VULNERABILITY ASSESSMENT DUE TO WIND STORM IMPACT

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ABSTRACT

Wind related damage is increasing in Malaysia. The information related to wind characteristics is very important. High wind speed area will result higher rate of damage. In this study, the wind speed identities are finding out by using Geographical Information System (GIS) application and the locations are located. Mean wind speed from weather station are been use. Spatial analyses are conducted to Peninsular Malaysia. From the analysis it shows that wind related disasters are tendency to follow any high wind speed. Therefore it can conclude that the higher wind speed will cause high rate of wind damage.

ABSTRAK

Bencana yang melibatkan angin semakin meningkat di Malaysia. Maklumat yang berkaitan tentang ciri-ciri angin sangat penting untuk direkodkan. Kawasan yang mempunyai kelajuan angin yang tinggi biasanya akan menyebabkan kekerapan kejadian dan peratusan kerosakan yang tinggi. Dalam kajian ini, ciri-ciri dan kelajuan angin telah direkodkan dengan menggunakan perisian GIS dengan mengikut kordinat lokasi yang tepat dan min kelajuan angin daripada stesen kaji cuaca juga telah direkodkan. Analisis spatial didalam perisian GIS telah membolehkan analisis tentang kelajuan angin dan peratusan kerosakan dijalankan untuk kawasan di Semenanjung Malaysia. Analisis tersebut telah menunjukkan bahawa peratusan kejadian bencana angin dipengaruhi oleh kelajuan angin yang tinggi pada sesuatu tempat. Oleh yang demikian, dapat disimpulkan bahawa kelajuan angin yang tinggi akan menyebabkan peratusan untuk berlakunya bencana angin juga tinggi.

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LIST OF SYMBOLS

km/hr	kilometer per hour
m/s	meter per second
°C	Celsius
%	Percent

LIST OF ABBREVIATIONS

GIS	Geographical Information Sysytem
MMS	Malaysian Meteorological Service
MMD	Malaysian Meteorological Department
NST	New Street Time

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Damage that occurs by wind now days is very familiar in our daily life. (Kosmo, 2013) reported on 15th June 2013 at Sungai Dua, Georgetown Penang, roof and ceiling for 13 houses at top level Block C Flat Hamna has been overturn during storm and heavy rain in the evening. All occupants go out by running from the crushed roof or ceiling that collapsed and no injuries and dead recorded for the accident. One month after that, (Berita Harian, 2013) has been reported at Putra Ria Apartment, Bangsar Kuala Lumpur, also happened the same things. Although no injuries and dead has been recorded, this accident involve damage of vehicles that park at around the apartment area. 10 vehicle has been damage and the cost for the damage has estimated around RM 10,000. Not only happened for commercial building, this damage also happened at school building. (New Straits Time, 2013) reported on 21st May 2013, a roof structure of a building has been overturn at Sekolah Menengah Teknik Setapak, Kuala Lumpur. Rm 40,000 to Rm 50,000 loss has been recorded from this damage. One the most severely damaged is teacher room and computer lab.

Wind is basically caused by the temperature gradient of the atmosphere due to variable Solar heating of the earth's surface. It is initiated, in a more immediate sense, by density difference or pressure gradient between points of equal elevation. (Tamura & Cao, 2010).

Strong winds are the most common means of destruction associated with hurricanes. Their sometimes continuous barrage can uproot trees, knock over buildings and homes, sink or ground boats, and flip cars. (Department of Atmospheric Sciences, 2010).

(Holmes, 2007) Stated that Malaysia is entirely in the equatorial zone. Malaysia does not experience typhoons and has very low extreme winds from weak thunderstorms and monsoons winds. But from the observation, there are still damage causes by strong wind. As an example, 18th December 2012, typhoon Utor occurs in JB and cause lots of damage which cost millions Ringgit Malaysia. It shows that more study need to be done.

1.2 PROBLEM STATEMENT

Speed of wind induced damage occurred in Malaysia (Figure 1.1). However there are no significant studies that relate between the wind speed that induced damage in Malaysia. Base on previous record, some of the damage is repeatedly occurred at same location. No vulnerability study due to wind storm been conducted seriously in Malaysia. Therefore, the significant of this study is to investigate the potential of damage due to wind speed. No improvements were made to reduce the damages level. This may cause by:

1. The design of the building is not consider the load from the wind due to their location and topography.
2. Storm occurs not recorded by weather station due to location of weather station.
3. Structure of the building which may not kind of engineered building.

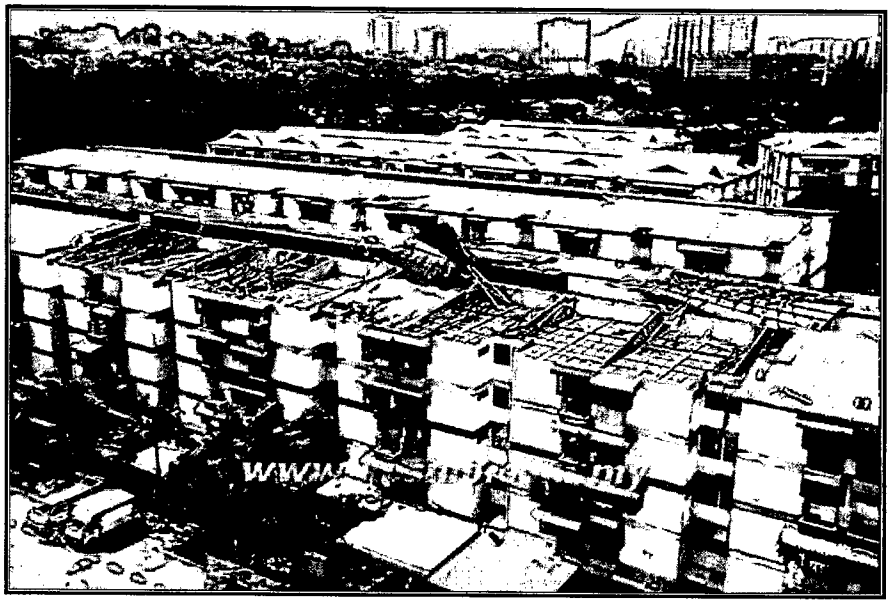

Figure 1.1: Damages Cause By Strong Wind Speed at Bangsar Kuala Lumpur 2013

Source: Berita Harian 2013

1.3 OBJECTIVE

The strong wind speed will affect a structure or building when it happened suddenly. It is a neutral disaster that has no one can know when it will be happened. We as human only can predict or take precaution to minimize the damage to the surrounding. Therefore, the objective of this study as bellow:

1. To identify the wind characteristic during the wind damage incident.
2. To study the relationship between mean wind speed and level of damage.
3. To assess the damage frequency with wind means speed.

1.4 SCOPE OF STUDY

The scope of the study is to determine the success of the objectives. The scopes of this study are:

1. The ArcGIS database that complete with the wind speed, wind gust, wind direction and the distance between the location and the weather station.
2. The area of study is limited to Peninsular Malaysia.
3. The ArcGIS software to produce map and zoning area.

1.5 STUDY AREA

The study area of this study is limited to peninsular Malaysia only (Figure 1.2). Sabah and Sarawak are excluded in this study.

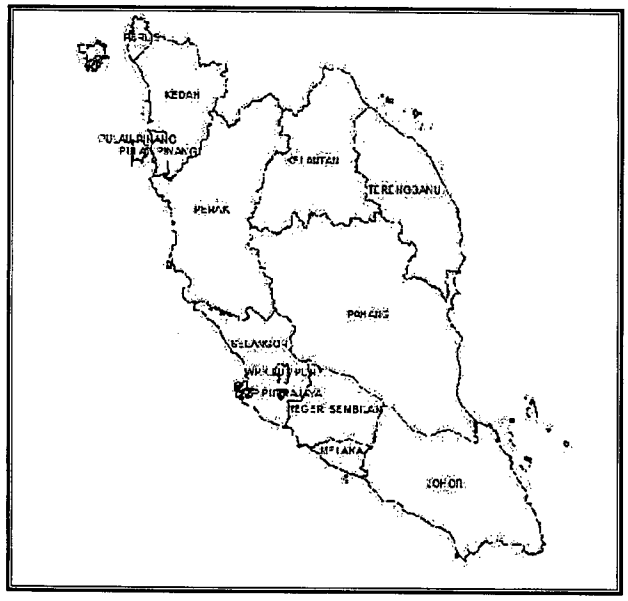

Figure 1.2: Map for Peninsular Malaysia

1.6 SIGNIFICANT OF STUDY

From the vulnerability assessment, it can identify the place that highly potential to receive high wind load. Designers can increase the resistibility of the building due to wind load by having the information from this study. By conducting this study, pattern of wind at Malaysia can be determined and wind hazard damage can be reduced. As an example, if any place record high mean wind speed for past 5 years, the structure of building at the area should be design vary with the sustainability to withstand high wind speed.

1.7 THESIS STRUCTURE

This thesis is divided into five chapters:

1. Introduction : This chapter includes overview of problem statement, objective and scopes of the study, significance of the study and study area.
2. Literature review : This chapter is the previous study material related to objectives.
3. Methodology : The flow of the thesis production using GIS software.
4. Discussion : Discuss the result obtained based on case study.
5. Conclusion : Conclusion of the discussion based on thesis result and provides the future suggestion.

CHAPTER 2

LITERATURE RIVIEW

2.1 INTRODUCTION

This chapter presents a review of the literature review on wind effect and related previously study.

2.2 WIND HAZARD DAMAGE

Wind hazard damage is one kind of natural disaster that cause by wind. Known as hydro-meteorologal hazards, wind storm including cyclones, hurricanes and typhoons contribute to percentage of damages by natural disaster around the world. (Bosher, 2008) In Malaysia, we almost here about the damage occur that cause by strong wind. All the damage happened repeatedly and some time happened in the same location in 2 or 3 time.

Even though many damage have been happened, no action has been taken by government of engineer to counter back for this problem to make sure the number of damage can be decrease or decrease the level of the damage. By determination of wind mean speed for every district in Malaysia may help the engineer design better design based on mean wind speed profile.

High wind speeds can cause significant damage to property. Hurricanes, cold fronts, strong areas of low pressure and even simple thunderstorms can produce winds strong enough to cause damage and threaten buildings and boats. Understanding the level of threat posed by sustained winds at high speeds can help you to minimize the risks to property and physical well-being. (McBride, 2012).

Environmental wind studies-investigate the wind effects on the surrounding environment caused by erection of the structure (e.g. tall building). This study is particularly important to assess the impact of wind on pedestrians, motor vehicles and architectural features such as fountains, etc, which utilize public domain within the vicinity of the proposed structure. (Mendis et. al, 2007).

(Holmes, 2007) stated that Malaysia only experience wind speed between 24-32 m/s and. It has been concluded based on 50 year gust values for 20 stations of the Malaysian Meteorological Service (MMS) around Malaysia but as we can see almost every month there are storm occurs and cost a lot of money.

2.3 MALAYSIA

It consist of thirteen states and three federal territories and has a total landmass of 329,847 square kilometers separated by the South China Sea into two similarly sized region, Penisular Malaysia and East Malaysia. The capital city is Kuala Lumpur, while Putrajaya is the seat of the federal government. Pahang is the biggest state in peninsular Malaysia and Perlis is the smallest states (Figure2.1).

Malaysia located near the equator (Figure 2.2) between 1 and 7 latitude North and longitude 100 and 119 East, and subject to the influence of the sea and the wind system changes from the Indian Ocean and the South China Sea. Usually, the climate here is divided into the southwest monsoon and the northeast monsoon. The average temperature in most of Malaysia is between 21 °C to 32 °C. Humidity is rather high. (Chempawan Mat Abu, 2009).

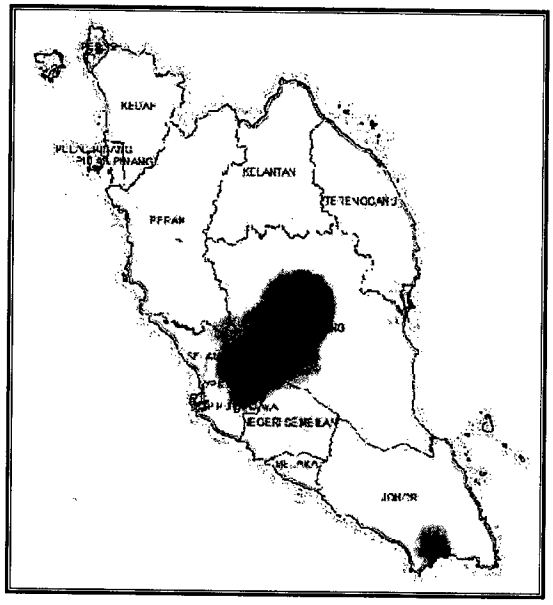

Figure 2.1: Peninsular Malaysia Map with Zoning Area

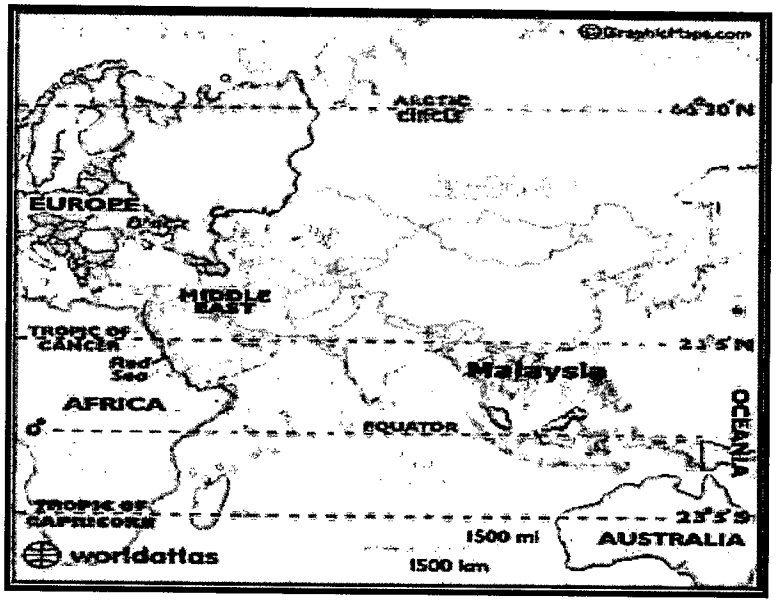

Figure 2.2: Malaysia Located Near The Equator

Sources :worldatlas.com

2.3.1 Type of Wind at Malaysia

The weather in Malaysia is characterized by four monsoon regimes, namely, the southwest monsoon, northeast monsoon and two shorter periods of inter-monsoon seasons. From (Hafezatul, 2010), it was found out, in Malaysia there are only two type of wind. First type is weak wind means that area are discomfort thermal and the second type is comfort range to strong wind means that area are comfort thermal. The minimum value of mean wind speed from 2005 to 2009 is O.mis in mean temperature is over 2 °C at Sitiawan. For the maximum value of mean wind speed is I .7m/s in average value of mean temperature is 276 °C at Mersing.

The southwest monsoon season is usually established in the later half of May or early June and ends in September. The prevailing wind flow is generally southwesterly and light, below 15 knots.

The northeast monsoon season usually commences in early November and ends in March. During this season, steady easterly or northeasterly winds of 10 to 20 knots prevail. The winds over the east coast states of Peninsular Malaysia may reach 30 knots or more during periods of strong surges of cold air from the north (cold surges).

During the two inter-monsoon seasons, the winds are generally light and variable. During these seasons, the equatorial trough lies over Malaysia. It is worth mentioning that during the months of April to November, when typhoons frequently develop over the west Pacific and move westwards across the Philippines, southwesterly winds over the northwest coast of Sabah and Sarawak region may strengthen to reach 20 knots or more.

As Malaysia is mainly a maritime country, the effect of land and sea breezes on the general wind flow pattern is very marked especially during days with clear skies. On bright sunny afternoons, sea breezes of 10 to 15 knots very often develop and reach up to several tens of kilometers inland. On clear nights, the reverse process takes place and land breezes of weaker strength can also develop over the coastal areas. (Malaysian Meteorological Department, MMD)

2.4 WEATHER WARNINGS

Weather warning provided by the Malaysian Meteorological Department (MMD) seems to ignore the potential threat cause by tropical storm (Figure 2.3). This is due to possible impact MMD identified in relation to two warning stages: red and orange.

The orange one list "flooding in low lying areas and river banks" as well as "thatched/zinc roofs being blown off by wind" as possible impact of tropical storm. The red one is stronger tropical storm and much stronger typhoon list only "swift water currents that can be dangerous to children playing beside monsoon drains and river banks".

MMD looks not really take serious on the impact of tropical storm that hit Malaysia. MMD should create new warning stages beyond red and orange exclusively for tropical storm such as light and dark purple. Even though the wind speed range for tropical storm is low, it was potential to create more devastation than red stages monsoon storm. MMD should reclassify the tropical depression in light purple warning stages and add landslide as a potential impact in addition to strong wind.

For tropical storms and typhoons, we classify it as dark purple stages. It should wake up call to everyone concerned since the level of damage is very bad. Additional possible impacts such as downed trees and power lines, collapsed telco and advertisement towers may happen. The authorities concerned should broadcast a mandatory evacuation order to those living near the coast, on hillsides, riverbanks and high-risk low-lying areas well before the storm arrives since it is going to be too

dangerous for anyone to be outside when the storm is in progress in the dark purple warning stages.

Shelter that can withstand the very strong wind that accompanies tropical storms or typhoons should be identified so that affected population can easily reach them. For tropical storms a different severe weather warning system is urgently needed so that the general population is alerted to their presence and to save countless lives that might be lost due to ignorance. (Hartono, 2013).

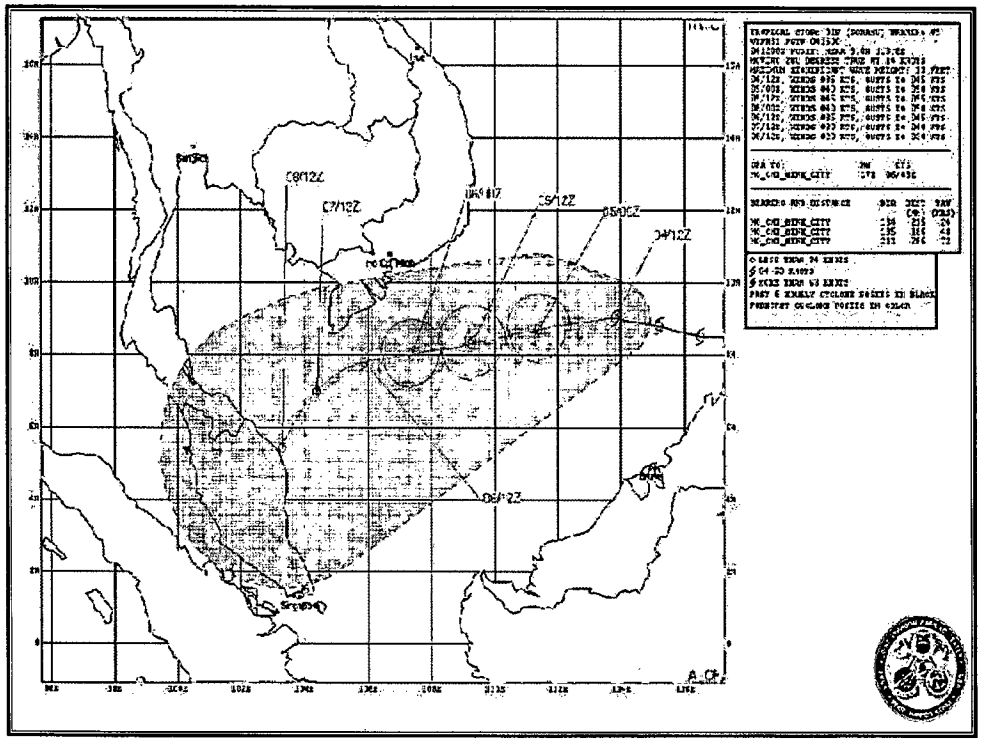

Figure 2.3: Warning alert, Third Category Sonamu might land at East Coast of Peninsular Malaysia (Terengganu) on 8 January 2013.

Sources: http://www.usno.navy.mil/JTWC

2.4.1 Storm Alert

The MMD would like to express its appreciation and thanks to Zahar Hartono for his letter "Need for different alert for severe storms" (NST, 2013).

MMD like most country only use three color codes for warnings and Zahar's suggestion will be forwarded on the extra color code for tropical storm warning to the 2013 Asia-Pacific Typhoon Committee Meeting for consideration.

Suitable shelters that can withstand strong winds in the event the storm hits Kelantan, Terengganu and Pahang has been identified by the government through the National Security Council and other authorities. (Malaysian Meteorological Department, Science, Technology and Innovation Ministry, 2013)

2.5 WIND EFFECT

2.5.1 Hurricane Damages

Hurricane is one of powerful acts of nature. It deliver massive downpour of rain and particular large storm are held together during the hurricane. That amount of rain may create flooding and potentially devastating large areas. Both manmade and natural structures can't sustain wind within the storm. Collapsed wall, blow over trees are the effect of these high wind speed. (Brain et. al, 2007).

2.5.2 How Wind Damages Roof

While wind is blowing, rain is driving down and falls on the roof. The roof is taking a beat and the wind goes from shriek to howl. Roofs are designed to resist typical wind loads of their location but none of them may resist the extreme wind speed such as big storm. In between breezes and twister, there are winds that incrementally damage the roofing system as wind flows, its effect is not stable, and certain parts may experience different pressure.

At the center part of roof, the stress is lower at the corner and edges of the roof, its exerts high pressure this is due to nature of wind blowing across the roof. Depends on the shape, type, location of the roof and the way the wind blows, there will be negative pressure, suction, positive pressure and pushing. Most of wind damages start on the edge of the roof system. Wind blow over the roof is not a problem until it starts to move materials including membrane itself or the syringes. At the loose part, the suction of wind is going to raise it up and wind may flow under it and push it up.

It is a kind of peeling effect. It starts from lift up the roof, and wind gets to push up and over a little much time, until a whole corner of insulation is exposed. Starts from small and grows by repeated wind cycles (Figure 2.4). (Naomi Millan, 2010).

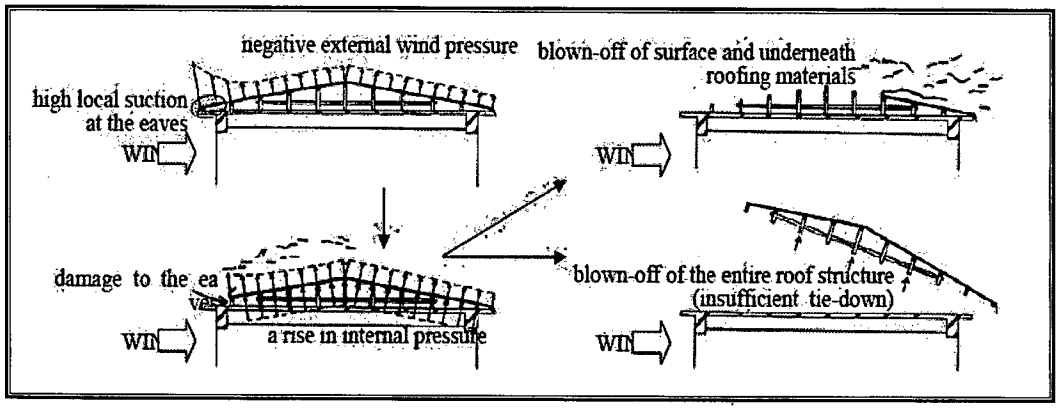

Figure 2.4: Wind Damages Roofs Phenomena
(Tamura & Cao 2010)