International Journal of Research in Engineering and Modern Technology (IJREMTE)
Volume 2, No 1, April 2025, Pages 31-38
ISSN 3089-4077

Comparison of Green Building Implementation in Surabaya and Johor Baru

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Abstract*— The implementation of the green building concept is a strategic effort to promote sustainable development, particularly in office buildings, which are known for their high energy consumption. This study aims to evaluate the application of green building principles in office buildings located in Surabaya, Indonesia, and Johor Bahru, Malaysia, and to identify the key features, barriers, and solutions related to the adoption of Green Building Materials (GBM). A qualitative descriptive and evaluative approach was employed, guided by the EDGE (Excellence in Design for Greater Efficiencies) and Greenship standards from the Green Building Council Indonesia (GBCI). The analysis of the case study in Surabaya revealed energy savings of 16.63%, water savings of 34.79%, and material savings of 92%. With recommended improvements, energy savings increased to 23.84%, exceeding the EDGE minimum threshold of 20%. In Johor Bahru, the most important GBM features identified were energy efficiency, low carbon emissions, and recyclable materials. Major barriers included high costs, lack of awareness, and insufficient regulatory frameworks. Recommended solutions involve cost subsidies for key materials (e.g., sustainable bricks, lightweight concrete, and wood flooring), mandatory training for construction workers, and the integration of sustainability-related content into higher education curricula. The findings highlight the critical role of collaboration among government bodies, construction industry stakeholders, and educational institutions in advancing green building practices. This study contributes to the formulation of policies and strategic initiatives aimed at fostering environmentally responsible construction in Southeast Asia.

Keywords— Green Building; Energy Efficiency; Sustainable Materials; EDGE Certification; Construction Policy

I. INTRODUCTION

Sustainability is very important in today's construction world. Not only related to building design but all aspects are important components, both in terms of architecture, construction and economy. The concept of green building is an effort so that buildings can reduce energy consumption (maximize natural energy) and have minimal negative impacts on the environment.

Office buildings are one of the building functions that have a high level of energy consumption. Buildings are one of the causes of global warming because they have the potential to produce carbon gas emissions of more than 40% (Ervianto, 2012). This shows that the construction world has a role in the occurrence of significant global issues. In 2015, the Regulation of the Minister of Public Works and Public Housing No. 02 / PRT / M / 2015 concerning Green Buildings was issued. Along with the issuance of the regulation, assistance was also provided for the preparation of regional regulations for three cities, namely Surabaya, Bandung, and Makassar so that local governments can accelerate the process of preparing regulations related to the obligation of environmentally friendly building concepts. As a follow-up to the regulation, office buildings should apply the green building concept in their buildings. Surabaya is one of the cities appointed by the central government as a pilot city in promoting the green city concept. In fact, the city of Surabaya has received awards at the national level, one of which is the 2016 Indonesia Green Awards.

Green building index (GBI) assessment criteria is to enhance the environmental initiatives in the construction project in Malaysia. The following are critical review of journals, which is summarized and relevant to this paper research. Green building materials (GBM) is, defined as sustainable materials, qualified by the Life-Cycle Assessment (LCA) methodology during their full life cycle [1], which is supported by [2] who did comparison for the assessment tools. However, [3] analyzed the ways to enhance the implementation which is education and training should be provided, government initiatives and enhance the level of awareness. The challenges in assisting the green initiatives for policy makers and to overcome the challenges are identified to bring forward Malaysia to a sustainable environment [4]. The challenges in Malaysia to adopt the sustainable materials are such as lack and access of information on GBM, low awareness of the GBM, costly, regulation/code and GBM is limited. Therefore, the implementation of GBM in Malaysia is still low and better strategies should be adopted to encourage the uses [5]. The objective of this research is to address the gap in enhanced strategies by identifying the current preferred features and types of GBM. Furthermore, by addressing the main barriers and main solutions, this research will be able to assist policy makers, education industry and government initiatives will be more apparent in implementation of GBM among construction industry stakeholders in Johor Bahru.

With this background, it is necessary to study the extent to which the green building concept is implemented in the cities of Surabaya and Johor Baru.

II. Literature Review

Green Building is a concept of designing, constructing, and operating buildings that prioritize energy efficiency, reducing environmental impact, and the comfort and health of its occupants. The main goal of Green Building is to reduce the carbon footprint and use resources more wisely without sacrificing quality of life.

The green building concept is based on several key principles, namely:

• Energy Efficiency: Using energy more efficiently through technologies such as LED lighting, solar panels, and good ventilation systems.

• Water Conservation: Implementing efficient water management systems, such as recycling rainwater and using water-saving equipment.

• Eco-Friendly Materials: Using sustainable building materials, such as certified wood, recycled concrete, and low-emission paints.

• Indoor Air Quality: Improving air circulation and reducing indoor pollutants with natural ventilation and the use of low-VOC (Volatile Organic Compounds) materials.

• Waste Management: Reducing and recycling construction and operational waste.

• Adaptive and Sustainable Design: Designing buildings to suit local climate conditions and be resilient to environmental changes.

Some international standards and certifications used to measure the level of sustainability of buildings include:

• LEED (Leadership in Energy and Environmental Design) – A global standard for green buildings developed by the USGBC (U.S. Green Building Council).

• BREEAM (Building Research Establishment Environmental Assessment Method) – A sustainability assessment system from the UK.

• Greenship – Green building certification from the Green Building Council Indonesia (GBCI).

• EDGE (Excellence in Design for Greater Efficiencies) – A certification system developed by the IFC (International Finance Corporation).

The implementation of green buildings provides significant benefits, both in terms of economy, social, and environment, including:

• Operational cost efficiency through energy and water savings.

• Occupant health and comfort with better air quality.

• Reduction of carbon emissions that contribute to climate change mitigation.

• Increased property value because green buildings are more in demand in the market.

EDGE certification is a form of assessment of a building that has an environmentally friendly concept or a sustainable concept. This rating or assessment is expected so that the building industries that are currently operating or will be built in Indonesia so that development refers to an environmentally friendly concept. EDGE itself has criteria for a building, including:

1. EDGE Certification (savings on energy, water and materials reach a minimum of 20%)
2. EDGE Advanced (savings on water and materials reach a minimum of 20% and energy savings of at least 40%)
3. Zero Carbon (use of 100% renewable energy or purchase carbon offsets up to 100%)

III. Materials and Methods

This study uses a qualitative analysis method with a descriptive analysis and evaluative method approach. The qualitative analysis method used in this study is related to the application of the green concept of office buildings using a descriptive analysis and evaluative approach. The researcher creates a complex picture of the object of study, then conducts a study on the existing conditions, related to the design, maintenance and operation of the building. The evaluative method is used as an approach method in evaluating existing conditions guided by the Greenship Existing Building version 1.1, from GBCI. The qualitative method is a research procedure with results in the form of descriptive data, namely written or spoken words from the objects or users of the buildings observed (Meleong, 2007). This method is carried out by means of field observation and interviews. The study was conducted based on research variables that are used as references in analyzing the green building concept guided by the Greenship Existing Building version 1.1,

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namely using 6 greenship criteria as research variables including; appropriate land use, energy efficiency and conservation, water conservation, material sources and recycling, health and comfort of space, and environmental and building management.

IV. Result and Discussion

The building type is an office building located in Surabaya, Indonesia with a building floor area of 724.4 m2. In the study process, the post-construction building certification stage and existing buildings are planned. The number of floors in the building is 3 floors above ground level. Given that the building type is an office, the working day data is known to be 5 days/week with operating hours of 8 hours/day and the number of holidays is 24/year. City climate data also affects the amount of energy use, so data is needed in the form of temperature, humidity, and air speed for the city of Surabaya in 2023.

Energy Efficiency Calculation

Electricity saving is one of the three main resource categories in the EDGE standard. Data analysis was conducted from the data obtained during 3 days of observation with the following details:

Table 1 Energy saving measures taken by office buildings

No.	Tindakan Penghematan Energi	Nilai *Base Case*	Nilai	Satuan
EEM01	Window-to-Wall Ratio	60	*Base case*	%
EEM05	Roof Insulation	1,28	*Base case*	W/m^2.K
EEM06	Base/Suspended Floor Slab Insulation	0,49	*Base case*	W/m^2.K
EEM08	Exterior Wall Insulation	2,8	*Base case*	W/m^2.K
EEM09	Glass Savings	5,8	*Base case*	W/m^2.K
EEM13	Cooling System Savings	2,91	3.74	COP
EEM22	Energy-Efficient Indoor Lighting	65	103.84	lm/W
EEM23	Energy-Efficient Outdoor Lighting	65	94	lm/W

The base case value is a value for similar buildings in general in the EDGE program which can be used if there are limited data required

Existing Conditions

a. Window to Wall Ratio

It is important to balance the lighting and ventilation benefits of glazing with the impact of heat transfer on passive cooling and/or heating needs. Savings can be achieved if the Window to Wall Ratio (WWR) is lower than the local base case. The WWR value is defined as the ratio of the area of windows or other glazing (including studs and frames) divided by the gross area of the exterior walls.

Due to limitations in obtaining data calculations for the window to wall ratio, the base case value (generally similar buildings) will be used automatically in the EDGE application. In the Window to Wall Ratio (WWR) savings action, the value used is 60%.

b. Roof Insulation

Insulation is used to prevent heat transfer from the outside environment to the inside (for warm climates) and from the inside to the outside (for cold climates). Insulation helps reduce heat transfer through conduction, so the more insulation, the smaller the U value and the better the performance.

Since the building does not use roof insulation, it will automatically use the base case value (generally similar buildings) in the EDGE application. In the Roof Insulation saving action, the value used is 1.28 W/m2 K.

c. Base/Suspended Floor Slab Insulation

Insulation is used to prevent heat transfer from the outside environment to the inside (for warm climates) and from the inside to the outside (for cold climates). Insulation helps reduce heat transfer through conduction, so the more insulation, the smaller the U value and the better the performance. Because the building does not use exterior wall insulation, it will automatically use the base case value (generally similar buildings) in the EDGE application. In the Exterior Wall Insulation Saving Action, the value used is 0.49 W/m2 K.

d. Exterior Wall Insulation

Insulation is used to prevent heat transfer from the outside environment to the inside (for warm climates) and from the inside to the outside (for cold climates). Insulation helps reduce heat transfer through conduction, so the more insulation, the smaller the U value and the better the performance. Because the building does not use exterior wall

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insulation, it will automatically use the base case value (generally similar buildings) in the EDGE application. In the External Wall Insulation saving action the value used is 2.8 W/m2 K.

e. Glass Savings

Adding a Low Emissivity coating to glass reduces heat transfer from one side to the other by reflecting heat energy. A Low Emissivity coating is a very thin layer of metal or metal oxide that coats the surface of the glass to help keep heat on the same side of the original glass. Office buildings use Indoflot Clear type glass with a thickness of 5 mm. This type of glass has a light transmission value of 0.89 which allows 89% of visible light to enter and a U-Value of 5.8 W/m2 K.

f. Cooling System Savings

Savings can be achieved if the Coefficient of Performance (COP) or Coefficient of Performance of the air conditioning system is greater than the base case (2.91). COP is the total electrical output of cooling per electrical input and can be seen on the information on the side of the cooler.

In the building, split AC is used with an average COP value of 3.74. By using air conditioners that have a higher COP, it can be said that electricity savings have occurred well.

g. Indoor Area Saving Lighting

Lighting savings at the building level can be expressed in one of two ways, namely as lighting power density (watts/square meter) - lower is better, or lighting efficacy (lumen/watt) - higher is better. The efficacy of the interior lights used has a value of 103.84. This shows that the efficacy of the existing lights is higher than the Base case so it can be said that electricity savings have been carried out well.

h. Outdoor Area Savings

Lighting savings at the building level can be expressed in one of two ways, namely as lighting power density (watts/square meter) - lower is better, or lighting efficacy (lumen/watt) - higher is better. The efficacy of the exterior lights used is 94. This shows that the efficacy of the existing lights is higher than the Base case (65) so it can be said that electricity savings have been carried out well.

Water Efficiency Calculation

Water conservation is one of the three main resource categories in the EDGE standard. Data analysis was carried out from the data obtained during 3 days of observation with the following details:

Table 2. Water conservation

No.	Tindakan Penghematan Air	Nilai *Base Case*	Nilai	Satuan
WEM02	Water-Saving Faucet for Private/All Bathroom Sinks	6	3,21	L/menit
WEM04	Efficient Toilet for Private/All Toilets	8	4,27 / 1,63	L/*flush*
WEM08	Water-Saving Faucet for Kitchen Sink	8	8.74	L/menit

a. Water-Saving Taps for Private/All Bathrooms

A sink is a plumbing fixture that is shaped like a bucket and channels water. In office buildings, sinks are generally used for washing hands or washing dishes. Savings can be achieved if the flow rate of the tap set for the bathroom sink is lower than the base case in liters per minute. Measurements are made using a glass beaker and a timer for the sink flow rate. The existing sink faucet has a flow rate of 3.21 L/minute. This value is lower than the base case value (6 L/minute) so it can be said that water savings have been carried out properly.

b. Efficient Toilets for Private/All Toilets

A toilet is a sanitation facility for defecating and urinating, washing hands and faces. Savings on faucets for public toilets can be achieved if the flush flow rate is lower than the base case in liters per flush. Measurements are made using a glass beaker to determine the toilet flow rate per flush. The existing toilet has a flow rate of 4.36 L/flush for a large flush and a flow rate of 2.18 L/flush for a small flush. This value is lower than the base case value (8 L/flush) so it can be said that water savings have been carried out well.

c. Water-Saving Taps for Kitchen Sinks

A sink is a plumbing fixture that is shaped like a bucket and channels water. In office buildings, sinks are generally used for washing hands or washing dishes. Savings can be achieved if the flow rate is less than the Base case in liters per minute. Measurements are made using a glass beaker and a timer for the sink flow rate. The existing sink faucet has a flow rate of 8.74 L/minute. This value is greater than the Base case value (8 L/minute) so it can be said that water savings have not been maximized.

From the results of the building analysis, the final result of water savings was 34.79%. This value is more than the EDGE standard of 20%, so there has been good savings.

Material Efficiency Calculation

Material savings are one of the three main resource categories in the EDGE standard.

1. Existing Conditions

Data analysis was conducted from data obtained during 3 days of observation with the following details:

Table 3 Material saving measures taken by office buildings

No.	Ground Floor Construction	Reuse of Existing Floor Slab
1	Intermediate Floor Construction	Reuse of Existing Floor Slab
2	Floor Finishing	Tiles / Ceramic Flooring
3	Roof Construction	Reuse of Existing Roof Structure
4	Exterior Wall	Reuse of Existing Wall
5	Interior Wall	Reuse of Existing Wall
6	Window Frame	Aluminum
7	Window Glass	Single Glazing
8	Roof Insulation	No Insulation
9	Wall Insulation	No Insulation
10	Floor Insulation	No Insulation
11	Ground Floor Construction	Reuse of Existing Floor Slab

Note: Because the building is more than 5 years old since the construction period, the material is considered as reuse of existing material.

From the results of the building analysis, the final result of material savings was 92%. This value is more than the EDGE standard of 20%, so there has been good savings.

Recommendations

Because the energy efficiency value still does not meet the EGDE standard, which is a minimum of 20% for each saving. Then several actions can be recommended to increase the efficiency value, including:

1. Maximizing the efficacy value of the lamp

Lamps that have an efficacy value below 100 can be maximized by replacing lamps with higher efficacy values. With a high efficacy value, higher lumens and brightness are obtained with the same wattage so that it is more efficient.

2. Request for technical drawings of building buildings

Used to determine the window-to-wall ratio of office buildings. For more details regarding the calculation, you can submit a request for technical drawings of the building, including:

1. Facade View Drawing (Front, Right Side, Left Side, Back)
2. Floor Plan Drawing of Frames, Doors and Windows
3. Detailed Drawing of Frames, Doors and Windows

The assessment obtained if the recommendation is implemented will get a value of 23.84% energy savings, 34.79% water savings, and 94% material savings. The following is a comparison of the value of savings in existing conditions with the value after the recommendation:

Table 4. Conservation Recommendations

Parameter	Initial Savings	Savings After Recommendation	Type of Recommendation
Energy Efficiency	16.63%	19.50%	Maximizing lighting efficacy
		23.84%	Maximizing lighting efficacy & Creating technical drawings to determine Window-to-Wall Ratio
Water Efficiency	34.70%	–	No recommendation
Material Efficiency	92%	94%	Adjustment in energy efficiency parameters

The Important Features of GBM EE in Johor Bahru

In Table 5, it indicates that "Energy efficiency" with (M = 4.20, SD = 0.90) is the most important feature when choosing the GBM. The mean value revealed that the features of GBM with the highest level of agreement is "Energy efficiency".

Table 5. The Important Features of GBM

Features of Green Building Materials	Mean	Standard Deviation
Low carbon emission	4.12	0.82
Row Material/ waste is recyclable	4.00	0.69
Energy efficiency	4.20	0.90
Durable	3.88	0.96
Low transportation	3.00	1.00
Low Volatile Organic Compound	3.92	0.83

The Important Types of GBM Building Material in Johor Bahru

The respondents were to give the opinions on the importance level on the type of GBM. The purpose of asking the importance level of GBM is to determine the major type of GBM in Johor Bahru. In Table 6, the top-ranked GBM in Jo hor is "sustainable brick" which has the highest mean (M = 3.84, SD = 0.99).

Table 6. The Important Types of GBM

Type of Green Building Material	Mean	Standard Diviation
Wood flooring	3.66	0.97
Lightweight reinforced concrete	3.72	1.09
Triple glazed window	3.32	1.06
Sustainable brick	3.84	0.99
Steel stud	3.20	1.03
Paper Insulation	3.02	1.15
Natural stone	3.32	1.08

The Important Barriers in Adopting GBM in Johor Bahru

In Table 7, the major barrier in implementing the GBM in Johor Bahru is "Higher cost" which has a (M = 4.04, SD = 0.95).

Table 7. The Important Barriers in Adopting GBM.

Barriers of Green Building Materials	Mean	Standard Diviation
Lack of awareness	4.00	0.93
Higher cost	4.04	0.95
Lack of information	3.80	0.76
Lack of Rules & regulation	3.84	0.77
Client's preference	3.82	0.77
Availability of green materials	3.78	0.93

The Important Solutions in Adopting GBM

The respondents were investigated with their opinions on the importance level of the solutions should be provided to increase the usage of GBM in Johor Bahru. In Table 8, "Reduce green building materials cost" (M = 4.20, SD = 0.83) is the most importance solution in the construction industry in Johor Bahru.

Table 8. The Important Solutions in Adopting GBM.

Solutions of Green Building Materials	Mean	Standard Diviation
Government Cooperate	3.86	0.99
Government policy	3.06	0.95
Education	3.98	0.98
Reduce green building materials cost	4.20	0.83

Solutions of Green Building Materials	Mean	Standard Diviation
Supplier recommendation	3.44	1.20
Training campaign	3.92	1.03

Findings and Discussions

. Fulfilling the first research objective, the research discovered three major features of GBM and GBCI, which are energy efficiency, low carbon emission and raw material and waste is recyclable. This research conforms to research review by [14], which expressed that the GBM and GBCI is more energy efficiency compared to conventional materials. The research find that energy cost would be the upmost concern to most construction industry stakeholders and complying to the international and Malaysian government requirement such as low carbon emission would be the second priority. The research also proved that GBM will eliminate the construction waste based on study by [11]. However, the research find the least important features, is the low transportation cost for the GBM probably due to fuel cost is still low in **Malaysia (MGBC) and Indonesia (GBCI).**

The respondents deemed that the "sustainable brick", "lightweight reinforced concrete" and "wood flooring" are the top three ranked GBM in Johor Bahru and GBCI in Surabaya. Contrary to findings in [20], top GBM and GBCI are sustainable concrete, paper insulation and triple glazed windows. However, the respondents find the least important types, is the "paper insulation" as the GBM and GBCI. Research in [21], shows the top GBM and GBCI are wood flooring, thatch roof and sustainable bricks.

Achieving the second research objective respondents find that, "Higher cost", "Lack of awareness" and "Lack of rules and regulations" are the top three ranked core barriers. On the contrary to research review by [22], expressed that the barrier in Malaysia and in Indonesia was lack of awareness. Research by [23], stated that few barriers to implement the GBM and GBCI such as the availability of the building materials, the higher initial cost and the compliance of regulation and code. However, in this research, the most importance barrier in Johor Bahru is the higher cost of GBM and GBCI. The respondents believe that the "Availability of Green Building Materials" is the least important barrier. Attaining the third research objective , the research find that, "Reduce green building material cost", "Education" and "Training campaign" are the top three ranked solutions importance level in adopting GBM in Johor Bahru and GBCI in Surabaya. Conforming to research by [3], stated that the ways to enhance the implementation, which is education and training is provided, government initiatives and enhance the level of awareness. The respondents believe that the "government policy" is the least important.

V. Conclusion

The value of the application of the green building concept carried out in office buildings based on the assessment of green buildings by EDGE certification obtained a value of 16.63% energy savings, 34.79% water savings, and 92% material savings. This is still below the EDGE standard with a minimum achievement of 20% in energy, water, and material savings. Recommendations that can be made to increase the energy savings value are by maximizing the efficacy value of the lamps on several lamps that have less than maximum efficacy values and requesting technical drawings of the building. If the recommendations are applied, a value of 23.84% energy savings, 34.79% water savings, and 94% material savings will be obtained. So it can be submitted for certification.

The development of GBM can be improve by regulating the policy in Malaysian construction industry specifically by revising the Green Building Index rating tools and MS 1525. Furthermore, with implementation of tax breaks for developers specifically who adopt GBM, which are energy efficiency, low carbon emission and raw material and waste is recyclable. To control the main barrier of higher cost of GBM, government can implement controlled price or subsidize cost for "sustainable brick", "lightweight reinforced concrete" and "wood flooring". Training can be carried out by all construction stakeholders to ensure their employees are aware of the operation and maintenance cost of the GBM long run is lower. The most effective solution on resolving the low implementation of GBM is education this can be enhanced by compulsory training course for final year graduates in the field of built environment in relation to green building materials and sustainability implemented in construction industry. Therefore, the government should regulate new policy that the school and university should implement the development and knowledge of GBM in the syllabus. The development of GBM should involve the collaboration between government , construction industry stakeholders and education industry stakeholders.

References

[1] UNFCCC, "United Nations Kyoto Protocol," pp. 1–24, 1997.

[2] UNFCCC, "Doha Amendment to the Kyoto Protocol," Unfccc, p. 41, 2012, [Online]. Available: https://unfccc.int/kyoto_protocol/doha_amendment/items/7362.php%5Cnhttps://treaties.un.org/doc/Publication/CN/2012/CN.718.2012-Eng.pdf.
[3] P. R. Indonesia, "Undang-Undang Republik Indonesia Nomor 17 Tahun 2004 Tentang Pengesahan Kuoto Protocol to the united nations framewrok convention on climate change," Nasional, pp. 1– 6, 2004.
[4] O. Golubchikov and A. Badyina, Sustainable Housing for Sustainable Cities, no. October. 2012.
[5] IEA and UNEP, 2019 Global Status Report for Buildings and Construction: Towards a zero- emissions, efficient and resilient buildings and constructi on sector, vol. 224. 2019.
[6] ASHRAE, "ASHRAE Technical FAQ 92: What are the recommended indoor temperature and humidity levels for homes?," pp. 1–2, 2013, [Online]. Available: https://www.ashrae.org/File Library/Technical Resources/Technical FAQs/TC-02.01-FAQ-92.pdf.
[7] T. H. Karyono, "Arsitektur, kenyamanan termal dan energi," no. November, pp. 1–5, 1996, [Online]. Available: https://www.researchgate.net/publication/305186728.
[8] S. C. Lee and M. Chang, "Indoor and outdoor air quality investigation at schools in Hong Kong,"Chemosphere, vol. 41, no. 1–2, pp. 109–113, 2000, doi: 10.1016/S0045-6535(99)00396-3.
[9] T. H. Karyono, "Bangunan hemat energi," no. 8, p. 40561, 2016.
[10] J. J. Randolph, "A guide to writing the dissertation literature review," Pract. Assessment, Res. Eval., vol. 14, no. 13, 2009.
[11] Y. H. Prasetyo, "DAN PENGUKURAN LAPANGAN STUDI KASUS : BANGUNAN KONVENSI GRHA WIKSA PRANITI BANDUNG Building Performance of Passive Design Based on Ecotect Simulation and Field Measurement Case Study : Convention Center Building Grha Wiksa Praniti Bandung," vol. 9, no. 1, pp. 41–53, 2014.
[12] Y. H. Prasetyo et al., "NUSANTARA DALAM REGIONALISME Tropic Climate Form of Nusantara Traditional Architecture ' s Expression in Regionalism," vol. 12, no. 2, pp. 80–93, 2017.
[13] E. I. Santoso, "KENYAMANAN TERMAL INDOOR PADA BANGUNAN DI DAERAH BERIKLIM TROPIS LEMBAB," pp. 13–19, 1982.
[14] K. M. Al-Obaidi, M. Ismail, and A. M. Abdul Rahman, "Passive cooling techniques through reflective and radiative roofs in tropical houses in Southeast Asia: A literature review," Front. Archit. Res., vol. 3, no. 3, pp. 283–297, 2014, doi: 10.1016/j.foar.2014.06.002.
[15] S. Kim, P. A. Zadeh, S. Staub-French, T. Froese, and B. T. Cavka, "Assessment of the Impact of Window Size, Position and Orientation on Building Energy Load Using BIM," Procedia Eng., vol. 145, no. December, pp. 1424–1431, 2016, doi: 10.1016/j.proeng.2016.04.179.
[16] M. Kolokotroni et al., "Cool roofs: High tech low cost solution for energy efficiency and thermal comfort in low rise low income houses in high solar radiation countries," Energy Build., vol. 176, no. July, pp. 58–70, 2018, doi: 10.1016/j.enbuild.2018.07.005.
[17] W. Rattanongphisat and W. Rordprapat, "Strategy for energy efficient buildings in tropical climate," Energy Procedia, vol. 52, pp. 10–17, 2014, doi: 10.1016/j.egypro.2014.07.049.
[18] H. Truong and A. M. Garvie, "Chifley Passive House : A Case Study in Energy Efficiency and Comfort ScienceDirect ScienceDirect ScienceDirect ScienceDirect Chifley Passive House : A Case Study in Energy Efficiency and Comfort Chifley Passive House : A Case Study in Energy Efficiency a," Energy Procedia, vol. 121, no. June, pp. 214–221, 2019, doi: 10.1016/j.egypro.2017.08.020.
[19] E. Perlova, M. Platonova, A. Gorshkov, and X. Rakova, "Concept project of zero energy building,"
[20] Procedia Eng., vol. 100, no. January, pp. 1505–1514, 2015, doi: 10.1016/j.proeng.2015.01.522.
[21] U. C. Shin, "An empirical study of performance characteristics of BIPV (Building Integrated Photovoltaic) system for the realization of zero energy building q," Energy, vol. 66, pp. 25–34, 2014, doi: 10.1016/j.energy.2013.08.012.
[22] A. N. Sadeghifam, S. M. Zahraee, M. M. Meynagh, and I. Kiani, "Combined use of design of experiment and dynamic building simulation in assessment of energy efficiency in tropical residential buildings," Energy Build., vol. 86, pp. 525–533, 2015, doi: 10.1016/j.enbuild.2014.10.052.
[23] Y. Zhang, J. Kang, and H. Jin, "A review of green building development in China from the perspective of energy saving," Energies, vol. 11, no. 2, 2018, doi: 10.3390/en11020334.
[24] F. Shi, S. Wang, J. Huang, and X. Hong, "Design strategies and energy performance of a net-zero energy house based on natural philosophy," J. Asian Archit. Build. Eng., vol. 19, no. 1, pp. 1–15, 2020, doi: 10.1080/13467581.2019.169620