

Applying Indonesia Regulation on Fire Protection System at WTC 1 Building in Jakarta through Fire Risk Assessment (FRA)

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Abstract. Currently, the development of building maintenance should be a major consideration in particular against fire hazards, in order to carry out activities, and increase productivity and improve quality in their life. This Ministerial Regulation is intended to be a reference for building administrators in realizing building operations that are safe against fire hazards. The purpose for the FRA implementation is functioning the WTC 1 building and environments those are safe for humans, property, especially from the danger of fire, so as not to cause social welfare disturbances. The scope of this ministerial regulation covers fire protection systems in buildings and their environment starting from the planning stage, implementation of development to the utilization stage, so that the building is always reliable and of good quality according to its function.

1 Introduction

A Fire Risk Assessment (FRA) should be carried out on all types of buildings (excluding domestic residential property) to ensure compliance in Indonesia Regulation of The Minister of Public Works, in England and Wales with The Regulatory Reform (Fire Safety) Order 2005, in Scotland with The Fire Safety Regulations 2006 (Scotland) and Northern Ireland with The Fire Safety Regulations 2010 (Northern Ireland). A fire risk assessment is about understanding the potential risks and improving your fire safety precautions to keep employees and visitors safe. It is important to reduce the risk of fire to keep people safe in the workplace, because it can save lives and is your legal duty.

All the people who work in the building have responsibility to help protect people and property from the fire hazard, such as the employer or self-employed person, the person responsible for all or part of a building which is solely for business purposes, or a contractor with a degree of control over the premises for life safety through the system. It is essential to have a proper management fire policy in place, supported by maintenance and inspection programs, to mitigate the risk and prevent loss of life or assets in the event of fire breaking out. The coverage areas of Fire Risk Assessment including:

1. Door Openings
2. Travel Distance to Exits
3. Number of means of Egress
4. Egress Capacity
5. Arrangement of Means of Egress

Fire protection system in building is a physical form resulting from construction work that is integrated with

its domicile, partially or wholly located above and/or in the land and/or water, which functions as a place for humans to carry out their activities, either for housing or residence, religious activities, business activities, social activities, culture, and special activities. Building parts are parts of building elements that have certain functions, such as carrying loads, filling, and others. And fire hazard is a hazard caused by a potential threat and the degree of exposure to fire from the start fire and the spread of fire, smoke and gases. Then fire load is the sum of the net calorific value of the easy ingredients fires that are thought to have burned in the combustion compartment, including cover materials, movable and installed materials and building elements.

There are several elements or parts of the building that need to be known that must be protected from fire hazards, such as Basement, Block, Rescue path, Fire Wall, Inner Wall, Outer Wall, Wall Panel, Exit Route, Escalator, Hydrant, Fire Nozzle, Access Route, Evacuation Route, Corridors, etc.

In Indonesia at least there are 10 classes of building based on Regulation of The Minister of Public Works, such as:

- Class 1: Ordinary residential buildings, example: residential, hotel, or total floor area less than 300 m² and no permanently occupied by more than 12 people,
- Class 2: Residential buildings, examples: apartment
- Class 3: Residential buildings outside the building class 1 or class 2, examples: guest house, cottage, nursing home
- Class 4: Mixed residential buildings.
- Class 5: Office building
- Class 6: Commercial building, examples: restaurants, café, bar, salon/barber shop, workshop

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- Class 7: Storage/warehouse building
- Class 8: Laboratory/Industrial/Factory building.
- Class 9: Public buildings, examples: mosques, church, hall
- Class 10: Buildings or structures that are not residential, examples : carport, swimming pool, gate

World Trade Center Jakarta is a commercial office complex located on Jalan Jenderal Sudirman, Jakarta. The buildings in this complex are named WTC 1, WTC 2, WTC 3, WTC 5, and WTC 6. The area of this complex is about 8 hectares. Construction of WTC 5 and WTC 6 was completed in 1985, and at that time still using the names Wisma Metropolitan I and Wisma Metropolitan II. Both are 65 meters high with 17 floors above the ground. Construction of WTC 1 was also completed in 1985, with a height of 90 meters and 20 floors above ground, while construction of WTC 2 was completed in 2002, with a height of 160 meters and 30 floors above ground. WTC 3 is the tallest building in this complex with a height of 209.1 meters and 44 floors above ground and 5 floors below ground.

2 Literature review

Based on Regulation of the Minister of Public Works Regulation ([1]) regarding building fire protection systems mentioned that every person or legal entity including Government and government agencies regions in the implementation of building construction must meet the technical requirements stipulated in the ministerial regulation, such as:

- o general requirements,
- o access and supply of water for firefighting,
- o means of rescue/egress,
- o passive fire protection systems,
- o active fire protection system,
- o building utilities,
- o fire prevention in buildings,
- o management of fire protection systems in buildings,
- o and supervision and control.

In general requirements there are terms that mentioned to be understand such as:

- o atrium,
- o building,
- o public building,
- o parts of building,
- o fire hazard,
- o material cover,
- o fire load,
- o basements,
- o block,
- o Rescue opening,
- o fire wall,
- o outer wall,
- o inner wall,
- o panel wall,
- o exit,
- o horizontal exit,
- o building elements,
- o escalator,

- o hydrant,
- o fire hose,
- o Fire Resistance Rating,
- o Integrity,
- o Isolation,
- o Fire Intensity,
- o Access route,
- o Evacuation Route,
- o Fire-protected track,
- o Building Classification,
- o Structure Reliability,
- o Completeness of the building environment,
- o Lift,
- o fire resistance,
- o technical requirements,
- o Fire compartments,
- o compartments,
- o Structural Component,
- o Fire Resistance Construction,
- o light construction,
- o general corridor,
- o Fireproof cover,
- o protective layer,
- o monolith floor,
- o Flammable,
- o Mezzanine,
- o load bearer,
- o Setting the building environment,
- o building arrangement,
- o concrete cover,
- o Plumbing, PVC,
- o Open Space,
- o protected ram,
- o effective space,
- o circulation room,
- o vertical slide,
- o Sprinkler,
- o Aisle,
- o elevator slide,
- o gathering place/room,
- o Effective height,
- o Open car park,
- o non-flammable,
- o Festival,
- o Safe Place,
- o Protected fire ladder,
- o fire ladder,
- o fire exit,
- o Escalator,
- o outside air,
- o Single occupancy unit,
- o fire standard test, smoke and heat fan,
- o Rescue/evacuation time,
- o Type of Construction.

Every building must be equipped with means of egress that can be used by building occupants, so that they have sufficient time to escape safely without being hampered by things caused by an emergency. In means of rescue or egress, the objective is to prevent accidents or injuries when evacuating when an emergency occurs. Means of egress from the building must be provided so that building occupants can use it for self-rescue with

the number, location and dimensions in accordance with the distance traveled, number, mobility and other characteristics of the occupants of the building, the function or use of the building, the height of the building, the direction of the means of exit from the top of the building or from below the ground level. Egress must be located separately by taking into account the number of floors of the building connected by the egress, the fire protection system installed in the building, the function or use of the building, the number of floors traversed the actions of firefighters. In order for the occupants or users of the building to use the egress safely, the egress path must have dimensions determined based on the number, mobility and other characteristics of the occupants or users of the building and the function or use of the building. Corridor is part of the means of egress which used as exit access and serve an area that has an occupancy load of more than 30 must be separated from other parts of the building with walls that have a fire resistance level of 1 hour and according to the provisions on "fire barriers".

For exit door, in existing buildings and not high-rise height, existing protected exit stairs must have fire resistance level of at least 1 hour. A protected exit area, when designed as a shelter area, may not be used for any use that has the potential to interfere with its use as an exit. For exit door is a means of salvation that need to be installed the swing and in a way, to open in any position until it reaches a fully open position.

If an exit serves more than one floor, only the occupancy load of each floor is calculated separately. It must be used within the required capacity of the exit on that floor, provided that the required egress capacity from the exit is not reduced in the direction of the egress path. For example, if the occupancy load per floor is 300 occupants, the capacity for each exit is at least 2 with a capacity of 150 occupants each. Based on drawing given on the WTC 1 building on the 3rd and 4th floors, it has 4 exits with a total of about 300 occupants. The minimum number of means of egress from each floor or part thereof other than for existing buildings as permitted for all building classifications must be as follows:

- (1) Occupancies load is more than 500 but not more than 1000, at least 3.
- (2) The occupancy load is more than 1000, at least 4

The distance travelled to the exit shall be measured on the floor or other road surface, it is shown in Table 1.

Table 1. The distance travelled to the exit.

Function	Shared Cross Boundary		Dead End Limit		Distance Limit	
	Without Sprinkler (m)	With Sprinkler (m)	Without Sprinkler (m)	With Sprinkler (m)	Without Sprinkler (m)	With Sprinkler (m)
Commercial						
A,B,C Classes						
- New	23	30	6.1	15	45	78
- Existing	23	30	15	15	45	78
- Open Air	No Req	No Req	0	0	No Req	No Req
Mall						
- New	23	30	6.1	15	45	120
- Existing	23	30	15	15	45	120
Business						
- New	23	30	6.1	15	61	91
- Existing	23	30	15	15	61	91

Based on the picture given on the 3rd floor of the WTC 1 building, the distance traveled to the exit is about 35-40 meters and for the 4th floor the distance traveled to the exit is about 40 – 70 meters which is less than 91 meters since the 3rd and 4th floor have sprinklers installed.

Since the emergency exit is very important as a means of egress, it is necessary to have a sign symbol indicating the direction of exit. The following is an example of an image and an exit symbol as shown in Figure 1.



Fig. 1. Image and an exit symbol.

Passive fire protection systems need to be considered as a means of rescue/egress. It consist of:

- the construction of building,
- Design and construction of fire walls and fire barrier walls,
- fire resistance of doors and windows,
- Interior upholstery,
- Fire barriers,
- Partitions,
- Smoke Barriers,
- Atrium.

All fire protection systems and equipment that have been installed must be able to be used and function properly in accordance with the permitted provisions, including the active fire protection systems, such as:

- Design and installation of standpipe systems must comply with SNI 03-1745-2000, or the latest edition,
- Procedures for Planning and Installation of Upright Pipe and Hose Systems for Prevention of Fire Hazards in Buildings. High-rise buildings must be fully protected with a Class I Upright Pipe System, which must be more than three stories above the ground, more than 15 m above the ground and have intermediate floors or balconies, more than one level below ground, and more than 6 m above the ground and underground.
- Automatic sprinklers must be installed and fully operational in accordance with SNI 03- 3989-2000, or the latest edition, especially for the high rise building. Annually, in relation to cold air temperatures, buildings with wet plumbing systems, should be inspected to ensure that windows, skylights, doors, ventilators, other openings or closures, dead-end spaces, unused attics, stair towers, building rooftops, and low spaces under buildings, not to freeze the sprinkler pipes filled with water and to ensure that there is sufficient heat with a minimum temperature of 4.4°C.
- Fire pumps must be installed according to SNI 03-6570-2001, Fixed pump installation for protection fire, or the latest edition. In the case of pump

operation, a qualified person must respond to the location of the fire pump to determine that the fire pump can operate satisfactorily. Fire pump units installed in spaces must be separated or protected by fire-resistant construction as shown in Table 2.

Table 2. Fire-resistant construction separation.

Pump House	Building near pump house	Separation Required
No Sprinkler Installed	No Sprinkler Installed	
No Sprinkler Installed	Fully Sprinkler Installed	Fire resistance is 2 hours or 15 m
Fully Sprinkler Installed	No Sprinkler Installed	
Fully Sprinkler Installed	Fully Sprinkler Installed	Fire resistance is 1 hours or 15 m

- Procedures for planning, installing fire extinguishers for fire prevention in houses and buildings as shown in Table 3.

The fire extinguisher classification must consist of letters indicating the class of fire in where the fire extinguisher is proven effective, preceded by a number (class A and class B only) indicating the relative extinguishing effectiveness. Fire extinguishers classified for class C, class D, or class K fire hazard use are not required to have a number that precedes the letter of the classification. The fire extinguisher must always be maintained in full condition and ready to operate and must be maintained at all times in the designated place when the equipment is not in use. Fire extinguishers must be located prominently where they are easily accessible and ready to use and always available in the event of a fire. It is better if the device is placed along the normal path, including exits from an area.

Table 3. Fire extinguishers requirement.

Building Utilization	Requirements
Ambulatory health care	Y
Apartment	Y
Ball Room	Y
Bisnis	Y
Day Care	Y
Jail	Y
Education	Y
Health care	Y
Hotel or Dormitory	Y
Industrial	Y
Guest House	Y
Trading	Y
Special Structure	Y
Residential	N
Home care	Y
Warehouse	Y

The cabinet where the fire extinguisher is located must not be locked, unless the fire extinguisher is the target of malicious acts and the cupboard is included as an emergency access facility. The cabinet containing the fire extinguisher is not allowed to be locked, unless the fire extinguisher in the cabinet can be used for evil deeds, and the equipment is stored

in the cabinet for emergency access.

The fire extinguisher must be clearly visible and unobstructed. In large rooms, and in certain locations there are unavoidable visual obstructions, a means must be provided to indicate the location of the fire extinguisher. Fire extinguishers other than the wheeled fire extinguisher must be securely attached to a hanger, or a binder made by the fire extinguisher manufacturer, or a registered fastener approved for this purpose, or placed in a cabinet or wall that the construction goes into. A wheeled fire extinguisher must be placed in a designated location. Fire extinguishers installed in conditions of installation that are prone to dislodgement must be equipped with specially designed harnesses. Fire extinguishers installed in conditions prone to physical damage (eg from impact, vibration, the environment) must be properly protected. Fire extinguishers with a gross weight not exceeding 18 kg must be installed so that the top end of the fire extinguisher is not more than 1.5 m above the floor. Fire extinguishers weighing more than 18 kg (except the type equipped with wheels) must be installed no more than 1 m above the floor. In any case, there must be a distance between the fire extinguisher and the floor not less than 10 cm. The manufacturer or supplier must submit to the Owner or the owner's representative a fire extinguisher instruction manual detailing the brief instructions and warnings necessary for the fire extinguisher installation, operation, inspection and maintenance. The manual must refer to SNI 03-3987-1995, or the latest edition. The distance travelled for the Fire extinguishers must not exceed 15 m.

- Fire alarm systems or automatic fire detectors must provide and installed according to SNI 04- 0225-2000 or the latest edition of “General Requirements for Electrical Installation 2000 (PUIL 2000)”, and SNI 03-3985-2000 or the latest edition “Procedures for Planning and Installing Fire Detection and Alarm Systems for Hazard Prevention Fire in Houses and Buildings. Single-station and multiple-station smoke alarms must comply with SNI 03-3985-2000 or the latest edition and be configured to function in the same manner as single-station smoke alarms and multiple-stations should be allowed instead of smoke alarms. Smoke alarms, apart from devices that operate on batteries and the requirements of a low-power cordless system of SNI 03-3985- 2000 or the latest edition, must obtain electrical power for their operation from buildings. Smoke detectors in lobbies, elevator slides and associated engine rooms used only for elevator recalls when they occur fire alarms, and heat detectors used only to disconnect elevator power, shall not be required to activate building evacuation alarms when the power supply and wiring installations to such detectors are monitored by the building fire alarm system, and when activation of such detectors initiates a control signal, supervisory signal at a location that is always guarded. Smoke detectors are used only to cover dampers or turning off ventilation and air

conditioning systems, it shall not be required to activate a building evacuation alarm, provided that power supply and wiring installations to such detectors monitored by the building's fire alarm system, and the activation of the detector initiates a supervisory signal at a location that is always guarded. Visual signals are not necessarily required in elevator trains. Where a floor area exceeds 2090 m², additional fire alarm zones shall be provided, and the length of any single fire alarm zone shall not exceed 91 m in any direction. Where a building is protected by an approved automatic sprinkler system, the area of the fire alarm zone shall be permitted to coincide with the allowable area of the sprinkler system. A fault signal in the system shall be annunciated at the control center by means of audible and visual indicators. A system supervision signal shall be annunciated at the control center by means of audible and visual indicators as shown in Table 4.

Table 4. Sprinkler systems.

Function	Occupancy Class	Function of Building	Number of		Detection and Alarm system
			Floor	Square Meter (m ²)	
1a	Single Building	Residential	1	-	-
1b	Residential building	Dormitory, Guest House (< 300 m ²)	1	300	-
2	Residential building	Shop House (> 2 floors)	1	No Limit	(M),(S)
			2-4	No Limit	(M),(S)
3	Residential building	Nursing Home, Health Care	1	No Limit	(M)
			2-4	No Limit	(M)
			>4	No Limit	(O)
4	Mix Residential Building	Residential class 5,6,7,8, and 9	1	No Limit	(M)
			2-4	No Limit	(O)
			>4	No Limit	(O)
5	Office Building	Commercial	1	400	(M)
			2-4	200	(M)
			>4	No Limit	(O)
6	Trading Building	Restaurant, Store, Salon, Market, etc.	1	400	(M)
			>4	No Limit	(O)
7	Warehouse	Parking area, Warehouse	1	400	(M)
			2-4	200	(M)
			>4	No Limit	(O)
8	Lab, Industrial, Plant	Production, Assembly, Packing	1	400	(M)
			2-4	200	(M)
			>4	No Limit	(O)
9a	General Building	Health Care, Lab Medic	1	No Limit	(M)
			2-4	No Limit	(O)
			>4	No Limit	(O)
9b	General Building	Hall, Worship Place, Education, Culture, Lab	1	400	(M)
			2-4	200	(M)
			>4	No Limit	(O)
10a	Structure not building	Carport	1	No Limit	(M)
			2-4	No Limit	(M)
			>4	No Limit	(O)

NL = No Limit M = Manual O = Automatic S = Single Station Smoke Detector

3 Research methodology

In this study, the subject to be covered are:
 Fire Risk Assessment at 3rd and 4th Floor WTC 1 building, Jakarta.

The following methods were adopted in the audit process:

1. Review of the floor drawing
2. Verification and validation of the result

4 Results and discussion

Based on building classification, the floor (3rd and 4th) in WTC 1 is classified as Building Class 5.

All result is based on the Indonesia Regulation ([1]).

1. Design density:
 - For 3rd floor base on the gross area is 314 people/occupants (maximum). The actual populations for 3rd floor base on the number of the occupants is 299 people.
 - Design density for 4th floor is 314 people (maximum) and the actual population base on the number of the occupants is 282 people. It is complied with Indonesia Government Regulation.
2. Door Openings:
 - There are 4 main Push doors to the emergency exit stairs, it is comply with Indonesia Government Regulation for room with maximum 200 occupants per side or per emergency exit stair.
3. Travel Distance:
 - Total travel distance to exit of the building is between 35-40 m for 3rd floor and total travel distance to exit of the building between 40-70 m for 4th floor. It is complied with Indonesia Regulation with maximum travel distance is 91meters.
4. Number of means of Egress:
 - Minimum 2 exits doors for less than 400 occupants. The density for 3rd floor and 4th floor based on drawing layout there are 4 exits doors on each floor, so it is complied with the Indonesia Government Regulation.
 - For Legal Compliance Team can take the evacuation route to the closest of emergency door near the lift (left side lift)
 - For Treasury Team can take the evacuation route to the closest of emergency door near the lift (right side lift)
5. Egress Capacity:
 - 50% from total number of people/occupants, based on drawing layout, the building had 4 egresses which have maximum capacity of 800 occupants, and it is comply with the Indonesia Government Regulation.
 - Based on drawing, width of emergency stairs is 120 cm, which is complied with Indonesia Government Regulation.
 - Width of doors based on drawing is 90 cm which is not specify with requirement of Indonesia Government Regulation
 - Width of emergency doors allowed by regulation is 100 cm, based on drawing layout 180 cm which is comply with the requirement of Indonesian Government Regulation.
6. Arrangement of Means of Egress:
 - Minimum 91.5 cm wide of access allowed this building have more than 100 cm, which is complied with the requirement of Indonesian Government Regulation.
7. Fire protection system layout:

- a. Fire Extinguisher in every 15 m or around 200 m², based on drawing layout there should be at least 13 units on each floor (3rd Floor and 4th Floor).
- Based on drawing total usage of fire extinguishers are 12 units. (see attached drawing/red dots)
- Placement of fire extinguisher are:
 - Depend on the materials that has potential hazard around the building
 - On free space or not deterred
 - Easy to reach
- b. 1 unit Hydrant coverage of 800 m², based on square meter and Indonesia Government Regulation, Hydrant required is 4 units for each floor.
- Placement of fire hydrant are:
 - Depend on the materials that has potential hazard around the building
 - On free space or not deterred
 - Easy to reach
- c. Alarm system needed based on the Indonesia Government Regulation is unlimited for building that has > 400 m² and must be automatic.
- d. Smoke detector needed based on the Indonesia Government Regulation is 12 units, which is every 12 m excluding 6 m from the edges of the walls and based on gross square meters.
- e. Sprinkler installation based on the Indonesia Government Regulation is 68 units, which is every 4.6 m excluding 1.8 m from edges of the walls or based on the gross square meters. (see Figure 2 and 3; see Table 5 and 6).

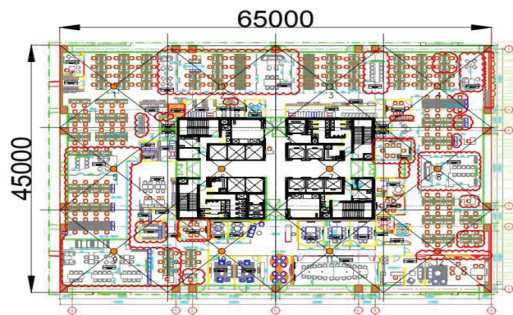


Fig. 2. 3rd floor WTC 1 building.

Table 5. Assessment result 3rd floor WTC 1 building.

No.	Floor	Semi Gross SQM	No of People	Descriptions	Specification	Std/Reg.	UOM	Based On Drawings	Remarks
1	3rd	2,918	299	Density based on layout area	Gross Area/9.3	314	Person	299	Ok
				Class of Building	Class IV or V (Mixed Building, Office Building)				Ok
				Doors Openings	Building Class V which has more than 3 floors - For main doors must be opened as a "push" doors through the corridors and or exit doors (more than 50 people)		Units	- There are door opening blocking the isle Red Circle on the drawing	Need to be reviewed

									- For meeting rooms, doors opening must be "pull" doors (Less than 50 people) inside the room
Travel Distance to Exits	Less than 91 m	91	m	35-40	Ok				
Number of means of Egress	Minimum 1 exits door for more than 200 people	2	Exits	4	Ok				
Egress capacity	50% from total number of people	800	People	299	Ok				
	Width of emergency stairs	120	cm	120	Ok				
	Width of doors	Not Specific	cm	90	Ok				
	Width of emergency doors	100	cm	180	Ok				
Arrangement of means of Egress	Minimum 91.5 cm	91.5	cm	> 91.5 (140 - 150)	Ok				
	1 Fire Extinguisher in every 15 m	13	Units						
	1 Hydrant covered 800 m ²	4	Units	2					Need to be reviewed
Fire protection system layout	Smoke detectors placed between sprinkler	4	m	12					
	Distance between sprinkler maximum 4 m	4.6	m	68					
	Fire Alarm	unlimited for building >400 square meters	Units						



Fig. 3. 4th floor WTC 1 building.

Table 6. Assessment result 4th floor WTC 1 building.

No.	Floor	Semi Gross SQM	No of People	Descriptions	Specification	Std/Reg.	UOM	Based On Drawings	Remarks
2	4th	2,917.62	282	Density based on layout area	Gross Area/9.3	314	Person	282	Ok
				Class of Building	Class IV or V (Mixed Building, Office Building)				Ok
					Building Class V which has more than 3 floors				

Doors Openings	- For main doors must be opened as a "push" doors through the corridors and or exit doors (more than 50 people) - For meeting rooms, doors opening must be "pull" doors (Less than 50 people) inside the room	Units	- Meeting room is "Pull" door	Ok
Travel Distance to Exits	Less than 91 m	91 m	40-70	Ok
Number of means of Egress	Minimum 1 exits door for more than 200 people	2 Exits	4	Ok
Egress capacity	50% from total number of people	800 People	282	Ok
	Width of emergency stairs	120 cm	120	Ok
	Width of doors	Not Specific	90	Ok
	Width of emergency doors	100 cm	180	Ok
Arrangement of means of Egress	Minimum 91.5 cm	91.5 cm	>91.5 (160-300)	Ok
	1 Fire Extinguisher in every 15 m	13 Units		
	1 Hydrant covered 800 m2	4 Units	2	Need to be reviewed
Fire protection system layout	Smoke detectors placed between sprinkler	4 m	12	
	Distance between sprinkler maximum 4 m	4.6 m	68	
	Fire Alarm	unlimited for building >400 square meters	Units	

and built in buildings that are used for the purpose of active protection systems, passive protection systems and management methods in order to protect buildings and their environment against fire hazard. Good Safety means Good Company.

References

1. Minister of Public Works, Regulation of the minister of public works no. 26 building fire protection systems (2008)
2. OB Park, NFPA 101 life safety code, (National Fire Protection Association, 2000)
3. NFPA, NFPA 220 standard on types of building construction ISBN 10:1455916854 ISBN-13:978-1455916856 (2017)
4. NFPA, NFPA 221 standard for high challenge fire walls (Fire Walls, and Fire Barrier, 2018)
5. NFPA, NFPA 252 standard methods of fire tests of door assemblies ISBN-10:1455915645 ISBN-13:978-1455915644 (2017)
6. NFPA, NFPA 25 standard for the inspection, testing, and maintenance of water-based fire protection systems (2022)

5 Conclusion and suggestion

Based on the results of the assessment, it can be concluded that the 3rd and 4th floors of the WTC1 building have met the requirements of the regulations of the minister of public works for the fire risk assessment carried out, although there are still some things that need to be reviewed, such as the number of hydrants available on each floor, there are only 2 units. while the actual need based on the area is 4 units. Also seen from the direction of the door opening, it still needs to be reviewed again by considering the number of occupants who will pass through the door during an emergency. The safety of the people who are in the building and its environment must be the main consideration, especially regarding the danger of fire, so that they can carry out activities and increase their productivity and improve their quality of life. The fire protection system in buildings and the environment is a system consisting of equipment, completeness and facilities, both installed