Omnisense Moisture Monitoring

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This workshop will cover:

1. Questions you can answer with monitoring, through examples
2. Other things you need to know

Part 1: Questions you can answer with monitoring

Either it's drying out well

or

If not drying as expected, why and what can we do about it.

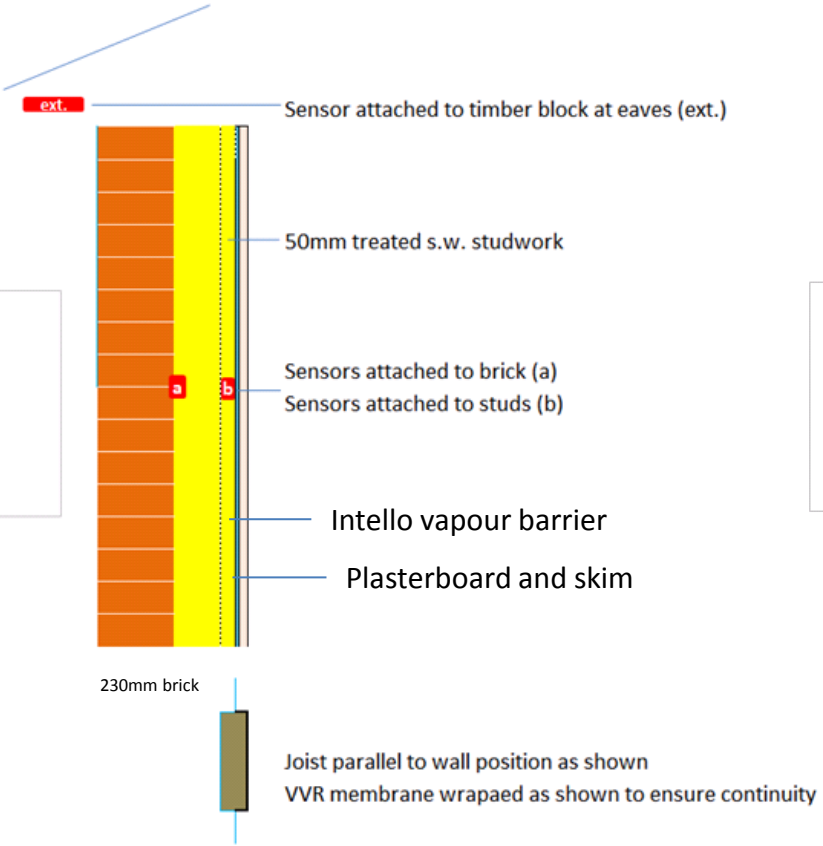
Examples Taken from Two IWI Case Studies

Low vapour resistance PU Spray Foam
100+50mm between studs

External finishes:

LHS wall treated with brick cream

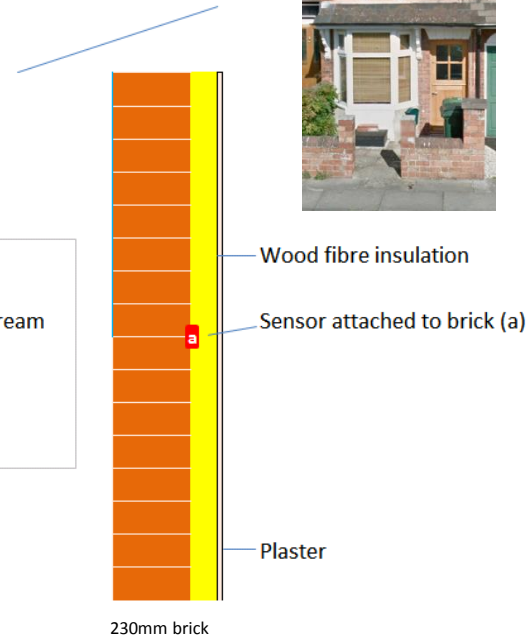
RHS untreated



Wood Fibre
100mm

External finishes:

treated with brick cream



Projects courtesy of
Simmonds.Mills Architects

Wall build-ups used

PU Spray Foam

Case Study 1a U value 0.22

Solid Wall, PU Foam IWI with brick cream

West Midlands rural solid brick end terraced house

		thickness mm	λ W/mK	Vapour Resistivity MNs/gm	Substrate Class
Inside	Plasterboard & skim	15	0.25	50	
	Intello membrane	0.1	0.04	1.2 - 50	
	BASF PU spray foam	150	0.037	11.9	3
Outside	Brick (assume protected)	230	0.56	50	2

Potential Moisture Influences

Interior med: Variable Vapour Resistance membrane, insulation continuous at 1st floor - joists run parallel to wall

ground low: Injected DPC

rain low: hydrophobic vapour permeable brick cream applied to whole exterior surface

rain cat: 2 Medium 33-56 l/m2 per spell wall faces West (afternoon sun and driving rain)

Wood Fibre

Case Study 11 U value 0.354

Solid wall, Timber IWI

West Midlands Wood Fibre IWI

		thickness mm	λ W/mK	Vapour Resistivity MNs/gm	Substrate Class
Inside	render	10	0.56	50	1
	wood fibre board	100	0.045	0	
	sand cement parge	20	0.56	50	2
Outside	brick wall, with brick cream applied	230	0.56	50	2

Potential Moisture Influences

Interior low: Wood fibre board designed to cope with interstitial condensation

ground low: DPC identified

rain med: brick cream and repointing should offer protection from rain

rain cat: 2 Medium 33-56 l/m2 per spell front of house faces S (some sun and driving rain)

Easy Questions

- How much moisture is in the wall, the starting ‘reservoir’?
- Are walls drying out, how fast?
- Is it drying steadily or is it occasionally re-wetted?
- Is there any rot risk and if so where?
- What’s the effectiveness of DPC’s
- Are joist ends in good condition?
- What’s the condition and effect of capillary active materials?
- What’s the temperature across different building assemblies
- What’s the humidity in crawl spaces and basements?

WME

No Calcs

But with a bit of calculation you can answer much more in-depth questions …..

In Depth Questions

Answered for each case study, or provided the data to answer it

Risks

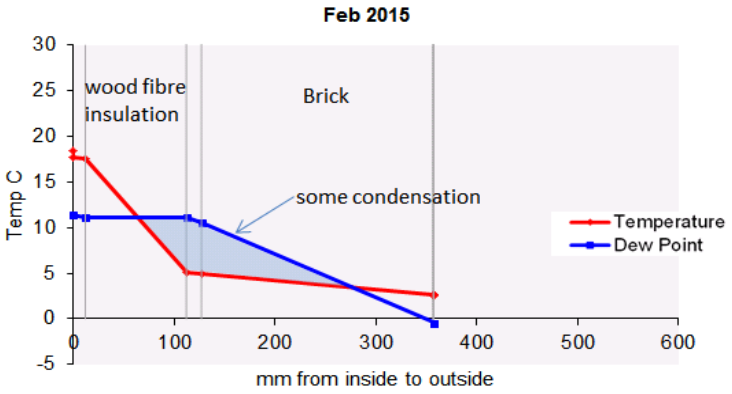
- Is there any mould risk and if so where?
- How does mould risk change over time?

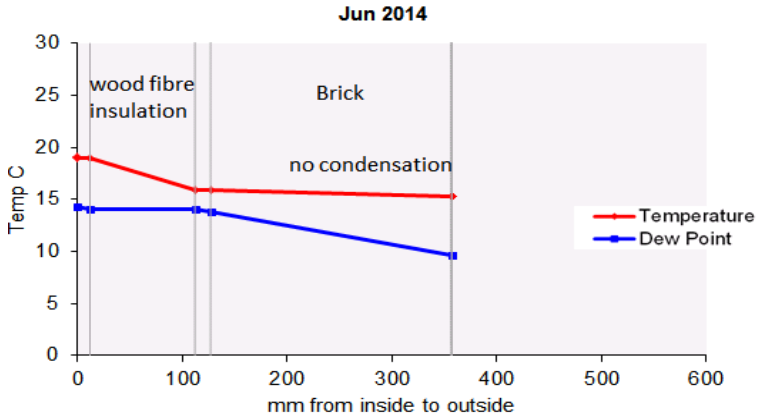
Mechanisms

- How likely is interstitial condensation from internal moisture? What time of year? How big is this effect and should we be concerned?
- Is rain adding much moisture to the wall?
- In what layer of the wall is the moisture greatest and where is capillary action taking it?
- Are there any difference in the evaporation for treated and untreated walls? What's the effect of diffusion membranes?
- What's the effect of sun on IWI systems?
- What's the effect of EWI on masonry?
- Is it drying inwards or outwards and is there a specific time of day when it is greatest?

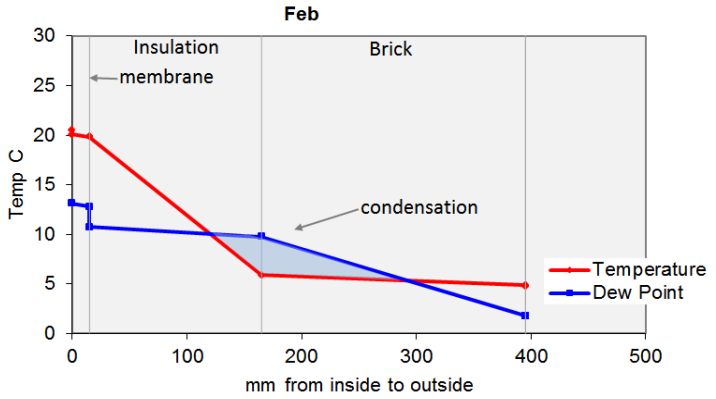
How likely is interstitial condensation from internal moisture? What time of year?

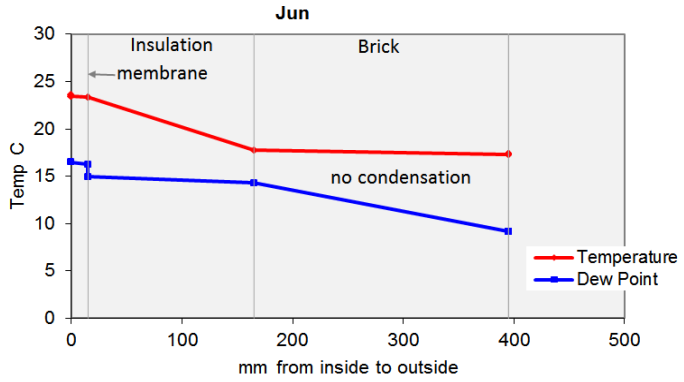
Wood Fibre IWI





PU Spray Foam IWI

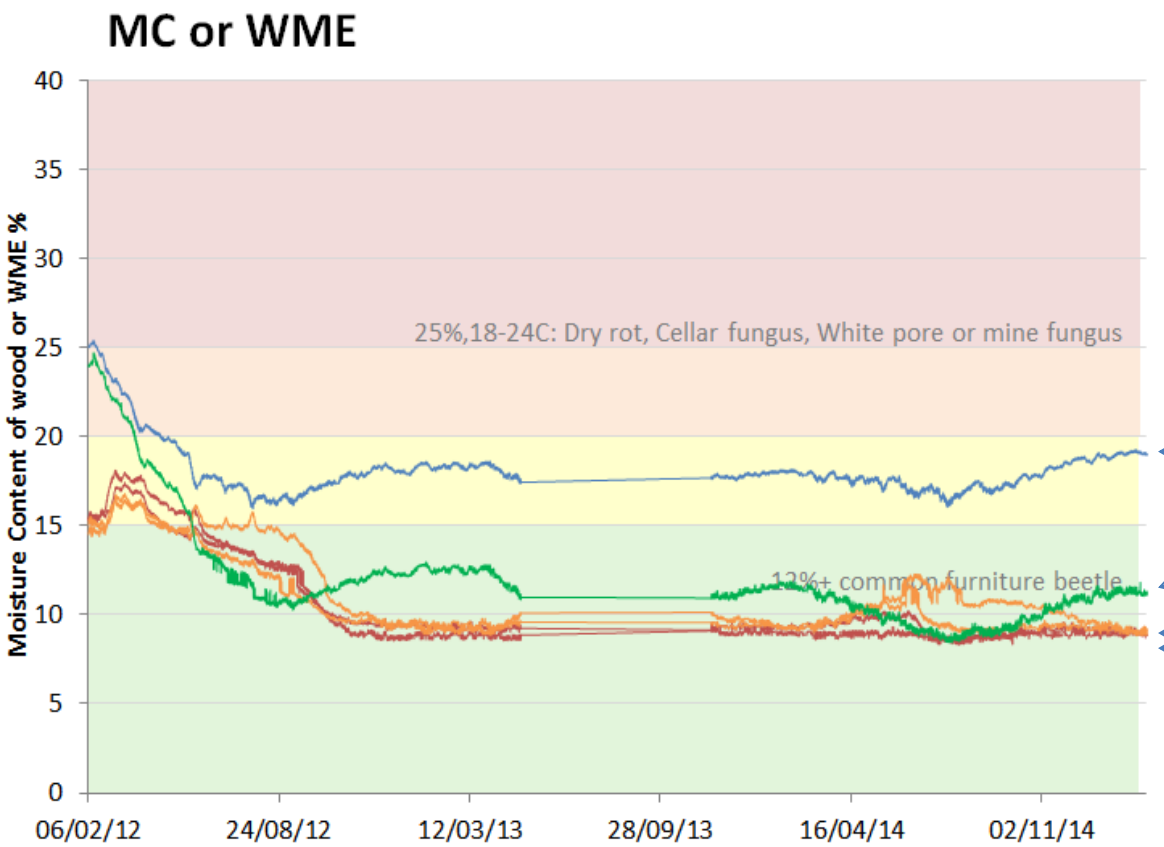


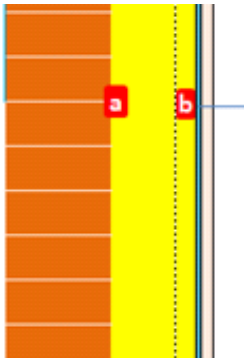


Glaser Method using measured data for internal and external RH/Temp

How fast is the wall drying out?
Is it drying steadily or is it occasionally re-wetted?

Solid brick wall with PU spray foam IWI





(a) interface, untreated brick

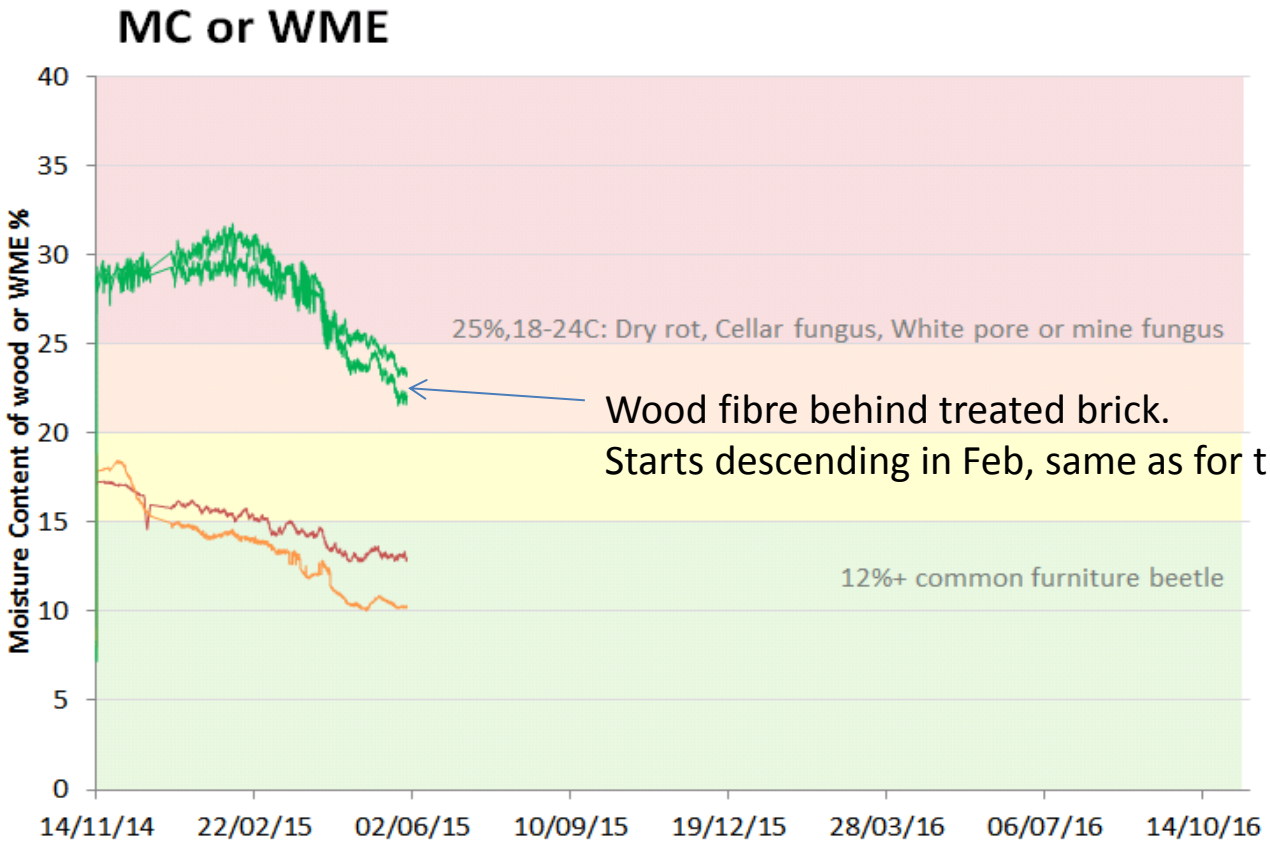
(a) interface, treated brick

(b) timber studwork

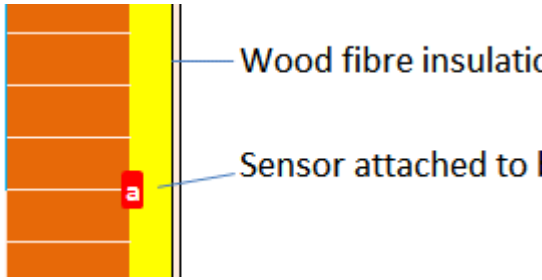
Is rain adding much moisture to the wall? Is there any rot risk and if so where?
How much interstitial condensation are we getting and should we be concerned?
What's the effectiveness of DPC's.

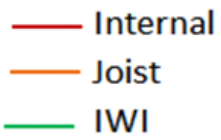
How fast is the wall drying out?
Is it drying steadily or is it occasionally re-wetted?

Solid brick wall with wood fibre IWI



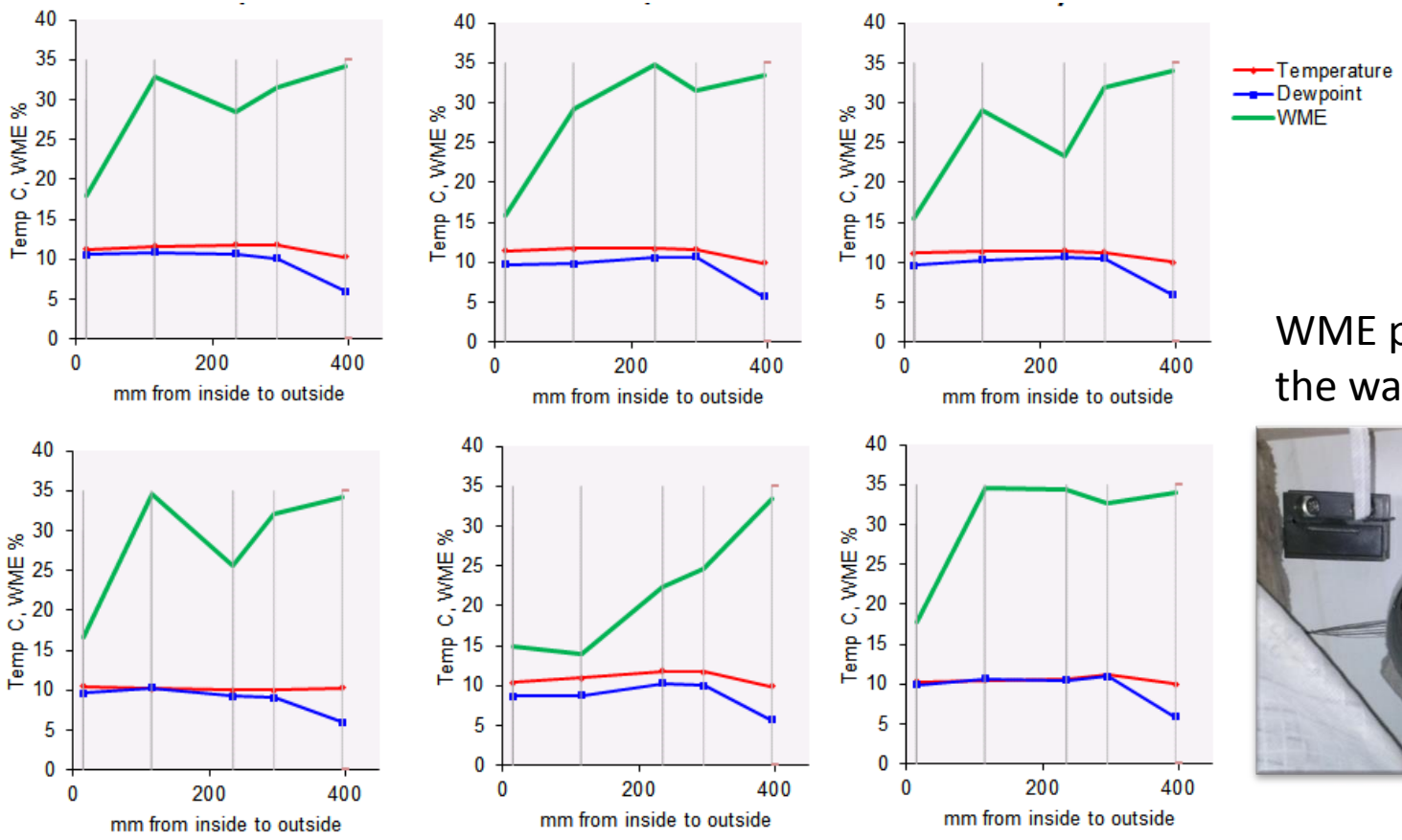
Wood fibre behind treated brick.
Starts descending in Feb, same as for the foam





How fast is the wall drying out? Is it drying steadily or is it occasionally re-wetted? Is rain adding much moisture to the wall? How much interstitial condensation are we getting and should we be concerned? **What's the condition and effect of capillary active materials? Is there any rot risk and if so where? Are joist ends in good condition?**

In what layer of the wall is the moisture greatest and where is capillary action taking it? How much of a moisture reservoir is there?



WME profiles through the wall

Is there any mould risk and if so where?
First method – using just RH and substrate from Part F guidelines

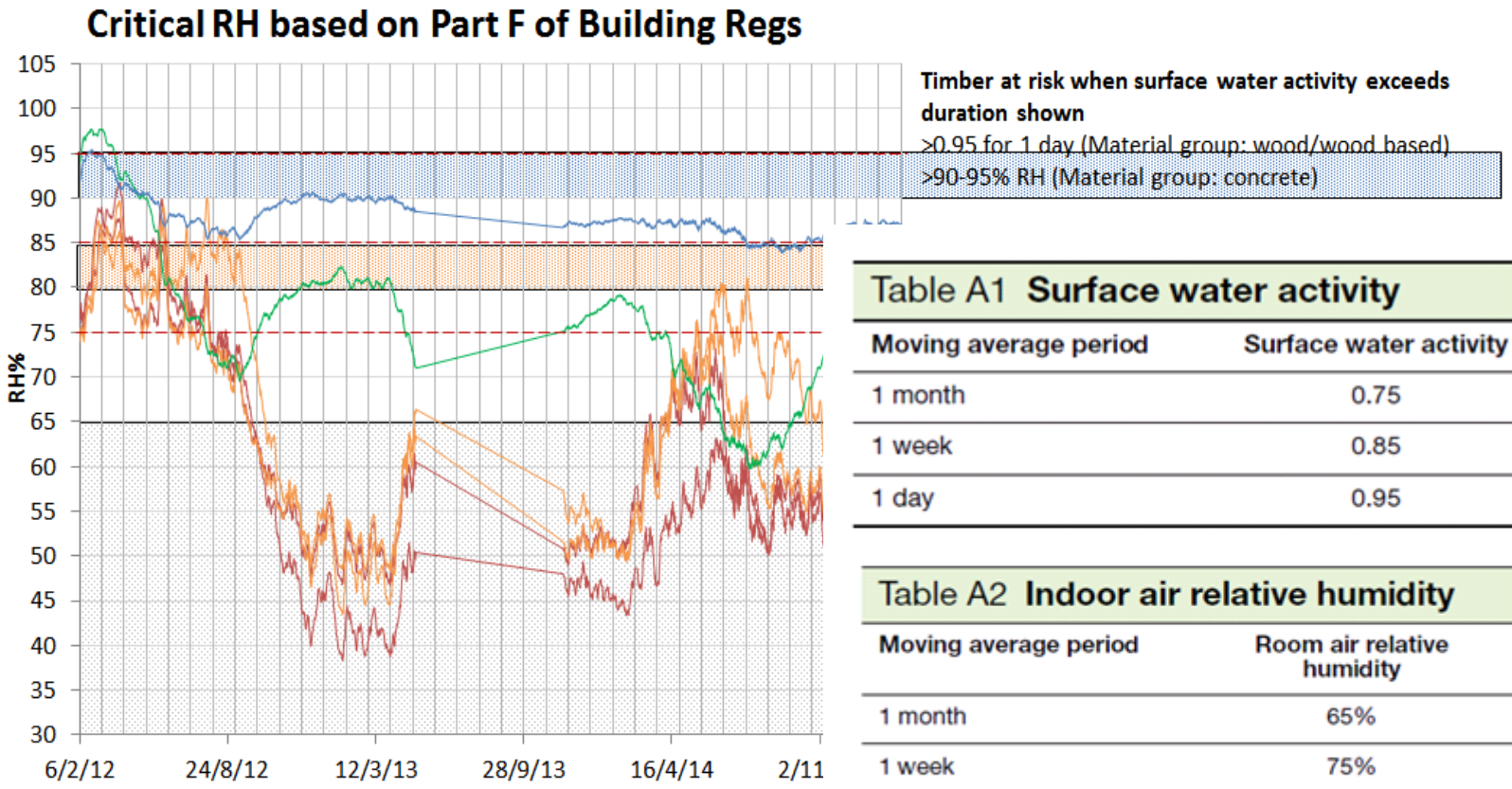


Table A1 Surface water activity

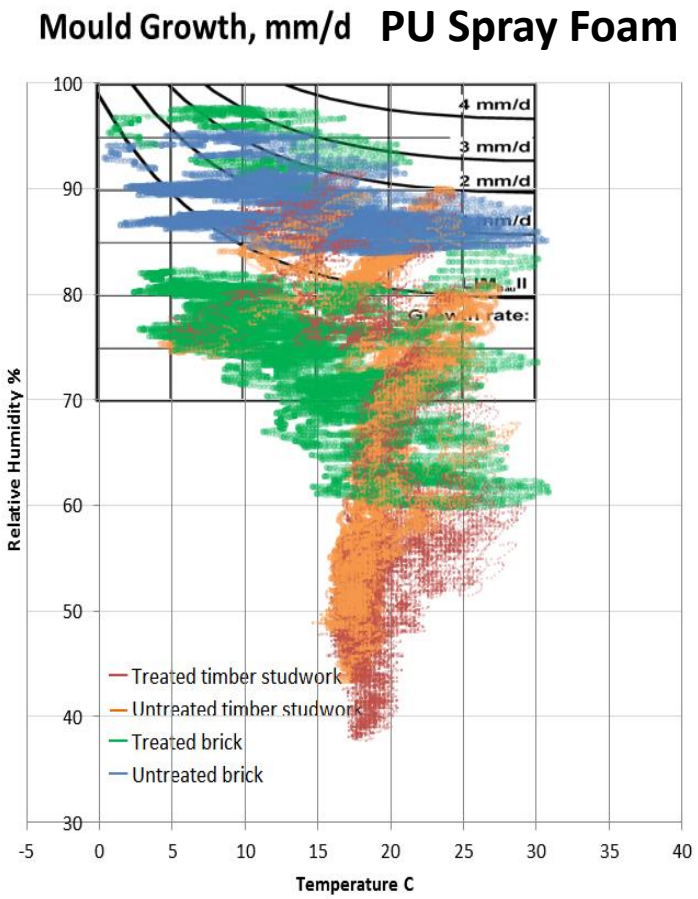
Moving average period	Surface water activity
1 month	0.75
1 week	0.85
1 day	0.95

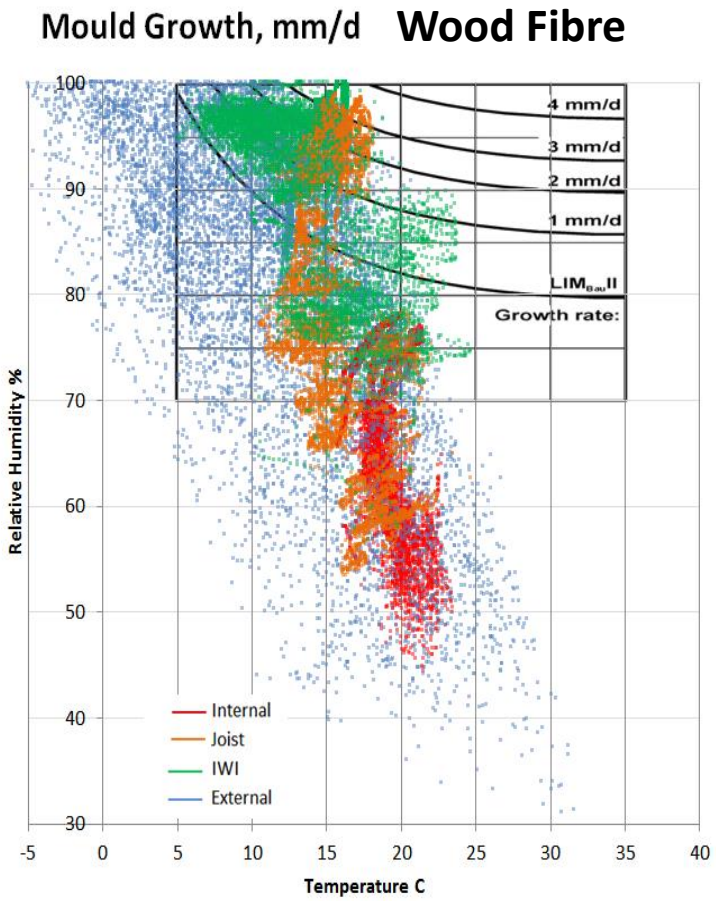
Table A2 Indoor air relative humidity

Moving average period	Room air relative humidity
1 month	65%
1 week	75%
1 day	85%

From Part F Appendix A

Is there any mould risk and if so where?
Second Method: using measured mould growth rates from Sedlbauer

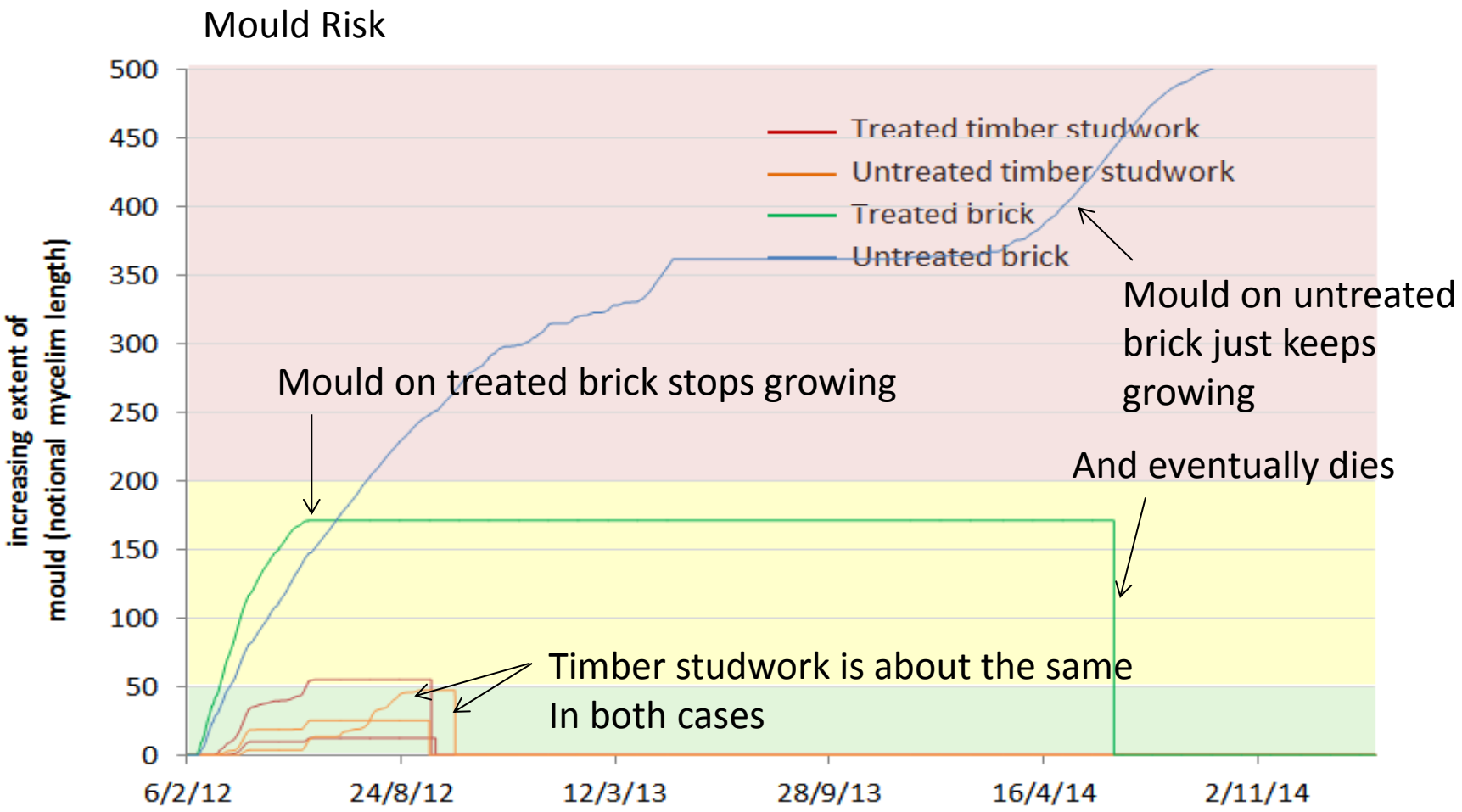




Sedlbauer for Cat. II substrates, *"Building materials with porous structure such as renderings, mineral building material, certain woods as well as insulation material"*.

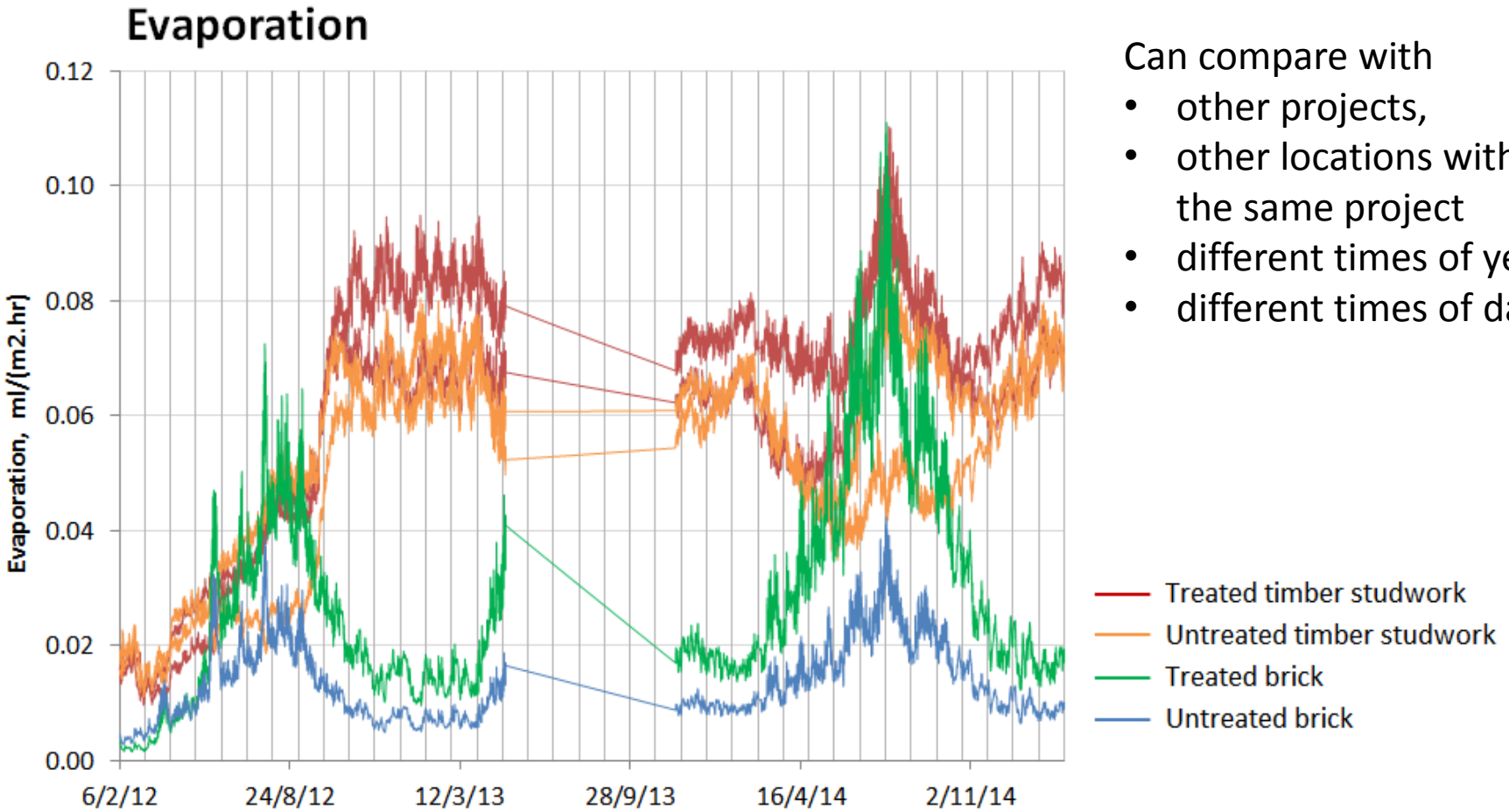
Cat. I substrates are Wallpaper, plaster, cardboard, and other biodegradable materials such as woodfibre.

How does mould risk change over time?



Are there any difference in the evaporation for treated and untreated walls?

Foam IWI treated and untreated with hydrophobic brick cream

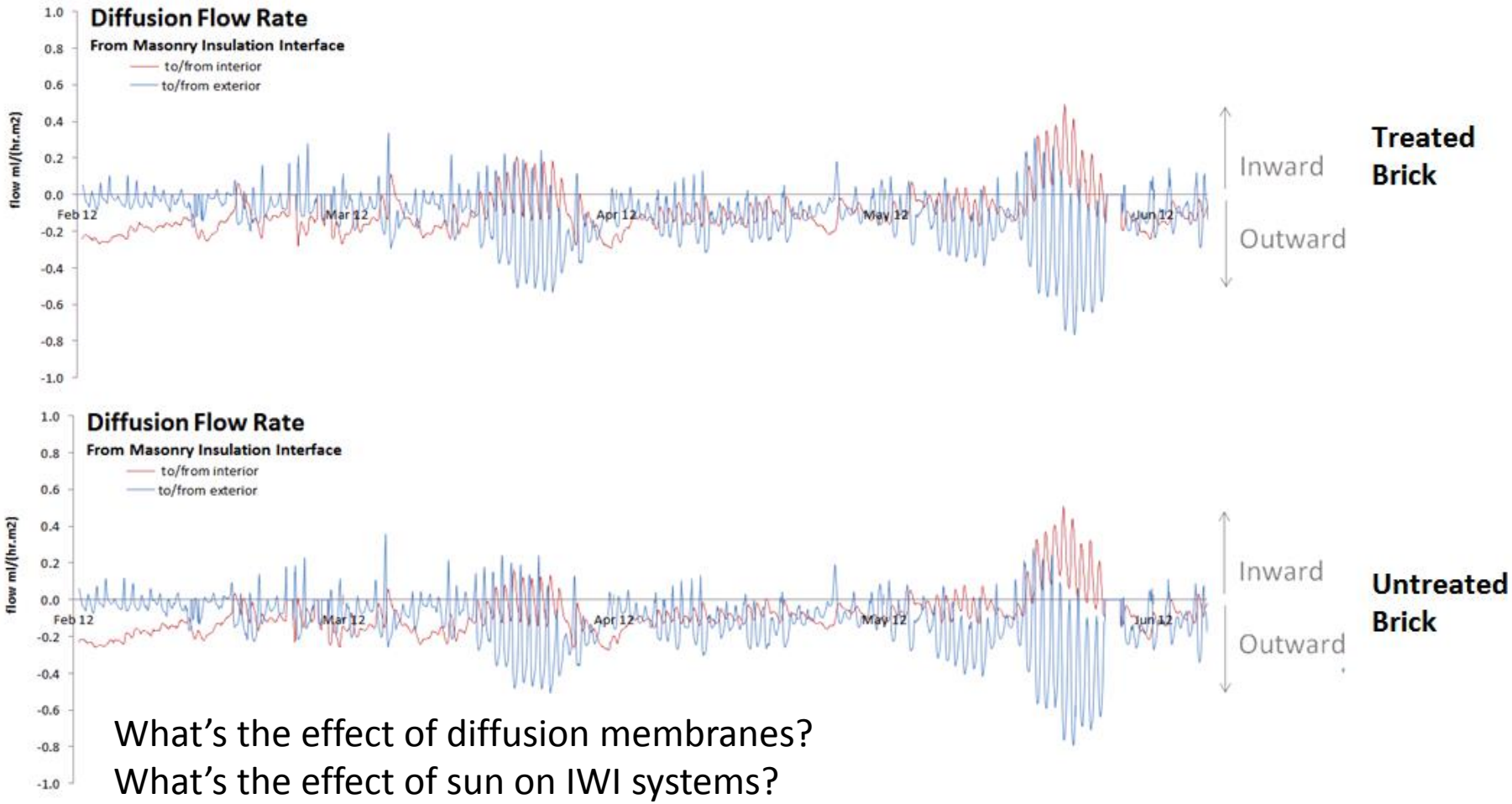


Can compare with

- other projects,
- other locations within the same project
- different times of year
- different times of day

Is there a specific time of day when diffusion is greatest?

Diffusion from measured vapour pressure and wall build up



What's the effect of diffusion membranes?

What's the effect of sun on IWI systems?

What's the effect of EWI on masonry?

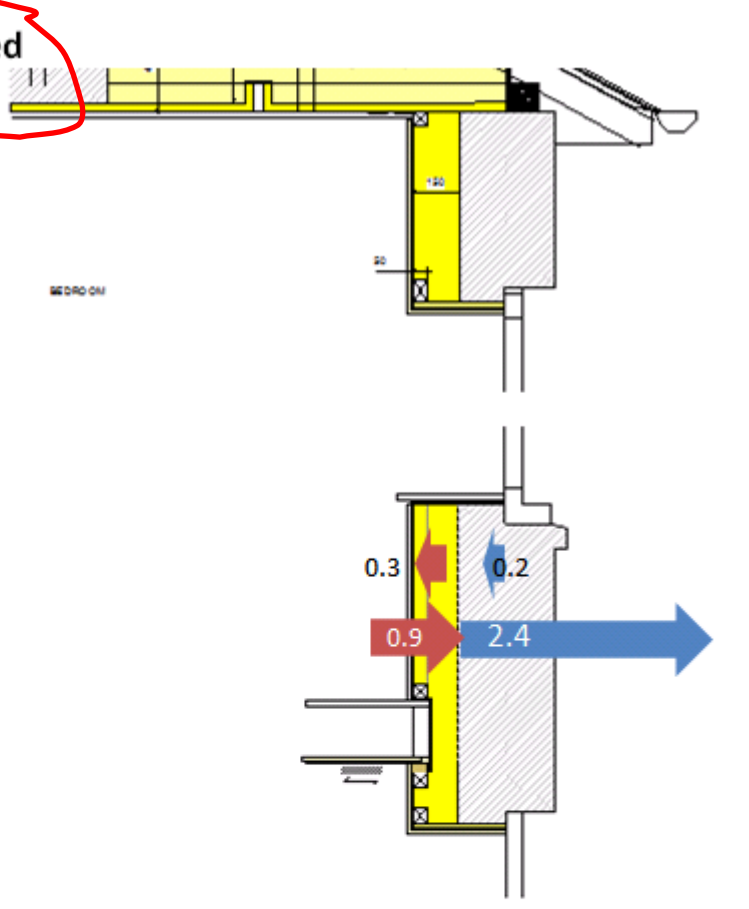
Is the wall drying inwards or outwards?

Figures are in litres/m2 over 36 months (using estimated internal vapour pressures for the red arrows).

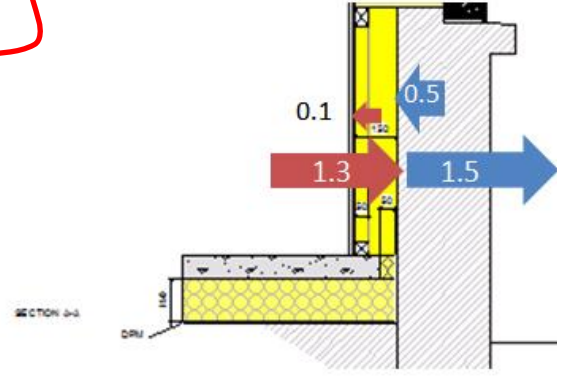
Process is very similar for both, wall is mostly drying outwards in both cases.

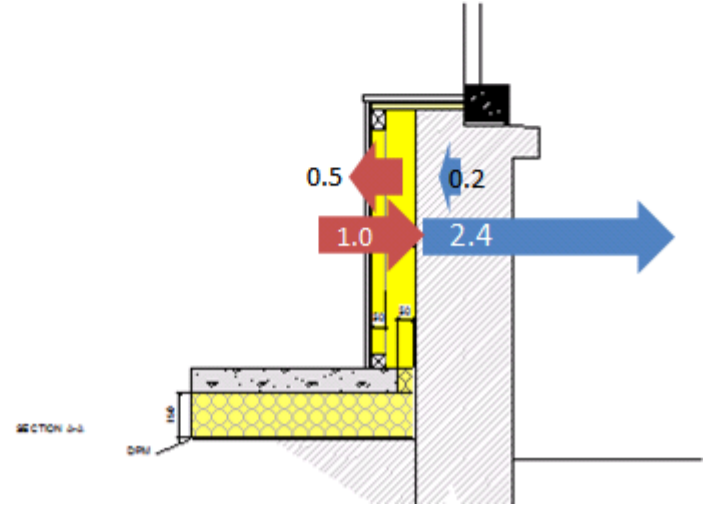
More vapour is involved in the Untreated wall.

Untreated



Treated





Further Actions

- Remedial action is cheaper if detected at an earlier stage
- Identifying the mechanisms and drying pattern allows you to anticipate future problems in this and other projects

This is covered in great depth in the new AECB Retrofit course, there's a lot of theory and we have about 10 case studies covering the mechanisms.

Previous slides show the depth of understanding we have gone to.

Part 2: Loggers, gateways and how to install them

When to Log

Probably not critical

- new build
- Retrofits for ‘safer’ external Wall Insulation (EWI) installations but see exceptions opposite

Or to summarise:

Not required where design is ideal, from a moisture point of view

Logging Recommended

- IWI (Internal Wall Insulation) retrofit installations or part installations
- EWI retrofit installations (External Wall Insulation) where there are other influences that cannot be ruled out e.g. from ground moisture, rainwater leaks, moisture bypasses, historically damp walls, hygroscopic salts present, where there are compromises in the design or concerns about installation quality…quite a lot of exceptions after all!

Sensors

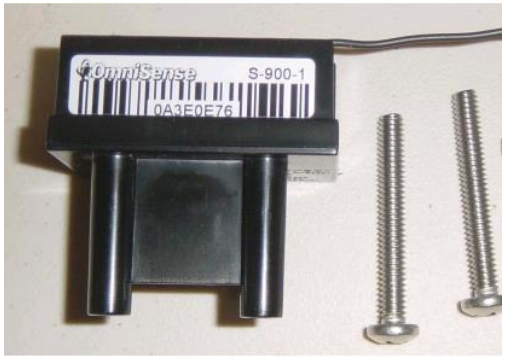
2 types of Gateway: with and without a SIM card. Without a SIM is <u>much</u> simpler.

Loggers: Temperature and RH through an air sensor
Moisture Content of wood (called WME if not in wood) through their mounting screws

1. Installing the sensors

From the installation instructions:

- **Battery life** 15-45 years with 1 hour logging, shorter with 5min logging. They can arrive with either 5min or 1hr logging interval, You should change it to 1 hour, Omnisence in the USA can remotely change it for you on request.
- **Distance** nominally up to 100m from the gateway but this is hard to predict especially when embedded in materials
- **Antenna** you must unfold it for best reception about ½" from the cover
- **Screws** use those provided, don't use your own
- **Keep a record** of the ID, you'll need this to assign a name to the logger



http://www.omnisense.com/oms_cds/media/sensor_installation_instructions.pdf

Photo credit: Mischa Hewitt

Photo credit: Simmonds Mills

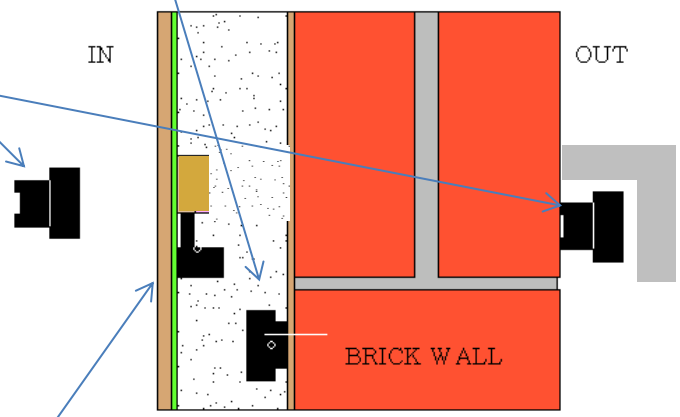
Fit directly into timber.
Self tapping. No changes to the legs.

For the best information, install the sensors in cross-sections of the wall.

One should be on the insulation- masonry interface (shown here prior to insulation install). The wall has been parged to reduce the likelihood of mould.

Sensor locations

- Include the highest risk area, for IWI the interface between internal insulation and the brick wall
- For any diffusion calculations (this is a service we offer) you will also need an internal sensor and an external sensor under some kind of cover (e.g. high density EPS)
- Useful to know RH behind any membrane e.g. when comparing intelligent v. impermeable membranes



In masonry the feet can be shortened and put in parallel to the wall face …

… or at right angles to the wall face

Photo credit: Mischa Hewitt

Can also be mounted on blocks of wood embedded in wall

- **Advantage**: you can get a true moisture content because readings are calibrated to different wood types
- **Disadvantage:** if the location gets damp, you could be introducing mould or rot into the wall.

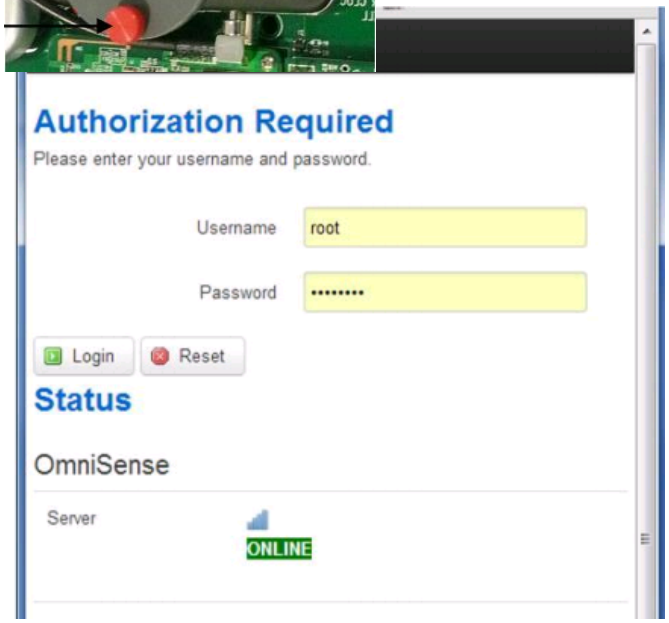
2a. Installing a Non SIM Gateway

Has one aerial to pick up signal from loggers

1. Install sensors
2. Plug network cable into house broadband
3. Plug into mains

It doesn't have to be matched with the sensors, it will listen out for and record any within range.

2b. Installing a SIM Gateway



Non – SIM version

Has an extra aerial to send info via a SIM card.

You will need APN, PIN, username and password

1. Install sensors
2. Unscrew case of gateway (small crosshead screwdriver), untighten screws for USB mobile broadband stick and insert SIM (small crosshead screwdriver), replace case.
3. Plug gateway into mains
4. Plug laptop into gateway with Ethernet cable
5. Open a web browser and type in http://omnisense (there's no www.) using "root" as the username and the Gateway serial number as the password
6. 6. Follow the manual instructions for entering the information

	EE	**GiffGaff**
APN	everywhere	giffgaff.com
PIN	1111	-
username	eesecure	-
Password	secure	-

3. Adding Another Site

Log in via www.omnisence.com

All your existing sites are displayed

Add a New Site

Required Fields: *

*Site Name:

*Address:

*City:

*State: *Outside the US & Canada

*Postal Code: Enter 0 if no ZIP/Postal Code

*Country: United Kingdom

*Contact Name:

*Phone Nbr:

Fax Nbr:

Claim/Job Nbr: none

Job Complete: Y N

Site Contact E-mail:

*Alarm Notification E-mail:

Alarm Notification Text Message E-Mail:

*Site Inactivity Timeout (minutes): 1440 Enter 0 to disable inactivity alarms

*Temperature Units: °F °C

Required For Alternate Contact: *
NOTE: If alternate job site contact is used, then these fields are required

*Alt Contact Name:

*Alt Phone Nbr:

Fax Nbr:

*Alt E-Mail Address:

*Time Zone: (GMT) Greenwich Mean Time : Dublin, Edinburgh, Lisbon, London

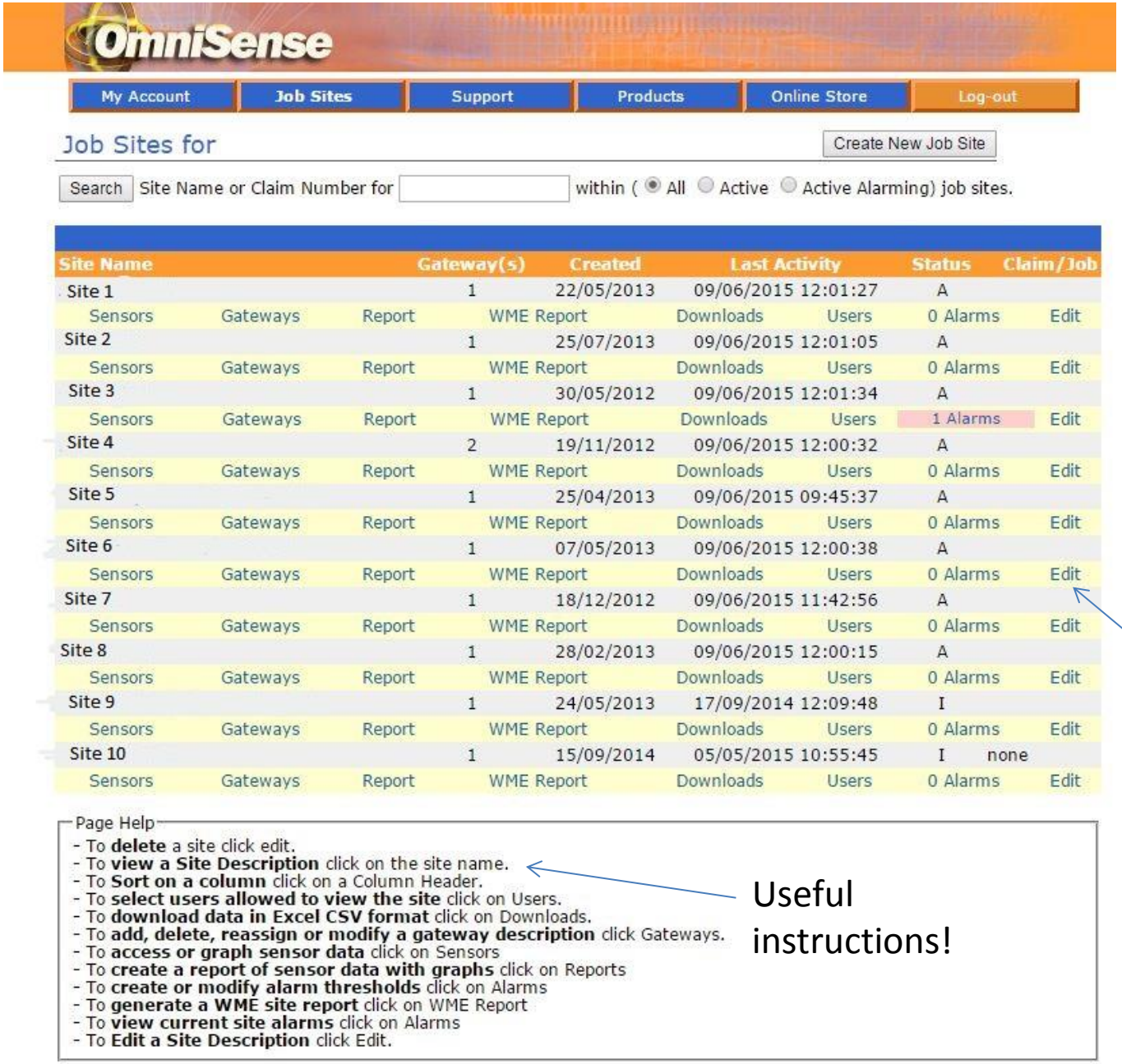
Save Reset Cancel

Enter the information for the new site

Check which of those you have given login info to should have access to this new site

Enter the Gateway ID:– its on the back of the Gateway as shown

Enter a name



Useful instructions!

You will then return to the main list with your new site added to it

To delete a site click on the relevant Edit and use the delete button.

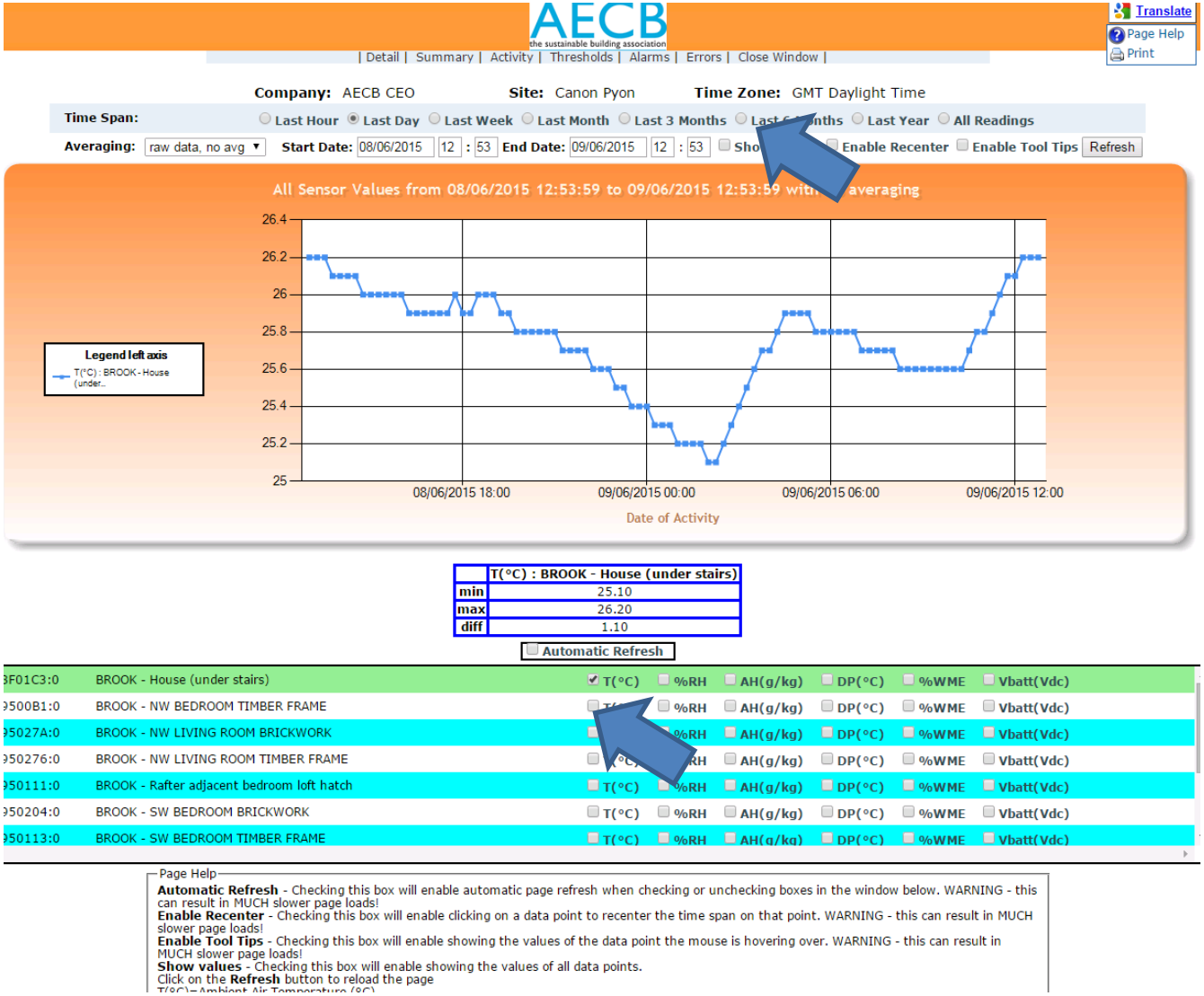
4. How to view your data

Click on “sensors” for that site

A table is shown.

Click on a name to edit it.

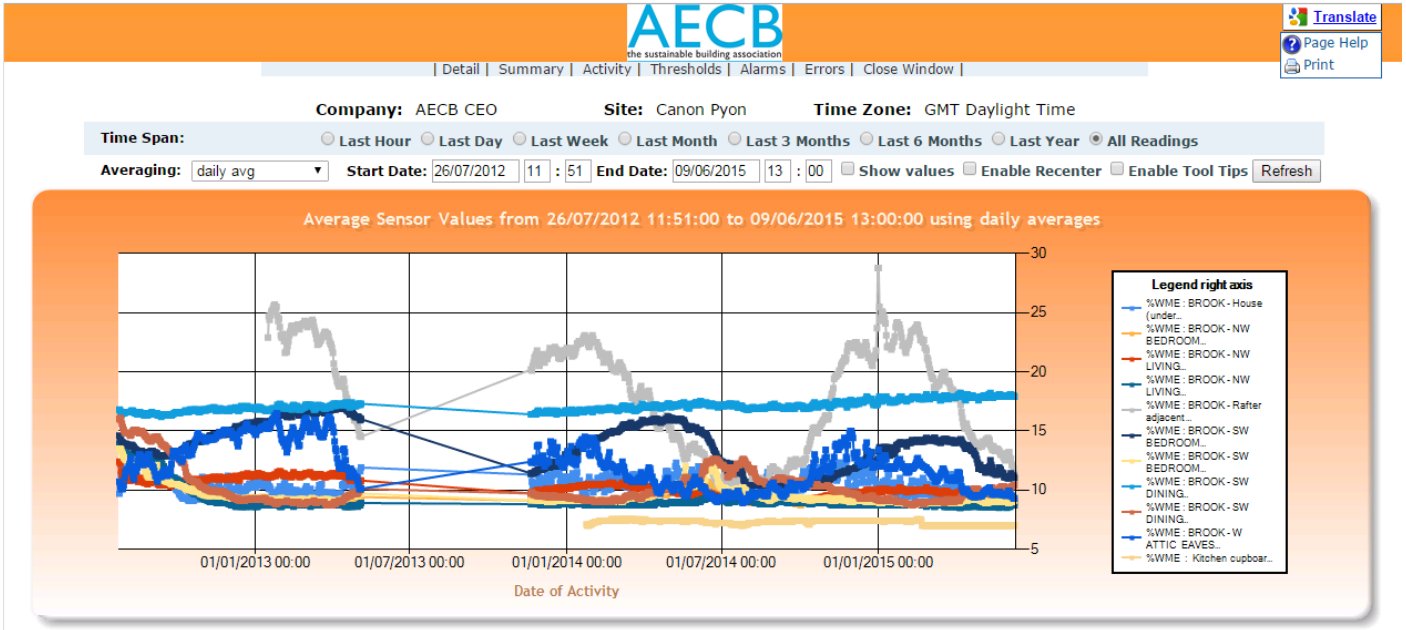
Click on a reading to view a graph of it.



Last few days of readings shown

Choose longer date range..

And add more readings by ticking them (you may have to scroll), then press Refresh



	%WME : BROOK - House (under stairs)	%WME : BROOK - NW BEDROOM TIMBER FRAME	%WME : BROOK - NW LIVING ROOM BRICKWORK	%WME : BROOK - NW LIVING ROOM TIMBER FRAME	%WME : BROOK - Rafter adjacent bedroom loft hatch	%WME : BROOK - SW BEDROOM BRICKWORK	%WME : BROOK - SW BEDROOM TIMBER FRAME	%WME : BROOK - SW DINING ROOM BRICKWORK	%WME : BROOK - SW DINING ROOM TIMBER FRAME	%WME : BROOK - W ATTIC EAVES AMBIENT	%WME : Kitchen cupboard top
min	8.70	8.70	8.90	8.50	10.10	10.30	8.70	16.20	8.70	8.90	7.00
max	12.30	14.00	12.40	13.90	28.80	17.10	13.50	18.20	16.10	16.50	7.50
diff	3.60	5.30	3.50	5.40	18.70	6.80	4.80	2.00	7.40	7.60	0.50

Page Help

Automatic Refresh - Checking this box will enable automatic page refresh when checking or unchecking boxes in the window below. WARNING - this can result in MUCH slower page loads!
Enable Recenter - Checking this box will enable clicking on a data point to recenter the time span on that point. WARNING - this can result in MUCH slower page loads!
Enable Tool Tips - Checking this box will enable showing the values of the data point the mouse is hovering over. WARNING - this can result in MUCH slower page loads!
Show values - Checking this box will enable showing the values of all data points.
Click on the **Refresh** button to reload the page
T(°C)=Ambient Air Temperature (°C)
%RH=Ambient Air Relative Humidity
AH(g/kg)=Ambient Air Absolute Humidity

Finished Graph, but limited to raw sensor readings.

For calculations you will have to download the data:
Mould risk,
Evaporation Rate
Diffusion Rate

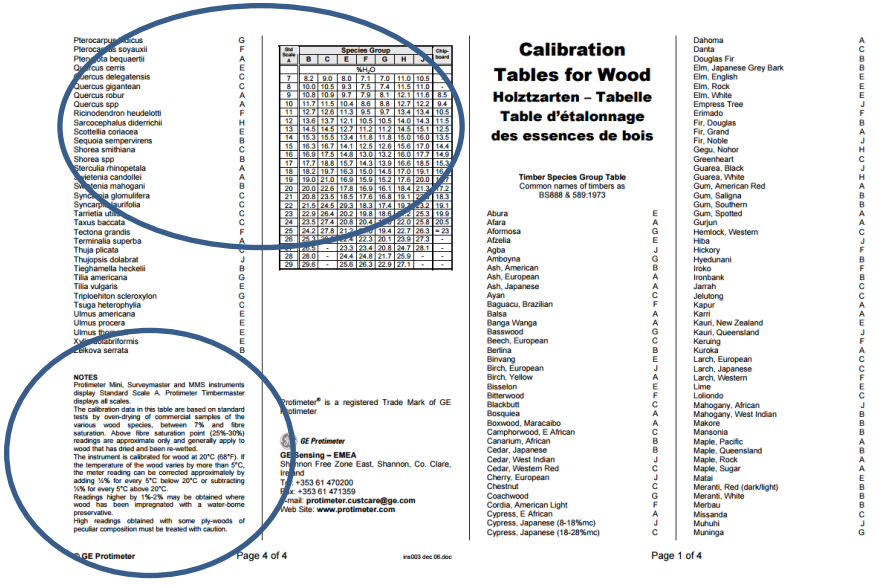
Part 2: Other things you need to know

What's the difference between Moisture content and WME?

- Moisture content is a measure of the % of moisture in the wood, usually by weight, depending on the species
- In other materials (Wood Moisture Equivalent WME by GE,) it only gives a very rough idea
- Values seem to vary too much in other materials to give a reliable result. Nevertheless, if we are getting a WME of 30% we can guess it is damp, unless it has salts

How accurate are moisture readings?

- Moisture content is accurate to a few percent in wood
- If there are any salts present then the reading will be greatly affected: chlorides, sulphates, nitrates and carbonates form salts such as gypsum (calcium sulphate, $CaSO_4$) and sodium sulphate (Na_2SO_4). Look for signs or use a salt test kit.
- Even in wood the species and temperature should be taken into account. Calibration table comes with the meter www.emlab.com/m/store/Protimeter%20Calibration%20Tables%20for%20Wood.pdf



Pterocarpus indicus G
Pterocarpus soyauxii F
Pterygota bequaertii A
Quercus cerris E
Quercus delegatensis C
Quercus gigantean C
Quercus robur A
Quercus spp A
Ricinodendron heudelotti F
Sarcocephalus diderrichii H
Scottellia coriacea E
Sequoia sempervirens B
Shorea smithiana C
Shorea spp B
Sterculia rhinopetala A
Swietenia candollei A
Swietenia mahogani B
Syncarpia glomulifera C
Syncarpia laurifolia C
Tarrietia utilis C
Taxus baccata C
Tectona grandis F
Terminalia superba A
Thuja plicata C
Thujopsis dolabrat J
Tieghamella heckelii B
Tilia americana G
Tilia vulgaris E
Triplochiton scleroxylon G
Tsuga heterophylla C
Ulmus americana E
Ulmus procera E
Ulmus thomasii E
Xylia dolabriformis E
Zelkova serrata B

NOTES
Protimeter Mini, Surveymaster and MMS instruments display Standard Scale A. Protimeter Timbermaster displays all scales.
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Std Scale A	Species Group B	C	E	F	G	H	J	Chip-board
	%H2O							
7	8.2	9.0	8.0	7.1	7.0	11.0	10.5	-
8	10.0	10.5	9.3	7.5	7.4	11.5	11.0	-
9	10.8	10.9	9.7	7.9	8.1	12.1	11.6	8.5
10	11.7	11.5	10.4	8.6	8.8	12.7	12.2	9.4
11	12.7	12.6	11.3	9.5	9.7	13.4	13.4	10.5
12	13.6	13.7	12.1	10.5	10.5	14.0	14.3	11.5
13	14.3	14.5	12.7	11.2	11.2	14.5	15.1	12.5
14	15.3	15.5	13.4	11.8	11.8	15.0	16.0	13.5
15	16.3	16.7	14.1	12.5	12.6	15.6	17.0	14.4
16	16.9	17.5	14.8	13.0	13.2	16.0	17.7	14.9
17	17.7	18.8	15.7	14.3	13.9	16.6	18.5	15.3
18	18.2	19.7	16.3	15.0	14.5	17.0	19.1	15.8
19	19.0	21.0	16.9	15.9	15.2	17.6	20.0	16.2
20	20.0	22.6	17.8	16.9	16.1	18.4	21.3	17.2
21	20.8	23.5	18.5	17.5	16.8	19.1	22.2	18.3
22	21.5	24.5	29.3	18.3	17.4	19.7	23.2	19.1
23	22.9	26.4	20.2	19.8	18.6	20.9	25.3	19.9
24	23.5	27.4	20.8	20.4	19.4	22.0	25.8	20.5
25	24.2	27.8	21.2	20.9	19.4	22.7	26.3	- 23
26	25.3	29.4	22.1	22.3	20.1	23.9	27.3	-
27	26.1	-	23.3	23.4	20.8	24.7	28.1	-
28	28.0	-	24.4	24.8	21.7	25.9	-	-
29	29.0	-	25.6	26.3	22.9	27.1	-	-

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Calibration Tables for Wood
Holztzarten – Tabelle
Table d'étalonnage des essences de bois

Timber Species Group Table
Common names of timbers as BS888 & 589:1973

Abura E
Afara A
Aformosa G
Afzelia E
Agba J
Amboyna G
Ash, American B
Ash, European A
Ash, Japanese A
Ayan C
Baguacu, Brazilian F
Balsa A
Banga Wanga A
Basswood G
Beech, European C
Berlina B
Binvang E
Birch, European J
Birch, Yellow A
Bisselon E
Bilterwood F
Blackbutt C
Bosquiea A
Boxwood, Maracaibo A
Camphorwood, E African C
Canarium, African B
Cedar, Japanese B
Cedar, West Indian J
Cedar, Western Red C
Cherry, European J
Chestnut C
Coachwood G
Cordia, American Light F
Cypress, E African A
Cypress, Japanese (8-18%mc) J
Cypress, Japanese (18-28%mc) C

Dahoma A
Danta C
Douglas Fir B
Elm, Japanese Grey Bark B
Elm, English E
Elm, Rock E
Elm, White E
Empress Tree J
Ermado F
Fir, Douglas B
Fir, Grand A
Fir, Noble J
Gegu, Nohor H
Greenheart C
Guarea, Black J
Guarea, White H
Gum, American Red A
Gum, Saligna B
Gum, Southern B
Gum, Spotted A
Gurjun A
Hemlock, Western C
Hiba J
Hickory F
Hyedunani B
Iroko F
Ironbank B
Jarrah C
Jelutong C
Kapur A
Karri A
Kauri, New Zealand E
Kauri, Queensland J
Keruing F
Kuroka A
Larch, European C
Larch, Japanese C
Larch, Western F
Lime E
Lollondo C
Mahogany, African J
Mahogany, West Indian B
Makore B
Mansonia B
Maple, Pacific A
Maple, Queensland A
Maple, Rock A
Maple, Sugar A
Matai E
Meranti, Red (dark/light) B
Meranti, White B
Merbau B
Missanda C
Muhuhi J
Muninga G

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How accurate are the readings?

Pterocarpus indicus	G
Pterocarpus soyauxii	F
Pterygota bequaertii	A
Quercus cerris	E
Quercus delegatensis	C
Quercus gigantean	C
Quercus robur ← English Oak →	A
Quercus spp	A
Ricinodendron heudelotti	F
Sarcocephalus diderrichii	H
Scottellia coriacea	E
Sequoia sempervirens	B
Shorea smithiana	C
Shorea spp	B
Sterculia rhinopetala	A

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	B	C	E	F	G	H	J	
	$\%H_2O$							
7	8.2	9.0	8.0	7.1	7.0	11.0	10.5	-
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13	14.5	14.5	12.7	11.2	11.2	14.5	15.1	12.5
14	15.3	15.5	13.4	11.8	11.8	15.0	16.0	13.5
15	16.3	16.7	14.1	12.5	12.6	15.6	17.0	14.4
16	16.9	17.5	14.8	13.0	13.2	16.0	17.7	14.9
17	17.7	18.8	15.7	14.3	13.9	16.6	18.5	15.3
18	18.2	19.7	16.3	15.0	14.5	17.0	19.1	16.1

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Not very accurate above 25-30%

Temperature correction 0.5% for every 5C below 20C

Formula for Vapour Pressure

Font | Alignment

f_x =(0.6105*EXP((17.269*D2)/(237.3+D2))) *(E2/100)

	D	E	F	G	H	I	J	K	L	M
	temperature	humidity	gpkg	dew_point	wood_pct	battery_voltag	VP (kPa)	WME	Growth Rate m	Tot Growth, m
)	10.5	107	8.5	11.6	30.9	3.2	1.36	30.0	0.00	0.00
)	10.4	107	8.4	11.5	30.7	3.2	1.35	30.0	0.00	0.00
)	10.4	106.9	8.4	11.5	30.7	3.2	1.35	30.0	0.00	0.00