GroundSolve Ltd
Consulting Geotechnical Engineers

LLANGOLLEN ROAD, ACREFAIR - GROUND GAS PROTECTION VERIFICATION REPORT, PLOTS 6, 9, AND 17/18

GSL3116LR04

VERSION 1

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FINAL

Prepared for:

Gower Homes Ltd

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GroundSolve Ltd

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This report has been prepared by GroundSolve Ltd with all reasonable care and diligence, within the best practice and guidance current at the time of issue within the proposed redline boundary and proposed Site end use as presented by the Client.

This report is confidential to the Client and GroundSolve Ltd accepts no responsibility whatsoever to third parties to whom this report is presented.

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1 INTRODUCTION

1.1 Report Objectives

GroundSolve Ltd was commissioned by Gower Homes Ltd to carry out a verification report for the installed ground gas protection measures for Plots 6, 9 and 17/18 at the former Air Products Site located at Llangollen Road, Acrefair, Wrexham, LL14 3HW. The purpose and objectives of this report is given below:

- To confirm that the measures have been implemented in accordance with the design protective of the site's gas situation.
- To verify that the protection measures implemented on site have been installed correctly without fault.

1.2 Introduction

GroundSolve Ltd were commissioned by Gower Homes Ltd to undertake 2 No. membrane verification visits to validate the gas protection measures which have been implemented on site for plots 6, 9 and 17/18. Site verification visits were conducted between 5th September and 13th November 2024 by a suitably qualified GSL Engineer.

Verification works were conducted in accordance with all relevant guidance including:

- BS 8485:2015+A1:2019.
- CIRIA C735 (2014)
- CL:AIRE RB17 (2012)

All information given in this report is based on the ground conditions encountered during the site work and on the results of laboratory and field tests performed during the investigation. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata, contaminant concentrations and water conditions between or below exploratory holes. It should be noted that groundwater levels, gas concentrations and gas flows usually vary due to seasonal, atmospheric and/or other effects and may at times differ to those measured during the investigation.

2 SITE DETAILS AND DESCRIPTION

Table 2.1 Current Site Overview.

Site name	Llangollen Road, Acrefair.
Site address	Llangollen Road, Acrefair, Wrexham, LL14 3HW.
National Grid Reference (NGR)	328158 , 343235.
Approximate Site area	 **Figure 1 – Site Location Plan**
Current land use on the Site	The site is currently in development to build new residential plots.
Surrounding land uses	The surrounding land use to the site is primarily residential and open space.
General topography and ground levels	The site is approx. 145m AOD in the northeast of the site falling to 137m AOD in the south of the site.
Published Geology	BGS map 121 1:50,000 of Wrexham and BGs GeoIndex details the site is not in an area of artificial Made Ground. The site is underlain by superficial deposits of Till, and bedrock of the Pennine Middle Coal Measures Formation. Previous third-party investigations were reviewed by GroundSolve as part of the Remediation Strategy produced for the site (report reference: GSL3059R01 dated 26th February 2024) detailed Made Ground on site although not detailed on published mapping.

3 GROUND GAS REGIME

3.1 Introduction

GroundSolve Ltd did not conduct any ground gas monitoring on site, however monitoring data has been provided, conducted by Earth Environmental & Geotechnical and WSP which have been reviewed in detail to ensure that the proposed ground gas regime recommended is in agreement with the opinions of GSL based on the data.

Site work has previously been conducted on site by third parties. Earth Environmental & Geotechnical (EEG) classified the site as CS1 based on their calculated Gas Screening Value (GSV) of 0.0074 which is within the CS1 threshold, however Table 8.5 in CIRIA C665 guidance states *consideration should be given to increasing the site's protection to CS2 if carbon dioxide concentrations are above 5% v/v or methane above 1% v/v.* GroundSolve reviewed the full monitoring data for the site conducted by EEG which detailed consistent carbon dioxide above 5% v/v .

WSP conducted 3 No. monitoring visits, however they did not conduct a ground gas risk assessment. The GSV calculated from their results also detailed the site as a CS1 scenario.

Following this review of the results from WSP and EEG it was determined by GroundSolve that the site should be classified as Characteristic Situation 2 – Low Risk Scenario for which ground gas protections measures are required in accordance with BS:8485:2015+A1:2019 and CIRIA C665 based on the consistently elevated carbon dioxide.

Based on the CS2 classification of the ground gas regime for the site; a ground gas protection scheme with a points score of 3.5 has been recommended in accordance with British Standard B8485:2015+A1:2019 which is protective of the Characteristic Situation applied to the site.

Basic radon protection measures are also required on the site.

3.2 Protection Measures Detail

The finalised protection measures to be implemented on site comprise:

- Floor Slab – 1.5 point:
    - 150mm cast in situ reinforced suspended floor slab.
- Pressure relief pathway – 0.5 points:
    - Very good performance – 100mm gravel layer with gas drains to the external of the building.
- Gas membrane – 2 points:

- Visqueen low permeability gas membrane suitable for CS2 and basic radon protection.
- Visqueen ultimate double-sided joining tape.
- Visqueen ultimate top hat units.
- Visqueen foil lap tape.

The gas protection measures installed on site equal 4.0 points, which exceeds the protective for the CS2 classification for the site. Drawings provided by the client outlining the design have been included within Appendix A.

4 GROUND GAS VERIFICATION VISITS

In total 2 No. verification visits have been conducted by GroundSolve Ltd to verify the installation of the protection measures at plots 6, 9 and 17/18

The ground gas protection measures were installed by Gower Homes Ltd site staff.

The membrane was inspected to ensure it was installation has been carried out in accordance with the agreed design scheme. The membrane was lapped by 100mm and sealed with Visqueen double sided joining tape. Lapped edges, seams and service entries were subject to integrity testing via mechanical picking to ensure a full, non-broken seal was in place.

Any defects or deviations from the design identified by the GSL engineer were recorded and highlighted to the site team/installers and remediated in the presence of the GSL engineer.

Site visit verification sheets detailing the works conducted are included within Appendix B**.**

5 SITE CERTIFICATION

Based on the site visits conducted on site by GroundSolve, it is considered that the implemented ground gas protection measures are acceptable and conform with the specification.

6 REFERENCES

AGS: 2010: Electronic transfer of geotechnical and geoenvironmental data (Edition 4 including addendum 3, 2011). Association of Geotechnical and Geoenvironmental Specialists.

BRE Special Digest 1: 2005 Concrete in aggressive ground.

BS 1377 : 1990 : Methods of test for soils for civil engineering purposes. Published in nine parts. British Standards Institution.

BS 5930 : 2015 + A1:2020 : Code of practice for site investigation. British Standards Institution.

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

BS 10175 : 2011 + A2:2017: Investigation of potentially contaminated sites – Code of Practice. British Standards Institution

BS EN 1997-1: 2004 : Eurocode 7 – Geotechnical Design – Part 1: General rules. Including UK National Appendix of November 2007. British Standards Institution.

BS EN ISO 14688-1 : 2002 : Geotechnical investigation and testing – Identification and classification of soil – Part 1: Identification and description. British Standards Institution.

BS EN ISO 14688-2 : 2018 : Geotechnical investigation and testing – Identification and classification of soil – Part 2: Principles for a classification. British Standards Institution.

BS EN ISO 14689 : 2018 : Geotechnical investigation and testing – Identification and classification of rock – Part 1: Identification and description. British Standards Institution.

BS EN ISO 22475-1 : 2006 : Geotechnical investigation and testing – Sampling methods and groundwater measurements – Part 1: Technical principals for execution (July 2011 reprint). British Standards Institution.

BS EN ISO 22476-3 : 2005 : Geotechnical investigation and testing – Field Testing – Part 3: Standard penetration test

Britain From Above - https://britainfromabove.org.uk/en/image/WPW060399

http://www.warstateandsociety.com/Bombing-Britain

https://www.epa.gov/pfas/basic-information-pfas

UK Maps of Radon, http://www.ukradon.org/information/ukmaps

Health and Safety Executive (2015) Construction (Design and Management) Regulations.

Coal Authority Interactive Map Viewer, http://mapapps2.bgs.ac.uk/coalauthority/home.html

BGS Geology of Britain Viewer http://mapapps.bgs.ac.uk/geologyofbritain/home.html

CIRIA C665 Assessing risks posed by hazardous ground gases to buildings (2007)

NHBC Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present (2007)

7 DEFINITIONS

AOD	Above Ordnance Datum
bgl	Below ground level
BGS	British Geological Survey
BRE	Building Research Establishment
CBR	California Bearing Ratio (test)
COMAH	Control of Major Accident Hazards (regulations)
DQRA	Detailed Quantitative Risk Assessment
DWS	Drinking Water Standard
EQS	Environmental Quality Standard
GAC	Generic Assessment Criterion
GQA	General Quality Assessment (Environment Agency)
GQRA	Generic Quantitative Risk Assessment
GSV	Gas Screening Value
HCV	Health Criteria Value
IPPC	Integrated Pollution Prevention and Control (regulations)
NGR	National Grid Reference
NIHHS	Notification of Installations Handling Hazardous Substances (regulations)
OS	Ordnance Survey
ppm	Parts per million
ppmv	Parts per million by volume
SAC	Special Area of Conservation
SPZ	Source Protection Zone
SSAC	Site-Specific Assessment Criterion
SSSI	Site of Special Scientific Interest

APPENDIX A – DRAWINGS

SITE PLAN

LLANGOLLEN ROAD

CWRT H

BOWLING GREEN

LANCASTER TERRACE / MAES DERWYDD

PLOTS 17-21 INCLUSIVE TO FACE OUTWARDS ONTO LLANGOLLEN ROAD

BIN COLLECTION AREA plots 4 - 8 6M WIDE PRIVATE DRIVE

BIN COLLECTION AREA plots 14 - 19 6M WIDE PRIVATE DRIVE

2m wide footpath link

6M WIDE PRIVATE DRIVE

OPEN SPACE AND SUDS ATTENUATION AREA

ESTABLISHED SOFT LANDSCAPE AREA TO BE RETAINED TO GIVE SOFT, NATURAL BORDER WITH MAES DERWYDD

1 HI FFL 50.60
2 R FFL 51.15
3 C FFL 51.55
4 HI FFL 51.95
5 C FFL 52.55
6 B FFL 52.80
7 F FFL 53.00
8 B FFL 52.50
9 F FFL 51.90
10 B FFL 51.00
11 R FFL 50.40
12 HI FFL 49.90
13 B FFL 49.85
14 R FFL 49.80
15 C FFL 49.80
16 B FFL 49.80
17 E FFL 49.90
18 E FFL 49.90
19 E FFL 49.90
20 E FFL 49.90
21 R FFL 49.90

1 9 10 50 51 52 53 42 43 44 45 14 17

0M 10 20 50M

SCALE BAR 1:500

EDGE ARCHITECTS

RIBA Chartered Practice

EDGE Architects NW Ltd.
Studio 55:20
North Wales Business Park, Abergele
Conwy, LL22 8LJ

CLIENT:
Gower Homes Ltd

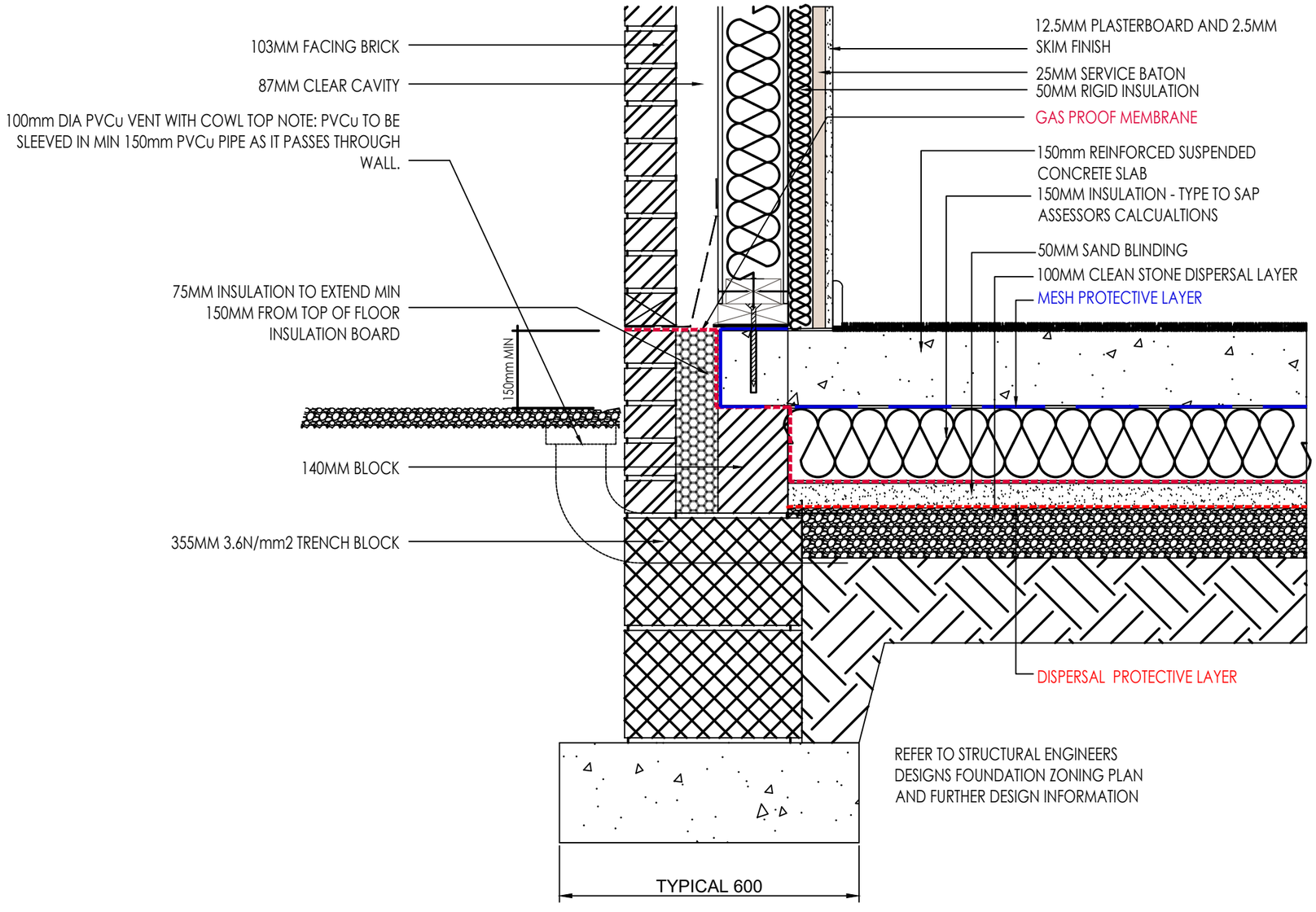
ADDRESS:
Former Air Products site, Llangollen Road, Acrefair LL14 3HW

PROJECT:
Proposed residential development

DRAWING No: 21-DES-001-02 C

DATE: MARCH 2022

SCALE: 1:500 @ A3



VENTED GAS MEMBRANE PROTECTION DETAIL- LLANGOLLEN ROAD, ACREFAIR

EDGE ARCHITECTS

RIBA Chartered Practice
EDGE Architects NW Ltd.
Studio 55:20
North Wales Business Park, Abergele
Conwy, LL22 8LJ

CLIENT:
GOWER HOMES

HOUSETYPE:
BEAUMARIS

TITLE:
VENTED- GAS MEMBRANE PROTECTION DETAIL

DRAWING No:
DETAIL 002 - Rev A

DATE: MAY 2024

SCALE: 1:10 @ A3

APPENDIX B – GROUND GAS VERIFICATION VISIT SHEETS

GroundSolve Ltd Visual Inspection of Gas Protection Measures

Job Name:	Llangollen Road, Acrefair	**Gas Characteristic Situation:**	CS2 and basic radon protection
Job No.:	GSL3116	**Development Type:**	Residential
Date:	05/09/2024	**Foundation type**	Strip and Pad
Visit By:	Eve Rowland	**Passive or Active?**	Passive
Weather:	Partly cloudy and cool	**Other Staff on Site:**	Gareth Evans – Gower Homes

Assessment of Measures on Site

Verification Area		
• The verification visit conducted on the 5th of September 2024 was to verify Plot 6 ahead of the concrete slab pour.		
No.	**Item**	**Comment**
1 Gas Membrane		
1.1	Condition of sub-grade and underside of gas membrane	Subgrade in good condition, comprising; • 100mm of clean stone. • Terram dispersal protection membrane layer. • 50mm of sand blinding. • Gas membrane.
1.2	Gas membrane type	Yellow Visqueen Low Permeability Gas Membrane.
1.3	Gas membrane condition	Good condition
1.4	Joining tape product and or sealing technique used	Visqueen Ultimate Double-Sided Jointing Tape and Visqueen Gas Resistant Foil Lap Tape.
1.5	Lapping design	100mm laps at membrane edges with double taped edges.
1.6	Laps, welds, and joint seals	Localised area needing additional taping; see photographs below.
1.7	Service entry seals	Sealed with ultimate double-sided jointing tape and to form the seal then reinforced with foil lap tape.
2 Passive Venting		
2.1	Sub-floor void	A sub floor void has been installed comprising of 100mm of clean stone.
2.2	External wall airbricks	N/A
2.3	Internal sleeper walls	N/A
2.4	External air vents/ducts	The sub-floor void is connected to vents to the exterior of the buildings.
3 Active Venting		
3.1	System details	N/A – passive venting system in place.
Additional Notes		

GroundSolve Ltd

Job No.:	GSL3116
Job Title.:	Llangollen Road, Acrefair
Engineer:	E Rowland

Conclusion
Plot 6 has been verified and shown to comply with the specification.



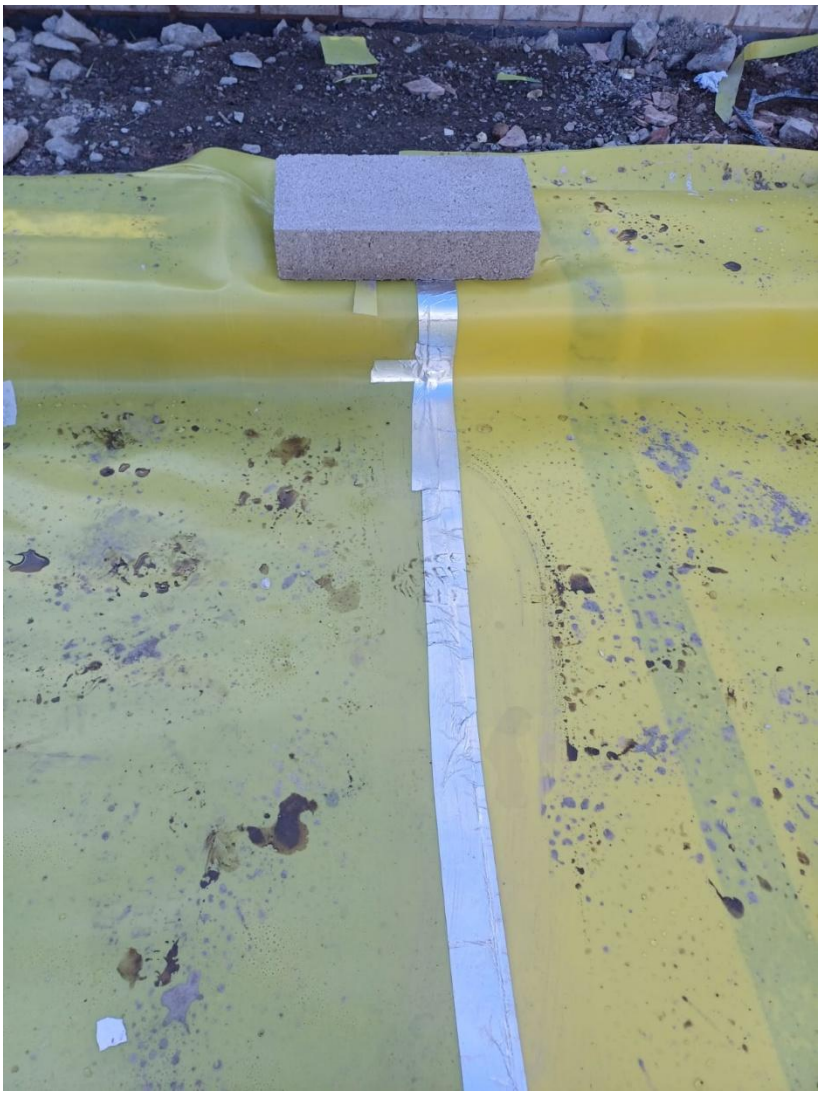
Photograph 1 – Overview of plot 6



Photograph 2 – Other side overview of plot 6, also detailing well sealed corners, lapped seas and service entries.



Photograph 3 – Plot 6 garage connected to main building.



Photograph 4 – Well sealed double taped, lapped joints



Photograph 5 – Mechanical picking showing well sealed service entries.



Photograph 6 – Mechanical picking of taped corners to demonstrate seal.

GroundSolve Ltd

Job No.:	GSL3116
Job Title.:	Llangollen Road, Acrefair
Engineer:	E Rowland

GroundSolve Ltd Visual Inspection of Gas Protection Measures

Job Name:	Llangollen Road, Acrefair	**Gas Characteristic Situation:**	CS2 and basic radon protection
Job No.:	GSL3116	**Development Type:**	Residential
Date:	13/11/2024	**Foundation type**	Strip and Pad
Visit By:	Eve Rowland	**Passive or Active?**	Passive
Weather:	Cloudy, cold, and foggy	**Other Staff on Site:**	Gareth Evans – Gower Homes

Assessment of Measures on Site

Verification Area		
• The verification visit conducted on the 13th of November 2024 was to verify Plot 9 and Plot 17/18 ahead of the concrete slab pour.		
No.	**Item**	**Comment**
1 Gas Membrane		
1.1	Condition of sub-grade and underside of gas membrane	Subgrade in good condition, comprising; • 100mm of clean stone. • Terram dispersal protection membrane layer. • 50mm of sand blinding. • Gas membrane.
1.2	Gas membrane type	Yellow Visqueen Low Permeability Gas Membrane.
1.3	Gas membrane condition	1 No. puncture hole identified in plot 9, and loose tape identified on Plot 17/18; both of which were repaired whilst on site.
1.4	Joining tape product and or sealing technique used	Visqueen Ultimate Double-Sided Jointing Tape and Visqueen Gas Resistant Foil Lap Tape.
1.5	Lapping design	100mm laps at membrane edges with double taped edges.
1.6	Laps, welds, and joint seals	Localised area needing additional taping; see photographs below.
1.7	Service entry seals	Sealed with ultimate double-sided jointing tape and to form the seal then reinforced with foil lap tape.
2 Passive Venting		
2.1	Sub-floor void	A sub floor void has been installed comprising of 100mm of clean stone.
2.2	External wall airbricks	N/A
2.3	Internal sleeper walls	N/A
2.4	External air vents/ducts	The sub-floor void is connected to vents to the exterior of the buildings.
3 Active Venting		
3.1	System details	N/A – passive venting system in place.
Additional Notes		
This plot does not have a connected garage.		

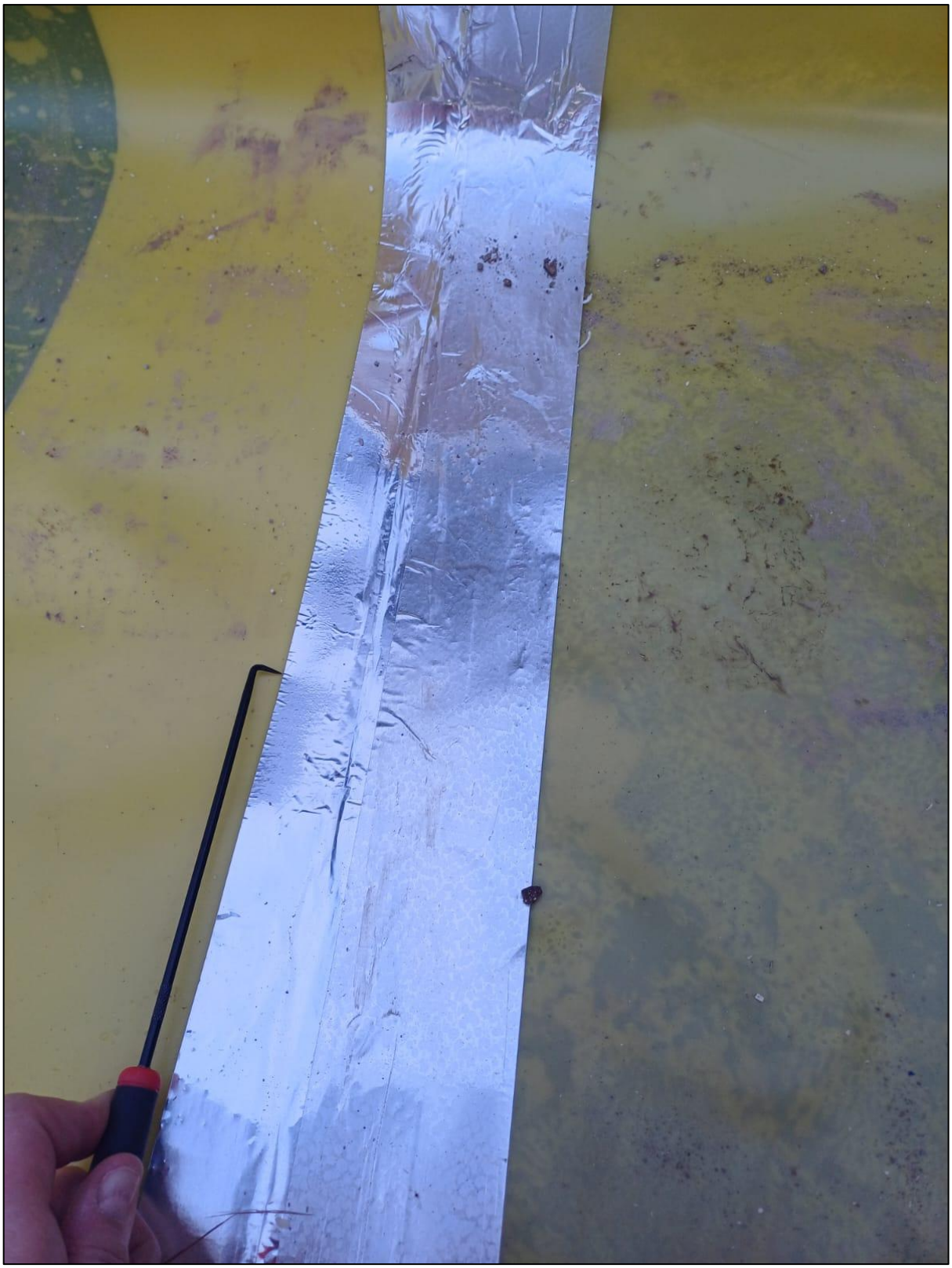
GroundSolve Ltd

Job No.:	GSL3116
Job Title.:	Llangollen Road, Acrefair
Engineer:	E Rowland

Conclusion
Plot 9 and Plot 17/18 has been verified as acceptable and complies with the specification.



Photograph 1 – Overview of plot 9



Photograph 2 – Double lapped seams mechanically picked.



Photograph 3.1 – Puncture hole identified



Photograph 3.2 – repairing of puncture hole



Photograph 3.2 – repaired puncture hole



Photograph 4 – Mechanical picking demonstrating good seals around service entries



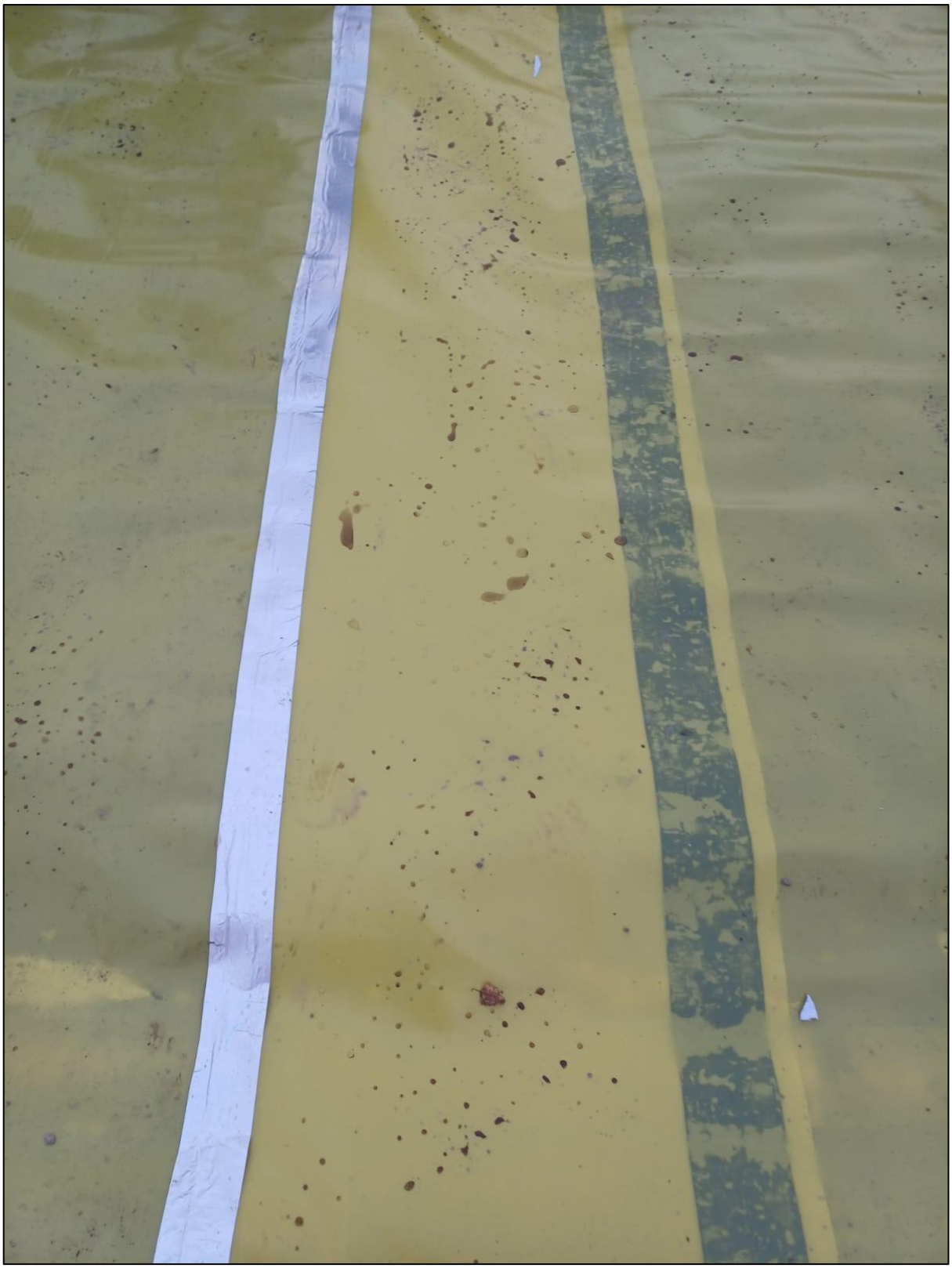
Photograph 5 – Venting.



Photograph 6 – Overview of plot 17



Photograph 7 – Overview of Plot 18



Photograph 8 – Double taped laps adjoining plot 17/18



Photograph 9.1 – Identified loose tape in plot 18



Photograph 9.2 – Sealing loose tape in plot 18



Photograph 9.3 – Final taped and sealed corner



Photograph 10 – Well sealed service entries on plots17/18

APPENDIX C– CURRENT GUIDANCE FOR GROUND GAS RISK ASSESSMENT

Box 8.4 of CIRIA C665 Gas protection measures for low-rise housing development based upon allocated NHBC Traffic light (Boyle and Witherington, 2007)	
Traffic Light Classification	**Protection Measures Required**
Green	Negligible gas regime identified, and gas protection measures are not considered necessary.
Amber 1	Low to intermediate gas regime identified, which requires low-level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to limit the ingress of gas into buildings. Gas protection measures should be as prescribed in BRE Report 414. Ventilation of the sub-floor void should facilitate a minimum of one complete volume change per 24 hours.
Amber 2	Intermediate to high gas regime identified, which requires high-level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to prevent the ingress of gas into buildings. Gas protection measures should be as prescribed in BRE Report 414. Membranes should always be fitted by a specialist Contractor. As with Amber 1, ventilation of the sub-floor void should facilitate a minimum of one complete volume change per 24 hours. Certification that these passive protection measures have been installed correctly should be provided.
Red	High gas regime identified. It is considered that standard residential housing would not normally be acceptable without a further Gas Risk Assessment and/or possible remedial mitigation measures to reduce and/or remove the source of gas.

For a 'Situation A Development' (All development except low rise housing with gardens), the GSV value is used to derive the appropriate Characteristic Situation from Table 8.5 of CIRIA C665 (below):

Table 8.5 from CIRIA C665 Modified Wilson and Card Classification					
Characteristic Situation (CIRIA R149)	**Comparable Partners in Technology gas Regime (see Box 8.2)**	**Risk Classification**	**Gas Screening Value (CH_4 or CO_2) (l/hr)[1]**	**Additional Factors**	**Typical Source of Generation**
1	A	Very low risk	<0.07	Typically, methane ≤ 1% and/or carbon dioxide ≤ 5%. Otherwise consider increase to Situation 2	Natural soils with low organic content "Typical" made ground
2	B	Low risk	<0.7	Borehole air flow rate not to exceed 70l/hr. Otherwise consider increase to characteristic Situation 3	Natural soil, high peat/organic content. "Typical" made ground
3	C	Moderate risk	<3.5		Old landfill, inert waste, mine working flooded
4	D	Moderate to high risk	<15	Quantitative risk assessment required to evaluate scope of protective measures.	Mine working susceptible to flooding, completed landfill (WMP 26B criteria)
5	E	High risk	<70		Mine working unflooded inactive with shallow workings near surface
6	F	Very high risk	>70		Recent landfill site

It was intended in CIRIA C665 that the characteristic situation allocated to the development from the table above would then be used in Table 8.6 of CIRIA C665 in order to determine the level of gas protection the development requires. However, BS8485:2015 superseded this document and a different set of mitigation standards were put forward.

The recommended minimum gas protection score (points) be selected based on the building type (Table 3 which defines four building types) and the ground gas Characteristic Situation as detailed in Table 4 of BS8485:2015+A1:2019 (see below).

The first step in the decision-making process is to obtain the level of gas protection necessary in the range 0 to 7.5 from Table 4. Then a combination of structural barriers (Table 5) ventilation protection measures (Table 6) and/or gas resistant membranes (Table 8)should be chosen to meet that requirement. The level of gas protection necessary should take into account the characteristic gas situation and a number of other factors. The whole decision-making process should be made transparent, where all parties can see the approach being taken, can understand the various steps and decisions made and be confident that a risk-assessed solution has been designed and installed commensurate with the construction and site constraints.

Where the gas Characteristic Situation is 4 or more (and for NHBC Red situations according to CIRIA C665), the site requires a comprehensive risk assessment to confirm the scope of protection measures. These are higher risk sites and reliance on Table 4 alone is not sufficient.

BS8485:2015+A1:2019 Table 3 Building Types				
	Type A	**Type B**	**Type C**	**Type D**
Ownership	Private	Private or commercial/ public, possible multiple	Commercial / public	Commercial / industrial
Control (change of use, structural alterations, ventilation	None	Some but not all	Full	Full
Room sizes	Small	Small / medium	Small to large	Large industrial / retail park style

BS8485:2015+A1:2019 Table 4 Gas Protection Score by CS and Type of Building				
CS	Required Gas Protection			
	High risk	Medium risk	Low risk	
	Type A	Type B	Type C	Type D
1	0	0	0	0
2	3.5	3.5	2.5	1.5
3	4.5	4	3	2.5
4	6.5 (A)	5.5(A)	4.5	3.5
5	(B)	6A)	5.5	4.5
6	(B)	(B)	(B)	6
a) Residential building should not be built on CS4 or higher sites unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g., high-performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system, e.g., in institutional and/or fully serviced contractual situations.				
b) The gas hazard is too high for this empirical method to be used to define the gas protection measures				
NOTE 3 The NHBC has published guidance for use on residential developments, which utilise an alternative classification ("traffic light") system. This guidance typically applies to Type A buildings utilising beam and block floor constructions with clear void ventilation. The design choice variables are limited to decisions relating to the membrane specification and verification recommendations (see Table 7). Designers utilising this system would therefore need to refer to NHBC to assess compliance for specific recommendations [see 8485:2015 for further on this note]				
NOTE4 The method of selecting the combination of these types of protection is given in section 7.2 of BS8485:2015. Once type of measures has been decided, the detailed design and specification of the measures should be undertaken (section 7.3)				

Section 7.2 defines the order of selecting protective measures. The first choice is provided by structural barriers as defined in Table 5.

BS8485+A1:2019 Table 5 Gas protection scores for structural barriers		
PROTECTION ELEMENT/SYSTEM	SCORE	COMMENTS
Floor and substructure design		
Floor slabs Block and beam floor slab	0	*General – score conditional that breaches of slab are sealed*
Cast in situ ground-bearing floor slab (with only nominal mesh reinforcement)	0.5	
Cast in situ monolithic reinforced ground-bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations (with only nominal mesh reinforcement)	1 or 1.5	*To achieve 1.5, raft or suspended slab to be well reinforced to prevent cracking and minimal penetrations*
Basement floor and walls to BS 8102:2009, Grade 2 waterproofing – See notes in BS8485:2015+A1:2019	2	
Basement floor and walls to BS 8102:2009, Grade 3 waterproofing - See notes in BS8485:2015+A1:2019	2.5	*Conditional that waterproofing is not based on geosynthetic clay liner*

Ventilation methods are detailed in Table 6, and points can only be gained from using one of the five types:

BS8485:2015+A1:2019 Table 6 Gas Protection Scores for Ventilation Protection Measures		
PROTECTION ELEMENT/SYSTEM	**SCORE**	**COMMENTS**
a) Pressure relief pathway (usually formed by low fines gravel or with a thin geocomposite blanket with strips terminating in a gravel trench external to the building	0.5	*Whenever possible, a pressure pathway relief pathway (as a minimum) should be installed in all gas protection measures systems.* *If a layer has a low permeability and/or is not terminating in a venting trench (or similar), then the score is zero.*
b) Passive sub floor dispersal layer Very good performance Good performance Media used to provide the dispersal layer are: • Clear void • Polystyrene void forming blanket • Geocomposite void former blanket • No-fines gravel layer with gas drains • No-fines gravel layer	 2.5 1.5	*Performance criteria shown in Fig B.6 and B.7 of BS 8484:2015.[See Annex B]*
c) Active dispersal layer, usually comprising fans with active abstraction (suction) from a subfloor dilution layer, with roof level vents. The dilution layer may comprise a clear void or be formed of geocomposite or polystyrene void formers	1.5 to 2.5	*This system relies on continued serviceability of the pumps; therefore, alarm and response systems should be in place. [See Annex B].*
d) Active positive pressurisation by the creation of a blanket of external fresh air beneath the building floor slab by pumps supplying air to points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket	1.5 to 2.5	*This system relies on continued operation of the pumps; therefore, alarm and response systems should be in place. [See Annex B].*
e) Ventilated car park (floor slab of occupied part of the building under consideration is underlain by a basement or under croft)	4	*Assumes car park is vented , designed to Building Regulations 2000, Approved Document F.*

Membrane methods are detailed in Table 7.

BS8485:2015+A1:2019 Table 7 Gas protection score for gas resistant membrane		
PROTECTION ELEMENT/SYSTEM	**SCORE**	**COMMENTS**
Gas resistant membrane meeting all of the following criteria: • Sufficiently impervious to gases with a methane gas transmission rate <40.0 ml/day/m²/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method) • Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions; • Sufficiently strong to withstand in-service stresses (e.g., settlement if placed below a floor slab); • Sufficiently strong to withstand the installation process and following trades until covered (e.g., penetration from steel fibres in fibre reinforced concrete, dropping tools etc); and to withstand in-service stresses (e.g., settlement if placed below a floor slab) • capable, after installation, of providing a complete barrier to the entry of the relevant gas; and • verified in accordance with CIRIA C735	2	*The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation, and the integrity of joints.* *If a membrane is installed that does not meet the criteria, then the score is zero.*
See notes in BS8485:2015+A1:2019 regarding membrane requirements		

For a site which is impacted by migratory gases from an off source, the development may be protected by imposing pathway intervention methods, which if successfully validated, could also remove the need for further analysis. It is essential that the gas regime in these circumstances has been fully characterised and that the only source impacting the site is located off site and that the pathway is clearly defined and its interception equally proven before construction commences. Pathway intervention methods may include vertical membrane installations, venting trenches, rows of stone columns, activated trenches and various proprietary systems. These systems are particularly relevant to domestic housing where there is limited scope for foundation type solutions.

APPENDIX D– SPECIFICATION SHEETS

Technical support: +44 (0) 333 202 6800

Date Published: 04/04/2024

Visqueen Low Permeability Gas Membrane

Features and benefits

- BBA certified - third party accreditation
- Complies with NHBC Foundation's NF94 guidance for use in Type A and Type B membrane locations in reinforced cast in situ suspended floor slabs and rafts
- Complies with NHBC Amber 1 - suitable for low gas risk NHBC housing sites
- Flexible - easy to detail and install on site
- Supplied centre folded - reduces the risk of cracks in screed and limits creases
- 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 Low Permeability Gas Membrane is a co-polymer thermoplastic gas membrane, 0.5mm thick, yellow in colour and supplied 4m x 12.5m in a centre folded roll.

Approvals and standards

- Third party accreditation (BBA 13/5069)
- Complies with NHBC Foundation's NF94 guidance for use in Type A and Type B membrane locations in reinforced cast in situ suspended floor slabs and rafts
- Conforms to the specification requirements of NHBC Amber 1 applications
- Conforms to the specification requirements of BR 211:2023
- UKCA UKNI CE to EN 13967:2017
- Visqueen certified with Quality Management System ISO 9001:2015
- Visqueen certified with Occupational Health and Safety System ISO 45001:2018
- Visqueen certified with Environmental Management System ISO 14001:2015

Usage

Visqueen Low Permeability Gas Membrane can be used as a high performance radon membrane and/or damp proof membrane positioned within the ground floor construction either above or below the structural floor slab.

Radon, carbon dioxide and methane protection – NHBC NF94 guidance:
Visqueen Low Permeability Gas Membrane when installed with either taped or welded joints complies with NHBC Foundation's NF94 publication, Hazardous ground gas - an essential guide for housebuilders, in Type A membrane locations in cast in situ monolithic reinforced ground bearing rafts and reinforced cast in situ suspended floor slabs with minimal penetrations. Visqueen Low Permeability Gas Membrane also complies with this guidance when installed with welded joints in Type B membrane locations in cast in situ monolithic reinforced ground bearing rafts and reinforced cast in situ suspended floor slabs with minimal penetrations. For site or zone characteristic gas situations of CS4 and above, contact Visqueen Technical Services.

Carbon dioxide and methane protection – NHBC Traffic Light System:
Visqueen Low Permeability Gas Membrane is suitable to prevent the ingress of harmful levels of ground gases for housing applications where NHBC are the warranty provider and the site has been classified as Amber 1. In this application, the membrane is used above a precast suspended segmental subfloor, e.g. beam and block floor.

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 Top Hat Units
- VisqueenPro Detailing Strip, 300mm x 10m, 500mm x 10m
- Visqueen TreadGUARD 300, 2m x 75m
- Visqueen TreadGUARD 1500, 1m x 2m

Find your local stockist

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Visqueen Low Permeability Gas Membrane

Storage and handling

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

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

Installation

Visqueen Low Permeability Gas Membrane should be loose laid on the substrate. The membrane 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 Foil Lap Tape. In demanding site conditions seal lap joints with Visqueen Ultimate GR Lap Tape. Alternatively lap joints can be heat welded to achieve an effective seal. The overlap in the barrier is typically 100mm and when hand welding, a 35mm weld is normally achieved. When hand welding, a roller must be used.

Airtight seals should be formed around all service entry points. Visqueen Preformed Top Hat Units are available 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 Foil Lap Tape. The upstand should be secured with the supplied jubilee clip. Alternatively VisqueenPro Detailing Strip can be used to seal service entry points. The upstand should be secured with a 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 VisqueenPro Detailing Strip can be used to seal awkward junctions.

If the membrane is punctured or perforated a patch of the same material should be lapped at least 150mm beyond the limits of the puncture and either heat welded or bonded with Visqueen Pro Double Sided Jointing Tape and sealed with Visqueen Foil Lap Tape. Alternatively a patch can be formed using VisqueenPro 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 membrane the wire reinforcements and spacers must be prevented from puncturing the membrane. Where there is a high risk of potential damage, the membrane 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 Low Permeability Gas Membrane and all associated system components should not be installed below 5°C

Additional information

When used in full radon protection areas, a Visqueen Radon Sump or subfloor ventilation system maybe required.
To assist build sequencing, Visqueen Zedex CPT DPC is available for gas protection through masonry wall constructions.
For suspended beam and block floor detailing see LPGM-01.
For internal and external corners Visqueen Preformed Corner Units should be used see PFU-553.
To seal around steel columns use VisqueenPro Detailing Strip see LPGM-52.
For additional detailing information, contact Visqueen Technical Services +44 (0) 333 202 6800.

The product is recyclable and categorised under LDPE recycling code 4.

Visqueen is part of Berry bpi, the largest European recycler of polyethylene. This product is recyclable and should be segregated on site in accordance with site management procedures for plastic waste. We have 4 recycling sites in the UK where the plastic waste could be recycled and converted back into a second life product. Please contact us to find out more.

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Visqueen Low Permeability Gas Membrane

Propertry	Test method	Units	Compliance criteria	Result
Visible defects	EN 1850 -2	-	Pass/Fail	Pass
Length	EN 1848-2	m	-10%/+10%	12.5
Width	EN 1848-2	m	-2.5%/+2.5%	4
Straightness	EN 1848-2	-	Pass/Fail	Pass
Thickness	EN 1849-2	mm	-12%/+12%	0.5
Tensile strength - MD	EN 12311	N/mm^2	MLV	15
Tensile strength - TD	EN 12311	N/mm^2	MLV	15
Tensile elongation - MD	EN 12311	%	MLV	400
Tensile elongation - TD	EN 12311	%	MLV	400
Joint strength	EN 12317-2	N	MDV	298
Watertightness 2kPa	EN 1928	-	Pass/Fail	Pass
Resistance to impact	EN 12691	mm	>MLV	200
Durability (artificial 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	333
Resistance to tearing (nail shank) MD	EN 12310-1	N	MDV	335
Radon permeability	SP Test Method	m^2/s	MDV	5.477×10^{-12}
Radon transmittance	SP Test Method	m/s	MDV	1.095 x 10-8
Carbon dioxide permeability	IS0 2782	m/s/Pa	MDV	2.8 x 10-17
Methane gas transmission rate	ISO 15105-1	$ml/m^2/day/atm$	MDV	213
Reaction to fire	EN 13501-1	Class	MDV	F
Water vapour resistance	EN 1931	MNs/g	MDV	1445
Water vapour - permeability/ density flow rate	EN 1931	$g/m^2/d$	MDV	0.1239
Equivalent air layer thickness	EN 1931	SD in m	MDV	290
Water vapour resistance factor	EN 1931	u	MDV	615,000

Health and safety information

Refer to the Visqueen Low Permeability Gas Membrane safety datasheet (SDS).

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Visqueen Low Permeability Gas Membrane

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Complete Range, Complete Solution



Structural Waterproofing | Gas Protection | Damp Proof Membrane | Tapes | Damp Proof Course | Stormwater | Vapour Control

Visqueen Technical Support

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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).

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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

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Technical Datasheet - Product Overview

VISQUEEN INSTALLATION & SYSTEM COMPONENTS

Technical support: +44 (0) 333 202 6800

Date Published: 03/08/2020

Visqueen Ultimate Double Sided Jointing Tape, 100mm x 15m

Features and benefits

- Third party certification - part of a gas protection BDA approved jointing system
- Gas resistant - provides excellent resistance to harmful bulk gases ingress and moisture ingress
- Excellent adhesion - to gas membranes
- Extra wide - to improve joint strength and prevent gas ingress

Product description

Visqueen Ultimate Double Sided Jointing Tape is a double sided butyl based compound with an oversize quick release film. It is available in roll format 100mm x 15m.

To complete the joint use the Visqueen Ultimate Gas Resistant Lap Tape for sealing laps.

Approvals and standards

- Third party accreditation - BDA certification
- Conforms to the specification requirements of BS 8485:2015 + A1:2019
- Quality Management System ISO 9001:2015
- Occupational Health and Safety System ISO 18001:2007
- Environmental Management System ISO 14001:2015

Usage

Visqueen Ultimate Double Sided Jointing Tape is used to bond Ultimate range of membranes together along the appropriate sheet lap ends. It can also be used internally and externally and is suitable in compressed load applications.

It can also be used for patch work where the membrane is punctured, creating airtight seals around pipe penetrations and bonding the floor membrane to the damp proof course at the horizontal plane.

System components

Find your local stockist

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Technical support: +44 (0) 333 202 6800

Date Published: 03/08/2020

Visqueen Ultimate Double Sided Jointing Tape, 100mm x 15m

Storage and handling

Store in warm, dry and clean environment in its current packaging. The tape should not be exposed to long periods of ultraviolet light. In very cold weather, prior to use ensure that the material is stored in warm conditions above 5°C.

Preparation

Ensure all surfaces are clean and dry, if applying to a surface that is not a membrane i.e. concrete, ensure that the surface is free from loose friable material prior to using the Visqueen HP Tanking Primer. The membrane joint surfaces should be dry and free from contamination such as dust, sand or moisture. Ensure the surface and working area is not water logged. Avoid areas of unsupported jointing.

Installation

Apply tape to the lap area of the laid sheet starting approximately 50mm from the membrane edge. Apply pressure to the tape to ensure the tape has adhered to the membrane. Remove quick release paper from the tape and overlap the adjoining membrane by minimum 150mm. Once the tape is applied, the completed lap should be well rolled with firm pressure to ensure a complete seal joint has occurred, and continuity with the adjacent sheet has been achieved. Seal the overlap using Visqueen Gas Resistant Lap tape equidistant over the lap.

Usable temperature range

It is recommended that Visqueen Ultimate Double Sided Jointing Tape and other system components should be used above 5°C.

Additional information

Avoid areas of unsupported jointing.

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Technical Datasheet - Test Data

VISQUEEN INSTALLATION & SYSTEM COMPONENTS

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Date Published: 03/08/2020

Visqueen Ultimate Double Sided Jointing Tape, 100mm x 15m

Property	Result
Width	100mm
Length	15m
Colour	Black
Adhesive type	Butyl
Dynamic Shear Adhesion	18 N/cm2
Dynamic Tensile Adhesion	18 N/cm2
180° Peel Adhesion	11 N/cm2
Service Temperature Range	-40 to 90°C
Application temperature	>5°C

Health and safety information

Please refer to material safety datasheet.

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Technical Datasheet - Product Overview

Technical support: +44 (0) 333 202 6800

Date Published: 28/05/2024

Visqueen Ultimate Top Hat Units

Features and benefits

- Provides a gas and damp proof seal around service pipe penetrations
- Suitable for use with Visqueen damp proof membranes, gas and hydrocarbon protection systems

Product description

Visqueen Ultimate Top Hat Units are made from Visqueen Ultimate HC BLOK and are supplied with a metal jubilee clip.

The units are available in the following standard sizes: 110mm, 135mm and 160mm. These sizes relate to the external diameter of the pipe.

Non standard sizes are available on request.

Approvals and standards

- Third party certification with Visqueen Ultimate Membranes and Visqueen Gas Membranes
- Visqueen certified with Quality Management System ISO 9001:2015
- Visqueen certified with Occupational Health and Safety System ISO 45001:2018
- Visqueen certified with Environmental Management System ISO 14001:2015

Usage

Visqueen Ultimate Top Hat Units are used in conjunction with all Visqueen damp proof membranes, gas and hydrocarbon protection systems to provide continuity of protection at service pipe penetrations.

System components

Find your local stockist

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+44 (0) 333 202 6800 | enquiries@visqueen.com | www.visqueen.com

Technical support: +44 (0) 333 202 6800

Date Published: 28/05/2024

Visqueen Ultimate Top Hat Units

Storage and handling

Visqueen Ultimate Top Hats should be stored under cover in their original packaging.

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

Preparation

Ensure all surfaces are clean, dry and free from contamination such as dust or sand. Avoid areas of unsupported jointing.

Installation

Cut a circular hole in the Visqueen membrane as close as possible to the pipe. Bond the Visqueen Ultimate Top Hat Unit to both the pipe and the membrane with Visqueen double sided tape appropriate for the membrane specification. Seal the top hat laps to the pipe and membrane with the Visqueen single sided tape appropriate for the membrane specification.

Complete the installation by fixing the supplied jubilee clip around the top hat upstand.

When used in conjunction with Visqueen Ultimate HC BLOK membrane, the skirt of the top hat unit can be heat welded to the membrane.

Usable temperature range

it is recommended that Visqueen Ultimate Top Hat Units and associated system components should not be installed below 5°C.

Additional information

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.

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Visqueen Ultimate Top Hat Units

Property	Test method	Units	Criteria	Result	
Colour				Gold/White	
Standard sizes *		mm		110, 135, 160	
* Non standard sizes available on request					
BS8485:2015 + A1:2019 - Methane testing	Test method	Units	Criteria	Result	
Methane permeability	ISO 15105-1	ml/m²/d/ atm	<40	1.3	
C748 - Permeation vapour tests - 100% concentration		Criteria	ml/m²/d	mg/m²/d	mg/m²/ hr
benzene	ISO 15105-2	MDV	0.08	70	2.92
toluene	ISO 15105-2	MDV	0.09	78.5	3.27
ethyl benzene	ISO 15105-2	MDV	0.11	93.8	3.91
m,p xylene	ISO 15105-2	MDV	0.01	6.7	0.28
hexane	ISO 15105-2	MDV	gas	2.6	0.11
vinyl chloride	ISO 15105-2	MDV	0	6.4	0.27
tetrachloroethene (PCE)	ISO 15105-2	MDV	0	3.2	0.13
trichloroethene (TCE)	ISO 15105-2	MDV	solid	0.3	0.01
naphthalene	ISO 15105-2	MDV	0.03	19.7	0.82
C748 - Chemical immersion testing		weight %	Thickness %	Tensiles/ elongation	
Pass is achieved if the aged membrane is within 25% of the fresh sample					
Benzene	BS EN 14414	Pass	Pass	Pass	
Toluene	BS EN 14414	Pass	Pass	Pass	
Ethyl benzene	BS EN 14414	Pass	Pass	Pass	
(m,p, and o) xyxlenes	BS EN 14414	Pass	Pass	Pass	
Hexane	BS EN 14414	Pass	Pass	Pass	
Vinyl chloride	BS EN 14414	Pass	Pass	Pass	
Tetrachlororthene	BS EN 14414	Pass	Pass	Pass	
Trichloroethene	BS EN 14414	Pass	Pass	Pass	
Naphthalene	BS EN 14414	Pass	Pass	Pass	

Health and safety information

Refer to Visqueen Ultimate Top Hat Units safety datasheet (SDS).

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