New hybrid solution for energy efficient cooling, heating and ventilation – chilled beam integrated with radiant panels

Panu Mustakallio
Oy Halton Group Ltd., Helsinki, Finland.
panu.mustakallio@halton.com

Other authors: **_Risto Kosonen and Risto Paavilainen_**
Oy Halton Group Ltd., Helsinki, Finland.

Halton introduces new hybrid solution for energy efficient cooling and heating in office environment. The chilled beam integrated with radiant panels aims to combine the benefits of chilled beams and radiant panels. The room unit is shown in the **Figure 1**. The chilled beam is located inside and top of the unit, and radiant panels on the bottom surface. Radiant panels can be equipped with acoustic material or replaced with acoustic panels.

Combining chilled beam with radiant panels, the conductance of the unit can be increased. It means higher cooling/heating power per room unit, and is the same as increasing the induction rate of the chilled beam, but now the increase has been done with integrated radiant panel. This is more favourable solution for thermal conditions point of view, because higher air circulation can increase the risk of draft. The room unit also provides

Figure 1. The chilled beams integrated with radiant panels (red colouring).

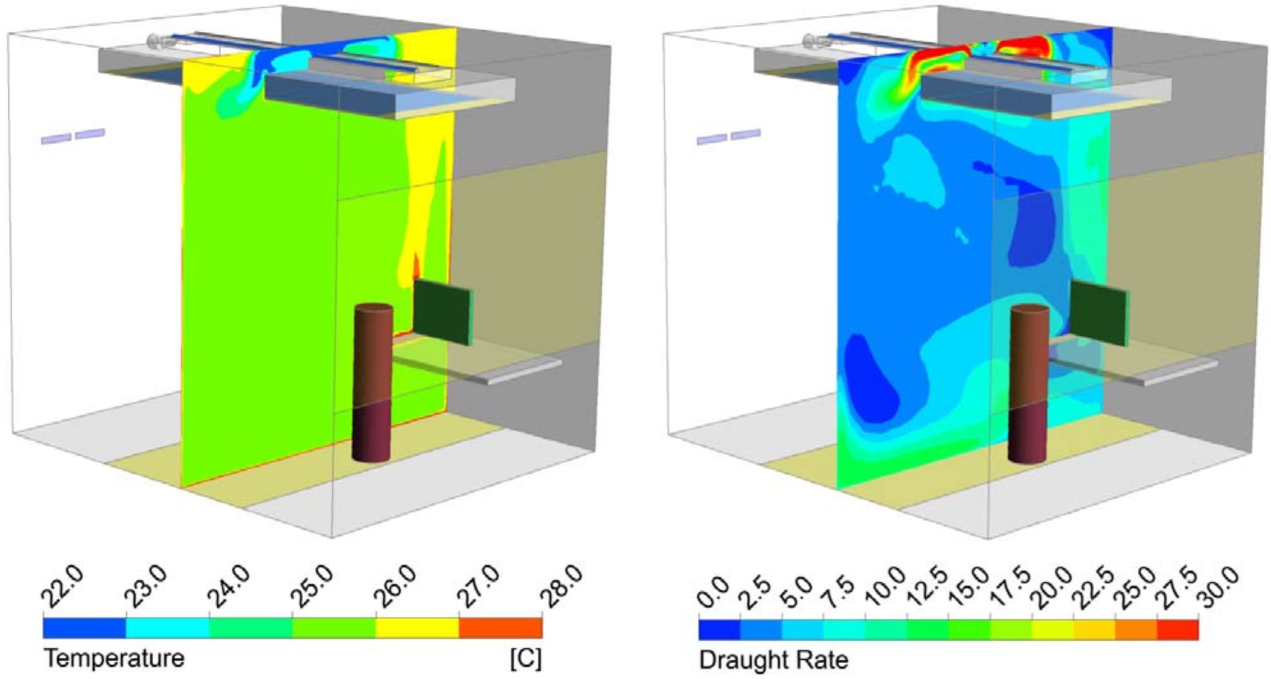

Figure 2. Temperature (left) and draught rate (right) distribution in CFD-simulation of office room with room unit integrating chilled beam with radiant panels.

effective radiant heating or cooling when the ventilation is turned off.

Other advantage is in the energy efficiency of the whole HVAC system, as the room unit with high conductance can operate efficiently in high temperature cooling and in low temperature heating system. This means higher COP for the chilled water system and possibility to use free cooling longer time as well as good possibilities to use renewable energy sources.

In the case study shown below, new chilled beam solution with integrated radiant panels was studied in cooling conditions with computational fluid dynamics (CFD) modelling and in heating conditions with dynamic thermal modelling (DTM).

The case study consisting of one person office room is simulated with CFD in cooling conditions. The cooling need is 50 W/m^2_{floor} consisting of occupant 70 W, computer 150 W, lighting 112 W, window load 140 W and direct solar load 50 W. Supply air flow rate is 18 $l/s/m^2_{floor}$ at 18°C. One three meters long unit is installed into room perpendicular to the window façade. Radiant panels are located to the bottom surface and air is supplied from the top part of the unit. Cooling water inlet temperature is 20°C and return 23°C.

Temperature and draught rate distribution in the room is shown in the **Figure 2**. Average room temperature is 25°C and the draught rate is at very low level especially in the most sensitive head region, as being below the strictest criterion of 10%.

In heating conditions, chilled beam integrated with radiant panels enables heating operation without the need of supply air. Temperature stratification will be lower because heating power of radiant panels is mostly based on radiant heat transfer in heating case. DTM was used to calculate the conditions and energy consumption for similar office room simulated with CFD, with Stockholm weather data during heating season. Compared to the situation, where air handling unit is used one hour longer for heating up with traditional beam system, in addition to the normal ventilation schedule, it caused 9% increase in the fan electricity consumption during the heating season. This can be avoided with integrated system.