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Dynamic Architectural Site: An Experimental Idea for the Recording Landscape

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ABSTRACT

Since indicating the dynamic landscape, the site of the active area as Mount Merapi, people around the slopes have begun to develop new livelihoods through tourism. Since then, facilities have emerged to support the tourism sector on the slopes ranging from lodging to food stalls and souvenirs. But while growing tourism potential, the risk of Mount Merapi eruption still endangers all activities around Mount Merapi. From pyroclastic Flow, volcanic ash to hot lava flows can result in material losses to loss of life. Based on this phenomenon, it is necessary to have facilities that can accommodate tourism potential but still pay attention to the risk aspects of the eruption of Mount Merapi. The architecture response is a hotel, an experimental architectural model that can record the Merapi eruption's impact on environmental conditions and protect tourists from eruption hazards. The result highlighted that the adaptable building approach is the direct approach applied to the design object. It was changing environmental conditions in the area with adaptive facades to meet the occupant safety aspects

Keywords: adaptive, architecture, disaster, mount, Merapi

1. Introduction

According to UNESCO, volcanic risk refers to the expected consequences of a volcanic event referring to death or injury to a population and damage from the particular property or other economic loss, and volcanic hazards refer to destructive or potentially destructive volcanic events [1]. Various volcanic events directly or indirectly endanger the population, explicitly inhibiting the surrounding areas and causing considerable damage such as settlements, agriculture, waters, and communication and transportation channels. Smith [2] divides volcanic hazards into primary and secondary hazards. Immediate hazards are materials released during volcanic eruptions, pyroclastic flow, hot clouds, lava, ash rain, and volcanic gases. Meanwhile, secondary hazards are land deformation, landslides, cold lava, and tsunami. Pyroclastic flows are avalanches of hot gravel, rocks, and gas moving at high speed down the slopes of mountains during explosive eruptions[3]. Natural eruptions involve phreatic explosions resulting from magma. Meanwhile, volcanic dust is a rock material with low density that vomits from mountains and floats in the air. Large amounts of dust vomit will produce a dust funnel when volcanic ash coalesces to form tuff.

Since 2010, disaster tourism has developed in the Merapi area, where the main attraction of this tourism is to enjoy how disasters affect a site directly. According to the previous findings [4], [5], Disaster Tourism is a vehicle for understanding how the impact of a disaster appears through a tour. Tourists want to see first-hand how conditions have changed after an eruption has occurred.

Based on the background and issues described previously, the design problem is how to accommodate the potential for disaster tourism in the Merapi area, namely changes in environmental conditions that result, but still consider safety and security from the dangers caused by eruption events. Furthermore, the idea is conducted to maintain tourists' protection from the threat of eruption. Therefore, we need an architecture that can record the impact of the eruption of Mount Merapi on changes in environmental conditions from pre, current, and post-eruptions.

2. Method

This research focuses on analyzing the response of the dynamic site to the architectural landscape. The necessary design criteria can be described: 1. The design can present the experience of changing environmental conditions; 2. The method can record the traces of the eruption; 3. Eruption-resistant design; 4. The design can apply hotel building standards.

This time, the focus of the design is how the relationship between the area and architecture to changes in conditions resulting from the eruption of Mount Merapi are related to one another. The approach used in this design is Palimpsest. Palimpsest is a metaphor for proposing a process of transformation over time. Palimpsest (Figure 1) departs from the phenomena that occur in the world around us, which are constantly changing and evolving, but at the same time leave traces. With Palimpsest, depth to architecture and place is obtained. The landscape, buildings, and objects are interrelated and become piles of events over time. That way, the events that occurred from the past to the present can be traced to the resulting layers.

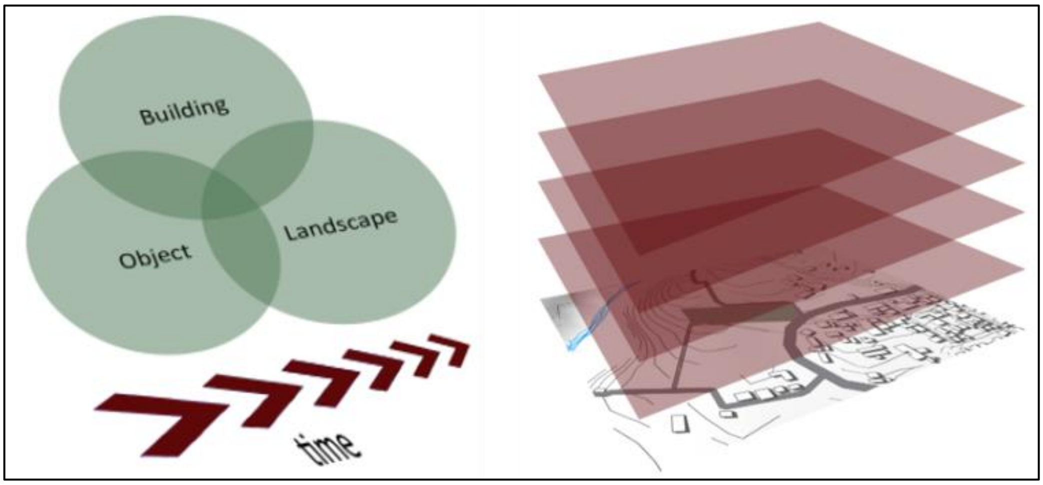

Figure 1 Palimpsest illustration of the building, object, and landscape related to time

Force identification is carried out based on a force-based framework. The main point of this framework is to make all the forces deemed necessary accessible and sequenced so that design decisions can be made against those forces. The forces that have been identified are then responded to both on the site, building, and building details. The response given to the force is adjusted to the predetermined design criteria. The site analysis was carried out as follows: 1. Identify the distribution of existing vegetation on the site. Each vegetation type will have a different impact on the Merapi eruption cycle. 2. Identify the existing contour conditions on the site. The contours will relate to the flow of rain and falling ash. Contours also affect the structural system used in the building. 3. Identify the direction and average wind speed. Both will affect the direction and slope of the ash coming from Merapi. 4. Identify the weather and average air temperature. The weather before, during, and after the eruption will be different. 5. Identify access to the site. 6. Identify potential views both within the site and throughout the site. The possible existing idea can affect building orientation, building facade, and the selection of space zoning.

3. Results and Discussions

Dynamic Site Location

The site is on Boyong street Km 25, West Kaliurang, Hargobinangun, Sleman Regency, Special Region of Yogyakarta (Figure 2). The selected location is about 6.78 km from the crater of Mount Merapi and has an area of 9923.5 m^2. Based on the zoning for Disaster Prone Areas issued by the National Disaster Management Agency (BNPB) in 2011, the site is in KRB (*Kawasan Rawan Bencana* / disaster-prone areas) II, a zone that still has the threat of being exposed to heavy ash rain. The location was chosen based on the consideration of the direct impact of the eruption of Merapi, but it is still permissible to build permanent buildings [6].

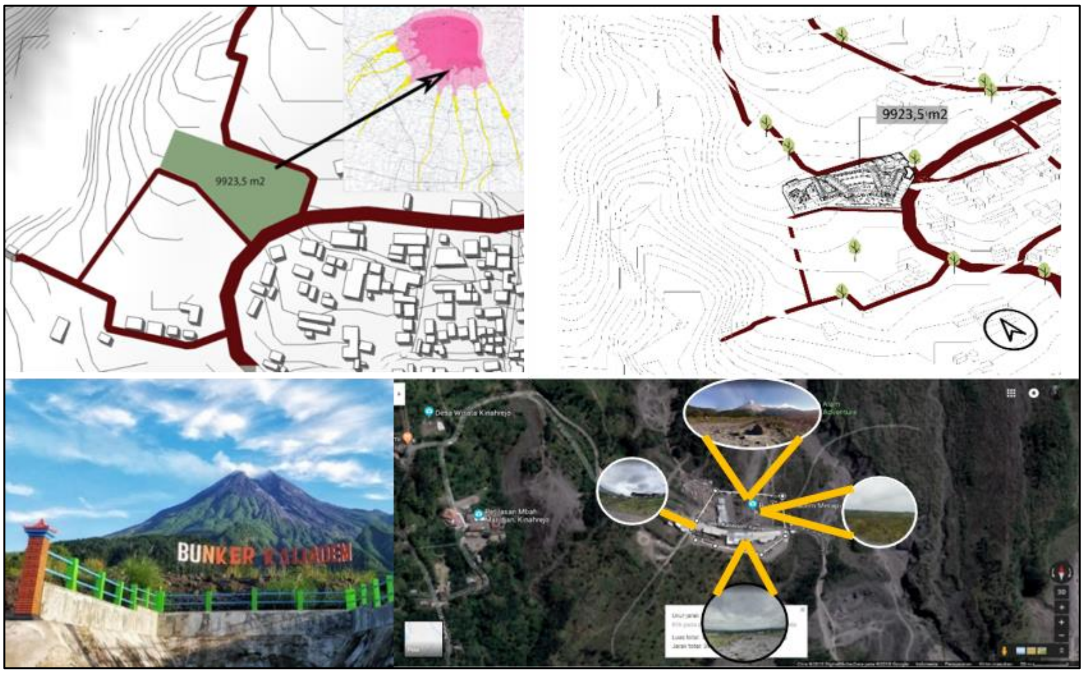

Figure 2 Potential dynamic site location

Despite being in the shadow of danger, many people still live on the slopes of Mount Merapi. Until 2010 before the big eruption occurred, the population in the area was approximately 100 thousand people in KRB III and 140 thousand people in KRB II. Before the eruption of Mount Merapi in 2010, the main livelihoods of the people living on the slopes of Mount Merapi were farming and animal husbandry[5]. This is inseparable from the quality of the fertile soil caused by the material spewed out by Mount Merapi. This is also the reason why many people live in the area of Mount Merapi. However, after the eruption in 2010, people living on the slopes of Mount Merapi began to develop new sources of livelihood through the tourism sector.

According to UNESCO, volcanic risk (volcanic risk) refers to the expected consequences of a volcanic event, and volcanic hazard refers to destructive or potentially destructive volcanic events. Volcanic hazards are divided into two, namely primary and secondary. Immediate hazards are materials released during volcanic eruptions, pyroclastic flows, hot clouds, lava, ash rain, and volcanic gases. At the same time, secondary hazards are land deformation, landslides, cold lava, and tsunamis. Volcanic ash thrown at Merapi can cause negative impacts on humans and the environment, damaging plants and even causing the death of small plants. It is acidic and corrosive, so it can damage infrastructure containing metal and rocks such as temples, contaminating water sources. Such rivers, lakes, or wells cause health problems such as irritation to the lungs, skin, and eyes.

Tourism is a recreational activity outside the domicile to escape from routine work or find another atmosphere. Disaster tourism is a vehicle for understanding how disaster impacts appear through tourist tours. However, the purpose of disaster tourism itself is only an interest in destruction and not an intention to help. Thus, the attractiveness of tourism on the slopes of Mount Merapi lies in the impact of the eruption that produces changes in local environmental conditions.

Architectural Experiment

The cycle generally consists of explored Pre, Eruption, and Postcondition (Figure 3). In addition, to respond to the previous findings[7], the site described earlier, a channel was designed to create zoning for the area to be built. Figure 4 displays the site exploration during the buildings. The building response described earlier in Figure 5 is then used as a reference to produce a building shape that conforms to the design criteria. Meanwhile, Figure 6 expresses the final experiment to adapt the dynamic phenomenon of fluctuating eruption for the site model.

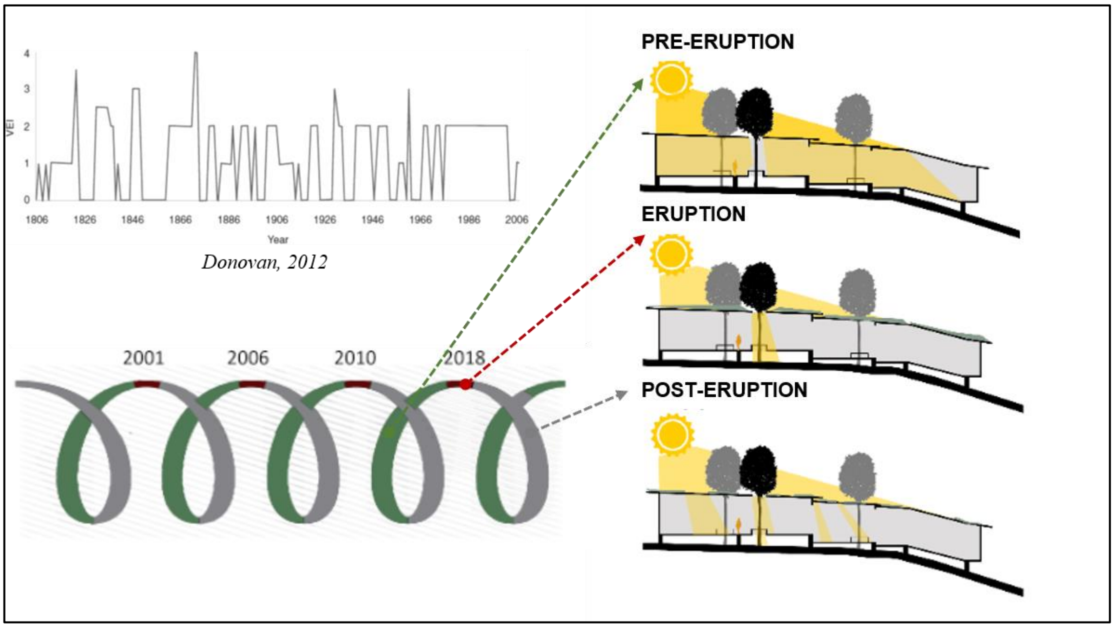

Figure 3 Dynamic cycle on Merapi eruption

The site context cycle shows the idea of local regulation of the building boundary line (6 m) as the design limitation (Figure 4). Different from similar thinking [8], the conservation strategy on vegetation is the critical one. This strategy is essential in recording the natural phenomena of the eruption cycle. At the same time, the RTH (green open space) still has the role of the additional area when the zoning entrance for the architectural experiment is offered. The built space follows the rest of the unbuilt vegetation for the private and public spatial model. The hospitality building type as the hotel requires a comfortable and unique experience for occupants when the location on the eruption cycle maintains the natural design for a dynamic landscape.

Meanwhile, as shown in Figure 5, all site planning factors are synthesized in the building experiment, such as natural, cultural, and aesthetic (accessibility, wind direction view quality related to the eruption, and architectural issues). The stilt structure design is selected to avoid volcanic ash and the problem of volcanic mud. The contoured area is extruded for building massing. Un-cutting landscape design is the method for respecting the site because it is helpful for rainwater arrangement. As a characteristic of tropical architecture, the roof form is also designed to the potential eruption adaptable by sloping to the north and south orientation. Finally, the building experiment recommends a rigid structure for anticipating volcanic seismic.

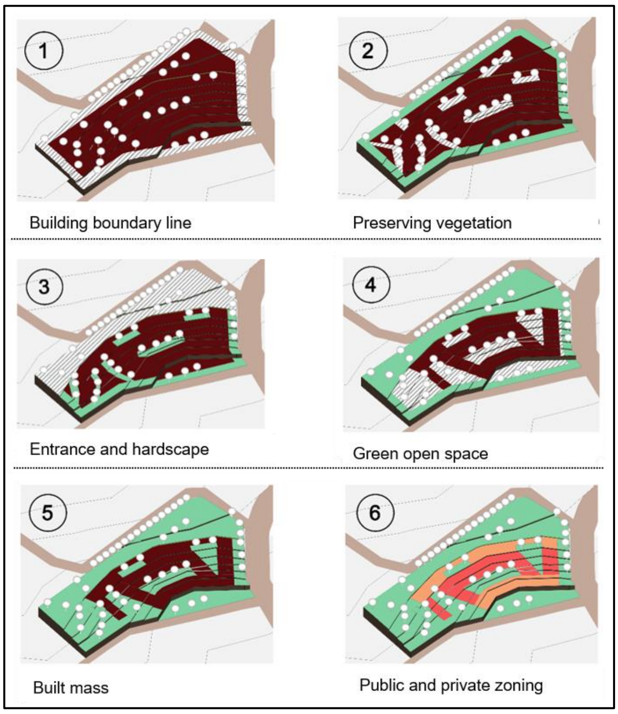

Figure 4 Architecture concept on site scale

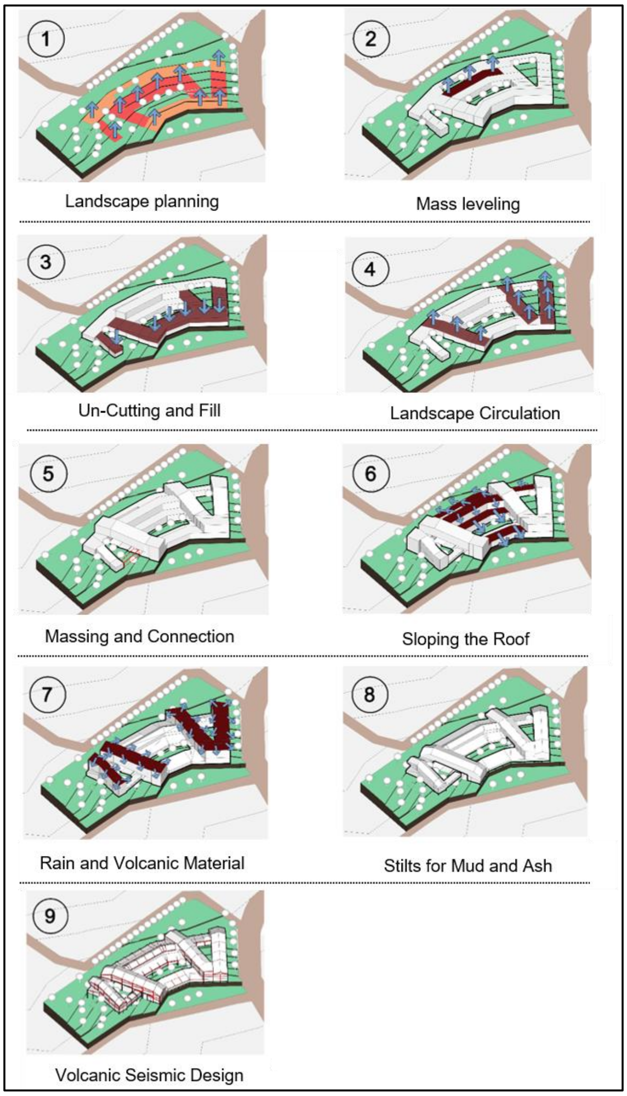

Figure 5 Architecture concept on building experiment

The final experiment shows the glass material for roofing cover to give the unique environmental change experiment for pre, eruption, and postcondition (Figure 6). A transparent façade also triggers the recording of the dynamic environment for every potential view. The natural element of the stone wall for the north and south areas is intended to show the natural weathering process because of the eruption process. In general, the offered recording is directed to keep all operations of the eruption cycle natural. In line with the previous discussion [9], [10], the final design idea will be transferred as essential thinking for rural or urban resilient development.

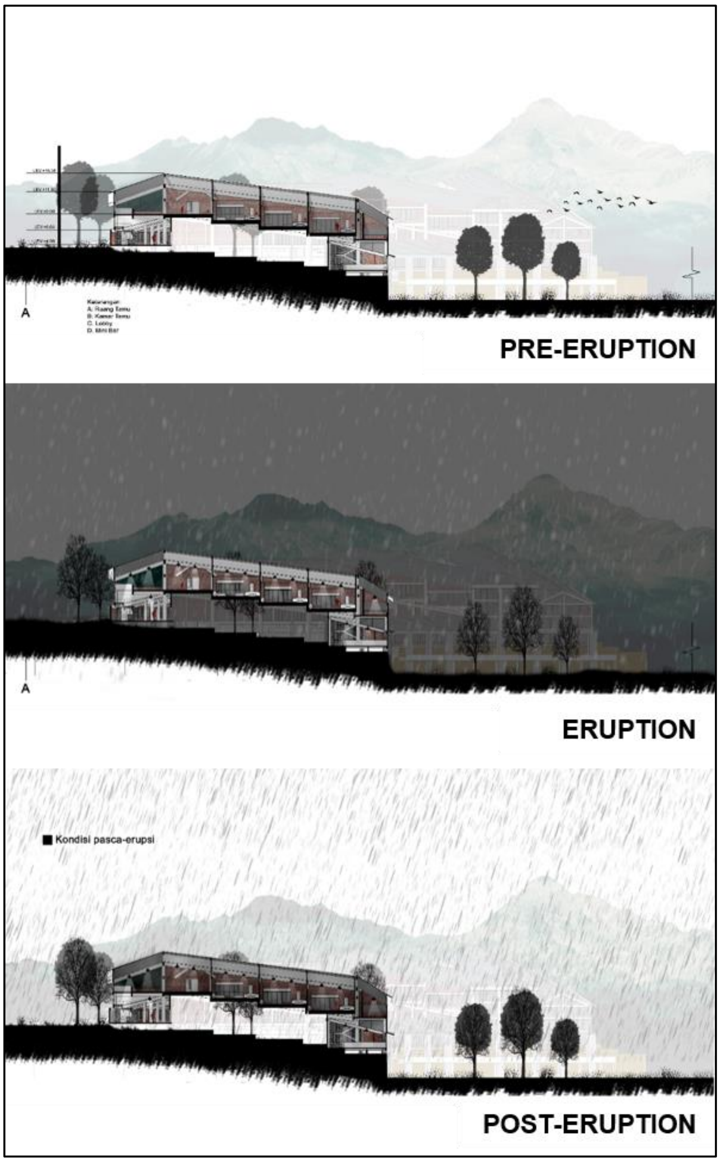

Figure 6 Final experiment

Technical Consideration

The technical infrastructure to mitigate the vulcanic is a very concerning proposal [11] [12] [13] [14] [15]. In addition to those results, the proposed structural system site locations that can be impacted by volcanic seismic or earthquakes, it is necessary to have a structural system that can withstand the shocks caused by the earthquake. Then the structural system is a rigid structural system with continuous columns. This is intended so that any lateral force that is received immediately flows into the column to be transmitted to the ground—an ongoing column for earthquake-prone areas. At the top of each door and window frame is given a beam connected to the column. The treatment is intended so that the door and window frames do not accept the load but are transferred by the beams above them to the column—the addition of beams for the top of the door and window frames.

Electricity Network System: The electricity used in the building comes from the National Electricity Company (PLN). However, as a form of anticipation of a power outage or disconnection of the electricity source from PLN, generators are used as a source of backup electricity and Genset as a backup source of electricity in buildings for the critical eruption. Air Ventilation System (HVAC) is urgently considered because volcanic ash harms the human body. Therefore, the air vents were minimized to prevent the entry of volcanic ash into the building during the eruption. Instead, the air ventilation system in the building uses artificial ventilation using an Air Conditioner (AC). This air conditioning system was chosen so that the AC maintenance and repair process can be more controlled and faster. Concentrating on the outdoor unit will be easier to protect the unit from exposure to volcanic ash in the outside air when an eruption occurs, damaging the overall air quality of the building. The selected water sanitation system uses an upper reservoir for the clean water sanitation system. The selection of the upper reservoir is intended so that the source of clean water for the entire room does not stop when there is no electricity, given the potential for electricity to go out during the eruption.

4. Conclusion

The eruption of Mount Merapi has given rise to a unique form of tourism—disaster tourism—that capitalizes on the area's volcanic activity. This study addresses the need for architectural solutions that can both accommodate this emerging form of tourism and ensure the safety of visitors in a hazardous environment. The proposed hotel, employing the Palimpsest approach, offers a dynamic architectural response by adapting to the shifting environmental conditions caused by volcanic activity. This design not only provides an immersive experience that reflects the changing pre-, during, and post-eruption states but also enhances the tourism infrastructure on the slopes of Mount Merapi. By integrating adaptive facades and eruption-resistant structures, the project demonstrates how architecture can protect both the environment and the public while fostering a sustainable tourism economy. Furthermore, the research highlights the importance of considering local hazards when designing buildings in disaster-prone regions. Future work should explore the use of advanced materials and technologies to further optimize building performance in the most critical areas of the eruption cycle. Additionally, extending this architectural approach to other volcanic regions could provide valuable insights into the global potential of resilient, dynamic tourism infrastructure. The findings contribute to the growing body of knowledge on how architecture can respond to natural disasters while simultaneously promoting regional development and tourism.

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6. Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper. The research was conducted independently, and no financial or personal relationships influenced the results and interpretations presented.

References

[1] D. R. Crandell, B. Booth, K. Kusumadinata, D. Shimozuru, G. P. L. Walker, and D. Westercamp, *Source-book for volcanic-hazards zonation*. Paris: UNESCO, 1984.

[2] K. Smith and D. N. Petley, *Environmental Hazards, Assessing risk and reducing disaster*. New York: Routledge, 2009.

[3] T. Rianto, "Spatial Analysis of Volcanic Risk Perception Case Study in Local Community at Merapi Volcano Dangerous Zones," Universitas Gadjah Mada., Yogyakarta, 2009.

[4] D. Shondell Miller, "Disaster tourism and disaster landscape attractions after Hurricane Katrina," *International Journal of Culture, Tourism and Hospitality Research*, vol. 2, no. 2, pp. 115–131, Jan. 2008, doi: 10.1108/17506180810880692.

[5] R. Butler, *Tourism and Resilience*. Glasgow: CAB International., 2017.

[6] P. R. Kadavi, W.-J. Lee, and C.-W. Lee, "Analysis of the Pyroclastic Flow Deposits of Mount Sinabung and Merapi Using Landsat Imagery and the Artificial Neural Networks Approach," *Applied Sciences* , vol. 7, no. 9. 2017. doi: 10.3390/app7090935.

[7] K. Donovan, A. Suryanto, and P. Utami, "Mapping cultural vulnerability in volcanic regions: The practical application of social volcanology at Mt Merapi, Indonesia," *Environmental Hazards*, vol. 11, no. 4, pp. 303–323, Dec. 2012, doi: 10.1080/17477891.2012.689252.

[8] T. Brittain-Catlin, "Architecture and Movement: the Dynamic Experience of Buildings and Landscapes," *The Journal of Architecture*, vol. 21, no. 3, pp. 465–468, Apr. 2016, doi: 10.1080/13602365.2016.1181840.

[9] F. X. T. B. Samodra, "Analysis of resilient design by thermoacoustic adaptation of tropical urban model," *Journal of Architecture and Urbanism*, vol. 41, no. 4, 2017, doi: 10.3846/20297955.2017.1413960.

[10] F. X. T. B. Samodra, Irvansyah, and C. Erwindi, "Model experiment for rural building performance in the dry season of tropical environment". International Conference on Emerging Applications in Material Science and Technology: ICEAMST *2020*. 2020. doi: 10.1063/5.0002375.

[11] R. J. Blong *et al.*, "Estimating building vulnerability to volcanic ash fall for insurance and other purposes," *Journal of Applied Volcanology*, vol. 6, no. 1, p. 2, 2017, doi: 10.1186/s13617-017-0054-9.

[12] N. I. Deligne *et al.*, "Investigating the consequences of urban volcanism using a scenario approach I: Development and application of a hypothetical eruption in the Auckland Volcanic Field, New Zealand," *Journal of Volcanology and Geothermal Research*, vol. 336, pp. 192–208, 2017, doi: https://doi.org/10.1016/j.jvolgeores.2017.02.023.

[13] Tomašek, I., Damby, D., Andronico, D., Baxter, P., Boonen, I., Claeys, P., ... & Elskens, M. (2021). Assessing the biological reactivity of organic compounds on volcanic ash: Implications for human health hazard. Bulletin of Volcanology, 83. https://doi.org/10.1007/s00445-021-01453-4

[14] Hayes, J. L., Wilson, T., Brown, C., Deligne, N., Leonard, G., & Cole, J. (2020). Assessing urban disaster waste management requirements after volcanic eruptions. International Journal of Disaster Risk Reduction, 50, 101935. https://doi.org/10.1016/j.ijdrr.2020.101935

[15] Domínguez, L., Bonadonna, C., Frischknecht, C., Menoni, S., & Garcia, A. (2021). Integrative post-event impact assessment framework for volcanic eruptions: A disaster forensic investigation of the 2011–2012 eruption of the Cordón Caulle volcano (Chile). Frontiers in Earth Science, 9. https://doi.org/10.3389/feart.2021.645945