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EXPERIMENTAL STUDY OF SHRINKAGE IN MUD BRICKS AND ITS CONTROL

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Abstract- Shrinkage in mud Adobe-Buildings is one of the major issues, need to be consider before the construction. Cracks formation occurs during shrinkage is the result of water evaporation from the mud. Cracking in any materials can lead to a pattern formation over a wide range of length scale from microscopic to macroscopic. It is unwanted phenomena often result in the abandonment of the technological process. Many researchers solve this process up to some extent but yet to overcome on it. In this study Poly Vinyl Alcohol (PVA) is used in some specific proportion with water to minimize the shrinkage and maximize the strength of adobe construction. The performance of different laboratory tests helps to determine the specific ratio of chemical stabilizer with soil through which the shrinkage get reduced to control cracks. The results show that chemical stabilizer used have reduced the shrinkage in the mud beam up to 3.02%.

Keywords- Adobe bricks, Chemicals ratio, Shrinkage, Sustainable development

1. INTRODUCTION

Around 36% of the Pakistan's population lives in buildings made up of earth materials [1]. The world is facing environmental problems such as carbon emissions, which create different health issues; moreover, the world approaching towards marvelous sky scrapers which is equally environmental non-friendly materials [2]. The problem caused by non-Eco-friendly construction materials like corrugated iron sheet, fired clay bricks, wood; bamboo and concrete are mitigated by earthen construction. Cement used as stabilizer can improve the strength but are not effective in improving the ductility. [3]. Mud is considered as a user friendly from ancient time and is accepted environment friendly universally [4]. Mud bricks are considered one of the oldest construction materials, engineers and builders do not have enough information about its mechanical properties [5]. When seeing into different types of mud construction, they have different types of cracks appearance after sometimes. There are three different typologies of adobe bricks in terms of their internal soil element proportions and some organic content [6]. The linear shrinkage crack formation in the mud decreases with increase of fiber content in soil at specific proportion [7]. This research paper aims to find out the optimum ratio of the chemical stabilizer at which there is minimum shrinkage cracks to occur with achieving better strength and minimum shrinkage to use it for structural buildings, which will be environment friendly, energy efficient and economical.

2. MATERIALS AND SAMPLE PREPARATION

In this research different types of materials are used having specific properties and behaviors and different samples were prepared to investigate the optimum water and stabilizer content on which there is minimum shrinkage occur.

2.1 Materials used

The materials used during this research is chemical stabilizer, water and locally available soil of Zangali area near Peshawar. The chemical stabilizer Poly Vinyl Alcohol (PVA) is nontoxic. It is resistant to oil and grease, having high tensile strength and flexibility, in this study the synthetic polymer is soluble in water and is biodegradable under both aerobic and anaerobic conditions. The portable water in the university premises is used. The test performed for the determination of liquid limit plastic limit and plasticity index is an accordance with ASTM D4318 as in [8]. The result is in the form of table.

Determination of liquid limit plastic limit and plasticity index	
Liquid limit	23.5%
Plastic limit	37%
Plasticity index	0

2.2 Sample Preparation

Sample preparation involves the gradation of soil, making solution of chemical with water and then it's mixing. Each of them is discussed below.

2.2.1 Gradation

The locally available Zangali soil can be seen from figure 1, which are passed through sieve no# 08 before use.

Figure 1: Zangali soil passed through sieve no # 8

2.2.2 Solution making

The solution is prepared by the mixing of water with chemical stabilizer at specific proportion by continuous shaking for at least 1 minute in a glass container.

Figure 2: Liquid solution of water and stabilizer

2.2.3 Mix preparation

At end the solution was poured into soil and kneading and crushing it with fingers for at least 15 minutes.

3. RESEARCH METHODOLOGY

In order to tackle with the control of shrinkage in super mud, first find out the proportion of all ingredients in specific ratio (mix design) and then moves towards testing the specimens.

3.1 Mix design

The main aim of the mix design is to find out specific quantity of different ingredients and determines their relative proportion to achieve minimum shrinkage and give optimum strength, durability and equally as economical as well.

3.2 Linear Shrinkage test

The linear shrinkage beam of internal dimensions 11.25*2*2inch is used for shrinkage test. This test is conducted to determine the change in length of mortar beam as it is drying at room temperature. The mix proportions prepared are put in the mortar beam in three equal layers with hands in mortar beam as the stabilizer is not toxic. Three samples of mortar beam named as Z-1, Z-2, and Z-3 are made respectively. Then taking the daily reading of these samples including the loss of weights, linear shrinkage and also take the daily reading after 24 hours of humidity and temperatures with digital hygrometer.

Figure 3: Linear shrinkage mortar beam Z-1

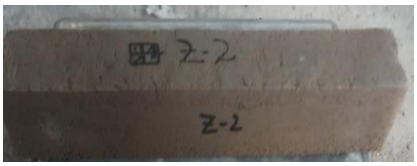

Figure 4: linear shrinkage mortar beam Z-2

Figure 5: linear shrinkage mortar beam Z-3

4. RESULT

The water loss and shrinkage occur in the mortar beam versus temperature and humidity is shown in figure 6.

4.1 Shrinkage test

The procedure used for this test was as per **ASTM C596** used in [9]. Graphical representation of the shrinkage test values is illustrated in figure 6. The x-axis shows the time in days, on the right y-axis shows the shrinkage limit and the left y-axis shows temperature of the place in which sample is placed. The graph shows that the shrinkage in the mud beam increases with time due to water loss and reach maximum of 3.55% at day eleven and then shows a gradual decrease after that due to temperature increase as shown in the figure. The flat curves start appear after 23rd day and the shrinkage percentage were 3.02% at the day 28.

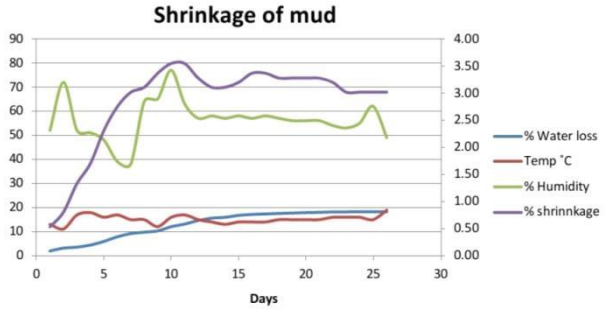

Figure 6: Times vs shrinkage in mortar beam

5. CONCLUSION

The shrinkage of Zangali site soil is examined in this study. More than 30 trials were conducted to find out that optimum ratio on which there is minimum shrinkage and durable samples. Following conclusions can be drawn from the conducted study:

- The shrinkage in mortar beam were gradually increases with time due to water loss and reach maximum of 3.55% with transverse crack.
- The experimental results show that as the water loss increases the shrinkage in the mud beam also increases, and

finally the linear shrinkage was 3.02% with no or few small cracks.

- Mud construction has important role to protect the world from climate change and having safe and unpolluted environment.

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