Domestic BER Technical Bulletin

July 2020

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Sustainable Energy Authority of Ireland

SEAI is Ireland's national energy authority investing in, and delivering, appropriate, effective and sustainable solutions to help Ireland's transition to a clean energy future. We work with the public, businesses, communities and the Government to achieve this, through expertise, funding, educational programmes, policy advice, research and the development of new technologies.

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Contents

1. Thermal Bridging in DEAP

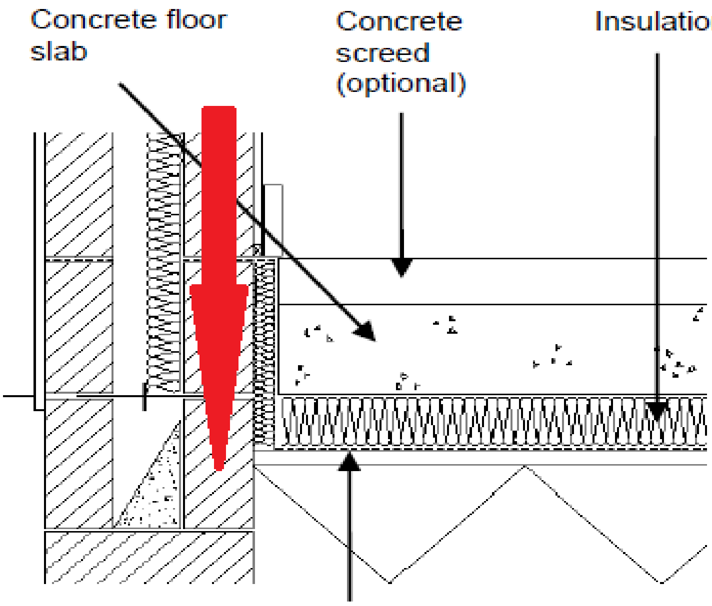
1.1. What is a Thermal Bridge?

Ideally, in order to minimise heat loss a dwelling would be completely enclosed in a continuous layer of insulation. In reality, there will be areas of the building fabric where it is impossible to maintain the continuity of insulation, particularly around doors and windows, and at the junctions between the building elements, e.g. the junction between the ground floor and the walls of the dwelling.

A **thermal bridge** occurs where there is a gap in insulation or a reduced level of insulation in the building fabric. This has a lower thermal resistance, which means it allows heat to escape more easily from the dwelling.

Figure 1 shows an example of a thermal bridge at the junction of a concrete slab ground floor with a masonry cavity wall. Because of the need to ensure structural stability, it is not possible to maintain a continuous layer of insulation across the junction.

Figure 1 - Section of the junction between a concrete ground floor and a masonry cavity wall



There is a gap between the floor insulation (under the slab) and the wall insulation (in the cavity). Heat will flow through this gap at a higher rate than through the floor or wall, both of which are well-insulated. This is the thermal bridge.

Measures can be taken to reduce the effect of the thermal bridge, e.g.

- The use of edge insulation around the perimeter of the floor;
- Bringing the wall insulation down below the top of the floor;
- The use of blocks of low thermal conductivity in the lower course(s) of the inner leaf of the cavity wall.

Section 1.3.3 of the TGD L requires that particular care must be taken to prevent excessive heat loss at these thermal bridges. Failure to do so could lead to problems with condensation and mould growth.

The rest of Section 1 sets out,

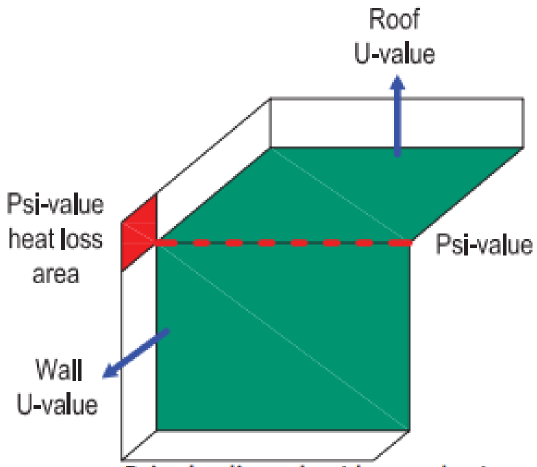
- How thermal bridging is accounted for in DEAP: the thermal bridging factor – Section 1.2 and 1.5;
- The use of the Acceptable Construction Details and certified details to determine the thermal bridging factor – Section 1.3 and 1.4;
- The documentary evidence required to support the use of a thermal bridging factor – Section 1.5;
- An example of a non-default thermal bridging factor calculation, with examples of the supporting documentation required – Section 1.6;
- The responsibilities of the BER Assessor in respect of the thermal bridging factor - Figure 8.

1.2. Heat Loss due to Thermal Bridges

In DEAP the heat loss through each building element - floor, wall, roof, window, door – depends on the **area** and the thermal transmittance (**U-value**) of that building element. However, while this accounts for the heat loss through those building elements, it does not account for heat loss at the *junctions* between those elements.

For example, in Figure 2, the wall area & wall U-value, and the roof area & roof U-value, account for the heat loss through the green sections. However, the heat loss through the junction of wall and roof, marked by the red dashed line, must also be accounted for.

Figure 2
Heat loss at a wall-roof junction



This is described as a **linear thermal bridge** as the heat loss occurs along the line of the junction between wall and roof. In the same way that the rate of heat loss through a unit area of a building element is measured by its thermal transmittance (U-value), the rate of heat loss through a unit length of a linear thermal bridge is measured by its **linear thermal transmittance**. It is represented by the Greek letter Psi (Ψ) and so it is also known as the **Psi-value**. It is measured in units of W/mK.

In general, the Psi-value represents the additional heat flow through the linear thermal bridge over and above that through the adjoining plane elements. The Psi-value is calculated using numerical modelling in accordance with BR497 and BS EN ISO 10211:2017 and is dependent on a number of factors including:

- The geometry of the junction and DEAP measurement conventions.
- The level of insulation at the junction.

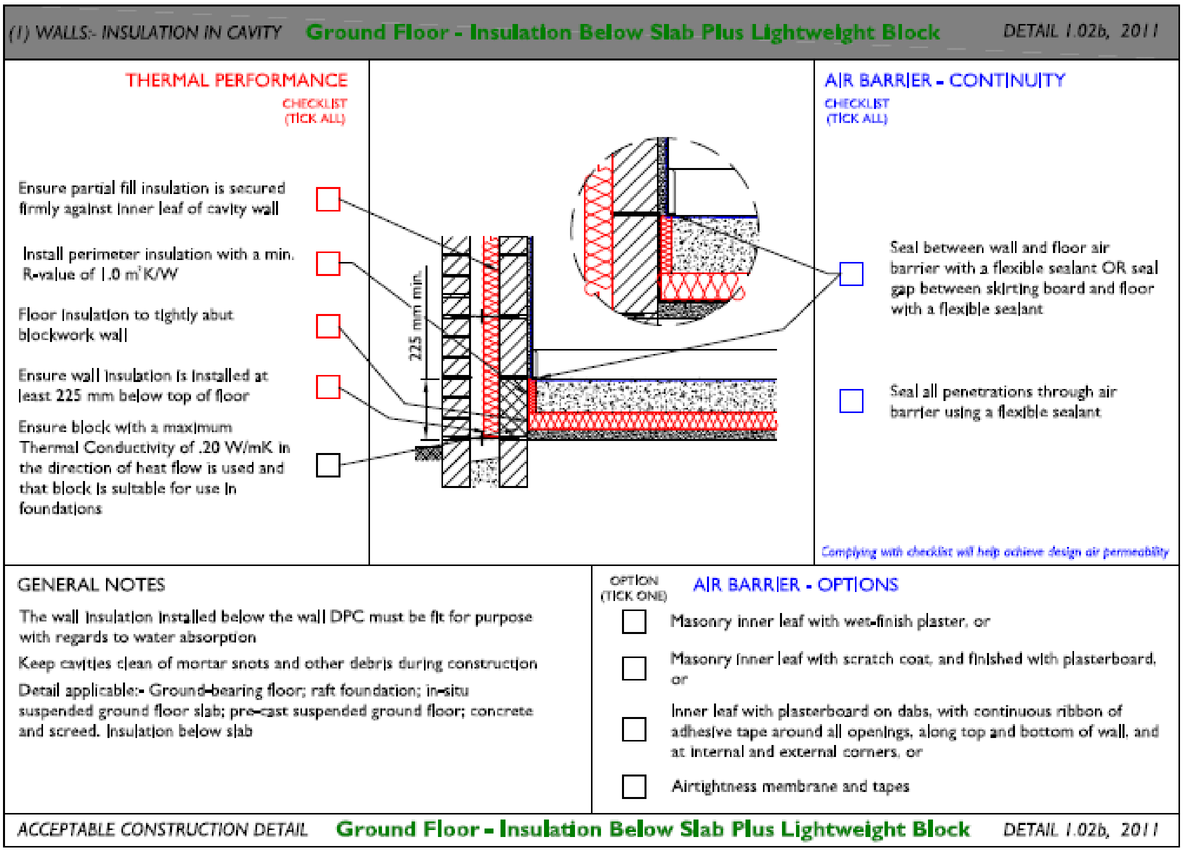
1.3. Acceptable Construction Details (ACDs)

In order to provide guidance on minimising heat loss through the thermal bridges in a dwelling, a set of junction details have been published for the most common construction methods used in Ireland. These are known as the Acceptable Construction Details (ACDs). For each junction in the ACDs the following is provided:

- A drawing of the junction detail;
- Construction requirements to achieve the necessary thermal performance;
- Requirements to ensure continuity of the air barrier;
- Options for the type of air barrier;
- The Psi-value of the junction detail – (also given in Tables D1 to D6 of TGD L).

These details are available to download from the Department of Housing, Planning and Local Government website.

Figure 3 - A detail from the ACDs.



(1) WALLS:- INSULATION IN CAVITY **Ground Floor - Insulation Below Slab Plus Lightweight Block** DETAIL 1.02b, 2011

THERMAL PERFORMANCE
CHECKLIST (TICK ALL)

- Ensure partial fill insulation is secured firmly against inner leaf of cavity wall
- Install perimeter insulation with a min. R-value of 1.0 m²K/W
- Floor insulation to tightly abut blockwork wall
- Ensure wall insulation is installed at least 225 mm below top of floor
- Ensure block with a maximum Thermal Conductivity of .20 W/mK in the direction of heat flow is used and that block is suitable for use in foundations

AIR BARRIER - CONTINUITY
CHECKLIST (TICK ALL)

- Seal between wall and floor air barrier with a flexible sealant OR seal gap between skirting board and floor with a flexible sealant
- Seal all penetrations through air barrier using a flexible sealant

Complying with checklist will help achieve design air permeability

GENERAL NOTES

The wall insulation installed below the wall DPC must be fit for purpose with regards to water absorption

Keep cavities clean of mortar snots and other debris during construction

Detail applicable:- Ground-bearing floor; raft foundation; in-situ suspended ground floor slab; pre-cast suspended ground floor; concrete and screed. Insulation below slab

OPTION (TICK ONE) AIR BARRIER - OPTIONS

- Masonry inner leaf with wet-finish plaster, or
- Masonry inner leaf with scratch coat, and finished with plasterboard, or
- Inner leaf with plasterboard on dabs, with continuous ribbon of adhesive tape around all openings, along top and bottom of wall, and at internal and external corners, or
- Airtightness membrane and tapes

ACCEPTABLE CONSTRUCTION DETAIL **Ground Floor - Insulation Below Slab Plus Lightweight Block** DETAIL 1.02b, 2011

Figure 3 has an example of an ACD: Detail 1.02b for the junction of a Cavity Wall – Insulation in Cavity and a Ground Floor – Insulation below Slab plus Lightweight Block. Note the requirements that must be met, for example, "Install perimeter insulation with a min. R-value of 1.0 m²K/W" and "Ensure wall insulation is installed at least 225 mm below top of floor".
For the purposes of the BER, if an ACD is being used, only the Thermal Performance checklist needs to be completed.

1.4. Junction Details not in the ACDs

The ACDs cover many common construction junction types, but they are not exhaustive. For example, the following features are typically not represented in the ACDs: cantilevered sections, non-standard window positions, façade bracketry (e.g. helping hand brackets).

As we will see in Section 1.5, where a non-default thermal bridging factor is to be used in DEAP, any key junctions not covered by ACDs need to be thermally modelled to determine the junction Psi-value. The Psi-value for non-ACD junctions can be taken from any of the following sources:

- A numerical model of the specific junction carried out and certified by an NSAI registered thermal modeller or equivalent. Details of the NSAI Thermal Modellers Scheme can be found here.
  Many construction material manufacturers have developed their own library of certified details.
- NSAI Agrément certificates or equivalent – this approach is typically used for building systems rather than individual junction details.
- The BRE Certified Thermal Products Database.[1]
  This is a database of Psi-values which have been independently assessed and certified by BRE.
  BRE are a UKAS Accredited Certification Body. The calculated Psi-values provided by the BRE Certified Thermal Products Database are acceptable for use in DEAP and NEAP.
  https://www.bregroup.com/certifiedthermalproducts/podpage.jsp?id=3590

[1] Please note: specifiers and constructors of these details should ensure that thermally approved details for the UK comply with all Parts of the Irish Building Regulations including Parts A-Structure, B-Fire, C-Site Preparation and Resistance to moisture, and D-Materials and Workmanship.

1.5. In addition, Accounting for heat loss at junctions in DEAP

In DEAP, the additional heat loss due to thermal bridging is accounted for by the Thermal Bridging Factor, also called the y-value, expressed in W/m²K. DEAP multiplies this number by the total exposed surface area of the dwelling to give the heat loss due to thermal bridging from all key junctions in the dwelling. This section sets out the appropriate value to enter for the y-value, which depends on how thermal bridging has been addressed in the dwelling.

Note: 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.

1.5.1. No information on junction details

Where no information is provided to the BER Assessor about the junction details, the default thermal bridging factor should be used: y-value = 0.15 W/m²K.

Even where this value is used, there is a responsibility to ensure junction design meets the TGD L requirements in relation to limiting risk of surface condensation, as set out in Appendix D of the TGD L. **This falls outside of BER assessments and is not considered here.**

1.5.2. All key junctions covered by ACDs

Where all of the key junctions in a dwelling are covered by details taken from the ACDs, there are two options for the thermal bridging factor:

Option 1: Use the thermal bridging factor, y-value = 0.08 W/m²K.

The use of this value is allowed for **new dwellings only**, where the dwelling has been designed and constructed in accordance with the acceptable construction details.

Documentary evidence is required **to support the use of a y-value of 0.08 W/m²K in a BER assessment**. The purpose of the supporting evidence is to show that:

- All junctions in the dwelling have been considered;
- All key junctions have been identified;
- Each key junction has been designed and built in accordance with the associated ACD.

For example, these requirements would be met by the following documentation:

- Construction Drawings showing **all** junctions in the dwelling.
- A schedule of junctions. This would,
    - List **all** junctions in the dwelling.
    - Identify all **key** junctions;
    - Reference the associated ACD for each key junction.
- A copy of the ACD for every key junction.

These documents should reference the dwelling being assessed and should be signed by the relevant person, i.e. one of,

- Developer,
- Builder,
- Architect,
- Engineer,
- Assigned certifier,

confirming that the key junctions identified were designed and built in accordance with the associated ACDs. (For New-Provisional ratings it is sufficient to confirm design only, as the dwelling has not yet been built.)

Option 2: Use a non-default thermal bridging factor.
Documentary evidence is required to support a non-default y-value.
The purpose of the supporting evidence is to show that:

- All junctions in the dwelling have been considered;
- All key junctions have been identified;
- Each key junction has been designed and built in accordance with the associated ACD;
- The non-default y-value has been calculated correctly.

For example, these requirements would be met by the following documentation:

- Construction Drawings showing **all** junctions in the dwelling.
- A schedule of junctions. This would,
    - List **all** junctions in the dwelling.
    - Identify all **key** junctions;
    - Reference the associated ACD for each key junction.
- A copy of the ACD for every key junction, as listed in the junction schedule.
- The calculation of the non-default y-value.
  The calculation of the y-value requires the length of each key junction in the dwelling so this should be clearly set-out either in the drawings or the schedule.

These documents should reference the dwelling being assessed and should be signed by the relevant person, i.e. one of,

- Developer,
- Builder,
- Architect,
- Engineer,
- Assigned certifier,

confirming that the key junctions identified were designed and built in accordance with the associated ACDs. (For New-Provisional ratings it is sufficient to confirm design only, as the dwelling has not yet been built.)

The use of a calculated y-value is typically of benefit to projects. For the majority of dwellings, the calculated y-value will be below the default 0.08 W/m^{2}K value for standard house types. This directly affects the overall energy performance of the dwelling.
Apartments will commonly have calculated y-values significantly above the 0.08 W/m^{2}K value. This is not necessarily due to poor detailing of junctions but is mainly due to the DEAP measurement convention. For the purpose of *design-stage* assessments, it is recommended to use the 0.15 W/m^{2}K default value for apartments. This allows a margin for error in the event that a y-value of 0.08 W/m^{2}K is not achieved in the final construction.

SEAI have developed a Thermal Bridging Calculator which can be used to carry out y-value calculations. This is available to download from the SEAI website here.

1.5.3. All junctions covered by a combination of ACDs and certified details

In this case a non-default y-value must be calculated.

Documentary evidence is required **to support a non-default y-value**. The purpose of the supporting evidence is to show that:

- All junctions in the dwelling have been considered;
- All key junctions have been identified;
- Each key junction has been designed and built in accordance with the associated ACD/certified detail;
- The non-default y-value has been calculated correctly.

For example, these requirements would be met by the following documentation:

- Construction Drawings showing **all** junctions in the dwelling.
- A schedule of junctions. This would,

    - List **all** junctions in the dwelling.
    - Identify all **key** junctions;
    - Reference the associated ACD/certified detail for each key junction.
- A copy of the associated ACD/certified detail for every key junction, as listed in the junction schedule.
- The calculation of the non-default y-value.
    - The calculation of the y-value requires the length of each key junction in the dwelling so this should be clearly set-out either in the drawings or the schedule.

These documents should reference the dwelling being assessed and should be signed by the relevant person, i.e. one of,

- Developer,
- Builder,
- Architect,
- Engineer,
- Assigned certifier,

confirming that the key junctions identified were designed and built in accordance with the associated ACD/certified detail. (For New-Provisional ratings it is sufficient to confirm design only, as the dwelling has not yet been built.)

1.6. Example – All key junctions covered by a combination of ACDs and certified details

The dwelling in the following example is a 2-storey **semi-detached** house.

The details of the building fabric are set out in the following table:

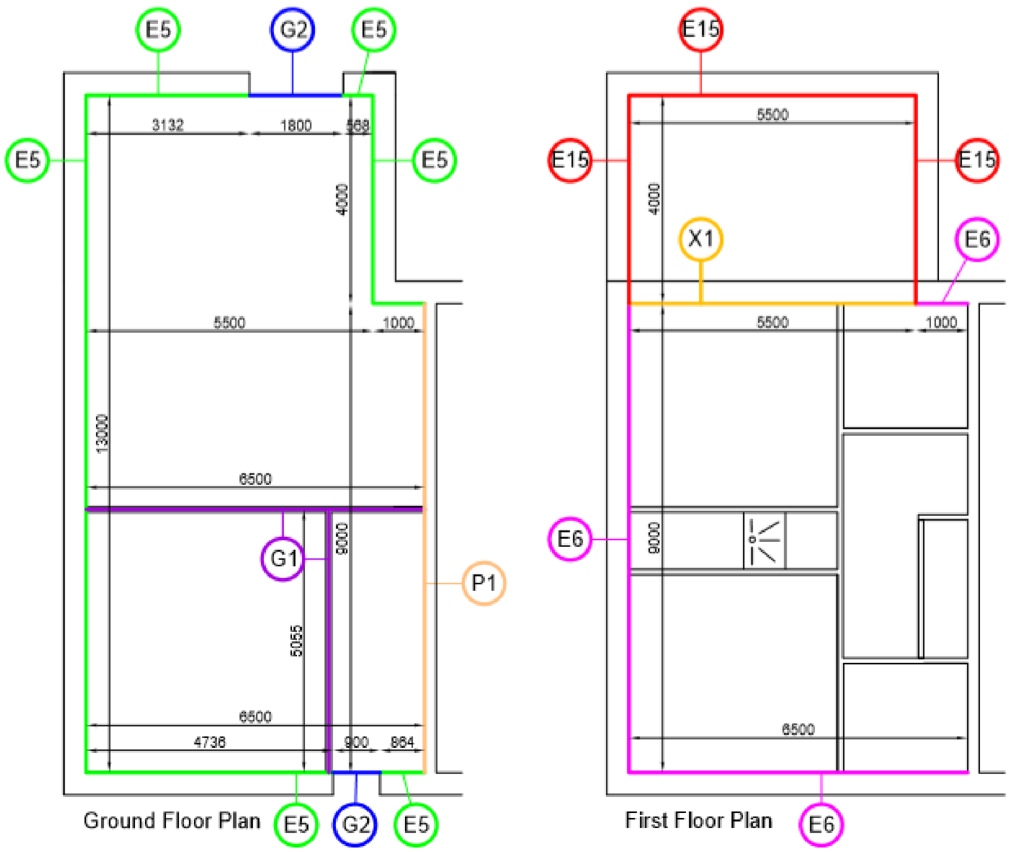
Table 1: Dwelling fabric		
Element	Description	Calculated U-value
Wall Type 1	Cavity walls with partial fill insulated cavity	0.14
Ground Floor	Solid concrete floor with insulation below slab	0.14
Roof Type 1	Pitched roof, insulated at ceiling level	0.13
Roof Type 2	Flat roof	0.14
First Floor	Timber intermediate floor	-
Party Wall**	Solid masonry	-
Wall Type 2**	Solid masonry internal partition penetrating ground floor slab	-
Wall Type 3**	Timber stud partition	-
** While the heat loss through this plane element is typically not accounted for in DEAP, if this non-heat loss plane element adjoins another heat loss element, heat loss at the junction may need to be accounted for.		

1.6.1. Documentary evidence for BERs

In this example, the following evidence has been provided to substantiate a non-default y-value.

(a) *Drawings with all junctions identified*

Figure 4: Floor plans with all junctions identified



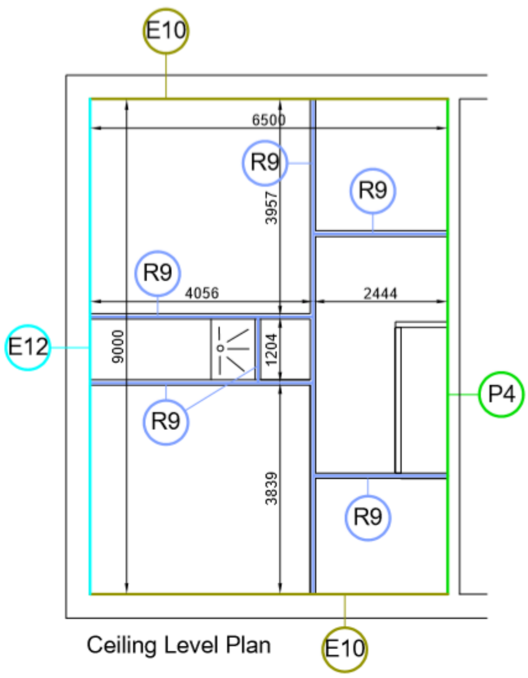


Figure 5: Elevations with all junctions identified

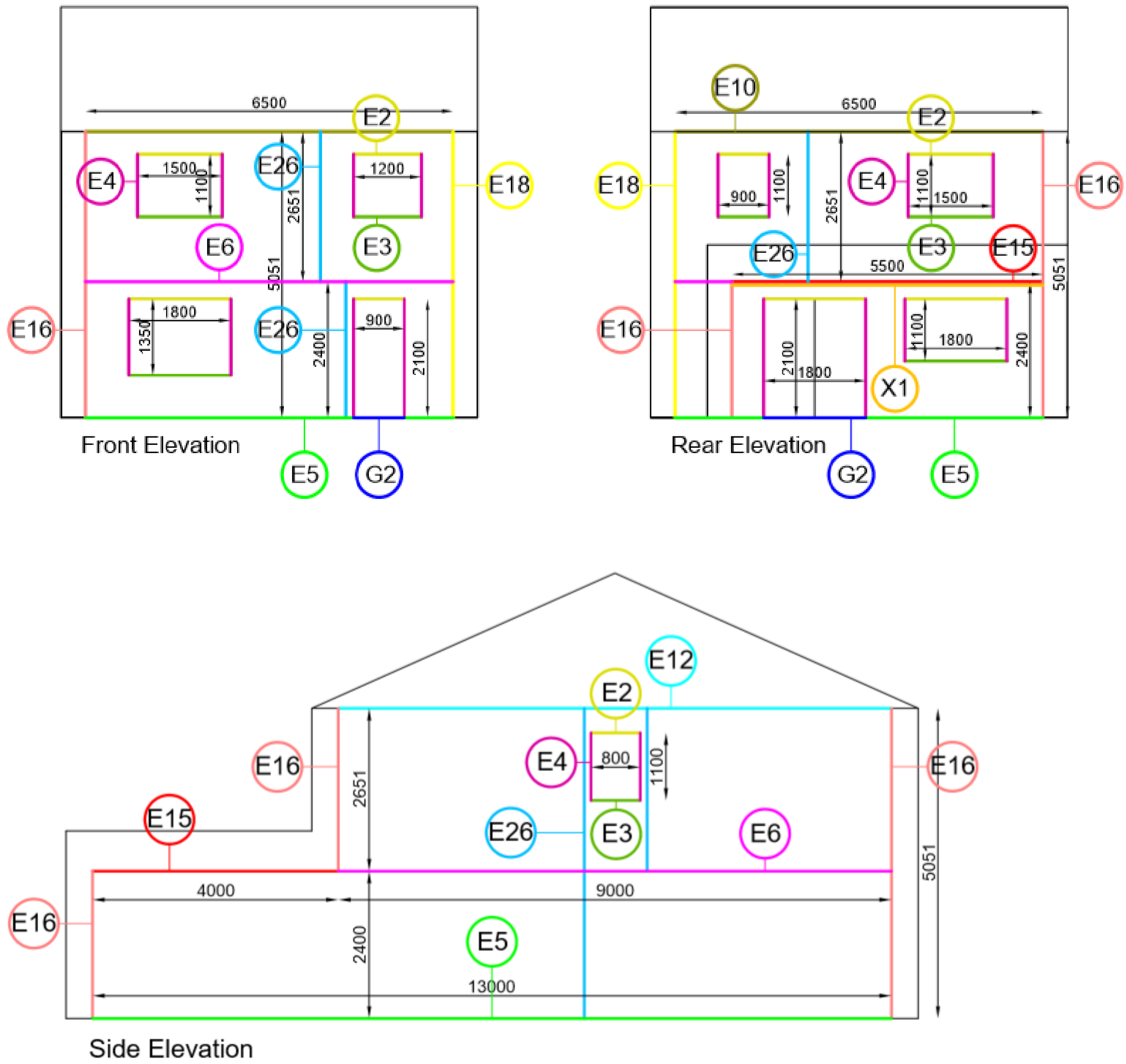


Figure 4 and 5 provide an ***example*** of a set of plans and elevations with all the junctions identified and labelled. These drawings are usually prepared by the designer of the dwelling. The drawings should reference the dwelling being assessed. While this level of detail may not be available from the designer of the dwelling, at a minimum all key junctions must be identified.

(b) *Schedule of all junctions identified in the drawings*

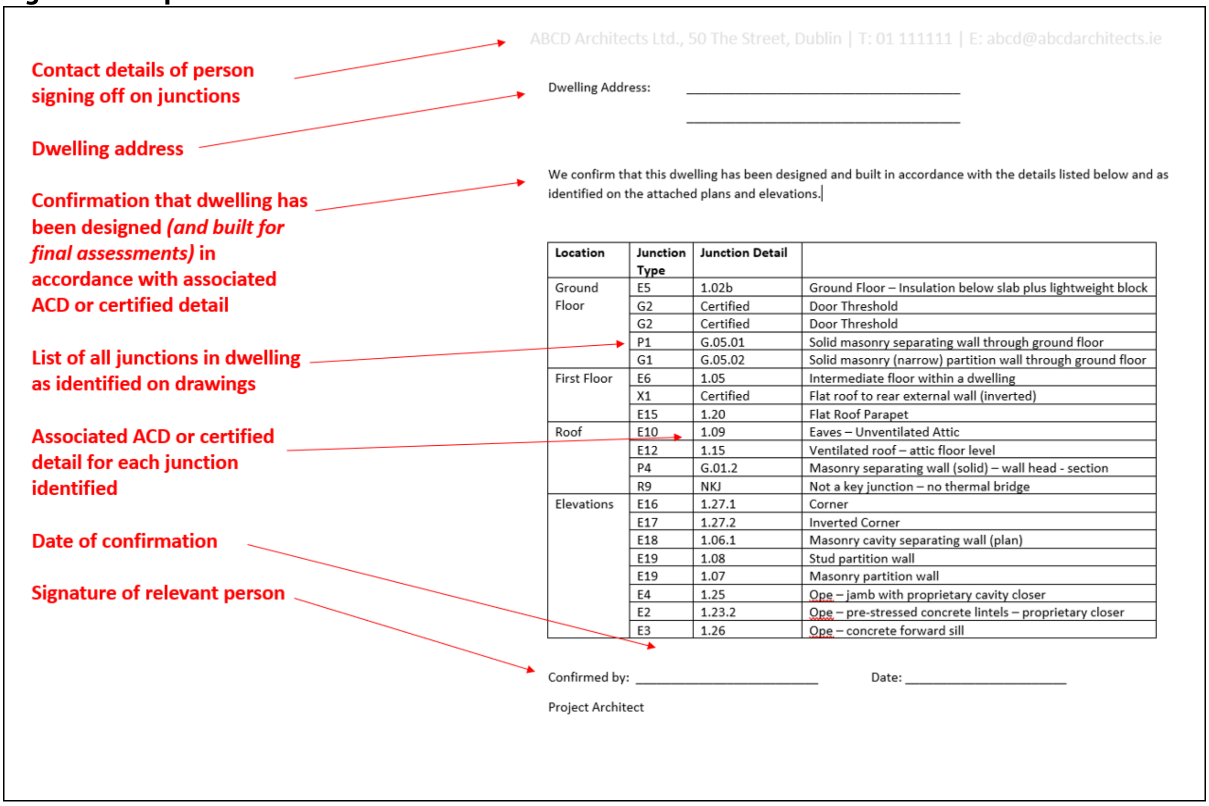
In this example, a schedule of all junctions in the dwelling has been provided.
This schedule should contain the following information:

- A clear reference to the dwelling being assessed.
- A list of **all** of the junctions in the dwelling.
  All junctions must be included in this list. The relevant person, as defined in Section 1.5, may consider a particular junction not to be a key junction, e.g. a door threshold, but must still include this junction here and explicitly state that it is not a key junction.
- For each junction that is considered to be a **key** junction, the associated ACD or certified detail must be identified. Note that all of the junction types listed in Section 1.5 are considered to be key junctions.

The schedule should be signed by the relevant person (developer/builder/architect/engineer/assigned certifier) confirming the junctions identified were designed and built in accordance with the associated ACDs and/or certified details.

Figure 6 is an example of a schedule of junctions for a dwelling.

Figure 6: Sample Schedule of Junctions



Location	Junction Type	Junction Detail	
Ground Floor	E5	1.02b	Ground Floor – Insulation below slab plus lightweight block
	G2	Certified	Door Threshold
	G2	Certified	Door Threshold
	P1	G.05.01	Solid masonry separating wall through ground floor
	G1	G.05.02	Solid masonry (narrow) partition wall through ground floor
First Floor	E6	1.05	Intermediate floor within a dwelling
	X1	Certified	Flat roof to rear external wall (inverted)
	E15	1.20	Flat Roof Parapet
Roof	E10	1.09	Eaves – Unventilated Attic
	E12	1.15	Ventilated roof – attic floor level
	P4	G.01.2	Masonry separating wall (solid) – wall head - section
	R9	NKJ	Not a key junction – no thermal bridge
Elevations	E16	1.27.1	Corner
	E17	1.27.2	Inverted Corner
	E18	1.06.1	Masonry cavity separating wall (plan)
	E19	1.08	Stud partition wall
	E19	1.07	Masonry partition wall
	E4	1.25	Ope – jamb with proprietary cavity closer
	E2	1.23.2	Ope – pre-stressed concrete lintels – proprietary closer
	E3	1.26	Ope – concrete forward sill

Confirmed by: ______________________ Date: ____________________

Project Architect

(c) *Copy of all ACDs / Certified Details*

A copy of all ACDs and/or certified details referenced in the junction schedule should be provided. Each detail should be signed by the relevant person confirming the junction was designed and built (or designed for provisional ratings) in accordance with the relevant detail.

Where a Ψ-value is used which is calculated by a certified thermal modeller, the junction detail clearly referencing the certified psi-value and thermal modeller name and registration details must be provided to the BER assessor

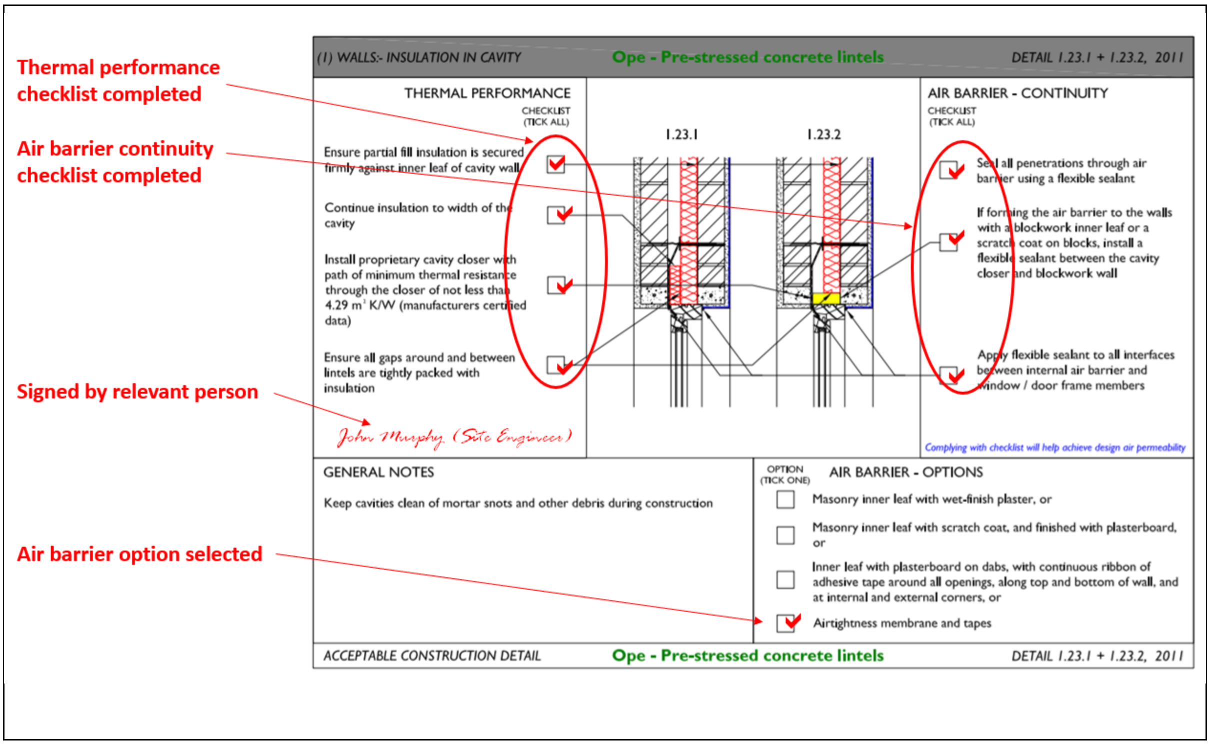
Where reports supporting the certified Ψ-value are not available in accordance with these requirements, this Ψ-value may not be used, and the y-value reverts to a default 0.15W/m^{2}K.

Figure 7 is an example of an ACD that has been appropriately completed and signed-off.

Note that,

- The checklist for Thermal Performance has been completed.
- It has been signed by the relevant person.
- The checklists for "Air Barrier – Continuity" and "Air Barrier – Options" have been completed in this example but these do not need to be completed in order to support the y-value.

Figure 7: Sample Signed ACD



(d) *Copy of non-default y-value calculation.*

The basic form of the calculation is as follows:
For each **key** junction in the dwelling:

- Measure the length of the junction, L;
- Identify the Ψ-value for the junction, either from the ACD documentation or from a thermal modelling report;
- Calculate the heat loss coefficient for the junction = Ψ x L.

The Total Thermal Bridging Heat Loss Coefficient (H_{TB}) is the sum of the heat loss coefficients for all key junctions.
Finally, the Thermal Bridging Factor, y = Total Thermal Bridging Heat Loss Coefficient/Total Exposed Area. This is the value that is entered into DEAP.

Ψ-values for each junction detail in the ACDs are provided in Tables D1 - D6 of Appendix D of the TGD L. Figure 8 shows an excerpt from Table D1 with the data for Detail 1.02b highlighted.

Figure 8
An excerpt from Table D1 with the data for Detail 1.02b highlighted

Table D1	Section 1 - Cavity Wall Insulation	Target U-values		
Junction detail Identifier 2011 Edition	Junction detail	U-value = 0.18 W/m²K, 150mm full-fill or partial fill cavity[1, 3] (roof U = 0.16) (floor U = 0.18)	U-value = 0.15 W/m²K, 150mm full-fill or partial fill cavity and internal insulation[2, 3] (roof U = 0.14) (floor U = 0.15)	U-value = 0.15 W/m²K, 200mm full-fill or partial fill cavity[2, 3] (roof U = 0.14) (floor U = 0.15)
		ψ-value (W/mK)	ψ-value (W/mK)	ψ-value (W/mK)
Section 1	Details			
1.01a	Ground Floor - Insulation above slab	0.170	0.072	0.196
1.01b	Ground Floor - Insulation above slab plus lightweight block	0.080	0.042	0.093
1.02a	Ground Floor - Insulation below slab	0.163	0.108	0.191
1.02b	Ground Floor - Insulation below slab plus lightweight block	0.070	0.061	0.083
1.03	Timber Suspended Ground Floor	0.219	0.102	0.227
1.04	Concrete Intermediate Floor within a dwelling	0.000	0.039	0.000
1.04a	Concrete Separating Floor between dwellings 6	[illegible]	[illegible]	[illegible]

The highlighted section shows three Ψ-values which can be used for this junction, depending on the U-values of the elements involved and the location of the insulation. Table 2 shows this in more detail:

Table 2 - Selecting the appropriate Psi-value for an ACD

Wall Insulation Type	Target Wall U-value (W/m2K)	Allowed Wall U-values (W/m2K)	Target Floor U-value (W/m2K)	Allowed Floor U-values (W/m2K)	Psi-value
Cavity insulation	0.18	0.18	0.18	0.16 – 0.21	**0.070**
Cavity insulation and internal insulation	0.15	0.12 – 0.17	0.15	0.12 – 0.18	**0.061**
Cavity insulation	0.15	0.12 – 0.17	0.15	0.12 – 0.18	**0.083**

Notes:

1) If the wall U-value or the floor U-value are not within one of the Allowed U-value ranges specified above (in Column 3 and Column 5 of Table 2), then an ACD Ψ-value ***cannot be used***.

In such a case, there are three possible ways to proceed:

- The junction would have to be thermally modelled to get the correct Ψ-value, which would allow the calculation of a non-default y-value; or,
- If all key junctions were covered by ACDs, then y = 0.08 W/m²K could be used; or,
- Otherwise, the default thermal bridging factor, y = 0.15 W/m²K would have to be used.

2) An additional restriction is imposed in cases where the U-value of one flanking element is above its target U-value and the U-value of the other flanking element is below its target U-value, as follows:

Where two building elements have one U-value above its target while the other is below its target U-value, the aggregate percentage change from the respective target U-values in the table should not exceed 20% for the Ψ-value to be valid.

Taking the example of the wall-floor detail 1.02b again: let's take a case where the wall has a partially filled cavity giving a U-value of 0.16 W/m²K. The target U-value for this wall is 0.15 W/m²K, so the wall U-value is 6.67% above the target. Therefore, the floor U-value can't be more than 13.33% below the target floor U-value for this Ψ-value to be valid, i.e. if the floor U-value is below 0.13 W/m²K ***then the Ψ-value cannot be used***.

Note that this restriction does not apply where both U-values are above their respective target U-values (but within the allowed ranges).

Also, this restriction does not apply where both U-values are below their respective target U-values (but within the allowed ranges).

Table 3 has the details of the y-value calculation for this example dwelling.

Table 3: y-value calculation

Location	Type	Junction Detail		Ψ (W/mK)	L (m)	Ψ * l (W/K)
Ground Floor	E5	1.02b	Ground Floor - Insulation below slab plus lightweight block	0.083	27.30	2.266
	G2	Certified	Door Threshold	0.054	1.80	0.098
	G2	Certified	Door Threshold	0.069	0.90	0.062
	P1	G.05.1	Solid masonry separating wall through ground floor	0.120	9.00	1.080
	G1	G.05.2	Solid masonry (narrow) partition wall through ground floor	0.150	11.56	1.733
First Floor	E6	1.05	Intermediate floor within a dwelling	-0.001	16.50	-0.017
	X1	Certified	Flat roof to rear external wall (inverted)	-0.063	5.50	-0.348
	E15	1.2	Flat Roof Parapet	0.206	13.50	2.781
Roof	E10	1.09	Eaves - Unventilated Attic	0.053	13.00	0.689
	E12	1.15	Ventilated Roof - Attic floor level	0.210	9.00	1.890
	P4	G.01.2	Masonry separating wall (solid) - wall head - section	0.229	9.00	2.061
	R9	NKJ	Not a key junction	0.000	23.20	0.000
Elevations	E16	1.27.1	Corner	0.035	12.50	0.438
	E17	1.27.2	Inverted Corner	-0.055	2.40	-0.132
	E18	1.06.1	Masonry Cavity Separating Wall (plan)	0.032	10.10	0.323
	E19	1.08	Stud Partition Wall	0.000	10.60	0.000
	E19	1.07	Masonry Partition Wall	0.000	4.80	0.000
	E4	1.25	Ope - Jamb with proprietary cavity closer	0.006	24.30	0.146
	E2	1.23.2	Ope - Pre-stressed concrete lintels- proprietary closer	0.006	12.20	0.073
	E3	1.26	Ope - concrete forward sill	0.019	9.50	0.181
Transmission Heat Loss Coefficient, H_{tb} (W/K)						13.324
Total Exposed Surface Area, ΣA_{exp} (m²)						291.322
y-value (W/m²K)						**0.046**

The SEAI thermal bridging factor tool can also be used to calculate a y-value.

1.7. Summary of Thermal Bridging Scenarios

The following table summarises the means of deriving the y-value in different scenarios and supporting evidence in each case.

Table 4 – Summary of Thermal Bridging Scenarios

	y-value = 0.08 W/m²K	Calculated y-value	y-value = 0.15 W/m²K
Summary	**ACDs met**	**Using ACD &/or certified Ψ-values**	**ACDs not met**
Refer to	TGD L 2019 1.3.3.2 (i)	TGD L 2019 1.3.3.2(ii) & (iii)	TGD L 2019 1.3.3.2 (iv)
Step 1 Identify junctions	Identify junctions in dwelling	Identify junctions in dwelling	Junctions are not assessed for DEAP[1].
Step 2 Applicability of ACDs	All key junctions must be designed and built in accordance with ACDs	Identify applicable ACDs and/or certified details for all key junctions	N/A
Step 3 Ψ-values	Individual Ψ-values not required	Ψ-values are required for all key junctions, sourced from: - Tables D1-D6 (where ACDs are applicable) and/or - Calculated by registered thermal modeller or equivalent	N/A
Step 4 y-value for BER	No calculation required Default y-value = 0.08 W/m²K **(new dwellings only)**	Calculation required Measure junction lengths and calculate y-value[2]	No calculation required Default y-value = 0.15 W/m²K
Step 5 Obtain & Check Documentary Evidence	- Signed-off drawings and schedule of all junctions as detailed above - ACDs signed off	- Signed-off drawings and schedule of all junctions as detailed above - ACDs signed off - Certified details where applicable	N/A

Notes:
1. There is a responsibility to ensure junction design meets the TGD L requirements in relation to limiting risk of surface condensation as set out in Appendix D of the TGD L. This falls outside of BER assessments and is not considered here.
2. Where a y-value is calculated by a third party, the BER assessor should check the calculation to ensure it is correct.

Figure 9 gives additional guidance on the process of accounting for Thermal Bridging in the form of a flowchart.

Table 5 looks at thermal bridging from the audit perspective.
It lists a number of scenarios that may arise and sets out the courses of action available to the Assessor.

Figure 9: Determining Thermal Bridging Factors & supporting documentation for DEAP

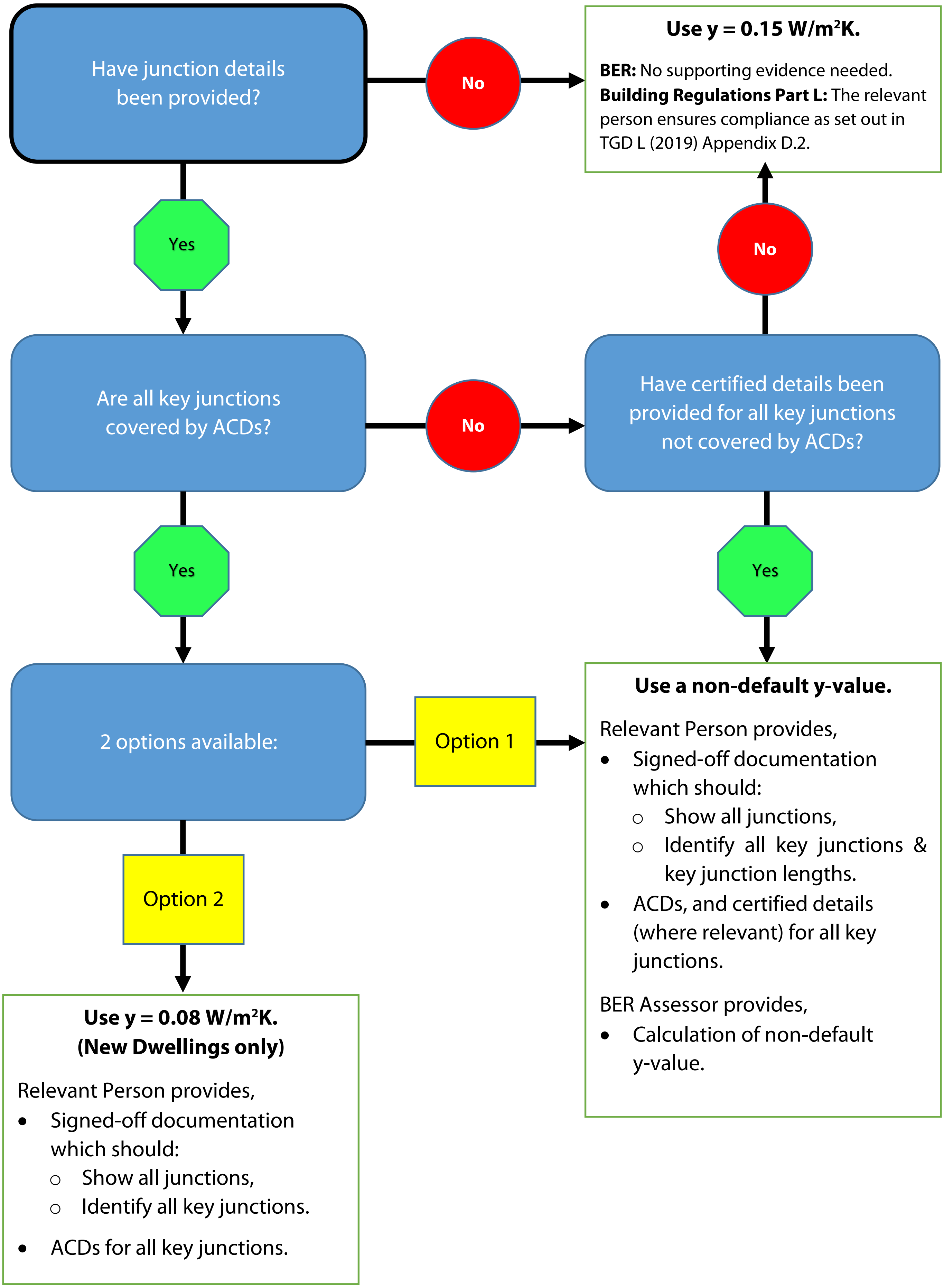


Table 5 – Different Thermal Bridging Scenarios and the Recommended Assessor Response

Scenario	Does this meet the BER requirements?	Assessor Recommended Action
All junctions are not identified in the documentation provided.	No: All junctions must be identified, even if they are not key junctions.	Request the missing information. If it is not provided then publish the BER with y = 0.15 W/m²K.
The relevant person has identified the floor-wall junction on the drawings but has stated in the schedule that it is not a key junction.	No: As stated in Section 1.5, the wall-floor junction is considered to be a key junction.	Request the missing information. If it is not provided then publish the BER with y = 0.15 W/m²K.
The relevant person has identified the door threshold on the drawings and schedule but has stated that it is not a key junction.	Yes: The door threshold is not listed in Section 1.5 as a key junction. The relevant person's statement that it is not a key junction is accepted.	Proceed as normal.
The relevant person has provided a set of bespoke detail drawings and stated that these details are equivalent to ACDs.	Yes: The relevant person's statement is accepted as long as for each detail the corresponding ACD is identified.	Proceed as normal.
The relevant person has provided a non-default y-value calculation. There is an error in the calculation.	No: The Assessor is responsible for the y-value entered into DEAP so any errors in the calculation are subject to audit.	Discuss with the relevant person how to correct the calculation. (i) Correct the calculation and use the result in DEAP, or, (ii) use the default y = 0.15 W/m²K where the calculation cannot be substantiated
The relevant person has provided a full set of ACD documentation with the intention of using a non-default y-factor. This includes an ACD for the wall-floor junction. However, the U-values of the wall and floor do not fall in the allowed range for that detail, as set out in Appendix D of TGD L.	No: A non-default y-value calculation cannot be completed because a Psi-value for this junction has not been provided.	Suggest that the junction be thermally modelled, which would allow the calculation of a non-default y-value, or, Use the ACD default value, y = 0.08 W/m²K.
One or more of the ACDs/certified details has not been provided.	No: The documentation is incomplete.	Request the missing information. If it is not provided then publish the BER with y = 0.15 W/m²K.
The relevant person has provided a full set of ACD documentation but one of the details has an incomplete Thermal Performance checklist.	No: The documentation is incomplete.	Request the missing information. If it is not provided then publish the BER with y = 0.15 W/m²K.

2. Using Non-Default Design Flow Temperatures to calculate heat pump space heating efficiency

To calculate the space heating efficiency of the heat pump, the following default design flow temperatures (Table 6) must be assumed unless there is sufficient documentary evidence available to support lower non-default flow temperatures.

Table 6: Default flow temperatures

Heat Emitter Type	Default supply temperature
Radiators	55°C
Fan Coil Radiators	45°C
Underfloor Heating	35°C

Where non-default flow temperatures are used to calculate the space heating efficiency of the heat pump, the following information is required and must be retained as documentary evidence:

- Designer/installer sign-off sheet;
- Heating design sheet;
- Radiator specifications.

The following guidance sets out the documentary evidence requirements and checks required to support non-default flow temperatures in BERs.

2.1. Designer/Installer Sign-off Sheet

For any heat pump to which Ecodesign, EN14825 or EN16147 applies, the Designer/Installer sign off sheet, or equivalent, must be completed and signed by the Designer/ Installer of the heat pump system.

A new version of the designer/installer sign-off sheet has been developed by SEAI, which includes

- a new heating design tab,
- a checklist[2] for BERs
- a checklist[3] for BER + heat pump grant applications

This Designer/Installer sign-off sheet must be completed by the Designer/Installer in either hardcopy or softcopy format and signed using one of the following methods[3]:

- Hardcopy signed by the Designer/Installer, or
- Softcopy format with an electronic (e.g. scanned) signature from the Designer/Installer, or
- Softcopy format accompanied by an email from the designer/installer confirming that the data with the sign off sheet is correct.

If the signed designer/installer sign-off sheet is <u>not</u> available, default values must be used for installation data, namely:

- **Default flow temperature for the distribution system present, as per Table 6;**
- **No of Hours per Day Heat Pump has been designed to run = 8 hours;**

Ecodesign/test data relating to the heat pump may still be used in this situation.

[2] A checklist is provided to assist assessors in ensuring all supporting documentation is obtained and the required checks have been carried out to support BER inputs (where non-default flow temperatures are used to calculate the heat pump efficiency for space heating) & the heat pump grant process. While it is not mandatory to complete the checklist, it is advisable.

[3] For the purpose of Better Energy Homes grants, the Registered Contractor must provide hardcopies of the Designer/Installer sign-off sheet to the homeowner. A copy must be submitted to SEAI by the homeowner along with the Declaration of Works.

Additional guidance on the Designer/Installer sign-off sheet is given in Table 7.

Table 7: Designer/Installer Sign-off Sheet – additional notes

1.	**General Information**	***Notes***
	- includes dwelling details	
2.	**Purpose of installation**	
	- identifies if the heat pump is supplying space heating / domestic hot water / both	*Confirm during site survey*
3.	**Heat Pump Selection**	
	- Make, model and any model qualifier for the heat pump identified in the dwelling being assessed	*Confirm during site survey*
	- Type of heat pump (e.g. A/W; B/W etc.)	
	- Date of installation	*Any heat pump installed after 26th September 2015 must be Ecodesign & Energy Label directive compliant*
	- Confirmation of compliance with the Ecodesign and Labelling Directive	
	- Confirmation of test standards for the heat pump	
	- Confirmation of hours of operation per day, (8, 16 or 24 hrs) closest to the number of hours of operation expected by the design. *This is the number of hours during which the heat pump can be activated by thermostatic/load control devices to maintain the occupant's required thermal conditions in the dwelling.*	
	- Confirmation of any backup systems installed to supplement the heat pump including backup heater details and fuel type.	*The main space heating backup heater is not the secondary heating. It is any other system capable of heating multiple rooms in the dwelling and supplementing the heat pump, such as a backup boiler. If a system is considered as a heat pump backup, then it is not eligible to be considered as a secondary heating system in DEAP.*
4.	**Heat Emitter Design**	
	- Heat emitters present in the dwelling	*Confirm during site survey*
	- Heating controls within dwelling	*Confirm during site survey*
	- Design flow temperature based on design conditions	*Where this is a non-default flow temperature, the completed heating design sheet (or equivalent) must be obtained from the designer/installer*
5	**Domestic Hot Water**	
	- Confirmation of hot water temperature based on certified data	*Check against certified data*
	- Confirmation of the type of store present	*Confirm during site survey*
	- Confirmation of the presence of immersion/ electric element in the heat pump capable of providing domestic hot water.	*This must be specified even if this integral immersion is only installed as a backup to the heat pump.*
6	**Confirmation**	
	- Signoff and details of system designer/installer is required	

2.2. Heating Design Sheet

Where non-default flow temperatures are used to calculate the efficiency of the heat pump **or where** an **air distribution system** is the **primary heating source**, the SEAI Heating Design Sheet (or equivalent) must be filled out by the Designer/Installer. **The Heating Design sheet must reflect what is installed in the dwelling.** This must be retained by the BER Assessor as documentary evidence for the BER. The Heating Design Sheet contains the following information for each room in the dwelling:

- Room heat loss (Watts)
- Type of emitter along with radiator manufacturer & model/size where applicable
- Single heat emitter output, no. of emitters, total heat emitter output.
- Design Room Temperature
- The ΔT for heat output for radiator and fan coil systems, where applicable
- W/m² for underfloor heating, where applicable
- Supply air temperature and air volume for each room, where applicable

The BER assessor must carry out a number of checks to ensure the information provided on the heating design sheet satisfies the following:

a) For the use of a lower non-default flow temperature. The checks are as follows:

1. Dwelling address of the heat pump installation has been provided
2. The design flow temperature and return temperature have been provided.
3. Design room temperatures have been provided (please note - these may be different to the temperatures assumed in DEAP)
4. The total heat emitter output (Watts) is greater than the total room heat loss (Watts)
5. The HLI ($W/K/m^2$) stated on the heating design sheet must be lower and within 10% of the HLI calculated in DEAP , i.e.

$$HLI_{DEAP} > HLI_{DesignSheet} > 0.9 * HLI_{DEAP}$$

6. The ΔT value for the radiator output has been provided for each radiator
7. Where underfloor heating is specified, the W/m^2 has been provided
8. Name and contact details of Designer/Installer has been provided

Where this evidence is not available a default flow temperature should be used.

Examples of a completed Heating Design Sheet are given in Figure 9 and Figure 10.

b) For the use of an air distribution system as the primary heating source. The checks are as follows:

9. The supply air temperature for each room has been provided. Where greater than 27°C it should be supported by manufacturer's data.
10. The air volume required meets the design specification for the heating system for provisional BERs or the commissioning sheet for Final BERs (i.e. the 'air volume provided by the system', as stated in the heating system design/commissioning sheet, must not be more than 10% lower than the 'air volume required' stated in the designer sheet).

Where this evidence is not available or does not meet the heating demand, the guidance in Appendix A of the DEAP manual should be followed.

Please note:

- **It is not the responsibility of the BER assessor to check the room heat loss calculations.** It is the responsibility of the designer/installer of the system to carry out these calculations in accordance with any of the following:
  - CIBSE Domestic Heating Design Guide;
  - SR 50-1 Code of practice for building services: Domestic plumbing and heating (to be published by NSAI);
  - SEAI Room heat loss and radiator sizing guidance.

- Where an alternative to the Heating Design Sheet has been provided as documentary evidence, the same checks (items 1 – 10 above) must be carried out by the BER assessor.

- The SEAI Heating Design Sheet <u>must</u> be completed as part of the SEAI heat pump grant application process

Figure 10: Heating Design Sheet
(Underfloor heating in ground floor and radiators in remainder of rooms)

Heating Design Details

Address of installation | Enter Dwelling address **1**

2 | 45.00 | Design Flow Temp °C
35.00 | Return Temperature °C

Notes

Please specify below all details of the Heat distribution system as designed & installed.
Instructions on how to fill in the spreadsheet is provided in the "Guidance" tab
These instructions & the documents referred to need to be read carefully before filling in the data

Additional lines can be inserted in the table as required

	Room	Room Heat Loss [W]	Type of emitter	Manufacturer	Model /Size	Single heat emitter output [W]	Number of emitters	Total heat emitters output [W]	Design Room Temp [°C]	ΔT for heat output	UF output [W/m2]	Supply Air temperature [°C]	Air Volu
3	Ground Floor	3050	Underfloor					3600	20		40		
	Bedroom 1	620	Radiator	Manufacturer	Model /Size	750	1	750	18	22			
4	Bedroom 2	450	Radiator	Manufacturer	Model /Size	450	1	450	18	22			
	Bedroom 3	670	Radiator	Manufacturer	Model /Size	750	1	750	18	22			
	Bathroom	320	Radiator	Manufacturer	Model /Size	450	1	450	18	22			

Total Heat Loss	5110	Watts	6
Area of Dwelling	110	m2	
HLI (Design)	1.94	W/K/m2	7
Heat pump output at design conditions	6	kW	8

Total Output | 6000 | Watts

9

Full Name	Input from Designer/Installer Sheet
Company Name	0
Email	0
Date	0

Check the following has been provided:

1. Dwelling address of heat pump installation
2. Design Flow and Return temperatures
3. Where underfloor heating is specified, the room (or area) heat loss (W), total heat emitter output (W) and UF output (W/m²)
4. Where radiators/fan coil emitters are specified, the room heat loss (W), manufacturer, model, single heat emitter output (W), number of emitters, total heat emitter output (W), design room temp (°C) and ΔT for heat output
5. Where an air system is specified, the room heat loss (W), manufacturer, model, single heat emitter output (W), number of emitters, total heat emitter output (W), supply air temperature (°C) and air flow rate (l/sec)
6. The total output (W) is greater than the total heat loss (W)
7. Check the HLI stated here is not less than 10% lower than Total Heat Loss per m² as calculated in DEAP
8. Heat pump output at design conditions based on test data & design flow temperature provided for DEAP assessment
9. Heating design sheet has been completed by Designer/Installer and includes their name and contact details

Figure 11: Heating Design Sheet
(Underfloor heating in one room and radiators in remainder of rooms)

Heating Design Details

Address of installation | Enter Dwelling address **1**

2 | 45.00 | Design Flow Temp °C
35.00 | Return Temperature °C

Notes

Please specify below all details of the Heat distribution system as designed & installed.
Instructions on how to fill in the spreadsheet is provided in the "Guidance" tab.
These instructions & the documents referred to need to be read carefully before filling in the data

Additional lines can be inserted in the table as required

	Room	Room Heat Loss [W]	Type of emitter	Manufacturer	Model /Size	Single heat emitter output [W]	Number of emitters	Total heat emitters output [W]	Design Room Temp [°C]	ΔT for heat output	UF output [W/m2]	Supply Air temperature [°C]	Air Volu
3	Kitchen	1100	Underfloor					1300	20		40		
	Living Room	1200	Radiator	Manufacturer	Model /Size	700	2	1400	20	20			
4	WC	300	Radiator	Manufacturer	Model /Size	450	1	450	18	22			
	Hall	450	Radiator	Manufacturer	Model /Size	450	1	450	18	22			
	Bedroom 1	620	Radiator	Manufacturer	Model /Size	750	1	750	18	22			
	Bedroom 2	450	Radiator	Manufacturer	Model /Size	450	1	450	18	22			
	Bedroom 3	670	Radiator	Manufacturer	Model /Size	750	1	750	18	22			
	Bathroom	320	Radiator	Manufacturer	Model /Size	450	1	450	18	22			

Total Heat Loss	5110	Watts	6
Area of Dwelling	110	m2	
HLI (Design)	1.94	W/K/m2	7
Heat pump output at design conditions	6	kW	8

Total Output | 6000 | Watts

9

Full Name	Input from Designer/Installer Sheet
Company Name	0
Email	0
Date	0

Check the following has been provided:

1. Dwelling address of heat pump installation
2. Design Flow and Return temperatures
3. Where underfloor heating is specified, the room (or area) heat loss (W), total heat emitter output (W) and UF output (W/m²)
4. Where radiators/fan coil emitters are specified, the room heat loss (W), manufacturer, model, single heat emitter output (W), number of emitters, total heat emitter output (W), design room temp (°C) and ΔT for heat output
5. Where an air system is specified, the room heat loss (W), manufacturer, model, single heat emitter output (W), number of emitters, total heat emitter output (W), supply air temperature (°C) and air flow rate (l/sec)
6. The total output (W) is greater than the total heat loss (W)
7. Check the HLI stated here is not less than 10% lower than Total Heat Loss per m² as calculated in DEAP
8. Heat pump output at design conditions based on test data & design flow temperature provided for DEAP assessment
9. Heating design sheet has been completed by Designer/Installer and includes their name and contact details

2.3. Radiator Specification & Sizing

Most radiator outputs provided by the radiator manufacturers are based on boiler systems and on a water-to-air temperature difference (ΔT) of 50°C, as defined in Figure 12.

Where non-default flow temperatures are used to calculate the efficiency of the heat pump, the output (W) and the ΔT of the radiators specified in the heating design sheet must be checked against the manufacturer's stated output for the radiators installed.

Figure 12: Formula for calculating ΔT value

$$\Delta T = \left[\frac{\text{Flow temperature + return temperature}}{2}\right] - \text{Room Temperature}$$

The higher the ΔT value, the higher the output will be. Traditional gas or oil boilers operate with much higher flow and return temperatures than heat pumps, meaning there is a greater temperature difference between the water temperature in the radiator and the air temperature of the room. Flow temperatures for boilers are typically in the region of 60°C - 80°C and return temperatures in the region of 50°C - 70°C. With a required room temperature of 20°C, the ΔT value typically ranges from 40°C - 55°C and so the radiator output is high; see Figure 13.

Figure 13: Examples of ΔT value calculations

Non-condensing boiler example $\Delta T = \left[\frac{80+70}{2}\right] - 20 = \mathbf{55°C}$

Condensing boiler example $\Delta T = \left[\frac{65+55}{2}\right] - 20 = \mathbf{40°C}$

In order to operate efficiently, the flow temperature of heat pumps is typically lower, at around 45°C. With a return temperature of typically 35°C, the ΔT value for the radiator is therefore much lower – around 20°C.

Heat pump example $\Delta T = \left[\frac{45+35}{2}\right] - 20 = \mathbf{20°C}$

The lower temperature difference will reduce the output of the same radiator. Table 8 is an example of information provided by the manufacturer:

Table 8: Example of information provided by radiator manufacturer

Radiator Height [mm]	Radiator Length		Heat Output at ΔT 50°C [W]
	[mm]	[inches]	
300	400	16	186
	800	31	382
	1000	39	480
	1200	47	578
	1600	63	774
	2000	79	969

Where radiators are to be installed for different ΔT values, the stated manufacturer's radiator outputs must be multiplied by a conversion factor to account for the different ΔT value in the heating design sheet. Manufacturers should be asked to provide heat outputs or conversion factors for different ΔT values.

In cases where it is not possible to source the conversion factor from the manufacturer, the values in Table 9 can be applied to outputs quoted at ΔT = 50°C to obtain the reduced outputs at the lower ΔT.

Please use conversion factors provided by the radiator's manufacturer where available.

Table 9: Default Conversion Factors for Radiators

ΔT	Multiply ΔT 50°C output by
15°	0.21
17.5°	0.26
20°	0.3
22.5°	0.35
25°	0.41
27.5°	0.46
30°	0.51
32.5°	0.57
35°	0.63
37.5°	0.69
40°	0.75

For ΔT values not included in manufacturer's data or in Table 9 you can calculate the conversion factor by using the formula in Figure 14:

Figure 14: Calculating a conversion factor

$$\text{Conversion Factor} = \left[\frac{\text{Actual } \Delta T\ ^\circ C}{\text{Catalogue } \Delta T\ ^\circ C}\right]^{1.3}$$

Actual ΔT = ΔT stated in heating design sheet
Catalogue ΔT = ΔT stated in manufacturer's data sheet

The examples in Figure 15 and Figure 16 provide guidance on checking the output of radiators specified & installed, against the Designer/Installer specification in the heating design sheet.

Figure 15: New radiator with manufacturer's data providing outputs at ΔT of 50°C and conversion factors

The heating design sheet specifies a radiator with an output of 450 W and a **ΔT of 20°C**.

Room	Room Heat Loss [W]	Type of emitter	Manufacturer	Model /Size	Single heat emitter output [W]	Number of emitters	Total heat emitters output [W]	Design Room Temp [°C]	ΔT for heat output	UF output [W/m2]	Supply Air temperature [°C]	Air Volume l/s	Notes
Study	450	Radiator	Manufacturer	Model /Size	450	1	450	20	20				

All outputs quoted are based on Delta T of 50°C

Nominal	Length	Double Convector		
Height	mm	Code	BTU/hr	Watts
	400	Q22504CR	2295	672
	500	Q22505CR	2869	841
	600	Q22506CR	3442	1009
	700	Q22507CR	4016	1177
	800	Q22508CR	4590	1345
	900	Q22509CR	5164	1513
500mm	1000	Q22510CR	5737	1681

The manufacturer's stated output at **ΔT** of **50°C**, for the radiator specified, is 1,513 Watts.

The manufacturer's conversion factors are available to convert from a **ΔT** of **50°C** to a **ΔT of 20°C**. The conversion factor for a **ΔT of 20°C** is 0.3039

The stated output (1,513 Watts) is multiplied by the applicable conversion factor (0.3039) to calculate the radiator output for a ΔT value of 20°C.

	Degrees Centigrade		
Delta T factors in °C and °F other than 50°C (122°F), Exponent n = 1.3	5°C	0.0501	30°C
	10°C	0.1234	35°C
	15°C	0.2091	40°C
	20°C	0.3039	45°C
	25°C	0.4061	50°C

Radiator output for a ΔT of 20°C = 1,513 * 0.3039 = **460 Watts**

The radiator output of 460W meets the requirement of 450W as specified in the heating design sheet

Nominal	Length	Double Convector		
Height	mm	Code	BTU/hr	Watts
	400	Q22504CR	2295	672
	500	Q22505CR	2869	841
	600	Q22506CR	3442	1009
	700	Q22507CR	4016	1177
	800	Q22508CR	4590	1345
	900	Q22509CR	5164	1513
500mm	1000	Q22510CR	5737	1681

The radiator's stated dimensions are 500 x 900mm

The radiator specified (500 x 900mm) matches the radiator size installed in the dwelling

Figure 16: New radiator with manufacturer's data providing outputs at ΔT of 20°C

The heating design sheet specifies a radiator with an output of **450 W** and a ΔT of 20°C.

Room	Room Heat Loss [W]	Type of emitter	Manufacturer	Model /Size	Single heat emitter output [W]	Number of emitters	Total heat emitters output [W]	Design Room Temp [°C]	ΔT for heat output	UF output [W/m2]	Supply Air temperature [°C]	Air Volume l/s	Notes
Study	450	Radiator	Radiator	ULOW-E2-080	450	1	450	20	20				

Performance Data.

Model	Operation Mode	Heat Output (Watts)			
		ΔT10	ΔT15	ΔT20	ΔT25
ULOW 040	Static	74	126	184	247
	Comfort	**125**	**197**	**272**	**350**
	Boost	147	231	317	407
ULOW 060	Static	111	189	276	371
	Comfort	**188**	**296**	**409**	**527**
	Boost	220	345	475	609
ULOW 080	Static	148	252	368	494
	Comfort	**250**	**394**	**545**	**702**
	Boost	294	461	634	813

The manufacturer's stated output at **ΔT of 20°C** = 545 Watts

The radiator output of 545 W meets the requirement of 450W as specified in the heating design sheet

Dimensions.

Model	Nominal Height (mm)	Depth* (mm)	Length (mm)
ULOW 040	600	105	400
ULOW 060	600	105	600
ULOW 080	600	105	800
ULOW 100	600	105	1000
ULOW 120	600	105	1200
ULOW 140	600	105	1400
ULOW 160	600	105	1600

The radiator's stated dimensions are 600 x 800mm

The radiator specified (600 x 800mm) matches the radiator size installed in the dwelling

Where **existing radiators are being retained in the dwelling,** you can refer to the document *'Heat Emitter Supplement to the Domestic Heating Design Guide'* for heat outputs of typical radiators found in existing buildings. Figure 17 has an example where no manufacturer's data is available on the radiators.

Figure 17: Existing radiator with no manufacturer's data available

The heating design sheet specifies a radiator with an output of 450 W and a ΔT value of 20°C.

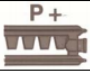
Room	Room Heat Loss [W]	Type of emitter	Manufacturer	Model /Size	Single heat emitter output [W]	Number of emitters	Total heat emitters output [W]	Design Room Temp [°C]	ΔT for heat output	UF output [W/m2]	Supply Air temperature [°C]	Air Volume l/s	Notes
Study	450	Radiator	Existing Rad	Unknown	450	1	450	20	20				

Similar to Stelrad Super or Hullrad or Belkon – 40mm wide sections – Period 1960/70/80

Watts output per each 100mm of length at a mean water to air Δt of 50degC. (Rounded to the nearest Watt)

HEIGHT (mm)	300	440	590	740
Single Panel	38	52	68	82
Double Panel	60	83	107	131
Triple Panel	83	114	147	179

Similar to Stelrad Accord – 40mm wide sections – Period 1980/90

	HEIGHT (mm)	300	450	600	750
P1 	Single Panel	37	53	69	83
K1 	Single Panel with extended surface	51	74	96	117
P+ 	Double Panel with one extended surface	78	113	145	176

The existing radiator (measuring 600 x 1200mm) is being kept and resembles the double panel radiator with one extended surface in the adjacent table from the *'Heat Emitter Supplement to the Domestic Heating Design Guide'.*

The output is 145 Watts per 100mm of length for a ΔT of 50°C.

The total output for the 1,200mm long radiator is 12*145 = **1,740 W for a ΔT of 50°C**

Manufacturer conversion factors are not available for this radiator, so conversion factors from the adjacent table can be applied to convert from a **ΔT** of **50°C** to a **ΔT of 20°C**.

ΔT	Multiply ΔT 50°C output by
15°	0.21
17.5°	0.26
20°	0.3
22.5°	0.35
25°	0.41
27.5°	0.46
30°	0.51
32.5°	0.57
35°	0.63
37.5°	0.69
40°	0.75

Table 2: Default Conversion Factors for Radiators

The conversion factor for a **ΔT of 20°C** is 0.30

The default output (1,740 Watts) is multiplied by the default conversion factor (0.30) to calculate the radiator output for a ΔT value of 20°C.

Radiator output for a ΔT of 20°C = 1,740 * 0.30 = **522 Watts**

The radiator output meets the requirement of 450 Watts as specified in the heating design sheet

For further guidance on how to estimate the heat output of existing radiators at the correct ΔT, please refer to the following documents:
- 'MCS 021 Heat emitter guide for domestic heat pumps', Department of Energy and Climate Change, UK;
- 'Domestic Heating Design Guide' by CIBSE
- 'Heat emitter supplement to the Domestic Heating Design Guide' by the Institute of Domestic Heating & Environmental Engineers (IDHEE).

This check must be done for each radiator installed in the dwelling, where a lower than default design flow temperature is being used to calculate the efficiency of the heat pump.

2.4. On-site checks

It is advisable for assessors to obtain the completed designer/installer sign-off sheet and the heating design sheet prior to carrying out the dwelling survey. Where it is intended to use a non-default design flow temperature to calculate the efficiency of the heat pump, the BER assessor must check the following during the site survey:

- Heat Emitter Type: Check that the installed heat emitter *in each room* matches the heat emitter type specified in the completed heating design sheet. For example, if the heating design sheet specifies a double-panel radiator in the living room, then check that this type of radiator has been installed in the living room.
- Radiator Size: Check that the radiators specified in the heating design sheet - and as described in the radiator technical data sheet - match those installed in the dwelling. The radiators installed in the dwelling should be within ± 20% of the size specified in the heating design sheet.

The heating design sheet must reflect what is installed in the dwelling. If an assessor finds something different in the house, they should request the designer/installer to amend the documents to reflect the installation in the dwelling. If this is not done, defaults should be used to calculate the heat pump efficiency.

2.5. Checklist

Figure 18: Checklist for BERs with heat pump and non-default flow temperature (taken from Designer/Installer sign-off sheet)

BER Checklist

Checklist		Notes
1.0 Designer/Installer sign-off sheet		
1.1 Designer/Installer sign-off sheet has been completed and signed using one of the 3 methods:	☐	*Methods for signing:* *1. Hardcopy signed by Designer/Installer, or* *2. Softcopy format with an electronic signature from Designer/Installer, or* *3. Softcopy format accompanied by email from designer/installer confirming that the data in the sign off sheet is correct.*
2.0 Heating Design Sheet contains:		
2.1 Dwelling address of heat pump installation.	☐	
2.2 The design flow & return temperatures.	☐	
2.3 Where radiators / fan coil emitters are specified, the room heat loss (W), manufacturer, model/size, single heat emitter output [W], number of emitters, total heat emitters output [W], design room temp. (°C) and ΔT for heat output.	☐	***PLEASE NOTE - To support the input of a heat pump in DEAP, the following is required:*** ***HP compliant with Ecodesign/Energy Labelling Directive:*** *1. Signed Designer/installer sign-off sheet;* *2. Technical documentation outlining declared test data in accordance with EN 14825 and EN 16147;* *3. Completed Heat Pump tool.* *4. Where non-default flow temperatures are used to calculate the SPF of the HP, all items on this checklist must also be provided* ***HP not compliant with Ecodesign/Energy Labelling Directive:*** *The SPF of the heat pump can be sourced from any of the following:* *1. Harp Database* *2. Certified or CE marked data from accredited laboratory with test certificates to IS EN 14511-2, IS EN 255-2 or EN 15879;* *3. Use of DEAP Table 4a for heat pump efficiencies*
2.4 Where underfloor heating is specified, the room (or area) heat loss [W], total heat emitter output [W] and UF output [W/m2].	☐	
2.5 Where an air system is specified, the room heat loss [W], manufacturer, model, single heat emitter output [W], number of emitters, total heat emitter output [W], supply air temperature [°C] and air flow rate l/s.	☐	
2.6 The total heat emitter output (W) is greater than total room heat loss (W).	☐	
2.7 The HLI stated on the heating design sheet, or equivalent, is not less than 10% lower than total heat loss per m2 of dwelling (as calculated in DEAP).	☐	
2.8 Heat pump output at design conditions based on test data & design flow temp. provided for DEAP assessment	☐	
2.9 The name and contact details of the Designer/Installer.	☐	
3.0 Radiator Technical Data Sheets		
3.1 For new radiators, the output of the radiators for the ΔT specified in the heating design sheet matches the manufacturer's stated output **and/or**	☐	
3.2 For existing radiators being retained, the output of the radiators for the ΔT specified in the heating design sheet matches the guidance for existing radiators contained within '*Heat Emitter Supplement to the Domestic Heating Design Guide*'.	☐	***For guidance on how to estimate the heat output of existing radiators at the correct ΔT, please refer to the following documents:*** *- SEAI BER Technical Bulletin;* *- MCS 021 Heat emitter guide for domestic heat pumps;* *- 'Domestic Heating Design Guide' by CIBSE* *- 'Heat emitter supplement to the Domestic Heating Design Guide' by the IDHEE.*
3.3 Where the ΔT as specified in the heating design sheet differs from the ΔT quoted in the manufacturer's technical data, the installed heat emitter meets the heat emitter output specified.	☐	
4.0 Site Survey		
4.1 Check that the type of heat emitter installed in each room matches the heat emitter type specified.	☐	**The heating design sheet must reflect what is installed in the dwelling.** If an assessor finds something different in the house, the Designer/Installer needs to update the heating design sheet to reflect the installation in the dwelling. If this is not done, default flow temperatures must be used.
4.2 Check that the radiators as specified in the heating design sheet and as described in the radiator technical data sheet, match (approximately) those installed in the dwelling.	☐	
4.3 Check the air volume as specified in the heating design sheet meets the design specification or commissioning data sheet for the air system.	☐	

Figure 19: Checklist Heat Pump Grant and associated BER (taken from Designer/Installer sign-off sheet)

BER + Heat Pump Grant Checklist

1.0 Designer/Installer sign-off sheet		**Notes**
1.1 Designer/Installer sign-off sheet has been completed and signed using one of the 3 methods:	☐	*Methods for signing:* *1. Hardcopy signed by Designer/Installer, or* *2. Softcopy format with an electronic signature from Designer/Installer, or* *3. Softcopy format accompanied by email from designer/installer confirming that the data in the sign off sheet is correct.*
2.0 Heating Design Sheet contains:		
2.1 Dwelling address of heat pump installation.	☐	
2.2 The design flow & return temperatures.	☐	
2.3 Where radiators / fan coil emitters are specified, the room heat loss (W), manufacturer, model/size, single heat emitter output [W], number of emitters, total heat emitters output [W], design room temp. (°C) and ΔT for heat output.	☐	***PLEASE NOTE - To support the input of a heat pump in DEAP, the following is required for** HP compliant with Ecodesign/Energy Labelling Directive:* *1. Designer/installer sign-off sheet;* *2. Technical documentation outlining declared test data in accordance with EN 14825 and EN 16147;* *3. Completed Heat Pump tool.* *4. Where non-default flow temperatures are used to calculate the SPF of the HP, all items on this checklist must also be provided* ***In addition to the above, the Registered Contractor must provide the following to the homeowner for grant payment:*** *1. Signed-Off Declaration of Works;* *2. Two hardcopies of the Designer/Installer sheet and Heating Design tab (no equivalent documents are accepted) and* *3. Ecodesign datasheet for heat pump installed* *4. The radiator heat output data must be verifiable through published datasheets. If this data is not widely available (e.g on internet), please submit the data source for the heat output.*
2.4 Where underfloor heating is specified, the room (or area) heat loss [W], total heat emitter output [W] and UF output [W/m2].	☐	
2.5 Where an air system is specified, the room heat Loss [W], manufacturer, model, single heat emitter output [W], number of emitters, total heat emitters output [W], supply air temperature [°C] and air flow rate l/s.	☐	
2.6 The total heat emitter output (W) is greater than total room heat loss (W).	☐	
2.7 The HLI stated on the heating design sheet, or equivalent, is not less than 10% lower than total heat loss per m2 of dwelling (as calculated in DEAP).	☐	
2.8 Heat pump output at design conditions based on test data & design flow temp. provided for DEAP assessment.	☐	
2.9 The name and contact details of the Designer/Installer.	☐	
3.0 Radiator Technical Data Sheets		
3.1 For new radiators, the output of the radiators for the ΔT specified in the heating design sheet matches the manufacturer's stated output **and/or**	☐	
3.2 For existing radiators being retained, the output of the radiators for the ΔT specified in the heating design sheet matches the guidance for existing radiators contained within '*Heat Emitter Supplement to the Domestic Heating Design Guide*'.	☐	***For guidance on how to estimate the heat output of existing radiators at the correct ΔT, please refer to the following documents:*** *- SEAI BER Technical Bulletin;* *- MCS 021 Heat emitter guide for domestic heat pumps;* *- 'Domestic Heating Design Guide' by CIBSE* *- 'Heat emitter supplement to the Domestic Heating Design Guide' by the IDHEE*
3.3 Where the ΔT as specified in the heating design sheet differs from the ΔT quoted in the manufacturer's technical data, the installed heat emitter meets the heat emitter output specified.	☐	
4.0 Site Survey		
4.1 Check that the type of heat emitter installed in each room matches the heat emitter type specified.	☐	**The heating design sheet must reflect what is installed in the dwelling.** If an assessor finds something different in the house, the Designer/Installer needs to update the heating design sheet to reflect what is installed. If this is not done, default flow temperatures must be used.
4.2 Check that the radiators as specified in the heating design sheet and as described in the radiator technical data sheet, match (approximately) those installed in the dwelling.	☐	
4.3 Check the air volume as specified in the heating design sheet meets the design specification or commissioning data sheet for the air system.	☐	

3. Calculation of DEAP entries for Decentralised Whole House Mechanical Ventilation systems

3.1. Introduction

This document outlines the methodology for the inclusion of non-default fan power and efficiencies of decentralised/non-ducted whole house heat recovery ventilation systems and mechanical extract ventilation systems. This methodology is based on the Ecodesign and Energy Labelling Directives for Residential Ventilation Units and simple weighting calculations to account for multiple units in a single dwelling.

3.2. Calculations

The following calculations are required to derive a weighted average **Specific Fan Power** and **Heat Recovery Thermal Efficiency** for entry in DEAP. As always, it is the responsibility of the system designer/installer to ensure the system meets all relevant parts of the building regulations, whatever combination is being used. **Systems using this guidance must always be entered in DEAP as whole house balanced mechanical ventilation systems with heat recovery if they have a heat recovery component. If the systems provide mechanical extract only, then they must be entered in DEAP as whole house mechanical extract ventilation systems.**

3.3. Reference Documents

The methodology outlined in this document is based on use of test data from the ErP label and Ecodesign Declared Performance Data which are required to be made publicly available for units being sold on the market. A similar approach has been in place for heat pumps in DEAP assessments since Q1 2016.

The key references for regulations as applied to the directives are as follows. These detail the data that must be displayed on manufacturer literature, website declarations etc. for compliant devices.

- **1253/2014** **"***implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for ventilation units".*
- **1254/2014** **"***supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of residential ventilation units".*
- ***2016/C 416/06****: "Commission communication in the framework of the implementation of Commission Regulation (EU) No 1253/2014 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for ventilation units and of the implementation of Commission Delegated Regulation (EU) No 1254/2014 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of residential ventilation units"*

The regulations set out that the directives are mandatory for residential ventilation units (RVUs) placed on the market after 1st January 2016.

The performance of the ventilation system under the directives is based on EN 13141 and EN 13142 standards as follows, with full detail of relevant standards in the document "2016/C 416/06" referenced above:

- **SPI – Specific Power Input – (more detail below on conversion to Specific Fan Power for DEAP)**
  - EN 13142: 2013 (scoping standard) and the test method for measured values is described in the 13141-series regarding type of unit. The units must be tested in compliance with the regulations (ie pressure and flow rate measurements). The relevant 13141 standard for these single room units is as follows:
  - EN 13141-8:2014 Ventilation for buildings — Performance testing of components/products for residential ventilation — Part 8: Performance testing of un-ducted mechanical supply and exhaust ventilation units (including heat recovery) for mechanical ventilation systems intended for a single room
- **Thermal Efficiency –**
  - The test methods are as per EN 13141 – 8.

The following data can be obtained from the supporting data for the Ecodesign Declared Data:

- Make and model of ventilation unit
- Type of Drive (variable, multi speed)
- Type of Heat Recovery System (recuperative, regenerative, none)
- Thermal Efficiency of Heat Recovery System in %
- Maximum flow rate in m^3/h
- Reference flow rate in m^3/s
- SPI in $W/(m^3/h)$
- Control factor and typology

Table 10: Ventilation system performance data sources

<u>Format of ventilation unit performance data for use toward DEAP / Part L calculations</u>

1) For all centralised (ducted) mechanical ventilation systems, DEAP will continue to require SFP (and thermal efficiency) from the SAP PCDB.
2) For single room systems the relevant performance figures must be provided in documents as follows:
   a. Test certs from laboratories accredited to the standard referenced above (EN13141-8)

      <u>and / or</u>

   b. Ecodesign technical documentation from the supplier/manufacturer referencing the relevant regulations (1253/2014 and/or 1254/2014)

      <u>and / or</u>

   c. For decentralised MEV, SPF figures may also be taken from the SAP PCDB.

As always, test performance data must reference the correct make and model of the unit(s) being installed in the dwelling.

3.4. Steps to derivation of DEAP entries:

- Convert the SPI W/(m3/h) to SFP W/l/s:
  - SFP = SPI*3.6
  - A flow rate of $1m^3/hr$ equates to a flow rate of 1000L every hour, or 1/3.6 l/s
  - Acceptable sources for SPI / SPF are detailed in Table above and must be retained as evidence when publishing a BER
  - SPI (or SPF) for MVHR and MEV can both be used, noting that DEAP requires SPF figures. While MEV may have lower power usage, the energy savings can be offset by the lack of heat recovery in these units.
- Calculate an average SFP (W/l/s) for the dwelling based on the SFP for individual units installed in the dwelling weighting by flow rate **<u>and</u>** hours per day run time:

Figure 20: Calculating average SPF (W/l/s)

$$\frac{\sum_{i=0}^{n}(SFP_i)\,(HD_i)(FR_i)}{\sum_{i=0}^{n}(HD_i)(\,FR_i)}$$

FR (l/s) is flow rate for each unit as provided by the system designer
HD is the hours per day run time for each unit as provided by the system designer
“i” represents each of the individual ventilation units installed, where there are a total of “n” unit

- FR and HD are dependent on the dwelling/installation so will not be shown on test certs or ecodesign technical documentation. BER Assessors must retain evidence of the designer specification showing flow rates and run times for each individual unit.
- For systems incorporating an element of heat recovery ventilation, it is also necessary to calculate an average thermal efficiency for the dwelling based on the thermal efficiency for individual units installed in the dwelling, weighted by flow rate and the run time:

Figure 21: Calculating average thermal efficiency η

$$\frac{\sum_{i=0}^{n}(\eta_i)(HD_i)(FR_i)}{\sum_{i=0}^{n}(HD_i)(FR_i)}$$

η thermal efficiency
FR (l/s) is flow rate for each unit as provided by the system designer
HD is the hours per day run time for each unit as provided by the system designer
"i" represents each of the individual ventilation units installed, where there are a total of "n" unit

  - This equation inherently caters for single room MEV accompanying the MVHR units. For MEV, the "η_i" value would be zero as MEV units don't recover heat.
  - This step is not required for systems including mechanical extract ventilation only. These systems are treated as mechanical extract ventilation systems in DEAP and have no DEAP entry for thermal efficiency of the ventilation unit.
- Please ensure that you use the same units for all Flow rates (e.g. l/s) in these calculations.
- Where figures are not available, defaults as listed in the DEAP manual for unit efficiency and SPF apply for MVHR and MEV units.