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A Review: An Attempt of Green Building Construction Using GFRG Panels

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ABSTRACT: Green construction involves more than just putting together a collection of the newest green technologies and materials. Rather, it is a process in which every aspect of the design is optimised first, followed by a re-evaluation, integration, and optimization of the impact and interplay of numerous different parts and systems inside the building and site as part of a whole building solution. India's rural housing need is estimated to be 44 million units. The urban housing shortfall in India is 18.78 million units, with 96 percent of them belonging to the Economically Weaker Section (EWS) and Low-Income Group (LIG) categories. As a result, given India's severe housing scarcity, rapid strategies for timely and cost-effective execution of construction projects, such as the use of alternate building materials and fast construction processes, are critical. One of the inventive methods to solve this difficulty is the use of Glass Fibre Reinforced Gypsum (GFRG) panels (also known as the fast wall). This product was developed and has been used for mass-scale building construction in Australia since 1990. GFRG Panels are made from gypsum, which is widely available as a waste product from the industrial sector. These lightweight panels are fire-resistant, thermally insulated, earthquake-tested waterproofed, rot-resistant, termite-resistant, and 100 percent recyclable, making them ideal for eco-friendly or green architecture.

This article compares the use of GFRG panels in the Indian building industry to traditional construction technologies on the basis of numerous functional, structural, and economic considerations, utilising Autodesk Revit Architecture to create a 3D model and Primavera to schedule the project. Preparation of an estimate using Microsoft Office Excel and a thorough drawing using Autodesk AutoCAD, as well as the installation of solar panels as a sustainable energy source and the creation of a vertical garden to enhance interior air quality.

KEYWORDS: Green Building, Revit Architecture, GFRG Panels, Primavera, AutoCAD, MS Excel, Solar Energy, Vertical Garden.

I. INTRODUCTION

Every year, the need for traditional materials such as clay, sand, stone, gravels, cement, brick, block, tiles, distemper, paint, lumber, and steel, which are employed as important construction components in the housing sector, grows. The cost of construction materials is gradually rising. It is also vital to discover functional/innovative replacements for traditional building materials in the construction sector due to high transportation costs of these raw resources, demand, and environmental constraints. The key challenges facing the mass housing sector today are reducing the use of these energy-intensive construction materials and delivering housing units quickly and at a reasonable cost. Buildings made of green building material Glass Fibre Reinforced Gypsum (GFRG) panels hold promise as a quick, economical, and long-term mass housing solution. GFRG Panels are prefabricated to a size of 12 m length, 3 m height, and 124 mm overall thickness (with cavities) and are relatively lightweight (44 kg/m²). They are made of calcined gypsum and reinforced with glass fibres. They are prefabricated to a size of 12 m length, 3 m height, and 124 mm overall thickness (with cavities). These panels can be cut to any size needed. There are four cells in each 1.0 m segment of the panel (cavities). Each cell is 250 mm broad, 124 mm thick, and has a 230 mm x 94 mm hollow. The cavities / created cells within the panel can be utilised to house building services such as plumbing and electrical conduits, or they can be filled, partially filled, or left empty depending on the structural requirements. To enhance strength and ductility, the panel has chambers that may be filled with concrete and reinforced with steel bars.

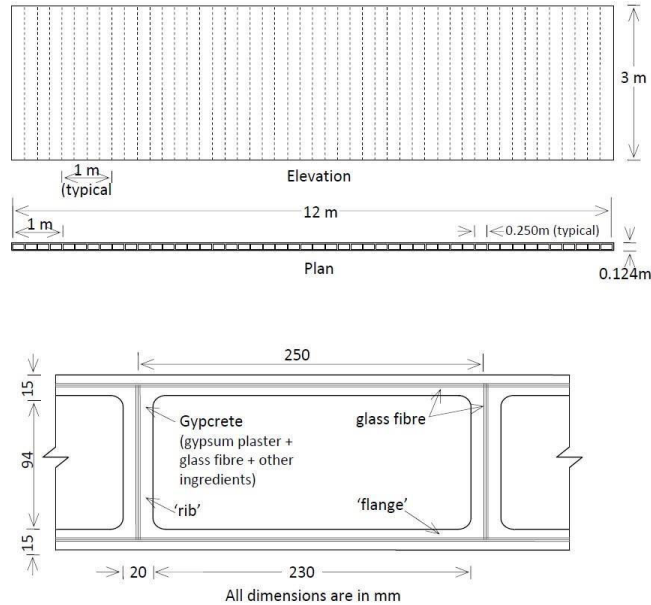


Figure 1 shows a typical GFRG panel cross-section (all dimensions are in mm)

Source: Building Materials & Technology Promotion Council (BMTPC)

The load-bearing capacity of these integrated composite GFRG panels is up to 8-10 stories without the usage of beams and columns. Although these panels are most commonly utilised in wall construction, they can also be employed in floor and roof slabs when combined with reinforced concrete.

Monocrystalline solar panels are used. Monocrystalline silicon, also known as single-crystal silicon and abbreviated as mono c-Si or mono-Si, is the foundation material for silicon-based discrete components and integrated circuits found in almost all modern electronic equipment. Mono-Si is also used in the production of solar cells as a photovoltaic, light-absorbing material.

To preserve a healthy atmosphere both within and outside the building, a vertical garden has been built to the buildings outside facades. Vertical gardens can build on this concept by 'naturally' blocking high-frequency sounds. With a layer of air between the plants and the wall, these walls act as additional insulation. They also have the ability to reduce noise levels by refracting, reflecting, and absorbing acoustic radiation.

II. LITERATURE REVIEW

1.A REVIEW OF RESERCH ON BUILDING SYSTEM USING GLASS FIBER REINFORCEMENT GYPSUM WALL PANALS

Aishwarya Shukla, Mohd.Afaque Khan [2016] researched on wall panel building system. This paper surveys about advancements in the field of building frameworks utilizing glass fibre strengthened gypsum boards. GFRG boards, made in institutionalized parts or segments prepared for quick gathering and erection as structures are instant gypsum boards with empty depressions. This Rapid divider is used in private and business-built abodes. At the point when the empty depressions of GFRG boards are loaded up with strengthened self-compacting concrete, the security between the solid and the GFRG boards yields another composite. Thus, the auxiliary execution of Rapid wall and the related building frameworks are more complex than that of other ordinary building systems. GFRG boards have a significant hub and shear quality when depressions of the board are loaded up with strengthened cement and along these lines are pertinent for development of multi-story structures. GFRG board faces the especially similar issue as that of solid shear dividers, i.e., concern with respect to the satisfactory association between the precast units[1]



2.A POWER CASE STUDY FOR MONOCRYSTALLINE AND POLYCRYSTALLINE SOLAR PANELS

According to Ali Vardar [2016], Solar energy is most commonly employed in the form of polycrystalline and monocrystalline panels, each having its own set of characteristics and efficiency. Climate conditions, the type of solar cells employed, and other factors all affect the effectiveness of photovoltaic panels, according to this study. For monocrystalline and polycrystalline solar panels, the daily average efficiency was 6.65 percent and 5.38 percent, respectively. More study is needed to figure out which precise factors trigger each type of cancer.

3.RAPID AFFORDABLE MASS HOUSING USING GLASS FIBRE REINFORCEMENT

Devdas Menon [2014] described a structure constructed at IIT Madras. The structure is built up of GFRG Panels, which are made up of mineral, usually in the form of phosphogypsum, a waste by-product of the fertiliser industry, and glass fibre as a reinforcing agent, which increases the panels' strength. The building panels are suitable for affordable mass housing, offering cost effectiveness and speed of construction. GFRG panels have cellular chambers between the outer flanges and the interior ribs, which may be stuffed with concrete and reinforced with steel bars if necessary to achieve the requisite load-bearing capability. In low to moderately unstable zones, buildings designed using this technique with no columns and beams will go all the way up to 8 to 10 storeys, and in high unstable zones, to a lower height. Electrical wiring and alternate plumbing operations might be concealed in the vacant holes within the panels. The use of GFRG Panels in building construction is a novel concept. This construction approach makes a major step towards sustainable living by lowering the negative environmental effect that is commonly associated to traditional construction technologies.

4.STUDY OF GFRG PANAL AND IT'S STRENGTHENING –

Eldhos M Manjummekudiyil [2015] studied regarding GFRG Panel strengthening victimization of very different concrete mixes crammed within the cavities. They used three very different concrete mixtures within the panels for testing. The concrete is a Nominal mix M25, fly ash concrete and Recycled Aggregate concrete. The main objective of victimization ash in most of the cement concrete applications is to urge sturdy concrete at a reduced value. The addition of fly ash as additional ingredients at the concrete mixing stage as part replacement of OPC and fine aggregates is a method that is more flexible. It permits for optimum utilization of the standard ash as a crucial element (cementitious and as fine aggregates) of concrete. Hence, here half-hour of cement is replaced by fly ash. From the results obtained from various tests conducted on GFRG panel, it is clear that the compressive strength is increased with the inclusion of filler materials. Nominal- M25 combine gave most strength once employed in panels.

5.CRITICAL REVIEW OF USE OFGLASS FIBRE REINFORCEMENT GYPSUM [GFRG] PANELS IN HOUSING IN INDIA

Kuldeep Kumar [2020] described GFRG Panels are made from gypsum, which is widely available as a waste product from the industrial sector. These lightweight panels are fire-resistant, thermally insulated, earthquake tested waterproofed, rot-resistant, termite-resistant, and 100 percent recyclable, making them ideal for eco-friendly or green architecture. the utilisation of GFRG panels in the Indian building sector by comparing them to traditional construction systems using a variety of functional, structural, and economic criteria.

6.COSTMODEL FOR USING GLASS FIBRE REINFORCEMENT GYPSUM SYSTEM

Mohamed Said Meselyhy Elsaed [2016] Studies about the GFRG framework and configuration cost model to examine coordinate expense for the framework amid the planning stage. The market cost for this framework is separated into two fundamental perspectives; cost and increase. The increase viewpoint is separated into the possibility, which is principally identified with hazard investigation and it contrasts regarding the site, proprietor and venture. The other angle is net revenue, which relies upon market status and plausibility examine for the undertaking. Cost viewpoint is partitioned into two stages, which are the immediate cost and roundabout expense. Increase and circuitous cost perspectives cannot be broke down in this exploration, as they are venture-arranged viewpoints. The paper plans to break down the immediate cost angle for GFRG framework and configuration cost show amid the structure stage; to accomplish the improvement level for a framework. The immediate expense of GFRG framework for structures, accepting that there are three hundred working days out of each year, eight



working hours out of each day and one GFRG board is worked in thirty minutes, and realizing the impression and developed zone for the building.

7.PERFORMANCE EVALUATION OF VERTICAL GARDENS

Ratih Widiastuti [2016] describes A field measurement was taken with the objective of researching the effectiveness of using vertical gardens to reduce surface temperature in the inside of a building's facade. The initial study was based on measurements of the interior façade thermal efficiency of vegetated and bare facades of the PERTAMINA branch office building in Semarang. The results showed that the plant layer on the façade successfully decreased the inner surface temperature on the façade. The internal surface temperature of the vegetated façade was always lower than the naked façade, as can be observed. The thermal lag of the vegetated façade was similarly slower than that of the naked façade, indicating that it might be advantageous to minimise cooling demands during peak hours. When the air temperature climbed, the effective thermal resistance of a plant layer steadily reduced.

III. CONCLUSION

During this study, a thorough examination, assessment, and analysis of the GFRG Panel-based construction system was conducted these are some points such as Environmental Benefits Reduce water waste, protect biodiversity and ecosystems, Conserve natural resources, improve air and water quality, protect biodiversity and ecosystems Benefits to the Economy Lower operational expenses, increase occupant productivity, Create a market for environmentally friendly products and services. Benefits to society Improve quality of life, reduce demand on local infrastructure, Improve occupant health and comfort.

This method may be appropriate for low-cost housing or EWS, as well as situations where rapid construction is necessary. It's a suitable option for rehabilitation housing, temporary housing (in the event of a natural disaster, for example), or when there's a high need for accommodation in a short period of time.

Even if the dwelling units are ready (in a short time) in isolation, the entire project cannot be operational in the absence of external ancillary and supporting services, according to the completion of the overall project, which includes the infrastructure and external development required for a project to become operational (drainage, electrical supply, water supply, storm water, roads, etc.). As a result, if this technology is to be employed in largescale housing developments where exterior development is critical, additional planning is necessary.

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