WIND ENVIRONMENT EVALUATION ON MAJOR TOWN OF MALAYSIA

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A thesis submitted in partial fulfillment of the
requirement for the award of the degree of
Bachelor of Civil Engineering

Faculty of Civil Engineering & Earth Resources
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NOVEMBER 2010

ABSTRACT

This study focus on wind flow or wind environment of residential areas in Peninsular Malaysia, Sabah and Sarawak. Natural wind flow is one of the most effective methods to help achieve the energy saving in large cities especially under the tropical climate like 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. For this study, the data of wind velocity in twenty-two (22) weather station in Malaysia obtained from Meteorological Department and considered in wind environment evaluations. Then that data of wind velocities will convert to 1.5 m height at all measuring points were calculated by using the ¼ power law. The result compared by Table 2.2 in previous researches (Kubota and Miura *et al.*, 2002). From the study, 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 0.3m/s in mean temperature is over 25°C at Sitiawan. For the maximum value of mean wind speed is 1.7m/s in average value of mean temperature is 27°C at Mersing. Base on results, it can be concluded that, when considering wind flow at a residential area, terrace housing is not a suitable option for towns located on the south of the Peninsular. It was prefer for high-rise building because it was considered this location of towns was weak wind condition. On the other hand, the major towns exclude the south of the Peninsular including Sabah and Sarawak, they was under the comfort thermal. So, terrace housing or high-rise building is suitable option.

ABSTRAK

Fokus kajian yang dibuat melibatkan arus angin atau persekitaran di kawasan kediaman di Semenanjung Malaysia, Sabah dan Sarawak. Aliran angin adalah salah satu kaedah yang paling berkesan untuk membantu mencapai penjimatan tenaga di bandar-bandar besar terutama di bawah iklim tropika seperti Malaysia. Cuaca di Malaysia mempunyai empat jenis monsun, iaitu monsun barat daya, monsun timur laut dan dua peralihan monsun. Dalam kajian ini, data kelajuan angin di dua puluh dua (22) pusat kajicuaca di Malaysia diperolehi daripada Jabatan Meteorologi dan dipertimbangkan dalam penilaian persekitaran angin dan data kelajuan angin akan ditukar kepada ketinggian 1.5m pada semua titik pengukuran dihitung dengan menggunakan '*¼ power law*'. Hasil kajian dibandingkan dengan kajian yang telah dilakukan oleh Kubota dan Miura et al, 2002. Dari hasil kajian terdapat dua jenis angin di Malaysia iaitu angin lemah dan angin kuat. Angin lemah kawasan yang tidak selesa dan angin kuat ialah kawasan yang selesa. Nilai minimum kelajuan angin pada tahun 2005-2009 adalah 0.3m/s pada suhu rata-rata lebih dari 25°C iaitu di Sitiawan. Untuk nilai maksimum rata-rata kelajuan angin 1.7m/s nilai rata-rata suhu rata-rata 27°C ialah di Mersing. Berdasarkan hasil kajian, dapat disimpulkan bahawa, dalam mempertimbangkan aliran angin di kawasan perumahan, ruamh teres bukanlah pilihan yang sesuai untuk bandar-bandar yang terletak di selatan Semenanjung. Ia lebih memilih untuk bangunan tinggi kerana dianggap lokasi bandar-bandar ini adalah keadaan angin lemah. Manakala, di bandar-bandar besar tidak termasuk selatan Semenanjung termasuk Sabah dan Sarawak, berada dalam keadaan selesa . Jadi, rumah teres atau bangunan bertingkat tinggi adalah pilihan yang sesuai.

LIST OF TABLE

LIST OF SYMBOLS

r	=	global responses
q	=	climatic factor
C_e	=	exposure factor
C_p	=	aerodynamic shape factor
C_i	=	influence factor
C_a	=	dynamic amplification factor
$u*$	=	friction velocity
τ_0	=	shear stress at the ground surface
ρ	=	air of density
K	=	Karman constant (K~0.4)
z_0	=	roughness length
z_{ref}	=	reference height
U_h	=	height of respective weather stations
$U\infty$	=	reference wind velocity above boundary layer in a wind tunnel (m/s)
zh	=	height of wind tunnel (mm)
$z\infty$	=	reference height above boundary layer in a wind tunnel (mm)
$V_{1.5}$	=	actual wind velocity in the respective case study towns (m/s)
V_h	=	mean wind velocity based on climatic data (m/s)
$U_{1.5}$	=	actual mean wind velocity (m/s)
U_{10}	=	mean wind velocity by Meteorological Department (m/s)

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The Kyoto Protocol on climate change come into effect in February 2005, one of the major contributors to green house gas, has approved rectification. Although currently the protocol refers only for the developed nations, which have huge amount of greenhouse gas emissions, it can be predicted that the developing countries including Malaysia will be required to consent to the protocol in the near future. Thus, it is very important and effective to examine the energy saving means to reduce the green house gas in the course of its economic development. This required the signatory nations is intend to cut global emission of greenhouse gases below 1990 levels, by 2012, as part of an attempt to achieve a more sustainable global environment. Only developed countries have been required to set greenhouse gas reduction targets, to date. However, energy-saving strategies are also important for developing countries.

The last three decades have seen tremendous growth of urban populations in Malaysia. The percentage of people living in urban areas has increased from 27% in 1970 to 64% in 2010 (research from NasionMaster.com). Current energy consumption in urban areas is therefore a very significant percentage of total energy consumption in the country and it is expected to rise further in the near future. The present nationwide final energy demand is almost five times larger than it was in 1980 (Malaysia, 2002a). Thus, it is essential to introduce energy-saving to urban areas wherever possible.

Climate is change in the statistical distribution of weather over period of time that range from decades to millions of years. It can be a change in the average weather or a change in the distribution of weather events around an average (for example, greater or fewer extreme weather events). Climate change may be limited to a specific region, or may occur across the whole Earth. To bring climate change to a halt, global greenhouse gas emissions must be reduced significantly.

The greenhouse gases caused by the use of air-conditioners in residential areas contribute substantially to emissions. Maximizing the use of natural ventilation can significantly reduce the reliance on air-conditioners and therefore emissions. Recent recognition of the need to save energy has been the catalyst for a reassessment of the important of natural ventilation.

The following authors, in several studies, examined planning methods of neighborhood areas in Japan, paying attention particularly to the effect of wind flow (Kubota, Miura, Tominaga and Mochida, 2000, 2002). Furthermore, the present author addressed similar subject matter in studies conducted in Malaysia (Kubota and Supian, 2004,2005)

1.2 Climatic Condition in Malaysia

Malaysia consists of the Peninsular Malaysia and a part of Borneo Island. Since the Peninsular has the major population (76%), the present study is aim on this area. The Peninsular Malaysia in situated between 1° N and 7° N latitude, under the tropical climate. Most towns in the Peninsular experience high temperature and humidity throughout the year without remarkable variations. However, there is a seasonal climatic change, which is dominated by the monsoon. Though the wind over the country is generally light and variable, there are, however, some uniform periodic changes in the wind flow patterns.

Based on these changes, four seasons can be distinguished, namely, the southwest monsoon, northeast monsoon and two shorter periods of inter-monsoon seasons. The southwest monsoon season is usually established in the latter half of May or early June and ends in September. The prevailing wind flow is generally southwesterly and light, below 7.72m/s. The northeast monsoon season usually commences in early November and ends in March. During this season, steady easterly or northeasterly winds of 5.15m/s to 10.3m/s prevail. The east coast states of Peninsular Malaysia where the wind may reach 15.46m/s or more during periods of strong surges of cold air from the north (cold surges). During the two intermonsoon 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 10.29m/s or more.

As mentioned earlier, Malaysia has high humidity. The mean monthly relative humidity is between 70 to 90%, varying from place to place and from month to month. For any specific area, the range of the mean monthly relative humidity varies from a minimum of 3% (Bintulu) to a maximum of about 15% (Alor Setar). In Peninsular Malaysia, the minimum range of mean relative humidity varying from a low 80% in February to a high of only 88% in November. The maximum range is found in the northwest area of the Peninsular (Alor Setar) where the mean relative humidity varies from a low of 72% to a high of 87%. It is observed that in Peninsular Malaysia, the minimum relative humidity is normally found in the months of January and February except for the east coast states of Kelantan and Terengganu which have the minimum in March. The maximum is however generally found in the month of November.

As in the case of temperature, the diurnal variation of relative humidity is much greater as compared to the annual variation. The mean daily minimum can be as low as 42% during the dry months and reaches as high as 70% during the wet months. The mean daily maximum, however, does not vary much from place to place and is always 94%. It may reach as high as 100%. Again, the northwest states of Kedah and Perlis have the largest diurnal variation of relative humidity

1.3 Problem Statement

The need for energy saving in cities is increasingly recognized in Malaysia. The world trade crude oil price has been continuing increase recently. Since more than 60% of the electricity is generated by gas, which price is related to the crude oil price, it is believed that the electricity tariff may be raised soon in Malaysia (the New Strait Times, 2004). Therefore, in order to maintain a stable economic growth, the government must

consider the ways to reduce the dependence on fossil fuels and promote every saving initiation. [8]. The present nationwide final energy demand is almost five times larger than it was in 1980 (Malaysia, 2002a). Thus, it is essential to introduce energy-saving strategies to urban areas wherever possible.

Greenhouse gases caused by the use of air-conditioners in residential areas contribute substantially to emissions. Maximizing the use of natural ventilation can significantly reduce the reliance on air-conditioners and therefore emissions. Recent recognition of the need to save energy has been the catalyst for a reassessment of the important of natural ventilation.

For naturally ventilated buildings, the wind flow around the structure strongly affects the air change rates within the building. Thus, if a wind environment that generates sufficient wind speed is design at a neighborhood scale, the energy consumption of air-conditioners in the area can be significantly reduce. In addition to the benefits stated above, wind flow also play an important role in diffusing air pollution and heat at an urban scale as well as a neighborhood scale.

1.4 Objective of Study

In order to realize the aims of this study the specified objectives are identified. The objectives of this study are listed as follow:-

i. To study the wind environment condition in Malaysia
ii. To identify mean wind velocity for each major town in Malaysia
iii. To analyses mean wind velocity in each major town in Malaysia

1.5 Scope of the Study

The scope of this study is about wind flow or wind environment of residential house areas which is focusing in Peninsular Malaysia, Sabah and Sarawak. This study will use climate data from years Jan 2005 to Dec 2009.

1.6 Significance of the Study

In order to maintain a stable economic growth, the energy saving may be done by limiting the electricity used. So, the best way to limit the electricity used is reduce the utilization of air-conditioners. Greenhouse gases caused by the use of air-conditioners in residential areas contribute substantially to emissions. Natural wind flow is one of the most effective methods to help achieve the energy saving in large cities especially under the tropical climate like Malaysia. Maximizing the use of natural ventilation can significantly reduce the reliance on air-conditioners and therefore emissions. Recent recognition of the need to save energy has been the catalyst for a reassessment of the important of natural ventilation.

CHAPTER 2

LITERETURE REVIEW

2.1 Introduction

Malaysia possesses a very good potential of renewable energy. Recently, wind energy conversation is given a serious consideration in Malaysia. Since this country lies in the equatorial region and its climate is governed by the monsoons, the potential for wind energy generation in Malaysia is very much dependent on the availability of the wind resource that varies with specific location. Wind energy is an alternative clean energy source compared the fossil fuel, which can be harmful and pollutes the layer of the atmosphere. [6]

On the other hand, greenhouse gasses effect and climate change will cause by the use of air-conditioners in residential areas contribute substantially to emissions. Maximizing the use of natural ventilation can significantly reduce the reliance on air-conditioners and therefore emissions. Recent recognition of the need to save energy has been the catalyst for a reassessment of the important of natural ventilation. [1]

That changed in the carbon dioxide content through human intervention have the potential to change the planet's circulation patterns for better or for worse. One of the consequences may be the increase in climate extremes. These increases in extremes are important from the wind engineering viewpoint because, currently, wind-related disasters are the most costly in terms of property damage and casualties. They are doubling roughly ever 5–10 years. The wind can provide power for windmills and sailing ships but can also cause catastrophic destruction. Wind engineering is vitally concerned with these interactions with human activities. [6]

2.2 Climate in Malaysia

The characteristic features of the climate of Malaysia are uniform temperature, high humidity and over rainfall. Winds are generally light. Situated in the equatorial doldrums area, it is extremely rare to have a full day with completely clear sky even during periods of severe drought. On the other hand, it is also rare to have a stretch of a few days with completely no sunshine except during the northeast monsoon seasons.

Though the wind over the country is generally light and variable, there are, however, some uniform periodic changes in the wind flow patterns. Based on these changes, four seasons can be distinguished, namely, the southwest monsoon, northeast monsoon and two shorter periods of inter-monsoon seasons.

The climate in the country is usually warm all through the year with temperatures ranging from 21°C to 32°C in the plains and as low as 16°C in the uplands. The average temperature is 32°C throughout the day and 22°C at night, although it is colder in the mountainous areas.

The country has two (2) different seasons: monsoon and the dry season. The dry season arises throughout the southwest monsoon from May to September. The weather is humid and hot in the month of September with average temperature of 35°C in the day and 25°C at night. Rainfall throughout this period of the year is minor. The northeast monsoon leads to the rainy season in the middle of November until March. It brings heavy rainfall specifically to the east coast states of western Sarawak and Peninsular Malaysia, while the southwest monsoon usually implies moderately drier climate. In the East coast of Peninsular Malaysia, rains arise from October to February and also in the region of Sabah and Sarawak. Rainfall in the West coast of the country arises between April and November. The rainfall annual average in the country is around 85.8 inches.

2.3 Monsoon

The word "monsoon" is derived from the Arabic word "mausim" which means season. Ancient traders plying in the Indian Ocean and adjoining Arabian Sea used it to describe a system of alternating winds which blow persistently from the northeast during the northern winter and from the opposite direction, the southwest, during the northern summer.

Monsoon is caused by land-sea temperature differences due to heating by the sun's radiation. From time to time, strong outbursts of cold air (termed as monsoon surges) interact with low pressure atmospheric systems and cyclonic vortices are formed near the equator resulting in strong winds and high seas in the South China Sea and heavy rainfall to east coast states of Peninsular Malaysia as well as the west coast of Sarawak in East Malaysia.

The weather in Malaysia is characterized by two monsoon regimes, namely, the Southwest Monsoon from late May to September, and the Northeast Monsoon from November to March. The Northeast Monsoon brings heavy rainfall, particularly to the east coast states of Peninsular Malaysia and western Sarawak, whereas the Southwest Monsoon normally signifies relatively drier weather. The transition period in between the monsoons is known as the inter-monsoon period.

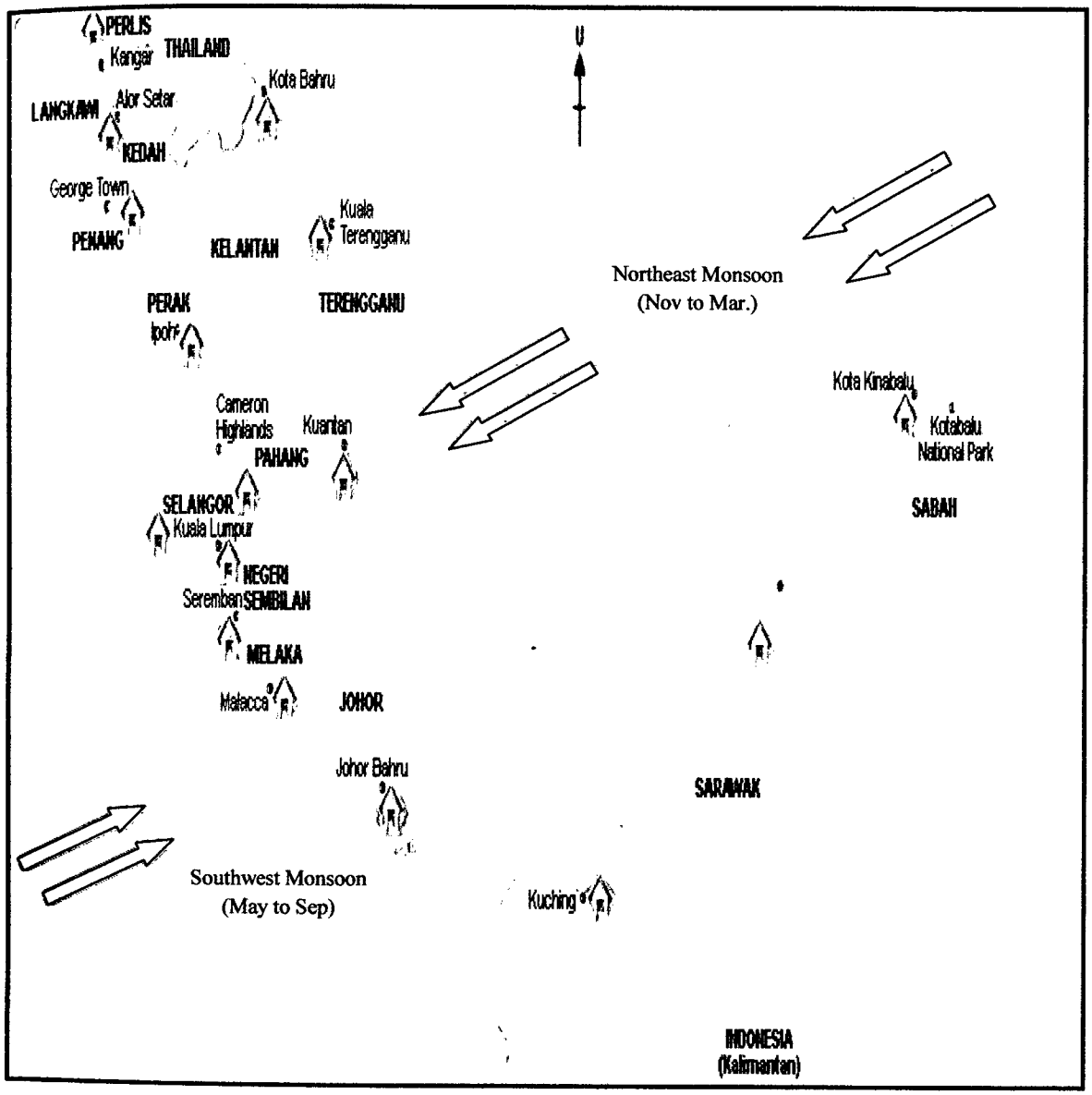

Figure 2.1: Map of Malaysia

2.3.1 Characteristics of the Southwest Monsoon

The Southwest Monsoon, also generally known as the northern hemisphere summer monsoon is characterized by a period of persistent southwest winds in the lower troposphere. The monsoon season usually sets in around the second week of May, but the actual onset date varies from year to year. It could be as early as the last week of April and as late as mid June. The active phase of the monsoon, typically lasts from June to August and by mid-September, it will start to weaken and eventually ended by the first week of October.

During this period the atmosphere becomes relatively more stable which causes less intense convective development, thus we get more dry days than wet days for most parts of the country. During the active phase of the season, there is an overall reduction in rainfall over Peninsular Malaysia and Sarawak. In particular, the west coast states of Peninsular Malaysia and western parts of Sarawak will experience lesser rainfall as compared to those few months just before the onset of the monsoon. However, coastal areas of the west coast states, from Southern Perak to Western Johor in Peninsular Malaysia will occasionally experience thunderstorms, heavy rain and strong gusting winds in the predawn and early morning brought about by the development of squall lines.

The relatively stable atmosphere, which suppresses strong vertical mixing and drier conditions during this period, also causes hazy conditions over urban and industrial areas where local activities generate large volumes of aerosol particles. Under prolonged dry conditions, for example during strong El Nino years (1997) widespread haze from

trans-boundary pollution from forest fires in neighbouring countries is another occasional feature during this season.

2.3.2 Characteristics of the Northeast Monsoon

The northeast monsoon is characterized by persistent winds from the northeast. During this period, the east coast states of Peninsular Malaysia, the coastal region of Sarawak and east coast areas of Sabah will experience heavy widespread rainfall lasting 2 to 3 days. It is possible that such event can occur in different places for 3 - 4 times. During the monsoon, it is also possible to have few days of totally no rain or light rain. During this monsoon, the west coast states of Peninsular Malaysia usually experience showers or thunderstorms in most places in the afternoons and the evenings.

Over in Peninsular Malaysia, the occurrence of widespread, continuous rain, occasionally becoming heavy, begins in Kelantan and Terengganu from early November and slowly moves to Pahang and East Johor in December and early January. This heavy, widespread rain occurring in November and early December will normally decrease slowly as the monsoon progresses after that.

At time, this monsoon weather system can spread to the west coast states of Peninsular and as such can cause widespread moderate intermittent rain lasting for several hours continuously.

Over in Sabah, generally the heavy monsoon rain occurs from late December lasting till early February. The east coast divisions of Sabah, namely Sandakan and