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# SUITABILITY OF BUILDING ENVELOPE FOR FIRE PREVENTION

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## ***Abstract:***

Nowadays, building envelope is widely used in Malaysia. The use of this finishes increases the aesthetic value of building exterior. There are three types of building envelope such as cladding, infill panel and curtain wall. It also comes in various type of materials and installation. However, the insulation of building envelope can contribute to fire incidents. Therefore, a study will be conducted on the building envelope with three objectives: to understand the behaviour of building envelope, to analyse fire occurrence in building with building envelope, and to propose fire prevention methods for building envelope. The case study will be conducted to gather information by using desk study. It is expected that the flammable material is the major factor for the cause of fire. This paper will provide conceptual framework to study the building envelope in relation to fire incidents. In conclusion, fire of buildings that are caused by the building envelope can be prevented by complying with the UBBL and Malaysian Standard.

**Keywords:** Building envelope; Fire; Cladding; Flammable material; Guideline.

## **1.0 INTRODUCTION**

Building envelope is one of the external finishes that has started to become popular in Malaysia. Mostly, people tend to make it as the alternative to increase the aesthetic value of the building itself compared to just painting the wall. Plus, building envelope has a variety of designs and materials that can be choose for the building. However, the rapid development of the finishes which exposes the consumer to the dangers of fires unconsciously.

There are some issues to this research. First, the building envelope is widely used in Malaysia especially in big cities that make it uncontrollable and this has led to improper supervision from the local authorities. Second, the level of awareness on the safety aspects in the building envelope is underestimated. Third, building envelope can still be categorized as the new finishes compared to the other modern countries that make it still has less information about it in all aspect. Fourth, the designers, manufacturers, developers and the owners did not follow the standard and guideline that have been set by the authority and they are also unaware of the suitable materials for our climate. Lastly, carelessness is one of the common human errors that can cause accidents which can be fatal to the consumers.

Therefore, there are three main objectives that can be met in order to solve the problems. First, to understand the behaviour of building envelope, to analyse fire occurrences in buildings with building envelope, and to propose fire prevention methods for building envelope. On the other hand, all the parties should play their role efficiently to make sure that the standard is complied. Besides that, local authorities should make regular inspections regularly to the buildings that apply this type of finishes. Penalty should be given to the developers and the designers who fail to follow rules that have been set. This will increase the awareness among themselves.

## **2.0 LITERATURE REVIEW**

### ***2.1 The concept of building envelope***



Building Envelope is defined as the primary boundary between indoors and outdoors. It includes the air barrier, thermal barrier and often the weather barrier (Builders, 2018). The concept of a building envelope relates to design and construction of the exterior of the house. A good building envelope involves using exterior wall materials and designs that are climate-appropriate, structurally sound and aesthetically pleasing. These three elements are the key factors in constructing building envelope (Builders, 2018).

### 2.2 Type of material for building envelope

Building envelope has various types of materials such as stone, timber, brick, tile, metal, vinyl, concrete and board, each of them has different characteristic (WFM, 2017).

### 2.3 Causes of fire in building envelope

The common failure of building envelope is design deficiencies. Architects occasionally specify materials or design systems that are inappropriate for their intended use. Common mistakes include oversight to specify materials that are incompatible which will cause inadequate performance criteria for thermal movement, structural capacity, or water penetration resistance. Second is material failure. It is also common for properly specified materials to meet the published performance levels. Next is poor workmanship. It is common to find building envelope components not installed per the manufacturing specifications. Lastly are acts of nature (Baker 2009).

## 3.0 METHODOLOGY

The method to conduct this research is through critical review by referring to previous research and cases that are related to relevant topics. There are 10 articles that have been used to collect the information and data. The topic about building envelope is quite familiar especially in 2018 when these finishes be the factor as fire occurrences in one of the buildings in Malaysia that make even more articles were published in the internet that can be used to further this research.

## 4.0 ANALYSIS AND FINDINGS

Figure 1 illustrates a conceptual framework for this research that consists of three sections. Every section has its own sub-topics that are explained below. This conceptual framework will help map out the idea of the research.

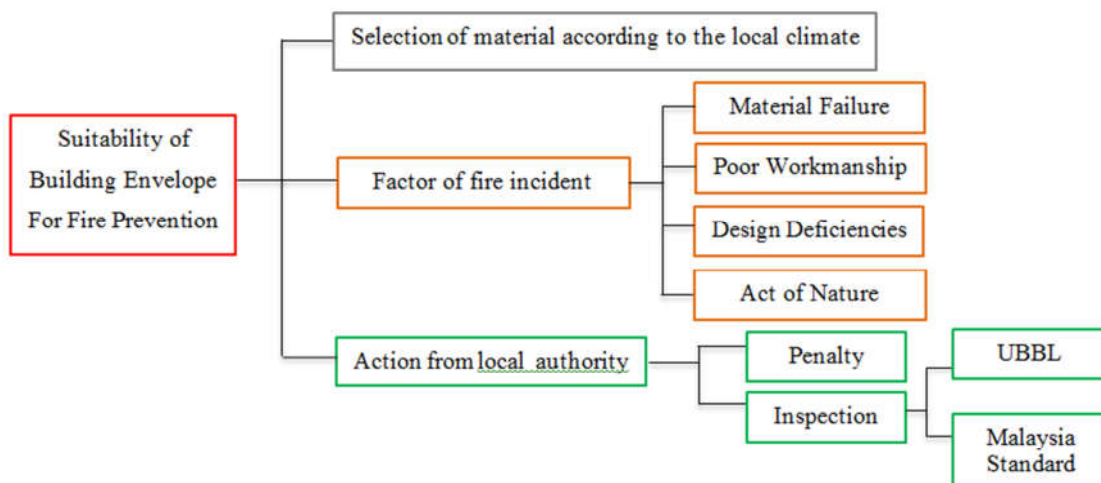


Figure 1 : Conceptual Framework

#### **4.1 Behaviour of building envelope according to climate.**

A well-designed of building envelope responds to the local climate. There are many classifications of climate such as Arid climate, Cold climate and Mixed Cold / Hot climate around the globe. The selection of building envelope is very important to suit the local climate to avoid the rapid spread of fire in the future. Arid climates are very dry, and usually hot, but they often have large swings of temperature from day to night. Thus, thermal mass on the outside of the building is the most crucial design strategy to even out such temperature swings. For consistently hot locations, it also helps to use light colours, and day lighting via reflected light (not direct sun) so that it will decrease the temperature of the building and eliminate the risk of fire incident, such as in the audience hall in the Jaipur city palace.

Next, Cold climates. It has many more heating degree days than cooling degree days. Thus maximizing insulation is the key to keeping warm, as well as using windows for solar gain on thermal mass inside the building envelope (not outside as in arid climates). Part of having effective insulation in cold climates is an air-tight envelope, avoiding infiltration. Before modern insulation, thick solid log walls will provide better insulation than board walls. Lastly is Mixed Cold / Hot Climate Envelope. Many “temperate” inland climates actually have two extremes--cold in winter, hot and humid in summer. Flexibility is the key to designing for these climates. It uses a light roof and darker walls to repel summer sun but absorb winter sun. Extra insulation retains heat in winter, but operable windows passively cool it in summer (Autodesk, 2017).

#### **4.2 Factors of fire incident in building envelope**

According to the research that has been done, the result shows that the factor of failure for building envelopes are design deficiencies, material failure, poor workmanship and act of nature. However, the major cause of this issue is material failure. It can be seen based on the tragedy of KWSP building that destroyed 40% of the building on Tuesday, 13 February 2018. It was the first case in Malaysia that is caused by building envelope. Besides that, there were some cases that were also related to building envelope in London and Dubai because of the flammable material.

For example, in London, the incident on 14 June 2017 to the Grenfell Tower that killed an estimated 79 people had made the authority to inspect other 600 high-rise buildings. The exterior cladding had contributed to the rapid fire, which consumed the 24-storey Grenfell Tower in West London in just one hour. Based on the test, the Department of Communities in London had mentioned that 34 apartment blocks had failed tests in 17 parts of the country, from London in the south-east to Manchester in the north, and Plymouth on the south-west coast. Combustible cladding used to insulate the tower and improve its appearance has been blamed for the rapid spread of the blaze. Further, a fire in 2015 at the Address Downtown Dubai, a hotel in United Arab Emirates had destroyed some parts of the hotel. That hotel also had flammable cladding on its exterior similar to the Grenfell Tower in London. The high number of the building envelop make it had less supervision from the authority.

#### **4.3 Fire prevention method for building envelope**

It involves all parties such as manufacturers, installers and also the local authorities. Inspections by local authorities should be carried on each building. Action should be taken for those who fail to follow the requirement as stated in the law such as Uniform Building by Law (UBBL) and Malaysia Standard.

### **5.0 CONCLUSION**

As a conclusion, safety is very important in every aspect especially when it comes to buildings. A small mistake can lead to a big accident that will involve a lot of lives. When it comes to finishes, the most important element is always the aesthetics aspect and not safety. That makes the safety to be in the second place. On the other hand, the lack of information regarding building envelope makes the consumers breach the rules when applying them to the buildings. By knowing the behaviour of

building envelope, it will help a lot in preventing the fire to the building. Besides that, all parties should be aware that the selection of building envelope should suit the climate of the country. People always underestimate the importance of safety. Therefore, local authorities should make a move to inspect all buildings. The best way to conduct the inspection is at the early stage of the construction, which is the planning stage. That is the time where the materials of the building are finalized. Prevention is better than cure. However, for those buildings that already exist, the inspection can be made as soon as possible to avoid unwanted incidents to happen in the future. For instance, the case in Kuala Lumpur, where the fire at the KWSP building had opened our eyes about the importance of safety. Besides that, manufacturers together with the installers also need to attend special training in order to have the best practices according to the guidelines from the UBBL and Malaysian Standard.

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