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Agrément Certificate
19/5617
Product Sheet 1 Issue 2

FOUNDATION SYSTEM USING EPS INSULATION AND REINFORCED CONCRETE

FUTURE FOUND FOUNDATION SYSTEM

This Agrément Certificate relates to the Future Found Foundation System, comprising white expanded polystyrene (EPS) flat sheet and edge profiles, black pins and shark's teeth galvanized steel combs. The system is for use in conjunction with concrete strength class C30/37 reinforced with steel reinforcement for raft foundation and external edge and internal beams, in single-family dwellings, subject to the design load criteria as defined in this Certificate.

(1) Hereinafter referred to as 'Certificate'.

The assessment includes

Product factors:
- compliance with Building Regulations
- compliance with additional regulatory or non-regulatory information where applicable
- evaluation against technical specifications
- assessment criteria and technical investigations
- uses and design considerations

Process factors:
- compliance with Scheme requirements
- installation, delivery, handling and storage
- production and quality controls
- maintenance and repair

Ongoing contractual Scheme elements†:
- regular assessment of production
- formal 3-yearly review

KEY FACTORS ASSESSED

Section 1. Mechanical resistance and stability
Section 2. Safety in case of fire
Section 3. Hygiene, health and the environment
Section 4. Safety and accessibility in use
Section 5. Protection against noise
Section 6. Energy economy and heat retention
Section 7. Sustainable use of natural resources
Section 8. Durability

The BBA has awarded this Certificate to the company named above for the system described herein. This system has been assessed by the BBA as being fit for its intended use provided it is installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of Second issue: 31 July 2024
Originally certified on 5 February 2019

Hardy Giesler
Chief Executive Officer

This BBA Agrément Certificate is issued under the BBA's Inspection Body accreditation to ISO/IEC 17020. Sections marked with † are not issued under accreditation.

The BBA is a UKAS accredited Inspection Body (No. 4345), Certification Body (No. 0113) and Testing Laboratory (No. 0357).

Readers MUST check that this is the latest issue of this Agrément Certificate by either referring to the BBA website or contacting the BBA directly.

The Certificate should be read in full as it may be misleading to read clauses in isolation.

Any photographs are for illustrative purposes only, do not constitute advice and should not be relied upon.

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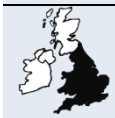
SUMMARY OF ASSESSMENT AND COMPLIANCE

This section provides a summary of the assessment conclusions; readers should refer to the later sections of this Certificate for information about the assessments carried out.

Compliance with Regulations

Having assessed the key factors, the opinion of the BBA is that the Future Found Foundation System, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements of the following Building Regulations:



The Building Regulations 2010 (England and Wales) (as amended)

Requirement:	**A1(1)**	**Loading**
Comment:		The system can sustain and transmit the loads from permanent and variable actions to the ground. See section 1 of this Certificate.
Requirement:	**C2 (c)**	**Resistance to moisture**
Comment:		The system can contribute to limiting the risk of surface condensation. See section 3 of this Certificate.
Requirement:	**L1(a)(i)**	**Conservation of fuel and power**
Comment:		The system can contribute to satisfying this Requirement but compensating fabric and/or services measures will be required. See section 6 of this Certificate.
Regulation:	**7(1)**	**Materials and workmanship**
Comment:		The system is acceptable. The system can contribute to satisfying this Requirement. See sections 8 and 9 of this Certificate.
Regulation:	**25B**	**Nearly zero-energy requirements for new buildings**
Regulation:	**26**	**CO2 emission rates for new buildings (applicable to England only)**
Regulation:	**26A**	**Primary energy consumption rates for new buildings (applicable to Wales only)**
Regulation:	**26B**	**Fabric performance values for new dwellings (applicable to Wales only)**
Regulation:	**26C**	**Target primary energy rates for new buildings (applicable to England only)**
	26C	**Energy efficiency rating (applicable to Wales only)**
Comment:		The system can contribute to satisfying these Regulations but compensating fabric and/or services measures will be required. . See section 6 of this Certificate

The Building (Scotland) Regulations 2004 (as amended)

Regulation:	**8(1)**	**Fitness and durability of materials and workmanship**
Comment:		The system can contribute to a construction meeting this Regulation. See sections 8 and 9 of this Certificate.
Regulation:	**9**	**Building standards applicable to construction**
Standard:	1.1(a)	Structure
Comment:		The system can sustain and transmit the loads from permanent and variable actions to the ground, with reference to clause 1.1.1(1) of this Standard. See section 1 of this Certificate.
Standard:	3.15	Condensation
Comment:		The system can contribute to limiting the risk of surface and interstitial condensation, with reference to clauses 3.15.1(1), 3.15.4(1) and 3.15.5(1) of this Standard. See section 3 of this Certificate.

Standard: Comment:	6.1(b)(c) (d)	Energy demand and carbon dioxide emissions The system can contribute to satisfying of this Standard with reference to clause 6.1.1(1) but compensating fabric and/or services measures will be required. See section 6 of this Certificate.
Standard: Comment:	6.2	Building insulation envelope The system can contribute to satisfying the requirements of this Standard but compensating fabric measures may be required, with reference to clauses 6.2.1(1) and 6.2.3(1). See section 6 of this Certificate.
Standard: Comment:	7.1(a)(b)	Statement of sustainability The system can contribute to satisfying the relevant requirements of Regulation 9, Standards 1 to 6, and therefore will contribute to a construction meeting a bronze level of sustainability as defined in this Standard. See section 6 of this Certificate.
Regulation: Comment:	**12**	**Building standards applicable to conversions** All comments given for the system under Regulation 9, Standards 1 to 6, also apply to this Regulation, with reference to clause 0.12.1(1) and Schedule 6(1).

(1) Technical Handbook (Domestic).

The Building Regulations (Northern Ireland) 2012 (as amended)

Regulation: Comment:	**23(1)(a)(i)(ii)(iii) and (b)(i)(ii)**	**Fitness of materials and workmanship** The system is acceptable. See sections 8 and 9 of this Certificate.
Regulation: Comment:	**29**	**Condensation** The system can contribute to limiting the risk of interstitial condensation. See section 3 of this Certificate.
Regulation: Comment:	**30**	**Stability** The system can sustain and transmit the loads from permanent and variable actions to the ground. See section 1 of this Certificate.
Regulation: Comment:	**39(a)(i)**	**Conservation measures** The system can contribute to satisfying this Regulations, but compensating fabric measures may be required. See section 6 of this Certificate.
Regulation: **Comment:**	**40(2)**	**Target carbon dioxide emission rate** The system can contribute to satisfying these Regulations. See section 6 of this Certificate**.**
Regulation: Comment:	**43B**	**Nearly zero-energy requirements for new buildings** The system can contribute to satisfying these Regulations, but compensating fabric measures may be required. See section 6 of this Certificate.

Additional information

NHBC Standards 2024

In the opinion of the BBA, the Future Found Foundation System if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements in relation to *NHBC Standards*, Chapters 3.1 *Concrete and its reinforcement;* Part 4 *Foundations*, 4.2 *Building near trees,* 4.4 *Raft, pile, pier and beam foundations,* and 5.1 *Substructure and ground floors*.

Fulfilment of Requirements

The BBA has judged the Future Found Foundation System to be satisfactory for use as described in this Certificate. The system comprising white EPS flat sheet and edge profiles, black pins and shark's teeth galvanized steel combs. The system has been assessed in conjunction with concrete strength class C30/37 reinforced with steel reinforcement for raft foundation and external edge and internal beams, in single-family dwellings, subject to the design load criteria as defined in this Certificate.

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ASSESSMENT

Product description and intended use

The Future Found Foundation System, comprising concrete reinforced with steel reinforcement, white EPS flat sheet and edge profile, black pins and shark's teeth galvanized steel combs.

The Certificate holder provided the following description for the system under assessment. The Future Found Foundation System consists of:

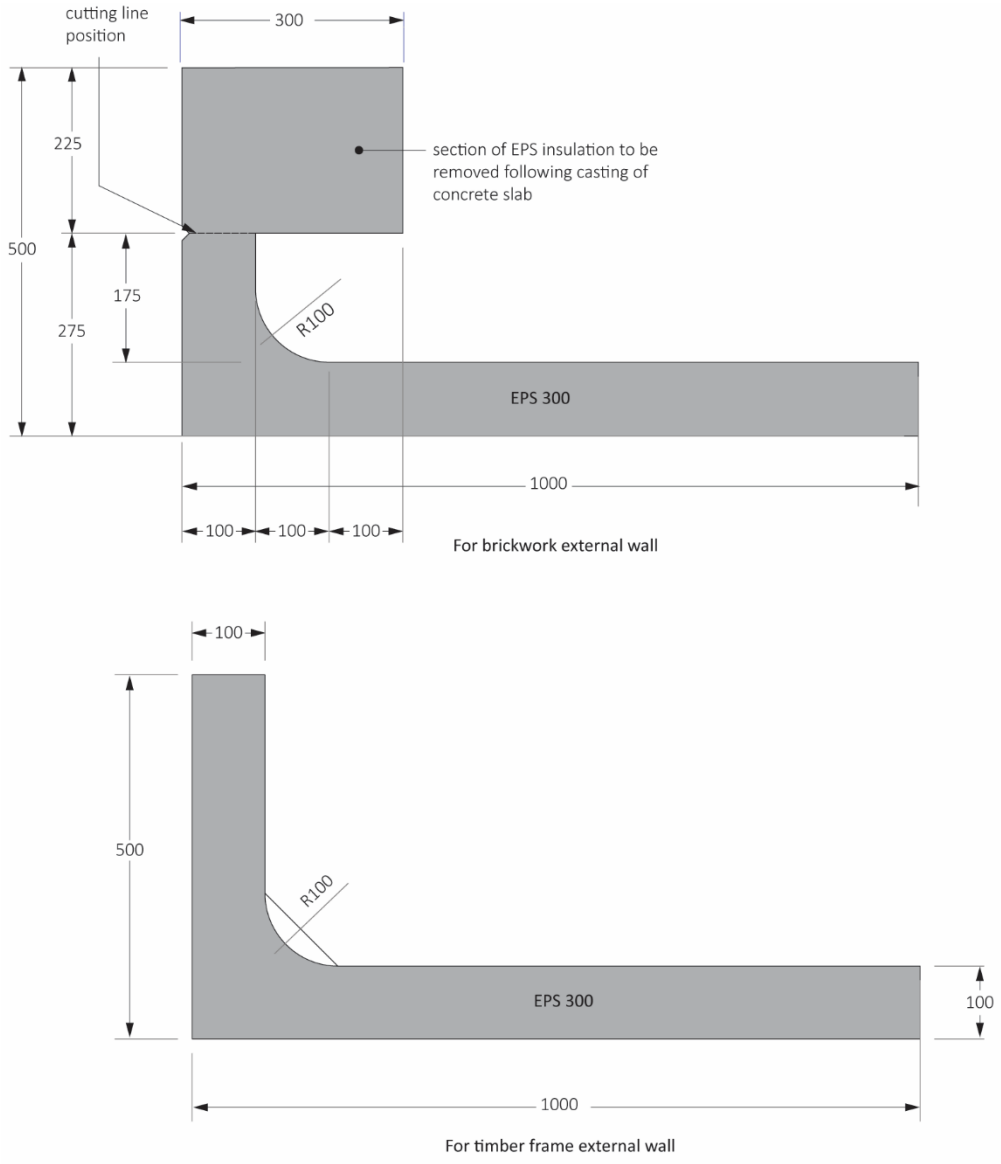
- white EPS flat sheets (100 and 300 kPa)
- white EPS for edge profiles (300 kPa)
- black pins and galvanized steel combs — used to join the flat sheets and edge profiles to each other.

EPS components

The EPS components (grades 100 and 300) are manufactured in accordance with principles of BS EN 13163: 2012, with the minimum properties given below and in Table 1 of this Certificate:

- edge profile, grade 300 kPa — 1200 mm (length) x (700 to 1300 mm - width) x 100 mm (thick) laid below the external concrete to form a shutter. To expose the toe of the concrete beam onto which the outer leaf of masonry is built, following casting of concrete edge beam, the top part of edge profile is removed (see Figure 1 for example of EPS edge profile and removed top part of the EPS edge profile)
- flat sheet, grade 300 kPa — 1200 x 800 x 100 mm (thick), laid under the internal timber frame or block wall
- flat sheets, grade 100 kPa — 2400 x 1200 x 100 mm (thick), laid in three layers below the concrete raft.

Figure 1 Example of the EPS Edge profile for external brickwork and timber frame



Note:

The top part of the EPS edge profile which is removed following casting of concrete slab is outside the scope of this Certificate.

All dimensions in mm

Table 1 Nominal characteristics for the EPS components

Characteristic (unit)	flat sheets where there is no internal loadbearing wall	edge profile for external traditional cavity masonry or timber framed wall and flat sheets under internal loadbearing wall
Compressive stress at 10% deformation (kPa)	100(1)	300(1)
Bending strength (kPa)	150(1)(2)	450(1)(2)
Shear strength (kPa)	50(2)(3)	225 (1)(3)

(1) For the design strength of the EPS against Ultimate Limit State (ULS) these values must be divided by γ_m (material factor of the EPS). The material factor for the EPS equals to 1.10.

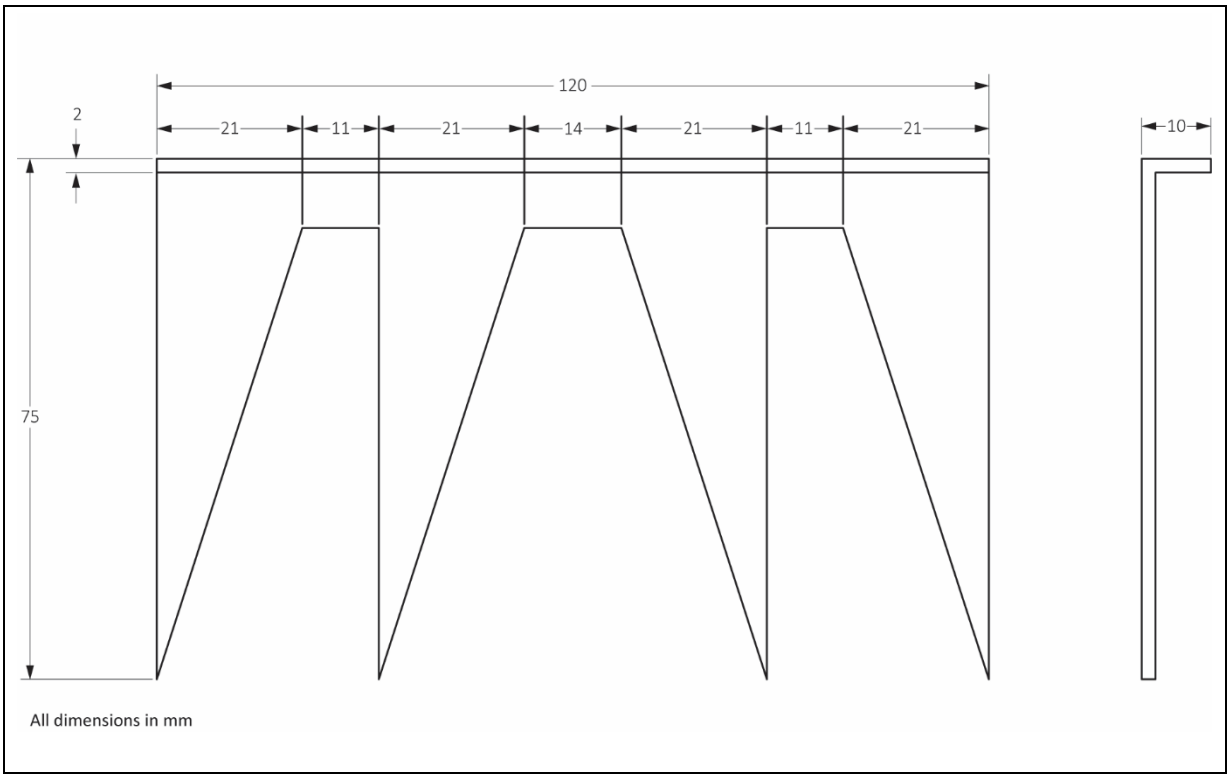
(2) The bending strength and compressive stress at 10% deformation of the EPS 100 and 300 comply with the principles of BS EN 13163 : 2012, Table C.1.

(3) The bending strength and the shear strength of the EPS 100 and 300 are in line with the principles of BS EN 13163: 2012, Table F.1.

Shark's teeth galvanized steel combs

The Shark's teeth galvanized steel combs are used to join the flat sheets and edge profiles to each other prior to concrete casting (see Figure 2).

Figure 2 Shark's teeth galvanized steel comb



Black pins

Eight black pins are used in the upper two layers, to join the flat sheets and edge profiles to each other.

Ancillary Items

The Certificate holder recommends the following ancillary items for use with the system, but these materials have not been assessed by the BBA and are outside the scope of this Certificate:

- the top part of the EPS edge profile which is removed after casting of the concrete (see Figure 1)
- concrete — the minimum strength class of the concrete must be C30/37 and the reinforcement for the concrete must be designed in accordance with principles of BS EN 1992-1 : 2004 and its UK National Annex. The minimum specification of the concrete and reinforcements are given in Table 2 of this Certificate

- steel reinforcement for concrete
- where required, gas/radon and/or VOC resistant barrier(1)
- air vapour control layer (AVCL)(1), in line with BS 5250 : 2021
- damp-proof membrane (DPM)(1) — must be placed beneath the EPS (see Figures 3 to 6)
- damp proof course (DPC)
- minimum 150 mm well graded (non-frost susceptible and with good drainage material minimum MOT type 1 must be used. The material must be in accordance with the *Manual of Contract Documents for Highway Works* (MCHW) Volume 1 Specification for Highway Works, Series 800 for Highway Works (Amendment – November 2021). The material must be compacted in layers of 150 mm
- fine sand blinding 30 to 50 mm below the DPM or gas resistant barrier membrane (if required) to minimise the risk of puncturing them
- flexible or rigid drain pipes
- Marmox thermal insulation brick, in accordance with BBA Certificate 10/4778
- masonry wall and timber frame
- selected fill material to Approved Document H
- perimeter land drainage to be connected to positive outfall.

(1) Must be compatible with EPS.

Table 2 Specification of concrete and reinforcement

Characteristic	Value
Compressive strength class	C30/37
Minimum cement content	300 kg·m^{-3}
Consistency class	S3
Aggregate	Maximum aggregate size must be 20 mm and aggregate must comply with BS EN 12620 : 2002
Cement types (BS EN 197-1 : 2011 and BS 8500-1 : 2023 designation)	CEM 1, IIA, IIB-S, IIB-V and IIIA
Admixture/super-plasticiser	Per manufacturer's instructions and BS EN 934-2 : 2009
Reinforcement for raft foundation and for external edge and internal concrete beams	Steel reinforcement to BS 8666 : 2020 and BS 4483: 2005 for with a characteristic yield strength (f_{yk}) of 500 N·mm^{-2}. The nominal cover to top and bottom steel reinforcement must be 50 mm.

Note:
- when applied on NHBC sites, reference should also be made to *NHBC Standards 2023*, Chapter 4.4.

Product assessment – key factors

The system was assessed for the following key factors, and the outcome of the assessments is shown below. Conclusions relating to the Building Regulations apply to the whole of the UK unless otherwise stated.

1 Mechanical resistance and stability

Data were assessed for the following characteristics.

1.1 Behaviour under Loading

1.1.2 The short and long terms compressive properties of the EPS components of the system were assessed and the results are shown in Table 3.

Table 3 Short- and long-term properties (compressive stress) of the EPS components of the system

Product assessed	Assessment method	Requirement	Result
EPS 100 for flat sheets	BS EN 826 : 2013	Compressive stress at 1% deformation (short term)	45 kPa
	BS EN 13163 : 2012	Compressive stress at 2% deformation (long term)	0.3 $\sigma10^{(1)}$ /(γ_m) $^{(2)}$ = 27.3 kPa
EPS 300 flat sheets and edge profiles	BS EN 826 : 2013	Compressive stress at 1% deformation (short term)	150 kPa
	BS EN 13163 : 2012	Compressive stress at 2% deformation (long term)	0.3 $\sigma10^{(1)}$ /(γ_m)$^{(2)}$ = 81.8 kPa

(1) σ10 is the compressive stress at 10% deformation.
(2) γm is the material factor of the EPS which equals to 1.10.

1.1.3 The strain against stress performance of the EPS 100 (flat sheets) and EPS 300 (edge profiles) under the applied loads at characteristic serviceability limit state (SLS) [$G_k^{(1)}$ + $Q^{(2)}$] condition (refer to characteristic load combination of BS EN 1990 : 2002, Equation 6.14a) must remain within the permitted elastic performance limit of 1.0%. For compressive stress at 1% deformation of the EPS 100 and 300, see Table 3 of this Certificate.

(1) G_k is permanent action.
(2) Q_k is variable action.

1.1.4 The long-term thickness reduction of the EPS flat sheets (EPS 100 and 300) and EPS edge profiles (EPS 300) under quasi permanent load combination [$G_k + \psi_2^{(1)} Q_k$] must remain within the acceptable limit of 2% after 60 years, when subjected to a permanent compressive stress of 0.3 σ10 (σ10 is the compressive stress of the EPS at 10% deformation- 81.8 KPa for EPS 300 and 27.3 kPa for EPS 100). For compressive stress at 2% deformation of the EPS 100 and 300, see also Table 3 of this Certificate.

(1) For residential applications ψ_2 equals 0.3 (refer to the UK National Annex to BS EN 1990 : 2002, Table NA.A1.1).

1.1.5 The EPS flat sheets and EPS edge profiles must have adequate compressive resistance against stress from ULS actions divided by $\gamma_m^{(1)}$. For ULS actions (1.35 G_k+1.5 Q_k) refer to BS EN 1990 : 2002, Equation 6.10. The applied compressive stress on the EPS 100 and EPS from ULS loads must be less than 90.9 kPa [100/ $\gamma_m^{(1)}$] and 272.7 kPa (300/γ_m) for the EPS 100 and 300 respectively.

(1) γ_m is the material factor for the EPS and equals 1.10.

1.1.6 On the basis of the data assessed, the EPS will adequately sustain and transmit the loads from permanent and variable actions to the ground and be unrestricted under the national building regulations for single-family dwellings up to two stories high provided that the design short- and long-term compressive stress applied on the EPS 100 and 300 does not exceed the values defined in sections 1.1.2 to 1.1.4. Also, the system must be designed and constructed in accordance with this Certificate.

2 Safety in case of fire

Not applicable.

3 Hygiene, health and the environment

Data were assessed for the following characteristics:

3.1 Water vapour permeability

3.1.1 The Certificate holder has declared the water vapour resistance factors (μ values) shown in Table 4.

Table 4 Water vapour resistance factors – (μ values)

Product assessed	Assessment method	Requirement	Result (μ)
EPS 100	BS EN 13163 : 2012	Declared value	30-70
EPS 300	BS EN 13163 : 2012	Declared value	40-100
Reinforced concrete(1)	BS EN ISO 10456 : 2007	Declared value	130

(1) See Table 2 of this Certificate for full specification.

3.2 Condensation

3.2.1 The example construction shown in Table 7 of this Certificate, was analysed numerically to BS EN ISO 10211 : 2017, BRE Information Paper IP 1/06 : 2006 and BRE Report BR 497 : 2016, and achieved minimum temperature factors in excess of 0.69 at internal corners.

3.2.2 On the basis of the data assessed, the construction in Table 7 will adequately limit the risk of surface condensation in low and high occupancy dwellings except areas with humidity class 5 as defined in BS 5250 : 2021.

3.2.3 For other constructions, the risk of surface condensation will be minimal when the minimum temperature factors are not less than the relevant values in BRE Information Paper IP 1/06.

4 Safety and accessibility in use

Not applicable.

5 Protection against noise

Not applicable.

6 Energy economy and heat retention

Data were assessed for the following characteristics.

6.1 Thermal conductivity

6.1.1 The system components were assessed for thermal conductivity and the results are given in Table 5.

Table 5 Thermal conductivities ($W \cdot m^{-1} \cdot K^{-1}$)

Product assessed	Assessment method	Requirement	Result ($W \cdot m^{-1} \cdot K^{-1}$)
EPS 100	BS EN 13163 : 2012	Declared value (λ_D)	0.036
EPS 300			0.033
Galvanized steel combs	BS EN ISO 10456 : 2007	Reference value	50

6.2 Thermal performance

6.2.1 Example floor U values are given in Table 6.

Table 6 Example floor U values [(1)(2)] ($W \cdot m^{-2} \cdot K^{-1}$)

Product assessed	Assessment method	Requirement	Result	
			p/a ratio	Floor U value ($W \cdot m^{-2} \cdot K^{-1}$)
Future Found System (EPS 100)	BS EN ISO 13370: 2017 and BRE Report BR 443 : 2019	Floor U value	0.4	0.095
			0.6	0.099
			0.7	0.10
			0.9	0.10

(1) These calculations are in accordance with section 6.2.3 and assume:
- minimum 150 mm reinforced concrete slab with conductivity $\lambda = 2.5\ W \cdot m^{-1} \cdot K^{-1}$
- a 300 mm thick perimeter wall
- ground conductivity is $1.5\ W \cdot m^{-1} \cdot K^{-1}$.

(2) Insulation layer is three 100 mm layers of EPS 100.

6.2.2 An example floor/external-wall junction, see figure 3, was thermally modelled to determine the linear thermal transmittance (psi value). The results, and specific construction details modelled, are shown in Table 7.

Table 7 Calculated Psi value to BS EN ISO 10211 : 2017 and BRE Report BR 497 : 2016 ($W \cdot m^{-1} \cdot K^{-1}$)

Product assessed	Assessment method	Requirement	Result
Future Found System (EPS 100) (see Figure 3)[(1)(2)]	Psi value to BS EN ISO 10211 : 2017 and BRE Report BR 497 : 2016	Value achieved	$0.40\ W \cdot m^{-1} \cdot K^{-1}$

(1) Assumed wall build-up: 102.5 mm brickwork ($\lambda = 0.77\ W \cdot m^{-1} \cdot K^{-1}$), 100 mm mineral wool full-fill cavity insulation ($\lambda = 0.035\ W \cdot m^{-1} \cdot K^{-1}$), 100 mm blockwork/mortar ($\lambda = 0.162\ W \cdot m^{-1} \cdot K^{-1}$, based on masonry $\lambda = 0.11\ W \cdot m^{-1} \cdot K^{-1}$, with 6.7 % bridged by mortar $\lambda = 0.88\ W \cdot m^{-1} \cdot K^{-1}$), 15 mm service cavity ($R = 0.17\ m^2 \cdot K \cdot W^{-1}$), 12.5 mm plasterboard ($\lambda = 0.25\ W \cdot m^{-1} \cdot K^{-1}$). 65 x 100 mm insulated loadbearing block ($\lambda = 0.048\ W \cdot m^{-1} \cdot K^{-1}$) to base of brickwork. 15 x 100 mm timber internal skirting board to plasterboard ($\lambda = 0.13\ W \cdot m^{-1} \cdot K^{-1}$).

(2) Assumed floor construction: Ground ($\lambda = 1.5\ W \cdot m^{-1} \cdot K^{-1}$), minimum 150 mm well compacted hardcore ($\lambda = 1.5\ W \cdot m^{-1} \cdot K^{-1}$), 1 mm DPM ($\lambda = 0.5\ W \cdot m^{-1} \cdot K^{-1}$, dressed around perimeter insulation and concrete slab), 100 mm EPS 300 to perimeter ($\lambda = 0.033\ W \cdot m^{-1} \cdot K^{-1}$) extending 100 mm externally beyond brickwork and 600 mm internally beyond blockwork, 175 mm dense reinforced concrete slab ($\lambda = 2.5\ Wm^{-1} \cdot K^{-1}$, based on 2 % reinforced steel) under brickwork and cavity, concrete slab increases to 300 mm under blockwork and at perimeter, concrete slab reduces to 200 mm to main floor over 300 mm EPS 100 ($\lambda = 0.036\ W \cdot m^{-1} \cdot K^{-1}$).

6.2.3 The overall floor U value will depend on the ground slab thermal resistance, the floor area and perimeter length, the wall thermal transmittance value, and the ground conductivity. Each floor U value must be calculated to BS EN ISO 13370 : 2017 and BRE Report BR 443 : 2019.

6.2.4 On the basis of data assessed, the calculated value in Tables 6 and 7 can be used in energy and carbon emission rate calculations.

6.2.5 The psi value of other constructions must be modelled in accordance with to BS EN ISO 10211 : 2017 and BRE Report BR 497 : 2016.

7 Sustainable use of natural resources

Data were assessed for the following characteristics.

7.1 Reuse and recyclability

The EPS material can be readily recycled if free from debris and contamination. The concrete and reinforcement steel can also be recycled.

8 Durability

8.1 Service life

Under normal service conditions, the system will have a service life of at least 60 years provided it is designed, installed and maintained in accordance with this Certificate and the Certificate holder's instructions.

PROCESS ASSESSMENT

Information provided by the Certificate holder was assessed for the following factors:

9 Design, installation, workmanship and maintenance

9.1 Design

9.1.1 The design process was assessed by the BBA and the following requirements apply in order to satisfy the performance assessed in this Certificate.

9.1.2 The Certificate holder must perform a site-specific assessment and design method using the appropriate structural design codes including BS EN 1990 : 2002, BS EN 1992-1-1 : 2004, BS EN 1997-1 : 2004 taking into account the following:

9.1.2.1 Variable actions (imposed, snow and wind load in accordance with the principles of BS EN 1991-1-1 : 2002, BS EN 1991-1-3 : 2003 and BS EN 1991-1-4 : 2005, and their UK National Annexes.

9.1.2.2 The permanent actions in accordance with the principles of BS EN 1991-1-1 : 2002 and its UK National Annexes

9.1.2.3 Site conditions, shape, size and construction to evaluate the variable actions (imposed, snow, wind), permanent actions (self-weight) and total loads applied to the EPS for the external and internal walls of traditional cavity masonry construction or timber framed dwellings.

9.1.2.4 Action during execution and accidental action in accordance with the principles of BS EN 1991-1-6 : 2005 and BS EN 1991-1-7 : 2006, and their UK National Annexes.

9.1.2.5 The specification of concrete and reinforcement must be as detailed in Table 2 of this Certificate.

9.1.2.6 Particular attention must be paid to ensure the crack width at intersection between the edge beam and the toe and the raft foundation do not exceed the acceptable limit (0.3 mm).

9.1.2.7 Particular attention must be paid to the design of structural raft foundations where there is an opening in the wall.

9.1.2.8 Movement joints and, where necessary, day (construction) joints, must be provided. The joints must be designed as if they act as a hinge which transfers vertical shear but no moment.

9.1.2.9 Provide appropriate dowel to avoid differential settlement of the foundation where the load applied on the foundation from the two leaves of a party wall are not the same.

Sound reduction

9.1.2.10 Particular attention must be paid for adequate resistance to sound transmission through the floor/separating-wall junction in terraced and semi-detached houses.

9.1.2.11 The slab must be discontinuous underneath masonry cavity separating walls. The engineered design solution must include de-bonded dowels across the discontinuity to prevent resistance to differential movement.

General

9.1.2.12 As a mitigation measure, in the event of possible ground movement, the external concrete edge beams and internal concrete beams reinforced with steel reinforcement must resist against the maximum applied loads from external or internal walls where they are designed either as a simply supported beam with a span of 3 metres, or as a cantilever beam with a span of 1.5 metres.

9.1.2.13 Frost susceptible soils and cold weather construction must be taken into consideration.

9.1.2.14 The modulus of subgrade reaction of the ground and the allowable ground bearing pressure must be taken into consideration.

9.1.2.15 The sub soil settlement must be in accordance with principles of BS EN 1997-1 : 2004 and its UK National Annex.

9.1.1.16 The maximum pressure on the ground at serviceability limit state (SLS) condition must not exceed the allowable ground-bearing pressure.

9.1.2.17 The maximum sub soil settlement and the maximum relative rotational soil settlement must be in accordance with principles of BS EN 1997-1 : 2004.

9.1.2.18 Risks presented by the geo-environmental status of the site, and that further consultation with other specialists to determine suitable additional protective measures and/or suitability of the foundation system with respect to ground gasses, contaminants or aggressive chemicals or soils that may be present.

9.1.2.19 The suitability of the underlying soil strata to support the loading imposed from the foundation.

9.1.2.20 Underground services, drains and relationship with adjacent services and drains.

9.1.1.21 Details and specifications of any additional groundworks, earthworks or remedial measures to mitigate other risks identified from the ground investigation to suit the adoption of the system.

9.1.2.22 Risk associated with land prone to flooding.

9.1.2.23 The area between the concrete beams should not be greater than 35 m^2 and the ratio of adjacent sides on the plan should not exceed 1:1.5.

9.1.2.24 A copy of all 'approved for construction' drawings including details of concrete mix design, connection, reinforcement and specific construction details are provided for each site.

9.1.2.25 Permitted floor loadings for concrete slab (raft foundation) reinforced with steel reinforcement is shown in Table 8. The variable action uniformly distributed load (UDL) or concentrated load must be in accordance with principles of BS EN 1991-1-1 : 2002 and its UK National Annex. The concentrated variable action of 2 kN must be applied to an area not less than 50 x 50 mm.

Table 8 Variable action, partition loads (variable and permanent actions) and finishes (variable action) for raft foundation reinforced with steel reinforcement

Description	Characteristic value of loads for single-family dwellings
Variable action – UDL ($kN \cdot m^{-2}$)	1.5(1)
Variable action concentrated load (kN)	2.0(1)
Permanent action – line load partition wall ($kN \cdot m^{-1}$)	1.0(2)(3)
Variable action – allowance for moveable partition ($kN \cdot m^{-2}$)	0.5(2)
Permanent action – finishes ($kN \cdot m^{-2}$)	0.5

(1) Variable action concentrated load of 2 kN must not be combined with the UDL of 1.5 $kN \cdot m^{-2}$ or other variable actions. For variable action of UDL and concentrated loads, refer to BS EN 1991-1-1:2002 and its UK National Annex.
(2) Variable action concentrated load of 2 kN must be applied to an area not less than 50 x 50 mm.
(3) Either the variable action for lightweight partitions (moveable) or line load partition (permanent action) must be taken into consideration.

9.1.2.26 Minimum spacer four per m² with minimum dimension of 50 by 50 mm for supporting the steel mesh reinforcement must be located on spreader plates over the flat sheets or edge profiles. This will reduce the risk of accidental penetration of the EPS during the construction phase and any resulting misalignment of the reinforcement within the concrete depth.

Spacers for supporting the steel reinforcement should be located on spreader plates over the flat sheets or edge profiles. This will reduce the risk of accidental penetration of the EPS during the construction phase and any resulting misalignment of the reinforcement within the concrete depth.

Moisture from the ground

9.1.2.27 A DPM must always be installed underneath the insulation layers. All joints and junctions between DPMs, wall DPCs, or tanking in substructure walls should be undamaged, especially while the concrete for the system is being poured.

Interstitial condensation

9.1.2.28 An AVCL must be incorporated to the warm side of the insulation.

9.1.2.29 The risk of interstitial condensation and mould growth must be assessed in accordance with principles of BS 5250 : 2021.

Surface condensation

9.1.2.30 To minimise the risk of condensation at service penetrations, care must be taken to minimise gaps in the insulation layer (for example, by filling with expanding foam insulation).

9.1.2.31 For buildings in England and Wales, floors will adequately limit the risk of surface condensation when the thermal transmittance (U value) does not exceed 0.7 $W \cdot m^{-2} \cdot K^{-1}$ at any point and the junctions with walls are in accordance with the relevant requirements of BRE Information Paper IP 1/06.

9.1.2.32 For buildings in Scotland, floors will adequately limit the risk of surface condensation when the thermal transmittance (u value) does not exceed 1.2 $W \cdot m^{-2} \cdot K^{-1}$ at any point and are designed and constructed to BS 5250 : 2021. Additional guidance can be found in BRE Report BR 262 : 2002.

Junction Ψ values

9.1.2.33 Care must be taken in the overall design and construction of junctions between the floor and external, internal and party walls, to limit excessive heat loss and air infiltration.

9.2 Installation

9.2.1 Installation instructions provided by the Certificate holder were assessed and judged to be appropriate and adequate.

9.2.2 Installation must be carried out in accordance with this Certificate and the Certificate holder's instructions. A summary of instructions and guidance are provided in Annex A.

9.3 Workmanship

9.3.1 Practicability of installation was assessed by the BBA on the basis of the Certificate holder's information. To achieve the performance described in this Certificate, installation of the system must be carried out by a competent general builder, or contractor, experienced with this type of system.

9.4 Maintenance and repair

9.4.1 As the system is installed within the foundation and has suitable durability, maintenance is not required.

10 Manufacture

10.1 The production processes for the system have been assessed, and provide assurance that the quality controls are satisfactory according to the following factors:

10.1.1 The manufacturer has provided documented information on the materials, processes, testing and control factors.

10.1.2 The quality control operated over batches of incoming materials has been assessed and deemed appropriate and adequate.

10.1.3 The quality control procedures and product testing to be undertaken have been assessed and deemed appropriate and adequate.

10.1.4 The process for management of non-conformities has been assessed and deemed appropriate and adequate.

10.1.5 An audit of each production location was undertaken, and it was confirmed that the production process was in accordance with the documented process, and that equipment has been properly tested and calibrated.

†10.2 The BBA has undertaken to review the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control operated by the manufacturer are being maintained.

11 Delivery and site handling

11.1 The Certificate holder stated that the EPS component is delivered to site in packaging bearing the product name, Certificate holder's name, batch number, health and safety information and weight of contents in kilograms.

11.2 The flat sheets and edge profiles are shrink-wrapped in polythene and delivered to site on pallets. Each pack shows the manufacturer's name, grade, type marking and the BBA logo incorporating the number of this Certificate.

11.3 Delivery and site handing must be performed in accordance with the Certificate holder's instructions and this Certificate, including:

11.3.1 The flat sheets and edge profiles must be protected from prolonged exposure to sunlight and should be stored under cover or protected with light-coloured opaque polythene sheets.

11.3.2 Normal precautions for handling EPS components must be taken to avoid damaging them during offloading, storage, handling and installation.

11.3.3 Care must be taken to avoid exposing EPS to solvents or materials containing organic components. In addition, they must not be exposed to open flame or other ignition sources.

11.3.4 The flat sheets and edge profiles must be stored flat, off the ground, on a clean, level surface. In high winds, the products must be stored under cover.

11.3.5 Damaged flat sheets and edge profiles must not be used.

11.3.6 All trained operatives involved with placing, compacting and finishing the concrete must wear appropriate personal protective equipment, eg goggles, impermeable gloves, long-sleeved jackets, full length trousers, boots etc, to avoid direct eyes and skin contact with fresh concrete.

ANNEX A – SUPPLEMENTARY INFORMATION †

Supporting information in this Annex is relevant to the system but has not formed part of the material assessed for the Certificate.

Construction (Design and Management) Regulations 2015
Construction (Design and Management) Regulations (Northern Ireland) 2016

Information in this Certificate may assist the client, designer (including Principal Designer) and contractor (including Principal Contractor) to address their obligations under these Regulations.

CE marking

The Certificate holder has taken the responsibility of CE marking the EPS flat sheets in accordance with harmonised European Standard EN 13163 : 2012.

Management Systems Certification for production

The management system of the manufacturer has been assessed and registered as meeting the requirements of ISO 9001 : 2015 by The British Assessment Bureau (Certificate 215458).

Additional information on installation

Installation must be in accordance with the Certificate holder's instructions and this Certificate. A summary of precautions and ancillary product components is provided below:

A.1 Prior to commencement of the detailed design, a ground investigation must be conducted to assess both the geotechnical and geo-environmental status of the site and its environs. Ground investigations should follow the guidance of BS 5930 : 2015, BS 10175 : 2011, BS EN 1997-2 : 2007 its UK National Annex and *NHBC Standards* 2023 Chapter 4.1 *Land quality – managing ground conditions* and be conducted with results interpreted, and solutions provided by suitably competent persons considering suitability of the underlying soil strata to support the loading imposed from the foundation and any precautions required to suit the geo-environmental conditions with respect to the proposed end use and to ensure adequate durability of the building fabric for its design life.

A.2 Before site preparation, certain investigations must be made, and information to all parties, including:

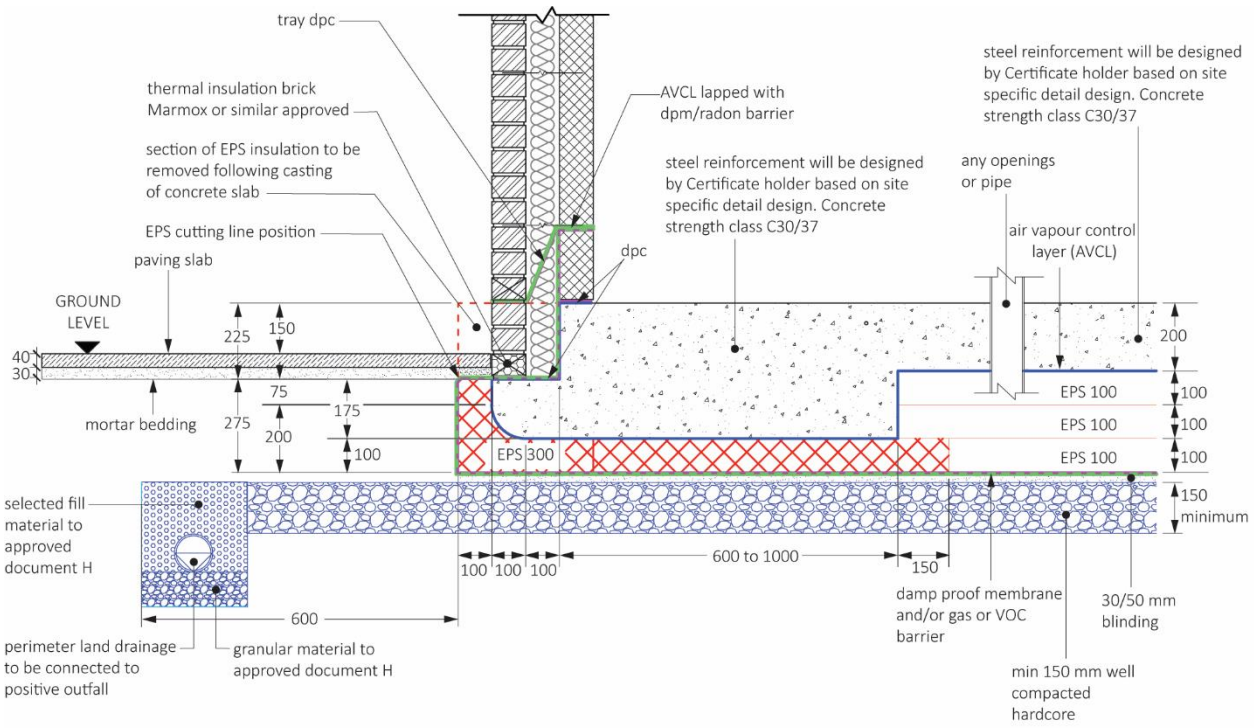
- report on the geo-technical and geo-environmental survey of the ground conditions
- drawing of the foundation layout
- details of the construction above foundation level
- plan of site, giving details of levels
- details of drainage and services
- details of neighbouring trees/shrubs likely to affect ground conditions
- risk of floatation of the EPS due to hydrostatic pressure, before the concrete is poured
- risk associated with construction of raft foundation below the water table level and ensure that the raft foundation can resist against the uplift force due to hydrostatic pressure during construction works before the weight of superstructure is in place.

A.3 The Certificate holder will supply:

- design documents incorporating:
  - specification for the concrete raft foundation including details of construction joints, if required, and specification of the EPS
  - details of steel reinforcement
- list of all EPS components required
- copy of all 'approved for construction' drawings including details.

A.4 Details of typical assemblies for internal and external walls of traditional cavity masonry or timber frame construction are shown in Figures 3 to 6.

Figure 3 Example of external wall detail for traditional cavity masonry

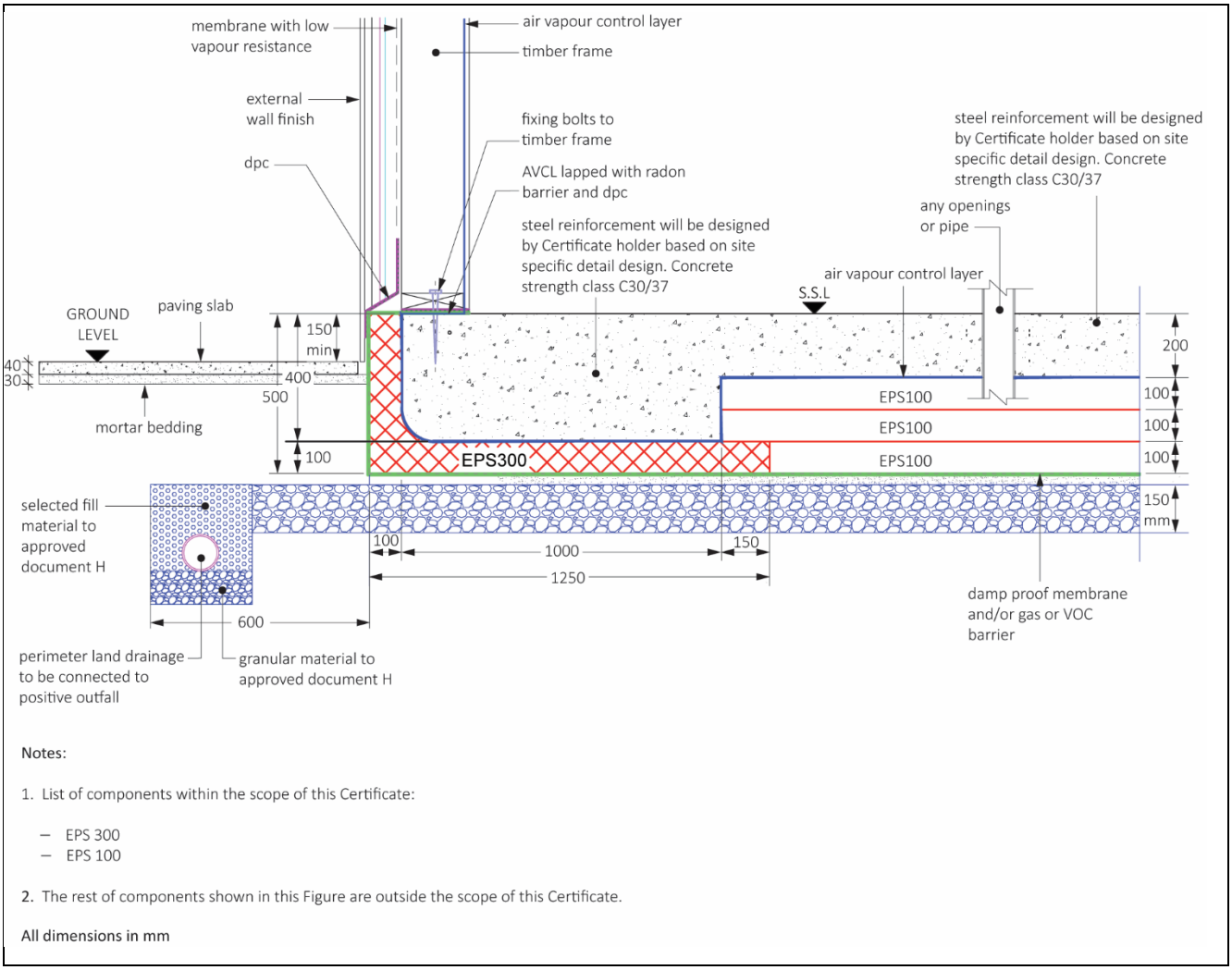


Notes:

1. List of components within the scope of this Certificate:
   - EPS 300
   - EPS 100
2. The rest of components shown in this Figure are outside the scope of this Certificate.

All dimensions in mm

Figure 4 External wall detail for timber frame



Notes:

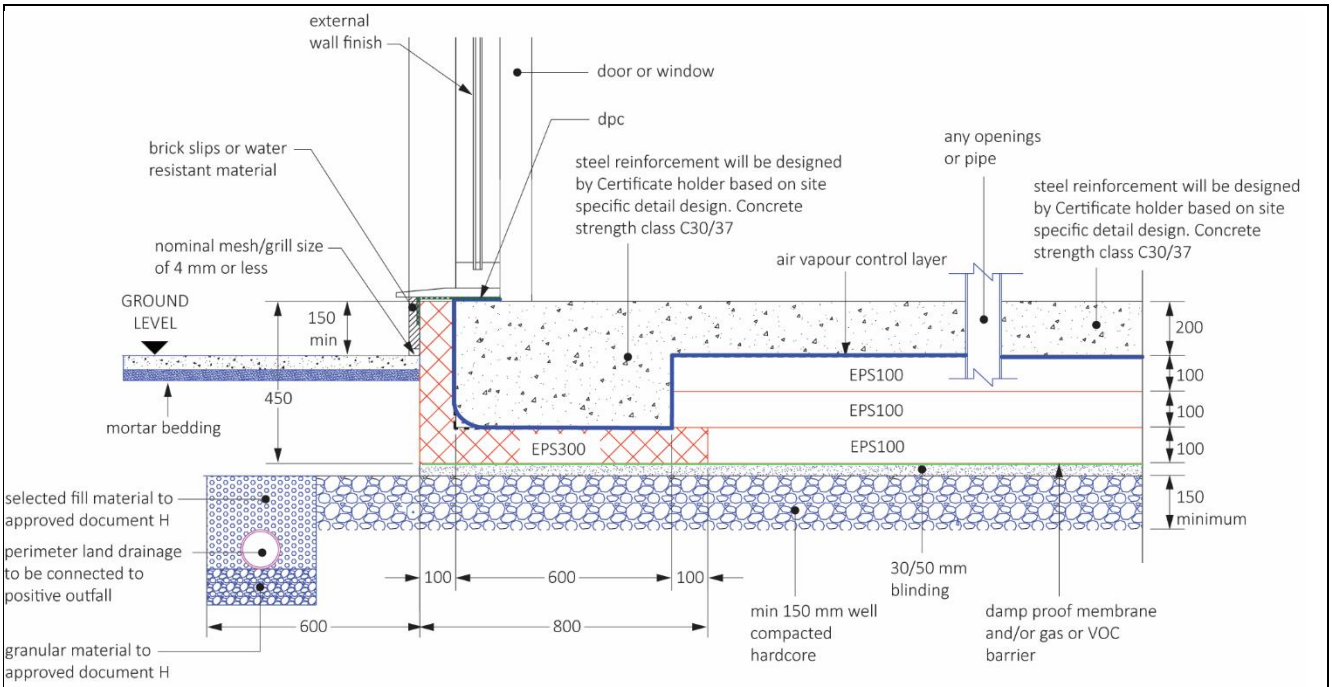
1. List of components within the scope of this Certificate:

   – EPS 300
   – EPS 100

2. The rest of components shown in this Figure are outside the scope of this Certificate.

All dimensions in mm

Figure 5 External wall detail for timber frame at door threshold



Notes:

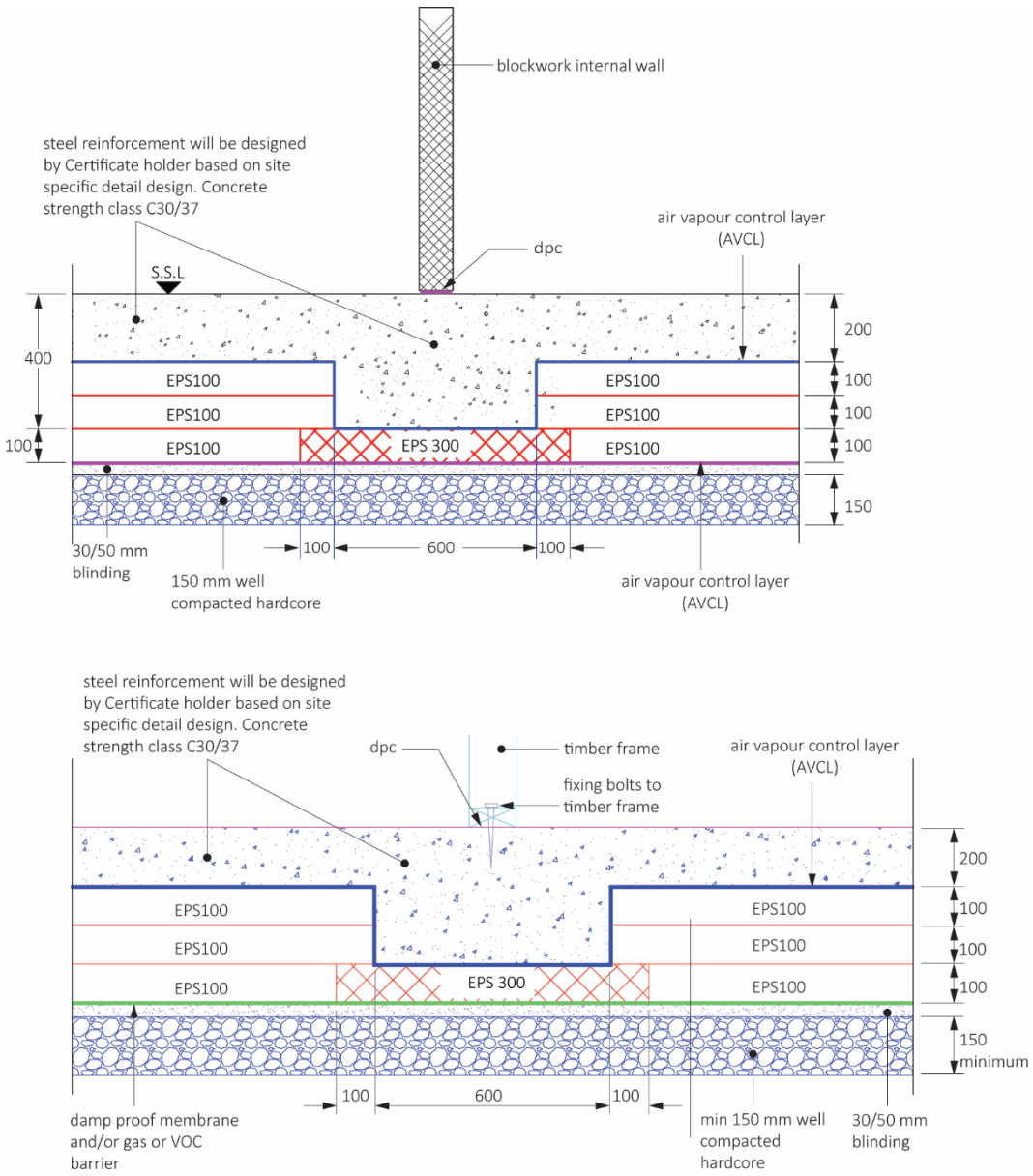
1. List of components within the scope of this Certificate:

   – EPS 300
   – EPS 100

2. The rest of components shown in this Figure are outside the scope of this Certificate.

All dimensions in mm

Figure 6 Internal wall detail for traditional masonry and timber frame



Notes:

1. List of components within the scope of this Certificate:
   - EPS 300
   - EPS 100
2. The rest of components shown in this Figure are outside the scope of this Certificate.

All dimensions in mm

Site preparation

A.5 The area should be excavated to a depth of 600 mm below the projected top level of the slab, ensuring all topsoil, degradable material and soft spots are removed; additional fill may be required to compensate.

A.6 On relatively level sites, the 'setting out' should be undertaken using normal procedures, ensuring that the lines of external and internal beams are accurately placed in accordance with the Certificate holder's 'Construction issue' drawing. On steeply sloping sites, special provisions may need to be made; the advice of the Certificate holder should be sought.

A.7 For the purposes of allowing for 'setting out' and construction tolerances of masonry walls, a foundation 100 mm wider than the wall thickness is required (refer to BS 8103-1 : 2011).

Procedure

A.8 Granular hardcore (150 mm) is placed and compacted as per the requirements of the Manual of Contract Documents for Highway Works (MCHW) Volume 1 Specification for Highway Works, Series 800 Series 800, Specification for Highway Works (Amendment – November 2021 and in order to meet the level tolerance of +10 mm/–20 mm (average –5 mm). Any provision for service pipes, services and drains is made at this stage.

A9 Laser levelling of the granular hardcore layer is carried out to ensure the level and footprint are as per the Certificate holder's drawing.

A.10 30 to 50 mm blinding (fine sand) is spread above the compacted hardcore 150 mm deep (the blinding must be spread 30 mm wider than the outer edge of the concrete for the edge beams).

A.11 A DPM, gas/radon and/or VOC resistant barrier (if required) is laid above the blinding and beneath the flat sheets (first layer insulation); any joints or openings for services must be taped and sealed. The gas resistance barrier membrane must ultimately be sealed to a gas resistant DPC. Ground-bearing concrete floor systems must include a suitable DPM laid beneath the insulation. In addition, an AVCL must be laid above the insulation.

A.12 The edge profiles are placed in position and set level (see stage 1 of Figure 7 of this Certificate). If the level needs adjusting, it should be done by adjusting the sand layer. Three shark's teeth galvanized steel combs are fitted at each edge profile junction to keep the profiles in place.

A.13 The EPS 300 flat sheets corresponding to the position of internal load bearing walls are installed. Two shark's teeth galvanized steel combs are fitted at each flat sheet junction (see stage 6 of Figure 7) and junction between the edge profile and flat sheet (see stage 2 of Figure 7).

A.14 The first layer of flat sheets is laid as per the Certificate holder's drawing (completing the first layer is essential before starting the second and third layers). One shark's teeth galvanized steel comb is fitted at the centre of the edge profile to fix it to the flat sheet (see stage 3 of Figure 7).

A.15 Openings for service pipes are cut on site during this process but all gaps should be completely sealed with expanding foam before the next layer is laid.

A.16 The second layer of flat sheets is laid, forming the first step of the outer external beam as per the design drawings. These sheets must be laid in the opposite direction to the first layer. The flat sheets are fixed using the black pins (8 per flat sheet). If there are internal loadbearing walls, the second layer of EPS must be cut around them (see stage 4 of Figure 7).

A.17 The third layer of flat sheets are laid flush with the second layer to complete the formation of the outer external beam (8 black pins per flat sheet). These sheets must be laid in the opposite direction to the second layer (see stage 5 of Figure 7). Any damaged EPS components must be replaced before pouring the concrete.

A.18 AVCL with third-party approval is laid above the last layer of the flat sheets, the EPS beneath the internal/external beam and edge profiles. The DPC must be lapped to the DPM at the edge detail.

A.19 If steel reinforcement is specified, spacers should be positioned over spreader plates (minimum four per m^2 and minimum size 50 by 50 mm). These should be installed so as to position the steel reinforcement at the correct level.

A.20 All dimensions and levels are checked, ensuring all fixings are completed and any debris removed prior to the concrete being poured.

A.21 Services and drainage entries must be positioned and installed accurately; errors will be difficult to rectify after the concrete has been cast. Services should be sleeved and future access must be obtained without affecting structural stability. Drainpipes require flexible connections or other means of accommodating differential settlement. Particular care must be taken when installing the drainpipe to ensure the EPS components are not damaged.

A.22 A bullnose trowel is used to finish the surface of the concrete.

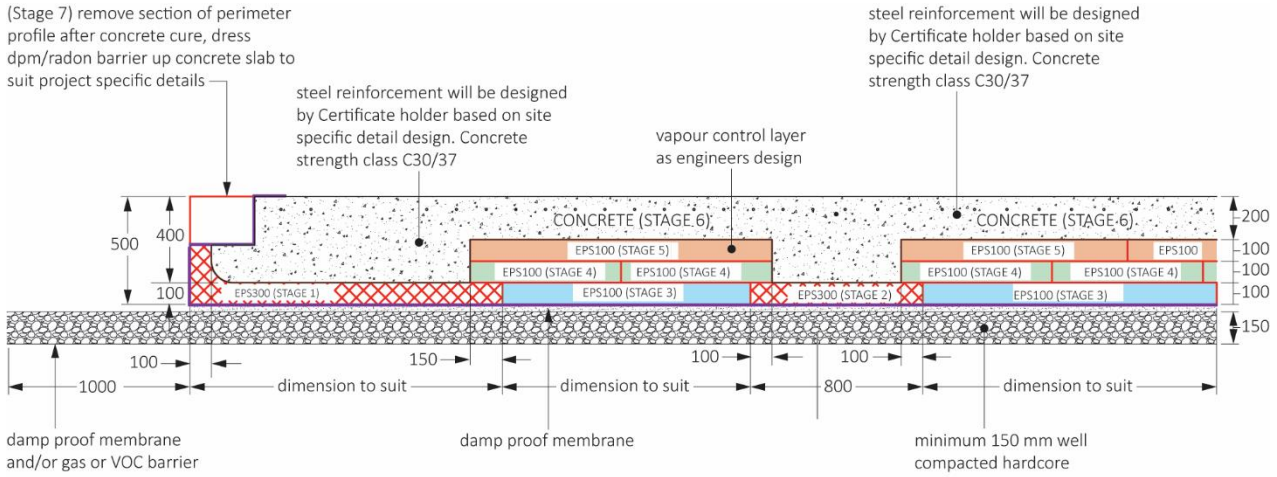
A.23 The following good practice should be taken into account throughout the installation process:

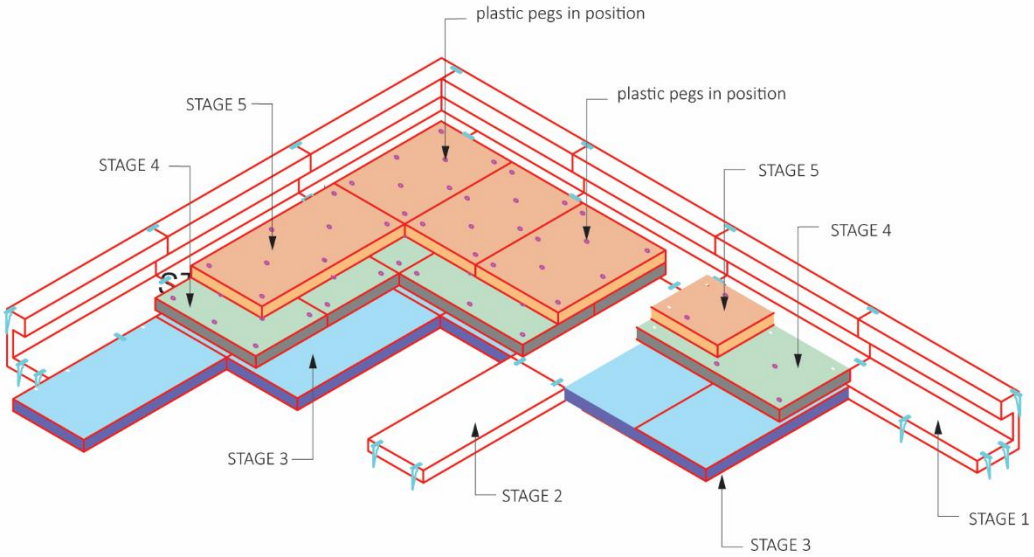
- cube compressive strength and slump tests for concrete are carried out
- limitation of consistency class for standard concrete
- concrete not to be poured below 5°C
- maximum temperature at which the concrete should be placed is 30°C and decreasing
- concrete not to be poured during rainfall.

A.24 To prevent shrinkage cracks:

- avoid the use of high shrinkage potential aggregate
- the w/c ratio should not be increased beyond the limits specified in BS 8500-1 : 2023 : 2019, BS 8500-2 : 2023 and BS EN 206 : 2013 : 2021
- steel reinforcement mesh or loose bars should be placed across re-entrant corners and any openings greater than 500 x 500 mm.

Figure 7 Future Found Foundation System – Construction stages 1 to 7





STAGE 6 - (Formwork now completed)- Casting of concrete slab
STAGE 7 - Removal of section of perimeter EPS300 profile above cutting line

Notes:

1. List of components within the scope of this Certificate:
   - EPS 300
   - EPS 100
2. The rest of components shown in this Figure are outside the scope of this Certificate.

All dimensions in mm

A.25 Ground-supported floor slabs/rafts in zones subject to clay heave - see sections A.26 and A.27, using the procedure described in *NHBC Standards* 2023, *Part 4,* Chapter 4.2 as shown below:

- the fill material below the concrete must be a stone fill material
- when building near trees in shrinkable soils, the installation may be designed and constructed using the procedures described in *NHBC Standards* 2023, Part 4, Chapter 4.2, provided the proposal complies with the acceptance criteria stated in detail in Clauses 4.2.8 and 4.2.9 which have a requirement for the:
  - depth of a traditional foundation derived in accordance with NHBC procedures, to be less than 2.5 m
  - raft to be founded on granular fill and compacted in layers
  - granular infill to be at least 50% of the foundation depth, and no more than 1.25 m deep
  - granular infill to extend by a distance equal to its natural angle of repose plus 500 mm, beyond the face of the raft.

A.26 The concrete should be in accordance with principles of BS 8500-1 : 2023, BS 8500-2 : 2023 and BS EN 206 : 2013 : 2021, manufactured in plants covered by the QSRMC or BSI scheme and laid by personnel with the appropriate skills and experience.

A.27 The floor must not be loaded by construction materials until the reinforced concrete has fully cured and the magnitude of loads must not exceed the design load of the foundation system.

Bibliography

BS 4483 : 2005 *Steel fabric for the reinforcement of concrete — Specification*

BS 5250 : 2021 *Code of practice for control of condensation in buildings*

BS 5930 : 2015 + A1 : 2020 *Code of practice for ground investigations*

BS 8103-1 : 2011 *Structural design of low-rise buildings — Code of practice for stability, site investigation, foundations, precast concrete floors and ground floor slabs for housing*

BS 8500-1:2023 Concrete. Complementary British Standard to BS EN 206 - Method of specifying and guidance for the specifier

BS8500-2:2023 Concrete Complementary *guidance to BS EN 206 - Specification for constituent materials and concrete*

BS 8666 : 2020 *Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete — Specification*

BS 10175 : 2011 + A2 : 2017 *Investigation of potentially contaminated sites — Code of practice*

BS EN 197-1 : 2011 *Cement - Composition, specifications and conformity criteria for common cements*

BS EN 206 : 2013 + A2 : 2021 *Concrete — Specification, performance, production and conformity*

BS EN 934-2 : 2009 + A1 : 2012 *Admixtures for concrete, mortar and grout. Concrete admixtures. Definitions, requirements, conformity, marking and labelling*

BS EN 826 : 2013 *Thermal insulating products for building applications – Determination of compression behaviour*

BS EN 1990 : 2002 + A1 : 2005 Eurocode : *Basis of structural design*
NA to BS EN 1990 : 2002 + A1 : 2005 UK National Annex to Eurocode : *Basis of structural design*

BS EN 1991-1-1 : 2002 Eurocode 1 *: Actions on structures — General Actions — Densities, self-weight, imposed loads for buildings*
NA to BS EN 1991-1-1 : 2002 UK National Annex to Eurocode 1 *: Actions on structures — General Actions — Densities, self-weight, imposed loads for buildings*
BS EN 1991-1-3 : 2003 + A1 : 2015 Eurocode 1 : *Actions on structures – General actions – Snow loads*
NA + A2 : 18 to BS EN 1991-1-3 : 2003 + A1 : 2015 Eurocode 1 : *Actions on structures – General actions – Snow loads*
BS EN 1991-1-4 : 2005 + A1 : 2010 Eurocode 1 : *Actions on structures – General actions – Wind actions*
NA to BS EN 1991-1-4 : 2005 + A1 : 2010 Eurocode 1 : *Actions on structures – General actions – Wind actions*
BS EN 1991-1-6 : 2005 Eurocode 1 : *Actions on structures – General actions – Actions during execution*
NA to BS EN 1991-1-6 : 2005 Eurocode 1 : *Actions on structures – General actions – Actions during execution*
BS EN 1991-1-7 : 2006 + A1 : 2014 Eurocode 1 : *Actions on structures – General actions – Accidental actions*
NA to BS EN 1991-1-7 : 2006 + A1 : 2014 Eurocode 1 : *Actions on structures – General actions – Accidental actions*

BS EN 1992-1-1 : 2004 + A1 : 2014 Eurocode 2 : *Design of concrete structures — General rules and rules for buildings*
NA to BS EN 1992-1-1 : 2004 + A1 : 2014 UK National Annex to Eurocode 2 : *Design of concrete structures — General rules and rules for buildings*

BS EN 1997-1 : 2004 Eurocode 7 : *Geotechnical design — Part 1: General rules*
NA to BS EN 1997-1 : 2004 Eurocode 7 : *Geotechnical design — Part 1: General rules*
BS EN 1997-2 : 2007 Eurocode 7 : *Geotechnical design — Part 2: Ground investigation and testing*
NA to BS EN 1997-2 : 2007 Eurocode 7 : *Geotechnical design — Part 2: Ground investigation and testing*

BS EN 12620 : 2002 + A1 : 2008 *Aggregates for concrete*

BS EN 13163 : 2012 + A2 : 2016 *Thermal insulation products for buildings — Factory made expanded polystyrene (EPS) products — Specification*

BS EN ISO 10211 : 2017 *Thermal bridges in building construction — Heat flows and surface temperatures — Detailed calculations*

BS EN ISO 13370 : 2017 *Thermal performance of buildings — Heat transfer via the ground — Calculation methods*

BS EN ISO 10456 : 2007 *Building materials and products – Hygrothermal properties – Tabulated design values and procedures for determining declared and design thermal values*

BRE Information paper IP 1/06 *Assessing the effects of thermal bridging at junctions and around openings*

BRE Report BR 262 : 2002 *Thermal insulation : avoiding risks*

BRE Report BR 443 : 2019 *Conventions for U-value calculations*

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

ISO 9001 : 2015 *Quality management systems — Requirements*

Manual of Contract Documents for Highway Works (MCHW) *Series 800* - Volume 1 *specification for Highway Works* – Amendment – November 2021

Conditions

1 This Certificate:

- relates only to the product that is named and described on the front page
- is issued only to the company, firm, organisation or person named on the front page – no other company, firm, organisation or person may hold or claim that this Certificate has been issued to them
- is valid only within the UK
- has to be read, considered and used as a whole document – it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English Law.

2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

3 This Certificate will be displayed on the BBA website, and the Certificate Holder is entitled to use the Certificate and Certificate logo, provided that the product and its manufacture and/or fabrication, including all related and relevant parts and processes thereof:

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate.

4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

5 In issuing this Certificate the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product or any other product
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product
- actual installations of the product, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product, including its manufacture, supply, installation, use, maintenance and removal
- any claims by the manufacturer relating to UKCA marking and CE marking.

6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product which is contained or referred to in this Certificate is the minimum required to be met when the product is manufactured, supplied, installed, used, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care.

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