Compatible Thermal Solutions for Historic Buildings

ecological BUILDING SYSTEMS
Naturally Better

March 26th 2025

Since our founding, we've been at the forefront of the green building movement, constantly researching and developing new systems that meet the needs of our customers and the planet.

Ecological's parent company is MacCann & Byrne, a family-owned hardware and timber company steeped in history that has been established on the same premises in Athboy since 1906.

1906

Our parent company, MacCann and Byrne, is founded in Athboy, County Meath.

Our parent company, MacCann and Byrne, is founded in Athboy, County Meath. McCann and Byrne successfully trade as an independent hardware merchant supplying hardware and timber products to the Irish market. The company remains family owned to this day.

1906

Our parent company, MacCann and Byrne, is founded in Athboy, County Meath.

2000

Ecological Building Systems launched as a subsidiary company of MacCann and Byrne.

2007-2008

Ecological Building Systems launch in the United Kingdom.

2009

Centre of Knowledge launched in Athboy.

2013

UK offices and warehouse are moved to Carlisle, Cumbria

2020

Re-launch of ecologicalbuildingsystems.com.

2022-2023

Ecological Building Systems in Ireland becomes an independent limited company

Products & Systems With Sole Distribution In Ireland & UK

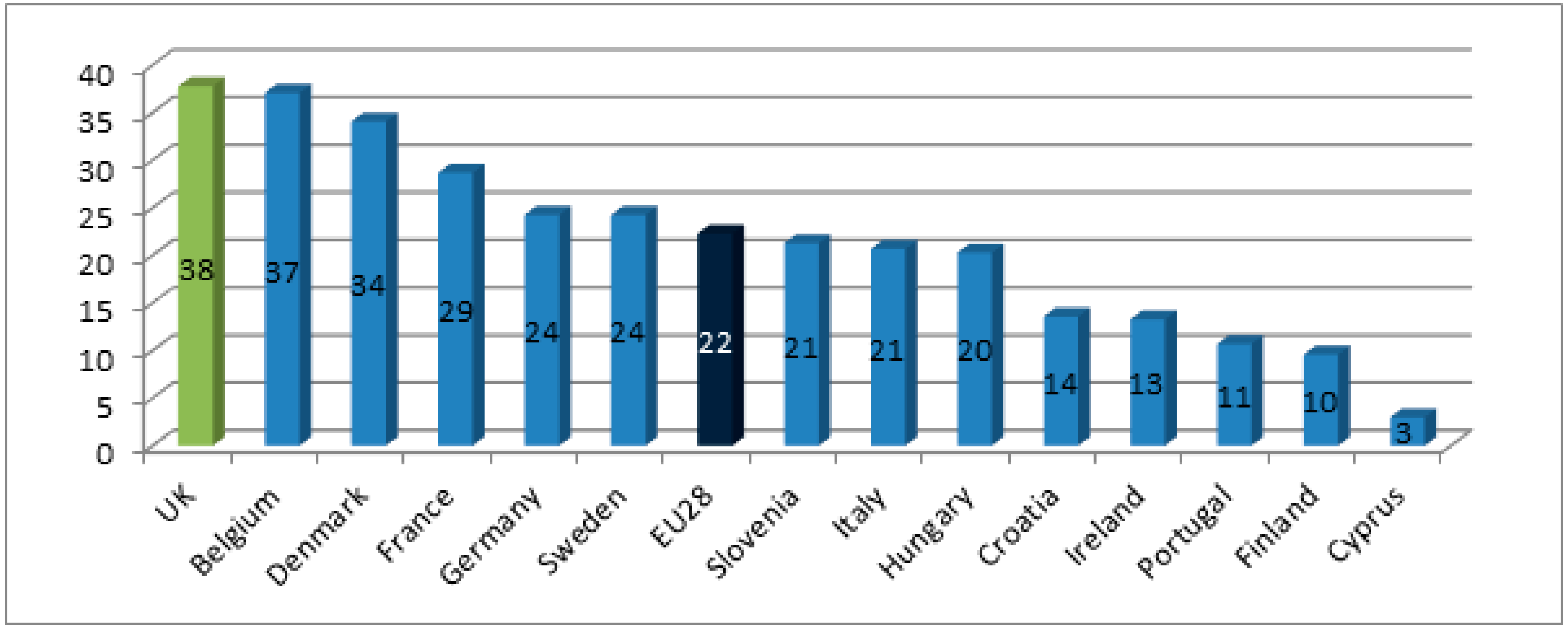
- Pro Clima Air & Windtight Membranes, Tapes & Seals
- Gutex Wood Fibreboards
- Diasen Cork Lime Thermal Plaster
- Calsitherm Climate Board
- Hemp/Jute Insulation
- Wellhoefer Insulated Airtight Attic Hatches
- InVENTer Decentralised Ventilation With Heat Recovery
- Optime Airtight Downlighter Boxes
- ELKA Strong Board – Diffusion Open Racking Board
- Bosig Phonotherm 200 thermal bridge insulation
- AURO Natural Paints
- FINSA Technical Structural Panels
- CELENIT Wood Wool Boards
- Grass insulation batts

Compatible Thermal Solutions for Historic Buildings

Presentation Overview

- Retrofit strategies
- Moisture - impact on buildings
- Primary drivers of moisture ingress
- Moisture and its relationship with internal wall insulation on solid masonry walls
- Internal Wall Insulation Systems
- Case Studies

Decarbonised building stock by 2050 will be a challenge



Pre 1946 homes, EU 28 (% of total residential stock)

Ref: Heritage Counts 2019 - Re-Use and Recycle to Reduce Carbon – Historic England 2019

1 in 6 Irish buildings are solid walled

>7 million in the UK

Moisture And Its Impact On Building

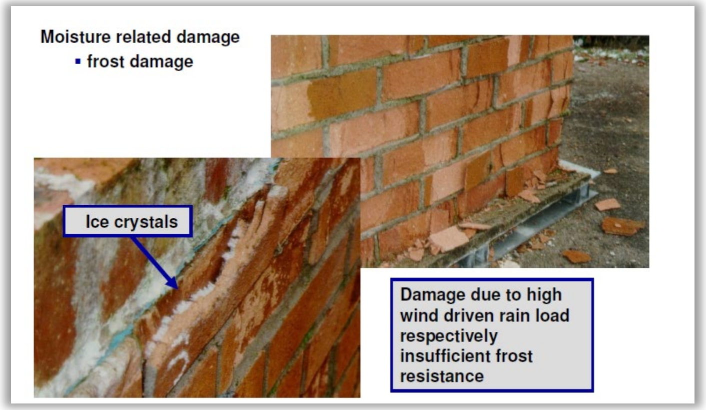
Ill-considered retrofits will often result in moisture related damages such as;

- decay of bricks due to freeze-thaw,
- structural rot of timber joists,
- condensation in attics leading to roof failure or,
- mould growth at cold surfaces, which is a potential health risk for occupants

"Except for structural errors, about 90 percent of all building construction problems are associated with water in some way" (ASHRAE, 2011)

90%

The Energy Efficiency and Moisture Balance Conundrum



Frost Damage

Salt Damage

Mould Growth

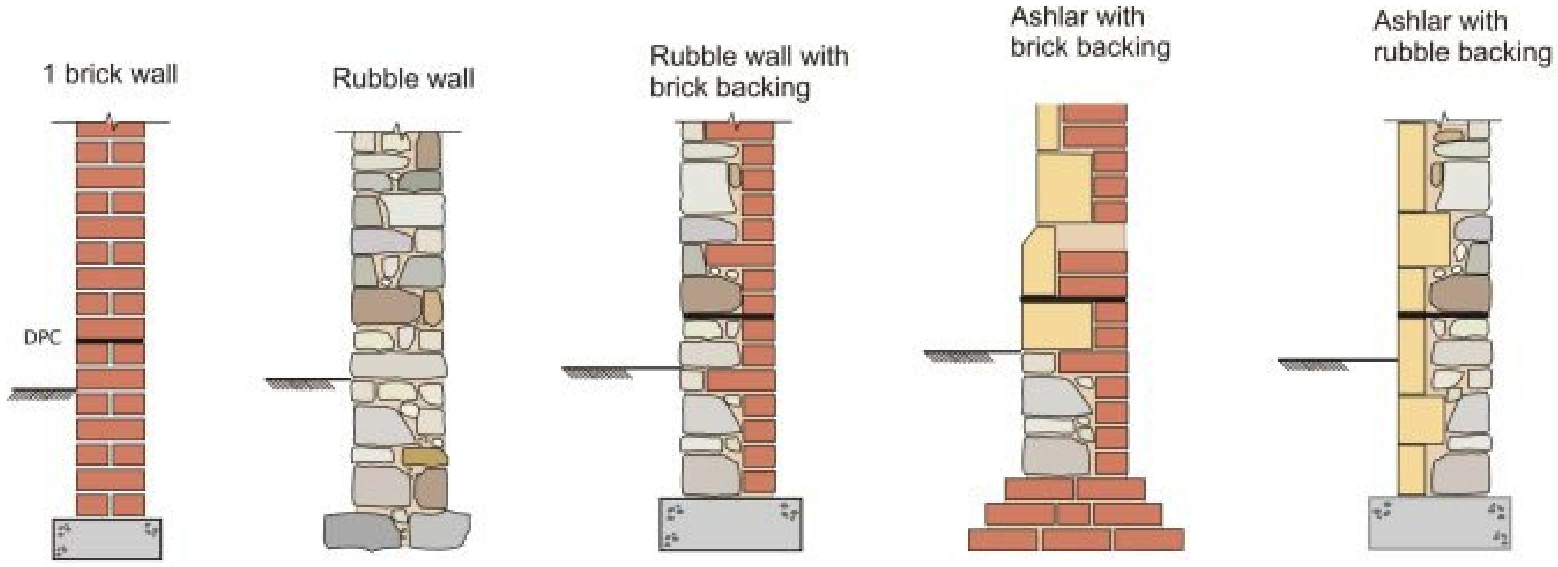
Wood Rot

Algae Growth

Ground Source Damp

Cavity Wall

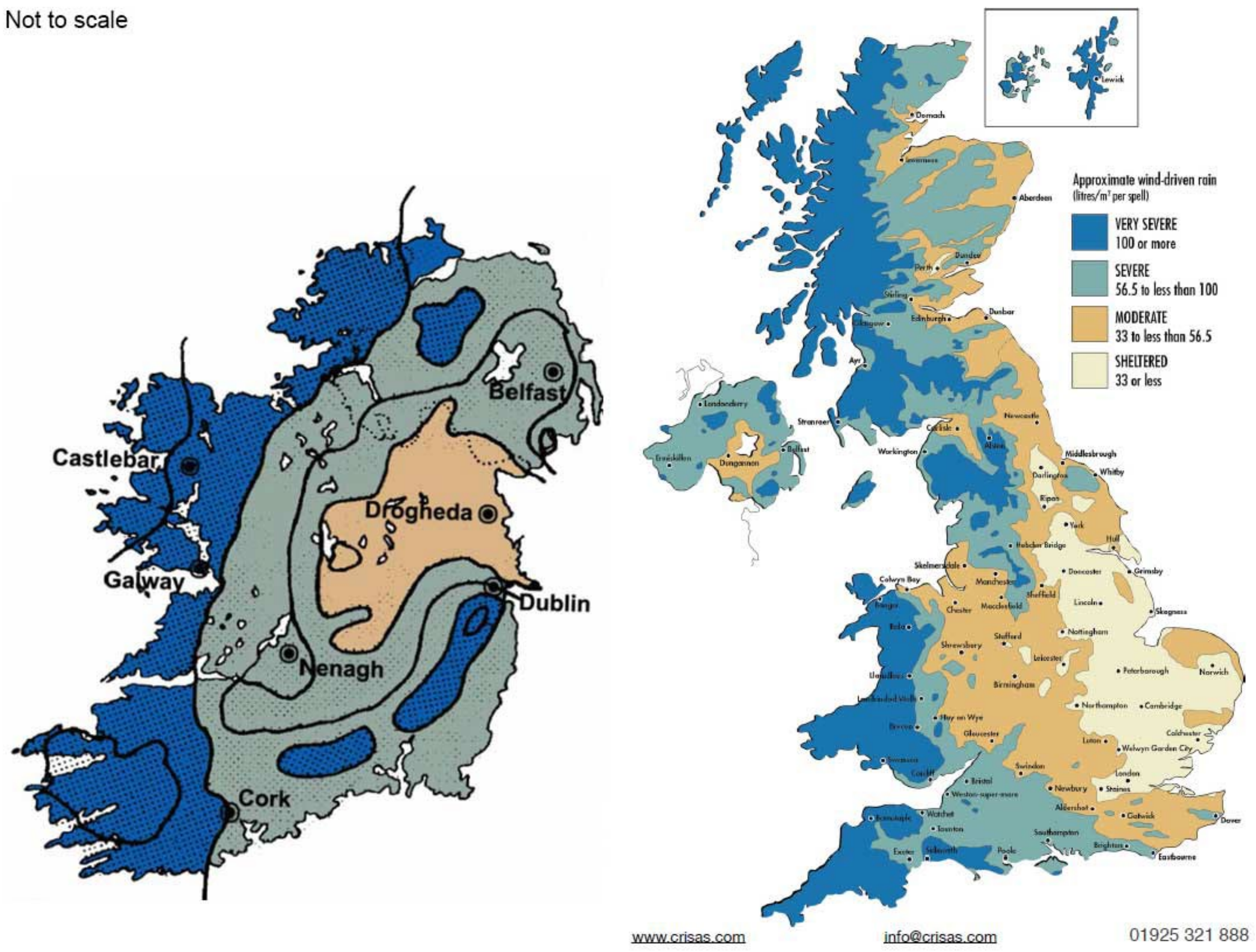
Solid Wall



Ref: https://fet.uwe.ac.uk/conweb/house_ages/elements/section2.htm

Moisture And Its Impact On Building

Thermal solutions must account for the local climate…especially when upgrading single leaf masonry walls.



- **Context**: understanding the building's history, setting, construction, condition, occupancy pattern, etc.
- **Coherence**: adopting a consistent, integrated, whole-building approach to all aspects of new-build and retrofit.
- **Caution**: identifying, assessing and managing moisture risks, and, where knowledge is limited, erring on the side of caution.
- **Capacity**: ensuring adequate capacity in building systems rather than over-optimising, to allow for unexpected or changing circumstances.

Ref: Joseph Little Architects

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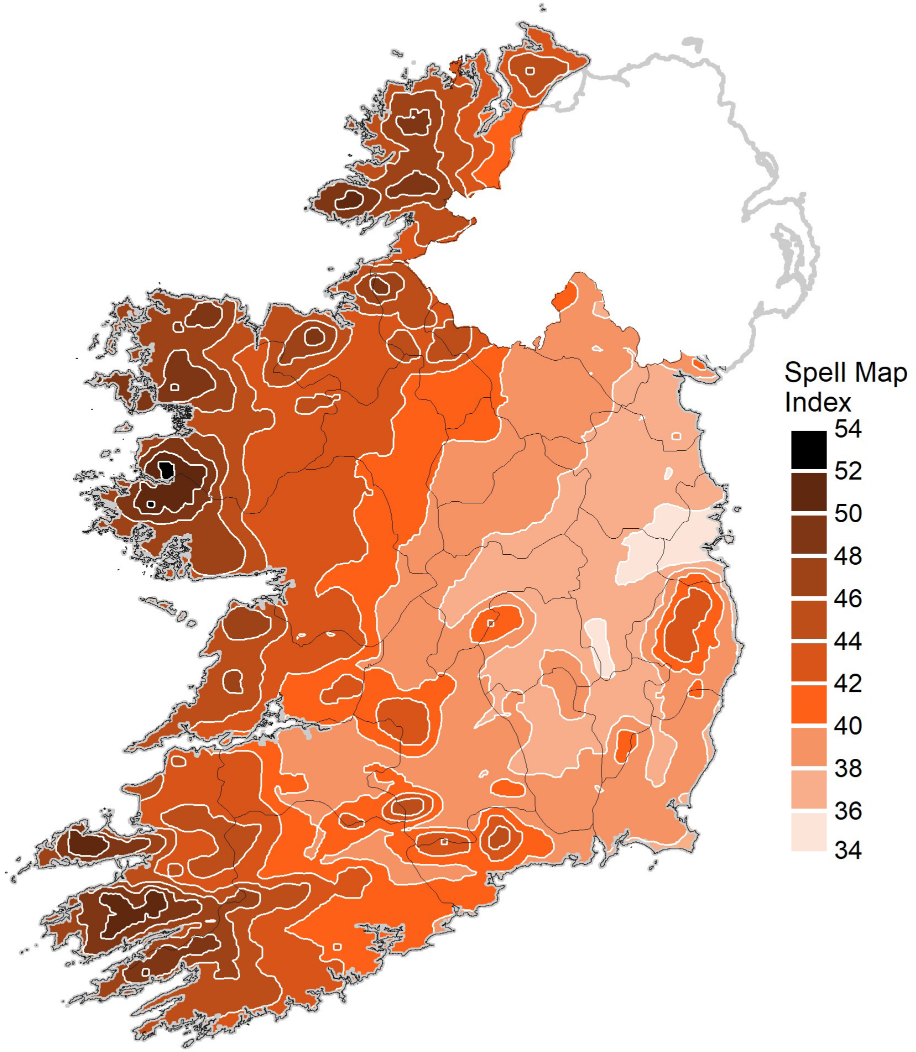
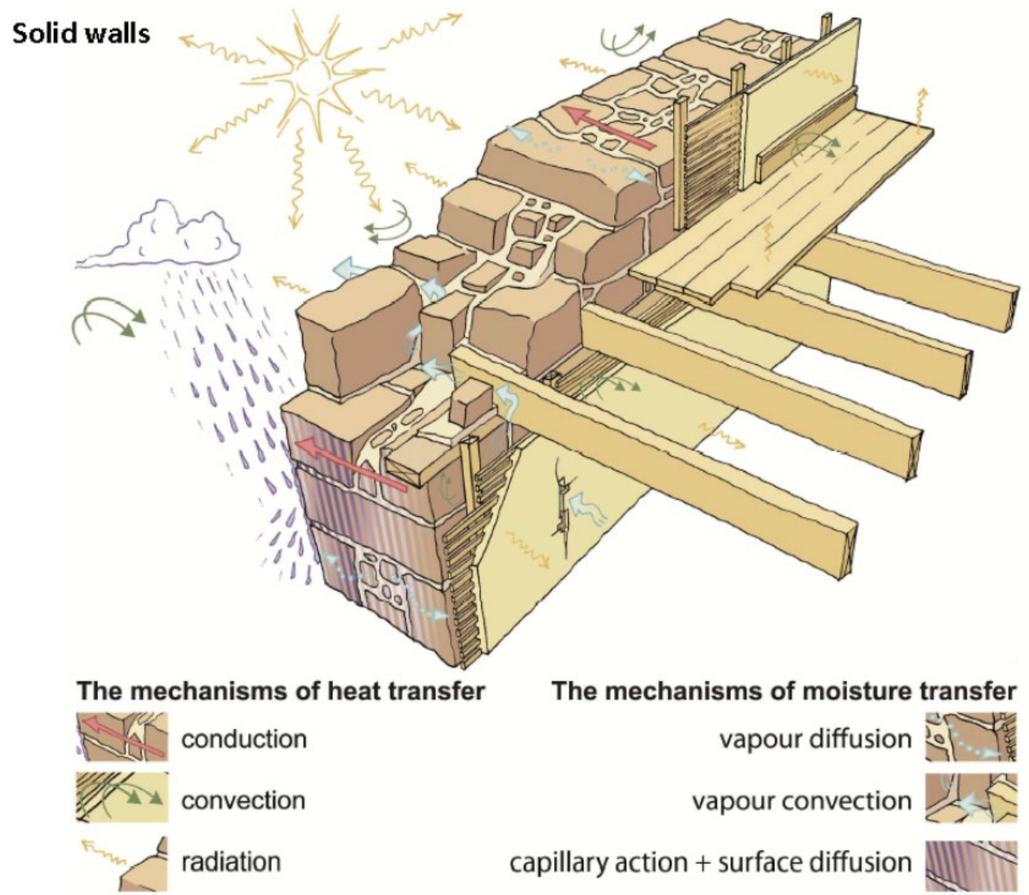


https://www.met.ie/distribution-of-driving-rain-in-ireland

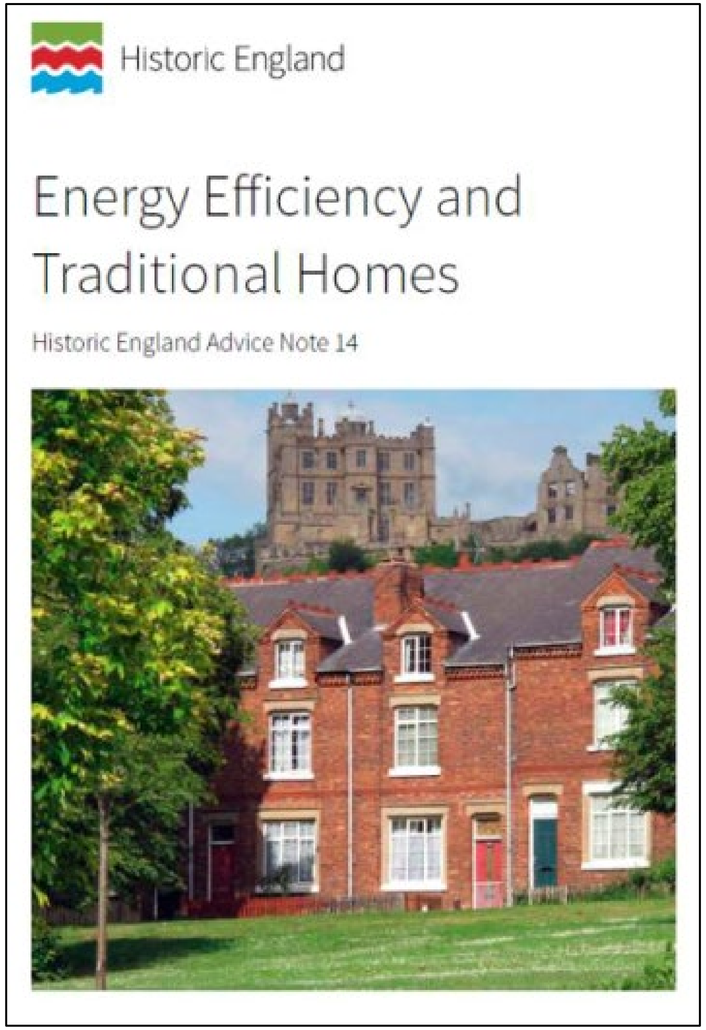
Primary drivers of moisture ingress

- External Climate
  (wind driven rain, snow, frost, humidity)
- Internal moisture
  (Cooking, washing, plants, etc)
- Built in moisture within building materials
- Ground source damp



Ref: Joseph Little Architects

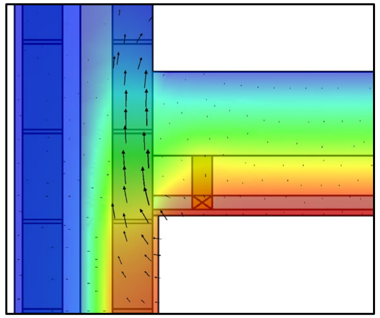
In New Build Or Retrofit A Building Should Be Seen As A System



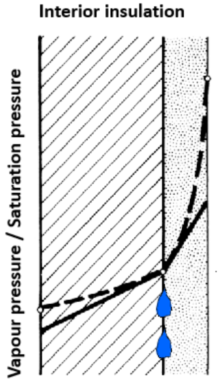
"A Whole building approach seeks the best balance"
Historic England 2020

AIRTIGHTNESS

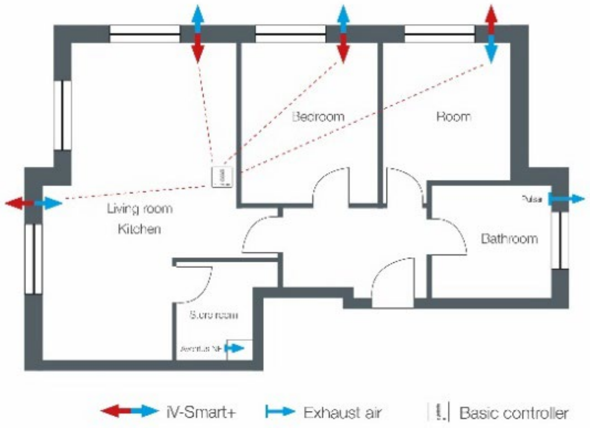
THERMAL BRIDGING



LOW RISK



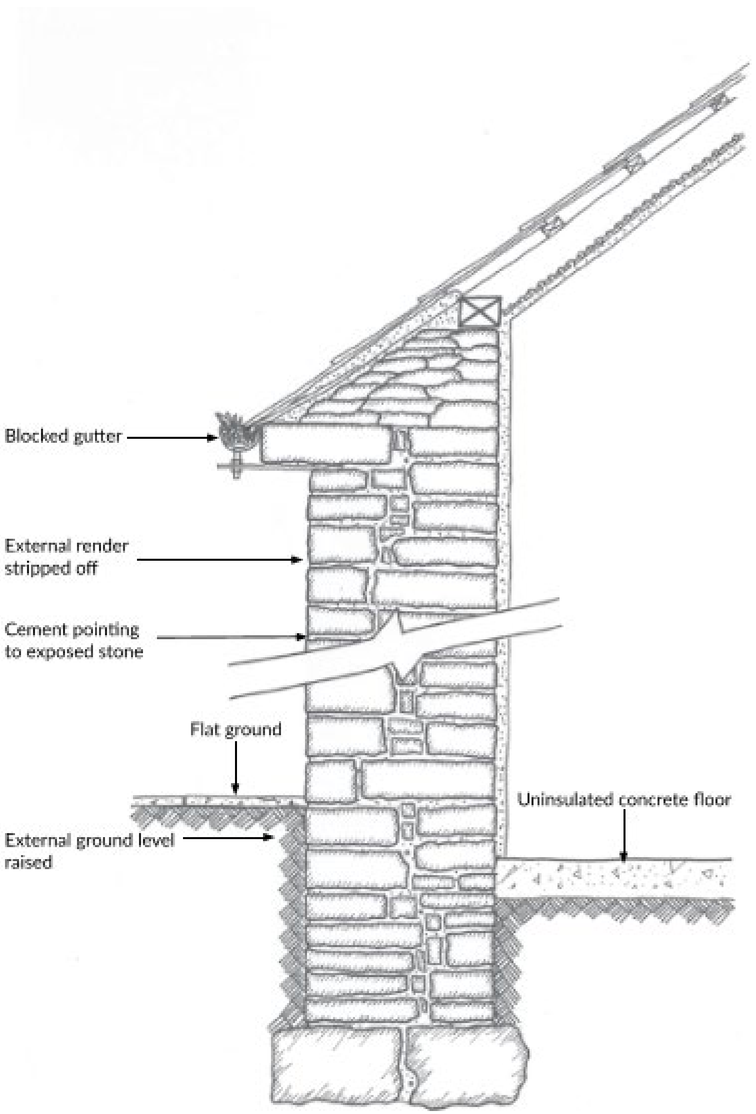
VENTILATION

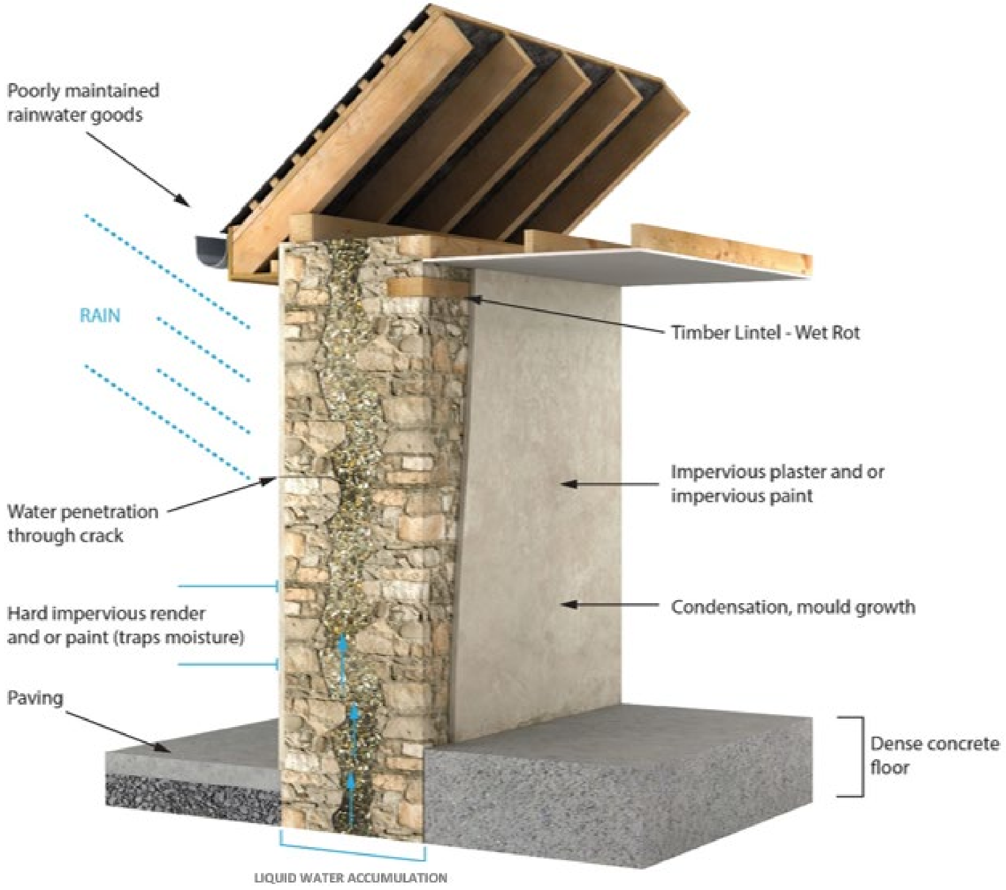


U-VALUE

MATERIAL TYPE

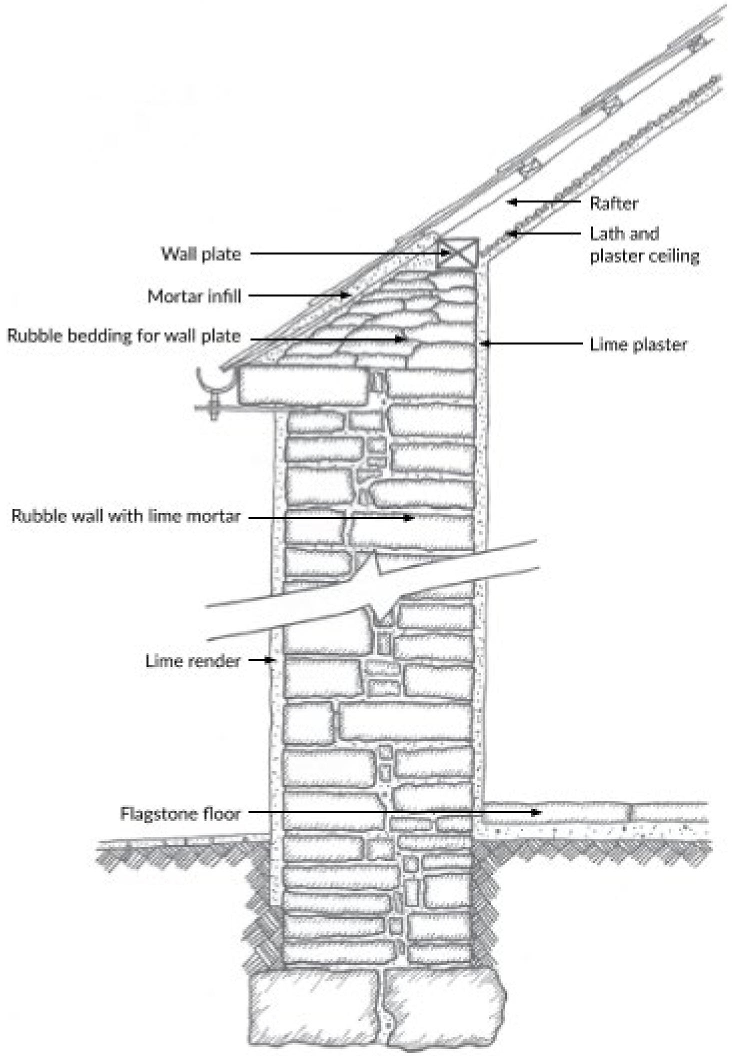
Impervious Cold Surfaces, Poor Drainage And High Internal Humidity Can Lead To Wet Buildings



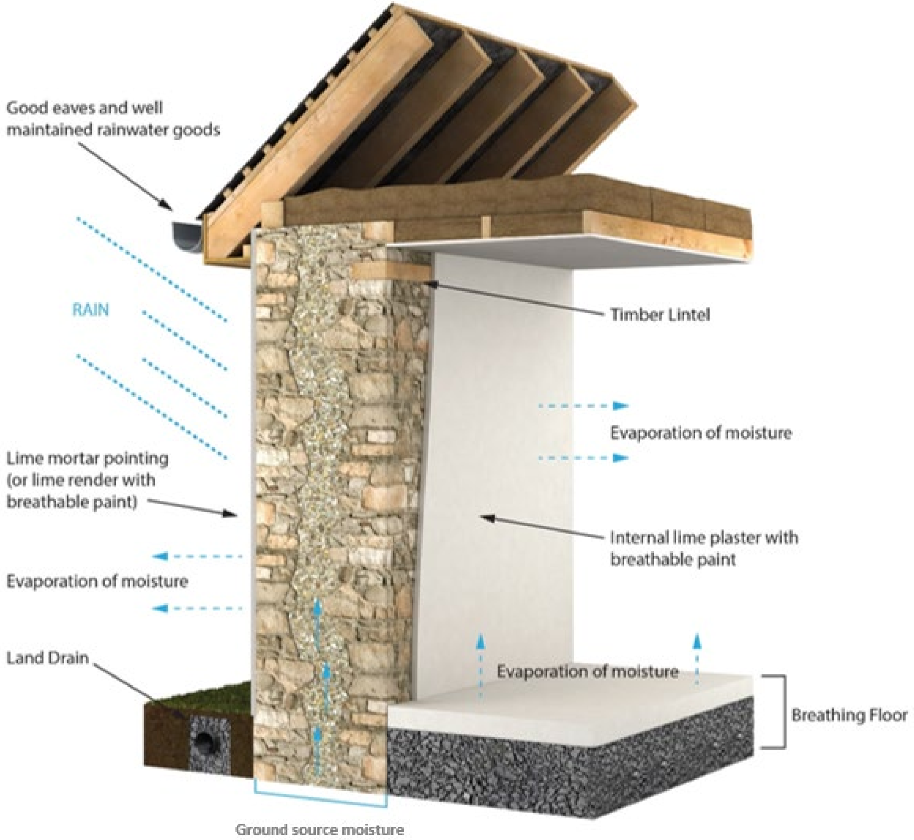


Source: DEPT. OF HOUSING LOCAL GOV AND HERITAGE 2024

Permeable warmer surfaces, effective drainage



Source: DEPT. OF HOUSING LOCAL GOV AND HERITAGE 2024



Impervious Non-breathable Insulation Can Result In Similar Symptoms

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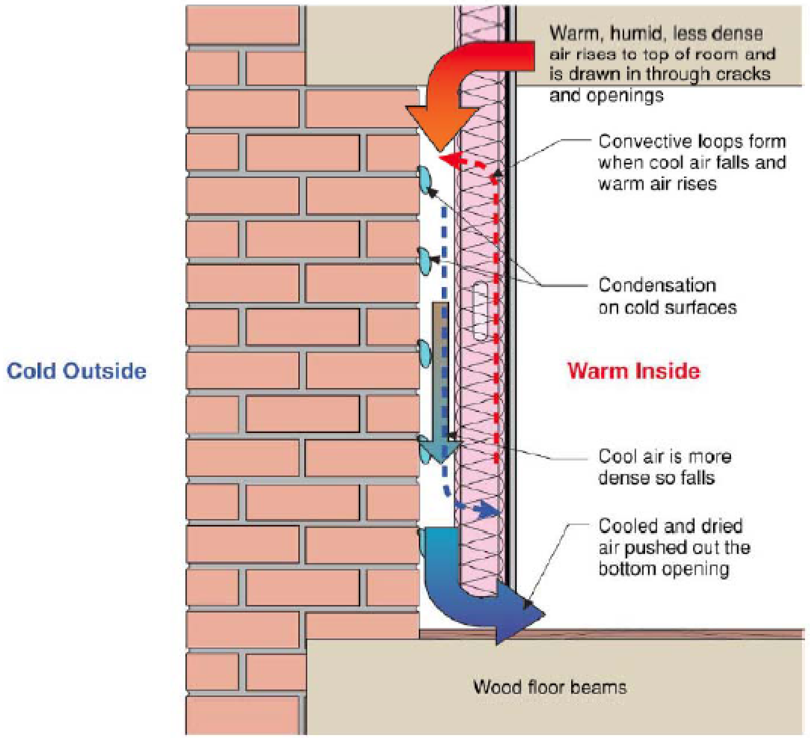


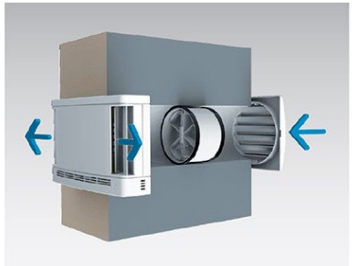
Figure 17: Problematic stud and batt interior retrofit with imperfect airtightness

DOE/BSC


Controlled Ventilation is an important step in any whole building approach to retrofit
Unplanned air movement can cause poor thermal comfort, surfaces become cooler & the risk of condensation and mould is increased

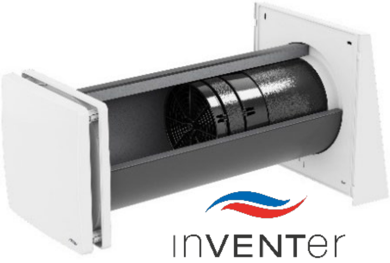
What are the ventilation options?

Mechanical systems can be designed to extract air from the building allowing it to be drawn in through vent openings. Some systems simply push air out of the building through openings



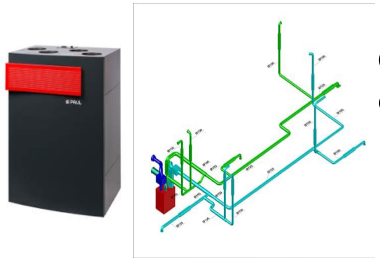
Demand Controlled reacts to air quality parameters like CO_2

Some systems work by moving balanced volumes of air in (supply) and out (extract) with single room heat recovering units centrally controlled to work in pairs (ductless).



Decentralised systems avoid duct networks in complex retrofit and achieve impressive heat recovery

Some systems achieve the same balanced volume of air in (supply) and out (extract) with using a ducted network of pipes returning to a central heat exchange unit.



Centralised systems are planned carefully with new builds and must be in place for airtight buildings

Natural Systems respond to pressure differential across a building envelope generated by wind forces and temperature differences both inside and outside.

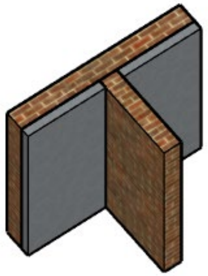
Cross flow natural or Stack ventilation can be a useful hybrid approach to offset overheating risk… even UK & Ireland are getting warmer!

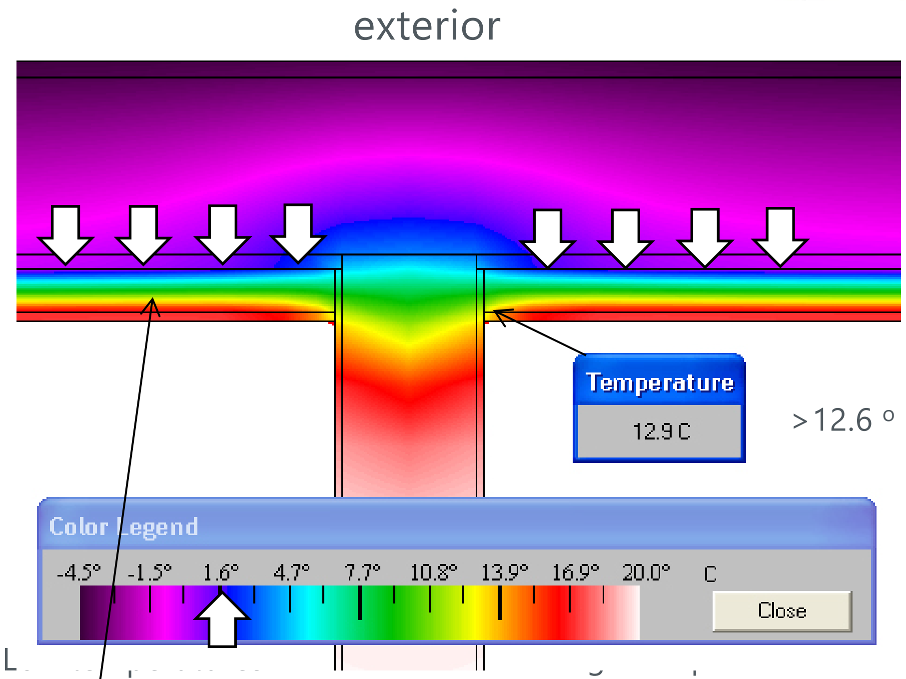
A break in the continuity of the thermal insulation with a material with a higher thermal conductivity

Moisture and its impact on Buildings

Solid masonry Internal wall meeting un-insulated external wall

Objectives:
Reduce heat loss
Raise internal surface temperature





> 12.6 °

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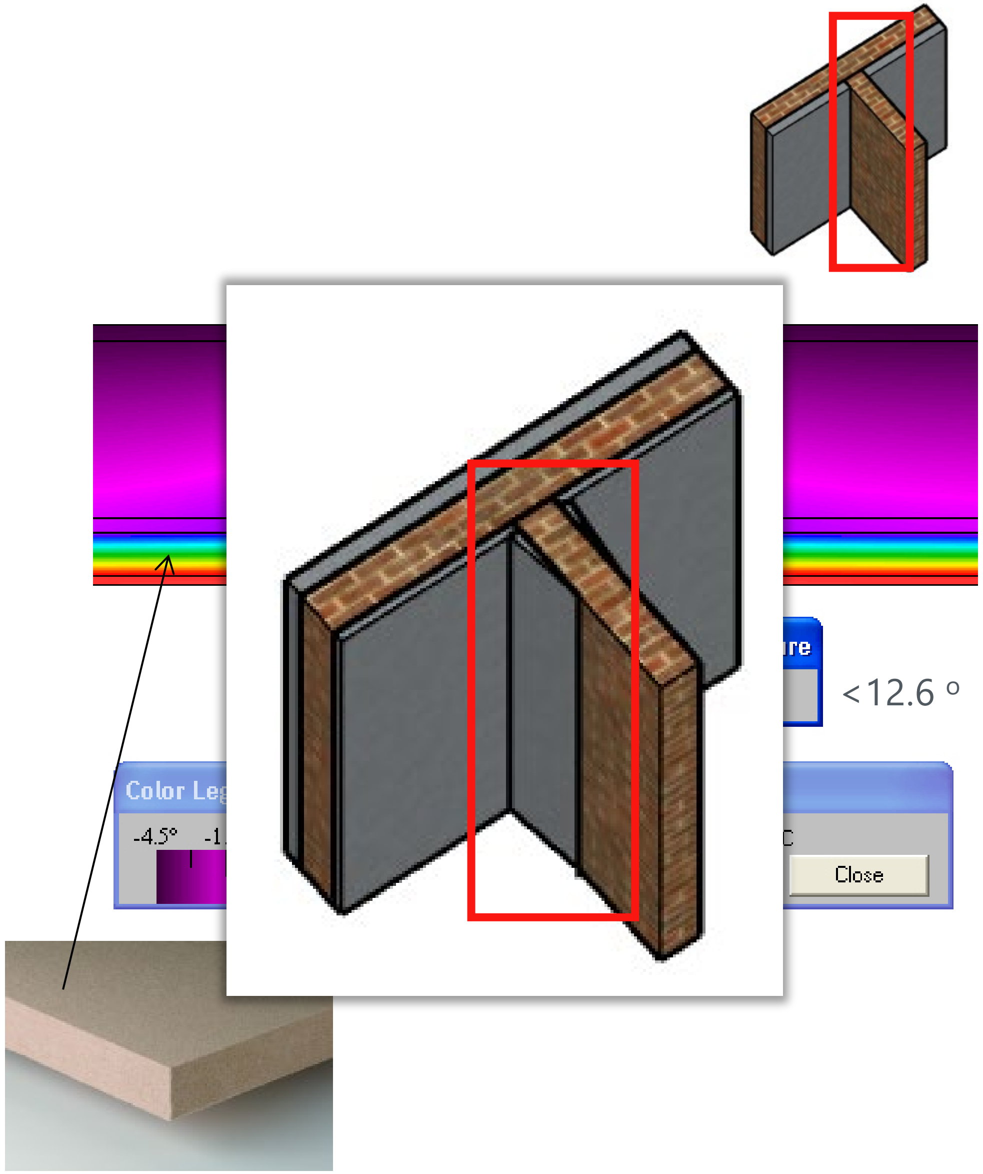
Moisture and its impact on Buildings

Solid masonry Internal wall meeting un-insulated external wall



Woodfibre 60mm

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Moisture and its impact on Buildings

Thermal Bridging
Window Shutter Boxes

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Latest Guidance From Irish Government

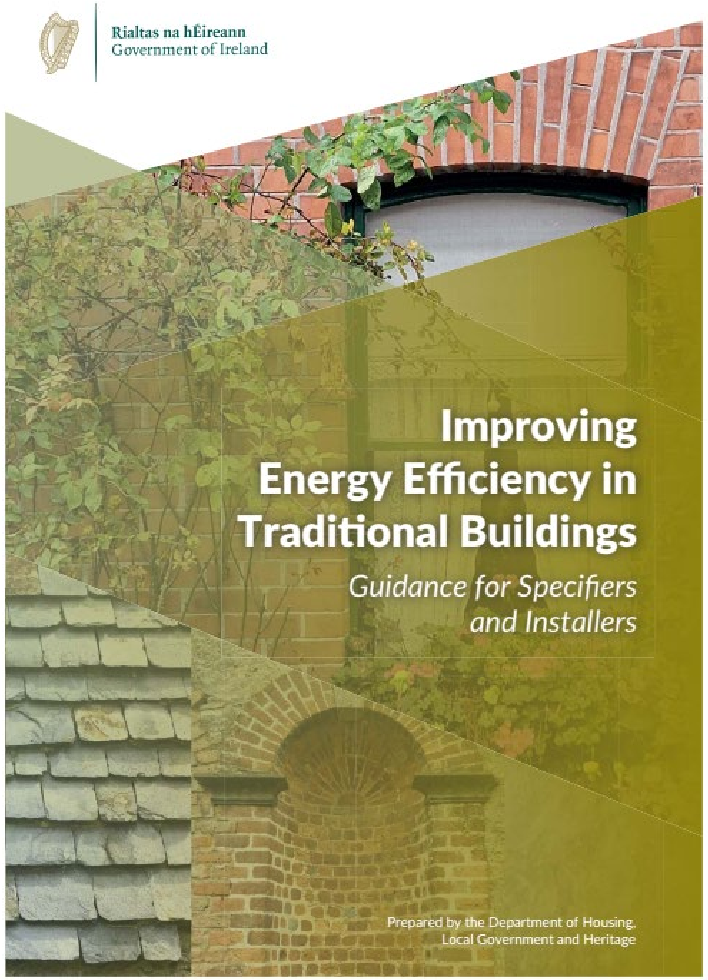


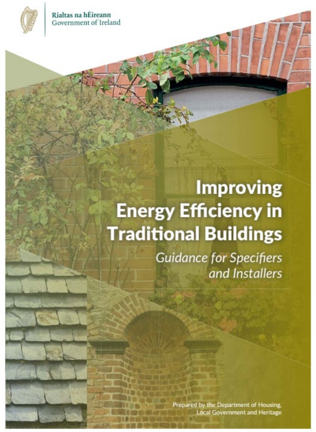
Figure 50: Tape to sash frame prior to application of IWI to ensure an airtight fit (Photograph by Con Brogan for OPW)

Figure 51: Woodfibre insulation board being prepared prior to application of finish coat

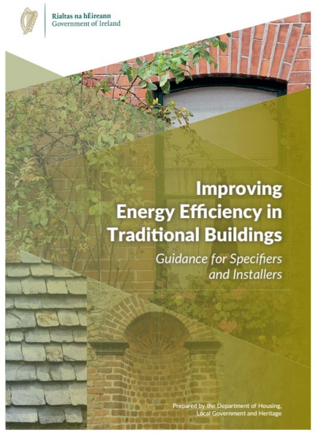
Figures 52 and 53: Insulating cork lime plaster sprayed on an uneven wall with reinforcement mesh applied below finish coat (Photographs by Con Brogan for OPW)

"Any measures that would present unacceptable hygrothermal risks should be excluded from the short list of measures."

Latest Guidance From Irish Government



- The method for calculating U-values of building elements and components is specified in I.S. EN ISO 6946:2017.
- The method for calculating U-values of components involving heat transfer to the ground, e.g. ground floors and basement walls, is specified in I.S. EN ISO 13370:2017.
- Further guidance on calculating U-values and a list of default values for common building materials can be found in Appendix A of TGD L.
- Thermal modelling of documented wall build-ups showing the combination and proportion of specific known Department of Housing, Local Government and Heritage 2.3 Potential Health Risks materials (e.g. lime mortar, limestone, air) can also be used to derive U-values in accordance with I.S. EN ISO 6946:2017.
- Where in-situ U-value assessment is undertaken, it should be done in accordance with ISO 9869-1:2014. However, in the absence of acceptance of the ISO 9869 methodology by the European Commission, in-situ U-values are currently not an acceptable source of data for demonstration of compliance with TGD L or for use in BER calculations.



Latest Guidance From Irish Government

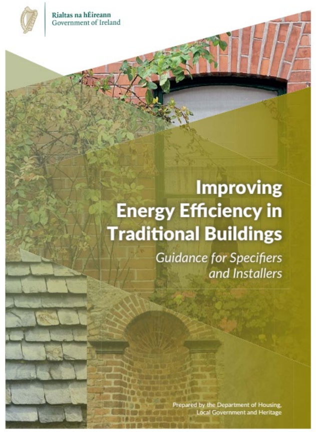
Complying with Regulations

Any materials used should comply with Parts D and L. TGD D defines proper materials as materials that are fit for the use for which they are intended and for the conditions in which they are to be used, and includes materials that:

- bear a CE marking in accordance with the provisions of the Construction Products Regulation
- comply with an appropriate harmonised standard or European Technical Assessment in accordance with the provisions of the Construction Products Regulation, or
- comply with an appropriate Irish Standard or Irish Agrément Certificate or equivalent with an alternative national technical specification of any state that is a contracting party to the Agreement on the European Economic Area, which provides in use an equivalent level of safety and suitability.

For traditional buildings, it is generally recommended that vapour-open insulations be used to minimise the risk of surface and interstitial condensation.

Extruded polystyrene (XPS) and polyurethane rigid foam (PUR)/polyisocyanurate (PIR) have a high vapour diffusion resistance factor, meaning they inhibit moisture from moving through them, which may retard the evaporation of interstitial condensation.



Latest Guidance From Irish Government

Product approvals and compliance with Construction Product Regulations

DIASEN GREEN BUILDING FUTURE

DECLARATION OF PERFORMANCE CPR-122/2020 DP001EN20442606

1. Unique identification code of the product-type: **Diathonite Evolution.**
2. Intended use/es: **Designed general purpose rendering/plastering mortar for external and internal use on walls, ceilings, columns and partitions.**
3. Manufacturer: **Diasen Srl - zona Ind.le Berbentina, 5 - 60041 Sassoferrato (AN) – www.diasen.com**
4. Systems of AVCP: **System 4.**
5. Harmonized standards: **EN 998-1:2016.**
   Notified bodies: **No tasks for the notified body.**
6. Performances declared:

Essential characteristics	Performances
Reaction to fire	Class A1
Water absorption	0,4 kg/(m²min^{0,5})
Water vapour permeability	μ = 4
Adhesion	≥ 0,10 N/mm² – FP: B
Thermal conductivity ($\lambda_{10,\,dry}$)	0,045 W/m·K
Durability	NPD
Dangerous substances	See SDS

The performance of the product identified above is in conformity with the set of declared performance/s. This declaration of performance is issued, in accordance with Regulation (EU) No 305/2011, under the sole responsibility of the manufacturer identified above.

Signed for and on behalf of the manufacturer by: **Diego Mingarelli (Legal Representative)**
Sassoferrato, 30/11/2020

DiaSen srl
Z. Ind.le Berbentina, 5
60041 Sassoferrato (AN)
P. IVA/C.F. 01553210426

DIASEN srl
Zona Ind. Berbentina, 5 60041 Sassoferrato (AN) - ITALY
Tel. +39 0732 9718 - Fax +39 0732 971899 - diasen@diasen.com - www.diasen.com
PARTITA IVA 01553210426 - R.E.A. Ancona n.150933
Reg.Imp. Ancona 01553210426 - Cap. Soc. €400.000,00 i.v.

Diasen QUALITY SYSTEM ISO 9001
Diasen ENVIRONMENTAL SYSTEM ISO 14001

Declaration of Performance
according Annex III of the Regulation (EU) No. 305/2011
redstone

Redboard pro

Unique identification code of the product-type	2019_RBP_G_19_0559
Intended use or uses	Thermal insulation board for internal insulation of walls and ceilings
Manufacturer	redstone GmbH & Co. KG Haferwende 1 28357 Bremen Tel.: +49 421 / 22 31 49 - 0 Fax: +49 421 / 22 31 49 - 90 E-Mail: info@redstone.de
System or systems of assessment and verification of constancy of performance	System 1 System 3
European Assessment Document	EAD 040012-00-1201
European Technical Assessment	ETA-19/0559 (30.10.2019)
Technical Assessment Body	Deutsches Institut für Bautechnik
Notified body	Materialprüfungsamt Nordrhein-Westfalen; (NB 0432)

Essential characteristic	Harmonised standard	Performance
Reaction to fire	EN 13501-1	Class A1
Release of dangerous substances	EN 16516	No dangerous substances released
Water vapour diffusion resistance coefficient	EN 12086	μ = 3
Thermal conductivity (at mean reference temperature of 10 °C)	EN 12667	$\lambda_{D(23,50)}$ = 0,059 W/(mK)
Conversion of humidity Mass-related moisture content	EN ISO 10456	$U_{23,50}$ = 0.014 kg/kg $U_{23,80}$ = 0.021 kg/kg
Mass-related moisture conversion coefficient Moisture conversion factor		f_{u1} = 0 (dry to 23 °C / 50% rel. humidity) f_{u2} = 2,11 (23 °C / 50% rel. humidity to 23 °C / 80% rel. humidity) F_{m1} = 1,00 (dry to 23 °C / 50% rel. humidity) F_{m2} = 1,01 (23 °C / 50% rel. humidity to 23 °C / 80% rel. humidity)

GUTEX

DECLARATION OF PERFORMANCE

GX-01-0014-04

1. Unique identification code of the product type

   GUTEX Thermoroom

2. Purpose of use

   Thermal insulation for buildings

3. Manufacturer

   GUTEX Holzfaserplattenwerk
   H. Henselmann GmbH + Co KG
   Gutenburg 5
   79761 Waldshut-Tiengen
   Germany

4. Authorised representative

   No authorised representative

5. System for the assessment and verification of constancy of performance

   System 3

6. Harmonised standard

   EN 13171:2012+A1:2015

   Notified body: NB 0672 - MPA Stuttgart

Deutsches Institut für Bautechnik DIBt

Member of EOTA www.eota.eu

Approval body for construction products and types of construction
Bautechnisches Prüfamt
An institution established by the Federal and Laender Governments

Designated according to Article 29 of Regulation (EU) No 305/2011 and member of EOTA (European Organisation for Technical Assessment)

European Technical Assessment **ETA-19/0559 of 30 October 2019**

English translation prepared by DIBt - Original version in German language

General Part

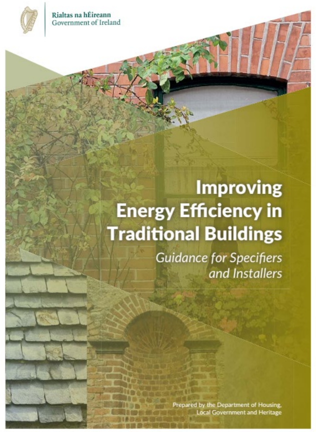
Technical Assessment Body issuing the European Technical Assessment	Deutsches Institut für Bautechnik
Trade name of the construction product	'Redboard basic' and 'Redboard pro'
Product family to which the construction product belongs	Thermal insulation board made of mineral material
Manufacturer	redstone GmbH & Co. KG Haferwende 1 28357 Bremen DEUTSCHLAND
Manufacturing plant	Calsitherm Silikatbaustoffe GmbH Hermann-Löns-Str. 170 33104 Paderborn-Sennelager DEUTSCHLAND
This European Technical Assessment contains	8 pages including 1 annex which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	EAD 040012-00-1201

Deutsches Institut für Bautechnik
Kolonnenstraße 30 B | 10829 Berlin | GERMANY | Phone: +49 30 78730-0 | Fax: +49 30 78730-320 | Email: dibt@dibt.de | www.dibt.de

Z72449.19 8.12.01-38/19

Latest Guidance From Irish Government

Novel materials mixed on site



INFORMATION PAPER IP 14/11

HEMP LIME

An introduction to low-impact building materials

Andy Sutton and Daniel Black, BRE
Pete Walker, University of Bath

This Information Paper provides a broad view of the benefits and limitations of non-loadbearing hemp lime walls for those considering their use in construction projects.

Hemp lime is a low-carbon building material with good insulation properties and robustness. It is particularly suited to projects where the design calls for a rendered or rain-screened external finish, good insulation and minimal thermal bridges. It is most commonly used in conjunction with timber frames, but can act as a non-structural walling element for a variety of construction types, including lining masonry walls.

This is one in a series of five Information Papers and parallel case studies on low-impact building materials. The others cover straw bale, unfired clay masonry, cross-laminated timber and natural fibre insulation.

Hemp has been used for millennia in a wide range of applications, from sacks and rope through to paper and oil. It was one of the first domesticated plants (originally in China) and was a sufficiently important material that it was taken to America in seed form by the Pilgrim Fathers.

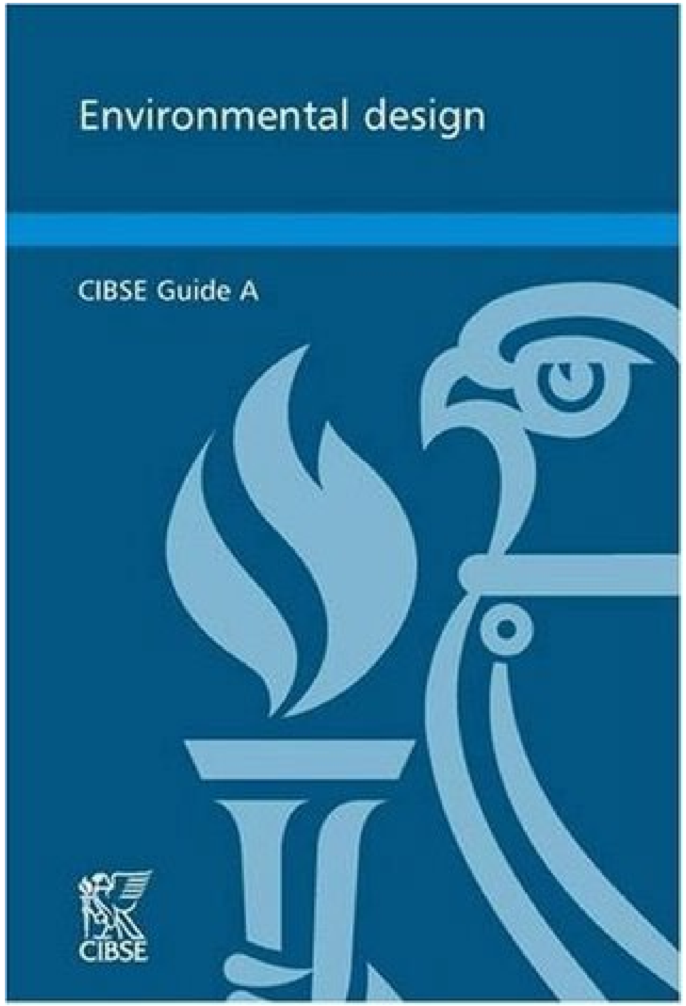
Industrial hemp is now grown again in Europe and North America, having been banned for a period due to the connection with cannabis (industrial hemp has very little active drug). It can be grown in many temperate climates, and in the northern hemisphere is usually planted in April and harvested at the end of August. Hemp is a fast-growing plant, reaching a height of 3–4 m at harvest with no need for pesticides or herbicides after planting. Once harvested, cut hemp is sometimes allowed to dry initially in the field before the shiv (the woody central core) is separated from the outer fibres. The fibres are extracted for a variety of uses (eg textiles, composites). After fibre extraction, the shiv is shredded into chips, graded and stored until required for construction.

Figure 1: The Renewable House on the Innovation Park at BRE near Watford, Herts, constructed with hemp lime walls (Courtesy of Lime Technology)

When used in situ, hemp lime is applied as a non-structural external infill; it is typically cast inside formwork. Alternatively, it can be spray-applied against a lining board. Both methods result in a homogeneous solid wall construction encapsulating a timber frame that has good insulation properties and good airtightness, and avoids thermal bridges.

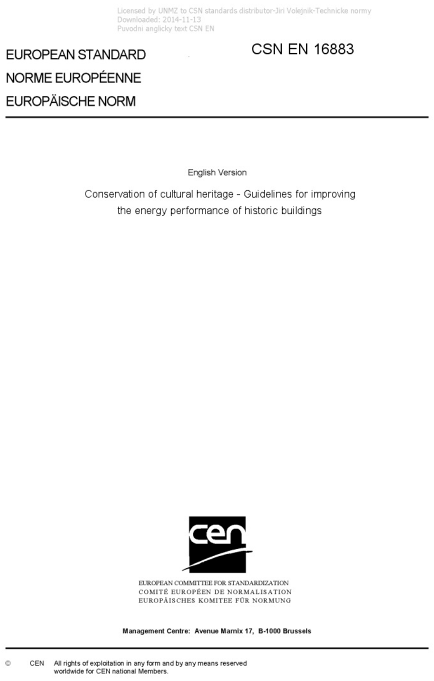
Hemp lime is most commonly a mix of renewably sourced hemp shiv, a specially formulated lime binder and water. Hydraulic lime (as opposed to hydrated lime), which is able to set and harden under water, has been used in place of formulated binders, with the mix created independently, although performance can be less reliable as a result. A proportion of cement is usually added to formulated commercial binders to aid the early age performance. The quantity of cement used varies between producers and in many cases has not been disclosed. However, the addition of pozzolanic material such as pulverised-fuel ash in many formulated limes minimises the use of cement.

IHS | bre press | UNIVERSITY OF BATH | EPSRC Pioneering research and skills | bre



Responsible retrofit of traditional buildings

- EN 16883:2017 Conservation of cultural heritage - Guidelines for improving the energy performance of historic buildings
- Requires a first phase of recognition of the significance and specific values of the construction based on which unsuitable measures should be excluded from the intervention design.
- Modern buildings designed to block moisture entry (i.e. capillary breaks , membranes to reduce vapour diffusion, vented cavities, etc)
- On the contrary traditional building are largely characterised with walls which absorb, buffer and then dry out thanks for their inherent vapour permeability, capillarity etc.
- Great care is needed to ensure the chosen thermal solution does not compromise this cycle leading to degradation and moisture accumulation.
- Buildings are like fingerprints, with no two the same and the thermal solution must be carefully considered.



EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

CSN EN 16883

English Version

Conservation of cultural heritage - Guidelines for improving the energy performance of historic buildings

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Internal Wall Insulation Systems
Assessing Risk

ecological
BUILDING SYSTEMS
Naturally Better

Steady State Assessment
Glaser EN 13788

Material Properties

μ, W/mK

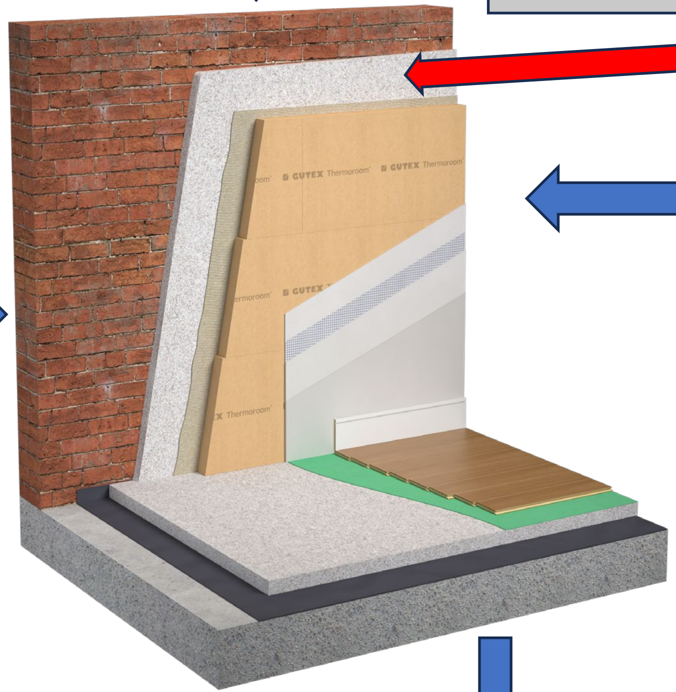
Critical interface

Internal moisture loads

T – RH (monthly)

Atmospheric moisture loads

T – RH (monthly)



Moisture Response
(Condensation)

Standard Glaser Assessment

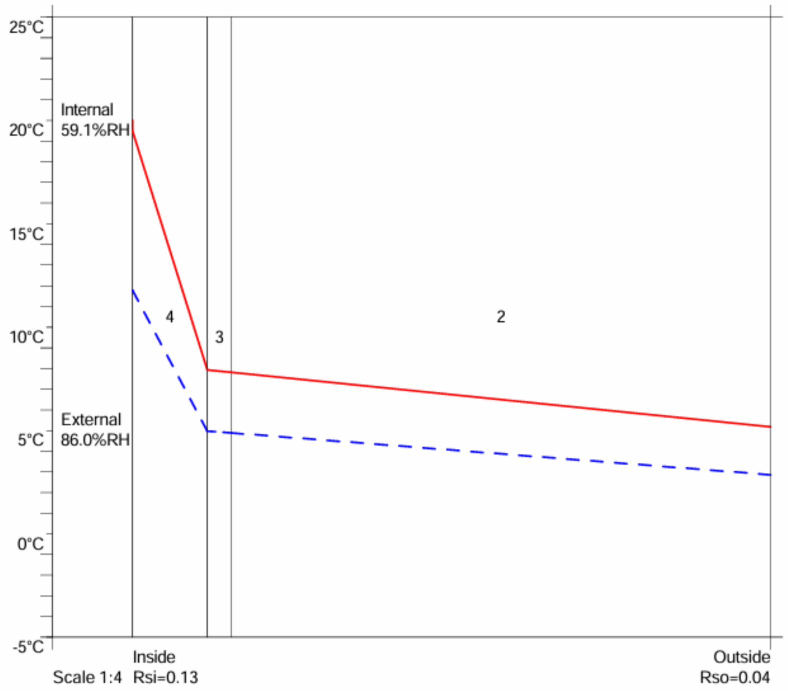
Condensation Risk Analysis (no account taken of thermal bridges)

3 - Dwellings with high occupancy and other buildings with unknown occupancy

Jan (worst)	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
20.0C 59.1%	20.0C 58.4%	20.0C 58.6%	20.0C 58.7%	20.0C 60.0%	20.0C 64.3%	20.0C 69.0%	20.0C 70.7%	20.0C 67.6%	20.0C 65.0%	20.0C 60.9%	20.0C 59.9%
5.0C 86.0%	5.0C 84.0%	6.3C 82.0%	7.9C 79.0%	10.5C 76.0%	13.4C 76.0%	15.1C 78.0%	14.9C 81.0%	13.1C 82.0%	10.6C 85.0%	7.0C 86.0%	5.9C 86.0%

	Interface Temp. °C	Dewpoint Temp. °C	Vapour Pressure (kPa)	Saturated V.P. (kPa)	Worst Cond. (g/m²)	Peak Buildup (g/m²)	Condensation
1 Outside surface resistance							
	5.2	2.9	0.75	0.88			No
2 Brick outer leaf							
	7.8	4.9	0.86	1.06			No
3 Render, lime-sand							
	7.9	5.0	0.87	1.07			No
4 Insulated Plasterboard - 62.5mm (For mechanically fixed insulated dry-lining)							
	19.5	11.8	1.38	2.26			No
5 Inside surface resistance							

Worst case internal / external conditions for graph : 20.0°C @ 59.1%RH / 5.0°C @ 86.0%RH



Positive result?

Standard Glaser Assessment

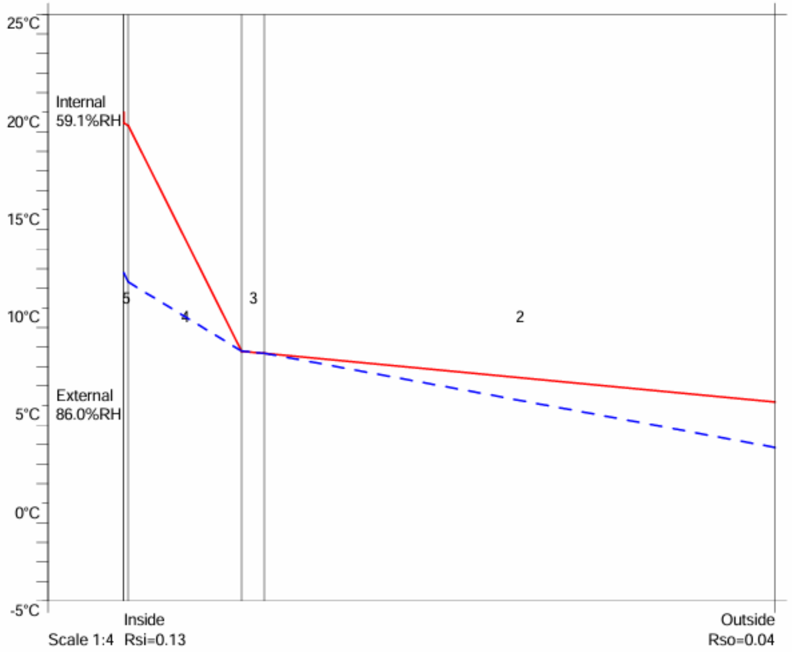
Condensation Risk Analysis (no account taken of thermal bridges)

3 - Dwellings with high occupancy and other buildings with unknown occupancy

Jan (worst)	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
20.0C 59.1%	20.0C 58.4%	20.0C 58.6%	20.0C 58.7%	20.0C 60.0%	20.0C 64.3%	20.0C 69.0%	20.0C 70.7%	20.0C 67.6%	20.0C 65.0%	20.0C 60.9%	20.0C 59.9%
5.0C 86.0%	5.0C 84.0%	6.3C 82.0%	7.9C 79.0%	10.5C 76.0%	13.4C 76.0%	15.1C 78.0%	14.9C 81.0%	13.1C 82.0%	10.6C 85.0%	7.0C 86.0%	5.9C 86.0%

	Interface Temp. °C	Dewpoint Temp. °C	Vapour Pressure (kPa)	Saturated V.P. (kPa)	Worst Cond. (g/m²)	Peak Buildup (g/m²)	Conden-sation
1 Outside surface resistance							
	5.2	2.9	0.75	0.88			No
2 Brick outer leaf							
	7.7	7.7	1.05	1.05			No
3 Render, lime-sand							
	7.8	7.8	1.06	1.06	344 in Jan	1637 in Apr	Yes
4 Diathonite Thermactive							
	19.3	11.3	1.34	2.24			No
5 Diasen Argatherm							
	19.4	11.8	1.38	2.26		0 in Apr	No
6 Inside surface resistance							

Worst case internal / external conditions for graph : 20.0°C @ 59.1%RH / 5.0°C @ 86.0%RH



Negative result?

Dynamic Hygrothermal Modelling

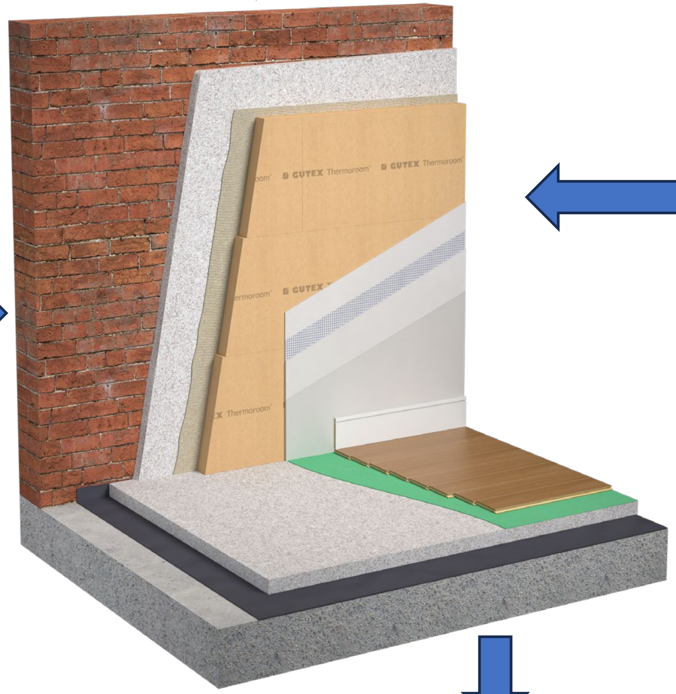
EN 15026 - WUFI, Delphin

Material Properties

Density, Porosity, µ, W/mK, sorption isotherm, liquid transfer coefficient, sorption, liquid transfer coefficient, redistribution, moisture dependent thermal conductivity, short wave absorptivity of surface

Additional moisture sources: service conditions

Atmospheric moisture loads



Internal moisture loads

T – RH (hourly)

Dry buld temperature
RH
Wind speed and direction
Solar radiation (global and diffuse)
Longwave (cloud index)
Rainfall
Windspeed and direction
Total atmospheric pressure
(Hourly)

Moisture Response
(Condensation)

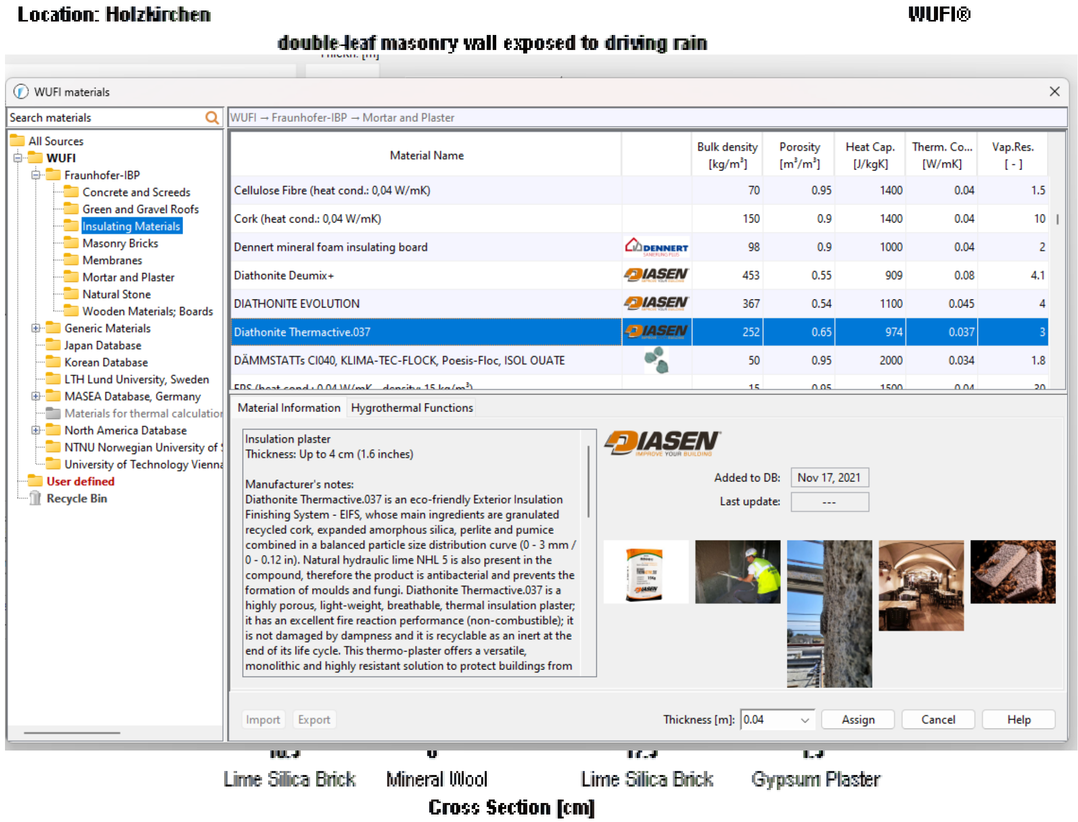
Liquid transport (surface diffusion and capillary flow), moisture storage by vapour sorption and capiliary forces, vapour diffusion, moisture content profiles temp, rH profiles, Moisture content / time, temp, RH/time

Hygrothermal Modelling And Its Role In Assessing Risk

Avoiding the Risks: Hygrothermal modelling

Computer- assisted simulation program for heat and humidity transports (dynamic). WUFI® is an acronym for Wärme Und Feuchte Instationär, which, translated, means heat and moisture transiency.)

WUFI®
25 years



- Real climatic data
- Inside and outside temperature
- Inside and outside humidity
- Light absorption
- Moisture storage capability
- Capillary action

(Data of one reference year at intervals of 1 hour)

Current EN 15026: 2023 provides higher accuracy compared with EN 13788: 2012

Hygrothermal Modelling And Its Role In Assessing Risk

BS EN 15026:2023

BSI Standards Publication

Hygrothermal performance of building components and building elements — Assessment of moisture transfer by numerical simulation

bsi.

BS EN 15026:2023
EN 15026:2023 (E)

Introduction

This document defines the practical application of hygrothermal simulation software used to predict transient heat and moisture transfer in multi-layer building envelope components subjected to dynamic climate conditions on either side.

In contrast to the steady-state assessment of interstitial condensation by the Glaser method (as described in EN ISO 13788), transient hygrothermal simulation provides more detailed and accurate information on the risk of moisture problems within building components and on the design of remedial treatment. While the Glaser method considers only steady-state conduction of heat and vapour diffusion, the transient hygrothermal simulation models which are composed of the formulae defined in this document also take account of heat and moisture storage, latent heat effects and liquid and convective transport under realistic boundary and initial conditions. The application of such models has become widely used in building practice in recent years, resulting in a significant improvement in the accuracy and reproducibility of hygrothermal simulation.

The following examples of transient heat and moisture phenomena in building components can be simulated by the models covered in this document:

— drying of initial construction moisture;

— moisture accumulation by interstitial condensation due to diffusion in winter;

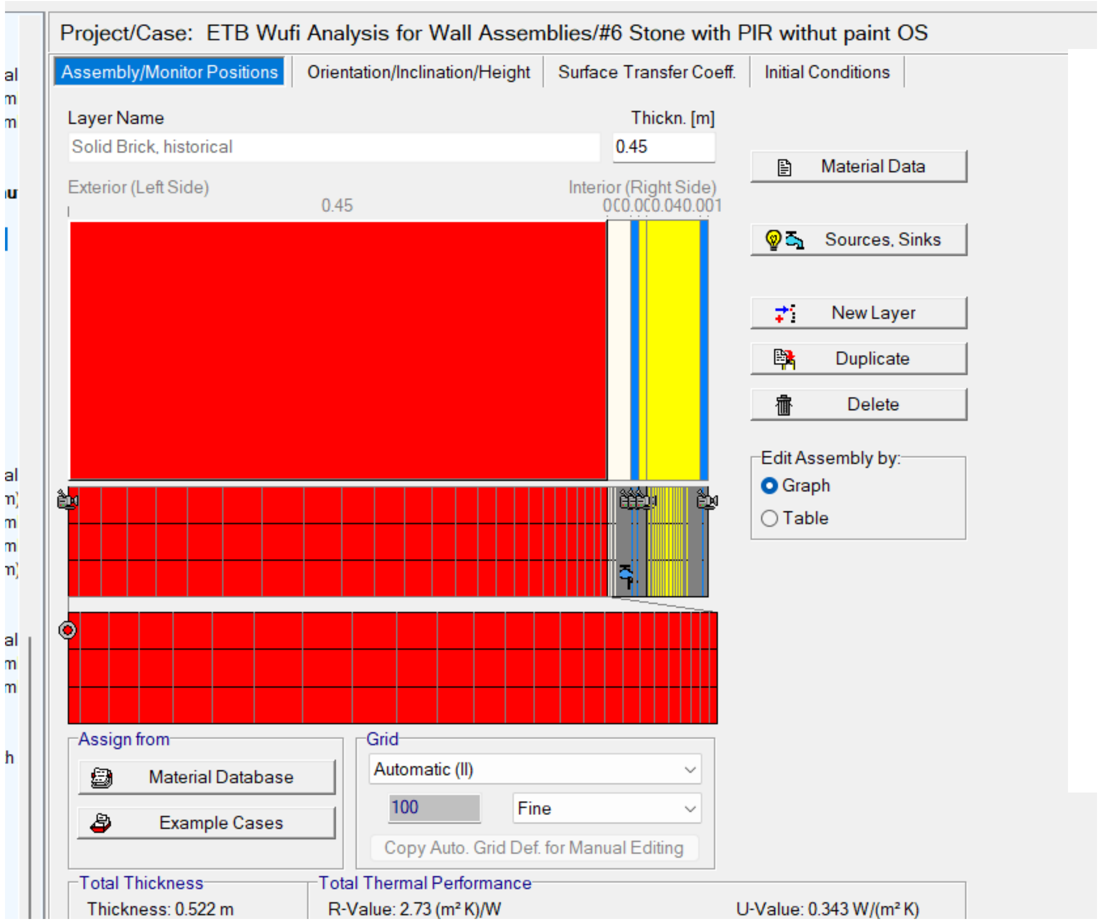
— moisture penetration due to driving rain exposure;

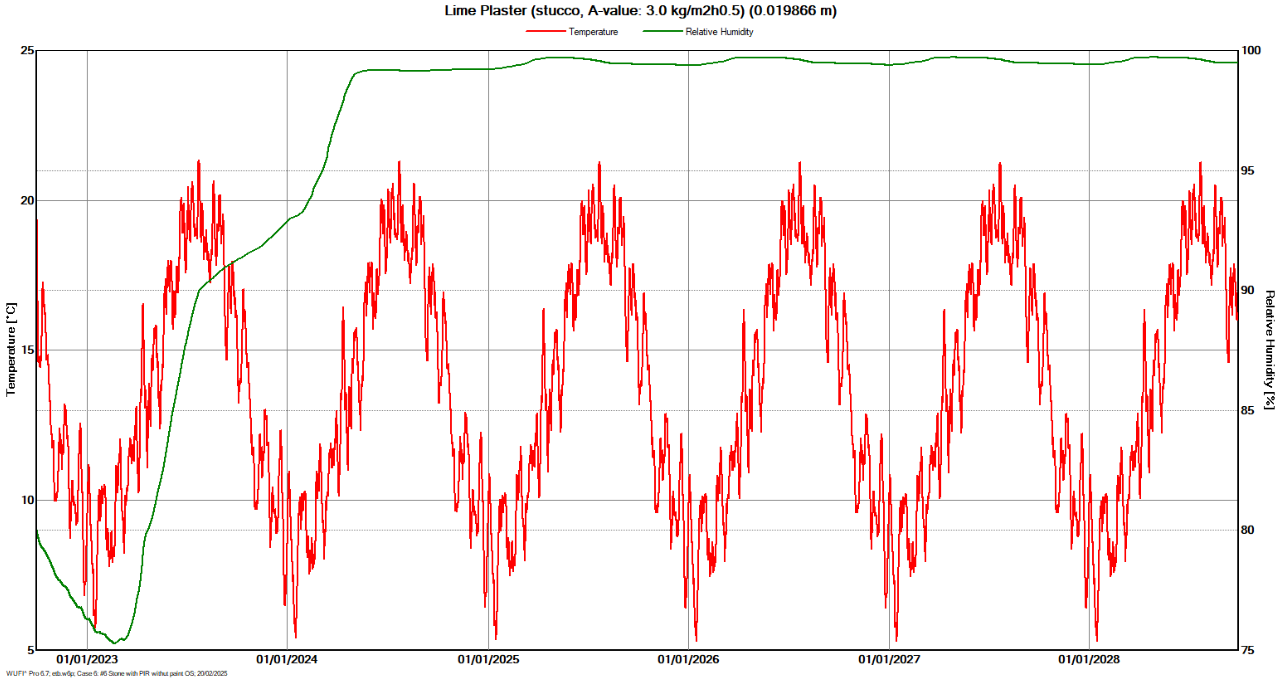
— summer condensation due to migration of moisture from outside to inside;

— outside surface condensation due to cooling by long-wave radiation exchange;

— moisture-related heat losses by transmission and moisture evaporation.

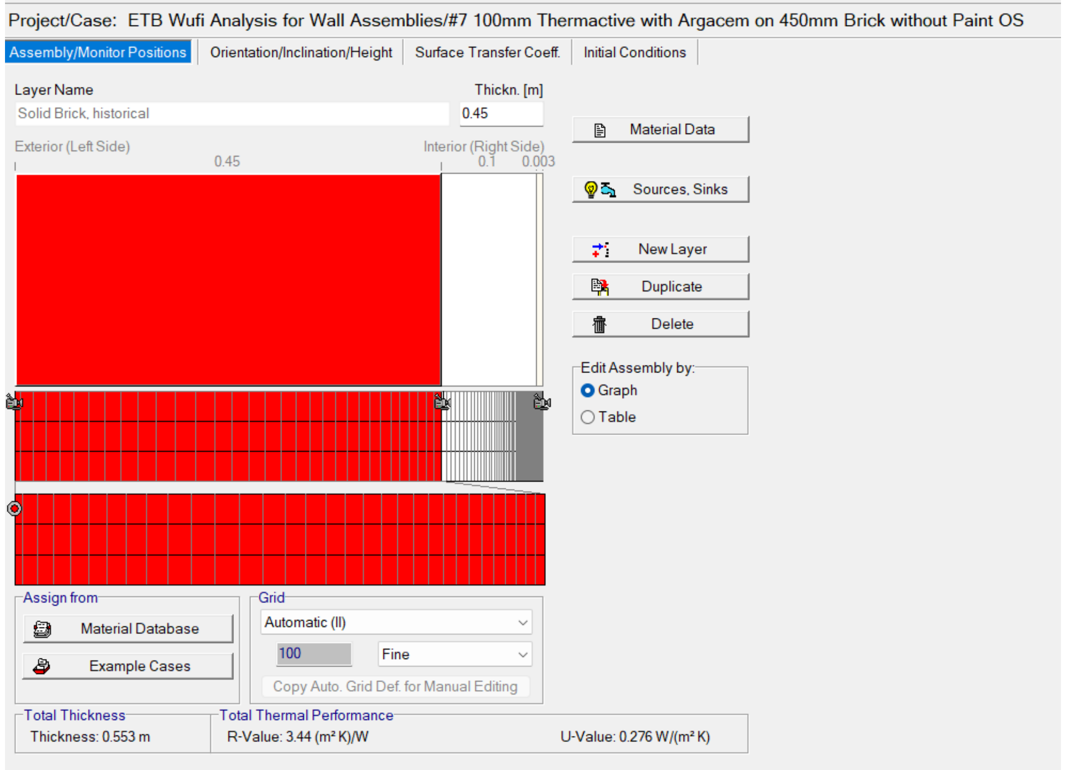
Wufi Assessment
Negative result

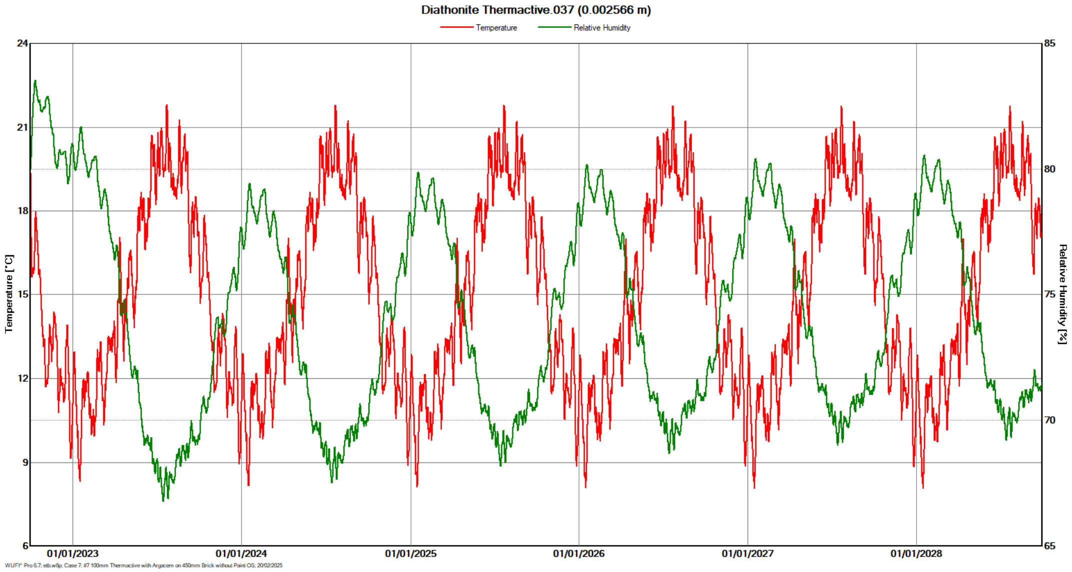


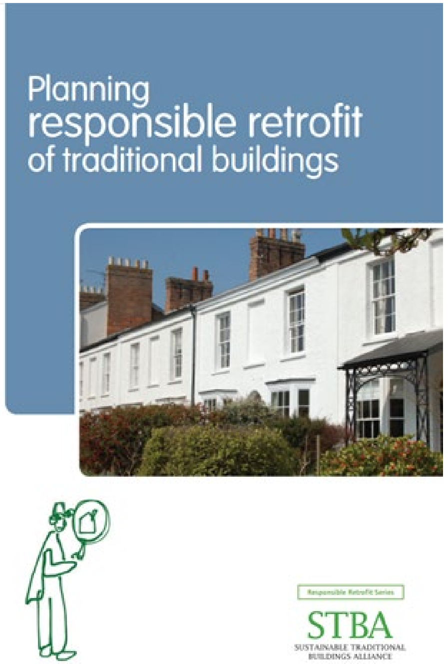


Wufi Assessment

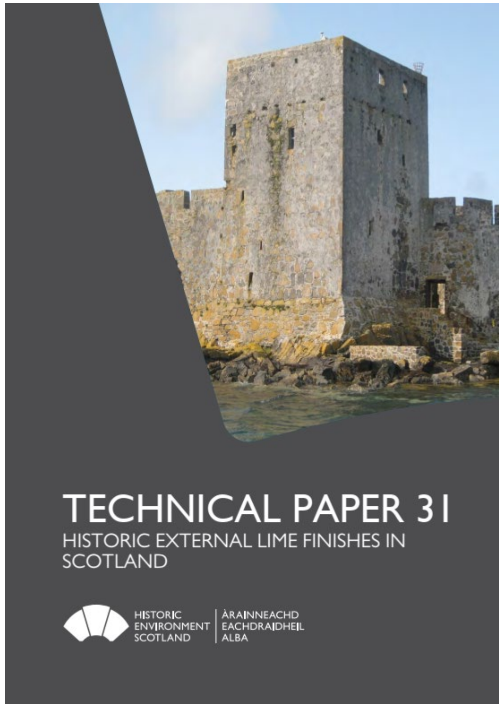
Positive result

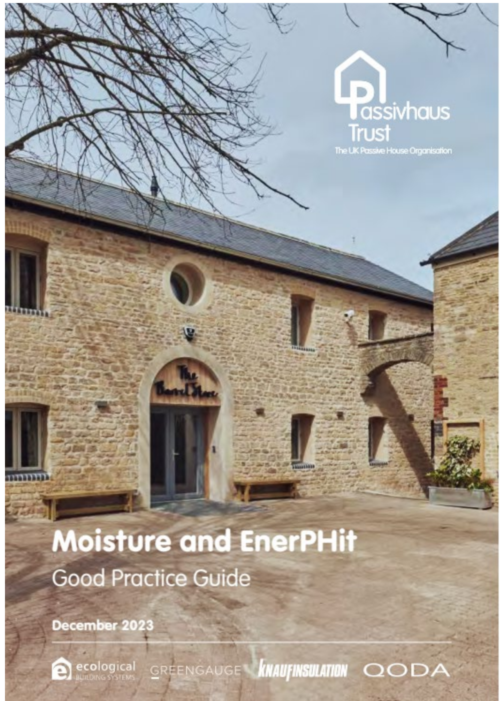




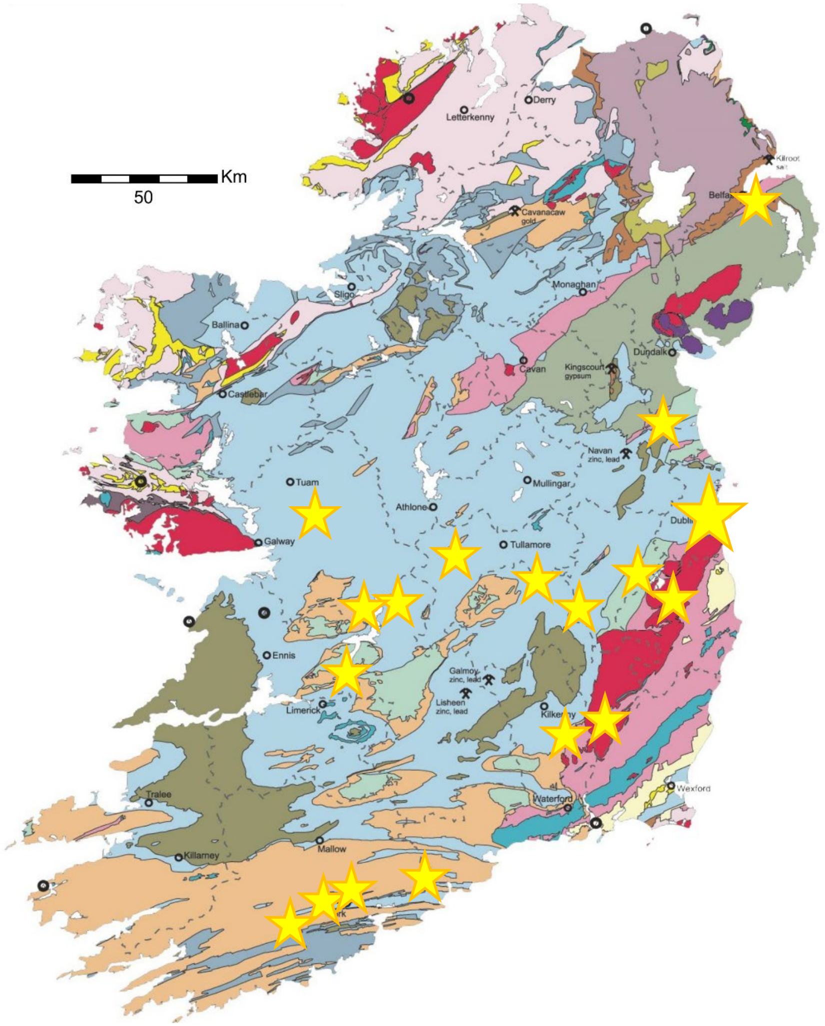


Cambridge Institute for Sustainable Leadership (CISL)
Entopia Project:
Regent Street, Cambridge: Enerphit/WELL
Architect: Architype





Irish brick and stone now in Wufi material database
UCD Fabtrads Project



Set out to test 25 different traditional walls

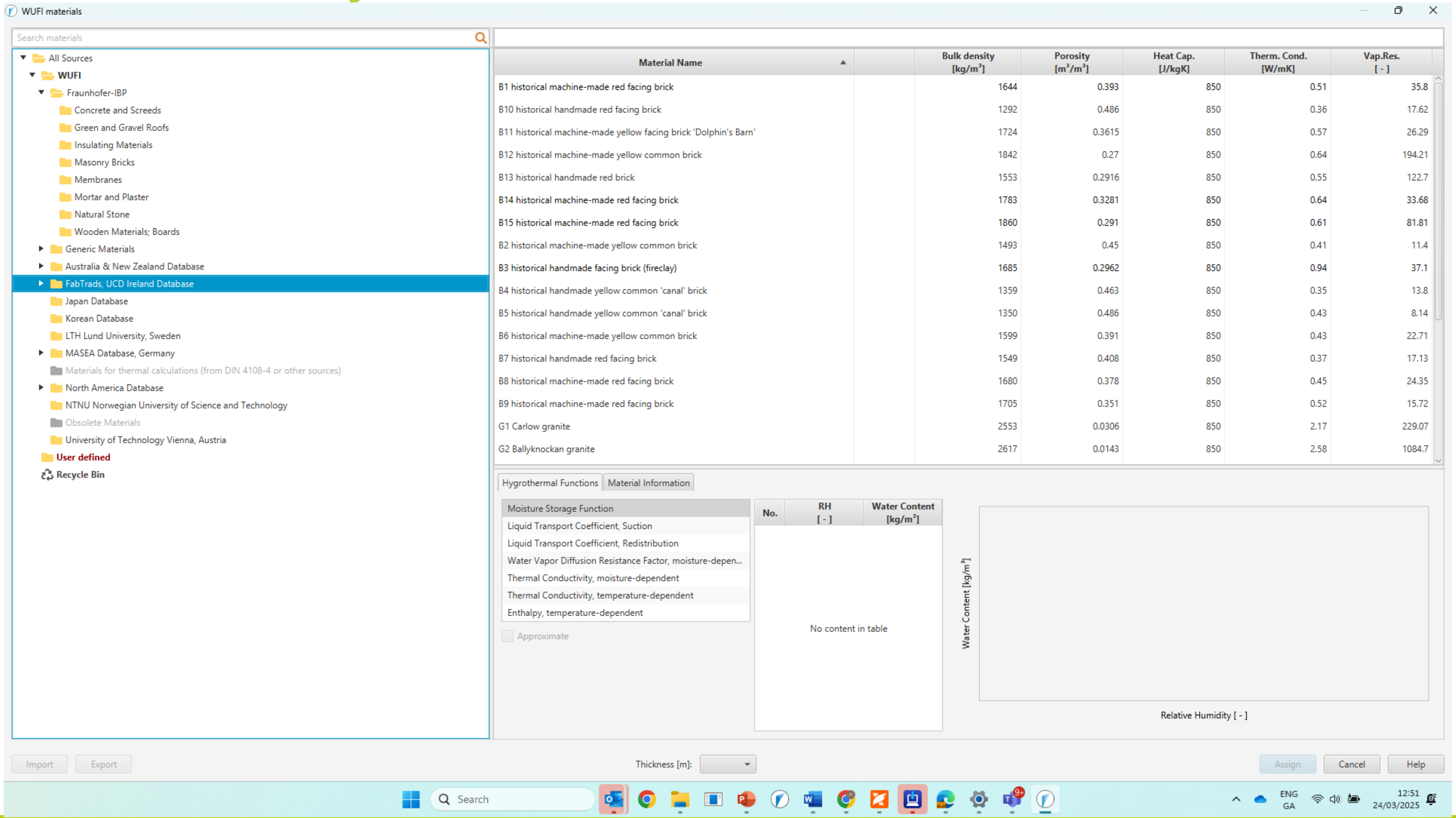
35 traditional walls tested across Ireland

- 17 over winter 2022/23
- 18 over winter 2023/24
- Each test was run for 6-7 days
- Software automatically selects best block of data to meet ISO requirements (min. 72hrs)

1 long-term in-situ U-value test (c.1890 325mm solid brick)

- 11-2023 – 11-2024 (ongoing)

Irish brick and stone now in Wufi material database
UCD Fabtrads Project



Material Name	Bulk density [kg/m³]	Porosity [m³/m³]	Heat Cap. [J/kgK]	Therm. Cond. [W/mK]	Vap.Res. [-]
B1 historical machine-made red facing brick	1644	0.393	850	0.51	35.8
B10 historical handmade red facing brick	1292	0.486	850	0.36	17.62
B11 historical machine-made yellow facing brick 'Dolphin's Barn'	1724	0.3615	850	0.57	26.29
B12 historical machine-made yellow common brick	1842	0.27	850	0.64	194.21
B13 historical handmade red brick	1553	0.2916	850	0.55	122.7
B14 historical machine-made red facing brick	1783	0.3281	850	0.64	33.68
B15 historical machine-made red facing brick	1860	0.291	850	0.61	81.81
B2 historical machine-made yellow common brick	1493	0.45	850	0.41	11.4
B3 historical handmade facing brick (fireclay)	1685	0.2962	850	0.94	37.1
B4 historical handmade yellow common 'canal' brick	1359	0.463	850	0.35	13.8
B5 historical handmade yellow common 'canal' brick	1350	0.486	850	0.43	8.14
B6 historical machine-made yellow common brick	1599	0.391	850	0.43	22.71
B7 historical handmade red facing brick	1549	0.408	850	0.37	17.13
B8 historical machine-made red facing brick	1680	0.378	850	0.45	24.35
B9 historical machine-made red facing brick	1705	0.351	850	0.52	15.72
G1 Carlow granite	2553	0.0306	850	2.17	229.07
G2 Ballyknockan granite	2617	0.0143	850	2.58	1084.7

Internal Wall Insulation Systems

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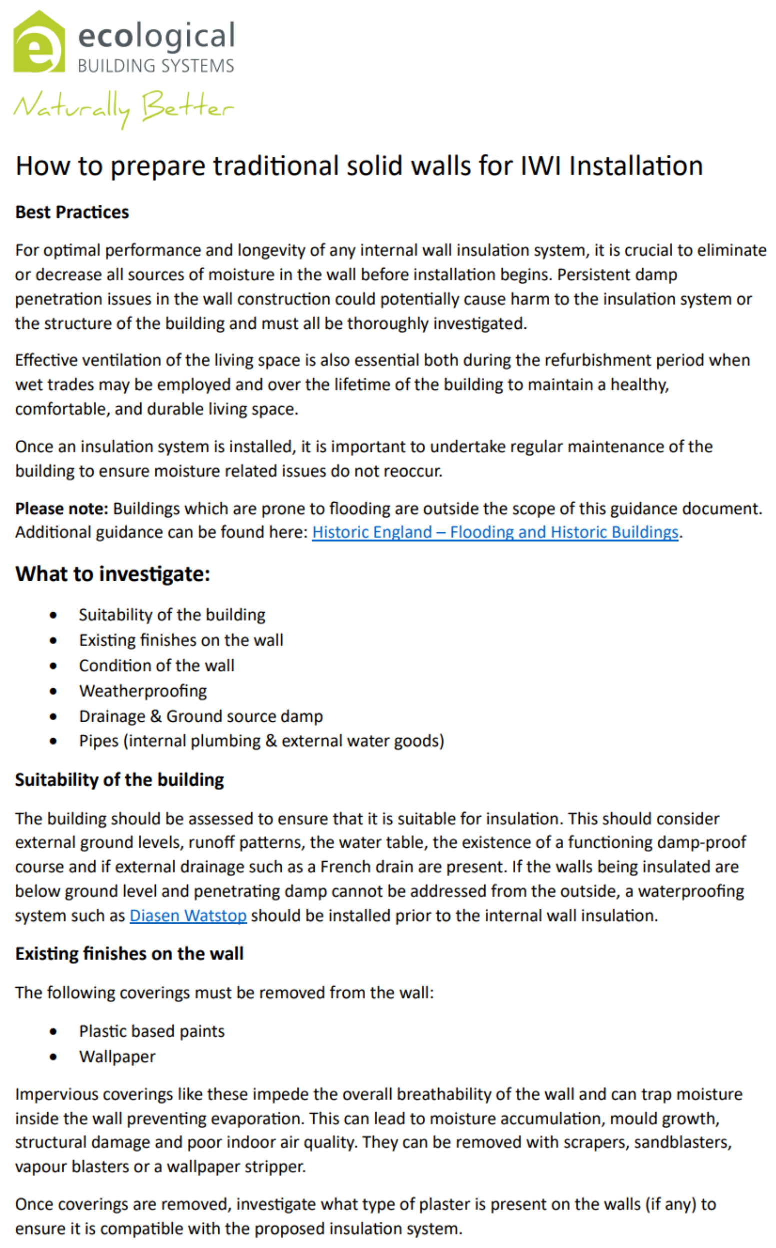
Wall Preparation

- Investigate for Damp Penetration Issues
- Assess for Salt Penetration
- Determine the type of existing plaster
- Strip Back Impervious materials and restore the wall surface



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How to prepare traditional solid walls for IWI Installation

Best Practices

For optimal performance and longevity of any internal wall insulation system, it is crucial to eliminate or decrease all sources of moisture in the wall before installation begins. Persistent damp penetration issues in the wall construction could potentially cause harm to the insulation system or the structure of the building and must all be thoroughly investigated.

Effective ventilation of the living space is also essential both during the refurbishment period when wet trades may be employed and over the lifetime of the building to maintain a healthy, comfortable, and durable living space.

Once an insulation system is installed, it is important to undertake regular maintenance of the building to ensure moisture related issues do not reoccur.

Please note: Buildings which are prone to flooding are outside the scope of this guidance document. Additional guidance can be found here: Historic England – Flooding and Historic Buildings.

What to investigate:

- Suitability of the building
- Existing finishes on the wall
- Condition of the wall
- Weatherproofing
- Drainage & Ground source damp
- Pipes (internal plumbing & external water goods)

Suitability of the building

The building should be assessed to ensure that it is suitable for insulation. This should consider external ground levels, runoff patterns, the water table, the existence of a functioning damp-proof course and if external drainage such as a French drain are present. If the walls being insulated are below ground level and penetrating damp cannot be addressed from the outside, a waterproofing system such as Diasen Watstop should be installed prior to the internal wall insulation.

Existing finishes on the wall

The following coverings must be removed from the wall:

- Plastic based paints
- Wallpaper

Impervious coverings like these impede the overall breathability of the wall and can trap moisture inside the wall preventing evaporation. This can lead to moisture accumulation, mould growth, structural damage and poor indoor air quality. They can be removed with scrapers, sandblasters, vapour blasters or a wallpaper stripper.

Once coverings are removed, investigate what type of plaster is present on the walls (if any) to ensure it is compatible with the proposed insulation system.

Wall Preparation

Remove any **impervious coatings** from the interior surface first

- gypsum plasters
- hard cement plasters***
- glossy paints
- wallpapers

Note: Lime plaster *(if stable)* is fine

Points to consider prior to specifying IWI Systems

Look before you leap!

- **Wall depth?**
- **Stone/Brick type?**
- **Exposure (driving rain)?**
- **Existing damp penetration?**
- **Existing external/Internal plaster?**
- **Plaster type both internally and externally?**
- **Thermal Bridging?**
- **Other points (airtightness, ventilation, etc)**

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Internal Insulation Of Solid Walls

1. Directly rendered natural insulation systems (Gutex woodfibre – hygroscopic material)

2. Mineral based capillary active insulation systems
   - Calcium silicate board (Calsitherm)
   - Insulating plaster (Diathonite)

3. Timber stud full filled with natural insulation with intelligent membranes

What is a Hygroscopic material?

Having a tendency to capture water molecules from the air through absorption

Ref: www. hygro.geroldinger.com

When dry rice is exposed to air with high relative humidity (RH) the rice grains will absorb water from the air

When wet rice is exposed to air with low RH the rice grains will release water to the air (drying).

Retro EcoWall by Ecological Building Systems

Hygroscopic IWI Insulation

Typical U-values for solid brick or stone walls.

Wall Type	Diathonite Levelling Plaster (mm)	Wood Fibre Thickness (mm)	U-value (W/m²K)
220mm (brick)	--	--	2.19*
220mm (brick)	20mm	40	0.49
220mm (brick)	20mm	60	0.39
220mm (brick)	20mm	80	0.32
220mm (brick)	20mm	100	0.28
500mm (stone)	--	--	2.38*
500mm (stone)	30mm	40	0.44
500mm (stone)	30mm	60	0.36
500mm (stone)	30mm	80	0.30
500mm (stone)	30mm	100	0.26

* uninsulated wall

If standard lime plaster is used (instead of Diathonite) with 60mm of Thermoroom, the U-value is 0.49W/m²K. With Diathonite, it is 0.36W/m²K.

lime|green

ARCHITECTURE + BUILDING EXPO 2022
DESIGN • BUILD • FITOUT

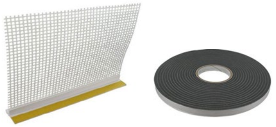
What you need

Lime plaster or Diathonite (leveling coat), ~20mm

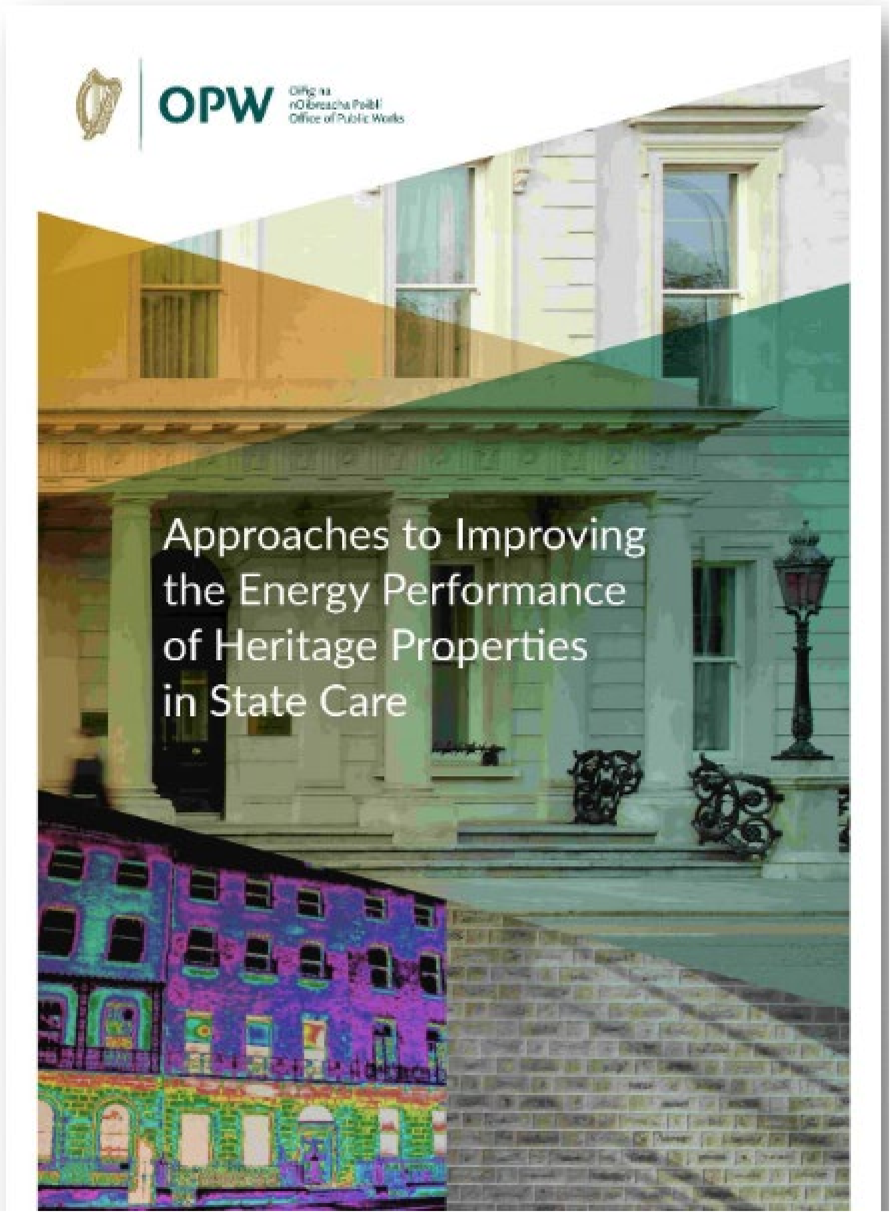
GUTEX adhesive, ~5mm

Gutex Thermoroom woodfibre boards, 40/60/80/100mm

Lime Green SOLO one-coat finishing plaster, 10mm



Accessories (corner beads, mesh, sealing strips etc)



OPW Oifig na nOibreacha Poiblí Office of Public Works

Case Study 2

Block M, Dublin Castle

Block M Dublin Castle – Hillfort Plastering

Calsitherm Calcium Silicate Board - Main Attributes

redstone
A company of the CALSITHERM® group

- High thermal resistance (λ=0,059W/mK)
- Capillary active & diffusion-open
- Mould inhibiting (high Ph value)
- Non-combustible
- Dimensionally stable, self-supporting, & compression-resistant
- Quick and easy to install
- Harmless to the environment and health
- Pest-resistant

Thermoroom vs Calsitherm vs Diathonite

Thermoroom vs Calsitherm vs Diathonite

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Calsitherm - capillarity

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When is capillary active insulation most important?

In extreme cases…

- Existing wall is very thick or very thin brickwork
- Very exposed to driving rain
- Low capillarity on internal surface (i.e. existing internal cement render which can't be removed)
- Mortar joints are very small
- Existing stone very hard & vapour resistant (e.g. Slate, Granite, Hard Limestone)

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Dublin Civic Trust 18 Ormond Quay

Detailing matters

Window reveals

Continuity

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Capillary Active diffusion open Calcium Silicate

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Capillary Active Insulation: Diathonite

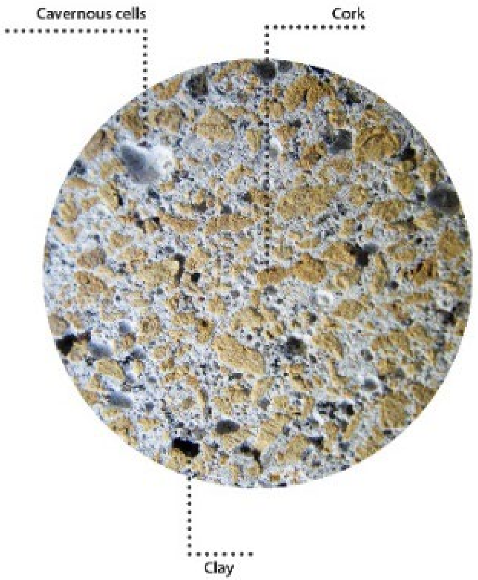
Lime Cork Thermal Plastering System

Base coat

Finish coat

Best Practice Guidance Capillary Active Moisture Open Insulation Systems

Cork Lime Thermal Plasters



1. Diatomaceous earth / 2. Cork / 3. Clay / 4. Natural hydraulic lime

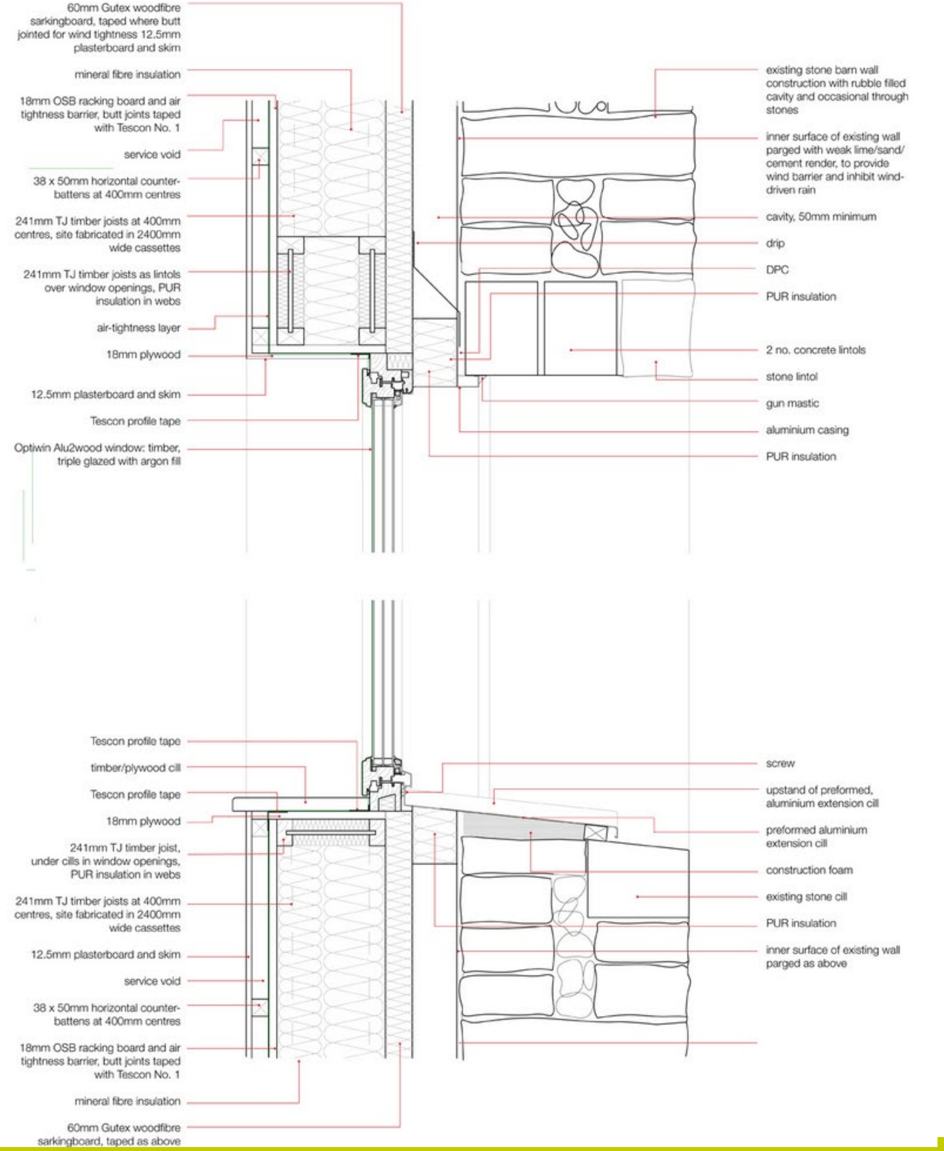
- ✓ Low Diffusion resistance
- ✓ High capillarity
- ✓ Low thermal conductivity
- ✓ Low thermal diffusivity
- ✓ A1 non combustible
- ✓ High PH giving high resistance to mould
- ✓ High elasticity with lower risk of cracking
- ✓ Faster working time compared to conventional lime

DIASEN® IMPROVE YOUR BUILDING

Option 3

Timber stud with natural insulation and intelligent membranes
Or
Timber stud with natural insulation and vented cavity

IWI System with independent breathable frame

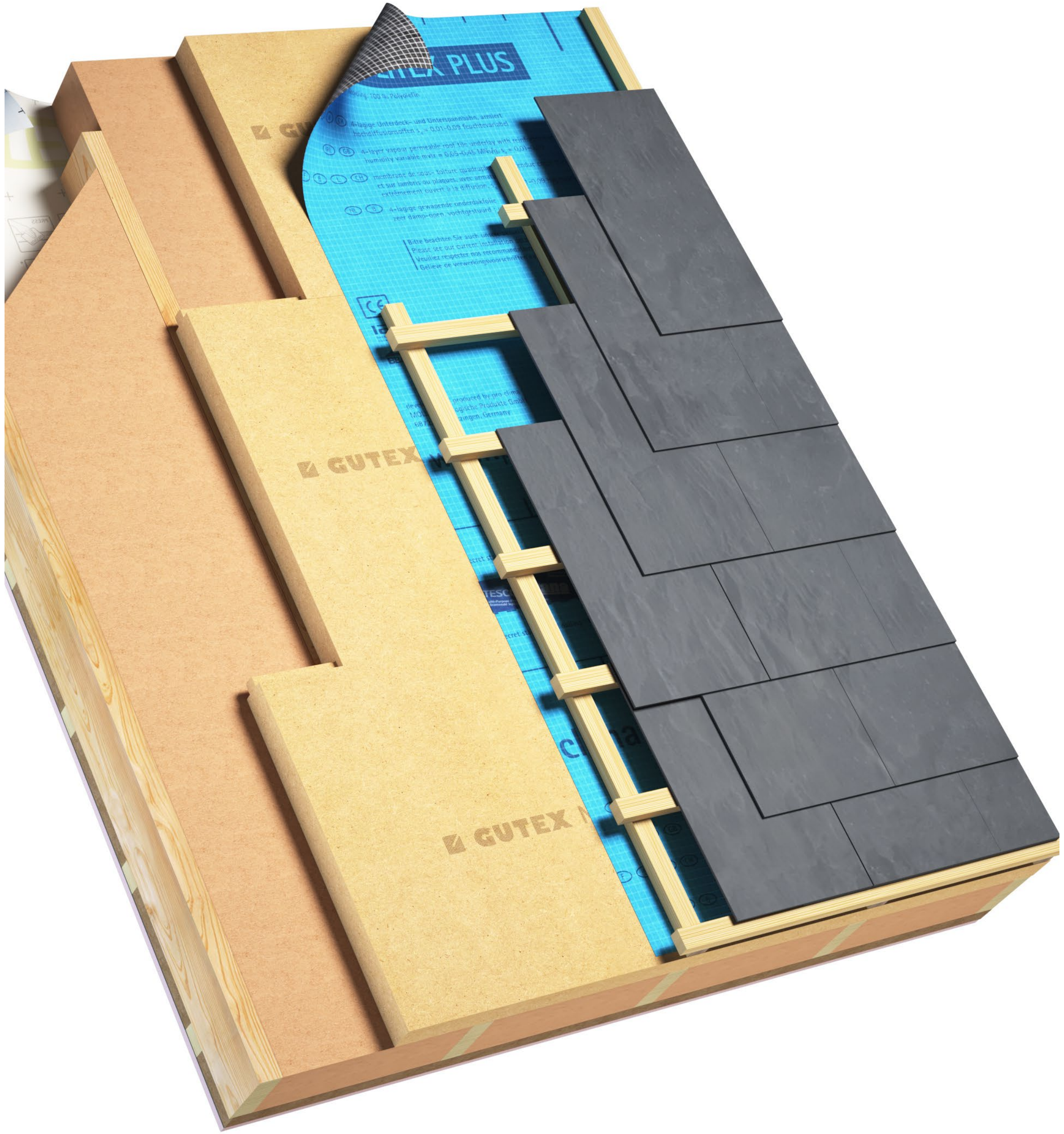


Experiences in Ireland and the UK

Dunshaughlin Protected Structure – barn/stable conversion – O'Daly Architects, Nigel Hora Contractors


INTELLO PLUS
www.proclima.com

Stable Conversion – Killarney Co. Kerry


GUTEX
GUTEX


GUTEX Thermoroom


GUTEX Multitherm

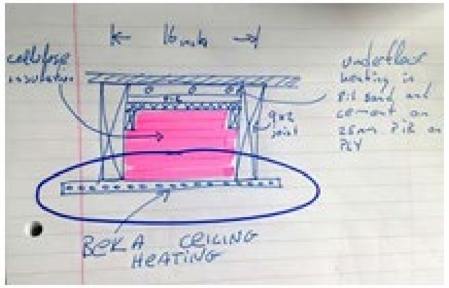


Credit: Daniel Keenan
Midlands Energy Consultants

Sustainable Retrofit in Practice:
Case Study : Main St Cloughjordan



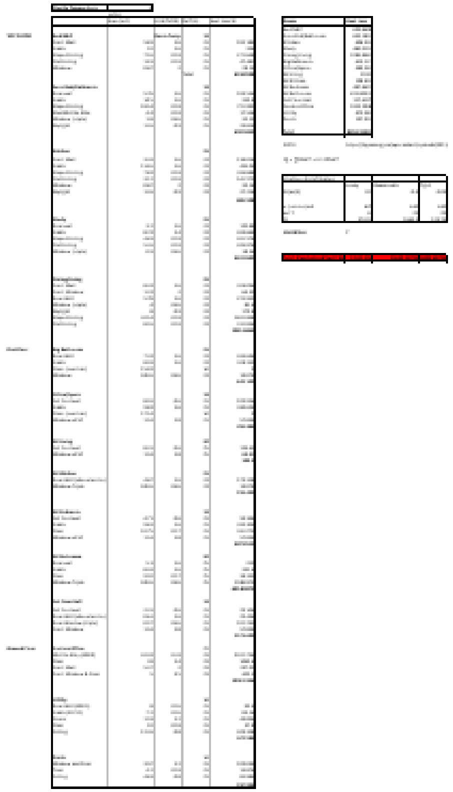
Other Works included
- Reclaimed timber floors & doors
- 40mm cork lime render at external walls
- 200mm woodfibre insulation under rafters
- 150mm cellulose insulation at intermediate floors
- Reuse of fibreglass & mineral wool in floors
- Passive windows & rooflights to north facade (sooon front/south windows, doors & shopfronts)
- Airtightness taping at all windows & junctions from first floor up
- Proclima Intello diffusion membrane at roof
- New natural slates replacing fibre cement




Caelan Bristow MRIAI Design Studio Main Street Cloughjordan Co. Tipperary

RIAI Registered Architect 2021

Sustainable Retrofit in Practice:
Case Study : Main St Cloughjordan



NUMBERS : ENERGY

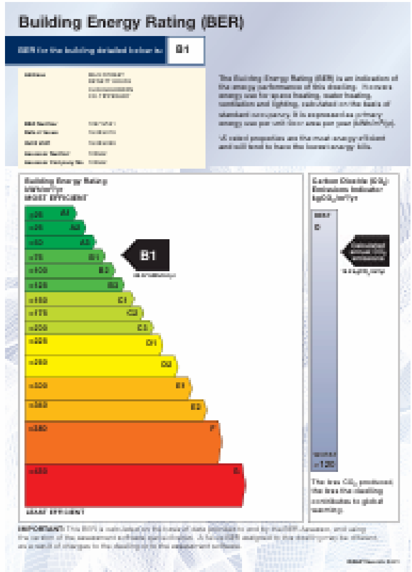
ENERGY PERFORMANCE

- Heat Loss indicator (HLI)
    - Estimated preworks = 3.48 W/m2/K
    - Projected after works = 1.85 W/m2/K
    - Using DEAP we projected 1.6 W/m2/K

- Original BER rating at G, 2018 assessment put it at B1 (82.37 kWh/m2/yr) and we are aiming for A3 when complete

- **In reality, it's already better!**
    - Electricity bills indicate we used 10,834 kWh for period 10/2020 to 10/2021
    - With floor area of 250 m2 – 10834/250 = 43 kWh/m2/yr
    - This is A2 performance (despite 8 months of overheating for my mother's apartment)

- Heat pump on automatic 24 hours/day
- constant temperature at 20 degrees
- energy supply is from renewable source

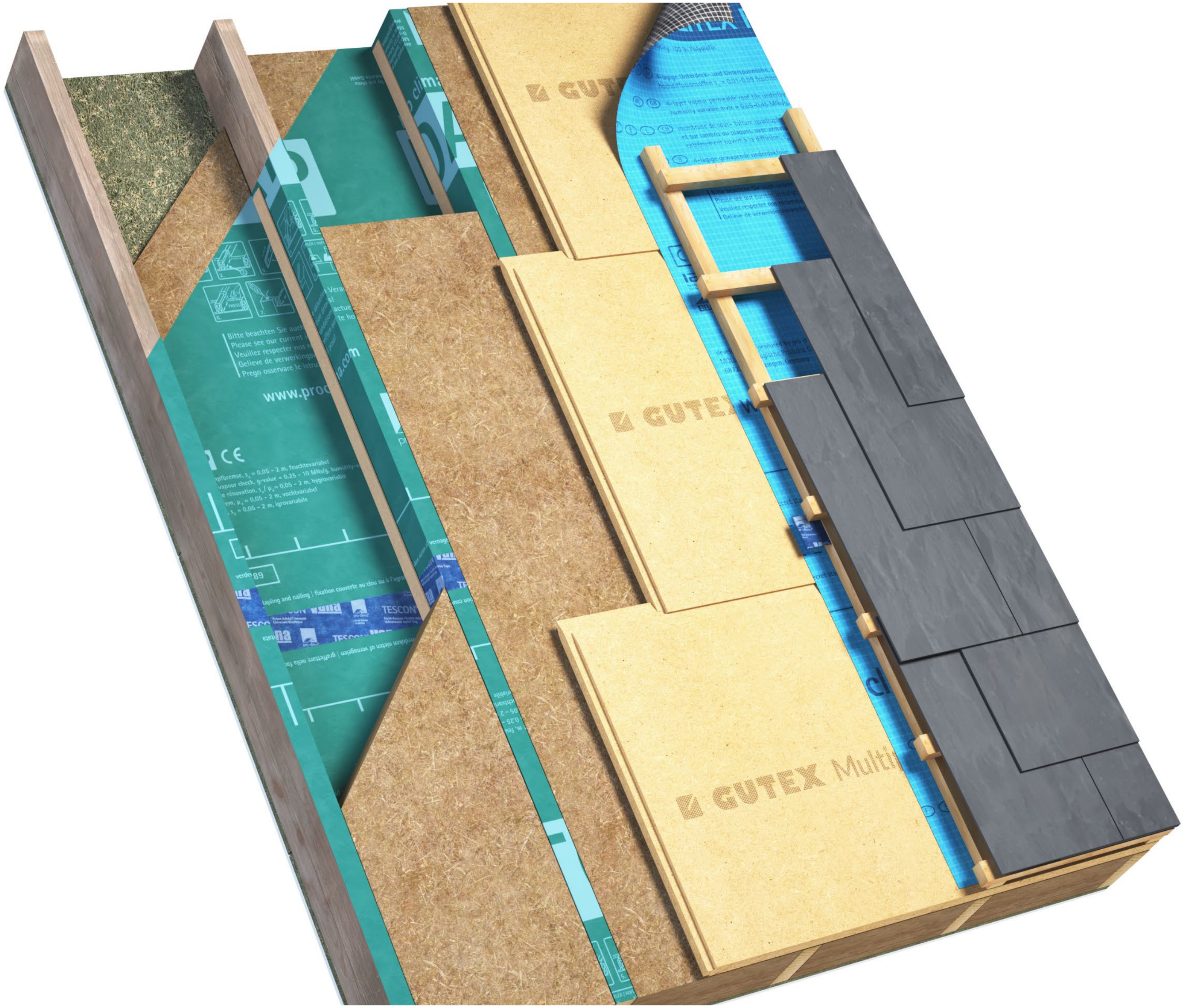


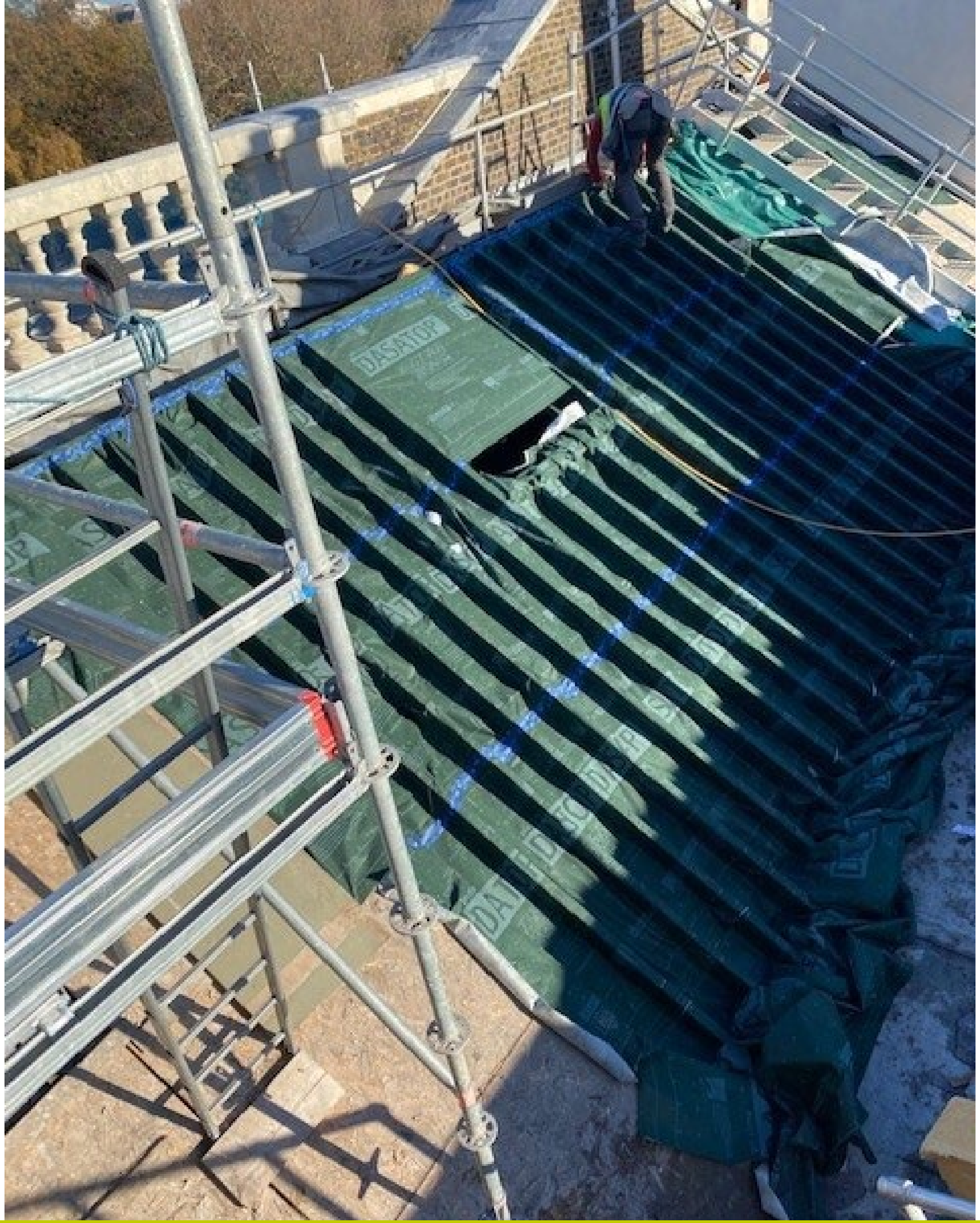
RIAI Registered Architect 2021

Clane farmhouse retrofit 2018 – A2 BER

Ellis Court Dublin – Historic Dublin Social Housing Scheme Restored
22 A rated homes

Appropriate thermal solutions for historic roofs




DASATOP

Appropriate thermal solutions for floors

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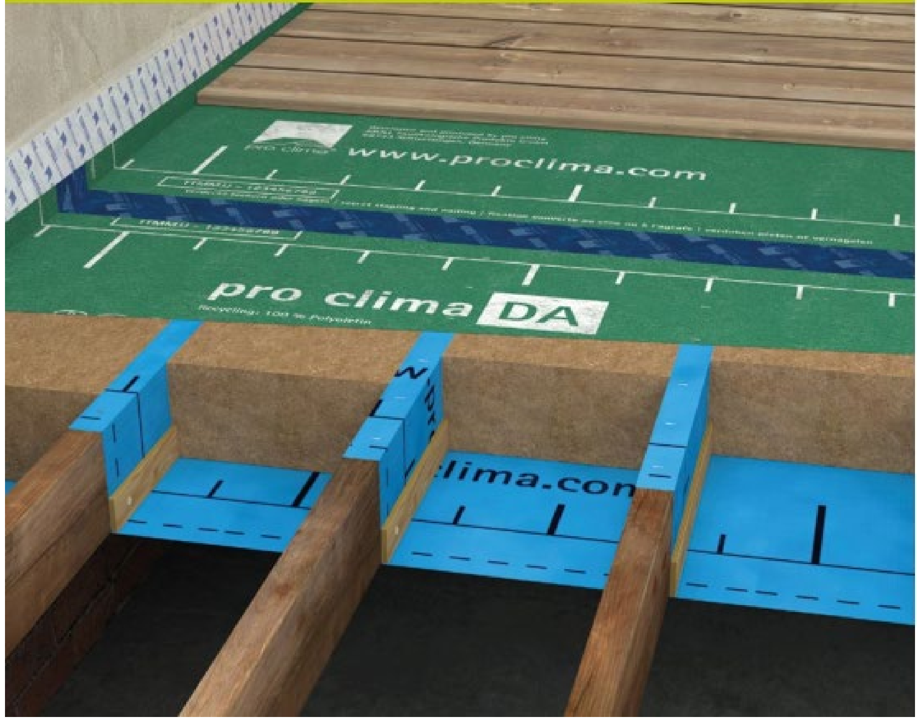
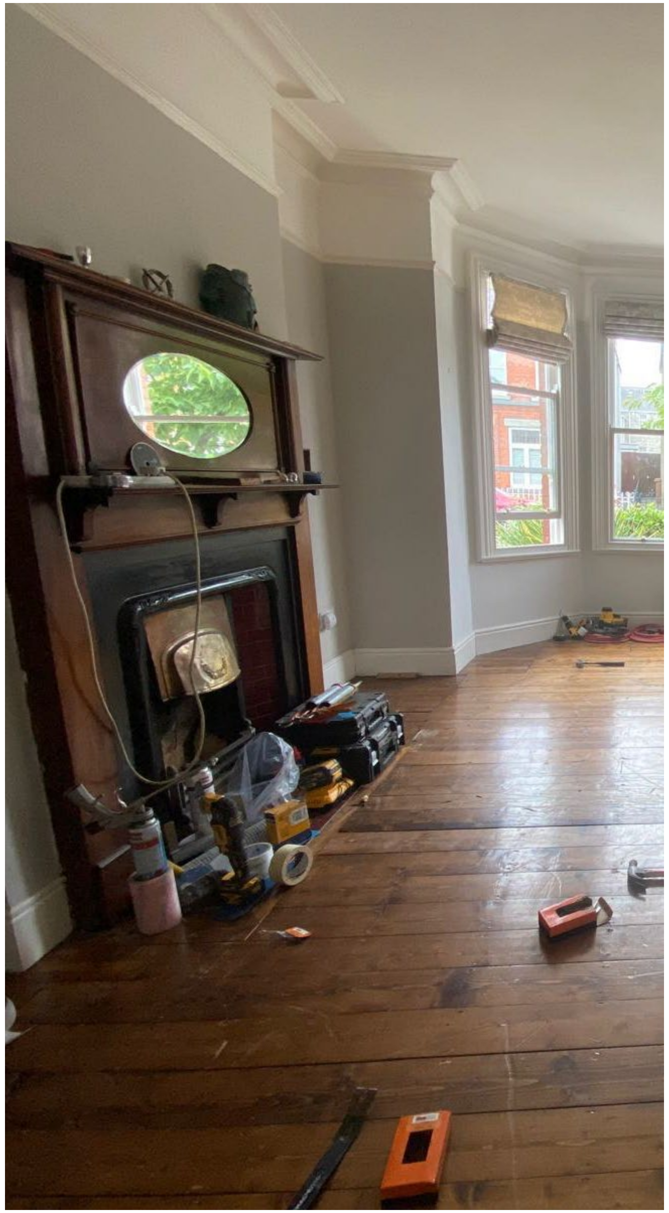
Suspended Timber Floor Insulation: From Above and Underneath Installation Guides

This step-by-step guide provides all the detail needed for a successful installation of underfloor insulation.

Installation Guide



Appropriate thermal solutions for floors

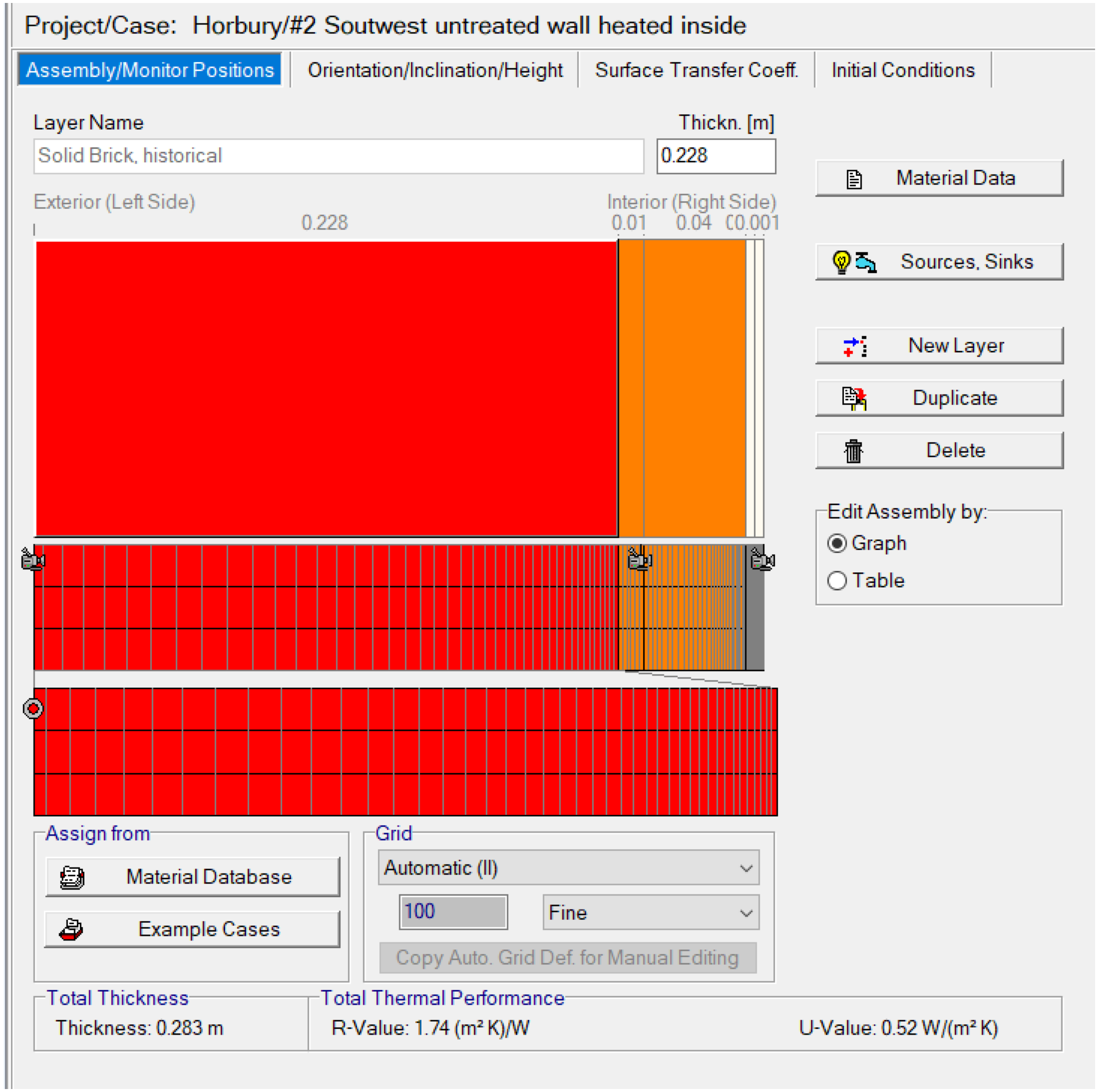


Installation by AerZeal Ltd

Mews House Deep Retrofit Prewett Bizley Architects

- RIBA Regional Award 2022: Winner
- AJ Retrofit Award 2022 – Best House>£500k: Winner
- Retrofit Academy Awards 2022 - Highly Commended Small Project Category

Hygrothermal analysis- Horbury Mews



Construction –

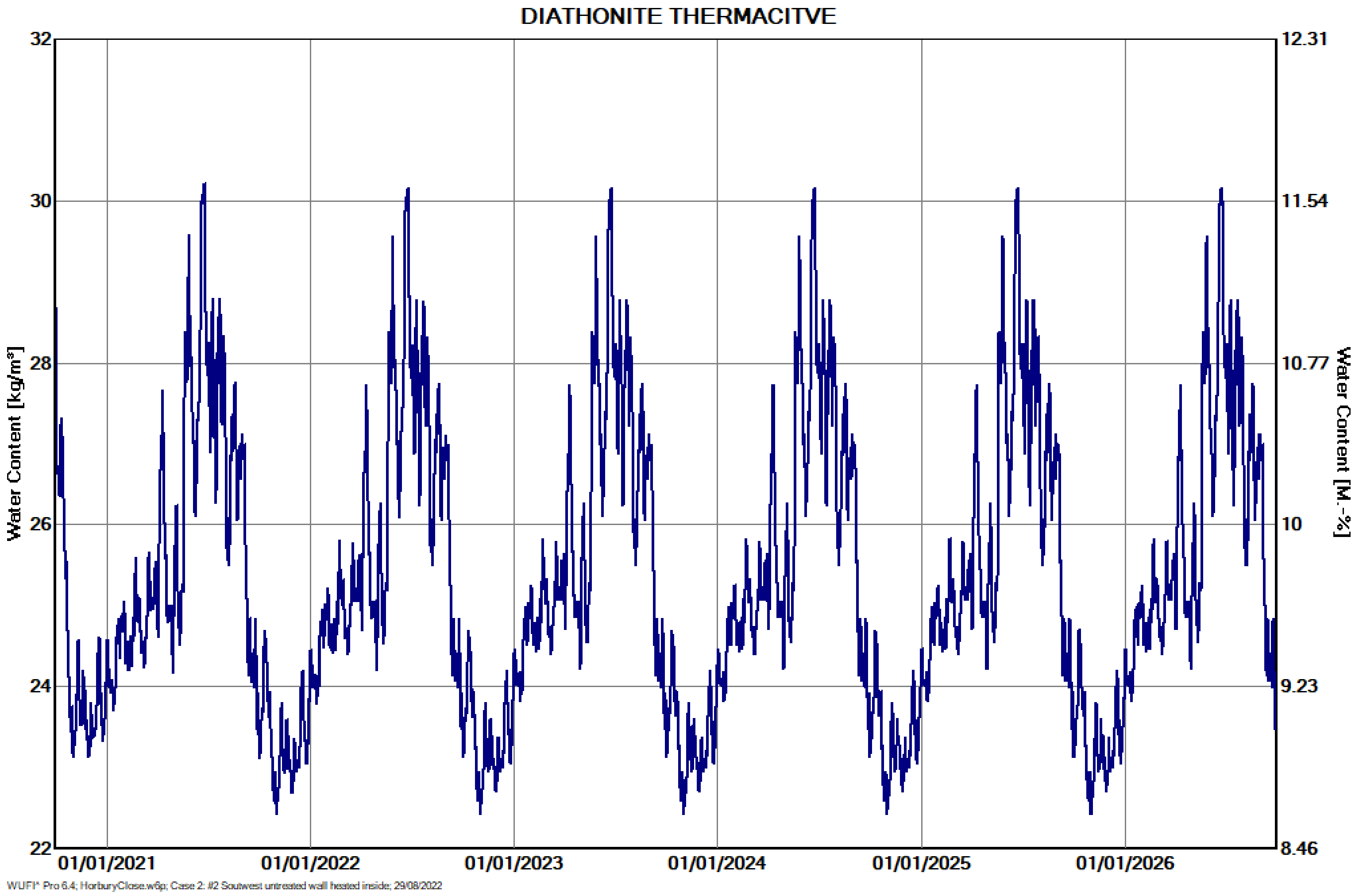
- 228mm brick
- 50mm Diasen Diathonite Thermactive
- Finished with Diasen Argacem lime skim
- Breathable natural paint internally

U value uninsulated – **2.1W/m2K**

U value with 50mm Diasen Diathonite Thermactive – **0.54 W/m2K**

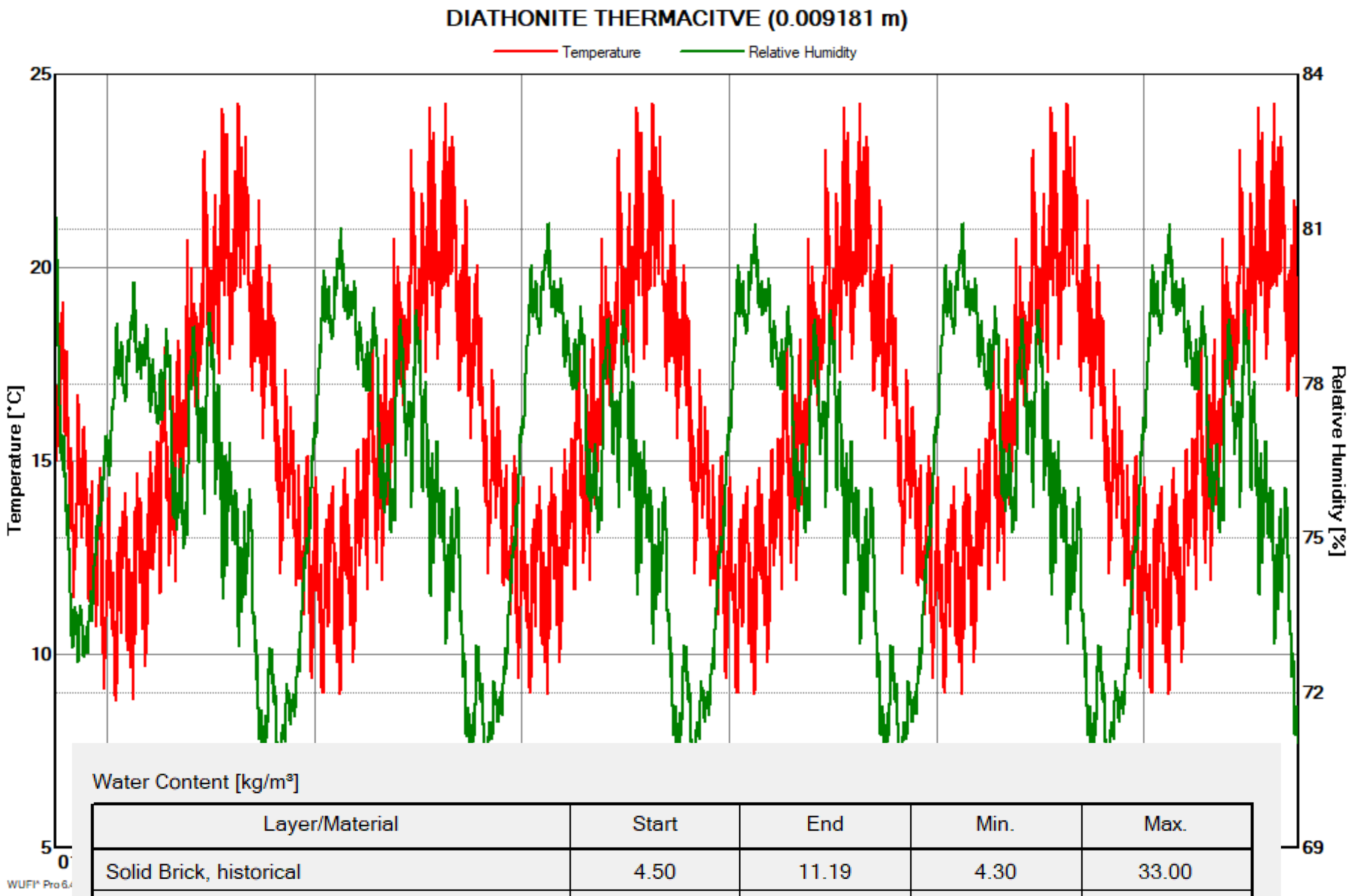
Hygrothermal Analysis- Horbury Mews

Moisture Content of Diasen thermal plaster



Hygrothermal Analysis- Horbury Mews

Relative humidity of inner side of Diasen thermal plaster



Water Content [kg/m³]

Layer/Material	Start	End	Min.	Max.
Solid Brick, historical	4.50	11.19	4.30	33.00
*DIATHONITE THERMACITVE	31.34	27.33	26.91	34.18
*DIATHONITE THERMACITVE	31.34	23.84	22.42	31.34
*Diasen Argacem HP	30.00	20.98	16.21	30.00
*Diasen Argacem ULTRAFINE	30.00	20.46	16.07	30.00

Post Occupancy Performance

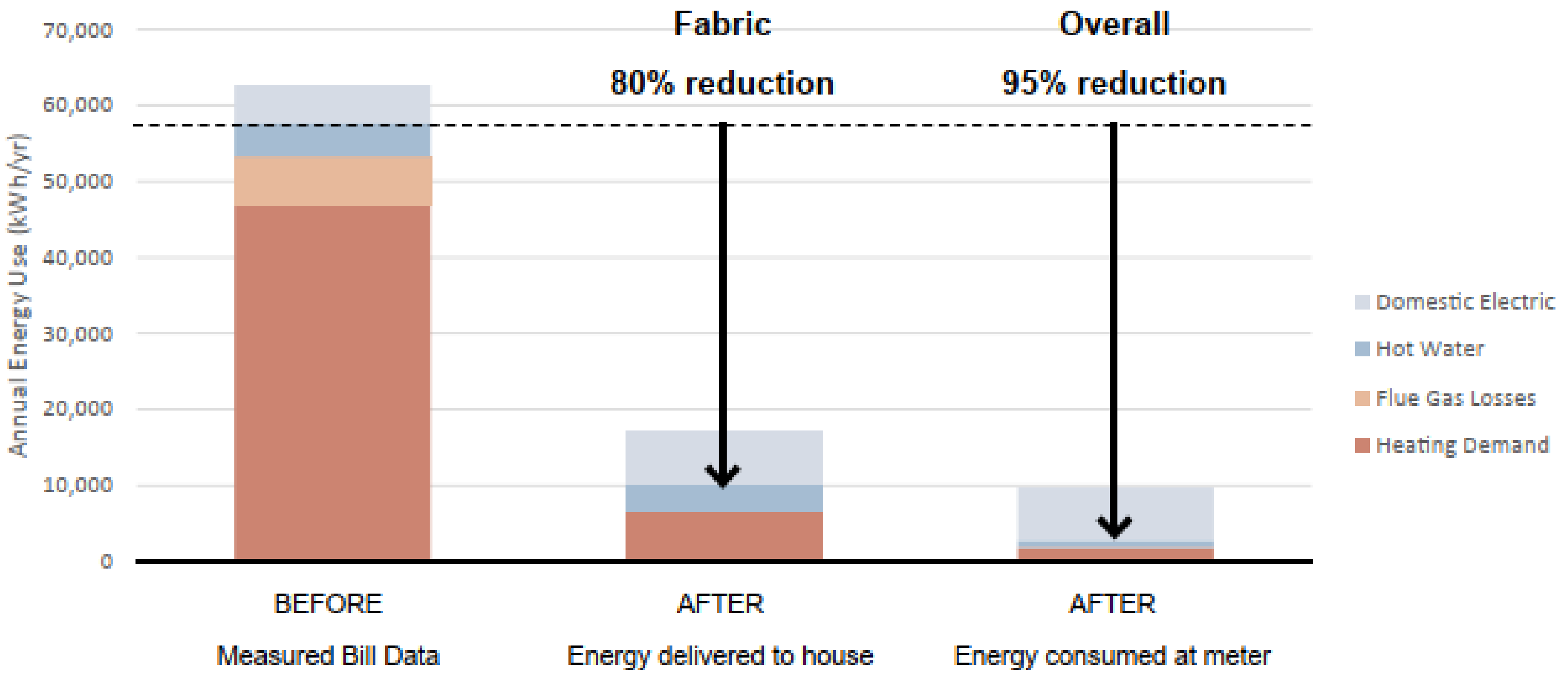


Figure 2 - Measured Energy Use (Before & After works)

The middle bar shows the effect of fabric improvments alone. The right-hand-side bar also includes the measured performance / efficiency of the heat pump (360%).

How much is enough?


ASBP Briefing Paper - June 2024

Insulation and retrofit: Finding the sweet spot

The retrofit challenge

The UK's 29m homes are among the least energy-efficient in Europe with approximately two-thirds in need of better insulation levels [1]. This includes 8.5 million difficult to treat 'solid wall' homes with over 90% of these currently uninsulated [2]. Improving the energy efficiency of our housing stock is vital if we are to meet our net zero commitments.

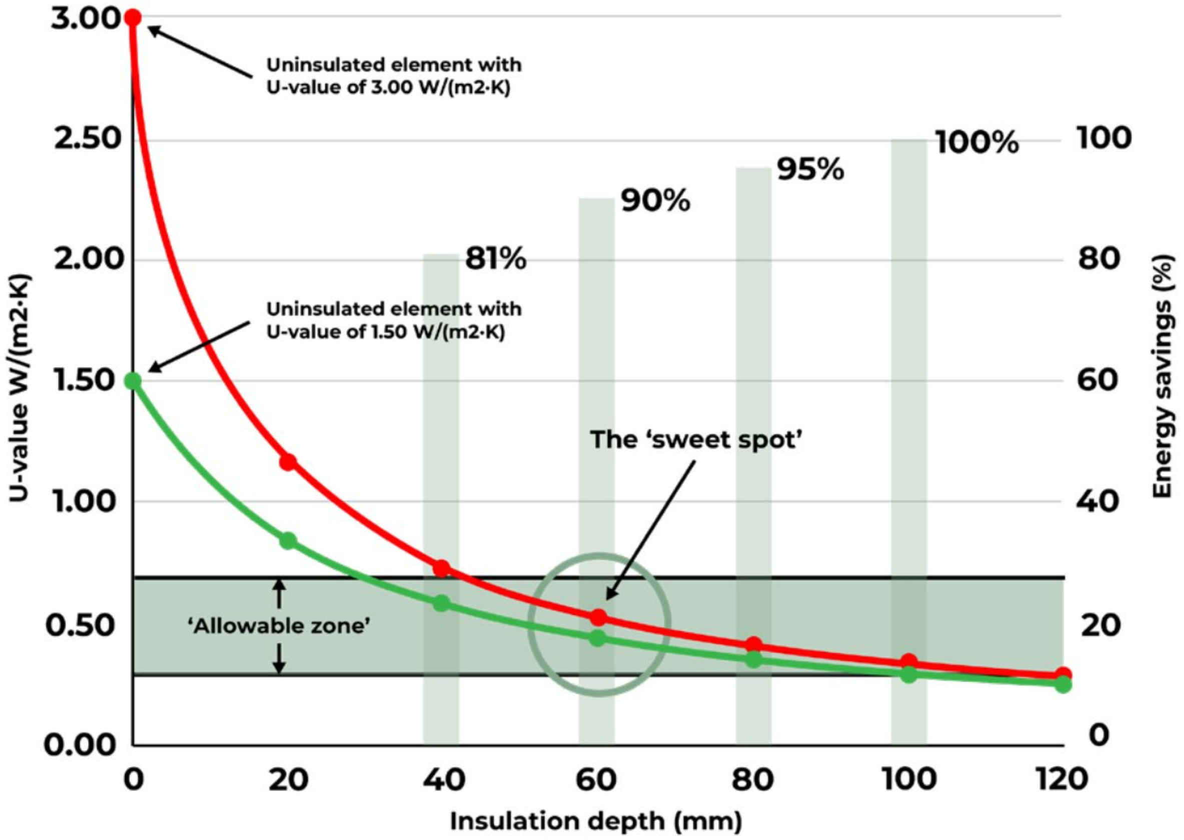
Building Regulations throughout the UK provide flexibility on target U-values in existing buildings. For example, Part L [3] of the Building Regulations for England (p26) offers some flexibility when retrofitting existing walls, roofs and floors.

An improved U-value of 0.30 W/(m2·K) is the target but a 'threshold' level of up to 0.70 W/(m2·K) is sufficient for walls, as long as the approach can achieve a simple payback not exceeding 15 years and is 'technically and functionally feasible'.

This lesser standard for the thermal element (U-value) is acceptable where retrofit measures seek to balance the requirements of Part C of the Building Regulations (England) to protect from the harmful effects of interstitial and surface condensation, which can lead to mould growth.

English Housing Survey data [4] published in July 2023 found that damp and mould affect 177,000 social homes. The effects of exposure to mould can be life-threatening, most recently amplified in the tragic case of Awaab Ishak [5].

ASBP The Alliance for Sustainable Building Products NATURAL FIBRE INSULATION GROUP www.asbp.org.uk 1



Conclusions

- Demonstrates that architectural/conservation concerns can be addressed alongside ambitious energy/carbon reduction targets
- Walls were made more moisture open through replacement of cement pointing with capillary active cork lime thermal plaster and plastic paints replaced with mineral paints
- Historic buildings can perform very well, using measures that fit comfortably with their original building physics and architecture.
- A combination of very good fabric measures and contemporary low-carbon heating can work together successfully and in a genuinely complementary way.
- Targeting super low U values is not necessary to attain high levels of comfort and energy performance.
- This demonstration suggests that there is real hope that hundreds and thousands of 'traditional' homes in the UK & Ireland can be upgraded responsibly, and in a genuinely sustainable manner.
- In order to reach this range, it first requires a 'good' fabric first approach.
- Architectural ambition can and should go hand in hand with 'carbon counting'. Both have a crucial part to play in making places and spaces that will stand the test of time and become truly sustainable.

Conclusions

1. Do not get blinkered by U value!! **0.27W/m2K for IWI can significantly increase moisture risk**

2. Hygrothermal simulation a key decision support tool to deliver robust long term solutions for IWI on solid masonry walls

3. Unrendered brick walls particularly prone to hygrothermal issues (thermal bridges, joist ends and consider insulation depth)

4. Wall thickness a key consideration, thinner walls more prone to moisture fluxes

5. We would not recommend using VCL's on externally unrendered, unprotected walls, especially in exposed areas

6. Where VCL's are used they must be "Intelligent hydrosafe membranes" and their integrity is critical. Validate with Blowerdoor!

7. Careful Wall preparation essential prior to insulating (remove gypsum, wallpaper etc)

8. Installers should receive adequate training

9. Ensure materials are carefully verified and at very least have relevant DOP or some form of 3rd party certification and clear discloser of performance characteristics

10. A Dublin solution is not representative of the whole of Ireland. Driving rain varies significantly from Belmullet to Dublin.

11. SEAI pilot programme opens the door to assess best practice approaches to sensitively retrofit traditional buildings, but shouldn't stop there, this is essential for all traditional buildings

12. A balance can be struck to improve thermal performance of traditional buildings and protect our heritage.

Striking the Balance:

Protecting our Heritage & Reducing Energy Demand

Rialtas na hÉireann
Government of Ireland

A Living Tradition

A Strategy to Enhance the Understanding, Minding and Handing on of Our Built Vernacular Heritage

An Roinn Tithíochta, Rialtais Áitiúil agus Oidhreachta
Department of Housing, Local Government and Heritage

Department for Communities
An Roinn Pobal
Depairtment fur Commonities
www.communities-ni.gov.uk

Caring For Our Vernacular Heritage

Meeting zero carbon presents many challenges…

“The greenest building is the one that already exists”

Carl Elefante, former president of the American Institute of Architects

…..but combining heritage protection & carbon reduction can be achieved.

Visit our stand D4 and Best Practice Arena for more detail

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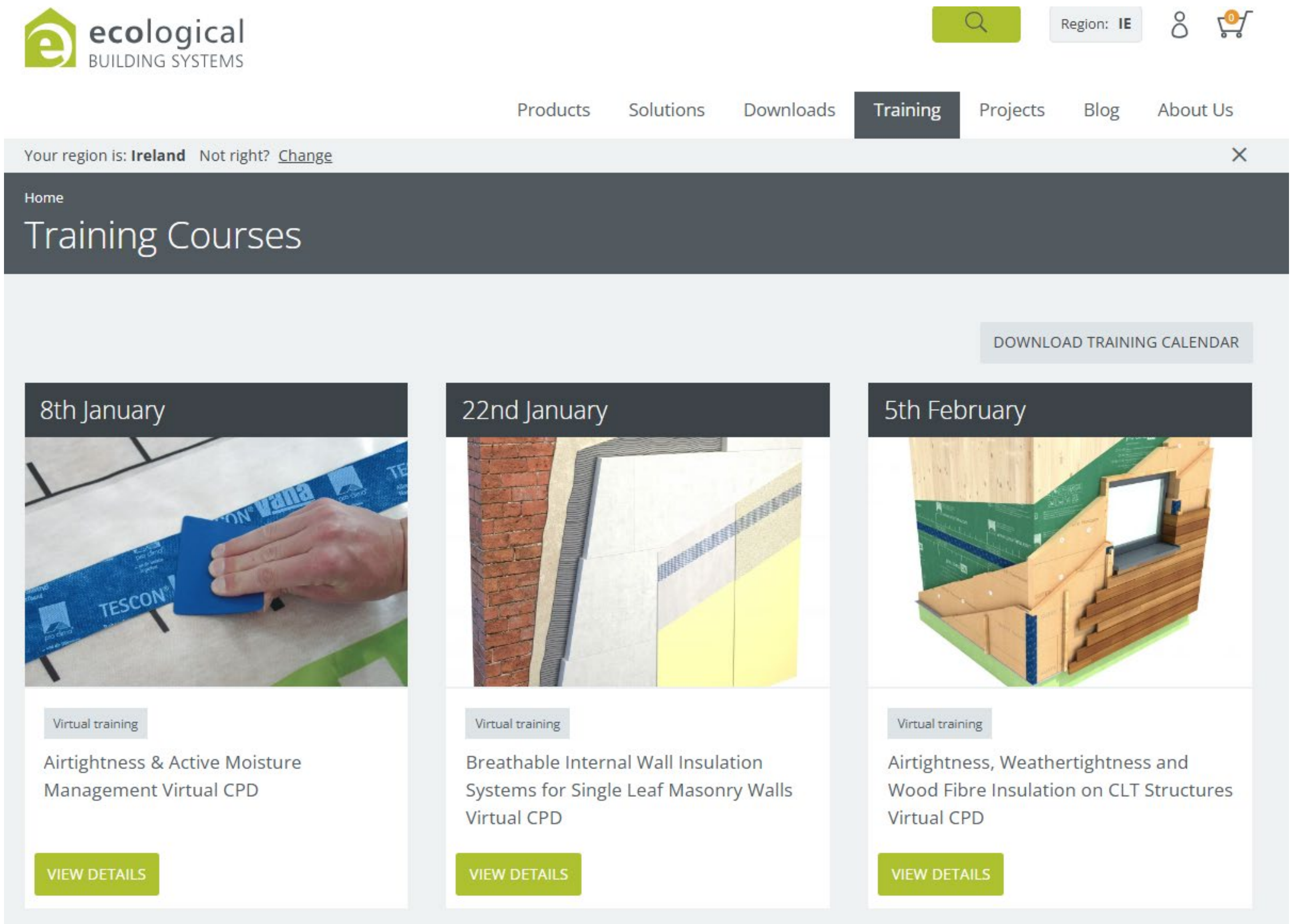
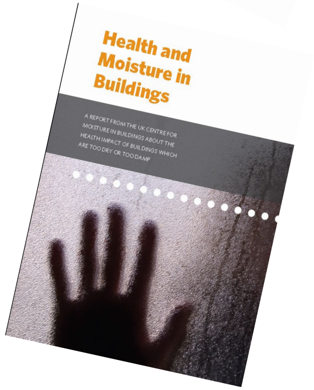
Training and Education

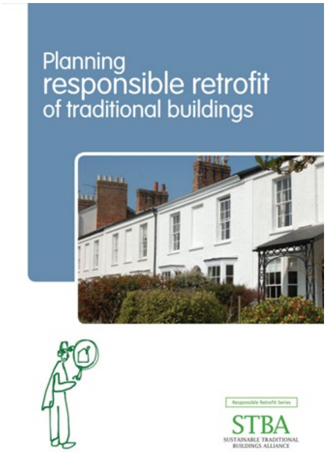


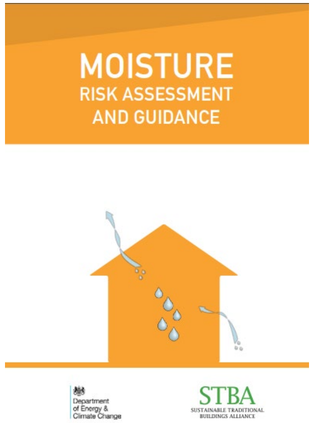
Further Readings

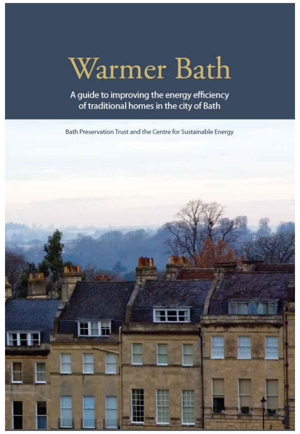
- www.igbc.ie
- https://www.heritagecouncil.ie/
- https://asbp.org.uk/
- http://stbauk.org/
- https://www.spab.org.uk/
- www.UKCMB.org
- https://www.historicenvironment.scot/
- BS 5250 - Code of practice for control of condensation in buildings
- BS 13788 - Hygrothermal performance of building components and building elements. Internal surface temperature to avoid critical surface humidity and interstitial condensation. Calculation methods
- IS EN 15026 - Hygrothermal performance of building components and building elements. Assessment of moisture transfer by numerical simulation
- PAS 2035/2030:2019 Retrofitting dwellings for improved energy efficiency. Specification and guidance
- BS 7913:2013 Guide to the conservation of historic buildings

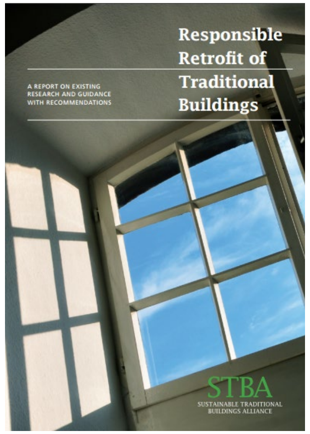


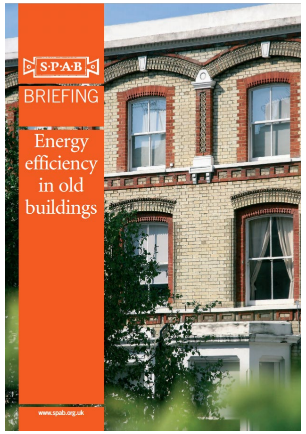
Some More Useful Resources

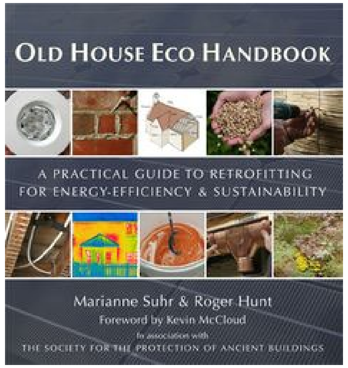


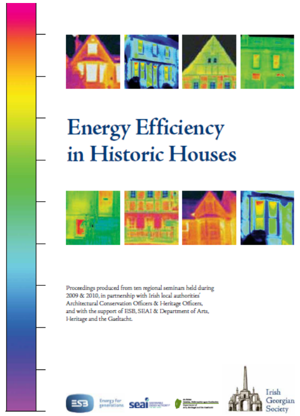


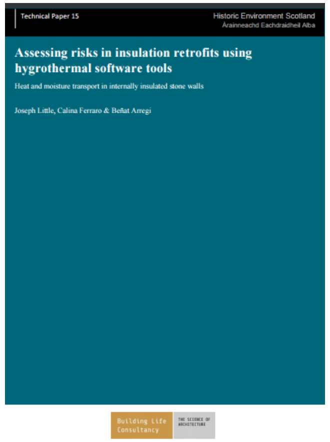


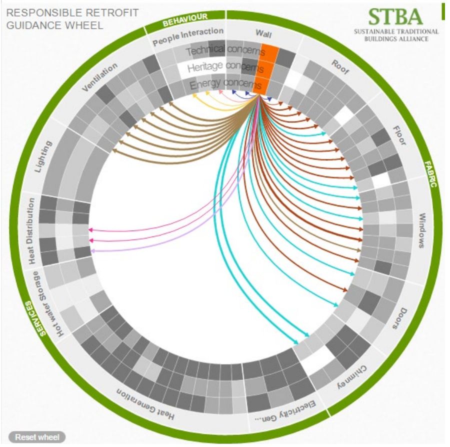


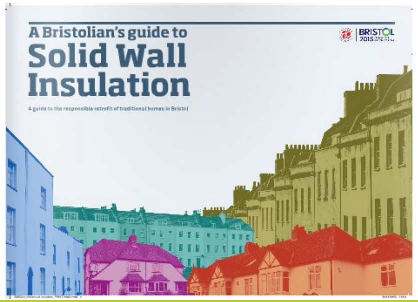












Thank you

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