European developments and perspectives in building and ductwork airtightness

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ABSTRACT

Legislative drivers and new research with demonstrated energy impact on the importance of building and ductwork airtightness are leading to increased activity in this aspect of building energy performance. The paper reviews examples of European countries that account for both building and ductwork airtightness and thus include in their energy performance regulations required or recommended minimum airtightness levels with or without mandatory testing. It addresses incentives through calculation procedures and subsidies that reward a good level of building airtightness. A summary of qualification schemes for competent testers, development of airtightness networks, specific trainings and awareness raising is provided together with information on existing envelope air leakage databases and monitoring of the building stock. This paper is based on the BUILD UP overview article entitled as: *'Right and Tight: What's new in ductwork and building airtightness'* published on the 19th of March 2013 available at: http://www.buildup.eu/news/34788

KEYWORDS

Building and ductwork airtightness, building thermal regulations, airtightness requirements, qualification schemes, airtightness networks

INCREASING PRESSURE ON BUILDING AND DUCTWORK AIRTIGHTNESS WITH THE EPBD RECAST

The implementation of the EPBD recast (European Union, 2010) puts increasing pressure to achieve better building and ductwork airtightness since for most European climates and countries, good airtightness levels are necessary to achieve nearly zero-energy buildings. This has been shown in a number of studies with energy impacts of the order of 10 kWh per m^2 of floor area per year for the heating needs in a moderately cold region (2500 degree-days) and 0 to 5 kWh/m^2/year for the ducts plus the additional fan energy use (Guyot et al, 2010). Several studies have also shown that better building and ductwork airtightness converge with better indoor air quality - provided that the building is equipped with an appropriate ventilation system whether natural, mechanical or hybrid (AIVC, 2012; TightVent, 2011).

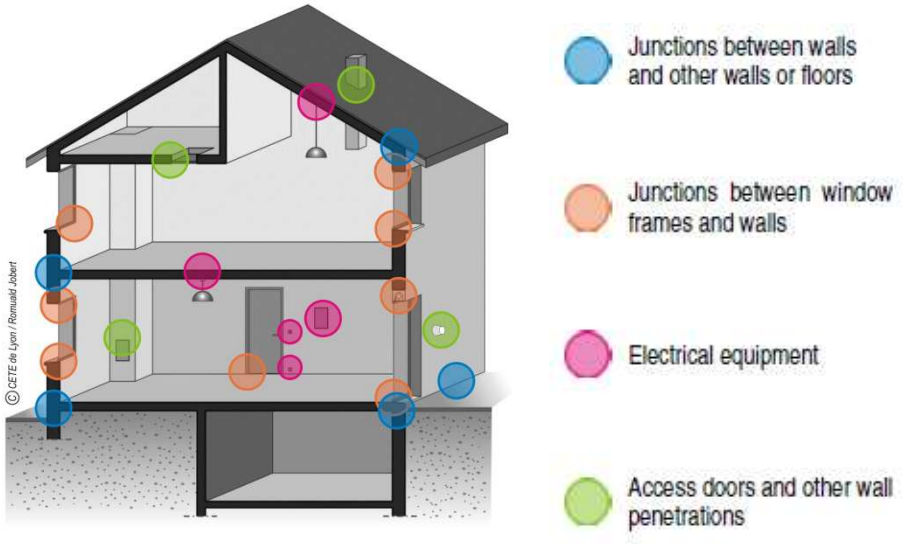

Figure 1: Common leakage sites (Cete de Lyon / Romuald Jobert)

EXAMPLES OF MEASURES TAKEN

The impact of envelope and, to a lesser extent, ductwork airtightness is accounted for in the energy performance regulations in many European countries (Guyot et al, 2010). The examples that follow include measures taken both for building and ductwork airtightness with respect to requirements and EP-calculation methods, as well as steps to encourage market transformation.

Airtightness requirements in European countries

An increasing number of countries (e.g. Czech Republic, Denmark, France, Germany, Ireland, Netherlands, Norway, Portugal, UK) include in their regulations either required or recommended minimum airtightness levels with or without mandatory testing (Kluttig et al, 2009). The number of tests performed on a voluntary basis is rapidly increasing either because of the energy penalty for untested buildings in the calculation method or due to the specific requirements of a given program. Furthermore, mandatory testing came gradually into force in the United Kingdom, Portugal, Denmark and France.

In the United Kingdom, the Building Regulations (HM Government, 2010) have gradually enforced building airtightness requirements over the last 10 years. Subjecting samples of newly built dwellings to a pressure test in order to measure and confirm their airtightness on completion is compulsory. Airtightness performance is specified in terms of air permeability, and should not be worse than10 $m^3/h.m^2$ at a reference pressure of 50 Pa. The same requirement applies to non-residential buildings above 500 m^2. Pressure testing of ductwork is also required and should be conducted for design flow rates greater than 1 m^3/s.

In Portugal, mandatory requirements for ductwork airtightness have been included in the regulation since 2006, as part of the implementation of the EPBD (Santos et al 2011). Requirements for new HVAC systems include a set of mandatory tests that

must be carried out during commissioning, before the building receives its use permit; these requirements apply to buildings larger than 1,000 m^2. To pass the test on airtightness, ductwork leakage may not exceed 1.5 L/s.m^2 under a static pressure of 400 Pa (TightVent, 2012).

In Denmark, with the BR 2010 regulation (Danish Ministry of Economic and Business Affairs, 2010), the municipal council is required to demand airtightness measurement in no less than 5 % of construction projects. Airtightness testing is required for the low-energy standard 'Building class 2020' which anticipates 2020 regulatory requirements.

In France, the building thermal regulation requires explicitly justified building airtightness levels for residential buildings. The latest update of the French energy performance regulation (RT 2012) (Ministère de l'Egalité des territoires et du Logement, 2013), limits the airtightness value of a single family house below 0.6 $m^3/h.m^2$ at 4 Pa (i.e. 3.2 $m^3/h.m^2$ at 50 Pa) and of other residences below 1 $m^3/h.m^2$ at 4 Pa (i.e. 5.4 $m^3/h.m^2$ at 50 Pa).

Incentives through calculation procedures and/or subsidies

Most energy regulations in Europe include the impact of the building airtightness on the overall energy performance calculation (Guyot et al, 2010). Some countries (e.g. Belgium and France) include also ductwork airtightness in the calculation. Since 2006, the French regulations reward quality management approaches implemented to improve building airtightness. In practice, this option is used mostly by builders who must fill an application to have their approach approved by the state. Successful applicants can use a better value than the default value in the energy performance calculation without systematic testing. With the RT 2012 energy performance regulation (Ministère de l'Egalité des territoires et du Logement, 2013), this will also be one path to prove compliance with the minimum airtightness requirements without systematic testing. A similar concept is also operational in Japan (Carrié et al, 2012).

There are also a number of low-energy programs whereby a good building airtightness is a precondition for claiming subsidies. The example of Norway (where the governmental House Bank gives economic incentives to low energy buildings, with a condition for payments according to documented energy relevant characteristics –one of which is airtightness) has been reported in the ASIEPI project (Guyot et al, 2010).

Development of competent tester schemes

The development of competent tester schemes represents an opportunity for improving the reliability of the building airtightness tests including monitoring the application of policies in practice. Schemes are based on EN 13829 (EN 13829, 2000) which provides guidance for testing with good repeatability and reproducibility, and includes additional specifications - e.g. for testing large or multi-family buildings or for reporting in a database. Such schemes are operational in Germany (FLiB) (FLIB, 2000), in Denmark (Foreningen Klimaskærm) (Foreningen Klimaskærm,

2006), in Finland (Rateko) (RATEKO, 1996), in France (QUALIBAT) (Qualibat, 2007), in Japan, in the UK (BINDT) (BINDT, 2007) and in the USA (RESNET) (RESNET, 1995). Note that Japan has developed a successful certification framework since the early 1990s: in 2011, about 3 800 testers were registered.

Development of airtightness networks

Many European countries are developing or considering the development of frameworks to increase the reliability of building airtightness testing and reporting for regulatory or voluntary compliance check purposes. Airtightness networks are often a central place to discuss these issues. The best known probably are the German FLiB (FLIB, 2000) and British ATTMA. (ATTMA, 2002) Since September 2012, TightVent (TightVent Europe, 2011) hosts an airtightness committee with representatives of national associations covering 8 countries.

Development of specific trainings and awareness raising

The development of specific trainings and awareness raising is one of the major steps towards a successful wide scale implementation of envelope and ductwork airtightness. BUILD UP events and publication listings include the latest updates on building and ductwork airtightness.

The European Building and Ductwork Airtightness platform, TightVent (TightVent Europe, 2011), has already organised 2 webinars, one targeted at a specific region: '*Airtightness and ventilation perspectives in Romania*' (TightVent Europe, 2011) and another one targeted on training, namely as: *'Achieving better envelope in practice – Norway*' (TightVent Europe, 2011). Meanwhile, relevant publications of reports have been prepared by the Air Infiltration and Ventilation Centre-AIVC (AIVC, 1979) (e.g. *'Methods and techniques for airtight buildings'* (Carrié et al, 2012)*, 'An overview of national trends in envelope and ductwork airtightness'* (Carrié et al, 2008)), or the NHBC Foundation (NHBC Foundation, 1936) (*'A practical guide to building airtight dwellings'* (Jaggs et al, 2009)).

Monitoring of the building stock

In France, the Observatoire BBC (Observatoire BBC, 2008), a database created by ADEME (ADEME, 1990), the Ministry of Ecology, Sustainable Development and Energy (MEDDTL) and effinergie® (effinergie, 2006), records examples of energy efficient buildings (BBC-Buildings) compliant with the BBC-effinergie® label (Collectif Effinergie, 2012) (that includes a minimum requirement on the airtightness value at commissioning) as well as award winners of regional calls for projects. Currently, the Observatoire BBC references over 900 projects while 450 buildings have been analysed (TightVent Europe, 2012).

A recent AIVC-TightVent publication (Chan, et al., 2012).includes information on existing envelope air leakage databases from countries involved in the AIVC - TightVent project: *'Development and applications of building air leakage databases'*

Exploratory field campaigns on airtightness measurements have been conducted in Denmark, Poland and Estonia. More information can be found in the 33rd AIVC - 2nd TightVent Conference summary (Heiselberg et al, 2013) as well as the summary of the AIVC - TightVent international workshop held in Brussels on 28-29 March 2012 '*Achieving relevant and durable airtightness levels: status, options and progress needed*' (Carrié et al, 2012).

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