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## CASE STUDY ON USE OF INDUSTRIAL WASTE IN CONSTRUCTION (GLASS FIBRE REINFORCED GYPSUM PANEL)

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### Abstract

We face Challenges and for developing countries like India, china, etc. The major problem they are suffering is the disposal of industrial waste like gypsum .The overview of research and development carried out at IIT Madras using glass fibre reinforced gypsum (GFRG) panels is given in this review work. This building technology is very feasible, cost-effective and promising. By constructing around 300 buildings this technology has been demonstrated in India . The GFRG panel (124mm thick ) made from recycled industrial waste gypsum ( from the fertilizer industry ) .GFRG panel , manufactured in standardized part or section ready for rapid assembling and erection as panel are readymade gypsum (size 3mX12m ) with cellular cavities that are filled with reinforced self-compacting concrete. GFRG building can completely evade cement plastering. compared to conventional buildings less use of steel, cement , sand and water required in GFRG buildings. With no columns and beam required GFRG panel walls are used both architecturally and structurally as wall and slab. At IITM campus two storied four apartment demonstration building has been successfully constructed and presently a mass housing scheme (40 apartment) using this technology is being established at Nellore .

*Index Terms: Industrial waste management , Rapid structure ,GRGF panels , Economical structure, Earthquake resistance .etc.*

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### 1. INTRODUCTION

Glass fibre reinforced gypsum panel commercially known as rapid wall. Is an energy efficient green building material with huge potential for use as load bearing and non load bearing wall panel. in the constructed dwelling industry made of high quality gypsum plaster reinforced with special glass rovings where first introduce in Australia in 1990 presently this panels are manufactured in a few Asian countries like India, China Saudi Arabia and Oman . GFRG wall is manufactured at FACT, RCF building products limited (FRBL ) Kochi Kerala and innovative housing technology was recently developed in IIT Madras . GFRG panels are ready-made gypsum panel with hollow cavities inside the panel is filled with self compacted concrete to provide more strength to the panel GFRG panel costs rs.999 /sq m . and it is made up of Calcined as a gypsum plaster and reinforced with cut glass fibres

The glass fiber amount in a panel is 800gm / sq m of rapid wall , surface wall in Australia use of panel where restricted to wall, resisting gravity loads since 2003 , the IITM research team has been engaged in extensive research and extending use of this panel as a structure member for all components of

the building such as floor slab and staircase thereby it reduces the consumption of reinforced concrete (RC) this structure is resistance to earthquake and wind resistance structure. GFRG can be manufactured out of any kind of gypsum as fuel gas gypsum, mineral gypsum ,phospho-gypsum and marine gypsum . India has almost **64** million tons stock piled gypsum waste generated at various fertilizer plants with an addition to 2.5 million tons every year .and therefore in India the panel are made from processed phosphor-gypsum so GFRG housing in India promotes . the reuse of industrial waste by-products

### TYPES OF MATERIAL USED :-

- **Phospogypsum**
- **Glass fibre roving**
- **Water**
- **White cement**
- **D50 (retarder)**
- **BS94 (water repellent )**

**METHODOLOGY :-**



- Raw gypsum is collected from the gypsum deposition at phosphoric acid plant
- Raw gypsum is crushed in the storage shade
- It is then Feded to calciner for calcinations process
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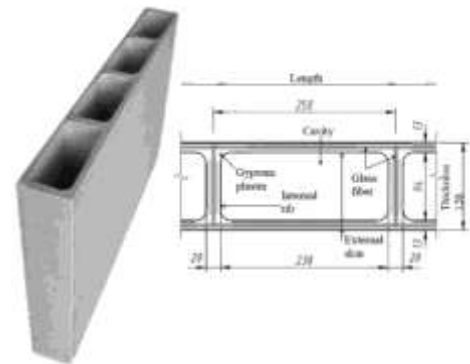
- In calciner raw gypsum is heated at 180<sup>0</sup>c to 200<sup>0</sup>c with the efficiency of 15T/hrs
- Calcined gypsum that is plaster is then stored in the silo which has a capacity to store 300T of plaster
- From silo , plaster is mixed with water while cement (D50 and BS94) in a mixer



- Now the first layer of slurry is spread over the table

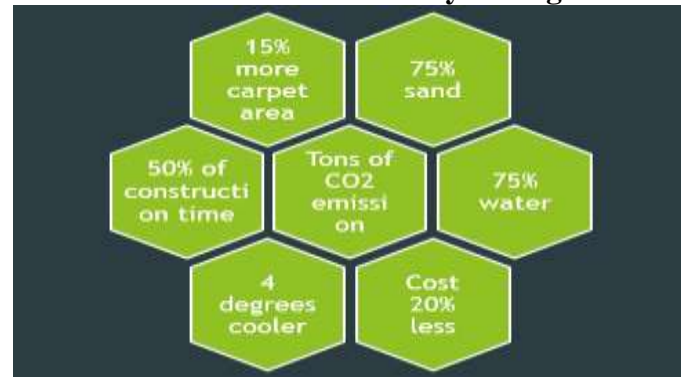


- 1st coating of glass fiber is spread above the slurry
- Then aluminium plugs are inserted for forming void in a panel after this the process of spreading slurry (first layer ) and glass fibres ( second layer ) is repeated
- After 20 min. The plugs are disconnected and the panel is set aside as it is for 20 min.



- Now the panels are dried in a drier at 200<sup>0</sup>c the drier can dry 6 panels at the same time

**How much can we save by using GFRG**



**ADVANTAGES :-**

1. Very is very Fast construction.
2. It reduces the inconvenience of construction with less materials.
3. It reduces the transportation cost of sand , cement.
4. It requires less no. of workers and this helps in economy.
5. It reduces the overhead expenditure & also it reduce the project time.

6. It does not produce any problem regarding disposal of wastes.
7. It is Eco-friendly.
8. It posses high thermal efficiency.
9. It reduces the cost for cooling & heating
10. It reduces maintenance cost etc.

- GFRG provide 15% more carpet area than the conventional building which is also beneficial n mentioned in fig
- This can last up to 80 years without deteriorating. while the Conventional buildings can last only up to 50 years

**DISADVANTAGES :-**

1. Handling panel should be handle with specific machinery and the Movement of the panel is slow.
2. GFRG panels is well arrange to avoid panel deformation, damage and moisture entrance.
3. Cutting of panel is done with specific machine and suddenly applied load tools such as hammer is not be used for cutting or removing part of the panel
4. GFRG panels is well packed and loaded on specifically designed for goods and delivered by suitable vehicle.

**3. CONCLUSION**

Hence it is conclude that this is an eco-friendly and sustainable building structure it has many advantages over conventional building . And it can easily assessable we can use it in entire superstructure it is more effective than the conventional one

**COMPARSION:-**

- GFRG can save up to 30% of the total construction cost. GFRG panel costs Rs 1000 per sq.m which is much less.
- It is economical and advanced Compared to conventional building
- GFRG is an eco-friendly material which saves tons of cement, thereby ultimately reducing the carbon footprint. With increase in global warming than the conventional building
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- GFRG houses can be built more rapidly than conventional buildings

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Materials/ Items	Rapidwall Building	Conventional Building	Saving in %
Cement	16 tons	32.55 tons	50.8
Steel	1800 kg	2779 kg	35.2
River sand	20 cum	83.37 cum	76
Granite metal	38 cum	52.46 cum	27.56
Bricks	-	57200	
GFRG Panel	500sqm	-	
Water	50000 ltr	200000ltr	75
Built Area	143 sqm	154.45sqm	8
Labour	389 mandays	1200 mandays	67.59
Construction Time	21 days	120 days	82
Total Weight of superstructure	170 tons	490 tons	65
Construction Cost	Rs 13.25 lakhs	Rs 18.27 lakhs	27.47%
Embodied energy in kWh	82921	215400	61.5

Table 1: Comparison of Rapidwall vs conventional building