Volume 4, No. 11 November 2026, pp. 1756-1763
e-ISSN 3031-5786
DOI: https://doi.org/ 10.46799/adv.v4i11.736

ADVANCES IN SOCIAL HUMANITIES RESEARCH

Analysis of Fire Protection System Readiness on Emergency Stairs of Multi-Storey Education Buildings: A Qualitative Case Study

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Keywords:
Emergency Stairways; Fire Protection; Educational Buildings; Occupational Safety; Qualitative Case Study.

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Abstract

Building safety is a fundamental concern, particularly in multistory educational buildings characterized by high occupant mobility. This study aimed to explore the implementation of fire safety measures and fire protection systems in the emergency stairways of Building I, Faculty of Economics and Business, at a private university in West Jakarta, Indonesia, from the perspectives and experiences of key stakeholders. Employing a qualitative descriptive approach with an intrinsic case study design, data were collected through in-depth interviews with seven informants selected using purposive sampling, field observations, and document reviews to establish the regulatory context. Data were analyzed using the Miles and Huberman interactive model, with trustworthiness enhanced through source triangulation, methodological triangulation, member checking, and peer debriefing. The findings identified four major themes: organizational commitment to safety and institutional limitations, perceived physical and operational barriers in emergency stairways, occupant vulnerability and emergency preparedness, and integrated strategies for strengthening a safety-oriented organizational culture. From a managerial perspective, fire safety policies had been established; however, their implementation was perceived as inadequate because of operational budget constraints. Regarding physical safety conditions, informants expressed concerns that the existing emergency stairways might not provide adequate protection during fire emergencies because of the absence of fire-rated doors and appropriate fire-resistant separation. Furthermore, building occupants were perceived to have limited emergency preparedness, primarily because regular evacuation drills had not been conducted. The recommended strategies emphasized strengthening organizational safety culture through routine evacuation drills and implementing context-appropriate physical improvements that integrate technical fire protection measures with behavioral aspects of emergency preparedness and fire safety management.

INTRODUCTION

Fire protection in multistory educational buildings is essential to ensure that occupants can evacuate safely under urgent and potentially hazardous conditions. Emergency stairways constitute a critical component of a building's means of egress, and their effectiveness depends on adequate passive fire protection, unobstructed access, and occupant preparedness. Indonesian building and fire safety regulations, including Government Regulation No. 16 of 2021 and Indonesian National Standard (SNI) 03-1746-2000, provide a regulatory framework for evaluating means of egress and associated fire safety requirements (Hesna et al., 2009).

The study was conducted in a multistory academic building at a private university in West Jakarta, Indonesia. The original building documentation identified two emergency stairways and highlighted concerns regarding the absence of fire-rated doors and adequate smoke-resistant separation, as well as the informal use of emergency stairway areas for student activities. These conditions raised important questions about how emergency stairways were perceived, managed, maintained, and utilized during routine building operations and how their functionality might be affected during fire emergencies.

Previous studies have emphasized regulatory compliance, fire protection equipment, and risk management requirements in building safety assessments (Tjahjono et al., 2023; Sukmawan & Yusiani, 2025). The present study also drew on the Resource-Based View (RBV) to examine organizational resource allocation, the Swiss Cheese Model to understand vulnerabilities across multiple safety barriers (Reason, 1990), and the Total Safety Culture framework to explore safety-related attitudes and behaviors (Geller, 2001). Together, these theoretical perspectives provided a comprehensive foundation for examining the interactions among technical fire protection measures, organizational management, and human factors.

The research gap lies in the limited context-specific understanding of how building managers, operational personnel, and occupants experience and respond to fire safety constraints in aging educational facilities. Although regulatory frameworks establish technical safety requirements, they do not fully explain the organizational and behavioral factors contributing to the absence of protective components, the informal use of emergency stairways, or variations in occupant preparedness. An intrinsic qualitative case study was therefore considered appropriate for exploring these interconnected issues within their institutional context without attempting to establish statistically generalizable compliance rates.

Addressing this gap is particularly important because delays in implementing physical safety improvements and the absence of regular evacuation drills may collectively compromise emergency preparedness. Emergency stairways that appear accessible during routine operations may become less effective during fire emergencies if smoke protection, passive fire resistance, evacuation signage, or occupant responses are inadequate. Qualitative investigation can provide insights into perceived operational barriers and organizational priorities, although its findings cannot replace technical assessments of fire resistance, smoke movement, or evacuation performance.

The novelty of this study lies in its integrated examination of organizational resources, physical fire protection measures, and occupant safety practices within a single educational building. By incorporating the RBV, Swiss Cheese Model, and Total Safety Culture as complementary analytical frameworks, the research extended beyond conventional regulatory compliance checklists to explore how institutional constraints, vulnerabilities in protective systems, and human behavior collectively shaped perceived fire safety readiness. This integrated perspective provided a context-specific understanding of the challenges identified by stakeholders.

Accordingly, this study aimed to explore stakeholders' experiences and perceptions regarding emergency stairway safety and fire protection readiness in a multistory educational building and to formulate practical recommendations for institutional improvement. The findings were expected to inform resource allocation priorities, identify potential improvements in passive fire protection and emergency egress arrangements, and strengthen evacuation preparedness through organizational and behavioral interventions. Furthermore, the study sought to contribute qualitative evidence to the literature on fire safety management in educational facilities and provide a foundation for subsequent engineering assessments and comparative investigations across multiple institutional settings.

METHOD

Table 1. Characteristics of Research Informants

Code	Job Title/Position	Groups
R1	Director of Campus Management Institution	Policy Makers
R2	Head of General Bureau	Policy Makers
R3	Head of General Sub-Division	Operational Implementer
R4	Head of K3 Sub-Division	Operational Implementer
R5	Building Security Officer	Operational Implementer
R6	FEB Lecturer	End Users
R7	FEB Education Staff	End Users

Source: Authors' compilation based on the characteristics of the seven research informants (R1–R7).

This study employed a qualitative intrinsic case study design to examine fire protection readiness in the emergency stairways of a multistory educational building at a private university in West Jakarta, Indonesia. Seven informants (R1–R7) were selected through purposive sampling to represent building policymakers, operational personnel, and building users, as presented in Table 1. The selection aimed to obtain diverse perspectives on fire safety management, emergency stairway conditions, and occupant preparedness.

Data were collected through semistructured, in-depth interviews, field observations, and document reviews. Observations focused on the physical conditions and use of emergency stairways, including fire-rated doors, smoke-resistant barriers, handrails, evacuation route obstructions, emergency lighting, exit signage, and associated fire protection equipment, with reference to relevant Indonesian fire safety standards. Interview guides, observation checklists, field notes, and available building documents were used as research instruments. Informant confidentiality was maintained through coded identifiers. Data credibility was supported through source and methodological triangulation, member checking, and peer debriefing.

Data were analyzed using the Miles and Huberman interactive qualitative analysis model, involving data condensation, data display, and conclusion drawing and verification. Thematic coding was conducted to identify patterns across managerial, physical, and behavioral dimensions of fire safety readiness. Findings from interviews, observations, and document reviews were compared to identify convergent and divergent evidence. The analysis focused on stakeholders' experiences, perceptions, and observed building conditions, without making definitive claims regarding the building's fire resistance or emergency evacuation performance under actual fire conditions.

RESULTS AND DISCUSSION

The qualitative thematic analysis resulted in four main themes that reflect the reality of implementing safety systems at the research site, as outlined below.

Theme 1: Safety Commitments and Organizational Limitations

Campus managers are aware of the importance of fire protection, but the policy clashes with the reality of the internal financial governance of private institutions. This is reflected in the following verbatim excerpts from the informant:

"We actually already have a commitment to building safety, but the implementation must be adjusted to the available budget capabilities. Maintenance funds must be divided with the need for repairs to other buildings, so that the fire protection improvement program is forced to be carried out gradually." (Informant R1, Director of LMK)

The interpretation of this theme shows that managerial commitment is still partial and has not placed the aspect of disaster mitigation as an absolute investment priority. As a result, safety is seen as secondary financing whose absorption is reactive, not proactive. This finding is in line with the Resource Based View (RBV) perspective, where organizations tend to be reluctant to allocate resources to protection aspects whose benefits are not immediately visible (Pratama, 2022), and reinforce the findings of Nugroho & Wijaya (2025) that negligence in allocating safety budgets in educational facilities risks causing legal and reputational consequences that are much greater than the value of the physical investment.

Theme 2: Perception of Physical Operational Barriers of Emergency Stairs

The informant assessed that the physical condition of the existing exit facilities does not provide optimal protection due to the characteristics of the old building that has not been structurally modified:

"The emergency stairs are currently not safe because they are not equipped with fire-resistant guardrails and fire-rated doors on each floor. In the event of a fire, smoke can enter directly into the stairs." (R7 Informant, Education Staff)

This condition without a closed door also triggers socio-operational problems where students use it as a gathering area. Informant R5 (Security Officer) stated that the access to the stairs is relatively clean from large items, but it is often used as a gathering place for students because there is no gate. Psychospatial interpretation shows that the absence of physical partitions changes the spatial perception of users from the emergency rescue line to an ordinary informal public space. When viewed through the Swiss Cheese Model (Reason, 1990), the absence of fireproof doors and smoke barriers is a "hole" in the building's passive defense layer that has the potential to be parallel to the active trigger of the fire and cause systemic failure in the form of a chimney effect; this finding is also consistent with the report of Ramadhan & Siregar (2023) that the absence of fire-rated doors in high-rise buildings increases the risk of exposure to toxic gases in the evacuation route.

Theme 3: Behavioral Vulnerability and User Preparedness

This theme highlights the lack of experience of the academic community in dealing with emergency scenarios, which triggers high behavioral vulnerability:

"I only know some safety information because I have never received thorough socialization. During my duty here, I have not participated in periodic fire training or simulations." (Informant R6, FEB Lecturer)

The lack of empirical experience in the form of simulations makes users view fire risk as abstract. Their understanding is limited to the cognitive aspects of the surface without psychomotor preparedness for evacuation. Based on the concept of Total Safety Culture (TSC) from Geller (2001), this condition illustrates the weak interaction between personnel factors (knowledge and experience) and behavioral factors (emergency response habits), which according to Sari et al. (2023) contributes to the tendency of individuals to experience freezing (panic fixation) or the wrong evacuation route when facing fire emergency situations.

Theme 4: Safety-Based Culture-Based Integrative Strategies

The informants agreed that improvements cannot be carried out separately, but must unite physical and non-physical aspects. Countermeasures must involve structured budget planning from the leadership, strict supervision by security officers in the emergency stairwell area to ensure function, and the implementation of periodic evacuation simulations at least once a year involving all elements of lecturers, staff, and students in order to foster a culture of mutual safety.

Table 2. Summary of Thematic Analysis

Analysis Aspect	Qualitative Findings	Meaning of Policy/Spatial	Theoretical Foundations
Managerial & Financial	Informants complained about budget limitations; protection improvements were carried out gradually/partially.	Safety is not considered the main asset protection investment, but rather a cost center.	*Resource Based View* / RBV in risk management (Nugroho & Wijaya, 2025; Pratama, 2022)
Physical & Technical	The physical condition of the emergency ladder has not been able to provide optimal protection due to the absence of a fireproof door.	There is a latent defect that can turn the evacuation path into a chimney effect.	*Swiss Cheese Model* (Reason, 1990); Impact of smoke inhalation Ramadhan & Siregar (2023)
Behavior & Culture	Users consider emergency stairs to be ordinary stairs; students abuse the function of evacuation routes.	Failure of risk perception due to the absence of emergency response exercises, increases the potential for panic (freezing).	*Total Safety Culture* / TSC Geller (2001); Evacuation Psychology Sari et al. (2023)

Source: Authors' synthesis of interview and observation findings and the theoretical perspectives cited in the table.

Physical & Technical The physical condition of the emergency ladder has not been able to provide optimal protection due to the absence of a fireproof door. There is a latent defect that can turn the evacuation path into a chimney effect. Swiss Cheese Model (Reason, 1990); Impact of Smoke Inhalation Ramadan & Siregar (2023)

Behavior & Culture Users consider emergency stairs to be ordinary stairs; students abuse the function of evacuation routes. Failure of risk perception due to the absence of emergency response exercises, increases the potential for panic (freezing).

Analysis of Managerial Factors and Financial Constraints (Resource-Based View)

Informants from the management level emphasized that there are obstacles to the allocation of operational funds that must be shared with the maintenance of other academic facilities. Organizationally, these findings indicate that management has not placed fire safety investments as an urgent priority; safety is treated as the financing of operating costs (cost centers), not as an instrument of the protection of the main assets and the sustainability of the organization. This phenomenon is in line with the concept of Resource Based View (RBV) in organizational risk management (Pratama, 2022): organizations tend to refuse to allocate resources to protection whose benefits are not immediately apparent. Nugroho & Wijaya (2025) emphasized that managerial failure in allocating safety budgets to public facilities has the potential to trigger criminal law implications and institutional reputational losses that are much greater than the value of the physical investment in protection itself. Regulations such as Government Regulation No. 16 of 2021 (Government of the Republic of Indonesia, 2021)

should be laid as the foundation of management's legal responsibility in managing institutional risks.

Technical Factor Analysis through the Swiss Cheese Model

The informants underlined that the absence of components such as fire rated doors and smoke retaining bulkheads makes emergency stairs at high risk during fires. Technically, this condition indicates that the emergency staircase loses its essential function as a refuge area; without thermal barriers, the evacuation path risks turning into a chimney that drains toxic gases to the upper floors. Using the Swiss Cheese Model from Reason (1990), the absence of these active and passive protection components constitutes a latent defect in the building's safety defense layer; when an active trigger occurs, the failure holes can align and trigger a systemic disaster. Ramadhan & Siregar (2023) report that the absence of fireproof doors in high-rise educational buildings significantly increases the risk of fatalities due to inhalation of toxic gases in the early minutes of a fire. Delaying the modification of old buildings (retrofitting) for budget reasons means leaving the structural failure gap open (Sutrisno et al., 2024). When compared to international standards such as the NFPA 101 Life Safety Code (Ahrens, Hall & Evarts, 2022) and ISO 13943:2017 on fire safety vocabulary (Standardization, 2019), which explicitly require passive protection in the form of fireproof doors and smoke compartmentalization in the evacuation path of high-rise buildings, the condition of the emergency stairs at the study site shows a significant gap to globally recognized fire safety practices.

Analysis of Behavioral Factors through Total Safety Culture (TSC)

The academic community equates emergency stairs with ordinary circulation stairs, so students often make them a gathering area and informal social activities. This reality indicates a massive risk perception failure among building users, triggered by the lack of socialization and visualization of real dangers. Based on the concept of Total Safety Culture (TSC) from Geller (2001), the risky behavior of building users is triggered by the interaction of environmental factors (the physical condition of the emergency staircase that opens without a guardrail) and personnel factors (lack of education and practical simulations). A study of evacuation psychology by Sari et al. (2023) proves that individuals who have never participated in a fire evacuation simulation tend to experience the phenomenon of freezing (panic fixation) or the wrong direction when the emergency alarm sounds. The transformation from risky behavior to a solid safety culture requires consistent structured educational interventions, not just sticking regulatory posters on the wall. This finding is also in line with the international literature review by Kobes et al. (2010) which confirms that human behaviour in fire is greatly influenced by familiarity with evacuation procedures, so that the lack of routine training is consistently a strong predictor of low preparedness of building users in various contexts, not only in this case studied.

CONCLUSION

The findings of this qualitative case study revealed that emergency stairway readiness in the examined multistory educational building was influenced by interconnected organizational, physical, and behavioral factors. Informants identified budgetary constraints, deficiencies in

passive fire protection measures, and inadequate routine evacuation training as key challenges affecting emergency preparedness. These findings highlighted the need for an integrated fire safety management strategy encompassing institutional resource prioritization, improvements in passive fire protection, appropriate management of emergency stairway access and use, and the development of a stronger organizational safety culture. However, the findings reflected stakeholders' perceptions and observed building conditions rather than a comprehensive engineering assessment or formal verification of regulatory compliance.

Future research should integrate systematic building safety audits, technical assessments of fire-rated components, smoke-control and evacuation simulations, and broader participation from building occupants across multiple educational institutions. The university should collaborate with qualified fire protection professionals to assess existing safety deficiencies, prioritize necessary physical improvements, and implement regular evacuation drills. Periodic evaluations should also be conducted to assess the effectiveness of these interventions in strengthening occupant preparedness and emergency evacuation readiness. Such efforts would provide a more comprehensive evidence base for improving fire safety management and evaluating the practical effectiveness of the proposed measures.

FUNDING

This research does not receive special funding from government, private, or other organizations.

CONFLICT OF INTEREST

The authors state that there is no conflict of interest in the research, writing, or publication of this article.

AUTHOR'S CONTRIBUTION

All authors contributed to the preparation of this article. Author 1 (Brahma Deva Joyo Nusantara) played a role in the conceptualization of the research, played a role in data collection and analysis, played a role in the interpretation of the results and the preparation of the manuscript, while the other authors contributed to the review, editing, and final approval of the manuscript.

GENERATIVE ARTIFICIAL INTELLIGENCE USAGE STATEMENT

The author states that no generative artificial intelligence was used in the preparation of this article.

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