EFFECT OF ENGINEERING PROPERTIES OF RED SOILS ON COLLAPSIBLE BEHAVIOUR

K.SAROJA RANI
Ph.D SCHOLAR
DEPARTMENT OF CIVIL ENGINEERING,
ANDHRA UNIVERSITY COLLEGE OF ENGINEERING (A),
ANDHRA UNIVERSITY, VISAKHAPATNAM

P.V.V.SATYANARAYANA
PROFESSOR
DEPARTMENT OF CIVIL ENGINEERING,
[1]ANDHRA UNIVERSITY COLLEGE OF ENGINEERING (A),
ANDHRA UNIVERSITY, VISAKHAPATNAM.

Abstract- Several methods have been used for understanding the behaviour of collapsible soils. The method selected depends on type, nature, composition of soil and type of structural loading. Structures to be built on the soil are to be free from distress and can be able to withstand against settlements. In the present study 10 soils are tested for various geotechnical characterizations to understand the collapsible behaviour of the soils with respect to their index and engineering properties.
Keywords: Red Soil, Collapsible behaviour, geotechnical Characteristics

I. Introduction

Collapsible soils can be considered as critical for infrastructures like buildings, embankments, irrigation works, road etc. Structures founded on these soils subjected to large differential settlements due to sudden decrease in the volume of soil deposits upon saturation. Loess is the best example of collapsible soils; Red soils are also come under this category. Visakhapatnam region is significant with red soil deposits. This region in recent years has been gaining importance in infrastructural development. Structures located on these soil deposit need a special attention to understand the behaviour of the soil to avoid distress. In the present investigation red soils in this region has been experimented to understand the collapsible behaviour by studying various geotechnical properties. Mitchell & Soga (2005), Pereira (2000), Holden Hiff (1961), Rogers(1994), Clemense & Finbar (1981), Latun (1992) etc are extensively studied on collapsible soils.

In the present analysis 10 red soils in Vishakhapatnam Region from north coastal districts of Andhra Pradesh were collected and tested for their geotechnical characterization. Based on these values, their collapsibility and effective utilization in geotechnical applications has been verified.

2. MATERIALS:

To study the geotechnical characterization of red soils 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 strength as per IS 2720.

3. TESTS & RESULTS:

To explain collapsibility behaviour of red soils parameters like porosity, Void ratio, degree of saturation and dry densities are considered in the dry side of compaction along with the index and engineering properties and these are shown in table:

Table 1. GEOTECHNICAL PROPERTIES OF RED SOIL:

Location/Property	**SM-SC-I**	**SM-SC-II**	**SM-SC-III**	**SM-SC-IV**	**SM-SC-V**	**SM-SC-VI**	**SM-SC-VII**	**SM-SC-VIII**	**SM-SC-IX**	**SM–SC- X**
Gradation Properties										
Gravel (%)	0	0	0	0	0	0	0	0	0	0
Sand (%)	80	78	80	83	78	84	82	76	78	74
Fines (%)	20	22	20	17	22	16	18	24	22	26
Silt (%)	12	13	15	10	16	11	14	14	12	14
Clay (%)	8	9	5	7	6	5	4	10	10	12
Index Properties										
Liquid Limit (%)	24	25	23	24	24	23	22	25	24	26
Plastic Limit (%)	19	19	18	18.5	18	17	17	18	17	19
Plasticity Index (I_p)	5	6	5	5.5	6	6	5	7	7	7
IS Classification	SM - SC	SM -SC	SM –SC	SM -SC	SM -SC	SM –SC	SM – SC	SM -SC	SM – SC	SM –SC
Compaction Characteristics										
(OMC %)	10	10.3	9.8	9.8	10	9.4	9	10.3	10.2	10.4
(MDD g/cc)	1.78	1.80	1.77	1.77	1.78	1.76	1.75	1.78	1.77	1.79
Ranges										
Υ_d to Υ_d Max.	1.78 -1.48	1.49 - 1.80	1.56 - 1.44	1.44 - 1.77	1.48 - 1.78	1.53 - 1.76	1.52 -1.75	1.48 - 1.78	1.46 – 1.77	1.52 - 1.79
Void Ratio	0.8-0.5	0.79 - 0.47	0.84 - 0.70	0.85 - 0.50	0.79 - 0.49	0.74 - 0.51	0.74-0.52	0.79 - 0.49	0.75 – 0.51	0.75 - 0.48
Porosity	44.4 -33.3	44.2 -38	45.7 - 41.2	45.9 - 33.8	44.13- 32.88	42.52- 33.77	42.52 - 34.21	44.13- 32.88	42.15 – 33.51	42.85- 32.43
Degree of Saturation	14.3 -53.2	16.2 - 58.3	12.6 - 63.6	12.5 - 52.14	13.13- 54.2	16.17- 49.02	14.32 - 45.86	14.47- 55.91	13.45 – 57.86	14.89- 57.63

4. DISCUSSIONS

Geo-morphological Identification:

- ✓ These are well drained, wind- blown, hill washers of loose consistency with Mechanical and chemical weathered materials of Khondolite rock mass.
- ✓ These are also residual soils. These soils are dominated by fine sand particles followed by silt particles and these are coated with small amounts of clay particles at their point of contact. Hence these are characterized by loose structure, with bulky shaped grains dominated with fine sand and silt particles with a small amount of clay particles.
- ✓ These are loose in state with honey combed structure and held together by water soluble cementing agents like $CaCO_3$, Cao, MgO, Fe_2O_3 and clay mineral like Kaolinite. Particles are cemented at their contact points under saturation the bond between these particles softens and soil particles come together forms (denser)/ Close packing under compression loading.

Engineering properties of red soil with respect to collapsibility compaction/Index properties:

- ✓ These deposits are ranging from 2 to 5 m thick with high void ratios for SM-SC Soil 0.84 – 0.74, porosity for SM-SC Soil 42.52-45.9% and low dry densities in the range of SM-SC Soil 1.44-1.78 g/cc.

Based of engineering properties of Red soils the following identifications are made:

- ✓ Red soils compacted at their dry densities less than their maximum dry densities and water content less than there OMC will exhibit high Collapsibility at these conditions. The soils are in dry state with high porosities; high void ratio and less degree of saturation. Obtained honey comb structure. Under saturation the water dispersion the soil particles by dissolving oxidise of salts, clay particles increases collapsible behaviour. Which accepts the statement of Tadepalli and Fredlund (1991) and Ayadat (2007), Reznik (2007).

5. CONCLUSION

Considering the test results of red soils the following conclusions are drawn:

1. Soil compacted at low dry densities and low water content exhibited high degree of collapsibility.
2. Saturation destroys the bond between sand particles by dissolved clay particles and salts of oxides leads to increases the collapsible behaviour.

REFERENCES:

1. Basma, A.A., and Tuncer, E.R. (1992). “Evaluation and control of collapsible soils.” Journal of Geotechnical Engineering, Vol.118 (No.10), 1491 – 1504.
2. Clemence, S. P,. and Finbarr, A. O. (1981). "Design Considerations for collapsible soils." Journal of the Geotechnical Engineering Division, Vol.107(No, GT3),305-317
3. Clevenger, W.A. (1956). "Experiences with loess as foundation materials." Journal of Soil Mechanics and Foundation Division, 82(3), 1025-1025-26.
4. Clayton, C.R.I (1980): “The collapse of compacted chalk fills.” Proceedings, International Conference on Compaction, Paris Session 2.
5. Jennings, J.E and Knight, K. (1975): “A guide to construction on or with materials exhibiting additional settlement due to collapse of grain structure.” Proceedings, 6th regional Conference for Africa on Soil Mechanics and Foundation Engineering, Durban, South Africa, Vol.1, pp.99-105.
6. Mitchell, J. K., and Soga, K. (2005). Fundamentals of soil behaviour, John Wiley& Sons Hoboken, N.J.
7. Pereira, J.H. F., and Fredlund, D. G. (2000). "Volume change behaviour of collapsible compacted gnesis soil." Journal of Geotechnical and Geoenvironmental Engineering, 126(10),907-916
8. IS 2720: Part 4:1985 Methods of Test for Soils – Part 4 Grain Size Analysis.
9. IS 2720: Part 8:1986 Methods of Test for Soils – Part 8 Laboratory Determination of Water Content – Dry Density relation using Heavy Compaction.
10. IS 2720: Part 3: Sec 2:1980 Methods of Test for Soils – Part III: Determination of Specific Gravity – Section 2: Fine, Medium and Coarse Grained Soils.
11. Tadepalli (1992), Rollins and Rogers collapsible soils exhibit this behaviour (Volume reduction) at low level of stresses.