



UNIVERSITI PUTRA MALAYSIA

***THE INFLUENCE OF URBAN HEAT TOWARDS PEDESTRIAN COMFORT
AND THE POTENTIAL USE OF PLANTS AND WATER AS HEAT
AMELIORATOR IN KUALA LUMPUR CITY CENTRE AREA***

SITI ZAKIAH BTE MOHAMMED

FRSB 2004 2

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By

SITI ZAKIAH BTE MOHAMMED

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Master of Science**

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November 2004

Chairman: Associate Professor Nordin Abdul Rahman, Ph.D.

Faculty: Design and Architecture

Kuala Lumpur, like other cities in a tropical environment faces serious environmental degradation of urban heat island, atmospheric pollution, traffic congestion and high energy consumption due to its rapid development and urbanisation. Unlike cities with a cool temperate climate and made worse by being in a valley set up, Kuala Lumpur outdoor living comfort is seriously affected by accumulation of heat and generation of dust and smoke. All these have resulted in a decrease in outdoor living comfort and quality, making outdoor life quite miserable, deterioration in public health and is even life threatening.

This thesis aims to provide a basis for understanding and create awareness on the importance of comfortable outdoor living environment for comfortable human life and living with serious attention on issues of urban heat and the effective use of natural elements such as plants and water as heat ameliorator. This will hopefully be a new tool to the city managers, planners, architects, engineers and even landscape architects to integrate the concern of their built environment with sustainable natural

landscape development toward sustainable and comfortable outdoor living environment.

This thesis is based on data obtained from survey questionnaires, site observations, field measurements and professional interviews. The data were analysed as to determine the needs and preferences of the outdoor users towards their outdoor comfort. Interviews were being justified through site observations and field measurements. Relevant professional groups were interviewed to gauge their understanding and views on their current approaches in planning, designing and managing the city outdoor environment.

The results showed that the temperature and humidity readings taken at vegetated and densely built-up areas in Kuala Lumpur city, showed a difference of an increase of 5°C to 8°C temperature and a reduction of 10% to 14% humidity. The general public displayed a lack of understanding and awareness on the impact of heat to their outdoor comfort. The professionals gave priority to requirements and guidelines in their own professional area rather than looking at the urban environment in total during the designing and implementation stage.

The research recommends continuous massive tree-planting programmes, encouragement of more vertical landscape or rooftop gardens and more moving water features to be the basis to ameliorate the urban heat while the professionals should integrate the their built environment with sustainable natural eco system. Political leaders, policy makers and the public need to understand and be more aware of the issue of the outdoor living comfort and how nature can help to comfort mankind and sustain a good outdoor living environment.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

**PENGARUH HABA BANDAR KEARAH KESELESAAN PEJALAN KAKI
DAN PENGGUNAAN BERPOTENSI TUMBUH-TUMBUHAN DAN AIR
SEBAGAI PEMBAIK HABA DI KAWASAN PUSAT BANDAR
KUALA LUMPUR**

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Kuala Lumpur, seperti bandaraya lain dalam iklim tropika menghadapi degradasi persekitaran yang lebih serius jika dibandingkan dengan bandaraya yang beriklim sederhana sejuk. Keadaan persekitaran seperti kepulauan haba bandar, pencemaran udara, kesesakan lalu lintas dan penggunaan tenaga yang banyak adalah disebabkan oleh pembangunan pesat dan proses perbandaran.

Kedudukan bandaraya Kuala Lumpur di kawasan lembah menjadikan keadaannya lebih teruk. Keselesaan hidup di kawasan luaran di Kuala Lumpur terjejas dengan teruknya oleh pengumpulan haba, penjaan habuk dan asap. Kesemua perkara ini telah mengakibatkan kehidupan di kawasan luaran menjadi kurang selesa dan sengsara, penurunan kualiti hidup dan kesihatan dan mengancam kehidupan.

Tesis ini bertujuan untuk menyediakan asas bagi kefahaman dan mewujudkan kesedaran tentang pentingnya persekitaran hidup di kawasan luaran yang selesa bagi manusia dan kehidupannya dengan memberi perhatian serius tentang isu haba dan

penggunaan unsur-unsur semula jadi yang berkesan seperti tumbuh-tumbuhan dan air sebagai elemen pembaik haba. Ini diharapkan akan menjadi alat baru kepada pengurus bandar, perancang, arkitek, jurutera dan malahan arkitek landskap untuk mengintegrasikan kepentingan persekitaran yang dibina dengan pembangunan landskap semula yang mapan bagi mencapai persekitaran luaran yang selesa dan mapan.

Tesis ini berdasarkan data yang diperolehi daripada tinjauan soal selidik, pemerhatian ditapak, pengukuran di tapak dan temubual dengan para profesional. Data telah dianalisa untuk menentukan keperluan dan kecenderongan pengguna di persekitaran luaran ke arah keselesaan mereka. Temubual kemudiannya dijustifikasikan melalui pemerhatian dan pengukuran tapak. Sementara keputusan temubual dengan profesional membantu menetapkan pendekatan bersepadu di dalam perancangan, rekabentuk dan pengurusan persekitaran luaran bandar.

Hasil kajian menunjukkan pembacaan suhu dan kelembapan di antara kawasan bertumbuhan hijau dan kawasan terbangun bertepu tinggi di sekitar Kuala Lumpur mewujudkan pembezaan peningkatan suhu di antara 5°C hingga 8°C dan penurunan kelembapan di antara 10% hingga 14%. Sementara orang ramai didapati kurang kefahaman dan kepekaan terhadap impak haba bandar terhadap keselesaan persekitaran mereka. Para profesional pula didapati memberi lebih keutamaan bagi memenuhi kehendak dan peraturan profesion masing-masing daripada menyelesaikan masalah persekitaran secara keseluruhan semasa peringkat rekabentuk dan implementasi.

Kajian mencadangkan bahawa program penanaman pokok secara besar-besaran, landskap menegak di bangunan, taman atas bumbung, elemen arca air bergerak wajib di perbanyakkan sebagai kaedah dan pendekatan semulajadi dan berkesan untuk mengatasi masalah haba bandar. Manakala para profesional patut mengintegrasikan kepentingan persekitaran yang dibina mereka dengan ekosistem semulajadi yang mapan. Pemimpin politik, para pembuat dasar dan orang ramai wajib memahami isu ketidakselesaan hidup di persekitaran luaran dan bagaimana alam semula jadi dapat membantu memberi keselesaan kepada manusia sejagat dan mengekalkan persekitaran luaran yang mapan.

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I certify that an Examination Committee met on 8th November 2004 to conduct the final examination of Siti Zakiah bte Mohammed on her Master of Science thesis entitled “The Influence of Urban Heat Towards Pedestrian Comfort and the Potential Use of Plants and Water as Heat Ameliorator in Kuala Lumpur City Centre Area” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

SITI ZAKIAH BTE MOHAMMED

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LIST OF ABBREVIATIONS

CHKL	-	City Hall Kuala Lumpur
Etc.	-	Etcetera
L. S. T	-	List Standard Time
m	-	Metre
No.	-	Number
URTI	-	Upper respiratory tract infection
°C	-	degree Celsius
%	-	Percentage

GLOSSARY OF TERMS

Within this study, several terminologies will be used to explain the meaning of these terms in the context of the research wherever applicable.

- Comfort - Comfortable weather for walking. Comfort will be the function of individual perception, expectation and needs which depend on individual physiological (elements of noise and pollution) and psychological (mental) responses to the environment.
- Outdoor user - One who uses the external area or surrounding.
- Outdoor living - Area (world) occupied for various activities of work, play, leisure, entertainment etc., outside of houses or any buildings.
- Pedestrian - People who uses the outdoor spaces only, specifically the walkway areas and those who were involved during the survey questionnaires and interviews.
- User comfort - A positive emotional reaction to external surroundings and situation including physiological, physical and psychological reaction.

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- Webster's Encyclopedia Unbridged Dictionary of the English Language.

CHAPTER 1

INTRODUCTION

In the beginning of the twentieth century, 14% of the world inhabitants lived in the cities. As cities fast become humanity's premier habitat, the challenge of the future is to give people a sense of existential security and comfort. Cities should become socially, economically and ecologically sustainable fulfilling basic human needs for shelter, subsistence, social cohesion and living comfort (Herbert, 1997). According to Nordin (2003), cities are developed to bring prosperity and comfort in terms of physical, social or psychological to man's living. Cities would not be fulfilling their vital function if they fail to provide a healthy environment for their inhabitants. A successful city can be described as a city which meets multiple goals such as good standard of living, high quality environment and good health including outdoor living comfort (Herbert, 1997).

However as urbanisation moves and takes place steadily, the impact is seen in the changes to the physical city environment, such as the 'concrete jungle' which is taking place rapidly and progressively in the urban areas together with other infrastructure developments. This creates a tendency towards city environmental degradation and problems such as heat, dust and air pollution through industrial, vehicles and anthropogenic activities ranging from house, workplace and to the outdoor space.

Development is absolutely necessary for the progress of any city. As the city develops the size of the city will increase as it accommodates the increasing city population.

This will result in more of the natural landscape within the city area to be replaced with built hard surfaces as to provide more facilities to its city dwellers (Nordin, 2003). This massive conversion of urban morphology, taking place without proper consideration being accorded to its negative side effects on the existing natural environment, will only lead to urban discomfort and low living quality. Public using the outdoor spaces will be the immediate entity and prime victims of these negative impacts. Not only from the environmental degradation surrounding them, but also the microclimate that can totally change from its natural state due to urbanisation. Therefore, rapid development if not controlled will upset a city's microclimate and its environment.

The modified climate impact is prone in areas such as the city centre. This area is normally densely populated with massive development to cater for all kinds of daily activities. This is also an area which becomes a central point for people using the outdoor and indoor spaces; where they congregate, meet, crowd and carry out their daily activities. Thus climate is one of the most influential factors that determine human comfort level in public areas and their social life as well. Many researchers have indicated that urbanisation has altered the city climate (Sham, 1987; Shaharudin 1997; Nordin, 2003). This is made worst in most hot humid cities like Kuala Lumpur, Bangkok and Jakarta where climatic changes bring about the urban heat and atmospheric pollution with reduced humidity and the air is polluted with dust and pollutants and the surrounding temperatures increase.

This is expressed by Sham (1983) that stagnant atmospheric condition of the heat also trap pollutants in the urban areas and add the stress of severe pollution to the already

stressing hot weather, can create health problems of undiscovered dimension. Sham (1986) further added that tall buildings, the concrete and asphalt of the city absorb and store greater quantities of solar radiation than do the vegetation and soil typical of rural area. The urban heat island phenomenon had been addressed since the early 19th century and by many (Chandler, 1964, 1965; Peterson; 1969, Oke, 1974, 1979, 1982) as quoted by Sham (1974, 1983, 1987 and 1993).

The physical properties of the city surfaces are impermeable. With rapid rainfall, the quick run-off of water results in severe reduction in evaporation. This radical change in the physical surfaces according to Sham (1987) cause an increase of 10°C observed in the city areas as compared to rural areas. Added to this, domestic household sources such as home heating and air conditioning, paved surfaces; industry and transportation have intensified the release of greenhouse gases and increased the consumption of energy.

Increase of greenhouse gases in the atmosphere, produces a big impact to the city environment especially the urban outdoor living environment. Compared to the indoor living environment, the outdoor living environment is considerably unpleasant as the indoor living is easily controlled by air conditioning or heating to decrease or increase room temperatures (Nordin, 2003). The outdoor environment cannot be controlled because it becomes part of the area exposed directly to the climatic condition. The city heat becomes more severely felt on very hot days and is very stressing water vapour evaporates very fast and make the surrounding air dry and hot. To make worse, these cities when planned, seldom put planting trees and water feature in mind and usually the last issue of concern resulting in harsh, hot and polluted cities (Salleh

and other 1990). Though cities are landscaped, the intention is mainly for beautification, as an attraction and pleasing the eyes. Thus landscape environment is an important issue that directly affects the life and living of mankind. If this is not tackled wisely in the modified city environment, it can caused life and living to become miserable, uncomfortable and life threatening as well (Nordin, 2003).

Plants and water are natural ways of arresting city heat build up. This is convinced by Nordin (2003) that in the tropical zones where temperatures are very hot, vegetation particularly trees play a major role as climate ameliorator where they help build up the high humidity that helps in cooling the area. Water on the other hand is an effective tool in maintaining a good refreshing air quality and as heat absorber (Hubbard, 2003). Combining trees and water elements with concrete landscape should be the main concern for a sustainable outdoor living comfort.

The need to understand that a sustainable outdoor city environment is important for the people using the outdoor spaces is crucial for city that sprawls rapidly. These people using the outdoor spaces are the main living entity that makes a city alive and vibrant. Therefore their outdoor living comfort should be addressed to ensure man's comfortable living. This will further help to create a stable man and ensure the sustainability of mankind (Nordin, 2003). A need for a well planned design and management of landscape is a very important agenda for city outdoor environment. Thus bigger commitment from all levels of management, practitioners and individuals should be the main tool towards a sustainable outdoor city environment. This help to alleviate human being uncomfortable feeling due to heat.

Kuala Lumpur being the capital city of Malaysia and set within the metropolitan region is no exception. Extensive development, urbanisation and population growth have resulted in the changing of urban morphology and the modification of climatic condition in Kuala Lumpur city. The degradation of the outdoor living comfort in Kuala Lumpur inevitably needs to be addressed as Kuala Lumpur is gearing toward a world class city where outdoor space is an important and heavily used entity in the city environment.

1.0 PROBLEM STATEMENT

Kuala Lumpur is one of youngest capital cities in South East Asia (Refer to Figure 1) and had undergone tremendous physical transformation for the last few decades. Kuala Lumpur is also seen as an urban-industrial centre where rapid development from various sectors; housing, industry, commercial, urban design, transportation take place. 8 percent or 1.4 million of the total population of Malaysia live in the city of Kuala Lumpur (Draft Structure Plan Kuala Lumpur 2020, 2003).

However the Kuala Lumpur environmental situation of post 1984 showed lack in environmental control and enforcement (Draft Structure Plan Kuala Lumpur 2020, 2003). Until now, it is still lacking in the control and enforcement of major development projects in the city which is taking place rapidly (Draft Structure Plan Kuala Lumpur 2020, 2003).

The draft structure plan Kuala Lumpur 2020, in the last nineteen years showed Kuala Lumpur city development mainly focused on economic and infrastructure whereby

the living comfort of city dwellers was more confined within the indoor built environment. The outdoor city environment mainly focussed its landscape for visual pleasure only and seldom a place of comfort for the outdoor space users especially during a hot day. Being a tropical city the issue of urban heat within the outdoor city environment should be given more attention and addressed firmly so as to create a more comfortable city environment for Kuala Lumpur.



Figure 1: Location of Kuala Lumpur in the Asia Pacific Region.

Source : Draft Structure Plan Kuala Lumpur 2020, 2003.

The urban heat in Kuala Lumpur city is due to various issues and factors as listed below that have contributed to the urban outdoor living discomfort in Kuala Lumpur city.

1.0.1 Kuala Lumpur within a Valley Set Up

Kuala Lumpur experiences the tropical rainforest type of climate and enjoys climate typical of a humid tropic. Sited at an elevation between 30m and 300m (mean sea level), the city is ringed by high peaks and ridge lines while topography indicates that the central planning area of Kuala Lumpur is surrounded by a series of hills and ridges to the west with levels approximately of height between 100m-125m. To the south, levels are of approximately 50m-80m to the east and north indicate level area between 40m-60m (City Hall Kuala Lumpur, 1998). This situation shows Kuala Lumpur city is developed within a valley setup. This also indicates that the Kuala Lumpur city receives less wind movements and this does not assist much in blowing away dust within the city. The anthropogenic pollutants and other noxious gases developed will accumulate within the city atmosphere, thus choking and poisoning the city dwellers (Nordin, 2002). This is further exaggerated by intense heat from the sun coupled with deflected heat from paved surfaces and also radiated heat from the concreted city. This scenario is supported by Herbert (1997) and Sham (1990) as shown in Figure 2 and Figure 3.

In general, from the author observation Kuala Lumpur city set up can be related to the analogy of noodles in a bowl of hot soup where heat is trapped for quite sometime before being dispersed upward, replacing much cooler air; thus forming an urban heat dome of stagnant hot and polluted air.



Figure 2: Urban heat dome for city bounded with mountain ranges.

Source : Herbert (1997).

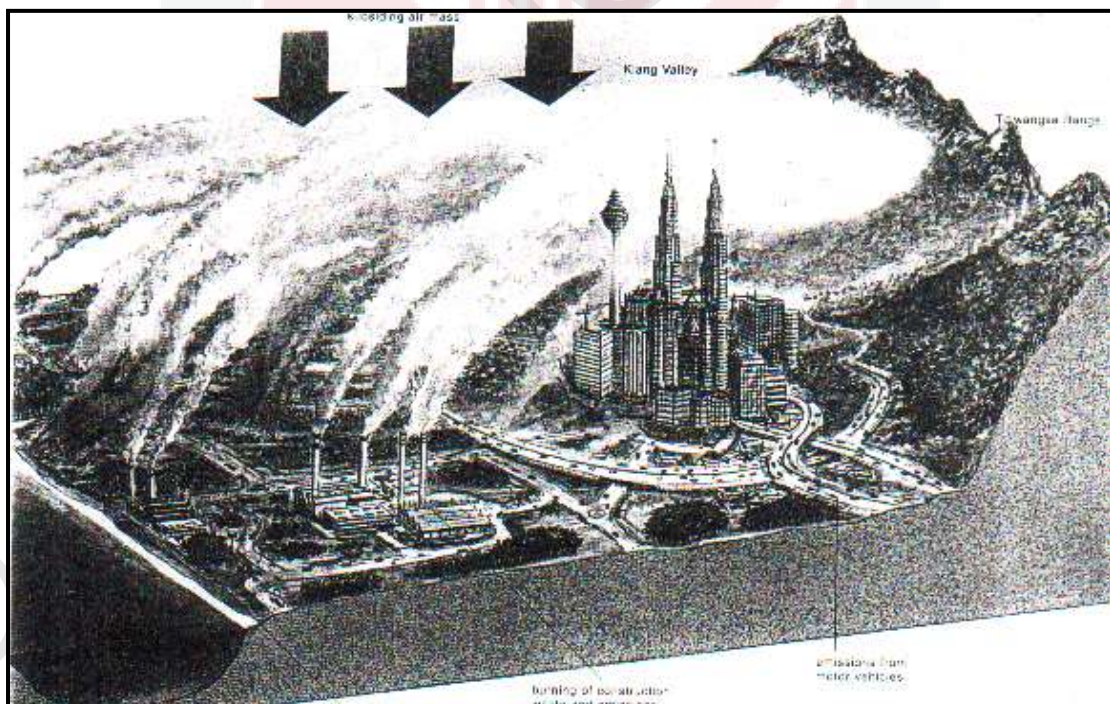


Figure 3: The concept of urban heat dome for Klang Valley especially Kuala Lumpur situated within a valley set up.

Source : Sham (1990).

1.0.2 Kuala Lumpur Urban Heat

The city image of Kuala Lumpur is now changing rapidly and transforming drastically. Kuala Lumpur's achievements as an international city with development of massive buildings, sky scrappers, modern structures and infrastructure added with various economic activities (industries, transportation) have contributed to the city urban heat and pollution. These impressive and credible developments above have resulted in the city outdoor living discomfort where urban heat is most pronounced. In the Draft Structure Plan Kuala Lumpur 2020 (2003), record for 2000 showed that 93.41 percent of the land were developed and to be developed for residential, commercial, committee center, institutional and infrastructure with only 6.59 percent is meant for greenery. This showed an extensive built up area in the Kuala Lumpur city.

1.0.2.1 City buildings

Kuala Lumpur being in a tropical setting and the location and layout of the city fabric with almost every tall building of various forms and heights close to each other, contribute directly to the city heat build up as shown in Figure 4. This also results in the alteration of the airflow. With greater surface roughness, wind speed is thus reduced (Sham, 1979 and 1986) (Abdul Hafiz, 1986). This results in heat stress and thermal discomfort to city dwellers.



Figure 4: Aerial view of Kuala Lumpur city showing close arrangement of building around the city.

Source : Peter creative photography (2002).

Kuala Lumpur known for its high rise buildings which take up tall vertical forms using glass and metal cladding as the façade treatment contribute to heat storing. Added to these, the present vertical walls of office buildings, stores and apartments around the city do not allow radiation to escape as readily as in outlying areas since the sides of these structural emit their stored heat and a portion is reradiated between buildings instead of upward and is therefore slowly dissipated (Refer to Figure 5).



Figure 5: Types of tall buildings in Kuala Lumpur City using glass panel, concrete and metal cladding facilitate in the heat storing.

Source : Internet <http://www.skyscraperpicture.com/KualaLumpur.htm>

The use of building materials such as concrete, glass and plastic have contributed to the increase of intense heat to the ambient environment (Jabatan Perancang Dan Kawalan Bangunan, Dewan Bandaraya Kuala Lumpur, 1996). At random there are more than three hundred tall buildings in the city with more than fifty buildings with extensive glass usage (Jabatan Perancang Dan Kawalan Bangunan, Dewan Bandaraya Kuala Lumpur, 1996). Presently, there is an effort from the authority to curb the use of inappropriate building materials by developers and private owners and even government agencies in most buildings in an effort to reduce urban heat in the city (Jabatan Perancang Dan Kawalan Bangunan, Dewan Bandaraya Kuala Lumpur, 1996). However due to lack of control and enforcement this heat absorber materials are still taking place (Jabatan Perancang Dan Kawalan Bangunan, Dewan Bandaraya Kuala Lumpur, 1996).

1.0.2.2 Hard Surfaces and Pavement in the City

The city image of Kuala Lumpur is now changing rapidly and transforming drastically by having wide pedestrian walkways at every area of the road corridor using concrete and tiles of dark colours (Refer to Figure 6). In general, Kuala Lumpur low relative humidity is due to the extensive paving and concreting of the city. This have greatly reduces the soil and grass areas in the city. Study made by notable Sham (1984) shows that the temperature difference by 6°C - 7°C as compared to sub urban area during the hot day. Sub-urban is well vegetated as compared to urban of heavily built up area.

Extensive upgrading of pavement around and within the city centre areas using tiles and concrete pavers with little attention being given to the characteristic of the material used and method of laying using reinforce concrete foundation had created impermeable surfaces.



Figure 6: Hard surfaces and pavement in Kuala Lumpur City replacing the soil and grass in the city.

Source : Author (2003).

During heavily rainfall, the rapid runoff of water results in severe reduction in the evaporation rate. Water is unable to be retained on these surfaces for a long time but is discharged immediately into covered drains. Records from City Hall Kuala Lumpur (2000) showed that almost 300km² of walkways, linkages and corridors in the city had been paved. This forms heat banks in the city, where heat stored is later slowly released, at the expense of the outdoor space users.

Ample of open parking area in the city result in the extensive exposure of tarmac surface to the sun radiation while congested stationary vehicles being parked for long hours contribute to the reflection of heat to the surrounding areas. This is made worse when trees which can reduce heat storage were not planted in these areas (Refer Figure 7). This is highlighted by Robinelte, (1972) and Nordin (2003) who strongly

showed the function of plants in making the environment more pleasant and reducing the heat from 50-70% as compared to exposed or un-shaded area.



Figure 7: Vast open car parks in the city with little planting aggravate the heat build up.

Source : Author (2003).

1.0.2.3 City Roads and Highway

Kuala Lumpur's road network system consists of concentric circle ring roads, which skirt around the city to link one suburb to another and allow motorists to bypass congested city areas.

Kuala Lumpur has 1,100km of roads which were fully widened into two to four tarmac carriage ways. This can make driving unpleasant as heat accumulates on the tarmac surfaces (Refer to Figure 8).



Figure 8: Widened roads and highways with tarmac surfaces increase the heat build up.

Source : Author (2003).



Figure 9: The concrete corridor in Kuala Lumpur city being hot, dusty and stuffy due to stagnant heat and polluted air from the traffic.

Source : Author (2003).

1.0.2.4 Monorail and Light Rail Transit Corridor

The development of the monorail and light rail transit was an alternative to reduce traffic congestion in the city. The rail corridors form huge and massive concrete tracks aligning the middle and sides of roads in the city centre areas. These areas devoid of plants form a passage sandwich between two ring roads tend to accumulate heat and dust especially during peak hours. People using these public spaces feel

uncomfortable, hot, stuffy, unprotected and unsafe to walk along the city streets. This is shown in Figure 9.

1.0.3 Traffic Congestion in Kuala Lumpur City

Traffic is no doubt a part of everyday life in the city while city dwellers are the highest users of motor vehicles. This rapid increase in the number of road vehicles is the core contributor towards congestion. It was reported that until October 2000, there were 812,000 vehicles plying the city main roads daily within a period of 16 hours (New Straits Times, 2002). This resulted in Kuala Lumpur facing air and noise pollution. From observations and from the records (Department of Public Health Malaysia, 2002) showed that pollution from motor vehicles has become the most recognised air quality issue especially on the release of massive heat, polluted substances and dust.

This is supported by an estimation made in the last decade that motor vehicles in Kuala Lumpur spewed out over 2.7 million tonnes of pollutants into the air with 85% representing the city load (City Hall Kuala Lumpur, 1998). The pollutants can be a nuisance to both the health of the people and the ambient atmosphere. From records released by the Department of Public Health Malaysia (2002) the number of people affected with upper respiratory track infection (URTI), asthma, conjunctivitis and other diseases related to air pollution in the Kuala Lumpur Federal territory between 1999-2000 increased tremendously from 590,068 to 1,176,147 people; an increase of almost 100%.

1.0.4 Kuala Lumpur Energy Consumption

Rapid developments followed by an increase in population are factors causing the increased of surrounding temperatures in the city. Kuala Lumpur city recorded one of the highest population densities with 5,600 people per sq km (Harian Metro, 10th March 2002). This resulted in compact living, increased transportation vehicles and substantial body heat being released, requiring extensive use of air conditioning. In general, air conditioning in buildings consumes 65% of the electricity; 25% for lighting with the balance for other electrical appliances (Harian Metro, 10th March 2002). Kuala Lumpur city which is made up of 22% residential buildings, 4.51% commercial, 6.69% institution and 25.5% infrastructure (City Hall Kuala Lumpur, 2000) reflects quite an extensive use of air conditioning with negative impact on the city environment, namely the greenhouse effect. Presently, there are thousands buildings in the city with an ever increasing demand and usage for air conditioning to provide indoor comfort and other home heating. This extensive load of mechanical heat is then distributed to the external surroundings. This further aggravates the heat build up in the city. Most of this heat is trapped along the streets, walkways, corridors, pedestrian areas and areas sandwiched between buildings and roads.

1.1 IMPORTANCE OF THIS STUDY

To sustain a good outdoor city life with caring good life quality and to be a world recognised city, the comfort of the outdoor space users should be address focusing on the following factors:

- i) Lack of awareness of climatic issues from the city dwellers, city designers, planners and city managers.
- ii) To influence the pedestrian on the importance of climate issues for urban environment.
- iii) To alleviate the concern of pedestrians on their outdoor comfort toward natural environment.

Although most research findings and literature focus on bioclimatic issues, the professionals and authorities are still not applying this knowledge to their work. Only few researches exist regarding human comfort in relation to climatic condition and urban outdoor setting and fewer still research on the improvement of the outdoor living comfort in a more natural way.

Further research on outdoor users comfort in urban areas in terms of their psychological and physiological aspects also needs to be undertaken. This lack of research has resulted in a scarce amount of theory to advise the urban manager, architect, engineers and planners to create better outdoor living comfort environment which integrates natural elements into their design and planning of the environment, buildings and infrastructure.

1.2 AIM OF STUDY

The aim of study is toward understanding and creating deep awareness on the importance of the condition of outdoor space to user comfort and use of natural element in ameliorating the modified urban climatic condition.

This research will discuss and focus on three main areas as follows:

- i) To understand the perception, preference of the outdoor space users toward their outdoor living comfort in the city.
- ii) To investigate the effective use of natural landscape elements particularly plants and water in the city in ameliorating urban heat discussing on the heat and humidity.
- iii) To increase the awareness of all parties concerned, particularly the political leaders, related professionals and the public on the issues of creating and sustaining outdoor living comfort and good life in the city.

This study hopes to provide the basis of understanding and bring awareness on the importance of comfortable climatic condition to human life and living; focussing serious attention on the issues of heat and humidity and the effective use of natural elements in ameliorating the unpleasant outdoor urban heat in the city.

Observations, interviews, questionnaires and field studies will be the main approaches and methodology in the collection of data. The findings will be a new tool to the city managers, planners, architects, engineers and even designers in approaching city outdoor comfort problems in appropriate ways with landscape development as a primary environment tool.

Thus the overall aim is to ensure an ideal and sustainable outdoor living comfort for outdoor pedestrian in Kuala Lumpur city and to improve the city environment by focusing on the city temperature and humidity through the use of plants and water element in a natural way.

This research is justified and timely as there are no other researches that dwell into the micro climate condition of Kuala Lumpur city as it becomes a world class city. Therefore outdoor living comfort should be one of the important attributes that must be emphasised and sustained in a tropical city. A conducive, healthy and comfortable outdoor living environment should be provided in the city aspiring to be of world class standard.

1.3 STUDY AREA

The study will generally address the whole Federal Territory (FT) of Kuala Lumpur with special focus being given to the city centre area formerly known as Central Planning Area (CPA) as shown in Figure 10.

The city centre which is the heart of the city covers an area of 18.03sq km or 1,812 hectares and is about 6.8% of the total FT area. It contains major commercial establishments, headquarters of private, public and quasi-government corporations, major administrative departments of both local and Federal Government, entertainment, recreational and residential establishments. Although the city centre is only a small part of the Federal Territory of Kuala Lumpur; it is this area, which is essentially referred to when one speaks of the city.

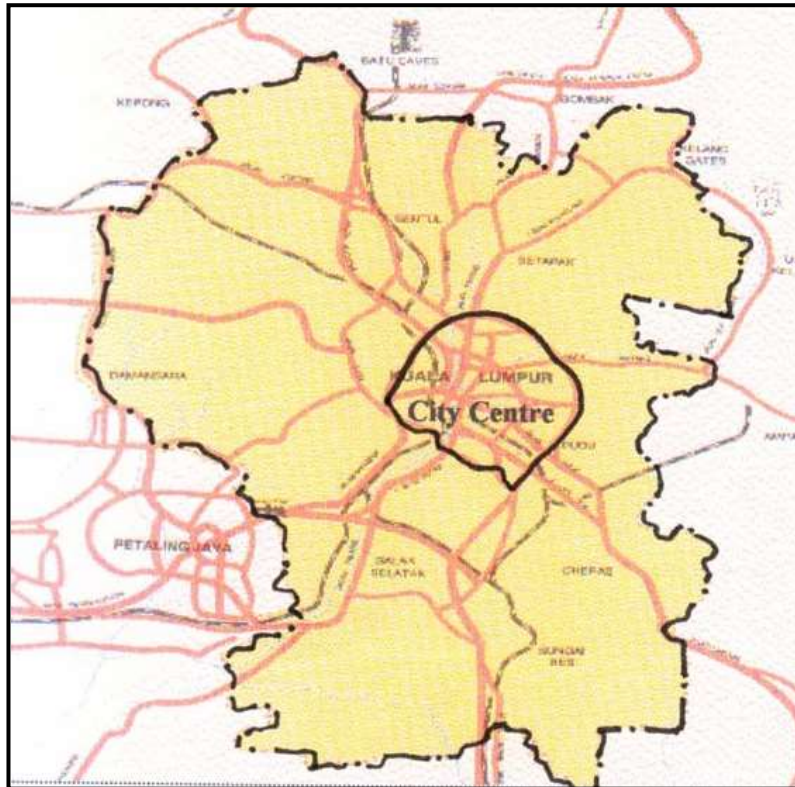


Figure 10: Kuala Lumpur City Centre in the context of Kuala Lumpur Federal Territory.

Source : City Hall Kuala Lumpur, 1998.

The present estimated population of city centre is about 128,000 (9%) projected share of the FT's population (Draft Structure Plan, 2000). The main reasons why this study focuses on the city centre are as follows:

- i) The awareness and affection of a city is strongest in the city centre which people take most pride.
- ii) The image of the city centre reflects and represents that of the whole.
- iii) It is the platform of local, national and international attraction.
- iv) Highest density of outdoor space users particularly pedestrians are located in the city centre area. The daytime population of outdoor users in the city centre could reach 250,000 persons (City Hall Kuala Lumpur, 1998). This is further discussed in Chapter 3.

1.4 ASSUMPTIONS AND LIMITATIONS OF STUDY

1.4.1 Assumptions

The following assumptions will be applied throughout the research study:

- i) Comfort perception, preferences and needs will be determined from pedestrian at the site chosen and not those in the buildings or in their vehicles. It is the outdoor users who are exposed to their outdoor environment, faced with the microclimate effect directly especially the heat discomfort and pollution from the traffic.
- ii) Temperature and humidity will be the two main parameters measured to determine outdoor user comfort. Other climatic factors such as wind velocity will not be measured, but these factors will be discussed wherever applicable through the research.
- iii) The outdoor users clothing is assumed to be the normal daily trend of Malaysia; suitable to the Malaysian climate.
- iv) Crowd dynamics are complex and therefore crowd dynamic areas will not be included in this study. This area has great potential for being noisy, distractive with shopping and cross flow movements.
- v) Outdoor users will be generalized during survey and field observation.

1.4.2 Limitations

Due to the time frame the following factors will be limited:

- i) Observations during daytime are from 10.00 a.m. - 5.00 p.m. No observation will be made during night time even though heat is still being released. Choice of daytime observation is to observe effects of direct exposure to heat (sun). Time of observation and data for temperatures and humidity reading will not be made too early in the morning as businesses usually start at 10.00 a.m.
- ii) Outdoor users' movements and flow at pedestrian bridges, crossings and junctions will not be taken into account since these areas are already considered to have the highest hourly volume of pedestrians.
- iii) Areas with construction and repair works are not taken into consideration. Temperature and humidity records will be taken to justify the heat influence at adjacent areas.
- iv) Observations will only be made on normal dry days and not influenced by heavy rain that hinders outdoor users' movements.
- v) Observations will not take into consideration any special street events or commercial activities such as cheap sales, special shows or even accidents.

1.5 CHAPTER ORGANIZATION

The outdoor living comfort problem stated throughout this chapter needs to be addressed in order to ensure better outdoor living comfort qualities and a sustainable city environment in Kuala Lumpur city.

In order to study the problem stated above and develop an understanding of the research to be carried out, it is necessary to highlight the background development of Kuala Lumpur city. This information is addressed in Chapter 3 while Chapter 4 will focus on the research methodology. Prior to this, Chapter 2 will present the literature review regarding theories related to outdoor living comfort and issues of urban heat by different authors and previous researchers. After the methodology is presented, the research result and discussions will be provided and highlighted in Chapter 5. Finally, the conclusion and recommendations are discussed in Chapter 6. The overall chapter organisation is shown in Figure 11.

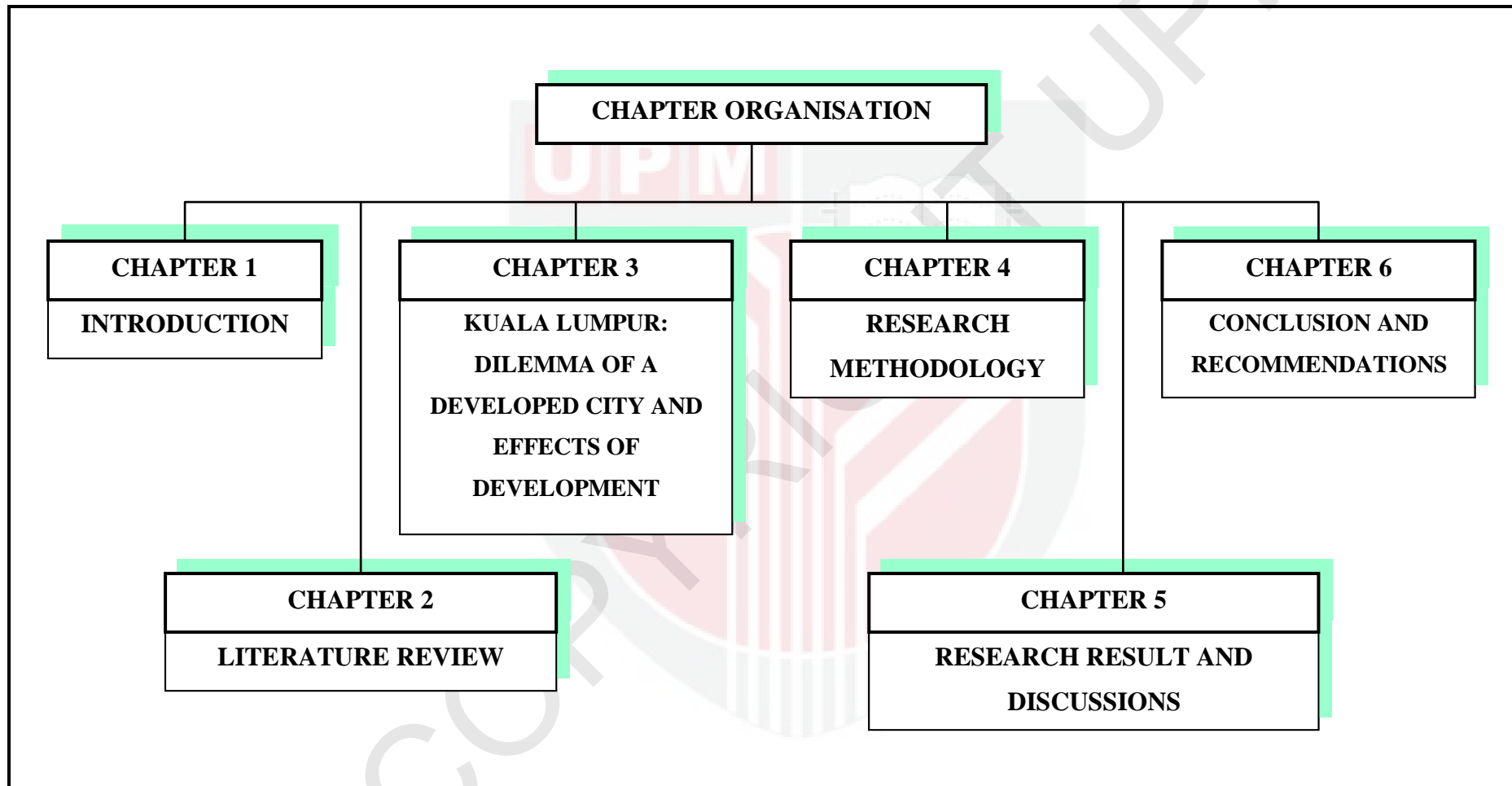


Figure 11: Chapter Organisation.

Source : Author (2003).



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