



Remediation method statement

**Land east of Knowle Lane
Fair Oak**

Version 1.0

May 2021

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Reference	EPG/8615/2021/RMS/V1	Version	1.0	Issue Date	May 2021
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1. INTRODUCTION

1.1 Purpose

In 2017, planning permission was granted for a hybrid commercial and low-rise/high-rise residential development covering a large site comprising distinct northern and southern areas connected by a narrow dog-leg (reference F/17/80640). Development of the northern area has been predominantly completed, and preliminary works have commenced on the southern area. Due to changes in the commercial (office space) market as a result of the ongoing pandemic a new application has been submitted relating to the southern area only, comprising a proposed change from office buildings to high-rise residential buildings. The proposed layout and associated infrastructure remain unchanged.

In 2017 and 2018 the Environmental Protection Group Limited (EPG) were appointed by Parsons Construction Limited (the Client) to undertake works relating to the original planning permission, with the following resultant reports:

- *Preliminary gas and vapour risk assessment.* EPG, March 2017, reference EPG/8615/2017/PRA/V1;
- *Appraisal of gas regime pursuant to surrender of environmental permit.* EPG, November 2017, reference EPG/8615/2017/PS/V1;
- *Detailed quantitative gas risk assessment.* EPG, January 2018, reference EPG/8615/2018/DQRA/V1;
- *Piling risk assessment.* EPG, April 2018, reference EPG/8615/2018/PRA/V1; and
- *Remediation method statement.* Environmental Protection Group, June 2018, reference EPG 8615/2018/RMS/V1.

Subsequently, in line with the amended planning application, EPG produced a letter report entitled *New planning application – impact on required gas protection measures*, December 2020, reference EPG/8615/2020/amended development. In response to the submission of the letter report, Eastleigh Borough Council contaminated land officer has advised the following:

Application No: F/21/89759

Address: Land East of Knowle Lane, Fair Oak, SO50 7DZ

Description: Conversion of planning permissions for office buildings B, C, D and E granted under F/17/80640, F/18/83954, F/18/84480 and F/20/87889 to 48 apartments (24 x 1 bedroom and 24 x 2 bedroom) with associated parking and landscaping and controlled pedestrian access to adjacent Site of Interest of Nature Conservation.

Regards the above application, the submitted contaminated land document (ref. EPG/8615/2020) dated 7th December 2020, is insufficient to address contaminated land concerns previously raised for this site. Due to the change in land use, the applicant is expected to submit a minimum of a desktop study (DTS) to address the change in potential contaminant linkages and the associated increased level of risk posed by potential contamination to the residential end users. The DTS should include a modified preliminary conceptual site model (CSM) and risk assessment with recommendations where required.

As such I would recommend that the following standard contaminated land conditions are placed on the Decision Notice, should you be mindful to grant permission:-

A. No work shall commence on site until the following has been submitted to, and approved in writing by the LPA:

- a. Report of Preliminary Investigation comprising a Desk Study, Conceptual Site Model, and Preliminary Risk Assessment documenting previous and existing land uses of the site and adjacent land in accordance with UK Land contamination risk management (LCRM) national guidance and including BS10175:2011+A2:2017 Investigation of potentially contaminated sites - Code of Practice, and, unless otherwise agreed with the LPA,*
- b. Report of a site investigation documenting the ground conditions of the site and incorporating chemical and gas analysis identified as appropriate by the Preliminary Investigation and in accordance with BS10175:2011+A2:2017, and BS 8576:2013 and unless otherwise agreed with the LPA,*
- c. Detailed site-specific scheme for remedial works and measures to be undertaken to avoid the risk from contaminants and/or gases when the site is developed and proposals for future maintenance and monitoring*

Such a scheme shall include nomination of a competent person to oversee the implementation of the works.

B. The development hereby permitted shall not be occupied / brought into use until there has been submitted to the LPA verification by the competent person approved under the provisions of condition A(c) that any remediation scheme required and approved under the provisions of condition A(c) has been implemented fully in accordance with the approved details (unless varied with the written permission of the LPA in advance of implementation).

Unless agreed in writing with the LPA such verification shall comply with UK Land contamination risk management (LCRM) and the guidance contained in EA Guidance for the Safe Development of Housing on Land Affected by Contamination - R&D Publication 66: 2008. Typically such a report would comprise:

- a. A description of the site and its background, and summary of relevant site information,*

- b. a description of the remediation objectives and remedial works carried out*
- c. verification data, including - data (sample locations/analytical results, as built drawings of the implemented scheme, photographs of the remediation works in progress, etc.*
- d. Certificates demonstrating that imported and / or material left in situ is free from contamination, gas / vapour membranes have been installed correctly*

Thereafter the scheme shall be monitored and maintained in accordance with the scheme approved under condition A(c)

This report is intended to fulfil the requirements of part c of the recommended condition A. It is a reproduction of Report 5 marginally amended to reflect the amended application, and should be read in conjunction with the likewise amended report prepared in pursuant to the discharge of anticipated conditions A part a and part b:

- *Detailed quantitative gas risk assessment.* EPG, May 2021, reference EPG/8615/2021/DQRA/V1.

The following background information was also referred to in the preparation of the reports:

- Reports provided by the Client and Eastleigh Borough Council as follows:
 - *Review of archival information, the Fair Oak landfill complex.* Landscan, May 2005;
 - *Fair Oak landfill study – final interpretative report.* Card Geotechnics Limited, June 2012. Reference CG/5515 revision 1;
 - *Ground gas assessment letter report.* Geo-Environmental Services Limited, March 2014. Reference GE8053/GR02/140325;
 - *Desk study report for the land at CWM site, Knowle Lane, Fair Oak.* Geo-Environmental Services Limited, September 2014. Reference GE10033-DSR-SEPT14 version 1.0;
 - *Ground investigation report for the land at CWM site, Knowle Lane, Fair Oak.* Geo-Environmental Services Limited, May 2015. Reference GW10615/GIR.MAY15 version 1.0;
 - *Desk study report for land east of Knowle Lane, Fair Oak.* Geo-Environmental Services Limited, January 2017. Reference GE10117-DSR-JAN17 version 1.0;

- Waste Acceptance Criteria analytical results for imported backfill material;
- Drawing PLA-03 revision F: *Restoration contours*. White Young Green, 2014;
- Drawing ENC-180317-7F1A provisional: *Topographical survey*. Encompass Surveys, 2017;
- Drawing 16-1092-M 02: *Masterplan site layout*. Urban Pulse Design, 2017;
- Drawing 5271:70 revision E: *Offsite FW sewer plan and longitudinal section*. MJA Consulting, 2015;
- Word of mouth records from the Client;
- Historic maps obtained from Landmark Information Group;
- British Geological Survey geological map: Southampton, England and Wales Sheet 315;
- Review of available web-based data resources, notably the Environment Agency's '*What's in your backyard?*' service, and the British Geological Survey's Geology of Britain viewer and borehole scans;
- Spot and high frequency gas monitoring results, 2017; and
- Results of surface emissions survey, November 2017.

This remediation method statement has been produced in accordance with guidance produced by the Environment Agency (EA), the Department of Environment, Food and Rural Affairs (DEFRA), and the British Standards Institution (BSI), namely:

- *The model procedures for the management of land contamination* (CLR11, EA/DEFRA, 2004); and
- *Guidance for the safe development of housing on land affected by contamination* (R&D66, EA/NHBC, 2008); and
- *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings* (BS8485:2015, + A1 2019).

The structure of this report is as required by the above guidance, which may be summarised as follows:

- Contents;
- Summary;
- Objectives;

- Site conditions and characterisation of the ground gas and soil regime;
- Construction and building related details;
- Product design, specifications and justification; and
- Recommended verification approach to the importation of topsoil and the installation of gas membranes.

2. ENVIRONMENTAL SETTING

The site is located in Fair Oak, approximately four miles to the east of Eastleigh. The location of the larger original site is shown in Figure 1, bounded in green. The area covered by the current application is bounded in purple. The previous application also included land to the southeast extending down to a pond, designated as a Site of Interest of Nature Conservation (SINC).



Figure 1: Site location

The original site is an irregular shape, comprising two roughly rectangular areas joined by a dogleg. The northern area comprises a closed and backfilled sand quarry sloping gently to the south. It is bounded to the north by a new residential development, to the east by open fields, to the south by commercial premises owned by the British Sky Broadcasting Group (BSkyB) and a closed engineered landfill, and to the west by Knowle Lane and the BSkyB site. Pedestrian and vehicular access is via a tarmac covered access road which enters the site off Knowle Lane in the southwest corner and extends along the southern boundary of the site before turning southeast at the dogleg. The southern area of the site currently under consideration has been in use as a carpark and office compound since purchase in 2008.

The original site extends to approximately 2 Hectares and is approximately centered at National Grid Reference 450600 118520. The proposed hybrid development layout is illustrated in Figure 2, with the originally proposed residential units represented in orange, and the commercial units in blue.



Figure 2: Proposed hybrid development layout

The proposed layout of the commercial (office) buildings in Zone B was amended in 2020 under planning permission reference F/20/87889, as detailed in drawing 16-1092-080-C, an extract of which is presented below as Figure 3. The proposed residential high-rise development is based on exactly the same layout, with no changes proposed to the foundation construction or associated infrastructure, including no proposals for additional areas of soft landscaping.



Figure 3: Proposed residential high-rise development across Zone B

At the time of writing, the original carpark formation material has been removed, and the levels reinstated using imported predominantly clay material. The piles and ring beams to Buildings B and C have been installed, together with the drainage and surface water attenuation tanks beneath the car park area in the northern part of the site. The lower area (Buildings D and E) has been reduced to the formation levels determined for the previous application and covered with crushed concrete.

A recent aerial photograph is presented as Figure 4 below.



Figure 4: Recent aerial photograph of site

2.1 Natural geology

The 1:50,000 British Geological Survey geological map for Southampton (*England and Wales Sheet 315 solid and drift edition*, 1987) identifies bedrock comprising the London Clay Formation (LCF) across the site. No superficial deposits are shown in the area, however an element of the LCF in the form of the Whitecliff Sand Member is indicated to be present across the western part of the site. A cross section presented on the map sheet identifies that the overall dip of strata across the site is to the south west. The general distribution of the LCF elements and the cross section local to the site are presented in Figures 5 and 6 below.

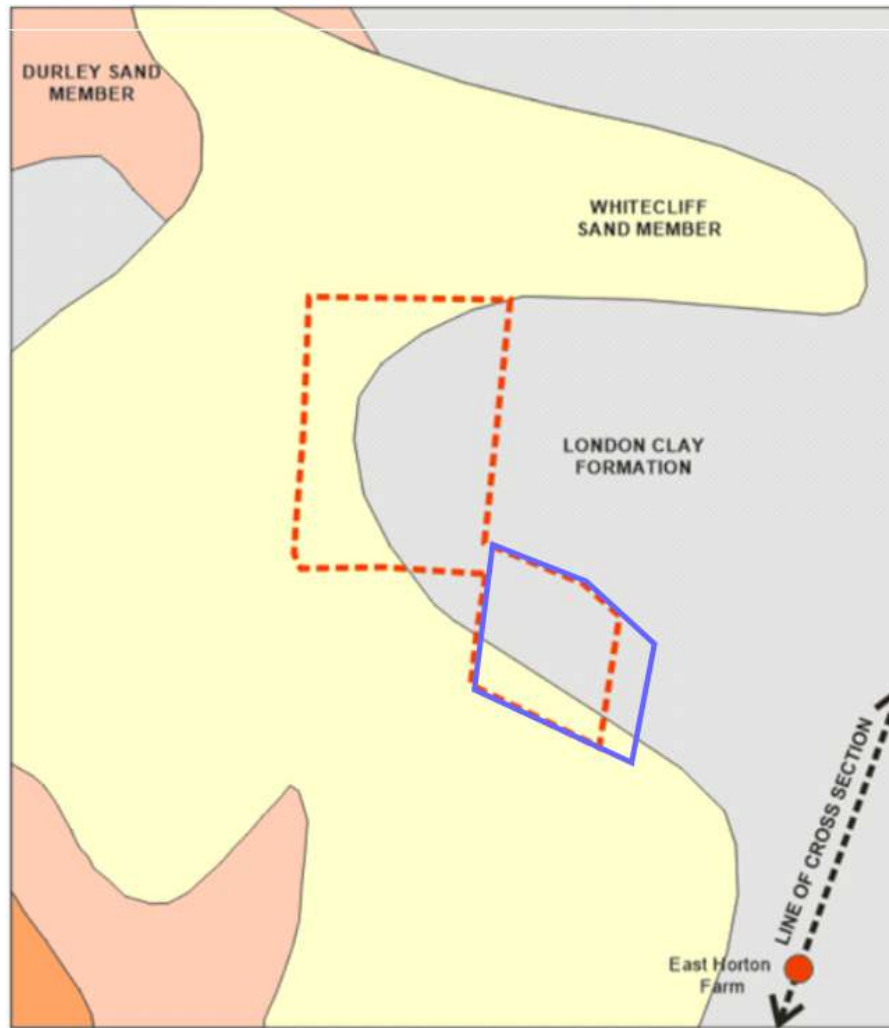


Figure 5: Geology local to the site, after BGS Sheet 315 solid and drift edition

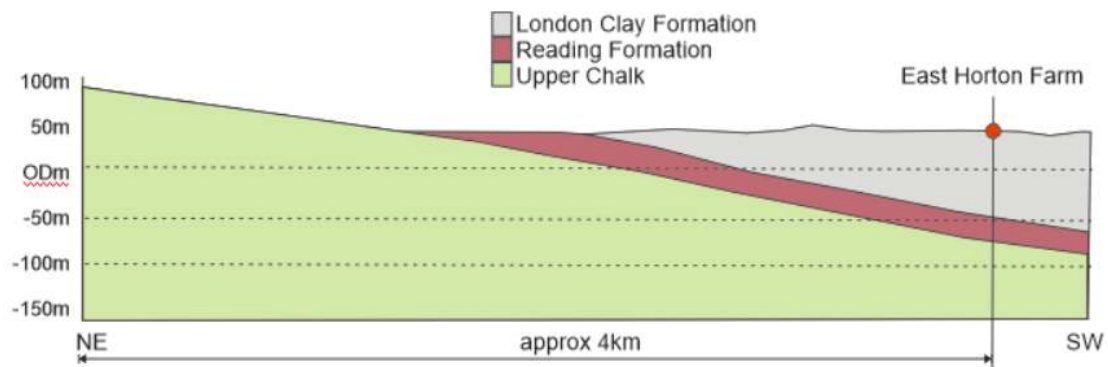


Figure 6: Geological section local to the site, after BGS Sheet 315 solid and drift edition (vertical exaggeration x4)

The Whitecliff Sand Member (WSM) is described as fine-grained sand occurring as lenticular bodies within the upper parts of the London Clay Formation as thin discontinuous beds and channels. Within the Southampton area, the London Clay Formation consists predominantly of interbedded silty sandy clay. Underlying the LCF at depth is the Reading Formation (clay, sand and pebbles) over the Upper Chalk. In the direct vicinity of the site, the Upper Chalk lies at >100m BGL.

2.2 Hydrogeology

The Whitecliff Sand Member is designated as a Secondary A Aquifer, whilst the main body of the London Clay Formation is designated an unproductive aquifer. The overall dip of bedrock strata across the site is to the southwest. Based on natural geology only, it is considered likely that the sandy elements of the LCF (such as the WSM) will contain groundwater perched upon the less- or non-permeable clay elements. The prevalent direction of flow of the perched waters will be locally dependant on the extent and dip of the underlying clay surface.

The history of sand extraction and landfilling across the area will have resulted in the local disruption of the groundwater regime. Groundwater/leachate within the adjacent dilute and disperse landfills will migrate predominantly to the southwest in line with the underlying dip in strata, however it is also likely to 'pool' within the waste.

2.3 Hydrology

The hydrology local to the site is summarised in the 2017 desk study report produced by Geo-Environmental Services Limited as follows:

No surface water features were observed on site. The nearest surface water feature identified was located approximately 68m south east of the site comprising a pond leading into a surface water drain. An issue leading into a surface water drain was also identified 150m west. Notwithstanding this, the site does include some run-off control, with sediment trap and collector ditch located along the eastern boundary (of Site B) and northern boundary (of Site C).

River quality data provided by the Environment Agency demonstrates that the Horton Heath Stream (Hamble Conference to Lower Upham) located 437m to the east was classified as *River Quality B – Good* in 2000.

The desk study identified seven licensed surface water abstractions within a radius of 1km of the site boundary and all associated with East Horton Golf Club used for spray irrigation. The closest was located 350m to the south east of the site.

The desk study identified two discharge consents to surface water within 500m of the site boundary:

- Sewage discharge, final/treated effluent into an unnamed drainage ditch, 198m north; and

- Sewage discharge, final/treated effluent into a freshwater stream/river, 350m south east.

One pollution incident to surface water was recorded within 500m of the site boundary:

- Sewage discharging into stream, category 3 minor incident, 308m south east.

2.4 Natura 2000 Sites and SSSI's

The site is not located in the proximity of a Natura 2000 site (<http://natura2000.eea.europa.eu/#>) or in the proximity of a RAMSAR or SSSI (DEFRA, Magic Map).

2.5 Site history

The history of the site and its environs in the context of this report is presented in detail in the DQGRA report (EPG, 2021), and is summarised below.

Historic records in the form of maps, plans, aerial photographs and regulatory records indicate that the site is located in an area of intensive historic sand extraction and landfilling as illustrated in Figure 7 below.

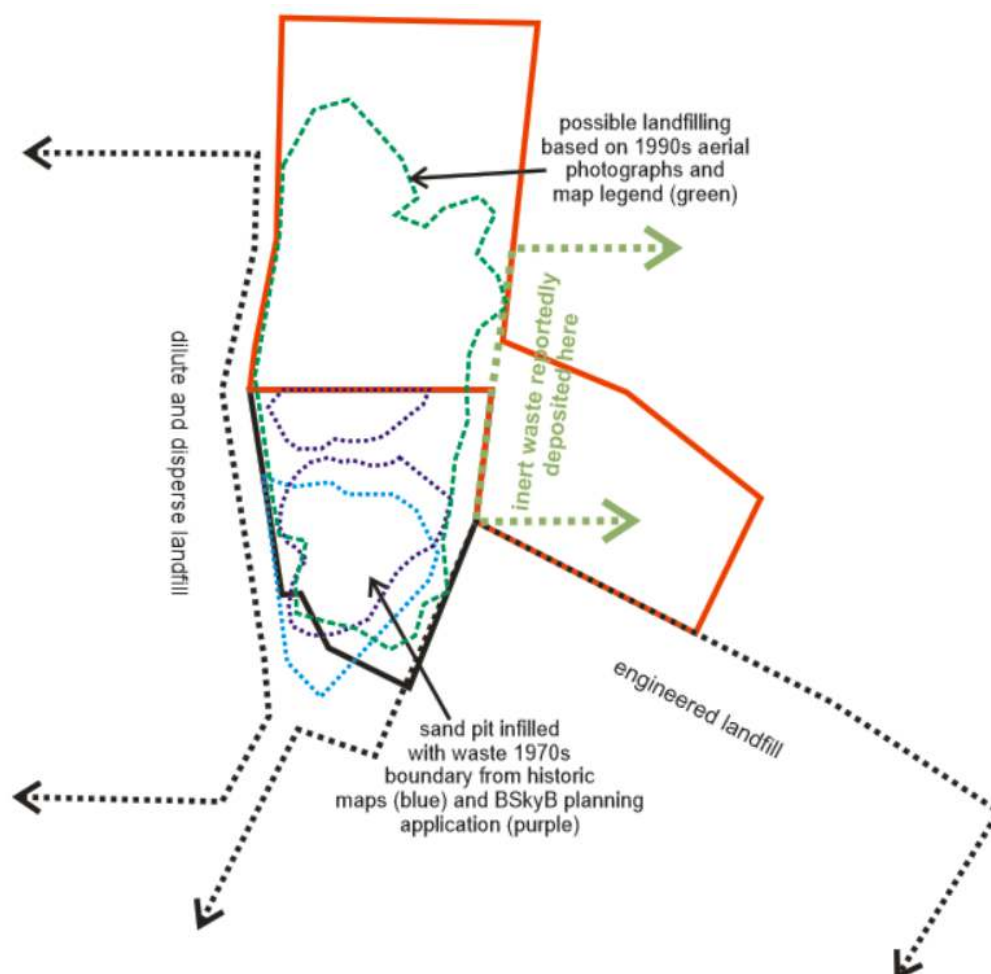


Figure 7: Approximate extent and location of landfilling as identified by historic records

Two separate areas of dilute and disperse landfilling outside the site boundary represent potential sources of historic gas/leachate in a position to impact the site via lateral migration. These are in the form of an aged dilute and disperse landfill to the west, and an infilled sand pit to the south/west, potentially extending beneath the site, and developed for commercial use c.2000. A more recent engineered landfill located at the southwest boundary of the site can be discounted as a potential source of gas/leachate due to its integrated gas extraction system and basal liner.

At the time of purchase by the Client in 2008, site investigation records identified that a large volume of waste was buried irregularly across the northern part of the site, some of which may have formed the northern extent of the infilled sand pit immediately to the south. The majority of the waste was removed as part of pre-development remedial works, with the exception of any residual material located beneath the access road. During these site clearance works; extensive sand deposits were identified beneath the site. Planning

permission was granted for the commercial extraction of the sand in the northern part of the site between 2012 and 2014.

In January 2014, an environmental permit was issued by the Environment Agency authorising the importation of inert waste for the restoration of the sand extraction pit. Between 2014 and 2016, inert predominantly clay material was imported and placed as backfill, together with natural site won overburden stockpiled on site throughout sand extraction works. During placement the infill materials were spread in thin layers and compacted using a 6-tonne sheep's foot roller. The surrender of the environmental permit was approved by the Environment Agency on the 19th February 2018. The southern area of the site has consistently been used as a site compound throughout this period, following removal of any made ground and the placement of inert carpark formation materials.

The extent of dilute and disperse landfilling in the direct vicinity of the site following completion of sand extraction and backfilling with inert imported material is depicted in Figure 8 below.

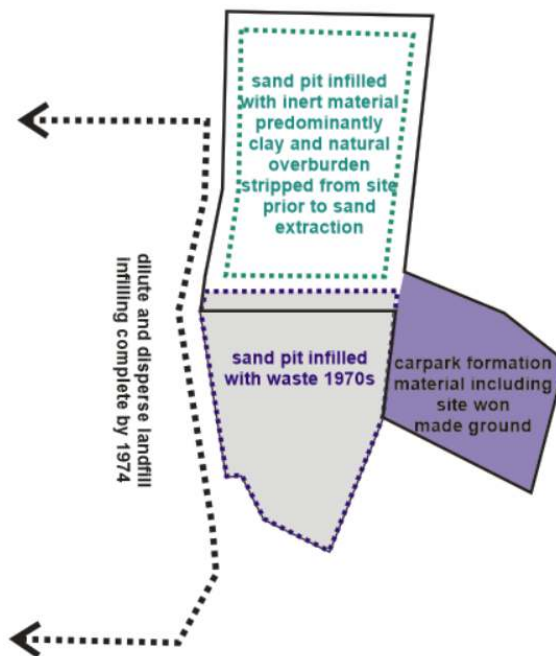


Figure 8: Current extent of dilute and disperse landfilling

In summary, it is evident that potential pollutant pathways may exist between the site and adjacent land parcels, and that the site cannot be considered in isolation from the areas of dilute and disperse landfilling within the Fair Oak landfill complex. Extensive areas of historic sand extraction and landfill are prevalent across the area, and it must be concluded that they are in hydraulic and gaseous continuity despite being tipped at

different times and with different waste composition. It is not considered that the inert backfill material imported to the northern part of the site represents a potential source of contamination.

3. GAS REGIME, MITIGATION AND VERIFICATION

The gas regime is interpreted fully within the detailed quantitative gas risk assessment report (EPG, May 2021). Based on multiple lines of evidence, the report concludes that the site should be considered a CS2 classification, with a requirement for basic gas protection measures. The required gas protection measures are specified as follows:

For commercial or flatted development – Type B building in accordance with BS8485 (3.5 points required):

- *Installation of a gas resistant membrane. The membrane to be specified in accordance with BS8485:2015 and installed/verified in accordance with CIRIA Report C735, Good Practice on the Testing and Verification of Protection Systems for Buildings Against Hazardous Ground Gases. Furthermore, it must be robust enough to withstand construction and should be a minimum of 0.6mm thick in between the scrim (e.g. Juta GP1) **BS8485, Table 7 – 2 points**; and*
- *Construction of an open void (minimum 225mm deep) beneath all residential properties, passively vented via air bricks constructed on at least two opposite walls, providing an actual opening of at least 1500mm² for each metre run of wall. All beams and sleeper walls beneath the properties to be constructed so as to allow cross ventilation. **BS8485, Table 6 – 2.5 points**.*

The membrane must be installed by a qualified and experienced installer (minimum one operative to hold an NVQ Level 2 in Gas Protection Installation). The membrane installations to all plots (100% coverage) are to be independently inspected by an independent verifier who should be able to demonstrate their competence, training and relevant experience. The inspection process should include a thorough visual inspection of the membrane. In the event of holes being identified during the membrane inspection process the inspection regime should be extended to include integrity testing (i.e. dielectric testing, or similar).

All (100%) joints, pipe penetrations etc. of the membrane should be independently air lanced to ASTM D4437.

Construction drawings of the proposed gas protection measures and verification plan have been produced. These are presented below.

3.1 Mitigation measures

The proposed gas protection measures are detailed in drawing 16-1092-260-1st *DPC DPM details*, Urban Pulse Design, February 2018 (contained in Appendix A). They comprise a passively ventilated sub-floor void of a minimum of 225mm depth combined with a gas membrane and associated accessories (for example tape etc). The membrane and accessories specified within the drawing (Visqueen) are in fact to be the equivalent Corden products, as illustrated in the suspended slab detail also contained in Appendix A.

The gas membrane will be installed by a specialist qualified to NVQ2 level from Gas Membrane Installations Limited (GMI).

3.2 Verification

Verification of the installation of the gas protection measures will be undertaken by an appropriately qualified specialist from MEC Environmental Limited (MEC). The methodology will follow that detailed in the Verification Plan, contained in Appendix B. On completion, MEC will produce a validation report containing the following information:

- Reference/name of job;
- Scope of work undertaken;
- Contractor's CQA evidence for ventilated void and membrane;
- Inspection survey sheets for all site visits; and
- Records of all non-destructive quality control tests and apparent failures.

This information will be made available to the Local Planning Authority prior to occupation of any structure.

4. SOIL REGIME, MITIGATION AND VERIFICATION

The soil regime in terms of the protection of human health, building materials and controlled waters is interpreted within the Ground investigation report (GESL, October 2017). Based on soil analytical results and risk assessment following current UK guidelines, the report did not identify any exceedances in contaminant concentrations, and concludes:

'In consideration of the current residential and commercial development proposals, it is considered that remedial measures are unlikely to be required within areas of soft landscaping for the protection of end users from soil contamination. It is considered that the use of clean imported topsoil will be required within proposed areas of soft landscaping, with these soils to be laid to a depth of at least 150mm, suitable to act as a growing medium'.

It then goes on to identify a number of generic mitigation measures, presented below in section 4.1.

4.1 Mitigation measures

The following basic mitigation measures are outlined within the ground investigation report and will be implemented during the construction works.

- The results of the soil analysis will be presented to the water utility company, and their recommendations for pipe material will be implemented;
- Clean granular backfill will be used in all service runs;
- Dust suppression techniques, e.g. damping down exposed soils will be employed;
- A material management plan will be produced in accordance with CL:AIRE Code of Practice (2011) prior to works commencing;
- Any soils to be removed from site will be subjected to waste acceptance criteria (WAC) testing and disposed of appropriately;
- A discovery strategy will be implemented, as detailed below.

4.2 Discovery strategy

It remains possible that unexpected soil conditions may be encountered during the process of construction. Examples may include oily pockets within the soil, pockets of cement boarding or fibrous materials within the soil, black ashy materials, soils exhibiting strong odours, brightly coloured materials, and former structures or brickwork.

Should previously undiscovered contamination be encountered during construction by the ground worker's, this will be reported to the site manager immediately in order that any necessary inspection may be made, and work in that area stopped and made safe. The following procedure will then be followed:

- Discovery;
- Works stopped in the area of unusual ground conditions, and the site manager made aware;
- The environmental consultant (a representative of GESL) will be notified and will attend site to assess and investigate; and
- The environmental consultant will identify whether it is safe to continue works. In the event that it is not considered safe, appropriate remedial actions will be agreed with the Local Authority.

A copy of the discovery strategy will be lodged on site and provisions made to ensure that all workers are made aware of their responsibility to observe, report and act on any potentially suspicious or contaminated materials they may encounter.

4.3 Verification

On completion of all groundworks, the verification of the placement of a minimum of 150mm of topsoil in areas of soft landscaping will be undertaken by randomly selected excavations in an appropriate number of locations. If these topsoils have been imported, analytical results at a ratio of 1:250m³ of imported soils will be compared with the criteria detailed within GESL's ground investigation report.

The analytical results together with any information generated via the discovery strategy procedure will be submitted to the Local Planning Authority for approval prior to any structure being occupied.

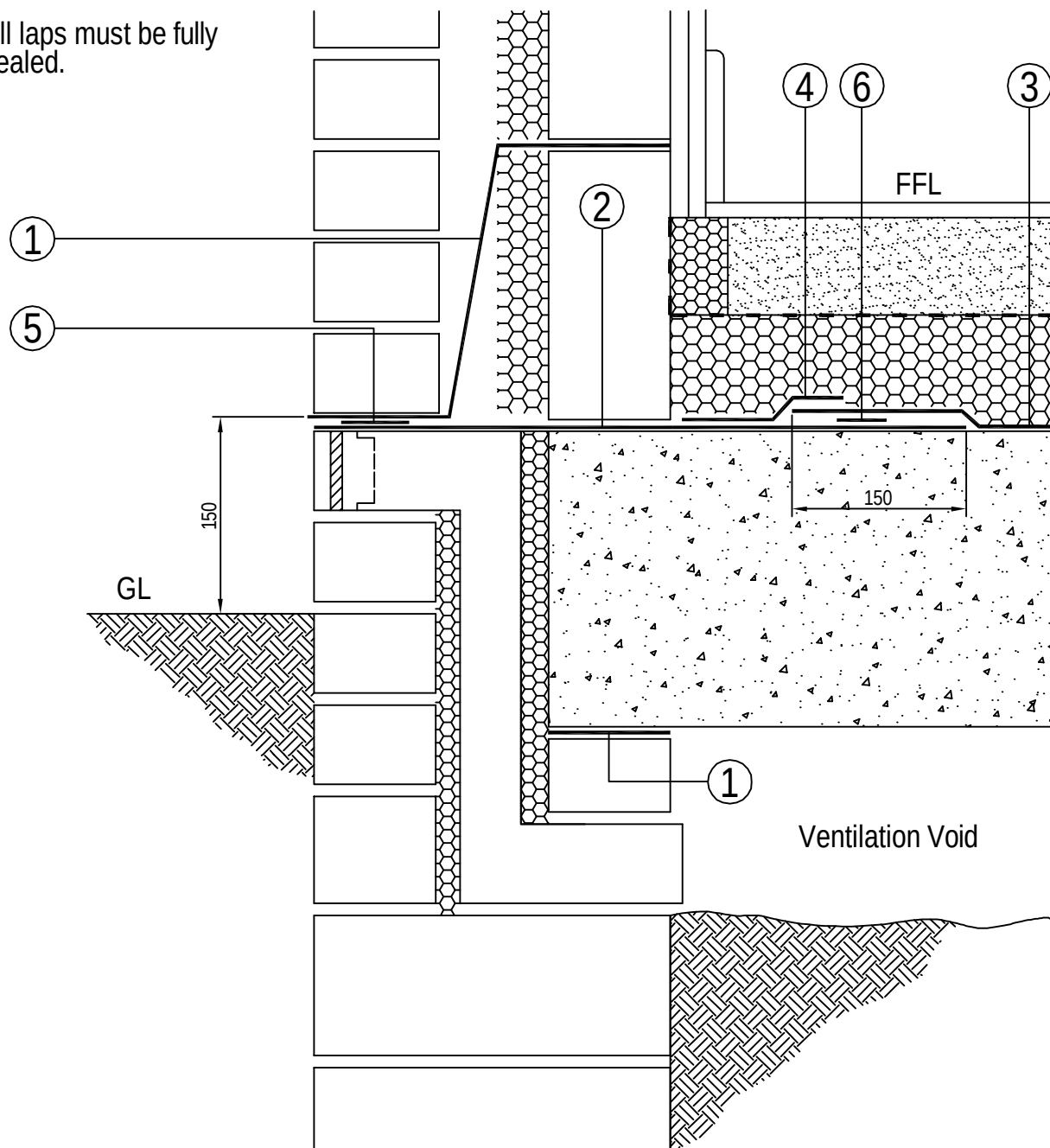
5. REPORTING

It is possible that construction and completion will be phased. As such, the verification information relating to both gas protection measures and soils will be presented to the Local Planning Authority for approval on completion of each phase pursuant to phased discharge of the anticipated pre-occupation condition relating to contaminated land (presented as condition B in section 1.1 above). The information will be in the form of the information detailed above, together with an explanatory covering letter.

APPENDIX A

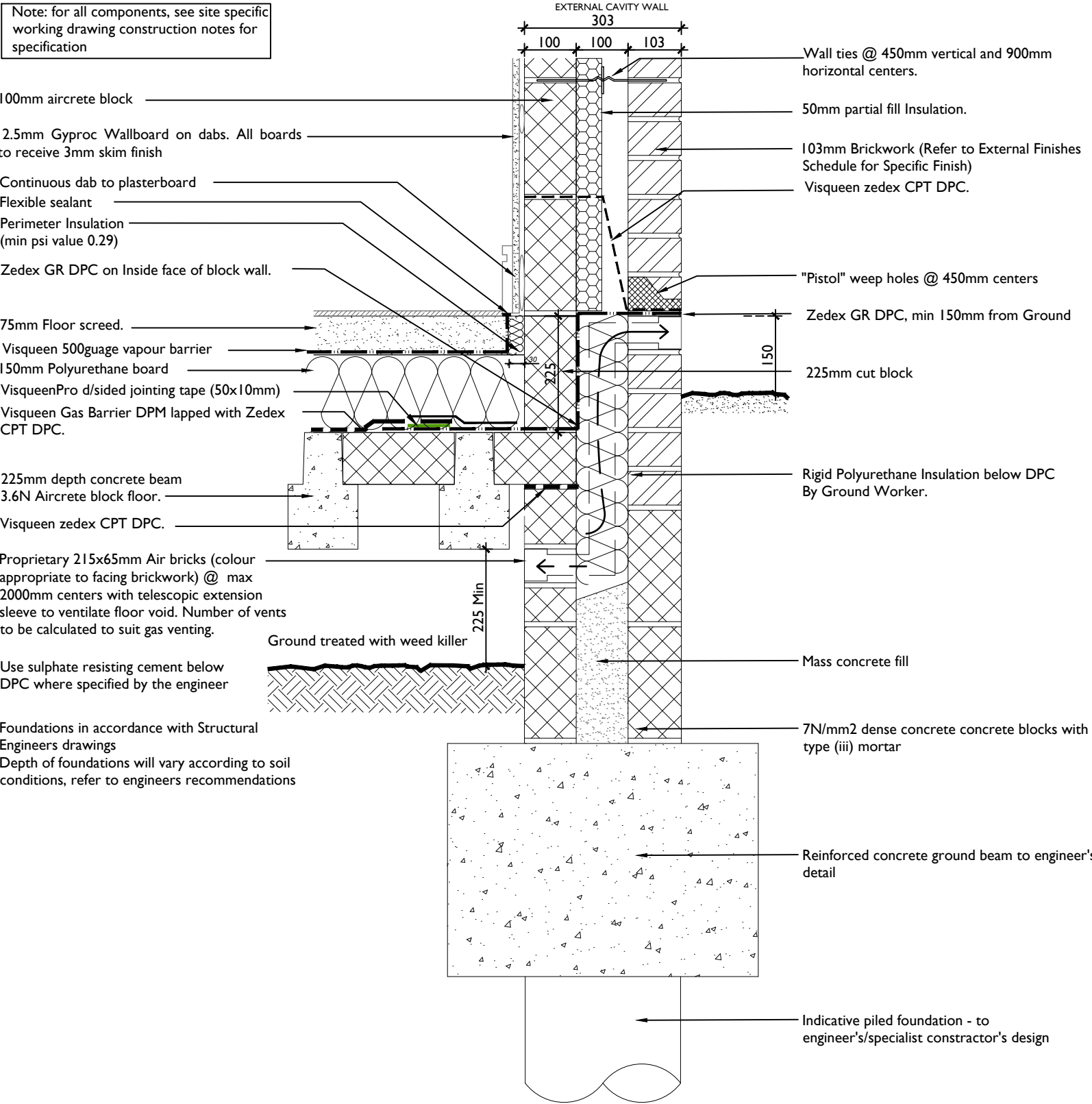
Construction details with gas membrane

All laps must be fully sealed.

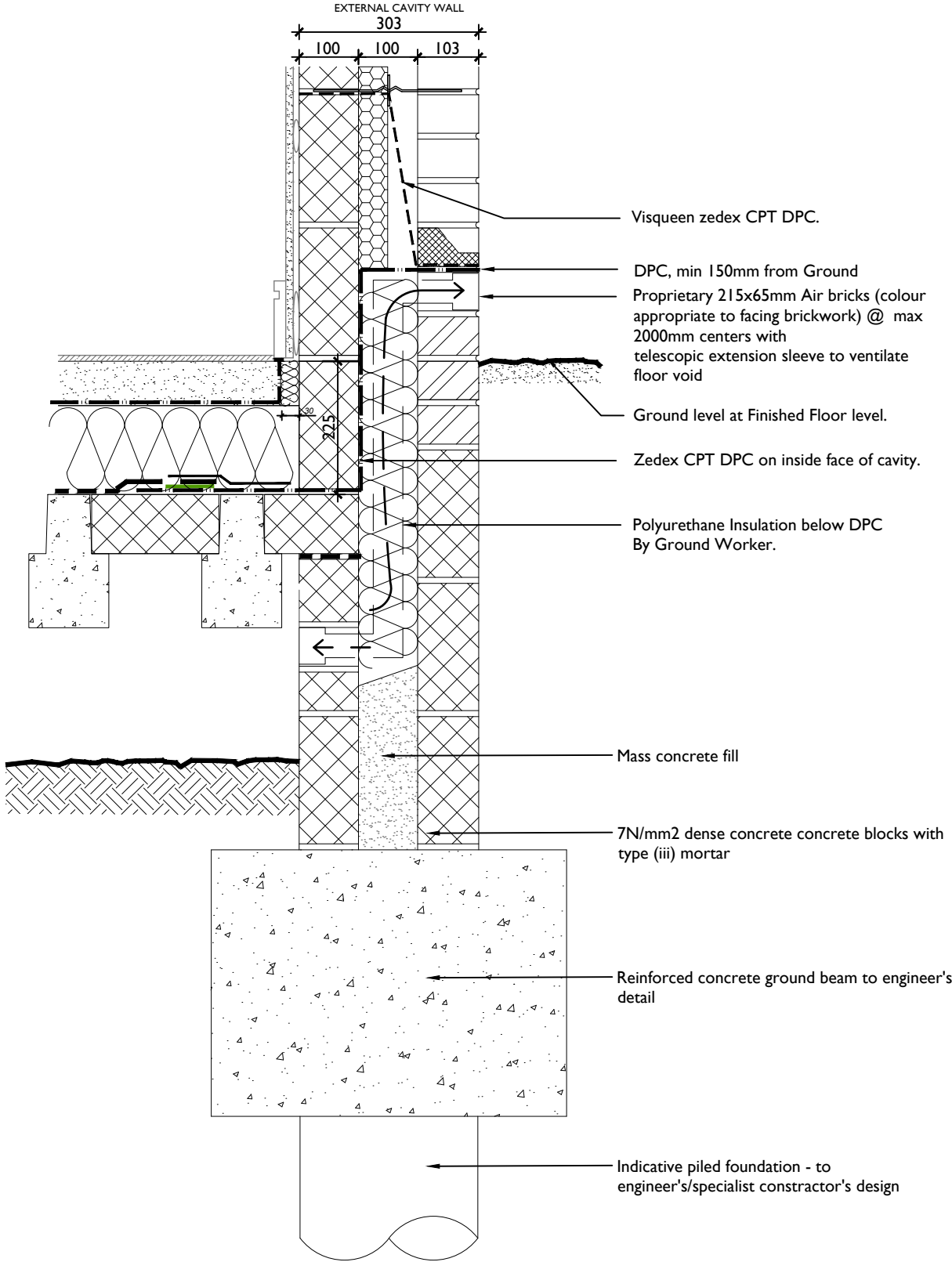


- 1) Corden EPS GR DPC
- 2) Corden EPS GR DPC
- 3) Corden EPS Gas membrane to specification
- 4) Corden EPS Lap Tape
- 5) Corden EPS Gas Tape to specification
- 6) Corden EPS Gas Tape to specification

Typical Foundation Detail
To comply with Accredited Detail no. MCI-GF-02

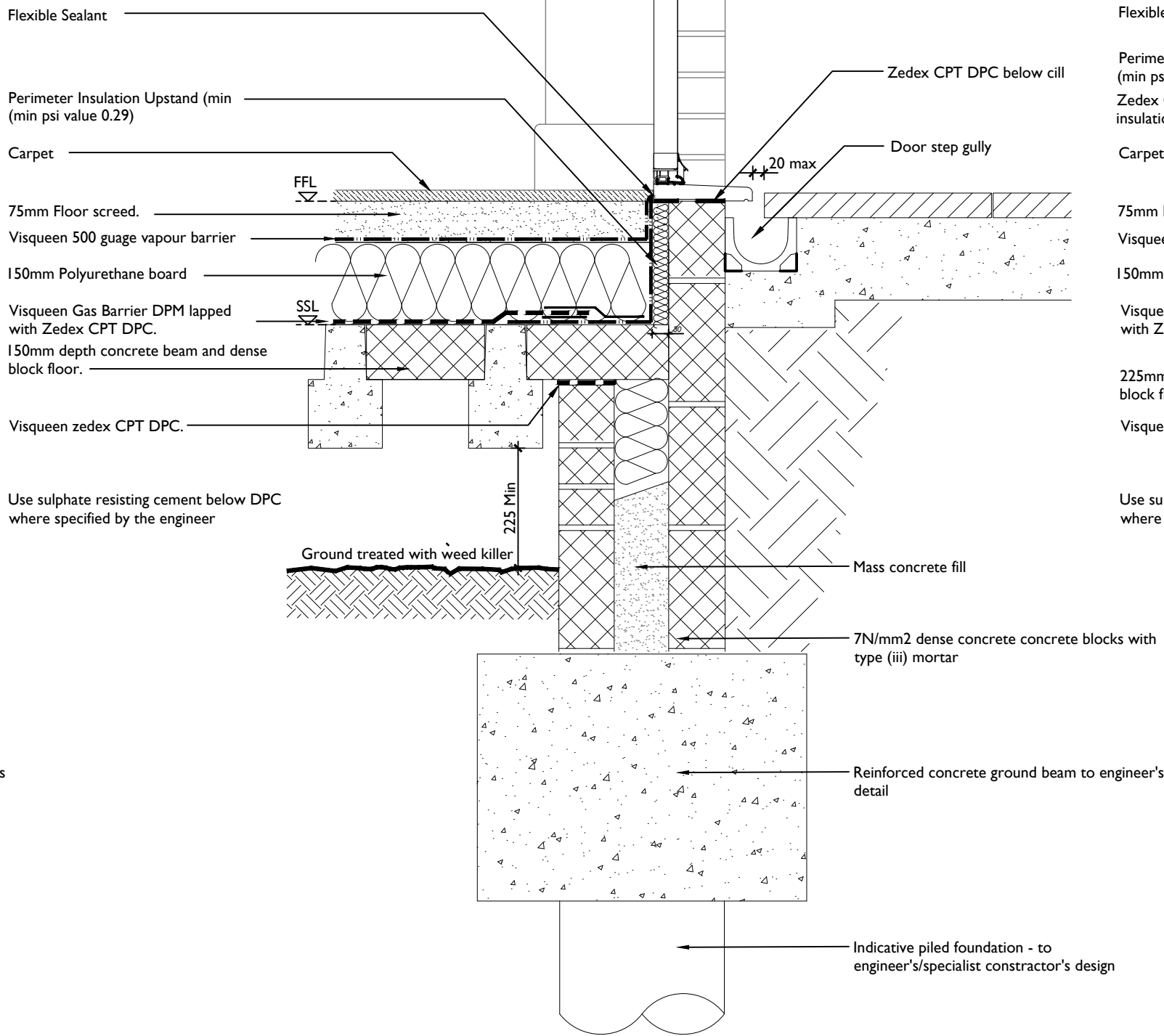


Typical Foundation Detail
Ground level 150mm below FFL



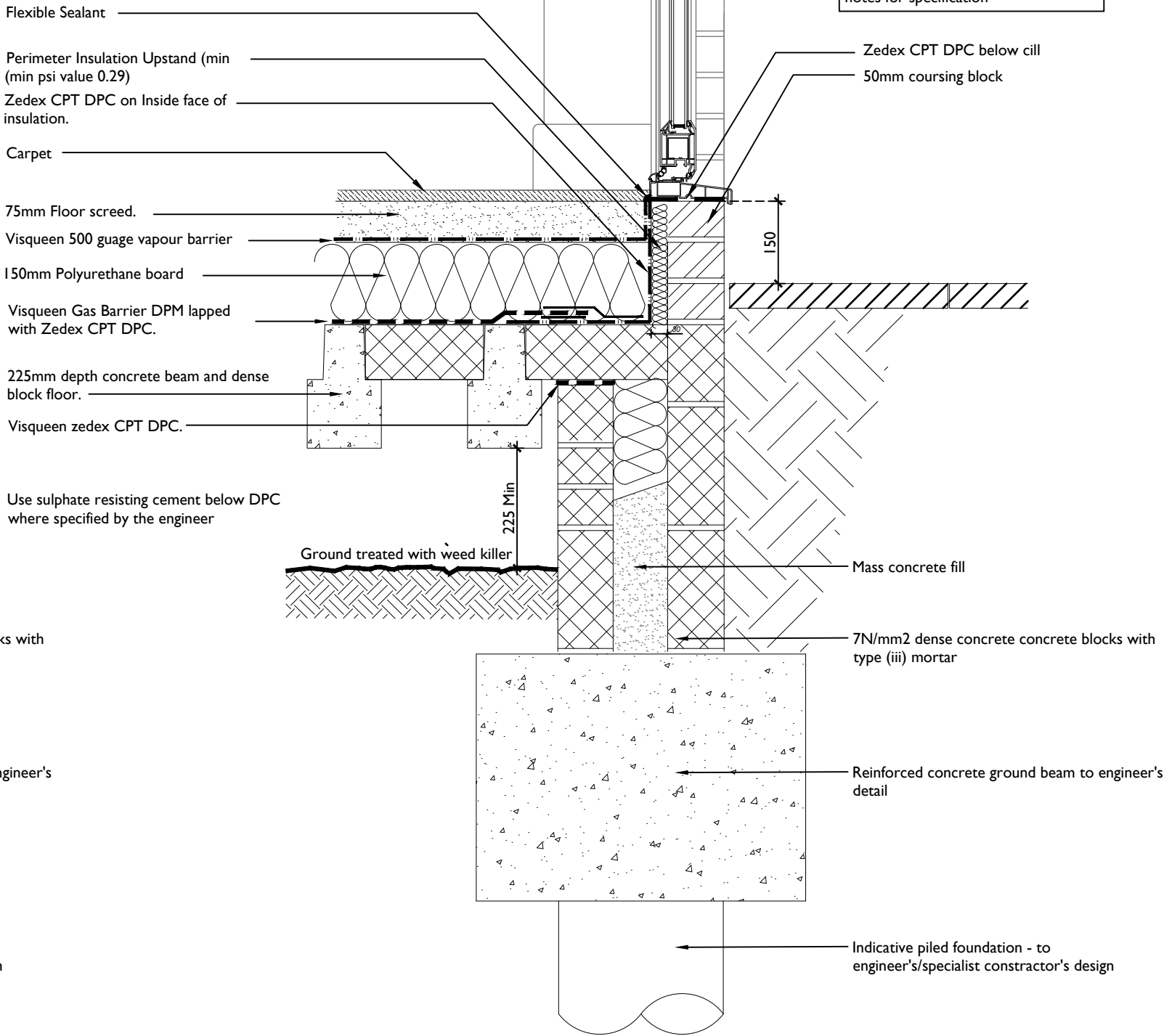
Typical Foundation Detail
Ground level at FFL

Note: for all components, see site specific working drawing construction notes for specification

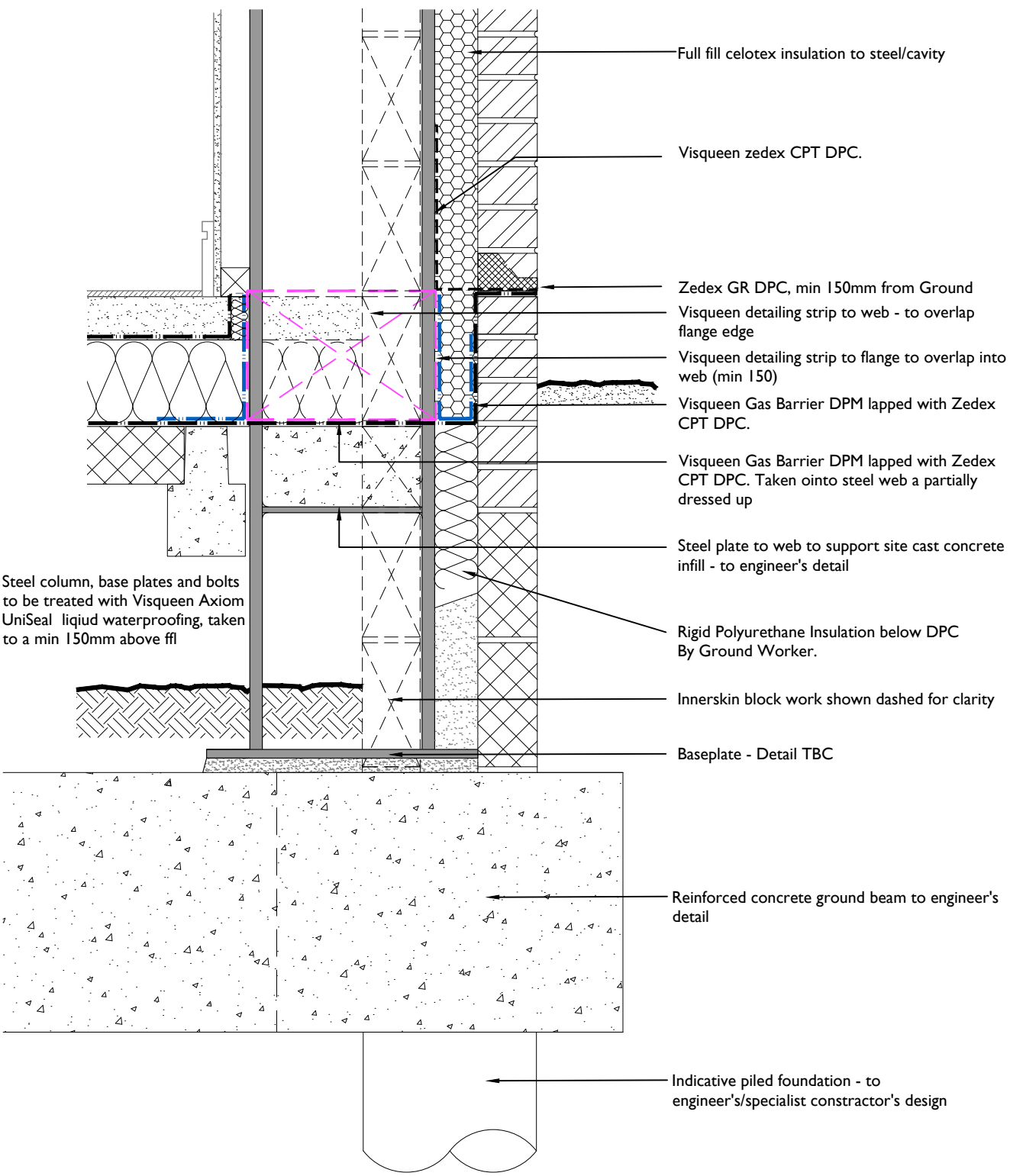


Mobility Level Threshold Detail / Front Door.

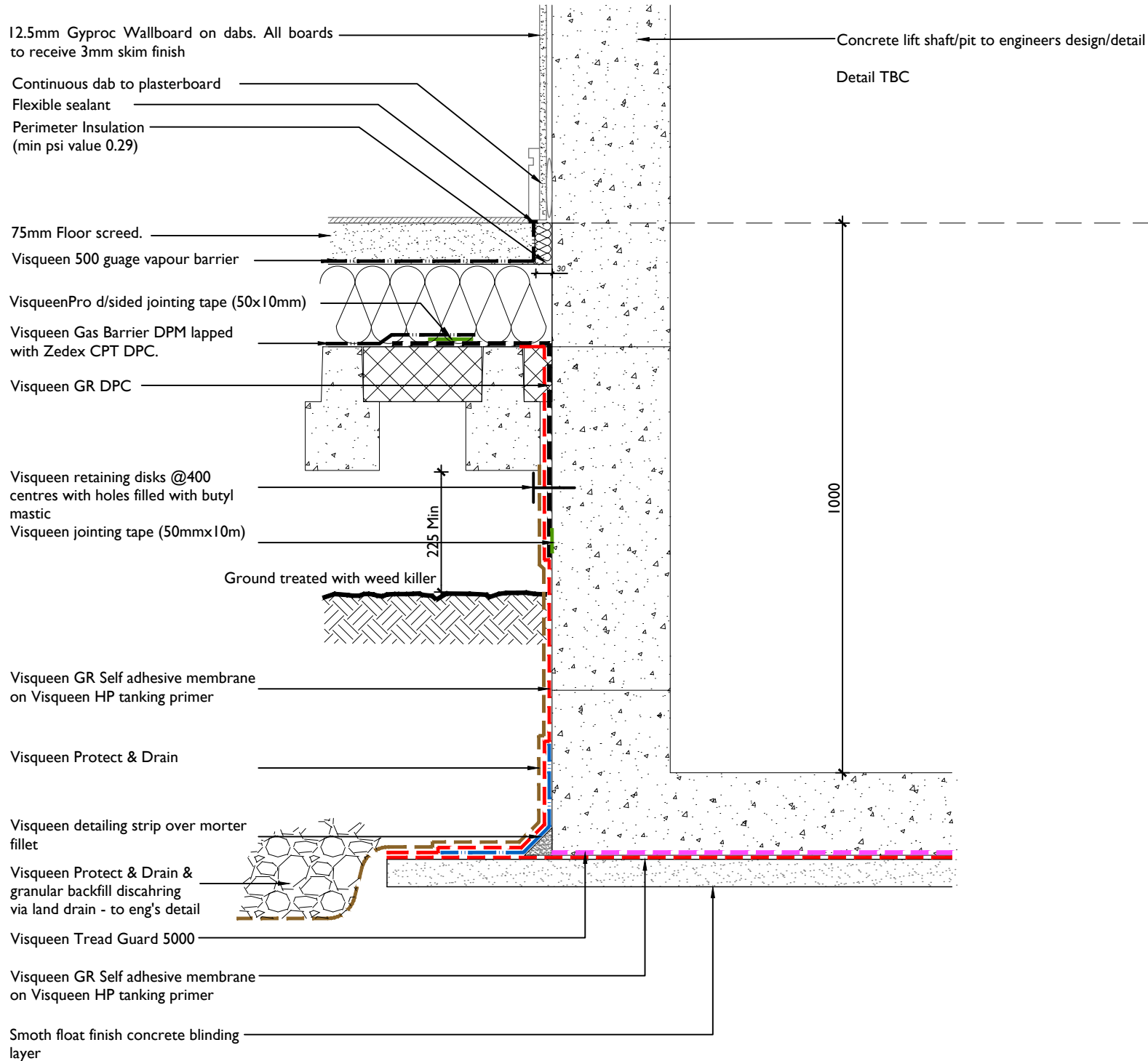
Note: for all components, see site specific working drawing construction notes for specification



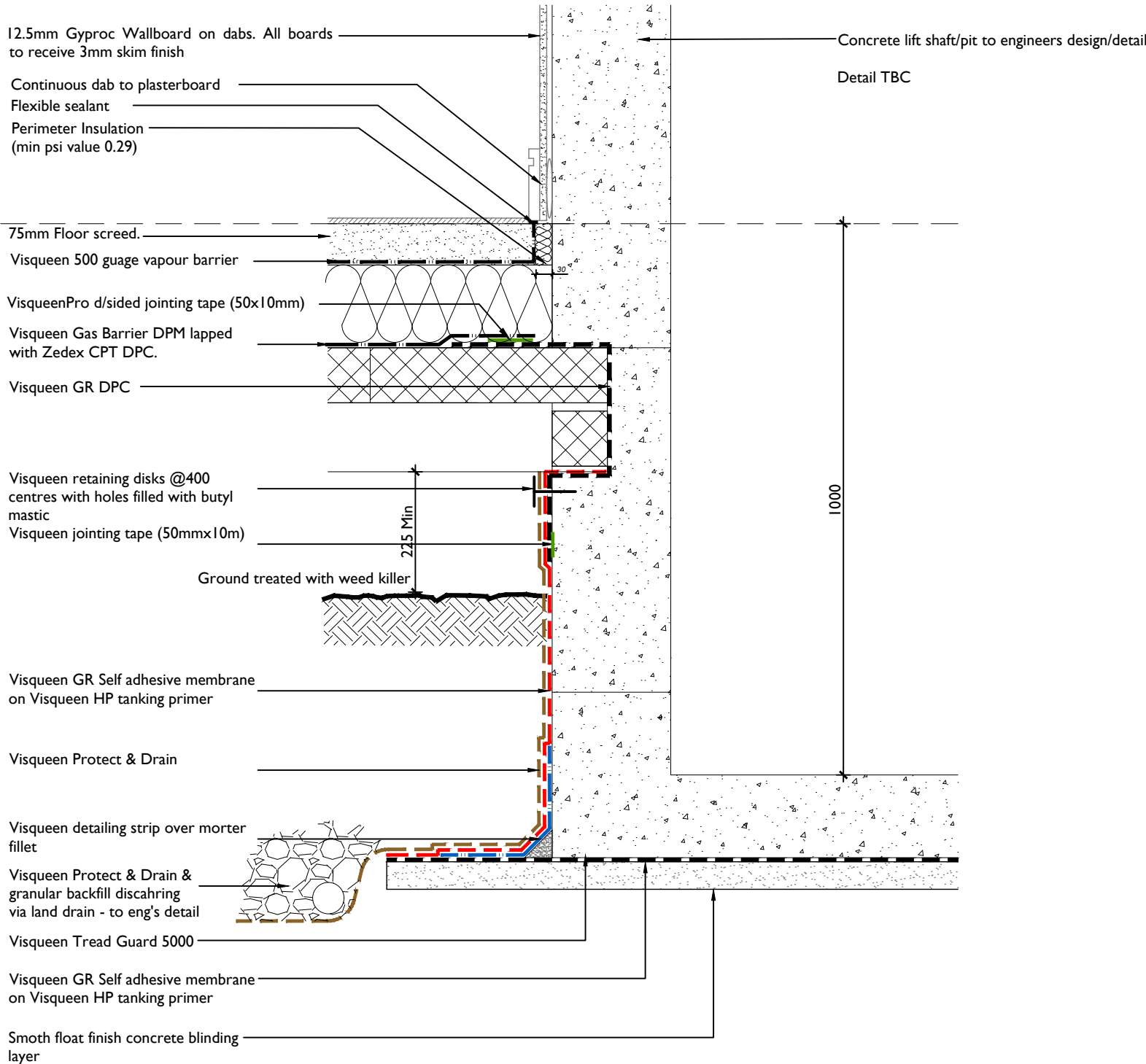
Stepped Threshold Detail / Rear Door.



Typical Steel DPC/DPM Detail
Ground level 150mm below FFL



Typical lift pit detail
B&B floor adjoining pit



Typical lift pit detail
B&B floor bearing onto pit

REVISIONS				
REV	DESCRIPTION	DRAWN	CHKD	DATE
A	####	##	##	##/##/##

APPENDIX B

Verification plan

Validation Procedures

Inspection/testing schedule – Knowle Lane, Fairoak

No covering such as reinforcement steel, insulation etc. shall be laid until the area under consideration has been fully inspected and signed off by the validation consultant. For programming purposes approx. 8 hours should be allowed from completion of the installation of the membrane for inspection and remedial works to be carried out.

Table 1			
Gas regime/risk	Slab type	Installer experience	Suggested minimum levels of verification and integrity testing
Amber 1/CS2	Poured concrete	50% of operatives to hold NVQ Level 2 Gas Membrane Installation	• Verifier to conduct thorough visual inspection to full surface area of membrane. • All joints, pipe penetrations etc. air lanced to ASTM D4437. • Leak detection testing (dielectric) min 25% (Ground Bearing % 100% Beam and Block)

1.0 Submissions

The following are to be submitted to MEC Environmental prior to work commencing on site;

- Full set of annotated drawings of the position and detailing of gas membrane
- Specialist Installers installation and CQA plan
- An experience and capability statement from the specialist installer along with relevant qualifications and membership of relevant trade associations/accreditation.
- A protection plan from the main contractor detailing how the membrane will be protected from damage prior to permanent covering.

2.0 Inspection method

The Validation Consultant will visually inspect 100% of the surface area of the gas membrane, gas resistant DPC and the like. The Validation Consultant will carry out leak detection testing by means of dielectric testing to a min. 25% of the surface area of the membrane to ground bearing slab and 100% to beam and block.

The Validation Consultant will integrity test (air lance to ASTM D 4437) 100% of all joints, pipe penetrations, corner details of the gas membrane.

Any defects will be repaired and recorded as per section 3.3 & 3.4 respectively. The purpose of this method of inspection and testing is to identify any holes, areas of bridging, poorly adhered seals or defects in the gas membrane and ancillary products. Validator reserves the right to undertake dielectric validation of the surface area of the membrane.

The Validation Consultant will:

- Perform all Visual Inspections and testing;
- Record all testing and photograph for inclusion in the final validation report
- Inform the Installation Contractor of any required repairs.
- The Installer will complete any required repairs in accordance with Section 3.3.
- Observe the repair and re-inspect/re-test the repair;
- Mark on the gas membrane that the repair has been successfully made and tested, photograph for inclusion in the final validation report

2.1 Equipment

- Electronic Tablet (IPad), Tape Measure, Air lancing Equipment, P1-20D Dielectric Testing Machine and PPE

3.0 Defects and repair

3.1 Identification

All seams and non-seam areas of the gas membrane will be inspected/tested as per 1.0 by the Validation Consultant for identification of defects, protruding and penetrating objects, lack of subgrade support, overheating, holes, blisters, undispersed raw materials, scratches and gouges, and any sign of contamination by foreign matter. To facilitate the examination the gas membrane surface will be kept clean by the Installer (or as agreed at the Preconstruction Meeting).

3.2 Evaluation

In areas that fail the visual inspection/testing, the Validation Consultant will communicate the defect to the Installer who will then repair this. Work will not proceed with any materials, which will cover locations that have been repaired until the Validation Consultant has passed the repair, and taken photographs, a sample of which will be included in the final validation report.

3.3 Repair procedures

Any portion of the gas membrane exhibiting a flaw, or failing a visual inspection/testing, will be repaired. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure will be agreed upon between the Validation Consultant and the Installer.

The procedures available include:

- Self-adhesive patching, used to repair all penetrating holes, tears, undispersed raw materials, and contamination by foreign matter;
- Capping with a strip of gas membrane, used to repair long lengths of failed seams.

In addition, the following provisions will be satisfied:

- All surfaces must be clean, free of all particulate matter, and dry at the time of the repair;
- All seaming equipment used in repairing procedures must be approved;
- The repair procedures, materials, and techniques will be approved in advance of the specific repair by the Validation Consultant;
- Patches and caps will extend at least 150 mm beyond the edge of the defect, and all corners of patches will be rounded with a radius exceeding 15 mm;
- Sharp ends of slits and cuts in the gas membrane should be rounded before patches are placed over them;

3.4 Verification of repairs

Each repair will be visually inspected/tested, repairs passing the inspection/testing will be considered acceptable. Failed tests will require the repair to be redone and re-inspected until a pass is obtained.

4.0 Validation report

A validation report will be produced by MEC Environmental on completion of the installation and

submitted to the client. The report will contain the following information as a minimum.

- Reference/name of job
- Scope of work undertaken (as per this document)
- Inspection survey sheets for all site visits