

IMPACT OF PREFABRICATION AND MODULAR CONSTRUCTION ON PROJECT SCHEDULE AND COST PERFORMANCE IN AFFORDABLE HOUSING SCHEMES

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Abstract

The construction industry is under increasing pressure to provide affordable housing within shorter time periods and controlled project costs. Traditional construction methods often involve long construction periods, high labour requirements, material wastage, and delays caused by weather and site-related problems. This study examines the impact of prefabrication and modular construction on project schedule and cost performance in affordable housing schemes. The study is based on a review of published research, document analysis, comparative analysis, and selected Indian and international case studies. The study compares traditional and prefabricated/modular construction methods based on construction time, project cost, productivity, quality, and material waste. The findings show that prefabrication and modular construction can reduce construction time by allowing factory production and site activities to take place simultaneously. These methods also improve productivity, provide better quality control, and reduce material waste. Although the initial investment can be higher due to factory production, transportation, and specialized equipment, overall cost performance can improve through lower labour requirements, reduced waste, faster completion, and better resource utilization. The case studies also show successful applications of these methods in affordable housing and residential projects in India and other countries. The study concludes that prefabrication and modular construction can provide a faster, more efficient, and sustainable alternative to traditional construction for affordable housing. Proper planning, coordination, transportation management, skilled manpower, and technological support are required to achieve the expected benefits.

Keywords: Prefabrication, Modular Construction, Affordable Housing, Construction Time, Cost Performance, Productivity, Quality, Material Waste, Sustainable Construction

1. Introduction

The construction industry plays an important role in providing housing, infrastructure, and employment. At the same time, the demand for affordable housing is increasing, especially in growing urban areas. Traditional construction methods are still widely used, but they often require a large amount of labour, take longer to complete, and may generate higher material waste. Delays in construction can also increase project costs and affect the timely delivery of housing projects. Because of these issues, there is a growing interest in faster and more efficient construction methods.

Prefabrication and modular construction have emerged as practical alternatives to conventional construction. In prefabrication, building components such as walls, slabs, beams, and other elements are manufactured in a controlled factory environment and then transported to the construction site. Modular construction takes this approach further by producing complete or partly complete building modules that can be assembled at the site. These methods can reduce the amount of work carried out directly at the site and make the construction process more organized.

1.1 Prefabrication and Modular Construction in Affordable Housing

Affordable housing requires construction methods that can control both time and cost without reducing the quality of the final building. Prefabrication can support this requirement because many components can be produced repeatedly using standardized designs. This can improve production speed, reduce material losses, and make quality control easier. Adeyemi et al. (2024) reported that prefabricated and modular systems can reduce construction time and cost while supporting flexible and scalable housing designs.

Modular construction is also useful when a large number of similar housing units need to be delivered within a limited period. Antunes et al. (2024) highlighted the potential of modular construction to provide quality and affordable housing while reducing project time and cost. Similar findings have been reported in studies related to prefabricated housing, where controlled manufacturing and faster assembly have helped improve overall construction efficiency.

1.2 Impact on Project Time and Cost

Project schedule and cost are two major measures of construction performance. In traditional construction, many activities are carried out sequentially at the site. This can create delays when there are problems related to labour availability, weather, material supply, or site conditions. Prefabrication changes this process by allowing factory production and site preparation to take place at the same time. As a result, the total construction period can be reduced.

Sari and Dinata (2022) found a significant reduction in construction time through the use of prefabrication, while their study also reported cost savings compared with conventional construction. Xu (2021) identified factors such as design planning, coordination, supply chain management, and communication as important influences on the time performance of prefabricated projects. These findings show that the benefits of prefabrication depend not only on the technology itself but also on proper planning and project management.

1.3 Need for the Present Study

Although prefabrication and modular construction offer several advantages, their adoption is still affected by challenges such as higher initial investment, transportation requirements, coordination problems, limited skilled manpower, and supply chain issues. Abdul Nabi and El-adaway (2021) also highlighted that risks related to modular construction can influence

both cost and schedule performance. Therefore, it is important to study the actual performance of these methods instead of considering only their expected benefits.

The present study focuses on the impact of prefabrication and modular construction on project schedule and cost performance in affordable housing schemes. The study compares these methods with traditional construction and also examines their productivity, quality, and waste reduction benefits. Selected case studies are used to understand how these methods have performed in practical projects. The overall purpose is to determine whether prefabrication and modular construction can provide a faster, more economical, and efficient approach for affordable housing projects.

2. Review of Literature

Albaadani et al. (2025) found that modular and prefabricated construction can improve productivity and sustainability in urban housing projects. The study reported reductions in construction waste, project delivery time, and overall cost. The findings suggest that prefabrication can support faster and more affordable housing development.

Itendrakumar (2026) compared prefabricated construction with traditional construction and found a major difference in project completion time. Prefabrication helped reduce construction duration and also improved construction quality. The study suggests that selecting an appropriate level of prefabrication is important for achieving better project performance.

Singh (2023) compared prefabricated and conventional construction for economically weaker sections. The study found that prefabrication can reduce embodied energy and carbon emissions, although its initial cost may be higher. The findings suggest that prefabrication becomes more economical when used for large-scale housing projects.

Shinde and Patil (2025) studied the time and cost performance of modular construction using Primavera P6. The study found that modular construction reduced project duration because off-site and on-site activities could be carried out together. However, the study also reported an increase in project cost, showing that transportation and other implementation costs need to be managed carefully.

Jain and Bhandari (2022) examined prefabricated construction technology for affordable housing in India. The study found that prefabrication can support faster housing delivery and sustainable construction. However, limited adoption and resistance from stakeholders remain important barriers.

Grover and Chhabra (2024) discussed the growing role of prefabrication in the Indian construction sector. The study highlighted its potential to meet increasing housing demand and improve construction efficiency. At the same time, social acceptance and practical issues need to be considered during implementation.

Padmasree and Niji (2023) identified planning problems, financial issues, and design changes as major factors affecting construction project performance. Although the study does

not focus directly on prefabrication, its findings provide a useful comparison with traditional construction and show how better planning and standardization can reduce project problems.

Bhayani et al. (2024) compared prefabricated residential modules using different construction materials. The study found potential benefits in cost and energy efficiency but also identified technical issues such as thermal bridging and cracking. This shows that prefabrication still requires proper technical design and quality control.

Arjun et al. (2022) studied prefabricated houses from the perspective of sustainable housing and user acceptance. The study highlighted affordability, quality, and durability as important factors influencing acceptance. The findings suggest that technical efficiency alone is not enough; user confidence also affects the adoption of prefabricated housing.

Sharma et al. (2024) reviewed prefabricated building construction in India and identified both opportunities and challenges. The study highlighted faster construction, improved efficiency, and sustainability as major benefits, while limited adoption and implementation barriers remain concerns. The findings indicate a need for more practical studies on large-scale prefabricated housing projects.

Adeyemi et al. (2024) found that modular and prefabricated construction can reduce construction time and cost while improving quality and design flexibility in affordable housing. The study also highlighted standardization and scalability as useful features for large housing schemes. Regulatory barriers and public perception were identified as challenges to wider adoption.

Roscetti et al. (2024) examined prefabrication and modular construction as solutions for affordable and temporary housing. The study found that modular units can be durable, transportable, and quickly assembled. However, funding, design limitations, and transportation requirements can influence project success.

Parisi and Donyavi (2024) examined modular construction as a response to the housing crisis in the UK. The study found that modular construction can provide faster, cost-efficient, and sustainable housing compared with traditional methods. The findings support its potential for addressing large housing requirements.

Sari and Dinata (2022) studied prefabrication in a high-rise building project and found significant improvements in construction time and cost. The study reported around 7% cost savings and a major reduction in construction duration compared with traditional construction. Improvements in quality, material efficiency, and worker safety were also observed.

Peng and Kim (2022) compared the Design-Manufacture-Construct method with the traditional Design-Bid-Build approach. The study found better cost performance with the integrated construction approach, although the difference in time performance was not statistically significant. The findings still indicate the potential of integrated construction methods for improving project efficiency.

Antunes et al. (2024) found that modular construction can be a suitable alternative for providing affordable and quality housing. The use of prefabricated systems can reduce construction time and cost while addressing labour shortages. The study supports the use of modular construction where fast housing delivery is required.

Kim (2025) reviewed the current development and future challenges of prefabricated and modular residential construction. The study identified faster construction, cost savings, quality control, and sustainability as major benefits. It also highlighted policy, technological, and industry-related challenges that need to be addressed.

Abdul Nabi and El-adaway (2021) examined the risks affecting cost and schedule performance in modular construction. The study found that modular construction can provide better schedule predictability and quality, but supply chain, coordination, and planning problems can reduce these benefits. Effective risk management is therefore important for successful implementation.

Ganiron and Almarwae (2014) compared prefabricated housing components with traditional construction methods. The study found that prefabricated components can reduce construction cost and time while maintaining acceptable quality and efficiency. The findings support the use of prefabrication for low-cost housing.

Xu (2021) reviewed the factors affecting the time performance of prefabricated construction projects. The study identified design planning, coordination, supply chain management, collaboration, and human resources as important factors. The findings show that good planning and coordination are necessary to achieve the expected time-saving benefits of prefabrication.

3. Objective of the Study

- To assess the impact of prefabrication and modular construction on project time.
- To evaluate the effect of these methods on project cost performance.
- To identify the benefits and challenges of prefabricated and modular construction systems.
- To compare prefabricated/modular construction with traditional construction methods.
- To review case studies to understand the practical outcomes of these techniques.

4. Methodology

Research Design

This study uses a descriptive and comparative research design to examine the impact of prefabrication and modular construction on affordable housing. The methods are compared with traditional construction mainly in terms of time, cost, productivity, quality, and waste reduction.

Data Collection

The study is based entirely on **secondary data** collected through literature review and document analysis. Research papers, conference papers, books, reports, and published case

studies related to prefabrication, modular construction, and affordable housing were reviewed.

Data Analysis

The collected information was analysed using **descriptive and comparative analysis**. Findings from different studies and case studies were compared to understand the differences between traditional and prefabricated/modular construction methods.

Case Study Analysis

Selected Indian and international case studies were reviewed to understand the practical application of prefabrication and modular construction. The case studies were examined mainly for project time, cost, quality, productivity, and overall construction efficiency.

Reliability of Data

The study uses information from multiple published and relevant sources. Comparing findings from different studies and documented projects helps provide a balanced understanding of the performance of prefabrication and modular construction in affordable housing.

5. Case Study Analysis

To understand the practical application of prefabrication and modular construction, eight case studies were reviewed, including six Indian examples and two international examples. The cases cover residential, affordable housing, commercial, and high-rise projects. The analysis mainly focuses on construction technology, project execution, time performance, cost efficiency, quality, and the practical challenges associated with prefabricated construction.

1. Case Study 1: The Hemisphere Project, Greater Noida

The Hemisphere Project in Greater Noida is a large residential development consisting of multiple housing units and supporting facilities. The project includes G+3 and G+13 structures and uses precast construction for major structural components.

The construction system included **precast wall panels, beams, columns, slabs, and staircases**. These components were produced in a controlled environment and transported to the construction site, where they were installed using cranes and mechanical connections. This reduced the amount of conventional brickwork and on-site concrete casting.



One of the main advantages observed was faster structural installation. Since the components were manufactured before reaching the site, several activities could be carried out in parallel. The use of factory-produced components also improved dimensional accuracy, surface finish, and consistency.

However, the project also highlights the importance of proper transportation, advance planning, and skilled operators. Overall, the case demonstrates that precast construction can be effectively used for large residential developments where repeated units and faster construction are required.

Key learning: The case shows that prefabrication can improve construction speed and quality, but its success depends on proper planning, transportation, and site coordination.

2. Case Study 2: Precast Affordable Housing Project, Ghaziabad

The Ghaziabad case study represents the use of precast technology for mass affordable housing. The main objective was to construct a large number of housing units within a shorter period while maintaining acceptable quality and controlling project cost.

The project used **precast wall panels, floor slabs, structural frames, and staircases**. These components were manufactured off-site and transported to the project location for assembly. Since the housing units were repetitive, similar components could be produced in large quantities, which improved productivity and reduced construction time.



The major time advantage came from the ability to carry out factory production and site preparation simultaneously. Faster installation and reduced dependence on weather-sensitive activities helped improve the overall construction schedule. Cost benefits were mainly associated with reduced labour requirements, lower material wastage, and faster project completion.

Factory-controlled production also helped maintain uniformity in strength, finishing, and dimensions across the housing units. However, transportation of heavy panels, proper site storage, and the initial investment required for precast facilities remain important challenges.

Key learning: Repetition in affordable housing makes precast construction particularly suitable because the same components can be produced and installed efficiently on a large scale.

3. Case Study 3: Tata Steel Nest-In Prefabricated Housing System

Tata Steel Nest-In represents a different form of prefabricated construction based on **Light Gauge Steel Framing (LGSF)**. The system has been used for different building applications, including housing, site offices, schools, and temporary structures.

The system uses factory-produced steel frames, pre-finished wall panels, roofing systems, and insulated panels. Components are designed and detailed using software, manufactured with precision, transported to the site, and assembled using bolted connections. Since the system follows dry construction, there is no conventional concrete curing period for the main structural assembly.



The major benefits are faster construction, lower structural weight, easier transportation, and greater flexibility in design. The reduction in labour requirements and shorter construction duration can also help control overall project costs. However, the use of steel can make material costs sensitive to market price fluctuations.

The case also highlights sustainability benefits because steel components can be recycled and the controlled manufacturing process can reduce material waste. At the same time, skilled labour is required for installation, and awareness of the technology remains a challenge in smaller projects.

Key learning: Prefabrication is not limited to precast concrete. Steel-based systems can provide lightweight, fast, and flexible construction solutions.

4. Case Study 4: Rapid Affordable Housing Projects under PMAY, India

The Pradhan Mantri Awas Yojana (PMAY) has supported large-scale affordable housing development across several Indian cities. The case study reviewed projects using modern construction technologies to achieve faster delivery of housing units at controlled costs.

Different construction systems were used depending on the project requirements, including **precast concrete, monolithic concrete, 3D modular construction, and panel systems**. Standardized designs and repeated housing units allowed components to be produced in large quantities while site development could continue at the same time.



The case indicates that prefabrication can significantly improve construction speed in large housing programmes. Multiple buildings can be developed simultaneously, while bulk production can reduce material wastage and improve cost control. The source also notes that in some cases construction time was reduced by nearly half compared with traditional methods.

Quality consistency was another important advantage because standardized designs reduced variation between housing units. However, large-scale implementation requires skilled workers, transportation planning, technology investment, and coordination between different agencies.

Key learning: PMAY-related projects demonstrate the potential of prefabrication for large-scale affordable housing, particularly where standardization and repetition are possible.

5. Case Study 5: Prefabricated Building at Technopark, Kerala

The Technopark case demonstrates the use of prefabrication in a commercial environment. Located in Thiruvananthapuram, Kerala, the project involved a multi-storey prefabricated building within an active IT park. The main objective was to achieve faster construction while reducing disturbance to the surrounding operational environment.



The construction system used prefabricated structural components such as **precast concrete panels, structural frames, floor slabs, and staircases**. These components were manufactured under controlled conditions and transported to the site for installation.

An important advantage in this case was the reduction of site disturbance. The controlled construction process helped maintain a cleaner and more organized site, while reducing dust, noise, and the need for extensive on-site labour. Faster installation and parallel factory-site activities also improved schedule performance.

The project also showed environmental benefits through reduced construction waste and better material management. However, transportation, scheduling, and handling of large components required careful coordination.

Key learning: Prefabrication can be particularly useful in urban and operational environments where construction speed, cleanliness, and minimum disturbance are important.

6. Case Study 6: NTPC Ash-Based Modular Housing, Chhattisgarh

The NTPC case represents an approach that combines modular construction with sustainable material use. The project used **fly ash-based materials** to develop affordable and environmentally friendly housing. This makes the case particularly relevant to sustainable and low-cost construction.

The system included fly ash bricks and panels, modular interlocking blocks, and pre-designed structural units. These components were prepared and transported to the site before being assembled using interlocking systems. The construction process required comparatively less mortar and curing than conventional methods.



The use of industrial waste material provided two important benefits: it supported faster construction and reduced the environmental impact associated with conventional materials. Lower material and labour requirements also supported the cost-effectiveness of the system.

The case further highlights the sustainability potential of using industrial by-products in construction. However, limited awareness, the need for proper training, and user acceptance can affect wider adoption.

Key learning: Combining modular construction with waste-based materials can support both affordability and sustainability.

7. Case Study 7: Rapid Modular Housing – Broad Group Projects, China

China provides several examples of highly industrialized modular construction. The Broad Group has developed rapid modular construction systems in which complete building modules are manufactured in factories and then transported to the site for assembly.

The modules include structural frames, walls, floors, and internal fittings. After factory production, the completed modules are transported to the site and assembled using cranes. Because the modules are largely pre-finished before delivery, the amount of site work is significantly reduced.



The main advantage demonstrated by these projects is very high construction speed. Large-scale production, standardized modules, and parallel factory and site activities can greatly improve schedule performance. The system also reduces on-site labour requirements and helps maintain consistency in quality.

However, this approach requires strong planning and logistics management. Transportation of large modules and the initial investment required for factory-based production can create practical difficulties.

Key learning: Fully modular construction can achieve very high construction speed, but it requires an efficient industrial supply chain and strong project planning.

8. Case Study 8: 461 Dean Street, USA

461 Dean Street in New York represents the application of modular construction to high-rise residential development. The building consists of prefabricated modules that were manufactured in a factory and then transported to the site for vertical assembly.

The modules included walls, floors, and interior elements. The basic construction sequence involved factory production, transportation, vertical lifting using cranes, structural

connection, and finishing. This approach reduced the amount of conventional work required directly at the construction site.



The project demonstrates that modular construction can be applied even to high-rise buildings. It offered benefits such as reduced on-site work, improved safety, and the possibility of faster construction. However, the case also provides an important warning: planning and coordination problems can lead to delays even when advanced construction technology is used.

The main lesson from this case is that technology alone cannot guarantee project success. Coordination between the factory, transportation system, site team, and structural installation activities is essential.

Key learning: Modular construction has the potential to be used for high-rise buildings, but strong project management and coordination are necessary to achieve the expected schedule benefits.

Table 1. Summary of Case Study Findings

Case Study	Construction Approach	Main Advantage	Major Challenge
The Hemisphere, Greater Noida	Precast construction	Faster construction and better accuracy	Transportation and planning
Ghaziabad Affordable Housing	Precast mass housing	Speed and cost efficiency	Heavy component handling
Tata Steel Nest-In	LGSF prefabrication	Fast and lightweight construction	Skilled labour and steel cost
PMAY Projects	Precast/modular systems	Large-scale fast delivery	Coordination and logistics
Technopark, Kerala	Prefabricated structural system	Less disturbance and faster assembly	Scheduling and transportation

NTPC, Chhattisgarh	Ash-based modular construction	Affordability and sustainability	Awareness and acceptance
Broad Group, China	Fully modular construction	Very high construction speed	Logistics and factory investment
461 Dean Street, USA	High-rise modular construction	Reduced site work	Planning and coordination

6. Results and Discussion

Basis of Comparative Analysis

The comparative analysis was carried out to understand how traditional construction differs from prefabricated and modular construction in affordable housing projects. The comparison focused on construction time, project cost, productivity, quality, and material waste. These parameters were selected because they directly affect the overall performance of affordable housing projects.

For the time and cost comparison, a hypothetical G+3 affordable housing project consisting of **50 housing units**, with **50 m² area per unit**, was considered. The resulting total built-up area was **2,500 m²**. This common project basis was used so that both construction methods could be compared under the same conditions.

Table 2. Basis of Comparative Analysis

Parameter	Value
Number of housing units	50
Area per unit	50 m ²
Total built-up area	2,500 m ²
Building type	G+3 residential
Methods compared	Traditional and Prefabricated/Modular

Comparison of Construction Time

Construction time showed one of the clearest differences between the two methods. Based on the study assumptions, traditional construction was estimated at a productivity of approximately **5 m²/day**, resulting in a theoretical duration of **500 days** for 2,500 m². For prefabrication, productivity was taken as approximately **10 m²/day**, giving an estimated duration of **250 days** before considering the additional benefit of parallel factory and site activities.

Table 3. Comparative Construction Time

Construction Method	Estimated Time
Traditional construction	500 days
Prefabrication/Modular construction	200–250 days

Using 500 days for traditional construction and 250 days for prefabrication, the estimated time saving is:

$$\text{Time saving} = (500 - 250) / 500 \times 100 = 50\%$$

Thus, the comparative model indicates an estimated **50% reduction in construction duration** under the selected assumptions. The reduction is mainly linked to faster installation and the ability to carry out factory production and site activities at the same time.

The result is also consistent with the general finding in the reviewed literature that parallel activities and better coordination can improve the time performance of prefabricated construction.

Comparison of Project Cost

Cost performance was analysed using the same 2,500 m² project basis. For traditional construction, the study used an assumed construction cost of **₹18,000/m²**, giving an estimated total cost of **₹4.5 crore**. For prefabricated construction, an assumed cost of **₹16,000/m²** resulted in an estimated total cost of **₹4.0 crore**.

Table 4. Comparative Cost Analysis

Cost Component	Traditional	Prefabrication
Material	₹2.7 crore	₹2.6 crore
Labour	₹1.1 crore	₹0.6 crore
Equipment + overhead	₹0.7 crore	₹0.8 crore
Total	₹4.5 crore	₹4.0 crore

The estimated saving is therefore **₹0.5 crore**, or approximately **11%** compared with the traditional method. The major difference comes from lower labour requirements and reduced project duration, while equipment and overhead costs are slightly higher for prefabrication.

This result should be interpreted carefully. Prefabrication does not always have a lower initial cost. Factory production, transportation, equipment, and specialized planning can increase some cost components. The benefit becomes more visible when repeated units and large-scale housing projects are considered.

Productivity Comparison

Productivity was compared using area productivity and site labour productivity. With the same 2,500 m² project, traditional construction produced an estimated **5 m²/day**, while prefabrication produced approximately **10 m²/day**. This represents a 100% increase in area productivity under the study assumptions.

Site labour productivity was also higher for prefabrication. The analysis considered an average site workforce of 60 workers for traditional construction and 30 workers for prefabricated construction. The calculated labour productivity was approximately **0.083 m²/labour/day** for traditional construction and **0.333 m²/labour/day** for prefabrication.

Table 5. Productivity Comparison

Parameter	Traditional	Prefabrication
Project duration	500 days	250 days
Average site labour	60 workers	30 workers
Area productivity	5 m ² /day	10 m ² /day
Labour productivity	0.083 m ² /labour/day	0.333 m ² /labour/day

The improvement is mainly related to factory-controlled production, repetition, standardization, reduced waiting time, and lower rework.

Quality and Waste Reduction

Quality performance also showed an advantage for prefabrication. Traditional construction is strongly dependent on site conditions, worker skills, supervision, and weather. These factors can create differences in surface finish, alignment, curing, and overall consistency.

Prefabricated components are manufactured in a controlled environment using standardized processes and quality checks. This can improve dimensional accuracy, surface finish, consistency, and reduce human errors. The comparison in the study therefore indicates better quality control and greater uniformity with prefabrication.

Material waste was also lower in the prefabrication system. Traditional construction can generate waste because of material breakage, poor storage, excess material use, and rework. Factory-based production allows more accurate material quantities, controlled handling, and better use of leftover materials.

Table 6. Quality and Waste Comparison

Parameter	Traditional Construction	Prefabrication
Quality control	Limited	High
Quality consistency	Variable	Uniform
Material waste	High	Low
Rework	Frequent	Minimal
Material handling	Less controlled	Controlled
Resource efficiency	Lower	Higher

Overall Discussion

The results of the comparative analysis indicate that prefabrication and modular construction have clear advantages in terms of **construction speed, productivity, quality consistency, and waste reduction**. Under the selected project assumptions, the construction duration reduced from 500 days to around 250 days, while area productivity increased from 5 m²/day to 10 m²/day. The estimated project cost also reduced from ₹4.5 crore to ₹4.0 crore.

At the same time, prefabrication should not be treated as an automatic solution for every project. Its performance depends heavily on early design decisions, factory capacity,

transportation, supply chain coordination, and proper site planning. The study also identifies higher initial investment and coordination requirements as important challenges.

For affordable housing, the findings are particularly relevant because these projects usually involve repeated housing units and require controlled cost and faster delivery. Repetition can make factory production more efficient, while faster completion can help reduce delays and improve resource utilization. Based on the comparative analysis, prefabrication and modular construction appear to be a suitable alternative to traditional construction for large-scale affordable housing, provided that planning and implementation are properly managed.

7. Conclusion

The study shows that prefabrication and modular construction can be useful alternatives to traditional construction, especially for affordable housing projects. The reviewed studies and case studies indicate that these methods can reduce construction time, improve productivity, provide better quality control, and reduce material wastage. Factory-based production also allows several activities to be carried out in parallel, which can help in faster project completion. These benefits are particularly relevant for large housing projects where similar units are constructed repeatedly. The comparative analysis also indicates that prefabrication can improve cost performance when the project is properly planned and implemented. Lower site labour requirements, controlled material use, reduced rework, and shorter construction periods can support overall cost efficiency. However, prefabrication should not be considered automatically cheaper than traditional construction. Transportation, factory setup, equipment, skilled manpower, and coordination can increase costs, especially in smaller projects. The case studies further show that the success of prefabricated and modular construction depends strongly on planning, logistics, design standardization, and coordination between factory and site activities. The Indian cases demonstrate its potential for affordable and large-scale housing, while the international cases show that modular systems can also be applied to more complex residential projects. Overall, prefabrication and modular construction have strong potential to improve the speed, efficiency, quality, and sustainability of affordable housing, provided that the method is selected according to project requirements and supported by proper project management.

8. Recommendation

Based on the findings of the study, the following recommendations are suggested:

- **Early Planning:** Prefabrication projects should be planned at an early stage, with proper coordination between design, manufacturing, transportation, and site activities.
- **Standardized Designs:** Standardized and repetitive designs should be preferred, especially in affordable housing projects, to improve productivity and reduce construction time.
- **Better Transportation and Logistics:** Proper transportation, storage, lifting, and installation plans should be prepared for prefabricated components.
- **Skilled Manpower:** Trained workers and experienced site teams should be provided for the proper assembly and installation of prefabricated components.

- **Government and Industry Support:** Government agencies and construction companies should promote modern construction methods through suitable policies, training, and technical support.

9. Limitations and Future Scope

Limitations

The study is mainly based on **secondary data** collected from published research papers, reports, and documented case studies. Primary field surveys, interviews, and laboratory experiments were not included. The findings therefore depend on the availability and quality of information reported in the selected sources.

Future Scope

Future studies can include **actual project data** collected directly from construction sites to provide a more detailed comparison of time and cost performance. Larger samples of affordable housing projects can also be studied to improve the reliability of the findings. Further research can examine the long-term performance, sustainability, and lifecycle cost of prefabricated and modular buildings.

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