

The slab could be designed as a fully suspended structure, supported on the main foundations, and incorporating an effective void beneath to accommodate future heave movement.

We have carried out a preliminary analysis and this indicates that a total unrestrained heave of approximately 80mm could occur as a result of the unloading. Approximately 50% of this heave movement is likely to occur during a typical construction programme, leaving a maximum possible post-construction heave of about 40mm to be accommodated. In reality ground movements may be somewhat lower than indicated due to sand beds/hard strata, and so on, within the Lambeth Group, however, the indicated ground response is useful as an upper-bound estimate.

Alternatively, the slab could be ground-bearing and designed to withstand potential heave forces/movements. If it is [reasonably] assumed that the relationship between heave movement and pressure is linear, the maximum heave pressure for an infinitely stiff slab could, therefore, be about 60kPa for the fully constrained condition. However, this may not occur in reality and the heave pressure beneath a more flexible slab will clearly be less [due stress dissipation as the slab deflects]; we anticipate that an 'average' stiffness slab would experience heave pressures of about 30kPa, with 20mm upward heave movement.

It will also be necessary to consider uplift of the slab due to potential hydrostatic pressures and in this respect the guidelines incorporated in BS8102:2009 [and any relevant Eurocode] should be followed, as appropriate. Whilst ground-water was not encountered in the boreholes, the slab design will need to take account of long term levels, potential seasonal fluctuations and/or accidental and flood conditions. Some engineering judgement will be required in deciding the design water level as this will be influenced by the geology, construction techniques and perceived risk. The safe, default position will be to assume a water level at, say, 1m below ground level, reflecting a relatively conservative condition. It MAY be possible to justify a lower permanent design ground-water level if the design reduces or eliminates the likelihood of ground-water flowing to the underside of the slab. Construction techniques that leave permeable zones and potential flow paths could, clearly, result in a relatively high risk of hydrostatic pressures developing underneath the slab. If the designer is confident that the risk of water flowing beneath the slab is low, then it MAY be possible to adopt a lower design water level; such an approach should be agreed with the local regulatory authority and should ensure the risk to the property [and surrounding structures] is suitably low.

It is important to note that the water pressures will not be additional to any soil heave pressures, but will be the minimum uplift pressure for design purposes. This is due to the fact that our model assumes hydrostatic conditions, uses total stresses throughout and includes the water pressure in the uplift pressures/stresses.

The design of the new basement floor slabs must ensure that potential uplift forces caused by any ground-water and/or soil heave are adequately addressed. Detailed analysis of the potential basement heave, pile tension and effects on adjacent structures is outside the scope of this interpretative report. These issues should be addressed when the final pile layout and configuration is known and the loading calculations for the existing building have been completed.

For a ground-bearing slab, the formation must be inspected, with any desiccated or root-infested clay removed and replaced with well-compacted coarse-grained fill.

6.5 Soakaways

The London Clay deposits that underlie the site are an unsuitable medium for accepting soakaways and a piped system of surface water disposal will have to be considered.



6.6 Foundation concrete

For the proposed development two situations are likely as regards aggression to buried concrete: concrete in contact with the existing made ground, and buried concrete entirely within natural soils.

For the first case [in contact with made ground], moderately high levels of soluble sulphates and neutral to alkaline pH values were measured in selected soil and ground-water samples. The sulphate results fall into Site Design Classes DS-2 to DS-3 of Table C2 given in BRE Special Digest 1 [2005]. We assess the made ground as having 'mobile' ground water and recommend that buried concrete is designed in accordance with ACEC Site Class AC-3.

For the natural soils, low to moderate levels of soluble sulphates and near-neutral to alkaline pH values were measured in selected soil samples. The sulphate results fall into Site Design Class DS-1 to DS-2 of Table C2 given in BRE Special Digest 1 [2005]. We assess the natural soils beneath the site as having 'static' ground-water and recommend that buried concrete placed entirely within the London Clay and/or Lambeth Group is designed in accordance with ACEC Site Class AC-1s.





GENERAL INFORMATION, LIMITATIONS AND EXCEPTIONS

Unless otherwise stated, our Report should be construed as being a Ground Investigation Report [GIR] as defined in BS EN1997-2. Our Report is not intended to be and should not be viewed or treated as a Geotechnical Design Report [GDR] as defined in EN1997-2. Any 'design' recommendations which are provided are for guidance only and are intended to allow the designer to assess the results and implications of our investigation/testing and to permit preliminary design of relevant elements of the proposed scheme.

The methods of investigation used have been chosen taking into account the constraints of the site including but not limited to access and space limitations. Where it has not been possible to reasonably use an EC7 compliant investigation technique we have adopted a practical technique to obtain indicative soil parameters and any interpretation is based upon our engineering experience and relevant published information.

The Report is issued on the condition that Soil Consultants Ltd will under no circumstances be liable for any loss arising directly or indirectly from ground conditions between the exploratory points which differ from those identified during our investigation. In addition Soil Consultants Ltd will not be liable for any loss arising directly or indirectly from any opinion given on the possible configuration of strata both between the exploratory points and/or below the maximum depth of the investigation; such opinions, where given, are for guidance only and no liability can be accepted as to their accuracy. The results of any measurements taken may vary spatially or with time and further confirmatory measurements should be made after any significant delay in using this Report.

Comments made relating to ground-water or ground-gas are based upon observations made during our investigation unless otherwise stated. Ground-water and ground-gas conditions may vary with time from those reported due to factors such as seasonal effects, atmospheric effects and and/or tidal conditions. We recommend that if monitoring installations have been included as part of our investigation, continued monitoring should be carried out to maximise the information gained.

Specific geotechnical features/hazards such as [but not limited to] areas of root-related desiccation and dissolution features in chalk/soluble rock can exist in discrete localised areas - there can be no certainty that any or all of such features/hazards have been located, sampled or identified. Where a risk is identified the designer should provide appropriate contingencies to mitigate the risk through additional exploratory work and/or an engineered solution.

Where a specific risk of ground dissolution features has been identified in our Report [anything above a 'low' risk rating], reference should be made to the local building control to establish whether there are any specific local requirements for foundation design and appropriate allowances should be incorporated into the design. If such a risk assessment was not within the scope of our investigation and where it is deemed that the ground sequence may give rise to such a risk [for example near-surface chalk strata] it is recommended that an appropriate assessment should be undertaken prior to design of foundations.

Where spread foundations are used, we recommend that all excavations are inspected and approved by suitably experienced personnel; appropriate inspection records should be kept. This should also apply to any structures which are in direct contact with the soil where the soil could have a detrimental effect on performance or integrity of the structure.

Ground contamination often exists in small discrete areas - there can be no certainty that any or all such areas have been located, sampled or identified.

The findings and opinions conveyed in this Report may be based on information from a variety of sources such as previous desk studies, investigations or chemical analyses. Soil Consultants Limited cannot and does not provide any guarantee as to the authenticity, accuracy or reliability of such information from third parties; such information has not been independently verified unless stated in our Report.

Our Report is written in the context of an agreed scope of work between Soil Consultants Ltd and the Client and should not be used in any different context. In light of additional information becoming available, improved practices and changes in legislation, amendment or re-interpretation of the assessment or the Report in part or in whole may be necessary after its original publication.

Unless otherwise stated our investigation does not include an arboricultural survey, asbestos survey, ecological survey or flood risk assessment and these should be deemed to be outside the scope of our investigation.

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APPENDIX A

Fieldwork, in-situ testing and monitoring

- ✚ Borehole records
- ✚ Standard Penetration Test results
- ✚ Standard Penetration Test equipment calibration certificate
- ✚ Gas and ground-water monitoring record

Laboratory testing

- ✚ Index property testing
- ✚ Plasticity charts
- ✚ Unconsolidated undrained triaxial compression test results
- ✚ Soil soluble Sulphate/pH results [QTS Environmental]

Ground profiles

- ✚ Plot of SPT 'N₆₀' value and undrained shear strength against depth
- ✚ Cross sections through boreholes

Plans & drawings

- ✚ Proposed development plans
- ✚ Site Plan
- ✚ Location Maps

10th April 2015 [Rev 0]



277A Gray's Inn Road, London WC1X 8QF				Borehole No: BH101		
Client: Regal Homes Ltd		Coordinates: 530425E, 182890N		Sheet 1 of 3		
Engineer: Pringuer-James Consulting Engineers Ltd		Ground Level: +17.90mOD		Report No: 9708/MC		
Progress & Observations	Samples & Tests		Strata		Strata Descriptions	Backfill / Installation
	Type	Depth (m)	Depth (m)	Level (m)		
BH commenced: 04/03/2015			0.10	17.80	MADE GROUND: Granite paving setts. [Description from driller's log]	
BH casing diameter: 150mm			0.25	17.65	MADE GROUND: Reinforced concrete slab. [Description from driller's log]	
Inspection pit to 1.20m	D	1.00	1.20	16.70	MADE GROUND: Soft, dark green-grey and dark grey, slightly gravelly, slightly sandy, clay, with occasional small pockets of sand. Gravel is of flint and fragments of concrete.	1
Casing depth: 2.50m	D	2.00	1.70	16.20	MADE GROUND: Firm, brown, slightly gravelly clay. Gravel is fragments of brick.	2
	D	3.00			Firm, becoming stiff below 2.5m, and very stiff below 4.5m, fissured, thinly laminated, brown and orange-brown, thinly veined blue-grey CLAY, with occasional selenite. Some orange-brown greying on fissure planes.	3
	D	4.00				4
	D	5.00				5
	D	6.00				6
	D	7.00	6.60	11.30	Very stiff, thinly laminated, fissured, dark grey-brown CLAY, with rare small pockets of light grey-brown silt.	7
Chiselling of claystone from 7.60m to 7.90m [0.5 hours]	D	8.00	7.90	10.00	...light brown claystone between 7.60m and 7.90m	8
	D	9.00			Very stiff, sparsely fissured, dark grey-brown, slightly sandy CLAY, with occasional small pockets of silt, rare pyrite nodules and rare carbonaceous matter.	9
	D	10.00	10.00	7.90		10
Continued on next sheet						
Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm ²] PID = Photo Ionisation Detector [ppmv] * = full SPT penetration not achieved - see summary sheet						Borehole type: Cable Percussion
Remarks: Approximate coordinates interpolated from public domain data. Approximate Ground Level interpolated from Pringuer-James drawing (ref. L1706-03_01, dated May 2014).						Borehole No: BH101

277A Gray's Inn Road, London WC1X 8QF				Borehole No: BH101		
Client: Regal Homes Ltd		Coordinates: 530425E, 182890N		Sheet 2 of 3		
Engineer: Pringuer-James Consulting Engineers Ltd		Ground Level: +17.90mOD		Report No: 9708/MC		
Progress & Observations	Samples & Tests		Strata		Strata Descriptions	Backfill / Installation
	Type	Depth (m)	Depth (m)	Level (m)		
					Very stiff, sparsely fissured, dark grey-brown, slightly sandy CLAY, with occasional small pockets of silt, rare pyrite nodules and rare carbonaceous matter.	
	D	11.00				11
	D	12.00				12
	D	13.00				13
	D	14.00				14
	U	15.00				15
	D	15.45				16
	D SPT/S	16.50	16.50	N=30 N ₆₀ =38		17
	D	17.25				18
	U	18.00				19
	D	18.45				20
	D SPT/S	19.50	19.50	N=33 N ₆₀ =42		
			20.00	-2.10		
Continued on next sheet						
Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm ²] PID = Photo Ionisation Detector [ppmv] * = full SPT penetration not achieved - see summary sheet						Borehole type: Cable Percussion
Remarks: Approximate coordinates interpolated from public domain data. Approximate Ground Level interpolated from Pringuer-James drawing (ref. L1706-03_01, dated May 2014).						Borehole No: BH101

277A Gray's Inn Road, London WC1X 8QF				Borehole No: BH101			
Client: Regal Homes Ltd		Coordinates: 530425E, 182890N		Sheet 3 of 3			
Engineer: Pringuer-James Consulting Engineers Ltd		Ground Level: +17.90mOD		Report No: 9708/MC			
Progress & Observations	Samples & Tests		Strata		Legend	Strata Descriptions	Backfill / Installation
	Type	Depth (m)	Depth (m)	Level (m)			
BH complete: 04/03/2015 BH depth: 25.00m Casing depth: 2.50m Water depth: Dry	D	20.25				Very stiff, sparsely fissured, dark grey-brown, slightly sandy CLAY, with occasional small pockets of silt, rare pyrite nodules and rare carbonaceous matter.	
	U	21.00	20.90	-3.00			
	D	21.40				Very stiff, very closely fissured, locally slickensided, variegated red-brown, orange-brown, brown and blue-grey, CLAY. Locally thinly laminated, locally bioturbated.	
	D	22.50					
	SPT/S	22.50				Stiff, becoming very stiff below 5.0m, fissured, thinly laminated, brown and orange-brown, thinly veined blue-grey CLAY, with occasional selenite. Some orange-brown gleying on fissure planes.	
	D	23.00					
	U	23.50				Very stiff, thinly laminated, fissured, dark grey-brown CLAY, with rare small pockets of light grey-brown silt.	
	D	23.90					
	D	24.50				Very stiff, thinly laminated, fissured, dark grey-brown CLAY, with rare small pockets of light grey-brown silt.	
	SPT/S	24.50					
			25.00	-7.10		End of borehole at 25.00m	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone HV = Hand Vane [kPa]
 PP = Pocket Penetrometer [kg/cm²] PID = Photo Ionisation Detector [ppmv] * = full SPT penetration not achieved - see summary sheet

Remarks: Approximate coordinates interpolated from public domain data.
 Approximate Ground Level interpolated from Pringuer-James drawing (ref. L1706-03_01, dated May 2014).

Borehole type: Cable Percussion
 Borehole No: **BH101**



277A Gray's Inn Road, London WC1X 8QF				Borehole No: BH102			
Client: Regal Homes Ltd		Coordinates: 530448E, 182853N		Sheet 1 of 3			
Engineer: Pringuer-James Consulting Engineers Ltd		Ground Level: +19.10mOD		Report No: 9708/MC			
Progress & Observations	Samples & Tests		Strata		Legend	Strata Descriptions	Backfill / Installation
	Type	Depth (m)	Depth (m)	Level (m)			
BH commenced: 02/03/2015			0.25	18.85		MADE GROUND: Soft, brown and orange-brown, slightly gravelly, slightly sandy, silty clay. Gravel is of flint, brick and concrete.	
BH casing diameter: 150mm							
Inspection pit to 1.20m	D	1.00				MADE GROUND: Firm, brown, slightly gravelly clay. Gravel is fragments of brick.	
Casing depth: 2.00m	D	2.00					
			1.70	17.40		Stiff, becoming very stiff below 5.0m, fissured, thinly laminated, brown and orange-brown, thinly veined blue-grey CLAY, with occasional selenite. Some orange-brown gleying on fissure planes.	
	U	3.00					
	D	3.50				Very stiff, thinly laminated, fissured, dark grey-brown CLAY, with rare small pockets of light grey-brown silt.	
	D	4.00					
	SPT/S	4.00				Very stiff, thinly laminated, fissured, dark grey-brown CLAY, with rare small pockets of light grey-brown silt.	
	D	4.50					
	U	5.00				Very stiff, thinly laminated, fissured, dark grey-brown CLAY, with rare small pockets of light grey-brown silt.	
	D	5.50					
	D	6.50				Very stiff, thinly laminated, fissured, dark grey-brown CLAY, with rare small pockets of light grey-brown silt.	
	SPT/S	6.50					
	D	7.25				Very stiff, thinly laminated, fissured, dark grey-brown CLAY, with rare small pockets of light grey-brown silt.	
	U	8.00					
	D	8.50				Very stiff, thinly laminated, fissured, dark grey-brown CLAY, with rare small pockets of light grey-brown silt.	
	D	9.50					
	SPT/S	9.50				Very stiff, thinly laminated, fissured, dark grey-brown CLAY, with rare small pockets of light grey-brown silt.	
	D	10.00					
Continued on next sheet							

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone HV = Hand Vane [kPa]
 PP = Pocket Penetrometer [kg/cm²] PID = Photo Ionisation Detector [ppmv] * = full SPT penetration not achieved - see summary sheet

Remarks: 50mm diameter standpipe with gas tap installed on completion.
 Approximate coordinates interpolated from public domain data.
 Approximate Ground Level interpolated from Pringuer-James drawing (ref. L1706-03_01, dated May 2014).

Borehole type: Cable Percussion
 Borehole No: **BH102**



Site & Location:		277A Gray's Inn Road, London WC1X 8QF		Borehole No: BH102	
Client:		Regal Homes Ltd		Coordinates: 530448E, 182853N	
Engineer:		Pringuer-James Consulting Engineers Ltd		Ground Level: +19.10mOD	
Progress & Observations		Samples & Tests		Field Test Results	
		Type	Depth (m)	Depth (m)	Level (m)
		D	10.25		
		U	11.00		
		D	11.50		
		D	12.50	N=26 N ₆₀ =33	
		SPT/S	12.50		
		D	13.25		
		U	14.00		
		D	14.50		
		D	15.50	N=27 N ₆₀ =34	
		SPT/S	15.50		
		D	16.25		
		U	17.00		
		D	17.50		
		D	18.50	N=35 N ₆₀ =44	
		SPT/S	18.50		
		D	19.25		
		U	20.00		
Continued on next sheet					
Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm ²] PID = Photo Ionisation Detector [ppmv] * = full SPT penetration not achieved - see summary sheet					
Remarks: 50mm diameter standpipe with gas tap installed on completion. Approximate coordinates interpolated from public domain data. Approximate Ground Level interpolated from Pringuer-James drawing (ref. L1706-03_01, dated May 2014).					
Borehole type: Cable Percussion Borehole No: BH102					

Site & Location:		277A Gray's Inn Road, London WC1X 8QF		Borehole No: BH102	
Client:		Regal Homes Ltd		Coordinates: 530448E, 182853N	
Engineer:		Pringuer-James Consulting Engineers Ltd		Ground Level: +19.10mOD	
Progress & Observations		Samples & Tests		Field Test Results	
		Type	Depth (m)	Depth (m)	Level (m)
		D	20.50		
		D	21.50	N=44 N ₆₀ =56	
		SPT/S	21.50		
		D	22.25		
		U	23.00		
		D	23.50		
		D	24.50	N > 50*	
		SPT/S	24.50		
BH complete: 03/03/2015 BH depth: 25.00m Casing depth: 2.00m Water depth: Dry					
End of borehole at 25.00m					
Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm ²] PID = Photo Ionisation Detector [ppmv] * = full SPT penetration not achieved - see summary sheet					
Remarks: 50mm diameter standpipe with gas tap installed on completion. Approximate coordinates interpolated from public domain data. Approximate Ground Level interpolated from Pringuer-James drawing (ref. L1706-03_01, dated May 2014).					
Borehole type: Cable Percussion Borehole No: BH102					

277A Gray's Inn Road, London WC1X 8QF				Borehole No: BH103			
Client: Regal Homes Ltd		Coordinates: 530478E, 182807N		Sheet 1 of 3			
Engineer: Pringuer-James Consulting Engineers Ltd		Ground Level: +19.10mOD		Report No: 9708/MC			
Progress & Observations	Samples & Tests		Strata		Legend	Strata Descriptions	Backfill / Installation
	Type	Depth (m)	Depth (m)	Level (m)			
BH commenced: 27/02/2015			0.20	18.90		MADE GROUND: Reinforced concrete slab. [Description from driller's log]	
BH casing diameter: 150mm						MADE GROUND: Soft, brown and orange-brown, slightly gravelly, slightly sandy, silty clay. Gravel is of flint, brick and concrete.	
Inspection pit to 1.20m	D	1.00					1
Casing depth: 2.00m	D	2.00					2
	D	3.00					3
	D	3.50	3.40	15.70		MADE GROUND: Firm, brown, slightly gravelly clay. Gravel is fragments of brick. [Description from driller's log]	
	D	4.50	3.60	15.50		Stiff, becoming very stiff below 5.0m, fissured, thinly laminated, brown and orange-brown, thinly veined blue-grey CLAY, with occasional selenite. Some orange-brown greying on fissure planes.	4
	D	5.50					5
	D	6.50				Very stiff, thinly laminated, fissured, dark grey-brown CLAY, with rare small pockets of light grey-brown silt.	6
	D	7.50					7
	D	8.50	7.70	11.40		Very stiff, sparsely fissured, dark grey-brown, slightly sandy CLAY, with occasional small pockets of silt, rare pyrite nodules and rare carbonaceous matter.	8
	D	9.50					9
			10.00	9.10			10
Continued on next sheet							
Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm ²] PID = Photo Ionisation Detector [ppmv] * = full SPT penetration not achieved - see summary sheet						Borehole type: Cable Percussion	
Remarks: Approximate coordinates interpolated from public domain data. Approximate Ground Level interpolated from Pringuer-James drawing (ref. L1706-03_01, dated May 2014).						Borehole No: BH103	

277A Gray's Inn Road, London WC1X 8QF				Borehole No: BH103			
Client: Regal Homes Ltd		Coordinates: 530478E, 182807N		Sheet 2 of 3			
Engineer: Pringuer-James Consulting Engineers Ltd		Ground Level: +19.10mOD		Report No: 9708/MC			
Progress & Observations	Samples & Tests		Strata		Legend	Strata Descriptions	Backfill / Installation
	Type	Depth (m)	Depth (m)	Level (m)			
	D	10.50				Very stiff, sparsely fissured, dark grey-brown, slightly sandy CLAY, with occasional small pockets of silt, rare pyrite nodules and rare carbonaceous matter.	11
	D	11.50					12
	D	12.50					13
	D	13.50					14
Ground-water strike at 14.50m depth - seepage, no rise	D	14.50					15
	U	15.00					16
	D	15.50					17
	D	16.50					18
	SPT/S	16.50			N=27 N ₆₀ =34		19
	D	17.25					20
	U	18.00					21
	D	18.50					22
	D	19.50					23
	SPT/S	19.50			N=29 N ₆₀ =37		24
			20.00	-0.90			25
Continued on next sheet							
Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm ²] PID = Photo Ionisation Detector [ppmv] * = full SPT penetration not achieved - see summary sheet						Borehole type: Cable Percussion	
Remarks: Approximate coordinates interpolated from public domain data. Approximate Ground Level interpolated from Pringuer-James drawing (ref. L1706-03_01, dated May 2014).						Borehole No: BH103	