CHECKING THE COMPLIANCE OF RESIDENTIAL VENTILATION SYSTEMS IN FRANCE

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ABSTRACT

This paper addresses the issue of the compliance of residential ventilation systems with building regulations. Because the French building code includes requirements on performance as well as on means, the approach adopted by the French government consists in checking both airflow rates and functional measures. This paper gives an overview of the methods used and analyses the results of tests performed on 260 building projects (multi-family buildings and grouped individual houses). Non-conformities are divided into major 8 categories, 4 regarding the type of equipment used, and 4 regarding the measured airflow rates. The non-compliance ranges between 4% and 39%. While the supply of industrial products is well adapted to the requirements, lack of care and coordination at the design, installation, and commissioning phases leads to poor results. Quality management could certainly help improve this situation.

KEYWORDS

Ventilation system, performance check, residential buildings

INTRODUCTION

Regulatory compliance checks on buildings have been initiated in France in the early 70s. These inspections are meant to urge contractors and project owners to build according to the rules set by the building code. They are also meant for the ministry for housing to monitor the application of the regulations.

Today, the compliance checks performed by the CETE network (Technical Studies Centres of the Ministry for Equipment) cover 8 fields : fire safety, balustrades, acoustics, automatic garage doors, stretcher transport, accessibility, energy performance, and ventilation. The controls are ordered by the state as a judiciary police mission on samples taken from the ORTEC (Observatoire de la Réglementation Technique) database managed by CSTB. The inspections are implemented by the CETE network; by law, they can be performed on site within 2 years after the building is declared finished by the owner.

This paper focuses on ventilation checks and the way they are performed in France. The results obtained on a sample of 260 multi-family buildings and grouped individual houses inspected in 2001 are analysed.

BACKGROUND

The French regulation on ventilation in new residential buildings is mostly based on the order dated 24/3/82. It is based on four major requirements:

1. The air renewal must be global and permanent throughout the dwelling.
2. The air circulates from main rooms where the air inlets are located, to service rooms, where outlets are located.
3. New dwellings must be equipped with a ventilation system (the ventilation cannot rely on window opening only). The ventilation system must be able to extract given airflow rates that depend on the dwelling type. Base and boost airflow rates are defined.
4. Airflow rates can be reduced if the indoor air quality is maintained and condensation risks are not increased. Therefore, humidity-controlled systems can be used.

In sum, there are both functional measures and given airflow rates that must be attained in order to comply with the regulation.

INSPECTION METHODS

The ventilation inspection form is divided into 6 chapters: technical characteristics; air renewal and ventilation equipment; extract airflow rates; presence of combustion appliances; general description; comments (open).

In chapter 1, the inspectors report the climatic zone (according to EP regulation), the type of ventilation system, and the presence of chimneys. In chapter 5, information regarding the availability of sizing documents, the contractor that has performed the installation, voluntary commissioning, etc. is included. Chapters 2 and 4 concern functional requirements whereas chapter 3 deals with performance requirements. These two aspects are further detailed below.

Functional measures

The functional measures are controlled through visual inspection—e.g., the location and characteristics of air inlets and outlets, faulty stop-alarm, exhaust air outlet, kitchen hood connected to the system.

Inspectors also report installation defects, including excessively long ducts, torn ducts, impossible maintenance of air terminal devices—e.g., due to the nearby presence of a water heater, etc.

Performance requirements

The performance checks are based on the evaluation of the extract airflow rates. Four requirements are checked:

1. base airflow rate in the dwelling;
2. base airflow rate in the kitchen;
3. boost airflow rate in the kitchen;
4. boost airflow rate in other rooms.

These verifications are performed either by direct airflow measurement or, if calibrated air terminal devices (ATD) are used, by measuring the pressure difference across the ATD. Note that in France, self-balancing outlets are almost systematically used in multi-family buildings.

The airflow rate is considered insufficient if smaller than the required airflow rate with an allowance of 3 m^3/h for a target airflow rate of 15 m^3/h and 5 m^3/h for greater airflows. In that case, the airflow is non-compliant with respect to the ventilation code. Excessive airflow rates are also reported. Although these cannot be considered non-compliant with respect to ventilation, they may affect the compliance of the building with respect to EP regulation. If the airflow rate exceeds the required airflow rates by more than 30%, it is considered excessive.

Reporting

Non-conformities are reported by the inspectors on standard forms for statistical processing. If one non-conformity is found on an item in a building project, all units are considered non-compliant. They are also recorded in minutes that include legal facts as well as observations. The minutes may be forwarded by state authorities to the attorney general. The inspectors also file a report that is sent to the owner. The report describes the non-conformities found; in addition, it includes comments and recommendations mostly on aspects that are known to affect the ventilation performance although not unambiguously covered by regulation (e.g., damaged ducts).

RESULTS AND DISCUSSION

The results of all inspections are compiled by CSTB. Figure 1 summarizes the results in terms of non-compliance rate for height major categories. The results show that 43% of the buildings inspected do not comply with the required functional measures, i.e, there exists at least one non-conformity to the building code. 49% of the buildings do not comply with the minimum requirements on base and boost extract airflow rates.

While the non-compliance rate is relatively uniform for extract airflow rates, there is some disparity regarding the functional measures. There are few non-conformities on the ventilation principle and exhaust air outlets. There is a significant percentage of non-compliance for extract ATDs and stop-alarms. The most frequent non-conformities are reported on air inlets. Common defaults concern the number, installation, and characteristics of the air inlets. In fact, overall for a building, the right types of ATDs are usually on the construction site; however, they are often misplaced. Regarding the extract airflow rates, common defaults that impact the performance are: inadequate ATDs, poor sizing, and poor installation resulting in excessive pressure drops. Based on CETE inspectors field experience, important and critical phases have been reported in Table 1. More detailed quality assurance tools (Garin, 2001) have appeared very promising when tested on pilot projects.

Regarding the type of ventilation system, there are great disparities in non-compliance rates on extract airflows (Figure 2). There are considerably less non-conformities on humidity-controlled extract-only systems (27%) than on standard extract-only systems (56%). Note however that, for humidity-controlled systems, only the pressure drop across the ATDs and compliance of the installation with the technical agreement is checked (no airflow rate

measurement). 78% of the buildings with gas appliances connected to the ventilation system do not comply with the regulation. Note however that the sample size is small (18 buildings).

As for the size of the building, the statistics are based on the number of units per building. Trends are difficult to establish although on the sample analysed here, the smaller buildings (less than 20 units) show greater non-compliance rates (Figure 3).

The presence of a technical inspector assigned by the owner to cover ventilation aspects is common. The assignment type may be more or less demanding on the inspection; however, this statistical data on the assignment type is not available yet. The results show that non-conformities remain very frequent when a technical inspector is assigned (40% on functional measures, 46% on airflow rates), although the non-compliance rate is much lower than without such inspectors (Figure 4). Further analyses on the assignment type appear necessary to better understand those results.

Table 1. Example of check list showing the critical steps to avoid non-compliance. Source. Garin and Janody. 2002. Qualité réglementaire des bâtiments d'habitation neufs. Fiche aér. n°1.

Code requirements	Building permit	Call for tender	Field	Commissioning
Global air renewal				
- Principle is met		⌖	✓	✓
Air inlets				
- All main rooms have air inlets		✓	⌖	✓
- Sizing is correct		✓	⌖	✓
Air outlets				
- Principle is met		⌖	✓	✓
Exhaust air				
- Exhaust air re-circulation into dwelling must be avoided		✓	⌖	✓

✓ : Important check point ⌖ : Critical step

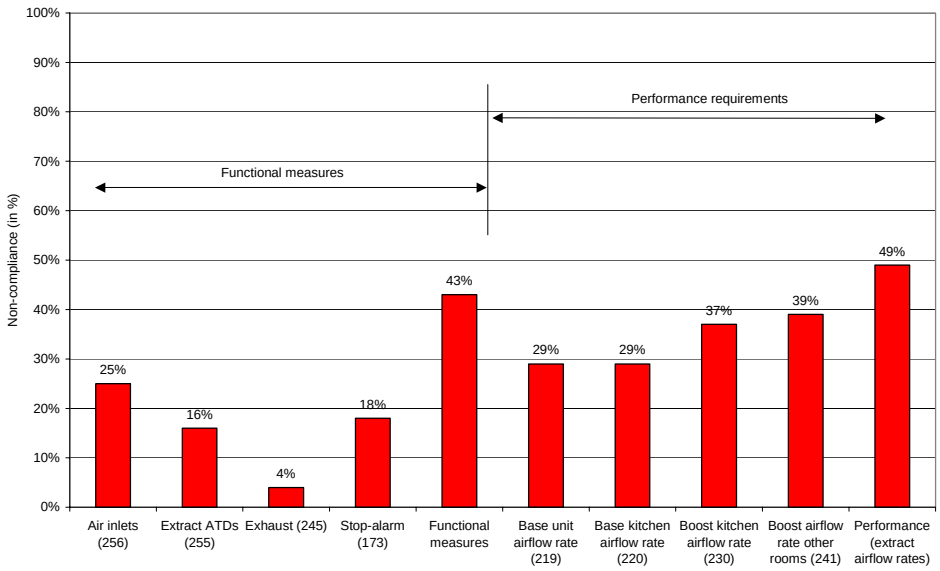

Figure 1. Percentage of non-compliant buildings (based on 260 inspections). By type of non-compliance. Sample size in parenthesis.

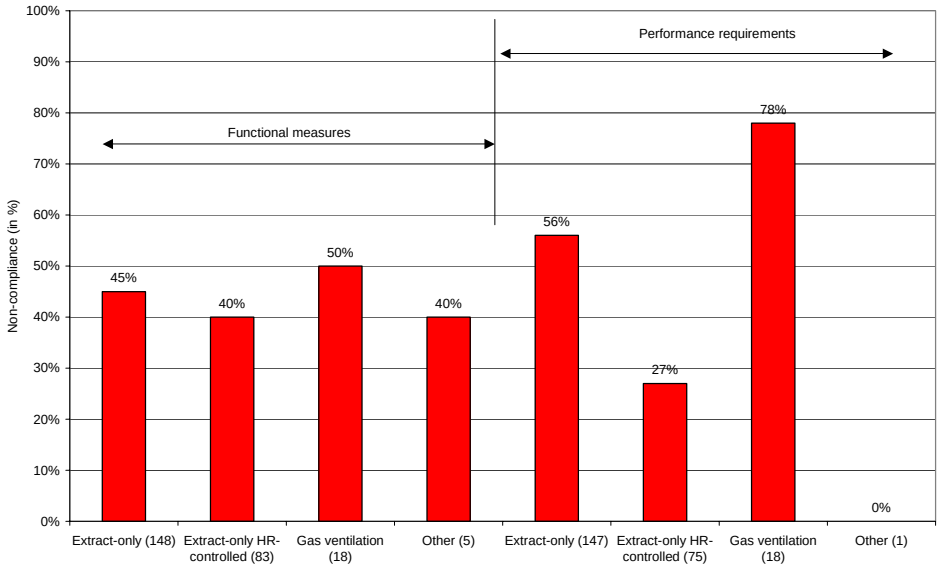

Figure 2. Percentage of non-compliant buildings (based on 260 inspections). By ventilation system type. Sample size in parenthesis.

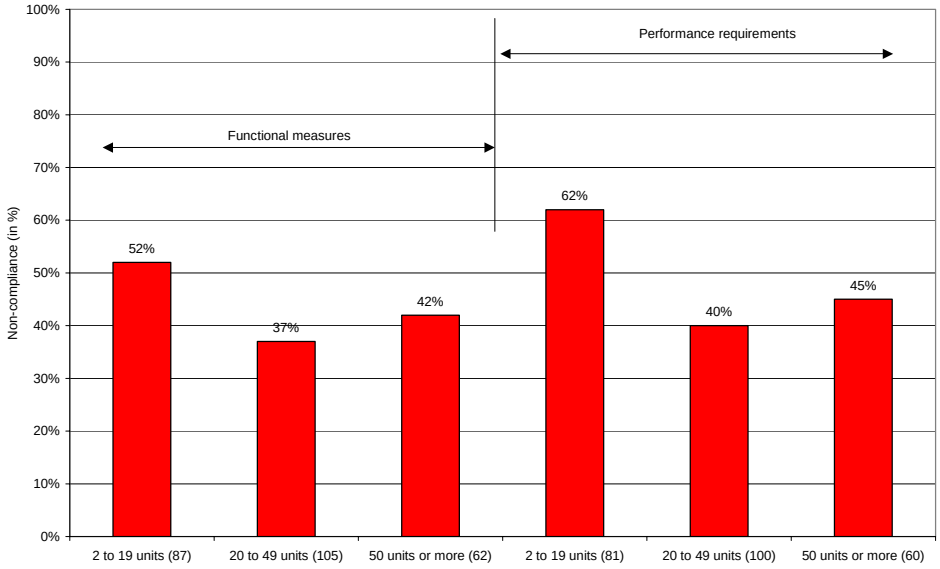

Figure 3. Percentage of non-compliant buildings (based on 260 inspections). By building size. Sample size in parenthesis.

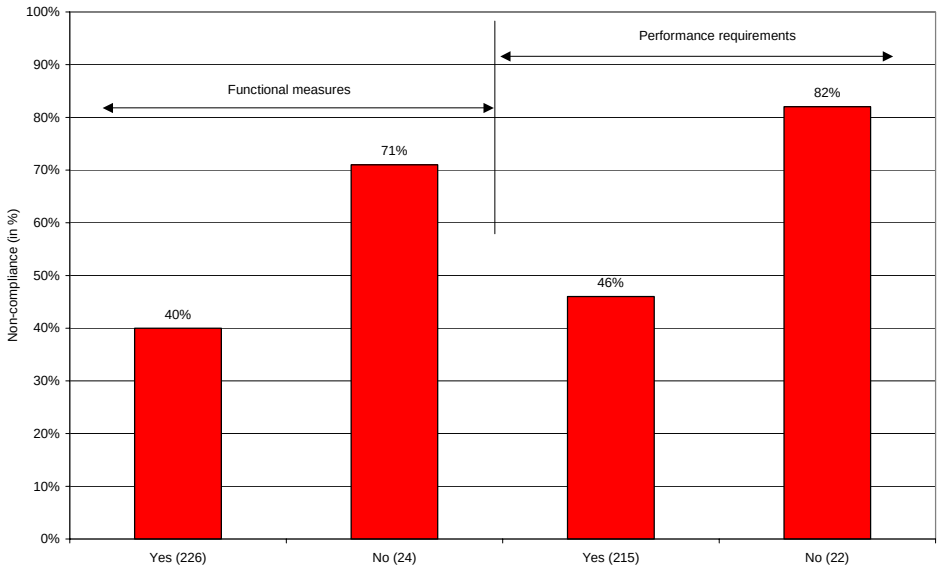

Figure 4. Percentage of non-compliant buildings (based on 260 inspections). By presence of technical inspector assigned by the owner. Sample size in parenthesis.

CONCLUSION

The results show that non-conformities on ventilation are quite common in multi-family buildings and grouped individual houses in France despite the availability of adequate industrial products. Often, the non-compliance results in a lack of care in the installation phase. Most defaults could be avoided should quality control be simply but efficiently implemented for all phases, including commissioning. In fact, voluntary commissioning is rarely done thoroughly with regard to ventilation in France. However, some industries have started stimulating practitioners with quality management, providing simple tools to implement control procedures, commissioning services, as well as guarantees in case of defaults found at commissioning. Also, CETE de Lyon has developed and experimented quality assurance tools to reduce the frequency of non-conformities, and has obtained very promising results (Garin, 2000). Such approaches appear very attractive to operate a market transformation.

ACKNOWLEDGEMENTS

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