Thermal Performance of Outdoor Tropical Environment

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Abstract: - The landscape setting very much shapes the thermal performance of the outdoor environment. The influencing variables are vegetation and ground surface materials among others. This paper presents the impact of landscape settings on the microclimate of three sites with different landscape environment. The investigation was conducted during the wet and dry monsoon seasons of the tropical environment of Malaysia. The study involves field measurement of air temperature, relative humidity and wind environment from 0900hr to 1600hr, conducted on several days of the said monsoon regimes. Significant results in terms of the magnitude of differences of air temperature and relative humidity between the studied sites were observed. The wind environment seems to be also affected by the landscape settings.

Key-Words*:* - ground surfaces, microclimate, vegetation

I. INTRODUCTION

The process of urbanization which involved changes in the natural landscape where more hard surfaces were introduced has led to the urban heat island (UHI) phenomenon among others. This is observed particularly in cities in developing countries, and the majority of these cities lay close to the equatorial line of tropical climates. The UHI further exaggerates the already hot environment of a tropical environment. The role of vegetation in modifying the climate particularly in urban areas is acknowledged following its cooling effect of the evaporation process [1]. Therefore, the urban landscape can be said as a complex and ever-changing spatial unit that is affected by many elements [2]. It also reflects the combination of natural environment creation and modification process [3]. Hence, three sites with different landscape setting were identified to see the impact of their landscape component on the microclimate in this study.

II. URBANIZATION AND MICROCLIMATE MODIFICATION

In hot-humid climate, the people are struggling to live comfortably due to the increment of air temperature. This condition is further exaggerated by the UHI effect where significantly high air temperature within the densely built environment is observed as compared to rural temperatures. Significant reduction of natural surfaces including the vegetated surfaces is commonly found in cities following the urbanization. These conditions are among the factors that contributed to the UHI. Hotter urban environment leads towards the increasing use of the air-conditioner – which means more energy demand. Malaysia as a developing country is facing the significant demand for energy, tries to control its energy consumption while working on renewable energy [4]. This effort should also be supported through sustainable outdoor design as the urban landscape continues to change. In creating a sustainable urban landscape, functional network of green space in maintaining the ecological aspect is important and needed [5].

A. Characteristics of tropical climate of Malaysia

There are two main monsoon regimes in Malaysia. The South-West monsoon (dry season) starts from late May or early June, and ends in September. The North-East monsoon (wet season) starts in early November and ends in March. High dry bulb temperature and less rain were observed during the dry season, while, on the contrary, low dry bulb temperature, solar radiation and high relative humidity and rainfall are observed during the wet season. In between these two monsoons, which is the inter-season, high solar radiation and low relative humidity is observed. Particularly for Kuala Lumpur, when analysed by the hour, high dry bulb temperature (≥31ºC), high solar radiation (594.4 – 625Wh/m^2) and low relative humidity (≤65%) is observed between 1100hr to 1300hr [6].

B. Wind environment for tropical regions

Wind is an important asset in hot-humid regions. It is needed all year round to cool the streets by removing excess heat, and it is also seen as a potential source to cool the building via cross-ventilation [7]. Air flows from areas of high pressure to areas of low pressure. The air has a relatively lower pressure when its temperature is higher [7]. In improving outdoor comfort, air movement plays an important role [1]. Ventilation is an essential factor for a hot-humid climate city as it helps to reduce the temperature within the urban environment [8]. Hence, good air flow is crucially needed by cities in the hot-humid region. Ventilation plays an important role in minimizing the heat island effects by flushing out the pollutants [9][10]. However, due to warm air over cities following the heat island effect leads towards increasing instability in the atmosphere over urban areas, and the air systems at lower levels slows down and stays longer due to rugged cities surfaces [11]. The following table 1 from the meteorology office of the United Kingdom website is adapted [12], defines the wind speed together with the descriptions.

Table 1: The Beufort wind scale

Beufort wind scale	Mean wind speed (m/s)	Limits of wind speed (m/s)	Wind descriptive terms
0	0	<1	Calm
1	1	1-2	Light air
2	3	2-3	Light breeze
3	5	4-5	Gentle breeze
4	7	6-8	Moderate breeze
5	10	9-11	Fresh breeze
6	12	11-14	Strong breeze
7	15	14-17	Near gale
8	19	17-21	Gale
9	23	21-24	Strong gale
10	27	25-28	storm
11	31	29-32	Violent storm
12	-	33+	hurricane

III. METHODOLOGY OF THE RESEARCH

The International Islamic University Malaysia (IIUM) is located in the Klang Valley, lies at latitude 3.2528° N and longitude 101.7375° E. The helipad area (HP), compound of the rector's house (RC), and the student's hostel – *Mahallah* Aminah (MA) of IIUM were identified as the sites for this study as they have distinguished landscape settings for microclimate comparison. The majority of the ground surface of HP is tarmac (grey in color) with fewer trees surrounding it. The RC has more turf (green in color) covering its soil and surrounded with greeneries, whereas MA is covered with turf – refer to fig. 1. Buildings within these areas are indicated in red. The site inventory and analysis of ground surface materials, and types and physical aspect of trees were conducted prior to collection of environmental data.

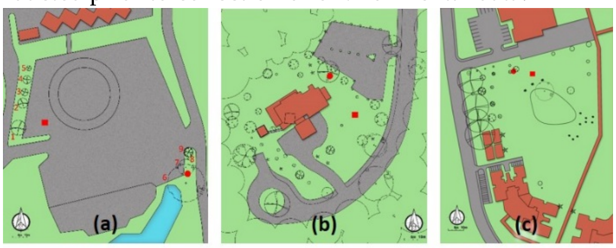

Fig. 1: Layout of HP (a), RC (b), and MA (c)

The field measurement of the environmental parameter was conducted at two sites at a time following the limitation of the quantity of the equipment. Since wide tarmac is covering its ground surface, HP is to be compared with RC and MA. Hence, the field measurement of the environmental parameter was conducted between HP and RC, and HP and MA. A two-days reading of air temperature (°C) and the relative humidity (%) with the interval of five minutes from 0900hr until 1600hr were recorded. It was during the dry season (twice) and the wet season (once) as shown in the following table 2. The wind environment of these three sites were also studied by recording the wind speed (m/s) with the interval of five minutes on the very same days. The wind environment is more volatile compared to air temperature and relative humidity.

Table 2: Dates of field work measurement

day	locations	date	season	monsoon
1	HP RC (set 1)	17/7/2013	Dry	South-west
2		31/7/2013		
3		10/7/2014		
4		23/7/2014		
5	HP MA (set 2)	28/6/2013		
6		15/7/2013		
7		3/7/2014		
8		14/7/2014		
9	HP RC (set 1)	24/12/2013	Wet	North-east
10		28/12/2013		
11	HP MA (set 2)	17/12/2013		
12		21/12/2013		

As these two monsoons significantly characterized the tropical climate with 'extreme' weather conditions, these two seasons were identified to conduct the field work and record the environmental data (air temperature and relative humidity).

Four units of the HOBO Pro V2 (U23-002) outdoor data logger were used at a time to record the air temperature and relative humidity where two units were located at each site – one unit under the direct sunlight (exposed) and the other one under a mature tree (shaded) of the sites – refer fig. 2. The locations of these equipment are indicated as red square (exposed) and red circle (Shaded) in fig. 1. Two units of Kestrel®4500 pocket weather station were also used to measure the wind environment of these sites. They were positioned beside the HOBO Pro V2 that were located in the direct sunlight as to allow free flows of winds.

Fig. 2: The trees where HOBO Pro V2 were located (HP – left, RC – middle, MA - right)

IV. ANALYSES AND RESULTS

The presentation of the analysis starts with the physical description of the three sites, followed by the analysis of the environmental data. The Excel 2013 software is used to analyze the environmental data recorded for this study. The hypothesis applied to guide and strategize the analysis is "HP with wider tarmac covering its ground surface is hotter than RC and MA". The environmental data analysis starts first with the discussion on the air temperature, follow by the relative humidity, and then the wind environment of the studied sites. The following table 3 shows the details of the tree aspects where outdoor data loggers were located.

Table 3: Aspects of trees where outdoor data loggers were located

	Canopy diameter (m)	Trunk height (m)	Canopy height (m)	Foliage density

HP	26.2	4	20	Dense
RC	12.2	3	15	Dense
MA	3.6	2.3	3	Medium dense

A. Landscape settings and physical character of the studied sites: HP and RC

The following table 4 and 5 describe the three investigated sites. The widest site is HP followed by MA and RC. The area size of HP is about 1.5 times bigger than RC, and 1.4 times bigger than MA. HP is covered by tarmac by 62% and 32% green area, considering that 24% and 72% for RC, and 19% and 66% for MA. RC has about 7.6 times more trees than HP with the majority of them (84%) with the canopy diameter in between one meter to less than seven meters, and 1.5 more tresses compared to MA.

Table 4: Size and percentage of ground surface types HP, RC and MA

	HP		RC		MA	
elements	(m^2)	%	(m^2)	%	(m^2)	%
turfed/ vegetated	7460	32	11300	72	11003	66
tarmac	14467	62	3767	24	3171	19
water	771	3	0	0	0	0
building	608	3	625	4	2407	15
total site area	23306	100	15692	100	16581	100

Table 5: Quantity and percentage of tree canopy diameter

	HP		RC		MA	
Canopy diameter (CD)	nos	%	nos	%	nos	%
1m to <7m	4	44	57	84	38	86
7m to <14m	4	44	7	10	1	2
14m to <19m	0	0	3	4	4	9
≥19m	1	12	1	2	0	0
total	9	100	68	100	44	100

B. Temperature differences of HP and RC, and HP and MA

In analyzing the impact of different landscape settings, the magnitude of difference of air temperature and relative humidity readings recorded at exposed area and the shaded area of these sites are studied. This approach is applied as it would be difficult to quantify the magnitude of differences between these sites. Especially when trying to compare directly the differences of the air temperature and relative humidity of exposed and shaded area of these sites (refer fig.3).

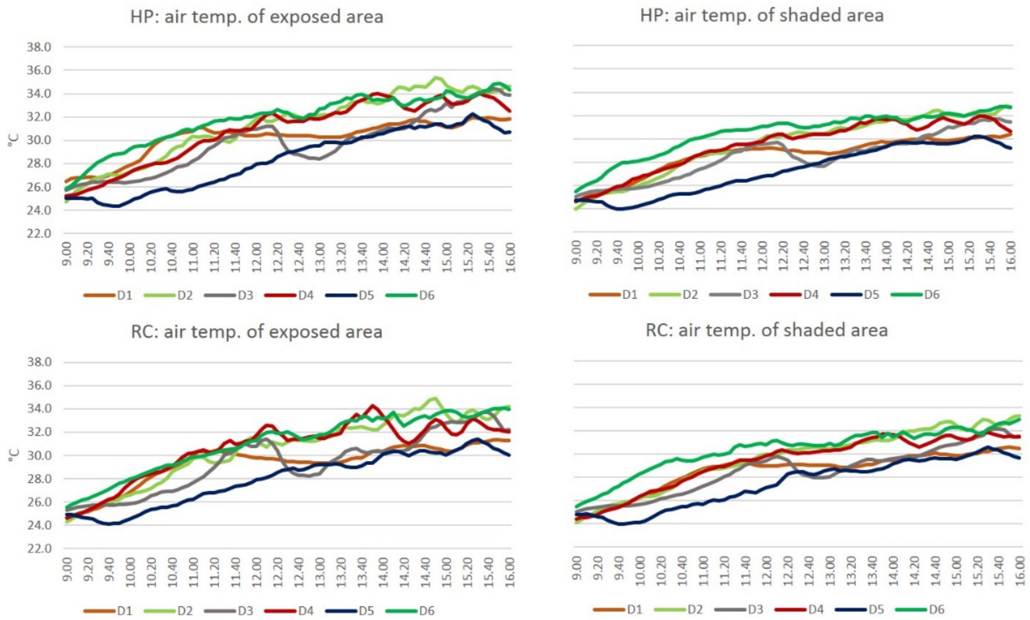

Fig. 3: Air temperature of HP and RC (exposed and shaded areas)

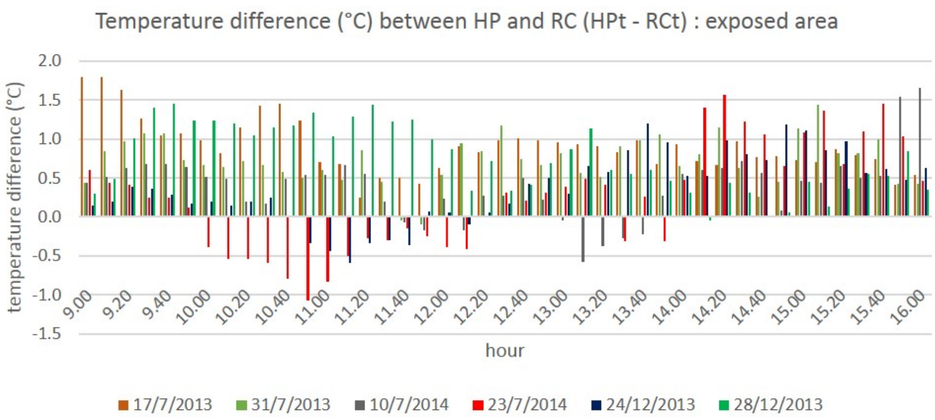

Fig. 4: Analysis on the air temperature difference of HP and RC (exposed area)

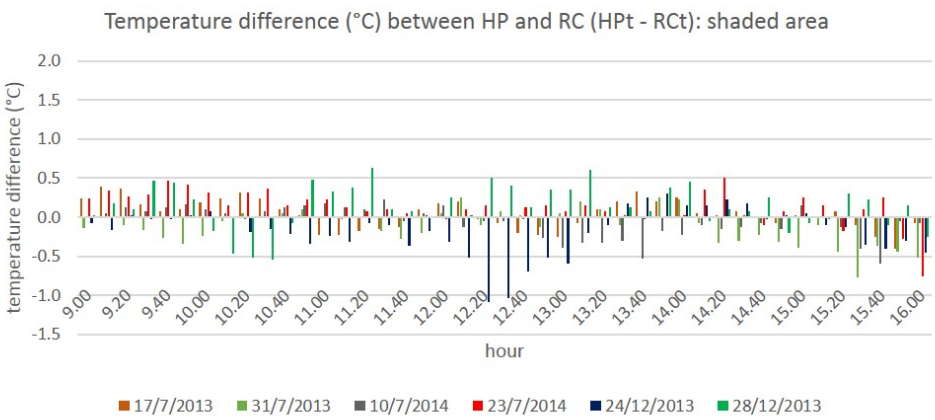

Fig. 5: Analysis on the air temperature difference of HP and RC (shaded area)

Referring to fig. 4, when the difference between the temperature reading of exposed area of HP and RC (HPt – RCt) is compared, the positive value (>0°C) indicates HP is hotter than RC. 0°C indicates similar air temperature reading of both sites, and the negative value (<0°C) indicates HP is cooler than RC at a given time. The following table 6 shows the amount and percentage of positive values obtained from the difference between HP and RC. The positive values seem to be giving a high percentage. Hence, it can be said that the exposed area of HP is experiencing hotter environment than RC with the maximum difference of above 1.5°C (refer fig. 4).

Table 6: Percentage of positive values of temperature difference between HP and RC (exposed area)

	17/7/2013	31/7/2013	10/7/2014	23/7/2014	24/12/2013	28/12/2013
Nos. of positive value	85	82	85	51	70	83
% of positive value	100	96.5	100	60	82.4	97.6
Note: Total nos of reading is 85/day						

A similar analysis is conducted for the shaded area (fig. 5). Unlike the exposed area, it can be observed that the percentage of positive values is lower for the shaded area, with two days reading (31/7/2013 and 24/12/2013) showing less than 50% (table 7). This could be due to the effect of the trees that helped to moderate the air temperature underneath their canopies, resulting in less air temperature volatility.

Table 7: Percentage of positive values of temperature difference between HP and RC (shaded area)

	1/7//2013	31/7/2013	10/7/2014	23/7/2014	24/12/2013	28/12/2013
Nos. of positive value	54	38	47	77	33	67
% of positive value	63.5	**44.7**	55.3	90.6	**38.8**	78.8
Note: Total nos of reading is 85/day						

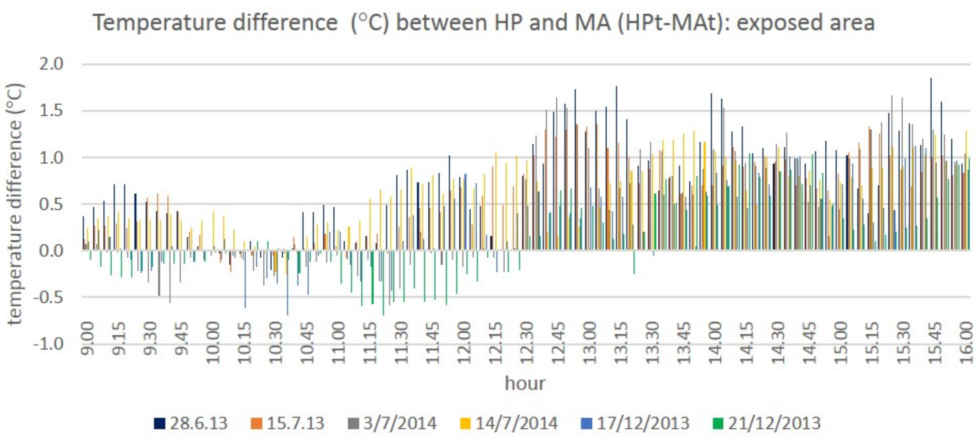

Fig. 6: Analysis on the air temperature difference of HP and MA (exposed area)

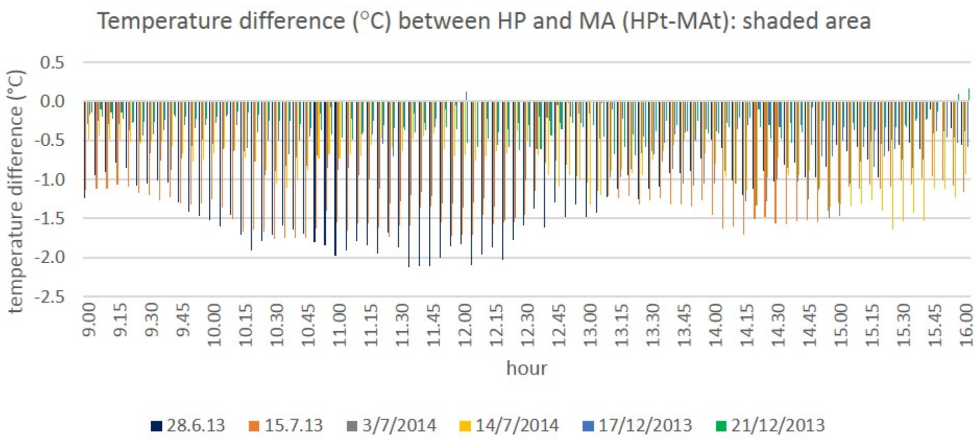

Fig. 7: Analysis on the air temperature difference of HP and MA (shaded area)

Similar to the approach of previous analysis on the air temperature difference of HP and RC, referring to fig. 6, the positive value (>0°C) indicates HP is hotter than MA most of the time. The following table 8 shows the amount and percentage of positive values obtained from the difference between HP and RC. The positive values seem to be giving a high percentage. Hence, it can be said that the exposed area of HP is experiencing hotter environment than MA with the maximum difference of above 1.5°C too (refer fig. 6).

Table 8: Percentage of positive values of temperature difference between HP and MA (exposed area)

	28/6/2013	15/7/2013	3/7/2014	14/7/2014	17/12/2013	21/12/2013
Nos. of positive value	81	80	55	83	63	51
% of positive value	95.3	94.1	64.7	97.6	74.1	60.0
Note: Total nos of reading is 85/day						

Table 9: Percentage of positive values of temperature difference between HP and MA (shaded area)

	28/6/2013	15/7/2013	3/7/2014	14/7/2014	17/12/2013	21/12/2013
Nos. of positive value	1	0	0	0	4	3
% of positive value	1.2	0	0	0	4.7	3.5
Note: Total nos of reading is 85/day						

However, it is very interesting to see that for the shaded area, MA demonstrates hotter environment compared to HP (refer fig. 7 and table 9). This could be due to the physical aspect of the tree in which the equipment was placed – refer to table 3. The tree at HP is larger in dimension with dense foliage. This result indicates that the physical aspect of tree plays significant roles in air temperature modification.

Based on table 6, 7, 8 and 9, further analysis can be done to compare relatively between these three sites by accumulating the positive values. Hence, the following table 10 is produced. It can be suggested that for exposed area, HP is hotter than RC and MA by 89.4% and 81.0% respectively of the investigated period. Whereas for the shaded area, HP is hotter than RC and MA by 62.0% and only 1.6% respectively and this might due to the physical aspect of the trees as mentioned earlier (refer table 3). Relatively, it can also be suggested that HP is experiencing the hottest environment, followed by MA and RC.

Table 10: Relative comparison of sites based on accumulated positive values

HP-RC	%
456/510 (exposed area)	89.4
316/510 (shaded area)	62.0
HP-MA	
413/510 (exposed area)	81.0
8/510 (shaded area)	1.6

C. *Identifying the magnitude of air temperature difference between HP and RC, and HP and MA*

It is also interesting to further analyse the magnitude or intensity of air temperature difference between HP and RC, and HP and MA following their landscape setting difference. This is done by analysing the score and percentage, according to the range of air temperature difference (refer table 11 and table 12).

Table 11: Analysis on the percentage of magnitude of air temperature difference for HP and RC

	Exposed area									Shaded area								
range of air temperature difference*	17/7/2013	31/7/2013	10/7/2014	23/7/2014	24/12/2013	28/12/2013	Total nos.	%		17/7/2013	31/7/2013	10/7/2014	23/7/2014	24/12/2013	28/12/2013	Total nos.	%	
	nos									nos								
-1.1 to -1.5°C	0	0	0	2	0	0	2	0.4	13.3%	0	0	0	0	2	0	2	0.4	38.0%
- 0.6 to - 1.0°C	0	0	2	6	1	0	9	1.8		0	3	2	2	6	1	14	2.7	
-0.1 to -0.5°C	0	3	12	26	14	2	57	11.2		31	44	36	6	44	17	178	34.9	
0°C	0	1	2	2	4	1	10	2.0	2.0%	11	17	16	14	15	11	84	16.5	16.5%
0.1 to 0.5°C	11	18	41	24	34	32	160	31.4	**84.7%**	43	21	31	63	18	51	227	44.5	**45.5%**
0.6 to 1.0°C	55	52	25	10	26	22	190	37.3		0	0	0	0	0	5	5	1.0	
1.1 to 1.5°C	14	11	1	12	6	28	72	14.1		0	0	0	0	0	0	0	0.0	
1.6 to 2.0°C	5	0	2	3	0	0	10	2.0		0	0	0	0	0	0	0	0.0	
Sub-total	85	85	85	85	85	85	510	**100.0**		85	85	85	85	85	85	510	**100.0**	

[*Note: the positive value (>0°C) indicates HP is hotter than RC, 0°C indicates similar air temperature reading, and the negative value (<0°C) indicates HP is cooler than RC at a given time.]

Table 12: Analysis on the percentage of magnitude of air temperature difference for HP and MA

	Exposed area									Shaded area								
range of air temperature difference*	28/6/2013	15/7/2013	3/7/2014	14/7/2014	17/12/2013	21/12/2013	Total nos	%		28/6/2013	15/7/2013	3/7/2014	14/7/2014	17/12/2013	21/12/2013	Total nos	%	
	nos									nos								
-2.1 to -2.5°C	0	0	0	0	0	0	0	0.0	19.0%	4	0	0	0	0	0	4	0.8	**98.0%**
-1.6 to -2.0°C	0	0	0	0	0	0	0	0.0		26	28	0	1	0	0	55	10.8	
-1.1 to -1.5°C	0	0	0	0	0	0	0	0.0		21	48	26	20	0	0	115	22.5	
- 0.6 to - 1.0°C	0	0	2	0	2	7	11	2.2		29	9	38	48	13	9	146	28.6	
-0.1 to -0.5°C	4	5	28	2	20	27	86	16.9		4	0	20	16	67	73	180	35.3	
0°C	6	6	8	3	4	7	34	6.7	6.7%	1	0	1	0	4	1	7	1.4	1.4%
0.1 to 0.5°C	23	23	9	30	29	24	138	27.1	**74.3%**	0	0	0	0	1	2	3	0.6	0.6%
0.6 to 1.0°C	26	37	14	38	28	20	163	32.0		0	0	0	0	0	0	0	0.0	
1.1 to 1.5°C	19	14	21	12	2	0	68	13.3		0	0	0	0	0	0	0	0.0	
1.6 to 2.0°C	7	0	3	0	0	0	10	2.0		0	0	0	0	0	0	0	0.0	
Sub-total	85	85	85	85	85	85	510	**100**		85	85	85	85	85	85	510	**100**	

[*Note: the positive value (>0°C) indicates HP is hotter than MA, 0°C indicates similar air temperature reading, and the negative value (<0°C) indicates HP is cooler than MA at a given time.]

Following the five minutes interval, 85 readings were recorded a day from 0900hr until 1600hr, and a total of 510 readings within six days per an area. For HP and RC (refer table 11), the influence of landscape setting on the air temperature can be significantly seen as HP is hotter than RC by 84.7% of the studied period for the exposed area, with the majority of the magnitude between 0.1°C to 1.0°C (68.7%). As for the shaded area, trees seem to moderate the air temperature readings, however a similar pattern is observed although HP is hotter than RC by only 45.5%.

For HP and MA (refer table 12), HP is hotter than MA by 74.3% for the exposed area with the majority of the magnitude between 0.1°C to 1.0°C too (59.1%). Whereas for the shaded area, the air temperature underneath the tree canopy of HP demonstrates a significantly cooler environment (98.0%) than MA. The majority of the difference (magnitude) is between 0.1°C to 1.5°C (86.4%). The results suggest that the physical aspect of tree plays a very significant roles in moderating the air temperature underneath its canopy. The minimum and maximum range of air temperature difference for HP-RC and HP-MA according to the exposed and shaded areas. The results are as follows:

HP-RC

- Exposed area: between -1.1°C to 1.8°C (2.9°C range value),
- Shaded area: between -1.1 to 0.6°C (1.7°C range value).

HP-MA

- Exposed area: between -0.7°C to 1.9°C (2.6°C range value),
- Shaded area: between -2.1 to 0.2°C (2.3°C range value).

Between HP and RC, following their landscape settings and physical aspect of trees, the recorded temperature difference can be up to 2.9°C and 1.7°C for exposed and shaded area respectively. Whereas between HP and MA, the recorded temperature difference can be up to 2.6°C and 2.3°C for exposed and shaded area respectively. The air temperature is the most significant ambient factor (apart from the sun, radiation, humidity and rain) which affects human internal temperature and level of comfort [13]. In terms of human thermal comfort, the maximum difference recorded here is significant as human skin is sensitive to the changes of the air temperature.

D. Relative humidity differences of HP and RC, and HP and MA

Relative humidity is having a negative association with the air temperature where relative humidity decreases as air temperature increases. Similar to the analysis of the air temperature, the differences between relative humidity between HP and RC, and HP and MA of both exposed and shaded areas are analysed (fig. 8, 9, 10 and 11).

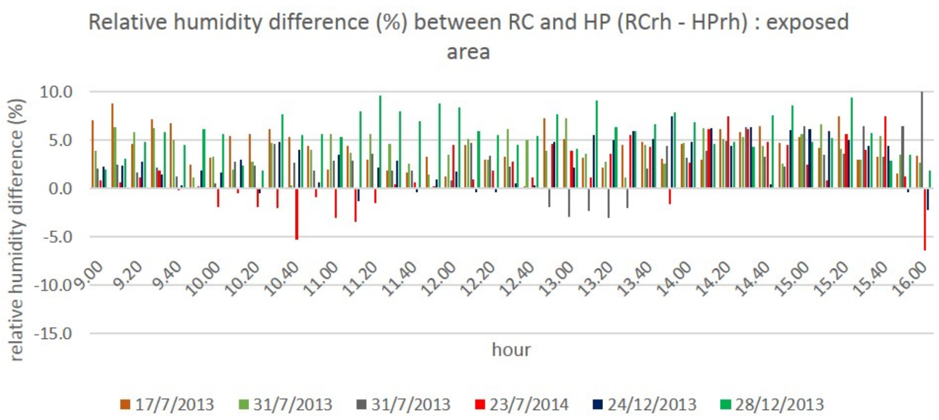

Fig. 8: Analysis on the relative humidity difference of HP and RC (exposed area)

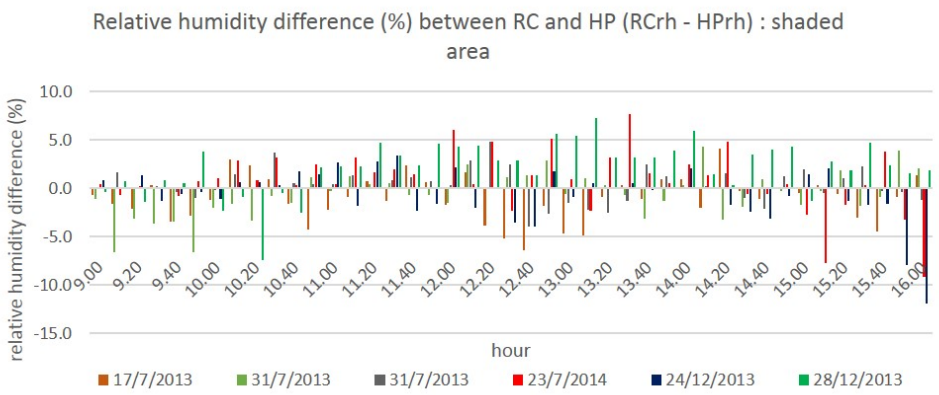

Fig. 9: Analysis on the relative humidity difference of HP and RC (shaded area)

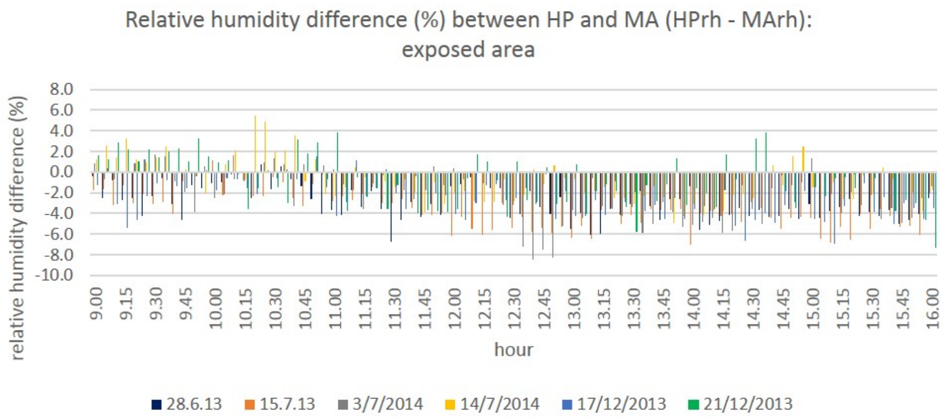

Fig. 10: Analysis on the relative humidity difference of HP and MA (exposed area)

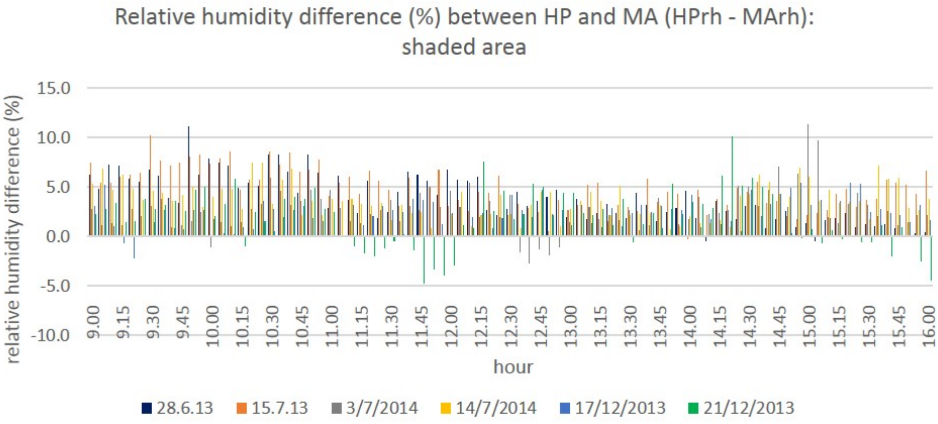

Fig. 11: Analysis on the relative humidity difference of HP and MA (shaded area)

Following the co-relationship and negative association with air temperature, a similar pattern is observed on the differences of relative humidity as well as their magnitude for both exposed and shaded area (refer fig. 4, 5, 6 and 7). Hence, the focus is more concentrated on the air temperature analysis.

E. Wind environment of HP and RC, and HP and MA

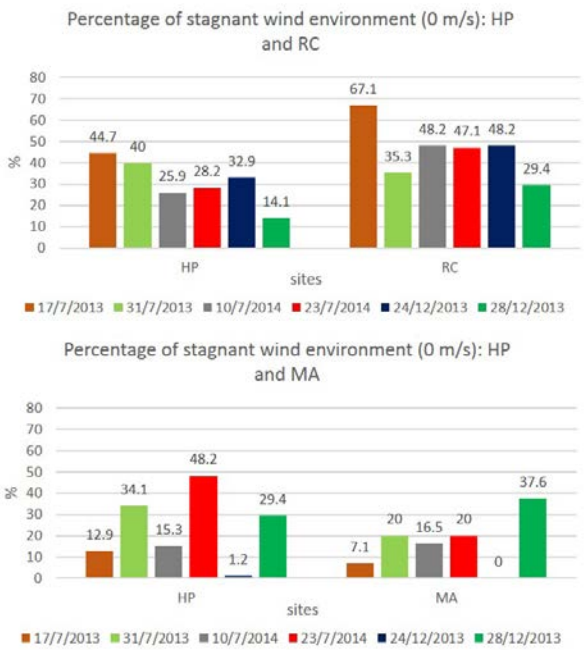

Fig. 12: Analysis on stagnant wind environment of HP and RC, and HP and MA

Air movement of wind is crucially needed in a hot-humid tropical region as it gives comfort to the people even as mild as 0.1m/s [6]. In other words, stagnant wind environment is unfavorable. Wind environment can be very dynamic and challenging to be studied. For this research, the wind environment recorded are between stagnant (0m/s) to the maximum of 7.8m/s. Hence, for the wind environment, the analysis on stagnant wind condition is carried out first (fig. 12).

From the fig. 12, it can be seen that RC is experiencing more stagnant wind condition than HP, with the highest stagnant condition of 67.1% on 17/7/2013. Hence, HP can be said having more dynamic wind environment with the lowest stagnant wind condition of 14.1% on 28/12/2013. As for HP and MA, MA demonstrates dynamic wind environment compared to HP with the non-stagnant condition on the 24/12/2013.

When the recorded stagnant conditions are accumulated and turn into percent, the following result is obtained:

Set1: HP (31.0%) and RC (45.9%)

Set 2: HP (23.5%) and MA (16.9%)

For HP of set 1, it is anticipated that HP would experience more dynamic end environment following the existence of the wide tarmac that results in hotter temperature, hence lower air pressure. This might have induced the wind flows following the difference in air pressure compared to the surrounding areas. The same was anticipated for set 2, however it demonstrates different result. Hence, further investigation can be further carried out in the future.

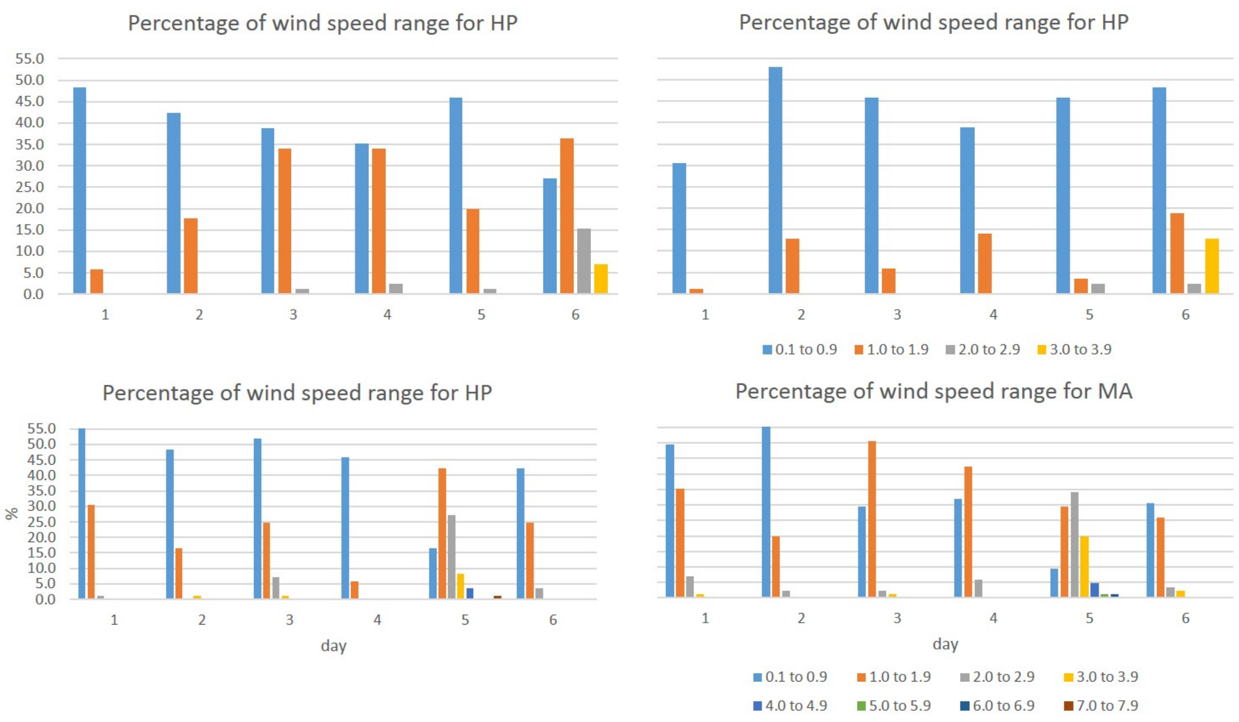

Fig. 13: Percentage of wind speed range by site for HP and RC, and HP and MA

As mentioned earlier, the equipment to measure the wind speed was located in the direct sunlight. Between HP and RC, it is observed that the exposed area of HP is experiencing hotter and more dynamic wind environment. However this is not the case for set 2, as MA is demonstrating more dynamic wind environment although HP is experiencing hotter environment.

The range of wind speed of studied sites for all six days is also analysed by looking at the percentage (fig. 13). It shows that the wind speed is between the ranges of calm to light breeze with the range between 0.1 to 0.9 m/s. It is experienced by both sites mostly, followed by the speed range of 1.0 to 1.9 m/s. The maximum wind speed range of 3.0 to 3.9 m/s is observed only on the sixth day (28/12/2013) on both HP and RC (set 1). However, for HP and MA (set 2), the ranges include gentle and moderate breeze as the maximum wind speeds recorded a 7.8m/s and 6.0m/s respectively. However, these two maximum readings were recorded only once throughout the period of study. It was observed that day 5 (17/12/2013) seems to be a very windy day as only one stagnant (0m/s) reading was recorded for HP whereas MA did not record any stagnant reading. The maximum readings were achieved on the same day.

V. CONCLUSIONS

The study has given some empirical evidence that landscape settings indeed influence the microclimate of the outdoor environment. High vegetation coverage – with more mature trees, turf and fewer hard surfaces covering the ground helped to make the ambient air temperature of RC cooler. Wide tarmac covering the ground surfaces with very little trees could enhance the urban heat island effect as observed at HP. The difference in air temperature ranging in between 0.1°C to 1.5°C in this study suggested that properly chosen vegetation and ground surface material could lead to even lower ambient temperature towards the sustainable outdoor environment. There were also times where the air temperature difference reached in between the range of 1.6°C to 2.0°C (refer Table 11 and 12). Hence, attention to good quality trees that provide better shades with less solar radiation penetration to the ground should be given. Similarly, the surfaces materials that absorb and reradiate less heat to the environment shows that there is a possibility to reduce further the ambient air temperature, resulting to significantly cooler tropical environment.

Looking at the relatively high readings of air temperature, relative humidity, and the light wind with stagnant wind condition from time to time. It is understandable that the people is trying to 'avoid' from prolonging their stay in the outdoor environment of hot, humid tropical region. However, staying indoors could lead to people doing a more sedentary activity. Therefore, by understanding the effect of landscape setting, it is hoped that the outdoor designer particularly, could play significant roles in modifying the thermal performance of the outdoor environment. This could be done through the effect of landscape elements on the microclimate, hoping that thermally comfortable outdoor environment would attract people to spend more time outdoor doing active activity leading towards healthy lifestyles. Similarly, other researchers also mentioned that successful green development and implementation of green innovation in an organizational system could produce a significant saving of business and environment resources [14]. Well designed and well maintained outdoor spaces results in provision of public for nature appreciation, recreation and sport which benefits the people physically and mentally, contributes to environmental biodiversity as well as improved air quality [5].

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