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GLASS FIBRE REINFORCED GYPSUM (GFRG) BRICKS

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Abstract: Glass fibre reinforced gypsum (GFRG) bricks are produced from gypsum and chopped glass fibres. This bricks provide an innovative solution for affordable mass housing and to reduce the use of sand, water, gravel etc. It is also a modern approach to overcome the drawbacks of existing GFRG panels. The idea of this paper is to find a use for this waste gypsum into something useful .They are light in weight and overall cost is also low as they are made from recycled industrial waste gypsum which is obtained as byproduct from various fertilizer industries, chopped fibres are the main filler material used which act as reinforcement instead of concrete to reduce the weight of brick. They are fabricated with dimensions 230x100x75mm with needed allowance. In this paper comparative study is shown between GFRG bricks and clay bricks. The results showed promise, that the GFRG Brick was efficient than the clay brick.

Index Terms **-Gypsum, Glass Fibre, Reinforcement, Affordable, Mass Housing**

I. INTRODUCTION

There is a need to be recognized that constructions are so adversely affecting the environment, through physical disruption. The depletion of key renewable resources like fertile top soil and excessive consumption of energy are the major problems faced. Therefore, there is a strong need required to adopt cost-effective, eco friendly technologies by up gradation of the conventional methods and to use local materials as well as using appropriate technologies using innovative construction materials with efficient, effective technology inputs.

Hence GFRG brick is a green and eco friendly product. This was originally developed and used since 1990 in Australia. In India also there is a need for mass-scale affordable housing which can be obtained by the use of this GFRG bricks as they are alternative to present bricks in the construction sector as India is witnessing a new phase in development, with rapid economic growth and high rate of urbanization. We have gypsum which is abundantly available and every year many tones of gypsum are produced as waste from various industries; hence the main motto of this project is to make effective utilization of this gypsum which is difficult to decompose.

II. LITERATURE REVIEW

At present, in our country we have GFRG panels in use for constructing buildings but there is a risk of handling these panels from factories to site and the transportation cost is also high. This technique also needs empty space around the plot to lift the panels and fixing them, which is highly difficult for constructing in normal populated area. To overcome these all problems this GFRG bricks can be used which also exhibit excellent mechanical properties similar to those of GFRG panels.

There is a study on glass fibres, that addition of them about 10% by volume increased the tensile strength by roughly two times, and the impact resistance by about 10 times hence they are used as reinforce with gypsum by many alternate layers in the formation of bricks.

III. MATERIALS USED

Gypsum, Glass fibres, Super plasticizers are the raw materials used to manufacture this brick.

3.1 Gypsum

It acts as long term strength gainer, to Control the rate of hardening and which is less soluble at high temperatures. It was collected from fertilizer industry where it is obtained as a byproduct. The specific gravity of gypsum was found to be 2.4. Various types of gypsum can also be used based on their properties such as specific gravity.

Fig -1: Gypsum Powder

3.2 Glass Fibre

They are common type of fibre reinforced plastics which are arranged randomly, flattened into sheet or woven into fabrics which are cheaper and more flexible used for reinforcement with gypsum which also enables a reduced weight of brick. It is even available in the mesh form or honey comb form.

Fig -2: Chopped Glass Fibers

3.3 Super plasticizers:

They are one type of synthetic polymers. Super plasticizer SP Ceraplast 300 which is based on naphthalene is used. They are also called as water reducers used to optimize the workability and they allow reduction in water content by 30% or more. It also increases the time of hardening. The water to gypsum ratio is reduced thereby increasing the strength of brick.

Fig -3: Super plasticizers

IV. METHODOLOGY:

GFRG bricks are manufactured very easily by initially preparing mould with required dimensions. Then a layer of chopped glass fibre is spread at the bottom of the mould. Gypsum, glass fibres, sp ceraplast 300 are used in required percentages as shown in the table below.

Table -1: Material composition

S.No	Raw Materials	Percentage (%)
1	Gypsum	50%
2	Chopped Glass Fibers	45%
3	SP Ceraplast 300	5%
	Total	100%

In next stage of work gypsum is mixed with super plasticizers SP ceraplast 300 in slurry form. This slurry is poured on the layer of glass fibre uniformly to obtain a thin layer of gypsum, then again a layer of chopped glass fibres are spread evenly. In the same way the process is repeated layer upon layer till the top layer is achieved. This raw brick is exposed to sunlight which thereby produces reinforcement between gypsum and the glass fibre within 2hrs.Then the brick is removed from the mould. These bricks are allowed to dry completely for 2 days then curing process is carried out which means watering the bricks. This process is done after 48 hours of manufacturing the brick.

The solid waste which is generated while manufacturing bricks can be recycled back and reused again. Various test where carried out on the brick of which the procedure for important testing is explained below.

Fig 4 - GFRG Brick

V. EXPERIMENTAL PROCEDURE

Various types of tests were conducted on bricks after 7, 14 & 28 days from curing to check the qualities of bricks for construction purpose. Following tests were conducted on bricks to determine its suitability for construction work.

5.1 Size of Brick

Sizes of bricks were checked to find whether they are according to the given dimensions or not**.** Uniformity of 5 samples was verified before calculating the compressive strength of brick.

5.2 Weight of Brick

As per the construction norms any brick should exhibit 10% moisture content of its weight, GFRG bricks were found to be light in weight and satisfies the above norm to proceed for further testing.

5.3 Absorption Test:

This test was conducted on brick to find out the amount of moisture content absorbed by brick .Initially sample dry brick is weighed then it is immersed in water for 24 hrs. Then the wet brick is weighed, the difference between these values was found to be less than 15 % which is appreciable.

5. 4 Efflorescence Test:

To identify the soluble salts present in brick this test is performed.5 samples of bricks were placed in water bath for 24 hrs and dry it in shade. When it was dried completely there were no white or grey colour deposits, hence it does not contain soluble salts.

5.5 Soundness Test

Sound test is performed to find out a clear ringing sound is obtained or not while striking the two bricks without any breakage. Hence this bricks were found to be sufficiently sound and the damping coefficient was found to be low.

5.5 Compressive Strength Test

Crushing strength of bricks was determined by placing the brick in compression testing machine, load was applied until brick breaks. The value of failure load was noted and crushing strength was calculated. It was found to be 5.5 N/sq.mm for all 5 samples.

Fig 5 – compressive test

5.6 Technical Specifications:

1. GFRG Brick Size: [4Inches]:- 230x100x75mm
2. Cost of brick: Rs 3/pc
3. Compressive Strength: 5.5N/Sq.mm
   (As against 3. 4N/Sq.mm for handmade clay bricks)
4. Water Absorption: 10-15%
   (As against 18 to 25% for clay bricks)
5. Efflorescence: Nil
6. Density: 1700Kg/m3
7. Weight: 3.1 to 3.5 kgs (approx)
8. Load Bearing Capacity: More than 25% as compare to clay bricks
9. Load Bearing Capacity: More than 25% as compare to clay bricks
10. Drying Shrinkage:0.035-0.04%

VI. ADVANTAGES

GFRG bricks are uniform in shape with smooth surface finish so does not require plastering of buildings. They are lighter in weight and eco friendly. This bricks provide good thermal comfort also as gypsum posses less radioactivity in general. Some other technical advantages of these bricks are energy efficient, resistant to fire, water, strong, durable versatile, safe, secure, robust, economical, and easy in handling. The other main advantage is the effective use of waste gypsum from industries which is difficult to decompose.

VI. CONCLUSIONS

From this we conclude that traditional buildings are more expensive when compare to GFRG bricks system. Nowadays there are varieties of bricks available. But still most of the people are not aware about this type of residential building practices. From this paper we can create some awareness about the cost, time management, resource allocation and quality and quantity of GFRG bricks. The main motto of this project is to create awareness.

GFRG buildings have the possibility to meet the challenge of providing affordable mass housing. This is an eco-friendly and sustainable green product, making the use of industrial waste gypsum or natural gypsum and minimizing the use of cement, steel, sand, water, gravel, labor input. This technology is now achieving acceptance in India and some other countries also.

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