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NEW VENTILATION TECHNIQUES

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NEW VENTILATION TECHNIQUES

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The context

At present, in France three quarters of new housing is fitted with a mechanically controlled ventilation system (MCV). In the last twenty years this type of ventilation system has progressed considerably, notably because of the help given by energy management policies in the housing sector.

Indeed, the evolution of legislation on the thermic characteristics of this sector has highlighted, over the years, the importance of air renewal in the energy balance of the home. The main innovations which have appeared have essentially been linked to a quest for better performance with minimum air flow.

Today the health and safety aspirations of users concentrate more and more on air quality.

Moreover, 1991 was a turning point in domestic ventilation with regard to :

- the intensification of attempts to standardize procedures across Europe.
- ever present constraints on the use of energy. Ventilation represents more than a third of all thermic loss from the home, that is about 15M TOE (tons of oil equivalent).
- the clear advances in research and development work which have given laboratories reliable methods of calculating air movement, thermic transfer and pollutant transfer (summary of GEVRA seminar - March 1991).

Taking into account both this context and functional problems encountered in existing systems, it was opportune to embark upon a conceptual and technological study in order to discover, in the short term, domestic ventilation systems which give better performance from a thermic, health and olfactory point of view and which better meet the needs of the user.

THE CURRENT PROBLEMS OF VENTILATION IN FRANCE

The requirements of ventilation and the legislative context

Concern about efficient ventilation systems is in reply to 3 requisites :

- to satisfy the comfort and health needs of the inhabitants
- to ensure the preservation of the construction
- to allow the safe function of fuel burning appliances installed on the premises, whether they are connected to outlet pipes or not.

To meet these requisites, present legislation requires that ventilation systems are conceived according to the principle of permanent and general aeration of the home with air flow extracted into the kitchen or the bathroom.

Since this legislation does not provide an answer to the issues of odour, air quality and humidity extraction, it is necessary to experiment with new products in order to update current legislation and to improve the image of ventilation.

With regard to occupancy, for example, the legislation makes no distinction between the different situations which can be found in the same type of accommodation, that is :

- its function (primary or secondary residence)
- its location (rural or urban)
- number of inhabitants
- type of domestic appliances

The principal pollutants within the home

In France, in the housing sector, control of air quality is based essentially on hygrometric considerations, of which the best known example is hygro-adjustable ventilation.

Air quality within the home is not only characterized by air humidity but also dependent on the level different permanent pollutants.

Under the pretext of improving air quality, some people tend to increase, to differing degrees, the flow of ventilation. It has been the case in certain instances that the air inside the home was more polluted than the air outside. Nevertheless it seems more judicious, rather than increasing the standard flow, (which may accentuate the spread of pollutants) to attack the source of contamination directly or to renew the air selectively depending on the current circumstances.

The user's perception of ventilation

Generally, users see their mechanically controlled ventilation system in a positive light and recognise its usefulness.
However, installations are often considered too noisy and air inlets are viewed negatively (presence of cold air streams - infiltration of external noise - dirty marks).

Moreover, the occupant wishes to be able to control the ventilation system from the kitchen or bathroom but is not really sure whether s/he prefers manual or electric controls.

All the same, efficiency remains the first priority if it is not to the detriment of silence, comfort and running economy.

Maintenance

The smooth running of the system is dependent on maintenance. The occupants themselves tend to maintain the vents in the kitchen or bathroom and, more rarely, those in the other rooms The pipes and extractors are hardly ever cleaned, this being the job of an outside company.

The opinion of occupants is divided as to the ease of cleaning. The frequency of cleaning, 3 to 6 months, is seen by 50% of users as too exacting.

Information

Even if users have a good knowledge of the need for air renewal, they only have a vague knowledge of their own ventilation system (only 35% of users receive written or verbal information).

Factors obstructing the working of ventilation

Whatever the system, air renewal in the home is not entirely controllable. This is for several reasons, connected or not, amongst which can be cited :

- the air-permeability of the building
- the presence of equipment such as fireplaces, cooker hoods, tumble driers
- the occupants habits concerning opening windows

The air-permeability of the building

Depending on the speed and direction of the wind, unwanted airflow in the home is linked partly to the airtightness of the walls, but also to the specific air flow and how much the particular ventilation system promotes transversal aeration.

Excessive permeability of walls leads to an alteration in the quality and transfers of air (modification of air movement), encourages discomfort (a feeling that it is cold), provokes condensation and causes a deterioration in the acoustics of the dwelling.

Chimneys

When the chimney is working, part of the interior air is drawn towards the hearth. Whatever its construction, a chimney modifies air renewal, to a small degree when the hearth is fitted with a glazed door and to a greater degree when it is open.

Cooker hoods

When a MCV system is present, a cooker hood affects ventilation both when it is connected to the air extraction pipe of the MCV or when it functions by extracting air out of the dwelling according to the pressure generated by its fan.

The non-connected hood (recycling system), on the other hand, is compatible with the ventilation system. As most of these hoods are not correctly installed, there is here, at the very minimum, a need for greater information.

Tumble driers

The tumble drier is, at present, in a phase of intense development with 10% of French homes equipped.

However, current ventilation systems are not equipped to extract the amount of air necessary for the smooth running of a drier which works by extraction, the most popular model on the market because of its low price. This type of machine must be connected to a pipe with an exterior opening if heavy condensation and short-term abnormalities are to be avoided.

Even in the case of a condensation drier, the room must be ventilated slightly to prevent temperatures from rising and to expel the slight water vapour (evaporation of condensate) which is formed when the machine is used.

Window opening

Seen by the occupant as a necessity, the opening of windows varies greatly from one home to the next.

The average rate of air renewal linked to the opening of windows is around 0,3 volume/hour, which is close to the average rate of air renewal of the MCV. An effective ventilation system must take this element into account.

The working Schedule of Conditions for a ventilation system

The Schedule of Conditions, given for information only, has been established by a working party from the EDF-GDF, the CSTB, the Lyon CETE and the Air-Industry Federation, UNICLIMA.

This exhaustive document enumerates all the requisites and functions that a ventilation system should satisfy.

The Principal Functions correspond to what the user expects from the ventilation system; the Constraining Functions are a consequence of the requisites.

Principal Functions

PF1 : to protect the occupant from internal (including metabolic) and external sources of pollution of the interior air :
- concentration of pollutants
- maintenance of RH within a certain range (about 30% - 70%)
- protection from accidental exterior pollution
- protection against insects, birds and exterior dust
- radon, atmospheric depression

PF1 encompasses :
- *insensitivity to varying climatic conditions*
- *a minimum level of protection against mites*
- *recirculating of air and pressure scales*
- *adaptability to needs (number of inhabitants)*
- *ability to overcome problems of air permeability of the building as a whole*

Matters of purification (ionizers etc....) are not included here.

PF2 : to preserve the structure of the building from damage caused by the humidity of the interior air.

PF3 :
- to satisfy the needs of the occupant with regard to control of ventilation
- extraction of odours, olfactory insulation
- running quality (maintenance, usage) (adjustable air inlets and extraction vents)

"Flow adjustment may be a means of eliminating serious odour problems"

Constraining functions

CF1 : to respect the safety of the occupants
- domestic safety
- protection against fire
- ventilation in case of system failure

CF2 : to respect the structure of the building
- protection against bad weather
- condensation in the pipes and other components
- protection against fire (2)

CF3 : to ensure the continued smooth running of open fuel-burning appliances
- combustible air and products of combustion
- connected and non-connected appliances
- acceptable differences in pressure

CF4 : to respect the environment
- rejection of polluted air (local)

CF5 : to conserve the acoustic and visual comfort of the occupant
- equipment noise, interphones, exterior noise, noise between rooms; (statistical approach)
- transmission of light between rooms
- noise caused by the lowering of air pressure

CF6 : to preserve the thermic comfort of the occupant :
- temperature stratification, air speeds (comfort rating, ADPI)

CF7 : to adapt to the behaviour of the occupant :
- window opening
- untimely actions

CF8 : to adapt to the nature of the dwelling :
- flexibility, adaptability
- lack of space
- architectural freedom (organisation of the dwellings, outlet through the roof, ...) possibility of conversion and restructuring

CF9 : to allow the function of different appliances :
- compatibility with fittings (chimneys, ...)
- tumble-driers, ...

CF10 : to limit cost :
- installation, running costs, maintenance
- consumption costs to include air renewal and auxiliaries
- maintenance to include awareness of the speed of clogging up (effect upon the system, maintenance possibilities, ...)

CF11 : to be aesthetically pleasing :
- equipment and dirty marks (curtains, ...)

AN INVITATION TO TENDER FOR HIGH-PERFORMANCE COMPONENTS AND VENTILATION SYSTEMS FOR THE HOME

The Environment and Energy Management Agency (ADEME) and the Plan for Construction and Architecture therefore decided to launch, in June 1991, an invitation to tender aimed at industry. This would allow them to study the ventilation of tomorrow by preparing technical solutions which are better suited to the the preoccupations of the user than those which are currently available on the market, in order to ensure :

- better air quality
- energy saving
- user-awareness of the importance of ventilation
- easier maintenance and servicing of materials

It was understood that proposed schemes could be beyond the current regulation levels without having to foresee the requirements which may be set down in the future.

Considered as a necessity, ventilation of the home must meet the needs as well as the desires of the user in so far as these do not involve significant disruptions to the system.

Results and major trends

The number and variety of responses to this invitation show the interest Heating and Air-conditioning manufacturers have in the subject of ventilation and in particular its evolution.

17 responses were received, all coming from industrial bodies which are, for the most part, associated with technical centres or research laboratories. Of these, the jury selected 8 prize-winning teams presenting 12 products; 8 in the form of components and 4 in the form of systems.

Amongst these products, the following major trends could be identified :

1 **Air inlets** : the industrial world seems to very interested in this component for its ability to fulfil several functions : filtration, protection, acoustics, non-return valves, preheating of new air.

2. **Assisted natural ventilation** : a compromise between a MCV and natural ventilation, this concept seemed to interest several of the tenderers. Economic in its use of energy, this type of system should also be able to readjust in the case of low ventilation through absence of natural draught. It is, moreover, well suited to the restoration of old houses.

3. **Individualization of the MCV** : this will allow the air flow to be moderated according to the needs of the occupants, and the MCV to be transformed into a real appliance whose utility and efficiency the user can see. Beyond constantly renewing air at a minimum level, the ventilation system will have further functions in the fields of hygiene and comfort.

4. **The cost of multi-function ventilation systems** : whilst ensuring modular air renewal, filtration and pre-heating can also be envisaged as it is foreseeable that the price will be somewhere between the current cost of a traditional MCV and the cost of the most popular domestic electrical appliances. (3000-5000F).

5. **Energy consumption** should not suffer with this evolution because sporadic needs for pollution extraction will not be treated by a permanent increase in the rate of air renewal but by temporary over-ventilation localised in the momentarily polluted zones.

In conclusion, this tender has enabled new concepts and products to emerge which comply with occupants aspirations.

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New Ventilation Techniques

The context requires action to be taken in the field of ventilation .....

- Intensification of standardization
- Growing demands for better air quality
- Energy management
- Drying-up of innovation
- Transmission of technical knowledge

... with multiple objectives .....

- To develop ventilation systems and components with high performance on a thermic, health and olfactory level
- To spread awareness of the importance of ventilation
- To improve servicing and maintenance techniques

New Ventilation Techniques

....taking into account current problems ...

- the requirements of regulation
- the elimination of pollutants
- the user's perception
- the factors affecting smooth running
- the ideal Schedule of Conditions

New Ventilation Techniques

The results of the ADEME-PCA invitation to tender

- A high number of entries :
  - 17 dossiers
  - strong presence of teams from industry / technical or research centres
- A large variety of responses with 21 products :

  Component preoccupations :
  - air inlets
  - air inlets / structure components
  - sensors, filtration, purification
  - MCV extractors
  - ANV extractors (assisted natural ventilation)

  System preoccupations :
  - air insufflation
  - MCV

New Ventilation Techniques

The results of the ADEME-PCA invitation to tender :

- 8 prize-winning teams
- Major trends :
  - multi-functional air inlets
  - assisted natural ventilation
  - individualization of the MCV
  - ventilation at a reasonable cost
  - controlled energy consumption

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