Stabilization of Natural Soil with Sand and Cement

Devansh Jain[1]Sanjay Kumar Shrivastava[2]
[1]Assistant Professor [2]Highway Engineer
[1]UIT-RGPV [2]Sheladia Associates Inc.

Abstract— In western Madhya Pradesh generally black cotton soil is found, Black cotton soil is exceptionally feeble and does not have enough steadiness for a development work. On pavement, subgrade layer is the base most layer basic the base form or surface form. To prepare the subgrade soil stable, by enhancing its building properties is extremely rudimentary. In the present study, an adjustment of subgrade soil by using sand and cement i.e. varying the rate of sand and consistent rate of cement by weight of soil is applied to improve the strength of subgrade soil. The grounds for this field is to determine the ideal measurement of the stabilizer, which heightens the effectiveness of soil. Which will be suited for pavement construction. To assess the strength of soil, different test has been performed on the soil. It has been noticed that sand and cement increases the effectiveness of the land.

Key words: Black cotton soil, stabilization, CBR, sand and cement, Pavement

I. INTRODUCTION

Far reaching soil is constantly hazardous for the building structures because of its swelling and shrinkage conduct. It gets shrunk when dried in summer and swells when wet in winter season. The social organizations on these soils encounter vast scale harms. The property of far reaching soil results, splits in the dirt with no notification. These breaks are sometime huge and endure thorough harm to the social system. Streets going through far reaching soil locales are subjected to serious trouble bringing about poor performance and expanded upkeep cost. Again clayey soil having versatility file more than 6 are required to be shared with and balanced out before starting to be employed for development, according to the detail of Ministry of Road Transport and Highway, Government of India. To preserve the structure from such harms, adjustment of soil is taken with the balancing out materials like fly fiery remains, lime, sand, bitumen, cement, rice husk powder and hence along. The designing properties of Black cotton soil (B.C. soil) can fundamentally be enhanced with these balancing out operators.

The scheme of balancing out the ground with sand and cement is being conveyed from long time. Blending Portland cement, sand and pummeled dark cotton soil with the ideal dampness content and compacting the blend to achieve the needed thickness. The material gained by combining soil, cement and sand is known as cement sand soil. Cement in the orbit of 2 to 5 percent gets momentous change the building qualities of B.C. soil. So as well expanding the extent of sand as a stabilizer additionally enhances the properties of land.

Soil–sand-cement is an all around arranged blend of ground when water is added to the blend and compacted; the least extent of cement is not quick to tie every one of the particles to an intelligible mass, however it passes with the sediment and dirt divisions and diminishes their partiality to water and decreases the swelling conduct of blend adjusts the properties of land and expand the effectiveness of soil.

II. METHODS AND MATERIALS

A. Material Used

The following fabrics are used in the study for stabilization of natural soil i.e. Black cotton soil. Soil was collected from western areas of Madhya Pradesh, the dirt is black cotton ground. This stain is used up as dried in the gentle wind and then it dried in oven at 100oC +- 10oC. The specific gravity of the soil is 2.69, IS Classification is MH and it's 2.1% gravel, 12.41% sand along with 85.49% Silt and Clay percentage. Natural river sand, which extends from 4.75 mm sieve is used in this project having specific gravity 2.64. Ordinary Portland Cement (OPC), having specific gravity 3.13 is utilized in this task.

B. Methodology

First properties of the natural soil is determined and then soil is stabilized with sand upto 40% by the weight of soil at an interval of 10% along with 2.5% cement. these proportions are tested for index properties and also for CBR. Test performed for this project is sieve analysis, liquid limit, Plastic limit, Standard proctor test and CBR test in the laboratory. Mix proportions of the soil used in this project is give below in table 1, these mixes used for stabilization are made up with soil.

S.No.	Mix	Cement	Sand
1.	T1 (Natural Soil)	--	--
2.	T2	2.5%	10%
3.	T3	2.5%	20%
4.	T4	2.5%	30%
5.	T5	2.5%	40%

Table 1: Mix Proportions of Soil used for stabilization

III. RESULT AND DISCUSSION

A. Atterberg Limit Test

The Atterberg limits are a basic criterion of the nature of fine grained soil. Depending upon the urine capacity of the soil, it may come out in four states namely solid, Semi soiled, Plastic, Liquid. In each state the consistency and behavior of the soil are different and therefore so are its engineering properties. Thusly, the limit between each nation can be set based on a change in the soil's behavior. These boundaries were created by Albert Atterberg and were subsequently refined by Arther Casagrande. Liquid limit test, Plastic limit test and swelling index test are being carried out with the following answers. Results of atterberg limits are presented in table 2.

S.No.	Mix	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
1.	T1	69.8	36.7	33.1
2.	T2	62.1	30.9	31.2

3.	T3	56.9	30.2	26.7
4.	T4	50.7	29.1	21.6
5.	T5	49.9	29.2	20.7

Table 2: Results of Atterberg Limits.

B. Proctor Compaction Test.

To quantify the amount of compaction and the water content required in the field, compaction tests are done on the soil samples in the laboratory. The tests provide the following results, the optimum moisture content and maximum dry density of soil. The result of proctor compaction test is presented in table 3.

S.No.	Mix	Optimum Moisture Content (%)	Maximum Dry Density(KN/m3)
1.	T1	28.20	1.30
2.	T2	25.04	1.55
3.	T3	20.19	1.60
4.	T4	14.85	1.69
5.	T5	13.95	1.80

Table 3: Result of Proctor Compaction Test.

C. California Bearing Ratio (CBR) Test

The California bearing ratio (CBR) test was developed by the California Division of highway as a method of measuring soil-subgrade and base course materials for flexible pavement. The CBR is a situation of resistance of a material to penetration of standard plunger under maximum density and optimal moisture conditions. The test consists of causing a cylindrical plunger of 50 mm diameter to penetrate a pavement component material at 1.25 mm/minute. The load, for 2.5 mm and 5 mm are recorded. The load is expressed as a part of standard load value at a respective deformation level to obtain CBR value. The soil samples for the CBR test were set up as per standard procedure. The CBR value is found corresponding to both 2.5 mm and 5 mm penetration, and greater value is to be used for the design.

CBR = (Test load /Standard load) x 100

S. No.	Mix	Soaked CBR (%)
1	T1	2.04
2	T2	3.12
3	T3	3.62
4	T4	5.79
5	T5	7.91

Table 4: Results of California Bearing Ratio (CBR).

IV. CONCLUSION

Following points are derived from the presented study. The study reveals that the CBR value increases when we increase the sand content and reaches to a desirable CBR value for subgrade of pavement. Generally for pavement design soaked CBR value is considered.

Experimentally it is found that the addition of sand content in the soil results in the improvement of soaked CBR value. CBR values varies from 2.04% to 7.91%. 40% sand and 2.5% cement with the natural soil i.e T5 mix posses maximum value of CBR. It has been observed that when we increases sand content so that Liquid limit, plastic limit, plasticity index and free swelling index decreases and Whereas moisture content goes on decreases and maximum dry density increases when we increases sand content in the mix.

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