Advice on the installation of gas membranes

Introduction

This document has been produced to assist developers and their agents in satisfying Contaminated Land conditions placed on planning or building control applications relating to the installation of ground gas protection measures. It is aimed at answering frequently asked questions our officers are routinely asked.

As the Local Planning Authority, Runnymede Borough Council (RBC) is not able to design a gas protection system for your development. You will need to seek the advice of a specialist designer, installer or contractor and submit details against each specific application.

What is ground gas?

The most common gases referred to are carbon dioxide and methane, produced when organic material breaks down. Methane and carbon dioxide can be found not only in former landfill areas but also from imported material with a high organic content, or fill material such as ashy waste.

The hazards of landfill gas (and its individual components) must be taken into account when designing and constructing developments on areas suspected to present gassing conditions, to protect future users of that development. Methane is a flammable, asphyxiating gas, which when allowed to accumulate has the potential to explode; carbon dioxide, whilst not flammable, is an asphyxiating gas.

How can ground gas affect a development?

Landfill gas can be drawn into a building by the pressure difference that exists between the inside and outside of the building (warm indoor air is less dense than cold outdoor air). Landfill gas and its components can enter buildings through:

- gaps around service pipes
- construction joints
- wall cavities
- cracks in walls, below ground, and ground slabs

Having entered buildings, landfill gas may accumulate in confined spaces such as:

- sub floor voids / voids created by settlement beneath floor slabs
- cupboards
- drains and soakaways

RBC policy on developments in potentially gassing areas

The Council currently checks all development and building control applications to establish if they are located within 250m of land with the potential to provide a historical or current contamination source, including potential for gassing conditions. The Council uses a mapping database to indentify such sites and their former uses within the Borough, compiled from historical Ordnance Survey maps and other sources.

For any development within 250m of a potentially contaminative source the applicant is expected to provide adequate protection for the future occupants of the development. Unless information in the form of confirmation of ground gassing conditions is available to mitigate any concerns surrounding a particular site, a worst case scenario will be assumed. Therefore, in the absence of any recent investigation or gas monitoring data, the potential for ground gas to migrate onto the development site at unacceptable levels will be assumed. The works to be carried out are assumed to create new potential pathways for any such contamination to affect future receptors. The same applies for an application for conversion of a property, if the end use of the building will be a more sensitive one i.e. conversion of commercial premises to residential dwelling.

In most cases however, where the potential risk from landfill gas is considered to be manageable, or very low, the requirement to undertake consideration of gas conditions will be made by way of a condition attached to the application.

Failure to provide the necessary information to meet this condition and to undertake any necessary protective measures could result in enforcement action being taken and delays in the application and development.

Applicant actions to meet gas protection requirements

Where considered appropriate, applicants may be given the choice between undertaking a risk assessment to establish gassing conditions or installing gas protection measures to the specification of the Council. It should be noted however that latter option is offered in the hope of reducing any overly excessive financial or time constraints likely to be experienced by the developer.

Where the Council is aware of the presence of land with the potential to exude gas but the risk of gas migration is considered minimal due to the age, nature and location of the fill, it is more likely that the Council may ask applicants to incorporate gas protection measures in the first instance as mitigation measures.

Applicants choosing to install gas protection measures rather than to undertake gas investigations, must accept that the gas protection measures required will be reasonably onerous and considered extreme, or indeed unnecessary if gas investigation was actually undertaken on the development site and found to present no need for such precautions.

Conditions providing the option of gas investigation or gas protection measures will not normally be applied to applications for whole or new build developments, these will normally require gassing conditions to be investigated and confirmed prior to development.

Whether or not an applicant is required to undertake gas investigations or to provide gas protection measures, a methodology for works should be submitted for approval in writing to the Councils

Contaminated Land Officer, prior to any works commencing on site. Failure to do so may result in further work being required from the developer and in consequence, additional costs and delays.

What are gas protection measures?

In most residential buildings the primary passive gas protective measures are constructed either at or just below the ground floor level. The protection consists of a number of individual elements, which combine to form an integrated gas protection system. The most commonly used components in a passive gas protection system are:

- ground floor construction
- gas resistant membrane
- open void
- granular blanket
- sealed service entries

Gas protection measures are used to interrupt possible gas migration pathways. Most passive measures rely on creating a permeability difference between the property and areas where gas can vent to the atmosphere.

Suspended Concrete Slab

A properly constructed ground floor slab supported on load bearing walls can form a primary means of gas protection as the concrete mass itself has a low permeability. Cracks within the slab and at the joints with the walls can however allow gas to enter. A gas resistant membrane positioned above a reinforced floor slab and protected by a screed, or positioned below the floor slab, resting on a blinded granular layer can overcome this problem. Ventilation to the ground floor construction can be provided either by a granular layer, or by a vented subfloor void.

Beam & Block

This form of ground construction is highly permeable, with gas entry routes at the joints between the beams and the concrete blocks, and through the blocks themselves. Permeability is increased further when blocks are omitted or are cut out at service entries. The advantage this floor construction does have however is that an open void exists, thus providing good underfloor ventilation. The problems of gas seepage through the floor construction can be overcome with the inclusion of a gas resistant membrane laid continuous across the beam and block floor, spanning the wall cavity, and overlaid by a concrete screed.

Raft Concrete Foundation

This type of floor construction commonly used in compressible ground conditions provides an effective barrier to gas entry, providing there is sufficient reinforcement to prevent cracking. Whilst this design can encourage the accumulation of gas beneath the raft slab, this problem can be overcome with the inclusion of a granular blanket below the raft, with ventilation pipes to allow passive ventilation.

Gas Resistant Membranes

The purpose of the gas resistant membrane is to provide a low permeability barrier against the ingress of gas from the ground into the building, which when used with venting measures, encourages the gas to migrate to atmosphere on the outside of the structure. There are many different gas membranes available on the market.

The most effective membranes are those with the highest durability / toughness. Polyethylene is the principal material used as a gas resistant membrane. It is marketed in a variety of thicknesses and can be reinforced to improve the durability of the material during the construction process. Membranes should ideally be resistant to puncture abrasion and tearing, in addition to ultraviolet light, shrinkage, water, organic solvents and bacteriological action.

In general the thinner the material, the more susceptible the membrane will be to mechanical damage. The minimum recommended standard of membrane is 2000 gauge (or 0.5mm thick). It

should be noted that in certain gassing situations specific gas resistant membranes, specifically manufactured to resist methane and / or carbon dioxide will be required.

The need for high quality workmanship during the installation of the gas resistant membrane should not be under-estimated. The health and safety of the occupants of the building is dependent on its satisfactory performance. If installed incorrectly or damaged during the construction process, the membrane can be rendered ineffective and thus fail to provide adequate protection against the ingress of gas.
A membrane should be laid continuously over the whole ground floor area, including the cavity walls (using cavity trays). Any joints in the membrane should be overlapped and taped, or site welded to the manufacturers specifications. Before laying the membrane all projections on the underlying structure, which may puncture, or damage the membrane must be removed. Protection for both sides of the membrane should be provided through the use of a floor screed and blinding. Ideally the membrane should be protected with boarding prior to laying any screed or constructing a timber floor.

Please note that some gas membranes do not comply with the appropriate British Standards for damp-proof courses and should not be used to resist damp penetration. Gas membranes, which do not satisfy the relevant requirements, must be laid in conjunction with a suitable damp proof course.

Ideally membrane installation should be subject to a third party inspection. Where doubt exists as to the quality of any installation, it is recommended that post installation integrity testing is undertaken.

Service Entry

Where possible services should enter the building above slab level, with all entry points being sealed, however, where this is not possible, care must be taken to minimise membrane penetration. The use of ‘tophats’ is recommended to ensure adequate sealing around the membrane.

Ventilation of the Sub-floor by Granular Blanket

Granular blankets provide an alternative method to an open void for forming a gas-venting layer. The use of a granular blanket should however be restricted to sites with a low groundwater level and where the underlying soils are of a high permeability and free draining. Where the granular blanket is constructed beneath a concrete suspended slab on loadbearing walls it should consist of minimal compacted crushed rock or concrete or natural gravel’s (20mm minimum size). However, where the blanket is constructed beneath a ground bearing in-situ concrete slab, raft or semi-raft foundation, the blanket should only be constructed from angular and sub-angular crushed rock or concrete, with a particle size range of between 20mm to 40mm. The blanket should be placed and compacted in layers no less than 150mm thick and no more than 600mm thick. Granular layers should be ventilated to the atmosphere by means of vent pipes and a granular trench around the perimeter of the building or via vertical risers.

Ventilation of sub-floor by Ventilated Void

The recommended minimum area of ventilation for a subfloor void is 1500mm2 per metre run of wall or 500mm2 per square metre of floor area, whichever gives the greater area of opening. The void should be well cross ventilated (airbricks located on opposite walls). Ventilation efficiency can be increased by:

- Increasing the frequency of vents to allow a higher rate of air flow and promote cross wall ventilation
- The provision of vertical risers, which if increased in height will increase the effect of wind pressure
- Vertical stacks should discharge above eaves level, and should be positioned some distance from windows, rooflights, air vents, or other openings in the external envelope of the building.

Information to be submitted to discharge conditions

Method Statement

A method statement showing an understanding of the importance of correct installation is required to be submitted. Inclusion of standard details such as those stated in *Building Research Establishment paper 414 (Ref 1.)* would be appropriate as would manufacturers' specifications and instructions. It is advisable to get these plans put onto the working drawings through their architect or agent.

For further information please see, the *Building Research Establishment Paper No 414* and the NHBC / RSK document '*Guidance on Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are Present, Appendix E' (Ref 2)*. *CIRIA document C665 (Ref 3.)* requires a minimum of two levels of protection in basic gas protection measures e.g. a vented sub-floor and a membrane. This does not mean you have to have a suspended (block & beam) floor, as a cast in-situ slab can be used, with a ventilated layer under the slab e.g. with a granular blanket.

Photographic Evidence

A photographic record of major points of installation and verification should be submitted to the Contaminated Land Officer, to provide evidence of planned installation methods and final finish. These photographs should be clear, labelled with descriptive text, and submitted in chronological order. We suggest the following stages to be photographed as a minimum as well as general installation activity:

- General condition of membrane
- Photograph both sides of membrane, upper surface and lower to identify the type
- If visible, joints between rolls of membrane to ensure a 150mm overlap, presence of double sided butyl tape and girth jointing tape
- Confirm presence of blinding or granular void
- Sealing of tophats

Please refer to the Liverpool City Council document *'Inspection of Characteristic Situation Gas Precaution measures with methane resistant membrane for suspended slab'* document in Appendix 1 for an example of photographic evidence expected.

Submit all information relating to these activities to your planning case officer or directly to Lucy Hawkings, Contaminated Land Officer.

References:

Ref 1: *Building Research Establishment Paper 414 (2001) Protective measures for housing on gas-contaminated land BR414*
Ref 2: National House Building Council *Guidance on Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are Present (2007)*
Ref 3: *CIRIA document C665 (2007) Assessing Risks posed by hazardous ground gases to buildings RP711*

Appendix 1: Photographic Evidence of correct installation

A Liverpool City Council document

The following represent correct installation methodology for methane resistant membranes.

The City of Liverpool

LIVERPOOL CITY COUNCIL
PUBLIC PROTECTION DIVISION

INSPECTION OF CHARACTERISTIC SITUATION 2 GAS PRECAUTION MEASURES WITH METHANE RESISTANT MEMBRANE FOR SUSPENDED SLAB.

1) Check general condition of membrane for punctures/tears etc – take panoramic photograph showing general condition of the membrane.

2) Confirm membrane product type and the membrane is sufficient for methane resistance – Photograph both sides of gas membrane.

3) Check joints between rolls of membrane to ensure 150mm overlap, presence of double sided butyl tape (by feel – may not be seen visually) and girth jointing tape.

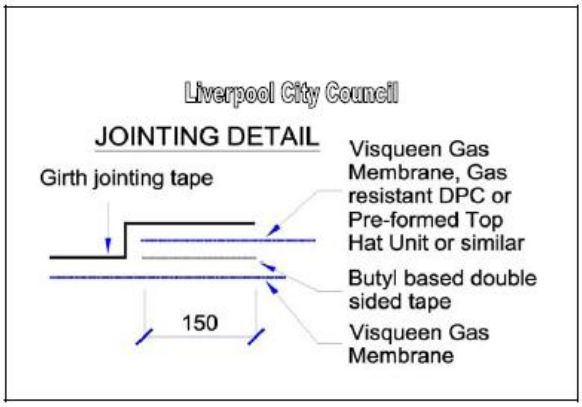
4) Confirm presence of swan neck vents on sides and rear of property (note – front of property does not require venting).

5) Lift membrane to confirm the presence of sand blinding over the sacrificial 1200 gauge (300 micron) DPM. Lift DPM to confirm granular void forming the stone venting layer.

6) Check tophat is sealed to membrane and pipework. If the formed tophat is not tight to the pipework then also confirm presence of jubilee clip beneath butyl tape.

7) If new delivery of product types is present and copies of supply tickets are not available then inspect product labels to confirm manufacturers and product types.

8) If no product labels are present then inspect stores for product types



In the example above, Visqueen has been utilised as the ground gas membrane. There are other products which are as suitable for use. Specifications for these the proposed membrane types should be issued at the earliest opportunity for the Council to review.

The following photographs are examples of membranes not correctly installed and potentially putting the future inhabitants of the properties at risk.

No DPC present under internal wall.

Use of non-gas resistant DPC (right of picture) compared to gas resistant DPC (left of picture)

No girth jointing tape between sections of membrane (although butyl tape visible)

Tears in gas resistant membrane

Gas membrane not sealed.

Gas membrane not sealed and no gas resistant DPC.

No tophat (formed or preformed) around service entry. "Duck Tape" used to seal overlaps of membrane. No butyl seal on joints. Membrane not sealed to tape.

Top hat split, not sealed to service entry or membrane.

Duck tape failing to seal membranes rather than use of butyl tape and girth jointing strap.

Membrane not sealed to gas resistant DPC.

DESIGN TYPE – SUSPENDED SLAB WITH PASSIVE VENTING COMPRISING GRAVEL VENTING LAYER WITH SACRIFICIAL DPM, SAND BLINDING AND GAS RESISTANT DPM (METHANE)

Use of non gas resistant DPM (blue backing colour) of same colour as gas resistant DPM (silver backing colour), with only gas resistant membrane used across cavity (to appear like gas resistant membranes after casting of slab. Sacrificial membrane absent with sand blinding filling granular void.

Tophat split over to fit service entry

Butyl tape used span over seals of membrane rather than in between.

Jointing not sealed and membranes torn, as visible after casting of slab.

No seals present over wall cavity

No tophats sealing service entry

Use of standard butyl tape as a tophat

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