operating the blind in a controlled manner improves thermal comfort in spring by preventing excessive solar radiation from being absorbed.

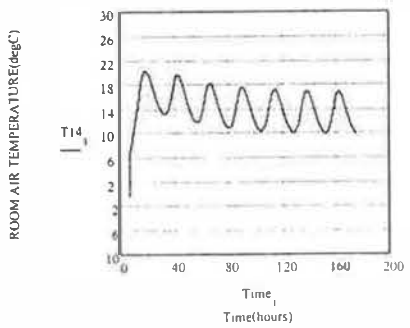

Fig.2.Passive response of TI room without blind, (starting January 21st).

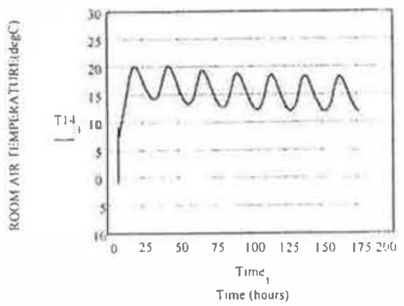

Fig.3. Passive response of TI room with day-night control for the blind (starting January 21st).

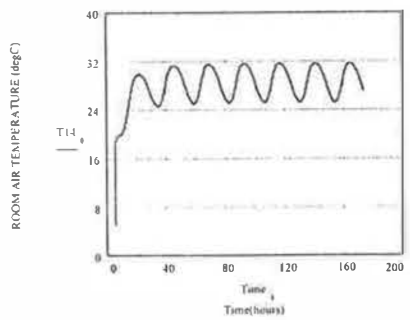

Fig.4. Room air temperature starting April 1st, when the blind is not applied.

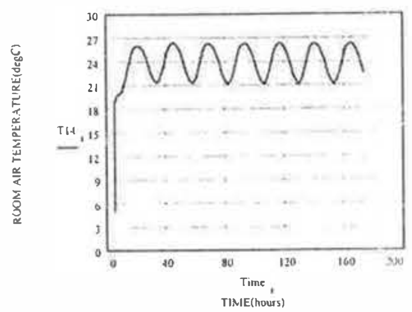

Fig.5. Room air temperature starting April 1st, when the blind is controlled to prevent overheating.

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RENEWABLE ENERGY

NATURAL VENTILATED BUILDINGS: USE OF CONTROLS FOR CHANGING INDOOR CLIMATE

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ABSTRACT

This study is based on the analysis of the data obtained through a yearlong thermal comfort survey in one of the even naturally ventilated buildings in Oxford. It is concerned with how much the use of available controls contributes to thermal comfort by modifying the indoor thermal environment. The results show that the availability of the controls and their appropriate use plays a significant role in modifying the indoor thermal conditions. Cross ventilation plays a significant role in lowering the indoor temperature.

KEYWORDS

Buildings, thermal comfort, natural ventilation, controls, indoor temperature, outdoor climate.

INTRODUCTION

The climate outside a building differs from that inside, and has a great influence on the indoor thermal conditions. Its effect can be modified by the use of available controls. A building's characteristics enter into the problem of thermal control in three distinct ways:

1. Transmission of the external environment through the building fabric i.e. modified by the building envelope (light- or heavy weight, well or poorly insulated).
2. Transmission of solar energy and daylight through open or glazed area can be controlled by the use of blinds, curtains or coloured glazing
3. Infiltration of the outside air i.e. use of windows for ventilation and air movement.

The ability of occupants to control their internal environment is usually available. Recently the importance of control in reducing the need for high energy solutions has become increasingly clear (Leaman & Bordass 1997, Baker and Standeven 1995). In natural ventilated buildings, greater control over thermal environment and ventilation could be obtained by using common means of control e.g. openable windows, blinds and to some extent lights. The control over lighting and direct solar gain depends on the individual's control over the use of light switching and blinds. In open plan areas individuals have less control.

In most naturally ventilated buildings, the common means of controlling the indoor summer climate are openable windows and blinds. Some individuals also have electric fans. Surveys of the use of these controls were undertaken as part of a larger study of comfort in buildings. The data was analysed to explore the effect of a change in outdoor temperature on indoor comfort in relation to the use of environmental controls during summer. Analysis of the change of use of each control was also carried out at different indoor and outdoor instantaneous temperatures and comfort votes. In this paper results from only one building (1-MF) are presented.

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THE SURVEY

A thermal comfort field survey was conducted in buildings in Oxford and Aberdeen over a period of one year during 1996-97. The subjects were office workers. The study involved over 800 subjects in fifteen buildings, nine in Oxfordshire and six in Aberdeen. The buildings were of mixed characteristics - heavy and light-weight, naturally ventilated and air-conditioned, in the private and public sector. Transverse and longitudinal surveys were used in each building. However, in this paper only the results of the longitudinal survey in one building (1-MF) are presented.

In the longitudinal survey for this building thirteen subjects took part. Each subject was asked to fill a questionnaire three to four times a day recording his thermal sensation and preference, clothing, activity and use of controls. The positions of the subjects relative to doors and windows were also noted. The thermal environment closed to each subject was monitored, recording air and globe temperatures, relative humidity and air movement at an interval of 15 minutes. The concurrent outdoor weather data were obtained from Radcliffe Meteorological Station of Oxford University.

RELATIONSHIP BETWEEN INDOOR AND OUTDOOR TEMPERATURE

The influence of the outdoor climate on indoor thermal environment is shown in Table 1 which is constructed using the data for peak summer months (June-August) from seven naturally ventilated buildings. The tabulated results show that indoor and outdoor temperatures are highly correlated. (r ranging from 0.560 to 0.688). This suggests that the use of controls in naturally ventilated buildings may be driven by outdoor climate. Similar results have been presented in ASHRAE RP-884 [de Dear et al 1997]. So the role of controls and their use is an important factor in explaining how thermal comfort might be related to outdoor climate [1]. In NV buildings openable windows, manually operated blinds and electric lights are the essential design features.

Table-1: Correlation between instantaneous indoor temperature and concurrent outdoor temperature.

Buildings	1-MF	2-AL	4-BH	6-CN	7-GT	8-RP	9VW	All
Correlation (r)	0.629	0.648	0.632	0.615	0.560	0.688	0.583	0.518

ANALYSIS AND DISCUSSION

●f thirteen subjects taking part in the longitudinal survey, eleven filled the questionnaires regularly over the period under consideration, providing 1131 records for individual parameters. The numbers of individual records range from 21 to 206. For analysis 'window and door open', 'blind down' and 'fan on' was coded as '1' otherwise '0'. The data was averaged over every 10 responses in order of each parameter (indoor and outdoor instantaneous temperatures, comfort votes) under investigation.

Statistical analysis was made of the data for individual subjects. The percentage usage of various thermal controls by each subject over the period of under consideration is shown in Table 2. The table also shows the effect of the position of the subjects in relation to a window on thermal sensation of the subject. Thermal sensation is shown on the Bedford scale from 1 (much too cold) to 7 (much too warm) with comfort at around 4. Linear regression was used to find the relationship between use of a control and the temperature. In the regression instantaneous indoor and outdoor temperatures are used. The results of the proportion using each control are displayed in Figures 1. The figures also show the relationship of the control usage with comfort votes.

Table 2: Use of control by the occupants in building 1-MF.

Subject code	Seating Position	Outdoor T (°C)	Thermal Sensation	Door (%)	Window (%)	Blind / Curtain %	Fan (%)
1.01	Away	21.0	4.75	00.0	46.0	26.4	4.6
1.02	Away	21.5	4.88	00.0	31.0	28.9	57.1
1.03	Near	20.7	4.46	00.0	79.8	14.3	10.7
1.04	Near	19.8	4.40	00.0	83.1	29.2	29.2
1.05	Near	19.9	4.19	100	74.1	-	-
1.06	Near	19.8	5.09	100	89.2	27.7	-
1.07	Away	20.2	6.74	99.3	96.3	8.1	25.7
1.09	Near	21.5	4.29	33.3	100	76.2	14.3
1.10	Away	19.9	4.94	12.5	56.3	26.6	12.5
1.12	Near	20.3	4.88	2.4	94.7	27.7	35.4
1.13	Near	19.9	3.73	96.8	69.9	-	41.9

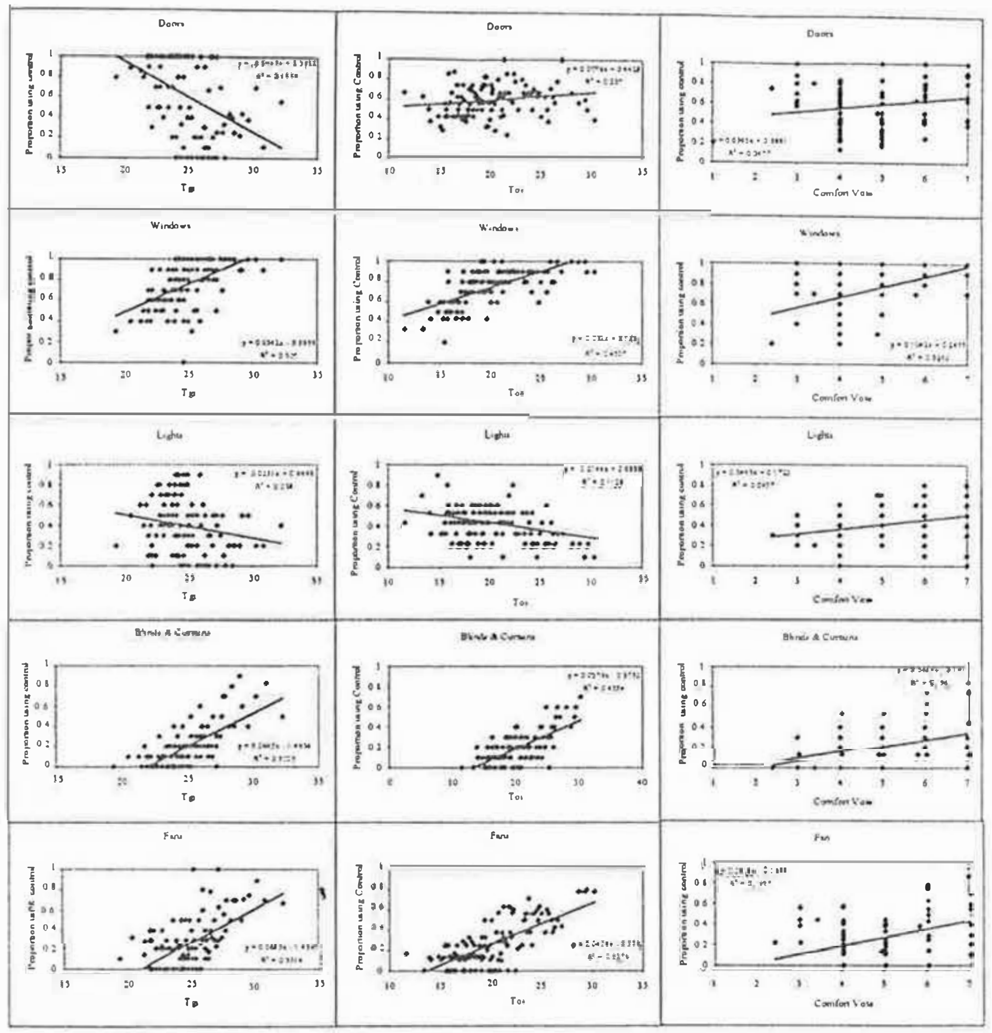

Figure-1: Relationship of named control with indoor temperature, outdoor temeprature and comfort vote.

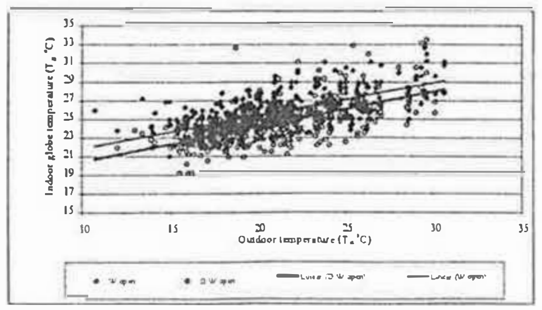

Figure-2: Effect of cross ventilation on indoor temperature.

Door Open:
From Figure 1, the poor correlation suggests that 'door open' has little impact on thermal sensation and is little influenced by indoor or outdoor temperatures. Contrary to its relation with thermal sensation and outdoor temperature, the proportion of 'door open' decreases with increase in indoor temperature.

Window Open:
Open windows allow fresh air in and may help to cool the building in summer. Of all available controls use of windows has biggest effect on indoor climate. On average 66.4% of the total responses reported open windows. The use of windows varies from person to person (31% to 100%) and the seating position. Obviously a person near the window will have greater control. As shown in Figure 1, 'window open' is closely related with thermal sensation, indoor and outdoor temperatures. The proportion of 'window open' increases, as a person feels hot due to increase in both indoor and outdoor temperatures. Various reasons are given for closed windows, such as "others want them shut", "to prevent draught", "to keep the noise level low", or interference with blind.

Blind/Curtain Usage:
The blinds/curtains are used by all subjects where appropriate with "glare reduction on VDUs" and "reduction of direct sunlight" given as reasons. Blinds /curtains are fully drawn or half-drawn in about 30% of responses. The use of blinds/curtains varies from person to person and with seating position. From Table-2, a person away from the window records the lowest use (8.1%). It is used most extensively (76.2%) by a person near to the window. The 'blind/curtain usage' increases with increase in indoor and outdoor temperatures and thermal sensation.

Light Usage:
Despite a poor correlation, Figure –1 suggests that on sunny days in summer people tend to switch off the lights. In open plan offices individual users have less control over general lights. Therefore despite adequate daylighting the lights have been found on in such places. Another factor worth mentioning is that switching on the lights in early morning often means that they stay on throughout the day.

Use of Fan
In natural ventilated building fans play a significant role in reducing the heat stress. Use of fans modifies the indoor climate by regulating and increasing air movement. Figure 1 shows that the proportion using fans bear has a correlation with indoor and outdoor temperatures and thermal sensation and is comparable to that for 'window open'. However, its use is relatively low (25.7% on the average, ranging from 4.6% to 57.1% for individuals), as shown in Table 2. Despite the increase in 'fan usage' with the increase in three parameters, the low proportion of people using fans suggests that fans are not universally available to achieve indoor thermal comfort.

Cross Ventilation (Door-Window Open)
Figure 2 demonstrates the effect of cross ventilation i.e. both door and window open. Regression line for 'door-window open' lies about 1.5 °C below the line due to 'window open' only.

CONCLUSION

The results show that the availability of controls and their appropriate use plays significant role in modifying the indoor thermal conditions. For example, the occupants closer to the windows reported less discomfort than those away from the windows did. Windows and blinds/curtains are the most extensively used controls. The proportion of windows open and blinds/curtains drawn increased with an increase in indoor or outdoor instantaneous temperatures. The study shows that blinds/curtains are fully drawn or half-drawn in about 30% of responses and 'window open' for 66.4% of the responses. In two separate thermal comfort studies, Baker & Standeven [1995, 1995a] found the use of control (opening of the window or deploying of blind) 31.6% and 39.9% respectively. Allowing cross ventilation helps to lower the indoor temperature. There are therefore, significant opportunities in UK climate for adaptability by simply operating local controls, windows, doors and blinds/ curtains.

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RENEWABLE ENERGY

TOWN PLANNING AND THE USE OF RENEWABLE ENERGIES NEAR ROME

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ABSTRACT: The environmental problems and the ecological crisis demonstrate that time is ripe for a wide exploitation of Renewable Energies in architecture and urban planning: These could be employed within infinite functions as climatization, ventilation, illumination, distribution and supply within infrastructural and service networks according to a scalar articulation of the different areas, ranging from the district, to the city and territory. They could also be involved in a specialized and diversified manner according to the different energy sources as sun, wind, water and the energetic transformation of the agricultural and forestal productions as well as of the residues of organic and urban wastes. The holistic and organic structuration of our philosophy has brought us to a reconsideration of the development and growth mechanism of architecture, of the city and territory according to self sufficient and autonomous entities. Sophisticated technologies and experimentations have allowed us to establish an application methodology based upon design parameters according to decentralized functional sectors relative to the city and the territory thus constituting a strategy of "ecological and energetic islands". © 1998 Elsevier Science Ltd. All rights reserved.

THE HISTORICAL CITY AND ITS NATURAL ENVIRONMENTAL ALLIANCE

We may not deny that today one of the fundamental problems of our century, in addition to the degradation of life quality within our cities, is represented by the progressive qualitative and quantitative environmental transformation if their surrounding territory that had always constituted their logical cultural continuation. The still organic structure of our "historical ecosystem" is no longer correlated to the structure of its "natural ecosystem" with an almost total loss of its primitive holistic and systemic reference substratum. The age old alliance that has always represented the bond between man's structures and territory has therefore been altered. Our time is the extreme product of the "fourth territorial technological consolidation cycle" characterized by almost three centuries of maximum development and growth of the industrial era, but especially by a "great artificiality" with a consequent fragility of structures become too complex and too opposite compared to the bearing capacity of the "natural structure" itself.

THE HISTORICAL CITY AND ITS DEVELOPMENT LAWS

The environment and territory acquired since centuries by the great man's "Ecumeni civili", represent an organic living entity "articulated according to a dynamic law connected to diversified to geomorphologic and climatic elements strongly characterized in the single cultural areas. Man's introduction occurs gradually through aggregation mechanisms and interrelations gaining greater values according to the cultural and

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