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AIR VELOCITY BEHAVIOUR AT COURTYARDS IN THE TROPICAL CLIMATE: CASE STUDIES OF COURTYARDS AT IIUM CAMPUS

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ABSTRACT

The paper presents the air velocity measurement at eight courtyards in International Islamic University Malaysia (IIUM). At IIUM, the courtyards can be categorized into two typologies according to geometry. Air velocity behavior are varies at the two different courtyard geometry. The typologies of courtyards analyzed in this paper are; the enclosed courtyard and the 'U' shape courtyard. Utilizing the data from this study, the effects of the typologies on the air velocity measurements are studied. The data collected indicated that wind flow at the courtyard could contribute in lowering the temperature and humidity, thus making the courtyard more comfortable. This factor will indirectly contribute to the savings of energy through providing comfortable naturally ventilated spaces.

Keywords: air velocity, courtyard, hot humid climate

INTRODUCTION

Careful planning in designing courtyards in the hot humid climate may be useful to ameliorate the conditions at transitional spaces between outdoor and indoor. Air velocity that is one of the main contributors to thermal comfort is highly subjected to the geometry of outdoor spaces (Noor Hanita & Abdul Razak, 2000). In a field experiment at plazas adjacent to tall buildings, geometry has been proven to be one distinct parameter in determining the air velocity behavior and consequently affecting the thermal comfort of the outdoor space.

Courtyards have been considered as transitional space that affects the microclimate by modifying the comfort of the surrounding building/s. Both Cadima (1998) and Bagneid (1987) agreed that the parameters influencing the microclimate are ratio, form proportions, finishes and landscaping. Nevertheless, orientation has also been one of the most important parameter in influencing the outdoor climate (Md Najib & Noor Hanita, 1999; Emmanuel, 1993; Bosselman et. Al., 1997; Shaviv and Capeluto, 1992).

DEFINITION OF COURTYARD

The courtyard is a spaces surrounded (enclosed) by a continuous solid wall of few openings while the outside climate has direct impact on the spaces through an opening in the roof (bagneid, 1987). A courtyard is also defined as a space without a roof but enclosed by walls (Oxford, 1985). Meanwhile, the Funk and Wagnall's encyclopedia (1999) defines a courtyard is a court that opens to the sky, especially if it is enclosed on all four sides.

THE PARAMETERS

a. The Location

IIUM is located in Kuala Lumpur, Malaysia approximately 14 km. from Kuala Lumpur City Centre. The case study was conducted at IIUM represented courtyards of different orientations and geometry but of mainly similar proportion and ratio. The buildings surrounding the courtyards are four storeys high forming U-shape and enclosed courtyards that are surrounded on four sides.

b. The Courtyards

In International Islamic University of Malaysia (IIUM), two distinct geometries of courtyards are evident. Eight courtyards were surveyed in this study. The courtyards are;

1. Courtyard at Kulliyyah of Engineering (Figure 1)
2. Courtyard at IIUM Clinic (Figure 2)
3. Courtyard at Kulliyyah of Economic (Figure 3)
4. Courtyard at Ahmad Ibrahim Kulliyyah of Laws (Figure 4)
5. Courtyard at Central Complex (Figure 5)
6. Courtyard at Kulliyyah of Islamic Revealed Knowledge and Human Sciences (IRKH) (Figure 6)
7. Courtyard at Research Centre (Figure 7)
8. Courtyard at IIUM Mosque (Figure 8)

The courtyards can be subdivided into Enclosed and 'U' shape (Figure 9 and 10)

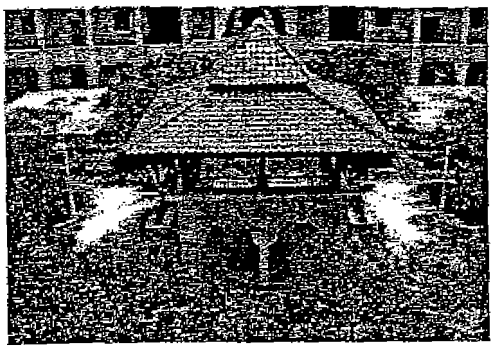

FIGURE 1 Courtyard at Kulliyyah of Engineering

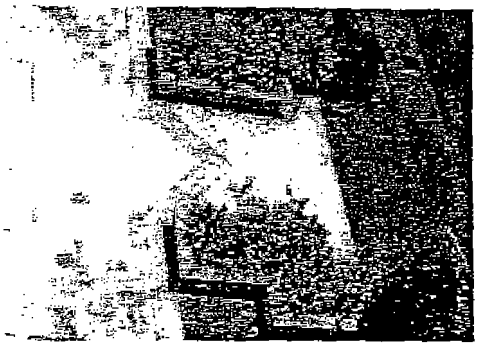

FIGURE 2 Courtyard at IIUM Clinic

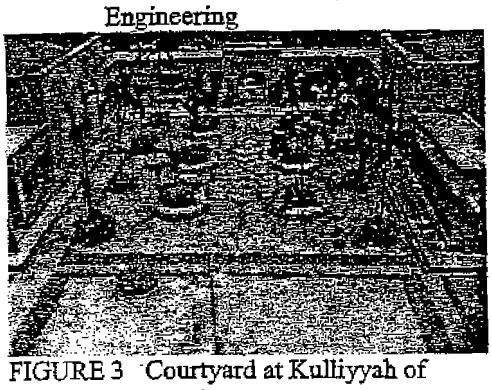

FIGURE 3 Courtyard at Kulliyyah of Economic

FIGURE 4 Courtyard at Ahmad Ibrahim Kulliyyah of Law

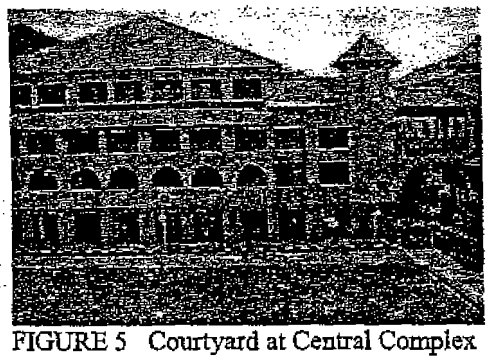

FIGURE 5 Courtyard at Central Complex

FIGURE 6 Courtyard at Kulliyyah of Islamic Revealed Knowledge and Human Sciences (IRKH)

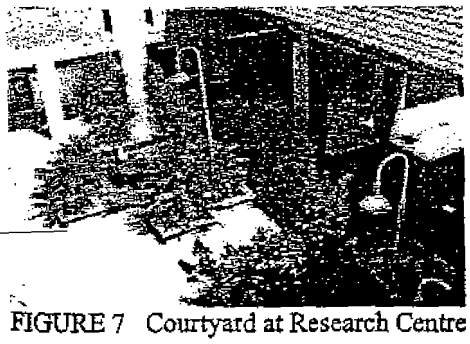

FIGURE 7 Courtyard at Research Centre

FIGURE 8 Courtyard at IIUM Mosque

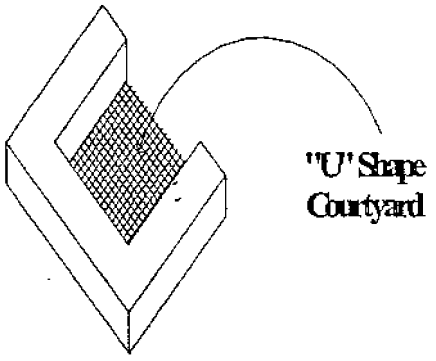

FIGURE 9 "U" Shape Courtyard
1. Courtyard at Kulliyyah of Economic,
2. Courtyard at Ahmad Ibrahim Kulliyyah of Law
3. Courtyard at Research Center,
4. Courtyard at IIUM Central Complex

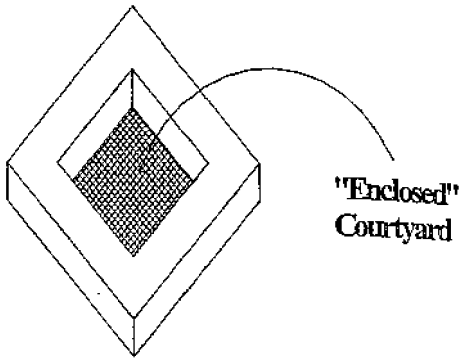

FIGURE 10 Enclosed Courtyard
1. Courtyard at Kulliyyah of Engineering
2. Courtyard at IIUM Clinic
3. Courtyard at Kulliyyah of IRKH
4. Courtyard at IIUM Mosque

c. The Climate

The general climatic conditions of Kuala Lumpur (latitude 3° 08'N, longitude 101° 44'E) is hot humid throughout the year. It is characterized by seasonal and daily temperature variation. The annual average temperature is around 27 °C and diurnal range is minimal around 10 °C. Relative humidity is high throughout the year with range from minimum of 50% to 99% and average of 84%. Wind is generally calm and light with wind speed recorded between 0 – 3.0 m/s in the urban area (Noor Hanita & Abdul Razak, 2000)

d. The Measurement

The experiment was conducted on eight consecutive days from 24th. to 31st. March 2001. The data was measured from 0700 hour to 1900 hour with the data reading at an interval of 30 minutes. This period has been selected for the experiment due to the critical conditions of the daytime in the tropical region.

RESULTS AND ANALYSIS

TABLE 1 Air Velocity Data at Eight Experimented Courtyards

LOCATION	GEOMETRY	RATIO	AIR VELOCITY (m/s)		
			Min	Mean	Max
1. Kulliyyah Of Engineering's Courtyard	Enclosed	3:1	0.21	0.84	1.75
2. Clinic's Courtyard	Enclosed	2:1	0.02	0.20	0.53
3. Mosque's Courtyard	Enclosed	5:1	0.02	0.95	2.67
4. Kulliyyah Of Islamic Revealed Knowledge & Huminities's Courtyard	Enclosed	3:1	0.07	0.76	2.09
5. Kulliyyah Of Economy's Courtyard	U Shape	3:1	0	0.48	1.15
6. Kulliyyah Of Law's Courtyard	U Shape	5:1	0.01	0.48	1.7
7. Central Complex's Courtyard	U Shape	3:1	0.01	0.17	0.63
8. Research Centre's Courtyard	U Shape	2:1	0.04	0.40	1.14
RANGE			***0.01-0.21***	***0.2 - 0.9***	***0.6-2.7***

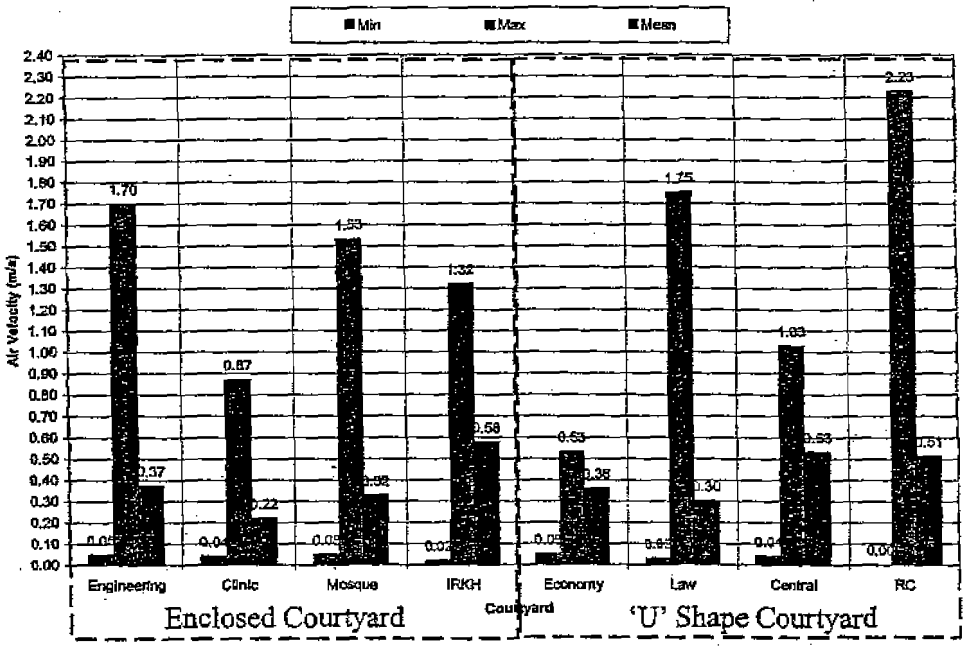

FIGURE 11 The Result of Air Velocity Performance at Eight Experimented Courtyards in Graphical Format

CONCLUSIONS

From the result and analysis as shown in table 1 and figure 11, it can be concluded that;

1. The ratio of the courtyard did affect the air velocity inside the courtyard
2. The same ratio shows similar result.
3. Ratio 5:1 shows the highest recorded air velocity due to its openness
4. Ratio 2:1 shows the lowest recorded air velocity due to its constricted.

REFERENCES

AbdelRahman, M.A. (1990). Field Evaluation of a Comfort Meter. ASHRAE Transactions, Vol 96 PT 2, pp 212-215.

Bagneid, Amr Abdalla (1987). Courtyard Bioclimatic: Comparative Experiments. Arizona State University. Masters Thesis.

Benton, C.C.*et. al.* (1990) Field Measurement System for the Study of thermal Comfort. ASHRAE Transactions, Vol 96 PT 2, pp 623-633.

Bosselman, P., Arens, E., Dunker, K., Wright, R. (1997). Urban Form and Climate: Case Study of Toronto. Html at www.clr.utoronto.ca.

Cadima, Paula (1998). The Effect of Design Parameters on Environmental Performance of the Urban Patio: A Case Study in Lisbon. Proceedings of Plea '98, Lisbon, Portugal, June 1998.

Cambridge (1995). Cambridge International Dictionary of English. London: Cambridge University Press.

de Dear, R.J. & Fountain, M.E.(1994). Field Experiments on Occupant Comfort and Office thermal Environments in a Hot Humid Climate. ASHRAE Transactions, Vol 100 PT 2, pp 457-475.

Elias, Salleh (1994). Tropical Urban Outdoor Environment and Human Thermal Comfort. The Architectural Association Graduate School, London. PhD Thesis.

Emmanuel, Rohinton (1993), A Hypothetical Shadow Umbrella for Thermal Comfort Enhancement in the Equitorial Outdoors. Architectural Science Review, 36(4):pp 25-36.

Funk and Wagnalls (1999) Encyclopedia. Versaware Technologies. http://www.funkandwagnalls.com

Md Najib, Ibrahim & Noor Hanita, Abdul Majid (1999). Thermal Comfort Assessment of Plazas in Kuala Lumpur. Proceedings of the World Renewable Energy Congress, Kuala Lumpur, Malaysia, 8-11 June 1999.

Noor Hanita, Abdul Majid (2000). Thermal Comfort Assesment at Plazas Adjacent to Tall Building. University of Technology Malaysia. PhD Thesis.

Noor Hanita, Abdul Majid & Abdul Razak, Sapian (2000). Air Velocity Behaviour at Tropical Urban Plazas Adjacent to Tall Buildings: A Case Study of Kuala Lumpur. SENVAR, Surabaya, Indonesia, 23-24 October 2000.

Padmanabhamurthy, B.(1991).Microclimates in Tropical Urban Context. Energy and Buildings. Vol. 15, No 1-2. pp 83-91.

Rowe, D. (1991). Climatic Control of Outdoor Spaces in Expo '92. Sevilla, Spain: Publication Centre, Sociedad Estatal para la.

Shaviv, E.& Capeluto, I.G. (1992). The Relative Importance of Various Geometrical Design Parameters in a Hot Humid Climate, ASHRAE Transactions, PT1, Vol 98, pp 589-605.

Schiller,G.E.(1990). A Comparison of predicted and Measured Comfort in Office Buildings. ASHRAE Transactions. Part 1, Vol 96. pp 609-622.