

**INTRODUCING NATURAL VENTILATION  
IN SELECTED MALAYSIAN HOTELS  
FOR ENVIRONMENTAL SUSTAINABILITY**

**AZUSA IKEDA**

**UNIVERSITI SAINS MALAYSIA**

**2009**

**INTRODUCING NATURAL VENTILATION  
IN SELECTED MALAYSIAN HOTELS FOR  
ENVIRONMENTAL SUSTAINABILITY**

**by**

**AZUSA IKEDA**

**Thesis submitted in fulfillment of the requirements  
for the degree of Master of Science**

**July 2009**

## ACKNOWLEDGEMENTS

I would like to convey my gratitude and appreciation to the following individuals and organizations in the preparation of this thesis. Dr. Muna Hanim Abdul Samad and Associate Professor Ar. Dr. Abdul Malik Abdul Rahman both from the Universiti Sains Malaysia, as being thoughtful lecturers in the many aspects throughout my research. They gave generously their knowledge, time and effort, provided academic directions and offered constructive views and criticisms. I am also grateful to Mrs. Teh Siew Hong, for her entire assistance and cooperation on operating, observing and downloading very important information using the with BABUC data logger.

I wish to thank various personal whom I interviewed and they are Ms Amphai Wejw ithan, Manager of Green Leaf Foundation, Ms Nurul Fatanah Zahari, Environment and Education Officer of The Frangipani Langkawi Resort & Spa, and also the cooperation given by the hotels which I visited namely, D'MA Pavilion Hotel Bangkok, Banyan Tree Bangkok, Siam City Hotel and Resort, Paradise Sandy Beach Resort Penang, Hotel Equatorial Penang, and other hotels which I did not visit but cooperated for questionnaire survey.

Finally I would also like to thank the Universiti Sains Malaysia for the research grant given to both my supervisors to make the research a success.

## TABLE OF CONTENTS

Acknowledgements.....	ii
Table of Contents.....	iii
List of Plates.....	viii
List of Figures.....	ix
List of Tables.....	x
Abstrak.....	xi
Abstract.....	xiii

### CHAPTER 1: INTRODUCTION

1.1	Introduction.....	1
1.2	Sustainable Issues and Tourism Industry.....	6
1.3	Background of Green Hotels.....	7
1.4	Green Hotels in Malaysia.....	9
1.5	Statement of Issues.....	10
1.6	Objective of This Research.....	11
1.7	Hypothesis.....	12
1.8	Research Methodology.....	13
1.8.1	Primary Data.....	14
1.8.1.1	Case Studies.....	14
1.8.1.2	Standard Effective Temperature (SET).....	18
1.8.2	Secondary Data.....	20
1.8.2.1	Preliminary Study of Malaysia Hotels.....	20

1.8.2.2	Review on Green Hotels in the World.....	21
1.8.2.3	General Sources of Data.....	21
1.8.2.4	Proposition of a Criterion for Malaysia Green Hotels.....	22
1.9	Limitation of Research.....	23
1.10	Structure of the Thesis.....	24

## **CHAPTER 2: LITERATURE REVIEW**

2.1	Sustainability Issues and Energy Efficient Buildings.....	26
2.1.1	Advantages of Passive Cooling.....	28
2.1.2	Variety of Passive Cooling.....	29
2.1.2.1	Insulation.....	29
2.1.2.2	Heat Elimination.....	30
2.1.2.3	Refrigeration.....	31
2.1.3	Case Studies on Energy Efficient Building.....	33
2.1.3.1	A Case Study in UK.....	33
2.1.3.2	Case Studies in Malaysia.....	34
2.2	Literature Review into Green Hotels.....	39
2.2.1	Main Objective of Green Hotels and Standards.....	39
2.2.2	Advantage of Environmentally Friendly Hotel.....	40
2.2.3	Subject of Green Hotels.....	42
2.2.4	Researches on the Method for Green Hotel.....	44
2.3	Green Concept Assessment in Hotel Industry.....	46
2.3.1	Proposed Environmental Sustainability Checklist.....	47
2.3.2	Green Hotels –Active System.....	49
2.3.2.1	Water.....	49

2.3.2.2	Roof and Wall Spray.....	50
2.3.2.3	Air-Conditioner: Heater / Cooler.....	51
2.3.2.4	Lighting.....	51
2.3.3	Passive Building Design Elements.....	53
2.3.3.1	Location and Orientation.....	53
2.3.3.2	Natural Lighting.....	55
2.3.3.3	Natural Ventilation.....	56
2.3.3.4	Greening & Shading.....	57
2.3.3.5	Double Skin and Insulation.....	58
2.3.3.6	Materials.....	59
2.3.4	Environmental Activities.....	60
2.4	Green Leaf Foundation in Thailand – An Example of Eco-Tourism .....	62
2.4.1	Objective of Green Leaf Foundation and Green Leaf Program .....	63
2.4.2	Benefits of the Green Leaf Program.....	65
2.4.3	Activities of Green Leaf Program.....	67
2.4.4	Green Leaf Certification Procedure.....	69
2.4.5	Green Leaf Hotels in Practice.....	71
2.4.6	Lesson from the Investigation into Existent Green Hotel Standard.....	80
2.5	Thermal Comfort Level in Malaysia.....	82

### **CHAPTER 3: PRELIMINARY SURVEY INTO ENVIRONMENTAL POLICY IN MALAYSIA HOTELS**

3.1	Investigation into Malaysian Environmental Hotels - Questionnaire Survey.....	85
3.1.1	Survey Methodology.....	85

3.1.2	Outcome from Active System.....	86
3.1.3	Outcome from Passive Systems.....	89
3.1.4	Outcome from Environmental Management Policy.....	97
3.2	Investigation into Malaysia Environmental Hotels - A Field Survey at Frangipani Langkawi Resort in Pulau Langkawi, Malaysia.....	98
3.3	Environmental Template for Malaysian Hotels.....	102
3.4	Findings from the Preliminary Surveys.....	104

#### **CHAPTER 4: CASE STUDIES ON NATURAL VENTILATION AS A PASSIVE ELEMENT**

4.1	Methodology & Field Investigation.....	105
4.2	Case Study at a Beach Hotel in Penang.....	109
4.2.1	The Land and Sea Breeze.....	109
4.2.2	Background of the hotel.....	111
4.3	Case Study at a hilltop Hotel, Penang.....	113
4.3.1	The prevailing winds of hill slopes.....	113
4.3.2	Background of the hotel.....	114

#### **CHAPTER 5: RESULTS AND DISCUSSION OF THE CASE STUDIES**

5.1	Results and Discussions of Case Study at the Beach Hotel.....	117
5.1.1	Air Temperature.....	117
5.1.2	Air Velocity.....	119
5.1.3	Relative Humidity.....	121
5.1.4	Standard Effective Temperature.....	123
5.2	Summary of Beach Hotel Case Study.....	125
5.3	Results and Discussions of Case Study at the Hilltop Hotel.....	128

5.3.1	Air Temperature.....	128
5.3.2	Air Velocity.....	130
5.3.3	Relative Humidity.....	131
5.3.4	Standard Effective Temperature.....	132
5.4	Summary of Hill Top Hotel Case Study.....	133
5.5	Discussion of the Results of Two Case Studies.....	134

## **CHAPTER 6: CONCLUSIONS**

6.1	Conclusion and Recommendations.....	138
6.2	Recommendation for the Future Research.....	142

<b>REFERENCES.....</b>	<b>144</b>
------------------------	------------

## **APPENDICES**

Appendix A-1: Data of Air Environment at the Lobby of Paradise Hotel.....	150
Appendix A-2: Data of Air Environment at the Lobby of Hotel Equatorial Penang.....	154
Appendix B: Questionnaire Papers.....	158
Appendix C: Outcome of the Questionnaire Survey.....	161
Appendix D: Environmental Certification Program for Hotel Industry in the World.....	173
Appendix E: List of Green Leaf Hotels in Thailand.....	175
Appendix F: Example of the Questionnaires for Green Leaf Certification.....	178
Appendix G: Selection Procedure of the 20 Reference Hotels for Green Leaf Certification.....	191
Appendix H: The First and Second Standard Scores for Green Leaf Hotel.....	192
Appendix I: The latest criteria for Malaysian hotel rating (The Star, 2007).....	193



## LIST OF PLATES

		Page
Plate 2.1	Wind catcher in Iwate, Japan	31
Plate 2.2	Low Energy Office in Putra Jaya, Malaysia	37
Plate 2.3	Zero Energy Office in Bangi, Malaysia	38
Plate 2.4	Drip irrigation	49
Plate 2.5	Outdoor misting system	50
Plate 2.6	(left) Regular lump and (right) energy efficient lump after the renovation in D'MA Pavilion Hotel, Bangkok, Thailand	52
Plate 2.7	Skylight with stained glass softens sun heating at the entrance lobby in Siam City Hotel, Bangkok, Thailand	56
Plate 2.8	Greened hotel surface at Equatorial Hotel Penang, Malaysia	57
Plate 2.9	Paper recycle box at Ciam City Hotel, Bangkok, Thailand	61
Plate 2.10	Green garden facing the lounge of Banyan Tree Bangkok, Thailand	76
Plate 2.11	A huge eaves above the entrance door of D'MA Pavilion Hotel, Bangkok, Thailand	78
Plate 2.12	A lot of greens covers the building to cut direct sun heating, at Siam City Hotel, Bangkok, Thailand	79
Plate 3.1	Facade of Frangipani Beach Resort, Pulau Langkawi, Malaysia	99
Plate 4.1	The BABUC environmental data logger	111
Plate 4.2	(left) Paradise hotel lobby looking towards the sea. (right): The hotel lobby as seen from Main Entrance and location of the BABUC environmental data logger	111
Plate 4.3	Upside of the Paradise hotel lobby	112
Plate 4.4	(top left) The main entrance glass door and wall (top middle) Hotel lobby and atrium (bottom) The panoramic view to the swimming pool from the lobby, in Hotel Equatorial Penang, Pulau Penang, Malaysia	115

Plate 4.5	(Top) The BABUC environmental data logger. (Bottom) Skylight at the lobby in Hotel Equatorial Penang, Pulau Penang, Malaysia	116
-----------	--	-----

## LIST OF FIGURES

		<b>Page</b>
Figure 1.1	Scheme of sustainable development Image at the confluence of three preoccupations	2
Figure 1.2	Methodology flowchart	13
Figure 1.3	Diagrammatic perspective and air movement of Paradise Beach Hotel	17
Figure 2.1	Cool Tube	32
Figure 2.2	Environmentally sustainable criteria for hotel building design	48
Figure 2.3	Cross section of Aurum Lodge	58
Figure 2.4	The procedure to achieve the Green Leaf Certification in Thailand	70
Figure 2.5	Direction of the monsoon around Malaysia	82
Figure 2.6	Air temperatures and rainfall in (light) Kuala Lumpur and (left) Penang	82
Figure 3.1	Outcome of the questions on lighting	86
Figure 3.2	Outcome of the questions on photovoltaic system	87
Figure 3.3	Outcome of the questions on air-conditioning	88
Figure 3.4	Questions on building orientation and the outcome	89
Figure 3.5	(left) Outcome of the questions on shading and (right) Sky-lighting	91
Figure 3.6	Outcome of the questions on (above left and right) natural ventilation, and (bottom left and right) Frequency of air-conditioning	92
Figure 3.7	Outcome of the questions on greening	92

Figure 3.8	Outcome of the questions on insulation	94
Figure 3.9	Outcome of the questions on building construction	95
Figure3.10	Outcome of the questions on building color	96
Figure 4.1	Diagrammatic perspective and air movement of the Paradise Beach Hotel	110
Figure 4.2	Diagrammatic cross section of Hotel Equatorial Penang	114
Figure 5.1	Air temperature at the lobby of Paradise Beach hotel (Degree centigrade)	117
Figure 5.2	Air velocity at the lobby of Paradise Beach hotel (Meter per second)	119
Figure 5.3	Relative Humidity at the lobby of Paradise Beach hotel (Percentage)	122
Figure 5.4	Standard Effective Temperature at the lobby of Paradise Beach hotel (Degree centigrade)	123
Figure 5.5	Air Temperature at the lobby of Hotel Equatorial Penang (Degree centigrade)	128
Figure 5.6	Air Velocity at a Hilltop Hotel at the lobby of Hotel Equatorial Penang (Meter per second)	130
Figure 5.7	Relative Humidity at the lobby of Hotel Equatorial Penang (Percentage)	131
Figure 5.8	Standard Effective Temperature at the lobby of Hotel Equatorial Penang (Degree centigrade)	132
Figure 5.9	Average readings for (above) Beach hotel and (bottom) Hilltop hotel	135

### LIST OF TABLES

		<b>Page</b>
Table 2.1	Environmental activities and building design at Green Leaf Hotel in Thailand	73
Table 3.1	Proposed sustainability passive system checklist	103

**PENERAPAN PENGUDARAAN SEMULAJADI  
PADA HOTEL TERPILIH DI MALAYSIA  
BAGI KELESTARIAN PERSEKITARAN**

**ABSTRAK**

Kekurangan sumber alam semulajadi dan pencemaran alam sekitar dianggap sebagai tanda pemanasan global dan satu ancaman serius kepada iklim dunia pada beberapa dekad yang lepas. Justeru itu, kepentingan pemuliharaan alam sekitar telah meningkat di semua sektor ekonomi di kebanyakan negara. Walaupun terdapat banyak badan berkuasa pelancongan yang telah mengadakan sijil piawaian bagi hotel-hotel yang lestari terhadap persekitaran, hanya sebilangan kecil hotel di Malaysia mempunyai polisi yang menyentuh isu-isu berkenaan. Kajian ini bertujuan untuk mengenalpasti keadaan semasa polisi alam sekitar di industri perhotelan di Malaysia, dan mencadangkan kaedah yang efektif dan praktikal bagi hotel-hotel lestari di Malaysia. Kajian ini ialah kajian tinjauan (exploratory) dalam mengaplikasikan rekabentuk bangunan pasif dari aspek pengudaraan semula jadi sebagai salah satu cara yang signifikan dan berkesan dalam mengurangkan tenaga di dalam bangunan hotel. Kajian kes yang dijalankan telah menguji keberkesanan pengudaraan semula jadi sebagai satu kaedah pasif pada bangunan hotel di tepi pantai dan hotel di atas bukit. Suhu udara, kelembapan relatif dan kelajuan angin telah dipantau dengan menggunakan 'BABUK environmental logger' dan pengiraan 'Standard Effective Temperature' (SET) telah diambil dari ketiga-tiga faktor bagi membuat perbandingan dengan suhu selesa di Malaysia. Rumusan dari kajian telah membuktikan hipotesis bahawa kaedah penggunaan pengudaraan semula jadi

pada ruang awam khususnya di lobi-lobi hotel dapat menjimatkan tenaga.tanpa kompromi terhadap keselesaan .

Tinjauan soal-selidik dan kajian lapangan telah dijalankan untuk mengenalpasti keadaan semasa hotel-hotel di Malaysia, serta membuat penelitian perbandingan terhadap piawai dunia dari tinjauan sorotan literature. Penemuan daripada kajian ini menunjukkan hotel-hotel di Malaysia kurang memberi pertimbangan dan pengetahuan dalam mewujudkan kelestarian persekitaran dengan penggunaan peralatan dan sistem mekanikal yang sangat tidak berkesan. Kajian ini merumuskan dengan cadangan-cadangan bahawa (1) Industri perhotelan di Malaysia perlu mengadakan garis panduan dan/atau sijil persekitaran bagi memperbaiki tahap kelestarian dan memberi pengetahuan dan kemahiran berhubung program alam sekitar, (2) memanipulasikan elemen-elemen pasif rekabentuk bangunan untuk memperbaiki kelestarian persekitaran bagi industri perhotelan, lantaran itu. garis panduan yang diwujudkan perlu memberi pertimbangan ini sebagai keutamaan.

# **INTRODUCING NATURAL VENTILATION IN SELECTED MALAYSIAN HOTELS FOR ENVIRONMENTAL SUSTAINABILITY**

## **ABSTRACT**

Shortage of natural resources and environmental pollutions are considered as signs of global warming and a serious world climatic threat in the last few decades. Hence, environmental conservation has been increasing important to all sectors of the economy for the countries. Though there are many tourism authorities that have created the standards or certifications for environmentally sustainable hotels, very few Malaysia hotels have policies addressing the issues. This study aims to define the current state of environmental policy in Malaysian hotel industry, and proposing the effective and practical method for Malaysian environmental hotels. This is an exploratory research in applying passive building design in the aspect of natural ventilation as one of the significant and effective method in attempting at reducing energy in hotels. The case study conducted tested efficiency of natural ventilation as one of the passive elements, for beach hotels and hilltop hotels. The air temperature, relative humidity and wind velocity were observed by using BABUK environmental logger and Standard Effective Temperature (SET) is calculated from the three air factors in order to compare with comfortable temperature for Malaysia. Conclusions from the research proved the hypothesis that the use of natural ventilation in public spaces, hotel lobbies in particular can reduce energy without compromising on comfort.

Questionnaire survey and field survey were carried out to grasp the present condition of Malaysian hotels whilst doing comparative studies on world standards from the literature review. Findings of this study show that Malaysian hotels lacked in consideration and knowledge for environmental sustainability with ineffective use of mechanical equipments and systems. This study is concluded with the suggestions that (1) Malaysian hotel industry requires setting up environmental guidelines and/or certification to improve its sustainability and provide knowledge and skills of environmental programs, (2) manipulation of passive building design elements to improve environmental sustainability for hotel industry, therefore the guidelines created should have this consideration as a priority.

# **CHAPTER ONE:**

## **INTRODUCTION**

### **1.1 Introduction**

Presently, 'sustainability' is a very important and essential concept whenever people discuss on social development and environmental issues. The words 'sustainability' has been widely recognized since the World Commission on Environment and Development presented 'Our Common Future' in 1987 under United Nations (Brown, 2005). The report advocated 'sustainable development' and it means the development which satisfies present needs without damaging future needs. However, sustainable is a concept very much discussed and it is very difficult to measure in our society. Many indexes have been developed, but until recently there was no index, which comprises all the aspects of a sustainable society, which is simple, clear and transparent and which is adequate for comparison between countries.

Figure 1.1 is one of the most approved schemes of sustainable development advocated by Johann Dreo (2006). He insisted that sustainable development policies encompass three general policy areas: economic, environmental, and social. In support of this, several United Nations texts, most recently the 2005 World Summit Outcome Document, refer to the "interdependent and mutually reinforcing pillars" of sustainable development as economic development, social development, and environmental protection.



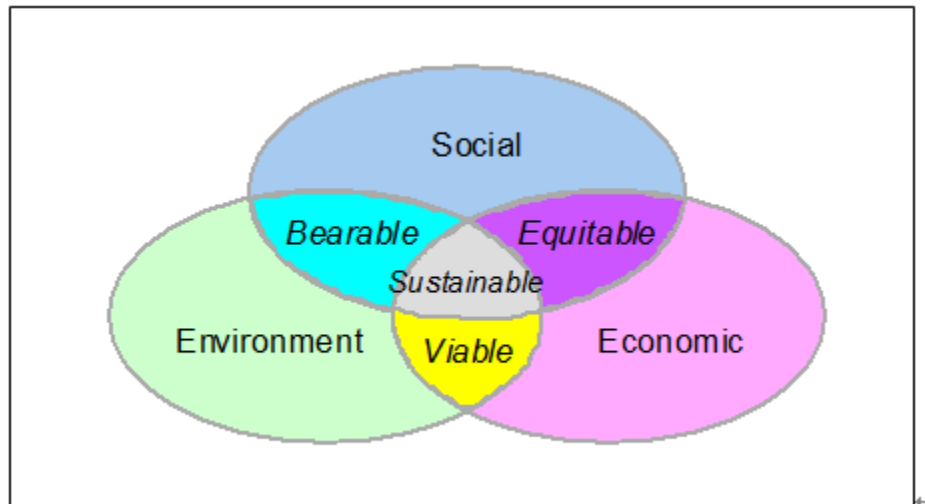


Figure 1.1; Scheme of sustainable development image at the confluence of three preoccupations (Johann, 2006)

Serious energy crisis had occurred after the first oil shock in 1973 (Hayashi, et al, 1997). The oil had been running out and the biggest problem worrying most people was the rising energy cost at that time. Shortage of petroleum was not seriously recognized until second oil shock in 1979 (Hayashi, et al, 1997). Many scientists and researchers tried to invent new energy which can be used similarly to petroleum with chemical treatment, for example, oil-sand and oil-shale. However, inventing this new chemical energy had lacked environmental-consciousness. As a result the oil crisis caused new environmental issues, namely environmental pollutions in the late 1980s.

As mentioned above, currently 'sustainability' started to be recognized as an important word in the world (Hayashi, et al, 1997). A lot of Environmental standards have been established all over the world. For example, a series of ISO14000, which proposed Environmental Management System (EMS), is offered in Rio de Janeiro, Brazil, in 1992 and enacted in 1996. The series

suggests 'PDCA' (Plan, Do, Check and Act) cycle for world sustainable development and composed with many categories, for example, Environmental Label (ISO14020-24), Environmental Performance Evaluation (ISO14030-31), and Environmental Conscious Design (ISO14062) (Akita Prefecture, 2000).

Shortly, Kyoto Protocol is adopted at the third session of the Conference of the Parties to the United Nations Framework Convention on Climate Change in Kyoto, Japan, December 1997 (Akita Prefecture, 2000). The protocol is an international treaty designed to limit global greenhouse gas emissions. 155 countries both developed and developing countries agreed to cut the amount of exhaust gas. In other words, the whole world started to try to reduce energy consumption and drive for sustainable development.

Environmental pollution has a lot of factors; shortage of energy, global warming, ozone depletion, environmental destruction and so on. These factors are all part of a ring and relate very closely to each other. It is possible that a solution for a factor causes new problems on the other factors, such as new chemical energy. On the other hand, ideal environmental solution can help to solve not only one issue but also other problems at the same time. For example, reduce of energy consumption cut carbon dioxide and it holds ozone depletion. 'Reuse, reduce and recycle', which is principle policy for environmental sustainability today, is one of the most ideal solutions.

In Malaysia, as in other parts of the world, the success of the tourism industry depended largely on the success of the hotel industry. The star ratings

would provide indication as to the kind of services provided by the hotels. It also indicates as to the level of comfort that can be experienced such as material comfort, activities and facilities convenience and also thermal comfort.

The hot humid climate of Malaysia necessitates the use of all kinds of mechanical systems to cool the surroundings. To feel comfortable one has to be under shade and experiencing ample air movement. These two elements have to occur concurrently. Otherwise, if there is only the element of shading without the wind or ample air movement, one would feel the radiant heat from the tropical sun. Of course by being under the tropical sun one experience the stifling heat unless the wind is moving with sufficient velocity to get rid of the radiant heat, normally any air velocity of more than two meter per second would suffice. Under the shade an air velocity of one meter per second is already sufficient.

At night time when the surrounding areas are no more exposed to the sun, ample wind is needed to get rid of the high relative humidity. Otherwise the high humidity in the air gives stickiness to the human skin. Unfortunately the tropical climate in Malaysia is described as hot and humid and has no reference to wind. This means the much desired wind in Malaysia for natural thermal comfort cannot be depended upon because of its characteristic behavior in that it is unpredictable, multidirectional and when there is wind the velocity may not be of the required speed. As a result air conditioning, fan and misting fountain were resorted to. These equipments would add to the running cost especially when

air-conditioning alone takes up nearly seventy percent of the electricity bill in most commercial industries.

Only two natural phenomena as reported by Malek (1994) can be identified to provide ample and air velocities that can have an influence in the design of buildings. They are normally experienced at locations by the beach where it is geographically termed as land and sea breezes and the other occurrence is the prevailing winds of the hill slopes.

One of the main attractions of why Western tourists would flock to Malaysia is to enjoy the Malaysian sun. A typical and habitual behavior for the tourist other than sightseeing activities, are to bask in the sun by the beach. Therefore, for the same reasons hotels in other parts of the world are mostly located along the fringes of attractive beaches.

Early in the year 2006 there was an increase in the cost of electricity tariffs in Malaysia of up to 12% (New Straits Times, 2006). For commercial activities (including the hotel industry), there were desperate attempts for everyone in business to reduce their operating cost on energy consumption. One example of this attempt is a general manager resorted to switching off air conditioning for one hour at the administrative section of the hotel in order to save energy. (Buttgen, 2007) This is not the right move as productivity of the staff might be affected. Steps should be taken towards energy efficiency in all activities.

## **1.2 Sustainable Issues and Tourism Industry**

Environmental issues have influenced a wider range of industries throughout the 1980s and 1990s. This research focuses on environmental sustainability for tourism industry whereby its business is easily affected by energy consumption. Environmental sustainability is highly meaningful for tourism industry in two conditions; keeping its selling points and securing its management.

In present days, many tourists travel around locally and overseas desiring for vernacular culture, people and nature. This calls for a proper environmental management to be one of the important selling points for tourism industry.

The other point is that high energy consumption causes high overhead, especially in accommodation section which seems to be the back bones of tourism industry. This phenomenon is not only for tourism but similar to other industries as well. However, the difference between the two is that the tourism industry cannot easily compromise on the comfort in material, thermal and facility wise for the guests. Slacking in these three items would have direct repercussions on occupancy rates.

### **1.3 Background of Green Hotels**

Similarly to other industry, tourism industry would no longer be able to ignore its environmental responsibilities in the 1990s. Hotel industry is being recognized as one of the sector which plays paramount roles in the ecological tourism industry and many efforts on environmental protection work in hotels began in the 1990s. The hotels which work on environmentally-friendly efforts are generally called Green Hotels.

There was not that much interest in environmental management in the hotel industry until the development of the International Hotels Environment Initiative (IHEI) set up in 1992, as a non-profit organization by twelve executives of multi-national hotel companies based in British. The first practical outcome was the development of a manual on environmental management for hotels (IHEI, 1993). Following the IHEI, the Hotel Catering & Institutional Management Association (HCIMA) and the World Travel and Tourism Council was established (HCIMA, 1994). Awareness for the environmental management has been gradually becoming widespread across the world and developing with the establishment of an environmental certification program. Examples are the Green Leaf (Thailand), Green Key (Denmark), Nordic Swan (Scandinavia), and EU Flower (European Union).

Over the years a number of guidelines and standards aimed at incorporating environmental and socio-cultural responsibility into hotel management have been published. Currently, over 100 eco-rating and

certification schemes are available for tourism and the hospitality industry worldwide (Front, 2002).

## **1.4 Green Hotels in Malaysia**

Comparing with the other environmentally developed hotel industry from other countries, Malaysia hotel industry appears lacking in the awareness for environmental policy. Even the latest tighter criterion for hotel ratings does not mention about environmental elements at all as shown in Appendix I.

The new criterion places a special emphasis on convenience for their guests, such as providing the Internet access for all area, 18 hours restaurant operation in a hotel and massive television programs. Though some hotels have taken environmental effort individually and on voluntary basis, the Malaysian Hotel Industry has no clear unified guidelines for environmental management.

This study therefore aims to review the environmental policy of Malaysian hotels and present definite criteria which will go far toward being more environmental friendly for them. In addition to that, passive building design elements will be demonstrated for its merit with some case studies.



## **1.5 Statement of Issues**

According to previous researches on environmental management for hotel industry and various literature which will be discussed further in the next chapter the following issues can be concluded as listed below;

1. Awareness in Environmental Policy is important but lacking in many developing countries.
2. Passive building system should adapt to the local conditions, such as the climate and immediate surrounding environment.
3. Sustainability from the viewpoint of the building design received very little attention and even ignored by previous established environmental programs and yet a critical factor in the whole phenomenon.
4. Malaysia is one of the countries that lack the above mentioned considerations.

## 1.6 Objective of This Research

This research limits itself to find out the practical environmental standard for Malaysia hotel industry. Though 'environmentally friendly hotel' has a lot of meanings, this research will approach the object from a viewpoint of building design, especially focuses on passive building design. The objectives of this research are as follows;

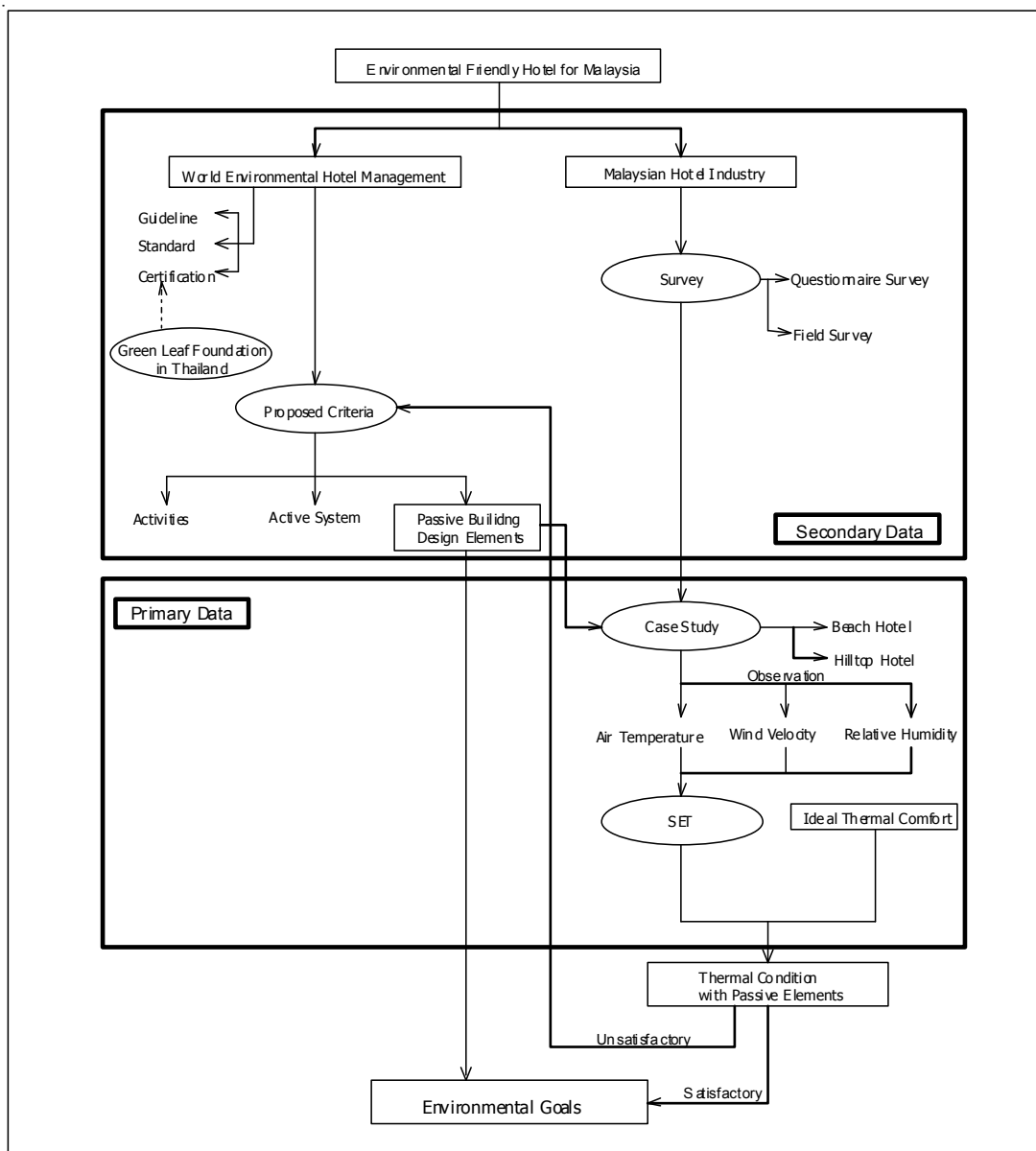
1. To examine the present condition of environmental sustainability in the Malaysian hotel industry comparing with world standard of green hotels.
2. To propose practical checklist of sustainable building design for Malaysian hotels.
3. To conduct an exploratory study on selected Malaysia hotels in the aspect of the natural thermal conditions, and to substantiate the possibility of energy reduction when Malaysia hotel incorporate passive building elements, specifically natural ventilation

## **1.7 Hypothesis**

In this study, as mentioned above, passive building design elements will be demonstrated for its merit based on a hypothesis that 'Passive Building Design can help to reduce energy consumption utilizing natural energy instead of electricity. Therefore, it plays an important role in a sustainable management in tourism industry.'

## 1.8 Research Methodology

The methodology adopted in fulfilling the research objectives and study can be categorized below and summarized in Figure 1.2 which shows the methodology flowchart.



Figure; 1.2 Methodology flow chart

## 1.8.1 Primary data

### 1.8.1.1 Case Studies

In order to test how passive building design would effect on environmental sustainability for Malaysia hotels, only two case studies were carried out in Pulau Pinang, Malaysia. One hotel is a beach hotel, the Paradise Sandy Beach Resort Penang, the other is a hillside hotel, the Hotel Equatorial Penang. The reason for this limited number of case studies is due to the exploratory nature of this research in ideal climatic conditions for natural ventilation which is explained further in the next paragraph.

According to Malek (2004), two ideal building location to take in natural breeze are, (i) location which receive land and sea breeze, and (ii) location where receive prevailing wind in valleys nomally found at hill slopes. At a seaside location, during daytime dense land is heated more rapidly than the sea. Heated air rises up and low pressure zone is created. This low pressure zone is filled up with relatively cooler air from above the sea. This process is termed as thermo-siphon. At night time reverse of the phenomenon occurs as dense land is cooled more rapidly than the sea. As for the prevailing winds, it usually occurs at sloping terrains and valleys. Cold heavy air move down towards the bottom of the valleys at night and create cool air lakes. The air gets wamer when the sun starts to rise. Warmed air gradually ascends following the landform so the air movement is constantly experienced by the hill slopes and valleys. Therefore the Paradise Sandy Beach Resort Penang and the Hotel Equatorial Penang were chosen as represent of seaside location and hilltop location.

Paradise Sandy Beach Resort Penang lies beside the Tanjung Bungah beach at north part of Penang, Malaysia. The building has 24 stories and the ground floor opens itself toward the sea and the entrance doors are always opened. The lobby is not air-conditioned nor using any electrical cooling equipment. Therefore the lobby is suitably designed to observe how much the beach hotel could receive the natural wind and how is the thermal condition without electrical cooling. It is expected that this hotel would received land and sea breeze.

The Equatorial Hotel Penang is located on a hillside at almost center of Penang Island, Malaysia. The building is composed of 3 wings; North wing, East wing and West wing with 655 guestrooms. This hotel also has an open planned lobby without any electrical cooling system. There is no hillside hotel in Penang except Equatorial Hotel and the hotel is suitably designed to incorporate prevailing winds of hill slopes.

Although the number of case study is small but the amount is limited to the positive response from hotel management to participate in the research and the aforementioned reasons. Many hotels were approached to be involved in the research but declined to be included in the case studies although agreed to the survey.

The measuring equipment, the BABUC environmental data logger, would be placed at the lobby to measure the air temperature, the relative

humidity and the wind speed under shaded condition. Readings of every 15 minutes intervals are continuously taken for 24 hours for a week.

Though most area of hotel building is appropriated for guest rooms, the case study were carried out at the lobby because of three reasons. Firstly, most tourists pursue temporary pleasures on their hotel stay. Therefore the hotel cannot force their guests to control energy consumption, especially on the use of air-conditioning. Second and third reason is security and privacy reason. It is not appropriate to keep guests' safety and privacy if the guest rooms are opening planned to adopt natural ventilation system.

The location of the BABUC environmental data logger at the Paradise Sunday Beach is shown as indicated in white arrow. The BABUC environmental data logger comprised of sensor probes for air temperature (dry), relative humidity, hot wire probe for detecting air velocity. Care was taken in setting up the environmental data logger so that the probes were measuring the climatic elements under shaded environment and away from the sun rays. The readings were taken at every fifteen minutes interval continuous twenty four hours for one week to find an average pattern of the indoor climate.

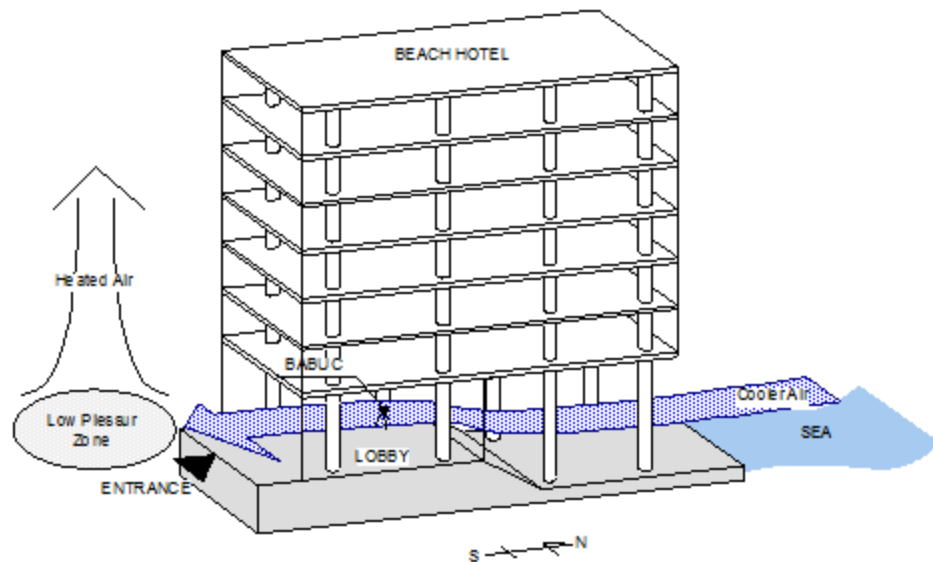


Figure 1.3; Diagrammatic perspective and air movement of Paradise Beach Hotel

Similar to at Paradise Hotel, at the Equatorial Hotel Penang the BABUC is set at the lobby to measure the air temperature, the relative humidity and the wind speed under shaded condition. The readings are continuously taken for a week in every fifteen minutes intervals.

Both of case studies at seaside hotel and hilltop hotel will be carried out for seven days in April which is in dry season in Malaysia. The case studies limit themselves for seven days because Malaysia is a tropical climate which only has hot and wet condition, the experiment is conducted in hot season for the worst case scenario. Throughout the year the climate is predictable, which means the behaviors of air temperature, air velocity and humidity are very similar everyday except for wet season in which case the climate is less critical



These case studies should be fulfilled to check whether natural breeze could serve enough cool condition at Malaysia hotel lobby, therefore hotter dry season is chosen for the case studies.

#### 1.8.1.2 Standard Effective Temperature (SET)

Collected empirical data from the case studies was analyzed individually and also used to calculate the Standard Effective Temperature (SET). Using ASHRAE Thermal Comfort Program, SET will be figured out with three thermal factors; air temperature, wind velocity and relative humidity, and two personal factors; metabolic rate and clothing level. In this study metabolic rate was set at 1.0met and clothing level at 0.6clo. Metabolic rate at 1.0met deserves that one is sitting down on a chair, which seems a kind of normal behavior for tourist at hotel lobby. According to ASHRAE, clothing level at 0.6clo is a summer light wearing. Calculated SET was compared and contrasted with the comfortable temperature zone for Malaysia. Many researchers have found out the comfortable zone based on their case studies or surveys. These studies were referred to analyze how the tested hotels' thermal conditions are.

In the case studies, the tested hotels are chosen with the proviso that the lobbies satisfied suitable condition for natural ventilation, which is listed on the proposed criterion. Therefore, this study would be concluded that the natural ventilation, that is a part of passive building design, will be effective for Green Hotels if the calculated SET is in the comfortable zone. Besides, if the SET is not in the comfortable zone at all, the proposed criterion would be reviewed and

corrected otherwise the study concluded that the passive building design is not effective for green hotels since the element would not be helpful to reduce energy consumption without dissatisfaction.

## 1.8.2 Secondary Data

### 1.8.2.1 Preliminary Study of Malaysia Hotels

A hotel survey was carried out by sending structured questionnaire forms to various hotels to find out present condition of environmental sustainability in Malaysian hotel industry. There are about 1700 hotels in Malaysia including all kinds of accommodation and 1360 hotels of them have own buildings (Register with Hotel Ministry Malaysia, 2007). For the questionnaire survey, 80 hotels (5.8 percent of 1360 hotels) were chosen at random from all over Malaysia within two month; from March, 2007 to April, 2007, but only fourteen responded.

About fifty percent of the respondents are city hotels, forty-three percent are resort hotels, and another seven percent are from the suburbs or on top of hills. Entitled as 'The Survey on Malaysian Green Hotel –Sustainable management of energy consumption', all questions are regarding the effective energy consumption in three categories namely (i) active system (ii) passive design and (iii) environmental management policies.

A field investigation was also conducted of the Frangipani Langkawi Resort and Spa in Langkawi Island, Malaysia, because of a newspaper review on it mentioning to be the most comprehensively practiced in environmental program. The resort has received the highest score as Responsible Tourist Award by Wild Asia, and is acknowledged as one of the best environmentally

friendly resort in Malaysia. The approach adopted by this hotel will be discussed in Chapter 3.

#### 1.8.2.2 Review on Green Hotels in the World

In order to present a clear criterion of environmental management program for hotel industry, existing environmental tourism and hospitality authorities was reviewed. Detail of Green Leaf Foundation in Thailand is mentioned as a successful example of environmental program for hotel industry in Southeast Asia.

Personal interviews were undertaken with Amphai Wejwithan (2007), a manager of Green Leaf Foundation, and three Green Leaf Hotels which are certificated by Green Leaf Foundation; Stapom Nuchcharoen (2007), a security manager of Banyan Tree Bangkok, Vilas Wongtrakul (2007), a manager of D'MA Pavilion Hotels, and Amnuary Rodphant, a director of engineering maintenance of Siam City Hotel, in Thailand.

#### 1.8.2.3 General Sources of Data

The general data collected for this research was from various sources such as the internet, research papers, books, journals, newspaper reports, other reports and interviews. In the early stage, a review of literature and existing studies were undertaken to get an overview and groundwork of the research area.

#### 1.8.2.4 Proposition of a Criterion for Malaysia Green Hotels

Based on the review of existing worldwide standards or certification for green hotels, an original criterion which is particularly for Malaysia hotels will be proposed. The criterion will be created with profound consideration to Malaysia climate, environment, sociality, and so on. This criterion will be referred as to compare and contrast with hotels' conditions which are case study for primary data.

## **1.9 Limitation of Research**

As the study of similar nature has not been conducted before in Malaysia, therefore the research is exploratory and can only focused in examining the thermal comfort and energy efficiency of the case study buildings within the lobby area due to its natural ventilation and easy access within the limited time frame of a Masters Research. The scope is limited to only two case studies due to lack of response from the hotels and also the two scenarios where natural ventilation phenomena deem fit for the experimentation. However, the questionnaires survey gives a good overview on the emphasis and understanding by the hotel management on the environment program. An important aspect is to derive a set of criteria for future researches to undertake.

## **1.10 Structure of the Thesis**

The structure of the thesis is composed as summarized below:

### **Chapter 1: Introduction**

Describing the background of environmental sustainability in hotel industry, to state the issues of that area, and introducing the aim of this research with objective and limitation of it.

### **Chapter 2: Literature Review**

Introducing literatures on energy efficient buildings, green hotels and green concept assessment in hotel industry. Green Leaf Foundation in Thailand is investigated as an example of environmental policy for hotels.

### **Chapter 3: Preliminary Survey into Environmental Policy in Malaysia Hotels**

A questionnaire survey and a field survey is carried in order to check the statement of Environmental Policy for Malaysia hotels.

### **Chapter 4: Case Studies on Natural Ventilation as a Passive Element**

Two case studies are carried out in this chapter to find out the effectiveness of passive building design in Malaysia hotels.

### **Chapter 5: Results and Discussion**

The results of the case studies are described in this chapter. The results are categorized into four parts in each, air temperature, air velocity, relative