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THE STUDY OF OCONOMIC RESIDENTIAL BUILDING WITH ENVIRONMENTALLY FRIENDLY CONCEPT IN KUTUH VILLAGE

[*1]Ni Kadek Sri Ebtha Yuni,[2]Ni Made Sintya Rani,[3]Ni Putu Indah Yuliana, [4]I Gusti Ayu Wulan Krisna Dewi

[1]Civil Engineering Department, Bali State Polytechnic, Badung, Indonesia
[2]Civil Engineering Department, Bali State Polytechnic, Badung, Indonesia
[3]Civil Engineering Department, Bali State Polytechnic, Badung, Indonesia
[4]Civil Engineering Department, Bali State Polytechnic, Badung, Indonesia

Author's email:
[1]ebthayuni@pnb.ac.id;[2]sintyarani@pnb.ac.id ; [3]putuindah3107@pnb.ac.id , [4]wulankrisna@pnb.ac.id

Abstract. *A House is designed to be able to provide comfort for its occupants including the requirements for ventilation systems, lighting, sanitation, and the use of building materials. The concept applied is energy-efficient homes, by utilizing natural air and natural lighting. The concept of an environmentally friendly building or green building concept is the process of construction stages from the planning, implementation and use of construction products that are environmentally friendly, efficient in the use of energy/resources, as efficient cost and pay attention to the health of the occupants. Designing the house in such a way that it is not completely dependent on the air conditioning (AC) and lights. In addition, the selection of building materials needs to be considered as well, that in the use of materials for buildings, those materials are to be renewable (easily replaced). Thus, so the balance is maintained. After the design determined, the costs of the construction can be estimated. The environmentally friendly concept is adopted in residential buildings of type 36 m2 is the arrangement and use of land according to its designation, saving energy resources (electricity and water), improving health and comfort, choosing environmentally friendly materials and have the longlife cycle. The construction cost according to the adopted design is IDR 165,381,649. This value includes tax of 11%. The operational costs for the type 36 m2 residential house is IDR 688,333 per month consisting of maintenance, electricity, water, debris and dues.*

Keywords: *residential, economic, and environmentally friendly*

1. INTRODUCTION

The number of the population in Province of Bali has experienced a significant increase every year (BPS Province of Bali, 2020). The house is expected to be able to provide comfort for its residents including the requirements for ventilation systems, lighting, sanitation, and the use of building materials (Regulation of the Minister for the Environment Number 8 of 2010, 2010). One of the requirements for eco-architecture planning is to save non-renewable natural energy sources and reduce dependence on central energy and waste systems (Simbolon, 2017). The concept of an environmentally friendly building or green building concept is the creation of construction from the planning, implementation and use of construction products that are environmentally friendly, efficient in the use of energy/resources, as well as low cost, and pay attention to the health of the occupants. Designing the house in such a way that it is not completely dependent on the air conditioning (AC) and lights. The selection of building materials needs to be considered, thus in the use of materials for buildings these materials are renewable (easily replaced) so that the balance is maintained. Based on the results of previous studies, it was stated that 75% of people wanted simple and healthy homes (Putranto, 2014). This research was conducted with the aim of knowing the environmentally friendly concept that can be adopted, development costs and operational costs.

2. LITERATURE REVIEW

A dense settlement without supported by good planning will result in an unhealthy living environment. The ability of the community, especially those with low assistance, is still limited to buy decent, healthy, safe, harmonious and orderly housing. Therefore, it is necessary to build houses which can be done in stages (Sukowoyono, 2012). Eco-Friendly House is a concept of a house that preserves the environment and reduces the impact of damage to the environment. This eco-friendly home concept utilizes more efficient energy use so that it can help reduce the impact of global warming. An environmentally friendly building is to design a building that pays attention to lots of openings to maximize air circulation and natural light. Like interior design, using environmentally friendly interiors and reducing excessive use of electricity. This is supported by the Regulation of the State Minister for the Environment (2010), a building can be classified as an environmentally friendly building if it meets the following criteria, namely:

a. Using environmentally friendly building materials.
b. There are facilities, infrastructure and facilities for the conservation of water resources in buildings.
c. There are facilities, infrastructure and energy conservation and diversification
d. Using non-ozone depleting materials in buildings.
e. There are facilities, infrastructure and domestic wastewater management in buildings.
f. There are waste sorting facilities
g. Ensure health aspects for building occupants, including:
h. Manage the clean air circulation system;
i. Maximize the use of sunlight.
j. There are facilities, infrastructure and facilities for sustainable site management.
k. There are facilities, infrastructure and facilities to anticipate natural disasters.
l. Using climate resistant building material or extreme weather with high intensity of rain, drought and high temperatures

There are several factors and strategies that must be considered in choosing building materials (Siagian, 2005):

a. Buildings that are designed is to be reused and pay attention to building waste/waste when used.
b. These building materials can be reused (recycled).
c. Material authenticity
d. Embodied energy
e. Material production and impact of materials
f. Poisonous material
g. ventilation efficiency
h. Construction techniques used
i. Prioritizing natural materials
j. Consider the durability and life of the product

The green concept that was built is certainly in line with the principles of healthy homes in accordance with the circular of the Director General of Human Settlement, Ministry of PUPR. A healthy home must have:

a. Has Building Elements, which consists of Top, Body and Footing
b. Floors and walls must be dry
c. Located higher than the outer yard with a minimum floor height of 10 cm from the yard and 25 cm from road level
d. Adequate ventilation/windows so that the air in the room can always flow. The minimum window opening area is 1/9 of the floor space.
e. Opening holes/windows must be penetrated by sunlight.

Project cost estimation is an important role in project implementation. Cost estimation is a process for estimating the cost of the resources needed to complete the project (Basuki, 2002)

4. RESULTS AND DISCUSSION

4.1 General Description and Location

Kutuh Village is one of the villages in South Kuta District, Badung Regency. The condition of this area is hilly and has a type of hard soil, namely limestone soil. The area that is the object of research is housing in the Banjar Kaja Jati area. In this area there are several housing complexes such as Home Hill, D Kutuh Residence, Perdana Cluster, D' Residence Kutuh. The residential building is inhabited by one head of family with an average number of members of 4 people. This area is close to public facilities such as elementary, junior high, high school and tourist attractions such as Pandawa Beach, Gunung Payung Cultural Park. Most community activities work in the tourism sector and traders. These housing estates were built through Developer services. The purchase price for type 36/70 land and buildings averages Rp. 500 million. This price is the price of the House Ownership Credit from Developer services.

4.2 Condition of the Existing Building

This residential building is built on land with area 70 m2, the building area is 36 m2. The space of the room consists of 2 bedrooms, 1 bathroom, 1 living room, kitchen and carport. The building is not equipped with rosters.

Tabel 1. Specification of the Existing Building

No	Specification Description
1	The field area 70 m2
2	The area of the building is 36 m2 for one storey
3	Karang stone foundation
4	Reinforced concrete building
5	Light steel roof frame
6	Roof cover made of concrete
7	Wall made of concrete brick
8	Wall finish with paint
9	Floor finish with tiles
10	Door leaf manufacturing
11	Aluminum window
12	Ceiling: Rangka Hollow + Gypsum
13	Municipal Waterwork, State Electric Company Facility, paved pathway
14	Carport : concrete slab

4.3 The Concept of Friendly Environment

The process of deforestation (forest clearing) for other purposes or functions has contributed 18.3% of CO2 emissions. Here it can be seen that the emissions that are released indirectly indicate that these activities both in forest clearing and after being used for other functions use quite a large amount of energy. Therefore, the selection of land deserves careful attention and consideration, especially in large and small scale construction processes. For example: housing, apartments, supermarkets, residential houses. So that in terms of function transfer, human ability is needed to maintain the

balance of the land function chain, especially from natural to artificial conditions that do not damage the environment, where local living things (ecosystems) live (Karuniastuti, 2016). For environmentally friendly buildings (green buildings), not only the building design and building materials are considered, but also energy issues, apart from electricity as above, penetrate the world of sanitation. Septic tanks with biological filters (biological filter septic tanks) made of fiberglass are designed with special technology not to contaminate groundwater and the environment, are leak-proof or do not seep, corrosion resistant. As well as creating a clean wastewater treatment system that recycles everyday waste water (washing hands, dishes, vehicles, washing oneself) and waste water (waste water from bathrooms) which can be reused for washing vehicles, flushing toilets, and watering gardens , as well as making water absorption wells. The environmentally friendly concepts that will be adopted in this study are:

a. Arrangement and use of land in accordance with its designation.
b. Saving energy resources (electricity and water).
c. Improved health and comfort.
d. Selection of materials that are environmentally friendly and have a long cycle.

4.4 Planning of Building Design

1. Planning Based on Land Arrangement and Use

The condition of the land area in Kutuh village is hilly, and if the selection of development sites is only in flat areas, it will be very difficult. Because of this slope condition, the land is filled with limestone material to achieve flat area conditions. The arrangement here is the placement of the building which must be effective, because the existing land is narrow. In addition, this land arrangement also considers the placement of a holy place for owners who are Hindus. The arrangement of the building must also pay attention to harmony with nature through the provision of open space. This open space can be planted with grass, or trees that can reduce air pollution. Through the provision of green space, it is hoped that it can support the availability of Regional Green Space (RTH) (Dwiyanto, 2009). Currently residential land is increasingly limited, so many innovations are being made in creating green open spaces. An alternative that can be done is to use a fence as a place to put potted plants, use roof decks to plant plants. Utilization of fences and roofs as a place for planting green plants can function to absorb solar heat and reduce pollution as well as produce oxygen and condition the environment.

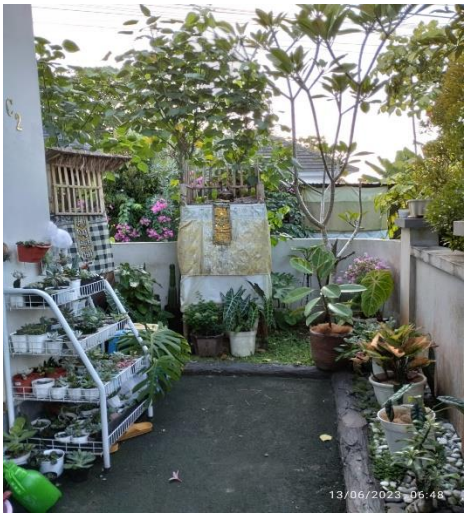

Figure 1. Green Open Space of the Yard

Figure 2 Utilization of Fences and Walls for Green Open Space

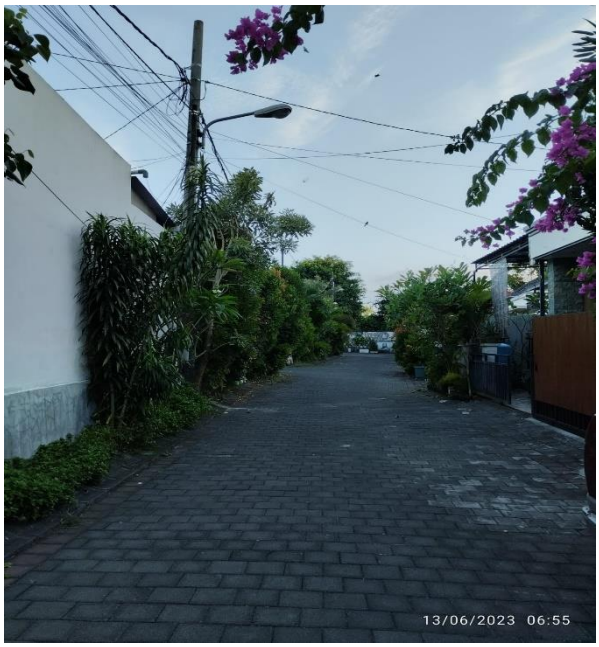

Figure 3. Outdoor Courtyard with Green Concept

2. Planning Based on Energy Saving

Energy saving in this study is to reduce the use of electricity and water. Electricity savings are made by paying attention to the design of door and window openings, ventilation used for air circulation and lighting. In the existing conditions, most of the houses built in Kutuh Village lack air circulation and lighting. Such as lack of ventilation and low building height between floors and ceilings. Apart from going through doors and windows and ventilation, the use of garden lights from solar panels is also useful for lighting at night. The use of solar panels in residential homes can be used for garden lighting, or roads. The design for energy saving is as follows:

Figure 4. Front Section Building

Based on above design, the lighting concept is obtained from the south, west and east directions. In the morning light can enter through the east in the kitchen and bedroom, so there is no need to turn on a lot of lights. Glass blocks and concrete windows are installed on the kitchen walls, so that light and air can enter naturally. This building consists of 2 entrances and each room is equipped with an articulated window, with a roster on it. With this condition during the day can reduce the use of lights and air conditioning. In the bathroom, glass blocks and concrete windows are installed for air and lighting. To save water, this is done by using a faucet that uses a tap that only emits a certain volume of water.

3. Planning Based on the Health and Leisure

The designed building elements also pay attention to health requirements, such as building elements consisting of a head, body and legs. Floors and walls must be dry (not damp) and easy to clean. Adequate ventilation/windows so that the air in the room can always flow. The window opening area is at least 1/9 of the floor space, the openings/windows must be able to penetrate sunlight.

4. Planning Based on Material Selection

Residential materials that can be modified as part of selecting environmentally friendly materials are:

a. The use of adobe material as a wall covering is replaced with brick material. This is with the aim that the conditions inside the house remain cool even though it is hot outside, considering that the Kutuh area is a limestone hill. The ability of bricks to absorb heat is the focus in selecting environmentally friendly materials. In addition, when applied using exposed brick, the building does not need to be finished with plaster, plaster and paint. In addition to natural bricks, other wall covering materials that can be used are fabricated bricks (light bricks) which have the characteristics of being fire resistant, strong against high pressure, low water absorption, soundproof, and absorbs solar heat significantly.
b. b. The use of mild steel and aluminum for the main building frame and roof began to be used as a substitute for wood materials. The circulation of the issue of illegal logging due to uncontrolled logging of forest wood has reduced the number of buildings made of wood as a form of concern for the preservation of the earth. Mild steel can be selected based on several levels of quality depending on the raw material. Steel roof and building frames have the advantages of being stronger, anti-corrosive, anti-porous, anti-termite, flexible, easy to install, and lighter so they don't burden the construction and foundation, and can be installed using architectural design calculations and civil engineering calculations.
c. The use of solid wood materials such as frames, doors and furniture is replaced by using engineered wood that has been modified. As the name suggests, this

material is a combination of used wood with plastic and other materials. Together with other materials, these pieces of scrap wood are pressed and glued together until they are firmly bonded. When compared to wood, this material is certainly more sustainable. Maintenance is also easier than the treatment of real wood. Wood composites are made to overcome weaknesses in wood such as being easily eaten by termites and fungi. This composite material is claimed to be more weather resistant and has almost the same strength as some types of real wood.

d. The use of scaffolding made of bamboo or rake is replaced by renting steel scaffolding so that it does not generate waste.
e. Ceramic floor covering with a size of 40 x 40 cm throughout the room. Ceramic shards can be installed on a random and neat kitchen wall.

4.5 Planning Based on Construction Cost

Recapitulation of the Cost Budget Plan Recapitulation of building prices is part of the calculation of the building cost budget plan which functions to recapitulate the results of unit price analysis calculations so that they are easy to read and understand. Before making a recapitulation of building prices, the price of each work item is calculated first. Based on the design with the concept adopted, then the construction costs are calculated.

Table 2. Construction Costs

NO	JOB DESCRIPTION	TOTAL PRICE
1	Preliminary work	1.422.400,00
2	Soil works	4.003.866,50
3	Footing works	8.290.560,00
4	Concrete works	9.497.025,00
5	Plaster and smooth plaster work	30.304.088,00
6	Roof work	23.960.000,00
7	Ceiling, floor and concrete work	16.352.150,00
8	Jambs and hanging	22.800.000,00
9	Electricity work	5.025.000,00
10	Sanitary work	14.610.000,00
11	Wall finish	9.244.387,50
12	Carport work	3.483.000,00
	TOTAL	148.992.477,00
	PPN 11%	16.389.172,47
	GRAND TOTAL	165.381.649,47

Based on the results of the analysis of the construction cost calculation according to the adopted design, a total cost of IDR 165,381,649 was obtained. This value includes tax of 11%.

4.6 Building Operational Cost

Residential operational costs normally consume a large amount of household finances which can make residents confused about how to deal with them. Routine expenditures for electricity, water and telecommunications are often out of calculation due to wasteful usage. The house model determines the amount of operational costs, a one-story house is more cost-effective in operation and maintenance than a two-story house. A modern interior design with a game of lighting will also require greater operational and maintenance costs. However, we cannot limit people from building

houses of more than one floor or limit them to choosing a simple house model because it really depends on the taste and financial condition of the owner, but how to organize a house so that it effectively uses energy, water, and so on. In addition, not a few residents want to save money but do not have an effective strategy to reduce household operational costs. Therefore, this paper will discuss various strategies to reduce operational costs and routine housing expenses (Syamsidarti, 2016).

Table 3. Operational Cost

No	Description	Cost
1	House Liability	208.333
2	Power Supply	200.000
3	Water	180.000
4	Debrish and dues	100.000
	Total	**688.333**

Based on the table above, it is obtained that the operational costs of a 36 m2 type residential house are IDR 688,333 per month.

CONCLUSION

1. The environmentally friendly concept adopted in residential buildings of type 36 m2 is (a Land arrangement and use according to its designation, (b) Saving energy resources (electricity and water), (c) Improving health and comfort, (d) Selection of materials that are environmentally friendly and have long life cycle.

2. Development costs according to the adopted design, amount IDR 165,381,649. This value includes tax of 11%.

3. The operational costs for one unit 36 m2 type residential house are IDR 688,333 per month consisting of maintenance costs, electricity, water, debris, and dues.

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