

Performance-based assessment methods for ventilation systems: Overview of on-going work in France and in Europe

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1 KEYWORDS

Ventilation, normalization, regulation, performance, design, indoor air quality

2 SUMMARY

In the field of energy performance, successive regulations pushed a "performance-based" approach, based at least on an energy consumption requirement at the design stage for heating and/or cooling systems (Spekkink 2005). Nevertheless, in the field of building ventilation, regulations throughout the world are mainly still based on "prescriptive" approaches, using airflows or air change rates requirements (Dimitroulopoulou 2012).

This paper introduces the evolution of the French context towards performance-based approaches in the frame of the national building code revision, and on-going work at the European level with the revision of EN 15665 and TR 14788.

2.1 The context in France towards performance-based approaches

Over the past few years, the French context of building performance codes – and especially ventilation – has been changing at an unprecedented pace.

The French dwellings airing regulation (J.O. 1982) consists in a prescriptive approach requiring a general and continuous airing system, a compulsory general layout of ventilation installations, and minimal exhaust airflows in each humid room depending on the total number of rooms in the dwelling.

This regulation has been modified in 1983 to allow a reduction of these minimal airflows for demand-controlled ventilation (DCV) systems. In this case, the manufacturer must follow a performance-based compliance procedure to ensure adequate ventilation. The procedure (CCFAT 2015) describes the common hypotheses (dwellings, occupancy scenarios, weather files, ...) used to evaluate the DCV systems using the multizone software MATHIS (Demouge, Le Roux, and Faure 2011). Two IAQ performance indicators are calculated: a condensation risk (number of hours with relative humidity higher than 75%) and a cumulative CO₂ exposure exceeding 2000 ppm, further described in (Guyot, Walker, and Sherman 2018). Each room of the dwelling is modelled as single zone, with a time-step of 15 minutes. Once a system receives certification of compliance via this procedure called "Technical Agreement", it can be installed in new dwellings according to its specifications. For each type and size of dwelling, the agreement gives the references of inlets and outlets to be installed, as well as the input data for energy calculations.

This procedure is based on the evaluation of widely used humidity-based DCV systems and thus must be adapted for other types of DCV systems.

In 2018, a working group of the national consultative body described in (Jobert et al. 2018) has been put in charge of developing a methodology to extend this performance-based approach to any new DCV system. This method is based on the procedure used in the Technical Agreements and proposes more relevant performance indicators:

- The cumulative CO₂ exposure as a function of CO₂ threshold (ppm.h): for concentrations higher than 400 ppm above the outdoor concentration, in every living room and bedroom, the calculated value for a new ventilation system must be lower than the one obtained with a reference system.
- Percentage of cumulative hours with relative humidity higher than the threshold (%): for every threshold higher than 60%, in every room of the dwelling, the calculated value for a new ventilation system must be lower than the one obtained with a reference system.

In addition, the building code is currently being revisited with the aim to allow innovative systems (J.O. 2018). Several working groups (called GT ESSOC) are translating all the prescriptive approaches in the building regulation into performance-based approaches. For ventilation, the on-going work finds its roots in the approaches described above and aims to generalize them at the building stage of every new building.

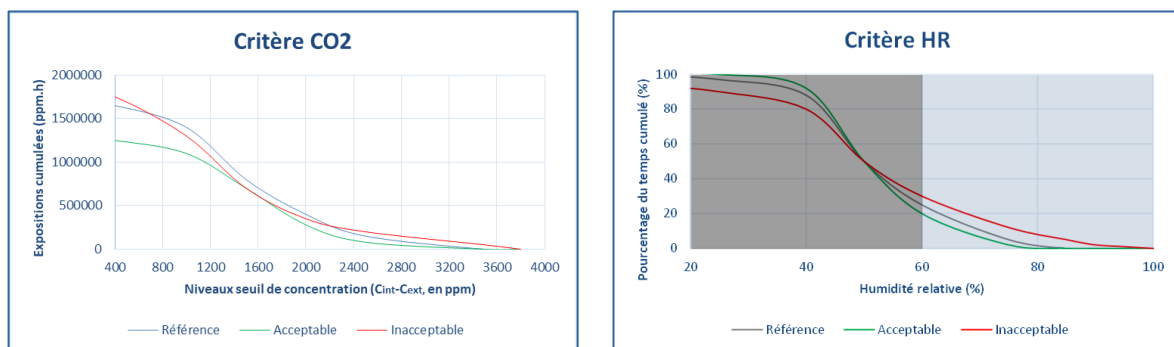


Figure 1: New performance indicators.

2.2 On-going work for the revision of EN 15665 and TR 14788

The performance-based approach has been formally introduced in European standards in 2009 via EN 15665. It was a methodology for regulators to determine minimal airflows to impose in local standards. Today, the revision of this standard, along with the revision of TR 14788, a technical report on design of ventilation systems, is an opportunity to introduce performance-based approaches at a design stage.

EN 15665 is a normative document which purpose is to give a method and to define criteria for evaluating the performance of residential ventilation systems. The target group of this document is the people involved in the redaction of standards and regulations.

A comprehensive method for determining the airflows to require in regulations is described. The procedure includes the selection of key pollutants in each room, of emission scenarios, of criteria to calculate for each pollutant and of requirements to apply to the selected criteria. Three levels of calculation details are proposed to evaluate the performances, ranging from simply specifying a flowrate (prescriptive approach, only evaluated performance is energy, no IAQ) to a full year-long multizone calculation (performance-based approach).

The criteria are a central element in performance-based approach. The standard includes a list of possible criteria to quantify IAQ, as well as recommendations on their use sorted by type of pollutants (humidity, specific pollutants or background pollutants).

TR 14788 is an informative document issued by CEN complementing EN 15665. It gives guidelines for designing and dimensioning residential ventilation systems. The target group for this document is architects, designers, builders and regulators.

First, the document lists parameters to consider when designing and dimensioning a ventilation system: mainly weather, building geometry and airtightness, occupancy and external noise and pollution levels. Second, it describes the end goals of the design: good IAQ, but also thermal comfort, acoustics, and ease of use and maintenance. Third, it gives an overview of common residential ventilation systems. Finally, it sets general and specific design rules concerning

noise, energy and modulation. Information about emission rates of pollutants and calculation methods are given in annexes.

Revision of these documents has begun in 2018. An objective has been set by the working group to merge the two documents in order to create a clear link between the design and the performance of the system.

The two main objectives of this on-going work are: 1) Better describing the performance-based approach in EN 15665 to promote a broader use and extend its normative existence to the design stage, thus backing the existing national regulations of several countries in Europe and opening the way to innovative systems, and 2) Further including hybrid and natural ventilation systems in the text.

The work done so far in this working group tackled the scope and writing rules, system definitions and the structure of the document. The main redactional difficulty ahead will be the articulation of prescriptive and performance-based approaches in the future text.

Registration as a CEN Work Item will be done before the end of 2019, publication can be expected in year 2023.

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