Strength Improvement of Clayey Soil by using Fly ash and Marble dust

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Abstract

Strength improvement of soil means that to improve the properties of soil. Some waste material are used to improve the soil such materials are fly ash, marble dust. Fly ash is the ash produced by burning of pulverized coal in thermal power plants. Marble industries are producing larger amount of marble dust. The rapid growth of marble dust creates a big problem on environment as it acts as a pollutant and disturbs the ecological system. Hence both material are cheap by cost. The object to carry out this study was to evaluate the effect of materials i.e marble dust and fly ash mixed with soil of clayey type. The physical as well as chemical characteristics of soil was improved by addition of such those materials. Whereas some expecting properties are index properties, compaction characteristics and strength characteristics. In the research marble dust is added in range of 5–20 % in corporation with fly ash 10-30%. Laboratory studies were performed to identification the Atterberg limits, proctor test, Unconfined compression strength, triaxial test. It was found that addition of 20% fly ash in soil shows maximum strength value increases 114.42% Unconfined compression strength(UCS). Further addition of fly ash has negative effects on these properties. Triaxial test is performed to calculate shear strength parameters of mixed soil i.e soil, fly ash and marble dust. It was found that cohesion character ('c') went down and angle of internal friction (ϕ) goes up by addition of marble dust in soil and optimized fly ash. Test result

depicts marble dust and fly ash improves strength characteristics of soil along with those use of materials is economical and also solves the problem of environment. .

Keywords: Fly ash, marble dust, physical properties and triaxial test.

1. Introduction:

Soil is defined as the unconsolidated material which is composition of solid particles and produced by disintegration of rocks. The soil is formed by weathering of rocks because of mechanical deterioration or chemical decay. In case stone surface comes in contact with climate for a time, then that stone or rock get disintegrates or breaks into small particles and then formation of soil takes place. Also we can consider the soil as a accidental material gets from geologic cycle which always occurs in nature for continuously. The geologic cycle comprise of disintegration, transportation, deposition and change of soil .uncovered rocks are dissolved and debased by different physical and chemical forms the results of disintegration are done by transportation, for example, water and wind and it moves the soil to different new areas and deposit .This moving of the material disturb the equilibrium on the earth and cause large scale earth developments and changes.

2. MATERIAL USED

2.1 MARBLE DUST

Marble is rock produced when the lime stone comes in contact with pressure and heat in crust of earth and it is called as metamorphic rock. Marble dust is generated during cutting of raw marble into pieces. Around 20-25% waste produced during the cutting of raw marble. Marble dust is by product of marble cutting and grinding industries.

2.2 FLY ASH

The waste produced in during the combustion of coal is called the fly ash. That residue which is formed is due to combustion in the fired power plants. The very fine particles are collected by filter bags of the electrostatic precipitator which flew with the gases. This is a waste which can be disposed of or recycled.

3. Various test Performed:

3.1 Specific gravity

The specific gravity G of the fly ash was tested in a non-aqueous medium (kerosene) as per International Union of Laboratories and Experts in Construction Materials, Systems, and Structures (RILEM) (1989) recommendations.

3.2 Grain size distribution

The grain size distribution was carried out as per the Indian Standard IS: 2720 (Part 4) –

1985.

3.3 Atterberg limit test

The tests for Atterberg limits were conducted as per Indian Standards IS: 2720 (Part 5) – 1985. Liquid limit tests were carried out using Casagrande's equipment.

3.4 Compaction characteristics

Light (standard Proctor), and heavy (modified Proctor) compaction tests were carried out to determine the maximum dry density (MDD) and optimum moisture content (OMC) of Badarpur, Dadri and Rajghat pond ashes and their mixes as per IS: 2720 (Part 7) – 1980 and IS: 2720 (Part 8) – 1983.

3.5 Unconfined Compressive Stress test

The UCS test is performed on the soil to check the strength. In the investigation the test is performed for the fly ash mixed in soil .Various percentage of fly ash is added in soil , in the starting preparation of sample is done by using the sampler and compacting the soil properly

3.6 Tri-axial test

The triaxial test is performed to calculate the shear strength value of the material. In this test we calculate the shear strength parameters or C and φ for soil. In this test, the sample is encased by a thin rubber membrane and put into plastic cylindrical chamber which will fill with water, that water puts the pressure on sample, the axial load will act on the sample which cause axial stress. The axial stress goes increases till the sample fails, the axial deformation will be measured by a digital meter attached to the apparatus which directly delivers the reading to computer. The soil sample is subjected to all around confining pressure as σ_3.

4. Test results and discussion

Table 4.1.1 Properties of soil

S.No	Properties	Value
1	Liquid Limit	37.5
2	Plastic limit	22.5
3	Plasticity index	15
4	Classification of soil	CI
5	O.M.C	16 %
6	M.D.D	1.65 g/cc
7	U.C.S	213.65 kN/m^2
8	Specific gravity	2.63

.**Table 4.1.2 M.D.D and OMC of soil:fly ash**

Sr no.	**Soil : fly ash**	**MDD (g/cc)**	**OMC (%)**
1) 1.	100:0	1.65	16
2) 2.	90:10	1.63	18
3) 3.	80:20	1.61	19
4) 4.	70:30	1.58	20

Table 4.1.3 MDD and O.M.C of soil:fly ash:Marble dust

Sr no.	**Soil : fly ash :marble dust**	**MDD (g/cc)**	**OMC (%)**
1)	100:0:0	1.65	16
2)	75:20:5	1.64	17
3)	70:20:10	1.69	15.5
4)	65:20:15	1.72	14.7
5)	60:20:20	1.75	14

Table 4.1.4 Chemical composition of marble dust obtained by XRF test

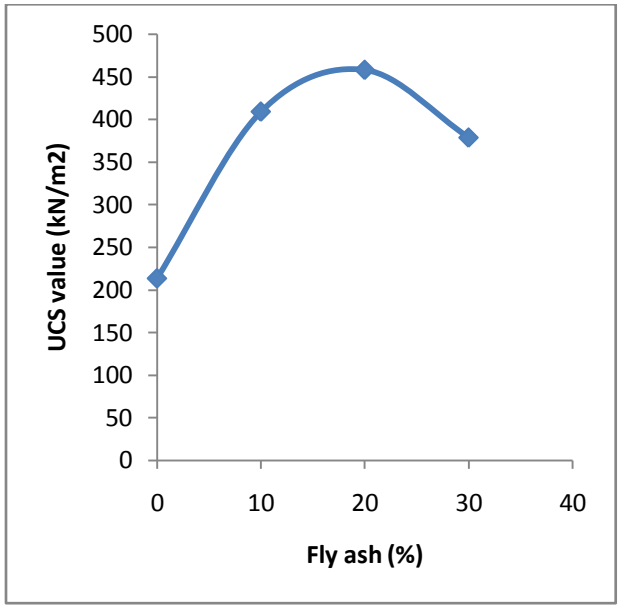
Sr . no	**Elements**	**Percentage**
1.	O	44.87
2.	Ca	24.16
3.	C	13.87
4.	Mg	12.54
5.	Si	3.93

Table 4.1.5 Chemical properties of fly ash obtained by XRF test

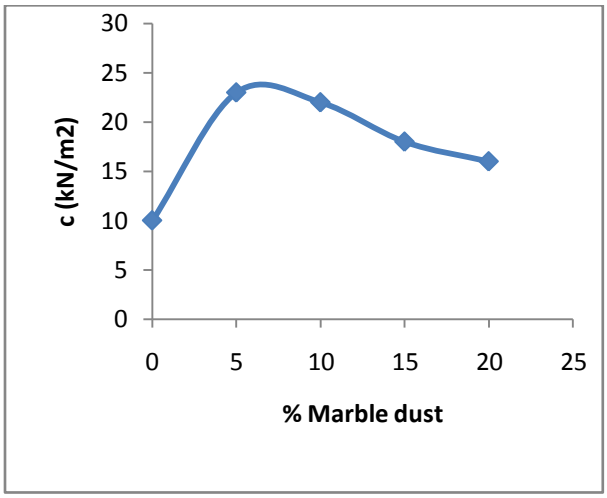
Sr . no	Compound	Percentage
1.	SiO_2	61.87
2.	Al_2O_3	28.09
3.	Fe_2O_3	5.12
4.	TiO_2	1.71
5.	K_2O	1.39

4.2 UNCONFINED COMPRESSIVE STRENGTH

4.2.1 Graph showing variation of unconfined compressive strength value with fly ash percentage.



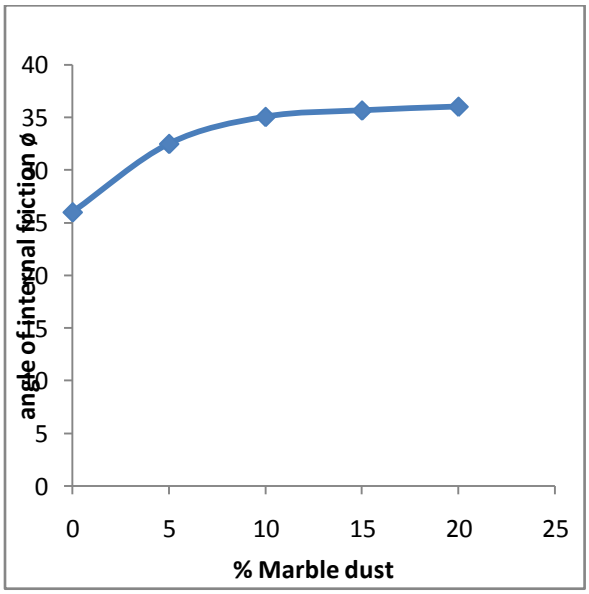
4.2.2 Graph showing variation of C value with marble dust percentage.



variation of c value with marble dust percentage

4.3 Tri-axial test results

4.3.1 Graph showing variation of Angle of internal friction Φ (in degrees) with marble dust percentage.



Results of Triaxial test by varing percentage of marble dust and optimum percentage of fly ash (20%).

Sr no	Mix proportions (soil:fly ash :Marble Dust)	C (kN/m sq)	Angle of internal friction Φ (in degrees)
1.	100-0-0	10	26
2.	75-20-5	23	32.51
3.	70-20-10	22	35.08
4.	65-20-15	18	35.69
5.	60-20-20	16	36.05

8. Conclusion

1. M.D.D decreasing and O.M.C increases with addition of fly ash, it is due to specific gravity.
2. M.D.D increases when marble dust is added in soil whereas OMC decreases.
3. The optimum percentage of fly ash is 20% calculated by U.C.S test as 458.11 kN/m2.
4. The maximum shear strength value is observed for optimized percentage of fly ash(i.e 20%) and marble 10 % by the Tri-axial test.

9.References

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