A Handbook of thermal bridging details incorporating FOAMGLAS® PERINSUL HL

Book 5 — Thermal bridging solutions for ground floor and flat roof

Prepared for *Pittsburgh Corning Europe*

by the *BBA* and *RDL*

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Purpose of the handbook

This handbook was prepared for Pittsburgh Corning (they can be contacted at www.foamglas.com) and it provides two thermal bridging junction details for a new dwelling, incorporating the FOAMGLAS PERINSUL HL product. The details are for a masonry external wall with a full fill cavity wall insulation, constructed using blocks of different conductivity values. The drawings provided are for typical details and show all the elements essential in achieving the calculated ψ-values. All other site requirements and all relevant building regulations must be taken into consideration when implementing the details.

Each detail in this handbook includes drawings of the junction, ψ-values calculated by an experienced thermal modeller and a process checklist for use on site to facilitate the achievement of the calculated ψ-values.

List of Constructive Details

There are a total of 2 details, labelled CD0056 and CD0057. To provide additional guidance for designers and specifiers the corresponding E numbers given in the latest SAP conventions document are also included.

The Handbook covers the use of the product FOAMGLAS PERINSUL HL in masonry constructions.

Detail number	Detail title	SAP Ref
CD0056	FOAMGLAS PERINSUL HL External Masonry Cavity Wall. Full Fill Concrete ground bearing floor — Insulation below slab	E5
CD0057	FOAMGLAS PERINSUL HL External Masonry Cavity Wall. Full Fill Flat roof with parapet — Warm deck — Insulation above joists	E15

How to use this handbook

The details have been prepared in line with the range of U values appropriate to achieve compliance within The Building Regulations 2010 (England and Wales) (as amended), Part L. Therefore all of the building elements have an upper U value limit of 0.30 $W \cdot m^{-2} \cdot K^{-1}$ for a wall, 0.25 $W \cdot m^{-2} \cdot K^{-1}$ for a floor and 0.20 $W \cdot m^{-2} \cdot K^{-1}$ for the roof element, inline with the limiting fabric parameters given in Approved Document L1A.

The ψ-values are provided for different bands of U values. For each band the ψ-value is calculated for the worst case after considering the effect of thickness and conductivity of insulation independently. This ψ-value can therefore be taken for the complete range of U values quoted.

The wall finish drawn is plasterboard on dabs. This was chosen for consistency and also as it is a common construction method. It is not, however, essential to use this internal finish solution to achieve the stated ψ-value. The same applies for the use of rendered block or brick for the outer leaf. Additionally the mortar joints are indicative and may not necessarily coincide with those shown in the diagrams. Also intermediate block conductivity values can also be used. When using FOAMGLAS PERINSUL HL under load-bearing walls, the engineer must check for admissible loads. The product must be laid in a bed of mortar.

As a general rule, unless a specific solution for a wall or floor finish is either indicated in the *Notes* section or is explicitly mentioned in the annotations, it should be considered optional. The main driver in selecting the materials for each detail would be to achieve the U value bands as provided in each detail. Please ensure that for correct, implementation you need to check the manufacturers data-sheet.

Some minimum guidance on how to achieve air tightness is also provided. As a general rule, acceptable barrier options are the use of plastercoat, blockwork inner leaf/parging coat applied to the internal face of the inner leaf with plasterboard cover, or plasterboard on dabs. Where plasterboard on dabs is used, a continuous ribbon of adhesive should also be applied around all openings, along the top and bottom of the wall and at internal and external corners. In general, all penetrations through the air barrier should be sealed with a flexible sealant. This type of guidance can also be found in the current Accredited Construction Details, available at the DCLG portal.

A series of tips on interpreting the information in each Constructive Detail, is given below, starting from the first to the last page.

Front page — Illustration

The drawing

The front page drawing is in full colour, and the annotations identify the critical parameters that must be observed in order for this junction to achieve the calculated ψ-values. The annotations are also consistent with the wording used in the *Notes* section, to make it easier to read and understand the important elements.

The Notes

This section relates to the steps in the build process of the junction that are essential for the construction of the detail with regards to achieving the stated ψ-values. Any other guidance by all relevant Building Regulations must be followed and this detail focuses only on the thermal performance and provides basic guidance with regards to air tightness.

Main body — ψ-values

The drawing

The second drawing provides additional information to that given on the front page. It highlights in colour the product for which these details have been produced, in this case, the aircrete blocks FOAMGLAS PERINSUL HL. It also indicates the position of the air barrier that must be maintained and provides the necessary information to enable the U value calculation, based on the examples provided.

ψ-values

A table of ψ-values (psi-values) and temperature factors is provided for each detail. The banding of U values provides the specifier with the flexibility to use different U values for the main elements, but ensures that the calculated ψ-value is still valid within that range. The ψ-values were calculated and checked by an experienced individual, as required by Approved Document L1A.

The temperature factor is a property of the construction and is used to assess the risk of surface condensation or mould growth. In all cases the calculated values are higher than the critical temperature factor for dwellings (0.75) as given in BRE Information Paper IP 1/06 *Assessing the effects of thermal bridging at junctions and around openings*, which limits the risk of surface condensation or mould growth.

All ψ-values have been calculated in accordance with BRE Report 497: 2007 *Conventions for calculating linear thermal transmittance and temperature factors* and other relevant standards quoted within that document.

U value examples

Some indicative guidance on the insulation thickness and thermal conductivity values required to achieve the U value example constructions in combination with different inner blocks, are also provided. There is no specification for the type of insulation used, but the necessary information is provided to enable the calculations to be repeated. The U values were calculated in accordance with BRE Report (BR 443 : 2006) *Conventions for U-value calculations* and other relevant British Standards.

A fully detailed U value calculation using the stated thickness and thermal conductivity values may produce lower U values than that indicated in the details, as only the minimum amount of information is provided, such as thickness and conductivity of insulation. Other combinations of thicknesses and conductivities can be used to achieve the U values, and as long as these are within the bands provided, the corresponding ψ-value will still be valid. This provides the user with considerable flexibility compared to more traditional representations of ψ-values, while maintaining the accuracy and technical rigour of the calculation.

Last page — checklist

Guidance checklist

This part of the detail relates to the quality assurance aspect, which used in combination with guidance given on the first page, would provide reassurance to the builder that this detail will perform as expected. The *Notes* box is intended for the inspector or the site supervisor to record any additional information or changes that may have occurred to the final built detail. It can be used as a log of the work done for each detail and as a process for checking by the site supervisor, to ensure the detail was constructed as detailed and so that the calculated ψ-values can be achieved

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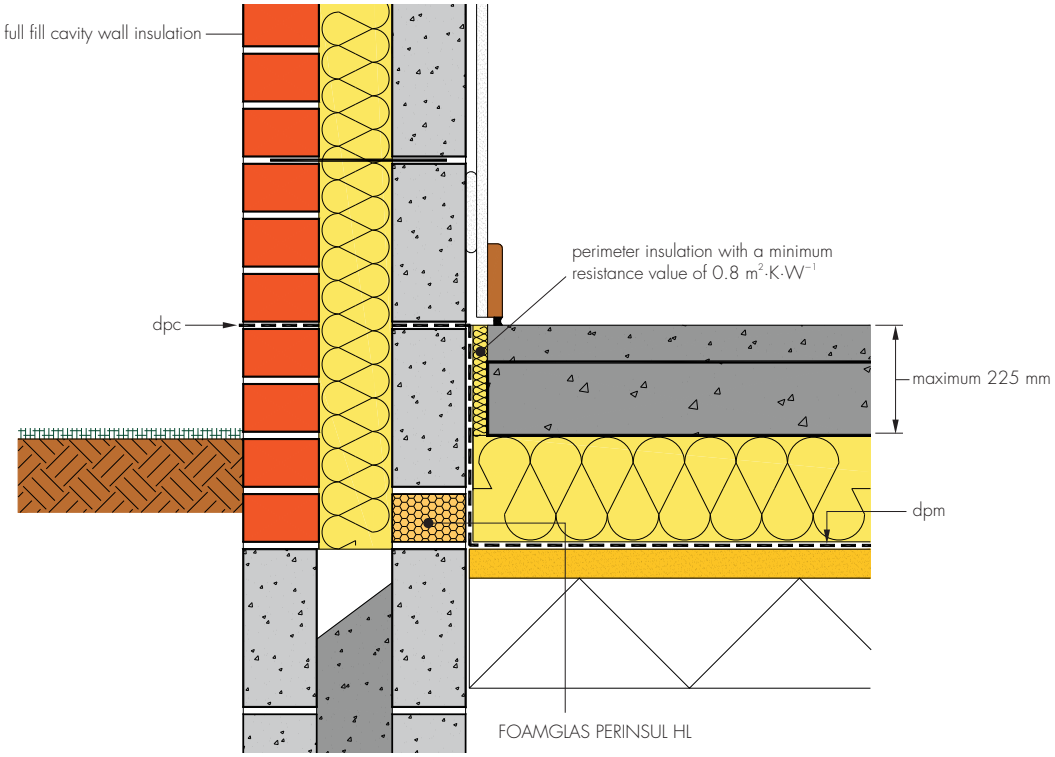
FOAMGLAS® PERINSUL HL

External Masonry Cavity Wall. Full Fill

Concrete ground bearing floor — Insulation below slab

CD0056



This indicative guidance illustrates good practice for design and construction with respect to achieving thermal performance and air barrier continuity only. It must be implemented taking due regard of site conditions and all other requirements imposed by Building Regulations.

Notes

- FOAMGLAS PERINSUL HL 65 mm by 100 mm with $\lambda = 0.058$ W·m^{-1}·K^{-1}
- 100 mm thickness of inner leaf blocks
- ensure that the wall and floor insulations fully overlap both sides of the Perinsul HL unit
- maximum 225 mm concrete floor slab (including floor finish)
- perimeter insulation with a minimum resistance value of 0.8 m^2·K^1·W^{-1} (eg 20 mm of insulation with $\lambda = 0.025$ W·m^{-1}·K^{-1}) and installed up to top of floor finish
- ensure that the full fill wall insulation is installed correctly between the inner and outer leaf of the cavity wall with no gaps
- ensure that the full fill wall insulation is fit for purpose with regard to water absorption and wall exposure
- ensure that the floor insulation tightly abuts blockwork wall
- ensure there is a seal between the wall and the floor air barrier, and that there are no gaps between skirting board and the floor
- other improved air barrier continuity solutions can be used.

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Concrete ground bearing floor — Insulation below slab

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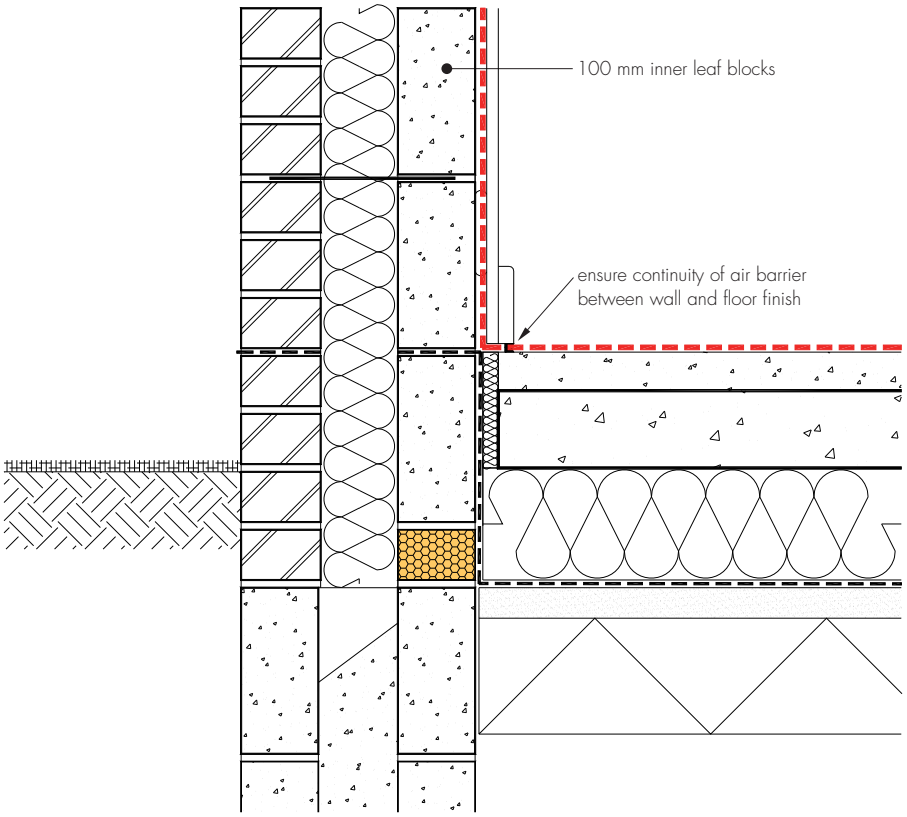

denotes 'notional' line of continuous air barrier to be maintained

This indicative guidance illustrates good practice for design and construction with respect to achieving thermal performance and air barrier continuity only. It must be implemented taking due regard of site conditions and all other requirements imposed by Building Regulations.

Calculated ψ-values for this detail

Case 1: Floor U value between 0.08 and 0.11 W·m^{-2}·K^{-1} (for a perimeter/area ratio of 0.25)

For example, floor U values for the range shown above can be achieved with insulation thickness between 130 mm and 200 mm with λ ⩽ 0.023 W·m^{-1}·K^{-1}.

	Wall U value less than or equal to 0.20 W·m^{-2}·K^{-1}		Wall U value between 0.21 and 0.25 W·m^{-2}·K^{-1}		Wall U value between 0.26 and 0.30 W·m^{-2}·K^{-1}	
Inner leaf block conductivity (W·m^{-1}·K^{-1})	ψ-value (W·m^{-1}·K^{-1})	Temperature factor	ψ-value (W·m^{-1}·K^{-1})	Temperature factor	ψ-value (W·m^{-1}·K^{-1})	Temperature factor
0.19	0.086	0.95	0.093	0.94	0.097	0.94
0.57	0.098	0.94	0.107	0.93	0.112	0.92
1.13	0.108	0.93	0.115	0.93	0.122	0.92

The Table below provides U values for the same floor construction for P/A ratios other than 0.25. The ψ-values can only be used when the actual floor U value is less than that given for the P/A ratio relevant to the dwelling in question:

P/A (m·m^{-2})	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00
U (W·m^{-2}·K^{-1})	0.11	0.11	0.12	0.12	0.13	0.13	0.13	0.13	0.13	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14

Case 2: Floor U value between 0.12 and 0.19 W·m^{-2}·K^{-1} (for a perimeter/area ratio of 0.25)

For example, floor U values for the range shown above can be achieved with insulation thickness between 50 mm and 125 mm and with $\lambda \leqslant 0.023$ W·m^{-1}·K^{-1}.

	Wall U value less than or equal to 0.20 W·m^{-2}·K^{-1}		Wall U value between 0.21 and 0.25 W·m^{-2}·K^{-1}		Wall U value between 0.26 and 0.30 W·m^{-2}·K^{-1}	
Inner leaf block conductivity (W·m^{-1}·K^{-1})	ψ-value (W·m^{-1}·K^{-1})	Temperature factor	ψ-value (W·m^{-1}·K^{-1})	Temperature factor	ψ-value (W·m^{-1}·K^{-1})	Temperature factor
0.19	0.093	0.95	0.103	0.94	0.109	0.93
0.57	0.105	0.94	0.111	0.93	0.122	0.92
1.13	0.117	0.93	0.124	0.92	0.132	0.92

The Table below provides U values for the same floor construction for P/A ratios other than 0.25. The ψ-values can only be used when the actual floor U value is less than that given for the P/A ratio relevant to the dwelling in question:

P/A (m·m^{-2})	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00
U (W·m^{-2}·K^{-1})	0.18	0.19	0.21	0.22	0.23	0.23	0.24	0.25	0.25	*0.26*	*0.26*	*0.27*	*0.27*	*0.28*	*0.28*	*0.28*	*0.28*

Note: The U values shown in italics are above the limit floor U value according to The Building Regulations 2010 (England and Wales) (as amended).

Case 3: Floor U value ⩾ 0.20 W·m^{-2}·K^{-1} (for a perimeter/area ratio of 0.25)

For example, floor U values for the range shown above can be achieved using 45 mm of insulation with $\lambda = 0.023$ W·m^{-1}·K^{-1}.

	Wall U value less than or equal to 0.20 W·m^{-2}·K^{-1}		Wall U value between 0.21 and 0.25 W·m^{-2}·K^{-1}		Wall U value between 0.26 and 0.30 W·m^{-2}·K^{-1}	
Inner leaf block conductivity (W·m^{-1}·K^{-1})	ψ-value (W·m^{-1}·K^{-1})	Temperature factor	ψ-value (W·m^{-1}·K^{-1})	Temperature factor	ψ-value (W·m^{-1}·K^{-1})	Temperature factor
0.19	0.069	0.95	0.078	0.94	0.080	0.93
0.57	0.080	0.94	0.087	0.93	0.093	0.92
1.13	0.088	0.93	0.095	0.92	0.104	0.91

The Table below provides U values for the same floor construction for P/A ratios other than 0.25. The ψ-values can only be used when the actual floor U value is greater than that given for the P/A ratio relevant to the dwelling in question:

P/A (m·m^{-2})	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00
U (W·m^{-2}·K^{-1})	0.18	0.20	0.22	0.23	0.24	0.25	*0.26*	*0.26*	*0.27*	*0.27*	*0.28*	*0.28*	*0.29*	*0.29*	*0.30*	*0.30*	*0.30*

Note: The U values shown in italics are above the limit floor U value according to The Building Regulations 2010 (England and Wales) (as amended).

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External Masonry Cavity Wall. Full Fill

Concrete ground bearing floor — Insulation below slab

CD0056

In all the example calculations, wall ties are stainless steel double triangle types (2.5 per m^2), with 100 mm inner leaf blocks.

Wall U values $\leqslant$ 0.30 $W \cdot m^{-2} \cdot K^{-1}$ can be achieved with:

— 100 mm $\leqslant$ insulation thickness $\leqslant$ 115 mm with $\lambda \leqslant$ 0.036 $W \cdot m^{-1} \cdot K^{-1}$ and inner block conductivity of 0.19 $W \cdot m^{-1} \cdot K^{-1}$ or less

— 110 mm $\leqslant$ insulation thickness $\leqslant$125 mm with $\lambda \leqslant$ 0.036 $W \cdot m^{-1} \cdot K^{-1}$ and inner block conductivity of 1.13 $W \cdot m^{-1} \cdot K^{-1}$ or less

Wall U values $\leqslant$ 0.25 $W \cdot m^{-2} \cdot K^{-1}$ can be achieved with:

— 120 mm $\leqslant$ insulation thickness $\leqslant$ 150 mm with $\lambda \leqslant$ 0.036 $W \cdot m^{-1} \cdot K^{-1}$ and inner block conductivity of 0.19 $W \cdot m^{-1} \cdot K^{-1}$ or less

— 130 mm $\leqslant$ insulation thickness $\leqslant$ 160 mm with $\lambda \leqslant$ 0.036 $W \cdot m^{-1} \cdot K^{-1}$ and inner block conductivity of 1.13 $W \cdot m^{-1} \cdot K^{-1}$ or less

Wall U values $\leqslant$ 0.20 $W \cdot m^{-2} \cdot K^{-1}$ can be achieved with:

— 155 mm minimum insulation thickness with $\lambda \leqslant$ 0.036 $W \cdot m^{-1} \cdot K^{-1}$ and inner block conductivity of 0.19 $W \cdot m^{-1} \cdot K^{-1}$ or less

— 165 mm minimum insulation thickness with $\lambda \leqslant$ 0.036 $W \cdot m^{-1} \cdot K^{-1}$ and inner block conductivity of 1.13 $W \cdot m^{-1} \cdot K^{-1}$ or less.

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External Masonry Cavity Wall. Full Fill
Concrete ground bearing floor — Insulation below slab

CD0056

Guidance checklist

Date: ..... Site manager/supervisor: .....

Site name: ..... Plot No: .....

Ref	Item	Yes/No Inspected (initials and date)
1	Is the FOAMGLAS PERINSUL HL insulated block as specified? — Dimensions: width 100 mm and thickness 65 mm	☐ ☐ .....
	— Thermal conductivity of 0.058 $W \cdot m^{-1} \cdot K^{-1}$.	☐ ☐ .....
2	Are the inner leaf blocks 100 mm thick?	☐ ☐ .....
3	Is the perimeter insulation as specified? — minimum resistance of 0.8 $m^2 \cdot K^1 \cdot W^{-1}$ (eg 20 mm of insulation with λ = 0.025 $W \cdot m^{-1} \cdot K^{-1}$)	☐ ☐ .....
	— installed up to top of floor finish.	☐ ☐ .....
4	Is the FOAMGLAS PERINSUL HL unit overlapped with insulation both sides?	☐ ☐ .....
5	Is the full fill wall insulation installed correctly with no gaps?	☐ ☐ .....
6	Is the full fill wall insulation appropriate for moisture and wall exposure?	☐ ☐ .....
7	Is the screed and floor finish a maximum thickness of 225 mm?	☐ ☐ .....
8	Is the floor insulation firmly against the blockwork wall leaving no gaps?	☐ ☐ .....
9	Is the continuity of the air barrier between the floor and the wall achieved? If not, please provide details.	☐ ☐ .....

Notes (include details of any corrective action)

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FOAMGLAS® PERINSUL HL

External Masonry Cavity Wall. Full Fill

Flat roof with parapet — Warm deck — Insulation above joists

CD0057

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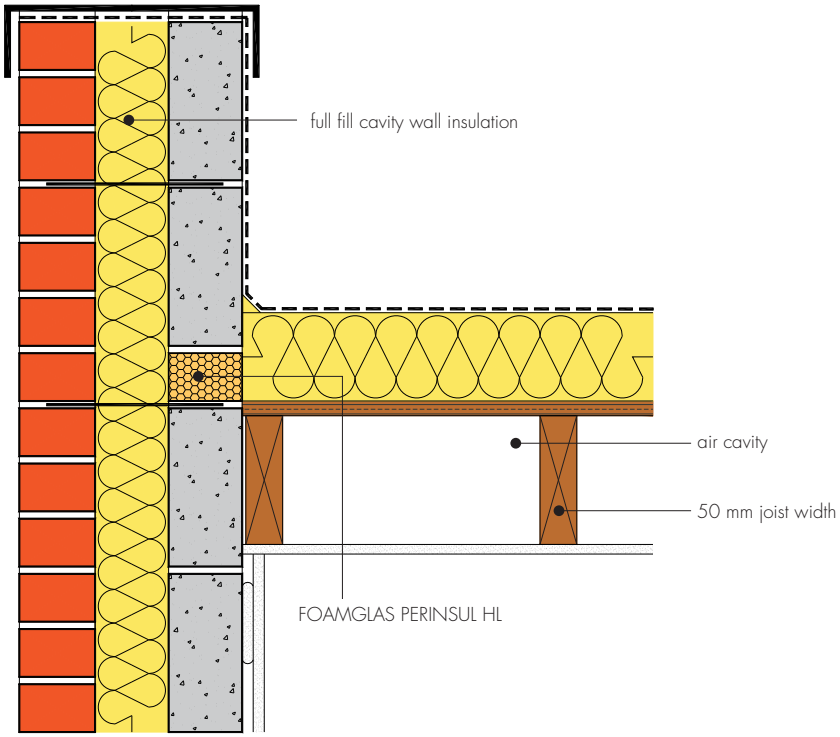

This indicative guidance illustrates good practice for design and construction with respect to achieving thermal performance and air barrier continuity only. It must be implemented taking due regard of site conditions and all other requirements imposed by Building Regulations.

Notes

- FOAMGLAS PERINSUL HL 65 mm by 100 mm with $\lambda = 0.058$ $W \cdot m^{-1} \cdot K^{-1}$
- 100 mm thickness inner leaf blocks
- Maximum 200 mm air cavity thickness (between roof joists)
- 50 mm minimum joist width
- Ensure that roof insulation tightly abuts the inner face of the parapet wall and fully overlaps the Perinsul HL unit maintaining continuity with wall insulation
- If required by BS 5250 : 2011 use of a vapour control layer between deck and insulation
- ensure that the full fill wall insulation is installed correctly between the inner and outer leaf of the cavity wall with no gaps
- ensure that the full fill wall insulation is fit for purpose with regard to water absorption and wall exposure
- seal between the ceiling and wall with either plaster, adhesive or flexible sealant.

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External Masonry Cavity Wall. Full Fill

Flat roof with parapet — Warm deck — Insulation above joists

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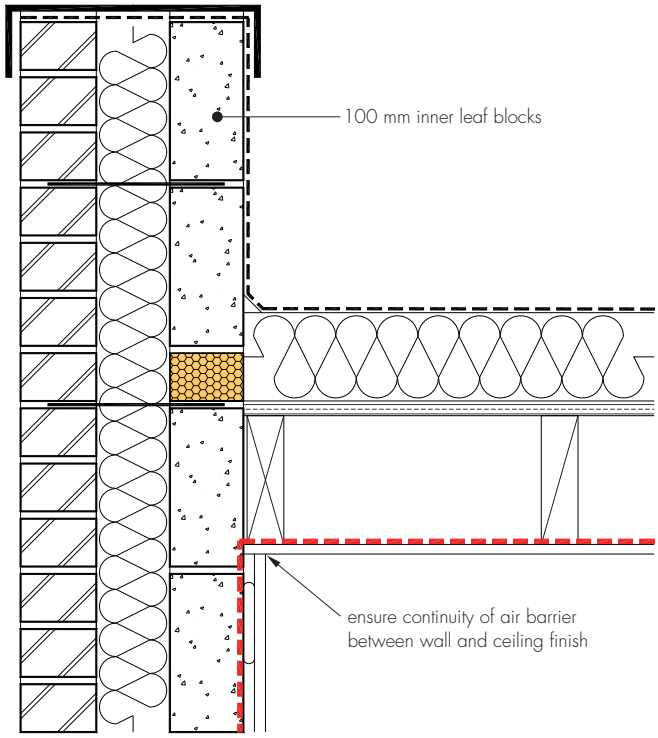

denotes 'notional' line of continuous air barrier to be maintained

This indicative guidance illustrates good practice for design and construction with respect to achieving thermal performance and air barrier continuity only. It must be implemented taking due regard of site conditions and all other requirements imposed by Building Regulations.

Calculated ψ-values for this detail

	Wall U value less than or equal to 0.20 $W \cdot m^{-2} \cdot K^{-1}$		Wall U value between 0.21 and 0.25 $W \cdot m^{-2} \cdot K^{-1}$		Wall U value between 0.26 and 0.30 $W \cdot m^{-2} \cdot K^{-1}$	
Inner leaf block conductivity ($W \cdot m^{-1} \cdot K^{-1}$)	ψ-value ($W \cdot m^{-1} \cdot K^{-1}$)	Temperature factor	ψ-value ($W \cdot m^{-1} \cdot K^{-1}$)	Temperature factor	ψ-value ($W \cdot m^{-1} \cdot K^{-1}$)	Temperature factor
0.19	0.078	0.95	0.085	0.95	0.094	0.93
0.57	0.103	0.93	0.111	0.93	0.118	0.92
1.13	0.121	0.93	0.129	0.92	0.136	0.91

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External Masonry Cavity Wall. Full Fill

Flat roof with parapet — Warm deck — Insulation above joists

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These values are valid for roof U value equal or less than 0.20 $W \cdot m^{-2} \cdot K^{-1}$.

In all the example calculations, wall ties are stainless steel double triangle types (2.5 per m^2), with 100 mm blocks. Examples to achieve theses U values are:

Wall U values $\leqslant$ 0.30 $W \cdot m^{-2} \cdot K^{-1}$ can be achieved with:

— 100 mm $\leqslant$ insulation thickness $\leqslant$ 115 mm with $\lambda \leqslant 0.036\ W \cdot m^{-1} \cdot K^{-1}$ and inner block conductivity of 0.19 $W \cdot m^{-1} \cdot K^{-1}$ or less

— 110 mm $\leqslant$ insulation thickness $\leqslant$ 125 mm with $\lambda \leqslant 0.036\ W \cdot m^{-1} \cdot K^{-1}$ and inner block conductivity of 1.13 $W \cdot m^{-1} \cdot K^{-1}$ or less

Wall U values $\leqslant$ 0.25 $W \cdot m^{-2} \cdot K^{-1}$ can be achieved with:

— 120 mm $\leqslant$ insulation thickness $\leqslant$ 150 mm with $\lambda \leqslant 0.036\ W \cdot m^{-1} \cdot K^{-1}$ and inner block conductivity of 0.19 $W \cdot m^{-1} \cdot K^{-1}$ or less

— 130 mm $\leqslant$ insulation thickness $\leqslant$ 160 mm with $\lambda \leqslant 0.036\ W \cdot m^{-1} \cdot K^{-1}$ and inner block conductivity of 1.13 $W \cdot m^{-1} \cdot K^{-1}$ or less

Wall U values $\leqslant$ 0.20 $W \cdot m^{-2} \cdot K^{-1}$ can be achieved with:

— 155 mm minimum insulation thickness with $\lambda \leqslant 0.036\ W \cdot m^{-1} \cdot K^{-1}$ and inner block conductivity of 0.19 $W \cdot m^{-1} \cdot K^{-1}$ or less

— 165 mm minimum insulation thickness with $\lambda \leqslant 0.036\ W \cdot m^{-1} \cdot K^{-1}$ and inner block conductivity of 1.13 $W \cdot m^{-1} \cdot K^{-1}$ or less.

FOAMGLAS® PERINSUL HL
External Masonry Cavity Wall. Full Fill
Flat roof with parapet — Warm deck — Insulation above joists

CD0057

Guidance checklist

Date: ..... Site manager/supervisor: .....

Site name: ..... Plot No: .....

Ref	Item	Yes/No Inspected (initials and date)
1	Is the FOAMGLAS PERINSUL HL insulated block as specified? — Dimensions: width 100 mm and thickness 65 mm — Thermal conductivity of 0.058 $W \cdot m^{-1} \cdot K^{-1}$.	☐ ☐ ..... ☐ ☐ .....
2	Are both vertical faces of the insulated block fully in contact with wall/roof insulation?	☐ ☐ .....
3	Is the ceiling air cavity thickness 200 mm maximum?	☐ ☐ .....
4	Is the width joist 50 mm minimum?	☐ ☐ .....
5	Is the full fill wall insulation installed correctly with no gaps?	☐ ☐ .....
6	Is the full fill wall insulation appropriate for moisture and wall exposure?	☐ ☐ .....
7	Is the roof insulation firmly against the inner face of the parapet wall leaving no gaps?	☐ ☐ .....
8	Is the continuity of the air barrier between the ceiling and the wall achieved? If not, please provide details.	☐ ☐ .....

Notes (include details of any corrective action)

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