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STUDY ON UTILIZATION OF STONE DUST FOR STABILIZATIONOF BLACK COTTON SOIL

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ABSTRACT
Soil stabilization has become a major issue in construction engineering. Due to rapid growth of population and urbanization, there is tremendous increase in construction activities may lead to shortage of land for construction of buildings, roads, etc. The land available may not be suitable for construction activites. Thesoil may be black cotton, clayey, and loamy. This existing sites not suitable for construction because These soil has less bearing capacity and stability. The present experiment work briefly describes the suitability of local available Stone Dust(SD).The objective of this study to improvement of properties of soil by using of Stone Dust(SD) obtained from stone quarry.It will minimizethe environment harzord also.Different percentage of stonedust mix with black cotton soil. The effect of Stone Dust(SD) on Liquid Limit, Plastic Limit, Plasticity Index, Dry Density, Optimum Moisture Content (OMC) and California Bearing Ratio(CBR) values is tested in laboratory.

Keywords: Black cotton, clayey,loamy soil,Stone Dust(SD), Optimum moisture content(OMC),California Bearing Ratio(CBR), PlasticLimit(PL), Liquid Limit(LL), Plastic Index(PI).

INTRODUCTION

Natural soil is a complex material and it is variable material. There is variation in the properties of soil at different places. There is also variation in the properties of black cotton soil with depth, loading; drainage as wellas environmental conditions the variations in properties is observed. There is a mineral generally known as montmorillonite which presents in black cotton soil and it is responsible for the behaviour of shrinkage and swelling of soil is subjected to water. This variation creates so many geo technical problems. In India there is about20% soil is black cotton soil. There is so many methods are available to improvement of black cotton soil.

Soil stabilization is carried out to improve soil strength and to increase resistance to softening by water through bonding the soil particles together. Also, it is done for water proofing the particles or combination of the two processes. Compaction and drainage are the simplest process of stabilization, which improve inherent shear strength of the black cotton soil. The improvement of gradation of particle size The soil stabilization can be done by mixing weak soils with binders that can be mechanical stabilization, stabilization with cement, lime, bitumen and chemicals etc. To achieve desirable engineering properties in soft soils (like silt, clayey peat or organic soils), the stabilization of soils undertaken Lime is an inorganic mineral which contains mainly calcium and carbonates, oxides and hydroxides.

Generally, lime and cement are most commonly used stabilizers for enhancing the poor soil properties. The solid waste materials such as Fly Ash, quarry dust can also be used as soil stabilizing materials. Rice husk ash is also used but it cannot be used alone for stabilization of black cotton soil because of it has lack of cementitious pproperties. So, it is used with a binder like Lime, cement, lime sludge, Calcium chloride etc.

In this paper, the properties of the black cotton soil stabilized with different proportions of quarry dust are found. Quarry dust is the by-product of extraction and processing of aggregates. Every year 20 MT quarry dust is produced in India. Generally, the quarry waste has a size below 90 microns. Quarry dust is the waste which is hazardous and effects the environment and human health. To eliminate the negative effect of these waste materials, these can be disposed in a proper and safe manner. Also, to ensure a more economically viable disposal, these areblended with other construction materials like clayey soil then it can be used best for

various construction purposeslike sub grade, foundation base and embankments. Quarry dust exhibits high shear strength which is highly beneficial for its use as a geotechnical material Soosan et al., (2001a).
It has a good permeability and variation in water content does not seriously affect its desirable properties. Figure 2 represents the quarry waste at the site. The waste materials must be disposed in proper and safe manner to eliminate the negative effect of them. To meet the engineering requirements, the technique used which improves the properties of expansive soil is called Soil stabilization. If these materials can't be disposed of properly and its disposal is not economically possible, but it is blended with other construction materials like clayey soil then it can be used best for various construction purposes like sub grade, foundation base and embankments. It removes environmental problems as well as also contribute to the economy. Quarry dust is having higher shear strength then other wastes, which is highly beneficial for its use as a soil stabilizer. With addition of quarry dust, the dry density increased with decrease in optimum moisture content.

METHODOLOGY

Sample Collection Black Cotton Soil Soil is the principal material for the construction of embankment and subgrade of highways. The design and performance of the pavement, particularly the flexible pavement, dependson the type of subgrade soil and its properties. Some of the essential laboratory tests were carried out to determine the engineering properties i.e. index properties, atterbarge limits, compaction and strength characteristics of the soils. Laboratory tests were carried out as per relevant IS codes.

Figure No 1

Fig. No.1 shows the black cotton soil used in the present study is locally available soil taken from bead by pass, Hyderabad.The material was excavated from 1m below the ground surface.Stone Dust Index properties of the stone dust were determined as per IS codes. It was randomly mixed with soil samples in 5%,10%, 15%, 20% & 25% of the dry weight of soil.

Figure No. 2

Stone dust for the present work was obtained from stone crusher located at Hyderabad, Telangana,India. The stonedust used in soil which is passing though 90 micron IS sieve.

EXPERIMENTAL WORK

Consistency Limits: Soil consistency is the strength with which soil materials are held together or the resistance of soils to deformation and rupture. Soil consistency is measured for wet, moist and dry soil samples. For wet soils, it is expressed as both stickiness and plasticity, as defined below. Soil consistency

may be estimated in thefield using simple tests or may be measured more accurately in the laboratory.
Liquid Limit: The liquid limit is defined as the moisture content at which soil begins to behave as a liquid material and begins to flow. The liquid limit is determined in the lab as the moisture content at which the two sides of a groove formed insoil come together and touch for a distance of 2 inch after 25 blows.

Plastic Limit: The plastic limit of a soil is the water content of the soil below which it ceases to be plastic. It beginsto crumble when rolled into threads of 3mm diameter.

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 densest and achieve its maximum dry density.

CBR Test (California Bearing Ratio Test): California Bearing Ratio (CBR) is defined as the ratio expressed in percentage of force per unit area required penetrating a soil mass with a circular plunger of 50 mm diameter at therate of 1.25 mm/min to that required for corresponding penetration in a standard material. Tests are performed outon natural or compacted soils in water soakedor unsoaked conditions and the results so obtained are compared with the curves of standard test.

EXPERIMENTAL RESULTS

The materials which are considered are soil and sand dust with composition of tests are conducted to determine different properties of soil sample collected and results are tabulated and presentedin Table No. 1

Table No. 1 Properties of soil

Sr. No.	Laboratory Test	Result
1	Atterberg Limits	
	Liquid Limit	66.00%
	Plastic Limit	30.02%
	Plasticity Index	35.98 %
2	Modified Proctor Test	
	Optimum moisture Content (OMC)	19.90 %
	Maximum dry Density (MDD)	1.16 gm/cc
3	California Bearing Ratio Test, CBR	4.31%

Stone dust which pass through 90 µ is added to the Black Cotton Soil in percentages of 5, 10, 15, 20 and 0.5, 1.0, 1.5, 2.0 respectively. The standard proctor test has been conducted on the sample and graphs obtained are shown below in Figures4 to 8

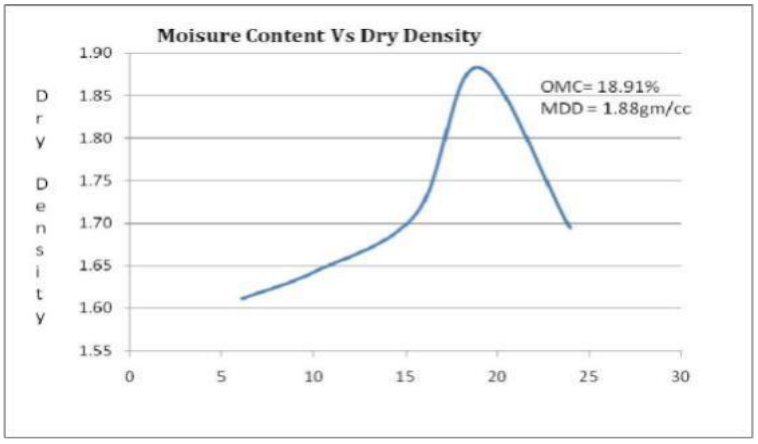

Figure No. 4

Fig. No. 4 shows compaction curve of standard proctor test of combination of black cotton soil, 5% of stone dust by weight of soil. The optimum moisture content is deceases and dry density is increases. The optimum moisture content is 18.91% and dry density is 1.88 gm/cc.

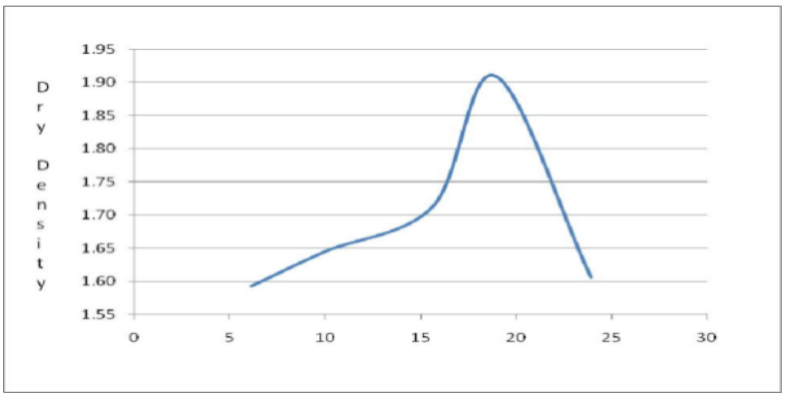

Fig. No. 5

Fig. No. 5 shows compaction curve of standard proctor test of combination of black cotton soil, 10% of stone dust by weight of soil. The optimum moisture content is deceases and dry density is increases. The optimum moisture content is 18.87% and dry density is 1.91 gm/cc.

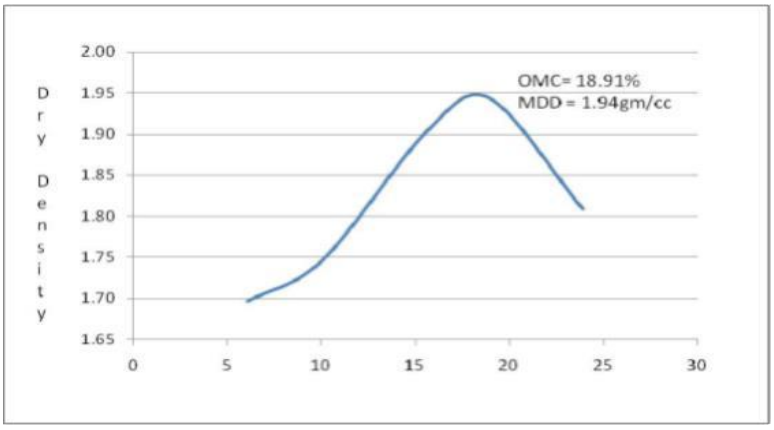

Fig.No. 6

Fig. No. 6 shows compaction curve of standard proctor test of combination of black cotton soil, 15% of stone dust by weight of soil. The optimum moisture content is deceases and dry density is increases. The optimum moisture content is 18.79% and dry density is 1.94 gm/cc.

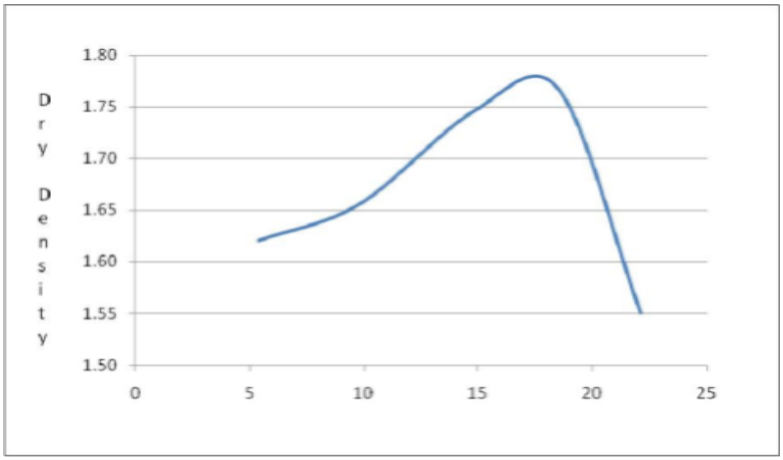

Fig.No. 7

Fig.No.7 shows compaction curve of standard proctor test of combination of black cotton soil, 20% of stone dust by weight of soil. The optimum moisture content is decreases and dry density is deceases. The optimum moisture content is 18.51% and dry density is 1.77 gm/cc.

Table No. 2

Material	CBR Value(%)
Plain soil	4.32
Soil+5% Sand Dust	5.1
Soil+10% Sand Dust	7.32
Soil+15% Sand Dust	9.25
Soil+20%Sand Dust	7.92

Similarly, California Bearing Ratio (CBR) Test was conducted to obtain the CBR Value on the samples with Stonedust which pass through 90 µ and it is added to the Black Cotton Soil in percentages of 5, 10, 15, 20 and 0.5, 1.0, 1.5, 2.0 respectively. The results obtained are presented as follow in Table No 2.

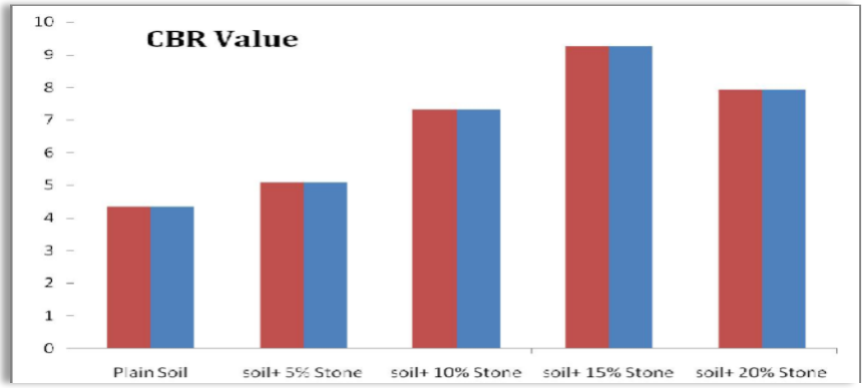

Fig. No. 8 CBR Valve Graph

Fig. No. 8 shows the graphical representation result of CBR valve in unsoaked condition with the variation of mixing stone dust. The optimum parentage of mixing stabilizing agent is 15% stone dust by weight. The CBR value is increase from 4.32% to 9.25 and further decreasing.

CONCLUSION

The waste product removed from Stone Crusher which can be used as soil stabilizer. stone dust is waste productwhich is generated from stone crusher plant.

In the present study, the improved CBR value of the soil is due to the addition of stone dust. Stone dust can be utilized as one of the material that can be used as a soil stabilizing agent but the proper proportion of stone dust must be there, which helps in increasing the CBR value of the soil.

It can be concluded that CBR percentage goes on increasing up to 15% of stone dust content in the soil and there on it decreases with increase in stone dust. Hence, we can say that 15% stone dust content is the optimum content of material in the soil.

The maximum dry density (MDD) of soil is increasing with addition stone dust with soil and the optimum moisture content (OMC) is decreasing with addition of stone dust.

The maximum dry density is 1.94 gm/cc and optimum moisture content 18.91% at 15% stone dust. This is the optimum percentage of addition of material. Further addition of stone dust the maximum dry density decrease and optimum moisture content is increases.

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