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ABSTRACT

The object of the research study focuses on the concept of low-energy architecture in the Sasak Senaru Traditional Architecture (ATSS). The first stage of the study was carried out relevant literature studies as material for analyzing low-energy living buildings on ATSS. The analysis was carried out descriptively to produce elements that support low energy criteria. Testing low energy elements using the Analytical Hierarchy Process (AHP) method to determine the weight of the priority elements of traditional low energy ATSS architectural design. The research results obtained are important factors in the ATSS design (bale/ traditional house, berugak, and geleng/barn) in Traditional Village Senaru, where low energy conceptors are site design factors (orientation and land cover/pavement, geo-biological disturbances, vegetation, topography and type of land, and guardrail) that are integrated in the green concept based on suitability and carrying capacity of the site and landscape.

***Key words** : Low Energy, Sasak, Senaru, Traditional Architecture*

Introduction

Building design that is not responsive to climate and environmental aspects can be a cause of energy waste (Faisal, 2012). It was realized together that building design aims to create amenities for its residents, through the achievement of physical comfort (spatial, auditory, visual, and thermal). The phenomena that exist in creating amenities for residents' attitudes and behavior tend to be wasteful on energy use (Kurniawaty, 2011). This explanation reinforces the opinion of Conran (2009) which states that one of the biggest sources of pollutants and energy waste comes from residential buildings. One of the archipelago's architectural assets in the form of residential buildings is the Sasak Senaru Traditional Architecture (ATSS), in North Lombok, West Nusa Tenggara Province where the results of its sustainability study show a very adequate significance (Arief, 2017)

Low energy architecture is an architectural design that is based on the thought of minimizing energy use without limiting or changing building functions, the comfort and productivity of its inhabitants by actively utilizing the latest science and technology. Based on the study of Kurniawaty (2011), the best energy conservation is through integrated building design with three approaches: (1) designing building envelopes that can reduce heat transfer by conduction, convection, and radiation; (2) using renewable energy resources; and (3) applying passive design. Passive design utilizes geometry, orientation, and building mass and structural conditions oriented to natural resource potential and climatological conditions, such as the sun, wind, topography, microclimate, and landscape (Mediastika, 2002; Kibert, 2008).

One of the passive designs in architecture is that

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utilizes solar energy known as solar architecture. This solar architecture is based on the principle of diversification of energy that explores renewable energy (Priatman, 2002: Subadyo, 2004). In energy-conscious architectural design, design strategies commonly used are passive design strategies and active design strategies (Satwiko, 2005). From the results of Kurniawaty's research (2011), it was found that the design approach actively in its reformation requires the architect to simultaneously apply passive design strategies.

In the passive design strategy, the element that is quite often mentioned is the factor of ventilation, especially natural ventilation (openings) which is realized through windows (living windows) and vent holes for guaranteed air motion (Faisal, 2012). In wet tropical regions such as, Indonesia the building mass should be rectangular, with the optimum proportion between width and length is 1:1.7 and the proportion that is best assessed is 1:3 so that it is advantageous for the application of cross ventilation (Widjayanti, 2007; Yuwono 2007) The condition, location or position and characteristics of the site affect the use of energy in the building. The location or position is represented by site orientation.

The orientation of the building mass in passive design is a relative position of the shape of the base plane, the direction of the wind, or the view of someone who sees it. The building mass orientation is also related to the solar orbit which is part of the natural lighting element (Herniwati, 2005; Kurniawaty, 2011). In tropical climates irradiation in excessive amounts will cause a problem, so the existence of elements that can reduce the blazing effect of the sun through the movement of the wind is attempted. Passive design strategy as an energy-saving variable on the site can be realized in the orientation and land cover/pavement factors, environmental systems (utilities), geo-biological disturbances, vegetation, topography and soil types, and guardrails (Kurniawaty, 2011).

Based on the results of Arief's research (2016) it was found that in traditional Sasak community settlements - Senaru has conformity with the ecovillage concept of Global Ecovillage Network, which is evident from the results of the analysis based on the Community Sustainability Assessment (CSA) of a total value of 1240. The meaning that the Senaru Village community demonstrates the sustainability of their community. Energy conservation is carried out for the construction of traditional Sasak Senaru architectural buildings such as:

„h Orientation and location of residential buildings are designed so that the building becomes comfortable.

„h Using passive airing methods where the air circulation in the building is quite good and the use of porous building materials

• Using conservation and energy efficiency methods in building design. Energy use in buildings is minimized by using natural lighting from the porous wall.

Based on studies that have been conducted, it is necessary to reformulate the concept of low energy architecture for the formation of traditional architecture in Indonesia. Traditional architecture in Indonesia needs to be explored by the values and rules of excellence and their suitability with low-energy ecological designs.

Materials and Methods

Methods

The study was conducted with a qualitative descriptive method. The descriptive method is triangulation which is reinforced by expert judgment. The process of analyzing, evaluating and verifying low energy elements and components in ATSS as one of the archipelago's tropical architectures is interpreted descriptively.

Data Collection

Secondary data compiled in this study formulation of low energy concept formulation and its implementation in ATSS are data from related institutions (customary institutions) and related data regarding the architecture of tropical buildings of the ATSS archipelago and site and environment from the place of construction of the related building and support the theme of the low energy design concept. While the primary data is obtained through field surveys, interviews with traditional leaders, and justifications based on the expert judgment instrument by selected experts.

Analysis

Analysis was carried out with descriptive analysis techniques. Descriptive analysis was conducted by focusing on energy-saving variable factors on site elements (Table 1) and energy-saving variables on pavement elements (Table 2).

Table 1. Energy Saving Variables on Site Elements

Variables	Weight	Design criteria for scores		
		1	2	3
The intensity of site cover	0.323	60% : 40%	50% : 50%	40% : 60%
Building and environmental service systems (utilities)	0.213	Minimization of utilization, minimization of waste	Minimization of utilization, waste minimization, water conservation and waste management (partial)	Minimization of utilization, waste minimization, water conservation and waste management
Free of geo-biological interference	0.139	Without maintenance Unstable	Maintenance with chemicals Medium stability	Maintenance with biological materials Stable
Orientation	0,130	West	East	North-South
Topography	0,108	>15%	8% - 15%	0 – 8%
Type of soil	0,087	Physical structure and low fertility	Physical structure and moderate fertility	Physical structure and high fertility

Source: Kurniawaty, 2011

Table 2. Energy Saving Variables on Pavement Elements

Peubah	Bobot	Kriteria design untuk skor		
		1	2	3
Pavement	0.515	Low porosity pavement type	Medium porosity pavement type	High porosity pavement type
Fences & dividing walls	0.485	Massive and solid	Medium hollow space	Hollow space

Source: Kurniawaty, 2011

Determination of these elements is based on consideration of design related to sustainable design issues with a green design approach and passive design strategy (Kibert 2008). From the results of the descriptive analysis, a low energy element is obtained which is related to the site on ATSS.

Results

The location of TVS is in the Sasak Senaru Traditional Village, in Senaru Village, Bayan Sub-district, North Lombok District, West Nusa Tenggara Province. Geographically, TVS is located at position 115 ° 46 'BT - 116 ° 28' BT and between 8 ° 112 '- 8 ° 55' LS. TVS has an area of around 5,500 m2 consisting of 19 bale/traditional houses.

In the sasak language, Senaru has an understanding of sinar aru (girl), in this ATSS there are only a large portion of the Sasak indigenous people. Land use on TVS consists of settlements, yards, and livestock pens. The type of land use is relatively small and limited apart from the small size of the village and the binding of customary regulations. The

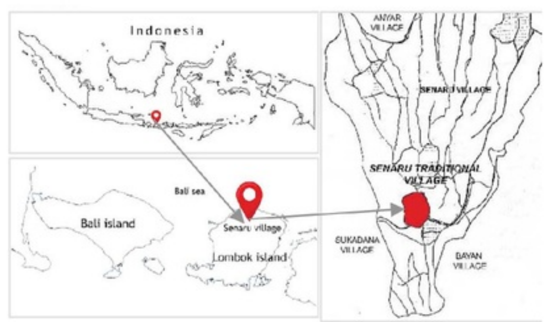

Fig. 1. Research Location

dominance of land use in TVS is settlements consisting of bale/traditional houses, berugak, and geleng/barn, and livestock pens.

Settlement patterns on TVS form a chessboard pattern (grid) which is limited by a fence around the village. The orientation of the TVS layout faces west with its philosophy, which is the direction of Qibla in Islamic prayer (Ka'bah in Mecca, Saudi Arabia). Likewise, the orientation of the location of the traditional bale / house building is facing west and east.

The establishment of the orientation of the building is a heritage of tradition and culture that has become the customary provisions of the Sasak tribe in Senaru Hamlet. The cover forest surrounding the TVS site is the scope of the existence of the village, while the community agricultural land is in the south. The orientation direction of the TVS spatial pattern facing west is a customary provision inherited from the ancestors as an irreversible provision.

Fig. 2. Existing Site Plan TVS, Bayan, North Lombok

Fig. 3. Existing Atmosphere Perspective of TVS

Based on the study and analysis of the climatology and environmental factors of the TVS site that are connected with the site orientation factor with the orientation of the building ATSS (bale/traditional house, berugak, geleng/barn) through solar chart analysis and wind direction, it was found that the ATSS building (bale/traditional house, berugak, geleng/barn) façade received direct exposure to sunlight, wind and rain. Theoretically, the best building orientation on ATSS is north-south, which climatologically makes the façade of the building on the front-back do not receive direct sun exposure because the east-west side of the building is attached to another house, so only light is received reflection or diffuse light from sunlight, so the building temperature is relatively lower.

In TVS, the composition of the building mass (ATSS) forms a grid, making each bale / traditional house has a yard with an area that is relatively the same size. The concept of page architecture is expressed in this yard where its use is not for agroecosystem purposes but rather is communal and social space for the TVS community. Lay out bale / ATSS traditional house in the TVS area which lined up neatly with a gedeg fence, thatched roofs and surrounded by coffee gardens and adjacent to the gate of Mount Rinjani National Park (TNGR).

Fig. 4. The courtyard conditions in TVS allow air movement so that it eliminates heat trapped (heat trap), before and after there is a pedestrian lane

Arrangement of bale buildings is carried out with a mirror concept, in which between two bale buildings erected berugak '. This bale / traditional house building in TVS is not much different from other Sasak tribe traditional house/bale which has a multifunctional and aesthetic value and philosophy for its residents. The architecture of his roof is shaped like a mountain dipping down with a distance of 1.5 to 2 meters from the ground. The area of the land is not too narrow for a yard. Low land cover intensity is a customary provision contained in awig-awig. There is a certain distance between buildings (bale / traditional house, berugak, and geleng/barn and livestock pens) into noise buffers. The availability of open space also plays a role as an area of hazard mitigation, such as fire, and the availability of service areas as well as communal space or social space.

Open space on TVS is quite extensive, it is possible to plant grass and add other elements to improve the microclimate. The open land also allows air movement to eliminate heat trapped (heat trap). The area of land on TVS is generally planted with grass vegetation. This is related to the rules of plants that should not be planted around traditional bale / houses because they are believed to be disastrous. These plants include jackfruit trees, sapodilla trees, guava trees, horseradish trees, ambarella trees, malay gooseberry trees, black-wood cassia trees, and calabash trees.

Fig. 5. Grass plants form a courtyard architecture and fill open spaces between bale, berugak and geleng buildings, but in 2018 pedestrian lines were built which actually caused environmental problems.

The growth of plants in TVS is related to the type of soil that exists. Well structured soils will also have good drainage and aeration conditions, making it easier for the root system of plants to penetrate and absorb (absorb) nutrients and water, so that growth and production are better (positively correlated with fertility). Topographic conditions on TVS with a slope of <5%, open to harsh climates, earthquake hazards, landslide hazards, unstable soil, can be overcome with special treatment. The land condition is included in the criteria for energy saving variables as stated by Kurniawaty (2011), which is on a good topographic factor (slope of soil 0-8%).

At ATSS, the use of organic building materials in buildings is one form of use of local materials in the surrounding environment. But this provides the threat of biological disorders such as termites. Prevention efforts are carried out by injecting thermitisides at each foundation hole / pedestal evenly on the ground surface. Whereas for wood treatment only by spraying, dipping, or soaking with thermitisida (Kurniawaty, 2011). Furthermore, Kurniawaty (2011) explained that these efforts included maintenance with chemicals.

Site engineering efforts that are expected to have an effect on energy efficiency, one of them is by using pavement elements. This element has the potential for excessive heat absorption if it is not designed properly. The concept of the selection of pavement elements is determined so that the functional aspects can still function properly and also the environmentally friendly concepts are also fulfilled. This is in accordance with the results of Kurniawaty's (2011) study in table 2. There are two energy-saving variable factors, namely pavement factor and fence / parapet wall. The pavement factor has a high weight as an energy saving variable.

At the beginning of 2018, TVS by the regional government was constructed of pavement in the form of paving blocks which could damage and harm the originality of TVS. One problem that is caused is the reduction in land that functions to absorb water, even blocking the movement of water flow, and causing permanent puddles at certain points. Another serious problem is the existence of vernacular architecture nullified by pedestrian infrastructure that is very artificial and incompatible, and even incompatible with the principles of sustainable development and reduce the value of

Fig. 6. The use of pavement on pedestrian lines is expected to have an impact on the site and the originality of the traditional village Sasak Senaru.

Fig. 7. Changes in courtyard architecture on TVS that use pavement for pedestrian lines are thought to cause new problems in this traditional village.

uniqueness and break through the rules of heritage historic buildings that must be protected.

The existence of ATSS's vernacular architecture has a courtyard architecture concept in the form of a large yard. The yard generally consists of grass vegetation and terrain. The yard has various functions, such as children's play area, clothes drying area, and socialization area between neighbors.

Fig. 8. The Courtyard Architecture on TVS , Senaru, Bayan, North Lombok, as a children's playground.

Fig. 9. The Courtyard Architecture on TVS , Senaru, Bayan, North Lombok, as a clothes drying area.

In relation to that, the object of research (ATSS on TVS) is the existence of plants or plants which are only at the boundary of the site as a guardrail. Plant fences on TVS also function as security and barriers to prevent criminal acts such as theft of livestock. On the fence surrounding TVS there are 4 doors that function as circulation channels in and out of the village. The four doors are located in the north, south, east and west respectively. The width of the door is about 1.5 meters, so it can be passed by animals. The location of the four doors also has a philosophical meaning other than its function as circulation from the region and to all directions outside the region.

The use of vegetation elements for fencing can be one step to suppress the use of hard materials to function the fence as well as function to help climate amelioration. In line with the view of Werdiningsih (2007) which states that, plants that meet the criteria to be used or combined with a green fence, are plants that: (1) are resistant to weather changes; (2) annual; (3) not easily aborting leaves; (4) not liked by herbivores; (5) easy to maintain and not productive plants; and (6) the shape and size are proportional to the yard area and environmental conditions. Some alternative plants that can be recommended include: a) Shrubs, such as Orange jasmine (Muraya paniculata), Red rose (Rosa sp.), Tongue-

Fig. 10. The site boundary fence of the TVS village, Bayan, North Lombok and the main entrance that utilizes plants as its building blocks.

in-law (Sanseviera trifasciata), b) Vines, such as Costus maroon, Bugenvil, c) Bamboo, such as Japanese Bamboo (Arandinaria japonica), and d) Cactus plants, such as Astrophytum asterias.

Conclusion

In ATSS the concept of low energy sites is influenced by the concept of vernacular architecture with the concept of page architecture. Passive design strategies on TVS sites that can influence the ATSS low energy architecture concept are influenced by factors of land cover / cover / pavement, geo-biological disturbances, vegetation, topography & soil type, and guardrail. The concept of low energy footprint on ATSS is one manifestation of sustainable development of the built environment. Joint efforts are needed in preservation and excavation further related to the formulation of the low energy 7 architectural formula owned by ATSS.

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