

Carbonlite Retrofit Demo

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AECB Conference 2016

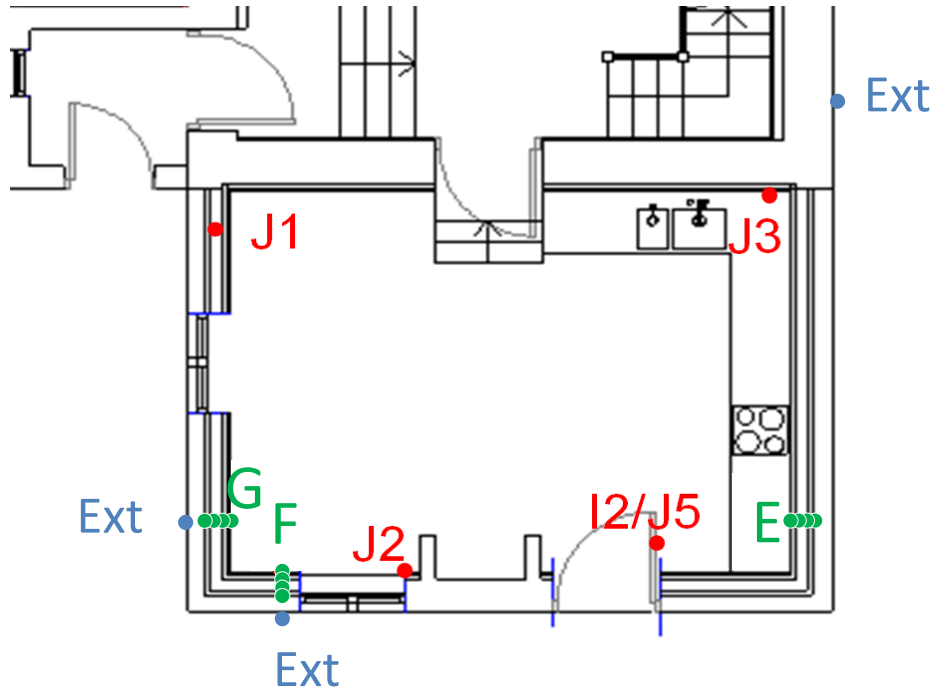
AECB monitors about 20 construction types on 10 sites including 4 construction types for commercial clients.

This presentation covers two examples from case Study 10, one of these is explained as an example in 5.16 of the course.

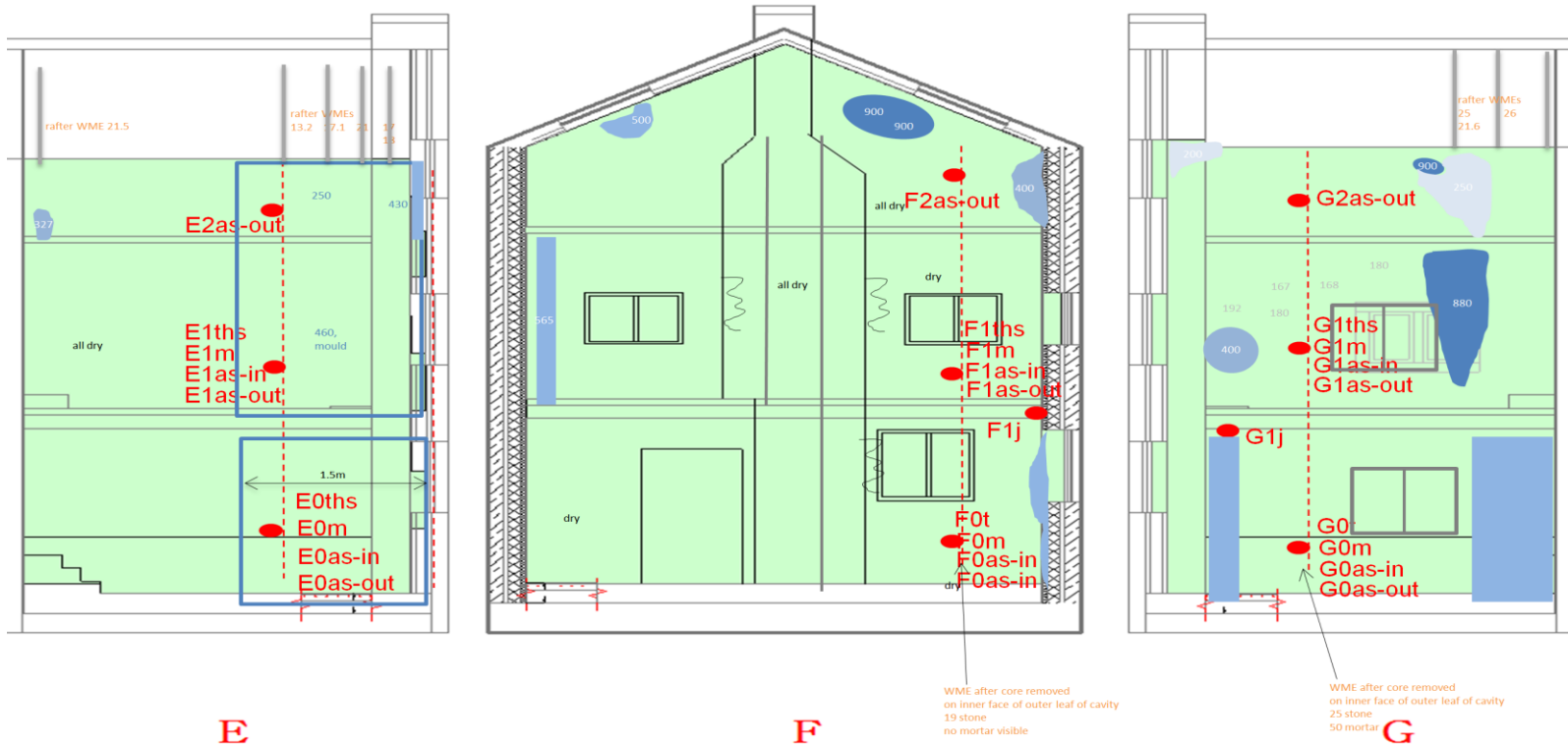
Key Details	
Original assembly	Cavity wall: concrete block inner leaf, stone outer leaf
Insulation	Mineral wool IWI with timber battens
Vapour control	Variable Vapour Resistance (VVR) membrane directly on inner face of insulation
Airtightness	1.5 ACH (aiming for AECB Silver)
Ventilation	MVHR installed
Area of interest	Insulation-masonry interface
Concerns	Risk of mould growth on insulation-masonry interface
Sensor type	Omnisense S-900-1 Wireless T, %RH, WME Sensor

Sensor Plan

- 3 sensor positions, E, F and G
- 3 external sensors Ext
- 1 internal sensor I2
- 3 joist sensors J1, J2, J5



Sensor Elevations



Name is composed of

Sensor position

Floor level

Surface

E East

F South

G West

0 Ground

1 1st Floor

2 2nd floor

ths

m

as-in

as-out

OSB

masonry-insulation interface

masonry, inner leaf of airspace

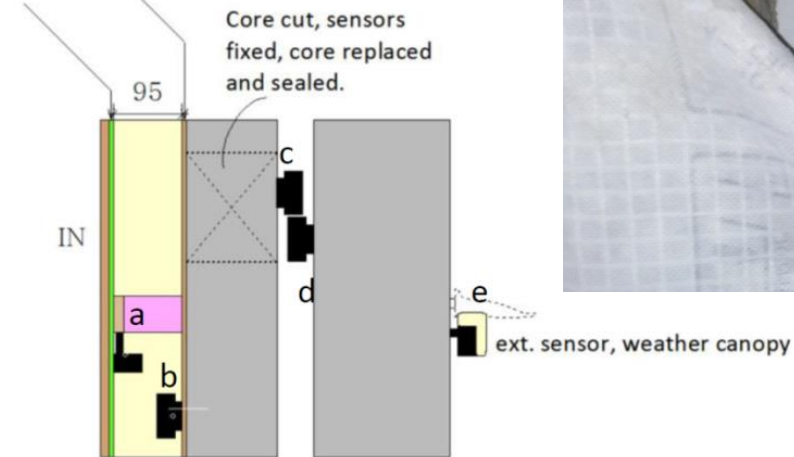
masonry, outer leaf of airspace

Cumberworth



Cumberworth

Mineral wool insulation
Existing gypsum retained
on basis of analysis in
WUFI



Sensor Layers

a:OSB

b:plaster/masonry inner leaf

c:masonry inner leaf/airspace

d:masonry outer leaf/airspace

e:external sensor

Two main questions in any case study:

1. Is the insulation working safely?

- a. What's the moisture content inside the wall and
- b. What is the rot risk for any timbers?
- c. What's the risk of mould?

2. If not, where is the moisture coming from and how?

- a. Rain via Capillary Flow?
- b. Inside the house via Vapour Diffusion?
- c. Hygroscopic Effects?

Insulation Type 1: mineral wool internal insulation.

1. Is the insulation working safely?

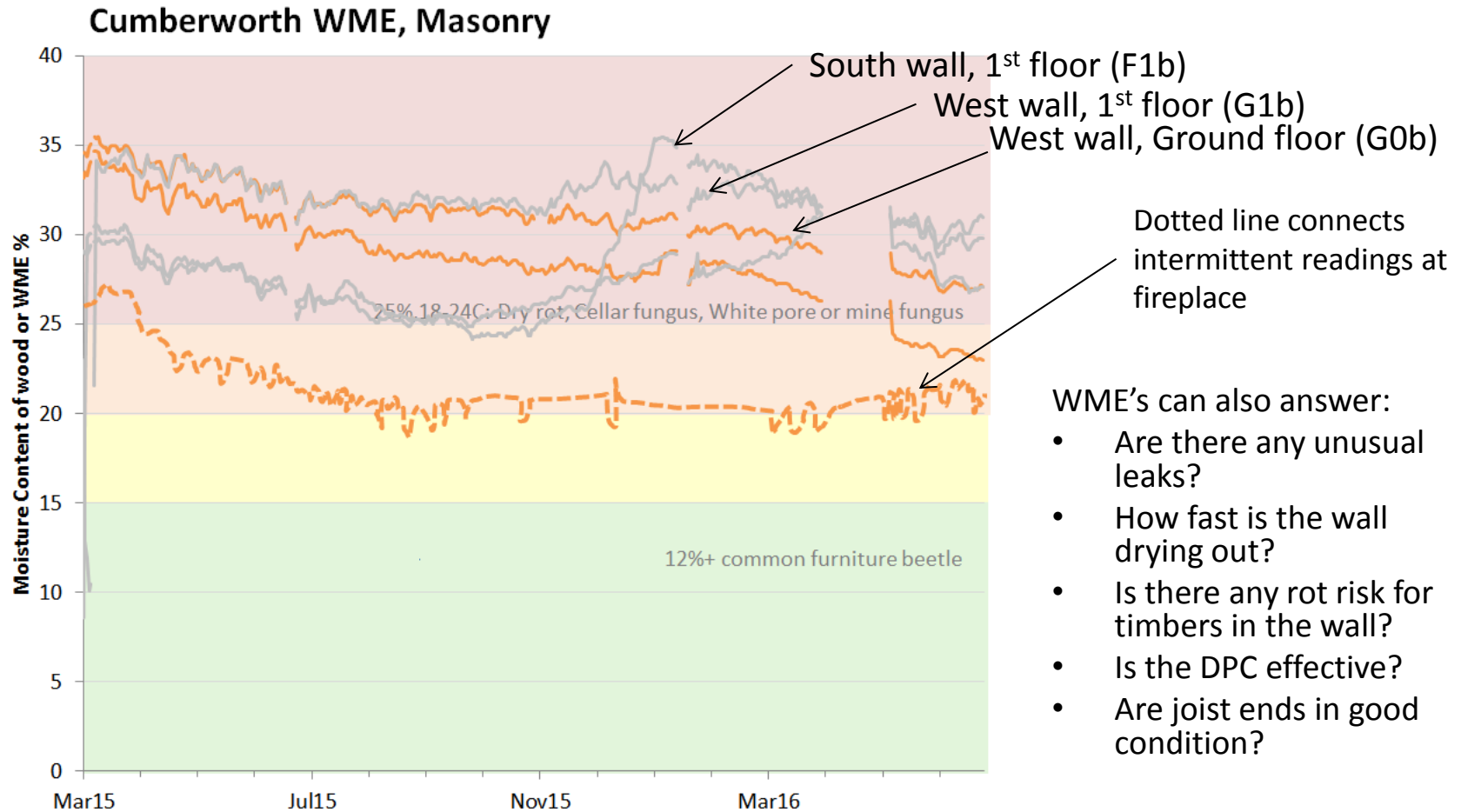
- a. What's the moisture content inside the wall and
- b. What is the rot risk for any timbers?
- c. What's the risk of mould?

2. If not, where is the moisture coming from and how?

- a. Rain via Capillary Flow?
- b. Inside the house via Vapour Diffusion?
- c. Hygroscopic Effects?

1. Is the insulation working safely?

a. What is the moisture content inside the wall?

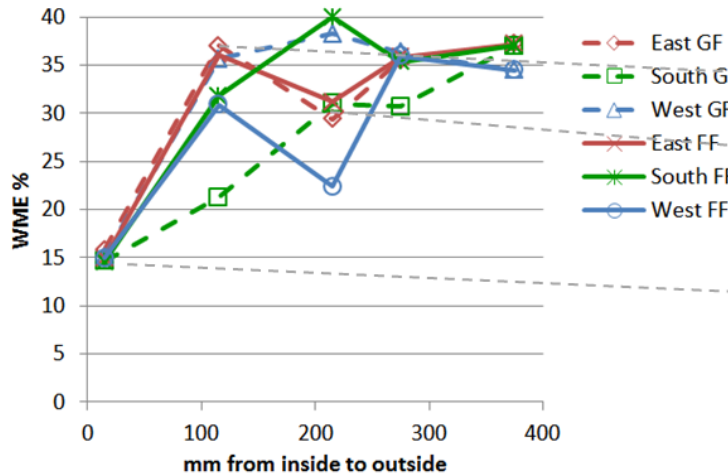


WME's can also answer:

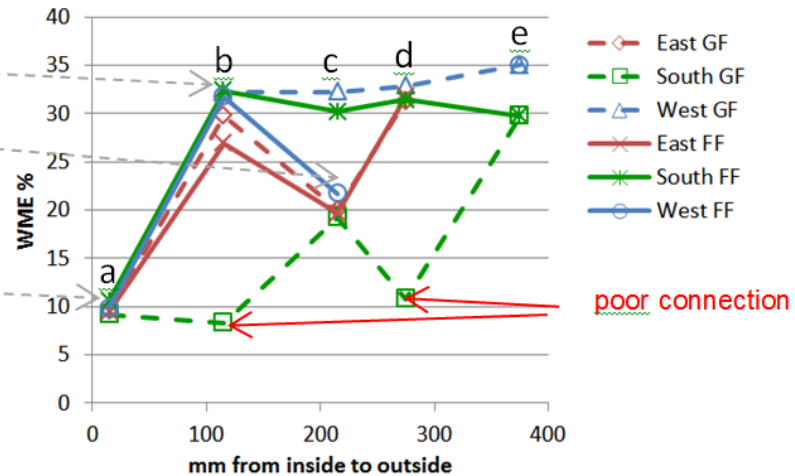
- Are there any unusual leaks?
- How fast is the wall drying out?
- Is there any rot risk for timbers in the wall?
- Is the DPC effective?
- Are joist ends in good condition?

Insulation Type 1: mineral wool IWI

a. What is the moisture content inside the wall as a Profile?



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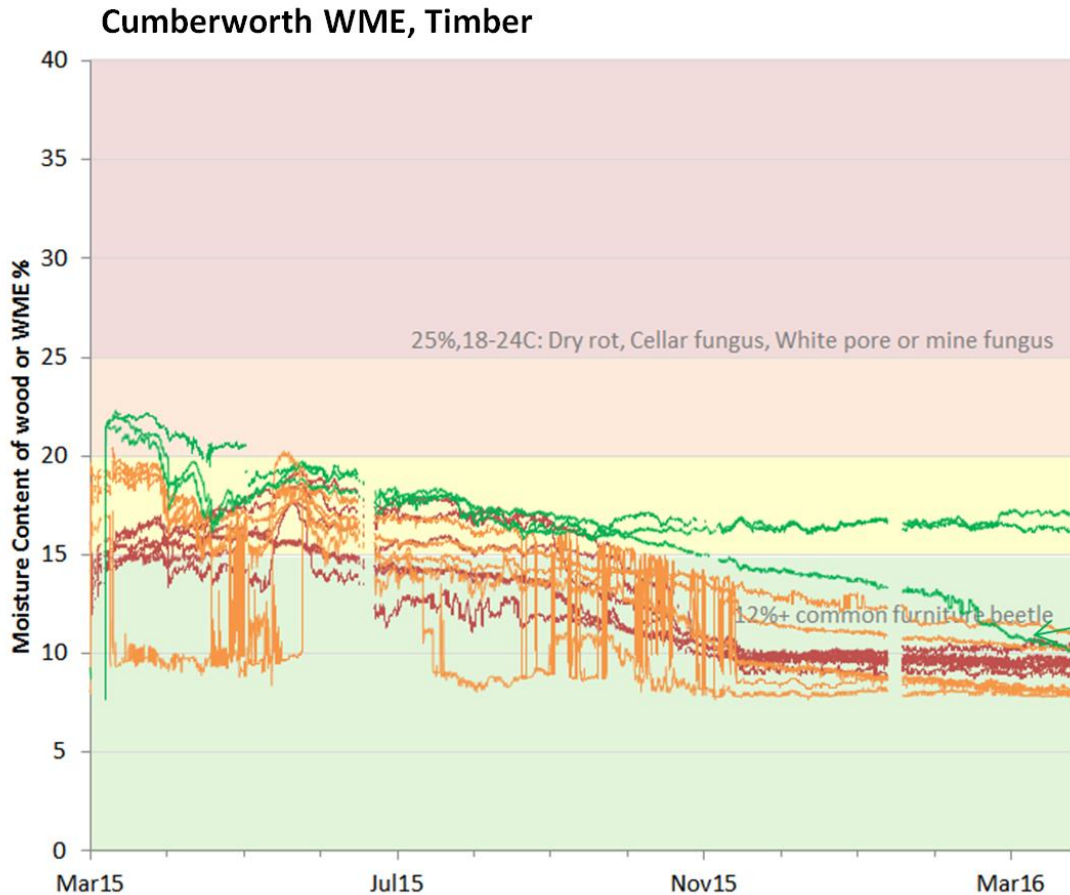


Mar 2016

	thickness	mm
Inside	Plasterboard/skim	15
	VVR membrane	-
	mineral wool	90
	plaster	10
	blockwork	100
	EPS attached to blockwork	25
	ventilated cavity is "exterior"	~50
Outside	Solid stone exterior wall	~400

1. Is the insulation working safely?

b. What's the rot risk for timber components?



- OSB has dried to safe levels
- Joists not under VVR have dried to safe levels (though have to be careful because 1 has poor connection)
- Two Joists haven't dried so well, both under VVR, J1 on West ext wall, J3 on cross wall

J1,J3 under VVR

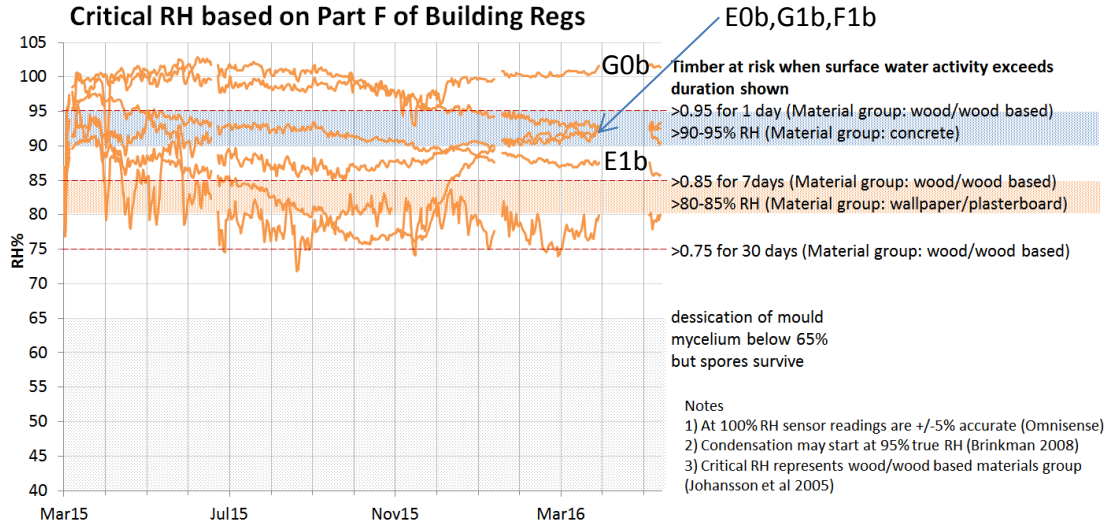
J5 under VVR

Joists not under VVR and layer a: OSB

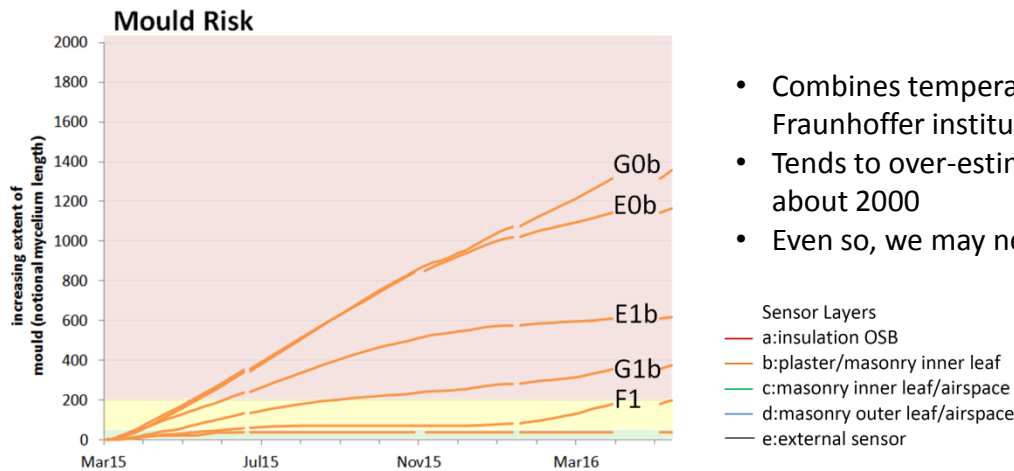
WME is corrected for temperature using Protimeter correction tables.

1. Is the insulation working safely?

c. What's the risk of mould?



- Building regs RH based mould risk, only valid near 20C
- Suggests a problem for G0b, E0b,G1b and F1b
- Some parts have high RH but temperature is low



- Combines temperature, RH and substrate in an algorithm published by the Fraunhofer institute for WUFI Bio
- Tends to over-estimate risk, actual measurements suggest no mould up to about 2000
- Even so, we may need to be careful for G0b and E0b

Insulation Type 1: mineral wool internal insulation.

1. is the insulation working safely?

- a. What's the moisture content inside the wall and
- b. What is the rot risk for any timbers?
- c. What's the risk of mould?

2. if not, where is the moisture coming from and how?

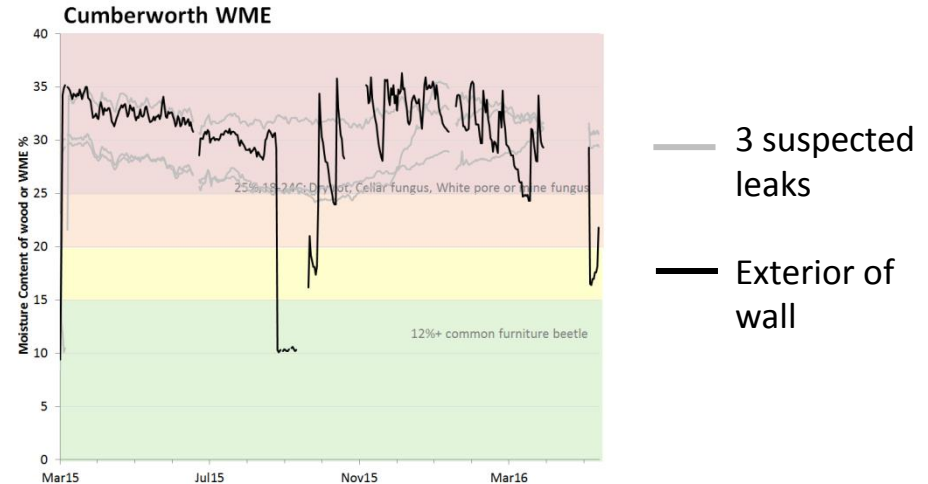
- a. Rain via Capillary Flow
- b. Inside the house via Vapour Diffusion?
- c. Hygroscopic Effects

2. If not, where is the moisture coming from and how?

a. Rain via Capillary Flow?

	Crossection E, (East)		Crossection F, (South)		Crossection G, (West)	
	Level 0	Level 1	Level 0	Level 1	Level 0	Level 1
a: OSB	9	9	9	10	9	9
b: masonry	30	27	18	32	32	31
c: as-in	19	18	18	29	32	20
d: as-out	31	31	10	30	33	

snapshot of WME at 31/3/16



There could be leaks at these 3 sensor positions,
 the moisture content for the leaks is similar to
 the exterior of the wall:
 South wall 1st floor (F1)
 West wall Ground floor (G0)
 West wall 1st floor (G1)

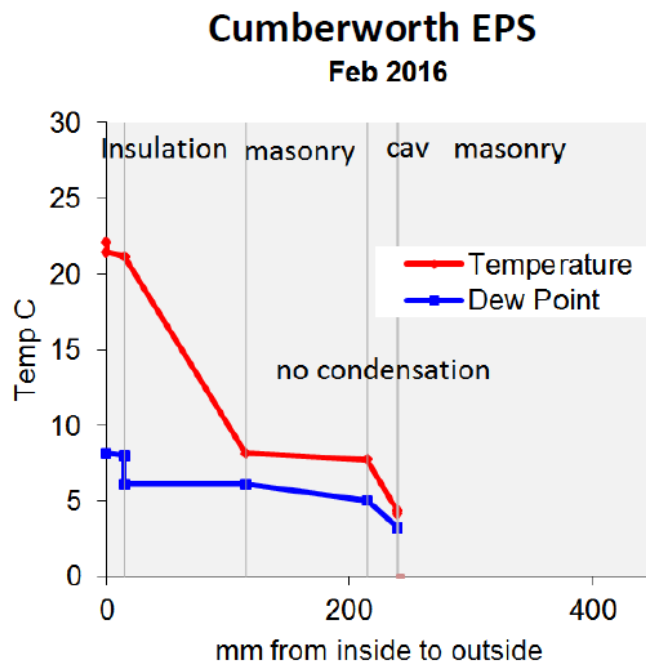
Cumberworth



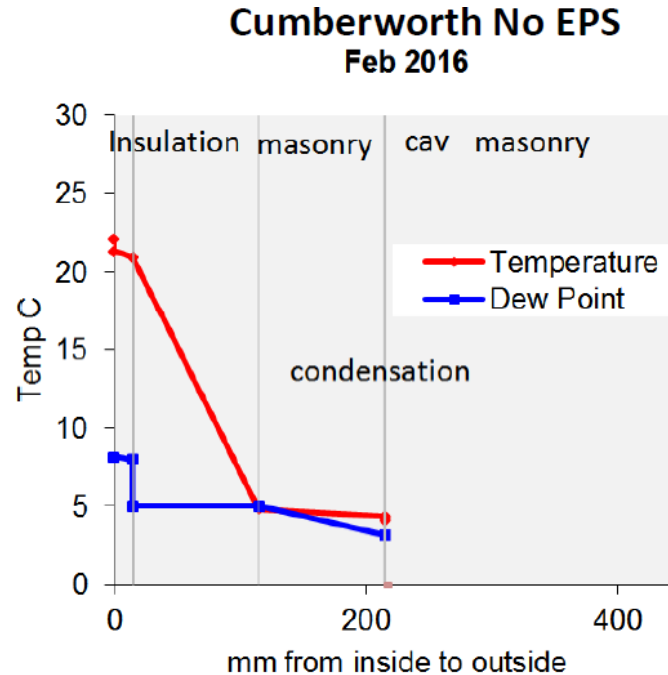


Photos of south wall under new extension

2. If not, where is the moisture coming from and how? b. Inside the house via Vapour Diffusion?



Typical results for Cumberworth when the EPS is included.

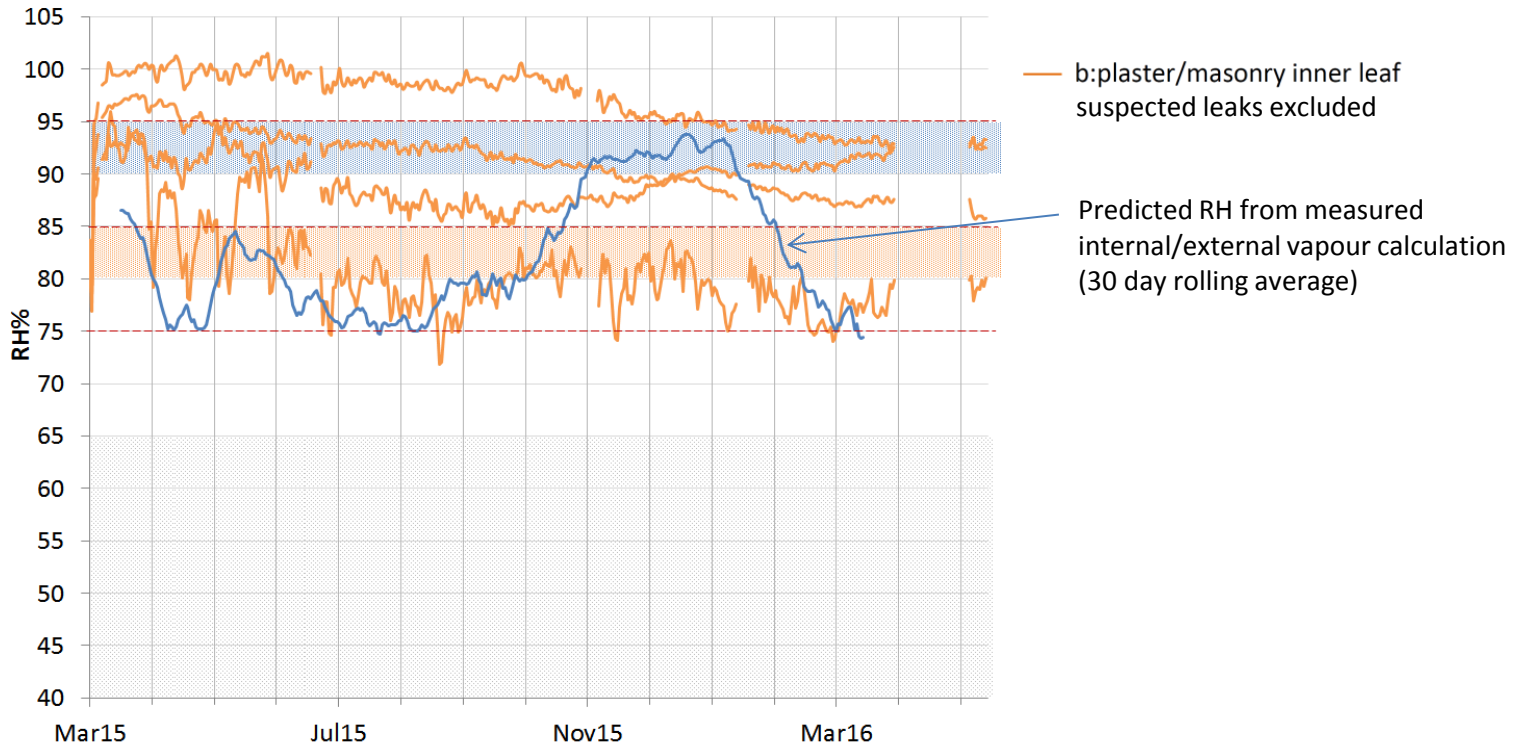


Condensation is borderline on the masonry for Feb 2016.

- Glaser suggests there could be some Interstitial condensation where there is no EPS in winter

2. If not, where is the moisture coming from and how? b. Inside the house via Vapour Diffusion?

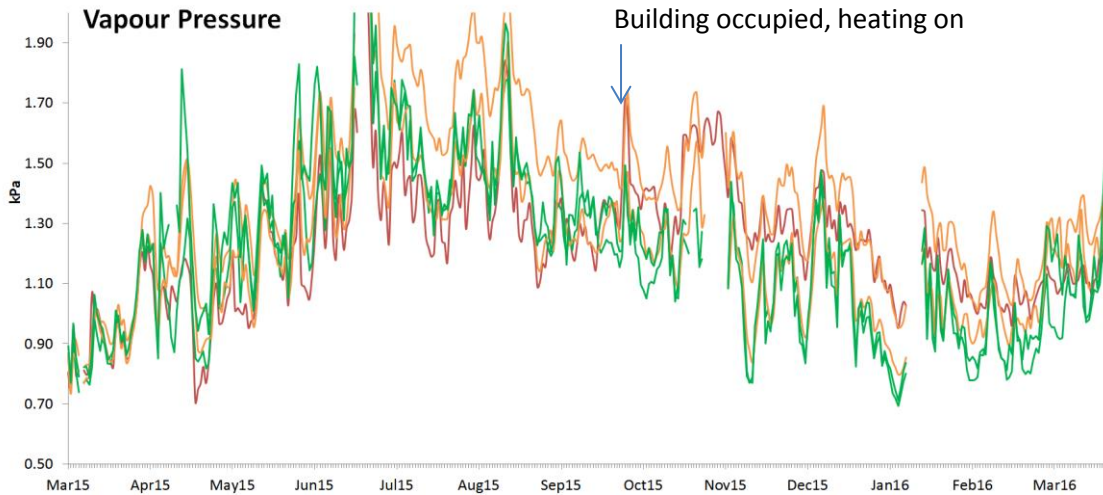
Critical RH based on Part F of Building Regs



- Trend in plaster/masonry inner leaf moisture content does not follow what we would expect from simple vapour calculations (using Glaser).

2. If not, where is the moisture coming from and how?

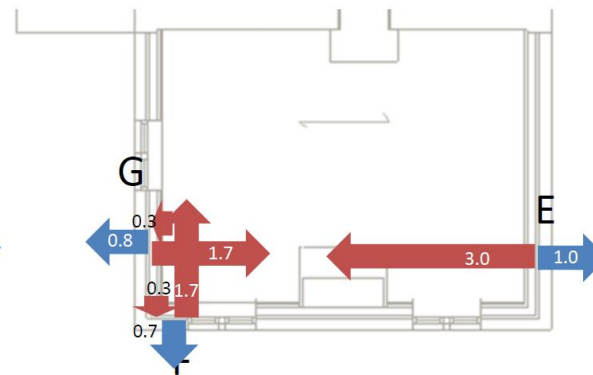
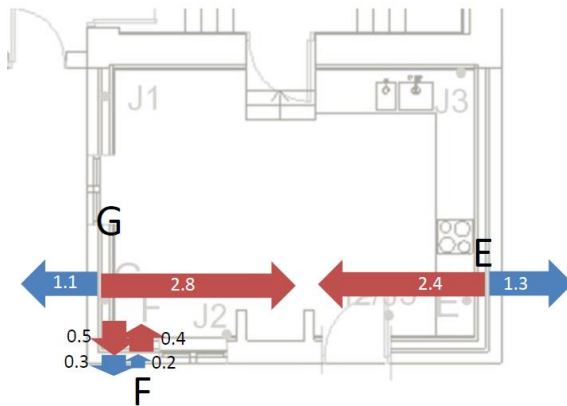
b. Inside the house via Vapour Diffusion?



- Vapour pressure from ground floor sensors (excluding suspected leak) suggests variable direction
- sometimes drying inwards and outwards from the centre of the wall.
- occasionally moving from the house interior into the wall.

Ground Floor

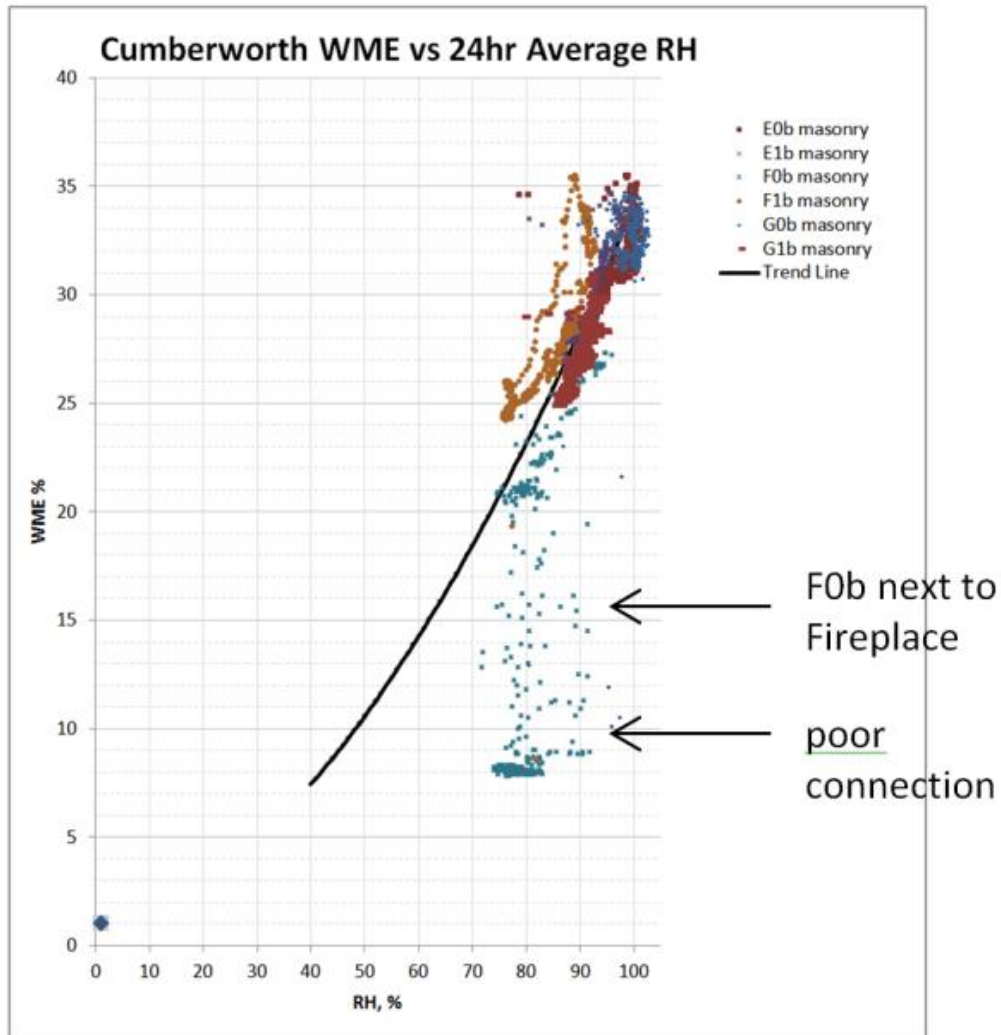
First Floor



- Overall there has been a lot of inward drying, but most of it before the insulation was installed

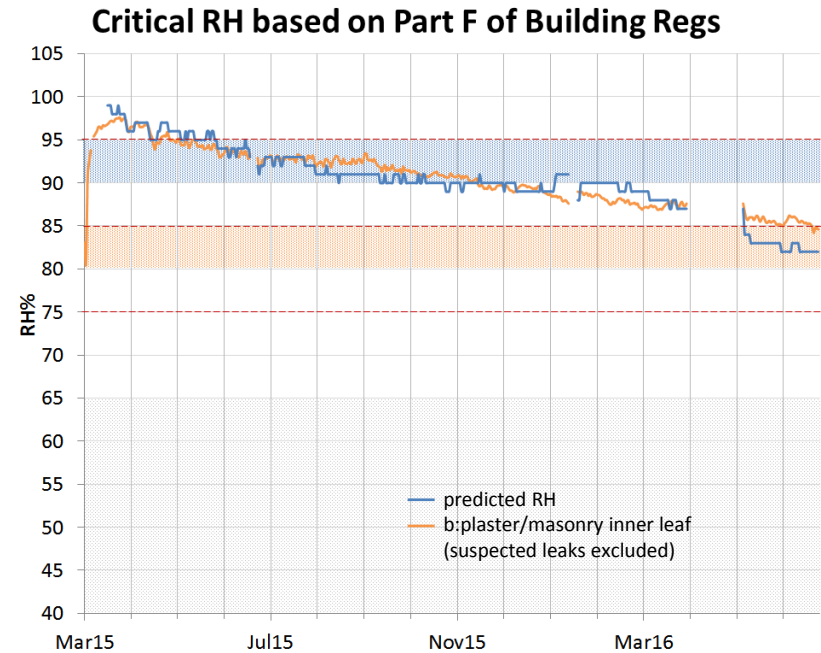
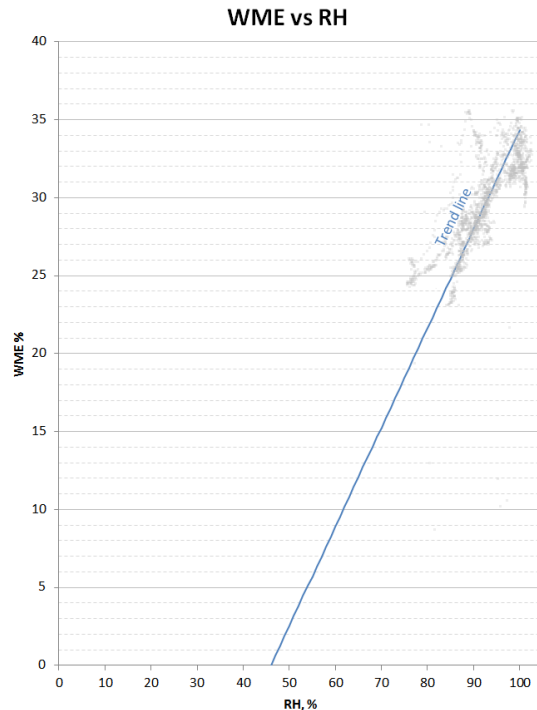
2. If not, where is the moisture coming from and how?

c. Hygroscopic Effects



2. If not, where is the moisture coming from and how?

c. Hygroscopic Effects



- WME and RH affect each other in a curve
- F0b excluded because it has intermittent data
- F1b is excluded because it has an odd shape and is a proven leak.

- When RH's for E1b are predicted from WME's using this curve there is a good correlation
- This means the initial moisture content of the brick combined with hygroscopic effects (equilibrium of WME with RH) explain the RH much better than vapour (Glaser) effects.

Insulation Type 1: mineral wool internal insulation.

Summary

1. Is the insulation working safely?

- a. Moisture content inside the wall is 20-28%WME, 29-32% at suspected leaks, higher than we would like, but it will probably dry within the next year or two.
- b. Rot risk for any joists and OSB generally minimal, slight risk for 2 joists.
- c. May be some risk of mould, generally where there are suspected leaks.

2. If not, where is the moisture coming from and how?

- a. Leaks are allowing rain to reach the inner leaf via Capillary Flow in 2, perhaps 3 cases.
- b. Little if any from inside the house via Vapour Diffusion.
- c. Hygroscopic Effects are strong, RH closely follows a hygroscopic relationship from changes in WME.

Insulation type 2: Tectem



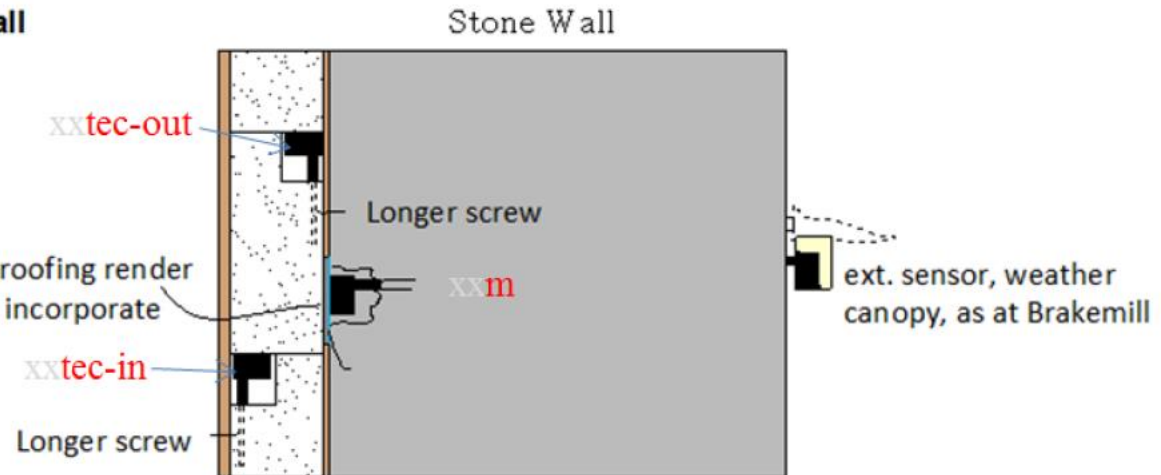
Sensor Arrangement



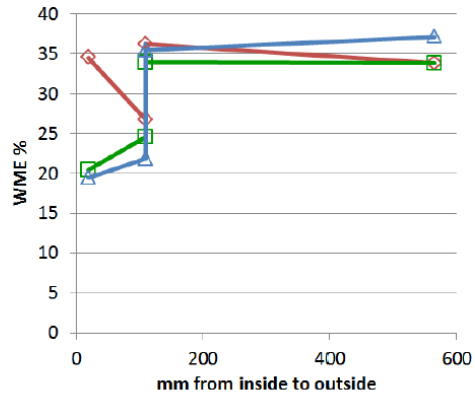
Tectem on Solid Wall



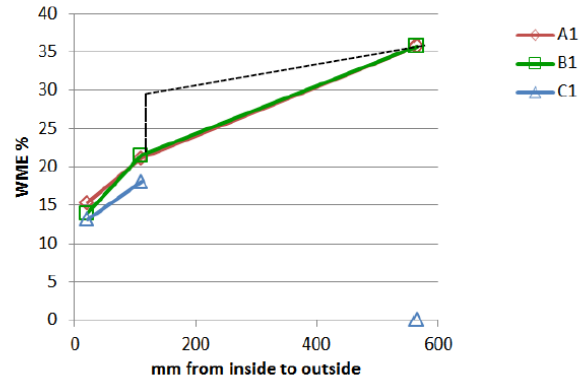
repatching of waterproofing render over sensor position, incorporate reinforcing mesh



Insulation Type 2: tectem IW1



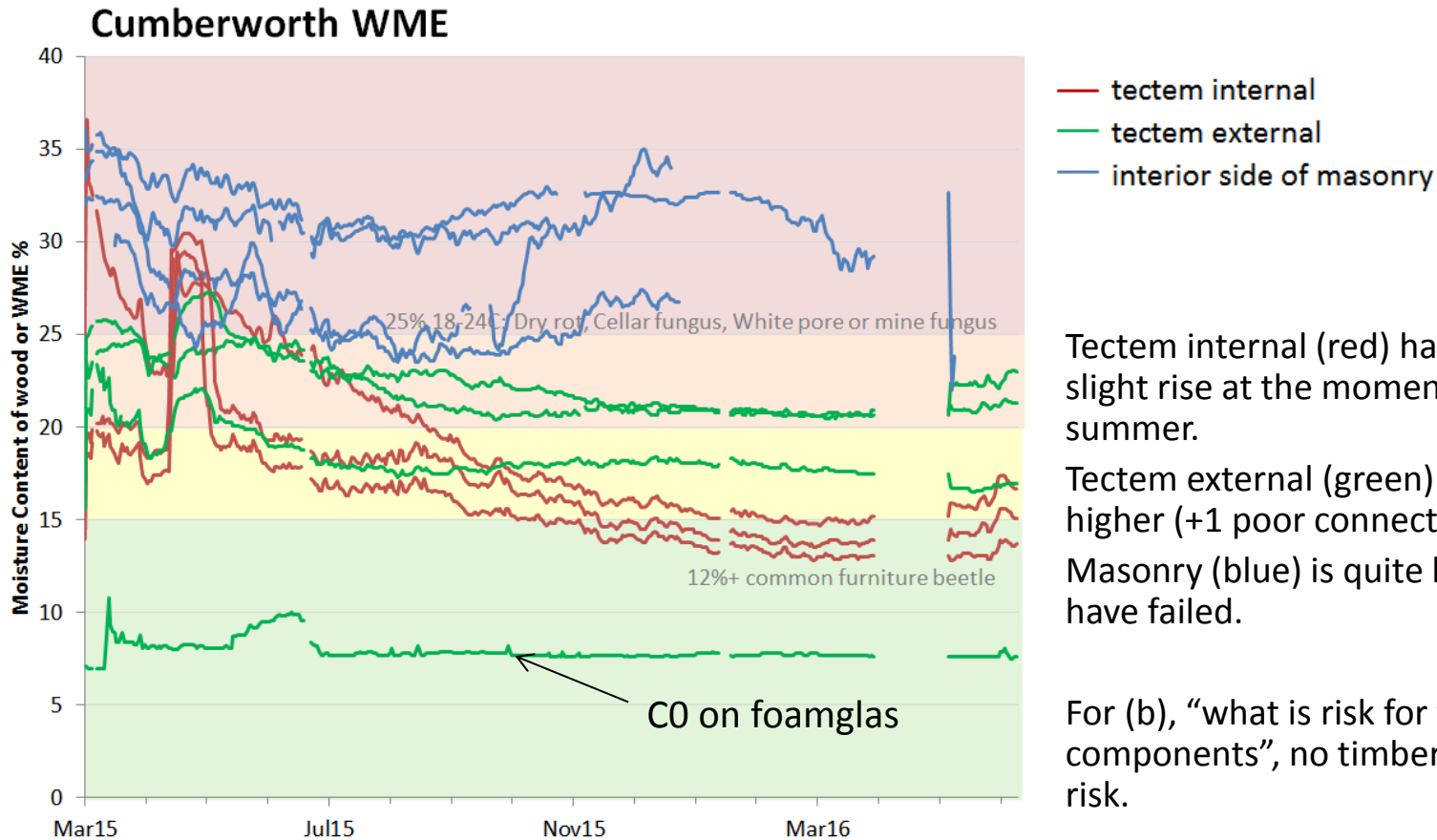
Mar 2015



Mar 2016

1. Is the insulation working safely?

a. What is the moisture content inside the wall?



Tectem internal (red) has dried well, slight rise at the moment for summer.

Tectem external (green) a little higher (+1 poor connection)

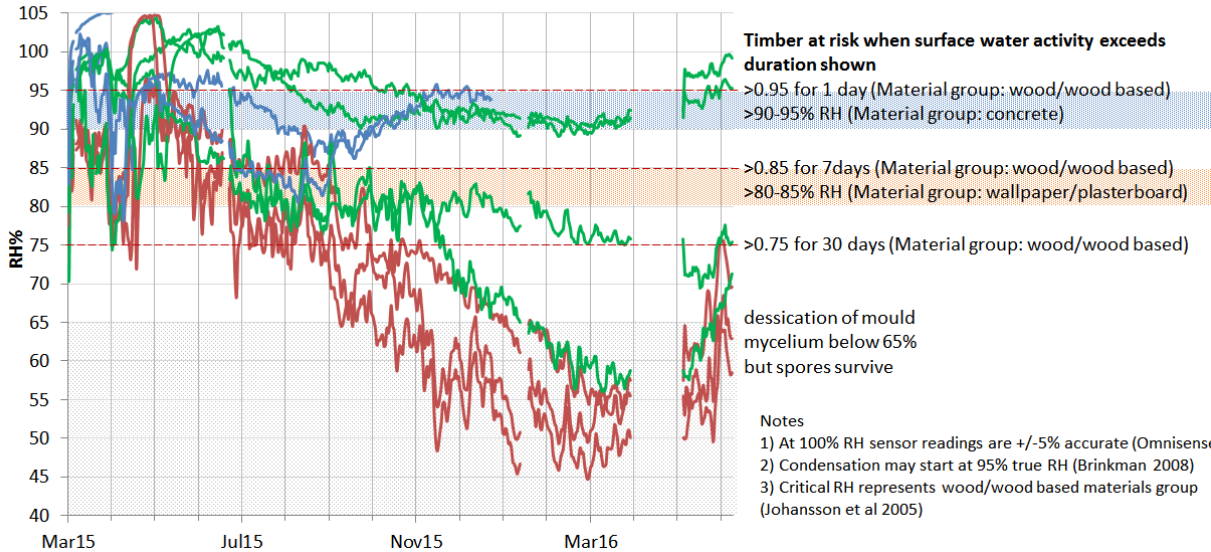
Masonry (blue) is quite high, all 3 have failed.

For (b), “what is risk for timber components”, no timbers so no rot risk.

1. Is the insulation working safely?

c. What's the risk of mould?

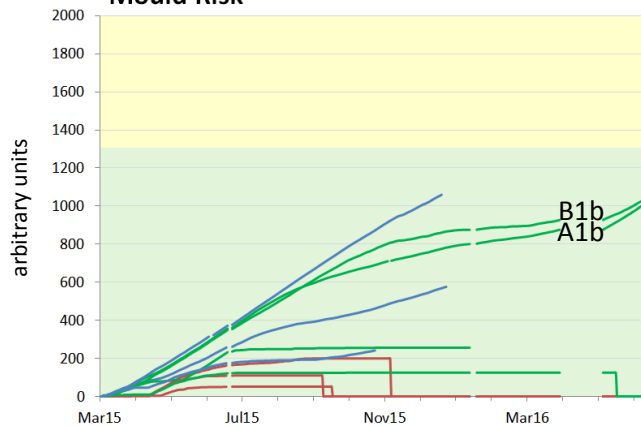
Critical RH based on Part F of Building Regs



There are no gaps within the tectem, but there may be gaps in the adhesive behind. Installers were asked to apply it over the whole surface.

- tectem internal
- tectem external
- interior side of masonry
- external East/West

Mould Risk

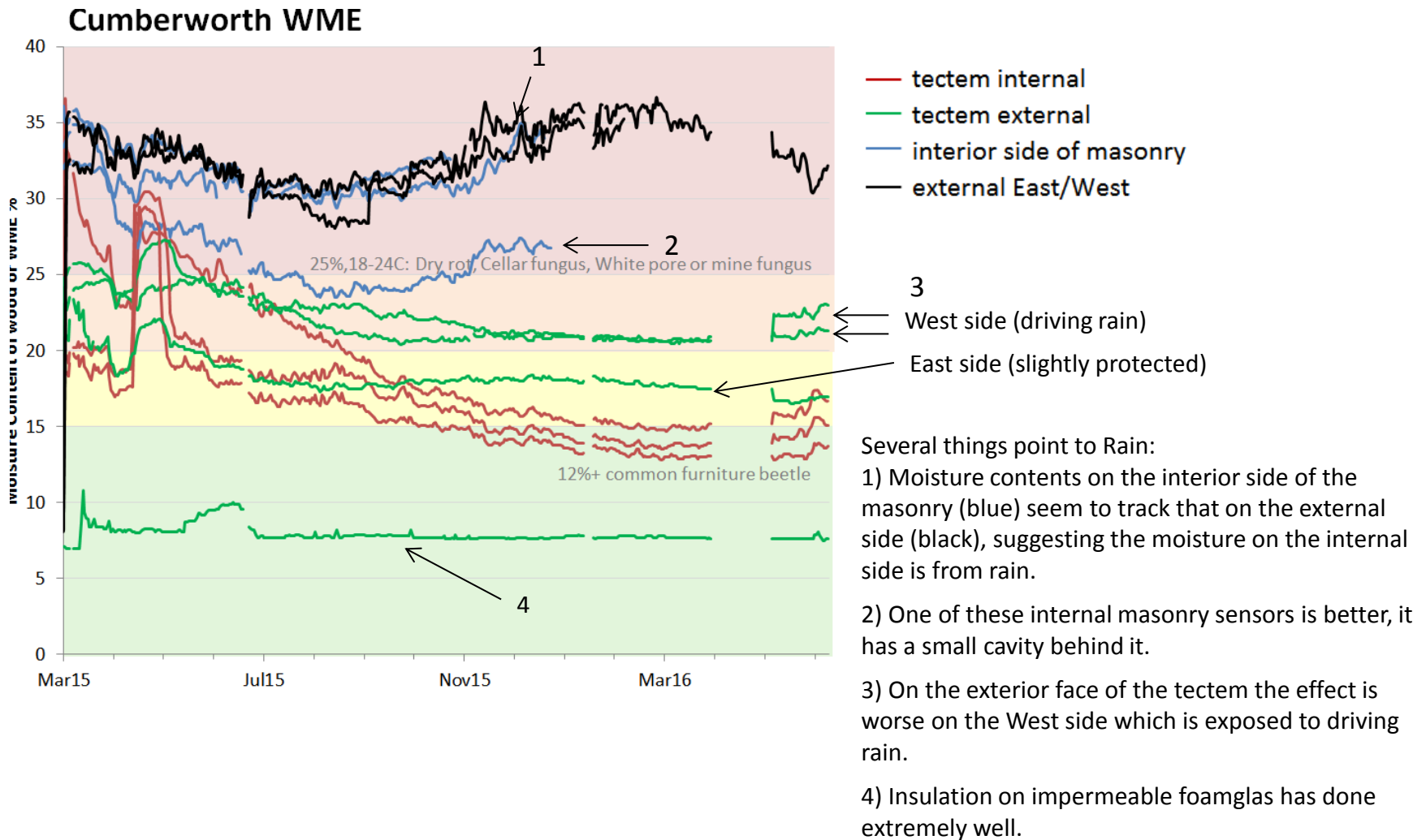


- Masonry sensors have failed, and one in tectem external, they have had a rather high RH, near 100%.
- There is a mould risk but it is not particularly high

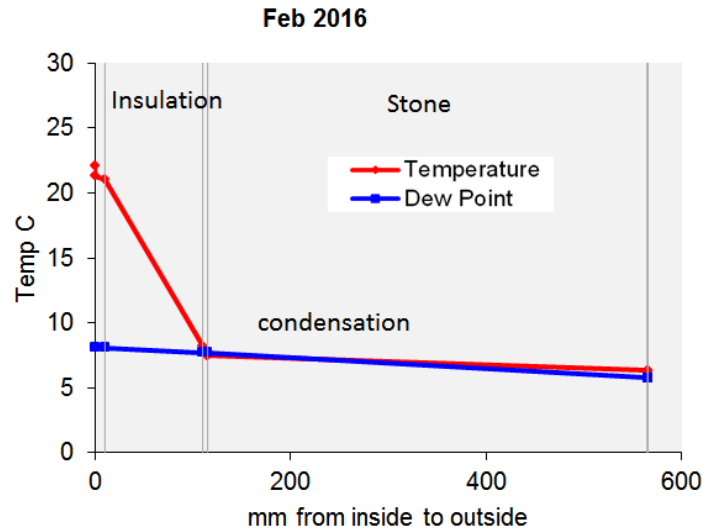
- tectem internal
- tectem external
- interior side of masonry
- external East/West

2. If not, where is the moisture coming from and how?

a. Rain via Capillary Flow?



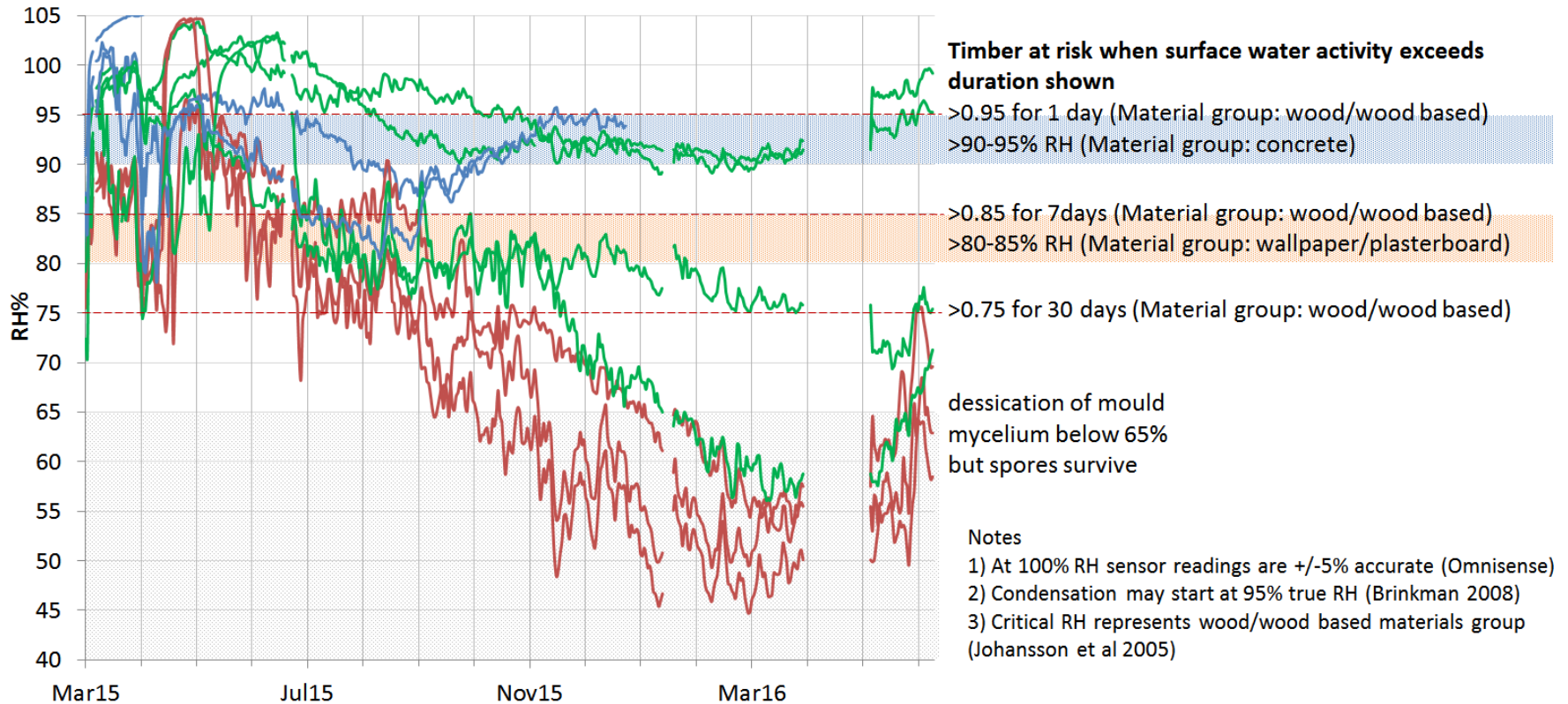
2. If not, where is the moisture coming from and how? b. Inside the house via Vapour Diffusion?



- Glaser suggests it is very close to 100% RH on the cold side of the Tectem, there would be condensation, but the tectem is designed to cope with this.

2. If not, where is the moisture coming from and how? b. Inside the house via Vapour Diffusion?

Critical RH based on Part F of Building Regs



- We are getting high RH's inside the wall, particularly on the masonry

Insulation Type 2: tectem internal insulation.

Summary

1. Is the insulation working safely?

- a. The surface of the tectem has dried well.
- b. No rot risk as no embedded timbers.
- c. Mould risk is within limits for the surface, there should be no voids for it to grow in.

2. If not, where is the moisture coming from and how?

- a. Rain moisture is coming through the wall, particularly on the West.
- b. Some is via diffusion from the inside, but tectem is designed to cope with that.
- c. We haven't looked specifically for hygroscopic effects but we know tectem is a capillary active material.