Part L 2013 - where to start:

An introduction for house builders and designers - masonry construction

For England

Guide

NHBC Foundation
Housing research & guidance

F58

Acknowledgements

This guide was written and illustrated for the NHBC Foundation by Richards Partington Architects.

The psi-value guidance published in this guide was developed in conjunction with C4Ci Ltd.

Special thanks to the Building Research Establishment Ltd. (BRE) for verifying the new SAP 2012 guidance.

Front cover image: Derwenthorpe Housing, York architect: Richards Partington Architects; photography © Tim Crocker.

Supported by:

NHBC Foundation
NHBC House
Davy Avenue
Knowlhill
Milton Keynes
MK5 8FP
Tel: 0844 633 1000
Email: info@nhbcfoundation.org
Web: www.nhbcfoundation.org

First published 2014 by NHBC Foundation.
NF58
ISBN 978-0-9930691-0-9

About the NHBC Foundation

The **NHBC Foundation**, established in 2006, provides high quality research and practical guidance to support the house-building industry as it addresses the challenges of delivering 21st century new homes. To date we have published over 50 reports on a wide variety of topics, including the sustainability agenda, homeowner issues and risk management.

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

To find out more about the NHBC Foundation, please visit **www.nhbcfoundation.org**. If you have feedback or suggestions for new areas of research, please contact **info@nhbcfoundation.org**.

NHBC is the standard-setting body and leading warranty and insurance provider for new homes in the UK, providing risk management services to the house-building and wider construction industry. All profits are reinvested in research and work to improve the construction standard of new homes for the benefit of homeowners. NHBC is independent of the Government and builders. To find out more about NHBC, please visit **www.nhbc.co.uk**.

NHBC Foundation Expert Panel

The NHBC Foundation's research programme is guided by the following panel of senior representatives from Government and industry:

Rt Hon Nick Raynsford MP, Chairman of the NHBC Foundation and Expert Panel

Dr Peter Bonfield OBE, Chief Executive, BRE Group

Jane Briginshaw, Head of Design and Sustainability, HCA

Andrew Burke, Policy Officer, National Housing Federation

Claire Curtis-Thomas, Chief Executive, British Board of Agrément

Hywel Davies, Technical Director, Chartered Institution of Building Services Engineers

Andrew Day, Director, Architecture, Design & Sustainability - New Homes and Communities, Countryside Properties (UK) Ltd

Michael Finn, Design and Technical Director, Barratt Developments plc

Cliff Fudge, Technical Director, H+H UK Ltd

Richard Harral, Head of Technical Policy, Building Regulation and Standards Division, Department for Communities and Local Government

Neil Jefferson, Director, NHBC and Chief Executive, Zero Carbon Hub

Rod MacEachrane, NHBC Director (retired)

Robin Nicholson CBE, Senior Partner, Cullinan Studio

Tadj Oreszczyn, Professor of Energy and Environment and Director of the UCL Energy Institute, University College London

Geoff Pearce, Executive Director of Regeneration and Development, Swan Housing Association

Mike Quinton, Chief Executive, NHBC

Helen Saunders, Group Marketing Director, Crest Nicholson plc

Steve Turner, Head of Communications, Home Builders Federation

Andy von Bradsky, Chairman, PRP Architects LLP

Karl Whiteman, Divisional Managing Director, Berkeley Homes

Tony Woodward, Managing Director, Kingerlee Homes

Neil Smith, Head of Research and Innovation, NHBC and Secretary to the Expert Panel

Foreword

This Government is taking the necessary steps to ensure that new homes are zero carbon from 2016. This is important to help achieve significant reductions in carbon emissions and to help save hard working families money on their fuel bills.

The energy efficiency requirements for new homes set out in Part L1A of the Building Regulations are crucial to the achievement of these aims. Following the steps taken to raise the energy efficiency regulatory requirements in 2010 and 2013, Government recently confirmed a further increase will be made alongside the policy of 'Allowable Solutions'. As we take the steps to implement this important zero carbon objective, it is equally important to ensure that new homes are meeting the required levels of energy efficiency.

Thanks to the work of the Zero Carbon Hub and partners we know that in construction, the detailing of junctions is a key factor in heat loss from homes. It is crucial that builders get the junctions right, but Government recognises the technical challenges that builders face in this area. This is why these publications from the National House Building Council are to be welcomed. Using their own resources and goodwill from partners, NHBC has produced guidance for builders on how to construct some of the key masonry and timber junctions in homes. The guidance is therefore a useful starting point and reference point for builders who are working towards achieving compliance with the Building Regulations.

I am pleased to be able to support these publications which will be a useful companion to the Building Regulations and the Approved Documents. In particular I am pleased that these construction techniques will be useful for smaller builders, who often have less access to technical expertise and resources than larger firms. I am grateful for the support of NHBC and other organisations who have contributed to the production of this guidance.

Stephen Williams MP
Minister for Communities

Contents

Introduction to the guide		**1**
1	**Options for compliance**	**3**
	1.1 How to use this section	3
	1.2 Large detached house	4
	1.3 Detached house	5
	1.4 Mid-terrace house	6
	1.5 End-terrace house	7
	1.6 Apartments	8
	1.7 Compliance for apartments and terraces	9
	1.8 Other low and zero carbon technologies	9
	1.9 Homes with rooms in roofs	9
2	**Thermal bridging details**	**11**
	2.1 How to use this section	11
	2.2 Introduction to thermal bridging	12
	2.3 Calculating thermal bridging	12
	2.4 Thermal bridging details	13
3	**Construction build-ups**	**23**
	3.1 Notes on U-values assumptions	23
	3.2 U-values: external walls	24
	3.3 U-values: cold roof and ground floors	25
4	**Home types & modelling assumptions**	**27**
	4.1 General modelling assumptions	27
	4.2 Detached homes	28
	4.3 Attached homes and apartments	29
Glossary		**30**

Introduction to the guide

This guide is intended to help house builders and designers understand the 2013 changes to Approved Document L1A - Conservation of fuel and power in new dwellings (ADL1A). ADL1A 2013 builds on the process for demonstrating compliance established in previous editions. However, there are some key differences in the detail when compared to previous editions. ADL1A 2013 now sets a minimum fabric energy efficiency target, and when this has been achieved a combination of further fabric improvements, efficient services and renewables may be needed to achieve the overall carbon dioxide (CO_2) emissions target.

This guide gives examples of some typical homes outlining a combination of measures needed to comply with ADL1A 2013. The intention is to give a broad understanding of the specifications that may be adopted as a starting point for detailed design. It also illustrates the effects of thermal bridging, which has a considerable impact on the approaches to overall compliance.

To supplement the 'options for compliance' tables and construction 'build-ups' we have also included diagrams of important construction junctions to give house builders and their advisors a better feel for the critical elements and their likely performance.

This is only a general guide and there is no obligation to adopt any of the options given. You should always check with the Building Control Body that your proposals comply with all the requirements of the Building Regulations. You will also need to comply with NHBC Standards and any planning requirements etc.

As part of your Building Regulations application you will have to provide a CO_2 emissions rate and fabric energy efficiency rate calculation using the Government's Standard Assessment Procedure (SAP) before construction commences and again on completion.

The five criteria that must be met in order to demonstrate compliance with Part L are:

Criterion 1

Achieving the Target Emission Rate (TER) and Target Fabric Energy Efficiency (TFEE) rate: these target values are set using the approach set out in ADL1A and SAP 2012 based on a reference building, known as the 'concurrent notional' building, constructed to the specification set out in Appendix R of the SAP document.

Criterion 2

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

Criterion 3

Limiting the effects of heat gains in summer: the building does not suffer from excessive solar and other heat gains. This takes into account the ventilation strategy adopted in the home and gives greater prominence to the insulation of hot water circulation pipes within communal spaces.

Criterion 4

Building performance consistent with the Dwelling Emission Rate (DER) and Dwelling Fabric Energy Efficiency (DFEE) rate: the performance of the building fabric and services verified through appropriate site inspection procedures, testing and commissioning.

Criterion 5

Provisions for energy efficient operation of the dwelling: information is provided to the home occupiers to enable them to operate their new home efficiently.

Section 1: Options for compliance

1.1 How to use this section

This section sets out an approach for discussions with advisors and suppliers. For each home type there is a summary page showing the possible options for compliance. This is only a general guide and the options illustrated are not exhaustive or prescriptive.

Decide on approach to thermal bridging

The first step is to decide how to approach the mandatory fabric energy efficiency target - there are two ways that this may be approached.

Option 1, given in the blue table, shows the fabric specification required if no particular attention is given to thermal bridging. In this instance, the SAP assessor can input a 'default' y-value into the SAP calculations.

Option 2, shown in the yellow tables, shows the fabric specification required if the heat loss through thermal bridges is accounted for by calculations specific to the junction detail adopted. With this approach attention should be paid to the construction of the junctions on site. Note, the fabric specifications needed for option 2, where thermal bridging is calculated for specific junctions, are less demanding and overall are likely to be more cost-effective.

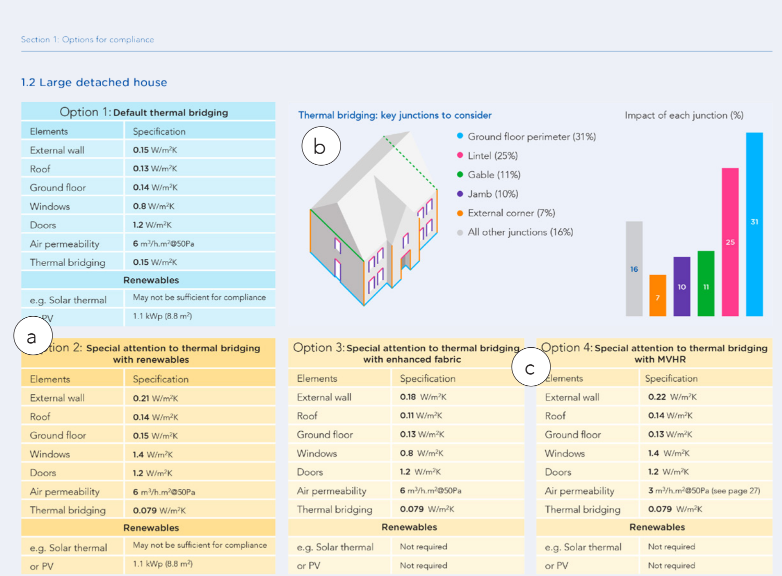
Decide on approach to overall compliance

An indication of the amount of renewables (e.g. solar thermal panels or PV panels) that will be needed to meet the target CO_2 emissions is also included in the tables. Alternative approaches to overall compliance when thermal bridging is being accounted for are shown as options 3 and 4.

Further advice on thermal bridging

If attention is paid to thermal bridging, reference should be made to Section 2 of this guide, which shows construction details. A bar chart is included on each specification page indicating the relative impact of each junction on overall thermal bridging for that home type.

A typical specification page



Section 1: Options for compliance

1.2 Large detached house

Option 1: Default thermal bridging	
Elements	Specification
External wall	0.15 W/m²K
Roof	0.13 W/m²K
Ground floor	0.14 W/m²K
Windows	0.8 W/m²K
Doors	1.2 W/m²K
Air permeability	6 m³/h.m²@50Pa
Thermal bridging	0.15 W/m²K
Renewables	
e.g. Solar thermal	May not be sufficient for compliance
or PV	1.1 kWp (8.8 m²)

Option 2: Special attention to thermal bridging with renewables	
Elements	Specification
External wall	0.21 W/m²K
Roof	0.14 W/m²K
Ground floor	0.15 W/m²K
Windows	1.4 W/m²K
Doors	1.2 W/m²K
Air permeability	6 m³/h.m²@50Pa
Thermal bridging	0.079 W/m²K
Renewables	
e.g. Solar thermal	May not be sufficient for compliance
or PV	1.1 kWp (8.8 m²)

Option 3: Special attention to thermal bridging with enhanced fabric	
Elements	Specification
External wall	0.18 W/m²K
Roof	0.11 W/m²K
Ground floor	0.13 W/m²K
Windows	0.8 W/m²K
Doors	1.2 W/m²K
Air permeability	6 m³/h.m²@50Pa
Thermal bridging	0.079 W/m²K
Renewables	
e.g. Solar thermal	Not required
or PV	Not required

Option 4: Special attention to thermal bridging with MVHR	
Elements	Specification
External wall	0.22 W/m²K
Roof	0.14 W/m²K
Ground floor	0.13 W/m²K
Windows	1.4 W/m²K
Doors	1.2 W/m²K
Air permeability	3 m³/h.m²@50Pa (see page 27)
Thermal bridging	0.079 W/m²K
Renewables	
e.g. Solar thermal	Not required
or PV	Not required

(a) At the outset first decide whether to assume the 'default' thermal bridging value (0.15 W/m^2K) or account for heat loss along each junction. The specifications listed give an indication of what is needed to meet the mandatory fabric energy efficiency target. Additional measures (e.g. solar renewables) may be needed to comply with the CO_2 emissions target.

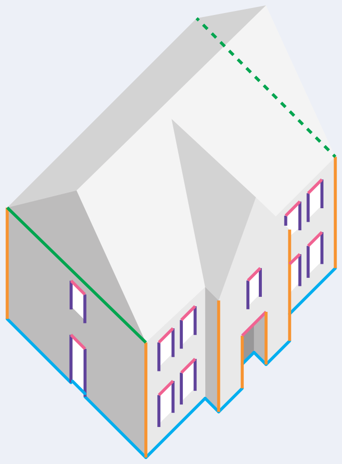
(b) The icon highlights the type of home and the five junctions that have the greatest impact on the total heat loss through thermal bridging. Refer to Section 2 for the corresponding details.

(c) If the heat loss through each junction is being considered, then two alternative routes are available to achieve overall compliance: enhanced fabric specification and the incorporation of an MVHR system. For options 3 and 4, renewables are not required.

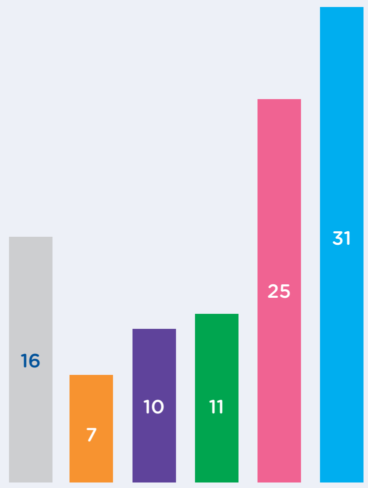
1.2 Large detached house

Option 1: **Default thermal bridging**	
Elements	Specification
External wall	**0.15** W/m²K
Roof	**0.13** W/m²K
Ground floor	**0.14** W/m²K
Windows	**0.8** W/m²K
Doors	**1.2** W/m²K
Air permeability	**6** m³/h.m²@50Pa
Thermal bridging	**0.15** W/m²K
Renewables	
e.g. Solar thermal	May not be sufficient for compliance
or PV	1.1 kWp (8.8 m²)

Thermal bridging: key junctions to consider



Impact of each junction (%)



Option 2: **Special attention to thermal bridging with renewables**	
Elements	Specification
External wall	**0.21** W/m²K
Roof	**0.14** W/m²K
Ground floor	**0.15** W/m²K
Windows	**1.4** W/m²K
Doors	**1.2** W/m²K
Air permeability	**6** m³/h.m²@50Pa
Thermal bridging	**0.079** W/m²K
Renewables	
e.g. Solar thermal	May not be sufficient for compliance
or PV	1.1 kWp (8.8 m²)

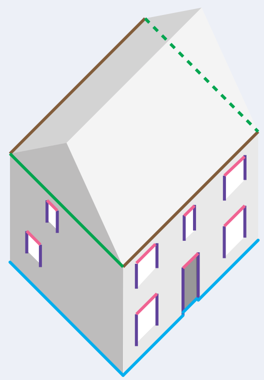
Option 3: **Special attention to thermal bridging with enhanced fabric**	
Elements	Specification
External wall	**0.18** W/m²K
Roof	**0.11** W/m²K
Ground floor	**0.13** W/m²K
Windows	**0.8** W/m²K
Doors	**1.2** W/m²K
Air permeability	**6** m³/h.m²@50Pa
Thermal bridging	**0.079** W/m²K
Renewables	
e.g. Solar thermal	Not required
or PV	Not required

Option 4: **Special attention to thermal bridging with MVHR**	
Elements	Specification
External wall	**0.22** W/m²K
Roof	**0.14** W/m²K
Ground floor	**0.13** W/m²K
Windows	**1.4** W/m²K
Doors	**1.2** W/m²K
Air permeability	**3** m³/h.m²@50Pa (see page 27)
Thermal bridging	**0.079** W/m²K
Renewables	
e.g. Solar thermal	Not required
or PV	Not required

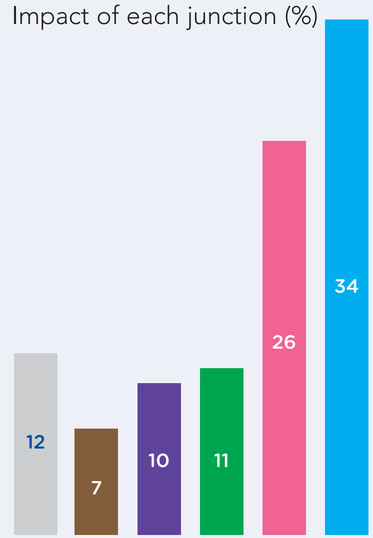
1.3 Detached house

Option 1: **Default thermal bridging**	
Elements	Specification
External wall	**0.15** W/m²K
Roof	**0.13** W/m²K
Ground floor	**0.14** W/m²K
Windows	**0.8** W/m²K
Doors	**1.2** W/m²K
Air permeability	**6** m³/h.m²@50Pa
Thermal bridging	**0.15** W/m²K
Renewables	
e.g. Solar thermal	2.0 m² flat plate solar panels
or PV	0.6 kWp (4.8 m²)

Thermal bridging: key junctions to consider



- Ground floor perimeter (34%)
- Lintel (26%)
- Gable (11%)
- Jamb (10%)
- Eaves (7%)
- All other junctions (12%)



Option 2: **Special attention to thermal bridging with renewables**	
Elements	Specification
External wall	**0.2** W/m²K
Roof	**0.13** W/m²K
Ground floor	**0.15** W/m²K
Windows	**1.4** W/m²K
Doors	**1.2** W/m²K
Air permeability	**6** m³/h.m²@50Pa
Thermal bridging	**0.078** W/m²K
Renewables	
e.g. Solar thermal	2.0 m² flat plate solar panels
or PV	0.6 kWp (4.8 m²)

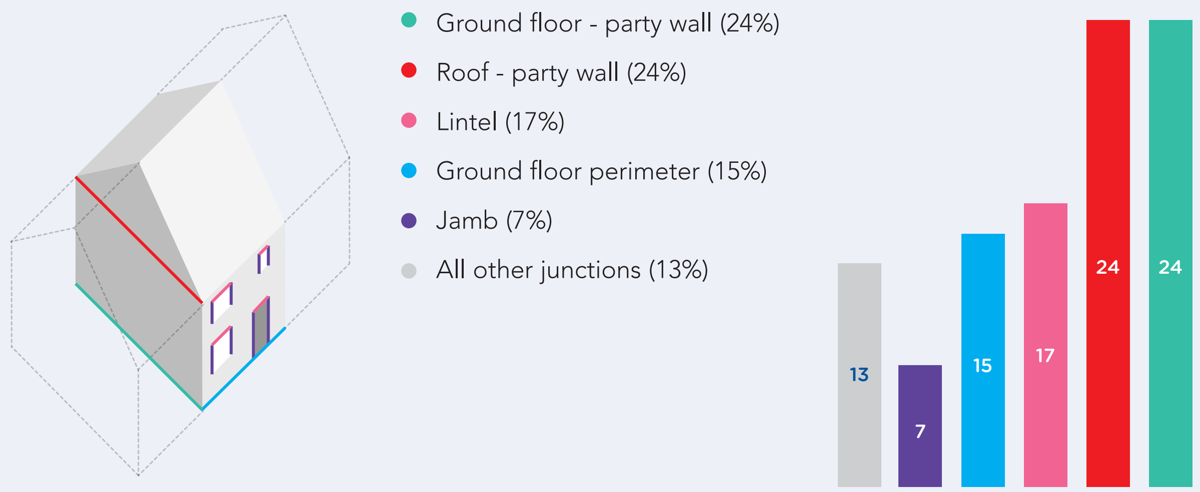
Option 3: **Special attention to thermal bridging with enhanced fabric**	
Elements	Specification
External wall	**0.18** W/m²K
Roof	**0.11** W/m²K
Ground floor	**0.13** W/m²K
Windows	**0.8** W/m²K
Doors	**1.2** W/m²K
Air permeability	**6** m³/h.m²@50Pa
Thermal bridging	**0.078** W/m²K
Renewables	
e.g. Solar thermal	Not required
or PV	Not required

Option 4: **Special attention to thermal bridging with MVHR**	
Elements	Specification
External wall	**0.21** W/m²K
Roof	**0.13** W/m²K
Ground floor	**0.13** W/m²K
Windows	**1.4** W/m²K
Doors	**1.2** W/m²K
Air permeability	**3** m³/h.m²@50Pa (see page 27)
Thermal bridging	**0.078** W/m²K
Renewables	
e.g. Solar thermal	Not required
or PV	Not required

1.4 Mid-terrace house

Option 1: **Default thermal bridging**	
Elements	Specification
External wall	**0.15** W/m²K
Roof	**0.1** W/m²K
Ground floor	**0.1** W/m²K
Windows	**0.8** W/m²K
Doors	**1.2** W/m²K
Air permeability	**6** m³/h.m²@50Pa
Thermal bridging	**0.15** W/m²K
Renewables	
e.g. Solar thermal	1 m² flat plate solar panels
or PV	0.4 kWp (3.2 m²)

Thermal bridging: key junctions to consider



Option 2: **Special attention to thermal bridging with renewables**	
Elements	Specification
External wall	**0.18** W/m²K
Roof	**0.1** W/m²K
Ground floor	**0.11** W/m²K
Windows	**1.4** W/m²K
Doors	**1.2** W/m²K
Air permeability	**6** m³/h.m²@50Pa
Thermal bridging	**0.126** W/m²K
Renewables	
e.g. Solar thermal	1 m² flat plate solar panels
or PV	0.4 kWp (3.2 m²)

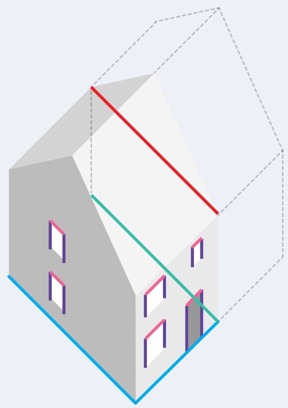
Option 3: **Special attention to thermal bridging with enhanced fabric**	
Elements	Specification
External wall	**0.15** W/m²K
Roof	**0.07** W/m²K
Ground floor	**0.1** W/m²K
Windows	**0.8** W/m²K
Doors	**1.2** W/m²K
Air permeability	**3** m³/h.m²@50Pa (see page 27)
Thermal bridging	**0.126** W/m²K
Renewables	
e.g. Solar thermal	Not required
or PV	Not required

Option 4: **Special attention to thermal bridging with MVHR**	
Elements	Specification
External wall	**0.2** W/m²K
Roof	**0.12** W/m²K
Ground floor	**0.13** W/m²K
Windows	**1.4** W/m²K
Doors	**1.2** W/m²K
Air permeability	**3** m³/h.m²@50Pa (see page 27)
Thermal bridging	**0.126** W/m²K
Renewables	
e.g. Solar thermal	Not required
or PV	Not required

1.5 End-terrace house

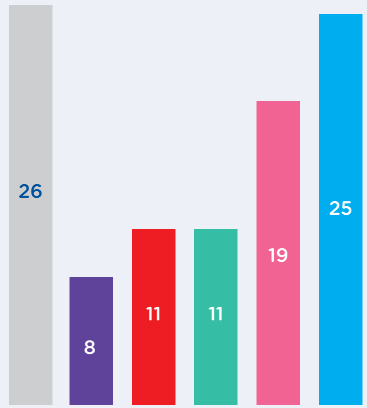
Option 1: **Default thermal bridging**	
Elements	Specification
External wall	**0.15** W/m^2K
Roof	**0.1** W/m^2K
Ground floor	**0.12** W/m^2K
Windows	**0.8** W/m^2K
Doors	**1.2** W/m^2K
Air permeability	**6** $m^3/h.m^2$@50Pa
Thermal bridging	**0.15** W/m^2K
Renewables	
e.g. Solar thermal	1.5 m^2 flat plate solar panels
or PV	0.5 kWp (4 m^2)

Thermal bridging: key junctions to consider



- Ground floor perimeter (25%)
- Lintel (19%)
- Ground floor - party wall (11%)
- Roof - party wall (11%)
- Jamb (8%)
- All other junctions (26%)

Impact of each junction (%)



Option 2: **Special attention to thermal bridging with renewables**	
Elements	Specification
External wall	**0.18** W/m^2K
Roof	**0.13** W/m^2K
Ground floor	**0.13** W/m^2K
Windows	**1.4** W/m^2K
Doors	**1.2** W/m^2K
Air permeability	**6** $m^3/h.m^2$@50Pa
Thermal bridging	**0.1** W/m^2K
Renewables	
e.g. Solar thermal	1.5 m^2 flat plate solar panels
or PV	0.5 kWp (4 m^2)

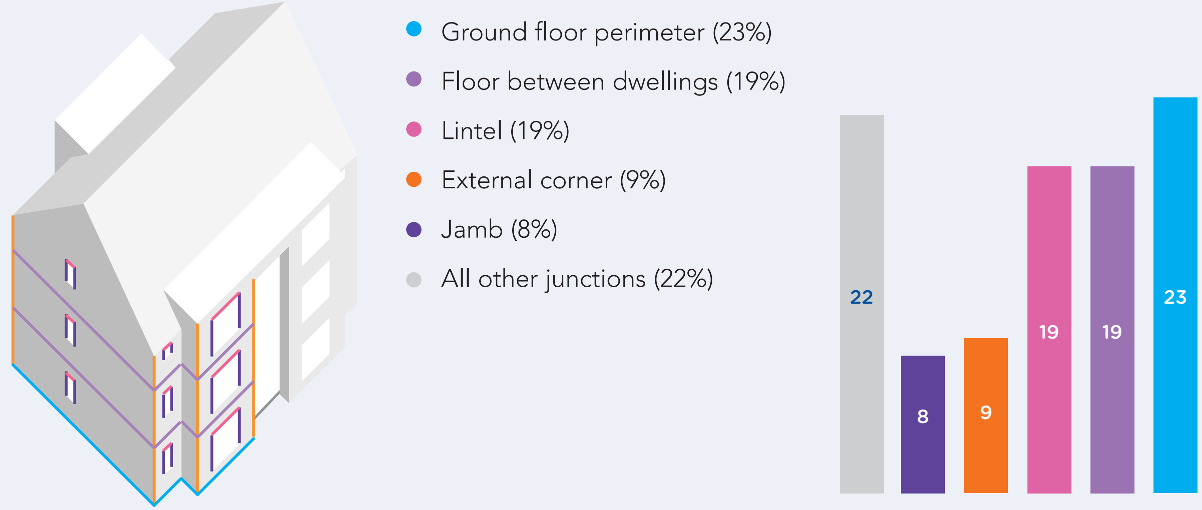
Option 3: **Special attention to thermal bridging with enhanced fabric**	
Elements	Specification
External wall	**0.15** W/m^2K
Roof	**0.1** W/m^2K
Ground floor	**0.1** W/m^2K
Windows	**0.8** W/m^2K
Doors	**1.2** W/m^2K
Air permeability	**3** $m^3/h.m^2$@50Pa (see page 27)
Thermal bridging	**0.1** W/m^2K
Renewables	
e.g. Solar thermal	Not required
or PV	Not required

Option 4: **Special attention to thermal bridging with MVHR**	
Elements	Specification
External wall	**0.18** W/m^2K
Roof	**0.13** W/m^2K
Ground floor	**0.13** W/m^2K
Windows	**1.4** W/m^2K
Doors	**1.2** W/m^2K
Air permeability	**3** $m^3/h.m^2$@50Pa (see page 27)
Thermal bridging	**0.1** W/m^2K
Renewables	
e.g. Solar thermal	Not required
or PV	Not required

1.6 Apartments

Option 1: **Default thermal bridging**	
Elements	Specification
External wall	**0.15** W/m²K
Sheltered wall	**0.15** W/m²K
Roof	**0.13** W/m²K
Floor	**0.15** W/m²K
Windows	**0.8** W/m²K
Doors	**1.2** W/m²K
Air permeability	**6** m³/h.m²@50Pa
Thermal bridging	**0.15** W/m²K
Renewables	
e.g. Solar thermal	Not feasible
or PV	0.25 kWp (2 m²)

Thermal bridging: key junctions to consider



Option 2: **Special attention to thermal bridging with renewables**	
Elements	Specification
External wall	**0.21** W/m²K
Sheltered wall	**0.21** W/m²K
Roof	**0.13** W/m²K
Ground floor	**0.14** W/m²K
Windows	**1.4** W/m²K
Doors	**1.2** W/m²K
Air permeability	**6** m³/h.m²@50Pa
Thermal bridging	**0.093** W/m²K
Renewables	
e.g. Solar thermal	Not feasible
or PV	0.25 kWp (2 m²)

Option 3: **Special attention to thermal bridging with enhanced fabric**	
Elements	Specification
External wall	**0.18** W/m²K
Sheltered wall	**0.18** W/m²K
Roof	**0.13** W/m²K
Ground floor	**0.15** W/m²K
Windows	**0.8** W/m²K
Doors	**1.2** W/m²K
Air permeability	**6** m³/h.m²@50Pa
Thermal bridging	**0.093** W/m²K
Renewables	
e.g. Solar thermal	Not required
or PV	Not required

Option 4: **Special attention to thermal bridging with MVHR**	
Elements	Specification
External wall	**0.23** W/m²K
Sheltered wall	**0.23** W/m²K
Roof	**0.15** W/m²K
Ground floor	**0.15** W/m²K
Windows	**1.4** W/m²K
Doors	**1.2** W/m²K
Air permeability	**3** m³/h.m²@50Pa (see page 27)
Thermal bridging	**0.093** W/m²K
Renewables	
e.g. Solar thermal	Not required
or PV	Not required

1.7 Compliance for apartments and terraces

For homes in a block of apartments or that form part of a terrace, compliance with the CO_2 emissions and fabric energy efficiency targets may either be demonstrated individually for each home or as an average across the block. The form of some home types is inherently energy efficient, such as mid-terraces and mid-floor apartments, where there is relatively smaller surface area through which heat is lost. 'Block averaging' allows for the fabric specification to be optimised across attached homes, with better performing unit types compensating for less efficient ones.

If solar renewable technologies are adopted to comply with the CO_2 emissions targets, the size of the panel may be optimised across the dwellings as long as the average target is met. In the case of apartments, the output from PVs may be connected to the landlord's supply for common services.

1.8 Other low and zero carbon technologies

A combination of other technologies such as flue gas heat recovery and waste water heat recovery systems may be used to achieve overall compliance. These systems may be particularly beneficial in small or attached home. For developments with no access to main gas connections, heat pumps may be a suitable choice.

1.9 Homes with rooms in roofs

Further explanations of the considerations that are needed for homes with complex building geometries may be found in NHBC Foundation publication 'Designing homes for the 21st century - Lessons for low energy design' (NF50).

For each of the home types illustrated in this guide a flat ceiling has been assumed. For thermal bridging around dormers and rooms-in-the-roof etc., see Appendix R of SAP 2012. In such cases, heat loss values will need to be calculated or data from system manufacturers may be used where appropriate.

Section 2: Thermal bridging details

2.1 How to use this section

This section introduces thermal bridging and illustrates typical approaches to the key construction junctions identified for the home types discussed in Section 1. These junctions have been designed to correspond with the U-values that are applicable for ADL1A 2013.

The calculated psi-values stated for each junction can be used by the SAP assessor provided that on-site construction is in strict accordance with the detail.

Some details can be significantly improved by changing the density of the blockwork, and in these cases two calculated psi-values have been given.

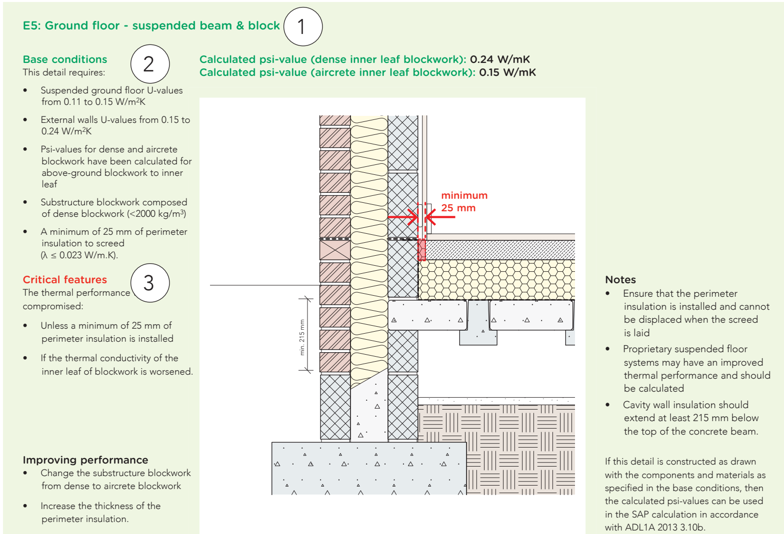
Other ways in which the performance of the junction may be improved are also described. However, these improvements in psi-values can only be claimed if these are modelled in accordance with the guidance in ADL1A 2013.

Only details for junctions that are relevant to the home types in this guide have been included. For other masonry details refer to Constructive Details' 'Handbook of thermal bridging details' (www.constructivedetails.co.uk), the Concrete Block Association (www.cba-blocks.org/uk/tech/thermal-bridge), LABC Registered Details, and individual manufacturers' literature.

Note:

The details illustrated here are not intended to be working drawings and consideration must also be given to structure, waterproofing, airtightness, general good-practice and sequencing on site. The calculated psi-values have been tested for robustness against the ranges of variations stated. The details have been verified to meet the provisions under ADL1A 2013 (paragraph 3.10b).

A typical thermal bridging detail page



E5: Ground floor - suspended beam & block (1)

Base conditions (2)
This detail requires:

- Suspended ground floor U-values from 0.11 to 0.15 W/m²K
- External walls U-values from 0.15 to 0.24 W/m²K
- Psi-values for dense and aircrete blockwork have been calculated for above-ground blockwork to inner leaf
- Substructure blockwork composed of dense blockwork (<2000 kg/m³)
- A minimum of 25 mm of perimeter insulation to screed (λ ≤ 0.023 W/m.K).

Calculated psi-value (dense inner leaf blockwork): 0.24 W/mK
Calculated psi-value (aircrete inner leaf blockwork): 0.15 W/mK

Critical features (3)
The thermal performance compromised:

- Unless a minimum of 25 mm of perimeter insulation is installed
- If the thermal conductivity of the inner leaf of blockwork is worsened.

Improving performance
- Change the substructure blockwork from dense to aircrete blockwork
- Increase the thickness of the perimeter insulation.

Notes
- Ensure that the perimeter insulation is installed and cannot be displaced when the screed is laid
- Proprietary suspended floor systems may have an improved thermal performance and should be calculated
- Cavity wall insulation should extend at least 215 mm below the top of the concrete beam.

If this detail is constructed as drawn with the components and materials as specified in the base conditions, then the calculated psi-values can be used in the SAP calculation in accordance with ADL1A 2013 3.10b.

(1) Refers to the junction reference as given in SAP 2012.

(2) The base conditions may be varied within the ranges stated.

(3) Conditions that are critical to achieving the stated psi-values are listed as 'critical features' and must be adhered to on site.

The following U-value assumptions form the basis of modelling:

- External walls: U-values from 0.15 to 0.24 W/m²K. The calculated psi-values are applicable to both fully and partially filled walls;
- Party walls: U-value of 0.00 W/m²K as per SAP 2012 guidance (with a fully filled cavity) and compliant with Robust Details;
- Ground floors: U-values from 0.11 to 0.15 W/m²K;
- Cold roofs: U-values from 0.09 to 0.13 W/m²K.

For robustness, the U-values quoted in this section are based on build-ups and materials illustrated in Section 3. Any variations in construction and materials will need to be modelled.

2.2 Introduction to thermal bridging

A thermal bridge occurs at any point of weakness or discontinuity in the insulation of a thermal element (wall, floor and roof, etc.) such as where a lintel bridges the wall insulation or where a wall and floor meet. In ADL1A these junctions are called 'linear' thermal bridges because heat loss occurs along the length of the bridging element.

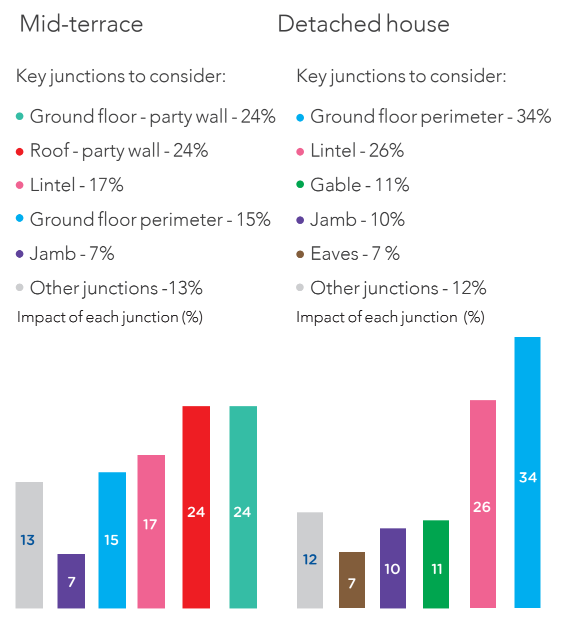
Thermal bridges also occur where components that are integral to the construction, for instance wall ties or timber studs, span across the insulation layer. These repeating thermal bridges are accounted for in the U-value calculation for each element and are not considered in this section.

The proportion of heat loss from thermal bridges generally increases as the performance of the insulation and airtightness improves. With the introduction of a fabric energy efficiency target in ADL1A 2013, homes will become even better insulated and airtight and therefore it is advisable to pay special attention to the thermal bridging losses.

2.3 Calculating thermal bridging

The heat loss along a linear thermal bridge is expressed as its psi-value, which is calculated by using complex thermal modelling (following the guidance in BR 497 and IP 1/06). Once the psi-value is established, the SAP assessor can then calculate the heat loss for the whole junction by multiplying the psi-value by the length of the corresponding construction junction (i.e. the length of the lintel or length of the junction where the wall meets the floor). The total calculated heat loss from all junctions is then divided by the area of all exposed (heat loss) surfaces, i.e. floors, roofs and walls (including windows and doors and rooflights), to arrive at what is known as the overall y-value for that particular home.

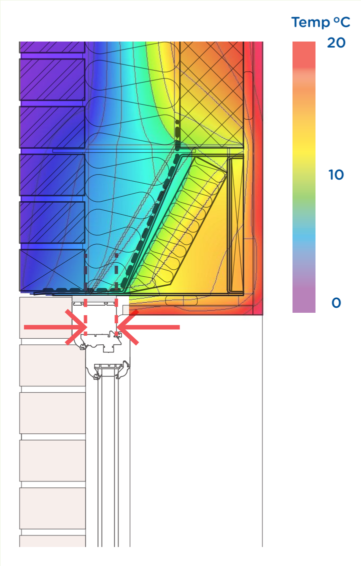
The calculated y-value will vary for different home types across a development.



The impact of different construction junctions and the proportion of heat loss associated with each junction will both vary depending on the home type.

This is illustrated in the bar graphs to the left which show that for detached homes the heat loss through the junction between the external walls and the ground floor is quite significant; while in mid-terraces, the junction between the party walls and the ground floor is more important.

The details to consider will vary by home type and consequently the calculated y-values will differ depending on the design of the home.



Where combination steel box lintels are commonly used considerable heat loss may occur because of the proportion of steel, the minimal and discontinuous insulation and the length of the bridge.

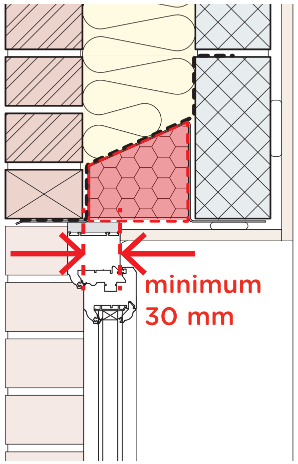
As an illustration, in a mid-terrace home, using this type of lintel can worsen the overall y-value to an extent that the wall U-value would need to be improved from 0.18 W/m^{2}K to 0.13 W/m^{2}K to meet the Target Fabric Energy Efficiency rate.

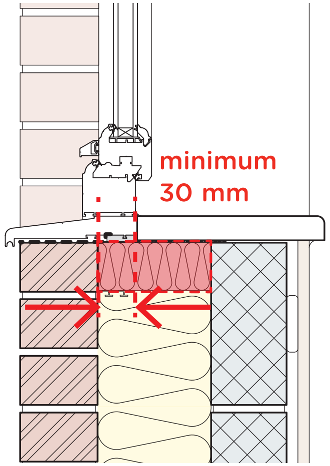
Notes

- Position the window in the design drawings to allow for some tolerance on site so that the minimum window frame overlap is always maintained.

If these details are constructed as drawn with the components and materials as specified in the base conditions, then the calculated psi-values can be used in the SAP calculation in accordance with ADL1A 2013 3.10b.

E2: Lintel
Calculated psi-value: 0.30 W/mK





E3: Sills
Calculated psi-value: 0.05 W/mK

Base conditions

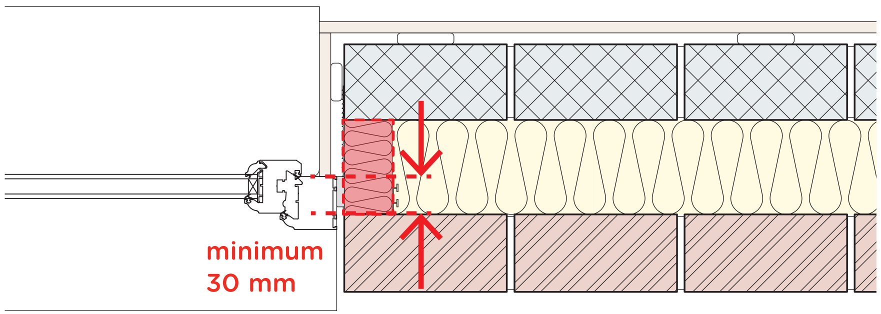
This detail requires:

- External walls U-values from 0.15 to 0.24 W/m^{2}K
- External walls with either partially or fully filled cavities
- An overlap between the window frame and cavity closer of 30 mm
- Any insulated cavity closer.

Critical features

The thermal performance will be compromised:

- Unless there is a minimum 30 mm overlap between the window frame and the cavity closer
- Unless there is an insulated cavity closer installed to the sill and jamb junctions.



E4: Jamb
Calculated psi-value: 0.05 W/mK

Improving performance

- Increase the overlap between the window frame and cavity closer.

E5: Ground floor - suspended beam & block

Base conditions

This detail requires:

- Suspended ground floor U-values from 0.11 to 0.15 W/m^{2}K
- External walls U-values from 0.15 to 0.24 W/m^{2}K
- Psi-values for dense and aircrete blockwork have been calculated for above-ground blockwork to inner leaf
- Substructure blockwork composed of dense blockwork (<2000 kg/m^3)
- A minimum of 25 mm of perimeter insulation to screed ($\lambda \leq 0.023$ W/m.K).

Critical features

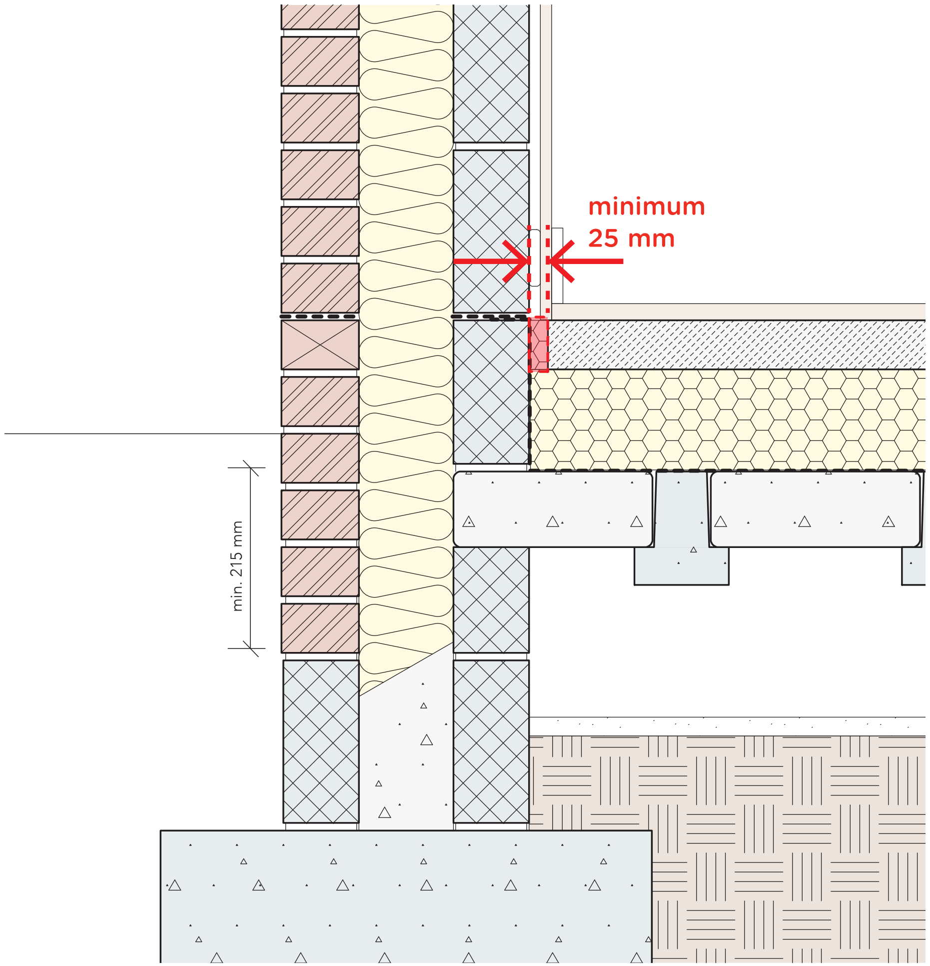
The thermal performance will be compromised:

- Unless a minimum of 25 mm of perimeter insulation is installed
- If the thermal conductivity of the inner leaf of blockwork is worsened.

Improving performance

- Change the substructure blockwork from dense to aircrete blockwork
- Increase the thickness of the perimeter insulation.

Calculated psi-value (dense inner leaf blockwork): 0.24 W/mK
Calculated psi-value (aircrete inner leaf blockwork): 0.15 W/mK

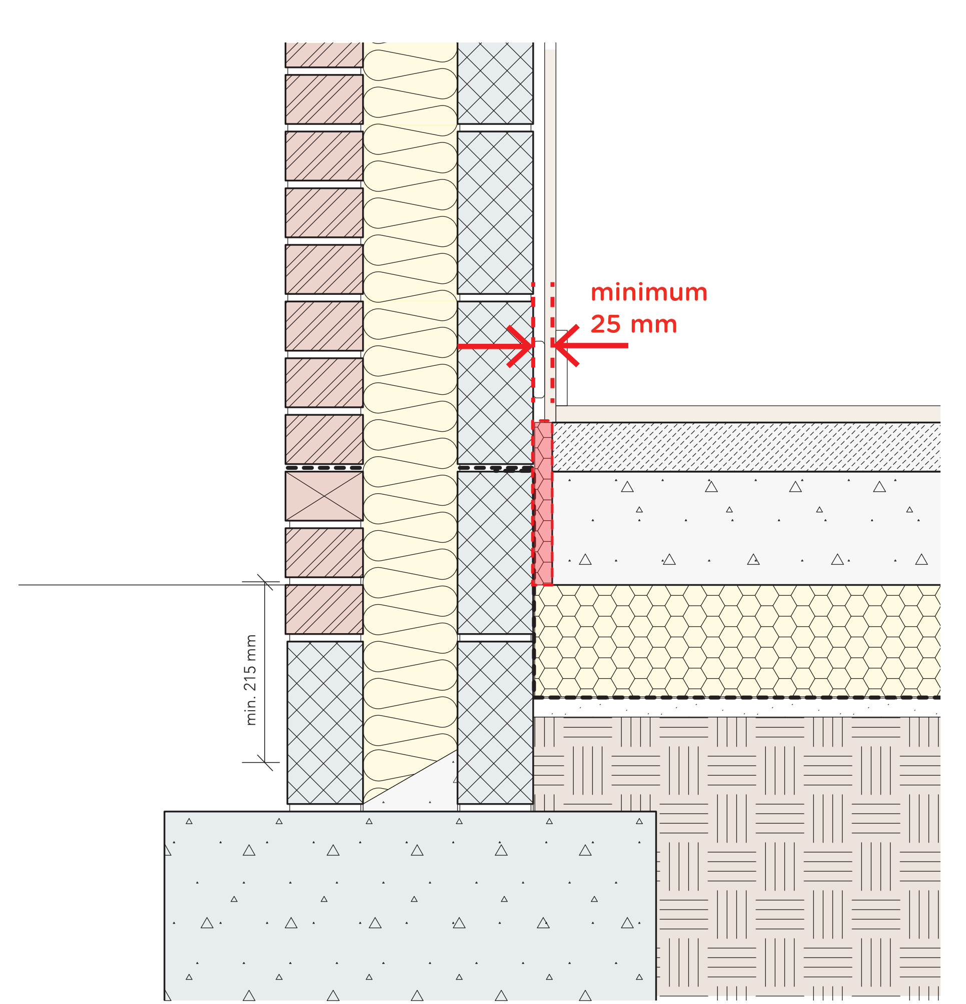


Notes

- Ensure that the perimeter insulation is installed and cannot be displaced when the screed is laid
- Proprietary suspended floor systems may have an improved thermal performance and should be calculated
- Cavity wall insulation should extend at least 215 mm below the top of the concrete beam.

If this detail is constructed as drawn with the components and materials as specified in the base conditions, then the calculated psi-values can be used in the SAP calculation in accordance with ADL1A 2013 3.10b.

Calculated psi-value (dense inner leaf blockwork): 0.24 W/mK
Calculated psi-value (aircrete inner leaf blockwork): 0.19 W/mK



Base conditions

This detail requires:

- Ground bearing floor U-values from 0.11 to 0.15 W/m^{2}K
- External walls U-values from 0.15 to 0.24 W/m^{2}K
- Psi-values for dense and aircrete blockwork have been calculated for above-ground blockwork to inner leaf
- Substructure blockwork composed of dense blockwork (<2000 kg/m^3)
- A minimum of 25 mm of perimeter insulation to screed ($\lambda \leq 0.023$ W/m.K).

Critical features

The thermal performance will be compromised:

- Unless a minimum of 25 mm of perimeter insulation is installed
- If the thermal conductivity of the inner leaf of blockwork is worsened.

Improving performance

- Change the substructure blockwork from dense to aircrete blockwork
- Increase the thickness of the perimeter insulation.

Notes

- Ensure that the perimeter insulation is installed and cannot be displaced when the screed is laid
- Cavity wall insulation should extend at least 215 mm below the underside of the slab.

If this detail is constructed as drawn with the components and materials as specified in the base conditions, then the calculated psi-values can be used in the SAP calculation in accordance with ADL1A 2013 3.10b.

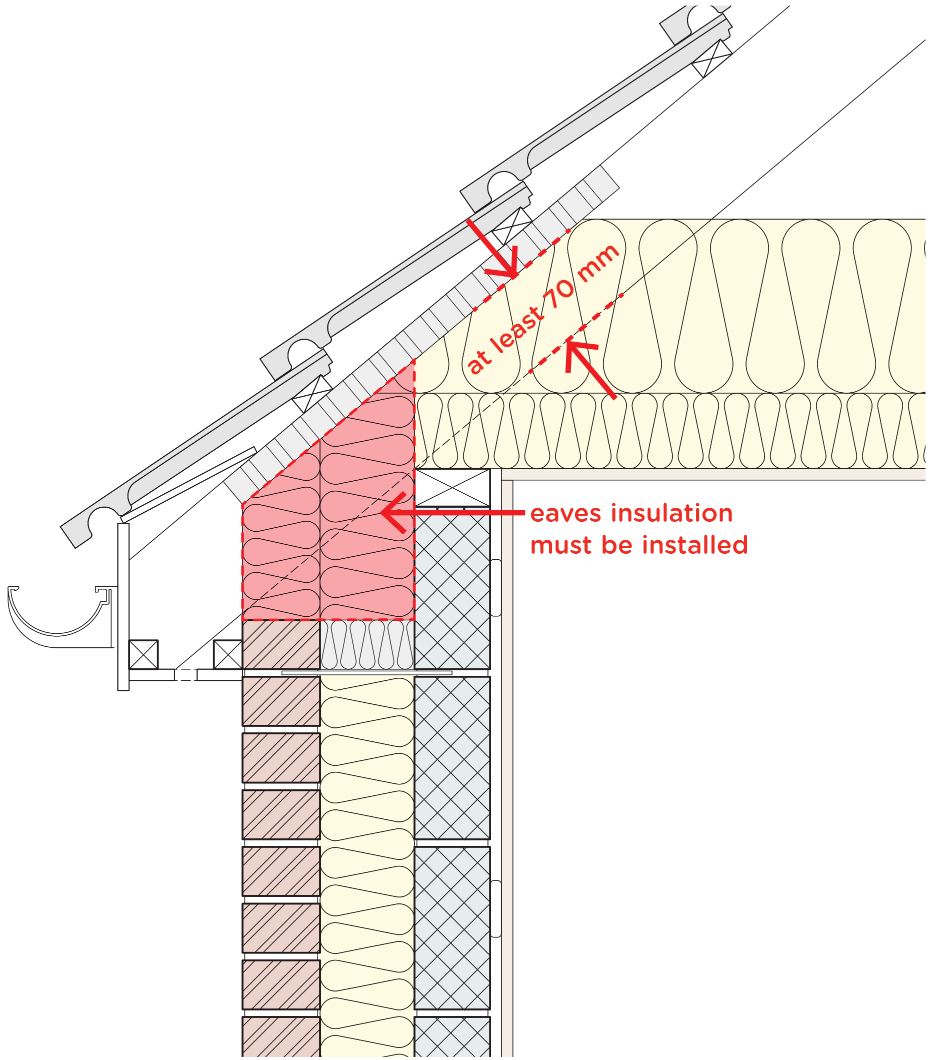
E10: Eaves

Base conditions

This detail requires:

- Cold roof U-values from 0.09 to 0.13 W/m²K
- External walls U-values from 0.15 to 0.24 W/m²K
- External walls with either partially or fully filled cavities
- Inner leaf of blockwork with any density
- Minimum roof pitch of 30 degrees.

Calculated psi-value: 0.10 W/mK



Critical features

The thermal performance will be compromised:

- Unless there is a minimum distance of 70 mm between the underside of the ventilator tray and the wall plate that is fully insulated
- If the area under the eaves is not fully filled with insulation.

Improving performance

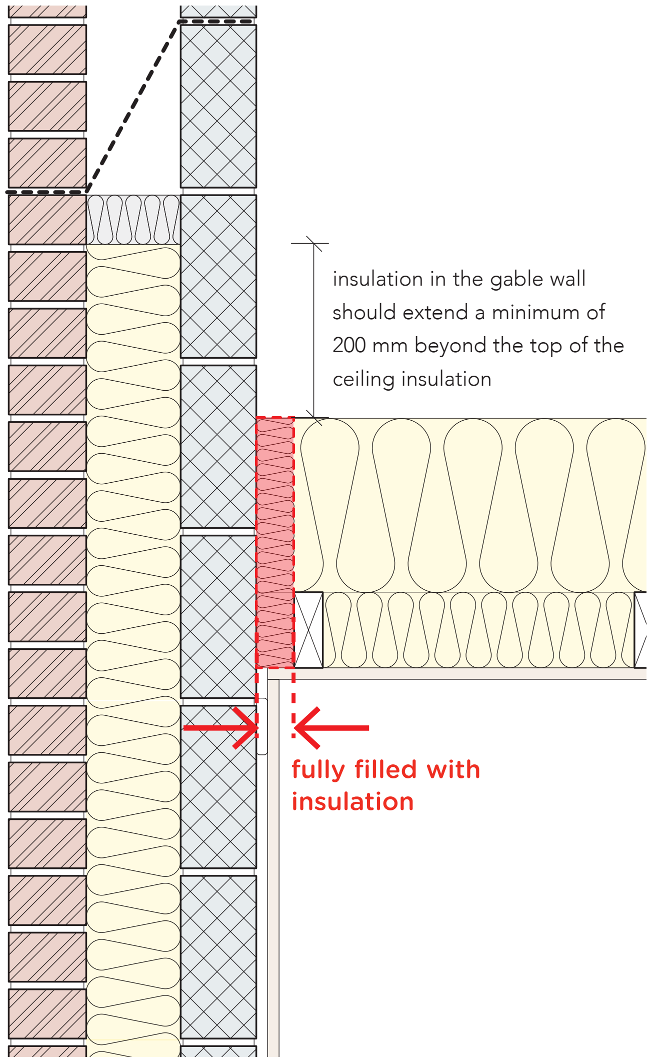
- Increase the depth of the insulation between the ventilator tray and the wall plate.

Notes

- Installing the perimeter eaves insulation can be difficult with shallow pitch roofs or where the distance between the ventilator tray and the wall plate is reduced. It is often helpful to fix insulation to the wall plate and fold it down towards the cavity before any roof tiling is installed.

If this detail is constructed as drawn with the components and materials as specified in the base conditions, then the calculated psi-values can be used in the SAP calculation in accordance with ADL1A 2013 3.10b.

Calculated psi-value (dense blockwork): 0.17 W/mK
Calculated psi-value (aircrete blockwork): 0.07 W/mK



Notes

- Install a minimum of 200 mm of insulation between the top of the cold roof insulation and the top of the insulation in the gable wall.

If this detail is constructed as drawn with the components and materials as specified in the base conditions, then the calculated psi-values can be used in the SAP calculation in accordance with ADL1A 2013 3.10b.

Base conditions

This detail requires:

- Cold roof U-values from 0.09 to 0.13 W/m^{2}K
- External walls U-values from 0.15 to 0.24 W/m^{2}K
- External walls with either partially or fully filled cavities
- Psi-values for dense and aircrete blockwork have been calculated for above-ground blockwork to inner leaf
- Insulation tightly packed between the last truss and the blockwork.

Critical features

The thermal performance will be compromised:

- Unless the void between the last truss and the blockwork wall of the gable is fully filled with insulation.

Improving performance

Not applicable to this detail.

E6 & E7: Intermediate and party floors

Base conditions

This detail requires:

- External walls U-values from 0.15 to 0.24 W/m²K
- External walls with either partially or fully filled cavities
- Inner leaf of blockwork with any density
- For E7: any compliant Robust Detail party floor for masonry construction.

Critical features

Not applicable to these details.

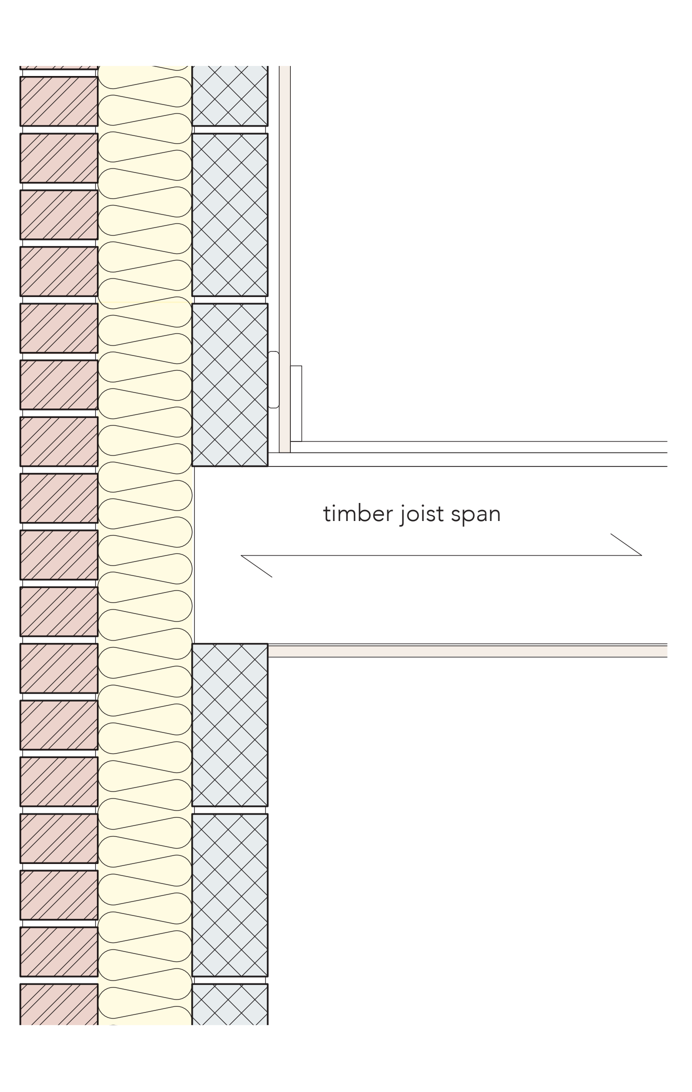
Notes

Not applicable to these details.

If these details are constructed as drawn with the components and materials as specified in the base conditions, then the calculated psi-values can be used in the SAP calculation in accordance with ADL1A 2013 3.10b.

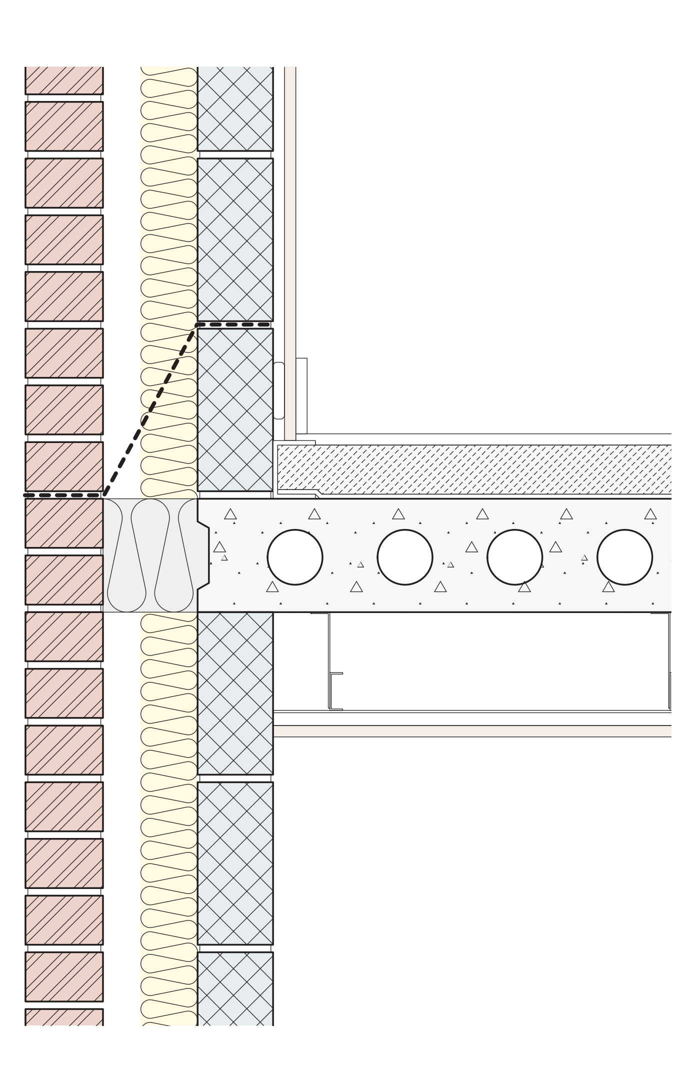
E6: Intermediate floor (within dwellings)

Calculated psi-value: 0.007 W/mK

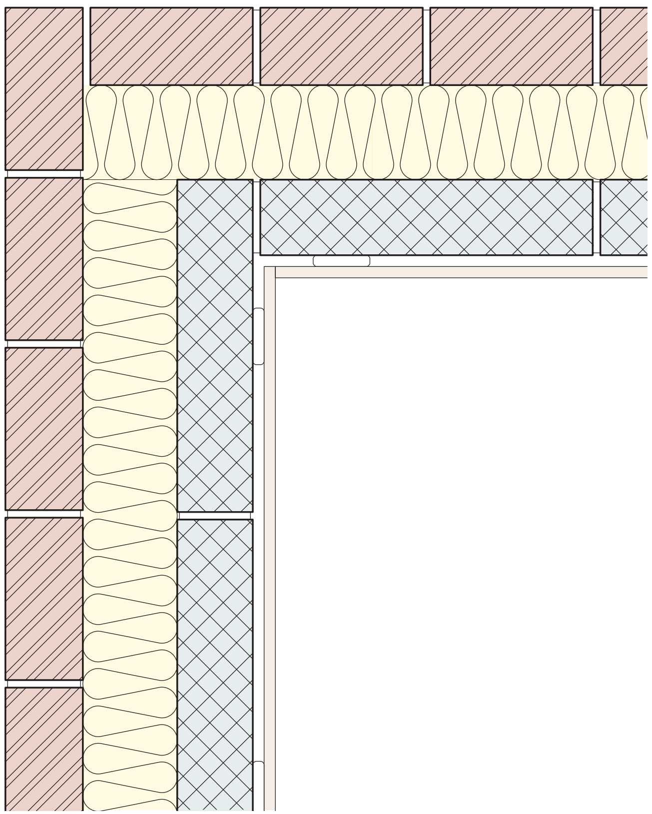


E7: Party floor (between dwellings)

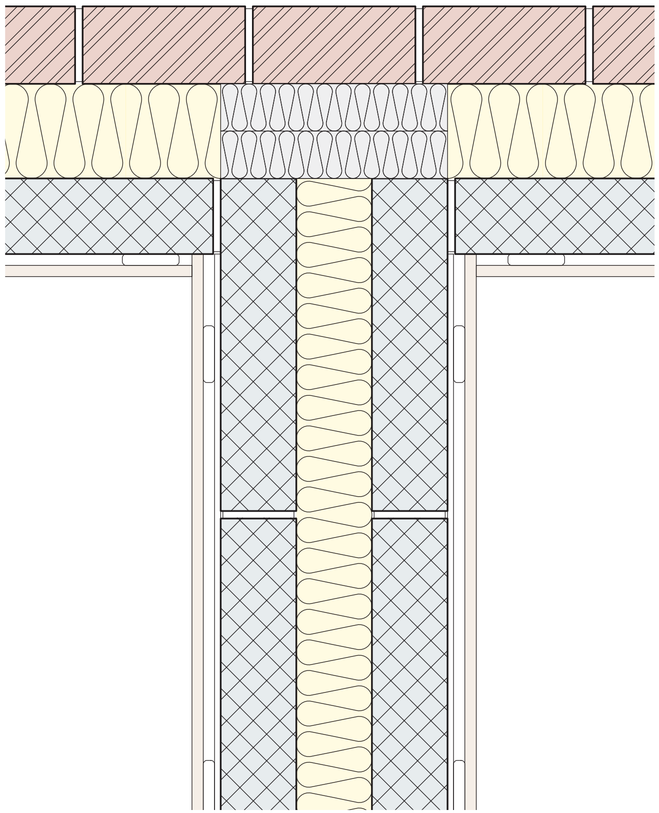
Calculated psi-value: 0.05 W/mK



E16: Corner
Calculated psi-value: 0.07 W/mK



E18: Party wall
Calculated psi-value: 0.05 W/mK



Base conditions
This detail requires:

- External walls U-values from 0.15 to 0.24 W/m^{2}K
- External walls with either partially or fully filled cavities
- Inner leaf of blockwork with any density
- For E18: any masonry party wall construction with a fully filled cavity (maximum cavity width of 100 mm) that is both compliant with Robust Details and achieves a U-value of 0.00 W/m^{2}K as per SAP 2012 guidance.

Critical features
Not applicable to these details.

Notes
Not applicable to these details.

If these details are constructed as drawn with the components and materials as specified in the base conditions, then the calculated psi-values can be used in the SAP calculation in accordance with ADL1A 2013 3.10b.

P1: Ground floor - suspended beam & block / party wall

Base conditions

This detail requires:

- Suspended ground floor U-values from 0.11 to 0.15 W/m²K
- Any masonry party wall construction with a fully filled cavity (maximum cavity width of 100 mm) that is both compliant with Robust Details and achieves a U-value of 0.00 W/m²K as per SAP 2012 guidance
- Psi-values for dense and aircrete blockwork have been calculated for above-ground blockwork to party wall
- Substructure blockwork composed of dense blockwork (<2000 kg/m³)
- A minimum of 25 mm of perimeter insulation to screed (λ ≤ 0.023 W/m.K).

Critical features

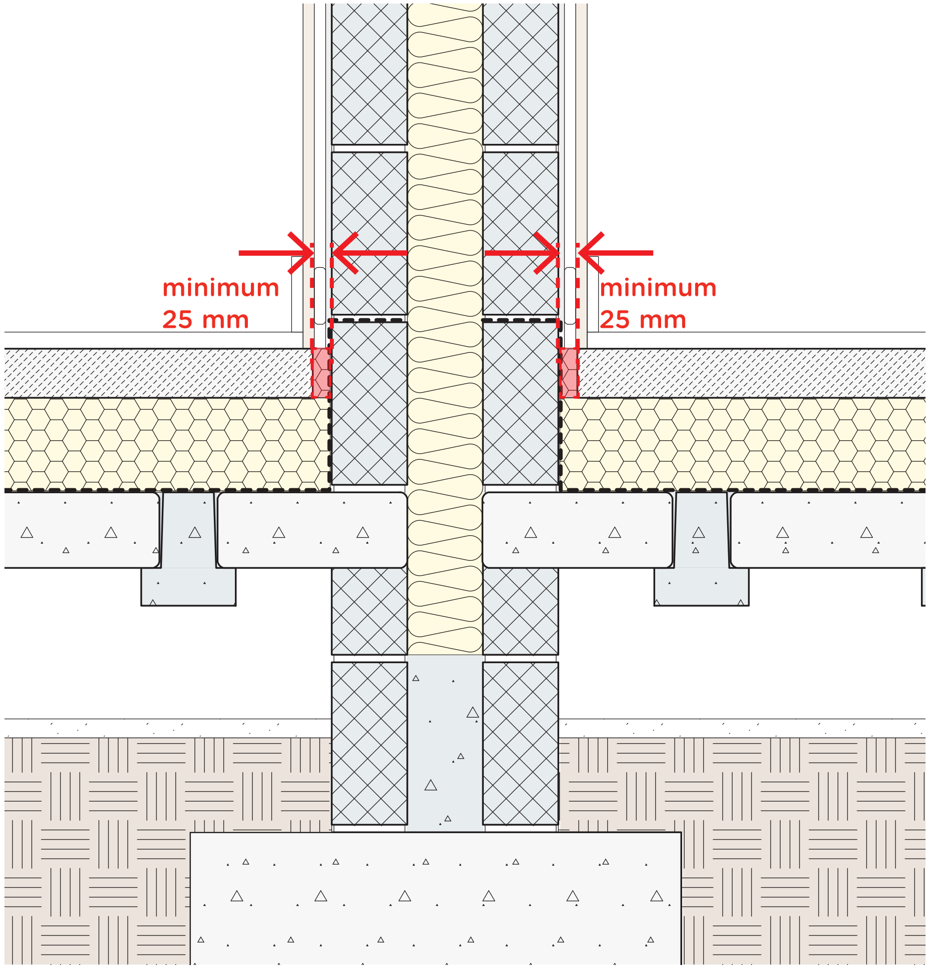
The thermal performance will be compromised:

- Unless there is a minimum of 25 mm of perimeter insulation
- If the thermal conductivity of the inner leaf of blockwork is worsened.

Improving performance

- Change the substructure blockwork from dense to aircrete blockwork
- Increase the thickness of the perimeter insulation.

Calculated psi-value (dense inner leaf blockwork): 0.24 W/mK
Calculated psi-value (aircrete inner leaf blockwork): 0.17 W/mK

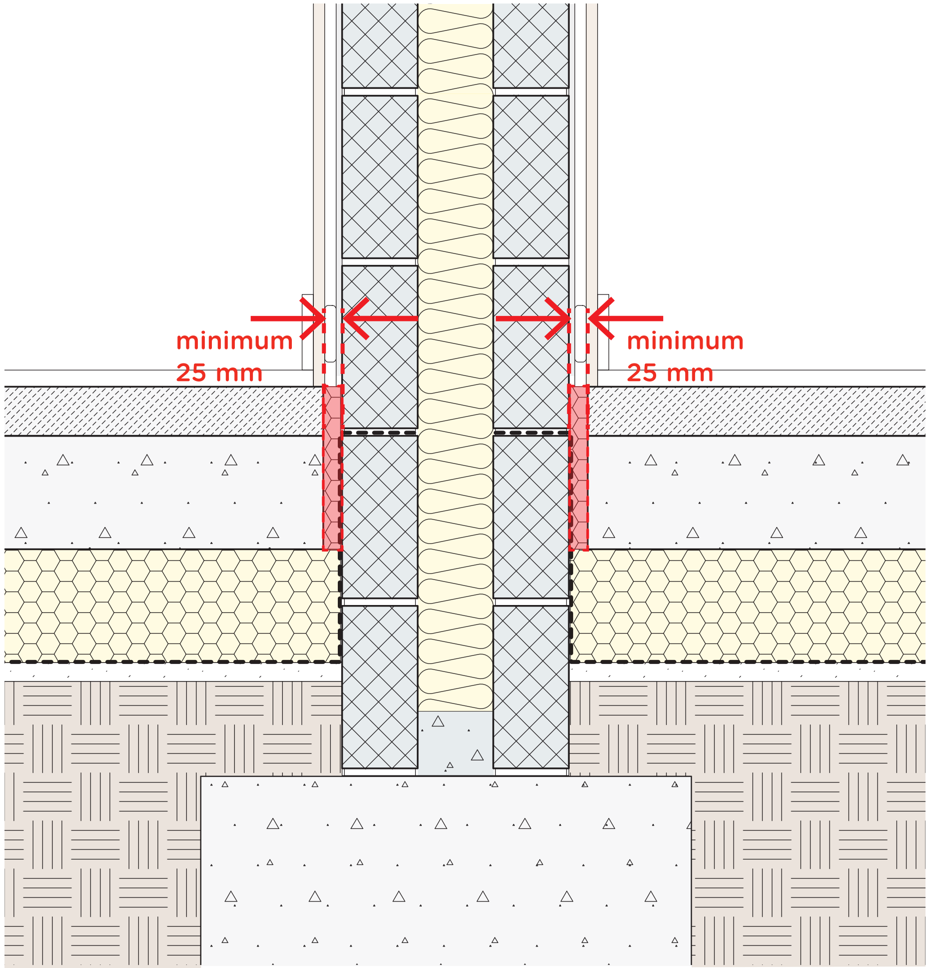


Notes

- Ensure that the perimeter insulation cannot be displaced when the screed is laid
- Party wall insulation should extend at least 215 mm below the top of the concrete beam
- Proprietary suspended floor systems may have an improved thermal performance and should be calculated.

If this detail is constructed as drawn with the components and materials as specified in the base conditions, then the calculated psi-values can be used in the SAP calculation in accordance with ADL1A 2013 3.10b.

Calculated psi-value: 0.17 W/mK



Base conditions

This detail requires:

- Ground bearing floor U-values from 0.11 to 0.15 W/m^{2}K
- Any masonry party wall construction with a fully filled cavity (maximum cavity width of 100 mm) that is both compliant with Robust Details and achieves a U-value of 0.00 W/m^{2}K as per SAP 2012 guidance
- Party walls with any density of blockwork
- Substructure blockwork composed of dense blockwork (<2000 kg/m^3)
- A minimum of 25 mm of perimeter insulation to screed ($\lambda \leq 0.023$ W/m.K).

Critical features

The thermal performance will be compromised:

- Unless there is a minimum of 25 mm of perimeter insulation.

Improving performance

- Change the substructure blockwork from dense to aircrete blockwork
- Increase the thickness of the perimeter insulation.

Notes

- Ensure that the perimeter insulation cannot be displaced when the screed is laid
- Party wall insulation should extend at least 215 mm below the underside of the slab.

If this detail is constructed as drawn with the components and materials as specified in the base conditions, then the calculated psi-values can be used in the SAP calculation in accordance with ADL1A 2013 3.10b.

P4: Roof

Base conditions

This detail requires:

- Cold roof U-values from 0.09 to 0.13 W/m^{2}K
- Any masonry party wall construction with a fully filled cavity (maximum cavity width of 100 mm) that is both compliant with Robust Details and achieves a U-value of 0.00 W/m^{2}K as per SAP 2012 guidance
- Psi-values for dense and aircrete blockwork have been calculated for above-ground blockwork to party wall
- Insulation tightly packed between the last truss and the blockwork.

Critical features

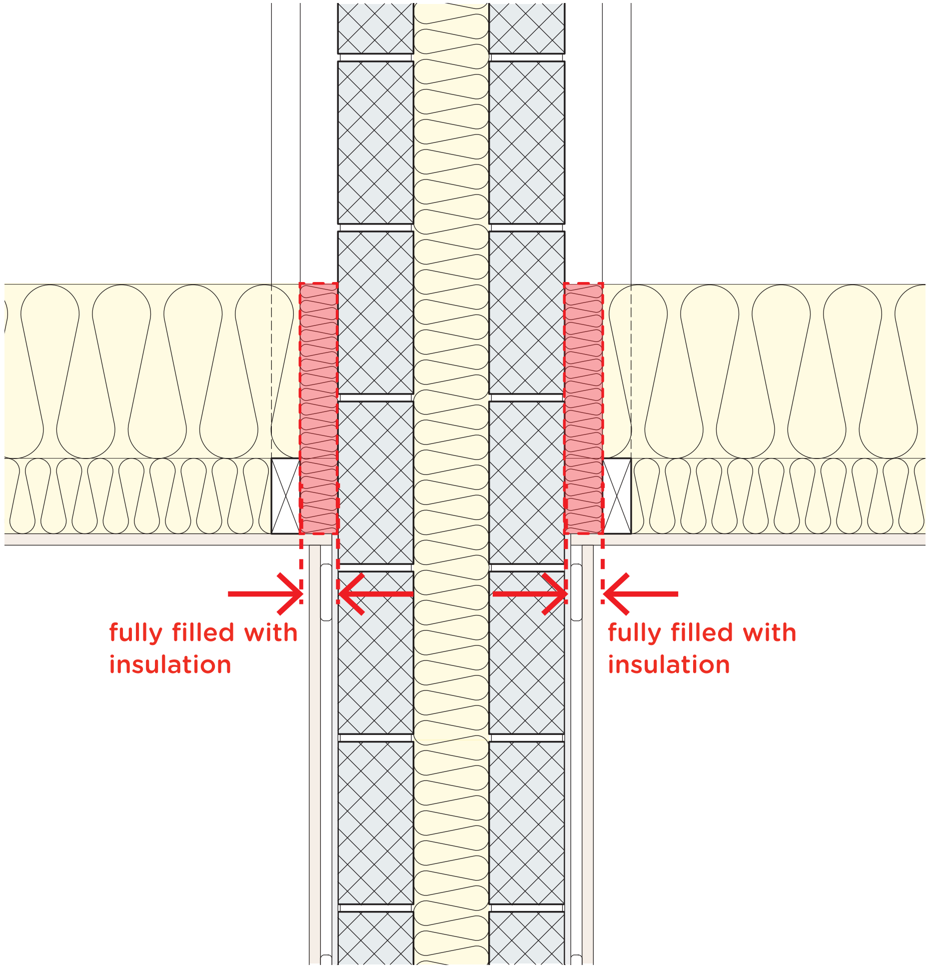
The thermal performance will be compromised:

- Unless the void between the last truss and the blockwork of the party wall is fully filled with insulation.

Improving performance

Not applicable to this detail.

Calculated psi-value (dense inner leaf blockwork): 0.24 W/mK
Calculated psi-value (aircrete inner leaf blockwork): 0.06 W/mK



Notes

- Insulation within the party wall should extend to the underside of the roof to comply with Robust Details.

If this detail is constructed as drawn with the components and materials as specified in the base conditions, then the calculated psi-values can be used in the SAP calculation in accordance with ADL1A 2013 3.10b.

Section 3: Construction build-ups

3.1 Notes on U-value assumptions

This section includes construction details for the U-values given in Section 1. 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 gaps as these can have a significant effect on the overall performance.

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

Cavity width:
All mineral wool options are for fully filled cavities. Rigid insulation build-ups include a 50 mm clear cavity behind the outer leaf for effective cavity drainage.

Cavity wall ties:
Stainless steel wall ties have been assumed with a cross section and density as per guidelines in BR443 (2006). Low thermal conductivity options such as basalt ties are commonly available and are beneficial when seeking high thermal standards.

Ground floor:
Ground conditions will affect the type of floor construction that may 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 two floor systems are illustrated: a ground bearing slab and a suspended beam and block floor system.

Mineral wool insulation:
The term mineral wool generally describes insulation derived from inorganic sources and may refer to glasswool or rockwool. Two representative values for thermal performance have been assumed in this guide: one for external walls (a better performing glasswool in the form of batts with a thermal conductivity of 0.032 W/mK) and one for roofs (a more common mineral wool quilt used over ceiling joists with a thermal conductivity of 0.044 W/mK); however 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 constructions. The rigid insulation in partial fill walls illustrated in this guide is of the PIR type. For partially filled cavity wall construction, foil-backed insulation has been assumed with a resulting airspace resistivity of 0.54 m^2k/W as agreed with the representing trade organisations.

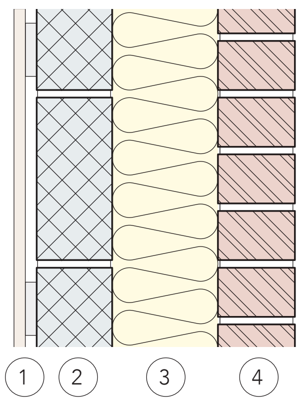
Roofs:
Flat ceilings have been assumed in each type of home with mineral wool insulation installed between and above the ceiling joists. The insulation to the roof is generally less dense than that in the walls, allowing for easier installation between the joists. The timber fraction for these U-value calculations is as per guidelines in BR443 (2006).

3.2 U-values: external walls

	Aircrete blockwork (λ = 0.15 W/mK)		Ultra lightweight blockwork (λ = 0.28 W/mK)		Dense blockwork (λ = 1.33 W/mK)	
U-value	Insulation thickness	Wall thickness	Insulation thickness	Wall thickness	Insulation thickness	Wall thickness
0.23 W/m²K	115 mm	345 mm	125 mm	355 mm	140 mm	370 mm
0.20 W/m²K	140 mm	370 mm	150 mm	380 mm	160 mm	390 mm
0.18 W/m²K	160 mm	390 mm	175 mm	405 mm	180 mm	410 mm
0.15 W/m²K	195 mm	425 mm				

Wall type 1: fully filled external wall

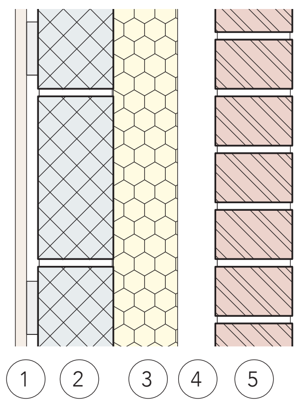
1. Plasterboard on dabs
2. 100 mm blockwork
3. Mineral wool insulation (λ = 0.032 W/mK)
4. 100 mm brickwork



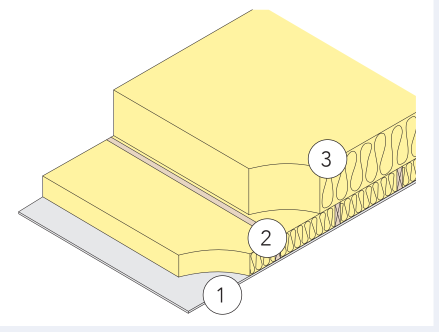
	Aircrete blockwork (λ = 0.15 W/mK)		Ultra lightweight blockwork (λ = 0.28 W/mK)		Dense blockwork (λ = 1.33 W/mK)	
U-value	Insulation thickness	Wall thickness	Insulation thickness	Wall thickness	Insulation thickness	Wall thickness
0.23 W/m²K	65 mm	345 mm	75 mm	355 mm	80 mm	360 mm
0.20 W/m²K	80 mm	360 mm	90 mm	370 mm	95 mm	375 mm
0.18 W/m²K	95 mm	375 mm	105 mm	385 mm	110 mm	390 mm
0.15 W/m²K	120 mm	400 mm	125 mm	405 mm	135 mm	415 mm

Wall type 2: partially filled external wall

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



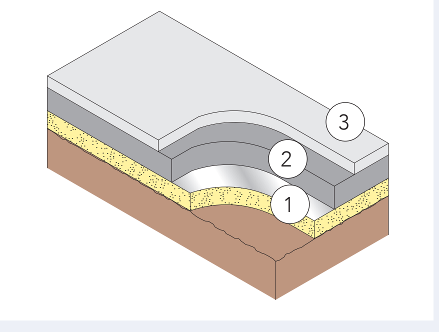
3.3 U-values: cold roof and ground floor



Roof: cold roof

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

	Insulation thickness	
U-value	Between joists	Above joists
0.15 W/m²K	100 mm	200 mm
0.13 W/m²K	100 mm	250 mm
0.11 W/m²K	100 mm	290 mm

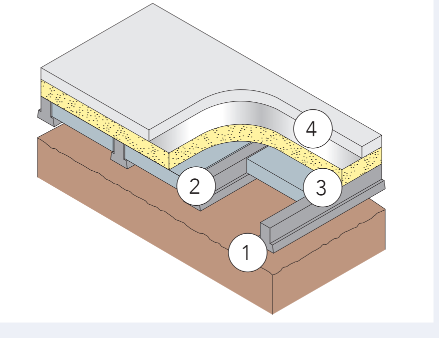


Ground floor type 1: ground bearing slab

1. Rigid PIR insulation (λ = 0.022 W/mK)
2. Reinforced concrete slab
3. 75 mm screed topping

The floor U-values have been calculated based on perimeter:area ratio of 0.53, as calculated for the detached house.

	Insulation thickness
U-value	Below slab
0.15 W/m²K	115 mm
0.13 W/m²K	140 mm
0.11 W/m²K	170 mm



Ground floor type 2: suspended beam and block floor

1. Ventilated void
2. Concrete beam and block
3. Rigid PIR insulation (λ = 0.022 W/mK)
4. 75 mm screed topping

The floor U-values have been calculated based on perimeter:area ratio of 0.53, as calculated for the detached house.

	Insulation thickness
U-value	Below slab
0.15 W/m²K	110 mm
0.13 W/m²K	125 mm
0.11 W/m²K	160 mm

Section 4: Home types & modelling assumptions

4.1 General modelling assumptions

All of the approaches in this guide consider standard practice - what can be achieved with readily available materials and common construction practices.

Along with the fabric specifications, which were discussed in Section 1 of the guide, the following assumptions have been made:

Ventilation:
Where natural ventilation has been proposed this will be achieved by a combination of trickle vents, opening windows and intermittent extractor fans. Where increased levels of air permeability are proposed, particular care should be taken to ensure that the ventilation requirements in Approved Document F can be achieved.

MVHR systems:
A high efficiency system has been selected with a specific fan power of 0.85 W/l/s and a heat recovery efficiency of 90%. For this type of ventilation system the target air permeability has been reduced to 3 $m^3/h.m^2$@50Pa.

Window specifications:
The windows modelled are thermally efficient, typically double-glazed with low-e coating and thermally broken frames. Double-glazed units have a U-value of 1.4 W/m^2K while triple-glazed units have a U-value of 0.8 W/m^2K. The overall light transmittance properties of the glazing, 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 for double-glazed units and 0.57 for triple-glazed ones.

Door specifications:
Insulated timber frame entrance doors have been assumed with a U-value of 1.2 W/m^2K.

Heating systems:
All units have been modelled with a gas condensing boiler (SEDBUK efficiency of 89.5%) with a weather compensator (which allows for a conservative improvement in boiler efficiency by 3%) programmer and radiators with time and temperature zone controls. It is assumed that all hot water systems will be separately timed and thermostatically controlled.

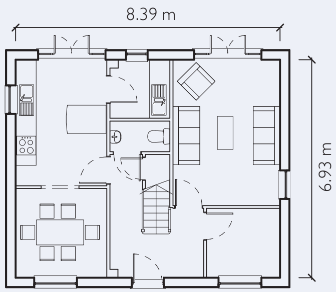
Solar renewables:
PVs with an easterly orientation have been assumed with a collector tilt of 30 degrees. SAP 2012 default efficiencies have been assumed for the flat plate solar panels.

Since the locations of the homes are unknown, 'moderate' overshading (20 - 60%) values has been assumed for both the PV and solar thermal panels.

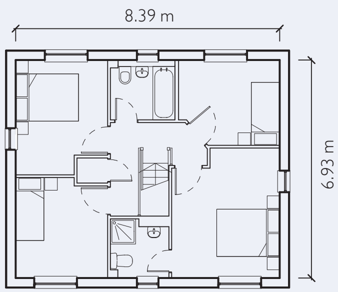
Y-values:
In Section 2, for particular details, two psi-values have been given - depending on whether dense or aircrete inner leaf blockwork has been used in the above-ground construction. In these cases the worse case psi-value (i.e. for dense blockwork) has been adopted to calculate the y-values given in Section 1. Improved y-values would be achieved if the better psi-value (i.e. for aircrete blockwork above ground) is used.

For any of the additional suggested improvements, including changes to the substructure blockwork, further modelling must be undertaken.

4.2 Detached homes



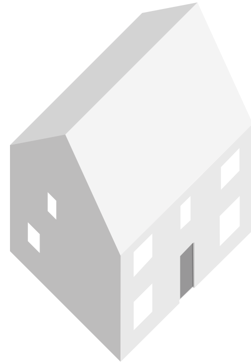
Ground floor

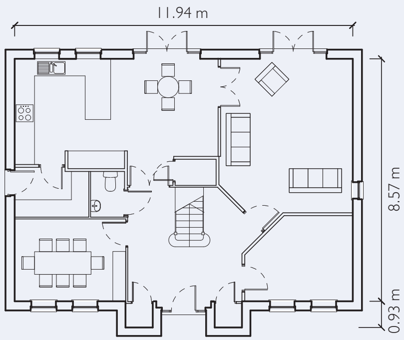


First floor

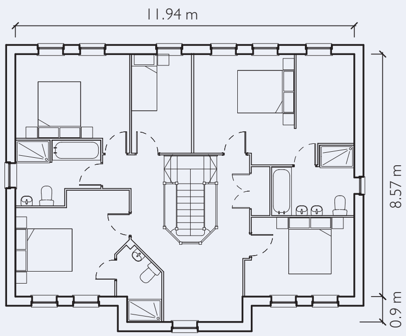
Detached house

Gross internal area:	116.3 m^2
Ground floor area:	58.1 m^2
Roof area:	58.1 m^2
Zone 1 area:	15.8 m^2
External wall area:	157.3 m^2
Opening area:	27.6 m^2
Average internal heights:	
Ground floor:	2.40 m
First floor:	2.70 m





Ground floor

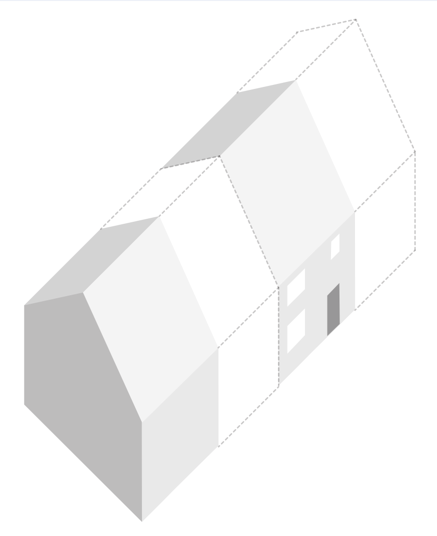


First floor

Large detached house

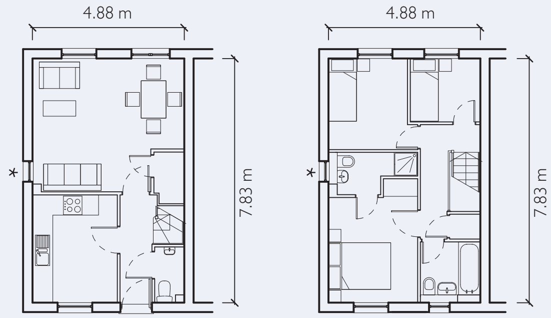
Gross internal area:	201.5 m^2
Ground floor area:	104.5 m^2
Roof area:	105.9 m^2
Zone 1 area:	25.6 m^2
External wall area:	222.2 m^2
Opening area:	42.1 m^2
Average internal heights:	
Ground floor:	2.40 m
First floor:	2.70 m

4.3 Attached homes and apartments



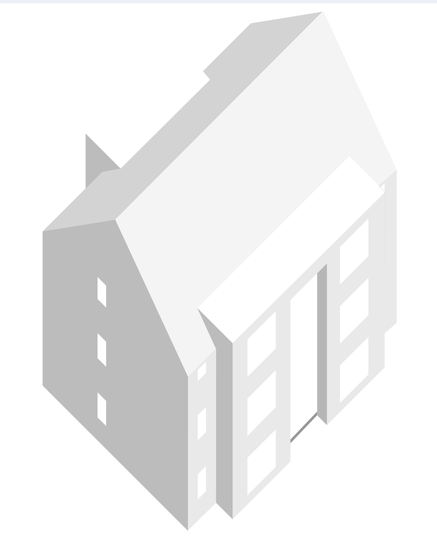
Terraced homes

	Mid-terrace	End-terrace
Gross internal area:	76.3 m^2	76.3 m^2
Ground floor area:	38.1 m^2	38.1 m^2
Roof area:	38.1 m^2	38.1 m^2
Zone 1 area:	19.3 m^2	19.3 m^2
External wall area:	49.7 m^2	89.6 m^2
Opening area:	13.7 m^2	15.5 m^2
Party wall area:	79.9 m^2	39.9 m^2
Average internal heights:		
Ground floor:	2.40 m	2.40 m
First floor:	2.70 m	2.70 m



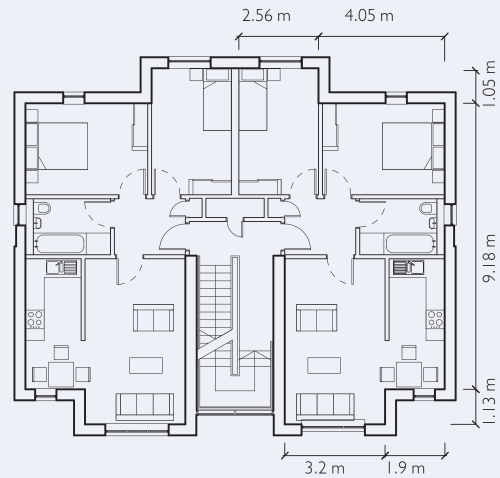
Ground floor First floor

*Windows only applicable to end-terrace houses



Two bedroom apartment

Typical floor:	
Gross internal area:	59.0 m^2
Zone 1 area:	25.0 m^2
Sheltered wall area:	19.7 m^2
External wall area:	61.4 m^2
Opening area:	11.9 m^2
Party wall area:	10.3 m^2
Average internal heights:	
Ground floor:	2.55 m
First floor:	2.55 m
Second floor:	2.55 m



Glossary

Accredited Construction Details (ACDs): Typical construction details which were published in 2007 by the Department for Communities and Local Government to address issues with continuity of thermal and airtightness layers in construction. While ACDs are largely out of date, they have not been withdrawn and are still available for use.

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).

Appendix R: Included in SAP 2012, this appendix contains the reference values for the parameters of the SAP calculation which are used to establish the Target Fabric Energy Efficiency (TFEE) and target CO_2 emission rates (TER) for demonstrating compliance in new homes.

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

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

Concurrent notional dwelling: In SAP, this is a notional home of the same size and shape as the new home, which is created based on the reference values in Appendix R. This notional home is used to calculate the TER and TFEE values against which the new home is assessed.

Design air permeability: The target value set at design stage and evaluated through a mandatory testing regime outlined in ADL1A 2013. A default value is set in ADL1A 2013 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 $kgCO_2/(m^2.yr)$ and takes into account energy used for space heating, hot water, fixed internal lighting, fans and pumps. To demonstrate compliance with ADL1A 2013, the DER of a dwelling must be no greater than its corresponding Target Emission Rate (TER).

Dwelling Fabric Energy Efficiency (DFEE) rate: A measure of the space heating and cooling demand of a home, expressed in terms of $kWh/(m^2.yr)$, and considers U-values, thermal bridging, air permeability, thermal mass and any features that affect lighting or solar gains. To demonstrate compliance with ADL1A 2013, the DFEE of a dwelling must be no greater than its corresponding Target Fabric Energy Efficiency (TFEE).

MVHR: mechanical ventilation with heat recovery - a system of fans and ducts that recovers waste heat from outgoing air and pre-heats incoming air.

Natural ventilation: The supply of adequate fresh air to the home through windows, trickle ventilators, etc. Removal of air may take place by natural or mechanical means (via intermittent extracts).

Psi-value: Psi-value or linear thermal transmittance is the measure of heat loss along a non-repeating thermal bridge calculated as per guidance in BR 497 (2006) and IP 1/06; expressed in terms of W/mK.

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 geothermal 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.

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 concurrent notional dwelling of the same size and shape as the proposed dwelling.

Target Fabric Energy Efficiency (TFEE) rate: The target fabric energy efficiency rate as calculated by SAP for a particular home and is expressed as $kWh/(m^2.yr)$. The calculation is based on a concurrent notional dwelling of the same size and shape as the proposed dwelling, using the reference values in Appendix R. A 15% increase is then added to this target value.

Thermal conductivity: The theoretical rate at which a material conducts heat across a unit thickness; expressed in terms of 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.

References

Approved Document ADL1A: Conservation of fuel and power in new dwellings
(NBS, March 2014)

Conventions for calculating linear thermal transmittance and temperature factors
(BR 497) (BRE Press, September 2007)

Conventions for U-value calculations **(BR 433)** (BRE Press, July 2006)

Assessing the effects of thermal bridging at junctions and around openings
(IP 1/06) (BRE Press, March 2006)

Part L 2013 - where to start:

An introduction for house builders and designers - masonry construction

This NHBC guide has been written in response to the 2013 changes made to Part L: Conservation of fuel and power (ADL1A 2013). It is intended to give house builders, designers and assessors a broad understanding of the changes to the specification that will need to considered as a starting point for detailed design.

The guide provides examples of typical types of homes outlining possible options for overall compliance with ADL1A 2013. It also focuses on the new fabric performance standard and the ways in which this may be tackled by house builders.

The NHBC Foundation, established in 2006, provides high quality research and practical guidance to support the house-building industry as it addresses the challenges of delivering 21st century new homes. To date the NHBC Foundation has published over 50 reports on a wide variety of topics, including the sustainability agenda, homeowner issues and risk management.

Visit **www.nhbcfoundation.org** to find out more about the NHBC Foundation research programme.

F58

Written and illustrated by Richards Partington Architects on behalf of the NHBC Foundation
ISBN 978-0-9930691-0-9

NHBC FOUNDATION
Housing research & guidance