Section 6 - Energy

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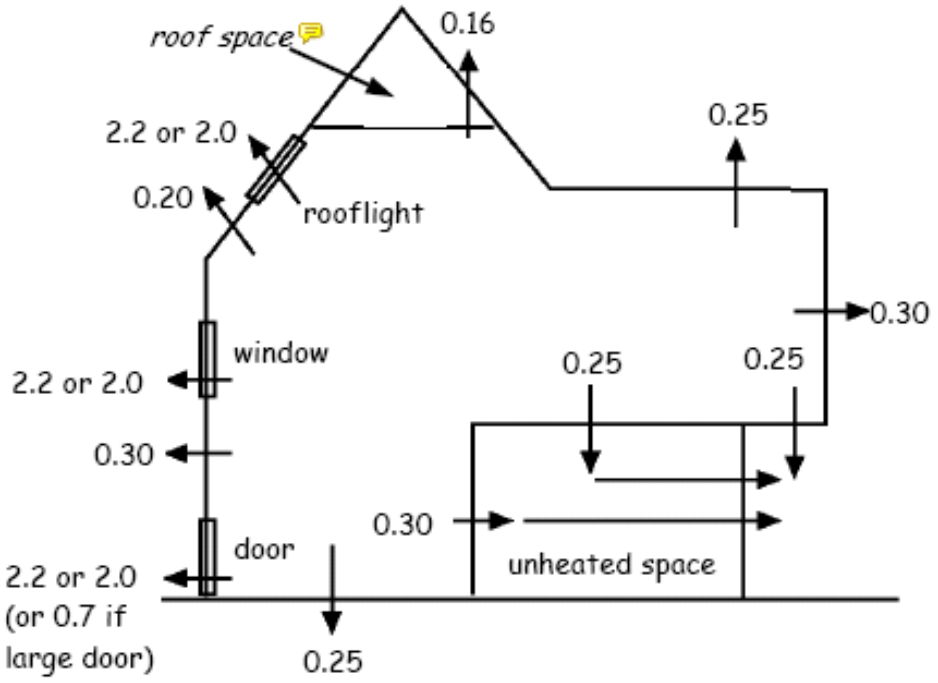
BACKGROUND

Where we were…

Compliance Routes

Elemental Method

Heat Loss Method



Easy!!!

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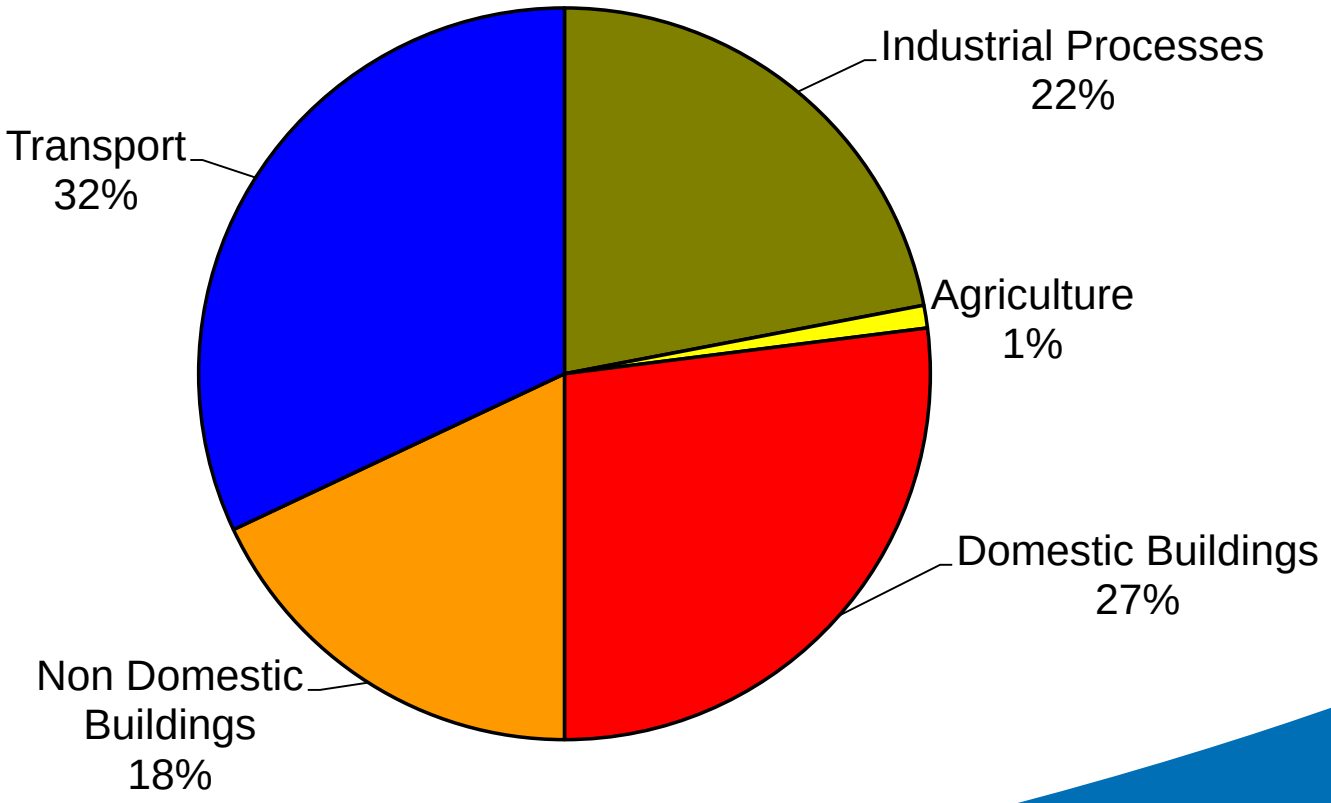
UK Carbon Emissions by Sector

(*source BRE*)



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DRIVERS FOR SECTION 6

Future Issues

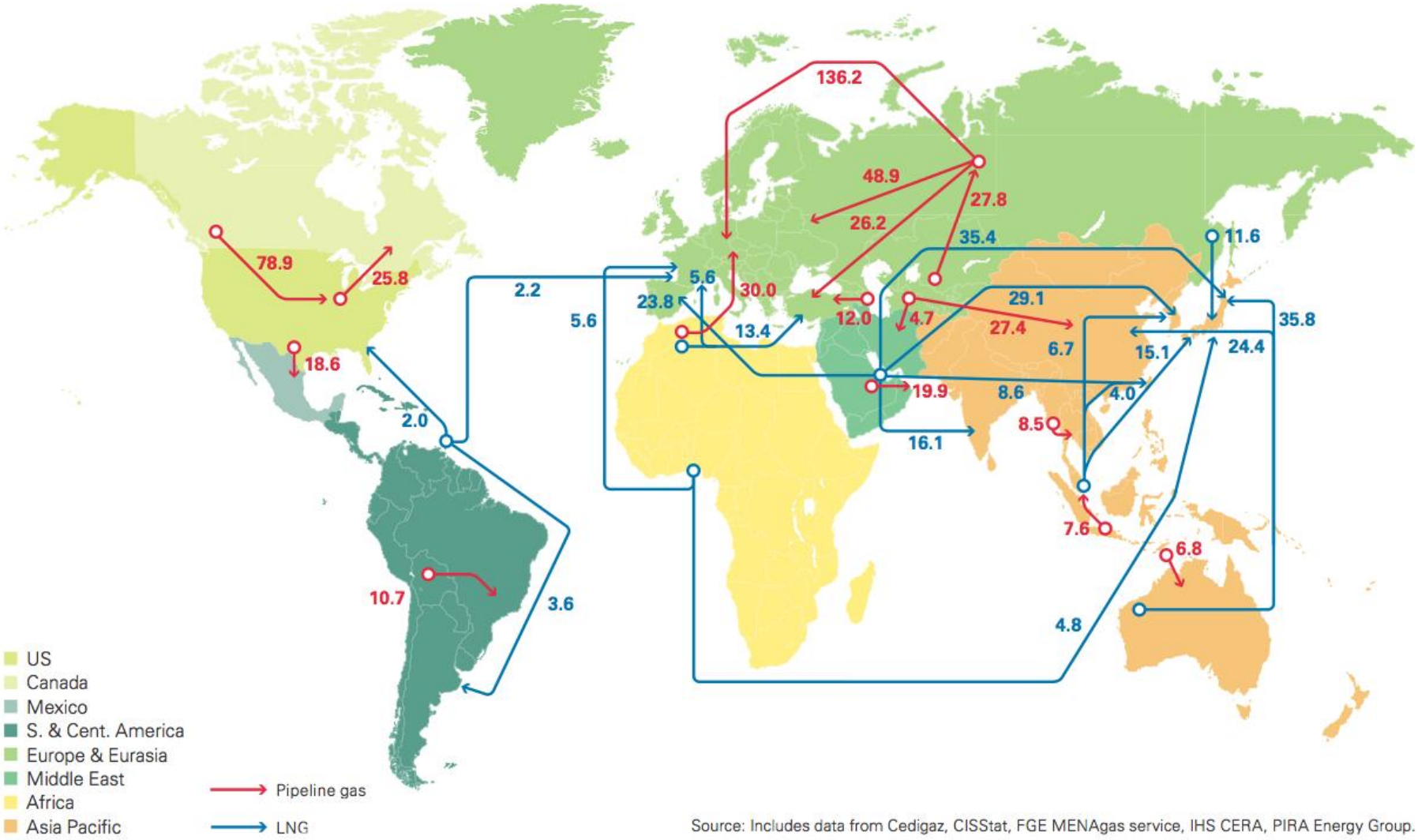
- Energy Security
- Climate Change
- Political Targets

Energy Security

More than 50% of EU energy comes from fuel from non-EU states

Major trade movements 2013

Trade flows worldwide (billion cubic metres)



Source: Includes data from Cedigaz, CISStat, FGE MENAgas service, IHS CERA, PIRA Energy Group.

Energy Performance of Buildings Directive (EPBD)

"To promote the improvement of the energy performance of buildings within the Community, taking into account outdoor climatic and local conditions, as well as indoor climate requirements and cost-effectiveness"

(Directive 2002/91/EC, 16 December 2002)

EPBD Objectives

- Develop a general framework for calculation of energy performance of buildings;
- Minimum energy performance requirements for new buildings and large renovations;
- Energy performance certificates;
- Building service inspections;
- Subsidiarity – each member state to choose measures that best correspond to their circumstances.

EU Climate Action and Renewable Energy Package

Agreed December 2008

20-20-20 Target: By 2020 –

- 20% less CO_2 (compared to 1990 levels)
- 20% of generation mix from renewable sources

EPBD 2 (Recast) - targets

- Total EU energy consumption reduced by 5-6% by 2020.
- 5% less CO_2 emissions by whole EU in 2020.
- Improved and more reliable information.
- Targets for Low / Zero Carbon buildings.
- Creating a demand as well as imposing prescriptive energy targets.
- Public sector to lead by example.

National Targets for Carbon Emissions

- 2006 – UK Government target to reduce carbon emissions by 60% below 1990 baseline;
- 2007 – UK government announce all new homes will be zero carbon from 2016;
- 2008 – UK Government increase target to 80 reduction!

Changing Building Standards – Scotland (2007)

- Increases in energy standards in 2010 and 2013;
- Net zero carbon emissions for space heating, hot water, lighting and ventilation within the next 10 years, if practical;
- Ambition of total-life zero carbon buildings by 2030.

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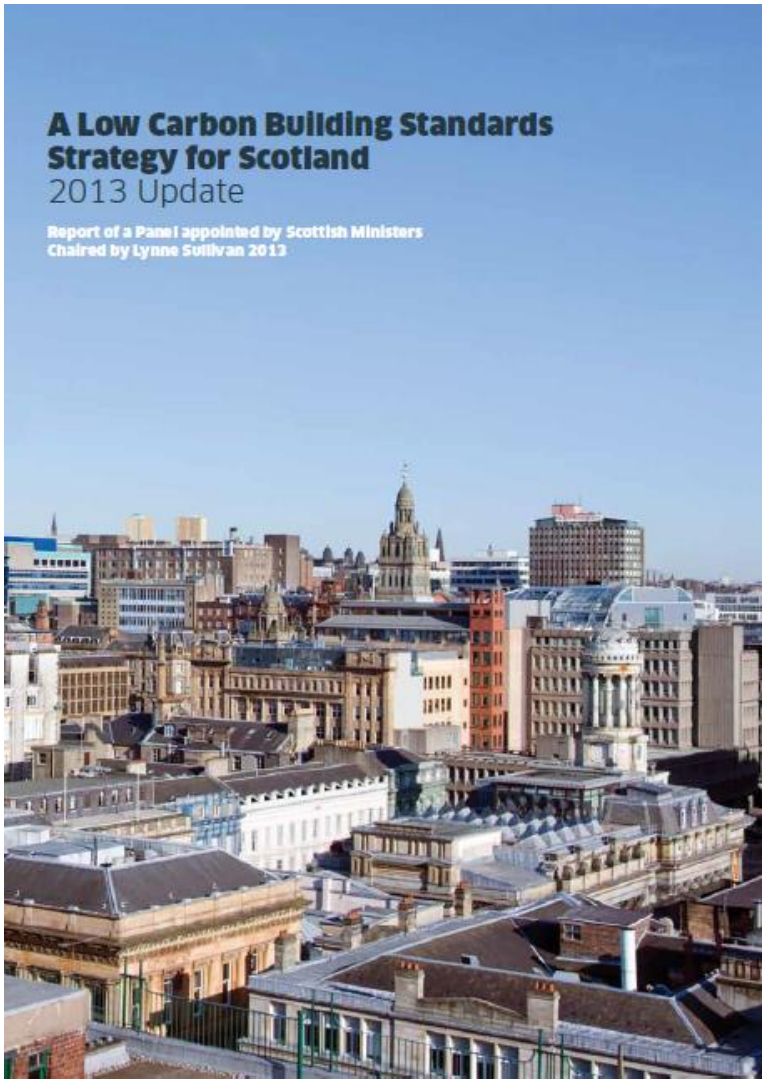
New Thinking? (2013)

- Slower lead in of 2013 proposals – 2015
- “Nearly Zero energy” new buildings from 2019.
- Net Zero Carbon Standard?
- Closer Planning and Building Standards.



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Zero Carbon Buildings?

How are we going to deliver this?

- Low-carbon electricity by 2030 through increase renewables and the implementation of carbon capture and storage (CCS) technology;
- Adoption of low-carbon vehicles and electrification of the rail network;
- Low-carbon heating through reduced demand, better energy efficiency and more use of renewable and low-carbon heating systems;
- Reduced emissions from agriculture and more woodland planting.

From Scottish Government - Climate Change Delivery Plan

SECTION 6

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Section 6.1 – Carbon dioxide emissions

Standard 6.1

Every building must be designed and constructed in such a way that:

a. **the energy performance is estimated in accordance with a methodology of calculation approved under regulation 7(a) of the Energy Performance of Buildings (Scotland) Regulations 2008, and**

b. **the energy performance of the building is capable of reducing carbon dioxide emissions.**

Section 6.2 – Building Insulation Envelope

Standard 6.2

Every building must be designed and constructed in such a way that an insulation envelope is provided which reduces heat loss.

Limitation:

This standard does not apply to:

a. non-domestic buildings which will not be heated, other than heating provided solely for the purpose of frost protection

b. communal parts of domestic buildings which will not be heated, other than heating provided solely for the purpose of frost protection, or

c. buildings which are ancillary to dwellings, other than conservatories, which are either unheated or provided with heating which is solely for the purpose of frost protection.

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Section 6.3 – Heating Systems

Standard 6.3

Every building must be designed and constructed in such a way that the heating and hot water service systems installed are energy efficient and are capable of being controlled to achieve optimum energy efficiency.

Limitation:

This standard does not apply to:

a. buildings which do not use fuel or power for controlling the temperature of the internal environment, or

b. heating provided solely for the purpose of frost protection.

Section 6.4 - Insulation of pipes, ducts and vessels

Standard 6.4

Every building must be designed and constructed in such a way that temperature loss from heated pipes, ducts and vessels, and temperature gain to cooled pipes and ducts, is resisted.

Limitation:

This standard does not apply to:

a. buildings which do not use fuel or power for heating or cooling either the internal environment or water services

b. buildings, or parts of a building, which will not be heated, other than heating provided solely for the purpose of frost protection, or

c. pipes, ducts or vessels that form part of an isolated industrial or commercial process.

Section 6.5 – Artificial and display lighting

Standard 6.5

Every building must be designed and constructed in such a way that the artificial or display lighting installed is energy efficient and is capable of being controlled to achieve optimum energy efficiency.

Limitation:

This standard does not apply to:

a. process and emergency lighting components in a building, or

b. alterations in dwellings or a building ancillary to a dwelling.

Section 6.6 – Mechanical ventilation and air conditioning

Standard 6.6

Every building must be designed and constructed in such a way that:

a. **the form and fabric of the building minimises the use of mechanical ventilating or cooling systems for cooling purposes, and**

b. **ventilating and cooling systems installed are energy efficient and are capable of being controlled to achieve optimum energy efficiency.**

Limitation:

This standard does not apply to buildings which do not use fuel or power for ventilating or cooling the internal environment.

Section 6.7 – Commissioning Building Services

Standard 6.7

Every building must be designed and constructed in such a way that energy supply systems and building services which use fuel or power for heating, lighting, ventilating and cooling the internal environment and heating the water, are commissioned to achieve optimum energy efficiency.

Limitation:

This standard does not apply to:

a. major power plants serving the National Grid

b. the process and emergency lighting components of a building

c. heating provided solely for the purpose of frost protection, or

d. energy supply systems used solely for industrial and commercial processes, leisure use and emergency use within a building.

Section 6.8 - Written Information

Standard 6.8

The occupiers of a building must be provided with written information by the owner:

a. **on the operation and maintenance of the building services and energy supply systems, and**

b. **where any air-conditioning system in the building is subject to regulation 17, stating a time-based interval for inspection of the system.**

Limitation:

This standard does not apply to:

a. major power plants serving the National Grid

b. buildings which do not use fuel or power for heating, lighting, ventilating and cooling the internal environment and heating the water supply services

c. the process and emergency lighting components of a building

d. heating provided solely for the purpose of frost protection

e. lighting systems in a domestic building, or

f. energy supply systems used solely for industrial and commercial processes, leisure use and emergency use within a building.

Section 6.9 – Energy Performance Certificate

Standard 6.9

Every building must be designed and constructed in such a way that:

a. **an energy performance certificate for the building is affixed to the building, and ***

c. **the energy performance certificate is displayed in a prominent place within the building**.

Limitation:

a. This standard does not apply to:

   i. buildings which do not use fuel or power for controlling the temperature of the internal environment

   ii. non-domestic buildings and buildings that are ancillary to a dwelling that are stand alone having an area less than 50 square metres

   iii. conversions, alterations and extensions to buildings other than -

      (aa) alterations and extensions to stand-alone buildings having an area less than 50 square metres that would increase the area to 50 square metres or more, and

      (bb) alterations to buildings involving the fit-out of the building shell which is the subject of a continuing requirement, or

b. Standard 6.9(c) only applies to buildings:

   i. with a floor area of more than 250 square metres

   ii. into which members of the public have an express or implied licence to enter, and

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Section 6.10 - Metering

Standard 6.10

Every building must be designed and constructed in such a way that each building or part of a building designed for different occupation is fitted with fuel and power meters.

Limitation:

This standard does not apply to:

a. domestic buildings

b. district or block heating systems where each part of the building designed for different occupation is fitted with heat meters, or

c. heating fired by solid fuel or biomass.

The Technical Requirements

- Progressive step changes in performance requirement.
- Progressive step changes in complexity.
- Most Recent Change was October 2015

Section 6.1 – Changes

- Housing - Overall aim is to reduce CO2 by 21% compared to 2010 levels.
- Non-Domestic - Overall aim is to reduce CO2 by 43% compared to 2010 levels.
- Now Fuel independent calculation.

Part L 2014 – Changes

- Housing - Overall aim is to reduce CO2 by 6% compared to 2010 levels.
- Non-Domestic - Overall aim is to reduce CO2 by 9% compared to 2010 levels.
- Different NCM calculation.

Section 6.2 – Backstop U-values for Non-Domestic

Element	Average for All (W/m^2K)	Individual Element (W/m^2K)
	2015	2015
Walls	0.27	0.7
Floor	0.22	0.7
Roof	0.2	0.35
Windows, doors, etc	2.0	3.3

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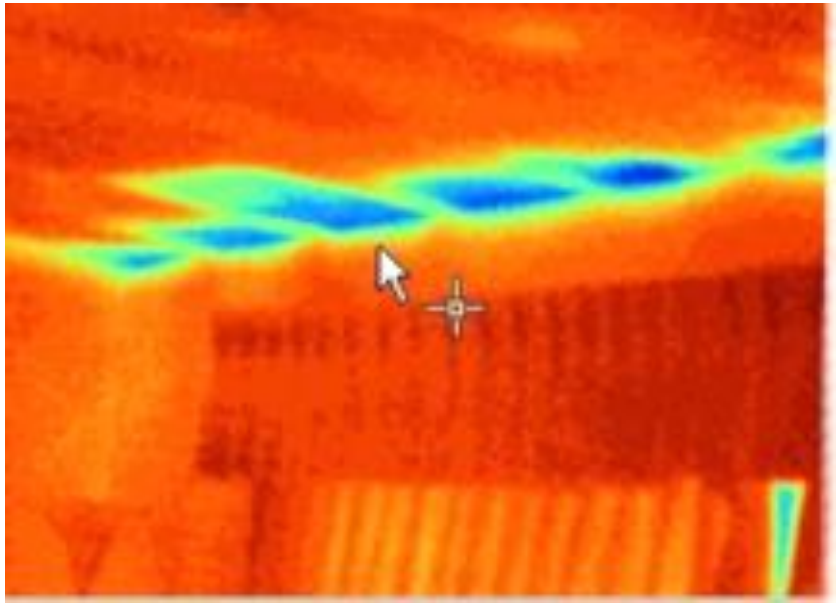
Section 6.2 – Airtightness testing

- Following the same direction taken by Part L in England and Wales;
- Sample fan pressurisation testing now to be required – BS EN 13829:2001;
- Standard of 10m3/hr/m2 @ 50Pa recommended;
- TER will assume better than standard;
- Possible to fail compliance based on being too leaky even when design was acceptable.

Post Construction Testing



Section 6.3 – 6.6 – Non-domestic Building Services Compliance Guide

http://www.gov.scot/Topics/Built-Environment/Building/Building-standards/techbooks/techhandbooks/ndbscg

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Comparing Section 6 and Part L

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Comparison of Section 6 and Part L

- Essentially same intention – conservation of fuel and power
- Different structure
- Many issues the same
- Some new differences in 2015 in the targets and calculations.

REFURBISHMENT ISSUES

External Wall Insulation Concerns

Cavity Bypass and Dampness

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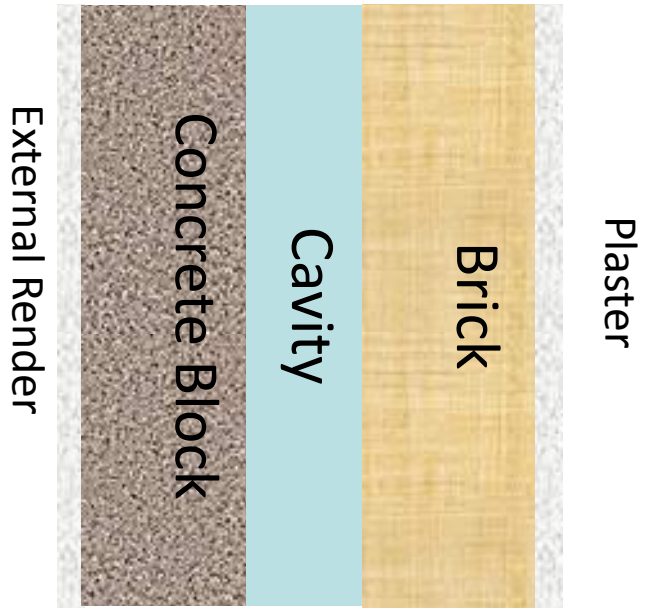
Introduction

External wall insulation (EWI) has been mainly applied to post-war social housing in Scotland.

These dwelling are generally of cavity wall construction, e.g.

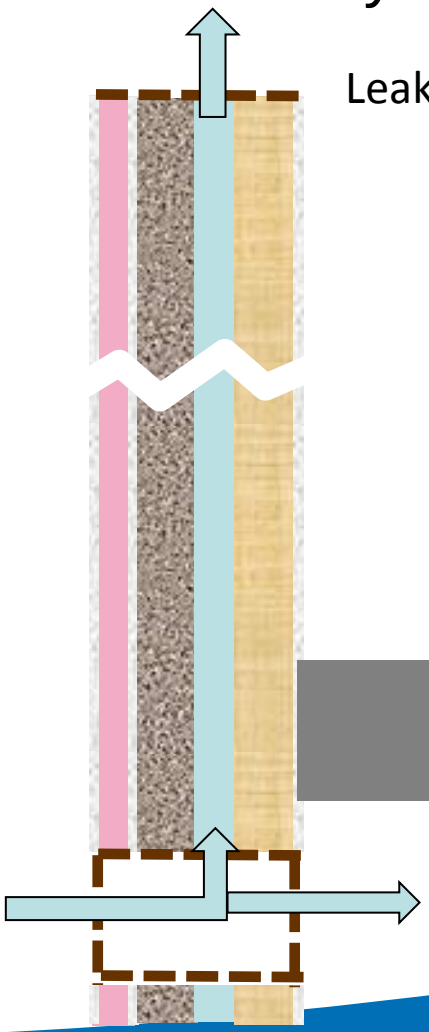


Introduction

Assuming an unventilated cavity, applying EWI should achieve good thermal performance depending on type and thickness.

Risk to Thermal Performance

Greatest risk is that thermal performance is compromised by ventilation of the cavity.



Leaky wall head closer

Floor

Leaky under floor vent, e.g. Slate box construction

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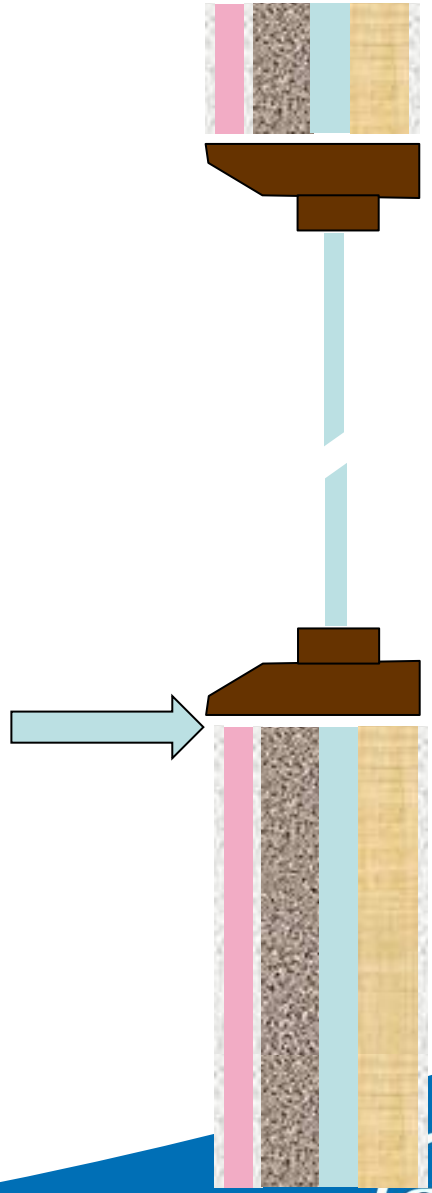
Risk to Thermal Performance

Leaky window opening.

Air and water penetration



Risk to Thermal Performance

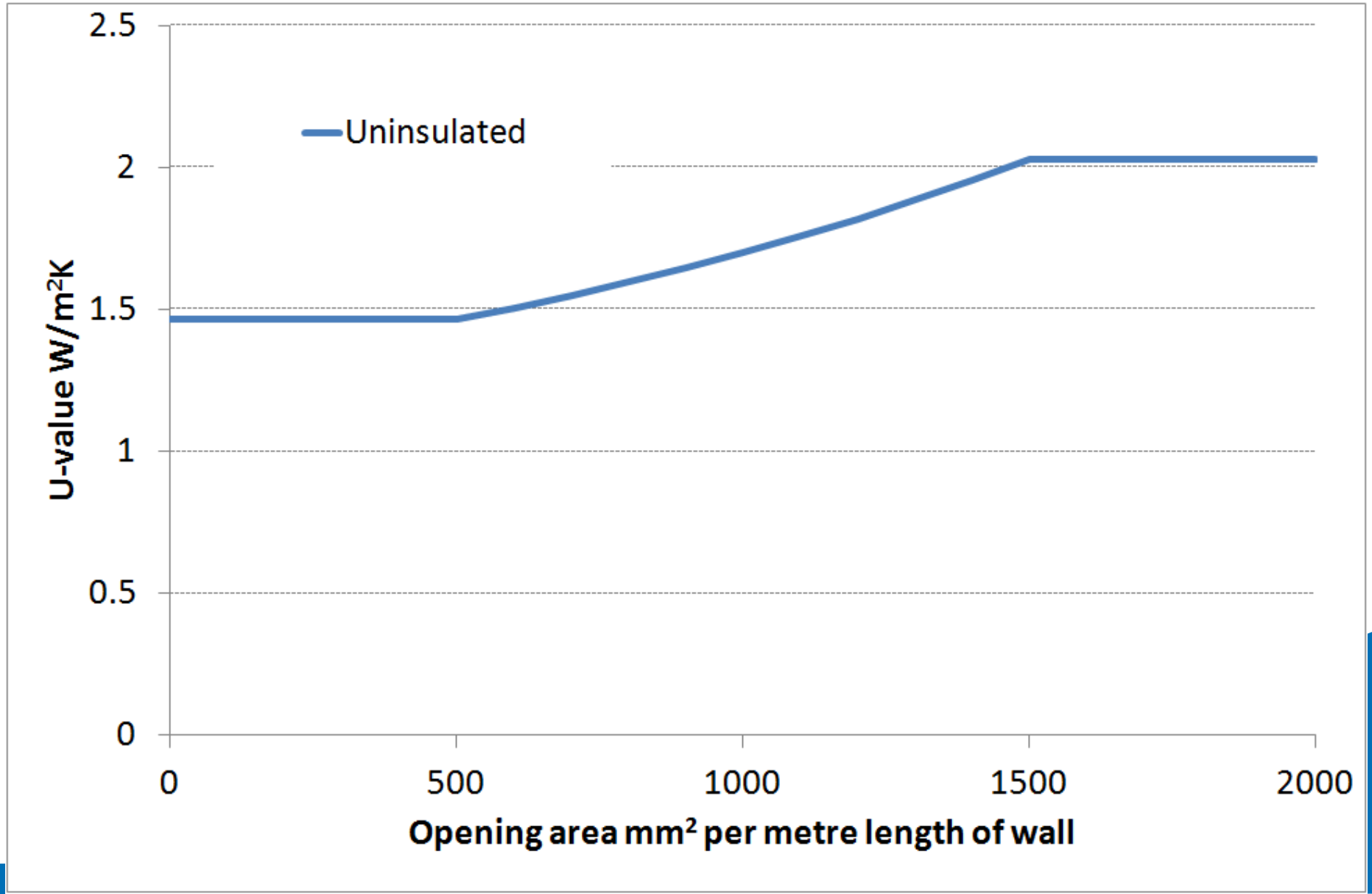
BRE U-value Calculator

The ventilation of an air layer is defined by:

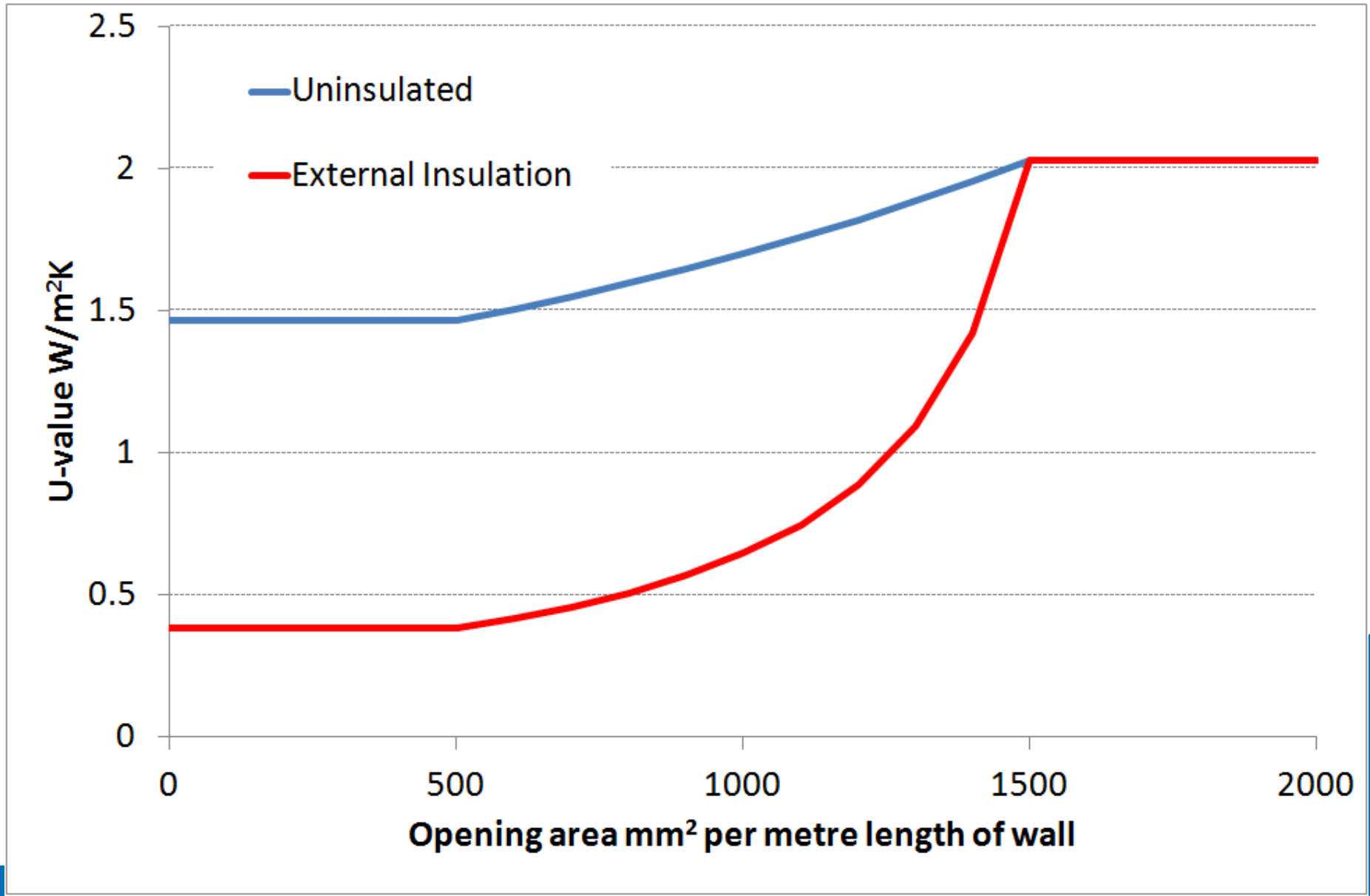
Walls

- Unventilated: openings <= 500 mm² per metre length;
- Slightly ventilated: 500 mm² < openings <= 1500 mm² per metre length;
- Ventilated: openings > 1500 mm² per metre length.

Effect of cavity ventilation – Original Construction



Effect of cavity ventilation – Adding EWI

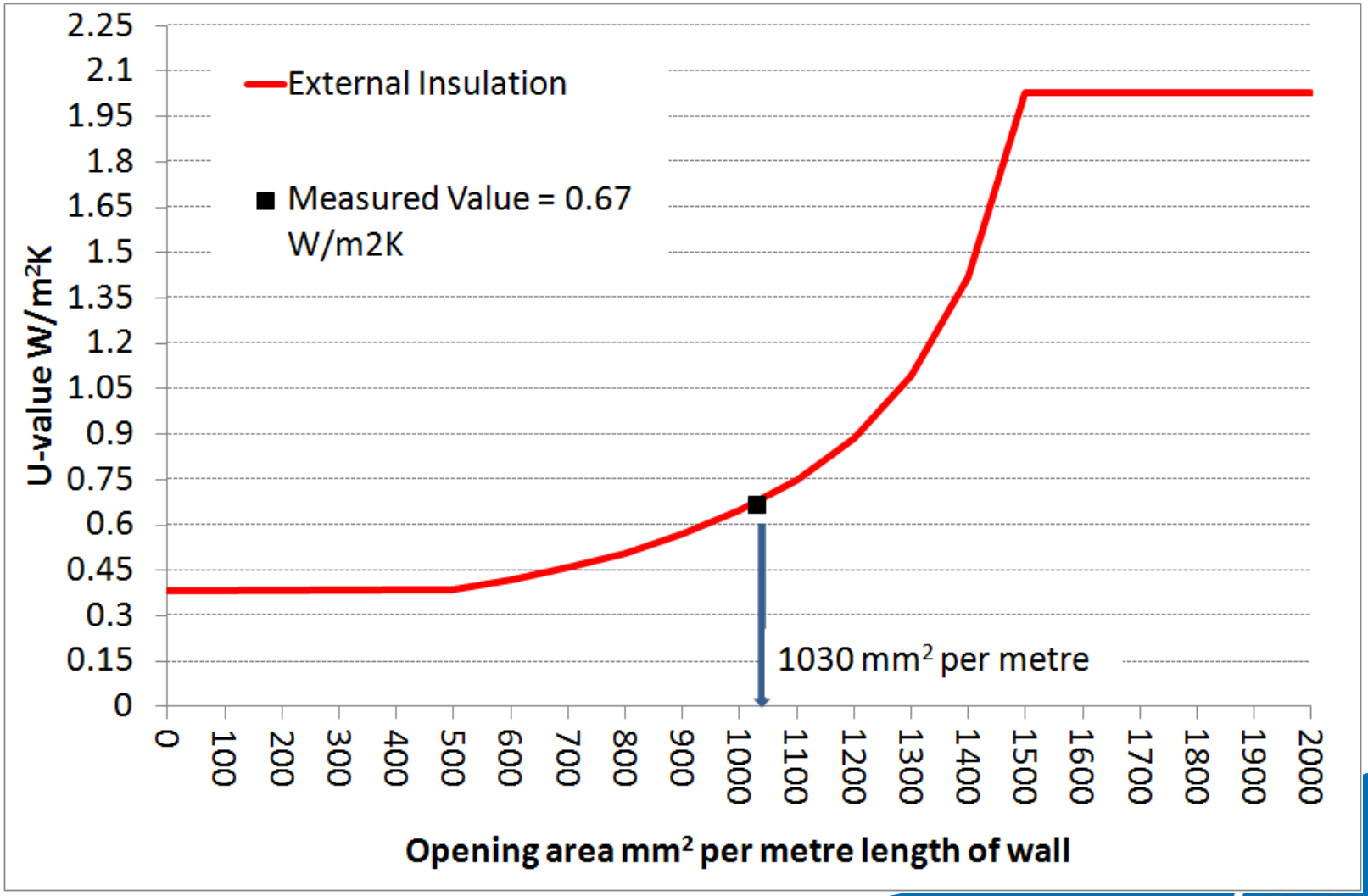


Effect of cavity ventilation – on site measurements

Expected U-value about 0.38 W/m^{2}K.

Measured U-value from 3 locations on gable wall 0.67 W/m^{2}K.

Effect of cavity ventilation – on site measurements



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Effect of cavity ventilation – on site measurements

Anemometer readings in cavity indicate air flow.

Removal of part of internal wall indicates that source is leaky slate under floor vent.

Solutions

Identify problem:

•Survey.

•Drill through external wall into cavity above floor vent – view with borescope or insert anemometer to test for air movement.

•Check for air flow using smoke test – observe for smoke at wall head.

Actions if required:

•Replace under floor vent.

•Seal wall head.

Risk of damp/mould

- Some anecdotal evidence – complaints by occupants of mould.
- Could be linked to air tightness?
- Ventilation strategy should be considered as well as insulation upgrade.
- Needs further study.

Internal Wall Insulation Concerns

Interstitial Condensation & Moisture Risk

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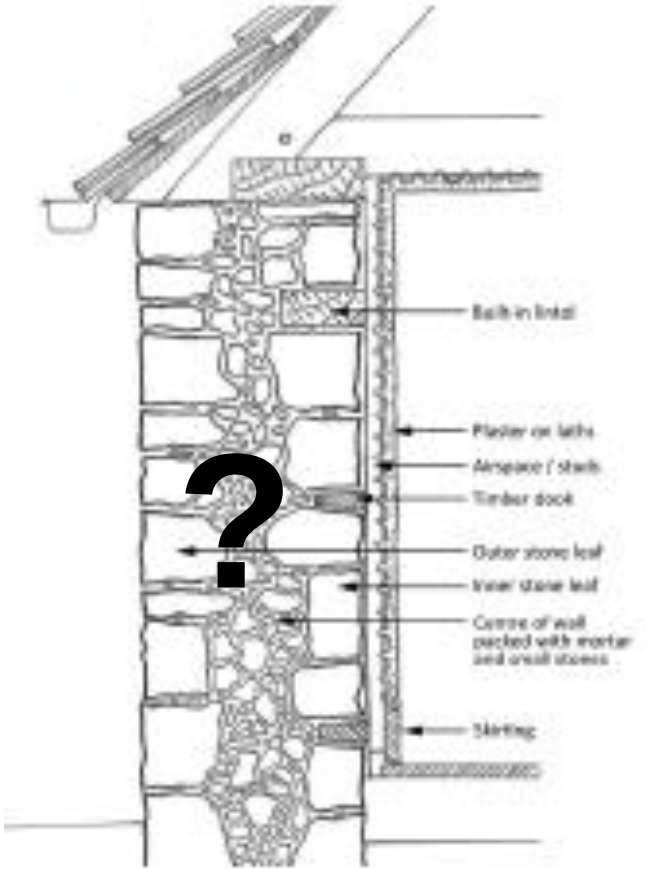
- EST's GPG 138 recommends the use of a vapour control layer (VCL) on the warm side of the insulation (as would expect in new build).
- However, there is an argument for more vapour open 'breathable' constructions, using insulation which is more vapour permeable and able to absorb moisture.
- Calculations according to BS EN ISO 13788 certainly support the use of a VCL.
- More sophisticated software such as WUFI, which considers moisture capacity and rain penetration, provide some evidence to support the contrary argument.
- What's correct?

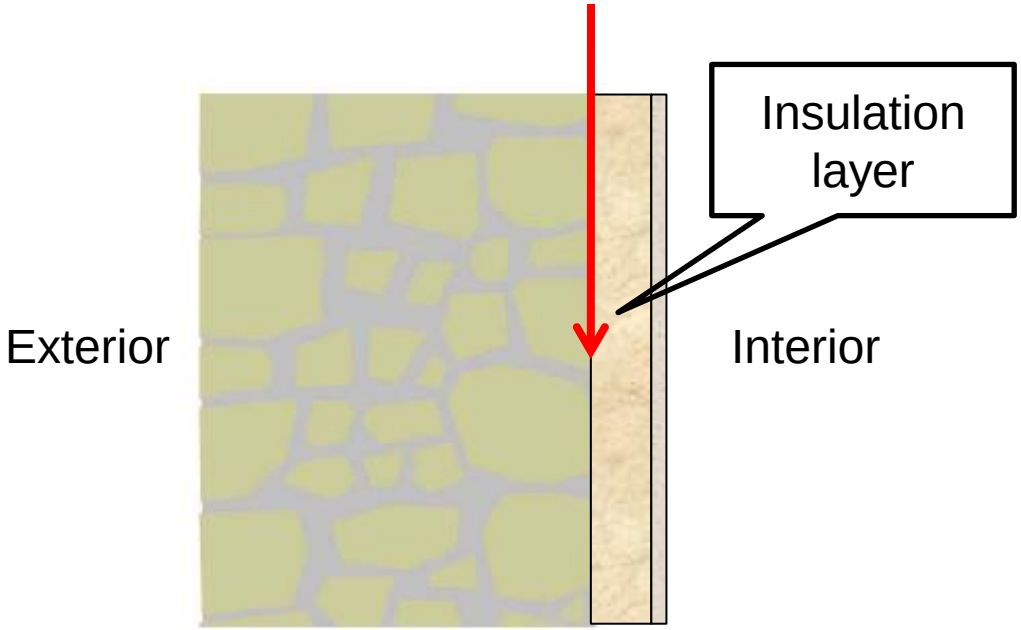
There are issues with modelling of traditional build-ups:

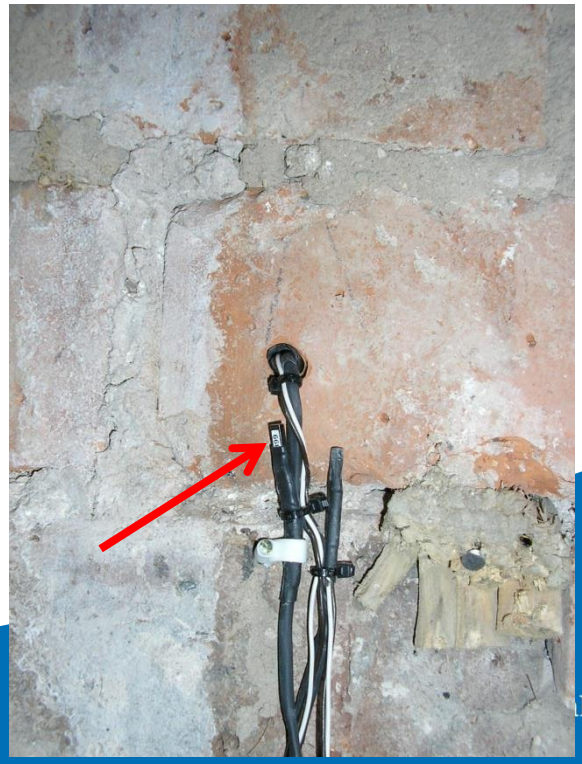
- Unknown construction details?
- Unknown material properties?
- Research is needed to address these problems including monitoring of actual performance.



Monitoring Methodology

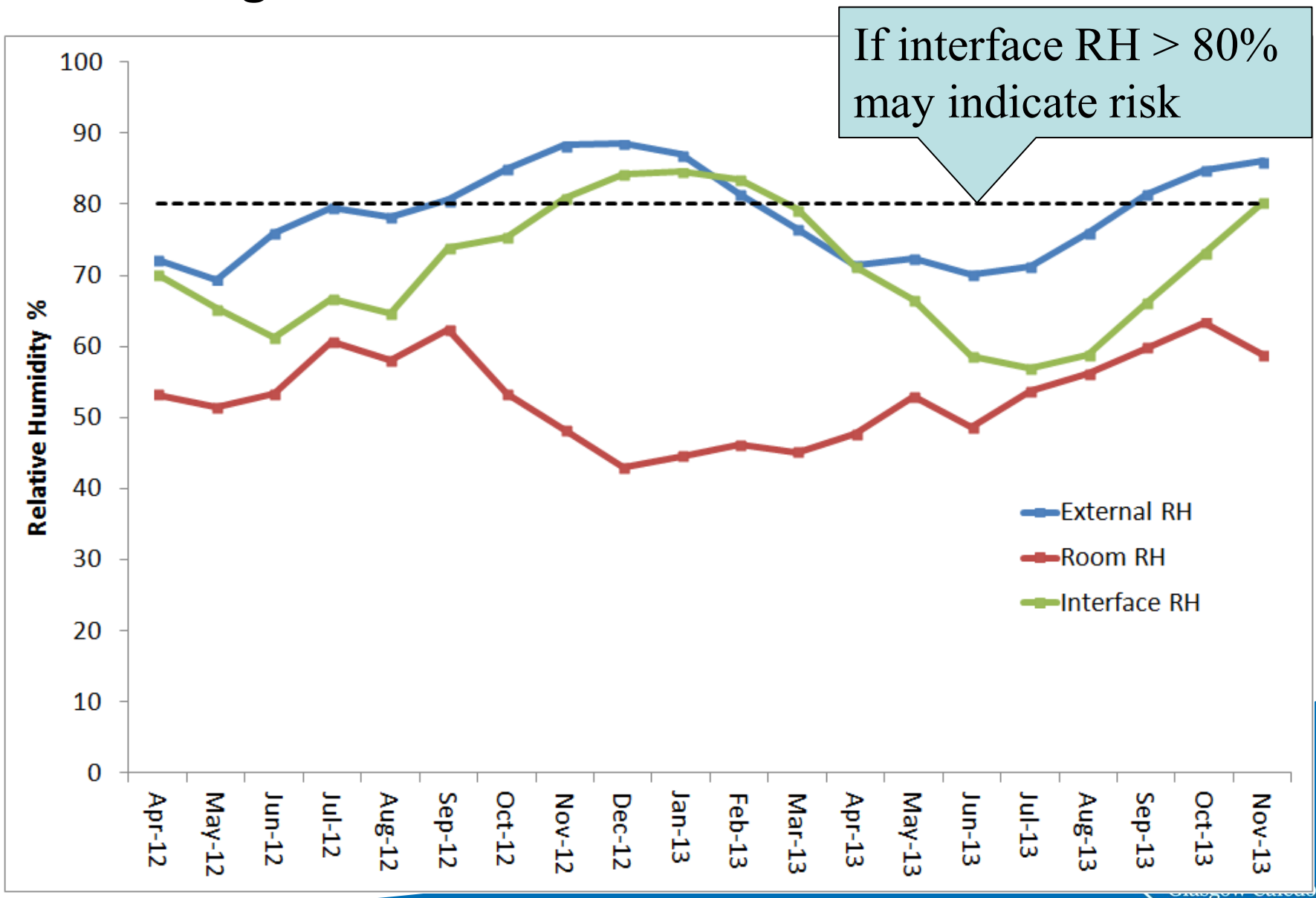
Calculations and experience shows that the risk of condensation is greatest at the interface between the masonry and the cold side of the insulation.



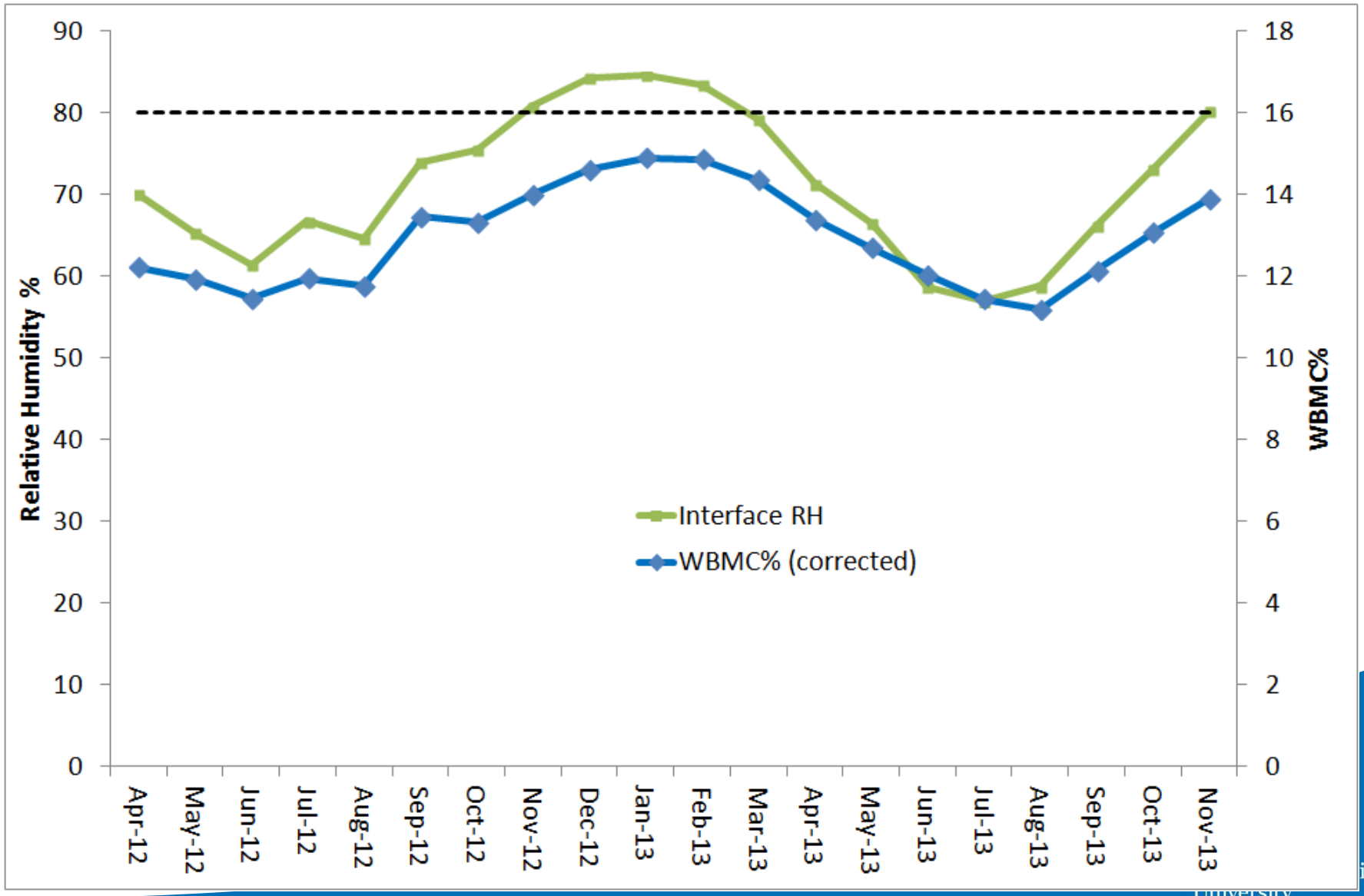


The simplest solution is to measure the Relative Humidity (& temperature) at the interface.
Sometimes we have added wooden blocks for “proxy” moisture measurements.

Monitoring – Relative Humidities



Wood Block Moisture contents indicate low risk



Problems and Unintended Consequences

Change in Emphasis on Importance of Fuel

- Before October 2015 – Actual building compared versus notional natural gas building – Biomass favoured fuel. Electric heating very difficult.

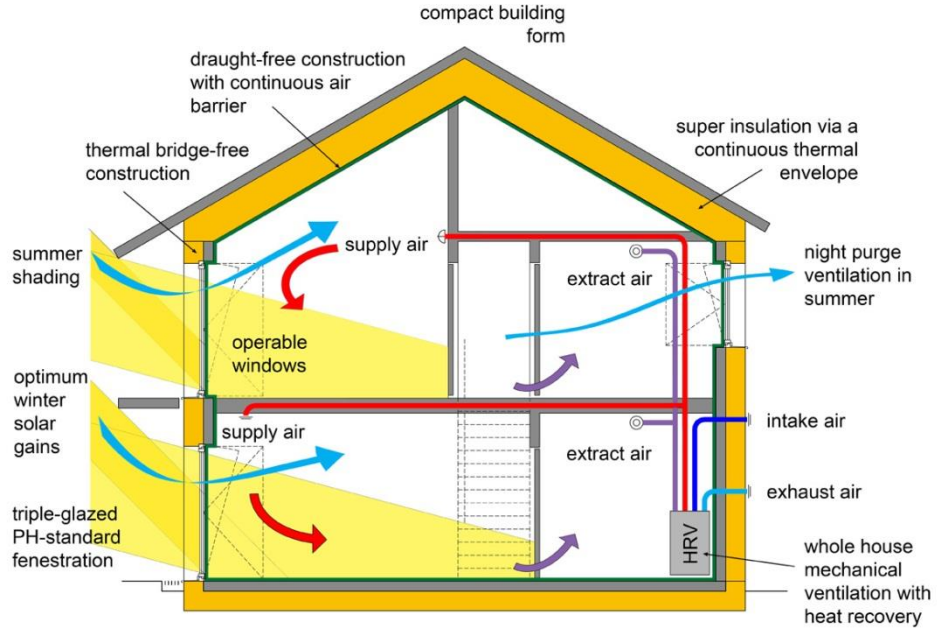
- Now – Compared against building with same fuel
  - Electric is a more attractive solution – Expensive to run and Fuel Poverty consequences…..
  - No incentive to use Biomass

Calculation Software Problems

- For non-domestic buildings - calculation software not ready for the release;
- Compliance relies on Software;
- What happened??

Ventilation Becoming an Issue?

- Increased pressure for airtightness improvements?
- Ventilation design often relies on trickle ventilation.
- Low air change rates unhealthy.
- Linked to condensation and mould issues.
- Passivehaus – tight construction but with mechanical ventilation.



Overheating Risk?

- Highly insulated buildings have a finely tuned heat balance. So zero carbon may be difficult
- Heat waves problematic.
- Extra occupants can be problematic
- Solution is to use mechanical cooling – but Energy intensive.

What about existing buildings?

- Building Standards have been sharpened to encourage new buildings to be thermally efficient.
- In UK only 1% of building stock is replaced annually.
- By 2050s 60% of current building stock will still be in use.
- Existing buildings are the problem, if politicians are serious they must be tackled.

Thank for your attention

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