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Evaluation of Fire Protection System in Library Building Universitas Negeri Padang

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ABSTRACT

The fire of a building will have a major impact on the building owner, both in the form of material, moral and environmental losses. In residential areas, offices and other public facilities often cause casualties. Therefore, a building needs to take into account the risk of fire so that building users can carry out activities safely and comfortably. One of the causes of fires is the fire suppression system that has not received full attention, where there is often an inadequate building fire protection system. The UNP Library Building is one of the public facilities buildings that are always crowded with students. It is necessary to evaluate the availability of the fire protection system to ensure the safety and comfort of its users. This research is in the form of an evaluation of the availability and completeness of the available fire protection systems and their remedies against the threat of fire. The data was taken through direct observation and question and answer and the distribution of questionnaires with the library. From the results of the analysis of the fire protection system inspection of the UNP Library building, it is known that on the 1st floor the lowest rediness value is 18.9%, for the 2nd and 3rd floors is 44.1%, the 4th and 5th floors are 45.9% and 45.6 % fulfilled the requirements based on the Minister of Public Works Regulation No. 26/PRT/M/2008.

Keywords: *Fire-alarm; Protection-system; Library-building.*

INTRODUCTION

Fire hazard is one of the problems that always need to be watched out by all parties, because every time a fire will cause big losses for the owner, occupants of the building as well as the community and the environment. The losses incurred are not only material, moral, life and also time, because buildings and facilities that have been burned will result in the loss of assets and the cessation of all activities and production activities in the burning building. Fires often also have a double impact on the lives of the surrounding community, especially in economic, social and environmental terms.

According to Law no. 28 of 2002 concerning buildings "safety factor is an important requirement that must be met by a building"[1]. Buildings should have a fire protection system that meets the requirements, which are able to prevent fires, prevent the spread of fire and smoke, extinguish fires and provide safe evacuation routes for building users. The purpose of implementing building safety regulations against fire hazards is to ensure the safety of building users and prevent building damage due to the fire itself [2, 3, 4, 5]. The

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reality on the ground shows that the level of risk of fire hazard is not only caused by the area of the building, but the number of occupants and the number of floors of the building also determine, in addition to many other factors that can cause a high level of risk or vulnerability to fire. This concerns the presence of fire sources, flammable materials and the level of difficulty in evacuation [6, 7, 8, 9].

One of the important aspects that requires attention in organizing an environment in the form of houses, buildings, and others is security against fire hazards" [10, 11]. where the means of rescue is a means that prepares to be used by residents and firefighters in an effort to save human lives and property in the event of a fire in a building and the environment.[12, 13]. Therefore, it is important for a building to be equipped with safety and health facilities and infrastructure for its occupants [14, 15].

Universitas Negeri Padang Library Building, which was established in 1992, has five floors with a total floor area of ±5000 m2, where each floor certainly requires a fire protection system and adequate rescue facilities. This is because the building has a function as a public facility, namely the central library on floors 2,3,4, and 5, as well as an office center on the 1st floor, so it has complex behavior in a closed building.
High-rise buildings should have adequate fire protection systems and redines in order to identify fires properly and effectively, but because this building has been built since 30 years ago, it is possible that some of the fire protection systems are no longer functioning, there have been 2 major earthquakes which has occurred in West Sumatra in 2007 and 2009, which has caused damage to several main buildings at UNP, although the library building is one of the buildings considered safe from heavy damage by the earthquake at that time. . Therefore, periodic inspection of fire protection equipment needs to be carried out so that the tool can be ensured its functionality (readiness) in the event of a fire.

According to the Minister of Public Works No. 26 of 2008, "fire is a phenomenon that arises due to an increase in temperature of a material which then reacts chemically with oxygen to produce heat and emission of fire, starting from the beginning of the fire, during the process of spreading the fire, to the smoke and gases generated"[3, 4]. In addition, fire is a hazard caused by the presence of a flame that cannot be controlled. Fires can happen anywhere and anytime. The problem of fires is still common in the surrounding environment, this states that it is necessary to increase prevention vigilance against fire hazards [7, 16]. Meanwhile, according to the NFPA (National Fire Protection Association) fire is an "oxidation event where three elements meet, namely combustible materials, oxygen in the air, and heat which can result in property loss or injury and even human death” [17]..

Furthermore, Law no. 28 of 2002, explains that buildings must include requirements for safety, health, comfort, and convenience [1]. Safety requirements include the requirements for the building's ability to support loads and the building's ability to prevent and cope with fire hazards and lightning hazards. To ensure that the building has met the requirements, it is necessary to have a proper function certificate as regulated by Minister of Public Works Regulation no. PU No. 25/PRT/M/2007 regarding SLF [18].

The definition of fire protection system in buildings and the environment according to the Regulation of the Minister of Public Works no. 26/PRT/M/2008, concerning Technical Requirements for Fire Protection Systems in Buildings and the Environment is “a system consisting of equipment, completeness and facilities, both installed and in buildings that are

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used for the purpose of active protection systems, passive protection systems and other methods of management methods in order to protect buildings and their environment against fire hazards" [4, 19]. Fire protection systems are used to detect and extinguish fires as early as possible by using equipment that is driven manually or automatically.

Fire classification is also useful for determining the means of fire protection in ensuring the safety of the life of the firefighting team. In relation to the requirements for the installation and maintenance of Light Fire Extinguishers, fires according to NFPA regulations [17] are classified as table.1

Table 1. Fire Classification

Class	Type	Example
Class A	Solids	Fires with solid nonmetallic fuels
Class B	Liquid/gaseous materials	Fires with flammable liquid or gaseous fuels
Class C	Electrical	Fires of live installations
Class D	Metallic materials	Fires with metallic fuels

Source: [17]

The components of rescue facilities according to the Regulation of the Minister of Public Works No. 26/PRT/M/2008, among others: (1) Exit; (2) Reliability of egress; (3) Doors; (4) Shielded space and high protection; (5) exit canal; (6) Number of means of egress; (7) Arrangement of exits; (8) Exit discharge; (9) Exit illumination; (10) Emergency lighting; and (11) Marking of means of egress [17, 20].

The fire protection system is divided into types of Minister of Public Works Regulation No.26/2008), namely:

a. An active fire protection system is a means of fire protection that must be moved with something to function to extinguish fires as well as to prevent and minimize fires.Examples of active fire systems are;(a) heat detectors;(b) fire detectors;(c) smoke detectors;(d) fire alarms;(e) Sprinkler;(f) Light Fire Extinguishers;(g) Fire hydrant [21, 22], for details see Figure 1.

Gambar 3. Detektor Panas
Gambar 4. Detektor Api
Gambar 5. Detektor Asap
Gambar 6. Alarm Kebakaran
Gambar 7. Sprinkler
Gambar 8. Alat Pemadam Api Ringan
Gambar Fire Hydrant

Figure 1. Active fire protection system components

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Passive fire protection system is a fire protection system that is formed or built through the regulation of the use of materials and building structural components, compartmentalization or separation of buildings based on the level of fire resistance and protection against openings. Passive protection systems are emphasized on the aspect of building materials, the attitude of the burning part cannot be separated from the resistance of building materials to fire.This system consists of: (a) fire resistance and stability, (b) barrier, (c) fire retardant protection, (d) safety distance.

RESEARCH METHODS

The research method used is descriptive method, the type of data is primary and secondary data. Observations are made to determine the conditions and conditions objectively by first preparing a checklist format for the completeness and reliability of the building's fire protection system.For this reason, a literature study has previously been carried out to determine the layout and completeness of the building through building drawings, then structured questions and answers were also conducted with building users, both librarians and students as library visitors..

RESULTS AND DISCUSSION

In determining the fulfillment of standards and requirements on fire protection equipment, the value of the reliability level is used.Reliability is the level of perfection of the condition of fire protection equipment that ensures the safety and function and comfort of a building and its environment during the lifetime of the building in terms of fire hazard.The value of the level of reliability can be seen in table 2:

Based on the Regulation of the Minister of PUPR RI No.11/PRT/M/2018 [21] in a review of the security of the fire protection system in Universitas Negeri Padang Library Building using descriptive data analysis with the case study method using data tabulation which then calculated the percentage, then analyzed.The requirements are divided into two categories, meet (M) and do not meet (TM), each checklist mark is rewarded with 1 (one) then added up for each criterion, so that it can be seen the percentage of technical requirements that are met by each building object under study [20]

Data analysis is calculated using the following formula (PUPR Ministerial Regulation no.11/2018).

Table 2. Value of Reliability Level

Value	Conformity	Reliability
80%< Reliability≤100%	According to requirements	Well
60%≤ Reliability≤80%	Installed but there are a small number of agencies that do not meet the requirements	Enough
Reliability< 60%	Not suitable at all	Not enough

Source: [20]

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$$M = \frac{\sum M}{\text{Total Requirements}} \text{x}100\% \quad (1)$$

$$TM = \frac{\sum TM}{\text{Total Requirements}} x100\% \quad (2)$$

Information:

M=Percentage that meets the requirements
∑M=Number of scores that meet the requirements
TM=Percentage that does not meet the requirements
∑TM= Number of scores that do not meet the requirements

Universitas Negeri Padang Library is a stand-alone library building in the UNP environment with an area of approximately 5000 m² and consists of five floors, the 1st floor is used as an office, the 2nd and 3rd floors are reading rooms and reading collections, while the 4th floor is an office space.leadership, administration, and library warehouse, 5th floor Classrooms, meeting rooms and other facilities.

From the results of research data on the reliability of rescue facilities, passive protection systems, and active protection systems of 1st floor buildings as listed in table-3 and graphs of figure-2

Table 3. Total Score Assessment Floor 1

Inspection Section	Inspection		Requirements		Total (%)	
	A	TA	M	TM	M	TM
Rescue Facilities	58	52	35	75	31,8	68,2
Passive Protection System	7	9	4	12	25	75
Active Protection System	0	42	0	42	0	100

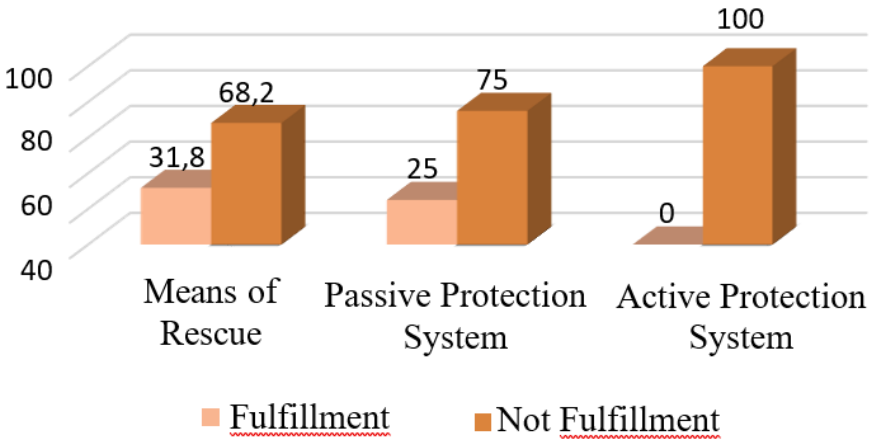

Figure 2. Distribution of floor-1 reliability

To get the level of reliability of protection against fire on the 1st floor, the following formula is used:

$$M = \frac{\sum M}{\text{Total Requirements}} \text{x}100\%$$

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$$M1 = \frac{31{,}8 + 25 + 0}{3} x\ 100\% = 18{,}93\%$$

$$TM = \frac{\sum TM}{\text{Total Requirements}}\ x100\%$$

$$TM = \frac{68{,}2 + 75 + 100}{3} x100\% = 81{,}1\%$$

In the same way, the reliability data for the 2nd floor is also obtained as described in table-4 and figure-3 below

Table 4. Total Score Assessment Floor 2

Inspection Section	Inspection		Requirements		Total (%)	
	A	TA	M	TM	M	TM
Rescue Facilities	60	41	36	72	31,6	65,4
Passive Protection System	12	4	8	8	50	50
Active Protection System	26	16	20	22	47,6	52,4

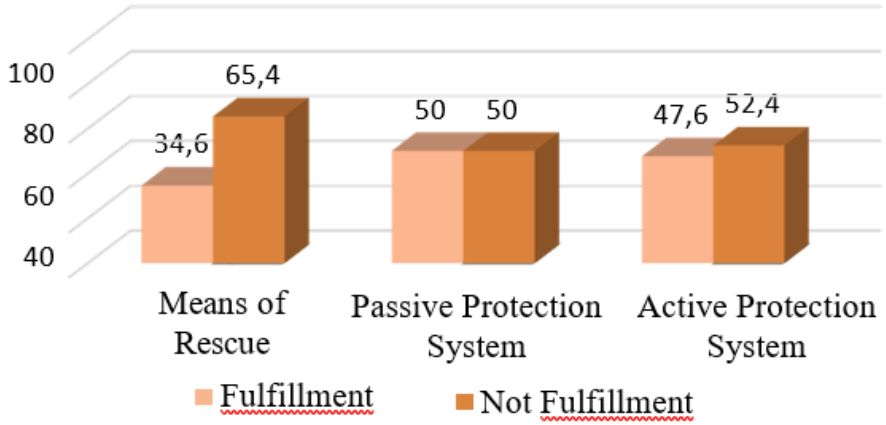

Figure 3. Distribution of floor-2 reliability

$$M = \frac{\sum \text{M}}{\text{Total Requirements}} \text{x100\%}$$

$$M2 = \frac{31{,}6 + 50 + 47{,}6}{3} x\ 100\% = 44{,}1\%$$

$$TM = \frac{\sum TM}{\text{Total Requirements}}\ x100\%$$

$$TM2 = \frac{65{,}4 + 50 + 52{,}4}{3} x100\% = 55{,}9\%$$

Then in the same way, the reliability data for the 3rd floor is also obtained as described in table-5 and figure-4 below:

Table 5. Total Score Assessment Floor 3

Inspection Section	Inspection		Requirements		Total (%)	
	A	TA	M	TM	M	TM
Rescue Facilities	60	41	36	72	31,6	65,4
Passive Protection System	12	4	8	8	50	50
Active Protection System	26	16	20	22	47,6	52,4

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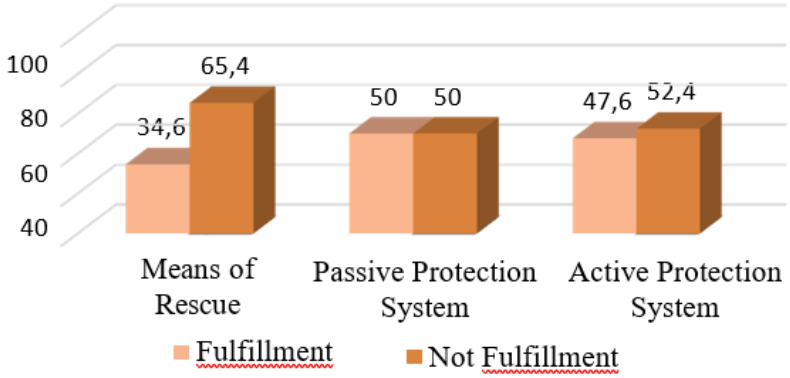

Figure 4. Distribution of floor-3 reliability

$$M = \frac{\sum \mathrm{M}}{\text{Total Requirements}} \mathrm{x}100\%$$

$$M3 = \frac{31{,}6 + 50 + 47{,}6}{3} x\ 100\% = 44{,}1\%$$

$$TM = \frac{\sum TM}{\text{Total Requirements}}\ x100\%$$

$$TM3 = \frac{65{,}4 + 50 + 52{,}4}{3} x100\% = 55{,}9\%$$

Then in the same way, the reliability data for the 4th floor is also obtained as described in table-6 and figure-5 below

Table 6. Total Score Assessment Floor 4

Inspection Section	Inspection		Requirements		Total (%)	
	A	TA	M	TM	M	TM
Rescue Facilities	68	42	44	66	40	60
Passive Protection System	12	4	8	8	50	50
Active Protection System	26	16	20	22	47,6	52,4

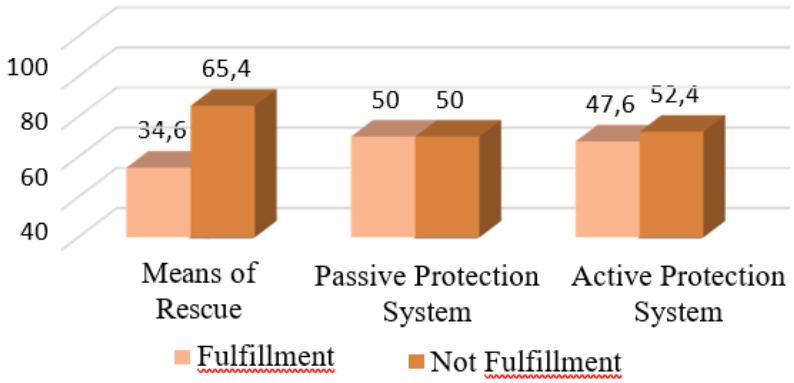

Figure 5. Distribution of floor-4 reliability

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$$M = \frac{\sum \text{M}}{\text{Total Requirements}} \text{x}100\%$$

$$M4 = \frac{40 + 50 + 47{,}6}{3} x\ 100\% = 45{,}9\%$$

$$TM = \frac{\sum TM}{\text{Total Requirements}}\ x100\%$$

$$TM4 = \frac{60 + 50 + 52{,}4}{3} x100\% = 54{,}1\%$$

In the same way, the reliability data for the 5th floor is also obtained as described in table-7 and figure-6 below:

Table 7. Total Score Assessment Floor 5

Inspection Section	Inspection		Requirements		Total (%)	
	A	TA	M	TM	M	TM
Rescue Facilities	68	42	43	67	39,1	60,9
Passive Protection System	12	4	8	8	50	50
Active Protection System	26	16	20	22	47,6	52,4

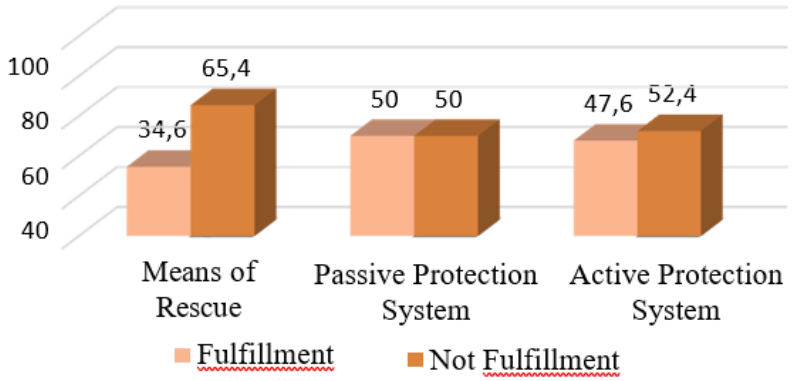

Figure 6. Distribution of floor-5 reliability

$$M = \frac{\sum \text{M}}{\text{Total Requirements}} \text{x}100\%$$

$$M5 = \frac{39{,}1 + 50 + 47{,}6}{3} x\ 100\% = 45{,}6\%$$

$$TM = \frac{\sum TM}{\text{Total Requirements}}\ x100\%$$

$$TM5 = \frac{60{,}9 + 50 + 52{,}4}{3} x100\% = 54{,}4\%$$

From the results of data analysis obtained from the calculation of the percentage of the Fire Protection System in the Universitas Negeri Padang Library Building, the total results of the overall fire protection examination can be seen below and in Table-8 and Figure-7.

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Table 8. Combined score

Floor	Fulfil	Does not meet
1st floor	18,9	81,1
2nd Floor	44,1	55,9
3rd floor	44,1	55,9
4th floor	45,9	54,1
5th floor	45,6	54,4
Average score	**39,72**	**61,9**

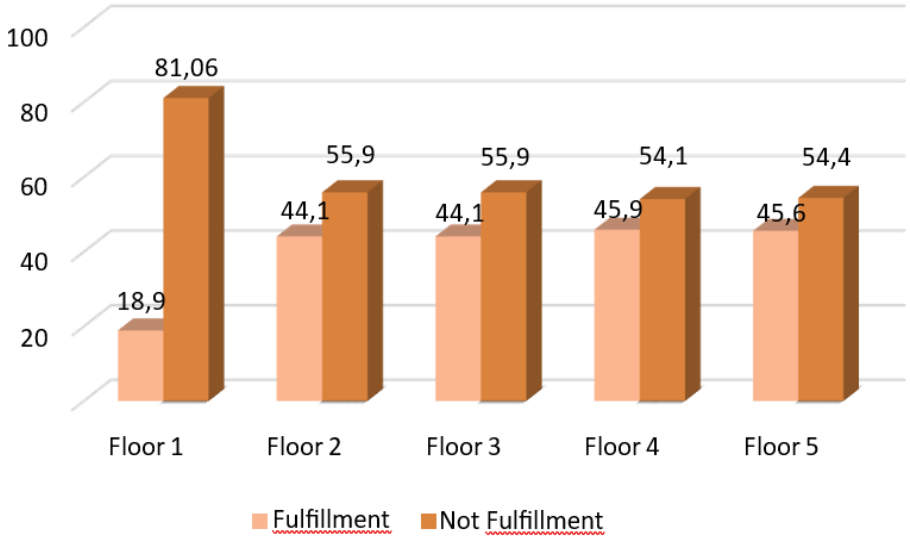

Figure 7. Total Reliability Value of the UNP Library Building Protection System

CONCLUSION

Based on the data and the results of the evaluation of the Fire Protection System in the Padang State University Library Building which was established in 1992, the following conclusions can be drawn:

1. The Fire Protection System at the time of construction had begun to pay attention to the fire protection aspect, but it was not yet complete in accordance with the Minister of Public Works No. 26/PRT/M/2008, concerning Technical Requirements for Fire Protection Systems in Buildings.
2. The use and maintenance of the fire protection system in Universitas Negeri Padang Library building as a whole is still low, namely 39.72% of the level of reliability, because there are still many fire protection devices that are not yet available and some others do not meet the requirements.
3. The 1st floor gets the lowest assessment score, namely 18.9% meets the requirements, the percentage for the 2nd floor and 3rd floor is the same, namely 44.1% meets the requirements because they have similar layouts and facilities in it which are reading rooms and activity centers in the library, while the 4th floor is used as the head office, administration, production, and warehouse. The 5th floor is used as a meeting room, conference room, lecture hall and other facilities.

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