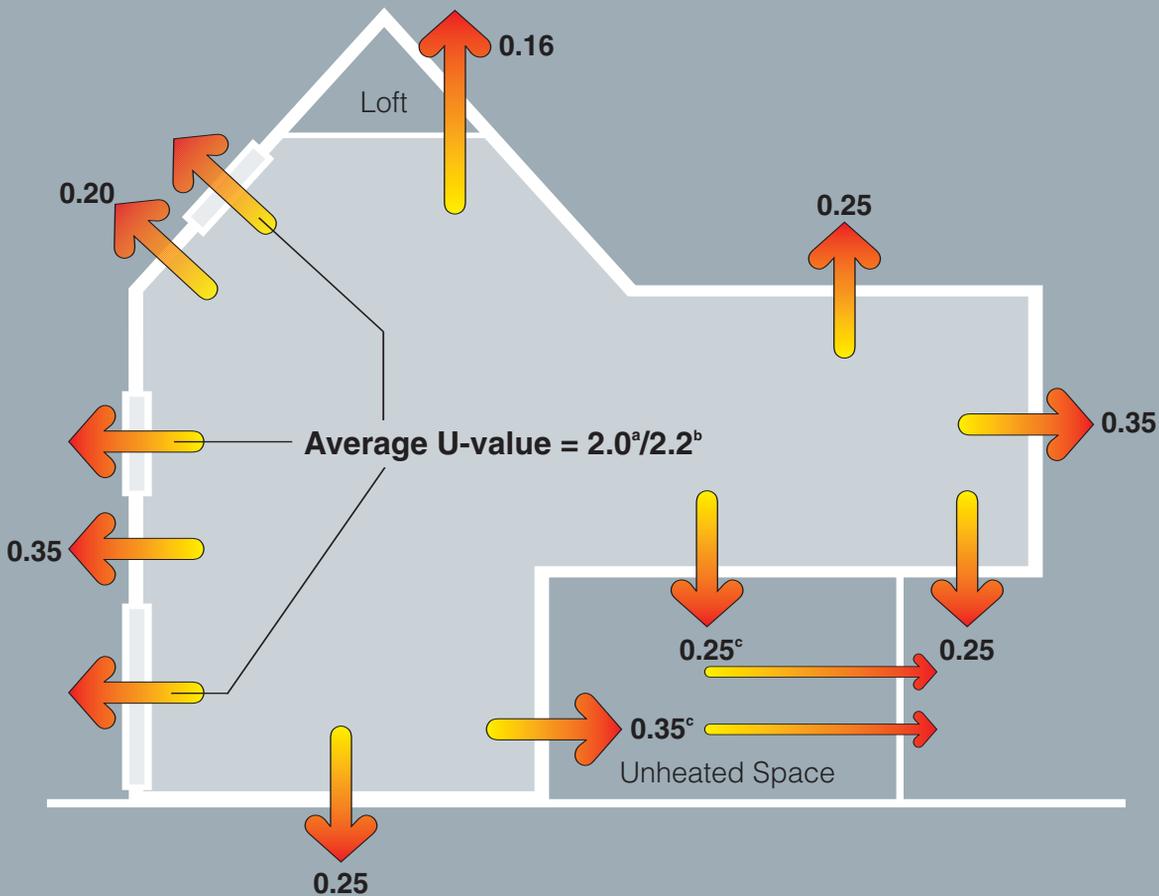




## The Guide to Part L (England & Wales)



# Xtratherm<sup>®</sup>



## Introduction

The improved standards of design and construction imposed by successive revisions to building regulations make greater demands of designers and contractors; as part of Xtratherm's commitment to energy efficient construction we have produced this guide to the requirements for conservation of fuel and power which were introduced on 1st April 2002.

Xtratherm Polyiso thermal insulation combines excellent thermal performance with robust physical characteristics, making it ideal for creating energy efficient buildings.

## Background to the changes

As part of its response to global climate change the UK government has committed itself to substantial reduction in the emission of greenhouse gases, reducing emissions of the six main gases to 12.5% below 1990 levels by 2012 with CO<sub>2</sub> emissions cut to 80% of 1990 levels by 2010. This is linked to a further target of reducing CO<sub>2</sub> emissions to 40% of 1990 levels by 2050.

Because buildings account for about 40% of UK CO<sub>2</sub> emissions, improvements in the energy efficiency of the building stock will make a substantial contribution towards meeting the CO<sub>2</sub> target. Government has decided to use the building regulations to achieve the required improvements: the 2002 changes being the first stage in a continuing process, with further changes scheduled for 2005.

## What the regulations require

Part L of the Building Regulations require that 'reasonable provision shall be made for the conservation of fuel and power' within buildings. The measures needed to comply with that requirement depend upon the building type: dwellings, treated in Approved Document L1 and buildings other than dwellings, treated in Approved Document L2. The requirements for buildings other than dwellings are more complex than those for dwellings.

## Dwellings

For dwellings, fuel and power should be conserved by:

- limiting heat loss through the fabric, heating pipes and ducts, and hot water vessels;
- providing energy efficient space heating and hot water systems;
- providing lighting systems which can be used efficiently;
- providing information with heating and hot water services so building owners can operate and maintain services so as to use no more energy than is reasonable in the circumstances.

Approved Document L1 (2002) sets out three methods of demonstrating compliance with the basic requirement:

- Elemental method;
- Target U-value method;
- Carbon Index method.

Because it is necessary to show compliance using only one of the methods designers can select the method most suitable for each project. The Elemental method is the simplest method to use, but is the least flexible, whilst the Carbon Index method requires the most data and calculation, but allows trade-offs between heating systems and fabric. The Target U-value method sits between the two.

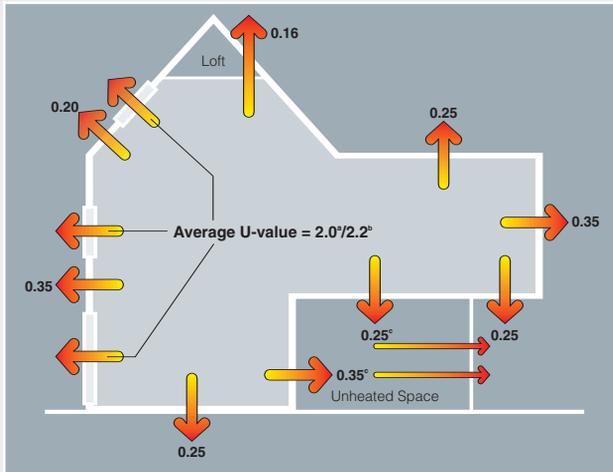
## Elemental method

Using the Elemental method the U-values of the building elements must not exceed those given in Table 2, and boiler efficiencies must be not less than those given in Table 1. The average U-value of windows and doors must not exceed the Table 2 figures and their area must not exceed 25% of the total floor area.

Table 1  
Boiler efficiencies for elemental method

Central heating fuel system	SEDBUK %
Mains natural gas	78
LPG	80
Oil	85

Figure 1 Summary of Elemental Method



- <sup>a</sup> if windows have wood or PVC frames
- <sup>b</sup> if windows have metal frames
- <sup>c</sup> includes the effect of the unheated space

### Target U-value method

A dwelling complies by Target U-value method if its average U-value is less than or equal to a Target U-value based upon the building's dimensions and the efficiency of its heating system. The Target U-value method gives designers greater flexibility than the Elemental method; it allows trade-off between the areas of openings, U-values of elements and the efficiency of the heating system. The method can also allow for solar gain.

The Target U-value method may only be used for whole dwellings.

### Carbon index method

The Carbon Index method is a measure of the amount of CO<sub>2</sub> produced per square metre of building and is calculated using the SAP worksheet (see information panel **3**). The calculation takes account of fabric, building size, heating and hot water systems. To demonstrate compliance the Carbon Index must be 8 or higher on a scale of 1-10.

### Additional requirements

Thermal bridging: as insulation standards improve heat losses at junctions and edges of openings become more significant: dwellings should not have significant thermal bridging at such locations. That may be achieved by adopting robust construction details (see information panel **2**).

Limiting air leakage: air leakage, through building elements and junctions of elements, results in significant heat loss by convection: it must be

reduced to reasonable levels while maintaining enough ventilation for health and combustion appliances. This requirement may be met by pressure testing - achieving a result lower than 10m<sup>3</sup>/hm<sup>2</sup> at 50Pa - or by adopting robust construction details.

Energy use: heating and hot water systems must be efficient in their use of energy: that may be achieved by:

- installing heating systems with adequate controls, such as zone controls, timing control, boiler interlocks;
- efficient operation of the heating and hot water system, without excessive boiler firing and primary circuit losses;
- adequate insulation of hot water storage vessels;
- proper commissioning of the systems.

In addition, building occupants must be provided with information on how to run the system efficiently.

### Lighting:

The dwelling must include a number of luminaires which will only accept efficient units. The required number depends upon the size of the dwelling.

1

### U-values

The U-value for a building element is a calculated value of the rate of conduction heat loss through it: lower U-values indicate lower rates of heat loss. For roofs, walls and intermediate floors U-values are calculated using the combined method (defined in BS EN ISO 6946:1997), which takes account of repeating thermal bridges and corrections for air infiltration and mechanical fixings. Calculations for ground floor and basement U-values are defined in BS EN ISO 13370:1998.

2

### Robust details

The BRE has produced a series of details which, when properly built, will minimise thermal bridging and air leakage at edges and junctions of elements. There are sets of details for the commonest types of construction found in dwellings. Adopting these robust construction details is one method demonstrating compliance with the requirements to limit thermal bridging and air leakage.

3

### SAP

The government's Standard Assessment Procedure is a method of measuring the energy efficiency of buildings by calculating heat losses through the fabric, solar gains and the energy requirements for space and water heating using the specified heating systems. SAP ratings go from 1 (worst) to 120 (best). The SAP rating is not a means of demonstrating compliance, but the methodology is used for determining the Carbon Index. All new dwellings must be given a SAP rating.

## Buildings other than dwellings

For buildings other than dwellings, fuel and power should be conserved by:

- limiting heat loss through the fabric, heating pipes and ducts, and hot water vessels;
- providing energy efficient space heating and hot water systems;
- providing lighting systems which can be used efficiently;
- limiting exposure to solar overheating;
- providing reasonably efficient air conditioning and cooling systems, with the heat gains with in such systems being limited;
- providing information with heating and hot water services so building owners can operate and maintain services so as to use no more energy than is reasonable in the circumstances.

Approved Document L2 (2002) sets out three methods of demonstrating compliance:

- Elemental;
- Whole Building;
- Carbon Emissions.

The methods offer a choice between ease of calculation and flexibility - the Elemental method is the simplest, but only allows for limited trade offs between fabric standards and energy use, whilst the carbon emissions method requires extensive calculation but imposes few constraints upon designers.

### Elemental method

To comply by this method the U-values of the building elements must not exceed the those given in Table 2, the areas of openings should not exceed those of Table 3 and the heating system must be reasonably efficient. That may be demonstrated by means of the carbon intensity (a measure of carbon emitted for each useful kWh of heat output). There is some limited scope for trade-off between the U-values and areas of walls, roofs and openings and the efficiency of the heating systems. The building must also:

- have adequate space heating controls;
- be designed to avoid solar overheating;
- have energy efficient lighting;
- have an energy efficient air conditioning system where one is fitted.

### Whole building method

Under the whole building method the carbon emissions or primary energy consumption for the whole building have to be reasonable: there are three methods for demonstrating this:

- for offices see BRE Digest 457;
- for schools DfEE Building Bulletin 87;
- for hospitals, NHS Estates publication 'Achieving energy efficiency in new hospitals'.

### Carbon emissions calculation method

For a building to pass by the carbon emissions method its calculated carbon emissions should be no worse than those from a notional building which complies by the Elemental method.

The calculations must be done by using an 'acceptable method'.

**Table 2**  
Limiting U-values for the Elemental method

	Dwellings (L1)	Non Dwellings (L2)
Pitched roof insulation between rafters	0.20	0.20
Pitched roof, integral insulation	0.25	0.25
Pitched roof insulation between joists	0.16	0.16
Flat roof, or with integral insulation	0.25	0.25
Walls, including basement walls	0.35	0.35
Floors, including ground floors and basement floors	0.25	0.25
Windows, roof windows, personnel doors (weighted av. for building), metal frame	2.2	2.2
Windows, roof windows, personnel doors (weighted av. for building), wood or PVC frame	2.0	2.0
Rooflights	-	2.2
Vehicle access and other large doors	-	0.70

**Table 3**  
Limiting areas of windows and doors - buildings other than dwellings

Building type	Windows and doors (% of area of exposed wall)	Rooflights (% area of roof)
Residential buildings	30	20
Places of assembly, offices, shops	40	20
Industrial and storage buildings	15	20
Vehicle access doors, display windows, similar glazing	As required	-

### Additional requirements

The building must not have excessive thermal bridging: this may be demonstrated by showing the use of appropriate design details and fixings or by the use of infra-red thermography to show reasonably continuous thermal insulation on the external envelope. To counteract heat loss through air leakage the building must be reasonably airtight, for buildings less than 1000m<sup>2</sup> the use of appropriate design details will be sufficient, for larger buildings air leakage testing to CIBSE TM 23 must demonstrate an air permeability rate not exceeding 10m<sup>3</sup>/hr/m<sup>2</sup> @ 50Pa.

### Existing buildings

The requirements of Part L apply to existing buildings when:

- There is a material change of use, for example converting a factory into flats;
- Alterations to a building could result in a worsening of performance;
- Any of the following are to be replaced: windows, doors, roof lights, space and water heating boilers.

However, the standards required by the regulations will often be lower than for new buildings, because of the impracticality of full compliance or the effect it would have upon historically sensitive buildings.

### Looking ahead

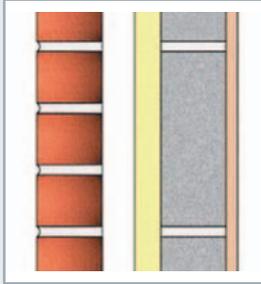
In order to meet its targets for CO<sub>2</sub> reduction the government had brought forward the next revision of Part L to 2005. The revised regulations will encourage a holistic approach to achieving energy efficiency, looking at whole building performance rather than a reliance on elemental U-values and minimum plant performance standards. Elemental methods of compliance will still be available for extensions and alterations, but acceptable values are likely to be reduced to 0.13 - 0.16W/m<sup>2</sup>K for roofs, 0.25 W/m<sup>2</sup>K for walls and 0.20 - 0.22 W/m<sup>2</sup>K for floors. Permissible air leakage levels will also be reduced: airtightness testing will be extended to buildings over 200m<sup>2</sup> and may be required for some domestic developments.

The revised regulations will also address the contribution which existing buildings make to CO<sub>2</sub> emissions by extending the range of work classified as 'material alterations'. Such alterations will have to comply with the relevant requirements of Part L.

# Ready Reckoner

## Walls

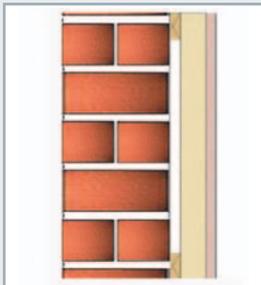
### XT/CW Partial Fill Cavity Walls



Block Lambda	Wet Finish		Dot & Dab	
	0.035	0.30	0.035	0.30
0.10	30 (0.34)	40 (0.30)	25 (0.35)	40 (0.29)
0.11	30 (0.35)	40 (0.30)	30 (0.33)	40 (0.29)
0.14	35 (0.34)	45 (0.30)	30 (0.35)	45 (0.29)
0.17	35 (0.35)	45 (0.30)	35 (0.34)	45 (0.29)
0.18	35 (0.35)	50 (0.29)	35 (0.34)	45 (0.30)
0.19	40 (0.33)	50 (0.29)	35 (0.34)	45 (0.30)
0.22	40 (0.34)	50 (0.30)	35 (0.35)	45 (0.30)
0.25	40 (0.34)	50 (0.30)	35 (0.35)	50 (0.29)
0.32	40 (0.35)	50 (0.30)	40 (0.34)	50 (0.29)
0.34	40 (0.35)	55 (0.29)	40 (0.34)	50 (0.30)
0.51	45 (0.34)	55 (0.29)	40 (0.35)	50 (0.30)
0.99	45 (0.35)	55 (0.30)	45 (0.33)	55 (0.29)
1.06	45 (0.35)	55 (0.30)	45 (0.33)	55 (0.29)
1.12	45 (0.35)	55 (0.30)	45 (0.34)	55 (0.29)
1.13	45 (0.35)	55 (0.30)	45 (0.34)	55 (0.29)

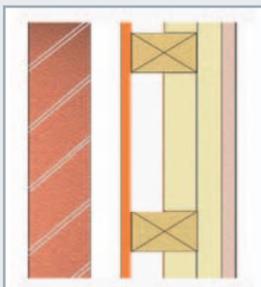
Wall ties taken as S/S wire @ 3 ties per m<sup>2</sup>

### XT/TL-MF Solid Walls (Refurbishment)



Thickness of XT/TL-MF on Battens	300mm Cavity Wall Brick/Block	600mm Random Limestone Wall	215mm Solid Brickwork
25	0.44	0.51	0.50
30	0.40	0.46	0.45
35	0.37	0.42	0.41
40	0.34	0.38	0.38
45	0.32	0.35	0.35
50	0.30	0.33	0.33
55	0.38	0.31	0.30

### XT/TF Timber Framed Walls

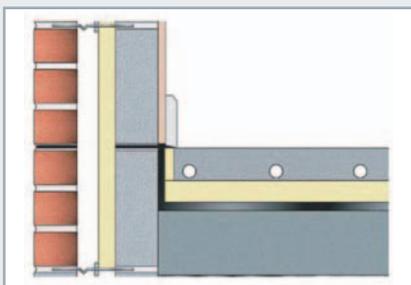


Thickness of XT/TF between Studs	U-value achieved	U-value achieved with additional 25mm TL	U-value achieved with additional 30mm TL	U-value achieved with additional 40mm TL
25	0.55	0.34	-	-
30	0.51	0.33	0.30	-
35	0.48	0.31	0.29	-
40	0.44	0.30	0.28	0.25
45	0.42	0.28	0.27	0.24
50	0.39	0.27	0.26	0.23
55	0.37	0.26	0.25	0.22
60	0.35	0.25	0.24	0.22
75	0.31	0.23	0.22	0.20

Timber stud percentage taken as 15%.

## Floors

### XT/UF Slab on Ground Floors



### Solid Floors under screed to achieve 0.25W/m<sup>2</sup>K

	Perimeter/Area								
	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Xtratherm XT/UF required	25 (0.24)	40 (0.25)	50 (0.24)	55 (0.25)	60 (0.24)	60 (0.25)	65 (0.25)	65 (0.25)	70 (0.24)

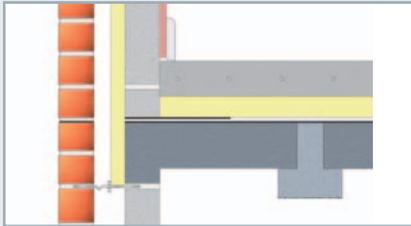
Ground default value taken as 1.5W/m<sup>2</sup>K.

Good workmanship and appropriate site procedures are necessary to achieve expected thermal and airtightness performance. The example calculations are indicative only. Default values for components and cavities have been used, for specific constructions contact Xtratherm Technical Support.

# Ready Reckoner

## Floors

### XT/UF Suspended Beam & Block Floors



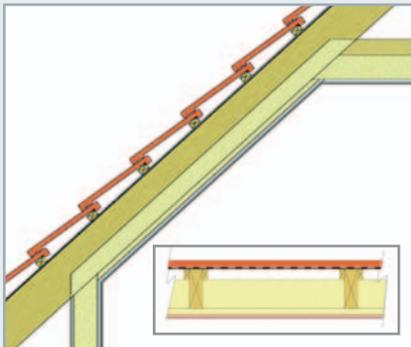
### Suspended Beam & Block Floors to achieve 0.25W/m²K

	Perimeter/Area								
	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Xtratherm XT/UF required	35 (0.25)	50 (0.25)	55 (0.25)	60 (0.25)	65 (0.24)	65 (0.25)	65 (0.25)	65 (0.25)	70 (0.24)

Ground default value taken as 1.5W/m²K.

## Roofs

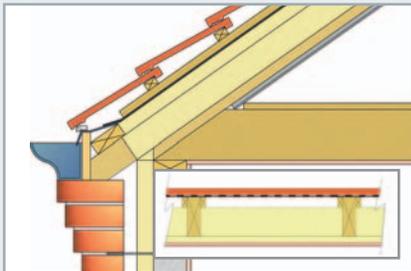
### XT/PR+(TL-MF) Roofs Sloped - Ventilated



New Build to achieve 0.20			Refurbishments to achieve 0.30		
Thickness of *XT/TL-MF under Rafters	Thickness of XT/PR between Rafters 400cs	Thickness of XT/PR between Rafters 600cs	Thickness of XT/TL under Rafters	Thickness of XT/PR between Rafters 400cs	Thickness of XT/PR between Rafters 600cs
25+	120	110	0	110	95
30+	115	100	25+	65	60
40+	100	90	30+	55	50
45+	90	80	35+	50	45
50+	80	75	40+	40	40
55+	75	70	70+	-	-
60+	65	60			
-	180	150			

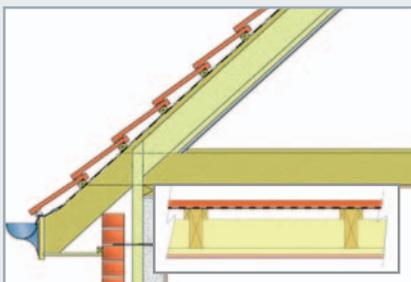
\*Thickness of insulation only.

### XT/PR Roofs Sloped (Warm with Sarking Insulation)



New Build to achieve 0.20		
Thickness of XT/PR over Rafters	Thickness of XT/PR between Rafters 400cs	Thickness of XT/PR between Rafters 600cs
40+	80	75
50+	70	60
55+	60	55
70+	40	35
75+	30	30
100	-	-

### XT/PR+(TL-MF) Roofs Sloped (Warm no Sarking Insulation unvented)



New Build to achieve 0.20		
Thickness of XT/TL under Rafters	Thickness of XT/PR between Rafters 400cs	Thickness of XT/PR between Rafters 600cs
0	150	135
25+	105	95
30+	90	100
35+	90	80
40+	85	75
45+	75	70
50+	70	65
55+	60	55

Construction requires breather type membrane.

Good workmanship and appropriate site procedures are necessary to achieve expected thermal and airtightness performance. The example calculations are indicative only. Default values for components and cavities have been used, for specific constructions contact Xtratherm Technical Support.



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### References

- BRE Digest No 457: "The Carbon Performance Rating for offices".
- DfEE, Guidelines for environmental design in schools, Building Bulletin 87, TSO, 1997.
- NHS Estates: Achieving energy efficiency in new hospitals, TSO, 1994.
- BS EN ISO 6946:1997 Building components and building elements. Thermal resistance and thermal transmittance. Calculation method.
- BS EN ISO 13370:1998 Thermal performance of buildings. Heat transfer via the ground.

### Calculation methods

- BS EN 13165:2001 Thermal insulation products for buildings. Factory made rigid polyurethane foam (PUR) products. Specification.
- Approved Document L1 (2002) Limiting thermal bridging and air leakage: Robust construction details for dwellings and similar buildings, 2001.
- Approved Document L2 (2002) Limiting thermal bridging and air leakage: Robust construction details for dwellings and similar buildings, TSO, 2001.

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