Fraunhofer Institut Bauphysik

443

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Hybrid Ventilation Systems which Meet the Demands of the Users of Office Buildings

Objective and investigation

In connection with the international research project of the International Energy Agency IEA-Annex 35 "Hybrid Ventilation in New and Retrofitted Office Buildings", practical investigations with various innovative system components have been carried out. The resulting thermal comfort was recorded with a thermal-comfort measuring system, similar to a climate measuring dummy. In this connection it was possible to determine the suitability for use of the system components, depending on the requirements they make on the system [1]. This project was promoted by the Federal Ministry of Economics and Labour (Project-support organisation Jülich) and carried out in co-operation with various industrial partners. The novel components included in this investigation are described in the following:

Novel components
Experiment room and radiant ceiling panels

The floor space of the test office amounts to 27 m², the average height is 3 m. At the west side a double-glazed window with automatically controllable window-tilt drive is situated. At a distance of about 1 m from the window, a sample workplace with a desk top is installed. The radiant ceiling panel with integrated lighting for heating or cooling the room is suspended approximately 0.3 m below the ceiling. The window is provided with blinds for daylight control **(Figure 1)**.

Figure 1: Radiant ceiling panel with integrated lights.

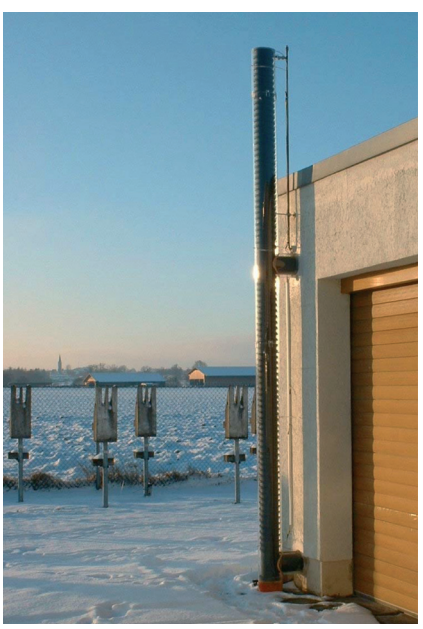

Figure 2: Solar chimney at the south-west corner of the experiment building

Solar chimney

As a force for ventilating buildings, use can be made of the pressure differences in chimneys induced by the wind or caused by thermal pressure differences. In the case of the solar chimney examined within the scope of these investigations **(Figure 2)**, the driving power is increased by solar components. For this purpose the surface of the chimney, which is made of sheet metal, was provided with a black coating and insulated with acrylic glass in order to reduce heat losses.

Figure 3: Window ventilation system in fully tilted position.

Should the driving power be insufficient, a ventilator in the duct leading to the solar chimney may be switched on.

Window ventilation system and air quality sensor

The automatic window ventilation system **(Figure 3)** consists of an actuator for the position of the window with monitoring status and integrated automatic ventilation. On the outside of the window a weathering sensor is installed which provides the electronic control with the necessary climate data. In case critical climatic conditions arise, the opening of the window is prevented, i.e. it is automatically closed. For the measurement of air quality and to activate the hybrid ventilation components, a gas mix sensor [2] was utilized. The sensor reacts above all to volatile organic substances. To provide ventilation which matches the demands, the electronics and software of the sensor permit the activation of two relay contacts when two freely selectable boundary values of the output signal from the sensor are exceeded. After adaptation and extension of the hardware it is possible to switch on the window ventilation system after the first boundary value has been exceeded and to switch on the ventilator in the solar chimney when the second boundary value has been surpassed.

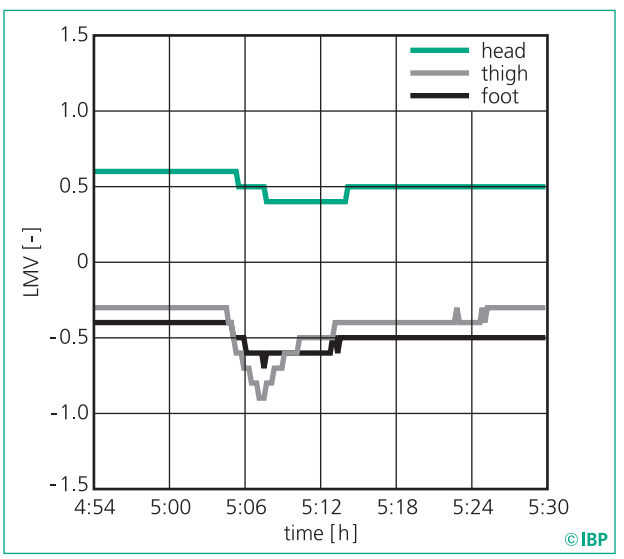

Figure 4: Drop in the comfort value LMV (Local Mean Vote) in the foot area to below the barely-acceptable value 0.5 with the radiant ceiling panel switched off and the window open for ventilation [4].

Indoor temperature controller and equivalent-temperature sensor for controlling an individual indoor climate

The Indoor temperature controller is installed near the workplace. When the window is opened, thus opening the window contact, two adjustment control versions are possible (radiant ceiling panel switched on or switched off). The air temperature sensor which is installed as standard on the indoor air temperature controller usually measures only the air temperature. An equivalent temperature sensor [3] which was available at the IBP has been further developed for the projected application. It is now possible to convert an equivalent temperature ranging from 0 °C to 40 °C into a voltage from 0 V to 10 V which can be used for controlling the ventilation or climate components, while the other comfort parameters of air velocity and thermal radiation are also taken into account. As the sensor is fitted on the desk close to the person working there, it can transmit the prevalent climatic scenario to the control unit.

Practical conclusions

The investigations show that in winter at temperatures of about 0 °C or below, with a cyclically-controlled window ventilation system, a feeling of excessive cold in the foot area has to be reckoned with **(Figure 4)**. The opening times of the window ought, therefore, to be further reduced. For hygienic reasons this cannot however always be realized. Logically, but in contradiction of the idea of energy saving, the radiant ceiling panel should not be switched off. All in all, the investigation provides evidence that all components used are suitable for use in hybrid ventilation systems, but that there is still room for improving the adaptation of the components one to another when they are used with existing automatic control techniques.

Bibliography

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