Some key aspects to consider ventilative cooling in energy performance regulations

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International Workshop on summer comfort technologies in buildings
9-10 March 2016, Athens, Greece
Outline

• Key outcomes of a survey amongst 9 countries
• Approach to ventilative cooling with the new set of EPBD standards
• What’s new in the EPBD standard FprEN 16798-7 to calculate airflow rates?
• What is critical for compliance checks?
KEY OUTCOMES OF A SURVEY AMONGST 9 COUNTRIES
ARE EP-REGULATION IN EUROPE ABLE TO IMPLEMENT VENTILATIVE COOLING?

4 key questions:

- Is there a thermal comfort criteria?
- Is at least one ventilative cooling technique taken into account?
- What is the calculation time step?
- How are natural ventilation air flow rates assessed?
Thermal comfort criteria?

Source: Venticool report 2015, Provisions for ventilative cooling, Kapsalaki M. and venticool webinars
At least one ventilative cooling technique taken into account?

Residential

Non-residential

Yes

No

Source: Venticool report 2015, Provisions for ventilative cooling, Kapsalaki M. and venticool webinars
Monthly vs hourly calculation

• Why monthly calculation fails to model ventilative cooling?
  – Averaging the need for cooling in both time and space underestimates the need for cooling
  – No correlation between cooling need with simplified method and number of hours with elevated temperature

Source: Venticool report 2015, Provisions for ventilative cooling, Kapsalaki M. and venticool webinars
Natural ventilation air flow rates

- Most countries do not have airflow model based on building parameters such as windows size, vents characteristics, etc.

Source: Venticool report 2015, Provisions for ventilative cooling, Kapsalaki M. and venticool webinars
APPROACH TO VENTILATIVE COOLING
WITH THE NEW SET OF EPBD
STANDARDS
Climatic data
Outdoor temperature
Wind speed
Wind direction

Building occupancy
and operating conditions
Acceptable temperature range

Calculation of building energy need
Indoor temperature

Control options and descriptions

Calculation of air flowrates through openings and mechanical system

Heat transfer by infiltration and ventilation

Building description:
Windows/Vent/Passive duct/Mechanical system/Internal partition

Temperature set point
Occupancy

Source: inspired by prCEN/TR 16798-10 (PE draft, 2015)
Climatic data

Building occupancy and operating conditions

Calculation of building energy need

Temperature set point

Occupancy

Control options and descriptions

Calculation of airflow rates

FprEN 16798-7, FprEN 16798-5-1

Supply and extract flow rate + temperature

Heat transfer by infiltration and ventilation

EN ISO 52010-1

prEN 16798-1

Building description: Windows/Vent/Passive duct/ Mechanical system

EN 15232

Source: inspired by prCEN/TR 16798-10 (PE draft, 2015)
What works ...

- Description and calculation of:
  - Natural airflow rates through vents / leakage / passive ducts / windows
  - Mechanical airflow rates
- Use of climatic data
- Instantaneous comfort criteria (see EN 16798-1) and long term comfort indices (see prCEN/TR 16798-2)
- ...
Major elements missing to implement ventilative cooling in regulations

- Guidelines, depending on system type, to distinguish:
  - Key input parameters that should be described accurately
  - Input parameters for which default values are proposed (but other values can be used)
  - Input parameters for which conventional values are defined (other values cannot be used)
  - Other parameters not critical for ventilative cooling

- Guidelines to set limits for long term comfort criteria (long term comfort indices exist, see prCEN/TR 16798-2)

- Control algorithms, in particular to obtain the window opening ratio
### Building description: control options

<table>
<thead>
<tr>
<th>Included systems</th>
<th>Control of mechanical /hybrid system</th>
<th>Control of natural flowrate</th>
<th>Control of windows opening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>Automatic/manual</td>
<td>Indoor temperature set point, outdoor temp. limits and temp. difference set point / limit</td>
<td>Type of controller, on/off, proportional, PID etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Various scenarios (night cooling, free-cooling, etc.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Burglary resistance of windows</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Surrounding noise (impact on windows opening)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Impact of adaptive comfort</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Occupation</td>
</tr>
</tbody>
</table>

- **Yes**
- **No**
- **To be set by user**
WHAT’S NEW IN THE EPBD STANDARD FprEN 16798-7 TO CALCULATE AIRFLOW RATES?
What’s new in the EPBD standard FprEN 16798-7 to calculate airflow?

Major changes on airing (i.e., natural airflow rates through windows)

- **Airing**
  - Flowrate depends on:
    - Wind speed
    - Thermal draft
    - Windows area and height
  - Or simplified method
    - Directly proportional to hygienic flowrate
- **Specific § for summer comfort**
  - No method described
  - Cross ventilation « has to be taken into account »

- **No distinction between airing and summer comfort**
- **Calculation for cross-ventilation** included in the standard
- **3 proposed methods**
  - Simplified calculation (idem)
  - Explicit calculation
    - Single sided and cross-ventilation
  - Implicit calculation

EN 15242 (old)

FprEN 16798-7 (new)
What’s new in the EPBD standard FprEN 16798-7 to calculate airflows?

• Other changes in EN:
  – Calculation of mass balance (instead of volume balance)
  – More details on passive duct calculation (implicit equation included)
  – Required airflow rates can take into account heating/cooling needs (if applicable)
  – Required supply temperature can be calculated (if applicable)

• Moved to TR:
  – Information on multi-zone modelling
  – Use of window openings depending on ext. temperature and wind

• Removed
  – Explicit calculation to calculate total airflow rates
WHAT IS CRITICAL FOR COMPLIANCE CHECKS?
Compliance checks

• In our context:
  – Compliance = Fact of conforming with EPC procedures

• Implies:
  – Someone will check the EPC
  – He has to be able to unambiguously say if the EPC is compliant or not, based on
  – Rules that are defined, inc.:
    • Technical rules to determine the EPC input data
    • Organisational requirements (e.g., requirements for certification, etc.)
    • Rules to show evidence of compliance
Some evidence of issues

• Denmark
  – Airflow rates are directly entered, but there is no rule to calculate these airflow rates, therefore...
  – Input parameters (natural airflow rates) can be checked neither with technical documents nor with measurements
  – Strong barrier for designers to implement ventilative cooling
  – Difficult to show evidence of (non) compliance

• Estonia
  – Open calculation method
  – Input parameters that have to be considered are not defined
  – Results can differ considerably depending on hypotheses and methods used
  – Difficult to show evidence of (non) compliance
What can be verified?

• Mostly (only ?) input parameters
• Key input parameters have to be highlighted
• It should be clear:
  – How to define these key input parameters
  – How the characteristics can be verified, either:
    • Technical documentation, preferably based on a product standard
    • Measurement, preferably based on test standard
  – The tolerance for deviation when the characteristics are verified
  – How to show evidence that the characteristics are in accordance with the input parameters
What’s in FprEN 16798-7?

- All EPBD standards have tables with input/output values in a common format (see presentation by J. Hogeling)

<table>
<thead>
<tr>
<th>Name</th>
<th>Symbol</th>
<th>Units</th>
<th>Range</th>
<th>Origin-Module</th>
<th>Varying</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topography coefficient depending on the local environment of the meteorological station</td>
<td>$C_{\text{top,met}}$</td>
<td>-</td>
<td>0 to $\infty$</td>
<td>ISO·15927-1</td>
<td>No</td>
</tr>
<tr>
<td>Topography coefficient depending on the local environment of the building site at building height</td>
<td>$C_{\text{top,site}}$</td>
<td>-</td>
<td>0 to $\infty$</td>
<td>ISO·15927-1</td>
<td>No</td>
</tr>
<tr>
<td>Topography coefficient depending on the local environment of the building site at height of 10m</td>
<td>$C_{\text{top,10,site}}$</td>
<td>-</td>
<td>0 to $\infty$</td>
<td>ISO·15927-1</td>
<td>No</td>
</tr>
<tr>
<td>Airing factor (see B.3.3.8)</td>
<td>$f_{\text{arg}}$</td>
<td>-</td>
<td>0 to 3</td>
<td>Local</td>
<td>No</td>
</tr>
<tr>
<td>Cross-ventilation factor</td>
<td>$F_{\text{cros}}$</td>
<td>-</td>
<td>0 or 1</td>
<td>Local</td>
<td>No</td>
</tr>
<tr>
<td>Control factor</td>
<td>$f_{\text{ctrl}}$</td>
<td>-</td>
<td>0 to 1</td>
<td>Local</td>
<td>Yes</td>
</tr>
<tr>
<td>Supply outdoor air fraction</td>
<td>$f_{\text{ODA}}$</td>
<td>-</td>
<td>0 to 1</td>
<td>M5-6</td>
<td>Yes</td>
</tr>
<tr>
<td>Operation requirement signal (combustion appliance)</td>
<td>$f_{\text{op,comb}}$</td>
<td>-</td>
<td>0 or 1</td>
<td>Local</td>
<td>Yes</td>
</tr>
<tr>
<td>Operation requirement signal (ventilation)</td>
<td>$f_{\text{op,vant}}$</td>
<td>-</td>
<td>-</td>
<td>Local</td>
<td>Yes</td>
</tr>
</tbody>
</table>
What’s in FprEN 16798-7?

- Checklist for quality control and compliance check

- **8 - Quality control**
  
  The calculation report shall:
  
  - state the calculation interval, methods and options used for the calculation
  
  - list all input data
  
  - list all output data of Table 4 transferred to other modules
  
  - besides the output values of Table 4 transferred to other modules, include the values of the total volume-air flow rates are $q_{v,tot,in}$ and $q_{v,tot,out}$

- **9 - Compliance check**

  Compliance check performed in the context of an energy performance regulation may be based on checks performed on a selection of input data, in particular those for which a minimum requirement is set at national level, and/or those that have a significant weight on the calculated energy use.

  When checks are performed on-site, they shall include the following verifications:
  
  - Ventilation system type
  
  - Location and characteristics of air terminal devices used for passive ducts

  - Location of $C_{ATD}$ and $A_{ATD}$
  
  - Location and characteristics of cowls
Summary

• In most European countries EP-calculation tools do not fairly consider ventilative cooling
• The new EPBD set of standard gives models to implement ventilative cooling. Missing information are mainly with:
  – Control of systems
  – Guidance on parameters that shall be defined by the user or taken as default
  – Guidance for long-term thermal comfort criteria
• Windows openings is better considered in FprEN 16798-7, in particular cross-ventilation
• Unambiguous definition of input parameters and ways to checks those input parameters are pre-requisites for compliance checks
• FprEN 16798-7 gives a checklist that can be useful for quality control and compliance checks. First attempt... to be evaluated

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