Quality of Indoor Air and Functionality of Ventilation in Day-Care Centres

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ABSTRACT

The aim of the study was to develop solutions to the problems and deficiencies encountered in the ventilation systems of day-care centres, which are manifested as poor indoor air quality or excessive energy consumption in the building at the maintenance stage of ventilation. At the first stage of the project, mostly day-care centres (15) constructed in the 1990s with mechanical exchange of supply and exhaust air were chosen for study. Four day-care centres built in the 1960s – 1980s were also included. During the afternoon rest hour, carbon dioxide content, temperature and relative humidity were monitored and other measurements of ventilation capacity made in altogether 32 resting rooms. At the same time, the directors and maintenance personnel of the day-care centres were interviewed and a questionnaire was presented to the staff. The results obtained at the first stage and the observations made during the visits to the day-care centres are reported here.

The carbon dioxide content was too high if ventilation was inadequate relative to the number of people present. In six resting rooms, the carbon dioxide content exceeded the official recommendation of 1 500 ppm when monitored during a rest break. One of the resting rooms was in an old day-care centre facility with only mechanical exhaust. In altogether 12 resting rooms, the carbon dioxide content of indoor air remained under 1 000 during the two-hour measurements, indicating that the quality of indoor air in the resting rooms was good in terms of the carbon dioxide content. Two of the resting rooms were in an old day-care facility with mechanical exchange of both supply and exhaust air.

In 15 resting rooms, the quantity of supply air measured during the rest hour differed from the design value by more than 20 %. In seven of the 15 rooms, the supply air flow was notably larger than the design value, while in eight rooms it was smaller than the design value. In 12 resting rooms, the exhaust air flow measured during the rest hour differed from the design value by more than 20 %. In all cases, the measured exhaust air flow was smaller than the design value.

According to the questionnaire, the day-care staff mostly complained of stuffy air, temperature, draught and inadequate ventilation in the winter. In each facility studied, ventilation capacity was cut down by 50 % in very cold weather to save energy.

Based on the results, the quality of indoor air is poor if the supply and exhaust air flows are only half of the recommended minimum value (2 l/s, m^2). The ventilation system should hence be designed with more scope for variation, i.e. the supply and exhaust air flows per room should be higher than the minimum if ventilation capacity of cut down by 50 % in cold weather.

Based on the results, even new systems seem dysfunctional because of inadequate planning and implementation of ventilation or inadequate use or maintenance of the ventilation system. There must be clearly defined goals for the planning and implementation of ventilation before it is possible to attain good quality of indoor air at a feasible level of energy consumption. When a new building is adopted into use, it should be ensured that ventilation functions adequately in all situations that can be anticipated to occur. At the maintenance stage, the functionality of the ventilation system should be checked regularly by measuring the quality and temperature of indoor air and the air flows in each room. The ventilation system should also be cleaned regularly.