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Assessing Fire Safety Protection System in High-Rise Building: Case Study in Kuala Terengganu

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Abstract

As mentioned by Craighead [1], *high-rise building is defined as a building that is considered to be one that extends higher than the maximum reach of available fire-fighting equipment. In absolute numbers, this has been set variously between 75 feet (23 meters) and 100 feet (30 meters) or about seven to ten stories (depending on the slab-to-slab distance between floors. This study identifies the types of fire protection system used in High-rise buildings around Kuala Terengganu City. The objective of this study were to evaluate the fire protection system accordance to Uniform Building By-Law standard (UBBL) and to propose some recommendations and suggestions to improve the existing fire safety protection system in the buildings. A safety checklist based on expert opinions from validity questionnaire was being developed. The questionnaire survey was circulated to the selected buildings occupants to obtain their opinion on the fire safety protection system used by the building. The results from the questionnaire were analyzed using Statistical Package for the Social Sciences (SPSS). The data checklist was analyzed to obtain the types of protection system used by the buildings and also the implementation of fire safety protection system accordance to UBBL standard (Tenth Schedule) was evaluated. The results reveal that all the buildings fulfill the requirements of UBBL standard (Tenth Schedule) the safety level was satisfactory as the percentage was more than 75%. Finally, the results from the analysis satisfy the objectives of this study and some recommendations were proposed to improve the findings for further study and fire safety protection system in the high-rise buildings.*

Keywords: *Safety checklist, high-rise building, UBBL standard, SPSS.*

1 Introduction

Fire is a form of oxidation known as combustion. Fire safety has become one of the major criteria for planning and design of tall buildings. This is evident when taking into account the rising population of building inhabitants as well as the harmful gases and fumes that may result from the combustion of different furnishing materials. Several codes of practice suggest requirement for fire fighting and prevention for tall building structures. Both active and passive systems are considered. These include sprinkler system, fire barriers, automatic smoke vent and many others. Normally, fire is a major issue in any type of buildings. The fire safety issue of high-rise building requires an extremely complex system of engineering. Installing fire safety often has three goals: keeping people alive, keeping property safe, and keeping operations running[2]. Ideally, building should be designed to prevent fire from occurring within them.

According to Heerwagen [3], there are four fundamental issues which arise when designer seek to create buildings that will offer safety and protection against fire. First, in the presence of a fire event, means must be available to ensure that the building occupants can be evacuated or otherwise rendered safe from the hazardous conditions produced by the fire. Second, the protection of property in the course of a fire event is strictly important. Design effort must be made to help minimize the damage that may result. Third, initial building design work must be directed toward minimizing the amount of money and time that would otherwise be needed for making repairs after a fire does happen. Fourth, building must also be designed to minimize circumstances whereby buildings adjacent to one in which a fire event occurs might suffer fire-related damage.

The aim of this study is to identify the types of protection system and also to investigate whether high-rise buildings in Kuala Terengganu city fulfill the requirements required by the Uniform Building By-Law (UBBL) standard. The information obtained will be compiled and recommendations proposed to improve the existing fire protection system in those particular buildings in order to provide an optimum safety condition for staff and occupants. This study will only focus on selected high-rise buildings in Kuala Terengganu.

The aim of this study is to assessing Fire Safety Protection System in high-rise buildings in Kuala Terengganu. Therefore, some objectives have been proposed and been identified in order to study the system used by the buildings. These objectives are as listed below:

- To identify the types of Fire Protection System in high-rise buildings
- To evaluate Fire protection System in accordance to UBBL Standard (Tenth Schedule).

To make recommendations and suggestions to improve the existing Fire Safety Protection System condition in the buildings.

2 Literature Review

According to Craighead [1], a tall building is a multi-storey structure in which most occupants depend on elevators to reach their destinations. This is apparent by considering the increasing number of building occupants and the toxic gases and fumes, which may arise from the combustion of various furnishing materials. The terms do not have internationally agreed definitions. However, generally, a high-rise structure is considered to be one of that extends higher than the maximum reach of available fire-fighting equipment. In absolute numbers, this has been set variously between 75 feet (23 meters) and 100 feet (30 meters), or about seven to ten stories (depending on the slab-to-slab distance between floors). According to Guidelines for Fire Protection in Chemical, Petrochemical, and Hydrocarbon Processing Facilities [4], fire protection is the science of reducing loss of life and property from fire by control and extinguishment. Fire protection includes fire prevention, detection of a fire, providing systems or fire mitigation and providing manual firefighting capabilities.
Based on Michael and Carol [5], fire is actually a by-product of a larger process called combustion. Fire and combustion are two words used interchangeably by most people, however there are still some differences between them. Combustion is the self-sustaining process of rapid oxidation of fuel, which produces heat and light. Fire is a result of combustion reaction. According to Stein and Reynolds [2], fire has a triangle of needs: fuel, high temperature and oxygen. If deprived of any of these, building fires will be extinguished.

2.1 Fire Safety Protection System

There are several differences in the definition of safety defined by various individuals. However, all the definitions ultimately bring the same meaning. According to Hughes and Ferret [6], safety is the protection of people from injury.
At the same time, LONGMAN Dictionary of Contemporary English [7] defined safety as when someone or something is safe from danger or harm.

Fire safety protection system is a very important system in any building. The objective of this system is to detect fire during the early stage so that it will be able to provide protection to life, property and the continuity of operation. There are two main components of fire safety protection systems, namely: Active Fire Protection System and Passive Fire Protection System

2.1.1 Active Fire Protection System

According to Collins [8], active fire protection system is those which come into use when the fire breaks out, for example detection and alarm systems, sprinkler systems, emergency lighting, smoke exhaust and many more.

a. Suppression System

Prevention is the best action to take when dealing with fire. Several actions can be taken in order to prevent fire incidents such as through enforcement of buildings and fire codes, inspection programs and public education. However, if after all these precautionary actions have been taken and a fire still occurs, it is important to have a fire suppression system in place to contain or extinguish the fire before the fire department arrives [9].
Nowadays, there are variety of fire suppression systems used in buildings. Suppression system may be wet or dry and composed of extinguishing agents but the most important thing to determine is which system will be most effective against fire hazard. According to Heerwagen [3], the most common of these systems is the automatic sprinkler system.

b. Fire Alarm Systems

Based on UBBL [10], Fire Alarm System must be provided in accordance with the Tenth Schedule to these By-laws (see appendix A). All premises and buildings with gross floor area excluding car park and storage areas exceeding 9290 square meters or exceeding 30.5 meters in height shall be provided with a two-stage alarm system with evacuation (continuous signal) to be given immediately in the affected section of the premises while an alert (intermittent signal) be given in the adjoining section. Provision shall be made for the general evacuation of the premises by action of a master control. The Tenth Schedule provided in the appendices.

c. Portable Fire Extinguisher

According to Burke [11], portable fire extinguishers are provided in buildings as a first-aid measure in the event that fire breaks out. They are designed for use by building occupants; however fire extinguisher may also be used by the fire department. Before the type of fire extinguisher is chosen for a building or portion of a building, it is important to know what types of hazards or fuels are present.
As mentioned by Uniform Building By-Law (UBBL) [10], portable fire extinguisher shall be provided in accordance with relevant codes of practice and shall be sited in prominent positions on exit routes to be visible from all directions and similar extinguishers in a building shall be one of the same methods of operation.

2.1.2 Passive Fire Protection System

As mentioned by Collins [8], passive fire protection systems are in-built characteristics, which are inherently safe and are effective. It includes spacing and layout, fireproofing, good means of escape, firewalls, ventilations and many more.

a. Establishing Means of Egress

According to Heerwagen and Dean [3], the basic principle for providing egress from a building space in which a fire could occur involves ensuring that occupants have continuous, unobstructed, fire-safe pathways leading from their occupancy spaces to grade-level external areas beyond the affected building. Alternatively, if access to the exterior of a building at grade-level cannot be gained, then these people must be provided with areas of refuge within the building.
Mean of egress for building occupants generally consist of multiple sets of three components: an exit excess, the exit, and an exit discharge. The intent in the design of egress is to create pathways that will be free of smoke, flame and heat for the time necessary for occupants to leave the buildings. The components of egress include the enclosures, the passageways and doors separating exit access and exits, as well as exits and the exterior.
In addition, any exit that is present more than 75feet (22.9meters) above grade level must be able to be pressurized by mechanical means, in this case having pressurizing fans to help minimize smoke entry into the exit.

b. Fireproofing

According to Guidelines for Fire Protection in Chemical, Petrochemical, and Hydrocarbon Processing Facilities [4], fireproofing is a fire resistant material or system that is applied to a surface to delay heat transfer to the surface. Fireproofing, a form of passive protection, protects against intense and prolonged heat exposure that can cause the weakening of steel and eventually collapse of unprotected equipment's, vessels and supports and lead to the spread of burning liquid sand substantial loss of property.

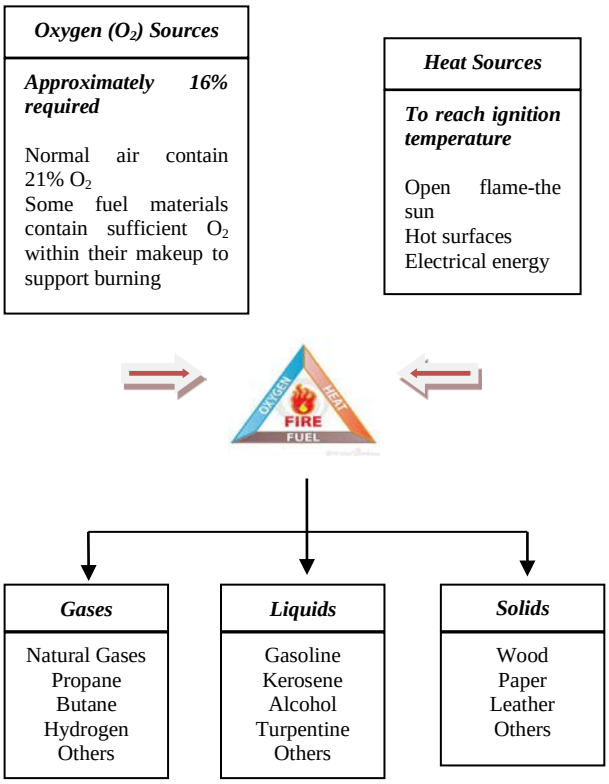


Fig. 1. The Fire Triangle

c. Fire Doors

As mentioned by UBBL [10], fire doors for the appropriate fire resistance period (FRP) shall be provided. Opening in compartment walls and separating walls shall be protected by a fire door having an FRP in accordance with the requirements for specified wall in the Ninth Schedule of these By-laws.
Openings in protective structures shall be protected by fire doors having an FRP of not less than half the requirement for the surrounding wall specified in the Ninth Schedule to these By-laws but in no case less than half hour. Openings in partitions enclosing a protected corridor or lobby shall be protected by fire doors having FRP for half-hour.

d. Compartment and Separating Walls

As defined by UBBL [10], compartment means any part of a building which is separated from all other parts by one or more compartment walls or compartment floors or by both such walls and floors; and for the purposes of the part, if any part on the top storey of a building is within the compartment, the compartment shall also include any space above such part on the top storey. Clearly the need for compartmentation can have a substantial impact on both the form and the cost of a building, but economy in the long term can be derived from the accrued saving in insurance premiums by reducing the risk of fire spread [8].

e. Communications and Safety

According to Collins [8], communication for fire safety is not merely a matter of symbols, signs, lights and bells. It embraces the entire gamut of comprehensive design so that people can be confident about assuming the obvious and can be correct, with instant recognition, instant understanding and thus, safety.
The purpose of good communications should be to inform upon five important points which are the possibility of fire, the means of preventing fire, the advent of fire, the routes of escape from fire and the means of fighting fire.

f. Selecting and Placing Signs

According to Collins [8], there are several considerations in selecting and placing signs. These considerations are listed below:

i. Use internationally accepted symbols instead of typeface notices wherever possible.
ii. Keep signs low enough to avoid smoke obscuration.
iii. Avoid signs on doors or on flanking walls; open doors will put such signs out of sight
iv. Locate signs so that they are illuminated by secondary lighting if not self-illuminated
v. Fix signs so that they are not easily removed or defaced.

2.2 Performance Criteria

Table 1. Measurement of Safety Level

Percentage	Level Of Safety
≥75%	Satisfactory
50-75%	Acceptable
≤50%	Poor

3 Results and Discussions

3.1 Safety checklist

A safety checklist based on expert opinions from validity questionnaire was developed. The checklist helped to identify the types of safety protection system used by the buildings and to evaluate the system according to UBBL Standard (Tenth Schedule). Refer to Appendix B.

Based on Table III (refer to Appendix C), from 45 items listed as should be installed in a high-rise building by the expert, the percentage of yes answered is 85.7%. Thus, the safety level is satisfactory as the percentage is more than 75% as shown in the performance criteria, Table I, Measurement of Safety Level. Meanwhile, all the buildings also followed the requirement needed by UBBL Standard (Tenth Schedule).

3.2 Questionnaire Analysis

Around 70 sets of questionnaires were distributed to selected participants. Those questionnaires were distributed in five different locations which was Hotel X, Menara Y, Wisma Z, Wisma K and Wisma L. Only 52 out of 70 sets were returned perfectly.

Based on Table II in Appendix D, the participants in this survey were male (22 participants) and female (30 participants). Most of the participants were around 21 to 30 years old and most of them are SPM holders.

Based on Table III in Appendix D, the analysis also revealed that majority of the participants knew and recognized the importance of fire protection system in the building. Most of them also knew the location of fire extinguisher but in contrast, a lot of them didn't know how to use the fire extinguisher. This is a situation which could lead to disaster if anything bad happens. The responsible officer should take action to train their staffs on how to use fire extinguisher immediately. However, luckily enough the majority of them still realize that an automatic sprinkler system is provided throughout the building and it can be concluded that they are still aware that some safety protection systems have been installed in the particular building.

Based on Table III in Appendix D, questions 6; 7; 8, the discussion related to the alarm system. Most participants claimed that they never heard any sound from it during their working period in that particular building. However, there are some who said that they had heard the alarm sound but it was due to maintenance work. At the same time, the majority of the participants also said that fire doors assemblies are not modified. They also claimed that there was no obstacle blocking or obstructing fire doors.

As for the category of fire protection system used in the building which consist of active and passive system, most participants claimed that they didn't realize the types of systems used by the building and even didn't know the difference between those systems. However, there were still a quite large number of participants stating they knew the system as well as the differences between them (Refer to Appendix D, Table III, question 11 & 12).

A more concern figure occurred regarding to seminar of fire safety. From 52 respondents, more than half of them never involved in any kind of seminar about fire safety. Action must be taken immediately to ensure that occupants have a basic knowledge of fire safety (Refer Appendix D, Table III, question 13).

In order to determine the respondent's response in an emergency situation, 5 questions were asked to the participant (Refer to Appendix D, Table IV). Most of the participants agree that they will realize that the building is on fire by listening alarm sound. Besides, they also stated that they would realize the situation by looking for the occurrence of smoke. However, there is a small group of participants stating that they would depend on their friends to the situation.

Regarding the reaction be aware of alarm sounds, there is a higher percentage of participants, who agree that they will quickly run out of the building once they hear alarm sound. Therefore, it is clear that alarm system is very important in a high-rise building. Only small number of occupants will wait for the instruction from the officer as well as call the emergency department. This situation clearly answered why a large percentage of occupants prefer to get out from the building as soon as possible if fire occur right in front of their eyes.

A majority of the participants said that they will bring together important documents with them before exiting the building. At the same time, all the participants also agree that they will use emergency staircase as their exit pathway (Refer to Appendix D, Table IV, question 4 & 5).

Table III in Appendix D (question 15, 16 & 17) shows the emergency situations. There is quite a high percentage of knowing what to do during emergency situation. This statement is based on a high percentage of participants who knew exactly what number should be called in case of an emergency. Though the percentage of knowing what number to be called is acceptable, there are still a slight percentage of them who does not. The building management should establish the emergency number at every single floor especially near the entrance. The same condition also occurs for emergency exit. About 80% of them knew the location of the emergency exit. However, there are still a slight percentage of them who does not know the exact location. Once again the building management should establish the emergency exit on floor plans.

Based on Table V in Appendix D, the questionnaire was also used to determine the criteria needed to improve the level of fire safety protection system in the buildings. There are four criteria listed which include exercise or training, information gathering, maintenance and effective communication.

As for training, three questions were asked to the participants. More than half of the participants rate the importance level as agree (40) and strongly agree (6) regarding training in using fire safety equipment. At the same time, the majority of them also agree (40) and (4) strongly agree if seminars on fire safety were given to them (Refer to Appendix E, Table V, question 1).

For information gathering, the majority of the participants also rate agree (29) and strongly agree (6) regarding the idea of company distributing all the information concerning fire safety equipment to workers. However, some of them chose rating 3 which meant they neither agree nor disagree (17) about creating a new safety plan. This might be due to lack of understanding about the meaning of new safety plan (Refer to Appendix E, Table V question 2).

As for maintenance works, all participants that agree (23) and strongly agree (29) with the statement all the fire safety equipment must be regular checked. However, a small number of them disagree (3) if company hired a technician to perform this regular checking or maintenance. Even though some of them might think that company should not waste their

money to pay an extra worker but majority of them still believed that a special technician must be hired to perform this maintenance works. This is because there was no specific job description regarding this maintenance work, it might lead to improper maintenance routine (Refer to Appendix E, Table IV, question 3).

The same situation also occurred when it comes to communication. Most of the participant rate as 4 and 5 which are agree (34) and strongly agree (18) that a good communication system is very important in a high-rise building. It was because a high-rise building normally consists a huge number of occupants and if the communication system is low, it might lead to chaos when an emergency happen. They also believed that staff should be trained to deal with panic (Refer Appendix E, Table V, question 4). A more accurate percentage from the questionnaire is attached on Appendix D, Table III and Appendix E, Table VI.

3.3 Discussion

A safety checklist based on expert opinions from validity questionnaire is developed. The checklist helped to identify the types of safety protection system in used by the buildings and also to evaluate the system accordance to UBBL Standard (Tenth Schedule). As the scope for health and safety according to UBBL Standard is very big, the checklist used in this study only covers certain parts of the standard which is the Tenth Schedule.

Since the safety level regarding fire incident is very qualitative, thus it is not possible for us to measure it. Hence the questionnaire was developed to ask building occupants their opinion and feeling.

4 Conclusion

It is widely accepted and understood that safety events (accidents, incidents, fires, environmental damage, etc.) cost money. The financial costs to an organization following a fire are substantial [11]. Clearly complacency about office health and safety is an attitude that no employee or safety representative should tolerate and one that no employer can afford. Therefore, employers and employees should work together to reduce the risk of accidents and potential hazards in the workplace.

Generally this study succeed in achieving the objectives, namely to identify the types of fire protection system used in high-rise buildings, to evaluate the system accordance to UBBL Standards, and to make some recommendations and suggestions to improve the condition of existing fire safety protection systems in the building.

Finally, it can be concluded that all the buildings in the study in Kuala Terengganu fulfill most of the criteria needed in providing an optimum fire safety protection for users.

4.1 Future Studies

To enhance the findings recommendations for further study are as follow:

(i) To distribute questionnaires to more participants.
(ii) To conduct study of different types of high-rise buildings such as Hospitals and Apartments.
(iii) Detailed of study fire safety protection system in high-rise buildings.

4.2 Recommendations

Below are a few recommendations to improve the fire safety protection system in the high-rise buildings:

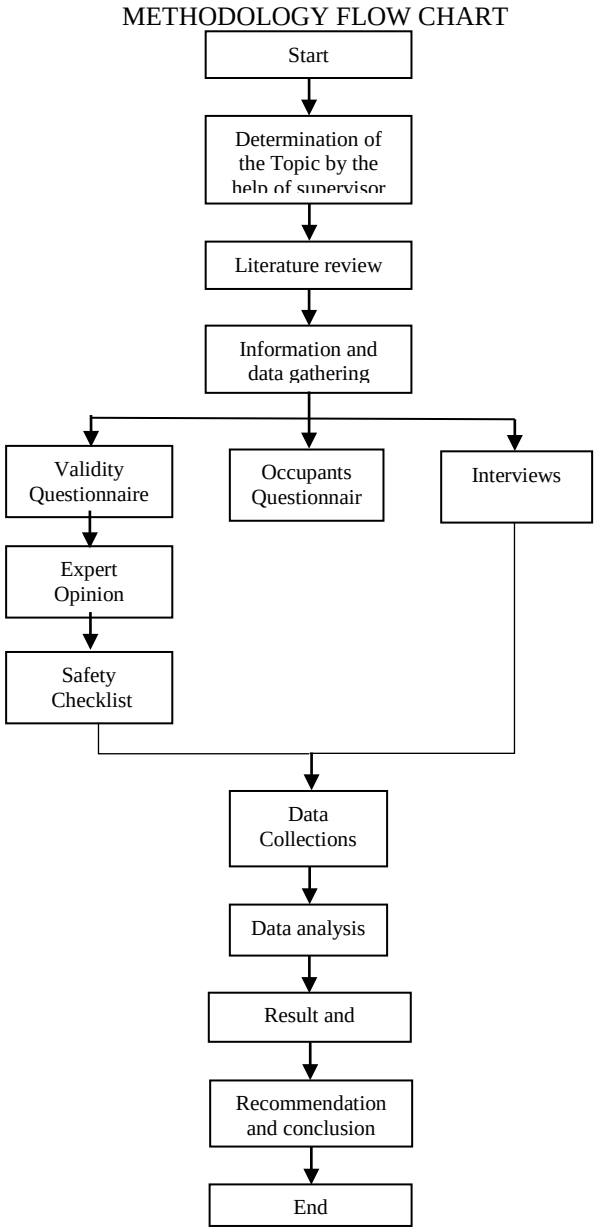
(i) Have fire drill at least twice a year
(ii) Mark the fire escape route and emergency exit clearly on the floor plan
(iii) Place first aid kit at places which are easily seen and reached
(iv) Give a seminar regarding Fire Safety Protection System to all workers

(v) Give flyers or brochures regarding the Fire Safety Protection System to all workers

The results from the analysis and discussion on the entire test conducted satisfy the objectives and aim of the study and are within the range of the suitability as stated in the study. However for further study and experiment, measures should be taken to obtain a more accurate result. The study should be more detail and well performed in accordance to the Uniform Building By-Law Standard. The research for this field should be developed as Malaysia is a developing country, where there will be lots of development, thus it is very important to provide an optimum working environment for the office user.

5 Appendix

5.1 Appendix A



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5.2 Appendix B

TABLE I. REQUIREMENTS FOR FIRE EXTINGUISHMENT ALARM SYSTEMS AND EMERGENCY LIGHTING
(By-law 225 (1), 237 (1))

Occupancy hazard	Extinguishing system Note 2	Fire alarm system Note 3	Emergency lighting Note 4
HOSPITALS AND NURSING HOMES			
i. Clinic-day care			
ii. In patient treatment			
a) Not exceeding 250 m^2 per floor			
i. single storey	-	-	a
ii. 2 storey	-	3	a
iii. 3 or 4 storeys	G	3	b
iv. 5 or 6 storeys	G	1&3	b or c
v. 18 m and over	AG	3	b or c
vi. Operating theatres	G	3	a
b) Exceeding 250 m^2 per floor			
i. Single storey	-	-	a
ii. 2 storey	G	3	a
iii. 3 or 4 storeys	G	1&3	a
iv. 5 storeys and over	AG	3	a
NOTE: i. Stretcher lift facilities to be provided for buildings above 4 storeys ii. Corridors and landings to be design to accommodate stretcher and bed movement iii. Design shall provide for horizontal evacuation of bed patients iv. Laboratories and kitchen shall not have sleeping accommodation above them and shall separate compartment from in-patient, treatment areas, public areas and staircase ad lift discharge areas			
HOTELS			
i. Open design balcony approach with open staircase with extended lobby or tower staircase			
a. 1 storey less than 20 rooms			
b. I) 1-3 storeys			
II) more than 50 rooms	-	-	-
c. 4 – 5 storeys	-	-	a
d. 6 – 10 storeys	G	-	b
e. 11 storeys and over	G	2	b
ii. Other design	G	1 & 2	c
a. Less than 10 rooms	AG	2	c
b. 11 to 20 rooms			
c. 21 rooms and over	-	-	a
d. 51 rooms and over	G	2	a
3 storeys and below			
4 storeys and above	G	1&2	a
e. 4 to 6 storeys but less than 20 rooms	G	-	c
f. Exceeding 18 meters	AG	2	c
	G	1&2	a

Occupancy hazard	Extinguishing system Note 2	Fire alarm system Note 3	Emergency lighting Note 4
	AG	2	c
OFFICES			
i. 4 storeys and less or less than 1000 m^2 gross floor area	-	-	-
ii. 5 storeys and over or exceeding 1000sq.m	G	2	A
iii. Exceeding 18 m but less 10000 m^3	G	1&2	c
iv. Exceeding 30m or 10000sq.m	AG	2	c

NOTE 2:
The letter in the second column of this schedule refer to types of fixed extinguishing system as follows:
A – automatic sprinklers
B- water spray system
C – high expansion foam system
D – carbon dioxide system
E – approved halogenated extinguishing system
F - other automatic extinguishing system
G – hose reel
H – hydrant system

NOTE 3:
The figures in third column refer to the types of fire alarm as follows:
1. Automatic fire detection system
2. Manual electrical fire alarm systems
3. Signal indicator alarm system
4. Manual alarm system

NOTE 4:
Types of emergency illumination:
a. Signal point units
b. Central battery
c. Generators
In all cases the duration of emergency illuminations in the event of failure of normal supply shall not be less than 1

5.2 ***Appendix C***

TABLE III. QUESTIONNAIRES RESULTS

No	Question	Frequency		Percentage (%)	
		Yes	No	Yes	No
1	Sprinkler system	5	-	100	-
2	Wet Pipe System	5	-	100	-
3	Dry Pipe System	4	1	80	20
4	Water Storage	5	-	100	-
5	Marking On Wet Riser And Etc.	5	-	100	-

No	Question	Frequency		Percentage (%)	
		Yes	No	Yes	No
6	Sprinkler Valves	5	-	100	-
7	Fire Hydrants	5	-	100	-
8	Static Water Supply	5	-	100	-
9	Fire Department Connection	2	3	40	60
10	Stand Pipes	5	-	100	-
11	Fire Alarm Panels	5	-	100	-
12	Manual Pull Stations	5	-	100	-
13	False Alarm Protective Covers	2	3	40	60
14	Smoke Alarms	5	-	100	-
15	Beam Detectors	4	1	80	20
16	Duct Detectors	3	2	60	40
17	Carbon Monoxide Detectors	5	-	100	-
18	Flame Detectors	3	2	60	40
19	Audible Detectors	2	3	40	60
20	Voice Alarm Detectors	1	4	20	80
21	Fire Command Centers	4	1	80	20
22	False Alarm Reduction	2	3	40	60
23	Portable Fire Extinguisher	5	-	100	-
23	Elevators	4	1	80	20
25	Smoke Dampers	5	-	100	-
26	Fire Dampers	5	-	100	-
27	Smoke Control Systems	5	-	100	-
28	Stair Pressurization	5	-	100	-
29	Fire Alarm System Maintenance And Testing	5	-	100	-
30	Periodic Test	4	1	80	20
31	Suppression System And Testing	5	-	100	-
32	Stand Pipes Maintenance And Testing	4	1	80	20
33	Fire Pumps Maintenance And Testing	4	1	80	20
34	Portable Fire Extinguisher Maintenance And Testing	5	-	100	-
35	Elevator Maintenance and Testing	4	1	80	20
36	Generators And Emergency Lighting Units Maintenance And Testing	5	-	100	-
37	HVAC And Smoke Control Maintenance And Testing	4	1	80	20
38	Establishing Means Of Escape	4	1	80	20
39	Fireproofing	5	-	100	-
40	Fire Doors	5	-	100	-
41	Compartment And Separating Walls	4	1	80	20
42	Communication And Safety	4	1	80	20
43	Selecting And Placing Signs	4	1	80	20
44	Hose Reel	5	-	100	-
45	Manual Electrical Fire Alarm System	5	-	100	-

5.3 Appendix D

TABLE II. DEMOGRAPHIC BACKGROUND

No	Question	Frequency	Percentage (%)
1	gender		
	i. male	22	42.3
	ii. female	30	57.7
2	Age		
	i. <21 years old	7	13.5
	ii. 21 - 30 years old	20	38.5
	iii. 31 - 40 years old	17	32.7
	iv. 41 - 50 years old	7	13.5
	v. >50 years old	1	1.9
3	Academic		
	i. PHD	-	-
	ii. Master	-	-
	iii. Degree	9	17.3
	iv. Diploma	19	36.5
	v. SPM	24	46.2
4	Position/status		
	i. Guess	8	15.4
	ii. Worker	44	84.6
5	How many years you have been working in this building?		
	i. <1 year	12	23.1
	ii. 1 - 5 years	22	42.3
	iii. 5 - 10 years	17	32.7
	iv. >10 years	1	1.9

TABLE III
QUESTIONNAIRES RESULTS

No	Question	Frequency		Percentage (%)	
		Yes	No	Yes	No
1	Do you know what fire protection system is?	45	7	86.5	13.5
2	Do you know the importance of Fire Protection System in the building?	45	7	86.5	13.5
3	An automatic sprinkler system is provided throughout the building?	46	6	88.5	11.5
4	Do you think there are enough safety protection system in this building?	45	7	86.5	13.5
5	Do you know where the fire extinguisher is placed?	38	14	73.1	26.9
6	Do you know how to use fire extinguisher?	18	34	34.6	65.4
7	Fire door assemblies are not modified?	47	5	90.4	9.6

No	Question	Frequency		Percentage (%)	
		Yes	No	Yes	No
8	Fire doors and smoke barriers does not blocked or obstructed?	41	11	78.8	21.2
9	There is no any paint on sprinkler head?	44	8	84.6	15.4
10	During your workings period here, have you ever heard the sound of alarm system?	13	39	25	75
11	There are two major category in fire protection system which is:- a) Active system - sprinkler, fire extinguisher, alarm system, hose reel system b) Passive system - exit way, fire doors, compartment and separating walls Based on the statement above, do you notice what are the types of fire protection systems used by this building?	23	29	44.2	55.8
12	Do you know the differences between active and passive system?	23	29	44.2	55.8
13	During your working period here, have you ever involved in any seminars about fire safety?	10	42	19.2	80.8
14	Are you going to bring anything before out from the building?	33	19	63.5	36.5
15	In case of fire in this building, do you know the fire escape route?	43	9	82.7	17.3
16	In case of an emergency, do you know what number to call?	45	7	86.5	13.5
17	Do you know where the emergency exit located in this building is?	42	10	80.8	19.2

TABLE IV. QUESTIONNAIRES RESULTS

No	Question	Frequency	Percentage (%)
1	How will you realize that the building was on fire?		
	i. By smoke	16	30.8
	ii. Being told by collogues	9	17.3
	iii. Listen to alarm sound	26	50.0
	iv. other	-	-
2	If you listen to alarm sound, what will you do?		
	i. Wait for the instruction from the officer	11	21.2
	ii. Quickly out from the building	30	57.7
	iii. Call the emergency department	10	19.2
	iv. Didn't do anything	1	1.9
	v. Others	-	-
3	If fire was occur right in front of your eyes, what will you do?		
	i. Screaming	6	11.5
	ii. Try to eliminate the fire	9	17.3
	iii. Get out from there	23	44.2
	iv. Tell others	14	26.9
	v. Keep silent	-	-
	vi. others	-	-
4	If your answer is yes, please state what the lucky thing is?		
	i. wallet/purse	8	15.4
	ii. important document	33	63.5
	iii. laptop	6	11.5
	iv. others	5	9.6
5	During an emergency, where will you go to out from the building?		
	i. Emergency staircase	52	100
	ii. Lift	-	-
	iii. Windows	-	-

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