Xtratherm

More than insulation.

Building fabric performance and the code for sustainable homes

Insulation for performance

UK | **2009** 2nd Edition

www.xtratherm.com

Xtratherm®

More than insulation.

Xtratherm Innovation - delivering better performance

For over 21 years Xtratherm have provided the construction industry with our range of innovative rigid insulation products, components and detailing to meet the ever more stringent requirements of the Building Regulations. These regulations have been developed to form a crucial part in the goal to reduce carbon emissions from our buildings; the Code for Sustainable Homes has been introduced to advance that goal towards Zero Carbon and encourage a more sustainable life style.

Xtratherm delivers the performance required to achieve these new levels.

XTRATHERM
AND THE CODE FOR
SUSTAINABLE HOMES

Contents

The following guidance on energy performances is indicative only of the house designs illustrated. The CSH ratings quoted should not be assumed for any house type as variation of specifications as well as size and shape of the building will effect the energy performance. Xtratherm can advise on CSH/SAP calculation and give guidance on indicative ratings, but it is advised to contact a CSH Consultant at an early stage in the design process. Xtratherm accepts no liability for errors, omissions or claims arising from the use of this information.

XTRATHERM
AND THE CODE FOR
SUSTAINABLE HOMES

Sustainable Homes?

There has been steady progress towards the objectives set within the Code for Sustainable Homes since its introduction in 2006. Many papers have been written, pilot projects undertaken, and valuable lessons learnt on the inputs required to achieve more sustainable homes.

Although the theories and methods differ as to how best to reach the target of Zero Carbon (by 2016) general agreement has been reached on one aspect of the task - it will prove difficult, and most probably, expensive for industry to adopt.

There is little doubt that we need more homes (Government targets of building 240,000 homes a year to a target of zero carbon by 2016), and in a climate of economic downturn, homes that are affordable, practicable and easy to maintain, but these difficulties do not negate the requirement for us to deliver a low carbon future, with practical low carbon houses delivered as part of the strategy.

This Xtratherm Guide to the Code will concentrate on delivering fabric performances in new dwellings up to the standards required for CSH 3 and CSH 4. Indeed at the U-values demonstrated the higher Codes of 5 & 6 can be achieved - if the decision to include more renewable technologies are installed.

Low carbon buildings are only one part of a low carbon lifestyle. The carbon savings gained by improving a dwelling from Code level 4 to Code level 5 will be relatively small (if replacing gas), and will involve significant cost increases to install the technologies required to reach the higher level. These technologies will also have the added complication of essential maintenance regimes for the home owner to ensure that the properties are operated safely and efficiently.

For social housing it is particularly important that low impact houses are delivered in a cost-effective and practical way, resulting in properties that are low maintenance, durable and preferably using traditional build methods with a proven track record.

This Xtratherm Guide 3-4 gives our solutions to a particular design, a detached, 5 bedroom dwelling (Above), but the solutions offered generally will achieve the same Code levels for 4 different designs - data sheets on these can be downloaded from **www.xtratherm.com/thecode.**

What is the Code for Sustainable Homes?

The Department for Communities and Local Government laid the foundations for greener housing when it launched the Code for Sustainable Homes in 2007. Homes built under the scheme are built to standards set in the Code creating dwellings that are more energy and water efficient, produce fewer carbon emissions and encourage their owners to live a more sustainable lifestyle.

The Code assesses the sustainability of a home by awarding points in nine design categories. The total points are translated into a star rating for the home:

Level 1 requires 33.3 points, Level 2 is set at 43 and so on up to Level 6 at 64.9 points.

CODE FOR SUSTAINABLE HOMES TIMETABLE

PRIVATE SECTOR	Assessment mandatory	Level 3 mandatory	Level 4 mandatory	Level 6 mandatory
TIME TABLE	2009	2010	2013	2016
PUBLIC SECTOR	Level 3 mandatory	Level 4 mandatory	Level 6 mandatory	

The nine categories are:

- **Energy and carbon dioxide** (including insulation, electric lighting, heating systems, domestic appliances)
- **Water** (internal and external potable water consumption)
- **Materials** (responsible sourcing of construction and finishing elements)
- **Surface water run-off** (rainwater recovery, attenuation of surface water run-off, reduction of flood risk)
- **Waste** (household recycling facilities, site waste management, composting facilities)
- **Pollution** (insulants with low global warming potential, low emissions)
- **Health and well-being** (specific daylight factors for particular rooms, sound insulation, and adherence to the principles of Lifetime Homes)
- **Management** (Home User Guide, information on the site and its surroundings, adoption of the Considerate Constructors Scheme)
- **Ecology** (protection or enhancement of site habitats, use of the BRE's Ecological Value Checklist)

HOW IS CSH TREATED IN THE REGIONS?

England
Since May 2008 all new homes in England are required to have a Code rating against the Code and for a Code certificate to be included within the Home Information Pack.

Wales
The National Assembly for Wales has announced that they will be adopting the Code in the near future.

Scotland
The Code does not apply in Scotland. EcoHomes is still in use.

Northern Ireland
Northern Ireland has required Code Level 3 for all public sector housing since April 2008.

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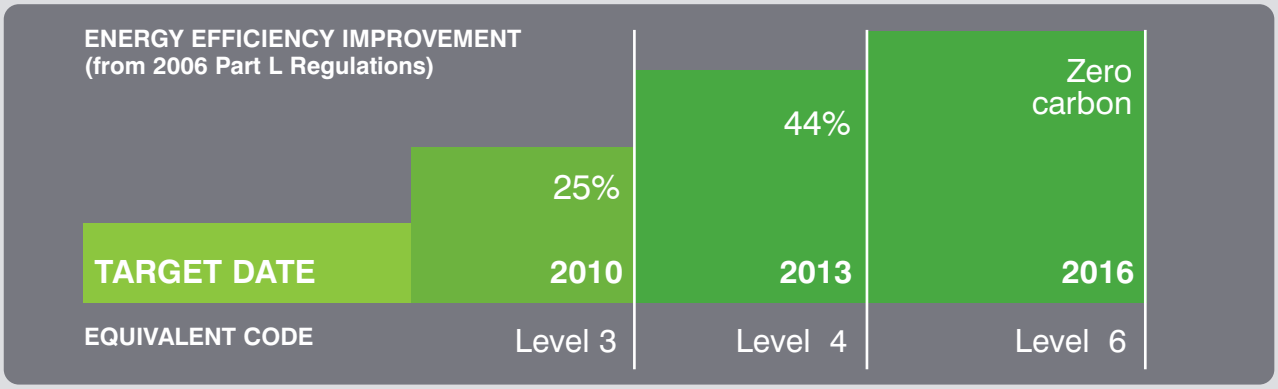
The Code for Sustainable Homes & Energy Efficiency

The adoption of the Code for Sustainable Homes states the intended direction of future changes to Part L of the Building Regulations, which will make dramatic improvements in reducing CO_2. The most important factor in energy saving is having a well insulated building fabric that includes efficient U-values, excellent detailing and effective air permeability.

Points are awarded for percentage improvements over Building Regulations Approved Document L (2006) - Conservation of Building Fuel & Power; calculated using SAP:2005, with level 3 achieving 25% better, level 4 - 44% better, until Zero Carbon is achieved at Code level 6.



CREDITS WILL BE GAINED BY ACHIEVING IMPROVED LEVELS IN EACH OF THE 9 CRITERIA - ENERGY EFFICIENCY MEASURES HAVE THE GREATEST POTENTIAL FOR GAIN.

Credits within the Code are not created equal. Each section is weighted with Criteria 1, Energy and CO_2 emissions, having the greatest potential for gain. Xtratherm solutions deliver on U-value and detailing - even within traditional build techniques. Credits are also gained if the insulating materials used do not have a global warming potential (GWP) of 5 or more (and an Ozone Depleting Potential of zero) in either their manufacture or composition - Xtratherm materials meet both these criteria.

CSH Assessors will advise that the target ratings desired are met in the most cost effective and practical way possible. So, for example, meet the mandatory requirements within materials, but even achieving 100% of the credits in materials would only contribute 2.2% to the final score. Targeting sections such as Site Ecology and Management offer the most scope for possibly the smallest capital investment.

Total numbers of Credit available and the Weighting Factors for each of the Issue Categories

Environmental Impact Categories	No of Credits in each Category	Environmental Weighting Factor (as % Points Score of total possible Score Available)
1 Energy and CO2 Emissions	**29**	**36.4%**
2 Water	6	9.0%
3 Materials	24	2.2%
4 Surface Water Run-off	4	7.2%
5 Waste	7	6.4%
6 Pollution	4	2.8%
7 Health and Wellbeing	12	14.0%
8 Management	9	10.0%
9 Ecology	9	12.0%
TOTAL	104	100.0%

Unlike previous assessment methodologies, the Code for Sustainable Homes assesses each individual dwelling and includes an assessment on completion. BRE are intending to inspect up to 50% of the developments to ensure compliance (this is in addition to the assessors inspection).

Xtratherm Innovation - delivering better performance

For over 21 years Xtratherm have provided the construction industry with our range of innovative rigid insulation products, components and detailing to meet the ever more stringent requirements of the Building Regulations. These regulations have been developed to form a crucial part in the goal to reduce carbon emissions from our buildings; the Code for Sustainable Homes has been introduced to advance that goal towards Zero Carbon and encourage a more sustainable life style.

Xtratherm delivers the performance required to achieve these new levels.

Why PIR?

There are three ways in which heat is lost from buildings: conduction through materials, convection by air movement and radiation across cavities. Xtratherm Polyiso helps tackle each of these.

Thin-**R**

Rigid Thermal Insulation (Polyiso)

Polyiso is a foil faced Polyisocyanurate (PIR) insulation board. Polyiso is a rigid foam with a variety of high performance facings, including low emissivity foil. Xtratherm Polyiso achieves a lambda value of 0.023 W/mK, has fully engineered joints, with components available to form systems.

Polyiso **Plus**

Rigid Thermal Insulation (Polyiso Enhanced)

Innovations by Xtratherm have improved the insulation performance of the Cavity Plus foam core. The Lambda value of 0.021 W/mK achieves the most efficient value available for rigid foam insulation and again is complemented by engineered jointing and components such as corner and proprietary reveal closers.

Products & Performance - Making the connection

It's not just the U-values achieved in your walls, floor and roof that delivers energy performance, it's also how the insulation system 'knits' together. In a recent report, the improvement in the detailing of insulation from default to enhanced improved the energy performance of a semi-detached house by approx 20%. To achieve the same improvement by improving the air tightness alone, the air permeability achieved would have to improve from 10 to below 1 - a very difficult goal, but shows just how significant the detailing of insulation actually is. Xtratherm have been at the fore-front in developing innovative products with enhanced detailing to build insulation systems that deliver improved performance.

Xtratherm Cavity Plus Wall System includes a pre-formed 90 degree corner panel to effectively insulate a junction that is normally vulnerable to thermal bridging.

The Tongued and Grooved jointing system results in a more robust, continuous layer of cavity wall insulation that minimises the threat of thermal bridging through inaccurate installation.

The Lambda value of 0.021 W/mK and resultant low 'E' cavity achieves the most efficient value for cavity wall insulation certified by accreditation.

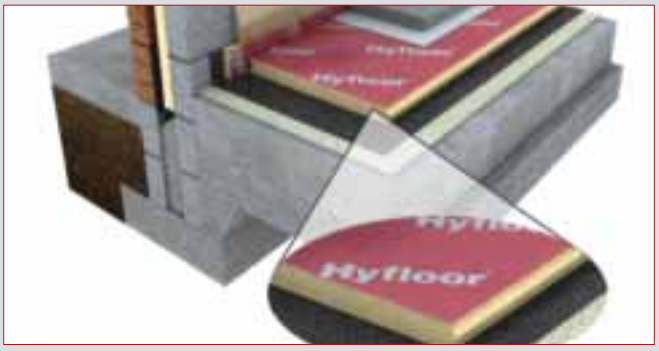
Innovation - delivering better performance

Xtratherm Close-R fully insulated cavity closers are a cost effective solution for builders and specifiers for the closing of cavities around window and door openings, preventing cold bridging, damp penetration, air infiltration and condensation. The Close-R range is used to close cavities and is suited to all types of windows and doors and is available in sizes to fit cavity widths from 100mm - 150mm, with checked detail to suit brick or dry-lined specifications and flanged detail to suit block outer facings.

Innovation - delivering better performance

Hyfloor Under Floor Insulation has superior thickness to performance ratio allowing the lower U-values to be achieved but with superior detailing included. Hyfloor has T&G jointing and is used with Xtratherm perimeter strip to reduce thermal bridging at floor perimeters.

Innovation - delivering better performance



Xtratherm RLOC2 Pitched Roof Insulation has a unique width variation feature offering a 10/20mm adjustment margin to ensure a tight fitting, high performance insulation locked between rafters.

Used in conjunction with a layer of Xtratherm XT/TL or XT/PR below the rafters, the RLOC2 system provides a robust, cost effective solution to insulating sloped rafters to the most efficient standards with minimal wastage and reduced fitting time.

Innovation - delivering better performance

The Xtratherm Solutions to

The fold-out section at the back of this guide illustrates the specifications to achieve levels 3 & 4 of the Code for Sustainable Homes. Although the solutions are specifically set for the detached house shown, the indicative U-values chosen have proven to be typical of what is required to achieve level 4 (or better) in 4 other house types.
(Details on the specification required for these variations can be downloaded at www.xtratherm.com/thecode)

Regional regulations in Northern Ireland and Scotland differ from those in England and Wales, but in general the chosen scenarios will perform similarly under the specific regional regulations.

The Merton Rule

Local authorities have been given increased powers to plan for and require decentralised energy generation. The draft planning policy statement (PPS) gives them increased powers to plan for and require either renewable or low carbon energy generation. Many authorities have adopted the Merton Rule, as their commitment to renewable energy in new build.

The definition of what is referred to, as the **'Merton Rule'** is planning policy that requires new developments to generate at least 10% of their energy needs from on-site renewable energy equipment. The most commonly accepted threshold is 10 homes or 1,000m^2 of non-residential development - though this is sometimes lower. This is the accepted definition by local (and regional) planning authorities, academic institutions, trade and professional bodies, and the development, construction and engineering industries.

The Merton Rule encompasses all buildings and not just homes. As the huge number of planned houses gets built they will be accompanied by new schools, supermarkets, shopping, malls, office blocks, leisure centres, etc, and it is essential that these heavy energy users also play their part in contributing to the Government's renewable energy and climate change strategies and targets.

FABRIC PERFORMANCE & RENEWABLES

An important factor that should be considered when deciding on the performance level of the building fabric is the effectiveness of any renewable technologies that might be installed. Renewable technologies have a very important role to play as we strive towards the goal of 'Zero Carbon' in new buildings, the target simply will not be attainable without their inclusion. But it is imperative that when installed - they are installed into a building that is as energy efficient as possible; giving the renewable technologies a chance of meeting that much reduced energy demand.

Heating systems and any other technology, renewable or otherwise, will eventually fail and have to be replaced - however the building itself will probably be around for at least 100 years. It is imperative that best practice U-values, robust detailing and airtightness are adhered to from the outset and any reduction in fabric performance permitted through the SAP calculation be avoided, or at least minimized.

A higher performing U-value for each element has been illustrated beyond the Code 4 levels to give designers the option of pushing the fabric U-values to higher performances.

THE MERTON RULE & RENEWABLES

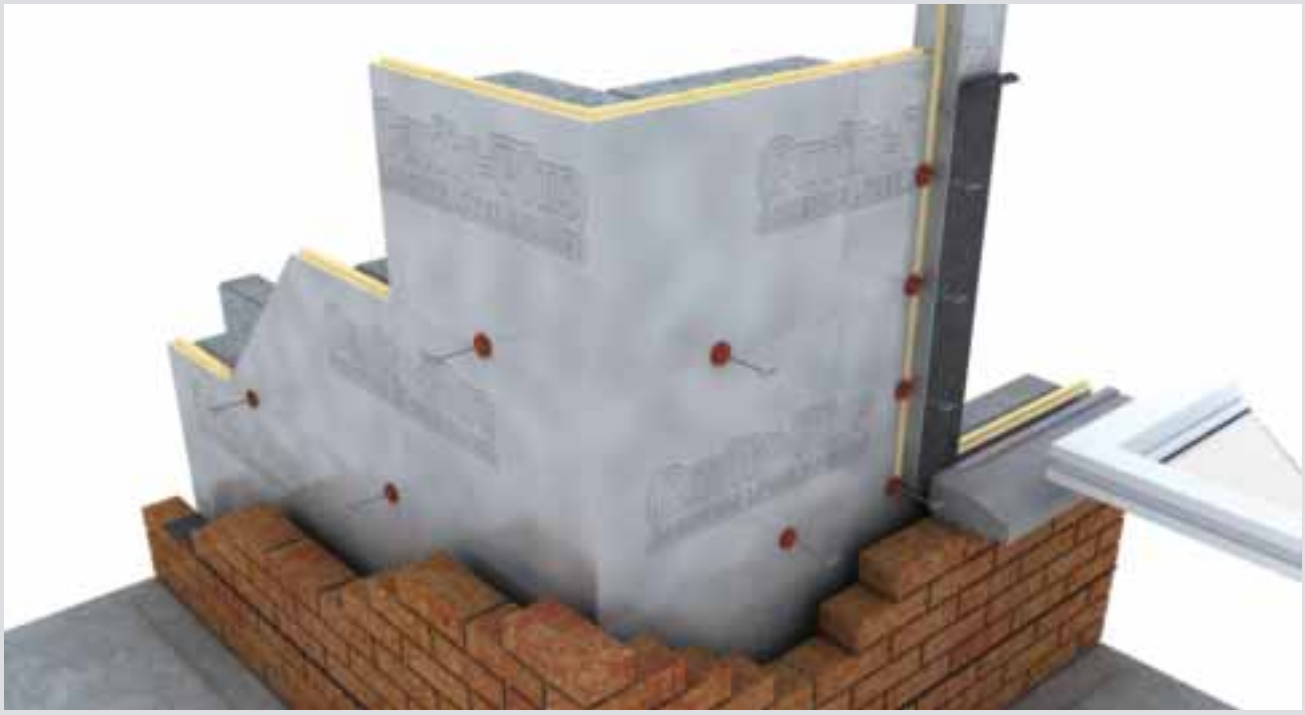
Where renewables are installed, whether in compliance with Merton guidelines (see separate panel) or voluntarily, the fabric performance can be reduced and still comply with the energy criteria. We have, in the fold out section, shown a specification that will meet the Code levels when this route is taken.

MECHANICAL VENTILATION & HEAT RECOVERY (MVHR)

The drive towards Codes 4, 5 & 6 will require at some point that ventilation be delivered to the property by mechanical means. When installed and operated properly MVHR can deliver healthy fresh air to the occupants with benefits in energy being achieved through the pre-warming of fresh air coming into the dwelling. To work efficiently however the system must be installed into an air tight building. It is imperative however, that the occupants receive full instruction as to the effective operation of the system and that the system is checked and maintained according to the system manufacturers instructions.

Some of the Xtratherm solutions illustrated call for the inclusion of MVHR systems; where the permeability requirement has been set at a reasonable 4m^3/m^2/yr. Following the Enhanced accredited Details should achieve close to this target.

Efficient Fabric U-values



Thermal Bridging and Accredited Detailing

A major factor in the performance of the building fabric is not simply the amount of insulation you install, but how it interconnects with its other components and the other insulated elements within the design.

Take a wall construction for example: you may indeed succeed in achieving a very good U-value by increasing the cavity and adding more insulation, but in the well insulated building that is required for Code level 3 and beyond, most of the fabric heat loss will not be through the main body of the wall, floor or roof - but at the junctions where those elements meet. This is why detailing and jointing of the insulation layer has become a critical factor in energy efficient design. It has been estimated that up to 30% of the heatloss in a well insulated house is through these 'Non Repeating Thermal Bridges' at wall/floor junctions,corners, reveals, ceiling junctions heads and sills.

Appropriate detailing to ensure the 'Continuity of insulation' is now asked for by Part L, and this continuity can be satisfied by following details printed in the publication 'Accredited Construction Details', published by the DCLG. Using these details will allow the assessor to ascribe a good score to the detailing section within SAP with a Y-value of 0.08. However it is paradoxical, that the better insulated the element is - the worse the heat loss through the junction becomes, to such an extent that at a better U-value the junction thermal transmittance fails to meet the default values laid down in the paper IP1/06 Assessing the effects of thermal bridges at junctions and around openings. To recognize this factor, the specifications referred to within this guide, asks that a Y-value of 0.04 be achieved in certain instances. This would entail using the Enhanced Accredited Details that generally asks for internal thermal lining to the construction, or detailing available from the Aircrete Products Association.

To continually push a cavity wall width out to install greater thickness's of insulation, although achieving a better elemental U-value may result in other problems such as condensation and mould growth manifesting themselves at the junctions in the future.

TARGET U-VALUES

BUILDING FABRIC	U-VALUE TARGETS 2010 Level 3	2013 Level 4	2016 Level 6
Walls	0.22	0.18	0.15
Solid Floor	0.15	0.13	0.10
Roof Ceiling	0.16	0.13	0.10
Roof Slope	0.16	0.13	0.10

Xtratherm innovation has resulted in superior performing engineered jointing systems that have had extensive test results proving Enhanced Detailing performance suitable for higher levels of the Code (contact Xtratherm Technical Support for details).

Building fabric insulation

Cavity Walls

Partial Fill Cavity Walls - Our climate lends itself to the predominance of the cavity wall. Prevailing westerly winds with ever increasing amounts of rain through out the year necessitate protection from the weather, retaining a cavity by only partially filling with insulation provides that protection without any loss of thermal performance. Adding a thermal liner to the inner surface of the wall can achieve best practice U values, addressing thermal bridging and maintaining the protection required.

STABILITY/CAVITY WIDTH

Traditionally the overall wall width in the UK has been around 300mm, this might have to be increased to accommodate more insulation to achieve better U-values. We have estimated that a 'reasonable' overall wall width is around 350mm,and used this limited within the solutions shown. A 350mm wall, incorporating an actual cavity of 150mm, does not significantly change practice on sites, and can be structurally stable using commonly sourced wall ties.

Building walls wider than this may lead to concerns about structural stability and overall building footprint. The wider the cavity is the greater the amount of wall ties are required to maintain stability. Each of these wall ties is in effect a Thermal Bridge through the insulation layer, this has a significant detrimental effect on the wall U-value. There are other practical/cost implication of keeping the overall wall width reasonable.

Foundation Width

Pushing the overall wall width out will increase the dimensions of the foundations required to support the wall, adding significantly to the amount, and cost, of the concrete required in the foundations. Consideration should also be given to the availability and cost of bespoke heads and sills that may be required for non-standard wall widths.

U-value versus detailing

In a well insulated house, with wall U-values below 0.22 W/m^{2}K, up to 30% of the heat loss experienced in the house disappears not through the walls, floors and roof themselves - but the junctions between them. Continually improving the wall U-value without addressing the Thermal Bridging/Accredited detailing at these junctions can result in condensation and mould growth, the Accredited/Enhanced Details should be followed.

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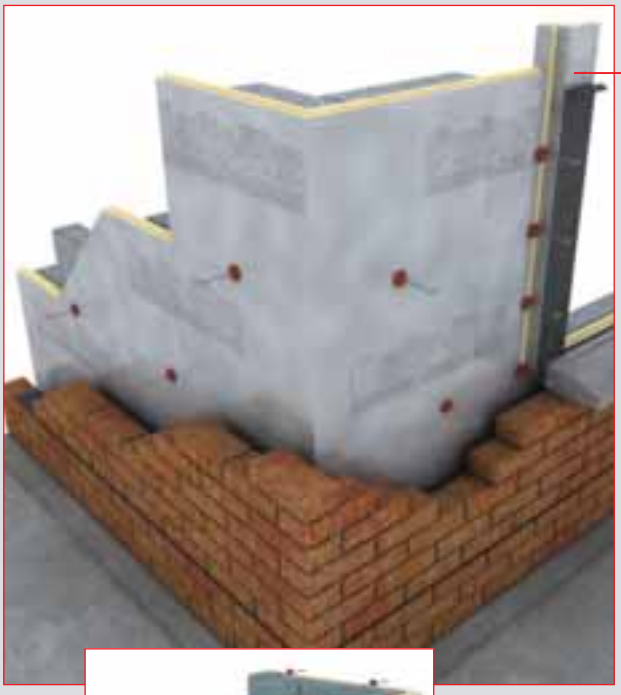
CERTIFICATE 07/4407



Xtratherm XT/CW and XT/CWP wall insulation is available with pre-formed corner panels.

Installation of such systems as the build progresses allows for accredited detailing and QA inspection during the build process.

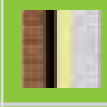
Cavity Wall insulation improvement

% IMPROVEMENT/CODE LEVEL ACHIEVED

CODE LEVEL 5&6
INDICATIVE VALUE
0.15 Wm^2K

CODE LEVEL 4
44% IMPROVEMENT
0.18 Wm^2K

CODE LEVEL 3
25% IMPROVEMENT
0.21 Wm^2K



SPECIFICATION

LAYERS	Conductivity Wm^2K	Option A: Dense block Thickness	Option B: Aerated block Thickness	Option A: Dense block Thickness	Option B: Aerated block Thickness	Option A: Dense block Thickness	Option B: Aerated block Thickness
Plasterboard	0.180	13mm	13mm	13mm	13mm	13mm	13mm
XT/TL	**0.023**	–	–	**38mm**	–	**50mm**	**25mm**
Air layer dabs	–	15mm	15mm	15mm	15mm	15mm	15mm
Concrete block aerated	0.110	–	100mm	–	100mm	–	100mm
Concrete block dense	1.150	100mm	–	100mm	–	100mm	–
XT/CW T&G	**0.023**	**80mm**	–	**60mm**	–	**75mm**	–
XT/CWP T&G	**0.021**	–	**60mm**	–	**75mm**	–	**75mm**
Cavity Low E	–	50mm	50mm	50mm	50mm	50mm	50mm
Concrete block dense	0.77	105mm	105mm	105mm	105mm	105mm	105mm

SPEC FOR 25% IMPROVEMENT
+25%

LEVEL 3 =

Option A - Dense Block
Xtratherm XT/CW 80mm

Option B - Aerated Block
Xtratherm XT/CWP 60mm

SPEC FOR 44% IMPROVEMENT
+44%

LEVEL 4 =

Option A - Dense Block
Xtratherm XT/CW 60mm with 38mm XT/TL Lining

Option B - Aerated Block
Xtratherm XT/CWP 75mm

Note: A full range of U-values including those indicated can be achieved using a range of Xtratherm materials and specifications. A full range of specification options are available for download form the Xtratherm web site at www.xtratherm.com/thecode

Building fabric insulation

Timber frame

Building Timber Frame construction is a fast, systematic method that can result in buildings that perform well in environmental terms and provide excellent Energy Performance ratings, if insulated to the highest standards. Placing insulation between the timber studding has proven effective until recent changes to building regulations asked for U-values better than 0.27 W/m²K. Improving the wall performance past this figure has proven difficult because of the amount of timber that bridges the insulation.

Timber Bridging Proportions

The timber studs, wall plates, foot plates, and noggins that all cut through the insulation when it is placed between the studs in timber framed constructions, must be taken into account when calculating the wall U-value. The default proportion of timber to insulation is taken as 15% of the total wall area, but can be higher in certain circumstances.

Lining the studs - Because of the restriction that stud depth presents, the only pragmatic solution to pushing timber frame wall performance toward 0.20 W/m²K and beyond is to actually insulate the thermal bridges (Timber studs) with either internal insulated lining or externally with adding an insulated sheathing board within the traditional cavity. In a traditional 140mm stud, standard fibreglass will achieve a U-value of approximately 0.31W/m²K; by adding an additional 30mm of Xtratherm applied as an insulated sheathing the U-value improves to 0.20 W/m²K. To achieve this U-value using fibre between the studs only would necessitate increasing the studs to 250mm.

Further information - The BRE with, the support of Xtratherm, have published a paper, SD7, on achieving significantly improved U-values in Timber Framed constructions, achieving a very efficient 0.14 W/m²K.
For your copy, of either SD7 or full Xtratherm Timber Frame literature pack, please contact Xtratherm Technical support.

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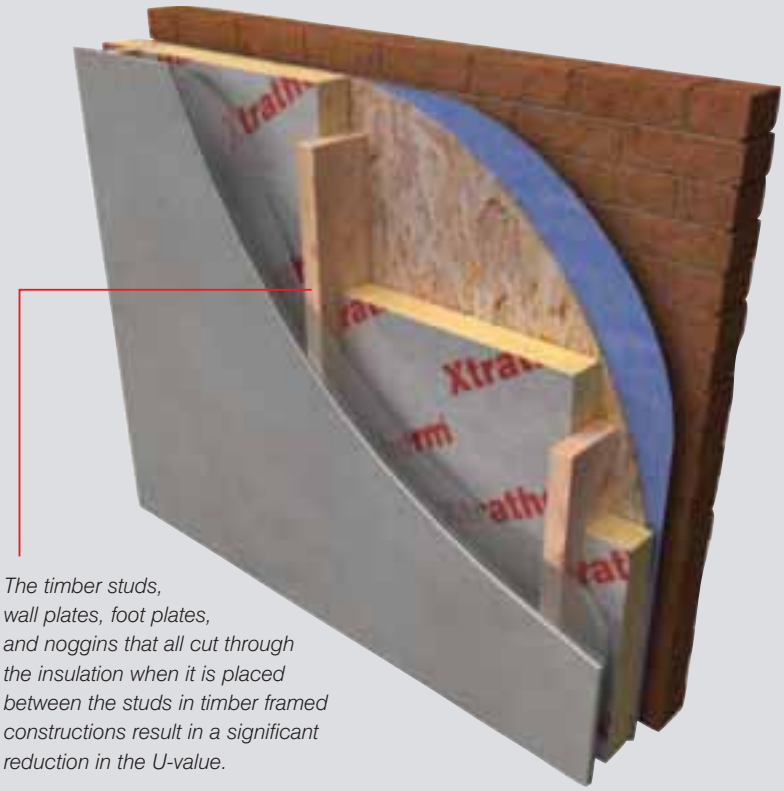
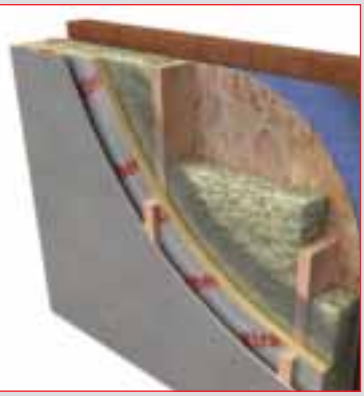
CERTIFICATE 08/4613



The timber studs, wall plates, foot plates, and noggins that all cut through the insulation when it is placed between the studs in timber framed constructions result in a significant reduction in the U-value.



Because of the restriction that stud depth presents, the only pragmatic solution to pushing timber frame wall performance toward 0.20 W/m²K is to insulate the timber studs with an internal or external insulated layer.

Timber Frame Wall insulation improvement

% IMPROVEMENT/CODE LEVEL ACHIEVED

CODE LEVEL 5&6
INDICATIVE VALUE
0.15 Wm^2K

CODE LEVEL 4
44% IMPROVEMENT
0.18 Wm^2K

CODE LEVEL 3
25% IMPROVEMENT
0.22 Wm^2K

SPECIFICATION

LAYERS	Conductivity Wm^2K	Option A: Liner — Option A Thickness	Option B: Sheathing — Option B Thickness	Option A: Liner XT/TF 50mm — Option A Thickness	Option B: Sheathing XT/TF 40mm — Option B Thickness	Option A: Liner XT/TF 70mm — Option A Thickness	Option B: Sheathing XT/TF 60mm — Option B Thickness
Plasterboard	0.180	13mm	13mm	13mm	13mm	13mm	13mm
XT/TF Liner	0.023	**25mm**	–	**50mm**	–	**70mm**	–
Vapour control layer	–	0.5mm	0.5mm	0.5mm	0.5mm	0.5mm	0.5mm
Mineral fibre	0.040	140mm	140mm	140mm	140mm	–	140mm
Mineral fibre dense	0.035	–	–	–	–	140mm	–
Plywood sheathing	–	12mm	12mm	12mm	12mm	12mm	12mm
Breathable membrane	–	0.5mm	0.5mm	0.5mm	0.5mm	0.5mm	0.5mm
Xtratherm Sheathing XT/SB	0.023	–	**25mm****	–	**40mm**	–	**60mm**
Cavity (Low E with Sheathing)	–	–	50mm	–	50mm	–	50mm
Cavity	0.570	50mm	–	50mm	–	50mm	–
Brick outer leaf	0.770	105mm	105mm	105mm	105mm	105mm	105mm

** U-value 0.20W/m^2K achieved

SPEC FOR 25% IMPROVEMENT
+25%

LEVEL 3 =

Option A - Thermal Liner inside Frame
Xtratherm XT/TF Lining 25mm

Option B - Sheathing Insulation in cavity
Xtratherm XT/SB 25mm

SPEC FOR 44% IMPROVEMENT
+44%

LEVEL 4 =

Option A - Thermal Liner inside Frame
Xtratherm XT/TF Lining 50mm

Option B - Sheathing Insulation in cavity
Xtratherm XT/SB 40mm

Note: A full range of U-values including those indicated can be achieved using a range of Xtratherm materials and specifications.
A full range of specification options are available for download form the Xtratherm web site at www.xtratherm.com/thecode

Building fabric insulation

Floors

Achieving a U-value of 0.15 W/m2K or better should be set as a goal for all floors as the costs of material and installation required to achieve this goal over the current building regulation standards is relatively small in relation to other elements within the structure.

CALCULATING PERFORMANCE

Floor thermal performance is dependant on the size and shape of the floor. The calculation for the performance is based on a ratio between the floor edge perimeter length (P) and the total floor area (A). Dividing the Perimeter by the Area (P/A) results in a ratio that can be used to formulate the floor U-value. (See the Xtratherm floor ready reckoner table next page.)

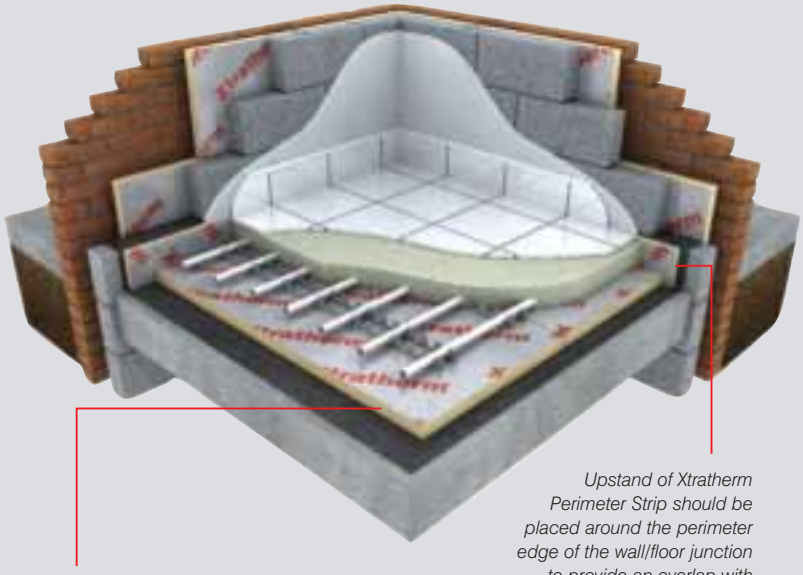
PERIMETER EDGE INSULATION

As heatloss from a floor is primarily lost through the floor edge, the detailing at the floor/wall junction is critical to avoid thermal bridging. Placing an upstand of Xtratherm insulation at the floor edge will alleviate the problem and is obligatory under the Accredited Details for Construction that must be followed under the Building Regulations to form a reasonable overlap with the wall insulation and allow a Y-value of 0.08 to be used in SAP. This Y should be improved to 0.04 which would necessitate better jointing and detailing; connecting the floor insulation with the thermal lining on the wall or using aerated block inner skin. Placing the insulation below the slab rather than the screed may make the achieving of acceptable detailing more problematic as it is more difficult to overlap with the wall insulation.

VAPOUR BARRIERS & DAMP PROOF MEMBRANE

All floor insulation should be protected from ground moisture by using a DPM to the underside - this can take the form of a Radon Barrier. If moisture is allowed to penetrate the insulation layer the heat loss through the floor will be increased, no matter what the insulation type is. In accordance with the BRE Good Building Guide 45 (GBG45) a separate layer of plastic sheeting should be laid over the insulation layer before the screed or slab is laid.

BBA BRITISH BOARD OF AGREMENT
CERTIFICATE 07/4406



Upstand of Xtratherm Perimeter Strip should be placed around the perimeter edge of the wall/floor junction to provide an overlap with the wall insulation and avoid reduce thermal bridging.

Xtratherm XT/UF underfloor insulation is ideal for use with Under Floor Heating systems. It is recommended to provide maximum U-values when UFH is installed. All floors using underfloor heating should achieve a U-value of 0.15 W/m²K, or better.

Xtratherm Hyfloor has T&G jointing to improve detailing.

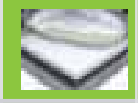
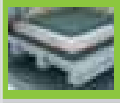
Floor insulation improvement

% IMPROVEMENT/CODE LEVEL ACHIEVED

CODE LEVEL 5&6
INDICATIVE VALUE
0.10 Wm^2K

CODE LEVEL 4
44% IMPROVEMENT
0.13 Wm^2K

CODE LEVEL 3
25% IMPROVEMENT
0.15 Wm^2K

	Option A: Solid Floor	Option B: Suspended Floor
CODE LEVEL 3		
CODE LEVEL 4		
CODE LEVEL 5&6		

SPECIFICATION

LAYERS	Conductivity Wm^2K	Option A Thickness	Option B Thickness	Option A Thickness	Option B Thickness	Option A Thickness	Option B Thickness
Screed	0.41	–	65mm	–	65mm	–	65mm
Vapour Control Layer	–	1mm	1mm	1mm	1mm	1mm	1mm
Xtratherm XT/UF	0.023	**110mm**	**115mm**	**135mm**	**140mm**	**180mm**	**185mm**
Dense Concrete Blocks	1.13	–	100mm	–	100mm	–	100mm

SOLID FLOOR READY RECKONER

		PERIMETER/AREA (P/A)					
CODE LEVEL	U-VALUE	0.3	0.4	0.5	0.6	0.7	0.8
Code Level 3	0.15	100	110	120	120	120	125
Code Level 4	0.13	120	130	140	140	150	150
Code Level 5&6	0.10	170	180	190	200	210	210

SUSPENDED T-BEAM & BLOCK FLOOR READY RECKONER

		PERIMETER/AREA (P/A)					
CODE LEVEL	U-VALUE	0.3	0.4	0.5	0.6	0.7	0.8
Code Level 3	0.15	110	115	115	120	120	125
Code Level 4	0.13	130	135	140	140	145	145
Code Level 5&6	0.10	180	185	190	190	195	195

Note: A full range of U-values including those indicated can be achieved using a range of Xtratherm materials and specifications. A full range of specification options are available for download form the Xtratherm web site at www.xtratherm.com/thecode

Building fabric insulation

Sloped Roof

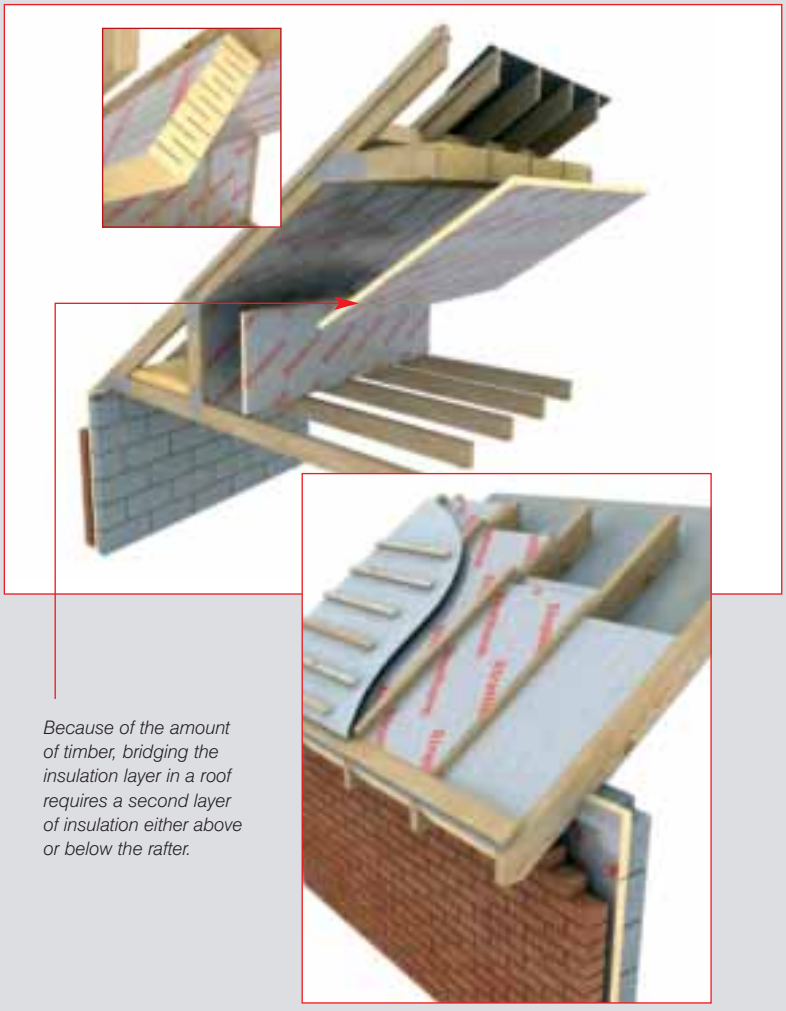
Insulating the roof area effectively is problematic in the fact that so much timber penetrates through the insulation layer, and also the complicated junctions with walls (including stud wall) ceilings and internal junctions are prone to thermal bridging and air leakage. These should be addressed by providing a lining to the rafters, which most commonly is placed to the underside of the rafters, but with the demand for better U-values choosing a 'Warm Roof' may provide the solution. Whatever method is chosen, the most important factor in insulation choice is the thickness to performance ratio, a very efficient rigid insulation is required to minimise the intrusion into valuable living space.

TO VENTILATE OR NOT

In a typical sloped roof situation, a 50mm ventilation gap was maintained between the roof insulation and the traditional roofing felt. This was to allow any moisture that may develop on the cold side of the insulation layer to be vented away. However, with the advent of 'Breatheable' or Vapour Permeable underlays, this 50mm void may be dispensed with as the felt allows the vapour to dissipate through it. The inclusion of an unvented space below the breather membrane can add to the thermal performance of the roof also, as ventilated spaces are ignored in U-value calculation. **Seek advice from the membrane manufacturer.**

WARM ROOFS

Warm Roof construction is a particularly effective way of insulating complex roofs. Insulating above and between the roof timbers ensures that the structure is kept at, or near the internal environmental conditions, reducing thermal stress and condensation risk. It is necessary to use a vapour permeable membrane over the system with an effective vapour control layer to the underside see the Xtratherm warm roof animation at **www.xtratherm.com.**



Because of the amount of timber, bridging the insulation layer in a roof requires a second layer of insulation either above or below the rafter.

Warm Roof XT/SK-T&G over rafters

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CERTIFICATE 07/4402

Sloped Roof insulation improvement

% IMPROVEMENT/CODE LEVEL ACHIEVED

CODE LEVEL 5&6
INDICATIVE VALUE
0.10 Wm^2K

CODE LEVEL 4
44% IMPROVEMENT
0.13 Wm^2K

CODE LEVEL 3
25% IMPROVEMENT
0.16 Wm^2K

Roof: Xtratherm between & below rafters

Roof: Xtratherm between & above rafters

Roof: Xtratherm between & above rafters

SPECIFICATION

LAYERS	Conductivity Wm^2K	Option A Thickness	Option A Thickness	Option A Thickness
Tile/Batten Space	1.000	–	–	–
Breather Membrane	1.000	–	–	–
XT/SK over rafters	0.023	–	**80mm**	**100mm**
XT/PR between rafters	0.023	**125mm**	**100mm**	**150mm**
XT/TL-MF* below rafters	0.023	**30mm**	–	–
Air Layer	–	–	25mm	50mm
Vapour Control Layer	–	0.5mm	0.5mm	0.5mm
Plasterboard	0.180	13mm	13mm	13mm

** Insulation thickness only*

SPEC FOR 25% IMPROVEMENT
+25%

LEVEL 3 =

Xtratherm XT/PR Between Rafters 125mm with 42.5mm O/A Xtratherm Thermal Liner XT/TL(MF) below.

SPEC FOR ZERO CARBON
+44%

LEVEL 4 =

Xtratherm XT/PR Between Rafters 100mm with 80mm Xtratherm T&G Sarking Board XT/SK (T&G) over rafters.

Note: A full range of U-values including those indicated can be achieved using a range of Xtratherm materials and specifications. A full range of specification options are available for download form the Xtratherm web site at www.xtratherm.com/thecode

Building fabric insulation

Ceilings

Insulating at ceiling level to meet even current regulations will necessitate placing double layers of fibre insulation materials between and over the ceiling joists, resulting in health and safety concerns when accessing the roof space. As target U-values for the roof improve, letting the insulation layer follow the rafter line rather than the ceiling may prove a more practical solution, with many benefits.

Placing a layer of insulation to the underside of the ceiling will insulate the thermal bridging through the joists and allow the roof space to be floored (depending on joist depth)

Placing an extra layer of insulation over the top of ceiling joists to achieve the required U-values makes access to the loft area very difficult. Purpose built access walkways should be installed to allow maintenance of services within the loft.
(See Xtratherm Walk-R)

This over layer also restricts how the loft area is used. If the loft is used for storage purposes, or flooring is placed on top of the joists, the compressed insulation becomes ineffective resulting in valuable heat escaping from the house through the ceiling line.

It may be wise to let the insulation of the roof follow the rafter line instead of ceiling level, to allow the extra space to be used either as storage space, or adding the potential to add further living area. Adding extra rooms to roof space will have a dramatic effect on the value of a typical home.

Insulating at roof line will also dispense with the need to further insulate any water tanks or services within the cold space. As the U-values at the ceiling level continues to improve, the effective insulation of pipe and services becomes critical. In the past, unintentional heatloss through the ceiling kept the pipes and storage vessels at a reasonable temperature, now that 'escaping' heat has been reduced; the threat of freezing pipes in the roof space has increased.

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CERTIFICATE 04/4130

Ceiling insulation improvement

% IMPROVEMENT/CODE LEVEL ACHIEVED

CODE LEVEL 5&6
INDICATIVE VALUE
0.10 Wm^2K

CODE LEVEL 4
44% IMPROVEMENT
0.13 Wm^2K

CODE LEVEL 3
25% IMPROVEMENT
0.16 Wm^2K

SPECIFICATION

LAYERS	Conductivity Wm^2K	Material Thickness	Material Thickness	Material Thickness
		Ceiling:	Ceiling:	Ceiling:
Fibre over joists	0.040	–	100mm	150mm
Fibre between joists	0.040	200mm	150mm	150mm
Xtratherm XT/TL MF*	0.023	**40mm**	**40mm**	**60mm**
Plasterboard	0.180	13mm	13mm	13mm



** Insulation thickness only*

SPEC FOR 25% IMPROVEMENT
+25%

LEVEL 3 =

Mineral fibre 200mm between joists with 52.5mm O/A Xtratherm Thermal Liner XT/TL(MF) under joist.

SPEC FOR ZERO CARBON
+44%

LEVEL 4 =

Mineral fibre in 2 layers, 150mm between joists and 100mm over with 52.5mm O/A Xtratherm Thermal Liner XT/TL(MF) under joist.

Note: A full range of U-values including those indicated can be achieved using a range of Xtratherm materials and specifications.
A full range of specification options are available for download form the Xtratherm web site at www.xtratherm.com/thecode

Technical Notes

GLAZING / DOOR PERFORMANCE

The performance of glazing and doors can have a significant effect on the overall energy performance of a dwelling. Whilst the building regulations ask for an average U-value of 2.2 W/m²K to be achieved, a single solid timber door with a U-value of 3 W/m²K can mitigate any improvement of glazing below 2.0 - so an overall approach to the specification should be followed.

As with other inputs into a SAP calculation, the glazing performance must be accredited by certification for the SAP Assessor to accept the claims; your glazing supplier should be able to provide such certification. The thermal performance of openings depends on a number of factors including the design, the materials used, including the glass, the cavity and framing material itself.

Double glazing has now been standard specification for some time, but improvement on the standard performance can be made by the inclusion of certain technologies. Low emissivity coatings on the glass itself, either hard coat low-E or improved soft coat Low E will improve performance. Within the cavity space between the glass, the inclusion of ARGON GAS filling will improve the U-value. And in the design of the frame material itself, thermal breaks within the frame construction can significantly improve overall window U-values. While the specification of better glazing U-values is crucial for low energy design - it is not the only factor. Good air permeability is also reliant on window and door frames being properly sealed. Poorly sealed opening casements and sashes can result in further heatloss. Your window supplier will be able to advise.
(see www.bfrc.org for further information)

THERMAL BRIDGING (see page 9)

Insulation components should come together to form a continuous layer through out the design. Enhanced detailing asks that all rigid insulation materials be engineered (T&G) jointed rather than square edge to achieve continuity. Xtratherm have recognised the importance of effective jointing of components and elements and have developed innovative system components to improve overall insulation performance. In walls, the Xtratherm insulation system includes preformed corner panels and reveal panels for openings that knit with the main cavity wall insulation perfectly. In roofing the Xtratherm Rafterloc pre-cut rafter panels expand to fill rafter spaces whilst in the floor our Hyfloor boards now come with full T&G jointing and perimeter strip. For full details see the installation animations on www.xtratherm.com or contact Xtratherm Technical Support for full Thermal Bridging information.

VENTILATION & AIR PERMEABILITY

Air leakage from buildings, the uncontrolled flow of air through gaps and cracks in the fabric of dwellings (sometimes referred to as infiltration, exfiltration or draughts) is a major cause of energy loss and increased CO2 emissions. Improving airtightness in dwellings will reduce air leakage. Too much air leakage leads to unnecessary heat loss and discomfort from cold draughts. With more stringent building regulations requiring better energy efficiency, airtightness is an increasingly important issue, the new regulations ask for a minimum air permeability of 10m³/m²/yr at Q10.

By following the Accredited Details a target permeability of 7 should be achieved whilst following the Enhanced Accredited Details should improve the permeability to around 4. The aim should be to 'build tight - ventilate right'. Buildings cannot be too airtight; it is, however, essential to ensure appropriate ventilation.

Ventilation, the controlled flow of air into and out of the dwelling through purpose-built ventilators is required to provide good air quality for the comfort and safety of the occupants. Ventilation methods commonly used include trickle vents, extract fans, and openable windows. Whatever method is installed, it should work in harmony with the energy efficiency principle of the house in mind, any mechanical systems will use energy to run. Mechanical ventilation may become necessary as the air permeability is improved better then 4 m³/m²/h. at 50P. At this point combining the ventilation with heat recovery can become very effective - look for efficiencies of the systems and importantly the Specific Fan Power.

CSH Assessors

The information given within this guide is indicative only, and should not be assumed to indicate energy efficiency levels in all cases. Assessment of every individual design should be undertaken at an early stage to prove compliance with Part L and give indicative CSH ratings. To this end, an Energy Assessor/Consultant should be engaged early in the design process to give guidance as to the consequences of specification changes as the design/build progresses, and who will issue the required CSH certificate upon completion. Working closely with the assessor/consultant will save significant expense by dispensing with unnecessary measures during the build or avoiding costly remedial work at the end of the process. Xtratherm can provide guidance on design and provide a full list of Energy Assessors in your area.

RENEWABLES

LOW & ZERO CARBON TECHNOLOGIES (LZCS)

As previously mentioned, the first step in energy efficiency in new build is to provide a robust, energy efficient building fabric before incorporating any Low or Zero Carbon Technologies (LZCs). It does not make sense to install renewable generation into a design if much of the output is to be wasted through inefficient usage. The building fabric will last a lot longer than the services that are put into it. Most technologies such as boilers, glazing, and renewables will be replaced within one or two decades. It is therefore vital to get the fabric right at time of construction. It is always more costly to insulate properly at a later stage.

SOLAR GAIN

The 'Free' energy – good design takes advantage of solar gain, but difficult to predict and control in the Irish climate. When designing to take advantage of solar gain the heating and ventilation system used within the design should be very responsive to temperature fluctuations.

Solar Water Heaters

Can provide up to 50% of hot water requirements on a SE-SW roof, available as flat plate or vacuum tube systems, normally require the installation of higher volume storage cylinders.

Photovoltaics (PV)

Uses energy from the sun to create electricity to run appliances and lighting. PV requires only daylight - not direct sunlight - to generate electricity. A typical array would cover 10-15m^2 of roof area.

Pellet Stoves

Energy from biomass is produced from organic matter of recent origin - not fossil fuels, the CO_2 released during burning is balanced by the CO_2 absorbed during the fuel's production - this is Carbon Neutral. Storage of pellets is a major consideration.

Ground Source Heat Pump

The ground keeps a constant temperature of about 11-12^oC Ground source heat pumps (GSHP) can transfer this heat into a building to provide space heating. For every unit of electricity used to pump the heat, 2.5 - 4 units of heat are produced. Particularly suitable for under floor heating because of lower operating temperatures.

HEATING SYSTEMS

Energy to heat the space will be necessary in all houses including Passive/Low carbon houses at certain periods in the year. The task is to supply that energy requirement as efficiently as possible by choosing a cleaner fuel – natural gas is cleaner than oil or electricity, and burning it as efficiently as possible, boilers should perform above the 86% minimum efficiency but can be sourced over 90% efficient. Burning biomass - logs or pellets which are carbon neutral will also reduce carbon production.

HEATING CONTROLS

Boiler based heating systems should incorporate: space heating control on the basis of room temperature (room thermostats and/or TRVs); water heating control on the basis of stored water temperature (cylinder thermostats); separate and independent time control of space heating and water heating; and boiler interlock (i.e. the boiler does not fire when there is no demand for space or water heating). Equivalent control should provided for other types of systems.

Good practice guide CE51 from the BRE gives invaluable information on the specification of control systems.

ENERGY EFFICIENT LIGHTING

As we achieve better control of space heating requirement through effective insulation of the building fabric and good control of our hot water needs - the energy demand for lighting becomes a bigger proportion of the energy demand and a major contributor to CO_2 production, not least because the energy is electric based which is a costly fuel and dirtier than all other fuels. Using energy efficient light fittings will reduce CO_2. Although we should aim to have 100% EE lighting - fashions dictates that this is not always possible and should be reflected as such in the calculations.

Xtratherm

Cost effective specifications

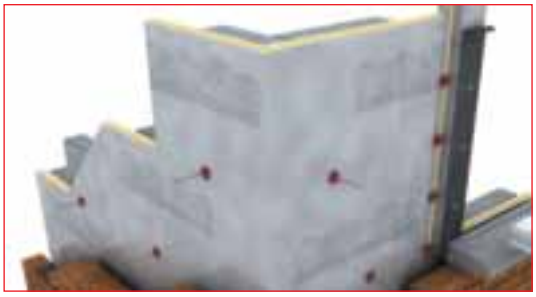
See Application pages for range of options

Typical Detached House		25% IMPROVED		44% IMPROVED
		CODE LEVEL 3 MERTON RULE OPTION	CODE LEVEL 3 INSULATION OPTION	CODE LEVEL 4 (AND ABOVE)
GROUND FLOOR / EXPOSED UPPER FLOOR INSULATION		0.22	0.15	0.15
EXPOSED WALLS INSULATION		0.22	0.18	0.18
SEMI- EXPOSED WALLS INSULATION		0.22	0.16	0.16
ROOF INSULATION BETWEEN JOISTS		0.14	0.12	0.12
ROOF INSULATION BETWEEN RAFTERS		0.18	0.16	0.13
FRONT DOOR		U-VALUE 1.2 PVC HIGH PERFORMANCE THERMAL BREAK	U-VALUE 1.2 PVC HIGH PERFORMANCE THERMAL BREAK	U-VALUE 1.2 PVC HIGH PERFORMANCE THERMAL BREAK
GLAZING		U-VALUE 1.4 PVC HIGH PERFORMANCE THERMAL BREAK	U-VALUE 1.0 PVC HIGH PERFORMANCE THERMAL BREAK	U-VALUE 1.0 PVC HIGH PERFORMANCE THERMAL BREAK
THERMAL BRIDGING (see page 9)		Y-VALUE 0.08	Y-VALUE 0.04	Y-VALUE 0.04
VENTILATION		Extract Fans	Extract Fans	MVHR
AIR PERMEABILITY		m^3/m^2h 6.0	m^3/m^2h 6.0	m^3/m^2h 4.0
BOILER EFFICIENCY (NATURAL GAS)		91%	91%	91%
SPACE HEATING SECONDARY+		None	None	Flueless Gas Fire 90%
HEATING CONTROLS		Zone Control & Weather Compensator	Zone Control & Weather Compensator	Zone Control & Weather Compensator
SOLAR WATER HEATING		6.4m^2 Panel	None	6.4m^2 Panel
HOT WATER CYLINDER		SIZE / INSULATION 310 Litre / 80mm	SIZE / INSULATION 210 Litre / 80mm	SIZE / INSULATION 310 Litre / 80mm
ENERGY EFFICIENT LIGHTING		PROPORTION 43%	PROPORTION 43%	PROPORTION 43%
PHOTOVOLTAICS		None	None	None
TARGET ENERGY RATING (TER)		21.01	21.01	21.01
DWELLING EMISSION RATE (DER)		<15.76	<15.76	<11.77

The guidance on energy performances is indicative only of the house designs illustrated. The DER ratings quoted should not be assumed for any house type as variation of specifications as well as size and shape of the building will effect the energy performance. Xtratherm can advise on calculation and give guidance on indicative ratings, but it is advised to contact a DER Consultant at an early stage in the design process. Xtratherm accepts no liability for errors, omissions or claims arising from the use of this information.

Summary

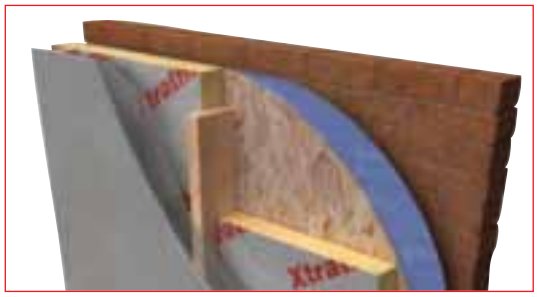
FOLD OUT HERE TO VIEW COST EFFECTIVE SPECIFICATION GUIDE Xtratherm



CAVITY WALLS

CODE LEVEL 3
25% IMPROVEMENT
0.21 Wm^2K
Dense Block:
XT/CW 80mm
Aerated Block:
XT/CWP 60mm

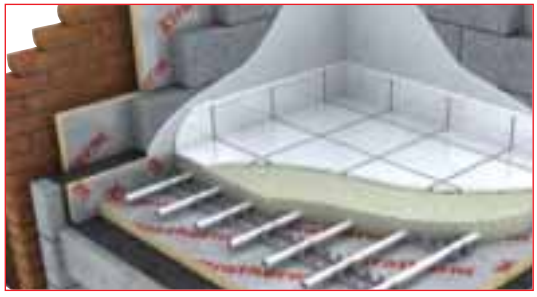
CODE LEVEL 4
44% IMPROVEMENT
0.18 Wm^2K
Dense Block: XT/CW 60mm with 38mm XT/TL Lining
Aerated Block:
XT/CWP 75mm



TIMBER FRAME WALLS

CODE LEVEL 3
25% IMPROVEMENT
0.20 Wm^2K
Thermal Liner in frame
XT/TF Lining 25mm
Sheathing in cavity
XT/SB 25mm

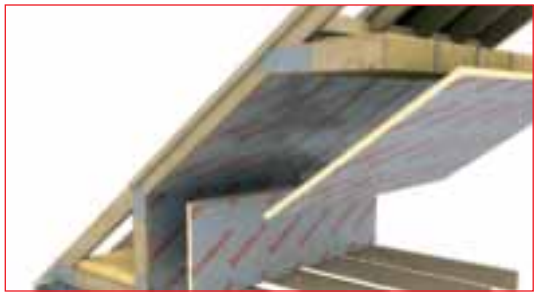
CODE LEVEL 4
44% IMPROVEMENT
0.17 Wm^2K
Thermal Liner in frame
XT/TF Lining 50mm or
Sheathing in cavity
XT/SB 40mm



FLOORS

CODE LEVEL 3
25% IMPROVEMENT
0.15 Wm^2K
Solid Floor:
XT/UF 110mm
Suspended Floor:
XT/UF 115mm

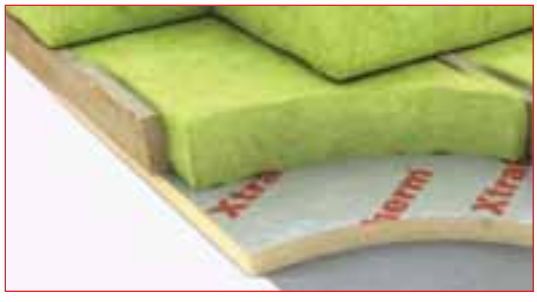
CODE LEVEL 4
44% IMPROVEMENT
0.13 Wm^2K
Solid Floor:
XT/UF 135mm
Suspended Floor:
XT/UF 140mm



SLOPED ROOFS

CODE LEVEL 3
25% IMPROVEMENT
0.16 Wm^2K
XT/PR between rafters
125mm with 42.5mm
O/A XT/TL(MF) below

CODE LEVEL 4
44% IMPROVEMENT
0.13 Wm^2K
XT/PR between rafters
100mm with 80mm
XT/SK (T&G) over rafters



CEILINGS

CODE LEVEL 3
25% IMPROVEMENT
0.16 Wm^2K
Mineral fibre 200mm
between joists
with 52.5mm O/A
XT/TL (MF) under joist

CODE LEVEL 4
44% IMPROVEMENT
0.13 Wm^2K
Mineral fibre 150mm
between joists and 100mm
over with 52.5mm O/A
XT/TL (MF) under joist.

Full specifications for all elements, and a U-value ready-reckoner can be downloaded from the web site www.xtratherm.com/thecode

3 Bed Terraced - Spec Build+

2 Bed Apartment - Spec Build

2 Bed Semi - Spec Build

*4 Bed Detached**

The Department for Communities and Local Government laid the foundations for greener housing when it launched the Code for Sustainable Homes in 2007.

Homes built under the scheme are built to standards set in the Code creating dwellings that are more energy and water efficient, produce fewer carbon emissions and are better for the environment.

This Guide shows the Xtratherm solutions to achieving the fabric performances required to achieve Levels 3, 4 and above within traditional build types.

+ *Smaller properties on development sites may not have the ability to install solar panels to meet the renewable input requirements, group heating schemes may have to be considered.*

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