

## Sustainability in Architecture of traditional Sasak settlements in Lombok

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### Abstract

*Sasak* is one of the Indonesian indigenous tribes who live in the island of Lombok. Until now, they still maintain the customs and culture as well as settling in Sembalun, Senaru, Segenter, and Sade. The Large of *Sasak* traditional settlement area in Lombok is not increased so that it feared the carrying capacity will be exceeded and could lead to a shift of customs and culture. This paper (1) to formulate the concept of a traditional *Sasak* sustainability settlement, (2) reconstruct the conception and typology of layout, mass configuration, space-organization, structure and building construction homes custom of *Sasak*, to analyze the sustainability level of *Sasak* traditional settlement used questionnaires Community Sustainability Analysis. The results obtained in this study is the traditional settlement of the *Sasak* people - PTSDS is in conformity with the ecovillage concept of Global Ecovillage Network. It is evident from the analysis of data by CSA which finds the total in 1226; with the value of the ecological aspect, the social aspect and the spiritual aspect, respectively 432, 373 and 421, which means the *Sasak* people - PTSDS shows very good progress on sustainability.

**Keywords:** Ecohouse, ecoliving, settlements, Sasak, Senaru, PTSDS (Permukiman Tradisional Sasak Dusun Senaru)

### 1. Introduction

Conditions traditional settlements that exist in Indonesia explored the values and the principles of excellence and compliance with ecological design. Until now, most of these communities still maintain the customs and culture and modernization have not been affected. With their traditional settlement site conditions are not increased, and the population continues to grow, feared to tread carrying capacity will be exceeded. Therefore, the conceptual model is needed to maintain the sustainability of *Sasak* traditional settlements. Cultural treasures such as Sasak traditional settlement should be stabilized its sustainability that based on the concept Ecohouse and ecoliving so it can be passed on to future generations. Research on ecological home communities and ecological life has never been done in the *Sasak* traditional settlement. With this study will determine the level of sustainability of *Sasak* traditional settlements in

ecological aspects, social and cultural / spiritual. In addition it will be known local values and compliance to ecological design concept in terms of aspects of thermal comfort and illumination. The existence and sustainability are important for the stabilization of the design model formulated for *Sasak* traditional settlement, this one of the nation's property assets which are invaluable

### **1.1 Sasak Settlement and Its Space Layout**

The formation of a traditional Sasak village on the island of Lombok usually starts from a group of people (tribe) which form a small village then more and more perfect (Subadyo, 2003). The existence of the traditional village tends to spread up the hills or even at the foot of the mountain, which occurs because of the inter-tribal clashes, beliefs, etc., so as to escape from the pursuit of the enemy, they had to look for places that are difficult to reach (Sulistianto, 2005). *Sasak* traditional village on the island of Lombok is composed of a number of custom homes, buildings berugak, rice container buildings (barn), cattle pens and the surrounding environment. Spatial Sasak village is basically a miniature sort of arrangement that is larger than the spatial Regions (Subadyo, 2003; Auliya, 2009).

In the Sasak tradisioanal settlement on Lombok island, there are several function rooms or buildings. Research Auliya (2009) on Sasak settlement in Senaru confirm that the concept of seniority in settlement patterns, and the formation of the spatial structure based cultural ritual are still deeply rooted in the indigenous Sasak. The difference of space and building function are implemented in the regional arrangement, settlements as well as the arrangement of buildings, including homes. Arrangement of buildings on the traditional Sasak settlement, also known as the land and building use for personal, social and coupled with a sacred function (Sulistianto, 2005; Auliya, 2009). Study Sabrina (2010) on the preservation of settlement patterns traditional Sasak strengthening the existence of spatial structure traditional settlement Sasak formed based on the concept of the philosophy of the trajectory of the sun, the concept of the Mount Rinjani, the orientation direction toward and layout of the topography of terraces and the concept of home form uniform stood in a row (Sutera). Based on the configuration of the masses, the pattern and shape of the whole building oriented towards Mount Rinjani which is a manifestation of the imaginary cosmic line based on the belief system of the Sasak people against where the ancestral spirits reside as well as the symbol of the interaction of the society with its cosmological environment is interpreted through the traditional house (Subadyo, 2003; Sabrina, 2010). Similarly, the results of Fitriya (2010) study in Bayan - North Lombok, explained that the pattern of settlements in Indigenous Village

Bayan there is a division of areas based on social stratification societal. In addition there is a division of space in the environment where living, and the formation of spatial patterns based on traditional activities that are still implemented by the community of Bayan traditional Village.

## 1.2. Sasak Traditional Architecture

Technology owned by the Sasak tribe on the island of Lombok is still relatively simple, but highly uphold the wisdom of the environment. Sasak traditional building structure is a frame system made of wood in the form of a beam and a rectangular pole. While the wall coverings made of woven bamboo (chamber), which is left on the original color and character. Building construction is connected using a bonding system, pedestal, pegs, interlocking pedestal and linked joints. In addition to the above mentioned system it is prohibited for use (Subadyo, 2003). Building materials used to tie a connection are rattan and bamboo materials. Construction of roof coverings used Rumbia, which is supported by bamboo construction and is tied with the use of fibers or bamboo. For Sasak indigenous communities to build houses or other buildings, it must start with the intention and this is considered as a sacred act, meaning that it must be taken into account the necessary conditions (Subadyo, 2003; Sulistianto, 2005). Usually these conditions include: how to choose building materials, requirements and restrictions on building a house, facing the house, choosing a good day and doing *selamatan*. In addition to the architecture of traditional house buildings, *berugak* is one of the traditional buildings that became a means of socialization conducted by the community of Sasak tribe with others or also function as a place of gathering, discussion or in the implementation of traditional ceremonies. *Berugak* is a stage-shaped building without any partitions except on the south side (Subadyo, 2003; Sulistianto, 2005). While the barn is a traditional building Sasak tribe that is also widely found in many villages on the island of Lombok. The existence of barns is not only used as a place to store rice during harvest, but the barns is also used as a sign of the level of one's caste (Subadyo, 2003; Sulistianto, 2005). The highest form of barns is only for the nobility. Establishment of settlement patterns based on Sasak customary rules passed down from generation to generation becomes something that attracts the attention of outsiders. In arranging Sasak traditional house and its elements have a pattern of lined (bale, *berugak*, barns, cages, all lined in a straight line). Overall residential buildings have the same direction facing, ie facing East / West (Sasongko, 2005). This is in line with the study conducted by Subadyo (2003), which stated that the traditional house of Sasak is one of the cultural forms of the community that has special characteristics and is not less unique to the traditional houses of other regions. Sasak traditional house vertically is a

reflection of the division of the universe. The legs or poles symbolize the underworld (the dark world, hell), the body or the walls and the spaces within them symbolize the middle world (the world of the universe's life) and the roof symbolizes the world above (eternal world, heaven).

### **1.3. Ecological House, Ecological Life and Ecological village**

Environmentally friendly and efficient development systems in resource use, called ecological homes (Frick & Darmawan, 2008; Widyarti, 2011). Achievement of the build can be done through an integrated approach in design. Home building (sustainable building) interpreted also as an ecological house. The benefits achieved from the application of the concept of ecological house is a reduction in operating costs (energy and water), improving occupant health by improving air quality inside buildings, and reduce environmental impacts (minimizing the impact of waste and heating in the building). 'Ecological life' (ecoliving) is the life to commit to a better way of life by taking account of and responsible for the environment in order to create ecologically sustainable living (Seo, 2001; The UNSW Ecoliving Center, 2006). This concept is a derivative of 'ecovillage' developed as a lifestyle choice in either rural or urban societies by integrating the overall environmental sustainability of society. Looking at aspects of ecological design, permaculture, ecological building, alternative energy, water efficiency, and so on (GEN, 2000). Indonesia traditionally has had a philosophy regarding the protection of natural resources so that they can live in a sustainable ecosystem (Arifin et al. 2003). "'Ecological life' (ecoliving) can also be realized in the form of lifestyle because with a healthy lifestyle and attention to human wisdom and policy in applying the results of existing technology to harvest the potential of natural resources and the environment that can produce an environmentally sustainable life. The definition of the 'ecological village' used by the Global Eco-villages Network (GEN) (2000); Widyarti, (2011) is; Quality full-featured settlement where the inhabitants' activities are integrated with nature and support the development of human health and can last indefinitely. This approach to achieve this dream is what is then called 'ecological village' (Gilman, 1991). Further, Widyarti, (2011) states that ecological dimensionless development principles in ecological village are: (1) land use in accordance with its carrying capacity; (2) efficient utilization of natural resources; (3) a healthy environment; (4) the use of non-toxic local building materials; (5) preservation of critical vegetation and fauna and natural habitats; (6) optimization of natural energy harvesting; (7) eco-friendly economic structure system; And (8) application of recycling system to all products used.

This principle of ecological development as the basis for thinking about sustainability with a deep understanding that all natural resources, both

renewable and non-limited, therefore human activity must not exceed the ecosystem support capacity of the earth (Randia, 2002). White & Masset (2003), states that the high level of sustainability of the community is determined by the degree of community to be able to affluent and independent.

In order to gain a measure of the sustainability of a community, GEN (2000) developed a concept of how to audit a sustainability as a basis for assessing individuals, and communities to compare their current status with the ideal goal of ecological, social and spiritual / quasi-ecological sustainability (Widyarti, 2011 ). The instruments and analytical units used as action-taking for individuals and communities to become more sustainable are called Community Sustainability Assessments (CSAs).

Research studies that aims to produce a residential building (house-residential-settlement) is more environmentally friendly (Widyarti, 2011), among others, research is conducted Kim (2005), Gaitani (2007) and Mahdavi (2008). Nowadays modern architecture does not have the capacity to control the micro-environment inside a building without the use of technology that consumes a lot of energy and this will have an impact on environmental issues. The statement is the conclusion of Kim's (2005) research, about the comparison of environmental controls in buildings on traditional Korean architecture with modern architecture.

Furthermore, Gaitani (2007) research in Great Athens on the importance of applying architectural bioclimatic criteria and passive cooling systems and energy conservation principles in order to improve the thermal comfort conditions on the outside of a building. The background of this research is dissatisfaction with the sensation of climatic conditions outside the building. The results of the analysis of this study resulted in comparison of conventional structures with other designs that improve the bioclimatic principle.

Meanwhile Mahdavi (2008) conducted research on occupant activity to control the main climate conditions thermal inside the building. Roles and functions of building elements such as windows, shade, lighting and heat sources and fans are usually done to condition the room to achieve the conditions in the building in accordance with the desired. The results of Mahdavi's (2008) study reinforce that conditioning of microclimate behavior in buildings and energy savings, through this control, has a very significant impact.



## **2. Purpose and Research Benefits**

### **Research purposes**

This study aims to assess the sustainable level of Sasak Traditional Settlements in Dusun Senaru (PTSDS), Bayan District, North Lombok Regency, West Nusa Tenggara Province. In the next stage, the basic concepts and typology of mass configuration, layout, spatial organization, plan, view, piece, structure and construction of custom house on PTSDS are used.

### **Benefits of research**

While the benefits of the research results in this first year is to know the level of sustainability of traditional Sasak settlements in Dusun Senaru in ecological, social and kultural / spiritual aspects (eco-house and eco-village concept). Besides it can be used to obtain the sustainability driven factor of Sasak traditional village management in Dusun Senaru as traditional architecture artifact sustainably.

## **3. Research Method**

### **Research design**

The research to uncover the phenomenon of un sustainability of residential community and traditional architecture in Indonesia which is characterized in two forms that is physical and non physical require specific method of research that must be able to reveal physical aspect as well as non physical aspect so that in this research used combination of quantitative and qualitative method.

### **Data collection**

In this first year research, secondary data were collected based on a number of representative sources and relevant to this research topic, while the primary data will be taken directly in the field. Primary data collection will be conducted through interviews using a questionnaire from CSA (Community Sustainability Assessment).

### **Data Analysis Method**

The Sustainability Analysis used the CSA questionnaire in this first year study to analyze and assess the sustainability of the Sasak community - PTSDS, in Senaru Village, Bayan District, North Lombok District. The data was collected through interviews through Focus Group Discussion (FGD) technique with sample of key respondents (adat leaders, village elders, and Sasak community leaders in Dusun Senaru). Respondents were determined by purposive sampling strategy of 30 respondents consisting of 19 heads of households in PTSDS, and 3 elders of sasak, 3 government bureaucrats, and 5 community observers of traditional Sasak settlements. Also observed the location with tools that will be used is a compass, anemometer, Global Positioning System (GPS).

### **Overview of Traditional Settlements of Sasak Senaru Village (PTSDS)**

The research titled: Implementation of Ecohouse and Ecoliving Concept on Sasak Traditional Settlement Architecture was conducted in PTSDS community, in Senaru Village Bayan District, North Lombok Regency, West Nusa Tenggara Province. Geographically, the PTSDS village is located at 115 ° 46 'BT - 116 ° 28' east and between 8 ° 112 ' - 8 ° 55' LS. Dusun Senaru is in the administrative area of Senaru Village. The village located at the foot of Mount Rinjani has advantages when compared with other villages in North Lombok regency. Because it serves as a climbing gateway to Mount Rinjani, also has some beautiful and charming attractions. The area of the village of Senaru is 41.62 km<sup>2</sup> consisting of 11 hamlets *Dasan Baro, Sembilan Batu Dusun, Dusun Telaga Lenggundi, Dusun Kebaloan, Dusun Bon Gontor, Dusun Oma Segoar, Dusun Lokaq Klungkung, Dusun Tumpangsari, Dusun Pawang Kreok, Dusun Lendang Cempaka, and Dusun Senaru.*

Indigenous village of PTSDS located at the foot of Mount Rinjani, in this PTSDS live mostly Sasak indigenous people. This village has an area of about 5,500 m<sup>2</sup> consisting of 19 traditional houses. PTSDS village is about 90 km away. To reach the location of PTSDS from the city of Mataram can pass through 2 lanes, namely the west and east lanes. The western route is also divided into 2, namely the path through the coast of Senggigi and the path through the Pusuk protected forest. East line through Labuhan Lombok.

Physical conditions, PTSDS is part of the slopes of Mount Rinjani located at an altitude of 600 mdpl and with a hilly landscape or mountain slopes and rainfall 2379 mm / year. In general, land use is land for wetland, dry land, yard, and others. Most of the area is used for dry land that is 3,524 hectares. The designation of the yard in Senaru Village has an area of 36.6 hectares. The environment in PTSDS when viewed from the conditions of rainfall, hydrological and commodities shows that environmental conditions support the efforts of the preservation of Senaru village which has an agricultural base. Soil types and climate support for sustainability of agriculture on site. Land use in PTSDS, consisting of settlement, yard, and cattle pen. Types of land use are small and limited in addition to the small size of the village and there are customary regulations that bind. The dominance of land use in PTSDS is a residential area consisting of Sasak traditional houses. In the area of PTSDS the pattern and layout of the building and its structure is a customary provision that can not be changed because it contains good intentions and goals. Meanwhile, the use of land outside the PTSDS area, more diverse and dynamic but still associated with local cultural order.

Land use within the area or PTSDS fence and outside the village gate has a difference. Inside the PTSDS footprint is used for community social activities, while outside the fence is used for agricultural land.

#### **Settlement Patterns PTSDS**

According to the beliefs of the Sasak tribe, the higher the position of the village means the inhabitants in it have high caste levels as well. PTSDS is one of the traditional villages that has the highest geographical position among other traditional Sasak villages in Sub district of Bayan. PTSDS has a historical background as the oldest traditional village in Bayan district with its inhabitants having the highest caste levels among other residents of the township. Until now the institutional structure of adat is still maintained as a form of local wisdom that is binding for all residents of the village. Layout. The village of PTSDS which is maintained for generations is a great potential in the development of the area as a cultural tourism area.

The typical settlement pattern of the Sasak tribe in the PTSDS region forms a chessboard pattern (grid) that is limited by the fence around the village. The orientation of the PTSDS village layout facing west with its philosophy is the direction of the Qibla praying that faces west. Similarly, the orientation of traditional houses that all face to the west and east. The formation of the orientation is a legacy of tradition and culture that has become the custom of the Sasak tribe in the hamlet of Senaru. The pattern of traditional settlement layout in PTSDS as well as traditional architectural styles that exist is one form of cultural heritage rich in the history, philosophy, art, and culture of the local community. Therefore, as one of the customary villages that have a unique spatial settlement pattern that is full of cultural values, the area of PTSDS needs to get special attention by still paying attention to the existence and balance of the traditional principles of the standard, that is the spatial pattern that has been realized in space Traditional area.

In the village of PTSDS in it there are buildings such as custom homes, berugak and barns and agricultural land outside the village gate is a unity of landscapes with typical architectural layout patterns of the Sasak tribe. The absence of construction or addition of buildings (in the footprint) aims to not damage the pattern of layout of the traditional architecture in addition to the binding customary law. The main components that form the PTSDS area consist of custom house, berugak and granary. While other components that are supporters are guardrail fence, yard and public and social facilities. From these various components form a unified landscape that is PTSDS with uniqueness and distinctive characteristics that have the potential to be developed into a cultural tourism area.





Existing Site Plan of PTSDS Villages  
 (Source: Researcher, 2016)

In this PTSDS region the elements of the formation also have the same layout that is with the presence of customary head house at the forefront of the village (on the east) and then another custom house with residents who have lower caste levels to the west. The overall orientation of the building faces west and east. Thus the unified landscape that has an identity that reflects the culture of the Sasak tribe is expressed in the layout of the village of PTSDS with its components both within and outside the settlement.

The existence of PTSDS is characterized by the presence of a fence around its tread. The fence is made of plants, bamboo or wood arranged in parallel with a height of  $\pm 2$  meters. The fence on PTSDS has the main function as a territorial divider of traditional village area. Since the size of the village can not increase or decrease, then plotting. The fence can not be changed. The hedgerows in the PTSDS area also serve for security and barriers to prevent criminal acts such as livestock theft.

### Energy

The energy that people use comes from renewable energy sources. They use oil and porous building designs for lighting and for cooking using biomass derived from wood, branch, or twig. It is set and taught in their custom. The rules of planting and harvesting trees are already regulated by custom. For cooking they harvest the dry branch of the tree from within the PTSDS region bioregion. Energy conservation is implemented in the construction of community houses such as:

- Orientation and location of buildings designed to make the building comfortable.
- Using a good passive air conditioning method and porous material
- Communities use methods that conserve and energy efficiency in building design. The use of energy at home is minimized by conserving

practices such as using natural lighting from the pore holes in the gedeg wall (porous).

### **Building material**

Building materials are taken, among others, from forest cover, fields and they must ask for permission first to *Tua loka*, where the use of building materials are:

- A. Natural/recycable
- B. Can be reused / reusable
- C. Comes from within bioregion

Customary rules have successfully conserved their environments and forest cover so that both building and preservation techniques in Sasak - Senaru use environmentally friendly techniques. Development of materials used and construction methods are naturally sourced from nearby areas and do not use a mixture of chemicals. Wood construction can last up to 35 years and the durability of bamboo construction is more than 15 years without preserved with chemicals. The use of construction materials such as wood and bamboo is in line with the recommended use of environmentally friendly materials because wood and bamboo are renewable building materials. Especially bamboo which includes fast growing plants (Environment Protection Agency, 2010).

### **Build system**

The process of establishing a house is done on a month when on the farm (fields) there is no activity.

Land is forbidden to be dug to build a house and this is due to the density of the soil will decrease its carrying capacity if the soil is *urugan*/heap so that the possibility of the decline of the building.

Elements of building construction is made where the building materials are located and taken to the location is already a component. Constructing of Sasak house - PTSDS uses pre-fabrication system. Before a house is constructed. Parts and components of the house such as roof coverings, wall coverings, floor coverings have been prepared homeowners into parts that are ready to be installed. If wood is not available in the garden around the village, it can be taken in the forest cover land with the permission of *Tua Loka*.

The system of implementation of constructing is mutual assistance between citizens (*gotong royong*). The Sasak area development system - PTSDS is in line with the eco-friendly development initiatives developed today in the framework of environmental protection.

**Environmentally friendly construction system**

Construction element	Material	Origin of Materials	Place of Manufacture	Method
<b>Roof</b>				
Roof covering	Rumbia	Field Forest cover	Village	Mutual cooperation (Gotong royong)
Roof frame	Bambo	Field Forest cover	Village	Mutual cooperation
Roof structure	Wood	Field Forest cover	Village	Mutual cooperation
Colomn	Wood	Field Forest cover	Village	Mutual cooperation
beam	Wood	Field Forest cover	Village	Mutual cooperation
wall	Bambo	Field Forest cover	Village	Mutual cooperation
floor	Soil	Fields and Rice Fields	Village	Mutual cooperation
foundation	Umpak mount ain rock	River	Village	Mutual cooperation

(Source: Researchers, 2016)

The Environmental Protection Agency (EPA) in 2010 suggested that the building materials being used are processed in place and the building elements installed off-site. Elements brought to the site are already components to minimize waste and do not pollute the location with noise and dust (EPA, 2010).

Results obtained from the questionnaires obtained.

**Table 1.** Value sustainability PTSDS communities from ecological aspects

No	Ecological Aspects Scores	Scores
1	Meaning of residence	53
2	The availability of food (production and distribution)	54
3	Infrastructure (buildings and	65

	transportation)	
4	Patterns (consumption and solid waste management)	75
5	Water (source, quality and usage patterns)	61
6	Management (wastewater & water pollution)	64
7	Energy, (source and use)	74
	Total	446

**Table 2.** Value sustainibilitas PTSDS communities of the sociological aspect

No.	Social Aspects Scores	Scores
1	Openness, (trust and security; a common room)	57
2	Communication (flow of ideas and information)	50
3	Network (achievement & services)	50
4	social Sustainibilitas	57
5	Education	50
6	Medical services	54
7	Sustainibilitas economy; (Health of the local economy)	55
	Total	373

**Table 3.** Value sustainibilitas communities PTSDS from spiritual

No	Spiritual Aspect Score	Value
1	Sustainibilitas culture	75
2	Arts and recreation	46
3	spiritual Sustainibilitas	51
4	Entanglement society	68
5	Resilience community	72
6	new Holographic; (Worldview / global)	67
7	Peace and global thinking	63
	Total	421

## Conclusion

Based on the results of the analysis and discussion above it can be concluded that the traditional settlements of the Sasak community - PTSDS is in accordance with the ecovillage concept of the Global Ecovillage Network. This is evident from the results of data analysis based on CSA that get a total value of 1240; With the values of ecological, social, and spiritual aspects of each 446, 373, and 421. The magnitude of these values has meaning that the Sasak community - PTSDS has shown excellent progress on the sustainability of its community

### Suggestion

In order to follow up the findings of this research in the first year it is necessary to conduct further studies or research related to the technological of traditional architectural reconstruction in Sasak Village - PTSDS which is made in an iconic manner to be studied and simulated with CFD (Computing Fluid Dynamic).

### Bibliography

- Andersen KT. 2007. Airflow rates by combined natural ventilation with opposing wind -unambiguous solutions for practical use. *Journal of Building and Environment* 42.
- Arifin HS, NHS Arifin, IGP Suryadarma. 2003. Integrating the value of local tradition and culture in ecological landscape planning in Indonesia. Inside: Hayashi Y, Manuwoto S, Hartono S, editor. *Sustainable Agriculture in Rural Indonesia*. Ed. Number 1. Yogyakarta: Gajah Mada University Press.
- Auliya T et al. 2009. Permukiman Tradisional Suku Sasak di Dusun Senaru. *Arsitektur E-Journal*. Vol 2 No.2 Juli 2009.
- Bastide A et al. 2006. Building energy efficiency and thermal comfort in tropical climates : Presentation of a numerical approach for predicting the percentage of well-ventilated living space in buildings using natural ventilation. *Journal Energy and Buildings* 38.
- Capra F. 2003. What is an eco-village. <http://www.ecovillage.findhorn.com/building/.html> [4 June 2014]
- Chunhai X. 2008. Building simulation as assistance in the conceptual design. *Journal Building Simulation* 1.
- Duangporn and Jitkhajornwanich N, Panin O, Chindavanig T. 2004. Thermal comfort and adaptation to living for local people, Silpakom University Bangkok, Thailand.
- Engin N et al. 2007., Climatic effect in the formation of vernacular 13hroug in the Eastern Black Sea Region. *Journal Building and Environment* 42.
- Frick H, Ardiyanto A, Darmawaan AMS. 2008. Ilmu Fisika Bangunan. Penerbit Kanisius. Yogyakarta.
- Gaitani N et al. 2007, On the use of bio climatic architecture principles in orde to improve thermal comfort conditions in outdoor spaces. *Journal Building and Environment* 42.
- Gilman R. 1991., Ecovillage definition. <http://www.contect.org/ICCIB/Jc29/gilman.html>
- Global Ecovillage Network. (GEN) 2007, Community Sustainability Assessment, <http://gen.perkampungan ekologis.org/activities/index.html>



- Hildur J. 2006, Global Ecovillage Network, Gaia Trust, <http://www.ross-jackson.com/copy-of-book/global.html>.
- Hirano T et al. 2006, A study on porous residential building model in hot and humid regions : Part 1 – the natural ventilation performance and the cooling load reduction effect of the building model. *Journal Building and Environment* 41.
- Kim DK. 2007, The natural environment control system of Korean traditional architecture: comparison with 14hroug contemporary architecture. *Journal Building and Environment* 7.
- Livermore SR, Woods AW. 2006. Natural ventilation of multiple storey buildings: The use of stacks for secondary ventilation. *Journal Building and Environment* 40.
- Maciel AA. Et al. 2007 . Main influences on the design philosophy and knoladge basis to bioclimatic integration into architechtural design. *Journal Building and Simulation* 42.
- Mahdavi A et al. 2008. Shading and lighting operation in office building in Austria : A study of user control behavior. *Journal Building and Environment* 16.
- Rilatupa J. 2008. Aspek kenyamanan termal pada pengkondisian ruang dalam. *Jurnal Sains dan Teknologi EMAS* 18.
- Ryn S, Cowan S. 1998. Ecological Design, USA : Island Press.
- Sabrina R. et al. 2010. Pelestarian Pola Permukiman Tradisional Suku Sasak Dusun Limbungan Kabupaten Lombok Timur. *Jurnal Tata Kota dan Daerah. Vol 1. No 2 Juli 2010*.
- Subadyo, A. Tutut. 2003. Arsitektur Tradisional Lombok. Jurusan Arsitektur Universitas Merdeka Malang.
- Sulistianto, MI. 2005. Perencanaan Lansekap Permukiman Tradisioanl Segenter Sebagai Kawasan Wisata Budaya. IPB Bogor.
- Smed J, Wall M. 2007. Enhanced energy conservation in houses 14hrough high performance. *Journal Building and Environment* 42.
- Sozen MS, Gedik GZ. 2007, Evaluation of traditional architecture in terms of building physics : Old Diyarbakir houses. *Journal Building and Environment* 42.
- Tenorio R. 2007. Enabling the hybrid use of air conditioning : A prototype on sustainable housing in tropical regions. *Journal Building and Environment* 42.
- Wardi LHS. 2012. Pembentukan Konsep Ruang Perempuan Pada Lingkungan Hunian Tradisional Suku Sasak di Dusun Sade Kecamatan Pujut Kabupaten Lombok Tengah. *Jurnal Media Bina Ilmiah Vol 6. No 2 Maret 2012*.
- White H, Masset. E. 2003. Importance of household size and composition in construction poverty. *Journal Development and Change* 34.

- Widyarti M. 2011. Kajian dan Rekonstruksi Konsep Eco-village dan Eco-house pada Permukiman Sasak - Senaru Dalam berdasarkan Community Sustainability Assessment. Disertasi. IPB Bogor.
- Wong NH et al. 2007. Environmental study of *the impact of greenery in an institution campus in the tropics*. *Journal Building and Environment* 42.
- Wong NH, Lin S. 2007. A study of the effectiveness of passive climate control in naturally ventilated residential buildings in Singapore. *Journal Building and Environment* 42.