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Ventilation and air permeability of traditional dwellings: a Lake District case study

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30 March 2011



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Ventilation and air permeability of traditional dwellings: a Lake District case study

- Background - assumptions on air permeability of the UK's traditional housing stock
- MSc Case study – 19th Century terrace in the Lake District
- SPAB Old Building Energy Efficiency Research 2011 - 2012



Diiane Hubbard

- Mechanical engineer
- MSc Centre for Alternative Technology - Architecture: Advanced Environmental and Energy Studies
- SPAB 2011-2012 Old Building Energy Efficiency Research
- Cumbria Action for Sustainability (CAfS) – Cumbria Green Build Festival and Professional Programme
- Green Footsteps – home energy audits, air permeability investigations and testing and related projects

Ventilation in traditional dwellings



Level of ventilation
occurring in dwellings

vs.

Level of ventilation the
buildings and occupants
need.





Background – Ventilation losses

- Domestic space heating = 18% UK energy use (BERR 2005)
- 48% space heating energy loss due to air change (Orme 1998)
- Potential 20% reduction in CO₂ emissions if ventilation rates cut to minimum required

Building Regulations Part F for new dwellings (natural ventilation)

Ventilation = Infiltration + Purpose provided

ventilation

Extract

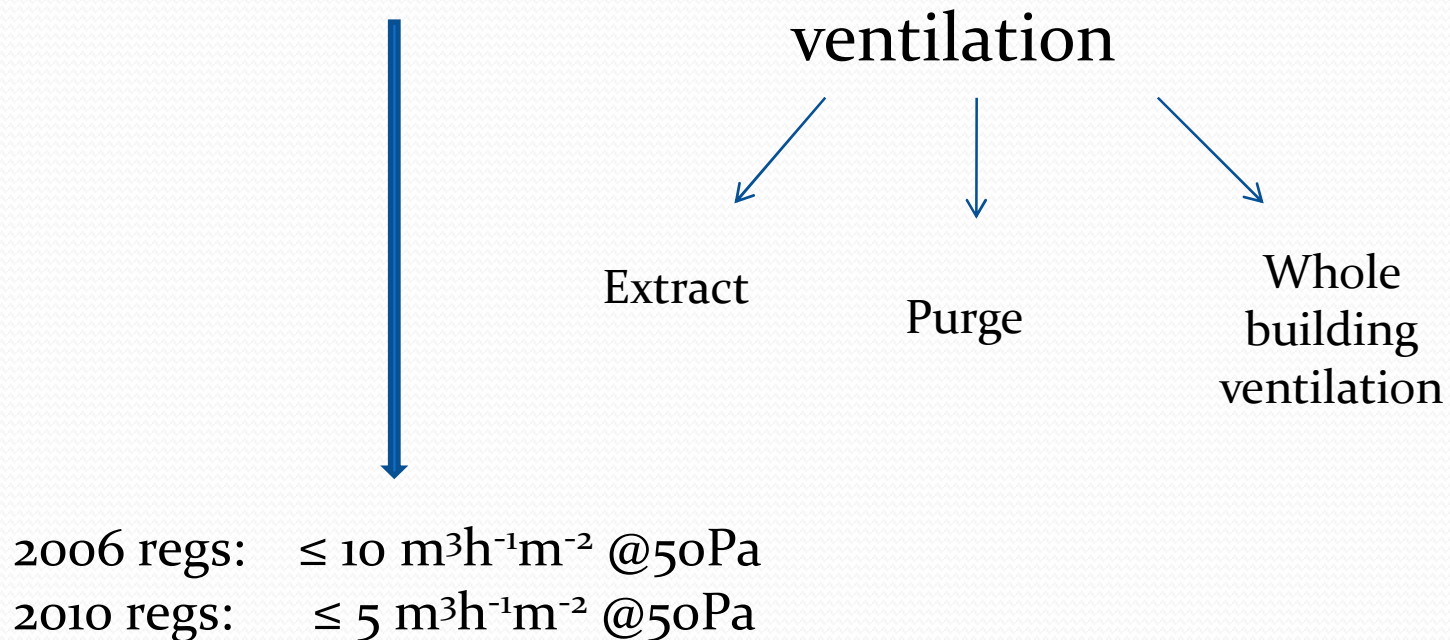
Purge

Whole
building
ventilation



Building Regulations Part F for new dwellings (natural ventilation)

Ventilation = Infiltration + Purpose provided



Air permeability testing

Air permeability

- $\text{m}^3\text{h}^{-1}\text{m}^{-2}$ @50Pa
- relates to overall surface area of building

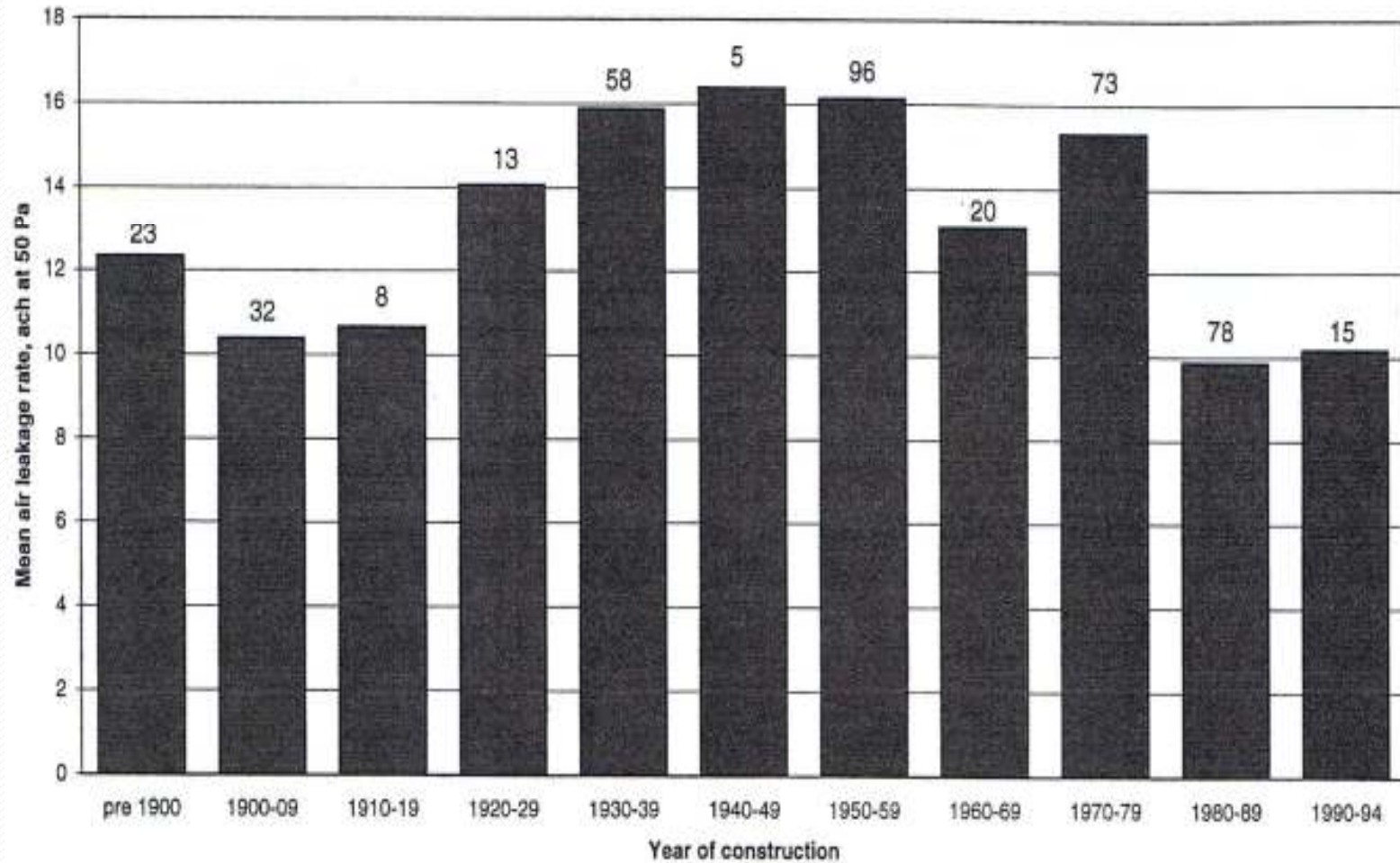
Air changes per hour (ach @50Pa)
– relates to the building volume





Ventilation in traditional dwellings

- Rule of thumb - “twice the normal level of ventilation” required for historic buildings
- Anecdotal – older buildings will be less airtight
- Lack of research on un-improved traditional buildings
- Small number of available air tightness results
- Wide range of air permeabilities
- Air permeabilities do not necessarily relate to building age and construction



Effect of building age on air leakage rate for dwellings

Source: Stephen 2000



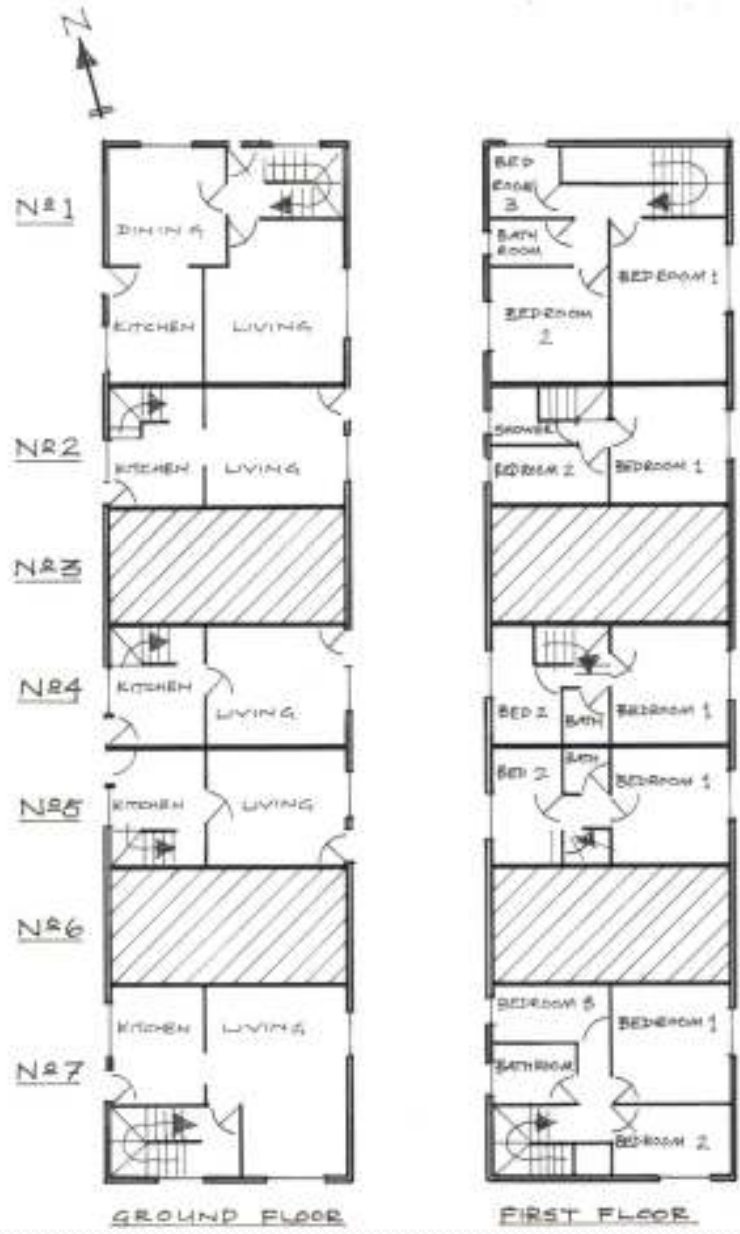
Ventilation in traditional dwellings

- Rule of thumb - “twice the normal level of ventilation” required for historic buildings
- Anecdotal – older buildings will be less airtight
- Lack of research on un-improved traditional buildings
- Small number of available air tightness results
- Wide range of air permeabilities
- Air permeabilities do not necessarily relate to building age and construction
- Energy efficiency measures - ventilation rates likely to be reduced - implications for the building and air quality?

Case Study – Fitz Steps, Little Langdale

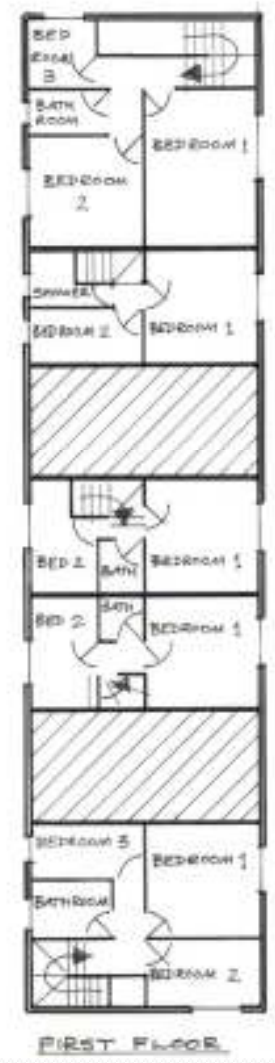


- 1890s terrace
- Slate and lime
- Mainly un-improved
- Private social landlord
- 5 dwellings studied
- Range of occupancy patterns
- Evidence of significant condensation in one dwelling



	Dwelling				
	No.1	No.2	No.4	No.5	No.7
Type	End terrace	Mid terrace	Mid terrace	Mid terrace	End terrace
No. of bedrooms	3	2	2	2	3
Occupants	Family of 6 persons	Single person	Couple	Couple	Couple
Installed Heating Devices					
Living Room	Coal fire	Coal fired range	Coal fire	Multifuel stove	Coal fire and radiator (from back boiler)
Kitchen	None	None	Storage heater	None	Radiator
Bedroom 1	None	Radiator (from range)	None	None	Radiator (from back boiler)
Bedroom 2	None	Radiator (from range)	Storage heater	None	Radiator (from back boiler)
Bedroom 3	None	-	-	-	Radiator (from back boiler)
Bathroom	None	None	None	None	Radiator (from back boiler)
Water heating					
Primary source for heating water	Electric immersion	Back boiler	Back boiler	Back boiler	Back boiler







Bathroom, 1 Fitz Steps: 18 – 25 February 2010

1 Fitz Steps

- Extraction
- Improved space heating
- Insulation
- Change occupant behaviour
- Replacing bath with shower





Case Study - Results

- Air permeability levels lower than anticipated
- Results around AD Part F 2006 ($10\text{m}^3\text{h}^{-1}\text{m}^{-2}$)
- Different occupancy patterns demonstrate a single ventilation rate is inappropriate
- Rule of thumb “twice the normal level of ventilation” does not appear to be valid for these dwellings.

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- 7 occupied dwellings in study
- Subject to refurbishment before Winter 2011 – 2012
- Air permeability – reinforce or question orthodoxy?
- Thermal imaging
- Investigate chimney air flow rates

SPAB Old Building Energy Efficiency Research 2011 - 2012



SPAB Old Building Energy Efficiency Research 2011 - 2012



Total floor area 113m²

Whole building
8.7 m³h⁻¹m⁻²
9.4 ach

Original dwelling
9.3 m³h⁻¹m⁻²
9.6 ach

Awaiting confirmation

SPAB Old Building Energy Efficiency Research 2011 - 2012



SPAB Old Building Energy Efficiency Research 2011 - 2012



Total floor area 86 m²

Whole building

6.9 m³h⁻¹m⁻²

7.2 ach

Original dwelling

5.8 m³h⁻¹m⁻²

7.5 ach

Awaiting confirmation



Summary – air permeability

- Lack of test data on un-improved traditional buildings
- Case study – air permeabilities lower than anticipated
- Corroborated by some initial evidence from SPAB research
- Ventilation occurring vs. ventilation needed by the building and its occupants
- *What ventilation rates should we be aiming for?*

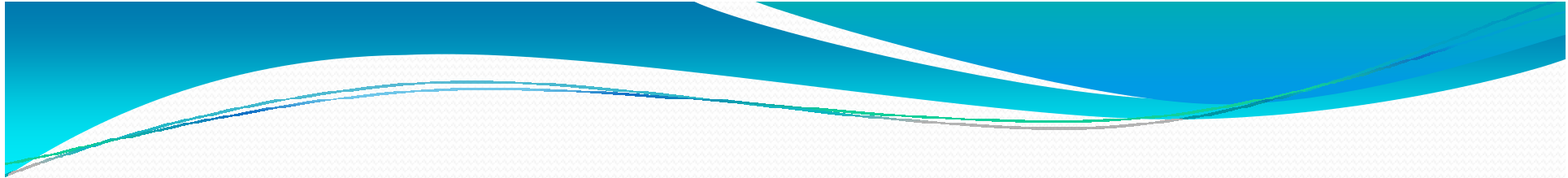


BRE Building Performance Group

A guide to Part F of the Building Regulations: ventilation
(2006):

“Specific guidance when dealing with historic buildings is:

- Consult the local planning authority’s conservation officer
- Establish leakage rates by pressure testing
- Take a balanced view between conservation and ventilation”



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Green Footsteps

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