

**Ventilation and air permeability of
traditional dwellings**
**Controlling moisture and maintaining building
performance: a Lake District case study**

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- Mechanical engineer
- MSc Centre for Alternative Technology - Architecture: Advanced Environmental and Energy Studies
- SPAB 2010-2011 Historic Buildings Energy Survey
- Cumbria Action for Sustainability (CAfS) – Cumbria Green Build Festival and Professional Programme
- Green Footsteps – home energy audits and home ventilation investigation.
- Green Footsteps – consultancy e.g. evening classes “Understanding your traditional home”



Ventilation and air permeability of traditional dwellings

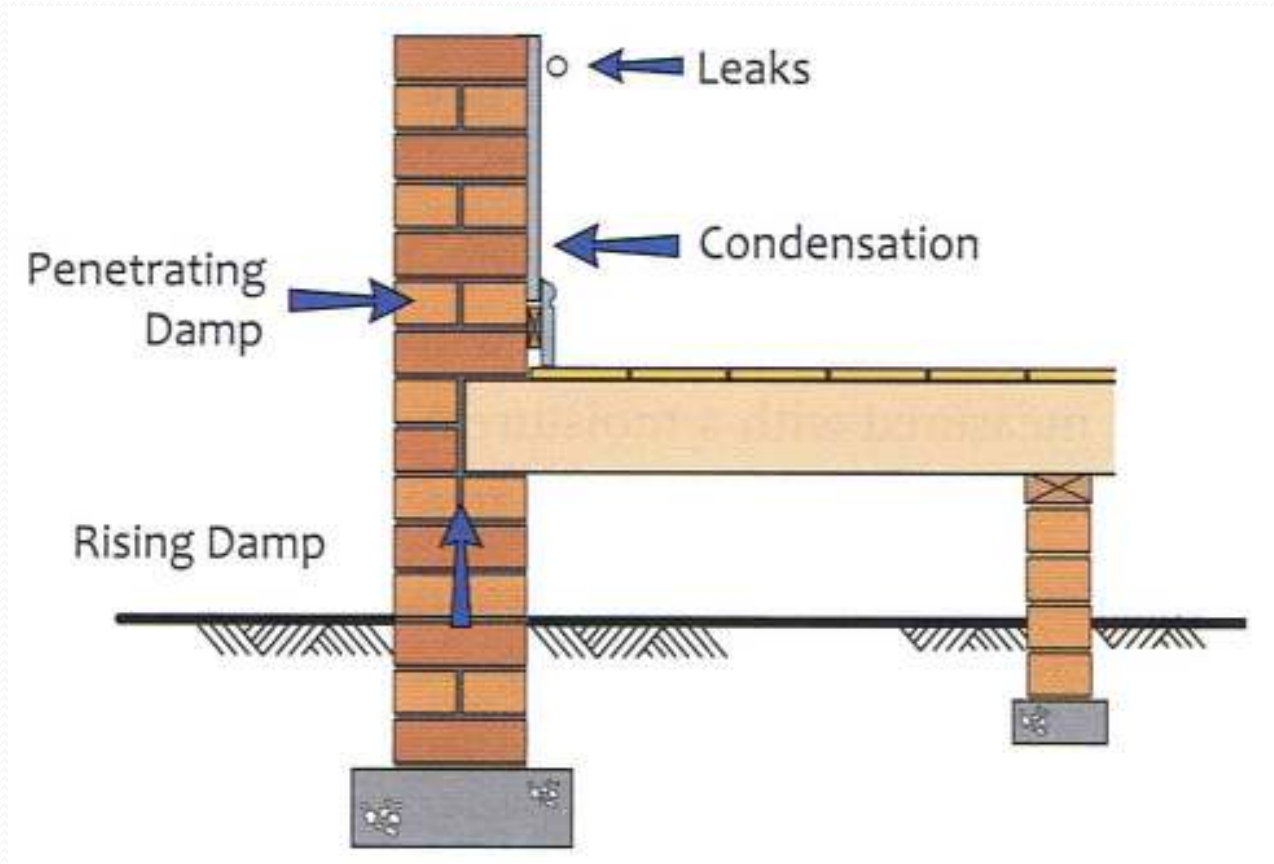
- Moisture in homes
- Role of Ventilation
- Assumptions about the UK's traditional housing stock
- Case study – 19th Century terrace in the Lake District
- Proposed further research

Moisture in homes

- Penetrating damp
- Rising damp
- Condensation

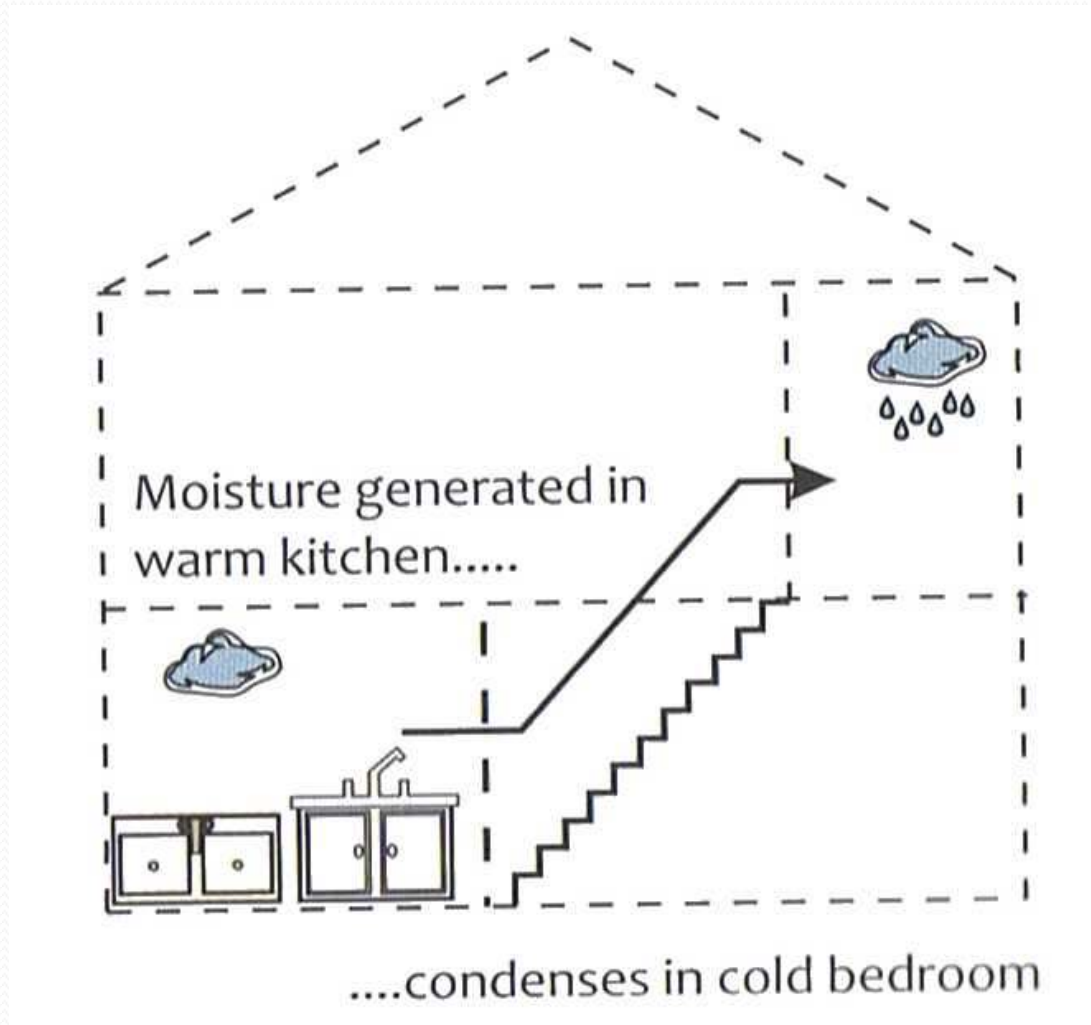


Moisture in homes



Source: Marshall et al 2009

Condensation



Why does condensation happen?

- Excessive moisture production
- Inadequate ventilation
- Inadequate heating
- Poor insulation
- Thermal bridging
- Thermal mass





Typical moisture levels produced in a 3 bedroomed house (per day)

	kg moisture
Family asleep	1.5 - 2
Family during the day	2.5 - 3.5
Cooking	2.0 - 3.0
Washing and bathing	1.0 - 1.5
Washing clothes	0.4 - 0.6
Drying clothes indoors	3.0 - 5.0

Source: Marshall et al 2009



Simple steps to reduce condensation

- Reduce how much moisture you are generating
- Keep the moisture where it is produced
- Open windows for short periods
- Direct extraction from kitchen and bathroom
- Try to make a routine / automatic
- Avoid anti-damp /anti-mould paints – will just temporarily mask problem
- Dehumidifier



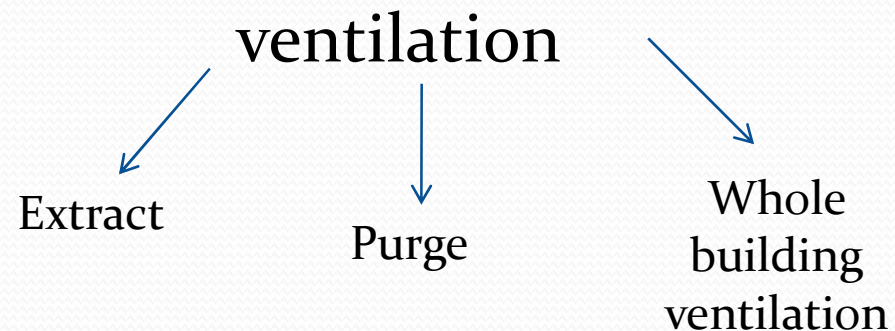
Major changes to reduce condensation

- Specialist ventilation (e.g. single room heat recovery ventilator)
- Improve your insulation
 - Ceilings
 - Windows
 - Walls
- Improve localised heating
- Hygroscopic materials

Role of Ventilation

Building Regulations Part F for new dwellings (natural ventilation)

Ventilation = Infiltration + Purpose provided



Purpose provided ventilation



Purge



Extraction



Whole building
ventilation

Infiltration



Source: Hall (ed.) 2008

Air permeability= measurement of infiltration

Measured in

- $\text{m}^3\text{h}^{-1}\text{m}^{-2}$
- Air changes per hour





Ventilation losses - overview

- 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



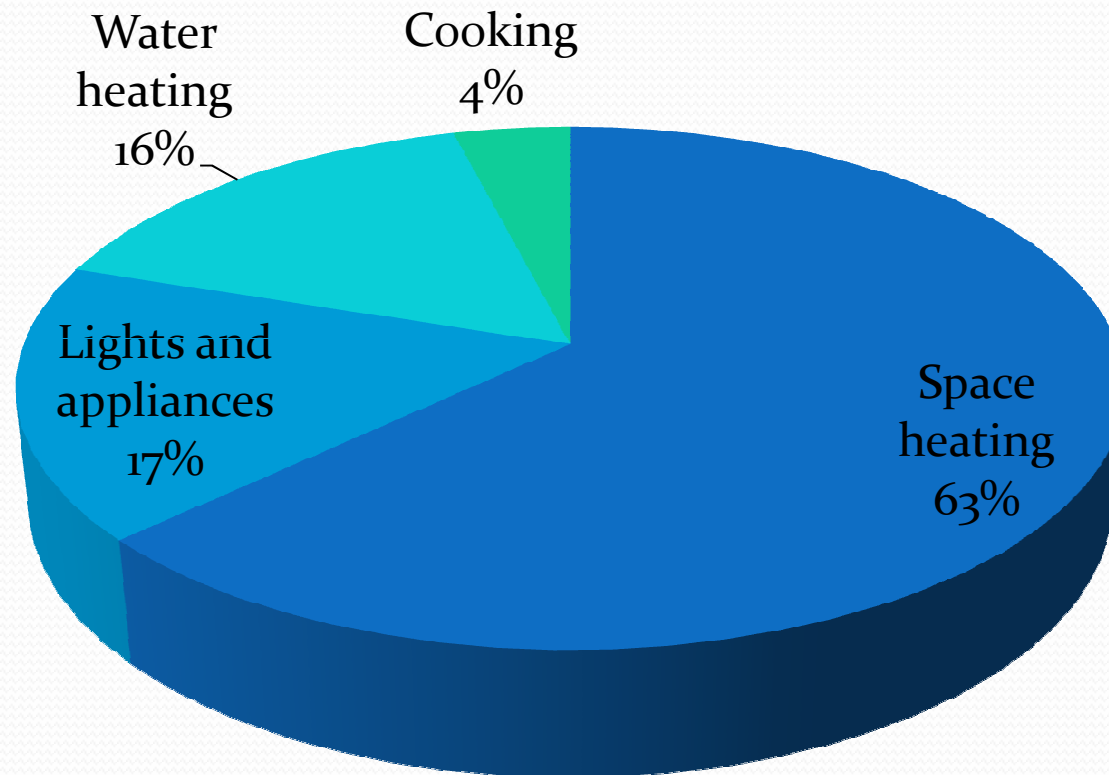
UK Traditional housing stock

- What is a traditional dwelling?

English Heritage:

- “Solid walled construction
 - No damp-proof course
 - Bay or sash windows, single glazed
 - Likely to have been built before 1919”
- UK housing stock = 25 million dwellings
 - 6 million are solid wall
 - 4 million built 1840 – 1919

Typical energy use in an unimproved Edwardian house



Source: Godfrey Cook ,2009



Ventilation in traditional dwellings

English Heritage / CIBSE:

Rule of thumb - “twice the normal level of ventilation”
required for historic buildings

Valid for traditional dwellings?



Ventilation in traditional dwellings – background research

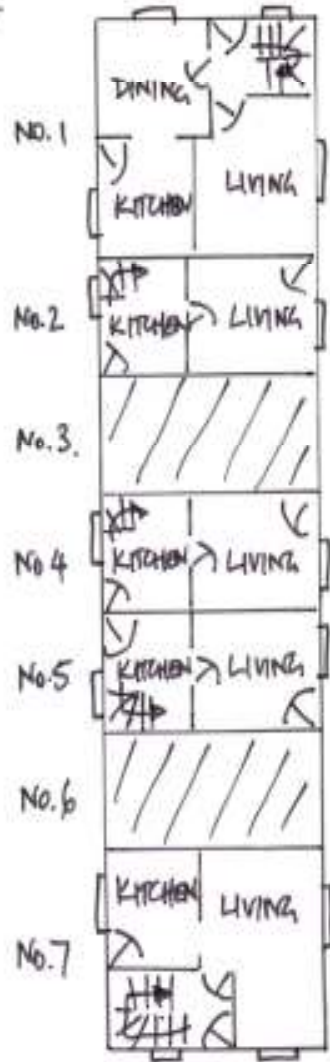
- Lack of research on un-improved traditional buildings
- Small number of available air tightness results
- Wide range of air permeabilities
- Air permeabilities do not necessarily relate to building age and construction

- Energy efficiency measures - ventilation rates likely to be reduced - implications for the building and air quality?

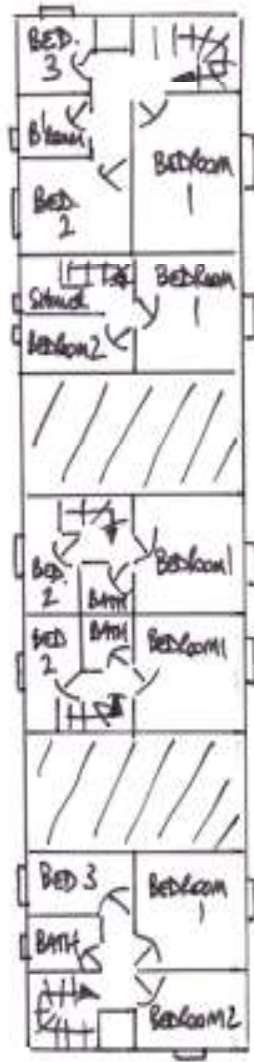
Case Study – Fitz Steps, Little Langdale



- 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



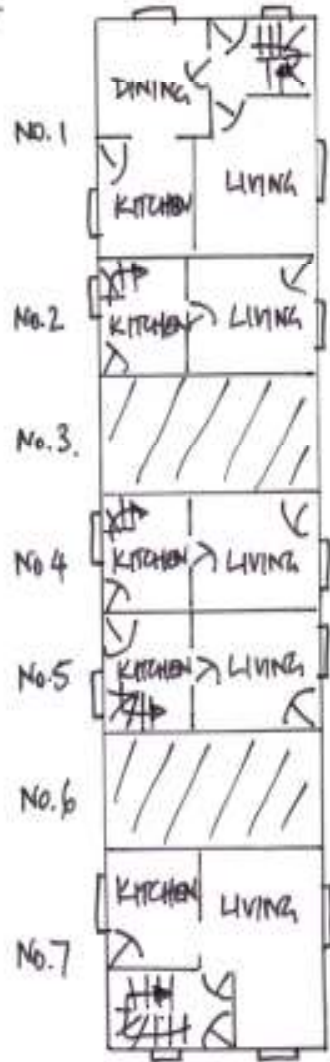
GROUND FLOOR



FIRST FLOOR

	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





GROUND FLOOR



FIRST FLOOR



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

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



Research for SPAB Winter 2010 – 2011

Historic Buildings Energy Survey

- 4 dwellings
- Air permeability – reinforce or question orthodoxy?
- Air flow rates for chimneys
- Surface moisture conditions

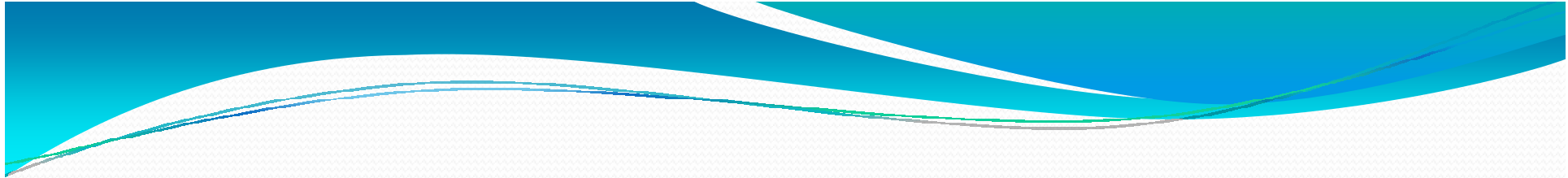


BRE Building Performance Group

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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