ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26nov972

Cost Effective Construction Techniques in Residential Housing

Mehraj Ahmed[1]; Neeta Mishra[2]

[1]Student of Department of Architecture, Amity University Chhattisgarh, Raipur, India
[2]Associate Professor of Department of Architecture, Amity University Chhattisgarh, Raipur, India

Publication Date: 2026/11/25

Abstract: The growing demand for affordable housing in India, alongside increasing material and labour costs, has encouraged the examination of construction techniques that use resources more efficiently. This paper comparatively evaluates four techniques for residential construction: Rat-Trap Bond Masonry, Filler Slab Construction, Compressed Stabilised Earth Blocks (CSEB), and Fly-Ash Bricks/Blocks. The study uses a document-based research approach, drawing on published literature, technical guidance and three residential case studies—Belapur Housing in Navi Mumbai, Aranya Low-Cost Housing in Indore, and Vikas Community in Auroville. The techniques are assessed against five parameters: cost, material use, construction method, performance and applicability. The review indicates that Rat-Trap Bond Masonry may reduce brick and mortar consumption; filler slabs may reduce concrete use and dead load when structurally designed; CSEB can make use of suitable local soil; and fly-ash products can utilise an industrial by-product. However, these benefits depend on design, material quality, skilled workmanship, transport and quality control. Preliminary Raipur material prices are available, but they are not supplier-verified and do not establish completed wall or slab costs. Therefore, no reliable local percentage saving can be claimed. The paper concludes that these techniques may be selectively applicable to housing in Chhattisgarh, subject to technical testing and like-for-like cost assessment.

Keywords: *Affordable Housing; Cost-Effective Construction; Rat-Trap Bond Masonry; Filler Slab; CSEB; Fly-Ash Bricks; Chhattisgarh.*

How to Cite: Mehraj Ahmed; Neeta Mishra (2026) Cost Effective Construction Techniques in Residential Housing. *International Journal of Innovative Science and Research Technology*, 11(11), 1440-1446. https://doi.org/10.38124/ijisrt/26nov972

I. INTRODUCTION

Affordable housing is still a major issue in India. The construction cost of any housing depends on the cost of materials, availability of labour, transportation and the type of building required to ensure safety and durability. However, affordable housing is not simply about using the cheapest materials. It is a matter of considering the design, building system, material efficiency, structural performance, maintenance and potential for the household to improve their house [1] [2].

Traditional burning clay brick masonry and reinforced cement concrete (RCC) are commonly used construction methods but can offer an opportunity to review different construction techniques. This paper has looked at four different techniques. Rat-Trap Bond Masonry and CSEB for walls; Filler Slab Construction for roofs and fly-ash bricks/blocks for masonry units.

This research looks at how these different techniques might be applicable to housing in residential properties within Chhattisgarh. This does not necessarily mean that one technique will be cheaper than the others but highlights when they could be considered. Information needed to give an accurate comparison of costs is also identified.

II. LITERATURE REVIEW

- *Cost-Effective Housing and Construction Technology*

Prior research has shown that low-cost housing entails the use of suitable design, materials and construction technology that ensures resource efficiency. The performance of the building in economic terms relies on the entire construction system and not on the price of different construction materials [1], [2]. Research about low-cost housing technologies in India indicates that local availability, craftsmanship and construction implementation practices play an important role as well [3], [4].

- *Rat-Trap Bond Masonry*

The Rat-Trap Bond Masonry is defined as a construction technique where bricks are laid in such a way that a cavity is formed in the wall. This technique leads to less consumption of bricks and mortar than conventional techniques applied to a similar construction. Besides, the cavity has an impact on the thermal behaviour of the wall. Proper bonding, details of wall construction, as well as craftsmanship should be taken into consideration, and the technique should not be replaced with

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26nov972

any conventional techniques without additional calculations [5], [6].



Fig 1 Rat Trap Bond Construction
Source: https://www.civilconcept.com/rat-trap-bond/

➢ *Filler Slab*

Filler slabs are a type of RCC roof where appropriate filler units are placed between the ribs that have been constructed using reinforced concrete. This will reduce the amount of concrete required however care must be taken to ensure the design is correct so that the slab can span and take the loads. The ribs should be at the correct spacing and the filler units should be well arranged. To make the design cost effective the filler units shouldn't be too expensive. The cost saving would depend on how much concrete, steel, formwork, labour and finishing was needed [2] [7].



Fig 2 Filler Slab Construction
Source: https://studiodcode.com/filler-sab.html?utm_source

➢ *Compressed Stabilised Earth Blocks*

The blocks are manufactured by compacting an appropriate soil and mixing in stabilisers (such as cement/lime) and allowing them to cure. Advantages could include less use of fired masonry units as local earth can be used. The blocks must be manufactured from an appropriate soil, correct amount of stabiliser, compacted and properly cured. Investigations into using earthen materials show they can have cost-effective potential, however they need to be investigated for the area in question [8] [9].



Fig 3 Compressed Stabilized Earth Block Construction
Source: https://www.earth-block.com/

➢ *Fly Ash Bricks/Blocks*

Blocks/bricks that are manufactured with fly ash mixed with bonding materials and aggregates. These can be an alternative to burnt clay bricks by using an industrial waste product. The blocks must be of an appropriate quality with adequate compressive strength, water absorption, consistent size and certified. The price must take into account transport and laying [10] [11].



Fig 4 Fly Ash BrickS/Blocks Construction
Source: https://www.ascolite.in/blog/aac-and-fly-ash-blocks-sustainable-solutions-for-modern-construction/

III. RESEARCH METHODOLOGY

This research uses qualitative, comparative and documentary methods. Information was gathered from existing research, technical documents and case studies. New laboratory tests, structural tests and independent measurements of construction quantities were not performed. An analysis was conducted to compare characteristics and determine which data must be included in a future detailed cost study.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26nov972

➢ *Technique & Case Study Selection*

Four techniques were selected as they cover key aspects of residential construction and use differing materials/resources. Rat-Trap Bond Masonry, CSEB and fly-ash bricks/blocks were selected for their potential in walls. Filler Slab Construction was selected for its potential in roof slabs. Three case studies were selected to understand how affordable housing can be planned and how alternative materials can be used. These were Belapur Housing (Navi Mumbai), Aranya Low-Cost Housing (Indore) and Vikas Community (Auroville).Before you begin to format your paper, first write and save the content as a separate text file. Keep your text and graphic files separate until after the text has been formatted and styled. Do not use hard tabs, and limit use of hard returns to only one return at the end of a paragraph. Do not add any kind of pagination anywhere in the paper. Do not number text heads-the template will do that for you.

➢ *Evaluation Criteria*

Each construction method was evaluated on various criteria, these are as follows, 1) Cost of the construction method, including materials, labour, transport, tools, mortars, reinforcement, formwork and waste. 2) Materials available. 3) Construction method and skill required. 4) Structural, Thermal and Durability properties. 5) Appropriate for residential construction in the local area. The costs are compared directly, based on costs per m2 of finished wall/roof slabs.

➢ *Local Material Costs*

The following costs are indicative of the costs you would expect to pay for the materials in Raipur in 2026. These costs are not verified by supplier quotes. The quantities are not fully detailed therefore they do not include labour, transport, taxing or finishing. This means that they cannot be used to calculate the savings as a percentage or overall cost of construction.

IV. COMPARATIVE ASSESMENT OF THE FOUR TECHNIQUE

Each of these techniques has a specific role and cannot really be compared. A brief summary of each technique is given below showing how they could be used to advantage and their main criteria.

Table 1 Comparative Analysis of Selected Residential Case Studies

Technique	Main Application	Potential Benefit	Key Requirement / Limitation
Rat-Trap Bond Masonry	Wall construction	May reduce brick And Mortar Use; cavity may improve thermal resistance.	Skill masons. Correct bonding and structural detailing.
Filler Slab	RCC roof slab	May reduce concrete volume and slab dead load.	Structural design, reinforcement detailing and suitable filler units.
CSEB	Wall construction	Can use suitable local soil and reduce transport of masonry units.	Soil testing, stabilisation, compaction, curing and moisture protection.
Fly-Ash Brick Blocks	Wall construction	Uses fly ash as an input and offers an alternative masonry unit.	Verified product strength, water absorption, quality and supply availability.

Rat-Trap Bond Masonry will be most appropriate when cavity walls can be constructed and skilled masons are available. Filler slabs are only relevant to roof design and therefore require engineering design for the span and loading. CSEB could be appealing if suitable soils and block making facilities are available locally. Fly-ash products could be considered if reliable, tested products can be obtained and at a competitive delivery price.

➢ *Indicative material prices in Raipur*

Table 2 Material Prices in Raipur

Material	Indicative rate	Unit
Clay/mud filler pots	₹100–270	per piece
Terra cotta filler units	₹180–330	per piece
Precast concrete filler unit	about ₹40	per sq. ft.
CSEB	₹16–45	per piece
Fly-ash bricks	₹3–7	per piece
Interlocking/hollow fly-ash bricks	₹3–5	per piece
Special fly-ash blocks	₹5–10	per piece
Red clay bricks	₹6–9	per piece
AAC Blocks	₹67–103	per piece

The below costs have been taken from the initial Raipur Case Study review. All prices have not been confirmed by suppliers. Different units, sizes, specifications, taxes and delivery terms may apply. Prices for individual units shouldn't be directly compared as they will vary based on individual unit size, quantity per m 2 and specification. Costs are not indicative to total building costs.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26nov972

V. CASE STUDY

➢ *Belapur Housing, Navi Mumbai*

Belapur Housing Scheme was commissioned by CIDCO and designed by Charles Correa. It was developed between 1983-1986. The housing scheme accommodates approximately 550 households (approx. 100 households/ha) across an area of 5.4ha. Plots (approx. 45-75m²) are designed for growth within households. The layout is medium rise with communal courtyards and social spaces. Cost per dwelling within the scheme in previous years varied according to income level; costing approximately ₹20,000 (low), ₹30000-50000 (middle) and approx. ₹180,000 (higher). These costs cannot be directly compared to current costs.

Table 3 Belapur Housing: Project Characteristics and Planning Approach

Parameter	Documented Data
Architect/ client	Charles Correa / CIDCO
Period	1983-1986
Site Area	Approx.5.4 ha
Planned housing	Approx. 550 families
Plot range	Approx. 45-75 m^2
Strategy	Low-rise clusters, courtyards, individual plots, incremental expansion
Cost data	Historical unit cost ranges; not current comparable rates
Research relevance	Planning, density, incremental

This scheme demonstrates that it is possible to provide affordable housing via good design and incremental development but does not specifically demonstrate cost reductions from choice of walling/roofing materials.



Fig 5 Belapur Housing, Navi Mumbai
Source: https://hiddenarchitecture.net/belapur-housing/

➢ *Aranya Low Cost Housing, Indore*

Aranya was designed by the Vastu-Shilpa Foundation (led by Balkrishna V. Doshi) in 1989, with an overall site area of approximately 85 ha. The project was intended to house 6500 homes for a total of 60,000 people. A central commercial boulevard leads to 6 sectors, each with a linear park. House types were provided according to income levels in this site and service development. At the lowest income level, houses were constructed with a plot, plinth, service block and single unit. Additional units could be added by the inhabitants.

Table 4 Aranya Housing: Project Characteristics and Housing Strategy

Parameter	Documented Data
Architect / organisation	Balkrishna v.doshi/ Vastu-Shilpa Foundation
Client	Indore Development Authority
Completion	1989
Net planning area	Approx. 85 ha
Planned dwellings	Approx. 6500
Planned Population	Approx. 60000
Housing Strategy	Site-and-service and incremental development
Research relevance	Affordability through land, services and phasing

Affordable housing and incremental development are evident. Information regarding costs in relation to these four methods is not greatly provided.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26nov972



Fig 6 Aranya Low Cost Housing, Indore
Source: https://www.re-thinkingthefuture.com/case-studies/a5290-aranya-low-cost-housing-by-b-v-doshi-low-cost-urban-housing/#google_vignette

➢ *Vikas Community, Auroville*

The Vikas community was constructed in stages between 1992 and 1998, by the Auroville Earth Institute. The building was designed by Satprem Maïni. It comprises 23 dwellings and common areas. In total there is 1448m² of floor space across 10000m² of land. The 3rd block contains 13 dwellings, spanning 4 floors (with a basement). There is 819m² of floor space. The earth from the basement was used to make CSEB blocks. The foundation system is stabilised rammed earth, walls are constructed from 240mm thick CSEB blocks. Composite beams and lintels have been used, as well as CSEB vaults and domes. Stabilisation has been achieved using ~5% cement by weight.

Table 5 Vikas Community: Project Characteristics and Construction Systems

Parameter	**Documented Data**
Architect / team	Satprem Maïni / Auroville Earth Institute
Construction period	1992–1998
Apartments	23
Carpet area	Approx. 1,448 m²
Plot area	Approx. 10,000 m²
Third block	13 apartments; 4 floors above basement
CSEB wall thickness	Approx. 240 mm
Stabilisation	Approx. 5% cement by weight

This building clearly demonstrates application of CSEB, recycling of soil and earth based systems. However, full verified cost information could not be found. Therefore, an analysis is conducted on the construction system and material use, and not savings percentage.



Fig 7 Vikas Community, Auroville
Source: https://auroville.org/page/earth%20institute-low-carbon-award-marrakech

VI. DISCUSSION

The comparative analysis shows that not only does the material efficiency effect cost effectiveness, but the method of construction might increase the demand for labour, machinery, testing, transportation and supervision. For example although using a filler slab will reduce the volume of concrete required, it needs to be properly reinforced and formed. CSEB can utilise local soil, however if the soil is not suitable or curing times are insufficient it can impact upon performance. Rat-Trap Bond Masonry can lead to material savings, however skilled labour is needed. Fly-ash products require quality assurance and reliable supply.

The three case studies demonstrate how other factors can lead to cost effective housing. Belapur and Aranya have good planning, shared utilities, serviceable plots and phased building. Vikas Community has used natural materials and a hybrid system. This suggests that housing should be designed with a strategy in mind.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26nov972

From the four methods of construction Chhattisgarh can utilise Rat-Trap Bond Masonry for suitable walls, filler slabs for well designed roof spans, CSEB if local soil has been tested and found suitable and finally fly ash masonry if certified products can be sourced at a competitive price for delivery. The final decision should take into consideration exposure to the climate, structural safety, local skills, distance for delivery, durability and maintenance.

VII. FINDING AND LIMITATIONS

➢ *Key Findings:*

- Rat-Trap Bond Masonry can reduce the amount of brick and mortar used but depends on quality of bond, skilled labour and structural detailing.
- Filler Slab Construction can reduce the amount of concrete and dead load used but depends on proper design of filler and RCC.
- CSEB can utilise local soil, however care needs to be taken to ensure the soil is tested, stabilised, compacted, cured and protected from moisture.
- Fly-ash bricks/blocks can utilise industrial waste but depend on quality of the product (needs to be proven) and availability locally.

Case studies show that availability of affordable housing also depends on how the housing is planned, built incrementally, how much it is serviced and what materials are used.

➢ *Limitations of Study:*

Not all case studies had full BOQs availab from published information and therefore costs were not consistent. Each project varied due to location, size, design and construction time. Price observations from Raipur were initial observations and therefore may not be accurate. Labour, transport, plant, reinforcement, formwork, finishes and wastage were not fully quantified. No independent lab testing was carried out and so no long term monitoring of performance. Findings are comparative and cannot be taken as proven to save % of cost.

VIII. CONCLUSION AND FUTURE SCOPE

This paper has discussed four alternate construction methods to produce more resource efficient housing using Rat-Trap Bond Masonry, Filler Slab Construction, CSEB and Fly-Ash Bricks / Blocks. It is difficult to determine what is the most cost-effective as it depends on the type of element being used, design requirements, quality, availability, transport, skilled labour and supervision. The case studies have shown that cost effectiveness will depend on the layout of housing, incremental development, communal spaces and what local materials are available. Residential projects within Chhattisgarh should be considered on an individual basis with technical input. By comparing costs with the same type of walls/slats, accurate quantities, up to date quotes from suppliers, cost effectiveness can be established.

Further research can be conducted as a survey can be carried out on suppliers in Raipur to get prices, a detailed BOQ, soil samples, CSEB strength and water absorption tests can be undertaken, comparison of structural designs of filler slabs and Rat-Trap Bond. Life cycle analysis can also be undertaken looking into maintenance and durability. Demonstration projects will help to establish how long it will take to build, how much skilled labour is needed and final costs.

REFERENCES

[1]. A. G. Warrier, P. Tadepalli, and S. Palaniappan, “Low-cost housing in India: A review,” IOP Conference Series: Earth and Environmental Science, vol. 294, 012092, 2019, doi: 10.1088/1755-1315/294/1/012092.
[2]. V. W. Y. Tam, “Cost effectiveness of using low cost housing technologies in construction,” Procedia Engineering, vol. 14, pp. 156–160, 2011, doi: 10.1016/j.proeng.2011.07.018.
[3]. M. Srivastava and V. Kumar, “The methods of using low cost housing techniques in India,” Journal of Building Engineering, vol. 15, pp. 102–108, 2018, doi: 10.1016/j.jobe.2017.11.001.
[4]. United Nations Industrial Development Organization, Environment Friendly Indian Building Material Technologies for Cost Effective Housing. UNIDO, 2006.
[5]. N. Sengupta, “Evaluation of appropriateness of rat-trap bond wall and filler slab roof in housing sector in India,” doi: 10.36375/prepare_u.a16.
[6]. S. Sinha, S. Mishra, P. Kumar, and S. Saurabh, “Sustainable low-cost housing using cost effective construction technology ‘Rat Trap Bond Masonry’ and ‘Filler Roof Slab’ in Bihar,” International Journal of Engineering Research & Technology, vol. 13, no. 7, pp. 1780–1785, 2020, doi: 10.37624/IJERT/13.7.2020.1780-1785.
[7]. Kerala State Nirmithi Kendra, “Filler slab,” 2018.
[8]. A. Raj et al., “Building a sustainable future from theory to practice: A comprehensive PRISMA-guided assessment of compressed stabilized earth blocks (CSEB) for construction applications,” Sustainability, vol. 15, no. 12, 9374, 2023, doi: 10.3390/su15129374.
[9]. Y. Kulshreshtha et al., “The potential and current status of earthen material for low-cost housing in rural India,” Construction and Building Materials, 2020, doi: 10.1016/j.conbuildmat.2020.118615.
[10]. S. Kumar, “A perspective study on fly ash-lime-gypsum bricks and hollow blocks for low-cost housing development,” Construction and Building Materials, 2002, doi: 10.1016/S0950-0618(02)00034-X.
[11]. Bureau of Indian Standards, IS 12894:2002—Pulverized Fuel Ash-Lime Bricks—Specification, 2002.
[12]. Charles Correa Foundation, “Incremental housing: Belapur, Navi Mumbai (1983–86),” project documentation, 2022.
[13]. Centre Canadien d’Architecture, “Balkrishna Doshi’s Aranya,” project documentation, 2018.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26nov972

[14]. Aga Khan Award for Architecture, “Aranya Community Housing: Local on-site review report,” Archnet publication record, 1995.
[15]. The Energy and Resources Institute, “Energy-efficient buildings: Vikas Apartments, Auroville,” technical publication.
[16]. Auroville Earth Institute, Vikas Community in Auroville: Towards a Holistic Development—A Case Study, revised 2004.