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## THE USE OF SECONDARY SKIN MATERIALS FOR NATURAL LIGHTING IN HOTELS RESORTS

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### ABSTRACT

*Natural lighting is one aspect of ecological architecture to reduce energy use by utilizing sunlight as the main lighting. However, direct and excessive sunlight decreases the comfort level of room users because it can increase room temperature and interfere with visualization. So it takes control of the distribution of the sun in the room. In addition, the issue of environmental damage has become hot news in the community today, especially in the property sector, such as using materials that can damage the surrounding environment. Efforts to regulate the entry of sunlight into the room but not harm the surrounding environment, one of which is the application of second skin that utilizes environmentally friendly materials. This paper aims to determine the form and material of secondary skin that is environmentally friendly and suitable for use in resort hotels. This research uses a qualitative comparative method based on three objects in the form of secondary skin in the hotel resort building: Ananta Legian Hotel Bali, EcoSuites (A Reed-Clad Hotel Greece), and Lenora Hotel Bandung with variables namely opening, shape, and shading. For three secondary skin material objects in the resort hotel building, namely Amnaya Resort Kuta, Four Points by Sheraton Bali, and Potato Heads Studio Hotel Bali, with variables namely shape, material, and aesthetics. Based on the results of the study, it was found that two types of second skin openings are applied to the hotel resort building, namely dead slots and sliding doors that are used to adjust the shape with the dominance of the modified rectangular base shape and the shadow produced from the second skin itself adapts to the function of the shaded space. Environmentally friendly materials used are made from nature, such as vegetation, wood, and roaster bricks that do not damage the surrounding environment; which is applied in a modified rectangular base shape and can improve the aesthetics of the building.*

**Keywords:** Sunlight, Eco-Friendly Materials, Second Skin, Hotel Resort, Environment.

## INTRODUCTION

In the current era of globalization, it can harm the environment, one of which is development, especially in the property sector. The higher population in Indonesia results in high demand for housing, so green areas are decreasing and causing environmental problems. Based on (Direktorat Jenderal Kependudukan dan Pencatatan Sipil, 2022), Indonesia's population increased by 1.64 million in June-December. 2021. Indonesia still needs to achieve the provisions based on the Spatial Planning Law, namely that there must be a minimum of 20% green open space in the available city area. According to data from the Ministry of PUPR, only 13 of 174 cities in Indonesia have a portion of Green Open Space (RTH) of 30 per cent or more (Wahdaniyat, 2019). It would cause environmental problems, especially air pollution, which can interfere with the health of living things. The property sector can be a solution to improve the quality of the surrounding environment and still provide residential accommodation for the community. Developing an ecological architectural approach can be one solution to create buildings that can reduce the risk of environmental damage with one of the principles of maximizing natural lighting and using environmentally friendly materials.

Lighting is an essential aspect of the space so that users can feel comfortable doing activities. Lighting plays a significant role in architecture, supporting the function of space and carrying out various activities, forming a visual aesthetic image, and creating comfort and safety for space users. (Manurung, 2012). The lighting itself is divided into 2, namely artificial lighting from lamps and natural lighting, namely sunlight. Natural lighting in a building can be maximized by openings so that light can enter the space. The utilization of sunlight can reduce energy requirements in a building. According to SNI No. 03-2396-2001 concerning Procedures for Designing Natural Lighting Systems, sunlight during the day is good at 08.00 - 16.00 local time because of the large amount of light that can enter the room. However, excessive direct sunlight can increase room temperature, reducing room users' comfort. In addition, light entering the room can also cause contrasting colours that can interfere with visuals. Direct sunlight can harm the body; according to the article, Dr Fadhli Rizal Makarim is known that direct sunlight can increase the risk of skin cancer, sunburn, and impaired vision. Ultraviolet light can damage the central nervous system of vision and the macula, the part of the retina at the back of the eye, and in the long term, can cause cataracts (Makarim, 2020) so that the building requires control of the distribution of sunlight that enters the room so that it does not become a threat to users.

One solution to regulate the distribution of sunlight into the room is to use a secondary skin on the facade of the building. The secondary skin has various forms so that it can adapt to the function of the building being built. Secondary skin, in addition to reducing the intensity of incoming sunlight, can also increase the aesthetic value of the appearance of the building. Secondary skin on buildings, in addition to increasing the aesthetic value of building facades, also plays a role in reducing exposure to solar radiation in buildings, reducing wind and noise, and reducing light received by buildings so that the light received by building users is light indirect (Rahadian, Dwiastuti, Maretia, & Fitriana, 2021). Secondary skin also has various

types of materials that can be used. However, using environmentally friendly materials is the main focus of reducing the negative impact on the surrounding environment. Therefore, in this study, it is necessary to know how the form and type of secondary skin material are environmentally friendly and suitable for use in resort hotels, especially in tropical climate conditions in Indonesia.

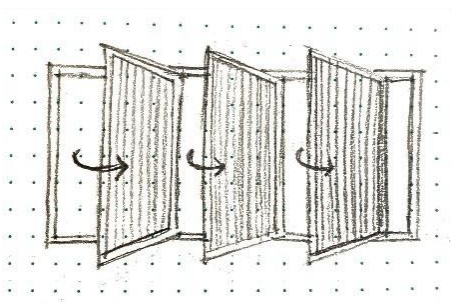
This paper comprises five parts: introduction, theoretical and methodological review, results and discussion, and conclusion. The introduction section explains this research's background, problems, and objectives. The theoretical review consists of two subsections: the first discusses secondary skin, while the second section discusses environmentally friendly materials that can be used. The methodology describes the method used to conduct this research, namely the comparative method or comparing three objects based on qualitative data. As for the results and discussion, this section consists of 2 parts: discussing the shape of the opening on the second skin and environmentally friendly materials that can be applied to the second skin. In the end, there is a conclusion summarizing this study's findings.

## **THEORY / RESEARCH METHODS**

### **Secondary skin**

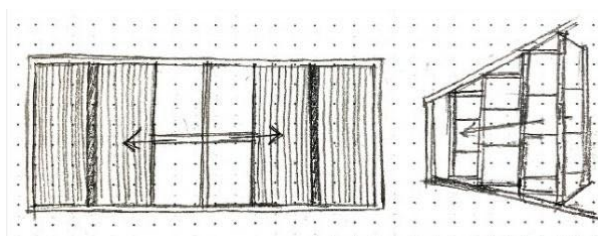
The facade is the first thing the public can see from the whole building, creating a memorable impression that produces various perceptions for those who see it (Sastra, 2013). One aspect that can increase the aesthetic value of the facade is the application of secondary skin. In addition, secondary skin or double skin facades are also widely used in buildings to reduce sun exposure in the room. Thus, secondary skin is widely applied to buildings with a tropical climate and a relatively high sunlight intensity. Double Skin Façade or DSF is an additional building wall, generally transparent and installed above the existing wall (Dewi et al., 2020). Secondary skins were first applied in early 1849 by Richard Steiff to the Steiff Factory building. The application in the building aims to maximize sunlight and reduce heat and cold air from outside the building with a transparent layer on the exterior of the building. The application of secondary skin on the facade has several benefits, such as protecting the house from exposure to excessive sunlight, which can cause health problems, can reduce heat in the room, protecting from extreme weather hazards, facilitating air circulation, increasing the privacy of space users, and can increase the aesthetic value of the facade building exterior (Sumberjaya Laser, 2021). The secondary skin has various types of forms according to the needs of each room user, and there is even a second skin that can be operated in its use. Considerations that can be considered when choosing a secondary skin can be seen from the type of activity in the room that will affect the amount of light needed in the room to produce several choices of shapes and sizes of secondary skin openings so that they can maximize the need for natural light in the room. In addition, it can also be seen that the overall concept of the building increases its aesthetic value. The operation of the openings on the secondary skin also influences the shape of the second skin. There are four types of design: open-close design, folding design, slide design, and dead opening design (Zulfikar, 2020).

The first type of secondary skin is an open-close design that can quickly adapt to user needs because it is like a window that can be opened and closed. If the user needs more light, it can unlock as many secondary skins as needed. If you need privacy in the space, you can complete the secondary skin again.



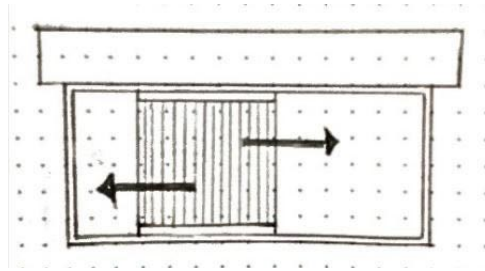
**Figure 1.** The type of opening of the secondary skin is open and close  
Source: Sketch, 2022

The second type is a folding design, similar to a folding door, and the open and close design of this type of folding can adjust to user needs but requires a more extensive area when folded. This form also requires more care for the smoothness of the second skin when folded.



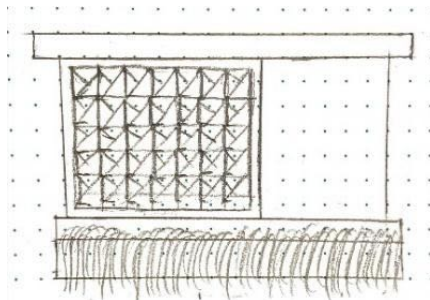
**Figure 2.** Folding secondary skin opening  
Source: Sketch, 2022

The next type is slide design which can also be applied to the 1st floor, saves more on using materials, and can regulate which parts want to protect from the sun. If using this type of opening also covers only a few wall surfaces.



**Figure 3.** Sliding secondary skin opening  
source: Sketch, 2022

The last type is a dead opening design; this type cannot be operated on or changed from the building's initial design, making it less flexible. However, this type can produce various horizontal or vertical lines or geometric shapes such as rectangles, circles, and triangles. Because it cannot be moved or shifted, this design requires careful planning and considering the shadows generated in the room.



**Figure 4.** Dead skin secondary opening type  
Source: Sketch, 2022

### **Eco-friendly Material**

Secondary skin can be produced from various types of material because there is no particular material to form it. Material is an aspect of choosing secondary skin because it can affect the aesthetics of the exterior of the building, the way of installation and operation, as well as the concept of the building. The choice of material on the second skin will affect the heat transfer in the building because each material has a different ability to conduct heat. Resistance to heat, sunlight, and moisture is also an aspect of secondary skin material (Kurniansyah, Nugroho, & Martiningrum, 2016). The selection of environmentally friendly materials is one of the steps in the property sector to suppress existing environmental pollution. Environmentally friendly materials are materials sourced from nature and do not contain substances that can interfere with health, such as natural stone, wood, bamboo, and clay (Ervianto, Soemardi, Abduh, & Surjamanto, 2013). Environmentally friendly materials that can

apply to secondary skin are wood, used/recycled materials, bamboo, roster brick, and vegetation.

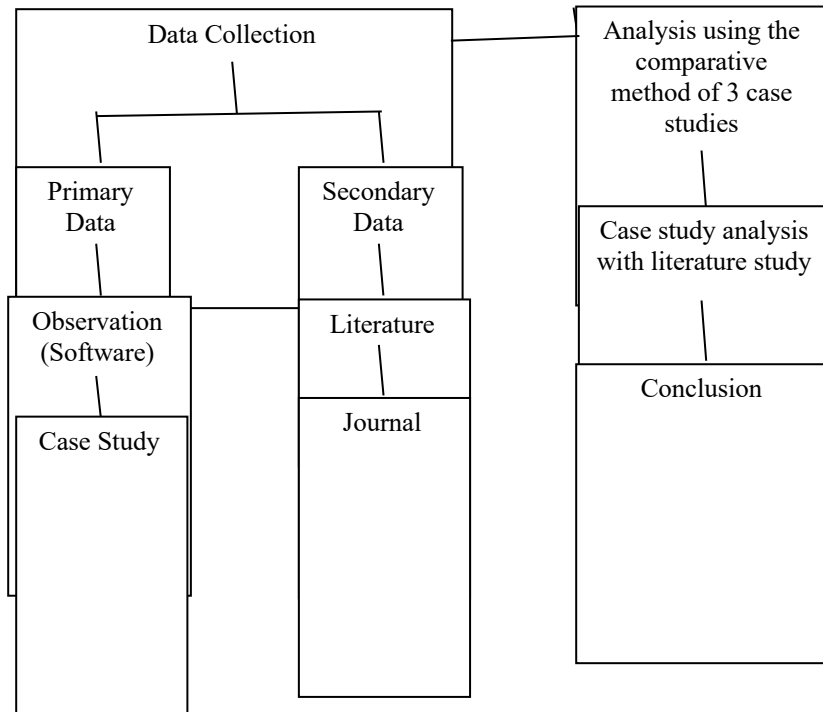
Wood has become a material that is often used to build a building. The advantages of wood are that it is easy to obtain and environmentally friendly because it can absorb CO<sub>2</sub> gas, and processing that does not require much energy. However, the use of wood must also be balanced with sound forest management. The use of wood will also make the dwelling feel more relaxed and natural. Next, used/recycled materials such as plastic banner in research can be innovated in their constituent materials needed because it has yet to be widely explored, one of which is plastic banners (Amijaya, 2019). The plastic banner is a thermoset plastic type that cannot follow temperature changes (irreversible), so a laminate and adhesive method are needed for its application. Bamboo material begins when the bamboo is harvested, transported and stored, cleaned of attached pests, preserved, and then preserved (Muhsin, Bimo, Faudina, Fadhil, & Sakinah, 2020). The characteristics of bamboo itself have advantages and disadvantages. The advantage of bamboo is that it is a material that is easy to find and grows faster than wood. The resistance of bamboo to fire is higher than that of wood. Bamboo also has an elastic structure and has lightweight. Bamboo has several drawbacks; it cannot be protected effectively using wood preservatives, and bamboo cannot withstand a too-heavy structure because of its cylindrical shape.

The next one is roster brick; a roster is a product of building materials made of a mixture of cement, sand, and water in a cube (Mauldin & Nurhasan, 2019). Roster brick is made of clay, and the manufacturing process is similar to making pottery or pottery. The roster itself has many types depending on the shape of the opening. The last one is vegetation, such as a green wall. A green wall is a development of the basic strategy of a double-skin facade by utilizing vegetation as the outer material (Dewi & Bakhtiar, 2017). Applying a green wall also has several ways, such as with a planter box + wire/steel so that vines can fill the area. Second, compact cells, where plants are planted in an insulated area above the wall so that the plants can be diverse. The third can be with a pot that is hung on the wall of the building. The lack of green land makes vertical gardens a solution to replace green space so that a particular climate comfortable for the surrounding environment can be formed (Destiawan & Purwanto, 2021)

## **Methods**

This study uses a comparative qualitative research method with a qualitative approach. The primary data collection is carried out primarily by making observations using software to visualize the secondary skin form and secondarily through journals and literature needed for research. The analysis is carried out using a comparative method related to the application of secondary skin on buildings with qualitative data, Reviewing and analyzing three objects that are used as objects of study, conducting a comparative method that compares three types of secondary skin objects in resort hotel buildings both in form and material with different functional contexts. So that the analysis carried out is more comprehensive and the data comparison results can

be grouped in the form of secondary skin and environmentally friendly materials that can be applied to Resort Hotel buildings. The three objects of study for secondary skin are Ananta Legian Hotel Bali by Airmas Asri (2012), EcoSuites, A Reed-Clad Hotel, Greece by Alex A. Tsolakis Architecture (2018), and Lenora Hotel Bandung by RDMA (2019). At the same time, the three study objects for environmentally friendly materials on secondary skins are Amnaya Resort Kuta by Grounds Kent Architects (2017), Four Points by Sheraton Bali, and Potato Heads Studio Hotel Bali by OMA Architects (2020).



**Figure 5.** Research Method Scheme

Source: Schematic, 2022

## RESULTS AND DISCUSSION

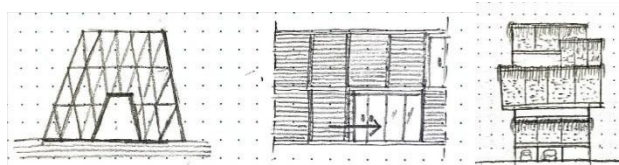
In this study, two objectives are to be achieved: identifying the shape of the opening on the second skin and environmentally friendly materials that can be applied to resort hotel buildings.

### Secondary skin opening

Secondary skins have various types of openings, both living and dead. Live secondary skins require more calculation of operational issues, such as the direction and shape of the opening. This section will explain three secondary skin variables in 3 different building cases. The variables are how to open or operate the secondary skin, the form

of the secondary skin, and the resulting image. Comparisons are made based on 3 study objects, namely case 1 Ananta Legian, case 2 EcoSuites A Reed-Clad Hotel, and case 3 Lenora Hotel Bandung.

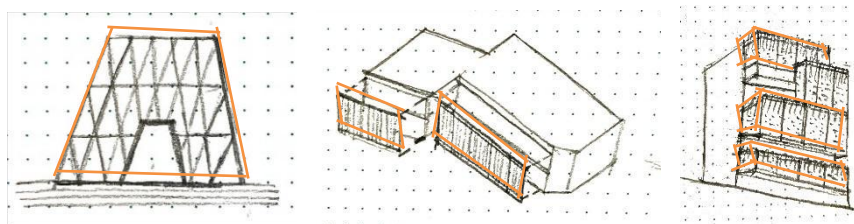
For how to open or operate openings based on a comparison, it was found that resort hotel buildings use more dead openings than live openings. Dead openings are widely used because there is minimal risk of damage due to operation. In case 2, use a living opening, which is a sliding double-function, to protect against excessive sunlight and as a door to the terrace area of each room so that it can be used flexibly for guests staying overnight. In cases 1 and 3, the secondary skins function alone, so they do not need a second skin that can be opened.



**Figure 6.** Variable 1: How to open

Source: Moify from (Ananta Legian Hotel / Airmas Asri, 2013); (González, 2018); (Abdel, 2020)

A modified rectangular base shape dominates the shape of the second skin. In case 1, choose a trapezoidal shape, like a pyramid with a triangular base shape that covers the lobby area. This shape was chosen to give a deep impression on visitors entering the hotel area. Whereas in cases 2 and 3, choose a basic rectangular shape following the shape of the building to maximize the use of the secondary skin itself. Moreover, in the case of 3, the rectangular shape was modified into a box that covered four open balconies so that they were too exposed to the main road and to cover the AC ducts, which could interfere with the aesthetics of the building's facade. With the selection of the shape of the net - the net can provide more privacy but is less than optimal in protecting against sunlight from the east, so the application of this net is also intended as a vertical garden medium to block excess sunlight into the balcony area. The shape of the secondary skin is also influenced by the operation of the opening on the secondary skin itself (Zulfikar, 2020), so the operation and shape of the secondary skin are interconnected.

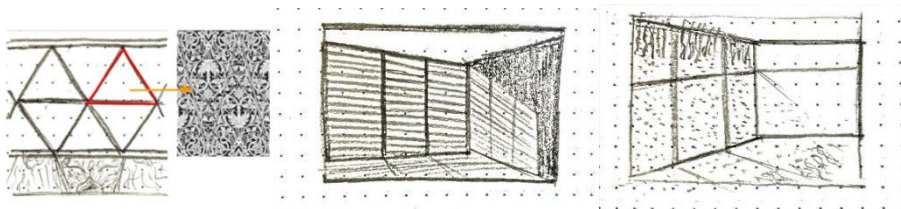


**Figure 7.** Variable 2: Shapes

source: Modify from (Ananta Legian Hotel / Airmas Asri, 2013); (González, 2018); (Abdel, 2020)



As for the shadows produced, it adapts to the application of the shape of the second skin and the material used. Private areas tend to produce shadows that do not interfere with the visual not to disturb the space users. However, the public area can be explored more to give the impression or characteristic of the building, as in case 1. In case 1, the resulting image is the Balinese flower ornament from I Wayan Lungguh's painting which was modified into a secondary skin. In cases 2 and 3, place the second skin in the room area (Private) so that the resulting image is only like the basic shapes such as nets and lines. The need for secondary skin in the hotel resort area can pay attention to aspects of space function, user privacy, and exterior aesthetics and maximize the secondary skin function, protecting against excessive sunlight.



**Figure 8.** Variable 3: Shadows

source: Modify from (Ananta Legian Hotel / Airmas Asri, 2013); (González, 2018); (Abdel, 2020)

The following is a comparison of the form of secondary skin openings from 3 resort hotel function buildings:

**Table 1.** Comparison of types of secondary skin openings in 3 resort hotel buildings

Variable	Case 1	Case 2	Case 3	Findings
How To Open	Dead Opening	Slide Opening	Dead Opening	Dominated by dead openings
Shapes	Trapezoid inspired by Pyramid	Rectangle	Box	Dominated by a rectangular base shape
Shadows	Bali Flower Ornament	Line	Net Shaped	Private areas prefer shadows that interfere with visuals.

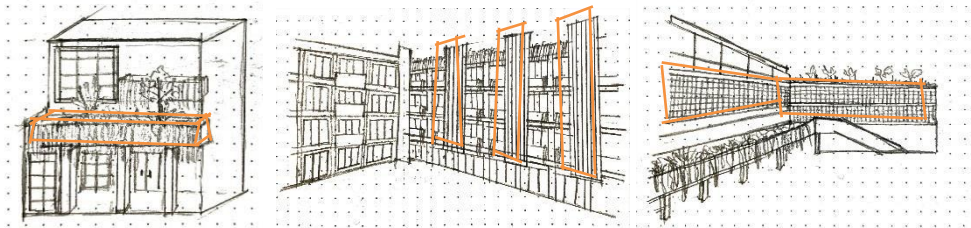
Source: Survey, 2022

### Eco-friendly Material

Secondary skin can be produced from various types of material because there are no special provisions regarding the material. So many types of materials can be applied to become secondary skins. Environmentally friendly material is one of the most chosen materials for the second skin of buildings because they can also increase the

aesthetic value of the exterior of the building. This section will explain three variables of secondary skin environmentally friendly materials in 3 different building cases. The variables are the form of secondary skin, secondary skin material, and aesthetic value. The comparison is based on 3 study objects: case 1 Amnaya Resort Kuta, case 2 Four Points by Sheraton Seminyak Bali, and case 3 Potato Heads Studio Hotel Bali.

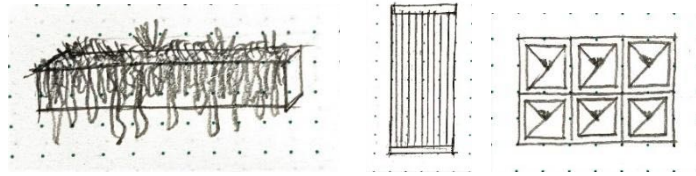
The secondary skin shape is dominated by a rectangular base shape following the shape of the building and the existing space requirements, as in cases 2 and 3, which have a rectangular shape but different arrangements. Case 2 is arranged vertically, and case 3 is arranged horizontally to reduce solar heat. The case of 2 vertically arranged forms can also provide more privacy for space users because they face a public area. In case 3, the overall horizontal shape is also chosen to serve as a barrier between the inner and outer spaces, namely the corridor area. In contrast to case 1, it uses a basic rectangular shape that is formed into a planter box as a medium for placing vegetation on the roof. Using vegetation as the outer material of a Second Skin in the form of a green wall is a development of the basic strategy of a double-skin facade by utilizing vegetation as the outer material. (Dewi & Bakhtiar, 2017).



**Figure 9.** Variable 1: Shapes

source: Modify from (Our Artists | Kuta - Amnaya Hotels Resorts Kuta); (Nancy, 2021); (Pintos, 2020)

Environmentally friendly materials used are those that come from nature and do not contain substances that can interfere with health (Ervianto, Soemardi, Abduh, & Surjamanto, 2013) as in case 1, namely vegetation that is easy to care for and can produce O<sub>2</sub> and absorb CO<sub>2</sub> so that can increase the fresh air around the building and reduce pollution. Based on research (Dewi & Bakhtiar, 2017) on the use of green walls as secondary skins, green walls effectively reduce buildings' cooling load by up to 45%. Case 2 uses wood materials that are easy to find, processed into various forms, and can absorb CO<sub>2</sub> to improve the surrounding air quality. While in case 3, using clay rooster bricks made of natural clay, the manufacturing process is like making pottery. The shape of the brick rooster also affects the amount of light that can enter the space because a specific rooster shape will suppress the amount of natural light entering the space (Mauldin & Nurhasan, 2019). However, the advantages of this material are easy to find because the primary material that makes it comes from nature.

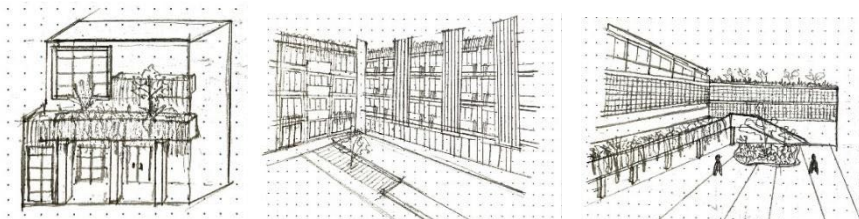


**Figure 10.** Variable 2: Materials

Source: Modify from (Our Artists | Kuta - Amnaya Hotels Resorts Kuta); (Nancy, 2021); (Pintos, 2020)

Secondary skin also needs to support aesthetics, one of which is the selection of materials. In-resort hotel buildings, it was found that the selection of environmentally friendly materials can improve the aesthetics of the building according to the concept of the function of the building and the function of the room it shelters. As in case 1, use plants hanging in the public area around the swimming pool to give a natural, cool, and calm impression. Vertical plants or hanging plants on the walls of buildings are considered to link public art with environmental aspects so that they can become living works of art (Abu Bakar, Mansor, & Harun, 2013). In case 2, using wooden lattices arranged vertically in the private area, namely the balcony of the room, thereby increasing the natural aesthetics of the hotel area, which directly faces the swimming pool area, but space users can still see outside.

Meanwhile, in the case of 3 brick roasters, they replace the corridor walls so that they are entirely placed on the outside and produce a natural impression with the colour of clay on the exterior of the building. The shift in the function of the roster from a barrier between spaces to an aesthetic element on the facade is widely used in buildings today (Mauldin & Nurhasan, 2019). The selection of the clay roster adapts to the concept of the building and is combined with the surrounding vegetation. The selection of environmentally friendly materials is very harmonious when combined with the function of resort hotels, especially those in Bali because they have great natural potential. Material selection also considers the desired shape of the opening to the space requirements of the building.



**Figure 11.** Variable 3: Aesthetics

source: Modify from (Our Artists | Kuta - Amnaya Hotels Resorts Kuta); (Nancy, 2021); (Pintos, 2020)

The following figure is a comparison of the types of environmentally friendly materials on the second skin of the three resort hotel function buildings:

**Table 2.** Comparison of types of secondary skin environmentally friendly materials in 3 hotel resort buildings

Variable	Case 1	Case 2	Case 3	Findings
Shapes	Squares (Planter box)	Rectangular	Rectangular	Dominated by a rectangular base shape
Materials	Vegetation	Wood	Roster Brick (Clay)	Using materials that are easy to find
Aesthetics	Hanging Plants	Vertical Grating	Bentuk roster	Adjusting to the concept and function of the building and space

Source: Survey, 2022

## CONCLUSIONS

Based on the comparison of the three secondary skin study objects in resort hotel buildings, it can be seen from the shape of the openings and the environmentally friendly materials used found the results of 5 variables, namely how to open, shape, shading, material, and aesthetics. Research on variable 1, namely how to open or operate secondary skin, found that resort hotel buildings use more types of dead openings because there is minimal risk of damage during operation. However, some use live openings because they have a dual function, as in case 2, as an entrance. In variable 2, namely the secondary skin form, it was found that the dominating shape is the basic rectangular shape which is modified to follow the shape of the building and by the function of the shaded space. In variable 3, namely shading, it is found that the resulting shadow adjusts to the application of the form of the secondary skin itself, which adjusts the function of the space so as not to disturb the visuals of the space used. In private areas, it tends to produce a simple image, while in public areas, it can be more explored to give the impression or characteristics of the building. In variable 4, the environmentally friendly materials at resort hotels are dominated by materials derived from nature, such as vegetation, wood, and roster bricks. In variable 5, the aesthetics of secondary skin is essential to support the resort hotel building, which can represent the concept of the building itself, such as hanging plants, vertically arranged wooden lattices, and roster bricks as a substitute for corridor walls that are exposed from outside areas. The selection of environmentally friendly materials is very harmonious when combined with the function of resort hotels, especially those in Bali because they have great natural potential.

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