International Journal of Application on Social Science and Humanities
Vol. 1, No. 1, Feb 2023: pp 1159-1169 ISSN-L 2987-8241 (Electronic Version)

Green Building Office Tower Design with Bioclimatic Architecture and Design Articulation

Sesilia Melissa[1] Budijanto Chandra[2] Rudy Trisno[3]

[1]Master Program of Architecture, Faculty of Engineering, Universitas Tarumanagara, West Jakarta, Indonesia
[2]Master Program of Architecture, Faculty of Engineering, Universitas Tarumanagara, West Jakarta, Indonesia
[3]Master Program of Architecture, Faculty of Engineering, Universitas Tarumanagara, West Jakarta, Indonesia
Email: rudyt@ft.untar.ac.id

Submitted : July 2022, Revised : December 2022, Accepted: February 2023

ABSTRACT

The growth in the urbanization rate that occurs in big cities in Indonesia, especially in Jakarta, is offset by the growth of tall buildings. Office buildings are one of the most popular building constructions for investors and developers for economic and political progress in Jakarta. however, the construction of tall buildings in Jakarta can have a negative impact on the balance of the surrounding environment. This has become an impetus for the Jakarta government to move in saving the environment balanced by rapid infrastructure development with the Jakarta 30:30 as their commitment for sustainable city. The purpose of this paper is to provide design guidelines for the design of new buildings that embed a green building approach for the safety and balance of the surrounding environment. the method used in this paper is a mix method which uses quantitative and qualitative by looking at the applicable local regulatory guidelines and researching case studies that have similarities to research on green building design with a bioclimatic architectural approach and design articulation.

Keywords: *office building, green building, bioclimatic architecture, design articulation*

1. PREFACE

Population growth is increasingly evident from World Bank data in the last two years [1]. there are differences in facilities between rural and urban areas, this has caused many rural communities to flock to cities in search of better opportunities. This is what is called urbanization. Urbanization is currently happening in big cities in Indonesia, especially in Jakarta. The growth of the population in a city must be balanced with the development of industrialization. The development of industrialization can affect the economic development of a region. By keeping pace with economic growth in Jakarta, there are many job vacancies for people who have the potential so that high-rise office buildings are needed to meet community needs and economic growth. This becomes a problem when there are many high-rise buildings in Jakarta. The main problem is when the construction of tall buildings requires the use of energy for the continuity of the building. the use of this energy can affect the emission of CO_2 emissions which can affect the temperature in the world [1]. The increasing influence of temperature in the world can cause the greenhouse effect, so that every country currently insists on the construction of high-rise buildings in order to implement green buildings to protect the surrounding environment.

Related Work

According to the phenomenon from urbanization to greenhouse effect, Jakarta has a movement about green buildings to protect the environment. This commitment is carried out by the presence of the Jakarta Governor's regulation no. 38 of 2012 about Green Buildings to uphold the 30:30 Jakarta Commitment in emphasizing the use of energy sources, water, and suppressing CO_2 emissions [2]. The governor's regulation becomes a mandatory regulation when constructing buildings to implement green building points. In addition, there is a certification issued from GBCI called GREENSHIP which assesses green buildings with ratings based on predetermined assessments [3]. In designing green buildings in Jakarta, it must comply with Governor's Regulation No. 38 of 2012 about Green Buildings. This Governor's Regulation is

one of the requirements for development in Jakarta considering several points such as site management, waste management, building management as well as the comfort of the room that will be used by its users [4]. Building design supported by articulation theory and bioclimatic architecture approach teaches that a visualization forms an expression. Articulation is the geometric form of form and space. From form to create space, space to create volume, then volume can be a shade for the user. This design element can also be used as a character in the building [5].

Table 1
Previous Researches

Title	Description
Mesiniaga Tower: Traditional in Modernity [6]	Innovation is important for architects in planning and designing new buildings. In addition to providing solutions to building problems in the surrounding context, it also provides new knowledge for the next development. The problem that arises at this time is how the building responds to the climate so that it feels comfortable for its users. Southeast Asia is one of the regions that has a tropical climate, high development is actually not suitable for a country with a tropical climate but the space requirements are proportional to the population growth in that country. To overcome all this, Ken Yeang created a green building with a modern design which is where he began to introduce bioclimatic architecture to tall buildings. This is one of the design inventions that can be used in the development of high-rise buildings in Indonesia.
Bioclimatic Architecture [7]	Frank Lloyd Wright first introduced sustainable architecture to his home design known as Falling Water in 1963. After that it began to develop into high-rise buildings in the 1990s under the name bioclimatic architecture. Bioclimatic architecture arises because of the design approach by the climate context of the building site. With the strategy used, it can modify the shape of the building to provide thermal comfort for the building. The need for the amount of energy each year nationally can be reduced if the building is designed with the concept of energy saving. With natural ventilation, the air used also uses natural air by applying an energy-efficient design. This paper is a design that does not cause an increase in energy consumption and environmental damage, in the form of air pollution, noise pollution, but creates an architectural design that is environmentally friendly and natural architecture
Low-rise Floating Apartment Design with Bioclimatic Architectural Approach in Surabaya [8]	The impact of global warming is an issue that cannot be avoided because it cannot be attended to. The increase in population gives an increase in the need for space for housing. Lack of land for housing, many government and private companies provide new housing but utilize vertical housing such as apartments or flats. However, attention must be paid to energy use in high-rise buildings. This suitable place for residents is also supported by the existence of a design concept that starts from its approach to the climate at the site.
Application of Bioclimatic Architecture in City Apartment Design in Bandung City [9]	Bandung is one of the cities in Indonesia that has very rapid economic growth. Bandung is a city called a metropolitan city which has a fairly high population growth. In line with population growth, Bandung has the same problem as Jakarta which does not have a large enough land to accommodate growing facilities for its people. This has an impact on utilizing vertical land to support the needs of the community. With a climate design approach, bioclimatic architecture becomes the concept of planning and designing apartment buildings in Bandung. The purpose of using bioclimatic architecture is to provide thermal comfort to its users, both in designing the exterior and interior elements.
Principles of Bioclimatic Architectural Design in Tropical Climates [10]	The development of building construction must consider various aspects ranging from environmental quality, space requirements for users and also the use of energy in the building itself. By fostering a high sense of awareness, it is important for architects to be aware of the local natural conditions and start planning designs by taking advantage of the novelty of the design methods that will be used. The design approach to climate can use the concept of bioclimatic architecture which takes advantage of the site context conditions starting from the influence of climate. Several ways can be seen from the exterior and interior elements that affect the level of temperature capture that enters the

 https://doi.org/10.24912/ijassh.v1i1.25731

Title	Description
	building and which is removed from the building so as to create thermal comfort in the building.

Our Contribution

In research on the design of a green building office tower with a bioclimatic architecture approach and design articulation, the design parameters of a green high-rise building are located on Jalan Metropolitan Pondok Indah, Kebayoran Lama, South Jakarta. The design of high-rise green buildings will overcome urbanization problems and the influence of climate on design buildings with a bioclimatic approach to architecture and design articulation.

This study aims to expand building design principles that focus on the surrounding climatic conditions. This study aims to find appropriate contextual solutions to the previously existing environmentally friendly design concepts. The results of this study are expected to be able to add to the repertoire of knowledge in the field of architecture. The results of this study are expected to raise awareness for the community about the importance of elaborating on the role of the environment in buildings. The results of this study are expected to be a guide in designing environmental-based buildings. The design of high-rise green buildings will overcome environmental problems caused by increasing urbanization and the influence of climate on the design of buildings with an architectural bioclimatic approach and design articulation.

Paper Structure

The rest of the paper is organized as follows. Section 2 introduces the hypothesis used in this paper, which explain the presumption on this paper. Section 3 presents a method of Green Building design which using Bioclimatic architecture, articulation design, Governor's Regulation no 38 2012 and GREENSHIP. Then, the finding and discussion will be on Section 4. For the conclusion will be on Section 5, how designing Green Building according to Governor's regulation no. 38 2012 GOLD certification from GBCI with bioclimatic and articulation design approach [11].

THEORY

Main Requirement of Green Buildings in Jakarta

In designing green buildings in Jakarta, it must comply with Governor Regulation No. 38 of 2012. Governor Regulation is one of the requirements for development in Jakarta by taking into account several points such as site management, waste management, building management as well as the comfort of the room that will be used by its users [12].

Building design supported by articulation theory and bioclimatic architecture approach teaches that a visualization forms an expression. Articulation is the geometric form of form and space [5] . From form to create space, space to create volume, then volume can be a shade for the user. This design element can also be used as a character in the building.

The Governor's Regulation becomes mandatory in designing a building. The building will also be supported by a GREENSHIP assessment so that it will produce green buildings that are environmentally friendly and comfortable for users. In the case study that will be explained by the author below, it will be assessed by the existence of GREENSHIP because the Governor's Regulation only applies in Jakarta.

2. RESEARCH METHODS

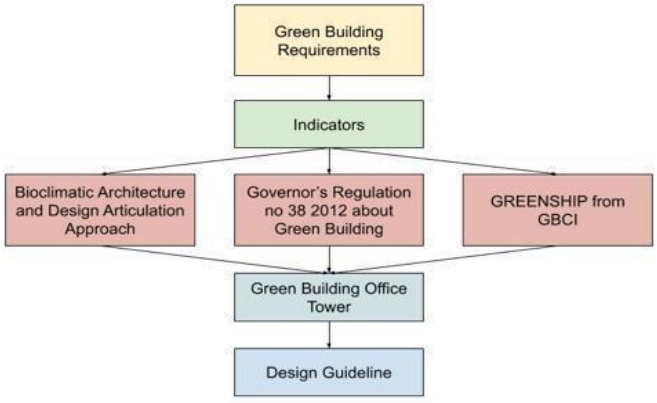
Research through a mixture of qualitative and quantitative methods by conducting comparative research journals also reviews several literature studies and case studies of precedents that have

been carried out at home and abroad on similar buildings that already exist, namely Mesinaga Tower, Bioclimatic Flexi-Office, Intiland Tower and the Ministry Building. PUPR. The quantitative method used in this paper is to measure data through scientific calculations derived from thermal calculations, waste disposal calculations, building area calculations and other calculations. while the qualitative method used is by direct observation by means of documentation of the surrounding environment, collecting data, analysing sources that have similarities in writing research and other research. Observations are carried out offline and research through the website. From the results of research and case studies, researchers will analyse and observe the data, information and field conditions obtained. This analysis was carried out descriptively and comparatively to find out what things were related and influenced the bioclimatic architecture program.

The method research uses three indicators to be a design guideline in this research (see **Figure 1**):

1. Bioclimatic Architecture and Design Articulation Approach
   In this section, it analyses the massing and building's orientation towards the site. For the final result of the mass of the building to be designed, the shape of this building adapts the mass that is influenced by sunlight. The shape of this building mass is expected to be an office tower green building with a bioclimatic architecture approach and design articulation.
2. Governor's Regulation no 38 2012 about Green Building
   Governor's Regulation no 38 of 2012 is a mandatory regulation that must be met in every new building in Jakarta according to Minister of Public Works Regulation No. 21 of 2021. This gubernatorial regulation No. 38 of 2012 must be fulfilled so that the planned building to be built becomes a green building that is suitable for use by users and can be used by users. balance the environmental ecosystem around the building.
3. GREENSHIP from GBCI
   The GREENSHIP assessment from GBCI becomes a volunteer assessment for the planned building. This assessment also evaluates the green building concept in the planned building based on energy efficiency criteria as well as health and comfort in the space. this assessment supports the building plan to become a green building with a GOLD assessment.

Figure 1
Research Methods



Source: *Authors, 2022*

 https://doi.org/10.24912/ijassh.v1i1.25731

3. FINDING AND DISCUSSION

The design of new buildings in Jakarta can already be called a green building if it only refers to the Governor's Regulation No. 38 of 2012 concerning Green Buildings. However, in the design of this building, the author added a certification from GREENSHIP from the Green Building Council Indonesia so that this building becomes a certified green building. In the planning and design of the green office building, this office tower meets GREENSHIP certification with a Gold Rating with an income of 58 points. There are several things that must be considered in planning and designing this green building to maintain the ecological balance and the surrounding environmental ecosystem as well as this aims to save energy that will be used for the sustainability of the building. All points in GREENSHIP have been fulfilled in this planning and design so that it can become a green building with Gold Certification**.**

Bioclimatic Architecture and Articulation Design Approach

The site of the planned building will be located in Jakarta, precisely on Jalan Metropolitan Pondok Indah, South Jakarta. The planned building will be located at a main road intersection which has a very strategic location where it is supported by adequate public transportation such as Transjakarta and MRT as well as a location traversed by pedestrian-friendly main roads so that it can support comfort for passengers. cyclists and pedestrians. Analysis of the planned building will begin by looking at the direction of the sun on the site, this will affect the orientation of the building and also the mass of the building to be erected. According to the RDTR, the zone on this site includes an office zone with a building height of 16 floors and a maximum KTB of 50%. With the main purpose of this plan building being a green building, it is a building that can reduce energy use by 20%. Looking at the existing case studies, there are several points that will be applied to the design of this green building.

Table 2

Building Mass

Massing Building	Description	Massing Building	Description	Massing Building	Description
	The planned site will be designed according to the RTDR according to the zoning map with an area of 10,000m2 planner.		To support the continuity of the building, there is an additional service area on the rooftop and also a service area on the basement floor.		Influenced by the movement of the sun, there will be a mass rotation of 45º in order to avoid sunlight entering directly into buildings, especially in the office tower area.
	The mass of the building in the following figure is the mass of the building without applicable local regulations in planning the design of a green building.		In the division boundary between the 2 main programs, a buffer area will be added where this area becomes an open area		In addition to adapting the mass rotation due to the sun, there will also be an adjustment to the shape of the building mass so that it becomes an articulation of the characteristics of

Massing Building	Description	Massing Building	Description	Massing Building	Description
					the building itself.
	The mass of the building after the reduction is due to the sixteen-story clearance of 10m in accordance with the PUPR Ministerial Regulation No. 14 of 2017 concerning the Ease of Building Buildings		The mass of the building in the upper tower (private area) will experience a mass reduction to follow the predetermined NLA area requirements.		In the lower tower there will be adjustments and mass reductions in order to help the building for cross ventilation systems and energy savings
	The mass program in this building is divided into 2 main programs, namely public areas and private areas.		The service area on the rooftop has also been reduced because the main function of this area is for gondola tracks, water tanks and also LMR.		For the final result of the mass of the building to be designed, the shape of this building adapts the mass that is influenced by sunlight. The shape of this building mass is expected to be an office tower green building with a bioclimatic architecture approach and design articulation.

Assessment Governor's Regulation No. 38 of 2012 about Green Buildings

These five points are the attempt of the DKI Jakarta regional government to create a green building that emphasizes the use of energy and maintains and uses resources efficiently [12].

1. Calculation of building envelope
2. Application of ventilation system
3. Setting the air conditioning system in the building
4. Setting the lighting system
5. Use of the transportation system in the building

Become a design guideline for the design of green buildings by applying Governor's regulation, GREENSHIP assessments and the composition of the building mass that avoids the direction of the sun, providing articulation in the form and use of materials in this building so that they characteristically become elements of green building design, especially for offices.

Table 3
Governor's Regulation No. 38 of 2012

 https://doi.org/10.24912/ijassh.v1i1.25731

Criteria	Achievement
OOTV Calculation	
	1. Total conduction through walls: 181,318.13 Watt 2. Total Conduction through the aperture 22,324.35 Watt 3. Total radiation through the aperture is 101,123.02 Watt 4. Total 304.765.50 Watt 5. Total facade area: 7,207.92 m2 OTTV: 42.28W/m2
Ventilation System and Air Conditioning System	
	1. The bridge section of the lower tower will be opened due to the use of cross ventilation. In addition, the rooms in the building will use the type of cooling machine mentioned above 2. The podium is a buffer between the public area building and the office tower area. The podium area becomes a food court area which applies cross ventilation in that area. 3. The AHU Chiller system is placed in the office tower area, meeting rooms, libraries, and ballroom areas. The AHU Chiller system uses a Water-Cooled Chiller <150 TR (screw) with 4.1 COP and 0.858KW/TR
Lightning System	
	1. The toilet will use a light motion system which will light up if there is motion in the toilet. 2. The lighting system in the office tower room will use a light shelves system which is installed on the window wall 3. The system in the corridors, lobby areas and work areas uses artificial light that has been adapted to SNI 03-6575-2001 and added with MEP needs such as speakers, sprinklers and smoke alarms.
Vertical transportation in-building	
	1. The manual ladder system will be applied to service stairs which use a double landing system. This is done to save the total area of MEP 2. The escalator system will be placed at the lower part of the tower. This escalator system uses VVVF to save electricity usage. 3. The elevator system is the main system in the office tower green building. This system is a means of transportation from the basement to the top floor of the building. The elevator system is also supported by VVVF.

Assessment GREENSHIP from GBCI

Office buildings that will be planned and designed must meet the green building requirements according to the PUPR Ministerial Regulation No. 21 of 2021 following the Governor's Regulation No. 38 of 2012 concerning Green Buildings. This regulation is a mandatory regulation for new buildings on vacant land. This regulation was created in order to suppress the disposal of carbon emissions that affect the macro and micro environment in the plan site. The GREENSHIP New Building certification system in Jakarta itself consists of Eligibility provisions and 6 assessment criteria, such as [13]:

1. Appropriate Site Development (ASD) is explained in outline by looking at the arrangement of the site area which can affect the development of infrastructure in the

surrounding area such as the development of green areas, transportation developments, the development of building user comfort.

2. Energy Efficiency and Conservation (EEC) refers to the use of energy for sustainable building operations such as water use, electricity use, thermal comfort and also energy conservation in buildings and others.
3. Water Conservation (WAC) refers to the use of water and technology to recycle and reduce water and also regulates how water is disposed of into waste.
4. Material Resources and Cycle (MRC) explains how the use of materials in buildings affects environmental pollution and certificates of sustainable materials, especially the use of wood materials.
5. Indoor Health and Comfort (IHC) explains how the air is comfortable in buildings and also controls CO_2 in public spaces. It also explains the view from inside the building for psychological comfort.
6. Building and Environmental Management (BEM) explains more about building management so that the building can operate properly.

There are 4 levels of GREENSHIP certification assessment, namely Bronze, Silver, Gold and Platinum. The assessment that will be used in this design is Gold which is the measuring point for the design of green buildings to be designed and planned [11] [4]

Table 4
GREENSHIP

Criteria	Achievement
Appropriate Site Development	
	1. Have at least 5 public facilities that can be reached by the main road as far as 1.5 km from the site. Provide pedestrian facilities that are safe, comfortable, and free from car driver access that connects 5 public facilities with mass transportation stations. 2. Have pedestrian facilities within the site area to get to transportation stations that are close, safe and comfortable in accordance with PUPR Ministerial Regulation No. 30 of 2006
  	1. This building has secure bicycle parking as much as 1 bicycle parking unit per 20 building users (maximum 100 bicycle units). 2. The building has showers and lockers for every 10 parked bikes on site. 3. This building has a green open space area that is free from buildings with a minimum area of 40% of the total land area. The area is calculated by the presence of gardens on the roof of the building, terrace garden and wall garden in accordance with the PUPR Ministerial Regulation No. 5 of 2008 concerning green open space.
Energy Efficiency and Conservation	
  	1. OTTV is mandatory in accordance with SNI 03-6389-2011 which discusses the use of building envelope energy in buildings. 2. Following the minimum power value listed in SNI 03-6197-2011 where the lighting power is 15%. Using natural lighting to the maximum for a building with a minimum of 300 lux

 https://doi.org/10.24912/ijassh.v1i1.25731

Criteria	Achievement
	3. Do not use air conditioning in the corridors of the elevator lobby, stairs and toilet rooms and are equipped with natural ventilation.
Water Conservation	
 	1. The highest use of clean water is 80% from the main source (PDAM) without reducing the number of needs in accordance with SNI 03-7065-2005 2. Using a water fixture that is adjusted to the waste water disposal capacity of at least 25% of the total water fixture 3. Reusing used water that has been filtered for bathroom needs (flushing) or cooling towers. Reusing water from air conditioning condensation, water used for ablution or catching rainwater
Material Resources and Cycle	
 	1. Using local products that have sustainable, eco-friendly, and non-toxic certificates. The average material used uses the standard from ISO 14001 2. The planning and design of the building uses a prefabricated system which is 30% of the total material cost. 3. The materials used come from the main raw materials and the manufacturing is within a radius of 1000 km from the site location
Indoor Health and Comfort	
 	1. This building has CO_2 sensors in every room with a high user density and has a setting for the amount of CO_2 concentration 2. “No Smoking” signs are posted in every area of the building. If there is a smoking area, it must be 5m from the entrance, outdoor air intake and window openings.
Building and Environmental Management	
	1. The Bin centre area is used as a waste collection area before being dumped into a landfill for recycling by third parties. It is planned to separate various organic, inorganic and toxic wastes. 2. Garbage Calculation: (D x Ts x PA)/(Vol bin x Fp) (1000 x 3 x 0.45)/(660 x 1.2) 1350/792=1.7 UNITS | 1 unit sulo=660L =2 units of sulo Sulo required 2 units, but to distinguish the types provided 3 types of sulo: organic, inorganic and toxic. D: Number of Users Ts: Garbage Vol (3L/person (for big cities) Pa: Inorganic waste (45% based on local regulations) FP: Tool Compaction Factor (1.2 based on SNI) 3. Used water (grey water) or liquid waste is accommodated in the STP room to be filtered before being discharged into the city drainage.

4. CONCLUSIONS AND RECOMMENDATIONS

Against the background of the phenomena of the world of urbanization and climate change which is getting worse, an architect is required to plan and design a building that is environmentally friendly and has excellent performance. The need for economic development coupled with this development, especially office buildings, leads to the enforcement of green building concepts to improve the environment in the future. There are several conclusions from this design

1. The design of high-rise office buildings can address the need for work space and facilities as well as global warming problems in Jakarta by applying green building standards and a bioclimatic architecture approach and design articulation.
2. The design method using Governor Regulation No. 38 of 2012 concerning Green Buildings as a mandatory green building standard in Jakarta and the volunteer Gold Rank GREENSHIP Certification helps design office green buildings as a design guideline to realize the 30:30 Jakarta Commitment to Jakarta Grand Design in 2030.

ACKNOWLEDGMENT

Gratitudes to the parties on which this work was supported from

REFERENCES

Baden,S, Waide,P, Fairey,P & Laustsen,J (2006) Hurdling Financial Barriers to Lower Energy Buildings: Experiences from the USA and Europe on Financial Incentives and Monetizing Building Energy Savings in Private Investment Decisions, Florida Solar Energy Center, vol. 1,8-15,.

Ching,F.D (2014) Architecture: Form, Space, & Order, New Jersey: John Wiley and Sons,

Dhini,P. G. (2016) Dinas Komunikasi, Informatika dan Kehumasan, Pemprov DKI Jakarta, Tandatangani Komitmen 30:30, Pemprov DKI Jakarta Kukuhkan Posisi Sebagai Center of Excellence Bangunan Gedung Hijau, https://smartcity.jakarta.go.id/blog/109/tandatangani-komitmen-3030-pemprov-dki-jakarta-kukuhkan-posisi-sebagai-center-of-exellence-bangunan-gedung- hijau.

Green Building Council Indonesia,(2020). https://www.gbcindonesia.org.

Green Building Rating, (2020). https://www.gbcindonesia.org/greens/new .

Handoko,J. P. S.(2019) Prinsip Desain Arsitektur Bioklimatik pada Iklim Tropis, vol. 6, Pontianak: Universitas Tanjungpura Pontianak.

Jakarta Green Building, (2020). https://greenbuilding.jakarta.go.id.

Leach,N (2005) Rethinking Architecture: A Reader in Cultural Theory - Structuralism, London: Routledge Taylor and Francis Group.

Mahyuddin,E. R, Rilatupa,J &. Marpaung,C.O (2006) Optimasi Facade Kantor Dinas Pendidikan Provinsi DKI Jakarta, Jalan Gatot Subroto Kav 40-41, Jakarta dengan Konsep Bangunan Hijau..

Mungkasa,O (2017) Design Besar Bangunan Gedung Hijau Jakarta Dalam Mencapai Komitmen 30:30 Jakarta Sebagai Center of Excellence Bangunan Gedung Hijau,,” Pemda Provinsi DKI, Jakarta.

Nurdarajat,F (2019) Penerapan Arsitektur Bioklimatik pada Perancangan City Apartemen di Kota Bandung, vol. 4, Bandung,11.

Nurmalita,A (2018) Perancangan Low-Rise Floating Apartment dengan pendekatan Arsitektur Bioklimatik di Surabaya, Malang: Universitas Islam Negeri Maulana Malik Ibrahim.

Panjaitan,F (2012) Pergub No 38 tahun 2012 tentang Bangunan Gedung Hijau, Jakarta,

 https://doi.org/10.24912/ijassh.v1i1.25731

Prajnawrdhi,T. A. (2004) Mesiniaga Tower: Tradisionalitas Dalam Balutan Modernitas (Sebuah Apresiasi Karya Arsitektur): Universitas Udayana, Mesiniaga Tower: Tradisionalitas Dalam Balutan Modernitas, vol. 2, Bali. 55.

Ratnaningsih,A,Hasanuddin,A & Hermansa,R. (2019) Penilaian Kriteria Green Building Pada Pembangunan Gedung IsDB Project,, vol. 7, Jember: Universitas Jember.

Tumimomor I. A. & Poli,H (2011) Arsitektur Bioklimatik, vol. 8, Manado: Media Matrasain, 13