Job Number: 150605

CROFT STRUCTURAL ENGINEERS

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Basement Impact Assessment

Property:

50 Rochester Place
Camden
London
NW1 9JX

Client:

Michael Anastassiades

Structural Design Reviewed by	Above Ground Drainage Reviewed by
Chris Tomlin MEng CEng MIStructE	Phil Henry BEng MEng MICE

BIA (Land Stability, Surface Water, Ground Water) Report by
(Separate report by Soils Ltd) A. P. Dykes, CGeol

Revision	Date	Comment
-	26 August 2015	First issue
1	5 October 2015	Second issue
2	28 June 2016	Layout and content revised

Contents

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Executive (non-technical) Summary	
	The London Borough of Camden requires a Basement Impact Assessment (BIA) to be prepared for developments that include basements and lightwells. This document forms part of the BIA and gives details of the scheme design for the proposed subterranean structure. This document should be used in conjunction with the BIA by Soils Ltd (ref 15051, dated August 2015). This is a separate report and is referred to, where relevant, within this document. This BIA follows the requirements contained within Camden Council's planning guidance CGP4 – Basements and Lightwells (2015). In summary, the council will only allow basement construction to proceed if it does not: • cause harm to the built or natural environment and local amenity • result in flooding • lead to ground instability. In order to comply with the above clauses, a BIA must undertake five stages detailed in CPG 4. This report has been produced in line with Camden planning guidance and associated supporting documents such as CPG1, DP23, DP26, DP25 and DP27. Technical information from 'Camden geological, hydrogeological and hydrological study - Guidance for subterranean development', Issue 01, November 2010 (GSD, hereafter) was also used and is referred to in this assessment.
Existing Property	The site comprises a single storey, open-plan building, which is currently used as a car servicing and repair garage. The building joins masonry structures on both sides. The property fronts onto Rochester Place. The building occupies the whole of the site area; there is no rear garden.

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	 Figure 1: Birdseye view from north (looking south) with approx. site area indicated
Proposed Development	The proposed development involves the construction of a new basement below the existing structure. The basement will be below the footprint of the existing building.  Figure 2: Aerial view with approx. site area indicated There will also be alterations to the above ground structure. Details of this are not required, and are not described in this assessment. Further details showing the extent of the basement are shown in architectural drawings by AWDM. These are available as separate items and are not included within this report.
Stage 1 –	The Screening identified the following:

Screening	• There are no issues with regards to Surface Flow and Flooding. • The basement is unlikely to extend below the water table; a ground investigation must confirm this. • The basement will be in clay and may increase the increase the differential depth relative to the neighbouring buildings. • The basement is unlikely to be close to an underground tunnel.
Stage 2 – Scoping	The Scoping stage identified the potential impacts of issues that were highlighted in the Screening phase and drew attention to mitigation effects that may be required at Design stage. The Scoping stage highlighted the requirement for a Ground Investigation.
Stage 3 – Site Investigation and Study	A structural engineer inspected the building to determine the current condition of the property and verify information from a desk study. Visual inspections were completed of the adjacent properties and external features surrounding the site. A ground investigation with a borehole and a trial pit was completed. Clay was found to be present at the proposed formation level of the basement. Laboratory testing was undertaken on the soil samples. The absence and subsequent presence of groundwater was noted, during an initial investigation and return visit respectively.
Stage 4 – Impact Assessment	**Land Stability** The BIA advises that various mitigation measures should be adopted to reduce the likelihood of undermining adjacent structures. Movement monitoring during the construction phase is also recommended. **Hydrogeology** The BIA concludes that the groundwater may be a cause for concern during the construction phase. Measures to mitigate this, including dewatering are proposed. **Surface Water Flow** The BIA does not identify any adverse effects that the basement will have on surface water flow and potential for flooding.

1. Screening Stage	
	This stage identifies any areas for concern that should be investigated further.
Land Stability	Refer to the report by Soils Ltd (ref 15051, dated August 2015).
Subterranean Flow	Refer to the report by Soils Ltd (ref 15051, dated August 2015).
Surface Flow and Flooding	Refer to the report by Soils Ltd (ref 15051, dated August 2015).

2. Scoping Stage	
	Refer to the report by Soils Ltd (ref 15051, dated August 2015) which discusses the issues that were carried forward to Scoping Stage.

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3. Site Investigation and Desk Study

This section identifies the relevant features of the site and its immediate surroundings, providing further scoping where required. Additional information is on the site investigation is described within the report by Soils Ltd.

Desk Study and Walkover Survey

A structural engineer from Croft visited the site on 16 June 2015

The site comprises a single storey, open-plan building, which is currently used as a car servicing and repair garage. The building is approximately 100 years old and joins masonry structures on both sides. The property fronts onto a road, Rochester Place. The building occupies the whole of the site area; there is no rear garden.

Figure 3: Birdseye view from north (looking south) with approx. site area indicated

Proposed Development

The proposed development involves the construction of a new basement below the existing building. There will also be alterations to the above ground structure. Details of this are not required, and are not described in this assessment.

Further details showing the extent of the basement are shown in architectural drawings by AWDM. These are available as separate items

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	and are not included within this report. The construction site area is indicated below. In addition to the basement area, this also includes areas that are likely to be temporarily occupied for construction purposes.  *Figure 4: Aerial view with approx. site area indicated* The basement will be a single-storey below ground level. The maximum excavation depth will not exceed 3.5m. The outline construction sequence is appended to this report.
Listed Buildings and Conservation Areas	The existing building is not listed. Data from Historic England shows that there are no listed buildings close by.

Figure 5: Extract of map from Historic England showing no listed buildings adjacent to site

The site is in the Rochester conservation Area.

Local topography & external features

The area immediately in front of the site is covered with hard surfaces, this comprises a cobbled road with pavement either side. There are drainage gullies on Rochester Place.

Figure 6: Front elevation of property

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	The area surrounding the property is flat. No surface water features were noted in the immediate vicinity. Trees were noted in gardens to the rear of the property.
Geology	Refer to the Ground Investigation report and the BIA by Soils Ltd.
Highways & public footpaths	The site is within 5m of a public highway (Rochester Place).
London Underground and Network Rail	The site is more than 50m away from the nearest national rail line. The Northern Line runs relatively close by. London Underground (LUL) have been informed of this proposal and have confirmed that the line will not be affected (refer to appended e-mail).
UK Power Networks	There are no significant items of electrical infrastructure (such as pylons or substations) in the immediate vicinity.
Proximity of Trees	The closest tree is more than 2.5m away from the outline of the proposed basement. The diameter of the trunk of this tree is no greater than 300mm. BS 5837: 2005 *Trees in relation to construction* estimates the root protection area (RPA) to be equivalent to a circle with a radius12 times the stem diameter. Based on a trunk diameter of 300mm, the diameter of this circle would be 3.6m. The roots concerned would therefore be within 1.8m from the trunk. These would not be affected by a basement that is 2.5m away.
	Adjacent Properties The external facades of the neighbouring properties have been inspected. These are indicated below.

Figure 7: Plan view of site, showing site area marked in red and adjacent properties indicated

There are buildings further to the front and rear. These are beyond 6m for the proposed basement boundary and are not considered to be directly affected neighbours.

References to the left and right are given as facing the front of the properties, looking from south-west to north-east.

No. 52 – Property to Left	The building occupying No 52 is of a similar age and construction to No 50. It is a single storey masonry structure and is occupied for commercial use. During the walk-over survey, no signs of structural defects were noted. There was nothing to indicate the presence any subterranean structure. A search on Camden Council's planning portal did not return any proposals for a basement.

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	 *Figure 8: view of No 52*
No. 48 – Property to Right	No 48 is a Victorian building that is occupied for residential use. The building is two storeys high with additional floor that was converted from roof space to form habitable areas. The structure is built from traditional building materials (brickwork and timber). During the walk-over survey, no signs of structural defects were noted. There was nothing to indicate the presence any subterranean structure. A search on Camden Council's planning portal did not return any proposals for a basement.

Figure 9: Partial view of No 50 and No 52

Monitoring, Reporting and Investigation

The ground investigation report, which has data from initial site investigations and data from subsequent monitoring, is available as a separate report.

Ground Investigation

Ground Investigation Brief	
	The ground investigation was completed by Ground & Water Ltd. From the Scoping Stage, Croft considered that their brief should cover: • A trial pit to confirm the extent of the existing foundations. The purpose is to consider the effect of the works on the neighbouring properties and the find the ground conditions below the site. • One borehole to a depth of 6m below ground level (i.e. more than twice the internal height of the proposed basement). • Stand pipe to be inserted to monitor ground water, record initial strike and the water level after one month. • Site testing to determine in-situ soil parameters. • Laboratory testing to confirm soil make up and properties.

	• Factual report on soil conditions. • Interpretative reports • Calculation of bearing pressures • Indication of Ø (angle of friction) • Indication of soil type Refer to the ground investigation report by Ground & Water Ltd, which is submitted as a separate document. Data relevant to land stability and subterranean flow is examined separate documents.

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4. Basement Impact Assessment

Impacts relating to Subterranean Flor and Land Stability are described within the BIA produced by Soils Ltd [Ref15051]. Proposed measures to mitigate these, which should be developed further at detailed design stage, are presented in this section.

Ground Movement Assessment & Predicted Damage Category

The design and construction methodology aims to limit damage to the existing building on the site, and to the neighbouring buildings, to Category 2 or lower as set out in Table 2.5 of CIRIA report C580. For this development, suitable temporary propping during the construction phase will limit the amount of movement due to the basement works. This is described in the Basement Method Statement (appended).

The ground movement assessment (GMA) is carried out to show the anticipated movement that neighbouring buildings may experience. This is presented at the end of Appendix A.

Mitigation Measures Ground Movement

A method statement, appended, has been formulated with Croft's experience of over 500 basements completed without error. As mentioned previously, the procedures described in this statement will mitigate the impacts that the construction of the basement will have on nearby properties.

The works must be carried out in accordance with the Party Wall Act and condition surveys will be necessary at the beginning and the end of the works. The Party Wall Approval procedure will reinforce the use of the proposed method statement and, if necessary, require it to be developed in more detail with more stringent requirements than those required at planning stage.

It is not expected that any cracking will occur in nearby structures during the works. However, Croft's experience advises that there is a risk of movement to the neighbouring property.

To reduce the risk to the development:

- Employ a reputable firm that has extensive knowledge of basement works.
- Employ suitably qualified consultants Croft Structural Engineers has completed over 500 basements in the last five years.
- Provide method statements for the contractors to follow
- Investigate the ground this has now been done.
- Record and monitor the properties close by. This is completed by a condition survey under the Party Wall Act, before and after the works are completed. Refer to the end of the appended Basement Construction Method Statement.

With the measures listed above, the maximum level of cracking anticipated is 'Hairline' cracking. This can be repaired with normal decorative works. Under the Party Wall Act, minor damage, although unwanted, can be tolerated it is permitted to occur to a neighbouring property as long as repairs are suitability undertaken to rectify this. To mitigate this risk, the Party Wall Act is to be followed and a Party Wall Surveyor will be appointed.

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Monitoring of Structures

In order to safeguard the existing structures during underpinning and new basement construction, movement monitoring is to be undertaken.

Risk Assessment

Monitoring Level proposed	Type of Works.
Monitoring 4 Visual inspection and production of condition survey by Party Wall Surveyors at the beginning of the works and also at the end of the works. Visual inspection of existing party wall during the works. Inspection of the footing to ensure that the footings are stable and adequate. Vertical monitoring movement by standard optical equipment Lateral movement between walls by laser measurements	New basements greater than 2.5m and shallower than 4m deep in gravels Basements up to 4.5m deep in clays Underpinning works to grade I listed building

Before the works begin, a detailed monitoring report is required to confirm the implementation of the monitoring. The items that this should cover are:

- Risk Assessment to determine level of monitoring
- Scope of Works
- Applicable standards
- Specification for Instrumentation
- Monitoring of Existing cracks
- Monitoring of movement
- Reporting
- Trigger Levels using a RED / AMBER / GREEN System

Recommend levels are shown within the proposed monitoring statement (appended).

Basement Design & Construction Impacts and Initial Design Considerations

Foundation type	Reinforced concrete cantilevered retaining walls will form the new foundation of the property. The design of the retaining walls was calculated using software specifically designed for retaining walls. This ensures that the construction is kept to a limit to prevent damage to the adjacent property. The overall stability of the walls is designed using K_a & K_p values, while the design of the wall structure uses K_0 values. This approach minimises the level of movement from the concrete affecting the adjacent properties. The investigations highlight that water is present. This is likely to be perched water. The walls are designed to resist hydrostatic pressure. The design of the walls considers long-term scenarios. It is possible that a water main will break, causing a local high water table. To account for this, the wall is designed for hydrostatic pressures applied to the full height of the retaining wall. The new reinforced concrete (RC) basement structure, will place the bottom of the new foundations at a depth which is beyond influence of trees and the related volumetric changes in the soil.
Intended use of structure and user requirements	Commercial use
Loading Requirements (EC1-1)	see table below
Part A3 Progressive collapse	Number of Storeys: 1 + Basement

Loading Requirements (EC1-1):

	UDL kN/m²	Concentrated Load kN
Office General Use	2.5	2.7

Part A3 Progressive collapse:

Number of Storeys 1 + Basement

Class 2A	5 storey single occupancy houses Hotels not exceeding 4 storeys Flats, apartments and other residential buildings not exceeding 4 storeys Offices not exceeding 4 storeys Industrial buildings not exceeding 3 storeys Retailing premises not exceeding 3 storeys of less than 2000m^2 floor

	area in each storey Single storey educational buildings All buildings not exceeding 2 storeys to which members of the public are admitted and which contain floor areas not exceeding 2000m^2 at each storey
	Change of use To NHBC guidance compliance is only required to other floors if a material change of use occurs to the property.
Lateral Actions	The lateral earth pressure exerts a horizontal force on the retaining walls. The retaining walls will be checked for resistance to the overturning force this produces. Lateral forces will be applied from: • Soil loads • Hydrostatic pressures • Surcharge loading from behind the wall These produce retaining wall thrust. This will be restrained by the opposing retaining wall.
Retained soil Parameters	Design overall stability to K_a & K_p values. Lateral movement necessary to achieve K_a mobilisation is height/500 (from Tomlinson). This is tighter than the deflection limits of the concrete wall.
Water Table	As described previously, hydrostatic pressures will be applied to the full height of the retaining wall. For this development, global uplift forces can be ignored because the water table is lower than the basement. BS8102 only indicates guidance.
Loading requirements and mitigation measures relating to neighbouring physical assets	**Surcharge Loading** The following will be applied as surcharge loads to the retaining walls: • 10kN/m^2 if within 45° of road • 5kN/m^2 if within 45° of Pavement • Garden Surcharge 2.5kN/m^2 + 1 m of soil (if present above basement ceiling) 20kN/m^2 • Surcharge for adjacent property 1.5kN/m^2 + 4kN/m^2 for concrete

Initial Building Class	2A
Proposed Building Class	2A
If class has changed material change has occurred	N/A

	ground bearing slab <u>Highways loading:</u> The basement is within 5m of the public highway. For the design of retaining walls at the front of the property, a highways loading of 10kN/m² should therefore be allowed for, at detailed design stage. <u>Adjacent Properties:</u> Vertical loads from walls that are shared with neighbouring properties should be accounted for in the design of the retaining walls. The appended calculations show the design of one of the most heavily loaded retaining walls. The most critical parameters have been used for this. The appended GMA has predicted the movement relating to nearby properties, during construction. The excavations will be a similar thought the extent of the basement. The movement predictions also apply to the front and the rear of the property; movements of the road in front of the property will be similar to those at the side and suitable mitigation measures will apply throughout. Refer to the appended proposed basement method statement for more details.
Mitigation Measures - Internal Flooding	Basements have an inherent risk of flooding internally (eg due to burst mains). To mitigate the risks associated with this, and to mitigate any related damage, Croft would recommend the following measures to reduce these risks: • A positive pumping device should be installed for the proposed basement. There is a likelihood that this may fail and allow excess water to accumulate. If this were to occur, the build-up of water would be gradual and noticeable before it becomes a significant life-threatening hazard. • Install a dual pumping system to maintain operation in the event of a failure. This should include a battery backup and a suitable alarm system for warning purposes. • Route all electrical wiring at high level. •
Mitigation Measures - Drainage and Damp-proofing	The site will be covered with impermeable surfaces, as before. The above-ground drainage and the discharge volume into the sewer system will remain unaltered. The basement structure will need to be adequately waterproofed, below ground level. The design of drainage and damp-proofing is not within the

	scope of this assessment and would not normally be expected to be part of the structural engineer's remit at detailed design stage. A common and anticipated detailed design stage approach is to use internal membranes (Delta or similar). These will be integral to the waterproofing of the basement. Any water from this will enter a drainage channel below the slab. This will be pumped and discharged into the exiting sewer system. It is recommended that a waterproofing specialist is employed to ensure all the water proofing requirements are met. The waterproofing specialist must name their structural waterproofer. The structural waterproofer must inspect the structural details and confirm that he is happy with the robustness. Due to the segmental construction nature of the basement, it is not possible to water proof the joints. All waterproofing must be made by the waterproofing specialist. He should review the structural engineer's design stage details and advise if water bars and stops are necessary. The waterproofing designer must not assume that the structure is watertight. To help reduce water flow through the joints in the segmental pins, the following measures should be applied: • All faces should be cleaned of all debris and detritus • Faces between pins should be needle hammered to improve key for bonding • All pipe work and other penetrations should have puddle flanges or hydrophilic strips
Mitigation Measures - Localised Dewatering	Monitor water levels one month prior to starting on site and throughout the construction process. Localised dewatering to pins may be necessary. As advised in the report by Soils Ltd, the advice of a reputable dewatering contractor should be sought prior to finalising the design of the temporary works for the basement.
Temporary Works	Temporary propping details will be required. This must be provided by the contractor. Their details should be forwarded to the design stage engineer. To demonstrate the feasibility of the works, a proposed basement construction method statement is appended.

Construction Management	The property is in a conservation area. The contractor should strictly control the impacts on the local amenity. A management plan for demolition and construction will be required at detailed design stage. This is not included in this BIA document and is not within Croft Structural Engineer's brief. Considerations that the contractor and the design team should account for in the construction management plan are described below. <u>Noise Control</u> • The hours of working will be limited to those allowed: 8am to 5pm Monday to Friday and Saturday, 8am to 1pm. The hours of working will further be defined within the Party Wall Act and the requirements of Camden Council. • The site will be hoarded with 8' site hoarding to prevent access. • Working in the basement generally requires hand tools to be used. The level of noise generally will be no greater than that of digging of soil. The noise is reduced and muffled by the works being undertaken underground. The level of noise from basement construction works is lower than typical ground level construction due to this. • None of the construction practices cause undue noise greater than what is expected on a typical construction site (a conveyor belt typically runs at around 70dB). Site hoarding acts as a partial acoustic screen and will reduce the level of direct noise from the site. <u>Dust and Vibration Control</u> • Reduce the need to use vibrating and percussive machinery. • Use well-maintained and modern machinery • Plant/vehicles should be cleaned before exiting the site. • Water should be applied to suppress dust • Skips and storage of fine materials should be covered <u>Traffic Control</u> • Consideration of site traffic to, from and along Rochester Place should be considered carefully; this should include identifying access and exit routes, planned delivery times and vehicle swept paths, which will be critical within the narrow width of Rochester Place. • Banksmen should assist with vehicle movements close to and within the site to ensure the safety of site staff, visitors and other people close to the site. • Construction vehicle movements should be co-ordinated with deliveries to other properties close by and vehicle movements for other construction sites in the vicinity.

	• A Construction Traffic Management Plan should implement the above. This should be developed at detailed design stage. The contractor is to follow the good working practices and guidance laid down in the 'Considerate Constructors Scheme'. This scheme commits construction sites to commit to care about appearance, respect the community, protect the environment and secure everyone's safety. The scheme will reinforce the measures above described above. With good construction practices adopted, the impact on the local amenity will be minimised.

Appendix A: Structural Calculations

CPG4, Section 5 highlights that other permits and requirements will be necessary after planning. Item 5.1 highlights that Building Regulations will be required. As part of the package required for Building Control, full calculations must be undertaken and provided at detailed design stage once planning permission is granted. The calculations must be completed to a recognised Standard (BS or Euro Codes). The calculations must take into account the findings of this report and the recommendations of the auditors.

The design must resist:

- Vertical loads from the proposed works and adjacent properties
- Lateral loads from wind, soil water and adjacent properties
- Loadings in the temporary condition
- All other applied loads on the building
- Uplift forces from hydrostatic effects and soil heave

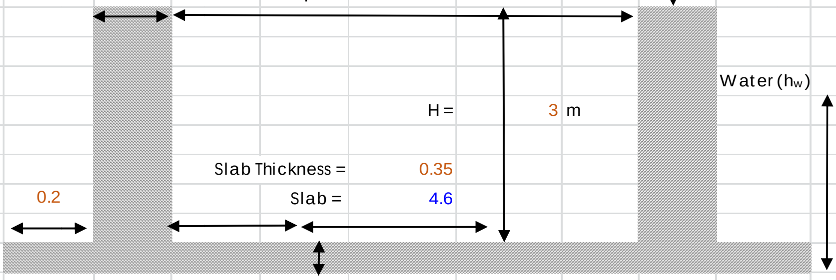
The final proposed scheme must:

- Provide stability in the temporary condition to all forces
- Provide stability to all forces in the permanent condition

As part of the planning application, Croft Structural Engineers has considered some of the pertinent parts of the basement structure to ensure that it can be constructed. The following calculations are not a full set of calculations for the final design. The structural calculations that Croft considers pertinent and included in this appendix for this development are those for the party wall foundation and retaining wall.

Slab Uplift & Heave

Ref	Slab Uplift							
	Wall DL1	40	kN/m		Wall DL2	80	kN/m	
	w =	0.375	m					
			soil depth above=	0	m			
			Span=	7.6	m			
						Water (h_w)	3.4	m
			H =	3	m			
			Slab Thickness =	0.35				
Heel=	0.2		Slab =	4.6				
			Toe =	0.35	m			
			Toewidth=	1.5	m	soil unit weight=	18	kN/m^3



Slab Uplift

Slab =	8.8	kN/m	Uplift =	33.5 kN/m	= h_w x $10kN/m^3$
Service Moment =	-178.7	kNm/m			
Factored Design moment=	-209.2	kNm/m	[At Detailed Design stage, the slab should		
Factored Design shear =	-110.1	kN/m	be designed to resist these forces]		

Global Heave

Weight of building =	268.0	kN/m
Weight of soil removed =	450.9	kN/m
% change	41%	
width of heave protection =	3.4	m

Heave protection measures should be allowed for, such as the inclusion of clayboard below central slab.
Predicted movements due to heave should be determined at detailed design stage, to ensure that the thickness of the heave protection (clayboard or similar) is adequate.

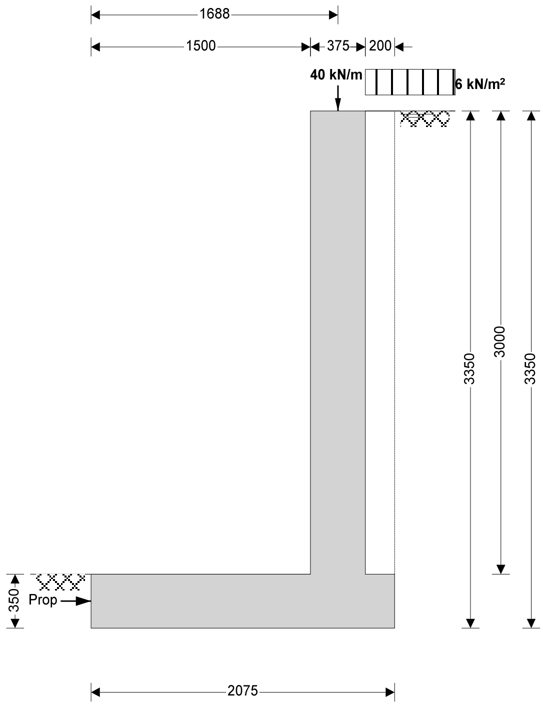
Retaining Wall Design

RETAINING WALL

Typical retaining wall below party wall with No 52. Opposite side (below No 48) is similar.

RETAINING WALL ANALYSIS (BS 8002:1994)

TEDDS calculation version 1.2.01.06



Wall details

Retaining wall type	**Cantilever**		
Height of wall stem	h_{stem} = **3000** mm	Wall stem thickness	t_{wall} = **375** mm
Length of toe	l_{toe} = **1500** mm	Length of heel	l_{heel} = **200** mm
Overall length of base	l_{base} = **2075** mm	Base thickness	t_{base} = **350** mm
Height of retaining wall	h_{wall} = **3350** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **350** mm
Position of downstand	l_{ds} = **1525** mm		
Depth of cover in front of wall	d_{cover} = **0** mm	Unplanned excavation depth	d_{exc} = **0** mm
Height of ground water	h_{water} = **3350** mm	Density of water	γ_{water} = 9.81 kN/m^3
Density of wall construction	γ_{wall} = **23.6** kN/m^3	Density of base construction	γ_{base} = **23.6** kN/m^3
Angle of soil surface	β = **0.0** deg	Effective height at back of wall	h_{eff} = **3350** mm
Mobilisation factor	M = **1.5**		
Moist density	γ_m = **18.0** kN/m^3	Saturated density	γ_s = **21.0** kN/m^3
Design shear strength	ϕ' = **24.2** deg	Angle of wall friction	δ = **0.0** deg
Design shear strength	ϕ'_b = **24.0** deg	Design base friction	δ_b = **18.0** deg
Moist density	γ_{mb} = **18.0** kN/m^3	Allowable bearing	$P_{bearing}$ = **125** kN/m^2

Using Coulomb theory

Active pressure	K_a =**0.419**	Passive pressure	K_p = **4.057**

At-rest pressure K_0 = **0.590**

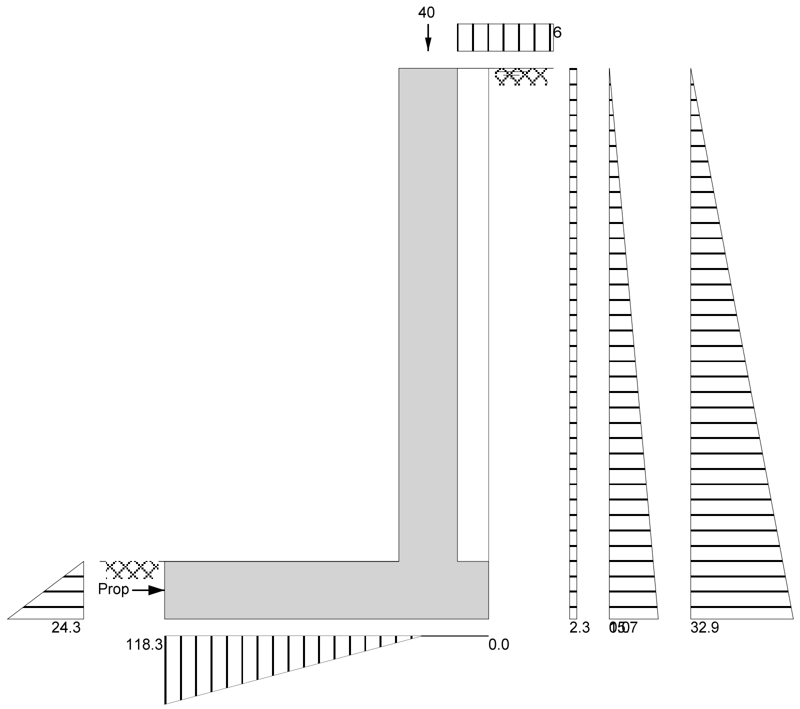
Loading details

Surcharge load Surcharge = **5.5** kN/m^2

Vertical dead load W_{dead} = **40.0** kN/m Vertical live load W_{live} = **0.0** kN/m

Horizontal dead load F_{dead} = **0.0** kN/m Horizontal live load F_{live} = **0.0** kN/m

Position of vertical load l_{load} = **1688** mm Height of horizontal load h_{load} = **0** mm



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

Calculate propping force

Propping force F_{prop} = **53.5** kN/m

Check bearing pressure

Total vertical reaction R = **97.4** kN/m Distance to reaction x_{bar} = **549** mm

Eccentricity of reaction e = **489** mm

Reaction acts outside middle third of base

Bearing pressure at toe p_{toe} = **118.3** kN/m^2 Bearing pressure at heel p_{heel} = **0.0** 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 pressure factor γ_{f_e} = **1.4**

Calculate propping force

Propping force F_{prop} = **53.5** kN/m

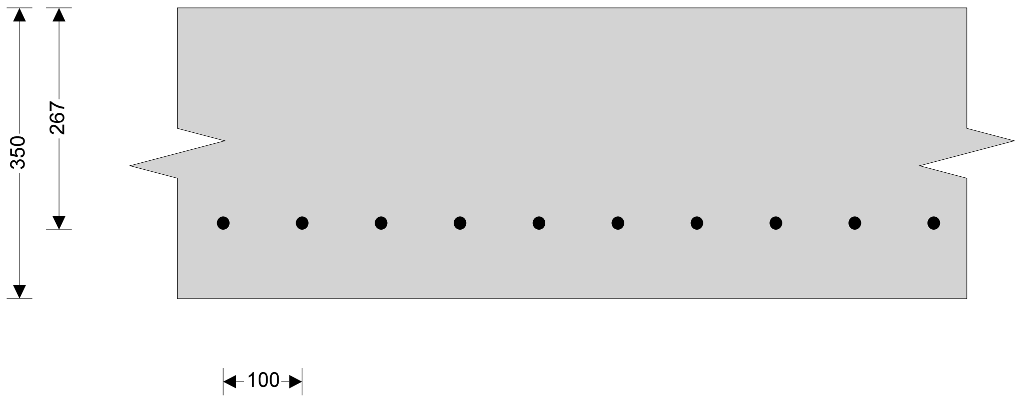
Design of reinforced concrete retaining wall toe (BS 8002:1994)

Material properties

Strength of concrete f_{cu} = **35** N/mm^2 Strength of reinforcement f_y = **500** N/mm^2

Base details

Minimum reinforcement k = **0.13** % Cover in toe c_{toe} = **75** mm



Design of retaining wall toe

Shear at heel V_{toe} = **119.2** kN/m Moment at heel M_{toe} = **166.6** kNm/m

Compression reinforcement is not required

Check toe in bending

Reinforcement provided **16 mm dia.bars @ 100 mm centres**

Area required $A_{s\_toe\_req}$ = **1560.8** mm^2/m Area provided $A_{s\_toe\_prov}$ = **2011** mm^2/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress v_{toe} = **0.447** N/mm^2 Allowable shear stress v_{adm} = **4.733** N/mm^2

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_toe} = **0.712** N/mm^2

$v_{toe} < v_{c\_toe}$ - No shear reinforcement required

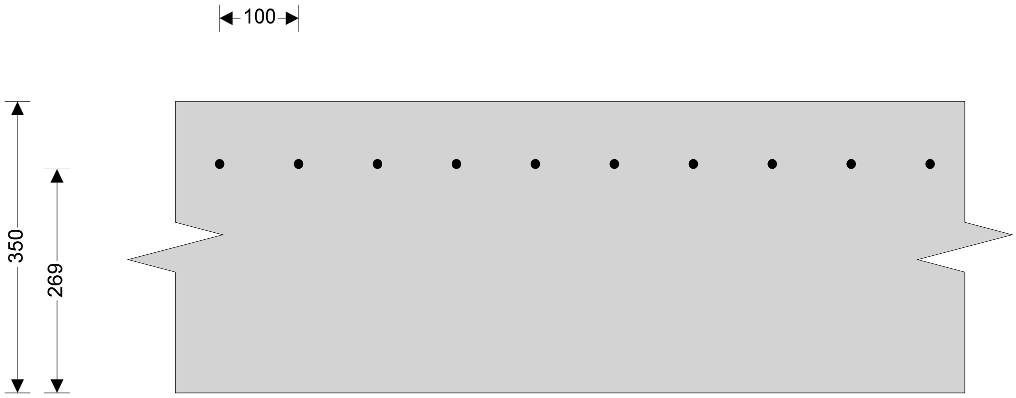
Design of reinforced concrete retaining wall heel (BS 8002:1994)

Material properties

Strength of concrete f_{cu} = **35** N/mm^2 Strength of reinforcement f_y = **500** N/mm^2

Base details

Minimum reinforcement k = **0.13** % Cover in heel c_{heel} = **75** mm



Design of retaining wall heel

Shear at heel V_{heel} = **21.7** kN/m Moment at heel M_{heel} = **6.4** kNm/m

Compression reinforcement is not required

Check heel in bending

Reinforcement provided **12 mm dia.bars @ 100 mm centres**

Area required $A_{s\_heel\_req}$ = **455.0** mm^2/m Area provided $A_{s\_heel\_prov}$ = **1131** mm^2/m

PASS - Reinforcement provided at the retaining wall heel is adequate

Check shear resistance at heel

Design shear stress v_{heel} = **0.081** N/mm^2 Allowable shear stress v_{adm} = **4.733** N/mm^2

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_heel} = **0.464** N/mm^2

v_{heel} < v_{c_heel} - No shear reinforcement required

<u>Design of reinforced concrete retaining wall stem (BS 8002:1994)</u>

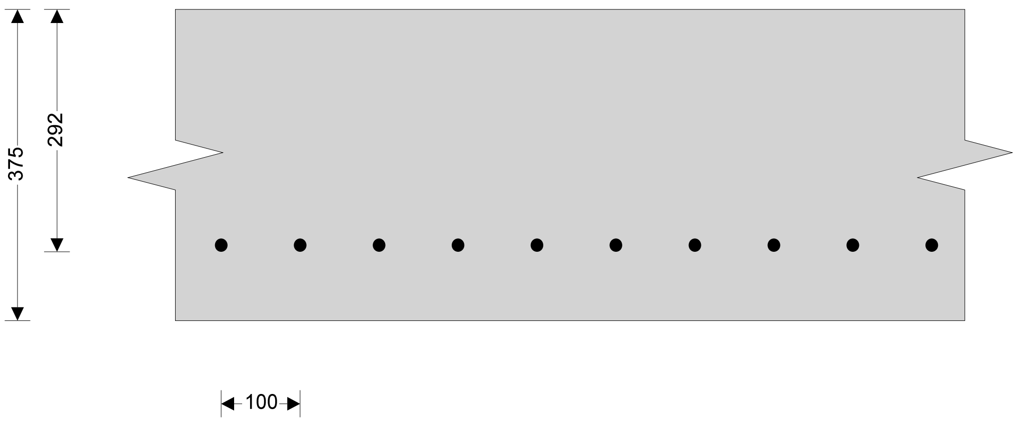
Material properties

Strength of concrete f_{cu} = **35** N/mm^2 Strength of reinforcement f_y = **500** N/mm^2

Wall details

Minimum reinforcement k = **0.13** %

Cover in stem c_{stem} = **75** mm Cover in wall c_{wall} = **75** mm



Design of retaining wall stem

Shear at base of stem V_{stem} = **22.4** kN/m Moment at base of stem M_{stem} = **129.5** kNm/m

Compression reinforcement is not required

Check wall stem in bending

Reinforcement provided **16 mm dia.bars @ 100 mm centres**

Area required $A_{s\_stem\_req}$ = **1074.0** mm^2/m Area provided $A_{s\_stem\_prov}$ = **2011** mm^2/m

PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

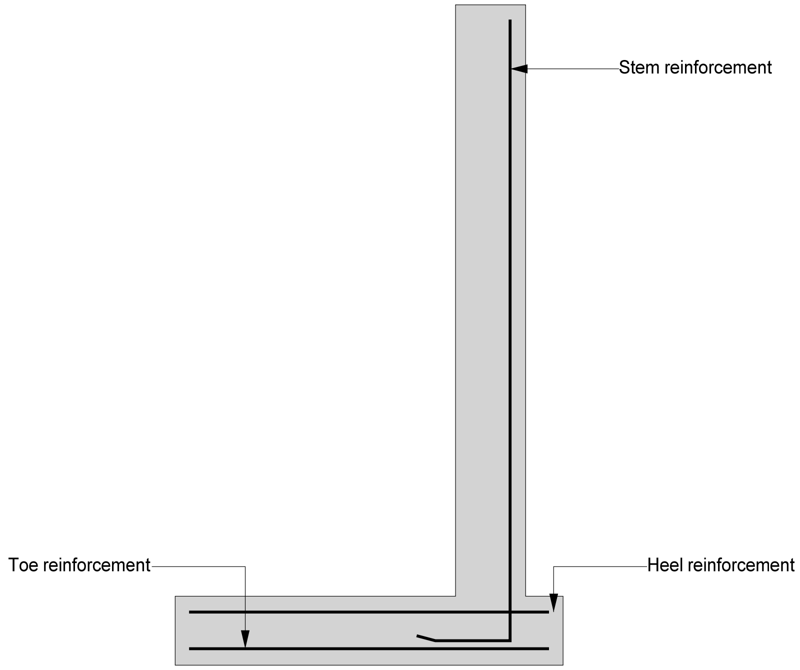
Design shear stress v_{stem} = **0.077** N/mm^2 Allowable shear stress v_{adm} = **4.733** N/mm^2

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_stem} = **0.675** N/mm^2

$v_{stem} < v_{c\_stem}$ - No shear reinforcement required

Indicative retaining wall reinforcement diagram



Toe bars - 16 mm dia.@ 100 mm centres - (2011 mm^2/m)
Heel bars - 12 mm dia.@ 100 mm centres - (1131 mm^2/m)
Stem bars - 16 mm dia.@ 100 mm centres - (2011 mm^2/m)

Ground Movement Analysis

Potential ground movements are calculated using empirical methods from CIRIA Report C580, Embedded Retaining Walls: Guidance for Economic Design.

Parameters relating to excavation and building dimensions are shown within the following calculations. These are for the potential movements related to No 52; due to the dimensions of this building, the movement is more critical than movement related with No 48

The following parameters are also relevant to the analysis:

- The method of basement construction will be traditional underpinning (CIRIA580 parameters relevant to excavations only are used)
- A high wall stiffness has been assumed
- Soil comprising stiff clay has been assumed

Ref	Movement of closest neighbouring property (No 52 Rochester Place)		
	Neighbouring building		
	Building width, L =	8000	mm
	Distance to furthest point of building from excavation & installati	8000	mm
	Height H=	4000	mm
	L/H =	2.00	
	New Basement		
	Excav'n depth H_b=	3.5	m
	analysis depth, D =	3.5	m
	Note: the height of the neighbouring building varies. Conservatively, the lowest height is used (height to eaves).		

Movement Assessment CIRIA C580: Embedded retaining walls - guidance for economic design

[continued on next page]

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Potential movement due to excavation of wall

using parameters from Table 2.4 of CIRIA C580

(high stiffness: excavation will be propped during construction)

Horizontal Surface Movement / excavation depth					=	-0.15%	
	max δ_h =	-0.15%	x	3500	=	-5.25	mm
Distance behind wall to negligible movement (multiple of excav					=	4	
	L_0 =	3500	x	4	=	14000	mm

Vertical Surface Movements

Distance behind wall to negligible movement (multiple of excav					=	3.5	
	L_0 =	3500	x	3.5	=	12250	mm

Total differential movement

(from Graph 1, Sheet GMA - 2)

Total Horizontal Movement	δ_h =	3.0	mm
Total Vertical Movement	Δ =	1.5	mm

Table C

Distance from wall in mm (x)	Total Movement horizontal (δ_h) in mm	Total Movement vertical (δ_v) in mm
0	-5.3	-1.4
2000	-4.5	-2.7
4000	-3.8	-2.3
6000	-3.0	-1.6
8000	-2.3	-0.9
10000	-1.5	-0.4
12000	-0.8	-0.1
14000	0.0	0.0
16000	0.0	0.0
18000	0.0	0.0
20000	0.0	0.0

values above used for Graph 1, GMA - 2 (separate sheet)

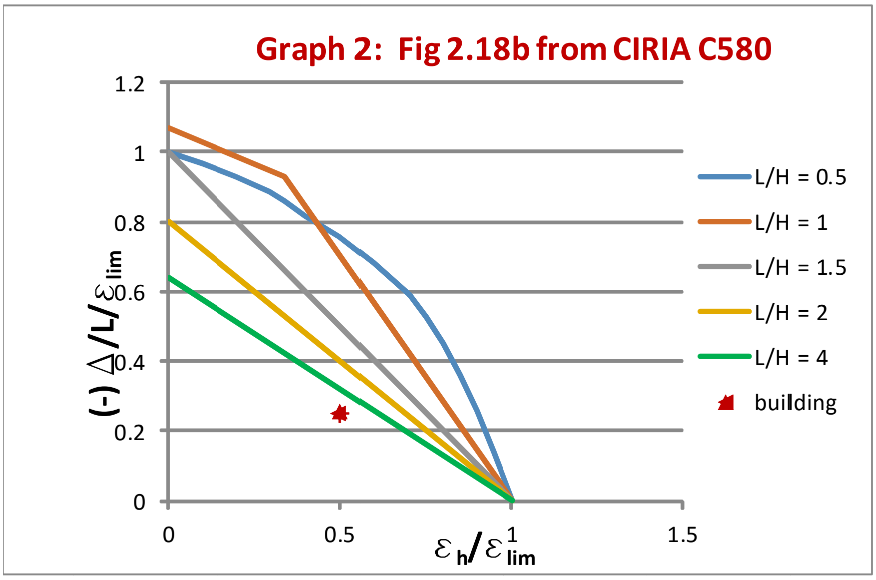
TOTAL STRAIN (EXCAVATION AND INSTALLATION)

Table 2.5 CIRIA C580

Category of Damage	Normal Degree	Limiting Tensile Strain %		
0	Negligible	0.00%	-	0.05%
1	Very slight	0.05%	-	0.075%
2	Slight	0.075%	-	0.15%
3	Moderate	0.15%	-	0.30%
4 to 5	Severe to Very Severe		>	0.30%

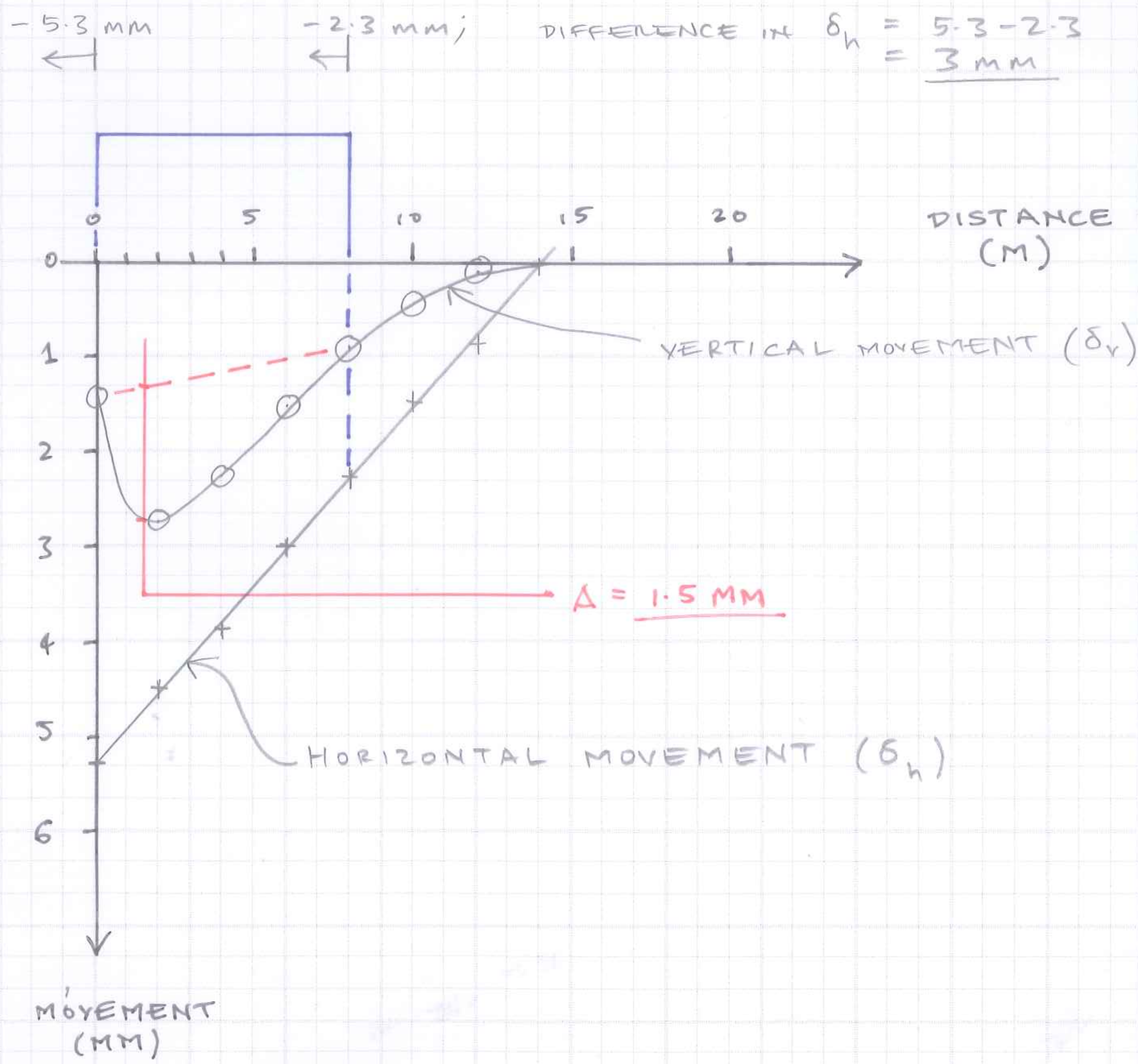
Max Anticipated Damage may be categorised as **'Very Slight' ; Category 1**

ϵ_{lim}	=	**0.075%**			
ϵ_h	=	0.038%	$\epsilon_h/\epsilon_{lim}$	=	0.50
Δ/L	=	0.019%	$\Delta/L/\epsilon_{lim}$	=	0.25



CROFT	Project: 50 ROCHESTER PLACE				Job Number: 150605
enquiries@croftse.co.uk	Title: GROUND MOVEMENT ASSESSMENT FOR 52 ROCHESTER PLACE	By: GW	Date: 27.6.2016		Section:
		Checked: PH	Date: 27.6.2016		Sheet: GMA - 2
					Rev:

VALUES ENTERED FROM TABLE C



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Appendix B: Construction Programme

The Contractor is responsible for the final construction programme

Outline Construction Programme (For planning purposes only)																
	Months															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Planning Approval																
Derailed Design																
Tender Package Compiled and Issued																
Party Wall Application																
Monitoring of Adjacent Structures																
Enabling Works																
Basement Construction																
Superstructure Construction																

Appendix C: Construction Method Statement

Job Number: 150605

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Croft Structural Engineers
Clock Shop Mews
Rear of 60 Saxon Road
London SE25 5EH

T: 020 8684 4744
E: enquiries@croftse.co.uk
W: www.croftse.co.uk

Basement Method Statement

Property:

50 Rochester Place
Camden
London
NW1 9JX

Client:

Michael Anastassiades

Revision	Date	Comment
-	Aug 2015	First Issue
-	28.06.2016	Floor support details removed

Contents

50 Rochester Place

1. Basement Formation Suggested Method Statement

1.1. This method statement provides an approach that will allow the basement design to be correctly considered during construction. The statement also contains proposals for the temporary support to be provided during the works. The Contractor is responsible for the works on site and the final temporary works methodology and design on this site and any adjacent sites.

1.2. This method statement has been written by a Chartered Engineer. The sequencing has been developed using guidance from ASUC (Association of Specialist Underpinning Contractors).

1.3. This method has been produced to allow for improved costings and for inclusion in the Party Wall Award. Final site conditions need there to be flexibility in the method statement: Should the site staff require alterations to the Method statement this is allowed once an alternative methodology, of the changes is provided, and an Addendum to the Party Wall Award will be required.

1.4. Contact Party Wall Surveyors to inform them of any changes to this method statement.

1.5. On this development, the approach is: construct the underpins insert the new steelwork remove load from above and place it onto new supporting steelwork cast floor slabs.

1.6. On this project, the retaining walls are required to be propped at both the top and bottom in the temporary case. During construction, in the temporary condition, the edge of the slab is buttressed against the soil in the middle of the property: Temporary props will be provided near the head and will provide support until the concrete has gained sufficient strength. Skin friction between the concrete base and the soil provides further resistance. In the temporary case, the main lateral support is provided by back propping to the central soil mass. The central soil mass is to be removed in 1/3 portions and cross propping subsequently added.

1.7. A ground investigation has been undertaken. The soil present at formation level is London Clay

1.8. The bearing pressures have been limited to 125kN/m^2.

1.9. The water table is not expected to be encountered above the formation level of the basement.

1.10. The structural waterproofer (not Croft) must comment on the proposed design and ensure that he is satisfied that the proposals will provide adequate waterproofing.

1.11. Provide engineers with concrete mix, supplier, delivery and placement methods two weeks prior to the first pour. Site mixing of concrete should not be employed apart from in small sections (less than 1m^3). The contractor must provide a method on how to achieve site mixing to the correct specification. The contractor must undertake toolbox talks with staff to ensure site quality is maintained.

2. Enabling Works

2.1. The site is to be hoarded with ply board sheets, at least 2.2m high, to prevent unauthorised public access.

2.2. Licences for skips and conveyors should be posted on the hoarding.

2.3. Provide protection to public where conveyor extends over footpath. Depending on the requirements of the local authority, construct a plywood bulkhead over the pavement. Hoarding to have a plywood roof covering over the footpath, night-lights and safety notices.

2.4. Perched water may be present. This can be dealt with by localised pumping, typically achieved by a small sump pump in a bucket. The contractor should seek the advice of a dewatering contractor prior to works commencing on site.

2.5. On commencement of construction, the contractor will determine the foundation type, width and depth. Any discrepancies will be reported to the structural engineer in order that the detailed design may be modified as necessary.

3. Basement Sequencing

3.1. Begin by placing cantilevered walls 1, 2, 3 and 4 as noted on drawing SL-10. (Cantilevered walls to be placed in accordance with Section 4.)

3.2. Needle and prop the front wall over.

Figure 1 Example of needling to existing wall

3.3. Install conveyor.

3.4. Continue cantilevered wall formation around perimeter of basement following the numbering sequence on the drawings.

3.4.1. Excavation for the next numbered sequential sections of underpinning shall not commence until at least 8 hours after drypacking of previous works. Excavation of adjacent pin to not commence until 48 hours after drypacking. (24hours possible due to inclusion of Conbextra 100 cement accelerator to dry pack mix). No more than

3.4.2. Rear wall over to be propped as excavation progresses. Steelwork to support Ground floor to be inserted as works progress.

3.5. Excavate and cast floor slab

3.5.1. Excavate 1/3 of the middle section of basement floor. As excavation proceeds, place Slimshor props at a maximum of 2.5m c/c across the basement. Locate props at a third of the height of the wall.

Fix top waler beams along head of wall. Excavate a 1/3 of the middle section of basement floor. As excavation proceeds place Slimhor props at a maximum of 2.5m c/c across the basement. Locate props at a 1m from the base of the wall and also to the waler beam at high level.

3.5.2. Continue excavating the next 1/3 and prop then repeat for the final 1/3.

3.5.3. Place below-slab drainage. Croft recommends that all drainage is encased in concrete below the slab and cast monolithically with the slab. Placing drainage on pea shingle below the slab allows greater penetration for water ingress.

3.5.4. Place reinforcement for basement slab.

3.5.5. Building Control Officer and Engineer are to be informed five working days before reinforcement is ready and invited for inspection.

3.5.6. Once inspected, pour concrete.

3.6. Provide structure to ground floor and water proofing to retaining walls as required. It is recommended to leave 3-4 weeks between completion of the basement and installing drained cavity. This period should be used to locate and fill any localised leakage of the basement

4. Underpinning and Cantilevered Walls

4.1. Prior to installation of new structural beams in the superstructure, the contractor may undertake the local exploration of specific areas in the superstructure. This will confirm the exact form and location of the temporary works that are required. The permanent structural work can then be undertaken whilst ensuring that the full integrity of the structure above is maintained.

4.2. Excavate first section of retaining wall (no more than 1000mm wide). Where excavation is greater than 1.2m deep, provide temporary propping to sides of excavation to prevent earth collapse (Health and Safety). A 1000mm width wall has a lower risk of collapse to the heel face.

4.3. Excavation of pins involves working in confined spaces and the following measures should be applied:

- Operatives must wear a harness and there must be a winch above the excavation.
- An attendant must be present at all times, at ground level, while excavation is occupied.

- A rescue plan must be produced prior to the works as well as a task-specific risk and method statement.

- Working in the confined space should require a permit to work.

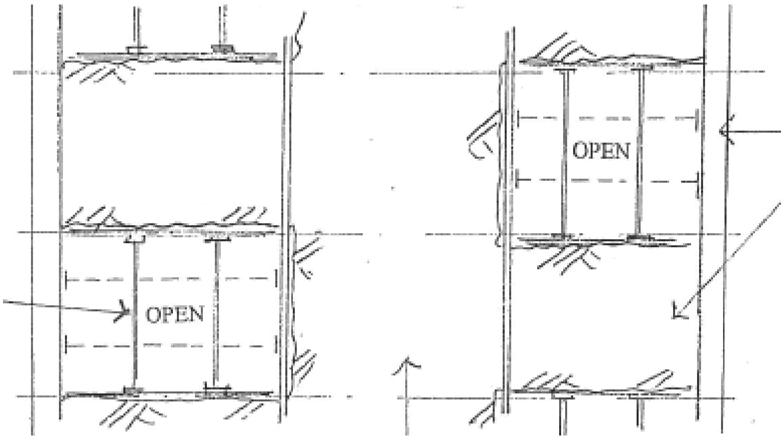


Figure 2 – Schematic Plan view of soil propping

Figure 3 Propping examples

Figure 4 Examples of excavations of pins

Figure 5 Example of completed walls and back propping to central soil mass

4.4. Backpropping of rear face: Rear face to be propped in the temporary conditions with a minimum of 2 trench sheets. Trench sheets are to extend over entire height of excavation. Trench sheets can be placed in short sections as the excavation progresses.

Figure 6 Example of trench sheet back propping

4.4.1. If the ground is stable, trench sheets can be removed as the wall reinforcement is placed and the shuttering is constructed.

4.4.2. Where soft spots are encountered, leave in trench sheets or alternatively back prop with precast lintels or sacrificial boards. If the soil support to the ends of the lintels is insufficient, then brace the ends of the PC lintels with 150x150 C24 timbers and prop with Acrows diagonally back to the ground.

4.4.3. Where voids are present behind the lintels or trench sheeting, grout voids behind sacrificial propping. Grout to be 3:1 sand/cement packed into voids.

4.4.4. Prior to casting, place layer of DPM between trench sheeting (or PC lintels) and new concrete. The lintels are to be cut into the soil by 150mm either side of the pin. A site stock of a minimum of 10 lintels should be present to prevent delays due to ordering.

4.5. If cut face is not straight, or sacrificial boards noted previously have been used, place a 15mm cement particle board between sacrificial sheets or against the soil prior to casting. Cement particle board is to line up with the adjacent owner's face of wall. The method adopted, to prevent localised collapse of the soil, is to install these progressively, one at a time. Cement particle board must be used in any condition where overspill onto the adjacent owner's land is possible.

4.6. Excavate base. If soil over is unstable, prop top with PC lintel and sacrificial prop.

4.7. Visually inspect the footings and provide propping to local brickwork. If necessary install sacrificial Acrow, or pit props, and cast into the retaining wall.

4.8. Clear underside of existing footing.

4.9. Local Authority inspection to be carried out for approval of excavation base.

4.10. Place blinding.

4.11. Place reinforcement for retaining wall base and stem. Drive H16 Bars U-bars into soil along centre line of stem to act as shear ties to adjacent wall underpin.

4.12. Site supervisor to inspect and sign off works before proceeding to next stage.

4.12.1. For pins 1, 3 and 5, inform the engineer five days before the reinforcement is ready, to allow for inspection of the reinforcement prior to casting.

4.13. Cast base. On short stems it is possible to cast base and wall at the same time. <u>It is essential that pokers/vibrators are used to compact concrete.</u>

4.14. Concrete Testing:

4.14.1. For first 3 pins take 4 cubes and test at 7 days then at 14 days and inform engineer of results. Test last cube at 28 days. If cube test results are low then action into concrete specification and placement method must be considered.

4.14.2. If results are good from first three pins, then from the 4th pin onwards take 2 cubes of concrete from every third pin and store for testing. Test one at 28 days. If result is low, test second cube. Provide results to client and design team on request or if values are below those required.

Ensure that concrete is of sufficient strength check engineer's specifications

4.14.3. A record of dates for the concrete pouring of each pin must be kept on site.

4.14.4. The location of where cubes were taken and their reference number must be recorded.

4.15. Horizontal temporary prop to base of wall to be inserted. Alternatively cast base against soil.

4.16. Place shuttering and pour concrete for retaining wall. Stop a minimum of 75mm from the underside of existing footing. It is essential that pokers/vibrators are used, hitting shutters is **not** considered adequate.

4.17. 24 hours after pouring the concrete pin, the gap shall be filled using a dry-pack mortar. Ram in dry-pack between the top of the retaining wall and existing masonry.

4.17.1. If gap is greater than 120mm, place a line of engineering bricks to the top of the wall. Dry pack from the engineering bricks to existing masonry.

4.18. After 24 hours, the temporary wall shutters can be removed.

4.19. Trim back existing masonry corbel and concrete on internal face.

4.20. Site supervisor to inspect and sign off for proceeding to the next stage. A record will be kept of the sequence of construction, which will be in strict accordance with recognised industry procedures.

5. Approval

5.1. Building Control Officer/Approved Inspector to inspect pin bases and reinforcement prior to casting concrete.

5.2. Contractor to keep list of dates of pins inspected and cast.

5.3. One month after the work is completed, the contractor is to contact Adjoining Party Wall Surveyor to attend site and complete final condition survey and to sign off works.

6. Basement Temporary Works Design Lateral Propping

This calculation has been provided for the trench sheet and prop design of standard underpins in the temporary condition. There are gaps left between the sheeting and as such no water pressure will occur. Any water present will flow through the gaps between the sheeting and will be required to be pumped out.

Trench sheets should be placed at regular centres to deal with the ground. It is expected that the soil between the trench sheeting will arch. Looser soil will require tighter centres. It is typical for underpins to be placed at 1200c/c in this condition the highest load on a trench sheet is when 2 No.s trench sheets are used. It is for this design that these calculations have been provided.

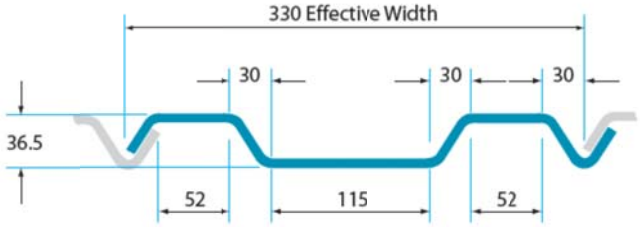
Soil and ground conditions are variable. Typically one finds that, in the temporary condition, clays are more stable and the C_u (cohesive) values in clay reduce the risk of collapse. It is this cohesive nature that allows clays to be cut into a vertical slope. For these calculations, weak sand and gravels have been assumed. The soil properties are:

Trench Sheet Design

Soil Depth	Dsoil = 3500mm	
Surcharge	sur = $10kN/m^2$	
Soil Density	γ = $18kN/m^3$	
Angle of Friction	$\phi = 24°$	
	$k_a = (1 - \sin(\phi)) / (1 + \sin(\phi))$	= **0.422**
	$k_p = 1 / k_a$	= **2.371**
Soil pressure bottom	soil = $k_a * \gamma *$ Dsoil	= **26.569**kN/m^2
Surcharge pressure	surcharge = sur * k_a	= **4.217** kN/m^2

STANDARD LAP

The overlapping trench sheeting profile is designed primarily for construction work and also temporary deployment.



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Technical Information

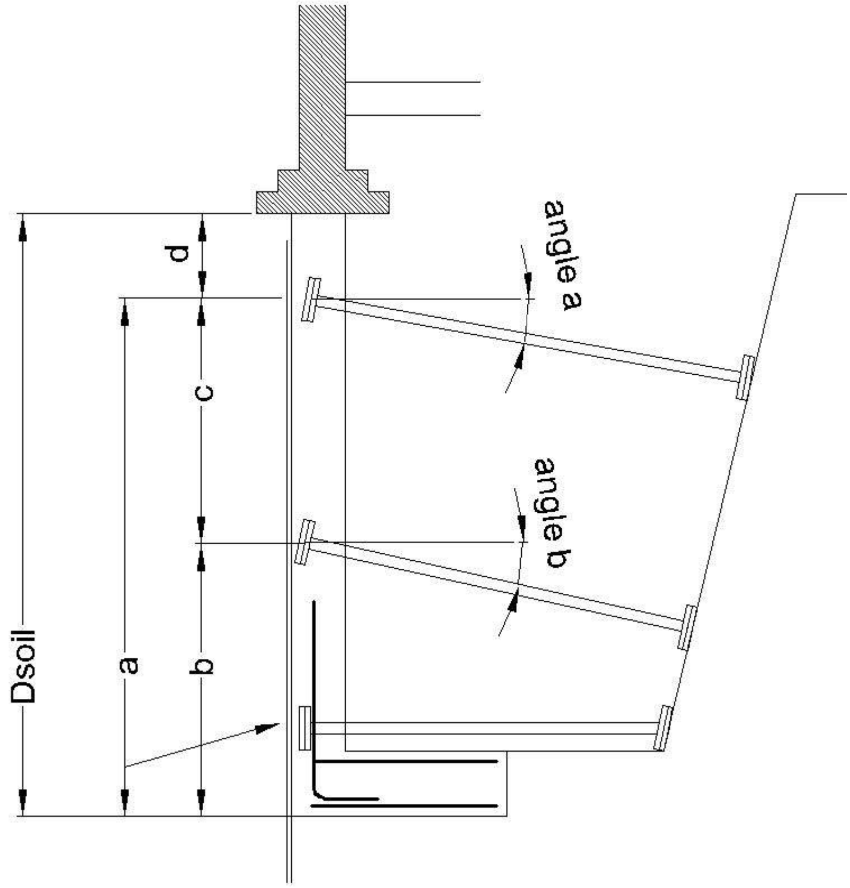
Effective width per sheet (mm)	330
Thickness (mm)	3.4
Depth (mm)	35
Weight per linear metre (kg/m)	10.8
Weight per m² (kg)	32.9
Section modulus per metre width (cm³)	48.3
Section modulus per sheet (cm³)	15.9
I value per metre width (cm⁴)	81.7
I value per sheet (cm⁴)	26.9
Total rolled metres per tonne	92.1

$S_{xx} = 15.9\ cm^3$

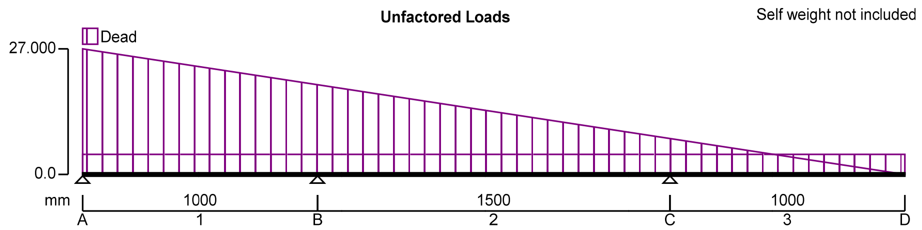
$p_y = 275 N/mm^2$

$I_{xx} = 26.9 cm^4$

$A = (1m * 32.9kg/m^2) / (7750kg/m^3) =$ **4245.161** mm^2



Length	a = Dsoil – d = **2.500**m
1 M from top	b = 1m
M from bottom	d = 1m
Middle	c = Dsoil – b – d = **1.500**m



CONTINUOUS BEAM ANALYSIS - INPUT

BEAM DETAILS

Number of spans = **3**

Material Properties:

Modulus of elasticity = **205** kN/mm^2

Material density = **7860** kg/m^3

Support Conditions:

Support A	Vertically	**"Restrained"**	Rotationally	**"Free"**
Support B	Vertically	**"Restrained"**	Rotationally	**"Free"**
Support C	Vertically	**"Restrained"**	Rotationally	**"Free"**
Support D	Vertically	**"Free"**	Rotationally	**"Free"**

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Span Definitions:

Span 1 Length = **1000** mm Cross-sectional area = **4245** mm² Moment of inertia = **269.×10³** mm⁴

Span 2 Length = **1500** mm Cross-sectional area = **4245** mm² Moment of inertia = **269.×10³** mm⁴

Span 3 Length = **1000** mm Cross-sectional area = **4245** mm² Moment of inertia = **269.×10³** mm⁴

LOADING DETAILS

Beam Loads:

Load 1 UDL Dead load **4.3** kN/m

Load 2 VDL Dead load **27.0** kN/m to **0.0** kN/m

LOAD COMBINATIONS

Load combination 1

Span 1 1.4×Dead

Span 2 1.4×Dead

Span 3 1.4×Dead

CONTINUOUS BEAM ANALYSIS - RESULTS

Support Reactions - Combination Summary

Support A Max react = **-15.4** kN Min react = **-15.4** kN Max mom = **0.0** kNm Min mom = **0.0** kNm

Support B Max react = **-43.7** kN Min react = **-43.7** kN Max mom = **0.0** kNm Min mom = **0.0** kNm

Support C Max react = **-28.1** kN Min react = **-28.1** kN Max mom = **0.0** kNm Min mom = **0.0** kNm

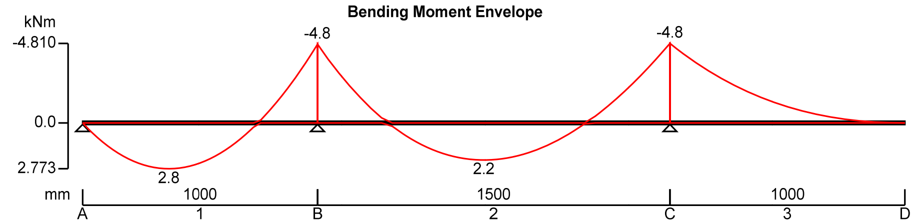
Support D Max react = **0.0** kN Min react = **0.0** kN Max mom = **0.0** kNm Min mom = **0.0** kNm

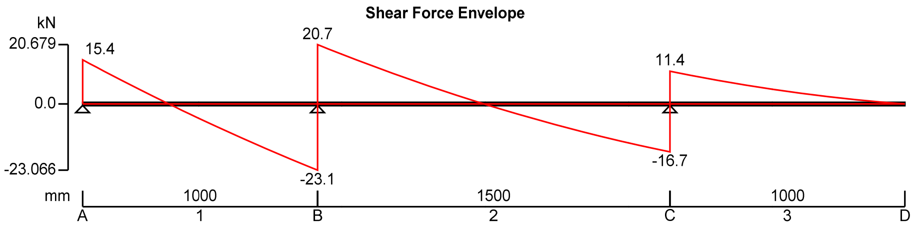
Beam Max/Min results - Combination Summary

Maximum shear = **20.7** kN Minimum shearF_{min} = **-23.1** kN

Maximum moment = **2.8** kNm Minimum moment = **-4.8** kNm

Maximum deflection = **23.2** mm Minimum deflection = **-0.1** mm





Number of sheets Nos = 3

Moment M_allowable = Sxx * py * Nos = **13.118**kNm

Deflection D = / Nos = **7.726**mm

Acrow Load Acrow= R_{max_B} / 2 = **-21.873**kN

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SRU 4.0

Safe working loads for Acrow Props — loads given in kN

For normal purposes 1 kilo Newton (kN) = 100 kg	Height (m / ft)	2.0 / 6.6	2.25 / 7.4	2.5 / 8.2	2.75 / 9.0	3.0 / 9.8	3.25 / 10.7	3.5 / 11.5	3.75 / 12.3	4.0 / 13.1	4.25 / 13.9	4.5 / 14.8	4.75 / 15.6
TABLE A Props loaded concentrically and erected vertically	Prop size 1 or 2	35	35	35	34	27	23						
	Prop size 3				34	27	23	21	19	17			
	Prop size 4						32	25	21	18	16	14	12
TABLE B Props loaded concentrically and erected 1½° max. out of vertical	Prop size 1 or 2 or 3	35	32	26	23	19	17	15	13	12			
	Prop size 4						24	19	15	12	11	10	9
TABLE C Props loaded 25 mm eccentricity and erected 1½° max. out of vertical	Prop size 1 or 2 or 3	17	17	17	17	15	13	11	10	9			
	Prop size 4						17	14	11	10	9	8	7
TABLE D Props loaded concentrically and erected 1½° out of vertical and laced with scaffold tubes and fittings	Prop size 3				35	33	32	28	24	20			
	Prop size 4						35	35	35	35	27	25	21

Acrow Props A or B are acceptable placed 1m from top, 1m from bottom and bottom of excavation

Cross Props

Props should be placed a third up the wall measured from the bottom slab.

Surcharge	sur = 10kN/m^2
Soil Density	γ = 24kN/m^3

Angle of Friction ϕ = 24°

Soil Depth Dsoil = 3500mm

$k_a = (1 - \sin(\phi)) / (1 + \sin(\phi))$ = **0.422**

$k_p = 1 / k_a$ = **2.371**

$1 - \sin(\phi)$ = **0.593**

Soil force bottomsoilforce = $k_a * \gamma *$ Dsoil * Dsoil / 2 = **61.994**kN/m

Surcharge Force Surchargeforce = k_a * sur * Dsoil = **14.761**kN/m

Place Props every other pin spacing = 2m

Propforce Propforce = spacing * (soilforce + Surchargeforce) = **153.510**kN

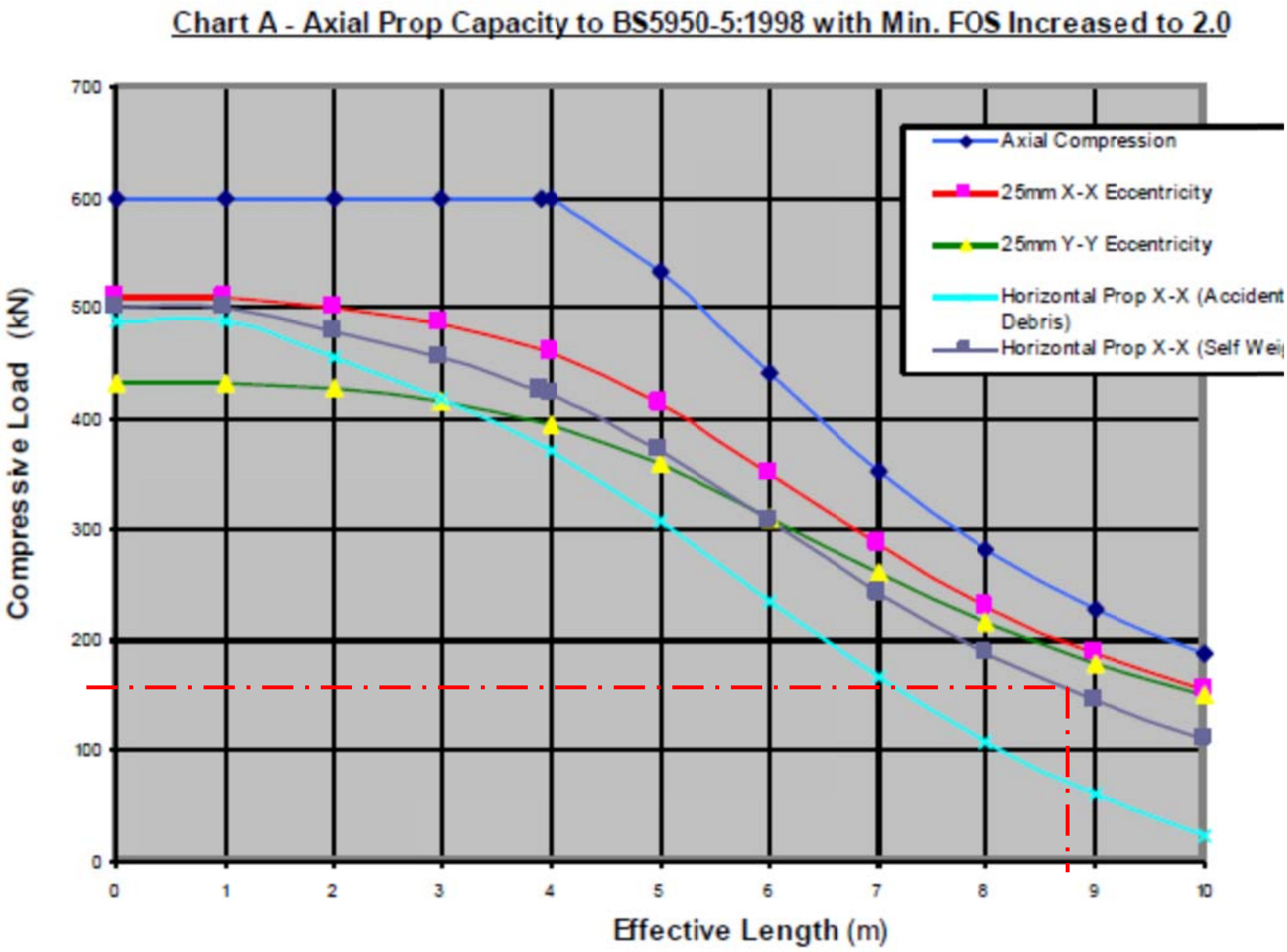


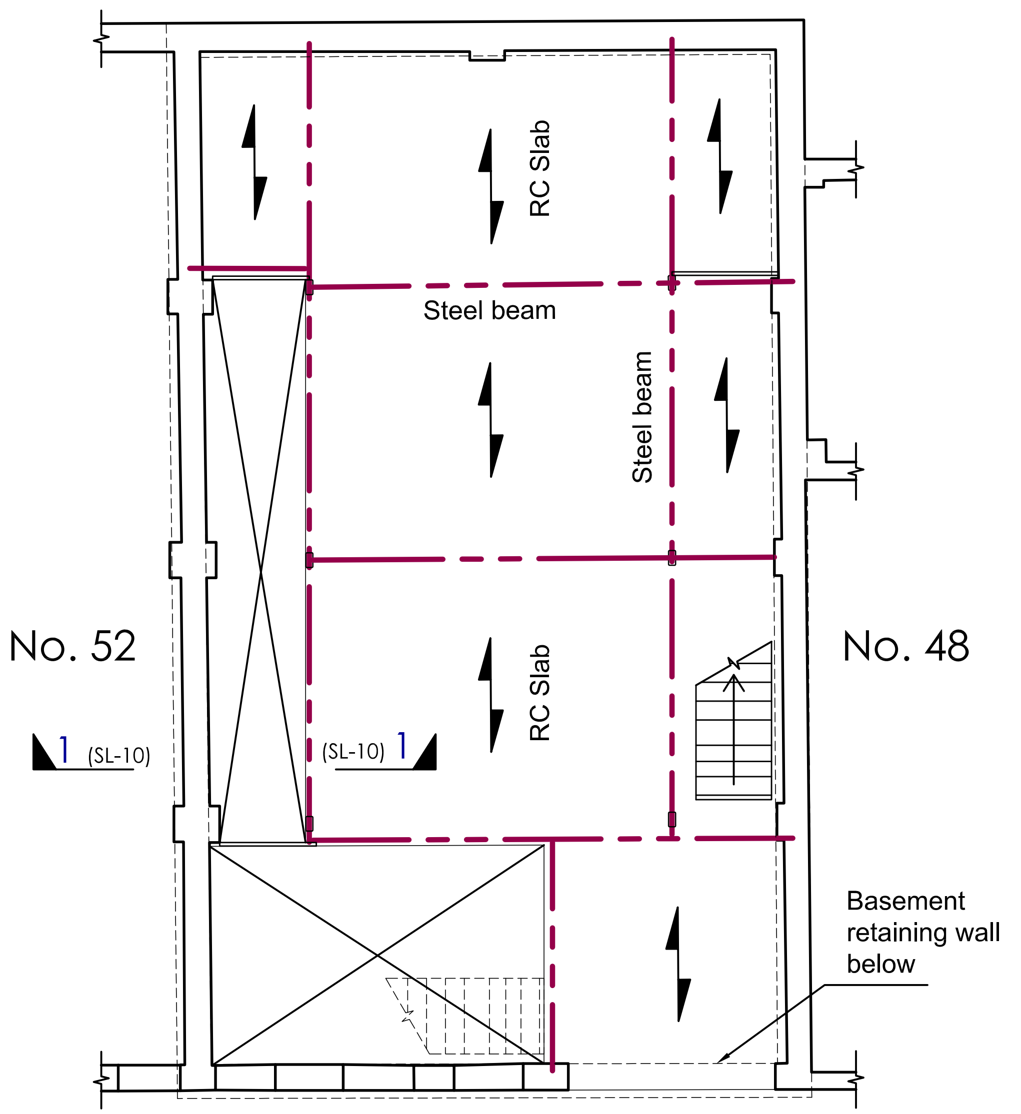
Figure 7 Mabey Mass 50 Load Chart

Provide Mabey Mass 50 at 2m centres at 1/3 the height of the wall.

CROFT STRUCTURAL ENGINEERS

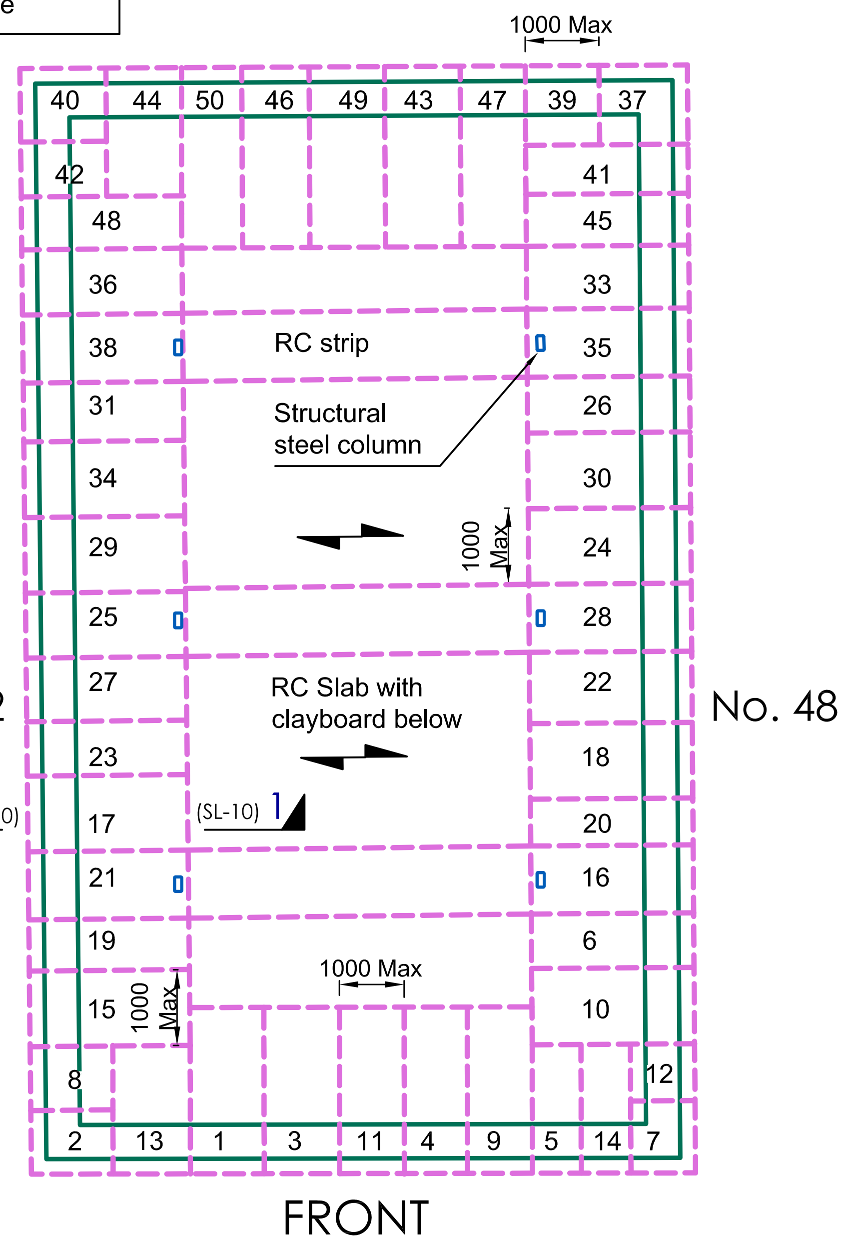
Appendix D: Structural Drawings

Numbers below denote proposed pin construction sequence



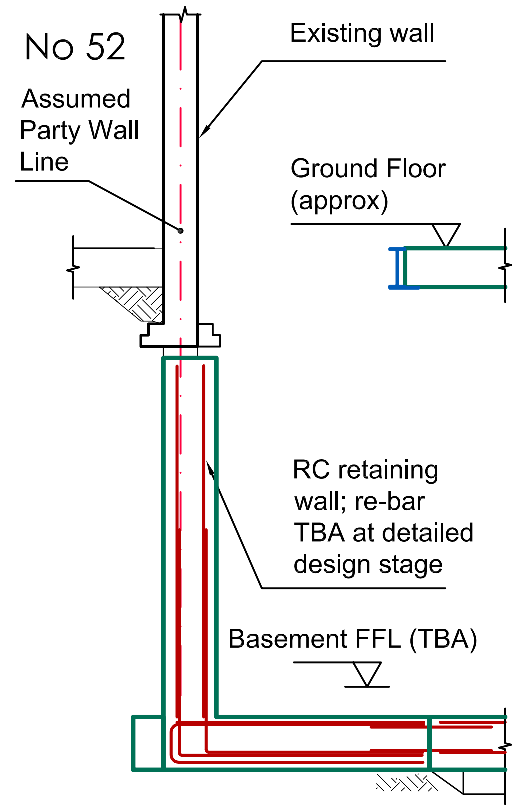
Ground Floor Plan

Scale (1:100)



Basement Plan

Scale (1:100)



Section 1-1

(1:50)

- PLANING ISSUE -
NOT FOR CONSTRUCTION

Rev	Date	Amendments
1	28.6.2016	Layout changes; Section details altered
-	26.8.2015	First issue for comment

Job No 150605	Client: Michael Anastassiades
Dwg No SL-20	Project: 50 Rochester Place
Date August 2015	Title : Floor Plans and Sections
Drawn GW / Chk'd NM	
Scale As shown @ A3 / Rev 1	

Croft Structural Engineers
Clockshop Mews,
r/o 60 Saxon Rd,
London, SE25 5EH.
020 8684 4744
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Appendix E: Monitoring Statement

Job Number: 150605

CROFT STRUCTURAL ENGINEERS

Croft Structural Engineers
Clock Shop Mews
Rear of 60 Saxon Road
London SE25 5EH

T: 020 8684 4744
E: enquiries@croftse.co.uk
W: www.croftse.co.uk

Structural Monitoring Statement

Property:

50 Rochester Place
Camden
London
NW1 9JX

Client:

Michael Anastassiades

Revision	Date	Comment
-	27.06.2016	First Issue

Contents

CROFT STRUCTURAL ENGINEERS

1. Introduction

Basement works are intended at 50 Rochester Place. The structural works for this require Party Wall Awards. This statement describes the procedures for the Principal Contractor to follow to observe any movement that may occur to the existing properties, and also describes mitigation measures to apply if necessary.

2. Risk Assessment

The purpose of this risk assessment is to consider the impact of the proposed works and how they impact the party wall. There are varying levels of inspection that can be undertaken and not all works, soil conditions and properties require the same level of protection.

Monitoring Level Proposed	Type of Works.
Monitoring 1 Visual inspection and production of condition survey by Party wall surveyors at the beginning of the works and also at the end of the works.	Loft conversions, cross wall removals, insertion of padstones Survey of LUL and Network Rail tunnels. Mass concrete, reinforced and piled foundations to new build properties

CROFT STRUCTURAL ENGINEERS

Monitoring 2 Visual inspection and production of condition survey by Party Wall Surveyors at the beginning of the works and also at the end of the works. Visual inspection of existing party wall during the works. Inspection of the footing to ensure that the footings are stable and adequate.	Removal of lateral stability and insertion of new stability fames Removal of main masonry load bearing walls. Underpinning works less than 1.2m deep
Monitoring 3 Visual inspection and production of condition survey by Party Wall Surveyors at the beginning of the works and also at the end of the works. Visual inspection of existing party wall during the works. Inspection of the footing to ensure that the footings are stable and adequate. Vertical monitoring movement by standard optical equipment	Lowering of existing basement and cellars more than 2.5m Underpinning works less than 3.0m deep in clays Basements up to 2.5m deep in clays
Monitoring 4 Visual inspection and production of condition survey by Party Wall Surveyors at the beginning of the works and also at the end of the works. Visual inspection of existing party wall during the works. Inspection of the footing to ensure that the footings are stable and adequate. Vertical monitoring movement by standard optical equipment Lateral movement between walls by laser measurements	New basements greater than 2.5m and shallower than 4m Deep in gravels <u>Basements up to 4.5m deep in clays</u> Underpinning works to Grade I listed building
Monitoring 5 Visual inspection and production of condition survey by Party wall surveyors at the beginning of the works and also at the end of the works. Visual inspection of existing party wall during the works. Inspection of the footing to ensure that the footings are stable and adequate. Vertical & lateral monitoring movement by theodolite at specific times during the projects.	Underpinning works to Grade I listed buildings Basements to Listed building Basements deeper than 4m in gravels Basements deeper than 4.5m in clays Underpinning, basements to buildings that are expressing defects.
Monitoring 6	

Visual inspection and production of condition survey by Party wall surveyors at the beginning of the works and also at the end of the works. Visual inspection of existing party wall during the works. Inspection of the footing to ensure that the footings are stable and adequate. Vertical & lateral monitoring movement by electronic means with live data gathering. Weekly interpretation	Double storey basements supported by piled retaining walls in gravels and soft sands. (N<12)
Monitoring 7 Visual inspection and production of condition survey by Party wall surveyors at the beginning of the works and also at the end of the works. Visual inspection of existing party wall during the works. Inspection of the footing to ensure that the footings are stable and adequate. Vertical & lateral monitoring movement by electronic means with live data gathering with data transfer.	Larger multi-storey basements on particular projects.

3. Scheme Details

This document has been prepared by Croft Structural Engineers Ltd. It covers the proposed construction of a new basement underneath the existing structure at 50 Rochester Place.

Scope of Works

The works comprise:

- Visual Monitoring of the party wall
- Attachment of Tell tales or Demec Studs to accurately record movement of significant cracks.
- Attachment of levelling targets to monitor settlement.
- The monitoring of the above instrumentation is in accordance with Appendix A. The number and precise locations of instrumentation may change during the works; this shall be subject to agreement with the Principal Contractor (PC).
- All instruments are to be adequately protected against any damage from construction plant or private vehicles using clearly visible markings and suitable head protection e.g. manhole rings or similar. Any damaged instruments are to be immediately replaced or repaired at the contractors own cost.
- Reporting of all data in a manner easily understood by all interested parties.
- Co-ordination of these monitoring works with other site operations to ensure that all instruments can be read and can be reviewed against specified trigger values both during and post construction.
- Regular site meetings by the Principal Contractor (PC) and the Monitoring Surveyor (MS) to review the data and their implications.
- Review of data by Croft Structural Engineers

In addition, the PC will have responsibility for the following:

- Review of methods of working/operations to limit movements, and
- Implementation of any emergency remedial measures if deemed necessary by the results of the monitoring.

The Monitoring Surveyor shall allow for settlement and crack monitoring measures to be installed and monitored on various parts of the structure described in Table 1 as directed by the PC and Party Wall Surveyor (PWS) for the Client.

Item	Instrumentation Type
Party Wall Brickwork	
Settlement monitoring	Levelling equipment & targets
Crack monitoring	Visual inspection of cracking, Demec studs where necessary

Table 1: Instrumentation

General

The site excavations and substructure works up to finished ground slab stage have the potential to cause vibration and ground movements in the vicinity of the site due to the following:

a) Removal of any existing redundant foundations / obstructions;
b) Installation of reinforced concrete retaining walls under the existing footings;
c) Excavations within the site

The purpose of the monitoring is a check to confirm building movements are not excessive.

This specification is aimed at providing a strategy for monitoring of potential ground and building movements at the site.

This specification is intended to define a background level of monitoring. The PC may choose to carry out additional monitoring during critical operations. Monitoring that should be carried out is as follows:

a) Visual inspection of the party wall and any pre-existing cracking
b) Settlement of the party wall

All instruments are to be protected from interference and damage as part of these works.

Access to all instrumentation or monitoring points for reading shall be the responsibility of the Monitoring Surveyor (MS). The MS shall be in sole charge for ensuring that all instruments or monitoring points can be read at each visit and for reporting of the data in a form to be agreed with the PWS. He shall inform the PC if access is not available to certain instruments and the PC will, wherever possible, arrange for access. He shall immediately report to the PC any damage. The Monitoring Surveyor and the Principal Contractor will be responsible for ensuring that all the instruments that fall under their respective remits as specified are fully operational at all times and any defective or damaged instruments are immediately identified and replaced.

The PC shall be fully responsible for reviewing the monitoring data with the MS - before passing it on to Croft Structural Engineers - determining its accuracy and assessing whether immediate action is to be taken by him and/or other contractors on site to prevent damage to instrumentation or to ensure safety of the site and personnel. All work shall comply with the relevant legislation, regulations and manufacturer's instructions for installation and monitoring of instrumentation.

Applicable Standards and References

The following British Standards and civil engineering industry references are applicable to the monitoring of ground movements related to activities on construction works sites:

1. BS 5228: Part 1: 1997 - Noise and Vibration Control on Construction and Open Sites -Part 1.Code of practice for basic information and procedures for noise and vibration control, Second Edition, BSI 1999.
2. BS 5228: Part 2: 1997 - Noise and Vibration Control on Construction and Open Sites -Part 2.Guide to noise and vibration control legislation for construction and demolition including road construction and maintenance, Second Edition, BSI 1997.
3. BS 7385-1: 1990 (ISO 4866:1990) - Evaluation and measurement for vibration in buildings - Part 1: Guide for measurement of vibrations and evaluation of their effects on buildings, First Edition, BSI 1990.
4. BS 7385-2: 1993 - Evaluation and measurement for vibration in buildings - Part 2: Guide to damage levels from ground-borne vibration, First Edition, BSI 1999.
5. CIRIA SP 201 - Response of buildings to excavation-induced ground movements, CIRIA 2001.

SPECIFICATION FOR INSTRUMENTATION

General

The Monitoring Contractor is required to monitor, protect and reinstall instruments as described. The readings are to be recorded and reported. The following instruments are defined:

a) Automatic level and targets: A device which allows the measurement of settlement in the vertical axis. To be installed by the MS.

b) Tell-tales and 3 stud sets: A device which allows measurement of movement to be made in two axes perpendicular to each other. To be installed by the MS.

Monitoring of existing cracks

The locations of tell-tales or Demec studs to monitor existing cracks shall be agreed with Croft Structural Engineers.

Instrument Installation Records and Reports

Where instrumentation is to be installed or reinstalled, the Monitoring Surveyor, or the Principal Contractor, as applicable, shall make a complete record of the work. This should include the position and level of each instrument. The records shall include base readings and measurements taken during each monitoring visit. Both tables and graphical outputs of these measurements shall be presented in a format to be agreed with the CM. The report shall include photographs of each type of instrumentation installed and clear scaled sections and plans of each instrument installed. This report shall also include the supplier's technical fact sheet on the type of instrument used and instructions on monitoring.

Two signed copies of the report shall be supplied to the PWS within one week of completion of site measurements for approval.

Installation

All instruments shall be installed to the satisfaction of the PC. No loosening or disturbance of the instrument with use or time shall be acceptable. All instruments are to be clearly marked to avoid damage.

All setting out shall be undertaken by the Monitoring Surveyor or the Principal Contractor as may be applicable. The precise locations will be agreed by the PC prior to installation of the instrument.

The installations are to be managed and supervised by the Instrumentation Engineer or the Measurement Surveyor as may be applicable.

Monitoring

The frequencies of monitoring for each Section of the Works are given in Appendix A.

The following accuracies/ tolerances shall be achieved:

Party Wall settlement	±1.5mm
Crack monitoring	±0.75mm

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REPORT OF RESULTS AND TRIGGER LEVELS

General

Within 24 hours of taking the readings, the Monitoring Surveyor will submit a single page summary of the recorded movements. All readings shall be immediately reviewed by Croft Structural Engineers prior to reporting to the PWS.

Within one working day of taking the readings, the Monitoring Contractor shall produce a full report (see below).

The following system of control shall be employed by the PC and appropriate contractors for each section of the works. The Trigger value, at which the appropriate action shall be taken, for each section, is given in Table 2, below.

The method of construction by use of sequential underpins limits the deflections in the party wall.

Between the trigger points, which are no greater than 2 m apart (giving a combined horizontal distance of 4m between two points either side of each node), there should be no more than:

Allowable movement to BS5950 for brittle finishes

<u>Vertical</u> = Span / 360 = 4000mm / 360 = 11.1mm

Croft proposes a tighter recommendation of <u>2mm</u>

Above Monitoring Level 3, lateral movement is required to be measured. Based on studs placed 1m above ground level (which will be 4500mm above the formation level), the figures should be

<u>Horizontal</u> = Height / 500 = 4500mm / 500 = 9mm

Croft proposes a tighter recommendation of <u>3mm</u>

During works measurements are taken, these are compared with the limits set out below:

MOVEMENT		CATEGORY	ACTION
Vertical	Horizontal		
0-2mm	0-3mm	Green	No action required
2-5mm	3-5mm	AMBER	Detailed review of Monitoring: Check studs are OK and have not moved. Ensure site staff have not moved studs. If studs have moved reposition. Relevel to ensure results are correct and tolerance is not a concern. Inform Party Wall surveyors of amber readings. Double the monitoring for 2 further readings. If stable revert back. Carry out a local structural review and inspection. Preparation for the implementation of remedial measures should be required. Double number of lateral props
5-8mm	5-8mm		Implement remedial measures review method of working and ground conditions
>8mm	>8mm	RED	Implement structural support as required; Cease works with the exception of necessary works for the safety and stability of the structure and personnel; Review monitoring data and implement revised method of works

Table 2 – Movement limits between adjacent sets of Tell-tales or stud sets

Any movements which exceed the individual amber trigger levels for a monitoring measure given in Table 2 shall be immediately reported to the PWS, and a review of all of the current monitoring data for all monitoring measures must be implemented to determine the possible causes of the trigger level being exceeded. Monitoring of the affected location must be increased and the actions described above implemented. Assessment of exceeded trigger levels must not be carried out in isolation from an assessment of the entire monitoring regime as the monitoring measures are inter-related. Where required, measures may be implemented or prepared as determined by the specific situation and combination of observed monitoring measurement data.

Standard Reporting

1 No. electronic copy of the report in PDF format shall be submitted to the PWS.

The Monitoring Surveyor shall report whether the movements are within (or otherwise) the Trigger Levels indicated in Table 2. A summary of the extent of completion of any of the elements of works and any other significant events shall be given. These works shall be shown in the form of annotated plans (and sections) for each survey visit both local to the instrumentation and over a wider area. The associated changes to readings at each survey or monitoring point shall be then regulated to the construction activity so that the cause of any change, if it occurs, can be determined.

The Monitoring Surveyor shall also give details of any events on site which in his opinion could affect the validity of the results of any of the surveys.

The report shall contain as a minimum, for each survey visit the following information:

a) The date and time of each reading:
b) The weather on the day:
c) The name of the person recording the data on site and the person analysing the readings together with their company affiliations;
d) Any damage to the instrumentation or difficulties in reading;
e) Tables comparing the latest reading with the last reading and the base reading and the changes between these recorded data;
f) Graphs showing variations in crack width with time for the crack measuring gauges; and
g) Construction activity as described. It is very important that each set of readings is associated with the extent of excavation and construction at that time. Readings shall be accompanied by information describing the extent of works at the time of readings. This shall be agreed with the PC.

Spread-sheet columns of numbers should be clearly labelled together with units. Numbers should not be reported to a greater accuracy than is appropriate. Graph axis should be linear and clearly labelled together with units. The axis scales are to be agreed with the PC before the start of monitoring and are to remain constant for the duration of the job unless agreed otherwise. The specified trigger values are also to be plotted on all graphs.

The reports are to include progress photographs of the works both general to the area of each instrument and globally to the main Works. In particular, these are to supplement annotated plans/sections described above. Wherever possible the global photographs are to be taken from approximately the same spot on each occasion.

Erroneous Data

All data shall be checked for errors by the Monitoring Surveyor prior to submission. If a reading that appears to be erroneous (i.e. it shows a trend which is not supported by the surrounding instrumentation), he shall notify the PC immediately, resurvey the point in question and the neighbouring points and if the error is repeated, he shall attempt to identify the cause of the error. Both sets of readings shall be processed and submitted, together with the reasons for the errors and details of remedial works. If the error persists at subsequent survey visits, the Monitoring Surveyor shall agree with the PC how the data should be corrected. Correction could be achieved by correcting the readings subsequent to the error first being identified to a new base reading.

The Monitoring Surveyor shall rectify any faults found in or damage caused to the instrumentation system for the duration of the specified monitoring period, irrespective of cause, at his own cost.

Trigger Values

Trigger values for maximum movements as listed in Table 2. If the movement exceeds these values then action may be required to limit further movement. The PC should be immediately advised of the movements in order to implement the necessary works.

It is important that all neighbouring points (not necessarily a single survey point) should be used in assessing the impact of any movements which exceed the trigger values, and that rechecks are carried out to ensure the data is not erroneous. A detailed record of all activities in the area of the survey point will also be required as specified elsewhere.

Responsibility for Instrumentation

The Monitoring Surveyor shall be responsible for: managing the installation of the instruments or measuring points, reporting of the results in a format which is user friendly to all parties; and immediately reporting to all parties any damage. The Monitoring Surveyor shall be responsible for informing the PC of any movements which exceed the specified trigger values listed in Table 2 so that the PC can implement appropriate procedures. He shall immediately inform the PWS of any decisions taken.

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APPENDIX A
MONITORING FREQUENCY

INSTRUMENT	FREQUENCY OF READING
Settlement monitoring and Monitoring existing cracks	**Pre-construction** Monitored once. **During construction** Monitored after every pin is cast for first 4 no. pins to gauge effect of underpinning. If all is well, monitor after every other pin. **Post construction works** Monitored once.

APPENDIX B

An Analysis on allowable settlements of structures (Skempton and MacDonald (1956))

The most comprehensive studies linking self-weight settlements of buildings to structural damage were carried out in the 1950's by Skempton and MacDonald (1956) and Polshin and Tokar. These studies show that damage is most often caused by differential settlements rather than absolute settlements. More recently, similar empirical studies by Boscardin and Cording (1989) and Boone (1996) have linked structural damage to ground movements induced by excavations and tunnelling activities.

In 1955 Skempton and MacDonald identified the parameter $\delta\rho/L$ as the fundamental element on which to judge maximum admissible settlements for structures. This criterion was later confirmed in the works of GRANT *et al.* [1975] and WALSH [1981]. Another important approach to the problem was that of BURLAND and WROTH [1974], based on the criterion of maximum tensile strains.

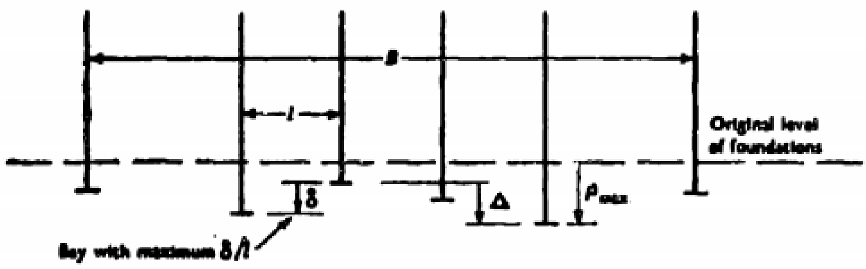


Figure 2.1 – Diagram illustrating the definitions of maximum angular distortion, δ/l, maximum settlement, ρ_{max}, and greatest differential settlement, Δ, for a building with no tilt (Skempton and MacDonald, 1956).

Figure 1: Diagram illustrating the definitions of maximum angular distortion, δ/l, maximum settlement, ρ_{max}, and greatest differential settlement ,Δ , for a building with no tilt (Skempton and MacDonald, 1956)

The differential settlement is defined as the greatest vertical distance between two points on the foundation of a structure that has settled, while the angular distortion, is the difference in elevation between two points, divided by the distance between those points.

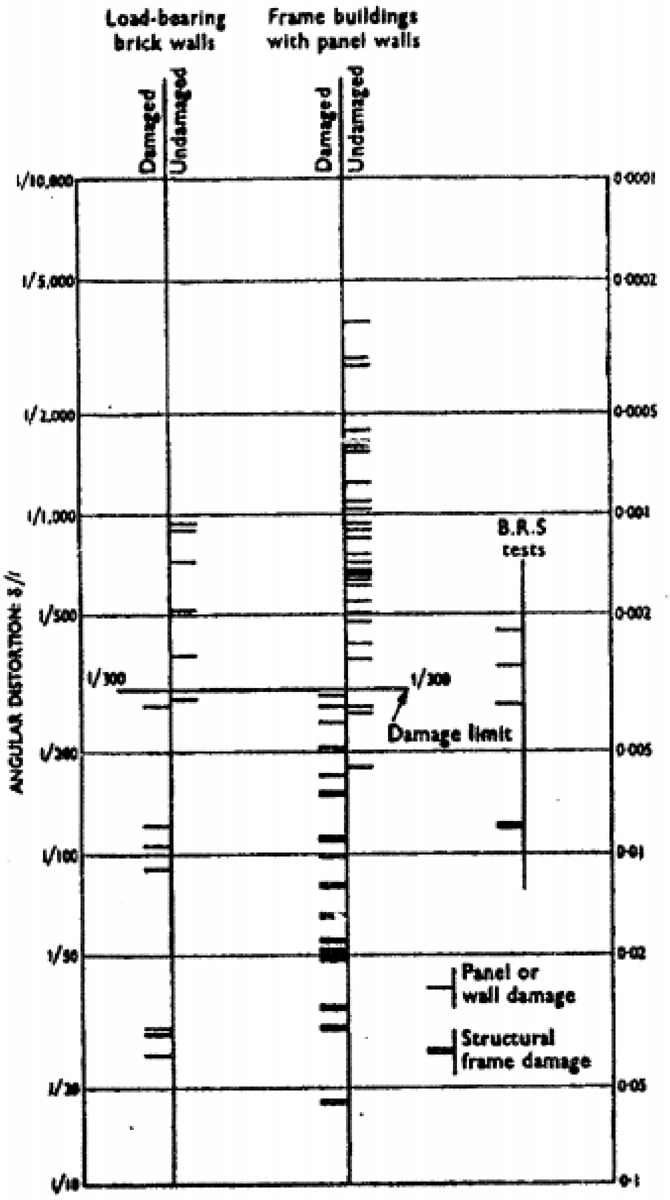
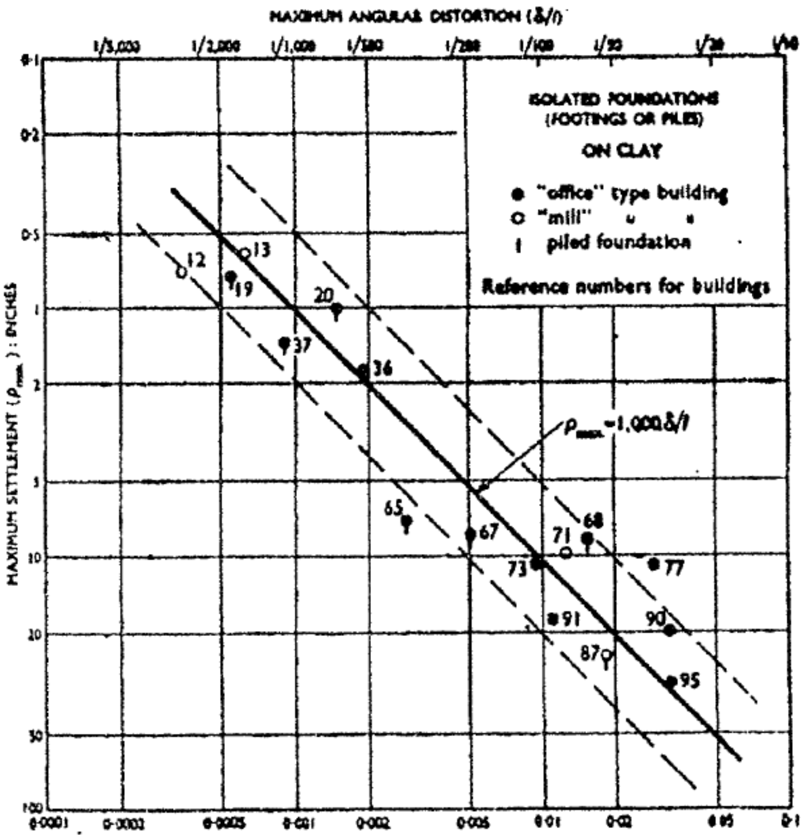
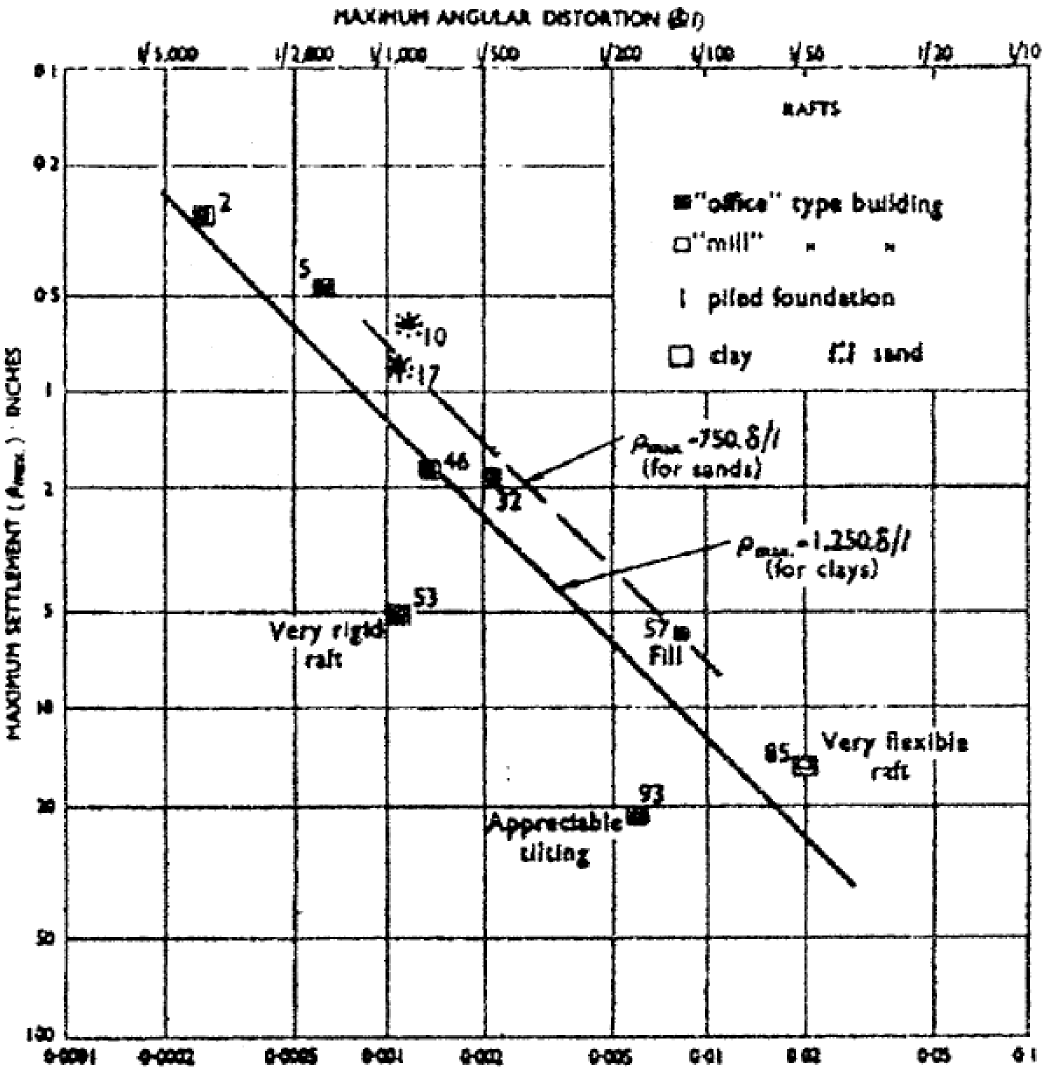


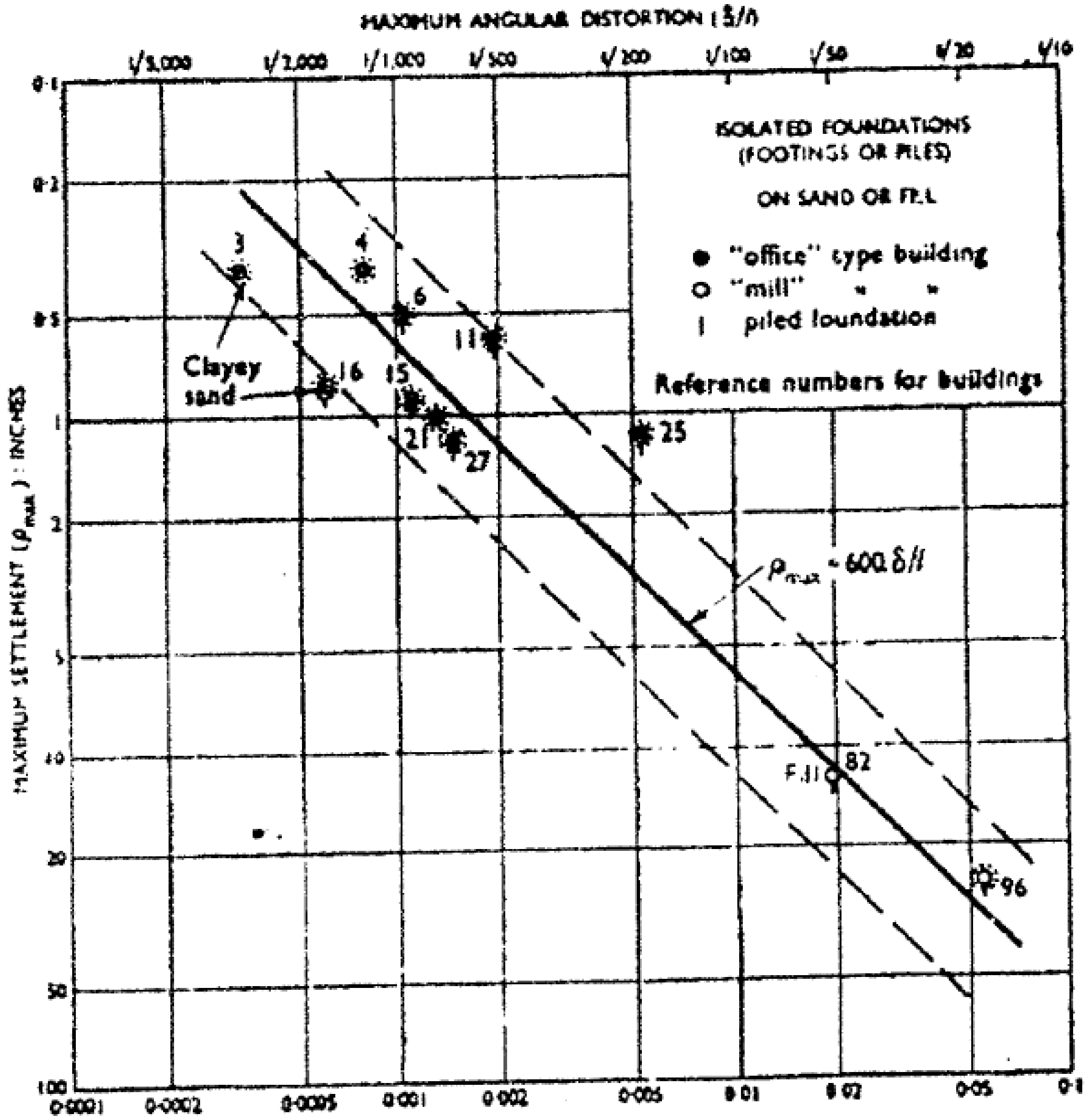
Figure 2: Skempton and MacDonald's analysis of field evidence of damage on traditional frame buildings and loadbearing brick walls

Data from Skempton and MacDonald's work suggest that the limiting value of angular distortion is 1/300. Angular distortion, greater than 1/300 produced visible cracking in the majority of buildings studied, regardless of whether it was a load bearing or a frame structure. As shown in the figure 2.

Other key findings by Skempton and MacDonald include limiting values of δ/l for structure, and a relationship between maximum settlement, ρ_{max} and δ/l for structures founded on sands and clays. The charts below show these relations for raft foundations and isolated footings.






MAXIMUM ANGULAR DISTORTION (δ/l)
1/5,000
1/2,000
1/1,000
1/500
1/200
1/100
1/50
1/20
1/10
ISOLATED FOUNDATIONS
(FOOTINGS OR PILES)
ON SAND OR FILL
"office" type building
"mill"
piled foundation
Reference numbers for buildings
Clayey sand
MAXIMUM SETTLEMENT (ρ_{max}) : INCHES
ρ_{max} = 600 δ/l
0·0001
0·0002
0·0005
0·001
0·002
0·005
0·01
0·02
0·05
0·1

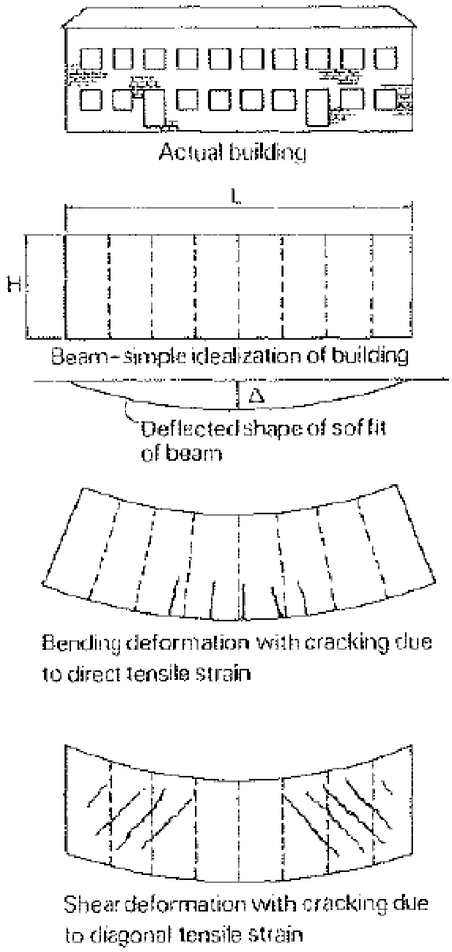


TABLE I

Angular distorsion	Characteristic situation
1/300	Cracking of the panels in frame buildings of the traditional type, or of the walls in load-bearing wall buildings;
1/150	Structural damage to the stanchions and beams;
1/500	Design limit to avoid cracking;
1/1000	Design limit to avoid any settlement damage.

CROFT STRUCTURAL ENGINEERS

Appendix F: Communication with London Underground

Geoff Watson

From: Holland, Stephen <Stephen.Holland@tubelines.com>
Sent: Friday, 24 June, 2016 2:29 PM
To: gwatson@croftse.co.uk
Cc: Location Enquiries
Subject: FW: 50 Rochester Place, London NW1 9JX

Thanks Geoff based on the feedback I have had we are circa 70 m away so will not be effected by this development.

Kind regards
Steve

Stephen Holland
Infrastructure Protection
JNP Lead Engineer

Mobile 07899060254
Email: Stephen.Holland@tubelines.com

From: Laurie, Philip (OneLondon)
Sent: 24 June 2016 1:57 PM
To: Holland, Stephen
Cc: Cadman, John (OneLondon)
Subject: FW: 50 Rochester Place, London NW1 9JX

Steve,

60 metres, I recon it could be marginal.

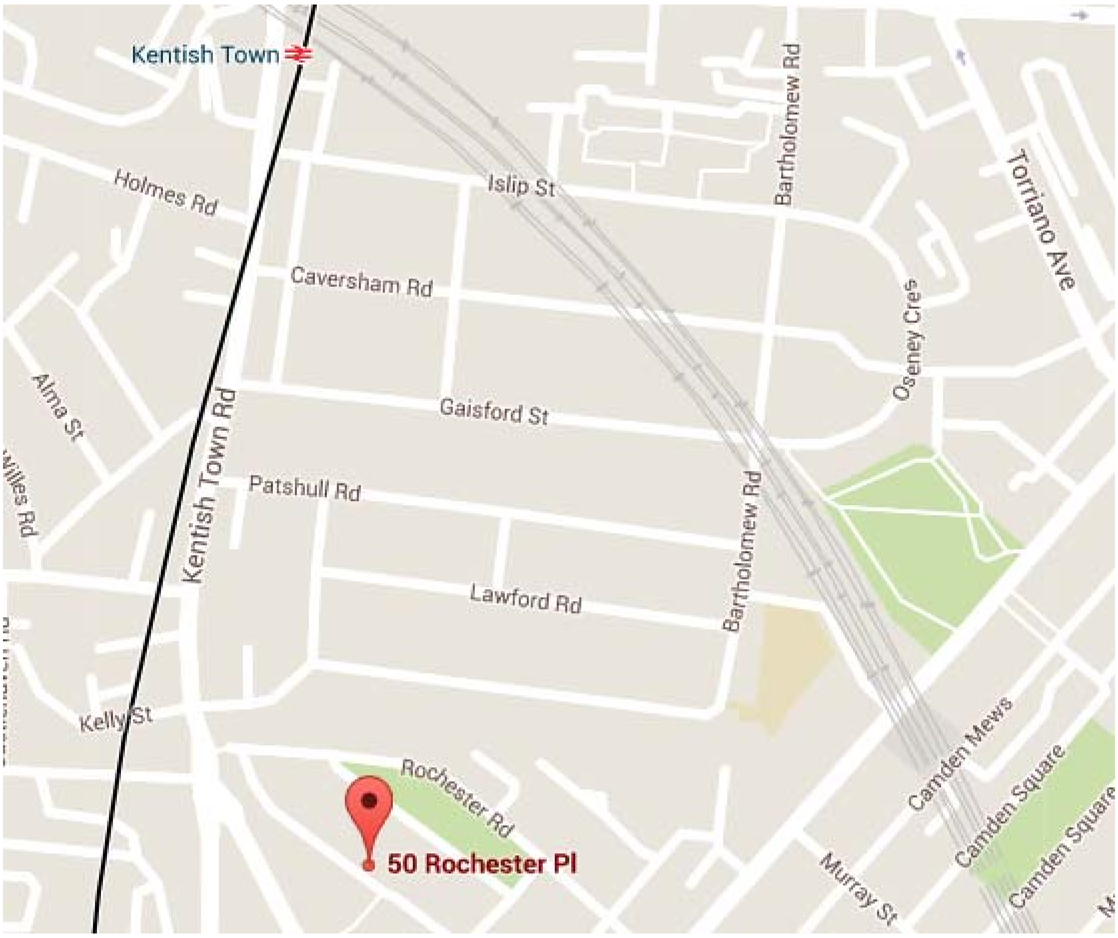
Regards

Phil

From: Geoff Watson [mailto:gwatson@croftse.co.uk]
Sent: 24 June 2016 09:54
To: Cadman John
Cc: Laurie Philip
Subject: 50 Rochester Place, London NW1 9JX

Dear John and Philip

We are involved in the planning application of a basement (not more than 4.5m deep below ground level) for the above property which is appears close to a tube line (see attached image). The property is in Camden and is possibly within 60m of the northern line, as shown in the Google screen-grab below:



We've learnt the hard way not to rely on Google maps for plan distances to tube lines, so this might be closer than we think. Please could you advise:

- At design stage, would we need a correlation survey for this?
- At design stage, would our client need to sign an RoCD?
- At design stage, will the client be expected to comply with G0023 and S050?
- At planning stage, will LUL require anything more from us besides notification (by way of this e-mail) and stating whether the above will be necessary at a later stage?

Please let us know if any of the above applies.

Kind regards

Geoff Watson
Structural Engineer

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w: www.croftse.co.uk
Follow us at @CroftStructures