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# Natural Lighting and Air Conditioning Systems in Traditional Bugis Houses

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**Abstract.** Traditional Bugis houses have various window shapes/types, based on the construction frame of the walls that form them. This research aims to determine the natural lighting and ventilation system in traditional Bugis houses from the aspects of environmental health, comfort and occupant needs. The sources selected in this research were subjectively chosen by cultural figures who understand the placement and shape of Bugis house windows. The data obtained is then compared with related documents/theories to determine the validity of the field data. The analysis used is a qualitative description by comparing theories of ventilation and natural lighting based on architectural science. The results of the research show that the window/*tellongeng* functions as natural ventilation and lighting which is placed on the outer wall of each section of the *aliri*/pole construction. The window is a place for air to flow into the room and it continues to flow based on the direction of the wind (cross ventilation) so that it feels cool in the room. Likewise, natural lighting through windows/*tellongeng* to illuminate the room from the four sides of the house walls can make the room feel comfortable.

**Keywords:** Bugis House, Air Conditioning, Lighting, Health and Environment.

## INTRODUCTION

A good house location is in line with the direction of the sun (east-west) so that sunlight can be evenly distributed from 08.00 – 16.00. Natural lighting is obtained by sunlight entering the room through windows, gaps and open parts of the building [1]. Sunlight is useful for lighting and can also reduce room humidity, repel mosquitoes, kill germs from certain diseases such as tuberculosis, influenza, eye diseases and others. The minimum standard requirement for natural light that meets health requirements for various purposes according to WHO, one of which is for family rooms and sleeping in the house, is 60 – 120 Lux. In order to get the optimal amount of sunlight in the morning, the bedroom window should face east and a good window area should have a minimum area of 10-20% of the floor area.

Good artificial lighting that meets standards can be influenced by the way the light source is installed on the wall or ceiling, the construction of the light source in the ornaments used, the area and shape of the room and the spread of light from the light source. Light can be measured in foot candle units (Fc or Lux).

Apart from that, natural ventilation is also one of the requirements for a healthy home. Place sufficient ventilation/windows so that indoor air can always flow. [2] Kleiven revealed that natural ventilation or natural ventilation is the process of

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exchanging air in a building through the help of open building elements. Good air circulation in the building can provide comfort. Air flow can speed up the evaporation process on the surface of the skin so that it can provide coolness for building occupants.

The ventilation applied to Bugis houses is natural ventilation in parallel with lighting. As a characteristic of Bugis houses, windows (*tellongeng*) are installed between the main construction pillars, but there are no standard provisions on how large the dimensions of the windows must be installed. Each segment of the outer wall of the house has a window that can be used in three types, namely; as natural air circulation or called natural ventilation, and natural lighting and can be used to look outside the house. The two functions above, namely natural ventilation and natural lighting, are a reflection of an environmentally conscious culture and are also in line with architectural concepts. It is said to be environmentally friendly because it does not use fans or air conditioning (AC) to cool the space, meaning there is no electricity generation from petroleum sources and the like. Just like natural lighting, during the day there is no need to use electrical energy for lighting because there are windows on all sides of the wall for room lighting needs.

The main consideration in designing the optimization of natural ventilation is to analyze the direction of the wind. In general, the wind has a direction that is influenced by the macro climate. For example, in Indonesia, the wind in the macro climate flows from the Southeast to the Southwest. However, the microclimate which is influenced by the weather and the shapes around the building will have a greater influence on the wind flow [3].

The typology of window shapes in traditional Bugis houses in the South Sulawesi Miniature Complex at Somba Opu Makassar, there are five types, namely plank windows, panel windows, combination panels and jalousie/lattice windows, permanent windows with grilles, and wooden combination *awning* windows. and glass. Typological variations can be identified based on basic shape, material, size, measurements, and ornamentation. In general, traditional materials and shapes are still used, except for the Wajo house which has been influenced by modern materials in the form of glass [4].

Increase the number of openings. The recommended openings or air ventilation are at least 15% of the building floor area. Arrange the location of the air ventilation openings must be on both sides of the building or room. There won't be much benefit if the opening is only on one side of the building. In determining the size, a basic approach is used, including the function and activities of space, space capacity, human need for oxygen and so on.

Standard area of lighting/light holes [5]:

a. For bedrooms 1/6 × floor space
b. Sitting room 1/7 – 1/6 × floor area of the room
c. Ventilation 40/1 to 10/1 x floor area
d. Warehouse 1/10 × room floor area

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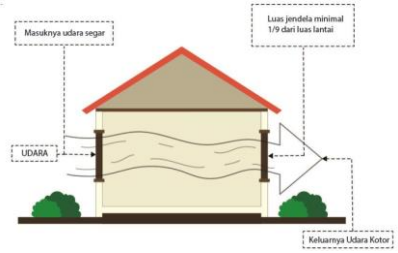
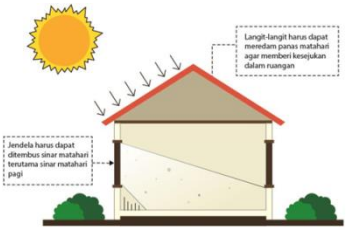
Healthy Home Principles based on Air conditioning and Lighting [6]:

1. Sufficient ventilation/windows so that indoor air can always flow. The minimum window opening area is 1/9 of the floor space. As Picture 1.
2. The openings/windows must allow sunlight to penetrate. As in Figure 2.




Gambar 1. Alur Udara




Gambar 2. Alur Sinar Matahari

The provisions for residential health requirements are as follows:

Natural Lighting Natural lighting is obtained by sunlight entering the room through windows, gaps and open parts of the building. Sunlight is useful for lighting and can also reduce room humidity, repel mosquitoes, kill germs from certain diseases such as tuberculosis, influenza, eye diseases and others. The minimum standard requirement for natural light that meets health requirements for various purposes according to WHO, one of which is for family rooms and sleeping in the house, is 60 – 120 Lux. In order to get the optimal amount of sunlight in the morning, the bedroom window should face east and a good window area should have a minimum area of 10-20% of the floor area [7].

## RESEARCH METHOD

[8] Moleong states that qualitative research is research that intends to understand phenomena regarding various perceptions, motivations, actions, etc., holistically, and by means of descriptions in the form of words and language, in a context. specifically natural ones and by utilizing various scientific methods. In other words, qualitative methods prioritize the researcher's ability to deepen the focus of the problem being studied.

The descriptive qualitative research method is analyzing phenomena regarding events, social activities, attitudes, beliefs, perceptions, thoughts individually and in groups in society, understanding humans as socio-cultural actors as subjects, then linking them to the objects of the phenomena studied by comparing related theories. Humans as subject actors provide data as is based on the knowledge they have about the object. The data obtained is compared with related documents/theories to determine the validity of the field data.

This research will examine the work of Bugis house architecture from the perspective of ventilation and lighting theory based on the expressions of cultural informants from the Bugis tribe to describe it. The selected sources are subjectively cultural experts who understand the shape of Bugis houses in terms of window placement and ventilation, thereby reducing as little bias as possible regarding opinions on the placement and shape of Bugis house windows.

The analysis used is a description of the shape of windows and ventilation by

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comparing it with the theory of ventilation and natural lighting based on architectural science.

## RESEARCH RESULT AND DISCUSSION

Culturally, windows in Bugis are called *tellong* which means looking out of the house. With windows (*tellongeng*), residents can look out or monitor the outside of the room. Placing large windows will have an impact on occupant comfort both in terms of ventilation and lighting. Based on the function of the window, the Bugis tribe places each segment of the outer wall structure.

The Bugis habit of designing their house windows as a function of ventilation and natural lighting is an architectural work that is relevant to standard openings for ventilation and lighting. The use of open windows in Bugis houses is one of the cultural elements that are environmentally conscious because the open windows and ventilation of Bugis houses are brought all the way to the top so that air flow (oxygen) flows into the room and exits through the top ventilation which makes the room feel cool and comfortable.

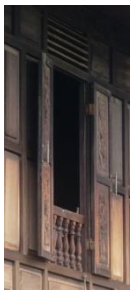
### 1. Natural Eventation

Data on window cross-sections in several areas such as Sidrap, Wajo and Soppeng compared with the floor area supplied with air and natural light is as follows.

Window: 1,5x075 =1,1m$^2$
Floor area: 30x10=30m$^2$
Figure 3: House windows Nadira in Sidrap

Window: 1x0,8= 0,8 m$^2$
Floor area: 2,75x7=19,3
Figure 4: House Windows Munawwara in Wajo

Window: 0,6x1=0,6m$^2$
Floor area: 3x4 = 12m$^2$
Figure 5: House Windows Rakyt in Amparita



Window: 0,8 x 1,75 = 2,2 m
Floor area: 6 x 5 = 30m$^2$
Figure 6: House Windows SaoMario in Soppeng

Windows: 0,8x2 = 1,6m$^2$
Floor Area: 3x8= 24 m$^2$
Figure 7: House Windows Saoraja in Sidrap

Living room in Figure 3 with an area of 10 x 3 = **30 m$^2$**.
Window cross-section 1.5 x 0.75 = 1.125 m$^2$, 5 pieces = **5.6 m$^2$**.
Standard Living Room Window = 1/7 – 1/6 of the floor area.
To get the standard window area = floor area divided by standard 1/6 = 30/6 = **5 m$^2$**.
So the area of the window in Figure 1 really meets the standard requirements for window cross-section **5.6 m$^2$**.

Living room in Figure 4 with an area of 2.75 x 7 = **19.3 m$^2$**.
Window cross-section 1, x 0.8 = 0.8 m$^2$, 4 pieces = **3.2 m$^2$**.
Standard Living Room Window = 1/7 – 1/6 of the floor area

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To get the standard window area = floor area divided by standard 1/6 = 19.25/6 = **3.2 $m^2$**.
So the area of the window in Figure 2 meets the standard window cross-section requirements of **3.2 $m^2$**.

Bedroom in Figure 5 with an area of 3 x 4 = **12 $m^2$**
Window cross-section 1, x 0.6 = 0.6 $m^2$, 3 pieces = **1.8 $m^2$**
Standard Living Room Window = 1/6 of the floor area
To get the standard window area = floor area divided by standard 1/6 = 12/6 = **2 $m^2$**
So the area of the window in Figure 3 is almost the same as the standard window cross section of **2 $m^2$ but reality 1.8 $m^2$**.

Private Room Figure 6 with an area of 6 x 5 = **30 $m^2$**
Window cross-section 2.2 x 0.8 = 1.76 $m^2$, 3 pieces = **5.28 $m^2$**
Standard Living Room Window = 1/7 – 1/6 of the floor area
To get the standard window area = floor area divided by standard 1/6 = 30/6 = **5 $m^2$**
So the area of the window in Figure 5 really meets the standard requirements for a window cross section of **5.28 $m^2$ which meets the standard of 5 $m^2$**

Living room in Figure 7 with an area of 6 x 8 = **48 $m^2$**
Window cross-section 2 x 0.8 = 1.6 $m^2$, 5 pieces = **8 $m^2$**
Standard Living Room Window = 1/7 – 1/6 of the floor area
To get the standard window area = floor area divided by standard 1/6 = 48/6 = **8 $m^2$**
So the area of the window in Figure 5 meets the standard requirements for window cross-section which **should be 8 $m^2$**

Of the five types of Bugis house windows, based on their function, there is one type that is almost perfect, namely Figure 5, which should be for a bedroom with a floor area of 12 $m^2$ and has a window area of 2 $m^2$, but the one available is 1.8 $m^2$. The remaining two are perfect, namely the window type in Figure 4 of the Munawwarah Wajo house with a living room area of 19.3 $m^2$ which must have a window area of 3.2 $m^2$ and Figure 7 Saoraja in Sidrap living room with a floor area of 48 $m^2$ which has a window cross-sectional area of 8 $m^2$ in accordance with the standard aperture. There are two types of windows that are very perfect, namely Figure 3 Nadira Sidrap's living room 30 $m^2$ with a window cross-section of 5.6 $m^2$ which should be 5 $m^2$ and Figure 6 Sao Mario in Soppeng special room with a floor area of 30 $m^2$ with a window cross-section of 5.28 $m^2$.

Based on the description above, it can be stated that the window type designation for Bugis houses is in accordance with the standard area required for residential use. Bugis house window works are only made based on intuition, the tastes of the occupants but do not conflict with the principles of architectural planning and environmental health demands of the community.

The Bugis house window system is the work of local architects or also called traditional architecture, which is a work of local wisdom that is in line with natural

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ventilation theories built by scientists based on ideal research. The use of Bugis house windows has four side walls called *sulapa eppa* which are placed in each section of the construction or installation of windows between the pillars/columns of the house so that perfect air flow in the house (cross ventilation) is created, causing the air in the house to feel cool and comfortable as seen in the following picture.

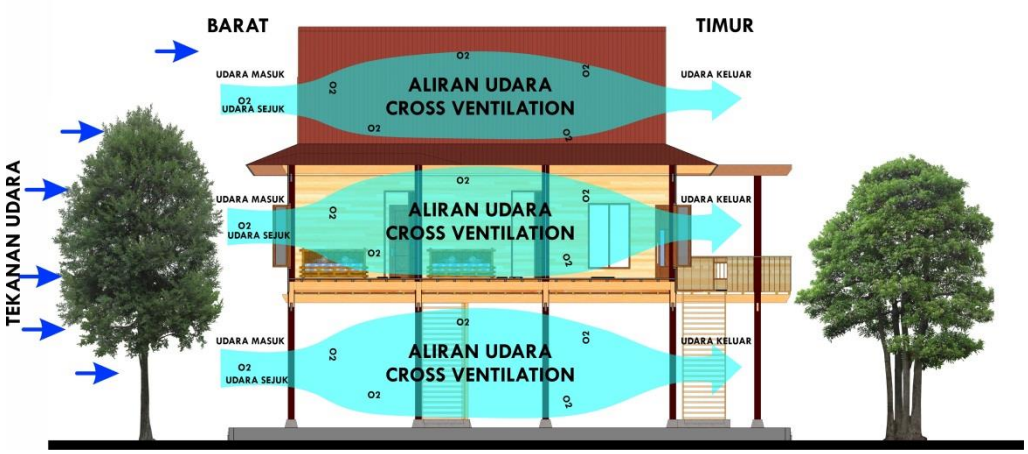


Figure 8. Air Circulation Patterns in Bugis Houses

## 2. Natural Lighting

Based on the description of the standard window openings for residential houses of 1/7 – 1/6 of the floor area, it shows that the window openings for natural lighting for Bugis houses are identical to the standard openings. As stated by [9], natural ventilation is parallel to natural lighting. The windows of the Bugis house are designed for natural lighting in the room, which indicates that the Bugis ancestors already understood about healthy living, including lighting the room as shown in the following picture.

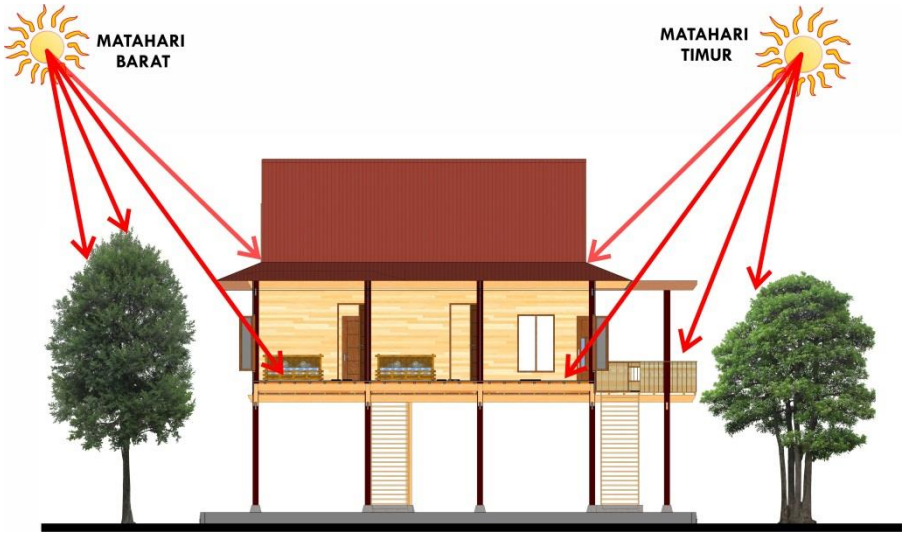


Figure 9. Flow of Sunlight on a Bugis House

The use of windows in Bugis houses with a system of opening and closing shutters which allows sunlight to penetrate the windows to light the room so that it

feels spacious in the room and avoids damp odors and mold/bacteria

The characteristic of a Bugis house apart from the crown of the roof (head) can also be seen from the arrangement of windows on the outer walls which tend to repeat types due to the structure of the wall frame that forms the windows. The tendency to use windows in every frame segment is because there is a Bugis tribal palsafa "*Aja muetai manu'e majjama*" (M Munawwarah, 2022) meaning that humans should not be preceded by chickens coming down from their coops to look for sustenance. The behavior of chickens, if they see dawn rising, they will come down from their coop to look for food. Likewise, humans must wake up earlier than chickens. The indicator that requires humans to wake up quickly is seeing dawn dawning first. In this regard, bugis houses must have lots of windows so that sunlight can enter into the house.

### 3. Environmental Health

The benefits of using windows like the picture above show that the Bugis tribe in building houses cannot be separated from thinking about the health elements of the home environment to avoid diseases caused by lack of light, such as dengue fever and malaria and the room feels damp if there is no air exchange in the room.

## CONCLUSION

The window/*tellongeng* functions as natural ventilation and lighting which is placed on the outer wall of each section of the flow/pole construction. The window is a place for air to flow into the room and it continues to flow based on the direction of the wind (cross ventilation) so that it feels cool in the room. Likewise, natural lighting through windows/*tellongeng* to illuminate the room from the four sides of the house walls can make the room feel comfortable. The presence of ventilation and lighting that enters the house means that the room is protected from TB bacteria and mosquitoes that carry malaria and dengue fever, so that residents feel comfortable and calm in social life.

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