

Site: Fairfield Road, Droylsden
Plots: Ground Floor of Apartment Block (Plots 1-9) & Plots 37-62
Date: 23rd November 2023
LKC Ref.: CL-602-LKC 20 1791-02 Plots 1-9 & 37-62 R1



GAS MEMBRANE VALIDATION REPORT

1 INTRODUCTION

LK Consult (LKC) has been appointed by J Greenwood (Builders) Ltd to carry out on-construction validation work at Fairfield Road, Droylsden. This work has been undertaken to allow discharge of planning conditions associated with the redevelopment of the site for residential end use. This validation report concerns the validation of gas membranes installed in the ground floor of the apartment block (including Plots 1-9, corridors and lift pit) and Plots 37-62. Plots 1-9 are apartments located on the ground floor of the apartment block situated in the north east of the site. Plots 37-62 are semi-detached houses. A site layout plan is provided in Appendix A.

The requirement for remedial works across the site arose as a result of previous site investigations and risk assessments carried out by LKC (ref. CL-602-LKC 19 1024-02 R3, dated March 2022 and CL-602-LKC 20 1761-01 R1, dated March 2022).

The following was recommended with regards to gas protection measures:

- Proposed type A building with a point score of 3.5 to be achieved by:
 - Gas resistant membrane (2 points) and;
 - Passive sub-floor dispersal via clear void with telescopic vents.
- Protection measures installation validated by a suitably qualified independent consultant.

2 GAS PROTECTION MEASURES

Gas protection measures have been installed in the ground floor of the apartment block (including Plots 1-9, corridors and lift pit) and in the semi-detached houses (Plots 37-62).

The membrane specification is presented in Appendix B. The type of membrane installed in all plots is Visqueen Gas Barrier. Keytec 400 HP Gas Barrier was installed in the lift pit of the apartment block.

LKC attended site on the following dates to verify the presence of clear sub-floor voids and for gas membrane validations:

- 5th February 2021 – gas membrane inspection of lift pit within apartment block.
- 17th March 2021 – verify presence of clear sub-floor voids on Plots 49-60.
- 15th April 2022 – verify presence of clear sub-floor voids on ground floor of apartment block.
- 25th June 2021 - verify presence of clear sub-floor voids on Plots 45-48.
- 27th July 2021 - verify presence of clear sub-floor voids on Plots 37-44.
- 18th August 2021 - gas membrane inspection of Plots 49-60.
- 31st August 2021 - gas membrane inspection of Plots 1-9 (excluding Plot 8 and corridor) in apartment block.

- 22nd September 2021 – gas membrane inspection of Plot 8 and corridor in apartment block.
- 11th November 2021 - verify presence of clear sub-floor voids on Plots 61-62.
- 7th February 2022 - gas membrane inspection of Plots 45-48.
- 24th March 2022 - gas membrane inspection of Plots 37-44.
- 27th May 2022 - gas membrane inspection of Plots 61-62.

The inspections noted the following:

- Membrane in lift pit inspected and appropriately sealed.
- Passively vented sub-floor void.
- Air bricks and telescopic vents were present and appropriately spaced.
- Sufficient membrane overlap had been provided (minimum 150mm).
- The membrane was sealed to the DPC (with minimum 150mm overlap), which was continuous through the cavity wall to the external brickwork.
- The service penetrations were sealed with appropriate tape and/or top hats.
- There were no visible rips or tears. No potential puncture points from the underlying slab were noted.

Photographic evidence of gas membranes is provided in Appendix C.

3 CONCLUSIONS

LKC has completed the validation of the gas membranes installed in the ground floor of the apartment block (including Plots 1-9, corridors and lift pit) and Plots 37-62 at Fairfield Road, Droylsden and conclude that they have been installed to a suitable standard and are in line with the remedial requirements.

Report Prepared By:

Report Reviewed By:

**Ella Mcleod
Geo-Environmental Consultant**

**Catherine Baranek
Associate Director**

Enc:

**Appendix A: Site Layout Plan
Appendix B: Gas Membrane Specification
Appendix C: Gas Membrane Photographs**

Disclaimer

This report has been prepared by LKC who have exercised such professional skill, care and diligence as may reasonably be expected of a properly qualified and competent consultant experienced in preparing reports of a similar scope. However, to the extent that the report is based on or relies upon information contained in records, reports or other materials provided to LKC which have not been independently produced or verified, LKC gives no warranty, representation or assurance as to the accuracy or completeness of such information.

This report is issued on the condition that LKC will not be held liable for any loss arising from ground conditions between sampling points (i.e. boreholes/trial pits/hand augers/surface samples) which have not been shown by the sampling points or related testing carried out during the investigation, nor for any loss arising from conditions below the maximum depth of the investigation, or for any works done to the garden areas following the date of inspection. Opinions on such conditions, where given, are for general guidance only.

Other works including *inter alia* hotspot removal, drainage, soil texture, permitting, invasive species management and geotechnical requirements are out with this scope and should be dealt with by others.

This report is prepared solely for the benefit of J Greenwood (Builders) Ltd. It may not be relied upon by, or submitted to a third party for their reliance for the purposes of valuation, mortgage, insurance and regulatory approval, until all invoices have been settled in full. Those using this information in subsequent assessments or evaluations do so at their own risk.

Appendix A – Site Layout Plan



KEY

Site Boundary

Accommodation Schedule

1-bed, 2-person apartments over 4 storeys:
36no. apartments @ 50sqm

3-bed, 5/6-person houses over 3 storeys:
26no. semi-detached houses @ 105sqm
(excluding undercroft hardstanding)

Total Units: 62no

Sampling Locations and features annotated by LK Consult Ltd are approximate and are based upon observed measurements unless otherwise stated. Do not scale from this drawing and work from marked dimensions only. All dimensions and features should be confirmed on site by the Contractor. Where this drawing includes information provided to LK Consult Ltd by others, LK Consult Ltd gives no warranty, representation or assurance as to the accuracy of such information.



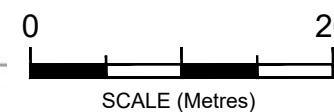
Client:
J Greenwood (Builders) Ltd

Site:
Fairfield Road, Droylsden

Title:
Proposed Development Plan

Job No. LKC 20 1761	Scale (See Scale Bar): 1:500 @ A3	Figure: 3	Revision:
Drawn By: AC	Checked By: EM	Drawn: Jul 2023	

Extract from: NC Architecture
Drawing Ref: Proposed Site Plan, No.P-001, Rev:14 (November 2020)



Appendix B – Gas Membrane Specification

Visqueen Gas Barrier

Features and benefits

- BBA certified - third party accreditation
- Complies with BS 8485:2015 + A1:2019 - industry standard for methane and carbon dioxide protection
- Flexible - easy to detail and install on site
- Multi functional - also acts as a radon and damp proof membrane
- Dual jointing methods - lap joints can be taped or heat welded

Product description

Visqueen Gas Barrier is a multi-layer reinforced polyethylene gas barrier with a 20 micron aluminium foil. The barrier is coloured blue on the upper surface and silver on the reverse. The product is supplied in single wound rolls (not folded), 2m x 50m.

Approvals and standards

- Third party accreditation (BBA 13/5069)
- Conforms to the specification requirements of BS 8485:2015 + A1:2019
- Suitable for all Characteristic Gas Situation (CS) ground gas regimes
- Conforms to the specification requirements of NHBC Amber 1 and Amber 2 applications
- Conforms to the specification requirements of BR 211:2015
- CE Mark EN 13967:2017
- Quality Management System ISO 9001:2015
- Occupational Health and Safety System ISO 45001:2018
- Environmental Management System ISO 14001:2015

Usage

Visqueen Gas Barrier is suitable for use in all types of buildings to prevent the ingress of harmful levels of ground gases e.g. methane, carbon dioxide and radon.

The barrier can be positioned above or below a solid concrete ground floor slab or above a precast suspended segmental ground floor system, e.g. beam and block floor.

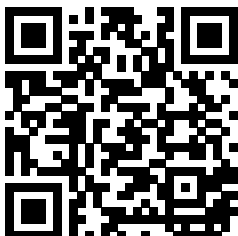
The barrier can also be used as a high performance radon membrane and/or damp proof membrane.

The product is not intended for use where there is a risk of hydrostatic pressure.

System components

- VisqueenPro Double Sided Jointing Tape, 50mm x 10m
- Visqueen Gas Resistant Foil Lap Tape, 75mm x 50m
- Visqueen GR Lap Tape, 150mm x 10m
- Visqueen Ultimate Top Hat Units
- Visqueen Preformed Units
- VisqueenPro Detailing Strip, 300mm x 10m, 500mm x 10m
- Visqueen TreadGUARD 300, 2m x 75m
- Visqueen TreadGUARD 1500, 1m x 2m

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Visqueen Gas Barrier

Storage and handling

Visqueen Gas Barrier should be stored horizontally, under cover in its original packaging.

Care should be taken when handling the product in line with current manual handling regulations.

Preparation

Visqueen Gas Barrier should be installed on a smooth continuous surface e.g. grouted beam and block floor, a compacted blinding layer e.g. 50mm thick sand blinding, or smooth concrete blinding. The substrate should be free from irregularities such as voids or protrusions.

The barrier can be cut with a sharp retractable safety knife or robust scissors.

When installing the membrane in demanding site conditions, use Visqueen GR Lap Tape in place of Visqueen Gas Resistant Foil Lap Tape.

Installation

Visqueen Gas Barrier should be loose laid on the substrate with the blue side up so as to avoid sunlight glare.

The barrier should be clean and dry at the time of jointing. It should be overlapped by at least 150mm, bonded with Visqueen Pro Double Sided Jointing Tape and sealed with Visqueen Gas Resistant Foil Lap Tape.

Alternatively lap joints can be heat welded to achieve an effective seal. Welded lap joints can be less than 150mm provided the joint integrity is not compromised.

Airtight seals should be formed around all service entry points. Visqueen Preformed Top Hat Units should be used for sealing service entry pipes. The base of the top hat and the upstand should be bonded using Visqueen Pro Double Sided Jointing Tape and sealed with Visqueen Gas Resistant Foil Lap Tape. The upstand should be secured with the supplied jubilee clip.

Forming an effective barrier to gases may give rise to complex three-dimensional detailing where, it is recommended Visqueen Preformed Units are used e.g. corners. Alternatively Visqueen Pro Detailing Strip can be used to seal awkward junctions.

If the barrier is punctured or perforated a patch of the same material should be lapped at least 150mm beyond the limits of the puncture and bonded with Visqueen Pro Double Sided Jointing Tape and sealed with Visqueen Gas Resistant Foil Lap Tape. Alternatively a patch can be formed using Visqueen Pro Detailing Strip and lapped at least 150mm beyond the extents of the puncture.

Long periods of exposure to ultraviolet light will reduce the effectiveness of the membrane. The membrane should be covered by a protective layer immediately after installation to prevent damage from following trades, ultraviolet light, etc. Care should be taken to ensure that the membrane is not punctured, stretched or displaced when applying a screed or final floor covering. A minimum thickness of 50mm screed is recommended. When reinforced concrete is to be laid over the barrier the wire reinforcements and spacers must be prevented from puncturing the barrier. Where there is a high risk of potential damage, the barrier should be covered with Visqueen TreadGuard protection, screed, or other approved protection material before positioning the reinforcement.

Usable temperature range

It is recommended that Visqueen Gas Barrier and all associated system components should not be installed below 5°C.

Additional information

When used in accordance BS8485:2015 + A1:2019 a subfloor ventilation system or pressure relief maybe required

Where hydrocarbon or VOC contamination is present use Visqueen Ultimate VOC or HC Blok gas protection systems

To assist build sequencing, Visqueen GR DPC is available for gas protection through the wall constructions

For suspended beam and block floor detailing see GB-01

Visqueen Preformed Top Hat Units should be used at service pipe penetrations see GB-51

For internal and external corners Visqueen Ultimate Preformed Units should be used see PFU-553

To seal around steel columns use Visqueen Pro Detailing Strip see GB-52

For additional detailing information, contact Visqueen Technical Services +44 (0) 333 202 6800

The information in this datasheet was correct at the time of publication. It is the user's responsibility to obtain the latest version of the datasheet as it is updated on a regular basis. The information contained in the latest datasheet supersedes all previously published editions.

Visqueen Gas Barrier

Property	Test method	Units	Compliance criteria	Result
Dimensions	EN 1848-2	m		2 x 50
Overall thickness including scrim mesh	EN 1849-2	mm	+/-10%	0.52
Mass	EN 1849-2	g/m ²	-0%/+5%	400
Tensile strength - MD	EN 12311	N	MLV	350
Tensile strength - CD	EN 12311	N	MLV	350
Tensile elongation - MD	EN 12311	%	MLV	20
Tensile elongation - CD	EN 12311	%	MLV	21
Joint strength	EN 12317-2	N	MLV	332
Watertightness 2kPa	EN 1928	-	Pass/Fail	Pass
Resistance to impact	EN 12691	mm	MDV	150
Dart impact	BS 2782	g	MDV	731
Low temperature flexibility	EN 495-5	°C	MDV	-40
Durability against ageing	EN 1296 and EN 1928	-	Pass/Fail	Pass
Durability chemical resistance	EN 1847	-	Pass/Fail	Pass
Resistance to tearing (nail shank) CD	EN 12310-1	N	MDV	358
Resistance to tearing (nail shank) MD	EN 12310-1	N	MDV	368
Resistance to static loading	EN 12730	kg	MLV	20
Water vapour transmission - resistance	EN 1931	MNs/g	MDV	7000
Water vapour transmission - permeability	EN 1931	g/m ² /d	MDV	0.03
Visible defects	EN 1850 -2	-	Pass/Fail	Pass
Reaction to fire	EN 13501-1	Class	MDV	F
BS 8485:2015 + A1:2019 testing requirements				
Mass	EN 1849-2	g/m ²	Average >370	400
Methane permeability	ISO 15105-1	mls/m ² /d/atm	Pass/Fail	<0.15
Puncture CBR	BS EN ISO 12236	N	MDV	1114
Tensiles yield strength MD	ASTM D4885-01	kN/m	MDV	12.5
Tensiles yield strength CD	ASTM D4885-02	kN/m	MDV	7.3
Resistance to static loading	EN 12730	kg	>MLV	20
Yield elongation CD	ASTM D4885-04	%	MDV	19
Tear resistance - trouser method A - MD	BS ISO 34-1	kN/m	MDV	48.2
Tear resistance - trouser method A - CD	BS ISO 34-1	kN/m	MDV	44.8
Tear resistance - angle method B - MD	BS ISO 34-1	N	MDV	53.5
Tear resistance - angle method B - CD	BS ISO 34-1	N	MDV	60.6

Health and safety information

Refer to the Visqueen Gas Barrier material safety datasheet (MSDS).

Visqueen Gas Barrier

About Visqueen

The Visqueen name has long been recognised as one of the leading manufacturers of high quality advanced membrane technologies and design based solutions by specifiers, distributors, builders merchants and contractors throughout the UK and Europe.

For further guidance on the Visqueen services shown below, please refer to the relevant section of the Visqueen website (www.visqueen.com) or contact Visqueen Technical Services on +44 (0) 333 202 6800 or enquiries@visqueen.com

Complete Range, Complete Solution



Structural
Waterproofing



Gas
Protection



Damp Proof
Membrane



Tapes



Damp Proof
Course



Stormwater



Vapour
Control

Visqueen Technical Support

Visqueen combine an extensive product portfolio with industry leading levels of service and support which includes guidance over the phone, bespoke CAD drawings to help with complex detailing, electronic NBS specifications and access to a dedicated team of highly knowledgeable and experienced field based Technical Support Managers.

Visqueen Technical Support is available to all our customers including architects, specifiers, distributors, builders merchants, contractors and end users. All of our technical team have been awarded the industry recognised qualification Certificated Surveyor in Structural Waterproofing (CSSW).

Visqueen CPD Seminars

The Visqueen Continuing Professional Development (CPD) Seminars provide up-to-date information on changes within Building Regulations/Building Standards and nationally recognised industry guidance affecting damp proofing, water vapour control, hazardous ground gas protection and below ground structural waterproofing.

The one hour seminars have been produced for design specialists within the construction sector and are delivered by our team of Technical Support Managers.

Visqueen PI designs and special projects

From initial design to the completed project, Visqueen are with you every step of the way. Whether it be hazardous ground gas protection and/or below ground waterproofing protection employing barrier, structurally integral or drained systems, Visqueen can offer professional indemnity (PI) insurance for bespoke Visqueen design solutions.

Visqueen Technical Support Managers work with all stakeholders to provide cost effective Visqueen solutions offering complete peace of mind throughout the construction phase and beyond.

Visqueen Training Academy

Based at our manufacturing facility in Derbyshire, the Visqueen Training Academy is available to support Visqueen customers throughout the UK by providing a wide range of both theory and practical skills related training.

Courses include one day product awareness training for our distributors and builders merchants to help them in their day-to-day jobs, through to intensive three day courses giving detailed hands-on training in the practical skills required for safe and robust product installation.

Keytec Geomembranes Ltd

Unit 6 Plover Close
Newport Pagnell
Milton Keynes MK16 9PS

Tel: 01908 617269

e-mail: info@keytec.co.uk

website: www.keytec.co.uk



Agrement Certificate

20/5815

Product Sheet 1

KEYTEC GAS-RESISTANT MEMBRANE

KEYTEC 400 HP GAS BARRIER

This Agrément Certificate Product Sheet⁽¹⁾ relates to Keytec 400 HP Gas Barrier, for use as a low-density polyethylene (LDPE) gas barrier and damp-proof membrane in concrete ground floors, above and below the slab not subject to hydrostatic pressure, to protect the building against moisture, radon, methane and carbon dioxide from the ground.

(1) Hereinafter referred to as 'Certificate'.

CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.



KEY FACTORS ASSESSED

Resistance to water and water vapour — the membrane provides an effective barrier to the passage of liquid water and water vapour from the ground (see section 6).

Resistance to underground gases — the membrane is capable of restricting the ingress of radon, methane and carbon dioxide into the building (see section 7).

Resistance to puncture — the membrane has a high resistance to puncture and on a smooth or blinded surface will not be damaged by foot or site traffic (see section 8).

Durability — under normal service conditions, the membrane will remain effective against the ingress of water and water vapour, and will restrict the ingress of radon, methane and carbon dioxide during the lifetime of the flooring construction in which it is installed (see section 12).



The BBA has awarded this Certificate to the company named above for the product described herein. This product 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 First issue: 4 November 2020

Hardy Giesler
Chief Executive Officer

The BBA is a UKAS accredited certification body – Number 113.

The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at www.bbacerts.co.uk

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

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

British Board of Agrément

Bucknalls Lane
Watford
Herts WD25 9BA

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tel: 01923 665300
clientservices@bbacerts.co.uk
www.bbacerts.co.uk

Regulations

In the opinion of the BBA, Keytec 400 HP Gas Barrier, 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 presence of a UK map indicates that the subject is related to the Building Regulations in the region or regions of the UK depicted):



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

Requirement:	C1(2)	Site preparation and resistance to contaminants
Comment:		When properly installed in a correctly designed structure, the membrane forms an effective barrier to radon, methane and carbon dioxide, enabling compliance with this Requirement. See section 7.1 of this Certificate.
Requirement:	C2(a)	Resistance to moisture
Comment:		When properly installed in a correctly designed structure, the membrane forms an effective barrier to the movement of water within the ground floor slab, enabling compliance with this Requirement. See sections 6.1 and 6.2 of this Certificate.
Regulation:	7(1)	Materials and workmanship
Comment:		The membrane is an acceptable material. See section 12.1 and the <i>Installation</i> part of this Certificate.



The Building (Scotland) Regulations 2004 (as amended)

Regulation:	8(1)	Durability, workmanship and fitness of materials
Comment:		The membrane can contribute to a construction satisfying this Regulation. See section 12.1 and the <i>Installation</i> part of this Certificate.
Regulation:	9	Building standards applicable to construction
Standard:	3.1	Site preparation – harmful and dangerous substances
Standard:	3.2	Site preparation – protection from radon gas
Comment:		The membrane will enable a floor to satisfy the requirements of these Standards, with reference to clauses 3.1.2 ⁽¹⁾⁽²⁾ , 3.1.6 ⁽¹⁾⁽²⁾ , 3.1.7 ⁽¹⁾⁽²⁾ , 3.1.8 ⁽¹⁾⁽²⁾ , 3.2.1 ⁽²⁾ and 3.2.2 ⁽¹⁾⁽²⁾ . See section 7.1 of this Certificate.
Standard:	3.4	Moisture from the ground
Comment:		When properly installed in a correctly designed structure, the membrane forms an effective barrier to the movement of water within the ground floor slab, enabling compliance with this Standard, with reference to clauses 3.4.2 ⁽¹⁾⁽²⁾ , 3.4.4 ⁽¹⁾⁽²⁾ and 3.4.6 ⁽¹⁾⁽²⁾ . See sections 6.1 and 6.2 of this Certificate.
Standard:	7.1(a)	Statement of sustainability
Comment:		The membrane can contribute to meeting 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.
Regulation:	12	Building standards applicable to conversions
Comment:		Comments in relation to the product under Regulation 9, Standards 1 to 6 also apply to this Regulation, with reference to clause 0.12.1 ⁽¹⁾⁽²⁾ and Schedule 6 ⁽¹⁾⁽²⁾ .

(1) Technical Handbook (Domestic).

(2) Technical Handbook (Non-Domestic).



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

Regulation:	23(a)(i)	Fitness of materials and workmanship
Comment:	(iii)(b)(i)	The membrane is acceptable. See section 12.1 and the <i>Installation</i> part of this Certificate.
Regulation:	26	Site preparation and resistance to contaminants
Comment:		When properly installed in a correctly designed structure, the membrane forms an effective barrier to radon, methane and carbon dioxide enabling compliance with this Regulation. See section 7.1 of this Certificate.
Regulation:	28(a)	Resistance to moisture and weather
Comment:		When properly installed in a correctly designed structure, the membrane forms an effective barrier to the movement of water within the ground floor slab, enabling compliance with this Regulation. See sections 6.1 and 6.2 of this 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.

See section: 1 *Description* (1.2) of this Certificate.

Additional Information

NHBC Standards 2020

In the opinion of the BBA, Keytec 400 HP Gas Barrier, 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 4.1 *Land quality – managing ground conditions* and 5.1 *Substructure and ground bearing floors*.

CE marking

The Certificate holder has taken the responsibility of CE marking the product, in accordance with harmonised European Standard BS EN 13967 : 2012.

Technical Specification

1 Description

1.1 Keytec 400 HP Gas Barrier is a multilayer, LDPE membrane, reinforced with a polypropylene reinforcing grid with an integral aluminium foil.

1.2 The membrane has the following nominal characteristics:

Thickness (mm)	0.6 (including reinforcement scrim)
Effective thickness (mm)	0.4 (measured between the reinforcement scrim)
Roll length (m)	various
Roll width (m)	various
Mass per unit area (g·m ⁻²)	370
Tensile strength (N·50 mm ⁻¹)	
Machine direction	600
Cross direction	480
Elongation (%)	
Machine direction	20
Cross direction	20

Nail tear resistance (N)	
Machine direction	330
Cross direction	400
Watertightness	pass
Colour	
upper surface	various
lower surface	various.

1.3 Ancillary products for use with the membrane include:

- Keytec Butyl Tape or Keytec Bitumen Tape — for securing laps and joints
- Keytec Jointing Tape — for securing laps and joints.

1.4 Ancillary products for use with the membrane, but outside the scope of this Certificate, include:

- Keytec 400 HP Top Hats — to seal around entry points to the membrane
- Keytec Internal Corner Cloaks — prefabricated corner details
- Keytec External Corner Cloaks — prefabricated corner details
- Keytec Primer — used to provide adhesion for application of bitumen enhanced geomembranes
- Keytec Void Vent 25 — cusped high-density polyethylene (HDPE) drainage core with a non-woven polypropylene geotextile separator/filter bonded to one side
- Keytec Void Vent 40 — cusped HDPE drainage core with a non-woven polypropylene geotextile separator/filter bonded to one side
- Keytec Protection Fleece — to form a protective layer to prevent damage to the membrane
- Keytec SAM — a gas-resistant self-adhesive membrane.

2 Manufacture

2.1 The membrane is manufactured by an extrusion/coating process.

2.2 As part of the assessment and ongoing surveillance of product quality, the BBA has:

- agreed with the manufacturer the quality control procedures and product testing to be undertaken
- assessed and agreed the quality control operated over batches of incoming materials
- monitored the production process and verified that it is in accordance with the documented process
- evaluated the process for management of nonconformities
- checked that equipment has been properly tested and calibrated
- undertaken to carry out 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.

3 Delivery and site handling

3.1 Rolls are wrapped in polythene film. Each roll has a leaflet enclosed describing the membrane and installation details. The BBA logo and the number of this Certificate are printed on the leaflet and pallet label.

3.2 The rolls must be stacked on a flat surface, kept under cover and protected from sunlight and mechanical damage.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on Keytec 400 HP Gas Barrier.

Design Considerations

4 Use

4.1 Keytec 400 HP Gas Barrier is satisfactory for use as a gas-resistant barrier to restrict the ingress of radon, methane and carbon dioxide into buildings from landfill and naturally occurring sources.

4.2 Buildings in areas of risk should be constructed in accordance with the recommendations of BRE Report BR 211 : 2015 and following the guidance set out in BS 8485 : 2015.

4.3 The membrane is also satisfactory for use as a damp-proof membrane in accordance with CP 102 : 1973 Section 3, BS 8000-0 : 2014 and BS 8000-4 : 1989.

5 Practicability of installation

The membrane is designed to be installed by a competent general builder, or a contractor, experienced with this type of product.

6 Resistance to water and water vapour



6.1 The membrane, including joints, provides an effective barrier to the passage of liquid moisture from the ground.

6.2 The membrane will comply with the minimum sheet thickness detailed in the documents supporting the national Building Regulations.

6.3 The membrane is impervious to water and provides a waterproof layer capable of accepting minor structural movements without damage.

7 Resistance to underground gases



7.1 The membrane will restrict the ingress of radon, methane and carbon dioxide into buildings from landfill and naturally occurring sources and satisfy the performance criteria for a gas-resistant membrane as defined in BS 8485 : 2015.

7.2 Measured gas permeability/diffusion values on unjointed membrane are given in Table 1.

Table 1 Gas permeability of Keytec 400 HP Gas Barrier

Gas	Method	Result
Methane ⁽¹⁾	BS ISO 15105-1	<0.09 ml·m ² day ⁻¹ ·atm ⁻¹
Carbon dioxide	BS ISO 15105-1	<0.09 ml·m ² day ⁻¹ ·atm ⁻¹
Radon	K124/02/95	8.0 x 10 ⁻¹⁵ m ² ·s ⁻¹

(1) BS 8485 : 2015 requires that the methane transmission measured in accordance with BS ISO 15105-1 :2007 for a gas-resistant membrane is <40 ml·m²·d⁻¹·atm⁻¹.

7.3 In the opinion of the BBA, the membrane satisfies the criteria for a radon gas resistant membrane of BRE Report BR 211 : 2015.

8 Resistance to puncture

8.1 The membrane can be punctured by sharp objects and care should be taken when handling building materials over the exposed surface.

8.2 Provided there are no sharp objects present on the membrane's surface prior to and during installation of the protective layer, the membrane will not be damaged by normal foot traffic.

9 Compatibility with other materials

The membrane contains an aluminium foil interlayer which may be subject to corrosion by alkaline conditions if damage to the membrane and exposure occurs. However, under normal circumstances, the polyethylene faces of the membrane are compatible with other materials and products typically used in the same areas, with the exception of those containing pitch.

10 Underfloor heating

There will be no adverse effect on the membrane from the underfloor heating under normal service conditions. In other circumstances, the Certificate holder's advice should be sought.

11 Maintenance

As the membrane is confined under concrete and has suitable durability (see section 12), maintenance is not required. However, any damage occurring before enclosure must be repaired (see section 15).

12 Durability



12.1 The membrane will, in normal circumstances, remain effective against the ingress of water and water vapour, and will restrict the ingress of radon, methane and carbon dioxide during the lifetime of the building.

12.2 Long periods of exposure to ultraviolet light will reduce the effectiveness of the membrane.

Installation

13 General

13.1 Keytec 400 HP Gas Barrier must be installed and fixed in accordance with this Certificate, the Certificate holder's instructions, the relevant clauses of BRE Report BR 211 : 2015 and the guidance given in BS 8485 : 2015.

13.2 The membrane can be installed in all normal site conditions, provided that the air temperature is not below 5°C to prevent the risk of surface condensation.

14 Procedure

14.1 The membrane must only be applied to surfaces that have a smooth finish, ie they should be free from voids, projections and mortar deposits. Surfaces should be dry and free from dust and frost.

14.2 Concrete surfaces should be dense. Vertical surfaces of brickwork and blockwork must be dry and rendered to provide an even surface. Brickwork or blockwork not rendered must be flush pointed to give a smooth surface without sudden changes in level.

14.3 The membrane is rolled out with the printed side uppermost, ensuring that it is properly aligned. All end and side overlaps should be a minimum of 100 mm where taped and prepared in accordance with the Certificate holder's instructions.

14.4 When the membrane is laid below the concrete slab, it should be loose-laid to accommodate any small movements.

14.5 All surfaces must be dried thoroughly prior to joining. Roll edges can be welded or taped. A strip of the tape is unrolled over the membrane with its nearest edge 50 mm from the membrane edge. The protective paper is removed from the butyl tape prior to rolling an adjacent run of the membrane, which must be carefully unrolled over the jointing tape, ensuring a 100 mm overlap.

14.6 All service penetrations and direction changes should be properly detailed in accordance with the Certificate holder's instructions. Service ducts should be vented to prevent the possibility of gas accumulating in confined spaces.

14.7 The continuity of the gas protection must extend over the footprint of the building, and the membrane must be sealed to a gas-resistant dpc where required.

14.8 The membrane should be covered by a screed or other protective layer, such as GP Protection Fleece, as soon as possible after installation. If blockwork protection is used, care must be taken to avoid damage to the membrane during construction.

14.9 The membrane installation should be subject to third-party independent validation, in accordance with BS 8485 : 2015.

15 Repair

Any damage to the membrane must be repaired using a patch of the membrane, and laps welded or sealed with double sided tape and secured with the butyl tape. All patched areas must extend a minimum of 100 mm from the damaged area. If required by the local authority, repair work should be confirmed by an independent validation report, as all gas membrane installations should be subject to third-party validation in accordance with BS 8485 : 2015.

Technical Investigations

16 Tests

16.1 An assessment was made of data to BS EN 13967 : 2012 in relation to:

- tensile strength and elongation
- nail tear resistance
- watertightness
- resistance to static loading.

16.2 Tests were carried out to determine:

- thickness, width, density and mass per unit area
- dimensional stability, low temperature flexibility and water vapour permeability
- tensile strength and elongation (control, heat aged, and UV exposed)
- watertightness (control and heat aged)
- nail tear strength (control and heat aged)
- resistance of joints to air pressure
- tensile strength of joints (control and heat aged)

to assess:

- membrane characteristics
- durability of the membrane and joints.

17 Investigations

17.1 An evaluation was made of the results of the test data regarding permeability of radon, methane and carbon dioxide.

17.2 A site visit was conducted to assess practicability of installation.

17.3 The manufacturing process was evaluated, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

Bibliography

BRE Report BR 211 : 2015 *Radon : Guidance on protective measures for new buildings*

BS 8000-0 : 2014 *Workmanship on construction sites — Introduction and general principles*

BS 8000-4 : 1989 *Workmanship on building sites — Code of practice for waterproofing*

BS 8485 : 2015 + A1 : 2019 *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings*

BS EN 13967 : 2012 + A1 : 2017 *Flexible sheets for waterproofing — Plastic and rubber damp proof sheets including plastic and rubber basement tanking sheet — Definitions and characteristics*

BS ISO 15105-1 : 2007 *Plastics. Film and sheeting — Determination of gas-transmission rate — Differential-pressure methods*

CP 102 : 1973 *Code of practice for protection of buildings against water from the ground*

K124/02-95 *Radon diffusion coefficient by Czech Technical University to test number 124-11 — Measurement of radon coefficient*

18 Conditions

18.1 This Certificate:

- relates only to the product/system 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.

18.2 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.

18.3 This Certificate will remain valid for an unlimited period provided that the product/system 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.

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



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

18.6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system 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.

Appendix C – Gas Membrane Photographs

Lift Pit in Apartment Block

	
<p>Photograph 1: Evidence of gas membrane coverage in lift pit.</p>	<p>Photograph 2: Evidence of appropriate sealing and overlap.</p>
	
<p>Photograph 3: Evidence of appropriate sealing and overlap.</p>	<p>Photograph 4: Evidence of appropriate overlap of the membrane.</p>

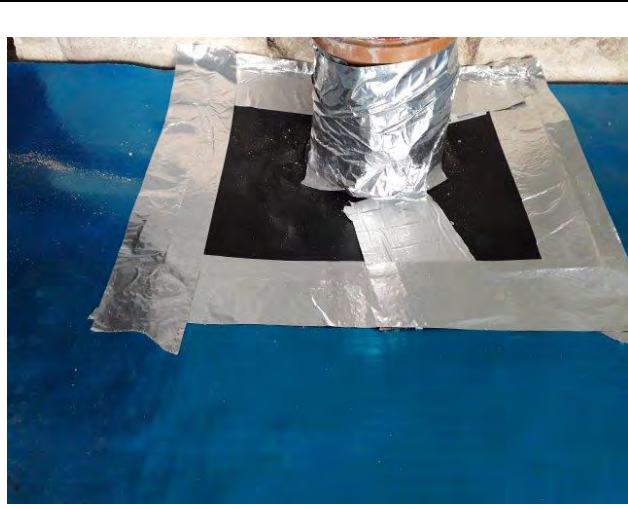
Plot 1

	
<p>Photograph 1: Evidence of gas membrane coverage across Plot 1.</p>	<p>Photograph 2: Evidence of appropriate sealing around services for Plot 1.</p>
	
<p>Photograph 3: Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 1.</p>	<p>Photograph 4: Evidence of appropriate overlap of the membrane for Plot 1.</p>
	
<p>Photograph 5: Evidence of sub-floor void in Plot 1.</p>	

Plot 2



Photograph 1:
Evidence of gas membrane coverage across Plot 2.



Photograph 2:
Evidence of appropriate sealing around services for Plot 2.



Photograph 3:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 2.



Photograph 4:
Evidence of appropriate overlap of the membrane for Plot 2.



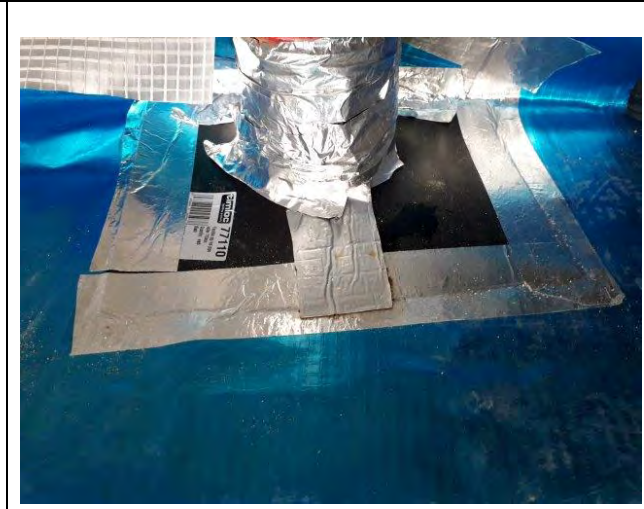
Photograph 5:
Evidence of sub-floor void in Plot 1.



Plot 3



Photograph 1:
Evidence of gas membrane coverage across Plot 3.



Photograph 2:
Evidence of appropriate sealing around services for Plot 3.



Photograph 3:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 3.



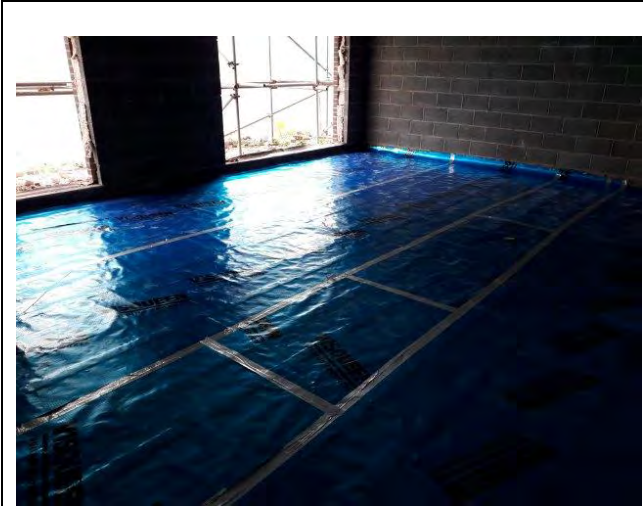
Photograph 4:
Evidence of appropriate overlap of the membrane for Plot 3.



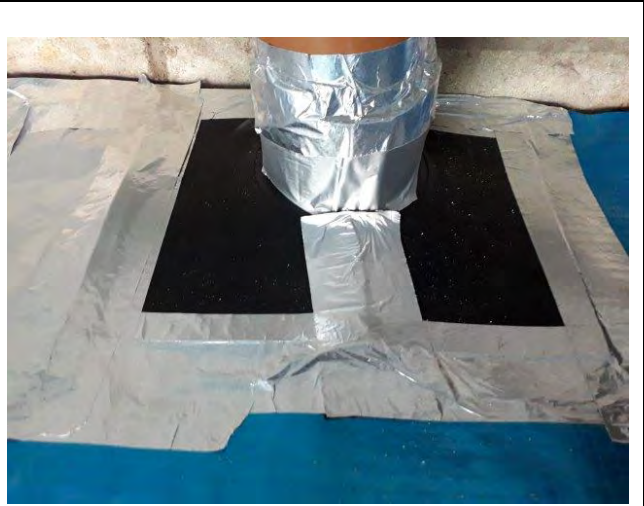
Photograph 5:
Evidence of sub-floor void in Plot 3.



Plot 4



Photograph 1:
Evidence of gas membrane coverage across Plot 4.



Photograph 2:
Evidence of appropriate sealing around services for Plot 4.



Photograph 3:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 4.




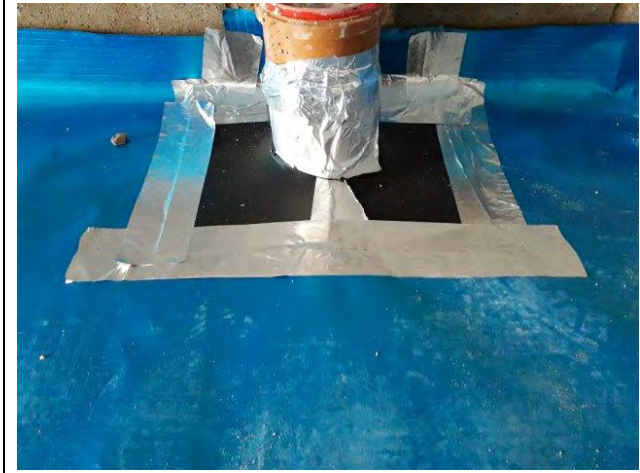



Photograph 4:
Evidence of appropriate overlap of the membrane for Plot 4.




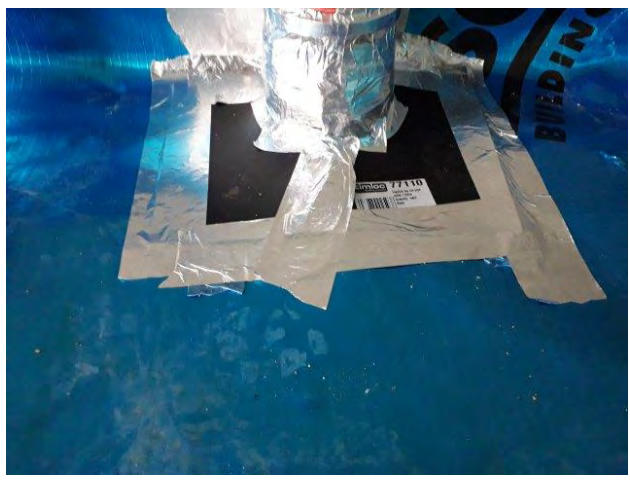
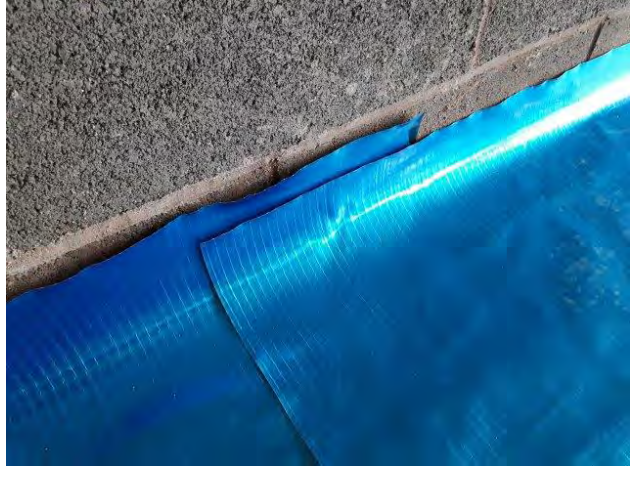
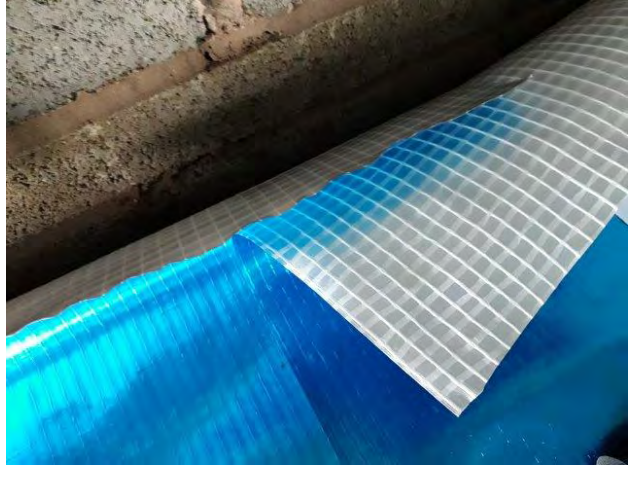


Photograph 5:
Evidence of sub-floor void in Plot 4.



Plot 5

	
<p>Photograph 1: Evidence of gas membrane coverage across Plot 5.</p>	<p>Photograph 2: Evidence of appropriate sealing around services for Plot 5.</p>
	
<p>Photograph 3: Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 5.</p>	<p>Photograph 4: Evidence of appropriate overlap of the membrane for Plot 5.</p>
	
<p>Photograph 5: Evidence of sub-floor void in Plot 5.</p>	

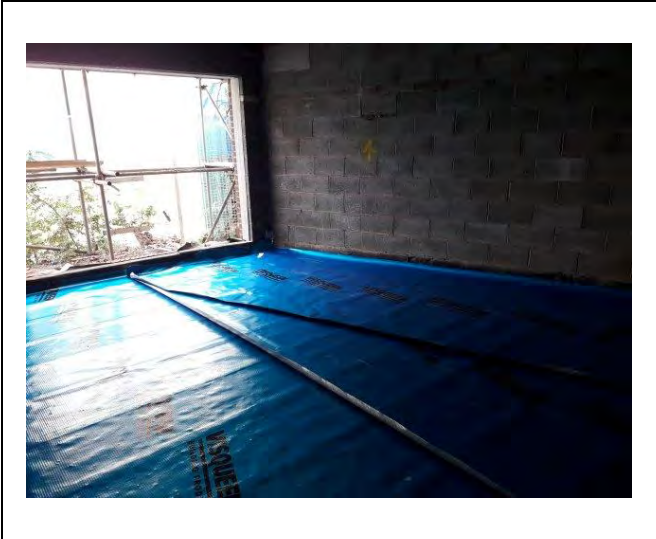
Plot 6

	
<p>Photograph 1: Evidence of gas membrane coverage across Plot 6.</p>	<p>Photograph 2: Evidence of appropriate sealing around services for Plot 6.</p>
	
<p>Photograph 3: Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 6.</p>	<p>Photograph 4: Evidence of appropriate overlap of the membrane for Plot 6.</p>
	
<p>Photograph 5: Evidence of sub-floor void in Plot 6.</p>	

Plot 7

	
<p>Photograph 1: Evidence of gas membrane coverage across Plot 7.</p>	<p>Photograph 2: Evidence of appropriate sealing around services for Plot 7.</p>
	
<p>Photograph 3: Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 7.</p>	<p>Photograph 4: Evidence of appropriate overlap of the membrane for Plot 7.</p>
	
<p>Photograph 5: Evidence of sub-floor void in Plot 7.</p>	

Plot 8



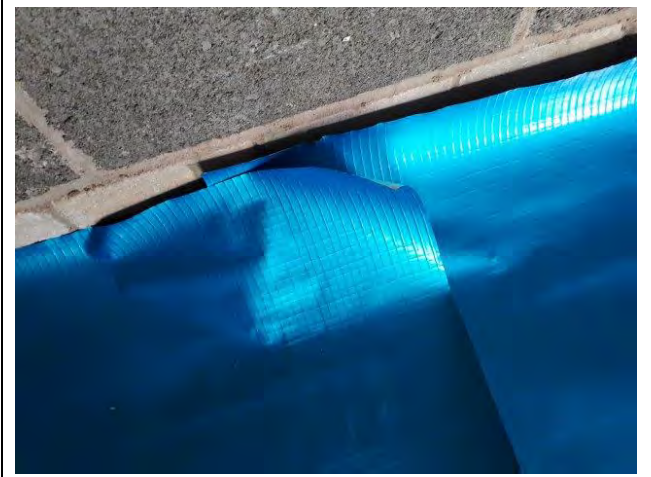
Photograph 1:
Evidence of gas membrane coverage across Plot 8.



Photograph 2:
Evidence of appropriate sealing around services for Plot 8.



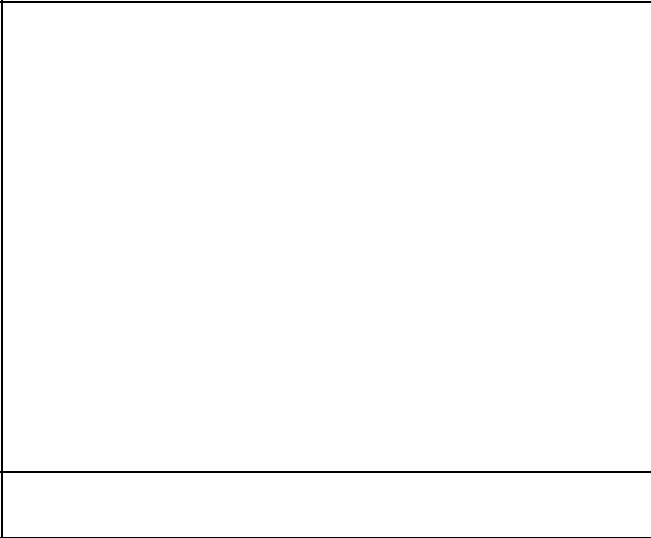
Photograph 3:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 8.



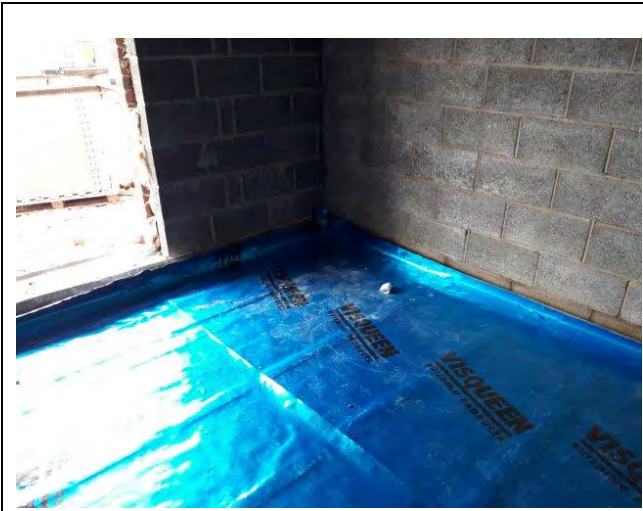
Photograph 4:
Evidence of appropriate overlap of the membrane for Plot 8.



Photograph 5:
Evidence of sub-floor void in Plot 8.



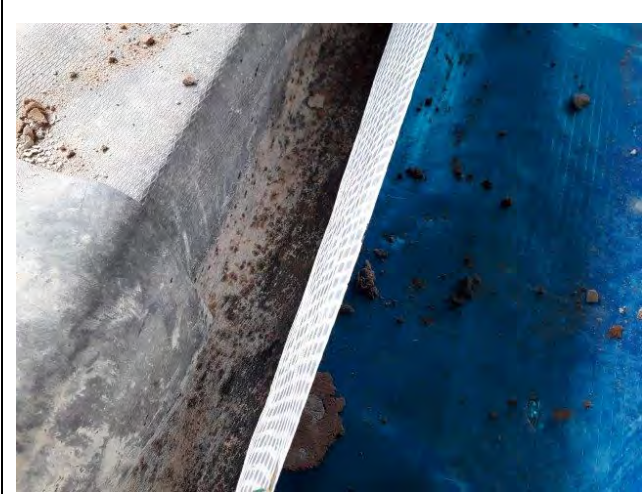
Plot 9



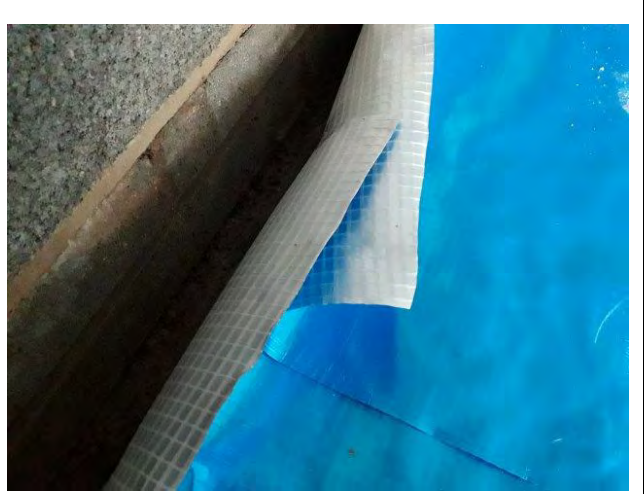
Photograph 1:
Evidence of gas membrane coverage across Plot 9.



Photograph 2:
Evidence of appropriate sealing around services for Plot 9.



Photograph 3:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 9.



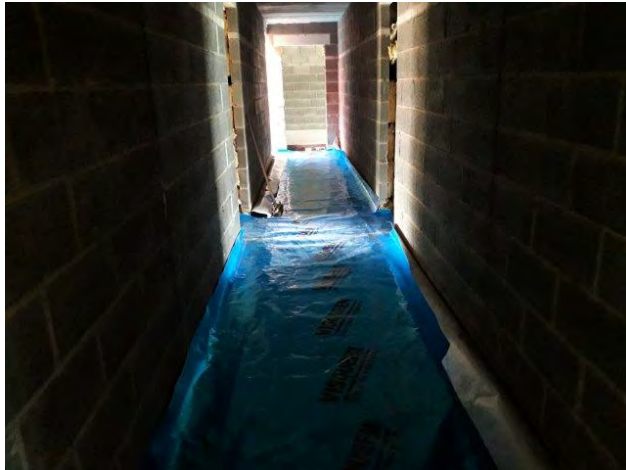
Photograph 4:
Evidence of appropriate overlap of the membrane for Plot 9.



Photograph 5:
Evidence of sub-floor void in Plot 9.



Apartment Block Corridor



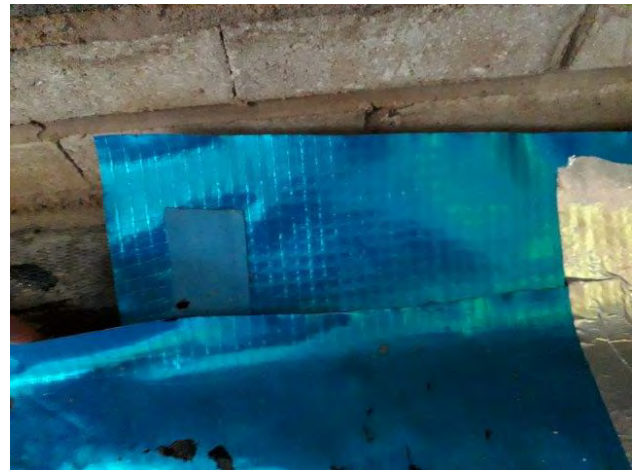
Photograph 1:
Evidence of gas membrane coverage across corridor.



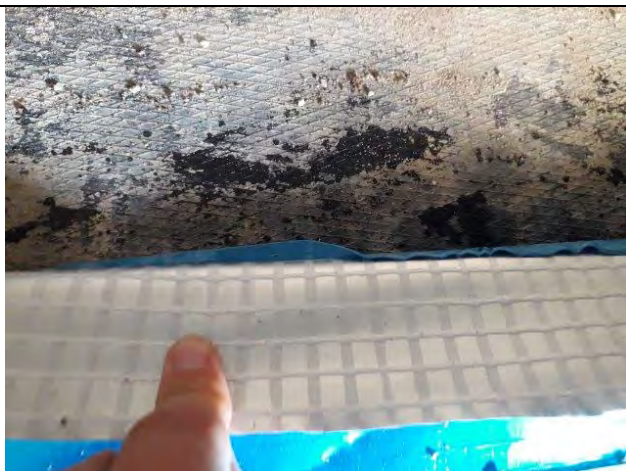
Photograph 2:
Evidence of gas membrane coverage across corridor.



Photograph 3:
Evidence of gas membrane coverage across corridor.



Photograph 4:
Evidence of appropriate overlap of the membrane for corridor.

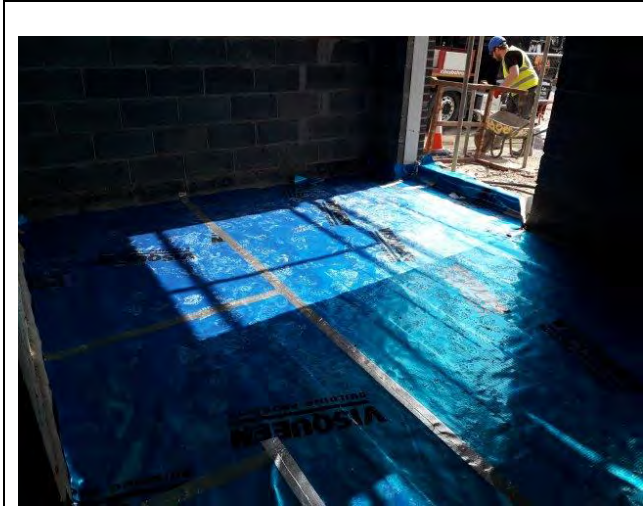


Photograph 5:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap.

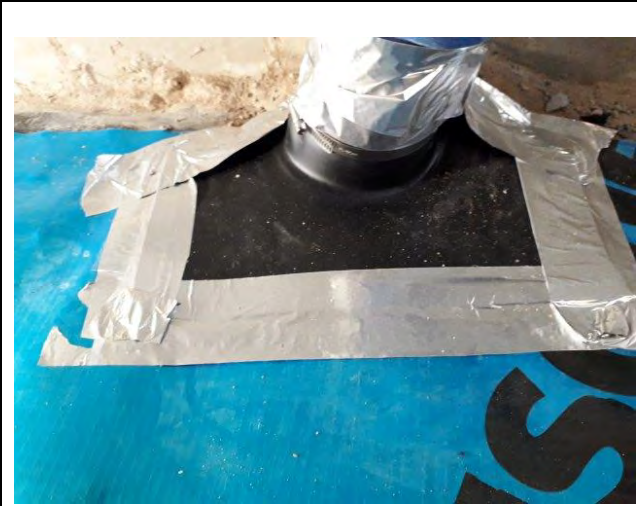


Photograph 6:
Evidence of sub-floor void across apartment block.

Plot 37



Photograph 1:
Evidence of gas membrane coverage across Plot 37.



Photograph 2:
Evidence of appropriate sealing around services for Plot 37.



Photograph 3:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 37.



Photograph 4:
Evidence of appropriate overlap of the membrane for Plot 37.



Photograph 5:
Evidence of sub-floor void in Plot 37.

Plot 38

	
<p>Photograph 1: Evidence of gas membrane coverage across Plot 38.</p>	<p>Photograph 2: Evidence of appropriate sealing around services for Plot 38.</p>
	
<p>Photograph 3: Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 38.</p>	<p>Photograph 4: Evidence of appropriate overlap of the membrane for Plot 38.</p>
	
<p>Photograph 5: Evidence of sub-floor void in Plot 38.</p>	

Plot 39

	
<p>Photograph 1: Evidence of gas membrane coverage across Plot 39.</p>	<p>Photograph 2: Evidence of appropriate sealing around services for Plot 39.</p>
	
<p>Photograph 3: Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 39.</p>	<p>Photograph 4: Evidence of appropriate overlap of the membrane for Plot 39.</p>
	
<p>Photograph 5: Evidence of sub-floor void in Plot 39.</p>	

Plot 40

	
<p>Photograph 1: Evidence of gas membrane coverage across Plot 40.</p>	<p>Photograph 2: Evidence of appropriate sealing around services for Plot 40.</p>
	
<p>Photograph 3: Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 40.</p>	<p>Photograph 4: Evidence of appropriate overlap of the membrane for Plot 40.</p>
	
<p>Photograph 5: Evidence of sub-floor void in Plot 40.</p>	

Plot 41

	
<p>Photograph 1: Evidence of gas membrane coverage across Plot 41.</p>	<p>Photograph 2: Evidence of appropriate sealing around services for Plot 41.</p>
	
<p>Photograph 3: Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 41.</p>	<p>Photograph 4: Evidence of appropriate overlap of the membrane for Plot 41.</p>
	
<p>Photograph 5: Evidence of sub-floor void in Plot 41.</p>	

Plot 42



Photograph 1:
Evidence of gas membrane coverage across Plot 42.



Photograph 2:
Evidence of appropriate sealing around services for Plot 42.



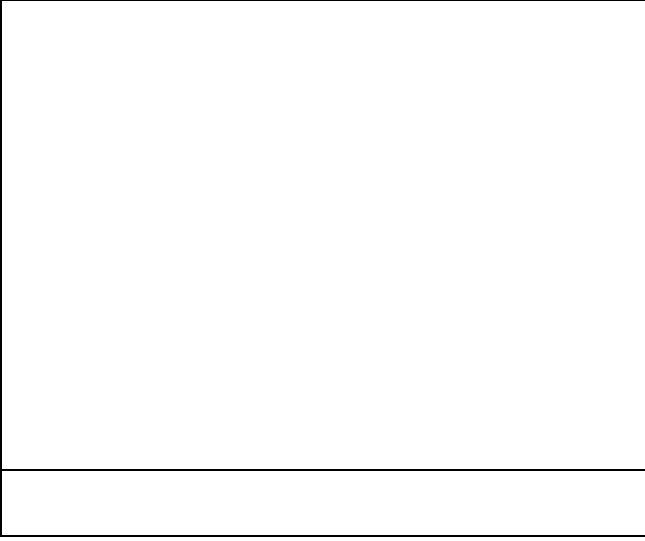
Photograph 3:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 42.



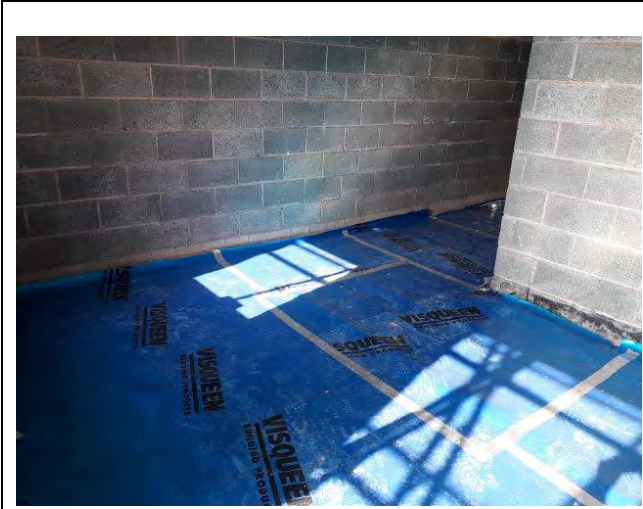
Photograph 4:
Evidence of appropriate overlap of the membrane for Plot 42.



Photograph 5:
Evidence of sub-floor void in Plot 42.



Plot 43



Photograph 1:
Evidence of gas membrane coverage across Plot 43.



Photograph 2:
Evidence of appropriate sealing around services for Plot 43.



Photograph 3:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 43.



Photograph 4:
Evidence of appropriate overlap of the membrane for Plot 43.

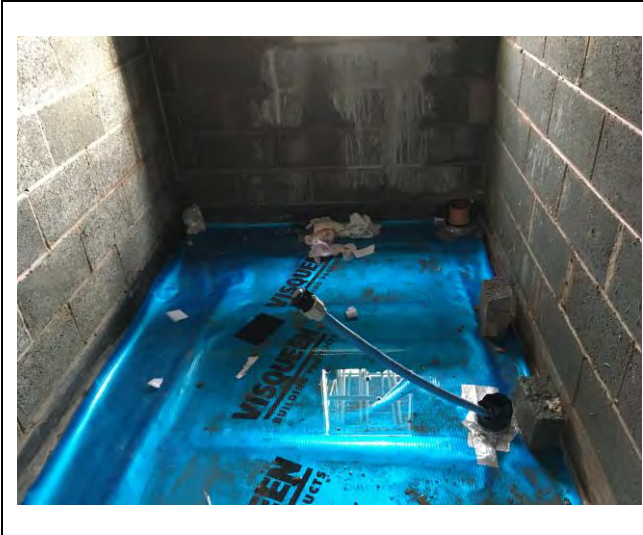


Photograph 5:
Evidence of sub-floor void in Plot 43.

Plot 44

	
<p>Photograph 1: Evidence of gas membrane coverage across Plot 44.</p>	<p>Photograph 2: Evidence of appropriate sealing around services for Plot 44.</p>
	
<p>Photograph 3: Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 44.</p>	<p>Photograph 4: Evidence of appropriate overlap of the membrane for Plot 44.</p>
	
<p>Photograph 5: Evidence of sub-floor void in Plot 44.</p>	

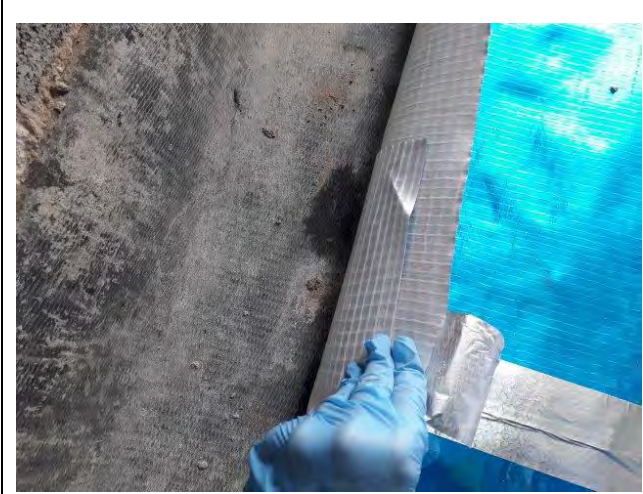
Plot 45



Photograph 1:
Evidence of gas membrane coverage across Plot 45.



Photograph 2:
Evidence of appropriate sealing around services for Plot 45.



Photograph 3:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 45.



Photograph 4:
Evidence of appropriate overlap of the membrane for Plot 45.



Photograph 5:
Evidence of sub-floor void in Plot 45.

Plot 46

	
<p>Photograph 1: Evidence of gas membrane coverage across Plot 46.</p>	<p>Photograph 2: Evidence of appropriate sealing around services for Plot 46.</p>
	
<p>Photograph 3: Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 46.</p>	<p>Photograph 4: Evidence of appropriate overlap of the membrane for Plot 46.</p>
	
<p>Photograph 5: Evidence of sub-floor void in Plot 46.</p>	

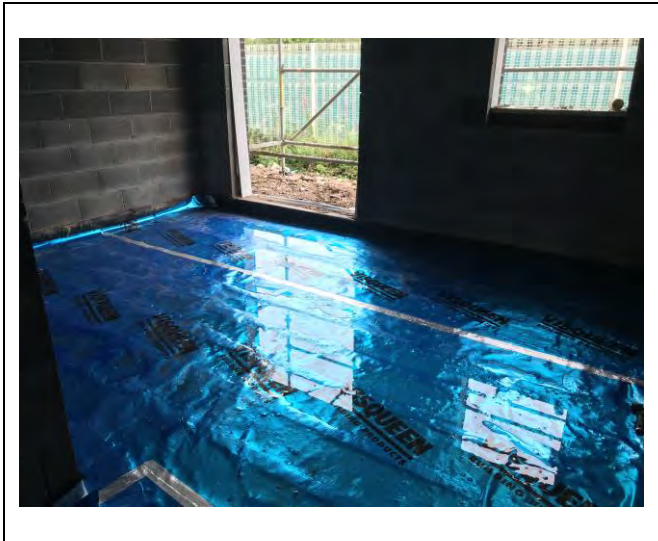
Plot 47

	
<p>Photograph 1: Evidence of gas membrane coverage across Plot 47.</p>	<p>Photograph 2: Evidence of appropriate sealing around services for Plot 47.</p>
	
<p>Photograph 3: Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 47.</p>	<p>Photograph 4: Evidence of appropriate overlap of the membrane for Plot 47.</p>
	
<p>Photograph 5: Evidence of sub-floor void in Plot 47.</p>	

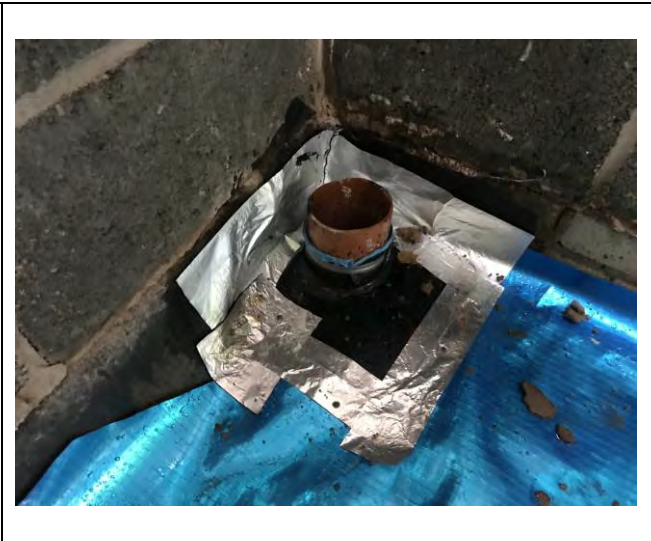
Plot 48

	
<p>Photograph 1: Evidence of gas membrane coverage across Plot 48.</p>	<p>Photograph 2: Evidence of appropriate sealing around services for Plot 48.</p>
	
<p>Photograph 3: Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 48.</p>	<p>Photograph 4: Evidence of appropriate overlap of the membrane for Plot 48.</p>
	
<p>Photograph 5: Evidence of sub-floor void in Plot 48.</p>	

Plot 49



Photograph 1:
Evidence of gas membrane coverage across Plot 49.



Photograph 2:
Evidence of appropriate sealing around services for Plot 49.



Photograph 3:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 49.



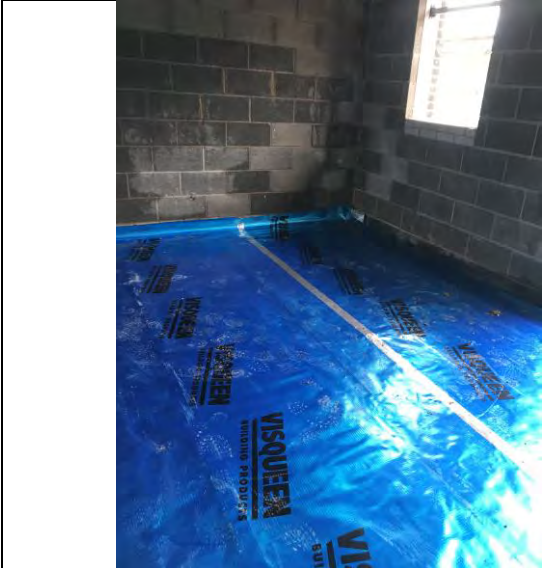
Photograph 4:
Evidence of appropriate overlap of the membrane for Plot 49.



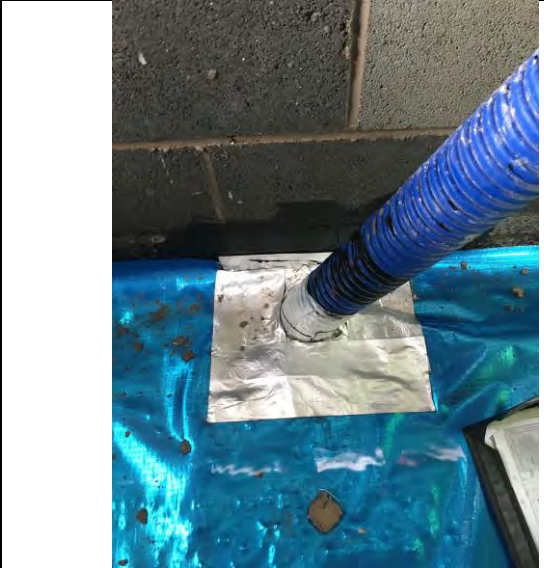
Photograph 5:
Evidence of sub-floor void in Plot 49.



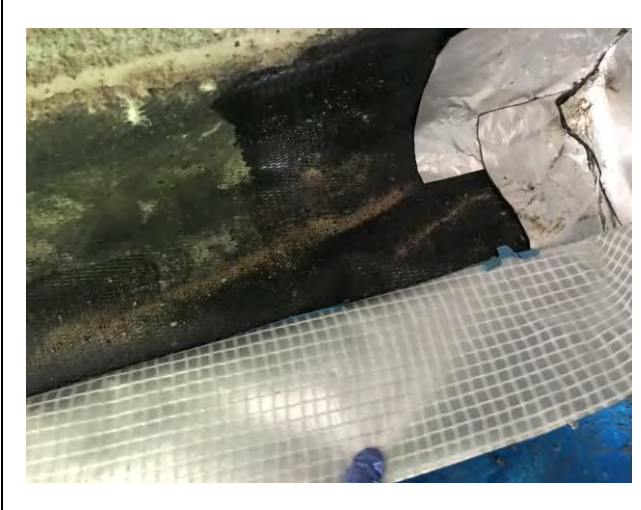
Plot 50



Photograph 1:
Evidence of gas membrane coverage across Plot 50.



Photograph 2:
Evidence of appropriate sealing around services for Plot 50.



Photograph 3:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 50.

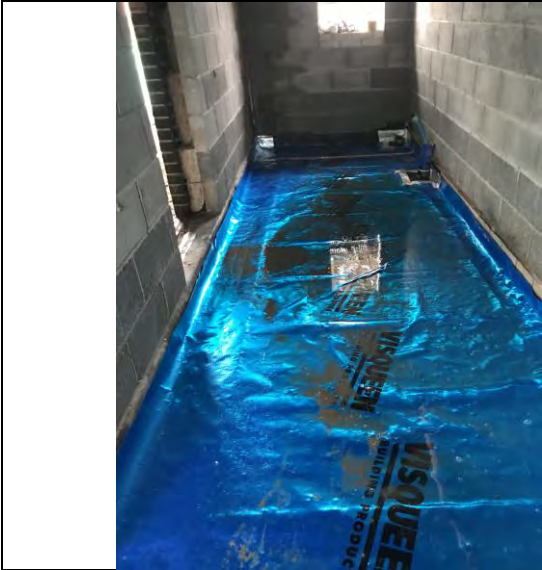


Photograph 4:
Evidence of appropriate overlap of the membrane for Plot 50.

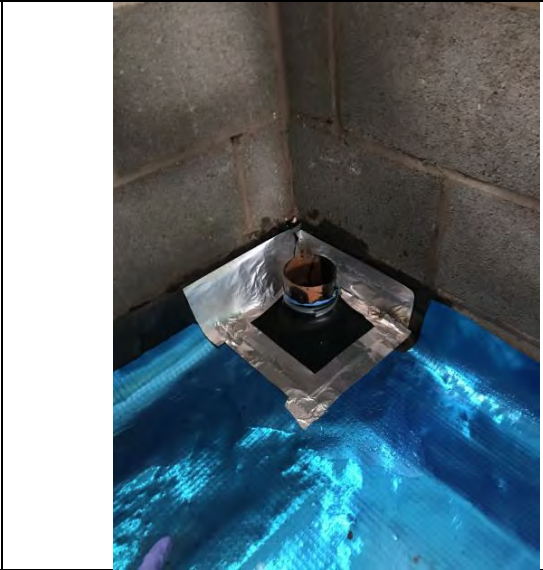


Photograph 5:
Evidence of sub-floor void in Plot 50.

Plot 51



Photograph 1:
Evidence of gas membrane coverage across Plot 51.



Photograph 2:
Evidence of appropriate sealing around services for Plot 51.



Photograph 3:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 51.



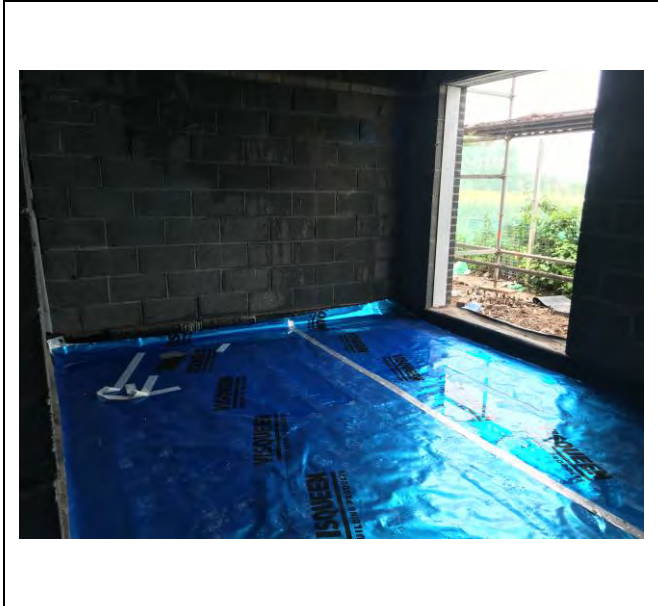
Photograph 4:
Evidence of appropriate overlap of the membrane for Plot 51.



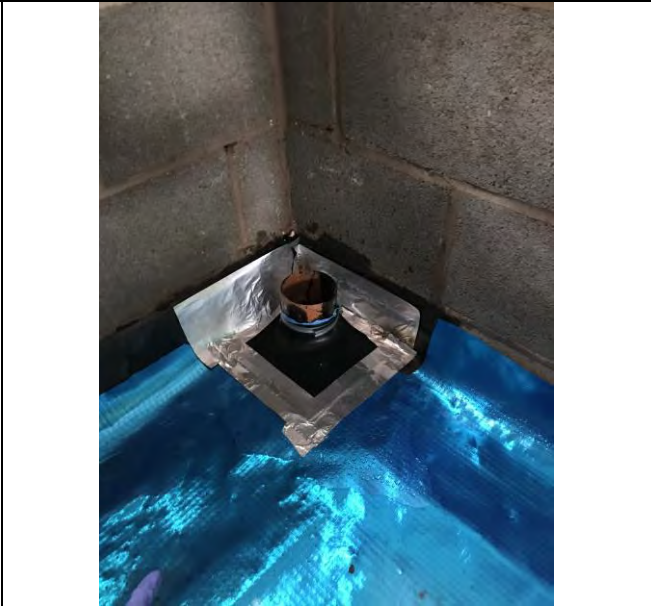
Photograph 5:
Evidence of sub-floor void in Plot 51.



Plot 52



Photograph 1:
Evidence of gas membrane coverage across Plot 52.



Photograph 2:
Evidence of appropriate sealing around services for Plot 52.



Photograph 3:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 52.



Photograph 4:
Evidence of appropriate overlap of the membrane for Plot 52.

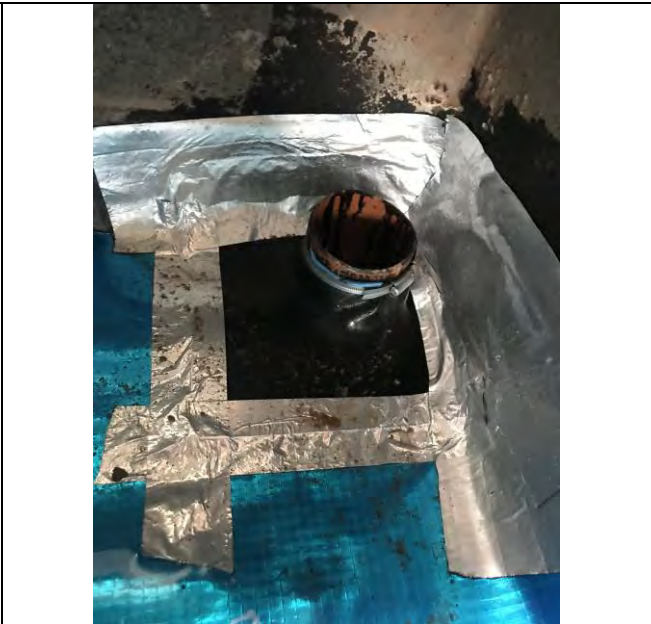


Photograph 5:
Evidence of sub-floor void in Plot 52.

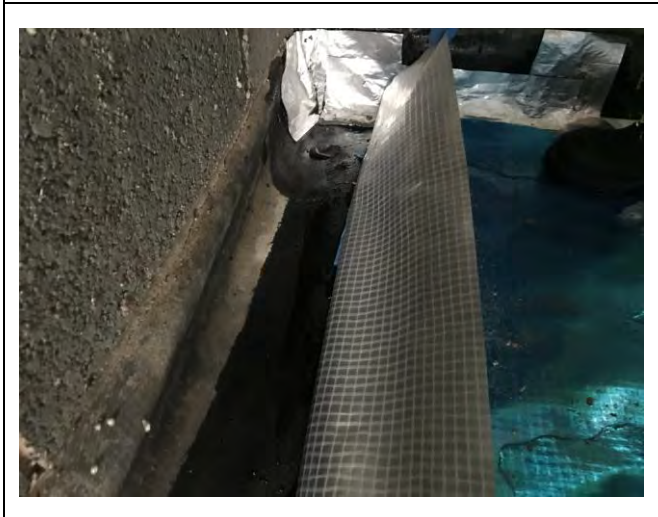
Plot 53



Photograph 1:
Evidence of gas membrane coverage across Plot 53.



Photograph 2:
Evidence of appropriate sealing around services for Plot 53.



Photograph 3:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 53.



Photograph 4:
Evidence of appropriate overlap of the membrane for Plot 53.



Photograph 5:
Evidence of sub-floor void in Plot 53.

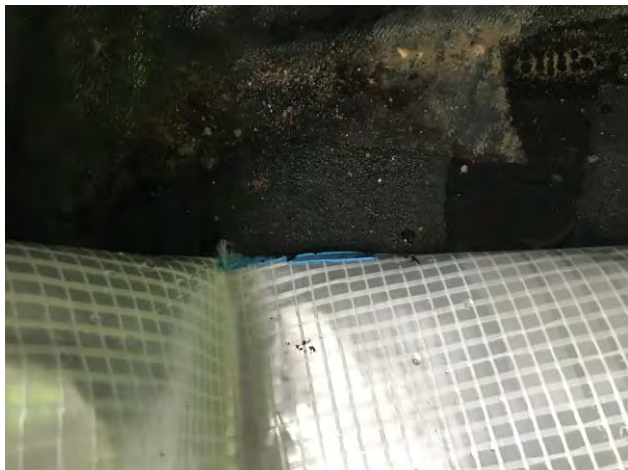
Plot 54



Photograph 1:
Evidence of gas membrane coverage across Plot 54.



Photograph 2:
Evidence of appropriate sealing around services for Plot 54.



Photograph 3:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 54.

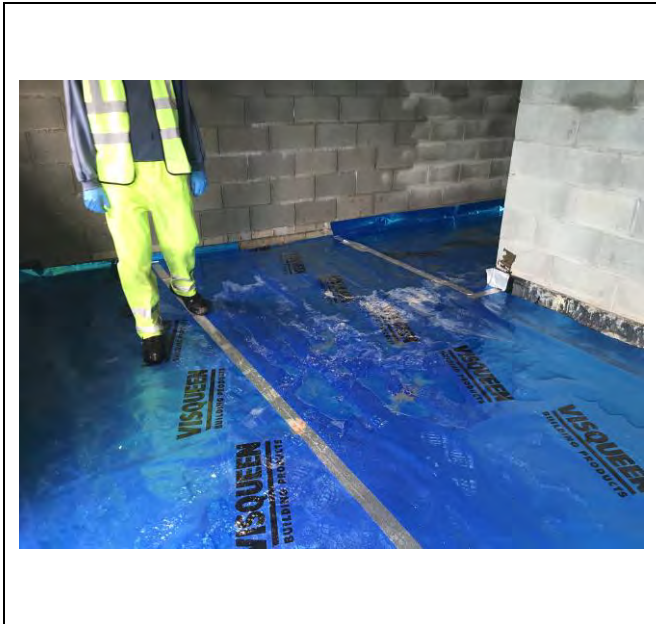


Photograph 4:
Evidence of appropriate overlap of the membrane for Plot 54.



Photograph 5:
Evidence of sub-floor void in Plot 54.

Plot 55



Photograph 1:
Evidence of gas membrane coverage across Plot 55.



Photograph 2:
Evidence of appropriate sealing around services for Plot 55.



Photograph 3:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 55.



Photograph 4:
Evidence of appropriate overlap of the membrane for Plot 55.



Photograph 5:
Evidence of sub-floor void in Plot 55.



Plot 56



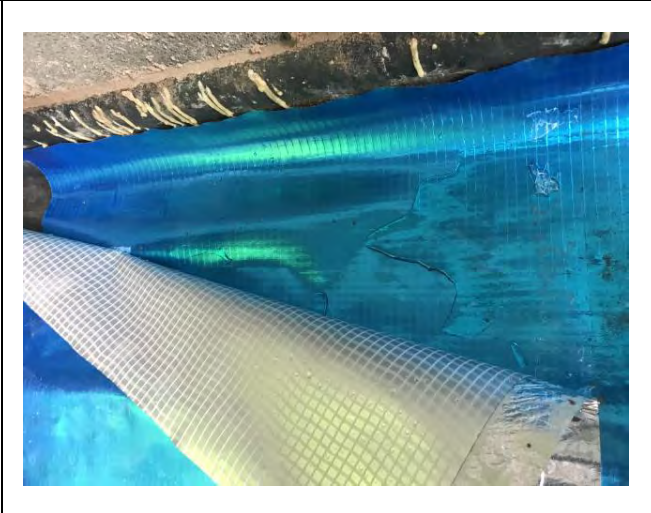
Photograph 1:
Evidence of gas membrane coverage across Plot 56.



Photograph 2:
Evidence of appropriate sealing around services for Plot 56.



Photograph 3:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 56.



Photograph 4:
Evidence of appropriate overlap of the membrane for Plot 56.



Photograph 5:
Evidence of sub-floor void in Plot 56.

Plot 57



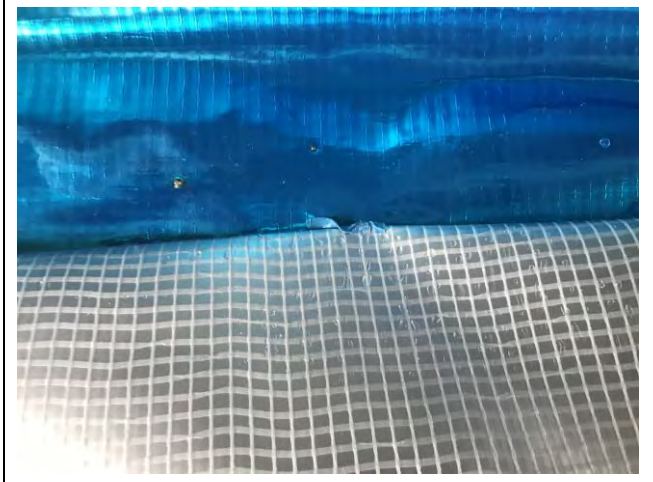
Photograph 1:
Evidence of gas membrane coverage across Plot 57.



Photograph 2:
Evidence of appropriate sealing around services for Plot 57.



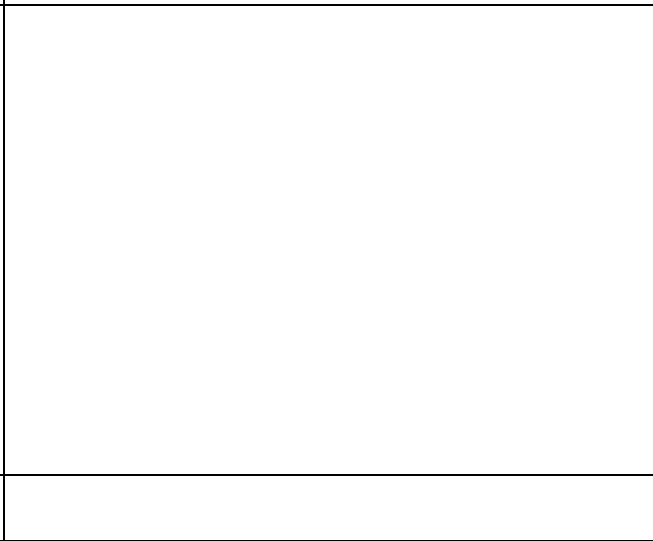
Photograph 3:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 57.



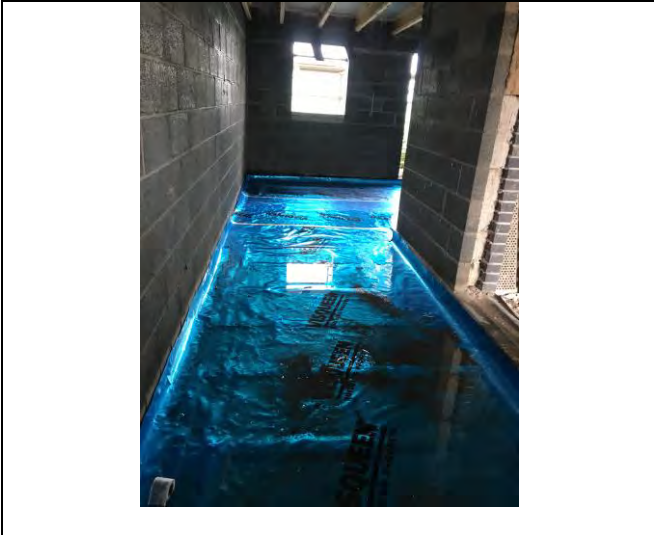
Photograph 4:
Evidence of appropriate overlap of the membrane for Plot 57.



Photograph 5:
Evidence of sub-floor void in Plot 57.



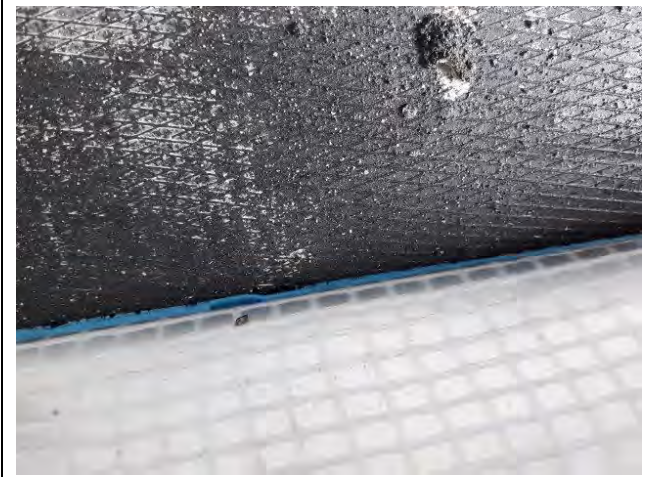
Plot 58



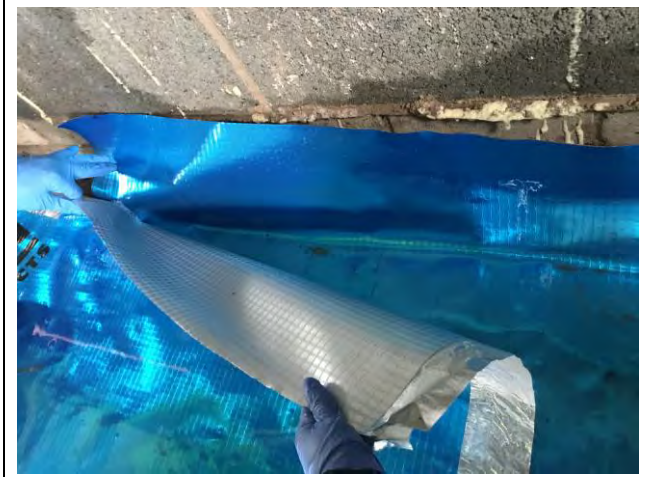
Photograph 1:
Evidence of gas membrane coverage across Plot 58.



Photograph 2:
Evidence of appropriate sealing around services for Plot 58.



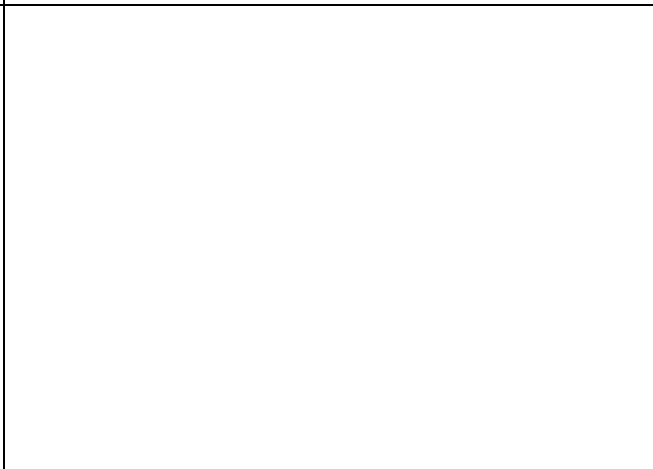
Photograph 3:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 58.



Photograph 4:
Evidence of appropriate overlap of the membrane for Plot 58.



Photograph 5:
Evidence of sub-floor void in Plot 58.



Plot 59



Photograph 1:
Evidence of gas membrane coverage across Plot 59.



Photograph 2:
Evidence of appropriate sealing around services for Plot 59.



Photograph 3:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 59.



Photograph 4:
Evidence of appropriate overlap of the membrane for Plot 59.



Photograph 5:
Evidence of sub-floor void in Plot 59.



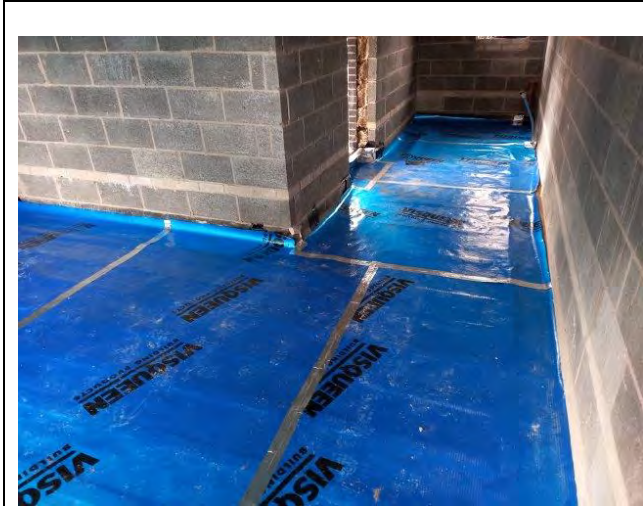
Plot 60

	
<p>Photograph 1: Evidence of gas membrane coverage across Plot 60.</p>	<p>Photograph 2: Evidence of appropriate sealing around services for Plot 60.</p>
	
<p>Photograph 3: Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 60.</p>	<p>Photograph 4: Evidence of appropriate overlap of the membrane for Plot 60.</p>
	
<p>Photograph 5: Evidence of sub-floor void in Plot 60.</p>	

Plot 61

	
<p>Photograph 1: Evidence of gas membrane coverage across Plot 61.</p>	<p>Photograph 2: Evidence of appropriate sealing around services for Plot 61.</p>
	
<p>Photograph 3: Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 61.</p>	<p>Photograph 4: Evidence of appropriate overlap of the membrane for Plot 61.</p>
	
<p>Photograph 5: Evidence of sub-floor void in Plot 61.</p>	

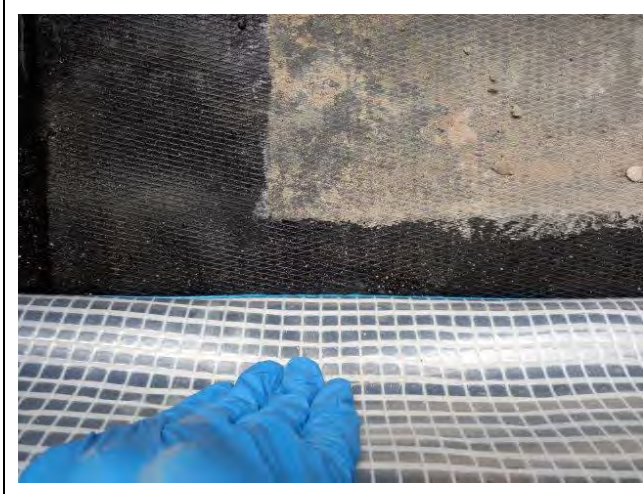
Plot 62



Photograph 1:
Evidence of gas membrane coverage across Plot 62.



Photograph 2:
Evidence of appropriate sealing around services for Plot 62.



Photograph 3:
Evidence of appropriate sealing of membrane to DPC with appropriate overlap for Plot 62.



Photograph 4:
Evidence of appropriate overlap of the membrane for Plot 62.



Photograph 5:
Evidence of sub-floor void in Plot 61.



Based across the UK with offices in
Manchester, London,
Liverpool, Swindon and Glasgow.

Manchester (Head Office)

Unit 29
Eton Business Park
Eton Hill Rd, Radcliffe
M26 2ZS

t: 0161 763 7200
e: info@thelkgroup.com

Swindon

39 Bowman House Business Centre
Bowman Court
Whitehill Lane
Royal Wootton Bassett
Swindon
SN4 7DB

t: 01793 987 390
e: info@thelkgroup.com

London

Brooklands Business Park
Wellington Way
Weybridge
KT13 0TT

t: 01932 871872
e: info@thelkgroup.com

Glasgow

Wright Business Centre
1 Lonmay Road
Glasgow
G33 4EL

t: 0141 773 6269
e: info@thelkgroup.com

Liverpool

The Corn Exchange
Fenwick Street
Liverpool
L2 7QL

t: 0151 235 8716
e: info@thelkgroup.com



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