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## EFFICIENCY ACP BUILDING MATERIALS OF BIM 5D GLODON

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### Abstract.

BIM (Building Information Modeling) is a method that enhances efficiency in terms of time, cost, volume, and form visualization. The fundamental value of BIM is that it can dramatically improve the processes, expertise, and fragmentation within construction industry organizations by increasing the level of collaborative integration, thereby enhancing industry productivity. The efficiency of materials used in the construction industry is a crucial factor affecting the final project's cost, time, and quality. Aluminum Composite Panel (ACP) is often used as a facade material in modern buildings because of its aesthetic, durability, and ease of installation advantages. However, ACP materials undergo a relatively long ordering process because most of these materials are not produced in Indonesia, which requires additional time for import. Inefficient management of ACP materials (cutting size) can cause waste and increase costs. This study aims to analyze the efficiency of ACP material use in construction projects using Glodon software, an application based on Building Information Modeling (BIM), specifically 5D BIM, which can accurately calculate material quantities. This study aims to provide insights into the efficiency of Glodon software for architects in Indonesia, offering a quick alternative design method that prioritizes waste efficiency to reduce waste emissions, in line with the concept of green building. Efficiency in material waste management contributes to the development of green buildings because reduced waste means a more efficient use of resources and a lower environmental impact. Many green building standards and systems, such as LEED (Leadership in Energy and Environmental Design), assess material efficiency as one of the criteria in the overall assessment of green buildings. This study employed a quantitative descriptive method through a case study of a construction project utilizing ACP. This study also analyzes the potential for reducing material waste by utilizing Glodon software for the first and second calculation stages, employing Maxcut software, and its impact on project costs and time. The application of Glodon also contributes to accelerating the time to manage ACP cutting patterns and waste calculations. If you want even smaller waste, Maxcut software determines efficient cutting patterns to reduce project costs because the waste is relatively small. Factors that affect the efficiency of ACP materials identified include the level of calculation accuracy, material management in the field, and user skills in operating Glodon software, significantly increasing the efficiency of ACP material use and suggesting wider use of 5D BIM technology in material management in the construction industry to achieve more efficient and environmentally friendly projects.

**Keywords:** Aluminum Composite Panel (ACP), Glodon, material efficiency, Building Information Modeling (BIM), construction



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## 1. Introduction

Designing with Aluminum Composite Panels (ACP) requires the integration of visual design principles and material efficiency within the broader framework of sustainable architecture. ACP is a lightweight yet durable material that has become increasingly popular for building facades due to its ability to enhance aesthetic quality while offering functional and environmental advantages. From a visual perspective, ACP offers a high degree of aesthetic versatility, as it is available in a wide range of colors and finishes that enable architects to create expressive, modern, and luxurious façade compositions (Ramadhani, 2023). Moreover, its capability to form complex and detailed facade patterns enhances architectural identity and contributes to the distinct character of contemporary buildings (Ramadhani, 2023).

In addition to its visual appeal, ACP makes a significant contribution to waste efficiency in architectural design and construction. Its lightweight properties and ease of installation reduce the generation of material waste during the building process (Bahari et al., 2018). Furthermore, the recycling potential of ACP offers opportunities for reusing leftover materials in other functional applications, such as workstations or interior panels, thereby supporting the broader goal of material sustainability in the construction industry (Bahari et al., 2018).

From a performance standpoint, ACP also enhances energy efficiency through its thermal and acoustic insulation properties, which help lower energy consumption and improve indoor comfort (Lin & Wu, n.d.). Within this context, ACP is not only an aesthetic solution but also a strategic material that supports energy-conscious architectural practices. The integration of Building Energy Modeling (BEM) and Building Information Modeling (BIM) further strengthens the role of ACP in achieving optimal building energy performance by enabling detailed simulations and data-driven design decisions (Lin & Wu, n.d.). For architects who adhere to green building principles, such as those promoted by LEED (Leadership in Energy and Environmental Design), these digital tools provide valuable support in minimizing waste and optimizing resource use. Before ACP materials are discarded as waste, the application of advanced BIM 5D platforms, such as Glodon, can assist in processing cutting data and facade pattern designs. Through this approach, architects can develop design alternatives that are visually refined, environmentally responsible, and efficient in material usage.

The use of Glodon software exemplifies the integration of digital technologies into sustainable facade design. As a BIM-based system, Glodon facilitates comprehensive planning, three-dimensional modeling, and precise quantity measurement, optimizing both design accuracy and waste reduction. The process typically involves developing a 3D model of the building facade, identifying specific areas for ACP installation, and arranging panel patterns strategically to balance aesthetic and material considerations. Complementary 2D drafting using Autodesk AutoCAD supports detailed design visualization. By incorporating panel size optimization, Glodon enables designers to align ACP layouts with standard manufacturing dimensions, thereby minimizing off-cuts and reducing construction waste. Its automatic quantification and installation simulation features further allow for accurate material estimation, waste prediction, and performance visualization prior to on-site implementation. The efficiency of this process can be enhanced through Microsoft Excel-based analyses, which enable the calculation of optimal cutting combinations and material conversion ratios to further minimize waste generation.



Overall, the integration of ACP with BIM-based applications such as Glodon reflects a contemporary architectural paradigm that unites aesthetic innovation, environmental efficiency, and digital precision. This synergy supports the development of sustainable building practices by optimizing visual design, energy performance, and material utilization, aligning architectural production with the broader goals of ecological responsibility and technological advancement.

## 2. Method

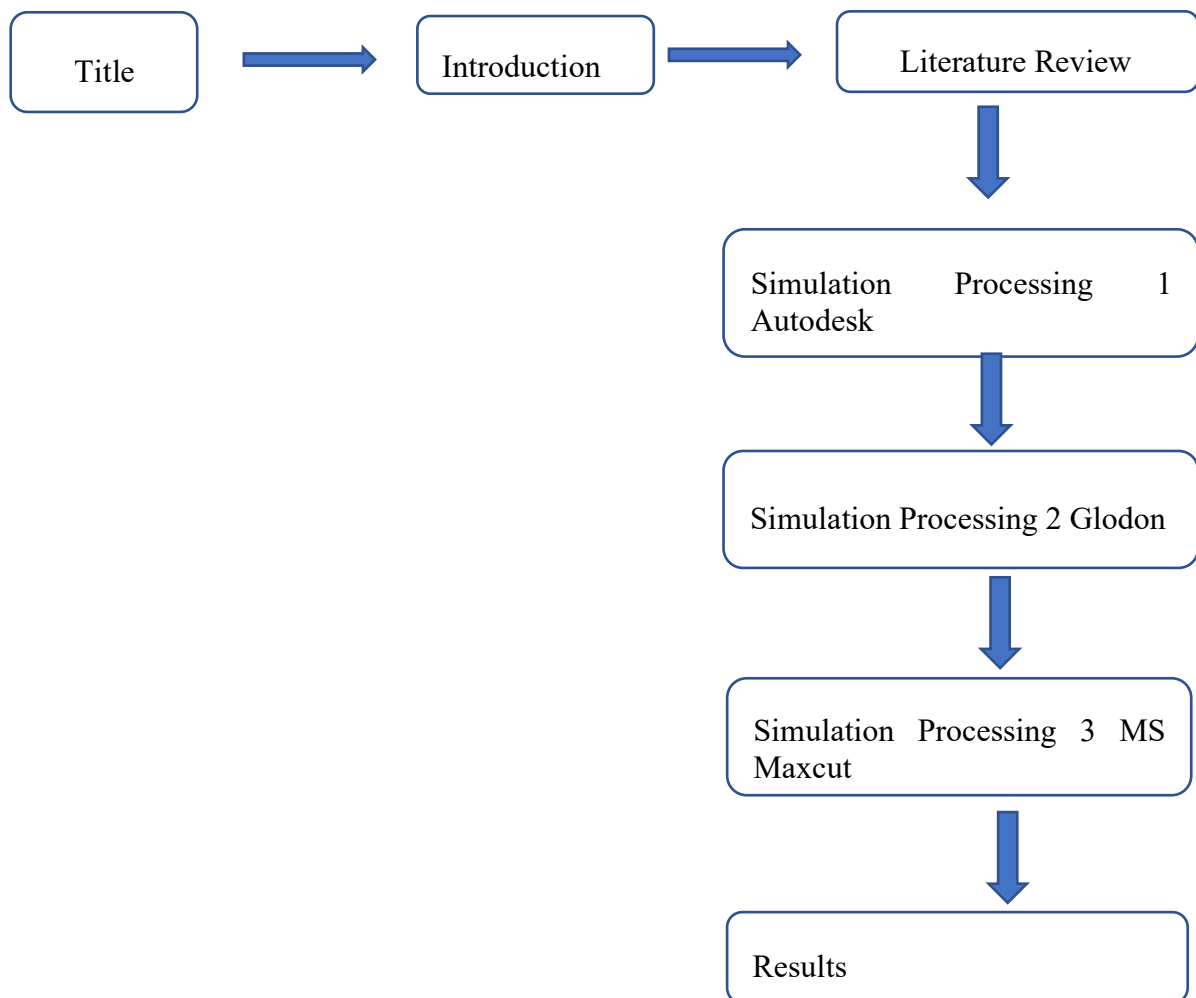


Figure 1. research methodology

### 2.1 BUILDING INFORMATION MANAGEMENT (BIM) BIM 5D

5D BIM is the next evolution of BIM technology that combines the three primary dimensions of BIM (3D) with two additional dimensions, namely time (4D) and cost (5D). It is



an integrated approach to construction project management that allows for more comprehensive modeling, planning, and control. Dimensions are:

1.
  - a. BIM dimensions refer to how certain data types are related to the information model.
  - b. Each dimension and the data added to it provide a broader understanding of the project, such as its cost, how it will be delivered, what maintenance is required, and so on.

### 2.1.1 BIM 3D

The main component of 3D BIM is a digital representation of a building in three dimensions, including architectural, structural, and mechanical-electrical-plumbing elements. 3D BIM allows multiple disciplines to work within the same model, reducing the risk of design conflicts. The benefits of 3D BIM are that it will enable stakeholders to better understand the project through a visual representation close to reality. Early detection of clashes, conflicts, or collisions between elements reduces the risk of changes in the field. Providing the same understanding to all parties, including clients, contractors, and consultants.

### 2.1.2 BIM 4D

BIM 4D enables project teams to integrate construction scheduling with 3D models, allowing them to visualize the project's progress over time. Projects can be simulated through various stages of construction, providing a visual representation of construction progress from start to finish. Optimize project schedules by identifying potential delays and testing scenarios to accelerate project schedules without sacrificing quality. BIM 4D facilitates communication between stakeholders through easy-to-understand visual presentations of project schedules and anticipating risks associated with project delays through simulations of various time scenarios. BIM 4D grew from the need to incorporate time-scheduling elements into 3D BIM to improve project management efficiency.

### 2.1.3 BIM 5D

BIM 5D is a dimension of Building Information Modeling that adds cost estimation elements to the BIM model. In BIM 5D, geometric information and time data are integrated with cost data, enabling more accurate and real-time cost calculations throughout the project lifecycle. Data from these calculations can provide material, labor, and equipment cost data, which can be added to the model, resulting in a total cost estimate for the project. In cost scenario analysis, BIM 5D allows users to run simulations and compare various design scenarios or construction methods to evaluate their impact on costs. Assisting in preparing more structured and detailed budget and cash flow plans. In analyzing alternative designs and materials, BIM 5D enables the comparison of various design and material options to select the most economically efficient solution. BIM 5D is one of the essential dimensions in BIM, focusing on project cost management.



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#### **2.1.4 GLODON**

Glodon Company Limited has been dedicated to digitalizing the construction industry for almost thirty years. Glodon Solutions serves a diverse range of stakeholders, including industry regulators, developers, designers, consultants, contractors, equipment and material manufacturers, as well as city operations, finance, and education sectors. We leverage core digital technologies and systematic digital capabilities to drive high-quality development in the construction industry.

The construction industry faces significant uncertainty due to the economic downturn and the increasing complexity and demands of low-carbon construction projects. Glodon provides professional digital solutions that cover the entire building lifecycle, featuring systematic digital capabilities and an open ecosystem that connects partners and clients throughout the supply chain.

This strategy uses advanced lean construction methods and integrates people, processes, data, technology, and business systems to make all construction processes, factors, and stakeholders online, digital, and intelligent. By promoting industry innovations that feature digital design, construction, and O&M approaches, Glodon aims to enhance the industry and achieve the goal of making every project successful. These processes provide opportunities to make informed decisions, reduce costs, improve efficiency, drive sustainability, and ultimately deliver better value to clients. Some of the tools available in Glodon :

#### **2.1.5 TAS & TRB 5D BIM Quantity Take off for Architecture, Structure, and Rebar**

TAS and TRB software for BIM-based quantity calculations support the entire construction industry (owners, consultants, and contractors) with fast and accurate calculations that improve work efficiency, material, and cost management.

#### **2.1.6 TMEC 5D BIM Quantity Takeoff**

TMEC is a 5D BIM Product for MEP Professionals. It dramatically improves the efficiency of Quantity Takeoff in MEP through rapid identification, accurate modeling, and flexible quantification, allowing you to understand the project's path and calculation from the outset.

#### **2.1.7 TBQ Estimated costs Digital BIM 5D & Management**

Enhance cost estimation and management by making them more time-efficient, intuitive, and highly automated. Redefine highly efficient team tendering by combining project cost data, rates, tenders, and cost analysis into a single platform, enabling teams to work smoothly and collaboratively. So that the volume of work at the time of tendering can be easily applied to this tool.

### **3. Result and Discussion**

Study 1 by Canggih Gilang Pradana H. S1 (2022) serves as a construction actor; this study focuses on comparing volume calculations in m<sup>2</sup> for architectural work, namely red brick



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walls, ceramics, and ceilings, using Glodon TAS and TRB software. It achieves an efficiency of 11.55% compared to the RAB from the planning consultant.

In study 2 from (Rizqi Rahayu & Priyo Suseno, 2023) Construction professionals in the field of quantity surveying, who compare RAB (Cost Budget Plan) with RAP (Implementation Budget Plan) using Glodon TAS and TRB software, can reduce the RAP budget by 0.511% compared to the RAB. The materials studied are the volume of architectural work, namely, brick walls, ceramics, and ceilings.

Study 3 (Fariq et al., 2022) investigated the technical risks of 5D BIM practices at the pre-contract stage and explored risk mitigation strategies for construction projects that adopt 5D BIM technology. Three main groups of technical risks were identified and reviewed: modeling problems, poor implementation procedures, and design change problems. The population of this study consisted of quantity surveyors, and respondents came from consulting firms, contractors, and developers.

The 4th study (Zhou et al., 2023) examined the competitive strategy following market changes to continuously renew itself and maintain competitiveness, which can be formed through synergistic cooperation between glodon application actors and platform ecology. So that it can build a stable and orderly platform ecology; fourth, collaborative governance, based on the realization of collaboration between various departments in the company, creating a new management paradigm of governance that leads the platform company and collaborative governance of various participating subjects

The 5th study (Hongyan, 2021) compares Glodon GTJ and Revit-based quantity calculations with calculation materials for column, beam, and plate concrete structures. The use of Glodon is better than Revit.

The sixth study (Immanuel et al., n.d.) examined the marketing method for the Glodon software platform in education, such as universities. Universities will play a crucial role in developing the infrastructure necessary to support sales growth in the industry.

The 7th study (Ibrahim, 2023) examined the analysis of the coefficient of structural reinforcement materials using BIM Glodon Cubist and TRB, and the max cut application. After being modeled with max cut, the volume of reinforcement was obtained, which took into account the coefficient of the reinforcement material; the coefficient value of the column work material was received at 1.08; the coefficient of the core wall work reinforcement material was 1.08, and the coefficient of the beam work reinforcement material was 1.06. This result is also slightly larger than the previous study by Wiryonoto, which reported a value of 1.045.

The 8th study (Alifa et al., 2024) this study was to determine the volume calculation using the help of BIM Cubicost TAS software (for calculating concrete volume) and Cubicost TRB (for calculating reinforcement volume) in the basement plaza area on the 1st floor of the Batam Center Grand Mosque Revitalization Project, resulting in a volume that is relatively small compared to the results of manual volume calculations carried out by quantity surveyors (BoQ). The research that an architect will carry out is expected to be able to provide an ACP pattern design with an ACP cutting pattern with the help of Glodon Cubicost TAS so that it can provide an evaluation of the ACP waste material used and can be called a green architect



concept and can order ACP at the beginning of the project so that the time for material procurement is not hampered.

## 4. Conclusion

The following are the steps for working using Glodon software:

### 4.1 Autocad 2D

Glodon is a tool that can help obtain ACP cutting pattern designs from Autodesk Autocad 2D. First, you must detail the ACP visible image cut openings so that they can be read later by the Glodon software. So, the determination of Glodon results depends on the results of the Autocad 2D work; the more detailed the optimal results will be.

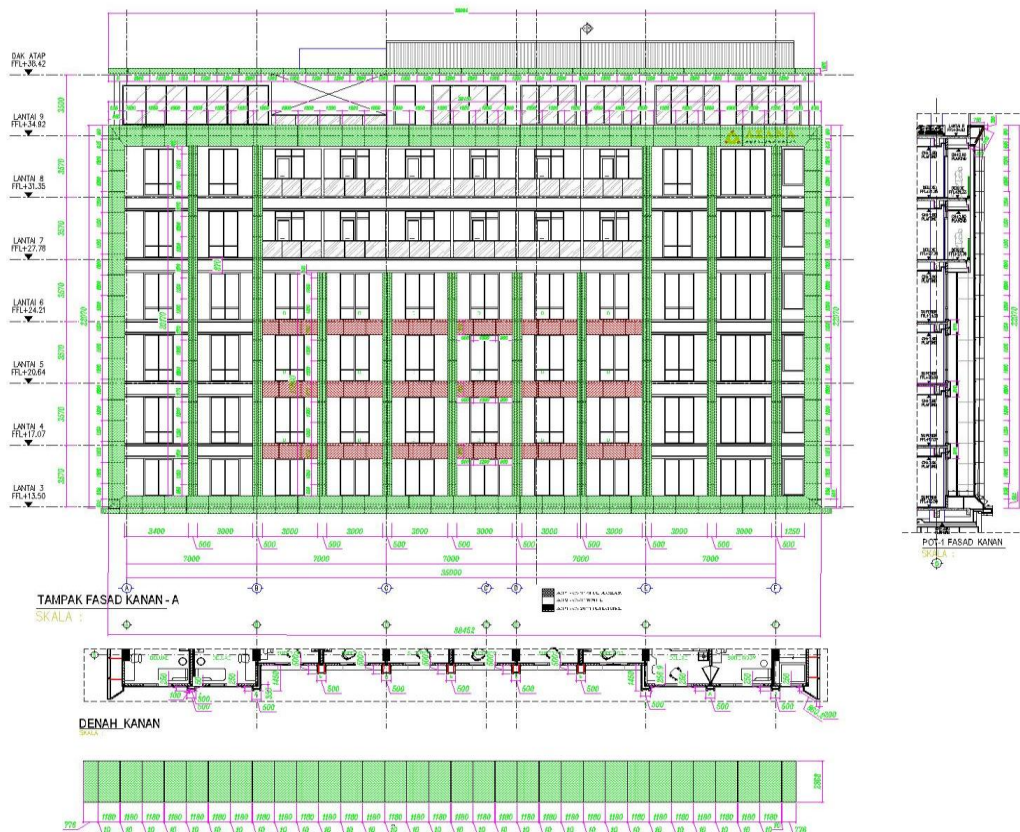


Figure 2. ACP Simulation results in visible image simulation.

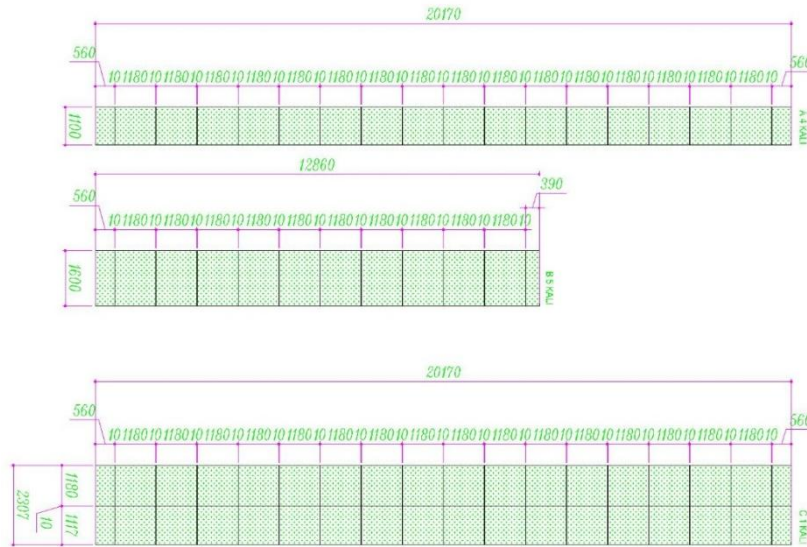


Figure 3. Simulation Detail of visible opening ACP

## 4.2 Glodon TAS

	A	B	C	D	E	F	G	H	I	J
1	Tile Name	Tile Spec	Cut Shape	Cut Label	Number of Cuts	Number of Tiles	Net Total Area (m2)	Actual Total Area (m2)	Wastage (%)	
2	F1(1110*915)	1110*915		1110*915	1	1	1.016	1.016	0.00	
3	F1(1180*1110)	1180*1110		1180*1110	4	11	5.239	14.408	0.01	
4	F1-5(Irregular)			1180*1110	1		1.309			
5	F2(1180*1110)			1180*1110	3		3.929			
6	F2-4(Irregular)			1180*1110	1		1.310			
7	F2-5(Irregular)			1180*1110	1		1.310			
8	F2-6(Irregular)			1180*1110	1		1.309			
9	F1(1180*1180)	1180*1180		1180*1180	12	32	16.709	44.557	0.01	
10	F1-1(Irregular)			1180*1180	2		2.784			
11	F1-2(Irregular)			1180*1180	1		1.392			
12	F1-3(Irregular)			1180*1180	1		1.392			
13	F1-4(Irregular)			1180*1180	1		1.392			
14	F2(1180*1180)			1180*1180	12		16.709			
15	F2-1(Irregular)			1180*1180	1		1.392			
16	F2-2(Irregular)			1180*1180	1		1.392			
17	F2-3(Irregular)		1180*1180	1	1.392					
18	F1(1180*800)	1180*800		1180*800	5	12	4.720	11.328	0.01	
19	F1-7(Irregular)			1180*800	2		1.887			
20	F2(1180*800)			1180*800	5		4.720			
21	F1(1180*915)		1180*915		1180*915		2			3
22	F2(1180*915)			1180*915	1	1.080				
23	F1(1180*980)			1180*980	6	6.938				

Figure 4. Simulation results from golden

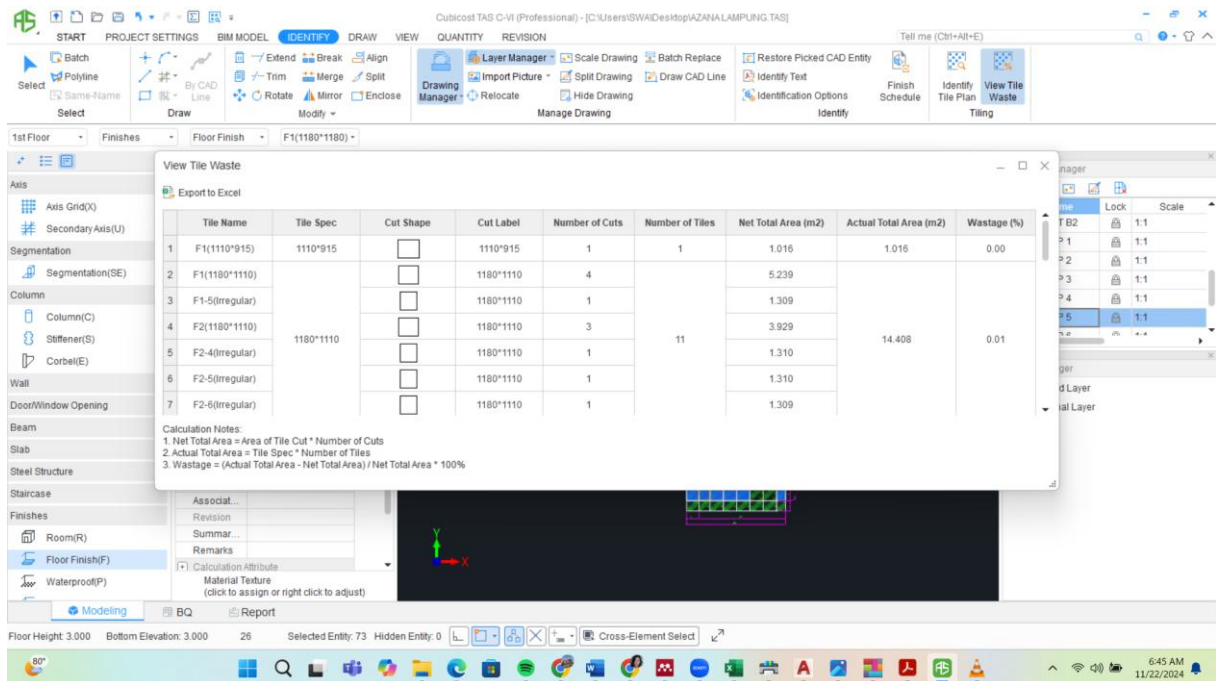


Figure 5. Simulation results example with golden

### 4.3 Maxcut

MaxCut is not a specific application of BIM 5D, but it can be categorized as one of the tools that support the concept, depending on how the software is used in construction projects. MaxCut is software designed to assist in optimizing the cutting of materials such as steel, aluminum, wood, or other sheet materials. It can also be used for ACP material because ACP is in sheet form. The goal is to minimize material waste and maximize material usage efficiency. MaxCut is often used in industries that require precise calculations to reduce material waste. This cost element is highly dependent on material use efficiency and is directly related to tools such as MaxCut. This reduces wasted material costs, which is essential in project cost estimation. This enables data integration into the BIM 5D system, allowing for accurate estimation and tracking of material costs throughout the project life cycle. MaxCut is a specialized tool that supports certain aspects of BIM 5D, particularly in relation to material efficiency and cost estimation.



Especially related to material efficiency and cost estimation.

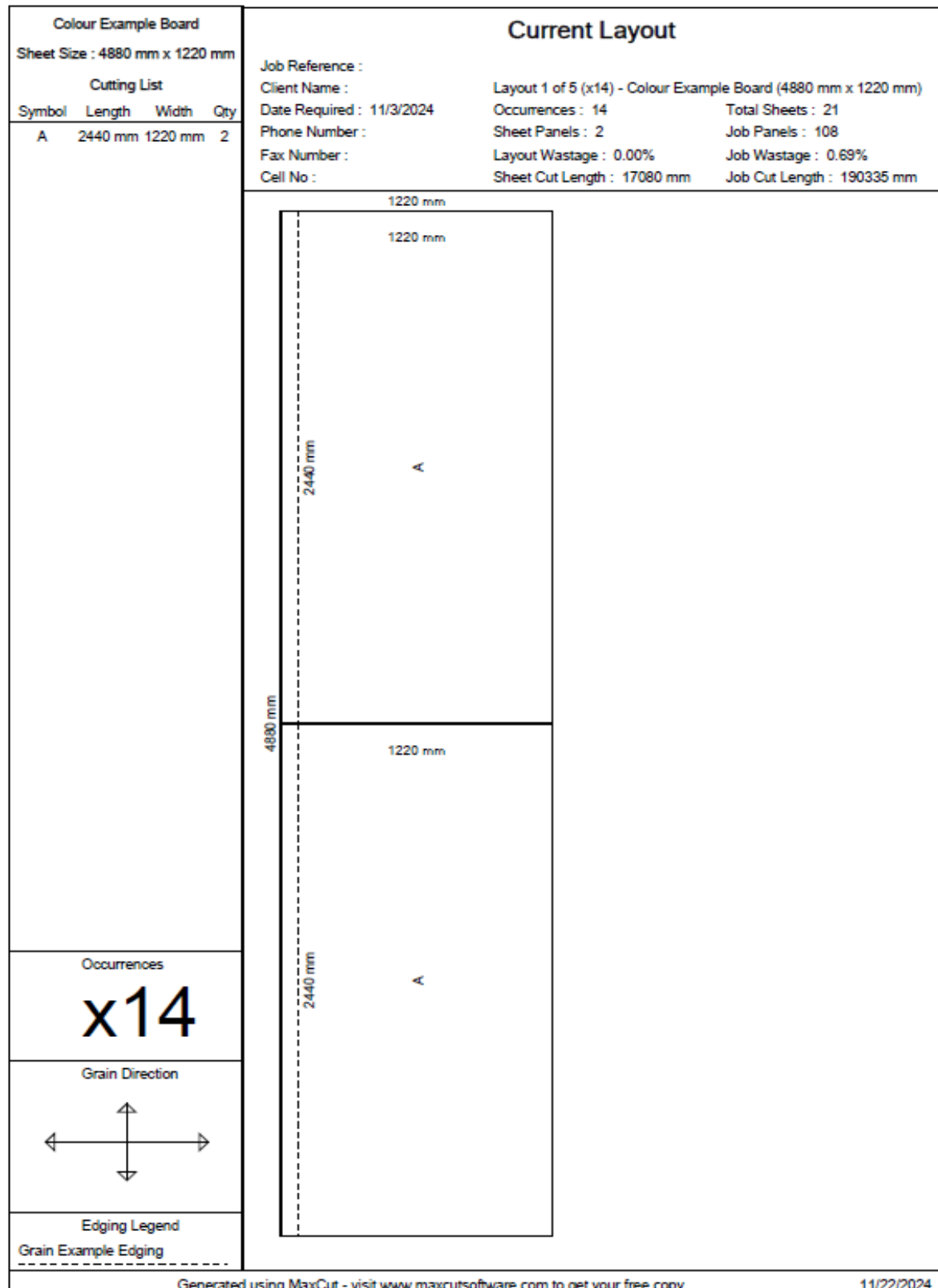


Figure 6. Examples of ACP Patterns using Maxcut



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## 5. Results

There is a gap in several existing studies. Namely, there has been no research on calculations for visible materials. Therefore, we attempt to examine this by providing a simulation of the waste material calculation process using Glodon software, which is very helpful in quickly classifying the size of the ACP cutting pattern and the number of patterns used. For the Maxcut application, it is beneficial in how efficiently the patterns classified in the Glodon software are translated again into one sheet of ACP, into how many cut patterns according to the number of pattern volumes and pattern variants. The results will be explained in more detail in the following study, not just as a simulation of the calculation process.

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