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A Comparative Analysis of Quantity Take-Off Processes in Construction Projects Using Graphisoft Archicad and Autodesk Revit

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ARTICLE INFO

Article history:
Received 15 November 2025
Revised 4 December 2025
Accepted 5 December 2025
Available online 11 December 2025

E-ISSN: -
P-ISSN: -

How to cite: J. G. A. Sianturi, G. C. R. Hasibuan, S. Syahrizal, I. Jaya, R. A. Dewi, and G. G. A. Syafridon, "A comparative analysis of quantity take off processes in construction projects using Graphisoft Archicad and Autodesk Revit," Journal of Civil Engineering and Public Infrastructure Management, vol. 1, no. 1, 2025.

ABSTRACT

The Quantity Take-Off (QTO) calculation is one of the crucial stages in construction project planning, as it affects cost estimation, project duration, and material usage efficiency. Errors in QTO can lead to waste, delays, and budget discrepancies. The development of Building Information Modeling (BIM) technology enables the QTO process to be carried out more accurately and efficiently through three-dimensional modeling. This study aims to compare the QTO results of structural works (columns, beams, and tie beams) and wall volumes in a residential building project using two BIM software applications, namely Autodesk Revit and Graphisoft ArchiCAD, and to evaluate the differences between the results obtained. The research employs a comparative method with a quantitative approach. Data were obtained from the project's design drawings and Bill of Quantity (BoQ), followed by re-modeling in both BIM applications to generate QTO data. The analysis results show that the concrete volume generated by Revit is 0.15% lower than ArchiCAD, the reinforcement weight is 0.27% smaller, and the wall volume produced by ArchiCAD is 0.37% lower than Revit. These differences arise due to variations in the internal calculation systems and modeling techniques used by each software. Based on the analysis, the application of BIM has been proven to enhance accuracy, consistency, and efficiency in quantity calculation compared to conventional methods, while reducing the risk of errors caused by human factors. The results of this study are expected to serve as a reference for construction practitioners in selecting the most suitable BIM software according to the project's needs and characteristics.

Keywords: *Quantity Take-Off, Building Information Modeling, Autodesk Revit, Graphisoft ArchiCAD, structural works*

1. Introduction

The construction sector plays a vital role in economic and infrastructure development [1] [2], requiring accurate planning to ensure cost efficiency, timely execution [3] and material optimization [4]. Quantity Take-Off (QTO), the process of calculating required material quantities is central to this planning stage [5]. Inaccurate QTO may lead to excess material procurement, increased storage costs, waste, or shortages that disrupt project schedules [6], ultimately affecting project profitability and stakeholder satisfaction. Implementing advanced technologies like Building Information Modeling (BIM) can significantly enhance QTO accuracy and efficiency [7].

Technological advancements have transformed construction planning workflows, shifting from manual drafting to Computer-Aided Design (CAD) and, more recently, Building Information Modeling (BIM) [8]. BIM facilitates the creation of integrated, information-rich digital models that enhance coordination, reduce design errors, and streamline cost estimation. In relation to circular economy, the adoption of BIM can support sustainable practices by enabling better resource management and waste reduction throughout the construction lifecycle, aligning with circular economy principles [9]. The integration of BIM in construction not only improves efficiency but also fosters

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a more sustainable approach by supporting the reduction, reuse, and recycling of materials throughout the project lifecycle [10].This holistic approach not only minimizes waste but also contributes to the overall sustainability of construction projects, ensuring long-term benefits for the environment and the economy [11],[12].

Moreover, using BIM boosts teamwork among stakeholders, enabling instant updates and communication, which is crucial for reaching project objectives while reducing waste and increasing resource efficiency.

In Indonesia, BIM is increasingly adopted following regulations such as the Ministry of Public Works Regulation No. 22/2018 and Government Regulation No. 16/2021 [13]. However, industry-wide implementation outside government projects remains limited. Selecting appropriate BIM software is therefore crucial, as different platforms such as Autodesk Revit and Graphisoft ArchiCAD offer varying modeling systems and QTO capabilities [14]. This study compares QTO results generated using Revit and ArchiCAD for structural components in a residential building project. The aim of this study is to evaluate accuracy, identify differences between software outputs, and assess the implications of these differences for project planning and cost estimation.

2. Method

This study employs a comparative quantitative research method to analyze differences in QTO results generated by Revit and ArchiCAD.

2.1 Data Source

In this study, secondary data are used, consisting of project design drawings and the Bill of Quantity (BoQ) from a residential building project located in Samosir, Indonesia.

2.2 Data Collection

Drawings and BoQ documents were obtained from the contractor. These documents serve as the basis for re-modeling using both BIM software platforms.

2.3 Data Processing Procedure

The data processing procedure involves several key steps that guide the analysis from initial preparation to final interpretation.

2.3.1 Re-modeling in ArchiCAD

The modeling process begins with establishing the project grid, which is created based on the input floor plan by accessing the Grid Element Tool through the “More” menu. This step provides a clear reference framework that guides the placement of structural components. Once the grid is in place, dimensions are added to define the distances between grid points, ensuring that all subsequent modeling follows accurate spatial references.

The next stage involves modeling the pad foundations. This is done by selecting the Object Tool and navigating to the foundation options within the concrete structure library. The dimensions are then adjusted to match those specified in the structural drawings. After the foundations are completed, the ground beams or sloof are modeled using the Beam Tool, where the required beam sizes are entered before drawing them along predetermined paths that connect the structural supports. Column modeling follows a similar procedure (fig. 1). The Column Tool is opened, the column sizes are set according to the design data, and the columns are placed at locations shown in the structural drawings. The beam modeling process is continued for each floor, with the Beam Tool used to input the appropriate beam types and dimensions before positioning them according to the structural layout.

The floor slab is then modeled using the Slab Tool. After adjusting the slab properties, the slab is drawn to follow the floor plan geometry. Wall elements are added next by selecting the Wall Tool, inputting the required specifications, and placing the walls accurately based on the floor plan. To complete the model, door and window elements are inserted, allowing for a more precise calculation of wall volumes and improving the overall accuracy of the building information model (fig. 2).

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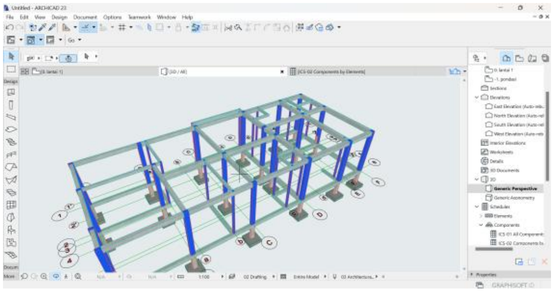

Figure 1. Beam Modelling

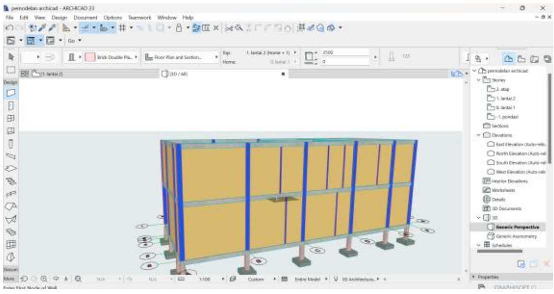

Figure 2. Wall Modelling

2.3.2 Re-modeling in Revit

The modeling workflow begins with creating the main structural elements: columns, beams, and slabs, based on the layout shown in the design drawings. This is done by selecting the appropriate tools within the Structure menu: Column for vertical supports , Beam for horizontal framing members, and Floor for the slab system (fig.3 and fig. 4). These elements form the core structural framework that guides the rest of the modeling process.The foundation is modeled first by using the Slab tool to represent the pad foundation. Its dimensions are adjusted to match the construction drawings, and the foundation is positioned accurately according to the specified footing layout. Once the foundation is in place, the columns are created by selecting the Column option, choosing the appropriate shape, setting the required dimensions, and placing them on the grid points indicated in the floor plan.The beam modeling process follows, where the desired beam type is selected, its dimensions are adjusted, and the beams are placed in alignment with the structural layout shown in the design drawings. After the beams are completed, the floor slabs are modeled by selecting the correct slab type, refining the dimensional settings, and positioning the slabs according to the architectural and structural floor plans.Wall elements are then added using the Wall tool, where the wall type, thickness, and material properties are adjusted before placing them in accordance with the layout on the floor plan. To complete the building model, doors, windows, and ventilation openings are inserted through the Architecture menu. Including these components not only enhances the accuracy of the model but also ensures more precise wall volume calculations for quantity takeoff and further analysis.

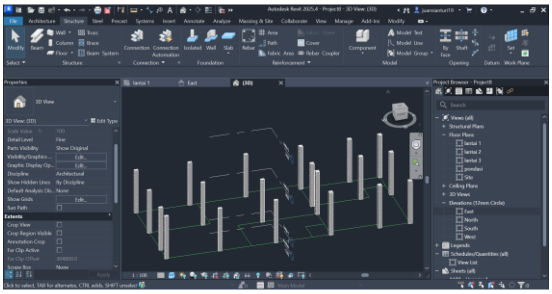

Figure 3. Column Modelling

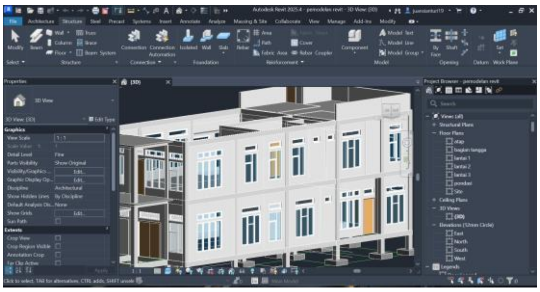

Figure 4. Door and Window Modelling

2.3.3 Comparative Analysis

The analysis focuses on comparing the concrete volume, reinforcement weight, and wall volume produced by the BIM models with the corresponding values obtained from manual calculations. This comparison allows for a clearer understanding of how closely the digital outputs align with conventional quantity takeoff practices. In addition to assessing these quantities, the study also evaluates the percentage differences relative to the manual Bill of Quantities, providing insight into the accuracy and reliability of BIM-generated estimates when measured against traditional methods.

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3. Results and Discussion

3.1 Concrete Volume Comparison

Revit produces concrete volume values 0.15% lower than ArchiCAD. The difference (0.06 m³) is minimal, likely due to minor discrepancies in modeling precision and volume calculation formulas.

Table 1. Concrete Quantity Comparison

	BIM Archicad	BIM Revit
COLUMN (20 x 30)	4,86	4,82
COLUMN (30 x 30)	7,92	7,99
COLUMN (13 x 13)	2,10	2,2
BEAM (20 x 30)	7,50	7,64
BEAM (30 x 30)	7,06	7,06
BEAM (13 x 20)	2,09	2,18
SLOOF (25 x 30)	5,5	4,97
SLOOF (30 x 30)	3,40	3,36
SLOOF (20 x 20)	0,93	1,08
TOTAL	**41,36**	**41,3**

Difference : 0,06 m^3
Percentage Difference : 0,15%
The comparison (Table 1) shows that the concrete work volume generated by BIM Revit is slightly lower than that produced by BIM ArchiCAD, with a difference of 0.15%. This minimal discrepancy indicates that the calculated concrete volumes between Revit and ArchiCAD are highly similar, as the modeling and quantity-extraction methods for concrete in both software platforms follow comparable workflows.

3.2 Reinforcement Weight Comparison

A difference of 20.69 kg (0.27%) is found between the two software. ArchiCAD generates slightly higher values, potentially resulting from differing rebar representation and calculation methods.

Table 2. Comparison of Reinforcement Weights

	BIM Archicad	BIM Revit
COLUMN (20 x 30)	963,65	955,83
Reinforcement (d14)	761,6	766,23
Stirrups	202,05	189,6
COLUMN (30 x 30)	1374,76	1363,44
Reinforcement (d16)	1111,01	1106,1
Stirrups	263,75	257,34
COLUMN (13 x 13)	434,61	425,24
Reinforcement (d10)	320,14	318,5
Stirrups	114,47	106,74
BEAM (20 x 30)	1669,91	1709,47
Reinforcement (d14)	1365,02	1377,56
Stirrups	304,89	331,91
BEAM (30 x 30)	1395,02	1394,78
Reinforcement (d16)	1155,24	1147,4
Stirrups	239,78	247,38

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BEAM (13 x 20)	336,32	327,94
Reinforcement (d10)	228,78	232,57
Stirrups	107,54	95,37
SLOOF (25 x 30)	818,51	818,32
Reinforcement (d14)	652,52	634,18
Stirrups	165,99	184,14
SLOOF (30 x 30)	616,46	562,85
Reinforcement (d16)	505,42	459,55
Stirrups	111,04	103,3
SLOOF (20 x 20)	169,09	199,77
Reinforcement (d14)	123,02	149,19
Stirrups	46,07	50,58
TOTAL	**7778,33**	**7757,64**

Difference : 20,69 kg
Percentage Difference : 0,27%

The comparison (Table 2) indicates that the reinforcement weight generated by BIM Revit is lower than that produced by BIM ArchiCAD, with a difference of 0.27%. This discrepancy is relatively significant, as the methods used for reinforcement modeling and the completeness of available features in each software differ, leading to a notable variation in the resulting reinforcement quantities.

3.3 Wall Volume Comparison

Revit's wall volume is 0.37% higher than ArchiCAD. Variations stem from differences in how openings (windows, doors) are represented and subtractive calculations applied by each system.

Table 3. Wall Volume Comparison

ITEM	BIM Archicad	BIM Revit
Walls	609,76	612

Difference : 2,24 m^2
Percentage Difference : 0,37%

The comparison (Table 3) shows that the wall volume generated by BIM Revit is lower than that produced by BIM ArchiCAD, with a difference of 0.37%. This discrepancy arises because the door and window plug-ins used in Revit and ArchiCAD are not identical, resulting in variations in how wall openings are modeled and consequently affecting the calculated wall volumes in both software platforms.

3.4 Analysis of BIM Results Compared to Manual Calculations

A comparison of the quantities generated by both BIM applications has been conducted previously. The next step is to analyze the comparison between the quantities produced by BIM and those obtained through manual calculations.

3.4.1 Analysis of ArchiCAD BIM Volume Compared to Manual Calculations

The comparison of work volumes is carried out by comparing the quantities generated by BIM ArchiCAD with those obtained through manual calculations. Table 4 presents the comparative results for concrete volume, reinforcement weight, and wall volume:

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Table 4. Comparison Between ArchiCAD BIM Calculations and Manual Calculations

ITEMS	VOLUME OFARCHICAD	MANUAL CALCULATION	DIFFERENCE	COMPARISON
Concrete (m^3)	41,36	41,96104	0,60104	1,43%
Weight of rebar (kg)	7778,33	7804,69944	26,36944	0,34%
Walls (m^2)	609,76	627,71	17,95	2,86%

The comparison shows that the volumes generated by ArchiCAD BIM are lower than those obtained through manual calculations, with discrepancies of 1.43% for concrete work, 0.34% for reinforcement weight, and 2.86% for wall volume. These results highlight how crucial it is to choose the appropriate BIM software to improve precision in material estimation and better allocate resources in construction projects. Ultimately, the choice of BIM software can significantly influence project outcomes, impacting both cost efficiency and sustainability in construction practices. The findings highlight the necessity for thorough evaluation of BIM tools, as the choice between platforms like Revit and ArchiCAD can lead to substantial variations in material estimation accuracy and project efficiency [15]. Therefore, stakeholders should focus on choosing the right software to guarantee good planning and implementation, which will lead to better project results and sustainability.

3.4.2 Analysis of Revit BIM Volume Compared to Manual Calculations

The comparison of work volumes is carried out by comparing the quantities generated by BIM Revit with those obtained through manual calculations. Table 5 presents the comparative results for concrete volume, reinforcement weight, and wall volume:

Table 5. Comparison Between Revit BIM Calculations and Manual Calculations

ITEMS	REVIT VOLUME	MANUAL CALCULATION	DIFFERENCE	COMPARISON
Concrete (m^3)	41,3	41,96104	0,66104	1,58%
Weight of Rebar (kg)	7757,64	7804,69944	47,05944	0,60%
Walls (m^2)	612	627,71	15,71	2,50%

The comparison indicates that the volumes produced by BIM Revit are lower than those obtained through manual calculations, with discrepancies of 1.58% for concrete work, 0.60% for reinforcement weight, and 2.5% for wall volume. These findings highlight the potential for BIM to optimize material estimates, thereby enhancing project efficiency and reducing waste in construction practices. These findings highlight the value of using BIM technology in building projects, as it provides more precise estimates and supports sustainability efforts by reducing waste and improving resource efficiency. Furthermore, the integration of BIM in construction practices not only leads to improved accuracy in material estimations but also aligns with the principles of sustainable development by minimizing waste and enhancing resource efficiency [15, [16].Similar comparisons between BIM based and conventional quantity take off methods have been reported in Indonesian construction projects, with consistent differences in calculated quantities [17].

4. Conclusion

The comparison between ArchiCAD and Revit shows that both platforms are capable of producing highly consistent quantity takeoff results. ArchiCAD records a concrete volume of 41.36 m³,

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reinforcement weight of 7778.33 kg, and wall volume of 609.76 m³. Revit delivers closely comparable outputs, with a concrete volume of 41.30 m³, reinforcement weight of 7757.64 kg, and wall volume of 612 m³. The differences between the two remain minimal, falling within a narrow range of 0.15 to 0.37 percent, which indicates that both tools offer reliable estimations for construction planning. What becomes evident from this comparison is the advantage of BIM-based workflows in producing more accurate and consistent quantity takeoffs, helping reduce the likelihood of human error that often occurs in manual calculation processes. Building on these findings, it is advisable to integrate BIM from the earliest stages of a project. Early implementation allows teams to detect design inconsistencies sooner, improve coordination across disciplines, and prepare more efficient cost estimates. When choosing between the two software platforms, project needs should guide the decision. ArchiCAD generally suits designers who focus on architectural visualization, while Revit offers broader analytical features and tends to be more aligned with engineering requirements.

5. Acknowledgements

The authors are deeply grateful to all who contributed to the success of this research.

6. Conflict of Interest

The authors confirm that there is no conflict of interest related to the manuscript.

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