

Comparison Of BIM And CAD Efficiency In The Planning Phase: A Case Study Of The Construction At PT. Sinar Meadow International Indonesia, Jakarta

Ashar Herrianto¹, Monica Dewi², Inge Anggitasari³, Susilowati⁴

¹Civil Engineering Student, University of Kahuripan Kediri, Kediri, 64212, Indonesia

²Department of Civil Engineering, University of Kahuripan Kediri, Kediri, 64212, Indonesia

³Department of Civil Engineering, University of Kahuripan Kediri, Kediri, 64212, Indonesia

⁴Department of Civil Engineering, University of Kahuripan Kediri, Kediri, 64212, Indonesia

Corresponding Author: Ashar Herrianto, e-mail: nazwa. asherr.sby@gmail.com

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ABSTRACT

The rapid development of BIM and CAD greatly influences the world of architecture, engineering, and construction (AEC) today, both in the project planning phase, project implementation phase, operational phase, and until demolish. This makes favorite software such as revit and autocad the standard for practitioners and scientists in the AEC world. This study aims to determine the efficiency and effectiveness of using BIM revit and CAD autocad in planning development projects at PT. Sinar Meadow International Indonesia. Such as design speed, clash detection effectiveness, and efficiency and effectiveness in quantity takeoff. This study uses an experimental observation method with analysis of variance. is a test designed to find the relationship between the two variables comparing between research samples. The research instrument is used in collecting primary data between CAD autocad observations and BIM revit. The results of the analysis of the structural, architectural, and mechanical electrical planning drawing experiments explain that the design using BIM revit is 31% faster than using CAD autocad. While in clash detection, revit with interference check tools found 44 cases compared to 3 cases of manual autocad. For quantity take off work, Revit software uses schedule/quantities tools 260% faster than using conventional with AutoCAD software and AutoCAD is 4% cheaper than Revit software..

Keywords: *BIM Building Information Modelling, CAD Computer-Aided Design , Design Efficiency, Clash Detection, QTO Quantity Take Off*

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INTRODUCTION

The majority of architecture, engineering, and construction (AEC) students have switched to using Autodesk Revit over Autodesk AutoCAD. The majority of students prefer Revit due to its drawing speed, ease of use, and future career opportunities. [1] [2] Meanwhile, there has been an increase in ROI for various construction companies that have started or have implemented BIM in their infrastructure construction projects. The percentage increase varies. [3] In construction cost estimation, there is a difference between BIM Revit which is calculated instantly by Revit compared to CAD AutoCAD which calculates conventionally. [4] [5] The use of BIM provides improvements over CAD in planning design, interoperability between engineering software and tools, and project scheduling. [6] [7] The implementation of BIM in Indonesia also encountered obstacles including Flexibility and Collaboration between, Problems of Technical Skills and Uneven Training,

Unsynchronized BIM Data Management, and High Cost of BIM, and Limited Utilization of BIM. [8]

PT. Sinar Meadow International Indonesia has a long-term project plan that has been carried out since 2014 until now. In this study, the author was given the opportunity to conduct research in the context of the construction of the P6 & P7 Production Area building, the Conveyor Line, and the SSHE area. The construction design in this study includes structural, architectural, and mechanical electrical construction carried out by the author using BIM Revit and CAD Autocad software without using external tools including Xref (Autocad) and Dynamo (Revit). The author uses the design to compare BIM Revit and CAD Autocad to find the best of both in

1. the speed of modeling / drafting work between CAD and BIM,
2. the use of clash detection between CAD and BIM,
3. the speed of quantity take off work,
4. the accuracy of quantity take off (QTO) work,

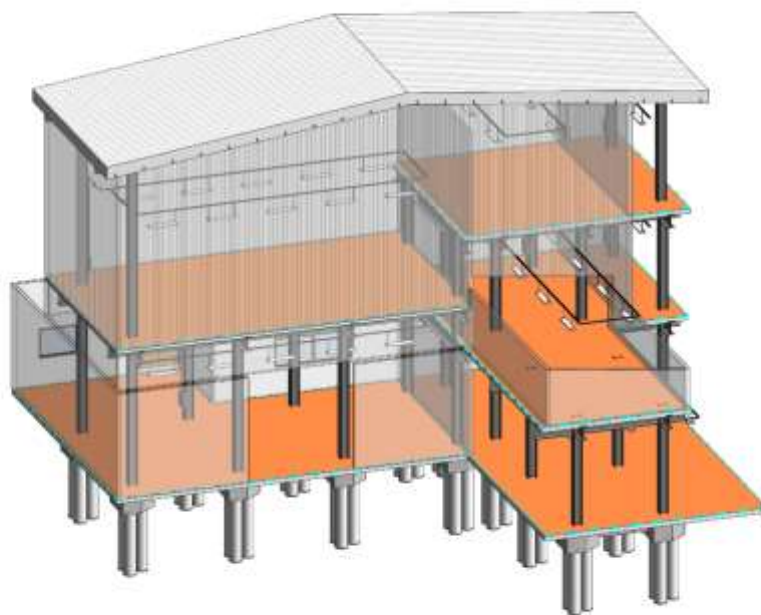


Figure 1. 3D perspective view of building plan

MATERIAL AND METHOD

It should be mention time and place of study in first part. All materials and methods that used such chemical for analysis, treatment and experimental design must be stated clearly and briefly. State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results. A Theory section should extend, not repeat, the background to the article already dealt with in the Introduction and lays the foundation for further work. a Calculation sections represents a practical development from a theoretical basis.

1. BIM

BIM merupakan representatif digital karakter fisik dan fungsional sebuah bangunan, yang dimana didalamnya berisi semua informasi elemen-elemen bangunan tersebut yang bertujuan sebagai dasar untuk mengambil keputusan dalam fase desain bangunan, fase konstruksi bangunan, fase operasional bangunan, fase demolish, dan fase renovasi. (digitape twin). [9] While there are differing definitions of BIM, there is a general consensus that BIM is the process of combining information and technology to create a digital representation of a project.

It integrates data from multiple sources and evolves parallel to the actual project across its timeline, including design, construction, and operational information currently in use. [10]

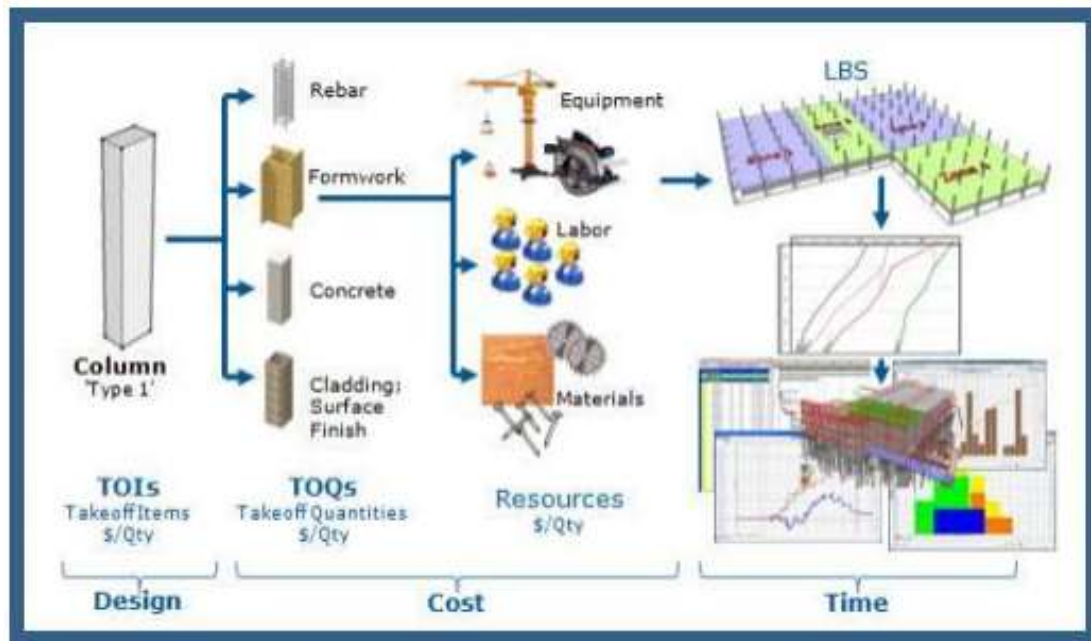


Figure 2. Calculation process on objects with design orientation [10]

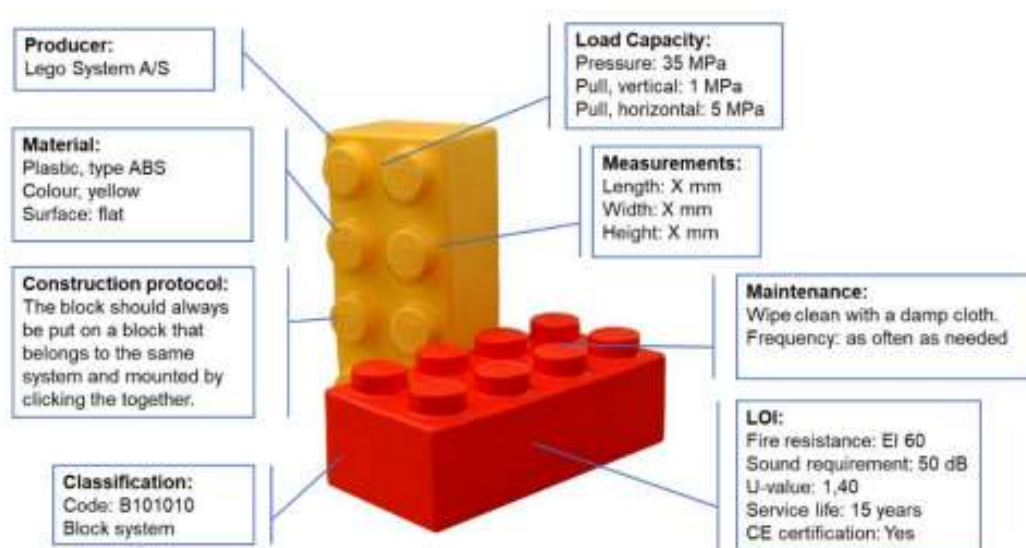


Figure 3. BIM example explains information on a material [10]

2. CAD

At first glance it is the same as BIM but it is not the same, CAD is software to assist with engineering design and drawing. [11] CAD helps professional designers visualize and interpret their designs into detailed 2D/3D sketches in software for future reference during actual construction. [12] CAD provides detailed descriptions of the designed object, displaying 2D views, sections, detailed sections, and 3D views.

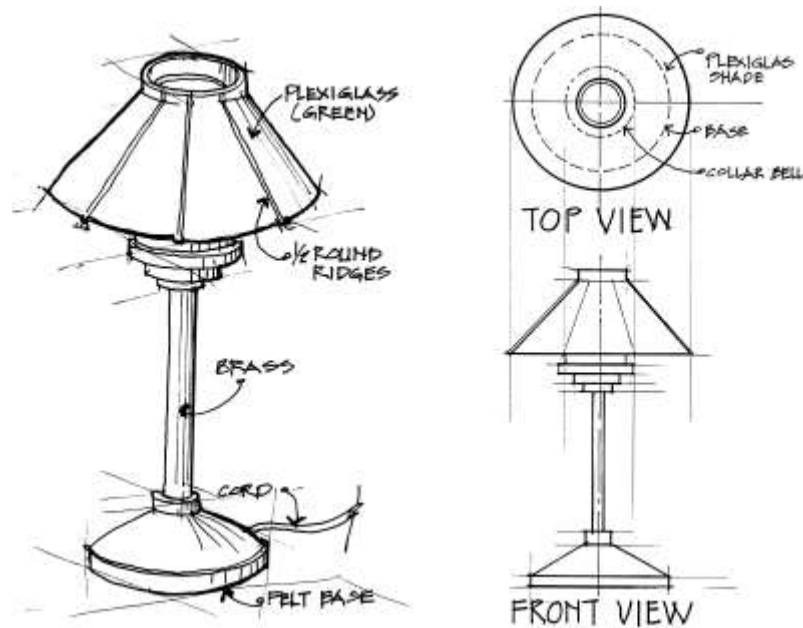


Figure 4. projecting a 3D object onto a CAD drawing [12]

CLASSIFICATION OF DRAWING SYSTEMS					
MULTIVIEW	TYPE		APPLICATION	RELATIONSHIP OF OBJECTS TO PICTURE PLANE	
			OBJECT		INTERIORS
		ORTHOGONAL	 PLAN ELEVATION	 PLAN ELEVATION RECTN	AN OBJECT'S RECTANGULAR FACES ARE PARALLEL TO THE PICTURE PLANE.
SINGLEVIEW	PARALLEL LINES REMAIN PARALLEL TO EACH OTHER	AXONOMETRIC	 ISOMETRIC		THE THREE PRINCIPAL AXES MAKE EQUAL ANGLES (30°) WITH THE PICTURE PLANE. ALL LENGTHS ARE EQUAL.
			 DIMETRIC		THE TWO PRINCIPAL AXES MAKE EQUAL ANGLES WITH THE PICTURE PLANE. AND TWO LENGTHS ARE EQUAL. OBJECTS CAN BE ROTATED AT VARIOUS ANGLES.
			 TRIMETRIC		EACH OF THE TWO PRINCIPAL AXES MAKES A DIFFERENT ANGLE WITH THE PICTURE PLANE. HEIGHT IS REDUCED, SIMILAR TO A DIMETRIC.
		OBLIQUE	 ELEVATION		THE FACE (ELEVATION) OF THE OBJECT IS PARALLEL TO THE PICTURE PLANE. DEPTHS ARE USUALLY REDUCED IN RATIO.
			 PLAN		THE TOP VIEW (OR PLAN) OF THE OBJECT IS PARALLEL TO THE PICTURE PLANE. HEIGHTS ARE USUALLY REDUCED.
		PERSPECTIVE	PARALLEL LINES APPEAR TO CONVERGE TO VANISHING POINTS	 ONE-POINT	
	 TWO-POINT				VERTICAL FACES ARE AT AN ANGLE TO THE PICTURE PLANE. PROJECTOR LINES CONVERGE TO TWO POINTS.
	 THREE-POINT				VERTICAL FACES ARE AT AN ANGLE TO THE PICTURE PLANE. PROJECTOR LINES CONVERGE TO THREE POINTS.

Figure 5. image classification system for projecting a 3D object onto a CAD drawing [12]

3. Method

The author used a pre-experimental method with a one-shot case study design, where the author divided the experimental samples into two and produced two measurement results. The effects of these two measurement results can then be measured, studied, compared, and reported.

In this research, the author conducted experimental observations to collect primary data, using tools to support this activity, including:

1. research instruments to collect data from the research sample.
2. Photo documentation during the observations as evidence of the data collection activities.

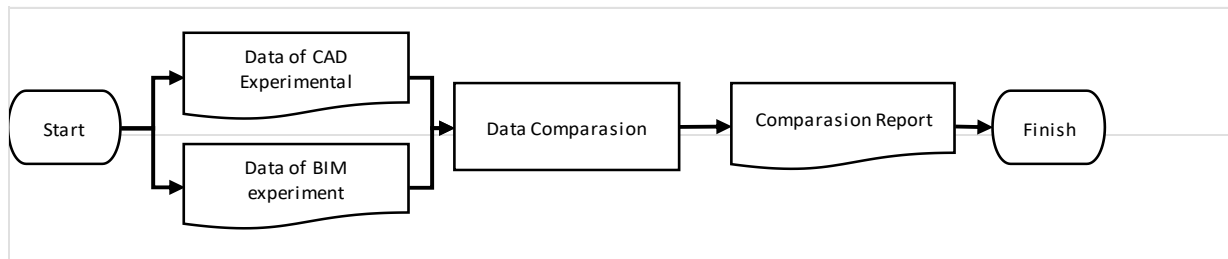


Figure 6. Study Flowchart

RESULT AND DISCUSSION

1. The Speed Of Modeling / Drafting Work Between CAD And BIM

The author conducted experimental testing on architectural and mechanical and electrical structural design. The author sought speed and compared CAD AutoCAD and BIM Revit.

In structural design, the author found a total time gap of 45 minutes between Revit and AutoCAD. This 30-minute gap is due to the "views and sections" tools in Revit, which allow for instant section drawing creation compared to drafting "section drawings" using AutoCAD. The 15-minute time gap is due to the process of creating "structural families" in Revit and "structural blocks" in AutoCAD.

Table 1. Structural Design Comparison

Structural Design Comparisson			
Drawing Name	Time		Notes
	Revit 2025 (B) (minutes)	Autocad 2025 (A) (minutes)	
Structural 1st Floor	35	25	efficient Autoca
Structural 2nd Floor	10	20	efficient revit
Structural 3rd Floor	10	20	efficient revit
Structural 4th Floor	10	20	efficient revit
Roof	20	15	efficient Autoca
Section 1	5	20	efficient revit
Section 2	5	20	efficient revit
Total	95	140	
$(C) = A - B =$		45	menit
$\text{Efisiensi } (x\%) = \frac{A-B}{B} \times 100\% =$		47%	
			efficient revit

In architectural design, the author found a total time gap of 44 minutes between Revit and AutoCAD. The 40-minute gap is due to the "views" tool in Revit, which allows for instant view

creation compared to drafting "view drawings" using AutoCAD. The 4-minute gap is due to the process of creating "architectural families" in Revit and "architectural blocks" in AutoCAD.

Table 2. Architectural Design Comparison

Architectural Design Comparison			
Drawing Name	Time		Notes
	Revit 2025 (B)	Autocad 2025 (A)	
	(minutes)	(minutes)	
Wall & Frame Plan 1st floor	20	15	efficient Autoca
Wall & Frame Plan 2nd floor	7	10	efficient revit
Wall & Frame Plan 3rd floor	7	10	efficient revit
Wall & Frame Plan 4th floor	7	10	efficient revit
North View	5	15	efficient revit
West View	5	15	efficient revit
East View	5	15	efficient revit
South View	5	15	efficient revit
Total	61	105	
$(c) = A - B =$			
$Efisiensi (x\%) = \frac{A-B}{B} \times 100\% =$			
	44	menit	efficient revit
	72%		

In the mechanical and electrical design, the author found a total time gap of 26 minutes between Revit and AutoCAD. This gap occurred due to the process of creating an "electrical family" in Revit and an "electrical block" in AutoCAD.

Table 3. Mechanical - Electrical Design Comparison

Mechanical - Electrical Design Comparison			
Drawing Name	Time		Notes
	Revit 2025 (B)	Autocad 2025 (A)	
	(minutes)	(minutes)	
Electrical Power 1st floor	15	10	efficient Autoca
Electrical Power 2nd floor	10	3	efficient Autoca
Electrical Power 3rd floor	10	3	efficient Autoca
Electrical Power 4th floor	10	3	efficient Autoca
Layout Processing Tank & Motor	0	0	
Layout Piping Din-En	0	0	
Single Line Diagram	0	0	
Total	45	19	
$(c) = A - B =$			
$Efisiensi (x\%) = \frac{A-B}{B} \times 100\% =$			
	26	menit	efficient Autoca
	137%		

The three tabulated data points described above will be summarized to determine the efficiency percentages for modeling/drafting between Revit and AutoCAD. Modeling using Revit took 201 minutes, while AutoCAD took 264 minutes, resulting in a 63-minute gap.

Table 4. recapitulation of efficiency in design

No .	Design0	Revit 2025	Autocad 2025	Gap	efficiency	Notes
		Minutes	Minutes	Minutes	%	
1	Gambar Perencanaan Struktur	95	140	45	47%	Efficient Revit
2	Gambar Perencanaan Arsitektur	61	105	44	72%	Efficient Revit
3	Gambar Perencanaan Mekanikal Elektrikal	45	19	26	137%	Efficient autocad
	Total	201	264	63	31%	Efficient Revit

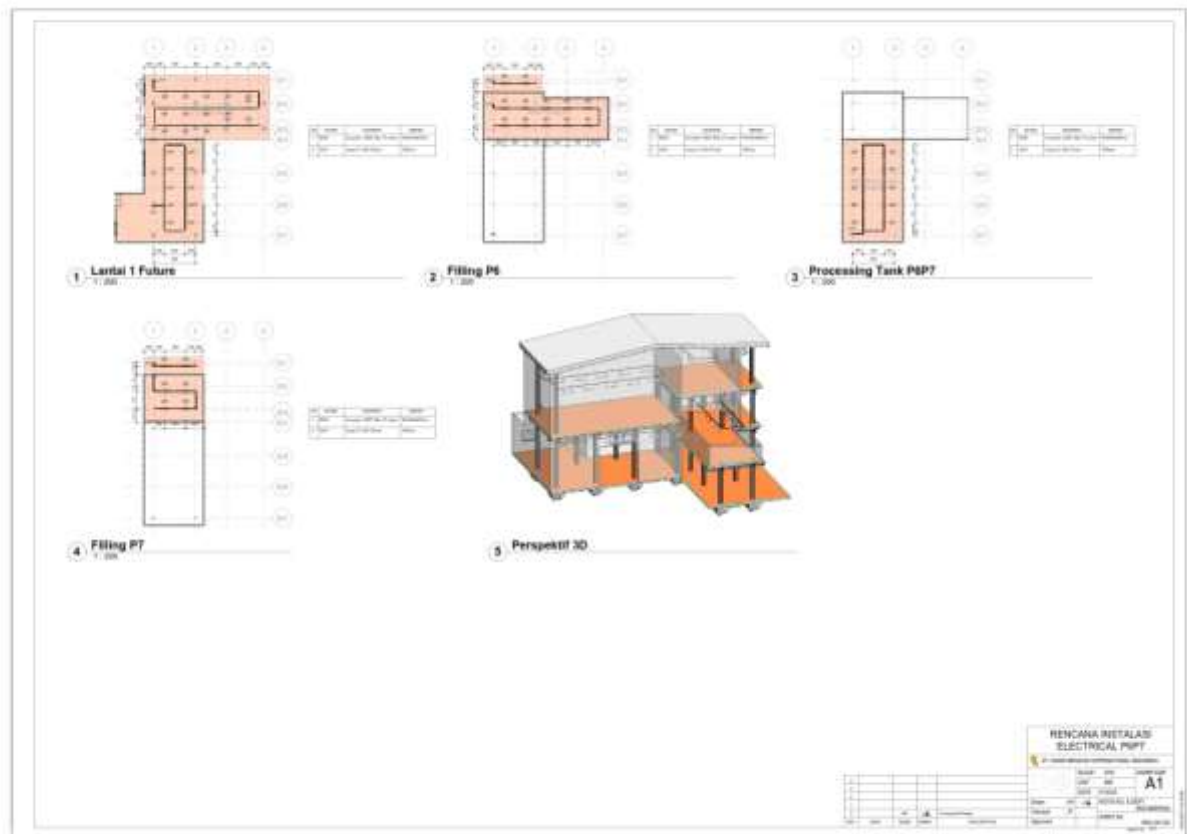


Figure 7. Revit Shopdrawing

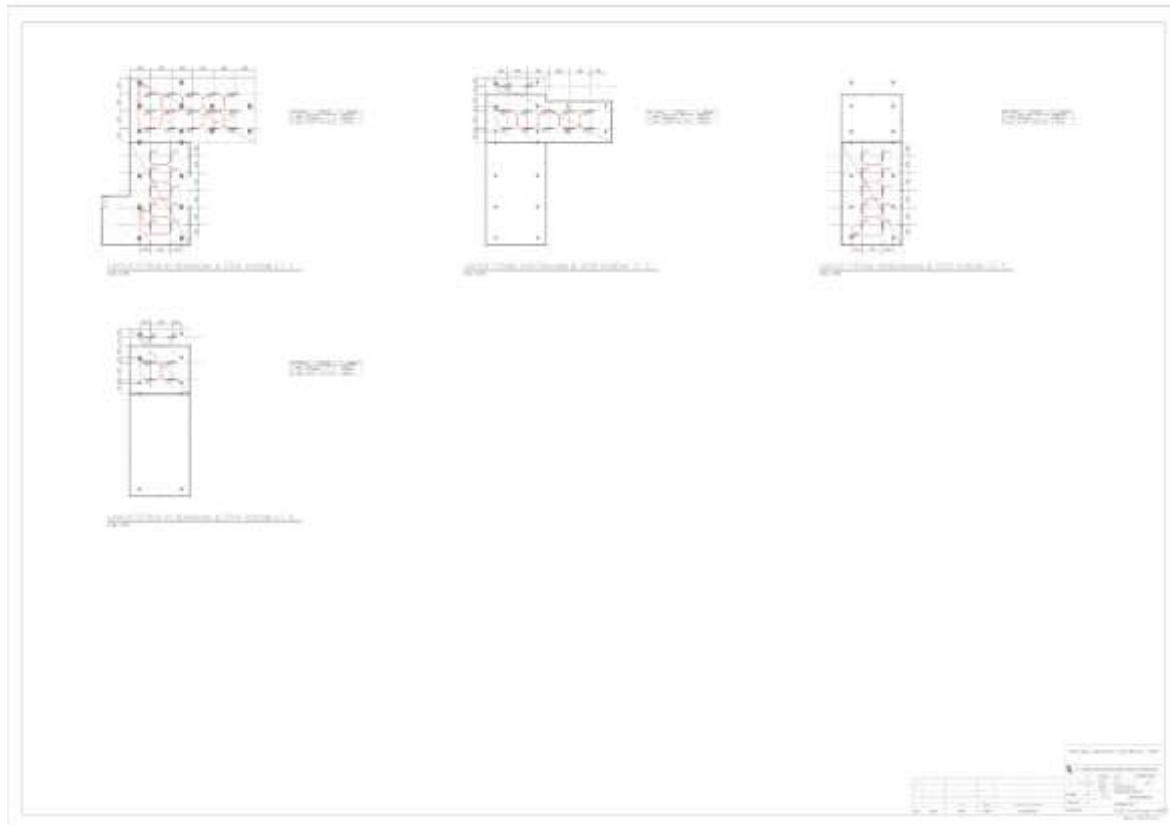


Figure 8. Autocad Shopdrawing

2. The Use Of Clash Detection Between Cad And Bim

Clash detection is used by site engineers to identify collisions between designs. This allows engineers to report them, and designers to revise the affected designs. This provides solutions to streamline materials and work methods. In contrast, without clash detection, numerous interdisciplinary issues can arise during implementation.

The author conducted an experiment to determine the extent to which AutoCAD and Revit BIM are capable of processing and identifying clashes during the clash detection process. In Revit, clash detection can be performed instantly using the "interference check" tool, while AutoCAD does not yet have internal tools capable of processing clash detection. The results revealed 44 clash detection cases in Revit and 3 in AutoCAD.

Table 5. clash detection use cases

Clash Detection			
Drawing Cases	Clash		Note
	Revit 2025(A)	Autocad 2025(B)	
	(cases)	(cases)	
Structural Design - Architectural Design	32	1	less Autocad
Structural Design - Mechanical electrical Design	12	2	less Autocad
Architectural Design - Mechanical electrical Design	0	0	less Autocad
Total	44	3	
$(C) = A - B =$	41	cases	less Autocad
$Efisiensi (x\%) = \frac{A-B}{B} \times 100\% =$	1367%		

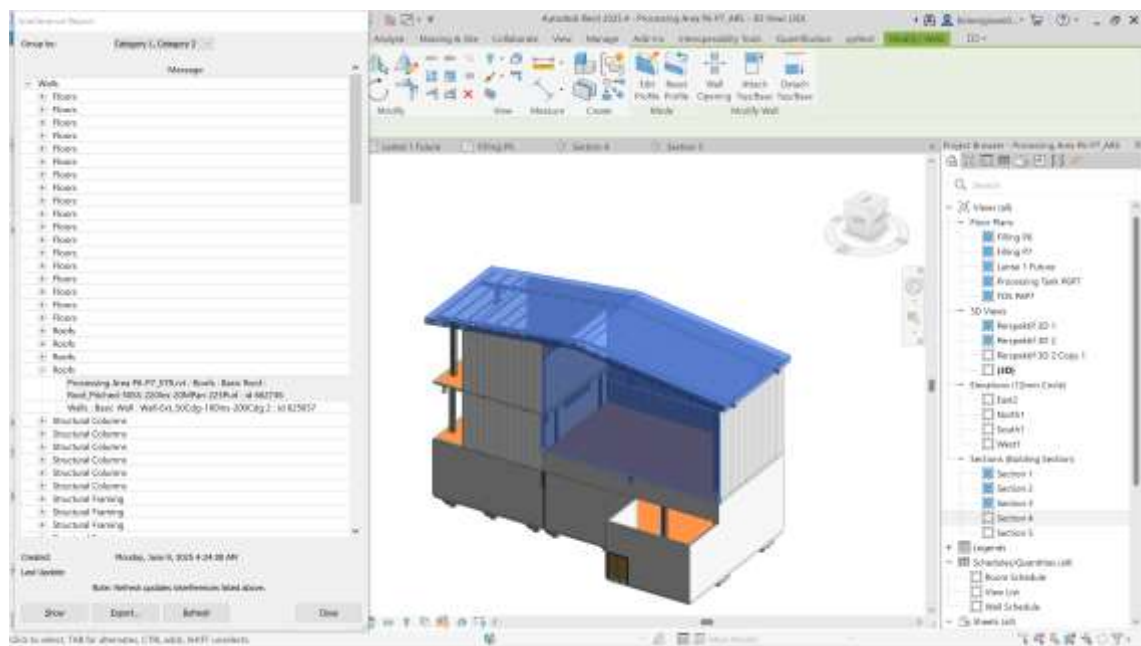


Figure 9. Clash Detection Using “interference check” tools at revit

The use of clash detection is now essential for writers and engineers to initiate and complete projects. It can assist in the design change decision-making process during the design phase and reduce the impact and waste of overhead costs during the construction phase.

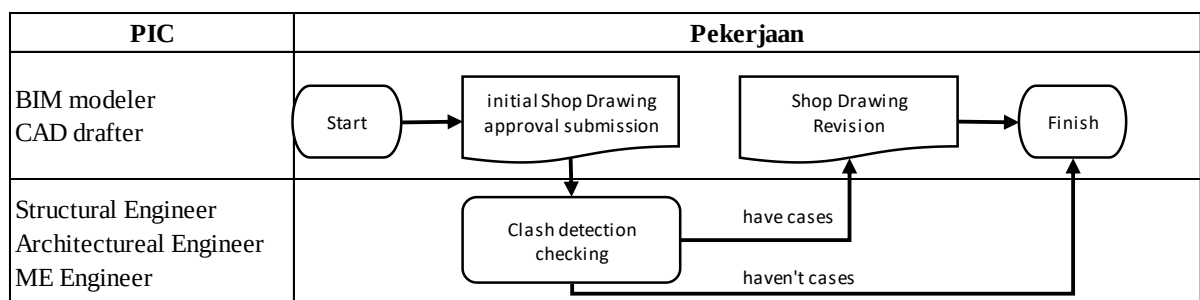


Figure 10. Clash Detection Workflow in Desgin Phase

In the past, clash detection was rarely used, and discrepancies between design and field conditions often occurred during the construction phase. This resulted in design changes (revisions) that ultimately resulted in cost overruns due to demolition and construction revisions.

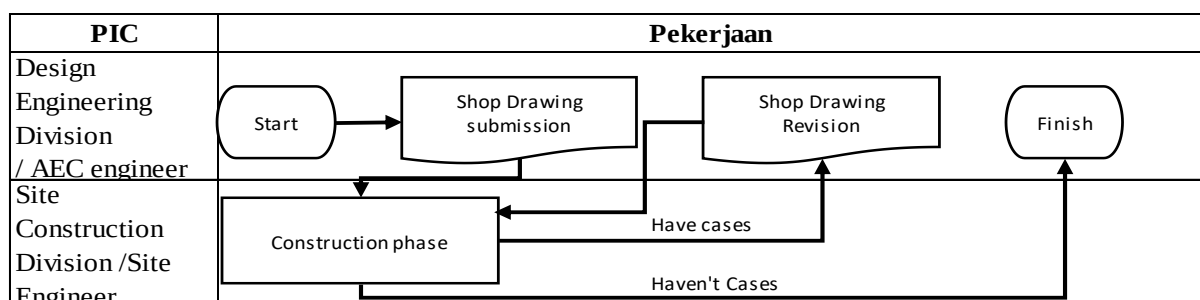


Figure 11. Clash Detection Workflow in Construction Phase

3. The Speed Of Quantity Take Off Work

In Revit quantity takeoff, the author uses the "schedule/quantities" tool to obtain quantity data from a family. Meanwhile, in AutoCAD, the author uses a conventional method by reading the drafted design to obtain quantity data.

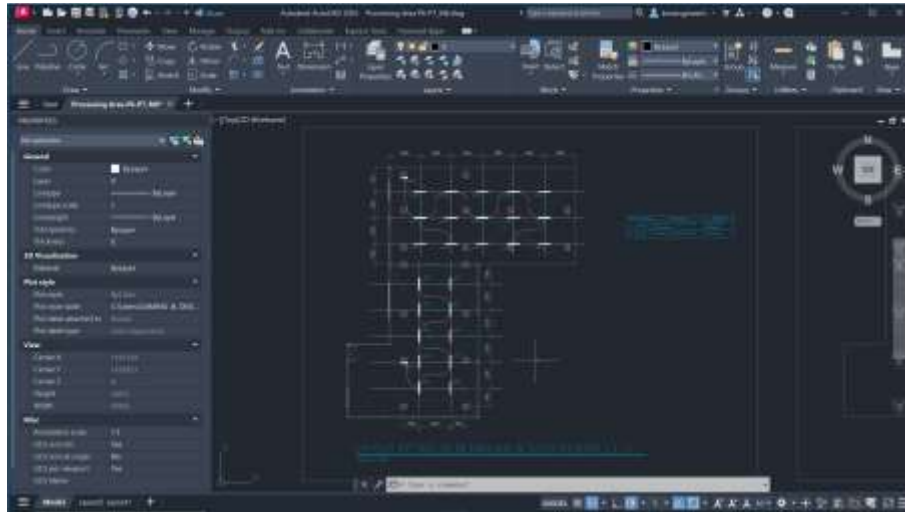


Figure 1. conventional QTO process on autocad

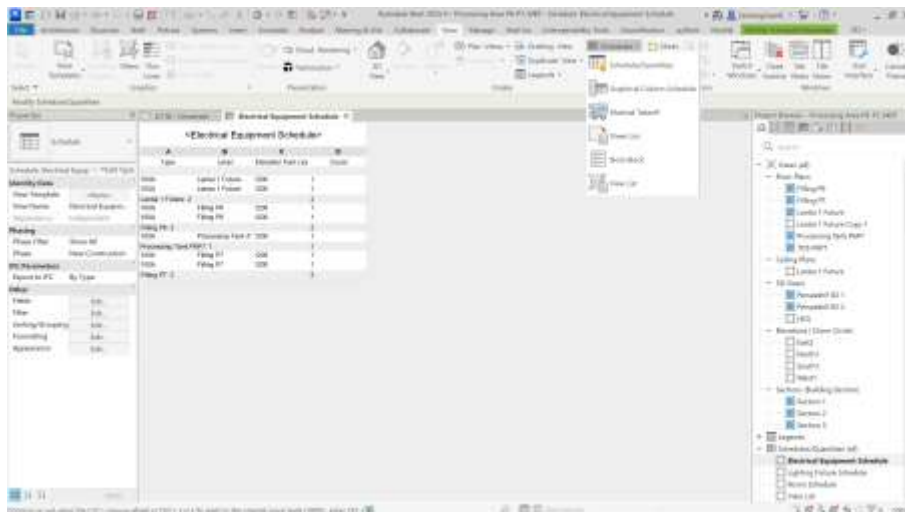


Figure 2. Schedule and quantity tools use case on revit

Regarding the speed of the quantity takeoff process, the author found a 65-minute gap in Revit work using the "schedule/quantities" tool compared to conventional AutoCAD. This translates to a 260% faster time. This is because Revit instantly reads the quantities in the "parameter family" they have, accurately and instantly. AutoCAD, on the other hand, does not have a tool to read the parameters the author desired.

Table 6. quantity take off speed comparision

Design	Quantity Take Off (QTO) Autocad 2025 and convention	Quantity Take Off (QTO) Revit 2025 and schedule B	Notes
	A (Minutes)	(Minutes)	
Structural Design	45	17	no. qtostr-01/CAD/0425; no. qtostr-02/CAD/0425; no. qtostr-03/CAD/0425; no. qtostr-04/CAD/0425; no. qtostr-01/BIM/0425; no. qtostr-02/BIM/0425; no. qtostr-03/BIM/0425; no. qtostr-04/BIM/0425;
Architectural design	30	5	no. qtoars-01/CAD/0425; no. qtoars-02/CAD/0425; no. qtoars-01/BIM/0425; no. qtoars-02/BIM/0425;
mechanical electrical design	15	3	no. qtome-01/CAD/0425; no. qtome-01/BIM/0425
Total	90	25	
	$(c) = A - B =$	65 Minutes	efficient revit
	$Efisiensi (x\%) = \frac{A-B}{B} \times 100\% =$	260%	

4. The Accuracy Of Quantity Take Off (QTO) Work

From this quantity takeoff process, the author obtained the expected quantity data according to the "item/scope of work." When comparing the Revit and AutoCAD methods, there was a difference in work volume. This indicates a volume change resulting from revisions following clash detection in each software.

Result and discussion must be written in the same part. They should be presented continuously start from the main result to the supporting results and equipped with a discussion. Unit of measurement used should follow the prevailing international system. Avoid extensive citations and discussion of published literature.

Table 7. Quantity Take Off Difference between BIM and CAD

No.	Work / Scope	Sat	QTO Revit 2025 and schedule tools A (Qty)	QTO Autocad 2025 and conventional B (Qty)	Difference A-B (Qty)
A	Structural Works				
1	Foundation	M3	27.36	27.36	0
2	Pile	M1	972	972	0
3	Anchor HTB	Ttk	72	72	0
4	Sloof	M3	20.4192	20.4192	0
5	Slab Fl.1	M3	64.6	66.74676	-2.14676
6	Steel Column Fl.1	Kg	14524.664	7600.8768	6923.7872
7	Steel Beam Fl.2	Kg	12787.83486	12663.018	124.81686
8	Slab Fl.2	M3	28	27.528	0.472
9	Steel Column Fl.2	Kg	5067.2512	5192.8404	-125.5892
10	Steel Beam Fl.3	Kg	10309.47975	9634.7736	674.70615
11	Slab Fl.3	M3	25.6	25.2496	0.3504
12	Steel Column Fl.3	Kg	5067.2512	4848.8352	218.416
13	Steel Beam Fl.4	Kg	8449.31565	8014.8744	434.44125
14	Slab Fl.4	M3	16.4	16.0304	0.3696
15	Steel Column Fl.4	Kg	1234.0504	3270.7796	-2036.7292
16	Rafter	Kg	2093.04	1871.9856	221.0544
17	Roof	M2	229	244.704	-15.704
B	Architectural Works				
1	Wall Work Fl.1	M2	250	278.4	-28.4
2	Wall Work Fl.2	M2	216	312.6888	-96.6888
3	Wall Work Fl.3	M2	319	372.48	-53.48
4	Wall Work Fl.4	M2	170	139.3968	30.6032
5	Doors Works	Unit	1	1	0
6	Windows Works	Unit	4	4	0
C	Mechanical Electrical Works				
1	Lamp Fitting Fl.1	Unit	25	25	0
2	Lamp Fitting Fl.2	Unit	12	12	0
3	Lamp Fitting Fl.3	Unit	10	10	0
4	Lamp Fitting Fl.4	Unit	6	6	0
5	Power Fixture Fl.1	Unit	2	2	0
6	Power Fixture Fl.2	Unit	2	2	0
7	Power Fixture Fl.3	Unit	1	1	0
8	Power Fixture Fl.4	Unit	2	2	0

CONCLUSION

Based on the differences studied in this project design, the author concludes that modeling using Revit BIM is 31% more efficient than drafting using AutoCAD. For quantity takeoff work, Revit is 260% more efficient than using conventional AutoCAD methods. Meanwhile, for cost estimates, there was a price difference of Rp. 195,871,595.70, representing a 4% difference in cost estimates using Revit compared to conventional AutoCAD methods.

The use of clash detection in project design planning significantly impacts cost estimates. This helps designers avoid many issues during the construction phase and provides concrete explanations, thereby reducing work time.

ACKNOWLEDGEMENTS

This study is expected to contribute to the development of construction technology from the planning phase, construction phase, building operation phase, and demolition and renovation phase. The author would like to thank the lecturers at university of kahuripan kediri (UKK), for their extensive guidance and direction in completing this journal.

BIBLIOGRAPHY

- [1] G. O. Deniz, "Emerging cad and bim trends in the aec education: An analysis from student's perspective," *Journal of Information Technology in Construction (ITcon)*, vol. 23, pp. 138-156, 2018.
- [2] J. J. Maina, "CAD and BIM in architectural education: Awareness, proficiency and advantages from the student perspective.," *Gazi University Journal of Science Part B: Art Humanities Design and Planning*, vol. 6, no. 4, pp. 167-178, 2018.
- [3] S. A. Jones and D. Laquidara-Carr, *The business value of BIM for infrastructure 2017*, Dodge Data & Analytics, 2017.
- [4] I. Rahmani and B. Herumanta, "Comparison Of Estimation Of Reinforced Concrete Structure Working Costs Based On The Concept Of Computer-Aided Design (Cad) And Building Information Modeling (Bim)," *Indonesian Journal of Multidisciplinary Science*, vol. 01, pp. 1237-1244, 2022.
- [5] R. N. A'la, "The BIM Implementation for Preparing Mutual Check-0 (MC-0) Documents in the Building Development Project of Edusmart Soerojo Hospital Magelang," *Inersia : Jurnal Teknik Sipil dan Arsitektur*, vol. 18, no. 02, pp. 113-121, December 2022.
- [6] M. Mamdouh, O. Moursy, A. A. Hassan and V. F. Gerges, "A comparison between CAD system and building information," *IOP Conference Series: Earth and Environmental Science*, vol. 1396, pp. 1-11, 2024.
- [7] M. Ristevski, M. Karakašić, I. Grgić and D. Šotola, "Technical aspect of CAD and BIM technology in the engineering environment," *Tehnički glasnik*, vol. 12, no. 4, pp. 271-274, 2018.
- [8] A. Primasetra, D. Larasati and S. Wonorahardjo, "BIM Utilization in Improving Energy Efficiency Performance on Architectural Design Process: Challenges and Opportunities," *IOP Conference Series: Earth and Environmental Science*, vol. 1058, pp. 1-12, 2022.
- [9] Direktorat Kelembagaan dan Sumber Daya Konstruksi, *Standar Protokol BIM di Kementerian PUPR*, Jakarta: Perpustakaan Kementerian Pekerjaan Umum dan Perumahan Rakyat 2020, 2020.
- [10] J. T. Snæbjörnsson, I. B. Kjartansdóttir, S. Mordue, P. Nowak and D. Philp, *BUILDING INFORMATION MODELLING – BIM*, Warszawa: Civil Engineering Faculty of Warsaw University of Technology, 2017, pp. 24-26.
- [11] M. D. Ferdiana, *Dasar-Dasar Menggambar Bangunan*, Yogyakarta: TAKA Publisher, 2014.
- [12] W. O. Kilmer and R. Kilmer, *Construction Drawings And Details for Interiors: Basic Skills*, Danvers: John Wiley & Sons, inc., 2003.