

Gas Protection Design Report

Site: The Barns, Halewood

Reference: 18-365-R3-1

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1. BACKGROUND

Mac Roofing and Contracting Limited instructed E3P to prepare a Gas Protection Design Report (GPDR) to document the mitigation measures and verification requirements to ensure compliance with the approved Remediation Strategy and ensure that relevant planning conditions are met and can be subsequently discharged.

This GPDR specifically relates to the Architectural Emporium Limited house types and corresponding mitigation measures and verification requirements.

The site has been subject to a site Investigation, undertaken by BEK Geoenvironmental Consulting (Ref: BEK-23116-2, dated November 2023), which informed the development of the Conceptual Site Model and, ultimately, the ground gas risk assessment summarised in Table 1.1.

These documents have been reviewed by the Local Planning Authority (LPA) and the Environment Agency (EA), and the subsequent remediation work incorporating the associated building phase mitigation measures has been approved.

This GPDR has specifically been developed to clearly define the mitigation measures required for individual sectors of the site and provide design justification and verification requirements to demonstrate the compliant construction before the first occupation of a house.

If any of the procedures outlined in this summary are not completed, this may delay obtaining a Warranty and Council for Mortgage Lenders and a Certificate of Completion.

Table 1.1 Previous Works

Previous Reports	The following previous reports are known to have been completed for the site:	
		Geo Ventures: Phase 1 Desk Study / Preliminary Risk Assessment Report. (Dated June 2021) Prepared for Charles Attard;
		BEK Geo-Environmental Consulting: Site Investigation and Ground Assessment (Dated November 2023) prepared for Mac Roofing and Contracting Ltd. (Ref: BEK-23116-2);
		BEK Geo-Environmental Consulting: Ground Gas Risk Assessment (Dated: 28th February 2024) prepared for Mac Roofing and Contracting Ltd (Ref: BEK/23116/280224/3);
		E3P Ltd: Remediation and Enabling Works Strategy (Dated February 2026) prepared for Mac Roofing and Contracting Ltd (Ref: 18-365-R1-1);
		E3P Ltd: Asbestos Management Plan (Dated February 2026) prepared for Mac Roofing and Contracting Ltd (Ref: 18-365-R2-1);



1.1. OVERVIEW OF GROUND GAS RISK ASSESSMENT

The final ground gas risk assessment is summarised within the BEK Ground Gas Risk Assessment, this assessment concluded the following:

- ❶ BEK identified potential ground-gas sources as Made Ground, an infilled pond, and an adjacent former refuse tip and sewage works.
- ❷ Site investigation identified heterogeneous Made Ground including coal, ash and clinker, between approximately 0.15 m and 1.40 m thick, generally overlying natural clay;
- ❸ Ground gas monitoring was undertaken on six occasions between October 2023 and January 2024 at WS2, WS3, WS5 and WS6.
- ❹ No methane was detected above the limit of detection, while steady-state carbon dioxide concentrations reached a maximum of 4.8% v/v.
- ❺ Calculated GSVs were low, with a maximum CO₂ GSV of 0.0132 l/hr at WS5, initially indicating CS1.
- ❻ Monitoring was affected by high groundwater levels and limited well headspace, with water entering sampling tubes during several monitoring visits; the report therefore considered that some measured gas concentrations and flow rates may not represent sustained surface emissions.
- ❼ An assessment using CL:AIRE RB17 calculated an average TOC of 4.24%, which could indicate CS3; however, because ash, clinker and coal can elevate TOC without being readily degradable, the report adopted CS2 (low risk).
- ❽ The report recommends CS2 gas protection measures comprising a gas-resistant membrane and passive ventilation beneath suspended beam-and-block floors, with all joints and penetrations sealed and the installation independently validated in accordance with a Gas Verification Plan.

In line with the above assessment, all plots will require construction with mitigation measures that are compliant with CS2 Characteristic Situation.

The design of mitigation measures to protect dwellings from the ingress of ground gases should be completed in accordance with pertinent industry guidance and best practise.



2. GAS MITIGATION DESIGN AND VERIFICATION

2.1. OVERVIEW OF RISK CLASSIFICATION

The Ground Gas Risk Assessment suggests the site will fall into the bracket for Characteristic Situation 2.

The site is recorded as being in an area where <1% of homes are affected by Radon; therefore, no radon mitigation measures are required in the proposed dwellings.

The site is not located in an area that is potentially at risk from historical or shallow coal workings. Therefore, the potential ground gas risk from mine workings is considered to be negligible and a CL:AIRE Good Practice for Risk Assessment for Coal Mine Gas Emissions assessment has not been undertaken for the site.

The ground gas risk assessment is to be approved by all stakeholders, including the local authority, building control, and warranty providers, before the commencement of any work on-site to construct mitigation measures.

2.2. OVERVIEW OF REQUIREMENTS FOR RESIDENTIAL BUILDING GAS RISK MITIGATION

2.2.1. DESIGN STANDARDS

The overarching design criteria for mitigation of ground gases are defined within British Standards BS8485:2015 +A1:2019 Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Gases for New Buildings.'

The BS8485:2015 +A1:2019 design system references the type of building being constructed (Type A to D), and the gas risk as defined by the site Conceptual Site Model (CSM) to determine a points-based system for the design of the protection measures.

2.2.2. BRITISH STANDARD BS8485:2015+A1:2019

British Standard BS8485 has determined that the proposed development comprises low-rise residential dwellings that are classified as follows:

- **Type A Building** – Private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Some small rooms are present. Probably conventional building construction (rather than civil engineering). Examples include private housing and some retail premises.
- **Type B Building** – Private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium sized rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises and parts of some public buildings (such as schools, hospitals, leisure centres) and parts of hotels.



Based on the ground gas risk assessment and the proposed Type A Building, it is envisaged that a point score of 3.5 will be required for affected properties, as summarised in Table 2.1 and specified in Table 2.2.

Table 2.1 BS8485:2015+A1:2019 Points Required for Type A and Type B Buildings

CHARACTERISTIC SITUATION	MINIMUM GAS PROTECTION SCORE (POINTS)	
	HIGH SENSITIVITY	
	TYPE A BUILDING	TYPE B BUILDING
1	0	0
2	3.5	3.5
3	4.5	4
4	6.5 A)	5.5 A)
5	– B)	6
6	– B)	– B)

BS8485 (2015)+A1(2019) Notes:

A) Residential buildings 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.



Table 2.2 Summary of Ground Gas Mitigation Measures – BS8485:2015+A1:2019

GAS PROTECTION SCORES FOR THE STRUCTURAL BARRIER			SCORE^A
Floor and Substructure Design			
Precast Suspended Segmental Subfloor (Beam and Block)			0
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			1 or 1.5 ^B
Basement Floor and Walls Conforming to BS 8102:2009, Grade 2 WaterproofingC D			2
Basement Floor and Walls Conforming to BS 8102:2009, Grade 3 WaterproofingC D			2.5
Notes			
A) The scores are conditional on breaches of floor slabs, etc., being effectively sealed.			
B) To achieve a score of 1.5 the raft or suspended slab should be well reinforced to control cracking and have minimal penetrations cast in (see A.2.2.2).			
C) The score is conditional on the waterproofing being provided by a suitable structural barrier with the design and detailing of the walls and floor meeting the requirements for Type B protection. The score cannot be assigned for Type A (waterproof membrane) or Type C (drained cavity wall).			
D) If a membrane is installed beneath and around the basement to provide Type A waterproofing (BS 8102:2009), it can be assigned a gas protection score in accordance with Table 7, if it meets all the criteria for a gas resistant membrane in that table.			
When practical, utilities should enter the building above floor level with any conduit or meter housing being properly vented outside of the building.			
PROTECTION ELEMENT SYSTEM		SCORE	COMMENTS
Gas protection scores for ventilation protection measures			
(a) Pressure Relief Pathway – Usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building.		0.5	Whenever possible a pressure relief pathway (as a minimum) should be installed in all gas protection measures systems.
(b) Passive Subfloor Dispersal Layer – Media used to provide the dispersal layer are: Clear void; Polystyrene void former blanket; Geocomposite void former blanket; No fines gravel layer with gas drains; and No fines gravel layer.	Very good performance	2.5	If the layer has a low permeability and/or is not terminated in a venting trench (or similar), then the score is 0. The ventilation effectiveness of different media depends on a number of different factors including the transmissivity of the medium, the width of the building, the side ventilation spacing and type and the thickness of the layer. The selected score should be assigned taking into account the recommendations in Annex B of BS 8485 (2015). Passive ventilation should be designed to meet at least "good performance".
	Good performance	1.5	
(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. There should be robust management systems in place to ensure the continued maintenance of the system, including pumps and vents. Active ventilation should always be designed to meet at least "good performance".
(d) Active Positive Pressurisation – Provided 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. The score assigned should be based on the efficient "coverage" of the building footprint and the redundancy of the system. Active ventilation should always be designed to meet at least "good performance".
(e) Ventilated Car Park – Floor slab of occupied part of the building under consideration is underlain by a basement or undercroft car park.		4	Assumes that the car park is vented to deal with car exhaust fumes, designed to Buildings Regulations 2000, Approved Document F [9].



PROTECION ELEMENT SYSTEM	SCORE	COMMENTS
Gas Protection Score for the Gas Resistant Membrane Gas resistant membrane meeting all of the following criteria: Sufficiently impervious to the gases with a methane gas transmission rate < 40 ml/day/m²/atm (average) for sheet and joints (tested in accordance with BS ISO 151051 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, penetration of reinforcement ties, tearing due to working above it, dropping tools); 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 integrity of joints. If a membrane is installed that does not meet all the criteria opposite then the score is zero.
A) Membrane with a methane gas transmission rate < 40.0 ml/day/m²/atm (average) for sheets and joints (tested in accordance with BS ISO 151051:2007 manometric method) is regarded as sufficiently impervious. B) For example, reinforced LDPE (virgin polymer) membranes having a minimum mass per unit area of 370 g/m² and not significantly less than 0.4 mm thickness between the reinforcement scrim (tested in accordance with Procedure D (2 mm diameter tip) of BS EN ISO 98631:2016) installed above floor slabs are considered sufficiently strong to meet the performance criteria (see also C.3). Thicker and more robust membranes or an additional membrane protection layer should be installed directly beneath cast in situ floor slabs.		



2.2.3. GAS MITIGATION COMPLIANCE WITH BS8485:2015 +A1:2019

The BEK Ground Gas Risk Assessment and developed Conceptual Site Model identified a theoretical risk from hazardous ground gas intrusion associated with viable sources as defined within the developed site CSM.

The risk associated with a gas intrusion pathway will be mitigated by constructing all dwellings to comply with Characteristic Situation 2 (CS2) in accordance with principles set out within BS8485:2015 +A1:2019.

E3P has utilised sound engineering judgement and analysis to inform the design of robust mitigation measures that will ensure adequate protection for new dwellings.

CIRIA 735 provides guidance with respect to the preparation and implementation of verification plan measures that will ensure that the potential for vapour ingress into a dwelling is mitigated in full.

The risk posed by a variety of potentially hazardous ground gases associated with intrusion into the proposed dwellings will be mitigated by a multi-layered pathway intervention strategy that will incorporate the following key attributes to achieve the minimum points requirement as stipulated by BS8485:2015 +A1:2019

2.2.4. SYNOPSIS OF MITIGATION DESIGN.

E3P has adopted a comprehensive approach by integrating standards from BS 8485 in designing mitigation measures to prevent gas ingress into dwellings. These guidelines offer robust frameworks to ensure that the risk of harmful gases, particularly carbon dioxide, entering properties is effectively managed.

BS 8485 provides specific design protocols for gas protection measures in buildings, by using this methodology, E3P ensures that all necessary protective measures, such as gas barriers, venting systems, and monitoring protocols, are implemented to safeguard occupants and maintain compliance with industry standards.

2.2.5. PASSIVE SUB-FLOOR VENTILATION DESIGN

The proposed ventilation of the subfloor layer is required to achieve a minimum 'good performance' following BS8485, clause 7.2.3 and Annex B.

Real-world applications and limitations in the ability to install close-centred telescopic and air brick ventilation, particularly to the front elevation of a dwelling, necessitate the need to over-design and install ventilation at all available opportunities.

The National House Building Council (NHBC) standards for the construction of new homes include requirements for ventilation to prevent damp and condensation, ensuring 'good ventilation performance of a sub-floor void'.

NHBC regulations and guidelines determine that airbricks are an essential part of ensuring proper ventilation in spaces such as underfloor voids in newly built houses.

The NHBC requires that subfloor voids in suspended floors be ventilated to prevent moisture build-up and maintain air quality.



Ventilation must be provided at a rate sufficient to achieve a minimum airflow rate to prevent condensation and related problems.

Standard Spacing: NHBC guidelines typically recommend placing airbricks at intervals of approximately 1.5 meters along the external walls. This spacing is intended to ensure even ventilation across the entire underfloor area.

Airbricks should be installed on opposing walls (cross ventilation) to allow air to flow freely across the entire subfloor area. This ensures effective ventilation by enabling air to enter from one side and exit from the other, carrying moisture away.

Airbricks should be positioned above the finished ground level to avoid water ingress, typically at least 150mm above ground level, to protect against splashing during rain and ensure clear airflow.

Additional airbricks should be placed near corners and where there are obstructions (like internal walls or beams) to ensure that all parts of the underfloor void receive adequate ventilation.

Airbricks can be made of different materials (e.g., clay, plastic, metal), but they should provide a minimum equivalent area of ventilation as specified by NHBC, which is typically around 1,500 mm² per meter run of external wall for underfloor voids.

In addition to spacing, NHBC standards emphasise that there should be a continuous line of ventilation along the perimeter of the building's subfloor void to maintain consistent airflow.

Airbricks should be kept clear of obstructions such as soil, debris, or plants to maintain effective ventilation.

The NHBC suggests regular inspection and maintenance to ensure airbricks remain unblocked.

To ensure compliance with NHBC standards for airbrick spacing and ventilation in new build houses in the UK:

- ❶ Ensure 1.5 m spacing guidelines along external walls.
- ❷ Ensure cross-ventilation by placing airbricks on opposing walls.
- ❸ Position airbricks above ground level to avoid water ingress.
- ❹ Maintain airbrick openings to prevent blockages and ensure effective ventilation.

By adhering to NHBC guidelines, new build houses can maintain adequate underfloor ventilation, ensuring a minimum performance requirement of 'good' in accordance with BS8485 2015 (+A1 2019).

2.2.6. VENTILATION REQUIREMENTS

BS8485:2015 +A1:2019, Section 7.2.3 covers the design of ventilation measures, which includes passive ventilation layers.

Ventilation systems (where pumps or power supply is required) are not appropriate for Type A (private residential buildings).

The proposed ventilation of the subfloor layer is required to achieve a minimum 'good performance' following BS8485, clause 7.2.3 and Annex B to effectively mitigate the risk from ground gas.



2.2.7. MEMBRANE SELECTION AND PERFORMANCE REQUIREMENTS

All membranes to be considered must be subject to testing in accordance with ISO 15105-2:2003.

Guidance on specifying the properties of a gas membrane is provided in Clause 7.2.4 and Table 7 of BS8485:2015 +A1:2019. Gas-resistant membranes should be:

- ❖ Sufficiently impervious, both in the sheet material and in the sealing of sheets and sealing around sheet penetrations, to prevent any significant passage of methane and/or carbon dioxide through the membrane;
- ❖ Capable, after installation, of providing a complete barrier to the entry of the relevant gas;
- ❖ 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. due to ground settlement if placed below a floor slab);
- ❖ Sufficiently strong to withstand the installation process and following construction activities until covered (e.g. penetration from steel fibres in fibre-reinforced concrete, penetration of reinforcement ties, tearing due to working above it, and dropping tools);
- ❖ Chemically resistant to degradation by other contaminants that might be present and;
- ❖ Verified in accordance with CIRIA C735.

BS8485:2015+A1:2019 places significant emphasis on Gas Transition Rates (GTR) requirements to ensure that a membrane is sufficiently impervious to impede the identified ground gas risk migration. The reliance on GTR must be considered within the context of the site-specific situation and the combined physical barriers that will ultimately inhibit gas migration.

BS8485:2015+A1:2019 Clause 7.2.4 states that *"a methane gas transmission rate of <40.0ml/day/m/atm (average) for sheet and joints (tested in accordance with manometric method BS ISO 15105-1:2007) is usually considered sufficient for a membrane"*.

The maximum Gas Transmission Rate (GTR) that is appropriate depends on the reliance placed on the membrane to impede gas ingress into a dwelling.

BS8485 suggests a maximum value of 40ml/m² /day/atm. This applies where the membrane can be used in any Characteristic Situation, and it is feasible that the membrane will be the only protection against gas ingress.

In this situation, E3P confirms that the maximum GTR as defined within BS8485 2015 (+A1 2019) is a requirement of the overarching mitigation design specification for any foundation types where there is no ventilated sub-floor void with a good performance.

It is important to note that several additional key factors must be considered when selecting a membrane to ensure it is suitable for use within the design situation (Gas Resistance & Robustness). The potential for damage or degradation to a membrane during construction is of particular concern.



The selected membrane must be able to withstand/demonstrate sufficient performance, as detailed below.

- ✿ Tensile Strength
- ✿ Puncture resistance;
- ✿ Elongation potential;
- ✿ Impact risk mitigation;
- ✿ Puncture and tear resistance.

Statements provided by a membrane supplier to demonstrate durability will be supported by written confirmation from a supplier with respect to Quality Assurance to demonstrate soundness.

All membranes to be utilised in a Characteristic Situation 2 must have minimum mechanical properties as prescribed in Table 2.3.

Table 2.3 Gas Membrane Performance – Physical Property Minimum Requirements

PROPERTY	TEST	UNITS	REQUIREMENT
Membrane Thickness	EN 1849-2	mm	0.40
Tensile Strength	EN 12311	N/mm ²	15
Tensile Elongation	EN12311	%	400
Joint Strength	EN 12317-2	N	298
Resistance to impact	EN12691	mm	200
Durability chemical resistance	EN1847	-	Pass

A manufacturer's guarantee of suitability and compliance will accompany all membranes selected for use within the design situation.

All membranes should be approved by E3P before their use in the construction. E3P understands that the client proposes to install the Visqueen Low Permeability Gas Membrane (Yellow), which is considered to be suitable for plots classified as Characteristic Situation 2.

2.3. MEMBRANE INSTALLATION REQUIREMENTS

Due to the meagre permeation rates that will be required to minimise the risk associated with gas intrusion, it is essential that the membrane is installed correctly and is not damaged afterwards or during construction.

CIRIA C748 defines the dominant mode of fluid transport through poorly installed membranes via holes present due to poor seals and welds, material defects and damage during construction. This mode of transport is significantly greater than permeation through intact membranes.

Installation by suitable, trained and qualified persons and subsequent validation by an independent specialist is vitally important in ensuring the long-term integrity of the membrane and, thus, removal of the theoretical exposure pathway associated with gas migration.



2.3.1. CONTRACTOR PRE-COMMENCEMENT REQUIREMENTS

Prior to the commencement of any installation works, the following will be provided to E3P as a supervising engineer/consultant for review.

- ✿ Relevant qualifications of all operatives (minimum NVQ Level 2 – Gas protection installation).
- ✿ Detailed installation plan inclusive of method Statement, CQA Procedures and qualifications.
- ✿ Provision of the final choice of the membrane system to be utilised.

Section 3.3 of CIRIA C735 states that it is essential that an appropriately experienced and qualified workforce is employed on-site to install ground protection systems.

An appropriate, experienced and skilled workforce is recommended, with an installer carrying an NVQ level 2 diploma in gas membrane installation or accreditation for plastic welding.

2.4. SITE-SPECIFIC DESIGN REQUIREMENTS

E3P has been provided with the standard gas membrane construction details, which are included in Appendix IV.

Architectural Emporium prepared the site-specific engineering drawings on behalf of Mac Roofing and Contracting Limited.

The sub-structure designs are included within the Architectural Emporium (attached to this specification in Appendix IV).

Figure 3.1 Typical Substructure Detail





3.1.1. SERVICE PENETRATIONS

All service penetrations passing through the gas protection measures shall be sealed using an appropriate butyl-based sealant system to maintain the continuity and integrity of the gas resistant membrane. The sealing arrangement shall be compatible with the service duct and membrane materials and installed in accordance with the manufacturer's recommendations.

The integrity of the seal shall be inspected and verified following the installation and pull-through of the infrastructure services within the ducts to ensure that no damage has occurred and that an effective gas-tight seal has been achieved. Any defects identified during the inspection process shall be repaired immediately before completion of the works. This approach will provide mitigation against the ingress and migration of ground gases through service entry points into the proposed development.



4. INSTALLATION REQUIREMENTS – VALIDATION REQUIREMENTS

4.1.1. PERSONS RESPONSIBLE FOR VERIFICATION

CIRIA C735 (Section 3.2.2) states that the person validating the membrane must be independent of the installation contractor or material supplier. It is recognised that under certain circumstances, others may assist the independent third-party verifier, but in such a case, their work must be subject to an independent third-party audit.

4.1.2. VERIFICATION ACTIVITY PLAN

Table 4.1 Verification Activity Plan

VERIFICATION ACTIVITY	FREQUENCY
Inspection of the sub-floor void dimensions	Intermittent inspections - as and where possible.
Inspection of telescopic ventilation and air-brick system	All plots.
Inspection of membrane construction and installation.	All plots.
Sealing of service ducts	All plots (photographs by site construction team)

4.1.3. VENTILATED SUB-FLOOR VOID

Photographic evidence will be collected for the relevant plots to demonstrate that, as a minimum a 150 mm clear void is present beneath the suspended floor slab with interconnecting ventilation to the periphery constructed in accordance with the structural engineers' design.

Inspection of sub-floor voids will be completed on an intermittent basis as and where possible. It is not practicable to inspect each and every plot. Therefore, intermittent inspections will be completed to demonstrate a high degree of general compliance.

4.1.4. MEMBRANE STORAGE AND PREPARATION

The gas membrane should be stored horizontally, undercover, in its original packaging.

Gas membrane is to be installed on a smooth continuous surface e.g. grouted beam and block floor, a compacted blinding layer e.g. 50 mm thick sand blinding, or smooth concrete blinding.

The substrate should be free from irregularities such as voids or protrusions.

When installing the membrane in demanding site conditions, use specialist measures to enhance construction and, specifically, the jointing of membranes.



4.1.5. INSTALLATION GENERAL PRINCIPLES

The approved installation contractor will provide all necessary information pertaining to the installation process, as detailed in the earlier sections of this verification strategy.

- ❖ The gas membrane will be loosely laid on the substrate with the correct side up to avoid direct sunlight.
- ❖ The membrane will be clean and dry at the time of joining.
- ❖ It should be overlapped by at least 150 mm, bonded with the appropriate jointing tape and sealed to the manufacturer's specification.
- ❖ Alternatively, lap joints can be heat welded to achieve an effective seal.
- ❖ The overlap in the barrier is typically 100 mm, and when hand welding, a 35 mm weld is normally achieved.
- ❖ When hand welding, a roller must be used.
- ❖ Airtight seals should be formed around all service entry points.
- ❖ Preformed 'Top Hat Units' are recommended for sealing service entry pipes.
- ❖ The base of the top hat and the upstand should be bonded using specialist jointing tape and sealed.
- ❖ Forming an effective barrier to gases may give rise to complex three-dimensional detailing where it is recommended that preformed units are used, e.g. corners. Alternatively, specialist detailing strips can be used to seal difficult 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 jointing tape and sealed. Alternatively, a patch can be formed using a detailing strip and lapped at least 150mm beyond the extent 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 specialist guard protection, screed or other approved protection material before positioning the reinforcement.



4.1.6. GROUND GAS MITIGATION MEASURES VALIDATION

The validation of ground gas mitigations should be completed in line with the items specified in Table 4.2.

Table 4.2 Ground Gas Mitigation Measures Validation Items

INSPECTION	METHOD
Product Verification	Confirmation that suitable products have been procured for installation to consist of photographs of product types, labels on packaging and delivery tickets.
Passively Ventilated Subfloor Cavity	A qualified engineer/consultant will be required to attend the site and validate the compliant construction of the sub-structure with a minimum 150 mm sub-floor void. Due to the nature of the construction process and construction using precast suspended segmental floors, it is considered appropriate to check the first run of plots constructed with the minimum 150 mm sub-floor void and then to check plots on an intermittent basis thereafter.
Wall Cavity Inspection	Confirmation that the gas membrane spans the external wall cavity above the periscopic vents.
General Condition	The membrane is to be inspected to ensure there are no tears, punctures or rips.
Structural reinforcement	Here, structural reinforcement is used over a membrane, which must either be supported by a physical barrier or inspected after placement over a membrane to ensure no damage.
Jointing	The engineer is to check the overlaps between membranes are correctly sealed with sufficient overlaps. The membrane is to be jointed and sealed in accordance with the pre-agreed CQA plan and design requirements.
Service Entry Points	Verification of the presence of preformed top hats or butyl-based sealant system sealed to the pipe and membrane as per the construction detail.
Remedial Action	Any damage or requirement for remedial action must be recorded and notified in writing. Once repaired, the verifier will undertake the necessary re-inspections.
Passive Venting Systems	The engineer should verify the presence of vents at 2m centres on at least three of the external walls. Verification of the stone venting layer and presence of pipes to be supplied by photographic records from the site.
CQA / Audit	The verifier must use an ISO approved system to ensure CQA. This will include electronic data capture with time and location stamps to ensure auditability if required.
Service Ducting	The annulus around all services that are installed through sealed ducting will be fully sealed by the constructor using expanding foam to ensure no potential for gas migration. This will not be checked and verified by E3P on the basis that it can be easily checked internally at any point to ensure satisfactory sealing and finishing.

Examples of gas membrane verification photographs are provided in Figure 4.1.

It should be noted that these are for illustrative purposes only, as each site will have a site-specific gas membrane specification.



Figure 4.1 Example Gas Membrane Verification

Plot Inspection 3 - 100%		100%					
Plot Number		118.5					
Type of Development; Other add note		House					
							Condition of sub-grade and underside of gas membrane Check that the subgrade does not contain rough/uneven surfaces, is appropriately clean and that there are no hard/sharp objects. That protective sand blinding or geotextile (if specified) is present and meets the design criteria.
Gas Characteristic Situation		012					
Foundation Type: Other add note		Supported floor					
Gas Membrane Type: Manufacturer, gauge, and colour.		Yellow visqueen brand not stated					
Gas Membrane Condition: Open punctures, tears, rips, stretching, Presence of debris, Repairs, Signs of weakness such as raised or sunken indentations, Protection plan in place to restrict access to lain gas membrane? IF FAIL DESCRIPTION IN ACTIONS AND PHOTOS REQUIRED		Pass	   				
   							Passive Venting
Laps, welds, and joints seals: Joints lapped and sealed in accordance with manufacturer's requirements/ specification? Minimum overlap insured? Sections taped twice? Are welds complete? Appropriate joining/double-sided tape used, Folds running in line with joints? (no joints cutting across folds)		Pass					
     							Sub-floor Void: Is a check possible on future plots (insert Plot number or NO in text box)
Service entries seals: Top hats seal arrangements fixed around service entries? Use of Jubilee clips?		Yes					
             							External Wall Air bricks: Numbers, size, positions as design drawing? (Minimum of 3 walls)
Type of joints/ Lapping		Taped					
Corners / internal joints: Check all corners are correctly formed or contractor has used performed corners.		Pass					
           							Extent of Coverage: Is the membrane covering the entire plot? Does membrane span over outside walls?
		Yes					

APPENDIX I

LIMITATIONS





GENERAL

1. This report and any associated works (together comprising the "Services") were compiled and carried out by E3P for the client (as present in Section 1) under the E3P "Terms of Business" or with those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed and outlined in the body of the report.
2. Unless explicitly agreed otherwise, in writing, this report has been prepared under E3P Standard Terms and Business as included within our proposal to the Client.
3. Project-specific appointment documents may be agreed upon at our discretion and a charge may be levied for both the time to review and finalise appointment documents and also for associated changes to the appointment terms. E3P reserves the right to amend the fee should any changes to the appointment terms create an increased risk to E3P.
4. The report needs to be considered in light of the proposal and associated limitations of scope. The report needs to be read in full and isolated sections cannot be used without full reference to other elements of the report and any previous works referenced within the report.

PHASE 1 GEOENVIRONMENTAL AND PRELIMINARY RISK ASSESSMENTS

5. Coverage: This section covers reports with the following titles or combination of titles: Phase 1; Desktop Study; Geoenvironmental Assessment; Development Appraisal; Preliminary Environmental Risk Assessment; Constraints Report; Due Diligence Report; Geotechnical Development Review; Environmental Statement; Environmental Chapter; Baseline Environmental Assessment; Project Scope Summary Report (PSSR), Program Environmental Impact Report (PEIR), Geotechnical Development Risk Register; Agricultural Land Assessment; Mineral Safeguarding Assessment; Desk Top Coal Mining Risk Assessment; Hydrogeological Appraisal; Construction Environmental Management Plan; and Site Water Management Plan.
6. The works undertaken to prepare this report comprised a study of available and easily documented information from a variety of sources (including the Client), together with (where appropriate) a brief walkover inspection of the site and correspondence with relevant authorities and other interested parties. Due to the short timescales associated with these projects responses may not have been received from all parties. E3P cannot be held responsible for any disclosures that are provided post-production of our report and will not automatically update our report.
7. The opinions given in this report have been dictated by the finite data on which they are based and are relevant only for the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in this report, E3P reserves the right to review such information and, if warranted, to modify the opinions accordingly.



8. It should be noted that any risks identified in this report are perceived risks based on the information reviewed. Actual risks can only be assessed following intrusive investigations of the site.
9. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials, this is for indicative purposes only and does not constitute or replace full and proper surveys completed by suitably qualified and experienced specialists in these fields.
10. E3P does not warrant work/data undertaken/provided by others.

INTRUSIVE INVESTIGATION REPORTS

11. Coverage: The following report titles (or combination) may cover this category of work: Geoenviromental Site Investigation; Geotechnical Assessment; GIR (Ground Investigation Reports); Preliminary Environmental And Geotechnical Risk Assessment; Preliminary Summary; Coal Mining Risk Assessment, Ground Gas Addendum; and, Geotechnical Risk Register.
12. The investigation has been undertaken to provide information concerning either:
 - I. The type and degree of contamination present at the site in order to allow a generic quantitative risk assessment to be undertaken; or
 - II. Information on the soil properties present at the site to allow for geotechnical development constraints to be considered.
13. The scope of the investigation was selected on the basis of the specific development and land use scenario proposed by the Client and may be inappropriate to another form of development or scheme. If the development layout was not known at the time of the investigation the report findings may need revisiting once the development layout is confirmed.
14. Unless otherwise specified in the scope of works, any site drawing(s) provided in this report is (are) not meant to be an accurate base plan but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (intrusive and sample locations etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.
15. For contamination purposes, the objectives of the investigation are limited to establishing the risks associated with potential contamination sources with the potential to cause harm to human health, building materials, the environment (including adjacent land), or controlled waters.
16. For geotechnical investigations, the purpose is to broadly consider potential development constraints associated with the physical property of the soils underlying the site within the context of the proposed future or continued use of the site, as stated within the report.



17. The amount of exploratory work, soil property testing and chemical testing undertaken has necessarily been restricted by various factors which may include accessibility, the presence of services; existing buildings; current site usage or short timescales. The exploratory holes completed assess only a small percentage of the area in relation to the overall size of the site, and as such can only provide a general indication of conditions.
18. The number of sampling points and the methods of sampling and testing do not preclude the possible existence of contamination where concentrations may be significantly higher than those actually encountered or ground conditions that vary from those identified. In addition, there may be exceptional ground conditions elsewhere on the site which have not been disclosed by this investigation and which have therefore not been taken into account in this report.
19. The inspection, testing and monitoring records relate specifically to the investigation points and the timeframe that the works were undertaken. They will also be limited by the techniques employed. As part of this assessment, E3P has used reasonable skill and care to extrapolate conditions between these points based on assumptions to develop our interpretation and conclusions.
20. The assumption made in forming our conclusions is that the ground and groundwater conditions (both chemically and physically) are the same as have been encountered during the works undertaken at the specific points of investigation and at the time of the investigation.
21. Conditions can change between investigation points both spatially and over time and these interpretations should therefore be considered indicative. The assessment of extreme weather events and their impact on ground conditions is not within the scope of E3P's work.
22. The risk assessment and opinions provided are based on currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values. Specific assumptions associated with the risk assessment process have been outlined within the body or associated appendix of the report.
23. Additional investigations may be required in order to satisfy relevant planning conditions or to resolve any engineering and environmental issues.
24. Where soil contamination concentrations recorded as part of this investigation are used for commentary on the potential waste classification of soils for disposal purposes, these should be classed as indicative only. Due consideration should be given to the variability of contaminant concentrations taken from targeted samples versus bulk excavated soils and the potential variability of contaminant concentrations between sampling locations. Where major waste disposal operations are considered, targeted waste classification investigations should be designed and the waste classification and any subsequent disposal option agreed upon with licenced subcontractors and/or the relevant regulators.
25. The results of the asbestos testing are factually reported and interpretation is given as to how this relates to the previous use of the site, the types of ground encountered and site conceptualisation. This does not however constitute a formal asbestos assessment. These results should be treated cautiously and should not be relied upon to provide detailed and representative information on the delineation, type and extent of bulk ACMs and/or trace loose asbestos fibres within the soil matrix at the site.



26. If costs have been included in relation to additional Site works, and/or site remediation works these must be considered as indicative only and must be confirmed by a qualified quantity surveyor.

EUROCODE 7: GEOTECHNICAL DESIGN

27. On 1st April 2010, BS EN 1997-1:2004 (Eurocode 7: Geotechnical Design – Part 1) became the mandatory baseline standard for geotechnical ground investigations.
28. In terms of geotechnical design for foundations, slopes, retaining walls and earthworks, EC7 sets guidance on design procedures including specific guidance on the numbers and spacings of boreholes for geotechnical design, there are limits to methods of ground investigation and the quality of data obtained and there are also prescriptive methods of assessing soil strengths and methods of design. Unless otherwise explicitly stated, the work has not been undertaken in accordance with EC7. A standard geotechnical interpretative report will not meet the requirements of the Geotechnical Design Report (GDR) under Eurocode 7. The GDR can only be prepared following confirmation of all structural loads and serviceability requirements. The report is likely to represent a Ground Investigation Report (GIR) under the Eurocode 7 guidance.

DETAILED QUANTITATIVE RISK ASSESSMENTS AND REMEDIATION AND ENABLING WORK STRATEGY REPORTS

29. These reports build upon previous report versions and associated notes. The scope of the investigation, further testing and monitoring and associated risk assessments were selected based on the specific development and land use scenario proposed by the Client and may not be appropriate to another form of development or scheme layout. The risk assessment and opinions provided are based on currently available approaches in the generation of Site Specific Assessment Criteria relating to contamination concentrations and are not considered to represent a risk in a specific land use scenario to a specific receptor. No liability can be accepted for the retrospective effects of any future changes or amendments to these values, associated models or associated guidance.
30. The outputs of the Detailed Quantitative Risk Assessments are based upon the manipulation of standard risk assessment models. These are our interpretation of the risk assessment criteria.
31. Before adoption on-site, assessment criteria will need to be discussed and agreed upon with the Regulatory Authorities prior to adoption on site. The regulatory discussion and engagement process may result in an alternative interpretation being determined and agreed. The process and timescales associated with the Regulatory Authority engagement are not within the control of E3P. All costs and programmes presented as a result of this process should be validated by a quantity surveyor and should be presumed to be indicative.
32. E3P does not accept liability for any subcontract work that has not been completed in strict accordance with an approved E3P Remediation and Enabling Works Strategy.



GEOTECHNICAL DESIGN REPORT (GDR)

33. The GDR can only be prepared following confirmation of all structural loads and serviceability requirements. All the relevant information needs to be provided to allow for a GDR to be produced.

MONITORING (INCLUDING REMEDIATION MONITORING REPORTS AND BUILD PHASE MITIGATION)

34. These reports are factual and comprise monitoring, normally groundwater and ground gas and data provided by contractors as part of earthworks or remedial works.
35. The data is presented and will be compared with assessment criteria.

APPENDIX II

GLOSSARY





TERMS

ACM	Asbestos-containing material	MMP	Materials management plan
ADS	Acoustic design statement	ND	Not detected
AST	Above-ground storage tank	NDP	Nuclear density probe
BGS	British Geological Survey	NMP	Noise management plan
BSI	British Standards Institute	NPSE	Noise policy statement for England
BTEX	Benzene, toluene, ethylbenzene, xylenes	NR	Not recorded
CA	Coal Authority	PAH	Polycyclic aromatic hydrocarbon
CBR	California bearing ratio	PCB	Polychlorinated biphenyl
CIEH	Chartered Institute of Environmental Health	PI	Plasticity index
CIRIA	Construction Industry Research Association	PID	Photo ionisation detector
CLEA	Contaminated land exposure assessment	POS	Public open space
CML	Council of Mortgage Lenders	PPE	Personnel protective equipment
CoC	Contaminants of concern	ProPG	Professional practice guidance
CSM	Conceptual site model	QA	Quality assurance
DNAPL	Dense non-aqueous phase liquid (chlorinated solvents, PCB)	SGV	Soil guideline value
DWS	Drinking water standard	SPH	Separate-phase hydrocarbon
EA	Environment Agency	SPT	Standard penetration test
EQS	Environmental quality standard	SVOC	Semi-volatile organic compound
FFL	Finished floor level	TPH	Total and speciated petroleum hydrocarbon
GAC	General assessment criteria	TPH CWG	Total Petroleum Hydrocarbon (Criteria Working Group)
GL	Ground level	UKWIR	United Kingdom Water Infrastructure Risk
GSV	Gas screening value	UST	Underground storage tank
HCV	Health criteria value	VCC	Vibro-concrete column
ICSM	Initial conceptual site model	VOC	Volatile organic compound
LEL	Lower explosive limit	VRSC	Vibro-replacement stone columns
LMRL	Lower method reporting limit	VSC	Vibro-stone columns
LNAPL	Light non-aqueous phase liquid (petrol, diesel, kerosene)	WHO	World Health Organisation
MCV	Moisture condition value	WRAP	Waste and Resources Action Programme





MIBK	Methyl isobutyl ketone	WTE	Water table elevation
m	Metres	ppm	Parts per million
km	Kilometres	mg/m ³	Milligram per metre cubed
% v/v	Percent volume in air	m bgl	Metres below ground level
mb	Millibars (atmospheric pressure)	m bcl	Metre below cover level
l/hr	Litres per hour	mAOD	Metres above ordnance datum (sea level)
µg/l	Micrograms per litre (parts per billion)	kN/m ²	Kilonewtons per metre squared
ppb	Parts per billion	µm	Micrometre
mg/kg	Milligrams per kilogram (parts per million)	SSRT	Site Specific Remediation Target
PSD	Particle Size Distribution	DD	Dry Density
CL:AIRE	Contaminated Land: Applications in Real Environments	Mc	Moisture Content
ρ	Bulk Density	GPR	Ground Penetrating Radar
NDP	Nuclear Density Probe	FFL	Finished Floor Level
LEL	Lower Explosive Limit	UKWIR	UK Water Industry Research
CIRIA	Construction Industry Research and Information Association	LOD	Limit of Detection



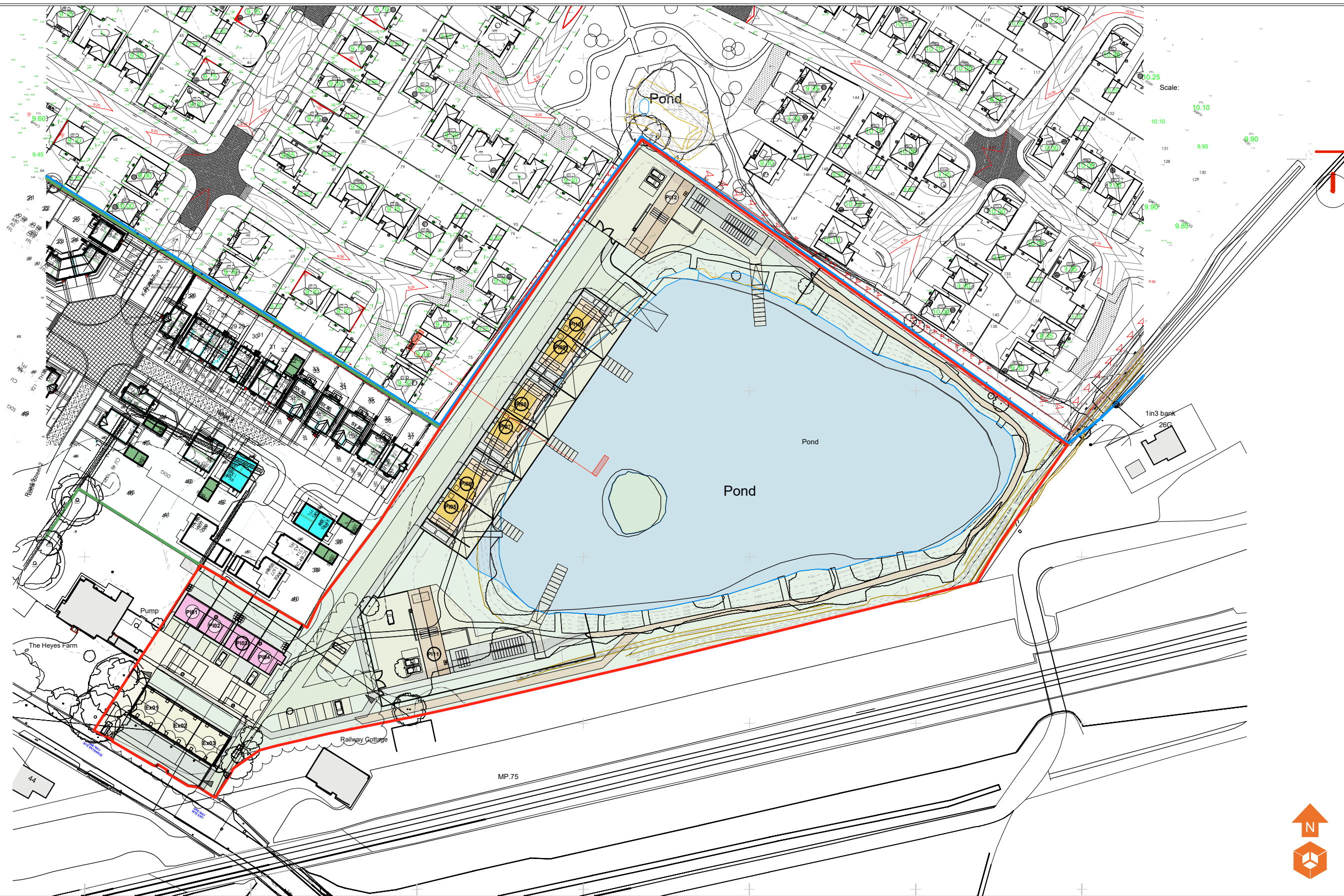
APPENDIX III

E3P DRAWINGS





	Notes:						Client: Mac Roofing	Job No: 18-365	Date: 06.02.2026	 Environmental Engineering Partnership Ltd Taylor Road, Trafford Park Urmston, Manchester, M41 7JQ Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk	
								Drawing No: 001	Scale: NTS		
							Job Title: The Barns, Halewood	Drawing Title: Site Location Plan			The client must not amend any drawing, design or other intellectual property produced by E3P Ltd without permission in writing from E3P Ltd in advance of any amendments being made. In the event that such written permission is not obtained in advance of the amendments being made, E3P Ltd shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.
	P1	REVA	06.02.2026	TG	HM	HM					
	Phase	Issue	Date	Drawn	Checked	PM					



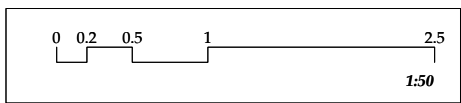
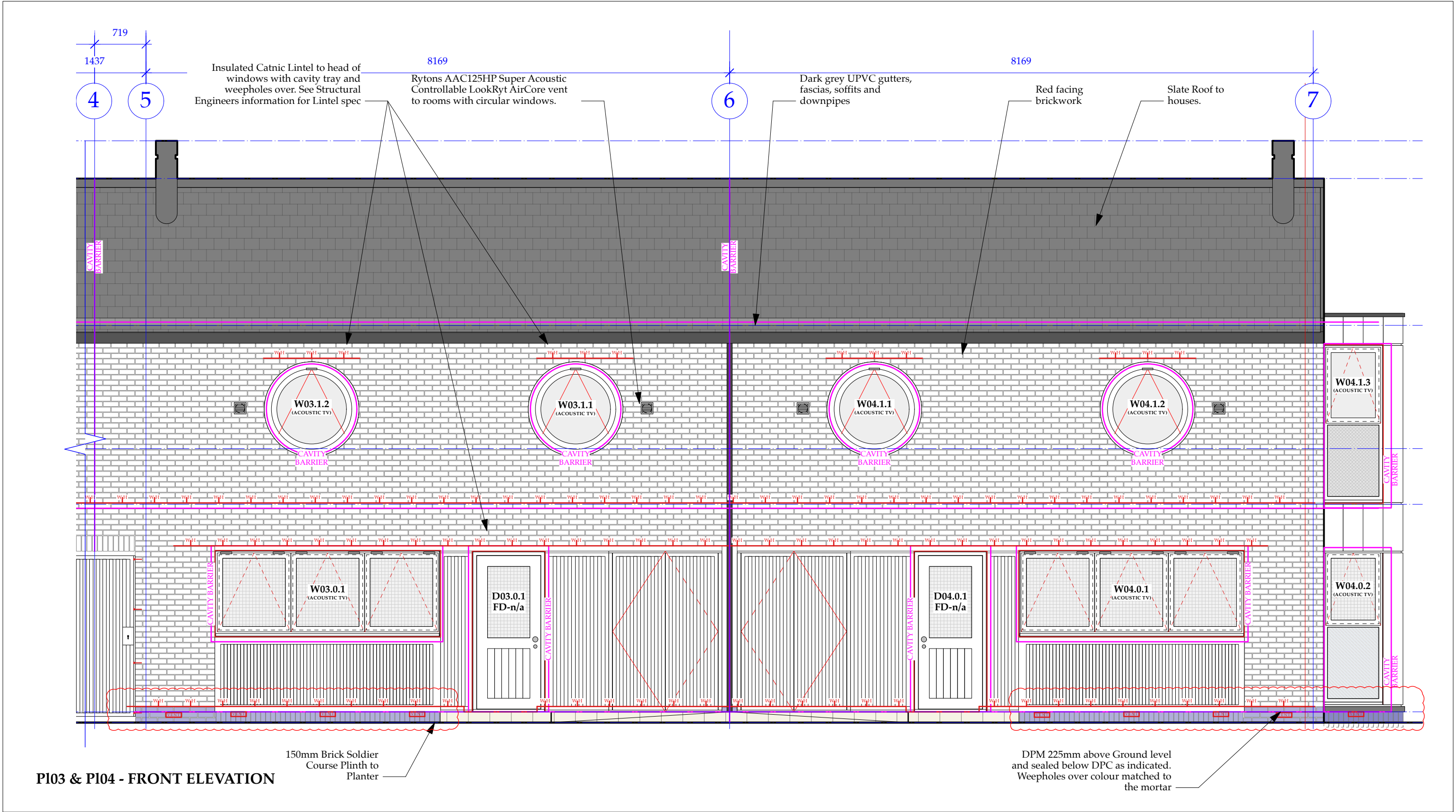
Notes:						Client: Mac Roofing		Job No: 18-365		Date: 06.02.2026			Environmental Engineering Partnership Ltd Taylor Road, Trafford Park Urmston, Manchester, M41 7JQ Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk
								Drawing No: 002		Scale: NTS			
						Job Title: The Barns, Halewood		Drawing Title: Proposed Development Plan		The client must not amend any drawing, design or other intellectual property produced by E3P Ltd without permission in writing from E3P Ltd in advance of any amendments being made. In the event that such written permission is not obtained in advance of the amendments being made, E3P Ltd shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.			
P1	REVA	06.02.2026	TG	HM	HM								
Phase	Issue	Date	Drawn	Checked	PM								

APPENDIX IV

STRUCTURAL ENGINEERS

DRAWINGS





Glazing Key:

- Glazing Type 1: Double Glazed Unit (Inner & outer pane: Float). Clear
- Glazing Type 2: Double Glazed Unit (Inner pane: Float / Outer Pane: Laminated). Clear
- Glazing Type 3: Double Glazed Unit (Inner pane: Toughened / Outer Pane: Float). Clear
- Glazing Type 4: Double Glazed Unit (Inner pane: Toughened / Outer Pane: Toughened & Laminated). Clear
- Glazing Type 5: Double Glazed Unit (Inner pane: Toughened / Outer Pane: Float). Opaque

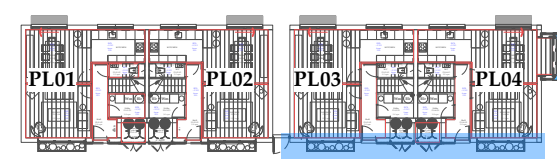
All Windows to achieve min U-Value 1.2W/m2K / See Detailed Schedule for additional Solar Control Requirements

Elevation Key:

- Cavity closers around openings, to extent of cavity, and to intermediate floor level. Lintel to close cavity at head of windows.
- Cavity Tray with weepholes at 450mm centres over.

SEE STRUCTURAL ENGINEERS INFORMATION FOR MOVEMENT JOINTS AND WIND POST LOCATIONS

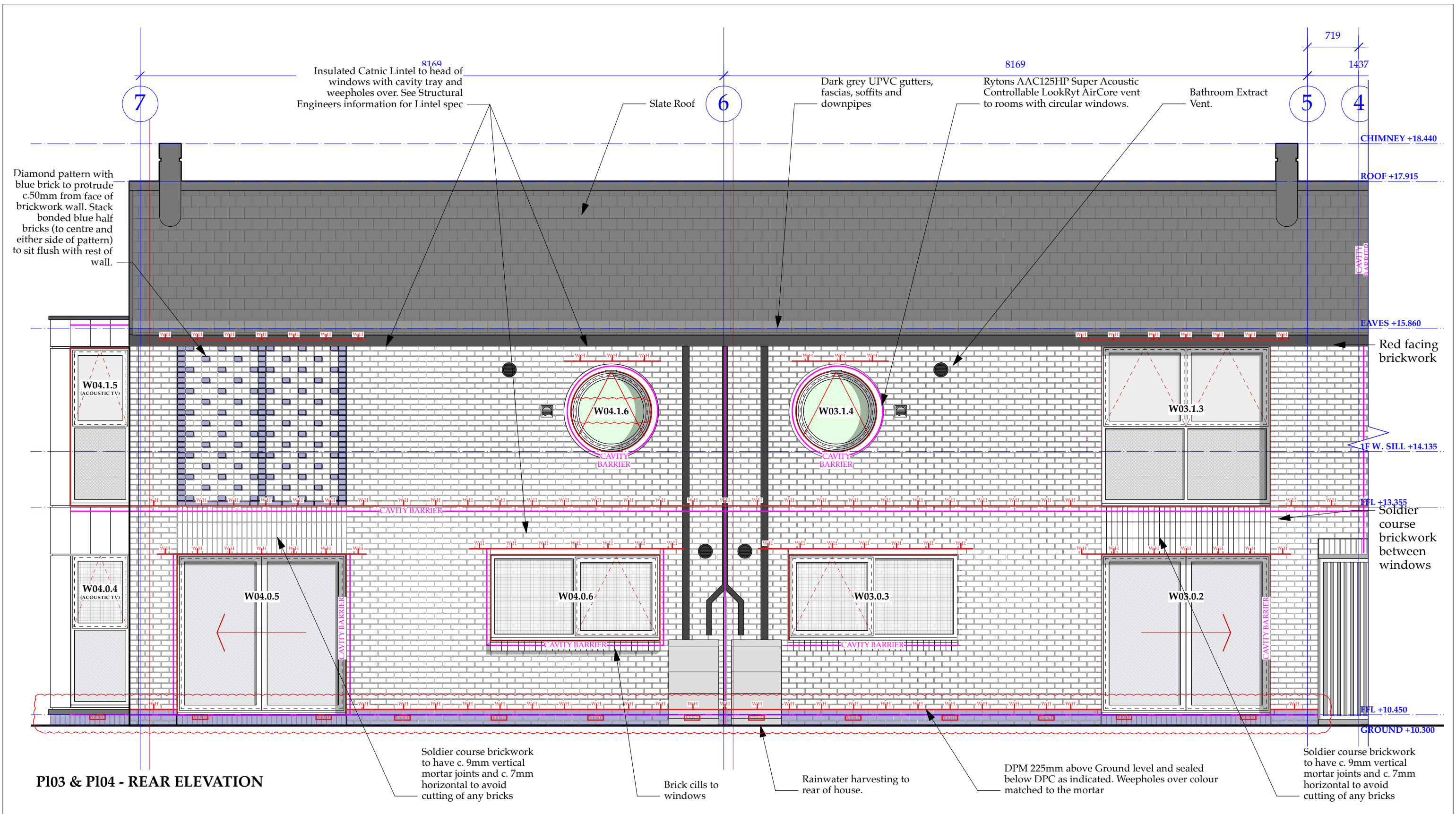
KEY MAP



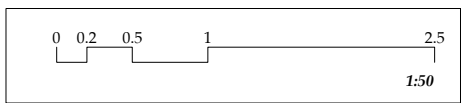
E	07/07/2026	JR	AJ	DPM upgraded to Gas membrane & Vent locations added.
Rev.	Date	Drawn	Checked	Note

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87 Kempston St, Liverpool, L3 8HE / +44 (0)151 363 0000

JOB:	LAKESIDE - 144
STATUS:	BUILDING CONTROL
SCALE:	1:50 @ ISO A3
FIRST ISSUE:	29/04/24
DRAWING No:	3.212 - E
Proposed Detail Elevations_Front 02	



PI03 & PI04 - REAR ELEVATION

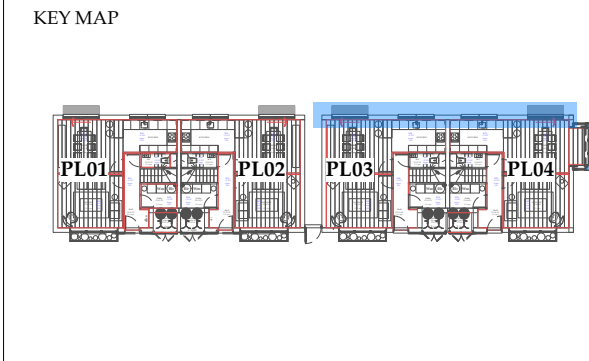


- Glazing Key:**
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 - Glazing Type 2: Double Glazed Unit (Inner pane: Float / Outer Pane:Laminated). **Clear**
 - Glazing Type 3: Double Glazed Unit (Inner pane: Toughened/ Outer Pane: Float). **Clear**
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All Windows to achieve min U-Value 1.2W/m2K / See Detailed Schedule for additional Solar Control Requirements

- Elevation Key:**
- Cavity closers around openings, to extent of cavity, and to intermediate floor level. Lintel to close cavity at head of windows.
 - Cavity Tray with weepholes at 450mm centres over.

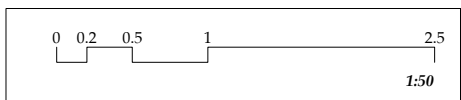
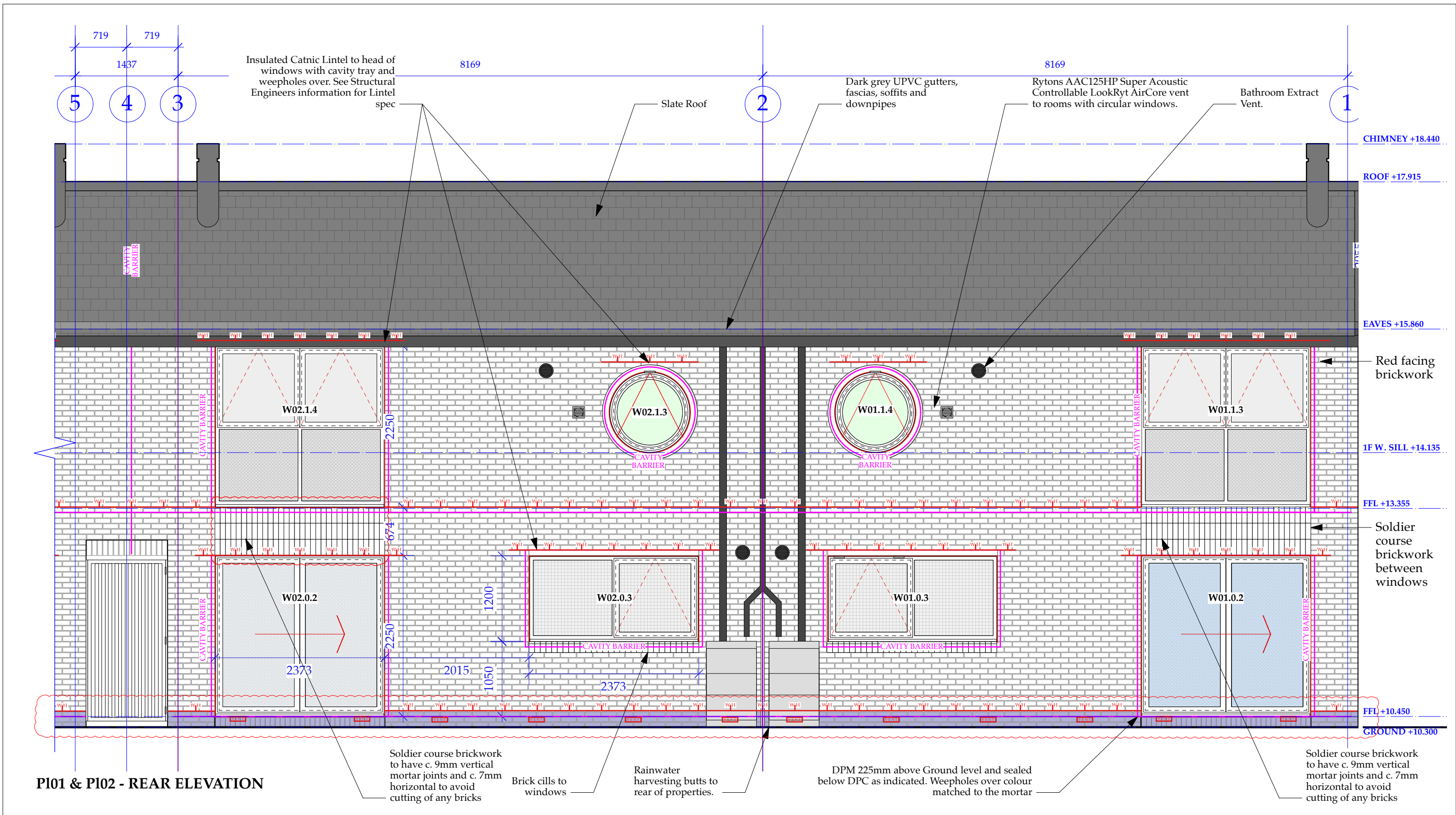
SEE STRUCTURAL ENGINEERS INFORMATION FOR MOVEMENT JOINTS AND WIND POST LOCATIONS



E 07/07/2026 JR AJ DPM upgraded to Gas membrane & Vent locations added.
Rev. Date Drawn Checked Note

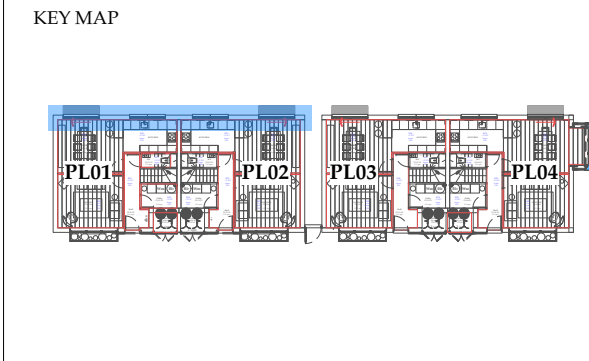
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JOB: **LAKE SIDE - 144**
STATUS: **BUILDING CONTROL**
SCALE: **1:50 @ ISO A3**
FIRST ISSUE: **16/05/24**
DRAWING No: **3.213 - E**
Proposed Detail Elevations_Rear 01



- Glazing Key:**
- Glazing Type 1: Double Glazed Unit (Inner & outer pane: Float). Clear
 - Glazing Type 2: Double Glazed Unit (Inner pane: Float / Outer Pane: Laminated). Clear
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 - Glazing Type 5: Double Glazed Unit (Inner pane: Toughened / Outer Pane: Float). Opaque
- All Windows to achieve min U-Value 1.2W/m2K / See Detailed Schedule for additional Solar Control Requirements*

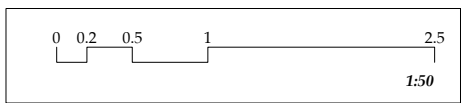
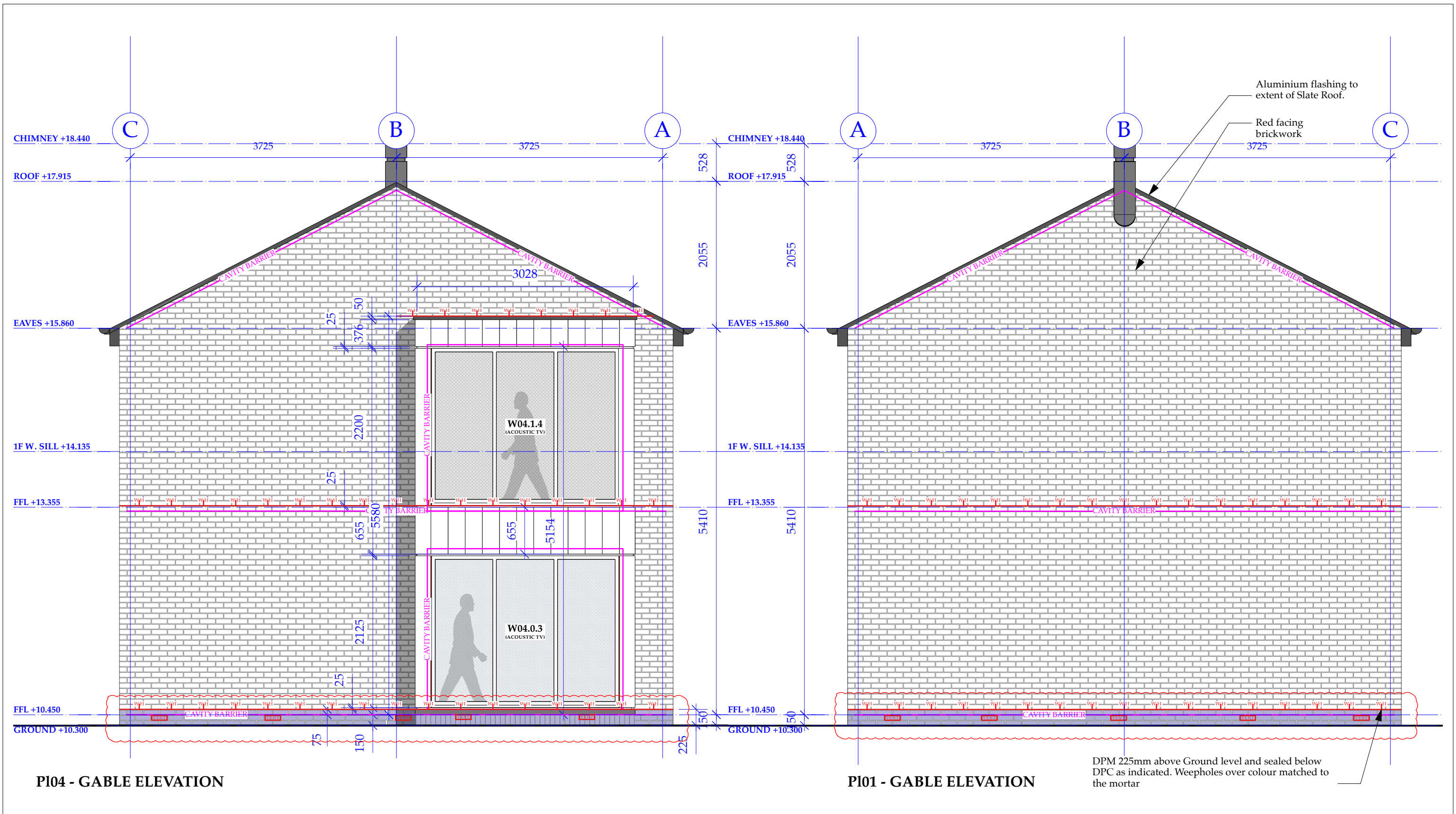
- Elevation Key:**
- Cavity closers around openings, to extent of cavity, and to intermediate floor level. Lintel to close cavity at head of windows.
 - Cavity Tray with weepholes at 450mm centres over.
- SEE STRUCTURAL ENGINEERS INFORMATION FOR MOVEMENT JOINTS AND WIND POST LOCATIONS*



E 07/07/2026 JR AJ DPM upgraded to Gas membrane & Vent locations added.
Rev. Date Drawn Checked Note

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FIRST ISSUE: **16/05/24**
DRAWING No: **3.214 - E**
Proposed Detail Elevations_Rear 02

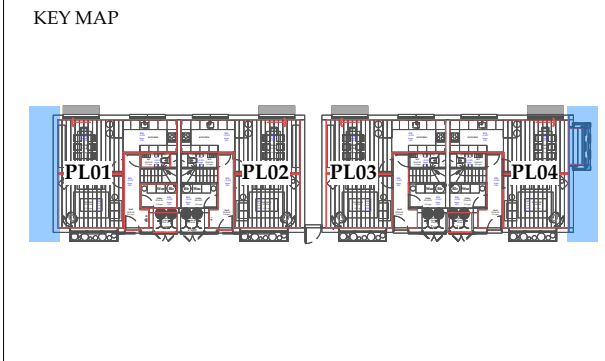


- Glazing Key:**
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All Windows to achieve min U-Value 1.2W/m2K / See Detailed Schedule for additional Solar Control Requirements

- Elevation Key:**
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 - Cavity Tray with weepholes at 450mm centres over.

SEE STRUCTURAL ENGINEERS INFORMATION FOR MOVEMENT JOINTS AND WIND POST LOCATIONS



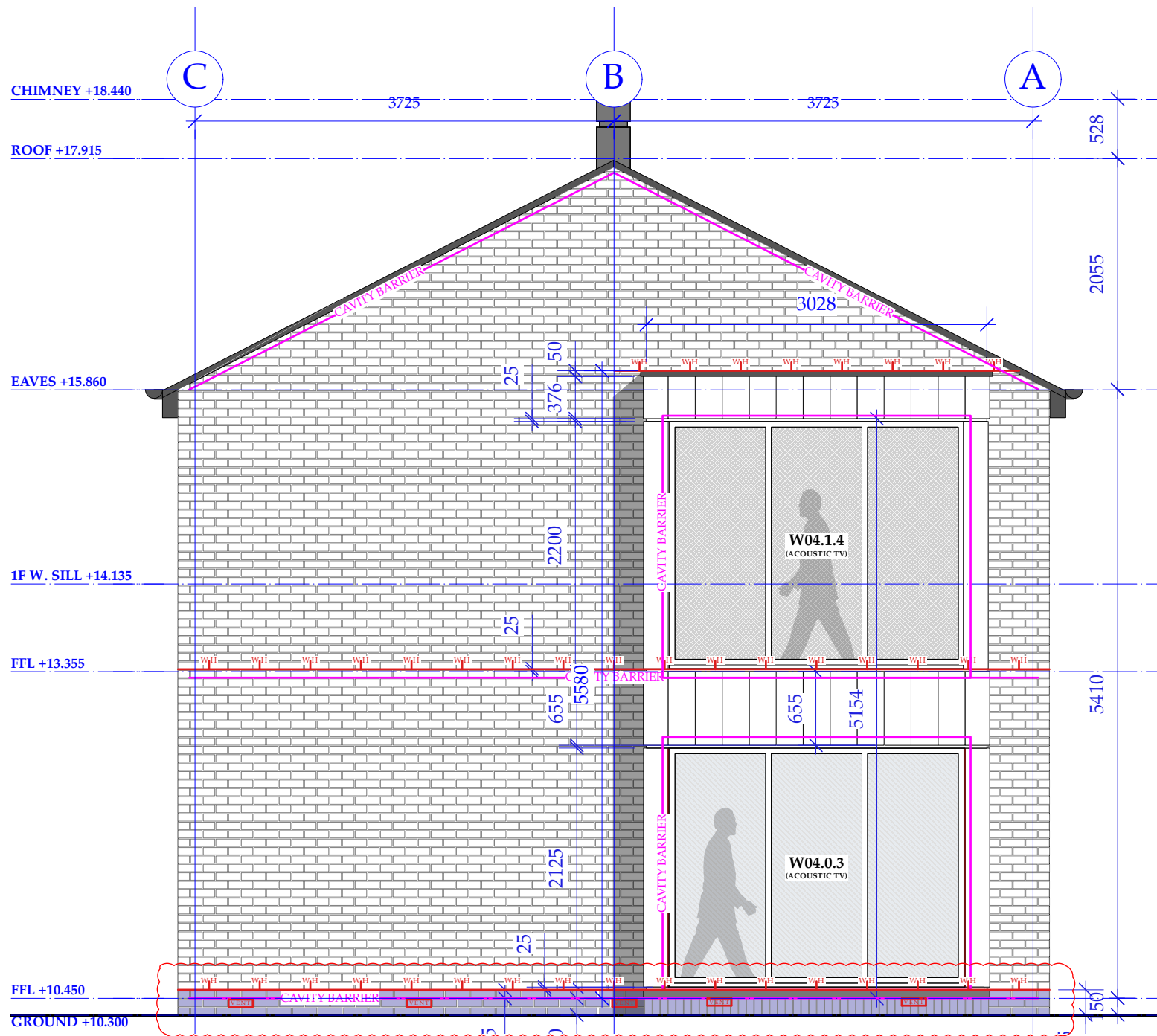
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Rev.	Date	Drawn	Checked	Note



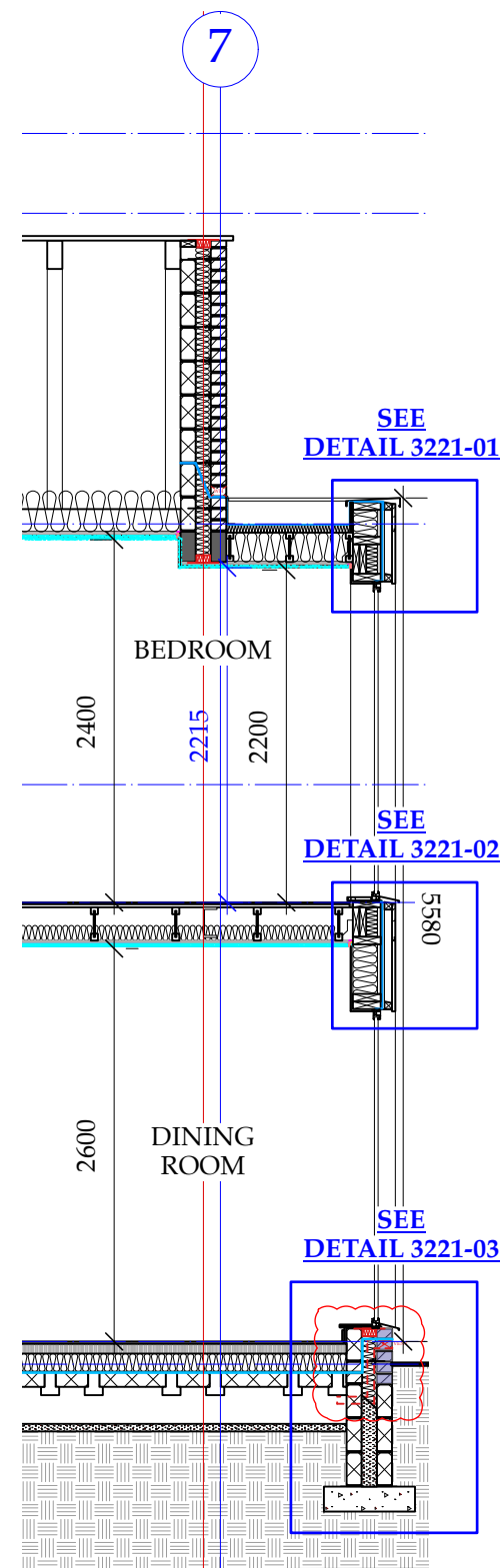
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JOB:	LAKESIDE - 144
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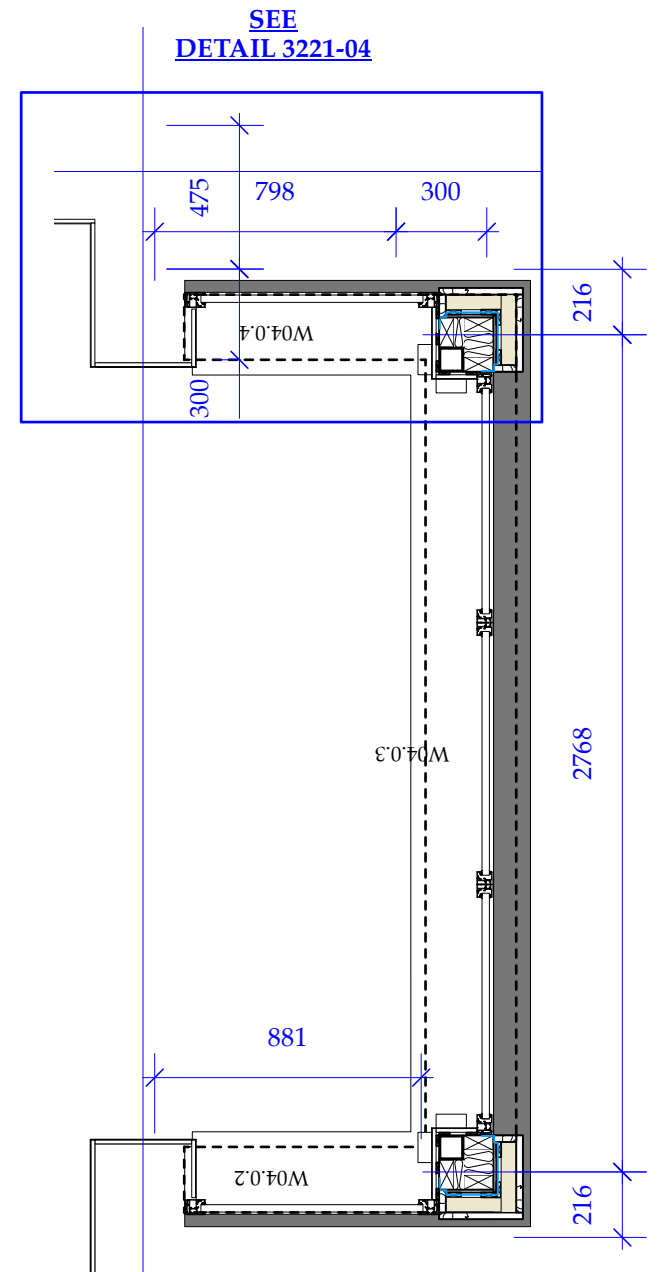
Proposed Detail Elevations_Gables



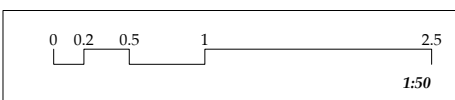
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PI04 BAY WINDOW
SECTION 02 | 1:50



PI04 GF BAY WINDOW
PLAN 03 | 1:25



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All Windows to achieve min U-Value 1.2W/m2K / See Detailed Schedule for additional Solar Control Requirements

Elevation Key:

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- Cavity Tray with weepholes at 450mm centres over.

SEE STRUCTURAL ENGINEERS INFORMATION FOR
MOVEMENT JOINTS AND WIND POST LOCATIONS

KEY MAP

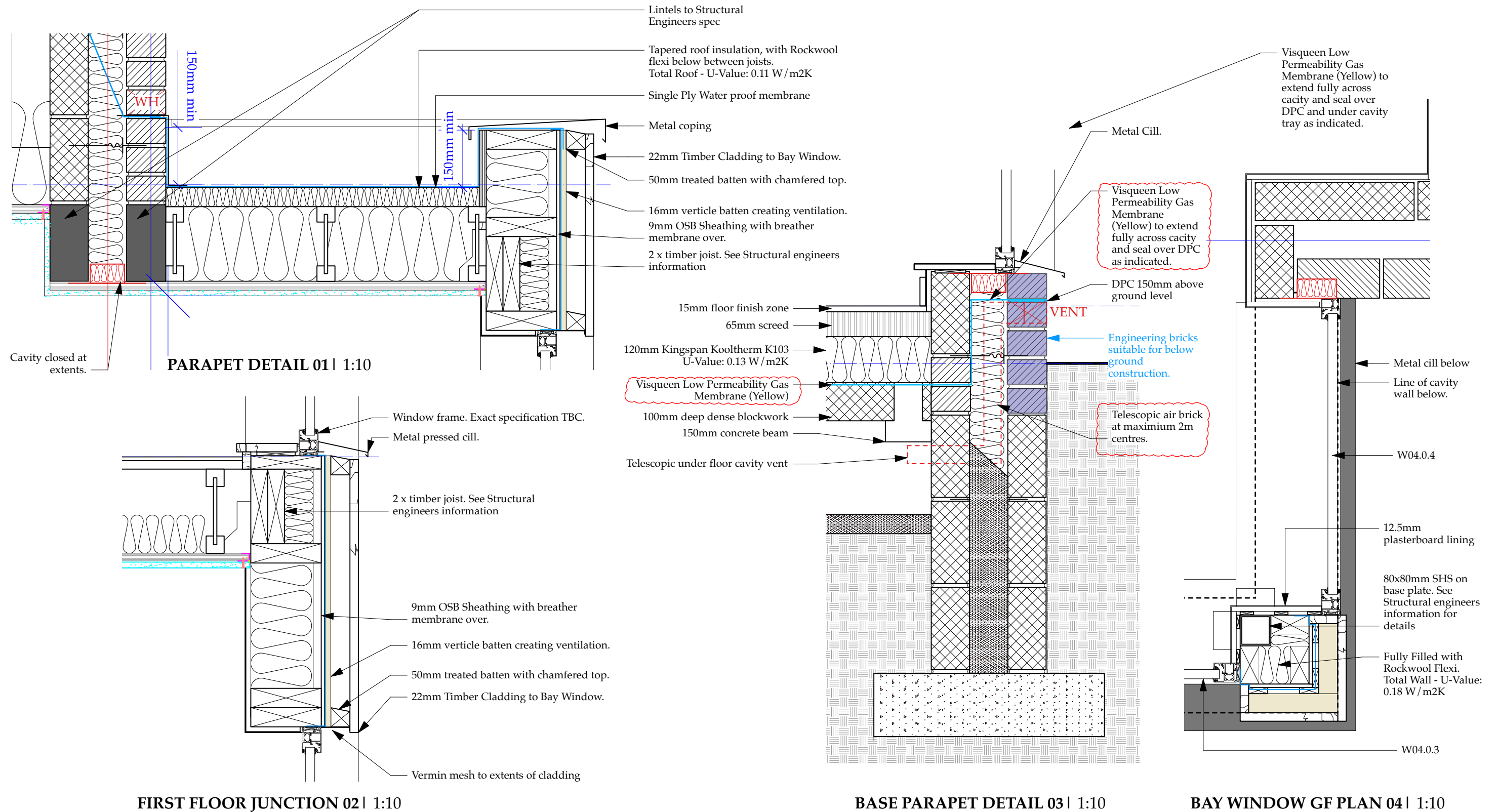


D 07/07/2026 JR AJ DPM upgraded to Gas membrane & Vent locations added.
Rev. Date Drawn Checked Note

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JOB: **LAKESIDE - 144**
STATUS: **BUILDING CONTROL**
SCALE: **AS NOTED @ ISO A3**
FIRST ISSUE: **29/04/24**
DRAWING No: **3.220 - D**

PR Elevations_Bay Window Gable 01



KEY MAP



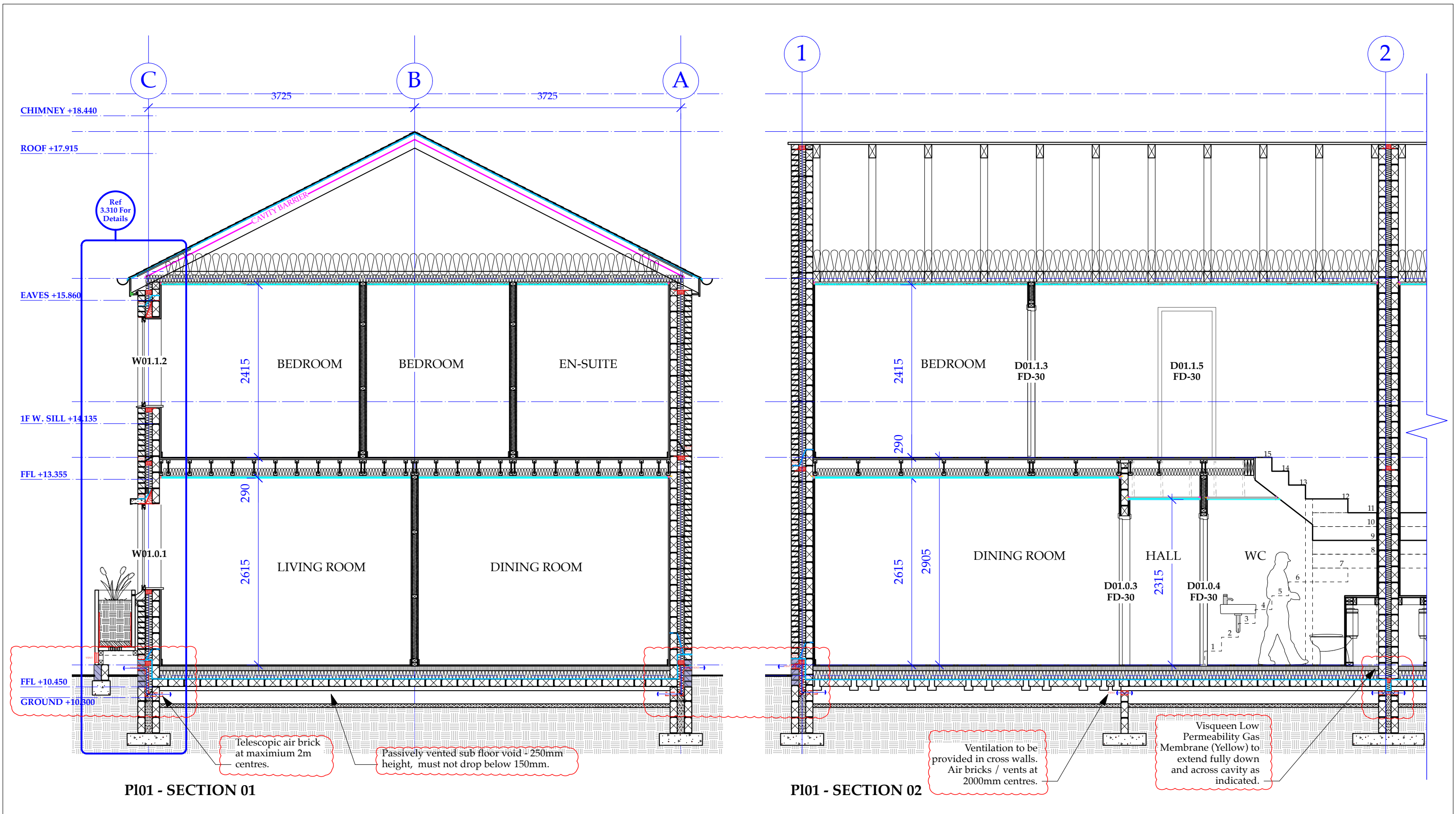
C 07/07/2026 JR AJ DPM upgraded to Gas membrane & Vent locations added.
Rev. Date Drawn Checked Note



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JOB: **LAKESIDE - 144**
STATUS: **BUILDING CONTROL**
SCALE: **1:10 @ ISO A3**
FIRST ISSUE: **16/05/24**
DRAWING No: **3.221 - C**

PR Elevations_Bay Window Gable 02



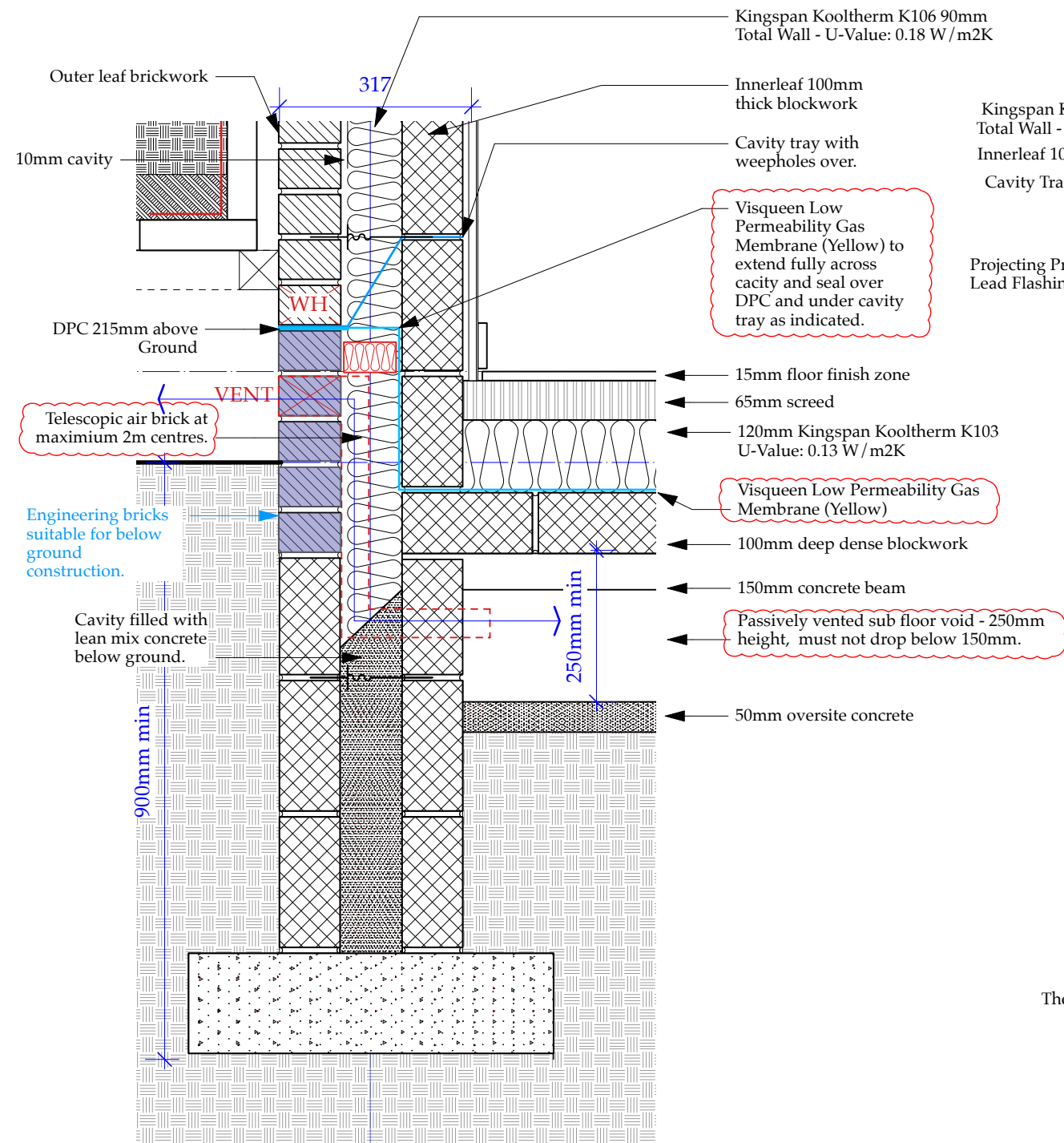
KEY MAP

E	07/07/2026	JR	AJ	DPM upgraded to Gas membrane & Vent locations added.
Rev.	Date	Drawn	Checked	Note

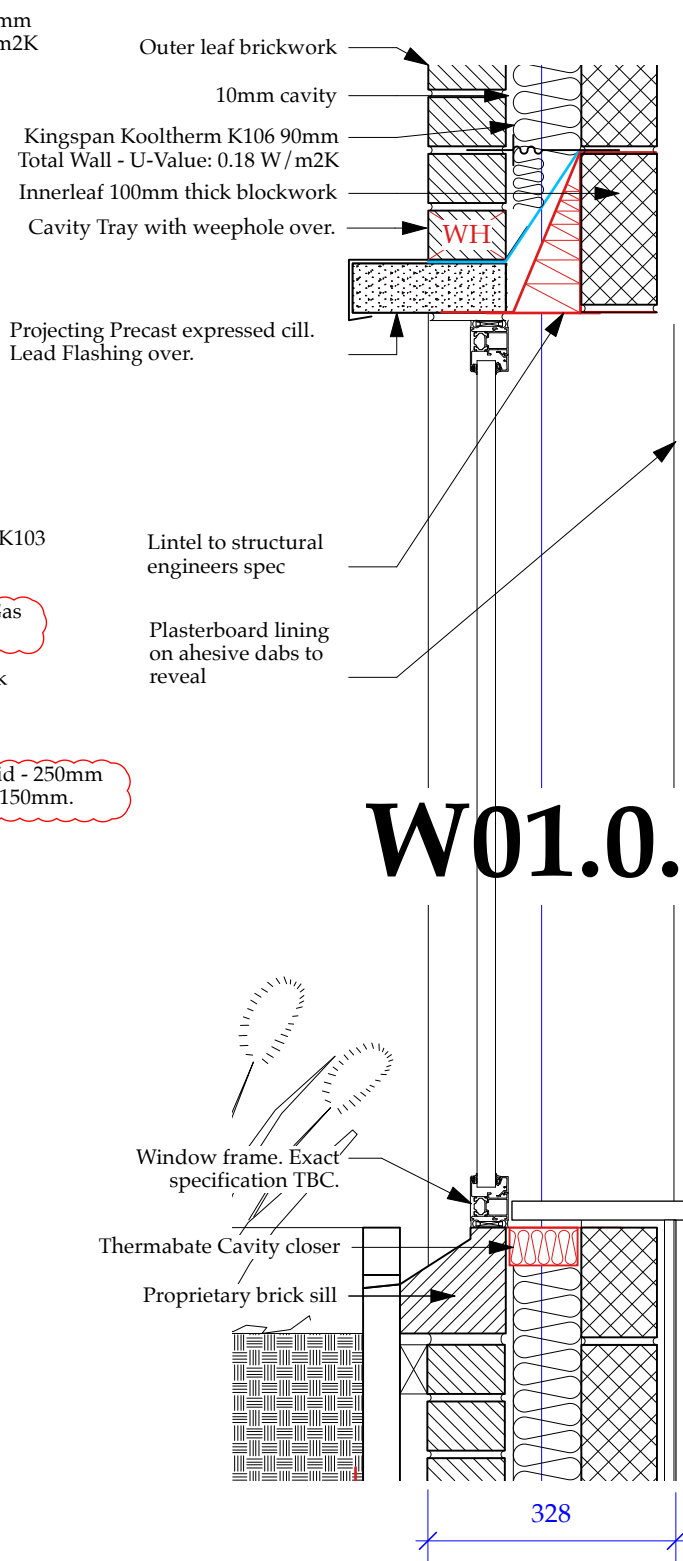
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JOB: **LAKESIDE - 144**
STATUS: **BUILDING CONTROL**
SCALE: **1:50 @ ISO A3**
FIRST ISSUE: **16/05/24**
DRAWING No: **3.300 - E**

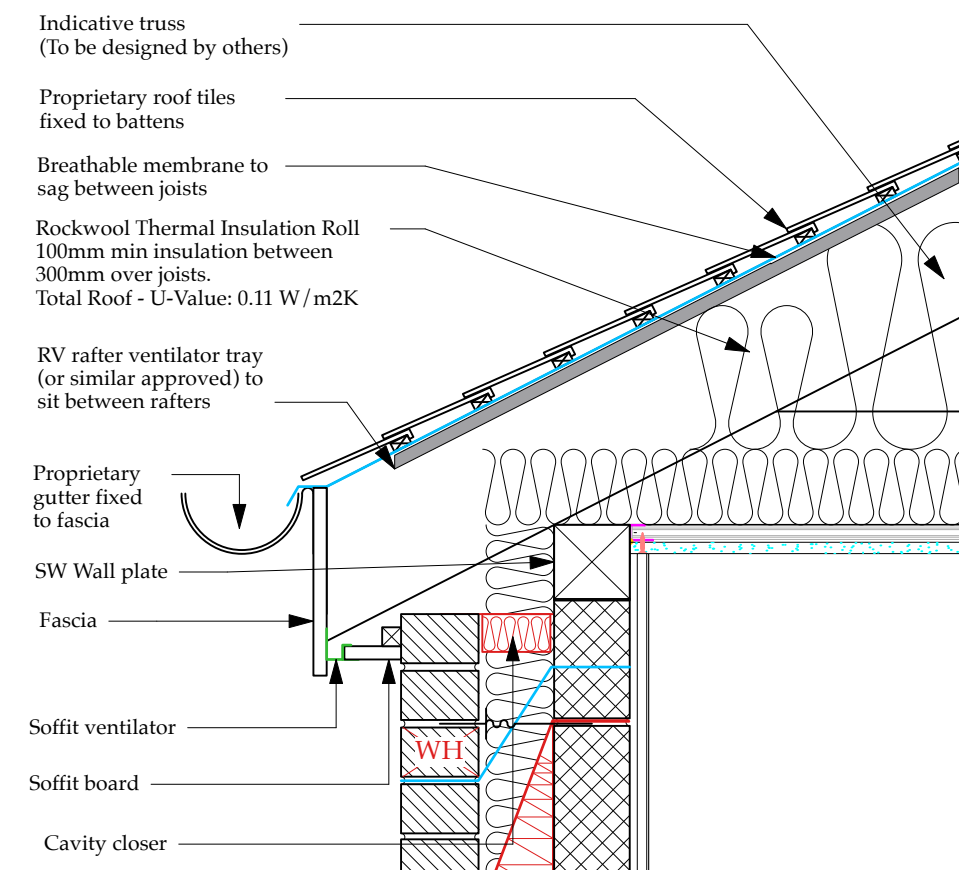
Proposed Detail Section



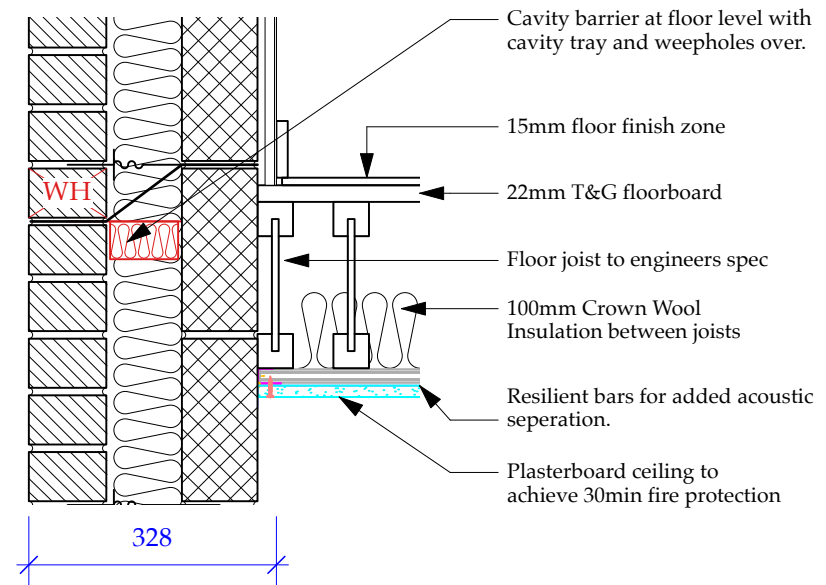
1. FOUNDATION DETAIL | 1:10



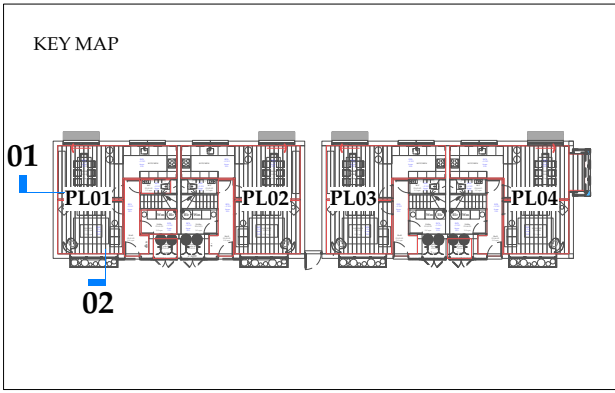
2. WINDOW DETAIL | 1:10



4. EAVES DETAIL | 1:10



3. FLOOR JUNCTION DETAIL | 1:10

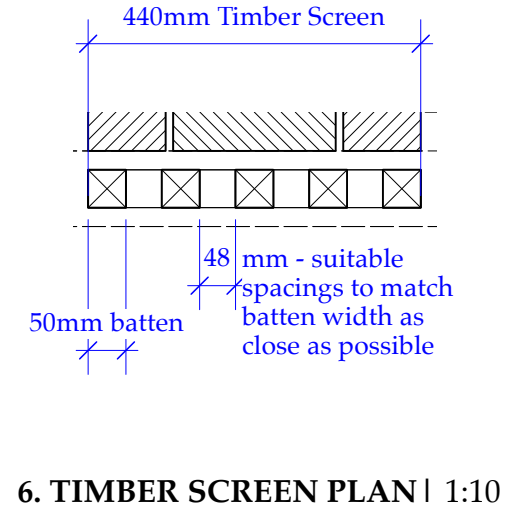
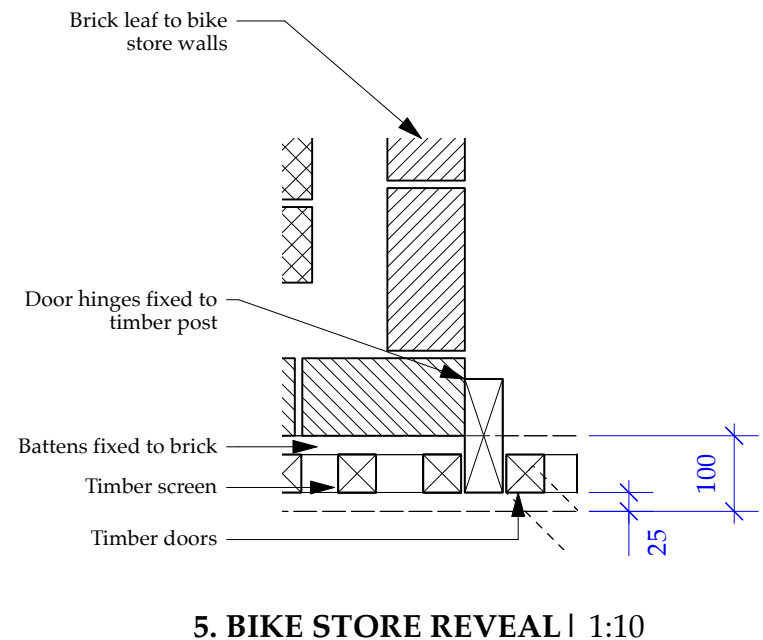
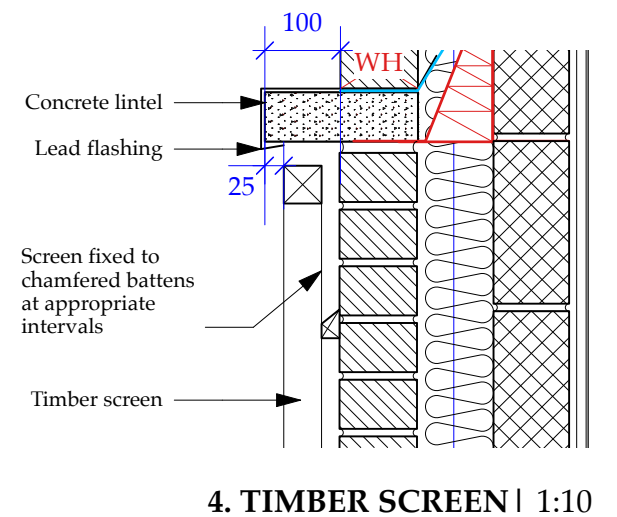
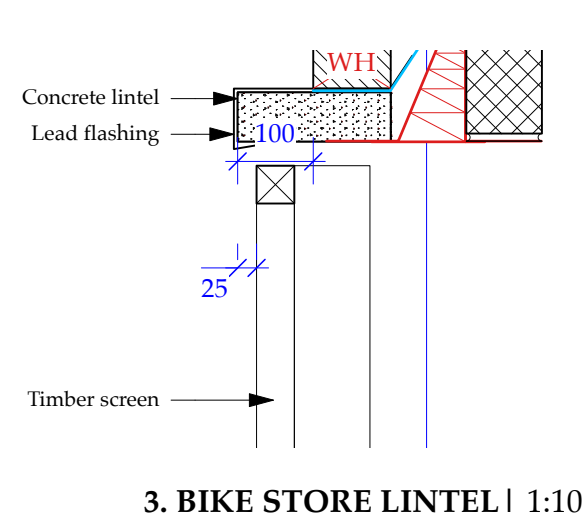
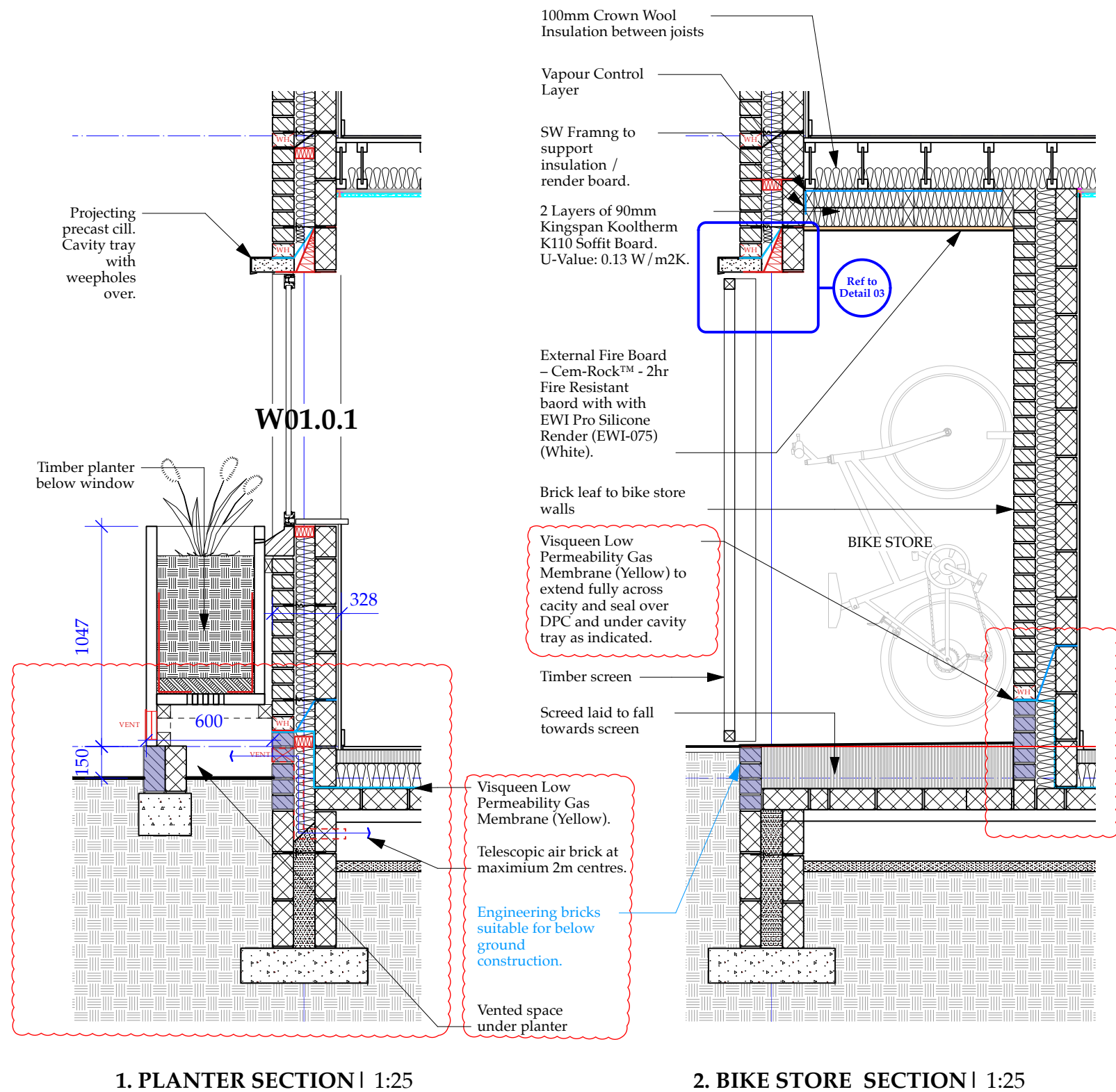


D	07/07/2026	JR	AJ	DPM upgraded to Gas membrane & Vent locations added.
Rev.	Date	Drawn	Checked	Note

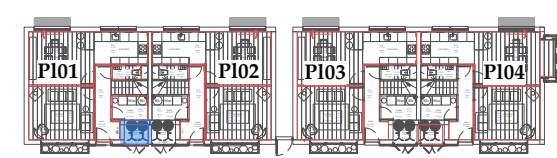
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JOB: **LAKESIDE - 144**
 STATUS: **BUILDING CONTROL**
 SCALE: **1:10 @ ISO A3**
 FIRST ISSUE: **16/05/24**
 DRAWING No: **3.310 - D**

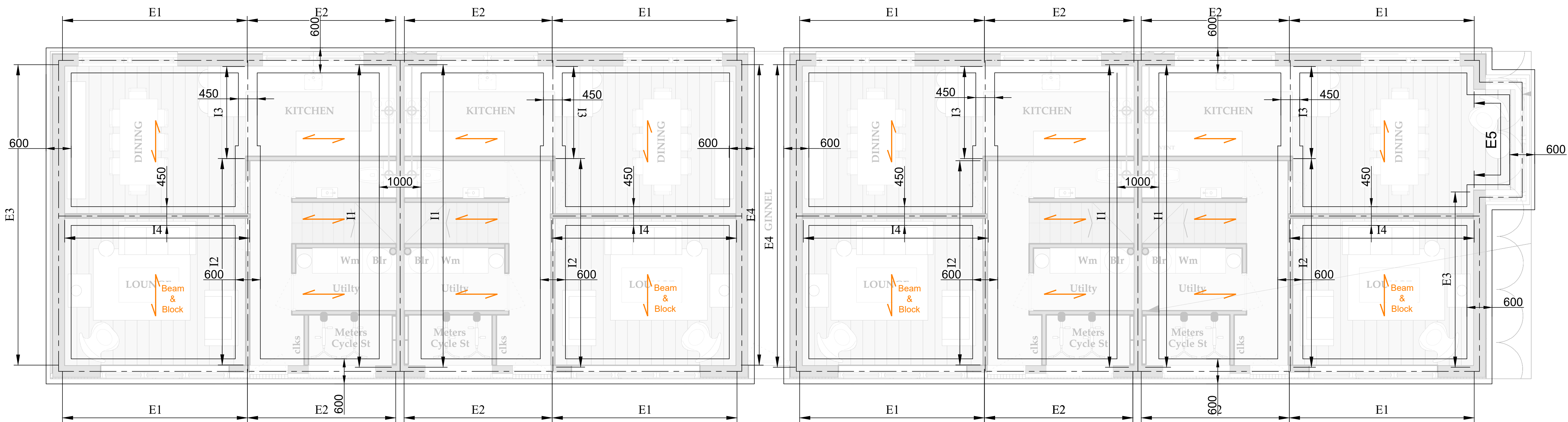
Proposed Detail Section



KEY MAP



D	07/07/2026	JR	AJ	DPM upgraded to Gas membrane & Vent locations added.
Rev.	Date	Drawn	Checked	Note
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JOB:		LAKESIDE - 144		
STATUS:		BUILDING CONTROL		
SCALE:		AS NOTED @ ISO A3		
FIRST ISSUE:		16/05/24		
DRAWING No:		5.002 - D		
Timber Screen - Detail				



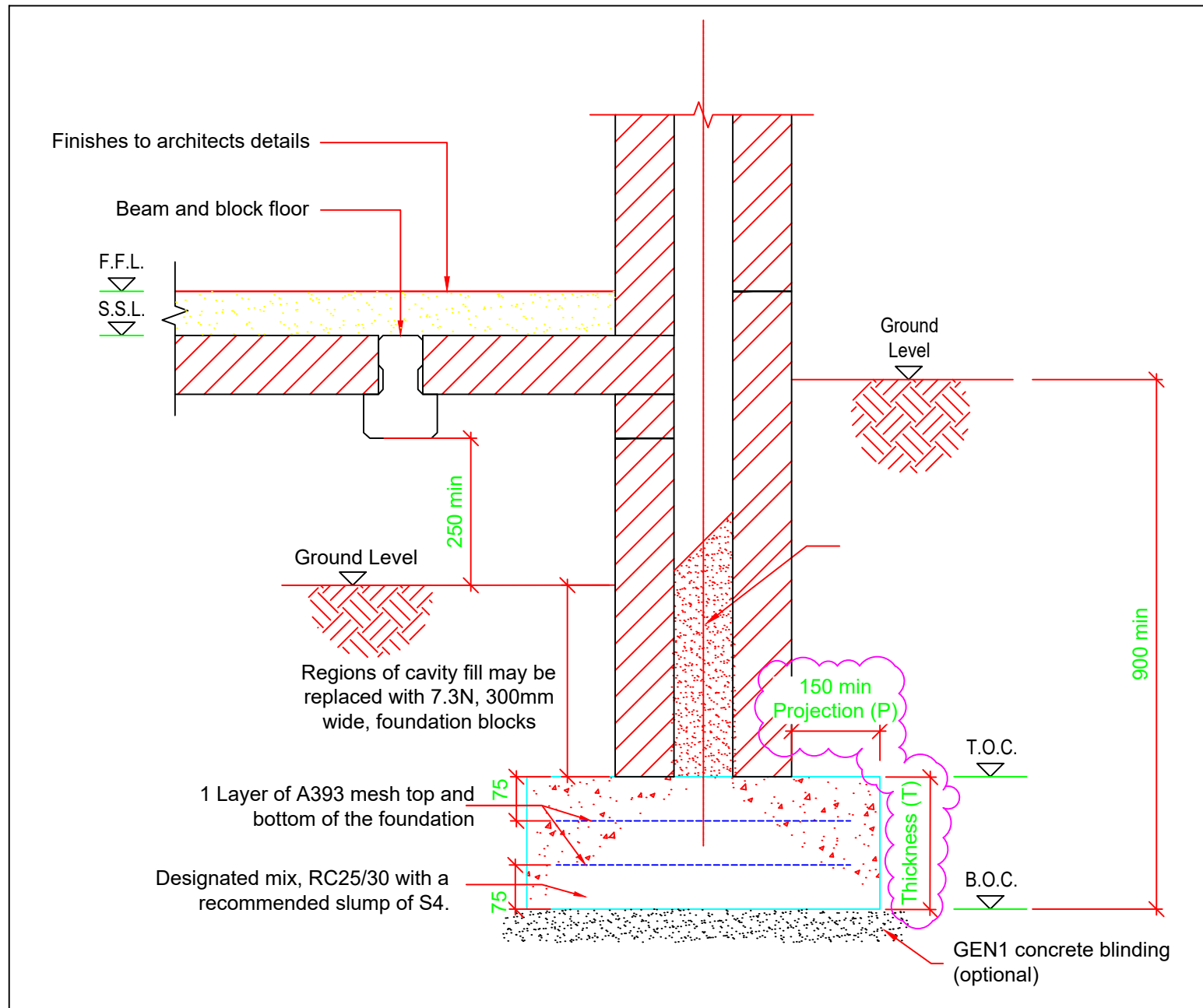
FOUNDATION LAYOUT (1:50)

These sections are indicative to show the typical relationship between foundation, sub-wall and beam and block floor.

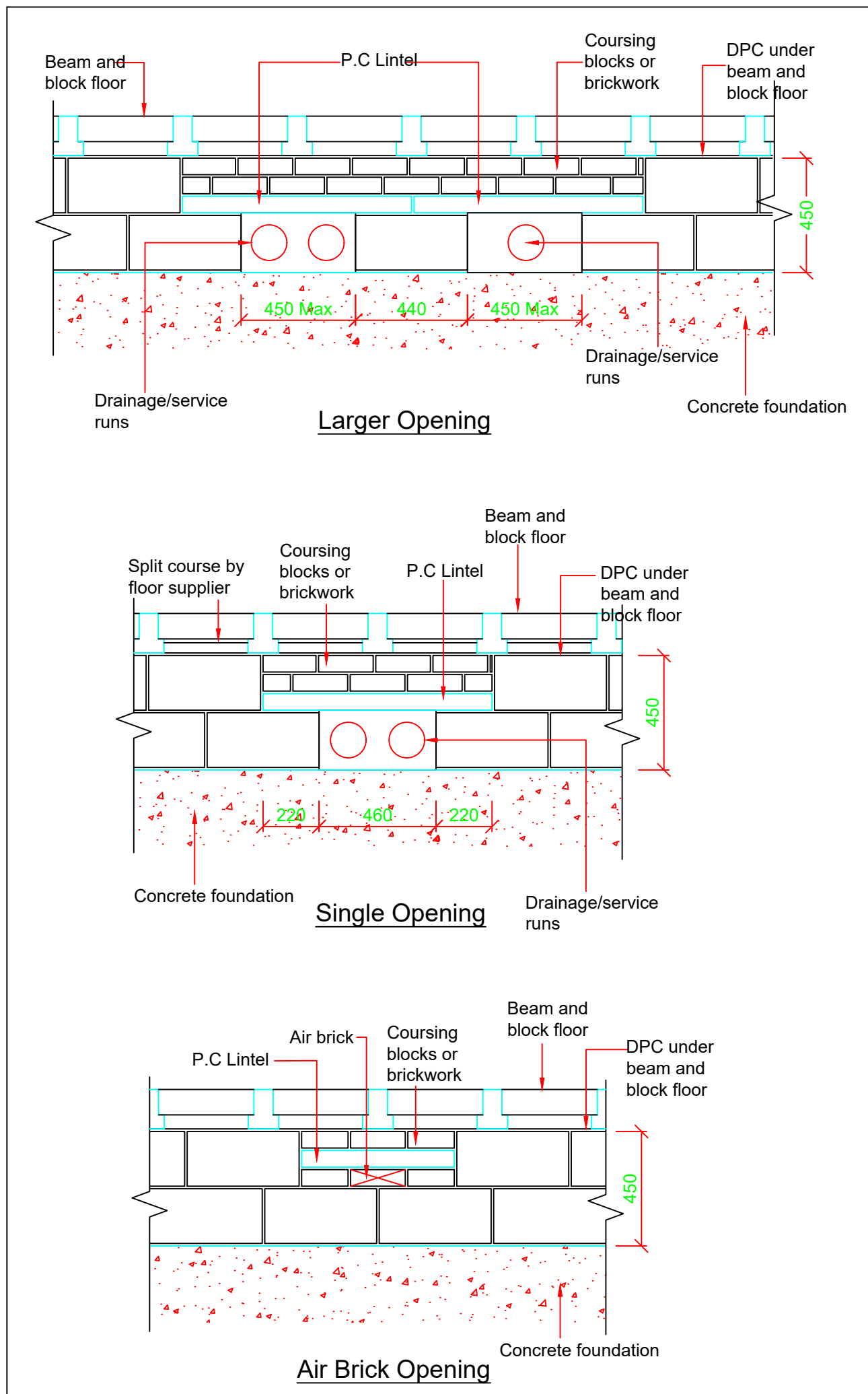
Refer to Architect's drawings and sections for details of DPC's, air bricks, gas membranes, ventilators, cavity trays, insulation and floor finishes.

Refer also to Architect's substructure wall layouts for setting out of sub-walls.

Table of minimum foundation thickness based on widths	
Foundation width (mm)	Foundation thickness (mm)
450 - 600	225
750 - 900	300
1000	400



DETAIL-A
TYPICAL SUBSTRUCTURE DETAILS
(1:10)



DETAIL-B
TYPICAL OPENING FORMATION IN SLEEPER WALLS
(1:20)

SITE SPECIFIC NOTES:

- Foundation depths to be minimum of 0.9m below existing or proposed ground level, whichever is lower.
- The foundation depths may need to be reviewed for tree influence, on receipt of an arboricultural survey.
- The foundation strata is to be stiff gravelly clay (see SI report for details).
- The foundation substrate has been defined to have a safe bearing capacity of 100kN/m2 (see SI report for details).
- The foundation substrate has been defined as having medium volume change potential (see SI report for details).
- For suspended floor construction, the minimum void below floors is to be 250mm for clay soil with medium volume change potential.
- The concrete classification used for this area of the site has been specified as DS-1 AC-1 (see SI report for details).
- Specification of concrete for foundations shall be designated mix RC25/30, with a recommended slump of S4.
- Water table depth is assumed to 1m bgl, based on the closest BH/TP records (see SI report for details).

GENERAL NOTES:

- Foundations to be formed at least 150mm into the depth of foundation strata.
- Soft spots should be deepened to a sound bottom. Hard spots should be removed.
- Trench bottoms should be horizontal, with all loose material removed.
- Trench sides and steps should be, as near as possible, vertical.
- Trench bottoms affected by rain water, ground water or drying should be re-bottomed to form a sound surface.
- Where roots are visible at the bottom or sides of trenches, especially in clay soils, excavations should be taken deeper, or special precautions in relation to protection against heave should be followed.
- Backfill in trenches should be properly placed and mechanically compacted to form a stable mass in layers not exceeding 225mm. Concrete may be used as an alternative to backfill in trenches.
- Cover to reinforcement to be minimum 75mm to all sides.
- Minimum overlap for fabric reinforcement fabric to be two bars plus 50mm.
- Walls are to be constructed central above the foundations below.
- Maximum retained height difference of retained earth, either side of substructure walls to be 4T, where T= combined thickness of the wall leafs, but no greater than 1m.
- These drawings must be evaluated by the principal designer and contractor prior to adoption.

CIVIL / STRUCTURAL DESIGN RISK MANAGEMENT

Abnormal or unusual residual risks associated with the design outcomes shown on this drawing are:-

RISK 1 Danger of excavation sides collapsing.

RISK 2 Danger from water within excavations.

RISK 3 Danger of skin burns from contact with fresh concrete.

RISK 4 Risks of falling from height from unprotected edges against excavations.

RCS Ltd has followed its Design Risk Management process for Hazard Elimination and Risk reduction in developing the designs shown on this drawing.

Abnormal or unusual residual risks may be shown above where it is considered that such risk may not normally be expected by competent persons engaged on work of this nature or type.

P03	09/04/2026	Additional details added	AS	RA	
P02	22/01/2024	Additional details added	RA	RA	
P01	12/01/2024	First Issue			
Rev.	Date	Amendment	Drawn	Chkd.	Appd.


ROYTON CIVIL & STRUCTURAL LIMITED
Prospect House, Featherstall Rd South, Oldham, OL9 6TJ

Client
MAC ROOFING & CONTRACTING LTD

Project Title
**PLOTS P101 to P104
LAKESIDE, LOWER RD,
L26 2XA**

Status
FOR INFORMATION

Drawing Title
FOUNDATION LAYOUT

Drawn AS	Date 09/04/26	Chk'd RA	Date 09/04/26	Apprv'd	Date
Scale As shown	Orig Size A1	Project No. CN12			
Drawing No. CN12-RCS-XX-DR-S-0001					Rev. P03

APPENDIX V

GAS MEMBRANE SPECIFICATION



Visqueen Low Permeability Gas Membrane

Features & benefits

- BBA certified - third party accreditation
- Complies with NHBC Foundation's NF94 guidance for radon protection in Type A and Type B membrane locations
- Complies with NHBC Amber 1 - suitable for low gas risk NHBC housing sites
- Supplied centre folded - reduces the risk of cracks in screed and limits creases
- Also provides radon and damp proof membrane protection
- Dual jointing methods - depending upon specification, lap joints can be taped or heat welded

Product description

Visqueen Low Permeability Gas Membrane is a flexible 0.5mm thick thermoplastic membrane. The product is yellow in colour and supplied 4m x 12.5m in a centre folded roll.

The membrane is manufactured from virgin polymer.

Approvals and standards

- Third party accreditation (BBA 13/5069)
- Complies with NHBC Foundation's NF94 guidance for radon protection in Type A and Type B membrane locations
- 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 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. Visqueen Low Permeability Gas Membrane also complies with this guidance when installed with welded joints in Type B membrane locations. For further information, contact Visqueen Technical Office on 0333 202 6800.

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
- VisqueenPro Detailing Strip, 300mm x 10m
- Visqueen Top Hat Units
- Visqueen TreadGUARD 1500, 1m x 2m
- Visqueen TreadGUARD 300, 2m x 75m
- Visqueen NF-Detailing Strip, 300mm x 10m
- Visqueen NF-60 Lap Tape, 60mm x 45m
- Visqueen NF-150 Lap Tape, 150mm x 10m

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

Visqueen Low Permeability Gas Membrane

and dry at the time of jointing. It should be overlapped by at least 150mm, bonded with VisqueenPro Double Sided Jointing Tape and sealed with Visqueen NF-60 Lap Tape. In demanding site conditions, or where specified, seal lap joints with Visqueen NF-150 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 VisqueenPro Double Sided Jointing Tape and sealed with Visqueen NF-60 Lap Tape. The upstand should be secured with the supplied jubilee clip. Alternatively VisqueenPro Detailing Strip or Visqueen NF-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 or Visqueen NF-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 VisqueenPro Double Sided Jointing Tape and sealed with Visqueen NF-60 Lap Tape. Alternatively a patch can be formed using VisqueenPro Detailing Strip or Visqueen NF-Detailing Strip and lapped at least 150mm beyond the extents of the puncture.

When the gas protection measures are to conform with the requirements of NHBC NF94 guidance, please ensure acceptance of VisqueenPro Detailing Strip by all stakeholders prior to use.

Long periods of exposure to ultraviolet light will reduce the effectiveness of the membrane. The membrane should be covered by a protective layer e.g. Visqueen TreadGuard protection or other approved protection material, 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 during or post installation.

When used in full radon protection areas, a Visqueen Radon Sump or subfloor ventilation system maybe required. For further guidance contact Visqueen Technical Office on 0333 202 6800.

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 additional detailing information, contact Visqueen Technical Office on 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.

Property	Test method	Units	Compliance criteria	Result
Visible defects	BS EN 1850 -2	-	Pass/Fail	Pass
Length	BS EN 1848-2	m	-1	12.5
Width	BS EN 1848-2	m	-1	4
Straightness	BS EN 1848-2	-	Pass/Fail	Pass
Thickness	BS EN 1849-2	mm	-1	0.5
Tensile strength - MD	BS EN 12311	N/mm ²	>MLV	16
Tensile strength - TD	BS EN 12311	N/mm ²	>MLV	16
Tensile elongation - MD	BS EN 12311	%	MLV	400
Tensile elongation - TD	BS EN 12311	%	MLV	400
Joint strength	BS EN 12317-2	N	MDV	298
Watertightness to 2kPa for 24 hours	BS EN 1928	-	Pass/Fail	Pass
Resistance to impact	BS EN 12691	mm	>MLV	200
Durability (artificial ageing)	BS EN 1296 and BS EN 1928	-	Pass/Fail	Pass

Visqueen Low Permeability Gas Membrane

Durability chemical resistance	BS EN 1847	-	Pass/Fail	Pass
Resistance to tearing (nail shank) CD	BS EN 12310-1	N	MDV	333
Resistance to tearing (nail shank) MD	BS EN 12310-1	N	MDV	335
Radon permeability	SP Test Method	m ² /s	MDV	5.477 x 10 ⁻¹²
Radon transmittance	SP Test Method	m/s	MDV	1.095 x 10 ⁻⁸
Carbon dioxide permeability	ISO 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	BS EN 13501-1	Class	MDV	F
Water vapour resistance	BS EN 1931	MNs/g	MDV	1445
Water vapour - permeability/ density flow rate	BS EN 1931	g/m ² /d	MDV	0.1239
Equivalent air layer thickness	BS EN 1931	SD in m	MDV	290
Water vapour resistance factor	BS EN 1931	u	MDV	615,000

Health and safety information

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

About Visqueen

Visqueen is a leading provider of construction membrane technologies and design-based solutions for ground gas, structural waterproofing, damp proofing and fire protection.

We offer complete support at every stage of the specification, including the supply chain process. As the UK's principal technical authority, we are best placed to ensure that the principal designer and contractor specify the most technically suited, durable, and competitive solution to guarantee their project is protected for the lifetime of the building.

Visqueen is at the forefront of advanced membrane technology and innovation in the construction industry, earning the trust and loyalty of specifiers throughout the UK and Europe.

For more information, visit visqueen.com or contact our sales office at [+44 \(0\) 333 202 6800](tel:+44103332026800) or enquiries@visqueen.com

Complete Range, Complete Solution



Passive Fire Protection



Gas Protection



Damp Proof Membrane



Air and Vapor Control



Stormwater



Damp Proof Course



Temporary Protection

Visqueen Technical Support

Visqueen offer a comprehensive full nationwide technical support. Our team of CSSW qualified technical support managers provide on site design-based solutions for specifiers, contractors and builders merchants, and will ensure that from design stage to installation the project is fully risk assessed and the specification is approved by all stakeholders.

Our Technical Office, can design, prepare and manage CAD detailing, together with assisting in quantity take offs, while offering advice on technical installations and product selection.

Competency & Design

Visqueen promotes competency in building design by ensuring that its technical team possesses the necessary skills, knowledge, experience, and ethical practices. The company adopts the "golden thread of information," ensuring all project data is digitally secure and accessible throughout a building's lifecycle. This approach aligns with the Building Safety Act and aims to foster accountability and compliance with evolving regulations, providing clients with confidence in the safety and reliability of their projects.

Visqueen Low Permeability Gas Membrane

Visqueen CPD Seminars

Visqueen's CPD Seminars offer insights into Building Regulations, Standards, and industry guidance related to damp proofing, hazardous ground gas protection, and structural waterproofing. These one-hour seminars are tailored for construction design professionals and delivered by our Technical Support Managers. Visit our website to book a free CPD.

Visqueen Contract Design Services

Visqueen Contract Design Services offers a bespoke design service led by our team of Certified Surveyors in Structural Waterproofing (CSSW), providing experienced and specialised waterproofing design expertise for complex projects. We provide comprehensive support throughout the entire project, ensuring that all work meets the requirements of warranty providers and adheres to the highest standards of quality, reliability and current legislation.

Visqueen Training Academy

Based at our Derbyshire facility, the Visqueen Training Academy offers a variety of training programs across the UK. These include one-day product awareness sessions for distributors and builders' merchants, and intensive two-day courses for hands-on product installation training. Contact us for more information.