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A COMPARATIVE STUDY OF MULTISTORIED BUILDING USING THE BUILDING INFORMATION MODELLING (BIM) METHOD & CONVENTIONAL MODELING METHOD

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ABSTRACT

Although the construction industry has been evolving for centuries and researchers have been seeking innovative solutions for decades, diverse challenges still exist in making the construction process faster, safer, cheaper, and more accurate. Building Information Modelling (BIM) is one of the emerging tools in the field of architectural engineering to overcome these problems. Applications of this tool are very promising but its uses are still relatively limited in many countries including Bangladesh. So this study conducted a pilot project and case study analysis using Building Information Modeling (BIM) to control the project's time and cost from Bangladesh's perspective. The objectives of this study are: (1) to examine the benefits of using BIM for project time and cost control and (2) to study the challenges of applying BIM to a case project during its life cycle. This project is being achieved by introducing Autodesk Revit MEP (2021) as the methodological tool of BIM software. The resultant data in the BIM system are extremely useful and can be generated to optimize the project delivery processes. The results also revealed that using a case study, BIM functions to help reduce costs, optimise the schedule, and make benefits for all project participants. Thus, model-based cost estimation and time schedule optimization show effective results of using BIM instead of conventional modelling methods.

INTRODUCTION

Building information model (BIMs) is a tool to support decision-making in constructing building or other built asset. At present, BIM tool is used by individuals, businesses and government agencies who plan, design, construct, operate and maintain diverse physical infrastructures including water, refuse, electricity, gas, communication utilities, roads, bridges, ports, tunnels, etc. Building Information Modelling (BIM) is an emerging technology in the construction industry since it offers various benefits over conventional construction drawings (Azhar et al., 2008).

After seeing the outcomes of this study, it would be beneficial to conduct further study about the use of BIM. Because the Architecture, Engineering and Construction (AEC) industry is still at a stage transferring into the 3D world, a lot more research would be required to promote the development of new techniques. Overall, the cost of the BIM and its supporting technologies can be expensive at the start. However, the powerful uses of BIM increase profits, lowers costs, and shorten scheduling time. This nature determines that BIM will be the trend of the AEC industry. Thanks to the advanced technology, various software is developed to extend the BIM application. But not all of them are suitable for any kind of projects. So the

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new technologies still need time for researchers to test. In this study only one case was studied, and the type of project were limited.

Therefore, a direction for future work on this subject is to develop more studies on various projects. More research about the connection and compatibility of BIM tools with other software will also be inquired. Because multi-dimensional models are becoming more attractive for multivariate data visualization, their application would require further review.

LITERATUR REVIEW

BIM was first adopted in Georgia Institute of Technology in 1970s and spread firstly after that. BIM tool comprises virtual design of a structure which exhibit virtual elements of actual building parts and pieces for constructing a building. These virtual elements are digital prototype of physical building elements that allows us to simulate the building and understand its behavior in a computer environment way before actual construction starts. BIM provides a much better means of communication and distribution of information between clients, construction and architecture firms and legal authorities involved in project (Martin & John, 2004).

Till now, when construction managers are dependent on historical data to execute a building project. And then, they adjust somewhat by their own experiences. However, construction productivity changes dynamically every day. The fluctuation between a plan and execution brings cost overruns and duration extension on construction site. If production is greater than the expected, resources such as labors and equipment will be wasted and materials will be scarce.

Thus, this situation leads to waste money from inputting unused resources such as labors, equipment, and time. On the other hand, if production is lesser than the expected, it also leads to problematic situations on construction site; materials will be remained, managerial cost from unused materials will increase, and delay will happen. Therefore, to decrease cost overruns and delay extension, the reliable prediction of productivity is required in construction management field (Wang & Dunston, 2006).

Building information modeling (BIM) technology has been receiving an increasing attention in the architecture, engineering, and construction (AEC) industry. Unlike traditional computer aided design (CAD) technology, BIM technology allow storing both geometric information and rich semantic information of building models, as well as the relationships, to support lifecycle data sharing. In terms of information technology (IT) adoption, BIM is a new trend in the AEC industry (Li et al., 2014).

MATERIALS AND METHODS

The main purpose of this research is to conduct a pilot project and case study of using BIM to help control the project's time and cost. The objectives of this study are: (1) to examine the benefits of using BIM for project time and cost control and (2) to study the challenges of applying BIM to a case project during its life cycle. This project is being achieved by introducing Autodesk Revit MEP (2021version) as the BIM software to develop project control and by generating data from the case-study project with a local architect and construction firm for discussion and analysis.

First, a literature review is conducted mainly considering the approaches of project time and cost control, and CAD and BIM applications. Basic concepts and current methods of project time and cost control are reviewed and presented. Existing problems that cause time and cost overruns in the AEC industry is described. Then a local architect and construction management firm is consulted to work together with a real project's BIM model. The process and model are analyzed. Data analysis based on the 3D models is conducted to illustrate how this new project deliver method can help optimize a project's time and cost control. Major challenges for the BIM process are stated, and the solutions to address these challenges are also addressed.

Table 1 shows the main BIM software used for construction management. Some of this software is designed to collect as much information as possible, while others are developed for special purpose depending on the user's needs. However, adopting BIM techniques involves much more than simply switching to its supporting software. The basic function of BIM is to enable 3D modeling and information management. Supporting by the software, BIM will lead to a unified system consisting of all interacting parts.

Table 1. BIM Software Tools

Product Name	Manufacturer	Primary Function
Navisworks Manage	AutoDesk	3D model-based design and clash detection
Revit	AutoDesk	Dynamic coordination between models and disciplines
Digital Project Suit	Gehry Technologies	Full featured suite: design, review and information management
Solibri Model Checker	Solibri	Quality Assurance/Quality Control (QA/QC)
Synchro Professional	Synchro Ltd.	Scheduling system and planning simulations
Tekla Structures	Tekla	3D structural modeling and detailing
Vico Office	Vico Software	Various 3D model analysis for coordination, scheduling and estimating

RESULTS AND DISCUSSION

A case study is developed to discuss how the application of BIM affects time and cost control in practice. The Revit model is studied to analyze the BIM applications. Major benefits and challenges from the project are summarized.

Project Overview

- Building type: Multistory
- Location: Banani, Dhaka, Bangladesh
- Area: 50,000 square feet
- Total floor: 11 Nos
- Basement: 1 Nos
- Typical floor: 6 Nos
- Total room: 50 Nos.
- Fully air conditioned.
- 1 elevator with 8 people capacity

Model Analysis and Discussion

BIM Process

Figure 1 shows the basic BIM process of project delivery. The project usually starts with the development of 3D BIM models. This stage is complex; during it the architects design and test the models, back and forth until no more clashes are detected visually. At that time, the coordinated BIM model is formed. Quantities can be extracted from this model for estimating, scheduling, etc. During construction, BIM models are used for directing, decision making and change management. After the project is finished, an as- built model is prepared for future use, bringing the model to another project cycle. The BIM models act as interactive connections to coordinate all project participants throughout the design, pre-construction, facility management, and renovation project life cycle.

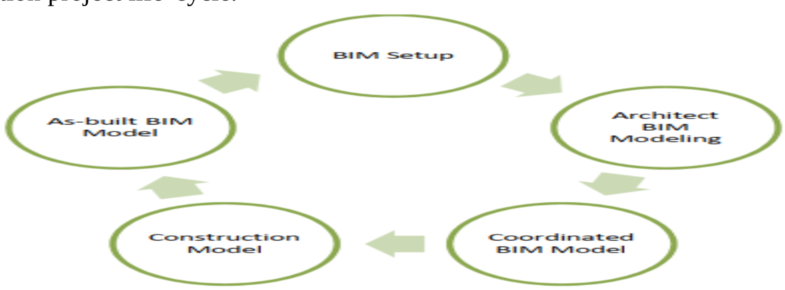


Figure 1. BIM Process

3D Visualization

Visualization is the apparent benefit that users have with BIM. BIM models are created by accurately simulating the actual project field. These models enable the users to see the building before the ground is broken. This function is tremendously important for all the project stakeholders because it can be difficult to visualize the structure from a stack of 2D drawings. Fig. 2, Fig. 3, Fig. 4, and Fig. 5 show the different views of the retail center model created in Autodesk Revit MEP 2022. The parametric flexibility offered in Revit is compelling. Unlike 2D applications, the views in BIM models are very similar to the real world. Each model is visible both vertically and horizontally; one can look over and under the models as well as from side to side without any other tools. Furthermore, Revit also enables the users to virtually walk through the space and to view the interiors and exteriors from a variety of angles prior to the start of any construction. Thus, the 3D visualization provides the client with a directly accurate impression for how the finished project would look.

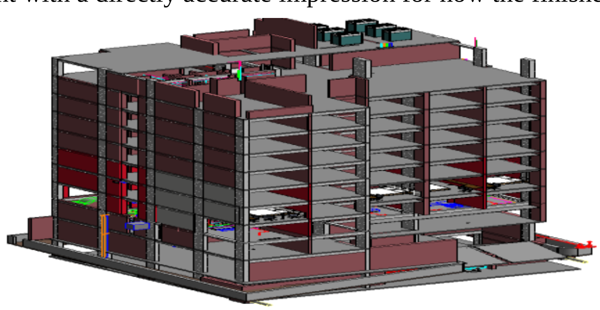


Figure 2. Multistoried Building-3D View

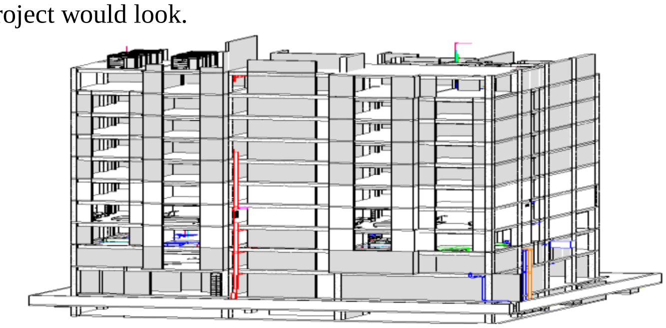


Figure 3. Multistoried Building: East View

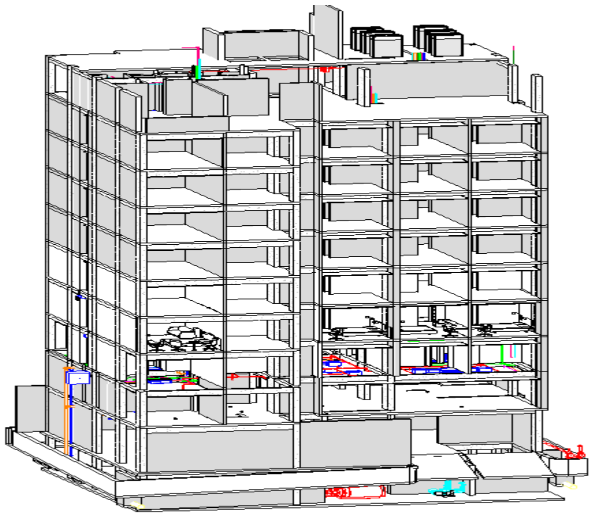


Figure 4. Multistoried Building: North View

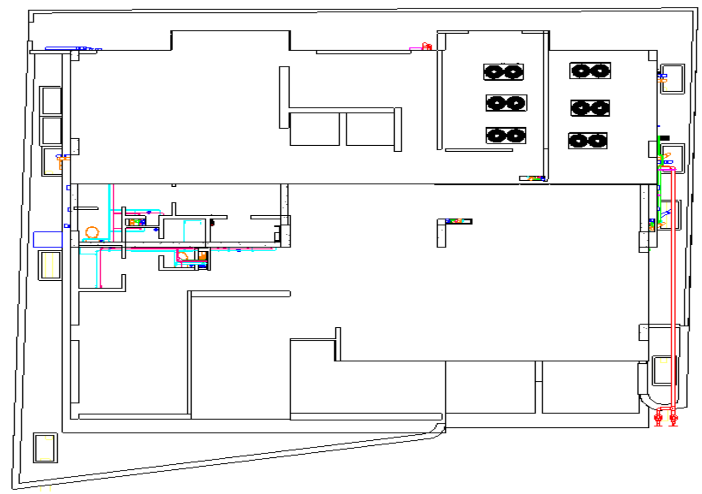


Figure 5. Retail Center: Top View

In addition, the 3D environment in Revit makes it very convenient to carry out conflict detection to identify the physical clash of building components. This function is used mostly for structure and MEP installation, but can also be used to detect design mistakes based on the 3D visualization. It is a common problem that design teams are working under pressure to complete their work at the lowest price to remain competitive. Shortcuts, which may cause design mistakes, are often taken. In traditional processes, people have to go through complex procedures to locate the interferences during the design phase. Otherwise, the mistakes remain hidden until problems are encountered when the project is moved to the construction phase. With this circumstance, change orders are the common way to keep the project moving. This process, inevitably, will affect the original plan, resulting in overtime and extra cost. Therefore, the later conflicts are found, the harder they are to control. With the BIM process, the coordinated models allow users to check for design conflicts and potential constructability issues among all the building systems at the front end of a project from the office instead of at the job site. This way can drastically reduce the number of change orders, save thousands of dollars in wasted effort, and accelerate the build process and time to market.

Information Integration

The information silo and information gap, resulting in the lack of data-exchange standards and information-integration mechanisms during the development of information for the construction industry, have made it difficult for the exchange and sharing of information during the different phases and different application systems, and have blocked the application of information technology in the construction area. Therefore, it has become a research direction and trend to construct the building life cycle management framework and to develop an integrated information management system in order to enhance the application level of information technology (IT) in the building industry.

The core essence of BIM is "I", which represents the information that the BIM models can carry. Unlike a 2D drawing, the 3D models created in Revit are not only simple graphics of the future building; but they also record all data for a project throughout the project life cycle. Each element input into the Revit model must be defined in detail. As Fig. 6 shows, when a door is created in Revit Architecture, its basic properties, such as material, type, thickness, height, width, fire rating, etc., are defined. When the information is input, the data are saved in the database corresponding to the component.

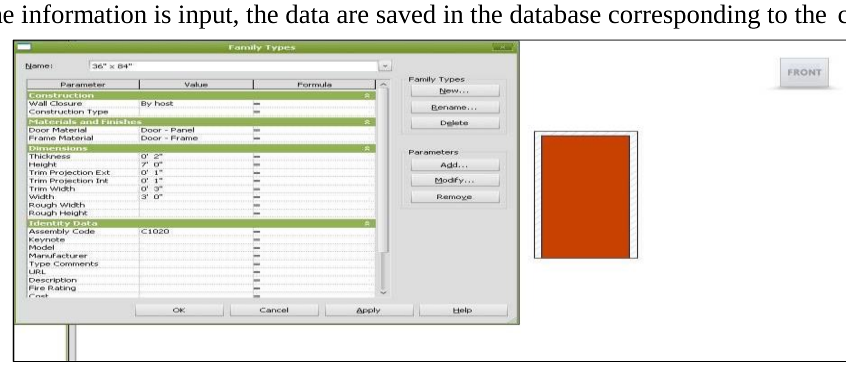


Figure 6. Define a Door in Revit

When using traditional processes, the design and construction teams are disconnected. The architect creates a building component with 2D drawings, but when the contractor reviews the drawings at the job site, a different one may form in his mind. To minimize the probability of this error happening, BIM seeks to reconnect the information and the people. Fig. 7 shows the detailed properties for the door created as well as its 3D view. This function gives all the viewers direct and highly detailed information. The components can be as detailed as a small bolt used in the structures as shown in Fig. 8. The information is changeable according to the project plan anytime.

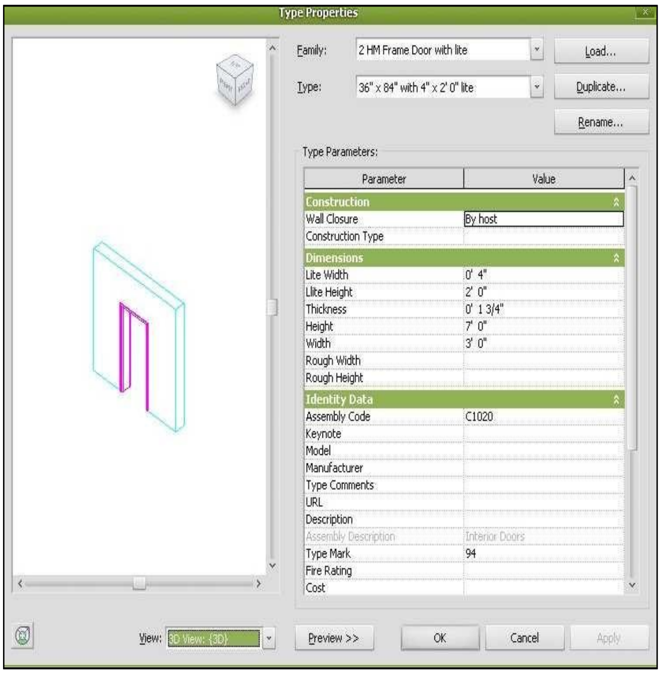


Figure 7. Door Properties in Revit

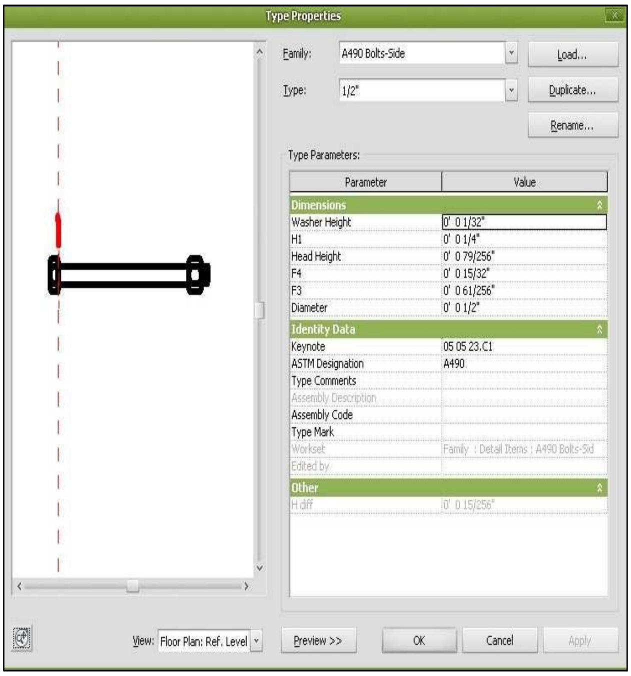


Figure 8. Properties of a Bolt in Revit

Meanwhile, the information in the database is not isolated by itself but linked with each other. Therefore, if one item is changed, the other related items are automatically updated. Likewise, the plans, drawings, specifications, takeoffs, etc. are all saved electronically in the same database at the time they are created. They can all be generated through relevant views. For example, Fig. 9 is the main floor view; Fig. 10 is part of the column material quantity takeoffs; Fig. 11 is the drawing sheet for the wall material takeoffs. They are all automatically recorded in the database during the design process, saving a large amount of time compared to the traditional process.

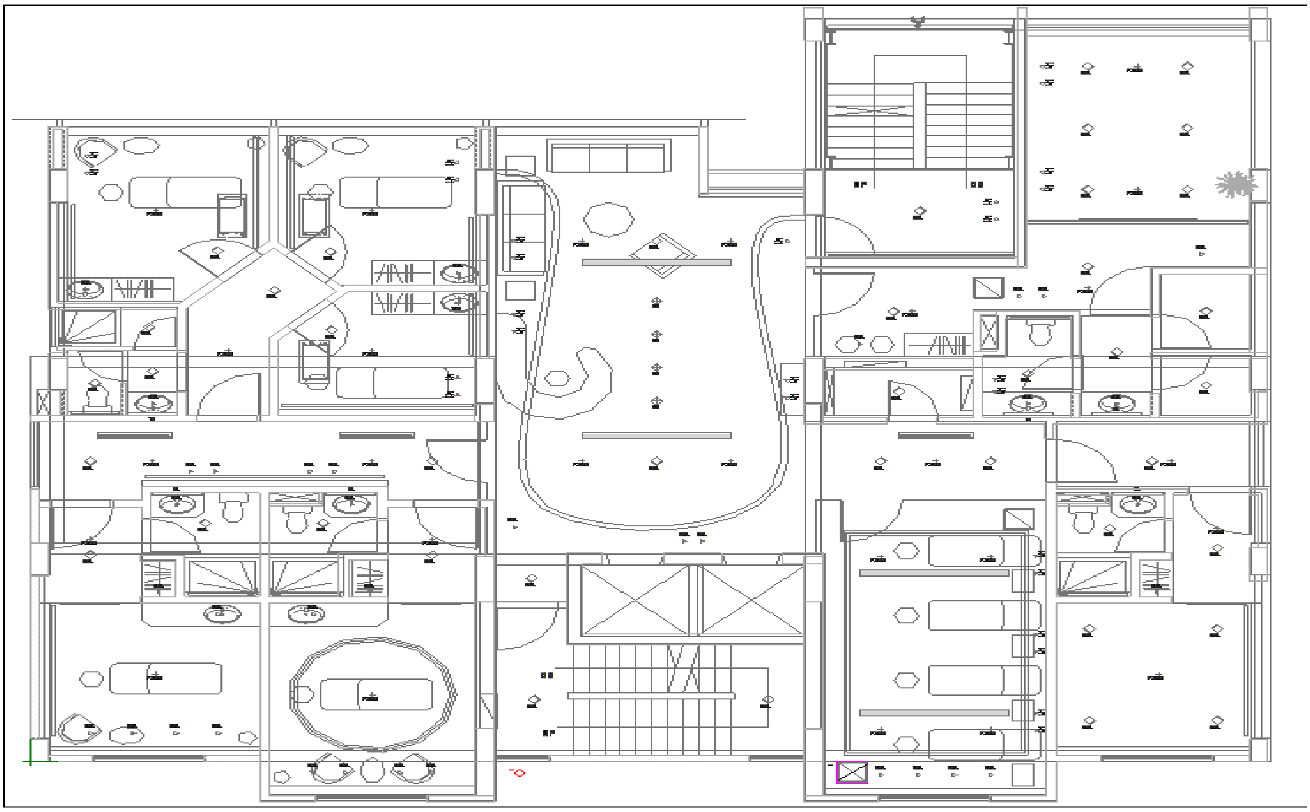


Figure 9. Main Floor Plan

<Analytical Column Schedule>

A	B	C	D
Family Type	Physical Material Asset	Count	Analyze As
Concrete-Rectangular-Column : 508 x 300	Concrete(1)	1	Gravity
Concrete-Rectangular-Column : 760 x 300	Concrete(1)	1	Gravity
Concrete-Rectangular-Column : 760 x 300	Concrete(1)	1	Gravity
Concrete-Rectangular-Column : 760 x 300	Concrete(1)	1	Gravity
Concrete-Rectangular-Column : 1060 x 300	Concrete(1)	1	Gravity
Concrete-Rectangular-Column : 1060 x 300	Concrete(1)	1	Gravity
Concrete-Rectangular-Column : 1060 x 300	Concrete(1)	1	Gravity
Concrete-Rectangular-Column : 1060 x 300	Concrete(1)	1	Gravity
Concrete-Rectangular-Column : 1060 x 300	Concrete(1)	1	Gravity
Concrete-Rectangular-Column : 1060 x 300	Concrete(1)	1	Gravity
Concrete-Rectangular-Column : 760 x 300	Concrete(1)	1	Gravity
Concrete-Rectangular-Column : 760 x 300	Concrete(1)	1	Gravity
Concrete-Rectangular-Column : 775 x 300	Concrete(1)	1	Gravity
Concrete-Rectangular-Column : 775 x 300	Concrete(1)	1	Gravity
Concrete-Rectangular-Column : 750x 300	Concrete(1)	1	Gravity
Concrete-Rectangular-Column : 750x 300	Concrete(1)	1	Gravity
Concrete-Rectangular-Column : 750x 300	Concrete(1)	1	Gravity
Concrete-Rectangular-Column : 508 x 300	Concrete(1)	1	Gravity

Figure 10. Part of Column Material Takeoffs

<Wall Schedule>

A	B	C	D
Family and Type	Area	Heat Transfer Coefficient (U)	Structural Material
Basic Wall: 1 inch wall wood color 2			
Basic Wall: 1 inch wall wood color 2			Wood - Dark
Basic Wall: 3 inch wall wood color			
Basic Wall: 3 inch wall wood color	1 SF		Wood - Dark
Basic Wall: 40 mm wall for ceiling			
Basic Wall: 40 mm wall for ceiling		0.7353 BTU/(h·ft²·°F)	
Basic Wall: Generic - 25 mm PAINTED BED SIDE WALL			
Basic Wall: Generic - 25 mm PAINTED BED		0.4015 BTU/(h·ft²·°F)	Acoustic Ceiling Tile 24 x 48
Basic Wall: Generic - 50 mm Brick Wall			
Basic Wall: Generic - 50 mm Brick Wall		1.9020 BTU/(h·ft²·°F)	Brick, Common
Basic Wall: Generic - 50mm Brick Wall 2			
Basic Wall: Generic - 50mm Brick Wall 2	109 SF		Paint - Blanco
Basic Wall: Generic - 75 mm Brick Wall			
Basic Wall: Generic - 75 mm Brick Wall		1.2680 BTU/(h·ft²·°F)	Brick, Common
Basic Wall: Generic - 75 mm Brick Wall 2			
Basic Wall: Generic - 75 mm Brick Wall 2	23 SF	1.2680 BTU/(h·ft²·°F)	Brick, Common
Basic Wall: Generic - 100 mm Brick Wall 2			
Basic Wall: Generic - 100 mm Brick Wall 2		0.9510 BTU/(h·ft²·°F)	Brick, Common
Basic Wall: Generic - 150mm Asphalt Shingle			
Basic Wall: Generic - 150mm Asphalt Shingl		0.5870 BTU/(h·ft²·°F)	Asphalt Shingle
Basic Wall: Generic - 150mm Brick Wall			
Basic Wall: Generic - 150mm Brick Wall		0.6340 BTU/(h·ft²·°F)	Brick, Common
Basic Wall: Generic - 150mm Brick Wall PAINTED			
Basic Wall: Generic - 150mm Brick Wall PAIN			Paint - BOC Red
Basic Wall: Generic - 170 mm Brick Wall			
Basic Wall: Generic - 170 mm Brick Wall	10 SF	0.5594 BTU/(h·ft²·°F)	Brick, Common
Basic Wall: Generic - 250 mm Asphalt Shingle			
Basic Wall: Generic - 250 mm Asphalt Shingl		0.3522 BTU/(h·ft²·°F)	Asphalt Shingle
Basic Wall: Generic - 250 mm Brick Wall 4			
Basic Wall: Generic - 250 mm Brick Wall 4		0.3804 BTU/(h·ft²·°F)	Brick, Common
Basic Wall: Generic - 250 mm Brick Wall PAINTED			
Basic Wall: Generic - 250 mm Brick Wall PAI			Blanco
Basic Wall: Generic - 300 mm Asphalt Shingle			
Basic Wall: Generic - 300 mm Asphalt Shingl		0.2935 BTU/(h·ft²·°F)	Asphalt Shingle
Basic Wall: Generic - 300 mm Brick Wall 3			
Basic Wall: Generic - 300 mm Brick Wall 3		0.3170 BTU/(h·ft²·°F)	Brick, Common
Basic Wall: Generic - 300 mm Brick Wall PAINTED			
Basic Wall: Generic - 300 mm Brick Wall PAI			Plasterboard
Grand total: 993			

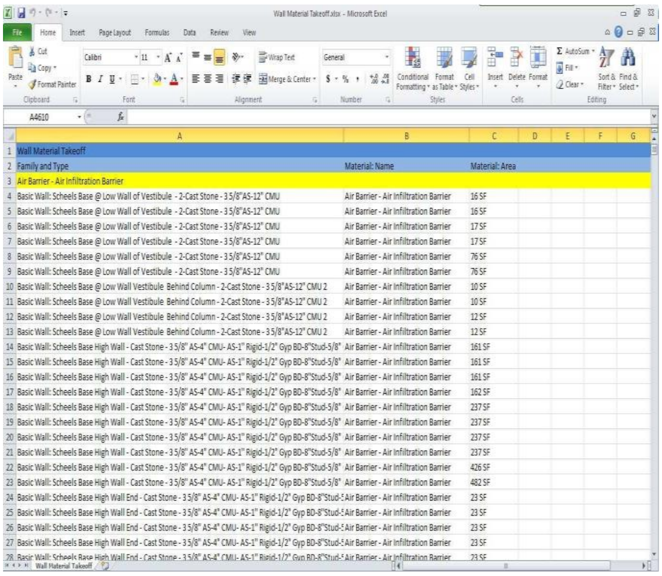
Figure 11. Wall Material Takeoff Drawing Sheet

Model-Based Cost Estimating

The first step of estimating is to identify the quantitative data that can be used because the accuracy of the data collection method is extremely important for the plan's outcome. BIM offers a new way to record data as real building components. For example, when all the properties of a window are defined in Revit, they are always grouped together. This means that part of the model can be scheduled or quantified as the window is created, which extremely decreases the amount of work for cost estimation.

Revit, as the design tool, automatically records and calculates the data input into the program, carrying information about quantity, cost, and types. These data are not independent. The function of Revit enables users to export data. For example, one can export the material takeoffs in Revit, put them into a Microsoft Excel spreadsheet (Fig. 12), and then send them to the cost estimator. The function of Revit enables users to export them out. For example, one can export the material takeoffs in Revit, put it into a spreadsheet, and then send it to the cost estimator. Besides the function embedded in Revit, data can also be extracted with various tools, which are developed by a third party for to extend the use of Revit.

Revit, as a platform, provides accurate data for project participants. As long as all the data input into Revit are correct, Revit can process them without faults. Because Revit runs all by itself to generate quantity takeoffs for cost estimation, the time spent by the estimator on quantification as well as the possibility of human errors are significantly reduced. The takeoffs generated in Revit can be used as the basis for cost estimating, decision making, procurement, etc.



	A	B	C
1	Wall Material Takeoff		
2	Family and Type	Material: Name	Material: Area
3	Air Barrier - Air Infiltration Barrier		
4	Basic Wall: Scheels Base @ Low Wall of Vestibule - 2-Cast Stone - 3 5/8"AS-12" CMU	Air Barrier - Air Infiltration Barrier	16 SF
5	Basic Wall: Scheels Base @ Low Wall of Vestibule - 2-Cast Stone - 3 5/8"AS-12" CMU	Air Barrier - Air Infiltration Barrier	16 SF
6	Basic Wall: Scheels Base @ Low Wall of Vestibule - 2-Cast Stone - 3 5/8"AS-12" CMU	Air Barrier - Air Infiltration Barrier	17 SF
7	Basic Wall: Scheels Base @ Low Wall of Vestibule - 2-Cast Stone - 3 5/8"AS-12" CMU	Air Barrier - Air Infiltration Barrier	17 SF
8	Basic Wall: Scheels Base @ Low Wall of Vestibule - 2-Cast Stone - 3 5/8"AS-12" CMU	Air Barrier - Air Infiltration Barrier	76 SF
9	Basic Wall: Scheels Base @ Low Wall of Vestibule - 2-Cast Stone - 3 5/8"AS-12" CMU	Air Barrier - Air Infiltration Barrier	76 SF
10	Basic Wall: Scheels Base @ Low Wall Vestibule Behind Column - 2-Cast Stone - 3 5/8"AS-12" CMU 2	Air Barrier - Air Infiltration Barrier	10 SF
11	Basic Wall: Scheels Base @ Low Wall Vestibule Behind Column - 2-Cast Stone - 3 5/8"AS-12" CMU 2	Air Barrier - Air Infiltration Barrier	10 SF
12	Basic Wall: Scheels Base @ Low Wall Vestibule Behind Column - 2-Cast Stone - 3 5/8"AS-12" CMU 2	Air Barrier - Air Infiltration Barrier	12 SF
13	Basic Wall: Scheels Base @ Low Wall Vestibule Behind Column - 2-Cast Stone - 3 5/8"AS-12" CMU 2	Air Barrier - Air Infiltration Barrier	12 SF
14	Basic Wall: Scheels Base High Wall - Cast Stone - 3 5/8" AS-4" CMU- AS-1" Rigid-1/2" Gyp BD-8"Stud-5/8"	Air Barrier - Air Infiltration Barrier	161 SF
15	Basic Wall: Scheels Base High Wall - Cast Stone - 3 5/8" AS-4" CMU- AS-1" Rigid-1/2" Gyp BD-8"Stud-5/8"	Air Barrier - Air Infiltration Barrier	161 SF
16	Basic Wall: Scheels Base High Wall - Cast Stone - 3 5/8" AS-4" CMU- AS-1" Rigid-1/2" Gyp BD-8"Stud-5/8"	Air Barrier - Air Infiltration Barrier	161 SF
17	Basic Wall: Scheels Base High Wall - Cast Stone - 3 5/8" AS-4" CMU- AS-1" Rigid-1/2" Gyp BD-8"Stud-5/8"	Air Barrier - Air Infiltration Barrier	162 SF
18	Basic Wall: Scheels Base High Wall - Cast Stone - 3 5/8" AS-4" CMU- AS-1" Rigid-1/2" Gyp BD-8"Stud-5/8"	Air Barrier - Air Infiltration Barrier	237 SF
19	Basic Wall: Scheels Base High Wall - Cast Stone - 3 5/8" AS-4" CMU- AS-1" Rigid-1/2" Gyp BD-8"Stud-5/8"	Air Barrier - Air Infiltration Barrier	237 SF
20	Basic Wall: Scheels Base High Wall - Cast Stone - 3 5/8" AS-4" CMU- AS-1" Rigid-1/2" Gyp BD-8"Stud-5/8"	Air Barrier - Air Infiltration Barrier	237 SF
21	Basic Wall: Scheels Base High Wall - Cast Stone - 3 5/8" AS-4" CMU- AS-1" Rigid-1/2" Gyp BD-8"Stud-5/8"	Air Barrier - Air Infiltration Barrier	237 SF
22	Basic Wall: Scheels Base High Wall - Cast Stone - 3 5/8" AS-4" CMU- AS-1" Rigid-1/2" Gyp BD-8"Stud-5/8"	Air Barrier - Air Infiltration Barrier	426 SF
23	Basic Wall: Scheels Base High Wall - Cast Stone - 3 5/8" AS-4" CMU- AS-1" Rigid-1/2" Gyp BD-8"Stud-5/8"	Air Barrier - Air Infiltration Barrier	482 SF
24	Basic Wall: Scheels Base High Wall End - Cast Stone - 3 5/8" AS-4" CMU- AS-1" Rigid-1/2" Gyp BD-8"Stud-5	Air Barrier - Air Infiltration Barrier	23 SF
25	Basic Wall: Scheels Base High Wall End - Cast Stone - 3 5/8" AS-4" CMU- AS-1" Rigid-1/2" Gyp BD-8"Stud-5	Air Barrier - Air Infiltration Barrier	23 SF
26	Basic Wall: Scheels Base High Wall End - Cast Stone - 3 5/8" AS-4" CMU- AS-1" Rigid-1/2" Gyp BD-8"Stud-5	Air Barrier - Air Infiltration Barrier	23 SF
27	Basic Wall: Scheels Base High Wall End - Cast Stone - 3 5/8" AS-4" CMU- AS-1" Rigid-1/2" Gyp BD-8"Stud-5	Air Barrier - Air Infiltration Barrier	23 SF
28	Basic Wall: Scheels Base High Wall End - Cast Stone - 3 5/8" AS-4" CMU- AS-1" Rigid-1/2" Gyp BD-8"Stud-5	Air Barrier - Air Infiltration Barrier	23 SF

Figure 12. Wall Material Takeoffs in Microsoft Excel

Optimization of Time Schedule

The application of the BIM process also improves the way engineers develop the project schedule. To plan a project with BIM, a fourth dimension, time, is added to the 3D model, forming the 4D model. This concept is still new to most people due to technical challenges for its application, but the emergence of BIM has totally changed the situation. The 4D scheduling model allows people to link components in the 3D BIM model to the corresponding tasks and time. This represents a visual representation of a project timeline, which again raises the probability to resolve conflicts before the construction of projects. With the 3D building model linked to schedules, the project constructors can evaluate various construction options off the job site.

There are also schedules stored in the Revit model; they specify the quantities of components, such as wall length, wall area, and the numbers of doors/windows. In fact, these schedules are also views. The following steps show how to achieve a wall schedule in Revit:

In the opened Revit project, go to *Tool Bar*; find the *View* tab; click on *New*, select Schedule/Quantities; this process is shown in Fig. 13; A dialog similar to Fig. 14 opens. Revit supplies many categories for users to select. Find *Walls*; click *OK*; In this dialog (Fig. 15), the properties of the wall schedule can be defined by adding expected fields, and then, click *OK* to see the schedule (Fig. 16).

The schedule created in Revit can be saved as views, and can also be exported for other purposes. For example, the schedule for the windows is exported to Excel for the manufacturer because, sometimes, they do not need drawings. Back to the 4D scheduling model, various tools, such as Autodesk Navisworks Manage, Vico Software, and Tekla BIM sight, are available now to support this scheduling method as the technology grows.

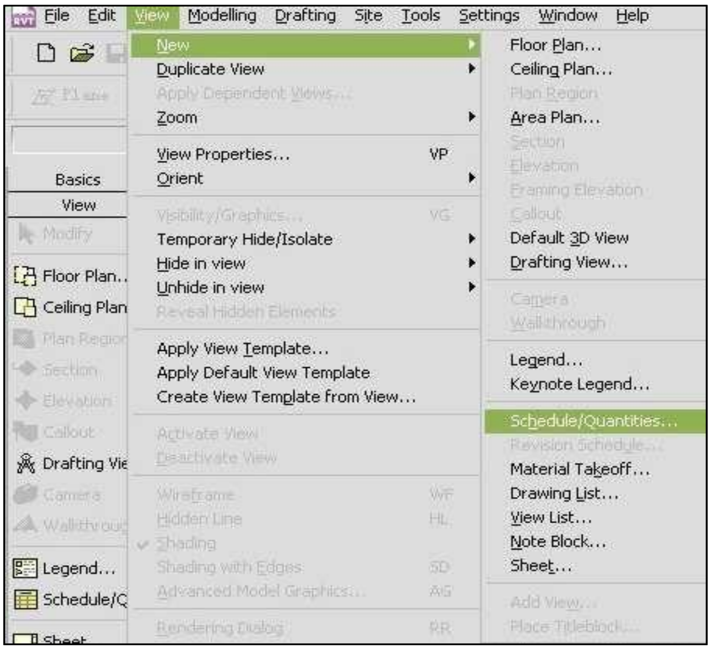


Figure 13. Dialog of Creating a New View in Revit

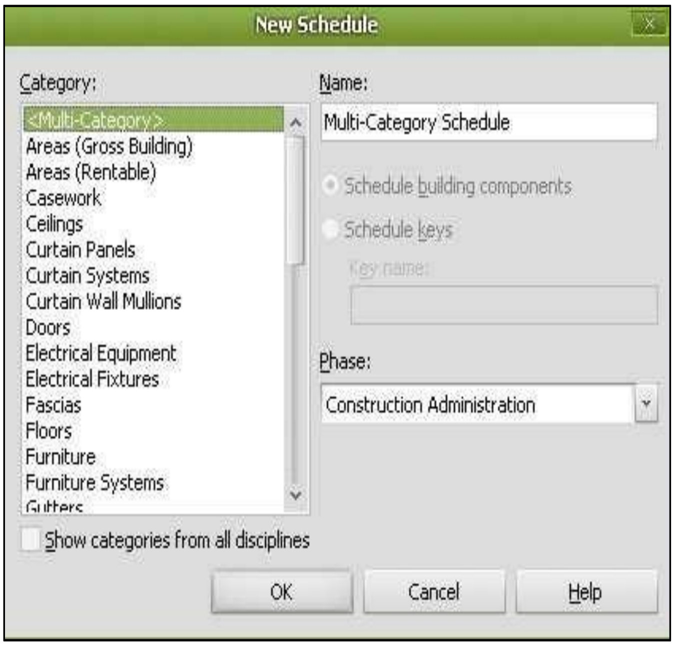


Figure 14. Dialog of Creating a New Schedule View in Revit

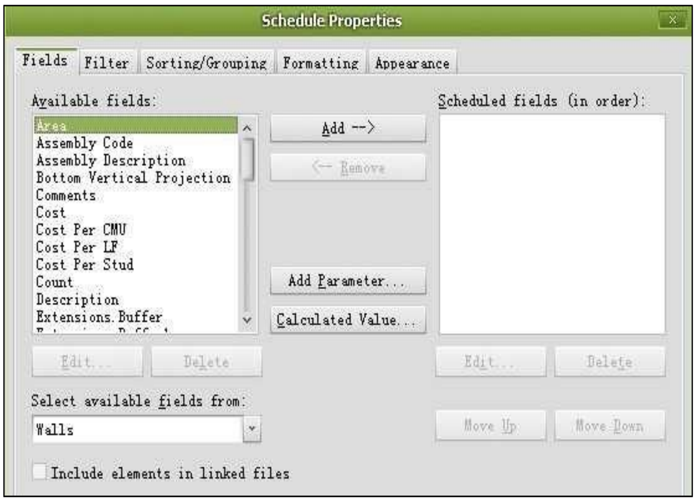


Figure 15. Dialog of Schedule Properties in Revit

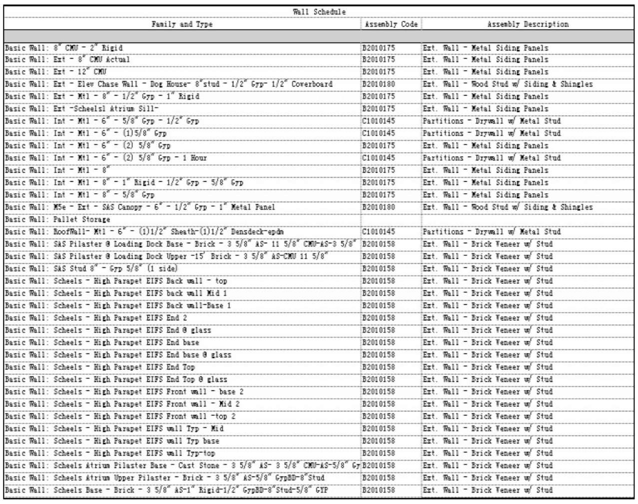


Figure 16. Part of Wall Schedule

CONCLUSIONS

Undeniably, from paper-based design to CAD, the remarkable technology leap has taken the Architecture, Engineering and Construction (AEC) industry to a computer-based age. What BIM can bring is not only another leap, but also a subversive change for the entire industry. In this new era, the design is not merely about drawings, but is more a serious of virtual processes of building models. The application of BIM can spread throughout the project life cycle, from the planning stage to construction and installation, and even rebuilding or dismantling. BIM is improving the AEC industry to a high-tech and high-productivity industry. Although there are various benefits when using BIM for project time and cost control, the learning curve required and the initial cost for BIM setup could be the main barriers for the spread of this advanced technology. A long-sighted company should be confident that the rewards of bringing in BIM are more significant. The application of BIM also meets the standard of sustainability in various ways: shortening the field-cycle time, increasing on-site renewable opportunities, reducing the waste produced through construction, saving energy, increasing labor productivity, etc. In summary, the impact of BIM on time and cost control is all about minimizing cost and accelerating progress.

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