Realization of Vertical Settlements with Ecological Concepts, Case: Dupak, Sombo, and Grudo Flats in Surabaya, Indonesia

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Abstract : One of the government's efforts to overcome the problem of informal settlements is by building flats. In Act No. 16 of 1985 Article 37 flats must meet ecological requirements which include harmony and balance of environmental functions. To improve the quality of the environment and the sustainability of flats in the future, it's necessary to conduct research on the application of ecological concepts by evaluating the physical condition of buildings and the environment of flats. From the results of this study produce recommendations for the design of an ecological flats namely; ecological improvement in land use, provision of networks and pedestrian facilities, parking, and provision of public transport lines. Water conservation and management by developing alternative water other than PDAM sources, management and processing of waste waste. Energy conservation by developing alternative electrical energy not only from PLN, utilizing solar energy for natural lighting, health and comfort in the room by optimizing natural ventilation.

1 INTRODUCTION

Urban populations in Asian countries experience faster growth. UN (2014) estimates that by 2030, 55% of the 4.9 billion Asian population will live in cities(Pravitasari, 2018) and (Rika Kisnarini, 2015). Urbanization always gives negative and positive influences to the development in any sectors. The consequence of urbanization is the rapid to urban flow area will cause the slum settlements spread widely, and the micro informal sectors are mushrooming(Felecia P. Adam, 2017) and (Ernawati Purwaningsih, 2011). Since the 20th century the government has begun to implement urban reforms, village improvement policies and resettlement. This resulted in an era of transformation of urban villages in Indonesia began to develop vertical settlements(Irkham and Utomo, 2017). One of the big cities with a fast population is Surabaya with 3,016,653 people. This number increased when compared to last year which was 2,943,528 people(East Java Statistic Center, 2017). in the end it led to many informal settlements and in the end the government provided solutions to build flats from 1989 to present(Ramadhani, 2015).

To maintain the continuity of the flat, it has been regulated in Law No. 16 of 1985 Article 37 concerning wedge buildings must meet ecological requirements which include harmony and balance of environmental functions(President of the Indonesian republic, 1985). In fact, after being built and inhabited, it affects the way or lifestyle. In Sari et al's study (2016: 73) revealed a flat solution raises several new problems(Sari. A. A, Shirleyana, Feliciani, F, 2016). From several studies on flats carried out in Surabaya, flats' 'as is' design was exacerbated by the living habits of the residents, making the apartment environment look more seedy and not well organized.

Based on the previous explanation, this research needs to be done with the aim of evaluating the physical condition and people who occupy the flat in the object of research, so that the concept of ecological settlements can be identified that can be applied to objects of observation. Evaluation is done to see the facts of deficiencies and strengths in settlements or flats to make ecological flats better and better in the future.

2 METHODOLOGY

In the evaluation study the application of the concept of ecological architecture in this flat uses a

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qualitative exploration approach and for deductive analysis(Lexy J. Moleong, 2017)and (Sudaryono, 2018). This approach is to evaluate the components of ecological architecture that have been implemented and that have not been applied to these flats, so that it can be known whether this building has been carried out in accordance with Law No. 16 of 1985 Article 37 concerning flats buildings must meet ecological requirements.

The things that are evaluated are increasing soil ecology, movement and connectivity, water management and conservation, solid waste management, and building energy. Collecting data in accordance with the components of architectural ecology, classifying data in information units, categorizing and drawing conclusions(Setiawan and Haryadi, 2010). Data collection techniques by making direct observations on the object of research with field notes. Observation by interviewing the managers and residents of the Flats. Observation results are then normalized to get new norms as a basis for the preparation of design recommendations for future improvements. The object of the study were three flats built in Surabaya, including: Dupak, Sombo, and Grudo (Figure 1).

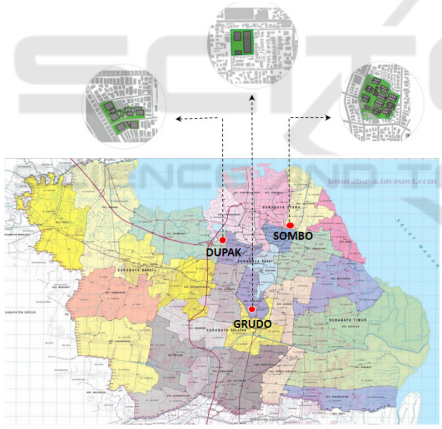

Figure 1. Research location
Source: Research Document, 2018

According to Sugiyono, 2011 the focus of research is anything that is in whatever form that is determined by the researcher to obtain the information, then draws it's conclusions(Sugiyono, 2011). The focus of the research on the object of this observation is the physical flats, corridors, blocks and areas that are associated with ecological design using green building design standards. after collecting data categorized and evaluated to produce design recommendations.

3 RESULTS AND DISCUSSION

3.1 Definition of Ecology

Ecology is the science that studies the interaction between organisms and their environment and others. Derived from the Greek word oikos ("habitat") and logos ("science"). Ecology is defined as the study of both the interaction between living things and the interaction between living things and their environment. The term ecology was first put forward by Ernst Haeckel (1834-1914). In ecology, living things are studied as a unit or system with their environment. The term, "ecology" was first created by Ernst Haeckel (1834-1919) in 1866. Haekal defines "comprehensive science about the relationship of organisms to the environment" (Frodin 2001 in Attmann, 2010: 32) (Ernst Haeckel,) as well as Frick and Suskiyatno (2007: 1) saying ecology is the relationship between living things (plants, animals, humans) with its environment (the light of the relationship of organisms to the environment, (krebs, (1972) the relationship between structure and the natural function of interaction relationships that determine the distribution and abundance of organisms, temperature, rainfall, humidity, topography.) Likewise according to haeckel (1866), Ecology is a comprehensive science, Odum (1963).

Architectural ecological principles (Batel Dinur, Interweaving Architecture and Ecology - A theoretical perspective). The ecological principles include:

a. Flutuation
   The principle of fluctuation states that buildings are designed and felt as a place to differentiate between natural culture and process relationships. Buildings should reflect the natural process relationships that occur at the site and more than that allowing a process to be considered a process and not as a presentation of the process, more will succeed in connecting people with the reality in that location.
b. Stratification
   The principle of stratification states that building organizations should emerge from the interaction of differences in parts and levels. Such an organization that allows complexity to be managed in an integrated manner.
c. Interdependence
   Stating that the relationship between buildings and their parts is a reciprocal relationship. Reviewers (designers and users) as well as locations cannot be separated from parts of the

building, interdependence between buildings and their parts is sustainable throughout the life of the building.

Eco architecture emphasizes high-quality architecture, although quality in the field of architecture is difficult to measure and determine, there is no clear boundary line between high-quality architecture and ordinary architecture(Amiratiara and Collinthia Erwindi, 2017). Existing phenomena are architectural qualities that only pay attention to the shape and construction of buildings and tend to pay less attention to the quality of life and the desires of the wearer, even though they are clear main characters.

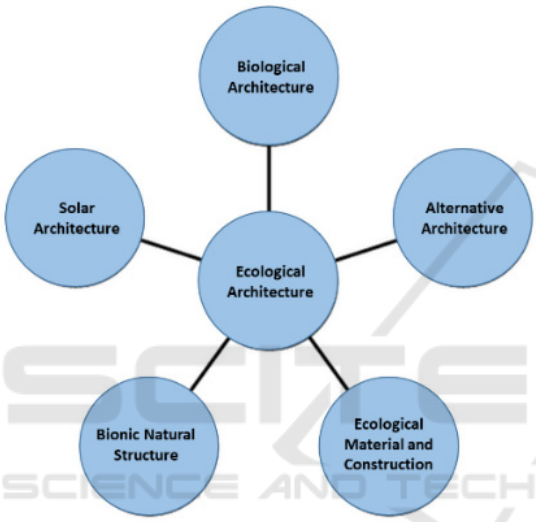

Figure 2 The concept of a holistic architectural ecology
Source: (Frick Heins dan Bambang Suskiyanto, 2007)

3.2 Ecological and Architecture

Ecological architecture holistic (whole). Ecological architecture contains parts of biological architecture (humanitarian architecture that pays attention to the health of residents), alternative architecture, solar architecture (relating to the use and processing of solar energy), bionic architecture (civil engineering and construction that takes into account natural development), and sustainable development. The holistic nature of ecological architecture(Karyono, 2010) and (Mahardika Ayodia, 2013).

Ecological architecture or eco-architecture is development carried out as the needs of human life related to the natural environment (Krusche. Per.et.al in Frick and Suskiyatno (2007: 52)(Frick Heins dan Bambang Suskiyanto, 2007) and (Sukawi, 2008) . Ecological architecture relates primarily to how ecological properties will affect buildings, their inhabitants and the environment, ecological architecture is used to describe the design of ecological buildings and their balance with nature Illustrations of the components of ecological architecture are as it is seen on figure 2.4.

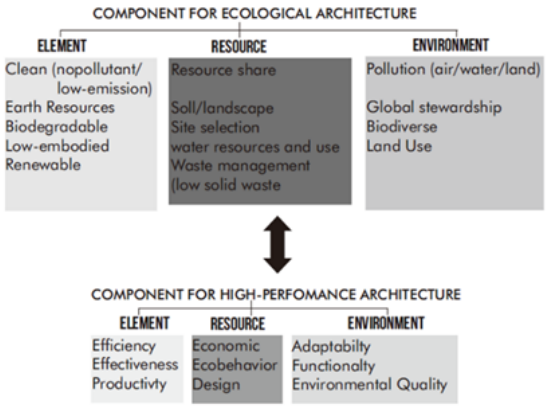

Figure 2.4. Ecological Architecture Components
Source: Krusche. Per.et.al in Frick and Suskiyatno (2007: 52)(Frick Heins dan Bambang Suskiyanto, 2007)

This balance is formed through three main components(Attmann, 2010) and (Mahardika Ayodia, 2013), namely:

1. Ecological elements (technology and material), must be selected from nature or resources from the earth that are minimally processed, biodegradable, renewable and low in energy
2. Resource ecology, considering building resources, site selection, soil type, and groundwater conditions before construction is designed and constructed. Water resources and waste management must be built and used ecologically.
3. Environmental ecology, Prevention of pollution (air, water and soil), preserving existing ecosystems. Planning for responsible land use must address problems by considering the climate, existing ecosystems and the natural environment. To see whether a building has met aspects of ecology can be measured by looking at the performance or performance of the building.

To evaluate and assess the application of ecological architecture in buildings that have already been operated, it can be done with a rating format from Greenship rating tools, the Green Building Council Indonesia 2012 for ecological areas can be seen from several indicators, namely:1). Land ecological enhancement, 2). Movement and connetivity, 3). Water management and conservation, 4). Solid waste, and 5). Building and energy (Direktorat Pengembangan Perangkat Penilaian, 2014). Whereas for the house building the category in ecology is having: 1). Green area, 2).

Supporting Infrastructure, 3). Community Accessibility, 4). Artificial lighting, 5). Heat reduction, 6). Water-saving output tools, 7). Use of material, 8). Clean air circulation, 9). Minimization of pollutant sources, 10). Maximize natural lighting, 11). Acoustic level(Titisari et al., 2012).

The above assessment to determine the level of application of ecological architecture, the results of the assessment can be used to improve the performance of the building so that it can meet the requirements of comfort, safety and health.

Building a flat should be in accordance with the designation of land as housing as stipulated in the Local Spatial Regulation. The five towers studied are located in the land with residential designation and in the local residential area. Dupak and Sombo flats are located in a very dense area with access to village roads as the main access. while the Grudo flats are located in areas that are not too densely populated and have close access to the highway.

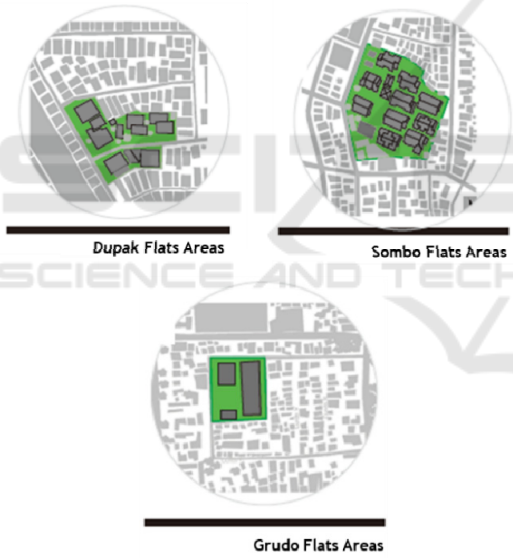

Figure 3. Land Use In The Object Of Research
Source: Research Document, 2018

The flat area with single or plural buildings must be well planned for green open space as a form of building sustainability with the surrounding environment. A green open space in the form of a park that maintains mature trees, the existence of land for food and land production to accommodate the activities of flat dwellers with public facilities such as sports fields and playgrounds. To improve the ecology of a land, it is necessary to have a Green Open Space that aims to maintain the harmony and balance of the ecosystem, to improve the quality and function of the natural environment and improve the comfort and health of residents in flats. The availability of green open spaces in the flat areas in Surabaya can be categorized into two types:

1. Area with a single building

Grudo flats are single buildings, with single loaded corridor and middle voids which are used as parks. In the flat area, there is only one flat block building. Based on the results of observations carried out by the two towers, the environment has a much better quality and an effort to improve the ecology of the land compared to other flats. In Grudo flats, there is a green open space that can be used for interaction and children's play, maintaining a number of large trees in the area and the efforts to produce food such as vegetables that can be directly used by residents, such as vegetable planting can be seen in the area and in the flat corridor planted on each floor.

Figure 4. Green Open Space In Grudo Flats
Source: Research Document, 2018

2. Area with plural buildings

Plural buildings in the flat area are in the Dupak and Sombo flats. In the second area, the flats have a very large land with more than five flats. In Dupak flats there are five flats with three floors, Dupak flats are very minimal with public facilities, open spaces are used as parking lots for flats, besides that there is no green space. There are only a number of trees that are maintained and some ornamental plants are planted in the area.

Figure 5. Green Open Space In Dupak And Sombo Flats
Source: Research Document, 2018

In Sombo flats, there are 10 flat blocks with four floors with adequate public facilities, but in the Sombo flat area there is not enough green open space to accommodate public activities as well as to maintain environmental balance, there are only a

number of retained trees and land for vegetable production in front of the management office.

Figure 6. Green Open Space In Sombo Flats
Source: Research Document, 2018

A good flat area with a single or plural building must be well planned for green open space as a form of building sustainability with the surrounding environment. A green open space in the form of a park that maintains mature trees, the existence of land for food and land production to accommodate the activities of flat dwellers with public facilities such as sports fields and playgrounds.

3.3 Movement and Connectivity

In an area of flats, pedestrian lanes must be available, this is aimed at connectivity between buildings or blocks within the flat area, the ease of achievement, security and comfort of the residents and other users. In the five cases of flats in Surabaya there are no networks and special facilities for khaki travelers. When viewed from the region, Sombo and Dupak flats, which have more than one flat block in the area providing pedestrian paths, should be available to connect between buildings and pedestrian paths to enter and exit in the area, while in Grudo flats which are single buildings and triple requires more pedestrian paths to enter the area. The unavailability of pedestrian paths in the towers causes the vehicles to be sequential in the same road.

Figure 7. Access To Flats
Source: Research Document, 2018

Efforts to encourage flat-dwellers to use public transportation with the aim of reducing emissions are also not easy, even though the rusun location is close to the road access which makes it easy for residents to access public transportation. For this reason, it is necessary to have a bus stop near the flat which can encourage residents to use public transportation rather than private, but in its development residents prefer private vehicles such as motorbikes for daily transportation.

3.3.1 Water Management and Conservation

Generally in the three flats as a case study the residents use well water and PDAM clean water. Their well water is used for bathing and washing purposes while water from PDAM is used for cooking purposes. In some flats, such as in Sombo, only using well water for cooking and bathing needs is caused by inability to pay for clean water from the PDAM. Problems faced by the residents of the flats, such as having to bear the burden of water payments, can be done with the effort to design alternative water uses that are not from groundwater and PDAM independently, in addition to reducing the burden on residents also aims to maintain ecology. Efforts to use alternative water must be developed, although not yet optimal in available Grudo flats, taps that can be drunk directly on each floor can help the occupants obtain clean water which can also save energy.

3.4 Solid Waste

Aspects that include ecological design are also the efforts to implement solid waste management, namely waste. It aims to reduce the negative impact of the environment. Ecological flats can be seen from the selection and collection facilities of three types of biodegradable waste, inorganic waste, and waste containing toxic and toxic materials found in all areas both in buildings, landscaping and public places. Based on the field observations, out of the three cases of flats there were only one flats, the Grudo flats were available, the sorting facilities were three types of garbage contained in the building and its area. This was also supported by the cooperation of the residents who carried out the selection and collection activities of the garbage so that it went well.

Figure 8. Waste Sorting Facilities
Source: Research Document, 2018

3.5 Conservation Energy

Ecological flats should take advantage of minimal and economical energy use but still be able to work efficiently and effectively for residents in flats. This can be seen in the flats design that utilizes efficient artificial lighting without reducing lighting quality. Maximizing natural lighting is one way to save electricity from the use of lights during the day. With the use of natural lighting such as sunlight can be beneficial to health and prevent the growth of microbes. In the case study of the three flats, there were two flats, namely Dupak and Sombo flats, which kept lighting on the corridors, housing units, kitchens, bathrooms throughout the day. This is influenced by the shape of the corridor, stairway placement, and the type and dimension of openings used.

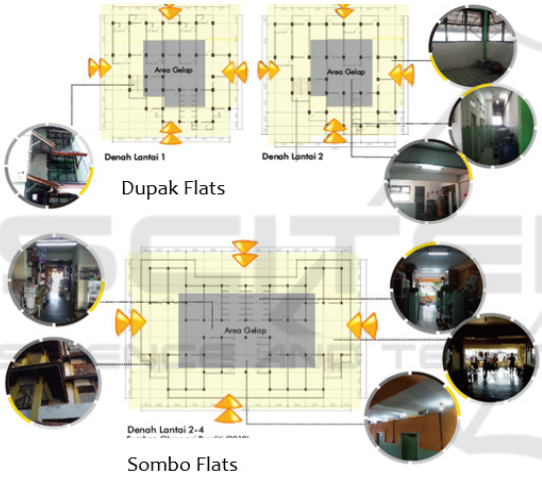

Figure 8. Use Of Electrical Energy Source: Research Document, 2018

The use of single loaded corridor is a fairly good form applied to flats as seen in the case of Grudo flats. In addition to the problem of energy use that must be minimal, energy conservation can be seen by the efforts to use alternative energy sources. In the third case of flats there was one flats that had used solar cells as an effort to use alternative energy, namely in the Grudo flats. The efforts to use solar cells can reduce the electricity burden that must be borne by the occupants at the stacking house and reduce the impact on the environment associated with electricity-based electricity generation.

Figure 9. Use of photovoltaics as alternative electricity Source: Research Document, 2018

3.6 Indoor Health And Comfort

In the case study of flats, there are two types of flats. Where in Dupak flats, Sombo uses a kitchen and communal bathroom. While Flats Grudo uses a kitchen and private bathroom. So that this section will be divided into two parts. Based on the results found in the field of natural ventilation and air circulation (exchange) is not optimal in Dupak and Sombo flats. This can be seen from: Openings and Openings Type used by flats. The inlet type must be able to direct the air motion as evenly as possible, and optimize the air rate and change the air in space and open the lid flexibly as needed. Basically the entry and exit of air and wind. Cross ventilation helps to optimize natural air inside the room. Based on the results of the analysis of the three flats that have optimal natural ventilation are in the Grudo flats.

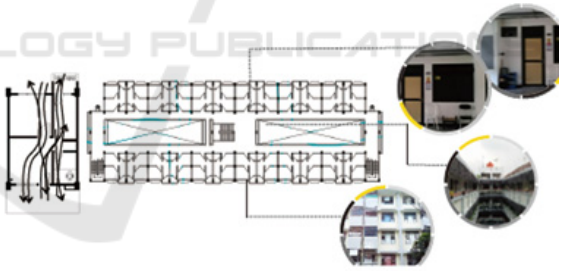

Figure 10. System Of Ventilation In Grudo Flats Source: Research Document, 2018

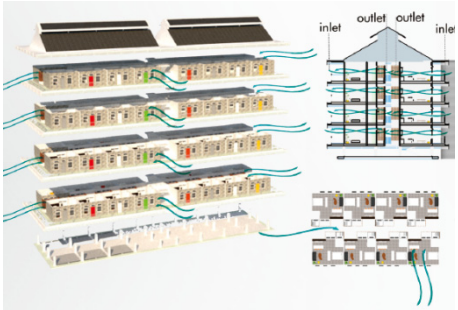

Figure 11. Development of natural ventilation systems Source: Research Document, 2018

4 CONCLUSION

The conclusions of this study are:

1. Land ecological enhancement and community in these three cases can be classified in single and multiple land uses. Input to land use and use for public facilities is to provide green open space for the public, preservation of plant habitat, providing a productive community / garden community for residents to produce their own food ingredients. Provide land for animal raising so as not to keep animals in the flat. Provide land for children's playroom and space for interaction among the residents. Provide land for sports fields and provide a hall to accommodate the social cultural activities of residents.
2. Movement and connectivity of three cases that have provided pedestrian networks and facilities, shared parking and vehicle lanes are grudo towers. Recommendation on Movement and connectivity are providing pedestrian paths within the area and between buildings with natural materials so that rainwater can directly absorb into the soil. Provide a shared parking space located at the bottom of the building to avoid on street parking.
3. On the Water management and conservation of the three cases that have been implemented in the Grudo flats in the presence of water ready to drink from the faucet and the provision of trash bins and waste disposal treatment tanks. Recommendations on Water management and conservation by planning rainwater harvesting systems to water plants in green open spaces and flat gardens. In addition, it can plan the processing of liquid waste to be managed into alternative energy such as biogas.
4. In the management of solid waste in three cases of buildings that have implemented Grudo flats, there are three types of waste available in the building and the area. For that, it is necessary to provide a container, sorting and processing facilities for waste, so that from the processing of the waste, organic fertilizer can be produced which can be used to fertilize the green open spaces and gardens in the flats.
5. The optimal use of natural ventilation in flat units with cross ventilation design so that the wind moves evenly. wide openings dimension without obstruction so that wind speed is higher, use single loaded corridor to avoid obstruction of air into the space by planning a plan of each rectangular plan so that natural ventilation will be evenly distributed throughout the room
6. In energy conservation, the three cases that have applied alternative energy are Grudo flats by utilizing solar energy as a source of energy for electricity using photovoltaic devices. a recommendation for energy conservation is to develop alternative energy that is already available for electricity. efficient use of electrical energy by optimizing natural lighting in buildings with north south building orientation so that natural lighting will be evenly distributed throughout the flats, using single loaded corridors to avoid darkness on the inside of the corridor and the optimal use of transparent openings with wide dimens on the walls.

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