Passive fire building protection system evaluation (case study: millennium ict centre)

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Abstract. Passive fire protection system is a system that refers to the building design, both regarding of architecture and structure. This system usually consists of structural protection that protects the structure of the building and prevents the spread of fire and facilitate the evacuation process in case of fire. Millennium ICT Center is the largest electronic shopping center in Medan, Indonesia. As a public building that accommodates the crowd, this building needs a fire protection system by the standards. Therefore, the purpose of this study is to evaluate passive fire protection system of Millennium ICT Center building. The study was conducted to describe the facts of the building as well as direct observation to the research location. The collected data is then processed using the AHP (Analytical Hierarchy Process) method in its weighting process to obtain the reliability value of passive fire protection fire system. The results showed that there are some components of passive fire protection system in the building, but some are still unqualified.

1. Introduction
Based on data from DIBI BNFB, within 100 years (1915-2015), the fire disaster was ranked fourth as the most frequent disaster in Indonesia. Fire can cause property loss, destruction of building structures, even death [1]. The design of a good protection system is needed so that the building has a preparedness in the face of fire and minimize losses caused by fire, especially in public facilities buildings and accommodate the crowd.

Passive fire protection system is a system that can be applied to cope with fire in buildings. Passive fire protection system refers more to the design of the building, both in terms of architecture and structure, and also to be able to inhibit the propagation of fire and accelerate the evacuation process to save lives [2]. Besides being more economical, passive fire protection system is the best fire protection system for buildings.

This research was conducted to evaluate passive fire protection system of building in Millennium ICT Center building. Millennium ICT Center is the largest and most complete electronic shopping center in Medan. With an age of 18 years since its establishment in 1999, the Millennium ICT Center is a building that has a high risk of fire hazard. As a public building that accommodates the crowd, a good and standard passive fire protection system is needed for this building.
2. Method
The type of this research is qualitative descriptive research. Descriptive research is a research that describes the facts about an object, in this case, the Millennium ICT Center. The results were then compared with the theoretical standards that have been studied. Qualitative research is done by direct observation to the location and interviewing related parties.

2.1. Variable
The limitation of research variables used in research to evaluate passive fire protection system of Millennium ICT Center building is as follows.

- Fire Resistant Construction
- Emergency Stairs
- Corridor
- Site
- Signboard
- Emergency Door
- Emergency Lighting

2.2. Data Analysis Method
The process of the data analysis starts from the study of data that has been obtained through observation, interview, and documentation. The collected data is then assessed and adapted to existing theoretical standards.

The calculation of the component weights of each element is performed using the AHP method and assisted by Expert Choice software. The AHP method is a method for solving a complex and unstructured situation into several components in a hierarchical order by giving subjective values about the relative importance of each variable and determining which variable has the highest priority to influence the outcome of the situation.

The AHP model uses the human perception that is considered 'expert' as its main input. The expert criterion here does not mean that the person must be a genius, smart, hold doctoral and so on but rather refers to the person who understands the problem properly, feels the result of a problem or has an interest in the problem. Measurement of qualitative matters is important given the increasing complexity of the problems around us with higher levels of uncertainty. Also, AHP also tests the consistency of assessment.

The structure of an AHP model is a model of an upside down tree. The single purpose at the top of the tree represents the problem of decision making. Just below the goal is a leaf point indicating the criteria, both qualitative and quantitative. The weight of the objective should be divided between points based on rating criteria [3].
Each criteria of passive fire protection system must be assessed for its reliability against fire hazard. The value of each criteria of passive fire protection system is divided into 4 levels:

- 1 = If there is none of the components of passive fire protection system in the building
- 2 = If there are some passive fire protection system components but they are not standarized
- 3 = If there are some passive fire protection system components and some are already standarized
- 4 = If all passive fire protection system components are standarized

The reliability of the total value of passive fire protection system components is divided into 5 levels:

**Figure 1.** Thinking Maps
Table 1. Total value levels

| Value       | Description     |
|-------------|-----------------|
| 1 – 1.5     | Very Poor       |
| 1.6 – 2     | Poor            |
| 2.1 – 2.5   | Fair            |
| 2.5 – 3     | Good            |
| 3.1 – 3.5   | Very Good       |
| 3.6 – 4     | Excellent       |

3. Results and Discussion

3.1. Research location
The study was conducted at the Millennium ICT Center located at Jalan Kapten Muslim No. 111, Dwi Kora, Medan Helvetia with the main building area 28.212 m² and consists of 6 floors. The main function of this building is as the biggest electronic mall in Medan, Indonesia.

Figure 2. Millennium ICT Center
(Source: http://www.medanwisata.com)

3.2. Calculations
The following is the calculation of the reliability level of passive fire protection system of Millennium ICT Center building.

Table 2. Calculations

| No. | Criteria                               | Value | Weight | Sum  |
|-----|----------------------------------------|-------|--------|------|
| I   | Fire Resistant Construction            |       |        |      |
|     | Made of fire resistant material.       | 4     | 0.210  | 0.84 |
|     | Has an element of forming structures that are able to withstand structural load structures. | 4 | 0.116 | 0.464 |
|     | Has a compartment to prevent the spread of fire to and from adjacent rooms. | 1 | 0.064 | 0.064 |
| II  | Emergency Stairs                       |       |        |      |
|     | Each state-level building of more than 3 floors must have an emergency stair / rescue min. 2 pieces with max distance. 30m (when using sprinkler distance of max. 45m). | 2 | 0.110 | 0.22 |
|     | Made of smoke-resistant material.      | 1     | 0.069  | 0.069 |
|     | Width min. 1.2m                        | 3     | 0.042  | 0.126 |
|     | The emergency stairs should not be a vertical circular stairs and exit on the ground floor is directly to the outside. | 3 | 0.026 | 0.078 |
| Section   | Description                                                                                      | Code | 1  | 2  |
|-----------|-------------------------------------------------------------------------------------------------|------|----|----|
| III       | Emergency stairs should be fire resistant min. 2 hours.                                        |      | 1  | 0.016 |
|           |                                                                                                 |      | 2  | 0.016 |
| Corridor  | Width min. 1.8m and height min. 2.3m                                                            |      | 4  | 0.062 |
|           | Corridors should be free of items that may interfere with the evacuation.                       |      | 3  | 0.037 |
|           |                                                                                                 |      | 1  | 0.111 |
|           | The distance of each point in the corridor to the emergency exit or the nearest exit direction shall not exceed 25m. |      | 4  | 0.021 |
|           |                                                                                                 |      | 1  | 0.084 |
|           | The corridor should be equipped with signs indicating the direction to the emergency exit / exit direction. |      | 3  | 0.013 |
|           |                                                                                                 |      | 1  | 0.039 |
| IV        | Site                                                                                           |      | 4  | 0.038 |
|           | Site access using pavement                                                                      |      | 2  | 0.019 |
|           |                                                                                                 |      | 1  | 0.038 |
|           | The width of the pavement min. 6m for fire truck and 4m for cars.                               |      | 3  | 0.011 |
|           |                                                                                                 |      | 1  | 0.033 |
|           | The outer radius of the turn-out cannot be more than 10.5m.                                     |      | 3  | 0.010 |
|           |                                                                                                 |      | 1  | 0.03 |
|           | Pavement should always be barrier-free from other parts of the building, trees, plants or other things, and should not block the path of site access. |      | 3  | 0.010 |
|           |                                                                                                 |      | 1  | 0.03 |
| Signboard | Placed in an easy-to-read location from all directions.                                         |      | 3  | 0.025 |
|           |                                                                                                 |      | 1  | 0.075 |
|           | Should be inscribed with the word "exit" or another word which means the same.                  |      | 4  | 0.014 |
|           |                                                                                                 |      | 1  | 0.056 |
|           | Must be equipped with normal lighting with a reading distance of 30m.                           |      | 1  | 0.008 |
|           |                                                                                                 |      | 1  | 0.008 |
| VI        | Emergency Door                                                                                  |      | 3  | 0.019 |
|           | Each state-level building of more than 3 floors must be equipped with an emergency exit min. 2 pieces. |      | 3  | 0.057 |
|           | Opening towards the stairwell except on the ground floor opening outwards.                      |      | 2  | 0.013 |
|           |                                                                                                 |      | 1  | 0.026 |
|           | Must be fire resistant min. 2 hours.                                                            |      | 3  | 0.009 |
|           |                                                                                                 |      | 1  | 0.027 |
|           | Should be equipped with a warning sign.                                                         |      | 4  | 0.006 |
|           |                                                                                                 |      | 1  | 0.024 |
|           | Should be painted in red.                                                                      |      | 4  | 0.004 |
|           |                                                                                                 |      | 1  | 0.016 |
|           | Width min. 100cm.                                                                              |      | 3  | 0.003 |
|           |                                                                                                 |      | 1  | 0.009 |
|           | Must be equipped with fireproof glass with max area. 1m² and placed in the upper half of the door leaf. |      | 3  | 0.002 |
|           |                                                                                                 |      | 1  | 0.006 |
|           | Should be equipped with an automatic closing device.                                            |      | 3  | 0.001 |
|           |                                                                                                 |      | 1  | 0.003 |
| VII       | Emergency Lighting                                                                              |      | 1  | 0.018 |
|           | Comes from an emergency power supply.                                                           |      | 1  | 0.018 |
|           | Installed on fire escape, corridor, alley way to safe place and public road.                    |      | 1  | 0.010 |
|           |                                                                                                 |      | 1  | 0.010 |
|           | The light is yellow and not dazzling.                                                            |      | 1  | 0.005 |
|           |                                                                                                 |      | 1  | 0.005 |
|           | **Total**                                                                                       |      |    | 2.952 |
4. Conclusions

The result of the evaluation of passive fire protection system of Millennium ICT Center is 2.952 from total value 4. This is categorized as averagely good, which means, there are some components of passive fire protection system in the building but some are not yet standardized.

In terms of building construction, the material of the structure are all fireproof but there is no compartment inside the building. The building is already equipped with emergency stairs but they are not fire and smoke resistant. The width of the pavement is too narrow for fire truck access. Signboards on the building has not been equipped with lighting and are mostly blocked by electronic retail pamphlets. Emergency doors do not work as how they should be and the size is not up to standard. There is no emergency lighting in the building. In case of fire, the users of the building will find it difficult to find a way out because there is no emergency lighting that lead the users to the way out or safer places.

From these results, it appears that the management parties of the building didn’t pay much attention to the passive fire protection system of the building. This is certainly not something to be ignored as the fact that the function of the building that accommodates the crowd and that fire can lead to loss of properties and death. Awareness of fire hazards and a better system of passive fire protection that can cope with fire are much needed.

References
[1] Ramli S 2010 Pedoman Praktis Manajemen Risiko Bencana (Disaster Management)
[2] Vinky 2003 Kajian Sistem Proteksi Pasif Desain Site Planning pada Beberapa Kasus Rumah Susun di Jakarta dan Bandung
[3] Amborowati Armadya 2008 Sistem Penunjang Keputusan Pemilihan Perumahan Dengan Metode AHP Menggunakan Expert Choice