To air condition or not?

by John Deasy

guidance for electrical services, and we need to establish specifications for areas such as fire alarms and hv switchgear.

BWa: How do you handle commissioning?

BWr: We insist upon separate hands-on commissioning contractors employed directly by J Sainsbury, but we also have outside engineers who are then managed by an internal team. It might appear heavy handed, but that's what it takes to get the job done properly.

BWa: How do you select your consulting engineers?

BWr: We have a select list of five consultanting practices that we use. We believe in learning together, not re-inventing the wheel.

BWa: What forms of contract do you use?

BWr: Generally our own JS forms of contract and also construction management contracts. We are trying the design-and-build approach too.

BWa: What about manufacturers?

BWr: We are highly selective regarding the manufacturers we use. We put our stamp on the ahu designs, control panels etc. In fact, we can say that we pioneered roof-top packaged air handling.

BWa: Any criticisms of consultants?

BWr: There seems to be an inability to ask the right questions which would enable them to perform their tasks. If the brief is incorrect, everything up to the completed job could be wrong. Many consultants understand the theory, but the practical application leaves a lot to be desired. Entrants into the industry just don't seem to have mentors any more.

Most practices are keen to show innovation, but often because of self-esteem and not because it is what the client needs or wants. Such situations rely on the client having his own in-house team of professionals to resolve any difficulties.

BWa: What about information technology, has that improved things?

BWr: It has mixed blessings. On the one hand it can drastically reduce the number of hours required to produce design calculations, but on the other it can lead to incorrect sizing of plant and equipment.

Over-reliance is placed on the data output from computer programs to size plant and equipment. The programs may be fine in principle, but the engineer who uses the package must have a clear understanding of the calculation methods and assumptions made by the program in producing its answer.

Although retail stores and shopping centres are usually air conditioned, the current trend towards mechanical ventilation brings into question whether retail centres require as much cooling as we have hitherto supposed.

When considering the mechanical or natural ventilation of an enclosed shopping centre – particularly those with mall areas – it is becoming increasingly more important to examine those factors which affect the building's occupants and the operation of the entire centre.

People visiting a shopping centre are usually dressed for the prevailing external ambient conditions. Therefore, is it sensible to cool or heat the mall areas to artificially controlled temperatures which, in fact, could make the occupants feel uncomfortable?

Many of us have been to hot climates, entered a cooled building, and have felt uncomfortable until the body has acclimatised to the lower temperatures. In these instances, therefore, the mall area should act as a buffer zone between the retail units and the outside world.

In general terms, the following variables affect the actual feeling of comfort in a shopping centre:

- ☐ air temperature;
- ☐ radiant or resultant temperature;
- ☐ relative humidity;
- ☐ air movement;
- ☐ ventilation rate.

There are other factors at work, including ambient noise levels and lighting, which are not considered here.

In a modern centre, most retailers impose high internal gains on their units due to both large amounts of lighting, and the obvious desire to have high occupancy rates in order to turn over merchandise quickly. For this reason, most units are comfort-cooled to provide peak-lopping temperature control at high occupancy levels.

On this basis, there is a case to suggest that mall temperature control bands can be allowed to increase or decrease. This is provided that temperature swings are not excessive, and that a temperature difference is maintained between the mall and the retail unit using the comfort control system within the tenancy.

Although the CIBSE *Guide* suggests 23°C as a suitable temperature for transient occupancy, figure 1 (A1.1 of the CIBSE *Guide*) indicates that 50% of people would still be comfortable at 25°C. Bearing in mind the varying number of visitors to a centre during opening hours, it would seem reasonable that 25°C is an appropriate design temperature, as the majority of the people would feel comfortable.

Indeed, at peak times average internal temperatures of 26-27°C could be tolerated for short periods, depending on outside ambient temperatures.

Obviously, the external ambient temperatures and solar gain via roof lights are important factors which require consideration. If 20 year average meteorological data is examined, it is clear that for most locations our temperate climate rarely achieves extended periods of temperatures above 25°C, subject to the unknown effects of global warming.

On the other hand, the effects of solar gain can vary greatly, but provided that high quality solar control glazing with a low U-value is used for any glazed roof area then the effects of solar gain can be measured and mitigated. Indeed, it may be

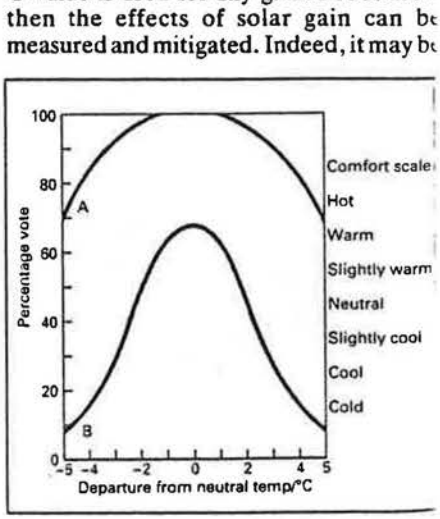
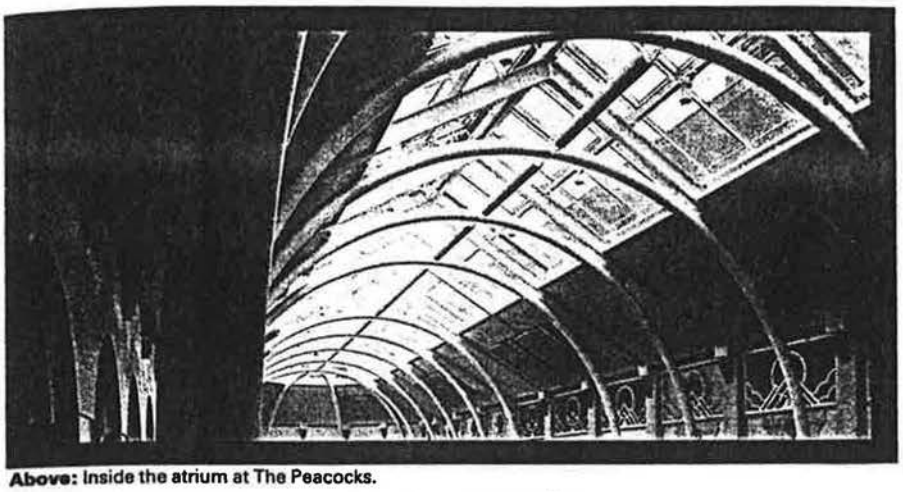


Figure 1 (A1.1 of the CIBSE *Guide*): The percentages of people in thermal comfort at temperatures around the optimum for the group. Curve A includes people giving any of the three central descriptions on a seven point comfort scale. Curve B is for the neutral/comfortable category alone.



Above: Inside the atrium at The Peacocks.

necessary in some cases to provide solar blinds or even examine passive solar techniques.

Relative humidity

The nature of our climate in the summer months means that relative humidity is not generally an issue. Therefore, artificial control of humidity levels would be uneconomic, particularly with the large natural air infiltration rates. Winter operation, however, should be examined as appropriate in terms of minimum humidity levels.

A combination of mechanical and natural ventilation can provide the required overall air movement, together with a high air change rate, thus introducing free-cooling in summer. This is normally achieved by the use of the building stack effect, the prevailing wind and the assistance of the mechanical ventilation system where appropriate.

The Meadowhall Centre in Sheffield uses this combination of natural stack and wind effects by combining the glazed opening rooflights that are required for the smoke control strategy, with the mechanical ventilation system.

During normal operation, the mechanical ventilation system provides 3 ac/h of 100% fresh air to the mall in order to cater for maximum occupant density. The air is supplied to the mall via direct gas-fired ahus using ductwork and grilles, and extracted at the same rate via high level louvres. A run-around coil recovers heat from the exhaust air during the winter cycle.

When the internal temperature of the mall exceeds the summer set-point (normally 23°C), the roof ventilators are allowed to open. At the same time, the extract system shuts down as exhaust air will leave naturally through the openings, although the supply fans will continue to run to provide positive air movement, thus catering for the windless days.

A series of rain sensors are programmed to close the ventilators if needed, and at the same time to restart the extract fans. A time-delay device prevents the ventilators hunting.

The system has the added advantage of regularly using the smoke ventilators which will minimise the risk of a hidden breakdown, otherwise only revealed in the event of fire.

Table 1 shows the effect that increasing the air change rate can have on internal temperatures.

The Peacocks centre at Woking has been approached on a similar basis, the five-floor central atrium being used as a stack-effect chimney if temperatures become excessive. In this case the natural ventilation is assisted by the supply and extract system (figure 2).

Obviously, as the internal temperature nears the external ambient, the effect diminishes. However, provided that air movement is created via the ventilation system and rooflights, the comfort levels can be maintained as previously defined.

Table 1: The effect of air change rate on internal temperature

Air change rate (ac/h)	Peak internal temperature – calculated (°C)	Sheffield 20-year average
3*	31	Max 24·3°C db
5**	27	
10	26	Min 10·6°C db
15	25·5	
25	25	Wet bulb 21·7°C

*Peak summer day, ventilation plant on 3ac/h, all mall lighting on, maximum mall occupancy (1/7m²), rooflights closed.
**Peak summer day, ventilation plant on (supply fans only), all mall lighting on, maximum mall occupancy, rooflights open.

In addition, it should be noted that many malls make use of durable hard-wearing materials, such as marble or stone, for flooring, and stone cladding for columns and shop fronts. These materials generally provide low surrounding radiant temperatures which will also enhance the cooling effect to the occupants.

Within defined limits, air conditioning can certainly control the shopping mall environment, irrespective of external conditions. But at what cost?

The environment suffers from the use of cfcs in chillers and the large amount of electricity that is consumed by the compressors; the client suffers because the capital cost is high, particularly as the air conditioning plant is only required to meet peak loads for a small part of the year.

Running costs are much higher than for a natural/mechanical system, and maintenance costs are higher due to machine complexity and lack of use.

On the other hand, natural/mechanical systems provide no guarantees in relation to internal environment. Nevertheless, such systems do provide air movement and improved air change rates, thus equalling outside conditions at little or zero running cost. Capital cost is also much reduced. For that reason, the case for natural/mechanical ventilation for retail developments at least warrants serious consideration.

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The Peacocks Centre

The Peacocks Centre, a new retail development in the Surrey town of Woking, uses a low-tech ventilation system, *writes Steve Hodgson.*

Situated in the middle of town, across the street from the town hall, the four-storey centre incorporates a library, a 1300-seat auditorium, a three-screen cinema and a night-club.

These are grouped around a common foyer across a first floor link from the retail area. Parking is on two roof levels, with space for 2400 cars.

The centre-piece of the retail side is a five-storey atrium – said to be unrivalled in size in the UK – upon which two main malls converge at different levels. At the base of the atrium is the seating area for the restaurant.

Ferguson & Partners, employed on a performance brief for the retail side of the development, set a winter design temperature in the malls of 18°C with 3 ac/h, and kept the summer requirement as simple as possible to minimise peak temperatures. How Design & Management carried out the work.

Shopping units vary from the three storey department store let to Allders, to a row of small kiosks overlooking the atrium from first floor level.

Sixty-five shop-sized units comprise the total retail floor area of 30 000 m². Shop units are provided with water, drainage, sprinkler and electricity terminations, together with a ventilation shaft.

Tenants are free to add air conditioning if they desire, and a site is provided on the roof for plant if the option is taken up.

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