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To Study the Construction Techniques for Slum Rehabilitation In Metro Cites

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Abstract - With increasing urbanization, the need for adequate affordable shelter also increases. Housing shortage is one of the major challenges faced in developing countries like India. It is imperative to provide housing that caters to all income groups with special focus on the low and middle income groups. In order to provide low cost housing, it is essential to adopt innovative sustainable technologies which are affordable, fast track, cost effective, durable as well as environment friendly. This seminar discusses emerging innovative technologies that can be adopted in the country to lower housing construction cost and help in provision of mass affordable housing. Some of the technologies discussed are Tunnel form, Sismo building technology, Light Gauge Steel Framed Structural technology, Precast Sandwich Panel technology etc. These technologies are reviewed on various parameters like local availability, affordability, energy efficiency, structural stability, quality, speed, cost effectiveness, eco friendliness and suitability for high rise construction. The advantages and limitations of the technologies are also mentioned. The seminar highlights the potential barriers for adoption of these technologies in the Indian urban scenario and methods which can be employed to overcome those barriers in order to provide affordable housing for the low and middle income groups. Fast track construction is very much essential for the mass housing projects like slum rehabilitation . For this rapid wall technique can be best option for construction

Keywords: urbanization Mass housing , Fast track construction, slum rehabilitation .rapid wall

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INTRODUCTION

India's population is growing at a rate of 1.4% per year and currently makes up 17.5% of the global population. In the ensuing five-year plans, India has gradually witnessed a shift in policing from decentralization to urbanization, with a greater emphasis being placed on heavy industrialization and commercialization relative to agriculture and agro-based sectors. The country is seeing an increasing trend of rural-to-urban migration as a result of these factors. 2. The infrastructure necessary to handle these sizable migrant populations is lacking in metropolitan regions.

The urban poor are a new demographic that has emerged as a result of these conditions. Squatter communities are made up of the majority of these urban impoverished people. Slum areas have appeared in all of the country's cities. The problem of impoverished people's right to housing has gained prominence due to the recent developments in democratic philosophy. In response to this idea, the Indian government has implemented a number of programs aimed at improving the squatters' quality of life and providing them with accommodations.

Need of Mass housing for Slum Rehabilitation

In the framework of current research, mass housing (MH) evaluation, regeneration, and redesign constitute a vital and difficult challenge because MH represent the predominant pattern of urban transformation and expansion in the second half of the 20th century. Different holistic approaches and design solutions that support both ecological transition and social change of these metropolitan settings are identified in the practical context of mental health rehabilitation. Nonetheless, there is a wide variation in the implementation of these strategies throughout Mumbai.

Current Scenario: India's economy is young and expanding. India is expected to have 580 million urban residents by 2030, doubling the country's 2001 urban population of 280 million. The majority of house construction in India is done by private contractors. Many people's perceptions of the construction industry will shift if we comprehend the implications of these two realities for the sector as a whole and the role it will play in the ensuing decades.

In 2001, there were an estimated 280 million people residing in India's cities and towns. Assuming five people live in each home on average, there would be 56 million homes. Accordingly, 56 million more homes will need to be constructed if the urban population doubles by 2030. Put another way, by 2030, we must have built about the same number of cities and towns that we did in 2001. This brings up the following query: Who will construct it and how should it be constructed?

With a few exceptions, we believe that the way our towns and cities have grown over the past few decades has been disastrous in terms of infrastructure, architectural designs, and urban planning. We can all agree that the last 20 years are not what we want to repeat. Furthermore, most of these new urban developments will only be built by individuals who are, if we are to think rationally, in the 25–30 age range or older. Therefore, some considerations need to be made regarding how we, as architects, town planners, and other professionals, along with the construction and infrastructure industry, partner to face this challenge and successfully achieve the goal. We can use a variety of strategies to solve this puzzle. We can examine our prior performance as municipal planners, architects, and designers and draw lessons from our errors. A few of them include indifference to the effects on the environment and a lack of concern for them. It's also important to recognize the value of public transportation and integrate it with private growth.Recalling that private companies will be responsible for the majority of these new development projects. For private companies undertaking large-scale projects, the provision of clean water, proper sanitation, the removal of solid waste, and the timely delivery of energy in coordination with local and state authorities will be essential to the project's success.

It's also critical to establish a forum where various industry professionals and private stakeholders can collaborate to produce a shared vision for the development of a certain area of the region. Both the government and the planning authority will likely provide us some guidance. To ensure overall success, however, cooperation between them and private players would be desirable.

Significance

A key component of sustainable development is housing. Housing contributes to the consumption of natural and artificial materials, water, and energy through its design, building, usage, and demolition. Sustainability metrics are increasingly at the forefront of housing provision efforts because housing is a crucial tool to achieve both sustainable development and quality of life. This is because sustainable development is closely tied to the concepts of quality of life, well-being, and liveability.

People's housing technologies and designs must be more sustainable in order to reduce their contribution to greenhouse gas (GHG) emissions, as a result of the imperative of climatic variability. It is anticipated that sustainable housing will lower waste and water pollution, guarantee access to clean, safe drinking water, and improve sanitation and hygiene. Along with other housing components like location, surroundings, and financial load, these structural and architectural aspects of housing can have a direct or indirect impact on people's choices and opportunities to improve their quality of life.

LITERATURE REVIEW

Ahuja et al. (2012) described the numerous important uncertainty factors that have an impact on an activity's duration while it's underway. This consequently influences the project completion schedule and, consequently, the project cost rise.

Enno et al. (2017) found that building operations in China and India required a lot of effort because equipment was frequently left behind. Furthermore, women make up a sizable portion of the labor force in many nations.

Okpala et al. (2020) found that: The three main causes of high construction costs were found to be shortage of materials, inadequate contract management, and methods of financing and payment for completed works. Price fluctuation was found to be the most significant factor responsible for the escalation of project cost. High costs can be minimized by minimizing lapses in the management of human and material resources.

Eldin et al. (2014) Although it was determined that there would have been more advantages and cost savings if the constructability enhancement program had been put into place earlier in the project, significant benefits were still attained.

Touran et al. (1992) discussed the overall approach to solving these issues. The conventional Monte Carlo simulation method was also explored, however issues were discovered. The variance of the overall cost might be predicted with a high degree of accuracy using the basic method that was suggested.

has approved the plan for Dharavi's reconstruction put forth by architect Mr. Mukesh Mehta. The Slum Rehabilitation Authority (SRA) will carry out the plan after it has been modified as needed. according to the norms of S. R. Act of 1971.

Development Plan:

Rehabilitative services are available to slum dwellers whose names are on the voters list as of January 1, 1995, and who are the real occupants of the dwelling, as per SRA regulations. Every family will receive a free 225 square foot self-contained home with carpet. The Rehabilitation project will cover the qualified slum dwellers listed in Annexure II who have been certified by the Competent Authorities. Rehab Tenements in Dharavi will be provided to qualified slum dwellers.

DATA ANALYSIS:

7 Method of Mass Housing for Slum Rehabilitation

Global anxiety is growing as the threat of climate change, brought on by an increase in greenhouse gas concentrations in the atmosphere, is putting the entire globe in danger of a catastrophic calamity. The 21st century demands environmentally friendly and energy-efficient products. Forty percent of CO2 emissions come from the building sector. Because of the energy required to produce energy-intensive building materials and the ongoing energy demand for heating and cooling indoor spaces, building construction results in CO2 emissions.

Rapidwall, commonly referred to as gypcrete panel, is a highly promising material for green building that is energy-efficient and can be used for both load-bearing and non-load-bearing wall panels. Rapidwall is a sizable load-bearing panel that can be used for indoor or external walls because of its modular cavities. It can also be utilized as a composite material with RCC as an interim floor or roof slab. Since the revolutionary Rapidwall panel was introduced in Australia in 1990, it has been applied to a variety of building types, including single-story and medium-to high-rise structures.

Rapidwall, which is lightweight, exhibits excellent flexural, shearing, compressive, and ductility properties. It is extremely resistant to rot, corrosion, heat, fire, and termites. Its ability to support both vertical and lateral loads is improved by concrete infill with vertical reinforcement rods. Buildings with rapidwalls are resistant to fire, cyclones, and earthquakes.

Figure 1: Worlds' largest load bearing lightweight panel

Manufacturing of GFRG panel

A byproduct of the phosphoric acid plant, phosphogypsum is calcined at a temperature of 140–1500 C at a rate of 15 MT/hr of calcined plaster. The 250MT product silo used to store this calcined plaster. In the wall panel manufacturing section, the plaster is subsequently moved to a batch hopper by screw conveyors and an entoleter. This section includes six 3 x 12 meter casting tables, a single crab with a mixer, and a glass roving delivery system for slurry and glass roving supply to three tables.

Plaster is added and mixed with the chemicals in water to create a slurry. The crab covers the surface with one layer of slurry and then a layer of glass roving. With the assistance of a screen roller, the glass roving is incorporated into the slurry. With the aid of a temping bar, a layer of glass roving is pressed inside the ribs after another layer of slurry has been poured. The top face of the wall panel is then covered with a layer of glass roving. The last Gilmore wall panel is moved to the dryer for drying after being hoisted from the casting table to the ACROBA frame.

The wall panel is allowed to dry for sixty minutes at 275˚C. The wall panel is moved to a storage area or the cutting table once it has dried. The wall panel is cut to the customer's specified measurements, and the cut parts are then placed on stands designed specifically for wall panel transportation. The technology recycles the liquid effluent produced during the production process to create fresh wall panels.

After breaking down and sorting plaster and glass roving in a recycling facility, the solid waste produced during the production of wall panels is recycled back into the calciner. This system operates in batches. For every table, six wall panels can be produced in an eight-hour shift. Similarly, an eight-hour shift with six tables may produce thirty-six wall panels. Attached is a flow diagram of the system that illustrates the manufacturing process.

Inspections & Testing:

It must be completed at the proper phases of the production process. The inspected panels need to be packed and stored carefully to prevent damage during transit. Regular in-process inspections will be conducted by the PAC holder's trained staff as part of quality assurance.

Physical and Material Properties:

The largest lightweight load-bearing panel in the world is the Rapidwall panel. The panels are 12 meters long, 3 meters tall, and 124 millimeters thick when they are constructed. There are 48 modular cavities in each panel, each measuring 230 mm by 94 mm by 3 m. One panel weighs 1440 kg, or 40 kilogram per square meter. With a density of 1.14g/cm3, the panel weighs just 10–12% more than similar concrete or brick masonry. The panels' material and physical characteristics are listed in table below.

Weight	44 Kg/ sqm
Axial load capacity	160 kN/m{ 16 tons/ m}
Compressive strength	73.2 Kg/cm2
Flexural strength	21.25 kg/cm2
Tensile Strength	35 KN/ m
Fire resistance	4 hr rating withstood 700-10000 C
Elastic Modulus	3000-6000Mpa
Water absorption	< 5%

Once the vertical reinforcement rods are in place, the vertical and lateral load capabilities of Rapidwall Panel can be multiplied several times over by adding concrete infill. Wall panel voids can be filled in a variety of ways depending on the structural requirements. (See Fig.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 illustrated in Fig.3.

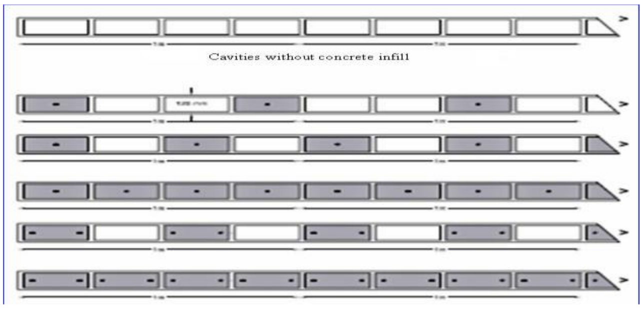


Figure 2: RCC infill to increase load capability

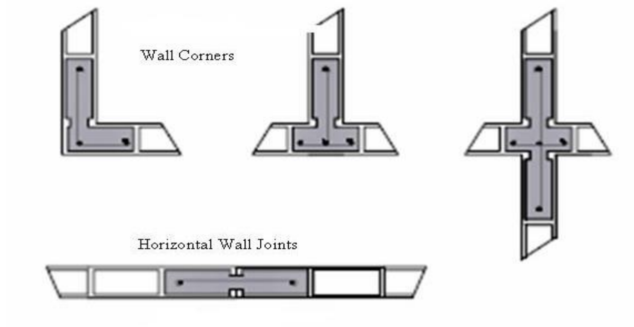


Figure 3: Various construction joints

In addition, Rapidwall Panel can be utilized with embedded RCC micro-beams and RCC screed concrete for intermediate floor slabs and roof slabs. (Fig.4).

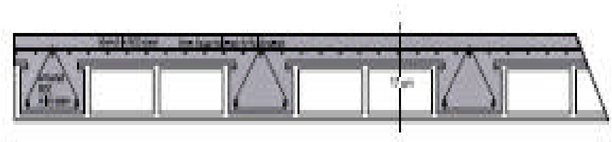
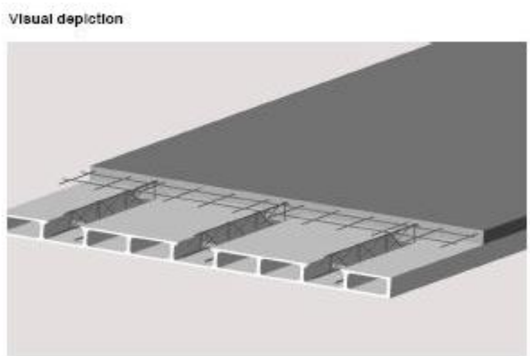
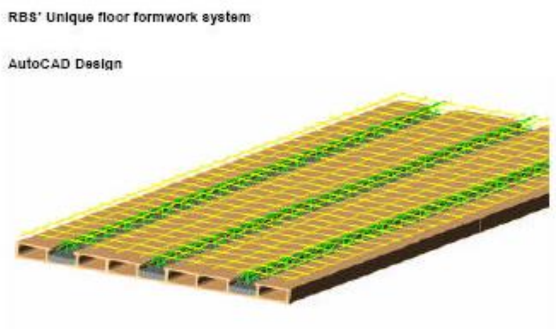


Figure 4: GFRG embedded with RCC micro beams and RCC screed concrete





Transportation and Lifting:

At the facility, panels are vertically put onto stillages for truck delivery to the construction sites. Five or eight pre-cut panels fit into each stillage. When constructing low-, medium-, and high-rise buildings, vehicle-mounted cranes or other types of cranes with the necessary boom length are used to erect the stillages near the foundation at the construction site. To ensure safe lifting and handling of panels, special lifting jaws that are suited for lifting panes are inserted into cavities and punctured into webs.

Figure 5: Transportation and lifting of the GFRG panel

Construction and Workmanship:

Foundation:

Depending on the soil conditions and load parameters, a conventional foundation such as a spread footing, RCC column footing, raft foundation, or pile foundation is used for Rapidwall Housing. There are RCC plinth beams all around the structure. In the foundation, standard materials for water proofing are employed.

Figure 6: Foundation part of the construction

Rapidwall:

The rapid wall makes it possible to build quickly. Traditional building construction entails a number of labor-intensive procedures, such as i) masonry wall construction ii) plastering with cement that needs to cure, iii) casting RCC slabs that need to be centered, scaffolded, and cured, iv) removing the scaffolding and centering, v) plastering ceilings, and so on. The quick wall approach reduces construction time to 15–25%. Rapidwall allows wall by wall building as an alternative to brick by brick construction.

Rapidwall also does not require cement plastering as both surfaces are smooth and even and ready for application of special primer and finishing coat of paint.

3Openings: Door/window, openings will be cut and reinforced concrete is provided there.

Figure 7: Window opening

Lintel:

Wherever needed, embedded RCC lintels must be installed by cutting the external flange open. The necessary shuttering and support can be given to reinforce lintels and RCC sunshades.

Concrete Infill:

Once the wall corners clamps are in place and the vertical reinforcing rods have been inserted in accordance with the structural plan, the cavities will be filled with 12mm aggregate concrete that is poured from above. Because the concrete inside the watertight cavities is self-compacted by gravity, a vibrator is not necessary. In general, concrete should be used in every third cavity.

Tie Beam:

The national building code requires that every floor or roof slab have an embedded RCC tie beam as a necessary precaution against earthquakes. In order to place horizontal reinforcement with stirrups and concrete it, the web section that corresponds to the appropriate beam depth at the top must be cut and removed.

Roof Slab:

The GFRG panels are utilized in place of a solid concrete floor slab, which is normally between 100 and 150 mm thick. In various roofs, they are positioned horizontally above the walls. Usually, the roofs extend in a shorter direction. At every intersection, concrete tie beams hold the panels and walls together. A reinforced cage is placed to act as a hidden beam into each of the horizontal GFRG panel's third cavities, which are cut open from the top. Additionally, a steel mesh that has been welded is positioned over the whole floor slab and then embedded in a 50 mm thick concrete screed. The advantage with the system over conventional concrete slabs is the there is no need of shuttering and the finish at bottom is excellent. .

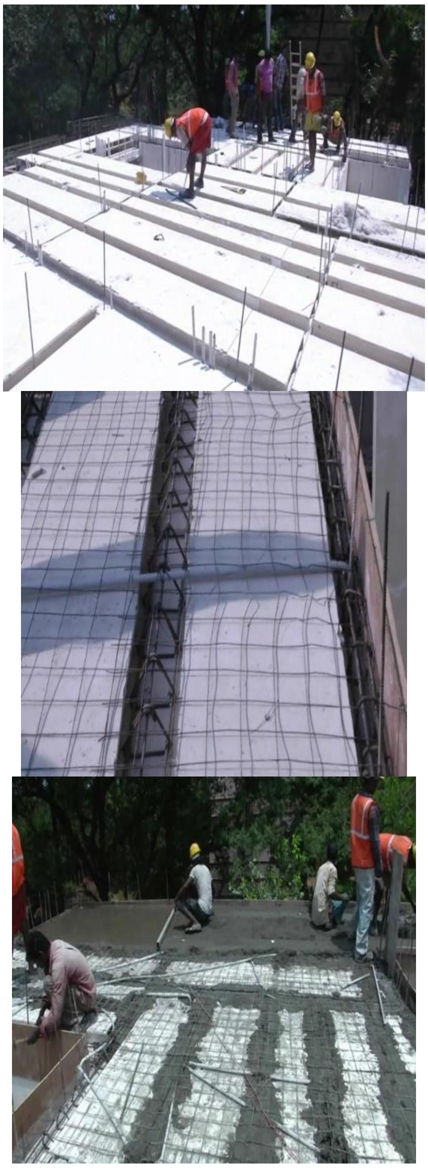


Figure 8: Roof slab construction

Erection of wall panel and floor slab for upper floor:

The floor below must have additional vertical reinforcement that extends to a height of 0.45 meters to function as lap length for the top floor and start-up rods. After the upper story wall panels are constructed, the RCC lintels, door and window frames, and vertical reinforcing rods need to be cast. Next, when necessary, fill the joints and add concrete. After that, concrete will be applied to all of the RCC tie beams.

Water proofing:

The PAC holder shall provide to the client details of water proofing treatment required at different levels of construction such as foundation, sunshade and flooring etc.

Stair Case:

The stair case work is taken up using GFRG panels as the landing slab withreinforced concrete bars in all the cavities.

Figure 9: Stair case construction

Finishing Work:

On the fourth day after the ground floor roof slab has been concreted, the wooden boards supporting the ground floor can be taken down. Skilled plasterers can use wall putty or special plaster to finish interior wall corners, ceiling corners, and other areas. Concurrently, tasks such as electrical installations, sanitary and water supply systems, floor tiling, marble or mosaic work, stairway construction, and more can be completed. The same method can be used to finish each upper story.

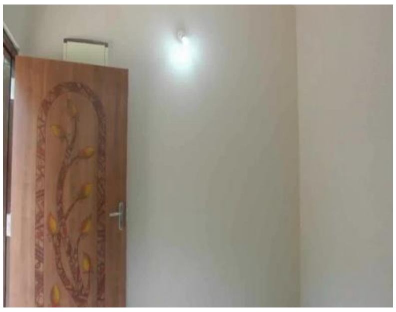


Figure 10: Finishing Wor

Comparison:

Comparative study of Rapidwall building and conventional 2storey 1500 sft Building:

Materials/ items	Rapidwall Building	Conventional Building	Saving in %
Cement	16 tons	32.55 tons	50.8
Steel	1800 kg	2779 kg	35.2
Sand	20cum	83.37cum	76
Granite	38cum	52.46cum	27.56
Bricks	-	57200	
GFRG panel	500sqm	-	
Water	50000ltr	200000ltr	75
Labour	389 mandays	1200 mandays	67.59
Construction time	21 days	120 days	82
Wt. of superstructure	170 tons	490 tons	65
Construction cost	Rs 13.25 lakhs	Rs 18.27 lakhs	61.5

CONCLUSION

Fast track management is now more widely accepted, mostly because of its time-saving methodology. It is absolutely necessary for mass housing. Additionally, there are a number of other advantages, such as clearing the backlog, entering emerging markets swiftly, cutting building costs, obtaining savings through advance purchase, and fostering closer cooperation. While there are benefits to fast-track construction, there are drawbacks as well. These include problems with quality, planning, and irrational client expectations. These drawbacks are likely the reason fast-track construction isn't now the preferred method for building projects of any kind.

According to our assessment of the fast-track initiative, one of the implications is a higher risk across multiple domains. In the construction industry, ensuring that projects are completed on schedule, within budget, and with the desired level of quality and safety is the primary task. One way to solve the issue is to build faster tracks. Shorter project durations are achieved through the use of fast tracking methodologies. The fast track construction is being impacted by many initiatives.

Three key tactics that impact expedited construction are delay management, resource management, and technology selection. The main reasons why fast-track construction was delayed were unpaid contractors, a lack of building materials, material substitutions, etc. Inadequate resource management can cause projects to be lost or run behind schedule. The use of cutting-edge technology in the building sector will facilitate quick project completion. Every approach has a variety of options for improvement, and applying these methods will contribute to a building project's success.

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