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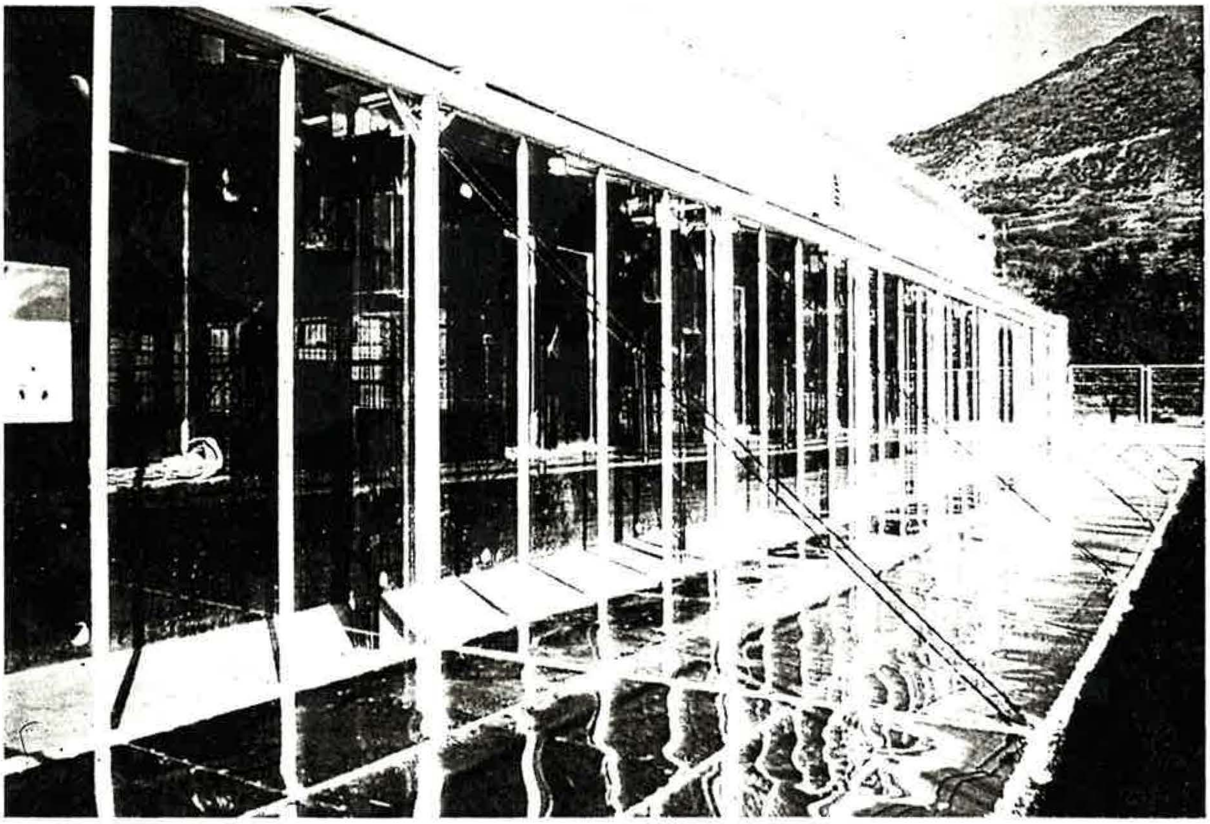
Back to nature

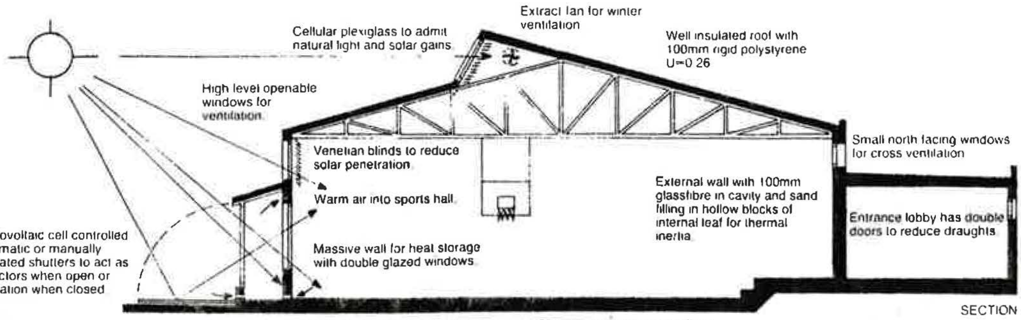
Incorporating passive systems of ventilation and cooling in office buildings significantly reduces energy consumption and the resulting indoor environment can result in a highly productive workforce. Simon Ellery reports on the challenge facing the architect and engineer in the speculative market

Maintaining the indoor temperature is primarily the job of the engineer, who generally specifies full air conditioning to guarantee a set temperature all year round. But with issues such as energy conservation, sick building syndrome (SBS) and air conditioning systems breaking down in the kind of hot, humid weather the country has recently been experiencing, an obvious but often overlooked solution is for the architect and the client to work with the engineer on a more natural answer.

Natural ventilation systems are claimed to be easily maintained, reduce risk of unpredictable failure, offer low energy consumption and often result in a far healthier and satis-



The Polysportive in Spain relies on passive solar for 70% of it's space heating requirement while natural ventilation adds to a resulting low energy bill



factory indoor environment. Ideas that all 'quality' office buildings have to be air conditioned are being challenged, especially with the green issues of low energy consumption and with symptoms of SBS (headaches, lethargy, nasal and eye irritation) being associated with modern air conditioned office buildings. The indoor climatic environment is commonly highlighted as the root cause of SBS, and the failure of air conditioning systems to adequately control the indoor environment is often blamed.

People suffering from SBS frequently complain of stuffiness, draughts, dryness, lack of temperature control and lack of fresh air. Problems have been shown to occur when the temperature rises above 23°C and when relative humidity falls below 35%. Ventilation rates in a building depend on whether or not people are smoking and the density of the occupancy. Also where offices have been partitioned off the air flow may be restricted, creating 'dead zones'.

Environmental discomfort and other health problems at the workplace lead to low staff morale, absenteeism and inefficient use of time. This all results in low productivity, therefore it can be assumed that a high level of design for environmental comfort will result in high staff productivity. Staff salaries are a high proportion of any company's expenditure, an increase in staff productivity is consequently of immense value. If a greater initial outlay means that a building can incorporate as much natural ventilation as possible, then the greater staff productivity and reduced running costs would

Sensible comfort conditions without resorting to full air conditioning all year round

result in a quick payback period.

Design can be introduced to reduce the need for air conditioning. Clearly there are a number of factors which dictate the economic benefits of deep plan design as opposed to to shallow plan design which encourage natural ventilation, mainly that space is expensive. In the UK climate it is possible to design buildings which can provide sensible comfort conditions without resorting to full air conditioning all year round. The main design factors in reducing dependence on air conditioning include:

- zoning to permit air conditioning to particular areas
- shallow platforms that permit natural ventilation, or a combination of natural ventilation assisted by simple mechanical ventilation
- automatic shading to control solar gain
- controllable ventilation openings appropriately positioned
- enhancement of buoyancy assisted ventilation (stack effect)

Energy conservation can be exploited where only certain zones require air-conditioning such as computer suites or board rooms. It is also recognised that air conditioning can be seasonal, where in the summer comfort cooling would be provided on demand and in the winter natural ventilation would suffice. To utilise this to the full it is essential for the engineer to work with a degree day table.

Passive stack ventilation can be incorporated into a building at very little cost, it is based on the movement of air due to differences in temperature inside and outside the building. It has been used in domestic dwellings and has become the accepted name for systems of vertical or near vertical ducts running from rooms which are often more humid, therefore requiring more ventilation (the kitchen or bathroom), to terminals on the roof, where wind has the effect of increasing the ventilation.

Incorporating high ceilings encourages buoyancy-assisted ventilation, again the stack effect, which keeps the air moving and hot air above head height. An atrium encourages the stack effect and provides thermal buffering to part of the building envelope. The atrium acts as a buffer space reducing heating requirement of adjacent areas in winter, encouraging stack effect in summer. It also allows for a highly flexible office building suitable for multi occupancy or general purpose single occupancy.

Air-conditioning buildings can incorporate passive methods of ventilation to reduce energy consumption. Energy consumption can be minimised by the installation of a building management system tested and commissioned properly, avoiding a common waste of energy where there is simultaneous heating and cooling. Automatic shading devices can exploit solar gain. In the summer months full shading would be provided reducing the cooling load, while in the winter solar gain could be incorporated. Ventilation openings could be sited in positions where they could utilise prevailing winds and exploit cross ventilation.

In the speculative market flexibilty to suit a wide variety of users is essntial: some users may want to rent a single floor or part, while others may want the whole building. Contrary to many thoughts on natural systems, there are features when designing for flexibilty which overlap with the incorporation of natural systems. Zoning to permit air conditioning to particular areas is an example, along with generous floor to ceiling heights while allowing for the future incorporation of services it also encourages the stack effect.

Cross ventilation is introduced under the floor and up through vents around the walls

Project Monitor, by the Commission of the European Communities, is a series of case studies illustrating passive solar architecture in the European Communities. One such project in Spain utilised solar gain and natural ventilation and has resulted in a sports centre which relies on passive solar heat gain for 70% of its heating demand while in the summer months it utilises passive ventilation systems. This design is estimated to have added 14% to the cost of the building for a saving of 41,571 kWh per year.

Called the Polysportive, it is a general purpose sports hall which makes full use of solar gain, is highly insulated and incorporates windows carefully positioned to allow natural ventilation. During the winter, when days are generally sunny but cold, ventilation is by fan as windows are closed to avoid heat loss, while in summer ventilation is purely passive through the opening of windows on either side of the building. Cross ventilation is also introduced under the floor and up through vents around the walls.

Compared to the rest of Europe, where energy conservation methods such as combined heat and power and district heating are common, the UK is far behind. But with clients increasingly looking at the benefits of the energy efficiency of buildings in financial terms, buildings being responsible for half of all CO_2 emissions adding to global warming, CFCs being frowned upon and impending environment friendly legislation come 1992, surely now is the time for the architect, client and engineer to work on more natural solutions.