A green guide to air conditioning

John Staunton at SAS International explains why chilled ceilings and beams are a water based cooling solution that can't be ignored

According to a 2001 policy brief on air conditioning, the energy consumption and associated carbon emissions resulting from air conditioning use in the UK represented around 5% of the total carbon emissions from non-domestic buildings. However, there is still a substantial projected growth in air conditioning use.

The occurrence of plant over sizing and the prevalence of systems operating outside occupancy hours have a substantial impact on energy use and must be addressed, as does the inherent efficiency of the systems themselves.

Until recently, many buildings were not regarded as fully serviced unless they were air-conditioned by traditional methods. However, in today's climate where reducing carbon emissions and energy usage, meeting amendments to the building regulations and achieving good room comfort are key considerations, it is unsurprising that alternative methods of providing such cooling within non-domestic environments are being explored.

In addition to their high energy consumption, a lack of uniform room comfort and issues relating to health concerns, such as legionnaires disease, are also placing an increasing interest on ways to modernise, avoid or minimise the use of traditional air conditioning systems.

The cooling potential of water

Chilled ceilings and beams, with low whole-life costs and energy consumptions, are emerging as a popular solution. Using water as a cooling medium, these systems offer an efficient way of cooling a building when compared to all-air, DX, VRF, VAV and fancoil systems. Requiring relatively modest cooling water temperatures of 14 to 17oC, natural cold water storage or free cooling from outside air can realise these temperatures throughout most of the year.

As a result a much better energy performance is possible. While not appropriate for every building there is no reason why this technology cannot be applied to most new and refurbished office developments, as well as within other environments such as schools, universities, airports, hospitals and libraries.

Design options

Chilled ceilings allow lighting and other ceiling mounted services to be integrated with factory formed apertures without affecting the acoustic performance. Chilled beams can also incorporate other building services such as cabling, PA, and fire detection and control systems – they are then referred to as Integrated Service Modules (ISMs) or Multi Service Chilled Beams (MSCBs).

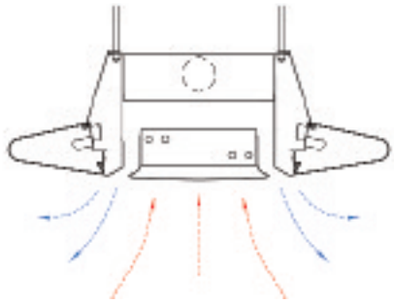
Chilled beams and ISMs, as suspended modules, offer architects greater flexibility to create aesthetically interesting spaces. Instead of opting for standard designs, a feature can be made of these beams by specifying unique casings or looking at different suspension options. This does require co-ordination between architects, service engineers and the manufacturer to ensure the correct balance between aesthetics and performance is achieved. However, this should not be a deterrent as manufacturers such as SAS are experienced in co-ordinating the design of such modules. Standard casings provide a non-bespoke alternative if cost is a key issue.

Active or passive?

Modules incorporating chilled beams can be either 'active' incorporating fresh air ventilation, or "passive", which are used in conjunction with a separate air distribution system.

Chilled ceilings use a combination of radiation and convection to achieve room cooling, while passive beams rely entirely on natural convection (see figure 1). This makes these systems sensitive to the location of the fresh air supply and any heat sources, as well as any resistance to air flow. For this reason you may choose to install passive chilled beams at the perimeter of a building with a large percentage of glazing, as the thermal convection produced during the summer can enhance the cooling capacity of the beam; and a chilled ceiling throughout the rest of the building, where the cooling loads are lower.

Active beams offer a greater amount of control, as the level of induction of 'hot room air' through the beam is managed by the flow of the fresh air supply (see figure 2). As the air



Active ISM

Passive ISM

induced through the beam is cooled this process determines its cooling capacity. The induction ratio of a beam measures the amount of room air drawn through it in relation to the volume of fresh air introduced. While a high induction ratio is often desirable it is not always required and the level should be determined by the requirements of the space.

Greater comfort

Whether chilled ceilings or beams are chosen, such water based systems are also very attractive in light of recent controversies over the aggressive effects of modern synthetic refrigerants used in air conditioning and the spread of Legionnaires Disease. Greater occupant comfort is also achieved as they generate minimal air movement and remove the obtrusive noise generated by mechanical alternatives.

More space

As there is no need for the large ducting associated with traditional air conditioning, with chilled ceilings and beams, and ISMs the perception of the floor to ceiling height is increased. In new buildings this can significantly reduce the overall construction costs because the building height can be lowered or an increased number of storeys can be constructed without increasing the building's height.

This also allows for the successful refurbishment of 1960's buildings with an increased floor to ceiling height. New partitioning and layout requirements can also be easily integrated with these solutions with minimal re-adjustment.

Thermal mass opportunities

Chilled beams and ISMs also offer the added benefit of opening the concrete soffit up for thermal mass cooling. Utilisation of a building's thermal mass cooling potential can significantly reduce internal ambient temperatures. This is a natural process centred on the building's thermal mass, provided by exposed concrete slabs. It is increasingly being adopted as a sustainable low energy solution and works by utilising the natural properties of concrete which has a high specific heat capacity and conductivity. This natural process has a cooling potential of up to 25W/m^2 according to the Concrete Centre.

Time and cost savings

Chilled ceilings and beams also offer significant reductions in whole-life cycle costs due to reduced maintenance requirements, bought about by fewer moving parts, and lower running costs. The fixed production, delivery and installation times of these prefabricated solutions also greatly reduce cost and the risk of project overrun.

There is mounting pressure to make clear inroads into reducing the carbon emissions of buildings and it looks likely that some type of energy performance labelling will also be required in the near future. Therefore, these water based cooling solutions can't be ignored, especially as energy prices continue to rise.

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