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GLASS FIBRE REINFORCEDGYPSUM (GFRG) BLOCKS

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Abstract

GFRG blocks are prepared from industrial and agricultural wastes adding glass fibres. This gives an alternative solution to the conventional construction materials including affordablehousing. 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, rice husk, fly-ash, glass fibres into something useful construction material. They are light in weight and overall cost is also low as they are made from recycled industrial waste gypsum and agricultural waste rice, these are obtained as byproduct from various fertilizer industries and agricultural activities. Chopped fibres are the main filler material used which act as reinforcement instead of concrete to reduce the weight of block. They are fabricated with cubical dimensions 100 mm and 150 mm. In this paper comparative study is shown between GFRG blocks and clay bricks. The results showedpromise, that the GFRG Blocks was efficient than the clay brick.

Keywords: gypsum, cement, flyash, glass fibres, rice husk, utilization of waste.

1. INTRODUCTION

The conventional construction techniques are so adversely affecting the environment through physical disruption. The depletion of basic renewable resources like fertile top soil and excessive consumption of energy are the major problems faced. Therefore there is a strong need to adopt eco-friendly and cost affective technologies by up-gradation of conventional methods. Making use the waste materials with appropriate technologies and using innovative construction materials with effective and efficient technology inputs.

Here GFRG block is a eco-friendly and green product. This was originally developed and used since 1990 in Australia by Rapid Wall Building Systems. In India also there is a need for mass- scale affordable housing which can be obtained by the use of this GFRG blocks as they are alternative to present bricks in the construction sector as India is a developing nation, with rapid economic growth and high rate of urbanization. In India there is a need of nearly 17.6 billion houses at present scenario. We have gypsum which is abundantly available and every year 2000 tones of gypsum are produced as waste from various industries; hence the mainobjective of this project is to make effective utilization of this gypsum which is difficult to decompose and flyash which is a thermal waste product.

2. LITERATURE REVIEW

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 present installation technique also needs empty space around the construction site to lift the panels and fixing them, which is highly difficult for construction in densely populated area. To overcome these all problems this GFRG blocks 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 blocks.

3. MATERIALS USED

Raw materials used for construction of GFRGblocks are -

I. Gypsum

II. Fly ash

III. Cement

IV. Glass fibres

V. Rice husk

3. I. 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.

3. II. Fly-ash

It improves workability (round shaped particles), Reduces drying shrinkage and permeability. It increases ultimate strength and durability. It is a waste from thermal power plants, cement industry etc.

3. III. Cement

The Portland cement has properties such as fineness, soundness, consistency, strength, etc.

3. IV. Glass fibres

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 block. It is even available in the mesh form or honey comb form.

3. V. Rice husk

It comprises of Cellulose-50%, Lignin-30%, Silica-20% , Moisture-15%. It improves stability and workability (large surface area-60m^2/g). It has some more properties such as waterproofing, rehabilitation, insulator, supplementary binder. It resists from chloride, sulphate and corrosion attack. It is an agricultural waste material.

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4. METHODOLOGY

GFRG blocks are manufactured very easily by initially taking mould with required dimensions. Then a layer of chopped glass fibre is mixed with ingredients. These ingredients are used in required percentages as shown in the table below

S. No.	Raw Material	Percentage
1.	Gypsum	80%
2.	Fly ash	7.5%
3.	Cement	5%
4.	Glass fibres	5%
5.	Rice husk	2.5%
	Total	100%

Table1: materials proportion

In the next stage of work, the ingredients are mixed and poured in the standard mould of block. This block is exposed to sunlight for 4 hours then the block is removed from the mould. The block is allowed to dry for 48 hours at room temperature.

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

5. EXPERIMENTAL PROCEDURE

Various types of tests were conducted on blocks after 7, 14 days from curing to check the qualities of bricks for construction purpose.

Following tests were conducted on blocks to determine its suitability for construction work.

5. I. Size of block

The size of blocks was prepared of standard concrete moulds. Sizes of blocks were checked to find whether they are according to the given mould dimensions or not. Uniformity of 3 samples was verified before calculating the compressive strength of block.

5. II. Weight of block

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

5. III. Absorption test

This test was conducted on block to find out the amount of moisture content absorbed by it. Initially sample dry brick is weighed then it is immersed in water for 1 hr and then re-dipped for 24 hrs. Then the wet brick is weighed, the difference between these values was found to be less than 12 % which is appreciable. The 1 hr and 24 hr weights were quite similar.

5. IV. Effloresence test

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

5. V. Compressive strength test

Crushing strength of block was determined by placing it in compression testing-machine, load was applied until block breaks. The value of failure load was noted and crushing strengthwas calculated. It was found to be 4.32 N/sq.mm.

Technical Specifications and Result:

1. GFRG Block Size:-100mm, 150mm cubes
2. Cost of block: Rs 3/pc
3. Compressive Strength: 4.32N/Sq.mm

(As against 3.4N/Sq.mm for handmade clay bricks)

4. Water Absorption: 10-12%

(As against 18 to 25% for clay bricks)

5. Efflorescence: Nil
6. Weight: 1.5 to 2 kgs (approx)

6. ADVANTAGES

GFRG blocks are uniform in shape with smooth surface finish so does not require plastering of buildings. They are lighter in weight and eco friendly. These blocks provide good thermal comfort also as gypsum posses less radioactivity in general. Some other technical advantages of these blocks 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 products such as fly ash, rice husk from agricultural wastes and gypsum from industries which is difficult to decompose.

7. CONCLUSION

From this we conclude that traditional buildings are more expensive when compared to GFRG blocks 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 blocks. The main motto of this project isto 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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