well as California Bearing Ratio (CBR) test. The response of elastic half space in CBR mould model in FEM was generated and the relationship between modulus of elasticity (E) and CBR was derived. In addition, the correlation between E and CBR was proposed and using E values, coefficient of subgrade reaction (ks) predictions were discussed. Thus, CBR test is expected to simplify the effort in determination of ks which is used in pavement design.

Sharma and Jain (2021) reviewed the, benefits, properties and applications of coir fiber in soil reinforcement through reference to published scientific data. They concluded that Coir fiber is a useful biodegradable waste that improves strength and stiffness of all types of soil coir used in different proportion and different lengths affect the soil properties. Further work can be done on degradation of coir waste.

Singh and Mittal (2021) conducted an experimental study on clayey soil mixed with varying percentage of coir fiber. Soil samples for unconfined compression strength (UCS) and California bearing ratio (CBR) tests are prepared at its maximum dry density corresponding to its optimum moisture content in the CBR mould without and with coir fiber. The percentage of coir fiber by dry weight of soil is taken as 0.25%, 0.50%, 0.75% and 1% and corresponding to each coir fiber content unsoaked and soaked CBR and UCS tests are conducted in the laboratory. Tests result indicates that both unsoaked and soaked CBR value of soil increases with the increase in fiber content. Soaked CBR value increases from 4.75% to 9.22% and unsoaked CBR value increases from 8.72% to 13.55% of soil mixed with 1% coir fiber. UCS of the soil increases from 2.75 kg/cm² to 6.33 kg/cm² upon addition of 1% randomly distributed coconut fiber. Adding of coconut coir fiber results in less thickness of pavement due to increase in CBR of mix and reduce the cost of construction and hence economy of the construction of highway will be achieved. This is because of composite effect of natural fiber changes the brittle behavior of the soil to ductile behavior.

Tiwari and Mahiyar (2021) have tested individual behavior of FlyAsh Crushed Glass & Coconut Coir Fiber with soil, which shows that for adding 10%, 15%, 20%, 25% & 30% FA with soil produces highest CBR of value 4 at max 25%, after that curve height decreases gradually. Similarly on adding 3%, 5% & 7% they obtained highest CBR of value 3 .1 at 7% CG after curves falls down enormously. Also for adding 0.25%, 0.5%, 0.75%, 1% & 1.25%.of CCR we obtained max curve height at CBR value of 3.6 after that curve should successive depletion. Hence they determined from experimental results for combinations made for 25%FA, 7% & 1%CCF to set range for combination for this 48 trial samples are made. During this trial C.B.R, curve attains highest value at 5.2 and falls down 2.2 and again it goes to 3.8, for different set of combination. Chapale and Dhatrak (2013) focused on effect of coir on bearing capacity and settlement of footing with parameters such as thickness of reinforced layer (B, B/2, B/4) with 20 0.25%, 0.5%, 0.75% & 1.0% of coir using the laboratory model tests on square footings supported on highly compressible clayey soil reinforced with randomly distributed coir fiber. Provision of coir reinforced layer increases bearing capacity ratio up to 1.5 to 2.66. There is significant increase in bearing capacity of clayey soil with the inclusion coir fibers. At 25 mm depth of fiber reinforced soil (B/4) and 0.50% fiber content the SBC is maximum. There is no need to place the fiber reinforced soil throughout the depth as the soil is affected to a significant depth of 2 to 2.5 times the width of footing. Only one fourth width of footing (B/4) is sufficient for increasing the SBC. In general, the results shows that the provision of coir reinforced layer, reduces the settlement and improves the bearing capacity , which found to be economical techniques among various types of bearing capacity improvement techniques.

H.P. Singh (2019) studied the influence of coir fibers on shear strength parameters (c and ϕ) and stiffness modulus ($\sigma d / \epsilon$) of fly ash. In the present investigation, samples of fly ash compacted to its maximum dry density at the optimum moisture content were prepared without and with randomly distributed coir fiber for triaxial compression tests. The coir fiber were taken as 0.25 %, 0.5 %, 0.75 % and 1 % by dry weight of fly ash and the shear strength parameters (c and ϕ) and stiffness modulus (σd /ϵ) of reinforced fly ash for each fiber content was determined in the laboratory. Finally these strength parameters (c, ϕ and σd /ϵ) of reinforced fly ash were compared with that of unreinforced fly ash. Tests results indicate that on inclusion of coir fiber, the shear strength parameters and stiffness modulus of fly ash increases. It was also observed that on increasing the fiber content, the values of these strength parameters further increases and the improvement is substantial at fiber content of 1 %.Thus there is a significant improvement in the strength parameters of fly ash due to inclusion of coir fiber.

Singh and Gill (2019) studied the effect of geo-grid reinforcement on maximum dry density (MDD), Optimum Moisture Content (OMC), California Bearing Ratio (CBR) of sub-grade soil. The clayey type of soil and one type of geo--grid were selected for this study. From the study it is clear that there is considerable improvement in California Bearing Ratio (CBR) of sub-grade due to geo-grid reinforcement. In case of without reinforcement (Geo-grid) the soaked CBR value was 2.9% and when geo-grid was placed at 0.2H from the top of the specimen the CBR increases to 9.4%. 21 • Vaidya et. al (2018), The stabilization of the fly ash with cement alone or in conjunction with polypropylene fibers is effective in order to enhance the either strength parameter-compression as well as tensile strength.

The strengths (UCS as well as BTS) increase up to 1% fiber in all the mixes and thereafter, it decreases. The value of the strengths (UCS and BTS) increases with increase in curing period. The rate of gaining the strength in most of the cases are rapid during initial phase of curing, i. e., up to 14 days curing. The value of strengths (UCS as well as BTS) in respect of un- soaked sample is higher than that in case of soaked sample.

At higher curing period such as 14 days considered in the present study, the durability of stabilized fly ash gets improved due to formation of pozzolanic reaction with the addition of cement. Both the strengths- compressive as well as tensile- is found to be higher in case of 20% cement contents and corresponding to 1% fiber in case of either samples, i.e., un soaked and soaked, indicating the optimum performance of the mix with 20% cement contents and 1% fibers.

III. CONCLUSION

The effect of adding this chemical stabilizer in expansive soil are characterized through various laboratory tests to determine Consistency Limits, Compaction Characteristics, Free Swell Index, Unconfined Compressive Strength, and California Bearing Ratio. The laboratory investigations indicate that RBI Grade 81 with up to 5% optimizes the engineering properties of expansive soil to be used as sub-grade.

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