

## The Application of Sustainable Materials in the Design of a Culinary Center at Klayar Beach, Pacitan

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### Abstract

Pacitan has many natural tourist destinations, one of which is Klayar Beach which is the mainstay of the Pacitan Regency Government in increasing regional income. Klayar Beach has experienced an increase in the number of visitors, so it needs supporting facilities that can be used by visitors while on Klayar Beach. It is also hoped that the design of the Culinary Center can improve the economy of the people around the Klayar Beach area. The use of Sustainable Materials was chosen as a solution to problems that respond to environmental conditions at Klayar Beach. The selected sustainable material that is applied to the design is bamboo material which is widely used by people in Pacitan. Bamboo is a sustainable material because it grows faster, is stronger, cheap and easy to get, is flexible, and lasts a long time with a pre-preservation process. The design method with descriptive qualitative includes problem identification, data collection, analysis and concept synthesis. The data collected is in the form of primary and secondary data and then analyzed so that the results obtained will be applied to the synthesis of the design concept. The final results obtained are to get the concept of mass composition, and the concept of building structures that respond to the environment by using bamboo materials as an implementation of the selected sustainable material concept.

**Keywords:** Culinary center, Klayar Beach, Sustainable Material, Bamboo.

### I. INTRODUCTION

Pacitan is one of the cities in Indonesia which has beautiful natural attractions. Pacitan natural tourism is the main attraction for visitors, so it can increase regional income. Beach tourism dominates tourism in Pacitan, because it stretches from the east to the west on the south side of Java Island. Klayar Beach is one of the most beautiful beach attractions and the most popular beaches in East Java, so it is known as one of the beautiful beaches in Indonesia.

Table 1. Number of Tourist Visitors in Pacitan

Tourist Destination	Number of Visitors
	2019
Pancer Door Beach	54.985
Srau Beach	115.071
Waturung Beach	252.935
Klayar Beach	699.429
Buyutan Beach	46.072
Taman Beach	24.416
Gong Cave	358.346
Tabuhan Cave	21.544
Banyu Anget	136.325

Source : pacitankab.bps.go.id

Klayar Beach is located in Sendang Village, Donorojo District, Pacitan, so it is still included in the south coast chain, so it offers a typical south coast atmosphere such as big waves, white sand beaches, and beautiful stretches of beach. At the end of 2017, Klayar Beach became one of the beaches that was hit by the Cempaka Storm followed by floods and landslides in Pacitan. At least 5,000 residents had to be evacuated, and 25 people died. When Hurricane Cempaka occurred, Pacitan turned into a disaster area which was very badly affected, lots of damage occurred everywhere. As a result of the cyclone, Klayar Beach suffered some damage, especially to the kiosks located in the east coast zone. The distance is only 7-10 meters from the beach.[1]



Figure 1. View of Klayar Beach  
Source : [www.sweetrip.id](http://www.sweetrip.id)



Figure 2. Impact of Cempaka Storm in Klayar Beach  
Source : [news.detik.com](http://news.detik.com)

Recovery of Klayar Beach after Cempaka Storm was not optimal yet, a year later the world was hit by the Covid-19 pandemic in 2019, so that visitors who came experienced a significant decrease. Currently the tourism sector in Pacitan began to reopen at the end of 2021, and is now slowly experiencing an increase of visitors.



Figure 3. Pembukaan Destinasi Wisata Pacitan  
Source : [pacitankab.go.id](http://pacitankab.go.id)

After the reopening of tourist destinations in Pacitan, Klayar Beach has slowly increased the number of visitors, so that improvements are needed in terms of facilities and infrastructure such as supporting facilities that visitors can take advantage of while on Klayar Beach. Thus, the visitors who come will increase. One of the facilities that can support the increase in tourism and the economy at Klayar Beach is by providing a Culinary Center which is expected to be a facility for visitors while enjoying the beauty of Klayar Beach, while helping to improve the economy of the surrounding community. Apart from having beautiful natural tourism potential and unique culinary delights, Pacitan also has other potentials such as bamboo as a local material which can be found growing in Pacitan. This also has an impact on the economy of the people who work as woven bamboo craftsmen.

Sustainable Architecture is a design approach that unifies and balances the aspects of quality of natural environment, social needs & equity, and economic growth, so that the limited needs of natural resources (non-renewable energy, materials and water) can still be fulfilled in the present, without endangering needs for

generations to come.[2] According to Mangunwijaya (1980) Sustainable architecture is an environmentally friendly building, which is designed and built with sustainable technology, sustainable building materials, as well as a sustainable energy system that does not have a negative impact, especially on the environment for future generations.[3] Sustainable Architecture can be applied by selecting materials to be used in building structures, building exteriors, room interiors, quality air circulation arrangements, and so on. So that it can be said that sustainable architecture is a design concept that applies energy efficiency, such as space-forming materials and furniture, lighting, ventilation.[4] Kamionka (2019) explains that sustainable architecture must be understood as architecture that is implemented in accordance with the principles of sustainable development and standards set by taking into account all issues related to integration and the environment, energy efficiency, water and waste management, material efficiency and management of raw materials, preference local as well as comfortable use and quality.[3] The principle of sustainability is a guideline in which the relationship between the natural environment and humans is closely interrelated to create a sustainable and better life.[4]

According to Innovative Design (2005) the sustainability parameters are as follows:

1. Low building operation and maintenance costs
2. Maintaining the preservation of the surrounding natural environment
3. Buildings that are healthy, safe, and comfortable
4. Support local community values
5. Building as needed
6. Buildings as a learning tool for sustainability[5]

One of the advantages about sustainable materials is their strong durability. It can be ensured that building construction using sustainable materials, if used for a long time, will not experience a shortage of supply during the replacement process. In addition, the thing that must be considered in choosing sustainable materials is that these materials come from plants that is easy to grow, can be recycled, and are available locally so they are easy to find. Sustainable materials are those that consume the least amount of energy, emit less waste, and ensure that they continue to be made or developed. So, if a lot of people buy materials from far away locations, the transportation costs and the distribution process can be bad for the environment. Sustainable materials will also not use large amounts of CO<sub>2</sub> in the production process.[6] An unnecessarily high carbon footprint is created when buildings are designed using materials which have travelled from far afield and you have less control over how these materials are harvested. By creating sustainable buildings, we can enrich lives and provide healthier working and living environments through the use of non-toxic building materials.[7] Therefore, using locally produced or grown materials for building is a good idea to minimize energy use. sustainable material philosophy: respecting the needs of society in present and future generations, energy efficiency such as natural resource management, and sustainable solutions that are cost effective, easy maintenance.[8]

The design of the Culinary Center at Klayar Beach uses bamboo material as a sustainable material so that it can become a sustainable building that can take advantage of natural potential and use building materials in its environment. Bamboo is a renewable and versatile resource, characterized by high strength and low volume weight, and easy to work with simple tools. Bamboo plants are plants that have extraordinary resistance with high enough strength, their tensile strength can be compared to steel. Therefore, bamboo is widely used for various forms of building construction. The moment of humidity in bamboo is high, because bamboo is in the shape of a pipe so that bamboo is good enough to carry bending moments. Bamboo also has elastic properties, high resistance to lateral loads such as wind and earthquakes.[9]



Figure 4. Bamboo Plant

Source : [www.independenmedia.id](http://www.independenmedia.id)





Figure 5. Bamboo types in Indonesia  
Source : [www.selasar.com](http://www.selasar.com)

The benefits of bamboo are numerous. First of all, it is a natural anti-bacterial that will help buildings where there are children or people who cannot come into contact with bacteria for fear of getting sick. Another great feature of bamboo is that it is water resistant, which makes it a better choice than wood which can stain or damage in humid weather. Bamboo is also a very durable material that is easy to move because it is light, yet tough enough to give you a strong construction.[6] The largest bamboos rise up to 30-40 meters and 30 centimeters in diameter. According to data from the International Bamboo and Rattan Organization (INBAR), bamboo has a very high ability to store or absorb carbon dioxide compared to other plants.[10]

## II. RESEARCH METHOD

The method used is descriptive qualitative. The purpose of the qualitative descriptive method is to thoroughly explain the problems found which will then be examined and observed. In addition, to answer the problem formulation and research questions/identification of research problems that have been formulated previously, so that these problems can be resolved. The data that has been collected in the form of primary data and secondary data will then be processed and analyzed to obtain a synthesis in the form of a design concept that will produce an appropriate design. The analysis carried out was in the form of site analysis, mass composition analysis, approach analysis as a reference for obtaining the design results of the Klayar Beach Culinary Center that apply sustainable materials.

## III. RESULT

The concept of Sustainable Material that is applied focuses on the use of bamboo materials. However, it is also supported by other sustainable materials such as bricks, straw, clay and wood. The use of natural materials such as wood and bamboo which are applied to the building of the Klayar Pacitan beach culinary center, such as the use of wood for floors, bamboo as the main structure of the building (middle structure and superstructure) and secondary skin, as well as roofs made of roof tiles and thatch. An overview of the design strategy used is shown in the figure below.

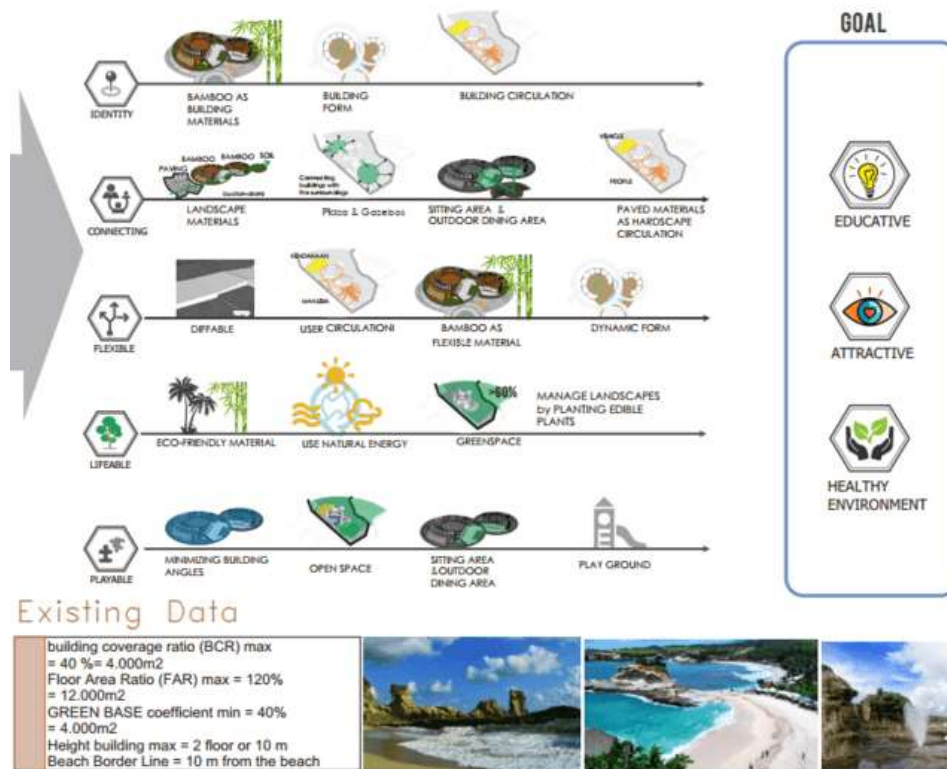


Figure 6. Design Strategy  
 Source : Researcher's analysis, 2022

A. Sustainable land-use

Planting in several site locations, especially those that receive high sunlight with edible vegetation. Land as a natural resource will be better if it is used as best as possible by planting. So that the land will remain fertile.

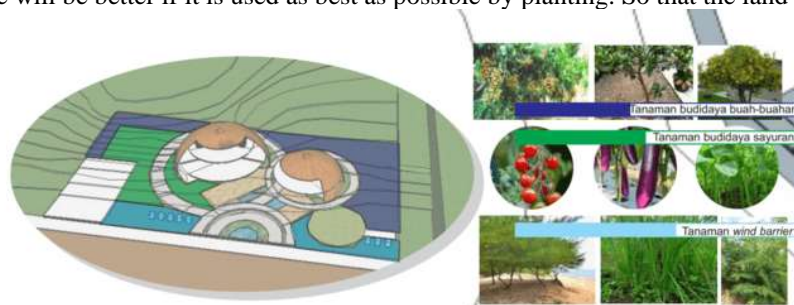


Figure 7. Sustainable land-use  
 Source : Researcher's analysis, 2022

B. Sustainable energy

Utilizing solar energy as natural lighting in the Culinary Center building on Klayar Beach.



Figure 8. Solar energy as natural lighting  
 Source : Researcher's analysis, 2022



Rainwater Utilization System, rainwater is collected and used for watering the garden area in the Culinary Center site on Klayar Beach.

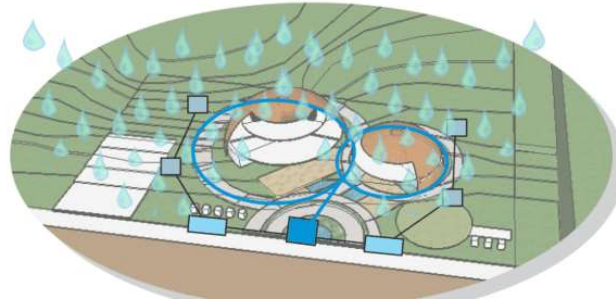


Figure 9. Rainwater Utilization System  
Source : Researcher's analysis, 2022

#### C. Healthful environment

On the ground floor, it is not fully paved so that the soil can become an optimal water absorption area. Minimizes cut and fill on the site.



Figure 10. Natural landscaping  
Source : Researcher's analysis, 2022

#### D. Sustainable form

The circular shape was chosen because it is suitable for depicting the concept of sustainability. The main function of a sustainable form is to design a mass form that can maintain harmony with the habitat and nature. Its circular shape minimizes the corners of the building thereby protecting it from possible threats. Based on the analysis of the mass shape of the building, the resulting mass shape adopts a non-rigid natural shape. In addition, this form also follows the elastic properties of bamboo. The building has the basic shape of two hemispherical compositions, and is connected by a sky walk.

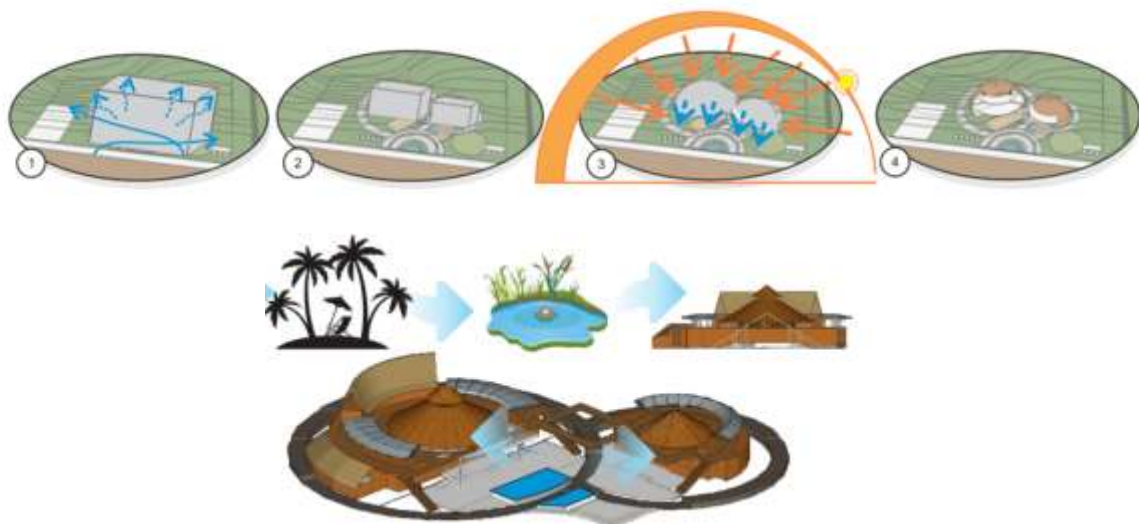


Figure 11. The circular shape as sustainable form  
Source : Researcher's analysis, 2022

E. Sustainable materials

The sustainable material used as the main building material is bamboo. The use of bamboo materials that is applied to the Klayar Pacitan beach culinary center building, such as bamboo as the main structure of the building (middle structure and superstructure) and secondary skin, the roof is made of bamboo and coconut leaves.

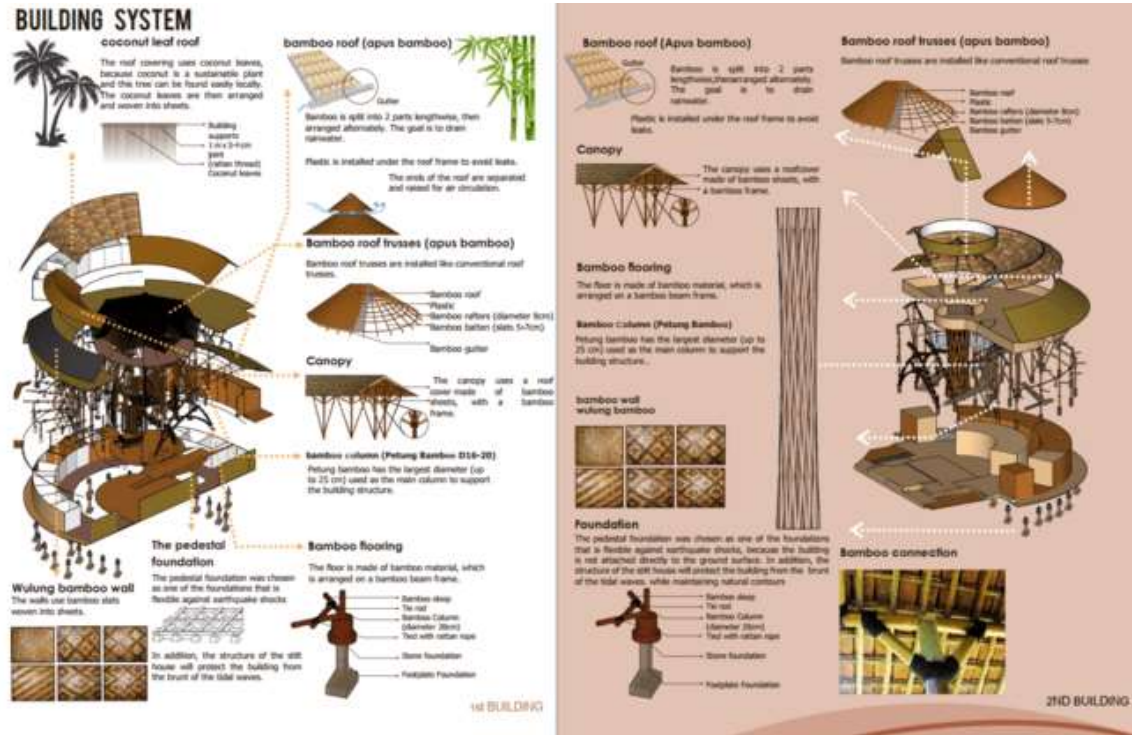

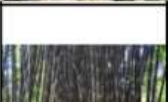





Figure 12. Building System  
 Source : Researcher’s analysis, 2022

Table 2. The type of bamboo used in the design

NO	Bamboo Type	Size (Diameter)	length	Needs	Picture
1	Petung Bamboo	diameter 16-20	25m	Structure Column	
2	Petung Bamboo	diameter 12-15	25m	Column	
3	Petung Bamboo	diameter 12-15	25m	Beam	
4	Wulung Bamboo	diameter 8-13	20m	Wall (bamboo sheets)	
5	Wulung Bamboo	diameter 8-15	20m	Furniture	
7	Apus Bamboo	diameter 8-10	7-8m	Roof truss (battens and ribs)	
8	Pring Ampel Bamboo	5-10cm	25-45cm	Landscape	

Source : Researcher’s analysis, 2022



Figure 13. Siteplan  
 Source : Researcher's analysis, 2022

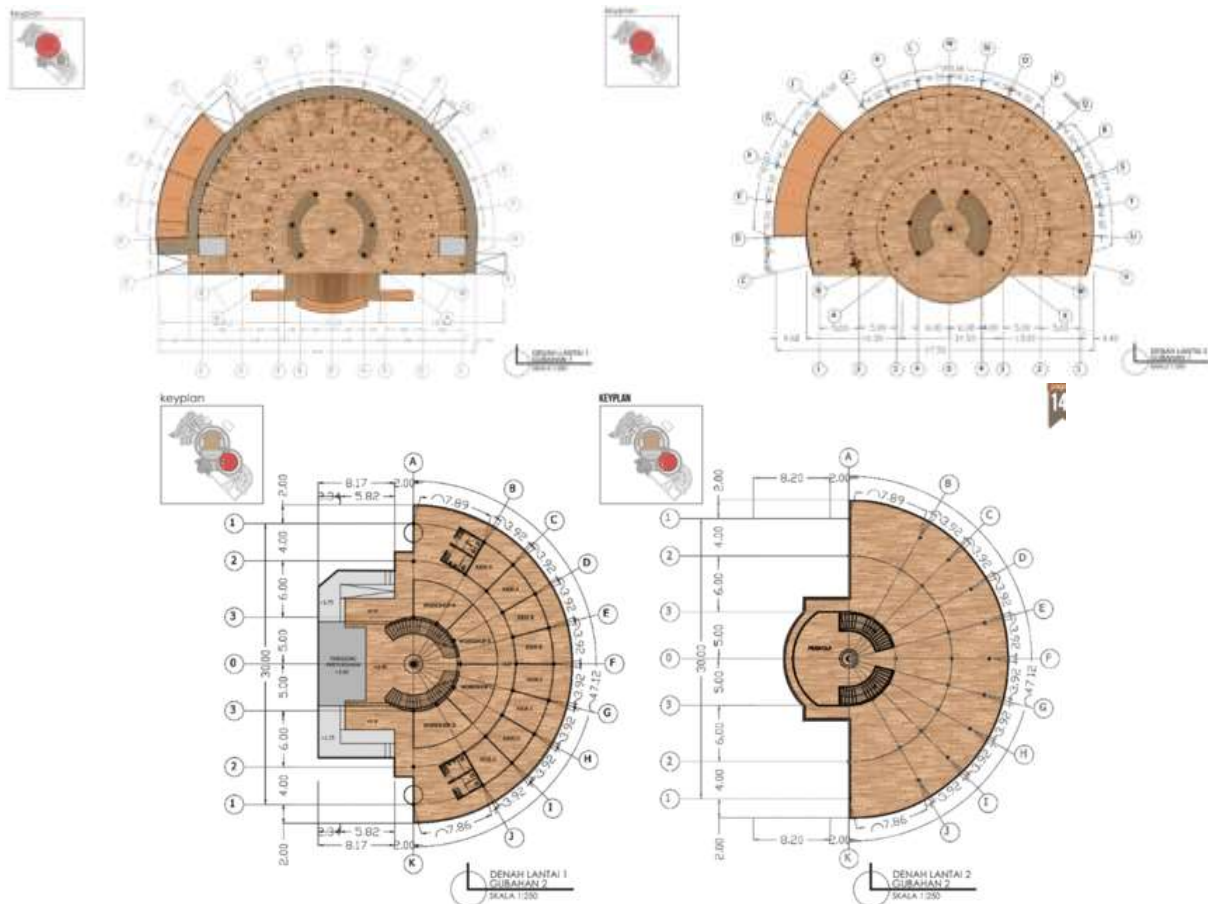


Figure 14. Layout Plan  
 Source : Researcher's analysis, 2022





Figure 15. Building facade  
Source : Researcher's analysis, 2022



Figure 9. Building section  
Source : Researcher's analysis, 2022

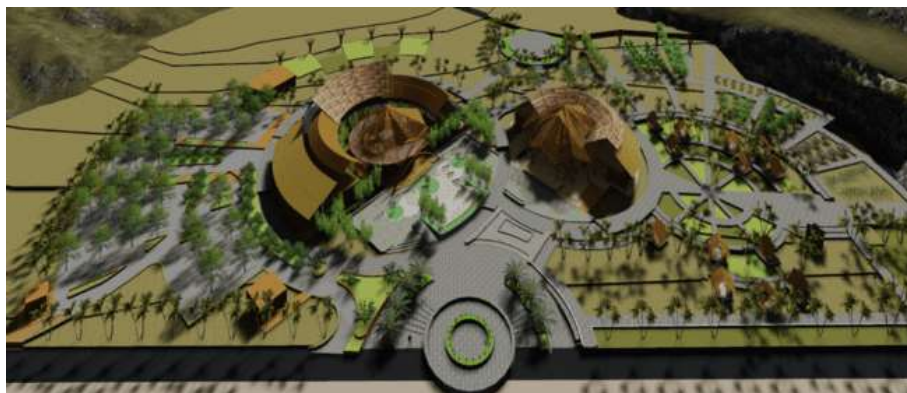


Figure 16. Aerial View  
Source : Researcher's analysis, 2022



Figure 17. Human View from the Park Area  
Source : Researcher's analysis, 2022



Figure 18. Human View of Plaza  
Source : Researcher's analysis, 2022

#### IV. CONCLUSION

1. Sustainable Architecture is a design approach that unifies and balances the aspects of quality of natural environment, social needs & equity, and economic growth, so that the limited needs of natural resources.
2. Sustainable Architecture is an environmentally friendly building, which is designed and built with sustainable technology, sustainable building materials, as well as a sustainable energy system that does not have a negative impact, especially on the environment for future generations.
3. Characteristic of sustainable materials :
  - 1) has a strong durability as a building construction and architectural element if used for a long time,
  - 2) will not experience a shortage of supply during the replacement process,
  - 3) renewable and versatile resource, can be recycled, if these materials come from plants that is easy to grow
  - 4) available locally so they are easy to find.
  - 5) consume the least amount of energy, and emit less waste in the manufacturing process
  - 6) ensure that they continue to be made or developed.
  - 7) can respond to contextual environmental conditions

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