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An Experimental Work on Expansive Soil Using Marble Dust and Glass Powder for Strength Extension

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Abstract: *Expansive soil is a major deposit in India. They expand and become sticky during rainy season and contract during summer causing deep cracks in the soil. The rate of montmorillonite is more in expansive soils which causes swelling and cracks in soil. In this investigation we used marble dust and glass powder. Marble dust contains high amount of calcium, silica, and alumina. Marble decreases the water content in the soil. glass powder also used in this stabilization. It increases the compressive stress of the soil. In the present study strength characteristics of soil is increased by using marble dust and glass powder in various proportions like 2%, 4%, 6%, & 8%. The various tests were conducted on these proportions like Compaction Characteristics, strength characteristics.*

Key Words: *Expansive Soil, Marble dust, Glass powder.*

1. INTRODUCTION:

The black cotton soil collected from Maskapalli. Black cotton soil is a heavy clay soil, varying from clay to loam with clay contents of 40 – 50%. It exhibits low bearing capacity, low permeability and high-volume change due to presence of montmorillonite in its mineralogical content and these properties makes it unfit for construction of embankment and other engineering structures. Soil stabilization enhance the engineering properties of soil and also increases the shear strength of the soil and control its shrink swell properties.The black cotton soil constitutes an important soil group covering nearly about 20% of land in India. These occurring the states of Madhya Pradesh, Gujarat, Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu. Here, in this project, soil stabilization has been done with the help of marble dust powder and glass powder. The improvement in the strength parameters has been stressed upon comparative studies have been carried out using different methods of shear resistance measurements.

1.1 Problems of black cotton soil

- In saturated conditions, these soils have high consolidation settlements.
- These soils have high swelling nature, due to this structure cause damage.
- When loads are applied on these soils in wet conditions these soils get shrinked.

2. MATERIALS AND METHODS:

To study the strength characterization of expansive soil from Maskapalli, the soil sample was collected at a depth of 1.0 m from the ground level and the collected sample was dried and subjected for geotechnical characteristics such as grain size distribution, plasticity, compaction and strength as per IS 2720.

2.1 Marble dust powder:

Marble is a non – foliated metamorphic rock composed of re-crystallized carbonate minerals, most commonly calcite or dolomite. Marble is a metamorphic rock resulting from the transformation of a pure limestone.

Oxide compounds Mass (%)	**Marble dust**
SiO_2	28.35
Al_2O_3	0.42
Fe_2O_3	9.70
CaO	40.45
MgO	16.25
Density	2.80

2.2 Glass powder:

Glass is an amorphous non crystalline material which is typically brittle and optically transparent. The familiar type of waste glass materials found around are drinking vessels and window glasses, most of the readily available waste glass materials are soda-lime glass bottles, composed of about 75% silica plus, Na_2O, CaO and several additives. This

material is added to soil in its powdered form for stabilization. Glass is totally inert and therefore non-biodegradable. Also angle of friction of glass powder is high when compared to black cotton soil which has low angle of friction. The size of glass powder chosen was <0.075mm.

2.3. Chemical composition:

Oxide compounds (%)	Glass powder
Al_2O_3	11.05
SiO_2	76
Na_2O	11.6
Specific gravity	2.5-2.9
Hardness	5 to 7
Other components	0.9

3. TESTS AND RESULTS:

To explain the behaviour of expansive soil properties the following tests were conducted and shown below:

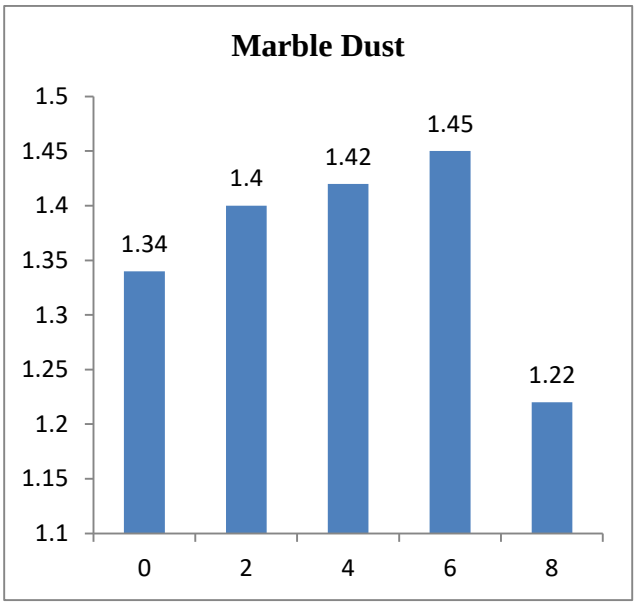
S.No	Properties of Soil	Values
1	Gravel (%)	0
2	Sand (%)	81.42
3	Fine (%)	18.58
4	Free swell index (%)	90.90
5	Specific gravity	2.41
6	Liquid limit (%)	54
7	Plasticity index	14
8	OMC (%)	14.3
9	MDD (g/cc)	1.34
10	UCS (kPa)	42.1
11	Direct Shear C (t/m^2), Φ (Degrees)	C = 3 Φ = 30º

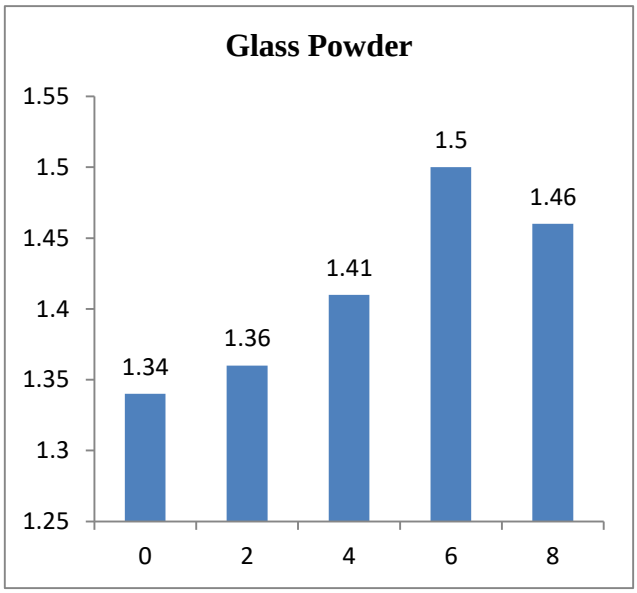
Grain size distribution analysis shows that expansive soil was dominated by sand particles (4.75 mm – 0.075 mm) of 81.42% and fines (< 0.075 mm) of 18.58%. It is identified that liquid limit of 54% and plasticity index of 14. The maximum dry density is 1.34 g/cc where as OMC was 14.3%. Shear strength of cohesion (C) as 3.0 t/m^2 and angle of shearing resistance as 30^0.

3.1. CHARACTERISTICS OF SOIL AT DIFFERENT PERCENTAGES OF ADMIXTURES:

S.No	Percentage of Admixture	Marble Dust		Glass Powder	
		OMC (%)	MDD (g/cc)	OMC (%)	MDD (g/cc)
1	0	14.3	1.34	14.3	1.34
2	2	18.3	1.40	20	1.36
3	4	20.4	1.42	23	1.41
4	6	22	1.45	25	1.50
5	8	26	1.22	28	1.46

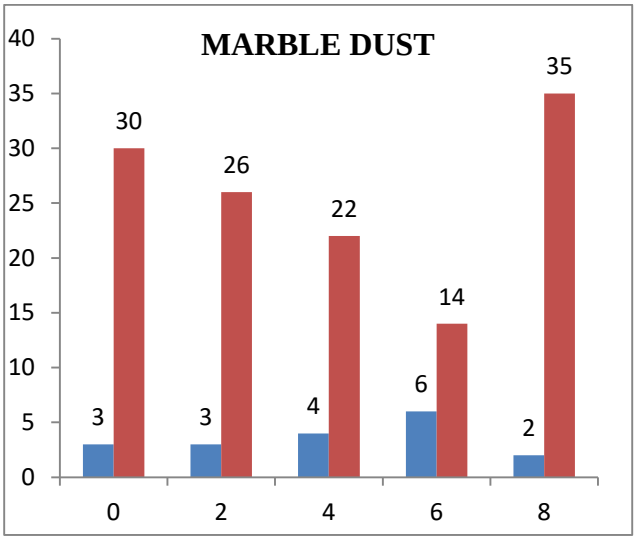
As percentage of marble dust is added to the soil, density goes on increase till 6% and gives the 1.45 g/cc. In the case of glass powder the density shows the high density of 1.5 g/cc as compared to the marble dust. And a gradual decrease is identified after the excess addition of admixture.

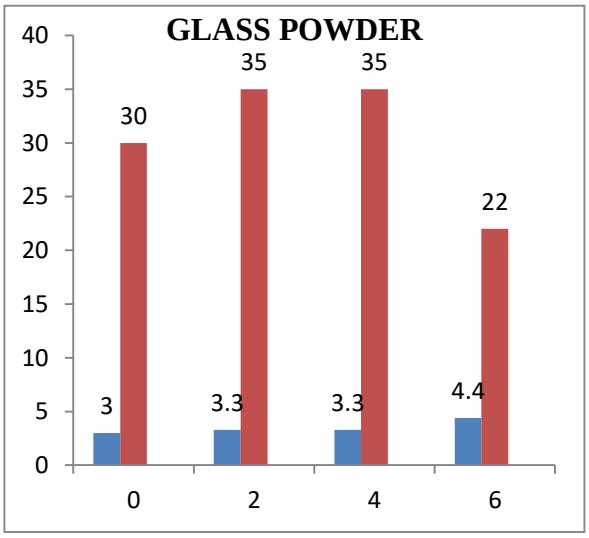




3.2. STRENGTH PARAMETERS OF SOIL AT DIFFERENT PERCENTAGES OF ADMIXTURES:

S.No	Percentage of Admixture	Marble Dust		Glass Powder	
		C (t/m^2)	Φ(Degrees)	C (t/m^2)	Φ(Degrees)
1	0	3	30	3	30
2	2	3	26	3.3	35
3	4	4	22	3.3	35
4	6	6	14	4.4	22
5	8	2	35	3.2	31





4. CONCLUSION:

- The strength of the soil goes on increasing up to 6 % by weight of marble dust and glass powder respectively.
- The maximum dry density is maximum at 6% of glass powder when compared to marble dust.
- When compared to glass powder, marble dust has got the maximum strength in the soil by angle of friction and cohesion. Marble dust is mostly suitable for the soil stabilization in increasing the strength characteristics of the soil.

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