

Climatological Aspects in the Circulation of Sustainable Apartment

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Abstract - Population density and depletion of land for buildings are one of the main reasons for the construction of vertical housing in this modern era. Apartment building is one of the vertical buildings which is suitable to accommodate many occupants to solve land problems, but the apartment also provides many major problems, especially in the surrounding natural environment. Therefore sustainable architectural design that is contextual to the environment is one solution to solve the problem. Jakarta is one of the cities with high intensity of apartment building growth. This paper will explain the architectural design process for sustainable apartments in Pluit, North Jakarta, Indonesia based on a climatological approach.

Keywords: Apartment, Climatologist, Sustainable

1. Introduction

The position Jakarta as the Capital City of the Republic of Indonesia, continues to improve from year to year and it can be stated that development is very rapid, even has become the center of various development activities. Economic, social, and educational activities are mostly concentrated in the Jakarta area, so that it will affect the number of residents living in the Jakarta area and surrounding areas and this will also be followed by an increase in the number of workers, and this will affect the need for providing infrastructure and other infrastructure facilities.

The hustle and bustle of life in the increasingly busy and congested areas of Jakarta makes Jakarta people choose a place to live that has its own facilities that are comfortable and able to meet the needs of life without having to travel far. That way apartments become the choice as a suitable housing for the lifestyle of the community.

Apartment is a place to live that is only part of a larger building. Usually it is a group of rooms on one floor of a highrise building in a city, where land is too expensive for people to have separate houses. This makes this building requires a lot of needs for long-term maintenance. The treatment affects the comfort and facilities in the building.

A building must be able to adjust to the climate / weather of the surrounding area. Care for the weather or climate can also affect the comfort in this residential building. With this, it is necessary to approach the sciences regarding tropical climate in the design process.

Harmonize between the building and the environment, with the climatological aspects approach in the design of a building will have a positive impact to quality of human life. That way the design of the building is expected to be a residence that is in harmony with the tropical climate in accordance with the environment and become a sustainable building that can utilize nature potentials.

2. Method

a. Research Approaches

The approach method used in this research is a qualitative approach, with an architectural design based research method where the findings will be solved in the form of architectural design solutions.

b. Method of Selecting Object Research

This study uses two objects that will be the focus of research. The main object of research is the direct study of field surveys by observing activities in the apartment and analyzing the design of the space in the apartment. The second object is the aspect of designing an apartment, by making digital simulations to find climatological data on the design and providing a conceptual solution that leads to sustainable building types.

c. Research Variable

The selection of research objects is based on the topic taken, namely the climatological aspects of apartment buildings. The location is the basis for choosing this research object, which sites are in Pluit, Jakarta which has a tropical climate with an open area so that it is suitable to be the object of digital sampling and simulation.

Sample measurements is operated by using Digital Eco-tech simulations, from 12.00 - 14.00 GMT + 07. Design samples are taken from the apartment and circulation room units. To limit the scope of this research discussion, three variables are taken as listed in the table below:

TABLE I. RESEARCH VARIABLE

	<i>Variable</i>	<i>Description</i>
1.	Climate	Temperature, Wind, Rainfall
2.	Environment	Vegetation, Drainage
3.	Architectural Design	Facade, Inner Space, Orientation

d. Design Method

According to Duerk, D.P. (1993) the design process is determined based on the problem, data collection and achievement of the solution. This design uses the design process of analysis, evaluation and synthesis. The analysis used is the analysis of several geometric shapes that ultimately undergo a testing process (testing) by being evaluated. With an iterative design process, eventually the results of the solution that will best suit the problem will be found. The design process of this study uses a basic stage of designing based on the Cyclical design process model that is :

1. Analysis: compilation of data in the form of natural conditions around the building and research related to design to produce design criteria.
2. Evaluation: sorting and decision making concepts. Sorting is based on case studies and pre-existing research (evidence based design).
3. Synthesis: the conclusion of the design concept that best fits the design criteria.



Figure 1. Cyclical Design Proces

In addition, the method used is the transformation that forms the basis of the facade then explored according to the criteria and design parameters that exist with the principle of the effect of the stack, incorporation at the design site, lighting principles (related to glare) and marine displacement reserves on the East side as a potential building (Stevens, G., 1990). Then the exploration process is made by forming a double skin façade and finally the process of exploring the form of double detail skin.

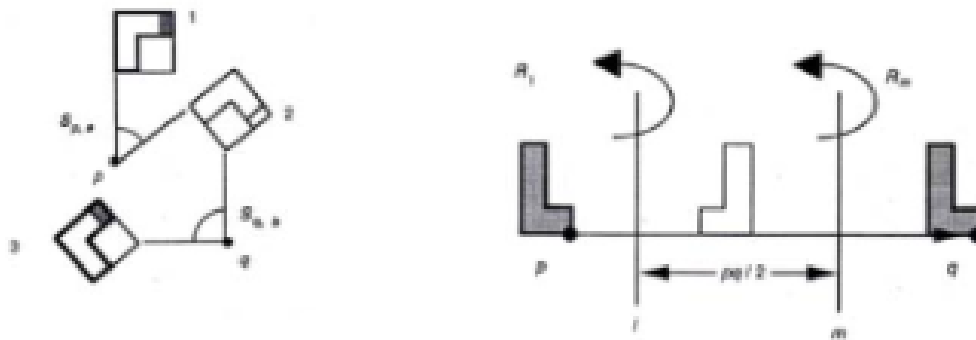


Figure 2. Rotation and Reflection Forms

3. Results And Discussion

The survey results from the field produce primary and secondary data which will be analyzed to answer questions from the formulation of the problem. This chapter draws both physical observations of the design and results of the field survey, which are the climatological aspects of sustainable apartments in Pluit.

a. Project Description

The area of the apartment to be studied is 10,000 square meters. the location is on Jalan Raya Pantai Mutiara, Pluit, North Jakarta, Indonesia. The area of the building permitted on this site is 40% of the site area. That means the area of the building permitted is 4000 square meters. The permitted building height is 24 floors or about 96 meters. In the northern part of the building there is the Regatta Apartment, in the southern area there is the Pantai Mutiara Apartment, in the western area there is a residential area and in the east there is a townhouse.



Figure 3. Apartment Site Location

b. Climate

Climate data taken as a basis for measuring comfort are determined according to the location of the study site in the area of Penjaringan Provision District D.K.I Jakarta, North Jakarta Municipality with a rainfall level of around 2,393 mm / yr and the average temperature reaches 30 degrees Celsius.

The orientation of the sun determines both thermal and visual comfort in apartment buildings. On the north and south sides of the building get good sunlight and not too hot. Whereas in the east-west area of the building get enough sun glare because it is not obstructed by other buildings directly also gives a fairly hot effect.



Figure 4. Site Orientation

The wind provides potential for ventilation into the site with open space within the site (between townhouses), as well as utilization for energy savings. The direction of the wind determines the position of open space so that it can create tropical gardens in open areas.



Figure 5. Wind Direction

c. Environment

Drainage is closely related to climate and rainfall in the region. The drainage on the site is quite good and clean so that it has the potential for the development of water discharge channels. Around the site is sea water that can be used as water distribution, so it does not overflow in the site. Rainwater can be recycled for use in water savings. Provision of green open spaces as a contribution to water catchment areas.

The potential of a relatively flat site makes planting vegetation not too difficult. But the constraints of the lack of trees / vegetation on exciting sites, tend to be arid and hot. Selection of the right tree can help solve problems such as noise and heat from the sun as shown in Fig. 6



Figure 6. Vegetation on Site

d. Architectural Design

As an apartment that emphasizes the concept of the resort because of the location of the site itself, this site has a specificity that is not owned by other sites, such as having a view towards the sea that is good both at night and during the day.

The concept of a resort apartment can be seen among other things in its facilities. This point is very important for a resort apartment. Because the purpose of the resort apartment itself is to make visitors feel at home to stay long in the apartment. With complete facilities, it is hoped that visitors will become more comfortable staying in the apartment for a long period of time.

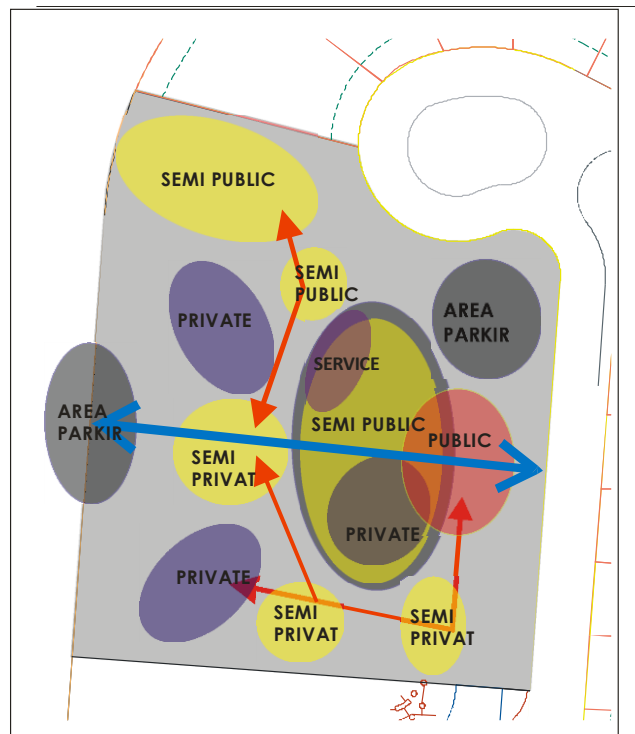


Figure 7. Zoning on Site

- Parking area for visitors is focused on the parking building area to facilitate visitors to access.
- Public Zone is an area that can be visited by public people. The public zone is located in the front area where the axis of the public zone is very strong, because it is located on one side of the road that can be seen by vehicles passing in front of the site. While the area for public facilities is placed on the site, because it is public, so it does not disturb the peace of the apartment visitors.
- The Semi-Public Zone is a facility area (sports, relaxation, outreach) placed in the middle because it is an area frequented by residents..
- The Private Zone is the room unit placed in front because it is assumed that visitors who stay have a higher level of mobility and are placed adjacent to apartment facilities. Townhouse area is placed on the site so that it has privacy and can enjoy the surrounding sea view.

The composition of the building mass and building zones are designed by considering the climate and environmental aspects of the site. Circulation is the main thing that limits the study in this study.

e. Digital Simulation

The simulation is run by using SketchUp software for modeling the shape and design of apartment buildings. The model is then tested in an EcoTech simulation software to find out the light brightness and thermal temperature in the apartment room.

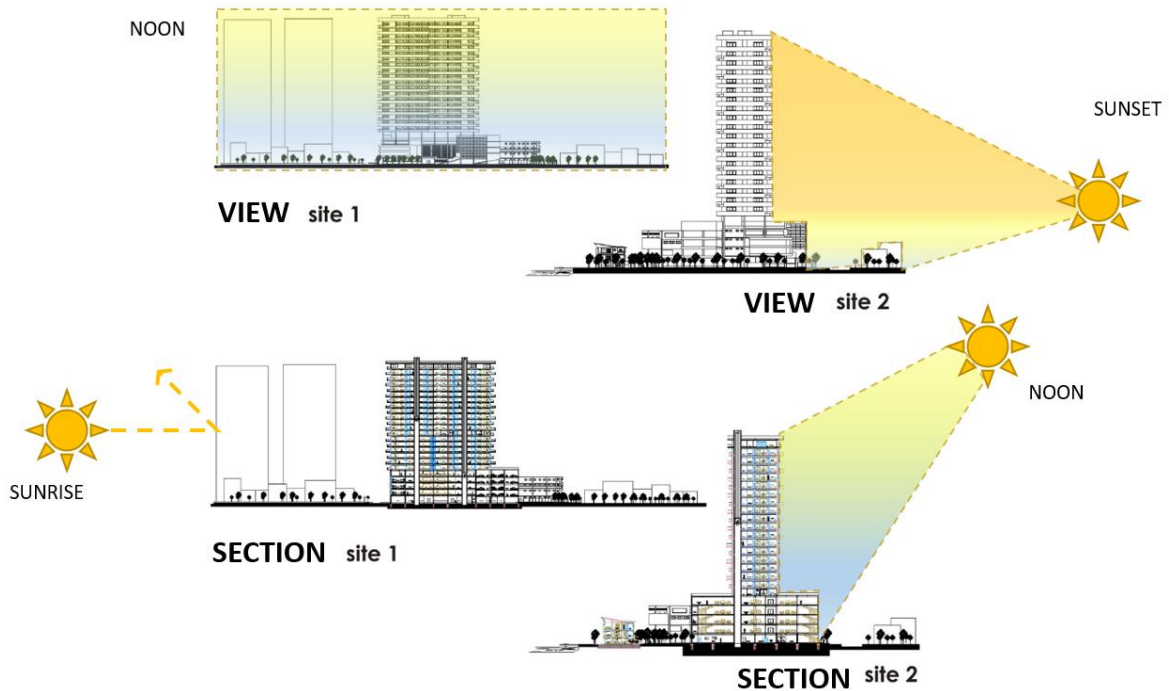


Figure 8. Sun Exposed Area

The design starts from the mass form. Based on research that has been done before, the stack effect in the double skin façade cavity can work optimally if the shape of the mass forms an angle of 45° and 135° towards the direction of the coming wind (Marques, F.S. and Gomez, M.G., 2008). In the design, the angle of mass 45° and 135° adjusted to the direction of the angle of arrival of the average wind in the Pluit region is East 100°. The possible direction of the wind angle is between East 70° to West 236°. The design of this study uses the average wind direction of East 100° as the main criterion while the other wind direction is used as the second criterion in the design. In addition to the direction of the wind, the shape of the mass is determined by the design criteria about the view.

The sea on the east side of the site is the main criteria for designing the form of mass that receives the most views of the sea. Besides the shape of the mass is also influenced by the number of residential units that can be designed. The form of circulation used in the design is a double loaded corridor type in accordance with the existing condition of the apartment building

Vegetation along the fins on the tower of apartment buildings helps the movement of incoming winds and changes in winds that carry relatively hot temperatures to cooler. the wind rubs against the greenery and the design of the building's fins is adjusted to the direction of the coming wind. (Fig. 9)

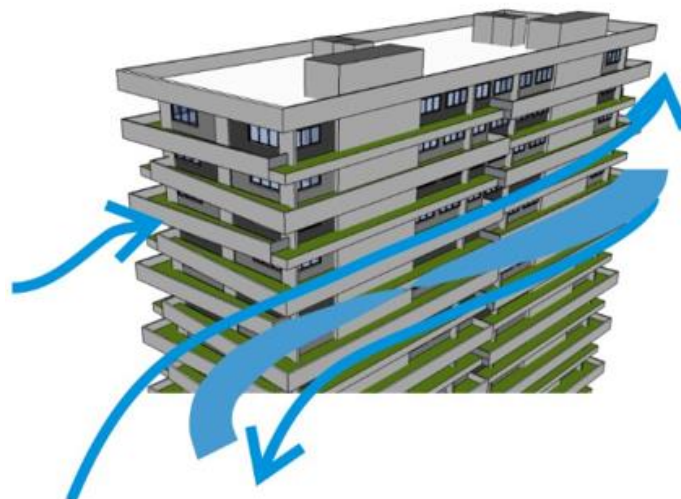


Figure 9. The Wind Passes Through The Apartment Facade

Based on research that has been done before (Hien, W.N., W. Liping, A.N. Chandra, A.R P., and Xiaolin.W., 2005), the use of double skin facade with stack effect can reduce the heat load on the facade through the application of cavities between the external and internal facades as a heat barrier from outside the building to the internal facade.

Utilization of green vegetation as carbon sinks produced by vehicles and other equipment so that the surrounding environment becomes healthier. selin that vegetation is also used as air conditioning outside and inside the building. (Fig. 10)



Figure 10. Carbon-Releasing Facade Hole

The sampling is done as accurately as possible by taking the right position in accordance with the longitude and latitude of the building site area. Site position is in the GPS-coordinates of Pluit are: $6^{\circ} 6' 56.801''$ S $106^{\circ} 47' 27.841''$ E and The UTM coordinates (WGS84) of Pluit are: Zone 48M E: 698205.91 N: 9323666.92.

From the simulation results using EcoTech software, it can be seen that a wide window opening in the circulation section helps in lighting natural light during the day and saves the use of artificial light so it is more energy efficient. lux level in the room is in the range of 100 lux luminance. (Fig. 11)

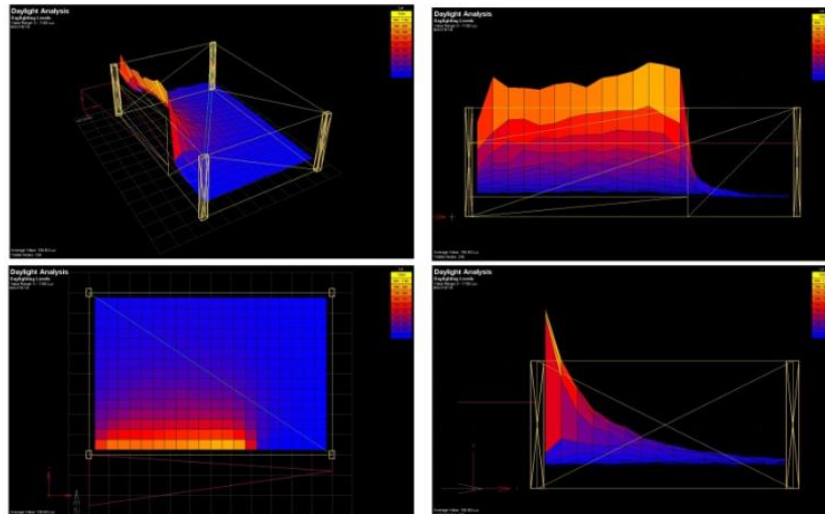


Figure 11. Thermal Simulation Results

4. Conclusion

Based on the explanation above, it can be concluded that architectural design can affect thermal comfort. This can be proven based on digital simulations showing changes in room temperature due to facade design, building mass orientation and circulation. The results of this simulation will vary depending on the climate, weather and building environment.

5. Acknowledgment

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