APPENDIX C
Fieldwork Logs

Ground and Water Ltd

Borehole No
BH1
Sheet 1 of 1

Project Name 51 Lancaster Grove	Project No. GWPR2283	Co-ords: -	Hole Type WLS
Location: Belsize Park, London NW3 4HB		Level: -	Scale 1:50
Client: Croft Structural Engineers		Dates: 12/10/2017	Logged By JH

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.05			TARMAC
		0.30	D					MADE GROUND:Dark brown to black sandy gravel. Sand is fine to coarse grained. Gravel is abundant, fine to coarse, angular to sub-rounded tarmac.
		0.50	D		0.45			
		0.80	D					MADE GROUND: Dark brown/orange brown sandy gravelly clay. Sand is fine to coarse grained. Gravel is occasional to abundant, fine to medium, sub-angular to sub-rounded tarmac, flint and brick fragments.
		1.00	SPT	N=10 (1,2/ 2,2,3,3)	0.90			
		1.00	D					
		1.50	D					LONDON CLAY FORMATION: Grey-brown and orange -brown CLAY.
		2.00	SPT	N=12 (2,4/ 3,3,3,3)				
		2.00	D					
		2.50	D		2.50			LONDON CLAY FORMATION: Grey-brown and orange brown slightly sandy silty CLAY. Sand is fine to medium grained.
		3.00	SPT	N=16 (2,3/ 3,4,4,5)				
		3.00	D					
		3.50	D					
		4.00	SPT	N=17 (3,4/ 4,4,5,4)				
		4.00	D					
		4.50	D		4.50			LONDON CLAY FORMATION: Grey-brown CLAY.
		5.00	SPT	N=20 (3,4/ 4,5,6,5)				
		5.00	D					
		5.50	D		5.50			LONDON CLAY FORMATION: Grey-brown CLAY. Rare claystone fragments and selenite crystals noted.
		6.00	SPT	N=28 (5,7/ 6,7,7,8)	6.00			LONDON CLAY FORMATION: Grey-brown sandy CLAY. Sand is fine to medium grained. Claystones band noted from 6.50m bgl.
		6.00	D					
		6.50	D					
					6.60			End of Borehole at 6.60 m
			Type	Results				

Remarks: No groundwater encountered.
Fine roots noted to 1.70m bgl.
Borehole refused on claystone band.

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Ground and Water Ltd

Borehole No
WS1
Sheet 1 of 1

Project Name 51 Lancaster Grove	Project No. GWPR2283	Co-ords: -	Hole Type WLS
Location: Belsize Park, London NW3 4HB		Level: -	Scale 1:50
Client: Croft Structural Engineers		Dates: 12/10/2017	Logged By JH

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
		0.30	D					MADE GROUND: Dark brown to black gravelly sand. Sand is fine to coarse grained. Gravel is occasional to abundant, fine to medium, sub-angular to sub-rounded flint and brick fragments.
		0.50	D		0.50			MADE GROUND: Dark brown sandy gravelly clay. Sand is fine to medium grained. Gravel is rare to occasional, fine to medium, sub-angular to sub-rounded flint and brick fragments.
		0.80	D		0.80			
		1.00	D		1.00			MADE GROUND: Orange sandy gravelly sub-base. Sand is fine to medium grained. Gravel is abundant, fine to coarse, angular to sub-rounded, brick and type 1.
		1.50	D		1.50			MADE GROUND: Brown sandy gravelly clay. Sand is fine to medium grained. Gravel is occasional to abundant, sub-angular to sub-rounded brick fragments and flint.
		2.00	D					LONDON CLAY FORMATION: Brown CLAY.
		2.50	D					
		3.00	D		3.00			LONDON CLAY FORMATION: Grey/brown CLAY.
					3.50			End of Borehole at 3.50 m
			Type	Results				

Remarks: No groundwater encountered.
Fine roots noted to 0.90m bgl.

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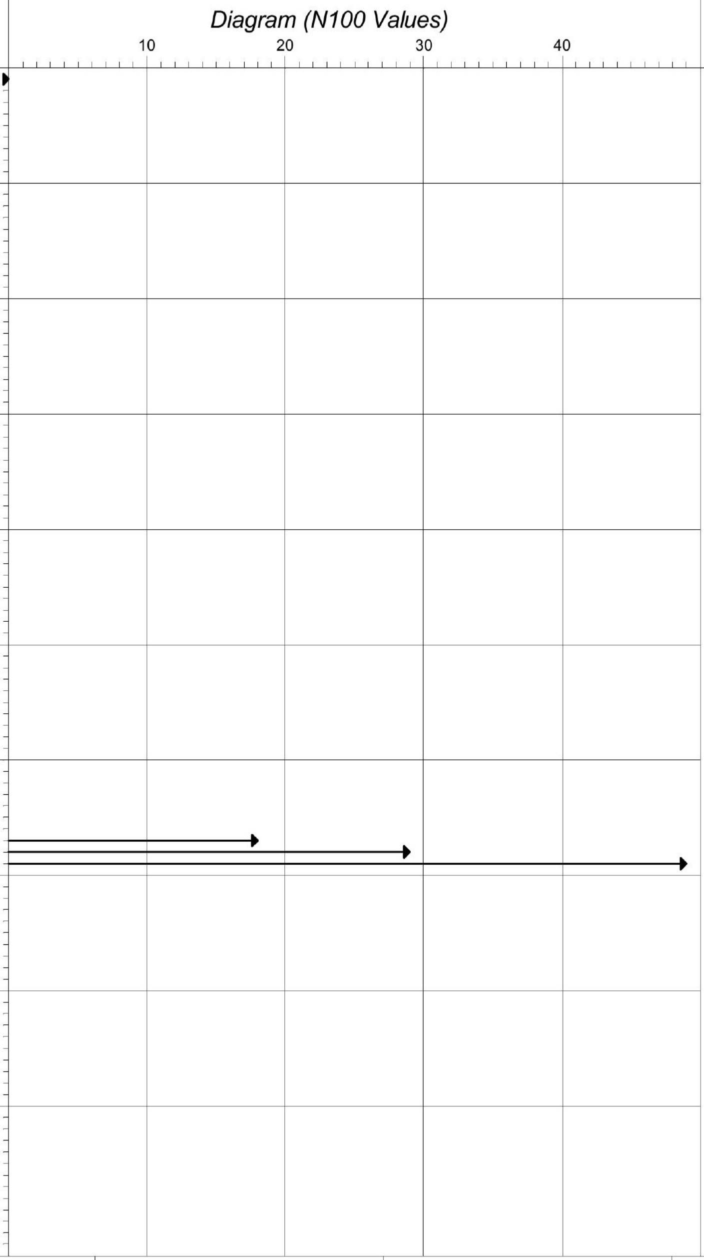
DYNAMIC PROBING

Probe No	**DP1**		
Client	**Croft Structural Engineers**	Sheet 1 of 1	
Site	**51 Lancaster Grove**	*Project No*	**GWPR2283**
E **-**	*N* **-**	*Level* **-**	*Date* **12/10/2017** — *Logged by* **JH**

Depth (m) — *Readings Blows/100mm* — *Diagram (N100 Values)* — *Torque (Nm)*

Depth (m)	0.1	0.2	0.3	0.4	0.5
0.0–0.5	0	-	-	-	-
0.5–1.0	-	-	-	-	-
1.0–1.5	-	-	-	-	-
1.5–2.0	-	-	-	-	-
2.0–2.5	-	-	-	-	-
2.5–3.0	-	-	-	-	-
3.0–3.5	-	-	-	-	-
3.5–4.0	-	-	-	-	-
4.0–4.5	-	-	-	-	-
4.5–5.0	-	-	-	-	-
5.0–5.5	-	-	-	-	-
5.5–6.0	-	-	-	-	-
6.0–6.5	-	-	-	-	-
6.5–7.0	-	18	29	49	-

Torque (Nm): 0



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Fall Height	**500**	*Cone Base Diameter*	**43**
Hammer Wt	**50.00**	*Final Depth*	**6.90**
Probe Type	**DPSH**	*Log Scale*	1:50

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HoleBASE 3.1 (Bld 422.20) Standard Dynamic Probe Log v2 dated 27th Nov 03

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Borehole No
WSA
Sheet 1 of 1

Project Name 51 Lancaster Grove	Project No. GWPR2283	Co-ords: -	Hole Type TP
Location: Belsize Park, London NW3 4HB		Level: -	Scale 1:50
Client: Croft Structural Engineers		Dates: 17/11/2017	Logged By JH

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.10			CONCRETE
		0.30	D		0.40			MADE GROUND: Dark brown to black gravelly sand. Sand is fine to coarse grained. Gravel is occasional to abundant, fine to medium, sub-angular to sub-rounded flint and brick fragments.
		0.50	D		0.65			
		0.80	D		0.85			MADE GROUND: Dark brown sandy gravelly clay. Sand is fine to medium grained. Gravel is rare to occasional, fine to medium, sub-angular to sub-rounded flint and brick fragments.
		1.00	D					
		1.50	D					MADE GROUND: Orange sandy gravelly sub-base. Sand is fine to medium grained. Gravel is abundant, fine to coarse, angular to sub-rounded, brick and type 1.
		2.00	D					LONDON CLAY FORMATION: Orange brown silty CLAY.
		2.50	D					
		3.00	D		3.00			End of Borehole at 3.00 m
			Type	Results				

1 2 3 4 5 6 7 8 9

Remarks: No roots noted.

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APPENDIX D
Geotechnical Laboratory Test Results

Summary of Natural Moisture Content, Liquid Limit and Plastic Limit Results

Job No.	Project Name	Programme	
23518	51 Lancaster Grove, Belsize Park	Samples received	17/10/2017
		Schedule received	16/10/2017
Project No.	Client	Project started	17/10/2017
GWPR2283	Ground & Water Ltd	Testing Started	27/10/2017

Hole No.	Sample				Soil Description	NMC	Passing 425µm	LL	PL	PI	Remarks
	Ref	Top	Base	Type		%	%	%	%	%	
BH1	-	1.50	-	D	Brown slightly mottled bluish grey silty CLAY with occasional selenite crystals and traces of fine rootlets	31					
BH1	-	2.00	-	D	Brown slightly mottled grey silty CLAY with occasional selenite crystals and orangish brown fine sand pockets	30					
BH1	-	2.50	-	D	Brown slightly mottled grey silty CLAY with occasional selenite crystals and black flecks	28					
BH1	-	3.00	-	D	Orangish brown slightly mottled bluish grey silty CLAY with occasional selenite crystals	28	100	71	24	47	
BH1	-	3.50	-	D	Orangish brown slightly mottled bluish grey silty CLAY with occasional selenite crystals and traces of fine rootlets	27	100	71	23	48	
BH1	-	4.00	-	D	Orangish brown slightly mottled grey silty CLAY with traces selenite crystals	27					
BH1	-	4.50	-	D	Brown slightly mottled grey slightly sandy silty CLAY with traces of selenite crystals	27	100	70	23	47	
WS1	-	3.00	-	D	Brown slightly mottled grey silty CLAY with occasional selenite crystals	28	100	73	22	51	

Test Methods: BS1377: Part 2: 1990:
Natural Moisture Content : clause 3.2
Atterberg Limits: clause 4.3 and 5.0

Test Report by K4 SOILS LABORATORY
Unit 8 Olds Close Olds Approach
Watford Herts WD18 9RU

Tel: 01923 711 288
Email: James@k4soils.com

Checked and Approved
Initials J.P
Date: 30/10/2017

2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

Sulphate Content (Gravimetric Method) for 2:1 Soil: Water Extract and pH Value - Summary of Results
Tested in accordance with BS1377 : Part 3 : 1990, clause 5.3 and clause 9

Job No.	Project Name	Programme	
23518	51 Lancaster Grove, Belsize Park	Samples received	17/10/2017
		Schedule received	16/10/2017
Project No.	Client	Project started	17/10/2017
GWPR2283	Ground & Water Ltd	Testing Started	25/10/2017

Hole No.	Sample				Soil description	Dry Mass passing 2mm	SO3 Content	SO4 Content	pH	Remarks
	Ref	Top	Base	Type		%	g/l	g/l		
BH1	-	3.00	-	D	Orangish brown slightly mottled bluish grey silty CLAY with occasional selenite crystals	100	1.12	1.35	7.80	

Test Report by K4 SOILS LABORATORY
Unit 8 Olds Close Olds Approach
Watford Herts WD18 9RU
Tel: 01923 711 288
Email: James@k4soils.com

Checked and Approved
Initials J.P
Date: 30/10/2017

2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

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russell.jarvis@qtsenvironmental.com

QTS Environmental Report No: 17-65721

Site Reference:	51 Lancaster Grove, Belsize Park, London, NW3 4HB
Project / Job Ref:	GWPR2283
Order No:	None Supplied
Sample Receipt Date:	17/10/2017
Sample Scheduled Date:	17/10/2017
Report Issue Number:	1
Reporting Date:	23/10/2017

Authorised by:
[redacted]
Kevin Old
Associate Director of Laboratory

Authorised by:
[redacted]
Dave Ashworth
Deputy Quality Manager

QTSE is the trading name of DETS Ltd, company registration number 03705645

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

4480

Soil Analysis Certificate							
QTS Environmental Report No: 17-65721	**Date Sampled**	02/10/17	02/10/17				
Ground & Water Ltd	**Time Sampled**	None Supplied	None Supplied				
Site Reference: 51 Lancaster Grove, Belsize Park, London, NW3 4HB	**TP / BH No**	BH1	WS1				
Project / Job Ref: GWPR2283	**Additional Refs**	None Supplied	None Supplied				
Order No: None Supplied	**Depth (m)**	5.00	2.00				
Reporting Date: 23/10/2017	**QTSE Sample No**	296508	296509				

Determinand	Unit	RL	Accreditation					
pH	pH Units	N/a	MCERTS	7.4	7.7			
Total Sulphate as SO_4	mg/kg	< 200	NONE	6493	15600			
Total Sulphate as SO_4	%	< 0.02	NONE	0.65	1.56			
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	3120	2400			
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	3.12	2.40			
Total Sulphur	%	< 0.02	NONE	0.23	0.52			
Ammonium as NH_4	mg/kg	< 0.5	NONE	< 0.5	< 0.5			
Ammonium as NH_4	mg/l	< 0.05	NONE	< 0.05	< 0.05			
W/S Chloride (2:1)	mg/kg	< 1	MCERTS	243	77			
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS	122	38.6			
Water Soluble Nitrate (2:1) as NO_3	mg/kg	< 3	MCERTS	< 3	< 3			
Water Soluble Nitrate (2:1) as NO_3	mg/l	< 1.5	MCERTS	< 1.5	< 1.5			
W/S Magnesium	mg/l	< 0.1	NONE	220	99			

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C
Subcontracted analysis (S)

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

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Soil Analysis Certificate - Sample Descriptions	
QTS Environmental Report No: 17-65721	
Ground & Water Ltd	
Site Reference: 51 Lancaster Grove, Belsize Park, London, NW3 4HB	
Project / Job Ref: GWPR2283	
Order No: None Supplied	
Reporting Date: 23/10/2017	

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
$ 296508	BH1	None Supplied	5.00	16.2	Brown clay
$ 296509	WS1	None Supplied	2.00	18.4	Light brown clay

Moisture content is part of procedure E003 & is not an accredited test
Insufficient Sample U/S
Unsuitable Sample U/S

$ samples exceeded recommended holding times

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
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Soil Analysis Certificate - Methodology & Miscellaneous Information
QTS Environmental Report No: 17-65721
Ground & Water Ltd
Site Reference: 51 Lancaster Grove, Belsize Park, London, NW3 4HB
Project / Job Ref: GWPR2283
Order No: None Supplied
Reporting Date: 23/10/2017

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

APPENDIX E
Ground Movement Assessment Calculations

Ground Movement Analysis - CIRIA C580 Embedded Retaining Walls (For EXCAVATION ONLY)

Project Ref: GWPR2283
Site: 51 Lancaster Grove, Belsize Park, London NW3 4HB

Excavation Depth: 3

Neighbouring Property 1		**Neighbouring Property 2**	
House No.	49	House No.	53
Closest Wall (m)	1.60	Closest Wall (m)	2.20
Length (m)	11.10	Length (m)	10.80
Furthest Wall (m)	12.70	Furthest Wall (m)	13.00
Height	14.40	Height	14.40

Ground Movement Due to Excavtion - Assuming High Stiffness Clays

(Table 2.4 CIRIA C580)

Distance to Negligible Movement	(m)
Horizontal:	12
Vertical:	10.5

Fig 2.11

Neighbouring Property 1 No. 49 Interval 2.78

Contour Plot Point	Distance (m)	Distance/Max Excavtion Depth
A	1.60	0.53
B	4.38	1.46
C	7.15	2.38
D	9.93	3.31
E	12.70	4.23

Horizontal Movement

Distance (m)	%	(m)	(mm)	
1.60	0.13	0.00390	**3.90**	Movement at closest wall
4.38	0.10	0.00286	2.86	
7.15	0.06	0.00182	1.82	
9.93	0.03	0.00078	0.78	
12.70	-0.01	-0.00026	**0.00**	Movement at furthest wall

Vertical Movement

Distance (m)	%	(m)	(mm)	
1.60	0.09	0.00264	**2.64**	Movement at closest wall
4.38	0.06	0.00175	1.75	
7.15	0.03	0.00096	0.96	
9.93	0.01	0.00016	0.16	
12.70	-0.02	-0.00063	**0.00**	Movement at furthest wall

Neighbouring Property 2 No. 53 Interval 2.70

Contour Plot Point	Distance (m)	Distance/Max Excavtion Depth
A	2.20	0.73
B	4.90	1.63
C	7.60	2.53
D	10.30	3.43
E	13.00	4.33

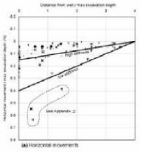
Horizontal Movement

Distance (m)	%	(m)	(mm)	
2.20	0.12	0.00368	**3.68**	Movement at closest wall
4.90	0.09	0.00266	2.66	
7.60	0.06	0.00165	1.65	
10.30	0.02	0.00064	0.64	
13.00	-0.01	-0.00038	**0.00**	Movement at furthest wall

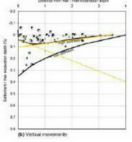
Vertical Movement

Distance (m)	%	(m)	(mm)	
2.20	0.08	0.00237	**2.37**	Movement at closest wall
4.90	0.05	0.00160	1.60	
7.60	0.03	0.00083	0.83	
10.30	0.00	0.00005	0.05	
13.00	-0.02	-0.00072	**0.00**	Movement at furthest wall

Horizontal movement calcs uses linear relationship from graph

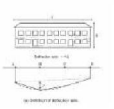


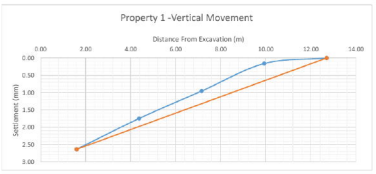
Vertical movement is not linear so relationship has been estimated from graph. The estimated relationship used in spreadsheet is shown in orange in graph below.

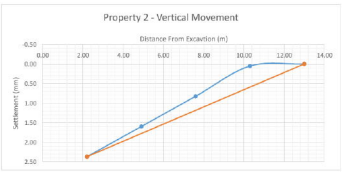


NOTE: If there are any are minus numbers change to 0 (Distance is more than distance to negligible movement from Table 2.4)

Potential Damage to Building







Neighbouring Property 1 No. 49

	m	mm
L	11.10	11100
H	14.40	14400
L/H	0.77	

Vertical Deflection (Δ)	0.5	mm	from graph (max difference between blue and orange line)
Defelction Ratio (Δ/L)	0.004505	%	
Horizontal Movement (δh)	3.90	mm	difference between horizontal movement at nearest and farthest walls
Horzontal Strain (Eh) = δh/L	0.03514	%	

Neighbouring Property 2 No. 53

	m	mm
L	10.80	10800
H	14.40	14400
L/H	0.75	

Vertical Deflection (Δ)	0.55	mm	from graph (max difference between blue and orange line)
Defelction Ratio (Δ/L)	0.005093	%	
Horizontal Movement (δh)	3.68		difference between horizontal movement at nearest and farthest walls
Horzontal Strain (Eh) = δh/L	0.03403	%	

CATEGORY OF DAMAGE Damage category limits are given in Table 2.5 (below).

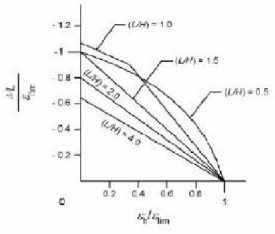
Method 1 - Prefferred method
- Open up 'Damage Category Relationship Plots GMA' spreadsheet
- Find relevant L/H grapgh (different graph on each each tab along the bottom of the spreadsheet)
- Input calculated values for deflection ratio and horizontal strain
- Point will plot on graph and show category of dameg

Method 2 - can be used to confirm category or is useful if L/H for property is between the given L/H graphs
- Plot points calculated below on figure 2.18 for each damage category
- Appropriate damage category will plot below L/H for property

	L/H	0.77
Negligible damage limit (Elim)	**0.05**	
(Δ/L)/(Elim)	0.09009009	Plot this point on fig2.18 (b) if the plotted point is
(Eh)/(Elim)	0.702702703	below the appropriate L/H line then damage falls into 'negligible' category - no need to plot points below
Very Slight damage limit (Elim)	**0.075**	
(Δ/L)/(Elim)	0.06006006	Plot this point on fig2.18 (b) if the plotted point is
(Eh)/(Elim)	0.468468468	below the appropriate L/H line then damage falls into 'very slight' category - no need to plot points below
Slight damage limit (Elim)	**0.15**	
(Δ/L)/(Elim)	0.03003003	Plot this point on fig2.18 (b) if the plotted point is
(Eh)/(Elim)	0.234234234	below the appropriate L/H line then damage falls into 'slight' category - no need to plot points below
Moderate damage limit (Elim)	**0.3**	
(Δ/L)/(Elim)	0.015015015	Plot this point on fig2.18 (b) if the plotted point is
(Eh)/(Elim)	0.117117117	below the appropriate L/H line then damage falls into 'moderate' category - if the point is not below, damage is 'severe'
Calculated Category of Damage		Negligible

	L/H	0.75
Negligible damage limit (Elim)	**0.05**	
(Δ/L)/(Elim)	0.101851852	Plot this point on fig2.18 (b) if the plotted point is below the
(Eh)/(Elim)	0.680555556	appropriate L/H line then damage falls into 'negligible' category - no need to plot points below
Very Slight damage limit (Elim)	**0.075**	
(Δ/L)/(Elim)	0.067901235	Plot this point on fig2.18 (b) if the plotted point is below the
(Eh)/(Elim)	0.453703704	appropriate L/H line then damage falls into 'very slight' category - no need to plot points below
Slight damage limit (Elim)	**0.15**	
(Δ/L)/(Elim)	0.033950617	Plot this point on fig2.18 (b) if the plotted point is below the
(Eh)/(Elim)	0.226851852	appropriate L/H line then damage falls into 'slight' category - no need to plot points below
Moderate damage limit (Elim)	**0.3**	
(Δ/L)/(Elim)	0.016975309	Plot this point on fig2.18 (b) if the plotted point is below the
(Eh)/(Elim)	0.113425926	appropriate L/H line then damage falls into 'moderate' category - if the point is not below, damage is 'severe'
Calculated Category of Damage		Negligible

Fig 2.18 (b)



(b) Influence of horizontal strain on Δ/L / ε_{1lim} (after Burland, 2001)

Table 2.5

Table 2.5 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 slopes 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	

Ground Movement Analysis - CIRIA C580 Embedded Retaining Walls (For EXCAVATION ONLY)

Project Ref: SWPR2288
Site: 53 Lancaster Grove

Excavation Depth: 3

Neighbouring Property 1		**Neighbouring Property 2**	
House No.	49	House No.	53
Closest Wall (m)	1.60	Closest Wall (m)	2.20
Length (m)	11.10	Length (m)	10.80
Furthest Wall (m)	12.70	Furthest Wall (m)	13.00
Height	14.40	Height	14.40

Ground Movement Due to Excavtion - Assuming High Stiffness Clays

(Table 2.4 CIRIA C580)

Surface Movement at Wall	(m)	(mm)
Horizontal:	0.0045	4.5
Verticle:	0.003	3

Distance to Negligible Movement	(m)
Horizontal:	12
Verticle:	10.5

Fig 2.11

Neighbouring Property 1 No. 49 Interval 2.78

Contour Plot Point	Distance (m)	Distance/Max Excavation Depth
A	1.60	0.53
B	4.38	1.46
C	7.15	2.38
D	9.93	3.31
E	12.70	4.23

Horizontal Movement

Distance (m)	%	(m)	(mm)		
1.60	0.13	0.00390	3.90	Movement at closest wall	
4.38	0.10	0.00286	2.86		
7.15	0.06	0.00182	1.82		
9.93	0.03	0.00078	0.78		
12.70	0.00	0.00000	0.00	Movement at furthest wall	

Verticle Movement

Distance (m)	%	(m)	(mm)		
1.60	0.09	0.00264	12.00	Movement at closest wall	
4.38	0.06	0.00175	7.50		
7.15	0.03	0.00096	3.00		
9.93	0.01	0.00026	0.00		
12.70	-0.02	-0.00063	0.00	Movement at furthest wall	

Neighbouring Property 2 No. 53 Interval 2.70

Contour Plot Point	Distance (m)	Distance/Max Excavation Depth
A	2.20	0.73
B	4.90	1.63
C	7.60	2.53
D	10.30	3.43
E	13.00	4.33

Horizontal Movement

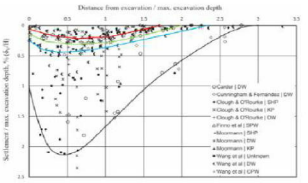
Distance (m)	%	(m)	(mm)		
2.20	0.12	0.00368	3.68	Movement at closest wall	
4.90	0.09	0.00266	2.66		
7.60	0.06	0.00165	1.65		
10.30	0.02	0.00064	0.64		
13.00	-0.01	-0.00000	0.00	Movement at furthest wall	

Verticle Movement

Distance (m)	%	(m)	(mm)		
2.20	0.08	0.00237	13.50	Movement at closest wall	
4.90	0.06	0.00160	6.00		
7.60	0.03	0.00083	3.00		
10.30	0.00	0.00005	0.00		
13.00	-0.02	-0.00072	0.00	Movement at furthest wall	

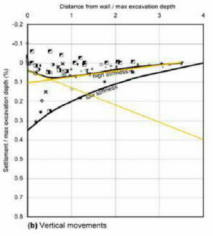
NOTE: If there are any are minus numbers change to 0 (Distance is more than distance to negligible movement from Table 2.4)

Horizontal movement calcs uses three lines: Blue is conservative, Green is moderate, Red is least stringent.



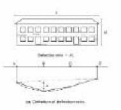
a Normalised settlements due to excavation in soft to firm clay

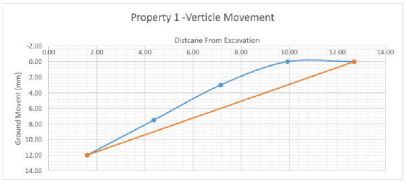
Verticle movement is not assessed with soft to firm clays, therefore stiff clay analysis is used. Vertical movement is not linear so relationship has been estimated from graph. The estimated relationship used in spreadsheet is shown in orange in graph to the right

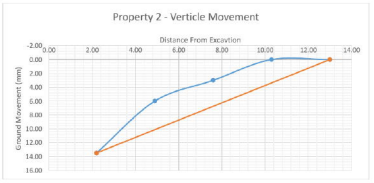


(b) Vertical movements

Potential Damage to Building







Neighbouring Property 1 No. 49

	m	mm
L	11.10	11100
H	14.40	14400
L/H	0.77	

Verticle Deflection (Δ)	3.6	mm	from graph (max difference between blue and orange line)
Defelction Ratio (Δ/L)	0.032432	%	
Horizontal Movement (δh)	3.90	mm	difference between horizontal movement at nearest and farthest walls
Horzontal Strain (Eh) = δh/L	0.03514	%	

Neighbouring Property 2 No. 53

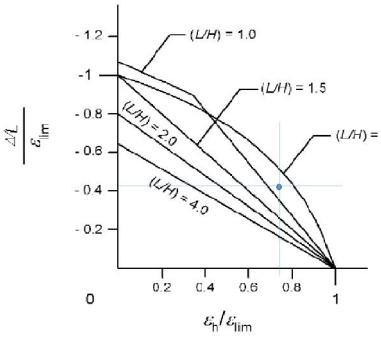
	m	mm
L	10.80	10800
H	14.40	14400
L/H	0.75	

Verticle Deflection (Δ)	4.4	mm	from graph (max difference between blue and orange line)
Defelction Ratio (Δ/L)	0.040741	%	
Horizontal Movement (δh)	3.68		difference between horizontal movement at nearest and farthest walls
Horzontal Strain (Eh) = δh/L	0.03403	%	

CATEGORY OF DAMAGE Damage category limits are given in Table 2.5 (below) you will also need Fig 2.18 (also shown below).

L/H	0.77		**L/H**	0.75	
Negligible damage limit (Elim)	**0.05**		**Negligible damage limit (Elim)**	**0.05**	
(Δ/L)/(Elim)	0.648648649	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'negligible' category - no need to plot points below	(Δ/L)/(Elim)	0.814814815	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'negligible' category - no need to plot points below
(Eh)/(Elim)	0.702702703		(Eh)/(Elim)	0.680555556	
Very Slight damage limit (Elim)	**0.075**		**Very Slight damage limit (Elim)**	**0.075**	
(Δ/L)/(Elim)	0.432432432	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'very slight' category - no need to plot points below	(Δ/L)/(Elim)	0.542209877	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'very slight' category - no need to plot points below
(Eh)/(Elim)	0.468468468		(Eh)/(Elim)	0.453703704	
Slight damage limit (Elim)	**0.15**		**Slight damage limit (Elim)**	**0.15**	
(Δ/L)/(Elim)	0.216216216	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'slight' category - no need to plot points below	(Δ/L)/(Elim)	0.271604938	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'slight' category - no need to plot points below
(Eh)/(Elim)	0.234234234		(Eh)/(Elim)	0.226851852	
Moderate damage limit (Elim)	**0.3**		**Moderate damage limit (Elim)**	**0.3**	
(Δ/L)/(Elim)	0.108108108	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'moderate' category - if the point is not below, damage is 'severe'	(Δ/L)/(Elim)	0.135802469	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'moderate' category - if the point is not below, damage is 'severe'
(Eh)/(Elim)	0.117117117		(Eh)/(Elim)	0.113425926	
Calculated Category of Damage	Moderate		**Calculated Category of Damage**	Moderate	

Fig 2.18 (b)



(b) Influence of horizontal strain on Δ/L / ε_{lim}
(after Burland, 2001)

Table 2.5

Table 2.5 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 fireplaces 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	

Ground Movement Analysis - CIRIA C580 Embedded Retaining Walls (For EXCAVATION ONLY)

Project Ref: SWPR2283
Site: 53 Lancaster Grove, Belsize Park, London NW3 4HB

Excavation Depth: 3

Neighbouring Property 1		**Neighbouring Property 2**	
House No.	49	House No.	53
Closest Wall (m)	1.60	Closest Wall (m)	2.20
Length (m)	11.10	Length (m)	10.80
Furthest Wall (m)	12.70	Furthest Wall (m)	13.00
Height	14.40	Height	14.40

Ground Movement Due to Excavation - Assuming High Stiffness Clays

(Table 2.4 CIRIA C580)

Surface Movement at Wall	(m)	(mm)
Horizontal:	0.0045	4.5
Verticle:	0.003	3

Distance to Negligible Movement	(m)
Horizontal:	12
Verticle:	10.5

Fig 2.11

Neighbouring Property 1 No. 49 Interval 2.78

Contour Plot Point	Distance (m)	Distance/Max Excavation Depth
A	1.60	0.53
B	4.38	1.46
C	7.15	2.38
D	9.93	3.31
E	12.70	4.23

Horizontal Movement

Distance (m)	%	(m)	(mm)		
1.60	0.13	0.00390	**3.90**	Movement at closest wall
4.38	0.10	0.00286	2.86	
7.15	0.06	0.00182	1.82	
9.93	0.03	0.00078	0.78	
12.70	-0.01	0.00000	**0.00**	Movement at furthest wall

Verticle Movement

Distance (m)	%	(m)	(mm)		
1.60	0.09	0.00264	**9.00**	Movement at closest wall
4.38	0.06	0.00175	6.00	
7.15	0.03	0.00096	1.50	
9.93	0.01	0.00026	0.00	
12.70	-0.02	0.00000	**0.00**	Movement at furthest wall

Neighbouring Property 2 No. 53 Interval 2.70

Contour Plot Point	Distance (m)	Distance/Max Excavation Depth
A	2.20	0.73
B	4.90	1.63
C	7.60	2.53
D	10.30	3.43
E	13.00	4.33

Horizontal Movement

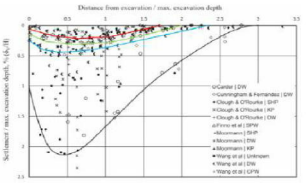
Distance (m)	%	(m)	(mm)		
2.20	0.12	0.00368	**3.68**	Movement at closest wall
4.90	0.09	0.00266	2.66	
7.60	0.06	0.00165	1.65	
10.30	0.02	0.00064	0.64	
13.00	-0.01	-0.00038	**-0.38**	Movement at furthest wall

Verticle Movement

Distance (m)	%	(m)	(mm)		
2.20	0.08	0.00237	**10.50**	Movement at closest wall
4.90	0.05	0.00160	4.50	
7.60	0.03	0.00083	1.50	
10.30	0.00	0.00005	0.00	
13.00	-0.02	-0.00072	**0.00**	Movement at furthest wall

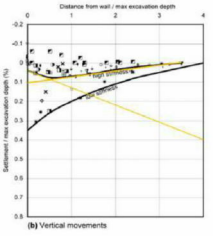
NOTE: If there are any are minus numbers change to 0 (Distance is more than distance to negligible movement from Table 2.4)

Horizontal movement calcs uses three lines: Blue is conservative, Green is moderate, Red is least stringent



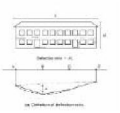
a Normalised settlements due to excavation in soft to firm clay

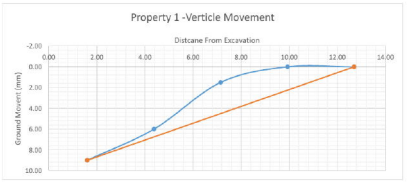
Verticle movement is not assessed with soft to firm clays, therefore stiff clay analysis is used. Vertical movement is not linear so relationship has been estimated from graph. The estimated relationship used in spreadsheet is shown in orange in graph to the right

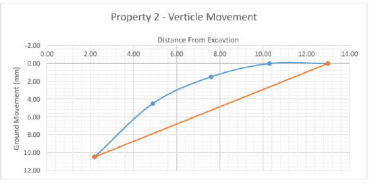


(b) Vertical movements

Potential Damage to Building







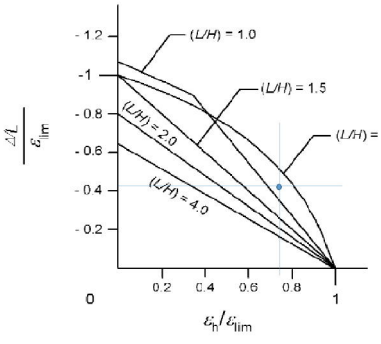
Neighbouring Property 1		No. 49		
		m	mm	
	L	11.10	11100	
	H	14.40	14400	
	L/H	0.77		
Verticle Deflection (Δ)		3.2	mm	from graph (max difference between blue and orange line)
Defelction Ratio (Δ/L)		0.028829	%	
Horizontal Movement (δh)		3.90	mm	difference between horizontal movement at nearest and farthest walls
Horzontal Strain (Eh) = δh/L		0.03514	%	

Neighbouring Property 2		No. 53		
		m	mm	
	L	10.80	10800	
	H	14.40	14400	
	L/H	0.75		
Verticle Deflection (Δ)		3.6	mm	from graph (max difference between blue and orange line)
Defelction Ratio (Δ/L)		0.033333	%	
Horizontal Movement (δh)		4.05		difference between horizontal movement at nearest and farthest walls
Horzontal Strain (Eh) = δh/L		0.03750	%	

CATEGORY OF DAMAGE Damage category limits are given in Table 2.5 (below) you will also need Fig 2.18 (also shown below).

L/H	0.77		**L/H**	0.75	
Negligible damage limit (Elim)	**0.05**		**Negligible damage limit (Elim)**	**0.05**	
(Δ/L)/(Elim)	0.575576577	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'negligible' category - no need to plot points below	(Δ/L)/(Elim)	0.666666667	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'negligible' category - no need to plot points below
(Eh)/(Elim)	0.702702703		(Eh)/(Elim)	0.75	
Very Slight damage limit (Elim)	**0.075**		**Very Slight damage limit (Elim)**	**0.075**	
(Δ/L)/(Elim)	0.384384384	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'very slight' category - no need to plot points below	(Δ/L)/(Elim)	0.444444444	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'very slight' category - no need to plot points below
(Eh)/(Elim)	0.468468468		(Eh)/(Elim)	0.5	
Slight damage limit (Elim)	**0.15**		**Slight damage limit (Elim)**	**0.15**	
(Δ/L)/(Elim)	0.192192192	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'slight' category - no need to plot points below	(Δ/L)/(Elim)	0.222222222	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'slight' category - no need to plot points below
(Eh)/(Elim)	0.234234234		(Eh)/(Elim)	0.25	
Moderate damage limit (Elim)	**0.3**		**Moderate damage limit (Elim)**	**0.3**	
(Δ/L)/(Elim)	0.096096096	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'moderate' category - if the point is not below, damage is 'severe'	(Δ/L)/(Elim)	0.111111111	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'moderate' category - if the point is not below, damage is 'severe'
(Eh)/(Elim)	0.117117117		(Eh)/(Elim)	0.125	
Calculated Category of Damage	Slight		**Calculated Category of Damage**	Slight	

Fig 2.18 (b)



(b) Influence of horizontal strain on Δ/L / ε_{lim}
(after Burland, 2001)

Table 2.5

Table 2.5 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 fireplaces 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	

Ground Movement Analysis - CIRIA C580 Embedded Retaining Walls (For EXCAVATION ONLY)

Project Ref: SWPR2283
Site: 53 Lancaster Grove, Belsize Park, London NW3 4HB

Excavation Depth: 3

Neighbouring Property 1		**Neighbouring Property 2**	
House No.	49	House No.	53
Closest Wall (m)	1.60	Closest Wall (m)	2.20
Length (m)	11.10	Length (m)	10.80
Furthest Wall (m)	12.70	Furthest Wall (m)	13.00
Height	14.40	Height	14.40

Ground Movement Due to Excavation - Assuming High Stiffness Clays

(Table 2.4 CIRIA C580)

Surface Movement at Wall

	(m)	(mm)
Horizontal:	0.0045	4.5
Verticle:	0.003	3

Distance to Negligible Movement

	(m)
Horizontal:	12
Verticle:	10.5

Fig 2.11

Neighbouring Property 1 No. 49 Interval 2.78

Contour Plot Point	Distance (m)	Distance/Max Excavation Depth
A	1.60	0.53
B	4.38	1.46
C	7.15	2.38
D	9.93	3.31
E	12.70	4.23

Horizontal Movement

Distance (m)	%	(m)	(mm)		
1.60	0.13	0.00390	**3.90**	Movement at closest wall
4.38	0.10	0.00286	2.86	
7.15	0.06	0.00182	1.82	
9.93	0.03	0.00078	0.78	
12.70	0.00	0.00000	**0.00**	Movement at furthest wall

Verticle Movement

Distance (m)	%	(m)	(mm)		
1.60	0.09	0.00264	**6.00**	Movement at closest wall
4.38	0.06	0.00175	3.98	
7.15	0.03	0.00096	0.00	
9.93	0.01	0.00036	0.00	
12.70	0.00	0.00000	**0.00**	Movement at furthest wall

Neighbouring Property 2 No. 53 Interval 2.70

Contour Plot Point	Distance (m)	Distance/Max Excavation Depth
A	2.20	0.73
B	4.90	1.63
C	7.60	2.53
D	10.30	3.43
E	13.00	4.33

Horizontal Movement

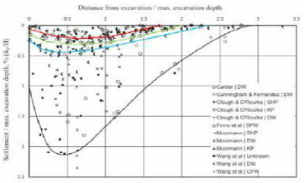
Distance (m)	%	(m)	(mm)		
2.20	0.12	0.00368	**3.68**	Movement at closest wall
4.90	0.09	0.00266	2.66	
7.60	0.06	0.00165	1.65	
10.30	0.02	0.00064	0.64	
13.00	0.00	0.00000	**0.00**	Movement at furthest wall

Verticle Movement

Distance (m)	%	(m)	(mm)		
2.20	0.08	0.00237	**7.50**	Movement at closest wall
4.90	0.05	0.00160	1.50	
7.60	0.03	0.00083	0.00	
10.30	0.00	0.00005	0.00	
13.00	0.00	0.00000	**0.00**	Movement at furthest wall

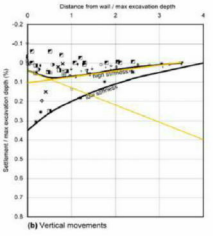
NOTE: If there are any are minus numbers change to 0 (Distance is more than distance to negligible movement from Table 2.4)

Horizontal movement calcs uses three lines: Blue is conservative, Green is moderate, Red is least stringent



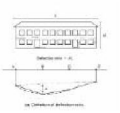
a Normalised settlements due to excavation in soft to firm clay

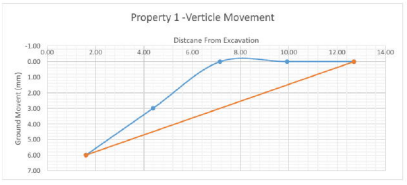
Verticle movement is not assessed with soft to firm clays, therefore stiff clay analysis is used. Vertical movement is not linear so relationship has been estimated from graph. The estimated relationship used in spreadsheet is shown in orange in graph to the right

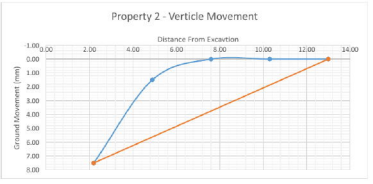


(b) Vertical movements

Potential Damage to Building







Neighbouring Property 1		No. 49		**Neighbouring Property 2**		No. 53	
		m	mm			m	mm
	L	11.10	11100		L	10.80	10800
	H	14.40	14400		H	14.40	14400
	L/H	0.77			L/H	0.75	
Verticle Deflection (Δ)		2.5	mm	Verticle Deflection (Δ)		3.5	mm
Defelction Ratio (Δ/L)		0.022523	%	Defelction Ratio (Δ/L)		0.032407	%
Horizontal Movement (δh)		3.90	mm	Horizontal Movement (δh)		3.68	
Horzontal Strain (Eh) = δh/L		0.03514	%	Horzontal Strain (Eh) = δh/L		0.03403	%

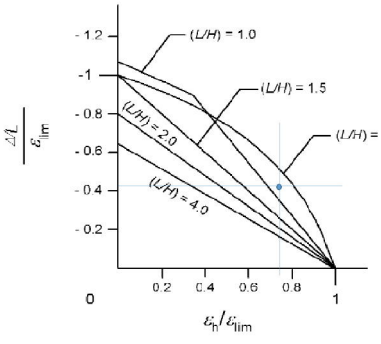
from graph (max difference between blue and orange line)

difference between horizontal movement at nearest and farthest walls

CATEGORY OF DAMAGE Damage category limits are given in Table 2.5 (below) you will also need Fig 2.18 (also shown below).

L/H	0.77		**L/H**	0.75	
Negligible damage limit (Elim)	**0.05**		**Negligible damage limit (Elim)**	**0.05**	
(Δ/L)/(Elim)	0.45045045	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'negligible' category - no need to plot points below	(Δ/L)/(Elim)	0.648148148	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'negligible' category - no need to plot points below
(Eh)/(Elim)	0.702702703		(Eh)/(Elim)	0.680555556	
Very Slight damage limit (Elim)	**0.075**		**Very Slight damage limit (Elim)**	**0.075**	
(Δ/L)/(Elim)	0.3003003	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'very slight' category - no need to plot points below	(Δ/L)/(Elim)	0.432098765	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'very slight' category - no need to plot points below
(Eh)/(Elim)	0.468468468		(Eh)/(Elim)	0.453703704	
Slight damage limit (Elim)	**0.15**		**Slight damage limit (Elim)**	**0.15**	
(Δ/L)/(Elim)	0.15015015	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'slight' category - no need to plot points below	(Δ/L)/(Elim)	0.216049383	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'slight' category - no need to plot points below
(Eh)/(Elim)	0.234234234		(Eh)/(Elim)	0.226851852	
Moderate damage limit (Elim)	**0.3**		**Moderate damage limit (Elim)**	**0.3**	
(Δ/L)/(Elim)	0.075075075	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'moderate' category - if the point is not below, damage is 'severe'	(Δ/L)/(Elim)	0.108024691	Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'moderate' category - if the point is not below, damage is 'severe'
(Eh)/(Elim)	0.117117117		(Eh)/(Elim)	0.113425926	
Calculated Category of Damage		Slight	**Calculated Category of Damage**		Slight

Fig 2.18 (b)



(b) Influence of horizontal strain on Δ/L / ε_{lim} (after Burland, 2001)

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Table 2.5 Classification of visible damage to walls (after Burland et al., 1977, Boscardin and Cording, 1989, and Burland, 2001)

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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	