

Progress needed on ventilation and air tightness in Romania

Horia Petran



INCD URBAN-INCERC
(INCERC Bucharest)
hp@incerc2004.ro

TightVent Webinar
Airtightness and ventilation perspectives in Romania
21 June 2011

Contents

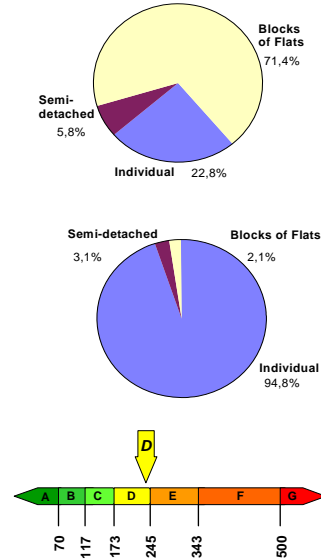
- **Airtightness of current building stock in Romania**
 - ▶ Potential / impact of ventilation
 - ▶ Envelope permeability
 - ▶ Testing methods and current investigations
- **Ventilation issues in the Thermal Rehabilitation Program**
 - ▶ Context and instruments / schemes
 - ▶ Key actors involved
 - ▶ Impact on indoor air quality
- **Ventilation of low energy buildings / nZEB**
 - ▶ Requirements and weight of ventilation in energy balance
 - ▶ Towards efficient solutions
- **Indoor air quality in educational buildings**
 - ▶ Requirements
 - ▶ Current situation
 - ▶ Challenges

■ Potential – RO building stock (BS):

- ▶ Residential: > 4.8 Mil. buildings
> 8 Mil. dwellings
(3.1 Mil. dwel. in ~84.000 blocks = 70% of BS)
> 450 Mil. m²
> 22 Mil. people
- ▶ Tertiary: > 230 Th. Buildings
> 70 Mil. m²
- ▶ Energy use (heating): 100-300 kWh/m²y

■ Energy strategy – Bucharest 2008:

- ▶ ~ 800.000 dwellings + tertiary
- ▶ Energy use (heating): ~ 7,9 TWh/y
- ▶ Potential for ventilation: ~ 2,4 TWh/y



- Most RO buildings do **not** have **mechanical ventilation** (except limited kitchen or bath exhaust systems) → rely on:
 - ▶ infiltration (i.e., leakage through the building envelope) and
 - ▶ natural ventilation (i.e., window opening)
 to maintain acceptable indoor air quality

■ Envelope permeability

- ▶ Air permeability of building components and building elements
 - Index / joint length (m³/h/m) @ 50Pa
- ▶ Air permeability at building level
 - Index / envelope area (m³/h/m²) @ 50Pa



■ Testing methods and investigations:

- ▶ Fan pressurization method → **blower door**
- ▶ Thermal imaging (thermography) → **air leaks**
- ▶ **Ventilation system functionality** surveys
- ▶ **Indoor climate** surveys

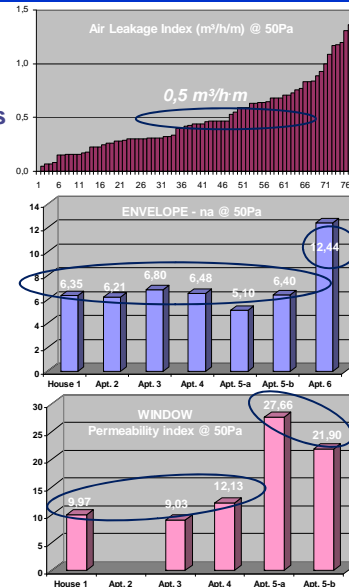
■ Windows testing (INCERC):

- ▶ **79 components: 0.1 - 1.35 m³/h/m @ 50Pa**
(average 0,51 m³/h/m @ 50Pa)
– current market

■ Building testing (INCERC):

- ▶ **1 individual house + 5 apartments**
- ▶ **na @ 50Pa = 5.1 ... 6.8; 12,4 h⁻¹**
- ▶ **Envelope: 3.2 ... 6.8 m³/h/m² @ 50Pa**
- ▶ **Windows: 9.0 ... 27 m³/h/m @ 50Pa**

■ Relevance of values @ 50Pa?



■ Context and instruments / schemes

- ▶ **Blocks-of-Flats** built in 1950-1990
- ▶ **Investment: 80% ensured by State and Local Budget + 20% ensured by the owner**
- ▶ **Financed solutions: thermal insulation building components, windows replacement and other envelope works**
→ **NO money for ventilation system**

■ Key actors involved

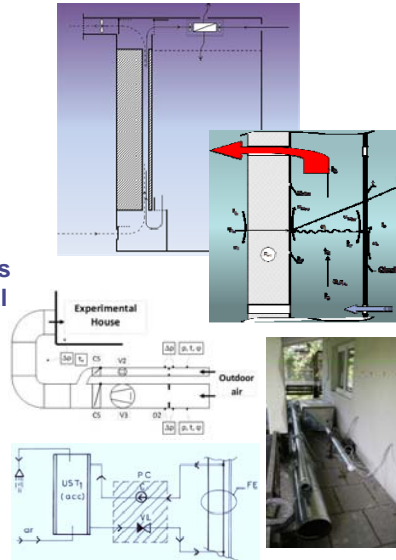
- ▶ Finance source (GOV, Local auth.)
- ▶ Designers, experts
- ▶ Beneficiary (Owner Associations)

■ Impact on indoor air quality

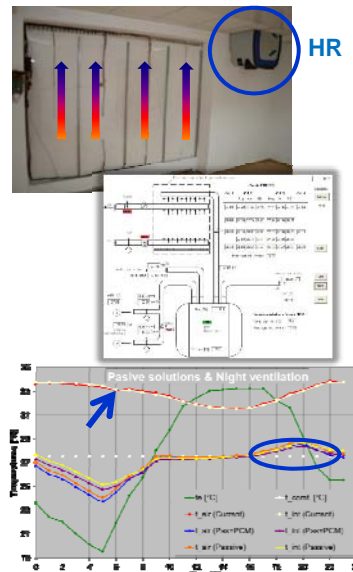
- ▶ Interventions on existing natural ventilation
- ▶ Occupants behaviour → use of open-flame source, not sufficient window opening
→ risk of Sick Building Syndrome



- **Ventilation requirements**
 - ▶ Very airtight envelope
 - ▶ Controlled ventilation is essential in highly airtight buildings
 - ▶ Air tightness of ductwork
 - ▶ Heat recovery (>80%)
- **Weight of ventilation in energy use**
 - ▶ Energy use for ventilation > Exergy loss by transmission (high envelope thermal performance) → from <30% to >50%
- **Towards efficient solutions**
 - ▶ Intelligent (adaptive) envelopes
 - ▶ Ventilated envelopes (int. / ext.)
 - ▶ Ventilation coupled with active/passive solar design
 - ▶ Night ventilation



- **Efficient solutions (ex.)**
 - ▶ Ventilated envelope system: wall with parietal-dynamic effect on the exhausted air from occupied spaces → Variable envelope thermal resistance
 - ▶ Ventilated solar space (preheating ventilation air)
 - ▶ Active or passive ventilated façades → use of PV panels as active covering and preheating the fresh air while cooling down PV elements
 - ▶ Night ventilation in summer → cooling passive or active elements: building mass, TABS, PCM)



■ Requirements

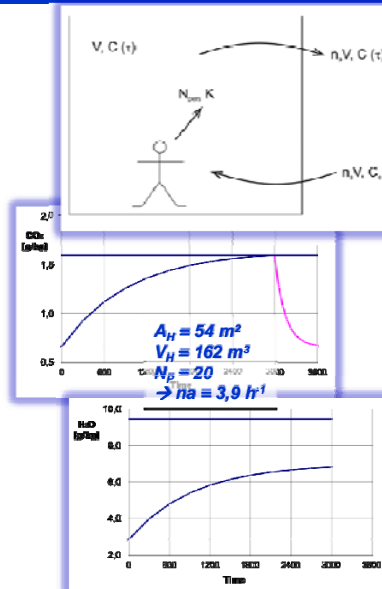
- ▶ Minimum air flow per person
- ▶ Ventilation needs are much higher → people concentrated in closed spaces over extended periods of time
- ▶ Need for *intelligent* ventilation system
- ▶ Need for low ventilation for long breaks

■ Current situation

- ▶ Direct and natural ventilation is not effective for adequate indoor air quality
- ▶ Major program for schools rehabilitation → increased air tightness, but no controlled ventilation

■ EPB evaluation – EP Certification

- ▶ Wrong ventilation strategy is used often in EPC elaboration →...
- ▶ Right n_a , but penalties for ‘no system’

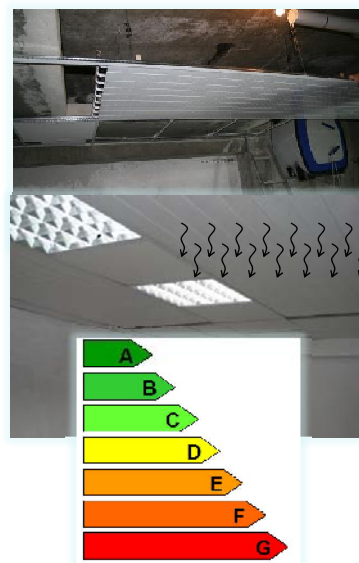


■ Challenges

- ▶ Detail and clarify legislation on ventilation & EP certification
- ▶ Training of the experts involved (architects, designers, energy auditors, inspectors) + building workforce
- ▶ Raising awareness – GOV, Inspectorates, Teachers → Education !

■ Adapted / tailored technological solutions:

- ▶ Monitoring indoor air quality in classrooms
- ▶ Ensuring comfort: thermal + physiological
- ▶ Prediction – correction → control strategy and system



- Significant potential for ventilation
- Not one identified problem with one potential solution
 - ▶ Envelope permeability → low EPB
 - ▶ Envelope air tightness + no ventilation + behaviour → SBS
 - ▶ Low EB → correct ventilation + adaptive solutions (ENV + systems)
 - ▶ Indoor air quality → to be high priority within rehabilitation schemes
- Strategy of “Build it tight. Ventilate it right”
- Indoor air quality → ventilation strategies + systems
- Importance of right ventilation in schools:
 - ▶ Ensuring ventilation when is needed
 - ▶ Low exergy systems → high EPB
 - ▶ Efficiency of ventilation and indoor comfort (incl. thermal, acoustical) → mixed radiative & convective systems
- nZEB → heat recovery, pressure balancing, passive strategies, night ventilation, PCMs, renewable sources etc.

Thank you !

Acknowledgements:
The information presented use the results obtained within the research team on Energy and Environmental Performances of Sustainable Buildings - coordinated by Prof. Dan Constantinescu

