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Letter from America

Geoff Brundrett reports from the ASHRAE winter meeting held in Dallas last February, and outlines some of the issues being tackled by USA building services engineers.

Money is now the main preoccupation for ASHRAE members, particularly the rising maximum demand charges for electricity, and this concern has displaced energy efficiency and searches for alternative sources of energy from the top of the ASHRAE agenda.

This change has given rise to two technical innovations. The first is off-peak ice storage for electric air conditioning. The second is a much more efficient multistage gas driven absorber refrigeration system. However the future now lies with making buildings work properly. Air quality has been highlighted as the most urgent factor and has formed the underlying theme in over a quarter of all of the technical sessions.

Air quality

A case study outlined the progress of teachers at a school where the common practice had been to paint the classrooms during the term and then immediately move the class back to the freshly painted room. The staff grew tired of sore eyes and spluttering children and took out a Court Injunction against the School Board. The Court upheld the staff request to limit redecoration to holiday time.

This led to an urgent reappraisal of the maintenance procedures and materials. After initial failure the investigators came up with a new paint and a new chemical deodoriser matched to retain the organic solvents of the paints. The teachers became happy, the maintenance men were happy to have both the work and the better working conditions and, surprisingly, the productivity of the painters increased dramatically. The new techniques not only speeded up the drying of the paints but enabled the painters to carry on without the frequent breaks for breath which they had taken earlier.

The compensation stories were of two types. The first was the special case where a particularly susceptible individual responded to a low concentration of a pollutant within the working space. While the building may comply with general guidelines they were not sufficient to deal with the special requirements of the individual. If the employee was working quite happily and satisfactorily before the pollutant appeared, then he may claim compensation for the loss of his job. Cases along these lines are now going through the American Courts.

The second type of compensation case is between the owner of the building and the occupying lessee. If the staff of the occupier find the building makes them ill then their employer will move them to new buildings, cancelling the lease of the original building. The owner may then sue for breach of contract.

This sensitivity was reported to be having an important bearing on the design of new offices. Regretfully the building owner is looking more clearly at items of potential risk than to the comfort of the occupants.

Humidification

One potential health hazard is the humidifier. Owners will no longer provide humidification. If humidification is required then the occupier must provide it and operate it at his own risk. As a result few modern offices in the United States now have humidification. If this trend continues then central plant facilities to sharing customers will decline in favour of completely decentralised plant operated by the occupier and not the landlord as it is now.

The technical implications of indoor air quality are immense. All countries assume that outdoor air is less polluted than indoor air and therefore specify how much dilution should be provided. It is customary to measure this quality in air changes per hour (ach). This dilution technique is practised without knowing the source, type or quantity of the contaminants.

Some speakers worried about the way the guidelines changed year to year in the absence of any evidence. Hospital operating theatres were quoted as an illustrative example. Ventilation rates in the early 1960s were designed to be 8 ach. This value was increased to 25 or even 40 ach by the early 1970s until the energy crisis. At the moment the guidelines request 20 ach of which 16 ach are filtered.

ASHRAE has not finally settled general guidelines on ventilation for 1988. However, a provisional guide for the ventilation of conventional buildings was circulated for public comment last autumn. These guidelines suggest tripling the minimum amount of air which is supplied per person.

Building design

NIOSH, the Government Department dealing with occupation safety, has surveyed troublesome buildings for several years. Their work cropped up several times in both papers and the discussions to them. NIOSH are tackling over 80 buildings each year which have been reported as giving the occupants trouble. Their global analysis of the first four hundred buildings formed a valuable basis for discussion.

Just over half of these troublesome buildings had substandard ventilation. This was in terms of ac/h and neglected any consideration of ineffective air distribution. Some 28% had a specific pollutant generated indoors while 11% had a special outdoor pollutant which was getting into the building. Only 5% were associated with biological problems such as mould spores.

One novel paper had everyone in laughter by presenting a wide range of most unsuitable ductwork installations. Fortunately most were on the roof-top out of sight. The heated discussion which followed reached agreement by blaming the architects who were not present.

One argument was that the designers knew how to design the ductwork properly but were prevented from doing so by the inadequate space allocated to them.

All this led to a growing realisation that perhaps buildings should be independently tested when built. While there are still some reservations about it, manufacturers admitted that recent improvements in logging and in instrumentation made it much more practicable to assess fan performance.

Filters in hospital ductwork were used to illustrate the difficulties. The filters themselves were usually exactly what the manufacturer specified. However the actual installation of the filters was not as requested.

Some of the US States used a torch to seek out gaps in badly fitted filters, others tested the filters with particulates and measured the quantities passing. The rejection rate could be as high as half of all the filters in the hospital.

Finally the educational needs of those who construct and operate buildings must not be forgotten. The ASHRAE President made a point of this in his public address. Apparently a large company had just published the results of an assessment of 21000 youngsters in their early twenties who had applied for a job. Only one in five could interpret a bus timetable.

Cigarette smoking is one aspect of American life which has changed. It was once the masculine image of the full way of life. Today there are no advertisements, it is banned in government offices except for specially designated areas for adult consenting smokers, ASHRAE prohibits smoking at all its meetings and hotel receptionists now ask if you would like a non-smoking room.

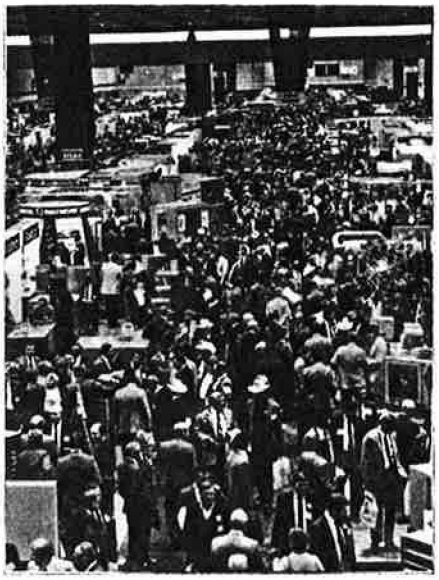
External air quality

External air quality was also discussed in two areas. The first was the role of chlorofluorocarbons (cfcs) in changing the world's climate. Research scientists are criticising engineers for their indiscriminate use of cfcs in refrigeration and air conditioning and also in propellant applications for aerosol cans and for foaming plastics.

The United Nations now have an international agreement to cut back the total manufacturing capacity of those cfcs which are destructive. The target is to halve the 1986 production level by July 1998. The harmful cfcs are R11, R12, R113, R114 and R115. It will not affect R22.

A new specially designed substitute refrigerant from R11 has been made called HFC-1349. This is already being produced in small quantities for evaluation. Trials on toxicity are already in progress but the time required to complete such tests is four years.

The quality of outdoor air in cities does have an effect on transport vehicles and this was the second conference air topic. Vehicles are not normally an ASHRAE topic but there was one presentation on how a combination of chemical and physical filters can be designed to provide a reasonable air quality inside vehicles.



650 companies displayed their products over 28 000 m² of exhibition space.

Technical innovations

The technical innovations presented at the conference were twofold. The first was how to avoid peak maximum demand costs for electricity in summer air conditioning. The second was how to use the growing potential in very advanced control systems.

The electrical maximum demand problem is one unique to the United States. The electrical utilities are usually modest in size each designed to serve the immediate community. Some utilities were optimistic about electrical load growth and several years ago planned for expansion, usually through the construction of a nuclear power plant. When this load was well above budget the finances of these utilities became strained.

The first utility to file for bankruptcy did it on the opening day of the ASHRAE conference. All other electric utilities are therefore delaying any decision to build new plant and prefer to offer lower night time prices and raise the electrical demand charge on those days when the demand is highest.

There are three technical solutions under investigation to avoid this high electrical maximum demand charge, including overnight ice banks, gas fired absorption and desiccant dehumidification to deal with the latent part of the air cooling load.

The arguments on ice banks hinge upon size, cost and design. The off peak electricity tariff permits the ice to be made at night and stored. This means that the temperatures are much lower than the conventional cool temperatures. In the ice bank system the chilled air can be transmitted at lower temperatures and therefore, for the same cooling effect, less of it need be supplied. This saves in pumping energy and ductwork size.

However, these savings have to be offset by a lower cooling performance of the refrigeration plant which makes the ice and extra power needed at the distribution end of the chilled air line to make sure it mixes well before entering the room. Total costs are reported to be similar to those of conventional air conditioning although the enthusiasts at the conference argue that it could be cheaper.

Market trends

The low price of gas in the United States means that gas-fired absorption equipment is receiving renewed attention. Research is being encouraged and combinations of pairs are being appraised. The present state of chemical knowledge is such that potentially explosive combinations can be made inert by the addition of very small traces of inhibitor. The more effective units will almost certainly be multi-staged and with heat recovery.

Large scale plant is becoming available but small scale applications are likely to use domestic hot water heaters. COPs around 1·5 are expected. Desiccant dehumidification used in conjunction with refrigeration also reduces the amount of cooling used. Research was described which combines desiccant drying with both electrical or gas-fired refrigeration. This combustion is particularly appropriate for those States which experience a very high summer humidity.

Modelling of both buildings and the occupants is already well developed. The technical sessions on these two topics tended to be more appraisals than extensions. For buildings, the major question was whether or not field experience should be sought so that the models could be verified. On the subject of people there was a review and an extension to include persons immersed in water. There was also consideration of turbulence in defining the draughtiness also clearly demonstrated the irritation which occurs to eyes when people spent several hours in an atmosphere of 30% rh.

Electric heat pumps and air conditioners are enjoying a revival in a modest way. Japanese technology has started to sweep through the United States too and the Japanese researchers were present in significant numbers, speaking English fluently. They have designed better heat exchangers and introduced new thinking to variable speed drives and to novel efficent and economical compressors. They were all listened to with respect.

While it was a pleasure to see some British products on display in the exhibition it was a surprise to see the large number of Japanese companies attending. The American companies are beginning to respond and small screw compressors and the new scroll compressors are now going into production.

In conclusion the ASHRAE organisation worked as smoothly as ever. Ten technical meetings ran in parallel for practically all the time and these were complemented by technical tours, ladies programmes and social events. The Texans turned up in force and could be recognised by their hats and boots and, yes, they did keep their hats on for breakfast.