Stabilization of natural soil using rice husk

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***Abstract*— Rammed earth is an ancient building technique used in many regions of the world. Rammed earth offers an economical and sustainable alternative to concrete. There are some issues which needs to be addressed like shrinkage, proper soil selection, low compressive strength, cracking, durability aspects etc for rammed earth construction. One way to address these problems is to stabilize rammed earth. The primary objective of this study is to make use of the RHA(waste material) with NS and understand its effects on the geotechnical properties, compressive strength & weathering.

The proctor tests results indicates that with the increase in RHA percentage there was an increase in the Optimum Moisture Content (OMC) and reduction in the Maximum Dry Density (MDD). The cube compressive strength values decreased with subsequent addition of RHA to its maximum at 5% RHA. The deterioration is increases with increasing in RHA content.

***Index Terms*— Rice husk ash, compressive strength, MDD , OMC, weathering.**

I. Introduction

Rammed earth is a construction technique where soil is taken from the ground and compacted to form structures. Removable formwork is installed, and the soil compacted within it. Rammed earth buildings are found around the Mediterranean, and along the same latitude in Iran, Pakistan, India and China. Rammed earth was taken by the Europeans to South America, and many colonial buildings in parts of Brazil and Columbia are constructed in rammed earth. The rediscovery of rammed earth as a sustainable building material prompted its use in Australia and the southern United States from the early 1970s onward. Today rammed earth is receiving increased interest as sustainable construction practices become more main stream. Rammed earth constructions can be classified into two broad categories: stabilized rammed earth and un-stabilized rammed earth. Unsterilized rammed earth is made from mainly soil, sand and gravel. Whereas stabilized rammed earth contains additives like cement or lime in addition to soil, sand and gravel.

II. Objectives

This research will draw a comparison between the NS available locally in Ahmadabad &available literatures thereby indicating the suitability of NS for the use of RE. Since there are very few guidelines available for rammed earth when combined with a waste material like RHA

- The primary objective of this study is to make use of the RHA(waste material) with NS and understand its effects on the geotechnical properties, compressive strength & weathering.

The study also intends to quantify the amount of RHA to be added to the NS according to the values of soil properties measured, in order to enhance the properties of rammed earth. Establishing properties of locally available natural soil and comparing it with properties of soil suitable for rammed earth construction as per published literature.

III. Experimental Program

1) collection of soil sample
2) establishing soil properties
3) proportioning with rha & re-establishing its properties
   Ns + rha (5,10,15%)
4) further investigation by analyzing its ucs, cube compressive strength results at various moisture contents and weathering results Following tests are carried out.

A. Geotechnical Properties

Grain Size Distribution,
Plastic Index,
Shrinkage,
Swelling,
Dry Density and Moisture Content etc.

B. Compressive Strength

Unconfined Compressive Strength (UCS),
Cube Compressive Strength,.

C. Weathering Effect

Spray Test.

IV. Results

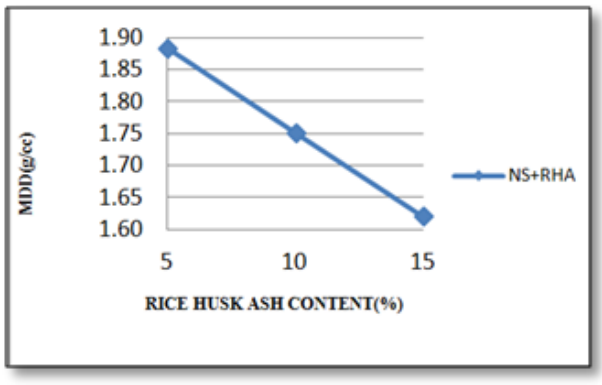

Figure 1 – MDD (g/cc) versus RHA (%)

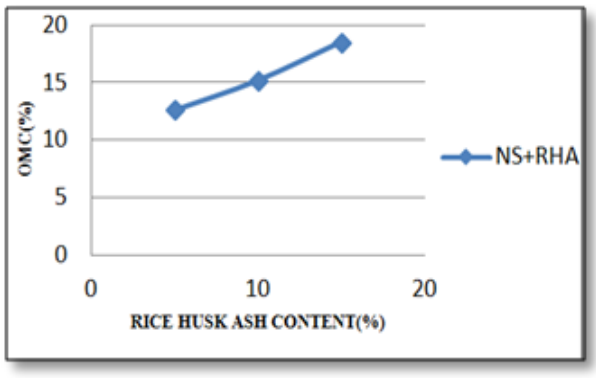

Figure 2 - OMC(g/cc) versus RHA(%)

The proctor tests results shown in the Figure A and B indicated that with the increase in RHA percentage there was an increase in the Optimum Moisture Content (OMC). It was also observed that with the increase in RHA percentage there was a reduction in the Maximum Dry Density (MDD)

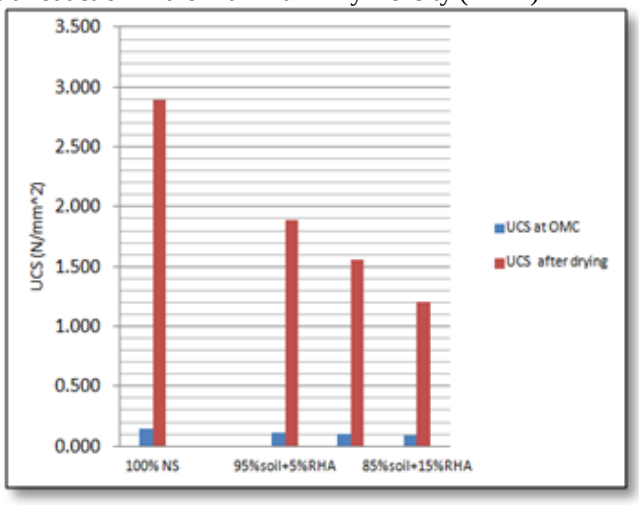

Figure – 3 Unconfined compressive strength of NS with Various percentage of RHA

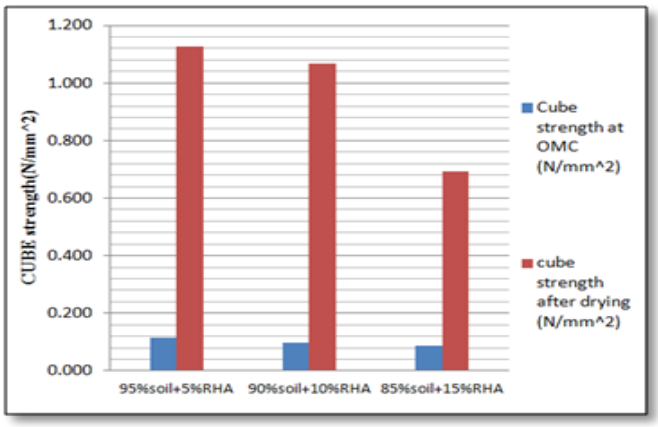

Figure – 4 Cube compressive strength of NS with various percentage of RHA

Weathering test

Proportion	Time taken(min)	Deterioration(%)	Type
NS	45	95	Disintegration
5% RHA + 95% NS	40	95	Disintegration
10% RHA + 90% NS	35	95	Disintegration
15% RHA + 85% NS	21	95	Disintegration

Table -1 Results of Spray Test

The UCS values decreased with subsequent addition of RHA to its maximum at 5% RHA. As shown in Figure C. Decreasing in UCS value may be due to the excess RHA introduced to the soil and therefore forming weak bonds between the soils.

The cube compressive strength values decreased with subsequent addition of RHA to its maximum at 5% RHA as shown in Figure D

As shown in table 1 as percentage of RHA increase the deterioation time decreases.

Figure -5 Deteriorate samples after Spray test

V. Conclusion

There was a decrease in the MDD on addition of RHA. There was an increase in the Optimum Moisture Content (OMC) from 9.84% to 19 % on addition of RHA.The decrease in the MDD can be attributed to the replacement of soil and by the RHA in the mixture which have relatively lower specific gravity compared to that of the soil.

Also since RHA has a low specific gravity & is inherently a weaker material than NS, there is reduction in the UCS values. From table 1. it was observed that when spray test was conducted on 100% N.S. sample the soil sample disintegrated in 45 min whereas when weathering test was conducted on N.S. + varying % of RHA (5%,10%,15%)cubes, the sample had disintegrated in 20 to 30 min. There is a reduction in compressive strength when RHA is added to NS due to the lack of formation of cementation compounds so addition of cement or lime is must required for stabilization of rammed earth.

References

[1] Paul Jaquin PhD Thesis Appendix A – Historic rammed earth distribution

[2] Prasanna Kumar P, "Stabilised Rammed Earth for Walls: Materials, Compressive Strength and Elastic Properties", Department of Civil Engineering. IISc, Bangalore, July 2009
[3] Peter Walker, Rowland Keable, Joe Martin, and Vasilios Maniatidis., "Rammed earth design and construction guidelines", BRE Bookshop Publications, UK, 2005
[4] I.S: 1905 - 1987(reaffirmed 1988), "Code of Practice for Structural Use of Unreinforced Masonry",Bureau o Indian Standards, New Delhi, India.
[5] SP: 36 (Part I) – 1987,
[6] SP: 36 (Part II) – 1988 (reaffirmed 1995), "Field Testing of Soils for Civil Engineering Purposes",
[7] IS 1498-1970, "Classification and Identification of soil for general engineering purpose".
[8] IS 1725-1982, "Specification for soil based blocks used in general building construction".
[9] IS 2720 (Part 10)-1991, "Method of Test for Soil (Determination of UCS)".
[10] IS 2720 (Part 20)-1992, "Method of Test for Soil (Determination of Linear Shrinkage)".
[11] IS 2720 (Part 4)-1985, "Method of Test for Soil (Grain Size Analysis)".
[12] IS 2720 (Part 40)-1977, "Method of Test for Soil (Determination of Free Swell Index)".
[13] IS 2720 (Part 5)-1985, "Method of Test for Soil (Determination \ of LL and PL)".