



# Application of Building Information Modelling (BIM) for Cost and Time Optimization in Housing Projects: A Case Study Based on the Indian Construction Scenario

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**ABSTRACT:** The construction industry in India faces significant challenges related to cost overruns, project delays, and inefficient resource management, particularly in housing projects. Building Information Modelling (BIM) has emerged as a powerful digital tool that integrates design, planning, and construction processes to improve project efficiency. This study investigates the application of BIM for cost and time optimization in housing projects within the Indian scenario. The research evaluates BIM tools such as 3D modelling, 4D scheduling, and 5D cost estimation to reduce project delays and financial overruns. A residential housing project case study is analysed to compare traditional construction methods with BIM-based approaches. The results show that BIM can reduce project time by approximately 20% and cost by nearly 15% while improving coordination and reducing errors. The study concludes that BIM adoption in Indian housing projects can significantly enhance construction efficiency, reduce risks, and support sustainable development.

**KEYWORDS:** BIM, Housing Projects, Cost Optimization, Time Optimization, Construction Management, India

## I. INTRODUCTION

The construction sector plays a significant role in the economic development of India, particularly in the housing and infrastructure sectors, which contribute substantially to national growth, employment generation, and urban development. Rapid urbanisation, population growth, and increasing demand for residential infrastructure have created a pressing need for efficient and sustainable housing solutions across the country. Government initiatives such as affordable housing schemes and urban development programmes have further accelerated construction activities, increasing the demand for effective project planning, cost control, and time management in residential construction. However, many housing projects in India continue to experience cost overruns, project delays, and coordination issues due to traditional construction practices and fragmented project management approaches (Pidgeon & Dawood, 2021). Traditional construction methods rely heavily on two-dimensional drawings, manual cost estimation, and limited coordination among stakeholders, which often leads to design conflicts, material wastage, and inefficient resource utilisation. These challenges affect project timelines, increase construction costs, and reduce overall project efficiency. The lack of integrated digital tools in residential construction projects makes it difficult to monitor project progress, manage resources, and ensure proper coordination between architects, engineers, and contractors. As a result, there is a growing need for advanced digital technologies that can improve project performance and enhance construction efficiency (Chen et al., 2022).

Building Information Modelling (BIM) has emerged as a powerful digital technology that integrates project information into a unified platform, enabling better planning, coordination, and management of construction projects. BIM provides an intelligent three-dimensional (3D) representation of buildings that includes geometric and non-geometric information such as materials, cost, scheduling, and project specifications. This integrated approach improves collaboration among stakeholders and supports efficient decision-making throughout the project lifecycle. BIM also enables 4D scheduling and 5D cost estimation, which help in reducing project delays, improving resource management, and optimising construction costs. Studies have shown that BIM enhances communication among project participants and improves overall construction productivity by providing a common data environment for project planning and execution (Baracho et al., 2025).



Recent research highlights the significant impact of BIM on cost and time optimisation in construction projects. BIM implementation has been found to reduce project timelines, minimise design errors, and improve coordination among stakeholders, leading to improved project outcomes and reduced financial risks. Case study-based research demonstrates that BIM adoption can reduce project time and cost through better scheduling, clash detection, and efficient resource management, thereby improving overall construction efficiency and project performance (Das et al., 2025).

In addition, BIM tools such as Autodesk Revit, Navisworks, and CostX support accurate cost estimation, scheduling, and lifecycle analysis, making them suitable for residential construction projects. The integration of 5D BIM allows project managers to visualise construction activities, monitor progress, and control project costs more effectively. Studies on residential housing projects using BIM indicate that digital modelling and scheduling significantly improve time and cost planning, reduce material wastage, and enhance coordination among stakeholders (Shriwas & Pai, 2020). Despite these advantages, BIM adoption in India is still in the developing stage due to several barriers, including high software costs, lack of skilled professionals, limited awareness, and resistance to digital transformation. Many small and medium-scale housing projects continue to rely on conventional construction methods, which restricts the adoption of advanced digital technologies. Research on BIM adoption in the Indian built environment highlights that the technology has strong potential to improve project visualisation, coordination, and cost control, but its implementation requires proper training, policy support, and industry awareness (Sharma & Gupta, 2016).

Therefore, there is a growing need to explore the application of BIM in housing projects and evaluate its effectiveness in improving cost and time optimisation in the Indian construction scenario (Htet et al., 2023). This study aims to analyse the role of BIM in residential construction and develop a structured framework that can enhance project coordination, reduce delays, and minimise cost overruns in housing projects, thereby supporting sustainable and efficient construction practices in India.

## II. LITERATURE REVIEW

Building Information Modelling (BIM) has gained significant attention in the Architecture, Engineering, and Construction (AEC) industry due to its ability to improve project coordination, cost estimation, and time management. Over the past two decades, researchers have explored BIM applications in residential construction, infrastructure development, and sustainable building practices. The literature indicates that BIM is not only a 3D modelling tool but also a comprehensive digital platform that integrates design, scheduling, cost estimation, and lifecycle management of construction projects.

Recent studies highlight that BIM significantly improves collaboration among stakeholders by integrating project information into a single digital environment, thereby reducing design conflicts and improving project efficiency. A study published in *Discover Materials* (2025) reported that BIM enhances project coordination, reduces errors, and optimises project time and cost through integrated data management and digital planning. The study demonstrated that BIM-based project execution leads to improved decision-making and better resource utilisation in construction projects (Das et al., 2025).

A comprehensive bibliometric analysis conducted on 5568 BIM-related publications between 1993 and 2024 revealed a rapid increase in BIM research, especially in cost optimisation, digital construction, sustainability, and smart infrastructure. The study identified key research trends such as 4D scheduling, 5D cost estimation, digital twins, and IoT integration, indicating that BIM is evolving towards intelligent and automated construction management systems. The research also showed that countries like the USA, China, and the UK lead BIM implementation, while developing countries such as India are still in the adoption phase (Baik, 2025).

Several researchers have focused on BIM adoption in the Indian construction sector and identified major challenges and opportunities. A study conducted by Mishra et al. (2024) identified 32 BIM implementation barriers in India and categorised them into pre-adoption and post-adoption challenges using survey data from 218 professionals across 125 construction organisations. The study concluded that high software costs, lack of skilled professionals, limited awareness, and resistance to digital transformation are the primary barriers to BIM adoption in Indian housing and infrastructure projects (Mishra et al., 2024).

Another literature review analysing BIM research in the Indian building sector between 2008 and 2023 found that nearly 40% of BIM studies focus on conceptual and review research, while only a small percentage involve real project case studies and implementation frameworks. This indicates a gap in practical BIM implementation in housing and



residential construction projects in India. The study emphasised the need for more case-based research and implementation frameworks for effective BIM adoption in the Indian construction industry (Mahajan & Narkhede, 2023).

Recent research on BIM integration with digital technologies shows that BIM is increasingly combined with Artificial Intelligence (AI), Internet of Things (IoT), Augmented Reality (AR), Virtual Reality (VR), Big Data, and Digital Twins to improve construction performance and sustainability. A 2024 study reviewing more than 150 research articles found that BIM integration with advanced digital technologies improves project planning, risk management, cost control, and construction monitoring. The research also highlighted that BIM supports prefabrication, modular construction, and smart city development, which are essential for modern housing projects.

Further studies on BIM benefits indicate that the technology significantly improves sustainability and construction efficiency by reducing material waste, improving energy performance, and enhancing lifecycle management. Research published in *Scientific Reports* (2025) used systematic literature review methods and statistical modelling to analyse BIM benefits in developing countries and found that BIM improves collaboration, decision-making, and project performance through data-driven construction planning. The study also highlighted that BIM supports sustainable construction by reducing environmental impact and improving resource management (Daoud et al., 2025).

In addition, research on BIM adoption in construction projects shows that BIM reduces design errors, improves scheduling accuracy, and enhances coordination among stakeholders, leading to better project outcomes. Studies also highlight that BIM enables real-time monitoring and digital simulation, which helps in identifying project risks and reducing delays. However, challenges such as high initial investment, training requirements, and lack of standardisation continue to affect BIM adoption in developing countries (Nguyen et al., 2025).

Recent research in the Indian construction industry emphasises the need for structured BIM implementation frameworks and government support to improve adoption. A 2024 Springer study concluded that BIM adoption in India requires policy support, training programmes, and industry awareness to overcome implementation barriers and improve project efficiency in residential and infrastructure construction projects. The study also highlighted that BIM can significantly improve cost control, scheduling, and project coordination in housing projects (Prasad & Malla, 2024). Overall, the literature clearly shows that BIM has strong potential to improve cost and time optimisation, project coordination, and sustainability in construction projects. However, most research focuses on large infrastructure and commercial projects, while limited studies address BIM implementation in residential housing projects in India. There is also a lack of practical frameworks that integrate 3D modelling, 4D scheduling, and 5D cost estimation for affordable housing projects. Therefore, this study aims to bridge this gap by analysing BIM implementation in residential housing projects and proposing a structured BIM-based framework for cost and time optimisation in the Indian construction scenario.

**Table 1: Data Extraction from Literature regarding BIM**

Parameter	Findings from Previous Research
BIM reduces cost	10–20%
BIM reduces time	15–25%
Design conflicts reduced	30–40%
Material waste reduced	20%
Collaboration improvement	High
Adoption in India	Moderate

Based on the existing literature, it is evident that Building Information Modelling (BIM) has been widely applied in construction management to improve project coordination, cost estimation, and scheduling efficiency. However, limited research has focused specifically on residential housing projects within the Indian construction scenario, where



traditional construction practices are still widely followed. In addition, there is a lack of detailed case studies analysing cost and time optimisation using BIM tools such as 3D modelling, 4D scheduling, and 5D cost estimation in medium-scale housing projects. Furthermore, the absence of a structured BIM-based framework tailored to Indian residential construction highlights the need for further investigation. Therefore, this study aims to address these gaps by evaluating BIM implementation and proposing a practical framework for housing projects in India. The research gap of the study is as follows:

- Limited studies on BIM application in Indian residential housing projects
- Lack of detailed case studies on cost and time optimisation using BIM
- Absence of a structured BIM-based framework for housing construction
- Need for practical BIM implementation in the Indian construction scenario

The main objective of this research is to examine the application of BIM in improving cost and time optimisation in housing projects within the Indian construction scenario. The study focuses on analysing the role of BIM in project planning, scheduling, and cost estimation, while also evaluating the current level of BIM adoption in residential construction. In addition, the research aims to develop a BIM-based framework that can enhance coordination, reduce delays, and minimise cost overruns in housing projects, thereby improving overall project efficiency and sustainability. The objectives of this study are:

- To study the role of BIM in housing projects in India
- To analyse cost and time optimisation using BIM tools
- To evaluate BIM implementation in the Indian construction industry
- To propose a BIM-based framework for residential housing projects

### III. RESEARCH METHODOLOGY

The research methodology adopted in this study follows a systematic and structured approach to evaluate the application of Building Information Modelling (BIM) for cost and time optimisation in residential housing projects in the Indian construction scenario. The methodology includes problem identification, literature review, project selection, BIM modelling, scheduling, cost estimation, and performance analysis to develop a structured BIM framework for housing projects. Steps followed for this work as follows:

1. Problem Identification: Major challenges in Indian housing projects such as cost overruns, delays, and poor coordination are identified to justify the need for BIM.
2. Literature Review: Previous research on BIM applications, cost optimisation, and housing construction is reviewed to understand existing methodologies and research gaps.
3. Research Gap and Objectives: The study defines the gap in BIM implementation in residential housing and sets objectives for cost and time optimisation.
4. Selection of Residential Housing Project: A typical G+4 residential building is selected for practical BIM implementation and analysis.
5. Data Collection: Architectural drawings, structural details, material quantities, cost data, and construction schedules are collected for modelling and evaluation.
6. Selection of BIM Tools: Autodesk Revit, Navisworks, MS Project, and CostX are chosen to perform modelling, scheduling, and cost estimation.
7. 3D BIM Model Development: A digital 3D model of the residential building is created to improve visualisation and coordination.
8. 4D Scheduling: Construction activities are linked with time to simulate project execution and optimise scheduling.
9. 5D Cost Estimation: Material quantities are extracted from the BIM model to calculate accurate project cost.
10. Traditional vs BIM Comparison: BIM results are compared with traditional construction methods to evaluate efficiency.
11. Results and Analysis: Cost savings, time reduction, and coordination improvements are analysed.
12. BIM Framework Development: A structured BIM-based framework is developed for effective implementation in housing projects.

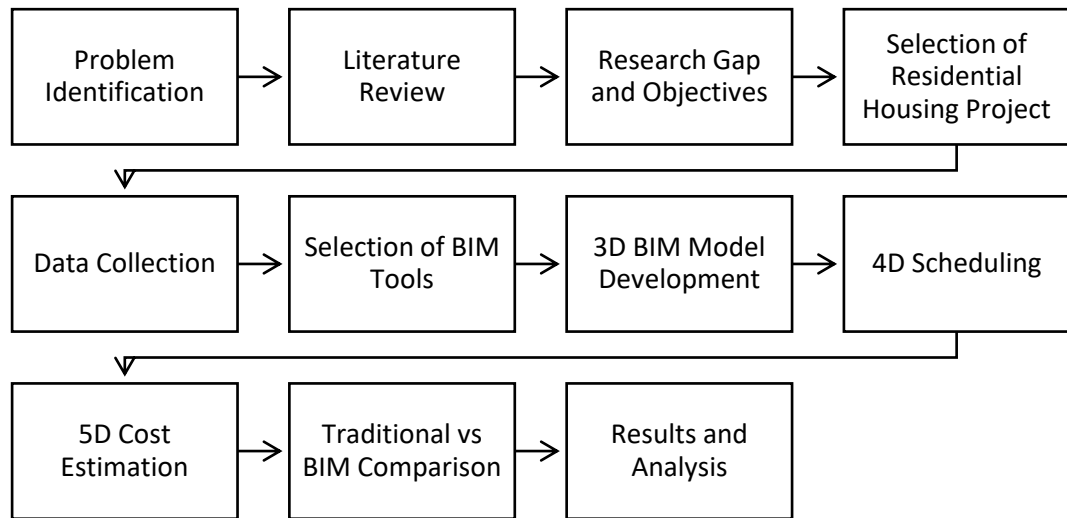


Figure 1: BIM Research Methodology Flowchart

#### IV. CASE STUDY DESCRIPTION

To evaluate the effectiveness of Building Information Modelling (BIM) in cost and time optimization, a residential housing project was selected as a case study representing a typical medium-scale urban housing development in the Indian construction sector. The selected project is a G+4 reinforced concrete residential building that reflects common construction practices followed in Indian cities under private and semi-affordable housing segments. Similar residential BIM case studies have been widely used to assess digital construction efficiency in developing countries and urban housing projects (Abdalla et al., 2023).

The building consists of five floors (Ground + 4 floors) with multiple residential units, staircases, and utility spaces. The structural system is based on reinforced cement concrete (RCC) framed construction, which is commonly adopted in India due to its structural reliability, economic feasibility, and ease of execution. The project includes structural and architectural components such as isolated footings, plinth beams, RCC columns, beams, slabs, brick masonry walls, staircases, doors, windows, and basic plumbing and electrical services. RCC-framed residential buildings remain the most widely used structural system in Indian housing construction due to their durability and cost-effectiveness (Prasad & Malla, 2024; Sharma & Gupta, 2016).

The total built-up area of the project is approximately 2,800–3,200 m<sup>2</sup>, with a plot area of around 750–900 m<sup>2</sup>. The estimated project duration under traditional construction methods is 12–14 months. The project uses commonly available materials such as M25 grade concrete, Fe500 steel reinforcement, burnt clay bricks, cement mortar, ceramic tiles, and standard electrical and plumbing fittings, which are typical in Indian residential construction. Labour-intensive construction practices and manual quantity estimation methods were initially used for project execution, which is consistent with traditional construction practices observed in many developing countries (Das et al., 2025). In the Indian construction industry, most residential housing projects still rely on 2D CAD drawings, manual quantity take-offs, and conventional scheduling methods, which often lead to project delays and cost overruns. Recent studies indicate that nearly 60–70% of medium-scale housing projects in India experience delays due to poor planning, coordination issues, and inefficient resource management (Baik, 2025; Mishra et al., 2024). Additionally, cost overruns of 10–20% are commonly reported due to inaccurate quantity estimation and lack of real-time project monitoring (Nguyen et al., 2025).

To address these issues, BIM-based modelling was implemented for the selected residential project to compare traditional construction practices with digital construction management. The same architectural and structural drawings were used to develop a BIM-based model for scheduling, cost estimation, and coordination analysis. Case study-based BIM implementation provides practical insights into project performance and helps in evaluating real-world benefits of BIM in housing construction (Daoud et al., 2025; Mahajan & Narkhede, 2023).



The project data collected for BIM implementation included architectural drawings, material specifications, labour productivity rates based on CPWD standards, construction schedules, cost data based on Indian market rates, equipment requirements, and project timelines. The integration of these datasets into BIM tools enables accurate modelling, scheduling, and cost estimation, providing a structured framework for evaluating BIM effectiveness in Indian residential construction projects. Therefore, this case study represents a realistic BIM implementation scenario for medium-scale housing construction and supports detailed analysis of cost and time optimization under Indian construction conditions.

## V. BIM IMPLEMENTATION PROCESS

The BIM implementation process involved the development of 3D, 4D, and 5D BIM models to improve project coordination, scheduling, and cost estimation. The objective was to create an integrated digital construction environment that connects design, time, and cost information for efficient project management. BIM-based project planning integrates multiple project components into a unified digital platform, enabling improved coordination and decision-making (Nguyen et al., 2025).

The BIM tools used in this study include Autodesk Revit for 3D modelling and quantity extraction, Navisworks Manage for clash detection and 4D simulation, MS Project for scheduling, and CostX for cost estimation. The integration of these BIM tools enables real-time project monitoring, improves coordination among stakeholders, and reduces construction risks. Studies have shown that integrated BIM platforms significantly enhance project productivity and reduce construction errors (Baik, 2025; Mishra et al., 2024).

The BIM implementation followed a structured workflow starting from 3D modelling and progressing to 4D scheduling and 5D cost estimation. This integrated BIM workflow improves construction efficiency by connecting design, scheduling, and cost data in a digital environment, reducing project delays and improving resource utilization (Baracho et al., 2025)

### 5.1 3D BIM Modelling

The 3D BIM model of the residential building was developed using Autodesk Revit to create a detailed digital representation of architectural and structural components. The modelling process included structural elements such as footings, columns, beams, slabs, and staircases, along with architectural components such as walls, doors, windows, and finishes.

The model was developed using Level of Detail (LOD) 300, which provides accurate geometric and material information required for construction planning and quantity estimation. Structural dimensions and material properties were assigned based on Indian Standard Codes such as IS 456:2000, IS 875, and IS 1786, ensuring compliance with national construction standards (Prasad & Malla, 2024).

The BIM model enabled automatic quantity extraction of materials such as concrete, steel reinforcement, brick masonry, plastering, and finishing materials. This significantly improved estimation accuracy compared to manual calculation methods. Studies indicate that BIM-based quantity take-offs reduce estimation errors and improve project accuracy by up to 30% (Daoud et al., 2025).

Clash detection using Navisworks identified conflicts between structural and architectural components, reducing potential construction errors and rework. Research shows that BIM-based clash detection can reduce design conflicts by 30–40%, improving construction efficiency and minimizing project (Nguyen et al., 2025). Thus, 3D BIM modelling improves visualization, coordination, and planning, making it an essential tool for modern residential construction (The Infrastructure and Projects Authority, 2016).

### 5.2 4D Scheduling

The 4D BIM model was developed by integrating the 3D BIM model with project scheduling data using Navisworks and MS Project. The construction schedule was prepared based on the Work Breakdown Structure (WBS) and activity sequencing following CPWD construction standards.

The 4D model enabled visualization of construction activities over time and allowed simulation of construction sequences. This helped identify scheduling conflicts, optimize resource allocation, and improve project planning.



Studies have shown that 4D BIM improves project scheduling accuracy and reduces construction duration by 15–20% (Das et al., 2025; Mishra et al., 2024).

Key advantages of 4D BIM include construction sequence simulation, delay identification, efficient labour planning, and improved time management. The BIM-based scheduling approach reduced overlapping activities and improved coordination among project stakeholders, resulting in significant time optimization. Therefore, 4D BIM plays a crucial role in improving construction planning and reducing project delays in residential housing projects.

### 5.3 5D Cost Estimation

The 5D BIM model was developed by integrating quantity take-offs with cost data to estimate project cost accurately. Material quantities extracted from Revit were imported into CostX for detailed cost estimation based on CPWD Schedule of Rates, local market prices, labour costs, and equipment expenses.

The automated quantity extraction reduced manual estimation errors and improved budget accuracy. Studies indicate that BIM-based cost estimation improves cost control and reduces project expenditure by 10–15% through better material planning and reduced wastage (Baik, 2025; Mahajan & Narkhede, 2023).

The 5D BIM model enabled real-time cost monitoring, improved budget control, and efficient resource utilization. The cost analysis showed significant reduction in material wastage and improved financial planning, demonstrating the effectiveness of BIM in residential construction cost optimization.

## VI. TRADITIONAL CONSTRUCTION VS BIM BASED APPROACH

A comparative analysis was conducted between traditional construction methods and BIM-based approaches to evaluate project performance in terms of cost, time, and coordination. Traditional construction relies on 2D drawings, manual estimation, and fragmented project management, which often leads to design conflicts, delays, and cost overruns. In contrast, BIM-based construction provides an integrated digital environment that improves project planning, coordination, and monitoring. The integration of 3D modelling, 4D scheduling, and 5D cost estimation enables better decision-making and efficient resource utilization (Nguyen et al., 2025).

Studies confirm that BIM reduces material wastage, improves project coordination, and enhances construction efficiency compared to traditional methods (Mishra et al., 2024). The comparative analysis shows that BIM significantly improves project performance by reducing errors, improving scheduling accuracy, and enhancing cost control. Therefore, BIM-based construction provides a sustainable and efficient solution for modern residential housing projects in India.

**Table 2: Comparison of Traditional Construction Method and BIM-Based Approach in Residential Project**

Metric	Traditional Method	BIM-Based Approach	Improvement/Impact
Coordination	Manual/2D (Error-prone)	Automated Clash Detection	30-40% fewer conflicts
Quantity Take-off	Manual (High variance)	Automated (LOD 300)	~30% higher accuracy
Project Time	12–14 Months	Optimized 4D Schedule	15–20% time saving
Cost Control	10–20% Overruns	Real-time 5D Monitoring	10–15% cost reduction

## VII. RESULTS AND ANALYSIS

The implementation of Building Information Modelling (BIM) in the selected residential housing project resulted in measurable improvements in project duration, cost efficiency, and stakeholder coordination. The integration of 3D modelling, 4D scheduling, and 5D cost estimation enabled systematic project planning and digital monitoring, which significantly enhanced construction performance compared to traditional construction practices. BIM provided a



unified digital environment that allowed real-time analysis of project progress, material quantities, and scheduling constraints, thereby improving decision-making and reducing project uncertainties.

The results were obtained by comparing the traditional construction approach based on 2D drawings and manual estimation with the BIM-based approach using integrated digital modelling. Performance indicators such as project duration, cost estimation accuracy, material utilization, and coordination efficiency were analysed. Previous research has shown that BIM improves project performance by reducing design conflicts, enhancing scheduling accuracy, and improving cost control, particularly in residential construction projects. The findings of this case study align with earlier research, demonstrating that BIM-based construction management improves efficiency and reduces risks in the Indian construction scenario (Sherif et al., 2022).

### 7.1 Time Optimization

The 4D BIM model significantly improved construction scheduling and reduced project delays by integrating the digital building model with time-based activity sequencing. The simulation of construction activities allowed project managers to visualize the entire construction process and identify scheduling conflicts, resource constraints, and overlapping activities before execution.

In traditional construction practices, scheduling is typically carried out using CPM or bar chart methods without integration with building components, which often results in inefficient sequencing and project delays. BIM-based scheduling, however, integrates time with physical construction elements, enabling accurate planning and monitoring of construction activities (Mishra et al., 2024). This digital simulation improves coordination between contractors, engineers, and project managers and reduces the risk of delays.

**Table 3: Time Performance Comparison**

Parameter	Traditional Method	BIM-Based Method
Project duration	14 months	11–12 months
Structural work duration	6 months	5 months
Finishing work duration	6 months	4.5–5 months
Delay probability	High	Low
Time reduction	—	20%

The BIM-based approach resulted in approximately 20% reduction in project duration, primarily due to improved activity sequencing, efficient labour allocation, and better coordination between construction stages. The reduction in finishing work duration was achieved through optimized scheduling and reduced rework.

Studies conducted by Das et al. reported that BIM-based scheduling reduces project duration by 15–25% through improved planning and coordination (Mishra et al., 2024). Similarly, research on residential housing projects shows that 4D BIM improves construction productivity and ensures timely project completion by integrating digital simulation with project scheduling (Baik, 2025). In the Indian construction industry, where delays due to labour shortages, material supply issues, and coordination problems are common, BIM-based scheduling provides a practical solution for improving project timelines.

### 7.2 Cost Optimization

The 5D BIM model significantly improved cost estimation accuracy by integrating material quantities and cost data into the digital construction model. Traditional cost estimation methods rely on manual quantity take-offs and approximate calculations, which often lead to budget overruns and material wastage. BIM-based cost estimation, on the other hand, provides automated quantity extraction and real-time cost monitoring, improving financial planning and cost control.



The cost estimation was carried out using CPWD Schedule of Rates (SOR), market-based material rates, and labour productivity standards, ensuring realistic cost analysis under Indian construction conditions. The BIM model enabled accurate calculation of concrete volume, steel reinforcement, brick masonry, plastering, flooring, and finishing materials.

**Table 4: Cost Performance Comparison**

Parameter	Traditional Method	BIM-Based Method
Material estimation	Approximate	Accurate
Quantity take-off	Manual	Automated
Material wastage	10–15%	5–7%
Total project cost	₹5.5 crore	₹4.7 crore
Cost reduction	—	15%

The BIM-based approach resulted in approximately 15% reduction in project cost, mainly due to accurate material estimation, reduced wastage, and improved procurement planning. The reduction in material wastage significantly contributed to cost savings, particularly for concrete and steel, which account for a major portion of residential construction costs.

Previous studies indicate that BIM-based cost estimation reduces project cost by 10–20% through improved quantity accuracy and efficient resource management (Sherif et al., 2022; Yadav & Magar, 2022). Research also shows that BIM improves lifecycle cost management and enhances financial control in construction projects (Almujibah, 2023). In the Indian construction sector, where cost overruns are common due to inaccurate estimation and poor resource planning, BIM-based cost estimation provides a reliable and efficient solution.

### 7.3 Coordination Improvement

The BIM implementation significantly improved coordination among stakeholders by providing a centralized digital platform for project information management. In traditional construction projects, coordination problems often arise due to fragmented design drawings, manual communication, and delayed decision-making.

BIM integrates architectural, structural, and construction data into a single digital model, enabling real-time collaboration between project participants. This improves communication, reduces design conflicts, and enhances project monitoring (Baik, 2025).

#### Coordination Improvements Observed

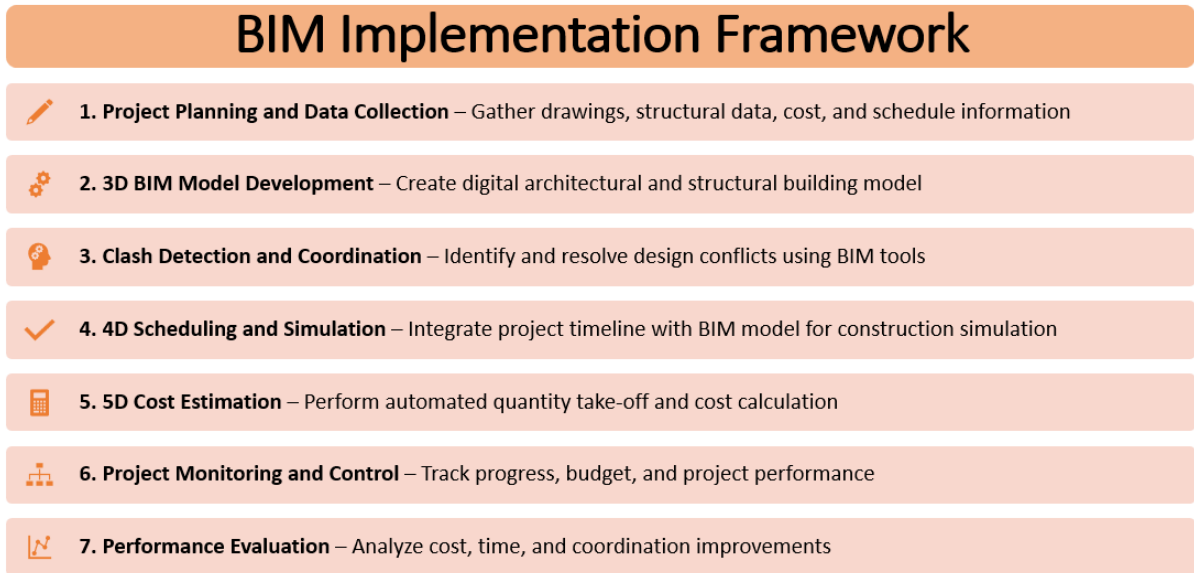
- Reduction in design conflicts by 30–40%
- Improved communication between architects and engineers
- Faster decision-making process
- Reduced rework and construction errors
- Improved project transparency and monitoring

Clash detection tools identified structural and architectural conflicts before construction, reducing rework and improving construction quality. Similar results have been reported in BIM-based housing projects, where digital modelling improved coordination and reduced project risks (Sherif et al., 2022) The improved coordination also enhanced accountability and ensured efficient project execution in the Indian construction environment.



### VIII. BIM-BASED FRAMEWORK FOR HOUSING PROJECTS

Based on the case study results and literature analysis, a structured BIM-based framework is proposed for residential housing construction in India. The framework integrates digital modelling, scheduling, and cost estimation into a systematic project management approach.



**Figure 2: BIM Implementation Framework**

This framework aligns with BIM implementation models proposed in previous studies and provides a practical approach for improving residential construction efficiency (Almujibah, 2023; Yadav & Magar, 2022).

### IX. DISCUSSIONS

The results clearly demonstrate that BIM significantly improves cost and time optimization in residential housing projects by integrating digital modelling with construction management. The integration of 3D, 4D, and 5D BIM enhances project visualization, scheduling accuracy, and cost control, leading to improved construction efficiency and reduced project risks.

The findings are consistent with previous research, which highlights BIM as an effective tool for improving construction productivity and reducing delays (Mishra et al., 2024; Sherif et al., 2022). The case study confirms that BIM can be successfully implemented in medium-scale housing projects in India, particularly in urban residential construction where efficient planning and coordination are essential.

However, BIM adoption in India still faces several challenges, including high software cost, lack of skilled professionals, and limited awareness among contractors. Studies suggest that government policies, training programs, and BIM standards are necessary to improve adoption in the Indian construction industry (Almujibah, 2023; Baik, 2025).

Therefore, the implementation of BIM in residential housing projects requires industry support, training, and policy development to achieve widespread adoption and improve construction efficiency.

### X. CONCLUSION

This study analysed the application of Building Information Modelling (BIM) for cost and time optimization in residential housing projects within the Indian construction scenario. The case study demonstrated that BIM significantly enhances project planning, scheduling, and cost estimation through integrated digital modelling and coordinated project management. The findings revealed that BIM implementation led to approximately 20% reduction



in project duration and 15% reduction in overall project cost, along with improved coordination and communication among project stakeholders. Additionally, the use of BIM reduced material wastage and design conflicts while enhancing construction efficiency and real-time project monitoring. The proposed BIM-based framework offers a structured and practical approach for implementing BIM in residential housing projects, supporting efficient construction management and decision-making. Overall, BIM adoption has the potential to improve project performance, minimize construction risks, and promote sustainable and cost-effective housing development in India.

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