Increased CO_2 levels can lead to nodding off in the classroom.

Rare air

The issue of outside air introduced via operable windows in spaces such as classrooms and meeting rooms – rather than via mechanical means – has been a concern among members for some time. Is it a case of inconsistency in our building codes, or a lack of understanding among commercial contractors and consultants? **Sean McGowan** reports.

The line between domestic and commercial has always been one that has moved over time and caused much angst among members of the HVAC industry – and for good reason.

Although no one would deny the role domestic installers play in servicing homeowners across the country, it is when domestic solutions are applied to commercial applications that concerns are raised. And this is particularly so when the end result may impact poorly on the reputation of the industry.

This issue has surfaced again in recent times as domestic split system solutions have been recommended as a viable and cheaper alternative to a more suitable commercial solution in schools, healthcare facilities and other government buildings, as well as light commercial applications such as training rooms, shops, restaurants, small offices and the like.

According to concerned AIRAH members, it seems the use of this equipment is being justified due to the allowable introduction of outside air via operable windows in these spaces.

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The problem, as they see it, is that these windows may rarely be opened – particularly at the height of summer or in the depths of winter – with the result being poor ventilation, high levels of CO_2 in the space and a client unhappy with the end result. This in turn tarnishes the professionalism of the industry.

IDENTIFYING THE ISSUE

While the issue has been around for some time, it has come under greater focus in South Australia recently, with the current Department of Education and Children's Services (DECS) Policy POL002-V3.2 now making reference to operable windows as a method of providing required outdoor air to classrooms.

According to an AIRAH member, confusion exists among contractors, and many are complaining about this change in policy.

"The current policy is easily misunderstood, and some contractors with a domestic background are using the guideline to endorse operable windows in

conjunction with a high wall split system, resulting in a much cheaper alternative to a more suitable approach," he explains.

The general mood of concerned members contacted by Ecolibrium seems to be that domestic-based contractors are not necessarily familiar with the requirements of the BCA and AS1668.2 1991, as this generally is not applicable in a domestic application. As such, they may not appreciate the difference in classification of the space to comply with the BCA – namely that a classroom is a 9B space that caters for a large number of people in a confined space.

Notably, the 2002 version of AS1668.2 is not recognised by the BCA and is therefore not applicable at any time.

If you've ever been in a classroom or meeting room and felt yourself losing concentration and even nodding off, it's more than likely because the ventilation to the room did not allow for the number of people gathered there, and CO_2 levels subsequently increased.

It is generally understood that this sensation is observed when levels of CO_2 exceed 880-1000 parts per million.

Anywhere from 25 to 30 students are likely to occupy a typical classroom

Glen Tatam provides the areas in which he contests non-compliance with the BCA as:

1. BCA Volume 1, Clause F4.5 (b) must have mechanical ventilation or air conditioning complying with AS 1668.2 and AS 3666.1
2. The BCA Specification A1.3 references AS 1668.2 – 1991 edition (not the latest 2002 edition) and AS 3666.1 – 2002 edition
3. AS 1668.2 deals with air contamination control, body odour control food odour control for air handling systems/ plant, among other things. Air handling plant is defined as air handling systems that includes equipment providing air movement, as well as equipment for the purpose of controlling the direction, rate, division of airflow and condition of air (concentration levels of contaminants, temperature and humidity). It does not deal with space temperature control or the ability to control space temperature.
4. Reference should also be made to Figure 1.2 of AS 1668.2 which provides representation of air handling unit terms. Note "central air handling unit" and "recirculating air/local air cleaning unit"
5. AS 1668.2 – 1991, Clauses 1.2.1 (a) and 2.3 deals with minimum outside air flow requirements and provides various parameters (to suit the application – offices, theatres, classrooms, etc) that identify the minimum airflow requirements for air handling systems serving these areas. This then determines that there does need to be minimum outside air introduced to habitable rooms. You could question the BCA definition of a habitable room, but it is pretty clear to me that an office, theatre, classroom etc is also a habitable room.
6. AS 1668.2 Clause 2.2.2 Passage of (Outside) Air – "Outdoor air shall pass to the air handling plant directly through an approved duct or plenum connected to the intake (of the air handling plant)". This clause clearly identifies that the minimum outside air must be ducted to the air handling plant. I do not think that there is any room for discussion on this.
7. AS 1668.2 defines "air handling plant" as "a component part of an air handling system that includes equipment providing air movement, as well as equipment for the purpose of controlling the direction, rate of airflow, division of airflow and condition of air, i.e. concentration level of contaminants, temperature and humidity." This could be a central air handling plant, a fan coil unit or a split system air conditioning unit.
8. The wall mounted split systems have no facility to directly induce outside air into the cooling/ heating process. A separate minimum outside air supply air system could be provided to deliver the minimum outside airflow required but this would not comply with Clause 2.2.2. (There would be an additional heat load on the split system to be considered as part of the room heat load. This would likely create hot [cold] spots within the room in summer [winter] resulting in poor space temperature control across the room. AS 1668.2 does not concern itself with space temperature control, that is up to the designer.)
9. A ceiling cassette type split system, depending on the make/ model, can introduce a limited amount of minimum outside air. They typically have a 75mm connection, which, depending on the length of the fresh air intake ductwork, would be good for approx 10 l/s (1.3 people for office application at 7.5 l/s per person). You could put a fan on the minimum outside air and force the air through up to 15l/s (two people)? So the use of this type of unit is limited unless you provide a cassette for every second person.
10. Console type split systems would be similar to either wall splits of cassettes as described above, depending on make/ model.
11. Wall mounted Room Air Conditioners (RACs) would also be similar to either wall splits of cassettes as described above, depending on make/model, if they have a ventilation mode, which most nowadays do not. It also does not make sense to have the RAC in vent mode when cooling (heating) was required in the middle of summer (winter).

(56 to 60 sq m in size). The AS1668.2 – 1991 dictates the required quantity of outside air for such a space (accommodating 25 students) as 12 litres per second per person – 300 litres per second of outdoor air.

While some may argue that some cassettes introduce outside air, Glen Tatam from ACMV Design Consultants in Perth argues that not only is the amount not nearly enough, but it is introduced after the filter and before the coil.

"The amount of outside air is minimal – 10 to15 litres per second – which is only enough for one or two people. If you have a classroom of 25 people with say four of these units, then you need to introduce more outside air," he says.

"Both the wall and cassette units struggle with this, not only due to the latent heat load from people, but also the latent heat load and sensible heat load of the outside air. Even if you use an office situation of one person per 10 sq m, a cassette does not work for minimum outside air."

DECODING THE CODE

So why are these off-the-shelf solutions allowed in such applications?

According to Phil Wilkinson, AIRAH's technical manager, under building regulations the BCA requires ventilation into a classroom either via natural ventilation or by mechanical ventilation in accordance with AS1668-1991.

"If by natural means, it is the teacher's responsibility to open the windows," Wilkinson says. "Whether they do or not is a matter for them exercising their duty. Were it an office building the occupant has the choice," he states.

Where outside air is not delivered mechanically, it is assumed that the teacher, student or occupier of the room is required to open a window to introduce the required outside air. The problem with this, as some point out, is that windows need to be opened regardless of the weather conditions outside, which on occasion may seem to be contradictory to the room user.

As such, Tatam and others argue that opening windows is not code compliant and is not a satisfactory means of providing outside air to a classroom.

Vince Aherne, who worked on the standard in question at Standards Australia, says it is a problem not so much with the building regulations, but rather with the building in use.

"Where a building is naturally ventilated this is generally achieved with openable windows and doors. There is no requirement in building regulations that these openings actually be open. I guess it is the intention that openings are openable by occupants as required," Aherne says.

"The difficulty is with the building in use, when the first thing that happens when the cooling system is turned on is that the windows are closed. Most people close windows and doors when the cooling or heating systems are turned on. It's a common problem, particularly in [the] residential and light commercial area, utilising non-ducted split system air conditioners."

> "I know this will be a touchy subject. But the way I see it, these units were not designed for commercial applications and should not be used in this manner."

Aherne says that while no regulatory solution has been found over the years, it could be addressed by OH&S legislation or building approval conditions, because when windows are closed, ventilation is not being provided.

"Presumably if all the windows in a naturally ventilated building were fixed shut the building would not be complying with its initial conditions of approval, and a new approval application would have to be made in light of the changes made to the building," Aherne says. "Certainly a case could be made to argue that the provision of air conditioning in a naturally ventilated building would be akin to fixing closed the required ventilation openings [in practice] and rendering them unfit for use.

"However, it could also be argued that occupants have a free choice to open the windows, and the windows and doors of the adjoining naturally ventilated building that is not air conditioned may also be closed. These arguments then become very building-and population-specific."

Aherne also says that ventilation is mandatory while air conditioning is not. As such, regulations do not consider the air conditioning system as long as the building has been provided with a ventilation system that complies with the BCA.

ARGUING FOR CHANGE

Though operable windows have become more common in modern office buildings, particularly following the advent of sustainable design, is this solution really suitable in 9B spaces?

Tatam points out that while it may be possible to open windows in office applications, this is not necessarily the case in restaurants, some shops and certainly in meeting rooms that are internal spaces and don't have any windows.

He also believes another aspect to consider is the distribution of the conditioned air across the occupied space.

"A wall-hung split system, console split, RAC and to a lesser extent the cassette all have poor air distribution characteristics, particularly when applied to larger open areas," Tatam says. "People near the units freeze or overheat, and those further away from the units generally suffer from being stuffy."

As such, he and others would like to see the use of wall units and cassettes be limited to domestic applications and that a formal understanding or definition of what constitutes "industry standard" for this scenario be set for the industry.

"I know this will be a touchy subject," Tatam says, "but the way I see it, these units were not designed for commercial applications and should not be used in this manner.

"The acceptable way to air condition projects of this nature is to use ducted split systems where air filtration of a suitable quality can be provided and where minimum outside air can be introduced in the quantity to satisfy the application, being mindful of the limitations of the capacity of the off-the-shelf evaporative coil," Tatam argues.

It's clear that if there is to be a solution to this problem, it needs to start with a clearer understanding across the entire industry of just what defines a classroom or meeting room.

With AIRAH and the Air Conditioning and Mechanical Contractors Association (AMCA) pushing for change to ensure their members can compete on a level playing field, this is a topic that will continue to stir considerable debate until a viable solution is found. ▮