EXPERIMENTAL STUDY ON STABILIZATION OF COLLAPSIBLE SOILS USING BENTONITE

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Abstract

Collapsible soils are unsaturated soils that collapse suddenly when wetted under loading. Majority of naturally occurring collapsible soils are Aeolian deposits such as loess. Red soils are also come under this category. Several methods have been used to study the behavior of collapsible soils by understanding their geotechnical properties. In present study bentonite was chosen as an additive and various geotechnical tests have conducted on Bentonite - Red soil mixes. To study the influence of fines on collapsible behavior, the experimental work says that the collapsibility was found to decreases with addition of 2, 4, 6,8,10 percentage of bentonite. The collapse behavior was quantified from criteria like Gibbs (1961), Denisov (1951) etc., based on Geotechnical properties.

Index Terms—Bentonite, Collapsiblebehavior ,Redsoils,

I. INTRODUCTION

Vishakhapatnam region is a rapid industrial urban growth area inhabited by number of infrastructure projects related to roads, residential buildings, embankments, and retaining walls etc., which are found on red soil deposits. Structures founded on these soils subjected to large deformations due to reduction in volume and loss of shear strength when in contact with water causes distress to the structures due to large differential settlements. In the present study red soils were collected and tested for index properties such as grain size distribution, Atterberg's limits, specific gravity and engineering properties like compaction and Strength tests, have been performed.. The degree of collapsible potential is estimated by using index and engineering properties such as grain size distribution, Atterberg's limits, void ratio, degree of saturation, water contents, compacted densities etc. Gibbs (1961), Priklonski (1952), Feda (1964), Denisov (1951)Mitchell & Soga (2005), Pereira (2000), Holden Hiff (1961), Rogers(1994), Clemense&Finbar (1981), Latun (1992) etc are extensively studied on collapsible soils.

II. MATERIALS

The materials used in this investigation are:

1. Red Soils 2. Bentonite

The soil are collected from different regions in Visakhapatnam region, the soil samples were collected at a depth of 1.0 – 1.5m from the ground level and the collected samples were dried and subjected for geotechnical characteristics such as grain size distribution, plasticity, compaction and Shear strength.

Bentonite soil is a type of clayey soil having montmorillonite clay mineral, which expands when, comes in contact with water and shrinks when the water evaporates. it usually forms from weathering of volcanic ash. It is hugely available in North West of India. i.e., Kutch area. The dried bentonite was subjected for geotechnical characterization such as gradation, consistency, swelling etc., as per IS 2720

III. METHODOLOGY

Exciting methods of Estimation of Collapsible Potential:

DENISOV (1951) used coefficient of subsidence (K) which is a ratio of void ratio at liquid limit to natural void ratio expressed as follows: Coefficient of subsidence K = void ratio at liquid limit / natural void ratio (eL/en)

If, K= 0.5 – 0.75: highly collapsible soil;

If, K= 0.75 – 1.5 likely to collapsible;

If, K= 1.5 – 2.0: non collapsible soil

GIBBS (1961) proposed a method to measure collapse potential named as in terms as collapsible ratio (R) . It is defined as Collapsible ratio R = wsat/ Wl

R is greater than 1 Collapsible

R is Less than 1 Free from collapsible.

.IV RESULTS AND DISCUSSION

A.GEOTECHNICAL PROPERTIES OF RED SOIL OF VISAKHAPATNAM REGION

Sand (%)	85
Silt (%)	13
Clay (%)	2
Specific Gravity G	2.65
Liquid Limit (%)	21.00
Plastic Limit (%)	18.00
Plasticity Index (Ip)	3.00
IS Classification	**SM**
(OMC %)	9.20
(MDD g/cc)	1.74
C (t/m2)	1.00
Φ (Degrees)	30

B. GEOTECHNICAL PROPERTIES OF BENTONITE:

<75μm (%)	100
<2μm (%)	78
<1μm(%)	60
Specific gravity	2.71
Liquid limit	486
Plastic limit	72
Plasticity index	414
Is classification	CH
OMC (%)	50
MDD (g/c.c)	1.25
Free swell index (%)	780
Swell pressure (kN/m2)	520

C.VARIATION OF INDEX PROPERTIES OF RED SOIL (SM) WITH BENTONITE :

Bentonite Percentage +SM SOLS	**WL(%)**	**Wp(%)**	**IP(%)**	**OMC(%)**	**MDD (%)**
SM+0	21	18	3	9.2	1.74
SM+2%	25	19	6	10.2	1.76
SM+4%	30	20	10	12	1.79
SM+6%	36	21	15	14	1.81
SM+8%	43	22	21	16.5	1.77
SM+10%	50	23	27	19.0	1.72

Test results of Red soil (SM) mixed with Bentonite has the following identifications. Increases the percentage of Bentonite increases liquid limit, plastic limit and plasticity index values. The percentage of Bentonite means increasing the percentage of fines particularly clay particles. These particles require more water to nullify their electric charges which increases a thin film of moisture coated around the particles inform of diffusion is known as diffused double layer. Increasing the percentage of Bentonite increases OMC gradually. This is due to the fines of Bentonite particles. In case of maximum dry density it is identified that increasing the percentage of Bentonite increases dry density by locking of moisture with clay surface upto 6% and then decreases.

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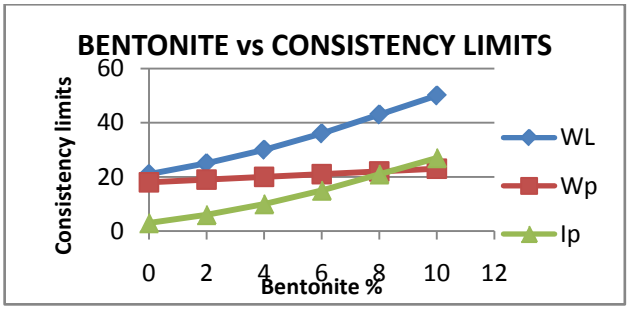
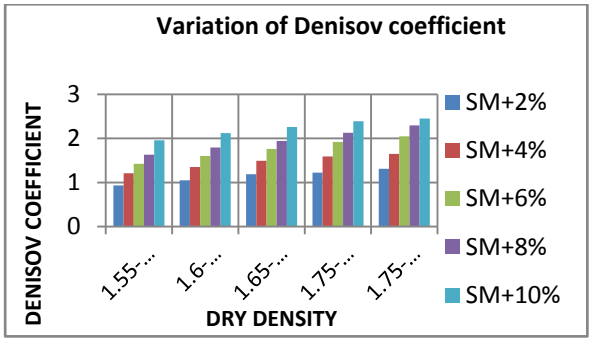


Fig (a)

D.Variation of Denisov coefficient with dry density variation of percentage of bentonite:

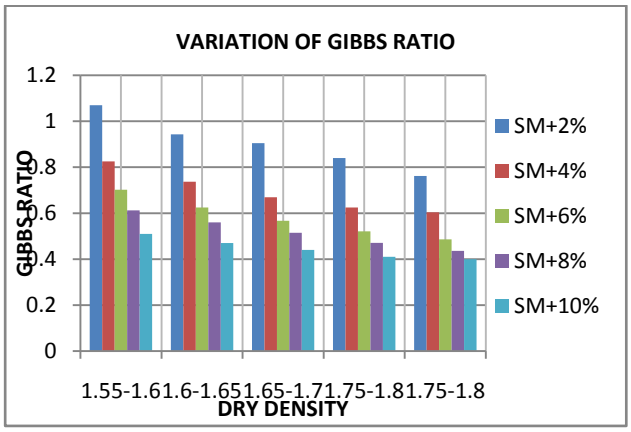
Υ_d (g/cc)	1.55-1.6	1.6-1.65	1.65-1.7	1.7-1.75	1.75-1.8
Soils↓	Denisov coefficient of subsidence↓				
SM	0.78	0.85	1.00	1.08	
SM+2%	0.934	1.05	1.186	1.224	1.31
SM+4%	1.211	1.35	1.494	1.59	1.65
SM+6%	1.424	1.6	1.763	1.92	2.05
SM+8%	1.63	1.795	1.942	2.13	2.294
SM+10%	1.957	2.12	2.26	2.39	2.45

Υ_d (g/cc)à	1.55-1.6	1.6-1.65	1.65-1.7	1.7-1.75	1.75-1.8
Soils↓	Gibbs collapible				
SM	1.32	1.19	1.00	0.93	
SM+2%	1.07	0.943	0.905	0.84	0.762
SM+4%	0.825	0.737	0.669	0.625	0.604
SM+6%	0.702	0.625	0.567	0.521	0.486
SM+8%	0.612	0.56	0.515	0.471	0.436
SM+10%	0.51	0.47	0.44	0.41	0.4



Fig(b)

E.VARIATION OF GIBBS RATIO WITH DRY DENSITY AT DIFFERENT PERCENTAGE OFBENTONITE:



Fig(c)

IV. CONCLUSION

1. Red soils compacted at dry densities in between 1.4g/cc-1.5g/cc susceptible to high collapsible 1.5-1.7 and 1.7-1.8g/cc, which are at their MDD are free from collapsible.

2.Addition of Bentoniteincreses plasticity index and degree of saturation of SM soils.

3.Addition of Bentonite decreases potentials of collapsible behavior when compacted at dry densities in between 1.5g/cc-1.6g/cc.

4.Denisov's and Gibbs approaches shows that addition of bentonite to red soils decresescolalpsiable potential upto 10%.

V. REFERENCES

1AASHTO Standard M 145, 2003: Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes, American Association of State Highway and Transportation Officials, Washington D.C.

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DOI: 10.21276/ijcesr.2017.4.3.7

2Amiya Prakash Das &T.Thyagaraj "Collapse behaviour of compacted red soil" International Journal of geotechnical Engineering, Vol-12, Issue-1,pp-20-27.

3Denisov, N. Y. (1951). Mechanical properties of loess and loams, in Russia Moscow,136p.

4Feda J. Collapse of loess upon wetting. Engineering Geology 1988:25 (2-4): pp: 263-9.

5.Gibbs, H. J. (1961). „„Properties which divide loess and dense uncemented soils.‟‟‟ Earth laboratory report EM-658, Bureau of Reclamation, U.S. Department of the Interior, Washington D.C.

6 Gibbs, H.J. and Holland, W.Y. (1960): Petrographic and engineering properties of loess, U.S. Bureau of Reclamation, Denver., Engineering Monograph, vol.28, pp.1- 37.

7.Holtz, W. G., and Hilf, J. W.(1961) „„Settlements of soil foundations due to saturation.‟‟‟ Proc. 5th International Conference on Soil Mechanics and Foundation Engineering, 673–679.

8. IS 2720: Part 5: 1985 Methods of test for soils – Part 5: Determination of liquid limit and plastic limit

9. Knight K. (1963) The origin and occurrence of collapsing soils. In: Proceedings of the 3rd regional conference for Africa on soil mechanics and foundation engineering; 1963. p. 127-30.

10.Pereira, J.H.F., and Fredlund, D.G. (2000); "Volume change behaviour of collapsible compacted gneiss soil." Journal of Geotechnical and Geo-environmental Engineering, 126 (10), 907 – 916.