

Structural Calculations	Project: AJS, Plot 9, SFEZ, Holbeach	Date: Aug. '22	Designer: APW
Project No. 21-257	Subject:	Sheet No. 1	Rev:

Ground Gas Protection Statement**Introduction**

Acting upon the instruction of Kirk Connected Construction, the following statement and design has been prepared following the recommendations with the phase I site investigation report.

From Enviro solution report ref: CL101 a gas situation of CS2 has be characterised.

The building has be categorised at commercial Type C building to Table 3 BS8485.

From BS 8485 Table 4 a gas protection score of 2.5 points will be required.

The Ground floor construction consists of a 275mm thick heavily reinforced in-situ concrete suspended slab with minimal penetrations.

From BS 8485 table 5, Structural barrier score = 1.5.

Note B - The slab is doubly reinforced as such full crack control reinforcement is present.

The remaining required score of 1.0 will be obtained through the provision of a sub-floor ventilation system.

The system will take the form of a passively ventilated no fines stone layer with gas drains.

The system will be specified as per the recommendations of the Department of Environment, Transport and the regions publication

" Passive Venting of Soil Gases Beneath Buildings Research Report - Guide For Design"

From BS 8485 table 6, ventilation protection score = 1.5.

Table 6, indicates a score of 1.5, a good performance, system must achieved for the use of a passively ventilated sub-floor dispersal layer.

Total gas protection score achieved = 3.0 > 2.5 required score. Therefore, requirements achieved.

Provisions of Structural Floor Slab are illustrated on drawings SW 21-257/101 thru 104

Provisions of Sub-floor ventilation requirements are illustrated on SW21-257/110 rev P4

Structural Calculations	Project: AJS, Plot 9, SFEZ, Holbeach	Date: Aug. '22	Designer: APW
Project No. 21-257	Subject:	Sheet No. 2	Rev:

Ground Gas Protection Statement

Ventilation Layer design

The sub-floor dispersal layer is intended to achieve the requirements of BS8485 Annex B using guidance and computational design models undertaken and published within Department of Environment, Transport and the regions publication Passive Venting of Soil Gases Beneath Buildings Research Report - Guide For Design

The sub-floor gas drain system will be designed and arranged as per the requirements of Annex B, BS8485 Figure B.2, Section B.10 and Figure B.12

BS8485, Table B.4 identifies granular blankets with gas drains for large foundation dispersal have a poor effectiveness.

However the recommendations contained within the Department of Environment, Transport and the regions publication

" Passive Venting of Soil Gases Beneath Buildings Research Report - Guide For Design" are more suitable Chapter 5, Table 6 demonstrates that Gas regime A should be considered for a CS 2 site.

Conclusions from the CFD models conclude that a good performance is provided for a gas regime A, CS 2. Chapter 13 - extracted below

- A 20mm single size gravel blanket provides good ventilation for small width foundation on sites up to and including Gas Regime B. For large width foundations granular blankets should be limited to sites corresponding to Gas Regime A
- Granular blankets with drains are suitable for large width foundations on sites up to and including Gas Regime B.

Table 27 - extracted below

				Open Void Space ⁴		Polystyrene Shuttering ⁴				Geocomposite Drainage Blanket		20mm Single Size Gravel Blanket		20mm Single Size Gravel Blanket with Interleaved Pipes at 3m Centres ³	
Foundation Width ⁴				5m	30m	Equivalent Clear Void Depth 22mm		Equivalent Clear Void Depth 100mm		Equivalent Clear Void Depth 36mm		5m	30m	5m	30m
Gas Regime				Gas Dispersal Characteristics of Media for Methane Hazards											
Gas Regime	Methane Conc. (%v/v)	Emission Rate ¹ (m/s)	Char Situ ²												
A ⁵	1	0.005	2	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
B	5	0.005	3	Very Good	Very Good	Very Good	Good	Very Good	Very Good	Very Good	Good	Good	Poor	Good	
C	5	0.01	4	Very Good	Very Good	Very Good	Good	Very Good	Very Good	Very Good	Fair	Fair	Unsuit	Fair	
D	20	0.005	4	Very Good	Very Good	Very Good	Fair	Very Good	Good	Good	Poor	Poor	Unsuit	Poor	
E	20	0.01	4	Very Good	Good	Good	Poor	Very Good	Good	Good	Unsuit	Poor	Unsuit	Unsuit	
F	20	0.05	5	Good	Poor	Fair	Unsuit	Fair	Poor	Fair	Unsuit	Unsuit	Unsuit	Unsuit	

¹ Emission rate values refer to equivalent total gas flow velocity from 50mm diameter borehole and Peckson⁽¹²⁾ assumption

² Characteristic situation after CIRIA Report 149⁽³⁾

³ Gas Dispersal Characteristics based on maximum steady state concentration over 80% area of foundation, pipes at interleaved 3m centres

⁴ Assumes sympathetically detailed underside of foundation

⁵ Gas dispersal characteristics have not been assessed using Figure 3, since maximum concentration entering the ventilation layer is equivalent to the target concentration

⁶ For open void space and polystyrene shuttered ventilation layers additional side ventilation provision can improve the gas dispersal characteristics

Table 27 Summary of Gas Dispersal Characteristics of Different Ventilation Media on Idealised Foundations

Structural Calculations	Project: AJS, Plot 9, SFEZ, Holbeach	Date: Aug. '22	Designer: APW
Project No. 21-257	Subject:	Sheet No. 3	Rev:

Ground Gas Protection Statement**Ventilation Layer design - Cont'd**

For more in depth considerations chapter 11 is now considered.

CFD model 5 is the appropriate model to be considered in relation to this project, a 30x30m foundation with a granular dispersal layer with gas drains at max. 3m c/c and side ventilation of 590 mm²/m.

The gas flow in to the layer, predicted from the gas emissions rate is taken from table 24 - extracted below

**Table 24: Results of CFD Modelling of Granular Blankets with Drain Networks:
Volume Flow Rate of Air through 20mm Single Size Gravel Blankets with Fully Permeable
Pipe Drains**

Foundation Size (m)	CFD Model	Depth of Gravel Blanket (mm)	Ventilation ⁽¹⁾ (mm ² /m run of wall)	Volume Flow Rate of Air Through Ventilation Layer (m ³ /m width/h)			Volume Flow Rate of Gas into Ventilation Layer (m ³ /m width/h)	
				Wind Speed 3m/s	Wind Speed 1m/s	Wind Speed 0.3m/s	Gas Emission Rate 0.05m/s	Gas Emission Rate 0.01m/s
5x5	3	200	2652 3140	1.56	0.20	0.02	0.18	0.035
30 wide	4	400	736 3926	2.13	0.30	0.03	1.06	0.21
	5	400	590 524	2.21	0.59	0.03	1.00	0.21

⁽¹⁾ on each of 2 sides only

Ventilation provisions will be provided to meet the minimum requirements as stated above
As can be seen from the above table sufficient ventilation flow ins achieved in all wind speeds in excess of 1 m/s which is a very low wind speed.

Ventilation cowls are to provide a min of 75% the area of the 100mm dia. Gas drains.
3 no. vents per side provided.

Ventilation provided per side = $3 \times (100 \times 100 \times \pi / 4) \times 0.75 = 17671 \text{ mm}^2$

Ventilation provision per m = $17671 / 20 = 884 \text{ mm}^2/\text{m} > 590 \text{ mm}^2/\text{m}$ from Table 24

Check flows against sub-soil permeability. Underlying subsoil is silty sand with a conservatively estimated permeability of 0.000005 m/s and a plan area of building of 575m²

Maximum gas flow through sub-soil = $0.00005 \times 575 \times 3600 = 10.35 \text{ m}^3/\text{hr}$.

Flow rate through Ventilation area at 1m/s = $0.59 \times 20 = 11.8 \text{ m}^3/\text{hr} > 10.35 \text{ m}^3/\text{hr}$ OK.

Structural Calculations	Project: AJS, Plot 9, SFEZ, Holbeach	Date: Aug. '22	Designer: APW
Project No. 21-257	Subject:	Sheet No. 4	Rev:

Ground Gas Protection Statement**Ventilation Layer design - Cont'd**

Consider requirements of Annex B, BS 8485 compared with results of design guide information

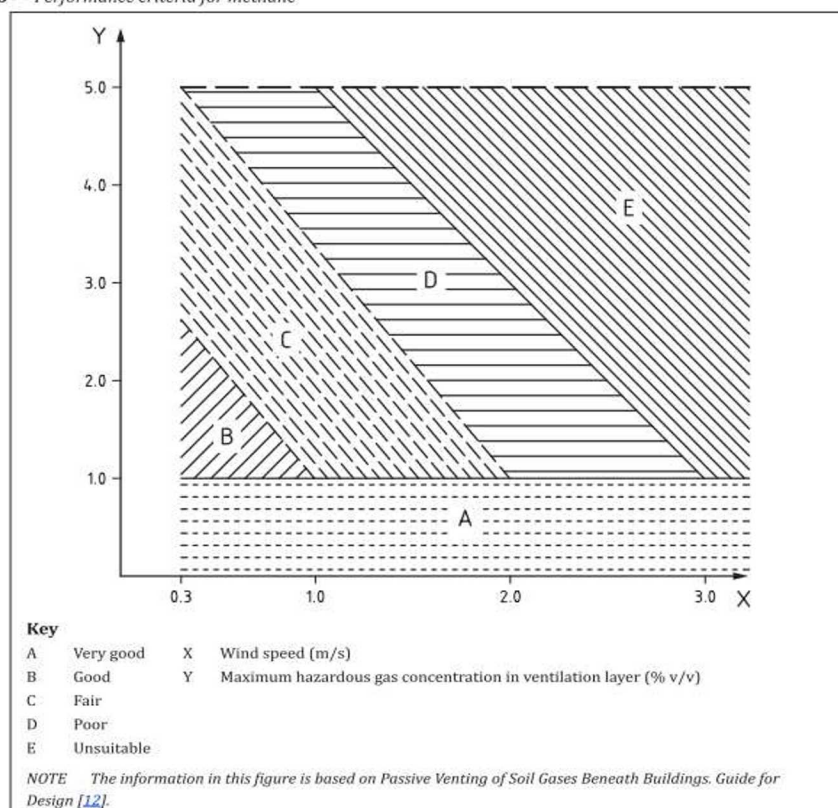
Table B.3 required drains at 2-3m c/c and min. 524 mm²/m extracted below for clarity.

Requirements of design guide exceed this and proposed provisions exceed the design guide recommendations

No fines gravel blanket with perforated pipe gas drains	Drains at 2 000 and 3 000 centres	524 to 3 140	200 blanket (5 000 × 5 000) 400 blanket (30 000 wide)
---	-----------------------------------	--------------	--

Figure B.6 provides performance criteria for methane this indicates a very good performance is achieved if a max. concentration of 1.0 %v/v can be achieved at all windspeeds.

Figure B.6 — Performance criteria for methane



Structural Calculations	Project: AJS, Plot 9, SFEZ, Holbeach	Date: Aug. '22	Designer: APW
Project No. 21-257	Subject:	Sheet No. 5	Rev:

Ground Gas Protection Statement

Ventilation Layer design - Cont'd

Figure B.7 provides performance criteria for carbon dioxide this indicates a very good performance is achieved if a max. concentration of 1.5 %v/v can be achieved at all windspeeds.

Figure B.7 — Performance criteria for carbon dioxide

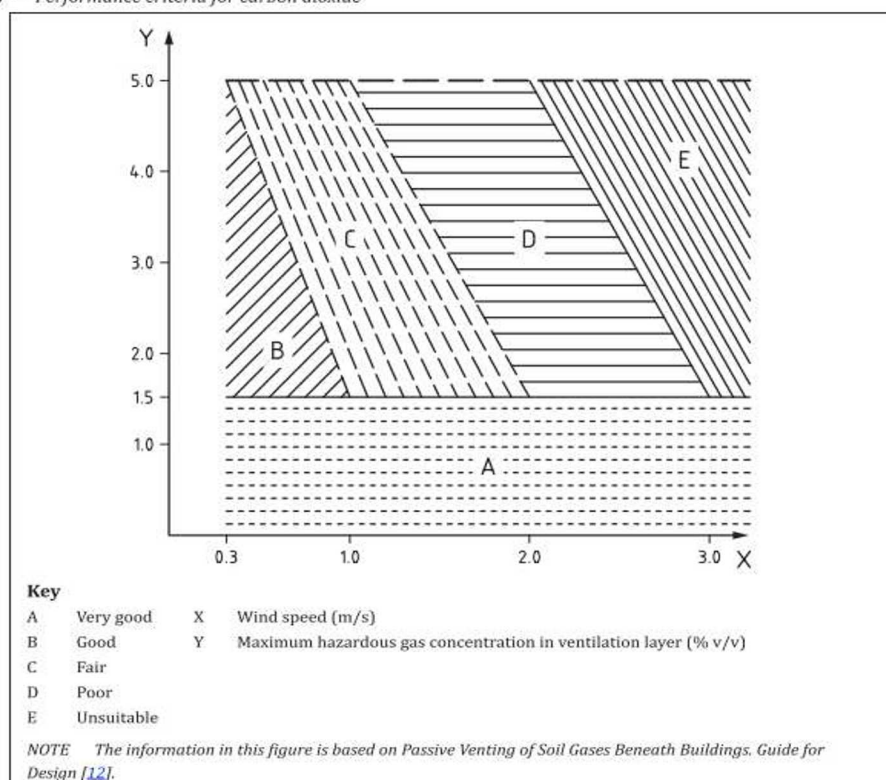


Table 26 of the guide for design indicates that the maximum modelled concentration of gas demonstrated for CFD model 5 (30x30x with gas drains @ 3mc/c) was 0.44 %v/v.

Table 26: Results of CFD Modelling for 20mm Single Sized Gravel Blankets with Fully Permeable Pipe Drains for 30m Wide Foundation:
Maximum Gas Concentrations over 80% of Ventilation Layer

Gas Regime	CFD Model	Depth of Gravel Blanket (mm)	Side Ventilation ⁽¹⁾ (mm ² /m run wall)	Maximum Hazardous Gas Concentration (%v/v)		
				Wind Speed 3.0m/s	Wind Speed 1.0m/s	Wind Speed 0.3m/s
A	4	400	736 3926	0.19	0.29	0.47
	5	400	590 524	0.08	0.18	0.44

In conclusion the ventilation meets the parameters and requirements of chapter 11 and therefore complies with the requirements of BS 8485 for providing a "good performance" ventilation system.

GAS VENT BOLLARDS

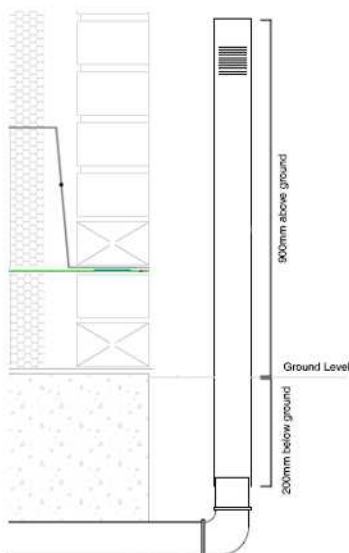


Gas Vent Bollards are an effective way to provide an outlet for the gas venting system. It makes for an aesthetic yet functional means to terminate the venting.

Our range of gas venting bollards include powder coated steel, self finished 304 grade stainless steel (316 grade available on request) and (UV Stabilised) PVC.

We can manufacture the powder coated bollards to any RAL colour range.

SPECIFICATIONS



Property	Unit	Value
Height (Total)	mm	1100
Height (External ground finish)	mm	800-900
Diameter	mm	110
Slot orientation		
Powder Coated/ Stainless Steel (304 grade)		Horizontal
(UV stabilised) PVC		Vertical
Air flow		
Powder Coated/ Stainless Steel (304 and 316 grade)	mm ²	25,000
(UV stabilised) PVC	mm ²	25,000

PRODUCT DETAILS

We are able to manufacture bespoke bollards to customer height requirement (to be approved by your engineer). Please ensure that the correct calculations have been projected to determine the number of bollards required on the project.

INSTALLATION

Correct Installations/specification should be sought from the specifier, ground engineers or the structural engineers to ensure the unit is suitable for the intended location.