Part L 2010 – where to start:

An introduction for house builders and designers

NHBC Foundation

Housing research in partnership with BRE Trust

Acknowledgements

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Foreword

Carbon dioxide emissions from housing contribute some 27% of the UK's total and so it is right that the energy performance of new homes is addressed and improved. Successive Governments have shown a commitment to the 2016 zero carbon target for new homes and an important step towards that target was taken in October 2010 with the introduction of the consolidated Building Regulations and revised Approved Document L.

Although the overall aim of the changes to the Approved Document is clear – to achieve a 25% improvement in carbon dioxide emissions – any change to requirements can present challenges for the industry. It can be especially hard for smaller firms with limited technical resources to understand how best they can respond.

This guide is not prescriptive but explains, in simple terms, ways for new homes to comply with the revised Approved Document. It allows builders and designers to compare a variety of approaches to achieving compliance and is a good starting point for discussions with energy assessors, suppliers and Building Control on the detailed design that will then follow.

The challenge of this revision to Approved Document L and future changes must not be underestimated and I do hope you find this guide useful. The NHBC Foundation and the Zero Carbon Hub are committed to developing further research, information and guidance over the next five years as we make the transition to zero carbon and to help you on the journey.

Neil Jefferson

Chief Executive,
Zero Carbon Hub

About the NHBC Foundation

The NHBC Foundation was established in 2006 by the NHBC in partnership with the BRE Trust. Its purpose is to deliver high-quality research and practical guidance to help the industry meet its considerable challenges.

Since its inception, the NHBC Foundation's work has focused primarily on the sustainability agenda and the challenges of the Government's 2016 zero carbon homes target. Research has included a review of microgeneration and renewable energy techniques and the groundbreaking research on zero carbon and what it means to homeowners and house builders.

The NHBC Foundation is also involved in a programme of positive engagement with government, development agencies, academics and other key stakeholders, focusing on current and pressing issues relevant to the industry.

Further details on the latest output from the NHBC Foundation can be found at:

www.nhbcfoundation.org.

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Introduction

This guide is intended to help house builders and designers understand what the October 2010 changes to Approved Document L1A (Conservation of fuel and power in new dwellings) mean. The new ADL1A builds on the process for demonstrating compliance established by previous versions. Together with the reduction in annual carbon dioxide (CO_2) emissions there are also technical changes including an allowance for party wall heat loss.

The guide gives examples of some typical homes, outlining a combination of measures needed to comply with ADL1A 2010. The intention is to give a broad understanding of the specification that may need to be incorporated, as a starting point for detailed design. These are only representative approaches to compliance and the intention of ADL1A 2010 is very much to allow builders flexibility in how they might choose to comply with the new requirements.

The examples used are based on typical homes on typical developments, from information gathered by NHBC about the homes being built today. These examples were used by the Zero Carbon Hub (ZCH) for their work on the Fabric Energy Efficiency Standard (FEES) and the definition of zero carbon homes that will apply from 2016.

This is only a general guide and there is no obligation to adopt any of the typical approaches given. You should always check with the Building Control Body that your proposals comply with the requirements of the Building Regulations. As part of your Building Regulations application you will have to provide a CO_2 emissions rate calculation for your new home using the Government's Standard Assessment Procedure (SAP 2009) before construction work commences and again on completion. You will also need to comply with NHBC Standards and planning requirements, etc.

Five criteria

The five criteria for establishing compliance are:

Criterion 1 – Achieving the Target Emission Rate; the predicted annual CO_2 emission rate of the new home is less than the target calculated using SAP 2009 and has a minimum overall improvement of 25% relative to 2006 standards.

Criterion 2 – Limits on design flexibility; the thermal performance of building elements and the building services efficiencies do not fall below minimum values.

Criterion 3 – Limiting the effects of solar gains in summer; the building does not suffer from excessive summer solar heat gains.

Criterion 4 – Building performance consistent with Design Emission Rate; the performance of the building and services are verified through testing and commissioning.

Criterion 5 – Provisions for energy efficient operation of the dwelling; information is provided to the home occupier to enable them to operate their new home efficiently.

For more detailed information a full version of Approved Document L1A 2010 can be downloaded from:

www.planningportal.gov.uk

How to use this guide

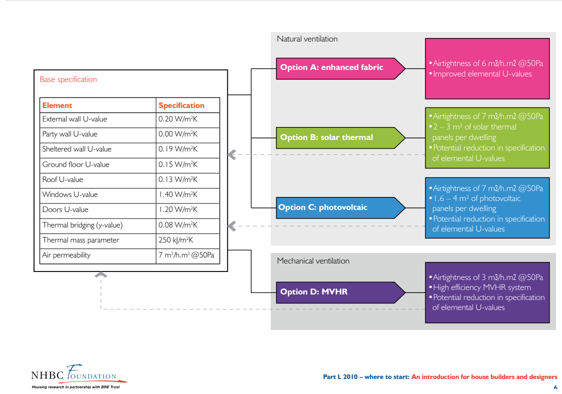
The guide is intended to be used as a starting point for discussions with advisers and suppliers and it follows a logical sequence of questions that might be asked at the outset of a new project:

What is current practice?
What choices are available now?
What is the detailed specification for each choice?
What will this look like as a construction?

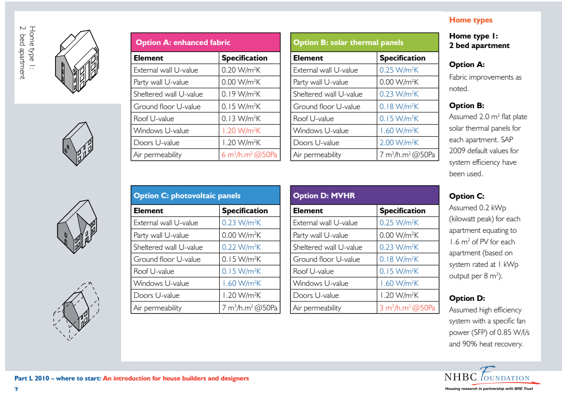
For each home type four possible alternatives are illustrated on the same page to aid comparison between approaches. There will be numerous routes to compliance and house builders will no doubt develop their own cost-effective strategies to meet the requirements. The options proposed are considered to be helpful illustrations of typical approaches but should not be regarded as definitive. Towards the end of the guide typical construction build-ups are illustrated to show the likely wall thicknesses and the types of insulating materials used; along with floor and roof constructions.

At the end of the guide we discuss the likely changes that are on the horizon for the next revision of ADL1A. This is by no means essential reading but it will be useful for house builders preparing to meet the higher standards expected to apply from 2013 and may influence some decisions now. For instance it will help to inform decisions as to whether to embrace a new construction or technology now in order that the implications are fully understood when it becomes a necessity.

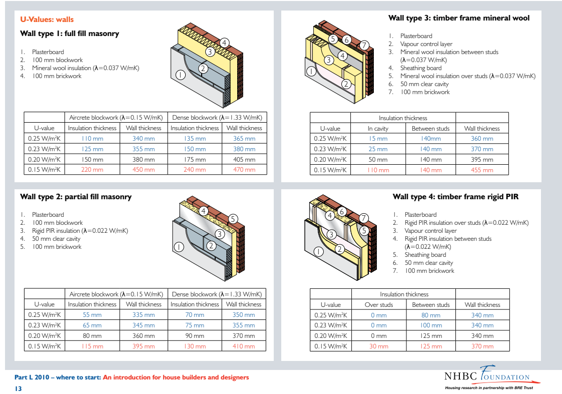
The first section shows the decision making process starting from an understanding of the base specification. Note the base specification does not by itself achieve ADL1A 2010 compliance. The colour coding for each option is followed for the remainder of the document and within each option the main changes to the base specification are shown.



The second section has four pages, one for each home type, which give four different specifications for each home. Where renewable technologies are used an indication of the approximate area of the solar hot water panels or photovoltaic panels is also given.

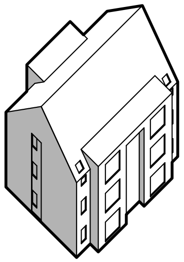


The third section shows at a glance each wall, floor and roof construction that has been developed with input from representatives of the masonry and timber frame supply industries.



Home types

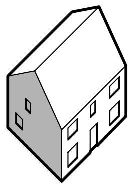
Home type 1:
2 bed apartment



Home type 1: 2 bed apartment

The apartment building has three storeys with a central access stair serving two apartments per floor. Each apartment has an internal area of 59 m^2 and is dual aspect, with the main living space facing east. The glazing area is assumed to be approximately 15% of the internal floor area. There is further detailed information on compliance for apartments on page 5.

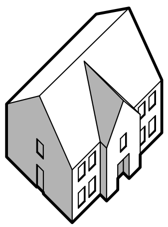
Home type 2:
detached house



Home type 2: detached house

The detached house is 118 m^2 with four bedrooms and two bathrooms over two storeys. The main aspect of the house faces west and the total glazed area amounts to approximately 20% of the internal floor area.

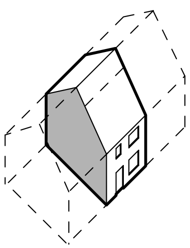
Home type 3:
large detached house



Home type 3: large detached house

The large detached house is 212 m^2 over two storeys with five bedrooms and three bathrooms. The main aspect faces west and the glazed area is approximately 18% of the total internal floor area.

Home type 4:
mid terrace house



Home type 4: mid terrace house

The terraced houses have two storeys with an internal area of 76 m^2, comprising three bedrooms and two bathrooms. The glazed area is approximately 15% of the total internal floor area. It has been assumed that the specification for a mid and end terrace house would be identical, for practical construction and simplicity on site. There is further detailed information on compliance for terraced houses on page 5.

What is current practice? The base specification

All of the examples in this guide are developed from a single base specification. The base specification reflects current good practice, that is, what can be achieved with readily available materials and common construction methods. For each of the homes illustrated, the base specification does not meet ADL1A 2010 so four possible routes to compliance are suggested.

The base specification assumes that homes will have natural ventilation (provided by a combination of trickle vents, opening windows and intermittent extractor fans) and to allow for the variation in air permeability results the target has been set at 7 $m^3/h.m^2$ @50Pa. This figure can be readily achieved for both masonry and timber frame construction.

Of growing significance is the heat loss due to thermal bridging (the heat loss at junctions of external surfaces and around the edges of openings and complicated constructions such as bay windows and dormers).

In ADL1A 2010, thermal bridging needs to be calculated for each house type being assessed under SAP. This means that although Accredited Construction Details (ACD) and Enhanced Construction Details (ECD) can still be referred to (for individual psi-values of details), the overall thermal bridging 'y-value' will have to be calculated by the SAP assessor. For the purpose of this guide, this value has been taken as 0.08 W/m²K for all the house types, which corresponds with the ACD route used under the previous version of ADL1A and is likely to be familiar to most builders.

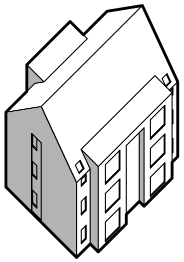
All units have been modelled with a gas condensing boiler (SEDBUK efficiency of 90%) with weather compensator, programmer and radiators with thermostatic radiator valves (TRVs). It is assumed that all hot water systems will be separately timed and thermostatically controlled.

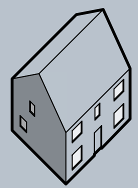
The windows modelled are thermally efficient, typically double glazed with low-e coating and thermally broken frames. The overall light transmittance properties of the units, which affect the extent to which light passes through are expressed as the 'g-value', which is set at a typical value of 0.63.

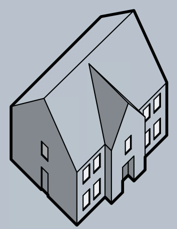
Base specification

Element	Specification	Notes
External wall U-value	0.20 W/m²K	Achievable with 130 mm cavity depending on wall type specification – see page 13.
Party wall U-value	0.00 W/m²K	Fully filled with insulation and edge sealed to prevent thermal bypass.
Sheltered wall U-value	0.19 W/m²K	This is the wall between apartments and corridors/circulation only.
Ground floor U-value	0.15 W/m²K	Suspended floor, concrete beams with EPS insulation infill blocks – see page 14.
Roof U-value	0.13 W/m²K	Cold roof with insulation above ceiling and insulated loft hatch – see page 14.
Windows U-value	1.40 W/m²K	Double glazed low-e with thermally broken frames.
Doors U-value	1.20 W/m²K	Insulated timber frame door.
Thermal bridging (y-value)	0.08 W/m²K	Based on the use of ACDs (Accredited Construction Details) and calculated thermal bridging for each dwelling.
Thermal mass parameter	250 kJ/m²K	Corresponds to SAP 2009 default for medium thermal mass.
Air permeability	7 m³/h.m² @50Pa	Assumption for natural ventilation (note the provisions for air pressure testing and confidence factors for untested units in ADL1A 2010 and the requirements in Part F of the Building Regulations for adequate ventilation).

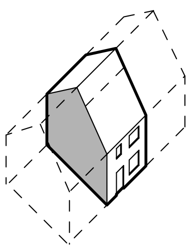
Home type 1:
2 bed apartment







Home type 4:
mid terrace house



Compliance for apartments and terraced homes

ADL1A 2010 offers some flexibility for the purpose of demonstrating compliance with Criterion 1 (DER/TER) in the case of certain dwelling types. For dwellings in a block of apartments or as part of a terrace, either individual units can be assessed to pass the relevant criteria or an average approach can be taken. This allows some flexibility in terms of building fabric specifications, with better performing types compensating for less efficient ones.

If renewable technologies are adopted there may be scope to alter the amount provided on each dwelling to achieve the target values where an average approach is being taken. For apartments, the output from roof-mounted solar panels can be attributed to individual units or averaged where the output is to be shared.

ADL1A 2010 also addresses heat loss that could occur through party walls, a mechanism that has only recently been understood. This heat loss can be overcome by constructing party walls as solid walls or fully filled and edge sealed (noting the requirements in Part E of the Building Regulations to control sound transmission).

What are the available choices? Decision chart

Four options are illustrated in the decision chart opposite. By using renewables or mechanical ventilation with heat recovery (MVHR) it may be possible to reduce the specification of some elements in the base specification. Alternatively, by improving the base specification it is also possible to comply without the use of renewables or MVHR. A combination of measures, acting together, will give the optimum result.

The chart opposite shows that for Options B, C and D the base specification can be revisited and possibly reduced in a particular area. The 'feedback' arrows pointing back to the base indicate that this can be an iterative process where an optimum design is derived from a combination of elements. For instance when solar photovoltaic (PV) power supply systems are adopted it may be possible to choose a larger PV installation that allows the specification of the fabric performance to be reduced.

Base specification

Element	Specification
External wall U-value	0.20 W/m^2K
Party wall U-value	0.00 W/m^2K
Sheltered wall U-value	0.19 W/m^2K
Ground floor U-value	0.15 W/m^2K
Roof U-value	0.13 W/m^2K
Windows U-value	1.40 W/m^2K
Doors U-value	1.20 W/m^2K
Thermal bridging (y-value)	0.08 W/m^2K
Thermal mass parameter	250 kJ/m^2K
Air permeability	7 m^3/h.m^2 @50Pa

Natural ventilation

Option A: enhanced fabric

- Airtightness of 6 m3/h.m2 @50Pa
- Improved elemental U-values

Option B: solar thermal

- Airtightness of 7 m3/h.m2 @50Pa
- 2 – 3 m^2 of solar thermal panels per dwelling
- Potential reduction in specification of elemental U-values

Option C: photovoltaic

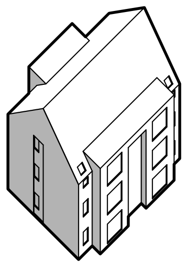
- Airtightness of 7 m3/h.m2 @50Pa
- 1.6 – 4 m^2 of photovoltaic panels per dwelling
- Potential reduction in specification of elemental U-values

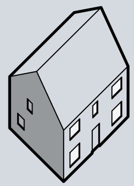
Mechanical ventilation

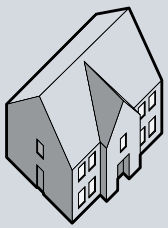
Option D: MVHR

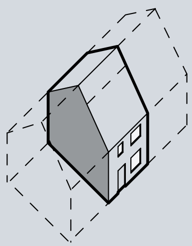
- Airtightness of 3 m3/h.m2 @50Pa
- High efficiency MVHR system
- Potential reduction in specification of elemental U-values

Home type 1:
2 bed apartment









Option A: enhanced fabric

Element	Specification
External wall U-value	0.20 W/m^2K
Party wall U-value	0.00 W/m^2K
Sheltered wall U-value	0.19 W/m^2K
Ground floor U-value	0.15 W/m^2K
Roof U-value	0.13 W/m^2K
Windows U-value	1.20 W/m^2K
Doors U-value	1.20 W/m^2K
Air permeability	6 $m^3/h.m^2$ @50Pa

Option B: solar thermal panels

Element	Specification
External wall U-value	0.25 W/m^2K
Party wall U-value	0.00 W/m^2K
Sheltered wall U-value	0.23 W/m^2K
Ground floor U-value	0.18 W/m^2K
Roof U-value	0.15 W/m^2K
Windows U-value	1.60 W/m^2K
Doors U-value	2.00 W/m^2K
Air permeability	7 $m^3/h.m^2$ @50Pa

Option C: photovoltaic panels

Element	Specification
External wall U-value	0.23 W/m^2K
Party wall U-value	0.00 W/m^2K
Sheltered wall U-value	0.22 W/m^2K
Ground floor U-value	0.15 W/m^2K
Roof U-value	0.15 W/m^2K
Windows U-value	1.60 W/m^2K
Doors U-value	1.20 W/m^2K
Air permeability	7 $m^3/h.m^2$ @50Pa

Option D: MVHR

Element	Specification
External wall U-value	0.25 W/m^2K
Party wall U-value	0.00 W/m^2K
Sheltered wall U-value	0.23 W/m^2K
Ground floor U-value	0.18 W/m^2K
Roof U-value	0.15 W/m^2K
Windows U-value	1.60 W/m^2K
Doors U-value	1.20 W/m^2K
Air permeability	3 $m^3/h.m^2$ @50Pa

Home type 1: 2 bed apartment

Option A:

Fabric improvements as noted.

Option B:

Assumed 2.0 m^2 flat plate solar thermal panels for each apartment. SAP 2009 default values for system efficiency have been used.

Option C:

Assumed 0.2 kWp (kilowatt peak) for each apartment equating to 1.6 m^2 of PV for each apartment (based on system rated at 1 kWp output per 8 m^2).

Option D:

Assumed high efficiency system with a specific fan power (SFP) of 0.85 W/l/s and 90% heat recovery.

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Home type 2: detached house

Option A:
Fabric improvements as noted.

Option B:
Assumed 3.0 m^2 flat plate solar thermal panels. SAP 2009 default values for system efficiency have been used.

Option C:
Assumed 0.75 kWp (kilowatt peak) equating to 6.0 m^2 of PV (based on system rated at 1 kWp output per 8 m^2).

Option D:
Assumed high efficiency system with a specific fan power (SFP) of 0.85 W/l/s and 90% heat recovery.

Option A: enhanced fabric

Element	Specification
External wall U-value	0.20 W/m^{2}K
Ground floor U-value	0.15 W/m^{2}K
Roof U-value	0.13 W/m^{2}K
Windows U-value	1.20 W/m^{2}K
Doors U-value	1.20 W/m^{2}K
Air permeability	6 m^3/h.m^2 @50Pa

Option B: solar thermal panels

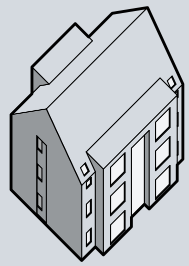
Element	Specification
External wall U-value	0.23 W/m^{2}K
Ground floor U-value	0.15 W/m^{2}K
Roof U-value	0.13 W/m^{2}K
Windows U-value	1.60 W/m^{2}K
Doors U-value	2.00 W/m^{2}K
Air permeability	7 m^3/h.m^2 @50Pa

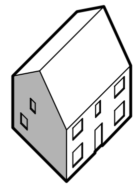
Option C: photovoltaic panels

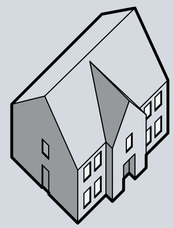
Element	Specification
External wall U-value	0.25 W/m^{2}K
Ground floor U-value	0.18 W/m^{2}K
Roof U-value	0.15 W/m^{2}K
Windows U-value	1.60 W/m^{2}K
Doors U-value	2.00 W/m^{2}K
Air permeability	7 m^3/h.m^2 @50Pa

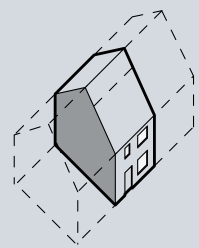
Option D: MVHR

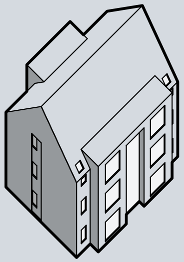
Element	Specification
External wall U-value	0.23 W/m^{2}K
Ground floor U-value	0.15 W/m^{2}K
Roof U-value	0.13 W/m^{2}K
Windows U-value	1.60 W/m^{2}K
Doors U-value	2.00 W/m^{2}K
Air permeability	3 m^3/h.m^2 @50Pa

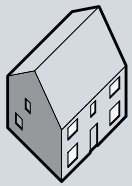




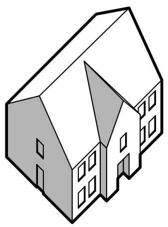


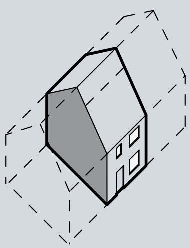






Home type 3:
large detached house





Option A: enhanced fabric	
Element	**Specification**
External wall U-value	0.20 W/m²K
Ground floor U-value	0.15 W/m²K
Roof U-value	0.13 W/m²K
Windows U-value	1.20 W/m²K
Doors U-value	1.20 W/m²K
Air permeability	7 m³/h.m² @50Pa

Option B: solar thermal panels	
Element	**Specification**
External wall U-value	0.25 W/m²K
Ground floor U-value	0.15 W/m²K
Roof U-value	0.13 W/m²K
Windows U-value	1.60 W/m²K
Doors U-value	1.20 W/m²K
Air permeability	7 m³/h.m² @50Pa

Option C: photovoltaic panels	
Element	**Specification**
External wall U-value	0.25 W/m²K
Ground floor U-value	0.18 W/m²K
Roof U-value	0.15 W/m²K
Windows U-value	1.60 W/m²K
Doors U-value	2.00 W/m²K
Air permeability	7 m³/h.m² @50Pa

Option D: MVHR	
Element	**Specification**
External wall U-value	0.25 W/m²K
Ground floor U-value	0.18 W/m²K
Roof U-value	0.15 W/m²K
Windows U-value	1.60 W/m²K
Doors U-value	2.00 W/m²K
Air permeability	3 m³/h.m² @50Pa

Home type 3: large detached house

Option A:
Fabric improvements as noted.

Option B:
Assumed 3.0 m² flat plate solar thermal panels. SAP 2009 default values for system efficiency have been used.

Option C:
Assumed 0.75 kWp (kilowatt peak) equating to 6.0 m² of PV (based on system rated at 1 kWp output per 8 m²).

Option D:
Assumed high efficiency system with a specific fan power (SFP) of 0.85 W/l/s and 90% heat recovery.

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Home type 4:
mid terrace house

Option A:
Fabric improvements as noted.

Option B:
Assumed 3.0 m² flat plate solar thermal panels. SAP 2009 default values for system efficiency have been used.

Option C:
Assumed 0.50 kWp (kilowatt peak) equating to 4.0 m² of PV (based on system rated at 1 kWp output per 8 m²).

Option D:
Assumed high efficiency system with a specific fan power (SFP) of 0.85 W/l/s and 90% heat recovery.

Option A: enhanced fabric

Element	Specification
External wall U-value	0.16 W/m²K
Party wall U-value	0.00 W/m²K
Ground floor U-value	0.14 W/m²K
Roof U-value	0.13 W/m²K
Windows U-value	1.20 W/m²K
Doors U-value	1.20 W/m²K
Air permeability	6 m³/h.m² @50Pa

Option B: solar thermal panels

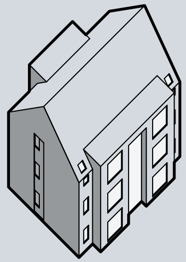
Element	Specification
External wall U-value	0.25 W/m²K
Party wall U-value	0.00 W/m²K
Ground floor U-value	0.18 W/m²K
Roof U-value	0.15 W/m²K
Windows U-value	1.60 W/m²K
Doors U-value	2.00 W/m²K
Air permeability	7 m³/h.m² @50Pa

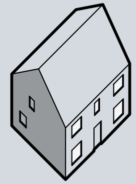
Option C: photovoltaic panels

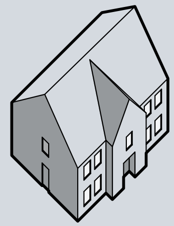
Element	Specification
External wall U-value	0.25 W/m²K
Party wall U-value	0.00 W/m²K
Ground floor U-value	0.18 W/m²K
Roof U-value	0.15 W/m²K
Windows U-value	1.60 W/m²K
Doors U-value	2.00 W/m²K
Air permeability	7 m³/h.m² @50Pa

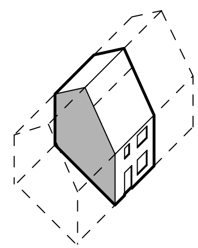
Option D: MVHR

Element	Specification
External wall U-value	0.25 W/m²K
Party wall U-value	0.00 W/m²K
Ground floor U-value	0.18 W/m²K
Roof U-value	0.13 W/m²K
Windows U-value	1.60 W/m²K
Doors U-value	1.20 W/m²K
Air permeability	3 m³/h.m² @50Pa









Home type 4:
mid terrace house

Demonstrating compliance

Once a preferred route for improving the performance of the home has been chosen builders are now responsible for communicating this to the Building Control Body prior to starting work on site. This is to demonstrate that the chosen construction delivers the fabric thermal performance entered into the calculation. The aim here is to give the Building Control Body sufficient information on the construction elements to confirm that what has been designed is actually built.

ADL1A 2010 provides guidance on how this could be achieved. The usual way for this would be through the reports published by proprietary SAP 2009 software (as described in **ADL1A Appendix A**). Typically the software will produce a checklist (as shown on the right) to be given to the Building Control Body detailing the specification that achieves Criteria 1, 2 and 3. This report should be accompanied by details of the floor, wall, roof, window and door U-value calculations for the home to demonstrate that the chosen construction delivers the U-value entered into the software.

In addition to the detailed U-value calculations the SAP assessor will need to take account of the air permeability and thermal bridging psi-value being targeted in the houses. After completion, a second stage report, including the 'as built' TER/DER calculation (using the site measured air permeability), is issued. This second report also records any changes to the design specification and incorporates these changes in the 'as built' TER/DER.

Typical output from proprietary SAP 2009 software:

L1A 2010 - Regulations Compliance Report

This design draft submission provides evidence towards compliance with Part L of the Building Regulations, in accordance with Appendix A of AD L1A. It has been carried out by an Authorised SAP Assessor. It has been prepared from plans and specifications and may not reflect the 'as built' property. This report covers only items included within the SAP and is not a complete report of regulations compliance.

Assessor name		Assessor number	
Client		Last modified	09/12/2010
Address			

Check	Evidence	Produced by	OK?
Criterion 1: predicted carbon dioxide emission from proposed dwelling does not exceed the target			
TER (kg CO_2/m².a)	Fuel = Mains gas Fuel factor = 1.00 TER = 18.88	Authorised SAP Assessor	
DER for dwelling as designed (kg CO_2/m².a)	DER = 14.36	Authorised SAP Assessor	
Are emissions from dwelling as designed less than or equal to the target?	DER 14.36 < TER 18.88	Authorised SAP Assessor	Passed
Criterion 2: the performance of the building fabric and the heating, hot water and fixed lighting systems should be no worse than the design limit			
Fabric U-values			
Are all U-values better than the design limits in Table 2?	Element / Weighted average / Highest Wall / 0.17 (max 0.30) / 0.18 (max 0.70) Party wall / (no party wall) Floor / (no floor) Roof / 0.15 (max 0.20) / 0.15 (max 0.35) Openings / 1.35 (max 2.00) / 1.40 (max 3.30)	Authorised SAP Assessor	Passed
Heating and hot water systems			
Does the efficiency of the heating systems meet the minimum value set out in the Domestic Heating Compliance Guide?	Community heating scheme Secondary heating system: None	Authorised SAP Assessor	N/A
Does the insulation of the hot water cylinder meet the standards set out in the Domestic Heating Compliance Guide?	No hot water cylinder in the dwelling	Authorised SAP Assessor	
Do controls meet the minimum controls provision set out in the Domestic Heating Compliance Guide?	Space heating control: Charging system linked to use, programmer and room thermostat No hot water cylinder in the dwelling	Authorised SAP Assessor	Failed
Fixed internal lighting			
Does fixed internal lighting comply with paragraphs 42 to 44?	Schedule of installed fixed internal lighting Standard lights = 0 Low energy lights = 8 Percentage of low energy lights = 100 % Minimum = 75 %	Authorised SAP Assessor	Passed
Criterion 3: the dwelling has appropriate passive control measures to limit solar gains			
Does the dwelling have a strong tendency to high summertime temperatures?	Overheating risk (June) = Slight Overheating risk (July) = Medium Overheating risk (August) = Medium Region = Thames Thermal mass parameter = 100.00 Ventilation rate in hot weather = 2.00 ach Blinds/curtains = Light-coloured curtain or roller blind	Authorised SAP Assessor	Passed
Check	**Evidence**	**Produced by**	**OK?**
Criterion 4: the performance of the dwelling, as designed, is consistent with the DER			
Design air permeability (m³/(h.m²) at 50Pa)	Design air permeability = 3.00 Max air permeability = 10.00	Authorised SAP Assessor	Passed
Mechanical ventilation system Specific fan power (SFP)	Mechanical ventilation with heat recovery: SFP = 1.00 W/(litre/sec) Max SFP = 1.5 W/(litre/sec) Heat recovery efficiency = 85.00 % Min heat recovery efficiency = 70.00 %	Authorised SAP Assessor	Passed
Have the key features of the design been included (or bettered) in practice?	The following walls/wall have a U-value less than 0.2W/m²K: • Wall 1 (0.18) • Wall 2 (0.15) • Wall 3 (0.15) The following openings have a U-value less than 1.5W/m²K: • Window reference 4 (1.40) • Window reference 5 (1.40) • Half glazed door reference 3 (1.40) • Door to corridor reference 6 (1.00) • Window reference 1 (1.40) • Window reference 2 (1.40) • Window reference 7 (1.40) Design air permeability of 3 m³/(h.m²) is less than 5 m³/(h.m²) at 50 Pa Community heating with CHP - Mains gas	Authorised SAP Assessor	

Wall, floor and roof constructions

Notes on U-value calculations

U-value calculations should account for the material characteristics of the main wall elements and the secondary items such as fixings, ties, framing and air cavities as these can have a significant effect on the overall performance.

A wide range of insulation products is available which may be used to limit the thickness of build-ups, especially to achieve very low U-values. In this guide assumptions regarding insulation properties have been kept consistent for ease of comparison.

The assumptions made in the U-value calculations in this guide are:

Timber proportions

• 15% timber has been assumed for walls as per guidelines (BR443:2006) based on 38 mm studs at 600 mm centres and additional framing.
• 9% timber has been assumed in roofs, as per guidelines (BR443:2006) based on 48 mm joists/rafters at 600 mm centres and an additional proportion for nogging.
These proportions will vary in different wall and roof constructions and should be verified based on actual design.

Blockwork

The thermal performance varies according to the density and type of blockwork. The guide shows U-values for dense and aircrete blocks. The final selection may be influenced by other factors such as compressive strength, which will depend on the structural design.

Mineral wool

The term mineral wool generally describes insulation derived from organic sources and may refer to glasswool or rockwool. A representative value for thermal performance has been assumed in the calculations although a wide range is available.

Rigid insulation

Rigid insulation boards are made from expanded or extruded polystyrene (EPS and XPS respectively), phenolic foam, polyurethane (PU) or polyisocyanurate (PIR). These can be used in wall, roof and floor construction. In this guide, the wall and roof build-ups include PIR insulation.

Cavity width

All mineral wool construction options are for fully filled cavities and rigid insulation build-ups include a 50 mm clear cavity behind the outer leaf.

Cavity wall ties

Stainless steel wall ties are generally used in cavity masonry walls and have been assumed in this document. Low thermal conductivity options such as basalt ties are available and are beneficial when seeking high thermal standards.

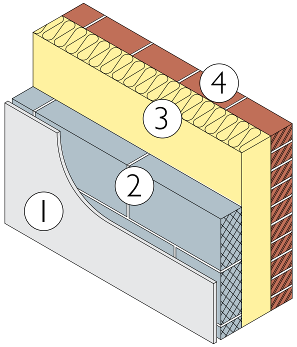
Ground floor

Factors such as ground conditions will affect the type of floor construction that will be used. In addition to this, the ratio of the exposed perimeter (along which a significant proportion of heat loss will occur) to the floor area will need to be taken into account. For this guide, a concrete beam and EPS insulation infill block suspended floor system has been used, with the Perimeter/Area ratio as per the detached house.

U-Values: walls

Wall type 1: full fill masonry

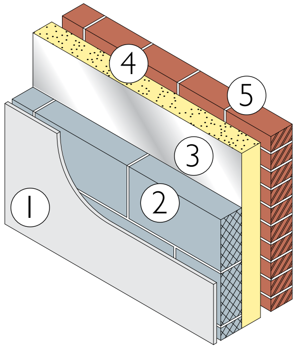
1. Plasterboard
2. 100 mm blockwork
3. Mineral wool insulation (λ=0.037 W/mK)
4. 100 mm brickwork



	Aircrete blockwork (λ=0.15 W/mK)		Dense blockwork (λ=1.33 W/mK)	
U-value	Insulation thickness	Wall thickness	Insulation thickness	Wall thickness
0.25 W/m²K	110 mm	340 mm	135 mm	365 mm
0.23 W/m²K	125 mm	355 mm	150 mm	380 mm
0.20 W/m²K	150 mm	380 mm	175 mm	405 mm
0.15 W/m²K	220 mm	450 mm	240 mm	470 mm

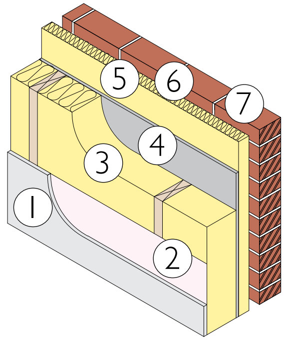
Wall type 2: partial fill masonry

1. Plasterboard
2. 100 mm blockwork
3. Rigid PIR insulation (λ=0.022 W/mK)
4. 50 mm clear cavity
5. 100 mm brickwork



	Aircrete blockwork (λ=0.15 W/mK)		Dense blockwork (λ=1.33 W/mK)	
U-value	Insulation thickness	Wall thickness	Insulation thickness	Wall thickness
0.25 W/m²K	55 mm	335 mm	70 mm	350 mm
0.23 W/m²K	65 mm	345 mm	75 mm	355 mm
0.20 W/m²K	80 mm	360 mm	90 mm	370 mm
0.15 W/m²K	115 mm	395 mm	130 mm	410 mm

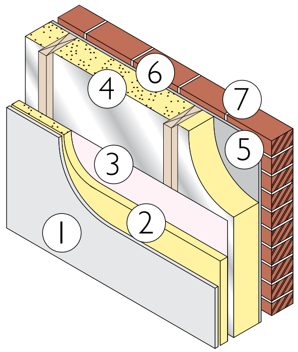
Wall type 3: timber frame mineral wool



1. Plasterboard
2. Vapour control layer
3. Mineral wool insulation between studs (λ=0.037 W/mK)
4. Sheathing board
5. Mineral wool insulation over studs (λ=0.037 W/mK)
6. 50 mm clear cavity
7. 100 mm brickwork

	Insulation thickness		
U-value	In cavity	Between studs	Wall thickness
0.25 W/m²K	15 mm	140mm	360 mm
0.23 W/m²K	25 mm	140 mm	370 mm
0.20 W/m²K	50 mm	140 mm	395 mm
0.15 W/m²K	110 mm	140 mm	455 mm

Wall type 4: timber frame rigid PIR



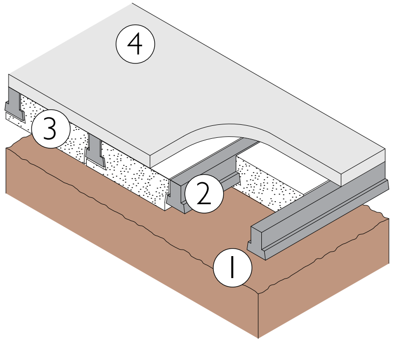
1. Plasterboard
2. Rigid PIR insulation over studs (λ=0.022 W/mK)
3. Vapour control layer
4. Rigid PIR insulation between studs (λ=0.022 W/mK)
5. Sheathing board
6. 50 mm clear cavity
7. 100 mm brickwork

	Insulation thickness		
U-value	Over studs	Between studs	Wall thickness
0.25 W/m²K	0 mm	80 mm	340 mm
0.23 W/m²K	0 mm	100 mm	340 mm
0.20 W/m²K	0 mm	125 mm	340 mm
0.15 W/m²K	30 mm	125 mm	370 mm

U-Values: floors and roofs

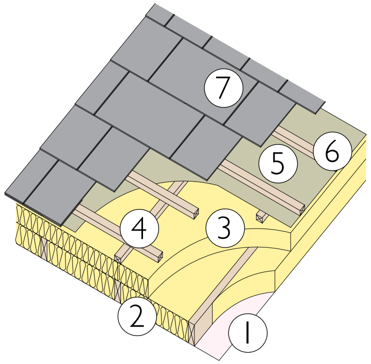
Floor type 1: suspended concrete beam with EPS insulation infill block

1. Ventilated void
2. Concrete beams
3. EPS insulation infill block (λ=0.035 W/mK)
4. 75 mm screed topping



	Insulation thickness	
U-value	Between beams	Below beam
0.18 W/m²K	150 mm	40 mm
0.15 W/m²K	180 mm	55 mm

Roof type 1: warm roof with mineral wool

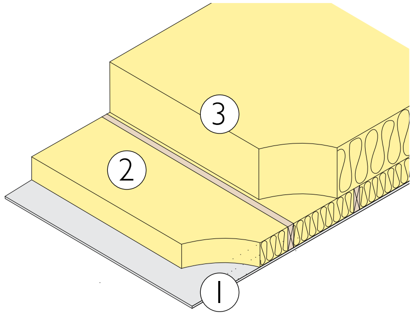


1. Vapour control layer
2. Mineral wool insulation between 150 mm rafters (λ=0.032 W/mK)
3. Mineral wool insulation over rafters (λ=0.032 W/mK)
4. Counter battens
5. Breather membrane
6. Battens
7. Tiles

	Insulation thickness	
U-value	Between rafters	Over rafters
0.15 W/m²K	200 mm	70 mm
0.13 W/m²K	200 mm	100 mm
0.11 W/m²K	250 mm	100 mm

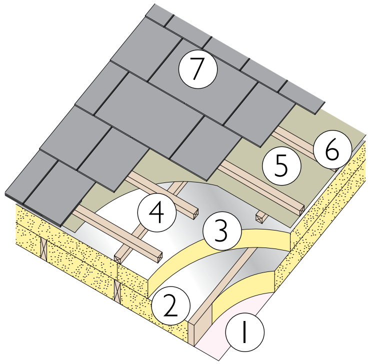
Roof type 3: cold roof

1. Plasterboard
2. Mineral wool insulation between joists (λ=0.044 W/mK)
3. Mineral wool insulation over joists (λ=0.044 W/mK)



	Insulation thickness	
U-value	Between joists	Over joists
0.15 W/m²K	100 mm	200 mm
0.13 W/m²K	100 mm	250 mm
0.11 W/m²K	100 mm	300 mm

Roof type 2: warm roof with rigid PIR



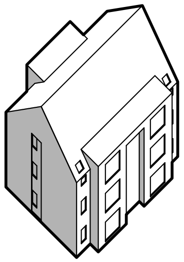
1. Vapour control layer
2. Rigid PIR insulation between rafters (λ=0.022 W/mK)
3. Rigid PIR insulation over rafters (λ=0.022 W/mK)
4. Counter battens
5. Breather membrane
6. Battens
7. Tiles

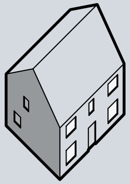
	Insulation thickness	
U-value	Between rafters	Over rafters
0.15 W/m²K	150 mm	30 mm
0.13 W/m²K	150 mm	50 mm
0.11 W/m²K	175 mm	70 mm

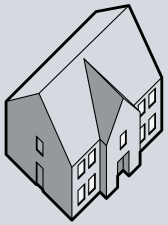
Home plans

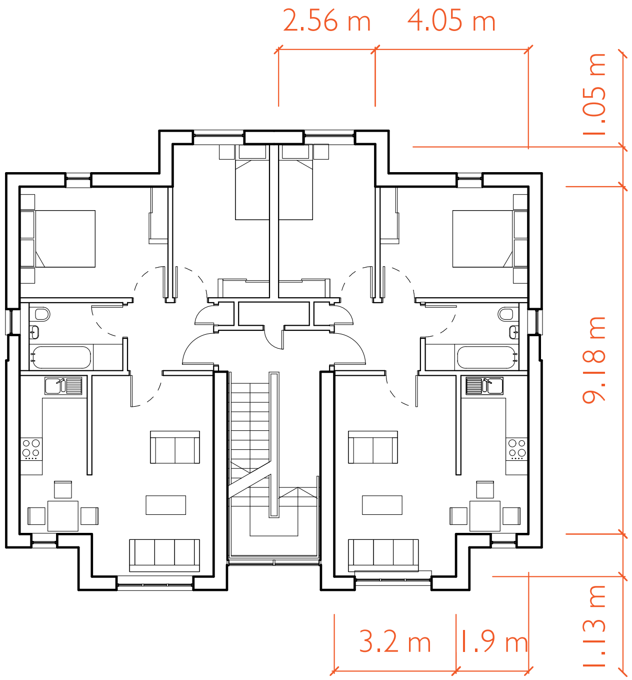
Type 1: 2 bed apartment

Home type 1:
2 bed apartment









First floor plan

Typical floor:

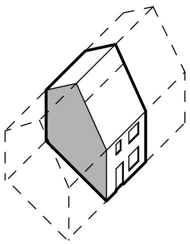
Gross internal area:	59.00 m²
Zone 1 area	25.04 m²
Sheltered wall area:	19.67 m²
External wall area:	61.38 m²
Opening area:	11.91 m²
Party wall area:	10.30 m²

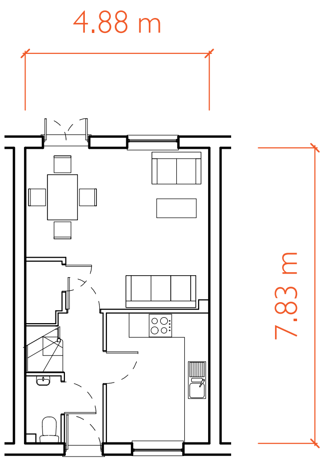
Average internal heights:

Ground floor:	2.55 m
First floor:	2.55 m
Second floor:	2.55 m

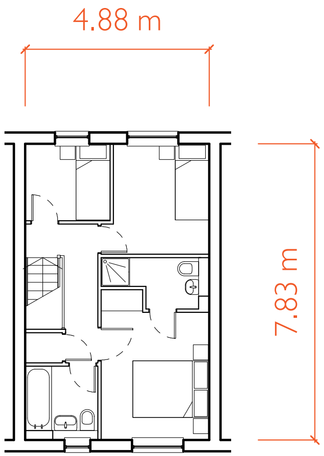
Type 4: mid terrace house

Home type 4:
mid terrace house





Ground floor plan



First floor plan

Gross internal area:	76.32 m²
Ground floor area:	38.16 m²
Roof area:	38.16 m²
Zone 1 area:	19.74 m²
External wall area:	49.73 m²
Opening area:	13.77 m²
Party wall area:	79.48 m²

Average internal heights:

Ground floor:	2.70 m
First floor:	2.40 m

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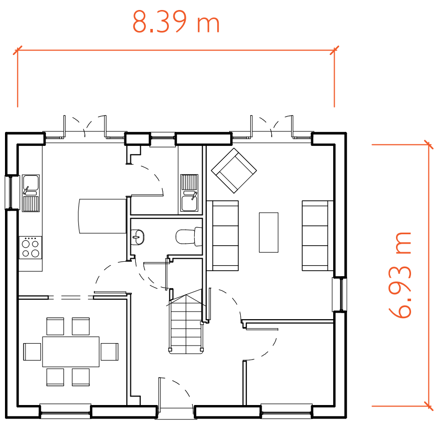
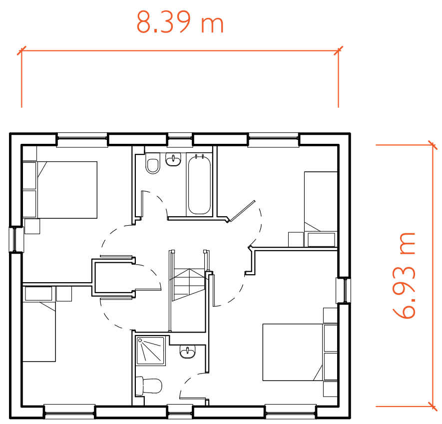
Type 2: detached house

Gross internal area: 117.92 m²
Ground floor area: 58.96 m²
Roof area: 58.96 m²
Zone 1 area: 16.22 m²
External wall area: 157.26 m²
Opening area: 26.38 m²

Average internal heights:
Ground floor: 2.70 m
First floor: 2.40 m



Ground floor plan

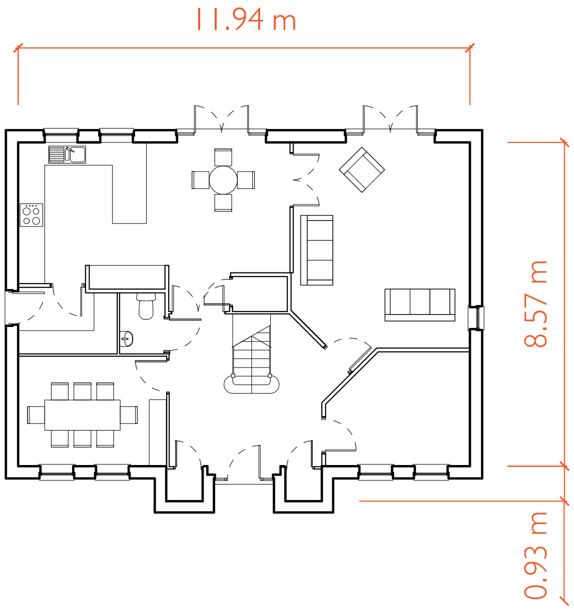


First floor plan

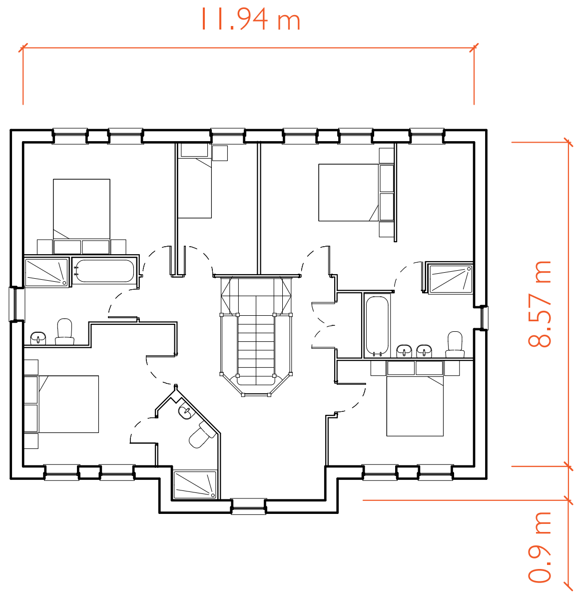
Type 2: detached house

Gross internal area: 211.80 m²
Ground floor area: 105.90 m²
Roof area: 105.90 m²
Zone 1 area: 26.10 m²
External wall area: 218.26 m²
Opening area: 39.38 m²

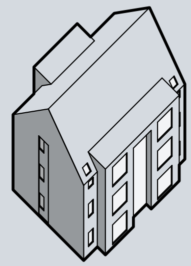
Average internal heights:
Ground floor: 2.70 m
First floor: 2.40 m

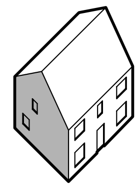


Ground floor plan

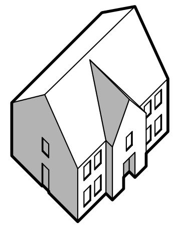


First floor plan

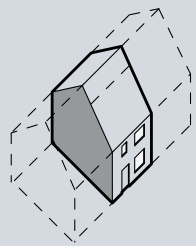




Home type 2: detached house



Home type 3: large detached house



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Looking forward

Future changes to the Building Regulations in 2013 and 2016

Although recently there has been much discussion about some of the detail and the precise definition of 'zero carbon', the fundamental targets in the building regulations have not changed: the proposed improvements to the CO_2 emissions, compared with a notional Part L 2006 dwelling, are broadly the same. The 25% improvement required from 2010 will be followed by further changes in 2013 and 'zero carbon' from 2016.

What is clear is that there will need to be further improvement to fabric performance with emphasis on building an airtight and well-insulated fabric to a minimum standard and that all homes will need some form of renewable energy installed/connected.

In July 2009 the Government established a Task Group to advise on a proposed minimum Fabric Energy Efficiency Standard, which will be the fundamental building block of zero carbon in 2016. The Fabric Energy Efficiency Standard (FEES) has been accepted in principle, and will be implemented through the changes in the building regulations (see to the right of page).

Although the FEES has been developed as the minimum standard that will apply from 2016, it may form the basis of an interim standard implemented from 2013. The Code for Sustainable Homes 2010 already recognises the FEES standard, and gives credit under Section ENE 2.

The emphasis on fabric energy efficiency can already be seen in ADL1A 2010. Changes have been made to reflect our better understanding of the mechanisms for heat loss, through the party wall for instance. More effort is also now required by designers and specifiers to account for heat losses from thermal bridging accurately. In a well-insulated dwelling heat losses through thermal bridging can account for up to 30% of the total losses so it is becoming increasingly important to consider and implement details and calculation methods that anticipate this. It is expected that quality-assured accredited details scheme(s) will be developed to better address thermal bridging.

There will be increasing emphasis on processes and procedures to ensure that the theoretical performance of homes is actually matched by what is built on site.

The Coalition Government has reaffirmed its commitment to the zero carbon homes policy and has initiated further work on the next part of the hierarchy, the site-generated component of emissions reduction, or 'carbon compliance'. The Task Group organised by the Zero Carbon Hub has reported its findings in February 2011, which can be obtained from:

www.zerocarbonhub.org

Fabric Energy Efficiency Standard (FEES)

What are the recommended levels?

Apartment blocks and mid terrace houses have a maximum energy demand of 39 kWh/m²/yr.

Semi detached, end of terrace and detached houses have a maximum energy demand of 46 kWh/m²/yr.

The FEES is a measure of the space heating and cooling demand related to:

- Building fabric U-values
- Thermal bridging
- Air permeability
- Thermal mass
- Solar shading
- Gains from metabolic, lighting, solar & household appliances (TV, computer etc)

Glossary

Accredited Construction Details: Typical construction details addressing issues with continuity of thermal and air-tightness layers in construction published by the Department for Communities and Local Government, which are available on http://www.planningportal.gov.uk/buildingregulations/approveddocuments/partl/bcassociateddocuments9/acd.

ACDs can be used by designers for detailing buildings and the corresponding psi-values for the purpose of thermal bridging calculations by the SAP assessor. These include checklists which are to be submitted to Building Control Bodies to demonstrate compliance.

Currently ACDs are available for masonry, steel and timber frame systems.

Air permeability: The unintended leakage of air through gaps and cracks in the external envelope of a building. It is measured as the volume of air leakage per hour per square metre of external building envelope ($m^3/h.m^2$) at a tested pressure of 50 pascals (Pa).

Background ventilation: Low levels of fresh air brought into the building through trickle vents to maintain air quality.

Carbon dioxide (CO_2) emissions: The release of carbon dioxide into the atmosphere, largely as a result of burning fossil fuels like coal, gas and oil to produce heat and electricity.

Cold roof: A form of roof construction where the insulation is placed between and/or above the ceiling joists and outside air is allowed to ventilate through the loft space.

Condensation: Water vapour from the air that can turn into water droplets when in contact with cold surfaces or cold air within a building element (interstitial), which can cause damp, mould and rot.

Design air permeability: The target value set at design stage and evaluated through a mandatory testing regime outlined in ADL1A 2010. A default value is set in ADL1A 2010 which may be used for specific cases and in the absence of testing.

Dwelling Emission Rate (DER): A measure of carbon dioxide emissions arising from use of energy in homes as calculated by the approved National Calculation Methodology, SAP. It is expressed as kg of CO_2 per square metre of floor area per year and takes into account energy used for space heating, hot water, fixed internal lighting and fans and pumps.

To demonstrate compliance with ADL1A 2010, the DER of a dwelling must be no greater than its corresponding Target Emission Rate (TER).

Enhanced Construction Details: Details published by the Energy Saving Trust (EST), which achieve performance standards that improve on the calculated performance of the current set of ACDs in terms of psi-values.

Mechanical ventilation: A system of fans and ducts to bring fresh air into a building. Can include pre-heating of incoming air and recovery of waste heat from outgoing air - mechanical ventilation with heat recovery (MVHR).

Natural ventilation: The supply of adequate fresh air to spaces within a home through windows, trickle ventilators etc. Removal of air may take place by natural or mechanical means.

Psi-value: Psi-value or linear thermal transmittance is the measure of heat loss along a non-repeating thermal bridge calculated as per the conventions set in BR 497.

Renewable energy: Energy produced without using finite fossil fuels (such as coal, oil and gas) and with minimal emissions of greenhouse gases. The main renewable energy sources are wind power, solar power, hydro-power and geo-thermal energy.

SAP: Standard Assessment Procedure; the Government's approved method for calculating energy efficiency and carbon emissions from homes to demonstrate compliance with Building Regulations.

Solar gains: The build-up of heat within a building from direct sunlight.

Target Emission Rate (TER): The benchmark emission rate as calculated by SAP for a particular home expressed as annual kg of CO_2 per square metre of floor area. The calculation is based on a notional dwelling of the same size and shape as the proposed dwelling.

Thermal bridging: Thermal bridges are weak points in the building envelope where heat loss is greater than through the main building elements. There are two kinds of thermal bridges, repeating bridges that occur at regular intervals as part of a building element like wall ties which are accounted for in U-value calculations; and linear non-repeating thermal bridges that occur at junctions of different elements for which psi-value calculations are made.

Thermal conductivity: The theoretical rate at which a material conducts heat across a unit thickness; expressed in W/mK.

U-value: The calculated rate at which heat is lost per unit area of a building element; expressed in terms of W/m^2K.

Vapour control layer: A layer resistant to water vapour used on the inside of the insulation in roofs and framed walls, which stops warm damp air coming into contact with cold surfaces where it may cause condensation.

Warm roof: A form of roof construction where the insulation is placed on the outside of the roof structure, removing the need for ventilation of the roof space at eaves level.

Zero carbon homes: Homes with very low energy demand, built to meet the Fabric Energy Efficiency Standard (FEES) which have all of the CO_2 emissions due to fuel use mitigated by a combination of on-site low and zero carbon (LZC) technologies, connected heat and Allowable Solutions.

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Part L 2010 – where to start:

An introduction for house builders and designers

This NHBC guide has been written in response to the October 2010 changes made to Part L: (Conservation of fuel and power) (ADL1A). It is intended to give house builders and designers a broad understanding of the changes to the specification that will need to be incorporated as the starting point for detailed design. The guide provides examples of typical home types outlining possible approaches to comply with ADL1A 2010 and typical construction build-ups.

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