ANALYZE EXTREME WIND SPEED IN PENINSULAR MALAYSIA

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ABSTRACT

The focus of the study is to analyze the maximum wind speed, maximum gust speed and damage to buildings cause of extreme wind in Peninsular Malaysia. Natural wind flow is one of the most effective methods to help achieve energy savings in large cities, particularly under tropical climate such as Malaysia. The weather in Malaysia is characterized by four monsoon regime of the southwest monsoon, northeast monsoon and two shorter than the monsoon season. For this study, data of wind velocity in a weather station in Malaysia obtained from the Department of Meteorology and considered in the environmental assessment of the wind. The maximum wind speed 6.68 m/s in July 2008, the maximum wind velocity and wind maximum in 2003-2013 to station in Penang. From these data, according to the Beaufort scale of wind is fresh Breeze and the maximum gust speed of 6.31 m/s in January 2005, the maximum wind velocity and wind maximum in 2003-2013 to station in Malacca. From these data, according to the Beaufort scale of wind is fresh Breeze. From this data, according to the Beaufort scale of wind is fresh Breeze. This study results are compared in Table 2.1 in the Beaufort scale. The damage of buildings caused by wind conditions often occur and are relevant for the design of the building was a storm, and the wind velocity at a specific height above the ground. This condition is generally associated with one of these situations including tornado, storm, wind conditions specific local wind from the geographical and climatic conditions and the latter is odd local wind conditions resulting from sea level. The effect of wind on the building can be classed into several parts due to certain criteria; the wind was in the know of direct pressure between the outer wall, the outer wall suction, pressure on the surface of the roof, the whole of the building and more. The effect of this can be solved with several conditions including a strong connection, a secure site, and the selection of appropriate materials, orderly arrangement of buildings and failure modes and prevention. Wind is moving air with a specific mass (density or weight) and it moves in a certain direction with a certain velocity. When this moving air collides with an object, it will produce a number of effects that result in a force on the object

ABSTRAK

Fokus kajian adalah menganalisis kelajuan angin maksimum dan kelajuan tiupan angin dan juga kemusnahan di sebabkan kelajuan angin terhadap bangunan di Semenanjung Malaysia. Aliran angin semula jadi adalah salah satu kaedah yang paling berkesan untuk membantu mencapai penjimatan tenaga di bandar-bandar besar terutamanya di bawah iklim tropika seperti Malaysia. Cuaca di Malaysia mempunyai ciri-ciri empat rejim monsun iaitu monsun barat daya, monsun timur laut dan dua tempoh yang lebih pendek daripada musim antara monsun. Untuk kajian ini, data halaju angin dalam stesen cuaca di Malaysia yang diperoleh daripada Jabatan Meteorologi dan dipertimbangkan dalam penilaian alam sekitar angin. kelajuan maksimum angin 6.68 m / s pada bulan Julai 2008, halaju angin dan angin maksimum maksimum dalam 2003-2013 untuk station di pulau pinang. Daripada data ini, menurut skala Beaufort angin adalah Breeze segar manakala kelajuan tiupan angin maksimum 6.31 m / s pada Januari 2005, halaju angin maksimum dan maksimum angin di 2003-2013 untuk station di melaka. Daripada data ini, menurut skala Beaufort angin adalah Breeze segar. Kajian ini juga hasilnya dibandingkan oleh Jadual 2.1 di Beaufort Skala. Kemusnahan bangunan di sebabkan oleh keadaan angin yg sering terjadi dan berkaitan bagi rekabentuk bangunan adalah ribut, halaju tinggi spesifik dan angin pada aras tanah. Keadaan ini secara umumnya berkaitan dengan salah satu situasi ini antaranya puting beliung,ribut, keadaan angin tempatan yang khusus iaitu angin daripada keadaan geografi dan iklim yang ganjil dan yang terakhir adalah keadaan angin tempatan yang terhasil daripada aras laut. Kesan angin yang besar terhadap bangunan boleh di kelaskan kepada beberapa bahagian kerana kriteria-kriteria tertentu keadaan angin telah di ketahui iaitu antaranya tekanan terus kepada dinding luar, sedutan ke atas dinding luar, tekanan ke atas permukaan bumbung, daya keseluruhan ke atas bangunan dan banyak lagi. Kesan - kesan ini boleh di selesaikan dengan beberapa syarat antaranya sambungan yang kuat, tapak yang selamat, pemilihan bahan yang sesuai, susunan bangunan yang teratur dan mod kegagalan dan pencegahannya. angin merupakan udara yang bergerak dengan jisimnya yang tertentu (ketumpatan atau berat) dan ia bergerak pada arah yang tertentu dengan halaju tertentu. apabila udara yang bergerak ini bertembung dengan sesuatu objek, ia akan menghasilkan beberapa kesan yang mengakibatkan suatu daya terhadap objek.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Most probably every year some part of Malaysia will expected of damages caused by the windstorm. The damages will effect either to properties (roof blown off and vehicle destroyed), environment (uprooted tree) and human (people killed and injured). The losses caused by a typical damage value reach from thousand to a million ringgit.. The impacts of windstorm also could create social problem such as trauma and homeless to the windstorm victims. Victims that had been interviewed after windstorm occurrence on May 18th, 2001 at Pasir Mas, Kelantan agreed that the experience was the most frightening in their life. While, for the victims of windstorm occurrence on September 27th, 2000 at Seberang Perai Tengah, Penang, they always feel unsafe when there is a bad weather.

This is due to what they had experienced. Even though, injury and death is minimal, victims still suffered trauma and this is according to the eyewitnesses from those who did site investigation work after tornado occurrence. 100 families at Chukai, Kedah had to stay a few nights at school temporary until their house is repaired because their homes have been damaged by windstorm on August 18th, 2001. Most of the damaged

houses were left without roofs and several trees were uprooted and fell on some of the houses. A significant increase in the number of people rendered homeless as a result of wind events in South African if more attention is being paid to underdeveloped communities and better reporting on damage in areas of mass housing and informal developments.

In general, Malaysian has a good awareness on this disaster. More than 90 % of the respondents agreed the windstorm were among the types of natural disasters that were capable of bringing destruction and should be concerned. Report through newspaper, television, radio and internet about the windstorm damage and proactive step that had been taken by Malaysia Meteorological Department (MMD) by published a detail about windstorm through the department website are believed as the factors that contribute to the increase of windstorm awareness among Malaysian. However, until to date, there is no conclusive statistics that relate to the scenario of this disaster that could be referred as a whole in Malaysia are readily available. Its hope that the information from the paperwork will shows how serious windstorm disaster in Malaysia. Furthermore, as a general warning to the public and input for holistic and in-depth study that relate to the storm in the future as well.

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

Analysis of wind speed effect has become an integral part of design. Wind induced structural vibration can caused severe structural damage and failure. According to International Disaster Database (OFDA/CRED, 2004) wind storm are listed top 10 natural disasters affecting in Peninsular Malaysia. A lot of building destroyed or damage due to extreme wind speed. On 6 of November 2004, wind storm has affected 40000 people in east coast of Peninsular Malaysia.

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 identify maximum wind velocity and gust speed based on whether station data in Peninsular Malaysia
ii. To analyses maximum wind velocity and gust speed based on whether station data in Peninsular Malaysia

1.5 SCOPE OF THE STUDY

The scope of this study is about extreme wind speed areas which are focusing in Peninsular Malaysia. This study will use climate data from years Jan 2003 to Dec 2013.

1.6 SIGNIFICANCE OF THE STUDY

The possibility risk of wind load damage to roof structure. Conventionally in Malaysia most of the roof design only considered wind load acting as a pressure load to the roof structure. However from the many research done it seem that wind also can cause suction load to the building structure. Most damage to roofs themselves is caused by local high suctions and large pressure fluctuations around the roof periphery and protruding portions. In Malaysia the most of truss system used as roof structure is steel and wood. Steel truss structure is commonly used almost at urban area and considered as engineered building while wood frame truss always used at rural area which is almost are non-engineered building. Recently both of the structure system fails during the thunderstorm. Currently study is conduct to examine whether the conventional method of design and current approach of construction in Malaysia is secure during the high wind speed.

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 every 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.

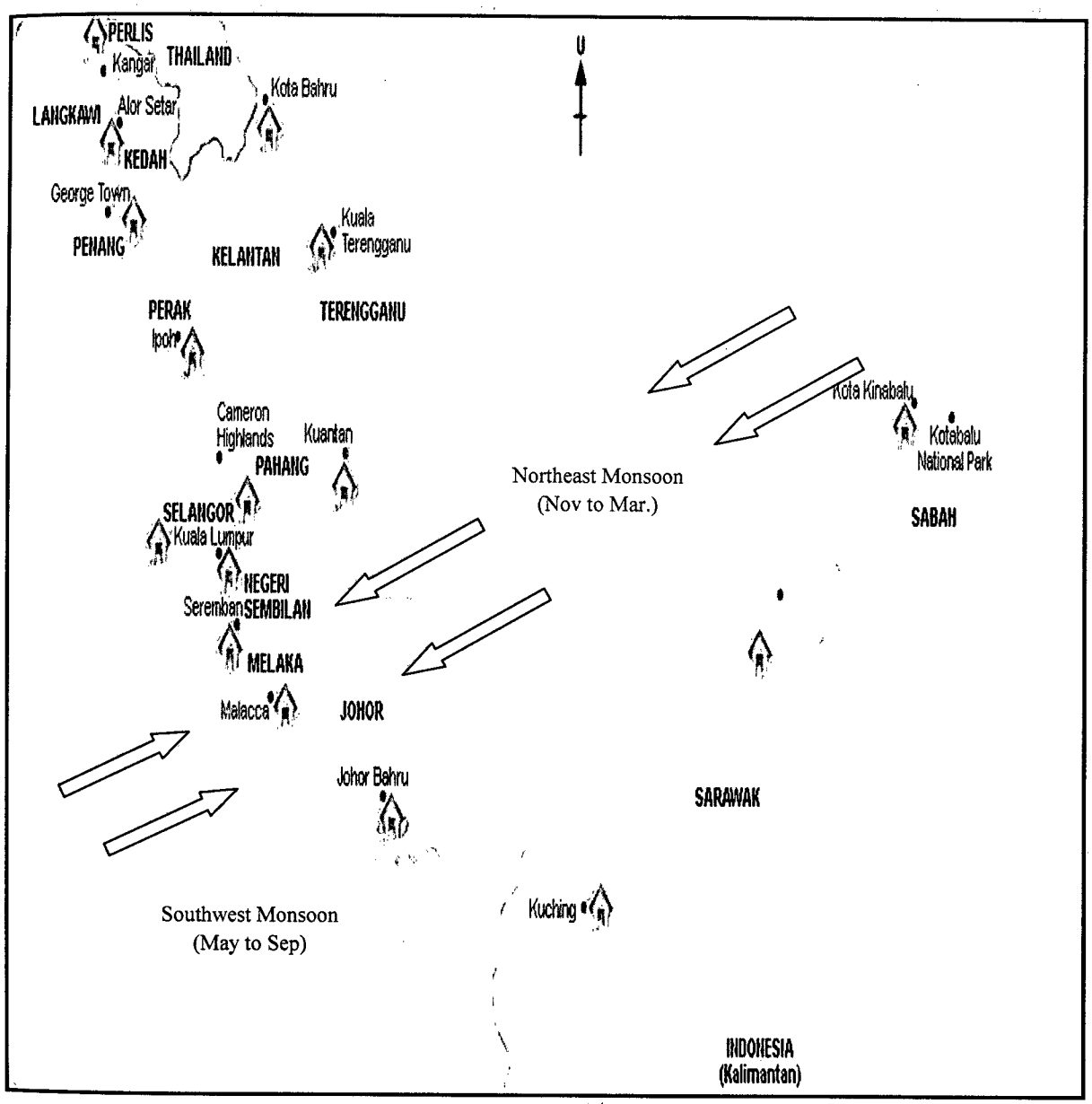


Figure 2.1: Map of Malaysia

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 Kudat will experience heavy rain in December and early January whereas the west coast divisions, interior and Tawau will experience showers and thunderstorms in the afternoons.

Over the Sarawak, heavy rain occurs from late December to early February. He heavy monsoon rain usually affects the west cost divisions of Kuching, Sri Aman, Sibu and Limbang in late December, January and early February. During this period, the eastern divisions of Bintulu, Kapit and Miri will experience scattered thunderstorm or showers in the afternoons and nights.

2.3.3 Characteristics of the Inter-monsoon

Base on these change, it have another two seasons known as the transition or inter-monsoon which of its months are between September to October and March to May. These period from southwest to northeast monsoon. The Southwest Monsoon, which is characterized by persistent winds from the southwest and drier conditions, comes to an end around middle September. Then, the transition period precedes the onset of the Northeast Monsoon season which normally starts in early November. However, the transition period is not a smooth process because of an abrupt change related to the withdrawal of the Southwest Monsoon and arrival of the Northeast Monsoon. Unlike the monsoon season, the wind direction during the inter-monsoon period is often variable and the wind speeds seldom exceed 5.15m/s.

Normally, during the inter-monsoon period the weather in Malaysia will be typically fair in the morning with strong convective clouds developing in the late morning and early afternoon. The west coast states and inland areas of Pahang, Terengganu and Kelantan in Peninsular Malaysia frequently experience scattered showers and thunderstorms in the late afternoon and evening, often accompanied by heavy rain and at times strong gusting winds. The rest of Peninsular Malaysia experience isolated showers and thunderstorms in the afternoon and evening. Over Sabah and Sarawak there is a general increase in rainfall amounts during these two months in comparison to the previous three months, with the exception of south-eastern Sabah.

2.4 WIND LOADING CHAIN

Some years ago the writer suggested that the key responses of a structure to wind forces could be summarized in terms of a chain of roughly five links or factors. We called it the "wind loading chain". The links making up this chain can be connected as follows: [6][7]

i. $\{q\}$, is a climatic factor providing statistical information on a reference wind velocity pressure, direction and recurrence interval, and reflecting the storm systems which prevail in the region;

ii. $\{C_e\}$, is an exposure factor defining the modifying influence of terrain roughness and topography on the wind velocity pressure;

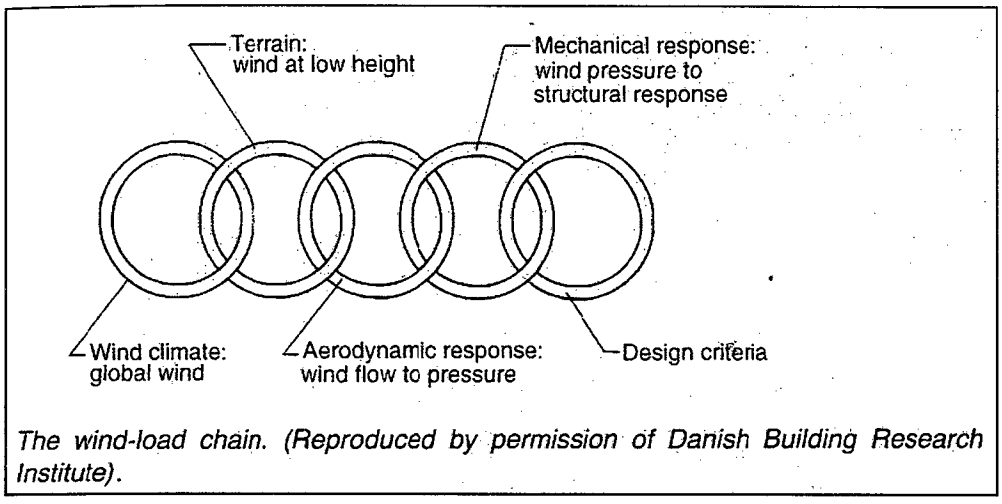
iii. $\{C_p\}$, is an aerodynamic shape factor describing the effect of geometric shape and leakage on the local pressures on the structure;

iv. $\{C_i\}$, is an influence factor which defines the ratio of the global responses $\{r\}$ of the structure to the local wind pressures acting over the exterior and interior surfaces of the structure; and

v. $\{C_a\}$, is a dynamic amplification factor describing the influence of resonance and other forms of dynamic magnification on the key global responses.

The global responses can then be written as

$$r=qC_eC_pC_iC_a \qquad (2.1)$$



The wind-load chain. (Reproduced by permission of Danish Building Research Institute).

Figure 2.2: The wind-load chain

2.4.1 Wind and Wind Response

The concept of the wind-load chain was introduced by A.G. Davenport, see Figure 2.2. Each link is necessary when wind actions and the response to be calculated. The concept of a chain symbolizes that the total design process is only as reliable as the least reliable of the links. Figure 2.2 also indicates some interactions between different phenomena in the chain.

2.4.2 Wind Climate

This term covers the general wind conditions in different geographical region. The term includes only variations in wind velocities averaged over a period at least 10 min. The reference wind velocity is determined mainly by the wind climate. [9]

2.4.3 Terrain Conditions

The roughness of the terrain exerts a major on the wind. The mean wind velocity is reduced by the roughness of the ground, but the same time the wind becomes turbulent and more difficult t describe. Mean wind velocity increases with the height above the ground. [9]

Usually, the terrain can only be described in a very coarse way by introducing different categories. These are then identified by the so-called roughness length z_0. As the terrain surrounding the structure in question characterizes the roughness, possible changes, such as the erection or demolition of nearby buildings, which may take place during the lifetime of the structure, may affect wind loads. [9]

2.5 MAXIMUM WIND SPEEDS

Wind speed, or wind velocity, is a fundamental atmospheric rate. Wind speed is caused by air moving from high pressure to low pressure. Wind speed affects weather forecasting, aircraft and maritime operations, construction projects, growth and metabolism rate of many plant species, and countless other implications. Wind speed is now commonly measured with an anemometer but can also be classified using the older Beaufort scale which is based on people's observation of specifically defined wind effects.

2.5.1 Factors affecting wind speed

Wind speed is affected by a number of factors and situations, operating on varying scales (from micro to macro scales). These include the pressure gradient, Rossby waves and jet streams, and local weather conditions. There are also links to be found between wind speed and wind direction, notably with the pressure gradient and surfaces over which the air is found.

Pressure gradient is a term to describe the difference in air pressure between two points in the atmosphere or on the surface of the Earth. It is vital to wind speed, because the