PCA
Property Care
ASSOCIATION

Discussion Document:

Ground Gas Protection Below Modular Buildings

April 2021

This discussion paper is relevant only to sites and projects where modular buildings are being built on site and low flux cardon dioxide and methane are a consideration. The discussion below is not relevant to sites where radon, volatile organic compounds or any other hazardous gas risks have been identified.

1. INTRODUCTION

Questions have been raised relating to the provision of ground gas protection and modular buildings. Modular buildings can be similar to structures that utilise suspended block and beam floors, in that significant excavation is required to create substructures to support the modular buildings which are then placed on those foundation structures. This usually results in voids below the modular units, potentially creating oversites that can be significantly lower than the surrounding earth.

This presents challenges to the detailed design of ground gas systems. Ventilated gas dispersal layers that are used below the protective slab or gas protection membrane as part of a pas protection system, must be vented to the outside atmosphere. This form of construction can add additional complexity when sequencing work, detailing systems, and considering the need for long term maintenance and care of the vent terminals.

Questions have been raised about the safety of using the ventilated void that exists between the horizontal gas control membrane or protective slab, and the underside of the floor or occupied space.

It is understood that in some situations the space below the modular units is being used as part of the gas protection system. This discussion paper will consider this practice - our aim is to present the issues in a way that may assist PCA members in making informed decisions.

This document is not intended to provide definitive instruction or guidance for those providing detailed design of gas protection systems but may enable members to consider the delivery of robust gas protection measures that are aligned with current standards and accepted industry best practice. Perhaps most importantly, it is aimed at ensuring that conversations and decisions remain focused on the long-term safety of the building's occupants.

2. NARRATIVE

Where ventilation forms part of a combined gas protection strategy, it is usual for the ventilated gas dispersal layer to be formed below the horizontal ground gas control membrane or slab. The intention of this sequence of measures is considered best practice as it dilutes and removes infiltrating ground gas to the atmosphere safely, before the barrier systems are relied upon. The idea is that this sequence of measures relieves the "pressure" on the membrane that then acts as a second line of defence. This combination of a permanently ventilated void below a monolithic gas control layer is considered to be the safest and most robust form of design.

In some situations - such as below modular buildings, or where level access is required - providing a ventilated void may result in this being installed below the level of the surrounding ground. In these situations, providing gas exchange to the atmosphere from the ventilation / gas dispersal layer, will require the use of periscope vents, ventilated trenches, air ducts, conduits, or ventilation fans. These may have to pass through the sub-structures with termination at vent points on the outside of the building.

Though this can be highly effective, these works can be costly, complex and require good sequencing and will require periodic inspection and maintenance to ensure the vent points are kept clear and serviceable.

Another consideration that should not be overlooked is the need to prevent these ventilated voids or gas dispersal layers becoming inundated with water.

It is therefore unsurprising that some solutions have suggested that instead of creating a ventilated space below the gas membrane, the space **above** the gas protection layer could be considered as ventilated space for the purposes of attaining the required gas protection score.

On the face of it, this would seem to be at odds with the principle of reducing gas concentrations by venting to atmosphere before the gas control membrane takes over. Using what is generally considered to be the secondary defensive structure as the primary barrier to hazardous gas infiltration, would certainly seem to be a departure from what is currently deemed best practice.

BS8485 2015 Annex B1 says: ***"Ventilation protection measures should only be used with an overlying barrier formed by an appropriate detailed and constructed slab and/or gas membrane".***

The Standard goes on to say: ***"The objective of having a gas dispersal layer is to reduce the concentrations of hazardous gases directly beneath the floor slab to acceptable levels".***

"Acceptable concentrations within the gas dispersal layer vary according to the hazardous gas(es) present; however the diluted concentration of each gas should be sufficiently low such that if the overlying barrier protection fails, the ingressing gas does not present a significant health hazard to the occupants."

The Standard also states in section 7.2.1: ***"Note – for low sensitivity buildings on low risk sites it might sometimes be possible to rely solely on a membrane or a slab; for example, where internal ventilation provides secondary protection."***

It is our view that this note does not provide the system designer with an option to avoid difficult or expensive design choices, or sanction gas protection systems that compromise the safety of the building occupants. What it does do is confirm that all gas protection systems must take account of the prevailing site conditions, be informed by the risk assessments, and have the approval and understanding of all those involved in the delivery of the future use of the building.

3. CONCLUSION

After looking closely at the existing documented Standards and taking into account information gathered from a range of experienced ground gas professionals, the following conclusions are offered.

In order to deliver the safest and most reliable form of ground gas protection, it should be considered normal and best practice to design and build systems that place the ground gas protection barriers (slabs or membranes), above any gas dispersal layer or ventilated void.

Designing the detail of ground gas protection systems in this way will effectively relieve "pressure" on the barrier systems and will create spaces above the barriers that are protected from hazardous ground gas. In doing so, any risk associated with damaged or defective slabs or membrane installation is minimised. This also ensures that the service void below the occupied rooms should (from a ground gas perspective) be safe to enter and that barrier provision continues to act as a secondary rather than the primary line of defence.

It is, however, conceded that in some special circumstances a ventilated void above the control barriers / membranes may have the capacity to offer an additional form of ground gas dispersal for low flux methane and carbon dioxide. It is our view, however, that this could only ever be considered where the ground investigation reports are favourable and the risk of gas entering any ventilated voids above the gas control slab or membrane are well understood and are considered by all parties (including the geotechnical engineers, system designers, verifiers, and planning officers) to be extremely low.

We would only ever envisage this alternative method of dispersal being accepted where the risk and appropriateness of utilising such systems have been fully evaluated, are supported by the geoenvironmental reports and where all risks and implications are fully understood by the developer, system designers, installing contractor and the verification provider. The requirements of any pre-existing planning conditions must also be met.

The British Standard (BS8485) clearly identifies that placing the gas barrier above a properly designed ventilated void or gas dispersal layer is the safest and most desirable form of design. It diminishes risk, offers superior protection from hazardous ground gases, incorporates robustness, and provides greater margins for error.

Any deviation from what all parties agree to be best practice must be fully justifiable and defensible. This document does not promote practices that are other than representative of best practice but acknowledges that in some special circumstances, there may be reasons to work in ways that are innovative or out of step of what is considered best practice.

Ultimately those who recommend, deliver, verify, or design ground gas protection systems need to be assured of the validity and wisdom of their decisions. Similarly, all those involved as part of a delivery team need to be prepared to take the liability that results from their actions.

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Discussion Paper, April 2021

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