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COST OF ELEMENT FOR FIRE PROTECTION SYSTEM IN SCHOOL BUILDINGS

Siti Nadhirah Binti Rosli [1] and Dr. Norfashiha Binti Hashim [2]
Department of Quantity Surveying, Faculty of Architecture, Planning and Surveying, Universiti Teknologi Mara Shah Alam
Email: sitinadhirahrosli@gmail.com[1] , norfashihahashim@gmail.com[2]

Abstract:
Construction industry is considered as one of the most important industries in Malaysia. It is well known that cost overrun is a typical problem that occurs in construction industries. Therefore, this phenomenon may affect the progress of construction industry as well as may reveal many institutions of construction to be destroyed. This study focuses to analyse the cost of each element of fire protection system . The objectives of this research are to extract the element of active fire protection system, to investigate the cost of element of active fire protection system and to determine the factor that influences the cost of element of active fire protection system . The scope of this research focuses on the active fire protection system in school building at SMK Orkid Desa, Smk Seri Sentosa and SMK Petaling, Kuala Lumpur. All the data utilized in this research are gathered from contract documents, previous researches, published articles and supported by an interview session among contractors of school building. Results of the analysis indicate that not all of the elements are installed in the school building. Besides, the costs of element in each case study and factor that influences the cost are different from one to another.

Keywords: Active Fire Protection System; Cost Of Element

1.0 INTRODUCTION

There are many reasons for school buildings to be on fire such as lack of appropriate fire protection system, lack of adequate resources and lack of systematic disaster mitigation. Moreover, most of the general requirements for fire disaster preparedness are not in place. Besides, most of the staffs and even teachers were not trained to practice fire drills. In fact, the schools did not have safety committees. New Straits Times, April, 2017 "Fire safety: Parents must stress on safety at home, says Fire and Rescue Department" .According to the statistics provided by the Fire and Rescue Department, tragic incidents occurr during a fire may be due to the lack of basic fire safety equipment at home, and the use of grilles on windows and doors that hinder the movements to save life. Most families also do not have an escape or rescue plan. Buildings that were built 30 years ago were made up of an inadequate fire protection systems where the systems applicable were only manual fire alarm systems (Hassanain, 2009). Inadequate fire protection systems is a clear evidence of violation of building regulations and by laws such as no sprinkler system in any of the fire exposed buildings. In some instances, the arrangements and the installation of fire protection system are not maintained and are only displayed on the walls. There is no payment made in order to improve the poor state of existing electrical wiring and installations even the entrance of fire protection inside the building at the passage ways are blocked.

After several fire tragedies in the past few years, the major concerns of the government is fire safety. New Straits Times, January, 2018 "Re-wiring at 433 private tahfiz schools done, 236 more to go. Giat Mara mentioned that around RM50 million was allocated by the authorized organisation in order to install the electrical system in the school. Besides, New Straits Times, October, 2017 "RM30 million allocation to upgrade tahfiz schools to be fully utilised, assures DPM" indicated that Deputy Prime Minister Datuk Seri Dr Ahmad Zahid Hamidi allocated RM30 million to upgrade the school building for the fire protection purpose. Hence the aim of this paper is to analyse the cost of each element of fire protection system in school building. The objectives of this study are, i) To study the element of active

fire protection system in school building, ii) To investigate the cost of each element of fire protection system in school building, and iii) To determine the factors that influence the cost of element of active fire protection system in school building.

2.0 LITERATURE REVIEW

As stated by Hassanain (2006), school is a type of building where a huge number of students are accommodated in a building for the purpose of learning and it requires to install the fire protection system to ensure the safety of the occupants. Most of the school occupants are inclusive of children and youths. These groups of people are easily panic and have difficulties to manage the situation of emergencies or fire crises. When a fire occurs in this type of building, it will lead to huge damages such as loss of lives, properties and the operation of the school itself. These occur because of an inappropriate installation of fire protection system in a building and ineffective use by the occupants. Tabancali and Bektas (2009) have explained that the school is a place where most of the students spend one third of their daily life with their teachers and friends. Schools have their own responsibility to give a good education to their students as well a good environment. This is because students should feel safe whenever they are in their school so that the good environment of learning can occur.

2.1 Fire Protection Tools provision in the UBBL Malaysia

2.1.1 Active System

Active fire protection systems is defined as devices that can receive to manage in a real or perceived fire condition. These types of fire protection systems include automatic detection and alarm systems, automatic sprinkler systems and automatic suppression systems (Hassanain, 2009). Furthermore, active systems are components of fire protection which is installed to function in a mechanical way during emergency situation. For example, a sprinkler system in a building will operate to discharge water to control and extinguish fire when it occurs (Justina et al., 2014). By installing a water sprinkler or inert gas flooding it may detect or extinguish a fire.

Active fire protection system will also detect heat or combustion products of a fire in its early stages and then raise the alarm with an automatic fire detection installation. In order to allow the fire brigade to be summoned without any delay, all the required systems should be observed when the building is not occupied, thus it will help to reduce the damage (Furness & Muckett, 2007). Active fire safety systems such as automatic sprinkler systems, smoke detection systems and smoke control systems are important in order to achieve the highest fire safety level in a building (Athapaththu et al., 2013).

2.1.2 Passive system

Passive fire protection systems are a component which is fixed in a building that whether or not a fire crisis exists (Fitzgerald, 2004, as cited in Hassanain, 2009). It refers to devices, features and characteristics which are a part of a process or structure then installed to prevent fire ignition, limit fire development and growth, prevent the fire from spread into building (Justina et al., 2014). Passive fire protection is a compartment of the building which is constructed so that in the event of fire, it will be restricted to one area (Furness & Muckett, 2007).

According to Aker (2008), when the fire protection systems are properly installed in the building whereby the penetration is properly sealed and protected with a suitable fire stop system, the fire barrier will function more effectively. Thus, it can save lives of the occupants, assets and the building itself. When a building is on fire, smoke can easily get in a chase wall then go upward to spread throughout the building. Besides, the passive fire protection can be invisible which actually consists a fire at its point of origin. There are elements of passive fire protection systems which are structural fire protection, compartmentation, fire stopping materials, opening protection and escape routes.

2.2 Factors Affecting Cost

2.2.1 Location

Cunningham (2013) stated that one of the factors that influence the cost of element to be different among other projects is its location. All the construction activities are controlled by the local development plans. Besides, building at urban locations are more expensive than rural locations. This is due to the material storage, higher local wages and the additional security measures.

Klerk (2011) analysed that location factor is one of the way to point out the effect on the construction cost. It is vital for inland locations and other locations that are far from a significant skill base. This is because there might be an issue regarding the supply and transporting of element to the site location.

2.2.2 Resource Availability

According to Cunningham (2013), as a contractor, it is important to compete with other subcontractors of large proportion of the work. The contractor has to ensure the cost of transportation that does not require to carry out the work do not exist. Thus, the contractor needs to consider the management of resources used whether it can be obtained within the contractors or it needs engagement with the specific subcontractor to carry out the specialist works. In addition, the contractor is also required to consider the demand resources on the project itself. The high quality materials tend to be more expensive than the low quality ones. Thus, the cost of the construction is higher. However, it is depending on the willingness of the client to pay based on their specified materials.

Al-Hazim et. al (2017) mentioned that the factors affecting budget of the construction projects are instability of the materials' price. Almost 76% of construction projects are suffering from cost diverge in which the average difference between estimated cost and actual cost is about 15%. In a construction industry, it is very difficult in order to obtain an adequate and regular supply of resources. There are many situations where late or wrong types of materials delivered to the site thus affecting other resources such as labour and machinery. This leads to cost overrun (Abdul Rahman et al., 2013).

2.3.3 Labour Costs

Cost of project might differ to one another due to some reasons such as cost of labour. Every contractor has his own rate to price his labour. It might be cheaper or expensive depending on their skills such as having a good training and competent organisation and supervision. Thus, the quality of the work produced increase as well as their wages (Cunningham, 2013).The most significant resources in a project are labour or human source. Successful project can be achieved with a good availability of labour either skilled or unskilled. Furthermore, an effective management plays important roles that can decrease the cost of labour and thereby increase profits for the company. Besides, improvement in productivity of labour is in critical need for reducing labour costs (Abdul Rahman et al., 2013).

2.2.4 Specialist Work

Nominated subcontractor is the person who is responsible for the specialist works. He is employed by the main contractor but selected by the employer or architect. During the process of nomination, the architect has a power to nominate any subcontractor to carry out specialist work in order to supply all the materials to the main contractor. Subcontractors are chosen based on their quality of work to complete the assigned work (Cunningham, 2017).

2.2.5 Function of the building.

The number of the mechanical and electrical elements in a project are depending on its complexity of the building itself. Thus, the more complex the building, the more value of mechanical and electrical input installed (Cunningham, 2017).

2.2.6 Project team knowledge

Furthermore, the cost of element for each project are different from others due to the incomplete designs, lack of technical knowledge among quantity surveyors and limited exposure by the contractor towards measuring bills of quantities. This occur because of insufficient experience by the quantity surveyors, lack of knowledge in controlling cost of the specialist works and lack of expertise (Cunningham, 2017).

2.2.7 Size

Unit costs of building decrease when the size of the building increase. This is due to a greater in ratio of perimeter, better usage of high cost service elements like elevators and greater quantities of purchasing power (Demkin, 2008).

2.2.8 Quantity

The cost of element in the building including the project cost will totally change due to the changes of quantities (Frigenti and Comninos, 2002).

2.2.9 Machineries and tools

Another factor that might diverge the cost of the element of construction project as well as the delay of the project is poor efficiency of machineries and tools (Al-Hazim et. al., 2017). According to Abdul Rahman et al. (2013) the choice of machineries are also vital in a project. However, the number and types of the machineries are depending on the nature of the project which affects directly on construction cost.

3.0 METHODOLOGY

Research methodology is a way to methodically resolve the research problem. It is an important procedure done by the researcher in studying his research objectives. All information of the research is obtained along the procedure and use a specific method and specific technique. Researchers additionally require to understand that each of the hidden techniques applied would give a different outcomes depending on the basis of the criteria and the adequacy of the techniques itself. Interview is used as the method, involving participants from at SMK Orkid Desa, SMK Seri Sentosa ***and*** SMK Petaling.

4.0 ANALYSIS AND FINDINGS

This section will discuss the results and findings obtained from the interview sessions and contract documents. The data was analysed via tables and explanation in order to give a better understanding on the result. All active fire protection system used in the case studies as listed in the Bills of Quantities are summarised in the table 4.1 in order to achieve the first objective of the research which is to study the element of active fire protection system in school building. Table 4.2 represents the cost of each element of fire protection system in school building (objective 2) whereas, the factors affecting cost of element of fire protection system in school building (objective 3) are explained in table 4.3.

4.1 Analysis On the element of active fire protection systems

Based on Table 1, there are many elements of active fire protection system installed in the building which are dry riser, fire extinguisher, hose reel system, wet riser, fire detection and alarm system and manual call point. However, not all of them are installed in the school building comply with the provision of the UBBL Malaysia such as automatic sprinkler system and fire hydrant. They are not installed in the building because each element of active fire protection system has its own characteristic and suitability.

Table 1: Active fire protection used in case studies

Components	Case Study 1	Case Study 2	Case Study 3
Automatic sprinkler system	X	X	X
Dry risers	√	√	X
Fire Extinguishers	√	√	√
Fire hydrant	X	X	X
Hose reel system	√	√	√
Wet risers	X	X	√
Smoke detector	√	√	√
Heat detector	√	√	√
Manual call point	√	√	√

Indicator: √ Yes **X** No

4.2 Analysis on the cost of each element of fire protection system

Table 2: The cost of each element of fire protection system

Components	Case Study 1	Case Study 2	Case Study 3
Automatic sprinkler system	X	X	X
Dry risers	55,110.00	24,266.00	X
Fire Extinguishers	5,060.00	374.00	20,200.00
Fire hydrant	X	X	X
Hose reel system	63,030.00	63,679.00	61,123.00
Wet risers	X	X	106,809.00
Smoke detector	Price includes all wiring to main fire alarm panel 37,620.00	231.00	204.00
Heat detector		77.00	60.00
Manual call point		55.00	60.00

All costs of element of active fire protection are explained in the table. All of the data gained are obtained from the contract documents. Based on the table, there is not any installation of automatic sprinkler system in all case studies. Thus, no cost is allocated in the contract documents. For dry risers element, the cost of element in the case study 1 is higher compared to the cost in the case study 2 whereas there is no installation of the element in the case study 3. Besides, fire extinguishers cost in the case study 1 is higher among the rest. In addition, all case studies do not allocate fire hydrant cost in the contract document. Thus, there is no cost for its installation. The cost of element of hose reel system in the case study 2 is higher whereas in the case study 3 is the lowest . Basically, there is no major difference in the cost of all case study. Furthermore, wet riser element is only installed in the case study 3. However, there is not any specific cost allocated in the case study 1 for Smoke detector, Heat detector and Manual call point. The cost allocated in the contract document includes all wiring to main fire alarm panel. Besides, the cost of element for smoke detector and heat detector in the case study 3 are lower while the cost for manual call point is higher.

4.3 Analysis of Factors Affecting Cost of Element of Fire Protection System

For case study 1, factors that influence the cost of element are due to the location, resource availability, cost of labour, specialist work, size of the building, quantity and machineries and tools. For case study 2, location, resource availability, cost of labour, specialist work, size of the building and quantity are the factors that influence the cost of element. Meanwhile, in the case study 3, functions of the building and

machineries and tools are not affecting the cost of element of active fire protection system in school building.

Table 3: Factors affecting cost of element of fire protection system in school building

Based on Literature	Case Study 1	Case Study 2	Case Study 3
Location	√	√	√
Resource Availability	√	√	√
Labour Costs	√	√	√
Specialist Work	√	√	√
Function of the building	X	X	X
Project team knowledge	X	X	√
Size	√	√	√
Quantity	√	√	√
Machineries and tools	√	X	X

From the results, it is shown that all of the cost of each case studies differ from one to another. This is due to the location of the case studies, resource availability, cost of labour, specialist work, knowledge of project team, size of the building, quantity and machineries and tools.

5.0 CONCLUSION

Fire protection system is one of the important elements to be provided in a building. This study was conducted to analyse the cost of each element of fire protection system in school building. There are many elements of active fire protection system installed in the building. However, not all of them comply with the provision of the UBBL Malaysia. Besides, it shows that all of the costs of element in each case study are differ to another. This is due to the location of the case studies, resource availability, cost of labour, specialist work, knowledge of project team, size of the building, quantity and machineries and tools.

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