

Analysis of GFRG Brick

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Abstract - Glass fiber reinforced gypsum bricks are manufactured from gypsum and chopped glass fibers. This bricks provide an innovative for affordable mass housing and to scale back the employment of sand, water, gravel etc. it's also a contemporary approach to beat the drawbacks of existing GFRG panels. The thought of this journal is to seek out a use for the waste gypsum into something useful. They are light in weight and overall cost is a smaller amount as they're made up of recycled industrial waste gypsum which is obtained as a byproduct from various fertilizer industries, chopped fibers are the most filler material used act as reinforcement rather than concrete to cut back the burden of the bricks. They're fabricated with dimensions 250x100x85mm with needed allowance. During this journal comparative study is shown between GFRG and clay bricks. The results showed, that the GFRG Brick was efficient than the clay brick.

Key Words: Gypsum, Chopped glass fiber, Reinforcement, Fabricated.

1. INTRODUCTION

There is a desire to be recognized the event are so adversely affecting the environment, through physical disruption. The depletion of key renewable resources like fertile layer of soil and excessive consumption of energy are the key problems are caused. Therefore, the strong need required to adopt cost-effective, eco- friendly technologies by up graduation of the standard methods and to use local material also as using appropriate technologies using innovative construction material with efficient and effective technology inputs. Hence GFRG brick could also be a green and eco-friendly product. This was originally developed and used since 1990's in Australia. In India also there is a desire for mass-scale affordable housing which can be obtained by use of this bricks as they're alternative to present bricks within the development sector as India is witnessing a replacement innovate development, with rapid process and high rate of urbanization. We've gypsum which is abundantly available and every year many tones of gypsum are produced as waste from various industries. Hence the foremost role of this journal is to form effective utilization of this bricks.

2. LITERATURE REVIEW

At present in our country we've the GFRG panels in use of constructing buildings but there's a risk of handling the panels form manufacturing sector to site and therefore the transportation cost is additionally high. This system acquires extra space for fixing them, which is extremely highly difficult in normal constructing areas. To beat all the issues the GFRG bricks used and it's the wonderful mechanical properties. Gypsum when reinforced with fiber produces precast elements much thinner typically 10mm than would be possible traditional steel-reinforced precast concrete, where 30mm or more concrete cover to the steel is important as protection against corrosion.

3. MATERIALS USED

The raw materials used to manufacture the GFRE brick are Gypsum, glass fiber, plasticizers

- Gypsum: - Gypsum could be a very soft sulfate mineral composed of calcium sulphate dehydrate, with formula $\text{CaSo}_4.2\text{H}_2\text{O}$. It's found in alabaster, an ornamental stone utilized in ancient Egypt. The origin of gypsum, its genesis, varieties and properties are discussed, and therefore the focus is then on the foremost common binding material produced from it, plaster of Paris. It acts as future strength gainer to manage the speed of hardening and which is a smaller amount soluble at heat. It's collected from the fertilizer industries where it's obtained. The particular gravity of the gypsum is 2.3 and hardness is 2.



FIG 1: Gypsum

- Glass fiber: -The reinforced plastics which arranged randomly, flattened into sheet or woven into fabrics which are cheaper and more flexible used for reinforcement with gypsum which is additionally enables a reduced weight of brick. It's even available within the mesh form or honey comb form. This fiber is extensively used for creating vessels. Fiber has recently seen use in biomedical application within the assistances of joint replacement where the electrical field orientation of short phosphate glass fibers can improve estrogenic qualities.



FIG 2: Glass fiber

- Plasticizers: - There are one form of synthetic polymer. Super SP Ceraplast 300 which relies on naphthalene is employed. They're also called as water reduce wont to optimize the workability and that they allow reduction in water content by 40% or more. It's also increases the time of hardening. The water to gypsum ratio is reduced their by increasing the strength of brick.



FIG 3

- Physical Properties of the gypsum: - Gypsum is moderately water soluble (~2.2-2.8g/1 at 25 °C) and, in contrast to most other salts, it exhibits retrograde solubility, becoming less soluble at higher temperature. When the gypsum is heated in a normal air conditions it loses the water and it converts into calcium sulfate hemi hydrate" and , if heated further, to anhydrous calcium sulfate. As for anhydrite, its solubility in saline solution and in brines is also strongly dependent in NaCl

concentration. Gypsum crystals mostly contain anion water and hydrogen bonding.

- Glass fiber Reinforced Plastics: -Glass reinforced plastic (GRP) can be a stuff manufactured from a plastic reinforced by fine glass fibers. Like graphite-reinforced plastic, the fabric is commonly named as fiberglass. The glass is also within the design of a chopped strand mat (CSM) or a woven fabric. Like many other material, the two materials act together, each overcoming the deficits of the other. Whereas the plastic resins are strong enough to sustain the compressive loading and but it's comparatively weak within the enduringness, the glass fibers are very strong in tension but tend to not resist compression. By combining the two materials the GRP had become that con resists both compressive and tensile forces well.



FIG 4: Brick manufacturing machine and die brick making



FIG 5: Final output

4. METHODOLOGY

GFRG bricks are nowadays mostly used for construction and gaining its popularity over builder sand engineers because of its high strength, uniformity and fewer consumption of mortar plastering. These are ecofriendly bricks and saves environmental damage caused by burnt clay bricks and saves top agricultural soil which the foremost stuff within the burnt clay bricks.

The GFRG bricks are manufactured very easily by initially preparing mould with required dimensions. Then a layer of chopped glass fiber is spread at the bottom of the mould.

S.NO	Raw Material	Percentage (%)
1	Gypsum	50%
2	Chopped Glass Fibers	42%
3	SP Ceraplast 300	8%
	Total	100%

5. MANUFACTURING OF GFRG BRICKS

There were two steps carried out in manufacturing of this bricks were within the first trial the number of gypsum to cement concentration was more which enabled good strength

Trial1 :-The concrete mix is ready by pouring gypsum, cement and glass fibers in 3:2:1 ratio. And also the material allowed into the brick manufacturing die as shown in fig (5), thereafter allowing it for curing there after by applying pressure by using the machine handle as shown in fig (4). The brick is removed and exposed to sunlight to form it hard.

Trial2 :-One layer of slurry is laid on the table followed by a layer of glass roving. This glass roving is embedded in to slurry. The layer of slurry is mixed with layer of glass roving and pushed inside the ribs with help temping bar. This manner continuously alternate layers were poured, finally a layer of glass roving is laid for the highest face of the brick. The solid waste which is generated while manufacturing bricks can be recycled and reused.



FIG 6: GFRG Brick

Characteristic of GFRG Bricks: -

- The standard size of the brick is 200x100x80mm.
- The brick are manufactured and tested as per IS 12894-2002
- GFRG Bricks are sound, compact and uniform in shape, size and color. Smooth rectangular faces of the bricks are accompanied with sharp corners.
- They are free from visible cracks, war page, flaws and organic matter.
- Economical & environmental friendly.
- 18%lighter than ordinary clay bricks.

6. PRELIMINARY TESTS

- **Compressive strength:** - The ability of the brick or block to resist crushing loads. The strength is 75to150kg/cm² (or) avg 7.5N/Sq.mm (as against 3.6N/Sq.mm for handmade clay bricks).
- **Dimensions:** - Masonry units and segmental paver's calls for bricks and blocks to be classified into dimensional categories based on their deviation from their work size, or the specified in manufacture. This is usually a standard size, it's important that deviation from this be controlled to a low levels of bricks layers are able to build the structure to the designer specification and with minimum joint thickness variation. GFRG brick size: 230x100x76mm.
- **Potential to efflorescence:** - Efflorescence may be a deposit of salts, usually white, on the surface of bricks and blocks after being laid. The salts usually come from water or out of the mortar, but may come from within the masonry units themselves. The Efflorescence is NIL.
- **Water Absorption:** - A regular soaking in water test can determine the porosity of bricks and blocks, which might then be used as a sign of the potential for the event of problems associated with the penetration of salts and other material into the units, like salt attack and efflorescence. Water absorption of brick is nothing but the kids of the water that the brick can absorbs when it's placed in water. It mustn't be over 15to20% of its weight. Density:- 1700Kg/m³.
- Water absorption is calculated by this formula:-

$$\frac{[W2-W1]}{W2} \times 100 = X\%$$

Where, W1=Dry weight of sample

W2=Weight after 24hrs in water.

7. Advantages and disadvantages

Advantage:-

- Appearance: - These bricks have pleasing color like cement, are uniform in shape and smooth in finish, also they require no plastering for building work. The bricks are of dens composition, uniformly shaped with / without a frog, free from visible cracks, wrap-age, organic matter, pebbles and nodules of free lime. They're lighter in weight than ordinary clay bricks and fewer porous too. The color of GFRG Brick may be altered with the addition of mixture during the method of brick making. They are available in various sizes, but generally are kind of like the sizes of clay bricks.
- Structural capability:-These bricks can provide advantage being available in several load-bearing grades, saving in mortar plastering, and giving smart looking brick work. High compressive strength eliminates breakages/wastages during transport and handling, the cracking plaster is reduced thanks to lower thickness of joint and plaster and basic material of the bricks, which is more compatible with cement mortar.
- Thermal properties: The thermal conductivity is 0.90-1.05W/m²C (20-30%) less than those of concrete blocks. These bricks do not absorb heat. They reflect heat and provide maximum light reflection without glare.
- Sound insulation: - It provides an acceptable degree of sound insulation.
- Durability and moisture resistance:-These blocks are highly durable, after proper pointing of joints, the bricks are often directly painted in dry distemper and cement paints, without the backing coating of plaster. Water absorption is 6-12%
- Toxicity and breadth-ability:-There are no definite studies on the toxic fume emissions or the indoor air quality of structures built with GFRG bricks, though claims of radioactive emissions by these blocks have been made at some scientific forums.
- Build ability, availability and cost:-The blocks have easy work ability and high compressive strength eliminates breakages/wastage during handling giving a straightforward finish, with lower thickness of joints and plaster. the development technique remains the identical as regular bricks ensuring easy change of fabric, without requiring additional training for the masons. Though these bricks are abundantly available closer to thermal power plants everywhere the country for obvious

reasons, finding dealers altogether major cities and towns wouldn't be an issue.

Disadvantage:-

- You do need some expertise in order make a house using this technology. The Handling, fixing and equipment requirement for these panels is fairly different from conventional style. Although it is not very difficult to learn the right techniques, it will eventually the time for becoming and industry trend.
- The panels are customized according the look and drawings of your house when manufactured. Unfortunately, you can't make plenty of changes during fixing stage. Hence planning is very important. Also the doors, windows and other openings are made by cutting through the panels; hence the look for putting doors and windows also has to be extensive.
- In India, if you looking to try and do a construction in a very normal geographic region, it's likely that your plot is already surrounded by built house. The GFRG technique needs empty space around the plots so cranes are going to be placed while fixing panels. Also the panels need special care while storing them and wish more room as compared to cement/blocks. These two factors make it difficult for a full scale implementation in India empty space to store and move panels is required.
- The fact that panels are specifically made for a design and transported from factory, the price of each type of panel goes done significantly only when used on a large scale. Comparatively you can save 30-40% compared to that of conventional building method and even more if used on large scale.

8. Applications of GFRG

- GFRG buildings panels are generally employed within the next ways
- As load bearings walls in buildings, to resist gravity load.
- As partition or infill walls in multi-storied framed RC structures.
- As compound walls at the side of minimum quality of concrete.
- As shear walls, to resist both gravity load and lateral load from earthquakes and wind also as walls of lift-well and parapet walls.
- As floor slabs and roof slabs, pitched roof slabs and also as staircase waist slabs and mid-landing slabs.

9. Conclusion

From this we conclude that conventional buildings are more costly when compare to GFRG bricks system. The bricks has good era as same as concrete structures. Nowadays the employment of GFRG bricks for construction evolves gradually. But still most of the people don't seem to bear in mind about this sort of construction practices for residential buildings. GFRG buildings have the potential to satisfy the challenge of providing rapid affordable mass housing. this will be often an eco-friendly and sustainable building system, making use of recycled industrial waste gypsum or natural gypsum and minimizing the utilization of cement, steel, sand, water and labor input. This technology is successfully running in India further as in Asian countries.

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