

# FEASIBILITY STUDY OF DEVELOPING LOW COST HOUSING FROM GLASS FIBER REINFORCED GYPSUM (GFRG) PANELS AT PRANTIJI

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**Abstract** - For healthy living one need a proper place to reside for his entire life and that is home. But contrary to this, in India type and number of homes available is not adequate as per the estimation reported by the Ministry of Housing and Urban Poverty Alleviation, Government of India. With an annual population growth rate, demand for housing is increasing simultaneously. The continuous growth of urban population creates alarming problems related to health and wealth into the urban areas of the country. To provide sufficient houses in affordable price one need to think about other concept as low cost housing or replacement of conventional material with new affordable materials. Low cost housing is a relative concept and has more to do with budgeting and seeks to reduce construction cost through better management, appropriate use of local materials, skills and technology but without sacrificing the performance and structure life. In this study, Main aim to focus on developing Low Cost Housing by GFRG (Glass Fiber Reinforced Gypsum) wall panels. Glass Fiber Reinforced Gypsum (GFRG) Panel branded as Rapid wall is a building panel product, made of in calcined gypsum plaster, reinforced with glass fibers, for Mass-scale building construction, was originally developed and used since 1990 Australia.

**Key Words:** Low cost housing, Glass fiber reinforced gypsum panels, Slum area, Composite material.

## 1. INTRODUCTION

The definition of "slum" varies from country to country. In Delhi, slums are commonly called 'Jhuggi - Jhompdi', whereas in Mumbai they are called 'Jhompadpatti or Chawls'. Other known names are - 'Ahatas' in Kanpur, 'Bustees' in Kolkata, 'Cherish' in Chennai and 'Keris' in Bangalore. But physical characteristic in most of these slums are essentially the same. They are usually a cluster of hutments suffering from lack of basic amenities, inadequate arrangement for drainage and for disposal of solid wastes and garbage. India is also the home for world's largest urban population with below poverty line incomes. The Pradhan Mantri Awas Yojana envisages providing housing to all by 15th August 2022. The mission seeks to build 20 million housing units. This would result in an enormous demand of building materials like steel, cement and wood etc. To reduce this dependence on conventional building material there is a

need to review alternate building materials and construction techniques. There is a myth in minds of many people. They think that whenever construction is accompanied with low cost the material used will always be of a low-grade quality.

Low cost house is a new concept which deals with effective budgeting and use of new techniques which help in reducing the cost of construction by the use of locally available materials or use of various waste materials along with improved skills and technology

## 2. NEED OF THE STUDY

India is also the home for world's largest urban population with below poverty line incomes, and to the world's largest population living in slums. In 2004-05, 25.6% urban dwellers were below the poverty line and the largest concentration of urban population was in Maharashtra (14.6 million), Uttar Pradesh (11.7 million), and Madhya Pradesh (7.4 million). The latest National Sample Survey Office (NSSO) survey estimates that the number of slums in India at 33,510 with 8.8 million households. Census 2011 found that there are 40% of total population lives in slums. Almost quarter of Indian metro cities live in slums area. The largest proportion of population living in slums in the world is in the Asian region, which is also urbanizing at the fastest rates. The continuous growth of urban population creates alarming problems related to health and wealth into the urban areas of the country. Due to increasing population in urban areas, it becomes congested in centre locations.

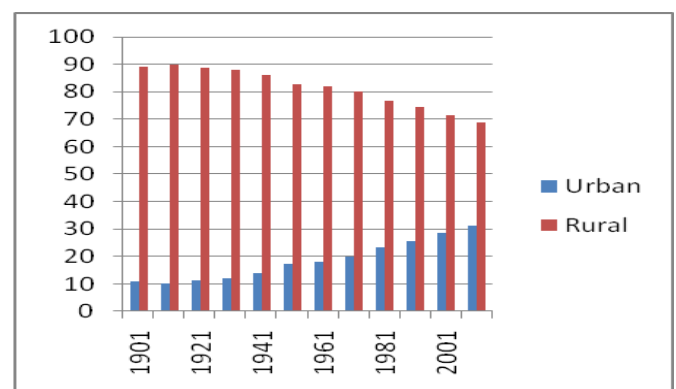


Chart-1: Rural-Urban growth differential of India with its urbanization rate (1901-2011)

### 3. OBJECTIVES

- To study alternative solution of Housing Scheme as with traditional building material.
- To analyze cost estimation of Housing scheme and comparison with GFRG panels and traditional buildings.
- Estimation comparison of traditional scheme and GFRG panel
- To Promote Low cost housing concept along with GFRG panels to the slum area for provisional of better lifestyle to the slum people as physical and social infrastructure.

### 4. MATERIAL PROPERTIES AND MANUFACTURE PROCESS

Glass Fiber Reinforced Gypsum (GFRG) Panel branded as Rapid wall is a building panel product, made of calcined gypsum plaster reinforced with glass fibers, for Mass-scale building construction, was originally developed and used since 1990 in Australia. The panel, manufactured to a thickness of 124mm under carefully controlled conditions to a length of 12 m and height of 3m, contains cavities that may be unfilled, partially filled or fully filled with reinforced concrete as per structural requirement.

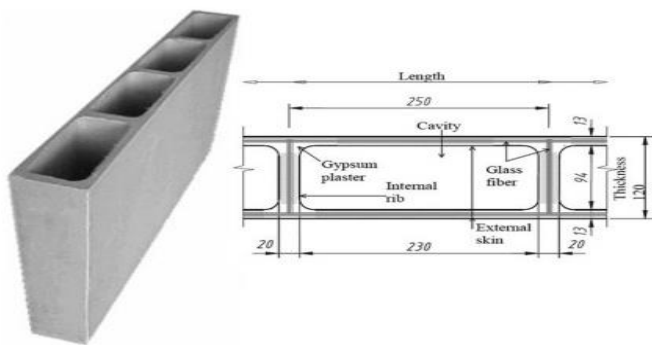


Fig.2: GFRG Panel Dimensions

The stock of waste gypsum about 7M tons piled up into a hill awaiting disposal every year. It is this waste product of the fertilizer industry reprocessed by calcite to make gypsum plaster that forms the raw material. The panels are cast in three stages on a special table by pouring a paste of calcined gypsum and other chemical additives. Glass fibers are spread evenly onto the mix by means of a screening and rolling process.

Raw gypsum is collected from gypsum deposition at fertilizer industry. Raw gypsum is crushed in the storage shed. Raw gypsum is than feeded to calciner in Calcinations process. In calciner, Raw gypsum is heated at 180 to 200 c with efficiency of 15tons/hr. Calcined gypsum plaster is than

stored in a silo which has a capacity to store 300 tons of plaster. From silo, plaster is mixed with water, white cement and chemicals (D50 and BS94) in a mixer.



Fig.3: Spreading gypsum plaster for 1<sup>st</sup> Layer



Fig.4: Alluminium plugs for hollow cavity

In next step, special aluminum plugs are inserted on top of the finished first layer with 20mm gaps in between to form the hollow cavities in the panel. Then second pouring of the raw mix gypsum plaster on the aluminum plugs along with cut glass fibers with tamping and rolling. After setting which takes 5 min the plugs are withdrawn and the casting table is rotated and in its vertical positions the panel to take out for drying chamber.

The drying of the panels is done in a dryer chamber in which hot air is circulated to dry the panel evenly for 90 min. After drying, as per the customer requirements the panels are cut using a computer aided and automated process machine to the specified requirement any construction of building project.

Table 1: Advantages of GFRG Panels over Conventional Building Materials:

Factors	Conventional	GFRG
Cost	Higher than GFRG	Can save 20-30%
Time for G+1	Approx 6 month	30 days
Fire	Melts at 1000°	Can withstand

resistant		1000 for 4 hours
Earthquake resistant	Can't resist unless separately designed	Can resist due to panels act as shear wall
Life span	50 years	80 years
Water Resistant	Water proofing coating is required	Panel itself water proof
Carpet area	9inch wall thickness hence required more area	5 inch wall thickness, hence required less area
Strength	Less stronger	5 * stronger than conventional

	absorption		weight
5	Compressive strength	Clause 10.4.6	Min 160 KN/m <sup>2</sup>
6	Flexural strength	Clause 10.4.7/10.4.8	Min. 2.1 KN/m
7	Fire resistance	Clause 10.4.10	Min 3h

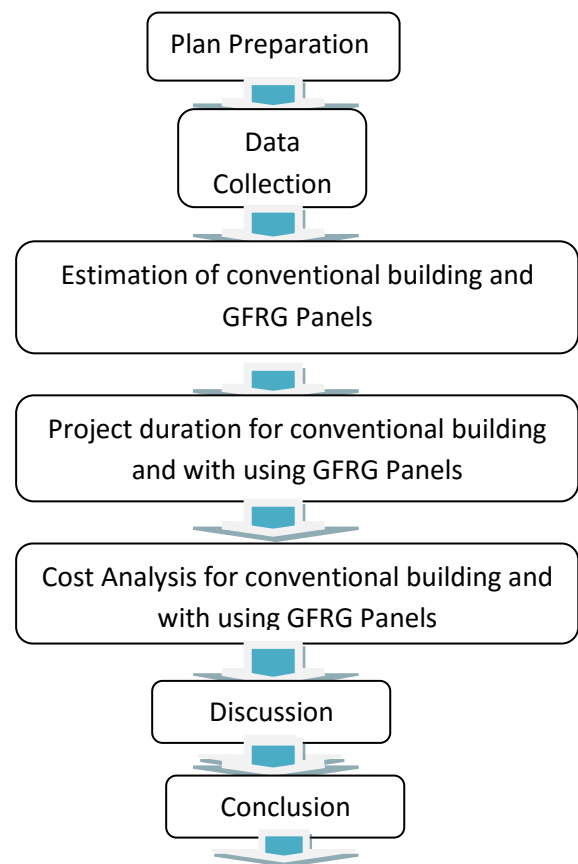
#### 4.1 Use of the GFRG Panels and Limitation:

1. For single or double storey construction GFRG panels can use without core filling (Cavities) of reinforcement.
2. As light weight load bearing wall panels.
3. In multi storey construction, GFRG panels can be use as shear vertical wall panels with partially, alternatively or fully core fillings.
4. As Horizontal floor/ roof slabs with reinforced concrete micro beams and screed (T-beam action)
5. As pitched (sloped) roofing
6. As compound wall

**Table 2: Tests required in laboratory:**

S. No	Parameters	Test Method	Requirements
1	Dimensions Length Height Thickness	BMBA PC-3:2011  Clause 10.4.2	12.02 m ± 3mm 3.05 m ± 3mm 124mm (tolerance +3 to -0mm)
2	Water Content	Clause 10.4.3	Less than 1%
3	Weight	Clause 10.4.4	40 kg/m <sup>2</sup> ± 6%
4	Water	Clause 10.4.5	Max. 5% by

#### 5. METHODOLOGY



#### 6. STUDY AREA

The study area is Prantij Town. Prantij town is situated in Sabarkantha district of Gujarat state. The current population of Prantij Town is 22,596 according to census data of year 2011. According to the gender consideration the male population is about 12093 and female population is 11503. The population of this village in year 2001 was 22,306. According to the gender consideration the male population is about 11,600 and female population is 10,706. The town is well connected by the district centre Himmatnagar at distance of about 20 km. There is one National Highway (NH-08) passes from near the town Prantij. Town also facilitated by broad-gauge railways and bus station. The city

transportation is mainly dependent on roadway system. The taluka centre for Prantij is itself Prantij urban town. Prantij taluka comprises 29 villages in taluka centre. All the nearby villages of Prantij town is less facilitated plus less obedient in health and education purpose. People living in nearby village have to depend on Prantij town for its basic facilities such as employment, transportation facility for long route journey, legal activity like court case, police station, municipality, taluka panchayat, gram panchayat. They are also depends on Hospitals of town for major health issue. The atmosphere of Prantij town is very pleasant due to surrounding green farms. The following study aims to provide residential buildings to the slum area people at low cost also the study works on new technology of precast material Glass Fiber Reinforced Gypsum GFRG for replacement of masonry wall which made of traditional building materials. The main objective is to evaluate cost estimation of Housing scheme and comparison with GFRG panels and traditional buildings materials. By comparison of the cost estimation of building with GFRG panels and traditional building material masonry wall, find out the cost saving from both the results. Arrow shows the study area of Prantij town on the map below.

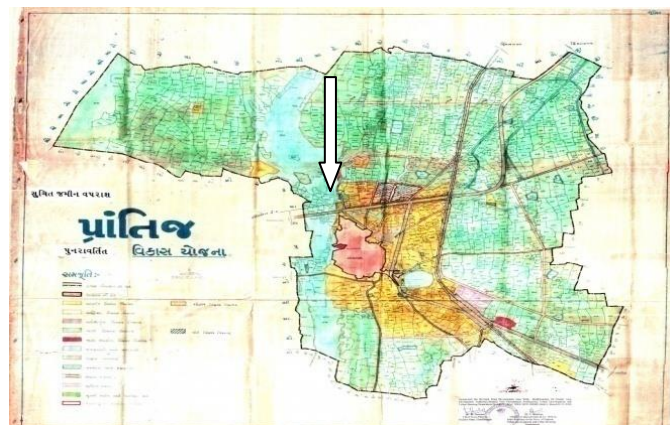


Fig 6.: Map of Prantij Town

7. DATA COLLECTION

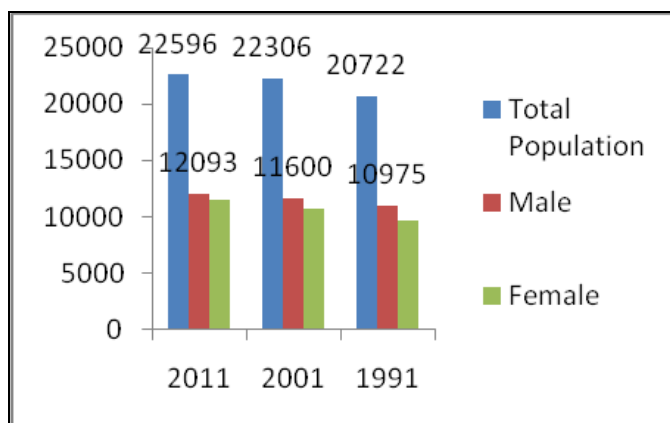


Fig.7: Population growth of Prantij Town

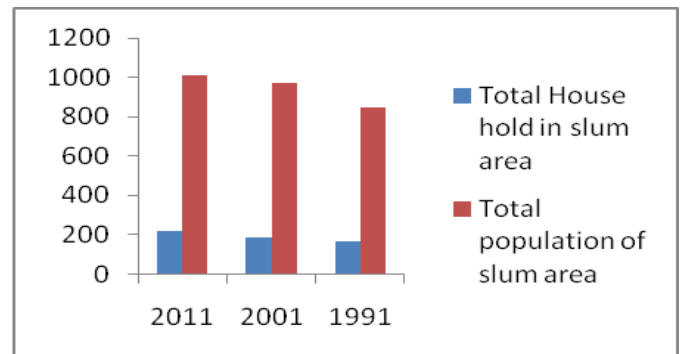


Fig.8: Slum area population growth of Prantij town.



8. CONCLUSION

On the basis of primary survey for total population growth and slum area population growth rate and observing current scenario of slum area it is observed that by every census year population has been increasing. Due to urbanization slum area has become congested at every passing year. In slum area It is observed that there is huge requirements of household for better residential purpose in slum area. To build housing in large area for large population, it also require huge demand for conventional building material as cement, bricks, steel etc and high investment. Cement is also globally polluted material, therefore it is necessary to look out for composite material to save the overall cost. GFRG(Glass Fiber Reinforced Gypsum) panels consist gypsum as raw composite waste material and glass fiber as alternative of masonry wall. Gypsum and glass fiber is much cheaper than conventional building material cement, bricks and steel. Thus, GFRG panels as low cost housing material is viable option.

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