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Assessment of Stabilizers Used as an Improvement of Mud Stability in Building Mud Houses in Adamawa State

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Abstract
This study titled Assessment of stabilizers used as an improvement of Mud stability in Building Mud Houses in Adamawa State was conducted in Numan Local Government. The purpose was to assess stabilizers in other to determine the Mud stabilizer suitable for stabilizing Mud during building Mud houses, in our rural areas. During the study three stabilizers were assessed; the Colter Stabilizer, the Rise Straws stabilizer and the Groundnut stabilizer. Bricks were molded using each stabilizer. The bricks were allowed to dry and the weight were measured. The average weight was 9kg, after which they were exposed to the rain for the first time. After the rain the bricks were allowed to dry again and the weight of each measured. This process was repeated for seven times. The brick stabilized by groundnut shares was found to be weaving at a faster rate than the other bricks stabilized by rise straws and Colter stabilizers. The finding revealed that the Colter stabilizer was more suitable than the other two, the rise and groundnut stabilizers. The groundnut stabilizer was discovered to be very poor stabilizer compare to the other two stabilizes. The study suggested the use of Colter stabilizer in place of the other two stabilizers.

Key Words: *Stabilizers, Mud, Houses, Brides, Colter, Rise and Groundnut*

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I. Introduction

Background of study

Next to foot in humans need is shelter. The need for qualitative shelter (house) cannot be overemphasized. In Adamawa State, the majority of the populace lived in the rural areas. Resources, local conditions such as climate, availability of building materials dictate the type of houses they build. It is therefore common to find mud houses in this rural set ups.

The vast of these mud houses are built without proper foundations and the people generally lack technical expertise on improved stabilizers (Job and Afunanya, 2016). During raining season Mud allows permeation of water through thereby causing cracks and eventually destruction of the houses.

Most stabilizers used for stabilizing mud used for traditional building in Lamurde local government area have a no adequate soil texture. This problem result into building being washed out by horizontal rain beating it. The assumption is that, ground nut shells (stabilizers) when used as a stabilizer in mud used for building the traditional houses, will solve the problem of washing the surface of the houses thereby reduce the cases of collapse of the traditional mud house in Lamurde community.

Statement of the problem.

One of the problems that lead to traditional mud building failure is due to the poor quality of building materials and the lack of technical expertise. Makson, (2018). Thesis materials: mud, corn stalks straws thatches lack durability and strength. Holmes (2012) observed that, mud ordinarily lacks compressive strength and it is also permeable and swell up when it absorbs water.In their statement Pa'al and Knut (2011) expressed worries that, thatched roofs provided over mud houses and blow off easily during storms and also often got burn and spread fire. Owing to these reasons, there is the need to conduct research on how to improve traditional mud building by improving its quality and characteristics

The main objectives of the research are:

i. To make known to rural dwellers, low income earners; building technologies etc the better methods of stabilization of mud using local materials (Rice strew; ground nut shells) for building construction.
ii. To evaluate and determine the best stabilizers that most improves mud building construction.

Justification of the Study:

Several studies have been undertaken with the aim of improving the standard of traditional mud building in Lafiya District of Lamurde local government. The research will be concerned with the existing method of mud stabilization and proffer an alternative. The results of the research will therefore be used to bridge the information gap in mud house building design within the study area and the state in general.The study will cover Lamurde local government area. The study use mud lump wall construction, sun-dried mud bricks wall construction and rammed earth construction using three stabilizers (straw/ ant hills, rice husks and ground nut shells) Related studies were reviewed on the following sub-topics:

i. Mud lump wall construction
ii. Sun-dried mud bricks/blocks wall construction and
iii. Rammed earth construction

Apagu and Gana (2013) find out that (clay and silt) are primarily groups affected by time dependent changes. Time dependent mud soil behavior affects the settlement process of building. The changes as a result of moisture variation often the stability of building and instability result to defects.Nigerian building and research institute NIBRRI (1995) in Apagu and Gana (2013), shows the nature and characteristics of black cotton soil as dark in color expansive clay's which are characterized by swelling on absorption of water and shrinkage on drying such soil generally less occur in poorly drained areas in alternating wet and dry seasons with annual rainfall generally less than 120mm. such physical features and climate condition are typical to the area of study.

During the physical survey on site tests conducted, the mud was sticky to touch when wet and were not easily crushed between fingers as it dried hard. This shows the phenomenon of swelling and shrinkage in varying moisture conditions. Soils with such characteristics affect building in various ways causing cracks appearing on walls, (Blanneneded Garcia and Brzew, 2013).

Mud lump wall construction

Mud lump wall construction is the simplest method of mud construction, (Berco, 2009). In this method, local soil, which is not too clayey or sandy first dug out and their mixed with requisite amount of water to form lumps of good consistency and are manually placed in layers and care is taken to see that no space is lift in the body of the wall. Earth layers are placed on alternate days to make allowance for sufficient drying time. Such houses are cheaply built in some cases through self-help. They are not durable and strong enough to withstand flooding and erosion. Makson, (2018).Mud is common and is generally silt or clay or a mixture of the two which contain large amount of water. It may also contain some organic materials. Sand and some clay or silt can be called mud when it is too wet. If it dried out, it shrinks and cracked easily and severely. In order to avoid such, traditional mud house building need to be improved (Mbata 2009).

Sun-Dried Mud Blocks Construction

This type of construction uses sun-dried blocks prepared from local soil. Green (2004) stated that, in preparation of this block, any clay which is found to contain 80%clay and 20% sand or 40% clay and 60%sand may be used. Water is added to the soil in the requisite quantity. The prepared mud is then molded into the shape of block of suitable size using wooden molder. Saidu (2005) observed that, wet

mud bricks are lift about a week in the open air to dry completely. In wall construction, the blocks are laid in courses and joined by mud mortar. The joints are staggered in each course. (Makson, 2018). The walls are raised in stages about 1m height everyday up to the required height of the room.Rammed EarthConstructionin this type of construction, damp or moist mud is rammed on layers build in courses to the required height of the building. The finished wall is finally rendered.

Existing method of mud stabilization for building construction

One of the most important objectives of soil stabilization is to increase the resistance of soil the action destructive agencies such as water, (Kadyaili 2011). These could be achieved in four main ways.

i. Mixing of soil with crushed ant hills or addition strews.
ii. The addition of certain plant juices
iii. Mixing of clay and sand which have the effect of increasing the strength and cohesion of the sand while reducing the movement tendencies of clay particles.
iv. Reducing the Alkality of clay by burning slightly. (pp25).

Holmes (2012) stated that, numerous other materials have been used for stabilizing soil, he gave with example, pulverized fly ash, (PFA) can be used by itself to improve the physical properties of soil or in connection with lime or cement to form a binder. Holmes further stated that, pulverized fly ash in a pozzolana, reacts with CaO +H2O to form a cementing materials. Pulverization is best suited to sand and gravel with low

clay contents. The characteristics of the PFA, cement, the degree of compaction and the efficiency of mixing determined the compressive strength of the stabilized materials.Holmes (2012) also stated that, bituminous materials have also been used to stabilize granular soils providing cohesion and thereby enhancing their strength. In the case of cohesive soil, the addition of bitumen may be applied hot of emulsion or as cut backs in which the bitumen is thinned by the addition of a volatile oil (kerosene).

Studies carried out on the improvement of building materials include;

1 Self-consolation concrete (SCC)

This is ideal for use in areas where reinforcement is congested or where formwork is highly complex and has the ability to produce smooth surface without any mechanical consolidation. SCC offers additional advantages; equipment and placement cost are lowered, saves time through quicker construction, elimination of the consolidation process, less noise since mechanical equipment are not used to consolidate and it has better hardening properties than convectional concrete (job and Afunanya, 2016).

Zakka, Job and Anigbogu (2015), developed the used of gum Arabic as an ecological self-compacting concrete. In their work it was observed that gum Arabic is a good plasticizer as well as a good viscosity modifying agent for use in the production of cheaper self-compacting concrete.

2 Rice Hush Ash (RHA)

Rice husk is a waste product and there is interest in using these materials in concrete. Rice husk is a natural waste from rice milling often with little or no commercial value. Duncan and Derek (2006) in Umoh and Ujene (2013), did a study on the utilization of RHA in lateritic brick and concrete production, further shows the positive applicability of this ash for production of brick that can be used for masonry purposes.

3 Saw Dust Ash (SDA)

Saw dust ash is produced by incinerating saw dust to a temperature of 600^{o}c-700^{o}c. the ash is grounded on cooling and graded in according to BS812 (1975). Sumaila and job (2016) on the empirical investigation of the possibility of using SDA as a construction material shows that SDA is an alkaline with little expansion due to low calcium content. The study also shows that there was increase in compressive strength with hydration age. The study suggested that a partial replacement of cement with SDA in the range of 10% by volume.

4 Laterite/Earth Materials

Laterite as a construction material has been used for centuries by people over the world employing various techniques depending on the emptied usage, climatic condition and traditions.This is particularly used in areas they are found in large quantities. Despite this laterite construction in many parts of the world particularly Nigeria is considered to be a construction material for the poor and hence undesirable. Application include; solid interlocking laterite blocks, adobe blocks, laterite bricks earth wall construction and straw bale construction (Fadairo and Olotuah, 2013).

Studies Carried Out on the improvement of mud building include;

In a study of an improvement of mud buildings, Pa'al and Knut (2011) resealed that it is common problem for almost all rural houses in the tropical developing countries for mud or soil to be use in one way or the other. The self-help builder only need to invest his own labour to produce a building material which can be used for foundation walls, floor and even in some cases of roofing.

Jamal S. O. & Sheik, A. S. (2018) stated that Stabilizers use for stabilizing mud use for traditional building in Lamurde local government area have no adequate soil texture. This problem result into buildings being washed out by horizontal rain beating it. The assumption is that, ground nut shells (stabilizers) when used as a stabilizer in mud used for building the traditional houses, will solve the problem of washing the surface of the houses thereby reduce the cases of collapse of the traditional mud house in Lamurde community.The permeability of a building materials is the ability of that material to allow water to pass through it. It is also the rate of water absorption by that material, Mbata (1989).The surface defects test will be carried out through visual inspection of the mud house stabilized using the various suggestion stabilizers and the known traditional stabilizers (caw dunk).The standard required will be visual cracks, no holes greater than 2.0mm depth and 4.0mm diameter, (Kenya, 2004).

II. Methodology

This study will be laboratory experimental study. Data will be collected by testing the quality and the strength of the molded bricks. Analysis of conveniences will be used to analyze the data collected. The research is to be carried out at Lafiya district of Lamurde local government area, Adamawa state.

Traditional method of mud building construction

The traditional method of mud building construction includes the following;

i. mud-lump construction ii, sun-dried mud clocks/bricks construction iii, Rammed earth construction

Traditional means of mud stabilization
Usually, the muds are stabilized by a mix of ant hills or stews.
The experiment is to be carried out by designing four mud houses.

Parameters of the construction
i. Mud brick designed with ground nut shells as stabilizer
ii. Mud brick designed with rice husk as stabilizer
iii. Mud brick designed with ground nut shells and rice husk as stabilizer

Data collection
i. The weathering of the brick.
ii. Observing the amount of mud weathered away after each rain.
iii. Stability of the bricks constructed by each type of the stabilizer.
iv. Graph plotted using the data collected after each rain.

Data Analysis
Data collection during the year (wet and dry season for one year) of the experiment will be subjected to bricks strength and quality test.

The Expected Research Contribution
The expectation of the research is that, the proper use of the stabilizer will reduce the rate of weathering on the wall, noticed on the constructed building under study. Thereby also reduce the cases of housing collapses. The result will be used to sensitize the people of the community in particular and the state in general of better mud stabilizer that can improve the quality and durability and resistance to weathering on their houses.

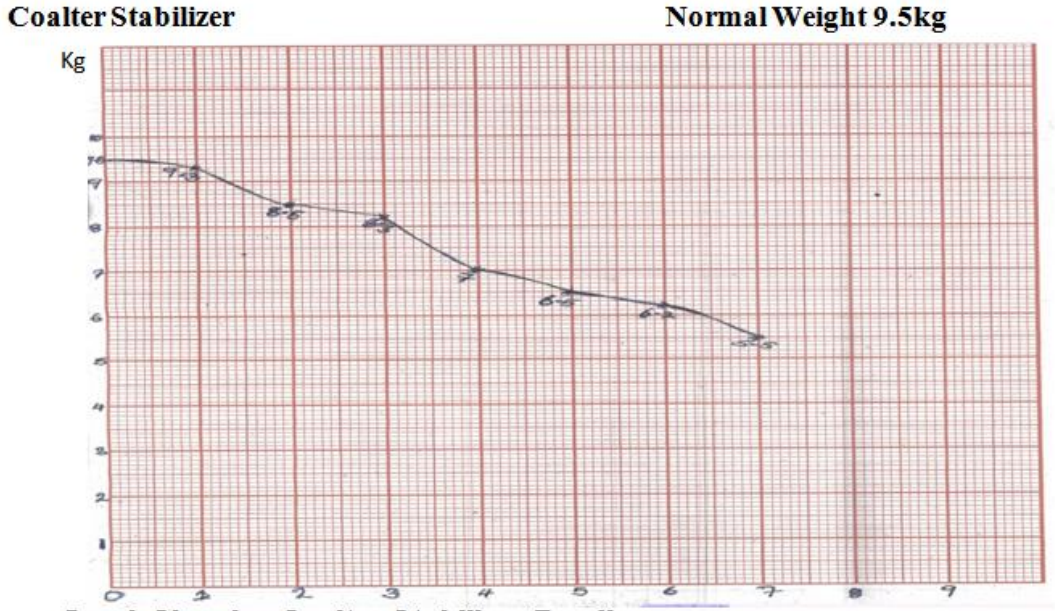
III. Discussion Of Result

To mold mud brick using Colter stabilizer
Materials and Tools Used; Colter, Mold, and Mud.Kerosene, Clay soil, Coalter
Fire wood, Water, Tools Used; Digger, shovel, Head pan, Mold, 2X2 wood, Plane wood, Pot

Procedure
1. We mixed clay soil with small amount of water
2. We set fire to melt the coater we leave the coater on fire for about 10 minute
3. After the coater have melt we mixed the melted coater with kerosene
4. After mixing the coater with kerosene we pow it on clay and mixed it together
5. We place the plane wood on the floor and put the mold on top of the plane wood
6. We put the mixed clay inside the mold and compact it very well
7. We use piece of 2X2 wood to smooth the top of it
8. And we remove the mold gradually

Conclusion
At last we obtain a good mud brick and we wash our tools that we used in molding and keep it safe

After we mold the bricks, we exposed the bricks to sun for two weeks for it to dried, we measure the normal weight of the brick, which was 9.5kg, then we exposed it to rain, for the rain to fall on it, after the rain we still dried it for some days, then we measured the weight of the brick after the first rain, which weight came down to 5.5kg. The same procedure was repeated up to seven times.



Graph Showing Coalter Stabilizer Readings

IV. Observations;

Rain one 9.3kg, Rain two 8.5kg, Rain three 8.3kg, Rain four 7kg, Rain five 6.5k, Rain six6.2kg
Rain seven 5.5k
After taking all the reading we observed that coalter stabilizer bricks have higher wearing resistance. Therefore, suitable for stabilizing bricks in construction of mud houses.

4.3 Rice Stabilizer

In the process of producing mud brick using rice stabilizer we use the same procedure as above

4.3.1 Aims

To mold mud bricks using rice stabilizer.

4.3.2 Materials and Tools Used; Water, Rice stabilizer (chaff), Clay,Digger, Shovels, Headpan,2x2 wood, Plane wood, Mud.

4.3.4 Procedure Used

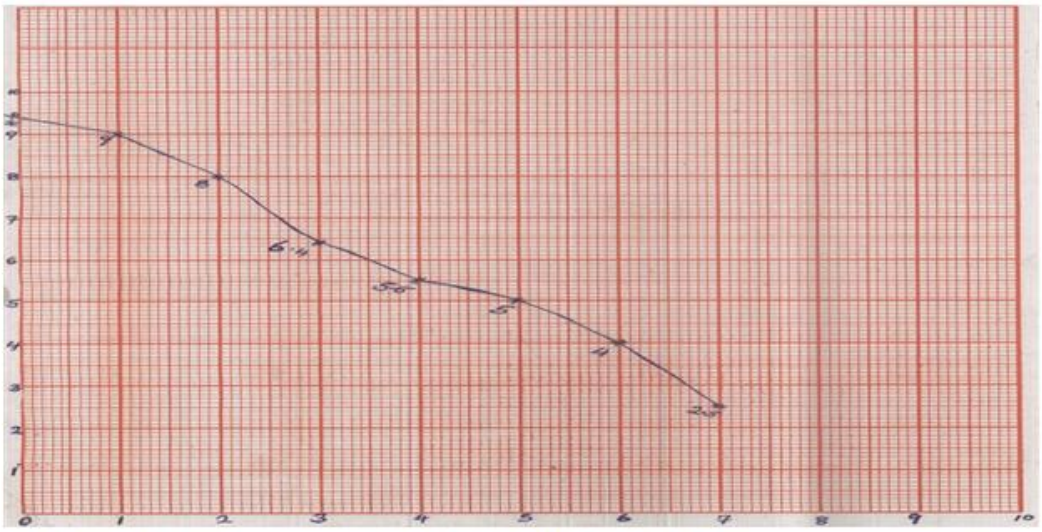
1. First of all,the top soilwas excavatedto find good clay soil for mud bricks.
2. the clay was mixed with water to form mud.
3. We also mixed the mud with rice stabilizer.
4. The area where the bricks were to be mold was prepared.
5. Plane wood was placed on the floor and the mold was put on top of the plane wood to get flat surface
6. Little water was sprayed on the mold and plane wood so that the mold will be remove easily
7. We put the mixed clay inside the mold and compact it very well and used piece of 2x2 wood to smooth the top of it
8. And the mold was removed gradually

Conclusion

At last the researchers obtained a good molded brick and the tools used were washed and kept safe. After molding the bricks, the bricks were exposed to sun for two weeks to dried. The normal weight of the brick, was 9.4kg, the brick was exposed to rain, after the rain the brick was allowed to dry for some days. Then the weight of the brick was measured after the first rain. The new weight was 9kg. the same procedure was repeated up to seven times as shown below.

Rice Stabilizer **Normal Weigh 9.4kg**

Kg



GRAPH SHOWING RICE STABILIZER READINGS **Rain**

Observations;
Rain one, 9kg, Rain two, 8kg, Rain three,6, Rain four 5.5kg, Rain five 5kg, Rain six, 4kg
Rain seven, 2.5kg

After taking all the readings, the readings show that rice stabilizer had little or no quality of preventing wearing of clay when beaten by rain. Therefore, not suitable to be used in construction of mud houses.

Groundnut Stabilizer

Aims

To mold mud bricks using groundnut stabilizer.

Materials and Tools Used; Digger, Shovels, Head pan, 2x2 wood, Plane wood, Mold, Water, Groundnut cover, Clay

Procedure used

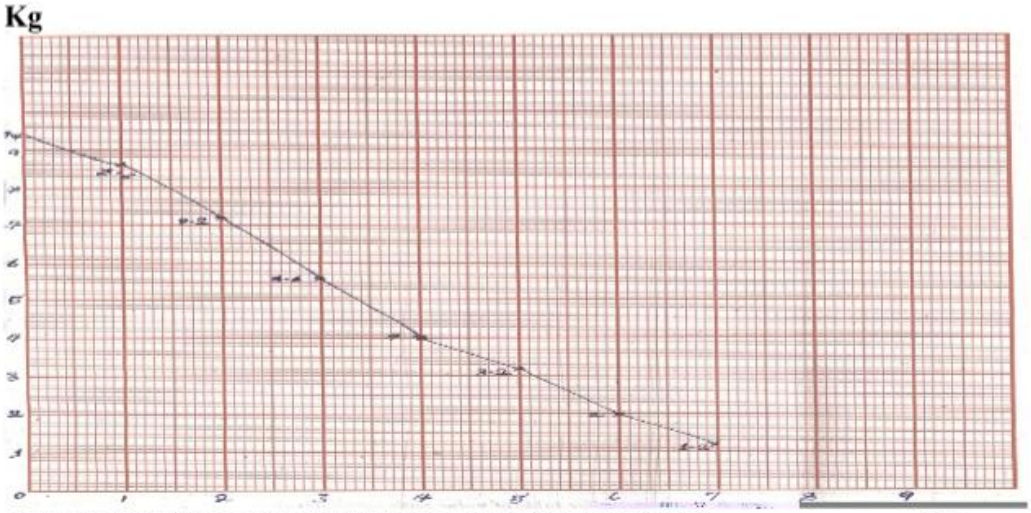
1. First of all, the top soilwas excavated to find the good clay soil to be used for mud bricks.
2. The clay soil was mixed with water.
3. The clay soil was mixed with groundnut stabilizer.
4. The floor where the mud brick was to be mold was prepared.
5. Plane wood was placed on the floor and the mold was placed on top of the plane wood to get flat surface.
6. Little water was spray on the mold and theplane wood, so that the mold can be removed easily.
7. Theclay was placed inside the mold and compacted very well with use of a piece of 2x2 wood to smooth the top of it.
8. And the mold was removed gradually.

Conclusion

At last we obtained a good brick and wash tools used in molding the brick and kept safe.

After molding the brick, it was exposed to sun for two weeks for it to dried. The normal weight of the brick was 9.4kg. It was exposed to rain. After the rain it was allowed to dry for some days. The weight of the brick was then taken again. And the weight became 8.6kg. the same procedure was repeated for seven times as shown below

Groundnut Stabilizer **Normal Weight9.4kg**

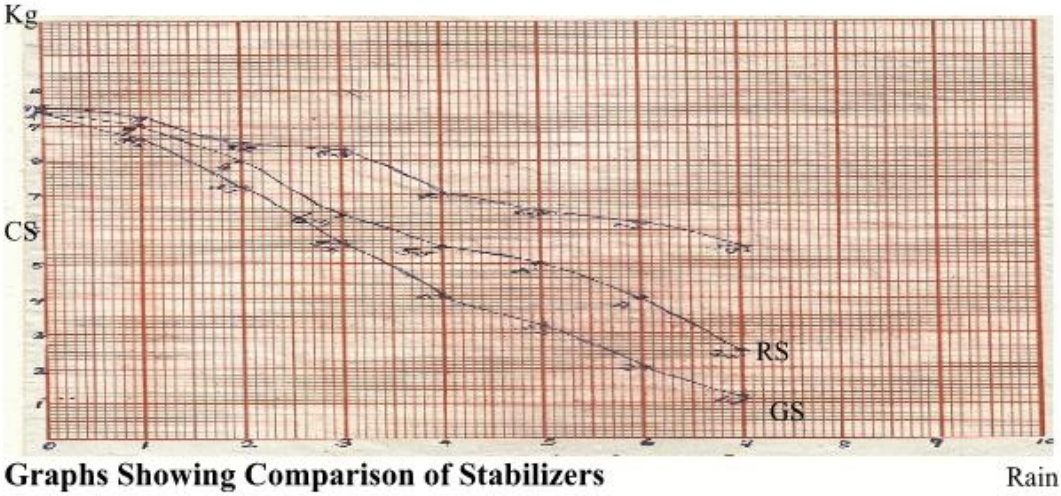


GRAPH SHOWING GROUNDNUT STABILIZER READINGS

Observations;
Rain one 8.6kg, Rain two7.2kg, Rain three 5.6kg, Rain four4.0kg, Rain five 3.2kg, Rain six 2.0kg
Rain seven1.2kg
After taking all the reading, the reading show that the groundnut stabilizer does not have the quality of preventing wearing, because of the clay stabilizer by it melt quickly during rain. Therefore, the brick stabilizers by it lack the quality to withstand the rain beating. This make the houses constructed by it collapse easily.

Procedure of taking readings
1. After molding the bricks, it was left on the sun for three weeks to dry.
2. After it dried the normal weight of the brick was taken.
3. The brick was exposed to rain to fall on the it.
4. After the rain the weight of brick was measured.
5. The same procedure was repeated up to the seven rain.

Comparison of Stabilizers Readings and Observations



Graphs Showing Comparison of Stabilizers

Observations:
After observing all the comparison of stabilize, the brick stabilized bycoalter was the most suitable for construction of mud bricks, because it has high wearing resistance. While the rice stabilizer was second to that of coalter and the groundnut was found not suitable for used for stabilizing mud bricks because of its poor resistance to weathering.

V. Summary, Conclusion And Recommandations

This chapter gives an insight into the outcome of the study conducted it discusses the result of the various mud bricks using different type of stabilizers such as coulter, rice and groundnut stabilizers. And also conclusion drawn from the results. Suggestion and recommendations were made.

Summary of Major Findings

First of all, the researchers excavated the top soils to find good clay soil for mud bricks, after finding a good clay (soils) for the production of mud bricks using different type of stabilizers such as coulter, rice straws and groundnut chaffs after finding the good soil, the soil was mixed to form mud. The mud was mixed with rice stabilizer to produce the mud brick. The same procedure was followed to produced groundnut chaffs and coulter stabilizer. After molding the bricks, they were exposed to the sun for two weeks to dry. To take the readings, the normal weight of each brick taken before exposing it to the rain and after to sun for seven times. After taking the readings the researchers observed that the rice stabilizer has little quality of preventing wearing of clay when beaten by rain. Which the groundnut stabilizer does not have the quality of preventing wearing, because the clay stabilized by it melt quickly during rain. For the coulter stabilizer it was observed that it has a higher wearing resistance. Therefore, is the most suitable stabilizer suggested to be used in mud bricks construction because of its high wearing resistance.

Conclusion and Recommendations

From the study of mud construction using the following stabilizer (coulter, rice and groundnut) the stabilizer such as rice and groundnut do not have quality of preventing wearing resistance so they are not suitable to be used for mud construction while the coulter stabilizer was found to be the most suitable because of its high quality wearing resistance.

In the light of the above conclusions, the following recommendations were made:

1. The national board for technical education (NABTE) makes it a matter of policy for student's projects to be technical and practical in nature.
2. The students should be going round into the rural areas to observed the type of clay and stabilizer to be used for mud bricks construction.
3. Department and student should be involved in minor construction work by the school authorities e.g. office of the head of department and workshop etc.
4. Property developers should be encouraged to use the coulter stabilizer (bricks) for their construction, so as to strengthen and increase the growth of the state owned bricks company as exemplified by the state government.
5. The rural community should be encouraged to use coulter stabilizer to stabilized their mud during constructing their houses. This can be done by organizing workshops for the rural dwellers.

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