



Ventilation – Why and How

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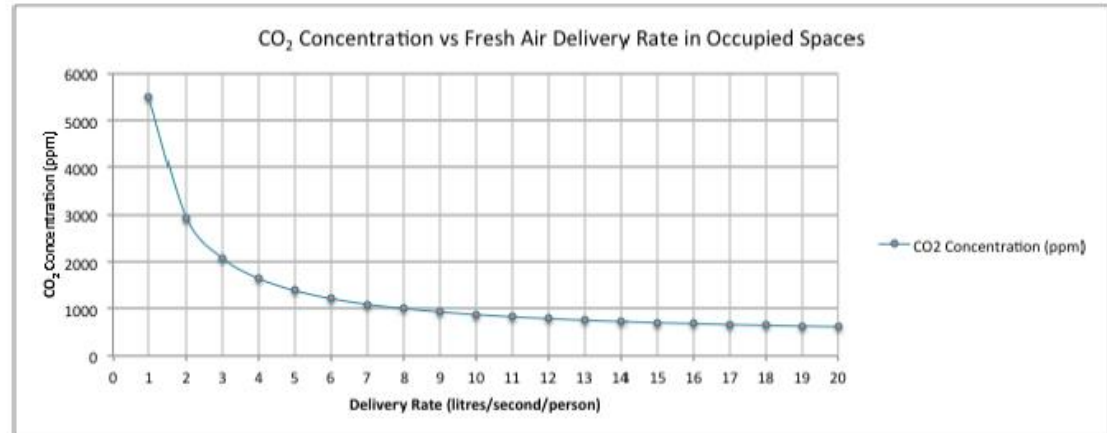
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Ventilation – why?

- Provision of fresh air
 - Removal of odours
 - Removal of pollutants
 - Removal of moisture
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- The aim – good IAQ. In reality AD-F is aiming at Category III, the lowest category.
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- But AD-F states explicitly ‘minimum’ ventilation rate..



Category	Air change rate ^a		Living room and bedrooms, mainly outdoor air flow	
	l/s,m ² (1)	ach	l/s, pers ^b (2)	l/s,m ² (3)
I	0,49	0,7	10	1,4
II	0,42	0,6	7	1,0
III	0,35	0,5	4	0,6

Table B.5 — Example of ventilation rates for the residences. EN15251:2007

Ventilation rates – for dwellings AD-F

- Extract – wet rooms
 - Kitchen – intermittent; 60 l/s, continuous; a high rate of 13 l/s (**minimum**)
 - Utility room – intermittent; 30 l/s , continuous; a high rate of 8 l/s (**minimum**)
 - Bathroom – intermittent; 15 l/s, continuous; a high rate of 8 l/s (**minimum**)
 - WC – intermittent; 6 l/s, continuous; a high rate of 6 l/s (**minimum**)
- Supply – whole house
 - Based on floor area (0.3 l/s/m²) (**minimum**)
 - Based on number of bed rooms (13 l/s for 1 bedroom and 4 l/s for each additional bedroom)
- AD-F notes; ‘...sized for the winter period. Additional ventilation may be required during warmer months’ and it is assumed purge ventilation (windows) will be used.
- Purge
 - extract air at 4 air changes per hour from each habitable room (living/bedroom) direct to outside. Normally achieved by opening windows.

Methods of Ventilation - Systems 1 ~ 4 in AD-F

- System 1 – Natural with local extract for occasional removal of pollutants
- System 2 – Passive stack, functional but little uptake
- System 3 – Extract only (MEV)
- System 4 – Fully balanced with heat recovery (MVHR)

- Systems 1, 2 & 3 rely on trickle vents (rated as equivalent area – normally slightly lower than free area)
 - System 1 = 5000 mm² min per habitable room (2" x 4" hole in every living/bed room)
 - System 3 = 2500 mm² min per habitable room (1" x 4" hole in every living/bed room)

- Noise and pollution outside – very hard to achieve high levels of attenuation and almost impossible to remove pollutants.

Do trickle vents work?

- Yes but... only if they are open and the internal air transfer route is unrestricted

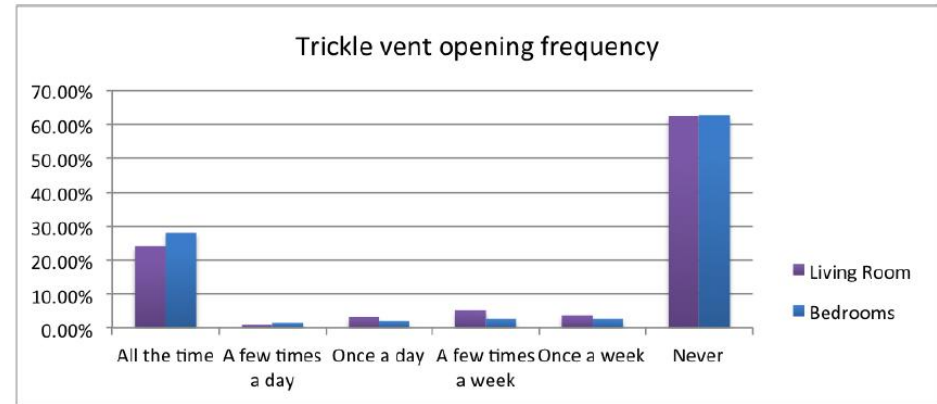


Figure 6: Trickle vent opening frequency.

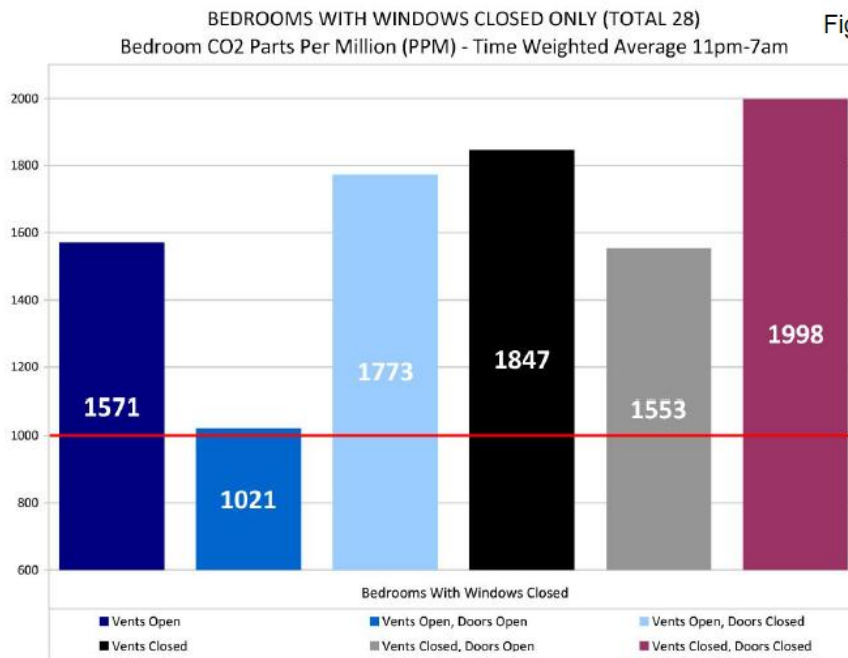


Figure 26: Condition dependant average CO₂ concentrations in bedrooms with trickle ventilation



System 4 – the answer?

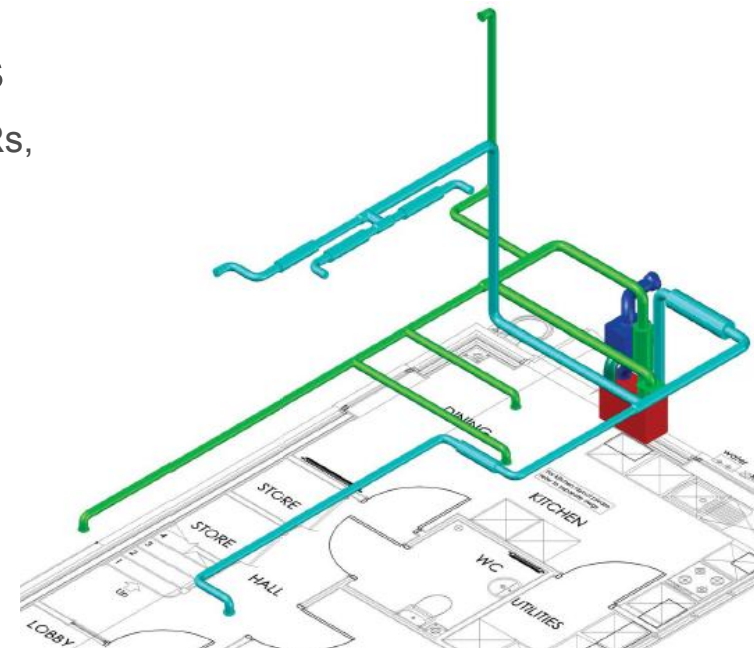
- Fully balanced supply and extract system, no trickle vents
- Many parts making it relatively complex for domestic market
- Findings over years of investigations: poor installation and commissioning widespread. Training schemes starting to address this.
- More recently, poor design revealed as widespread (under-sized ducts, undersized MVHRs, poor duct run design, inappropriate terminals, etc.)
- The result – developers have moved:

System 4

System 3 (centralised)

System 3 (de-centralised)

System 1 (natural ventilation in 2017 homes)



A. Farr. GBS

Purge ventilation - how?

- Purge ventilation – defined as intermittent, required to remove pollutants from occasional activities.
- Purge ventilation - should be capable of extracting a minimum of 4 ach per room directly to outside.

AD-F assumes that this is achieved through window opening in most cases (if this is not possible then an mechanical extract fan should be installed).

Window opening is based on degree of opening and then floor area. If window opens $> 30^\circ$ area of opening window to be $> 1/20^{\text{th}}$ floor area of room.

Purge ventilation — but who ‘designs’ the windows ?

- To meet AD-F the opening size of the window is all that is required. Therefore in reality nobody ‘designs’ the ventilation function of the window
- The result:

HOME IS WHERE
THE HEAT IS

“ We’ve forgotten how to design for natural ventilation in dwellings – we’ve lost the art
Michael Swainson

CIBSE Journal August 2014



Is this really good design?

Why are windows and purge ventilation rates important?

– an example of heat removal

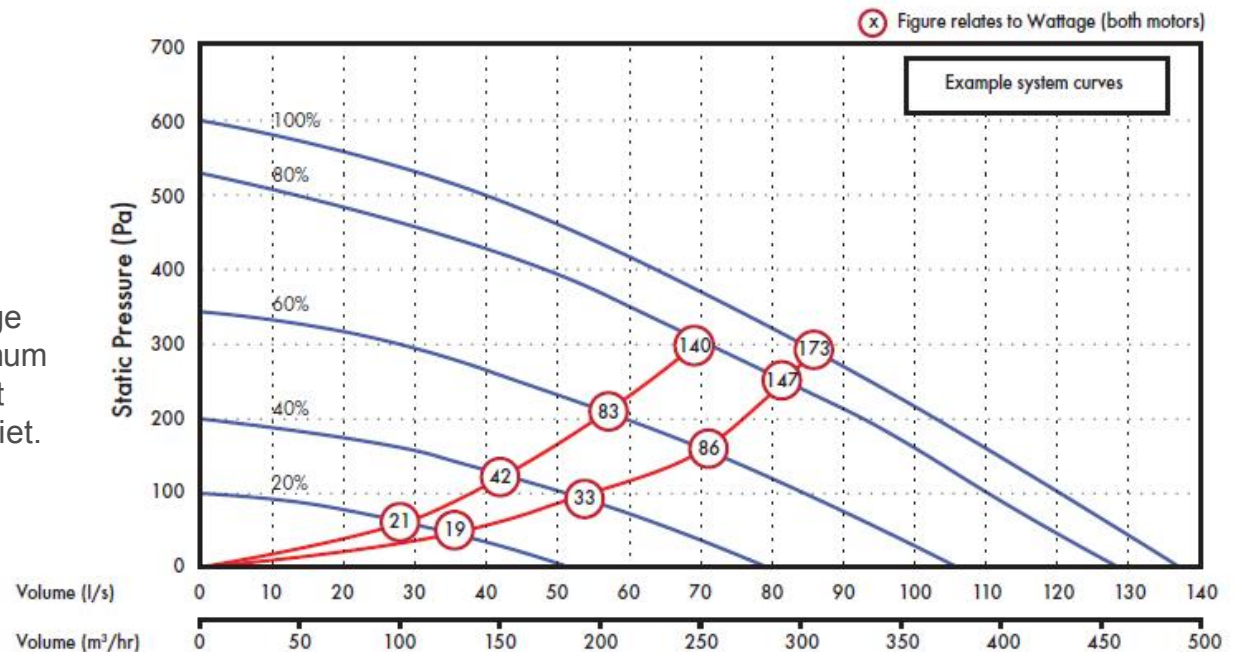
– Assume:

- 2 Bedroom flat - Kitchen and bathroom, background ventilation rate 21 l/s. Design allows for supply based on room volumes, living room; 9 l/s, bedroom 1; 8 l/s, bedroom 2; 4 l/s.
- Bedroom 1 with 2 occupants, sensible heat gains ~ 140 W.
- Heat removal at 8 l/s, and say 28° C in bedroom and 23° C outside: $8 \times 1.2 \times 5 = 48 \text{ W}$.
- Background ventilation rate does not remove gains of occupants, never mind stored gains, IT gains, etc.
- If background ventilation rate is approximately 0.5 ach, purge for the whole flat would be approximately 170 l/s, providing a heat removal rate of approximately 1 kW.

Can purge ventilation rates actually be achieved?

- Windows wide open all night – noise, pollution, security, safety (ROSPA), etc.
- Mechanical systems Clearly not the same as the background system

– VA Sentinel Kinetic Plus, a large system for the UK market. Maximum flow rate 80~90 l/s, but running at maximum speed, no MVHR is quiet.



The Sentinel Kinetic Plus is ideal for larger homes and multiple occupancy units such as care homes and student accommodation. Capable of 400m³/hr at 150Pa, the unit can extract from up to ten bathrooms and



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