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SUSTAINABLE BUILT ENVIRONMENT

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STUDENTS' AWARENESS ON THE PASSIVE FIRE SAFETY MEASURES IN ACADEMIC BUILDINGS

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ABSTRACT

The development and awareness of the passive fire prevention system in academic buildings is the focus of this research article. The study's goal is to assess the efficiency of passive fire protection measures in improving the fire safety requirements of these structures. A thorough literature analysis, on-site inspections, and questionnaires to the students were all part of the research approach. The research identifies and evaluates major passive fire protection systems such as compartmentation, fire appliances acces, means of escape and ventilation to staircase enclosure. The study evaluates these systems' adherence to applicable fire safety norms and laws. It also assesses their utility, durability, and upkeep requirements. The findings show that, while some academic buildings have acceptable passive fire prevention measures in place, there are still areas where modifications are needed. Buildings designed in accordance with the old prescriptive criteria, on the other hand, may not have the same fire safety level as the norm enforced today. The study makes recommendations for strengthening the passive fire protection system, such as upgrading existing fire-rated equipment, improving fire compartmentation, and raising fire safety awareness among students in the academic buildings.

Keywords: *Passive fire protection system, academic buildings, fire safety, compliance, students' awareness*

INTRODUCTION

Passive fire protection (PFP), also known as Built Fire Protection, is an important component of any fire safety strategy. It is crucial and becoming more important in protecting people and reducing fire and smoke damage to buildings and their contents. Passive fire protection works by using fire-resistant walls and floors to contain the spread of fire, heat, and smoke by isolating it in the area of origin, protecting escape routes and giving occupants crucial escape time, safeguarding a building's vital structural members, and safeguarding a building's assets. (Park et al., 2021) Active fire prevention measures including sprinkler systems, suppression systems, and extinguishers as well as the training of building inhabitants in fire safety go hand in hand with passive fire protection. In order to save lives and maintain the structural integrity of structures, passive fire protection is a crucial component of a building's fire safety plan. The goal of passive fire protection, a fire safety approach built into buildings, is to slow the spread of fire while providing users with a safe exit. (C et al., 2022) Cavity barriers are a type of passive fire prevention strategy whereby empty areas within walls, above ceilings, and beneath suspended floors are filled with fire-retardant materials to obstruct the passage of smoke and flames. To put it briefly, passive fire protection aims to stop the spread of fire and its potential negative effects through passive measures included into a building's construction. (Yin et al., 2019)

The tragedy at Pusat Tahfiz Darul Quran Ittifaqiah about 23 lives died because the school did not meet the level of safety including safety requirement which resulted in the escape characteristics of the path failing to function. (Salleh, 2017) On the other hand, buildings that have been constructed in accordance with the old prescriptive requirements may not have the same fire safety level as the standard enforced today, even if all fire safety items are maintained at the original design standard. (Lo et al., 2008) Lack of fire safety knowledge by building occupants parallels the misconceptions of fire safety engineers about occupants' behaviour and reactions during fire exist or when faced with fire. (Cai and Chow, 2011) Therefore, this research will be performed to identify the implementation of passive fire protection system in academic building especially in Annex 1 building of UiTM Seri Iskandar, Perak and investigate students’ awareness about implementation of passive fire protection system.

PASSIVE FIRE SAFETY MEASURES

Passive fire safety measures are ones that are created or produced by controlling building structures, compartmentalising or separating buildings based on their levels of fire resistance, and guarding against openings. The term "passive protection system" describes an architectural design that creates a sturdy structure that is fire resistant, can stop the spread of fire and heat, and designs access exits that allow occupants to safely leave the building. A full site and an escape route make up a passive fire protection system. The layout and orientation of the building, the distance between buildings, the positioning of yard hydrants, the creation of open areas, and other factors are all part of site design, which governs the site to prevent and reduce fire threats. According to Ministry of Public Works Decree No.10 / KPTS / 2000, yard hydrants, road environments, and water sources make up the components of a site's completeness. (Iras Muthiah Hanan & Basaria Talarosha, 2020).

Confining Fires by Compartmentation

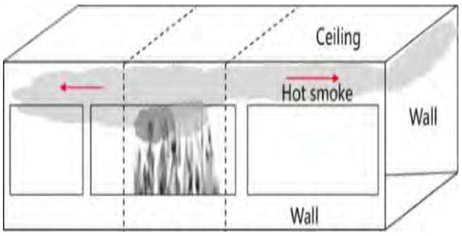

Figure 1: Semi-confined Fire

Building and site planning - Because the fire safety criteria have a significant impact on the architecture and design of the structure, fire safety engineering work should start early in the design phase. In this manner, the architect can more effectively and affordably implement fire safety systems into the building. The overall strategy takes into account the design and layout of the inside of the structure as well as the planning of the outer site. There is an increasing need for specialists in this area as functionally based requirements replace prescriptive code requirements. (Park et al., 2021).

Compartmentation

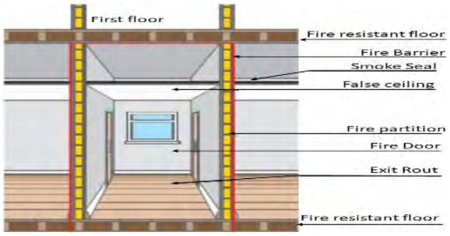

Figure 2: Compartmentation

A fire compartment is a space within a structure that spans one or more floors and is contained by dividing components in order to restrict the spread of the fire outside the compartment during the pertinent fire exposure. Compartmentalization is crucial in stopping the fire from spreading to expansive areas or the entire structure. The fact that the fire is put out or burns out on its own, as well as the slowing effect of the separating members on the spread of fire and smoke until the passengers are removed to a place of safety, can safeguard people and property beyond the fire compartment. A compartment's need for fire resistance is determined by both its intended use and the likelihood of fire. (Yin et al., 2019).

Structural integrity during a fire

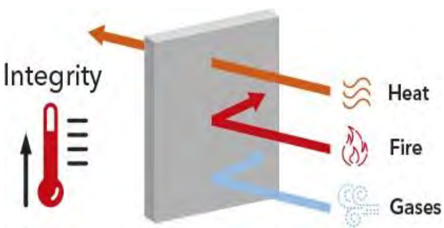

Figure 3: Structural Integrity

Avoiding structural collapse and the ability of the dividing components to stop ignition and flame propagation into adjacent compartments are necessary for sustaining structural integrity during a fire. Different methods can be used to develop a design that is fire resistant. These classifications are based on the ISO 834 standard fire resistance test, a mix of test and calculation, or just calculation, and performance- based computer prediction based on actual fire exposure. (Park et al., 2021) Interior finish - The material used to create exposed interior surfaces on walls, ceilings, and floors is known as interior finish. Interior finishing materials come in a variety of forms and include things like plaster, gypsum, wood, and plastic. They do a variety of tasks. The inside material serves acoustical and insulating purposes in addition to providing wear and abrasion resistance. (Amalina Hanapi et al., 2020).

Evacuation of Occupants

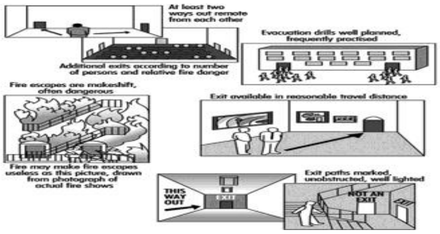

Figure 4: Principles of Exit Safety

Egress design - The examination of the entire fire prevention system of a building should serve as the foundation for egress design. During their escape from a burning building, people are influenced by a variety of impressions. Throughout the escape, the passengers must make a number of judgements in order to act appropriately in each circumstance. Depending on the physical and mental capacities and conditions of the building's residents, these responses can vary greatly. The building's escape routes, directional signage, and other installed safety systems will also affect the decisions made by the people. The inhabitants' decisions will be most strongly influenced by the spread of the fire and smoke. (Kwon, 2014).

RESEARCH METHODOLOGY

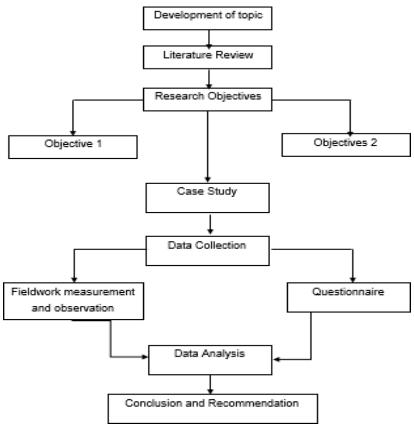

Figure 5: Flow Chart of Research Methodology

The secondary data methods used for the background research and literature of this study include reading and writing with citations of all the data readings that are linked to the research studies in order to support the justification of the validity of the research studies. Secondary data has been gathered through academic output, journal articles, websites, and research papers, among other places. Each of the aforementioned data sources is accessible via the internet.

This study also used observation in addition to qualitative methods to collect data. Fieldwork measurement and observation will be performed in selected academic building in UiTM Seri Iskandar, Perak. This research will focus on the FSPU building which is Annex 1 and Annex 3 buildings. Before going on to the next target respondent, the observation is designed to focus on the implementation of passive fire protection in academic buildings according to UBBL 1984. In-depth investigation of the fieldwork measurement is made possible by the qualitative method.

Additionally, online questionnaire surveys administered to 110 number of respondents using Google forms are the type of data collection employed for this study. The questionnaire will be provided through Google Form survey and the targeting respondents are the students in Annex 1 and Annex 3 buildings, UiTM Seri Iskandar, Perak to achieve objective 2 on implementation of passive fire protection in academic building. The online questionnaire approach was chosen as the survey method since it is the simplest and least expensive way when compared to other methods. The target population will receive the questionnaire via social media, such as WhatsApp account distribution.

CASE STUDY BUILDINGS

Figure 6: FSPU Annex 1 (AR)

Figure 7: FSPU Annex 3 (BS)

Figure 8: Plan of UiTM Seri Iskandar

The buildings involved in the project were FSPU Annex 1 mainly for the use of architecture course and FSPU Annex 3 for building surveying course of UiTM Seri Iskandar Perak. The case study involves two phases of construction and it was the Phase II of overall UiTM buildings construction, with different start and finish dates. The first construction of Phase II began on January 15, 1999, and was completed on

May 1, 2000. The second construction started on May 3, 2001, and concluded on October 8, 2002. The cost of the first construction amounted to RM 15,000,000.00, while the second construction cost RM 10,859,987.19. For the first construction, the project team consisted of Focus Architect Sdn. Bhd. as the architect, Dr Nik Associates Sdn. Bhd. as the civil and structural engineer, Budiman Ismail Construction Sdn. Bhd. handling mechanical and electrical construction, and Syarikat Syariff Din Sdn. Bhd. as the contractor. On the other hand, the second construction was carried out by Syarikat Pembinaan Farima Sdn. Bhd. as the main contractor.

RESULT AND ANALYSIS

Implementation of Passive Fire Protection in Academic Buildings

The entire case study at the Annex 1 and Annex 3 buildings concerning fire legislation and requirements is acceptable since the four key components of passive fire safety and element are satisfied and meet with the requirement. The Annex 1 and Annex 3 buildings features open space and a two-way street with three-quarters of the circumference around the building. Furthermore, the suitable Fire Resistance Period (FRP) fire doors are not used and installed at staircases, protected lobbies, fire- fighting access corridors, and lobby. In addition, no complied exit signage and assembly point signage are given in the event that a method of escape is required. The ventilation requirements for staircase enclosures must be met if there is an open staircase and adequate natural ventilation.

Table 1: Data Analysis of Fieldwork Measurement and Observation

PASSIVE FIRE PROTECTION SYSTEM		
Compartmentation		
Uniform building by-laws 1984	By-law 136 stipulates dimensions of building and compartment. There are five types of purpose group whereas institutional, other residential, shop, factory, store and general. By-law 162: fire doors of the appropriate fire resistance period (FRP) shall be provided.	
Case study	Annex 1	Annex 3
Fieldwork measurement and observation	Annex 1 building, as an institutional building of purpose group, has no area or volume compartment limits. The case study does not provides information on fire door resistance.	Annex 3 building, as an institutional building of purpose group, has no area or volume compartment limits. The case study does not provides information on fire door resistance.
Remarks	As a result, the compartment wall and floor have no limitations in terms of design spaces such as class and room selection. Only the conditions of By-laws 136 have been met while By- laws 162 are not.	As a result, the compartment wall and floor have no limitations in terms of design spaces such as class and room selection. Only the conditions of By-laws 136 have been met while By-laws 162 are not.

Fire Appliance Access		
Uniform building by-laws 1984	By-law 140: stipulates the proportion of the building perimeter that must be accessible to fire appliances.	
Case study	Annex 1	Annex 3
Fieldwork measurement and observation	The building's one-fourth perimeter appliance access (through main road and back lane) is adequate.	The building's one-sixth perimeter appliance access (through main road and back lane) is adequate.
Remarks	According to the estimate of the building, 56000 (cubic metre) is sufficient to comply with one fourth perimeter (accessible only from the main road). By-law 140 complies with the requirement.	According to the estimate of the building, 28000 (cubic metre) is sufficient to comply with one sixth perimeter (accessible only from the main road). By-law 140 complies with the requirement.
Means of Escape (MOE)		
Uniform building by-laws 1984	By-law 172: stipulates every exit shall be installed with emergency exit sign (KELUAR sign) By-law 174: stipulates arrangement of storey exit shall give direct access to a final exit, a protected staircase leading to a final exit or an external route leading to a final exit.	
Case study	Annex 1	Annex 3
Fieldwork measurement and observation	Every exit story of a building has an accessible staircase that leads to a final departure and assembly point in the front lane. But the 'exit' indicators are not sufficiently apparent and given.	Every exit story of a building has an accessible staircase that leads to a final departure and assembly point in the front lane. But the 'exit' indicators are not sufficiently apparent and given.
Remarks	As a result, the means of escape aspect is not fully meets the requirement.	As a result, the means of escape aspect is not fully meets the requirement.
Ventilation to Staircase Enclosure		
Uniform building by-laws 1984	By-law 174: stipulates all staircase enclosures shall be ventilated by having a minimum opening size of 1 square meter.	
Case study	Annex 1	Annex 3
Fieldwork measurement and observation	The circumstance of the staircase in the case study is an open area, and opening such a window is not required even at the top level staircase. Natural ventilation is adequate in stairwell conditions.	The circumstance of the staircase in the case study is an open area, and opening such a window is not required even at the top level staircase. Natural ventilation is adequate in stairwell conditions.
Remarks	Although there is no window in the staircase area, the open staircase offers adequate ventilation and thus meets the criteria.	Although there is no window in the staircase area, the open staircase offers adequate ventilation and thus meets the criteria.

Level of Students' Awareness Related to the Passive Fire Protection in Academic Buildings

Section A: Demographic Data of Respondent

Gender

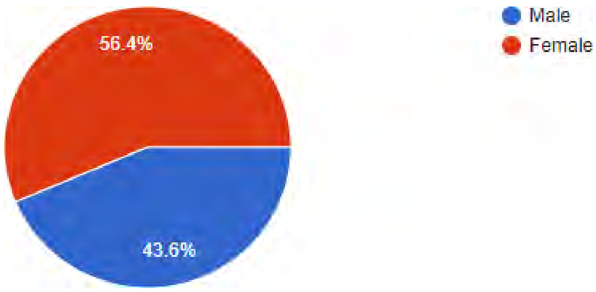

Figure 9: Pie Chart of Gender Distribution

Table 2: Demographic Data of Respondent by Gender

GENDER	RESPONDENT	PERCENTAGE (%)
Male	48	43.6
Female	62	56.4
Total	110	100

The data provided presents the gender distribution of respondents in the dataset. Among the 110 total respondents, 48 of them are male, representing 43.6% of the total, while 62 respondents are female, accounting for 56.4% of the total. The analysis reveals that there is a slightly higher representation of females in the dataset compared to males. This gender distribution provides valuable insights into the composition of the respondents and can be considered when interpreting any results or conclusions drawn from the dataset. It is important to note that the total percentage adds up to 100%, indicating that all respondents have been accounted for in the analysis.

Age

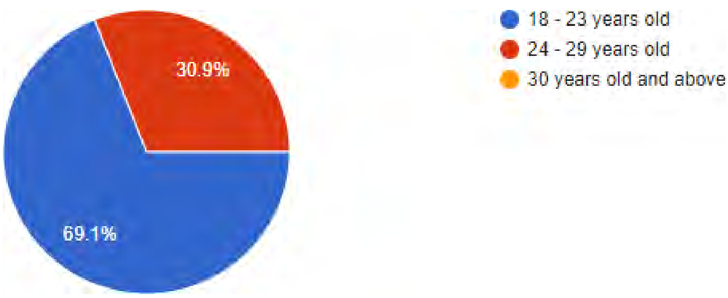

Figure 10: Pie Chart of Age Distribution

Table 3: Demographic Data of Respondent by Age

AGE	RESPONDENT	PERCENTAGE (%)
18 – 23 years old	76	69.1
24 – 29 years old	34	30.9
30 years old and above	0	0
Total	110	100

The provided data presents the age distribution of the respondents in the dataset. Among the total of 110 respondents, the majority, 76 individuals (69.1%), fall within the 18-23 years old age range. The next age group, comprising respondents aged 24-29 years old, consists of 34 individuals, accounting for 30.9% of the total. Interestingly, there are no respondents aged 30 years old and above represented in the dataset. This age distribution sheds light on the composition of the respondents and highlights a concentration of younger individuals, particularly in the 18-23 years old range. The absence of respondents from the 30 years old and above age group may limit the generalizability of findings and suggest a potential bias in the dataset towards younger participants.

Section B: Students' Awareness on Passive Fire Protection System In Academic Buildings

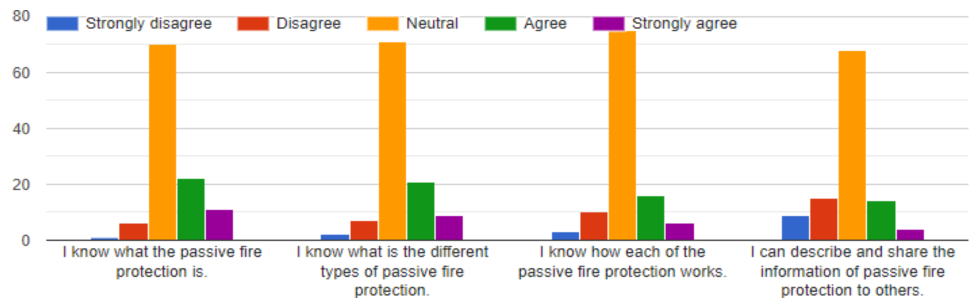

Figure 11: Bar Chart of Section B

Table 4: Result on Students' Awareness on Passive Fire Protection System in Academic Buildings

QUESTION	RATING SCALE [No. of Respondent / Percentage (%)]									
	1		2		3		4		5	
I know what the passive fire protection is	1	0.9%	6	5.5%	70	63.6%	22	20.0%	11	10.0%
I know what is the different types of passive fire protection	2	1.8%	7	6.4%	71	64.6%	21	19.1%	9	8.2%
I know how each of the passive fire protection works	3	2.7%	10	9.1%	75	68.2%	16	14.6%	6	5.5%
I can describe and share the information of passive fire protection to others	9	8.2%	15	13.6%	68	61.8%	14	12.7%	4	3.6%
Total	15	13.6%	38	34.6%	284	258.2%	73	66.4%	30	27.3%

(Strongly disagree – 1, disagree – 2, neutral – 3, agree – 4, strongly agree – 5)

The analysis indicates that the respondents generally have a moderate level of understanding and familiarity with passive fire protection. The Neutral option was frequently selected, suggesting a need for further knowledge or clarification. While some respondents showed confidence in their knowledge and ability to share information about passive fire protection, a significant portion expressed uncertainty or lack of confidence. These findings highlight potential areas for improvement in knowledge dissemination and education regarding passive fire protection.

Section C: Students' Perspective on Passive Fire Protection System In Academic Buildings

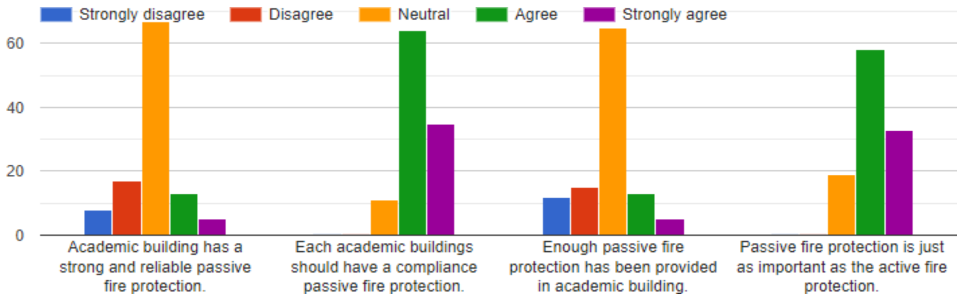

Figure 12: Bar Chart of Section C

Table 5: Result on Students' Perspective on Passive Fire Protection System in Academic Buildings

QUESTION	RATING SCALE [No. of Respondent / Percentage (%)]									
	1		2		3		4		5	
Academic building has a strong and reliable passive fire protection	8	7.3%	17	15.5%	67	60.9%	13	11.8%	5	4.6%
Each academic buildings should have a compliance passive fire protection	0	0.0%	0	0.0%	11	10.0%	64	58.2%	35	31.8%
Enough passive fire protection has been provided in academic building	12	10.9%	15	13.6%	66	60.0%	13	11.8%	4	3.6%
Passive fire protection is just as important as the active fire protection	0	0.0%	0	0.0%	19	17.3%	58	52.7%	33	30.0%
Total	20	18.2%	32	29.1%	163	148.2%	148	134.5%	77	70.0%

(Strongly disagree – 1, disagree – 2, neutral – 3, agree – 4, strongly agree – 5)

The analysis indicates that the respondents generally have a moderate to strong agreement with the statements related to passive fire protection in academic buildings. While there is general support for the importance of passive fire protection and compliance, opinions vary regarding the strength and adequacy of passive fire protection measures in academic buildings. These findings suggest the need for continued attention to passive fire protection and the importance of ensuring compliance in academic building safety standards.

CONCLUSION & RECOMMENDATION

The research study's first objective, which focused on the implementation of passive fire prevention in academic buildings, was met with success through fieldwork observation and measurement. The academic buildings at UiTM Seri Iskandar in Perak were visited and observed on the existing passive fire safety systems. The effectiveness in terms of fire containment, smoke control, and compartmentalization were assessed. Gaps and shortcomings in the deployment of passive fire protection systems by comparing actual conditions to relevant norms and regulations were detected. This accomplishment gives important insights on the existing level of fire safety measures in academic buildings and serves as the foundation for improvement proposals.

The use of questionnaires helped to achieve Objective 2, which aimed to examine students' awareness of passive fire safety in academic institutions. The questionnaires were sent to the students in order to assess their comprehension of fire safety measures, knowledge of passive fire protection systems, and compliance with fire safety regulations. The survey responses were analysed to evaluate the students' levels of awareness, familiarity with fire safety practises, and adherence to safety norms. The accomplishment of this goal gives useful information about students' perceptions of fire safety and their part in maintaining a safe environment within academic buildings. The data can be used to create targeted teaching campaigns and activities to raise student awareness and foster a fire safety culture.

The recommendations that can be made based on a research study conducted at UiTM Seri Iskandar, Perak is evaluate existing building walls to verify they satisfy adequate fire resistance ratings. To prevent the spread of fire between different areas of the building, consider upgrading or reinforcing walls with fire-resistant materials. Moreover, develop and implement fire safety education programmes for students, professors, and employees to promote fire safety. Training on fire prevention, evacuation protocols, and the proper use of fire safety equipment should be included in these programmes. Emphasise the importance of passive fire protection measures and encourage everyone to take an active role in keeping the environment safe.

FUTURE RESEARCH

Some of the areas that can be investigated for future research on the application of passive fire protection systems is investigate evacuation techniques for academic institutions. Examine the effectiveness of evacuation plans, emergency signage, and evacuation drills in academic settings. Consider aspects like as occupant density, the presence of people with mobility issues, and collaboration with emergency response teams. Futhermore, conduct a thorough fire risk assessment of the academic buildings of UiTM Seri Iskandar. Determine the likelihood of prospective fire threats, as well as the consequences of fire accidents. This study can help to establish focused fire prevention strategies and prioritise passive fire protection measures. Other than that, conduct a thorough cost-benefit analysis of installing passive fire protection equipment. Assess the initial investment needed for installation, maintenance costs, and possible cost savings from fewer fire incidences and damages. When allocating expenditures for fire safety measures, decision-makers can benefit from this approach.

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