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EVOLUATION OF COMPACTION AND STABILIZATION OF BLACK COTTON SOIL BY USING ADMIXTURES AS MARBLE DUST

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Abstract*— Black cotton soils are widely dispersed around the world, and are a wellspring of extraordinary harm to framework . The issue with Black cotton soils has been recorded everywhere throughout the world. In storm, they soak up water and swell and in summer, they shrivel on dissipation of water there from. The target of study is to assess the attainability of mechanical waste like marble dust as soil adjustment material. To research the impact of marble dust on file properties of dark cotton soil, a progression of lab tests have been led on Black cotton soil tests blended with 0% to 40% of marble dust by weight of dry soil. The Rapid development of ventures of marble produces risky waste materials at a vast degree which makes a major issue to the people encompassing them just as goes about as a contamination, so influence the biological arrangement of the earth. There is noteworthy improvement in the file properties of the dark cotton soil on expansion of marble dust into it. The broad conduct of the dirt has decreased as it were. From the examination of test outcomes, it was discovered that California bearing proportion expanded with an expansion in marble powder content.

***Keywords*— Black cotton soil, soil stabilization, waste marble dust**

I. INTRODUCTION

The development on Black cotton soil dependably makes an issue for structural architects due to its swell and therapists conduct. At the point when the Black cotton soil comes in the contact of water then over the top swelling is caused and when water content declines shrinkage happens in the dirt. On account of this development delicately stacked structures, for example, establishments, asphalts, trench beds, linings, and private structures established on them are seriously harmed (Chen, 1988). In India, it is found in real pieces of Rajasthan, Madhya Pradesh and Andhra Pradesh. In India, the dark cotton soil covers $0.7X10^6$ km² roughly 20-25 % land zone. The dark cotton soil contains high level of montmorillonite mineral which bestows far reaching nature to it. Development of different structures on Black cotton soils represents a noteworthy hazard to the structure in view of the expansive level of precariousness in these dark cotton soil. It is recorded that billions of dollars for each year is the misfortune in property consistently internationally because of the precariousness operating at a profit cotton soils. Likewise, transfer of waste marble dust is turning into a basic issue.

The three most commonly used stabilizers for expansive soils are bitumen, lime and cement. According to (Tesfaye, A., 2001; Nebro, D., 2002; Nigussie, E., 2011; Christopher, M., 2005) have reported that the stabilization of expansive soil with lime or cement is effective. Unfortunately, these stabilizers are so expensive and making them economically unattractive as stabilizing agents.

Hence, the conceivable utilization of modern waste, for example, marble dust, will significantly lessen the expense of development and just as decrease or dispose of the natural risks brought about by such waste. Extensive bits of marble waste can be utilized as bank or asphalt material, and waste marble residue can be utilized as added substances in certain enterprises (paper, concrete, clay and so on.).

II. LITERATURE REVIEW

Adjustment strategies are required to make the dirt reasonable for development purposes. The primary goal of adjustment is to expand the quality and strength of soil and to decrease the development cost by utilizing the locally accessible material. Many research works have been done on clayey soil to keep up its designing properties for development purposes by the diverse scientists.

Patel et al., (2017) studied the use of waste marble powder to improve the characteristics of black cotton soil. The proportion of marble powder used was 20% to 60% . The test results showed a significant change in consistency limits of sample containing marble dust powder. The liquid limit would decrease from 31.3% to 23.5%. The plasticity index decreased from 11.57% to 4.35%. The CBR test increases from 10.36 to 27.19. From this laboratory investigation it was concluded that the waste material like marble powder generated from stone industries has a potential to modify the characteristic of expansive clay soil.

V. Keshavan et al (2017) the clay soil has a poverty-stricken supporting capacity and large change in album on variations of moisture content. Black cotton soils manage need to be converted to collect them sufficient for construction activities. To penetrate the effect of marble dust and granite dust contradictory tests were conducted on soil mutually varying percentage of marble powder with 0%, 25%, 50%, and 75% of marble dust by weight of restrained soil. The liquid limit would decrease from 38.6% to 17.33%. The plasticity index decreased from 13.6% to 3.13%. Shrinkage limit increased from4.366%to40.88%.

Tesh Bansal and Gurtej Singh Sidhu (2016) add the waste marble dirt in the soil by percentage weight in aesthetic principle of 10% to 30% mutually an interruption of 10%. He manages that with increase in percentage of waste marble dirt from 0% to 30%, the liquid limit value decreases invariably from 31.70% to 25%, plastic charge from 17.69% to 19.26% and it was discovered that optimum moisture content (OMC) Of clay decreased from 18% to 14.10% and maximum dry density increased from 1.738gm/cc to 1.884gm/cc, CBR Value increases from 2.46% to 6.07%.

Ravi Shankar Mishra and Brajesh Mishra (2015) conducted a soil stabilization using quarry dust as replacement mutually soil in percentage of 20, 30 and 40 and apply it with soil stabilize by the adhesive and lime. He observed that OMC increases from 23% to 25.1% with increase in the percentage of quarry dust and MDD decreases from 1.83gm/cc to 1.71gm/cc. UCS increases desirable 30% with optimum outlay of 19.60kg/m2 and then decreases for 40% replacement. Plastic and liquid limits are also increased mutually increase in the percentage replacement anyhow in literally small range. Free swell index significantly decreases from 85% to 45%.

Er. Muthukumar and Er.Tamilarasan V S (2015) add the marble dust in the soil by percentage saddle in aesthetic principle of 5% to 25% with an interval of 5%. He concluded that mutually increase in percentage of marble powder increases, the Liquid limit value decreases constantly by all of 5 to 25% proportion of marble powder from 70% to 55%, plastic limit value was increased by 25% approx., it was noticed that the Optimum moisture Content (OMC) of clay increased from 18% to 24% and maximum dry density (MDD) increases desirable 10% and then starts decreasing with the addition of Marble powder.

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Chayan Gupta and Dr. Ravi Kumar Sharma (2014) conducted a review on the already stabilized soil (with fly ash – sand) by replacing soil with antithetical severity of marble dust from 0% to 20% in at the same time of 4% which shows 15% replacement gives optimum results. The mix gets MDD at proportion of soil-sand-fly ash-marble dust as 52.36%, 22.44%, 13.20%. California Bearing Ratio (CBR) value in soaked condition increased by 200% with the addition of sand, fly ash and marble dust in the moreover mentioned proportion.

III. MATERIALS USED

2.1 Materials used

2.1.1 Soil

The soil which is utilized to contemplate was acquired from close collectorate office baran area Rajasthan at a profundity of 1.5m from ground level.Various tests have been performed to decide the file just as the designing properties of the parent soil by IS determinations.

Table1. Geotechnical properties of the untreated BC soil

S.No.	Property		Value
1	Specific gravity		2.56
2	Liquid limit %		63.74
3	Plastic Limit %		26.74
4	Soil Classification	Gravel %	5.0
		Sand %	12.0
		Sand %	21.0
		Clay %	62.0
5	D.F.S.%		64.71
6	O.M.C.%		19.70
7	M.D.D.%		1.72
8	CBR(Soaked)		1.71

2.1.2 Waste marble dust

It is the by-product of the marble industry which is generated during cutting and grinding of marble. The literature

reveals that waste generation is approximately 40% of the total marble handled per annum. The waste is produced from the industries in the form of both solid and slurry. Table 2 shows the properties of waste marble dust.

Table2. Chemical composition of Waste Marble Dust (Choksi,and Mishra2018)

Component	Wt%
CaO	30-68.8
MgO	20-22.13
SiO2	3-6
Al2O3	2.75-4.8
Fe2O3	0.5-0.8
Cr2O3	0.2-0.4
ZnO	0.2-0.5
TiO	0.54-0.6

Figure.1: Waste Marble Dust

IV. LABORATORY INVESTIGATION

laboratory studies were carried out on the samples of Black cotton soil, Black cotton soil+ Waste marble dust mixes.
Liquid limit Liquid limit test was conducted on Black cotton soil, Black cotton soil with different % Waste marble dust mixes using Casagrande's liquid limit apparatus as per the procedures laid down in IS: 2720 part 4 (1970).
Plastic limit Plastic limit test was conducted on soil,Black cotton soil ,Black cotton soil with different % waste marble dust as per the specifications laid down in IS: 2720 part 4 (1970).
California bearing ratio Test The California bearing ratio tests were conducted on ,Black cotton soil ,Black cotton soil with different % waste marble dust mixtures as per IS 2720 part 16 (1979). The test was conducted under a constant strain rate of 1.25mm/min. The proving ring reading is noted for 50 divisions, and loading was continued until 3 (or) more readings are decreasing (or) constant. The test was conducted at Optimum moisture content. The samples were tested in soaked condition.
Differential Free Swell Test Differential Free Swell (DFS) is a parameter used for the identification of the Black cotton soil. For the determination of the differential free swell of a soil, 20g of dry soil passing through a 425µ size sieve is taken. One sample of 10g is poured into a 100c.c capacity graduated cylinder containing water, and the other sample of 10g is poured into a 100c.c capacity graduated cylinder containing kerosene oil. Both the cylinders are kept undisturbed in a laboratory. After 24 hours, the settled volumes of both the samples are measured
Standard Proctor Test In geotechnical engineering, soil compaction is the process in which a stress applied to a soil causes densification as air is displaced from the pores between the soil grains. It is an instantaneous process and always takes place in partially saturated soil. The Proctor compaction test is a laboratory method of experimentally determining the optimal moisture content at which a given soil type will become most dense and achieve its maximum dry density.

VI. RESULTS AND DISCUSSION

The experimental results reveal that the free swelling index,liquid limit and plastic limit of the soil decreases with addition of Waste marble dust, maximum dry density of soil increased from 1.72 g/cc to 2.01 g/cc by addition of 30% of Waste marble dust where as, Optimum Moisture Content decreased from 19.7% to 13.6%. Also, CBR value of soil

increased from 1.71 to 4.18 by the addition of Waste marble dust. The variation of liquid limit, plastic limit, OMC, MDD and CBR with Waste marble dust are present in figure(2-6)

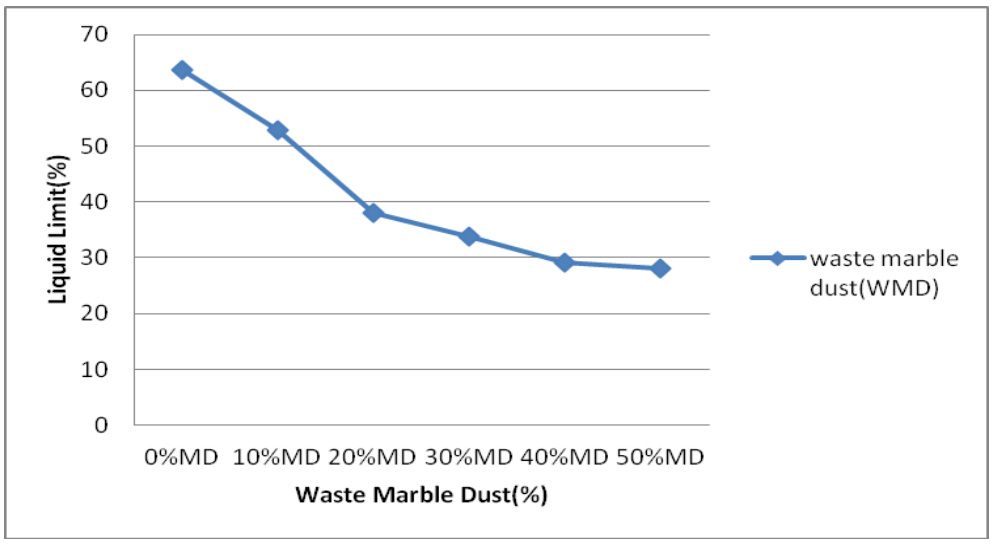

Figure. 2 Variation of Liquid limit with Waste marble dust

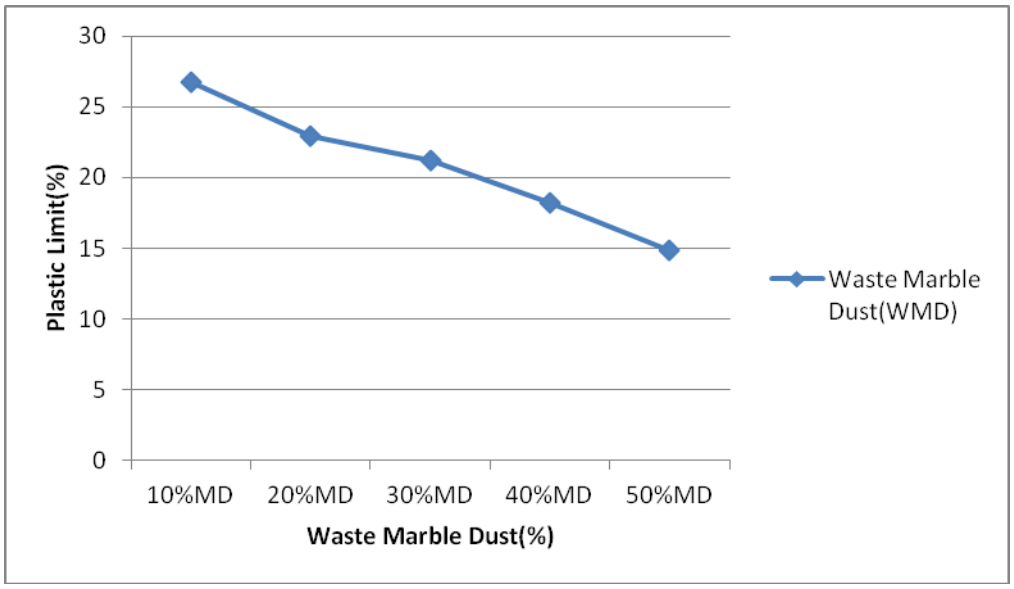

Figure.3 Variation of Plastic limit with Waste marble dust

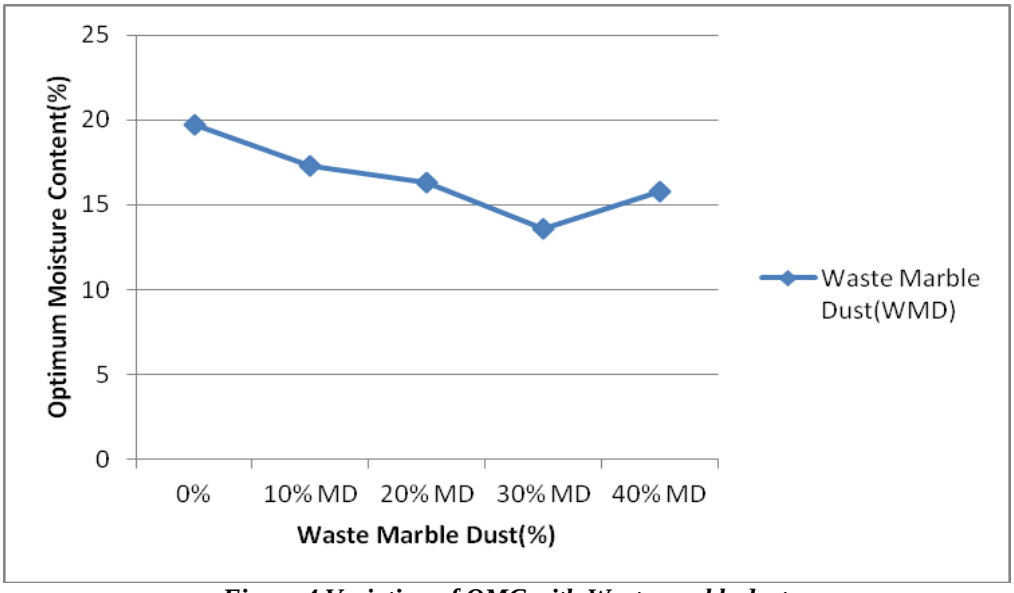

Figure.4 Variation of OMC with Waste marble dust

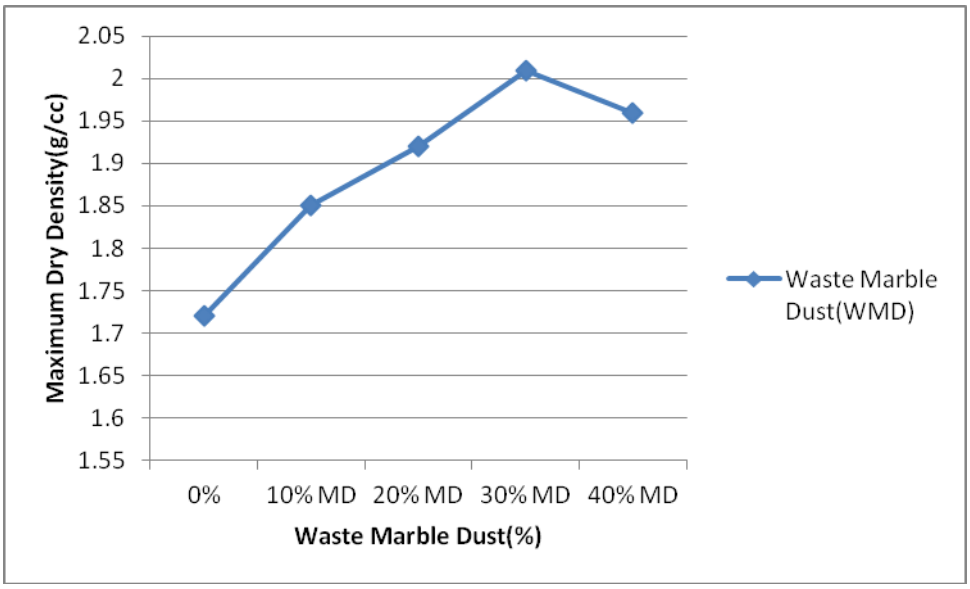

Figure.5 Variation of MDD with Waste marble dust

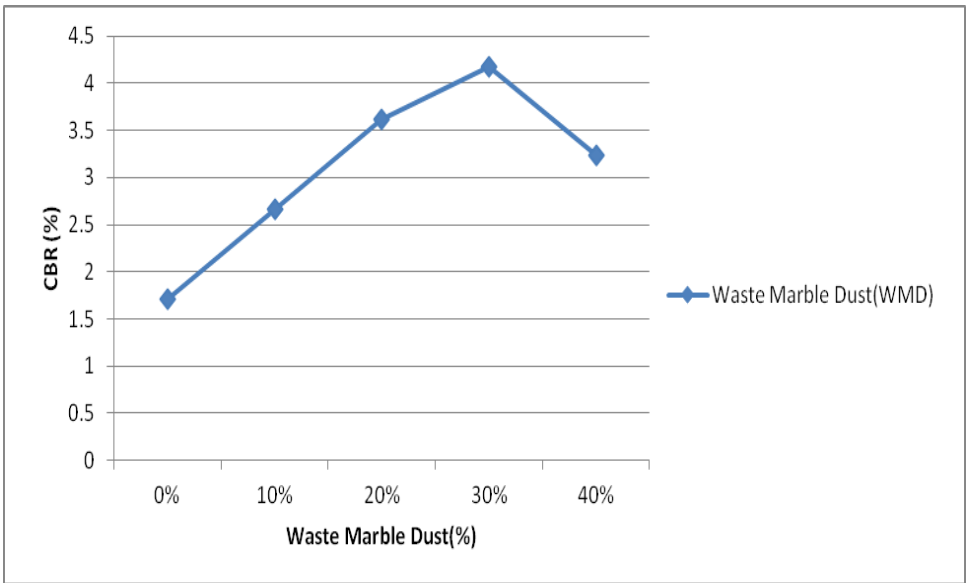

Figure.6 Variation of Soaked CBR with Waste marble dust

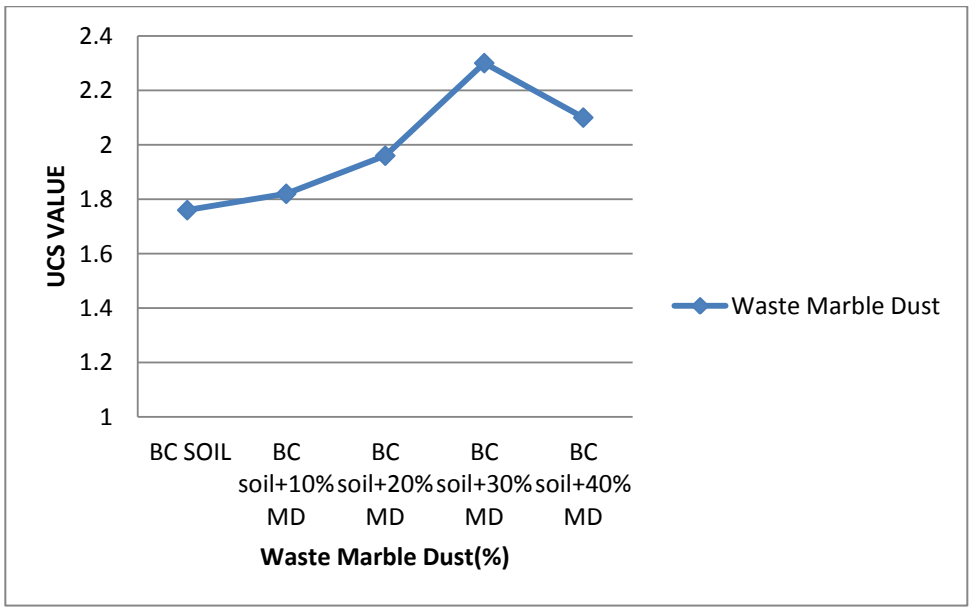

Figure.7 Variation of UCS Value with Waste marble dust

VII. CONCLUSIONS

Following conclusions are drawn from the study

- It was observed from the laboratory test results that the liquid limit values of the samples are decreasing with the inclusion of marble dust into the BC soils. It has been found that the liquid limit decreased from 63.74% to 28.03% on adding of 0% to 50% marble dust into it.
- There is significant reduction in The plastic limit values from 26.74% to 14.87% .The plastic limit was improved by 65.88% on adding 50% Waste marble dust. Further increase of Waste Marble Dust the value of MDD is decreased.
- The MDD value increased from 1.72g/cc to 2.01g/cc when compared with the untreated BC soil. The OMC value goes on decreasing from 19.7% to 13.6%.
- The Soaked CBR value increasing from 1.71% to 4.18% of the expansive soil increased up to 30% addition of Marble dust. Further addition of Marble dust decreased the soaked CBR of the expansive soil. The results are very favourable for design of pavement in expansive soil.
- The Maximum UCS value increased from 1.76kg/cm2 to 2.3kg/cm2 at 30% of marble powder.The UCS value for soil with 30% additive is 31.37% more compared to black cotton soil.

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