

Study of the Placement of Fire Extinguishers at the R.A. Kartini Museum Rembang using Space Syntax Analysis

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ABSTRACT

The R.A. Kartini Museum Rembang plays a crucial role as the caretaker of art collections and historical artifacts. This study emphasizes the importance of the presence of Fire Extinguishers in ensuring the security of the museum. The strategic placement of fire extinguisher points, considering accessibility and visibility, is the focal point for enhancing response and safety. Evaluation of the existing fire extinguisher layouts is fixed to ensure compliance with safety standards. The R.A. Kartini Museum Rembang, located within the Rembang Regency, operates as the residence of the regent and has now become a Cultural Heritage site. The museum's collection fixed to R.A. Kartini, with exhibition spaces encompassing various types of collections. This research employs the Space Syntax method to analyze spatial connectivity and visual integration. The results indicate that the placement of fire extinguishers in some rooms already exceeds safety standards. However, the presence of fire extinguishers needs to be reinforced with clear and easily locatable signage. Some fire extinguishers are obstructed by shelves or columns, and their placement requires review to ensure efficient accessibility. In conclusion, this study provides a foundation for strategic changes in the placement of fire extinguishers in the R.A. Kartini Museum Rembang. Recommendations include improved signage, a reevaluation of placement, and enhancements to accessibility. These measures will enhance safety and response to the potential threat of fire, preserving valuable cultural heritage.

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Keywords: R.A. Kartini Museum Rembang, Light Fire Extinguisher, Accessibility, Visibility, Space Syntax.

1. Introduction

The R.A. Kartini Museum Rembang is geographically located on Jalan Gatot Subroto No.8, Kel. Kutoarjo, Kec. Rembang, Kab. Rembang. Astronomically, the R.A. Kartini Museum Rembang is located at coordinates 6°42'24.85" South Latitude and 111°21'1.00" East Longitude. The R.A. Kartini Museum Rembang is located on a plot of land bounded by the following boundaries: to the north, it borders Jalan Gatot Subroto and Offices; to the east, it borders residential areas; to the south, it borders Jalan HOS Cokroaminoto, and to the west, it borders residential areas, offices, and Alun-alun Rembang.



Figure 1. Entrance gate to the R.A. Kartini Museum Rembang.

(Source: Personal documentation, 2021)

In general, the R.A. Kartini Museum Rembang complex faces north. This complex has a main entrance on the north in the form of a gate. Apart from the gate as the entrance gate to the complex, in this complex there is also the Kartini School building, the main building, and new buildings built to support the complex's function as the R.A. Kartini Museum Rembang and offices.

From 1903 to 1904, R.A. Kartini resided in this complex. She was the wife of K.R.M. Adipati Ario Djojoaningrat, the seventh Regent of Rembang, who served from 1889 to 1912. R.A. Kartini began living in the official residence of the Rembang regent following her marriage to K.R.M.A.A. Djojoaningrat in November 1903.

The R.A. Kartini Museum Rembang, as a cultural institution that contains artistic and historical values, has a big responsibility in maintaining the security and preservation of its collection. In this context, the existence of a fire extinguisher is crucial to protect the museum from potential fire risks. This introduction will highlight the urgent need for fire extinguishers at the R.A. Kartini Museum Rembang and the importance of determining strategic fire extinguisher points for accessibility and visibility, considering their role in increasing responsiveness and safety in the museum.

The existence of fire extinguisher at the R.A. Kartini Museum Rembang is not only a form of compliance with security regulations but also a proactive step to protect the valuable cultural heritage owned by this museum. Art collections and historical artifacts in museums require maximum protection against the risk of fire, and a fire extinguisher is one of the key elements in this security system.

Apart from that, determining fire extinguisher points by paying attention to accessibility and visibility is an important factor. Good

accessibility ensures that fire extinguishers can be quickly reached and used by security personnel or visitors in emergency situations. Meanwhile, optimal visibility will increase visitor awareness of the existence of fire extinguisher, making it easier to find and use quickly.

In the context of the R.A. Kartini Museum Rembang, where visitors experience direct interaction with valuable collections, the existence and strategic placement of fire extinguishers not only reflect compliance with safety standards but is also an investment in the protection of invaluable cultural values. Therefore, understanding the need for a fire extinguisher and carefully determining fire extinguisher points is crucial to creating a safe and responsive environment to potential fires in the R.A. Kartini Museum Rembang.

To ensure the sustainability and effectiveness of the security system at the R.A. Kartini Museum Rembang, an in-depth study is needed regarding the assessment of the layout of existing fire extinguishers. This study will evaluate the extent to which current fire extinguisher placement meets safety standards and how it can be improved to achieve optimal levels of effectiveness.

Through this study, it can be analyzed whether the fire extinguisher placement point has taken into account the required principles of accessibility and visibility. In addition, evaluation of possible obstacles or barriers to access to fire extinguishers located in certain areas can also be identified. This review will provide a deeper understanding of the effectiveness of current security systems and the extent to which changes or improvements can be implemented.

With this study, the R.A. Kartini Museum Rembang can make strategic changes in the layout of fire extinguisher which can improve the response to potential fires.

Recommendations resulting from this study may include moving the fire extinguisher to a more strategic location, adding standards-compliant markings, or other adjustments that can improve the accessibility and visibility of the fire extinguisher.

Overall, the study regarding the assessment of the layout of the existing fire extinguisher at the R.A. Kartini Museum Rembang will provide a basis for making appropriate decisions in improving the security system, protecting art collections and valuable artifacts, and providing a safer and more comfortable visitor experience.

2. Material and Methods

2.1. Rembang R.A. Kartini Museum Rembang

The R.A. Kartini Museum Rembang buildings occupy the former *Dalem* Regency or Pendopo of Rembang Regency. The use of the word *dalem* is closely related to the residence of the gentry or nobles and people who have high social status in Javanese society. *Priyayi*, or "*para yayi*" is the term for the "younger brothers" of the Javanese king (Sultan/*Sushunan*). In other words, *priyayi* are people with royal blood who, in their social environment, also have roles as princes, administrative officials, and regional leaders; in other words, people who are in Javanese aristocracy circles [1].

The term *dalem* is also used to refer to the house of the regional leader, namely the regent. Regent comes from the Old Javanese word "*bhupati*" which means leader. In the context of positions within the palace, the position of regent is given to leaders who lead an area or village (Rahayu, 2008: 18). The term *dalem* in *Dalem* Regency is used to refer to the entire complex where the regent lives. In the context of traditional Javanese buildings, a *dalem* can be referred to as the main building within a noble house building complex [2].

The R.A. Kartini Museum Rembang building consists of three main building parts, namely the pavilion, *pringgitan*, and *dalem*, which to this day are still preserved, and their original function can still be traced. While the pavilion is a public area usually used to meet the Rembang regent and his guests, the *pringgitan* is used to hold wayang kulit performances. The main house/ *dalem* is the main building where the Rembang regent carries out daily activities with his family.

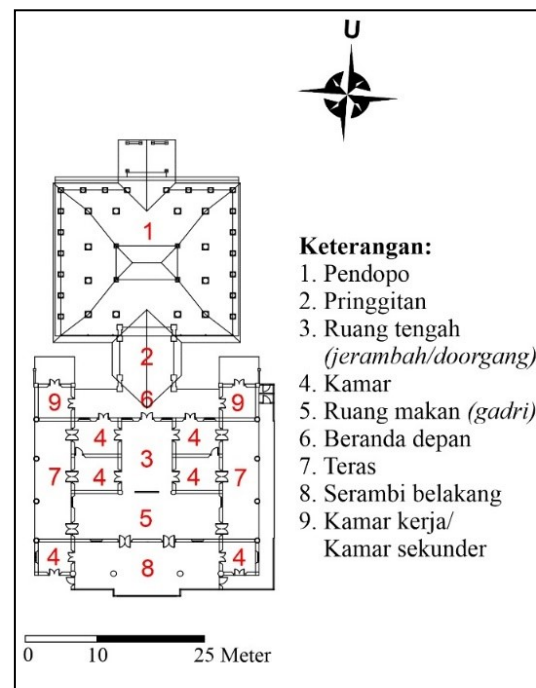


Figure 2. Floor Plan of Rembang Regency.
(Source: [1])

The R.A. Kartini Museum Rembang building is a Regency-level Cultural Heritage which has been determined by the Regent of Rembang through the Recommendation Manuscript of the Rembang Regency Cultural Heritage Expert Team Document Number: 002/TACB/25/05/2018. In the recommendation text, it is stated that this building has an *Indische* style building Empire Style, which was built in the 1750s when the center of government moved from Lasem to Rembang.

The *Dalem* Regency building which, is now used as the R.A. Kartini Museum, Rembang seems appropriate because this building is the place where R.A. Kartini wrote letters to her friends, namely a Dutch husband and wife couple, JH Abendanon and Rosita Manuela. This correspondence activity was a form of R.A. Kartini's expression in voicing emancipation and the role of women, which at that time was considered too far from the role of men in various matters [3].

collections are collections that are directly related to R.A. Kartini's life both when she was single in Jepara Regency and while he was married to KRMA Djojoadiningrat, and lived in *Dalem*, Rembang Regency (See

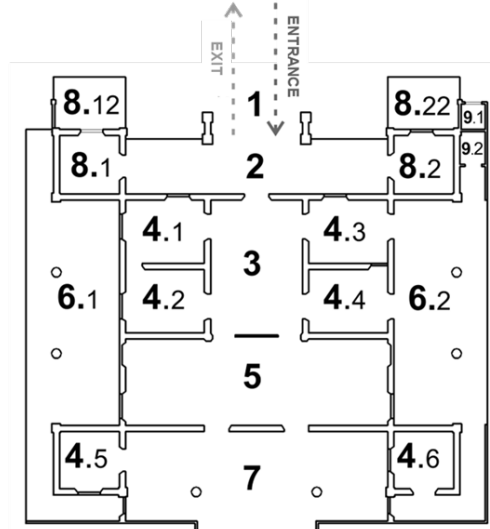
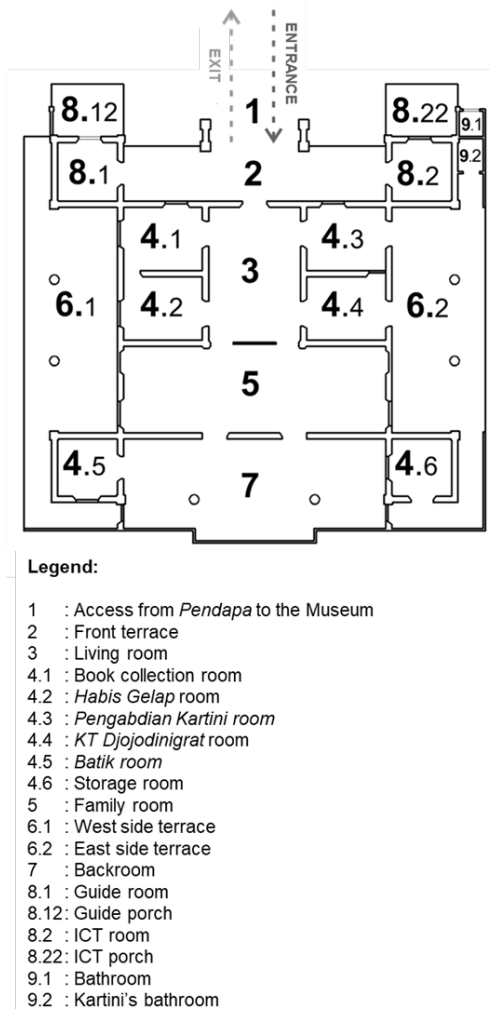


Figure 3) [1].

Figure 3. Museum Exhibition Space Layout.
 (Source: Personal documentation)

2.2. Fire Classification in Indonesia

A fire extinguisher is an extinguishing device that can be carried, lifted, and operated by individuals. Based on the Peraturan Menteri Tenaga Kerja dan Transmigrasi No: 4/MEN/1980 [4], the ability of fire extinguishers to extinguish fires is known as fire rating, fire share 4 class ratings (See Table 1).

The various collections of the Rembang R.A. Kartini Museum Rembang include archaeological, ethnographic, historical, ceramicological, philological, fine arts, and technological collections. Most of these

Table 1. Fire classification.

Class	Material/Type	Extinguisher
Class A	non- metallic solid materials	Water is the main means of extinguishing
Class B	Fires involving flammable liquids or gases	wet type as the main extinguishing agent
Class C	High voltage electrical installation fires	CO ₂ , <i>Dry Chemical</i> , Hallon Gas
Class D	Metal fuel fires	<i>Dry chemical powder sand powder prime</i>

(Source: [4])

Based on the Keputusan Menteri Tenaga Kerja No: Kep.186/Men/1999 Concerning Fire Management Units in Workplaces [5], museum buildings/spaces are classified as light fire hazards, with the statement that workplaces have a low number and flammability with low heat release capability so that the fire spreads slowly.

2.3. Fire Extinguisher Requirements

The fire extinguishers must have markers and identifiers, with conditions such as:

- a. Embossed letters/ sketches on soldered metal plates or on fire extinguisher tubes;
- b. Painted directly on the fire extinguisher tube;
- c. With durable labels;
- d. The year must be permanently marked on the fire extinguisher body;
- e. The fire extinguisher body must be red in color (Indonesia, KEPMENAKER No. Kep. 186/Men/1999, 1999).

Based on the Peraturan Menteri Tenaga Kerja dan Transmigrasi No:4/MEN/1980 [4], the number of fire extinguishers is determined by calculating using the formula:

$$\text{building floor area} = \frac{\pi}{4} D^2$$

$$D = \text{diameter of extinguisher} = 15 \text{ meter}$$

$$\text{the calculated area for 1 extinguisher} = \frac{3.14}{4} 15^2$$

(Source: [4])

NFPA 10 [6] states that determining the number of fire extinguishers in buildings with a fire *rating* of A uses the following formula:

$$\text{fire extinguisher quantity} = \frac{\text{total floor area}}{\text{maximum area protected per extinguisher}}$$

(Source: [6])

2.4. Failures Cases in Museum Fire Safety

The failure of fire safety in museums is a significant concern, as evidenced by several high-profile incidents that have resulted in substantial cultural and historical losses. One of the most notable cases is the fire at the National Museum of Brazil in September 2018. This catastrophic event destroyed millions of artifacts, highlighting the museum's inadequate fire safety measures, including the lack of a sprinkler system and malfunctioning fire hydrants [7]. The tragedy underscored the dire consequences of underfunding and neglecting essential safety infrastructure in cultural institutions.

Another significant incident occurred at the Glasgow School of Art, which experienced two devastating fires within four years, in 2014 and 2018. The second fire, which broke out during the restoration of damage from the first fire, destroyed much of the historic building. Investigations revealed that adequate fire safety measures, such as the installation of sprinklers, were not implemented during the restoration process [8]. This case highlights the critical need for stringent fire safety protocols, especially during restoration and renovation activities in historic structures.

The Notre-Dame Cathedral fire in April 2019, although not a museum, serves as a poignant example of the vulnerabilities of historic

buildings to fire hazards. The fire, which caused extensive damage to the cathedral, brought to light the absence of sufficient fire prevention measures during ongoing restoration work. The incident stressed the importance of integrating advanced fire safety systems in heritage conservation projects to prevent similar disasters [9].

Additionally, the fire at the Museum of the Chinese University of Hong Kong in 2016 resulted in the destruction of valuable artifacts. The investigation pointed to the inadequacy of the museum's fire detection and suppression systems [11]. This incident further emphasizes the need for museums worldwide to adopt comprehensive fire safety strategies to protect their collections and ensure the preservation of cultural heritage.

In conclusion, these case studies illustrate the critical importance of robust fire safety measures in museums and cultural institutions. The repeated failures in fire safety across different contexts highlight the urgent need for improved safety infrastructure and protocols to safeguard invaluable cultural assets.

2.5. Fire Extinguisher Placement

According to PERMENAKERTRANS No:4/MEN/1980 [4], the installation of fire extinguishers must pay attention to several things, including:

- a. Each individual or group of fire extinguishers must be placed in a position that is easy to see clearly, easy to reach and retrieve, and be equipped with installation markings.
- b. The sign is installed at a height of 125 cm starting from the bottom of the floor directly at one or a group of extinguishers in question.
- c. Installation and placement of fire extinguishers must be in accordance with the type and classification of fire.
- d. Placement of fire extinguishers one to another or in groups of one to another must not exceed 15 meters unless placed otherwise by a supervisory employee or work safety expert.
- e. Installation of fire extinguishers must be such that the top part is at a height of 1.2 m from the floor surface except for CO₂ and dry flour types. *powder* can be placed lower, if: the distance between the base of the fire extinguisher from the floor surface is ≥ 15 cm.
- f. fire extinguishers must not be installed in rooms or places where the temperature exceeds 49°C or drops to minus 44°C unless the light fire extinguisher is specifically made for temperatures outside the limits mentioned above [4][11].

Placement of fire extinguishers, according to NFPA 10 [6] must pay attention to several things, including:

- a. In fire extinguisher there is a fire class classification (A, B, C, D, and K).
- b. The distance between fire extinguishers is determined by the fire extinguisher class; for class A fire extinguishers, the distance is 75 ft (22.9 m), class B is 50 ft (15.25 m), class C is 75 ft (22.9 m), class D is 75 ft (22.9 m), and class K 30 ft (9.15 m).
- c. It is placed in an area that is highly conspicuous and easy to reach during a fire.
- d. Fire extinguishers placed outdoors have cabinet space but cannot be locked.
- e. Placement is not obstructed by other objects and avoids the danger of physical damage.
- f. Installation marks are provided if obstruction by other objects cannot be avoided.
- g. There are operating instructions on the front of the fire extinguisher.
- h. The safety seal is good, and the safety cover is securely attached.
- i. The weight is not more than 18.14 kg, and the top end of the fire extinguisher is 1.53

m from the floor. If the weight is more than 18.14 kg, it is installed with the top end of the fire extinguisher < 1.07 m from the floor.

- j. The fire extinguisher tube is red, in good condition, not rusty, or leaking.
- k. CO2 and *dry fire extinguishers* Chemical placement 1.5 m from the floor surface.
- l. All types of fire extinguisher are not placed at 40°C and at temperatures above 49°C.

The minimum distance for fire extinguisher placement in class A buildings according to NFPA 10 is explained in

Table 2 following:

Table 2. Distance between class A fire extinguisher placements.

Classification of fire extinguisher	fire extinguisher Rating	Maximum fire extinguisher Cover Distance (ft ² /m ²)	Building Area (ft ² /m ²)
Low	2A	75/6.97	11,250/1,045
Currently	2A	75/6.97	11,250/1,045
Tall	4A	75/6.97	11,250/1,045

(Source: [6][12])

2.6. Connectivity, Integration and Intelligibility: Space Analysis Syntax

According to Hillier & Hanson [13], connectivity is a measure of the configuration of spaces that are directly connected to other spaces in a configuration unit. Connectivity is used to determine the level of interaction of each space in a place. Apart from that, the main function of connectivity namely to measure the level of intelligence. How to calculate connectivity value by adding up all the spaces that are directly connected to the observation space. Apart from that, there is an attractor unit in an area that will have an influence on the integrity value. Attractors must be able to influence the movement or various activities of the community in a particular area whether formal or informal [14].

Integration in space syntax it is used to measure the configuration from each original space to other spaces in a system. In general,

integration is used to calculate how close an observation space is to all other spaces and can be seen as a measure of relative asymmetry (or relative depth). The more space connected to the observation space, the higher the integration value [13].

Visual Graph Analysis (VGA) simulation was carried out to see the connectivity between exhibition spaces and their relationship with the attractors (exhibition objects) in these spaces. Parts of the floor plan with high connectivity will be shown in red, while parts of the room with low connectivity will be shown in blue (See Figure 4).



Figure 4. Color description of the connectivity image.

(Source: [13])

This research uses quantitative methods that are experimental in nature [15]. The Existing Plan of the R.A. Kartini Museum Rembang (*dalem* Rembang Regency) is a case study for this research to find a potential spatial layout using spatial configuration testing.

Space Simulation The syntax was created using an application called DepthmapX, depthmapX is an open source and multi - platform spatial analysis software for spatial networks of different scales. This software was originally developed by Alasdair Turner of the Space group Syntax as Depthmap, now open-source and available as depthmapX [16].

Please note that the results of the VGA simulation are a depiction of general human behavior that occurs in public places through simulations using the Space program Syntax. The results of this simulation will be much better when there is data regarding visitor statistics, statistics on visitor interest values for

each collection object, visitor comfort in each room, etc. The results of this simulation will be shown in a color scale (See Figure 4) with the caption; the parts shown in yellow-blue depict areas of a location that have low connectivity so that the area will have minimal traffic and will be associated with low interest and attention from visitors, the parts shown in yellow-red depict areas of locations that have high connectivity so that these areas will be visited more often by visitors and will be associated with high levels of interest and attention from visitors.

3. Results and Discussion

3.1. Floorplan Visibility Analysis

According to the VGA simulation results of the museum floorplan (See Figure 5 & Figure 6), the analysis reveals that the most excellent connectivity is concentrated in the northern and southern areas of the central room and family room. Within the living room, optimal connectivity is observed in the access points to adjacent rooms. In contrast, in the family room, the highest connectivity is found at the entrances leading to the living room and back room.

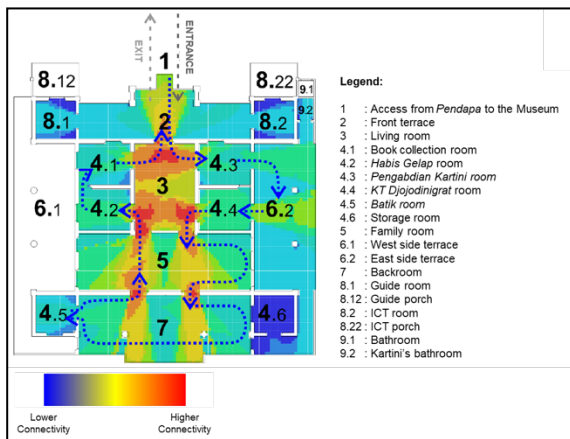


Figure 5. VGA Simulation Results of R.A. Kartini Museum Rembang floorplan.

(Source: Data analysis)

The areas highlighted in green-blue (See Figure 5) in the simulation results indicate sections requiring additional attention for strategically positioning attractors, thereby enhancing visitor engagement and exploration within the room.

Table 3. Summary of attribute analysis results

Attributes	Minimum	Average	Maximum
Connectivity	52	1388.79	3047
Visual Integration [HH]	2.94	8.28	13.91

(Source: Data analysis)

In the storage room, the connectivity is observed to be the lowest among all areas analyzed. Despite this, the functionality and connectivity of this room remain robust, as it operates independently of visitor traffic flow, thereby minimizing disruptions to their exploration of the museum space.

Conversely, the batik room needs better connectivity, necessitating a heightened emphasis on attracting visitor attention compared to other exhibition areas. Enhancing the attractiveness of this room through strategic placement of attractors becomes imperative to foster visitor engagement and encourage exploration within this space.

Areas highlighted in yellow-red denote sections characterized by high connectivity, indicating heightened visitor interaction and attention. These regions serve as crucial focal points for visitor exploration. However, there remains a notable deficiency in the arrangement and security measures concerning emergency preparedness. Key information regarding the location of safety equipment, including evacuation routes and gathering points, is notably absent. Additional details encompassing the museum's overall floorplan, restroom locations, accessibility features for disabled visitors, exit pathways, and guiding

markers are also lacking. Addressing these gaps is essential to bolstering the museum's safety infrastructure and ensuring visitor well-being during emergency situations (See Figure 1 and Figure 6).

3.2. Number of Fire Extinguishers Needed at The R.A. Kartini Museum Rembang

The calculation of the required number of fire extinguishers at the R.A. Kartini Museum Rembang can be determined utilizing the NFPA 10 formula.

$$\text{fire extinguisher quantity} = \frac{\text{total floor area}}{\text{maximum area protected per extinguisher}}$$

(Source: [6])

The building area of R.A. Kartini Museum Rembang is $\approx 1,013 \text{ m}^2$

$$\frac{1.013 \text{ m}^2}{1.045 \text{ m}^2} = 0,97 \text{ units (fire extinguisher type 2A for Class A fire classification)}$$

The calculations conducted reveal that in accordance with NFPA 10 regulations, the R.A. Kartini Museum Rembang should ideally possess a minimum of 0,97 fire extinguisher 2A units, rounded up to 1 unit. Presently, the museum exceeds the safety standards stipulated for Class A buildings/rooms, as the number of fire extinguishers already installed surpasses the required quantity.

4 units of fire extinguisher spread across several places in the museum, will not be on target and inefficient if the placement and marking system is not in accordance with applicable standards, because of this, it is necessary to make further determinations based on the results of the VGA simulation so that the points or placement of the fire extinguisher more optimized.

3.3. Current placement of fire extinguishers in the building

The R.A. Kartini Museum Rembang places a high priority on the security and safety of its visitors and historical collections. Consequently, the museum is equipped only with four fire extinguisher units.

Fire extinguishers in the existing museum are placed in several spaces, including 1) the porch wall of the guide room; 2) next to Kartini's bathroom entrance; 3) the south side backroom wall; 4) front of the storage room door (See Figure 6 & Figure 7).

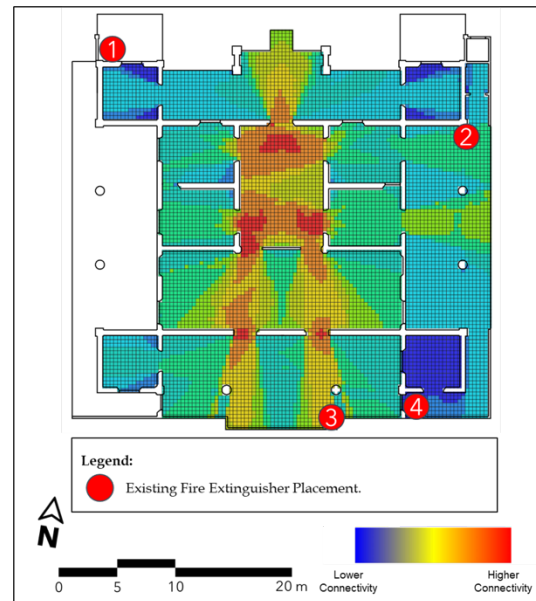


Figure 6. Location of existing fire extinguisher.
 (Source: Data analysis)

The fire extinguisher found at the R.A. Kartini Museum Rembang was identified without a marker (signage), making it difficult to find easily. Lack of markings on fire extinguishers can be an obstacle in emergency situations, where fast time and good accessibility are crucial. Therefore, it is recommended to immediately equip each fire extinguisher unit with clear and visible markings to provide clear instructions to visitors and security officers at that location. This action will

increase awareness and preparedness in dealing with potential fires at the R.A. Kartini Museum Rembang, creating a safer and more responsive environment.



Figure 7. Photos of the existing fire extinguisher at R.A. Kartini Museum Rembang.
 (Source: Personal documentation, 2021)

Apart from not being equipped with markers, it should be noted that several fire extinguishers in the R.A. Kartini Museum Rembang are also blocked by shelves or columns, and are placed at angles that are inaccessible to visitors or staff during emergency (See Figure 6 & Figure 7). This condition can provide additional challenges regarding accessibility and preparedness in dealing with emergencies. It is recommended to evaluate the placement of the extinguishers, to ensure that they are not only easily visible but can also be reached quickly and efficiently when needed. These steps to improve the placement and accessibility of fire extinguishers will positively contribute to safety and response to potential fires at the R.A. Kartini Museum Rembang.

Table 4. Assess connectivity & visual integration of existing fire extinguisher points.

fire extinguisher point	Connectivity	Visual Integration [HH]
1	907	7.14

fire extinguisher point	Connectivity	Visual Integration [HH]
2	1370	8.57
3	1930	10.47
4	212	4.05

(Source: Data analysis)

Based on the results of the VGA analysis, it is evident that the placement of the fire extinguisher on the terrace of the guide room (room 8.12 on the plan) and in front of the Kartini bathroom (room 9.2 on the plan) is suboptimal, as indicated by a visual integration score of 8,57. The placement of the fire extinguisher in front of the storage room has the lowest visual integration value, with a score of 4,05. Additionally, the fire extinguisher is placed on the wall of the back room on the south side (room 7 on the plan).

Placing fire extinguishers in less visible locations creates potential issues regarding visibility and ease of access in the event of a fire. Therefore, it is recommended that the positioning of fire extinguishers to be reconsidered to ensure optimal visibility and accessibility in accordance with applicable safety principles.

4. Conclusions

The significance of strong fire safety measures in museums and historic sites is evident from various incidents, such as those at the National Museum of Brazil, Glasgow School of Art, and Notre Dame Cathedral. These incidents emphasize the need for advanced fire safety systems during restoration to prevent similar losses.

The R.A. Kartini Museum Rembang has a safety policy that considers a building area of 1013 m². With four units of Fire extinguishers, this museum has met the minimum safety standards for the class A fire category, which corresponds to the size of the building. An excess number of fire extinguishers can provide a better level of preparedness, reflecting the museum's commitment to ensuring the safety of visitors and the valuable

art collections inside. However, it is still essential to ensure that fire extinguisher placement complies with safety guidelines, including optimal visibility and accessibility, to maximize effectiveness in emergency situations.

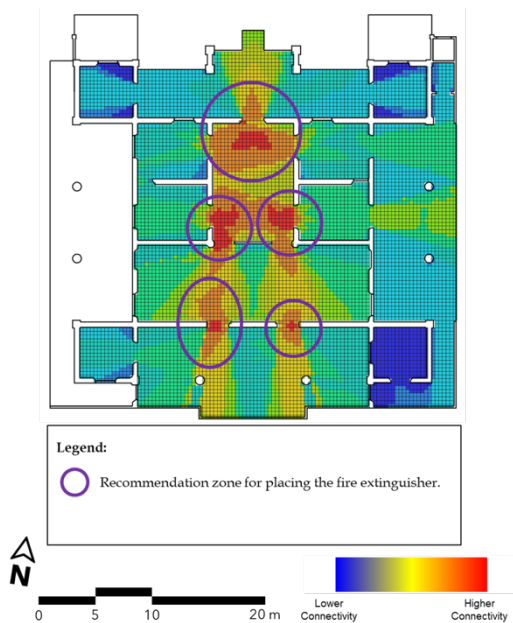


Figure 8. Recommended areas fire extinguisher placement based on VGA results.
(Source: Data analysis)

Visual Graph Analysis (VGA) indicates that the fire extinguisher at point 3 in the Kartini Museum is highly visible to visitors. This placement effectively raises awareness of the extinguishers' presence in the museum. However, it is crucial to ensure that fire extinguishers are visible and easily accessible to increase rapid response in potential fire situations. Periodic evaluation of fire extinguisher placement and availability is vital for maintaining optimal safety levels at the Kartini Museum.

It should be noted that the fire extinguisher located at point 4 in the R.A. Kartini Museum Rembang is inaccessible, and invisible to visitors. This condition is a potential risk in emergency situations, because limited access can hinder rapid response to fires. It is recommended to immediately re-evaluate the

location of fire extinguisher placement at this point to ensure optimal availability and readiness of fire extinguishers. Efforts to improve the visibility and accessibility of fire extinguisher will increase the level of safety at the R.A. Kartini Museum Rembang so that visitors and the art collection inside can be better protected from potential fire risks.

According to NFPA 10 regulations, the R.A. Kartini Museum Rembang requires only one type 2A fire extinguisher unit. The existing four fire extinguishers can be strategically placed in several recommended zones to handle fires effectively when they occur. To increase their effectiveness, it is recommended to place them in five strategic areas so they are visible and easily accessible. First, the front terrace area is a potential point, as it is often the first area seen by visitors. Second, the living room, the main center of activity, can ensure optimal visibility and accessibility. Third, the family room, often used for meetings and other events, is another strategic point. Fourth, placing extinguishers at the main door access point will ensure they can be easily reached in emergencies. Finally, placing extinguishers around art exhibition areas and valuable collections will increase response and readiness in dealing with fire emergencies.

To increase the effectiveness of fire extinguishers at the R.A. Kartini Museum Rembang, it is recommended to place fire extinguishers in five strategic areas to be visible and easily accessible. First, the front terrace area is a potential point because it is often the first area seen by visitors. Second, the living room, which is the main center of activity, could also be the right choice to ensure optimal visibility and accessibility. Third, the family room area can be used as a fire extinguisher point, considering that this room is often used for meetings and other events. Fourth, placement at the main door access point will ensure that the fire extinguisher can be easily reached in

emergency situations. Finally, it is strategic to place fire extinguishers around art exhibition areas and valuable collections, considering additional security for potential fire risks. Careful placement in these five areas can increase response and readiness in fire emergency situations at the R.A. Kartini Museum Rembang.

The Kartini Museum is recommended to add markers in accordance with the applicable Indonesian National Standards (SNI). The signage must include clear and easy-to-understand information, including instructions for fire extinguisher use and the location of other fire extinguisher points. Ensuring that markings conform to generally recognized symbols or icons and comply with guidelines from SNI or international safety standards, such as those issued by the NFPA, will ensure that fire extinguishers can be easily identified and accessed by visitors according to the latest safety norms in Indonesia and globally.

In summary, museum fire incidents emphasize the need for robust safety measures. Ensuring comprehensive data collection and analysis will enhance fire safety strategies, offering better protection for cultural and historical treasures. Further research and design development are needed regarding the prevention and handling of fires in museum buildings, especially those that utilize cultural heritage buildings.

References

- [1] Afriyanto, D. S., Putri, P. D., & Pradipto, E. (2021). Tektonika Perpaduan Unsur Jawa Dengan Eropa Pada Pendopo Dalem Kabupaten Rembang. *ARSITEKTURA*, 239-248.
- [2] Afriyanto, D. S., & Widyastuti, D. T. (2022). Karakter Spasial Arsitektur Dalem Kabupaten di Kota-Kota Pesisir Utara Jawa. *Jurnal Arsitektur Pendapa*, 11-21.
- [3] TACB Kabupaten Rembang. (2018). *Naskah Rekomendasi Tim Ahli Cagar Budaya Kabupaten Rembang Dokumen Nomor: 002/TACB/25/05/2018*.
- [4] Indonesia. (1980). PERMENAKERTRANS No:4/MEN/1980. *Peraturan Menteri Tenaga Kerja dan Transmigrasi Republik Indonesia No:4/MEN/1980*.
- [5] Indonesia. (1999). KEPMENAKER No. Kep. 186/Men/1999. *Keputusan Menteri Tenaga Kerja No. Kep. 186/Men/1999 Tentang Unit Penanggulangan Kebakaran di Tempat Kerja*.
- [6] NFPA. (2022). NFPA 10 Standard for Portable Fire Extinguishers. National Fire Protection Association.
- [7] News, BBC. (2018, September 3). *Brazil museum fire: Funding cuts blamed as icon is gutted*. From BBC: <https://www.bbc.com/news/world-latin-america-45395774>
- [8] Guardian, T. (2018, June 16). *Glasgow School of Art blaze: sprinklers had not been installed after 2014 fire*. From The Guardian: <https://www.theguardian.com/uk-news/2018/jun/16/firefighters-tackle-large-blaze-at-glasgow-school-of-art>
- [9] Times, N. Y. (2019, July 16). *Notre-Dame came far closer to collapsing than people knew. This is how it was saved*. From New York Times: <https://www.nytimes.com/2019/07/16/world/europe/notre-dame-fire.html>
- [10] SCMP. (2016, January 13). *Fire at Chinese University of Hong Kong museum destroys valuable artefacts*. From South China Morning Post: <https://www.scmp.com/news/hong-kong/law-crime/article/1900404/fire-chinese-university-hong-kong-museum-destroys-valuable>
- [11] Indonesia. (1995). SNI 03-3987-1995. *Standar Nasional Indonesia 03-3987-1995*.
- [12] Naru, M. P. (2019). Perancangan Tata Letak APAR dan Kebutuhan APAR dalam upaya pencegahan kebakaran di Gedung Medik RS. St. Carolus Jakarta tahun 2019. *Universitas Binawan*.
- [13] Hillier, B., & Hanson, J. (1989). *The social logic of space*. Cambridge university press.
- [14] Ramadhan, T., Ramadhan, G., Wijaya, K., & Permana, A. Y. (2018). Kajian Spasial Penempatan Fasilitas Sosial di Pemukiman Padat Kota Bandung: Analisis Space Syntax Studi Kasus: Wilayah Kelurahan Burangrang, Kecamatan Lengkong, Kota Bandung. *Jurnal Arsitektur ARCADE*, 66-72.
- [15] Groat, L. N., & Wang, D. (2013). *Architectural research methods*. John Wiley & Sons.
- [16] depthmapX, t. d. (2017). *depthmapX* (0.6.0 ed.). From <https://github.com/SpaceGroupUCL/depthmapX/>