

# U-values & Retrofitting Traditionally Built Walls

Coleman Court  
25<sup>th</sup> March 2014

Caroline Rye

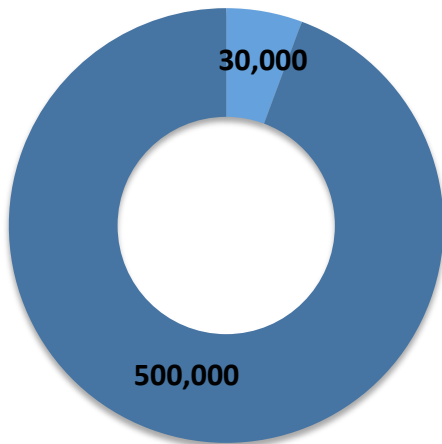
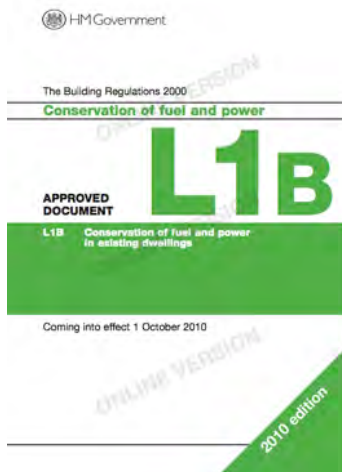
## Traditional Construction

Traditional buildings: are all buildings of a **solid wall** construction built with permeable fabric that both absorbs and readily allows the evaporation of moisture. These **mostly predate the 1920's** when **cavity wall** construction and the use of **damp proof membranes** became widespread.”

*English Heritage, Home Information Packs Energy Performance Certificates for Historic and Traditional Homes*



# Traditional & Historical Buildings – Part L



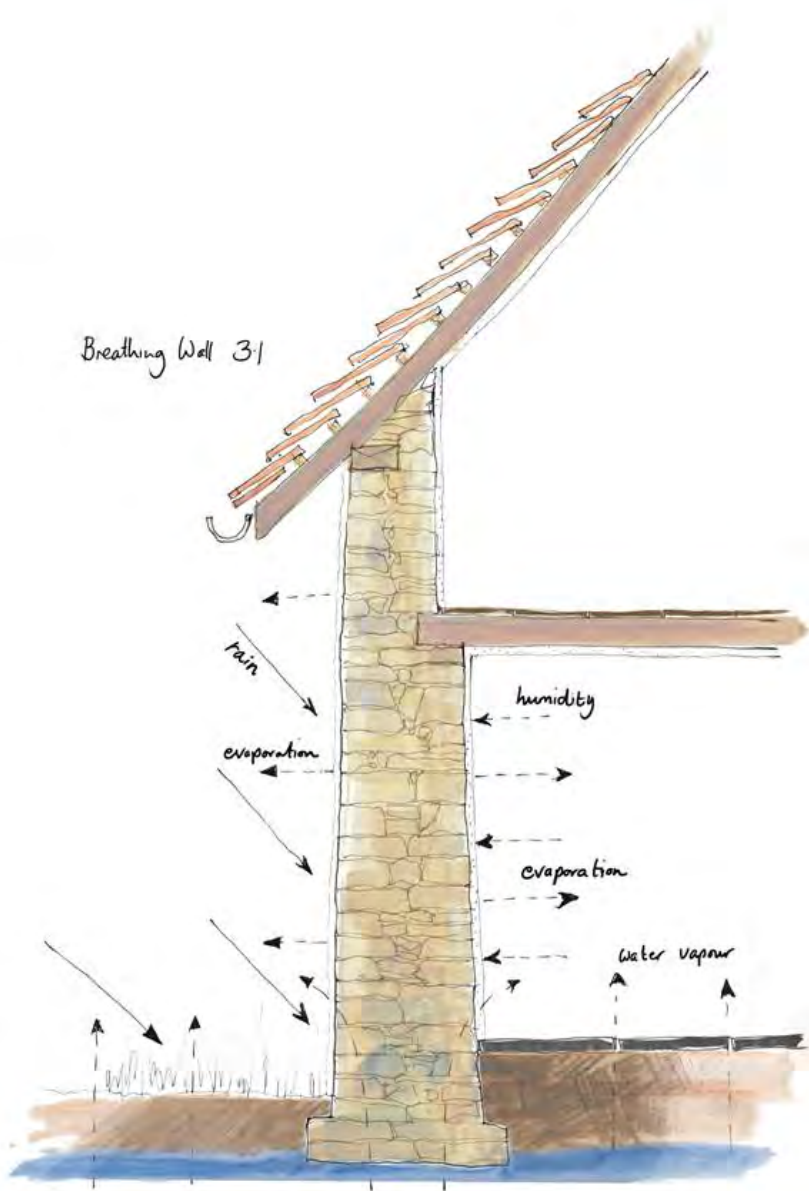
Numbers of Listed & Traditional Buildings in Wales

## Special Considerations

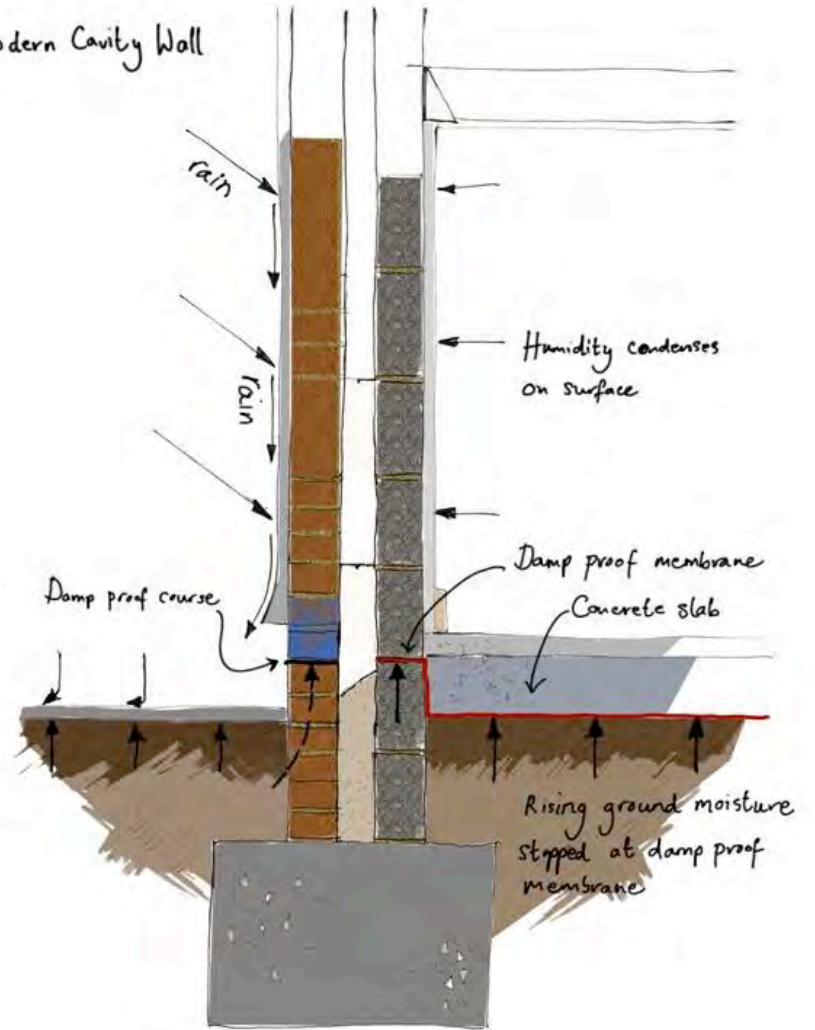
3.8 There are three further classes of buildings **where special considerations in making reasonable provisions for the conservation of fuel or power may apply:**

- buildings which are of architectural and historical interest and which are referred to as material consideration within a local authority's development plan or local development framework;
- buildings which are of architectural and historical interest within national parks, areas of outstanding natural beauty, registered historic parks and gardens, registered battlefields, the curtilages of scheduled ancient monuments, and world heritage sites, and;
- buildings of **traditional construction with permeable fabric** that both **absorbs** and **readily allows the evaporation of moisture.**"

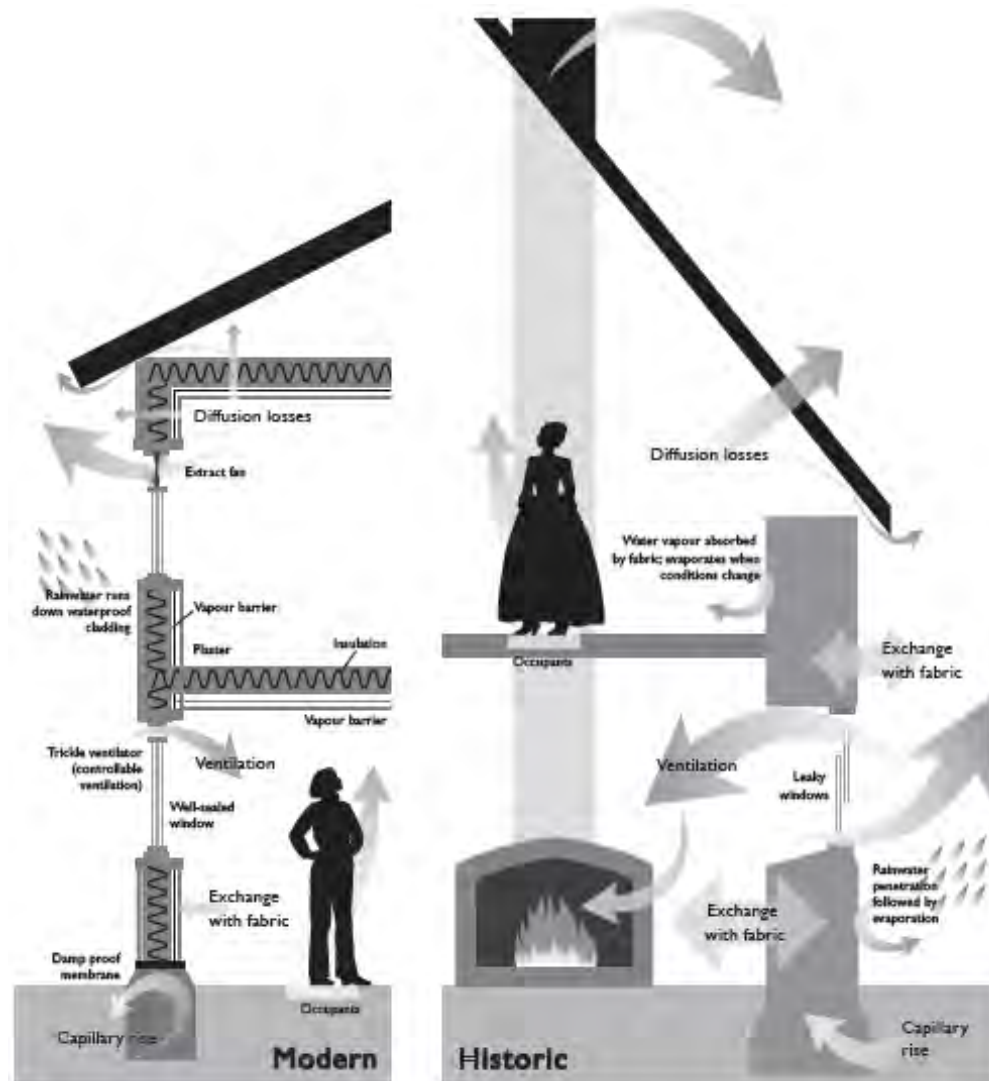
Breathing Wall 31



2 Modern Cavity Wall



# Moisture Management Ventilation (and heat) for Evaporation



*English Heritage 'Energy Efficiency and Historic Buildings'*

# Retrofitting - Heat Loss through Walls



35% heat loss occurs through the walls of a building.



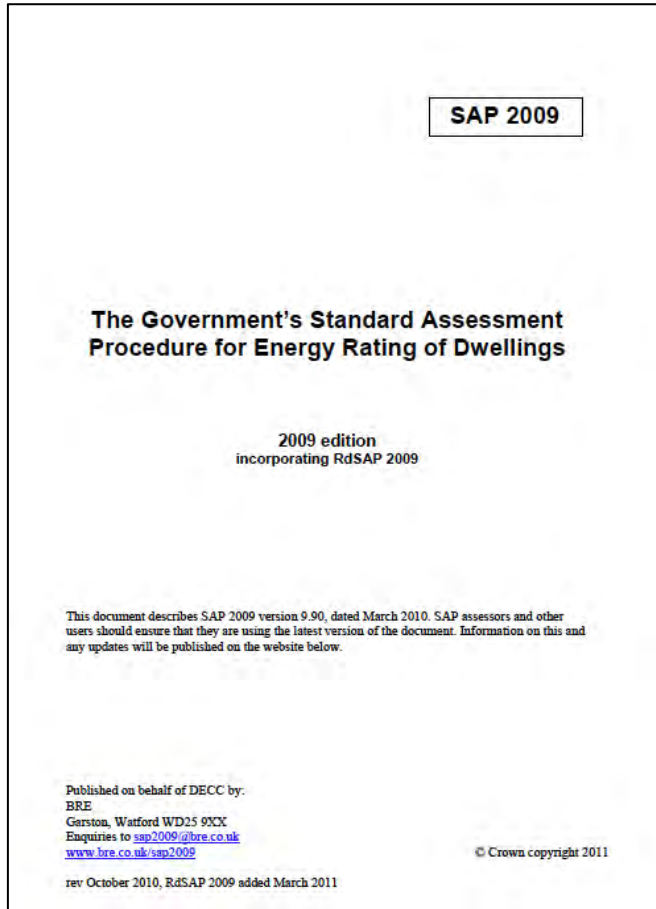
U-value =  $W/m^2K$



Document L1B requirement for upgrading walls =  $0.3 W/m^2K$



## U-values for the 5 'traditional' wall types given in SAP



Wall Material	Thickness m	SAP U-value
Granite/Whin	.500	2.3
Sandstone	.500	2.0
Brick	.220	2.1
Cob	.550	0.8
Timber Frame	.150	2.5

Table S6 : Wall U-values – England and Wales, RdSAP Appendix S

# Measured *in situ* U-values





## *In situ*/Calculated U-value comparison



### Wall build up

Lime Plaster	15
Granite	400
Cement render	13
Lime roughcast render	25
Overall	453mm

*In situ* U-value 1.75 W/m<sup>2</sup>K

RdSAP U-value 2.3 W/m<sup>2</sup>K



## *In situ*/Calculated U-value comparison



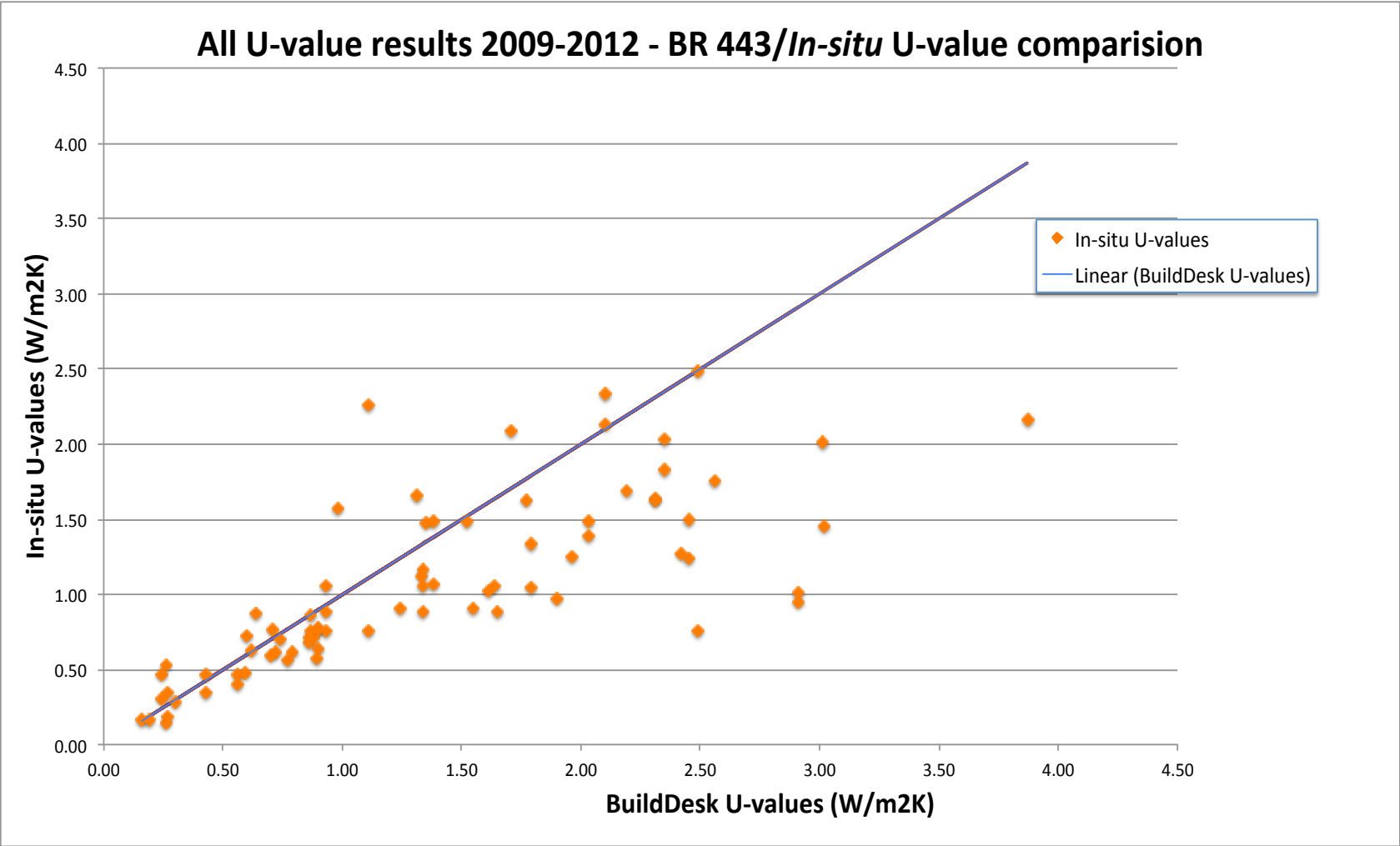
### Wall build up

Gypsum plaster	15
<u>Malmstone</u>	<u>310</u>
Overall	325mm

In-situ U-value 1.34 W/m<sup>2</sup>K

*RdSAP U-value 2.0 W/m<sup>2</sup>K*

# Measured in situ and calculated U-value comparison SPAB U-value Research



Calculation overestimates U-value in 77% of cases



## Measured/SAP default U-values comparison for Traditional Walls

**SAP 2009**

**The Government's Standard Assessment Procedure for Energy Rating of Dwellings**

2009 edition  
incorporating RdSAP 2009

This document describes SAP 2009 version 9.90, dated March 2010. SAP assessors and other users should ensure that they are using the latest version of the document. Information on this and any updates will be published on the website below.

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rev October 2010, RdSAP 2009 added March 2011

Material	SAP Thickness mm	Measured Ave Thickness mm	Measured U-value	SAP U-value
Granite/Whin	500	520	1.4	2.3
Sandstone	500	475	1.5	2.0
Brick	220	220	1.4	2.1
Cob	550	600	0.7	0.8
Timber Frame	150	135	2.0	2.5

# Uncertainty in U-value Calculations for Solid Walls

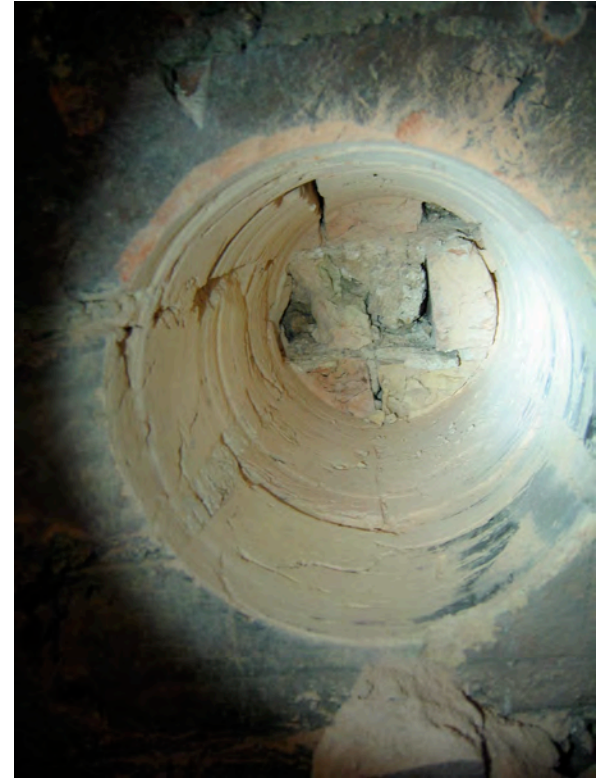


(Un)known Construction

Uncertain material thermal conductivity values



Mortar Fraction

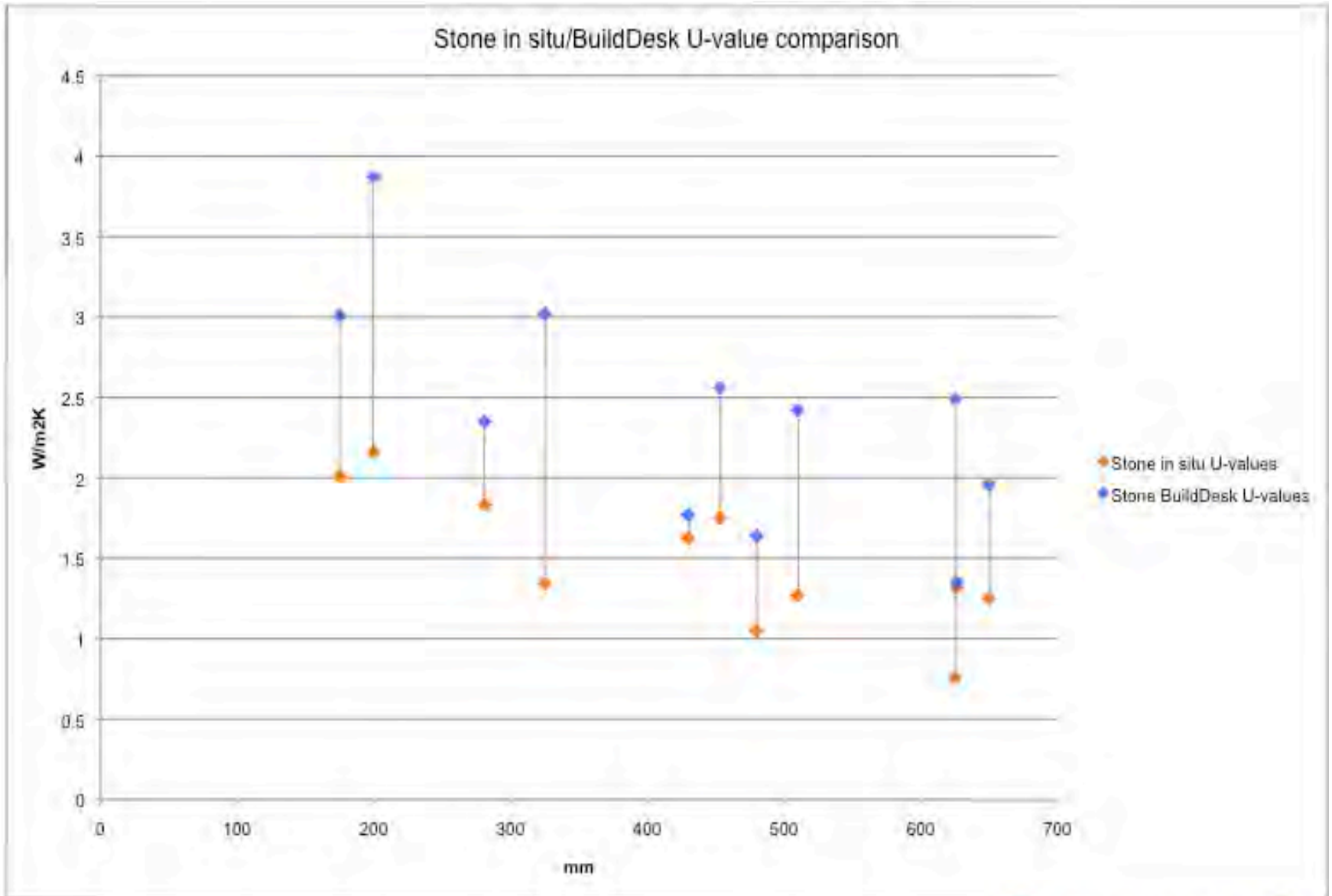


Air voids/cavities

Contribution of thermal mass



# Uncertainty in U-value Calculations – Stone Walls



## Close *In situ*/BR 443 correlations

ID	Build Up	mm	<i>In situ</i> U-value	BR 443 U-value
1c	Lime Plaster Brick Infill Lime Render	134.5	<b>2.48</b>	<b>2.49</b>
1h	Lime Plaster Hemcrete Timber Stud	162	<b>0.77</b>	<b>0.71</b>
11a	Lime Plaster Straw/Clay Clay/lime plaster	325	<b>0.28</b>	<b>0.30</b>
16a	Lime Plaster Straw Bale Lime Render	435	<b>0.16</b>	<b>0.16</b>
20a	Brick Lime Plaster Gypsum Skim	380	<b>1.48</b>	<b>1.52</b>
20c	Brick Lime Plaster Gypsum Skim	248	<b>2.13</b>	<b>2.10</b>
24c	Asbestos Sheet Mineral Wool Plasterboard & Skim	105	<b>0.46</b>	<b>0.43</b>

# Consequences of overestimation of U-values for retrofitting solid walls

Overestimation of energy and financial savings as a result of insulating solid walls



Excessive resource use (insulating materials)



Over insulation > excessive cooling > interstitial condensation



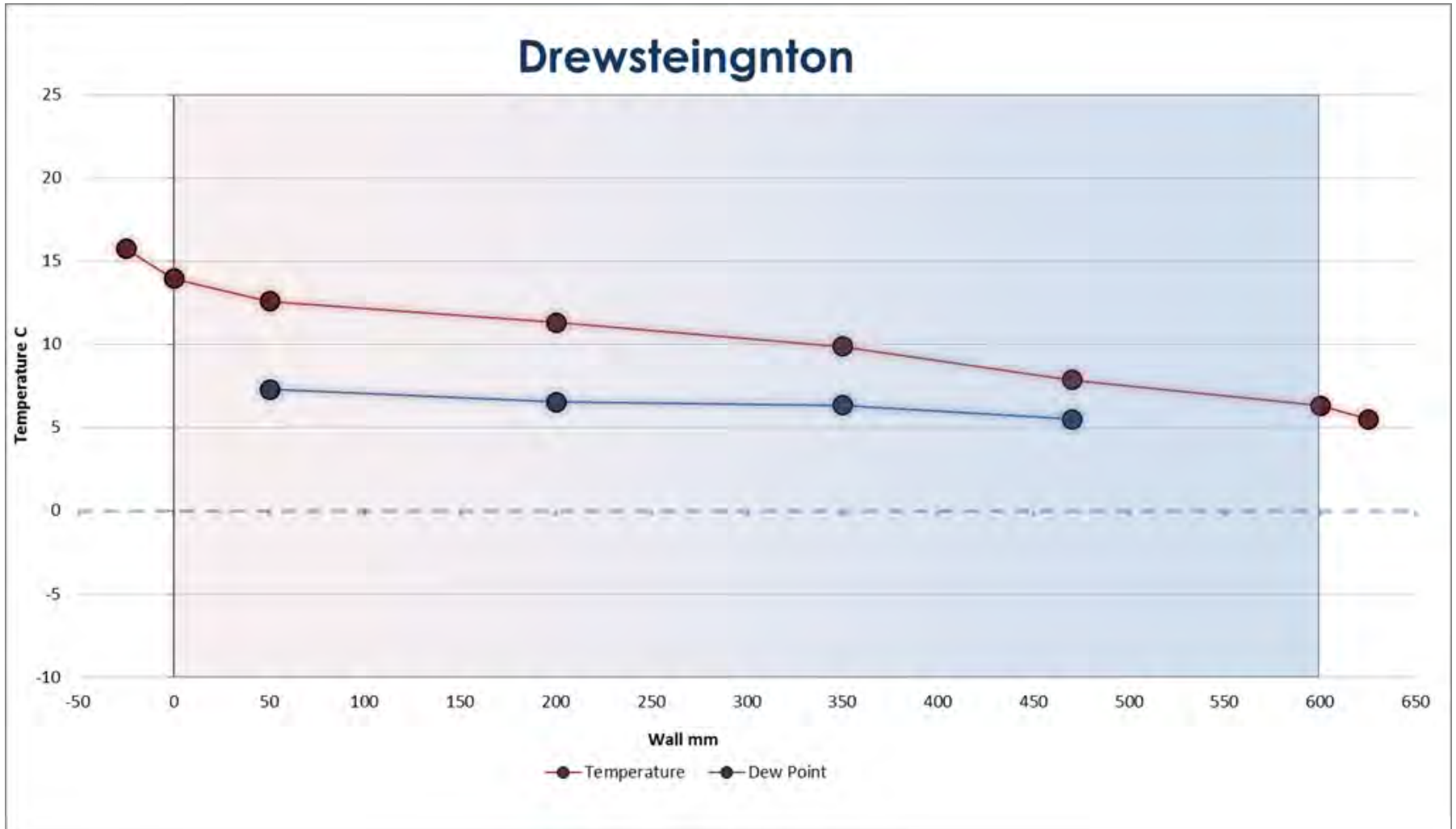
High performing (vapour closed) insulation > interstitial condensation and/or trapped moisture

## Consequences of overestimation of U-values for retrofitting solid walls

Wall Material	Base case U-value	Insulation	Thickness	Retrofit U-value
<b>SAP</b>				
Granite/Whin	2.3	MW/'Natural'	90mm	0.3 W/m2K
Brick	2.1	MW/'Natural'	90mm	0.3 W/m2K
Sandstone	2	MW/'Natural'	90mm	0.3 W/m2K
<b>Measured</b>				
Granite/Whin	1.4	MW/'Natural'	80mm	0.3 W/m2K
Brick	1.4	MW/'Natural'	80mm	0.3 W/m2K
Sandstone	1.5	MW/'Natural'	80mm	0.3 W/m2K
Granite/Whin	1.4	PIR	50mm	0.3 W/m2K
Brick	1.4	PIR	50mm	0.3 W/m2K
Sandstone	1.5	PIR	50mm	0.3 W/m2K



# Granite Wall – Hygrothermal Wall section - Uninsulated

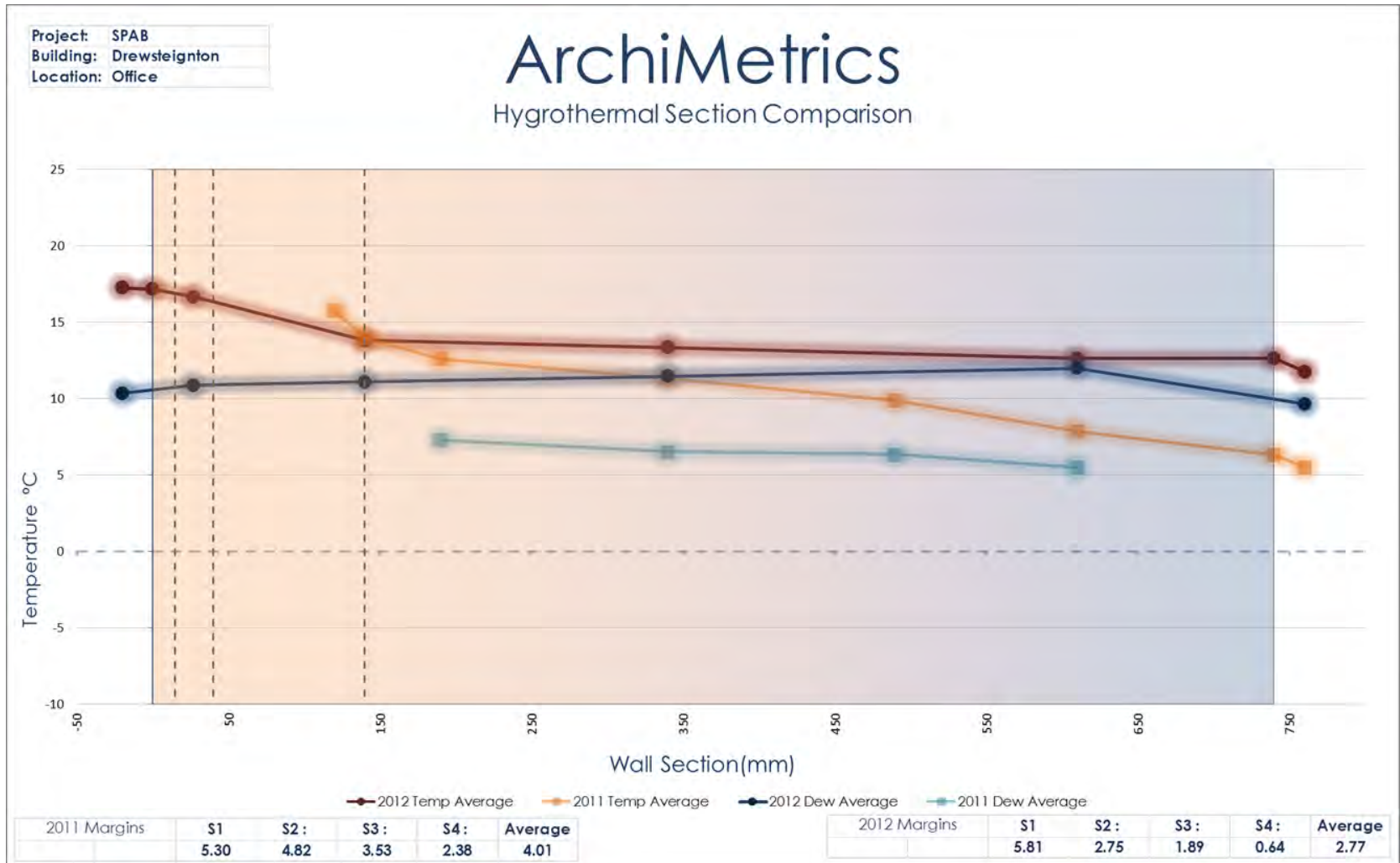


Uninsulated in situ U-value = 1.24 W/m<sup>2</sup>K

Dewpoint margin – all 4 nodes = 4.01°C, outer node = 2.98°C



# Granite Wall – Hygrothermal Wall section - Insulated



Insulated (100mm PIR) in situ U-value = 0.16 W/m<sup>2</sup>K

Dewpoint margin – all 4 nodes = 2.77°C, outer node = 0.64°C, 76% reduction

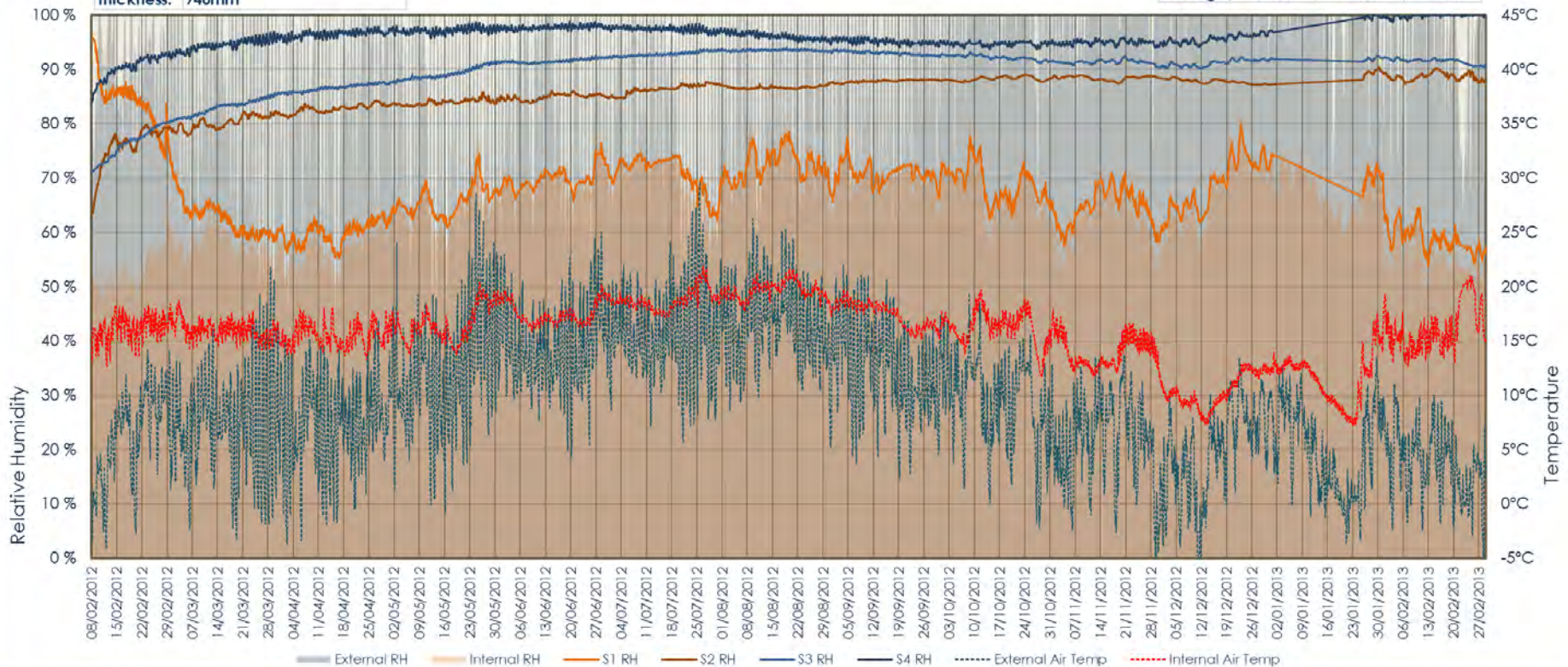


Project:	SPAB BPS
Building:	Drewsteignton
Location:	Office
Start:	08/02/2012
End:	28/02/2013
Logger:	AMIG/06
Material:	Granite & PIR IWI
Thickness:	740mm

# ArchiMetrics

## Relative Humidity Over Time

RH %	Minimum	Maximum	Average
Internal	45.08	86.13	64.57
S1	53.72	95.73	67.83
S2	63.24	90.38	85.45
S3	71.14	94.06	89.74
S4	84.09	100.00	96.01
External	28.54	100.00	92.31
Average	57.63	94.38	82.65



IWI - Drewsteignton - Granite Wall 600mm thick insulated with 100mm PIR – foil-faced, taped joints, air gap, plasterboard & skim





**L1B**

APPROVED DOCUMENT

L1B Conservation of fuel and power in existing dwellings

Coming into effect 1 October 2010

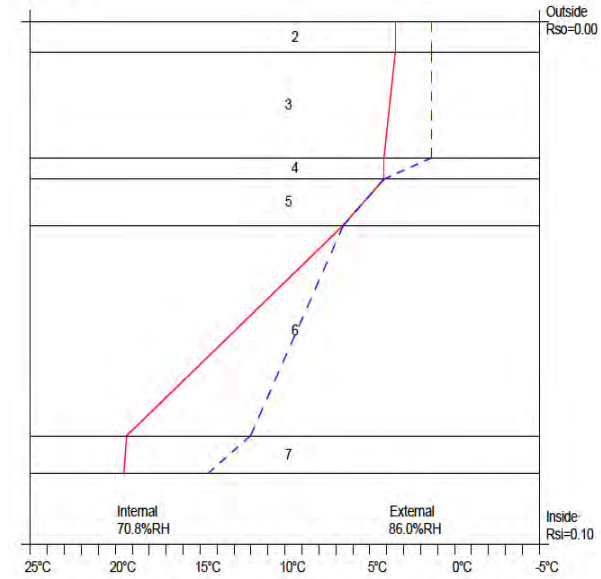
2010 edition

SAP 2009

The Government's Standard Assessment Procedure for Energy Rating of Dwellings



Scale 1:2



Material	In situ U-value	SAP U-value
Granite/Whin	1.4	2.3
Sandstone	1.5	2.0
Brick	1.4	2.1



## Research Reports & Contacts

*The SPAB Research Report 1: The U-value Report 2010 - 2012*

*The SPAB Research Report 2: The Building Performance Survey 2011 - 2013*

*The SPAB Research Report 3: The SPAB Hygrothermal Modelling 2012*

<http://www.spab.org.uk/advice/energy-efficiency/>

The SPAB Technical Helpline: 0207 456 0916

*Historic Scotland Technical Paper 10: U-values and Traditional Buildings*

*Sustainable Traditional Buildings Alliance (STBA)*

*Responsible Retrofit of Traditional Buildings: A Report of Existing Research and Guidance with Recommendations* [www.stbauk.org](http://www.stbauk.org)

This research has been carried out by Cameron Scott & Caroline Rye

[www.archimetrics.co.uk](http://www.archimetrics.co.uk)