14: Some design notes on passive chilled beams

This is not a design guide for chilled beams; rather, it is intended to raise some of the key issues for designers considering the use of passive type chilled beams (PCBs) in cooling applications; they are generally not used in heating applications. There are a number of useful general chilled beam design references provided by prominent manufacturers (see below). Guidance offered by manufacturers in relation to the limiting output per metre for a PCB varies widely; up to 200 W/m is common although 300 W/m has been published. Higher output generally equates to higher air flow across the coil, and the attendant risk of draughts. Manufacturers also differ in the way they apply correction factors, which are parameters that act to reduce the cooling output of the beam, such as chilled water flow rate and supply temperature, mounting height, the presence and relative dimensions of physical enclosing elements (for example, ceiling void barriers). It is not advisable to use one manufacturer's set of correction factors on another's products.

A PCB is one of the few terminal devices that responds passively to the heat gains imposed upon it. Consequently, its position in relation to heat gains is a critical consideration (although new devices having more radiant output are claimed to eliminate positional effects). Of course, these are rarely known at design time, and PCBs may simply be laid out in a regular grid. But those beams that are located directly above a point heat gain will adjust their output upwards to the limit represented by the inherent capacity of the chilled water flowing through it. Higher output means higher convective air flow and draughts may be created that can adversely affect occupant comfort. PCBs deployed in the perimeter zone commonly have to work much harder than those located in internal zones. The use of solar control glazing is normally essential to keep heat gains to a level that does not exceed PCB capacity. Absorbed gains on glazing can cause fast-flowing upward air flow. In order to ensure that return air does not bypass perimeter beams, it is normal practise to enclose the inside edge of the beam so as to direct air back over the coil.

Great care is needed if the designer is considering the use of ISO 7730 as part of the design specification, particularly in relation to draught ratings (DR). Where PCBs are combined with another form of ventilation such as displacement, PCBs will not necessarily be the dominant factor. In addition, air circulation at the building perimeter may strongly be affected by convection over hot glazing. Most importantly, DR is measured in relation to local comfort conditions, i.e., adjacent to the body. Averaging DR across an occupied volume during test procedures or modelling is incorrect.

Finally, choosing an appropriate air-on temperature for selecting PCBs is important because it affects both design and actual cooling outputs. It should not be selected arbitrarily; air temperature gradients in the space and parasitic gains from sources such as lighting within ceiling voids must be taken into account.

Keith Calder, August 2012

Key Issues

- Be aware of the differences between manufacturers' products and their performance measurements
- Review point heat gains and their positional relationship to PCB positions if possible
- Specify installed performance criteria carefully, especially when citing ISO 7730 parameters
- Design perimeter PCBs so as to ensure return air capture
- Take care when considering an appropriate return air temperature for PCB selection

Web Links

Manufacturer design guides by Trox and Halton