Journal of Advances in Science and Technology
Vol. 20, Issue No. 1, March-2023, ISSN 2230-9659

To Study the Construction Techniques for Slum Rehabilitation In Metro Cites

Mr. Sanap Sameer Somnath[1*], Dr . U. J. Phatak[2]

[1] PG Student, Dept of Civil Engg, PVPIT, Pune

[2] Professor, Dept of Civil Engg, PVPIT, Pune

Abstract - The need for decent, affordable housing rises along with urbanisation. One of the biggest issues in emerging nations like India is a lack of housing. All economic levels must have access to housing, but the poor and moderate income groups need special attention. Affordable, quick-to-market, cost-effective, long-lasting, and environmentally friendly new sustainable technologies must be adopted in order to provide affordable housing. This seminar explores cutting-edge, innovative technologies that may be used across the nation to reduce the cost of building homes and support the creation of widespread, affordable housing. Technologies like tunnel form, Sismo buildings, light gauge steel framed structures, precast sandwich panel technology, etc. are some of those that are covered. These technologies are evaluated according to a number of criteria, including their appropriateness for high-rise construction, local accessibility, affordability, energy efficacy, structural stability, quality, speed, and cost effectiveness. Also addressed are the technology' benefits and drawbacks. In order to offer low- and middle-income groups with cheap housing, the conference discusses potential obstacles to the adoption of these technologies in Indian cities as well as strategies for overcoming them. Fast-track building is very necessary for large-scale housing projects like slum redevelopment. The most advantageous alternative for building for this quick wall technique

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

---x---

INTRODUCTION

India currently accounts for 17.5% of the global population and is still expanding at a rate of 1.4% yearly. The successive five-year plans in India have gradually shifted the country's policy from decentralisation to urbanisation as commercialization and heavy industrialisation are given more attention than agricultural and agro-based sectors. These elements have caused a rising trend of rural-to-urban migration across the country. 2 However, the urban regions lack the infrastructure needed to handle these massive migrant populations. These elements have contributed to the emergence of a brand-new population group: the urban poor. The majority of these urban poor live in squatter communities. Slum areas have appeared in all of the country's cities. The topic of the poor's right to housing has gained attention recently thanks to the evolution of democratic ideology. This idea led the Indian government to develop numerous programmes in an effort to accommodate the squatters and improve their quality of life.

Need of Mass housing for Slum Rehabilitation:

The evaluation, regeneration, and redesign of mass housing (MH) constitute a vital and difficult work in the current research setting since MH represent the dominant pattern of urban change and development in the second half of the 20th century. Different holistic methodologies and design solutions that support both ecological transition and social change of these metropolitan environments have been found within the practical context of MH rehabilitation. However, the extent to which these methods are used in Mumbai varies substantially. .

Current Scenario: India's economy is young and expanding. According to estimates, India's urban population would increase from 280 million in 2001 to 580 million by 2030. In India, private contractors build the majority of the homes. Many people's perceptions of the construction industry will alter if we can grasp the implications of these two realities for the sector as a whole and the role it will play in the decades to come.

Indian cities and towns were home to an estimated 280 million inhabitants in 2001. If there are 5 people on average each house, it is 56 million dwellings. Therefore, if we estimate that the urban population will double by 2030, we would need to construct an additional 56 million homes. In other words, by 2030, we need to develop roughly as many cities and towns as there were in 2001. That brings up the following issue: Who will construct them, and how should they be constructed?

We believe that, with the exception of a few regions, how our towns and cities have grown over the past two decades has been a disaster in terms of urban planning, infrastructure, and architectural designs. Everyone will concur that we don't want to make the same mistakes again in the following 20 years. The majority of these new urban developments will also only be built by people who are already in the 25 to 30+ age range, if we use reason. "Now some thoughts need to be put up on 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 objective. We may approach this puzzle's solution from several angles. We may review our prior performance as town planners, architects, and designers and learn from our errors. There is a need to comprehend the significance of public transport systems and how to incorporate them with private growth. Some of these include a lack of care and awareness for environmental repercussions.Recall that the majority of these new structures will be carried out by private contractors. Water supply, sanitation, solid waste disposal, and the provision of energy in coordination with governmental and municipal organisations will be particularly important for the success of these developments for private actors undertaking large-scale projects. It is also very important to build a forum where a variety of private actors and business experts can join together to generate a shared vision for growing a specific area of the region. We may anticipate some guidance from the Planning Department and the Government. But to ensure overall success, cooperation between them and private players would be ideal.

Significance:

Sustainable growth must include enough housing. Housing contributes to the consumption of natural and man-made resources, water, and energy through its design, building, usage, and destruction. Housing is an important instrument to offer both quality of life and sustainable development, therefore sustainability metrics are increasingly at the forefront of housing provision efforts. This is because sustainable development is intimately interconnected with the concepts of quality of life, well-being, and liveability. People's dwelling technologies and designs must be more sustainable in order to reduce their contribution to greenhouse gas (GHG) emissions in order to meet the challenge of climate variability. Sustainable housing is anticipated to increase energy efficiency, provide access to clean, sanitary, and hygienic facilities, as well as lessen waste and water pollution. Along with other housing characteristics like location, surroundings, and cost burden, these structural and design aspects of housing have the potential to directly and indirectly influence people's choices and opportunities for enhancing their quality of life.

LITERATURE REVIEW

Ahuja et al. (2012) described the numerous key uncertainty variables that have an impact on an activity's duration while it is ongoing. This has an impact on the project completion time and, as a result, the rising project cost.

Enno et al. (2017) observed that building activities in India and China required a significant amount of labour since equipment was frequently underutilised. In many nations, women make up a significant portion of the labour force..

Okpala et al. (2020) despite some minor differences, the professionals generally agreed that shortages of materials, ineffective methods of financing and paying for completed works, and poor contract management were the three major causes of high construction costs. Price fluctuation was identified as the most significant factor responsible for the escalation of projects, and these findings show that: High costs can be minimised by minimising lapses in the management of human and material resources;

Eldin et al. (2014) Despite the fact that the constructability enhancement programme should have been undertaken at the project's earlier stages, significant gains were nonetheless attained and helped reduce costs.

Touran et al. (1992) discussed the overall approach to resolving these issues. Additionally, the conventional Monte Carlo simulation method was examined, but issues were discovered. The proposed general technique has a strong ability to estimate the variation of the overall cost.

OBJECTIVES

- To study effect of fast track construction technique on the time and cost of project by comparing with conventional techniques by taking actual cast study in Mumbai Region
- To study the construction safety aspect in mass housing

METHODOLOGY

- By taking actual case study effect of fast track construction technique on the time and cost of project by comparing with conventional techniques will be analyzed
- Stduy and analysis different construction safety aspect in mass housing

DATA COLLECTION: INTRODUCTION

The largest and densest slum area in Asia is called Dharavi. The Slum Rehabilitation Authority (SRA), in accordance with the guidelines of the S. R. Act of 1971, will carry out the reconstruction of Dharavi after making the necessary revisions to the architect's proposal, which was presented to the Maharashtra government.

Development Plan:

The slum resident whose name appears on the voters list as of January 1, 1995, and who is the real tenant of the hutment, is eligible for rehabilitation, under SRA guidelines. Each family will receive a free, self-contained home with 225 square feet of carpeting. The Rehabilitation plan would cover the approved eligible slum residents listed in Annexure II by the Competent Authority. Tenements in Dharavi will provide rehabilitation to eligible slum residents.

DATA ANALYSIS

Method of Mass Housing for Slum Rehabilitation

The threat of climate change brought on by an increase in the amount of greenhouse gases in the atmosphere is causing widespread alarm and driving the entire planet into a catastrophic disaster. Energy-saving and environmentally friendly goods are a must for the twenty-first century. 40% of CO2 emissions come from the construction sector. Due to the embodied energy required for the manufacture of energy-intensive building materials as well as ongoing energy demand for heating and cooling indoor environments, the construction of buildings results in CO2 emissions. Rapidwall, also known as gypcrete panel, is a highly versatile load-bearing and non-load-bearing wall panel that is both energy efficient and environmentally friendly. Rapidwall is a substantial load-bearing panel with modular cavities that may be used for both interior and exterior walls. As a composite material, it may also be utilised as an interim floor slab or roof slab when combined with RCC. Since the unique Rapidwall panel's introduction in Australia in 1990, it has been employed for structures ranging in height from one story to a medium-high rise. Rapidwall is a lightweight material with strong compressive, shear, flexural, and ductile strengths. It has a very high level of resistance to corrosion, termites, rot, heat, and water. The ability of the concrete to withstand vertical and lateral loads is improved by the use of vertical reinforcing rods. Buildings made using rapidwall are resistant to fire, cyclones, and earthquakes..

Figure 1: Worlds' largest load bearing lightweight panel

Manufacturing of GFRG panel

Phosphogypsum, a byproduct of the phosphoric acid factory, is calcined in a calciner at a rate of 15 MT of calcined plaster per hour between 140 and 1500 C. This calcined plaster is kept in a product silo with a 250MT capacity. The plaster is subsequently transported to the batch hopper in the wall panel manufacturing area using screw conveyors and an Entoleter. Six casting tables with dimensions of 3 m x 12 m are located in this area, and one crab has a mixer and a glass roving delivery system for three tables. Plaster is next added and mixed with the chemical mixture to create a slurry. The crab places a coating of slurry and then a layer of glass roving on the surface. With the assistance of a screen roller, the glass roving is incorporated into the slurry. A layer of glass roving is added after another layer of slurry, and this layer is pressed inside the ribs with the aid of a temping bar. The top face of the wall panel is then covered with a layer of glass roving. The completed Gilmore wall panel is then moved to the dryer for drying after being transferred from the casting table to the ACROBA frame. The wall panel is dried for 60 minutes at a temperature of 275 °C. The wall panel is either placed on the cutting table or moved to storage after drying.. The wall panel is cut to the customer's provided measurements, and the chopped pieces are then placed in stillages designed specifically for carrying wall panel. The system is recycled to produce fresh wall panels using the liquid waste produced during the production process. After being crushed and separated from plaster and glass roving at the recycling facility, the solid waste produced during the manufacture of wall panels is recycled back to the calciner. This system uses batch processing. For each table, six wall panels may be produced in an eight-hour shift. Similar to that, six tables can produce 36 wall panels in an eight-hour shift. A flowchart of the system outlining the production process is provided.

Inspections & Testing:

At the right points in the production process, it must be done. The examined panels must be packaged and kept carefully to prevent damage during delivery. Regular in-process inspections must be conducted as part of quality assurance by the PAC holder's trained staff.

Physical and Material Properties:

The biggest lightweight load-bearing panel in the world is the rapidwall panel. The panels have dimensions of 12 m in length, 3 m in height, and 124 mm in thickness. There are 48 modular cavities per panel, each measuring 230 mm by 94 mm by 3 metres. One panel weighs 1440 kg, or 40 kilogramme per square metre. The panel's density is 1.14g/cm3, which is just 10–12% of the weight of similarly sized blocks of concrete or brick masonry. In the following table 3.2.1, the physical and material characteristics of panels are displayed.

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%

After installing reinforcing rods vertically, concrete may be added to boost the Rapidwall Panel's capacity for both vertical and lateral loads by a factor of several. 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.

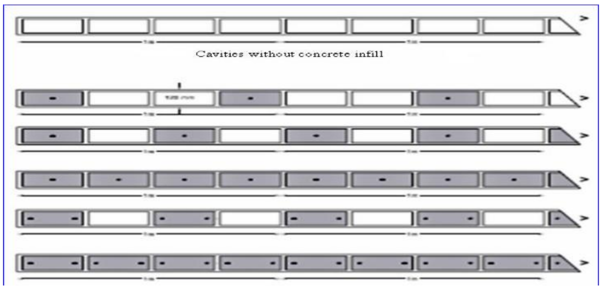


Figure 2: RCC infill to increase load capability

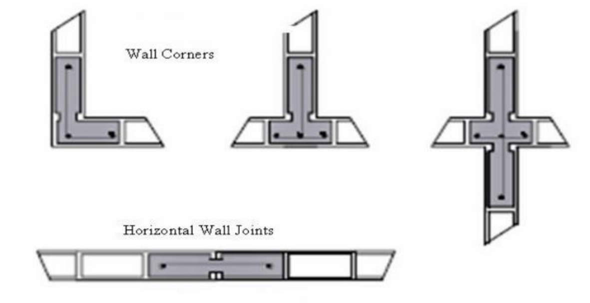
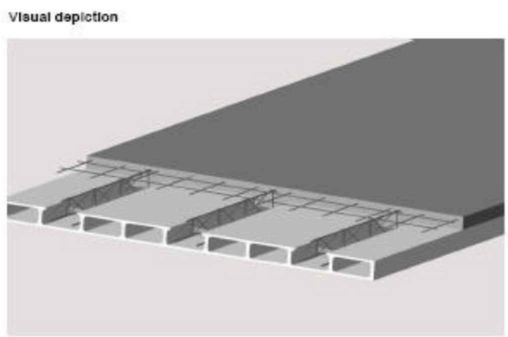
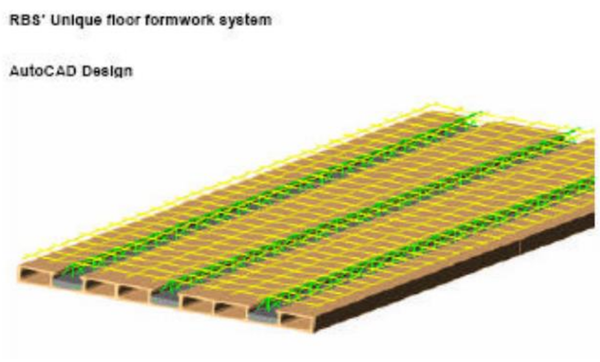


Figure 3: Various construction joints

Rapidwall Panel can also be used for intermediary floor slab / roof slab in combination with embedded RCC micro-beams and RCC screed concrete (Fig.4).

Figure 1.4: 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. There are 5 or 8 pre-cut panels in each stillage. For erection utilising a vehicle-mounted crane or another type of crane with the necessary boom length for the construction of low, medium, and high rise buildings, the stillages are erected at the construction site near to the foundation. In order to lift and handle panels safely, special lifting jaws that are designed for this purpose are inserted into the cavities and punctured into the webs.

Figure 5: Transportation and lifting of the GFRG panel

Construction and Workmanship:

Foundation:

Depending on the soil conditions and load considerations, a conventional foundation such as a spread footing, RCC column footing, raft, or pile foundation is utilised for Rapidwall Housing. The building has RCC plinth beams available all around it. The foundation is waterproofed using standard methods.

Figure 6: Foundation part of the construction

Rapidwall:

Rapidwall makes it possible to build quickly. Traditional building methods entail a number of labor-intensive procedures, such as 1) masonry wall construction. ii) cement plastering that has to cure, iii) RCC slab casting that needs centering, scaffolding, and curing, iv) removal of centering, and v) plastering of ceilings, etc. The quick wall technique cuts down construction time to 15% to 20%. Rapidwall permits wall-by-wall building as opposed to brick-by-brick construction. A unique primer and finishing coat of paint may be applied to both surfaces of Rapidwall without the need for cement plastering since they are both smooth and level.

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

Figure 7: Window opening

Lintel:

Everywhere necessary, exterior flanges have to be cut open in order to accommodate embedded RCC lintels. The necessary shuttering and support can be used to provide reinforcement for lintels and RCC sunshades..

Concrete Infill:

Concrete with an aggregate size of 12 mm will be poured from above into the cavities after vertical reinforcing rods have been inserted in accordance with the structural design and clamps for wall corners have been installed to maintain the wall panels in correct position. Gravitational pressure operates to self-compact the concrete inside the watertight compartments, eliminating the need for a vibrator. Generally, concrete should be placed in every third cavity..

Tie Beam:

As a crucial requirement of the national building code against earthquakes, an embedded RCC tie beam to floor/roof slab is to be installed at each floor/roof slab level. In order to place horizontal reinforcement with stirrups and pour concrete, the web part up to the appropriate beam depth at the top must be cut and removed.

Roof Slab:

The GFRG panels are utilised in place of a solid concrete floor slab, which is normally 100 to 150mm thick. In various roofs, they are positioned horizontally above the walls. The shorter route is usually where the roofs span. At every intersection, concrete tie beams join the panels to the walls. A reinforced cage is put into every third cavity at the top of the horizontal GFRG panel after being sliced open, acting as a hidden beam. A steel welded mesh is also added, and the entire floor slab is then covered with a 50mm thick concrete screed. The technique has the benefit over traditional concrete slabs in that shuttering is not required, and the bottom finish is superb. .

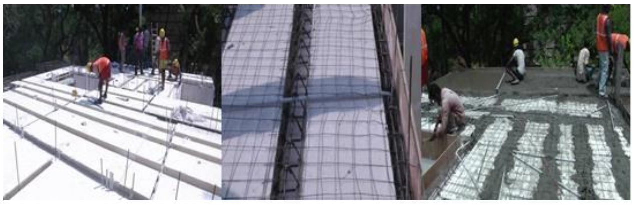


Figure 8: Roof slab construction

Erection of wall panel and floor slab for upper floor:

To act as start-up rods and lap length for the top floor, the vertical reinforcement of the floor below must be given enough additional length to protrude 0.45 metres. Vertical reinforcing rods, fixed door/window frames, and RCC lintels must all be cast after the upper floor's wall panels have been constructed. The joints must then be filled with concrete where necessary. Following that, all of the RCC tie beams must be concreted.

Water proofing:

Details on the water proofing procedures needed at various construction stages, such as the foundation, sunshade, and flooring, etc., must be provided to the customer by the PAC holder.

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:

Wooden planks with support supports on the ground floor can be removed on the fourth day after the ground floor roof slab has been concreted. Experienced plasterers can finish interior wall corners, ceiling corners, etc. using wall putty or specialty plaster. Electrical work, water supply and sanitary work, floor tiling, marble or mosaic work, stair construction, etc. can all be done concurrently. The same method may be used to finish each above 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 more widely accepted in part because it is a time-saving strategy. It is absolutely crucial in mass housing. The ability to catch up on backlog, enter growing markets rapidly, save construction costs, save money through advance purchases, and improve cooperation are other advantages. Fast track construction has some advantages, but there are also some drawbacks, such as quality problems, planning problems, and unreasonably high client expectations, which are likely the reasons why fast track construction isn't always the best option for any kind of project. An increased risk in numerous domains is one of the ramifications, according to our analysis of the fast track initiative. Creating confidence regarding delivery on schedule, within budget, and with the desired level of quality and safety is the key problem in the construction business. Fast track building is a solution to the issue. Shorter project durations are achieved through the use of fast tracking methodologies. The fast track construction is being impacted by many initiatives. Three major crucial tactics that have an impact on fast track construction are resource management, delay management, and technology selection. Contractor payments, a lack of building materials, a change in materials, etc. are the main factors that contributed to delays in fast track construction. Without effective resource management, projects may run late or incur losses. Utilising the most recent technologies in the building sector will enable quick project completion. For each strategy's improvement, several techniques are accessible, and their use will assist a building project succeed..

REFERENCES

1. Samer Ezeldin, Ahmed Soliman, "Hybrid Time-Cost Optimization of Nonserial Repetitive Construction Projects", Journal of Construction Engineering and Management, Volume 135, Number 1, ISSN 0733- 9364, January 2009, 42-55.
2. Abdulaziz M. Jarkas, Camille G. Bitar, "Factors Affecting Construction Labor Productivity in Kuwait", Journal of Construction Engineering and Management, Volume 138, Number 7, ISSN 0733-9364, July 2012, 811-820.
3. Adnan Enshassi, Sherif Mohamed, Ibrahim Madi, "Contractors' Perspectives towards Factors Affecting Cost Estimation in Palestine", Jordan Journal of Civil Engineering, Volume 1, Number 2, April 2007, 186- 193.
4. AH Touran, Edward P. Wiser, "Monte Carlo Technique With Correlated Random Variables", Journal of Construction Engineering and Management, Volume 118, Number 2, ISSN 0733-9364, June 1992, 258-272.
5. Ali Touran, "Probabilistic Approach for Budgeting in Portfolio of Projects", Journal of Construction Engineering and Management, Volume 136, Number 3, ISSN 0733-9364, March 2010, 361-366.
6. Amirhosein Jafari, Peter E. D. Love, "Quality Costs in Construction: Case of Qom Monorail Project in Iran", Journal of Construction Engineering and Management, Volume 139, Number 9, ISSN 0733-9364, September 2013, 1244-1249.
7. Benon C. Basheka, Milton Tumutegyereize, "Measuring the Performance of Contractors in Government Construction Projects in Developing Countries: Uganda's Context", African Journal of Business Management Volume 6(32), ISSN 1993-8233, August 2012, 9210-9217.
8. Burcu AkincI, Martin Fischer, "Factors Afæct1ng Contractors' Risk of Cost Overburden", Journal of Management in Engineering, Volume 14, ISSN 0742- 597X, January 1998, 67-76.
9. Daisy X. M. Zheng, S. Thomas Ng, Mohan M. Kumaraswamy, "Applying Pareto Ranking and Niche Formation to Genetic Algorithm-Based Multi objective Time–Cost Optimization", Journal of Construction Engineering and Management, Volume 131, Number 1, ISSN 0733-9364, January 2005, 81-91.
10. Daniel Blomberg, Paul Cotellesso, William Sitzabee, Alfred E. Thal Jr., "Discovery of Internal and External Factors Causing Military Construction Cost Premiums", Journal of Construction Engineering and Management, ISSN 0733-9364/04013060(9) , December 2013, 1-9.

Corresponding Author

Mr. Sanap Sameer Somnath*

PG Student, Dept of Civil Engg, PVPIT, Pune