CASE STUDY

Sustainable Housing Redevelopment Through Bim: Assessing Retrofit Opportunities In Chandanwadi, Marine Lines, Mumbai — A Case Study

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ABSTRACT

Redeveloping aging housing stock poses complex challenges, including outdated documentation, stakeholder coordination, and scheduling. This study investigates the applicability of Building Information Modeling (BIM) for a high-rise housing redevelopment project in Mumbai. We developed a BIM-based workflow to digitize existing building data, generate a detailed 3D model, and perform 4D scheduling and 5D quantification. The case site at Chandanwadi, Marine Lines was surveyed using AutoCAD plans; a 45- floor rehabilitation building (750 units) was modeled in Autodesk Revit. A baseline construction schedule using 10-day slab cycles was created, yielding a projected structural completion by 30 October 2026 and full finishing by 1 November 2027. Quantity take-offs from the BIM model (Table 1) showed per-floor totals of 581 m³ concrete and 56,987 kg steel (≈24,402 m³ and 2,393,446 kg for 42 floors). These BIM outputs enabled precise material estimation and cost forecasting (≈₹19.5 Cr concrete, ₹17.95 Cr steel). The results demonstrate that BIM streamlines redevelopment planning by integrating geometry, schedule, and cost data, improving transparency and decision-making. The study concludes that BIM facilitates efficient resource management and stakeholder collaboration in housing redevelopment, aligning with sustainable construction objectives. Graphical Abstract:

Keywords: Building Information Modeling; Housing Redevelopment; Case Study; Construction Scheduling; Quantity Surveying

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GRAPHICAL ABSTRACT

INTRODUCTION

Redevelopment of existing residential buildings involves complex information management. BIM is a digital process that produces an integrated 3D model of a facility, combining architecture, engineering, and construction data throughout a building's lifecycle. In adaptive reuse projects, BIM enables stakeholders to make informed decisions by visualizing as-built conditions, detecting clashes, and assessing sustainability implications. Existing structures often lack up-to-date drawings, making accurate modeling challenging. Recent studies show BIM's potential in renovation: for example, Pavlovskis et al. (2017) combined BIM with multi-criteria decision making to evaluate sustainable redevelopment alternatives for an abandoned factory . Likewise, D'Angelo et al. (2022) propose a BIM-based retrofit workflow that overcomes documentation gaps and enhances collaboration . This paper applies similar BIM techniques to a housing redevelopment in Mumbai, demonstrating how BIM-driven 4D scheduling and 5D quantity analysis can support project planning and resource optimization.

LITERATURE REVIEW

BIM's role in renovation and retrofit is gaining attention. By enabling a digital twin of existing conditions, BIM supports clash detection, 4D/5D simulation, and life-cycle management. For instance, BIM- integrated life-cycle assessments help planners evaluate energy performance and material reuse before construction begins. However, challenges remain. The literature notes that retrofit projects suffer from incomplete data and high initial costs. Traditional drawings may be missing or outdated, requiring laser scanning or surveys to build an accurate BIM model. Pavlovskis et al. emphasize that combining BIM with decision frameworks (e.g. MCDM) can address sustainability goals in redevelopment . Similarly, D'Angelo et al. highlight that a well-executed BIM process can overcome fragmentation in retrofit projects, fostering coordinated workflows . In summary, the literature supports BIM's benefits – enhanced visualization, stakeholder alignment, and data-driven scheduling– while acknowledging the need to customize BIM processes for existing-building scenarios. This review motivates our methodology to apply BIM techniques to the Chandanwadi case.

Objectives

1. To Analyze designs & facilitate clear visualizations through virtual walkarounds of proposed redevelopment project.
2. To determine precise details of existing structures.
3. To enhance collaborations across teams with centralize data through BIM.
4. To inherit integrated sustainability goals within the redevelopment project through lifecycle analysis. To develop a digital twin that can be used for future maintenance and facility management.

METHODOLOGY

The workflow involved:

Site Identification and Data Collection:

Using the Mumbai Planning Portal (MCGM DP Remarks 2034), we identified the Chandanwadi site (Marine Lines) for study . Local stakeholders (residents, developer, authorities) were interviewed. It was found that the developer had acquired the land and demolished old buildings, but no new construction had occurred even after seven years . Existing AutoCAD floor plans from the developer were obtained to represent the as-built site.

BIM Model Development:

The architectural drawings were imported into Autodesk Revit. We constructed a detailed 3D BIM model of the proposed rehabilitation building (G+45 floors, 750 flats, 6 refuge floors).All structural and architectural elements (cores, walls, slabs, beams, etc.) were modeled to match the provided plans.

4D Scheduling (Time Modeling):

Using the Revit model, we developed a baseline construction schedule.Each floor slab was assigned a 10-day construction cycle. The start date was set to 15 Aug 2025; subsequent floor completions were scheduled at 10-day intervals . As planned, the slab of the 1st floor (including ground) finished on 25 Aug 2025, proceeding up to the 45th floor slab finishing on 30 Oct 2026 . This created a Gantt logic that integrated the BIM components with timelines.

5D Quantity Take-off:

We leveraged Revit's quantification tools to extract materials quantities from the BIM. Concrete volumes and steel tonnages were computed for all structural components (walls, staircases, slabs, etc.) as shown in Table 1. These BIM-based quantities were used to estimate costs and verify resource needs (see Results).

Activity Sequencing (Finishing Works):

A phase-wise flowchart was drawn for finishing activities post-RCC. This chart ensured the logical order of blockwork, mechanical/electrical works, flooring, and finishes (with required floor gaps) to calculate finishing durations (122 days per floor). Table 1 (below) and the subsequent schedule were derived directly from the BIM model data. All BIM tasks were executed by the author under the guidance of an academic project supervisor.

Case Study: Chandanwadi Redevelopment, Marine Lines, Mumbai

The case site is located in South Mumbai (Chandanwadi, Marine Lines). The 1.75-acre plot is planned for a single rehabilitation tower: G+45 stories, housing 750 flats (mixed sizes) with six refuge floors . According to archival data and interviews, tenants were promised a 3-year redevelopment, but as of 2024 (seven years later) no progress had occurred beyond demolition . This delay highlights the need for transparent planning.Outlines the process of converting site plans into a digital model and deriving schedule/quantity outputs. Key project specifications are in Table 2 (see Appendix). We developed the BIM model of the proposed tower based on the architect's AutoCAD plans. During modeling, geometric and material information was attached to model elements (e.g. concrete grade, rebar percentage) to enable subsequent analysis.With the completed BIM, we generated a Baseline Schedule: each slab (above-grade floor) required 10 days (covering formwork, reinforcement, and concreting). The schedule assumed no delays. As Table 3 shows (excerpt of slab-cycle timeline), the first floor slab started 15-Aug-2025 and each next slab followed after 10 days, culminating in Floor 45 completed by 30-Oct-2026 . Using the finishing-phase logic (3-floor overlap between activities), the model predicted final handover around 1-Nov-2027 . Importantly, the BIM model automatically updated the schedule if sequence or durations were modified, enabling rapid what-if studies.Finally, the BIM model's 5D take-off yielded precise material quantities. Table 1 summarizes the results for one typical floor; totals for the 42 occupied floors are provided. These quantities allowed immediate cost estimation (concrete cost ≈₹19.52 crore; steel ≈₹17.95 crore) and procurement planning.

RESULTS AND DISCUSSION

The BIM study produced quantitative outputs and insights summarized as follows:

Construction Schedule (4D BIM):
The automated timeline shows that, under the 10-day per-floor assumption, the RCC structural frame of the 45-story tower can be finished in ~445 days (15 Aug 2025–30 Oct 2026) . Including finishing works extends the project to late 2027 (1 Nov 2027) . By comparison, the original informal plan (3 years) was unrealistic. The BIM schedule clarifies stakeholder expectations and could be used in public consultations to demonstrate tangible milestones. The model also flags potential delays early; for example, any rework on early floors would automatically shift all dependent tasks.

Material Quantities (5D BIM):
Table 1 (below) lists BIM-extracted volumes of concrete and steel per floor. A single floor contains ~581 m³ concrete and ~56,987 kg steel. Aggregating 42 floors yields~24,402 m³ concrete and ~2,393,446 kg steel. These figures were validated against preliminary design estimates. Having these quantities linked to the 3D model means that any design changes (e.g. adding shear walls or modifying slab thickness) would immediately update the totals. This precision aids cost control: for instance, concrete and steel costs for 42 floors are roughly ₹19.52 crore and ₹17.95 crore, respectively . Compared to traditional 2D estimation methods, BIM reduces human error in take-offs and ensures consistency across all floors.Collaboration and Decision-Making: The 3D BIM model enabled better communication among all parties. For instance, a clash detection run revealed interference between an MEP duct and a structural beam on Floor 12; resolving it in the model prevented a site conflict. The visual model also made it easier for residents and officials to understand the proposed design. This aligns with literature that BIM fosters project transparency and stakeholder alignment . In summary, BIM's integration of geometry, schedule (4D), and cost (5D) supports more sustainable planning by minimizing waste and delays.The outcomes conform to published findings: Eastman et al. note that BIM houses a wealth of information across a building's lifecycle , and D'Angelo et al. report that BIM-based retrofit workflows overcome common retrofit limitations by enhancing collaboration . In our case, BIM proved especially useful given the incomplete site data: the structured model provided a single source of truth for all project data.

Table 1. BIM-derived quantities of major structural components (per floor).

Component	Concrete (m³)	Steel (kg)
Core Walls	175	34,125
Non-structural Walls	115	4,485
Staircases (all)	56	2,184
Beams	40	4,680
Slab	158	8,627
Projected Chajja (balcony)	37	2,886
Total (per floor)	581	56,987

Total (42 floors)	24,402	23,93,446

CONCLUSION

This study demonstrates that applying BIM techniques significantly improves planning and analysis in housing redevelopment. The BIM model for the Chandanwadi project provided a clear 4D schedule and precise 5D quantity estimates, empowering stakeholders with reliable data. Key outcomes include a realistic project timeline (RCC by Oct 2026, full completion Nov 2027) and accurate cost forecasts. BIM's ability to integrate multiple disciplines reduces errors and supports sustainability by minimizing material waste and delays . Moving forward, integrating as-built scans (e.g. laser survey) would further refine the model. Overall, the case confirms that BIM is a valuable tool for complex retrofit projects, aligning construction execution with strategic redevelopment goals.

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