STABILIZATION OF SOIL USING JUTE FIBER AND STONE DUST

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***Abstract*: Because of fast development of population and industrialization everywhere throughout the world there is gigantic increment in development exercises. The urban areas and towns are coming nearer day by day. There is lack of land for development of structures, streets, interstates and runways. The land accessible here and there may not be appropriate for development exercises yet because of restricted land we need to do construction on that locations. So as to overcome these problems ground improvement techniques are evalved, for example, soil adjustment is advanced from most recent couple of decades by geotechnical Engineers. There are many soil stabilizers which have been used to improve the quality of soil are concrete, lime, gypsum, fly debris, rice husk debris, jute fiber, bio-compounds, stone residue and so forth. In this thesis work I have chosen two soil stabilizers that is jute fiber and stone dust. I have included jute fiber independently with fluctuating substance to improve the geotechnical properties of soil. Locally accessible soil of Srinagar is utilized in this thesis work. 21 specimens are prepared to investigate the properties of soil out of which 15 specimens are prepared by adding 0%, 0.25%, 0.50%, 0.75% and 1% of jute fibre with varying length of 30, 60 and 90mm and the remaining 6 specimens are prepared by adding 0%, 10%, 20%, 30%, 40% and 50% stone dust respectively. California Bearing Ratio (CBR) test was conducted on all the samples and result have been presented in this thesis. Result shows that maximum increase in CBR value was 200% over that of plain soil at a fiber content of 1 %, for fiber having length of 90 mm and diameter of 2 mm.**

***Keywords:* CBR, MDD, stabilization, Jute Fibre, OMC**

1. INTRODUCTION

Soil is an expansive term normally utilized in geotechnical designing applications which remembers all stores of free material for the world's outside that are made by enduring procedures and disintegration of basic rocks. In spite of the fact that enduring happens on a geologic scale and procedure is nonstop and keeps the dirt in steady change. The physical, concoction, and organic procedures that structure soils shift generally with time, area and natural conditions and result in a wide scope of soil properties, regardless of whether area is same. Physical enduring happens because of temperature changes from high to low, disintegration, exchange freezing and defrosting and because of plant and creature exercises causing breaking down of hidden stone layers while synthetic enduring deteriorates rock minerals by different procedures like oxidation, decrease, hydrolysis and carbonation separately.

Soil has a significant influence in geotechnical building, as all developments relies completely upon establishment which legitimately relies upon accessible soil at site. A few times it turns out to be perplexing for geotechnical designers to develop any structure on locales where soil isn't acceptable in quality. So as to supplant the accessible soil a gigantic sum must be pay which made venture an un-monetary. So soil adjustment is the main elective left for structural designers. So this procedure of improving the quality and sturdiness of soil is known as soil adjustment. There are an enormous number of strategies for soil adjustment, where we blend the accessible soil in with various material so as to reinforce the accessible feeble soil.

Soil adjustment is a procedure by which the geotechnical qualities of the parent soil gets improved through mechanical or concoction forms by utilization of certain added substances. So "adjustment" at the end of the day, can be accomplished through different techniques which are executed with intends to change building attributes of a specific soil so the rewarded soil reacts to a specific arrangement of designing prerequisite. Current pattern for improvement of building properties of soil is adjustment through organization of various added substances, particularly modern squanders in the activities which are perilous for our condition which makes scope for best usage of plentifully accessible mechanical squanders at a significantly minimal effort. Further, "adjustment" not just upgrades the quality and sturdiness of soil yet additionally assumes significant job in anticipation of soil disintegration in the controlled media individually.

1.2 OBJECTIVES OF RESEARCH WORK

The main objective of my thesis work:

- Improvement of locally accessible soil utilizing some eco-accommodating and modest waste materials.
- Evaluation of solidarity qualities of virgin soil just as mixed soil utilizing diverse length of Jute and various amounts of stone dust.
- Determination of suitable Jute and stone dust content proportion so as to accomplish the most extreme increase in quality of soil.

2. LITERATURE REVIEW

Ali and Koranne (2011); introduced the consequences of a trial program embraced to examine the impact of stone residue and fly debris blending in various rates on sweeping soil. They saw that at ideal rates, i.e., 20 to 30% of admixture, the growing of far reaching dirt is nearly controlled and there is a checked improvement in different properties of the dirt also. It is finished up by them that the blend of equivalent extent of stone residue and fly debris is more powerful than the expansion of stone residue/fly debris alone to the far reaching soil in controlling the growing nature.

Onyelowe Ken et al. (2012); had led concentrates on those characteristics and applications that make quarry dust a decent substitution or admixture during soil improvement. At the point when quarry dust is included with far reaching soil, it is normal that it will make it increasingly permeable, less tough, diminish attachment and so on, and furthermore quarry dust has unpleasant, honed rakish particles and as such causes an addition in quality because of better interlocking.

Satyanarayana et al. (2013); led pliancy, compaction and quality tests on rock soil with different level of stone residue and found that by expansion of stone residue versatility attributes were diminished and CBR of the blends improved. Expansion of 25-35% of stone residue makes the rock soil meet the determination of morth as sub-base material.

Sabat and Bose at ol. (2013); considered the joined impact of fly debris and quarry dust on compaction attributes, unconfined compressive quality, california bearing proportion (CBR), shear quality boundaries and growing weight of a far reaching soil. It is seen that most extreme dry thickness, California bearing proportion and point of inner rubbing increments and union and ideal dampness content reductions with expansion of expanded level of fly debris – quarry dust blend. The greatest estimation of unconfined compressive quality is accomplished when the fly debris – quarry dust blend is 45%. Smasher dust is blended in with high plastic rock to decrease the abundance disfigurement of the rock soils and increment the existence time of asphalt. Expansion of smasher dust diminished the plastic qualities and improved the CBR esteem.

Orekanti Eshwara Reddy (2015); considered the impact of quarry dust on compaction properties of earth. For the investigation, they utilized the clayey soil and quarry dust gathered from Madepalli, which is situated in Krishnagiri locale of Tamilnadu. The dirt was supplanted by quarry dust in the extent of 10,20,30,40 and half dependent on the examination they found that 30% substitution of soil by quarry dust is an ideal blend and is suggested for use in development.

Amit Kumar(2016); Using the jute fortification is seen as particularly successful for settling the sweeping soil as the CBR estimations of the dirt were improved. The progressions saw in the dirt after fortification is striking. The OMC of the dirt was diminished from 19.54% to 15.98%. The MDD was expanded at 2-layer support from 1.698 g/cc to 1.74 g/cc and after the 4-layer fortification of jute layer, the MDD supposedly was diminished to 1.72 g/cc. The CBR esteems were upgraded as the CBR estimation of common example was 2.67% and after 2-layer support of jute layer the improvement in CBR esteem was improved to 6.07% and when the jute layer fortification was expanded to 4-layers the enormous CBR estimation of 11.85% was gotten. In this way it very well may be inferred that most extreme improvement was found in 4-layer fortification of jute layer in soil.

Anzar Hamid(2017); Concluded that CBR estimation of soil increments with the incorporation of jute fiber. At the point when the jute fiber content is expanded, the CBR estimation of soil further increments and this expansion is exceptional at fiber substance of 0.75%. It is likewise presumed that there is noteworthy impacts of length of fiber on the CBR estimation of soil. The CBR estimation of soil additionally increments with the expansion long of fiber. The greatest increment in CBR esteem was seen as more than 200 % over that of plain soil at fiber substance of 0.75% for fiber having measurement 2 mm and length 90 mm. It has been inferred that support of soil utilizing jute-geotextile is monetarily favorable as it is modest and locally accessible material. Contrasted with existing techniques for soil support which have down to earth troubles in the field, the utilization of jute-geotextile is simpler.

3. MATERIALS AND METHODOLOGY

3.1 GENERAL

Primary and secondary binders form cementitious composite material when they come in contact with the water or in the presence of pozzolanic material reacts with water. The commonly used binders are:

- Cement
- Lime
- Gypsum
- Jute
- Fly ash
- Rice husk, ash
- Stone Dust
- Blast furnace slag etc.

The above materials can be used alone or in combination.

This Thesis makes the use of Jute fibre and Stone Dust with locally available soil. A brief introduction to the materials and their behaviour is given below:

3.2. JUTE FIBER

Jute is one of the most reasonable regular strands, and second just to cotton in the sum delivered and assortment of employments. Jute filaments are made principally out of the plant materials cellulose and lignin. It falls into the bast fiber class (fiber gathered from bast, the phloem of the plant, in some cases called the "skin") alongside kenaf, mechanical hemp, flax (material), ramie, and so on. The modern term for jute fiber is crude jute. The strands are grayish to brown, and 1–4 meters (3–13 feet) in length. Jute is likewise called the brilliant fiber for its shading and high money esteem.

Properties of experimental fibre

Fibre length, mm	30, 60 and 90.
Fibre diameter in mm	2
Specific Gravity of fibre	1.3
Bulk Density in kg/m^3	1300
Ultimate tensile strength in N/mm^2	3400

3.3. STONE DUST

It is a modern side-effect. It is a by stone pulverizing which broken downs into fine totals. It is dark in shading and resembles fine total. The stone residue was acquired from close by smashers from Spore. It causes natural issues like damping issues. Changing over stones into valuable result stone residue has numerous advantages like support of natural equalization. Likewise it is utilized for various exercises in development industry, for example, street development and production of building materials, for example, light weight totals, blocks and tiles. It is sieved through 1.18mm IS strainer.

Photograph of stone dust

Table 1 Physical properties of stone dust

S.No.	Properties of stone dust	value
01	Grain size distribution Course sand(2-4.75mm)% Medium sand (0.425 – 2mm)% Fine sand (0.075 – 0.425mm)% Silt (0.002 – 0.075mm) and Clay (<.002mm) %	 8 35 43 14 0
02	Compaction characteristics Maximum dry density gm/cm3 Optimum moisture content %	 1.91 11.20
03	Specific gravity	2.76
04	Soaked CBR value %	8.03

3.4. SOIL

Soil is a blend of rock or mineral particles, water, and air. It is based on these constituents that the properties of soil vary starting with one territory then onto the next. In addition, various sorts of soils carry on diversely to the development works. The sort of soil for a building site impact the structure and costs of the structure to be built

Physical properties of parent soil

Specific gravity	2.42
Water content	12.20%
Liquid limit	19.70
Plastic limit	7.23

Plasticity index	12.47
CBR value	6.08

3.5. METHODOLOGY

I have selected locally available soil of Srinagar for stabilization with jute fibre and stone dust. As various stone crushers are located in nearby vicinity and bi product of these crushers is not fully utilised. The stone dust is bi product formed during the crushing of stones and due to limited use of stone dust its demand is not at peak. So I wish to use stone dust as a reinforcing material with locally available soil in order to increase the shear strength of soil.
Following are steps which I have followed in methodology are:

- Identification of Suitable site that is Srinagar area.
- Collection of soil samples from Srinagar, Stone dust from SM stone crusher Srinagar and finally jute fibre from market.
- Determination of CBR Values of parent soil, soil reinforced with varying content & lengths of jute fibre and Soil reinforced with stone dust.
- Comparison of above results.

4. RESULTS AND DISCUSSIONS

4.1 CBR test on soil reinforced with jute fiber only

CBR value at 2.5mm penetration = (80+85.77/2) *100/ 1370 =6.05

CBR value at 5mm penetration = 94.02*100/2055 =4.57
So, higher value among above values that is 6.05 is taken as CBR value of parent soil.

4.2 CBR Test on soil reinforced with jute fiber having length of 30mm and diameter of 2 mm.

Table 2 CBR Test results of soil reinforced with jute fibers of 30mm

Length of jute fibre (mm)	%age of fibre by dry weight of soil	CBR value (%)	%age increase in CBR value
30	0%	6.05	------
30	0.25%	7.29	20.56%
30	0.50%	10.31	70.41%
30	0.75%	10.54	74.21%
30	1 %	11.09	83.30%

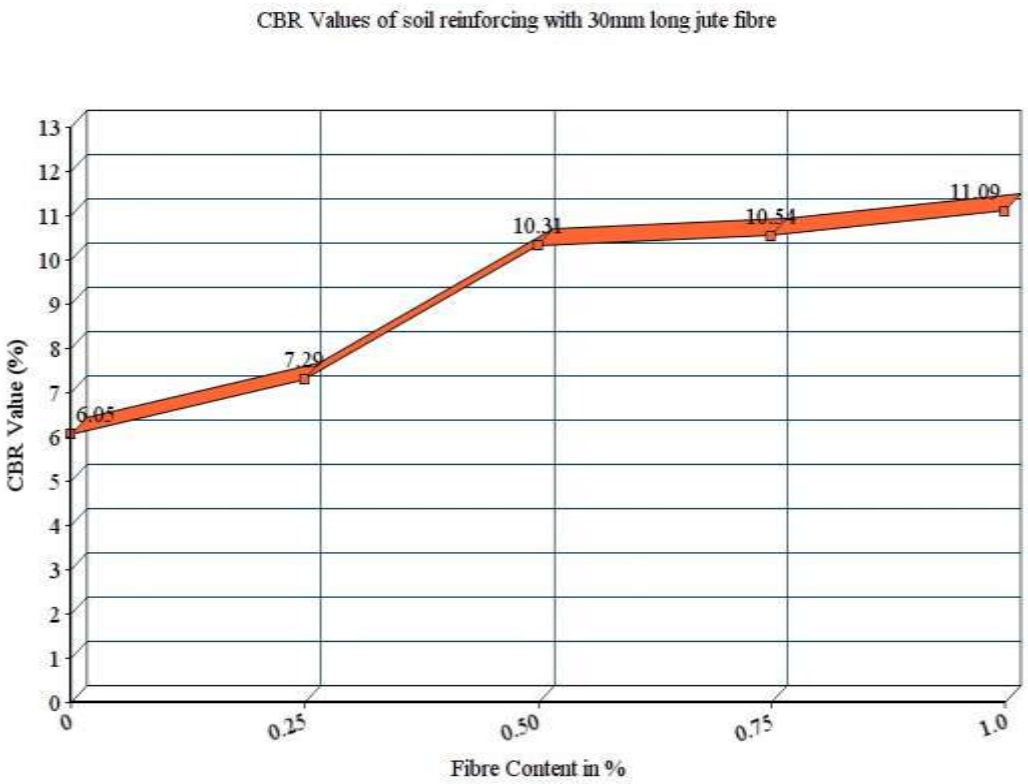

Figure 1 CBR Test results of soil reinforced with 30mm jute fibers

4.3 CBR Test on soil reinforced with jute fibre having length of 60mm and dia 2mm

Table 3 CBR Test results of soil reinforced with 30mm jute fibers

Length of jute fibre (mm)	%age of fibre at dry weight of soil	CBR value (%)	%age increase in CBR value
60	0%	6.05	---------
60	0.25%	11.52	90.41%
60	0.50%	11.87	96.20%
60	0.75%	12.36	104.29%
60	1 %	13.56	124.13%

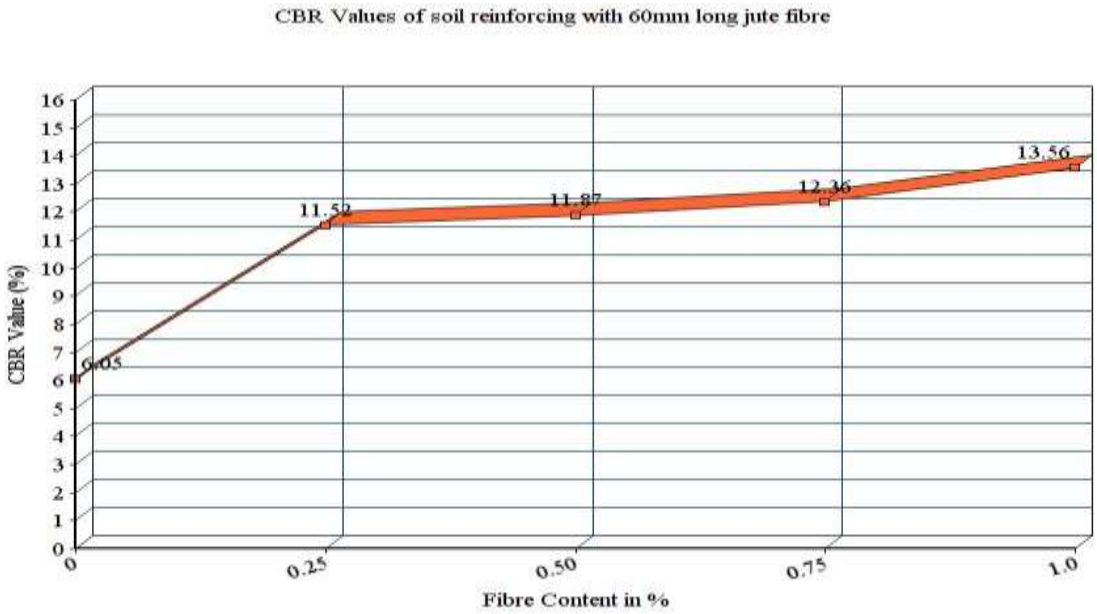

Figure 2 CBR Test results of soil reinforced with 60mm jute fibers

4.4 CBR Test on soil reinforced with jute fibre having length of 90mm and dia 2mm

Table 4 CBR Test results of soil reinforced with 90mm jute fibers

Length of jute fibre (mm)	%age of fibre by dry weight of soil	CBR value (%)	%age increase in CBR value
90	0%	6.05	----------
90	0.25%	13.50	123.14%
90	0.50%	13.67	125.95%
90	0.75%	15.18	150.91%
90	1 %	18.24	201.49%

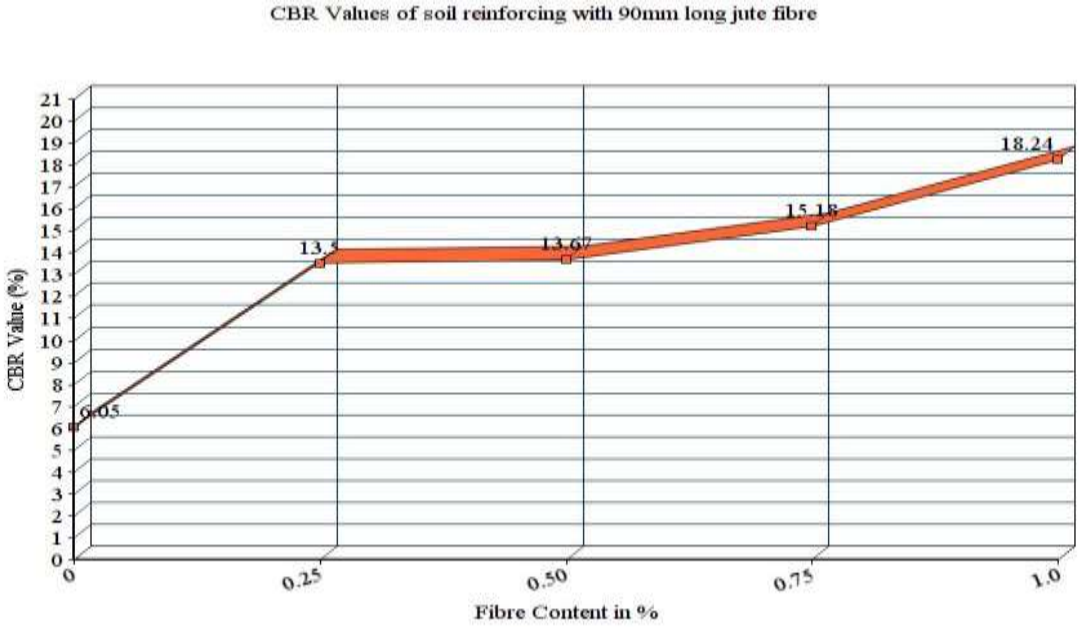

Figure 3 CBR Test results of soil reinforced with 90mm jute fibers

4.5 Comparison of results of all lengths of jute fibre:

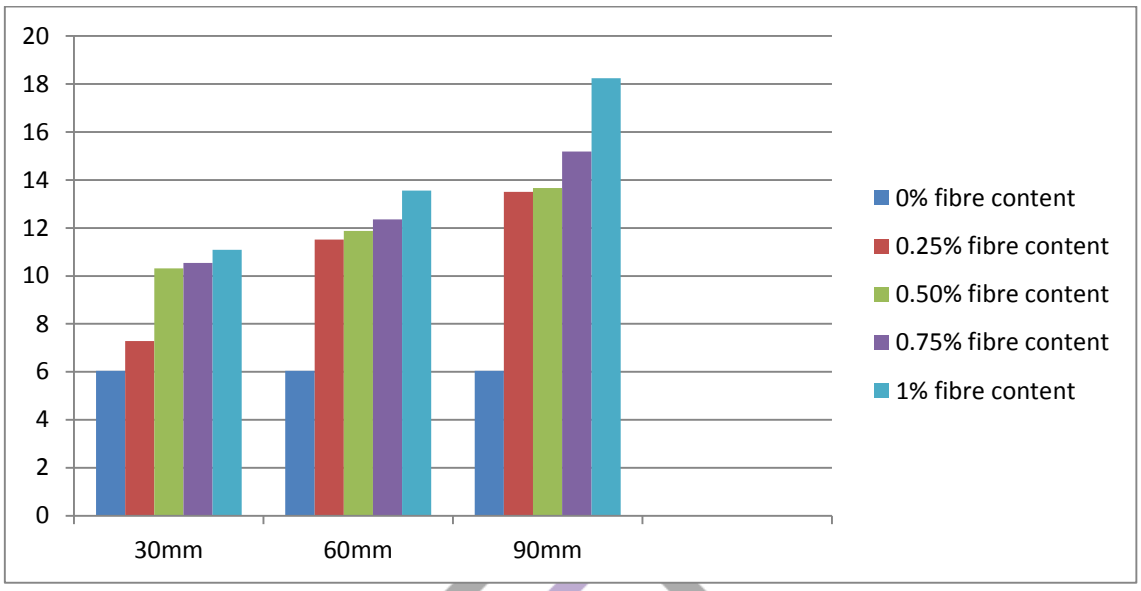

Figure 4 Comparison of CBR Test results of jute fibers of all lengths

4.6 CBR Test on soil reinforced with stone dust only:

Table 5 CBR Test results on soil reinforced with stone dust only

Stone dust content	CBR Value	%age increase in CBR value
0% stone dust	6.05	------
10% stone dust	7.04	16.36
20% stone dust	8.04	24.75
30% stone dust	10.01	65.45
40% stone dust	11.74	94.05
50% stone dust	13.98	131.07

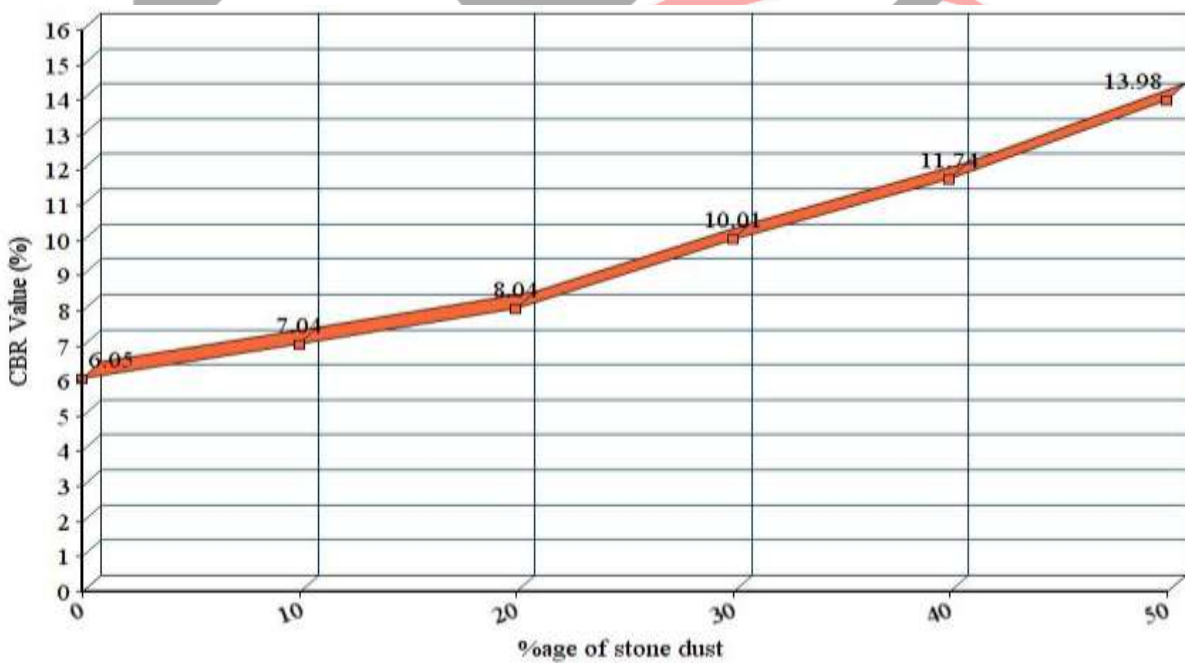

Figure 5 CBR Test results on soil reinforced with stone dust only

5 CONCLUSION

1. The CBR value of soil increases with the increases in length of length.
2. The maximum increases in CBR value was found to be more than 200% over that of plain soil at fibre content of 1% for fibre having diameter 2mm and length 90mm.

3. The CBR value increases with the increase in length of jute fibre.The CBR value of soil having length 30mm and fibre content 0.25% is increases by 20.56% while CBR value of soil containing same fibre content that is 0.25% but length of 90mm, the CBR value increases by 123.14%.
4. Results show that maximum increase in CBR value was times (200 %) over that of plain soil at a fiber content of 1 %, for fiber having length of 90 mm and diameter of 2 mm.Based on the above results , it is concluded that optimum stone dust content is 50% as beyond this content the CBR value shows very low increament.
5. Result shows that even after addition of 50% stone dust to soil the CBR values not increased as much as increased by addition of 1% jute fibre having length 90mm.Overall it can be concluded that fiber reinforced soil can be considered to be good ground improvement technique specially in engineering projects on weak soils.

6. SCOPE OF FURTHER STUDIES

Improving properties of soil become a matter of paramount importance today. Here an effort has been made to study the effect of Jute fibre and stone dust. In this study I have limited my work to maximum of 1% jute fibre content and 50% stone dust. Here are some suggestion made for further progress:

- A research can be done on soil stabilization with more than 1% jute fibre.
- Both jute fibre and stone dust can be added simultaneously with varying content.
- Various tests can be done other than CBR test.

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