



**INVESTIGATION OF THERMAL COMFORT OF SELECTED
TEMPORARY EVACUATION CENTER IN TROPICAL CLIMATE
AT MELAKA**



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HONOURS**

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**Faculty of Mechanical and Manufacturing Engineering
Technology**



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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2022

DECLARATION

I declare that this Choose an item. entitled “ Investigation Of Thermal Comfort Of Selected Temporary Evacuation Center In Tropical Climate At Melaka” is the result of my own research except as cited in the references. The Choose an item. has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical Engineering Technology (Refrigeration and Air Conditioning Systems) with Honours

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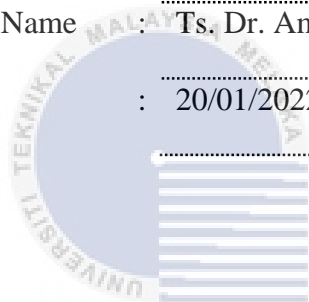
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DEDICATION

To my beloved parents, I acknowledge my sincerity and gratitude to them for their love, support, dream and sacrifices throughout my life. Initially, I am thankful for their sacrifice, patience and understanding that were inevitable to make this work completely. Their sacrifice had inspired me to learn how to study and write since the day I was born. I couldn't find the appropriate words that could properly describe my appreciation for their devotion, support and faith in my ability to achieve my dreams. Lastly, I would like to send my gratitude to any person that contributes to my final year project whether it is directly or indirectly. I would like to acknowledge their comments and suggestions, which are crucial for the completion of this investigation successfully.

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ABSTRACT

Temporary evacuation centers (TECs) are especially important in the event of a disaster. Unexpected disasters will cause property to be destroyed and the victims involved will have no place to shelter. With the TEC, it is able to place the victims involved in one area. TEC has some problems when too many victims are in the area. Among the problems that occur are uncomfortable conditions, hot areas due to overcrowding and the health of individuals will be disturbed. This study will examine the relation of thermal comfort in TEC. Factors identified in this study are air temperature, wind speed, humidity, ambient heat temperature, type of clothing and activities performed. To find out the comfort of the individual in the place, the software "CBE thermal comfort tool" is used to solve the problems encountered. The data obtained will be used in the software. The areas used are schools in the state of Melaka, namely SK Durian Tunggal, SJK (C) Sin Wah and SMK Bukit Katil. In the school, four things were taken into account in the data collection, namely the readings of air temperature, wind speed, humidity, and ambient heat temperature. For data collection for ambient temperature, humidity and heat temperature, the method used was by placing a globe thermometer with a height of 1m from the floor. The globe thermometer is placed in the center of the tent to get a good reading. For wind speed data, an anemometer is used to obtain the readings. An anemometer is placed in front of the tent to get a more accurate reading, this is because the passage of the tent door is one of the passages for air to enter. As the data from SK Durian Tunggal at 2.00 pm the temperature is 32.1°C is the high from the reading. When hot weather the air humidity that get is 47% to 67%, besides that the reading for air velocity is between 0.1m/s to 0.5m/s and the range of globe temperature is 23°C to 25.2°C. In addition, the survey method, which is by using a google form, is distributed to the victims involved. Based on the results obtained, several factors will affect the readings collected, among them are natural factors. Natural factors such as hot weather or rain will make the data obtained be in a comfortable state or not. The findings of this study indicate that comfort in flooded areas is not only influenced by individual activities but also surrounding factors.

ABSTRAK

Pusat pemindahan sementara (TEC) amat penting apabila berlakunya bencana. Bencana yang tidak disangka berlaku akan membuatkan harta benda musnah dan mangsa-mangsa yang terlibat tidak mempunyai tempat untuk berteduh. Dengan adanya TEC, ia dapat menempatkan mangsa-mangsa yang terlibat di satu kawasan. TEC mempunyai beberapa masalah apabila terlampau ramai mangsa yang berada di kawasan tersebut. Antara masalah yang berlaku ialah keadaan tempat yang tidak selesa, kawasan yang panas disebabkan terlalu padat dan kesihatan individu akan terganggu. Kajian ini akan mengkaji berkaitan keselesaan terma di TEC. Faktor yang dikenalpasti dalam kajian ini ialah suhu udara, kelajuan angin, kelembapan, suhu haba sekitar, jenis pakaian dan aktiviti yang dilakukan. Untuk mengetahui keselesaan individu di tempat tersebut, perisian "CBE thermal comfort tool" digunakan untuk menyelesaikan masalah yang dihadapi. Data-data yang diperolehi akan digunakan dalam perisian tersebut. Kawasan yang digunakan adalah sekolah di dalam negeri Melaka iaitu SK Durian Tunggal, SJK(C) Sin Wah dan SMK Bukit Katil. Di sekolah tersebut, empat perkara diambil kira dalam pengumpulan data iaitu bacaan suhu udara, kelajuan angin, kelembapan, dan suhu haba sekitar. Untuk pengumpulan data bagi suhu, kelembapan dan suhu haba sekitar, kaedah yang digunakan ialah dengan meletakkan termometer glob dengan ketinggian 1m dari lantai. Thermometer globe itu diletakkan di tengah-tengah khemah untuk mendapatkan bacaan yang baik. Untuk data kelajuan angin, anemometer digunakan untuk mendapatkan bacaannya. Anemometer diletakkan di hadapan khemah untuk mendapatkan bacaan yang lebih tepat, ini kerana laluan pintu khemah merupakan salah satu laluan untuk udara masuk. Berdasarkan data dari SK Durian Tunggal pada pukul 2.00 petang, suhu 32.1°C adalah tertinggi daripada bacaan. Apabila cuaca panas, kelembapan udara yang diperolehi ialah 47% hingga 67%, selain itu bacaan halaju udara adalah antara 0.1m/s hingga 0.5m/s dan julat suhu glob ialah 23°C hingga 25.2°C. Selain itu kaedah tinjauan iaitu dengan menggunakan borang google diagihkan kepada mangsa-mangsa yang terlibat. Berdasarkan hasil yang diperolehi, beberapa faktor akan mempengaruhi bacaan yang dikumpul, antaranya ialah faktor alam. Faktor alam seperti cuaca panas atau hujan akan menjadikan data yang diperolehi berada dalam keadaan yang selesa atau tidak. Dapatan kajian ini menunjukkan keselesaan di tempat banjir bukan sahaja dipengaruhi oleh aktiviti individu tetapi juga faktor sekeliling.

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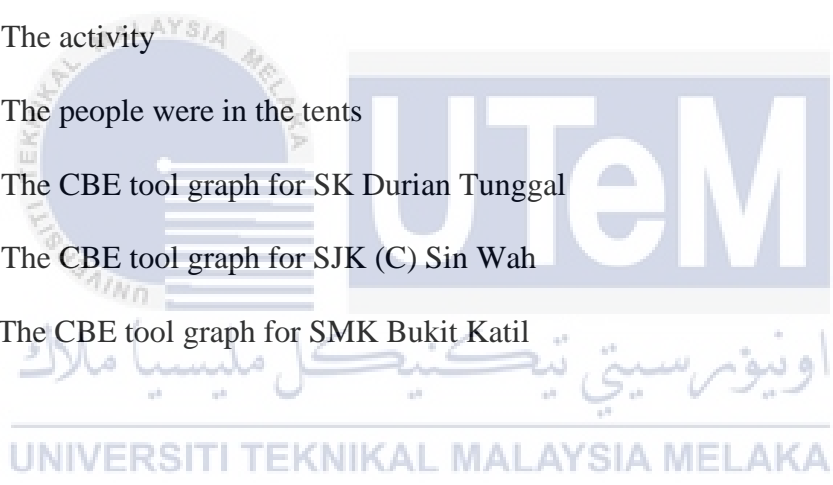
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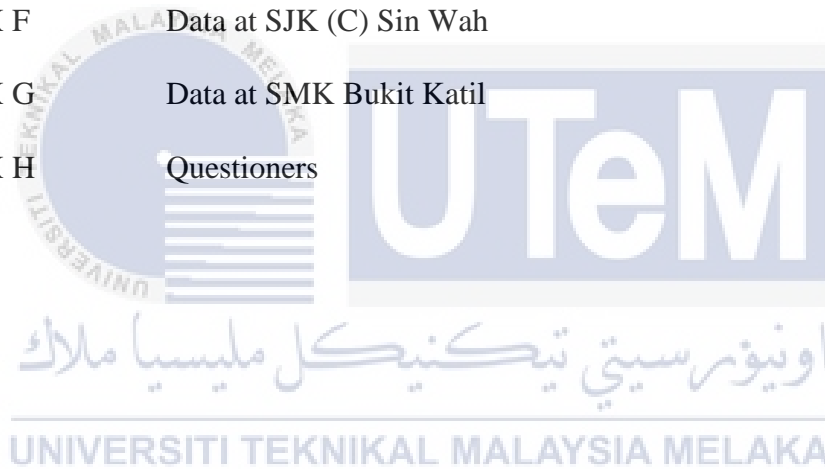
LIST OF SYMBOLS AND ABBREVIATIONS

TEC	-	Temporary evacuation center
PMV	-	Predicted mean vote
PPD	-	Predicted percentage of dissatisfied
km	-	Kilometer
°C	-	Celsius
°F	-	Fahrenheit
%	-	Percent
ASHRAE	-	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ms^{-1}	-	Meter per second
HSE	-	Health and Safety Executive



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CHAPTER 1

INTRODUCTION

1.1 Background

Malaysia is a Southeast Asian country that experiences heavy rainfall for most of the year. The effects of this heavy rain have resulted in Malaysia experiencing several natural disasters, such as floods, mudslides and landslides. Apart from that, Malaysia is also experiencing natural disasters such as haze due to forest fires in Indonesia. Apart from natural disasters, Malaysia also experiences disasters due to human actions, such as technological disasters, transportation accidents, damage to production and damage to public places (Ahmadun, 2006).

In Malaysia, floods are listed as 9 out of 10 natural disasters that have affected society. Floods have occurred in Malaysia as early as 1886, 1926, 1967, 1971 and 1986. The worst floods occurred on 3 December 1965, involving 300 thousand people (Emdat, 2012). Flood disasters occur due to heavy rains that result in high water levels in major rivers and, in turn, cause the river water to overflow in some areas (Ho, 2002). Other than that, flood disasters also occur due to human negligence. Among them are solid waste disposal activities, forest land development, unplanned urban development and inefficient water drainage systems (Ishak, 2013). This flood disaster is known as a flash flood. For example, the flash flood disaster that occurred in Melaka. As a result of the small drainage system, it is unable to hold water when it rains heavily and continuously for a day (Hashim, Muhamad, 2011).

In recent years, Malaysia has faced floods almost every year. For example, in December 2006 and January 2007, Johor is a Malaysian state have experienced floods within two weeks due to heavy rains. As a result, there are 100 000 flood victims who have been evacuated to over 100 evacuation centers (Norwawi, Katuk, 2009). Meanwhile, the floods in Kedah in 2002 claimed the lives of 124 000 people and cost the country \$30.20 million in costs (Nurzawati, 2015). Figure 1.1 shows the flood area in Malaysia.

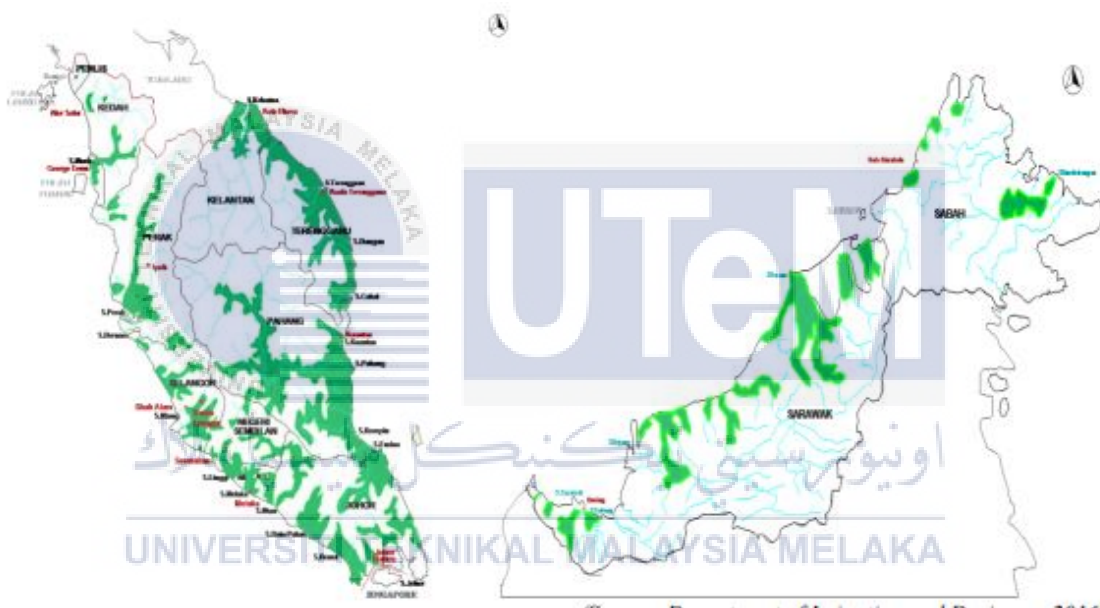


Figure 1.1 Flood area in Malaysia (N.S. Noor Haryantie, Z. Munirah, H. Nur Hasinah, 2016)

When floods occur, temporary evacuation centers (TEC) need to be opened for the flood victims involved. It allows the victim to be in a safe and comfortable place. There are some places that are used as flood evacuation centers, such as schools, multipurpose halls, mosques, and community halls. TEC that are opened need to have several factors so that the victims who are there feel comfortable (Yu et al., 2016).

In this study, the factor highlighted is thermal comfort. When a temporary evacuation facility is opened, one of the most significant factor is thermal comfort. This is because a comfortable place will keep the victim involved in a calm and comfortable state. In these circumstances, the parties involved can do the work well and efficiently (Singh et al., 2018).



1.2 Problem Statement

A TEC should be free of external physical risks and provide stability for those who live there to recover their mental health and physical health (UNISDR, 2010). Prior research has highlighted the need to apply the habitability concept to the TEC. The availability of a shelter, heating system, sanitary conditions to avoid infection, indoor quality (noise, smoking, drugs), and a source of drinking water is referred to as habitability. It also has more general characteristics, such as close ties to local communities, people's desire to recover, and consideration of a variety of needs based on people's physical and mental states (Choi, 2020).

Habitability should not be seen of as a bare minimum for survival, but rather as a means of building a soft environment that humans can love and treat with care. In order to better promote the concept of habitability, TEC for disaster survivors should provide a psychologically and physically secure living environment that addresses safety, hygiene, health and a protracted rehabilitation period in various disaster scenarios (KoreaKim et al., 2021).

Building a physically and mentally healthy living environment is critical for providing survivors with good quality of life and better service. When thermal comfort is not in a comfortable state. The problem that will be faced is that the health of the individual will be disturbed (Sansaniwal et al., 2020). Eliminating potential health hazards is also a very important aspect of maintaining ideal thermal comfort. It will result in the productivity of each individual not being at its best. A person's feelings will also be affected when the situation is uncomfortable. Moreover, the victims involved are in a hot state when the space