CURRENT TRENDS FOR INDOOR AIR QUALITY

By

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This article overviews the current state of Indoor Air Quality Best Practice.

BEST PRACTICE PROJECT DELIVERY

Poor indoor air quality is a result of poor construction techniques and project delivery, as well as substandard maintenance procedures. An important initiative to combat mediocre and poor construction practices has come from the Property Council of Australia which commissioned The Road Map to Project Excellence Report (1). This report determined the drivers of project excellence and covered 28 excellent projects extracted from 90 interviews from 80 organizations having project values from $350,000 to $350 million. Whilst only 10 percent of projects were classified as excellent, the drivers of project excellence were identified.

The subsequent conference (2) resulted in presentations from selected organizations, which had identified the key criteria for delivering excellence. The conference made a strong case that excellence in construction should be pursued at all stages and at all levels

of projects as a strong driver of total wealth creation and stakeholder satisfaction. The long-term costs of poor project design and delivery are very high even when the short-term cost savings are taken into account.

Environmentally sustainable development (ESD) principles, which include IAQ, are at last now being applied to new construction projects, with the most notable being projects associated with the Sydney Olympics. The author has been involved in applying these principles on several projects, most recently in the redevelopment of the CSIRO Clayton site with Design Inc. and the only recently approved Brisbane Magistrate's Court Project with Walter Constructions. The degree of innovation was also applied in the landmark Renzo Piano designed and Lend Lease built Macquarie Apartments in Sydney.

Trends in practice show that it is likely that competition, values and litigation will punish those organizations which neglect environmentally sustainable development principles and allow the design, installation and management of systems, which do not deliver high-quality indoor air environments upon commissioning and well into the future. Clients and occupants are increasingly aware of the requirement for high-quality indoor air for optimal occupant and office equipment performance. This is supported by the fact that occupant and related costs constitute almost 90 percent of the costs of operating most built environments.

There is the potential for productivity losses of up to 15 percent if air quality and the general indoor environment are deficient. Furthermore, in extreme cases, buildings cannot be occupied until the indoor environments are rectified. The author has been associated with one project where an important section of the building has been vacant for seven years and the occupants have been legally compensated. In the case of a legionella or asbestos incident, severe commercial disruption and health effects can result from deficient design, remediation and building management. Such incidents can adversely affect a commercial facility for up to five years.

HEALTH EFFECTS OF INDOOR AIR QUALITY AND THE INFLUENCE OF STRESS.

When strong motives are blocked by impassable barriers; or by barriers which we cannot circumvent then frustration, stress and conflict arise (3,4). If poor indoor air quality creates additional barriers such as lowered mental alertness, eye or throat irritation or a general feeling of unwellness, they can impede even the most motivated workers and thus lead to stress. Based on legal activity and publication, the general level of stress in office workplaces appears to be rising and is now a legitimate cause of workplace health and safety compensation claims.

Stress has been defined as a condition of chronic emotional tension arising from prolonged frustration, which can lead to homeostatic changes in the body, which call up our internal defensive forces such as secretions from glands and other physiological changes. With no conscious effort on our part, stress causes adrenal glands to secrete adrenaline and epinephrine hormones to equip us for fight or flight. Unlike primitive man we cannot dissipate these excessive levels of hormones since we have to remain behind a desk or a sales counter and endure the variety of tension reactions. Extensive animal experiments and human observations have led to the clinical field, known as psychsomatic medicine (5). This can include sinus disorders, asthma, high blood pressure, headaches, breathing problems, dry mouth, memory and concentration problems and certain skin disorders. It is important to differentiate stress symptoms from those caused by IAQ deficiencies.

Gawler (6) discusses the concept of the stress - performance graph and the stress cycle, as shown as Figure 1. Toates (7), in examining the conceptual and biological aspects of stress, looked at neurophysiology, endocrinology and biochemistry as well as the immune system. It is thus likely that sensitivity to poor environmental conditions is heightened when building occupants are stress due to their work environment.

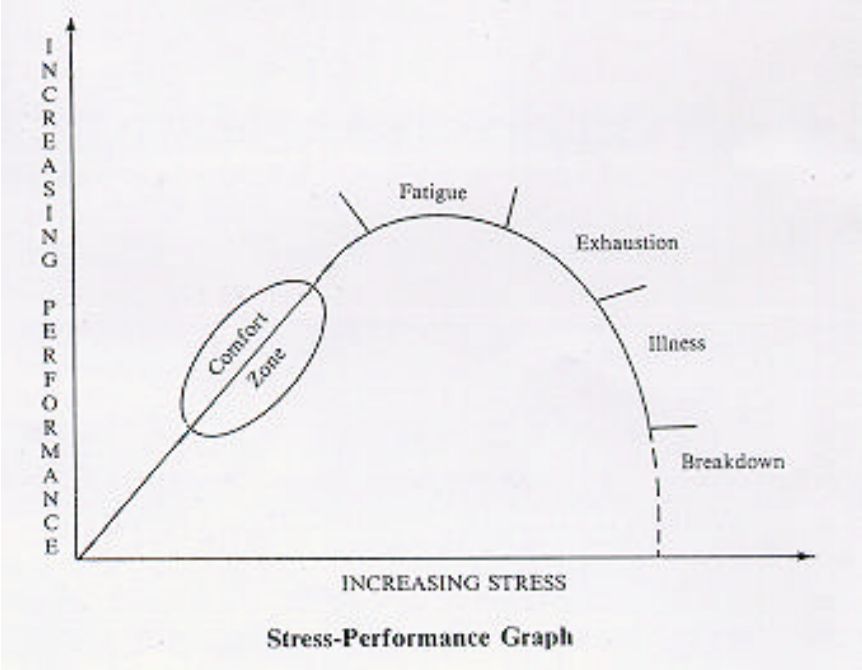

Figure 1 - Source - I Gawler (5)

The effects of poor indoor environments on health are currently being studied extensively and guidelines for air quality were set by the World Health Organization (WHO) Expert Task Force in 2000 (8). The WHO has indicated that health effects can include increased rates of cancer, lung disease, allergy and asthma, as well as fatal conditions such as legionnaires disease. The medical and social costs associated with these illnesses, and a related reduction in human productivity, result in staggering economic losses. The guidelines recommend that further building surveys, epidemiology and economic studies are required (8).

Air pollutant concentrations and other aspects which affect susceptibility, include meteorological, demographic, socioeconomic and pre-existing disease factors (3). The WHO Regional Committee for Europe in 1998 resolved that by the year 2015, people in the region should live in a safer physical environment, with exposure to contaminants hazardous to health at levels not exceeding internationally agreed standards (9).

Future studies are likely to examine the relationship between the perception of and health reactions to indoor environments by stressed and unstressed individuals and to the ability

of poor indoor environments to contribute to increased stress levels of the occupants.

In 2000, the American Society of Heating Refrigeration and Engineering (ASHRAE) reaffirmed that their standards should and do consider health impacts when setting the criteria for acceptable indoor air environment.

ASHRAE recommended the following:

1. Adoption of ASHRAE 62 (2001) and 65 on indoor thermal and IAQ management.
2. Expanded public and private support for research on IAQ and its effects on people.
3. Continued government support for IAQ education and implementation programs.
4. Continued research on building energy-efficiency and IAQ.
5. Continuous support of the above by ASHRAE.

A major issue in the United States is the introduction of the Toxic Mold Safety and Protection Act into the U.S. Congress which, when passed, will require massive expenditures from public, commercial and private buildings to eradicate moulds. The awareness of microbiological issues is also growing in Australia.

AUSTRALIAN ISSUES

In Australia, the indoor environment lacks a central regulatory focus. As discussed in the Commonwealth Department of Health and Aged Care, 'Literature Review and Research Survey, 2000' (10), the obstacles to an effective Australian IAQ policy were as follows:

1. Demarcation of air quality and coordinating agencies.
2. Policy action vacuum.
3. Poor coordination.
4. Data availability and coordination deficiency.
5. Skills deficiency.

The Environment Australia 2000 IAQ Report (11) confirmed the above difficulties, compounded by the inability of National Environment Protection Measures (NEPM) to address IAQ parameters as discussed by AIRAH (12).

On a more positive note, the Standards Australia Committee EV007-2 for Indoor Air Quality Measurement is developing standardised methodologies for the measurement of IAQ. Other relevant committees, which influence indoor air quality are the recently reviewed AS 1668.2(2002) for the Design of Ventilation Systems and to some degree, AS 3666 for Cooling Towers and the AS Committee EV007-1 for Ambient Air. The AIRAH air filters application manual, DA15 also makes a valuable contribution to the important subject of particulate management.

The Property Council of Australia, when it was still known as the Building Owners and Managers Association (BOMA), published an inaugural guide to the assessment of indoor air quality in buildings in 1991. This guide was closely followed by a similar guidance document from the United States Environmental Protection Agency.

OUTRAGE CONTROL AND RISK MANAGEMENT

Population or individual outrage is often a consequence of unresolved or unmanaged risk perception. Outrage can manifest itself as low level resentment, subversive behavior and up to outright confrontation resulting in evacuation and the pursuit of legal options. If issues remain unresolved and proper risk management procedures are not followed, long term aggravation may become entrenched and create very difficult loss of trust consequences.

The author has been involved in a wide number of outrage resolution projects arising from defective indoor air quality. In particular, projects involving schools or child-care centres can have very rapid transition to parental and teacher outrage, due to the protective role of parents and carers. The issues may then take a long time to resolve if trust is involved. In addition, the media can propagate outrage when the public is involved. Unfortunately, the professional IAQ community has not been given an opportunity to educate the media on the meaningfulness of IAQ issues and scope. Hence, a considerable amount of anxiety has been generated on, for example, legionella and asbestos, whilst the more persistent VOC, particulate and microbial issues are neglected or misreported.

The trend now and for the future is to incorporate indoor environmental issues and control into the role and scope of total organizational risk assessment and risk management. This has already occurred in the area of cooling tower and legionella management in most states. The most recent legislation, in Victoria, requires the assessment of cooling towers to be in the form of the Australian Standard 4360 for risk assessment and management.

It is not sufficient to attend only to the technical issues associated with indoor air quality. Communication and consultation is required as well as regular reviews with all stakeholders. After a survey is complete, the resultant report should be prepared so it can be read and understood by the occupants of the building. Ideally the report should be presented to the occupants and other stakeholders so that all parties can clearly

understand the management issues and work towards a joint solution. The direct presentation is also an opportunity to gauge the residual level of occupant concern with respect to the indoor environment and other associated issues.

TECHNICAL RESEARCH DIRECTIONS

The most recent IAQ technical event has been the Ninth International Conference on Indoor Air Quality and Climate, Indoor Air 2002 at Monteray, California (13).

The plenary lectures examined the following topics:

- Connection between particles, odorous filters and nasal pungency thresholds.
- Linkages between outdoor and indoor air quality.
- Development of indoor air policies.
- Comfort Research.
- Microbes.
- Asthma and indoor air.
- Environmental sustainability and IAQ.
- Risk assessment of disease from IAQ.

There were a very large number of papers presented at the Ninth International Conference. There was a very large emphasis on bioaerosols but the trend is towards formalized risk assessment and management. Children's health is also receiving a growing prominence. The general categories of the papers presented were as follows:

- Bioaerosols
- Special indoor environments.
- IAQ surveys
- Asthma and respiratory health
- Outdoor pollutant impacts on IAQ
- Health effects on adults and children
- Volatile and semi-volatile organic compounds
- Ventilation systems and hygiene – emissions and cleaning
- Particles and dust
- Life-cycle perspective: health and risk

- Emissions and laboratory investigations
- Thermal comfort and perceived IAQ
- Instruments and methods
- Pollutant transport and mixing
- Novel air distribution
- World Bank symposium -- indoor air quality and health in developing countries

PROTECTING BUILDING ENVIRONMENTS

Physical protection from terrorist attacks has been a feature of building design for some time, but recent events have emphasized that need to increase security of IAQ systems.

Since September 11, 2001, the U.S. Department of Health and Human Services (14) has issued guidance notes for protecting building environments from airborne chemical, biological or radiological attacks. This document identifies actions that the building owner or manager can implement without undue delay to enhance occupant protection from attacks. Aspects such as preventing access to outdoor air intakes, secure return air grills and roof, HVAC control options, upgraded filtration, fast acting baffles and emergency policies are outlined. The US Army Corps of Engineers (15) has also issued guidelines and these remind us that there are almost daily incidents involving accidental or deliberate contamination of indoor air.

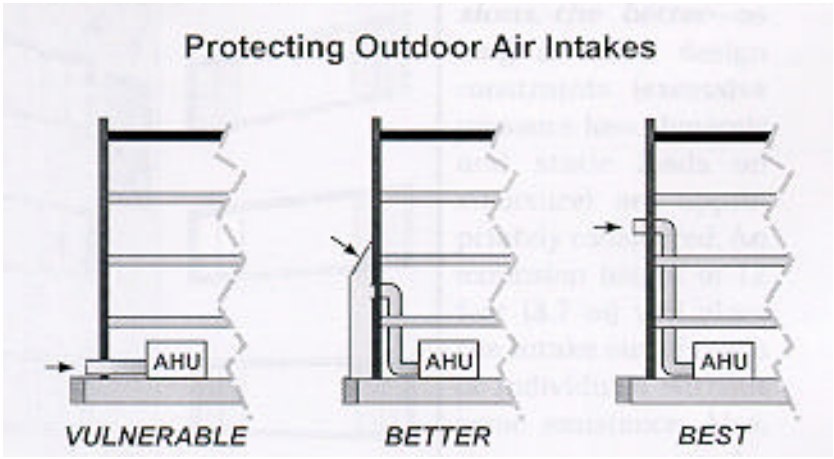

Figure 2 - Source - U.S. Department of Health and Human Services (14)

The following protective measures in the guidelines (15) are presented:

? high efficiency filters for removing gases and aerosols from makeup air
? re-circulating filter units [indoor air purifiers] available commercially
? physical security and entry screening measures
? architectural and mechanical design measures
? protective action plans covering sheltering, evacuation, paging and protective masks

Other organisations that have produced relevant information are as follows, including the U.S. Environmental Protection Agency (16), which has listed a range of guidance documentation available on their website. The ASHRAE Presidential Study Group on Health and Safety under Extraordinary Incidents (17) has issued a risk management guidance document which discusses the lessons learned from September 11, 2001 and makes recommendations for owners and managers of existing buildings. The U.S. EPA has further released a wide range of progress papers on the World Trade Center disaster with respect to measurements, dust cleaning strategies and health effects. This is recommended reading for those who have the appropriate responsibilities.

CONCLUSIONS

Facility Managers have traditionally been concerned with providing supplied air which are comfortable and free from visible dust. However, the increased demands of occupants, regulators and world trends now require a total Risk Assessment and Management approach to indoor air quality. This includes, for the health of occupants, monitoring for microbiological, particulate and chemical quality of the supplied air. The heightened awareness of terrorist and disruptive activities is also driving Facility Managers to design appropriate Risk Management strategies and the associated equipment modifications. These trends are unlikely to be reversed.

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The article was presented by Dy Vyt Garnys as the keynote address to AIRAH conferences in August and September 2002.

The author Dr Vyt Garnys has more than 30 years of professional, independent Risk Assessment and Management experience, specialising in both in Indoor Air Quality and also the Built Environment. Since 1980 he has held management positions for Amdel in South Australia and Victoria, before forming his own company **Cetec Pty. Ltd.**, in 1987. *Cetec also wholly owns Foray Laboratories Pty. Ltd., a national advanced analytical laboratory working collaboratively with CSIRO and more recently with the University of Sydney.*

Dr Garnys is presently chairman of Standards Australia Committee EV007-2 for Indoor Air Quality Measurement. *This committee is developing standardised methodologies for the measurement of IAQ*. Dr Garnys was also a member of the BOMA committee responsible for the inaugural guide to the Assessment of Indoor Air Quality in Buildings in 1991. *This guide was published by Building Owners and Managers Association (BOMA), now known as The Property Council of Australia. Dr Garnys is also the chairman of NATA's inorganic chemical committee.*