Ventilation for buildings - Calculation methods for the determination of air flow rates in buildings including infiltration EN 15242

Hicham LAHMIDI
CSTB / France
hicham.lahmidi@cstb.fr

Contract: EIE/07/069/SI2.466698 Duration: October 2007 – March 2010 Version: July 7, 2009

Outline

- The EU CENSE project
- Scope of the Standard
- Principle of the method
- Mechanical air flow calculation
- Passive and hybrid duct ventilation
- Combustion air flow
- Air flow due to windows opening
- Exfiltration and infiltration

Energy Performance of Buildings
cense
www.iee-cense.eu

The EU CENSE project
(Oct. 2007 - March 2010)

Aim of the project:

To accelerate adoption and improved effectiveness of the EPBD related CEN- standards in the EU Member States

These standards were successively published in the years 2007-2008 and are being implemented or planned to be implemented in many EU Member States. However, the full implementation is not a trivial task

Main project activities:

A. To widely communicate role, status and content of these standards; to provide guidance on the implementation

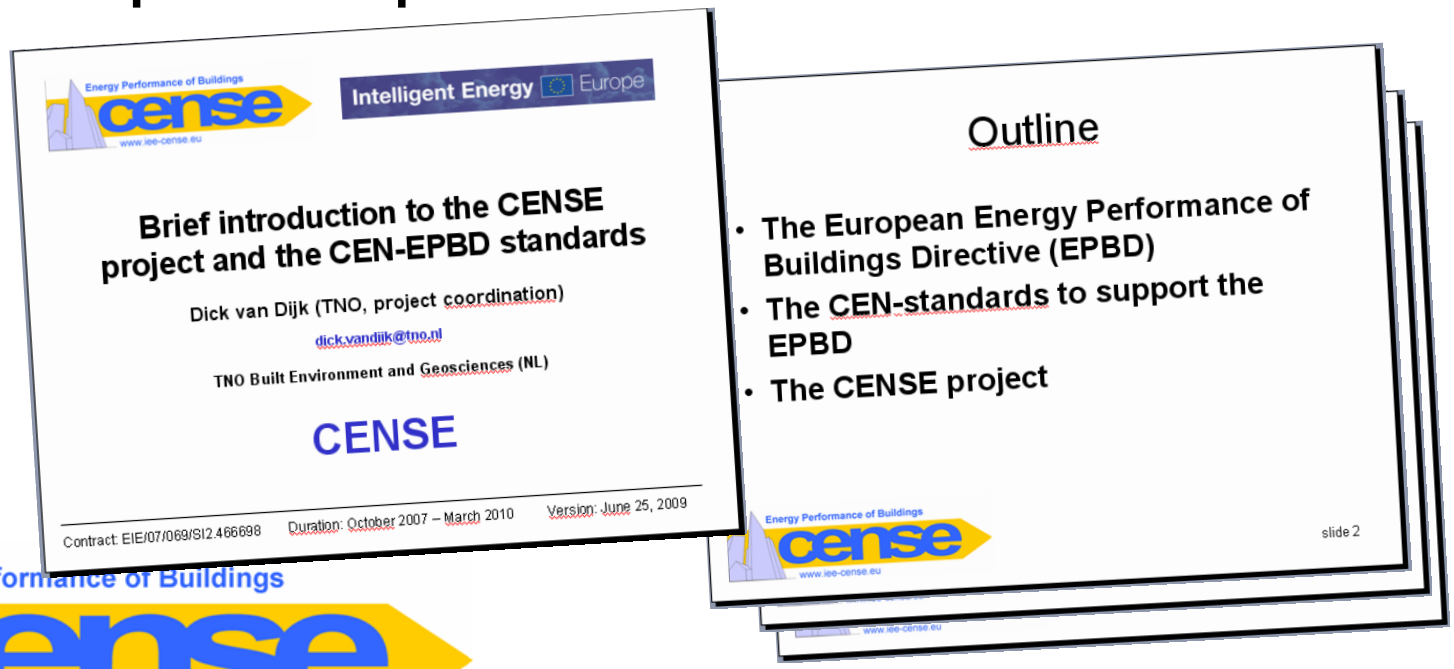
B. To collect comments and good practice examples from Member States aiming to remove obstacles

C. To prepare recommendations to CEN for a “second generation” of standards on the integrated energy performance of buildings

Energy Performance of Buildings
cense
www.iee-cense.eu

Brief introduction

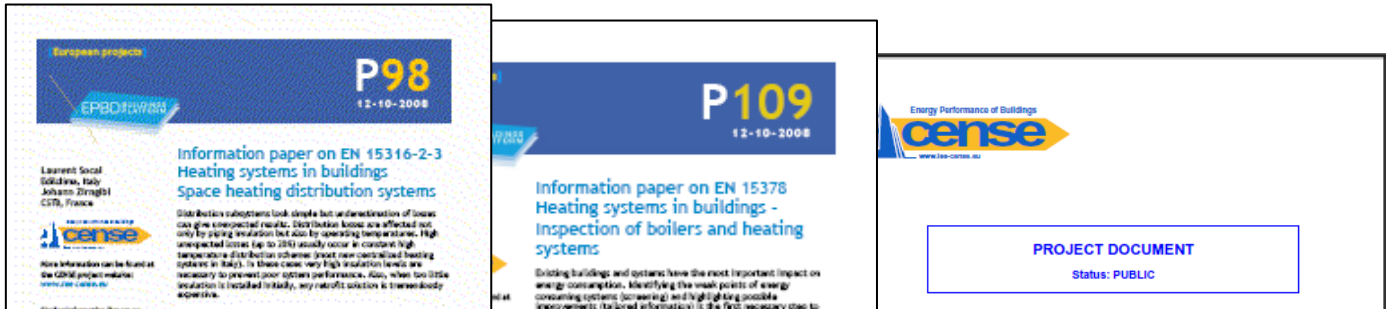
A brief introduction to the CENSE project and the CEN-EPBD standards is provided in a separate presentation:



Energy Performance of Buildings
cense
www.iee-cense.eu

More information

More information and downloads: www.iee-cense.eu



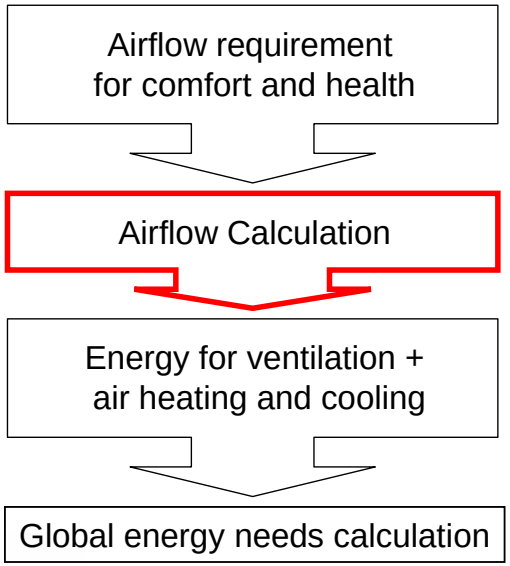
Disclaimer:
CENSE has received funding from the Community's Intelligent Energy Europe programme under the contract EIE/07/069/SI2.466698.
The content of this presentation reflects the authors view. The author(s) and the European Commission are not liable for any use that may be made of the information contained therein. Moreover, because this is an interim result of the project: any conclusions are only preliminary and may change in the course of the project based on further feedback from the contributors, additional collected information and/or increased insight.

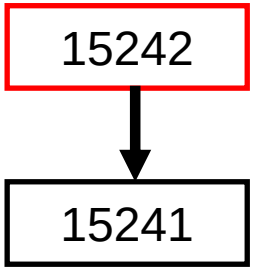
Energy Performance of Buildings
cense
www.iee-cense.eu

Scope of the Standard EN 15242

- EN 15242 applies to all types of buildings.
- This standard is not directly applicable for buildings higher than 100m and rooms where vertical air temperature difference is higher than15K.
- This standard is not applicable to kitchens where cooking is not for immediate use.
- This standard is not applicable to industry process ventilation

It describes the method to calculate ventilation air flow rates and infiltration to be used in energy calculations.





Energy Performance of Buildings
cense
www.iee-cense.eu

Methods

Three methods are proposed in the standard :

Iterative method

It is required when the interaction between the ventilation systems and the leakages can not be neglected.

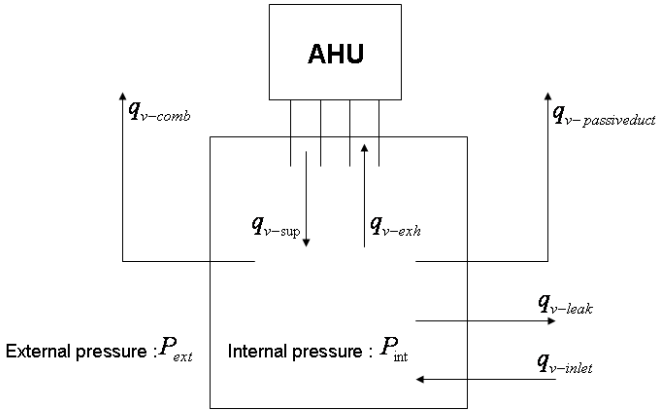
Direct method

It depends on the systems characteristics (external conditions and design air flows) and not on the internal pressure conditions.

Statistical analysis

This method can be defined at national level for energy calculations.

The methods cover :
Mechanically ventilation systems, Passive and hybrid duct ventilation, Combustion air flows, Windows opening by manual operating for airing or summer comfort issues, Leakage through external envelope components

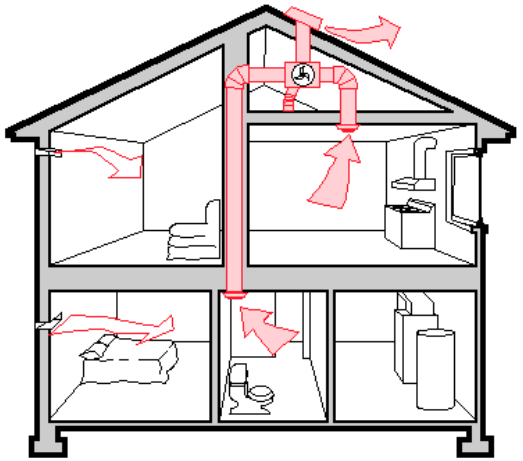


Energy Performance of Buildings
cense
www.iee-cense.eu

Mechanical air flow calculation

The calculation is based on the required air flows: which are part of the EN 13779. The values are corrected to take into account :

- The position of the air handling unit (indoor or outdoor)
- The fact of the switching on-off
- The ventilation effectiveness
- The accuracy of the system design
- The air flow through duct leakages
- The air leakages of the air handling unit
- The air recirculation, if any



Iterative, direct or statistical calculation

Energy Performance of Buildings
cense
www.iee-cense.eu

Passive and hybrid duct ventilation

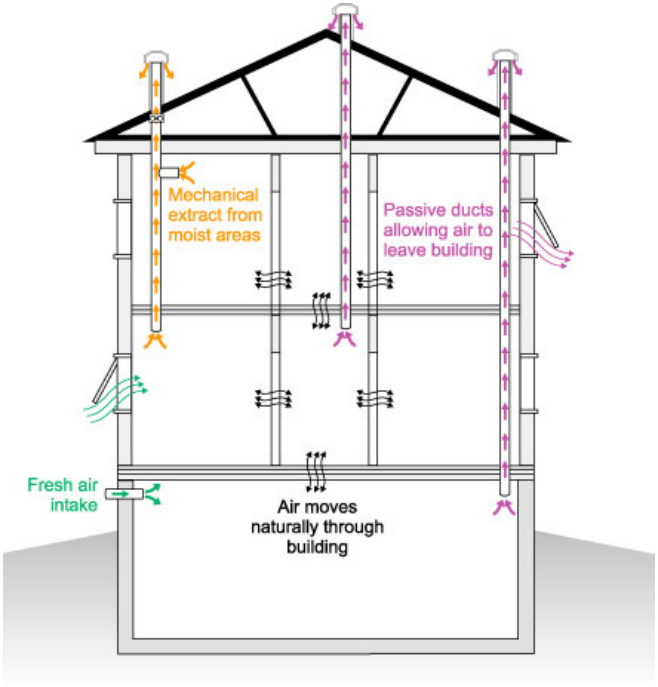
•The aim of the calculation is to calculate the air flow in the system taking into account the outdoor and the indoor conditions.

•The method provides the relationship between the air velocity in the duct and the pressure loss through the cowl which depend on the outside weather conditions

•The method takes into account :

1. The wind air velocity outside the building
2. The pressure loss coefficient of the cowl
3. The roof angle and the position of the cowl.

Iterative calculation



Energy Performance of Buildings
cense
www.iee-cense.eu

Air flow due to opening windows

The method takes into account :

- The surface of windows
- The wind turbulence
- The wind speed
- Stack effect
- The inside and outside temperature
- User behaviour

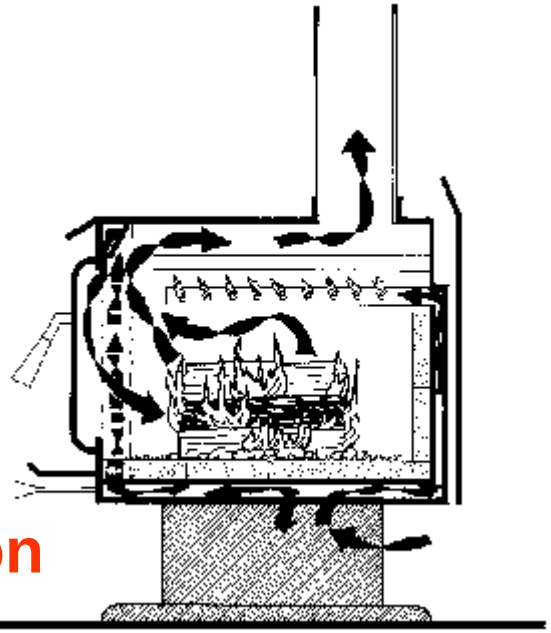
Iterative, direct or statistical calculation

Energy Performance of Buildings
cense
www.iee-cense.eu

Combustion air flow

The standard provides a method to calculate the additional air flow for combustion account :

- The device factor
- The power heat
- The fuel flow factor



Iterative, direct or statistical calculation

Energy Performance of Buildings
cense
www.iee-cense.eu

Exfiltration and infiltration

Two methods are available to calculate the air leakages through external envelope components :

- An iterative method
- A direct method if there is no passive duct system

Iterative method

This method is based on the calculation of the indoor reference pressure. The calculation requires the values of all the air flows which depends on the reference pressure. Hence an iterative method is needed to solve the implicit problem.

Direct method

In this simplified approach, does not take into account directly (an estimation is given by the standard) the positive or negative pressure in the building due to the differences between supply and exhaust.

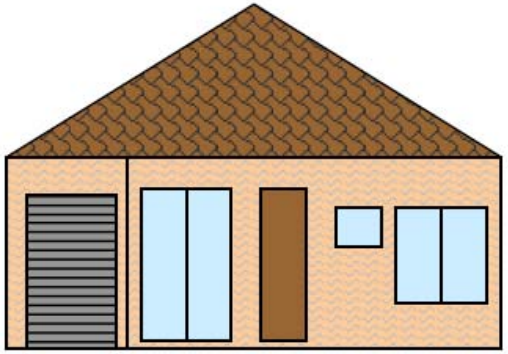
Energy Performance of Buildings
cense
www.iee-cense.eu

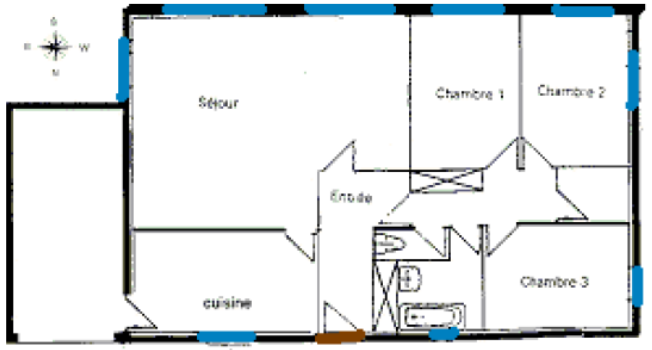
Application

- The standard provides some examples to calculate :
- Energy calculations
- Heating and cooling load
- Summer comfort
- Indoor air quality

French case : illustration of implementation

- In the French regulation, the iterative method is applied.





Surface (m²)	100 m²
Heating system	Natural gas boiler
Height	2.5 m
Hygienic ventilation flow m^3/h	57.3
House air tightness (4Pa)	0.6 $m^3/h.m^2$

Energy Performance of Buildings
cense
www.iee-cense.eu

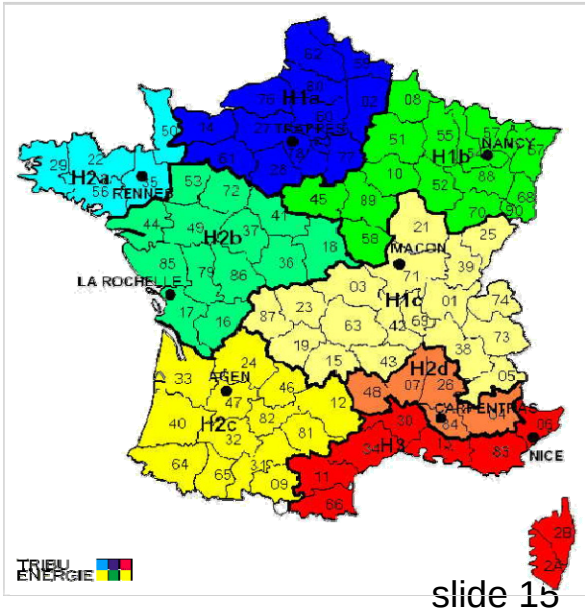
French Illustration on EN 15242

		Consumption (kWh/m²/an)	Exfiltration m³/h
Paris Climate	SF	53	-10.65
	DF	66.6	-35.67
Nice Climate	SF	23,6	-12.25
	DF	34.94	-40.19

SF : Natural supply with mechanical extraction

DF : Balanced ventilation system

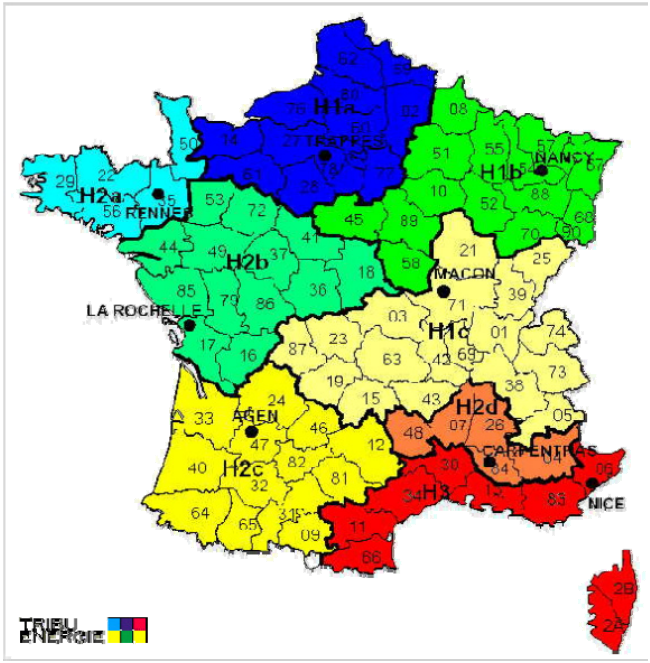
Hygienic Air flow = 57.3 m³/h



Energy Performance of Buildings

cense

www.iee-cense.eu



French Illustration on EN 15241

		Cep (kWh/m²/an)	Fan consumption (kWh/m²/an)
Paris climate	SF	53	2.16
	DF	66.6	11.8
	DF+ Hex	58.8	11.8
Nice Climate	SF	23,6	2.16
	DF	34.94	11.8
	DF+ Hex	32.77	11.8

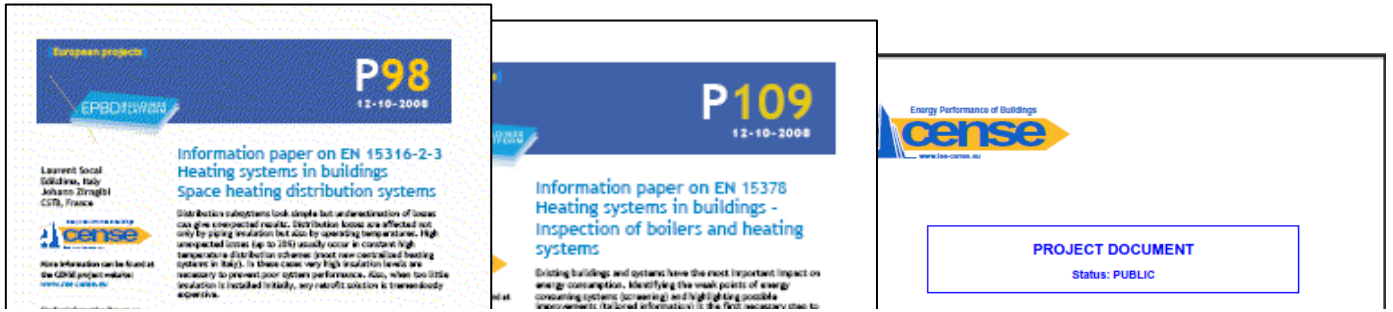
Energy Performance of Buildings
cense
www.iee-cense.eu

Hex : Heat Exchanger

Efficiency =80 %

More information

More information and downloads: www.iee-cense.eu



Disclaimer:
CENSE has received funding from the Community's Intelligent Energy Europe programme under the contract EIE/07/069/SI2.466698.
The content of this presentation reflects the authors view. The author(s) and the European Commission are not liable for any use that may be made of the information contained therein. Moreover, because this is an interim result of the project: any conclusions are only preliminary and may change in the course of the project based on further feedback from the contributors, additional collected information and/or increased insight.

Energy Performance of Buildings
cense
www.iee-cense.eu