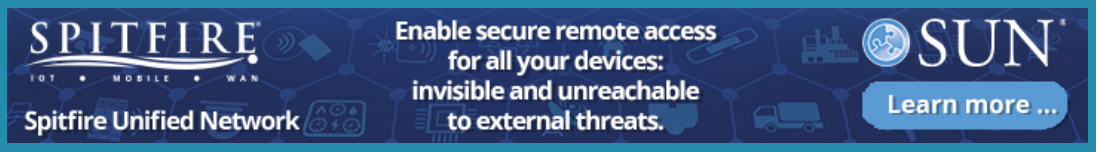
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Final draught

02 July, 2018



Stephan Lang

In ensuring effective ventilation to maintain good indoor air quality it's essential the system is designed to avoid creating draughts. Stephan Lang explains how problems can be avoided

Draughts from ventilation systems are a common problem, even in modern spaces such as classrooms and offices, and this can create serious comfort issues for the occupants.

For instance, many schools that were built under the Building Schools for the Future (BSF) programme as recently as the first decade of this century have significant draught problems. Indeed, this problem is reflected in the 2015 revision of TM 57 ('Integrated School Design') and the forthcoming update to BB101 ('Guidelines on Ventilation, Thermal Comfort and Indoor Air Quality in Schools').

Similar issues may be found in offices and other workspaces, where the ventilation system has not been designed to modern standards and does not take advantage of the functionality of today's smart ventilation units (SVUs). The latter can deliver draught-free ventilation through acombination of inlet temperature control and harnessing the Coanda effect.

A draught can be simply described as unwanted local cooling, though quantifying the draught problem is less simple. One approach is based in terms of the temperature difference (ΔT) between room air in

the occupied zone (To), and that of inlet air arriving at the occupied zone (Ta). The occupied zone is defined as the point at the centre of the space, 1.4 metres above floor level.

To - Ta = ΔT

The greater the value of ΔT, the greater the potential for draughts in a space.

Clearly, the temperature of inlet air is crucial to what happens in the occupied zone. For example, if air were to enter at 16°C, it will begin

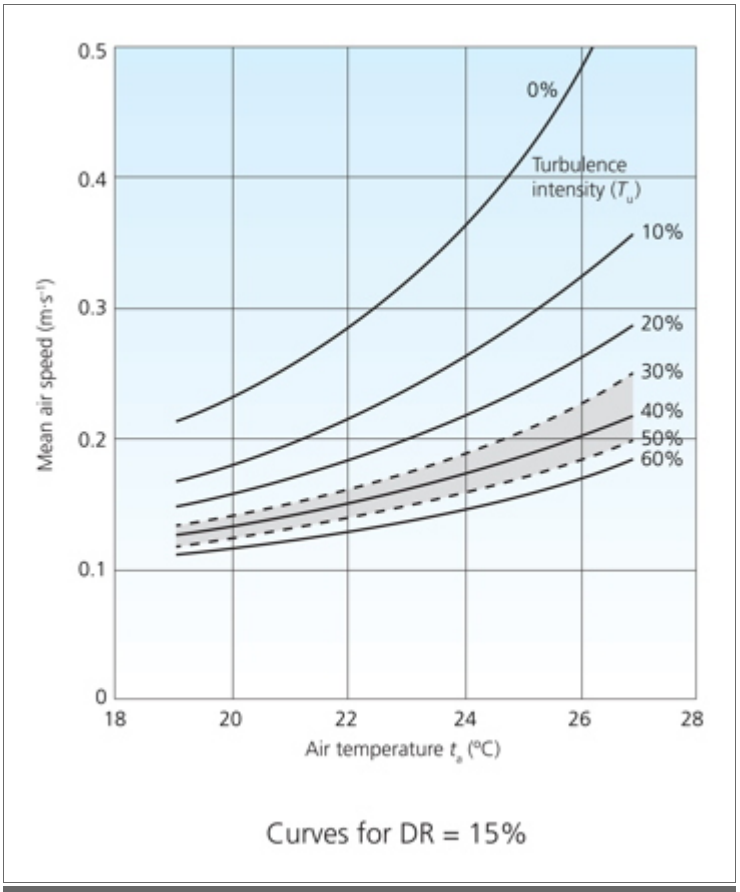


Figure 1: Curves for a draught rating of 15%

falling immediately as there is no natural buoyancy, arriving at the occupied zone before it has had a chance to increase its temperature.

Therefore, there must be sufficient time for the incoming air to be combined thoroughly with room air at, say 21°C, to allow its temperature to be raised.

Draught rating

In several countries of similar latitude to the UK, draught is assessed in terms of ISO EN 7730 (Ergonomics of the thermal environment), based on the concept of percentage draught rating (DR), which quantifies the proportion of room occupants who would feel discomfort because of draught. The allowable maximum value of DR is 15%, with any value greater than this being regarded as unacceptable. Figure 1

shows the curves for a DR of 15%, assuming normal turbulence intensity for classrooms of 40%.

Based on the above, there are two clear conclusions. One, that the temperature of incoming air arriving at the occupied zone (Fig.1, x-axis) should be at least 19°C. Anything less than this and higher values of DR come into play. Two, that if the velocity of incoming air at the occupied zone is over 0.15 m/sec, then the temperature of this air will need to be increased appreciably if higher DR values are to be avoided (see Fig.1). E.g. with an air velocity of just 0.2 m/sec, the air temperature will need to be at least 26°C.

Conventional ventilation systems in the UK have difficulty in meeting either of these challenges in winter. However, as noted earlier, the latest generation of SVUs addresses the problem in two stages. The first is to provide close control of inlet air temperature. The second is to ensure sufficient entrainment of room air within the inlet air to make certain of the required temperature increase before the inlet air arrives in the occupied zone.

Whatever value is chosen for inlet temperature (say 19°C) the ‘smart’ control of an SVU ensures that this is maintained as a minimum value, regardless of external temperature.

If the inlet temperature rises above the set point, an automatic bypass damper allows a proportion of air to enter directly from the outside, without passing through the heat exchanger. Provided the external temperature is low enough to make a difference, the inlet temperature will fall back to set point.

Conversely, should the inlet air temperature fall below the set point, the inlet fan slows automatically, whilst the exhaust fan speeds up. This results in a lower flow of cold air being warmed by an increased volume flow of warm air, producing an increase of inlet temperature.

Consequently, inlet temperature will be returned to its set point of 19°C. This smart temperature control mechanism enables close control of air temperature in classrooms and other spaces, removing a major cause of discomfort.

To provide sufficient mixing time once the fresh air has entered the room, for example, AirMaster SVUs use the Coanda effect to move the supply air across the ceiling for a throw of 6 – 8 metres, before falling away to the back of the space.

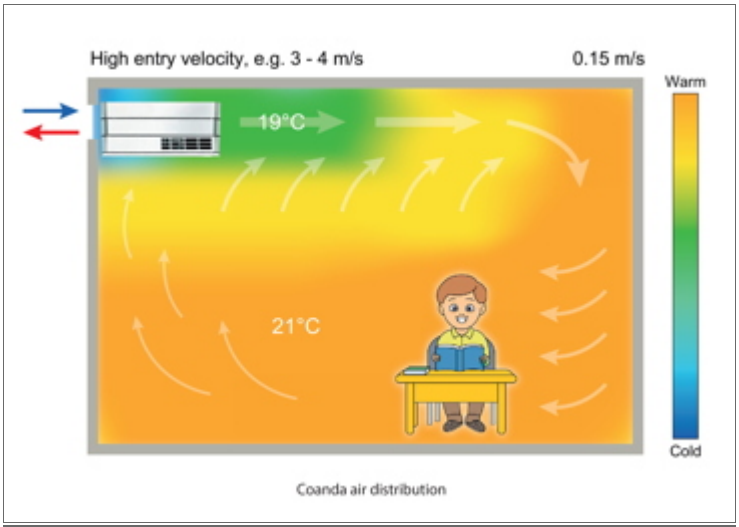


Figure 2: The Coanda effect

Good design

As it traverses the ceiling, the inlet air slows down and entrains room air, thus increasing in temperature as it moves along. By the time it is ready to detach from the ceiling and fall away at the back of the classroom, the incoming air has had the time to be warmed by the 2°C necessary for it to reach room temperature. This means that draught risk is eliminated (see Fig. 2).

The design of SVUs ensures that incoming air is at sufficient velocity and is close enough to the ceiling to maintain the Coanda effect. Room air is pulled in to the underside of the Coanda flow, producing a rise in temperature and a fall in velocity of the incoming air.

The jet velocity can be expected to fall to approximately 0.15 m/sec on reaching the end of the room. SVUs thus ensure that the room is well-ventilated, and that temperature and air quality are evenly distributed. DR is kept within the 15% limit.

IAQ is a key issue in the design of ventilation systems, combined with features such as demand controlled ventilation for efficiency. The development of SVUs will help building services engineers to ensure they meet IAQ and energy requirements without creating draughts.

Stephan Lang is sector manager for AirMaster SVUs with SAV Systems

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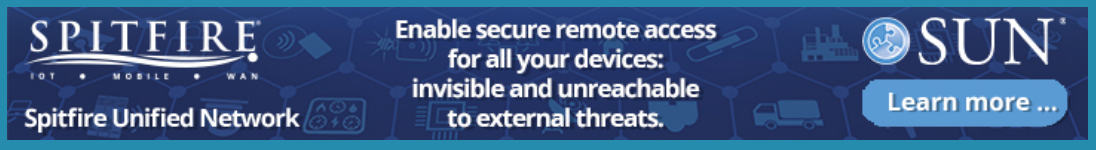
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