



**GEOTECHNICAL &
GEOENVIRONMENTAL CONSULTANCY**

A PHENNA GROUP COMPANY

Makki Masjid

Makki Mosque, Manchester

*Detailed Quantitative Risk Assessment
For Ground Gas*

Rev 0

August, 2024

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Contents

1.	INTRODUCTION	3
1.1	Background	3
1.1.1	2024 CGL Investigation	4
1.2	Aims	5
2.	BASIS OF THE GROUND GAS DQRA	7
2.1.1	Sub-floor Void	7
2.1.2	Ventilation	7
2.1.3	Voids and Assumptions	8
3.	VENTILATION CALCULATIONS	10
3.1	Methodology	11
3.2	Parameters	11
4.	GROUND GAS DQRA RESULTS	12
5.	CONCLUSIONS	15

FIGURES

- Figure 1 – Location plan
- Figure 2 – Site Layout Plan
- Figure 3 – External Ventilation Layout
- Figure 4 – Sub-floor Void Dimensions

APPENDICES

- Appendix A – Development Plans
- Appendix B – Client Supplied Information
- Appendix C – CGL Site Visit Record
- Appendix D – CGL Photosheets
- Appendix E – DQRA Calculation Sheets
- Appendix F – DQRA Parameters
- Appendix G – Manchester Wind Rose

1. INTRODUCTION

Card Geotechnics Limited (CGL) was instructed on 8th March 2024 to complete a Detailed Quantitative Risk Assessment for ground gas (DQRA) at Makki Masjid, Beresford Road, Longsight in Manchester, M13 0TA (the site). The approximate National Grid Reference for the site is 386710, 394880. A location plan is presented as Figure 1.

The site encompasses a fully constructed Mosque with some groundwork such as soft landscaping and paving to be completed around the exterior. The geology of the site mainly comprises Made Ground overlying natural Glacial Till. There is a potential infilled pond along the northern margin of the site according to historical records, and evidence of this was encountered during prior investigation in the form of organic rich Peat deposits underlying Made Ground.

The DQRA was completed following a 2024 CGL ground investigation undertaken at the Makki Masjid Mosque to satisfy planning application CDN/20/0507 still awaiting a decision by Manchester City Council (MCC). This report should be read in conjunction with the Geoenvironmental Investigation Report¹ associated with that investigation. A summary of the report is given below to cover sections pertinent to this DQRA encompassing ground gas and groundwater conditions.

This DQRA has been deemed necessary as the 2024 investigation included 5 rounds of ground gas monitoring during which a methane concentration of 5.9% at one borehole location was encountered on one occasion. The Gas Screening Values (GSV) calculated following the monitoring indicated a 'Characteristic Situation' CS1, however, the 5.9 % volume by air of methane may indicate CS2. The ground gas monitoring dataset was deemed insufficient to accurately determine the Characteristic Situation due to high groundwater levels precluding valid gas monitoring at some locations (i.e. the wells were flooded). As a result, this DQRA will aim to further assess the risk methane encountered poses to the Mosque structure. A detailed summary is given below.

1.1 Background

A planning application (Ref. No: 080663/FO/2006/N2) was validated for Makki Masjid on 7th June 2007 for demolition of existing properties and the construction of a new two-storey Mosque building, to include a basement car park. Based on this application and proposed development, CGL undertook an initial ground investigation on 22nd February 2010, and details of this ground investigation can be found in report:

¹ Card Geotechnics Ltd. CGN/5003, Makki Mosque, Manchester. Geoenvironmental Investigation Report, Jan 2024.

Card Geotechnics Ltd, Makki Masjid, Beresford Road, Longsight, Manchester – Geotechnical Interpretative Report (CGN/2638), April 2010.

This report did not include ground gas monitoring, as the proposed development included the provision of a well-ventilated, basement level car park which was considered sufficient to mitigate potential ground gas risks as a function of its necessary design ventilation. As such, no gas monitoring was deemed to be necessary.

However, more recent planning documentation refers to a change of proposed development layout which no longer includes a basement car park. Planning application (CDN/20/0507) validated on 14th August 2020 is understood currently (August 2024) still to be awaiting a decision for reasons raised by Manchester City Council (MCC) summarised below.

1. The 2010 report is 10 years old and an updated version or bridging report is required as a minimum.
2. The gas monitoring carried out is inadequate, as acknowledged by the report, and it is stated that the basement car park will remove the gas migration pathway, however approval 1101149/JO/2015 included the removal of the basement.
3. Risks from ground contamination in soft landscaped areas have not been investigated or assessed.

As such, further ground investigation was deemed to be required by MCC.

Subsequently, CGL completed a ground investigation in 2024 aiming to satisfy the above planning application feedback.

1.1.1 2024 CGL Investigation

Four windowless sampler boreholes were drilled around the finished, completed Mosque to a maximum depth of 3.0m below ground level (bgl), borehole arisings were logged, and representative environmental soil samples collected by a CGL engineer for geochemical testing. The boreholes were then installed with groundwater and gas monitoring equipment. Four subsequent rounds of gas and groundwater monitoring were completed. These four monitoring rounds were conducted during periods of heavy rainfall, and the boreholes were subject to very shallow groundwater conditions which flooded the response zones, precluding accurate gas monitoring readings. As such, a fifth, extra monitoring round was completed during low and falling atmospheric pressure to improve the dataset.

Peat deposits inferred to be related to a potential infilled pond were encountered within borehole WS04 and elevated methane gas was measured on the fifth monitoring round. A summary of the ground gas monitoring record is provided in Table 1 below.

Table 1. Summary of CGL Ground Gas Monitoring Records

Borehole	Well response zone		Steady Flow Rate (L/hr)	Depth to Groundwater (m)	Min. O ₂ (% vol in air)	Max. CO ₂ % vol in air [GSV L/h]	Max. CH ₄ % vol in air [GSV L/h]	Peak CO (ppm)	Peak H ₂ S (ppm)
	Stratum	Depth of Install (mbgl)							
WS01	MG / GT	1.0 - 3.0	<0.1*	0.25 – 0.48	10.7	2.0 [<0.0020]	<0.1 [<0.0001]	11	<0.01
WS02	MG / GT	1.0 – 3.0	<0.1*	0.00 – 0.51	12.7	2.2 [<0.0022]	<0.1 [<0.0001]	10	<0.01
WS03	GT	1.0 – 3.0	<0.1*	0.00 – 1.05	13.3	2.1 [<0.0021]	<0.1 [<0.0001]	10	<0.01
WS04	MG / PEAT	1.0 – 3.0	<0.1*	0.00 – 0.12	16.3	1.2 [<0.0012]	5.9 [<0.0059]	10	<0.01

*Gas Screening Value (GSV) calculated in accordance with CIRIA C665. Peak Flows not used due to pressure build ups outlined below.

MG – Made Ground

GT – Glacial Till

Steady flow rate values were presented because the first 0 – 10 seconds of flow readings were considered likely to be due to a build-up of pressure within the sealed monitoring wells caused by the high groundwater levels recorded during the monitoring visits. The absolute peak flow (max at WS04, 27.3 L/hr) was not sustained for longer than 10 seconds.

The Gas Screening Values (GSVs) presented within square brackets inside the Max. % Volume by air column in Table 1 correlated to a site Characteristic Situation 'CS1' however, the concentration of methane found in WS04 on monitoring round 5 (5.9% volume of air) may indicate that a Characteristic Situation 'CS2' could be applicable. This measurement of 5.9% was the only occurrence of detection of methane gas which happened when the gas source was exposed to air within the borehole. During normal conditions when covered by Made Ground and groundwater, the gas source is not likely to be significantly productive.

1.2 Aims

As the 2024 CGL dataset was deemed to be insufficient to properly assign a Characteristic Situation for the site. This subsequent DQRA was proposed in order to further investigate the risk the ground gas poses to the site, which has been constructed without specific gas protection measures, to assess whether there is potential for a significant build-up of gas within the building or not. The building has a passive ventilation system in the form of a sub-floor void which is ventilated by airbricks penetrating the exterior walls. The floor construction inside the building comprises beam and block

flooring so may not provide gas protection. Gas, if present, entering the building through the ground will enter the void and should be dispersed by the ventilation provided by the air bricks before a significant build up occurs. This report will be used as another line of evidence in assessing the Characteristic Situation for the site and not to assess the efficacy of the passive ventilation system as a form of gas protection or to inform design. While it is recognised that gas dilution alone is not usually sufficient to mitigate gas risk, the site and gas source are considered to be low-risk and as such could be classified as 'CS-1', requiring no further gas protection measures.

If it can be shown through this line of that there is a low risk of gas build-up within the Mosque and the site is 'CS-1', then further monitoring and assessment may not be needed.

On this basis, CGL was commissioned to carry out a DQRA to assess effectiveness of the passive ventilation for the sub-floor void beneath the mosque in areas close to the 'Potential Infilled Pond' and WS04 peat deposits only as no other occurrence of ground gas was found in boreholes WS01, WS02, or WS03 around the site.

2. BASIS OF THE GROUND GAS DQRA

2.1.1 Sub-floor Void

The foundation drawings (specifically drawing C5²) shown in Appendix A display how the sub-floor void is sectioned by interior beam and block walls. The construction image in Appendix B illustrates that the sub-floor void is passively ventilated by external airbricks and/or ventilation gaps left in the interior beam and block walls. The interior wall gaps will allow air to flow across the whole sub-floor void and enable effective passive ventilation.

2.1.2 Ventilation

A site visit was conducted by CGL on 4th June 2024 to view the passive ventilation system of the mosque structure to support this DQRA. The site visit record is included as Appendix C and records:

- Number of external air bricks
- Condition of external airbricks
- Equivalent area of external airbricks ($\neq$ geometric open area)
- External airbrick spacing/distribution

Photosheets of the site visit record showing the number and condition of external wall ventilation bricks are found as Appendix D.

Each ventilation brick is marked with an 'equivalent area' which denotes the theoretical area of airflow a singular brick provides, rather than its actual geometric open area as per BS EN 13141-1:2004³. For example, the interior sub-structure wall gaps have a geometric open area of 7500mm² however, when multiplied by discharge coefficient for a sharp-edged orifice as per BS5925:1991⁴ ($C_d = 0.61$), only have an equivalent area of 4575mm².

A ventilation layout plan is presented as Figure 3.

The external vents partially or fully obstructed by construction material or foliage must be cleared to be unobstructed prior to occupation of the building.

² Proposed Ground Floor Layout, 09 226/ A1 / 003, CCS Consulting, June 2009.

³ British Standards (2019) BS EN 13141. Ventilation for buildings. Performance testing of components/products for residential ventilation.

⁴ British Standards (1991) BS 5925. Code of practice for ventilation principles and designing natural ventilation.

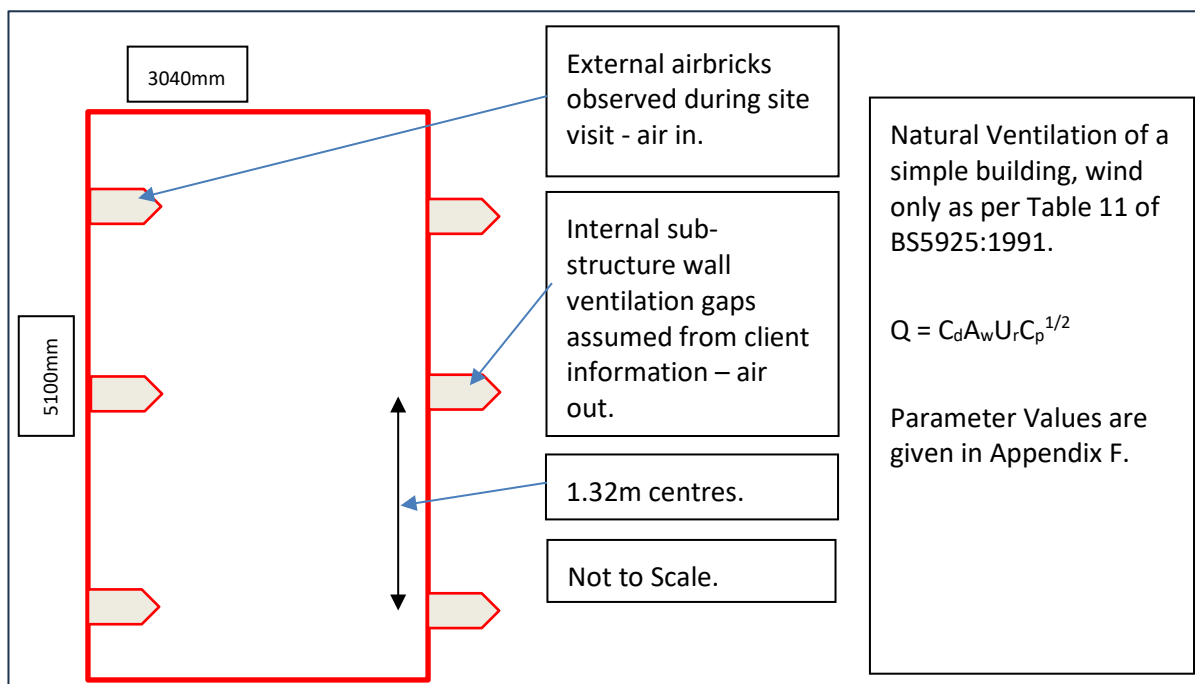
2.1.3 Voids and Assumptions

Methane was detected within WS04 at the location of the potential infilled pond and if methane was to enter the building it is most likely this would be in the northern margins. Therefore, it has been modelled that methane accumulation may occur within small sub-floor voids in this area. The development drawings are given in Appendix A and show the proposed foundations, sub-structure wall, and sub-floor void dimensions for the building. Two voids have been chosen for the purposes of the DQRA, comprising two sections of the sub-floor void closest to the potential methane source. These are described herein as Void 1 and Void 2, as shown in Figure 2 and 4a and summarised below.

2.1.3.1 Void 1

Void 1 comprises a rectangular section of the sub-floor void which measures approximately 5.10m x 3.040m in plan view (Figure 4). This void is ventilated by three external airbricks observed during the site visit (advised by the client to vent through both wall skins and cavity), and it is assumed that the opposite internal sub-structure wall also possesses three ventilation gaps. While these ventilation gaps are not visible on the foundation or sub-structure wall drawings within Appendix A, the client has advised that the sub-structure walls have ventilation gaps at 1.32m horizontal centres, which can be seen within the email correspondence and photograph within Appendix B. Three ventilation gaps are conservatively assumed given the dimension of the wall (5.1m / 1.32). Plate 1 of void 1 recreated from Figures 3 and 4 below illustrates the assumptions and the associated ventilation formula suggested for these conditions by Table 11 of BS5925:1991⁴.

Plate 1 – Void 1 Model



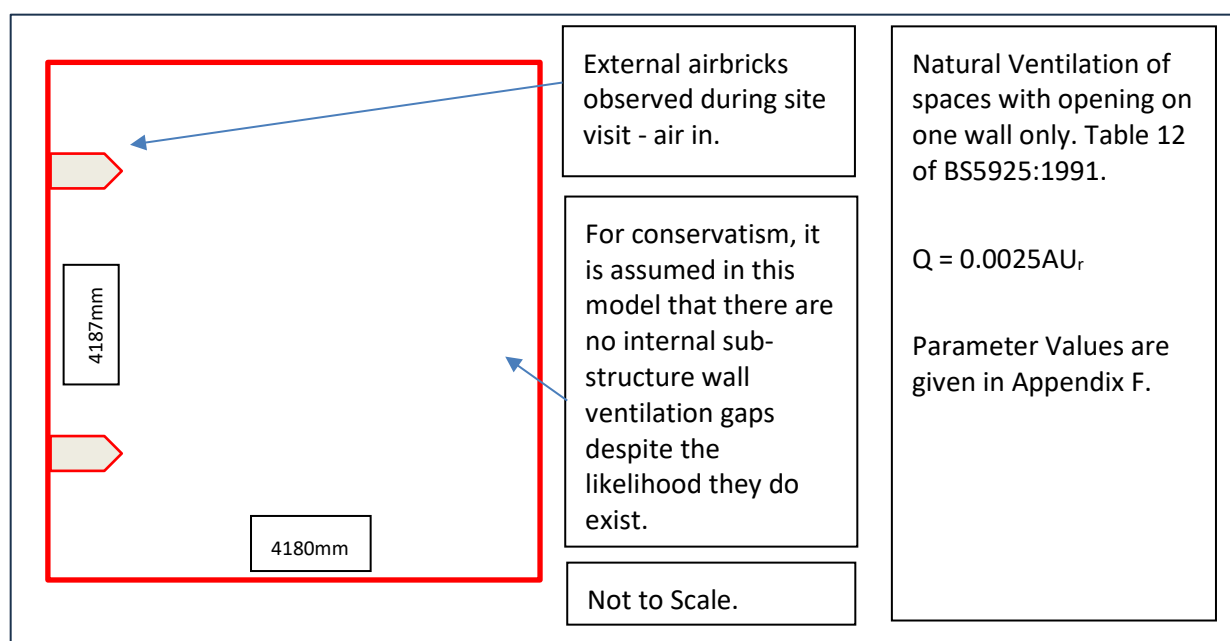
As we are assuming the same number of external air bricks as internal ventilation gaps, and the equivalent area of the internal gaps is lower, the equivalent area of the internal ventilation gaps is assumed to be the controlling factor in determining airflow and that value will be used in the calculations for this void rather than the equivalent area provided by the external air bricks (4575mm² per vent to be used as per Appendix E - 1.4, rather than 6170mm² stated by the external air bricks). Normally, it is preferred that the equivalent area of the internal ventilation gaps is greater than that provided by the external air bricks to ensure good throughflow. However, in this case there is only considered to be risk of gas ingress proximal to the potential infilled pond and as such the other sub-floor voids not proximal to the source will provide further dilution and flow.

2.1.3.2 Void 2

Void 2 comprises an approximately rectangular section (Figure 4) to the east of Void 1 and is approximately 4.180m x 4.187m in plan view. The measurement of 4.180m is an average of the two opposing walls as per Figure 4 to provide a void volume for an irregular shape. This void is ventilated by two external airbricks along a 4.187m section of external wall (observed to vent through both wall cavity skins and advised by the client). For the purposes of conservatism, for this void it has been assumed there are no ventilation gaps in the opposing sub-structure wall and that the void is ventilated only by air flow both in and out of the external airbricks. These assumptions allow an assessment of the theoretical ventilation under the poorest air flow conditions to give a conservative assessment for the structure.

The box diagram of void 2 recreated from figures 3 and 4 below illustrates the assumptions and the associated ventilation formula suggested for these conditions by Table 11 of BS5925:1991.

Plate 2 – Void 2 Model



3. VENTILATION CALCULATIONS

Calculations for both voids have been carried out using guidance from BS5925:1991⁴ and are included in Appendix E. This methodology is considered suitable as it allows for a calculation of the potential equilibrium concentrations of methane within the sub-floor void of the mosque to assess the risk of methane building up to dangerous levels. A 'design concentration' of methane of 0.25% volume by air will be used for comparison which allows a factor of safety of 20 when compared to the lower explosive limit of 5%⁵.

These calculations entail:

- Calculation of inflow of air required to dilute ground gas emissions.
- Calculation of ventilation required through sub-floor void to prevent build-up of methane to unacceptable levels.
- Equilibrium calculations
- Checks to determine if the ventilation is adequate in still or low wind conditions

For both voids (Void 1 and Void 2) two scenarios have been calculated. Both scenarios use the maximum methane measured and use differing flow values.

- A. Realistic conditions using maximum steady state methane flow observed on site.
- B. Hypothetical worst-case conditions using maximum peak flow observed.

The conditions used for scenario A use the maximum steady state flow observed on-site of 0.1L/hr which is considered to be realistic of normal gas-flow conditions on site. Scenario B includes a maximum peak flow of 27.3L/hr of gas from the ground as observed in WS04 on 5th January 2024 at the start of the monitoring. This flow rate dissipated to 3.3L/hr within 10 seconds and to 0.3L/hr within 30 seconds. This is not considered to be representative of the actual flow of ground gas coming from the ground as this measurement was taken from a sealed borehole which is considered likely to have experienced pressurisation due to a rise in groundwater levels as a result of heavy rainfall. This scenario is unlikely to be replicated across the wider site, even with rising groundwater conditions, as the ground surface is not a sealed unit. This scenario is included in this report as a sensitivity check to assess the ventilation scheme under the worst possible hypothetical conditions.

⁵ Ground Gas Handbook - Wilson et al. Ground Gas Handbook, 2009

3.1 Methodology

The DQRA presented in the following section assesses the methane emissions from the ground into the sub-floor void and the inflow of clean air required to achieve a safe level of dilution, taken to be 0.25% v/v methane. This is then compared to the capacity of the underfloor space. Once the capacity of the underfloor space can be demonstrated to exceed the required inflow of air, an assessment of the size of the required air inlets is made. A final check is then undertaken to assess whether the system is fail-safe in still air conditions.

The calculation sheets are included in Appendix E and are based on the methodology and assessment calculations presented in BS 5925:1991⁴.

3.2 Parameters

Tables F1 and F2 in Appendix F outline the parameters used in the calculations for each void presented in Appendix E respectively, and their source.

The estimation of prevalent wind flow direction was made from a Wind Rose collated for Manchester by Meteoblue⁶. The Meteoblue climate diagrams are based on 30 years of hourly weather model simulations. The correction factor of 0.83 used in the calculation sheet conservatively assumes that the chosen mean wind speed (4.25m/s or approx. 9.5mph) is exceeded for 60% of the time (BS5925:1991, Table 9). The Wind Rose used for this is presented in Appendix G.

⁶ Meteoblue, Manchester Wind Rose https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/manchester_united-kingdom_2643123. Accessed 17/06/2024

4. GROUND GAS DQRA RESULTS

Table 2. Required Ventilation

Void	Scenario	Area of Ventilation Required for Whole Section - Calculated (mm ² /m)	Area of Ventilation Required for Whole Section – Building Standards (mm ² /m)	Equivalent Area of Ventilation Provided per m run of windward facing wall (mm ² /m)	Comment
1	A – Realistic	0.543	1500	2691	Pass
	B – Worst Case	148.1	1500	2691	Pass
2	A – Realistic	18.25	1500	2947	Pass
	B – Worst Case	4984	1500	2947	Pass/Fail Insufficient ventilation against calculated requirement Sufficient ventilation against building regulations requirement

Only Void 2 in scenario B (hypothetical maximum gas flow, minimum ventilation conditions) provides insufficient ventilation compared to the calculated required amount. Given the conditions of scenario B are not representative of realistic or attainable *natural* conditions (hypothetical max flow used came from a sealed monitoring tube, actual sub-floor void vented on two walls) and the area of ventilation provided exceeds the minimum value required by National House Building Council (NHBC) Standards⁷, the area of ventilation provided to voids 1 and 2 is deemed to be sufficient.

Table 3. Equilibrium Contaminant Concentrations

Void	Scenario	Contaminant Equilibrium Concentration (% vol. air)	Comment
1	A – Realistic	0.000051	Pass >0.25% Design Value for Methane
	B – Worst Case	0.0138	
2	A – Realistic	0.00152	Fail >0.25% Design Value for Methane
	B – Worst Case	0.414	

⁷ NHBC Standards 2024, Chapter 5.2.10 – Damp Proofing and Ventilation, Ventilation. <https://nhbc-standards.co.uk/>. Accessed [20/06/2024]

Only Void 2 in scenario B (hypothetical maximum gas flow, minimum ventilation conditions) fails when comparing the contaminant equilibrium concentration of methane to the design value of 0.25% volume of air, however it is still significantly below the lower explosive limit of 5%. When comparing the realistic conditions (peak steady flow of 0.1L/hr) to the design contaminant equilibrium concentration for methane, the steady state flow conditions of the gas in the ground would need to increase by an approximate factor of 132 for the equilibrium concentration methane to reach the design value of 0.25%. This factor would be increased further again if ventilation on two opposing walls is considered rather than in one wall only. Given the conditions of scenario B are not representative of realistic conditions, and the realistic conditions for the site give equilibrium concentrations 2 orders of magnitude lower than the design value which already has a factor of safety of 20, the passive ventilation system of the building is considered to provide adequate ventilation to dilute the methane gas in the ground.

Table 4. Equilibrium Contaminant Concentrations – Poor Wind Flow Direction

Void	Scenario	Contaminant Equilibrium Concentration (% vol. air)	Comment
1	B – Worst Case	0.0249	Pass
2	B – Worst Case	0.745	Fail >0.25% Design Value for Methane

Another further sense check has been carried out also assuming poor conditions for wind flow direction, such that that the ratio of mean wind speed for 80% of the time to the 50% mean wind speed is 0.46 rather than 0.83 – the lowest ratio value given within BS5925:1991. The outcomes remain similar, with Void 1 still possessing and equilibrium contaminant concentration far below 0.25%, and Void 2 still having a concentration above the design value but far below the Lower Explosive Limit (LEL, 5%) and below the LEL with a factor of safety of 5 (1%).

Table 5. Check for time to fill the void to 1% Methane in still air

Void	Scenario	Time taken to fill void to 1% CH₄ (hrs)	Max time of still air condition in UK (hrs)	Comment
1	A – Realistic	15084.75	10	Pass > 10 hours
	B – Worst Case	55.26	10	
2	A – Realistic	15084.75	10	
	B – Worst Case	55.26	10	

Both voids in both scenarios pass the still air check when comparing the time taken to fill the void to 1% volume of air for methane to the maximum time of still air conditions in the UK of 10 hours⁵ by a factor of at least 5. As such, the dimensions of the void provide enough protection against a build up of methane in still air conditions.

5. CONCLUSIONS

Both voids are adequately protected by the passive ventilation system already in place at the site and comply with BS5925:1991.

Enough ventilation in terms of area (mm^2/m) is provided by structure's passive ventilation system when compared to calculated required values under realistic conditions and for all conditions compared to building regulation requirements.

The external vents partially or fully obstructed by construction material or foliage must be unobstructed prior to usage of the building and must remain unobstructed for the duration of building use.

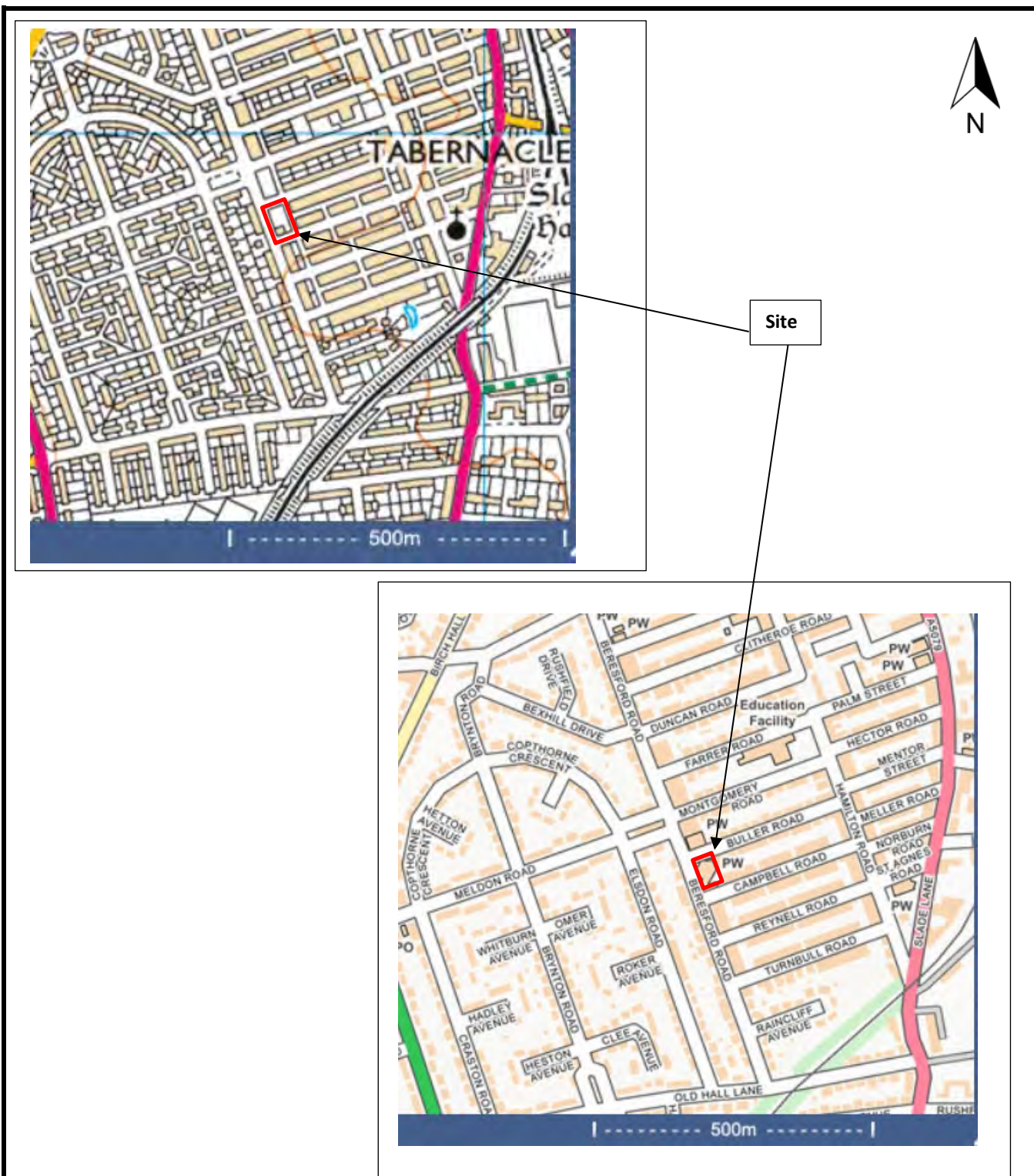
Contaminant equilibrium concentrations for methane fall significantly below the design value of 0.25% when considering realistic conditions.

The time taken to fill the sub-floor void to 1% methane volume of air is greater than the maximum time of still air in the UK by at least a factor of 5 in all conditions.

Marginal failures for study 2B under hypothetical worst-case conditions relating to calculated required ventilation and equilibrium contaminant concentration should not be used to assess the passive ventilation system and are included as a sensitivity check. This is not considered to be representative of the actual peak flow rate of ground gas coming from the ground as this measurement was taken from a sealed borehole which had experienced pressurisation due to a rise in groundwater levels as a result of heavy rainfall. The ground is not a sealed container and is unlikely to achieve peak flow rates like this even during rising groundwater conditions. Despite apparent failure, study 2B still possesses more than the minimum required ventilation cited by Building Standards and has an equilibrium concentration of methane significantly below the lower explosive limit of 5% and below the lower explosive limit with a factor of safety of 5 (1%) even under the worst-case gas flow, wind flow direction, and ventilation conditions. It should be noted that the ventilation provided to this void will be much greater in actuality as there are ventilation gaps in the internal sub-structure walls, while this study assumes none.

The line of evidence provided by this DQRA alongside the low gas flow rates, one occurrence of methane detection, low risk nature of the gas source, and its position outside of the building footprint means the characteristic situation at the site is considered to be 'CS1' and as such, no further ground investigation, monitoring, sampling, or ground gas protection measures are considered necessary.

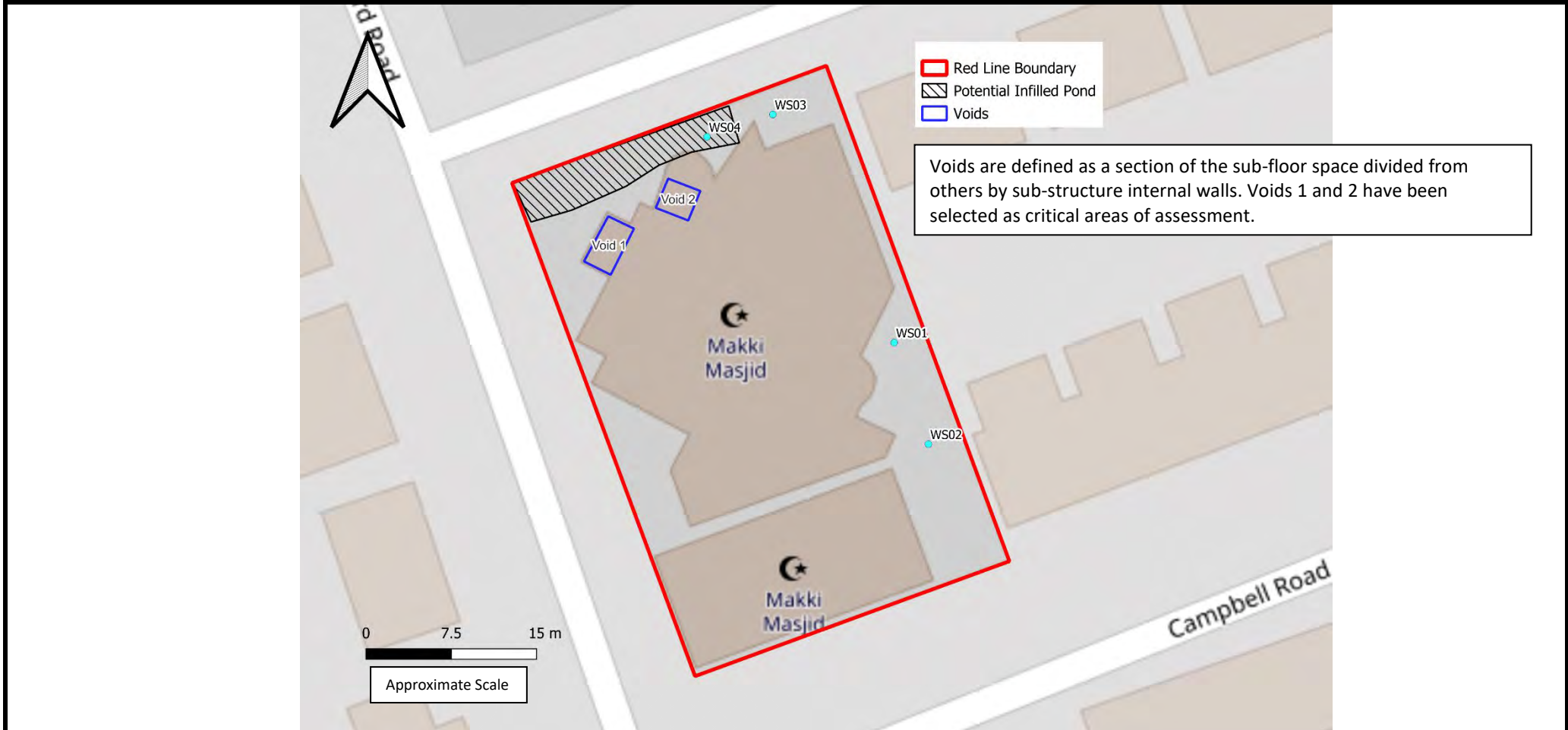
FIGURES



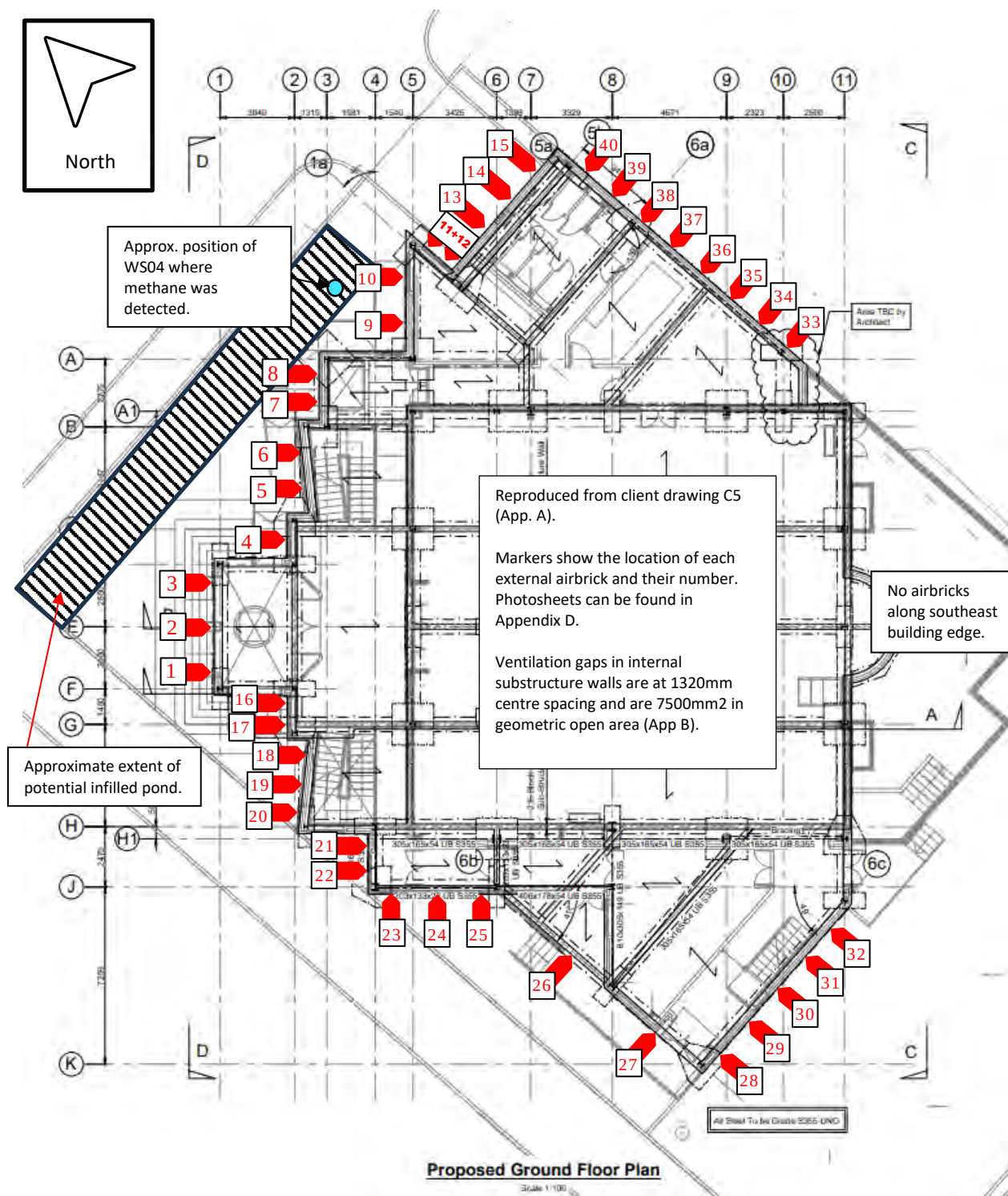
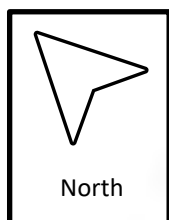
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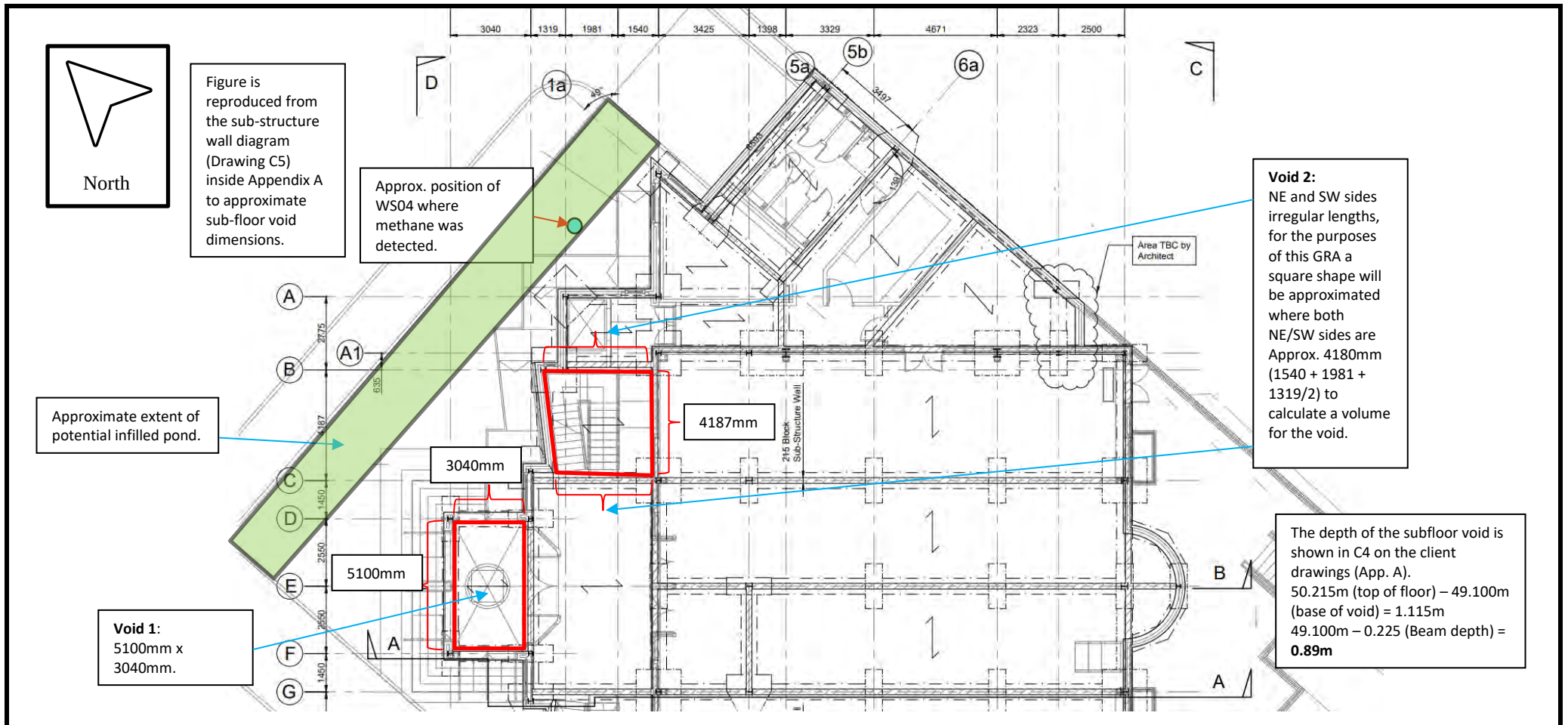
Client	Project	Job No
Makki Masjid	Makki Mosque, Manchester	CGN/05003A
 CGI GEOTECHNICAL & GEOENVIRONMENTAL CONSULTANCY A PHENNA GROUP COMPANY	Title	
	Site Location Plan	Figure 1



Client	Project	Job No
Makki Masjid	Makki Mosque, Manchester	CGN/05003A
	Title	
	Site Layout Plan	Figure 2



Client	Project	Job No
Makki Masjid	Makki Mosque, Manchester	CGN/05003A
 GEOTECHNICAL & GEOENVIRONMENTAL CONSULTANCY A PHENNA GROUP COMPANY	Title	
	External Ventilation Layout	Figure 3



Client	Project	Job No
Makki Masjid	Makki Mosque, Manchester	CGN/05003A
 CGL GEOTECHNICAL & GEOENVIRONMENTAL CONSULTANCY A BHEENNA GROUP COMPANY	Title	
	Sub-floor Void Dimensions	Figure 4

APPENDIX A

Development Plans

PROPOSED

Dimensions to suit overall existing dimensions
Applicant to confirm boundary.
Drawings to be read in conjunction.
This drawing is for the purpose of obtaining Local Authority approvals only and may not contain a full specification of the works.
Do not scale off this drawing.
All dimensions to be checked on site prior to commencing works.

Applicant should be aware that The Party Wall Act may apply where building work is on or near the boundary.



N.GEDAL
BA Hons Dip ARCH RIBA

ARCHITECT

REV B 14/04/17
REV A 9/11/16

CLIENT
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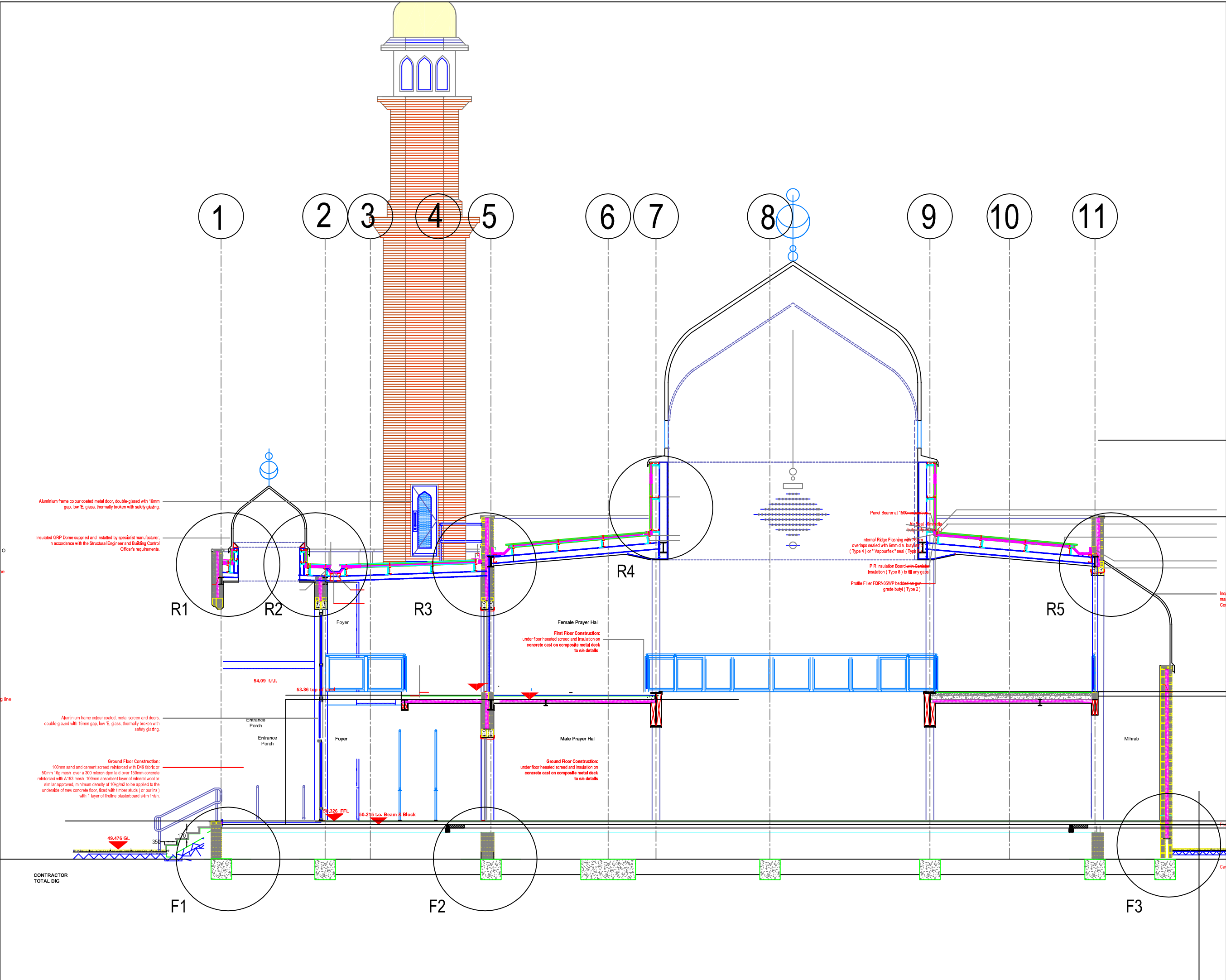
Architects
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DRAWING TITLE

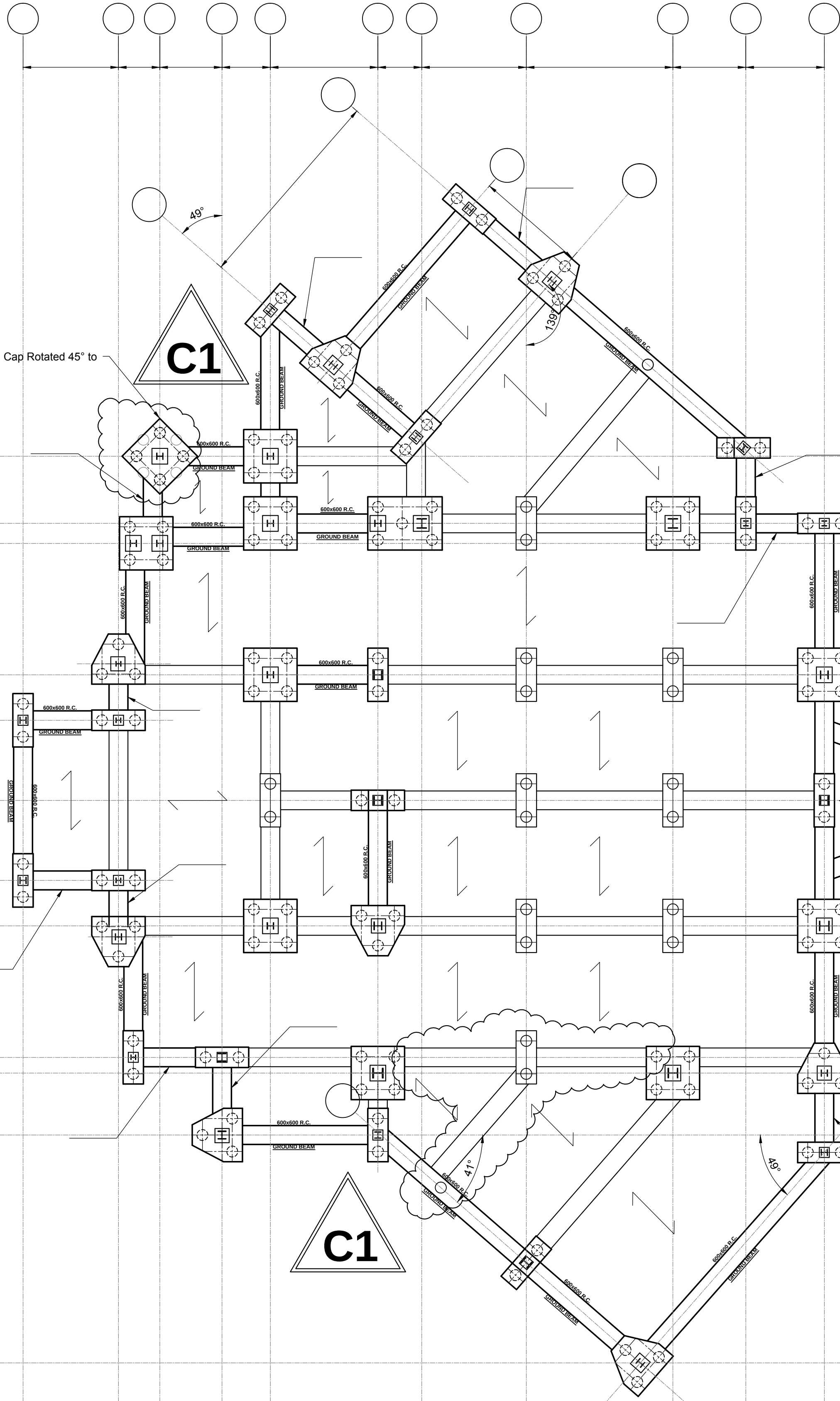
Proposed
Section

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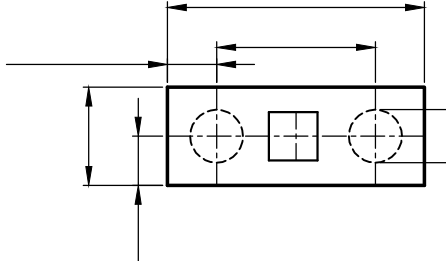
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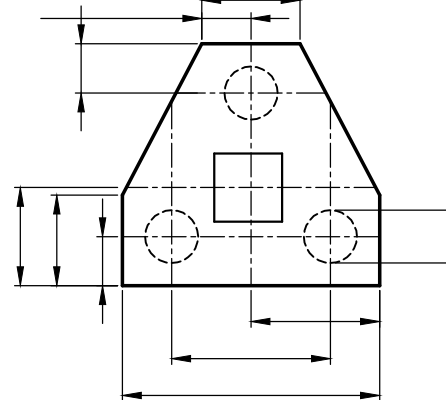
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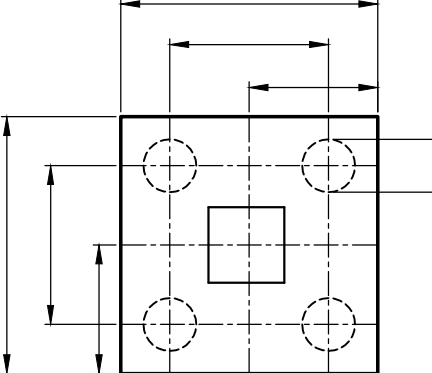
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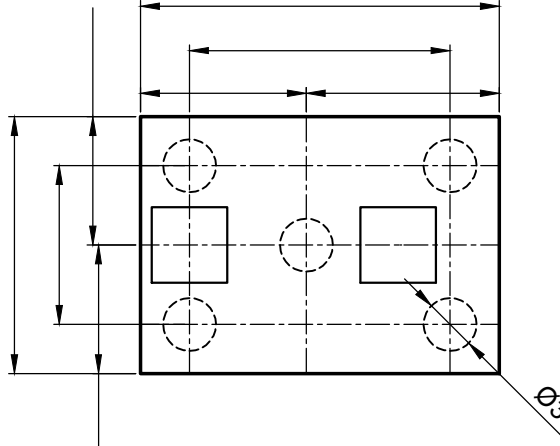
Pile Cap Type P0



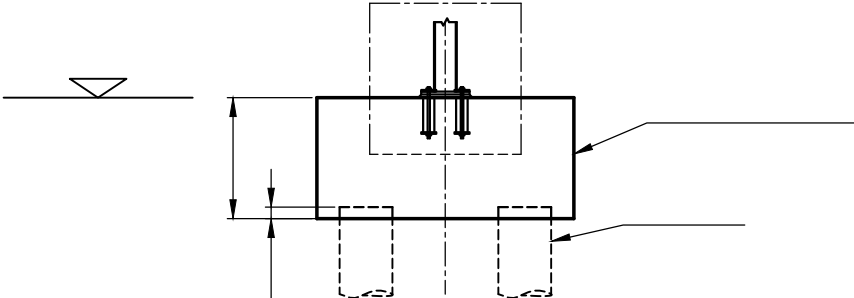
Pile Cap Type P02



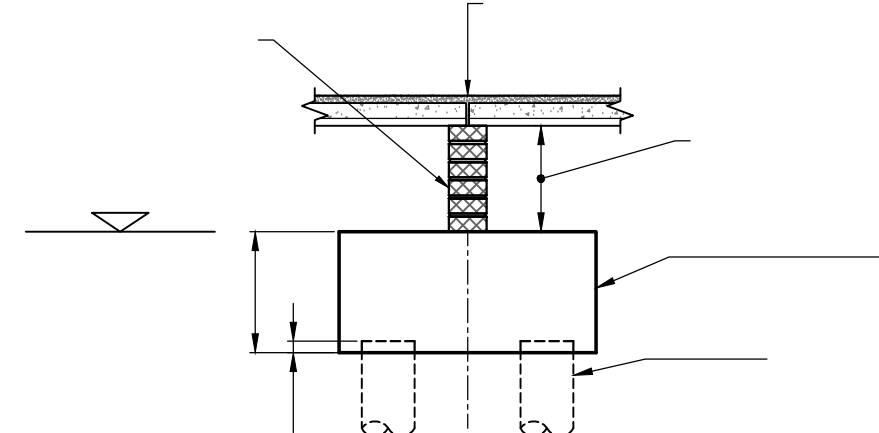
Pile Cap Type P03



Pile Cap Type P04



Typical Pile Cap Section



Typical Pile Cap Section - Dwarf Wall

Additional Piles for Beam & Block Scheme

-
-
-
-

[illegible]

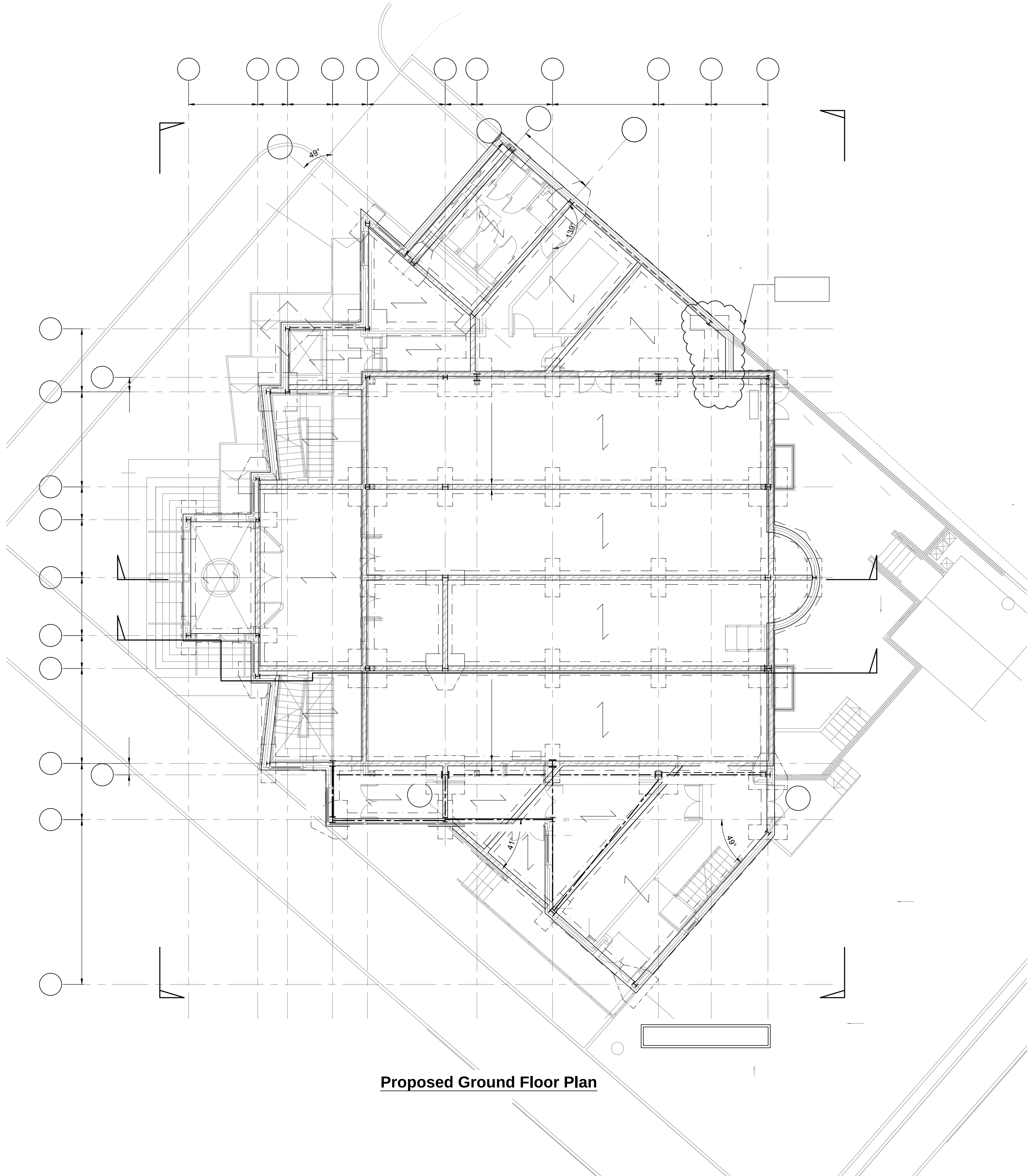
Makki Mosque

Makki Mosque
Beresford Road, Longsight

Proposed Foundation Plan

Tender	August '15	As Shown
09 226 / A1 / 001		C1
LS	WFF	BCH

notes :



Proposed Ground Floor Plan

↖
*

▨



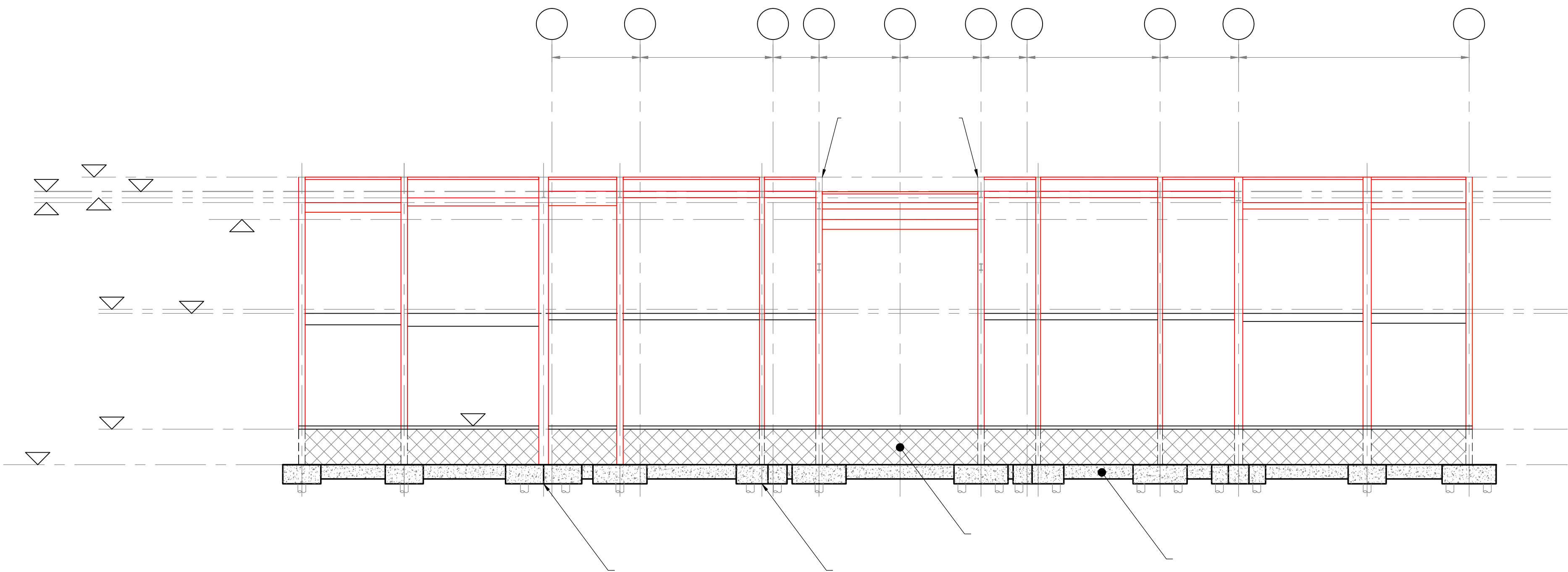
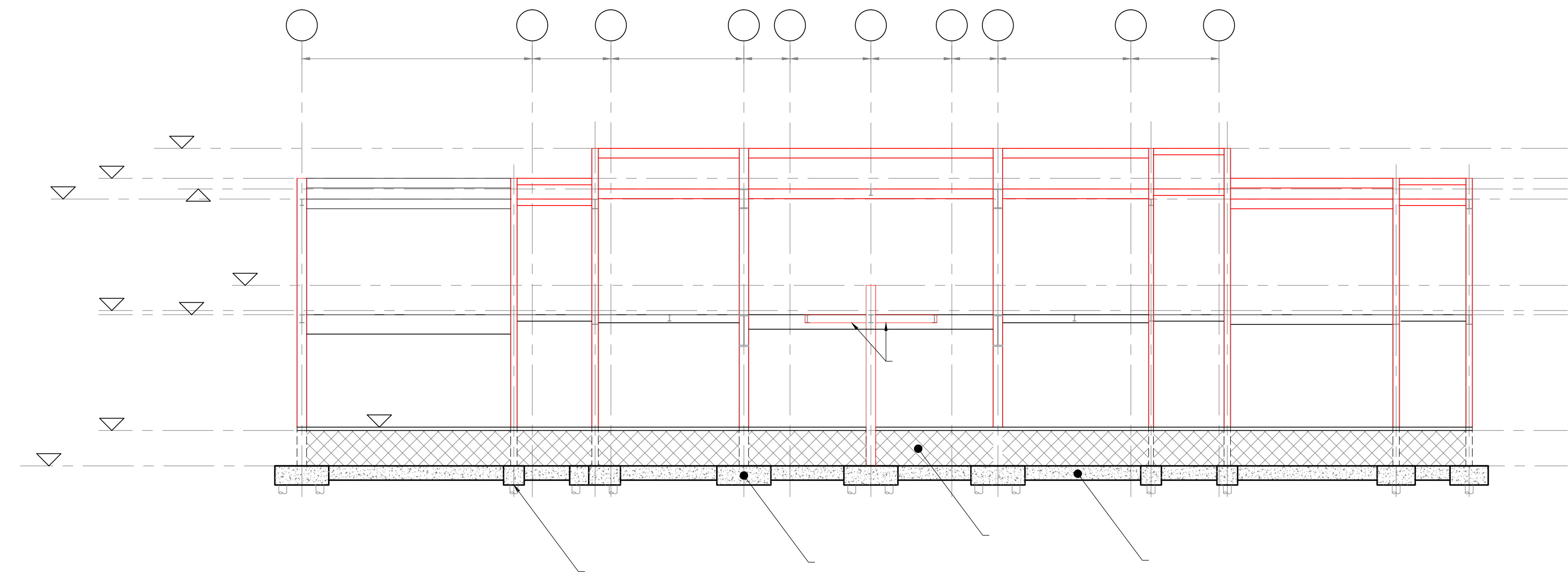
Makki Mosque

Makki Mosque
Beresford Road, Longsight

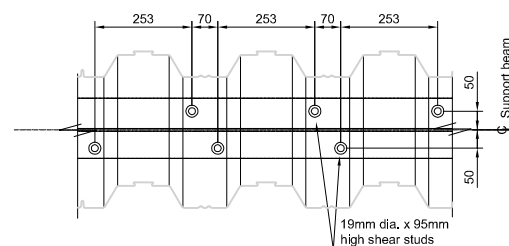
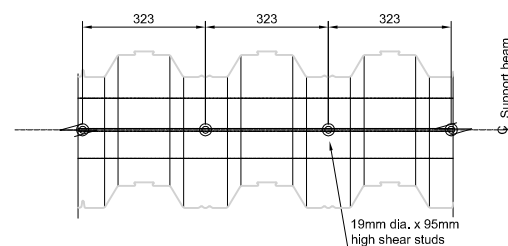
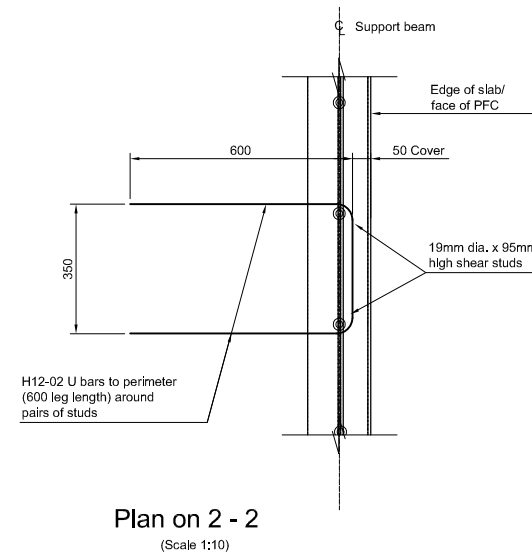
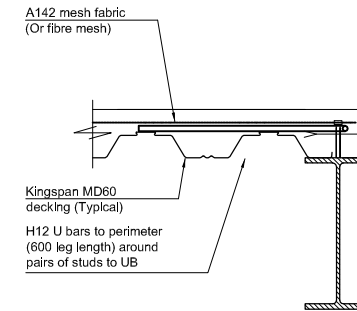
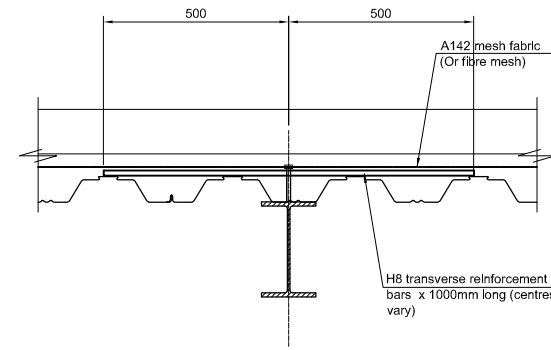
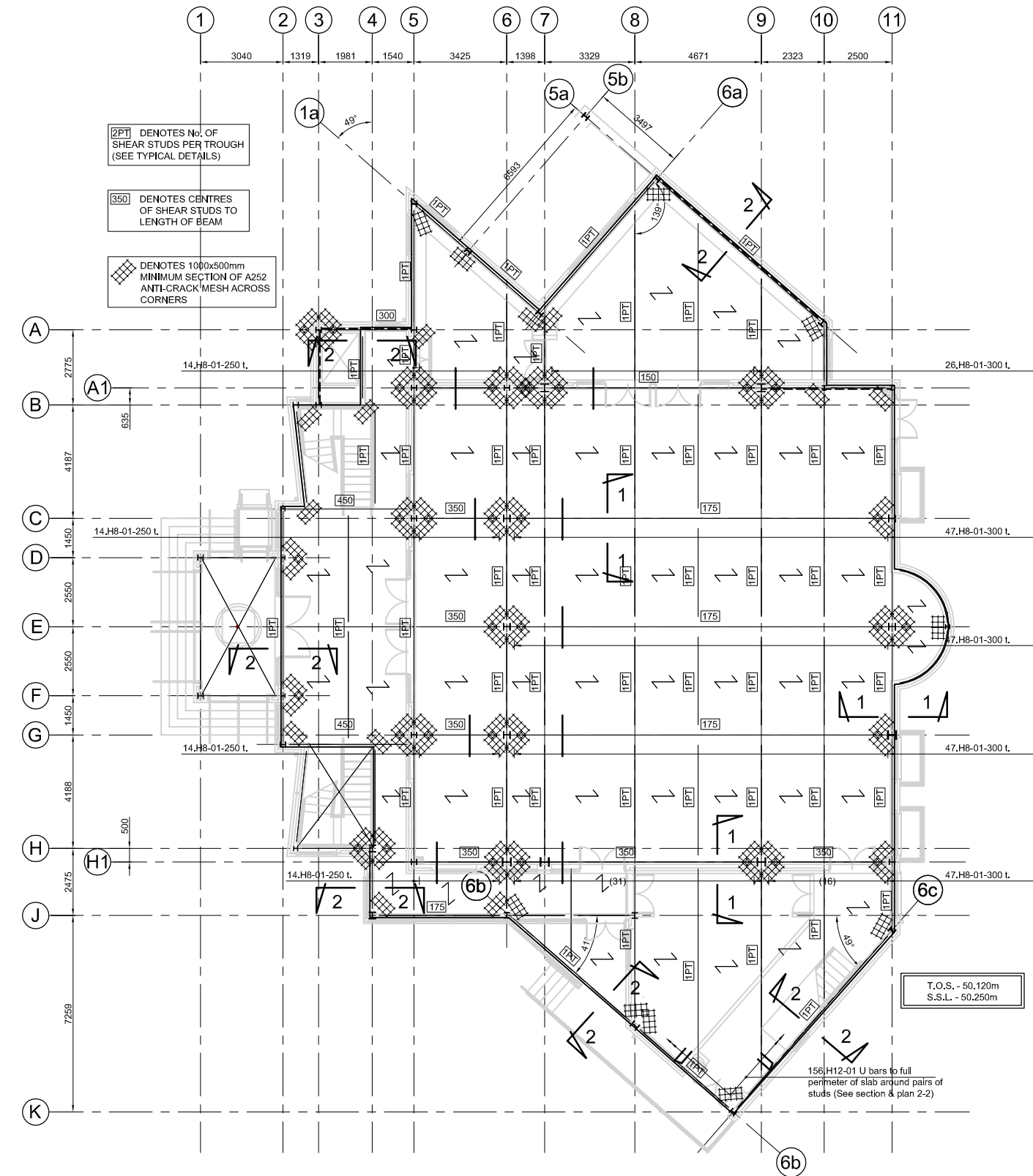
Proposed Ground Floor
Layout

Construction	June '09	As Shown
09 226 / A1 / 003		C5
LS	SPH	LS

notes :



ccs consulting			
Makki Mosque			
Makki Mosque Beresford Road, Longsight			
Proposed Steelwork Elevations C-C & D-D			
Construction	June '09	1:100	
09 226 / A1 / 008			C2
LS	SPH	LS	



notes :

1. IF THIS DRAWING HAS BEEN RECEIVED ELECTRONICALLY IT IS THE RECIPIENTS RESPONSIBILITY TO PRINT THE DOCUMENT TO THE CORRECT SCALE
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE. IT IS RECOMMENDED THAT INFORMATION IS NOT SCALED OFF THIS DRAWING
3. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS AND SPECIFICATIONS
4. ALL CONCRETE IS TO BE GRADE C40

T1	ISSUED FOR TENDER	BCH	23.10.13
rev	amendments	by	date



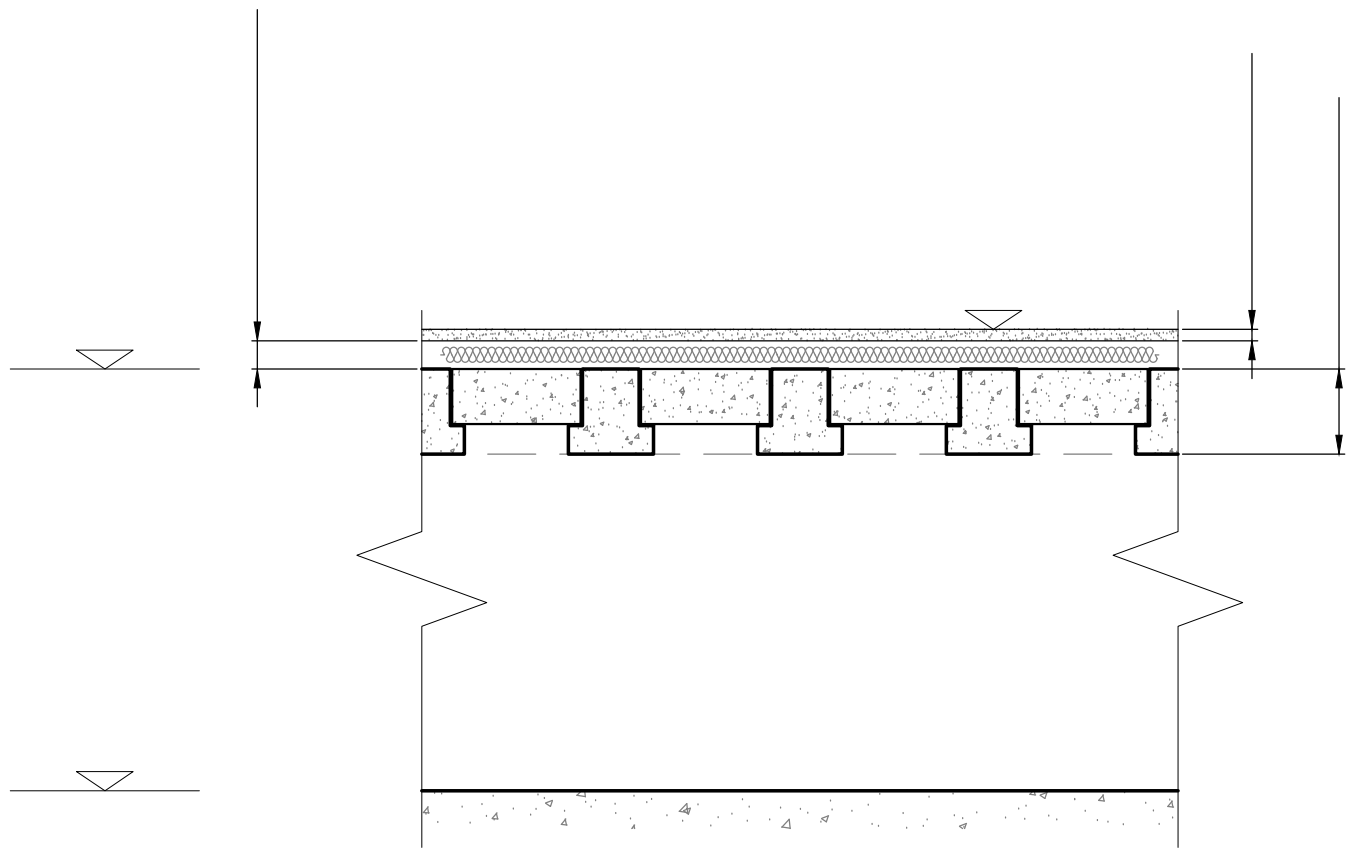
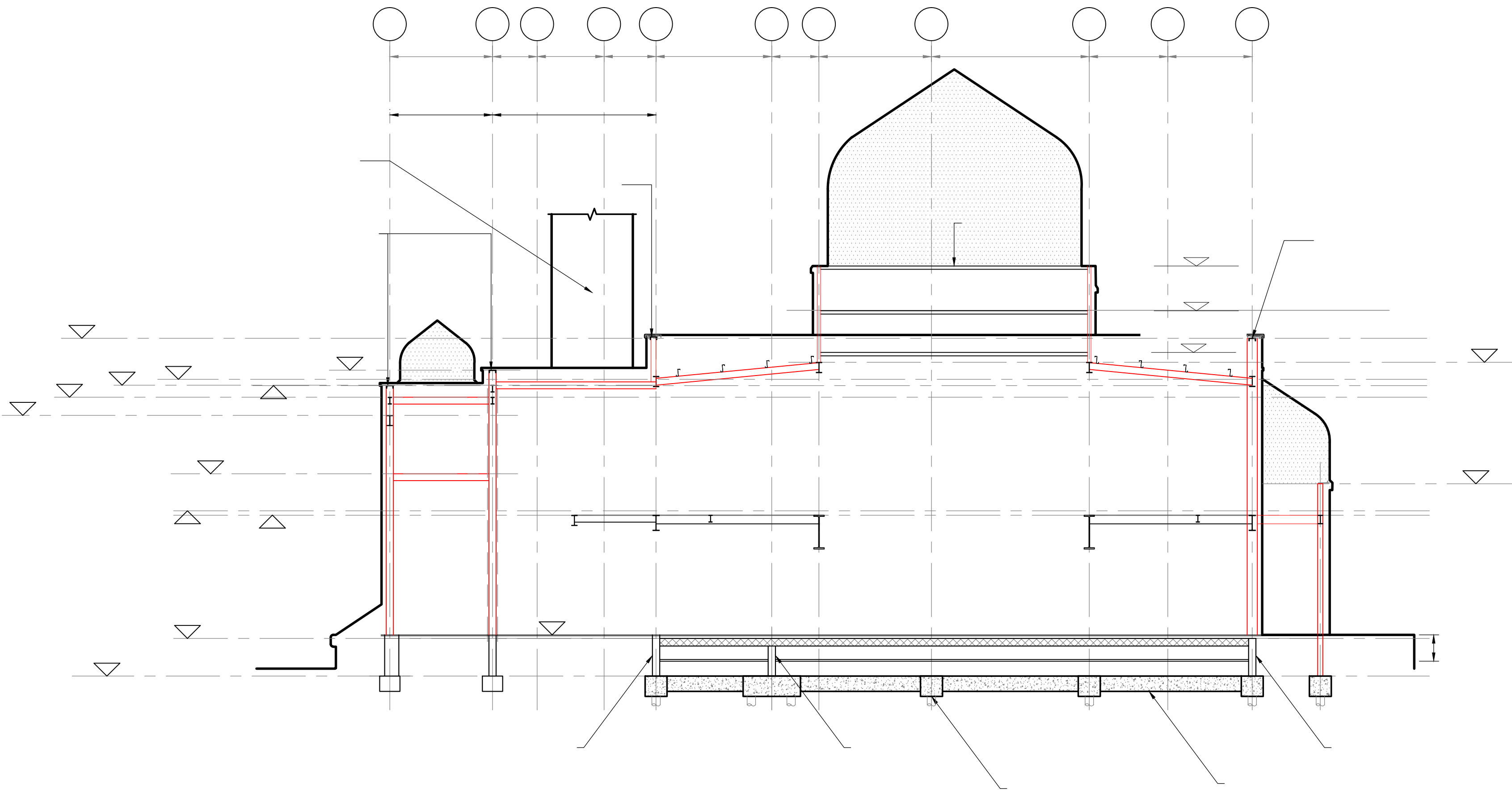
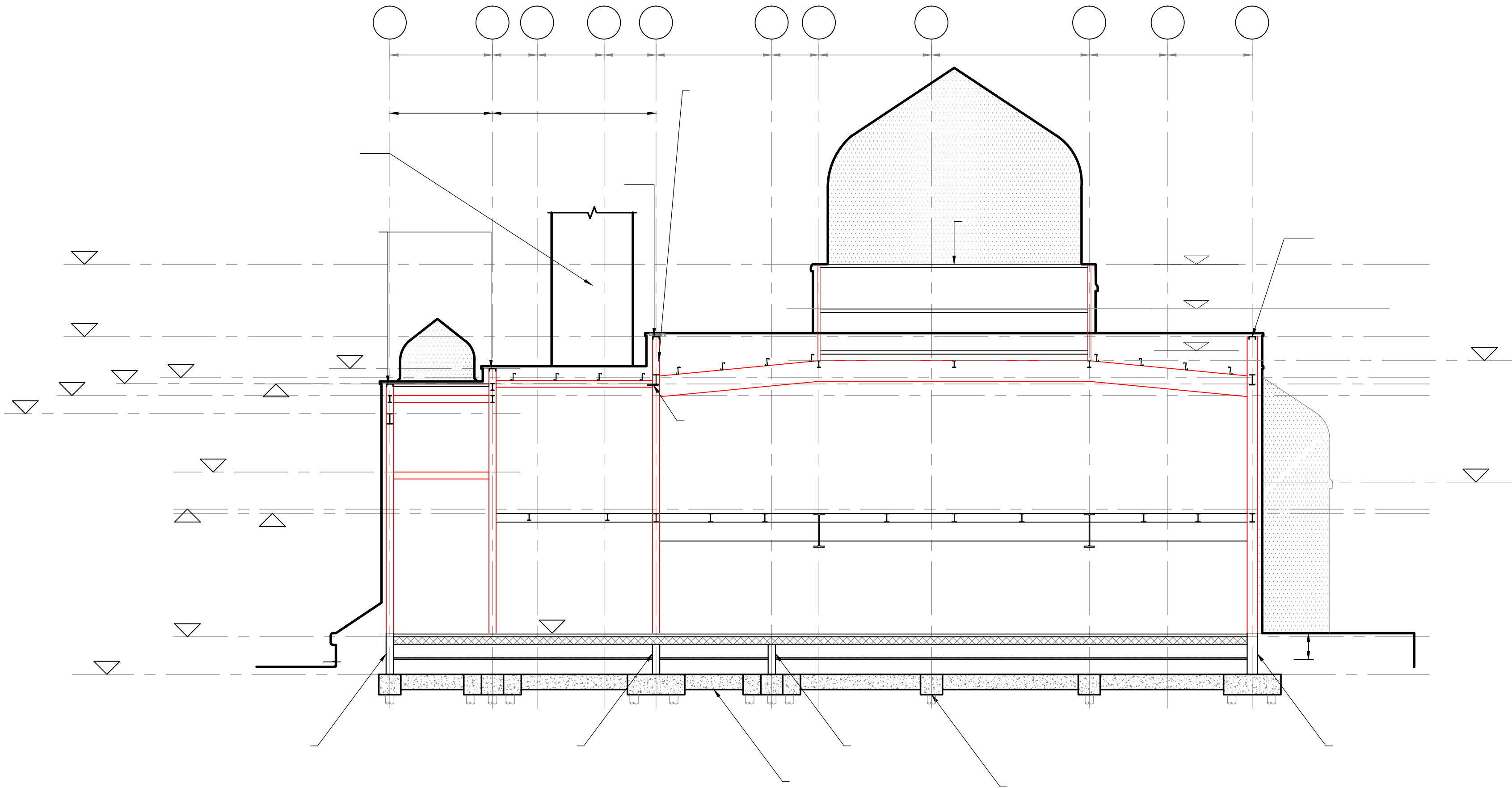
Client:	Makki Mosque		
Project:	Makki Mosque Beresford Road, Longsight		
Title:	Proposed Ground Floor slab		

Drawing Status:	Date Created:	Drawing Scale:
Tender	June '09	1:100

09 226 / A1 / 013	T1
--------------------------	-----------

Project Leader:	Drawn By:	Initial Review:
LS	SPH	LS

notes :



Typical Beam & Block Floor Detail



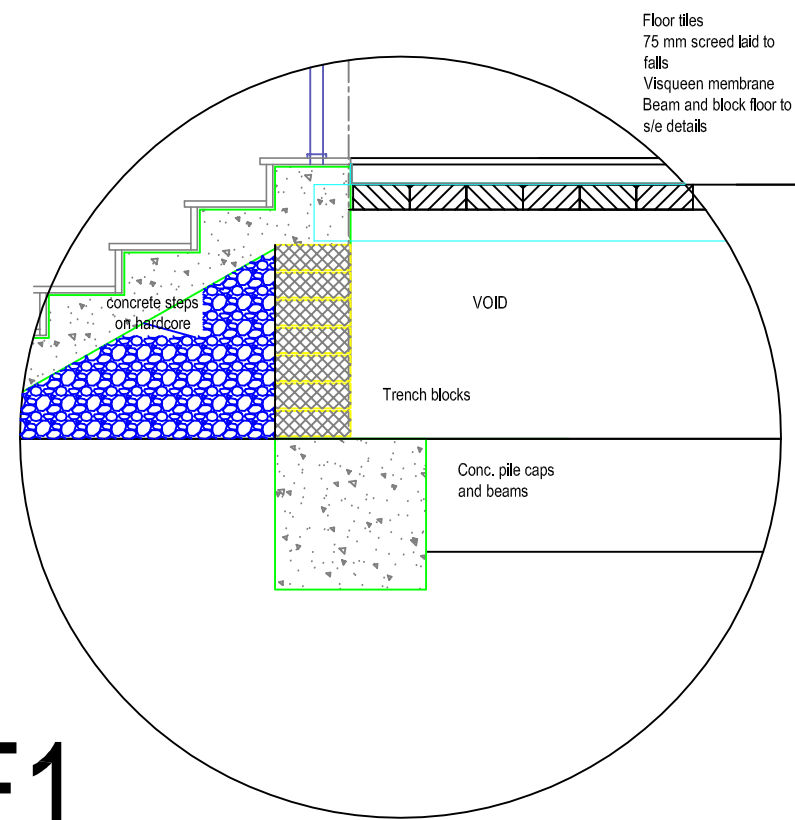
Makki Mosque

Makki Mosque
Beresford Road, Longsight

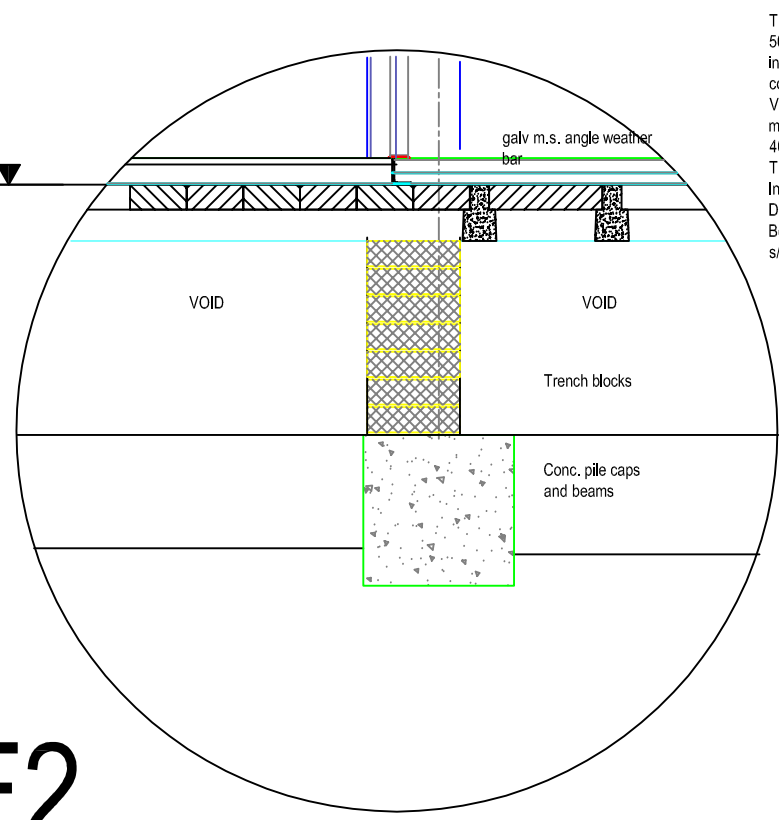
Proposed Steelwork
Sections A-A & B-B

Construction	June '09	As Shown
09 226 / A1 / 007		C4
LS	SPH	LS

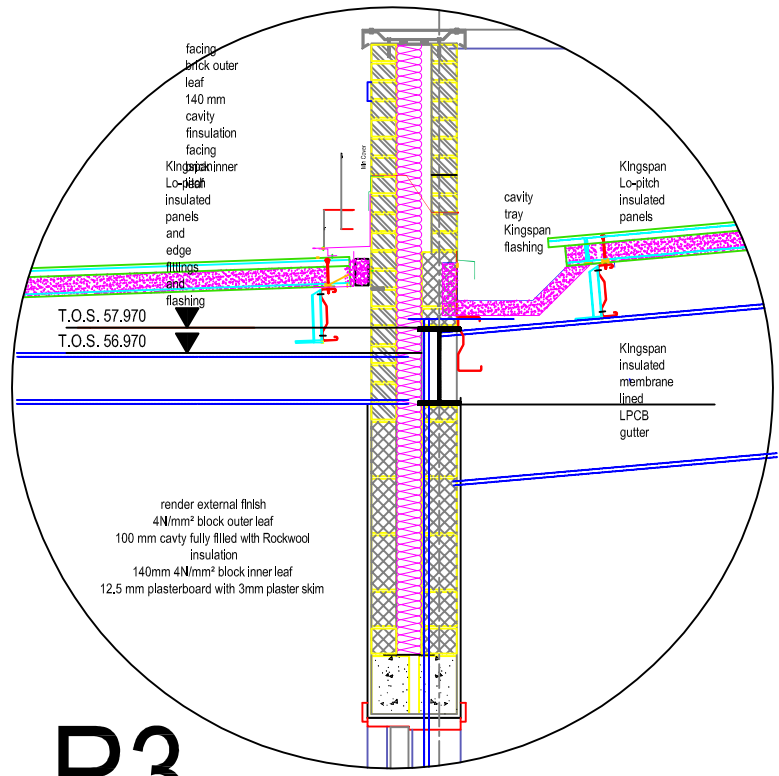
F1



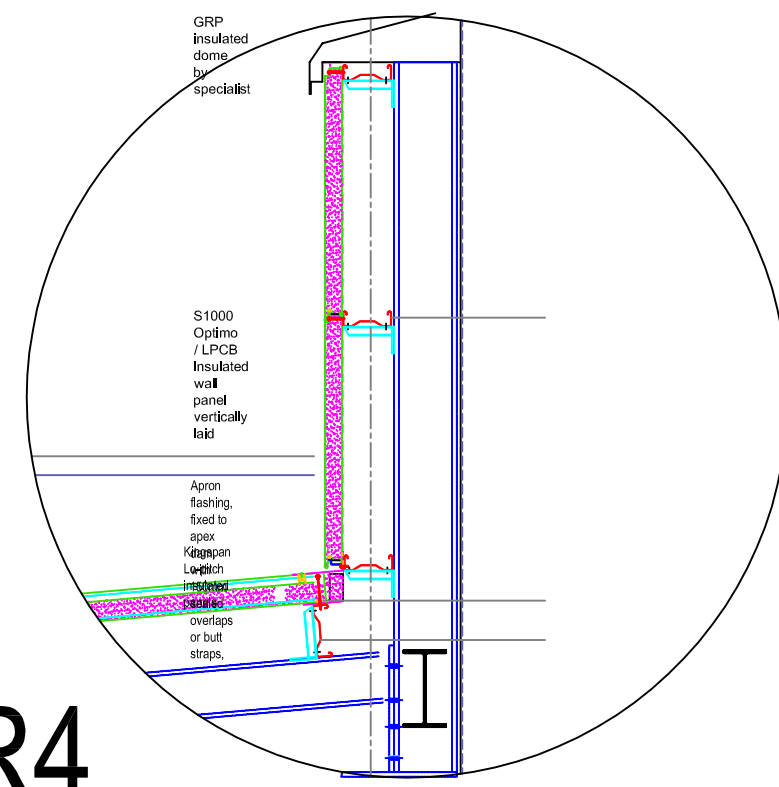
F2



R3



R4



PROPOSED

Dimensions to suit overall existing dimensions
Applicant to confirm boundary.
Drawings to be read in conjunction.
This drawing is for the purpose of obtaining Local Authority approvals only and may not contain a full specification of the works.
Do not scale off this drawing.
All dimensions to be checked on site prior to commencing works.

Applicant should be aware that The Party Wall Act may apply where building work is on or near the boundary.



N.GEDAL
BA Hons Dip ARCH RIBA

ARCHITECT

REV A 9/11/16

CLIENT
Makki Masjid
125 Beresford Road
Longsight
Manchester
M13 0TA

Architects
N.Gedal
4 Rutters Lane
Hazel Grove
Stockport
SK7 5AY
Tel: 0161-419 - 9757
najibgedalarchitects@hotmail.com

DRAWING TITLE

Proposed Details

DRAWING NO - 12

SCALE DATE
01.06.15

APPENDIX B

Client Supplied Information



From: [Aman Sheikh](#)
To: [Callum Brown](#); [Joleen Byers](#)
Subject: Fw: CGN/05003A - Makki Mosque
Date: 17 April 2024 18:03:58
Attachments: [image002.png](#)
[image004.png](#)
[image005.png](#)
[image006.png](#)
[image007.png](#)
[image002.png](#)
[image004.png](#)
[image005.png](#)
[image006.png](#)
[image007.png](#)
[image006.png](#)
[image007.png](#)

CAUTION: EXTERNAL EMAIL

Hi both

Pls see below.

Kind regards

Aman

[Sent from Yahoo Mail for iPhone](#)

Begin forwarded message:

On Wednesday, April 17, 2024, 5:36 PM, lee coverley <lee.coverley@ccs-consulting.co.uk> wrote:

Aman

I believe the block walls were formed as 440 wide standard blocks (100mm thick) laid flat.

Therefore the elevation on the pics is 440 horizontally, 100mm vertically. Gaps are therefore nominal 100mm high x 75 wide wide at 1320mm horizontal centres throughout

Upcoming Annual Leave: 18 – 23 April (inc)

Lee Coverley



ISO
9001 : 2015
REGISTERED

Certificate No:351532020



ISO
14001 : 2015
REGISTERED

Certificate No:351542020



SSIP



From:
Sent:
To:
Cc:
Subject:

From:
To:
Cc:
Sent:
Subject:

Callum Brown
Engineer



We are thrilled to share our fresh, updated logo and brand-new website as part of the Infrastructure Division at Phenna Group!

Our look may have changed but we continue to deliver value engineered solutions for our clients. Visit our new website here:

From:
Sent:
To:
Cc:
Subject:



From: _____

To: _____

Sent:

Subject:

Upcoming Annual Leave: 18 – 23 April (inc)

Lee Coverley



Certificate No:351532020



Certificate No:351542020



SSIP



From: _____
Sent: _____
To: _____
Subject: _____

From: _____
To: _____
Cc: _____
Sent: _____

Subject:

Callum Brown
Engineer





We are thrilled to share our fresh, updated logo and brand-new website as part of the Infrastructure Division at Phenna Group!



Our look may have changed but we continue to deliver value engineered solutions for our clients. Visit our new website here:

[_____](#)

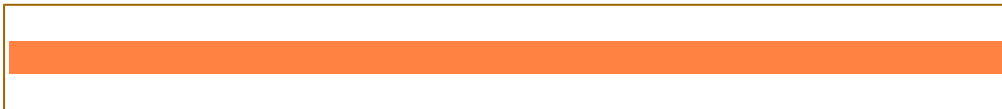
From: _____

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Subject:



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Subject:

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Callum Brown
Engineer



We are thrilled to share our fresh, updated logo and brand-new website as part of the Infrastructure Division at Phenna Group!

Our look may have changed but we continue to deliver value engineered solutions for our clients. Visit our new website here:

From: [Al Samarraie](#)
To: [Callum Brown](#); aman_sheikh@yahoo.co.uk
Cc: [Marina Kirkpatrick](#)
Subject: RE: CGN/05003A - Makki Mosque
Date: 14 June 2024 14:33:34
Attachments: [image001.png](#)
[image003.png](#)
[image004.png](#)

CAUTION: EXTERNAL EMAIL

From: Callum Brown <CallumB@CGL-UK.com>
Sent: Friday, June 14, 2024 10:12 AM
To: aman_sheikh@yahoo.co.uk
Cc: Marina Kirkpatrick <MarinaK@cgl-uk.com>; A Al-Samarraie <alsam@archi-structure.co.uk>
Subject: CGN/05003A - Makki Mosque

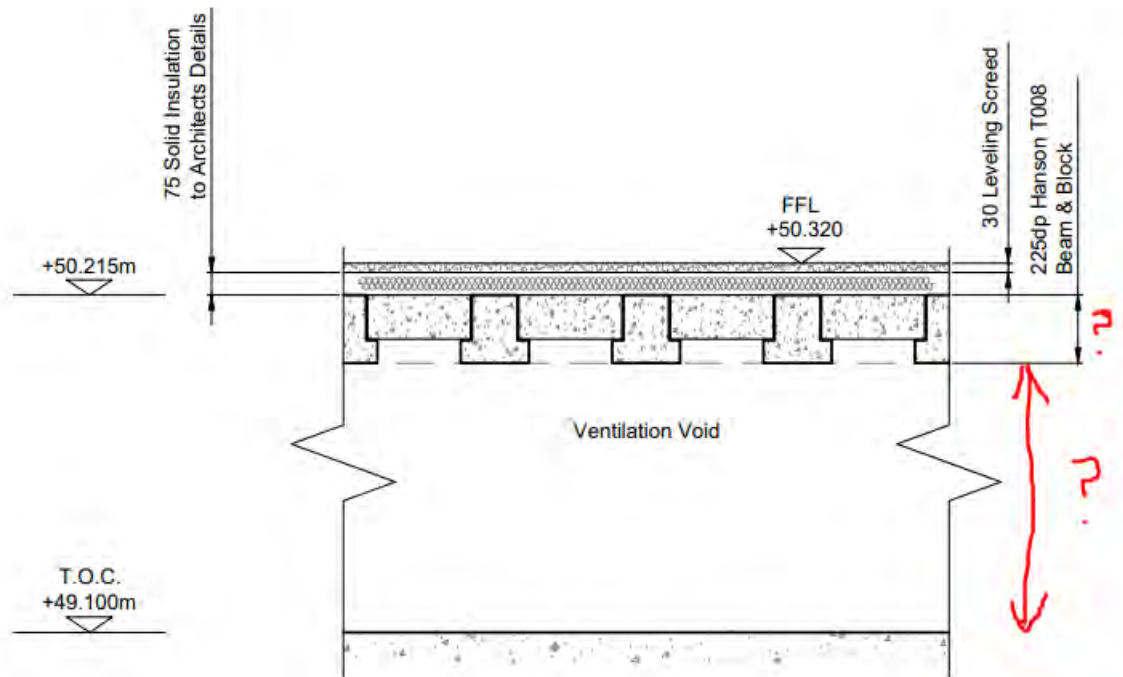
Hi Aman,

I'm busy progressing the ventilation calculations for the site but have another quite specific question which would help me a lot - perhaps a question for CCS consulting again?

I need to know the depth of the ventilation void, highlighted below with the arrow from Drawing C4. Most of the drawings only mark the TOP of the beam and block floor at 50.215m.

If I had the thickness of the beam and block floor, the level to the bottom of the beam and block floor, or the void height itself the problem would be solved.

I note on the attached drawing G12 a level of 49.995m, just below the top of the beam and block flooring at 50.215m – could this be the level of the base?



Typical Beam & Block Floor Detail

Scale 1:20

Callum Brown

Engineer

01423 276000 | 07376344077 |

CallumB@CGL-UK.com | www.cgl-uk.com



We are thrilled to share our fresh, updated logo and brand-new website as part of the Infrastructure Division at Phenna Group!

Our look may have changed but we continue to deliver value engineered solutions for our clients. Visit our new website here:

<https://cgl-uk.com/>



APPENDIX C

CGL Site Visit Record

Site visit record sheet

Site name: Makki Mosque	Job number: CGN/05003A
Date: 04/06/24	Visit by: CJB
Gas characteristic situation: Undefined - Preliminary CS1 / CS2	Weather: Overcast
Units / plots checked: Makki Masjid Mosque	Type of development: Other - Place of Worship
Foundation type: Beam and Block	Gas protection type: passive

Ref	Item	Status	Comments
1. Gas Membrane			
1.1	Condition of sub-grade and underside of membrane	None present	Informed by client No Gas Membrane, DPM consisting of: Visqueen 500 separating membrane (Does not provide Gas Protection) DPM Visqueen 1200 (Does not provide Gas Protection)
1.2	Gas membrane type		
1.3	Gas membrane condition		
1.4	Jointing tape product		
1.5	Lapping design		
1.6	Laps, welds and joint seals		
1.7	Service entries seals		
2. Passive venting			
2.1	Sub-floor void	Not inspected by CGL	Informed by Client with drawings and images peri-construction Vertical Depth: 1.115m No internal fill - clear CCS Consulting inform installation details and image
2.2	External wall airbricks	Pass	40 total around building exterior 16/40 partially blocked by temporary obstruction i.e light foliage/weeds or loose construction materials 23/40 in excellent condition 1/40 in good condition (plastic vent cover cracked or snapped in one 10mm x 10mm area) Equivalent area of each - 6170mm2 (noted on vents) Spacing ranges between 660 - 1800mm (centres) External airbricks not visible on construction drawings provided. All external wall air bricks vent both leaves of sub floor - informed by CCS consulting and confirmed on inspection using a torch.
2.3	Internal sleeper walls	Not inspected by CGL	Brickwork gaps nominal 100mm high x 75mm wide at 1320mm horizontal centres - Not visible on design drawings provided - No airbricks - full gap equivalent area 7500mm2
2.4	External vent renches/ducts	N/A	
3. Active venting			
3.1	System details	N/A	

The gas protection measures inspected:		Are acceptable and comply with the specification
		Are acceptable but attention is drawn to issues related to item no. xxx
		Are not acceptable due to the issues related to item no. xxx

Name	Callum Brown, Engineer Mgeol Bsc (Hons)	Signature		04/06/2024
------	--	-----------	---	------------

Notes: Inspection checklist

1.1	Underside of gas membrane	Check that the subgrade does not contain rough/uneven surfaces, is appropriately clean and that there are no hard or sharp objects. That protective sand blinding or geotextile (if specified) is present and meets the design criteria.
1.2	Gas membrane type	Record the membrane specification and manufacturer, gauge, colour, brand/name, material batch/roll numbers, storage arrangements (protected from dirt/damage?)
1.3	Gas membrane condition	Open punctures, tears, rips or stretching? Excessive footprints or evidence of traffic? Presence of debris? Repairs? Signs of weakness such as raised or sunken indentations? Protection plan in place to restrict access to lain gas membrane? Note if the membrane installation is complete.
1.4	Joining tape product	Product type, brand, colour, material, thickness, width? Use of double sided tape?
1.5	Lapping design	Joints lapped and sealed in accordance with manufacturer's requirements/specification? Minimum over lap insured? Sections taped twice? Check overlap with DCP is at least 150mm. Confirm the type of DCP used (manufacturer, specification).
1.6	Laps and joints sealed	Welds complete? Appropriate koining/double sided tape used?
1.7	Service entries sealed	Top hats seal arrangements fixed around service entries? Use of Jubilee clips? Other proprietary units?
2.1	Sub-floor void	Is a check possible? Void former (type)? Gravel (type/specification)? Height of void space? Is it clear?
2.2	External wall airbricks	Numbers, size, positions as design wall? Consistent with construction drawings? Check for blockage and damage of air bricks.
2.3	Internal sleeper walls	Ventilation holes (honeycomb brickwork/pipework crossing?) - size, spacing, location in accordance with design? Airbricks?
2.4	External vent trenches/ducts	Located and constructed in accordance with design drawings? If open-topped gravel - gravel type/presence of fines? If pipe or other vent, check position and construction functionality and absence of blockages. Ability of void former to withstand bearing of the super structure.
3.1	Active venting	Type of air supply: mechanical, natural, combined? Location/condition/number of fans and vents? Location and size of inlets? Provision of air-cleaning devices and air heaters? Supply and exhaust ducwork? Alarm provision/installation? Gas monitoring system in underfloor void?

APPENDIX D

CGL Photosheets

PHOTO SHEET



1. Front entrance to the mosque on the NW side, looking SE. Vents 1, 2, 3 visible at least 5 bricks from the ground (350mm).



2. External airbrick 4.



3. External airbricks 5 and 6, at 400mm height from ground level.



4. Closeup of external airbrick 5 partially obstructed.



5. External airbrick 7 and 8.



6. External airbricks 9 and 10.

Makki Masjid  GEOTECHNICAL & GEOENVIRONMENTAL CONSULTANCY A PHENNA GROUP COMPANY	Title	Makki Mosque, Manchester Appendix D – CGL Photosheet	CGN/05003A Appendix Drafted by: CJB Checked by: KJN Approved by: JoS
---	------------------------------	--	---



7. External airbricks 11 and 12.



8. External airbricks 13, 14, and 15.



9. Close-up of external airbrick showing stated equivalent area - 6170mm2.



10. External airbricks 16 and 17.



11. External airbricks 18, 19, and 20.



12. Airbricks 21 and 22 partially blocked by wooden pallet.

Makki Masjid	Makki Mosque, Manchester	CGN/05003A	
	Title Appendix D – CGL Photosheet	Appendix	
		Drafted by:	CJB
		Checked by:	KJN
		Approved by:	JoS



13. Closeup of airbrick 22.



14. Airbricks 23, 24, and 25 obscured by foliage.



15. Airbrick 26 obstructed by wooden door.



16. Airbricks 28 and 29.



17. Airbricks 30, 31, and 32.



18. Example section of the rear of the building, no visible external airbricks.

Makki Masjid	Makki Mosque, Manchester		CGN/05003A	
 GEOTECHNICAL & GEOENVIRONMENTAL CONSULTANCY A PHENNA GROUP COMPANY	Title	Appendix D – CGL Photosheet		Appendix
				Drafted by: CJB
				Checked by: KJN
				Approved by: JoS



19. External airbricks 33 - 40 left to right.

Makki Masjid	Makki Mosque, Manchester	CGN/05003A
	Title	Appendix
		Drafted by: CJB
		Checked by: KJN
		Approved by: JoS

APPENDIX E

DQRA Calculation Sheets

Client Makki Masjid

Job Title Makki Mosque

Drawing Ref No. Rev 0

Job No. CGN/05003A

Date 14/06/2024

Quality Plan

Made by CJB

Checked by KN

SHEET No.

1

Appendix E.1. Ground gas DQRA calculations – Study 1A – Void 1, Realistic Conditions

This study area has been chosen as it is a void section on the side of the building adjacent to the infilled pond/buried organic material. This void possesses ventilation on two opposing walls. The ventilation noted was 3 ventilation bricks in the exterior wall which bridge both wall skins, and with the interior beam and block walls having ventilation gaps at 1.32m horizontal centres, it is calculated that there are three ventilation gaps in the opposing beam and block wall.

1.1 Calculation of Inflow of air required to dilute ground gas emissions.

Using the worst case combined recorded methane concentration and realistic flow, from WS04 within the Peat Deposits, the inflow of gas into the underfloor space can be calculated.

Max Methane: 5.9% v/v Max Steady state Flow: 0.1 l/hr

Methane Gas Screening Value =0.0059 l/hr

Based on the Pecksen equation, assuming that gas emission from a borehole is distributed over a surrounding surface area of 10m², the surface emission rate is: 1.64x10⁻¹⁰ m³/s/m²

BS 5925 indicates that the required inflow of fresh air to dilute gas to a set equilibrium concentration, Q_a, is:

$$Q_a = q \{ (100 - C_E) / C_E \}$$

q= inflow rate of contaminant, C_E=equilibrium concentration (Required design concentration is 0.25%v/v for methane in the void (Based on recommendations in the Ground Gas Handbook, Section 8.6.1 page 159).

$$q \text{ (m}^3\text{/s)} = \text{void length (m)} \times \text{void width (m)} \times \text{surface emission rate (m}^3\text{/s/m}^2\text{)}$$

W O R K S H E E T



Client	Makki Masjid
Job Title	Makki Mosque
Drawing Ref No.	Rev 0
Job No.	CGN/05003A
Date	14/06/2024
Quality Plan	
Made by	CJB
Checked by	KN

SHEET No. 2

Assuming the dimensions for sub-floor void 1 requiring assessment= 3.04m x 5.10m

Total surface emission rate of CH₄ into void, $q = 3.04 \times 5.10 \times 1.64 \times 10^{-10} = 2.54 \times 10^{-9} \text{ m}^3/\text{s}$

$Q_a = 2.54 \times 10^{-9} \{ (100 - 0.25) / 0.25 \} = 1.01 \times 10^{-6} \text{ m}^3/\text{s}$ (Air flow required to dilute methane emissions to 0.25%)

1.2 Calculation of ventilation required through sub-floor void.

It has been assumed that the sub-floor voids beneath the beam and block flooring are not infilled, as confirmed by the client and indicated with a peri-construction image.

The area of ventilation required in order to reduce the concentration of methane in the void to 0.25% or lower for the void-section in this study can be derived using the following formula for natural ventilation of a space with opening on two opposing walls (From BS5925:1991 Page 22, Table 11, a):

Area of Ventilation Required for Whole Section, $A_w (\text{mm}^2) = (Q_a / (C_d U_r (V \Delta C_p) \times 10^6)$

At Reference Wind Speed, $U_{r=} = U_m K z^a$

Where:

$U_m = U_{50} \times \text{correction factor}$, the free wind speed (m/s) in the selected environment exceeded for the given proportion of time.

W O R K S H E E T

Client Makki Masjid

Job Title Makki Mosque

Drawing Ref No. Rev 0

Job No. CGN/05003A

Date 14/06/2024

Quality Plan

Made by CJB

Checked by KN

SHEET No.

3

U_{50} = Hourly mean wind speed (m/s) exceeded for 50% of the time = 4.25m/s

Correction factor = 0.83

$U_m = 4.25 \times 0.83 = 3.53\text{m/s}$

$K = 0.35$, constant determined by terrain type

$a = 0.25$, constant determined by terrain type

$z = 350$, height of vent (mm)

$U_r = 3.53 \times 0.35 \times 350^{0.25} = 0.95\text{m/s}$

$C_d = 0.61$, discharge coefficient of opening

Area of Ventilation Required for Whole Section to reduce methane concentration to 0.25% or lower:

$A_w = (1.01 \times 10^{-6} / (0.95 \times 0.61 \times (\sqrt{\Delta 0.4})) \times 10^6 = \underline{2.76\text{mm}^2}$

For the length of the building in the face of the flow path, the equivalent area of specific openings per m run = $2.76\text{mm}^2 / 5.1 = \underline{0.54\text{mm}^2/\text{m}}$

This is less than the minimum venting area required in the Building Regulations of $1500\text{mm}^2/\text{m}$, as such this value of $1500\text{mm}^2/\text{m}$ should be required.

Client Makki Masjid

Job Title Makki Mosque

Drawing Ref No. Rev 0

Job No. CGN/05003A

Date 14/06/2024

Quality Plan

Made by CJB

Checked by KN

SHEET No.

4

1.4 Equilibrium Calculations

Existing equivalent area of specific openings = 6170mm²

Geometric open area of internal wall ventilation openings = 7500mm².

7500 x 0.61 (C_d) = 4575mm², therefore the internal ventilation gaps are the limiting factor with an equal number of external airbricks and internal wall vent gaps, so **4575mm²** per opening should be used rather than 6170mm².

Over a 5.1 m run of wall, A_w = 4575 x 3 / 5.1 = 2691mm²/m

Volume flow rate of air:

$$Q = C_d A_w U_r C_p^{1/2}$$

$$Q = 0.61 \times 2691 \times 0.95 \times 0.4^{1/2} = 9.86 \times 10^{-4} \text{ m}^3/\text{s/m}$$

Contaminant Concentration:

$$C_E = q / (Q + q)$$

Inflow of gas into void (CH₄) = Surface emission rate x longest pathway

$$q (\text{CH}_4) = 1.64 \times 10^{-10} \times 3.04 = 4.98 \times 10^{-10} \text{ m}^3/\text{s/m}$$

$C_E = 4.98 \times 10^{-10} / (9.86 \times 10^{-4} + 4.98 \times 10^{-10}) = 5.05 \times 10^{-7} = 0.000051\%$ **Therefore, under realistic conditions the maximum equilibrium concentration of CH₄ is 0.000051%. This is significantly below the lower explosive limit (5%) and significantly below the design value of 0.25%.**

W O R K S H E E T



Client	Makki Masjid		
Job Title	Makki Mosque		
Drawing Ref No.	Rev 0	Job No.	CGN/05003A
Date	14/06/2024	Quality Plan	
Made by	CJB	Checked by	KN

SHEET No. 5

1.4 Check on adequacy of ventilation in still air

Time to fill void to dangerous levels of methane (1% volume of air – 20% of Lower Explosive Limit), T
= height of open void x 1% / surface emission rate

$$T = 0.89 \times 0.01 / 1.64 \times 10^{-10}$$

$$T = 5.43 \times 10^7 \text{ s}$$

$$= 150844.75 \text{ hrs}$$

This is $\gg 10 \text{ hrs}^1$, therefore venting is adequate.

Client Makki Masjid

Job Title Makki Mosque

Drawing Ref No. Rev 0

Job No. CGN/05003A

Date 14/06/2024

Quality Plan

Made by CJB

Checked by KN

SHEET No.

1

Appendix E.2. Ground gas DQRA calculations – Study 1B – Void 1, Worst Case Conditions

This void space (Figure 4) has been chosen as it is a void section on the side of the building adjacent to the infilled pond/buried organic material. This void possesses ventilation on two opposing walls. The ventilation noted was 3 ventilation bricks in the exterior wall which bridge both wall skins, and with the interior beam and block walls having ventilation gaps at 1.32m horizontal centres it is calculated that there are three ventilation gaps in the opposing sub-structure wall.

This further study of Study Area 1 is intended as a sense check of the mosque ventilation and will use the initial flow from the sealed borehole (WS04) which was not considered to be representative of actual maximum flow rate within the previous CGL report (Jan 2024) in order to further assess the risk of methane buildup in the sub-floor void.

1.1 Calculation of Inflow of air required to dilute ground gas emissions.

Using the worst case combined recorded methane concentration and worst case, pressurised (by rising ground water) flow from WS04 within the Peat Deposits, the inflow of gas into the underfloor space can be calculated.

Max Methane: 5.9% v/v Max. Peak Flow: 27.3 L/hr

Methane Gas Screening Value = 1.6107L/hr

Based on Pecksen approach, assuming that gas emission from a borehole is distributed over a surrounding surface area of 10m², the surface emission rate is: 4.47x10⁻⁸ m³/s/m²

BS 5925 indicates that the required inflow of fresh air to dilute gas to a set equilibrium concentration, Q_a, is:

$$Q_a = q \{ (100 - C_E) / C_E \}$$

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Client Makki Masjid

Job Title Makki Mosque

Drawing Ref No. Rev 0

Job No. CGN/05003A

Date 14/06/2024

Quality Plan

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SHEET No. 2

q = inflow rate of contaminant, C_e = equilibrium concentration (Required design concentration is 0.25% v/v for methane in the void (Based on recommendations in the Ground Gas Handbook, Section 8.6.1 page 159).

q (m^3/s) = void length (m) x void width (m) x surface emission rate ($m^3/s/m^2$)

Assuming the dimensions for the sub-floor void requiring protection* = 3.04m x 5.1m

Total surface emission rate of CH_4 into void, $q = 3.04 \times 5.1 \times 4.47 \times 10^{-8} = 6.94 \times 10^{-7} m^3/s$

$Q_a = 6.94 \times 10^{-7} \{ (100 - 0.25) / 0.25 \} = 2.77 \times 10^{-4} m^3/s$ (Air flow required to dilute methane emissions to 0.25%)

1.2 Calculation of ventilation required through sub-floor void.

It has been assumed that the sub-floor voids beneath the beam and block flooring are not infilled, as confirmed by the client and indicated with a peri-construction image.

The area of ventilation required in order to reduce the concentration of methane in the void to 0.25% or lower for the void-section in this study can be derived using the following formula for natural ventilation of a space with opening on two opposing walls (From BS5925:1991 Page 22, Table 11, a):

Area of Ventilation Required for Whole Section, A_w (mm^2) = $(Q_a / (C_d U_r (\Delta C_p) \times 10^6)$

At Reference Wind Speed, $U_{r-} = U_m K z^a$

Where:

U_m = U_{50} x correction factor, the free wind speed (m/s) in the selected environment exceeded for the given proportion of time.

U_{50} = Hourly mean wind speed (m/s) exceeded for 50% of the time = 4.25m/s

Correction factor = 0.83

W O R K S H E E T

Client Makki Masjid

Job Title Makki Mosque

Drawing Ref No. Rev 0

Job No. CGN/05003A

Date 14/06/2024

Quality Plan

Made by CJB

Checked by KN

SHEET No.

3

$$U_m = 4.25 \times 0.83 = 3.53 \text{ m/s}$$

$K = 0.35$, constant determined by terrain type

$a = 0.25$, constant determined by terrain type

$z = 350$, height of vent (mm)

$$U_r = 3.53 \times 0.35 \times 3.50^{0.25} = 0.95 \text{ m/s}$$

$C_d = 0.61$, discharge coefficient of opening

Area of Ventilation Required for Whole Section to reduce methane concentration to 0.25% or lower:

$$A_w = (2.77 \times 10^{-4} / (0.95 \times 0.61 \times (\sqrt{\Delta 0.4})) \times 10^6 = \underline{755.47 \text{ mm}^2}$$

For the length of the building in the face of the flow path (5.1m), the equivalent area of specific openings per m run = $755.47 \text{ mm}^2 / 5.1 = \underline{148.1 \text{ mm}^2/\text{m}}$

This is less than the minimum venting area required in the Building Regulations of $1500 \text{ mm}^2/\text{m}$, as such this value of $1500 \text{ mm}^2/\text{m}$ should be required.

1.4 Equilibrium Calculations

Existing equivalent area of specific openings = 6170 mm^2

Geometric open area of internal wall ventilation openings = 7500 mm^2 .

$7500 \times 0.61 (C_d) = 4575 \text{ mm}^2$, therefore the internal ventilation gaps are the limiting factor with an equal number of external airbricks and internal wall vent gaps, so **4575 mm^2** per opening should be used rather than 6170 mm^2 . Over a 5.1 m run of wall, $A_w = 4575 \times 3 / 5.1 = 2691 \text{ mm}^2/\text{m}$

Volume flow rate of air:

$$Q = C_d A_w U_r C_p^{1/2}$$

Client Makki Masjid

Job Title Makki Mosque

Drawing Ref No. Rev 0

Job No. CGN/05003A

Date 14/06/2024

Quality Plan

Made by CJB

Checked by KN

SHEET No.

4

$$Q = 0.61 \times 2691 \times 0.95 \times 0.4^{1/2} = 9.86 \times 10^{-4} \text{ m}^3/\text{s/m}$$

Contaminant Concentration:

$$C_E = q / (Q + q)$$

Inflow of gas into void (CH_4) = Surface emission rate x longest pathway

$$q (\text{CH}_4) = 4.47 \times 10^{-8} \times 3.04 = 1.36 \times 10^{-7} \text{ m}^3/\text{s/m}$$

$$C_E = 1.36 \times 10^{-7} / (9.86 \times 10^{-4} + 1.36 \times 10^{-7}) = 1.38 \times 10^{-4} = 0.0138\%$$

Therefore, under hypothetical worst case flow conditions the maximum equilibrium concentration of CH_4 is 0.0138%. This is significantly below the lower explosive limit (5%) and below the design value of 0.25%.

1.4 Check on poor wind conditions

As a further sense check, if it is assumed that the ratio of mean wind speed for 80% of the time to the 50% mean wind speed is 0.46 rather than 0.83, the equilibrium concentrations under the worst wind flow directions can be assessed.

$$U_m = 4.25 \times 0.46 = 1.96 \text{ m/s}$$

$$U_r = 1.96 \times 0.35 \times 3.50^{0.25} = 0.53 \text{ m/s}$$

$$Q = 0.61 \times 2691 \times 0.53 \times 0.4^{1/2} = 5.46 \times 10^{-4} \text{ m}^3/\text{s/m}$$

$$C_E = 1.36 \times 10^{-7} / (5.46 \times 10^{-4} + 1.36 \times 10^{-7}) = 2.49 \times 10^{-4} = 0.0249\%$$

A contaminant concentration of 0.0249% is still significantly below the design value of 0.25% even under the poor wind flow conditions.

W O R K S H E E T



Client	Makki Masjid		
Job Title	Makki Mosque		
Drawing Ref No.	Rev 0	Job No.	CGN/05003A
Date	14/06/2024	Quality Plan	
Made by	CJB	Checked by	KN

SHEET No. 5

1.5 Check on adequacy of ventilation in still air

Time to fill void to dangerous levels of methane (1% volume of air – 20% of Lower Explosive Limit), T
= height of open void x 1% / surface emission rate

$$T = 0.89 \times 0.01 / 4.47 \times 10^{-8}$$

$$T = 1.99 \times 10^{-5} \text{s}$$

$$= 55.26 \text{hrs}$$

This is $\gg 10 \text{ hrs}^1$, therefore venting is adequate.

Client Makki Masjid

Job Title Makki Mosque

Drawing Ref No. Rev 0

Job No. CGN/05003A

Date 14/06/2024

Quality Plan

Made by CJB

Checked by KN

SHEET No.

1

Appendix E.3. Ground gas DQRA calculations – Study 2A –Void 2, Realistic Conditions

This study area has been chosen as it is a void section adjacent to the infilled pond/buried organic material and provides a contrast to studies 1A and 1B. For the purposes of a sensitivity check, this study will assume that this void only possesses ventilation on the external wall. This limits air-flow through the void and provides an assessment ventilation under poor circumstances.

1.1 Calculation of Inflow of air required to dilute ground gas emissions.

Using the worst case combined recorded methane concentration and realistic flow, from WS04 within the Peat Deposits, the inflow of gas into the underfloor space can be calculated.

Max Methane: 5.9% v/v

Max Flow: 0.1 l/hr

Methane Gas Screening Value =0.0059 l/hr

Based on Pecksen approach, assuming that gas emission from a borehole is distributed over a surrounding surface area of 10m², the surface emission rate is: 1.64x10⁻¹⁰ m³/s/m²

BS 5925 indicates that the required inflow of fresh air to dilute gas to a set equilibrium concentration, Q_a, is:

$$Q_a = q \{ (100 - C_E) / C_E \}$$

q= inflow rate of contaminant, C_E=equilibrium concentration (Required design concentration is 0.25%v/v for methane in the void (Based on recommendations in the Ground Gas Handbook, Section 8.6.1 page 159).

$$q \text{ (m}^3\text{/s)} = \text{void length (m)} \times \text{void width (m)} \times \text{surface emission rate (m}^3\text{/s/m}^2\text{)}$$

W O R K S H E E T



Client Makki Masjid

Job Title Makki Mosque

Drawing Ref No. Rev 0

Job No. CGN/05003A

Date 14/06/2024

Quality Plan

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SHEET No. 2

Assuming the dimensions for the smallest mosque sub-floor void requiring protection*= 4.18m x 4.187m

Total surface emission rate of CH₄ into void, $q = 4.18 \times 4.187 \times 1.64 \times 10^{-10} = 2.87 \times 10^{-9} \text{ m}^3/\text{s}$

$Q_a = 2.87 \times 10^{-9} \{ (100 - 0.25) / 0.25 \} = 1.14 \times 10^{-6} \text{ m}^3/\text{s}$ (Air flow required to dilute methane emissions to 0.25%)

1.2 Calculation of ventilation required through sub-floor void.

It has been assumed that the sub-floor voids beneath the beam and block flooring are not infilled, as confirmed by the client and indicated with a peri-construction image.

The area of ventilation required in order to reduce the concentration of methane in the void to 0.25% or lower for the void-section in this study can be derived using the following formula for natural ventilation of a space with opening on one wall only (From BS5925:1991 Page 24, Table 12, a):

Area of Ventilation Required for Whole Section, $A_w (\text{mm}^2) = (40Q_a / (C_d U_r)) \times 10^6$

At Reference Wind Speed, $U_r = U_m K z^a$

Where:

$U_m = U_{50} \times \text{correction factor}$, the free wind speed (m/s) in the selected environment exceeded for the given proportion of time.

U_{50} = Hourly mean wind speed (m/s) exceeded for 50% of the time = 4.25m/s

Correction factor = 0.83

$U_m = 4.25 \times 0.83 = 3.53 \text{ m/s}$

$K = 0.35$, constant determined by terrain type

$a = 0.25$, constant determined by terrain type

Client Makki Masjid

Job Title Makki Mosque

Drawing Ref No. Rev 0

Job No. CGN/05003A

Date 14/06/2024

Quality Plan

Made by CJB

Checked by KN

SHEET No.

3

 $z = 400$, height of vent (mm)

$$U_r = 3.53 \times 0.35 \times 400^{0.25} = 0.98 \text{ m/s}$$

 $C_d = 0.61$, discharge coefficient of opening

Area of Ventilation Required for Whole Section to reduce methane concentration to 0.25% or lower:

$$A_w = (40 \times 1.14 \times 10^{-6} / 3.53 \times 0.61) \times 10^6 = 76.43 \text{ mm}^2$$

For the length of the building in the face of the flow path the equivalent area of specific openings per m run = $76.43 \text{ mm}^2 / 4.187 = 18.25 \text{ mm}^2/\text{m}$

This is less than the minimum venting area required in the Building Regulations of $1500 \text{ mm}^2/\text{m}$, as such this value of $1500 \text{ mm}^2/\text{m}$ should be required.

1.4 Equilibrium Calculations

Existing equivalent area of specific openings = 6170 mm^2

$$A_w \text{ for the } 4.187 \text{ m length of windward facing wall (2 openings)} = (6170 \times 2 / 4.187) = 2947 \text{ mm}^2/\text{m}$$

Volume flow rate of air:

$Q = 0.025 A_w C_d U_r$ ($C_d = 1$, as airbricks are marked with 'equivalent area' for ventilation openings as per BS EN 13141-1 : 2004. Equivalent area marking on the external airbricks already consider the coefficient of flow for a sharp-edged orifice and so a value of 1 is used here.)

$$Q = 0.0025 \times 2947 \times 1 \times 0.98 = 4.41 \times 10^{-5} \text{ m}^3/\text{s/m}$$

Contaminant Concentration:

$$C_E = q / (Q + q)$$

W O R K S H E E T



Client	Makki Masjid		
Job Title	Makki Mosque		
Drawing Ref No.	Rev 0	Job No.	CGN/05003A
Date	14/06/2024	Quality Plan	
Made by	CJB	Checked by	KN

SHEET No. 4

Inflow of gas into void (CH_4) = Surface emission rate x longest pathway

$$q(\text{CH}_4) = 1.64 \times 10^{-10} \times 4.10 = 6.72 \times 10^{-10} \text{ m}^3/\text{s}/\text{m}$$

$$C_E = 6.72 \times 10^{-10} / (4.41 \times 10^{-45} + 6.72 \times 10^{-10}) = 1.52 \times 10^{-5} = 0.00152\%$$

Therefore, under realistic conditions the maximum equilibrium concentration of CH_4 is 0.00152%.

This is significantly below the lower explosive limit (5%) and significantly below the design value of 0.25%.

1.4 Check on adequacy of ventilation in still air

Time to fill void to dangerous levels of methane (1% volume of air – 20% of Lower Explosive Limit), T
= height of open void x 1% / surface emission rate

$$T = 0.89 \times 0.01 / 1.64 \times 10^{-10}$$

$$T = 5.43 \times 10^{-7} \text{ s}$$

$$= 15084.75 \text{ hrs}$$

This is $\gg 10 \text{ hrs}^1$, therefore venting is adequate.

Client Makki Masjid

Job Title Makki Mosque

Drawing Ref No. Rev 0

Job No. CGN/05003A

Date 14/06/2024

Quality Plan

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SHEET No.

1

Appendix E.4. Ground gas DQRA calculations – Study 2B – Void 2, Worst-Case Conditions

This study area has been chosen as it is a void section on the side of the building adjacent to the infilled pond/buried organic material and provides a contrast to void 1A and 1B. For the purposes of a sensitivity check, this study will assume that this void only possesses ventilation on the external wall, limiting airflow and providing a assessment of the passive ventilation under poor circumstances.

This study of Void 2 is intended as a further sense check of the mosque ventilation and will use the initial flow from the sealed borehole (WS04) which was not considered to be representative of actual maximum flow rate within the previous CGL report (Jan 2024) in order to further assess the risk of methane buildup in the sub-floor void.

1.1 Calculation of Inflow of air required to dilute ground gas emissions.

Using the worst case combined recorded methane concentration and realistic flow, from WS04 within the Peat Deposits, the inflow of gas into the underfloor space can be calculated.

Max Methane: 5.9% v/v Max Flow: 27.3 l/hr

Methane Gas Screening Value = 1.6107 l/hr

Based on Pecksen approach, assuming that gas emission from a borehole is distributed over a surrounding surface area of 10m², the surface emission rate is: 4.47x10⁻⁸ m³/s/m²

BS 5925 indicates that the required inflow of fresh air to dilute gas to a set equilibrium concentration, Q_a, is:

$$Q_a = q \{ (100 - C_E) / C_E \}$$

W O R K S H E E T



Client Makki Masjid

Job Title Makki Mosque

Drawing Ref No. Rev 0

Job No. CGN/05003A

Date 14/06/2024

Quality Plan

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SHEET No. 2

q = inflow rate of contaminant, C_e = equilibrium concentration (Required design concentration is 0.25%v/v for methane in the void (Based on recommendations in the Ground Gas Handbook, Section 8.6.1 page 159).

q (m^3/s) = void length (m) x void width (m) x surface emission rate ($m^3/s/m^2$)

Assuming the dimensions for the smallest mosque sub-floor void requiring protection* = 4.18m x 4.187m

Total surface emission rate of CH_4 into void, $q = 4.18 \times 4.187 \times 4.47 \times 10^{-8} = 7.83 \times 10^{-7} m^3/s$

$Q_a = 7.83 \times 10^{-7} \{ (100 - 0.25) / 0.25 \} = 3.12 \times 10^{-4} m^3/s$ (Air flow required to dilute methane emissions to 0.25%)

1.2 Calculation of ventilation required through sub-floor void.

It has been assumed that the sub-floor voids beneath the beam and block flooring are not infilled, as confirmed by the client and indicated with a peri-construction image

The area of ventilation required for the void-section in this study can be derived using the following formula for natural ventilation of a space with opening on one wall only (From BS5925:1991 Page 24, Table 12, a):

Area of Ventilation Required for Whole Section, A_w (mm^2) = $(40Q_a / (C_d U_r)) \times 10^6$

At Reference Wind Speed, $U_r = U_m K z^a$

Where:

U_m = U_{50} x correction factor, the free wind speed (m/s) in the selected environment exceeded for the given proportion of time.

U_{50} = Hourly mean wind speed (m/s) exceeded for 50% of the time = 4.25m/s

Correction factor = 0.83

W O R K S H E E T

Client Makki Masjid

Job Title Makki Mosque

Drawing Ref No. Rev 0

Job No. CGN/05003A

Date 14/06/2024

Quality Plan

Made by CJB

Checked by KN

SHEET No.

3

$$U_m = 4.25 \times 0.83 = 3.53 \text{ m/s}$$

$K = 0.35$, constant determined by terrain type (BS5925:1991 page 21)

$a = 0.25$, constant determined by terrain type (BS5925:1991 page 21)

$z = 400$, height of vent (m)

$$U_r = 3.53 \times 0.35 \times 400^{0.25} = 0.98 \text{ m/s}$$

$C_d = 0.61$, discharge coefficient of opening

Area of Ventilation Required for Whole Section to reduce methane concentration to 0.25% or lower:

$$A_w = ((2.77 \times 10^{-4}) / (0.61 \times 0.74(\sqrt{0.4})))10^6 = 20866.25 \text{ mm}^2$$

For the length of the building in the face of the flow path the equivalent area of specific openings per m run = $20866.25 \text{ mm}^2 / 4.18 = 4983.58 \text{ mm}^2/\text{m}$

This is more than the minimum venting area required in the Building Regulations of $1500 \text{ mm}^2/\text{m}$, as such this value of $4983.58 \text{ mm}^2/\text{m}$ should be required to dilute methane emissions.

1.4 Equilibrium Calculations

Existing equivalent area of specific openings = 6170 mm^2

$$A_w \text{ for the } 4.187 \text{ m length of windward facing wall (2 openings)} = (6170 \times 2 / 4.187) = 2947 \text{ mm}^2/\text{m}$$

Volume flow rate of air:

$Q = 0.025 A_w C_d U_r$ ($C_d = 1$, as airbricks are marked with 'equivalent area' for ventilation openings as per BS EN 13141-1 : 2004. Equivalent area marking on the external airbricks already consider the coefficient of flow for a sharp-edged orifice and so a value of 1 is used here.)

$$Q = 0.0025 \times 2947 \times 1 \times 0.98 = 4.41 \times 10^{-5} \text{ m}^3/\text{s}/\text{m}$$

Client Makki Masjid

Job Title Makki Mosque

Drawing Ref No. Rev 0

Job No. CGN/05003A

Date 14/06/2024

Quality Plan

Made by CJB

Checked by KN

SHEET No.

4

Contaminant Concentration:

$$C_E = q / (Q + q)$$

Inflow of gas into void (CH_4) = Surface emission rate x longest pathway

$$q (CH_4) = 4.47 \times 10^{-8} \times 4.1 = 1.83 \times 10^{-7} \text{ m}^3/\text{s/m}$$

$$C_E = 1.83 \times 10^{-7} / (4.41 \times 10^{-5} + 1.83 \times 10^{-7}) = 4.14 \times 10^{-3} = 0.414\%$$

Therefore, under hypothetical worst case flow conditions the maximum equilibrium concentration of CH_4 is 0.414%. This is significantly below the lower explosive limit (5%) and above the design value of 0.25%.

1.4 Check on poor wind conditions

As a further sense check, if it is assumed that the ratio of mean wind speed for 80% of the time to the 50% mean wind speed is 0.46 rather than 0.83, the equilibrium concentrations under the poor wind flow directions can be assessed.

$$U_m = 4.25 \times 0.46 = 1.96 \text{ m/s}$$

$$U_r = 1.96 \times 0.35 \times 0.40^{0.25} = 0.54 \text{ m/s}$$

$$Q = 0.0025 \times 2947 \times 1 \times 0.54 = 2.45 \times 10^{-5} \text{ m}^3/\text{s/m}$$

$$C_E = 1.83 \times 10^{-7} / (2.45 \times 10^{-5} + 1.83 \times 10^{-7}) = 7.45 \times 10^{-3} = 0.745\%$$

A contaminant concentration of 0.745% is still significantly below the LEL of 5% and slightly higher than the design value of 0.25% even under poor wind flow conditions.

W O R K S H E E T



Client	Makki Masjid		
Job Title	Makki Mosque		
Drawing Ref No.	Rev 0	Job No.	CGN/05003A
Date	14/06/2024	Quality Plan	
Made by	CJB	Checked by	KN

SHEET No. 5

1.5 Check on adequacy of ventilation in still air

Time to fill void to dangerous levels of methane (1% volume of air – 20% of Lower Explosive Limit), T
= height of open void x 1% / surface emission rate

$$T = 0.89 \times 0.01 / 4.47 \times 10^{-8}$$

$$T = 1.99 \times 10^{-5} \text{ s}$$

$$= 55.255 \text{ hrs}$$

This is $\gg 10 \text{ hrs}^1$, therefore venting is adequate.

APPENDIX F

DQRA Parameters

Table F1 - Void 1 Parameters

Study Area	Parameter	Value	Reference
Void 1	Design Max Methane (% v/v)	5.9	Previous CGL Report ¹ Ground gas monitoring WS04 Max methane conc. %
	Design Max Flow (scenario A) (L/hr)	0.1	Previous CGL Report ¹ Ground gas monitoring WS04 Max Steady State Flow
	Design Max Flow (scenario B) (L/hr)	27.3	Previous CGL Report ¹ Ground gas monitoring WS04 Max Peak Flow (recorded for <10 seconds)
	Void Length (m)	3.04	Figure 4
	Void Width (m)	5.1	Figure 4
	Void Height (m)	0.89	Appendix A, Figure 4
	Design Contaminant Conc. CH ₄ (%)	0.25	Ground Gas Handbook ²
	Equivalent area of Ventilation Provided per external airbrick (mm ²)	6170	Appendix D.
	Geometric open area of sub-structure wall ventilation gaps (mm ²)	7500 (at 1320mm centre spacings)	Appendix B.
	Length of Windward Facing Wall (m)	5.1	Appendix A
	Hourly Mean Wind Speed, U ₅₀ (m/s)	4.25	BS5925:1991 Figure 5
	Wind Speed Correction Factor	0.83	BS5925:1991 Table 9 and Manchester Wind Rose - Appendix G.
	Constant K	0.35	BS5925:1991 Table 8 – Urban Terrain
	Constant a	0.25	BS5925:1991 Table 8 – Urban Terrain
	Height of vent, z (mm)	350	Appendix D.
	Discharge coefficient of sharp-edged orifice, C _d	0.61	BS5925:1991 page 18
	Surface Pressure Coefficient, C _p	0.4	Surface pressure coefficient (Table 13 in BS5925, pessimistic value)
	Longest pathway (m)	3.04	Figure 4.
	Maximum time of still air in UK (hrs)	10	Ground Gas Handbook ²

¹ Card Geotechnics Ltd. CGN/5003, Makki Mosque, Manchester. Geoenvironmental Investigation Report, Jan 2024.

² Ground Gas Handbook. Wilson, Card, & Haines. 2007

Table F2 - Void 2 Parameters

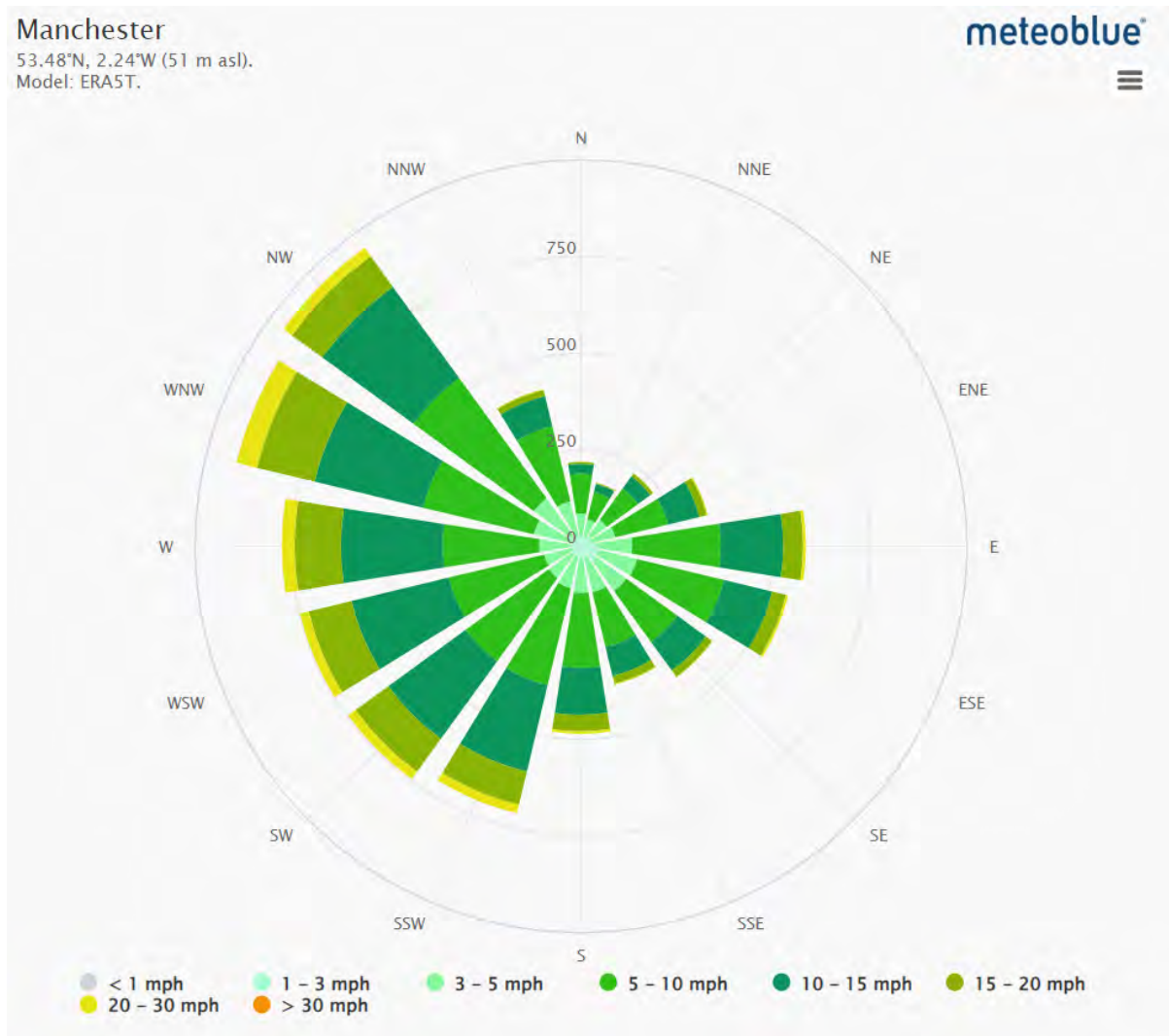
Study Area	Parameter	Value	Source
Void 2	Design Max Methane (%)	5.9	Previous CGL Report ¹ Ground gas monitoring WS04 Max methane conc. %
	Design Max Flow (scenario A) (L/hr)	0.1	Previous CGL Report ¹ Ground gas monitoring WS04 Max Steady State Flow
	Design Max Flow (scenario B) (L/hr)	27.3	Previous CGL Report ¹ Ground gas monitoring WS04 Max Peak Flow
	Void Length (m)	4.18	Figure 4
	Void Width (m)	4.187	Figure 4
	Void Height (m)	0.89	Appendix A, Figure 4
	Design Contaminant Conc. CH ₄ (%)	0.25	Ground Gas Handbook ²
	Equivalent area of Ventilation Provided per external airbrick (mm ²)	6170	Appendix D.
	Geometric open area of sub-structure wall ventilation gaps (mm ²)	N/A	Appendix B.
	Length of Windward Facing Wall (m)	4.0	Appendix A
	Hourly Mean Wind Speed, U ₅₀ (m/s)	4.25	BS5925:1991 Figure 5
	Wind Speed Correction Factor	0.83	BS5925:1991 Table 9 and Manchester Wind Rose - Appendix G.
	Constant K	0.35	BS5925:1991 Table 8 – Urban Terrain
	Constant a	0.25	BS5925:1991 Table 8 – Urban Terrain
	Height of vent, z (mm)	400	Appendix D.
	Discharge coefficient of sharp-edged orifice, C _d	0.61	BS5925:1991 page 18
	Surface Pressure Coefficient, C _p	N/A	N/A – Openings in one wall only.
	Longest pathway (m)	4.18	Figure 4.
	Maximum time of still air in UK (hrs)	10	Ground Gas Handbook ²

APPENDIX G

Manchester Wind Rose

Appendix G – Manchester Wind Rose

The below wind rose¹ was taken from Meteoblue and presents an aggregate of wind flow data over the past 30 years of hourly weather model simulations for the Manchester region.



¹ MeteoBlue, Manchester Wind Rose

https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/manchester_united-kingdom_2643123. Accessed 17/06/2024