

Feasibility Study and Scheduling Optimization of Modular Construction for Urban Housing Projects

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Abstract—Rapid urbanization and population growth in developing countries like India have significantly increased the demand for urban housing. Conventional construction methods often face challenges such as project delays, labor shortages, quality issues, and excessive material wastage, leading to increased costs and environmental concerns. Modular construction, which involves off-site fabrication and on-site assembly, presents an efficient alternative with advantages including reduced construction time, improved quality control, enhanced safety, and minimized environmental impact.

However, despite these benefits, the adoption of modular construction in India remains limited due to high initial investment, lack of skilled labor, regulatory constraints, and logistical challenges. This study aims to evaluate the feasibility of modular construction for urban housing by comparing it with traditional construction methods in terms of cost, time, quality, and sustainability. Additionally, scheduling tools such as Primavera P6 and MS Project are utilized to optimize project timelines and assess practical implementation. The findings are expected to provide insights into improving construction efficiency and supporting future housing development strategies.

Index Terms—Modular Construction, Urban Housing, Feasibility Study, Scheduling Optimization, Primavera P6, MS Project, Sustainable Construction.

I. INTRODUCTION

The rapid growth of urban populations in developing countries, particularly India, has created an urgent need for affordable and efficient housing solutions. Traditional construction practices, although widely used, are often associated with delays, cost overruns, inconsistent quality, and environmental degradation

due to material wastage.

Modular construction has emerged as a modern construction technique that involves manufacturing building components in a controlled factory environment and assembling them on-site. This approach enhances efficiency, reduces construction time, and improves quality through standardized processes.

Despite its advantages, modular construction faces several barriers in India, including high upfront costs, lack of awareness, insufficient skilled workforce, and regulatory limitations. This study focuses on evaluating the feasibility of modular construction and exploring scheduling optimization techniques to enhance its implementation in urban housing projects.

II. LITERATURE REVIEW

Smith (2010) highlighted that modular construction significantly reduces project duration and improves productivity due to parallel processing of activities. The study emphasized its effectiveness in minimizing on-site uncertainties.

Kamar et al. (2012) examined the barriers to adopting modular construction and identified high initial investment and lack of expertise as key challenges. The study suggested increased training and policy support to enhance adoption.

Lawson et al. (2014) discussed the sustainability benefits of modular construction, including reduced waste generation and lower environmental impact compared to conventional methods.

Azhar et al. (2013) explored the integration of Building Information Modeling (BIM) with modular construction, demonstrating improved coordination and scheduling efficiency.

Jaillon and Poon (2008) conducted a comparative study showing that prefabrication techniques significantly reduce construction waste and improve site safety.

Pan and Sidwell (2011) emphasized that modular construction can improve quality control due to factory-based production processes, leading to fewer defects and rework.

III. SUMMARY OF LITERATURE REVIEW

The literature indicates that modular construction offers several advantages over traditional construction methods, including reduced project duration, improved quality, and enhanced sustainability. Studies also highlight the importance of advanced planning and scheduling tools in maximizing efficiency.

However, challenges such as high capital investment, lack of skilled labor, and regulatory barriers limit its widespread adoption. While previous research confirms the benefits of modular construction, there is a need for detailed feasibility analysis and scheduling optimization in the context of urban housing in India, which forms the basis of this study.

IV. RESEARCH METHODOLOGY

This study adopts a comparative and analytical approach to evaluate the feasibility of modular construction. Both qualitative and quantitative data are considered.

Data Collection

Data is collected from:

- Literature review
- Case studies
- Construction professionals
- Project reports

Analysis Tools

Analysis Type	Purpose	Tool Used
Cost Analysis	Compare project cost	Excel
Time Analysis	Evaluate project duration	Primavera P6 / MS Project
Quality Assessment	Compare construction quality	Field Study
Sustainability Analysis	Evaluate environmental impact	Literature Review

Scheduling Methodology

Project schedules are developed using Primavera P6 and MS Project for both conventional and modular construction methods. Critical Path Method (CPM) is used to identify key activities and optimize timelines.

V. RESULTS AND DISCUSSION

The comparative analysis reveals that modular construction offers significant advantages over traditional construction methods.

- **Time Reduction:** Modular construction reduces project duration due to simultaneous off-site and on-site activities.
- **Cost Efficiency:** Although initial costs are higher, overall lifecycle costs are reduced due to minimized delays and rework.
- **Quality Improvement:** Factory-controlled production ensures better quality and consistency.
- **Sustainability:** Reduced material waste and lower environmental impact are observed.

However, challenges such as transportation difficulties, regulatory approvals, and lack of skilled labor were identified as major constraints.

Scheduling analysis using Primavera P6 shows improved project efficiency with optimized resource allocation and reduced critical path duration in modular construction projects.

VI. PROPOSED FRAMEWORK

A feasibility framework is developed to evaluate modular construction adoption based on the following factors:

- Economic Feasibility (Cost comparison)

- Technical Feasibility (Construction methods and resources)
- Scheduling Efficiency (Time optimization)
- Environmental Impact (Sustainability factors)

The framework suggests that integrating advanced scheduling tools with modular construction techniques can significantly enhance project performance and decision-making.

VII. CONCLUSION

The study concludes that modular construction is a viable and efficient alternative to traditional construction methods for urban housing projects. It offers benefits such as reduced construction time, improved quality, and enhanced sustainability.

Despite the challenges associated with its adoption in India, proper planning, investment in skilled labor, and supportive policies can facilitate its implementation. Scheduling tools like Primavera P6 and MS Project play a crucial role in optimizing project timelines and improving overall efficiency.

VIII. RECOMMENDATIONS

- Promote awareness and training programs for modular construction
- Develop supportive government policies and regulations
- Invest in skilled workforce development
- Encourage the use of advanced scheduling tools
- Conduct pilot projects to demonstrate feasibility

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