NATURAL VENTILATION ACTIVATED BY INDUCTION

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CONTEXT

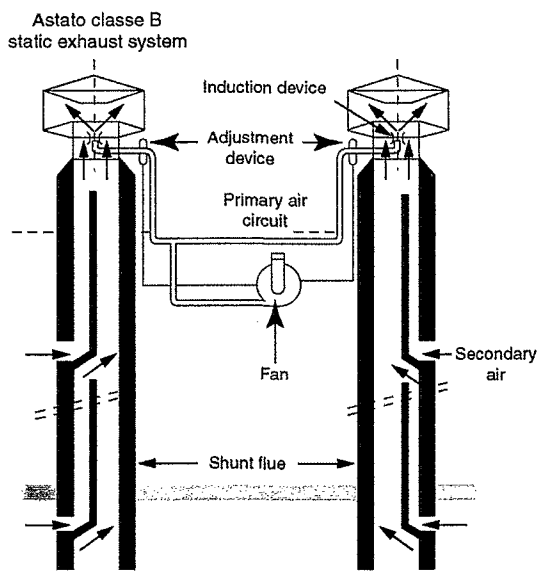
Energy-saving improvements in the thermal properties of buildings often have an adverse effect on indoor air quality, leading to risks of structural deterioration. In these cases, the air change rate inside dwellings must be increased while ensuring that flued gas appliances continue to function correctly.

The proposed ventilation system is a cross between natural draught and controlled mechanical ventilation. It activates natural ventilation of the dwelling by means of the induction principle. To develop this system a feasibility study was performed, financed in part by the JOULE III programme - CRAFT procedure (exploratory phase). This study enabled us to validate the technical principle applied, to identify the potential market and to set up a European partnership.

DESCRIPTION AND OPERATION OF THE SYSTEM

With this system, exhaust air and combustion products are discharged from the dwelling via a vertical flue. The natural draught is assisted by air induction at the chimney outlet. Figure 1, below, presents the operating principle on a shunt flue.

Figure 1 Natural ventilation activated by induction



The entraining medium is air, pressurized by a fan (primary air), which, after passing through a flue outlet and a venturi nozzle, entrains the ambient air (secondary air). The primary/secondary air ratio constitutes the induction ratio of the system. A preliminary experimental study by the Gaz de France R & D Division has shown that an induction ratio of more than 6 can be achieved, even with non-optimized equipment and ignoring the effects of up-draught.

ADVANTAGES OF THE SYSTEM

This system is able to operate with existing gas appliances connected to a natural draught flue, thus avoiding the need for expensive appliance replacement when installing a mechanical ventilation system. Moreover, the induction system runs at two different speeds, making it possible to adjust flow rates and to optimize the energy consumption of the ventilation system according to the needs of the occupant. T his results in lower installation, running and maintenance costs. In addition, if the induction system breaks down, natural draught maintains the minimum air flow required for health and safety.

POINTS TO BE IMPROVED: A EUROPEAN PROJECT

Whatever the type of induction system used (flue outlet or nozzle), efficiency is poor and needs to be optimized by means of a control system. To this end, five small and medium-sized European businesses have joined forces in a two-year project to develop three prototypes for use in houses, apartment buildings and schools. The technical studies for equipment sizing and adaptation to particular building characteristics will be performed in the laboratory (in a test house) and in the field.

RESEARCH AND DEVELOPMENT ASPECTS

The R & D component has consisted until now in different phases :

- Identification of ventilation and flue ducts most commonly used in European countries in which the NAVAIR system will be able to be installed.

- Comparison of regular air change rate in these countries.

A venturi nozzle system in which the air is injected with high speed has been tested to create the most efficient aspiration at the summit of the duct (that will be added to the upward driving force of the stack effect).

Tests have been carried out in laboratory. The parameters investigated were :

- In the main duct, the pressure and the induced air flow rate.

- At the induction system, the primary air flow rate, the speed of air exit at the venturi nozzle and the drop in pressure of the induction system.

The induction ratio evolves from 6 to 8 this depending on the section of the venturi nozzle (and, therefore, the air speed). Higher induction ratios can be reached (increasing the speed of the primary air by the reduction of the venturi nozzle section) but this is to the detriment

of the acoustic quality of the system. In addition the ventilation (primary air) necessitated by the increase of the drop in pressure will increase costs.

Figure 2 presents the variation of induction ratio and the primary air flow rate with different diameters of the venturi nozzle. The results show that the rate of induction depends on the size of the nozzle .

Figure 2 Variation of induction ratio and air flow rate with nozzle size