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Stabilization of Dredged Material Obtained from Floodspill Channel [Srinagar], for its Potential Use as Subgrade Material for Design of Flexible Pavements

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Abstract: ***Efforts in this study were primarily aimed at in making use of dredged material for potential use as road subgrade in the design of flexible pavements. It was decided to evaluate use of polymer based additives for stabilization of such soil. Soils are strong in compression but weak in tension. The current practice is to modify the strength of the soils by addition of polypropylene fiber to meet the design specifications.***

Keywords: Polypropylene fiber; CBR; Field tests; Subgrades ; Flexible Pavement

1. Introduction

Reinforcement aids in the strength and stability of soil. Reinforcement of soil with fiber is one of the most effective techniques to increase in soil strength. Therefore, a number of experimental studies have been carried out, wherein soil is mixed with polypropylene fibers. The present work shows the behavior of a CBR test on soil specimens collected from two different locations reinforced with randomly distributed discrete polypropylene fibers, under unsoaked conditions, when compared to a non reinforced soil specimens under similar conditions. In this paper it is shown that the soil reinforced with the polypropylene fibers have more strength than the non- reinforced soil. In this study efforts are being made in order to utilize the desilted material in the preparation of soil subgrade for the design of flexible pavements after its stabilization.

2. Laboratory and Field Testing

Programme

a) Materials

The soil samples used in the present study were derived from the flood channel, and were obtained from the region of Mehjoor Nagar and Rambagh, in Srinagar, Jammu and Kashmir, India. The soil 1 and Soil 2 are classified as low plasticity silty sand–clayey sand according to the USCS (Unified Soil Classification System). The specific gravity of soil 1 and soil 2 respectively are 2.60 and 2.5. The dry density of Soil 1 and Soil 2 are 1.89g/cm^{3}and 1.93g/cm^3 respectively. The Atterberg limits of the portion passing No. 40 sieve are: liquid limit 30.18% and 42.5 % respectively for Soil 1 and Soil 2, plastic limit 18.7% and 22.30% respectively for Soil 1 and Soil 2. Chopped polypropylene fibers were used throughout this investigation. Their average characteristics were: 12 mm in length, 0.06 mm in diameter, unit weight of 0.946 g/cm^3, tensile strength and elastic modulus of 350 and 3,500 MN/m2, respectively.

b) Laboratory Preparation and Testing of Specimens

The compacted soil and the fiber-reinforced laboratory specimens were prepared by hand mixing dry soil, water, and polypropylene fiber when applicable During the mixing process, it was found to be important to add the water previously to the fibers to prevent floating problems. Visual and microscopic examination of exhumed specimens proved the mixtures to be satisfactorily uniform. The specimens were statically compacted in three layers into a 50 mm diameter by 100 mm high cylindrical mould, to an optimum moisture content of 16.1% and 21 % and maximum dry unit weight of 1.8 g/cc and 1.74 g/cc respectively for soil 1 and soil 2. These values were obtained from standard Proctor compaction tests carried out on both soil and soil–fiber mixtures. For fiber mixed soils it was seen that the optimum moisture content decreases with increase in percentage of fiber and Maximum dry unit weight increases with increase in percentage of fiber.

Figure 1(a): Compaction Mould

Figure 1(b): CBR Test Setup

The CBR test is commonly used methods to obtain the strength of a sub base, sub grade soil and base course material for design of thickness for highways and runway pavement. The CBR test is penetration test meant for the evaluation of subgrade strength of roads and pavements. The results obtained from these tests are used with the empirical curves to determine the thickness of pavement and its layers. This is the most commonly used method for the design of flexible pavement. As per IS Code, the CBR test was performed on remolded soil by static compaction. The required amount of soil as well as fiber was first weighed and then the strips randomly mixed with dry soil at obtained moisture content. The soil was compacted in three equal layers by applying 75 evenly blows with 4.89Kg hammer at free fall. The care was taken to ensure a homogeneous mix. Surcharge weight of 2.5 Kg was placed over the specimen, clamped over the base plate and the whole mould with weight is placed under the testing machine. The penetration plunger is seated at the center of the specimen and is brought in contact with the top surface of the soil sample. The dial gauge, measuring the penetration values of the plunger is fitted in position. The dial gauge of the proving ring (for load reading) and the displacement dial gauge are set to zero. The load is applied through the penetration reading of 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 4.5, 5.0, 7.5, 10.0 and 12.5mm.

3. Test Results and Discussions

Load penetration behavior of reinforced/non reinforced soil samples were examined. The load penetration curve has been plotted for each specimen. Fig.2 (a) shows the typical plots of load- penetration curves for reinforced Soil 1 with polypropylene fiber at different proportions of polypropylene mixed under soaked conditions. Also, Fig.2 (b) presents the typical plots of load-penetration curves for soil 2 reinforced with polypropylene fibers at different proportions under soaked condition. The CBR values have been calculated for the load corresponding to the penetration of 2.5 mm and 5.0 mm. The higher of these values have been adopted as CBR value (IS-2720-16- 1979).

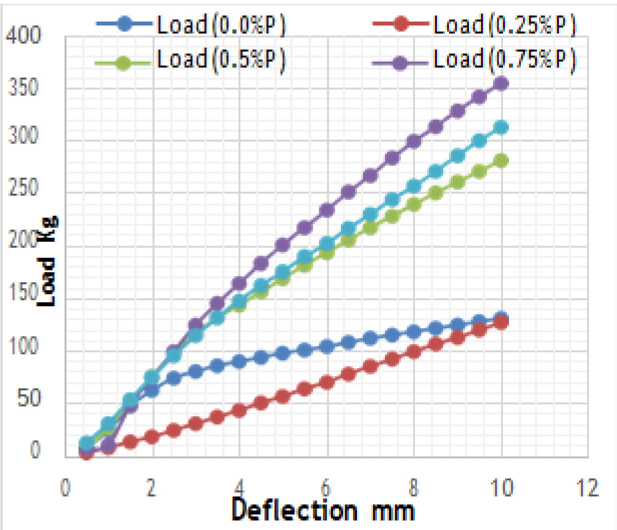


Figure 2 (a): CBR Curve for Sample 1 at Different Proportions of Fiber Mixed

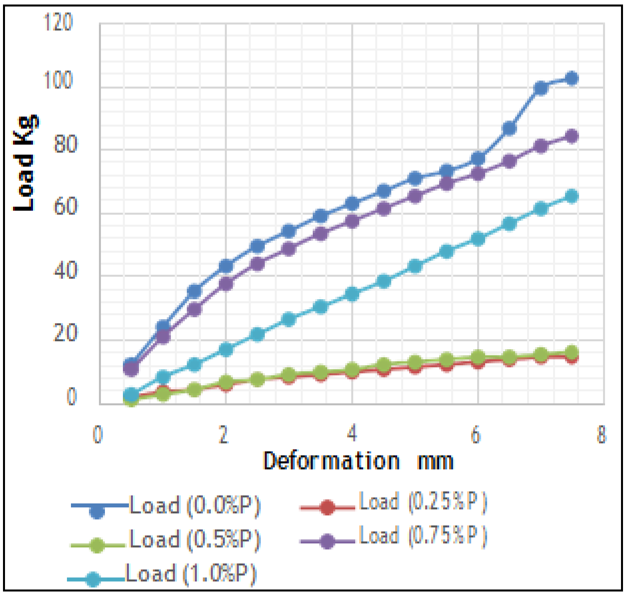
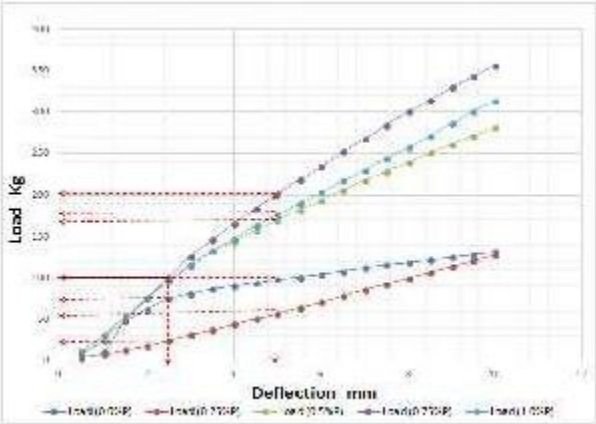


Figure 2 (b) CBR curves for Sample 2 at different proportions of fiber mixed.

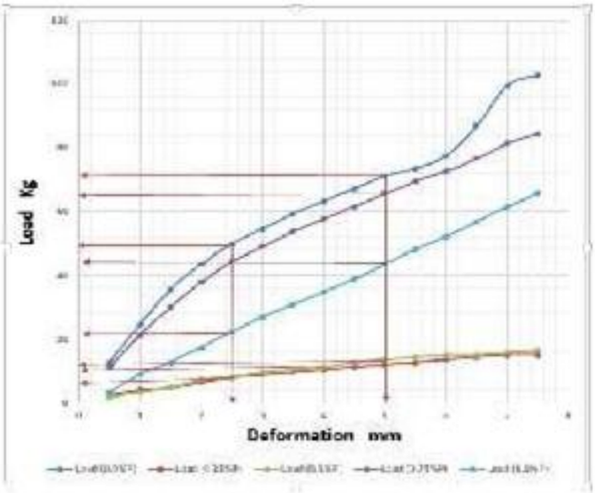
CBR Values at 0% of Polypropylene fiber		
Penetration in mm	***Soil 1***	***Soil 2***
2.5	5.47	3.6
5	4.80	3.46
CBR Values at 0.25% of Polypropylene fiber		
2.5	1.84	0.57
5	2.80	0.57
CBR Values at 0.50% of Polypropylene fiber		
2.5	7.20	0.57
5	8.26	0.65
CBR Values at 0.75% of Polypropylene fiber		
2.5	7.32	3.29
5	9.80	3.10
CBR Values at 1% of Polypropylene fiber		
2.5	7.03	1.61
5	8.57	2.11

4. Conclusion

The following observations and conclusions are made regarding the engineering properties and behavior of polypropylene fiber reinforced soil samples. The CBR test results showed that the addition of polypropylene fibers significantly improved the behavior of soil sample 1 as compared to the soil sample 2 of polymer has better strain absorption capacity with considerable increase in strength at the same time.



Load deformation curve of sample 1 at different %age of polymer



Load deformation curve of sample2 at different %age of polymer

It has been observed that for Sample-2 not much increase in strength in terms of CBR has been observed indicating that sample-2 is not fit for stabilization using polypropylene and same may respond to any other method of stabilization.

The noticeable stiffer response with increasing penetration was observed. This improvement of soil behavior due to fiber addition suggests the potential application of randomly distributed discrete fibers to reinforce soft soil subgrade/sub base under heavy loads for improving the strength which may suffer excessive deformation otherwise.

Given the fact that sample-1 has responded well to stabilization using polypropylene fibers with 44% increase in CBR. It is proposed that the dredged material from location of Sample-1 (N 34° 3’ 17.55” E 74°48’ 21.40”) can very well be used as potential sub grade material for flexible pavement.

It has been observed that for Sample-1 significant increase in CBR value were obtained at a dosage of around 0.75%. There has been almost 44% increase in CBR with polymer stabilization in comparison to unstabilised sample. It may be observed that stabilized sample of soil at 0.75%

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