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Accredited Construction details

June 2007

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Communities and Local Government

The Building Regulations 2000

ACCREDITED CONSTRUCTION DETAILS

In partnership with energy saving trust®

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Department for Communities and Local Government
Eland House
Bressenden Place
London
SW1E 5DU
Telephone: 020 7944 4400
Website: www.communities.gov.uk

Communities and Local Government Publications
PO Box 236
Wetherby
West Yorkshire
LS23 7NB
Tel: 08701 226 236
Fax: 08701 226 237
Textphone: 08701 207 405
Email: communities@twoten.com
or online via the Communities and Local Government website: www.communities.gov.uk

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Introduction

1 This Accredited Construction Details (ACDs) guide is intended to assist the construction industry to comply with the performance standards published in the Building Regulations Part L Approved Documents that came into force on 06 April 2006. It focuses on issues concerning insulation continuity and airtightness and is presented in two sections.

2 Section 1 (following this introduction) discusses the general theory of insulation continuity and airtightness in construction. A common approach to the design, construction and testing methodology is considered and suggestions made for the general improvement of the process.

3 The use of the Accredited Details as a route to compliance is discussed. A Compliance Checklist identifies the essential information to be forwarded to the Building Control Body (BCB) during construction and the layout and use of the ACD Detail sheets is explained.

4 Construction detailing can create opportunities for increased design flexibility and overall energy efficiency. The increasing significance of detailing and the principles of enhanced detail performance are discussed and illustrated using an example design specification.

5 A brief overview of common problems associated with thermal bridging and air leakage is presented within this section.

6 Section 2 (on separate web pages) provides large scale indicative detail drawings of thermal insulation and airtightness provisions for specific construction interfaces. The details, which draw heavily from those within the previous DEFRA/ DTLR publication *"Limiting thermal bridging and air leakage"*, have been updated to reflect the changed requirements in Building Regulations[1]. The details are accompanied by improved comments and checklists to assist the Designer, Constructor and Building Control Body (BCB) to achieve compliance at various stages throughout construction.

7 The guide and ACDs have mainly been conceived in relation to the construction, alteration and extension of dwellings. They are also valid, however, where the construction details are used in buildings of similar construction other than dwellings.

8 Use of the ACDs during construction will enable the constructor to demonstrate that provision has been made to eliminate all reasonably avoidable thermal bridges in the insulation layers (so far as the details apply). Further specific guidance may be found in each of the Approved Documents. Use of the ACDs for new dwellings will also warrant the implementation of a reduced airtightness testing regime as described in Approved Documents L1A 2006.

9 The Department would like to thank all those involved in the development of these Accredited Construction Details. In particular we wish to thank the contractors, industry bodies and working groups for the time and effort that they have contributed.

This document has been produced in conjunction with the Energy Saving Trust. Their best practice programme has developed a range of energy efficient solutions that go beyond the building regulations minimum standards to achieve the higher levels required by the Code for Sustainable Homes. These solutions provide an integrated package of measures for use in design and construction covering fabric, air tightness, ventilation, heating, lighting and hot water systems. Free resources – including best practice guides, training seminars, technical advice and online tools – are available to help building professionals achieve energy efficient homes. Further information can be obtained free of charge by telephoning the Energy Saving Trust on 0845 120 7799 or by visiting their website at: www.energysavingtrust.org.uk/housing

[1] DEFRA AND DTLR – Limiting thermal bridging and air leakage: Robust construction details for dwellings and similar buildings, published by TSO, 2001.

Section One

10 The energy consumed by dwellings accounts for a large proportion of the total energy consumption of the UK and some 28% of the carbon dioxide emissions which contribute to climate change[2]. Much of this energy is accounted for in the space heating. Insulation standards for roofs, walls, windows and floors in the Building Regulations have increased over the years since the early 70s to improve efficiency by reducing heat loss.

11 These standards relate to the average performance of the overall area of the building elements however, and as these standards increase, the significance of local areas of reduced insulation (thermal bridging) e.g. at joints and around the edges of window openings, and gaps in the building envelope leading to air leakage also increase. With average overall standards (U-values) as set in the Elemental Method in the 2002 edition of approved Document L1 for instance the proportion of the overall heat loss due to thermal bridging in average dwellings built recently is probably between 10 and 15% (though it can be substantially higher with certain construction systems and in dwellings with particularly poor detailing) and the typical additional heat loss due to easily avoidable air leakage is between 5 and 10%. Other deleterious effects include:

- Surface condensation damaging decorations and enabling mould growth
- Deterioration of the building fabric caused by interstitial condensation
- Occupant discomfort through draughts and cold rooms

12 To reduce the effect of the above problems, the issues of Insulation Continuity and Airtightness need to be thoroughly considered at all stages of design and construction.

Insulation Continuity

13 The thermal performance of a plane building element (within a particular construction) is described by its U value (W/m^2K). This is a measure of the heat transmission through the element per degree of temperature difference (degrees Celsius denoted as degrees Kelvin to signal temperature difference) between the internal and external environments. Thermal bridging typically occurs at the junctions between plane building elements, e.g. at wall/ roof and wall/ floor junctions, around openings, e.g. at window jambs, where the continuity of the insulation is interrupted. Thermal bridging increases the heat loss and also the risk of condensation due to the lower localised internal surface temperatures.

14 BRE IP 1/06[3] describes a method of quantifying this extra heat loss at a thermal bridge by way of its linear thermal transmittance or Psi value (ψ in units of W/mK).

15 The Approved Documents supporting Part L that came into force on 06 April 2006 indicate that heat loss calculations include the effects of thermal bridges when calculating Building Carbon Dioxide Emission Rates (DER & BER). The design details in Section 2 of this document have ψ no worse than those in Table 3 of IP 1/06 and Table K1 of SAP 2005.

16 BRE IP 1/06 also describes a method for assessing the effects of the low internal surface temperatures (that result from the construction) by way of the temperature factor f. Depending on the intended building function, the minimum temperature factor (f_{min}) of the detail must be no less than the critical factor, f_c, given in the paper. All of the details in Section 2 comply with the minimum requirements for rooms within a typical dwelling[4].

[2] EST Guide GPG224 – Improving airtightness in dwellings, 2005 Edition. Further information on airtightness principles and practice is contained within this document.
[3] BRE Information Paper IP1/06 – Assessing the effects of thermal bridging at junctions and around openings, 2006.
[4] A typical dwelling is considered to be a dwelling without rooms of high humidity such as swimming pools or saunas.

Airtightness

17 The airtightness of a dwelling, or its air permeability, is expressed in terms of air leakage in cubic metres per hour per square metre of external surface area when the building is subjected to a differential pressure of 50 Pascals ($m^3/(h.m^2)$@50Pa).

18 Air leakage is defined as the flow of air through gaps and cracks in the building fabric[5]. Uncontrolled air leakage increases the amount of heat loss as warm air is displaced through the envelope by colder air from outside. Air leakage of warm damp air through the building structure can also lead to condensation within the fabric (interstitial condensation) which reduces insulation performance and causes fabric deterioration.

19 The air permeability of a building can be determined by means of a pressure test. ATTMA TS1: 2006[5] discusses the methodology for air pressure testing including the test procedures, requirements and conditions of reporting.

20 The Approved Documents supporting Part L of the Building Regulations that came into effect on 06 April 2006 indicate that reasonable provision for airtightness is to achieve a pressure test result no worse than $10m^3/(h.m^2)$@50Pa. Current good practise[6] for energy efficient dwellings in the UK includes achieving airtightness of $7m^3/(h.m^2)$@50Pa and best practise is $3m^3/(h.m^2)$@50Pa. The airtightness appropriate for a particular dwelling design will depend upon the SAP Rating and Environmental Index[7] that the constructor is aiming to achieve.

21 Adopting the details in this publication will help to achieve airtightness no worse than $10m^3/(h.m^2)$@50Pa.

Ensuring Insulation Continuity and Airtightness

22 The following guidance may be considered good practice for delivering insulation continuity and airtightness in construction. The guidance considers construction projects at three stages of development – Design, Construction and Testing.

Design Stage

23 The complexity of the modern building envelope requires that consideration is given to achieving insulation continuity and airtightness early in the design stage. This two stage process should be undertaken at both the strategic and the detail level.

24 Consideration at the strategic level involves the identification of the primary construction and insulation method (masonry cavity insulation, insulated timber frame, etc.) together with the selection of the primary air barrier elements (plaster finishes, sheathing boards, etc.). The choices made at this level dictate the philosophy adopted for the remainder of the design and construction process.

25 At the detail level it is important that the design builds upon the above strategy clearly showing the builder how insulation continuity and airtightness will be maintained. Achieving continuity in practice requires that the designer:

- Identifies the components that form the insulation layer and air barrier in each part of the construction;
- Develops details that achieve continuity of the insulation and air barrier between each part of the construction and the next;
- Communicates the intentions clearly to the builder.

26 *The air barrier line* – The air barrier is a term used to describe a layer within the building envelope which will adequately restrict the passage of air between the internal and external environments. The air barrier should closely follow the line of the inside face of the insulation in the exposed elements of the fabric of the building.

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5 ATTMA TS1 – Measuring air permeability of building envelopes, 2006 Edition. This document conveys the approved method of pressure testing of buildings for purposes of showing compliance with the Building Regulations for England and Wales.

6 This good and best practice guidance refers to naturally ventilated dwellings. Dwellings incorporating mechanical ventilation and heat recovery systems should target lower air permeability level.

7 URL: http//projects.bre.co.uk/sap2005/pdf/SAP2005.pdf

27 Consideration should be given at an early stage in the design as to which layer of each exposed element of the fabric will form the primary air barrier, and to the junctions between them. The details contained within section two of this document assume that the air barrier will be formed largely by the internal plaster or plasterboard finishes.

28 *Pen-on-section drawings* – It is good practice for the air barrier line to be marked up on the architectural general arrangement and main section drawings as a bold distinguishable line. If the air barrier is continuous, it should be possible to trace around the whole section without lifting the pen. If you have to lift the pen, you have a discontinuity and a potential air leak. If the designer is not sure where the air barrier lies, it is unlikely that anybody else will be either.

29 *Larger scale drawings* – It is also good practice for the design team to prepare large scale drawings (1:10 or 1:5) of sensitive points in their design. These drawings should clearly identify the insulation components and the air barrier line. Preparation and submission of these drawings is a requirement of the Compliance Checklist (Refer to section on Routes to Compliance below). The drawings also should be disseminated to all relevant parties identifying how the integrity of the insulation layer and air barrier is to be maintained at particularly complex interfaces.

30 The following general approach to design will help to achieve insulation continuity and airtightness:

- Keep it simple! Simple designs are more likely to get designed and built right than complex ones.
- Decide which layer of the construction provides the air barrier and stick with this strategic decision as far as possible. Use the pen-on-section test to check continuity and to identify key details.
- Minimise the number of different types of construction within the thermal envelope – wherever one form of construction meets another, problems are likely to occur.
- Pay careful attention to the design of junctions between elements to ensure continuity of the air barrier. Think the construction sequence of each detail through, to ensure that it can be built. Be prepared to modify particular details if it becomes apparent that they do not work, or if site operatives identify better ways of doing them.
- Favour simplicity of form – complex forms increase the number of junctions within the thermal envelope, each of which increases the likelihood of discontinuities.
- Minimise the number of penetrations of the thermal envelope, whether by services or structure or construction.
- Where penetrations are unavoidable (soil stacks, ventilation exhausts and intakes, water supply, electricity and gas supplies), develop appropriate details and strategies for their proper execution; adopt appropriate details for making good damage to insulation and re-sealing pipes and ducts to the surrounding air barrier.

Design Thermal Resistance Paths

31 For the purposes of assessing cavity closers, the path of minimum thermal resistance through the cavity closer starts at one end of the boundary between the closer and the frame of the opening and finishes at the other end of that boundary.

32 For thin layers not greater than 4mm thick and with thermal conductivity not greater than 0.3W/mK, the thermal conductivity, within and parallel to the thin layer, should be considered zero (i.e. infinite thermal resistance) while the thermal conductivity across the thickness of the thin layer is that of the layer itself. Provided the thermal conductivity of the shell of a cavity closer is not greater than 0.3W/mK, this means considering only the thickness of the shell in any possible minimum thermal resistance path and ignoring any path within and parallel to the sides of the shell.

Construction Stage

33 It is suggested that three basic principles should be addressed throughout the construction stage to ensure insulation continuity and the formation of an effective air barrier. These are: Management; Communication and Education; and Quality Control.

34 ***Management*** – An on-going review of the design is required throughout the construction phase. The project management should ensure that details of all design changes involving elements of the external envelope are distributed throughout the design, procurement and construction teams.

35 It is important that the project programme reflects the required sequence for the effective formation of the air barrier and insulation installation. All trades must be permitted access to form not only the part of the insulation layer or air barrier for which they are responsible, but also to ensure that continuity is achieved between their works and that of other contractors.

36 It may be prudent when compiling the programme of works to include an 'Air Tight' milestone. Knowledge of this date may permit the management to schedule thorough envelope pre-test inspections and test dates in advance of the end of the project. Experience shows that these activities are of benefit to projects, relieving the inherent panic and potential penalties encountered as the completion date approaches.

37 ***Communication and Education*** – It is important that all management and operatives concerned with the procurement of the building materials and components and construction of the building fabric are aware of the requirement to ensure insulation continuity and airtightness. The more aware the team is of the issues and benefits surrounding insulation continuity and airtightness, the less likely essential components will be engineered out of the design for cost savings, and the more receptive the site people will be to requests for a higher standard of workmanship.

38 Awareness may be raised at key stages throughout the build by way of briefing to procurement offices and site tool-box talks. The detailed pen-on section drawings referred to above may be issued to all parties clearly identifying where and how insulation continuity and the air barrier will be maintained.

39 Operatives directly involved in constructing the elements including the insulation and air barrier should be encouraged to draw attention to difficulties and request direction rather than to bodge.

40 Operatives not directly involved in the procurement of the building fabric should also be made aware of the importance of maintaining insulation continuity and the air barrier line and of flagging up any breaches through these 'lines of defence'. They should also be required to remedy any potential thermal bridges or air leakage routes brought about by their own activities, or to seek help from other trades, depending on the nature of the breach.

41 ***Quality Control*** – Most contractors now have systems in place for monitoring the quality of their processes and products. Experience again shows that the QA system may be developed and extended to include checks for insulation continuity and airtightness. It is intended that the Accredited Details sheets be used for this purpose. Refer to the section on Routes to Compliance below for further information.

42 An essential QA control is that the issues of insulation continuity and airtightness are considered during all design changes or material substitutions affecting the external envelope. An ill-informed design change may jeopardise the final performance of the building envelope.

43 The QA process should ideally involve a process of inspection of finished works. This will enable the management to check that all works are being properly constructed prior to being covered over.

Testing Stage

44 ***Insulation Continuity*** – Inspection of the insulation will largely be one of a qualitative assessment undertaken throughout the construction phase. This must be undertaken as a series of inspections as recommended in the QA section above. These inspections may be recorded as a series of brief reports supplemented by photographic evidence of the state of insulation at the time of inspection together with the completed Accredited Details checklists.

45 ***Airtightness*** – The air permeability test is usually undertaken as the building nears completion. The external envelope must be practicably complete with all windows, doors and service penetrations installed and air sealed. The test is a quantitative assessment which culminates in either a pass or a fail result against a design value.

46 In cases where the building fails to meet the required airtightness standard, inspections might be undertaken utilising tracer smoke to identify areas of excessive air leakage. Remedial works must then be undertaken to improve the airtightness performance of the building fabric. Depending on the design and the formation of the air barrier, this might be an extremely difficult and time consuming exercise ultimately delaying completion of the affected dwellings.

Accredited Details – Route to Compliance

Compliance Checklist

47 Use of the ACDs as a route to compliance with the performance standards published in the Building Regulations Approved Documents to Part L requires that at least B), C) and F) of the following information is provided to the BCB:

A) Pen on section drawings (sections and plans) identifying the line of the air barrier
B) List of Accredited Details incorporated into the design
C) List of the builder's own details incorporated into the design
D) Specification of the air barrier materials/elements
E) Details of air barrier junctions and interfaces including means of sealing service penetrations
F) Evidence of Site Quality Control during the construction period (photos, check sheets, etc.)

48 A-E of the above checklist may be provided in a format deemed suitable by the relevant Building Inspector. Item F, however, will be satisfied through the use of the ACD sheets in accordance with the following guidance.

Use of Accredited Details

49 Section 2 of this publication provides a series of ACDs illustrating typical junction interfaces for various construction types. The details are indexed in accordance with their construction and junction type in the form **Construction Type – Junction Type – Reference Number** (e.g. MCI-GF-01). The table below outlines the section codes:

Construction Type		Junction Type	
MEI	Masonry External Insulation	EW	External Wall
MCI	Masonry Cavity Insulation	GF	Ground Floor
MII	Masonry Internal Insulation	IF	Intermediate Floor
TFW	Timber Frame	IW	Internal Wall
SFW	Steel Frame	RE	Roof Eaves
		RF	Flat Roof
		RG	Roof Gable
		WD	Windows and Doors

50 To assist the user all junction types for a particular construction are collated into one file which is available for free download from the Planning Portal website[8] in PDF format. The ACDs will be reviewed and updated via the website. Users are advised to periodically check the website and download the latest revisions as required.

51 Users of the ACDs are also encouraged to utilise the online feedback pages to offer constructive comment on the further enhancement of the details. Any intrinsic errors or omissions identified will be corrected and revised ACDs issued immediately.

Accredited Detail Sheets

52 The ACD sheets comprise a checklist together with an indicative illustration and general construction annotation. The purpose of the illustration (used in conjunction with the checklists and general notes) is to provide generic guidance on the key features that must be incorporated into the actual designs. It is not intended to provide a complete solution to airtightness or insulation continuity on any particular project.

53 The general notes outline important issues regarding the performance of the junction both in terms of insulation continuity and airtightness, and also raise potential conflicts such as ensuring adequate ventilation to roof voids. Whilst the notes are extensive it must be emphasised that the comments are not exhaustive and the user must satisfy themselves as to the fitness of their own designs to the intended purpose.

[8] URL: www.planningportal.gov.uk/england/professionals/en/1115314255826.html

Accredited Detail Checklists

54 The above Compliance Checklist requires that the builder submits to the BCB evidence that he has made reasonable provision for ensuring insulation continuity and airtightness. It is intended that the ACD checklists may be used for this purpose. The ACD checklist has been developed to be incorporated into the Quality Control systems throughout the design and construction stages.

55 For each dwelling a file should be opened which contains a copy of the appropriate ACD sheets for each construction and junction type. The design and construction should be reviewed at key stages during the process and compliance confirmed by ticking the appropriate ACD checklist item.

56 All boxes, with the exception of those under the Air Barrier Options heading, must be ticked in order to show compliance. The checklist items for the Air Barrier Options should be ticked to confirm which of the available options has been implemented.

Substitution of Contractors Own Designs and Proprietary Details

57 Contractors may choose to amend the ACD sheets by including their own in-house detailed designs in place of the indicative illustration. It is intended that blank ACD sheets will be provided online. Contractors should insert their own details and general construction notes into the appropriate ACD sheet. The ACD checklist must remain unchanged and all Contractor details must comply with the ACD checklist items.

58 Subcontractors and suppliers may also wish to prepare their own proprietary details for use by designers and contractors. The methodology for this is currently being considered and further details will be released via the website when the system is approved. Reference should be made to the website for further information.

SAP and DER Calculations

59 If all details for a new dwelling comply with the ACD checklists, the dwelling fabric design as a whole will conform with the guidance in Approved Document L1A paragraph 52a and qualify for the value of y[9]=0.08 in DER and SAP calculations as described in SAP 2005 Appendix K.

60 If not all details within a dwelling comply with the ACD checklists, then the appropriate ψ value for the compliant details may still be claimed from Table K in the DER and SAP calculations. ψ values for non-compliant details must be calculated in accordance with BRE IP 1/06.

61 In the case of Contractor specific details, if the detail design is compliant with the appropriate ACDs checklist items then the detail may be considered to comply. The DER and SAP calculations should be undertaken in accordance with the appropriate methodology above.

[9] The y value is heat loss factor for thermal bridging within the dwelling. The lower the y value the better. Where ACDs are not used a y value of 0.15 can be assumed due to the poorer thermal performance of junction details.

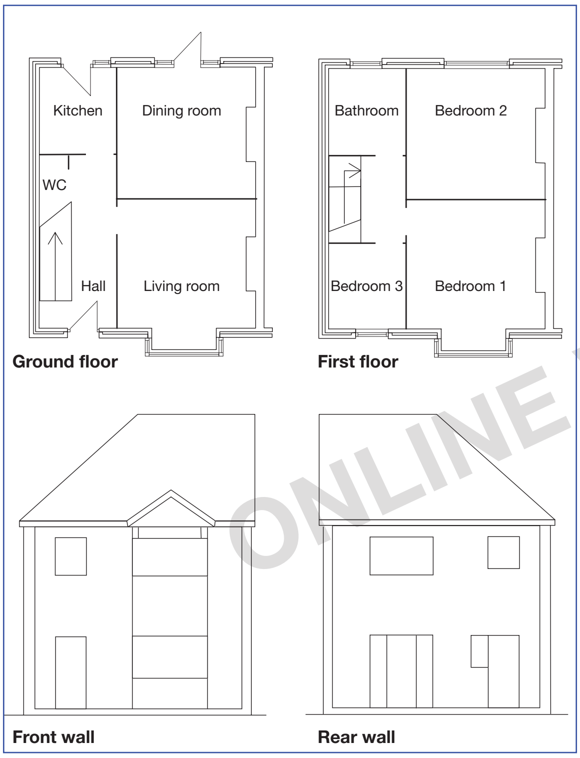
Design flexibility and enhancement

Detailing significance

62 Traditional design and construction practice has concentrated on insulating exposed walls, floors and roofs of buildings, in order to reduce their thermal transmittances (U-values). Until recently there has been limited focus on the heat losses that occur at the junctions between construction elements and around openings, or on the heat losses that occur because of uncontrolled air leakage. As standards of insulation have improved the proportion of the total heat loss that may be attributed to these causes has increased.

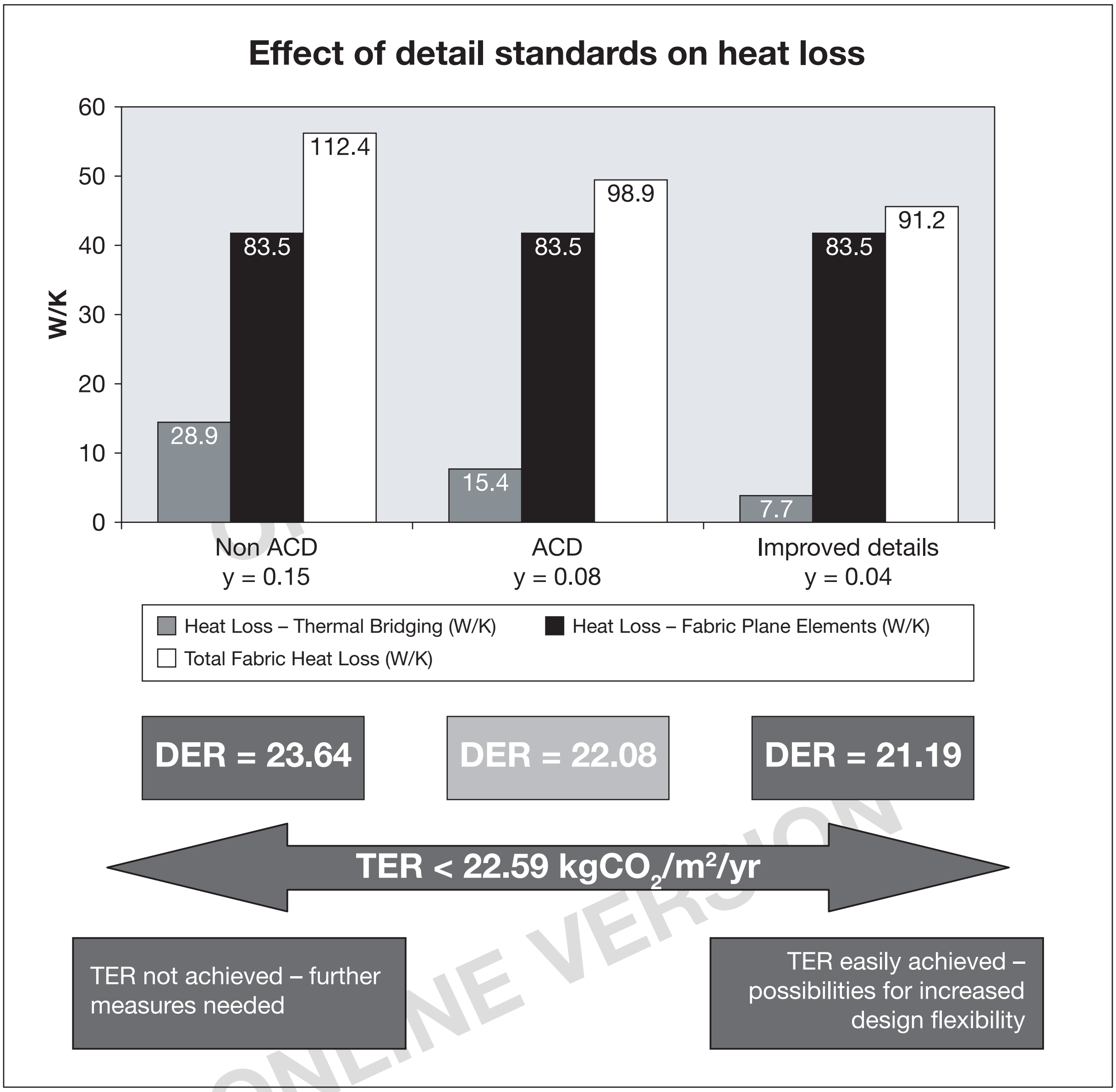
63 The design example shown below has been modelled using SAP 2005 to provide an insight into the significance that non-repeating thermal bridging has in terms of a dwelling's heat loss and CO_2 emissions. If being built in England and Wales this design would result in a Target CO_2 Emission Rate (TER) of 22.59 kg/CO_2/m²/yr. Three different levels of detailing have been assumed:

- Non-accredited construction details (y = 0.15 W/m²K)
- Accredited Construction Details (y = 0.08 W/m²K)
- Improved detailing, using ψ values lower than those for Accredited Construction Details, for the lintels, ground floor perimeter and gables (y = 0.04 W/m²K)



Example specification	
Floor	0.25 W/m²K
Wall	0.35 W/m²K
Window	1.8 W/m²K
Door	2.2 W/m²K
Roof	0.13 W/m²K
Air permeability	7 m³/m²/h @ 50Pa
Boiler	Gas-fired condensing boiler 90% seasonal efficiency
Controls	Full zone control with weather compensation
Secondary heating	Balanced-flue gas fire
Lighting	30% low energy
Ventilation	Natural with intermittent extract

64 The increasing significance of heat lost via the non-repeating thermal bridges is illustrated in the chart below. Targeting the thermal performance of key areas such as lintels, the wall to ground floor junction and wall to ceiling insulation at gables is shown to have a significant effect on both heat loss and the corresponding carbon emissions.



65 When the example house is designed with non-accredited details, the heat loss through the poorly performing non-repeating thermal bridges represents approximately 25 per cent of the total heat loss through the building fabric and the DER is 23.64 $kgCO_2/m^2/yr$. By improving the design to include Accredited Construction Details the heat loss due to thermal bridges reduces to 16 per cent and the DER to 22.08 $kgCO_2/m^2/yr$. Finally, three key details were improved to produce a further reduction in thermal bridge heat loss to 8 per cent resulting in a DER of 21.19 $kgCO_2/m^2/yr$.

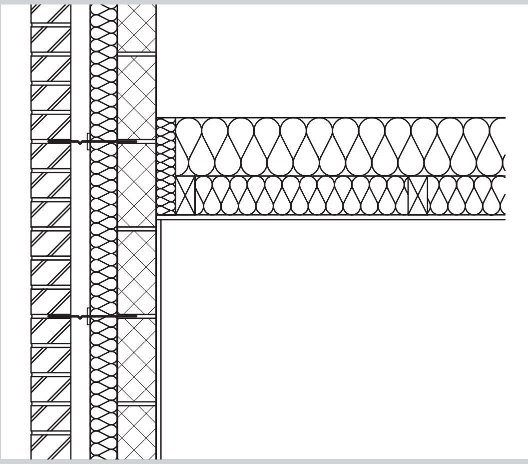
Enhanced thermal performance

66 The improved details used in the previous example are derived from a technical scoping study conducted by the Energy Saving Trust best practice programme. Thermal modelling found that significant reductions in ψ values could be achieved for key detailing areas. For example certain ground floor to wall junctions could be improved by approximately 80 per cent and ceiling to gable wall junctions by approximately 85 per cent.

67 The following diagrams illustrate some of the basic principles available to achieve enhanced thermal performance.[10] Further guidance on improving the performance of construction details can be found via the Energy Saving Trust best practice programme.[11]

[10] Please note these diagrams only present the principles involved and should not be considered as complete detail specifications.
[11] This can be found at www.energysavingtrust.org.uk/housing

Original design

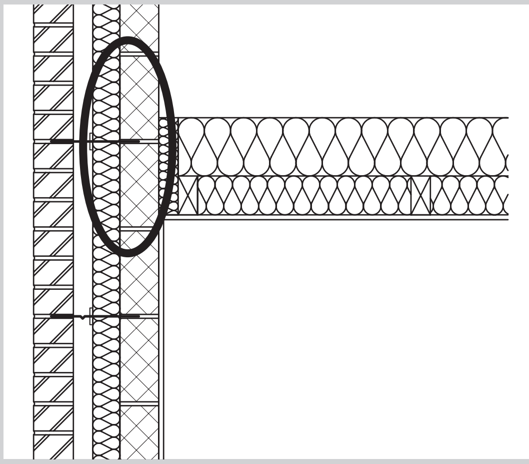


Partial fill insulated cavity wall with dense concrete inner block work (1.13 W/mK)
U-value = 0.25 W/m^{2}K

Ceiling with insulation between and above timber joists
U-value = 0.13 W/m^{2}K

ψ value = 0.189 W/mK

Improved design



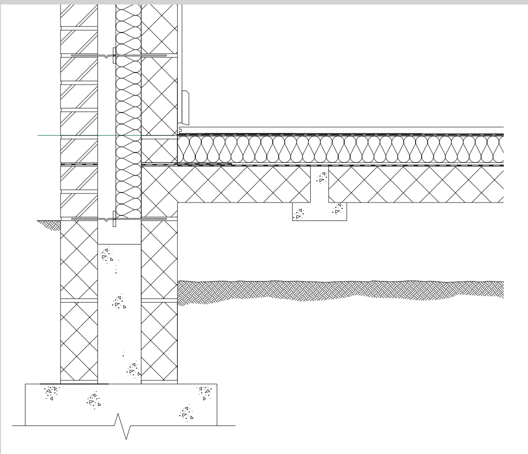
The key area of importance within this detail is circled in black. Changing the inner block work leaf to one with a lower thermal conductivity (0.11 W/mK) will help reduce the magnitude of bridging

Ceiling remains the same

value = 0.020 W/mK

Thermal improvement principles for a masonry cavity wall to ceiling detail

Original design

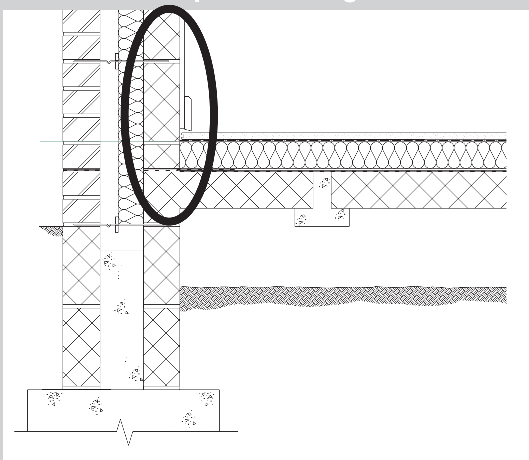


Partial fill insulated cavity wall with dense concrete inner block work (1.13 W/mK)
U-value = 0.25 W/m^{2}K

Suspended beam and block floor
U-value = 0.20 W/m^{2}K

ψ value = 0.163 W/mK

Improved design



The key area of importance within this detail is circled in black. Changing the inner block work leaf to one with a lower thermal conductivity (0.19 W/mK) will help reduce the magnitude of bridging.

Floor remains the same

ψ value = 0.027 W/mK

Thermal improvement principles for a masonry cavity wall to suspended beam and block floor detail

68 The following pages present a typical airtightness strategy and provide a brief overview of the problems usually encountered when considering insulation continuity and airtightness. The brief descriptions of the issues are supplemented by photographs and supported by a list of recommendations for limiting the effects of the problems on site.

Air Tightness Strategy

Design Stage

- Consider built form – simplify where possible.
- Define the line of the air barrier as early as possible. Mark up on large scale sections with a bold coloured line.
- Consider and rationalise construction sequencing.
- Redefine the air barrier route and insulation strategy in critical areas to simplify details and avoid problems.
- Establish and specify which materials will form the air barrier. Consider:
  - Material air permeability
  - Buildability
  - Position within the construction
  - Long term durability.
- Consider junction details between air barrier materials:
  - Practicality of forming the seals on site
  - Durability of the seals, especially where not accessible for future remedial work.
- Consider service penetrations through the air barrier and how these will be sealed.
- Rationalise service routes and penetrations.
- Highlight air barrier critical elements and junctions on construction drawings.
- Apportion responsibility for the formation of critical junction seals to specific trade packages.

Construction Stage

- Appoint a site 'air barrier manager' who will be responsible for coordinating and inspecting the overall formation of the air barrier.
- Brief the whole construction team (not just management) on the need for and importance of the air barrier. Inform the team of the air barrier line, the materials which will form the barrier and the critical junctions. Encourage operatives to draw attention to unforeseen difficulties rather than bodge a solution.
- Air barrier manager to undertake:
  - Coordination of the formation of the air barrier
  - Site quality assurance
  - Check and sign off all 'hidden' air barrier elements before covering up.
- Review the construction as work proceeds to identify any weaknesses in the air barrier strategy/areas not previously considered and feed this information back to the design team. Establish solutions to any problems identified.
- Undertake airtightness testing at the earliest possible opportunity in the build, independently of the requirements of the Building Control Body – it is in builders' interests that this first test be undertaken outside the compliance loop. Use an established pressure testing consultancy capable of giving good diagnostic feedback.

Overview of common problems

Insulation Continuity

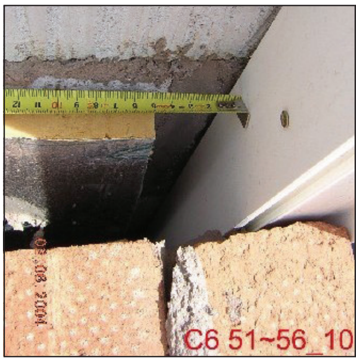
Poorly positioned cavity insulation

The cavity wall insulation should be installed tight to the outer face of the inner blockwork leaf. This will prevent air circulation between the block and insulation reducing the performance of the insulation layer.

Insulation boards may also have stepped rather than flat butt joints to improve continuity.

Debris bridging the cavity

Clear all debris including mortar snots from cavity as work progresses to prevent thermal bridging occurring between the inner and outer leaf.



Insulation cut short of the cavity closers

Cavity insulation should be cut to suit and sheets tightly butted to each other and surrounding cavity closers and loose fill insulation.

Discontinuity between wall and roof insulation at eaves/verge

Roof insulation should be installed to minimise the effects of thermal bridging at the eaves. The insulation should be laid over the top course of blocks and the wall insulation installed right up to the top of the wall.

Service Penetrations

Service penetrations should be core drilled to minimise damage to the insulation layer. Holes should be drilled to provide a snug fit by reducing the oversize to a minimum.

Any damage caused to the insulation layer by service penetrations should be made good. This might be achieved by filling any large gaps with loose fibrous insulation or expanding foam insulation.

Develop standard sealing procedures with subcontractors and make sure they have the appropriate materials for the job.

Airtightness

Socket outlet/switch plates

Where the air barrier is formed by a plasterboard lining it is recommended that a continuous ribbon of dabbing compound is applied around the hole prior to installing the plasterboard. This will reduce air leakage through the sockets/ switches into the void beyond.

Proprietary gasketed socket boxes and membranes are also available where required.

Develop standard sealing procedures with subcontractors and make sure they have the appropriate materials for the job.

Service penetrations – Including behind bath panels, shower trays, kitchen units and into service shafts.

Service penetrations should be core drilled to facilitate remedial air sealing. Holes should be drilled to provide a snug fit by reducing the oversize to a minimum.

All penetrations through the air barrier line must be effectively sealed following installation of the services. This might be achieved by sealing with a thin mastic fillet.

Develop standard sealing procedures with subcontractors and make sure they have the appropriate materials for the job.

Loft hatches

Proprietary loft hatches with low air permeability characteristics should be fitted in lieu of site manufactured hatches. Where site manufactured hatches are installed these should be complemented with draught stripping to minimise air leakage into the loft space above.

Window and door frames

Air leakage is often found to occur between window/ door frames and the surrounding construction. Mastic seals may be required between plaster finishes, window boards and frames.

This also applies to internal door frames (particularly the architrave over the door head) where air leakage may enter the wall lining void and track to the external cavities.

Proprietary products may be available to assist the formation of air barrier continuity at such interfaces.

Trickle ventilators

Some trickle ventilators can permit significant levels of leakage to occur during the air leakage pressurisation test. It is important to check the manufacturer's product literature to ensure that the ventilators provide a sufficient level of airtightness when closed and that they are correctly installed. Consideration should be given to sealing them with tape where test results are marginal.

Recessed light fittings

Recessed light fittings may permit air leakage to breach the plasterboard ceiling line into the voids or lofts beyond. They should never be allowed to penetrate the primary air barrier unless the units are of an air sealed type or a further secondary air barrier formed beyond. This needs a special detail because of the fire risk.

Extract fans

Extract fans should be installed and sealed to prevent air leakage occurring through plasterboard finishes. A continuous ribbon of adhesive should be installed around the penetration. Where possible the ducts should also be sealed to the blockwork inner leaf.

Extract fans may also be fitted with external flaps to minimise air infiltration through the unit.

Timber frame sole plates

Where reliance is placed on the timber framing to form the primary air barrier it is essential that continuity of the air barrier is maintained between the wall construction and the ground floor slab. Proprietary membranes and/or mastic may be used to seal the soleplate to the floor prior to installing the wall panels above.

Stairs

Plaster finishes are typically omitted from voids below stairs. Air leakage may then occur through mortar joints in poor quality blockwork into the externally ventilated wall cavities.

Plaster finishes should be installed below stairs or a thin parge coat applied to the surface of the blocks.

Dormers in room in roof

The plasterboard cheek linings will form the air barrier. The linings should therefore form a continuous air barrier and be sealed to the window frames. Proprietary products may be available to assist the formation of air barrier continuity at such interfaces.