

Evaluating the Effectiveness of REVIT in Supporting Sustainability Criteria in Buildings: A Case Study

Mohammed Ali Alshamali^{1*} , Alhsen Zeno² 

¹Department of Engineering Management and Construction, Faculty of Civil Engineering, Damascus University, Damascus, Syria

²Syrian Virtual University, Damascus, Syria

*Email: Engmohamed.lamar@gmail.com

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Received	13/04/2026	This study examines the importance of BIM technology in construction projects and its major role in achieving sustainability, with a particular focus on the Revit software package. Its contributions to building sustainability were analyzed through a descriptive-analytical methodology involving an applied case study of a specific building modeled using Revit. The findings indicated that Revit plays a significant role in promoting building sustainability through its contribution to improving the indoor environment of buildings and achieving thermal and visual comfort, with direct implications for energy savings, as it enables designers to take into account solar movement and prevailing wind direction at the construction site. It also contributes to detecting clashes and conflicts before they occur during construction. In addition, Revit plays an important role in water conservation, as it enables accurate identification of pipe diameters used in plumbing and drainage systems, as well as their quantities, lengths, required fittings, bends, expected maintenance points, and other related data. The study concluded that BIM technologies should be adopted in the construction industry, particularly Revit, due to their major benefits in improving building quality and achieving the desired level of sustainability.
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1. Introduction

In recent years, digital transformation in the building and construction sector has become an important factor in improving the quality, accuracy, and efficiency of construction projects through rapid technological advancement [1]. Among the most important of these transformations is Building Information Modeling (BIM), which has emerged as a critical methodology capable of fundamentally redefining project planning, design, execution, and management in a more efficient manner [2]. The BIM methodology includes a number of important tools and software applications, such as Autodesk Collaborate Pro, ArcGIS BIM Integration, Autodesk Revit, Massing & Site Tools, Autodesk Insight, Tally, and IES VE, among others.

These tools make BIM a leading approach for improving project efficiency by reducing costs, minimizing rework, enabling full life-cycle management, enhancing collaboration and coordination among different engineering disciplines, and ensuring high accuracy in quantity takeoff and estimation [3]-[6]. BIM also contributes significantly to achieving building sustainability by extending building life, improving indoor

environmental quality, ensuring thermal and visual comfort, conserving water and energy, reducing material waste, and improving site management, among other sustainability-related aspects [7].

The upcoming reconstruction phase in Syria presents an important opportunity to adopt such modern methods, especially Building Information Modeling (BIM), with its important and advanced technologies and software such as Revit, to ensure the quality of engineering projects and achieve a high level of sustainability. Therefore, this research focuses on Revit as a BIM tool and analyzes its contributions to building sustainability through an applied case study conducted on a specific building designed using Revit, with the aim of evaluating the program's performance and identifying its benefits and advanced role in meeting the requirements and standards of building sustainability, and thus contributing as much as possible to promoting the adoption of such technologies within the Syrian construction industry.

1.1. Research Problem

Numerous studies have shown that BIM is highly effective in achieving sustainability across various building types. Through the advanced and modern tools and software it encompasses, BIM helps increase building lifespan, conserve water, energy, and materials, and reduce thermal and lighting loads, among other sustainability criteria [1]. Among these tools, Revit has emerged as a leading application in this field, as it substantially contributes to integrating all stages of structural, architectural, electrical, and mechanical design into a single intelligent and flexible model. This leads to greater project accuracy, reduced errors through automatic updating of modifications, and savings in time, cost, and effort.

Given the economic and environmental conditions and limited resources in Syria, the need for modern and sustainable technologies is both urgent and essential, especially in the coming reconstruction phase. Accordingly, this research highlights the importance of Revit as a BIM tool, analyzes its contributions to sustainability, and clarifies how it can be utilized to enhance the sustainability of buildings and projects within the Syrian construction industry

1.2. Significance and Objectives of the Research

This research is significant because it highlights BIM technology and its role in achieving building and project sustainability, given the modern, effective tools it includes, such as Revit, which engineers across disciplines use.

This research aims to investigate Revit's effectiveness in achieving building sustainability by examining its role in integrating various engineering disciplines, architectural, structural, mechanical, electrical, and plumbing systems. It also examines its role in enabling real-time collaboration to detect interferences and clashes before execution. This reduces errors, saves effort and time, and ensures data accuracy. The study also examines its usefulness in modeling buildings while accounting for solar radiation movement, maximizing natural lighting and reducing reliance on electrical energy for illumination. It also considers its role in identifying prevailing wind directions and orienting the building accordingly, supporting natural ventilation and reducing dependence on mechanical ventilation. In addition, it offers important benefits in water conservation by controlling the routing of water supply pipes, facilitating future maintenance, optimizing pipe distances from the tank, and identifying the optimal tank location. These and other significant contributions make Revit an effective tool for enhancing building sustainability.

2. Research Methodology

This research adopts a descriptive-analytical methodology, as it can describe complex problems accurately and analyze causes and present results with greater precision and reliability. The research includes the following steps:

- 1) Reviewing previous studies and the literature on Building Information Modeling (BIM), and analyzing its importance and benefits in the field of sustainability, with particular emphasis on Revit.
- 2) Developing an integrated three-dimensional model of a building using Revit as a practical application (a case study).
- 3) Examining and analyzing Revit's contributions to achieving selected building sustainability criteria, including:
 - Sustainable site planning (orienting the building according to prevailing winds and alignment with solar radiation hours in summer and winter).
 - Detecting clashes and interferences among different engineering disciplines, including architectural, structural, mechanical, electrical, and plumbing systems.
 - Conserving water by helping determine the optimal routing of water supply pipes, tank locations, fittings, and related elements.
 - Accurate quantity takeoff, reducing waste, and improving management of the site surrounding the building.
- 4) Applying the previous contributions made by the Revit program to the sustainable building assessment criteria included in the American LEED system to determine the most important sustainability criteria that can be achieved by relying on this program.
- 5) Proposing recommendations to promote the adoption of BIM technologies, particularly Revit, in the building and construction sector in Syria.

Fig. 1 below illustrates the research methodology and steps.

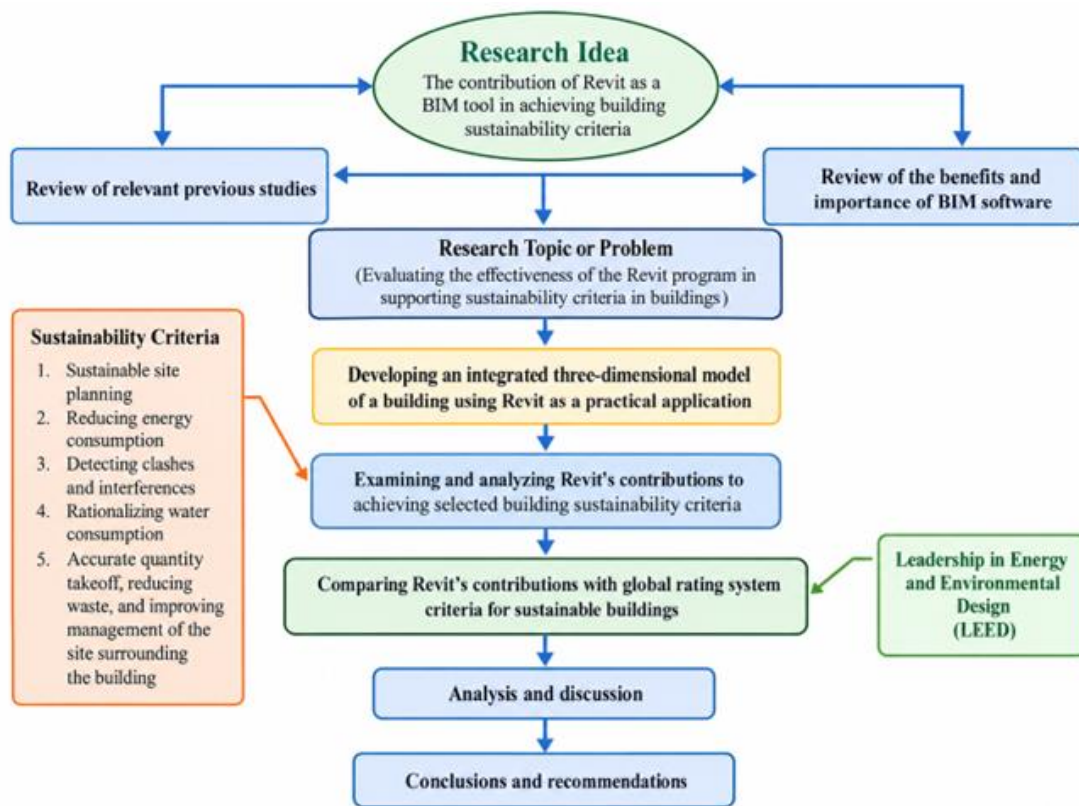


Figure 1. Research methodology and steps.

3. Literature Review

Hammed et al. [1] examined various aspects through which BIM software can be integrated with LEED requirements, beginning with the early design stages and the LEED criteria associated with them, then moving to building simulation and analysis and the LEED criteria relevant to this phase, and finally to building assessment for LEED certification, with the aim of improving the design process and ensuring compliance with sustainability standards. This study produced important results on integrating BIM software and LEED criteria, concluding that using BIM applications to assess LEED criteria enhances environmental building performance by analyzing indoor environmental quality, energy efficiency, water efficiency, and materials. Although the study referred to a number of BIM software applications, the present research focuses specifically on the contributions of Revit to achieving building sustainability criteria.

Qiang et al. [3] presented their Revit-based experiences and results within the context of higher education. They noted that architectural design programs in higher vocational colleges have undergone major changes and that instructional objectives are no longer aligned with contemporary developments in the field. Their study focused on current BIM-based architectural education and compared applications used in this context, such as CAD, SketchUp, and Revit. The researchers emphasized that BIM is an advanced technology and that all stakeholders can collaborate to bring about effective transformation in the construction sector through computerized BIM applications. Based on their experiences and Revit-based teaching projects, they obtained BIM skills certification. Their work also

presented experimental results, performance outcomes, and the effects of BIM implementation in education, using visual tools to enrich knowledge in BIM education.

Abu El-Hagag et al. [7] investigated the impact of using BIM as an effective solution for integrating the design, construction, and post-operation phases by examining three measurable key performance indicators: requests for information, change orders, and cost estimation applied to a residential complex as a case study in order to determine the anticipated benefits of BIM implementation. BIM application increased construction productivity by reducing time-consuming rework, avoiding missing information during execution, and resolving disputes before construction begins. The findings show that despite the relative novelty of BIM systems, many stakeholders have adopted them because of their ability to improve work efficiency, enhance communication among project teams, and reduce environmental waste, all of which contribute substantially to sustainability principles. Although the study identified certain barriers, such as a lack of qualified specialists, it confirmed that BIM adoption is expected to expand widely in the construction sector in the near future.

Sidhom [8] presented the use of BIM through simulation software in social housing projects implemented in Egypt, which were constructed using conventional materials such as steel and concrete without applying appropriate solutions to reduce energy consumption. The research also presented a selected case study of residential projects in Egypt within one category of housing, social housing, which suffers from deficiencies in building efficiency and sustainability. BIM software, including Revit Architecture, was used to create a

three-dimensional model of the housing unit, and Insight 360 for Revit was then used to run and analyze simulations such as solar path and solar analysis, and to calculate heating and cooling loads through appropriate solutions. The study concluded that BIM helps develop suitable solutions or alternatives, such as insulation materials and glazing types that allow natural light only, in order to achieve thermal comfort, improve heating efficiency, and reduce thermal loads, cost, and time.

Alshamali et al. [9] highlighted the importance of taking construction conditions and economic and environmental circumstances into account when evaluating sustainability criteria across different countries. The researcher identified major sustainability criteria within the LEED framework and recalculated their relative importance in a way that aligns with the Syrian construction industry [9]. The study concluded that it is important to adopt sustainability criteria and modern technologies within the construction sector, particularly during Syria's upcoming reconstruction phase. In the present research, the selected sustainability criteria will be applied to the contributions of Revit, and an appropriate comparison will be prepared in order to highlight the degree of sustainability that a building can achieve when this software is used during the design process and throughout the operation and maintenance phases.

Applying sustainability standards in residential towers significantly improves energy efficiency, reduces harmful emissions, and enhances effective waste management. A case study of a tower in the city of Basel showed that these standards can lead to substantial reductions in energy consumption through optimized design alternatives [10]. Integrating sustainability standards into the design and construction of residential towers is therefore essential for achieving long-term environmental, social, and economic benefits, with particular emphasis on the need to adopt internationally recognized sustainability assessment systems.

4. Theoretical Framework

4.1. Concept of Building Information Modeling (BIM)

Building Information Modeling (BIM) is the process of generating and managing building data throughout the building life cycle. This type of modeling treats design elements as abstract or defined objects, generic or specific products, and solid or void forms such as rooms. These objects carry geometric properties as well as associated attributes and relationships [2]. BIM design tools also allow the extraction of various building views (projections) for production and other uses. These views remain automatically coordinated with one another because each object is defined only once, as in reality, while its size, shape, and position remain consistent across all views. This automatic coordination eliminates many of the errors that arise when each view is drawn separately using traditional methods.

BIM is also considered an integrated digital methodology for managing architectural, structural, and mechanical information within a construction project, beginning from conceptual design, passing through execution, and extending to operation

and maintenance. BIM is based on the creation of an intelligent three-dimensional digital model containing rich information for every project element, including geometric dimensions, material properties, schedule data, cost data, and operational relationships [2]. BIM technology is one of the latest developments in construction engineering. It designs building elements not merely as two- or three-dimensional geometric forms, but as elements with physical, electrical, and mechanical properties. This allows both the design and simulation of the building on the one hand, and the analysis of engineering outputs and construction drawings on the other, thereby integrating computer-aided drafting, simulation, analysis, and design software within a single framework.

4.2. Dimensions of BIM

1D and 2D: These include two-dimensional drawings that illustrate the basic forms and initial project structures, such as architectural and engineering drawings used as the basic design reference.

3D: Represents the three-dimensional geometric model that includes the project's architectural, structural, electrical, and mechanical elements. It is used to display the design accurately and facilitate coordination among different disciplines.

4D: Links the three-dimensional model to the project schedule, enabling virtual simulation of construction stages, schedule analysis, and tracking of actual progress against planned progress.

5D: Involves linking the model to quantities and costs, which supports accurate budget estimation, cost analysis at each project stage, and informed financial decision-making.

6D: Focuses on environmental and sustainability aspects and enables analysis of energy and material efficiency and environmental impact, thereby supporting green building standards.

7D: Used for facility management, operation, and maintenance after project completion, where the digital model is employed to track operational data, schedule maintenance, and improve long-term asset management efficiency.

The concept of BIM Maturity Levels refers to the progressive stages through which organizations or projects pass in their implementation of BIM technologies and methodologies, beginning with simple modeling and advancing to full digital integration among all project stakeholders [11]-[13]. This classification was developed to assess the readiness and advancement of organizations in adopting BIM effectively. According to the UK BIM Framework and ISO 19650, BIM maturity is generally divided into four main levels [11]:

Level 0

At this level, there is no real digital modeling. Two-dimensional CAD tools are used to prepare drawings, and the project is managed through separate documents without digital coordination among parties. Information is fragmented and collaboration is minimal.

Level 1

This level includes a mix of three-dimensional modeling for some disciplines, such as architecture, while two-dimensional drawings continue to be used in other documentation. Common Data Environment (CDE) tools are used on a limited basis, but there is no real integration or direct information exchange among different teams.

Level 2

This is currently the most widespread level in many projects around the world. At this stage, separate three-dimensional models are created for each discipline—architectural, structural, mechanical, and so forth—and files are exchanged among teams using standard formats such as IFC. Shared coordination and clash checking are encouraged through tools such as Navisworks. This level represents an important stage in the transition toward integrated BIM implementation.

Level 3

This level represents the highest degree of maturity, where a single unified shared model is developed for all disciplines and managed within a Common Data Environment through a centralized cloud-based platform. This model enables real-time collaboration and supports advanced dimensions such as time management (4D), cost (5D), sustainability (6D), and asset management (7D). This level achieves full digital integration across design, construction, and operation.

4.3. Linking BIM Technologies to Sustainability

The relationship between BIM and sustainability is inherent because BIM enables and documents how sustainability can be implemented to meet present human needs without compromising the resources required by future generations. Sustainable design begins with the philosophy that good planning and design inherently include the characteristics that constitute sustainability. These include selecting environmentally appropriate sites, conserving water, and optimizing energy use. This means that all implemented design work should meet defined performance criteria, which are among the most important contributions to sustainable city design using BIM [14]. BIM provides the ability to incorporate add-ons that enable designers to simulate energy use and daylighting and to supply the database required by green building certification bodies. BIM can also facilitate the identification of optimal site selection and building orientation to maximize renewable energy generation and minimize energy consumption [14]–[20].

The stages of applying BIM technologies in sustainability involve integrating environmental analysis throughout the entire project life cycle, from site analysis to sustainable design and simulation, and ultimately to operation management. These stages contribute to reducing energy and resource consumption and selecting environmentally friendly building materials in order to enhance sustainability [8]. The application stages of BIM in sustainability can be summarized as follows:

Site Analysis: Studying the site, topography, sun, and wind in order to determine the most appropriate design, analyze elevations, spatial distribution, and their relationship to infrastructure and green areas.

Conceptual Sustainable Design: Conducting preliminary energy and daylight analysis and selecting the optimal building orientation to reduce heating and cooling demand.

Analysis and Simulation: Using BIM tools to simulate energy performance (6D), analyze water consumption, and assess the environmental sustainability of materials used.

Coordination and Collaboration (3D): Integrating architectural, structural, and mechanical disciplines within one model to detect clashes, reducing material waste during execution.

Sustainable Construction (4D/5D): Linking the model to schedule and quantities to reduce resource waste, improve logistics, and support the selection of environmentally friendly materials.

Facility Management (7D): Using the digital model to manage building maintenance, monitor energy performance, and reduce carbon emissions throughout the asset life cycle.

These stages contribute to achieving high energy efficiency, reducing execution errors, and extending building life, thereby making the construction process smarter and more professional [1]. Among the most important BIM programs, tools, and applications that contribute to these stages are the following:

First: Autodesk Collaborate Pro

An advanced version of BIM 360, Autodesk Collaborate Pro is an integrated cloud platform that allows real-time collaboration and coordination among different project disciplines. It is specifically designed to enable designers, project managers, and engineers to work simultaneously on the same digital model. This platform enhances collaboration throughout all project stages because it enables effective communication among all project stakeholders, which in turn reduces errors that may occur during the construction phase. Fig. 2 below illustrates the BIM 360 platform.

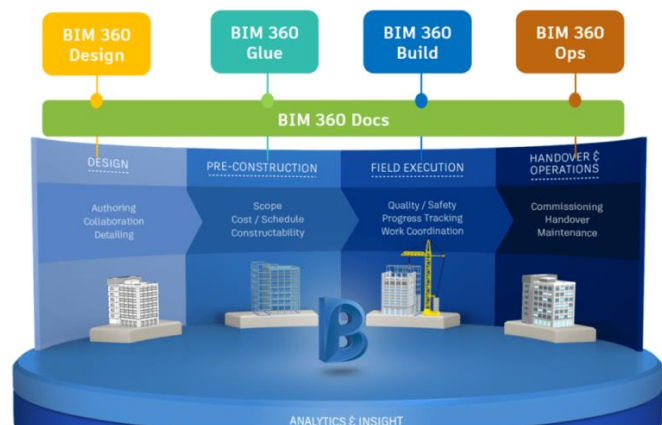


Figure 2. The BIM 360 platform.

Second: ArcGIS BIM Integration

This is an integration between GIS technologies and BIM, enabling site analysis and project planning in line with sustainability criteria. The integration improves informed decision-making regarding project location by combining detailed geographic and spatial data, such as public transportation and utility maps, with BIM models. Fig. 3 shows an image of the ArcGIS program.

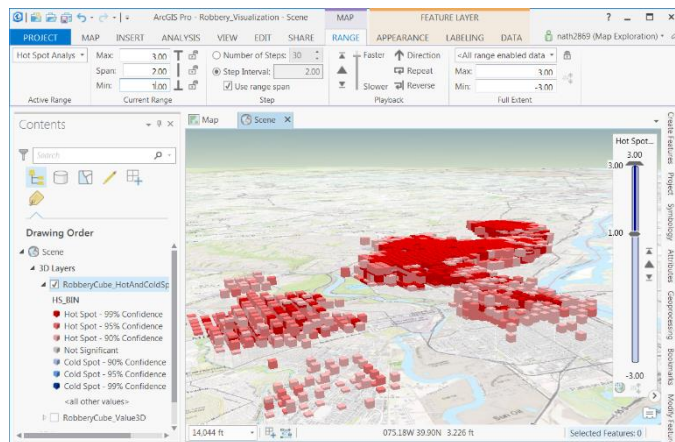


Figure 3. The ArcGIS software.

Third: Autodesk Revit:

Revit enables designers to integrate site and local environmental data into a three-dimensional model, allowing environmental analyses and the development of design solutions tailored to regional priority criteria. It can be used to analyze local climatic conditions and ensure that design solutions meet the environmental requirements specific to a region. Revit also enables work on an integrated three-dimensional model encompassing all disciplines, thereby reducing design-stage errors and allowing clashes to be detected before execution. This reduces waste in construction materials and minimizes time losses arising from rework caused by design errors and clashes, thereby supporting sustainability criteria. Revit also enables designers to analyze water consumption in interior spaces by creating accurate models that include all water-related fixtures. By inputting expected consumption data for each fixture, Revit can be used to calculate total water consumption and compare it against target standards, thereby supporting design decisions that enhance water efficiency. Fig. 4 shows a model of a building within the Revit program.

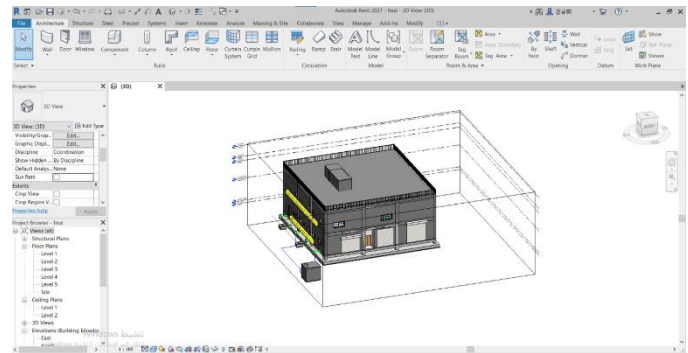


Figure 4. An image from within Revit.

Fourth: Massing & Site Tools:

The Massing & Site tools within Revit enable designers to analyze and study buildings in mass form before moving into detailed design. These tools can be used to determine the proposed building form, analyze its relationship to the site, and study shadows, solar radiation, and wind flow. Fig. 5 illustrates the use of Massing & Site tools in Revit.

Fifth: Autodesk Insight:

Autodesk Insight is used together with Revit to analyze building energy performance. Designers first create three-dimensional building models in Revit and then input data related to various energy systems, such as lighting, ventilation, heating, and air conditioning systems. Insight then analyzes projected energy consumption, allowing designers to make the required improvements and modifications. Fig. 6 below shows the use of Revit Insight.

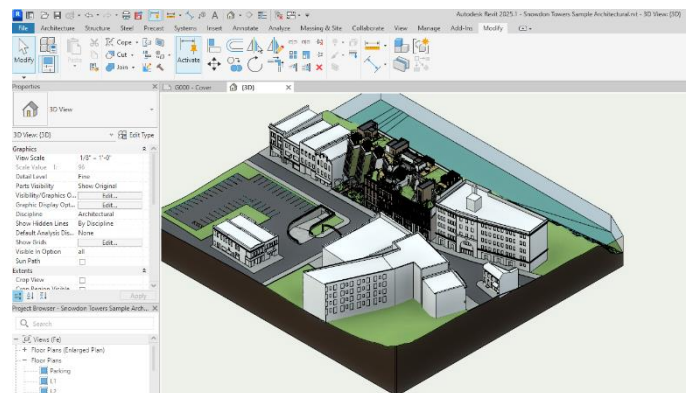


Figure 5. illustrates the use of Massing & Site tools in Revit.

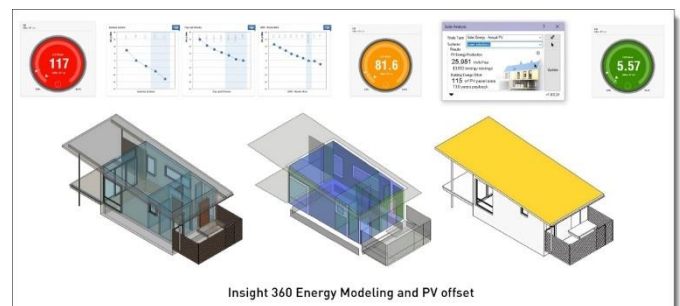


Figure 6. Illustrates the use of Revit Insight.

Sixth: Tally

Tally is a life cycle assessment tool that is added to Revit as an add-in. It enables designers to perform accurate and detailed environmental analyses of project materials, compare the sustainability impacts of different materials, and select the most appropriate alternatives. It provides analyses of material impacts on the environment, such as carbon emissions, energy consumption, and use of natural resources. Fig. 7 below shows the Tally tool within the Revit program.

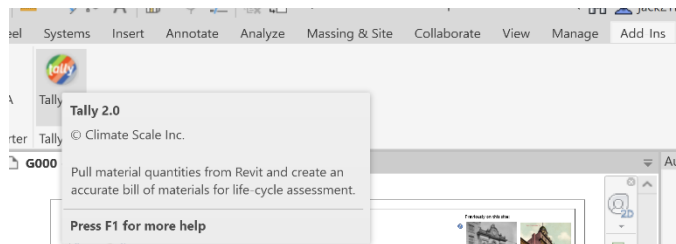


Figure 7. Illustrates Tally within Revit.

Seventh: IES VE

IES VE is a comprehensive program used for simulating and analyzing a building's environmental performance. It enables designers to analyze indoor environmental quality and the factors affecting indoor air quality, as well as thermal and acoustic comfort. The software simulates airflow within buildings and determines the effectiveness of ventilation systems to ensure good indoor air quality. It is also used to analyze daylighting in interior spaces, helping reduce reliance on artificial lighting and achieve visual comfort. In addition, it assesses thermal comfort by simulating heat transfer within the building and identifying zones that may require modifications and improvements to ensure a comfortable indoor environment.

This research focuses on Revit and its tools to achieve the required building sustainability by developing a building model in Revit and analyzing how the software contributes to sustainability.

5. Practical Study

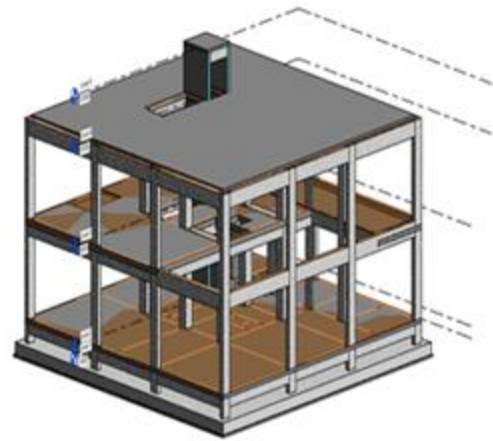
5.1. Building Description

As an applied model for the study, a two-story commercial building with a floor area of 576 m² was selected and modeled using Revit, as shown in Fig. 8 below.

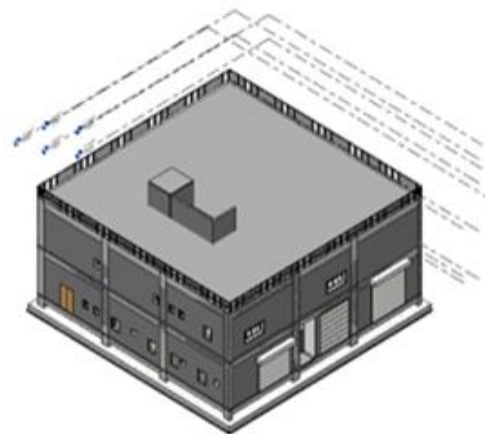
5.2. Using Revit, the following Aspects will be determined

- 1- The building orientation in a way that is compatible with maximum solar exposure and prevailing wind direction in the area, thereby contributing to energy savings through natural ventilation and solar gain.
- 2- The layout and routing of internal water supply and drainage pipes in a way that promotes efficiency and water conservation
- 3- Clash reports for the building (structural-architectural and structural-mechanical) in order to avoid potential errors during execution, thereby reducing cost and time.

4- Quantity takeoff for the structural section of the building, contributing to accurate identification of materials and project resources, reducing waste and construction debris, and consequently lowering cost.



a. Structural model



b. Architectural model

Figure 8. Building modeling using Revit.

Each of the four points above will be addressed in detail in order to determine Revit's role in achieving each of them.

From Fig. 9, summer and winter solar movement can be observed. Most of the windows were placed on the southern façade of the building, which provides appropriate natural lighting and contributes significantly to reducing reliance on electrical energy for lighting during specific daytime periods extending over several hours (summer: from 05:00 AM to 07:00 PM; winter: from 06:45 AM to 04:30 PM). In addition, determining the building's geographic location and orienting it to the prevailing wind direction substantially improves natural ventilation, which in turn reduces the mechanical load required for air conditioning [18].

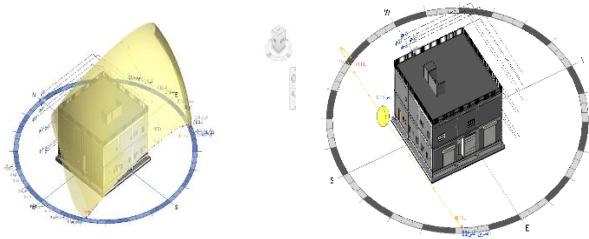


Figure 9. Illustrates the movement of the sun during summer and winter and the positioning of the windows.

Second: Plumbing and Mechanical Installations:

Using Revit, it is possible to determine with precision the diameters of pipes used in water supply and drainage systems, as well as their quantities, lengths, required fittings and bends, and other related components. It is also possible to determine the optimal drainage route, the required tank size, and the correct tank location on the basis of expected consumption and available facilities. Revit is also a primary BIM tool for modeling HVAC ductwork and related mechanical systems through its ability to provide accurate three-dimensional models and to reveal conflicts with other systems such as plumbing and electrical systems—at an early stage. This improves coordination, reduces execution errors, and increases productivity, thereby ensuring high accuracy in design and installation.

Fig. 10 illustrates the routing of drainage and water supply pipes, the method of connecting them to the tank, as well as the distribution of the air-conditioning system and its pipe routing in a neat and organized manner that prevents interference and clashes.

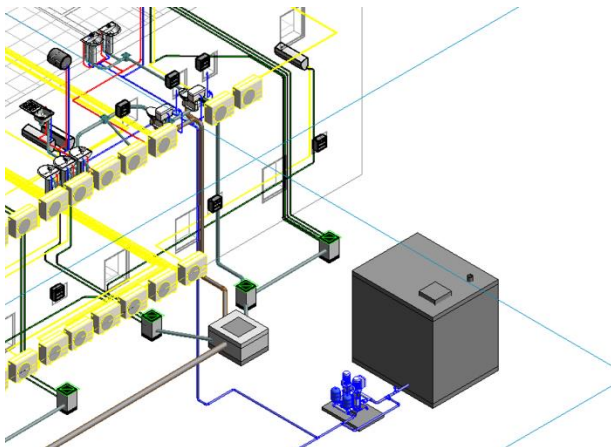


Figure 10. Modeling of drainage, water supply, and air-conditioning systems using Revit.

The importance of understanding pipe connections lies in detecting concealed leaks, as knowledge of pipe routing and connections allows leak sources to be identified and repaired quickly, thus preventing significant water loss. Properly distributed and correctly connected pipes also improve water pressure, reducing the need for additional pumping and thereby lowering consumption. Knowledge of pipe type and diameter

further allows for the selection of high-quality spare parts that prevent corrosion and breakage, thereby enhancing efficient system maintenance. In addition, identifying the locations of main and branch valves facilitates the installation of water-saving devices. It should also be noted that producing accurate plumbing drawings greatly assists in identifying the paths of hot and cold-water pipes, which is a fundamental step in ensuring good water distribution quality.

Third: Clash Detection and Interference Identification:

In addition to the major benefit Revit provides in detecting clashes and conflicts among plumbing, electrical, and mechanical systems, it also plays a key role in detecting architectural and structural clashes before construction begins, that is, during the design phase, which contributes to saving effort, time, and cost. For example, Fig.11 shows that the dimensions of the storage room are incompatible with the dimensions of the columns, causing insufficient clearance for the door opening and reducing storage space

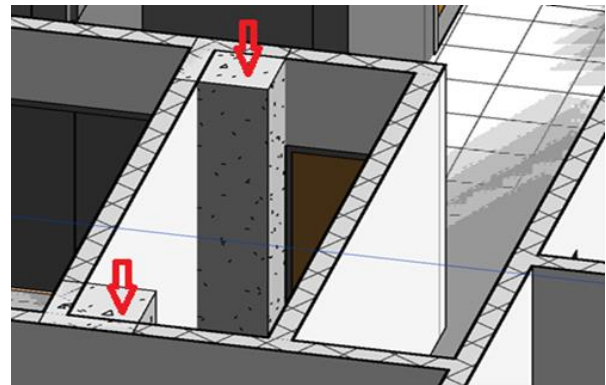


Figure 11. Structural-architectural clashes.

Fig. 12 shows that the louver height is greater than the height of the external wall below the beam, meaning that the louver box would be installed directly on the beam, which is incorrect. This problem can be resolved by modifying the louver door dimensions to suit the dimensions of the wall beneath the beam. Revit therefore helps identify the design dimensions of doors and windows during the design phase, thereby reducing cost and time by ensuring that the correct dimensions are known before these elements are brought to the site.

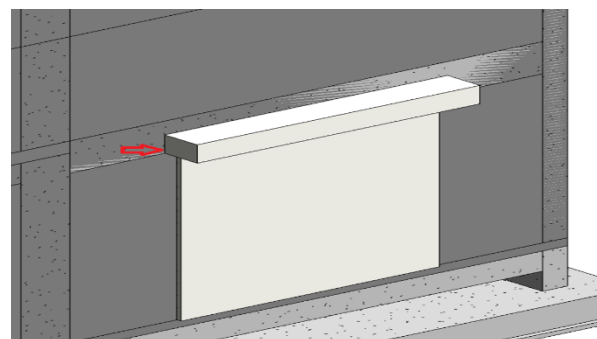


Figure 12. Shows that the louver height is greater than the height of the external wall below the beam.

Fig. 13 shows that the beam does not connect to the column and that the wall is offset from the beam above it, which constitutes a structural defect. If not corrected, it could cause cracks and future defects.

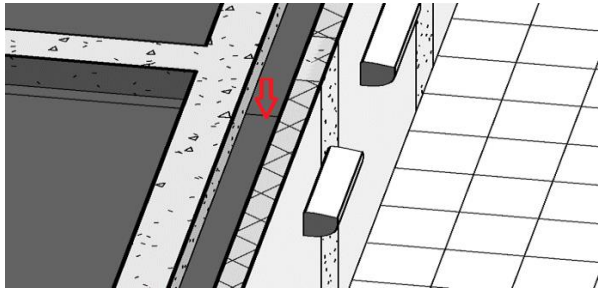


Figure 13. Shows that the beam does not connect to the column and that the wall is offset from the beam above it.

Fig. 14 shows a conflict between the location of the column and the adjacent door, noting that there is no alternative entrance to the room and no available space that can be allocated for another door.

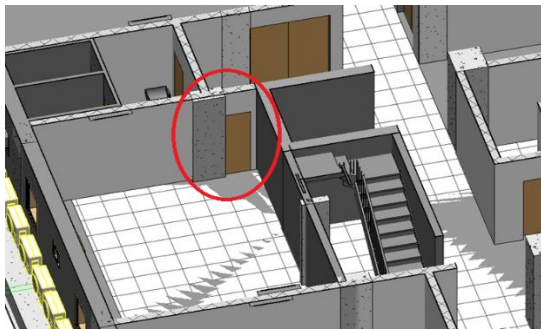


Figure 14. Shows a conflict between the location of the column and the adjacent door.

Fig. 15 shows that drainage pipes pass through the concrete beam, which is structurally unacceptable. This problem may be addressed by adding an external architectural projection through which such pipes can pass.

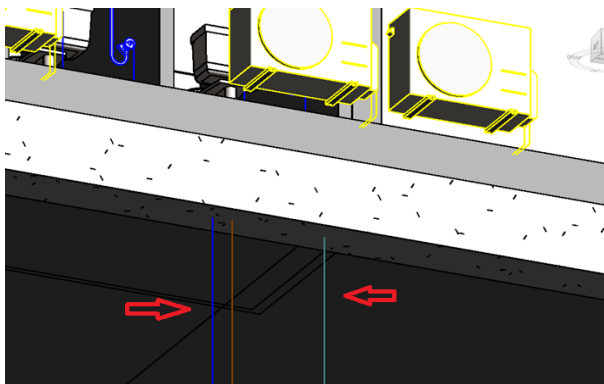


Figure 15. Shows that drainage pipes pass through the concrete beam.

Fourth: Quantity Takeoff:

Revit helps calculate the quantities of structural and architectural materials accurately, as well as the quantities of mechanical installations, the number of air-conditioning units (indoor and outdoor units), and the number, lengths, and dimensions of plumbing pipes. This benefits all project stakeholders. Through quantity takeoff, Revit contributes to preparing a detailed budget based on design drawings, which helps avoid unexpected increases and thus enables more accurate project cost estimation. It also contributes to reducing waste by preventing over-purchasing of accurately estimated materials and avoiding excess quantities that may lead to waste accumulation and debris on site. Furthermore, it assists in site planning and management during execution by facilitating the allocation of materials and labor for each project stage. It also contributes to the preparation of a comprehensive record that can be referred to during the operation and maintenance phases and supports the planning and design of future projects through thorough documentation of all project stages. The method of calculating quantities in Revit can be illustrated by following the path below within the software. As an applied example, the quantities of only the foundations for the studied building will be calculated.

By following the same method shown in Table 1, quantities can be calculated for all project elements.

5.3. Revit and the LEED System for Evaluating Sustainable Buildings

To clarify the actual effectiveness of Revit in achieving sustainability, it was necessary to compare the contributions provided by this software with widely recognized and commonly adopted sustainability assessment criteria. In this research, the criteria included in the LEED system for evaluating sustainable buildings [9] were mapped against the contributions provided by Revit in order to determine the sustainability aspects covered by this software; in other words, to estimate the percentage of sustainability that can potentially be achieved through reliance on Revit.

(The authors emphasize that it can be assumed that the sustainability standards included in the LEED system can be applied in general, contrary to some previous studies that indicate the lack of a fixed and unified assessment system for sustainability standards due to the difference in construction conditions between one region and another [9]. However, the LEED system was adopted to highlight the role of Building Information Modeling and Revit in achieving sustainability standards, and thus to use LEED as a means of measurement and comparison.

Table 1. Steps for Calculating Building Element Quantities in Revit.

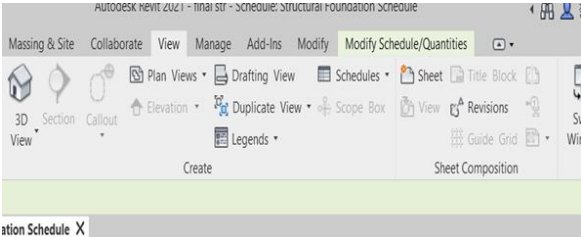
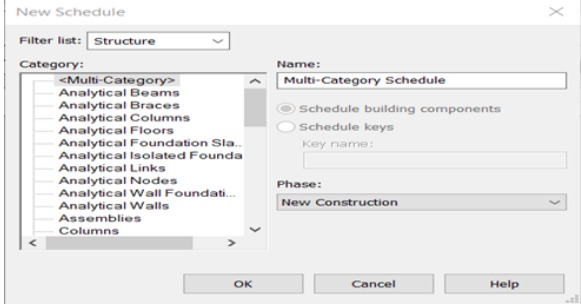
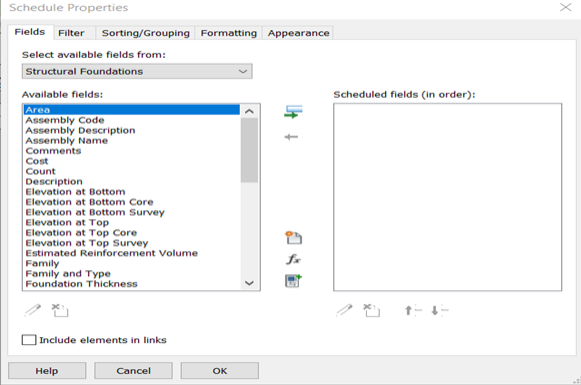
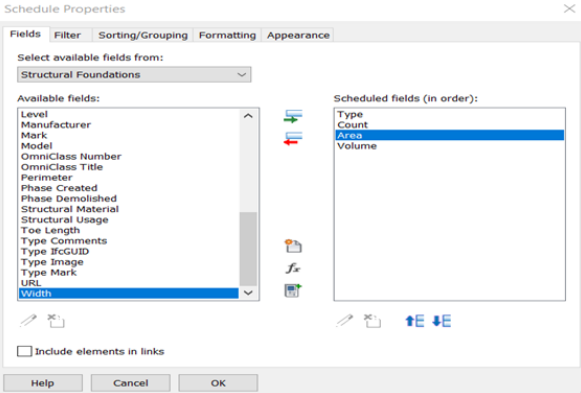
Illustration	Tool	Step
	From the View menu, choose Schedules	1
	Select Structure	2
	Under Category, choose Foundation	3
	Select the quantities to be calculated for foundations, such as Type, Area, Volume, and Cost	4
	The required quantity and cost schedule is displayed	5

Table 2 presents the main evaluation criteria within the LEED system, together with their relative weights and allocated points, based on selected reference studies relevant to this context [9], [14], [15].

Based on the practical study of the selected building, Table 3 summarizes some of Revit's sustainability-related contributions and their correspondence with LEED sustainability criteria.

Table 2. Evaluation criteria according to LEED.

Number	Evaluation criteria	Relative weights	points allocated
1	Sustainable Site Design	24%	32
2	Water Conservation	9%	38
3	Energy Consumption	32%	38
4	Construction Materials and Resources	13%	16
5	Indoor Environmental Quality	13%	21
6	Management, Design, and Innovation	9%	11
Total		100%	156

6. Results and Discussion

Table 3 presents findings on the contributions of the Revit program—as a BIM tool—to achieving building sustainability, based on a comparison with the American LEED (Leadership in Energy and Environmental Design) system criteria; notably, the table includes a dedicated column for quantitative analysis and discussion.

Table 3. Comparison Between Revit's Sustainability Contributions and LEED Criteria.

No.	LEED Sustainability Criteria	Contributions of Revit	Quantitative analysis and discussion
1	Sustainable Site Design	Design compatible with solar orientation; design compatible with prevailing wind direction; optimal use of interior and exterior open spaces	The efficiency of site sustainability and the percentage achieved by Revit depend primarily on the design engineer's decisions, but several studies indicate that integrating Revit for site sustainability can contribute to reducing energy consumption by up to 50% and decreasing building material waste by approximately 32%. Autodesk Revit doesn't specify a fixed percentage for its contribution to water savings. Instead, it provides building information design (BIM) tools and analysis that help engineers achieve the required savings for sustainability certifications (such as LEED or BREEAM), which typically range from 20% to over 50% [20]. This is accomplished through the following mechanisms: c. Water network calculations and designs. Integration with sustainability systems (e.g., LEED). d. Water-related energy consumption analysis: Autodesk Revit supports simulation and analysis of the performance of sustainable buildings, where water consumption is closely linked to energy savings and water-saving solutions. Revit does not automatically provide a fixed energy ratio, but rather achieves savings that typically range from 15% to 30% of energy costs. These savings are achieved through its available environmental design analysis and optimization tools (such as Autodesk Insight), which guide the reduction of the building's energy consumption. There is no fixed percentage for Revit's contribution to material and resource sustainability. Instead, the software is used as a Building Information Modeling (BIM) platform to extract material quantities, which are then analyzed by Life Cycle Assessment (LCA) to determine reductions in carbon emissions and resource consumption. Material and resource sustainability is assessed and managed using Revit through the following mechanisms: ➤ Accurate Quantity Takeoffs: Revit generates precise tables of the sizes and quantities of
2	Water Conservation	Determining the routing of drainage and water supply pipes, the locations of fittings and bends, the optimal positioning of tanks, and generating accurate documentation drawings for operation and maintenance	
3	Energy Consumption	Designing the building while considering solar radiation and solar path contributes significantly to natural lighting and thus reduces electrical energy consumption; likewise, design based on prevailing wind direction contributes to natural ventilation and reduces mechanical energy consumption	
4	Construction Materials and Resources	Accurate quantity takeoff before execution enables designers to identify materials and their uses, including environmentally friendly materials, within the model. This contributes greatly to reducing material waste, decreasing depletion of non-renewable resources, and reducing debris and waste accumulation on site	

5	Indoor Environmental Quality	Revit contributes to creating an accurate simulation model for environmental performance, improving daylighting and ventilation, and effectively coordinating MEP systems to avoid clashes, thereby ensuring the comfort and health of building occupants before execution	building materials required for a project, minimizing material waste. ➤ LCA Plugins: Revit models are integrated with analytical tools such as One Click LCA or Tally to calculate embodied carbon and assess the environmental impact of materials. ➤ Sustainable Material Selection: Through assessment, the footprint of materials (e.g., concrete versus wood) can be compared, environmentally friendly alternatives can be selected, and Environmental Product Declarations (EPDs) for each product can be evaluated. Autodesk Revit indirectly contributes to indoor environmental quality by providing 100% of the Building Information Modeling (BIM) tools that impact comfort factors. Digital data contributes 16% to 20% to the Indoor Environmental Quality (EQ) rating in standardized green building assessments (such as LEED). The software improves the building environment by meeting global assessment standards across the following areas: ➤ Thermal Analysis and Ventilation (Thermal Comfort & IAQ) ➤ Natural Lighting (Daylight) Studies ➤ Material and Acoustic Control
6	Management, Design, and Innovation	Innovative design through the creation of accurate parametric three-dimensional models enables performance simulation, early detection of engineering clashes, and automatic updating of modifications across all views. It also enhances building management through real-time data exchange, quantity and cost estimation, and improved energy efficiency. The software integrates architectural, structural, and MEP disciplines in one model, revealing system interferences and reducing costly site errors. It generates accurate and detailed schedules that are automatically updated with any model change, supports teamwork by allowing architects, designers, and engineers to work simultaneously on the same model, improves communication, reduces production time, and provides realistic visualizations and simulations that help stakeholders better understand the design and avoid defects before construction.	Mechanisms for supporting sustainability through creativity and innovation in Revit: ➤ Total energy analysis: Use Autodesk Insight to analyze thermal loads and accurately calculate operational carbon emissions. ➤ Innovation in materials assessment: Assess the embedded carbon in building materials before implementation. ➤ Building information modeling: Revit provides a precise information environment that enables innovation in green building strategies and facilitates compliance with global sustainability standards.

The percentages of the most important contributions of the Revit program to achieving sustainability standards can be summarized in Table 4.

Table 4. The percentage of the most important contributions of the Revit program in achieving building sustainability standards.

Criteria	Percentage %
Improving energy efficiency	20-30
Reducing waste	25
Reducing carbon emissions	50
Achieving lifecycle savings in the building	15-20

7. Conclusions

This research confirms that Revit contributes significantly to achieving building sustainability criteria, making it a leading tool within the BIM methodology. Revit enables engineers and architects to design and model buildings accurately in three dimensions and document them with comprehensive information, while integrating all disciplines architectural, structural, mechanical, and electrical within a single model. This facilitates collaboration, performance analysis, and reduces errors and project costs.

When the contributions Revit provided were mapped against the principal sustainability assessment criteria in the LEED system, it became clear that using this software in building design and modeling can achieve high levels of the desired sustainability. Revit contributes to site sustainability by

analyzing solar radiation, shadow behavior, and building orientation based on prevailing wind direction. It also supports water conservation by analyzing and identifying pipe diameters and routing, as well as optimal locations for water tanks and collection points. It also reduces energy consumption by enhancing natural ventilation, daylighting, and the optimal use of open spaces within and around the building. Through accurate quantity takeoff, it supports the adoption of specified, carefully selected environmentally friendly materials and minimizes material waste, thereby reducing non-renewable resource depletion. Revit also contributes substantially to indoor environmental quality by monitoring performance during operation and maintenance and by effectively coordinating mechanical, electrical, and plumbing systems to detect clashes and avoid interference among different engineering disciplines. From a management perspective, the software is also important because it enables real-time data exchange and accurate cost and quantity estimates through schedules that can be continuously updated with every modification to the model drawings. Revit also strengthens teamwork by enabling designers, architects, and engineers to work on the same model simultaneously, improving communication, reducing production time, and providing realistic visualizations and simulations that support better design understanding and defect avoidance before construction.

8. Recommendations

Given the major sustainability-related benefits that Revit can provide as a leading BIM tool, and in light of the local context with its significant economic and environmental challenges, especially during the anticipated reconstruction phase, modern and sustainable technologies represent a direct and essential response to practical needs and realities. It is therefore necessary to invest in these opportunities and work seriously toward transforming the conventional patterns used in the design, execution, and operation of buildings so that they become more sustainable through reliance on advanced and modern technologies represented by BIM and its important and effective tools such as Revit and others. Accordingly, the research recommends the following:

- 1- Developing training and qualification programs for engineers and professionals working in the construction industry on modern and advanced technologies such as BIM and the engineering tools and software it provides across all engineering disciplines, with the aim of raising professional competence and keeping pace with labor market requirements.
- 2- Organizing scientific seminars and conferences to clarify the importance of BIM in achieving sustainability, the ways in which its software can be integrated with sustainability criteria, and the mechanisms for benefiting from such integration at the local level.
- 3- Integrating sustainability criteria into local building laws and regulations in a manner that contributes to reducing effort, time, and cost, conserving water and energy, and realizing many other associated benefits.
- 4- In the context of future research related to this topic, the authors recommend incorporating the sub-criteria derived from

the main assessment criteria of the LEED system into any assessment, comparison, or measurement of sustainability to obtain more accurate and clearer results.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

Use of LLM and AI

None declared.

Author's Contribution

Mohammed Ali Alshamali proposed the concept and methodology and wrote the original draft. He wrote, reviewed, and edited the manuscript. Researcher Alhsen Zeno supervised the use of Revit software, data analysis, linguistic editing, and translation. All authors discussed the results and contributed to the final manuscript.

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References

- [1] A. Hammed, R. Gharib, M. Zenhom, and M. Ezzat, "The role of building information modeling (BIM) software in enhancing LEED certification standards for interior design," *Arab International Journal of Digital Art and Design*, vol. 4, no. 2, pp. 15–42, 2025. doi: <https://doi.org/10.21608/iajadd.2025.316947.1134>.
- [2] Autodesk, "What is BIM | Building Information Modeling," 2025. [Online]. Available: <https://www.autodesk.com/solutions/aec/bim>.
- [3] L. H. Qiang and T. Badarch, "Exploration of Revit software aided architectural design education based on computer BIM technology," *American Journal of Computer Science and Technology*, vol. 5, no. 2, pp. 56–62, 2022. doi: <https://doi.org/10.11648/j.ajcst.20220502.15>.
- [4] S. Akbari, M. Sheikhhoshkar, F. Pour Rahimian, H. B. El Haouzi, M. Najafi, and S. Talebi, "Sustainability and building information modelling: Integration, research gaps, and future directions," *Automation in Construction*, vol. 163, Art. no. 105420, 2024. doi: <https://doi.org/10.1016/j.autcon.2024.105420>.
- [5] C. I. El Hajj and G. Martínez Montes, "Examining green building practices: The influence on building information modeling function diffusion," *Sustainability*, vol. 17, no. 9, Art. no. 3843, 2025. doi: <https://doi.org/10.3390/su17093843>.
- [6] T. Borisova, Y. Molchanova, and E. Ermakova, "The future of green building: The role of VR and artificial intelligence in improving BIM efficiency," *E3S Web of Conferences*, vol. 614, Art. no. 05004, 2025. doi: <https://doi.org/10.1051/e3sconf/202561405004>.
- [7] M. Abu El-Hagag, O. El Nawawy, A. Ragab, T. Al-Salakawy, and D. Said, "Towards a sustainable approach for effective solutions to integrate building projects from design to construction," *Journal of Environmental*

- Science*, vol. 54, no. 7, pp. 1968–1999, 2025. doi: <https://doi.org/10.21608/jes.2025.362229.1972>.
- [8] B. M. T. Sidhom, “BIM-based model of energy analysis heating and cooling loads for residential building in Egypt,” *Journal of Architecture, Arts and Humanistic Science*, vol. 9, no. 48, pp. 81–98, 2024. Available: <https://aaciaegypt.com/wp-content/uploads/2024/11/BIM-Based-Model-of-Energy-Analysis-Heating-and-Cooling-Loads-for-Residential-Building-in-Egypt-Page-81-98.pdf>
- [9] M. A. Alshamali and M. Ibrahim, “Recalculating the sustainability criteria within the LEED system according to the Syrian construction conditions using the FAHP method,” *Jordan Journal of Applied Science—Natural Science Series*, vol. 17, no. 1, pp. 1–7, 2023. doi: <https://doi.org/10.35192/jjoas-n.v17i1.330>.
- [10] S. Adum, S. Ahmed, and A. Kadi, “Modeling sustainability standards and evaluation systems in high-rise buildings: Systematic review,” *International Journal of BIM and Engineering Science*, vol. 9, no. 1, pp. 11–16, 2024, doi: <https://doi.org/10.54216/IJBES.090102>.
- [11] Center for Digital Built Britain, “The UK BIM Framework,” 2020. [Online]. Available: <https://www.cdbb.cam.ac.uk/BIM/uk-bim-framework>.
- [12] E. Alasmari, P. Martinez-Vazquez, and C. Baniotopoulos, “Building information modeling (BIM) towards a sustainable building design: A survey,” *CESARE Conference Publications*, Art. no. 101, 2022. [Online]. Available: https://research.birmingham.ac.uk/files/180130138/Esam_Alamari_CESARE22_accepted_manuscripts.pdf
- [13] C. A. Diaz Schery, R. G. G. Caiado, E. T. Corseuil, and H. Neves, “Bridging BIM maturity with emerging paradigms: Understanding the role of Industry 4.0 and sustainability in the digital transformation of construction,” *Construction Innovation*, vol. 26, no. 7, pp. 2284–2343, 2026. doi: <https://doi.org/10.1108/CI-10-2024-0305>.
- [14] M. Zakaria, N. Mridha, S. Hossain, M. S. R. Khan, and L. Chunga, “The role of building information modeling (BIM) in enhancing efficiency, sustainability, and integration with emerging technologies,” *European Journal of Theoretical and Applied Sciences*, vol. 2, no. 6, 2024, doi: [https://doi.org/10.59324/ejtas.2024.2\(6\).60](https://doi.org/10.59324/ejtas.2024.2(6).60)
- [15] M. A. Alshamali, “Evaluating the sustainability criteria of the Damascene Islamic house based on the Leadership in Energy and Environmental Design (LEED),” *International Journal of BIM and Engineering Science*, vol. 12, no. 1, pp. 1–11, 2026. doi: <https://doi.org/10.54216/IJBES.120101>.
- [16] M. Z. Al-Shwabkeh, R. S.-E. Ghoneim, and M. A. R. Arabasy, “Using building information modeling (BIM) to improve the conventional interior design process,” *Dirasat: Human and Social Sciences*, vol. 51, no. 1, pp. 414–429, 2024. doi: <https://doi.org/10.35516/hum.v51i1.758>.
- [17] M. Nabawy, A. G. Mohamed, I. Awad, and A. O. Daoud, “Green building information modeling framework for sustainable residential development in Egypt,” *Buildings*, vol. 15, no. 7, Art. no. 1035, 2025. doi: <https://doi.org/10.3390/buildings15071035>.
- [18] G. T. N. Veerendra, S. Dey, E. J. Mantle, A. P. Manoj, and S. S. A. B. Padavala, “Building information modeling—simulation and analysis of a university edifice and its environs—a sustainable design approach,” *Green Technologies and Sustainability*, vol. 3, no. 2, Art. no. 100150, 2025. doi: <https://doi.org/10.1016/j.grets.2024.100150>.
- [19] A. K. Tamimi, G. Kashwani, A. Hamam, I. A. AlHaj, Y. Himeidi, and B. Ramadan, “Building information modeling (BIM) for energy optimization in green buildings: A case study of a residential villa in the UAE,” *Emirati Journal of Civil Engineering and Applications*, vol. 2, no. 2, pp. 51–54, 2024. doi: <https://doi.org/10.54878/mpv0jg86>.
- [20] H. Yin, J. Liu, M. Liu, and X. Li, “Research on BIM technology of green building based on GBSWARE software,” *Buildings*, vol. 15, no. 13, Art. no. 2297, 2025. doi: <https://doi.org/10.3390/buildings15132297>.