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Analysis of Active Fire Protection System in Building X of Yogyakarta City

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ABSTRACT

Background: A fire is a disaster that can occur at any time and bring material loss, environmental damage, and loss of life. In 2024, in the city of Yogyakarta, there will be 30 cases of fires in buildings that function as residences. One of the buildings at risk of fire is the hotel building. Suara Muhammadiyah (SM) Tower as a hotel has a potential fire hazard including coming from *the kitchen*, electrical panel room and electrical short circuit. This study aims to analyze the active fire protection system at "X" Yogyakarta. **Methods:** This type of research is a qualitative research that uses a case study approach. In this study, the total number of informants involved was 3 people, consisting of 1 manager as a key informant, 1 head of engineering as the main informant and 1 security person as a supporting informant. **Results:** The results of the study show that the "X" Yogyakarta building has a complete active protection system such as alarms and detectors, sprinklers, hydrants and fire extinguishers. However, there are active protection systems that do not meet the applicable reference standards. **Conclusion:** The active fire protection system in the "X" Yogyakarta Building is mostly in accordance with the Regulation of the Minister of Public Works (Permen PU) No. 26 of 2008. However, there are still four partially functional elements and one non-functional element.

1. Introduction

Fire is a disaster that can occur at any time and results in property loss, loss of important documents, environmental damage, psychological impact, and fatalities. According to the Regulation of the Minister of Manpower Number 26 of 2008, it is explained that fire is a danger caused by the potential threat and level of exposure to fire from the beginning of the fire to the spread of smoke and gases caused. Fires can occur due to natural and non-natural factors. Other factors that cause fires to occur are the provision of early protection systems, fire extinguishing and rescue systems that are not functioning properly [1]. In 2023, there will be known fire cases in Yogyakarta City according to data Yogyakarta Regional Disaster Management Agency (BPBD) namely 19 cases of fire [2].

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In 2024, Fire and Rescue Service reported that there were 40 fires in public buildings, 30 residential buildings, 15 in industrial buildings, and 3 fires involving vehicles [3]. The recent hotel fire incident in July 2024 has occurred in Depok, Sleman.

Of the many cases of fires that occur, fires in buildings require special attention. Based on Law of the Republic of Indonesia Number 28 of 2002 concerning Buildings, a building is a physical form of construction that is integrated with a location, partially or completely above or in land and water, which functions as a place for humans to carry out their activities, whether for residence, religious activities, business, social, cultural, or other special activities. One form of the results of construction activities is the hotel [4]. A hotel is a temporary residential building that must implement a protection system to protect residents/visitors [5].

To protect these visitors, a fire protection system is needed, one of which is active fire protection. Active protection systems are fire safety measures that function with tools that can be used by firefighters and building occupants to extinguish fires manually or automatically [6]. The key elements of an active protection system consist of fire alarms, smoke and temperature detectors, sprinkler systems, hydrants, and fire extinguishers. All of these elements collaborate to ensure the safety of residents when a fire occurs [7].

Active fire protection systems need to be suitability analysis to prevent and reduce the risk of fire and minimize the impact caused by fire. From the results of field observations and interviews with 6 informants which include 1 Informant 1 as a key informant, 1 Informant 2 as the main informant, 1 security officer, and 3 visitors as supporting informants, it was found that the “X” building in Yogyakarta City already has a complete active protection system such as alarms and detectors, sprinklers, hydrants and fire extinguishers. However, the active protection system still does not meet the applicable reference standards. This study aims to analyze the active fire protection system at “X” Yogyakarta

2. Methods

This research uses a qualitative approach through a case study method. The case study method was applied to analyze the active fire protection system for the handling and reduction of the effects of fire disasters. The result of qualitative research is a description of words that describe the events found by conducting interviews and direct observation [8]. The goal of the case study approach is to collect detailed and comprehensive information by utilizing a variety of data collection procedures. The data collection carried out is divided into two categories, namely primary data and secondary data.

The analysis in this study is descriptive in nature which describes the object with qualitative analysis. The object of this research is the active fire protection system at “X” Yogyakarta which consists of a fire alarm protection system, fire detector, sprinkler, fire, and hydrant. The informants in this study are divided into key informants, main informants, and supporting informants. The key informants in this study are managers, the main informants are the head of *engineering*, and the supporting informants are visitors to “X” Yogyakarta.

The main data in this study was obtained through observation by directly observing the active fire protection system in the “X” building, Yogyakarta City. Then it is adjusted to interviews with key informants, main informants and validated to supporting informants as well as documentation for each data collection. The results of observations and interviews are then associated with secondary data in the form of company profiles, available facilities, and fire protection system test reports. After the data is available, the next stage is to process the data by comparing the active fire protection system in the “X” Yogyakarta building with the standard reference of the Regulation of the Minister of Public Works (Permen PU) No. 26 of 2008, then given suggestions that can be implemented by the building manager. The final stage is to draw conclusions and provide suggestions based on the overall results of the research.

3. Results and Discussions

3.1. Results

The research results obtained in this study are presented in the following section, which contains the presentation of the analysis data in a systematic and structured manner in accordance with the research objectives.

The analysis of active fire protection systems in this study refers to the Regulation of the Minister of Public Works No. 26 of 2008 which was carried out at the "X" Yogyakarta Building. This study can be used to evaluate the readiness and suitability of the system in protecting in the event of a fire. This active fire protection system includes fire detectors and alarms, sprinklers, hydrants, and fire extinguishers. The suitability of this active fire protection system is described in the table below:

Table 1. Conformity of the Active Fire Protection System in the "X" Yogyakarta building with the Minister of Public Works Regulation No. 26 of 2008

No.	Elements analyzed	Compatibility			Remarks
		Works Full	Works Partial	No Works	
1.	Automatic alarm connected to sprinkler	✓			The alarm is automatically connected to the sprinkler
2.	Each floor of the building has a fire alarm available	✓			All floors in the building have alarms installed
4.	Fire detectors are installed in every room of the building	✓			Detectors are installed on each floor of the building
5.	Detector inspection is carried out every 6 months			✓	Inspections are carried out when damage is found and are not carried out regularly
6.	Sprinkler head testing is done once every 1 year		✓		Only some sprinklers were tested
7.	The maximum distance between the two sprinkler heads is no more than 4.6 m	✓			Distance between sprinkler heads 3.6 meters
8.	The water used is free of fiber or chemicals	✓			Water used in a clean state and free of fiber or chemicals
9.	The building's hydrant box should be easily accessible, clearly visible, and not obstructed by other objects		✓		There is a hydrant box that is blocked by cars parked in the *basement area*
10.	There are hose hydrant fittings, nozzles, couplings, opening faucets	✓			There are hoses, faucets, *nozzles* and couplings that are suitable for the fire department
11.	The length of the hydrant hose in the building is at least 30 meters	✓			The hydrant hose has a length of 30 meters
12.	The fire extinguisher is placed in a location that is clearly visible, easy to reach, and easy to pick up		✓		Some fire extinguishers are not visible when there are cars parked in the basement area
13.	Fire extinguishers weighing not more than 18 kg must be installed with a height of no more than 1.5 m above the floor surface	✓			The installed fire extinguisher weighs 3.5 kg with a height of no more than 1.5 m above the floor
14.	The fire extinguisher is equipped with clear operating instructions for use	✓			The fire extinguisher that has been installed is equipped with instructions for using the fire extinguisher
15.	The fire extinguisher is in good physical condition (no rust, leaks or *clogged nozzles*	✓			All fire extinguishers are in good condition and ready to use
16.	There are maintenance labels such as monthly inspections, paraphrasing of the personnel who carry out the inspection	✓			All installed fire extinguishers have been fitted with maintenance tags

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No.	Elements analyzed	Compatibility			Remarks
		Works Full	Works Partial	No Works	
17.	For a floor area of 278 m², it is mandatory to complete at least 1 unit of fire extinguishers	✓			All floors in the building have met the number of fire extinguishers

3.1.1. Fire Detectors and Alarms

The results of the analysis in this study found that the "X" Yogyakarta building has two types of detectors installed, namely *heat detectors* and *smoke* detectors. *Heat detectors* and *smoke detectors* are installed in all rooms in the building. The existence of *heat detectors* and *smoke detectors* as well as alarms installed in the "X" Yogyakarta building is evidenced by statements from informants regarding the active protection system available in the "X" building.

"*Then per alarm in all buildings/floors, there is per alarm, for the alarm itself will sound automatically and manually in the hydrant box with a loud sound on each floor, so that it is immediately heard in case of unwanted events. There are detectors, there are 2 types of detectors, some are smoke detectors and also heat detectors, especially for the room the smoke detector and for the corridor the heat detector*" **(Informant 2).**

"Then to detect the appearance of the fire, there are 2 types of detectors here, there are those that are for heat detection and smoke detection" **(Informant 1).**

The statement is reinforced by the understanding of how the detector system and continuous fire alarm work.

"The detector has smoke and hot heat. If we take an example from the smoke detector, when there is smoke that hits the smoke detector, the detector will start working, and then later at MCFA (Master Control Fire Alarm), there will appear a light on the indicator, it will turn on, it will continue to be conveyed to MCFA and on the MCFA monitor, there will appear the detected address on what floor and what zone and later the alarm will sound" **(Informant 2).**

"There are two types of detectors here, there are those that detect heat and smoke, then the fire alarm will sound and it will also appear in the monitor system, that's called MCFA, there will be found out where the position point or area in the MCFA is" **(Informant 3).**

Based on the informant's statement, it is known that active fire detectors work by receiving signals from the heat of the fire and smoke. Then the results of the document review were known if the fire detector had been tested by the vendor PT. The lamp was installed in the protection system when it was first installed, and the last time it was tested was during training and checking in mid-September 2024 which was carried out by the Yogyakarta City Fire Department. The results of the last test show that the fire detector system can function properly.

"X" has a fire alarm system that is mounted on the wall or attached to a connected hydrant box and will sound automatically if the detector system receives a signal of danger. The main equipment that functions as a system controller in this fire alarm is the *Main Control Fire Alarm* (MCFA). According to the informant's statement, there are 2 types of alarms installed in the "X" building, namely automatic alarms and manual alarms installed in the hydrant box. The fire detectors installed in this building are clearly visible, easily accessible, and in excellent condition. The results of the study show that the alignment of the fire detection and alarm system in the "X" Yogyakarta building is in accordance with the Regulation of the Minister of Public Works (Permen PU) No. 26 of 2008, most of it has been in accordance and some have not been compliant. The conformity has not been fulfilled with the applicable references, namely in terms of maintenance, including in inspecting the detector

3.1.2. Sprinkler

The results of the analysis of this study are known that in the "X" Yogyakarta building, automatic sprinklers are installed in every room and floor. A sprinkler containing water that has a pressure with

flow will provide a *flow switch signal* that is sent to the main panel of the alarm and the alarm will sound. As for the observation, it was seen that the installed sprinkler was in good condition without rust and leaks.

The existence of sprinklers in the "X" Yogyakarta building is supported by the informant's statement about the location of the sprinkler installation.

"Sprinklers, yes, they are in the room and all spaces, in the corridors there are also the same detectors" **(Informant 2).**

"If the sprinkler and detector are in all guest rooms, in the front corridor of the guest room, in the meeting room, gym, restaurant, there is a sprinkler" (while pointing to several sprinkler points) **(Informant 1).**

The statement was reinforced by another informant who gave a statement about the care and maintenance of the sprinkler.

"Only cleaning and checking what is visible to the eye, whether there is damage or rust or not, there is no special treatment" **(Informant 3).**

Based on interviews and observations conducted by researchers, almost all sprinkler systems in the "X" Yogyakarta building are in accordance with the Regulation of the Minister of Public Works (Permen PU) No. 26 of 2008, although some are not yet compliant. These conformities have not been met according to existing references, especially in maintenance that includes sprinkler system inspections.

3.1.3. Hydrants

The results of this research analysis show that in the "X" Yogyakarta building there are 2 types of hydrants, namely hydrants for buildings and hydrants for courtyards. The hydrant system installed uses a *wet riser system*, which is a system with hydrant pipes that are always filled with pressurized water. To flow water to the hydrant pipes in the "X" Yogyakarata building, a pump control panel consisting of *jockey*, electric and diesel panels has the function of regulating the minimum or maximum pressure of each pump.

There is a hydrant in the "X" Yogyakarta building supported by the statement of informant 1 by giving a statement about the hydrant.

"If the hydrant is here, there is one in the box on each floor, there must be 1 hydrant box and the one in front of it" (while pointing to the hydrant box) **(Informant 1)**.

The above statement was reinforced by another informant who gave a statement about how hydrants work.

"For the jockey pump, it stands by at 8 bars, starts at 7 bars and auto, also if the water pressure decreases, it will fill up again and it can turn off on its own. Then for electric pumps start at 5 bar and must be manual, so when there is a fire and hydrants are used it must be on standby in the pump room to turn off and wait for the directions to be completed and also for the diesel pump it is at 4 bar and also manual. When the fire is severe, the electricity does not flow, it is also used a diesel pump" **(Informant 2).**

The results of the study are known that almost all hydrant systems in the "X" Yogyakarta building are in accordance with the Regulation of the Minister of Public Works (Permen PU) No. 26 of 2008, but there are also those that are not in accordance with it. This conformity has not been fulfilled with the applicable references, namely in terms of hydrant placement.

3.1.4. Light Fire Extinguisher (Fire Extinguisher)

The results of the analysis in this study are known that it is known that the "X" Yogyakarta building has fire extinguishers and is available on every floor of the building with a capacity and a sufficient quantity. The way to store fire extinguishers is by hanging them on the wall. The fire extinguisher can be seen clearly, but there are still several fire extinguishers that are blocked by other objects.

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There is a fire extinguisher in the “X” Yogyakarta building which is supported by the statement of the informant by providing a statement of the type of fire extinguisher used.

"For the fire extinguisher we use 2 types, the first type is like flour that we install on all floors of the building, then for the other type it is CO2 which is installed in the kitchen" (**Informant 1).**

The statement was strengthened by informant 2 and informant 3 gave a statement about the fire extinguisher checking schedule.

"If we shake the fire extinguisher and then turn it back and forth, because later it can clump, right, usually to check the back and forth of the fire extinguisher once every 3 or 4 months, yes, it is done by engineering but with **Informant 3** *it is usually returned back and forth once a month"* **(Informant 2).**

"And check the fire extinguisher by shaking it so that we know whether it is still good or not the contents of the fire extinguisher, usually we do it once a month" **(Informant 3).**

Based on the above statement, checking the fire extinguisher has been carried out regularly, namely once every 1 month by the security team to ensure that the contents of the fire extinguisher are still suitable for use and do not clump, and once every 4 months by *the engineering team* as an overall inspection of the fire extinguisher by ensuring the contents and physicality of the fire extinguisher, so that the fire extinguisher is ready to be used. Each fire extinguisher that is installed has a fire extinguisher mark, how to use a fire extinguisher, type and weight of contents, and recommendations for fire extinguisher treatment. The light fire extinguishers in the “X” Yogyakarta building are classified as fire classes A, B and C.

Based on the results of interviews, observations, and document analysis that have been carried out by researchers, information was obtained that almost all hydrant systems at “X” Yogyakarta are in accordance with the Regulation of the Minister of Public Works (Permen PU) No. 26 of 2008, but some have not met the provisions. This conformity is not in accordance with the applicable references, especially in terms of the placement of fire extinguishers.

3.2. Discussion

3.2.1. Fire Detectors and Alarms

Fire detection and alarm systems are a must-have fire protection for every building. The installation of detector and alarm systems acts as devices that identify fire hazard signs through thermal temperature measurements and smoke detection by detectors. Then there is a warning or sign after a fire is detected in a building by a fire alarm [9]. “X” Yogyakarta Building is a multi-storey building that belongs to the category of high-rise buildings with 8 floors [10]. Based on these categories, this building must have a fire detector and alarm system.

This building has fire detectors with heat and smoke *sensors* installed in all rooms in the building. The type of detector installed in this building is an automatic detector, according to the residential category, namely a class 3 residential building that is used as a long-term or temporary residence by several people, without being related to the number of > 4 floors, then the detection and alarm system is automatic. This is in accordance with the standards that have been set in the Minister of Public Works Regulation No. 26 of 2008.

The fire detection device in this building has been connected to a sprinkler system and alarm that functions by detecting fires through smoke, heat, gas, and flame. After that, the alarm will sound as a warning sign and the sprinkler will spray water. The alarm will indicate where the fire is taking place, being a signal for the building's occupants to extinguish the fire or flee [11].

An active protection system that works automatically certainly requires an inspection in order to work properly. However, the “X” Yogyakarta Building does not carry out routine maintenance, so it does not meet the standards set in the Indonesian National Standard (SNI) 03-3985 -2000 Item 4.7.4 [12]. The performance testing of the fire protection system is the main step in validating the effectiveness of the system in detecting, warning and dealing with fires in buildings [13]. To ensure the function of the alarm in the “X” building, a test was carried out by the Yogyakarta City Fire Department by provoking

the alarm using cigarette smoke until the alarm sounded. The fire alarm will detect the presence of compounds or gases such as hydrogen or methane, if the gas or gas has a high concentration level then the fire alarm will sound [14].

Inspection, testing, and maintenance are recommended to be carried out annually by cleaning using special cleaning products and cleaning parts that contain dust or other dirt [15]. The purpose of fire alarm system maintenance is to prevent false alarms from occurring. Events *false alarm* can be caused by factors such as dust-polluted smoke detectors, resulting in *false alarm* [16].

3.2.2. Sprinkler

Sprinkler is one of the active fire protection systems that operates automatically to extinguish fires, thus preventing the spread of wide fires within buildings [17]. Based on the Minister of Public Works Regulation No. 26 of 2008, a sprinkler is a device that sprays water to extinguish fires with a deflector at the tip of the nozzle, so that water can spray in all directions evenly.

Based on the results of the research, it is known that the "X" Yogyakarta building has been equipped with an automatic sprinkler system that is integrated with a fire alarm system. The sprinkler system has been installed on every floor of the building, so that it meets the standards set in the Minister of Public Works Regulation No. 26 of 2008 in point 5.3.2.14, namely that automatic sprinklers must be installed either for the protection of the whole or part of the building. Automatic sprinklers installed in buildings and buildings must be operated automatically in order to function in the event of a fire, and sprinkler installation must be carried out permanently within the building [18].

The installation distance between the sprinkler heads installed in the "X" Yogyakarta building is 3.6 meters. In accordance with what has been stipulated in the Minister of Public Works Regulation No. 26 of 2008, namely the distance between sprinklers and others is 4.6 meters on each floor of the building. The determination of the distance between the sprinkler heads aims to prevent any unprotected areas or from being exposed to water evenly in each room of the building [19].

The water supply and clean water network for sprinkler systems is sourced from *Water tank* which contains clean water and has a water pump panel including *jockey pump, electric pump* and *Diesel Pump* which is placed in the pump chamber. The water pump used in the sprinkler acts as a drive when the water pressure in the pipeline system decreases, as well as as a water pressure counterbalance in the pipeline installation [20]. Then the clean water in this building comes from a borewell that must not contain fibers, salt substances or mud that can clog the sprinkler ducts, causing corrosion and leakage in the sprinkler head [21].

3.2.3. Hydrants

Hydrants are one of the fire extinguishing systems that can flow pressurized water through pipes and hoses to the fire site. This system includes clean water supply systems, pumps, pipes, hoses, and *Nozzle*. Each building must be equipped with fire hydrants according to the risk classification contained in it. "X" Yogyakarta has been equipped with hydrants that include building hydrants and garden hydrants. Hydrants as a means of fire protection play an important role in reducing the risk of fire and reducing material losses and the number of casualties [22].

The "X" Yogyakarta building is known to have 8 building hydrants and 1 unit of yard hydrants that can function properly. The built-in hydrant comes with a hose rack along with a hose and *Nozzle*. In accordance with the Minister of Public Works Regulation No. 26 of 2008 at point 7.4.5 states that this system must include pipes and suspensions, valves and hoses, as well as hydrant fire pumps (if any). Hydrants are generally equipped with a hose connected to the hose head which is stored in a red steel box [23].

The hydrants in the building still have a shortcoming, namely the placement of several hydrants that are blocked by something. The hydrant must not be obstructed by any object in order to be easily accessed in an emergency situation. The placement of hydrants that are obstructed by something will result in the inhibition of the fire extinguishing process when a fire occurs [24]. Strategic and appropriate hydrant placement and accurate distribution planning can assist fire teams in accessing at-risk areas quickly and efficiently [25].

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3.2.4. Light Fire Extinguisher (Fire Extinguisher)

A light fire extinguisher (fire extinguisher) is the main device in a fire protection system used to extinguish small fires. The use of fire extinguishers is one of the methods to prevent and deal with fires so that they do not grow and spread further [26]. The APAR is intended for every individual who is able and trained in using the APAR. Each building must be equipped with a fire extinguisher according to its fire hazard classification. The "X" Yogyakarta building has two types of fire extinguishers, namely *dry chemical powder* and carbon dioxide.

The "X" Yogyakarta building already has an active fire extinguisher protection system, but there are fire extinguishers that are not suitable. This is shown from the placement of fire extinguishers that are obstructed by objects and the number of inappropriate placement of fire extinguishers in the basement and 2nd floor. The results are not in accordance with the standard reference of the Minister of Public Works Regulation No. 26 of 2008 in chapter 5 point 5.6.3.6. A fire extinguisher that is obstructed by something can result in a delay in accessing the fire extinguisher during a fire [27].

The *National Fire Protection Association (NFPA)* 10 has determined that in determining the need for a fire extinguisher for an area of 200m², at least 1 fire extinguisher is needed [28]. The "X" building on the 4th to 8th floors with an area per floor of the building of 656.25 m² has placed 4 fire extinguishers on each floor. Strategic placement of fire extinguishers has a significant influence on handling fire risks and reducing potential losses due to fire [29].

The fire extinguisher installed in this building is placed at a distance of 1.2 meters above the floor surface, is not obstructed by objects, has an inspection tag and has been equipped with how to use the fire extinguisher. The installation of the fire extinguisher is in accordance with Permenaketrans No. 4 of 1980 article 8. The fire extinguisher test is carried out to find out whether the fire extinguisher is still in a decent condition, both the contents and the tube [30]. Officers who conduct inspections or inspections are required to keep records of all fire extinguishers that have been inspected. The archive is stored using the labels/tags attached to the fire extinguisher, so that this archive will help in the next inspection [23].

4. Conclusion

The conclusion of this study was obtained that most of the results of the analysis of the active fire protection system in the "X" Building in Yogyakarta City were in accordance with the Regulation of the Ministry of Public Works No. 26 of 2008. However, there are still 4 elements that partially function such as only some sprinklers that are tested, there are hydrant boxes and fire extinguishers that are blocked by cars in the *basement area*. Then there is 1 element that does not work, namely the detector inspection which is carried out when damage is found and is not carried out regularly.

Statement

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References

[1] F. F. Khikma and I. Sofwan, "The Effectiveness of Rapid Reaction Teams," *Higeia J. Public Heal. Res. Dev.*, vol. 5, no. 3, pp. 227–238, 2021, doi: https://doi.org/10.15294/higeia.v7i1.58841.

[2] DIY Regional Disaster Management Agency, "Disaster Data Analysis in 2023 DIY." [Online]. Available: https://bpbd.jogjaprov.go.id/berita/bedah-data-kebencanaan-tahun-2023-diy

[3] Fire and Rescue Service, "Fire Numbers in Yogyakarta City Increase in 2023." [Online]. Available: https://kebakaran.jogjakota.go.id/detail/index/31088

[4] President of the Republic of Indonesia, *President of the Republic of Indonesia. Law of the Republic of Indonesia Number 28 of 2002 concerning Buildings*.

[5] N. Noviastuti and D. A. Cahyadi, "The Role of Reservations in Improving Guest Service at Novotel Lampung Hotel," *J. Nusant. (Ilm. Tourism and Hospitality)*, vol. 3, no. 1, pp. 31–37, 2020, doi: https://doi.org/10.63986/nsn.v3i1.17.

[6] K. R. Ratnayanti, N. L. Hajati, and M. I. Rizki Utama, "Evaluation of Active and Passive Protection Systems as an Effort to Overcome Fire Hazards in X Mall Building," *J. Green Engineering*, vol. 3, no. 1, pp. 1–16, 2019, doi: https://doi.org/10.26760/jrh.v3i1.2816.

[7] M. F. N. Fakhriyanto, M. H. Azizi, and A. Abdusshomad, "The Effectiveness of Active and Passive Fire Protection Systems and Employee Education in Maintaining Safety from Fire Hazards in the Airport Terminal Area," *J. Ilm. Multidisciplinary*, vol. 1, no. 6, pp. 137–144, 2024, doi: https://doi.org/10.62017/merdeka.

[8] Suggestion, *Quantitative, Qualitative, and R&D Research Methods*. CV Alfabeta, 2018.

[9] M. P. Sinaga, A. Wiweko, and M. S. Siregar, "Analysis of the Performance Effectiveness of Fire Alarms in KMP. Rajakarta," *ATRIA J. Multidisciplinary Ris. Ilm.*, vol. 1, no. 1, pp. 15–21, 2024, doi: 10.62554/jd9mp344.

[10] M. Pratama, S. Putri, and E. Santoso, "Performance Analysis of High-Rise Buildings with the Addition of Sliding Walls," *Tek. Untan Civil*, vol. 7, no. 2, pp. 175–176, 2021, doi: https://doi.org/10.31849/siklus.v7i2.6922.

[11] R. Enjel and F. Mohammad, "Analysis of the Work of the Fire Alarm System in the Nusantara I Building of the House of Representatives of the Republic of Indonesia," *J. Researcher. Tech Science.*, vol. 2, no. 4, pp. 11–26, 2023, doi: https://doi.org/10.55606/juprit.v2i4.2497.

[12] SNI 03-3985, "Procedures for Planning, Installation and Testing of Fire Detection and Alarm Systems for the Prevention of Fire Hazards in Buildings," *Sni 03-3985-2000*, pp. 1–83, 2000.

[13] P. G. P. Maia, D. Setyanto, and A. D. Soewono, "Fire Protection Installation in Laboratory Buildings Using Heat Detectors and Smoke Detectors," *G-Tech J. Teknol. Apply.*, vol. 8, no. 3, pp. 1343–1353, 2024, doi: https://doi.org/10.33379/gtech.v8i3.4296.

[14] D. Hamdani, E. Handayani, and E. Risdianto, "Design and Construction of Cigarette Smoke and Flame Detection Devices for Health and Fire Management Based on Arduino Uno and GSM SIM900A," *Junal Sciences Fis.*, vol. 11, no. 1, pp. 37–46, 2019, doi: 10.25077/jif.11.1.37-46.2019 37.

[15] D. Anggraeni and M. A. Hamid, "Analysis of the Causes of False Alarms in the Fire Alarm System at the Nusantara I Building of the House of Representatives," *Techniques*, vol. 9, no. 1, pp. 79–88, 2024, doi: https://doi.org/10.52561/teknika.v9i1.324.

[16] A. Asniati, E. M. Hasiri, and W. O. Rosmiani, "Prototype of Air Pollution Detection System Using MQ-2 Smoke Sensor, Mq-6 Gas Sensor and In-Room Fire Sensor with Arduino Microcontroller-Based Alarm Output," *J. Inform.*, vol. 11, no. 2, p. 137, 2022, doi: https://doi.org/10.55340/jiu.v11i2.1204.

[17] M. S. Adinnagara, S. Nazla Wardhani, and S. T. Saputra, "The Role of Sprinkler Water in Airport Fire Emergency Plans: Evaluation of Risk Mitigation Protocols and Measures," *Aviat. Bus. Oper. J.* |, vol. 2, no. 1, pp. 40–47, 2024.

[18] I. Wardani, I. T. Pasaa, F. Nura, and Suhermana, "Evaluation Of The Fire Protection System In Terms Of Rescue Means And Active Protection Systems In Aviation," *J. Inov. and Kreat.*, vol. 4, no. 2, pp. 15–28, 2024, doi: http://dx.doi.org/10.30656/jika.v4i2.9376.

[19] A. Djafar, G. Gunawan, D. Suanggana, and H. Aprilia, "Sprinkler System Design in E, F, G Lecture Building," *G-Tech J. Teknol. Apply.*, vol. 6, no. 1, pp. 59–67, 2022, doi: 10.33379/gtech.v6i1.1248.

[20] Irwanto and A. A. Fahrul, "Analysis of Fire Fighting Installation System in SCBD Control Building at PT. Maintain the Core Image of Jakarta," *J. Tek. Machinery, Ind. Electrical and*

Periodical of Occupational Safety and Health
Vol. 4, No. 2 October 2025, pp. 12-21
e-ISSN: 2962-584X

Inform., vol. 2, no. 1, pp. 240–261, 2023, doi: https://doi.org/10.55606/jtmei.v2i1.1520.

[21] P. R. Utami, "Evaluation of the suitability of the fire protection system of the Muhammadiyah Museum Yogyakarta based on the Minister of Public Works Regulation no. 26 of 2008," *J. Health Lantern. Mass.*, vol. 4, no. 1, pp. 21–35, 2025, doi: https://doi.org/10.69883/jlkm.v4i1.63.

[22] M. Rafianza, Razul, and H. Bambang, "Analysis of Hydrant System Planning in Warehouses," *Precision*, vol. 26, no. 2, pp. 32–40, 2024.

[23] M. I. Senna, A. M. Jundan, W. Kholis, and L. A. Mochammad, "Evaluation of Active Fire Protection System in the Surabaya Electricity Company Administration Building," *J. Student Res.*, vol. 3, no. 2, pp. 79–86, 2025, doi: 10.55606/jsr.v3i2.3758.

[24] A. Manik, B. Tedja, and B. Arianto, "2. Design and placement of hydrants in the aircraft hangar of the 31st Air Squadron of Halim Perdanakusuma Air Base," *TNI Udar Force.*, vol. 1, no. 4, pp. 9–19, 2022, doi: https://doi.org/10.62828/jpb.v1i4.34.

[25] Y. A. Pradana and C. D. Indrawati, "The Use of Gravity Location Model in Determining the Optimal Location of Hydrants at PT PG Rejo Agung Baru," *JUSTER J. Science and Applications.*, vol. 4, no. 2, 2025, doi: https://doi.org/10.57218/juster.v4i2.1559.

[26] M. Reza, E. HS, I. Andesgur, and F. Asteriani, "Socialization of Fire Management in Rejosari Village, Tenayan Raya District, Pekanbaru City," *J. S. Scott. Indonesian.*, vol. 2, no. 3, pp. 771–778, 2022, doi: 10.54082/jamsi.243.

[27] D. N. H. Prastya, T. Martiana, and P. Parlan, "Evaluation of the Placement of Apar in the Ketintang Material Warehouse at Pt.X Surabaya," *J. Ind. Eng. Oper. Great.*, vol. 7, no. 2, pp. 197–207, 2024, doi: http://dx.doi.org/10.31602/jieom.v7i2.16375.

[28] "National Fire Protection Association (NFPA) 10, Standard for Portable Fire Extinguisher," in *National Fire Protection Association (NFPA) 10, Standard for Portable Fire Extinguisher*, 2013.

[29] M. N. Arkaan, R. Khrisna, and W. Dini, "The Effect of Knowledge, Application, and Condition of Light Fire Extinguishers on Fire Risk in Health Facilities," *Scientica*, vol. 2, no. 9, pp. 1–23, 2024, [Online]. Available: https://jurnal.kolibi.org/index.php/scientica/article/view/2288

[30] M. Rachman, D. Friyanto, and Kasda, "Testing Analysis of Light Fire Extinguisher of Dry Chemical Powder Type with a Capacity of 4 kg," *MESA (Mechanical Engineering, Tech. Electric, Tek. Civil, Tech. Architecture)*, vol. 8, no. 2, pp. 70–76, 2024, doi: http://dx.doi.org/10.35569/ftk.v8i2.1982.