



# Application of Sustainable Architecture Principles to Urban Green Open Spaces (Case: The Teras Cikapundung, Bandung, West Java)

June Ekawati<sup>1,\*</sup> Tasya Sabila Ardiyanti<sup>2</sup>

<sup>1,2</sup>Universitas Kebangsaan Republik Indonesia, Bandung City, West Java 40263, Indonesia  
ekawatijune@gmail.com

**Abstract.** The development of urban green open spaces within the framework of environmentally friendly sustainable architecture is one of the human efforts to create a better life without hindering opportunities for future generations. The Cikapundung Terrace is one of the urban green open spaces occupying the river border in Bandung City, West Java, Indonesia, built to support sustainable city programs. This research aims to determine the principles of sustainable architecture applied to green open spaces on the Cikapundung Terrace. This research uses a mixed method with a descriptive-quantitative research approach. The data collection techniques used were field observations, interviews, and documentation, with data analysis using scoring techniques on the application of site and land use principles, energy use, material use, waste management, water management, community role, and site vegetation. Based on the research results, it can be concluded that the principles of sustainable architecture applied to the green open space in Cikapundung Terrace are not good enough, with a total score of 44 and an average score of 2.32. Therefore, there needs to be considerable attention to improvements in the application of the principles of energy use and waste management, as well as minor improvements in the application of the principles of site planning and management, water conservation, prevention of hazardous and toxic materials, and community participation.

Keywords: Sustainable Architecture, Urban Green Open Spaces, Cikapundung Terrace.

## 1. Introduction

The rapid economic growth of cities, especially in developing countries, causes increasing urbanization so that cities become increasingly dense, and the need for land for housing and other facilities also increases rapidly [1]. As a result, urban development which has an impact on land use change is increasingly unavoidable. Rapid urban development also raises environmental problems at the local level that need to be immediately addressed and monitored [2]. Environmental issues such as climate change, environmental pollution, and

environmental degradation raise awareness of the need for sustainable development on three main pillars: ecological, socio-cultural, and economic.

According to the Report of the World Commission of Environment and Development in 1987, “Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland Report, 1987). Sustainable development must balance social, economic, and environmental sustainability [3], where all Sustainable Development Goals must be integrated because they will influence each other. To minimize the environmental impact of development, sustainable architecture emerged, defined as architecture that does not waste energy, does not require expensive maintenance costs, and is not a building that has poor insulation or too much glass [4]. In this research, Sustainable Architecture can be understood as an applied concept in the field of architecture. To support sustainable urban development, sustainable architecture is carried out by carrying out efficiency and moderation in the use of materials, energy, and development space with an energy conservation and ecological approach in the design of the built environment, so that what is used does not hinder the opportunities for future generations.

The development of urban green open spaces within the framework of environmentally friendly sustainable architecture is one of human efforts to create a better life. Green architecture, in this case, urban green open space, can even provide environmental, social, and economic benefits [5,6]. The issue of environmental pollution in big cities in Indonesia such as Jakarta, Bandung, and Yogyakarta, which has become a trending topic in the mass media recently, seems to remind us that urban green open spaces not only function as beautification but play a vital role in maintaining the health of city residents.

Based on the Indonesian Minister of Public Works Regulation number 5 of 2008 concerning Guidelines for the Provision and Utilization of Green Open Space in Urban Areas, it is stated that the proportion of green open space in urban areas is a minimum of 30% consisting of 20% public green open space and 10% consisting of from private green open space [7]. In Bandung City, the percentage of green open space in 2020 was around 12.25% with the percentage of city parks being 1.29% (<https://bandungkota.bps.go.id/statictable/2021/03/25/1459/potensi-ruang-terbuka-hijau-rth-di-kota-bandung-2020-.html>). The lack of availability of urban green open space in the city of Bandung is certainly a reason for the city government to continue making efforts to build green open space. Apart from that, to improve environmental quality, community happiness index and create a sustainable city, the Bandung city government and central government have revitalized green open spaces in several locations [6].

One of the urban green open spaces in the city of Bandung is the Cikapundung Terrace which has an area of approximately 5,128 m<sup>2</sup> RTH in the city of Bandung) which is a pilot green open space along the river border in the city of Bandung. Therefore, the Cikapundung Terrace certainly needs to meet the criteria for sustainable green open space in order to create a sustainable city.

The aim and objective of the research which took the case at this location is to find out how the concept of sustainable architecture is implemented in the green open space of Cikapundung Terrace and to assess the level of implementation by identifying the application of several variables in each principle of sustainable architecture. This research can be input for developing sustainable green open spaces, especially in using urban green open spaces on riverbanks in other locations, both for policymakers and the general public.

For cities, green open space is part of spatial planning which has very high life benefits [8]. It is stated in Law No. 26 of 2007 concerning Spatial Planning that "Spatial planning is expected to create a safe, comfortable, productive and sustainable living space". For this reason, public green open space management must refer to the concept of sustainable development.

There are six main principles in sustainable architectural strategies as follows [9,10]:

1. **Site & land use:** This principle includes careful selection of development locations, land efficiency, and minimizing the impact of development.
2. **Community:** The principles are related to the social environment of the community, including minimizing the use of resources and waste, limiting pollution, meeting local scale needs, ensuring community participation, and providing meaningful, beautiful, and useful places.
3. **Health & Wellness:** Health aspects that need to be considered include social, physical, and mental well-being conditions, namely creating a healthy urban environment by ensuring wide and accessible green spaces, pedestrian paths that are protected from vehicle noise, pollution, and accident hazards, as well as parks community.
4. **Material:** Among them by minimizing material requirements, using existing materials, reusing and recycling material designs, as well as minimizing material disposal and waste.
5. **Energy:** These include reducing energy needs, using energy more efficiently, and using green energy sources. Another effort in energy efficiency is zero energy or low energy building.
6. **Water:** The principles of sustainable architecture in this case include minimizing water needs, efficient use of water, and recycling water (both rainwater and used water).

In contrast to Sassi [9] who mentioned 6 pillars in a sustainable architectural strategy, previous research specifically conducted on green open spaces used 5 criteria as indicators for sustainable landscapes, namely environmental/ecological, sociocultural, economic, architectural/aesthetic and institutional [11,12]. These 5 criteria are also used as pillars in the concept of sustainable landscape development [13]. This research focuses more on the application of sustainable architectural principles so that it tends to use the principles of Sassi [9] with the novelty of modifying the addition of vegetation, where the criteria for vegetation are based on the ecological function of green open space. The ecological function

of green open space is as the lungs of the city, guardian of the microclimate, shade, windbreak, and in relation to river ecology [14].

The case studied is a green open space, so it is also necessary to deepen the material regarding green open space which in the Regulation of the Minister of Public Works of the Republic of Indonesia Number 5/PRT/M/2008 [7] is defined as "elongated areas/paths and/or clusters whose use is more open, a place for plants to grow, both those that grow naturally and those that are deliberately planted." Green open spaces function as protected areas which are also part of urban spatial planning, the aim of which is to maintain the availability of water as a catchment area, creating urban planological aspects through a balance of nature and the built environment. as well as increasing the harmony of the urban environment which is safe, comfortable, fresh, beautiful and clean River banks have various functions and benefits that must be managed properly. In Government Regulation Number 38 of 2011 concerning Rivers [15], river management includes conservation, development, and control of the destructive power of river water. River border management is included in conservation efforts to protect river borders which is carried out by determining river border lines and limiting use for certain purposes.

## 2. Method

The research was conducted in October-December 2022 in the Teras Cikapundung city park which is located on Jl. Siliwangi, Hegarmanah, Cidadap District, Bandung City, West Java, Indonesia, on the banks of the Cikapundung River.

The research method used is a mixed-method with a qualitative-quantitative research approach. The data collection techniques were carried out through field observations, interviews with management staff, site visitors, and the general public as well as personal documentation. The data collected in this research is a modification of the 6 main principles of sustainable architecture proposed by Sassi [9], namely Site and Land use, energy, water, materials, health and wellbeing, and community.

In this study, the data collected and analyzed were modified by adding data on vegetation on the site and waste management. This is because the study location is an urban green open space. The data analyzed in this research are as follows:

1. Cikapundung Terrace land use
2. Energy use on site
3. Water management
4. Use of materials
5. Waste management
6. Community Role
7. Vegetation on the site

To fulfill the above sustainability principles, each data collected is then grouped based on several applied aspects and then described according to Table 1:

**Table 1.** Applied aspects of sustainable green open space

| No | Principles        | Applied aspects   |
|----|-------------------|---|
| 1. | Site and land use | <ul style="list-style-type: none"> <li>• Ease of access</li> <li>• Conservation, reforestation, and management efforts</li> <li>• Site plan and management</li> </ul>   |
| 2. | Energy use        | <ul style="list-style-type: none"> <li>• Source of energy</li> <li>• Renewable Energy</li> <li>• Energy conservation</li> </ul>   |
| 3. | Water management  | <ul style="list-style-type: none"> <li>• Water source</li> <li>• Grey water management</li> <li>• Water conservation</li> </ul>   |
| 4. | Material use      | <ul style="list-style-type: none"> <li>• Local material use</li> <li>• Environmentally friendly and recycled materials</li> <li>• Efforts to minimize the use and prevention of Hazardous and toxic Material</li> </ul> |
| 5. | Waste management  | <ul style="list-style-type: none"> <li>• Environmental cleanliness facilities</li> <li>• Waste management</li> <li>• River trash cleaning</li> </ul>  |
| 6. | Community roles   | <ul style="list-style-type: none"> <li>• Community Participation</li> <li>• Community roles and empowerment</li> </ul>  |
| 7. | Vegetation        | <ul style="list-style-type: none"> <li>• Types of vegetation based on their function</li> <li>• Land cover</li> </ul>   |

Source: Author analysis, 2022

From the results of the recorded observation data obtained, an analysis was then carried out by giving a score on a scale of 1-3 as a quantitative analysis. A value of 1 is for implementation that is not good, a value of 2 is for implementation that is quite good and a value of 3 is for implementation that is very good. The total results of this assessment can be used as a reference for providing input regarding which aspects have not been implemented well so that later they can become input for the management of the Cikapundung Terrace area. The minimum score is 19 and the maximum score is 57. So, the total assessment range is: for a total score of 19-31 is not good, 32-44 is not good enough, while 45-57 is very good.

### 3. Result and Discussion

#### 3.1. Description of the Teras Cikapundung



Fig 1. Site Plan of The Teras Cikapundung (Source: Author documentation, 2022)

The Cikapundung Terrace is part of the Cikapundung River Restoration Project which is a work program of the Citarum River Basin Center (*Balai Besar Wilayah Sungai*). This restoration was carried out as an effort to organize the Cikapundung River Border Area for natural functions (for maintaining water quality) as well as for social functions (for tourism and education).

Based on the surface temperature distribution map, areas located in western Bandung have surface temperatures that tend to be high, namely 26-32°C [16]. Therefore, the existence of the green open space of the Cikapundung Terrace needs to be strengthened because it plays an important role in reducing the urban heat island, which will have a negative impact on the thermal comfort of residents in this area. This Urban Green Open Space also provides public open space as a means of conservation, education, and sports and opens up opportunities for economic empowerment of the surrounding community.

The Cikapundung Terrace area is divided into two namely the concretization area and the natural area. The concretization (man-made) area is directly adjacent to Jalan Siliwangi, while the natural area is directly adjacent to the slope of the Babakan Siliwangi City Forest (Figure 1), which is also the boundary/enclosed wall on the north side. The river divides the two zones and has different levels from the two areas.



**Fig 2.** Division of Space at TheTeras Cikapundung (Source: Processed from The Teras Cikapundung Information Board, 2022.)



**Fig 3.** Amphitheater at TheTeras Cikapundung (Source: Author documentation. 2022)

To support its social function as a tourist and educational location, the Cikapundung Terrace site is also equipped with supporting facilities (Figure 2) such as an amphitheater (Figure 3), a flower garden, Cikapundung habitat fish pond, and an educational area. This facility is intended to attract people's interest in visiting and participating in various activities held at this location

### 3.2. Data Analysis

#### Site and Land Use

Site is the main aspect of the concept of sustainable architecture. This can be observed from the increase in population in cities every year, causing the demand for land to meet community needs to be very high, but the carrying capacity of land is getting lower. The following (Table 2) are the results of site and land use analysis from The Teras Cikapundung.

**Table 2.** Analysis of Site and Land Use

| Applied Aspects | Observation Result   |
|-----------------|--|
| Ease of access  | <ul style="list-style-type: none"> <li>• The Cikapundung Terrace can be accessed from Jalan Siliwangi with paved roads, both by motorized vehicles and bicycles. For pedestrians, there are sidewalks along Jalan Siliwangi</li> <li>• This location can also be accessed by public transportation on the Cicaheum-Ledeng route and the Cicaheum-Ciroyom route. The closest bus stops to this location include Jalan Sangkuriang (322 m. from the location), BRI Ciumbuleuit (346 m.), Taman KS (486 m.), Jalan Sumur Bandung (603 m.).</li> </ul> |

| Applied Aspects  | Observation Result   |
|--|--|
| Conservation, reforestation, and vegetation management efforts | <ul style="list-style-type: none"> <li>• Integrated site entry access for motor vehicle users, bicycle users, and pedestrians</li> <li>• In natural areas, efforts are made to keep land vegetation natural by prioritizing existing vegetation as well as reforestation efforts in man-made areas.</li> <li>• Plant management (especially in the man-made area) is carried out at the same time as cleaning the Cikapundung Terrace area, every Friday.</li> </ul> |
| Site plan and management                                       | <ul style="list-style-type: none"> <li>• There is a parking area for motorized vehicles, but there is no special parking for bicycles.</li> <li>• Accommodate community requests to allocate space for the establishment of 4-5 kiosks (1 in the man-made area, 4 in the natural area) which were not previously planned.</li> </ul>   |

Source: Author analysis, 2022

From Table 2, it can be seen that there is easy access to the Teras Cikapundung site, both by private and public transportation, The management of the site is also quite good by working on land preservation and reforestation programs and accommodating the needs of the surrounding community.

Ease of access for motorized vehicle users and pedestrians has been met. However, the paths are not separated and there are no lanes for cyclists. The parking area is not well arranged so space utilization in this area is less than optimal. Efforts to preserve and green plants (vegetation) manage them well and maintain existing vegetation in natural areas. The existence of traders who are not involved in land management can have a positive impact on the economic aspects of the surrounding community but can have a negative impact on the efficiency of land use and the resulting packaging waste.

**Energy Use**

The concept of sustainable architecture seeks to minimize the use of non-renewable energy, utilize energy wisely, and process natural energy into renewable energy. This energy can be in the form of solar energy, wind energy, geothermal energy, and others with implementation strategies adapted to local conditions. Table 3 shows the results of the energy efficiency analysis at Cikapundung Terrace.

**Table 3.** Analysis of Energy Use

| Applied Aspects  | Observation Results  |
|------------------|--|
| Source of energy | <ul style="list-style-type: none"> <li>• Only uses the main electrical energy source from PLN</li> </ul> |



|                     |   |
|---------------------|---|
| Energy Conservation | <ul style="list-style-type: none"> <li>• Lights in the garden area utilize sunlight sensors for automatic activation so as to minimize waste of electrical energy.</li> <li>• Stopping water dancing operations to save energy, and only be used at certain times.</li> </ul> |
| Renewable energy    | <ul style="list-style-type: none"> <li>• Not yet using renewable energy for on-site energy consumption.</li> </ul>  |

Source: Author analysis, 2022

From Table 3, it can be seen that the main energy source is PLN electricity and other alternative energy sources have not been provided. Efforts to save energy are carried out by utilizing solar power as a light sensor for lights in the parking area and stopping water dancing operations to save energy.

### Water Management

The concept of sustainable architecture is through optimal use of clean water and minimizing the negative impact of gray water on the environment. There are special criteria for sustainable water management, namely: water efficiency, water sufficiency, water substitution, water reuse, recycling, and harvesting. Table 4 shows the result of the analysis of water management in the Cikapundung Terrace.

**Table 4.** Analysis of Water Management

| Applied Aspects       | Observation Results  |
|-----------------------|--|
| Source of water       | <ul style="list-style-type: none"> <li>• In natural areas, water comes from five springs and is stored in one well. This water source is often used by the surrounding community.</li> <li>• In the concretization area, water comes from two springs which are collected in the ground tank and channelled directly to the upper tank to be distributed to toilets, fish ponds, and water dancing in the education area.</li> </ul> |
| Grey water management | <ul style="list-style-type: none"> <li>• Management of domestic wastewater (Greywater) originating from sanitary ware is by adding coagulants to break down waste fats, then the treated water is channelled into rivers.</li> </ul>   |
| Water conservation    | <ul style="list-style-type: none"> <li>• There have been no concrete efforts to save water, only water utilization has been done.</li> </ul>   |

Source: Author analysis, 2022

Table 4 shows that the water source comes from seven springs and is used to flow into sanitary canals, fish ponds, and water dancing in educational areas, and is also used as a water source by local residents. Domestic waste water (grey water) originating from

sanitary ware is treated with the addition of coagulants (fat breakers) before being flowed back into the river.

**Material Use**

The concept of sustainable architecture is to use materials that are easily decomposed and renewable, not harmful to health, durable and the processing stage is environmentally friendly. Table 5 is the result of the analysis of material used in the Cikapundung Terrace.

**Table 5.** Analysis of Material Use

| Applied Aspects  | Observation Results  |
|--|--|
| Local material   | <ul style="list-style-type: none"> <li>• Some of the stone material comes from the Cikapundung River and is placed in the sculpture area which has economic value</li> </ul>   |
| Environmentally friendly and recycled material                               | <ul style="list-style-type: none"> <li>• In the man-made Area, the material is dominated by environmentally friendly natural stone, but the use of recycled materials has not yet been implemented. The management room uses brick material on the walls with paint finishing.</li> <li>• In natural areas, the materials used are more adapted to the forest, such as using natural stone for paths. The shape of the saung takes the concept of a house on stilts with wood and bamboo materials.</li> </ul> |
| Efforts to mini-mize the use and prevention of hazardous and toxic materials | <ul style="list-style-type: none"> <li>• No real efforts have been made yet. However, from observations, the materials used are dominated by natural and non-hazardous materials.</li> </ul>   |

Source: Author analysis, 2022

The choice of materials used in the two areas is quite different (Table 5), adjusted to the objectives and concept of the division of the two areas. In the concretization (man-made) area, most of them use hardscape materials such as concrete pavement, grass blocks, stone slabs, and river stones which come from the local area so they have their own meaning and economic value.



**Fig4.** Material used at TheTeras Cikapundung (Source: Author documentation. 2022)

In natural areas (Figure 4), the materials used include stone slabs for paths, stone, wood, and bamboo for huts which come from the local forest area (Babakan Forest). Meanwhile, the material for the bridge connecting the man-made area and the natural area is steel as the bridge frame and wood as the base.

### Waste Management

The concept of sustainable architecture is as follows: The process of managing solid and liquid waste from collection, and sorting to processing aims to ensure that it does not cause negative impacts on the environment. In its implementation, awareness is needed from the management of Teras Cikapundung to provide waste-related facilities. Table 6 below is the result of the waste management analysis in Teras Cikapundung.

**Table 6.** Analysis of Waste Management

| Applied Aspects                      | Observation Results  |
|--------------------------------------|--|
| Environmental cleanliness facilities | <ul style="list-style-type: none"> <li>At the Cikapundung Terrace Site there are no rubbish bins provided because visitors are not allowed to throw rubbish in the area so rubbish must be brought by each visitor. There is no verbal or written advice to visitors regarding this matter.</li> </ul> |
| Waste management                     | <ul style="list-style-type: none"> <li>Non-organic waste is sorted and resold, the rest is transported to the Bandung City waste landfill every day</li> </ul>   |
| River trash cleaning                 | <ul style="list-style-type: none"> <li>The Clean Friday program also includes cleaning the river at Cikapundung Terrace.</li> <li>Apart from that, the river community often carries out river cleaning programs, including the Cikapundung River.</li> </ul>  |

Source: Author analysis, 2022

### Community Role

The community aspect combines all sustainable aspects, where people must be able to socialize by providing shared open spaces. In accordance with Law Number 26 of 2007 concerning community involvement /participation in regional spatial planning. Green open space development is limited to environmental management, while community participation in managing it is very small, so that many green open spaces receive little attention [17]. Therefore, the involvement of the community in various activities such as the use and maintenance of the Cikapundung Terrace needs to be appreciated.



**Fig 5.** Sport activities at The Teras Cikapundung (Source: Management of The Teras Cikapundung’s documentation)

**Table 7.** Analysis of Community Roles

| Applied Aspects         | Observation Results   |
|-------------------------|---|
| Community roles         | <ul style="list-style-type: none"> <li>• Management of the Cikapundung Terrace involves the role of the surrounding community, starting from managing the parking area and stalls which aims to improve the economy of the surrounding community.</li> </ul>  |
| Community participation | <ul style="list-style-type: none"> <li>• Community participation can be seen in river cleaning actions which are generally carried out by river lover communities, namely the Cikapundung Community and the West Java River Community on a regular and voluntary basis.</li> <li>• Another participation is by taking part in various activities held in the Cikapundung Terrace Area so that it will bring more benefits to the community</li> </ul> |

Source: Author analysis, 2022

The Cikapundung Terrace is part of the Cikapundung River Restoration Project which is a work program of the Citarum River Basin Center (*Balai Besar Wilayah Sungai*). This restoration was carried out as an effort to organize the Cikapundung River Border Area for natural functions (for maintaining water quality) as well as for social functions (for tourism and education). This Urban Green Open Space provides public open space as a means of conservation, education, and sports and opens up opportunities for economic empowerment of the surrounding community.

## Vegetation

Vegetation on land can have positive or negative impacts, including shade, water absorption and humidity, comfort, and other environmental conditions. Table 8 below is an identification of vegetation on the Cikapundung Terrace based on its function.

**Table 8.** Analysis of Vegetation

| Applied Aspects  | Observation Results   |
|--|---|
| Vegetation as a producer of oxygen and absorber of air pollution | <ul style="list-style-type: none"> <li>• In the man-made area bordering the main road, there is vegetation in the form of mahogany and <i>trembesi</i> (<i>Samanea saman</i>) trees which have a dense leaf mass so they are able to absorb air pollution.</li> <li>• Natural areas are filled with domestic forest vegetation (bamboo, coconut trees, etc.) which are able to absorb pollution and produce oxygen.</li> </ul>  |
| Vegetation as a guardian of the microclimate                     | <ul style="list-style-type: none"> <li>• On one side of the corridor there are <i>Ketapang Kencana</i> trees (<i>Terminalia mantaly</i>) which are planted in groups and their crowns touch each other.</li> <li>• On the opposite side of the corridor, forest vegetation of various types is maintained and planting is dense.</li> </ul>   |
| Windbreak vegetation   | <ul style="list-style-type: none"> <li>• In the man-made area bordering the main road there are mahogany and <i>trembesi</i> (<i>Samanea saman</i>) trees planted in a row at a distance of <math>\pm 4</math> meters.</li> <li>• The natural area is filled with forest trees with closely spaced plantings.</li> </ul>  |
| Water-absorbing vegetation                                       | <ul style="list-style-type: none"> <li>• Comparison of hardscape and softscape 40:60</li> <li>• Diverse vegetation composition and dense vegetation planting in natural areas.</li> </ul>   |
| Other vegetation (shrubs, grasses, and family medicinal plants)  | <ul style="list-style-type: none"> <li>• In the open space area, various types of shrubs and bushes are scattered, including <i>Syzygium myrtifolium</i> (<i>Pucuk merah</i> Tree), <i>Philodendron ecuadoriense</i>, <i>Acalypha siamensis</i> (<i>Teh-tehan</i>), <i>Curculigo latifolia</i> (<i>Marasi</i> tree), <i>Solanum melongena</i> (Eggplant), <i>Citrus aurantiifolia</i> (Lime), and <i>Pleioblastus variegatus</i> 'Tsuboii' (Dwarf White-Striped Bamboo).</li> </ul> |
| Land cover   | <ul style="list-style-type: none"> <li>• In natural areas, land cover is dominated by green vegetation such as grass, bushes and shrubs as well as various trees. for man-made areas, the land cover is a combination of grass, rocks and cement floor</li> </ul>   |

Source: Author analysis, 2022

**3.3. Total Assessment**

As a summary of the analysis of the application of all sustainable architectural principles outlined in each related aspect, an assessment is given to provide an overview of whether the application of the principles that have been implemented in the Cikapundung Terrace area is good enough or not in each aspect. The following Table 9 is an analysis of the results of observations that have been made:

**Table 9:** Total Score for Implementation of Sustainable Architecture Principles in Cikapundung Terrace

| No          | Principles        | Applied aspects  | Score |
|-------------|-------------------|--|-------|
| 1.          | Site and land use | • Ease of access   | 3     |
|             |                   | • Conservation, reforestation and management efforts                         | 3     |
| 2.          | Energy use        | • Site plan & management   | 2     |
|             |                   | • Source of energy   | 1     |
|             |                   | • Renewable Energy   | 2     |
| 3.          | Water management  | • Energy conservation  | 2     |
|             |                   | • Water source   | 3     |
|             |                   | • Grey water management  | 2     |
| 4.          | Material use      | • Water conservation   | 2     |
|             |                   | • Local material use   | 3     |
|             |                   | • Environmentally friendly and recycled materials                            | 2     |
| 5.          | Waste management  | • Efforts to minimize the use and prevention of Hazardous and toxic Material | 2     |
|             |                   | • Environmental cleanliness facilities                                       | 2     |
|             |                   | • Waste management   | 2     |
| 6.          | Community roles   | • River trash cleaning   | 2     |
|             |                   | • Community Participation  | 2     |
|             |                   | • Community roles and empowerment  | 3     |
| 7.          | Vegetation        | • Types of vegetation based on their function                                | 3     |
|             |                   | • Land cover   | 3     |
| TOTAL SCORE |                   |  | 44    |
| MEAN SCORE  |                   |  | 2.32  |

Source: Author analysis, 2023

From Table 6 it can be seen that the total score is 44 and the average score of all indicators applied is 2.32. The total score is not good enough, especially for the scores obtained on the application of water management principles and material use principles. However, several

other principles are still not good and require better handling, namely energy use (especially the application of source of energy aspects) and waste management where the application of all aspects does not get a very good score.

#### **4. Conclusion**

The site management and land use of Teras Cikapundung is very good, especially in site selection, regional zone division, as well as accessibility to locations that can be accessed by various public and private transportation. However, the current site plan is not good enough because there is no separation of bicycle and pedestrian paths from motorized vehicles, and there is no special parking space for bicycles, so it is necessary to re-arrange the circulation routes and parking areas in the site plan.

Efforts to save energy are carried out by utilizing solar power as a light sensor for lights in the parking area and stopping water dancing operations to save energy. The main energy source is PLN electricity and other alternative energy sources have not been provided.

The choice of materials for the two areas in Cikapundung Terrace is quite good, especially because of the large use of local materials and vegetation for the land cover which is in accordance with the principles of sustainable architecture.

Waste management in The Cikapundung Terrace is still not good enough because there are no separate waste bins (based on type), and there are only a few rubbish bins provided by the Environment and Forestry Service (DLHK).

Unfortunately, the principles of water management in sustainable architecture at Cikapundung Terrace, such as minimizing its use, have not been implemented because groundwater sources at this location are quite abundant, and can even supply the water needs of the surrounding community.

The role of the community in managing the Cikapundung Terrace is quite good. However, community participation can be further increased in various social activities held at this location so that the Cikapundung Terrace provides more benefits to the wider community.

The vegetation on the Cikapundung Terrace is quite adequate because the selection of plant types, planting stages and management have been adjusted to the expected function of Urban Green Open Space.

Based on the total score of 44, the implementation of the concept of sustainable architecture at the study location was rated as still not good enough. Overall, the implementation of sustainable architectural principles on the Cikapundung terrace is not yet good with an average score of 2.32.

However, there are still several shortcomings that need to be corrected, especially indicators that have received poor and unfavorable ratings. In implementing the principles of waste management and energy use, it is necessary to apply alternative and renewable energy

sources, and make more efforts to prevent the use of hazardous and toxic materials. Another aspect that is also very important is the principle of waste management, where the provision of separate waste bins for each type in all areas visited by visitors is very important to maintain the cleanliness of this area and at the same time educate the public to participate in the process of sorting the waste they throw into the environment. For site plan and management indicators, improvements are needed such as separating pedestrian, bicycle and motor vehicle circulation routes. For water conservation indicators, it is necessary to implement water conservation, such as reusing gray water. Efforts that can be made to increase community roles are by intensifying promotions, such as inviting people to visit and carry out activities at the site more often, either individually, or with their families or with the community.

## Acknowledgments

The author would like to thank various parties who have assisted in this research, especially several management staff of The Teras Cikapundung who have been resource persons in interviews during the process of data collection and field observations, as well as colleagues in the Architecture Study Program at Universitas Kebangsaan Republik Indonesia who have provided much input in writing the report of research.

## References

1. S. I. Hidayat, "Green City: Solusi Problematika Perkotaan dalam Dimensi Pembangunan," in *Seminar Nasional Perencanaan Pembangunan Inklusif Desa Kota*, 2017, pp. 567–576.
2. N. K. M. Khair, K. E. Lee, and M. Mokhtar, "Sustainable City and Community Empowerment through the Implementation of Community-Based Monitoring: A Conceptual Approach," *Sustainability*, vol. 12, pp. 1–16, 2020.
3. J. Mensah, "Sustainable development: Meaning, history, principles, pillars, and implications for human action: Literature review," *Cogent Soc. Sci.*, vol. 5, no. 1, pp. 1–21, 2019, doi: 10.1080/23311886.2019.1653531.
4. F. H. Syam, D. Wisdianti, S. Sajar, and S. Bahri, "Study of Sustainable Architecture Concepts," *Int. J. Res. Rev.*, vol. 10, no. April, pp. 419–424, 2023, doi: <https://doi.org/10.52403/ijrr.20230450>.
5. A. Ragheb, H. El-shimy, and G. Ragheb, "GREEN ARCHITECTURE: A CONCEPT OF SUSTAINABILITY," in *Urban Planning and Architecture Design for Sustainable Development, UPADSD*, 2016, vol. 216, no. October 2015, pp. 778–787, doi: 10.1016/j.sbspro.2015.12.075.
6. Firmansyah, A. Soeriaatmadja, and Wulanningsih, "A set of sustainable urban landscape indicators and parameters to evaluate urban green open space in Bandung



- City A set of sustainable urban landscape indicators and parameters to evaluate urban green open space in Bandung City,” in *3rd International Symposium for Sustainable Landscape Development (ISSLD 2017)*, 2017, pp. 1–11, doi: 10.1088/1755-1315/179/1/012016.
7. D. Kirmanto, *Peraturan Menteri Pekerjaan Umum Nomor 5 tahun 2008*. Republic of Indonesia, 2008, pp. 1–63.
  8. S. Wulandari, Rifardi, A. Rasyad, and Yusmarini, “Status Keberlanjutan Ruang Terbuka Hijau Sebagai Cadangan Karbon di Kota Pekanbaru ( Sustainability Status of Green Open Space as Carbon Stock in Pekanbaru City ) Program Doktor Ilmu Lingkungan , Fakultas Pasca Sarjana Universitas Riau Jurusan Ilmu Kelaut,” *J. Mns. Lingkung.*, vol. 25, no. 2, pp. 73–80, 2018, doi: 10.22146/jml.23817.
  9. P. Sassi, *Strategies for Sustainable Architecture*, 1st ed. Abingdon: Taylor & Francis, 2006.
  10. S. Hidayatulloh and Anisa, “Kajian Prinsip Arsitektur Berkelanjutan Pada Bangunan Perkantoran (Studi Kasus: Menara Bca Jakarta),” *Media Matrasain*, vol. 18, no. 1, pp. 89–97, 2021.
  11. S. Winarni, Hamka, and S. T. Harjanto, “Konsep arsitektur lanskap berkelanjutan pada desain taman jingga rt.02 rw. 09 kelurahan merjosari, kota malang,” *Pawon J. Arsit.*, vol. VII, no. 1, pp. 95–110, 2023.
  12. Hamka, S. Winarni, and A. Widyarthara, “Study of Sustainable Landscape Criteria in Order to Green Open Space Planning for Settlements in RW 9 Kelurahan Merjosari–Malang,” *ESE Int. J. (Environmental Sci. Eng.)*, vol. 3, no. 1, pp. 13–22, 2020.
  13. G. Çetinkaya and N. Sözen, “Towards sustainable landscape development indicators for North Cyprus,” in *Conference: 2nd International Sustainable Buildings Symposium*, 2017, pp. 75–85.
  14. K. F. Aprillia, T. Lie, and C. Saputra, “Karakteristik desain ruang terbuka hijau pada sempadan sungai perkotaan,” *Arteks*, vol. 5, no. 2, pp. 235–244, 2020, doi: 10.30822/arteks.v5i2.394.
  15. S. B. Yudhoyono and P. Akbar, *Peraturan Pemerintah No. 38 Tahun 2011*. Indonesia, 2011, pp. 1–43.
  16. P. N. Indradjati and I. N. Aisha, “Adapting Urban Heat Island Mitigation Strategy on Bandung Downtown Area,” *Dimens. (Journal Archit. Built Environ.)*, vol. 46, no. 2, pp. 129–140, 2020, doi: 10.9744/dimensi.46.2.129-140.
  17. I. M. Agus Mahendra, “Analisis Ruang Terbuka Hijau Dalam Perspektif Pembangunan Kota Berkelanjutan (Studi kasus Kawasan pusat Kota Denpasar, Bali),” *J. Ilm. Vastuwidya*, vol. 5, no. 1, pp. 41–49, 2022, doi: 10.47532/jiv.v5i1.408.

**Open Access** This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

