Experts Opinion on Building Passive Strategy Performance

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Abstract. Passive strategy is believed as the primary strategy to achieve high performance on green building before applying an active strategy. Various passive strategy options need to be used optimally in buildings before implementing an active strategy. Architects can choose different passive strategy options while combining them to be applied to buildings. Architects need to listen to the opinions of experts who have been engaged in the field of green architecture or passive strategies to achieve the best performance. This study aims to determine the opinions of experts on the performance of passive green building strategies based on their understanding while giving weight to the main options available. This study has used an interview to confirm the available passive strategy options and have used the Analytic Hierarchy Process to weigh the performance of the passive strategy options according to criteria obtained from various sources. The criteria used in measuring passive strategy performance are energy efficiency, environmental impact, comfort, ease of implementation, savings in operational and investment cost. It can be concluded that according to experts, the most influential passive strategy option on building performance is the building shape, followed by building orientation, building envelope, interior design, and greenery.

1. Introduction

Strategies for responding to climate as a local specialty by adjusting orientation, shape, and choosing the right building envelope material are called passive strategy. Called a passive strategy because the building and its elements are designed to minimize energy consumption and achieve thermal comfort without using electrical or mechanical equipment [1]. Since it is related to building design, the passive strategy requires a large role from the architect. Besides reducing energy consumption, the use of passive strategies is related to efforts to utilize the potential of the environment optimally. It also reduces the adverse effects of buildings on the surrounding environment. Not only thinking about internal conditions (occupants) but also external conditions (the surrounding environment). Besides passive strategies, there are also active strategies, namely energy-saving and impact reduction strategies, through the selection and optimization of effective and efficient mechanical and electrical equipment in buildings.

For high-rise buildings, the efforts to implement an active strategy are inevitable because the need for space conditioning both thermally and visually requires the help of electrical and mechanical equipment. It takes a strong desire and great effort to be able to apply a combination of passive and active strategies. In contrast, the opportunity to accommodate active strategies is very tempting because it is more practical to apply than passive strategies. Whereas Yeang [1] asserts that efforts to get higher building performance will be achieved by optimizing passive strategies before implementing active strategies.

2. Methodology

This study uses a variety of research methods, including library research to obtain various passive strategy options and criteria used in assessing the performance of passive strategies; interview method to get confirmation of the various passive strategy options available from the experts; also Analytic Hierarchy Process (AHP) and other statistic methods to get a weighting on the performance of passive strategy options according to predetermined criteria based on experts opinion. [2]

What is meant by experts in this study includes two groups, namely academic experts and professional experts. This study included five academic experts with the following criteria: working as academics in public and private universities, having a PhD (Doctoral) degree in the field of science related to green building, and having experience in the field of green building for at least the last five years. The five selected academic experts came from Gajah Mada University in Yogyakarta, Atma Jaya University in Yogyakarta, Ten November Institute of Technology in Surabaya, Sam Ratulangi University in Manado, and Hasanuddin University in Makassar. While professional experts are 10 (ten) senior architects representing eight renowned architectural consultants in Indonesia, namely PT. Airmas Asri, PT Arkonin, PT. Indomegah Architect, PT. Urbane Indonesia, PT. Prada Tata International (PTI), PT. Megatika International, PT. PDW Architects, PT Wiratman. Academic experts are involved in weighting performance using AHP and simple statistics, while professional experts are involved in weighting using simple statistics.

3. Results and Discussion

Table 1 Summarize the considerations that have been started by William [3], Lennan [4], Bauer [5], Sarte [6] regarding the implementation of the green buildings concept which are optimization energy efficiency and conservation, reduction of environmental impact and improvement of human comfort or health. Bauer [5] states that additional economic and life cycle considerations of buildings. William [3] outlines additional factors regarding building life cycle considerations and local conditions; Lennan [4] mentions additional considerations about effective applied technology and understanding of place, and Sarte [6] conveys other concerns about project needs and objectives as well as site analysis.

Table 1. Green Building Implementation Criteria

No	Criteria	William (2007)	Lennan (2004)	Bauer (2007)	Sarte (2010)
1	Energy efficiency and conservation	V	V	V	V
2	Environmental Impact	V	V	V	V
3	Health and Comfort	V	V	V	V
4	Building Life Cycle	V		V	
5	Economic			V	
6	Appropriate Technology		V		
7	Project’s needs and purposes				V
8	Local Condition	V		V	V

Four authors agreed on 3 (three) fundamental criteria to assess green buildings' performance, namely increasing energy efficiency, reducing environmental impact, and improving health and comfort. It delivered in various terms, such as Building Life Cycle, Economic, Appropriate Technology, Project's Purposes, and Local Conditions. The conclusion that all of the terminology is related to two main things: ease of application and cost savings, both operational and investment. Furthermore, a summary of the opinions of the four authors is arranged into 6 (six) criteria to evaluate the performance of passive strategy implementation, namely:

1. Increasing Energy Efficiency and Conservation Criteria
2. Reducing Environmental Impact Criteria
3. Improving Human Comfort and Health Criteria
4. Ease of Implementation Criteria.

5. Reducing Operational Cost Criteria
6. Reducing Investment Cost Criteria

Furthermore, the six green building implementation criteria are also used as criteria to weigh the performance of passive strategy options, namely orientation, shape, envelopes (design & materials), interior and greenery that have been obtained from previous studies [7].

As stated earlier, the AHP method and the simple statistical method (through a questionnaire) are used to determine the performance or weight of the passive strategy. AHP method is a method of decision making by structuring the problem in the form of a hierarchy and incorporating considerations to produce a relative scale of priorities [2]. In this study, the AHP method is used with expert academic respondents with the consideration that they have a comprehensive theoretical understanding of the performance of each passive strategy option. At the same time, the simple statistical method is also used to obtain a comparison of understanding about passive strategy performance with professional expert respondents as well as academic experts.

Figure 1 shows the hierarchical model of Building Passive Strategies according to the AHP method. While Table 2 shows the results of weighting the criteria and passive strategy options using the AHP method. Based on the table, it can be concluded that the biggest weight criteria are in energy efficiency. Followed by the increased comfort, impact reduction criteria, operational cost saving criteria, investment cost saving criteria, and the smallest weight is the technical ease of implementation criteria. For the passive strategy option, the greatest weight is in the form strategy, then followed by the orientation strategy, the sheath strategy, the greening strategy and the smallest is the interior strategy as shown in Table 3.

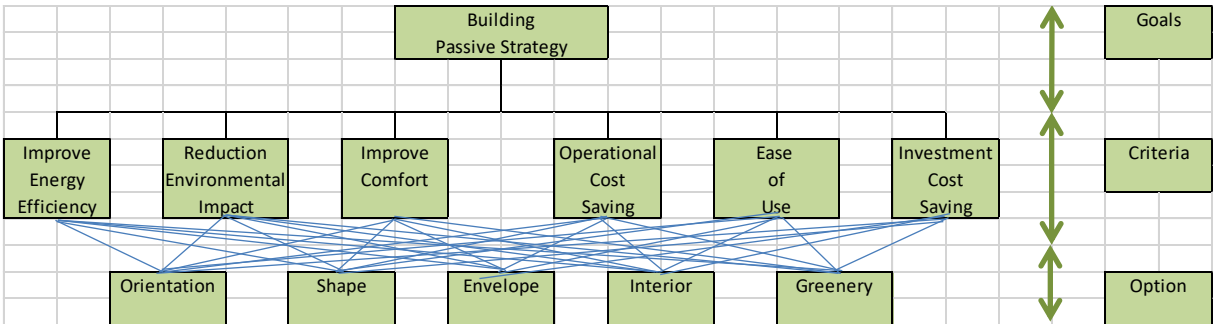

Figure 1. Hierarchical Model of Building Passive Strategies

Table 2. Priority of Criteria

Criteria Category	Priority	Weight
Improvement Energy Efficiency	I	29,41%
Reduction of Environmental Impact	III	16,99%
Improvement of Comfort and health	II	22,67%
Ease Of Implementation	VI	7,89%
Operational Cost Saving	IV	14,65%
Investment Cost Saving	V	8,39%

Table 3. Priority of Passive Strategy Option

Criteria Category	Priority	Weight
Orientation	II	27,78%
Shape	I	29,03%
Envelope	III	23,09%
Interior	V	9,73%
Greenery	IV	10,37%

Table 4 shows the results of the weighting or priority of passive strategy options based on six predetermined criteria. For the improvement of energy efficiency criteria, academic experts chose the orientation option as the first choice followed by choice of building forms, building envelope, greenery, and interiors options. For the improvement of comfort and health criteria, academic experts chose the building shape option as the first choice, followed by the building orientation, building envelope, interior, and greenery options. For the reduction of environmental impact criteria, academic experts chose the building orientation option as the first choice followed by choice of building shape, building envelope, greenery, and interiors options. For operational and investment cost-saving, academic experts chose the building shape as the first choice, followed by the building orientation, building envelope, interior, and greenery options. As for the ease of implementation criteria, academic experts chose the building shape as the first choice followed by the building envelope, building orientation, interior, and greenery options.

Table 4. Priority of Passive Strategy Option Based on Each Criteria

Criteria Category	Priority				
	Orientation	Shape	Envelope	Interior	Greenery
Improvement Energy Efficiency	I	II	III	V	IV
Improvement of Comfort and health	II	I	III	IV	V
Reduction of Environmental Impact	I	II	III	V	IV
Operational Cost Saving	II	I	III	IV	V
Investment Cost Saving	II	I	III	IV	V
Ease of Implementation	III	I	II	IV	V

For more details, researchers try to separate the material and design aspects of the building envelope when asking professional and academic experts to sort priorities using a questionnaire and process it with simple statistics. Tables 5 and 6 are the results obtained from questionnaires filled out by professional experts and academic experts. From this method, it was found that professional experts chose the building orientation as a priority, followed by the design of the building envelope, the building shape, the envelope material, the interior, and the greenery. Whereas academics experts also prefer building orientation as a priority, followed by building shape, envelope materials, envelope design, the interior, and the greenery.

Table 5. Passive Strategy Priority Based on Professional Expert Opinion

Passive Strategy	Priority						Number of	Value	Priotity
	1	2	3	4	5	6	Responden		
Material	1	1	1	4	3	0	10	37	IV
Shape	1	3	2	1	3	0	10	32	III
Orientation	6	0	0	1	0	3	10	28	I
Envelope	0	5	2	2	0	1	10	30	II
Interior	2	0	2	0	3	3	10	41	V
Greenery	0	1	3	2	1	3	10	42	VI

Table 6. Passive Strategy Priority Based on Academic Expert Opinion

Passive Strategy	Priority						Number of	Value	Priotity
	1	2	3	4	5	6	Responden		
Material	0	0	0	4	1	0	5	16	III
Shape	1	3	0	0	1	0	5	12	II
Orientation	3	1	0	0	0	1	5	11	I
Envelope	0	0	1	4	0	0	5	19	IV
Interior	0	1	0	0	3	1	5	23	V
Greenery	1	0	0	0	1	3	5	24	VI

The similarity of views between academics and professionals about the performance of orientation options as a top priority is an interesting indication of the importance of applying this strategy to buildings. Likewise, the similarity of views between academics and professionals on the fifth and sixth order, namely interior strategy and greening strategy, indicates a common understanding of the weak performance of these two passive strategy options.

Table 7 shows the comparison of the results of weighting or priority ranking in two ways, namely by AHP and with simple statistics based on a questionnaire. It can be formulated that there are two categorization groups based on their priorities. The priority category is the orientation strategy, shape, and envelope strategy (design and materials), while the second priority is the greenery and interior strategy.

Table 7. Comparation of Passive Strategy Priority

Priority	AHP	Priority Conclusion	Simple Statistic		Priority Conclusion
			Academic	Professional	
I	Shape	First	Orientation	Orientation	First
II	Orientation	Priority	Shape	Envelope	Priority
III	Envelope		Material	Shape	
IV	Greenery	Second	Envelope	Material	
V	Interior	Priority	Interior	Interior	Second
VI			Greenery	Greenery	Priority

4. Conclusion

Based Based on the results of passive strategy weighting, it can be concluded that:

- The first to third priority criteria on a passive strategy of green building implementation, which are increased energy efficiency, improved comfort, and reduced environmental impact, indicate the huge amount of academic interest in environmental conditions, including humans. The establishment of a building should not be a problem for the environment and should instead improve the quality of the environment and people.
- The following priority criteria on the passive strategy of green building implementation, which are savings in cost (investment and operational) and ease of implementation indicates that the importance of economic criteria (profit and loss) and technical or practical criteria should not reduce the importance of attention to environment and people. Human efforts to obtain cost savings (profits) and find solutions for technical ease of implementation should not sacrifice the quality of the environment and the people who live in them.
- The agreement of academic experts and professional experts to prioritize building design solutions through the elaboration of orientation, shape, and envelope indicates an understanding of the essence of design to achieve optimal building performance and not just to consider appearance. It also shows the doubts of the academic and professional on interior and greenery performance in terms of green building implementation to solve environmental and human problems.

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