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Case Studies of Affordable Houses by Using Various Construction Techniques

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Abstract

Examining affordable housing in India is the focus of this research. The long-term profitability of projects is ensured by the combination of sustainability and cost, despite their seeming antithesis. Using case studies, this study aims to explore contemporary architectures and provide insight into their global implementation. In pursuit of the "Housing for All Mission 2022," India has made significant progress, but more has to be done. Regulations about affordable housing have laid the groundwork for a more streamlined process that includes various stakeholders at different stages. An international ecosystem is required for India to provide both professional training and reasonably priced homes. The government launched the PMAY (U) initiatives in 2015 to help with the housing crisis in urban areas. However, implementing these initiatives frequently takes time, which raises cost projections and affects the EWS categories that are most vulnerable. To address this, the study looks into how present constructs are used globally using case studies. It also examines construction techniques, emphasizing the use of inexpensive and environmentally friendly building materials to reduce expenses and provide users with both financial and aesthetic benefits. This paper aims to present case studies on affordable materials and construction techniques.

Keywords: - Affordable housing, local materials, construction techniques

I. Introduction

Housing affordability is a crucial issue in urban development, and social, and economic policy due to sustained economic growth, rapid urbanization, and migration. Understanding this is essential as it addresses the need for affordable housing, emphasizing the importance of affordable housing. The Ministry of Housing and Urban Affairs (MoHUA, 2017) defines affordable housing based on size, price, and income. The MoHUA's definition is based on the Reserve Bank of India's (RBI, 2018) expenditure method of housing affordability, which states that affordable housing should not exceed 30%-40% of a household's monthly income, or the typical housing cost burden. Efficient planning, project management, use of low-cost materials, economical construction technologies, and alternative construction methods can help create affordable housing for low-income groups. The Indian government is implementing innovative, cost-effective, and environmentally friendly housing technologies to address the significant shortage of affordable housing for low-income and middle-income citizens. India's policymakers have failed to address housing poverty effectively, leading to myopic schemes. A nuanced understanding of housing poverty is needed for effective strategies. (Renita D'Souza, 2019). Low-cost, sustainable alternative building materials for India, address challenges and stereotypes in using these materials for affordable housing, highlighting their adaptability to various factors (Swaptik Chowdhury et al., 2013). The government recognising the need has acknowledged the importance of the housing issue in the country. The Planning Commission of India's Twelfth Plan delineates fast-paced, inclusive, and sustainable growth. Urbanization should be guided towards inclusive and equitable growth of towns and cities with proper civic amenities. The key would be to focus efforts towards land and housing policy reforms, delegation of power to urban local bodies, fostering innovative housing finance, and steps for reduction in project costs and schedule overruns. Planned urbanization would ensure that towns and cities are free from slums and provide adequate opportunities for productive employment and optimum quality of life to all their inhabitants including the marginalized segments of the society (ICC 2016). Demonstrating durable earthen structures in various locations can transform the earth's image and make it a desirable material for low-cost housing in rural India (Yask Kulshreshtha et al.,2020). The United Nations Development Program (UNDP) predicts urbanization will increase energy consumption, leading to increased greenhouse gas emissions. This aims to incorporate clean energy into affordable housing construction in Indonesia and Uganda (Hashwini Lalchand Thadani, 2021).

II. Affordable Housing

Affordable housing is gaining prominence globally and nationally, as governments recognize it as a basic need. Rakesh Mohan, Deputy Governor of the RBI, emphasized the importance of affordable housing in 2007: "Future national competitiveness and economic success

will depend on the comparative efficiency of cities. The quantity, quality, availability, and affordability of housing become a key component in national economic competitiveness, as housing is where jobs go to sleep at night."

Housing choices significantly impact infrastructure, employment, household wealth, health, education, poverty levels, maternal and child mortality, and women's workforce participation. As India strives to improve living conditions, affordable housing remains a significant obstacle for its citizens. To address this, Affordable housing technologies aim to reduce construction costs by using locally available materials, improved skills, and technologies without compromising structure strength, performance, and life. This approach involves using local and indigenous building materials, local skills, energy-saving options, and environmentally friendly options.

III. Case Studies:

1. Mr. Shyam Raghute Residence, Nagpur

Mr. Shyam Raghute, an eco-conscious individual, built his own house using various techniques and materials. He is very curious about the environment and nature. He wants to reduce CO2 emission which is generated by using cement components in the construction.

Mr. Raghuteji tries to use mostly local and easily available materials so the construction cost is directly reduced as well and he constructs his home with many different construction techniques such as jali wall, brick Jali wall, filler slabs, funicular slab, Mangalore tiles for compound wall, exposed brickwork, vault roof, etc. Fig. 1 shows the construction of Jali wall, Brick Jali wall instead of normal brick masonry. When you upstairs to this home, the beautiful terracotta brick Jali wall is the first thing that greets you. This brick jali fence provides privacy from the street. In addition, its design allows natural ventilation to flow through the side yard and into the home. These jali walls help to control the internal temperature.

Fig. 2 shows filler slab technology is an innovative and cost- effective technology where the dead load of the slab is reduced by replacing the concrete with filler material such as clay pots, Mangalore tiles (Fig 1 ceiling), etc. The filler slab decreases the carbon footprint. Filler slabs with the right patterns improve the ceiling's appearance as well as cut the cost of plastering or Plaster of Paris (pop) ceiling.

Fig. 2 Filler slab

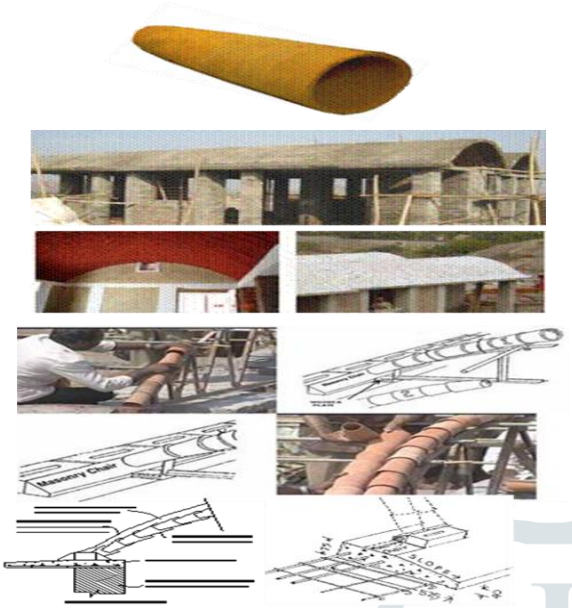
Figure 3 shows construction of funicular slab. Funicular slab technology is an innovative and cost-effective technology where the concrete is nearly replaced by bricks. This roof is one such compression structure, which ensures conservation of natural resources by utilizing waste materials effectively and optimizing the use of expensive steel and cement used in the conventional RCC roof. Provides roofing at a lower cost.

Fig. 3 Funicular slab

Mangalore tiles are a type of roof tile, this tile material is very easily available in the market at a lower cost. It is made up of clay. Fig. 4 shows, they used these tiles in compound walls instead of 230mm brick walls so the cost of constructing a compound wall is much less. These red-colored clay tiles are quite famous and are exported to all the corners of the world. They are unique and are made available in different shapes and sizes depending on the users' needs. Each technique or material used while constructing his house offers unique benefits, from cost savings to environmental friendliness, improved aesthetics, and enhanced structural strength.

Fig. 4 Compound wall

2. Centre of Science for Villages (CSV), Wardha



The Centre of Science for Villages (CSV) in Wardha, India, was founded in 1976 by Late Dr Devendra Kumar. The center aims to develop and demonstrate ecologically sound, economically viable, and socially just rural technologies. It promotes rural non-farm activities, provides a forum for rural innovation, collects and documents scientific and technological information, and undertakes adaptive R&D to adapt technology to local conditions and skill levels. Fig. 5 shows the process and design of the Vault Roof using burnt clay conical tile, which is permanently insulated and suitable for disaster-prone areas like floods and earthquakes. The roof is quick to build, comfortable to live, and low in cost. The roof of CSV houses is cost-effective, environmentally friendly, and uses locally available mud as a basic building material. It generates employment and is eco-friendly, as it can be recycled or reused, unlike other materials.

Fig. 5 Process of Vault Roof

3. Hands-on workshop, Sacred Groove Auroville

Sacred Groves, Auroville is a community in India that aims to create an ecologically balanced and sustainable model of construction. They prioritize creating jobs for locals, assisting architects and engineers in better understanding the materials they work with and striking the ideal balance between a building and its natural surroundings. They provide interactive workshops led by their knowledgeable faculty on a range of construction techniques. The Sacred Groves, provides hands-on workshops on various construction techniques, including Adobe Bricks, Cob Wall, Mud Plaster, Lime Plastering, Earth Crete, and Wattle & Daub, taught by experienced faculty.

1. Adobe bricks: It is also known as mud bricks, are traditional building materials made from clay, sand, straw, and other organic materials, typically sun-dried or air-dried, rather than fired in a kiln.
2. Cob wall: Cob walls are a traditional building technique using clay-rich soil, sand, and straw to construct walls. They are eco-friendly, using readily available materials, reducing carbon footprint, and offering excellent thermal properties. Cob construction has been used in various cultures and regions throughout history and is a popular choice for alternative construction projects due to its unique combination of aesthetic appeal, sustainability, and thermal performance.
3. Mud plaster: It is also known as earthen or clay plaster, and is a traditional, eco-friendly building material used in various cultures worldwide. It is a finishing layer applied to interior and exterior walls, providing protection and aesthetic appeal. Made from clay-rich soil, sand, and straw, it is often used in conjunction with other sustainable building techniques like cob, adobe, or straw bale construction to create holistic, eco-friendly structures. Mud plaster has seen a resurgence in contemporary sustainable and natural building practices due to its lower environmental impact.
4. Lime plastering: It is a traditional, eco-friendly building technique that uses lime, sand, and water to create plaster for walls, ceilings, and other surfaces. It is known for its durability, breathability, and versatility, making it useful in conservation and restoration of historic and heritage buildings. Lime plaster is appreciated for its sustainability, aesthetic qualities, and performance in various environmental conditions, making it a valuable and sustainable building technique.
5. Earth Crete: It is also known as rammed earth or compressed earth, is a sustainable and eco-friendly construction material made by compacting earth into solid, durable building blocks or walls. This versatile technique, which combines earth's natural availability with compaction, is suitable for various architectural styles and purposes, from homes to commercial buildings. Its energy-efficient properties make it an attractive choice for those seeking eco-friendly building options, making it a versatile and sustainable choice for construction.
6. Wattle and daub: It is a traditional wall construction technique in medieval Europe, known for its earthquake resistance. The wattle is a woven wooden skeleton, while the daub is a sticky mixture of subsoil and fibers like rice straw and rice husk. This versatile and sustainable method offers a blend of natural aesthetics, thermal performance, and durability.

Sacred Groves in Auroville, India, promotes ecologically balanced construction, creating jobs, and educating architects, engineers and students about materials, aiming to balance building with the environment.

IV. Conclusion

From the above case studies, it concludes that instead of traditional construction techniques such as RCC slabs, normal brick masonry, plastering, etc. we can use filler slabs, funicular slabs, vault roofs, jali walls, mud or lime plastering, etc. that help in reducing the construction cost. The period as well as the material required for the construction is reduced. The initiative of affordable housing

promotes environmentally friendly construction, fostering job creation and educating architects, engineers, and students about materials to promote sustainable building practices.

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