

Published online on the journal website: <http://jes-tm.org/index.php/jestm/index>

Journal of Engineering Science and Technology Management

ISSN (Online) 2828-7886 |



Article

Evaluation of Fire Safety System Implementation in the Rectorate and Lecture Buildings of Universitas Pahlawan

Khairun Aniiisya^{1*}, Hanantatur Adeswastoto², Deddy Gusman³

^{1,2} Civil Engineering Study Program, Faculty of Engineering, Universitas Pahlawan Tuanku Tambusai

³ Informatics Engineering Study Program, Faculty of Engineering, Universitas Pahlawan Tuanku Tambusai

DOI: 10.31004/jestm.v6i1.441

E-mail: khairunaniisya@gmail.com

ARTICLE INFORMATION

Volume 6 Issue 1
Received: 01 February 2026
Accepted: 20 February 2026
Publish Online: 30 March 2026
Online: at <https://JESTM.org/>

Keywords

Fire Safety System
Building Reliability
Indonesian National Standard

ABSTRACT

The results of this study show that the implementation of the fire safety system at Universitas Pahlawan Tuanku Tambusai buildings is considered poor based on the standards of quantity, size, site completeness, means of rescue, and active protection systems. Furthermore, the fire safety reliability system has partially followed applicable SNI (Indonesian National Standard), but some systems have not yet complied with the required safety standards. The methods used in this study include a descriptive method to determine the implementation of rescue facilities and passive protection systems against fire hazards, and a quantitative descriptive method to assess the reliability of building safety systems against fire hazards. Construction in major cities is currently increasing. The construction of various buildings aims to achieve urban success in improving public welfare. One of the safety aspects that must be considered in building construction is safety from fire hazards. The purpose of this study is to determine the implementation of the fire safety system in lecture buildings and to assess the level of fire safety reliability in accordance with the Indonesian National Standard (SNI) in lecture buildings.

1. Introduction

Construction in major cities is currently on the rise. The development of various buildings aims to achieve urban success in improving public welfare. One of the safety aspects that must be considered in building construction is protection against fire hazards.

Fire is one of the problems that cannot be separated from human life. Fire not only causes structural damage but also leads to moral losses and casualties. Some causes of fire include: low understanding and awareness of fire hazards, insufficient community preparedness to face and mitigate fire hazards, a fire management system that has not been fully realized and integrated, and inadequate infrastructure and facilities for fire protection systems.

Lecture buildings are among those that require fire protection systems, facilities, and rescue means, as they have complex functions and behaviors within an enclosed structure. Based on this, the authors conducted research on the Evaluation of Fire Safety Systems in Lecture Buildings.

Universitas Pahlawan Tuanku Tambusai, one of the higher education institutions in Bangkinang City, Kampar Regency, is also not immune to the threat of fire. A fire safety protection system is required in a building, including university buildings. University buildings are places that involve a large number of human activities. Therefore, the presence of a fire protection system will enable rapid fire detection and suppression.

This study aims to determine the implementation and reliability of the fire safety system in lecture buildings in accordance with the regulations of the Indonesian National Standard (SNI).

2. Literature Review

2.1. Macro Theoretical Framework of Building Safety and Fire Dynamics

According to Law of the Republic of Indonesia Number 28 of 2002 concerning Buildings, a building is a physical structure resulting from construction work integrated with its seat, which must fulfill technical requirements including reliability, safety, health, comfort, and convenience. In the context of educational facilities, fire safety is an absolute prerequisite prior to building operations. Scientifically, a fire is defined as an exothermic chemical reaction involving rapid oxidation among fuel, oxygen, and heat, a relationship commonly illustrated by the Fire Triangle. When these elements interact in proper proportions and reach their flashpoint, an uncontrolled fire occurs, sustained by a continuous chemical chain reaction. Based on the Regulation of the Minister of Manpower and Transmigration No. Per-

04/MEN/1980, fires are categorized into four classes to determine the appropriate extinguishing media: Class A for non-metal solids such as paper and wood, Class B for flammable liquids or gases like gasoline and LPG, Class C for energized electrical installations, and Class D for combustible metals including magnesium and titanium.

2.2. Site Completeness and Firefighting Accessibility

Site completeness serves as the primary line of defense for external firefighters to suppress and localize a fire. Referring to the Regulation of the Minister of Public Works No. 26/PRT/M/2008, site components must include a perimeter access road designed with adequate width and pavement strength to withstand heavy firefighting vehicles such as pump trucks and turntable ladders. Additionally, safe distances between buildings must be established to prevent fire spread through radiation or convection to adjacent structures. External water supplies, particularly yard hydrants connected to a dedicated fire water reservoir, must also be strategically positioned within a specified radius from the building's exterior walls to ensure rapid intervention during an emergency.

2.3. Means of Escape and Life Safety Facilities

Means of escape or rescue facilities encompass a continuously planned and unobstructed evacuation pathway leading from any point inside a building to a safe assembly point outdoors. The primary components of this system include emergency exit doors that must open outward in the direction of egress, be equipped with panic bars, and possess a specified fire resistance rating. Moreover, protected escape stairs must be enclosed by fire-rated walls and supported by smoke control systems, such as pressurized stairwells, to prevent dangerous smoke infiltration. To guide occupants under low-visibility conditions caused by heavy smoke, automatic emergency lighting and self-illuminating or LED exit signs must be integrated to function seamlessly during a power blackout.

2.4. Active and Passive Fire Protection Systems

Fire protection architecture is broadly divided into active and passive systems to minimize disaster impacts. Active protection systems rely on mechanical and electrical equipment that operates automatically or manually upon detecting fire parameters such as smoke, heat, or flames. This includes fire detection and alarm systems centered around smoke detectors, heat detectors, manual call points, and a Fire Alarm Control Panel (FACP) to provide early warnings. It also encompasses portable fire extinguishers (APAR) installed at maximum intervals of 15 meters for early-stage

suppression, standpipe and hose systems for manual indoor firefighting, and automatic sprinkler systems equipped with heat-sensitive glass bulbs that burst at specific temperatures, typically 68°C, to discharge water directly over the fire source.

Conversely, passive protection systems depend on architectural design and structural containment to limit fire and smoke propagation without requiring mechanical movement. This is achieved through fire compartmentation, which divides the building into smaller zones using fire-rated walls and floors, and structural fire resistance through protective coatings on concrete or steel columns and beams. Furthermore, smoke barriers and fire stops are applied to seal utility penetrations such as cables and pipes, effectively preventing toxic smoke from migrating across different rooms or floors.

3. Research Methodology

This study was conducted based on the regulations of the Indonesian National Standard (SNI). Data collection was performed with the objects of study being the Rectorate Building and the Lecture Building of Universitas Pahlawan Tuanku Tambusai, located in Bangkinang, Kampar Regency, Riau Province, with the research period beginning in April 2023. This study employs descriptive and quantitative descriptive methods. The data obtained from direct observation, checklists, and documentation were subsequently used to determine the implementation of the building safety system against fire hazards based on SNI 03-3985-2000 Procedures for planning, installation, and testing of fire detection and alarm systems for fire hazard prevention in buildings. To provide a clear and structured overview of how the methodology is executed, the complete research workflow from data collection to final evaluation is outlined in the following flowchart (Figure 1).

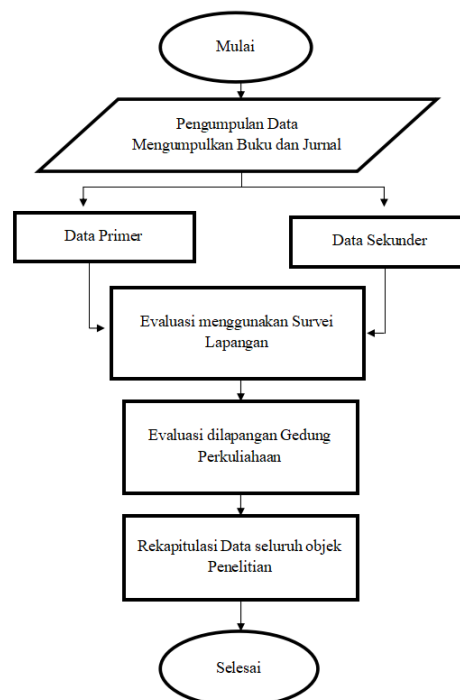


Figure 1. Flowchart

4. Results And Discussion

Data collected through direct field observation and interviews with building management at Universitas Pahlawan Tuanku Tambusai were analyzed to produce the following findings.

4.1. Site Completeness Components — Rectorate Building

Water Source: The Rectorate Building's water source is a borehole well with capacity sufficient for toilet supply, but no dedicated water source for fire suppression is available.

Surrounding Road: The access road around the Rectorate Building is 4.2 m wide, below the SNI-required minimum of 6 m for fire truck access. Vehicles parked along the roadside further reduce the available road width.

Building Setback: The setback of the Rectorate Building (10 m tall) from the nearest structure is 2 m, which complies with applicable requirements.

Yard Hydrant: No yard hydrant is available at the Rectorate Building. Yard hydrants are needed to resupply fire trucks with water during suppression operations.

4.2. Rescue Facility Components — Rectorate Building

Emergency Stairs: The Rectorate Building has no designated emergency staircase; however, the existing regular stairs — 135 cm wide, with 30 cm treads and 96 cm handrail height — can serve as an evacuation route. SNI 03-1735-2000 requires a minimum width of 110 cm, which the existing stairs

satisfy.

Emergency Door: No emergency door is available at the Rectorate Building. Emergency doors are passive protection components that serve as exit routes and shield occupants from fire and smoke during a fire event.

Exit Route and Construction: The exit route is 1.2 m wide. The exit corridor is constructed of concrete, which is fire-resistant up to 400°C, providing occupants with sufficient time to evacuate safely.

4.3. Active Protection System Components — Rectorate Building

Detector and Alarm: Not available. Per SNI 03-3985-2000, buildings such as schools, hotels, and hospitals are required to have automatic fire detection and alarm systems as early warning for occupants.

Building Hydrant and Sprinkler: Neither component is available. Sprinklers are required by SNI 03-3989-2000 as pressurized automatic water supply systems for early fire suppression.

APAR (Portable Fire Extinguisher): Each floor of the Rectorate Building is equipped with a 6 kg powder APAR. These can be used immediately upon fire detection to suppress the fire in its early stage before it spreads.

Other Active Protection Components: Overflow suppression systems, smoke detection, smoke control, smoke exhaust, fire elevator, emergency lighting, operations control room, and siamese connection are all absent. The lack of emergency lighting may hinder evacuation in low-visibility conditions caused by smoke. Emergency power is provided by a generator in compliance with SNI 04-0225-2000.

4.4. Passive Protection System Components — Rectorate Building

Structural Fire Resistance: The Rectorate Building's structure uses fire-resistant concrete. Concrete's fire resistance up to 400°C gives occupants adequate time to evacuate and firefighters sufficient time to suppress the fire, minimizing structural damage.

4.5. Site Completeness Components — Lecture Building

The Lecture Building's conditions are largely similar to the Rectorate Building. Water source is a borehole well. The 4.2 m surrounding road does not meet the SNI minimum of 6 m. The 2.5 m building setback complies with requirements. No yard hydrant is available. Vehicles parked along the access road further reduce the effective road width for firefighting vehicles.

4.6. Rescue Facility Components — Lecture Building

No designated emergency staircase is present; however, the 135 cm wide regular staircase can serve as an evacuation route. No emergency door is available. The exit route is 1.2 m wide with a distance of 2.5–3 m to open space on both sides of the building. Exit construction uses fire-resistant concrete, providing adequate evacuation time.

4.7. Active Protection System Components — Lecture Building

Like the Rectorate Building, the Lecture Building has no detector and alarm, building hydrant, sprinkler, overflow suppression, smoke detection, smoke control, smoke exhaust, fire elevator, emergency lighting, operations control room, or siamese connection. A 6 kg powder APAR is available on each floor. Emergency power is provided by a generator in compliance with SNI 04-0225-2000.

4.8. Passive Protection System Components — Lecture Building

The Lecture Building's structure uses fire-resistant concrete, providing adequate structural protection. Concrete's resistance to temperatures up to 400°C ensures the structure does not immediately collapse during a fire, giving occupants time to evacuate and firefighters time to suppress the fire.

4.9. Access and Water Supply for Firefighting

Following direct observation, an assessment of the access and water supply conditions for firefighting was conducted for both the Rectorate and Lecture Buildings.

1. Rectorate Building

Regarding the building environment, the Rectorate Building has a water source in the form of a borehole well, but no public communication facilities are yet available. The surrounding road has been paved with paving blocks, and the building setback (2 m) already complies with the applicable requirements. Regarding access for firefighters to the building, a road is available with a width of 4.2 meters; however, it does not meet the requirements and there is no marking on the fire access route. On the access road, several vehicles are parked along the roadside, reducing the road width. The results of the access assessment and direct observation can be seen in the table below:

Table 1. Results of Access Assessment and Direct Observation for the Rectorate Building

No	Component	Review Result	SNI
RECTORATE BUILDING			
Site Completeness Components			
1	Water Source – Rectorate Building	Available	
2	Surrounding Road	Not compliant with SNI	
3	Building Setback	2	
4	Yard Hydrant	Not available	
Means of Rescue Components			
1	Emergency Staircase	Available	SNI 03-1735-2000
2	Emergency Door	Not available	
3	Exit Route	1.2 m	
4	Exit Route Construction	Available	
Active Protection System Components			
1	Detector and Alarm	Not available	SNI 03-3985-2000
2	Building Hydrant	Not available	SNI 03-3989-2000
3	Sprinkler	Not available	
4	Overflow Suppression System	Not available	
5	Smoke Detection	Available	
6	APAR (Portable Fire Extinguisher)	Not available	
7	Smoke Control	Not available	SNI 03-6571-2001)
8	Smoke Exhaust	Not available	
9	Fire Elevator	Not available	
10	Emergency Lighting	Not available	SNI 03-6571-2001)
11	Operations Control Room	Not available	
12	Siames connection	Not available	
13	Emergency Power	Available	SNI 04-0225-2000
Passive Protection System Components			
1	Fire Resistance of Building Structure	Available	

2. Lecture Building

The Lecture Building conditions are not significantly different from the Rectorate Building. Regarding the building environment, the Lecture Building has a water source in the form of a

borehole well, but no public communication facilities are yet available. The surrounding road has been paved with paving blocks, and the building setback (2.5 m) already complies with the applicable requirements. Regarding access for firefighters to the building, a road is available; however, it does not meet the requirements and there is no marking on the fire access route. On the access road, several vehicles are parked along the roadside, reducing the road width. The results of the access assessment and direct observation can be seen in the table below:

Table 2. Results of Access Assessment and Direct Observation for the Lecture Building

No	Component	Review Result	SNI
RECTORATE BUILDING			
Site Completeness Components			
1	Water Source – Rectorate Building	Available	
2	Surrounding Road	Not compliant with SNI	
3	Building Setback	2.5	
4	Yard Hydrant	Not available	
Means of Rescue Components			
1	Emergency Staircase	Available	SNI 03-1735-2000
2	Emergency Door	Not available	
3	Exit Route	1.2 m	
4	Exit Route Construction	Available	
Active Protection System Components			
1	Detector and Alarm	Not available	SNI 03-3985-2000
2	Building Hydrant	Not available	SNI 03-3989-2000
3	Sprinkler	Not available	
4	Overflow Suppression System	Not available	
5	Smoke Detection	Available	
6	APAR (Portable Fire Extinguisher)	Not available	
7	Smoke Control	Not available	SNI 03-6571-2001)
8	Smoke Exhaust	Not available	

9	Fire Elevator		Not available
10	Emergency Lighting		Not available SNI 03-6571-2001)
11	Operations Control Room		Not available
12	Siames connection		Not available
13	Emergency Power		Available SNI 04-0225-2000
Passive Protection System Components			
1	Fire Resistance of Building Structure		Available

5. Conclusion

Based on the results of the research and discussion conducted, the following conclusions can be drawn:

1. The evaluation of fire safety system implementation at Universitas Pahlawan buildings reveals that fire safety components are rated as poor based on the standards of quantity, size, site completeness, means of rescue, active protection, and passive protection.
2. The fire safety reliability system of Universitas Pahlawan buildings has partially complied with applicable SNI; however, there are still several systems that have not yet met the required safety standards in accordance with SNI.

References

- Adeswastoto, H. (2022). Tinjauan Sistem Keselamatan Kebakaran pada Gedung Pondok Pesantren Daarun Nadhah Thawalib Kecamatan Bangkinang. *Jurnal Teknik*, 3(2), 112–120.
- Agni Akhassa Arkananta. (n.d.). *Manajemen Keselamatan Kebakaran Gedung*. Diambil dari <https://agniakhassaarkananta.com/en/manajemen-keselamatan-kebakaran-gedung>
- Annisa, K. (2021). Gambaran Penerapan Sistem Penanggulangan Kebakaran PT. Indonesia Power Pembangkit Listrik Tenaga Uap BARRU (BRU OMU). *Jurnal Kesehatan dan Keselamatan Kerja*, 2(1), 34–41.
- Asmi, A. (2020). Investigation Study of Fire Safety Systems in High-Rise Buildings: Case Study of ABC Tower. *Jurnal Teknik*, 1(3), 10–14.
- Bromindo. (n.d.). *Sistem Proteksi Pemadam Kebakaran*. Diambil dari <https://www.bromindo.com/sistem-proteksi-pemadam-kebakaran/>
- Dinas Kebakaran dan Penyelamatan Kabupaten Badung (Diskarmat). (n.d.). *Sistem Proteksi Kebakaran*. Diambil dari <https://diskarmat.badungkab.go.id/artikel/18015-sistem-proteksi-kebakaran>
- Fitriyanti, P. N. Q. (2020). Evaluation of Fire Protection Systems in Multi-Story Hotel Buildings. *Jurnal Ilmiah Teknik Sipil (JITSI)*, 1(1), 43–52. <https://doi.org/10.36423/jitsi.v1i1.474>
- Katigaku. (2021). *Sistem Proteksi Kebakaran Aktif dan Pasif*. Diambil dari <https://katigaku.top/2021/02/22/sistem-proteksi-kebakaran-aktif-dan-pasif>
- Kementerian Pekerjaan Umum. (2008). *Peraturan Menteri Pekerjaan Umum Nomor 26/PRT/M/2008 tentang Persyaratan Teknis Sistem Proteksi Kebakaran pada Bangunan Gedung dan Lingkungan*. Jakarta: Departemen Pekerjaan Umum.
- Kementerian Tenaga Kerja dan Transmigrasi. (1980). *Peraturan Menteri Tenaga Kerja dan Transmigrasi Nomor Per-04/MEN/1980 tentang Syarat-Syarat Pemasangan dan Pemeliharaan Alat Pemadam Api Ringan (APAR)*. Jakarta: Kemenakertrans.
- Mareta, Y., & Hidayat, B. (2020). Evaluasi Penerapan Sistem Keselamatan Kebakaran pada Gedung-Gedung Umum di Kota Payakumbuh. *Jurnal Rekayasa Sipil (JRS-Unand)*, 16(1), 65–76. <https://doi.org/10.25077/jrs.16.1.65-76.2020>
- Pengkaji Teknis. (n.d.). *Sistem Proteksi Kebakaran*. Diambil dari <https://pengkajiteknis.com/sistem-proteksi-kebakaran>
- Prayuda, H., Maulana, T. I., Fauzan, O. M., & Erlinda, R. D. (2020). Evaluasi Sistem Utilitas dan Pencegahan Kebakaran pada Bangunan Gedung Perkuliahan. *Jurnal Konstruksia*, 11(2), 85–94.
- Program Studi Agroteknologi Fakultas Pertanian Universitas Merdeka Pasuruan. (2022). Ketersediaan Sistem Proteksi Aktif dan Sarana Penyelamatan untuk Menghadapi Bencana Kebakaran di Kampus Air Tawar Universitas Negeri Padang. *Jurnal Buana Sains*, 22(1), 45–50.
- Republik Indonesia. (2002). *Undang-Undang Nomor 28 Tahun 2002 tentang Bangunan Gedung*. Lembaran Negara RI Tahun 2002. Jakarta.
- Safety Sign Indonesia. (n.d.). *Kebakaran Gedung Bertingkat: Minimalkan Risikonya dengan Memahami Penggunaan APAR*. Diambil dari <https://www.safety-sign.com/kebakaran-gedung-bertingkat-minimalkan-risikonya-dengan-memahami-penggunaan-epar/>

- dari
<https://www.safetysign.co.id/news/Kebakaran-Gedung-Bertingkat-Minimalkan-Risikonya-dengan-Memahami-Penggunaan-APAR>
- Sari, M. L., & Sukwika, T. (2020). Sistem Proteksi Aktif dan Sarana Penyelamatan Jiwa dari Kebakaran di RSUD Kabupaten Bekasi. *Jurnal Ilmu Kesehatan Bhakti Husada*, 10(1), 72–81.
- Totalfire Indonesia. (n.d.). *Sistem Manajemen Keselamatan Kebakaran Gedung*. Diambil dari <https://totalfire.co.id/sistem-manajemen-keselamatan-kebakaran-gedung>
- Wahyuni, S. R. I. D. (2022). *Evaluasi Keandalan Sistem Keselamatan Kebakaran (Studi Kasus Bank Syariah Indonesia KC Meulaboh Imam Bonjol)* (Tugas Akhir, Universitas Teuku Umar). Repositori Kampus Alue Peunyareng, Aceh Barat.
- Willianti. (2020). *Bab II Kajian Pustaka Sistem Proteksi Kebakaran*. Skripsi/Tugas Akhir Repositori Institusi, 12(1), 6–25.
- Yudila, P., Adha, M. Z., & Bahri, S. (2022). Evaluasi Penerapan Sistem Proteksi Kebakaran Aktif di Dinas Pemadam Kebakaran di UPT X. *Jurnal Ilmu Kesehatan Masyarakat*, 11(2), 105–114.