# AIR-CONDITIONING, HEALTH AND OUTDOOR THERMAL COMFORT IN SOME LOCAL CITIES

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## INTRODUCTION

We recently undertook an investigation into the outdoor environment from a view point of human comfort for Penang, Kuching and Kota Kinabalu. Using 10 year long meteorological records (1968 - 1977), monthly average Effective Temperatures were computed (ET is a most widely used index of thermal human comfort for topics which takes into account temperature, humidity and wind speed (Bedford, 1946; also in Van Straaten, 1967). In addition, a survey was undertaken to study the effective temperature (ET) distribution around Georgetown. A detailed experimental and related account of the work is to be given elsewhere. Rather the purpose of this note is to highlight those aspects of the study which might be of a more direct interest and possible use to the local medical practitioners.

## RESULTS AND DISCUSSION:

In Fig. 1, seasonal variability of monthly average of daily mean (i.e. 24 hour mean) Effective Temperatures is shown for Penang (airport); Kota Kinabalu and Kuching (present study); Petaling Jaya and Kuala Lumpur (airport) (Sham, 1977); and Singapore (Stephenson, 1963). In each case, the results are based upon a 10 year long basic data set even though the periods did not overlap completely. On the right hand side scale (Fig. 1), various comfort zones are indicated which are commonly used as criterion for environmental monitoring and refrigeration (the range varies slightly from country to country as can be seen from a summary table in Van Straaten, 1967; on this scale, 76°F ET is taken as the maximum upper limit with an optimum value of 69°F). For all places, the seasonal trend is common with a maximum in April/May and a minimum in December/January. The intercomparison shows Penang to be, on the average, comparable to Singapore in outdoor thermal comfort except in December and January. The inland stations of Kuala Lumpur and Petaling Jaya are, relatively, quite uncomfortable with the latter experiencing average ETs above 76°F for more than half of the year. The most interesting feature of the study is that the East Malaysian towns of Kota Kinabalu (KK) and Kuching (KU)

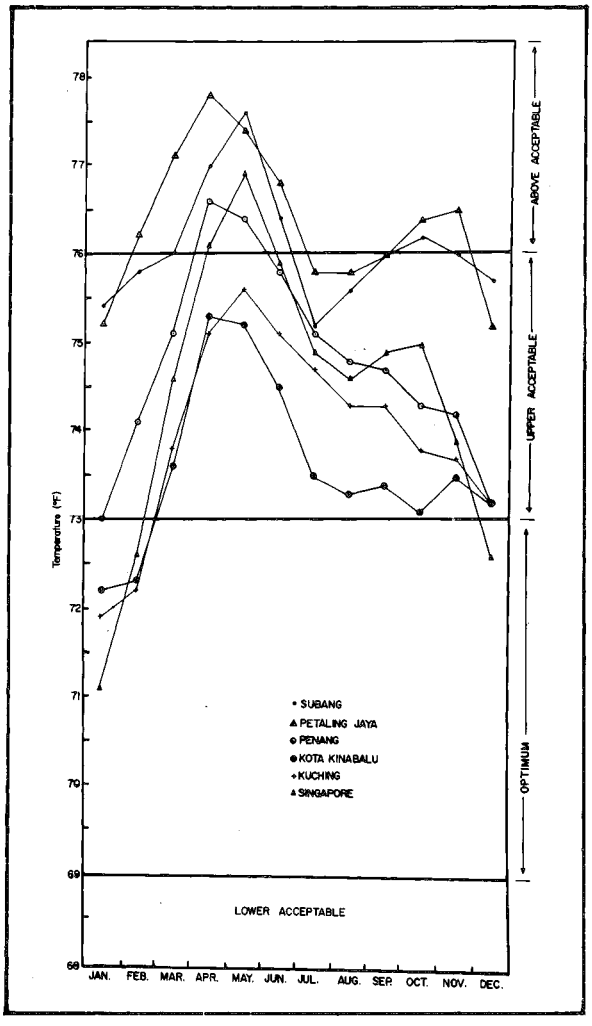


**Fig. 1 Comparison of monthly mean Effective Temperatures [ET] for Singapore and Malaysian stations.**

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are found to be significantly comfortable (remaining within the optimum to upper acceptable range) throughout the year and are even better in comfort than the islands - Penang or Singapore. Kota Kinabalu is most comfortable among the stations compared, having the benefit of its geographic location, and the staff of the new branch campus, to be established there, would enjoy this climatic benefit. Both stations (KK, KU) are ideal for relaxation and rest (medical!) although Penang is not too bad for this purpose.

The other aspect one needs to look into, is the thermal environment from the health aspect for outdoor activities - be it a labourer or a player (Thornes, 1977). For this purpose, we need to be careful that even though the monthly average of daily mean temperatures (and ET) may be in the acceptable range, thermal conditions for a particular period of day may be too harsh. Sham (1977) in a study of diurnal variability of ET for Kuala Lumpur found a difference of about 6°F between the maximum and minimum of ET over 24 hour period (annual average), meaning that, on the average, the maximum ET, at around past 12 hours may be about 3° - 4°F above the monthly average. Therefore, the few hours around midday need to be avoided for outdoor activities especially those involving hard labour; at these times of the day, there is an additional uncomforting and health hazard factor i.e. a high dosage of skin damaging ultraviolet radiation in the sunlight (Ilyas and Apandi, 1979).

Another factor that needs to be considered, is the variation of thermal conditions (or ET) from place to place at a given time. This is illustrated in Fig. 2 where aerial distribution of ET around Georgetown is shown based upon the measurements made on 20th February 1979. The survey, undertaken in the early hours of afternoon to study the maximized effect, shows the longer route to city via Perak Road preferable than via shorter Jelutong Road. Several locations are found to have high (H) and low (L) ET centres with the whole area lying above 76°F (above acceptable) at that time of the day and year, even though average monthly ET for February is relatively low (see Fig. 1). In a note in this journal *Almost 25 years ago*, Ward (1957) made an interesting comment that building air-conditioning should be restricted to temperatures that result in an outdoor - indoor temperature difference of no more than 10°F otherwise Enter/Exit physiological shocks may be experienced due to sudden vast environmental changes experienced by the body (it is not uncommon to find people with allergic problems e.g. one who has 50% chance of onslaught of sneezing every time he enters a highly air-conditioned room - some having found a cure in an iced drink before going in). It is surprising that little work seems to have been

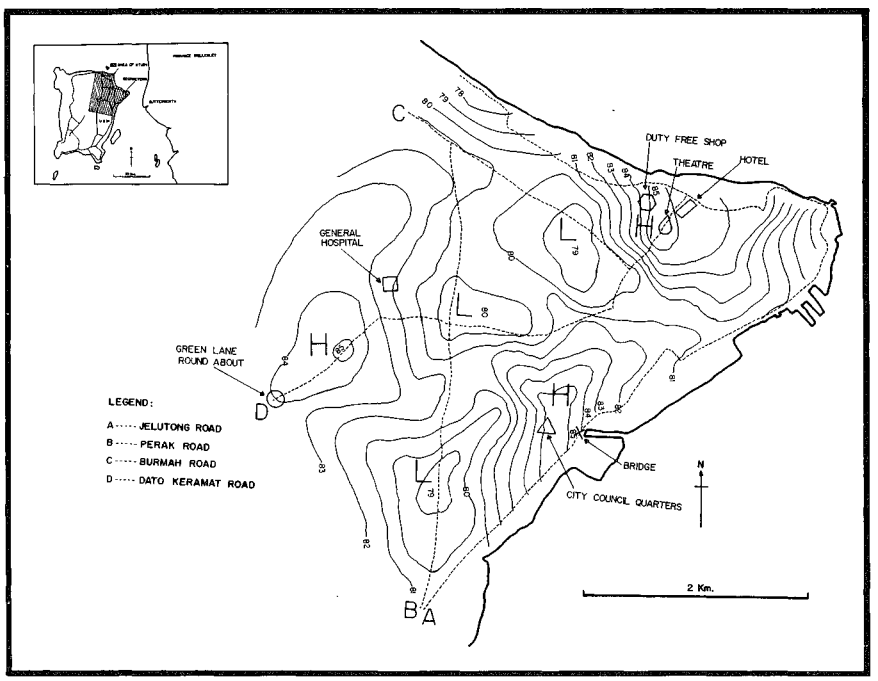


**Fig. 2 Distribution of ET [°F] around Georgetown [Penang] during 1200 - 1300 hours local time on 20th February 1979. L & H refer to low and high ET regions [see text for discussion].**

done on this aspect since. A close look at Fig. 2 shows that the ETs vary by almost 7°F (cf 10°F) over the small 6 sq. km. area. Furthermore, as pointed by Ward then, it is still not uncommon to see occupants either using pullovers or shivering in air-conditioned environments(Supermarkets, Complexes, Libraries and Department buildings, etc.), as the thermostats are set too low for comfort and of course it results in unnecessary energy consumption. Indeed Ward (1957) had questioned the validity of the comfort scale for acclimatized tropical populations and instead suggested that the upper acceptable range may be easily moved to about 80°F with an optimum value at 74°F for light work in tropical Malaysia. In a more recent work, Wyndham has suggested an upper limit of 81°F for light workers in Malaysia (see Sham, 1977). If these upper shifts are used in building air-cooling, it is obvious that huge amounts of expensive and scarce energy resources may be conserved. But, considerable systematic work would need to be done on thermal effect on human physiology for local populations in the tropics before such revised upward scales could be *forcefully* put into practice for medical and economical benefits. Climatic aerial surveys of the type in Fig. 2 should also be of benefit when constructing building complexes especially the primary utilities like hospitals. The outdoor climatic (ET) conditions may also be kept in mind when considering the occupational health in tropical countries (Mahathevan, 1976).

## REFERENCES


Bedford, T. (1946), Environmental Warmth and Its Measurements, Medical Research Council, War Memo No. 17, H.M.S.O. (London).

Ilyas, M. and Apandi, A.B. (1979), Measurements of erythemal ultraviolet dosage at Penang, *Med. J. Malaysia,* **34,** 181-183.

Mahathevan, R. (1976), Occupational health in West Malaysia, *Med. J. Malaysia,* **30,** 273-278.

Sham, S. (1977), An index of comfort for Kuala Lumpur - Petaling Jaya and its environs, *Sains Malaysiana,* **6,** 65-83.

Stephenson, P.M. (1963), An index of comfort for Singapore, *Meteorological Magazine,* **92,** 338-345.

Thornes, J.E. (1977), The effect of Weather on Sport, *Weather,* **32,** 258-268.

Van Straaten, J.F. (1967), Thermal Performance of Buildings (Chapter 4), Elsevier Publ. (London).

Ward, G.T. (1957), The modification of the tropical environment for comfort and efficiency - engineering aspects, *Med. J. Malaysia,* **11,** 185-189.