IEA EBC Annex 68 - Indoor Air Quality Design and Control in Low Energy Residential Buildings

Energy in Buildings and Communities Programme

Subtask 4 - Strategies for design and control of buildings

TOPICAL SESSION: "Ventilation design and control in residences - current challenges, innovative solutions and case studies gathered by IEA-EBC Annex 68"

Lessons learned from design and operation of ventilation systems in low-energy dwellings in the UK

40th AIVC conference, Ghent, Belgium

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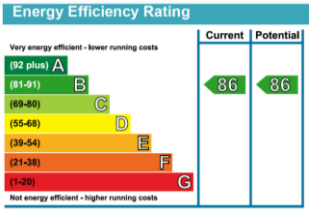
Case Study: MVHR System

Energy in Buildings and Communities Programme

- Completed in 2015 (approx. 7900 m²)
- 98 flats and maisonettes
- Mixed tenure: rent, leasehold, shared ownership
- Low air permeability: 2-3 m³/hr/m² at 50 Pa
- Mechanical Ventilation with Heat Recovery (MVHR)
- Communal heating (CHP led) managed by an ESCO



Energy & IAQ monitoring

Energy (heating demand & electricity): 1 year

T/RH/CO_2: 1 year

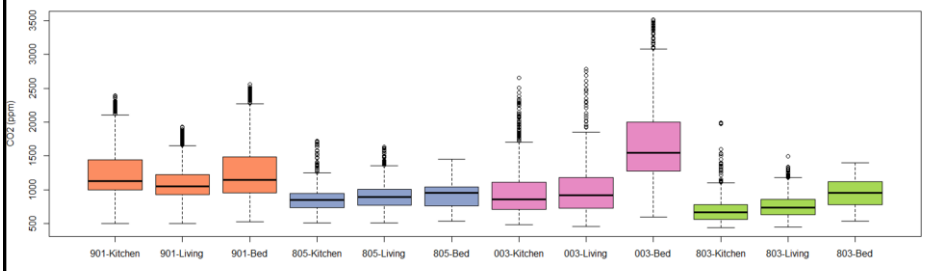
Outdoor site data

Passive sampling (VOCs, O_3, NO_2)
Weekly blocks in winter & summer

Active monitoring (PM1-10, NO_2, TVOC, CO)
Weekly blocks in winter & summer

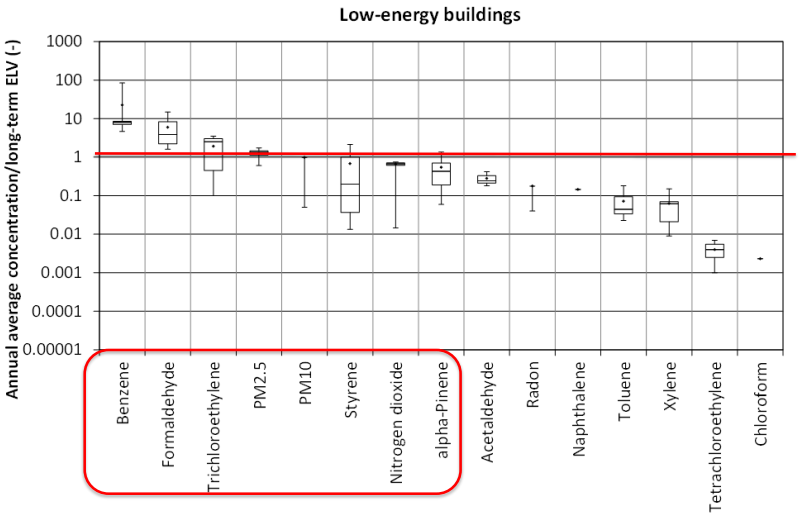
PFT measurements (air change rates)
Weekly blocks in winter & summer

CO_2 measurements (heating season)



- Median concentration levels between 800-1600 ppm in heating season
- Peaks of up to 3400 ppm
- PerFluorocarbon Tracer (PFT) method used to infer the ventilation rates

Pollutants covered



Source: Abadie et al., 2016. IEA EBC Annex 68 – Indoor Air Quality Design and Control in Low-energy Residential Buildings, SUBTASK 1: Defining the metrics

Passive sampling of VOCs (heating season)

VOC concentration (µg/m³) & Air Change rates per Hour for each zone	APT. 3 (Block A, 9th Floor)			APT. 4 (Block B, Ground Floor)			IEA EBC Annex 68 Long Term ELV
	Living room	Kitchen	Sample bedroom	Living room	Kitchen	Sample bedroom	
Benzene	**1.3**	**1.0**	**1.2**	**1.5**	**2.1**	**1.6**	0.2
Formaldehyde	**29.25**	**26.87**	**29.53**	**21.23**	**31.35**	**27.44**	9
Trichloroethylene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2
Styrene	1.5	2.2	3.0	0.8	0.7	1.7	30
Naphthalene	**5.4**	**5.4**	**5.0**	0.9	0.9	1.3	2
Toluene	2.7	2.9	3.1	2.2	2.6	2.4	250
Tetrachloroethylene	0.6	<0.6	<0.6	1.5	1.2	1.8	100
ACH (PFT measurements)	0.50	0.52	0.76	1.02	1.14	0.6	n/a

Concentration levels of benzene and formaldehyde are higher than best practice long-term/chronic exposure limit values (ELVs) in both apartments 3 years after completion.

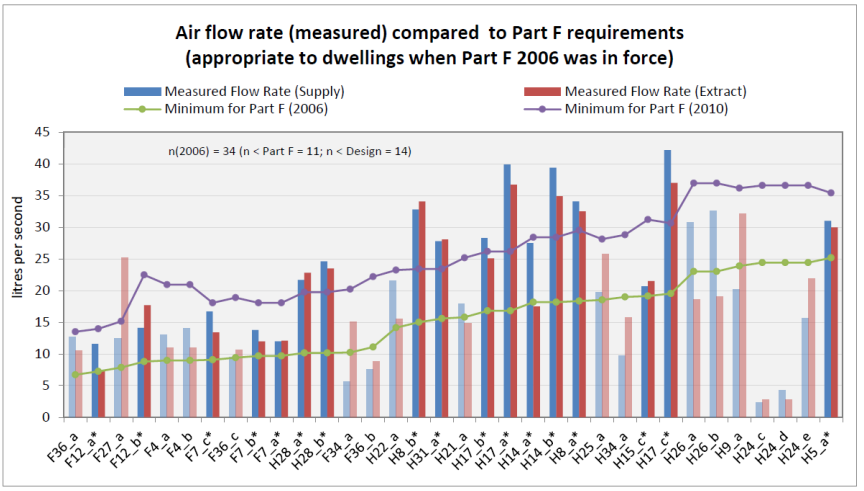
Maintenance of MVHR systems: Who is responsible?!

MVHR system installed in case study dwellings

Air filter (after cleaning!)

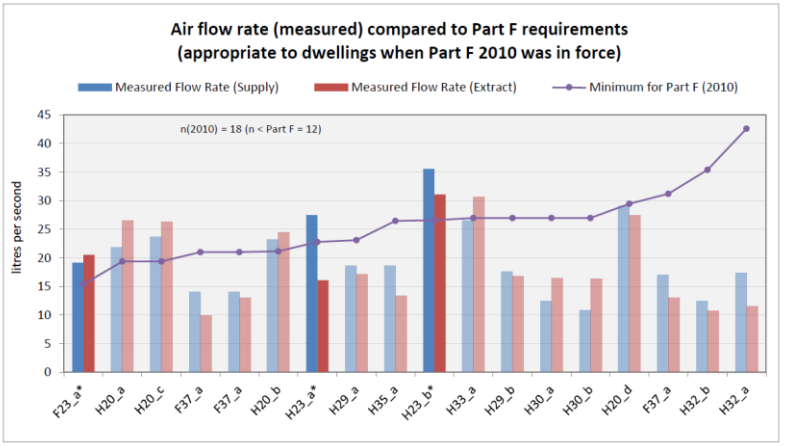
- Provision of training and adequate information to users is critical and often missing!
- *There might be a case to make Landlords and housing associations responsible in rented accommodation (analogy with gas safety/annual inspection of heating systems).*

Measured air flows in MVHR systems



Source: Sharpe T., et al., 2016. Characteristics and performance of MVHR systems

Measured air flows in MVHR systems



Source: Sharpe T., et al., 2016. Characteristics and performance of MVHR systems

Conclusions

- Internal sources of pollution become more relevant in dwellings (ACH<1 in heating season).
- Better source control measures and enhanced ventilation through MVHR systems could help.
- Commissioning and maintenance issues often mean actual ventilation rates are lower than design intent.
- Provision of training and adequate information to building users is critical and often missing.

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