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Manufacturing of Brick using Flood deposited soil and Fly ash

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ABSTRACT: In recent years, the flood occurrence in Kerala has increased substantially which led to the deposition of large amounts of mud and debris along the affected area. It will be wise if we make use of these flood deposits instead of throwing them away as a disposal material. Since bricks are one of the most common materials used in the construction industry, this project aims to promote a more environmentally friendly approach towards the construction industry. It attempts to study the behaviour of bricks by using different proportions of fly ash and flood deposited soil. Using flood deposited soil in bricks will increase the nutrients in the bricks built. The utilization of fly ash in the manufacture of bricks also helps in environmental pollution control. Fly ash usage increases the strength of bricks.

Since ancient times, bricks were produced by mixing natural resources, forming the bricks, drying and firing them. The conventional method in the preparation of the mud-brick is by mixing mud manually with water and a suitable amount of fly ash. Then the sample is compacted in a wooden mould and dried before firing. Tests on samples are done such as compressive strength test, water absorption test, and hardness test using varying proportions of fly ash and flood deposited soil. These tests will show whether bricks with flood deposited soil and fly ash could be used over conventional clay bricks and whether it is beneficial in the construction industry.

KEYWORDS: Flood, Soil, Fly ash

I. INTRODUCTION

Due to rapid population growth and industrialization, the construction of housing and infrastructure has emerged as an important sector in India, bricks being one of the major and essential components in the construction industry. Of all the bricks, clay bricks are one of the most common and conventional bricks used. It is acknowledged that the properties of ancient clay brick masonry depend basically on the quality of raw materials used, along with the manufacturing process technology. The composition of bricks is 50-60% by weight of silica, 20- 30% by weight of alumina, 2-5% by weight of lime, less than or equal to 7% by weight of iron oxide, and less than 1% by weight of magnesia. Bricks can be manufactured by three methods– unfired, fired, and chemically set. The typical steps involved in brick-making are clay preparation, moulding, drying, firing, and cooling of bricks. Since the demand for these traditional bricks is increasing, there will be a price hike for the same as well. Hence, alternative solutions must be considered for brick manufacturing that will be equally eco-friendly. Such an alternative method can be the use of fly ash on bricks. Fly ash being a waste material, can be used as an economical replacement for conventional clay bricks. The addition of fly ash on bricks seems to enhance the quality of the brick and helps to save the top agricultural soil. Furthermore, it meets the purpose of disposing of these otherwise hazardous wastes. Fly ash bricks can be used in all construction activities instead of conventional clay bricks and are lighter in weight and stronger than clay bricks. This thesis will explain the manufacturing of bricks using flood deposited soil and fly ash and how these can be used as a substitute for ordinary clay bricks. Various tests on bricks will be conducted and will show whether this type of bricks will be a suitable alternative compared to clay bricks.

II. MATERIALS USED

2.1 Flood Deposited Soil

Flooding can remarkably change the plant's available nutrients in the soil. Because of erosion, the soil lost can carry with it its nutrients and organic matter. Accumulation
of sediments from floods may result in a rise in the level of nitrogen, phosphorus, silicon, and

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potassium in the soil. Anaerobic bacteria may produce certain compounds such as gases like nitrogen, carbon dioxide, methane and hydrogen, hydrocarbons, alcohols, and nonvolatile acids. From various studies, it is evident that soils that have been prone to flooding are alkaline. The sequential deposits of suspended fine sediment during flooding often account for the presiding presence of fine particulate matter such as silt in alluvial soils. The concentrations of organic carbon and nitrogen are relatively lower in soils subjected to frequent flooding. Organic matter is a reservoir of nutrients that are released while it decomposes. Under anaerobic conditions, the rate of decomposition of organic matter reduces, resulting in low soil nutrient content.

2.2 Fly ash

Fly ash, flue-ash, or pulverized fuel ash (PFA) is the result of coal combustion. It is a finely divided by-product, carried by flue gases and accumulated in an electrostatic precipitator. The components of fly ash vary on the composition and source of the coal burned, but fly ash comprises considerable amounts of Silicon dioxide, Aluminium oxide, and Calcium oxide. Fly ash is the most used pozzolanic material all over the world. In recent times, the importance and use of fly ash in concrete have grown so much that it has become a common ingredient in concrete, particularly for making high-strength and high-performance concrete. This is because pozzolans guarantee the setting of concrete and plaster and offer concrete with additional protection from chemical attack and wet conditions.

2.3 Water

Water is one of the major components in the process of manufacturing bricks. Appropriate amount of water should be added cautiously during the manufacturing process, since it helps in production of better quality of bricks. The quantity and quality of water has much effect on the strength of bricks. Presence of salts in water affects the quality of bricks. Portable water is usually considered as sufficiently good enough for the mixing of constituents.

III. BRICK MANUFACTURING

3.1 Material Mixing

In this project, we manufactured 12 bricks with a set of three bricks having the same proportions of materials. Thus, a total of four sets of bricks were manufactured and the materials were mixed in fixed proportions with water as shown in table 1.

Table-1: Proportions of materials for each set of bricks

Flood deposited soil (kg)	Fly ash (kg)
10.5	0
9.75	0.75
9	1.5
8.25	2.25

From the table, we can see that the first set of bricks is having a total of 10.5 kg flood deposited soil, i.e. each brick with 3.5 kg of flood deposited soil and no-fly ash is used. And in the second set, each brick with 3.25 kg of flood deposited and 0.25 kg of fly ash is used. For the third set, each brick with 3 kg of soil and 0.5 kg of fly ash is used. Similarly, for the fourth set, each brick with 2.75 kg of flood deposited soil and 0.75 kg of fly ash is also used.

3.2 Brick Making

3.2.1Pouring the mixer into the mould

The soil is dug out and stored in the open space. Then fly ash is added according to varying proportions which is then mixed with water to get the right consistency for moulding. Mixing is done manually with hands and feet. A lump of the mix is taken and is slapped into the mould and is rammed in each layer. After that, the top of the mould is scraped using a trowel and then the mould was lifted.

Fig-1: Sample after lifting the mould.

3.2.2 Drying

After lifting the mould, the sample is then kept for drying in shade for 3 days and is then again kept for drying in sunlight for 4 days. Every

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two days, the samples are turned over to facilitate even drying and also to prevent warping.

Fig-2: Sample after drying

3.3.3 Firing

After drying, the samples were fired for about 12 days in the kiln for about 1000 degrees celsius. The samples were fired in the brick manufacturing industry in Kanjoor.

Fig-3: Bricks arranged for firing

3.3.4 Cooling

After firing, the samples were kept for cooling in the shade for about 2 days and then the samples were stored under protection.

Fig-4: Samples after cooling

IV. TEST ON BRICKS

4.1 Compressive Strength Test

The compressive strength test also known as the crushing strength test is carried out to determine the compressive strength of the brick. This determines the load-carrying capacity of the bricks on compression. For the test, first, the samples of bricks are selected and sent to a laboratory for testing. The measurements of each brick sample are noted. Remove the unevenness on the surface of the bricks to provide a smooth surface for crushing. Then, the samples are immersed in water for 24 hours, and are taken out. After that, remove the specimen and dry at room temperature. Place the smooth surface of the sample horizontally between the plates of the compression testing machine. A uniform load of $14N/mm^2$ is applied to the brick sample until failure occurs. After failure, note down the load at which the failure occurred. This load is the maximum load at which the specimen fails to produce any further increase on the indicator of the compressive testing machine.

4.2 Efflorescence test

Efflorescence is a white coloured crystalline deposit on surface of the bricks. Usually the presence of magnesium sulphate, calcium sulphate and carbonate of sodium and potassium shows efflorescence on bricks. The movement of groundwater into the foundations of buildings and the capillary action into brick is generally the cause of efflorescence.. Various apparatus required for efflorescence test is a slight flat bottom dish containing distilled water to completely saturate the specimens. The dish should be made of glass, porcelain or glazed stoneware and the size should be 180 mm x 15O mm X 40 mm depth for square shaped dish and 200 mm diameter X 40 mm depth for cylindrical shaped dish, other components are distilled water and brick specimens. Test procedure for efflorescence test is, first of all^t to fill the distilled water in shallow dish and place one end of brick.Then the water should be fill in dish and the bricks should be immersed in water up to a depth of 25 mm. Then place the dish in a warm ventilated room such that whole water is absorbed by the specimen and the excess water will get evaporated. Then cover the dish containing brick with suitable glass cylinder such that there will not be any excessive evaporation from dish. When the whole water gets absorbed and brick appears to be dry, place the similar quantity of water in the dish and allow it to evaporate again. After completing the process examine the bricks for any efflorescence and note the results.

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4.3 Hardness Test

This test is conducted to determine the hardness of a brick and a good quality brick is supposed to withstand any type of scratches on its surface. To perform this test, any type of sharp-pointed tool is required, or the finger nail can also be used. The test is nothing big, but to make a scratch on the surface of the brick sample. This scratch is made using the abovementioned sharp tools or a finger nail. After scratching, if any kind of impression is not left behind on the surface of the sample brick, then the brick is called a hard rock and are of good quality for the construction purpose.

V. RESULTS AND DISCUSSIONS

5.1 Compressive Strength Test

Table-2: Compressive Strength Test of Brick

Samples	Compressive Strength Test of Brick (kN/mm^2)			
	0% Fly ash	7% Fly ash	14% Fly ash	21% Fly ash
SET 1	90	110	130	140
SET 2	80	100	100	130
Average	85	105	115	135

Compressive strength of bricks with 0%, 7%, 14% and 21% fly ash are shown in table 10.1 above. From the table, bricks with 21% replacement of fly ash shows higher compressive strength than other bricks.

5.2 Effloresecence Test on Brick

When the bricks are placed in water partially immersed, the efflorescence was shown as nil with no perceptible deposit. Therefore, the bricks are of good quality.

5.3 Hardness Test on Brick

When the brick is scratched there is no impression left on the surface of brick which implies that the brick is of good quality and is also sufficiently hard. Thus, the brick samples can be used for construction purposes.

VI. CONCLUSIONS

The manufacturing of bricks with flood deposited soil and fly ash is a study made for better usage of waste materials as raw materials for construction purposes. Bricks being an important factor in construction works, new innovations are being made on this raw material. One of such innovation led us to a more effective and eco-friendly alternative for common clay bricks. As per studies, common clay bricks are the most widely used type of bricks in construction. The increased rate of coal burning caused thermal waste discharge and this thermal waste is fly ash. Fly ash is the unburnable powdery mineral form of coal. Thus, instead of leaving them as garbage, they can be used as an essential raw material in brick manufacturing. Fly ash has inevitable properties like fire resistance, durability, light weight, etc. These properties make it useful for construction purpose. Also, as the flood rate was disastrous over the past three years in Kerala, the rate of flood deposited soil was huge. In order to make use of these flood deposited soil in a more environmentally friendly way, we replaced common clay with flood soil as an alternative. The whole project was eco-friendly as well as effective.

The brick samples have passed tests of compressive strength, water absorption, and hardness. So clearly, this proposed alternative for common clay bricks as an important raw material in the coming generations is very much practical.

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