



RAPID WALL FOR RAPID CONSTRUCTION

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Abstract

To serve rapid growing population & Eco friendly , Light weight load bearing capacity, rapid wall construction is essential. The building industry accounts for 40% of CO2 emissions. Building construction causes CO2 emissions as a result of embodied energy consumed in the production of energy intensive building materials and also the recurring energy consumption for cooling and heating of indoor environment. Rapid wall, also called gypcrete panel is an energy efficient green building material with huge potential for use as load bearing and non-load bearing wall panels. Rapid wall is a large load bearing panel with modular cavities suitable for both external and internal walls. It can also be used as intermediary floor slab/roof slab in combination with RCC as a composite material.

1. INTRODUCTION

Rapid wall is a large load bearing panel with modular cavities suitable for both external and internal walls. It can also be used as intermediary floor slab/roof slab in combination with RCC as a composite material. Since the advent of innovative Rapid wall panel in 1990 in Australia, it has been used for buildings ranging from single storey to medium - high rise buildings. Light weighted Rapid wall has high compressive strength, shearing strength, flexural strength and ductility. It has very high level of resistance to fire, heat, water, termites, rot and corrosion. Concrete infill with vertical reinforcement rods enhances its vertical and lateral load capabilities.

2. RAPID WALL FOR RAPID CONSTRUCTION

Rapid wall enables fast track method of construction. Conventional building construction involves various cumbersome and time consuming processes like,



- Masonry wall
- Cement plastering requiring curing,
- Casting of RCC slabs requiring centring and scaffolding and curing
- Removal of centring and scaffolding and
- Plastering of ceilings and so on.

It also contributes to pollution and environmental degradation due to debris left on the site. In contrast,

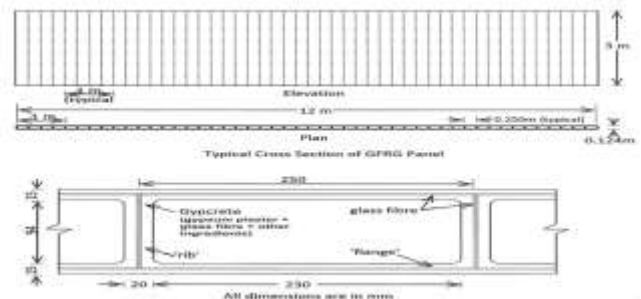
Rapid wall construction is much faster and easier. There will be no debris left at site. Construction time is minimized to 15-20%. Instead of brick by brick construction, surfaces are smooth and even and ready for application of special primer and finishing coat of paint.

2.1 Procedure For Rapid Wall Construction

As per the building plan, each wall panel will be cut at the factory with millimetre precision using an automated cutting saw. Door, window, ventilator, openings for AC unit etc. will also be cut and panels for every floor is marked relating to building drawing. Panels are vertically loaded at the factory on stillages for transport to the construction sites on trucks. Each stillage holds 5 or 8 pre-cut panels. The stillages are placed at the construction site close to the foundation for erection using vehicle mounted crane or other type of crane with required boom length for construction of low, medium and high rise buildings. Special lifting jaws suitable to lift the panel are used by inserting into the cavities and pierced into webs, so that lifting/handling of panels will be safe.

2.1.1 Dimensions

Typical Dimension of GFRG (gypsum fibre reinforced glass) building panel are 12.0m x 3.0m x 0.124m Each 1.0m segment of the panel contains four cells. Each cell is 250mm wide and 124mm thick.



2.1.2 Joints



Wall to wall 'L', 'T', '+' angle joints and horizontal wall joints are made by cutting of inner or outer flanges or web appropriately and infill of concrete with vertical reinforcement with stirrups for anchorage. Various construction joints are as follows.

2.1.3 Foundation

For Rapid wall buildings/ Housing a conventional foundation like spread footing, RCC column footing, raft or pile foundation is used as per the soil condition and load factors. All around the building RCC plinth beam is provided at basement plinth level. For erection of panel as wall, 12 mm dia vertical reinforcement of 0.75m long of which 0.45m protrudes up and remaining portion with 0.15m angle is placed into the RCC plinth beams before casting. Start-up rod are at 1m centre to centre.

2.1.4 Concrete Infill

After inserting vertical reinforcement rods as per the structural design and clamps for wall corners are in place to keep the wall panels in perfect position, concrete of 12 mm size aggregate will be poured from top into the cavities using a small hose to go down at least 1.5 to 2 m into the cavities for directly pumping the concrete from ready mix concrete truck. For small building construction, concrete can be poured manually using a funnel. Filling the panels with concrete is to be done in three layers of 1m height with an interval of 1 hr between each layer. There is no need to use vibrator because gravitational pressure acts to self-compact the concrete inside the water tight cavities.

3. RAPID WALL FOR ROOF IN COMBINATION WITH RCC

Rapid wall for floor/roof slab will also be cut to required size and marked with notation. First the wall joints and other cavities and horizontal RCC tie beams are in-filled with concrete then wooden plank of 0.3 to 0.45 m wide is provided to room span between the walls with support wherever embedded micro beams are there; finally roof panels will be lifted by crane using strong sling tied at mid-diagonal point, so that panel will float perfectly

horizontal. Each roof panel is placed over the wall in such a way that there will be at least a gap of 40 mm. This is to enable vertical rods to be placed continuously from floor to floor and provide monolithic RCC frame within Rapid wall. Wherever embedded micro-beams are there, top flanges of roof panel are cut leaving at least 25mm.

4. ERECTION OF PANELS

The following day, erection of wall panels for the upper floor can be arranged. Vertical reinforcement of floor below is provided with extra length so as to protrude to 0.45 m to serve as start-up rods and lap length for upper floor. Once the wall panels are erected on the upper floor, vertical reinforcement rods are provided, door/window frames fixed and RCC lintel cast. Then concrete is filled where required and joints are filled. Then RCC tie beams all around are concreted. Roof panel for upper floor is repeated same as ground floor. For every upper floor the same method is repeated. The concrete inside the water tight cavities.



5. FINISHING WORK

Once concreting of ground floor roof slab is completed, on the 4th day, wooden planks with support props in ground floor can be removed. Finishing of internal wall corners and ceiling corners etc. can be done using wall putty or special plaster by experienced POP plasterers. Simultaneously, electrical work, water supply and sanitary work, floor tiling, mosaic or marble works, staircase work etc. can also be carried out. Every upper floor can be finished in the same way.

6. ADVANTAGE

• Rapid wall building/housing is cooler

Rapid wall panel have low thermal conductivity and high thermal resistance. A comparative research study by Mohd Peter Davis et al in 2000 in University Putra Malaysia, Selangor, found that in summer indoor temperature of Glass Fibre Reinforced Gypsum Panel building is cooler by 5 to 6 degrees Celsius as compared to concrete building. The high thermal resistance of Rapid wall will keep interiors cooler in summer and warmer in winter, saving substantial recurring energy use.

• Rapid wall is energy efficient

The use of advanced low energy based green & cleaner technology in reprocessing / recycling their waste material into GFRG panels consumes very low energy and helps

to protect the environment. Environmental protection is economically priced now through carbon emission reduction (CER) trading under Kyoto Protocol linked through special market mechanism (CDM - Clean Development Mechanism). This makes Rapid wall Panel mass production very suitable to meet the challenge of affordable housing for the deprived. According to the Ministry of Housing, Govt. of India in Dec 2007 urban housing shortage has been estimated at about 24.7 million units at the end of the 10th Five Year Plan (2006-07) and 99% of the shortage pertains to the economically weaker sections and low income groups.

• **Rapid wall is for affordable quality housing**

Access to adequate shelter at affordable cost by low income section and common people is very important for India for inclusive development. The booming of real estate and construction industry has indeed shot up the cost of construction due to the ever increasing cost of cement, steel, bricks, river sand, concrete materials and labour cost. In this situation, safe and good quality housing will become unaffordable to all the sections.

7. DIS-ADVANTAGE

- The shorter span of slab (floor / roof) should be restricted to 5 m.
- Is ideal if the same floor / roof is replicated for all floors in multi storied structure.
- For any variations, structural designer needs to be consulted.
- Curved walls or domes should be avoided. In case it is essential, use masonry, concrete for that particular area.
- The electrical / plumbing drawing should be such that most of the pipes go through the cavities (in order to facilitate minimum cutting of panel).
- Rapid wall panel has excellent acoustic properties. Testing of panel by IIT Madras found that the panel belongs to a class of STC 40 with respect to air-borne sound insulation.
- Comparative study of Rapid wall building and conventional building (2 storey 1500 sqft) shows significant savings in Rapid wall buildings. Embodied energy of Rapid wall building is only 82921 kWh, while conventional same size building would have 215400 kWh, thereby saving 61.5% embodied energy.

8. COMPARISON OF RAPID AND CONVENTIONAL WALL

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	500 sqm	-	
Water	50000 lit	200000 lit	75
Built up	143 sqm	154.45 sqm	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

9. USES OF RAPID WALL

The most valuable use of Rapid wall is its use as load bearing wall in multi storey construction in combination with RCC. Rapid wall can also be used as non-load bearing and partition wall in RCC framed structures. IIT Madras has recently developed method of fixing panel in between RCC columns, beams and floor slab with clamping system. By this panel can be fixed to floor slab and panel at bottom using screws, which will be embedded within flooring and skirting. At top clamps will be fixed to panel and ceiling slab or beam. On sides also clamped at bottom to RCC column, floor slab and panel. Plastering of walls can also be saved thereby saving time and cost. If this is taken into account at design stage itself, dead load reduction of more than 50% can be made. This will save in foundation, RCC columns and beams, in turn steel and concrete. This will make substantial savings in cost of construction.

10. PROPERTIES OF RAPID WALL

Weight- light weight	40 kg/sqm
Axial load capacity	160 KN/m
Compressive strength	73.2kg/sqm
Unit Shear strength	50.90KN/m
Flexural strength	21.25kg/sqcm
Tensile Strength	35KN/m
Ductility	4
Fire resistance 4 hr rating withstood	700-1000 OC
Elastic Modulus	3000-6000Mpa
Sound transmission{STC}	40db
Water absorption	<5%

11. CONCLUSION

Rapid wall Panel provides a new method of building construction in fast track, fully utilising the benefits of prefabricated, light weight large panels with modular cavities and time tested, conventional cast-in-situ constructional use of concrete and steel reinforcement. By this process, man power, cost and time of construction is reduced. The use of scarce natural resources like river sand, water and agricultural land is significantly reduced. Rapid wall panels have reduced embodied energy and require less energy for thermo-regulation of interiors.

Rapid wall buildings thereby reduce burdening of the environment and help to reduce global warming. Rapid wall use also protect the lives and properties of people as these buildings will be resistant to natural disasters like earthquakes, cyclone, fire etc. This will also contribute to achieve the goal of much needed social inclusive development due to its various benefits and advantages with affordability for low income segments also. Fast delivery of mass dwelling/ housing is very critical for reducing huge urban housing shortage in India. Rapid wall panels will help to achieve the multiple goals.

12. REFERENCE

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