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Stability of Clay Soil using Rice Husk Ash and Stone Dust

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Abstract:
Soil is the foundation for any civil engineering structures. It is required to bear the loads without failure. In some places, soil may be weak which cannot resist the oncoming loads. In such cases, soil stabilization is needed. Soil stabilization is the process which improves the engineering properties of soil and makes it stable. The main objective of soil stabilization is to improve the strength and stability of soil and mainly to lower the construction cost. The stability and bearing capacity of soil depends on the shear strength, which is directly proportional to the type and condition of the soil. In some of the situations where two materials do not have the desired engineering properties, but when they mix together, they produce satisfactory material. The new stabilized material will be more stable and fulfil the desired conditions. One parameter of the main parameters is that the variation in the properties and characteristics of the soil is changes according to the change in the area and environment of the soil for any land-based structure, the foundation is very important and has to be strong to support the entire structure. In order for the foundation to be strong, the soil around it plays a very critical role. The process of soil stabilization helps to achieve the required properties in a soil needed for the construction work. From the beginning of construction work, the necessity of enhancing soil properties has come to the light. Some types of soil have low bearing capacity and do not fulfill the engineering works. So to improve the engineering properties of soil and make it suitable for engineering works soil stabilization is needed.

Keywords:-Rice Husk Ash (RHA), Clayey Soil (CI), Stone Dust (SD), Optimum Moisture Content (OMC) Unconfined Compressive Stress (UCS).

I.INRODUCTION

Soil is a good and comfortable material for the construction purpose so it is very important to know about the properties and feasibilities of soil before use in any kind of construction process. So, to work with soils, we need to have proper knowledge about their properties and factors which affect their behavior. The process of soil stabilization helps to achieve the required properties in a soil needed for the construction work. From the beginning of construction work, the necessity of enhancing soil properties has come to the light. Some types of soil have low bearing capacity and do not fulfill the engineering works. So to improve the engineering properties of soil and make it suitable for engineering works soil stabilization is needed. Soil stabilization is the process which improves the engineering properties of soil and makes it stable. The main objective of soil stabilization is to improve the strength and stability of soil and mainly to lower the construction cost. Expansive (clay) soil is one that changes in volume in relation to water content. Here the focus is on soils that exhibit significant swell potential and in addition shrinkage potential also exists. There are several cases where expansion can occur through chemically induced changes (e.g. swelling of lime treated sulphate soils). However, many soils that exhibit swelling and shrinking behavior contain expansive clay minerals, such as smectite. The stability and bearing capacity of soil depends on the shear strength, which is directly proportional to the type and condition of the soil. In some of the situations where two materials do not have the desired engineering properties, but when they mix together, they produce satisfactory material. The new stabilized material will be more stable and fulfil the desired conditions.

II. OBJECTIVES OF THE STUDY

1) Improvement in stability of soil for the good building construction in civil engineering.
2) Making the foundation process cheap and comfortable in economically.
3) Observe a right concentration mixture of the additional components like rice hush ash and stone dust.
4) Use of wastage material which is producing in high potential and having disposal problems.

III. LITERATURE REVIEW

Zhang et.al (2016) Through the spotlight on the laboratory frost-heave and thaw-weakening performance of pavement foundation resources that were alleviated with mixture of self-cementing class C fly ash, Portland cement, and polymer fibers. It was found that by adding flash (15% by weight), cement and cement + fibers improvement on frost susceptibility of soils was found beside this the Grain size distribution and curing time compaction delay of chemical stabilization also influenced soil freeze–thaw action of soil.

Gupta and Sharma (2014) had studied the effect of fly ash, sand and marble dust on compaction and CBR values of expansive soil, there was approximately 200% increase in soaked CBR in the sample having soil -52.36%, sand-22.44%, fly ash -13.2% and marble dust- 12%.

Modaket.al (2012) He did the stabilization using and conducted tests on assessment of soil properties like Optimum moisture content, dry density, and strength parameter (California Bearing ratio value). Singular quantities of Lime and Fly ash (% by weight) were added to the BC soil. The results showed that the employment of Lime and Fly ash boosted the California Bearing Ratio values and. the strength of soil to a big degree.
Hejazi et.al (2012) Reviewed the history, remuneration, uses of using singular types of fibers as soil reinforcement He found that purposeful fiber individuality increases strength and inflexibility of soil.

Radevsky (2001):- A summary of the issues with clay soil has been given by Radevsky. In his review of how different countries deal with expansive soil problems and a detail informative study from Arizona US has more recently been presented by **Houston et al (2011).** The Study demonstrated how the source of problems from expansive soils often stem from poor drainage, construction problems, home owner activity and its adverse effects and landscaping through use of vegetation and is often associated with a combination of these. These aspects may be more important as a predictor of expansive soil problems.
Akbulutet.al (2007) investigated the strength and dynamic behavior of the reinforced soils with haphazardly built-in squandered fiber particles. Tests like unconfined compression, shear box, and resonant frequency tests to find the strength and dynamic characteristics of the soil sample which was not reinforced and the one which was reinforced. It was found that the strength characteristics as well as dynamic behavior of clayey soils were enhanced.

IV. MATERIALS USED

Soil used in the experiments has been collected from national institute of technology Srinagar that was already brought for analysation of MDD. The properties of soil are as follows

Table.1. Properties of Soil

S.No.	Soil property	Soil sample
1	Color of soil	Yellowish
2	Nature of soil	Clay type
3	Natural moisture content (w %)	12.80
4	Specific gravity G	2.61
5	Liquid limit (%)	56.59
6	Plastic limit (%)	32.65

Rice Husk Ash: Locally available RHA was used in the test.
Stone Dust: The Stone Dust was collected from Local stone crusher.

V. EXPERIMENTAL PROCESS

1) Analysis of standard proctor test (SPT)
2) Unconfined Compressive Strength (UCS)

A. Standard Procter Test (SPT)

To perform the Standard proctor test (SPT) for Clay soil, rice husk ash and stone dust with variation in composition in quantity sample are prepared that are shown below in table 1.1

B. Unconfined Compressive Strength (UCS)

The unconfined compressive tests were conducted on the rice husk ash and stone dust clay soil samples. it is noted that unconfined compressive value of the rice husk ash and stone dust in various proportions has increased gradually from to maximum compressive strength and materials combinations is optimum percentages of unconfined compressive value is find out. Table 1.1 provided on the next page

Table.1. Sample preparation ratio for SPT& UCS

Sample 1	CI - 100% + SD - 0% + RHA- 0%
Sample 2	CI - 90% + SD - 0% + RHA- 10%
Sample 3	CI - 85% + SD - 0% + RHA- 15%
Sample 4	CI - 80% + SD - 0% + RHA- 20%
Sample 5	CI - 90% + SD - 10% + RHA- 0%
Sample 6	CI - 80% + SD - 10% + RHA- 10%
Sample 7	CI - 75% + SD - 10% + RHA- 15%
Sample 8	CI - 70% + SD - 10% + RHA- 20%
Sample 9	CI - 85% + SD - 15% + RHA- 0%
Sample 10	CI - 75% + SD - 15% + RHA- 10%
Sample 11	CI - 70% + SD - 15% + RHA- 15%
Sample 12	CI - 65% + SD - 15% + RHA- 20%
Sample 13	CI - 80% + SD - 20% + RHA- 0%
Sample 14	CI - 70% + SD - 20% + RHA- 10%
Sample 15	CI - 65% + SD - 20% + RHA- 15%
Sample 16	CI - 60% + SD - 20% + RHA- 20%

VI. RESULTS AND DISCUSSION

A. Standard Proctor Test Comparison

The Standard Proctor Test were conducted on the rice husk ash and stone dust with clay soil samples. it is noted that dry density value increase with the decreasing of water content . The various results for Standard Proctor Test are compared in graphical presentation in below. The table shows the maximum dry density at maximum water content for Standard Proctor test. The maximum water content values for Standard Proctor test is selected from the curve height. While performing the SPT test we plot various curve with combination of Clay soil, Stone Dust and Rice husk Ash.

Table.2. Result for all MDD & OMC

Result for All Maximum		
Dry density and Maximum water content		
Sample	Maximum	Maximum
	Dry density, Ɣd	Water contents, w (%)
Sample 1	1.95	30.00
Sample 2	1.76	26.00
Sample 3	1.76	25.00
Sample 4	1.77	24.00
Sample 5	1.79	24.00
Sample 6	1.78	23.00
Sample 7	1.78	24.00
Sample 8	1.76	24.00
Sample 9	1.77	25.00
Sample 10	1.95	30.00
Sample 11	1.80	23.00
Sample 12	1.81	23.00
Sample 13	1.77	21.00
Sample 14	1.79	20.00
Sample 15	1.76	23.00
Sample 16	1.74	24.00

VII. GRAPHICAL PRESENTATIONS OF COMPARISON BETWEEN MAXIMUM DRY DENSITY AND MAXIMUM WATER CONTENT

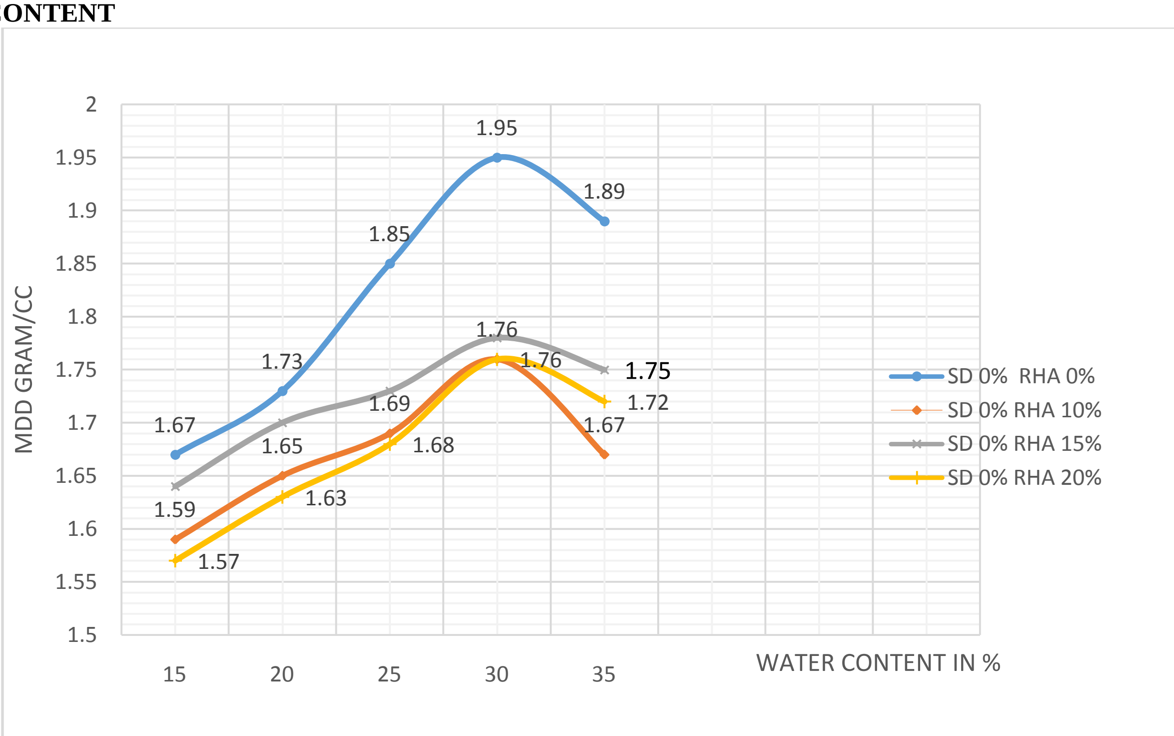


Figure.1. Graphical presentations of comparison between Maximum dry density and maximum water content for SD- 0 %, RHA-(0.0, 10.0, 15.0, and 20.0) %

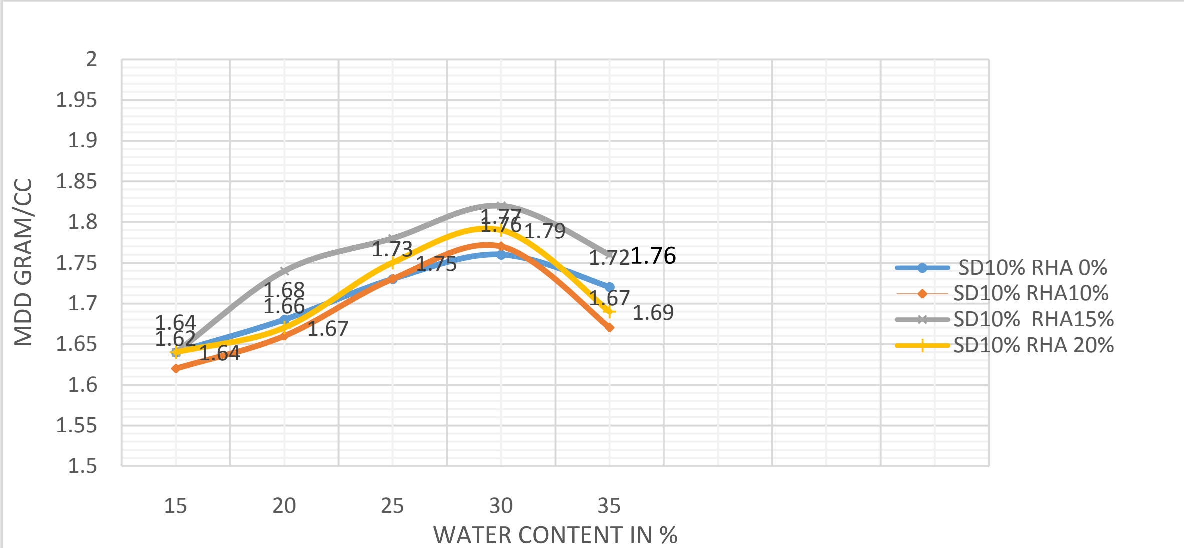


Figure.2. Graphical presentations of comparison between Maximum dry density and maximum water content for SD- 10 %, RHA-(0.0, , 10.0, 15.0, and 20.0) %

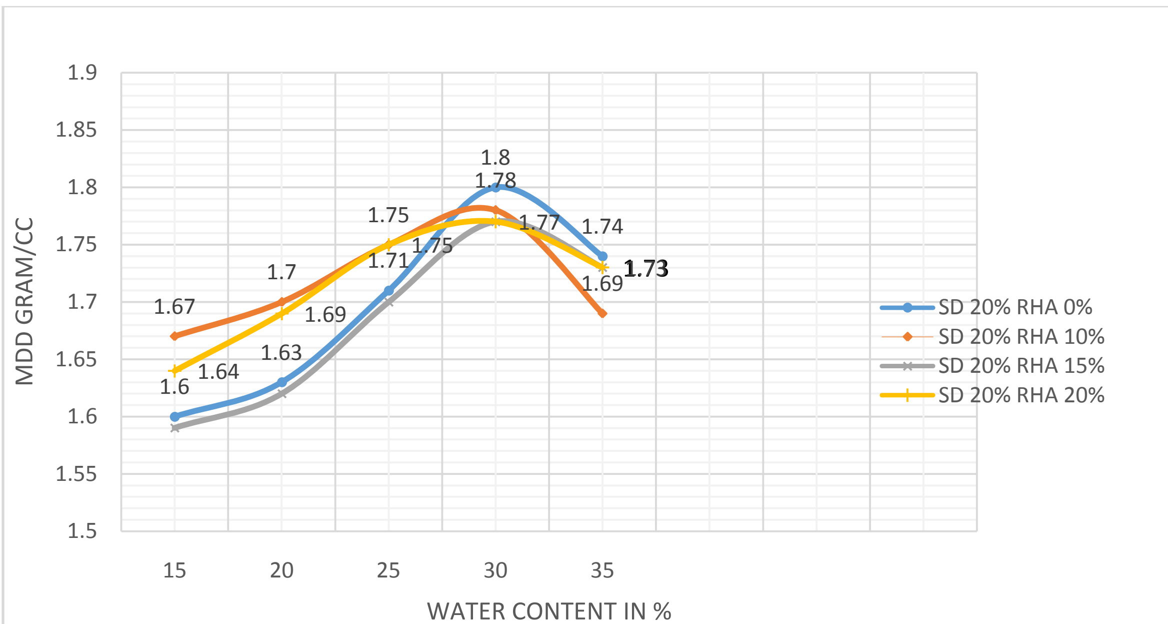


Figure.3.Graphical presentations of comparison between Maximum dry density and maximum water content for SD- 20 %, RHA-(0.0, 10.0, 15.0, and 20.0) %

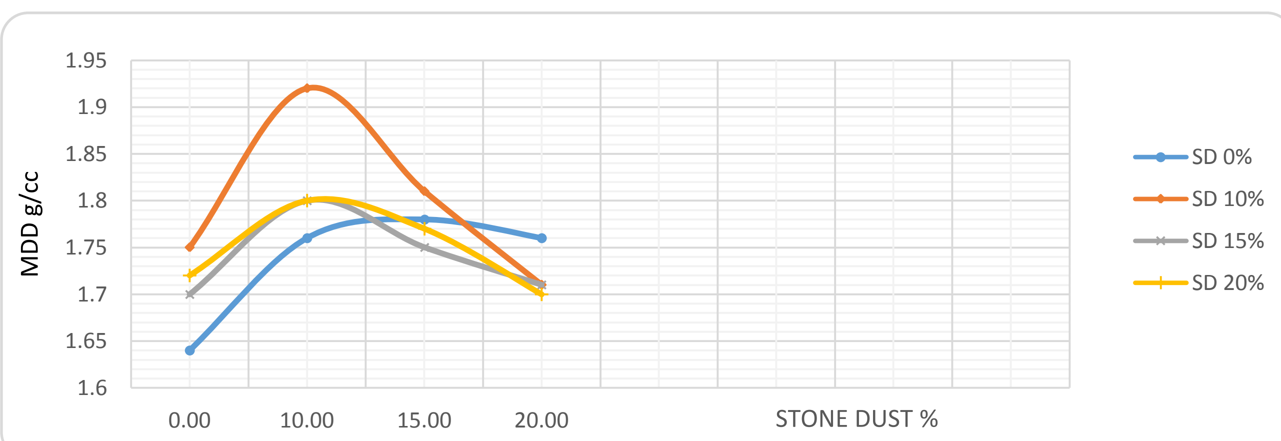
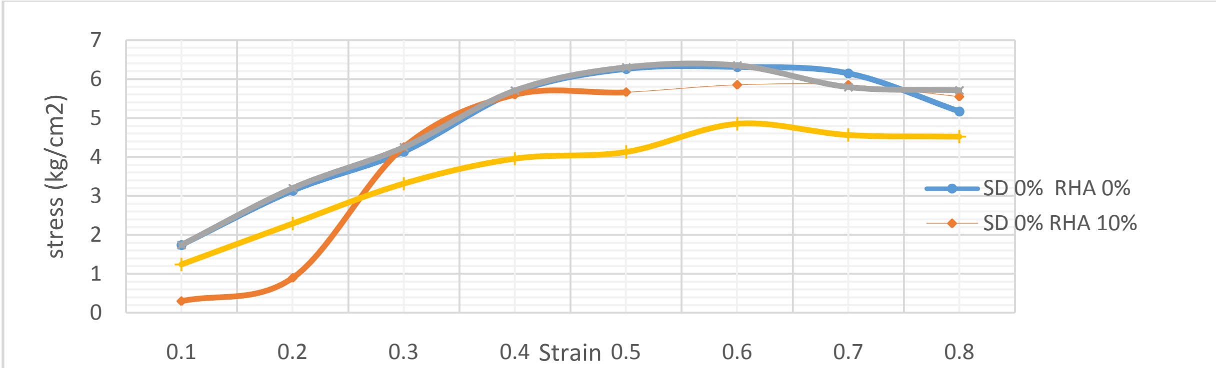


Figure.4. Graph Showing Moisture-Density Relationship of Parent Soil with varying stone dust%



Figurer.5. Graphical presentations of comparison between Maximum Stress and maximum Strain for SD – 0 %, RHA-(0.0, 10.0, 15.0, and 20.0) %

Comparison between maximum stress and maximum strain obtained

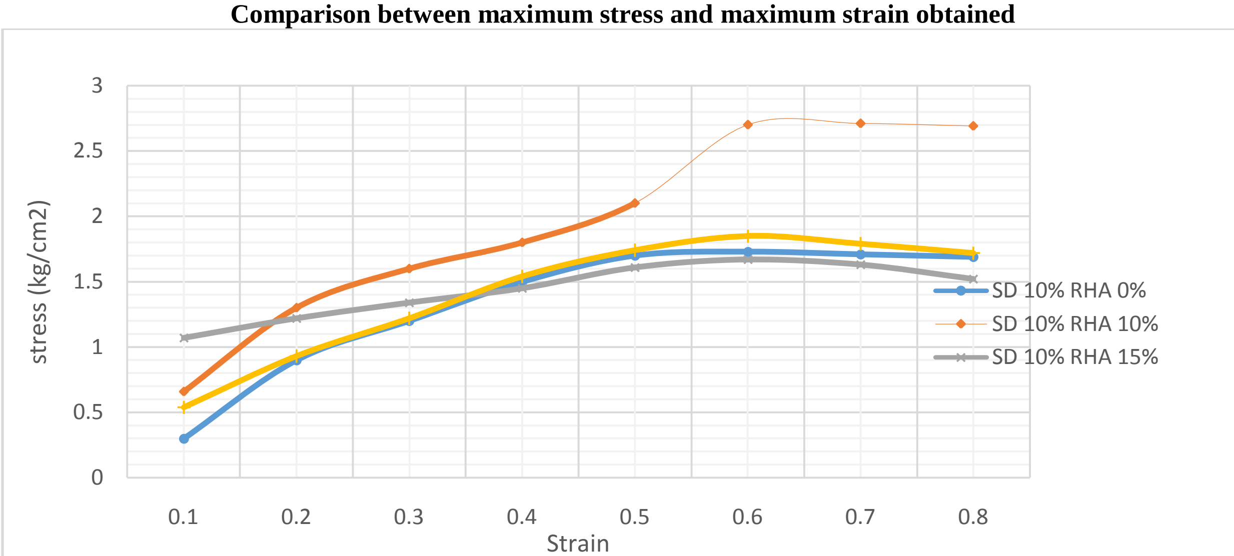


Figure.6. Graphical presentations of comparison between Maximum Stress and maximum Strain for SD – 10%, RHA-(0.0, 10.0, 15.0, and 20.0) %

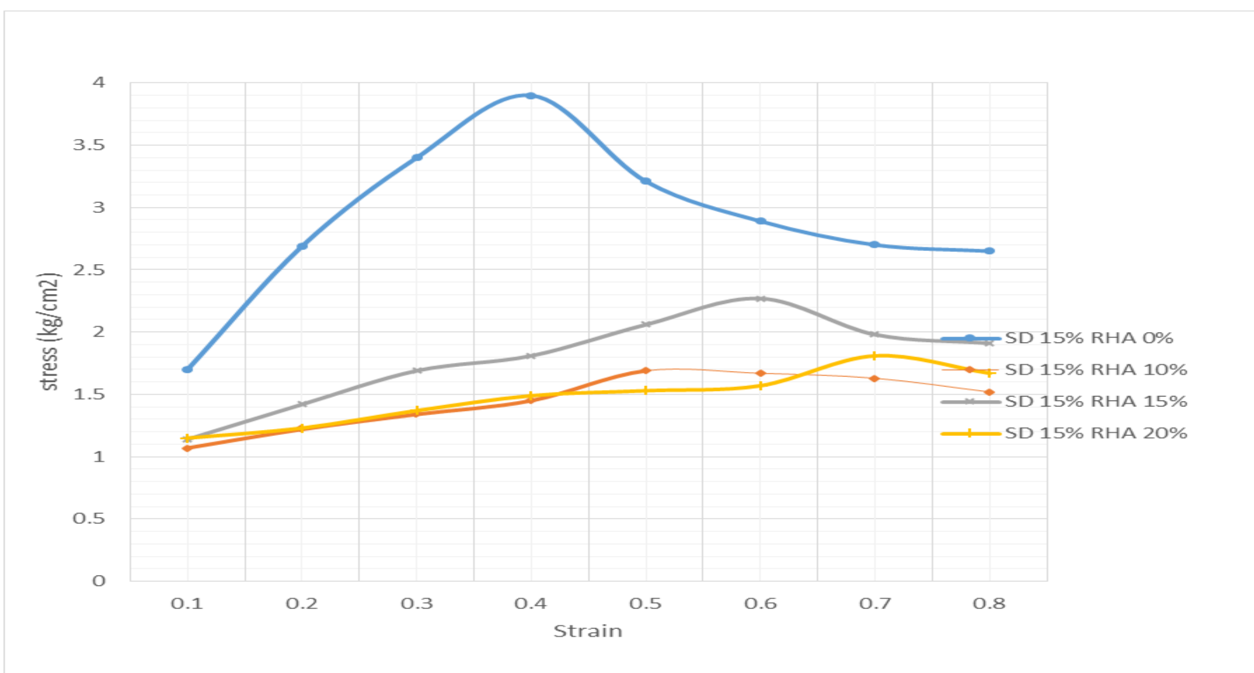


Figure.7. Graphical presentations of comparison between Maximum Stress and maximum Strain for SD – 15%, RHA-(0.0, 10.0, 15.0, and 20.0) %

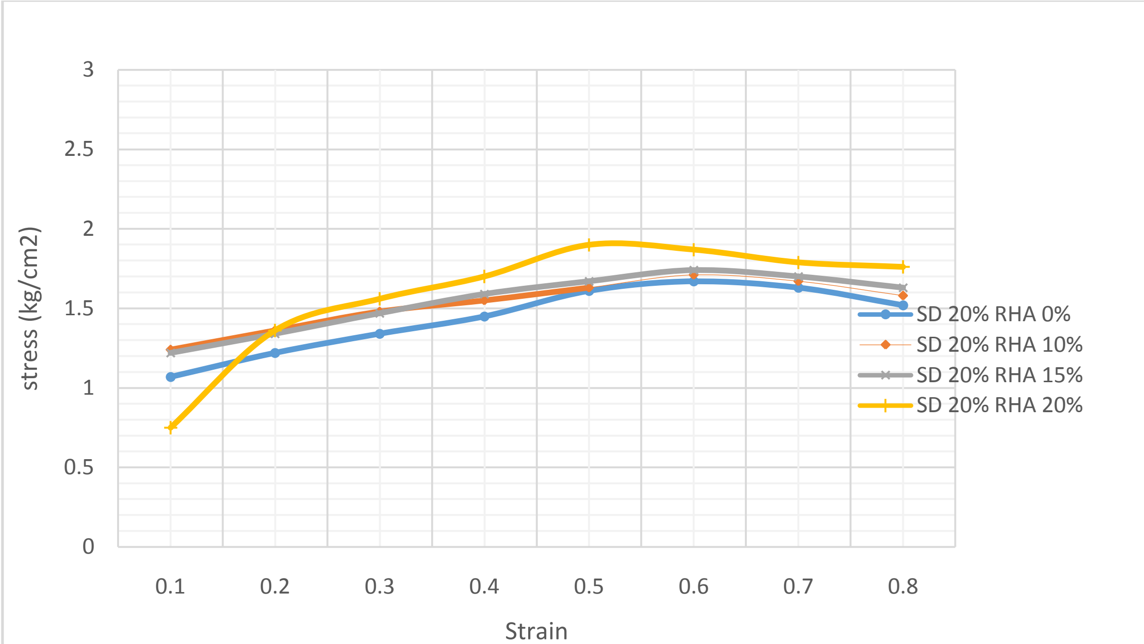


Figure.8. Graphical presentations of comparison between Maximum Stress and maximum Strain for SD – 15%, RHA-(0.0, 10.0, 15.0, and 20.0) %

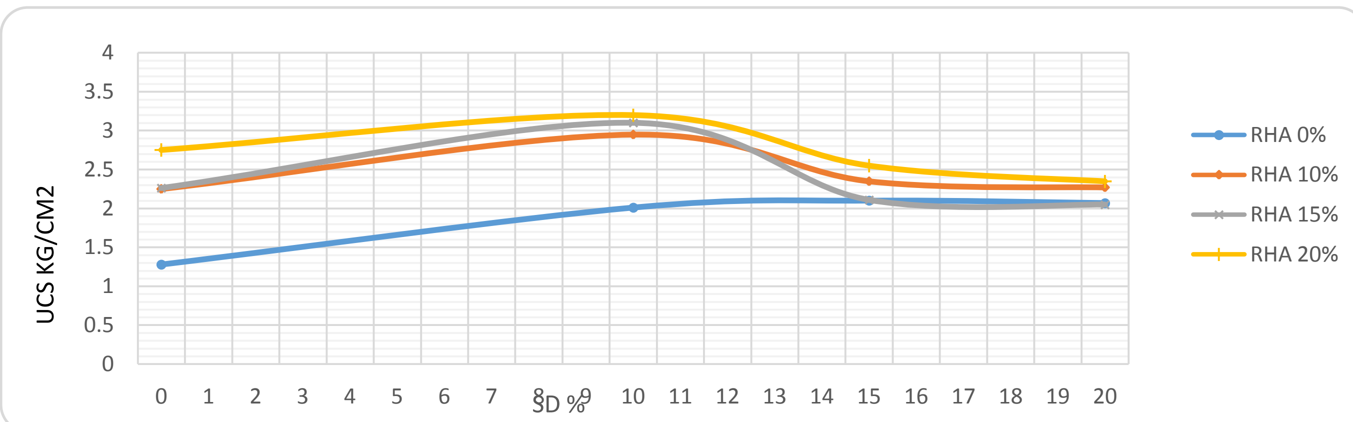


figure.9. Graph Showing Unconfined Compressive Strength Relationship

VIII. CONCLUSION

During test performance, we found that Atterberg's limit (Liquid Limit & Plastic Limit), Specific Gravity, Standard Proctor Test (SPT) and Unconfined Compression Test (UCS) are very important for testing the properties of used soil for the construction process. All the results were described above in detail, some conclusion were taking out from this study are given:-

- The dry density of the sample is increased with decreases in water content.
- Maximum water content during performing SPT excepting parent soil is 28 at 1.76 dry density Minimum water content during performing SPT excepting parent soil is 23 at 1.79 dry density
- Mixing materials like Stone Dust and rice husk ash must be available in high potential for this type of soil treatment.
- Maximum strength of mixture 1.612 with 0.0438 strain that is from the composition of 10% SD and 20% RHA (Rice Husk Ash) .The compressive strength of used mixture is increases for a particular composition after that it goes falling down.

For this kind of soil treatment mixing of soil with right composition is not very easy process it is also a very important process for best performance at lowest coast.

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