APPENDIX 4 – QUALITATIVE RISK ASSESSMENT METHODOLOGY

QUALITATIVE RISK ASSESSMENT METHODOLOGY

The following Contaminated Land Risk Assessment methodology is based on CIRIA C552 (2001) *Contaminated Land Risk Assessment – A Guide to Good Practice*, in order to quantify potential risk via **risk estimation** and **risk evaluation**, which can be adopted at the Phase I stage. This will then determine an overall risk category which can be used to identify likely actions. This methodology uses qualitative descriptors and therefore is a qualitative approach.

The methodology requires the classification of:

- the magnitude of the **consequence** (severity) of a risk occurring, and
- the magnitude of the **probability** (likelihood) of a risk occurring.

The potential consequences of contamination risks occurring at this site are classified in accordance with Table A4.1 below, which is adapted from the CIRIA guidance.

Table A4.1: Classification of Consequence

Classification	Definition of Consequence
Severe	• Short-term (acute) risks to human health. • Short-term risk of pollution of sensitive water resource or ecosystem. • Catastrophic damage to crops/buildings/property/infrastructure, including off-site soils.
Medium	• Medium/long-term (chronic) risks to human health. • Medium/long-term risk of pollution of sensitive water resource or ecosystem. • Significant damage to crops/buildings/property/infrastructure (on or off-site). • Contamination of off-site soils.
Mild	• Easily preventable, permanent health effects on humans. • Pollution of non-sensitive water resources. • Localised damage to crops/buildings/property/infrastructure (on or off-site).
Minor	• Easily preventable, non-permanent health effects on humans, or no effects. • Minor, low-level and localised contamination of on-site soils. • Easily repairable damage to crops/buildings/property/infrastructure.

The probability of contamination risks occurring at this site will be classified in accordance with Table A4.2 below which is also adapted from the CIRIA guidance. Note that for each category, it is assumed that a pollution linkage exists. Where a pollution linkage does not exist, the likelihood is zero, as is the risk.

Table A4.2: Classification of Probability

Classification	Definition of Probability
High Likelihood	Circumstances are such that an event appears very likely in the short-term or almost inevitable in the long-term; or there is already evidence that such an event has occurred.
Likely	Circumstances are such that such an event is not inevitable, but is possible in the short-term and is likely over the long-term.
Low Likelihood	Circumstances are such that it is by no means certain that an event would occur even over a longer period, and it is less likely in the short-term.
Unlikely	Circumstances are such that it is improbable that an event would occur even in the very long-term.

For each possible pollution linkage (source-pathway-receptor) identified, the potential risk can be evaluated, as presented in Table A3.3. Based upon this, CIRIA C552 presents definitions of the risk categories, together with the investigatory and remedial actions that are likely to be necessary in each case, as in Table A3.4. These risk categories apply to each possible pollutant linkage, and not simply to each hazard/source of contamination or sensitive receptor.

Table A4.3: Overall Contamination Risk Matrix

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**High likelihood**	Very high risk	High risk	Moderate risk	Low risk
	Likely	High risk	Moderate risk	Moderate risk	Low risk
	Low likelihood	Moderate risk	Moderate risk	Low risk	Very low risk
	Unlikely	Low risk	Low risk	Very low risk	Very low risk

Table A4.4: Definition of Risk Categories and Likely Actions Required

Risk Category	Definition and likely actions required
Very high	• Severe harm to a defined receptor is very likely, or has already occurred. • The risk is likely to result in a substantial liability. • Urgent investigation (if not already undertaken) is likely to be required. • Urgent remediation is likely to be required.
High	• Harm to a defined receptor is likely. • The risk, if realised, may result in a substantial liability. • Urgent investigation (if not already undertaken) is likely to be required. • Remediation is likely to be required in the long term, possibly sooner.
Moderate	• Harm to a defined receptor is possible, but severe harm is unlikely. • Investigation is likely to be required to clarify the level of potential liability and risk. • Some remediation may be required in the longer term
Low	• Harm to a defined receptor is possible, but is likely to be mild at worst. • Liabilities could theoretically arise, but are unlikely. • Further investigation is not required at this stage • Remediation is unlikely to be required.
Very low	• Harm to a defined receptor is unlikely, and would be minor at worst. • No liabilities are likely to arise. • Further investigation is not required at this stage • Remediation is very unlikely to be required.

APPENDIX 5 – BGS BOREHOLE RECORDS

GEOLOGICAL SURVEY OF GREAT BRITAIN

RECORD OF SHAFT OR BORE FOR MINERALS

(For Survey use only)
6-inch Map Registered No.
TQ28NE/38

Name of Shaft or Bore given by Geological Survey:

Name and Number given by owner:
C 16.

Nat. Grid Reference
2722.8520

For whom made

Town or Village Hampstead. County

Exact site Junction of Belsize Av. and Haverstock Hill. {Attach a tracing from a map, or a sketch-map, if possible.

1" N.S.Map No.	1" O.S.Map No.	Confidential or not
256		

Purpose for which made

Ground Level at shaft bore relative to O.D. 234' If not ground level give O.D. of beginning of shaft bore

Made by Date of sinking 1900.

Information from LCC. Date received

Examined by

SPECIMEN NUMBERS AND ADDITIONAL NOTES

(For Survey use only) Geological Classification	Description of Strata	Thickness Ft.	Thickness In.	Depth Ft.	Depth In.
MGRS	Made Ground	4	-		1.22
LC	Clay	16	-	20	- 6.10
	For Hampstead Tube Rly.				

(5412) Wt.32837/P8.154 2m 10/64 G.W.B.Ltd. Op.863

APPENDIX 6 – EXPLORATORY HOLE RECORDS

WINDOW/WINDOWLESS SAMPLING BOREHOLE RECORD

Exploratory Hole No:	WS2		
Site Address:	38 Glenoch Road, Camden, NW3 4DN	Project No:	P1207J1245
Client:	McKay Estates Ltd	Ground Level:	
Logged By:	MJ, LP	Date Commenced:	14/11/2017
Checked By:	PSw	Date Completed:	14/11/2017
Type and diameter of equipment:	Windowless Sampler	Sheet No:	1 Of 2

Water levels recorded during boring, m

Date:						
Hole depth:						
Casing depth:						
Level water on strike:						
Water Level after 20mins:						

Remarks

1: No water recorded.
2:
3:
4:

Sample or Tests										Strata				
Type	Depth (mbgl)	Result								Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description	Installation
		75	75	75	75	75	75	N						
									0.00		0.03		Paving slab. (MADE GROUND).	
											0.20		Reinforced concrete. (MADE GROUND).	
P + J	0.25												Light brown low strength gravelly clay. Gravel consists of frequent fine to coarse angular to sub-angular flint, brick and concrete fragments. (MADE GROUND).	
P + J	0.50								0.50					
SPT P + J	1.00	1	1	2	1	1	2	6	1.00		1.30			
									1.50				Light brown with blue veins medium strength CLAY (LONDON CLAY_	
SPT	2.00	2	2	2	2	3	3	10	2.00					
									2.50					
SPT	3.00	2	2	2	2	3	4	11	3.00					
									3.50					
SPT	4.00	1	1	2	3	3	4	12	4.00					
									4.50					
SPT	5.00	2	3	3	2	3	4	12	5.00					

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

Jomas Associates Ltd - Lakeside House, 1 Furzeground Way, Stockley Park, UB11 1BD
T: 0843 289 2187 E: info@jomasassociates.com W: www.jomasassociates.com

WINDOW/WINDOWLESS SAMPLING BOREHOLE RECORD

Exploratory Hole No:	WS2		
Site Address:	38 Glenoch Road, Camden, NW3 4DN	Project No:	P1207J1245
Client:	McKay Estates Ltd	Ground Level:	
Logged By:	MJ, LP	Date Commenced:	14/11/2017
Checked By:	PSw	Date Completed:	14/11/2017
Type and diameter of equipment:	Windowless Sampler	Sheet No:	2 Of 2

Water levels recorded during boring, m

Date:						
Hole depth:						
Casing depth:						
Level water on strike:						
Water Level after 20mins:						

Remarks

1: No water recorded.
2:
3:
4:

Sample or Tests										Strata				
Type	Depth (mbgl)	Result								Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description	Installation
		75	75	75	75	75	75	N						
SPT	5.00	2	3	3	2	3	4	12	5.00				Light brown with blue veins medium strength CLAY (LONDON CLAY_	
											5.45			
									5.50					
									6.00					
									6.50					
									7.00					
									7.50					
									8.00					
									8.50					
									9.00					
									9.50					
									10.00					

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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TRIAL PIT RECORD

Exploratory Hole No:	TP1		
Site Address:	38 Glenoch Road, Camden, NW3 4DN	Project No:	P1207J1245
Client:	McKay Estates Ltd	Ground Level:	
Logged By:	MJ, LP	Date Commenced:	14/11/2017
Checked By:	PSw	Date Completed:	14/11/2017
Type and diameter of equipment:	Hand Dug	Sheet No:	1 Of 1

Pit Dimension:	Length:	0.50	Width:	0.50	Depth:	0.85

Remarks

1: No water recorded.

2: *field description of the clays "consistency" and not a strength assessment.

3:

4:

Sample or Tests			Strata			
Type	Depth (mbgl)	Result	Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description
				0.00		
				0.02		Kitchen tile. (MADE GROUND).
				0.15		Concrete. (MADE GROUND).
P + J	0.40			0.72		Soft to firm consistency* dark brown sandy gravelly clay. Gravel consists of abundant fine to coarse angular to sub-angular flint, brick and concrete fragments. (MADE GROUND).
				0.85		Soft to firm consistency* light brown CLAY (LONDON CLAY)

0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50 5.00

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

Jomas Associates Ltd - Lakeside House, 1 Furzeground Way, Stockley Park, UB11 1BD
T: 0843 289 2187 E: info@jomasassociates.com W: www.jomasassociates.com

TRIAL PIT RECORD

Exploratory Hole No:	TP2		
Site Address:	38 Glenoch Road, Camden, NW3 4DN	Project No:	P1207J1245
Client:	McKay Estates Ltd	Ground Level:	
Logged By:	MJ, LP	Date Commenced:	14/11/2017
Checked By:	PSw	Date Completed:	14/11/2017
Type and diameter of equipment:	Hand Dug	Sheet No:	1 Of 1

Pit Dimension:	Length:	0.60	Width:	0.60	Depth:	1.40

Remarks

1: No water recorded.

2: Investigation terminated due to space limitations.

3: *field description of the clays "consistency" and not a strength assessment.

4:

Sample or Tests			Strata			
Type	Depth (mbgl)	Result	Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description
				0.00		Laminate flooring and wooden boards. (MADE GROUND).
				0.05		Suspended flooring. (VOID).
P + J	1.40			1.20		Soft to firm consistency* light brown gravelly clay. Gravel consists of abundant fine to coarse angular to sub-angular flint, brick and concrete fragments. (MADE GROUND).
				1.65		

0.00, 0.50, 1.00, 1.50, 2.00, 2.50, 3.00, 3.50, 4.00, 4.50, 5.00

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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TRIAL PIT RECORD

Exploratory Hole No:	TP3		
Site Address:	38 Glenoch Road, Camden, NW3 4DN	Project No:	P1207J1245
Client:	McKay Estates Ltd	Ground Level:	
Logged By:	MJ, LP	Date Commenced:	14/11/2017
Checked By:	PSw	Date Completed:	14/11/2017
Type and diameter of equipment:	Hand Dug	Sheet No:	1 Of 1

Pit Dimension:	Length:	0.30	Width:	0.50	Depth:	0.95

Remarks

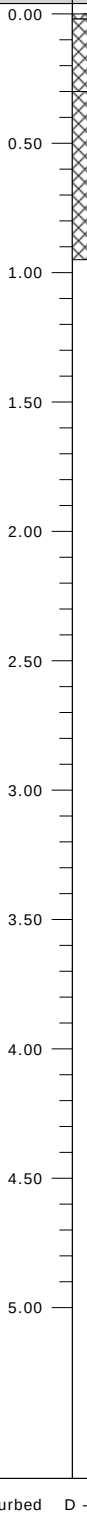
1: No water recorded.

2: *field description of the clays "consistency" and not a strength assessment.

3:

4:

Sample or Tests			Strata			
Type	Depth (mbgl)	Result	Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description
				0.02		Concrete paving slab. (MADE GROUND).
				0.30		Concrete. (MADE GROUND).
P + J	0.45			0.95		Soft to firm consistency* light brown gravelly clay. Gravel consists of abundant fine to coarse angular to sub-agular flint, brick and concrete fragments. (MADE GROUND).



Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

Jomas Associates Ltd - Lakeside House, 1 Furzeground Way, Stockley Park, UB11 1BD
T: 0843 289 2187 E: info@jomasassociates.com W: www.jomasassociates.com

TRIAL PIT RECORD

Exploratory Hole No:	TP4		
Site Address:	38 Glenoch Road, Camden, NW3 4DN	Project No:	P1207J1245
Client:	McKay Estates Ltd	Ground Level:	
Logged By:	MJ, LP	Date Commenced:	14/11/2017
Checked By:	PSw	Date Completed:	14/11/2017
Type and diameter of equipment:	Hand Dug	Sheet No:	1 Of 1

Pit Dimension:	Length:	1.33	Width:		Depth:	1.30

Remarks

1: No water recorded.

2: *field description of the clays "consistency" and not a strength assessment.

3:

4:

Sample or Tests			Strata			
Type	Depth (mbgl)	Result	Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description
				0.04		Concrete paving slab. (MADE GROUND).
				0.06		Concrete. (MADE GROUND).
P + J	0.30			0.60		Soft to firm consistency* light brown gravelly clay. Gravel consists of frequent fine to coarse angular to sub-angular flint, brick and concrete fragments. (MADE GROUND).
P + J	1.00			1.25		Firm to stiff consistency* light brown with blue veins clay containing rare rootlets. (MADE GROUND)
				1.30		Pink to brown clayey SAND. Sand is coarse containing fine to medium angular clinker fragments. (MADE GROUND)

0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50 5.00

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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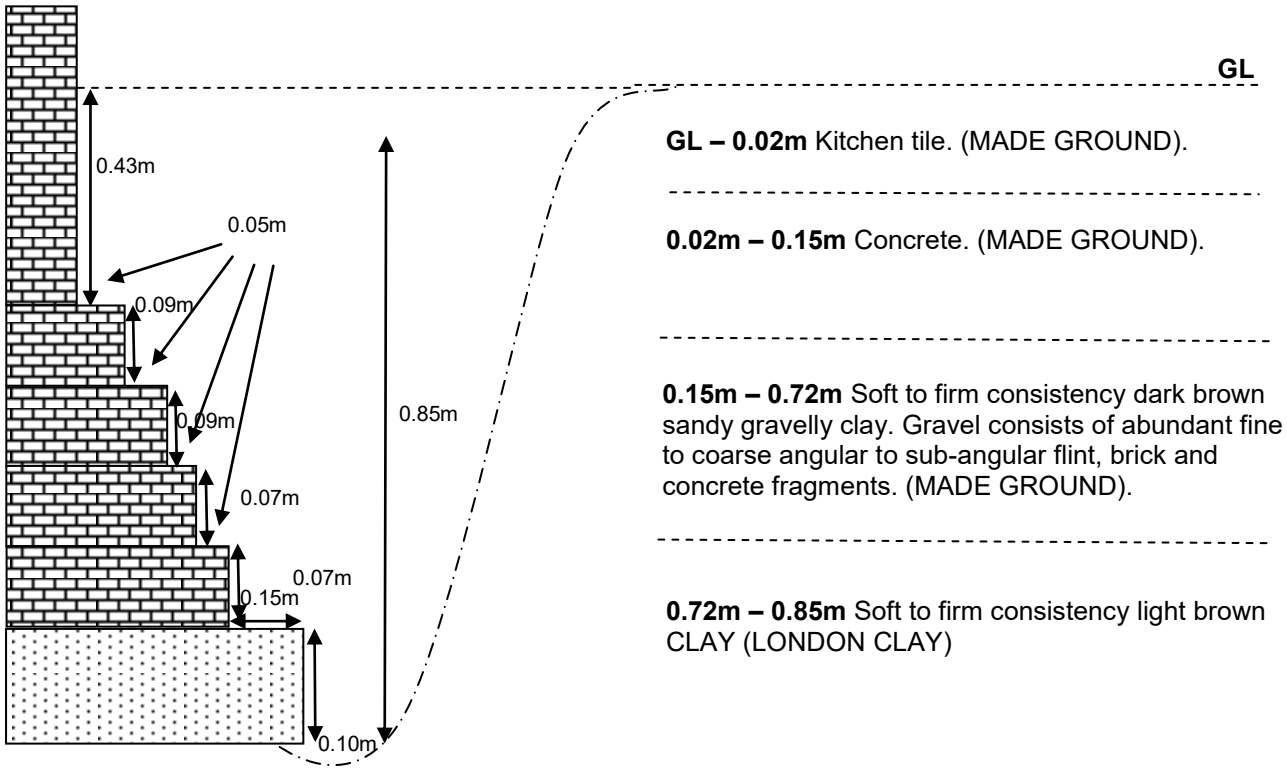
Specialists in the investigation & reclamation of brownfield sites

Job No.:	P1207J1245	**Issue Date:**	November 2017
Project:	Spectrum House	**Reference:**	P1207J1245/AM
Subject:	Foundation Inspection Pit Sketches	**Prepared by:**	AM

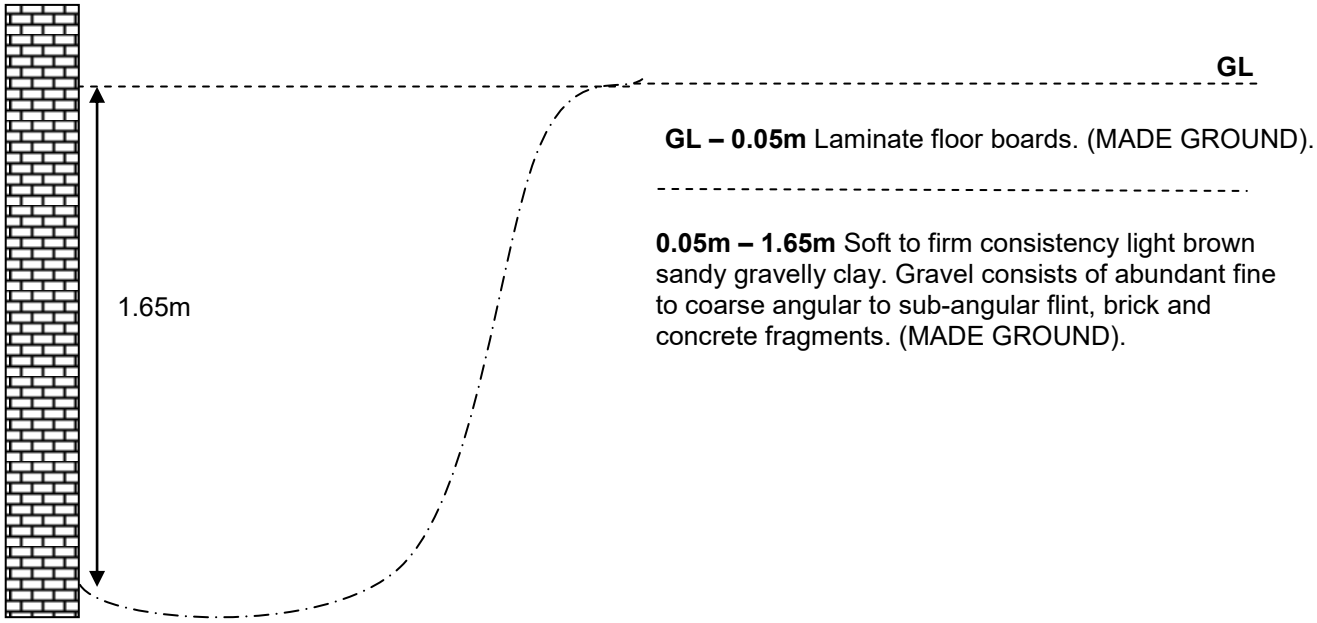
TP1
L: 0.5m, W: 0.5m, D: 0.85m



Depth proven

Job No.:	P1207J1245	**Issue Date:**	November 2017
Project:	Spectrum House	**Reference:**	P1207J1245/AM
Subject:	Foundation Inspection Pit Sketches	**Prepared by:**	AM

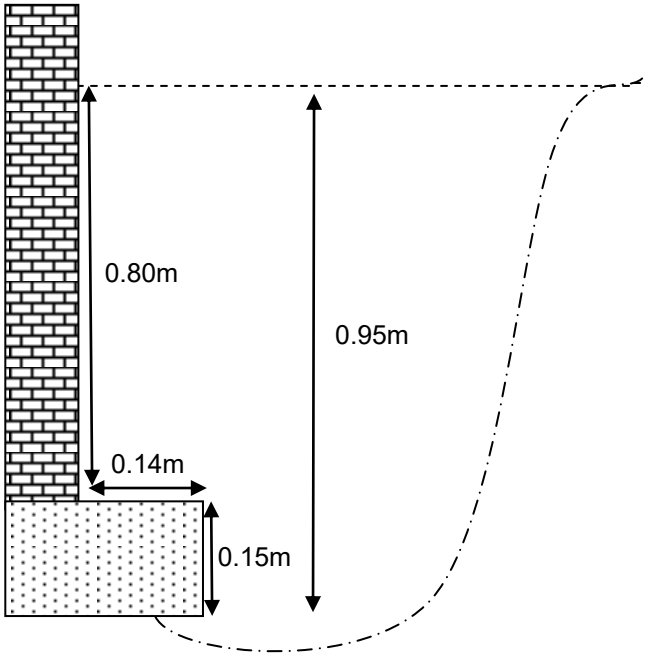
TP2
L: 0.5m, W: 0.5m, D: 1.65m



Depth not proven

Job No.:	P1207J1245	**Issue Date:**	November 2017
Project:	Spectrum House	**Reference:**	P1207J1245/AM
Subject:	Foundation Inspection Pit Sketches	**Prepared by:**	AM

TP3
L: 0.5m, W: 0.5m, D: 1.65m



GL – 0.02m Laminate floor boards. (MADE GROUND).

GL

0.02m – 0.30m Concrete. (MADE GROUND).

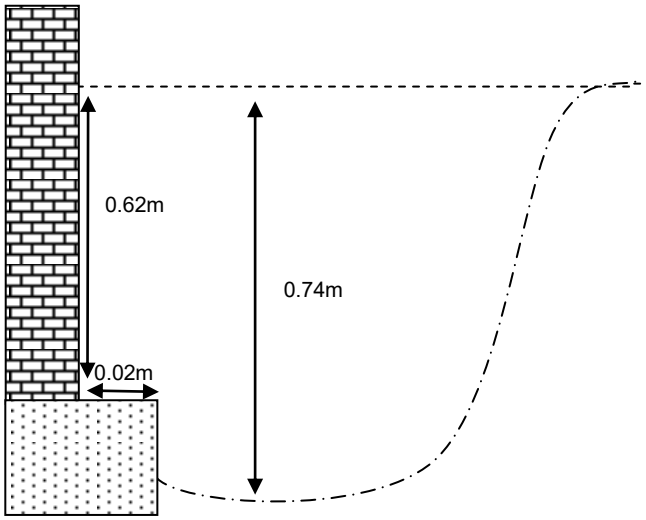
0.30m – 0.95m Soft to firm consistency light brown gravelly clay. Gravel consists of abundant fine to coarse angular t sub-angular flint, brick and concrete fragments. (MADE GROUND).

Depth proven

Specialists in the investigation & reclamation of brownfield sites

Job No.:	P1207J1245	**Issue Date:**	November 2017
Project:	Spectrum House	**Reference:**	P1207J1245/AM
Subject:	Foundation Inspection Pit Sketches	**Prepared by:**	AM

TP4a (Garden Wall)
L: 0.35m, W: 0.5m, D: 0.74m



GL

GL – 0.04m Laminate floor boards. (MADE GROUND).

0.04m – 0.06m Concrete. (MADE GROUND).

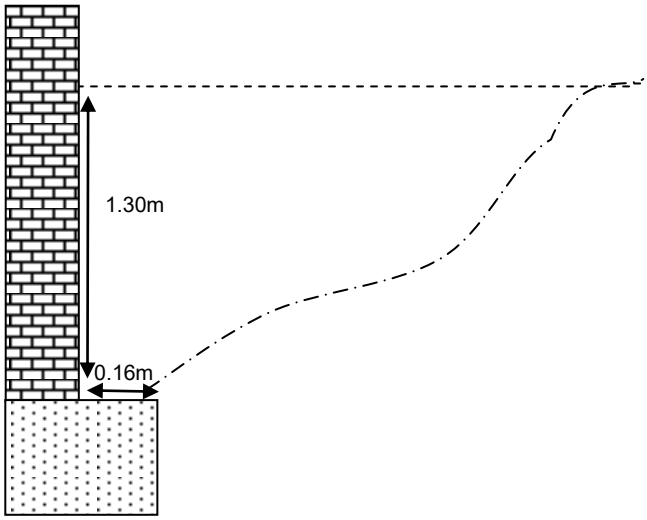
0.6m – 0.60m Soft to firm consistency light brown gravelly clay. Gravel consists of frequent fine to coarse angular t sub-angular flint, brick and concrete fragments. (MADE GROUND).

0.60m – 1.25m Firm to stiff consistency light brown CLAY containing blue veins and rare rootlets.

0.60m – 1.25m Pink to brown clayey SAND. Sand is coarse containing fine to medium angular clinker fragments.

Depth not proven

TP4b (Wall of House)
L: 1.33m, W: 0.5m, D: 1.30m



GL

GL – 0.04m Laminate floor boards. (MADE GROUND).

0.04m – 0.06m Concrete. (MADE GROUND).

0.6m – 0.60m Soft to firm consistency light brown gravelly clay. Gravel consists of frequent fine to coarse angular t sub-angular flint, brick and concrete fragments. (MADE GROUND).

0.60m – 1.25m Firm to stiff consistency light brown CLAY containing blue veins and rare rootlets.

0.60m – 1.25m Pink to brown clayey SAND. Sand is coarse containing fine to medium angular clinker fragments.

Depth and breadth of footing not proven

APPENDIX 7 – CHEMICAL LABORATORY TEST RESULTS

Emma Hucker
Jomas Associates Ltd
Lakeside House
1 Furzeground Way
Stockley Park
UB11 1BD

e: Jomas Group

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 17-67859

Project / Site name:	38 Glenoch Road, Camden, NW3 4DN	**Samples received on:**	15/11/2017
Your job number:	JJ1245	**Samples instructed on:**	16/11/2017
Your order number:	P1207JJ1245.3	**Analysis completed by:**	23/11/2017
Report Issue Number:	1	**Report issued on:**	23/11/2017
Samples Analysed:	2 10:1 WAC samples		

Signed:

Rexona Rahman
Customer Services Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

i2 Analytical
7 Woodshots Meadow
Croxley Green Business Park
Watford, WD18 8YS

Telephone: 01923 225404
Fax: 01923 237404
email:reception@i2analytical.com

Waste Acceptance Criteria Analytical Results

Report No:	**17-67859**						
					Client:	**JOMASASSOC**	
Location	**38 Glenoch Road, Camden, NW3 4DN**						
Lab Reference (Sample Number)	859439 / 859440				**Landfill Waste Acceptance Criteria Limits**		
Sampling Date	14/11/2017				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID	TP2 P+J						
Depth (m)	1.40						
Solid Waste Analysis							
TOC (%)**	1.0				3%	5%	6%
Loss on Ignition (%) **	3.9				--	--	10%
BTEX (µg/kg) **	< 10				6000	--	--
Sum of PCBs (mg/kg) **	< 0.007				1	--	--
Mineral Oil (mg/kg)	< 10				500	--	--
Total PAH (WAC-17) (mg/kg)	180				100	--	--
pH (units)**	7.4				--	>6	--
Acid Neutralisation Capacity (mol / kg)	2.4				--	To be evaluated	To be evaluated
Eluate Analysis (BS EN 12457 - 2 preparation utilising end over end leaching procedure)	10:1 mg/l			10:01 mg/kg	Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg (mg/kg)		
Arsenic *	< 0.0011			< 0.0110	0.5	2	25
Barium *	0.0289			0.205	20	100	300
Cadmium *	< 0.0001			< 0.0008	0.04	1	5
Chromium *	0.0011			0.0076	0.5	10	70
Copper *	0.010			0.074	2	50	100
Mercury *	< 0.0005			< 0.0050	0.01	0.2	2
Molybdenum *	0.0494			0.350	0.5	10	30
Nickel *	0.0009			0.0066	0.4	10	40
Lead *	0.0052			0.037	0.5	10	50
Antimony *	< 0.0017			< 0.017	0.06	0.7	5
Selenium *	0.011			0.080	0.1	0.5	7
Zinc *	0.0044			0.031	4	50	200
Chloride *	2.5			17	800	4000	25000
Fluoride	1.1			8.1	10	150	500
Sulphate *	1700			12000	1000	20000	50000
TDS	1200			8700	4000	60000	100000
Phenol Index (Monohydric Phenols) *	< 0.010			< 0.10	1	-	-
DOC	7.10			50.4	500	800	1000
Leach Test Information							
Stone Content (%)	< 0.1						
Sample Mass (kg)	1.4						
Dry Matter (%)	80						
Moisture (%)	20						

Results are expressed on a dry weight basis, after correction for moisture content where applicable.
Stated limits are for guidance only and i2 cannot be held responsible for any discrepancies with current legislation

*= UKAS accredited (liquid eluate analysis only)
** = MCERTS accredited

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes as defined by the Waste (England and Wales) Regulations 2011 (as amended) and EA Guidance WM3.
This analysis is only applicable for landfill acceptance criteria (The Environmental Permitting (England and Wales) Regulations) and does not give any indication as to whether a waste may be hazardous or non-hazardous.

i2 Analytical
7 Woodshots Meadow
Croxley Green Business Park
Watford, WD18 8YS

Telephone: 01923 225404
Fax: 01923 237404
email:reception@i2analytical.com

Waste Acceptance Criteria Analytical Results

Report No:	**17-67859**						
					Client:	**JOMASASSOC**	
Location	**38 Glenoch Road, Camden, NW3 4DN**						
Lab Reference (Sample Number)	859441 / 859442				**Landfill Waste Acceptance Criteria**		
					Limits		
Sampling Date	14/11/2017				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID	TP4 P+J						
Depth (m)	0.30						
Solid Waste Analysis							
TOC (%)**	0.6				3%	5%	6%
Loss on Ignition (%) **	3.2				--	--	10%
BTEX (µg/kg) **	< 10				6000	--	--
Sum of PCBs (mg/kg) **	< 0.007				1	--	--
Mineral Oil (mg/kg)	< 10				500	--	--
Total PAH (WAC-17) (mg/kg)	1.6				100	--	--
pH (units)**	7.8				--	>6	--
Acid Neutralisation Capacity (mol / kg)	3.7				--	To be evaluated	To be evaluated
Eluate Analysis	10:1			10:01	Limit values for compliance leaching test		
(BS EN 12457 - 2 preparation utilising end over end leaching procedure)	mg/l			mg/kg	using BS EN 12457-2 at L/S 10 l/kg (mg/kg)		
Arsenic *	0.0019			0.0117	0.5	2	25
Barium *	0.0382			0.238	20	100	300
Cadmium *	< 0.0001			< 0.0008	0.04	1	5
Chromium *	0.0021			0.013	0.5	10	70
Copper *	0.014			0.085	2	50	100
Mercury *	< 0.0005			< 0.0050	0.01	0.2	2
Molybdenum *	0.0106			0.0661	0.5	10	30
Nickel *	0.0064			0.040	0.4	10	40
Lead *	0.0035			0.022	0.5	10	50
Antimony *	< 0.0017			< 0.017	0.06	0.7	5
Selenium *	< 0.0040			< 0.040	0.1	0.5	7
Zinc *	0.012			0.073	4	50	200
Chloride *	1.2			7.7	800	4000	25000
Fluoride	2.1			13	10	150	500
Sulphate *	21			130	1000	20000	50000
TDS	93			580	4000	60000	100000
Phenol Index (Monhydric Phenols) *	< 0.010			< 0.10	1	-	-
DOC	6.39			39.8	500	800	1000
Leach Test Information							
Stone Content (%)	< 0.1						
Sample Mass (kg)	1.2						
Dry Matter (%)	77						
Moisture (%)	23						

Results are expressed on a dry weight basis, after correction for moisture content where applicable.
*= UKAS accredited (liquid eluate analysis only)
Stated limits are for guidance only and i2 cannot be held responsible for any discrepencies with current legislation
** = MCERTS accrediited

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes as defined by the Waste (England and Wales) Regulations 2011 (as amended) and EA Guidance WM3.
This analysis is only applicable for landfill acceptance criteria (The Environmental Permitting (England and Wales) Regulations) and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Analytical Report Number : 17-67859

Project / Site name: 38 Glenoch Road, Camden, NW3 4DN

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
859439	TP2	P+J	1.40	Brown clay and sand with gravel and brick.
859441	TP4	P+J	0.30	Brown clay and sand with gravel.

Analytical Report Number : 17-67859

Project / Site name: 38 Glenoch Road, Camden, NW3 4DN

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Acid neutralisation capacity of soil	Determination of acid neutralisation capacity by addition of acid or alkali followed by electronic probe.	In-house method based on Guidance an Sampling and Testing of Wastes to Meet Landfill Waste Acceptance""	L046-UK	W	NONE
BS EN 12457-2 (10:1) Leachate Prep	10:1 (as recieved, moisture adjusted) end over end extraction with water for 24 hours. Eluate filtered prior to analysis.	In-house method based on BSEN12457-2.	L043-PL	W	NONE
BTEX in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Chloride 10:1 WAC	Determination of Chloride colorimetrically by discrete analyser.	In house based on MEWAM Method ISBN 0117516260.	L082-PL	W	ISO 17025
Dissolved organic carbon 10:1 WAC	Determination of dissolved inorganic carbon in leachate by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
Fluoride 10:1 WAC	Determination of fluoride in leachate by 1:1ratio with a buffer solution followed by Ion Selective Electrode.	In-house method based on Use of Total Ionic Strength Adjustment Buffer for Electrode Determination"	L033B-PL	W	ISO 17025
Loss on ignition of soil @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L047-PL	D	MCERTS
Metals in leachate by ICP-OES	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil""	L039-PL	W	ISO 17025
Mineral Oil (Soil) C10 - C40	Determination of mineral oil fraction extractable hydrocarbons in soil by GC-MS/GC-FID.	in-house method	L076-PL	D	NONE
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols 10:1 WAC	Determination of phenols in leachate by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	ISO 17025
PCB's By GC-MS in soil	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L027-PL	D	MCERTS
pH in soil	Determination of pH in soil by addition of water followed by electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L005-PL	W	MCERTS
Speciated WAC-17 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate 10:1 WAC	Determination of sulphate in leachate by ICP-OES	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil""	L039-PL	W	ISO 17025
Total dissolved solids 10:1 WAC	Determination of total dissolved solids in water by electrometric measurement.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L004-PL	W	NONE
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L009-PL	D	MCERTS

Analytical Report Number : 17-67859

Project / Site name: 38 Glenoch Road, Camden, NW3 4DN

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

The results included within the report are representative of the samples submitted for analysis.

Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
TP2	P+J	S	17-67859	859439	b	BTEX in soil (Monoaromatics)	L073B-PL	b
TP2	P+J	S	17-67859	859439	b	Total BTEX in soil (Poland)	L073-PL	b
TP4	P+J	S	17-67859	859441	b	BTEX in soil (Monoaromatics)	L073B-PL	b
TP4	P+J	S	17-67859	859441	b	Total BTEX in soil (Poland)	L073-PL	b

Emma Hucker
Jomas Associates Ltd
Lakeside House
1 Furzeground Way
Stockley Park
UB11 1BD

e: Jomas Group

i2 Analytical Ltd.
7 Woodshots Meadow,
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Watford,
Herts,
WD18 8YS

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Analytical Report Number : 17-67858

Project / Site name:	38 Glenoch Road, Camden, NW3 4DN	**Samples received on:**	15/11/2017
Your job number:	JJ1245	**Samples instructed on:**	16/11/2017
Your order number:	P1207JJ1245.3	**Analysis completed by:**	23/11/2017
Report Issue Number:	1	**Report issued on:**	23/11/2017
Samples Analysed:	6 soil samples		

Signed:

Rexona Rahman
Customer Services Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Analytical Report Number: 17-67858

Project / Site name: 38 Glenoch Road, Camden, NW3 4DN
Your Order No: P1207JJ1245.3

Lab Sample Number				859433	859434	859435	859436	859437
Sample Reference				WS2	WS2	WS2	TP1	TP3
Sample Number				P+J	D	D	P+J	D
Depth (m)				0.50	1.00	3.00	0.40	0.95
Date Sampled				14/11/2017	14/11/2017	14/11/2017	14/11/2017	14/11/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	20	21	23	17	23
Total mass of sample received	kg	0.001	NONE	1.3	1.4	0.34	1.4	0.34
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	-	-	Not-detected	-
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	8.2	-	8.3	9.8	8.4
Total Cyanide	mg/kg	1	MCERTS	< 1	-	-	< 1	-
Total Sulphate as SO_4	mg/kg	50	MCERTS	470	-	-	12000	-
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.064	-	0.32	1.6	0.90
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	63.6	-	-	1590	-
Total Organic Carbon (TOC)	%	0.1	MCERTS	-	0.6	-	-	0.6
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	-	-	< 1.0	-
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	-	-	0.48	-
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	-	-	< 0.05	-
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	-	-	0.82	-
Fluorene	mg/kg	0.05	MCERTS	< 0.05	-	-	0.53	-
Phenanthrene	mg/kg	0.05	MCERTS	0.45	-	-	7.7	-
Anthracene	mg/kg	0.05	MCERTS	< 0.05	-	-	1.1	-
Fluoranthene	mg/kg	0.05	MCERTS	0.65	-	-	9.7	-
Pyrene	mg/kg	0.05	MCERTS	0.53	-	-	7.6	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.36	-	-	4.6	-
Chrysene	mg/kg	0.05	MCERTS	0.28	-	-	4.0	-
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	0.30	-	-	4.8	-
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.21	-	-	2.2	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.24	-	-	3.8	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.18	-	-	1.9	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	-	-	0.41	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.20	-	-	2.2	-
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	3.40	-	-	52.0	-
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	16	-	-	16	-
Boron (water soluble)	mg/kg	0.2	MCERTS	0.7	-	-	2.7	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	-	-	< 0.2	-
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	-	-	< 4.0	-
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	44	-	-	31	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	38	-	-	78	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	140	-	-	420	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	-	-	< 0.3	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	38	-	-	23	-
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	-	-	< 1.0	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	110	-	-	84	-
Petroleum Hydrocarbons								
Petroleum Range Organics (C6 - C10)	mg/kg	0.1	MCERTS	< 0.1	-	-	< 0.1	-
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	-	-	3.6	-
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0	-	-	11	-
TPH (C16 - C21)	mg/kg	1	MCERTS	< 1.0	-	-	45	-
TPH (C21 - C40)	mg/kg	10	MCERTS	< 10	-	-	100	-

Analytical Report Number: 17-67858

Project / Site name: 38 Glenoch Road, Camden, NW3 4DN
Your Order No: P1207JJ1245.3

Lab Sample Number				859433	859434	859435	859436	859437
Sample Reference				WS2	WS2	WS2	TP1	TP3
Sample Number				P+J	D	D	P+J	D
Depth (m)				0.50	1.00	3.00	0.40	0.95
Date Sampled				14/11/2017	14/11/2017	14/11/2017	14/11/2017	14/11/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					

Analytical Report Number: 17-67858

Project / Site name: 38 Glenoch Road, Camden, NW3 4DN
Your Order No: P1207JJ1245.3

Lab Sample Number				859438				
Sample Reference				TP4				
Sample Number				D				
Depth (m)				1.00				
Date Sampled				14/11/2017				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1				
Moisture Content	%	N/A	NONE	22				
Total mass of sample received	kg	0.001	NONE	1.3				
Asbestos in Soil	Type	N/A	ISO 17025	-				
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.8				
Total Cyanide	mg/kg	1	MCERTS	-				
Total Sulphate as SO_4	mg/kg	50	MCERTS	-				
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.40				
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	-				
Total Organic Carbon (TOC)	%	0.1	MCERTS	-				
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	-				
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	-				
Acenaphthylene	mg/kg	0.05	MCERTS	-				
Acenaphthene	mg/kg	0.05	MCERTS	-				
Fluorene	mg/kg	0.05	MCERTS	-				
Phenanthrene	mg/kg	0.05	MCERTS	-				
Anthracene	mg/kg	0.05	MCERTS	-				
Fluoranthene	mg/kg	0.05	MCERTS	-				
Pyrene	mg/kg	0.05	MCERTS	-				
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-				
Chrysene	mg/kg	0.05	MCERTS	-				
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-				
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-				
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-				
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-				
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-				
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-				
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	-				
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	-				
Boron (water soluble)	mg/kg	0.2	MCERTS	-				
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-				
Chromium (hexavalent)	mg/kg	4	MCERTS	-				
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-				
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-				
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-				
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-				
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-				
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-				
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-				
Petroleum Hydrocarbons								
Petroleum Range Organics (C6 - C10)	mg/kg	0.1	MCERTS	-				
TPH (C10 - C12)	mg/kg	2	MCERTS	-				
TPH (C12 - C16)	mg/kg	4	MCERTS	-				
TPH (C16 - C21)	mg/kg	1	MCERTS	-				
TPH (C21 - C40)	mg/kg	10	MCERTS	-				

Analytical Report Number: 17-67858

Project / Site name: 38 Glenoch Road, Camden, NW3 4DN
Your Order No: P1207JJ1245.3

Lab Sample Number				859438				
Sample Reference				TP4				
Sample Number				D				
Depth (m)				1.00				
Date Sampled				14/11/2017				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					

Analytical Report Number : 17-67858

Project / Site name: 38 Glenoch Road, Camden, NW3 4DN

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
859433	WS2	P+J	0.50	Brown clay with gravel.
859434	WS2	D	1.00	Brown clay with gravel.
859435	WS2	D	3.00	Brown clay with gravel.
859436	TP1	P+J	0.40	Brown clay and sand with gravel and brick.
859437	TP3	D	0.95	Brown clay and sand with gravel.
859438	TP4	D	1.00	Brown clay.

Analytical Report Number : 17-67858

Project / Site name: 38 Glenoch Road, Camden, NW3 4DN

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
PRO (Soil)	Determination of hydrocarbons C6-C10 by headspace GC-MS.	In-house method based on USEPA8260	L088-PL	W	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L009-PL	D	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	MCERTS
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L076-PL	D	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
TP1	P+J	S	17-67858	859436	b	PRO (Soil)	L088-PL	b
WS2	P+J	S	17-67858	859433	b	PRO (Soil)	L088-PL	b

Key: a - No sampling date b - Incorrect container
c - Holding time d - Headspace e - Temperature

APPENDIX 8 – GEOTECHNICAL LABORATORY TEST RESULTS

TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

UKAS TESTING 4041

Tested in Accordance with BS1377-2: 1990: Clause 4.3 & 5: Definitive Method

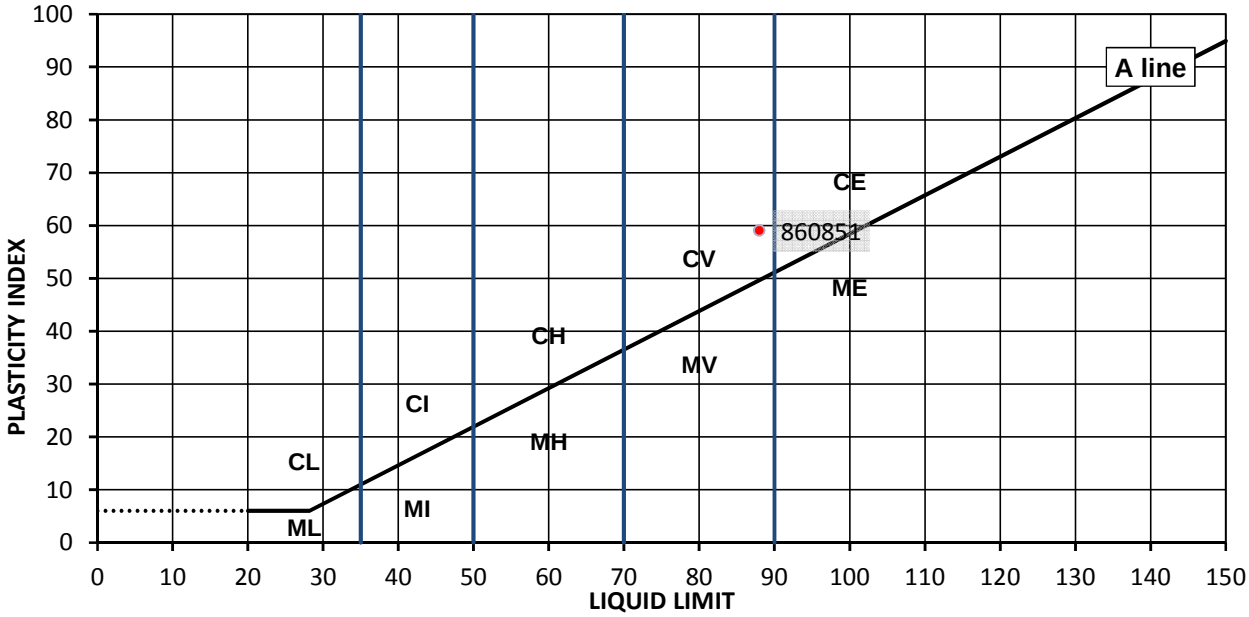
Client:	Jomas Associates Ltd	Client Reference:	JJ1245
Client Address:	Lakeside House 1 Furzeground Way Stockley Park UB11 1BD	Job Number:	17-68135
		Date Sampled:	Not Given
		Date Received:	15/11/2017
Contact:	Emma Hucker	Date Tested:	27/11/2017
Site Name:	38 Glenoch Road, Camden NW3 4DN	Sampled By:	Not Given
Site Address:	38 Glenoch Road, Camden NW3 4DN		

TEST RESULTS

Laboratory Reference: 860851
Sample Reference: Not Given

Description:	Yellowish brown CLAY	Sample Type:	B
Location:	WS2	Depth Top [m]:	2.00
Sample Preparation:	Tested in natural condition	Depth Base [m]:	Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
36	88	29	59	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Remarks

Approved:

Dariusz Piotrowski
PL Laboratory Manager
Geotechnical Section

Signed:

Darren Berrill
Geotechnical General Manager

Date Reported: 30/11/2017

for and on behalf of i2 Analytical Ltd

TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

UKAS TESTING 4041

Tested in Accordance with BS1377-2: 1990: Clause 4.3 & 5: Definitive Method

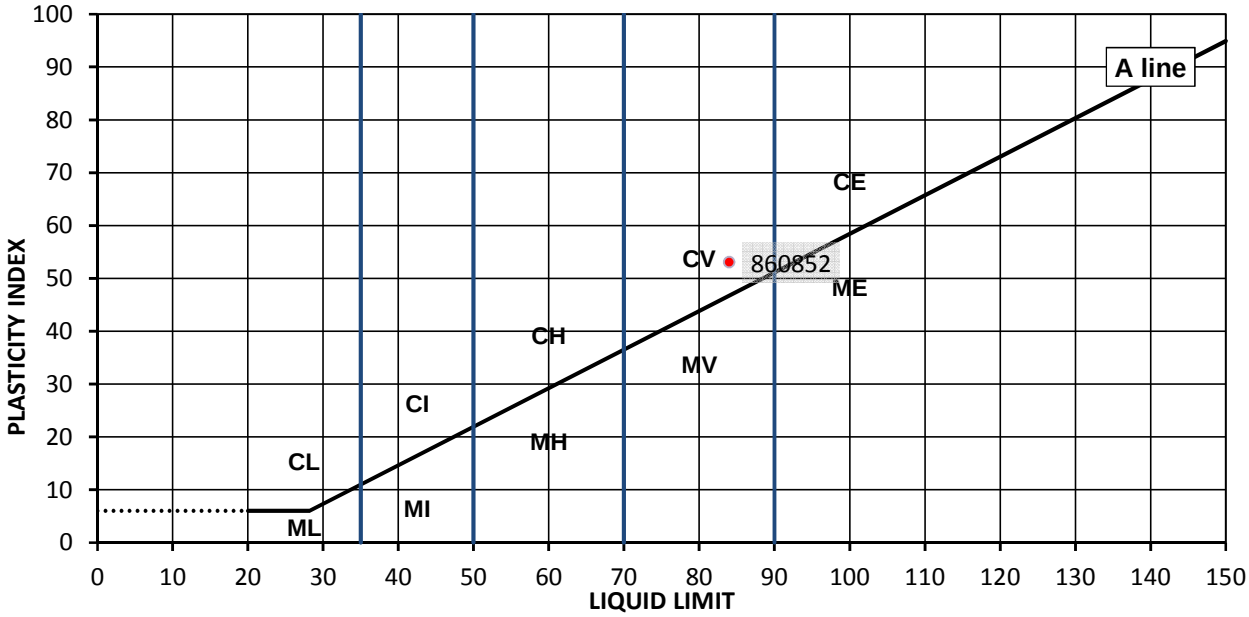
Client:	Jomas Associates Ltd	Client Reference:	JJ1245
Client Address:	Lakeside House 1 Furzeground Way Stockley Park UB11 1BD	Job Number:	17-68135
		Date Sampled:	Not Given
		Date Received:	15/11/2017
Contact:	Emma Hucker	Date Tested:	27/11/2017
Site Name:	38 Glenoch Road, Camden NW3 4DN	Sampled By:	Not Given
Site Address:	38 Glenoch Road, Camden NW3 4DN		

TEST RESULTS

Laboratory Reference: 860852
Sample Reference: Not Given

Description:	Yellowish brown CLAY	Sample Type:	B
Location:	WS2	Depth Top [m]:	3.00
Sample Preparation:	Tested in natural condition	Depth Base [m]:	Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
33	84	31	53	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Remarks

Approved:

Dariusz Piotrowski
PL Laboratory Manager
Geotechnical Section

Signed:

Darren Berrill
Geotechnical General Manager

Date Reported: 30/11/2017

for and on behalf of i2 Analytical Ltd

TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

UKAS TESTING 4041

Tested in Accordance with BS1377-2: 1990: Clause 4.3 & 5: Definitive Method

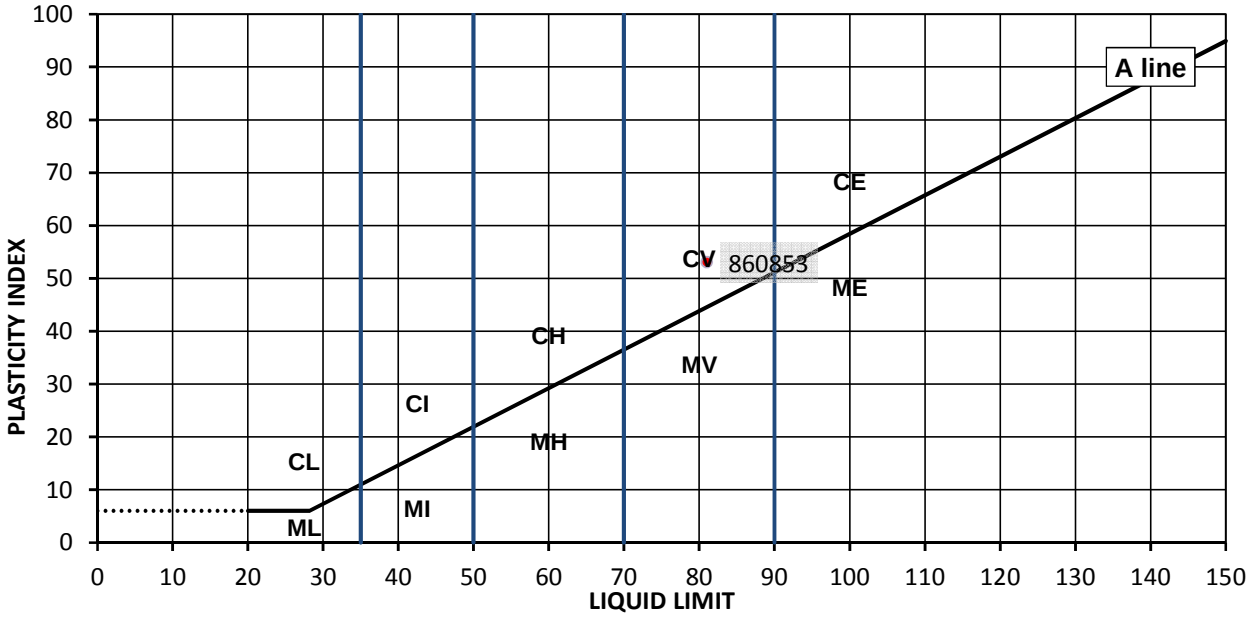
Client:	Jomas Associates Ltd	Client Reference:	JJ1245
Client Address:	Lakeside House 1 Furzeground Way Stockley Park UB11 1BD	Job Number:	17-68135
		Date Sampled:	Not Given
		Date Received:	15/11/2017
Contact:	Emma Hucker	Date Tested:	27/11/2017
Site Name:	38 Glenoch Road, Camden NW3 4DN	Sampled By:	Not Given
Site Address:	38 Glenoch Road, Camden NW3 4DN		

TEST RESULTS

Laboratory Reference: 860853
Sample Reference: Not Given

Description:	Yellowish brown CLAY	Sample Type:	B
Location:	WS2	Depth Top [m]:	4.00
Sample Preparation:	Tested in natural condition	Depth Base [m]:	Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
32	81	28	53	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Remarks

Approved:

Dariusz Piotrowski
PL Laboratory Manager
Geotechnical Section

Signed:

Darren Berrill
Geotechnical General Manager

Date Reported: 30/11/2017

for and on behalf of i2 Analytical Ltd

TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

UKAS TESTING 4041

Tested in Accordance with BS1377-2: 1990: Clause 4.3 & 5: Definitive Method

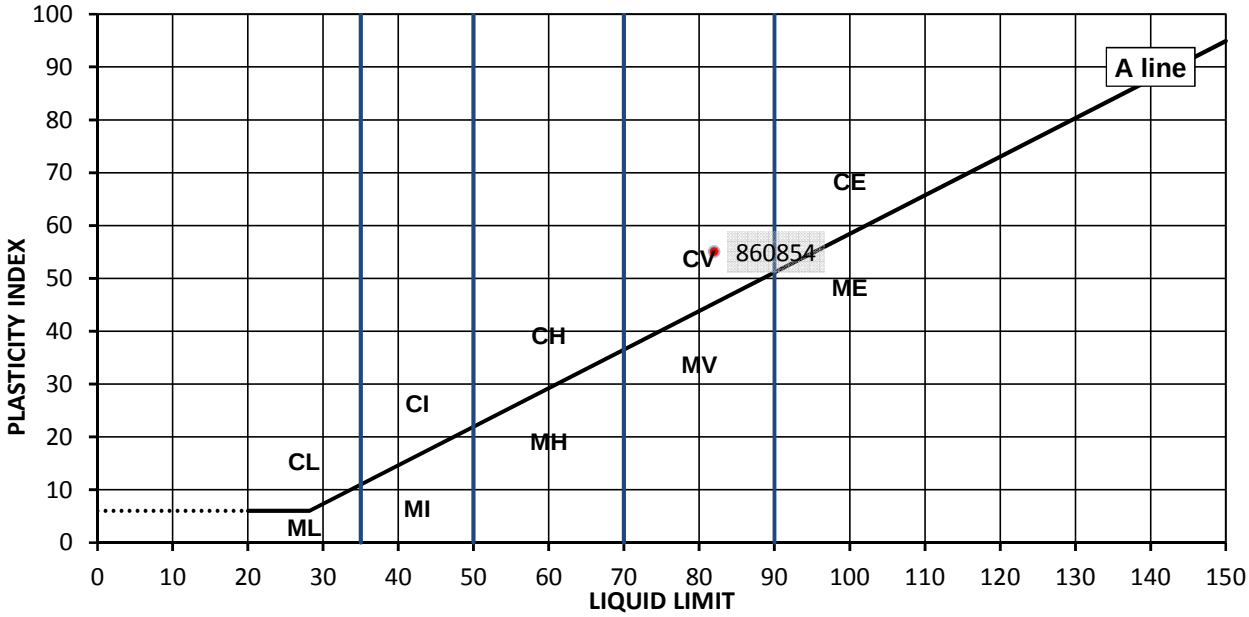
Client:	Jomas Associates Ltd	Client Reference:	JJ1245
Client Address:	Lakeside House 1 Furzeground Way Stockley Park UB11 1BD	Job Number:	17-68135
		Date Sampled:	Not Given
		Date Received:	15/11/2017
Contact:	Emma Hucker	Date Tested:	27/11/2017
Site Name:	38 Glenoch Road, Camden NW3 4DN	Sampled By:	Not Given
Site Address:	38 Glenoch Road, Camden NW3 4DN		

TEST RESULTS

Laboratory Reference: 860854
Sample Reference: Not Given

Description:	Yellowish brown CLAY	Sample Type:	B
Location:	WS2	Depth Top [m]:	5.00
Sample Preparation:	Tested in natural condition	Depth Base [m]:	Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
32	82	27	55	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Remarks

Approved:

Dariusz Piotrowski
PL Laboratory Manager
Geotechnical Section

Signed:

Darren Berrill
Geotechnical General Manager

Date Reported: 30/11/2017

for and on behalf of i2 Analytical Ltd

TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

UKAS TESTING 4041

Tested in Accordance with BS1377-2: 1990: Clause 4.3 & 5: Definitive Method

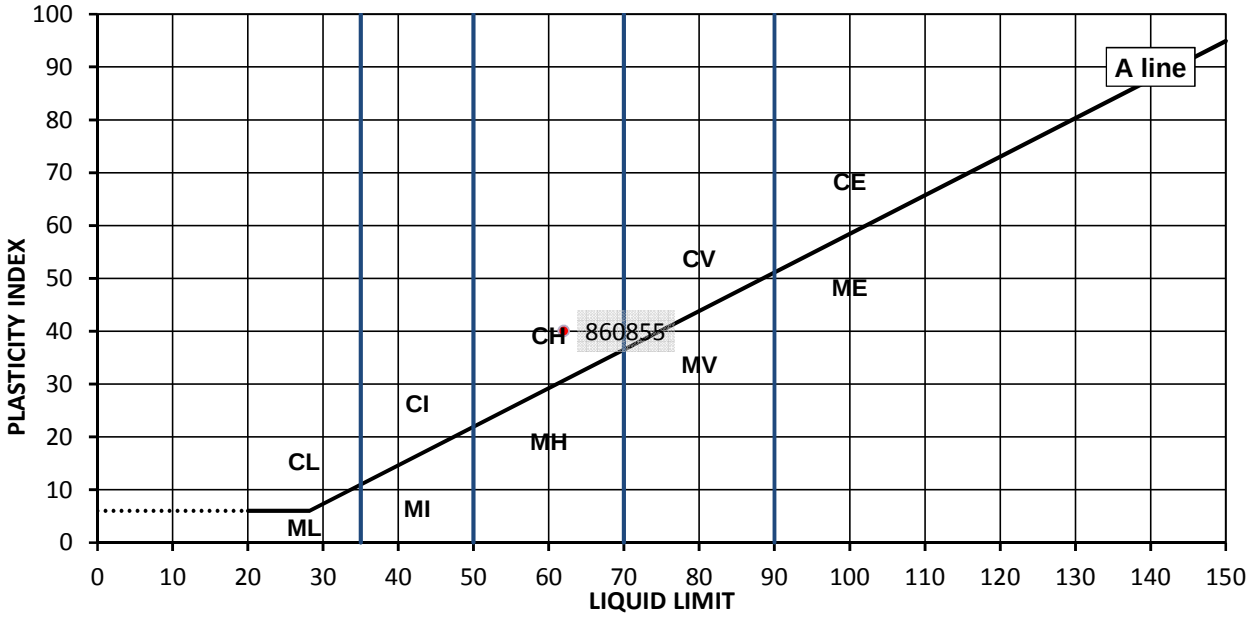
Client:	Jomas Associates Ltd	Client Reference:	JJ1245
Client Address:	Lakeside House 1 Furzeground Way Stockley Park UB11 1BD	Job Number:	17-68135
		Date Sampled:	Not Given
		Date Received:	15/11/2017
Contact:	Emma Hucker	Date Tested:	27/11/2017
Site Name:	38 Glenoch Road, Camden NW3 4DN	Sampled By:	Not Given
Site Address:	38 Glenoch Road, Camden NW3 4DN		

TEST RESULTS

Laboratory Reference: 860855
Sample Reference: Not Given

Description:	Brown slightly gravelly CLAY	Sample Type:	B
Location:	TP1	Depth Top [m]:	0.85
Sample Preparation:	Tested after >425um removed by hand	Depth Base [m]:	Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
31	62	22	40	93



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Remarks

Approved:

Dariusz Piotrowski
PL Laboratory Manager
Geotechnical Section

Signed:

Darren Berrill
Geotechnical General Manager

Date Reported: 30/11/2017

for and on behalf of i2 Analytical Ltd

TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

UKAS TESTING 4041

Tested in Accordance with BS1377-2: 1990: Clause 4.3 & 5: Definitive Method

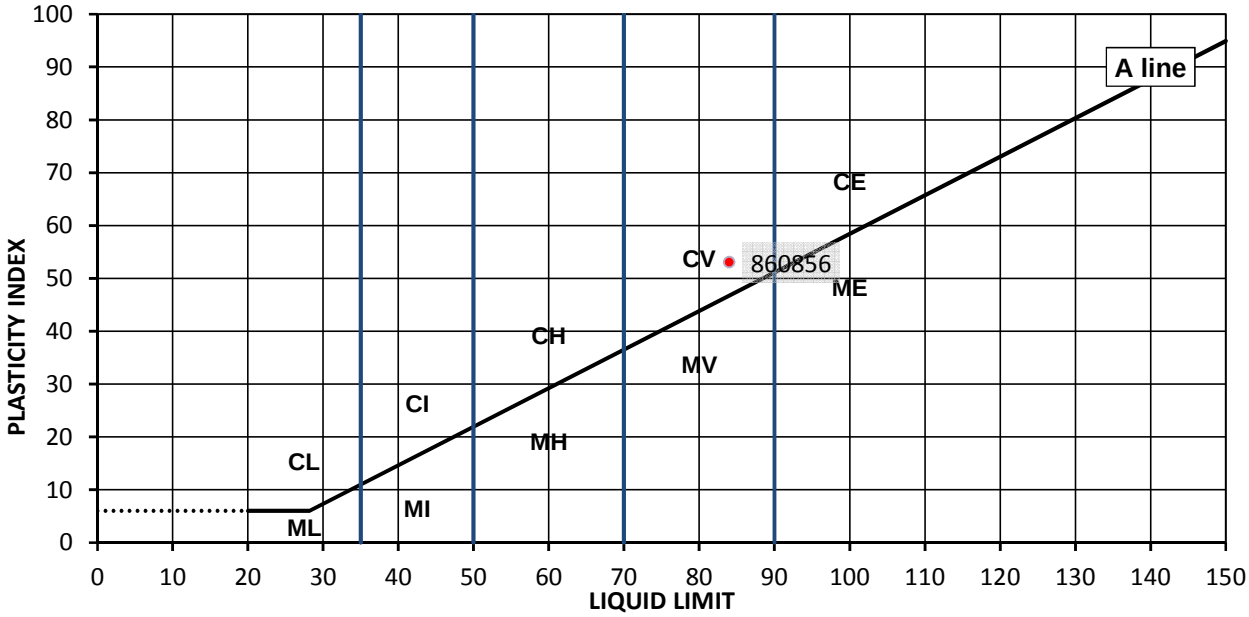
Client:	Jomas Associates Ltd	Client Reference:	JJ1245
Client Address:	Lakeside House 1 Furzeground Way Stockley Park UB11 1BD	Job Number:	17-68135
		Date Sampled:	Not Given
		Date Received:	15/11/2017
Contact:	Emma Hucker	Date Tested:	27/11/2017
Site Name:	38 Glenoch Road, Camden NW3 4DN	Sampled By:	Not Given
Site Address:	38 Glenoch Road, Camden NW3 4DN		

TEST RESULTS

Laboratory Reference: 860856
Sample Reference: Not Given

Description:	Yellowish brown gravelly CLAY	Sample Type:	B
Location:	TP3	Depth Top [m]:	0.95
Sample Preparation:	Tested after washing to remove >425um	Depth Base [m]:	Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
34	84	31	53	64



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Remarks

Approved:

Dariusz Piotrowski
PL Laboratory Manager
Geotechnical Section

Signed:

Darren Berrill
Geotechnical General Manager

Date Reported: 30/11/2017

for and on behalf of i2 Analytical Ltd

TEST CERTIFICATE

Summary of Classification Test Results

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

Client: Jomas Associates Ltd
Client Address: Lakeside House
1 Furzeground Way
Stockley Park
UB11 1BD
Contact: Emma Hucker
Site Name: 38 Glenoch Road, Camden NW3 4DN
Site Address: 38 Glenoch Road, Camden NW3 4DN

Client Reference: JJ1245
Job Number: 17-68135
Date Sampled: Not Given
Date Received: 15/11/2017
Date Tested: 27/11/2017
Sampled By: Not Given

Test results

Laboratory Reference	Hole No.	Sample				Soil Description	Density		M/C	Atterberg				PD
		Reference	Top depth [m]	Base depth [m]	Type		bulk Mg/m3	dry Mg/m3	%	% Passing 425um %	LL %	PL %	PI %	Mg/m3
860855	TP1	Not Given	0.85	Not Given	B	Brown slightly gravelly CLAY			31	93	62	22	40	
860856	TP3	Not Given	0.95	Not Given	B	Yellowish brown gravelly CLAY			34	64	84	31	53	
860851	WS2	Not Given	2.00	Not Given	B	Yellowish brown CLAY			36	100	88	29	59	
860852	WS2	Not Given	3.00	Not Given	B	Yellowish brown CLAY			33	100	84	31	53	
860853	WS2	Not Given	4.00	Not Given	B	Yellowish brown CLAY			32	100	81	28	53	
860854	WS2	Not Given	5.00	Not Given	B	Yellowish brown CLAY			32	100	82	27	55	

Comments:

Approved:

Dariusz Piotrowski
PL Laboratory Manager
Geotechnical Section

Date Reported: 30/11/2017

Signed:

Darren Berrill
Geotechnical General Manager

for and on behalf of i2 Analytical Ltd

TEST CERTIFICATE

Determination of Particle Size Distribution

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

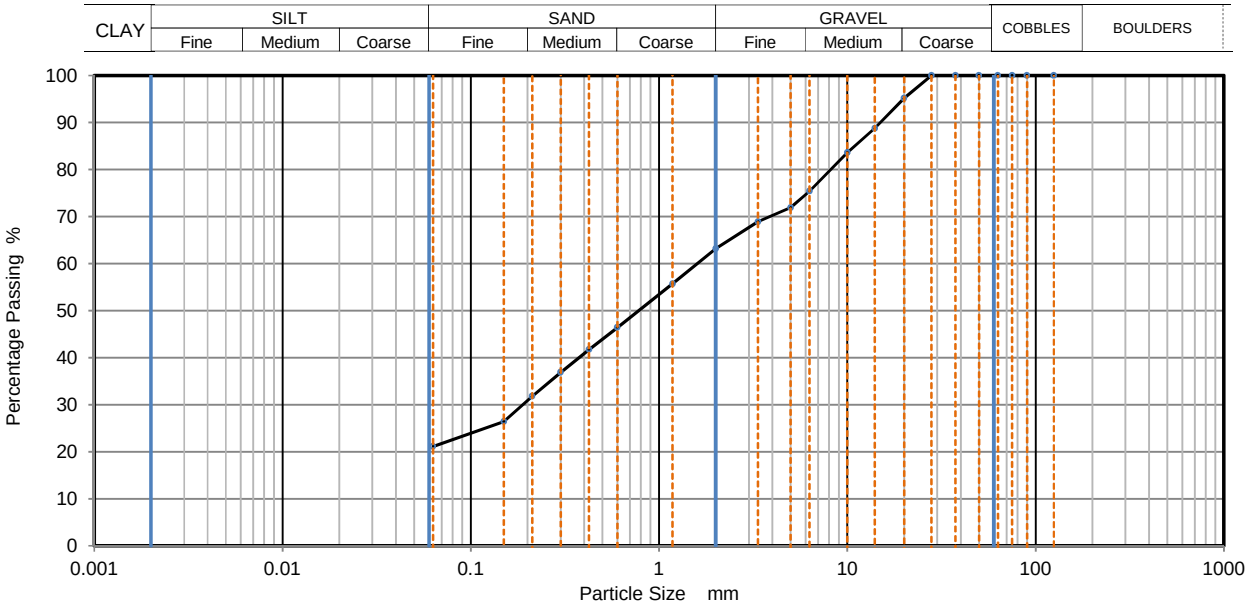
4041

Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Client:	Jomas Associates Ltd	Client Reference:	JJ1245
Client Address:	Lakeside House 1 Furzeground Way Stockley Park UB11 1BD	Job Number:	17-68135
		Date Sampled:	Not Given
		Date Received:	15/11/2017
Contact:	Emma Hucker	Date Tested:	27/11/2017
Site Name:	38 Glenoch Road, Camden NW3 4DN	Sampled By:	Not Given
Site Address:	38 Glenoch Road, Camden NW3 4DN		

TEST RESULTS Laboratory Reference: 860857

Sample description:	Brown clayey gravelly SAND	Sample Reference:	Not Given
Location:	TP4	Sample Type:	B
Supplier:	Not Given	Depth Top [m]:	1.25
		Depth Base [m]:	Not Given



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	95		
14	89		
10	84		
6.3	75		
5	72		
3.35	69		
2	63		
1.18	56		
0.6	46		
0.425	42		
0.3	37		
0.212	32		
0.15	26		
0.063	21		

Dry Mass of sample [g]: 1670

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	36.80
Sand	42.10
Fines <0.063mm	21.10

Grading Analysis		
D100	mm	28
D60	mm	1.6
D30	mm	0.189
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved:

Dariusz Piotrowski
PL Laboratory Manager
Geotechnical Section

Signed:

Darren Berrill
Geotechnical General Manager

Date Reported: 30/11/2017

for and on behalf of i2 Analytical Ltd

APPENDIX 9 – SOIL GAS MONITORING TEST RESULTS

GAS AND GROUNDWATER MONITORING BOREHOLE RECORD SHEET

Site: Glenoch Road	**Operative(s):** AM	**Date:** 21/11/2017	**Time:** 10:30	**Round: 1**	**Page:** 1

MONITORING EQUIPMENT

Instrument Type	**Instrument Make**	**Serial No.**	**Date Last Calibrated**
Analox	GA5000		19/06/2017
PID	Phocheck tiger		20/05/2016
Dip Meter	GeoTech		

MONITORING CONDITIONS

Weather Conditions: Overcast	**Ground Conditions: Dry**	**Temperature**: 10°C
Barometric Pressure (mbar): 1002	**Barometric Pressure Trend (24hr): Falling**	**Ambient Concentration:** **0.0**%CH_4, 0.1%CO_2, 21.1%O_2

MONITORING RESULTS

Monitoring Point Location	Flow		Atmospheric Pressure (mbar)	CH_4 %	CH_4 % LEL	CO_2 %	O_2 %	VOC (ppm)		H_2S (ppm)	CO (ppm)	Depth to product (mbgl)	Depth to water (mbgl)	Depth to Base of well (mbgl)
	Peak	Steady						Peak	Steady					
WS2	+0.6	+0.6	1002	0.1	/	0.8	20.6	2	1	0	0	/	4.16	4.70

GAS AND GROUNDWATER MONITORING BOREHOLE RECORD SHEET

Site: Glenoch Road	**Operative(s):** AM	**Date:** 30/11/17	**Time:** 10:05	**Round: 2**	**Page:** 1

MONITORING EQUIPMENT

Instrument Type	**Instrument Make**	**Serial No.**	**Date Last Calibrated**
Analox	GA5000		19/06/2017
PID	Phocheck tiger		20/05/2016
Dip Meter	GeoTech		

MONITORING CONDITIONS

Weather Conditions: Clear sky / Sunny	**Ground Conditions: Dry**	**Temperature**: 1°C
Barometric Pressure (mbar): 1000	**Barometric Pressure Trend (24hr): Steady**	**Ambient Concentration:** **0.0**%CH_4, 0.3%CO_2, 21.0%O_2

MONITORING RESULTS

Monitoring Point Location	Flow		Atmospheric Pressure (mbar)	CH_4 %	CH_4 % LEL	CO_2 %	O_2 %	VOC (ppm)		H_2S (ppm)	CO (ppm)	Depth to product (mbgl)	Depth to water (mbgl)	Depth to Base of well (mbgl)
	Peak	Steady						Peak	Steady					
WS2	+0.4	+0.4	1000	0.0	/	1.9	20.6	-	-	0	0	/	3.16	4.70

GAS AND GROUNDWATER MONITORING BOREHOLE RECORD SHEET

Site: Glenoch Road	**Operative(s):** AM	**Date:** 07/12/2017	**Time:** 10:05	**Round: 3**	**Page:** 1

MONITORING EQUIPMENT

Instrument Type	**Instrument Make**	**Serial No.**	**Date Last Calibrated**
Analox	GA5000		19/06/2017
PID	Phocheck tiger		20/05/2016
Dip Meter	GeoTech		

MONITORING CONDITIONS

Weather Conditions: Light Rain	**Ground Conditions: Damp**	**Temperature**: 5°C
Barometric Pressure (mbar): 998	**Barometric Pressure Trend (24hr): Falling**	**Ambient Concentration:** **0.0**%CH_4, 0.1%CO_2, 21.1%O_2

MONITORING RESULTS

Monitoring Point Location	Flow		Atmospheric Pressure (mbar)	CH_4 %	CH_4 % LEL	CO_2 %	O_2 %	VOC (ppm)		H_2S (ppm)	CO (ppm)	Depth to product (mbgl)	Depth to water (mbgl)	Depth to Base of well (mbgl)
	Peak	Steady						Peak	Steady					
WS2	+0.3	+0.3	998	0.0	/	1.0	20.4	2	1	0	0	/	Dry	4.70

GAS AND GROUNDWATER MONITORING BOREHOLE RECORD SHEET

Site: Glenoch Road	**Operative(s):** AM	**Date:** 12/12/2017	**Time: 11:45**	**Round: 3**	**Page:** 1

MONITORING EQUIPMENT

Instrument Type	**Instrument Make**	**Serial No.**	**Date Last Calibrated**
Analox	GA5000		19/06/2017
PID	Phocheck tiger		20/05/2016
Dip Meter	GeoTech		

MONITORING CONDITIONS

Weather Conditions: Clear sky - Sunny	**Ground Conditions: Damp - Dry**	**Temperature**: 0°C
Barometric Pressure (mbar): 999	**Barometric Pressure Trend (24hr): Rising**	**Ambient Concentration:** **0.0**%CH_4, 0.1%CO_2, 21.1%O_2

MONITORING RESULTS

Monitoring Point Location	Flow		Atmospheric Pressure (mbar)	CH_4 %	CH_4 % LEL	CO_2 %	O_2 %	VOC (ppm)		H_2S (ppm)	CO (ppm)	Depth to product (mbgl)	Depth to water (mbgl)	Depth to Base of well (mbgl)
	Peak	Steady						Peak	Steady					
WS2	+0.4	+0.4	999	0.0	/	2.5	20.4	1	1	0	0	/	2.42	4.70

Appendix D

Building Damage Classification Table

Classification of visible damage to walls (after Burland et al*, 1977, Boscardin and Cording, 1989; and Burland, 2001)*

Category of damage	Description of typical damage (ease of repair is underlined)	Approximate crack width (mm)	Limiting tensile strain ε_{lim} (per cent)
0 Negligible	Hairline cracks of less than about 0.1 mm are classed as negligible.	< 0.1	0.0–0.05
1 Very slight	Fine cracks that can easily be treated during normal decoration. Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection.	< 1	0.05–0.075
2 Slight	Cracks easily filled. Redecoration probably required. Several slight fractures showing inside of building. Cracks are visible externally and some repointing may be required externally to ensure weathertightness. Doors and windows may stick slightly.	< 5	0.075–0.15
3 Moderate	The cracks require some opening up and can be patched by a mason. Recurrent cracks can be masked by suitable linings. Repointing of external brickwork and possibly a small amount of brickwork to be replaced. Doors and windows sticking. Service pipes may fracture. Weathertightness often impaired.	5–15 or a number of cracks > 3	0.15–0.3
4 Severe	Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Windows and frames distorted, floor sloping noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Service pipes disrupted.	15–25 but also depends on number of cracks	> 0.3
5 Very severe	This requires a major repair involving partial or complete rebuilding. Beams lose bearings, walls lean badly and require shoring. Windows broken with distortion. Danger of instability.	usually > 25 but depends on number of cracks.	

Notes

1. In assessing the degree of damage, account must be taken of its location in the building or structure.
2. Crack width is only one aspect of damage and should not be used on its own as a direct measure of it.

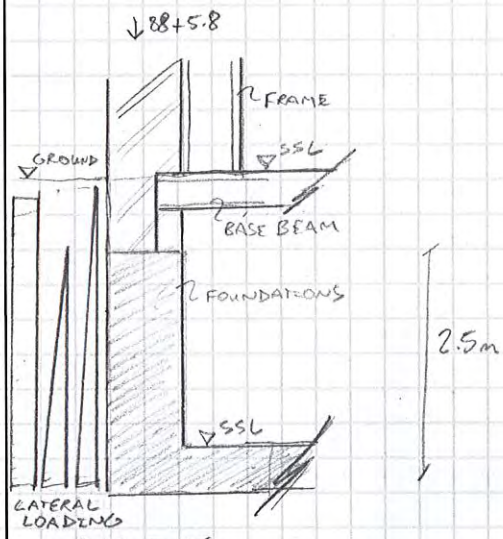
Appendix E

Design Philosophy and Preliminary Calculations

JOB TITLE:	JOB NUMBER / FILE:	CALCULATION NUMBER:		Form
38 G.R.	172904			
CALCULATION:	CALCULATION BY:	DATE:	CHECKED BY:	
FOUNDATIONS AT GRIDLINE 4D				

CALCULATIONS:

REF



OUTPUT

	DL	IL
LOADING		
MASONRY: $19kN/m^3 \times 0.35m \times 11.5m$ =	76.5kN/m	
MASONRY: $19kN/m^3 \times 0.25m \times (7m \times 1.8m \times 0.67) \div 2$ =	21kN	
ROOF: $0.9kN/m^2 \times 5m \div 2 \times 2m \div 2$ =	2.25kN	
IL $0.6kN/m^2 \times 5m \div 2 \times 2m \div 2$ =		1.5kN
3RD AND 2ND FLOORS: $1.1kN/m^2 \times 4m \div 2 \times 2m \div 2 \times 2$	4.4kN	
IL $2.5kN/m^2 \times 4m \div 2 \times 2m \div 2 \times 2$		10kN
FIRST FLOOR: $1.1kN/m^2 \times 5m \div 2 \times 2m \div 2$ =	2.8kN	
IL $2.5kN/m^2 \times 5m \div 2 \times 2m \div 2$		6.3kN
GROUND LEVEL: $6kN/m^2 \times 5m \div 2 \times 2m \div 2$ =	15kN	
IL $2.5kN/m^2 \times 5m \div 2 \times 2m \div 2$ =		6.3kN

TOTAL REAR FACADE LOADING DISTRIBUTED OVER $2 \times 2.1m = 4.2m$

$\therefore [21 + 2.25 + 4.4 + 2.8 + 15] \div 4.2m = 11kN/m$

$[1.5 + 10 + 6.3 + 6.3] \div 4.2m = 5.8kN$

$\therefore$ TOTAL LOADING = $76.5 + 11 = 88kN/m$ DL

$5.8kN/m$ IL

LATERAL LOADING: SOIL REFER TO TEDD'S CALCULATIONS

WATER AT 2.5m: REFER TO TEDD'S CALCULATIONS

SURCHARGE: $(20kN/m^3 \times 1.1m) + 10kN/m^2 = 32kN/m^2$

REFER TO TEDD'S CALCULATIONS

SPECIFY 350mm LINER AND 450mm BASE

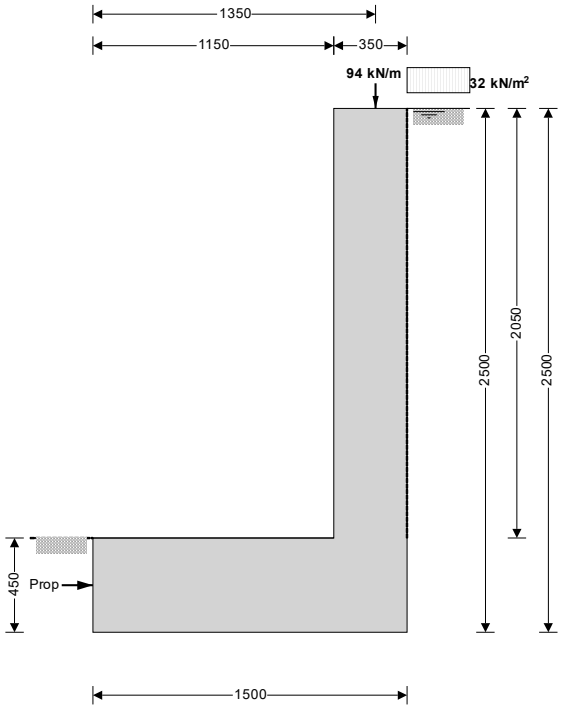
BEARING = $126.7kN/m^2 < 150kN/m^2$

$\therefore$ BEARING < BEARING CAPACITY

Tekla Tedds	Project				Job no.	
Form Structural Design 77 St John Street London EC1M 4NN	Glenloch				172904	
	Calcs for				Start page no./Revision	
	Foundations at gridlines 4D				1	
	Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date

RETAINING WALL ANALYSIS (BS 8002:1994)

TEDDS calculation version 1.2.01.06



Wall details

Retaining wall type	**Cantilever propped at base**
Height of retaining wall stem	h_{stem} = **2050** mm
Thickness of wall stem	t_{wall} = **350** mm
Length of toe	l_{toe} = **1150** mm
Length of heel	l_{heel} = **0** mm
Overall length of base	$l_{base} = l_{toe} + l_{heel} + t_{wall}$ = **1500** mm
Thickness of base	t_{base} = **450** mm
Depth of downstand	d_{ds} = **0** mm
Position of downstand	l_{ds} = **1050** mm
Thickness of downstand	t_{ds} = **450** mm
Height of retaining wall	$h_{wall} = h_{stem} + t_{base} + d_{ds}$ = **2500** mm
Depth of cover in front of wall	d_{cover} = **0** mm
Depth of unplanned excavation	d_{exc} = **0** mm
Height of ground water behind wall	h_{water} = **2500** mm
Height of saturated fill above base	$h_{sat} = \max(h_{water} - t_{base} - d_{ds}, 0\ mm)$ = **2050** mm
Density of wall construction	γ_{wall} = **23.6** kN/m^3
Density of base construction	γ_{base} = **23.6** kN/m^3
Angle of rear face of wall	α = **90.0** deg
Angle of soil surface behind wall	β = **0.0** deg
Effective height at virtual back of wall	$h_{eff} = h_{wall} + l_{heel} \times \tan(\beta)$ = **2500** mm

Retained material details

Mobilisation factor	M = **1.5**
Moist density of retained material	γ_m = **18.0** kN/m^3

Saturated density of retained material γ_s = **21.0** kN/m^3

Design shear strength ϕ' = **24.2** deg

Angle of wall friction δ = **0.0** deg

Base material details

Moist density γ_{mb} = **18.0** kN/m^3

Design shear strength ϕ'_b = **24.2** deg

Design base friction δ_b = **18.6** deg

Allowable bearing pressure $P_{bearing}$ = **150** kN/m^2

Using Coulomb theory

Active pressure coefficient for retained material

$$K_a = \sin(\alpha + \phi')^2 / (\sin(\alpha)^2 \times \sin(\alpha - \delta) \times [1 + \sqrt{(\sin(\phi' + \delta) \times \sin(\phi' - \beta) / (\sin(\alpha - \delta) \times \sin(\alpha + \beta)))}]^2) = \mathbf{0.419}$$

Passive pressure coefficient for base material

$$K_p = \sin(90 - \phi'_b)^2 / (\sin(90 - \delta_b) \times [1 - \sqrt{(\sin(\phi'_b + \delta_b) \times \sin(\phi'_b) / (\sin(90 + \delta_b)))}]^2) = \mathbf{4.187}$$

At-rest pressure

At-rest pressure for retained material $K_0 = 1 - \sin(\phi') = \mathbf{0.590}$

Loading details

Surcharge load on plan Surcharge = **32.0** kN/m^2

Applied vertical dead load on wall W_{dead} = **88.0** kN/m

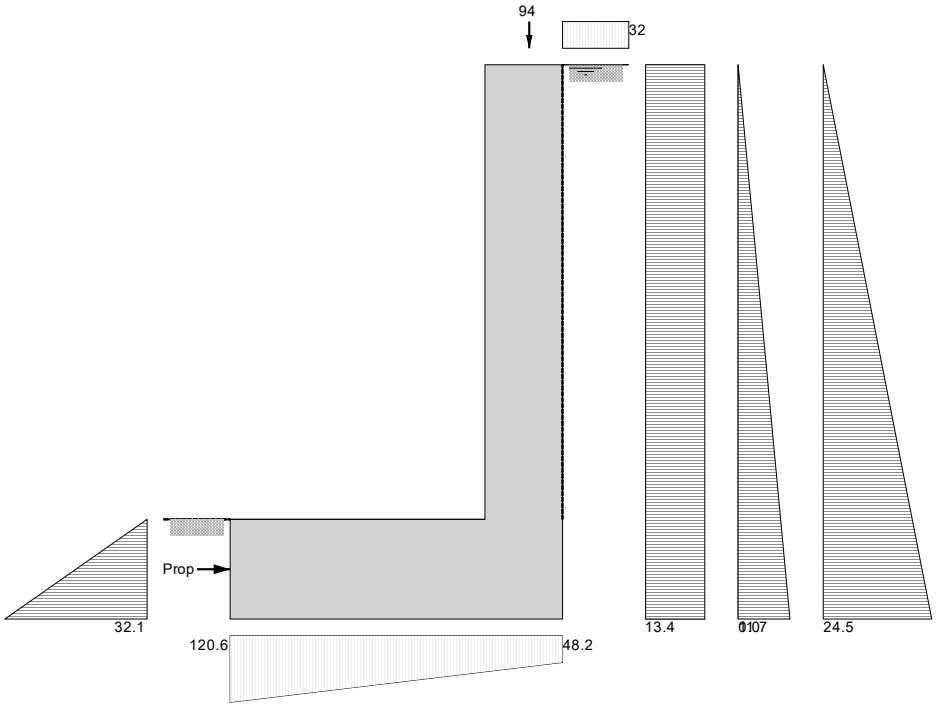
Applied vertical live load on wall W_{live} = **5.8** kN/m

Position of applied vertical load on wall l_{load} = **1350** mm

Applied horizontal dead load on wall F_{dead} = **0.0** kN/m

Applied horizontal live load on wall F_{live} = **0.0** kN/m

Height of applied horizontal load on wall h_{load} = **0** mm



Loads shown in kN/m, pressures shown in kN/m^2

Vertical forces on wall

Wall stem $w_{wall} = h_{stem} \times t_{wall} \times \gamma_{wall}$ = **16.9** kN/m

Wall base	$w_{base} = l_{base} \times t_{base} \times \gamma_{base}$ = **15.9** kN/m
Applied vertical load	$W_v = W_{dead} + W_{live}$ = **93.8** kN/m
Total vertical load	$W_{total} = w_{wall} + w_{base} + W_v$ = **126.7** kN/m

Horizontal forces on wall

Surcharge	$F_{sur} = K_a \times \text{Surcharge} \times h_{eff}$ = **33.5** kN/m
Saturated backfill	$F_s = 0.5 \times K_a \times (\gamma_s - \gamma_{water}) \times h_{water}^2$ = **14.6** kN/m
Water	$F_{water} = 0.5 \times h_{water}^2 \times \gamma_{water}$ = **30.7** kN/m
Total horizontal load	$F_{total} = F_{sur} + F_s + F_{water}$ = **78.8** kN/m

Calculate propping force

Passive resistance of soil in front of wall	$F_p = 0.5 \times K_p \times \cos(\delta_b) \times (d_{cover} + t_{base} + d_{ds} - d_{exc})^2 \times \gamma_{mb}$ = **7.2** kN/m
Propping force	$F_{prop} = \max(F_{total} - F_p - (W_{total} - W_{live}) \times \tan(\delta_b), 0\ \text{kN/m})$
	F_{prop} = **30.9** kN/m

Overturning moments

Surcharge	$M_{sur} = F_{sur} \times (h_{eff} - 2 \times d_{ds}) / 2$ = **41.9** kNm/m
Saturated backfill	$M_s = F_s \times (h_{water} - 3 \times d_{ds}) / 3$ = **12.2** kNm/m
Water	$M_{water} = F_{water} \times (h_{water} - 3 \times d_{ds}) / 3$ = **25.5** kNm/m
Total overturning moment	$M_{ot} = M_{sur} + M_s + M_{water}$ = **79.6** kNm/m

Restoring moments

Wall stem	$M_{wall} = w_{wall} \times (l_{toe} + t_{wall} / 2)$ = **22.4** kNm/m
Wall base	$M_{base} = w_{base} \times l_{base} / 2$ = **11.9** kNm/m
Design vertical dead load	$M_{dead} = W_{dead} \times l_{load}$ = **118.8** kNm/m
Total restoring moment	$M_{rest} = M_{wall} + M_{base} + M_{dead}$ = **153.2** kNm/m

Check bearing pressure

Design vertical live load	$M_{live} = W_{live} \times l_{load}$ = **7.8** kNm/m
Total moment for bearing	$M_{total} = M_{rest} - M_{ot} + M_{live}$ = **81.4** kNm/m
Total vertical reaction	$R = W_{total}$ = **126.7** kN/m
Distance to reaction	$x_{bar} = M_{total} / R$ = **643** mm
Eccentricity of reaction	$e = \text{abs}((l_{base} / 2) - x_{bar})$ = **107** mm
	Reaction acts within middle third of base
Bearing pressure at toe	$p_{toe} = (R / l_{base}) + (6 \times R \times e / l_{base}^2)$ = **120.6** kN/m^2
Bearing pressure at heel	$p_{heel} = (R / l_{base}) - (6 \times R \times e / l_{base}^2)$ = **48.2** kN/m^2

PASS - Maximum bearing pressure is less than allowable bearing pressure

RETAINING WALL DESIGN (BS 8002:1994)

TEDDS calculation version 1.2.01.06

Ultimate limit state load factors

Dead load factor γ_{f_d} = **1.4**

Live load factor γ_{f_l} = **1.6**

Earth and water pressure factor γ_{f_e} = **1.4**

Factored vertical forces on wall

Wall stem $w_{wall\_f} = \gamma_{f\_d} \times h_{stem} \times t_{wall} \times \gamma_{wall}$ = **23.7** kN/m

Wall base $w_{base\_f} = \gamma_{f\_d} \times l_{base} \times t_{base} \times \gamma_{base}$ = **22.3** kN/m

Applied vertical load $W_{v\_f} = \gamma_{f\_d} \times W_{dead} + \gamma_{f\_l} \times W_{live}$ = **132.5** kN/m

Total vertical load $W_{total\_f} = w_{wall\_f} + w_{base\_f} + W_{v\_f}$ = **178.5** kN/m

Factored horizontal active forces on wall

Surcharge $F_{sur\_f} = \gamma_{f\_l} \times K_a \times \text{Surcharge} \times h_{eff}$ = **53.6** kN/m

Saturated backfill $F_{s\_f} = \gamma_{f\_e} \times 0.5 \times K_a \times (\gamma_s - \gamma_{water}) \times h_{water}^2$ = **20.5** kN/m

Water $F_{water\_f} = \gamma_{f\_e} \times 0.5 \times h_{water}^2 \times \gamma_{water}$ = **42.9** kN/m

Total horizontal load $F_{total\_f} = F_{sur\_f} + F_{s\_f} + F_{water\_f}$ = **117** kN/m

Calculate propping force

Passive resistance of soil in front of wall $F_{p\_f} = \gamma_{f\_e} \times 0.5 \times K_p \times \cos(\delta_b) \times (d_{cover} + t_{base} + d_{ds} - d_{exc})^2 \times \gamma_{mb}$ = **10.1** kN/m

Propping force $F_{prop\_f} = \max(F_{total\_f} - F_{p\_f} - (W_{total\_f} - \gamma_{f\_l} \times W_{live}) \times \tan(\delta_b), 0\ \text{kN/m})$

F_{prop_f} = **49.9** kN/m

Factored overturning moments

Surcharge $M_{sur\_f} = F_{sur\_f} \times (h_{eff} - 2 \times d_{ds}) / 2$ = **67** kNm/m

Saturated backfill $M_{s\_f} = F_{s\_f} \times (h_{water} - 3 \times d_{ds}) / 3$ = **17.1** kNm/m

Water $M_{water\_f} = F_{water\_f} \times (h_{water} - 3 \times d_{ds}) / 3$ = **35.8** kNm/m

Total overturning moment $M_{ot\_f} = M_{sur\_f} + M_{s\_f} + M_{water\_f}$ = **119.8** kNm/m

Restoring moments

Wall stem $M_{wall\_f} = w_{wall\_f} \times (l_{toe} + t_{wall} / 2)$ = **31.4** kNm/m

Wall base $M_{base\_f} = w_{base\_f} \times l_{base} / 2$ = **16.7** kNm/m

Design vertical load $M_{v\_f} = W_{v\_f} \times l_{load}$ = **178.8** kNm/m

Total restoring moment $M_{rest\_f} = M_{wall\_f} + M_{base\_f} + M_{v\_f}$ = **227** kNm/m

Factored bearing pressure

Total moment for bearing $M_{total\_f} = M_{rest\_f} - M_{ot\_f}$ = **107.2** kNm/m

Total vertical reaction $R_f = W_{total\_f}$ = **178.5** kN/m

Distance to reaction $x_{bar\_f} = M_{total\_f} / R_f$ = **601** mm

Eccentricity of reaction $e_f = \text{abs}((l_{base} / 2) - x_{bar\_f})$ = **149** mm

Reaction acts within middle third of base

Bearing pressure at toe $p_{toe\_f} = (R_f / l_{base}) + (6 \times R_f \times e_f / l_{base}^2)$ = **190.1** kN/m^2

Bearing pressure at heel $p_{heel\_f} = (R_f / l_{base}) - (6 \times R_f \times e_f / l_{base}^2)$ = **47.8** kN/m^2

Rate of change of base reaction $\text{rate} = (p_{toe\_f} - p_{heel\_f}) / l_{base}$ = **94.87** kN/m^2/m

Bearing pressure at stem / toe $p_{stem\_toe\_f} = \max(p_{toe\_f} - (\text{rate} \times l_{toe}), 0\ \text{kN/m}^2)$ = **81** kN/m^2

Bearing pressure at mid stem $p_{stem\_mid\_f} = \max(p_{toe\_f} - (\text{rate} \times (l_{toe} + t_{wall} / 2)), 0\ \text{kN/m}^2)$ = **64.4** kN/m^2

Bearing pressure at stem / heel $p_{stem\_heel\_f} = \max(p_{toe\_f} - (\text{rate} \times (l_{toe} + t_{wall})), 0\ \text{kN/m}^2)$ = **47.8** kN/m^2

Design of reinforced concrete retaining wall toe (BS 8002:1994)

Material properties

Characteristic strength of concrete f_{cu} = **40** N/mm^2

Characteristic strength of reinforcement f_y = **500** N/mm^2

Base details

Minimum area of reinforcement k = **0.13** %

Cover to reinforcement in toe c_{toe} = **40** mm

Calculate shear for toe design

Shear from bearing pressure $V_{toe\_bear} = (p_{toe\_f} + p_{stem\_toe\_f}) \times l_{toe} / 2$ = **155.9** kN/m

Shear from weight of base $V_{toe\_wt\_base} = \gamma_{f\_d} \times \gamma_{base} \times l_{toe} \times t_{base}$ = **17.1** kN/m

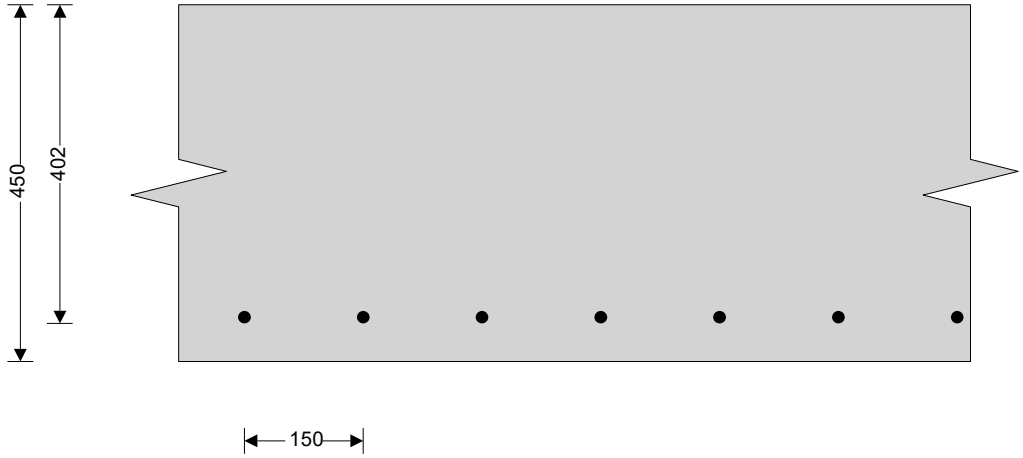
Total shear for toe design $V_{toe} = V_{toe\_bear} - V_{toe\_wt\_base}$ = **138.8** kN/m

Calculate moment for toe design

Moment from bearing pressure $M_{toe\_bear} = (2 \times p_{toe\_f} + p_{stem\_mid\_f}) \times (l_{toe} + t_{wall} / 2)^2 / 6$ = **130.1** kNm/m

Moment from weight of base $M_{toe\_wt\_base} = (\gamma_{f\_d} \times \gamma_{base} \times t_{base} \times (l_{toe} + t_{wall} / 2)^2 / 2)$ = **13.1** kNm/m

Total moment for toe design $M_{toe} = M_{toe\_bear} - M_{toe\_wt\_base}$ = **117.1** kNm/m



Check toe in bending

Width of toe b = **1000** mm/m

Depth of reinforcement $d_{toe} = t_{base} - c_{toe} - (\phi_{toe} / 2)$ = **402.0** mm

Constant $K_{toe} = M_{toe} / (b \times d_{toe}^2 \times f_{cu})$ = **0.018**

Compression reinforcement is not required

Lever arm $z_{toe} = \min(0.5 + \sqrt{}(0.25 - (\min(K_{toe}, 0.225) / 0.9)),0.95) \times d_{toe}$

z_{toe} = **382** mm

Area of tension reinforcement required $A_{s\_toe\_des} = M_{toe} / (0.87 \times f_y \times z_{toe})$ = **705** mm^2/m

Minimum area of tension reinforcement $A_{s\_toe\_min} = k \times b \times t_{base}$ = **585** mm^2/m

Area of tension reinforcement required $A_{s\_toe\_req} = \max(A_{s\_toe\_des}, A_{s\_toe\_min})$ = **705** mm^2/m

Reinforcement provided **16 mm dia.bars @ 150 mm centres**

Area of reinforcement provided $A_{s\_toe\_prov}$ = **1340** mm^2/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress $v_{toe} = V_{toe} / (b \times d_{toe})$ = **0.345** N/mm^2

Allowable shear stress $v_{adm} = \min(0.8 \times \sqrt{}(f_{cu} / 1\ \text{N/mm}^2), 5) \times 1\ \text{N/mm}^2$ = **5.000** N/mm^2

PASS - Design shear stress is less than maximum shear stress

From BS8110:Part 1:1997 – Table 3.8

Design concrete shear stress v_{c_toe} = **0.513** N/mm^2

v_{toe} < v_{c_toe} - No shear reinforcement required

Design of reinforced concrete retaining wall stem (BS 8002:1994)

Material properties

Characteristic strength of concrete f_{cu} = **40** N/mm^2

Characteristic strength of reinforcement f_y = **500** N/mm^2

Wall details

Minimum area of reinforcement k = **0.13** %

Cover to reinforcement in stem c_{stem} = **40** mm

Cover to reinforcement in wall c_{wall} = **40** mm

Factored horizontal active forces on stem

Surcharge $F_{s\_sur\_f} = \gamma_{f\_l} \times K_a \times \text{Surcharge} \times (h_{eff} - t_{base} - d_{ds})$ = **43.9** kN/m

Saturated backfill $F_{s\_s\_f} = 0.5 \times \gamma_{f\_e} \times K_a \times (\gamma_s - \gamma_{water}) \times h_{sat}^2$ = **13.8** kN/m

Water $F_{s\_water\_f} = 0.5 \times \gamma_{f\_e} \times \gamma_{water} \times h_{sat}^2$ = **28.9** kN/m

Calculate shear for stem design

Shear at base of stem $V_{stem} = F_{s\_sur\_f} + F_{s\_s\_f} + F_{s\_water\_f} - F_{prop\_f}$ = **36.7** kN/m

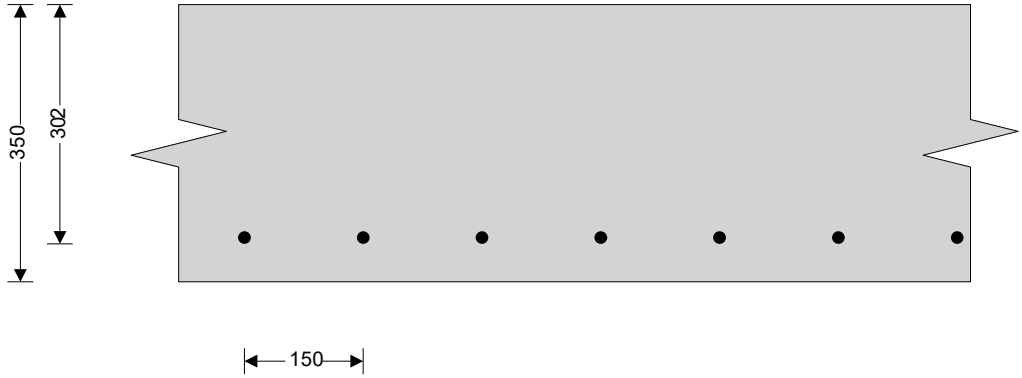
Calculate moment for stem design

Surcharge $M_{s\_sur} = F_{s\_sur\_f} \times (h_{stem} + t_{base}) / 2$ = **54.9** kNm/m

Saturated backfill $M_{s\_s} = F_{s\_s\_f} \times h_{sat} / 3$ = **9.4** kNm/m

Water $M_{s\_water} = F_{s\_water\_f} \times h_{sat} / 3$ = **19.7** kNm/m

Total moment for stem design $M_{stem} = M_{s\_sur} + M_{s\_s} + M_{s\_water}$ = **84** kNm/m



Check wall stem in bending

Width of wall stem b = **1000** mm/m

Depth of reinforcement $d_{stem} = t_{wall} - c_{stem} - (\phi_{stem} / 2)$ = **302.0** mm

Constant $K_{stem} = M_{stem} / (b \times d_{stem}^2 \times f_{cu})$ = **0.023**

Compression reinforcement is not required

Lever arm $z_{stem} = \min(0.5 + \sqrt{(0.25 - (\min(K_{stem}, 0.225) / 0.9))}, 0.95) \times d_{stem}$

z_{stem} = **287** mm

Area of tension reinforcement required $A_{s\_stem\_des} = M_{stem} / (0.87 \times f_y \times z_{stem})$ = **673** mm^2/m

Minimum area of tension reinforcement $A_{s\_stem\_min} = k \times b \times t_{wall}$ = **455** mm^2/m

Area of tension reinforcement required $A_{s\_stem\_req} = \text{Max}(A_{s\_stem\_des}, A_{s\_stem\_min})$ = **673** mm^2/m

Reinforcement provided **16 mm dia.bars @ 150 mm centres**

Area of reinforcement provided $A_{s\_stem\_prov}$ = **1340** mm^2/m

PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress $v_{stem} = V_{stem} / (b \times d_{stem}) = \mathbf{0.121}$ N/mm^2

Allowable shear stress $v_{adm} = \min(0.8 \times \sqrt{(f_{cu} / 1\ \text{N/mm}^2)}, 5) \times 1\ \text{N/mm}^2 = \mathbf{5.000}$ N/mm^2

PASS - Design shear stress is less than maximum shear stress

From BS8110:Part 1:1997 – Table 3.8

Design concrete shear stress $v_{c\_stem} = \mathbf{0.605}$ N/mm^2

v_{stem} < v_{c_stem} - No shear reinforcement required

Check retaining wall deflection

Basic span/effective depth ratio $ratio_{bas} = \mathbf{7}$

Design service stress $f_s = 2 \times f_y \times A_{s\_stem\_req} / (3 \times A_{s\_stem\_prov}) = \mathbf{167.5}$ N/mm^2

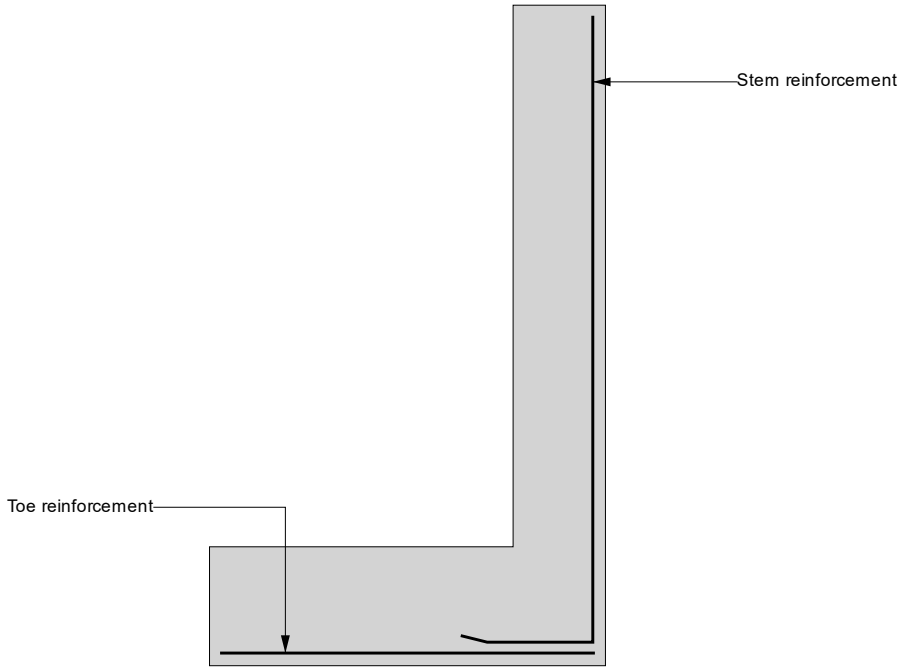
Modification factor $factor_{tens} = \min(0.55 + (477\ \text{N/mm}^2 - f_s)/(120 \times (0.9\ \text{N/mm}^2 + (M_{stem}/(b \times d_{stem}^2)))),2) = \mathbf{1.97}$

Maximum span/effective depth ratio $ratio_{max} = ratio_{bas} \times factor_{tens} = \mathbf{13.76}$

Actual span/effective depth ratio $ratio_{act} = h_{stem} / d_{stem} = \mathbf{6.79}$

PASS - Span to depth ratio is acceptable

Indicative retaining wall reinforcement diagram



Toe bars - 16 mm dia.@ 150 mm centres - (1340 mm^2/m)
Stem bars - 16 mm dia.@ 150 mm centres - (1340 mm^2/m)

JOB TITLE:	JOB NUMBER / FILE:	CALCULATION NUMBER:		Form
38 G.R.	172904			
CALCULATION:	CALCULATION BY:	DATE:	CHECKED BY:	
RC LINERS ADJACENT 40 G.R.				

CALCULATIONS:

REF

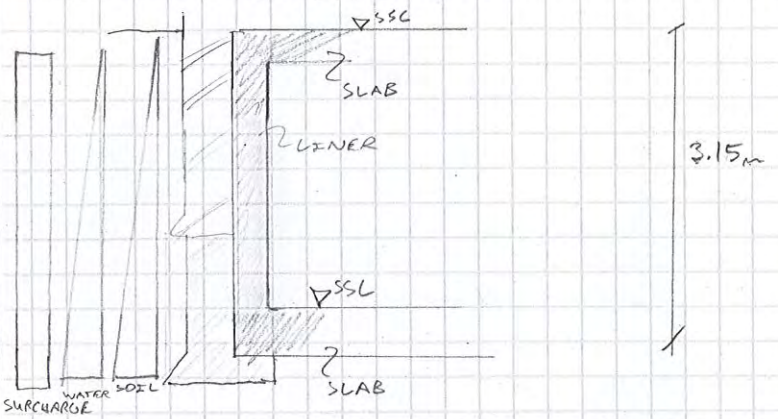
OUTPUT

TRIAL PIT INFORMATION SUGGESTS FOUNDATIONS AT SIMILAR LEVEL TO CELLAR BASE.

THEREFORE EXCAVATIONS RESULT IN EXISTING MASONRY RETAINING SOIL. THE RESULTING LATERAL LOADING IS EXCESSIVE AND THEREFORE THE RC LINER HAS BEEN DESIGNED TO RESIST THE LATERAL LOADING.

MASS CONCRETE FOUNDATIONS SIMILAR IN WIDTH TO THE EXISTING FOUNDATIONS ENSURE BEARING PRESSURES SIMILAR TO EXISTING LEVELS AND THEREFORE AVOID EXCEEDING THE GROUND BEARING CAPACITY.

LATERAL LOADING AT LINERS ($K_a = 0.4$)



LINER RESTRAINED AT BOTH GROUND AND BASE LEVELS

SOIL: $20kN/m^3 \times 0.4 \times 3.15m = 25.2kN/m^2$

WATER: $10kN/m^3 \times 2.5m = 25.5kN/m^2$

SURCHARGE: $10kN/m^2 \times 0.4 = 4kN/m^2$

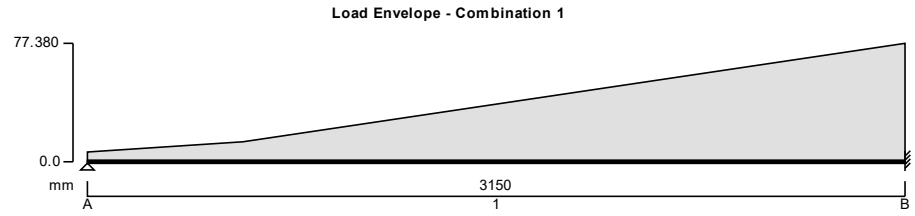
REFER TO TEDD'S CALCULATIONS

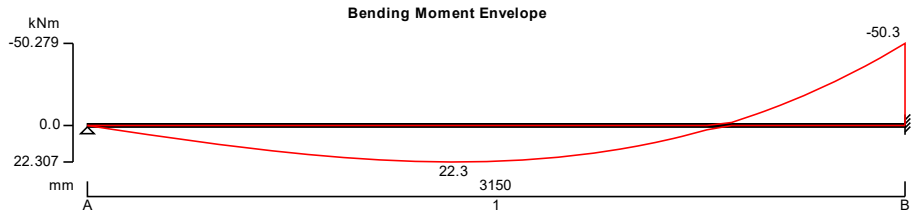
SPECIFY 200mm RC LINERS

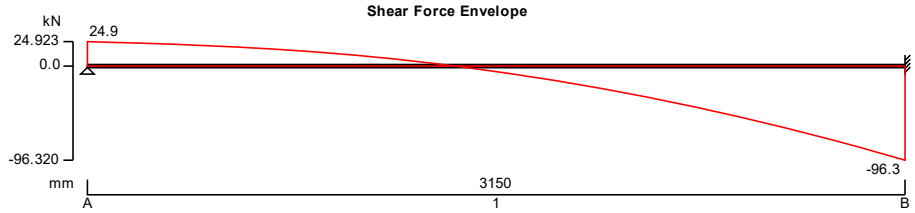
Tekla Tedds	Project: Glenloch				Job no.: 172904	
	Calcs for: RC Liners				Start page no./Revision: 1	
	Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date

RC BEAM ANALYSIS & DESIGN BS8110

TEDDS calculation version 2.1.12







Support conditions

Support A	Vertically restrained
	Rotationally free
Support B	Vertically restrained
	Rotationally restrained

Applied loading

Dead full VDL 0 kN/m to 25.2 kN/m
Dead partial VDL 0 kN/m at 600 mm to 25.5 kN/m at 3150 mm
Imposed full UDL 4 kN/m

Load combinations

Load combination 1	Support A	Dead × 1.40
		Imposed × 1.60
	Span 1	Dead × 1.40
		Imposed × 1.60
	Support B	Dead × 1.40
		Imposed × 1.60

Analysis results

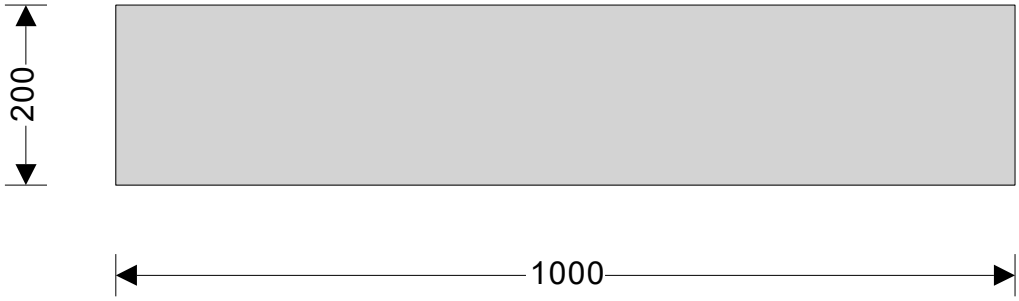
Maximum moment support A	M_{A_max} = **0** kNm	M_{A_red} = **0** kNm

Maximum moment span 1 at 1415 mm	M_{s1_max} = **22** kNm	M_{s1_red} = **22** kNm
Maximum moment support B	M_{B_max} = **-50** kNm	M_{B_red} = **-50** kNm
Maximum shear support A	V_{A_max} = **25** kN	V_{A_red} = **25** kN
Maximum shear support A span 1	$V_{A\_s1\_max}$ = **25** kN	$V_{A\_s1\_red}$ = **25** kN
Maximum shear support B	V_{B_max} = **-96** kN	V_{B_red} = **-96** kN
Maximum shear support B span 1	$V_{B\_s1\_max}$ = **-96** kN	$V_{B\_s1\_red}$ = **-96** kN
Maximum reaction at support A	R_A = **25** kN	
Unfactored dead load reaction at support A	R_{A_Dead} = **12** kN	
Unfactored imposed load reaction at support A	$R_{A\_Imposed}$ = **5** kN	
Maximum reaction at support B	R_B = **96** kN	
Unfactored dead load reaction at support B	R_{B_Dead} = **60** kN	
Unfactored imposed load reaction at support B	$R_{B\_Imposed}$ = **8** kN	

Rectangular section details

Section width b = **1000** mm

Section depth h = **200** mm



Concrete details

Concrete strength class	**C32/40**
Characteristic compressive cube strength	f_{cu} = **40** N/mm^2
Modulus of elasticity of concrete	E_c = 20kN/mm^2 + 200 × f_{cu} = **28000** N/mm^2
Maximum aggregate size	h_{agg} = **20** mm

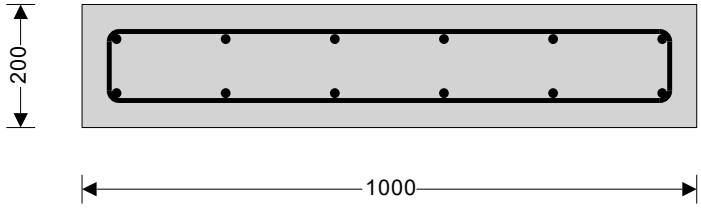
Reinforcement details

Characteristic yield strength of reinforcement	f_y = **500** N/mm^2
Characteristic yield strength of shear reinforcement	f_{yv} = **500** N/mm^2

Nominal cover to reinforcement

Nominal cover to top reinforcement	c_{nom_t} = **40** mm
Nominal cover to bottom reinforcement	c_{nom_b} = **40** mm
Nominal cover to side reinforcement	c_{nom_s} = **40** mm

Support A

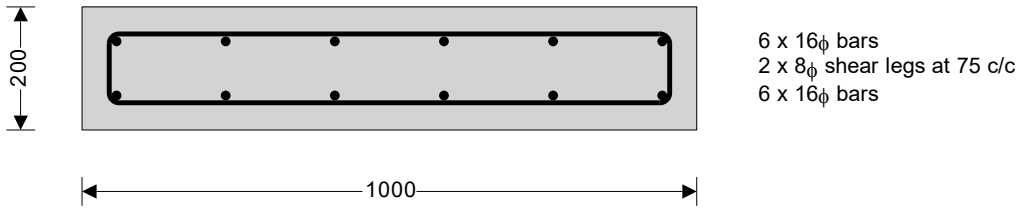


Rectangular section in shear

Design shear force span 1 V = max($V_{A\_s1\_max}$, $V_{A\_s1\_red}$) = **25** kN

Design shear stress	$v = V / (b \times d) =$ **0.173** N/mm^2
Design concrete shear stress	$v_c = 0.79 \times \min(3,[100 \times A_{s,prov} / (b \times d)]^{1/3}) \times \max(1, (400 /d)^{1/4}) \times (\min(f_{cu}, 40) / 25)^{1/3} / \gamma_m$
	$v_c =$ **0.900** N/mm^2
Allowable design shear stress	$v_{max} = \min(0.8$ N/mm$^2 \times (f_{cu}/1$ N/mm$^2)^{0.5}, 5$ N/mm$^2) =$ **5.000** N/mm^2
	PASS - Design shear stress is less than maximum allowable
Value of v from Table 3.7	$v < 0.5v_c$
Design shear resistance required	$v_s = \max(v - v_c, 0.4$ N/mm$^2) =$ **0.400** N/mm^2
Area of shear reinforcement required	$A_{sv,req} = v_s \times b / (0.87 \times f_{yv}) =$ **920** mm^2/m
Shear reinforcement provided	2 × 8ϕ legs at 75 c/c
Area of shear reinforcement provided	$A_{sv,prov} =$ **1340** mm^2/m
	PASS - Area of shear reinforcement provided exceeds minimum required
Maximum longitudinal spacing	$s_{vl,max} = 0.75 \times d =$ **108** mm
	PASS - Longitudinal spacing of shear reinforcement provided is less than maximum

Mid span 1



Design moment resistance of rectangular section (cl. 3.4.4) - Positive moment

Design bending moment	$M = \text{abs}(M_{s1\_red}) =$ **22** kNm
Depth to tension reinforcement	$d = h - c_{nom\_b} - \phi_v - \phi_{bot} / 2 =$ **144** mm
Redistribution ratio	$\beta_b = \min(1 - m_{rs1}, 1) =$ **1.000**
	$K = M / (b \times d^2 \times f_{cu}) =$ **0.027**
	K' = 0.156
	K' > K - No compression reinforcement is required
Lever arm	$z = \min(d \times (0.5 + (0.25 - K / 0.9)^{0.5}), 0.95 \times d) =$ **137** mm
Depth of neutral axis	$x = (d - z) / 0.45 =$ **16** mm
Area of tension reinforcement required	$A_{s,req} = M / (0.87 \times f_y \times z) =$ **375** mm^2
Tension reinforcement provided	6 × 16ϕ bars
Area of tension reinforcement provided	$A_{s,prov} =$ **1206** mm^2
Minimum area of reinforcement	$A_{s,min} = 0.0013 \times b \times h =$ **260** mm^2
Maximum area of reinforcement	$A_{s,max} = 0.04 \times b \times h =$ **8000** mm^2
	PASS - Area of reinforcement provided is greater than area of reinforcement required

Rectangular section in shear

Shear reinforcement provided	2 × 8ϕ legs at 75 c/c
Area of shear reinforcement provided	$A_{sv,prov} =$ **1340** mm^2/m
Minimum area of shear reinforcement (Table 3.7)	$A_{sv,min} = 0.4$N/mm$^2 \times b / (0.87 \times f_{yv}) =$ **920** mm^2/m
	PASS - Area of shear reinforcement provided exceeds minimum required
Maximum longitudinal spacing (cl. 3.4.5.5)	$s_{vl,max} = 0.75 \times d =$ **108** mm
	PASS - Longitudinal spacing of shear reinforcement provided is less than maximum

Design concrete shear stress $v_c = 0.79N/mm^2 \times \min(3,[100 \times A_{s,prov} / (b \times d)]^{1/3}) \times \max(1, (400mm/d)^{1/4}) \times (\min(f_{cu}, 40N/mm^2) / 25N/mm^2)^{1/3} / \gamma_m$ = **0.900** N/mm²

Design shear resistance provided $v_{s,prov} = A_{sv,prov} \times 0.87 \times f_{yv} / b$ = **0.583** N/mm²

Design shear stress provided $v_{prov} = v_{s,prov} + v_c$ = **1.483** N/mm²

Design shear resistance $V_{prov} = v_{prov} \times (b \times d)$ = **213.5** kN

Shear links provided valid between 0 mm and 3150 mm with tension reinforcement of 1206 mm²

Spacing of reinforcement (cl 3.12.11)

Actual distance between bars in tension $s = (b - 2 \times (c_{nom\_s} + \phi_v + \phi_{bot}/2)) /(N_{bot} - 1) - \phi_{bot}$ = **162** mm

Minimum distance between bars in tension (cl 3.12.11.1)

Minimum distance between bars in tension $s_{min} = h_{agg} + 5$ mm = **25** mm

PASS - Satisfies the minimum spacing criteria

Maximum distance between bars in tension (cl 3.12.11.2)

Design service stress $f_s = (2 \times f_y \times A_{s,req}) / (3 \times A_{s,prov} \times \beta_b)$ = **103.6** N/mm²

Maximum distance between bars in tension $s_{max} = \min(47000 N/mm / f_s, 300 mm)$ = **300** mm

PASS - Satisfies the maximum spacing criteria

Span to depth ratio (cl. 3.4.6)

Basic span to depth ratio (Table 3.9) $span\_to\_depth_{basic}$ = **20.0**

Design service stress in tension reinforcement $f_s = (2 \times f_y \times A_{s,req})/ (3 \times A_{s,prov} \times \beta_b)$ = **103.6** N/mm²

Modification for tension reinforcement

$f_{tens} = \min(2.0, 0.55 + (477N/mm^2 - f_s) / (120 \times (0.9N/mm^2 + (M / (b \times d^2)))))$ = **2.000**

Modification for compression reinforcement

$f_{comp} = \min(1.5, 1 + (100 \times A_{s2,prov} / (b \times d)) / (3 + (100 \times A_{s2,prov} / (b \times d))))$ = **1.218**

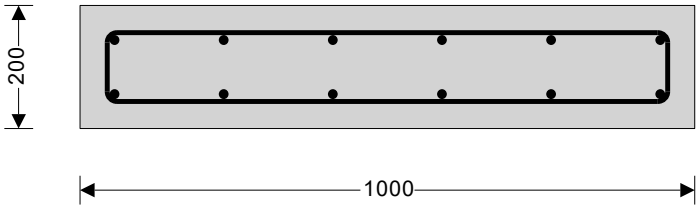
Modification for span length f_{long} = 1.000

Allowable span to depth ratio $span\_to\_depth_{allow} = span\_to\_depth_{basic} \times f_{tens} \times f_{comp}$ = **48.7**

Actual span to depth ratio $span\_to\_depth_{actual} = L_{s1} / d$ = **21.9**

PASS - Actual span to depth ratio is within the allowable limit

Support B



6 x 16ϕ bars
2 x 8ϕ shear legs at 75 c/c
6 x 16ϕ bars

Rectangular section in flexure (cl.3.4.4)

Design bending moment $M = abs(M_{B\_red})$ = **50** kNm

Depth to tension reinforcement $d = h - c_{nom\_t} - \phi_v - \phi_{top} / 2$ = **144** mm

Redistribution ratio $\beta_b = \min(1 - m_{rB}, 1)$ = **1.000**

$K = M / (b \times d^2 \times f_{cu})$ = **0.061**

K' = 0.156

K' > K - No compression reinforcement is required

Lever arm $z = \min(d \times (0.5 + (0.25 - K / 0.9)^{0.5}), 0.95 \times d)$ = **134** mm

Depth of neutral axis $x = (d - z) / 0.45$ = **23** mm

Area of tension reinforcement required $A_{s,req} = M / (0.87 \times f_y \times z)$ = **866** mm²

Tension reinforcement provided 6 x 16ϕ bars

Area of tension reinforcement provided	$A_{s,prov}$ = **1206** mm^2
Minimum area of reinforcement	$A_{s,min}$ = 0.0013 × b × h = **260** mm^2
Maximum area of reinforcement	$A_{s,max}$ = 0.04 × b × h = **8000** mm^2

PASS - Area of reinforcement provided is greater than area of reinforcement required

Rectangular section in shear

Design shear force span 1	V = abs(min($V_{B\_s1\_max}$, $V_{B\_s1\_red}$)) = **96** kN
Design shear stress	v = V / (b × d) = **0.669** N/mm^2
Design concrete shear stress	v_c = 0.79 × min(3,[100 × $A_{s,prov}$ / (b × d)]$^{1/3}$) × max(1, (400 /d)$^{1/4}$) × (min(f_{cu}, 40) / 25)$^{1/3}$ / γ_m
	v_c = **0.900** N/mm^2
Allowable design shear stress	v_{max} = min(0.8 N/mm^2 × (f_{cu}/1 N/mm^2)$^{0.5}$, 5 N/mm^2) = **5.000** N/mm^2

PASS - Design shear stress is less than maximum allowable

Value of v from Table 3.7	0.5 × v_c < v < (v_c + 0.4 N/mm^2)
Design shear resistance required	v_s = max(v - v_c, 0.4 N/mm^2) = **0.400** N/mm^2
Area of shear reinforcement required	$A_{sv,req}$ = v_s × b / (0.87 × f_{yv}) = **920** mm^2/m
Shear reinforcement provided	2 × 8ϕ legs at 75 c/c
Area of shear reinforcement provided	$A_{sv,prov}$ = **1340** mm^2/m

PASS - Area of shear reinforcement provided exceeds minimum required

Maximum longitudinal spacing	$s_{vl,max}$ = 0.75 × d = **108** mm

PASS - Longitudinal spacing of shear reinforcement provided is less than maximum

Spacing of reinforcement (cl 3.12.11)

Actual distance between bars in tension	s = (b - 2 × (c_{nom_s} + ϕ_v + ϕ_{top}/2)) /(N_{top} - 1) - ϕ_{top} = **162** mm

Minimum distance between bars in tension (cl 3.12.11.1)

Minimum distance between bars in tension	s_{min} = h_{agg} + 5 mm = **25** mm

PASS - Satisfies the minimum spacing criteria

Maximum distance between bars in tension (cl 3.12.11.2)

Design service stress	f_s = (2 × f_y × $A_{s,req}$) / (3 × $A_{s,prov}$ × β_b) = **239.2** N/mm^2
Maximum distance between bars in tension	s_{max} = min(47000 N/mm / f_s, 300 mm) = **197** mm

PASS - Satisfies the maximum spacing criteria