

PERCEPTIONS OF URBAN RESIDENTIAL LANDSCAPES: ROLE OF PLANTS IN ENHANCING OUTDOOR THERMAL COMFORT

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Abstract

Urban residents satisfies the need for a place of environment is comfort and pleasant to live in. Otherwise, their quality of life may be affected. Human naturally tend to live in a comfort surrounding, and changes in environment features will effecting on human health, satisfaction and social context. Generally, outdoor thermal comfort problem occurred within urban area as compared to rural area. This situation happened due to the decreases of green area and green buffer within urban area. Understanding the occupants' perceptions towards their living environment is critical for developing an effective development strategy. On the other hand public perception towards their outdoor environment is relatively under-researched, as the consequences there is great barrier isolate between climate science and public opinion. The aim of this paper, therefore, is to discuss public perception towards role of plants as a device to enhance outdoor thermal comfort level in urban terraced housing area in Malaysia. In addition, a questionnaire survey was conducted to evaluate occupants' perceptions. The findings demonstrate great understanding and awareness among occupants regarding the important of plants in enhancing outdoor thermal comfort level and suggest adequate number of plants should be planted in adequate size of green area within terraced housing area. The finding is significant as the contribution to an understanding the potential of

plant as a device in creating thermally comfortable housing environments in urban area.

Keywords: *Public perception, Plants, Urban Residential Area, Outdoor Thermal Comfort*

1 Introduction

Urban' is a term to define a gazette area consists of built-up and consolidated areas with a minimum population of 10,000 urban dwellers (JPBD 2006). Malaysia's rapid development was caused the proportion of urban population increased up to 71% in 2010 compared with 62% in 2000. Wilayah Persekutuan Kuala Lumpur and Wilayah Persekutuan Putrajaya are the most urbanized with 100% level in urbanization. Selangor and Pulau Pinang are the most urbanized states after the Wilayah Persekutuan Kuala Lumpur and Wilayah Persekutuan Putrajaya 91.4% and 90.8% (Population Census, 2010).

Human naturally tend to live in a comfort surrounding, and changes in environment features will effecting on human satisfaction and activity. Generally, outdoor thermal comfort problem occurred within urban area as

compared to rural area. This happened due to the decreases of green area and green buffer within urban area. According to Yuan (1987), the main causes of climatic stress in Malaysia are high air temperatures and solar radiation and terraced houses are the typical residential area that facing comfort problem that need specific consideration (Agung, 2007).

Strategic planning of planting trees, shrubs and vines can modify microclimate of a space by reduce air temperature, heat and glare from the sun. To achieve comfort in outdoor area, lots of aspects must to take into consideration rather than just environment factors. In order for planting design work effectively, a conceptualizing on the occupant's characteristics and feedbacks as a tools to supporting and outlining the design pattern is important to properly understood. Zarina (1997) stated that a quality design for community should not only place much attention on environmental factors but should be more concerned in understanding the culture and social habits and their perception.

According to Dola (2006), sustainable development can be achieved through providing public the opportunity to participate in decision-making processes. The important of communities that promote participation are as to become socially sustainable (Goodland, 2002). Public involvement includes groups and individuals can guide and result to better tolerance, understanding, and normally accepted standards of behaviour. Their perception and feedback can be a quality tools to sustain the design expectations and meet the needs of end-users. As a results, the successful performance of planting design in housing area where both occupants and environment interact positively.

However, there are lacks of information related to the public expectation and reaction regarding plant-climate relation. Previous research discovered that this country is still experiencing some problems and issues in considering the needs and demands of its users (Mohd Yunos, 2010). The lack of public involvement and participation in relevant decision-making might bring indisparity between public expectation and policy development.

Research finding might also to be helpful information and reference for future work as well as to determine the possible guidelines for future implementation and theoretical design.

2 RESEARCH ISSUES

2.1 *Outdoor Thermal Comfort Issues in Urban Residential Area*

The rapid emerging of population and rural-urban migration, the demand for housing in urban area will be as important. As the consequence, the development of housing area within urban area will remain continuous. A large area of agricultural land has been diminished and replaced into urban impervious areas, as the consequence, the urban morphology changed as well as urban microclimate. Previous study shown that land use for residential was the most significant change in land conversion, where more 12,000 ha in Kuala Lumpur area considered as occupantial area (Hashim & Khin, 2010).

Due to the rapid development, more green spaces, natural physical landscapes and vacant lands have been developed as residential areas and other types of developments. The destruction to the environment was very serious with all vegetation being flatten, as consequence, the surrounding land temperatures increase. According to Hashim et al. (2010) green spaces, forest and unused lands have been switched into commercial and business centres, government offices, residential areas and public amenities. Due to vast urban development, more people migrated to city centre as the consequence, more areas at the fringe of the city centre being developed.

Recent study on urban annual air temperature for the 30-years period found that there was positive linear correlation with slope coefficients from as low as 0.01 to as high as 0.12. This indicates to the urbanization within the last 30 years in most of the urban areas in Malaysia, and resulting to changing the urban air temperature patterns. A various studies of urban air temperature pattern within Malaysia also proved that the intensity of the phenomenon increased positively with the imperviousness (Hashim et al., 2010).

Urbanization always relates with problems of uncontrolled development of urban growth, which is not managed based on environmental concern and this condition was results climatic issues (Hassan, 2002). Environmental issues related to climatic stress have been a great impact to human daily life commonly in urban area. Increases of air temperature significantly will reduce the level of comfort in urban residential area. The developments of houses in urban area always neglect the human satisfaction predominantly in term of thermal comfort (Amin 2006). This problem potentially influences urban occupants' health and wellbeing. Furthermore, as the temperature reach to its limit the probability of crossing critical thresholds increases. Discreet assumption have been made by experts that the rise of temperature will bring great impacts to human societies, to geopolitical stability, and to human health (Anthony, 2010). As regards to the human health issues, Kubota & Ossen (2009) state that the rising of air temperature caused by the severe climate may also result in the expansion of tropical diseases such as dengue fever and malaria.

3 BACKGROUND

3.1 Significant of Thermal Comfort

Thermal comfort defined as “condition of mind which expression of satisfaction with thermal environment (Fergus 1995; Brown 1995). Thermal comfort influenced by several factors and the most significant factors related to the thermal comfort are air movement, air temperature, thermal radiation and humidity (Brown 1995). Nikolopoulou M, and N. Baker (2001) state that humanism response to environment and the thermal conditions are relied on a set of personal factors and psychological parameter. Thermal condition will affect people's psychological behaviour and how people use outdoor spaces.

3.2 General Terrace Housing Situation in Malaysia

Terrace houses in Malaysia as recorded in third-quarter 2011 of Malaysia property stock shows that terrace houses was predominant respectively in the existing stocked residential units in Malaysia. It was approximately 60.26% of total 93,729 existing stocked residential units and of the total

terrace houses, 28.12% provided in Selangor and most terrace houses existing stock was in Petaling district followed by Klang district with the percentage of 11.47% and 4.86% (NAPIC, 2011).

Typical urban terrace houses generally have a small private green area with the total area about 12m² to 15 m². Green area size for medium cost terraced houses was about 15% to 20% to the size of floor area. This small green area could not be planted even by a medium size tree with crown diameter about 5.0m to avoid the sunlight being blocked by its canopy and produce over shadow into the lawn as the results the house will looks gloomy (Said, 2001).

Most of the housing layout has been built without concerning appropriate sizes of green area within housing area. Ordinary terrace houses layout keeps the typical design; bare small frontage and backyard contribute to thermal comfort issues. The small proportion of green area to concrete building of terrace house is not influence to lower the air temperature of the outdoor housing area. Said (2001), in his research found that due to the small proportion of green area in the typical urban terraced house, occupants of terrace house normally used the road shoulder as extension of their gardens. Terrace houses in urban area are typical examples that suffer to the low thermal comfort problem that need specific consideration (Agung, 2007). The housing designs ignored the important of climatic components consequence to thermal comfort (Takahashi, 1981). This argument was supported by Hassan (2002) stated that the important of thermal comfort not been utilized in the most of the common housing designs.

Typical urban terrace houses generally have a small private green area with the total area about 12m² to 15 m². The size was about 15% to 20% to the size of the building (medium cost terrace houses) floor area. This small green area could not be planted even by a medium size tree with crown diameter about 5.0m to avoid the sunlight being blocked by its canopy and produce over shadow into the lawn as the results the house will looks gloomy (Said, 2001). Atiah (2010) in her research found that most occupants both in low cost urban terrace houses were utilized their existing outdoor green spaces in the front areas and turn the semi-public spaces available in

the forefront of their house areas as their primary garden. This situation identically similar in medium cost terrace houses where the semi-public spaces available in the forefront of the house areas had been changed as their 'Extended Garden' or additional area for landscaping. These finding shows that the size of green area (private and semipublic green area) in typical terrace houses layout in urban area are not appropriate and not achieve the occupant needs.

3.3 The Important of Green Area within Urban residential Area

Climatic issues in urban residential area that arise have increased the needs for green area. However, the lack of land for the green space and the land price issues in urban area has neglecting the important of green area within urban residential area. The quality of new housing development and its outdoor physical environments that are developed is determined by the value of land. This land is generally planned by the planning system and restricted under planning guidance. Due to this restriction, land in strategic location generally expensive sites to develop.

Tetsu et al.(2009) in his study found that green area in urban area was significant to the reduction of air temperature. The finding shows that the maximum air temperatures in the sunny day were recorded in relatively densely built-up areas such as large urban housing. It was found that relatively large green areas scattered in between the built-up areas will result to lower the air temperature as much as 1-2°C of that area. This finding proved the importance of green area within housing development.

Recent study by Saito, K., Said, I., Rasidi, M. H. (2011) strengthen the findings of previous study by Tetsuet al. (2009) in relation to the important of green space within housing area in contributing in lowering the air temperature, consequently increase outdoor thermal comfort level. The findings of the study on the typical urban terrace housing layout in Johor Bharu, shows that the temperature within the green area is relatively lower rather than other places caused by planted shrubs and trees, however it's influenced area are limited within the green area itself and not reached to surrounding buildings. By comparing the terraced house building to the

surrounding area, it clearly shows that the difference of 1-1.5°C average air temperature occurred by differences of building layout and surrounding situation.

3.4 Role of Plants to Enhance Outdoor Thermal Comfort Level

Plants have a profound impact on the environment as its primary mechanism to alter microclimate of a space. The evapotranspiration process by a tree can reduce air temperature and increase the humidity of a space. Previous studies proved that tree planting are the most effectives influence microclimate of a space. The application of tree planting to shade building and spaces provides an efficient passive method of solar control (Parker, 1983).

Previous study by Shahidan (2010) states that the higher values of Leaf Area Index and the lower percentage value of transmissivity consequently increase the percentage value of thermal radiation filtration and increase the humidity. Conversely, tree with transmissivity percentage between 1-10% is an excellent in filtering solar radiation due to combination of branching, twigs and leaf covers. The findings conclude that tree which has thicker branching, twigs and leaves are major influences in providing significant radiation filtration and types, sizes and arrangements of leaves are the important to improve the efficiency in radiation absorption and reflection.

4 RESEARCH METHODOLOGY

4.1 Study Area

A new township development Bandar Kinrara was being selected as the focus study. It is, situated in Petaling, a district of Selangor, with the area of 1904 acre. The development was develop in 1991 and continued expected until 2014. There will be a total 13,552 units of homes upon the completion of the development with an expected population 54,208. Bandar Kinrara was developed in seven sections which are Bandar Kinrara 1 to Bandar Kinrara 7. The selection of these sites is also based on the fast growing development in Selangor. Rapid development urban growth generally has decrease most of green area in urban area.

4.2 Questionnaires Design

The first section of the questionnaire was the instructions and objectives of the study to help respondents understand the rationale of the research and the questions. The second section of the questionnaire is the demography questions including gender, age, and educational level. Such data could tell whether the sample was representative of the general population (Bateman et al., 2002). Third section of the questionnaire was evaluating the characteristics of landscape design within respondents' residential area. This section will understand the respondents' knowledge, perception and attitude towards the landscape and its relation to the outdoor thermal comfort. Parts of the questions are asking about the importance of having a green space within respondents' residential area and benefits by having landscape.

Another section of the questionnaire was to understand respondents' suggestion to improve outdoor thermal comfort by using planting design. All the suggestions listed in questionnaire survey were based on the open ended question of the pilot survey and through literature review. The professional students of the University Putra Malaysia (Master in Landscape Architecture, Faculty of Design and Architecture students) with first-hand insights and experiences provided some inputs in the questionnaire design. The scale is used in questionnaires to obtain respondent's perception or degree of agreement with a set of statements. In the survey questionnaires, respondents were asked to indicate their level of agreement with a given statement. A numerical value is used to assign every item in survey according to their level. In this study, 5 level of scale is used to represent level of respondents' feedback. The 5 sets of level were (1) Strongly disagree, (2) Disagree, (3) Neutral, (4) Agree, (5) Strongly agree. The mean value will represent level of respondents' feedback in the subject matter.

4.3 Questionnaires Survey

A pilot test has been performed to understand real-world experience and feedback to refine the questionnaire. The survey season successfully interviewed 113 respondents face to face. During the survey season, some of the interviewers were provide some explanations when it necessary but most of the respondents completed the questionnaires independently.

The sample population has been determined using clustered sampling. Clustered sampling framework provided a suitable and cost-effective approach to evaluate large populations (Bateman et al. 2002). A total of 113 respondents from 7 sections of Bandar Kinrara randomly selected to answer the survey questions.

5 FINDINGS

The survey obtained information on the demographic characteristics of the respondents. From total of 113 respondents (n=113), 54% of respondents were male while 46% of the respondents were female. The distribution of respondents according to gender was almost equal.

5.1 Respondents' perception and awareness

Referring to Table 1, majority of the respondents (mean value 4.19) have aware about thermal problem within urban residential area and they (mean value 4.04) understand the relation between plant and its function to increase the level of outdoor thermal comfort within their housing area. Respondents (mean value 4.03) also realize the important of having landscape within their housing area and the important to have plant as an element to increase outdoor thermal comfort.

Moderate numbers of respondents (mean value 3.03) understand how to arrange plants that contribute in enhancing outdoor thermal comfort level. Majority of the respondents understand plant can increase outdoor thermal comfort through shading system (mean value 3.71) and increase humidity (mean value 3.07). Less numbers of respondents understand plant can control wind flow (mean value 2.71).

Respondents also asked about their existing landscape within their housing area. Survey found that most of the respondents' houses were planted with trees and shrubs. Majority of the respondents (mean value 3.72) found that typical planting design doesn't improve their outdoor thermal comfort and they believe that types of trees that being planted were not suitable to improve their outdoor thermal comfort level.

Table 1: Respondents' perception and awareness

Awareness	Level of Satisfaction (%)					Mean	Standard deviation (SD)
	Slightly Not Agree	Not agree	Not Sure	Agree	Slightly Agree		
<i>Heard about thermal problem in urban residential area</i>	4.4	6.2	6.2	51.3	38.1	4.19	0.902
<i>Aware plant can reduce outdoor thermal problem</i>	0.9	1.8	6.2	74.3	16.8	4.04	0.618
<i>Important to have plants (trees & Shrubs)</i>	0	8.2	10.2	58.2	23.5	3.97	0.818
<i>Important to use plant (trees & shrubs) to reduce outdoor thermal problems</i>	0.0	1.8	4.4	83.2	10.6	4.03	0.472
<i>Know how to arrange plant to increase outdoor thermal comfort</i>	3.5	15.0	35.4	39.8	6.2	3.03	0.925
<i>Understand, plant can increase outdoor thermal comfort through;</i>							
<i>i. Shading</i>	8.0	8.8	5.3	60.2	17.7	3.71	1.107
<i>ii. Increase humidity</i>	6.2	39.8	0.9	46.9	6.2	3.07	1.170
<i>iii. Control wind flow</i>	13.3	32.7	29.2	19.5	5.3	2.71	1.091
<i>Typical planting design doesn't improve outdoor thermal comfort</i>	5.3	13.3	5.3	56.6	19.5	3.72	1.089
<i>Existing type of trees doesn't improve outdoor thermal comforts</i>	5.3	27.4	3.5	50.4	13.3	3.39	1.175
<i>Enough space/area for landscaping</i>	2.0	8.2	1.0	51.0	37.8	4.41	0.942

Respondents predominantly (mean value 4.41) agree that typical green area was insufficient to plant enough trees and shrubs as to provide thermal comfort. This finding clearly shows strong evidence to support literature finding and author observation regarding the issues which is typical green area within housing area is not sufficient to plant enough plant especially trees in conjunction to provide thermal comfort.

5.2 Respondents' suggestion to improve level of outdoor thermal comfort

Referring to Table 2, respondents predominantly need more spaces for planting plants within their housing area with the meanest value 4.19. This

finding was the most significant with the issues of this study and supports the previous findings which are most respondents realize that there was insufficient size of green area in typical terrace housing layout. Respondents (mean value 4.13) also need suitable plants to be planted but the types of plant meet to their needs. Respondents (mean value 3.84) suggest that to increase the number of tree and shrub within housing area. The respondents also suggest that the planting design should be improved in order to improve outdoor thermal comfort without keep aside the aesthetical value.

Table 2: Suggestion to Improve Thermal Level within Housing Area. *Mean value: 1-5, which 1 indicate Strongly Disagree and 5 indicate Strongly Agree

Suggestion to improve thermal level within housing area	Degree of Satisfaction (%)					Mean	Standard deviation (SD)
	Slightly Not Agree	Not agree	Not Sure	Agree	Slightly Agree		
<i>Improve the planting design in order to improve both outdoor thermal comfort and aesthetical value</i>	4.4	22.1	2.7	59.3	11.5	3.51	1.095
<i>Increase the number of tree and shrub within housing area</i>	7.1	8.8	5.3	50.4	28.3	3.84	1.146
<i>Provide more spaces for planting within housing area.</i>	3.5	8.8	4.4	31.0	52.2	4.19	1.101
<i>Use the suitable plant that meet the user needs</i>	2.7	7.1	3.5	47.8	38.9	4.13	0.968

6 DISCUSSION

6.1 Respondents Perception and Awareness

Most of the respondents were aware and realize about thermal problems within their outdoor housing area. This finding is parallel with Dunlap, R.E and Van Liere K. D (1978), which has examined 24 countries environmental attitude and the findings show that interests in environmental issues are growing in developing countries. Majority of the respondents were realized that the problem was occurred because of the inadequate numbers of plants being planted within their housing area. They also understand and realize the importance of planting design and its capability to enhance outdoor thermal comfort level.

Respondents think that is most of the housing layout has been built without concerning appropriate size of green area within housing area. They also opine that ordinary terraced houses layout with bare small frontage and backyard contributes to the rise of thermal comfort problem in urban residential area. This finding is parallel with previous researcher's statement

that is the typical green area in housing layout was designed with limited shading from trees have generally result higher temperatures in that area (Sani,1990).

6.2 Respondents' Knowledge

Knowledge and understanding about the basic environment and issues related was essential to encourage a sense of responsibility and proactive environmental occupant and it is always a prominent feature towards a successful development of quality living environment. Knowledge and understanding are significant to achieve environmental awareness subsequently shaping occupant attitudes, and behaviour coherent with effective public participation. Quimbita (2005) stated that to prevent environment been harmed and damaged, the change in human behaviour and the direction of the naturalist dimensions is important. According to Maleki (2011) environmental behaviour of people can be influenced by the environmental knowledge. In line with this topic Frick, J., Kaiser, F., & Mark, G.W. (2004) state that effectiveness of environmental knowledge is more than just knowing how to protect environment but getting the maximum benefits from environment.

Referring to the findings, it is clearly shows that most of respondents aware about thermal issues in urban housing area and they understand that it is important to have plants within their housing area and planting a proper plants in order to increase the thermal comfort level within their housings area. Although the level of awareness is high there are still lacks of understanding in plant arrangement in order to increase outdoor thermal comfort level.

6.3 Suggestion to Improve Outdoor Thermal Comfort Level

Study results clearly shows that green area play a big role in neighbourhood environments and it's contribute in enhancing environmental quality as well as social quality. Therefore, in order to enhance the quality environment of urban residential area, there are some actions are recommended as below.

i. Proper Planting Development in the Housing Neighbourhood

Green spaces within housing neighbourhood have great potential to provide for many different activities for their occupants but they are regularly not properly develop and the trees being planted without much concern on environmental concern. The need for health benefits, comfort and relaxation from residential green space either private green space and semi-public such as street trees, public green area within housing neighbourhood will be much important and the planting development or planting program should give more attention. In addition, the development of the outdoor thermally comfortable area, the development should give more concern on the way the occupants react to the area and the design should more occupants oriented.

Planting design and programs for urban housing area should focus not only on getting trees planted, but on getting the right trees planted in the right places without left behind the occupants' preferences towards the types of landscape design. The planting design should put much consideration on the placement of trees, its function and design elements. The importance of thermal comfort and appearance factors in the decision to plant trees (the prominent of shade and aesthetics as motivators) direct the way towards in creating a quality neighbourhood landscape.

ii. Increase the Sizes of Green Spaces within Housing Area

Typical urban residential normally terrace housing types are located in subdivisions lot area. Generally, those developments be obliged to follow the clustering rules in which all the houses been planned and arranged on a portion of the total land and the remainder is left as open space with the total area about 12m² to 15 m². There had been proven that proper planting trees and shrubs provide numbers of significant benefit, for both the environmental functions and improve quality of life to the community and it is likely to be greater when more numbers of trees and shrubs are planted within residential neighbourhoods.

However, referring to the research findings, typical layout size of green space within urban residential area was insufficient and not adequate to improves neighbourhood environment quality; small scale size of private green space in terrace housing area are not enough to be planted with adequate numbers of trees, the typical single tree planting at road shoulder doesn't improve outdoor thermal comfort level. Some aspects must be considered in conjunction to improve the outdoor thermal comfort level in urban residential area such as the appropriate size of green area to improve numbers of plant to be planted within the housing area and greater to establish new green areas near houses.

7 CONCLUSION

This study attempts to state the absence of information by presenting a perspective of the occupants' perceptions towards the role of plants in enhancing outdoor thermal comfort within their housing area. It is seem possible that the findings are unique to the country future planning of housing landscape, by reflecting local occupants' perceptions of their outdoor environment within their housing area. It can be conclude that most of the occupants were aware about the thermal problems that exist within their housing area and realize the importance of having adequate number of appropriate plants to be planted within their housing in order to enhance the thermal comfort level within their housings area.

Referring to the study findings, it does probable to recommend some conclusive suggestion that might point to enhance outdoor thermal comfort level within housing area. It is important that planting design and programs for urban housing area should focus on acquiring the adequate right trees planted in the right places in order to enhance the thermal comfort level without left behind the aesthetical value.

Some aspects must be considered in conjunction to improve the outdoor thermal comfort level in urban residential area. It is important to provide appropriate size of green area in urban terraced housing area in order to improve numbers of plant to be planted. This is in line with a study by Streiling S. and A. Matzarakis (2003) which analysed the influence of single and small cluster of trees on the thermal environment and air quality of urban climate and conclude that the air temperature gradually to decrease as the number of trees increased and contribute to enhancing thermal comfort level in outdoor area. Clearly the information on public's perceptions would be important and it is useful for the present and future planning of housing environment. The finding is important as the contribution to an understanding the potential of plant as a device in creating thermally comfortable housing environments in urban area.

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