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Evaluation of Building Safety System Aspect Based on Risk (Case Study Building Heritage in Jakarta)

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ABSTRACT

Modern and cultural heritage buildings' safety is mandatory. The damage they suffered, especially the heritage buildings, requires the owners and managers to further improve the supervision of the safety aspects. This study aims to identify, assess, and respond to the safety risk of the heritage buildings. This research was conducted in Jakarta utilizing interviews and questionnaires to identify the risks. Experts and other respondents were deliberately chosen were chosen according to their experience. The risks were analyzed by the probability and weight matrices. This study reveals three high risks and provides the solution to reduce the risk. In addition to academic benefits, the findings are beneficial for the owners and suggest the government carry out risk management.

Keywords: Building Safety, Heritage Building, Probability and Weight Matrix, Risk, Risk Assessment

INTRODUCTION

The Government Regulation no 36 of 2005 gives worthy four performances for building functions, namely safety, comfort, health, and convenience. Safety connotes that the building could survive disasters such as fire, and earthquakes. Comfort indicates that the building provides comfort such as enough space. Health refers to the facilities the buildings have to support the user's health. Convenience suggests the ease of access between rooms.

The buildings must meet technical requirements, including reliability (safety, health, comfort, and convenience). In Indonesia, heritage building regulations refer to Law No. 11 of 2010 and the Minister of Public Works and Housing of the Republic of Indonesia Regulation number 01/PRT/M/2015 concerning preserved cultural heritage buildings. Each building must follow the conditions set by the government.

Differences in the condition of cultural heritage buildings compared to modern buildings require special handling since their material and historical value demands specific handling (Baharuddin, Bahrdin, Rashid, & Hashim, 2014). The Building operations must consider the safety of its occupants, even if the buildings are hundreds of years old (Druķis, Gaile, & Pakrastiņš, 2017). The buildings which are more than 100 years old require more attention, especially in the safety system.

This study is a case study of heritage buildings in Jakarta, built in 1905, in the Dutch colonial era. At present, the buildings are used as a company office. The substantial damages to the buildings are bumpy floors, leaky roofs, and stuffy rooms provoking accidents and threatening the resident's health. On this basis, it is necessary to identify the safety risk (Suwandari, Amin, & Primatama, 2020).

On January 16, a fire incident broke out in the Maritime Museum, which is categorized as a cultural heritage building. It burnt a large area of storage for historical objects and Building C with various museum collections. This is a warning for all concerned since cultural heritage has an invaluable value (Andayani & Subangi, 2020). This presents challenges for the local government of DKI Jakarta for underdeveloped superior products, decreased quality and quantity of buildings in the *Kota Tua* (Old Batavia) area, and inadequate quality human resources, infrastructure, promotion, quality and community participation (Sugihartoyo & Widagdo, 2010). This recent research paper aims to identify, assess, and respond to the safety risk of the heritage buildings.

Disrepair buildings harm the occupants as accidents are easy to occur (Akasah, 2010; Peters & Pikkemaat, 2008). Thus, the building owners must ensure they are safe, well maintained, regularly safety-evaluated, and well improved consistent with the technical survey (Akasah, Abdul, & Zuraidi, 2011; Idrus, Khamidi, & Sodangi, 2010). Based on Law No. 28 of 2002, buildings must be appropriate to use. They must meet the administrative and technical requirements. In addition, they must be reliable, as regulated in Law No. 28 of 2005 concerning buildings stating that building reliability is a condition that meets the safety, health, comfort, and convenience of the occupants.

When inspecting the safety and access of the buildings, the buildings are tested with their potential threats to the user’s health and safety. The tests include the strength of carrying capacity of the structural load to resist in case of fire (Roslan & Said, 2017), the availability of fire extinguishers, access to self-rescue, climate risk, and financial risk. Fire disaster is still the problem in Indonesia. Fire risk factors must be identified to avoid the impact of fire (Amin, Alisjahbana, & Simanjuntak, 2018).

The importance of knowledge and information about fire hazard mitigation need to be conveyed to people who live in densely populated areas where fire risk is high. Since most regions do not have laws and regulations about fire, no specific rules that can be regulated regarding fire risk (Handayani, 2019).

A good strategy provides goals set according to the plans. It is a process that connects the organization with management and external relations with suppliers, customers, and competitors, who take certain responsibilities from the economic and social environment in which the company is located (Wardani, Thanaya, Astana, & Yana, 2019).

RESEARCH METHOD

This study used a qualitative method. Interviews and questionnaires were used to obtain the data. To identify the safety risks, we used a literature review. The questionnaire method was used for determining the high risks. A total of 18 respondents were chosen based on their work experience in handling the heritage building maintenance process. Probability and impact factor analysis was used to analyze the data with the highest risk factor. Subsequently, after determining the highest risks, we conducted interviews with

experts about how to mitigate the risks. The interview results were used to define the most effective mitigation strategies. Figure 1 below illustrates the stages.

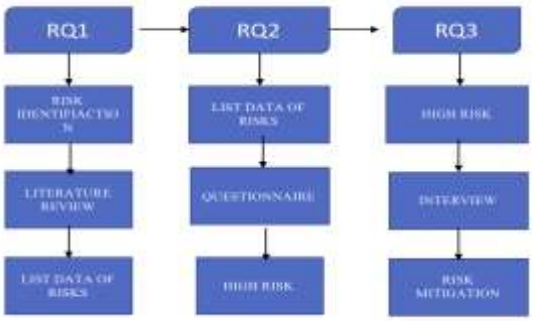

Figure 1. The Research Flow Diagram

RESULTS AND DISCUSSION

Based on the literature reviews and the expert's validation, we identified 19 risks, as presented in Table 1, chosen to be processed in the next step. The results were then sent to three experts by the open questionnaire. One variable was rejected. Furthermore, the questionnaire with 18 risk variables could be delivered to the respondent. Figure 2 shows the respondent demographics.

Table 1. Safety Risks

No	Var	Cultural Heritage Building Safety Risks
1	X1	The building has decreased beyond the threshold
2	X2	The collapse of part of or the whole building
3	X3	Damages in joints, installation parts due to deformation
4	X4	There is no evacuation access in case the building collapses
5	X5	The unavailability of passive fire protection such as fireproof floor/door/ wall coating
6	X6	There is no active fire protection such as fire detectors, hydrants/fire extinguishers
7	X7	No water source available in case of fire
8	X8	Narrow neighborhood roads deterring fire extinguishing equipment when a fire breaks out
9	X9	The overlapping distance between the buildings
10	X10	Inadequate egress construction materials such as flammability or damage
11	X11	No ventilation for air circulation
12	X12	There is a smell from the walls that endangers the occupants
13	X13	The occurrence of damage due to lightning strikes
14	X14	There was a short circuit
15	X15	Electrical installation does not meet the specified rules

16	X16	Chipped power cord
17	X17	The evacuation route is slippery/wet/mossy
18	X18	Workers do not understand occupational safety and health

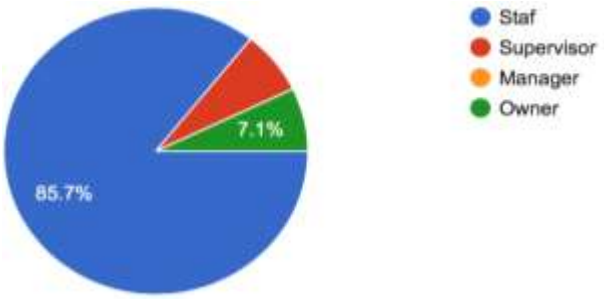

Figure 2. Respondent's Demographics

The 18 risks above were analyzed and grouped according to the assessment results (see Table 2). Table 2 indicates that there were three highest risks among the 18 risks. The identified high risks (X4, X5, and X6) could lead to fire and collapses, and harm the occupants.

Table 2. The list of Safety Risks

No	Var	Cultural Heritage Building safety risk events	fxr	Risk Level
1	X1	The building has decreased beyond the threshold	0,086	Medium
2	X2	The collapse of part of or the whole building	0,115	Medium
3	X3	Damages in joints, installation parts due to deformation	0,099	Medium
4	X4	There is no evacuation access in case the building collapses	0,191	High
5	X5	The unavailability of passive fire protection such as fireproof floor/door/ wall coating	0,211	High
6	X6	There is no active fire protection such as fire detectors, hydrants/fire extinguishers	0,22	High
7	X7	No water source available in case of fire	0,09	Medium
8	X8	Narrow neighborhood roads deterring fire extinguishing equipment when a fire breaks out	0,141	Medium
9	X9	The overlapping distance between the buildings	0,13	Medium

10	X10	Inadequate egress construction materials such as flammability or damage	0,123	Medium
11	X11	No ventilation for air circulation	0,052	Low
12	X12	There is a smell from the walls that endangers the occupants	0,06	Low
13	X13	The occurrence of damage due to lightning strikes	0,057	Low
14	X14	There was a short circuit	0,099	Medium
15	X15	Electrical installation does not meet the specified rules	0,127	Medium
16	X16	Chipped power cord	0,138	Medium
17	X17	The evacuation route is slippery/wet/mossy	0,106	Medium
18	X18	Workers do not understand occupational safety and health	0,127	Medium

As for the risk response, PMBOK (2013) suggests *avoid* for the high risks, and *transfer* and *accept* for the medium and low risks (see Figure 3).

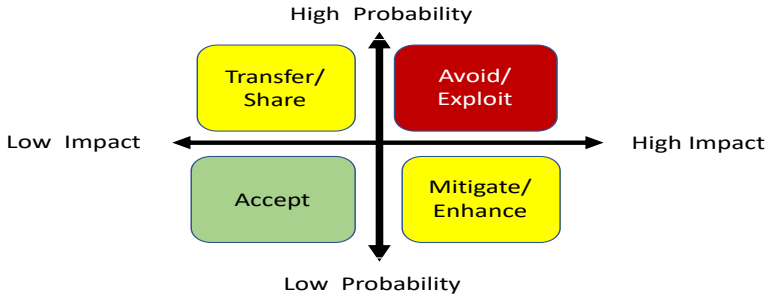

Figure 3. Risk Responses

To reduce the risks, the experts suggest providing regular training on firefighting and occupational safety and health for the building owners. Also, the building safety system requires regular examination. The government must legally enforce sanctions for those who do not apply the assembly point rules. The findings are in accordant with Roslan & Said (2017).

CONCLUSIONS

The eighteen safety risks can affect the process of maintaining cultural heritage buildings. However, the three highest risks, active and passive protection unavailability, and the absence of evacuation easy access, demand mitigation to control these risks. The mitigations are preventive measures, such as providing periodic training on firefighting, and corrective measures, such as restoration.

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