ELDERLY BEHAVIOR SETTING TO RESPONDING ERUPTION DISASTER AT THE TRESNA WERDHA SOCIAL SERVICE CENTER, PAKEMBINANGUN

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ABSTRACT

The purpose of this study is to investigate how the elderly respond to disaster situations involving volcanic eruptions in Indonesia. The study was conducted at the Tresna Werdha Social Service Center (Balai Pelayanan Sosial Tresna Werdha—BPSTW) in Pakembinangun, located 14 km from the summit of Mount Merapi, the most active volcano in Indonesia. This research applied an in-depth analysis of the behavior settings of vulnerable elderly groups using a deductive-qualitative research method. The data collection methods included observation, behavior mapping, time budgeting, and interviews. The research results include the formulation of standard behavior patterns of the elderly in responding to the potential for volcanic eruptions, particularly at BPSTW: 1) Comfort and safety are obtained from rooms/lodgings that have high accessibility and visibility (close to exits and close to assembly areas); 2) Elderly individuals with total physical disabilities and severe mental impairments require assistance for emergency response activities, necessitating quick connectivity in terms of accessibility and visibility for caregivers and other elderly individuals (mutual assistance); 3) Agreement on the division of roles and responsibilities between managers and the elderly in emergency response activities (formation of an emergency response team; regular disaster mitigation training). These behavioral settings can contribute to the basic knowledge of inclusive design, particularly for vulnerable elderly groups in responding to specific conditions related to volcanic eruption disasters.

Keywords: *Behavior Settings, Disaster Situation, Eruption, Inclusive Design*

INTRODUCTION

It is commonly understood that Indonesia lies on the Ring of Fire, which means the country's topography features many mountains. Indonesia has 13% of the total number of mountains worldwide; as many as 129 mountains with active status and as many as 500 mountains with inactive status (Gosal, Tarore and Karongkong, 2018). It becomes

relevant when disaster situations related to volcanoes become a focus in academic studies, leading to improvements in the quality of life for people in disaster situations.

On the other hand, the concept of inclusion is increasingly being discussed in various aspects of life. According to the learning achievement in early childhood education, primary education, and secondary education levels in the independent curriculum (Kementrian Pendidikan, 2024), inclusion is a concept for removing all barriers that limit a person's responsiveness and active participation in existing living standards. Inclusive can also be said that every human being has the right and freedom to use and enjoy facilities equally (Nussbaumer, 2012). When it comes to architecture, inclusive means “design that follows function.” as inclusive buildings aim to accommodate diverse needs (Wong, 2014). To understand whose needs must be prioritized, it is important to identify groups who are most affected in daily life. People who face obstacles or limitations in their activities are referred to as vulnerable groups namely the elderly, children, the poor, pregnant women, and people with disabilities (Humaedi, Wibowo and Raharjo, 2020). These groups are entitled to special treatment and protection (Indonesia, 1999).

The basic regulation related to older persons with disabilities requires the state to ensure accessibility, protection, and equal participation for persons with disabilities (including elderly) in all aspects of life, including in disaster scenarios (Indonesia, 2016). This regulation is also in line with the global framework of the United Nations Convention on the Rights of Persons with Disabilities and the Sendai Framework for Disaster Risk Reduction (2015–2030) (United Nations International Strategy for Disaster Reduction, 2015). In fact, when disasters occur, vulnerable groups are the most affected (Suwarningsih, Nurwidiasmara and Mujahidah, 2019), and some cases and studies even show that most disaster victims are elderly people (Nabil, Sakir and Abhipraya, 2021).

BPSTW is a social service center that provides guidance and follow-up services for elderly people who have been forced to evacuate, so that they can live well and remain integrated into society. BPSTW is located in Pakembinangun, only 14 km from the summit of Mount Merapi, Indonesia’s most active volcano.

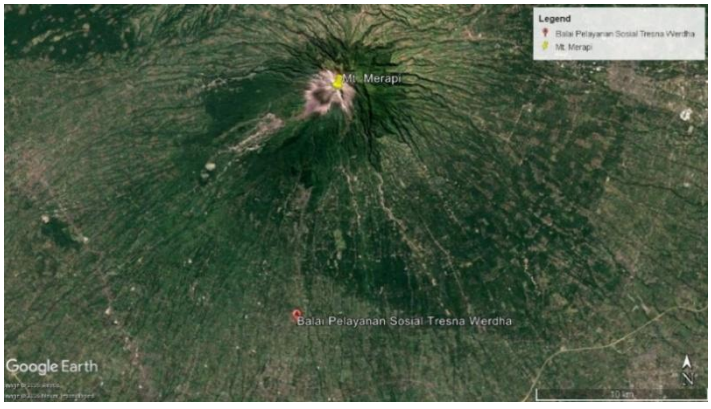

Figure 1. Position of BPSTW on Mt. Merapi
Source: Adapted from Google Earth, 2025

Mount Merapi has erupted more than 80 times. Currently, Mount Merapi erupts once every 4 years (Loeqman *et al.*, 2020). The eruptions of Mount Merapi are accompanied by hot clouds that flow down rivers at speeds of 60-100 km/h that pose as the primary danger (Yanuarto *et al.*, 2019). Disaster management for Mount Merapi is carried out as in general, which is divided into three stages: pre-disaster, emergency response, and post-disaster (Buchari, 2020). Pre-disaster includes preparedness, mitigation, and early warning. The emergency response stage may involve disaster risk reduction, evacuation, and post-disaster response. The post-disaster stage is the rehabilitation and reconstruction stage, both physical and social. There is a disaster management work stage, and there is one more stage after the post-disaster stage, before early warning, namely the disaster management planning stage (Hayati *et al.*, 2021).

The objective of this study is to evaluate mitigation strategies and recommendations with behavior settings, for the design of built environments for elderly people living in disaster-prone areas, using a case study at the BPSTW (Figure 1). The output of this research is practical recommendations in the form of standards for elderly behavior patterns in responding to volcanic eruption disaster situations, which can be used as a reference for policy, facility planning, and emergency preparedness protocols in Indonesia.

The study of behavior settings is considered appropriate to be able to determine how the relationship is established between the behavior of specific elderly with all their limitations (vulnerable groups) with BPSTW environmental settings that have the potential for eruption disasters. Behavior settings can be interpreted simply as an interaction between an activity and a specific place (Haryadi and Setiawan, 2010). Observation will be focused on repetitive elderly activities (behavior patterns) that occur in a specific environment, which also includes the social environment (circumjacent milieu) (Lang, 1987).

THEORY / RESEARCH METHODS

The deductive-qualitative method was used in the study. The principle brings the theory to see how the process of behavior settings is formed, especially how the elderly in BPSTW Pakembinangun, Sleman, DIY, as the object of research, behave on existing settings related to the condition of the potential disaster situation Mt. Merapi. This study uses a rationalistic paradigm that sees the truth not only from empirical terms (experience in the field), but also from perceptual arguments that are part of the construction of thinking (Muhadjir, 1996). Therefore, qualitative analysis was chosen to discuss this study. This research uses observation, behavioral mapping, time budgeting, and interviews as the data collection methods.

RESULTS AND DISCUSSION

Mount Merapi Disaster Situation

Looking through digital mass media, starting from November 5, 2020, the status of Mt. Merapi is alert (Level 3). From the statistics it shows that Mt. Merapi is still very active. The National Disaster Management Agency (BNPB) categorizes four levels of volcano status as mitigation efforts. This level is based on the level of severity and how high the risk of disaster arises. Through a literature study conducted through the information portal of the Geological Disaster Investigation and Technology Development Center (BPPTKG) of Mt. Merapi, noted that the lava fall activity of Mt. Merapi is very intense. View data recap activity Mt. Merapi that existed from July 31 to August 7, 2024, lava avalanches occurred every day at least 74 times and at most 120 times. The distance of the lava slide with the farthest reach is 1.9 Km, while the position of BPSTW in Pakembinangun is 14 Km from peak of Mt. Merapi. The manager of BPSTW said that his party always receives information related to the development of Mt. Merapi activities from local policy makers.

Elderly Behavior Patterns in the BPSTW

The elderly who are in BPSTW until August 2024 are 120. The amount is the maximum capacity provided by the BPSTW. Elderly women dominate with the number of 78 and the remaining 42 are elderly men. The oldest was 99 and the youngest was 58. The health condition of the elderly in BPSTW was slightly different: 89 elderly were declared healthy (quite independent in doing daily activities), 12 elderly were declared semi bed rest (still need to be assisted in some daily activities), 16 elderly were declared bed rest (all daily activities need to be assisted). While there are 3 other elderly with disabilities: one deaf and speech impaired, one is blind, and one with moderate mental disorders.

The behavior of the elderly in BPSTW is strongly influenced by the background of life before living in BPSTW. The background of the life in question is related to social, cultural, environmental, and physical conditions. The elderly who used to be homeless tend to find it more difficult to obey the rules and receive input when compared to the elderly who used to come from families who stayed at home. The routine of activities carried out by the elderly in BPSTW can be seen in Table 1:

Table 1. Elderly Time and Activities at BPSTW Abiyoso

No	Time	Activity
1	04.00 – 06.00	- Morning worship - Morning shower (independent)
2	06.00 – 08.00	- Breakfast
3	08.00 – 11.00	- Morning shower (assisted by officers) - Independent activities - Routine program
4	11.00 – 13.00	- Lunch

No	Time	Activity
5	13.00 – 15.00	- Break/taking naps - Independent activities
6	15.00 – 17.00	- Afternoon shower (assisted by officers/independent) - Independent activities
7	17.00 – 19.00	- Dinner
8	19.00 – 22.00	- Rest - Independent activities

Based on the results of interviews with BPSTW managers, information related to disaster emergency response in the BPSTW environment has not been managed clearly. The disaster emergency response mechanism that has been running until now is only related to evacuation, which relies on the personnel and facilities of the workers at BPSTW. The direction of the disaster emergency response depends only on the information and arrival of TAGANA, BPBD, BPPTKG.

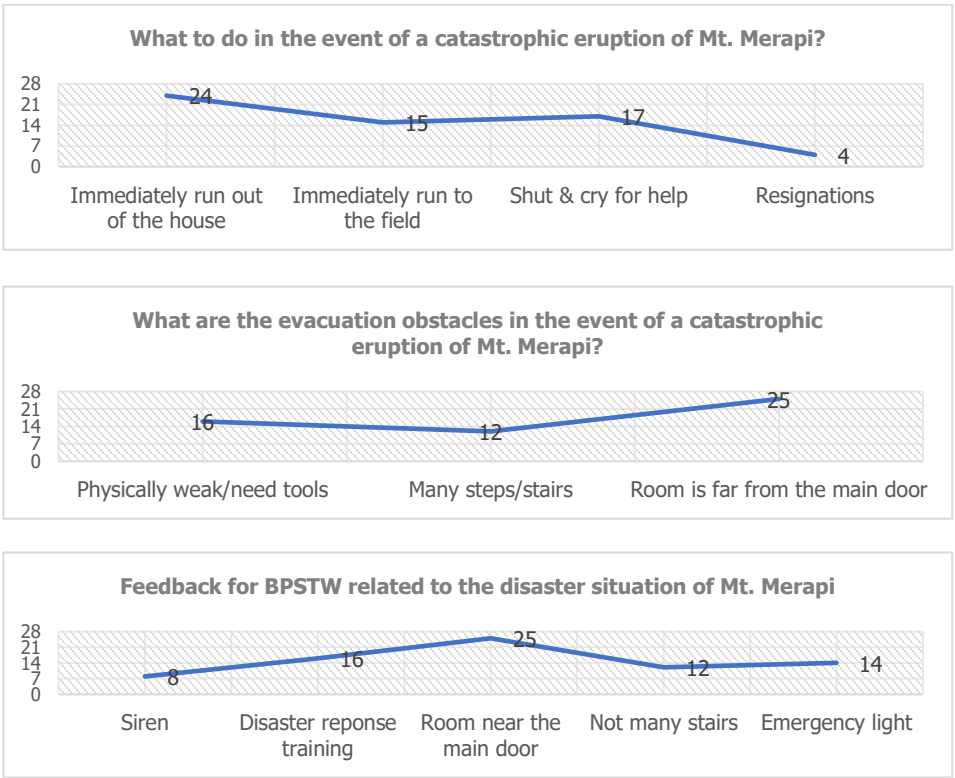

Figure 2. Interview Data of BPSTW Elderly related to Eruption Disaster Emergency Response of Mt. Merapi

Figure 2 presents the responses of 28 elderly participants to three questions related to the eruption situation of Mount Merapi. When asked what would be done in the event of a catastrophic eruption, the answer was dominated by immediately

running outside, followed by shouting for help and immediately gathered in the BPSTW field. A small number indicated that they would do nothing, explaining that they felt too old to respond actively. As for the evacuation constraints in BPSTW, the elderly noted that the room at the back of the guesthouse was too far from the main entrance. They also argue that weakened physical and sensory condition posed significant obstacles, thus increasing their dependence on assistance from others. In addition, several respondents highlighted that the stairs in front of the guesthouse were difficult to navigate, limiting accessibility to the exit.

Furthermore, the elderly provided specific feedback regarding BPSTW's preparedness for the Mount Merapi disaster situation. They suggested that the room doors should not be located too far from the main entrance of the guesthouse to ensure faster evacuation. In addition, the guesthouse itself should be situated closer to the designated gathering area in case of an emergency. They emphasized that the guesthouse should not be too isolated, as this could hinder timely evacuation and access to assistance. Seniors also proposed to hold disaster response training regularly so that the elderly are always reminded/alert. Some elderly pay attention to emergency lights and the idea to prepare *kentongan* for danger signs. Reducing the presence of stairs at some point felt easier for the elderly to activities (not easily tired and afraid of tripping).

Physical Setting of the BPSTW

BPSTW is a large area and has 22 buildings, 18 of which are used for service activities and programs for the elderly, and 4 buildings serve as technical support. The focus of the analysis is macro and micro. The macro analysis in question is to see the specific spatial (physical settings) BPSTW area and see the interrelation of spatial planning in it, while the micro analysis in question is to see the specific spatial (physical settings) guest houses in BPSTW and see the interrelation of spatial planning in it. Mapping the behavior of the elderly through the place centered mapping method is used to understand the spaces of elderly activities. The following is the order of the mass of the building and the order of the guest house space at BPSTW along with the macro and micro analysis.

Figure 3. Area and Building Mass Order Illustration of BPSTW
Source: Adapted from Google Earth, 2024

BPSTW has 12 guest houses that are used as housing for the elderly, as shown in Figure 3. The 12 guest houses have differences that are divided based on their designation. Guest houses number 1 and 2 are paid for which are specifically for the elderly who have their own wishes or their families live in BPSTW. Then the other 8 guest houses are number 3, 4, 5, 6, 7, 8, and 9 are non-paid used as an independent/normal residence for the elderly. While 1 guest house number 10 is a non-paid devoted to the elderly who in their activities need to be assisted by a nurse (bed rest). Meanwhile, there are guest houses that are separated by village road, namely guest houses number 11 and 12, not paid for and used as an isolation, specifically for the elderly who have mental disorders.

The mass order of buildings in BPSTW tends to be symmetrical with the vital space as the center of activity. The residence for the elderly is located on the side and back around the meeting house, management office and clinic. At the entrance of the meeting hall there is a field that is used as a parking area for guest/public vehicles and outdoor activities. The main circulation (road) in the land is in the form of a letter U with an advance on the guesthouse building leading to the road. The average distance between buildings is 5-10 meters.

The guest house has a typical spatial arrangement, except for the isolated guest house. Each guest house has 7 rooms used by 2 elderly people. There are 2 toilets at the back and an open space in the guesthouse that functions as a laundry room. The layout of the guesthouse creates the shape of a building in the form of the letter L. The living room inside the guesthouse is used as a communal area to relax and hang out with the elderly. In a paid guesthouse, room number 1 or 2 is used for the rest room of the officers/nurses who keep watch on schedule. As for the non-paid guest house, the entire room is used for the elderly (Figure 4).

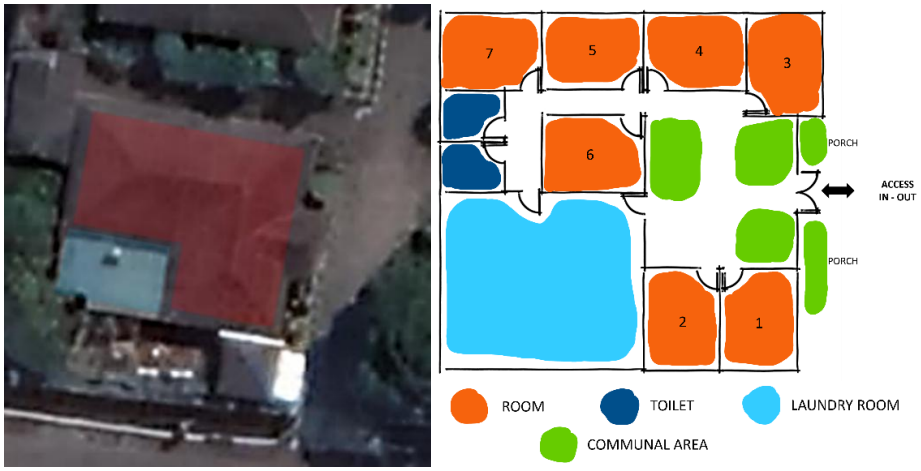

Figure 4. One of the BPSTW Guest Houses and Inside Layout Illustration
Source: Adapted from Google Earth, 2024

BPSTW has prepared several facilities that respond to the activities of the elderly, hand railing and ramp. Hand railing has been applied outside and inside the guesthouse. Its position is attached along the wall as a handle for the elderly when

moving, the material is from stainless steel and not slippery. Ramps are located at several points, especially on the terrace of the guesthouse, as a feature that makes it easier for the elderly to carry out activities from places that have elevation differences (Figure 5).

Figure 5. Hand Railing and Ramp in the BPSTW

Based on the results of observations and interviews, the analysis of research leads to spatial macro and micro with the perception of the elderly and their physical condition in responding to the eruption disaster situation. Spatial analysis focuses on the classification and quality of the existing space in BPSTW, while the analysis related to body condition and perception of the elderly focuses on the ability to access the spatial order in BPSTW.

Analysis of the Behavior Setting for Responding Eruption Disaster at BPSTW

The current response capacity of BPSTW to eruption disasters is still limited and far from optimal. There is no internal emergency response team that has been formed, nor have various basic training related to emergency response taken place. BPSTW managers still rely on existing personnel and facilities (private and community vehicles) to evacuate in the event of a disaster. Facts on the ground, currently BPSTW is still very dependent on external parties (TAGANA, BPBD, BPPTKG, etc.) in this Level 3 (Alert) of Mt. Merapi starting from November 5, 2020.

The eruption characteristics of Mt. Merapi occur on average once every 4 years, which is always followed by signs of rising magma activity. Mt. Merapi rarely erupts suddenly, usually going through Level 2 (Beware) and Level 3 (Alert), then erupting or Level 4 (Eruption). Because of this pattern, the activity of Mount Merapi can generally be anticipated through natural warning signs. Communities living on its slopes are highly attuned to these signals, which enables them to remain vigilant without falling into panic. The same awareness was also observed among the residents of BPSTW.

Administratively, there are requirements that an institution should respond to emergencies/disasters. The institution is encouraged to have an emergency response

team, referring to the Occupational Health and Safety Management System. Although the appeal is only binding on a company, the reality is that every agency involves many people, especially vulnerable groups. Currently, BPSTW is starting the formation of an emergency response team and is still collecting administrative requirements.

The elderly in BPSTW realize that the location of their residence is about 14 km from the summit, which leads to the understanding that they must immediately leave their dwellings and gather with others. It can be seen from the results of interviews with BPSTW managers that the elderly are asked to help each other, given their conditions that have been abandoned by their families. So, it is the fellow elderly in BPSTW—who are now the closest people in the rest of the elderly's lives.

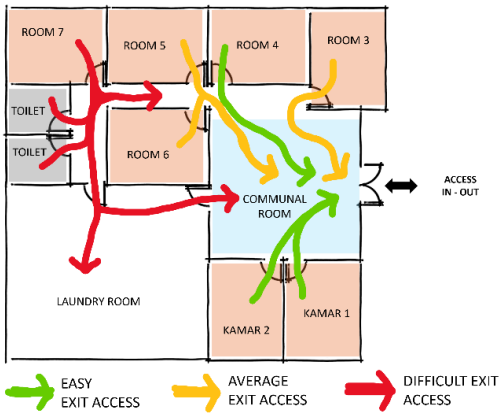

Figure 6. Illustration of Exit Access in the Guesthouse Layout

The microanalysis carried out in one of the (typical) guest houses focused on the layout of the rooms and the scheme of the circulation paths of the elderly. Most of the elderly feel that the arrangement of rooms cannot provide safe and comfortable access for the elderly. The illustration above explains that the room is located in front and adjacent to the main door will be easier to get access out. Rooms 1, 2, and 4 have easy access because the door directly leads to the living room and the main door. While room number 3 has a difficult exit, although the position of the room is in front but the room door opposite the main door. This condition will make it difficult for the elderly because they have to maneuver sharply to turn towards the main door.

Rooms 5 and 6 also have a difficult exit (Figure 6). With the condition of the room door facing the potential collision of the elderly when out will be great. As for room 7 along with the toilet, it has a very difficult exit. Access in the form of passages and branches will be very difficult for the elderly when they have to get out quickly. The distance from the room door to the main door is also quite far, which is 10-12 meters.

The analysis continued on a macro, which is related to the spatial layout of the area along with the scheme of elderly circulation paths in the area. The analysis was conducted especially in 13 guest houses where the dominant elderly activity occurred.

The BPSTW area consists of 2 areas (1 large area and 1 small area) separated by a village road. Each of these areas has an outdoor space as a gathering point.

Figure 7. Illustration of Exit Access from the Mass Layout of BPSTW

Figure 7 explains that the guest house located in front will be easier to get access to open space that functions as a gathering point. Guest houses 1, 2, 8, and 9 have an easy exit with a distance from the door of the guest house to the open space of approximately 20-40 meters. While guest houses number 3 and 7 have a difficult exit, this is because the distance from the door of the guest house to the open space is more than 60 meters. The guest houses 4, 5, 6, and 10 have a very difficult exit. In addition to the distance from the door of the guest house to the open space of more than 80 meters and the farthest is about 105 meters, access to the guest houses 5, 6, and 10 have a winding circulation. The most difficult access is in guest house number 10 because the elderly residents in the guest house are the elderly whose activities must be fully assisted by nurses/guards. In the event of a disaster situation, the elderly in number 10 must be carried or moved with a transportable bed.

Guest houses numbers 11 and 12 are in a smaller area, which is across the street to the west of the large area. The guesthouse is used as a residence for the elderly who have mental disorders. The numbers 11 and 12 are separated because they have different management policies and treatments, it has an easy exit with a distance to the open space of less than 20 meters.

Numbers 1 and 2 are paid guest houses, dominated by elderly people who have a more organized social, cultural, and educational background. Located in front is a form of ease of access and control provided by the manager. Wisma number 1 for elderly men and number 2 for elderly women. Numbers 3, 4, 6, 7, 8, and 9 a non-paid guest houses for elderly women, while guest house number 5 is a non-paid guest house for elderly men. They are deliberately placed at the back because they tend not to be

able to take care of themselves and the guest house properly, so they are kept away from guests/community.

Figure 8. The Ground Level is Getting Higher to the Rear and Access Stairs at Guest Houses

Behavior settings is a combination of activity (behavior) and place (setting/place/environment) that forms an association. The relationship can be explained as a synomorphy, in the form of a new understanding that is relevant to the goals or objectives of the situation/condition to be achieved (Laurens, 2004). Activity or behavior in this case is included with the perception that it is the basis for the emergence of behavior. As for what is meant by settings in this case, it includes the entire environment, whether physical or non-physical, which is a container for activity. It should be underlined that the purpose of the situation/condition to be achieved on the relationship between behavior and this setting. Table 2 describes the relationship between the BPSTW settings or environment and the behavior or activities of the elderly in responding to the eruption disaster situation of Mt. Merapi.

Table 2. Behavior Setting of the Elderly in BPSTW that Responds to the Eruption Disaster Situation of Mt. Merapi

BEHAVIOR SETTING		
SETTING (Environment of BPSTW)	**BEHAVIOR** (Perception of the elderly)	**SYNOMORPHY**
1. Accessibility a. Emergency exit access distance in emergency conditions *(room door to guesthouse main door; guesthouse main door to assembly point)* b. Room layout based on function *(bed rest guesthouse is far from the assembly point; toilet is secluded in the back)* c. Design of circulation path *(elevation of the backmost guesthouse by using stairs)*	**1. Basic attitude** a. The elderly are trained to have a mutual help attitude (*who else can be relied upon besides fellow elderly; the healthy help the sick/the strong help the weak*) b. Elderly with semi and bed rest conditions need the help of nurses/guards in carrying out routine activities c. Seniors need time to hang out with other seniors in order to express what they feel and encourage each other to live	**1. Comfort and safety are obtained from rooms/guest houses that have accessibility and high visibility** (*close to exit access and close to the assembly point*) **2. Elderly with physical limitations and mental disorders fully require assistance for emergency response activities, need a quick connection in terms of accessibility and visibility for caregivers and other elderly** (*mutual help*)
2. Emergency response facility a. Internal early warning system is not available b. There are no evacuation signs c. Emergency response training program is not available d. There are no emergency lights e. There are no disaster preparedness bags	**2. Knowledge of emergency response** a. Approximately 85% of the elderly already have an understanding of the potential natural disaster of eruption Mt. Merapi b. Approximately 53% of the elderly have understood disaster mitigation by gathering at assembly point when a disaster situation occurs c. Approximately 89% of the elderly chose that access was a major factor in mitigating the natural disaster of eruption of Mt. Merapi d. Approximately 57% of the elderly are aware that they are physically weak	**3. Agreement on sharing roles and responsibilities between managers and seniors in emergency response activities** (*establishment of Emergency Response Teams; periodic mitigation training disaster*)
3. Elderly friendly facilities a. *Hand railing* on each lane of circulation b. *Ramp* on circulation line with elevation difference c. Programs for the elderly		

BEHAVIOR SETTING		
SETTING (Environment of BPSTW)	**BEHAVIOR** (Perception of the elderly)	**SYNOMORPHY**
	and need emergency response training e. Approximately 50% of the elderly propose the existence of an internal Early Warning System; evacuation direction signs; emergency lights	

The explanation from the table above can be elaborated as follows. In the context of the design of the built environment that is specifically for the elderly, increasing accessibility is important for the elderly to get access as quickly and easily as possible. It is obtained with a distance of circulation that is spacious and barrier-free, so that the mobility of the elderly becomes smooth (Luciano et al., 2020).

The security and safety risks of the elderly in the design of the built environment are associated with a decrease in body functions. Falling while on the move is the main factor causing the death of the elderly. For this reason, elderly-friendly facilities (adequate lighting, grab bars, handrails, and non-slip surfaces) must be implemented properly without exception (Luciano et al., 2020).

The experience and knowledge of the elderly is determined from their young lives, and it is very diverse. Accordingly, the factors underlying a person's ability to understand and use technology are determined by the level of education and knowledge gained (Chimento-Diaz *et al.*, 2022). Access to technology cannot be fully provided to the elderly, seeing the elderly experience a decline in body function and cognition. Therefore, technology for the elderly should be something simple and easy to understand. If it is associated with technology that responds to disaster situations, then it is easy to understand specifically can be interpreted as a technology that is fast to be accepted sensually, understood, and carried out by the elderly.

The frequency of activity of a person or community in a space is the basic factor determining the quality of that space (Wen *et al.*, 2024). The higher the frequency of human activity in space, the more attention should be paid to the design of that space. Living room or room/guesthouse in BPSTW is the room that has the highest frequency of activity. This is the basis to recommend the results of the analysis of the elderly behavior settings in response to the eruption of Mount Merapi to be implemented in the room/guesthouse.

Recommendations from the Analysis of Elderly Behavior Settings to Respond to Eruption Disasters in BPSTW

During this study, have not found a form of space adaptation in response to the eruption disaster situation. Architectural adaptation to an environment (setting) occurs over a long time until it becomes a local knowledge (signs or symptoms that have

been understood) that is passed down from generation to generation (Naing and Djamereng, 2023). Looking at the existing conditions, BPSTW needs to accelerate space improvization in responding to eruption disaster situations, especially about how the architectural design of BPSTW that follows its function as a nursing home that responds to eruption disaster situations (Wong, 2014)

The need for high accessibility and visibility in the rooms/guest houses, as well as the need for fast connections for the elderly, especially for the elderly with physical limitations/mental disorders, basically talks about the layout and supporting elements of the rooms/guest houses that must be efficient in responding to the eruption disaster situation. Efficient referred to in this context are: 1) the distance and orientation of access out of the guest house with an assembly point; 2) the distance and orientation of access in/out of the guest house to the management office and other guest houses; 3) the distance and orientation of rooms with access out of the guest house; 4) the elevation of the ground. Here are some recommendations from the results of the above analysis for an efficient design in responding to the eruption disaster situation. Located in BPSTW.

Figure 9. Recommendations for the Mass Layout of Buildings in BPSTW

In principle, the recommendations made are still following the size of the BPSTW land area, while the size of the guesthouse is also still following the existing size (Figure 9). Recommendations related to the distance and orientation of the access to the exit of the guest house with an assembly point are realized by placing the guest house on the sides of the edge of the land with the orientation of the access to the exit leading to the center of the land. The exit is directly connected to the main circulation line in the land, which directly leads to the gathering point in the open land in front. Indeed, the distance is not entirely the same between one guesthouse and another, but it is certain that the circulation path is not blocked by anything.

The mosque should be in front of the meeting hall/office manager and close to the assembly point. The physical form of the mosque can be made open

(*pendapa/pendhopo*) so that, in emergency conditions, it can function as a temporary gathering place. Similarly, houses of worship for other religions should also be positioned at the front, as in the existing layout, and designed with open structures to allow their use as temporary gathering spaces during emergencies.

Recommendations related to the distance and orientation of access in/out of the guest house to the management office and other guest houses are related to guest houses that are specifically for the elderly who are bed rest (have total physical limitations). The guesthouse should receive special attention in terms of monitoring and handling from the manager and other elderly people. Bed rest guesthouse is recommended to be in the center between the management office and the clinic, to get maximum monitoring and handling (high accessibility and visibility). This is illustrated by the direction/flow of the green arrow which means having easy access.

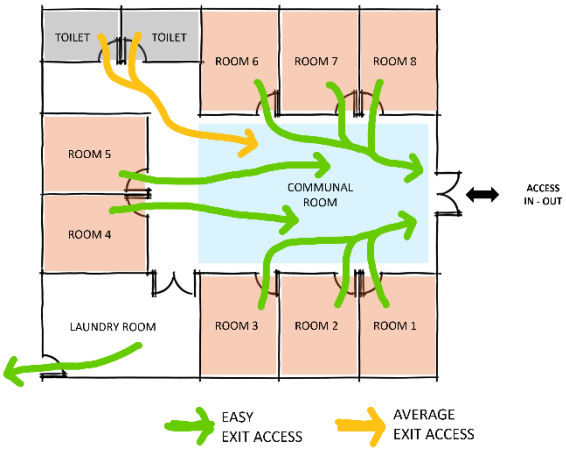

Figure 10. Recommendations for Room Layout at the BPSTW Guesthouse

Recommendations related to the distance and orientation of rooms with access outside of the guest house are made by changing the order of the elderly rooms (Figure 10). The room size and building area remain the same as existing. The composition of the room is made to be symmetrical, placed on the sides to maximize the common space. With this symmetrical composition, the number of rooms also increases, but the laundry area becomes smaller. It is not too influential considering the more benefits with an additional 1 room in the guesthouse. The orientation of the room door is entirely facing the common room, which also leads to the main door of the guesthouse. The quality of accessibility and visibility becomes higher toward the exit of the guesthouse. In the laundry area, there is also a rear exit that can be used as an emergency rear door access, which can also be used by managers to control.

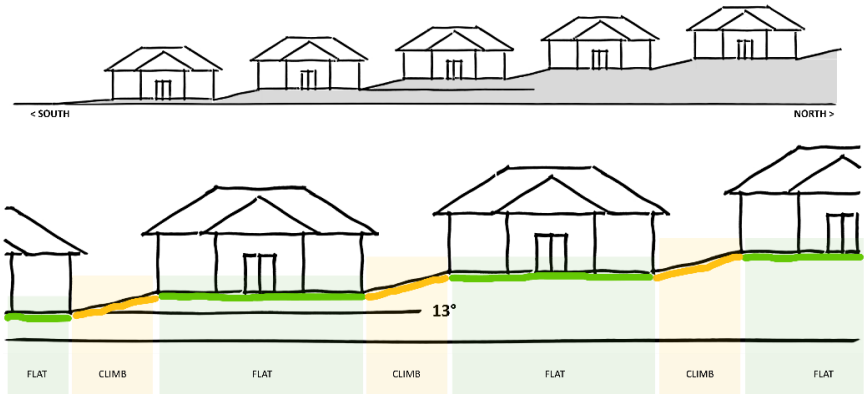

Figure 11. Recommendations for Contour Treatment in BPSTW

Recommendations related to the elevation of the ground surface and the floor of the guest house to the circulation line are made by changing the contour of the land in the BPSTW area as seen in Figure 11. The contour of the land that was getting higher/uphill on the back is changed by dividing the contour, there is a flat part and there is an uphill part. Land with a flat contour is land for a guesthouse, which means it does not need stairs for its elevation (at least a gentle ramp as an elevation path that distinguishes the road surface from the floor surface of the guesthouse). As for the division of the contours of the flat and uphill provides comfort and safety of circulation and provides a pause elevation for the elderly when walking on the path of circulation.

Other recommendations are related to policies that need to be implemented by BPSTW managers. At the time this study was conducted, the plan for the formation of an emergency response team was being pursued by the manager. The research team recommends that BPSTW managers immediately develop a training program related to emergency response with competent parties. In addition, procurement related to the completeness of disaster mitigation facilities also needs to be pursued, including early warning systems, evacuation direction signs, first aid equipment, disaster preparedness bags.

Finally, the notion of attachment to a place (space) with its users is an important factor for the well-being of users, one of which is psychological well-being (Xian and Defiana, 2023). Relevant to the topic of this study, if the elderly in BPSTW are given various training directly related to disaster mitigation on a regular basis, they will feel more confident facing disaster situations. Then, a safe and comfortable psychological condition will be realized

CONCLUSIONS

Looking at the table of elderly behavior settings at BPSTW in response to the Mount Merapi eruption disaster above (Table 2), the following conclusions can be drawn: 1) Comfort and safety are obtained from rooms/lodgings that have high accessibility and

visibility (close to exits and close to assembly areas); 2) Elderly individuals with total physical disabilities and severe mental impairments require assistance for emergency response activities, necessitating quick connectivity in terms of accessibility and visibility for caregivers and other elderly individuals (mutual assistance); 3) Agreement on the division of roles and responsibilities between managers and the elderly in emergency response activities (formation of an emergency response team; regular disaster mitigation training).

From this understanding, the following conclusions were drawn regarding the standard behavior patterns of vulnerable elderly groups responding to volcanic eruptions:

1. The elderly need uninterrupted physical and visual access. Easy access from rooms to building exits and from building exits to gathering points in the area is important. This ease of access is implemented by providing direct, unobstructed access from rooms to building exits, both physically and visually.
2. Elderly people with total physical limitations and complete mental disorders require the support of others with easy physical access without barriers (support assistants). The decline/failure of bodily functions and cognition in the elderly makes them extremely vulnerable; therefore, they need support from others (technology or people) to evacuate. Implementation in the design involves arranging the layout of the space occupied by the elderly so that it can be easily accessed physically and visually by others.
3. Elderly people who are independent (still physically/cognitively sound and able to perform routine activities without assistance) still need recognition from others (recognition for role assignment). Independent elderly people are still capable of being given roles. Relevant to the context of responding to disaster situations, independent elderly people can also be given emergency response/disaster mitigation training as a survival skill.

Uninterrupted access, support assistant, and recognition for role assignment are the three behavior patterns of the elderly in responding to volcanic eruption disaster situations found in this study. These behavior patterns are expected to enrich knowledge about inclusive design standards and can be recommended for development as a reference for policies, planning, and emergency preparedness protocols for vulnerable groups in the field of built environment design.

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