



**6th UNDERGRADUATE  
SEMINAR ON BUILT  
ENVIRONMENT  
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(USBET) 2023**

**SUSTAINABLE BUILT  
ENVIRONMENT**

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# e-Proceeding

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# IMPACTS OF CLIMATIC CHANGES ON BUILDING MAINTENANCE IN MOSQUE AT SERI ISKANDAR

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## ABSTRACT

*This study investigates the repercussions of climate change on building maintenance, focusing on two mosques in Bandar Baru Seri Iskandar, Perak, Malaysia. With weather reports indicating an annual temperature rise of approximately 0.24°C since 1961 and changes in rainfall patterns, extreme climate events such as heavy rains, storms, and heatwaves have become more frequent. These climate-induced phenomena have resulted in damages to building elements, particularly roofs and main structures, leading to consistent and repeated maintenance requirements. Roof leaks and mold/mildew growth were found to be the most common issues caused by extreme weather conditions. The study emphasizes the necessity of incorporating climate factors into building maintenance planning and advocating for dedicated financial allocations to address the increasing challenges posed by climate change. By proactively adapting maintenance practices, buildings can better withstand the impacts of climate change and safeguard infrastructure in the face of an evolving climate.*

**Keywords:** *climate change impact, building maintenance, mosques, adaption, energy consumption*

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## **INTRODUCTION**

Liau (2017) revealed that weather reports have revealed an increasing trend of warming in the country, an average of about 0.24°C every year starting from 1961 to 2017. This increase is in line with the global trend of increasing temperatures associated with climate change. In addition, Wahab (2019) reported that changes in rainfall patterns also occurred significantly. Wahab added that Malaysia has received extreme frequency of rain in Peninsular Malaysia. The discovery of evidence of the intensity of this phenomenon causes extreme weather events, frequent heavy rains, storms, and heat waves, major floods, and droughts across different regions of the country as well as extreme sea level rise (Yusop, 2017). This extreme phenomenon has had severe implications for the agricultural sector, infrastructure and human shelter buildings. Roaf et al., (2009) emphasized that effective adaptation and mitigation strategies must be implemented quickly given that the worst consequences can occur at any time. What's more, the construction industry holds the most important economic importance for a country, including Malaysia.

Buildings have been found to suffer physical damage and facilities due to storms, major floods, extreme droughts, and daily temperature increases. While changes in the behaviour of building elements as well as the degradation of the structure function also easily occur, such as the structure becoming fragile, rotting or losing its function. The bigger implication is the cost of building stock management, especially in terms of repair and maintenance activities. Increased wind, rain, hot temperatures and meteorological events such as landslides, fires and mud floods are expected to contribute to increased maintenance costs (Lis et al., 2003). Islam et al., (2015) stated that normally, the maintenance and operation of a building contribute up to 54% of the entire life cycle cost of a building. Nevertheless, the findings of previous studies have shown an increase in this cost up to around 75 - 80% (Madureira, 2017). This situation has started to be detected significantly in high-capacity buildings such as schools, government offices including houses of worship. For deeply investigating, this research chose the Seri Iskandar mosque as a case study location to identify the impact on building maintenance works due to climate change factors.

## **LITERATURE REVIEW**

Climate change is defined as a significant change in average weather conditions over several decades or longer, such as becoming warmer, wetter, or drier (Group, 2021). Climate change is distinguished from natural weather variability by the longer-term trend.

## **Summary of Climate change in Malaysia**

Climate change is defined as a significant change in average weather conditions over several decades or longer, such as becoming warmer, wetter, or drier (Group, 2021). Climate change is distinguished from natural weather variability by the longer-term trend.

Malaysia has a tropical and humid climate that is heavily influenced by its mountainous topography and land-sea interactions. While Malaysia has traditionally been considered relatively free from climate-related disasters, recent years have witnessed an increase in mild climate-related incidents. These include floods, droughts, landslides due to excessive rainfall, and strong winds in hilly and coastal areas, resulting in varying degrees of socio-economic impacts. Climate modelling using 14 Global Climate Models (GCMs) has forecasted temperature changes of 0.7 to 2.6 degrees Celsius and precipitation changes ranging from -30% to 30% for Malaysia (Department, n.d.).

The direct impact of climate change in Malaysia is evident in the degradation of natural resources, infrastructure, environment, and human health. Additionally, there are projected indirect damages that are expected to be equally significant (Al-Amin, 2014). The potential impacts of climate change in Malaysia encompass a wide range of effects, such as sea-level rise, reduced crop yields, increased diseases among forest species and biodiversity loss, shoreline erosion, intensified flooding, coral reef bleaching, higher disease incidences, tidal inundation of coastal areas, decreased water availability, loss of biodiversity, and increased frequency of droughts, among others (Haliza, 2009).

Meanwhile, building maintenance may be described as "the combination of all technical and assorted administrative actions carried out to retain an object so as or repair it to a stage wherein it may carry out its required function" (British Standard 3811-1974). It includes work undertaken to keep, restore, or improve every facility, physical, its services, and surroundings to a currently acceptable standard and to sustain the utility and value of the facility (Zeeshan, 2016). It strives to offer tenants safe, functional, and snug surrounding in any respect times (Eisner, 2022).

## **METHODOLOGY**

This study adopted quantitative research techniques for data collection and analysis. Firstly, the literature review on climate change in Malaysia is highlighted. Then, factors influencing building maintenance works will be identified and listed. The case study, namely the Masjid Bandar Universiti and Masjid As-Siddiq located at Bandar Baru Seri Iskandar, Perak. The selection of two mosques, (i) Masjid Bandar Universiti, and (ii) Masjid As-Siddiq as a case study because through a preliminary survey, it

was found that the buildings have an efficient and orderly data storage system. To identify climate change that occurs, this study will obtain detailed data from the Department of Meteorology Malaysia for the relevant years, and relevant to be associated with the pattern of damage/breakdown that occurred in the case study.

For fair results, all respondents from both mosques are selected from groups that are involved in mosque management and experienced in building maintenance. The analysis is also carried out to identify the type of building maintenance work that is consistently damaged and frequently repeated. To achieve the research objectives, due to limits and time constraints, some parameters, such as building age, location, size, and building geometry will be used as important criteria. Therefore, through Frequency Analysis, the data obtained from the questionnaire/google form will be analyzed using Excel.

## RESULT AND FINDINGS

A total of 13 responses were received, providing a response rate of 44.9%. (Tan et al., 2014) stated a response rate of 10% - 20% is acceptable in a research survey. Overall, the answers fulfilled the requirements for a valid response: all questions were fully answered and there were no vague answers (i.e., given the same score for each question). Table 1 presents a percentage of the respondent groups distribution.



**Figure 1: Percentage of The Respondent Groups in This Research**

In the four main questions related to building maintenance and climate, the findings are summarized in Table 2 to Table 5. Table 1 reveals that the building elements that are most vulnerable to the effects of climate change are the roof elements and the main structure of the building, which respectively recorded the highest score of 52% and 41%. Meanwhile, Table 2 displays Roof Leaks - 51%, the highest score followed by Mold/Mildew Growth - 30%, identifying the type of building elements that are damaged consistently and frequently due to climate. As for the issue of maintenance



work that is repeated consistently, roof leaks (50%) and structural damage (31%) are the focus as building elements that are always problematic due to weather changes in Bandar Baru Seri Iskandar. Regarding the issue of extreme climate always happening anyway, respondents gave the highest score to heavy rainfall - 48%; followed by the second highest extreme hot weather, 40%. The occurrence of storms is at 10% and the change in rainfall patterns is at 2%.

**Table 1: Analysis of Questionnaires**

<b>1 Building elements most vulnerable to the impact of climate change</b>		
	<b>Viewed/Observed Effects</b>	<b>Frequency (%)</b>
	Roof Leaks	62%
	Structural Damage	41%
	Leaking Ceiling	2%
	Wall Cracks	1%
	Mold/Mildew Growth	2%
	The exterior paint was peeling	2%
	Total	100%
<b>2 Type of building elements that are consistently damaged and frequently repeated due to climatic.</b>		
	<b>Viewed/Observed Effects</b>	<b>Frequency (%)</b>
	Roof Leaks	61%
	Mold/Mildew Growth	30%
	Structural Damage	10%
	Wall Cracks	9%
	Total	100%
<b>3 Maintenance work that is consistently repeated</b>		
	<b>Viewed/Observed Effects</b>	<b>Frequency (%)</b>
	Roof Leaks	50%
	Structural Damage	31%
	Leaking Ceiling	7%
	Wall Cracks	8%
	Mold/Mildew Growth	3%
	The exterior paint peeling	2%
	Settlement	0%
	Window & Door	1%
	Ground Floor	0%
	Total	100%
<b>4 Extreme climatic always happen</b>		
	<b>Viewed/Observed Effects</b>	<b>Frequency (%)</b>
	heavy rainfall	48
	extreme hot weather.	40
	storms.	10
	the change of rainfall patterns	2
	Total	100%

## CONCLUSION

Building maintenance procedures are indeed influenced by many factors. This study wants to highlight the factors that affect maintenance procedures and time due to unexpected phenomena, one of which is the climate. Findings clearly prove that building maintenance work planning must always consider weather and climate factors, not to mention the current environment where the climate has changed rapidly. This study explains, through the results of the prepared questionnaire, external elements especially the roof and physical structure are greatly affected by extreme weather factors such as heavy rain, extreme heat, and storms.

Finally, we can say that the factors related to the climate are no longer an emergency or contingency factor but instead, they must be included in the main list that affects building defects and need to be given special attention. In addition, this study also wants to suggest that financial allocations for natural disasters due to climate change should always be made into annual special allocations.

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