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WIND TRANSLUCENT BLOCK (GEDHEG BRICK): AN ALTERNATIVE MATERIAL WITH GREEN ARCHITECTURE CONCEPT IN OPTIMIZING AIR CIRCULATION IN WET TROPICAL CLIMATE BUILDING

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Abstract

It is important to apply the principles of green architecture in contemporary architectural design today. This concept was held with concerns about energy consumption in buildings, in particular, the use of air-conditioning equipment for thermal comfort indoors. The cause of thermal discomfort in the room is the accumulation of hot air in the room which could not get out and replaced by fresh air. The principle of cross-ventilation is a cheap solution and can be applied in creating an air conditioning system through natural openings. A proper opening, not only will make a good airflow, but also induct the light into the room and make the room brighter. The use of alternative materials as media exposure to improve cross-ventilation is not easy to come by. Alternatives offered is the use of concrete blocks designed in such a way to become cross ventilation. The idea of translucent concrete blocks derived from the form of bamboo woven (gedheg); which can penetrate the wind. The cost of building woud be cheaper because it uses local materials easily accessible throughout.

Keywords: *green architecture, cross ventilation, thermal, gedheg, wind translucent block*

1. Introduction

Energy crisis in 1973, with 50% of the energy used by buildings, resulting European Governments to promote environmentally friendly architecture or green architecture. It is a campaign to restore natural balance in which were damaged by architecture using architecture. As a matter of fact, architectural design has an important role in energy consumption particularly thermal and lighting. Air circulation and lighting design, however, related directly to thermal comfort. Important consideration in designing buildings in the wet tropical climate such as: high rainfall, high intensity of heat and light throughout the years, humidity and social as well as physical conditions surounding.

The elements of the building as openings are the roof and walls. Openings at the roof are useful for entering sunlight and removing hot air by cold air, while opening in the wall are useful for entering sunlight and entering cold air into the room. In general, openings in the wall consist

of doors, windows, and ventilation holes. The problem is that brick wall generally massive, thick and hot when exposed to sunlight, which stores the heat radiation and make the room hot (**Figure 1**). The character of concrete material that stores heat will cause the room hot and humid because of the heat radiation. The massive form causes the air can not pass through.

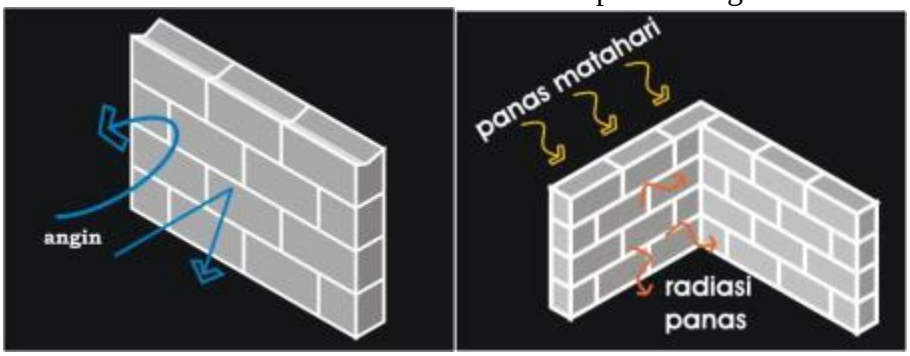

Figure 1. Conventional concrete brick wall
(Source: Gunawan et al, 2014)

The composition of conventional brick material was 1 cement: 6-8 sand. Compared to red brick, this concrete brick was waterproof, passing through the heat faster and saving the heat longer. Construction of a brick wall will be faster and longer to heat the room behind the wall. The climate in the room seemed to be more hot and stuffy due to heat in the room cannot be replaced rapidly. Concrete brick wall construction is not support the comfort climate in the room. Beside the appearance is less attractive and has to be plastered as finishing. The value is declining, because the manufacturing are too expensive. Comparison of material can be increased up to 1 cement: 12-15 sand with the consequences of declining quality of the concrete brick. Therefore, the research question is how to make the opening in the wall which also serves as the covering materials of the building.

This paper is aimed to offer an alternative material with green architecture concept in optimizing air circulation in wet tropical climate. In fact, the size and weight of the concrete block is less advantageous for Indonesian craftsmen, especially after the installation above one meter. This wind translucent block (gedheg brick) is designed for easy and fast installation. Moreover, gedheg brick brings air flow through the cracks of a couple of blocks and creates a thermal comfort in a room. With decorative shapes resembling woven bamboo, it can reduce sun heating by creating shadow. It also creates its own dramatic effect.

2. Research Methodology

1.1 Literature Review

The effect of poor air circulation system is thermal heating which lead to discomfort. The easiest solution is using air conditioner to cool the room. However, it causes some effects, such as nest of germs, huge electric consumption and contribution to thermal heating or global warming. Alternative solution is applying natural ventilation which is easy and cheap in procurement and maintenance. Appropriate opening will not only make a good air flow, but also a bright lighting. Natural ventilation is an integrated system using the concept of natural airflow, into and out of the

room, so that ventilation can provide a healthy alternative to air conditioning systems in buildings. The benefits of reducing carbon emissions and decreasing operating costs, allowing designers to develop environmental friendly buildings. [1]

There are three types of ventilation system: single sided, single double sided and cross ventilation. A room with single sided ventilation has an opening at one side only. The flow of air will be cold and warm air will flow out again through the same window. This type of ventilation is normal and commonly practiced, but only useful for certain spatial depth. Whereas a single double sided ventilation provides a double opening which is more efficient (**Figure 2**).

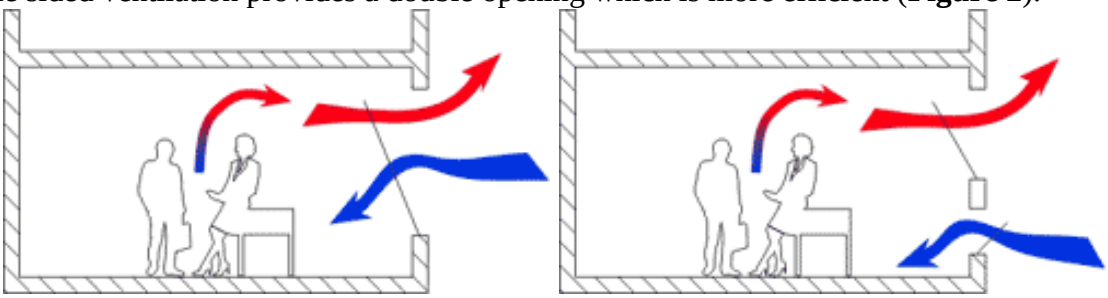

Figure 1. Single sided and single double sided ventilation
Source: www.dyerenvironmental.co.uk/natural_vent_systems.html

Afterwards, cross ventilation system (**Figure 3**) use pressure difference between the side facing and away from the wind. Positive pressure upon the wind and/ or a vacuum effect on the negative side, causing air movement through the building from upon the wind to the negative side. To obtain optimal airflow with minimal concept, a window at the windward side is opened smaller than at the negative side.

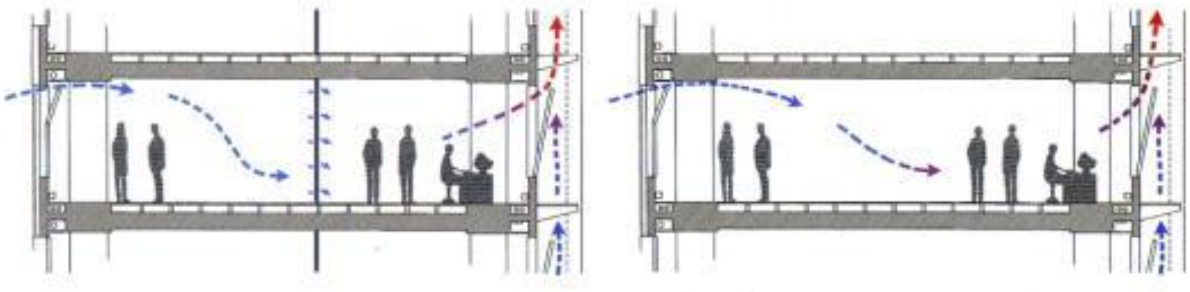

Figure 2. Cross ventilation system with and without partition
Source: GSW-energy-ventilation.htm

1. Result

Gedheg brick as an alternative building material with green architecture concept inspired by traditional gedheg wall (**Figure 4**). The idea came from the form of woven bamboo which was able to pass the air to attain thermal comfort in the room. It was made by reducing the dimensions and the thickness of the brick. Shrinking the thickness would save materials and reduce the weight of concrete blocks. This will ease the builders in doing construction. This innovation is expected

to increase the value of art and the visual appearance as well as add functions to cool the temperature of the wall.

Figure 4. The wind translucent concrete blocks (gedheg brick)
(Source: Gunawan et al, 2014)

Gedheg brick has a wavy verical areas. The wave inside the cavity is equal to the thickness - about 5 cm (**Figure 5**). In the middle of the top surface, the thickness of the block was enlarged to both sides, each about 2 cm in height half brick. The middle part of the upper and lower surfaces are made indentations with a depth of 3 cm, the length and width of about 5-7 cm. This is the foundation and the lock for the vertical connection of the concrete block. Vertical sides of gedheg is made perpendicular to the curved area.

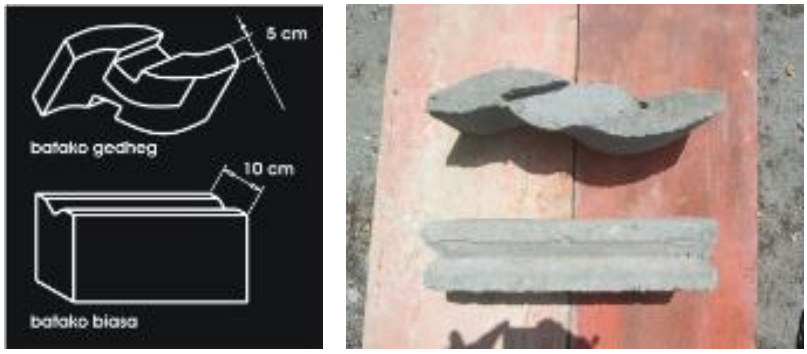

Figure 3. Comparison of the wind penetrating brick arch with a conventional concrete block
(Source: Gunawan et al, 2014)

Construction of the wavy brick is arranged in a row; connected with the space; and stacked on the top of the other concrete blocks alternately. The vertical connection of wavy brick use lockdown system. The vertical sides of brick meet in the middle of brick elements which are enlarged. The middle of the lower surface is supported by two end connections of brick and vertical sides brick meet in the middle of brick elements enlarged. the middle of the lower surface are supported by two end connections and reinforced concrete blocks with specific.

Construction created from the wavy brick is resembling embroidery. Among them, there are oval-shaped air holes on both sides of the wall – outside and inside. Air flow will pass through the connection between the concrete blocks so the speed of air flow can be controlled. Direction

of air flow is not perpendicular to the wall, thus the wind from outside is deflected downward or upward.

The brick, relatively thin with a thickness of 5 cm, is stiff and strong because the field is corrugated (**Figure 6**). The gedheg brick will provide shade when exposed to direct sun thus it will be able to shorten the time of solar heating. The shading and the air flowing will help keeping the temperature in the room. The embroidery surface become three-dimensional decoration with the upright surface causes shadows which can be changed by the influence of sunlight or artificial light. Gedheg brick does not need finishing, such as plastering in conventional brick, because the embroidery model is needed for the air circulation. Moreover, the shadow of curve field is needed to shorten the heating time.

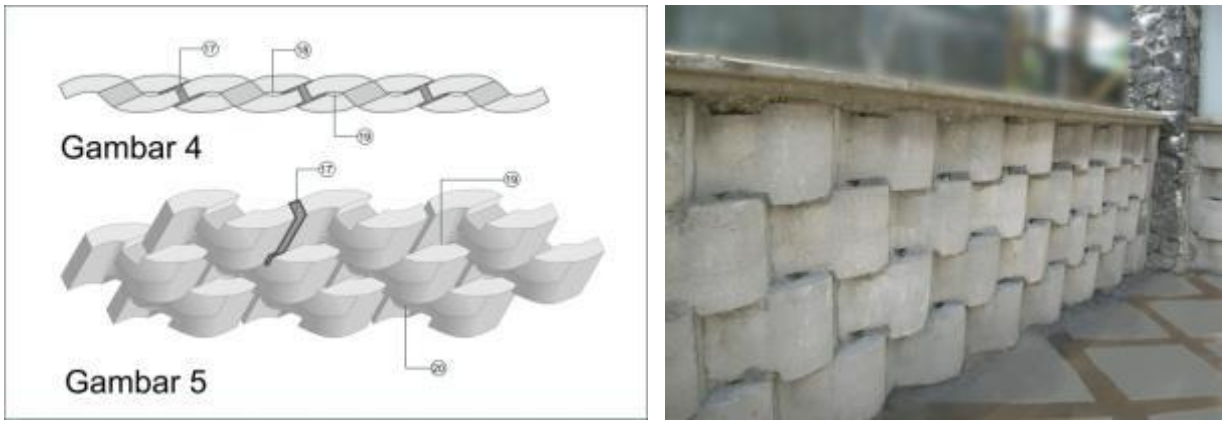

Figure 4. Arrangement of wind translucent blocks (gedheg brick) resembles bamboo woven (Source: Gunawan et al, 2014)

2. Conclusion

Green architecture in contemporary architectural design today is not only discourse. When the damage caused by human is so serious, green architecture is the doctrine that should be considered into account when designing. One of the doctrine is designing an energy-efficient building that use insulation, large openings, and proper building construction. Another doctrine is designing buildings that use natural air and lighting as much as possible.

From the description above, it is known that cross-ventilation efforts of natural air can be performed using alternative materials which are shaped like bamboo woven. The principle of cross-ventilation is a cheap solution and can be applied in creating an air conditioning system through natural openings. The weaknesses of this wind translucent concrete block (gedheg brick) is in finishing. It can be concluded that the relationship between aspects of the design can be summarized into the system. The system used as much as possible adapted to the conditions on the ground, both macro and micro.

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