Study of ecological and green architecture theories for a house in South Jakarta

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Abstract. Architecture has a major role in the issue of global warming today. Therefore, the architects began to endorse the concept of ecological architecture and green building design. This study aims to examine a project of Omah Harimurti in Jakarta based on ecological and green architecture principle theories by Sim Van Der Ryn and Stuart Cowan as well as Robert and Brenda Vale. Both of their design principles were compared to identify the ecological and green design parameters to test the Omah Harimurti. Results of the study revealed that there are 4 parameters of ecological-green architecture design, such as nature should be the main actor of the design; nature becomes a solution for every problem in the site; honor the user by involved them as a designer; and be a climate conscious building by conserving energy. From the examination conducted, it is also revealed that the Omah Harimurti qualified as an ecologic and green architecture design.

Keywords: ecological and green architecture, concept and study case

1.Introduction

Global warming has become a concerning issue for the world today. Some of the factors that cause global warming are the development of human lifestyles and the increasing demand for energy.

Architecture as the build environment has an important role in this issue. Based on research, one of the biggest contributors to energy usage is from the building sector. Seeing this condition, more and more architects started to be responsive to environmental issues. The concept of ecological and green design then started to appear in architecture.

Ecological and green architecture are concepts that are related to sustainability in architecture. These concepts promote problem-solving design, where building and nature are in a harmony through scientific and technical solutions.

Robert and Brenda Vale [1]. in their book *Green Architecture, Designed for a Sustainable Future* proposed six principles that could build into a green architecture. Those principles are:

1)Conserving energy - A building should be constructed so as to minimize the need for fossil fuels to run it.
2)Working with climate - Buildings should be designed to work with climate and natural energy sources.
3)Minimizing new resources – a building should be designed so as to minimize the use of new resources and, at the end of its useful life, to form the resource for the architecture;

4)Respect for user - A green architecture recognizes the importance of all the people involved with it;
5)Respect for site - A building will "touch-this earth-lightly"
6)Holism - All the green principle need to be embodied in a holistic approach to the built environment.

Another opinion stated by the scientist Sim Van Der Ryn and Stuart Cowan [2]. in their book, *Green Architecture, Designed for a Sustainable Future and Ecological Design.* They said, if we are to create a sustainable world - one in which we are accountable to the needs of all future generations and all living creatures - we must recognize that our present forms of agriculture, architecture, engineering, and technology are deeply flawed. They also stated that to create a sustainable world, we must transform these practices, we must infuse the design of products, buildings, and landscape with a rich and detailed understanding of ecology. That is why they stated 5 principles of ecological design. The principles are:

1)Solution grows from place - Ecological design begins with the intimate knowledge of a particular place. Therefore, it is small-scale and direct, responsive to both local condition and local people. If we are sensitive to the nuances of place, we can inhabit without destroying
2)Ecological accounting informs design - Trace the environmental impacts of existing or proposed designs. Use this information to determine the most ecologically sound design possibility
3)Design with nature – By working with living processes, we respect the needs of all species while meeting our own. Engaging in processes that regenerate rather than deplete, we become more alive
4)Everyone is a designer - Listen to every voice in the design process. No one is participant only or designer only, everyone is a participant-designer. Honor the special knowledge that each person brings. As people work together to heal their places, they also heal themselves
5)Make nature visible - De-natured environments ignore our need and our potential for learning. Making natural cycles and processes visible brings the designed environment back to life. Effective design helps inform us of our place within nature.

This study aims to examine a project of Omah Harimurti in Jakarta based on ecological and green architecture principle theories by Sim Van Der Ryn and Stuart Cowan [2] and Robert and Brenda Vale [1]. Both theories will be compared in order to generate parameters to test whether the Omah Harimurti had qualified to become an ecologic or green architecture design.

2.Materials and Method

Identification of ecological and green architecture design parameters : Robert and Brenda Vale, or the Vale couple [1], and Van der Ryn and Stuart Cowel [2] ad stated some principles related to sustainability, particularly on ecological-green architecture design. Both principles will be compared to find the similarities. The similarities then will be generated into ecological-green architecture design parameters used in this study.

Vale and Vale [1] said that we have to *respect the site*, meanwhile Ryn and Cowel [2] stated a point of *design with nature* and we have to *make nature visible*. Those points told us that we have to respect the site by design with nature as the nature itself has to be visible. Respect the site also means that we should minimize the destruction of surround nature when we build our building. Based on those points, the first point that can be a parameter to build an ecologically green architecture design is nature should be the main actor of the design.

Ryn and Cowel [2] stated a point where we should *grow any solution from place*. Every site has its nature that become its context. Based on this point, the second parameter is nature might become a solution for every problem exist in the site. This statement is also in line with the statement before that nature should be involved in every design.

Ryn and Cowel [2] said in their principles that *everyone is a designer*. No people can be ignored at the designed process. We should count needs from anyone of them. As Vale and Vale [1] said that we have *to respect the user*, architect or designer should have a proper view of the users of the building's need. By considering everyone needs and aspirations, we ensure that everyone will use the building in a good mood. By those points, the next parameter of making an ecological green architecture is honor the user by involved them as a designer.

In their principles, Vale and Vale [1] also stated that a green architecture must *conserve their own energy*. The energy used in the building should be accountable. The building has to use the energy responsibly due the shortage of energy in this era. To have an energy conscious building, we should *work with climate* as our consideration in design. As example, if we build a building in Jakarta, we have to use any theory of tropical architecture. By the uses of the macro climate theory, we know whether the use of energy in our building is proper or not. This point is in line with what Van Der Ryn-Cowel [2] said that we should *count ecological aspect of a design*. Every building has to be climate conscious to conserve energy. Based on those points, the last parameter is be a climate conscious building by conserving energy.

Based on the description above, it can be identified that the parameters of ecological-green architecture design that will be used in this study are:

1.Nature should be the main actor of the design
2.Nature become a solution for every problem in the site
3.Honor the user by involved them as a designer
4.Be a climate conscious building by conserving energy

Vale and Vale [1] advised that all the principles they have stated should be used in a holistic way. By using whole principles in a holistic way, we had built a green architecture or what Ryn and Cowel [2] said, ecologic design. The detail description of the design parameters can be seen in Table 1.

Table 1. Ecological-green architecture design parameters

No.	Parameters	Principles	Source
	Nature should be the main actor of the design	Respect the site	Vale and Vale
		Design with nature	Ryn and Cowel
		Make nature visible	Ryn and Cowel
2.	Nature become a solution for every problem in the site	Solution grows from place	Ryn and Cowel
3.	Honor the user by involved them as a designer	Everyone is a designer	Ryn and Cowel
		Respect for user	Vale and Vale
4.	Be a climate conscious building by conserving energy	Conserving energy	Vale and Vale
		Working with climate	Vale and Vale
		Minimizing new resources	Vale and Vale
		Ecological accounting informs design	Ryn and Cowel

The Omah Harimurti project should answer all the advice that taken from green architecture theory by Robert and Brenda Vale and the ecological design by Sim Van Der Ryn and Stuart Cowel to be called a ecologic or green architecture design.

3.Sample Data

Omah means house. Omah is a word of javanese language. Omah Harimurti Project is exhibited in Indonesian Architects Week 2017 in Seoul, last September. This project is admitted by the curators as a sample of Indonesian ecological house that built in the center of Indonesia capital city, Jakarta. Omah Harimuti is located in Depsos III street. It is located in south part of Jakarta. This Omah is located in average density residential area. The density of its residence shown by this figure:

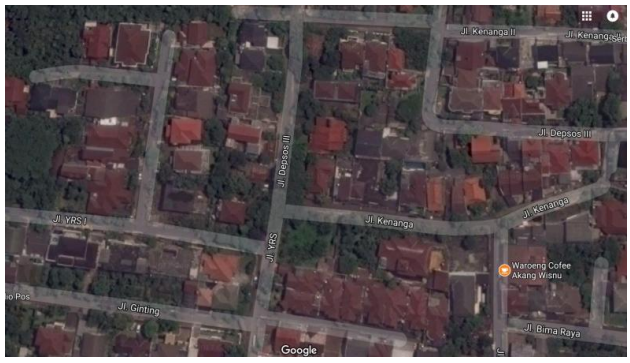

Figure 1. Aerial View of Site location (Source: Google Maps)

The site area consist of 364 sqm facing the west. By facing the east, heat is coming in the morning only. Here is the design of the Omah Harimurti:

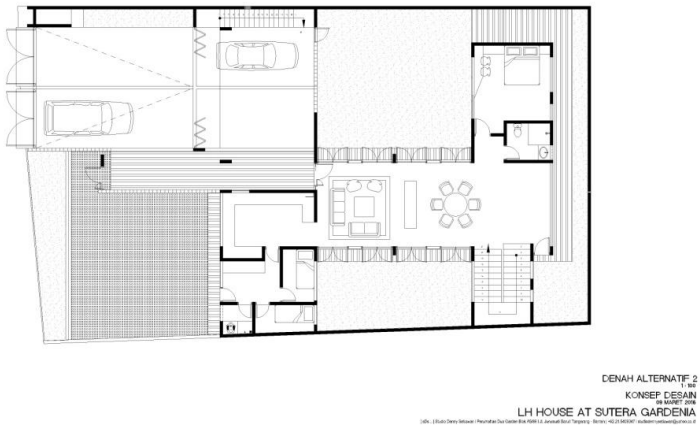

Figure 2. First level plan

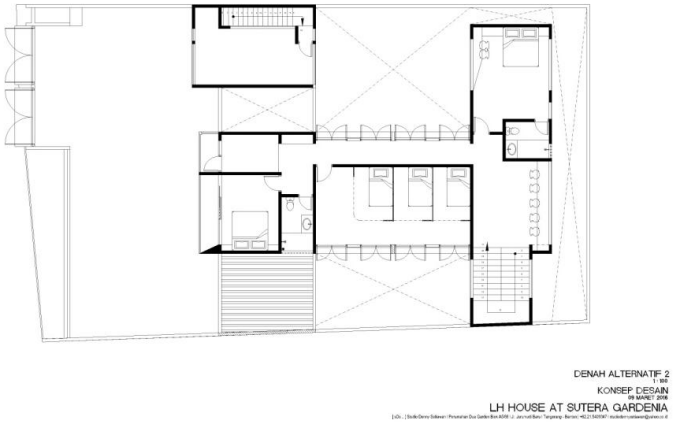

Figure 3. Second level plan

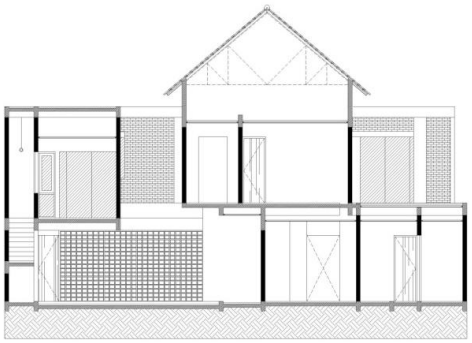

Figure 4. Section

Figure5. Elevation

The architects design Omah Harimurti by using space out of parks. They put parks in the back, big one in the middle, and one in the front yard. The function of this park is to produce oxygen to the whole house. Architects open huge space of ventilations. The Ventilations enable cross ventilation in this house. The windows also make the whole family able to see trough the parks. The flow of wind make this house work even without the air conditioner.

The Material that used in this house mostly brick and concrete. Brick that used is done by local worker. By using local and raw materials, architects try to aim less of energy used. The architects also use many clay vent block to enable the wind to come in.

All light bulb in this house use LED system. Almost all the bulbs are off in the day. The natural lighting came from the opening in the east, north and south. By turning all light off in the day, this house has decreased the use of fossil energy which is used to produce electricity.

4.Result and Discussion

After identifying 4 ecological-green architecture parameters, then we will try to examine the Omah Harimurti project by Studio Denny Setiawan with each of the parameters

1.Nature should be the main actor of the design

As we know that green architecture or ecological design always remind us about how important is greenery in a design. Architect with this house project tend to show us how plantation grow to answer the human need of CO^2.

The architect planted the *manggo tree* right in front of the house. The tree became heat barrier when the sun goes to the west. As the architect presumed, the tree will creates shadow in the wall. The shadow itself avoided the wall from direct radiation that creates heat inside. So by the existence of the trees, the temperature inside the house decreased passively without artificial air conditioning system. By minimizing air conditioner, it means the architect had reduced the use of electricity. As we know, mostly power plant in Indonesia still used crude oil as its fuel.

The architect also planted some other dangling plant named *lee kuan yew*. The existence of *lee kuan yew* around the house creates shadows which not only decreased the temperature, but also brought green aesthetic to the interior of the house. The *lee kuan yew* plant and the clay paint wall can be seen in Figure x.

The other benefit was, by the greenery that this house had, the surrounding of this house may also enjoy the fresh air from the plants. It means that this kind of houses bring back a good impact to site and its citizens nearby. This condition bring us to a statement that Vale and Vale [1] said, *"respect the site, and respect the user".*

The use of natural brick paint side by side with natural river stone as the outer layer of the elevation told boldly that the architect wanted to create another natural living space that can be enjoyed by the client inside the house.

This house also use some other used material as their resources. As we seen in the picture above, the architect used concrete without any additional materials. The concrete itself done by on site workers. So it doesn't need extra process in factory or energy to transport them from factory to site.

2.Nature become a solution for every problem in the site

Every site has its own problem. That is why understanding context is so important in architecture. Context brings us into problems and solutions. The more we understand the problems, the more solutions we had.

In this site, the architect face heat problem in the elevation. The west side received heat radiation every noon. The heat problem then was solved by the architect by replanting new trees in front of the house. The plants also become the answer to noise problem caused by T shape street in front of the house.

Nature also involved to be an answer while client and the architect tend to decide the paint color. In this house, rather than use conventional paint, the architect used clay bricks. The mixture between natural clay and concrete brought soft ambience into the whole house and reduced the use of new material in the house.

The architect chose used wood as railing of the house. The wood are waste from the construction process. it is the answer while make railing from iron need a huge amount of energy.

Some other used natural item added in this house bring the us confident that natural items are answer to many problem founded at the site.

3.Nature become a solution for every problem in the site

Every client has their own dream of a dream house. The client in this project has a dream of building a green house. He pushed the architect to find a way to have a self-sufficient energy house. The architect involved him to design this house. An idea to have styrofoam as the wall of the house and the usage of solar panel are also the client's idea.

By the involvement of the client, the client felt that this house also his design. To be sustain, every building has to be maintained well. It only happens if every user of the building has a sense of belonging. The sense of belonging appeared from the feeling that the user also act as a designer.

4.Be a climate conscious building by conserving energy

Ecological or green architecture also means that the building can consume less energy. These concepts can be perceived by conserving energy independently in the building. By doing so, the building needs to be conscious with the contextual climate.

The roof of the Omah Harimurti building was planned to use solar panels. The use of this technology is intended to capture solar energy optimally, and can be used as a source of energy in the house. By using this technology, it is expected that the use of electrical energy can be reduced.

From the previous discussion, it is known that many architect used many waste materials on this project. By using this, ecological foot print of the building can be minimized.

The use raw bricks as a substitute for paint finished bricks was proven to make the interior of the house cooler, which is minimizing the work of artificial air conditioning system. This al-

so means that the project had reduced the consumption of electrical energy.

The design of the Omah Harimurti also considered thermal comfort aspects in the building. This project utilizes natural ventilation so that the thermal comfort in the house can be created. In addition, openings are mainly located in the north-south east, made this house doesn't need electricity for lighting in daytime.

5.Conclusions

In this study, the parameters of ecological-green architecture design were identified. The parameters were nature should be the main actor of the design; nature becomes a solution for every problem in the site; honor the user by involved them as a designer; and be a climate conscious building by conserving energy. The parameters then became the basis to test the Omah Harimurti project.

Based on the examination of ecological-green architecture parameters with the Omah Harimurti Project, it can be concluded that this Project had implemented ecological and green architecture design principles and can be qualified as an ecologic and green architecture design. With this result, the house can be used as prototype development of environmentally friendly homes in the future.

Many things can be explored through ecological and green concept design in order to create an efficient energy use architecture and responsive to the environment. Rapid technological progress can stimulate architects to increase creativity in designing and finding solution to innovative and environmentally friendly design, care for the continuity of the ecosystem, as well as energy saving.

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Reference

[1] Vale B, and Vale R 1992 *Green Architecture: Design for an Energy-Conscious Future* (Bulfinch Press Little Brown and Company).

[2] Ryn S V, and Cowel S 2007 *Ecological Design, Tenth Anniversary Edition* (Washington, DC: Island Press)