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ISSN (Print: 2357-0849, online: 2357-0857)

Environmental Science and Sustainable Development

Received: 6 November 2023, Accepted: 15 November 2023, Published online: 31 December 2023
DOI: 10.21625/essd.v8i2.1043

Application of a Biomimetic Approach in the Design Exploration of the Indonesian Red Cross Memorial Covid 19 Volunteer Monument, Tangerang Regency

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Abstract

Coronavirus Disease 2019 (COVID-19) has been declared a global pandemic by the World Health Organization (WHO) and a national disaster by the Indonesian government since March 2020. The high speed of the virus' spread has caused an enormous multidimensional crisis in terms of health, social, and economic aspects all over the world, including Indonesia. As of May 8, 2023, Covid-19 has infected 6,787,354 people, with 161,459 of them having died. Among the many victims, there are also many volunteers who have fallen while serving the community in dealing with the pandemic. To commemorate the fallen volunteers, the Indonesian Red Cross of Tangerang Regency plans to immortalize them through a monument in the Solear area, Tangerang Regency, Banten. This monument is intended as a place to remember the fallen volunteers for their families, colleagues, and the public. The Architecture Student Association (Gamatara) of UPH had the opportunity to contribute their design ideas in the framework of community service. The approach used in developing the design of this monument is biomimetic. Biomimetic architecture is defined as the science and art of designing buildings by imitating aspects of nature as examples, models, references, and guidelines for solving problems in architecture. In the design of this monument, biomimetics is applied to make nature an inspiration for form. This approach is used as the actualization of the symbol that the way to prevent pandemics like this in the future is through harmonization with nature. This approach can be seen as the application of metaphor, prioritizing conceptual and visual synergy. The bamboo shoot shape was chosen as an appropriate metaphor that depicts resilience and the emergence of new hope. The design exploration is directed towards combining the form and the resulting spatial experience to create a sense of place and a meditative reflection space that supports activities.

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Keywords

Biomimetic, Architecture, Monument, Sense of Place, Covid-19, Landmark

1. Introduction

Coronavirus Disease 2019 (COVID-19) has been declared a global pandemic and a national disaster by the Indonesian government and the World Health Organization (WHO) since March 2020. The high rate of the virus' spread has caused an enormous multidimensional crisis in terms of health, social, and economic aspects all over the world, including Indonesia. As of May 8, 2023, Covid-19 has infected 6,787,354 people, with 161,459 of them having died. Among the many victims, many volunteers have tragically died to serve the community in dealing with the pandemic.

To commemorate the fallen volunteers, the Indonesian Red Cross of Tangerang Regency plans to immortalize them through a monument in the Solear, Tangerang Regency, Banten. This monument is intended as a place to remember the fallen volunteers for their families, colleagues, and the public. Then the architecture community service of UPH

which involved the professor and the involved team of GAMATARA (architectural student association), had the opportunity to contribute their design ideas in the framework of community service.

This study aims to further learn and explore the biomimetic approach that can be a basic architectural concept in developing the design of the Covid-19 Volunteer Memorial Monument. The specific research questions to be answered are as follows.

- What kind of biomimetic approach is suitable to produce a monument design that can create a sense of place?
- What parameters are needed in the design of the monument using the biomimetic approach?
- How is the biomimetic approach implemented in the form of architectural monuments?
- How is the arrangement of form and space in this monument so that it is in line with the biomimetic concept?

2. Theoretical Background

The components of the "sense of place" are closely related to form (Kevin, L., 1981). Place is not just space; space will become a place if it is marked with meaning in it. Hence, meaning is a value that is rooted in the local culture (Trancik, R., 1991). This can bring certain memories and feelings towards something that is visible in an area and has a strong influence on the identification of city identity. According to Lynch, in marking an environment, the visual strength factor (imageability/apparency) becomes very dominant. The stronger the visual factor, the stronger the element is remembered/understood by the observer and makes it easier to orient. Landmarks are one of the physical elements that strengthen the sense of place. (Kevin, L., 1981).

According to the Oxford Dictionary, a monument is a statue, building, or other structure erected to commemorate a famous or notable person or event (Stevenson, A. (Ed.).,2010). Monuments are closely related to landmarks because monuments are generally supported by several elements that can give prominent characteristics through their architectural art. (Redstone, L. G., & Redstone, R. R., 1981).

Monuments also have a social function, namely as a means of mirroring society that reflects socio-cultural values, as well as a means of transforming certain values that are considered important for the development of the spiritual aspects of its citizens and the embodiment of the continuity of the past, present, and future. (Sidharta, I., & Budihardjo, E., 1989). Based on appearance, monuments can be categorized into two: monuments with figurative main objects (personal, portrait statues, anamorphic, animal) and non-figurative objects (abstract, impersonal, formalist). (Miles, M,1989) The biomimetic approach can be used to get a good appearance of monument form.

Biomimetics or biomimicry is a conceptual approach to architectural design that tries to imitate living things. Etymologically, biomimetics comes from the Greek words bios, meaning life, and mimesis, meaning to imitate. Biomimetics, defined by Janine M. Benyus, is a new science that studies nature's models and then imitates or takes inspiration from these designs and processes to solve human problems. Considering nature as a model, Measure and Mentor can help to design a better and sustainable future (Benyus, J. M., 1997). Biomimetics can be divided into levels, namely the organismal level, the interaction/behavior level, and the ecosystem level. (Peters, T. 2011).

Biomimetic architecture was involved and applied in various ways such as form, function, process, and systems. (Santhosh, A., & Nair, S. R., 2016). In the era of postmodern architecture, biomimetic architectural approaches have been developed to generate innovation. Architects can integrate biomimetic concepts into their design such as economy, optimization, resilience, functionality, and aesthetics. (Yeler, G., 2015).

In this study, the focus of biomimetics is biomorphism which emphasizes the form of natural mimesis (Pawlyn, M., 2019). according to Peter Collins, biomorphism emphasizes the essence of biological analogy or more specifically the parallels between natural organisms with architectural aesthetics (Supardjo, S., 2014). The concept of Biomimetics by focusing on form is closer to the application of metaphors that are more concerned with conceptual and visual synergy. The application of the Biomimicry Concept to architecture can be through metaphors because the basic

process of taking ideas is taken from forms from nature. Antoniades describes metaphors into three categories, namely intangible metaphors, tangible metaphors, and combined metaphors (Antoniades, A. C., 1992). Beijing National Stadium, designed by Swiss architects Herzog & de Meuron, is a contemporary example of the use of biomimetics in architecture which was inspired by a bird's nest for its beguiling, latticed surface (Rogers, A., Yoon, B., & Malek, C., 2008).

Figure 1. Beijing National Stadium which was inspired by bird's

3. Methodology

In the design of this monument, the approach used in developing design insights is as follows:

- An object typology approach by identifying a monument object typology functionally, geometrically, and culturally related to the sense of place.
- Thematic approach, namely biomimetic architecture with a deep understanding of the meaning of the theme and its implementation strategy
- Site and environment approach, namely analysis of site conditions and their environment which can be a determinant of the design concept.

The design process is carried out with architectural design stages starting from the conceptual, being the design's experimentation through idea transformation both two-dimensional and three-dimensional, and evaluation which is repeated cyclically to obtain an optimum final design. Primary data collection methods through direct observation of objects, field surveys, and documentation. Meanwhile, secondary data was obtained from scientific sources in the form of literature studies and precedent studies.

4. Design Guidelines

Regarding the monumentality of landmarks, a building that becomes the focal point must be able to evoke the emotions of the observer in experiencing the townscape. This visual experience is created through the manipulation of the environment, providing gradually emerging views for curiosity. (Gordon Cullen,1961). Kevin Lynch stated that what needs to be considered in designing landmarks is the need for the following criteria (Kevin, L., 1981).:

- Gain form as the achievement of domination of the environment
- Contrast form as the achievement of uniqueness so that it stands out.
- Contextual or background of all buildings in the environment
- Strategic location, easy to see and accessible.
- Continuation of the sequence to achieve unity of meaning.
- Special details or in the need for ornament and decoration.

The guidelines mentioned above are the parameters set to realize the landmark design with a biomimetic approach in the form of monuments. The fulfillment of these parameters determines the success or failure of a design. These parameters are set to ensure the optimization of research in creating monuments that can produce an ideal sense of place.

5. Project Design

The location that is given for the monument to be constructed is in Solear, Tangerang. Its location is 66 kilometers away from the capital of Indonesia, Jakarta. This monument is located within the PMI, Indonesian Red Cross, Volunteer Park complex. Meaning it is placed in the center of the complex, for PMI and the Youth Red Cross Volunteer Education and Training related to humanitarian activities. This complex has an area of about 1.8 Hectares to cover, enough to complete the space with the required amenities. This monument was built with the aim of remembering volunteers and health workers who have died during the process of handling the Covid 19 pandemic. The choice of the location for this monument to be at the PMI volunteer park is to provide inspiration and a humanitarian spirit for PMI volunteers who are currently studying there.

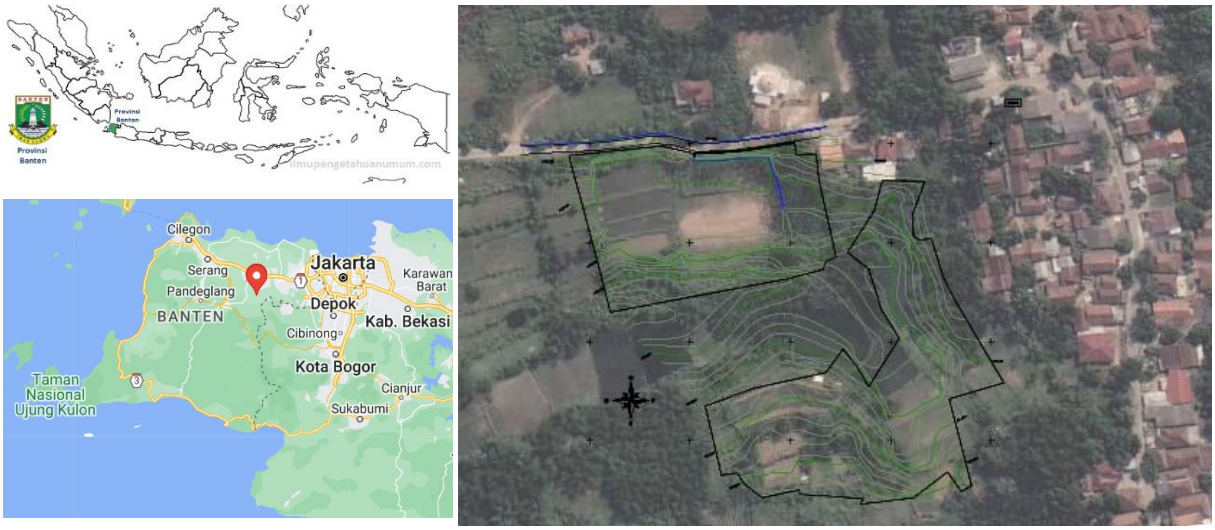

Figure 2. Location Map of PMI Volunteer Park, Solear (Wikipedia & personal documentation)

Figure 3. Site existing condition in 2019 (personal documentation)

The location has the following boundaries:

- north: Al Madani Islamic Boarding School
- south: plantations
- west: plantations
- east: residential areas

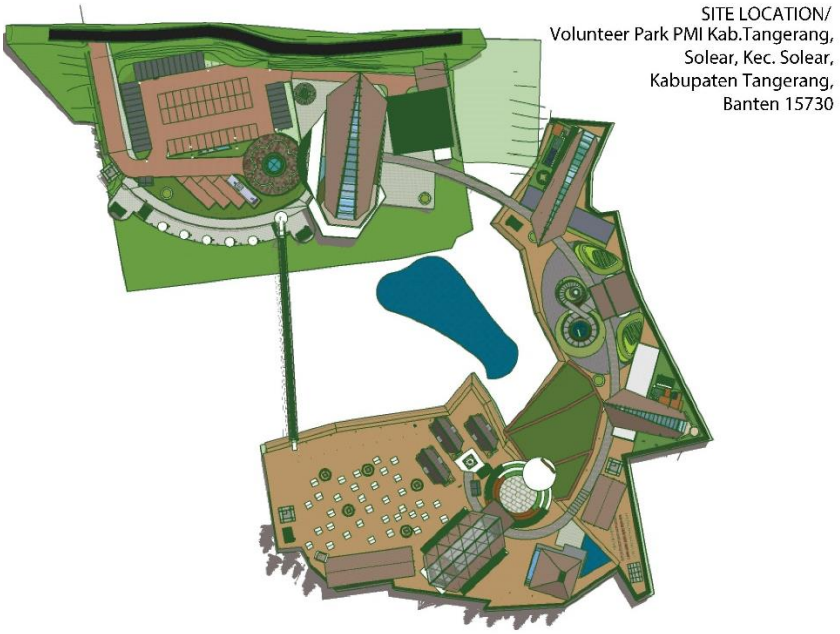

Figure 4. Position of Memorial Covid-19 Volunteer Monument in PMI Volunteer Park Complex

The biomimetic concept for this monument is adapted from the metaphor of bamboo shoots. Bamboo plants are one of the many plants found in Indonesia that are rich in benefits ranging from building materials, furniture, and handicrafts to food ingredients. Indonesia is estimated to have 11.5% of the world's bamboo species (Rijaya, I., 2019). It is estimated that 88 species of bamboo are endemic to Indonesia (Hingmadi, D., 2012). Bamboo has many benefits for the environment and humans, being also one of the fastest-growing plants. Therefore, we can conclude that the use of bamboo can be said to be a sustainable material that has various advantages.

In Indonesian culture, bamboo has a deep philosophical meaning because of the nature of this plant which grows fast, is strong in its own ways, has a straight shape, very flexible, and easily adapts to its environment. In Indonesia, bamboo is a symbol of the Indonesian people's struggle for independence because it is one of the weapons used to fight colonialism. In the local context, Tangerang Regency is known as a center for woven bamboo hats to foreign countries. Because this bamboo hat has become the identity of the people of Tangerang Regency, the bamboo hat is used as the logo of Tangerang Regency.

Figure 5. The Tangerang District logo is taken from a woven bamboo hat craft

Figure 6. Bamboo shoots and people hugging each other form the basic form of the monument

The shape of the bamboo shoots is transformed through a stylization process. Stylization is a deformation or change in shape without leaving the characteristics of the original shape. Stylization only imitates visual forms, so stylization is usually used as inspiration for shapes. The shape of a bamboo shoot was chosen as an appropriate metaphor that describes resilience and the emergence of new hope after the COVID-19 pandemic. The shape of crossed bamboo shoots is a symbol of mutual protection between residents so that this pandemic does not happen again. The design is made multilayer/layered, which symbolizes the spirit of regeneration of the Indonesian Red Cross's volunteers who are always ready for humanity.

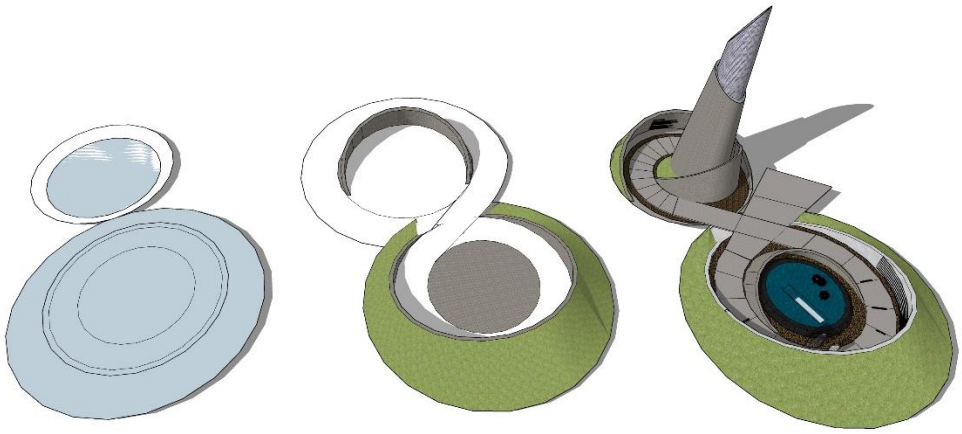

Figure 7. Form transformation of the monument

Design exploration is directed at combining forms and the resulting spatial experience, to create a sense of place and an appreciation of space that supports meditative reflective activities. The curved shape of this monument creates a contrast with the surrounding buildings in the form of landed buildings with gable or shield roofs. The tower of the monument is made as tall as 14 meters to create a dominance in scale, compared to its surroundings. The location is placed in the middle of the PMI volunteer park so that it can be easily reached and visually accessed from various angles.

The concept of serial vision is used to shape the image and drama of the area in a movement to produce sequential movement and emerging view, stimulating views through environmental contrasts. The outer shape of the monument is shown as a hill overgrown with grass to give an unexpected feeling when entering the inner space while at the same time creating a contrast between the outside of the monument and the inside of the monument. The existence of this grassy hill provides a visual continuity between the monument and the surrounding landscape in the form of plantations. This grassy hill is a symbol of the importance of harmonizing nature and the development of human civilization so that this pandemic does not appear again in the future.

Figure 8. The grassy hill that hides the inner space of the monument to create the effect of surprise and build curiosity

The circulation pattern on this monument is shaped like a mobius strip, better known as the infinity symbol. These shapes are used to construct visual experiences that provide a gradually emerging view of curiosity, continuity, and interest.

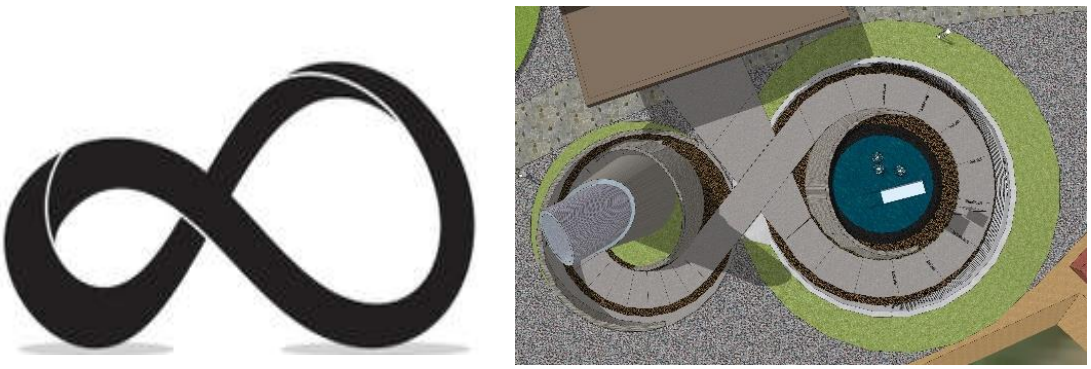

Figure 9. The circulation pattern of the monument in the form of a Mobius strip

The circulation pattern in this monument not only builds the atmosphere but also makes it feel like walking down a chronological time tunnel when the world is struggling to overcome the COVID crisis starting from the year 2020 up to 2023. Time chronological information is presented on the floor, while the wall is presented a graph of the development of the number of cases of infection. Which is presented in the appearance of wall cracks in the monument. The wall cracks were chosen to build visitors' emotions through the metaphor that this pandemic is causing great damage, while at the same time showing how fragile humans are when nature is out of balance.

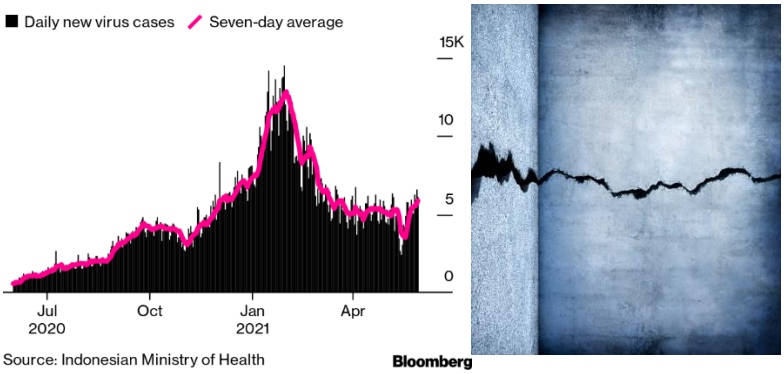

Figure 10. Chronology and graphics related to the pandemic are represented by cracks in the wall

The material’s textures are used to build narratives and emotions that visitors can feel, translating human experience into architectural composition. Special details were carried out using the finishing material of mixed concrete to give a hard and rough texture to provide a spatial atmosphere that describes the difficulty and severity of the situation during the pandemic. The texture of this rough concrete finish also gives a dramatic effect when exposed to light.

Another material used is the use of corten steel, also known as weathering steel or steel which is created through a weathering process so that a protective layer from the weather can form on the outer layer of steel. In appearance, corten steel looks like steel that has rusted with the weather for years, this gives a gloomy atmosphere for the many victims due to the pandemic. Lastly on the floor, using pebblestone concrete to create a rough texture to build the same emotion as the one created within the textured walls.

Figure 11. The materials that dominate the appearance of the monument: kamprot concrete, corten steel, and pebblestone concrete

The use of a reflection pond is to create a calm and quiet atmosphere within the monument. The existence of a dandelion fountain which has a shape similar to the COVID-19 virus and the fog it produces reminds us of how easy it is for the virus to spread through the air. The mist that is created from the dandelion fountain also builds a mystical and unclear atmosphere in this monument. In the middle of the reflective pool is a rectangular sunken where water from the pool enters into it to represent the loss of a loved one due to illness from exposure to this virus.

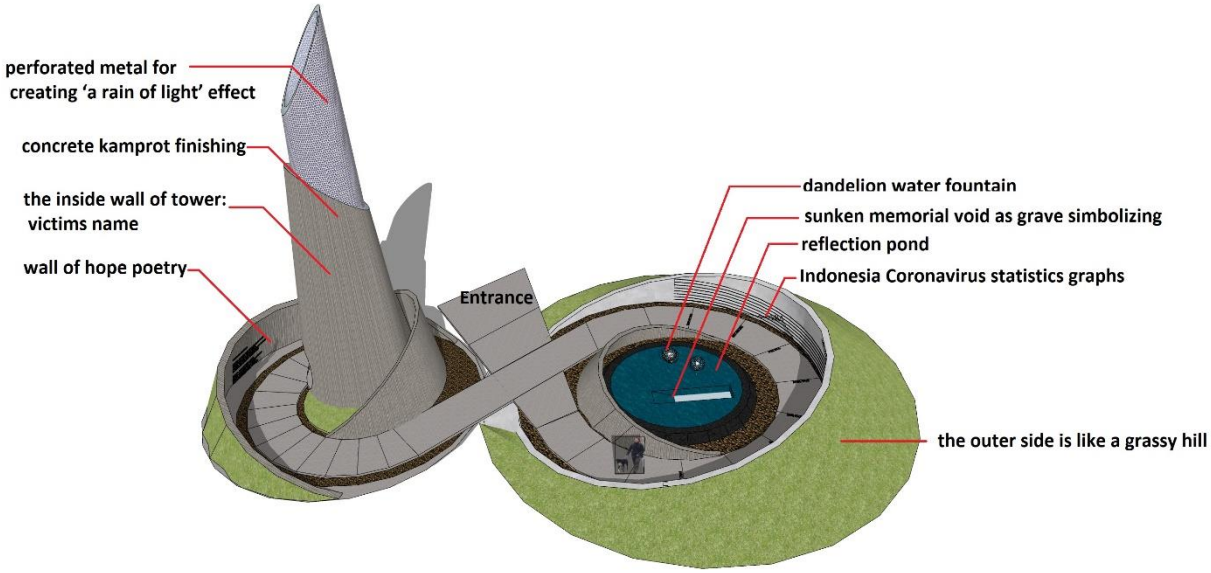

Figure 12. Anatomy of monument

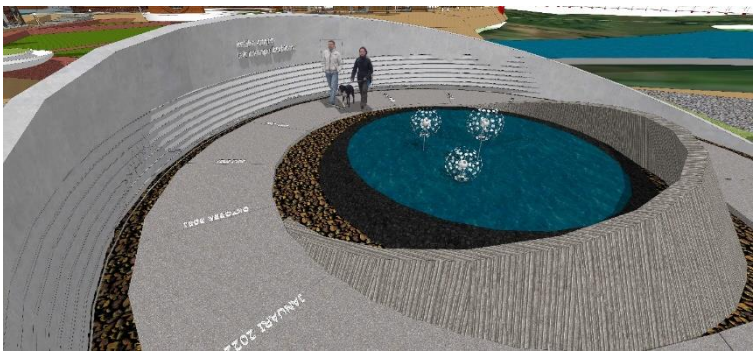

Figure 13. Atmosphere of inner space in the monument

At the end of the sequence, visitors are faced with a “wall of hope” poetry to build hope that rises before entering the tower. This tower is made higher than the surrounding buildings as a form of respect and appreciation for volunteers and health workers who have died. Inside this monument, a shine of light effects will be displayed. The first light effect is the rain of light which is produced from sunlight that penetrates perforated metal in the form of woven bamboo. The second light effect is the projection of the names of volunteers who died during the pandemic. This series of light effects is expected to produce a surreal space and become the climax of this monumental space sequence.

Figure 14. Atmosphere of inner space in the monument

Figure 14. The progress of the construction of the monument on the site

6. Design Evaluation and Conclusion

Based on the parameters set in the design guidelines, this project has successfully delivered a space that can accommodate and support the Application of a Biomimetic Approach in the Design Exploration of the Indonesian Red Cross Memorial Covid 19 Volunteer Monument, Tangerang Regency to build a sense of place.

- With the scale of the monument being quite high compared to the surrounding buildings, this monument is quite acceptable for domination of the environment.
- Curved shapes with different colors and textures with the environment produce contrast and make it unique uniqueness so that it stands out.
- Adaptation of form and appearance which originate from bamboo shoots that depart from local identity makes this monument contextual to local culture.
- The location of the monument which is in the center of the PMI volunteer park area provides easy circulation and visual accessibility.
- Movement patterns that build spatial sequences through serial vision produce continuity and unity of meaning.
- The selection of details, colors, textures, and materials in this monument reinforces emotions and narratives related to the covid 19 pandemic

Through this research, it can be concluded that the biomimetic architectural concept approach has the opportunity to form a sense of place, especially related to landmark design.

Acknowledgments

We would like to express our gratitude to each individual and organization who has contributed to the publishing of this journal. To the Indonesian Red Cross for giving us the opportunity to conduct our research and exploration on the related project.

We also acknowledge the Architecture Department at Universitas Pelita Harapan for giving us the resources and support we required to complete this project.

Finally, we would like to express our gratitude to our family and friends for their love and support during the research process as we could not have finished our study without their encouragement and assistance.

The abstract of this paper was presented at the Sustainability in Creative Industries (SCI) Conference–2nd Edition which was held on the 7th-9th of November 2023.

Funding declaration:

This research did not receive any specific grants from funding agencies in the public, commercial, or not-for-profit sectors/individuals.

Ethics approval:

Not applicable.

Conflict of interest:

The authors declare that there is no competing interest.

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