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STABILISATION OF EXPANSIVE SOIL BY RBI GRADE-81

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***Abstract*— The basic foundation for any Civil Engineering structures is soil. It is required to bear the loads without shear. States like Maharashtra exhibits higher expansive soils. The light compaction is done for rural road construction and as the time goes on, settlement of soil happens with pavement failure. In order to fully appreciate the usefulness of expansive soil, its problems (shrinkage and swelling) would have to be identified and useful solutions are needed, like stabilization. The main objectives of the soil stabilization are to increase the bearing capacity of the soil, its resistance to weathering process and to gain stability. Soil stabilization can be divided into two categories namely mechanical and chemical. Mechanical stabilization is the blending of different grades of soils to obtain a required grade. Chemical stabilization is the blending of the natural soil with chemical agents. This study deals with the complete analysis of the improvement of soil properties and its stabilization using RBI Grade 81. In this study RBI Grade 81 is mixed with soil for different percentage to investigate the relative strength gain and compaction. The effect of RBI Grade 81 on the geotechnical characteristics was investigated by conducting Atterberg's limit, standard and modified proctor compaction tests, Unconfined Compressive Strength test. The test was performed as per Indian Standard specifications. Testing is done by mixing RBI Grade-81 in different proportion i.e. 2% ,4% ,6% and 8 % for different curing days on 0,1,3,7,14,21,28,35 and readings are taken. It is found that UCS is increased by 563% with addition of 6% RBI Grade-81 in 21 days of curing.**

***Keywords*— compaction, geotechnical characteristics, proctor test, RBI Grade 81, U.C.S.**

I. INTRODUCTION

Expansive soil is predominantly clay soil that leads to noticeable changes in volume and strength due to change in moisture content. Due to increase and decrease in moisture content, the soil gets expand the pressure increases and sub grade of the structure losses its strength, load carrying capacity, fissures, deformation and undulation thereby pavement failing process starts. All these process decrease the life span of pavement. If the stability of the local soil is not adequate for pavement construction, the engineering properties are enhanced by adopting various soil stabilization techniques. Thus the principle of soil stabilized road construction involves the effective utilization of local soils and other appropriate stabilizing agents.

Sustainable growth in a Country's march towards progress, reach and development is largely based on its infrastructure. Connectivity remains the most important ingredient for infrastructural improvement. Roads, the arteries of a nation, bring rapid transformation along its path, changing socio-economic structure, demographics and environment. In India, roads are being built with little emphasis on the preservation of the environment. Daily reports of damage to the environment, stripping of forest cover, hills and riverbeds are being voiced. While western nations have timely identified the importance of preservation of nature, we still tend to be lackadaisical in our approach. No justification can be offered in the name of progress if it denudes and depletes the very environment that allows its sustenance. It is our endeavour to save the fast depleting natural resources with alternate technology in order to conserve our hills, forests and rivers. Green and environment friendly technologies are available which can create a permanent impact on our environment, as well as end the depletion of good quality conventional material. It would minimize the damage to the environment due to emission of gasses like carbon dioxide and heavy suspended particles in the air.
India has the second largest road network in the world. We have over 4 million km of roads. Our roads are classified as,

- Expressways 0.01%
- National Highways 2.78%
- State Highways 3.95%
- Major District Roads 13.99%
- Rural & Other Roads 79.28%

Though we are second in the world in terms of length but our roads quality does not rate very

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high. In spite of having 4 million km of connectivity, our connectivity is far from being sufficient. The construction of roads currently requires enormous amount of good soil, sand, aggregates and bitumen.

- Expansive soil deposits are problematic for the engineering structures.
- Different types of damages in the form of cracking, undulations differential settlement etc. are experienced by road, buildings, irrigation canal, sewer line etc.

So to overcome these damages to the structure its Engineering properties are to be improved.

A. RBI GRADE-81(ROAD BUILDING INTERNATIONAL)

- RBI Grade-81(Road Building International) is an odorless powder that is composed of a number of naturally occurring compounds.
- It improves the structural properties of a wide range of soils.
- It is particularly effective with silty - clayey soil with low geo-mechanical qualities and it works by hydration reaction (Alchemist technology limited New Delhi).
- This binding of the soil particle, through both chemical bonds and frictional forces, serves to limit the pore volume of the created rigid
- stabilized soil system.
- Expansive soil stabilized with RBI Grade-81 for different proportion i.e. 2% ,4% ,6% and 8 % stabilizer for different curing days on 0,1,3,7,14,21,28,35.

Table 1: Physical and chemical properties of RBI Grade-81

	Properties	(%) By mass
1	CaO	52-55
2	SiO2	15-19
3	SO3	9-11
4	Al2O3	5-7
5	Fe2O3	0-2
6	MgO	0-1
7	Polypropylene Fibres	0-1
8	Additives	0-4

Table no 2: Chemical Composition of RBI Grade 81

PROPERTIES	%BY MASS
Ca	Cao 52-56%
Si	SiO2 15-19%
S	SO3 9-11%
Al	Al2O3 5-7%
Fe	Fe2O3 0-2%
Mg	MgO 0-1%
Mn, K, Cu, Zn	0.1-0.3%
H2O	1-3%
Fibres	0-1%
Additives	0-4%

Table No 3: The Physical Properties of RBI Grade 81

Physical Properties RBI	Grade -81
Odour	Odourless
Ph	12.5
Freezing point	None
Flammability	Non-flammable
Shelf life	12 months
Storage	Dry storage
Bulk density	700 kg/m3

Fig. no.1. RBI Grade 81

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II. TEST PERFORMANCE

A. PARTICLE SIZE DISTRIBUTION

Preparation of sample:

1. Soil sample, as received from the field, dried in air or in the sun. In wet weather, the drying apparatus may be used in which case the temperature of the sample should not exceed 60oC. Tree roots and pieces of bark removed from the sample.
2. The big clods may be broken with the help of wooden mallet. Care should be taken not to break the individual soil particles.
3. A representative soil sample of required quantity as given below, is taken and dried in the oven at 105-120^{o}C.

Procedure to determine the particle size distribution of a soil:

The material retained on 75 µ IS sieve is collected and dried in oven at a temperature of 105-120^{o}C for 24 hours. The dried soil sample is sieved through 4.75mm, 2.36mm, 1.4mm, 1.18mm, 1mm, 850micron, 600micron, 425micron, 300micron, 150micron, 90micron IS sieves. Soil retained on each sieve is weighed.

B. LIQUID LIMIT TEST

Preparation of Samples

a) Air dry soil sample and break the clots. Remove the organic matter like tree roots pieces of bark, etc.
b) About 100g of specimen passing through 425µm IS sieve is mixed thoroughly with distilled water in the evaporating dish and left for 24 hours for soaking.

C. PLASTIC LIMIT TEST

Preparation of sample

Take out 30 gm of air dried soil from a thoroughly mixed sample of soil passing through 4.25 µ m IS sieve. Mix the soil with the distilled water in an evaporating dish and leave the soil mass for nurturing. This period may be up to 24 hrs.

D. STANDARD PROCTOR TEST (IS PART VII 1980/87)

The test consists in compacting soil at various water contents in the mould, in three equal layers, each layer being given 25 blows of the 2.5 kg rammer dropped from a height of 30.5cm. The dry density obtained in each test is determined by knowing the mass of the compacted soil and its water content. The compactive energy used for this test is 12,400 ft-lbf/ft^3.

E. UNCONFINED COMPRESSION STRENGTH (IS1943)

An Unconfined compression test is also known as uniaxial compression tests, is special case of a triaxial test, where confining pressure is zero. UC test does not require the sophisticated triaxial setup and is simpler and quicker test to perform as compared to triaxial test. In this test, a cylinder of soil without lateral support is tested to failure in simple compression, at a constant rate of strain. The compressive load per unit area required to fail the specimen as called unconfined compressive strength of the soil.

III. INVESTIGATING SOIL

A. LOCATION OF SOIL SAMPLE TAKEN

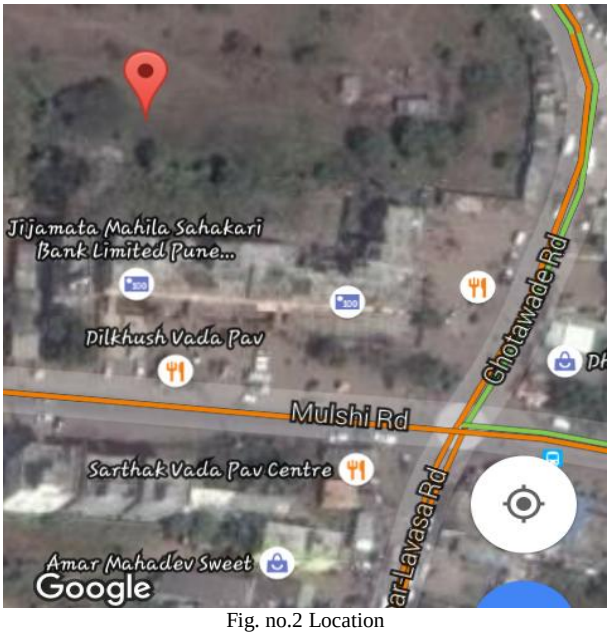

Fig. no.2 Location

LOCATION: Marnewadi village, ghotawade phata, Lavasa road, Paud, Mulshi, Pune, Maharashtra. (25km from MIT campus, Pune)
Latitude = 18°30'49.6"N
Departure = 73°40'38.3"E

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Table 3.1. Properties of Investigative Soil

Sr No.	Properties of expansive soil	Value
1.	Specific gravity	1.92
2.	Grain size classification: a. Gravel content % b. Coarse Sand content % c. Fine Sand content % d. Clay and Silt content %	 0 4.63 11.88 83.49
3.	Unified Soil classification	MH-CH
4.	Attreberg limits: a. Liquid limit% b. Plastic limit% c. Shrinkage limit% d. Plasticity index%	 56 32 8 24
5.	Unconfined Compression Strength (KN/m^2)	49
6.	Differential Free Swelling Index %	63
7.	Engineering Properties (Light compaction) a. Maximum Dry Density(KN/m^3) b. Optimum Moisture Content %	 14.8 20.4

IV. METHODOLOGY

1. Dry mixing of RBI grade 81 in soil with various % as, 2%, 4%, 6%, 8%.
2. Mixing water as per OMC.
3. Sample preperation in mould.
4. Sample extaction in extactor.
5. Sample curing for different curing days on 0,1,3,7,14,21,28,35.
6. Testing in U.C.S. testing machine.
7. Recording of readings.

Fig. no.3 dry mixing of RBI GRADE81 in soil

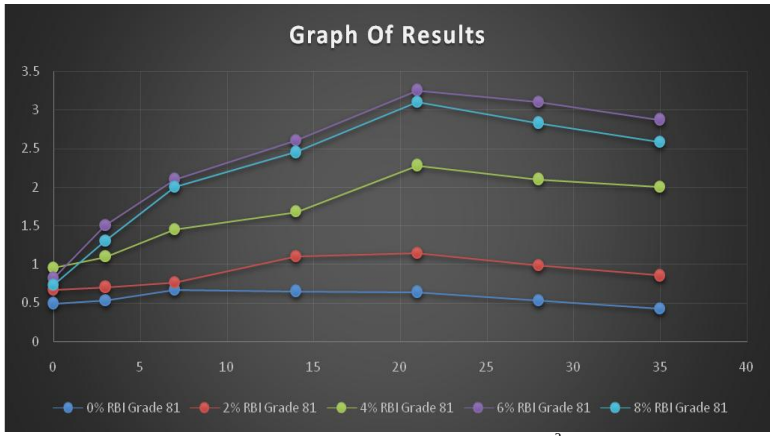
Fig. no.4 u.c.s. testing machine

V. RESULTS AND ANALYSIS

With different percentage of RBI Grade-81 and different curing days following reading of UCS are obtained. In 0% RBI Grade 81, the values are continuously increasing due to constant moisture content in dessicator.

Table no.5.1 Unconfined Compression Test (UCS in kg/cm^2) Results

Days	0% RBI Grade 81	2% RBI Grade 81	4% RBI Grade 81	6% RBI Grade 81	8% RBI Grade 81
0	0.49	0.67	0.95	0.82	0.73
3	0.53	0.7	1.1	1.5	1.3
7	0.67	0.76	1.45	2.1	2
14	0.65	1.1	1.68	2.6	2.45
21	0.64	1.14	2.28	3.25	3.1
28	0.53	0.98	2.1	3.1	2.83
35	0.42	0.85	2	2.87	2.58



Graph no.5.1 Unconfined Compression Test (UCS in kg/cm^2) Results

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On X axis curing in days and in Y axis UCS reading in kg/cm^2. It was seen that after 21 days the values are sligthly decreased. For 6% RBI Grade 81 with 21 days optimum value is obtained.

VI. CONCLUSION

1) RBI Grade-81 enhances Unconfined Compression Test of investigating soil by 563 percentage.
2) The investigating soil has significant improvement of Unconfined Compression strength by 6% addition of RBI Grade-81 on 21 days of curing.
3) Curing has positive effects on Unconfined Compression Test.
4) RBI Grade-81 can be used as a stabilizer for expansive soils in rural road construction.

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