Quest Journals
Journal of Architecture and Civil Engineering
Volume 7 ~ Issue 10 (2022) pp: 01-11
ISSN(Online) : 2321-8193
www.questjournals.org

Research Paper

The Impeding Factors on the Green Construction Management Application in New Building Projects

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ABSTRACT: *Presently, global warming and environmental degradation issues pose a threat to local communities and the international community. There are a few factors that cause global warming and environmental degradation issues. The factor that is considered to be a harmful environment is the construction industry. Environmental harm occurred during the construction process until the building was used. Reduction of green space, excessive energy consumption, and unfriendly building materials contribute to global warming. However, there hasn't been a thorough investigation of the obstacles to adopting green construction in Indonesia and solutions to them. Several challenges must be solved to use green construction in Indonesia, particularly in Malang City. A survey of authorities in the field of green construction is used to obtain data. Descriptive analysis was used to analyze the data to find agreement among the respondents. Additionally, the Analytical Hierarchy Process method seeks to determine the hierarchy of these barriers to design solutions to get around them and deploy green construction. Obstacles include a lack of specific regulation and a poor understanding of how to conduct green construction. Therefore, a strategy is also needed to overcome the barriers of each of these aspects by raising awareness about green construction practices and enacting detailed green construction regulations.*

KEYWORDS: *Green Construction, Inhibiting Factors, Obstacle, Strategy, Analytical Hierarchy Process Method*

R*eceived 21 Sep., 2022;* ***R****evised 03 Oct., 2022;* ***A****ccepted 05 Oct., 2022 © The author(s) 2022.*
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I. INTRODUCTION

The world and community organizations are currently facing major problems related to global warming and environmental deterioration [1]. Various causes bring both on. One of the things thought to have a bad effect on the environment is the construction industry. Environmental harm happens throughout development until the building is used [2]. Global warming results from declining green areas, excessive energy use, and environmentally unfavourable building practices [3]. As a result, builders began to use the idea of green construction management [4].

To reduce the development process' detrimental environmental impact, "green construction" is described as the design and implementation of the development process based on contract papers [5]. It balances the current ecological capacity with the needs of human life and future generations [6]. However, other communities must follow this concept and their sensitivity to efforts to protect and preserve the environment. This green construction is an excellent breakthrough in reducing the impact of global warming. Still, the movement also requires practical application by stakeholders and government support to implement another concept. The on-site construction phase is key in realizing a green construction perspective. In addition, the coalition of contractors in awareness and action on green construction sites through applying green principles at construction sites will play an important role [7]. This study aimed to investigate green construction awareness and clarify the gap between awareness and activity in adopting green specifications from the perspective of on-site personnel.

The construction process can be considered harmful to the environment if it is not properly controlled during implementation. According to Ervianto [8], the number of developments made in Indonesia's

construction industry is increasing yearly. Construction sector development is the development that is considered to cause environmental damage. One example of a building in Malang is the Dean Building of the Faculty of Engineering, Universitas Brawijaya Malang. The building received a bronze value, meaning its management needs to be evaluated. According to the Green Construction Council Indonesia (GBCI), the bronze value is the lowest in the assessment. Therefore, analyzing the inhibiting factors for applying green construction management in implementing building construction projects in Malang City is necessary. This research will analyze the constraints of green construction management on construction projects in Malang City. Constraints or obstacles in implementing green construction management must be identified so that it is known which obstacles are the basis for implementing green construction management in the construction industry in Malang City.

II. LITERATURE REVIEW

2.1. Construction Project

An activity part of a project is said to be temporary if it only lasts for a short time, requires the allocation of specific resources, and is designed to generate goods or deliverables that meet strict quality and risk standards [9]. According to Gray and Larson [10], a project is a difficult, irregular endeavour with constraints on time, money, resources, and performance standards that aims to satisfy client needs. Therefore, a project activity aims to complete tasks with clearly defined objectives during a brief period with the allocation of certain resources.

A construction project is a series of activities carried out only once and generally have a short period. Building-related activities are the product of a procedure that manages project resources. The construction project is a complex business and does not have exactly the same as any previous project, so a construction project must require construction project management [11]. A construction project is a collection of tasks completed just once over a certain time. Additionally, construction projects have distinct qualities, need for resources (labour, supplies, equipment, cash, and methodologies), and demand organization [12].

2.2. Green Construction

The term green construction generally refers to the environment. However, there is no specific definition of this green term. Similarly, many duplicate terms use terms related to this environment. These conditions are ultimately designed according to the program's criteria. Green Construction is a term related to the environment that develops in development projects in response to the effects of global warming. Green construction is the planning and execution of construction projects based on contract documents to reduce the damaging effects of the construction process on the environment [13]. The design and execution of the construction process to minimize any negative effects on the environment is the concept of "green construction," which aims to strike a balance between the requirements of the present and future generations and the environmental capabilities. Green construction, or green construction, is a sustainable movement that aspires to create construction from the planning, implementation, and use stages of environmentally friendly construction products [13]. In this instance, a construction project activity's execution stage is crucial.

In the building industry, the idea of green construction is well-known as a response to global warming. The three main advantages of putting this idea into practice are preserving natural resources, achieving energy efficiency, and reducing environmental harm. To minimize the negative effects of the construction process on the environment and to strike a balance between environmental capabilities and the needs of the present and future generations of humans, "green construction" is defined as the planning and implementation of the construction process based on contract documents [6]. A comprehensive construction process aims to maintain and restore harmony between the natural and built surroundings [15]. According to Ervianto [16], green construction entails organizing and carrying out the construction process to reduce its detrimental effects on the environment. It indicates a balance between the environment's capacity and human life's demands for the present and future. Green construction is a term that includes strategy, technical and construction products that, in its implementation, use few materials that cause pollution or environmental pollution [14]. Reduced operational costs, improved comfort from controlled humidity and temperatures, a robust air circulation system, easy and economical material replacement, and comparatively low maintenance costs are just a few of the benefits of green building [16].

The principle of green construction is to build construction without destroying the environment. There are a few guiding concepts for managing green buildings, including effectively using natural resources and energy and paying attention to all factors, including spatial design. The purpose of this action is to maintain the quality of indoor air quality. Furthermore, using renewable materials and paying attention to its residents' health are based on sustainable development principles. These aspects are considered during the life cycle of the building, namely from the planning, construction, operational, maintenance, renovation, and even demolition stages.

2.3. Influential Elements That Affect the Use of Green Construction

2.3.1. Inhibiting Factors

According to Sinulingga [17], the obstacles in using green construction include financing its upkeep, capital expenditures, creating legal guidelines for its use, raising public awareness of its significance, incorporating the idea of green construction into urban planning, choosing environmentally friendly building materials, disregard for human health, and developing strategic designs. Identification of obstacles faced by contractors in implementing green construction according to Ervianto [18], namely technology, the active role of project owners, limited regulations governing the implementation of green construction, socialization of saving natural resources that are not environmentally friendly, and funding intervention in the rejuvenation of various low emission and fuel-efficient equipment.

Aziz [19] shows that the most important obstacle in implementing green construction in Indonesia is legal and regulatory issues to provide guidelines for implementing green construction. Furthermore, according to Samari [20], investment risk is the obstacle to implementing green construction. Lack of credit to cover down payments for green construction, high final construction costs, lack of demand for green construction, lack of incentives for those already using green construction, absence of green construction regulations, high investment costs, absence of green construction promotion strategies, and lack of public awareness of green construction are all factors.

According to Djokoto [21], the identification of barriers to implementing green construction in Ghana as seen through the eyes of consultants, including the lack of a need for green construction, the absence of strategies to promote green construction, the high final costs, the lack of public awareness of the significance of green construction, the absence of government support, the absence of regulations regarding green construction, the high investment costs, the absence of measuring tools to assess green construction, and the lack of technology In addition, constraints in green construction from the design stage are the large budget for green construction compared to construction that does not apply green construction, lack of education and experience in green construction development work, stock availability and certification of environmentally friendly materials are still difficult to obtain, and project owners are reluctant to pay attention to the importance of costs for green construction [22].

According to Griffin [23], the interaction between stakeholders, rising costs, laws governing the use of green building materials, and a lack of materials are the key non-technical challenges preventing the implementation of green construction. Meanwhile, according to Kurniati [24], the barrier to green construction is the lack of understanding of its significance, the perception that it is expensive, the absence of "green" consultants and contractors in Indonesia, as well as the absence of legislation and standards governing green building and green-labelled goods. Constraints on green construction buildings are divided into several categories. Clean Water America Alliance [25] shows that green construction constraints are technical and physical constraints, legal and regulatory constraints, financial constraints, and constraints from the community and institutions in charge of the environment. Meanwhile, according to Naumann [26], green construction constraints are structural and procedural constraints from institutions and organizations, regulatory constraints, cultural and behavioural constraints, contextual constraints, capacity constraints, and technical constraints in implementing green construction.

2.3.2. Success Factors

Alfaiz et al. [27] show the success factors in implementing green construction are efficient legislation, competent team members through training and skills development, subsidies or tax reductions, experience and knowledge sharing, project manager competence, working conditions and information on existing buildings, effective project planning and control, support from top management, cost management, green technology maintenance, contract conditions, clear project scope, and stakeholder priorities, owner involvement, minimizing disturbance to existing occupants, space management, owner responsiveness, cultural traditions, and technological complexity.

The success factors in implementing green construction, according to Shen et al. [28], are project manager competencies, green construction consultant competencies, contractor competencies, designer competencies, senior support in making decisions, stakeholder relations, innovative technology approaches, initial stakeholder involvement, project team competence, project team motivation, communication between participants, advanced machinery and equipment, socio-political environment, economic environment, project type, and project size.

Dalibi et al. [29] show green construction success factors include the presence of green construction technical knowledge, innovation and effort among professionals in construction design, adequate costs, adopting of green construction features with preferences, overcoming political barriers, economic, social, technological, environmental, and cultural, and a concentrated view of the success factors and success criteria of green construction development among stakeholders.

According to Alqadami [30], the success factors for implementing green construction include public procurement to facilitate publicity for actions towards a greener approach; cooperation and synergy between government, consultants, and suppliers to develop a reliable and accessible green specification database; research evidence of cost savings with green procurement; evaluation of alternative methods to achieve goals; selection of materials that pose a low risk to the environment; and the competency of the person responsible for implementing green construction.

Rehman [31] shows the effectiveness of project planning and control, trust among stakeholders, communication and cooperation among project participants, a skilled facility management team, support from top management, work experience, level of awareness and skills, and clear and objective goals, longer monitoring and adjustment periods, policies, and project management practices are some of the success factors in implementing green construction.

2.4. Analytical Hierarchy Process

An approach to making decisions called the Analytical Hierarchy Process (AHP) begins with organized criteria [32]. The working principle of AHP is simplifying a complex problem that is not structured, strategic, and dynamic into its parts and arranged in a hierarchy [33]. Users of AHP can easily determine the relative weights of various criteria (or multiple alternatives to criteria). Giving the value of relative weight is done by making pairwise comparisons. AHP has the advantage of explaining the decision-making process because it can be described graphically, making it easy to understand by all parties involved in decision-making.

III. MATERIALS AND METHODS

This research was conducted on a Malang City, East Java construction project. The building in question is a building with a minimum of three floors. The building includes a private building and a building owned by the Malang City Government. The object of the research was the construction area of the Brawijaya Auditorium and KDP Integrated Entrepreneurship Building, the Bethany Yestoya Church of Malang, and the Malang Creative Center (MCC) Building. The method used in this research is a combination research method, which combines qualitative and quantitative methods to be used together.

3.1. Data Collection

Sequential mixed approaches are employed for the collection of data. Primary and secondary data are required for the study project. Conducting interviews and collecting questionnaires yielded primary data. Literature research yielded secondary information (journals and handbooks).

3.2. Population and Sample

In this study, purposive sampling and saturated sampling were used as sampling techniques. The respondent's considerations are expert judgment or those who are master and competent in the building field and can provide input to identify problems that occur in the project and their resolution. The number of respondents in the AHP method does not have a specific formulation, but there is only a minimum limit of two respondents [32]. The respondents in question include Project Implementers (Contractors) and Project Supervisors (Supervising Consultants).

3.3. Research Variables

The green construction concept is a series but can also be used independently; it is only used in the construction execution stage [34]. Therefore, this study uses the dependent variable (dependent). There are seven indicators for measuring the inhibiting variables for the implementation of green construction as follows:

1. Regulation
2. Government
3. Financial
4. Technical
5. Technology
6. Education
7. Culture and Habits

3.4. Data Analysis

Data analysis in this study was carried out by analyzing and ranking the discussion results of the problem using the AHP method. The rating focus is based on factors that hinder the implementation of green construction. Discussing the problem that contains the stages of calculating the existing data uses a valid formula for the AHP method. Each stage will be discussed maximally according to the steps contained in the AHP method. The data processing results in the previous stage will be used as material for further analysis to solve problems. The results of this problem-solving are expected to provide an alternative to anticipating

obstacles to applying green construction in Malang City, especially in construction projects. A hierarchy has explained the main objectives in assessing green construction barriers. The hierarchy is a simplification and becomes structured into groups. Each hierarchy is assigned a priority value/importance scale (number) and then processed through AHP so that the largest weight of each green construction criteria and factor can be known. Following are the stages of data analysis in this study utilizing the AHP approach for identifying obstacles to green building practices.

1. Develop a hierarchy of problems where problems are categorized into several parts, namely goals, factors, criteria, and sub-criteria, then arranged into a hierarchical structure.
2. Priority determination is carried out using a pairwise comparison approach to get the value of the level of importance in the form of numbers (quantitative). Diverse problems on a scale from 1 to 9 are optimal for evaluating opinions [32]. Therefore, pairwise comparisons are filled with a value scale of 1 to 9 adjusted for the number intensity of interest. The higher the number chosen, the greater the intensity of importance. If there is doubt in answering between two adjacent values, then you can choose an even number between the two, commonly called the middle value (a grey area). Furthermore, all comparison criteria are ranked based on the values of the comparison criteria.
3. Logical consistency. After weighing each hierarchy, the analysis uses Expert Choice 11 so that information about the consistency of the assessment can be immediately known. This evaluation is carried out by considering the consistency ratio (CR) value by obtaining a value that is less than or equal to 0.10 to be said to be consistent. Reference [32] explains that if the number of elements is large, the relative priority will be small, and errors can greatly distort this. On the other hand, if the number of items is small and the priority is comparable, the small error does not affect the order of magnitude of the answers. Hence, the relative priority will be about the same. Therefore, the consistency should not be greater than 0.10 on a scale of 0 to 1. If the CR value is more than 0.10, it is necessary to re-examine the considerations made.
4. Determination of the weight or priority calculated on each element in the respective hierarchy. Analysis at this stage can be done manually or with the help of computer programs/applications such as Microsoft Excel, as used in this study. After finding valid data through the AHP method, the analysis obtained the most dominant factor inhibiting green construction application.

After collecting all of the necessary primary and secondary data, data analysis was conducted for this study. Data analysis in this study used the AHP data processing method.

IV. RESULTS AND DISCUSSION

4.1. Evaluation of the Validity and Dependability

Seven criteria will be considered when deciding whether to prohibit the application of green building techniques in construction projects. The seven criteria are Regulations, Government, Financial, Technical, Technology, Education, and Culture and Habits. The weight of each criterion is calculated and presented in Figure 1.

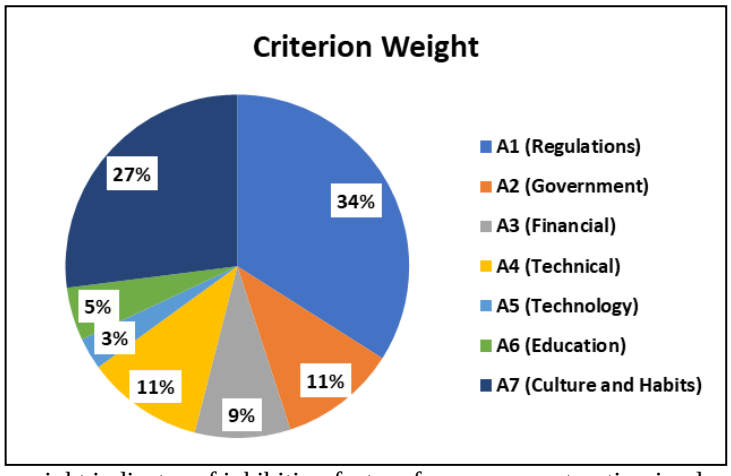

Figure1: weight indicator of inhibiting factors for green construction implementation

Calculation of priority weights between inhibiting factors using level 3 pairwise comparisons. The priority weight data source is obtained from the respondent's form. The pairwise comparison matrix at level 3 compares the factors contained at level 3 for each element at level 3. In the same way as pairwise comparisons, the Priority Weight of each factor against the seven criteria can be calculated. Based on the calculation of pairwise comparisons, the priority weights on the seven factors are obtained, as shown in Figures 2 to 8.

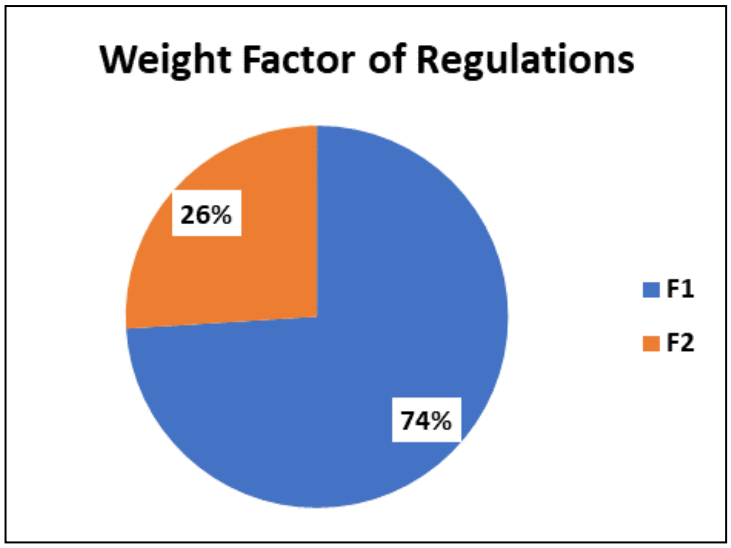

Figure2: weight factor of regulations

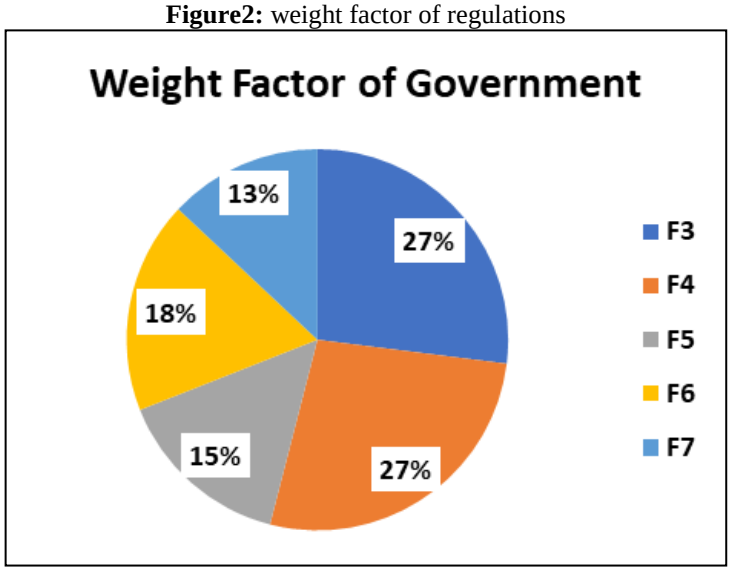

Figure3: weight factor of government

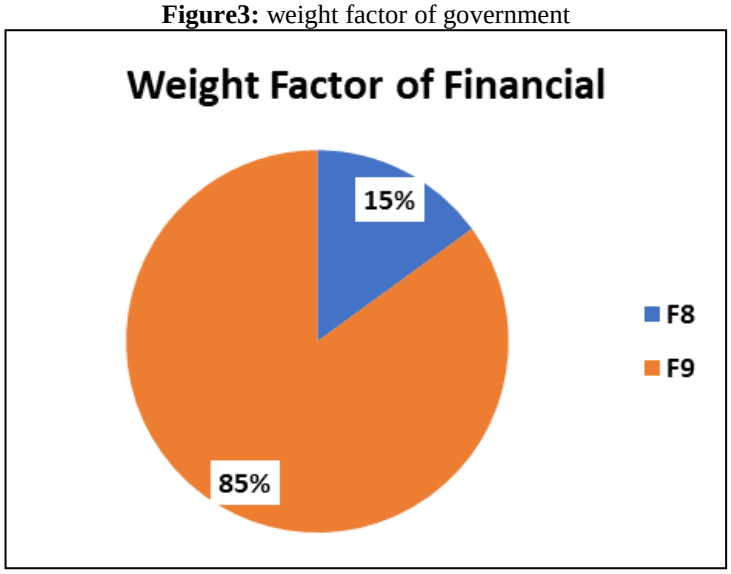

Figure4: weight factor of financial

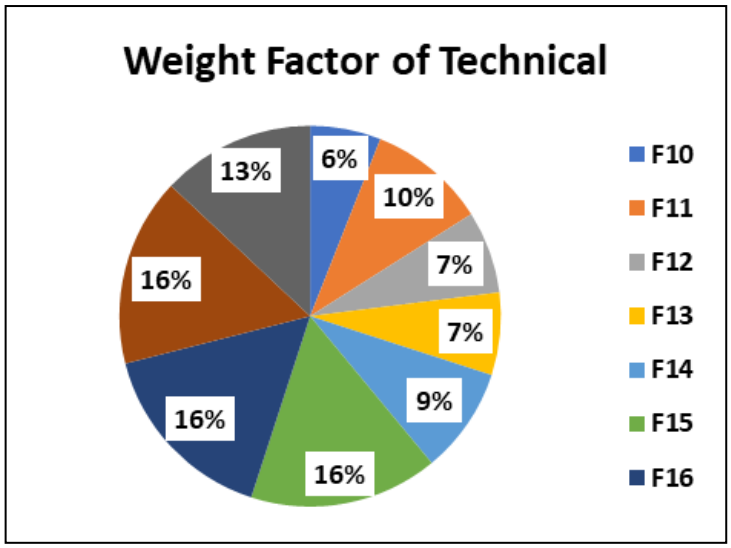

Figure5: weight factor of technical

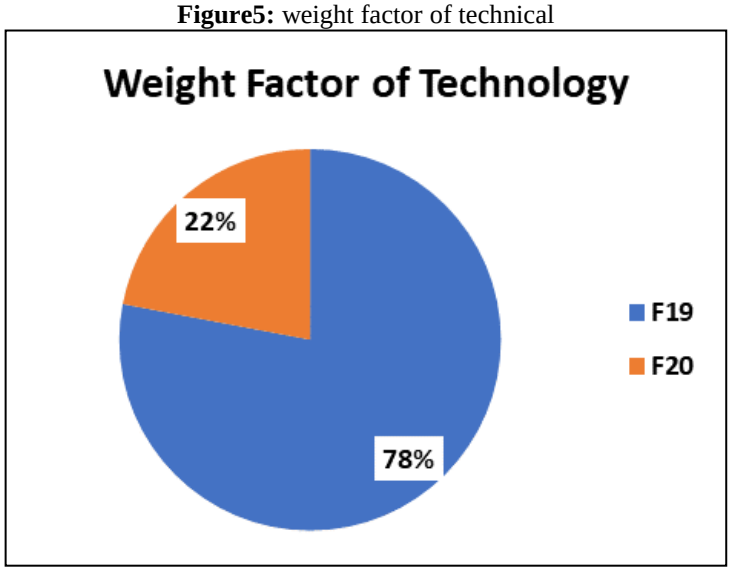

Figure6: weight factor of technology

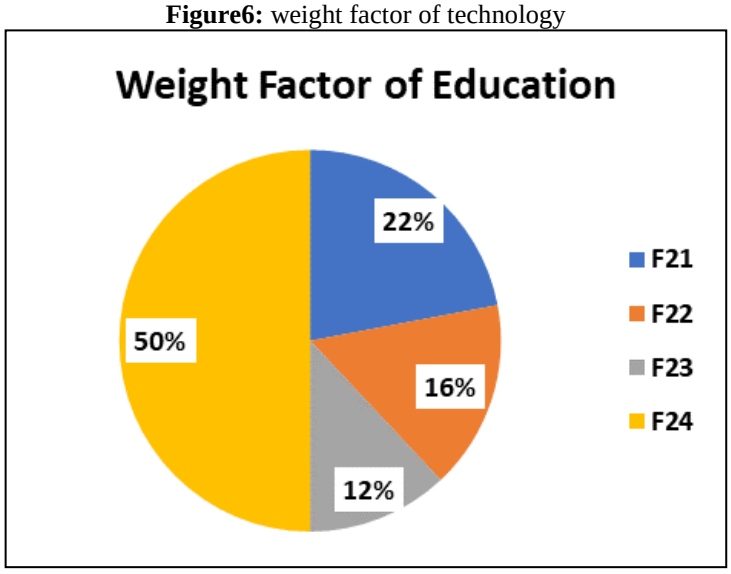

Figure7: weight factor of education

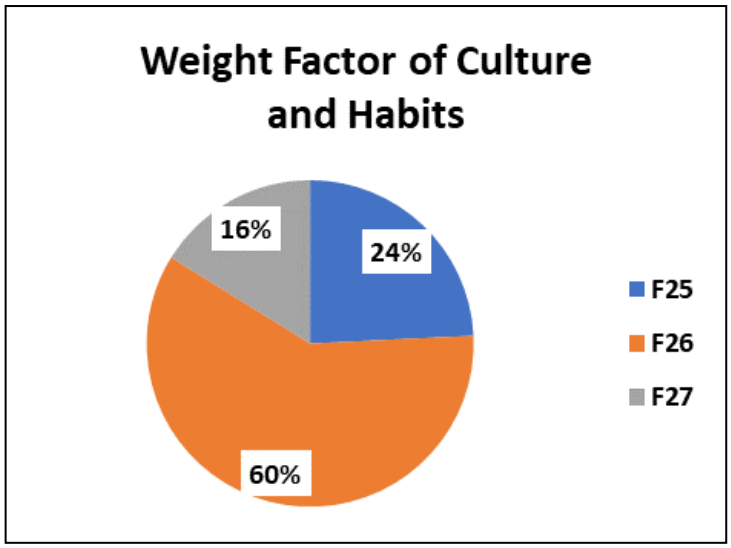

Figure8: weight factor of culture and habits

Figure 2 until Figure 8 show each criterion's percentage of factor weights. The conclusion from several main priorities based on criteria and factors determines the overall ranking order. Figure 9 shows the global weight of the factors, which indicates the results of the highest and lowest factor scores.

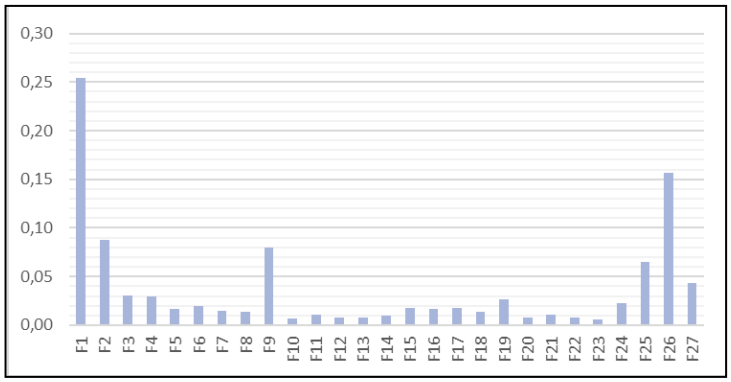

Figure9: global weight factor of obstacles to green construction implementation

The lack of detailed rules regarding the application of green construction in Indonesia, and second-placed awareness of the need to apply green construction, are the dominant factors that impede the application of green construction, according to all evaluations conducted on all criteria and factors in the selection of barriers to the application of green construction. The results of the criteria and factor weights obtained from the calculation are presented in Table 1 and Figure 10.

Table 1. Weight Factor Indicator

Factor	Weight Factor						
	A1 (Regulations)	A2 (Government)	A3 (Financial)	A4 (Technical)	A5 (Technology)	A6 (Education)	A7 (Culture and Habits)
F1	0.74						
F2	0.26						
F3		0.27					
F4		0.27					
F5		0.15					
F6		0.18					
F7		0.13					

Factor	Weight Factor						
	A1 (Regulations)	A2 (Government)	A3 (Financial)	A4 (Technical)	A5 (Technology)	A6 (Education)	A7 (Culture and Habits)
F8			0.15				
F9			0.85				
F10				0.06			
F11				0.10			
F12				0.07			
F13				0.07			
F14				0.09			
F15				0.16			
F16				0.16			
F17				0.16			
F18				0.13			
F19					0.78		
F20					0.22		
F21						0.22	
F22						0.16	
F23						0.12	
F24						0.50	
F25							0.24
F26							0.59
F27							0.16

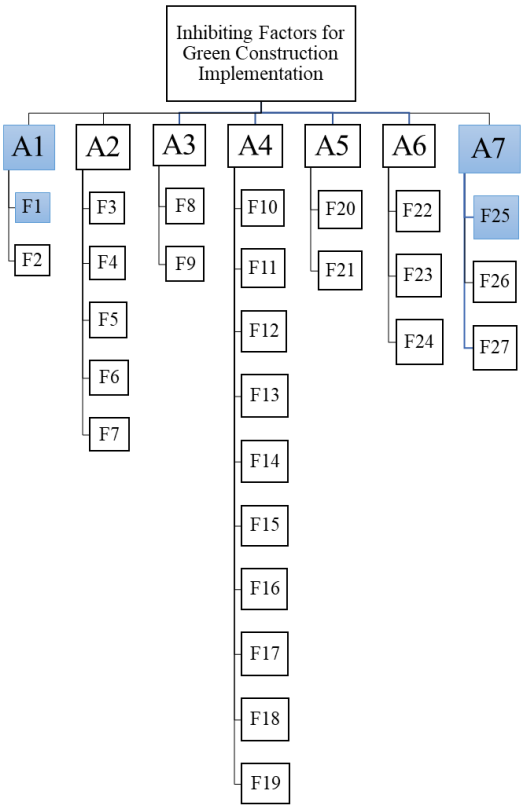

Figure10: hierarchy of inhibiting factors for green construction implementation

V. CONCLUSIONS

The implementation of green construction is hampered by several factors, including a lack of detailed rules regarding the application of green construction in Indonesia, the absence of comprehensive guidelines in implementing green construction, support from the government in implementing green construction, regional arrangements to support green construction, government socialization regarding resource savings energy that supports construction, and the formation of external priorities.

Detailed legislation addressing the application of green construction in Indonesia and the awareness of contractors to implement green construction are the most significant inhibiting factors to implementing green construction management in Malang City construction projects. The design of rules and regulations on this topic must be developed exhaustively and cover all technical, management, and operational aspects to address the prevailing impeding factor. Government laws and regulations are concurrently integrated with the construction industry's actors' increased awareness and understanding. A dedication to an ecologically sustainable construction culture must be ingrained in the company's vision and objective. The paradigm shift of construction service providers is carried out gradually by persistent education and awareness efforts, as well as numerous technical training programs.

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