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Technical Guidance Document L

Limiting Thermal Bridging and Air Infiltration

Acceptable Construction Details
2021 Edition

Prepared by the Department of Housing, Local Government and Heritage
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Introduction

This guide to Acceptable Construction Details (ACDs) is intended to help the construction industry achieve the performance standards in the Technical Guidance Document (TGD) to Part L of the Building Regulations - Conservation of Fuel and Energy - Dwellings. The 2021 edition of the ACDs updates drawings to take account of internal insulation which was previously provided for in text of 2011 ACDs and some editorial updates. It does not change the thermal performance of the details from the 2011 edition.

This Guide

This guide focuses on issues concerning thermal bridging and airtightness. The guide is presented in two parts.

PART 1

Part 1 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 are made for the general improvement of the process.

The use of the Acceptable Construction Details in the context of Technical Guidance Document L is discussed.

Construction detailing can create opportunities for increased design flexibility and overall energy efficiency. The increasing significance of detailing and detail thermal performance are discussed.

Finally, an overview of "How to achieve good performance in thermal bridging and air infiltration" is presented.

PART 2

Part 2 of this guide is in seven sections and provides large scale indicative detail drawings of thermal insulation and airtightness provisions for specific construction interfaces.

The details are accompanied by comments and checklists to assist the designer and builder to achieve the guidance provided in Technical Guidance Document (TGD) L 2021 Conservation of Fuel and Energy in Dwellings to Part L of the Building Regulations at various stages throughout construction. These checklists will also be of assistance to Building Control Authorities.

Application of Acceptable Details

The guide and the ACDs have mainly been conceived in relation to the construction of new dwellings, they may also be used for alteration and extension of dwellings, where appropriate. They are also valid in non-domestic buildings of similar construction.

Use of the ACDs during construction will enable the designer/builder to demonstrate that provision has been made to eliminate all reasonably avoidable thermal bridges in the insulation layers (so far as the details apply). As the ACDs focus mainly on Part L issues, further specific guidance relating to other parts of the building regulations may be found in each of the Technical Guidance Documents A-M.

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Table of Contents

Introduction.....	2
This Guide	2
Application of Acceptable Details	3
Acknowledgements	3
 Part 1 – General theory of insulation continuity and airtightness	
The benefits of improved construction detailing.....	7
Insulation Continuity	7
Airtightness	8
Ensuring insulation continuity and airtightness	10
Design Stage	10
Construction Stage	12
Testing Stage	13
Using acceptable construction details for compliance.....	15
Use of Acceptable Construction Details	15
Acceptable Construction Detail Sheets	16
Substitution of Contractors Own Designs and Proprietary Designs	16
DEAP Calculations	16
Design flexibility and enhancement	18
Detailing significance	18
Enhanced thermal performance	18
Choosing an airtightness strategy	19
Design Stage	19
Construction Stage	19
Achieving thermal continuity and airtightness.....	21
(1) General construction objectives	21
(2) Ground floors	22
(3) Masonry walls	23

(4) Timber and steel frame	25
(5) Intermediate floor junctions	26
(6) Separating wall junctions	28
(7) Windows and external door opes	28
(8) External Door Thresholds	29
(9) Service penetrations	30
(10) Roofs	32
Appendix A	35
Calculation of γ factor for use in DEAP with Example	35
Glossary	40
Documents referred to	42

Part 2 - Acceptable Construction Details

Acceptable Construction Details	44
Section 1: Cavity insulation	44
Section 2: External insulation	44
Section 3: Internal insulation (when combined with section 1, 4 or 5)	44
Section 4: Timber Frame	44
Section 5: Steel Frame	44
Section 6: Hollow Block Internal Insulation	44
Section G: General (applicable to all construction types)	44

Limiting Thermal Bridging and Air Infiltration

1

General theory of insulation continuity and air tightness

Part 1 of this guide 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 are made for the general improvement of the process. The use of the Acceptable Construction Details in the context of Technical Guidance Document L is also outlined.

The benefits of improved construction detailing

The energy consumed by dwellings accounts for a large proportion of Ireland's total energy consumption, and of the carbon dioxide emissions, which contribute to climate change. 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 to improve efficiency by reducing heat loss. These standards relate to the average performance of specific elements.

As insulation standards improve, 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, becomes increasingly important in terms of contribution to overall heating and ventilation losses from the dwelling. Reducing heat loss due to easily avoidable air leakage can significantly improve the energy performance.

Effects of thermal bridging and air leakage include-

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

To reduce the impact of these and to address the potential health risks they may pose to building occupants, insulation continuity and airtightness need to be thoroughly considered at all stages of design and construction.

Insulation Continuity

The thermal performance of a plane building element (within a particular construction) is described by its U-value ($\text{W}/\text{m}^2\text{K}$). 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 planar building elements, e.g. at wall/roof and wall/floor junctions, and around openings, e.g. at window jambs, where the continuity of the insulation is interrupted. Thermal bridging increases the heat loss and the risk of condensation due to the lower localised internal surface temperatures.

BRE IP 1/06 describes a method of quantifying this extra heat loss at a thermal bridging by way of its linear thermal transmittance, or Psi (Ψ) value, in units of (W/mK).

Building Regulations 2021 TGD L Dwellings indicates that heat loss calculations should include the effects of thermal bridges when calculating the Maximum Permitted Energy

Performance Coefficient (MPEPC) and Maximum Permitted Energy Performance Coefficient (MPEPC).

BRE Information Paper IP 1/06 also describes a method of assessing the effects of the low internal surface temperatures (that result from the construction) by way of the temperature factor f , or f_{Rsi} . Depending on the intended building function, the temperature factor (f_{min}) of the detail must be no less than the critical temperature factor, f_c , given in the paper. Use of the details in Part 2 meet with the guidance in Par 1.3.3.2 and Appendix D of TGD L 2021 Dwellings, for rooms within a typical dwelling, and make reasonable provision with regard to limitation of thermal bridging.

Airtightness

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

The dwelling envelope area is defined in this context as the total area of all floors, walls and ceilings bordering the dwelling, including elements adjoining other heated or unheated spaces.

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

The air permeability of a building can be determined by means of a pressure test. The procedure for testing is specified in I.S. EN ISO 9972:2015 "Thermal performance of buildings: determination of air permeability of buildings: fan pressurization method". Additional guidance on testing procedure is given in the ATTMA publication "Measuring air permeability of Building Envelopes".

Building Regulations 2021 TGD L Dwellings indicates that reasonable provision for airtightness is to achieve a pressure test result of no worse than $5m^3/(h.m^2)@50Pa$. Current typical values achieved in NZEB dwellings are less than $3m^3/(h.m^2)@50Pa$.

The airtightness appropriate for a particular dwelling design will depend upon the Building Energy Rating the builder is aiming to achieve. Care should be taken to ensure compliance with the ventilation requirements and permanent air supply of Part F and of Part J of the Building Regulations respectively. For further information, see TGD F and TGD J.

Adopting the details in this publication should help to achieve airtightness of $5\text{m}^3/(\text{h.m}^2)\text{@}50\text{Pa}$ or better.

All materials used for airtightness should meet the guidance in Technical Guidance Document D “Materials and Workmanship”, be fit for the use for which they are intended and for the conditions in which they are to be used.

In assessing the fitness for use and conditions of use of a material or a product, consideration should be given to durability, safety, local climatic conditions (e.g. wind driven rain, humidity etc.) and other such issues.

Ensuring insulation continuity and airtightness

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

Design Stage

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

Consideration at the strategic level involves the primary construction and insulation method (masonry cavity insulation, insulated timber frame, etc.) and selecting the primary air barrier elements (plaster finishes, membranes, etc.). The choices made at the strategic level may dictate the philosophy for the remainder of the design and construction process.

At the detail level, it is important that the design builds upon the above strategy, showing the builder how to maintain insulation continuity and airtightness. Achieving continuity in practice requires that the designer:

- Identifies the components which 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

The air barrier line – The air barrier is a layer within the building envelope which will adequately restrict the passage of air between the internal and external environments. The barrier should follow the line of the inside face of the insulation in the thermal envelope.

Consideration should be given at an early stage as to which layer of each element of the thermal envelope will form the primary air barrier, and to the junctions between them. The details in Part 2 assume the air barrier will be formed largely by internal wet plaster, airtightness membranes or plasterboard finishes.

Pen-on-section drawings – It is good practice to mark up the air barrier line on the architectural 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 the pen has to be lifted, there may be discontinuity and a potential air leak. The details in Part 2 show the air barrier as a blue line. It is important that the designer is clear on the location

and materials used to create the single air barrier layer in order to be able to communicate this effectively to the construction team.

There are four options indicated in the ACDs:

- Masonry inner leaf with wet-finish plaster, or
- Masonry inner leaf with scratch coat, and finished with plasterboard, or
- Insulated plasterboard system sealed to achieve appropriate airtightness, bedded on dabs and mechanically fixed, with continuous ribbon of adhesive around all openings, along top and bottom of wall and at internal and external corners, or
- Airtightness membrane and tapes

Generally, an airtightness finish of wet plaster on masonry or airtightness membranes and tapes will achieve the most effective airtightness layer and is likely to achieve the optimum airtightness performance. These systems also facilitate early airtightness testing before finishes or services are complete, avoiding any potential disruptive remediation works.

The use of plasterboard-on-dab finishes to achieve airtightness is mainly reliant on the skill and care of the installer to achieve the required airtightness performance. Any subsequent disruption of the boards also has the potential to compromise performance.

Where the airtightness performance only becomes evident close to final completion, remediation of the air barrier at that point in the construction process may involve significant disruption and delay completion.

Larger scale drawings - It is good practice to prepare large-scale drawings of sensitive points in the design. These drawings should clearly identify the insulation and the air barrier. The drawings should be issued to all relevant parties identifying how the integrity of the insulation layer and air barrier is maintained at particularly complex interfaces.

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

- Keep it simple! Simple designs are more likely to be constructed correctly.
- Decide which layer(s) of the construction provide the air barrier. Stick with this. Use the pen-on-section test to check continuity and to identify key details.
- There is only one effective air barrier. There is no benefit to be had from multiple air barrier layers; the barrier performance is always defined by its weakest link.

- Minimise the number of different types of construction that are used to form 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. Where details are changed during the course of construction the changes should be approved by the designer, or competent person.
- Favour simplicity of form – complex forms increase the number of junctions within the thermal envelope, each of which increases the likelihood of discontinuities.
- Minimise penetrations of the thermal envelope, whether by building services, structural elements or construction components. In general, a services cavity provided on the warm side of the air barrier will help to ensure that service penetrations are avoided and to simplify the installation of pipes and cables.
- Where penetrations are unavoidable (soil stacks, ventilation exhausts and intakes, water supply, electricity and gas supplies), appropriate details should be developed taking account of the sequence of construction.

Construction Stage

Three basic principles should be addressed during construction to ensure insulation continuity and effective air barriers: Management, Communication, and Quality Control.

MANAGEMENT

On-going review of the design is required. The project management team should ensure that details of all design changes involving elements of the external envelope are notified to the design, procurement and construction teams.

It is important that the project programme reflects the required construction sequence for effective formation and testing of the air barrier and for the installation of insulation.

It may be prudent when compiling the project programme to include airtightness milestones. Knowledge of these dates may permit management to schedule envelope component inspections and airtightness tests in advance of the completion of the project. Testing during the construction stage, along with good quality control procedures, allows problems to be identified and corrected early in the construction process prior to final testing.

COMMUNICATION AND EDUCATION

All personnel involved in design, procurement and construction of the building fabric should understand the need for insulation continuity and airtightness. The more aware people are of

the issues, the less likely essential components will be engineered out of the design in pursuit of cost savings, and the more likely it is that site staff will be able to provide the higher standard of workmanship involved.

Awareness may be raised at key stages by briefing the construction management team and through the use of on-site tool-box talks. Detailed drawings should be issued to all parties clearly identifying where and how insulation continuity and the air barrier continuity will be maintained.

Operatives directly involved in constructing the insulation and air barrier should be encouraged to draw attention to difficulties and request direction.

Operatives not directly involved in the building fabric should also be made aware of the importance of insulation continuity and air barrier integrity and report any breaches to the supervisor responsible.

QUALITY CONTROL

All contractors now have systems in place for monitoring the quality of their processes and products. Quality Assurance (QA) should be included to check for insulation continuity and airtightness. The ACD sheets can be used for this.

An essential QA control is that insulation continuity and airtightness are considered during all design changes and material substitutions affecting the thermal envelope.

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

Particular care is required in construction types which rely on a vapour control layer and sufficient time should be allocated to permit its detailed inspection prior to covering up.

Testing Stage

A series of tests are required as the building nears completion including ventilation validation and airtightness testing. Other elements will be subject to ongoing inspection for conformity with specification and compliance with building regulations.

INSULATION CONTINUITY

Inspection of the insulation will largely be a qualitative assessment during construction. This should be a series of inspections as recommended above. These inspections should be recorded and it is recommended that geo-located digital photographs are included with the completed ACD checklists.

AIRTIGHTNESS

The final air permeability test is usually undertaken close to 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 and should meet the provisions of section 1.5.4 of TGD L. Mechanical ventilation should be provided where airtightness is less than $3\text{m}^3(\text{h} \cdot \text{m}^2)$, see TGD F, section 1.2.1.1 (a) and (b).

It can be useful to perform airtightness checks on the dwelling during construction to identify areas of leakage prior to the completion of finishes.

Where the dwelling fails to meet the required airtightness standard, inspections can be undertaken utilising tracer smoke and/or thermal imaging to identify areas of excessive air leakage. Remedial works must then be undertaken to improve the airtightness performance of the fabric. Depending on the design and the formation of the air barrier, this might be difficult and time consuming, and may ultimately delay completion.

Using acceptable construction details for compliance

To make best use of the ACDs, the following will be helpful.

- Detail drawings (sections and plans) identifying the line of the air barrier
- List of Acceptable Construction Details incorporated into the design
- List of the designer/builder’s own details incorporated into the design
- Specification of the air barrier materials / elements
- Details of air barrier junctions and interfaces including means of sealing service penetrations
- Evidence of Site Quality Control during construction (photos, check sheets, etc.)

Use of Acceptable Construction Details

Part 2 of this publication provides a series of Acceptable Construction Details showing typical junction interfaces for various construction types.

Section 1	Cavity insulation
Section 2	External insulation
Section 3	Internal insulation (when combined with section 1, 4 or 5 construction types)
Section 4	Timber Frame
Section 5	Steel Frame
Section 6	Hollow Block Internal Insulation
Section G	General (applicable to all construction types)

At the start of each section there is an introduction outlining the details described in that section and the specific psi values associated with each detail. This also describes the range

of U-values of the flanking elements making up the junction which can be used. Outside of these ranges, the Table D psi-values should not be used.

Acceptable Construction Detail Sheets

The ACD sheets comprise thermal insulation and air barrier checklists together with an indicative illustration and general 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. They do not provide a complete solution to airtightness or insulation continuity on any particular project.

The general notes outline important issues regarding performance of each junction in terms of insulation continuity and airtightness, and raise potential conflicts such as ensuring adequate ventilation to roof voids. The notes and the comments are not exhaustive and users must satisfy themselves as to the fitness of their own designs for the intended purpose.

The checklists enable the builder to make reasonable provision for ensuring insulation continuity and airtightness. It is recommended that the design and construction of each dwelling be reviewed at key stages during the process by reference the ACD and other checklists, as appropriate.

Substitution of Contractors Own Designs and Proprietary Designs

If details other than Acceptable Construction Details are proposed for use in construction, they should meet the alternative requirements given in Paragraph 1.3.3.2 in Building Regulations 2021 TGD L – (Dwellings).

DEAP Calculations

Where all ACDs are adopted for all key junction details for a dwelling type and are installed as per the ACD checklists, the dwelling fabric design as a whole will meet the guidance provided in Par 1.3.3.2 in Building Regulations 2021 TGD-L (Dwellings).

The linear thermal transmittance can be calculated for each of the key junctions for the specific dwelling using the psi values given in Tables D1 to D6 in Appendix D of TGD L 2021 and assembled into a y-factor calculation to take account of the overall thermal bridge heat loss in the DEAP calculation, see example in Appendix A.

Psi values (heat loss per metre of junction length) for details which are not Acceptable Construction Details should be calculated and certified in accordance with Building Regulations 2021 TGD-L (Dwellings) Par 1.3.3.2. Certified details may be provided by a third

party certification body such as Agrément, or equivalent, or certified by a member of an approved thermal modellers scheme, or equivalent.

Heat loss through thermal bridging can be accounted for in terms of a factor (ψ) multiplied by the exposed surface area of the building. Where Acceptable Construction Details are used for all key junctions the value of (ψ) can be taken as 0.08.

Where this is not the case, but this method of accounting for thermal bridging is used, the default value of (ψ) is taken to be 0.15.

Design flexibility and enhancement

Detailing significance

Traditional design and construction practice has concentrated on insulating heat loss walls, floors and roofs of buildings, to reduce 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.

Enhanced thermal performance

Relatively straightforward changes in construction detailing can deliver reductions in psi values at key detail areas.

Issues to be addressed with regards to airtightness and thermal performance at key junctions are provided in the section entitled *Achieving Thermal Continuity and Airtightness* of this document. These include:

- substitution of normal medium-density concrete blocks by insulating blockwork:
 - at the ground floor zone in external walls
 - behind back cills at external wall opes
 - at the attic insulation level in party walls; and
 - at parapet roofs
- installation of a wind barrier in ventilated roof spaces, to reduce the wind effects on permeable insulation
- use of a purpose-made air-tight membrane, with joints taped and sealed, particularly at junctions in the external wall, around service penetrations, at windows and doors and at internal and external corners

Choosing an airtightness strategy

An effective airtightness strategy cannot be added to a design at construction stage, it must be included from earliest point of the design. Airtightness conflicts are most effectively solved on the drawing board and least efficiently solved on the site. Choices about construction type, sequencing of works and materials selection are all intrinsic to the airtightness strategy and decisions on these matters must take account of how they will impact on the airtightness performance required.

Further guidance to airtightness in less common junctions may be obtained in BSRIA Guide 47/2013 *Designing and constructing for airtightness*.

Design Stage

- Simplify built form where possible.
- Define the line of the air barrier as early as possible. Mark up 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.
- Decide 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, tapes, etc.
- Minimise the number of service penetrations, especially through the external wall.
 - Consider how service penetrations will be sealed
 - Rationalise service routes and penetrations.

Highlight air barrier critical elements and junctions on construction drawings and apportion responsibility for sealing critical junctions.

Construction Stage

Appoint a site “air barrier manager” to coordinate and inspect 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.

Air barrier management will include undertaking:

- Coordination of the formation of the air barrier
- Site quality assurance
- Check and sign off of 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 for appropriate approval.

Undertake airtightness tests at the earliest possible opportunity. This is typically done when the air barrier is first complete, after first-fix plumbing and electrics are installed and immediately prior to completion.

All materials and workmanship including airtightness tapes and sealants are to be proper materials fit for their intended use, supplied and installed as provided for in Technical Guidance Document D.

Achieving thermal continuity and airtightness

(1) General construction objectives

In designing and building for low heat loss, both good insulation and control of air infiltration/exfiltration are needed. Good attention to detailing is necessary during installation for insulation to work effectively and to ensure unwanted air infiltration is eliminated as far as practicable. This translates into "thermal continuity of the insulation" and "airtightness of the building".

It is important that, as buildings become more airtight, adequate ventilation is maintained. Technical Guidance Document F provides guidance on purpose-provided ventilation for buildings with an air permeability of $5\text{m}^3/(\text{h.m}^2)$ at 50pa, or less. Where the intended design is greater than $3\text{m}^3/\text{h.m}^2$ and the actual construction achieves a lower value, then appropriate additional measures should be implemented to ensure adequate ventilation.

HOW TO ACHIEVE THERMAL CONTINUITY - AND WHY

For thermal insulation to be effective, it needs to be continuous. This means no gaps between the insulation sheets or batts. It also means no way for cold air to circulate freely on the warm side of the insulation.

- Insulation boards with stepped rather than flat butt joints give better continuity.
- Cut cavity insulation to suit. Butt the sheets tightly to each other, as well as tight up against cavity closers.
- Install roof insulation over the top course of blocks at the eaves, prior to felting the roof, having brought the wall insulation up to the top of the external wall.

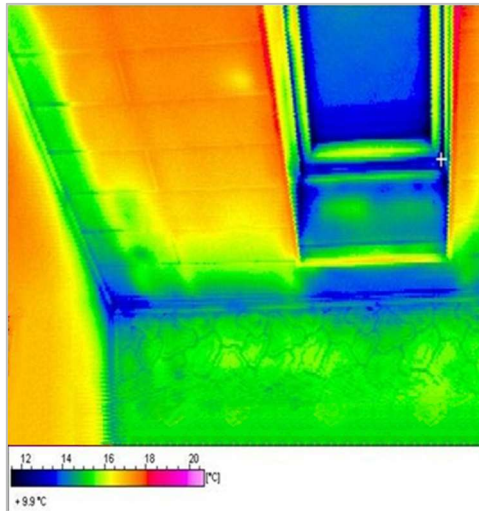


Figure 1: Gaps in insulation at critical junctions result in cold bridges, visible under thermal imaging (in blue and green)

Good practice

Use of an airtight membrane as the air barrier can provide improved airtightness performance. With internal dry lining, a vapour control layer is particularly important. To ensure the durability of the airtightness strategy, it may be necessary to use a reinforcing mesh in junctions subject to shrinkage, settlement or other movement in advance of plastering. Other good practice notes are provided on the diagrams in Part 2 for specific junctions.

HOW TO ACHIEVE AIRTIGHTNESS - AND WHY

Airtightness means cutting out unwanted draughts. Draughts can be so slight as to be imperceptible, but even slight draughts increase heat loss, sometimes dramatically.

The way to good airtightness is a continuous air-resistant layer all around the inside of the building. This includes under and around the ground floor, across the external walls and under the roof, to seal the inside from the outside. With masonry walls - whether concrete block or concrete - this is most easily done by using a wet plaster finish. It can also be done by using dry-lining boards and by taking extra care to seal around all gaps, all perimeters, and at windows and external doors.

Points to watch:-

- Plaster between the joists at suspended timber floors
- Ensure there's no gap between the floor and the walls
- Where pipes or wires pass through the air barrier, use suitable tape or grommets to seal around them
- Seal around window and external door frames with suitable airtightness tapes and/or sealants

(2) Ground floors

THERMAL CONTINUITY

Concrete ground-bearing floors: The insulation under the floor slab must be continuous. Continuous edge insulation should then be installed at the junction of the floor slab and the external wall.

Concrete suspended floors: The insulation is usually on top of the concrete and under a screed or a floor finish. As with ground-bearing slabs, this is easily installed and checked. Concrete suspended floors are often used on sloping sites. For this reason, there can be a significant amount of exposed external wall below the slab that should also be insulated.



Figure 2: Bonding an airtight membrane to the concrete floor slab using an appropriate certified sealant

Timber floors are, of their nature, suspended with a ventilated air space underneath. The potential for gaps in insulation between floor joists and a quilt is large. With well-built floors and for good thermal performance, insulation needs to be continuous between, under or over the joists, or a combination of these. Pay particular attention to potential gaps along joist edges.

AIRTIGHTNESS

Concrete ground-bearing floors: When properly installed, a concrete floor slab gives excellent airtightness. Appropriate tape or sealant should be provided behind the skirting to seal between the floor slab and the air barrier in the wall.

With timber frame external walls, it's essential to maintain air barrier continuity between the wall construction and the ground floor slab.

Concrete suspended floors: A well-cast concrete floor slab is airtight. As with a ground-bearing slab, use a suitable tape behind the skirting to seal the slab to the air barrier in the wall.

Timber floors: Timber floor boarding is prone to shrinkage over time, whereas a continuous sealed sheeted floor can provide an effective airtightness barrier.

(3) Masonry walls

The majority of dwellings in Ireland are built with masonry external walls. These walls may be cavity walls, with inner and outer leaves of blockwork, brickwork or concrete, with a cavity that is usually insulated, and frequently with additional insulation on the inner face. Alternatively, they may be built of single-skin masonry, frequently of hollow blockwork, precast concrete or insitu concrete, with insulation applied internally, sometimes externally, or sometimes both.

A well-built blockwork inner leaf with a coat of wet-finish plaster will, if properly applied and with proper detailing, deliver high levels of airtightness. Alternatively an airtightness membrane can be used. Dry-lining boards applied to the inside face can also provide airtightness. However, the issues surrounding continuity of thermal insulation and continuity

of airtightness at openings, roofs and suspended floors vary widely between these wall types. The details in Part 2 show these issues in detail.



Figure 3: External insulation being installed. Note that temporary weather protection may be required for some insulation types in accordance with manufacturer's instructions.



Figure 4: Internal dry-lining on blockwork with thermally efficient fixings (vapour control layer to be installed on the warm side of the insulation).

THERMAL CONTINUITY WITH SINGLE-SKIN MASONRY EXTERNAL WALLS

Internally applied insulation (insulated dry-lining) needs to be done carefully to achieve thermal continuity. Pay particular attention to gaps at the tops and bottoms of boards, at floors and ceilings and around opes.

Significant advantages of externally applied insulation are its ease of application and also of checking its continuity. Tightly-buttet or lapped sheets deliver thermal continuity with little difficulty.

THERMAL CONTINUITY WITH CAVITY MASONRY EXTERNAL WALLS

Well-built cavity walls have clean cavities, with cavity insulation held firmly against the inner leaf. Insulation sheets with lapped or tongue-and-groove edges, can be butted tightly against each other and give reasonable thermal continuity.

- Clear all debris including mortar snots from cavity as work progresses to prevent thermal bridging between the inner and outer leaf.
- Cavity insulation boards should be carefully cut to suit and tightly butted to each other.

- Fix insulation tight to the outer face of the inner blockwork leaf, to prevent air circulation between the block and insulation reducing the performance of the insulation layer.

AIRTIGHTNESS WITH CAVITY MASONRY EXTERNAL WALLS

The simplest way to achieve good airtightness is to wet plaster the inner leaf. Dry lining with proper sealing of all perimeters and joints will also achieve reasonable levels of airtightness. The key areas to watch are junctions at opes, at floors, and at service penetrations - see sub headings 5-10 below.

(4) Timber and steel frame

THERMAL CONTINUITY WITH TIMBER AND STEEL FRAME EXTERNAL WALLS

External walls of timber frame usually have insulation fitted between the load-bearing studwork in an inner leaf, possibly with additional insulation applied to the inner face of the studs. I.S. 440 *Timber frame construction, dwellings and other buildings* provides guidance on the construction of timber frame structures.

Well-built timber frame walls have sole plates tight to the masonry underneath, with insulation fitting snugly into the space between each pair of studs and the sheathing board outside.

- Ensure the insulation is cut to fit snugly into the space between each pair of studs and the sheathing board outside.
- Fill the entire stud depth with insulation
- Where required, fit a second layer of insulation inside the timber studs
- An internal vapour control layer is generally required in this form of construction.

External walls of steel frame usually have rigid insulation boards fitted outside the load bearing steel studwork of an inner leaf, possibly with additional insulation applied between the studs. With steel frame, some insulation must be placed outside the frame to provide a thermal break and avoid condensation.

Innovative construction systems should comply with Part D of the Building regulations and have independent third party certification. Works which involve systems, products, materials, techniques or equipment, for which published national standards do not yet exist, should have third party certification demonstrating compliance with Irish Building Regulations requirements.

Such certification may include, in part or in total, a European Technical Assessment or Agrément certification (e.g. NSAI Agrément) or equivalent.

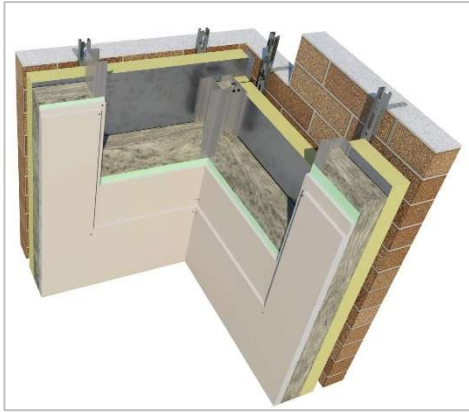


Figure 5: Hybrid lightweight steel frame construction with vapour control layer (shown in green) on the warm side of the insulation.

- Warm frame construction is where all the insulation is outside the steel frame.
- Hybrid construction is where insulation is included both outside the steel structure and in between the steel components.

At least 33% of the total thermal resistance should be provided on the outside of the steel studs.

Where compressible insulation is installed between studs in addition to rigid board insulation, it should be tightly packed and be in direct contact with the rigid board. Take care to ensure compressible insulation is maintained above dew-point temperature.

With hybrid construction, the system manufacturer should provide a condensation risk analysis in accordance with Technical Guidance Document L, Appendix B to ensure there is no risk of interstitial condensation.

AIRTIGHTNESS WITH TIMBER AND STEEL FRAME EXTERNAL WALLS

Best results are achieved with the use of a membrane fitted on the warm side of the insulation and held in place with battens forming a services cavity between the membrane and the plasterboard finish.

In some installations the plasterboard provides the airtightness layer. In this case, care is required in sealing the plasterboard to intermediate floors, roof and ground floor, external wall opens and service penetrations. Butt joints between plasterboard edges must also be sealed and fully supported on studs or noggins, for example, suitable compressible tapes may be used behind joints to ensure an airtight seal.

(5) Intermediate floor junctions

THERMAL CONTINUITY WITH TIMBER INTERMEDIATE FLOORS

If the thermal insulation is in the cavity or is external type, thermal continuity at the junction of the intermediate floor and the outside wall happens almost of its own accord. So long as the cavity insulation is continuous across the intermediate floor zone, continuity is achieved.



Figure 6: Foil-faced insulation board sealed to joists providing an effective VCL, airtightness barrier and insulation continuity through the intermediate floor void



Figure 7: Wet plaster scratch coat forms a continuous air barrier through the intermediate floor zone, joists penetrations sealed with appropriate tape

If the insulation is on the inner face of the external wall, thermal continuity requires greater attention to detail. There is a potential cold bridge all along the zone of the suspended floor. Continue the wall insulation through the intermediate floor zone and seal any vapour control layer, where present, to the joist penetrations.

THERMAL CONTINUITY WITH CONCRETE INTERMEDIATE FLOORS

As with timber floors, if the thermal insulation is in the cavity or is the external type, thermal continuity at the junction of the intermediate floor and the outside wall is achieved readily.

If the insulation is on the inner face of the external wall, thermal continuity is not possible.

AIRTIGHTNESS WITH INTERMEDIATE FLOORS

Airtightness at intermediate floors is a matter of extending the wall air barriers above and below the floor through the intermediate floor zone and taping up any penetrations of the air barrier by joist, joist hangers, beams, services etc. Where the intermediate floor is mass concrete this may form part of the airtight layer.

In timber floors, where joists are built into the inner leaf, airtightness is achieved by plastering the wall around the joists and taping the face of the joist to the plaster finish, see Figure 8. Alternatively, proprietary airtight caps are available for building in. Where joist hangers are used, it is recommended that these be installed on a layer of airtight membrane which is plastered over.

With timber frame or with dry-lined masonry, carry the airtight membrane or plasterboards through the floor zone and tape around the joists.

Alternatively, an airtight membrane can be carried from the inside face of the inner leaf, around the joist ends and back inside above the floor and taped to the air barrier in the wall above and below the floor. Because of the risk of interstitial condensation, diffusion open membranes are recommended in this location.

Diagrams B18 and B19 of TGD L 2021 provide guidance for the insulation of exposed floors. The floor void should be enclosed to prevent warm air moving horizontally into any voids in the exposed floor space where moisture might condense by, for example, using full height noggins.

With concrete intermediate floors, when the floor spans onto the wall, pay attention to any gap under the slab, especially with precast concrete slabs. If a blockwork wall is built off the floor slab above, this will give an excellent basis for airtightness once the blockwork is plastered right down to the slab. In the case of concrete intermediate floors, which employ precast elements, care is required in sealing any joints in the precast components.

(6) Separating wall junctions

The concern at separating walls is the structural continuity, which is usual between the separating wall and the exterior wall. This can result in breaks both in thermal insulation and also in airtightness.

THERMAL CONTINUITY

The issues which arise are similar to those with intermediate floors or with staircases. With a masonry structure, insulation in a cavity, or exterior insulation, both deliver thermal continuity. This is because the insulation runs uninterrupted either externally or in the cavity and outside the junction of the walls.

With an internally insulated masonry structure, the insulated dry lining needs to be returned for at least 1 metre along the separating wall.

AIRTIGHTNESS AT SEPARATING WALLS

The airtightness layer in the external wall should be continuous with that of separating wall

(7) Windows and external door opes

THERMAL CONTINUITY AT WINDOW AND EXTERNAL DOOR OPES

Correct choice of the lintel or lintels to be used when forming an ope in an external cavity wall is a key factor in ensuring thermal continuity. The selection of the method of closing the cavity at the jambs, and the detail of the cill or threshold, are equally important. The non-repeating cold bridges at these locations can account for a significant degree of heat loss in an otherwise well-insulated building.

For good thermal performance:-

- Use separate lintels and insulate between them.
- Fill all gaps around and between lintels with tightly packed insulation. Overlap the frame and this insulation by at least 15 mm.
- Secure any partial fill insulation firmly against the inner leaf.
- Cut cavity insulation to suit. Sheets should be tightly butted to each other and surrounding cavity closers and loose fill insulation.



Figure 8: *Certified proprietary airtightness reveal tapes are available for use with wet plaster air barriers*

AIRTIGHTNESS AT WINDOW AND EXTERNAL DOOR OPES

Air leakage often occurs between window or door frames and the surrounding construction. Appropriate airtightness sealants are required between plaster finishes, window boards and frames. Approved airtightness sealants and tapes are available to assist the formation of air barrier continuity at such interfaces.

For air barrier continuity:

- Apply a third party certified tape or sealant at all interfaces between the internal air barrier and the window or door frame
- If forming the air barrier to the walls with a plaster scratch coat on blockwork, install an appropriate airtightness tape. Where this tape is plastered over, the tape should provide a suitable key for the plaster.

To qualify for the NSAI Window Energy Performance (WEP) Scheme, manufacturers must first demonstrate that their window and door arrangements achieve a Class 4 airtightness rating when tested at 600 Pa to I.S. EN 12207:1999 Windows and doors - Air permeability - Classification. As a result, well-made windows should have little or no air leakage. The lower the air leakage value of the window assembly, the greater will be the overall efficiency of the window assembly.

(8) External Door Thresholds

THERMAL CONTINUITY

Achieving sufficient thermal continuity to minimise the thermal bridge at door thresholds and to meet the critical surface temperature factor, f_{Rsi} , requires careful design.

Compliance with the critical surface temperature, $fR_{si} \geq 0.75$, may entail a thermal model. However, certified details, or proprietary solutions, are available which have been thermally modelled by a registered thermal modeller.

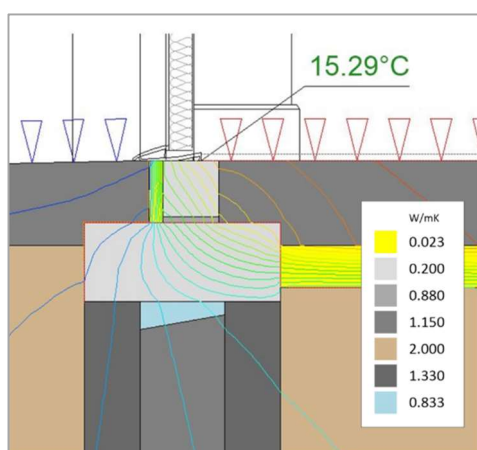


Figure 9: Example of a thermally modelled threshold detail

Where thresholds are of such a length to be considered “key junctions”, the thermal bridge associated with them should be fully accounted for, either through a Y-factor calculation, or by adoption of the default 0.15 thermal bridging factor.

The design and construction of door thresholds should comply with Parts A to M of the Building Regulations.

Each threshold should be designed to suit the components selected by the designer and take account of accessibility, moisture and insulation. Proprietary thresholds are available that assist in addressing these concerns.

Care is also required to ensure the continuity of DPC, DPM and/or radon barrier at thresholds.

AIRTIGHTNESS

Airtightness at thresholds can be achieved by sealing the threshold to the floor slab or air barrier and ensuring continuity of the air seal at the jambs.

Doors and frames tested in accordance with the WEP scheme will have good air permeability performance and will contribute to achieving a low overall air permeability test result.

(9) Service penetrations

Holes and chases are formed for many different services by different specialist contractors. They may be in roof spaces (recessed light fittings, water pipes, soil vent pipes, rainwater pipes, ventilation ducts, television cables); in external walls (soil and waste pipes, electrical cables) and in ground floors (soil and waste pipes, incoming mains). Penetrations may also be required behind bath panels, shower trays, kitchen units and into service shafts.

A key element in maintaining thermal continuity and airtightness around service penetrations is to agree standard sealing procedures with contractors and make sure the right materials and tools are available.

Specify appropriate sealing methods for services penetrations and/or structural penetrations of the thermal envelope, including:

- Cooker hood extract ducts
- Condensing boiler flues
- Background vents in walls
- Air intake/extract ducts
- W.C. cistern overflow pipes
- Outside taps
- Soil vent pipes
- Waste pipes
- Canopies to entrances
- Metal balconies
- Electricity connections and meters
- Gas connections and meters
- Security alarm systems
- External security lighting, security cameras, sensors
- TV, broadband & cable service

THERMAL CONTINUITY AT SERVICE PENETRATIONS

For good thermal performance:

- Core drill service penetrations to minimise damage to the insulation layer.
- Make good damage caused to the insulation layer by filling any gaps with loose fibrous insulation or approved expanding foam.
- Size drill holes to provide a snug fit, reducing oversize to a minimum.
- Where ducts and pipes are insulated and have a vapour-tight outer sleeve (required to prevent condensation), it is recommended this is sealed to the vapour control layer or air barrier layer, as appropriate, in the wall/floor/roof element penetrated.

AIRTIGHTNESS AT SERVICE PENETRATIONS

For good airtightness:

- All penetrations through the air barrier line should be effectively sealed following installation of the services. This can be achieved with the use of appropriate airtightness grommets, airtightness tape or airtightness sealants.
- Construction of a dedicated services cavity inside the airtightness barrier will reduce the number of penetrations of the barrier.



Figure 10: Sealing an air barrier membrane around connection to an electrical socket outlet

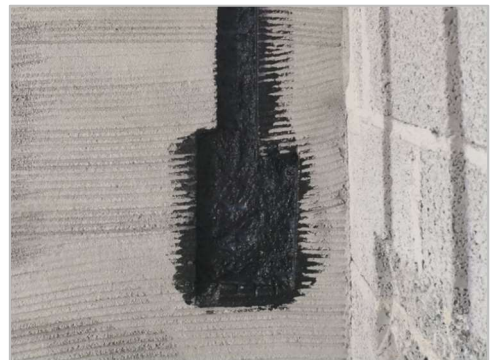


Figure 11: Sealing a chase in a masonry external wall with an airtight liquid-applied membrane prior to installing conduits

When installing **socket outlets or switch plates** in an air barrier formed by a wet plaster layer, seal any chases formed behind the wet plaster layer before installing the services. Consider using proprietary gasketed socket boxes.

Where airtight membranes are used, a services cavity on the warm side will allow for the installation of services without penetrating that airtight layer and ensure that accidental breaches are avoided, especially after occupation.

Where plasterboard linings form the airtight layer, apply a continuous ribbon of bedding compound around the hole and the electrical back box prior to installing the plasterboard. This will reduce air leakage through the sockets/switches into the void behind the plasterboard.

(10) Roofs

CONTINUITY OF WALL AND ROOF INSULATION AT EAVES / VERGE

Roof insulation should be installed to minimise the effects of thermal bridging at the eaves. Attention must be paid to the sequence of installation of insulation at the eaves to ensure that it is effective, as it is difficult to install insulation after the roof has been completed. The roof insulation should be laid over any cavity barrier at the top of the wall and be continuous with the wall insulation.

THERMAL CONTINUITY UNDER THE ATTIC

For best practice, in cold roof spaces, use insulation over the ceiling joists, to eliminate the cold bridge caused by the joist.

All access hatches and doors to ventilated attic spaces should be sealed and insulated.

AIRTIGHTNESS UNDER THE ATTIC

Proprietary attic trap doors with low air permeability characteristics should be fitted in lieu of site manufactured hatches. Where site manufactured doors are installed, these should be complemented with draught stripping and a compression catch to minimise air leakage into the attic space above. The attic hatch frame should be sealed to the air barrier in the ceiling.

Cables which pass through, or are enclosed in, insulation should be adequately rated to ensure that they do not overheat. Recessed fittings and transformers should have adequate ventilation or other means to prevent overheating.



Figure 12: Roof with breather membrane and ventilated counter-battens above an unventilated attic

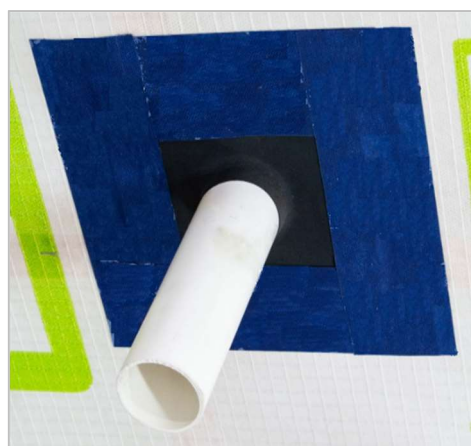


Figure 13: Sealing where pipes enter the roof space

Where ceilings form part of the fire protection to structural elements, the requirements of the Supplementary Guidance to TGD B may apply to penetrations, such as downlighters, soil vent pipes or ventilation duct terminals.

Care should be taken to seal around all penetrations of pipes, ducts, wiring, etc. through the ceiling, see Figure 13 above.

The use of a vapour control layer (VCL) at ceiling level, on the warm side of the insulation, will assist in limiting vapour transfer and should therefore be used, but cannot be relied on as an alternative to ventilation of a cold attic space.

Where the roof is insulated at rafter level, an alternative construction using a breathable membrane and an effective VCL is described in TGD L in accordance with Part D of the building regulations.

DORMERS

Sealed airtightness membrane should extend behind the plaster linings of the dormer walls and roof to form an air barrier and, where required, an effective VCL.

Appendix A

Calculation of γ factor for use in DEAP with Example

Heat loss through thermal bridging is not accounted for in the U-value calculation for the plane building elements containing the thermal bridge and therefore must be evaluated separately. It is usually expressed in terms of a fraction known as the γ factor. In order to determine the value of γ to be used in an energy rating calculation the following may be used;

- Use 0.15 where no calculations have been performed and where Acceptable Construction Details have not been used;
- Use 0.08 where the Acceptable Construction Details have been used in all key junctions
- Use a γ factor which can be determined through calculation using Ψ values for details in Table D1 to D6 or combined with details with certified Ψ values for all key junctions
- Use a γ factor which can be determined using certified Ψ values for all key junctions

The γ factor is derived using the linear thermal transmittance or Ψ (Ψ) value. The Ψ value is a property of a thermal bridge and is the rate of heat flow per degree per unit length of bridge.

THE Ψ VALUE CAN BE OBTAINED IN THE FOLLOWING WAYS:

- a) Specific Ψ value for Acceptable Construction Details from Building Regulations 2021 TGD-L (Dwellings) Tables D1 to D6 may be used, depending on the construction type.
- b) Certified Ψ values for other details which are assessed in accordance with the BRE IP1/06 "Assessing the effects of thermal bridging at junctions and around openings" and BRE Report BR 497 "Conventions for calculating linear thermal transmittance and temperature factors" in accordance with Appendix D of Building Regulations 2021 TGD-L (Dwellings). Certification should be provided by a third party certification body such as Agrément or equivalent or certified by a member of an approved thermal modellers scheme or equivalent. NSAI operate a third party certification scheme for thermal modellers
- c) Or they can be derived from measurement by a third party certification body.

The transmission heat loss coefficient (H_{TB}) can then be calculated from:

$$H_{TB} = \sum(L \times \Psi) \text{ W/m}^2\text{K}$$

Where:

- L is the length of the thermal bridge over which the thermal bridge applies.
- Ψ is linear thermal transmittance as defined in a) and b) above.

The γ factor can then be derived using the formula:

$$H_{TB} = \gamma \times \Sigma A_{exp.}$$

Where:

- $\Sigma A_{exp.}$ is the summed area of heat loss elements (walls, floors and roofs), in m^2 .

SEAI have developed a Thermal Bridging Application which can be used to calculate a non-default thermal bridging factor for use in the Dwelling Energy Assessment Procedure (DEAP). This can be downloaded from the SEAI website: <https://www.seai.ie/data-and-insights/forms/Thermal-Bridging-Application.xlsm>

SAMPLE CALCULATION

For a 3 bed semidetached house below using the actual lengths of the internal junctions the y factor for use in DEAP can be calculated as follows.

HOUSE DETAILS (all dimensions are internal)

Construction:

- Roof: Pitched tiled roof, insulation laid on attic floor, part between ceiling joists and part over ceiling joists. U-value = 0.14 W/m2K.
- Walls: Cavity wall (dense concrete blocks) rendered externally, with partial fill insulation in the cavity and internal insulation. U-value = 0.15 W/m2K.
- Floor: Concrete slab-on-ground floor with insulation under slab. U-value = 0.15 W/m2K.

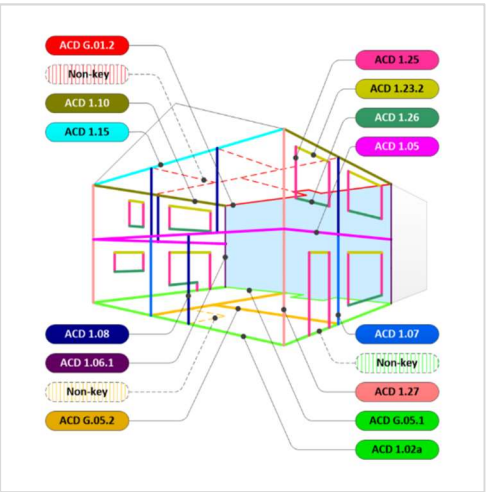
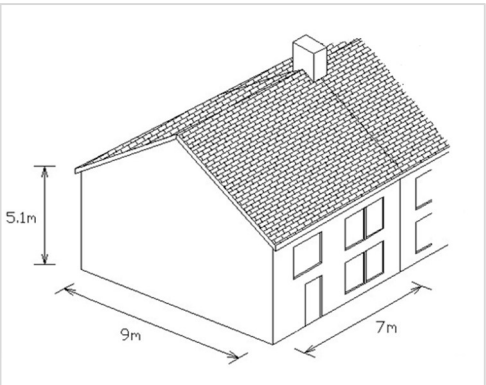


Figure 14: Wireframe of typical 3-bed semi-detached house showing typical thermal bridges normally present

Key junctions and their lengths

- Ground floor/external wall 23.0m
- Ground floor/separating wall 9.8m
- Ground floor/int. partition walls 12.8m
- Intermediate floor/external wall 23.0m
- Roof (eaves)/external wall 14.0m
- Roof (ceiling)/gable wall 9.0m
- Roof (ceiling)/separating wall 9.8m
- External wall/ext. wall corners 10.2m
- External wall/separating wall 10.2m
- External wall/masonry partition 9.0m
- External wall/stud partition 12.3m
- External wall/jambs 23.4m
- External wall/lintels 11.7m
- External wall/window cills 10.8m

Non-Key Junctions

- Roof (ceiling)/stud partition wall
- Ground floor/stud partition wall built off insulated ground floor slab
- Threshold to front and back doors

Exposed Surface Area:

- Total heat loss surface area (floor, walls and roof) 243.3 m²

Y-FACTOR CALCULATION

Key Junction Location/Description	ACD Reference	Target U-Value (W/m²K)	Psi-Value Table D1-6 (W/mK)	Junction Length (m)	Calculated Value Psi x L (W/K)
Ground floor/external wall	1.02a	0.15	0.108	23	2.484
Ground floor/separating wall	G.05.1	0.15	0.240/2	9.8	2.352
Ground floor/masonry partition wall through slab	G.05.2	0.15	0.150	12.8	1.920
Intermediate floor/ext. wall	1.05	0.15	0.020	23	0.460
Roof/external wall	1.10	0.15	0.030	14	0.420
Roof/gable wall	1.15	0.15	0.152	9	1.368
Roof/separating wall	G.01.2	0.15	0.458/2	9.8	2.244
External wall/external wall	1.27.1	0.15	0.032	10.2	0.326
External wall/separating wall	1.06.1	0.15	0.066/2	10.2	0.337
External wall/masonry partition	1.07	0.15	0.000	4.9	0.000
Ext wall/stud partition	1.08	0.15	0.000	12.3	0.000
External wall/jamb	1.25	0.15	0.011	23.4	0.257
External wall/lintel	1.23.2	0.15	0.012	11.7	0.140
External wall/cill	1.26	0.15	0.015	9.9	0.146
Non-key junctions Location/Description	Reason for exclusion				
Ground floor/stud partition	Fully within thermal envelope				0.0
Roof/stud partition	Fully within thermal envelope				0.0
Thresholds	fRsi ≥ 0.75, heat loss included in ACD 1.02a				0.0
Total heat transmission through thermal bridging, Σ(L x Ψ), expressed in W/m²K					12.4365
Total heat loss surface area of building, ΣA _{exp} , in m²					243.3
Y-factor = Σ(L x Ψ) / ΣA_{exp} =					0.051

R-VALUES FOR USE WITH ACD DRAWINGS

Insulation thickness required to achieve specified thermal resistance

THERMAL RESISTANCE [m ² K/W]	INSULATION THERMAL CONDUCTIVITY [W/mK]				
	0.020	0.025	0.030	0.035	0.040
0.45	9mm	11mm	14mm	16mm	18mm
0.75	15mm	19mm	23mm	26mm	30mm
1.00	20mm	25mm	30mm	35mm	40mm
1.20	24mm	30mm	36mm	42mm	48mm
1.50	30mm	38mm	45mm	53mm	60mm
2.00	40mm	50mm	60mm	70mm	80mm
2.50	50mm	63mm	75mm	88mm	100mm
3.00	60mm	75mm	90mm	108mm	120mm
4.00	80mm	100mm	120mm	140mm	160mm
4.50	90mm	113mm	135mm	158mm	180mm
5.00	100mm	125mm	150mm	178mm	200mm

Glossary

<i>ACH</i>	Air changes per hour
<i>Air barrier</i>	The uninterrupted line defined within any section through the envelope of the dwelling which identifies the barrier to air leakage which is to be provided in the construction
<i>Air leakage</i>	The uncontrolled flow of air through gaps and cracks in the fabric of dwellings (sometimes referred to as infiltration, exfiltration or draughts)
<i>Air Permeability</i>	The physical property used to measure the airtightness of the building fabric. It is defined as air leakage rate per envelope area at the test reference pressure differential across the building envelope of 50 Pascal (50N/m ²)
<i>Cavity barrier</i>	A construction provided to close a concealed space against penetration of smoke or flame, or provided to restrict the movement of smoke or flame within such a space
<i>Cavity closer</i>	Masonry unit or plastics component that closes a cavity at the vertical sides of an opening
<i>CPC</i>	Carbon Performance Coefficient - the calculated carbon dioxide emission rate of the building divided by that of the reference dwelling in Building Regulations 2021 TGD-L (Dwellings) Appendix C
<i>Dew point</i>	The temperature at which air becomes saturated with vapour
<i>EPC</i>	Energy Performance Coefficient -the calculated primary energy consumption of the proposed dwelling divided by that of the reference dwelling, Building Regulations 2021 TGD-L (Dwellings), Appendix C
<i>Key junction</i>	The following types of junctions are considered key junctions where they include a heat loss plane element: • Floor to wall (includes party walls) • Wall to wall (corners & party walls)

- Roof to wall (includes party walls)
- Lintel above window/door
- Sill below window
- Window/door jamb

This list is not exhaustive. Any junction in the dwelling which has a relatively long length or a high rate of heat loss, or both, should be considered a key junction.

Appropriate airtightness sealant

Sealant should be fit for its intended use and meet guidance in Technical Guidance D-Materials and Workmanship

Appropriate airtightness tape

Tape fit for its intended use and meet guidance in Technical Guidance D-Materials and Workmanship

Interstitial condensation

Condensation within building elements

MPCPC

Maximum Permitted Carbon Performance Coefficient

MPEPC

Maximum Permitted Energy Performance Coefficient

Vapour control layer

(Water) vapour control layers should comply with I.S. EN 13984 or should be verified according to I.S. EN ISO 12572.

The vapour resistance of all vapour control layers should be determined in accordance with I.S. EN 1931 and I.S. EN ISO 12572.

Where polyethylene is used as a vapour control layer it should have a minimum thickness of 0,12 mm (500 gauge), and a minimum vapour resistance of 250 MNs/g.

Where other materials, or integral boards containing a vapour control layer are used, they shall comply with Part D of the building regulations and their suitability should be determined by a condensation risk analysis in accordance with I.S. EN ISO 13788 or I.S. EN ISO 15026.

Documents referred to

Building Regulations Part L 2021 - Technical Guidance Document L Conservation of Fuel and Energy – Dwellings

BRE Report BR 497, Conventions for calculating linear thermal transmittance and temperature factors, BRE, 2016

BRE Information Paper IP 1/06 – Assessing the effects of thermal bridging at junctions and around openings, 2006

ATTMA TS1 – Measuring air permeability of building envelopes, 2006 Edition

BRE Report BR 262 - Thermal insulation: avoiding risks (2002 edition)

I.S. EN ISO 9972:2015 - Thermal Performance of Buildings - Determination of Air Permeability of Buildings – Fan Pressurization Method

“BISRA” Guide 47/2013 Designing and constructing for airtightness

NSAI airtightness testing - D-IAB-007 Airtight Testing Scheme Master Document Rev 5

SEAI Domestic BER Technical Bulletin, July 2020

2

Acceptable Construction Details

- 1 - Cavity Insulation
- 2 - External insulation
- 3 - Internal insulation
- 4 - Timber frame
- 5 - Steel frame
- 6 - Hollow block
- 7 - General details

Part 2 of this guide is in seven sections and provides large scale indicative detail drawings of thermal insulation and airtightness provisions for specific construction interfaces.

Acceptable Construction Details

Refer to the Department of Housing, Local Government and Heritage's website or follow the links below each to access the ACD detail sheets listed below.

Section 1: Cavity insulation

<https://assets.gov.ie/201047/fb140abf-dc10-4262-8eb1-da4e79bc237f.pdf>

Section 2: External insulation

<https://assets.gov.ie/201048/8a35795a-0876-4877-b5d6-2166238ce84b.pdf>

Section 3: Internal insulation

<https://assets.gov.ie/201050/1ecf69d3-8e37-49b7-8d53-b39dceb717d1.pdf>

Section 4: Timber Frame

<https://assets.gov.ie/201052/293075e1-3661-4085-816f-50d69cdc7f73.pdf>

Section 5: Steel Frame

<https://assets.gov.ie/201056/69791323-09a5-4f69-b741-61cc1ec4c8b5.pdf>

Section 6: Hollow Block Internal Insulation

<https://assets.gov.ie/201057/b7b9b481-f19f-4c91-b855-7223eec1f877.pdf>

Section G: General

<https://assets.gov.ie/201046/9e88e894-26f0-4bd3-b435-401ec43c9be5.pdf>

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