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AN INVESTIGATION OF BUILDING DEFECT DUE TO CLIMATES AT THE UITM SERI ISKANDAR BUILDINGS

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ABSTRACT

Climate plays a crucial role in shaping the performance and resilience of buildings, particularly in tropical regions. This paper presents a comprehensive study investigating the impact of climate factors on building defects at UiTM Seri Iskandar. Through an extensive literature review and meticulous data collection, this research explores the prevalent climatic challenges encountered by buildings in the region, including high humidity, intense sunlight, heavy rainfall, and temperature variations. Three selected buildings, Annex 1, Annex 3, and Pusat Islam, undergo a thorough inspection to identify and analyse defects directly associated with climate-induced influences. The study uncovers 34 defects linked to the tropical climate, underscoring the significance of regular maintenance and timely defect rectification to ensure the long-term sustainability of these structures. Based on the research findings, the paper proposes practical recommendations to enhance building resilience, including climate responsive design strategies, regular inspections, the utilization of climate-specific materials, collaboration with tropical climate experts, research initiatives, awareness programs, and monitoring systems. By implementing these measures, UiTM Seri Iskandar can proactively address climate challenges and create a safe and conducive environment for occupants, highlighting the importance of adopting sustainable and climate-resilient building practices in tropical regions.

Keywords: *"Climate", "tropical", "defect", "institutional".*

INTRODUCTION

A worldwide phenomenon, climate change has been more pronounced during the last three decades. In its Fifth Assessment Report, the Intergovernmental Panel on Climate Change (IPCC) finds that between 1880 and 2012, the average global land and ocean temperature increased by 0.85 °C. The IPCC is very certain that the years 1983 to 2012 were the warmest in the previous 800 years. Sea level, sea surface temperature, arctic sea ice, and the occurrence of extreme weather have also been tracked in order to understand climate change, although surface air temperature is most frequently employed to do so. (Tang, 2019)

Different geographical areas are affected by climate change in different ways. Drought and excessive heat pose the biggest problems for the built environment in hot climates. Overheating is not likely to be a concern for structures in coastal cold regions, but a warmer environment also presents difficulties. Evaluation of building adaption measures is therefore quite important. Mapping the scope of scientific papers on climate adaptation is crucial to support future research and draw implications from earlier studies. (Stagrum et al., 2020)

Due to the fact that climate change is a global issue, there is growing interest in learning more about how it affects different regions, including Malaysia. Peninsular Malaysia and Malaysian Borneo are the two regions that make up the Southeast Asian nation of Malaysia. The nation's 330,803 km2 of land area is home to an estimated 32 million people as of 2017. The nation has an equatorial climate, which is characterised by hot, muggy weather all year long. (Tang, 2019)

LITERATURE REVIEW

A worldwide phenomenon, climate change has been more pronounced during the last three decades. In its Fifth Assessment Report, the Intergovernmental Panel on Climate Change (IPCC) finds that between 1880 and 2012, the average global land and ocean temperature increased by 0.85 °C. The IPCC is very certain that the years 1983 to 2012 were the warmest in the previous 800 years. Sea level, sea surface temperature, arctic sea ice, and the occurrence of extreme weather have also been tracked in order to understand climate change, although surface air temperature is most frequently employed to do so. (Tang, 2019)

Since many nations are growing more susceptible to natural disasters, climate change is a global issue. Malaysia is a Southeast Asian nation and is not an exception to this issue. Recent decades have seen a discernible change in the global climate, which is a phenomenon that is predicted to last. The Intergovernmental Panel on Climate Change (IPCC) defines climate change as changes in the climate that are noticeable by changes

in the mean or variability of the features of the climate and that endure for a long time, generally decades or more. During the 2010–2019-time frame, which was the world's warmest decade on record, adverse and severe climatic occurrences persisted. (Boon Teck et al., 2021)

What is tropical climate?

Tropical climate is climate characterized by high temperatures and relatively consistent, warm temperatures throughout the year. Malaysia is a nation with a tropical climate. Particularly in the last two decades, Malaysia has seen warming and unique rainfall patterns, which has sparked a lot of interest in the study of climate trends and their implications. For a few Malaysian locales, Sammathuria and Ling (2009) looked at historical yearly averages of daily temperatures and annual precipitation. The study also included simulations of abnormal temperature changes and precipitation. (Tang, 2019)

In recent decades, Malaysia has experienced significant changes in its climate. The mean daily temperatures have been increasing annually, accompanied by more frequent occurrences of extreme weather events such as intense heat, heavy rain, thunderstorms, and powerful winds. Rainfall patterns have become more variable, with periods of heavy rainfall observed. Additionally, the average sea level off the coast of Malaysia has been rising, exceeding the global average. These changes suggest ongoing climate shifts in Malaysia, highlighting the need for continued monitoring and adaptation strategies.(Tang, 2019)

Institutional building

Institutions of higher learning have a moral obligation to foster the values, awareness, and knowledge required to build a just and sustainable future. Making this vision a reality depends critically on higher education, yet this is a role that is frequently ignored. In addition to preparing future educators, higher education has a significant impact on K–12 curriculum design since it heavily emphasises preparation for higher education. (Anthony D. Cortese, 2003)

In Malaysia, hundreds of higher education buildings and restorations have been planned, developed, and built over the past ten years, but only a small portion will ever be assessed against the needs of students and academics in terms of building facilities. The evaluation criteria acquired from the tenants of higher educational buildings need to be quantified in terms of the quality of facilities for general condition and suitability for education to standardise the evaluation of educational facilities. (Khalil et al., 2008)

Common defects found on building due to tropical climates

In Malaysia, buildings are built in accordance with British Standard and under strict supervision. Unfortunately, the maintenance aspects of the building are still weak. Making it worse, sometimes building maintenance is perceived as merely about the mechanical and electrical system in the buildings without much consideration given to civil and structural elements. For instance, a solid water proofing system is essential for structures with flat roofs in Malaysia due to the country's tropical environment and average annual rainfall of 250 cm. (Suffian, 2013)

Paint and other surface layers peel and break are type of defect as a result of prolonged weathering. Paint that is cracked or peeling is a regular occurrence. For instance, painted wooden doors exposed to the weather for a few years develop cracks, which frequently cause the paint to peel away from the underlying wood (Paquette et al., 2011)

With a humidity level of 80% and a significant rate of evaporation. Additionally, there has been a lot of rain, above 2500mm (International Business Publication, USA, 2008). Malaysia is more susceptible to moisture issues than other western nations, which has a negative impact on health, causes buildings to age more quickly, and impairs their functionality. (Othman et al., 2015)

In Australia, the United States, the United Kingdom, and the majority of other countries, atmospheric CO2 is a significant contributor to the corrosion of reinforcement in bridges, buildings, wharves, and other concrete structures. The possibility of corrosion brought on by carbonation will rise as CO2 levels rise due to global warming. (Stewart et al., 2011)

How the storm surge changed things Light-framed wood and unreinforced masonry residential buildings were particularly vulnerable to coastal floods. The ground-floor slab on grade and significant heaps of debris at the high-water mark were often the only remnants of residential construction in coastal areas. (Robertson et al., 2007)

Almost 60% of the working population would likely experience thermal discomfort at work as a result of changing climatic conditions and rising temperatures. To fulfil the rising demands of building occupants for thermal comfort, half of the energy produced worldwide is needed to heat, cool, ventilate, and regulate humidity in buildings (Sesana et al., 2021)

METHODOLOGY

The qualitative method was the first way of gathering data for this study. The inspection of the case study will be used to carry out this procedure. Three buildings have selected to achieve this study. All of the building used in this case study is institutional building. The information collected include the type of defect causes by tropical climate, the causes of the defect and prevention of the defect causes by the tropical climate. The defect that being found must be related to the defect that causes by the climate. For example, the defect that causes by heavy load cannot be put to the research findings. From the flow of this qualitative method conducted in this research, the structured type of inspection will be setting up towards the selected professional to gain clear information regarding to discussion study topics. Research tools that have been used in this study is 4 in 1 meter, lux meter, moisture meter. In order to obtain the result of this study, the data collection will be taken during morning, evening, and night. The tools used to determine the defect for each defect found.

CASE STUDY

Table 1: Case study

BUILDING	TOTAL DEFECT	AGE	BUILDING MATERIAL	BUILDING TYPE
Building 1	12	24 years	Concrete	Institutional building
Building 2	4	24 years	Concrete	Institutional building
Building 3	15	15 years	Concrete	Institutional building

The data presents three buildings: Annex 1 (24 years old, 4-storey, concrete) with 12 defects, Annex 3 (24 years old, 2-storey, concrete) with 4 defects, and Pusat Islam (15 years old, 2-storey, concrete) with 15 defects. Pusat Islam, the youngest, has the highest defect count, warranting further investigation to ensure its structural integrity and safety.

Defect found causes by tropical climate

Table 2: Total defect found due to climate factor

FACTOR CLIMATE / CASE STUDY	HOT CLIMATES	RAINFALL	EXTREME WEATHER	SEA LEVEL
ANNEX 1	**5**	**3**	**4**	**0**
ANNEX 3	**2**	**4**	**1**	**0**
PUSAT ISLAM	**7**	**5**	**3**	**0**

This case study focuses on three buildings building 1, building 2, building 3 in hot climates. The data highlights relevant factors like rainfall, extreme weather events, and sea level. Building 1 experienced five instances of extreme weather, three cases of rainfall, and four incidents of hot climate impacts. Building 2 encountered two extreme weather events, four cases of rainfall, and one instance of hot climate impact. Building 3

faced seven extreme weather events, five occurrences of rainfall, and three incidents of hot climate impact. Sea level data is not provided for any of the buildings. The study suggests that all three buildings are exposed to weather-related challenges, warranting careful consideration of climate resilience measures to ensure their long-term structural integrity and safety.

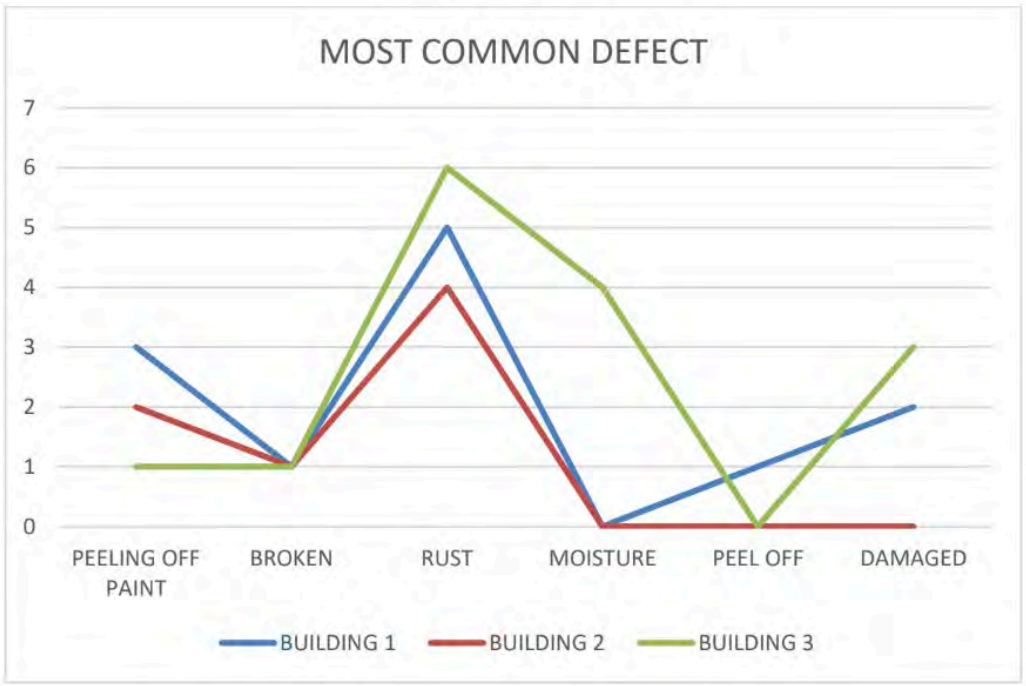
Most common elements

Table 3: Defect found by elements

CASE STUDY	CEILING	HANDRAILS	GUTTER	ROOF	FLOOR	WALLS
ANNEX 1	0	4	2	2	0	4
ANNEX 3	1	4	0	0	0	2
PUSAT ISLAM	2	3	2	4	2	2

This case study evaluates the condition of ceilings, handrails, gutters, roofs, floors, and walls in three buildings: building 1, building 2 and building 3. Building 1 exhibits no reported issues with ceilings but has four problems with handrails, two with gutters, two with roofs, and four with walls. Building 2 has one problem with ceilings, four with handrails, and two with walls, while the rest of the elements seem to be in satisfactory condition. Building 3 reports two issues with ceilings, three with handrails, two with gutters, four with roofs, and two with floors and walls. The findings indicate that there are various maintenance and repair requirements across all three buildings, particularly concerning handrails, walls, and roofs, which demand immediate attention to ensure the safety and functional integrity of these structures.

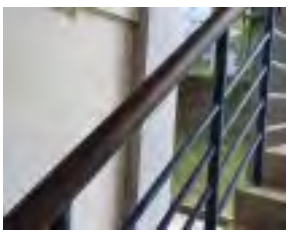
Type of defect



This case study examines the presence of various issues in three buildings: building 1, building 2, building 3. Building 1 reports peeling off paint in three instances, one broken element, five instances of rust, and two cases of peeling off, while no moisture-related or damaged issues are mentioned. Building 2 experienced two cases of peeling off paint, one broken element, and four instances of rust, with no moisture-related or damaged problems. Building 3 reported one issue of peeling off paint, one broken element, six cases of rust, and three damaged elements, but no moisture-related problems. The study reveals that rust-related issues are particularly prevalent across all buildings, warranting immediate attention to prevent further damage and ensure structural longevity.

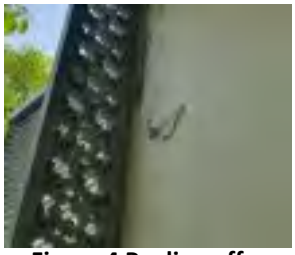
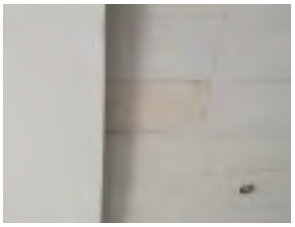
Defect found due to hot weather

Table 5: Defect causes by hot weather

 **Figure 1 Rust on handrails**	 **Figure 2 Rust on handrails**	 **Figure 3 Rust on handrails**

Defect found due to rainfall

Table 6: Defect due to rainfall

 **Figure 4 Peeling off paint**	 **Figure 5 Moisture on floor**	 **Figure 6 Dampness on ceiling**

Defect found due to extreme weather

Table 7: Defect due to extreme weather

 **Figure 7 Damage on roof**	 **Figure 8 Missing ceiling panel**	 **Figure 9 Missing panel**

Discussion of Data Collection

Recently, three buildings at UiTM Seri Iskandar underwent a comprehensive inspection to identify potential defects and issues arising from climatic factors. A total of 34 defects were discovered across building 1, building 2 and building 3, emphasizing the importance of regular maintenance and addressing environmental impacts. Despite being over 10 years old, the buildings were found to be in commendable condition, efficiently serving their purposes. Timely identification and rectification of climate-induced defects are vital for ensuring long-term durability and functionality. UiTM Seri Iskandar's commitment to providing a safe environment for its community is evident through its proactive approach to maintaining the structures.

CONCLUSION

In conclusion, this research study examined defects caused by tropical climate conditions in buildings at UiTM Seri Iskandar. Factors such as high humidity, intense sunlight, heavy rainfall, and temperature variations were found to significantly impact building integrity. The inspection of building 1, building 2 and building 3 confirmed 34 defects related to the

tropical climate, although the buildings were generally in good condition. Prompt addressing of these defects is crucial for long-term sustainability. Recommendations include climate-responsive design, regular inspections, climate specific materials, collaboration with experts, research, awareness programs, and monitoring systems. This research contributes to understanding tropical climate induced defects, but further studies are needed. By implementing these findings, UiTM Seri Iskandar can enhance building maintenance and resilience, providing a sustainable environment for occupants.

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