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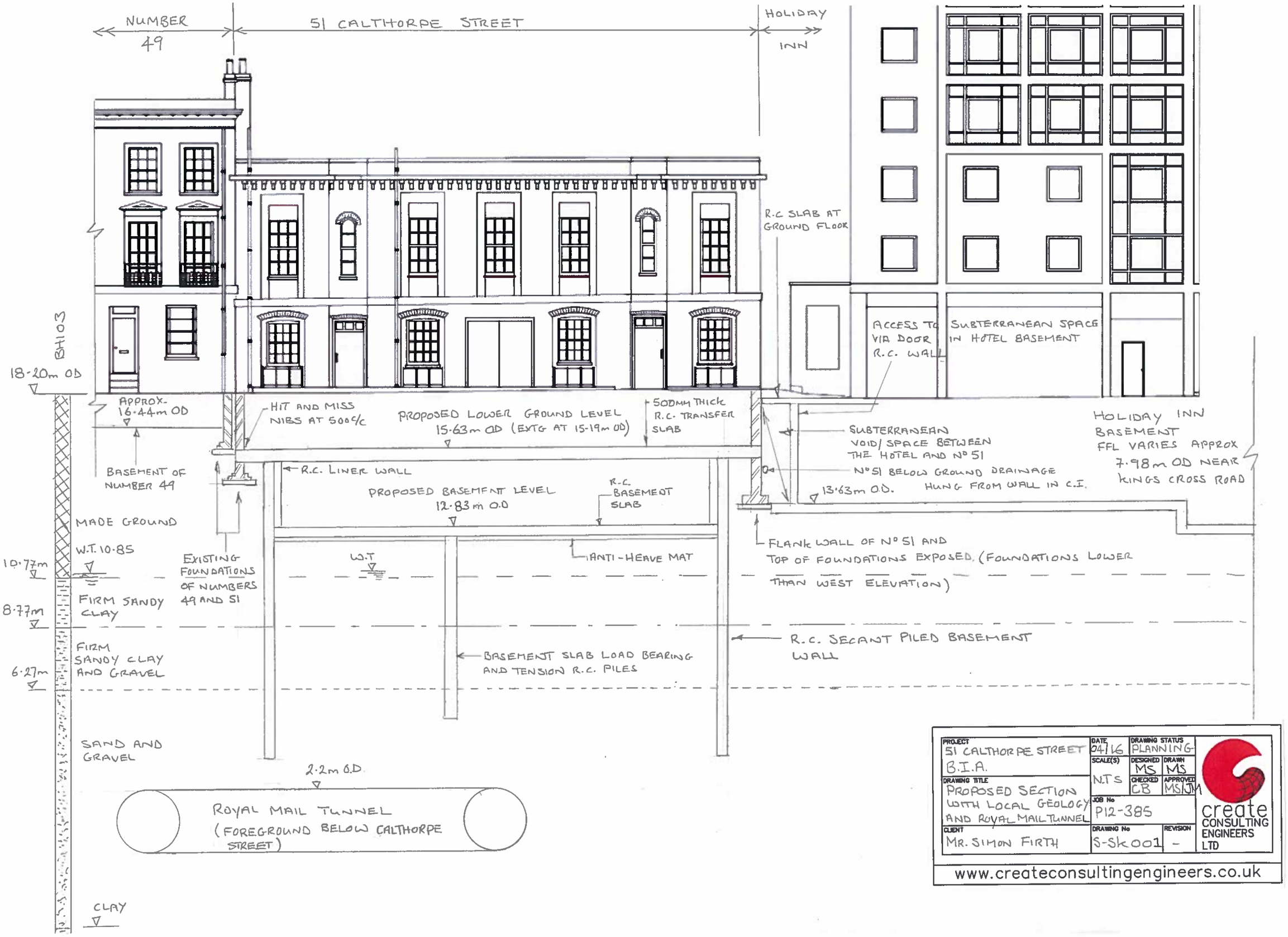
51 CALTHORPE STREET, LONDON WC1X 0HH

Basement Impact Assessment (Revision B) – Volume 5

APPENDIX N



PROJECT: 51 CALTHORPE STREET B.I.A.	DATE: 04/16	DRAWING STATUS: PLANNING	
	SCALE(S): N.T.S	DESIGNED: MS	DRAWN: MS
DRAWING TITLE: PROPOSED SECTION WITH LOCAL GEOLOGY AND ROYAL MAIL TUNNEL		CHECKED: CB	APPROVED: MS/JM
	JOB No: P12-385		
CLIENT: MR. SIMON FIRTH	DRAWING No: S-Sk001	REVISION: -	

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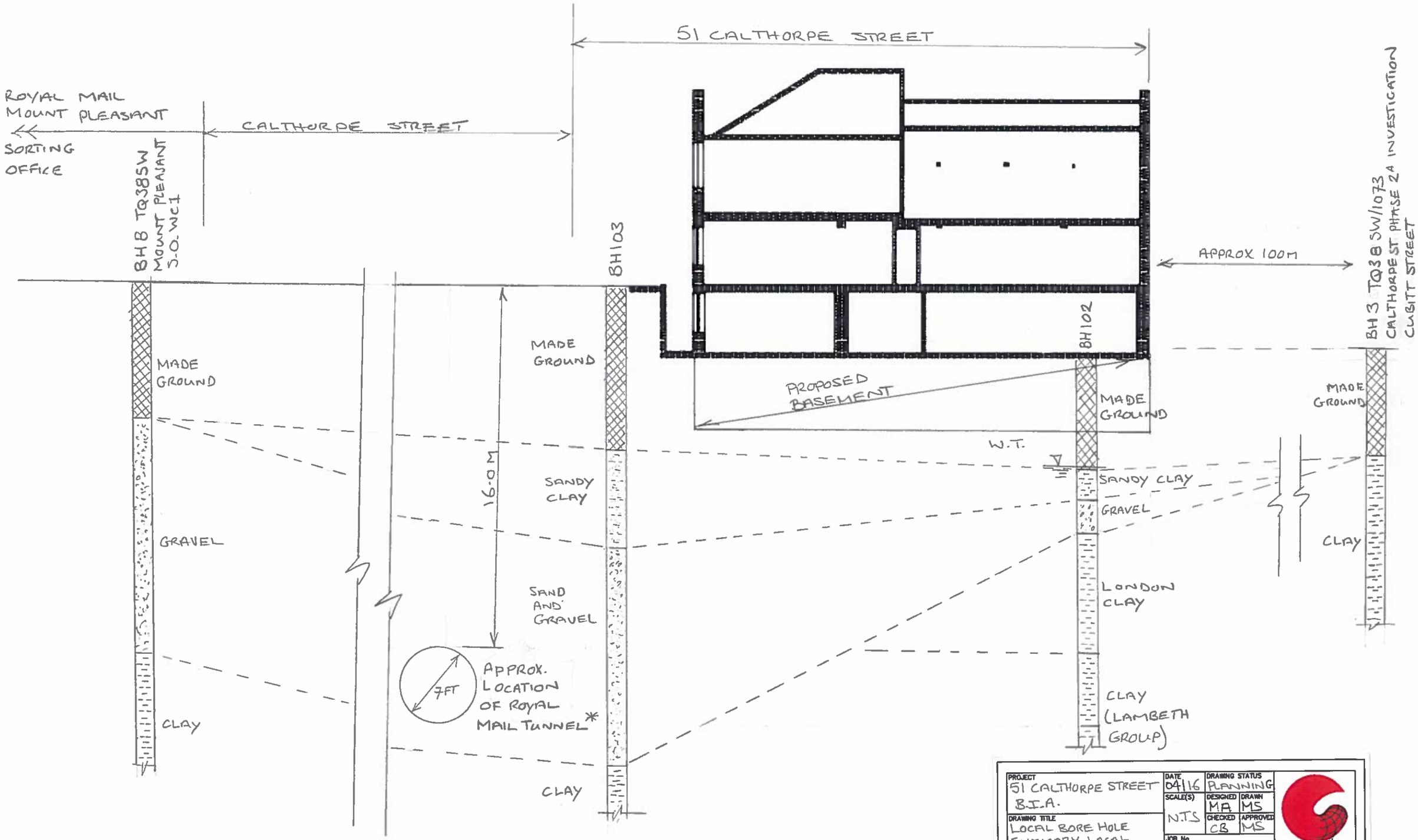

* ACTUAL POSITION UNDER CALTHORPE STREET VARIES

PROJECT: 51 CALTHORPE STREET B.I.A.	DATE: 04/16	DRAWING STATUS: PLANNING	
	SCALE(S): N.T.S	DESIGNED: MA	DRAWN: MS
DRAWING TITLE: LOCAL BORE HOLE SUMMARY, LOCAL GEOLOGY / GROUND CONDITIONS		CHECKED: CB	APPROVED: MS
	JOB No: P12-385		
CLIENT: MR. SIMON FIRTH	DRAWING No: S-Sk-002	REVISION: -	

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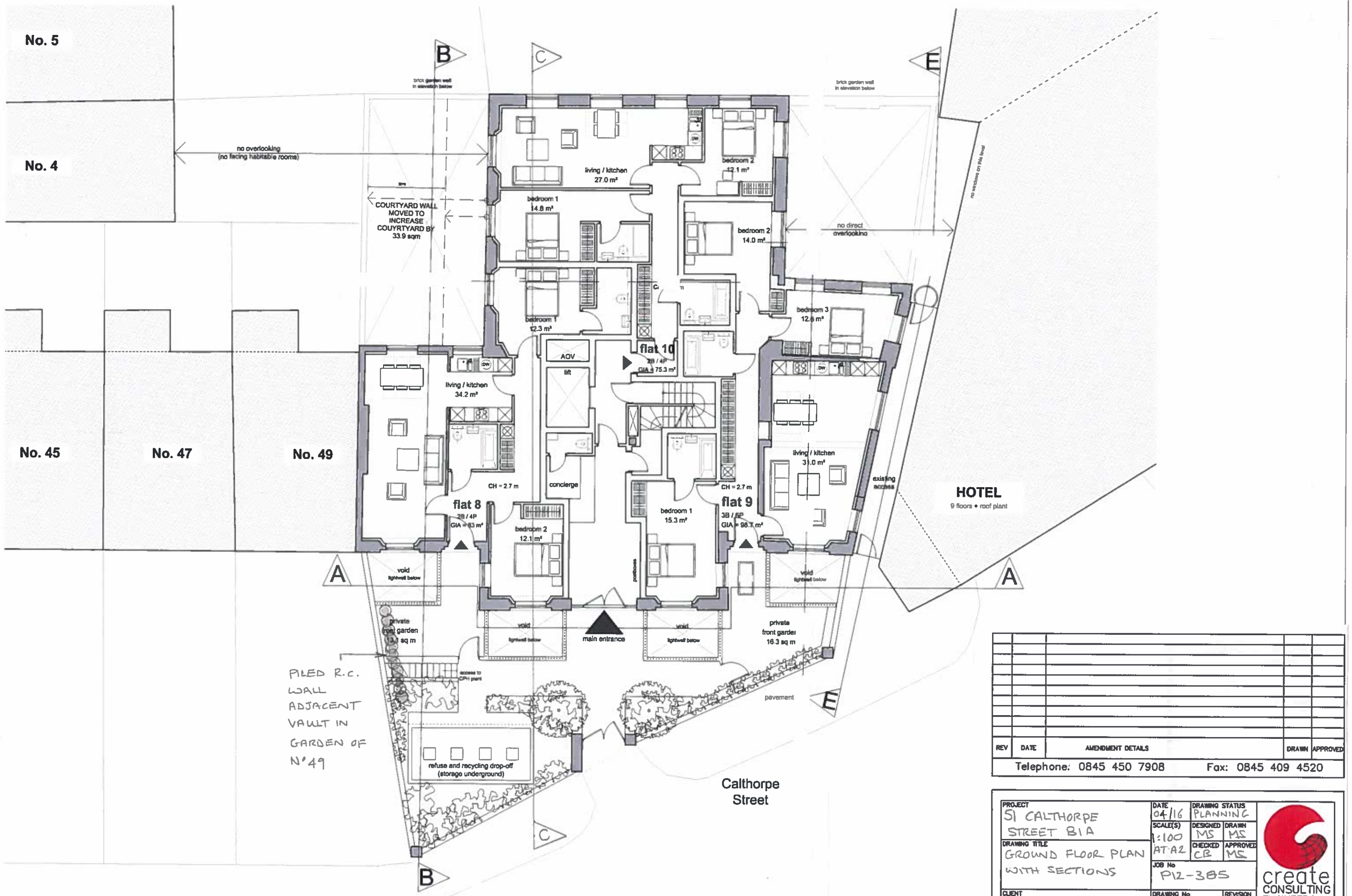

REV	DATE	AMENDMENT DETAILS	DRAWN	APPROVED

Telephone: 0845 450 7908 Fax: 0845 409 4520

PROJECT: 51 CALTHORPE STREET BIA	DATE: 04/16	DRAWING STATUS: PLANNING	
	SCALE(S): 1:100 AT A2	DESIGNED: MS	DRAWN: MS
		CHECKED: CB	APPROVED: MS
DRAWING TITLE: GROUND FLOOR PLAN WITH SECTIONS	JOB No: P12-385		
CLIENT: MR S FIRTH	DRAWING No: S-SK010	REVISION: —	

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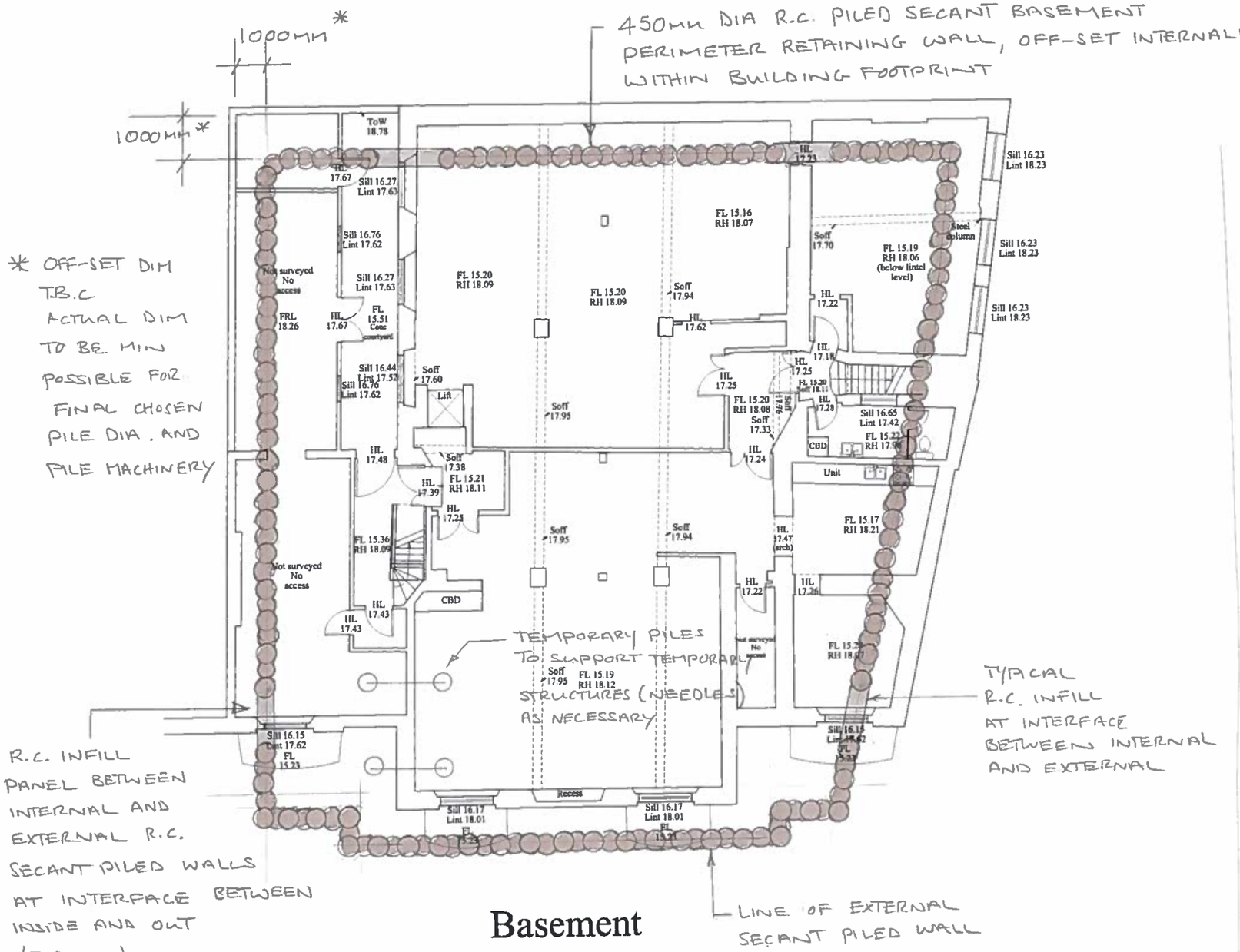

Basement

REV	DATE	AMENDMENT DETAILS	DRAWN	APPROVED

Telephone: 0845 450 7908 Fax: 0845 409 4520

PROJECT: 51 CALTHORPE STREET BIA	DATE: 04/16	DRAWING STATUS: 1 PLANNING	
	SCALE(S): NTS	DESIGNED: MS	DRAWN: MS
DRAWING TITLE: BASEMENT SECANT PILED RET. WALL		CHECKED: CB	APPROVED: MS
	JOB No: 1912-385		
CLIENT: MR. S FIRTH	DRAWING No: S-SK011	REVISION:	

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existing chimney retained

existing parapet height retained

new mansard roof

new dormers

(Assumed) lift over run 650mm max at middle of roof (not visible from street)

Roof Access Hatch

parapet in previous application shown red, ref 2013/5445/P

outline of previous application shown red, ref 2013/5445/P

Slate tile roof at the front of facade of the mansard only

height of top floor in previous application ref 2013/5445/P

reduced ridge height

height of parapet in previous application ref 2013/5445/P

reduced height of top floor

existing decorative ledge retained

existing brickwork

new white painted timber framed double/triple glazed sash windows style to match existing

existing white painted decorative band

51 CALTHORPE STREET

CAPPING BEAM

lightwell outline approximate

lightwell

Flat 4 Lightwell

Flat 5 Lightwell

Flat 5 Lightwell

Flat 5 Living Kitchen

Flat 6 Lightwell

lightwell

mirror shaft for daylight and ventilation

mirror shaft for daylight and ventilation

LOWER GROUND LEVEL 500mm THK R.C. TRANSFER SLAB

hotel basement

450 DIA RC SECANT PILED BASEMENT WALL

ANTI-HEAVE MAT

SECANT PILED WALL

WATER-TIGHT R.C. BASEMENT SLAB

PROJECT: 51 CALTHORPE STREET BIA	DATE: 04/16	DRAWING STATUS: PLANNING	
DRAWING TITLE: PROPOSED SECTION A-A	SCALE(S): 1:100	DESIGNED: MS / DRAWN: MS / CHECKED: CB / APPROVED: VS	
	JOB No: P12-385		
CLIENT: MR SIMON FIRTH	DRAWING No: S-Sk012	REVISION:	

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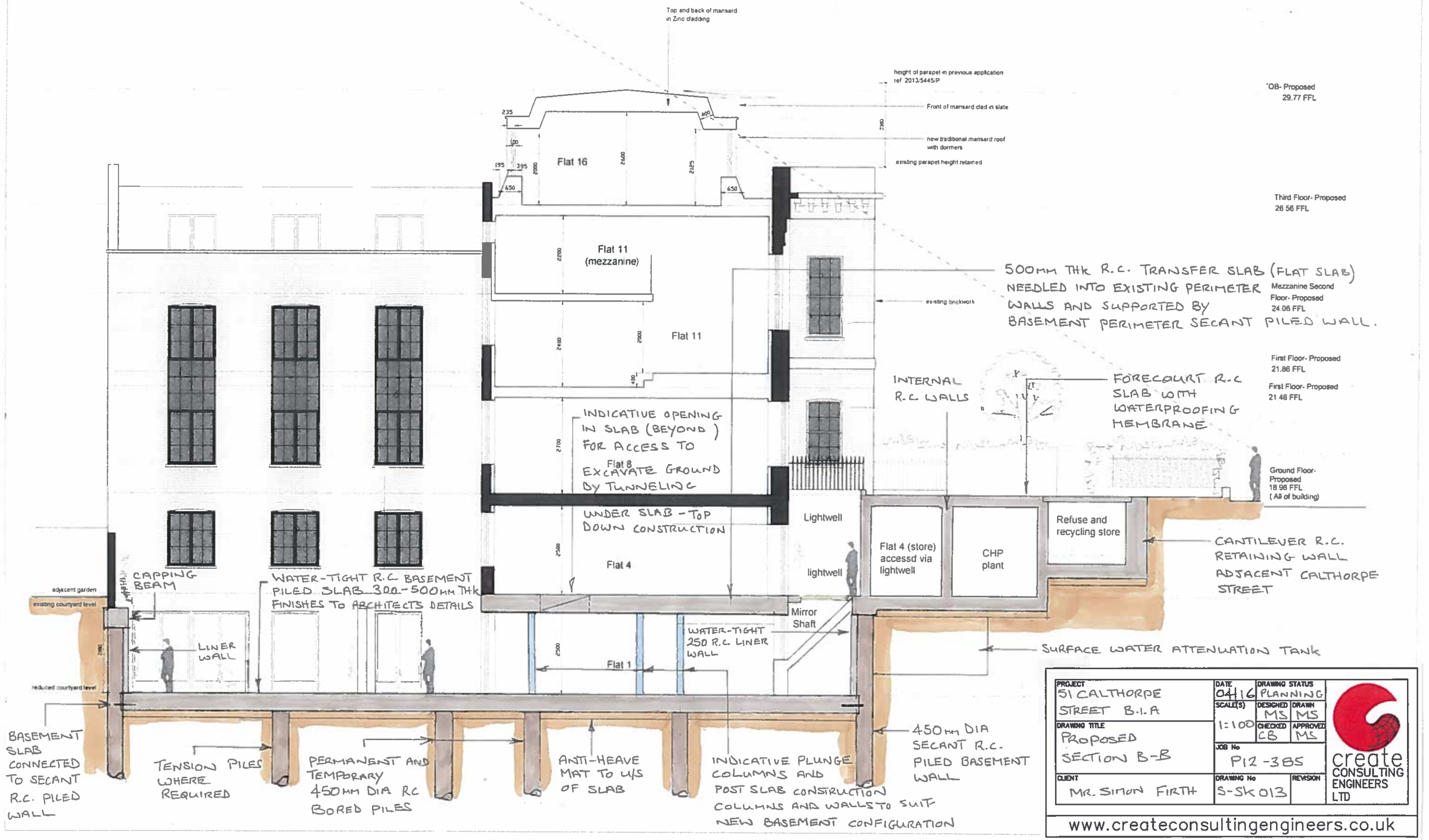

PROJECT: 51 CALTHORPE STREET B.I.A	DATE: 04/16	DRAWING STATUS: PLANNING	create CONSULTING ENGINEERS LTD
DRAWING TITLE: PROPOSED SECTION B-B	SCALE(S): 1:100	DESIGNED: MS / DRAWN: MS / CHECKED: CB / APPROVED: MS	
CLIENT: MR. SIMON FIRTH	JOB No: P12-385	DRAWING No: S-SK013	REVISION:

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INDICATIVE TEMPORARY WORKS SUPPORTED ON TEMPORARY OR PERMANENT PILES

Top and back of mansard in Zinc cladding

height of parapet in previous application ref 2013/5445/P

Front of mansard clad in slate

new traditonal mansard roof with dormers

existing parapet height retained

'OB- Proposed 29.77 FFL

Third Floor- Proposed 28.56 FFL

ALTERNATIVE TEMPORARY ACCESS DURING CONSTRUCTION

Mezzanine Second Floor- Proposed 24.06 FFL

FORECOURT RC SLAB WITH WATERPROOFING

First Floor- Proposed 21.88 FFL

First Floor- Proposed 21.46 FFL

Ground Floor- Proposed 18.96 FFL (All of building)

Flat 16

Flat 11 (mezzanine)

Flat 11

Flat 8

Flat 4

Flat 1

LOWER GROUND FLR 500mm THk R.C. TRANSFER SLAB

WATER-TIGHT R.C. BASEMENT SLAB (300-500 THk)

FINISHES TO ARCHITECT'S DETAILS

INTERNAL COLUMNS TO SUIT BASEMENT CONFIGURATION

lightwell

CHP plant

Refuse and recycling store

R.C. RETAINING WALL ADJACENT CALTHORPE ST

LOWER GROUND

adjacent garden

existing courtyard level

reduced courtyard level

WATER-TIGHT R.C. LINER WALL

450 DIA SECANT PILED R.C. BASEMENT WALL

BASEMENT

450mm DIA SECANT PILED WALL

ANTI-HEAVE MAT BELOW SLAB

PERMANENT AND TEMPORARY 450 ϕ BORED PILES

PROJECT: 51 CALTHORPE STREET BIA	DATE: 04/16	DRAWING STATUS: PLANNING	create CONSULTING ENGINEERS LTD
DRAWING TITLE: PROPOSED SECTION C-C	SCALE(S): 1:100	DESIGNED: MS / DRAWN: MS / CHECKED: CB / APPROVED: MS	
	JOB No: P12-385		
CLIENT: MR SIMON FIRTH	DRAWING No: S-SK014	REVISION:	

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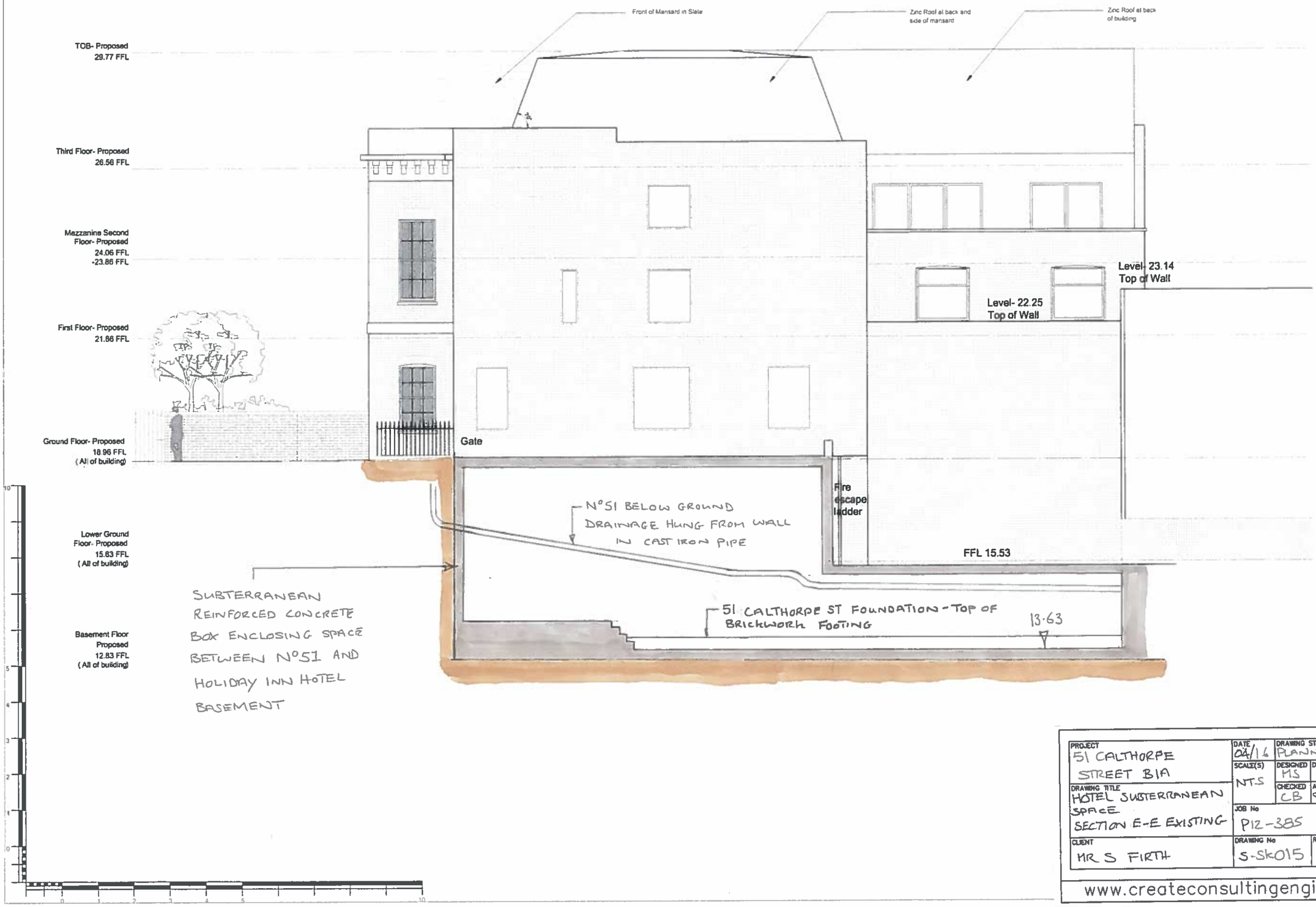

PROJECT: 51 CALTHORPE STREET BIA	DATE: 04/16	DRAWING STATUS: PLANNING	
	SCALE(S): NTS	DESIGNED: MS	DRAWN: MS
DRAWING TITLE: HOTEL SUBTERRANEAN SPACE SECTION E-E EXISTING		CHECKED: CB	APPROVED:
	JOB No: P12-385		
CLIENT: MR S FIRTH	DRAWING No: S-SK015	REVISION: -	

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TOB- Proposed
29.77 FFL

Third Floor- Proposed
26.58 FFL

Mezzanine Second Floor- Proposed
24.06 FFL
-23.86 FFL

First Floor- Proposed
21.86 FFL

Ground Floor- Proposed
18.96 FFL
(All of building)

Lower Ground Floor- Proposed
15.63 FFL
(All of building)

Basement Floor Proposed
12.83 FFL
(All of building)

Front of Mansard in Slate

Zinc Roof at back and side of mansard

Zinc Roof at back of building

Level- 23.14
Top of Wall

Level- 22.25
Top of Wall

Gate

Fire escape ladder

OUTLINE OF HOLIDAY INN SUBTERRANEAN SPACE IN THE FOREGROUND

FFL 15.53

Nº 51 PROPERTY EXTERNAL FRONT WALL

500mm LOWER GROUND FLOOR TRANSFER SLAB WITH NIBS BUILT INTO EXTERNAL WALL

REINFORCED CONCRETE INFILL PANEL AT INTERFACE WITH EXISTING EXTERNAL WALL

R.C. SECANT PILED BASEMENT PERIMETER RETAINING WALL

UNDERPINNING EXTERNAL FRONT WALL AT INTERFACE WITH INTERNAL AND EXTERNAL

PROJECT: 51 CALTHORPE STREET BIA	DATE: 04/16	DRAWING STATUS: PLANNING	
	SCALE(S): NTS	DESIGNED: MS / DRAWN: MS	
DRAWING TITLE: PROPOSED SECTION E-E AT INTERFACE WITH SUBTERRANEAN SPACE		CHECKED: CB / APPROVED: PD	
	JOB No: P12-385		
CLIENT: MR SIMON FIRTH	DRAWING No: S-Sk016	REVISION: -	

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APPENDIX O

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109-112 Temple Chambers, 3-7 Temple Avenue, London EC4Y 0HP
Tel: 0207 822 2300
Email: www.createconsultingengineers.co.uk

Photo 1: View of subterranean space between Holiday Inn and 51 Calthorpe Street at basement level	Photo 2: View of rear of the subterranean space between Holiday Inn and 51 Calthorpe Street.
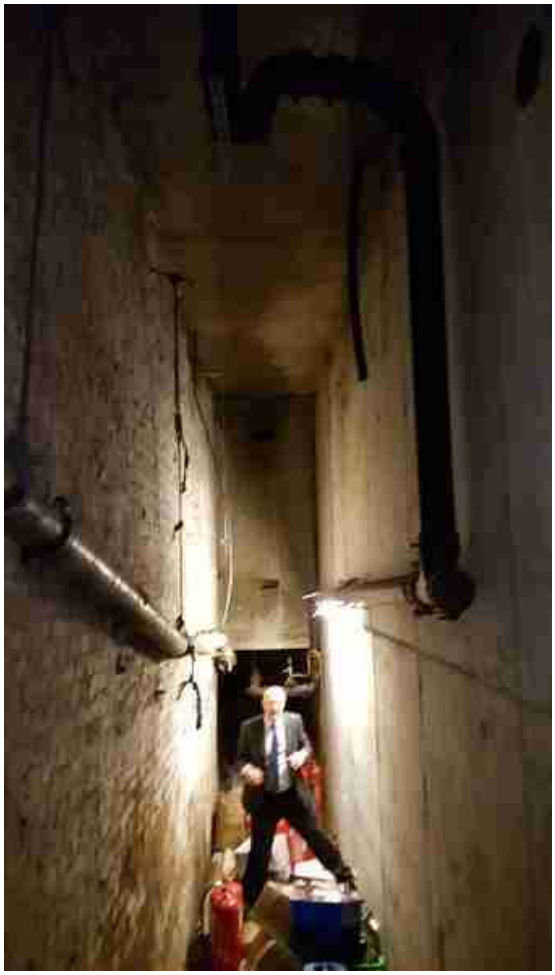	
Photo taken with back to rear of Calthorpe Street. Brick wall (left of photo) is the external basement face of 51 Calthorpe Street). Note the suspended sewer on left is assumed to serve the front lightwell(s) of 51. Concrete wall (right) is the external basement wall of the Holiday Inn. The suspended sewer on the right drains emergency escape passageway between the 2 properties at ground level.	View beneath the rear lightwell between 51 Calthorpe Street and the Holiday Inn

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Photo 3: Wall of 51 Calthorpe basement

View looking towards Calthorpe Street from within subterranean space

APPENDIX P

CALCULATION SHEET

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Project: 51 CACTHORPE STREET, LONDON, WC1X OHH	Job No: P12-385	Sheet No: P1	Rev.
Subject: GROUND Movement (Including Existing L. Co. F.)	Made by: MA	Checked by: MJ/MS	
	Date: 03.03.16	Date: 03/16	

Horizontal Movement CIRIA C580; Embedment retaining wall : Guide to Economic Design

Existing building height (Exluding Lower Ground Floor)

H = 8.8m

Existing building width = 10.4 = L

$L/H = 10.4/8.8 = 1:18$

Ground surface movement due to bored pile

Proposed basement depth (including existing Lge Lower Ground Level) = 5.7m or 5700mm

Horizontal surface movement = 0.08% Table 2

$\delta_H = \frac{0.04}{100} \times 5700 = 4.56$

Secant wall. TABLE 2.2

Vertical surface movement = 0.05

$\delta_V = 0.04/100 \times 5700 = 2.23mm.$

2.25

0.267mm/m

Distance behind wall

$L_H = 5700 \times 1.5 = 8550$

Potential movement due to wall excavation

Horizontal surface movement 0.15%

$0.15/100 \times 5700 = 8.55mm$

Vertical surface movement

$\frac{0.1}{100} \times 5700 = 5.7mm$

Distance behind Wall to negligible movement → PTO

CALCULATION SHEET

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Project: 51 CALTHORPE STREET, LONDON, WC1X 0HH	Job No: P12-385	Sheet No: P2	Rev.
Subject: Ground Movement (Including Existing & L.G.F.L)	Made by: MA	Checked by: MS	
	Date: 04.05.16	Date: 03/16	

5700 x 4 = 22800mm

TABLE 2.4

5.7 / 1.5 = 3.75 mm/m

		Excavation movement distance δv		Installation movement distance δv	
Node	x	22800	0	8550	0
	y	0	-5.7	0	-2.28

The result obtained are based on CIRIA C580, Maximum horizontal movement due to development is 0.56 + 8.55 = 13.11mm.

Maximum vertical movement due to development is 2.85 + 5.7 = 8.55mm.

DETERMINING the damage category

δ_H = 13.11mm.

distance behind wall to negligible movement = 22800

Damage category = $^{10.83}/_{22800} \times 100 = 0.0475\%$ → 0.0575 very slight catagary table 2.5

Based on table 2.4 of CIRIA C580

Damage Category	Degree of damage	Limiting tensile strain
0	Negligible	0.00% - 0.05
1	Very sligh	0.05% - 0.075%
2	very Slight	0.075% - 0.15%
3	Moderate	0.15% - 0.3%
4-5	Severe to very severe	>0.3%

Therefore, Anticipated damage may be categorised as negligible

CALCULATION SHEET

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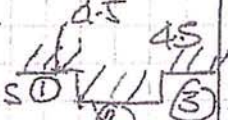
Project: 51 CALTHORPE STREET LONDON.	Sheet no of -	Job No: P12-385
	Calc. no: P/3	Checked by: PMO
Subject: RETAINING WALL: GROUND MOVEMENT	Made by: [illegible] Date: JULY 16	Date: 08/16

CATOGARY 'B' AUDIT + BIA. GROUND CONDITIONS

MADE GROUND SANDS ON. GRAVELS ON LONDON CLAY.

-ADJACENT TO HISTORIC RIVER.

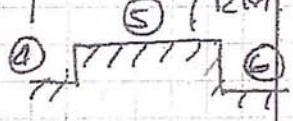
IT IS REQUIRED TO CONSIDER THE LONG ELEVATION OF THE BUILDING, RETAINING WALL. REFER TO SKETCHES



FRONT WALL: = 18.5M IN THREE SECTIONS.

H = 8.8M.

∴ L/H. = 9.5/8.8 = 1.07. FRONT WALL.



REAR WALL: -

MAX. LENGTH @ (5) = 12M.

∴ L/H = 12/8.8 = 1.5.

REF. BROOKS/MURRAY. ARCHS. DRG. 939-P2-110.

INTERNAL WALLS *. WITH VARYING WIDTHS

(7) LIFT SHAFT - 250 THK.

(8) MAIN DIVIDING. 750 THK.

(9) DIVIDING. 250 THK.

(10) " "

(11) " "

(12) " "

PROPOSED BASEMENT DEPTH = 6700MM.

CAMPBELL REITH. REPORT BIA AUDIT JULY 2016 CLAUSE 4.8

TOTAL WALL LENGTH = 21M. > 10 × M (PRETTIES length value)

∴ L/H = 21/8.8. = 2.39.

CALCULATION SHEET

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Project: 51 CALTHORPE STREET LONDON.	Job No: P12-385	Sheet No: P/4	Rev.
Subject: RETAINING WALL GROUND MOVEMENT.	Made by: J.	Checked by: PMC	
	Date: JULY 16	Date: 08/16	

CONSIDER THE FRONT ELEVATION OF WALL @ ADJACENT PROPERTY NO'S 29-45 (EXISTING) AS 13.5M. LONGEST SPAN (WORSTCASE).

4.5M. FOR EACH ELEVATION.

Y 3 NO DWELLINGS

13.5M. AS CONTINUOUS WALL, BUT RESTRAINED BY PARTY WALL IN EACH PROPERTY.

P64/3

FROM: BROOKS/MURRAY. DRG NO 938-109.

① CONSIDER FULL LENGTH OF WALL = 13.5M (8M (h))

VERTICAL DEFLECTION.

L/H = 1.68.

$\therefore \Delta = \frac{0.05}{100} \times 13500 \text{ (L)} = 6.75\text{mm}.$

$\downarrow = 5.4\text{mm}$ FOR WHOLE LENGTH OF WALL

$\div 3 = 2.25\text{mm}$ AS WALL IS < 5mm (MODERATE RESTRAINED @ 3RD POINTS (FIXED)

HORIZONTAL DEFLECTION.

$\Delta = \frac{0.08}{100} \times 4500 \text{ (h)} = 3.6\text{mm}$

∴ FINE DEFINITION. (SEE PAGE 65)

WITHIN THE CONFINES OF FIG 8.16 'EXTRACT FROM INSTITUTION OF STRUCTURAL ENGINEERS - "SUBSIDENCE OF LOW RISE BUILDINGS.

NOTE: FURTHER CRACK MONITORING WOULD BE ADVISABLE TO BE CARRIED OUT ON THE NEW + EXISTING WALLS OF THE BUILDINGS TO ASSESS WHETHER THE CRACK WIDTHS HAVE EXCEEDED 5MM 'SERIOUS' DEFINITION, IN WHICH CASE EXPANDED METAL/PLASTER REPAIRS WILL BE REQUIRED.

* VISUAL CONDITION SURVEYS TO BE CARRIED OUT IN NEIGHBOURING PROPERTIES IE 49 CALTHORPE ST.

(REFER TO CLAUSES: 8.61 TO 8.88 REGARDING EXISTING ROYAL MAIL TUNNEL + NEIGHBOURING PROPERTIES HOLD)

CALCULATION SHEET

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Project: 51. CALTHORPE STREET LONDON.	Sheet no 5 of 5	Job No P12-385
	Calc. no: P/S.	Checked by: PMO
Subject: RETAINING WALL GROUND MOVEMENT	Made by: J.	Date: 08/16
	Date: JULY 16	

VERTICAL MOVEMENT :- WITH HORIZONTAL

= 6.75 δL)
+ 3.6 δh)

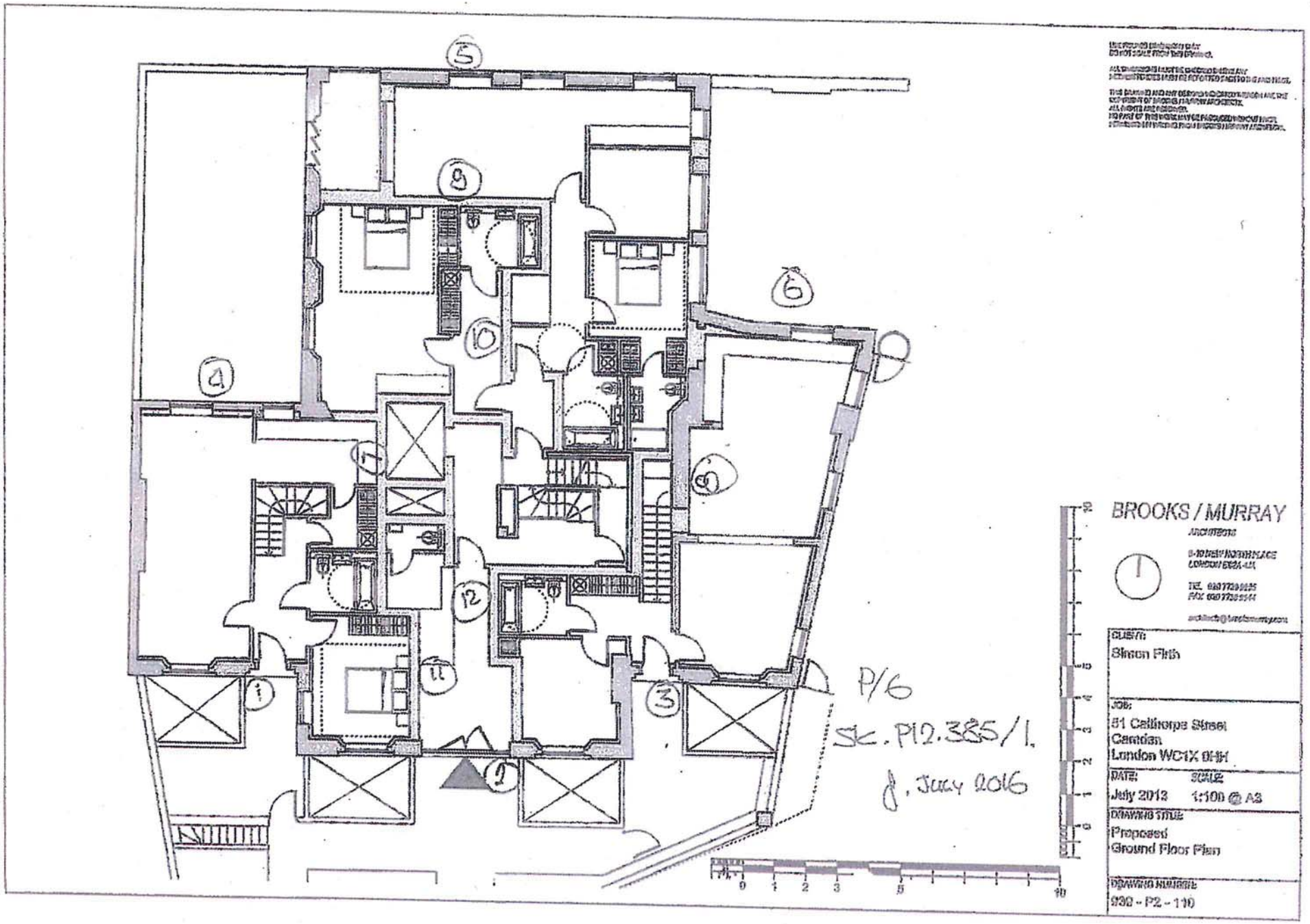
DETERMINE DAMAGE CATAGORY, DISTANCE BEHIND WALL FOR NEGLIGBLE MOVEMENT:

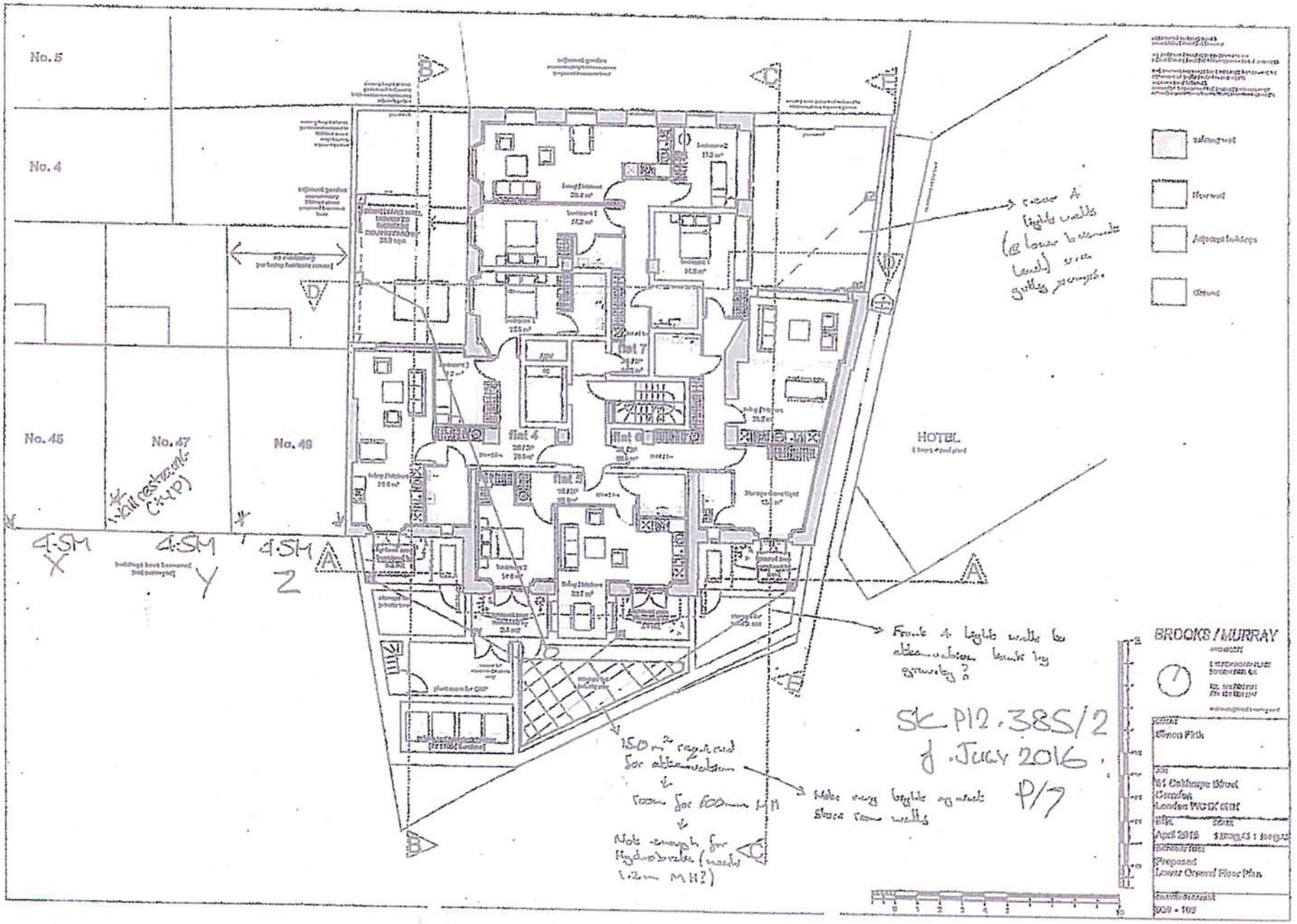
= 13-1./22800 × 100 . 5.7×10⁻⁵

FROM TABLE 5, CIRIA C580 < 0.05 ∴

CONSIDER CATOCARY OF DAMAGE NEGLIGBLE .

CRACK WIDTH: 0.1mm

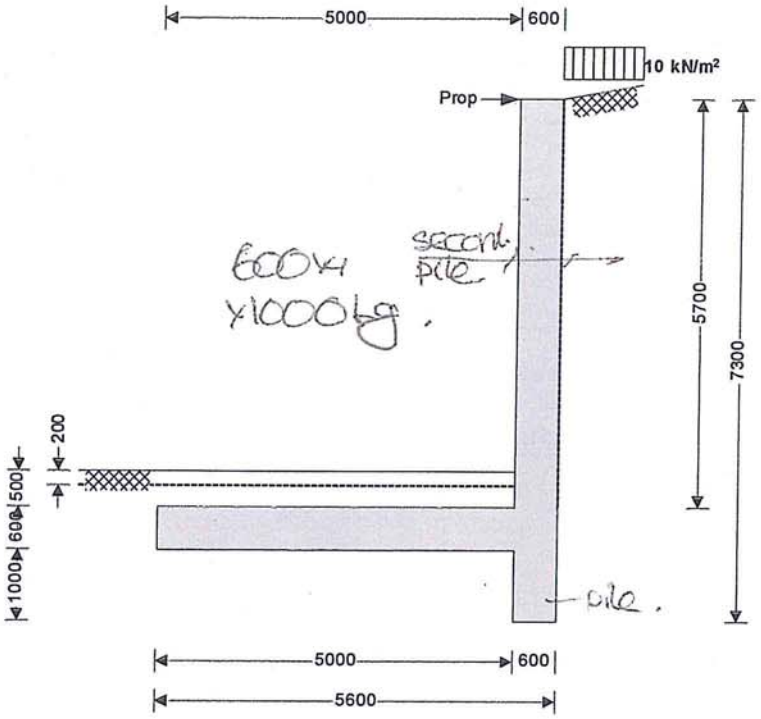

P/6
SK.P12.385/1.
8. July 2016
BROOKS / MURRAY
Simon Firth
51 Calliorpe Street
Camden
London WC1X 9HH
July 2013
1:100 @ A3
Proposed
Ground Floor Plan
930 - P2 - 110


No. 5
No. 4
No. 45
No. 47
No. 49
HOTEL
flat 7
flat 4
flat 5
flat 6
room A
light wells
(at lower basement
level) over
gulley pumps.
4.5M
4.5M
4.5M
X
Y
Z
A
B
C
D
Front 4 light wells to
obtain relaxation levels by
gravity ?
150 m² required
for obtain relaxation
to
room for 600mm MH
to
Note enough for
Hydrobrake (needs
1.2m MH?)
Make easy lightle against
Stores room walls
SK P12.385/2
4 JULY 2016
P/7
BROOKS / MURRAY
Simon Firth
61 Calthorpe Street
London WC1X 0HH
April 2016
Proposed
Lower Ground Floor Plan
309 - 102

TEKLA Tedds Create Consulting Engineers 109-112 Temple Chamber 3-7 Temple Avenue London EC4Y 0HP	Project 51 Calthorpe St London				Job no. P12-385	
	Calcs for Secant Pile Wall				Start page no./Revision P/8 :	
	Calcs by NT	Calcs date 09/08/2016	Checked by PMD	Checked date 9/08/16	Approved by	Approved date

RETAINING WALL ANALYSIS (BS 8002:1994)

TEDDS calculation version 1.2.01.06



Wall details

Retaining wall type	**Cantilever propped at top**
Height of retaining wall stem	h_{stem} = **5700** mm
Thickness of wall stem	t_{wall} = **600** mm
Length of toe	l_{toe} = **5000** mm
Length of heel	l_{heel} = **0** mm
Overall length of base	$l_{base} = l_{toe} + l_{heel} + t_{wall}$ = **5600** mm
Thickness of base	t_{base} = **600** mm
Depth of downstand	d_{ds} = **1000** mm
Position of downstand	l_{ds} = **5000** mm
Thickness of downstand	t_{ds} = **600** mm
Height of retaining wall	$h_{wall} = h_{stem} + t_{base} + d_{ds}$ = **7300** mm
Depth of cover in front of wall	d_{cover} = **500** mm
Depth of unplanned excavation	d_{exc} = **200** mm
Height of ground water behind wall	h_{water} = **0** mm
Height of saturated fill above base	$h_{sat} = \max(h_{water} - t_{base} - d_{ds}, 0\ mm)$ = **0** mm
Density of wall construction	γ_{wall} = **23.6** kN/m³
Density of base construction	γ_{base} = **23.6** kN/m³
Angle of rear face of wall	α = **90.0** deg
Angle of soil surface behind wall	β = **10.0** deg
Effective height at virtual back of wall	$h_{eff} = h_{wall} + l_{heel} \times \tan(\beta)$ = **7300** mm

Retained material details

Mobilisation factor	M = **1.5**
Moist density of retained material	γ_m = **18.0** kN/m³

Saturated density of retained material	γ_s = **21.0** kN/m^3
Design shear strength	ϕ' = **24.2** deg
Angle of wall friction	δ = **18.6** deg

Base material details

Peat (very variable)	
Moist density	γ_{mb} = **18.0** kN/m^3
Design shear strength	ϕ'_b = **24.2** deg
Design base friction	δ_b = **18.6** deg
Allowable bearing pressure	$P_{bearing}$ = **150** kN/m^2

Using Coulomb theory

Active pressure coefficient for retained material

$$K_a = \sin(\alpha + \phi')^2 / (\sin(\alpha)^2 \times \sin(\alpha - \delta) \times [1 + \sqrt{(\sin(\phi' + \delta) \times \sin(\phi' - \beta) / (\sin(\alpha - \delta) \times \sin(\alpha + \beta)))}]^2) = \mathbf{0.434}$$

Passive pressure coefficient for base material

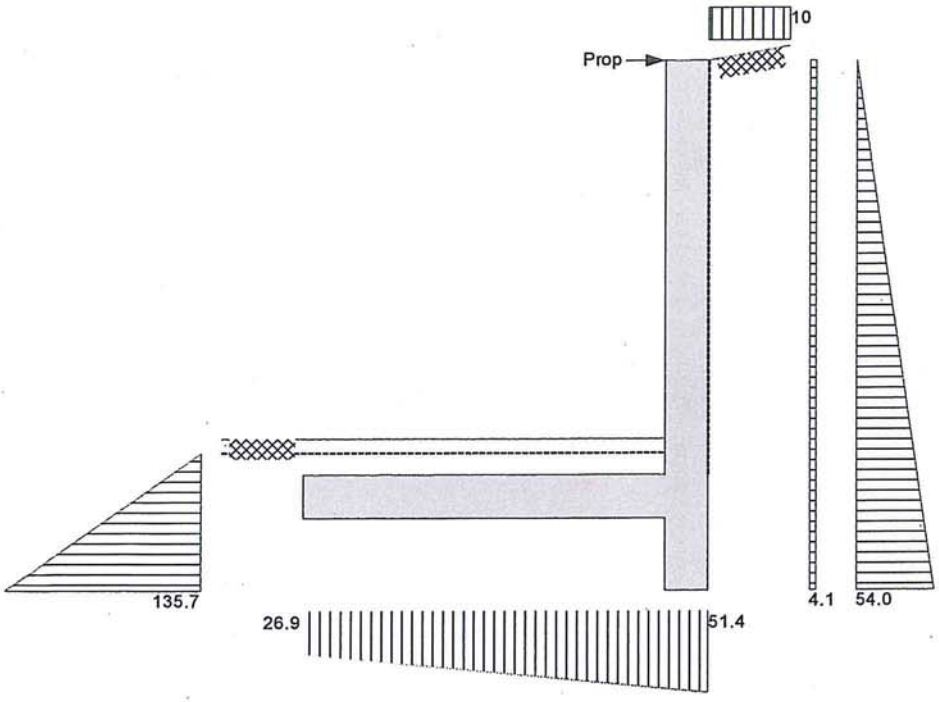
$$K_p = \sin(90 - \phi'_b)^2 / (\sin(90 - \delta_b) \times [1 - \sqrt{(\sin(\phi'_b + \delta_b) \times \sin(\phi'_b) / (\sin(90 + \delta_b)))}]^2) = \mathbf{4.187}$$

At-rest pressure

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

Loading details

Surcharge load on plan	Surcharge = **10.0** kN/m^2
Applied vertical dead load on wall	W_{dead} = **0.0** kN/m
Applied vertical live load on wall	W_{live} = **0.0** kN/m
Position of applied vertical load on wall	l_{load} = **0** mm
Applied horizontal dead load on wall	F_{dead} = **0.0** kN/m
Applied horizontal live load on wall	F_{live} = **0.0** kN/m
Height of applied horizontal load on wall	h_{load} = **0** mm



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

Vertical forces on wall

Wall stem	$w_{wall} = h_{stem} \times t_{wall} \times \gamma_{wall}$ = **80.7** kN/m
Wall base	$w_{base} = l_{base} \times t_{base} \times \gamma_{base}$ = **79.3** kN/m
Wall downstand	$w_{ds} = d_{ds} \times t_{ds} \times \gamma_{base}$ = **14.2** kN/m
Soil in front of wall	$w_p = l_{toe} \times d_{cover} \times \gamma_{mb}$ = **45** kN/m
Total vertical load	$W_{total} = w_{wall} + w_{base} + w_{ds} + w_p$ = **219.2** kN/m

Horizontal forces on wall

Surcharge	$F_{sur} = K_a \times \cos(90 - \alpha + \delta) \times \text{Surcharge} \times h_{eff}$ = **30** kN/m
Moist backfill above water table	$F_{m\_a} = 0.5 \times K_a \times \cos(90 - \alpha + \delta) \times \gamma_m \times (h_{eff} - h_{water})^2$ = **197.2** kN/m
Total horizontal load	$F_{total} = F_{sur} + F_{m\_a}$ = **227.2** kN/m

Calculate propping force

Passive resistance of soil in front of wall	$F_p = 0.5 \times K_p \times \cos(\delta_b) \times (d_{cover} + t_{base} + d_{ds} - d_{exc})^2 \times \gamma_{mb}$ = **128.9** kN/m
Propping force	$F_{prop} = \max(F_{total} - F_p - (W_{total} - w_p) \times \tan(\delta_b), 0$ kN/m)
	F_{prop} = **39.7** kN/m

Overturning moments

Surcharge	$M_{sur} = F_{sur} \times (h_{eff} - 2 \times d_{ds}) / 2$ = **79.5** kNm/m
Moist backfill above water table	$M_{m\_a} = F_{m\_a} \times (h_{eff} + 2 \times h_{water} - 3 \times d_{ds}) / 3$ = **282.6** kNm/m
Soil in front of wall	$M_{p\_o} = F_p \times [2 \times d_{ds} - t_{base} - d_{cover} + d_{exc}] / 3$ = **47.3** kNm/m
Total overturning moment	$M_{ot} = M_{sur} + M_{m\_a} + M_{p\_o}$ = **409.4** kNm/m

Restoring moments

Wall stem	$M_{wall} = w_{wall} \times (l_{toe} + t_{wall} / 2)$ = **427.8** kNm/m
Wall base	$M_{base} = w_{base} \times l_{base} / 2$ = **222** kNm/m
Wall downstand	$M_{ds} = w_{ds} \times (l_{ds} + t_{ds} / 2)$ = **75** kNm/m
Soil in front of wall	$M_{p\_r} = w_p \times l_{toe} / 2$ = **112.5** kNm/m
Total restoring moment	$M_{rest} = M_{wall} + M_{base} + M_{ds} + M_{p\_r}$ = **837.4** kNm/m

Check bearing pressure

Propping force	$M_{prop} = F_{prop} \times (h_{wall} - d_{ds})$ = **249.8** kNm/m
Total moment for bearing	$M_{total} = M_{rest} - M_{ot} + M_{prop}$ = **677.7** kNm/m
Total vertical reaction	$R = W_{total}$ = **219.2** kN/m
Distance to reaction	$x_{bar} = M_{total} / R$ = **3092** mm
Eccentricity of reaction	$e = \text{abs}((l_{base} / 2) - x_{bar})$ = **292** mm
	Reaction acts within middle third of base
Bearing pressure at toe	$p_{toe} = (R / l_{base}) - (6 \times R \times e / l_{base}^2)$ = **26.9** kN/m²
Bearing pressure at heel	$p_{heel} = (R / l_{base}) + (6 \times R \times e / l_{base}^2)$ = **51.4** kN/m²

PASS - Maximum bearing pressure is less than allowable bearing pressure

RETAINING WALL DESIGN (BS 8002:1994)

TEDDS calculation version 1.2.01.06

Ultimate limit state load factors

Dead load factor — γ_{f_d} = **1.4**

Live load factor — γ_{f_l} = **1.6**

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

Factored vertical forces on wall

Wall stem — $w_{wall\_f} = \gamma_{f\_d} \times h_{stem} \times t_{wall} \times \gamma_{wall}$ = **113** kN/m

Wall base — $w_{base\_f} = \gamma_{f\_d} \times l_{base} \times t_{base} \times \gamma_{base}$ = **111** kN/m

Wall downstand — $w_{ds\_f} = \gamma_{f\_d} \times d_{ds} \times t_{ds} \times \gamma_{base}$ = **19.8** kN/m

Soil in front of wall — $w_{p\_f} = \gamma_{f\_d} \times l_{toe} \times d_{cover} \times \gamma_{mb}$ = **63** kN/m

Total vertical load — $W_{total\_f} = w_{wall\_f} + w_{base\_f} + w_{ds\_f} + w_{p\_f}$ = **306.8** kN/m

Factored horizontal at-rest forces on wall

Surcharge — $F_{sur\_f} = \gamma_{f\_l} \times K_0 \times \text{Surcharge} \times h_{eff}$ = **68.9** kN/m

Moist backfill above water table — $F_{m\_a\_f} = \gamma_{f\_e} \times 0.5 \times K_0 \times \gamma_m \times (h_{eff} - h_{water})^2$ = **396.2** kN/m

Total horizontal load — $F_{total\_f} = F_{sur\_f} + F_{m\_a\_f}$ = **465.1** kN/m

Calculate propping force

Passive resistance of soil in front of wall — $F_{p\_f} = \gamma_{f\_e} \times 0.5 \times K_p \times \cos(\delta_b) \times (d_{cover} + t_{base} + d_{ds} - d_{exc})^2 \times \gamma_{mb}$ = **180.5** kN/m

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

F_{prop_f} = **202.6** kN/m

Factored overturning moments

Surcharge — $M_{sur\_f} = F_{sur\_f} \times (h_{eff} - 2 \times d_{ds}) / 2$ = **182.6** kNm/m

Moist backfill above water table — $M_{m\_a\_f} = F_{m\_a\_f} \times (h_{eff} + 2 \times h_{water} - 3 \times d_{ds}) / 3$ = **567.9** kNm/m

Soil in front of wall — $M_{p\_o\_f} = F_{p\_f} \times [2 \times d_{ds} - t_{base} - d_{cover} + d_{exc}] / 3$ = **66.2** kNm/m

Total overturning moment — $M_{ot\_f} = M_{sur\_f} + M_{m\_a\_f} + M_{p\_o\_f}$ = **816.7** kNm/m

Restoring moments

Wall stem — $M_{wall\_f} = w_{wall\_f} \times (l_{toe} + t_{wall} / 2)$ = **598.9** kNm/m

Wall base — $M_{base\_f} = w_{base\_f} \times l_{base} / 2$ = **310.8** kNm/m

Wall downstand — $M_{ds\_f} = w_{ds\_f} \times (l_{ds} + t_{ds} / 2)$ = **105.1** kNm/m

Soil in front of wall — $M_{p\_r\_f} = w_{p\_f} \times l_{toe} / 2$ = **157.5** kNm/m

Total restoring moment — $M_{rest\_f} = M_{wall\_f} + M_{base\_f} + M_{ds\_f} + M_{p\_r\_f}$ = **1172.3** kNm/m

Factored bearing pressure

Propping force — $M_{prop\_f} = F_{prop\_f} \times (h_{wall} - d_{ds})$ = **1276.3** kNm/m

Total moment for bearing — $M_{total\_f} = M_{rest\_f} - M_{ot\_f} + M_{prop\_f}$ = **1631.9** kNm/m

Total vertical reaction — $R_f = W_{total\_f}$ = **306.8** kN/m

Distance to reaction — $x_{bar\_f} = M_{total\_f} / R_f$ = **5318** mm

Eccentricity of reaction — $e_f = \text{abs}((l_{base} / 2) - x_{bar\_f})$ = **2518** mm

Reaction acts outside middle third of base

Bearing pressure at toe — p_{toe_f} = 0 kN/m² = **0** kN/m²

Bearing pressure at heel — $p_{heel\_f} = R_f / (1.5 \times (l_{base} - x_{bar\_f}))$ = **726.5** kN/m²

Rate of change of base reaction — rate = $- p_{heel\_f} / (3 \times (l_{base} - x_{bar\_f}))$ = **-860.15** kN/m²/m

Bearing pressure at stem / toe — $p_{stem\_toe\_f} = \max(p_{heel\_f} + (\text{rate} \times (l_{heel} + t_{wall})), 0 \text{ kN/m}^2)$ = **210.4** kN/m²

Bearing pressure at mid stem — $p_{stem\_mid\_f} = \max(p_{heel\_f} + (\text{rate} \times (l_{heel} + t_{wall} / 2)), 0 \text{ kN/m}^2)$ = **468.5** kN/m²

Check downstand in bending

Width of downstand	b = **1000** mm/m
Depth of reinforcement	$d_{down} = t_{ds} - c_{ds} - (\phi_{down} / 2)$ = **557.5** mm
Constant	$K_{down} = M_{down} / (b \times d_{down}^2 \times f_{cu})$ = **0.011**
	Compression reinforcement is not required
Lever arm	$z_{down} = \text{Min}(0.5 + \sqrt{(0.25 - (\text{min}(K_{down}, 0.225) / 0.9))}, 0.95) \times d_{down}$
	z_{down} = **530** mm
Area of tension reinforcement required	$A_{s\_down\_des} = M_{down} / (0.87 \times f_y \times z_{down})$ = **592** mm²/m
Minimum area of tension reinforcement	$A_{s\_down\_min} = k \times b \times t_{ds}$ = **780** mm²/m
Area of tension reinforcement required	$A_{s\_down\_req} = \text{Max}(A_{s\_down\_des}, A_{s\_down\_min})$ = **780** mm²/m
Reinforcement provided	**25 mm dia.bars @ 150 mm centres**
Area of reinforcement provided	$A_{s\_down\_prov}$ = **3272** mm²/m
	PASS - Reinforcement provided at the retaining wall downstand is adequate

Check shear resistance at downstand

Design shear stress	$v_{down} = V_{down} / (b \times d_{down})$ = **0.287** N/mm²
Allowable shear stress	$v_{adm} = \text{min}(0.8 \times \sqrt{(f_{cu} / 1\ \text{N/mm}^2)}, 5) \times 1\ \text{N/mm}^2$ = **5.000** N/mm²
	PASS - Design shear stress is less than maximum shear stress

From BS8110:Part 1:1997 – Table 3.8

Design concrete shear stress	v_{c_down} = **0.619** N/mm²
	$v_{down} < v_{c\_down}$ ***- No shear reinforcement required***

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

Material properties

Characteristic strength of concrete	f_{cu} = **40** N/mm²
Characteristic strength of reinforcement	f_y = **500** N/mm²

Wall details

Minimum area of reinforcement	k = **0.13** %
Cover to reinforcement in stem	c_{stem} = **30** mm
Cover to reinforcement in wall	c_{wall} = **30** mm

Factored horizontal at-rest forces on stem

Surcharge	$F_{s\_sur\_f} = \gamma_{f\_l} \times K_0 \times \text{Surcharge} \times (h_{eff} - t_{base} - d_{ds})$ = **53.8** kN/m
Moist backfill above water table	$F_{s\_m\_a\_f} = 0.5 \times \gamma_{f\_e} \times K_0 \times \gamma_m \times (h_{eff} - t_{base} - d_{ds} - h_{sat})^2$ = **241.6** kN/m

Calculate shear for stem design

Surcharge	$V_{s\_sur\_f} = 5 \times F_{s\_sur\_f} / 8$ = **33.6** kN/m
Moist backfill above water table	$V_{s\_m\_a\_f} = F_{s\_m\_a\_f} \times b_l \times ((5 \times L^2) - b_l^2) / (5 \times L^3)$ = **188.1** kN/m
Total shear for stem design	$V_{stem} = V_{s\_sur\_f} + V_{s\_m\_a\_f}$ = **221.7** kN/m

Calculate moment for stem design

Surcharge	$M_{s\_sur} = F_{s\_sur\_f} \times L / 8$ = **40.4** kNm/m
Moist backfill above water table	$M_{s\_m\_a} = F_{s\_m\_a\_f} \times b_l \times ((5 \times L^2) - (3 \times b_l^2)) / (15 \times L^2)$ = **210.4** kNm/m
Total moment for stem design	$M_{stem} = M_{s\_sur} + M_{s\_m\_a}$ = **250.8** kNm/m

Calculate moment for wall design

Surcharge	$M_{w\_sur} = 9 \times F_{s\_sur\_f} \times L / 128$ = **22.7** kNm/m
Moist backfill above water table	$M_{w\_m\_a} = F_{s\_m\_a\_f} \times 0.577 \times b_l \times [(b_l^3 + 5 \times a_l \times L^2) / (5 \times L^3) - 0.577^2 / 3]$ = **87.8** kNm/m

Check retaining wall deflection

Basic span/effective depth ratio $ratio_{bas} = \mathbf{20}$

Design service stress $f_s = 2 \times f_y \times A_{s\_stem\_req} / (3 \times A_{s\_stem\_prov}) = \mathbf{110.9}$ N/mm²

Modification factor $factor_{tens} = \min(0.55 + (477\ N/mm^2 - f_s)/(120 \times (0.9\ N/mm^2 + (M_{stem}/(b \times d_{stem}^2)))),2) = \mathbf{2.00}$

Maximum span/effective depth ratio $ratio_{max} = ratio_{bas} \times factor_{tens} = \mathbf{40.00}$

Actual span/effective depth ratio $ratio_{act} = h_{stem} / d_{stem} = \mathbf{10.22}$

PASS - Span to depth ratio is acceptable

CALCULATION SHEET

create CONSULTING ENGINEERS LTD

Project: 51. CALTHORPE ST LONDON.	Sheet no. of	Job No: P12-351.
	Calc. no: P/C4.	Checked by: y.
Subject: CLASSIFICATION OF VISIBLE DAMAGE TO WALLS, GROUND MOVEMENT CALCULATIONS	Made by: PMO	Date: AUG 16
	Date: 9/08/16	

FRONT ELEVATION - ADJACENT BUILDING - WORSE-CASE

H = d = 5.7m — SECTION.
D ≃ 2m

1.5d = 8.55m
2d = 11.4m
FROM ANALYSIS - δ = 10-15mm

IF δ = 10mm
∴ δ/2 = 5mm VERT. DISP

FOR LONG ELEVATION

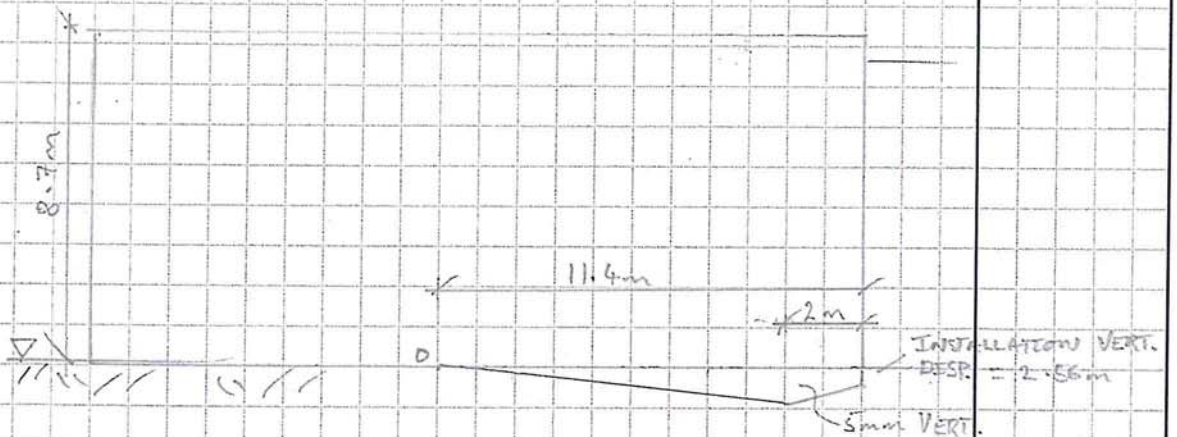


FIG 2.18 $\frac{\Delta}{L} = \frac{5mm}{11400mm} = 0.044\%$

HORIZONTAL MOVEMENT DUE TO LONG-TERM DISPLACEMENTS AT GROUND = NEG. DUE TO DIAPHRAGM SLAB

CALCULATION SHEET

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Project: 51, CALTHORPE ST LONDON.	Sheet no. of	Job No: P12-385
	Calc. no: A15	Checked by:
Subject: CLASSIFICATION OF VISIBLE DAMAGE TO WALLS. GROUND MOVEMENT CALCULATIONS.	Made by: PMO	Date: AUG '16
	Date: 08/16	

TABLE 2.2

HORIZONTAL MOVEMENTS DUE TO CONSTRUCTION
= 0.08% - SECANT PILE WALL
= 4.56mm

$\therefore \delta_h = \frac{4.56}{11400} = 0.04\%$

FIG 2.12

$\frac{L}{H} = \frac{11400}{8700} = 1.3$

TABLE 2.5

FOR VERY SLIGHT DAMAGE: $\varepsilon_{lim} = 0.075\%$

$\frac{A}{L} = \frac{0.044}{0.075} = 0.59$

$\frac{\varepsilon_h}{\varepsilon_{lim}} = \frac{0.04}{0.075} = 0.53$

FIG 2.18(b)

USING GRAPH → 0.53 Vs 0.5% IS JUST OUTSIDE BOUNDS OF $\frac{L}{H} = 1.3$

$\therefore$ DAMAGE PREDICTED TO BE WITHIN SLIGHT CATEGORY

CALCULATION SHEET

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Project: 51, CALTHORPE ST LONDON	Sheet no. of	Job No: P12-335
	Calc. no: P16	Checked by:
Subject: CLASSIFICATION OF VISIBLE DAMAGE TO WALLS. GROUND MOVEMENT CALCS	Made by: PMO	Date: AUG '16
	Date: 08/16	

EXTRACTS FROM CIRIA C580 GUIDE P60.

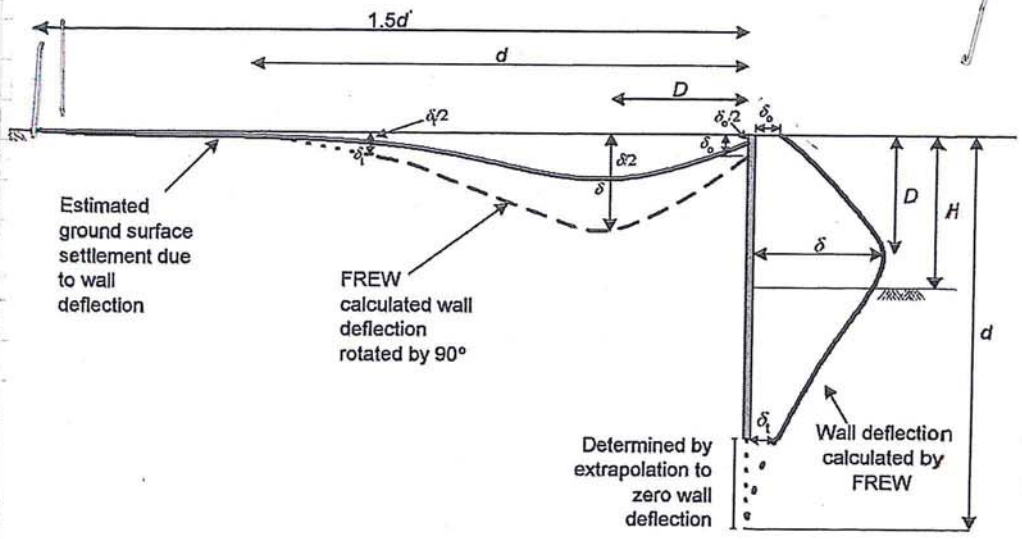
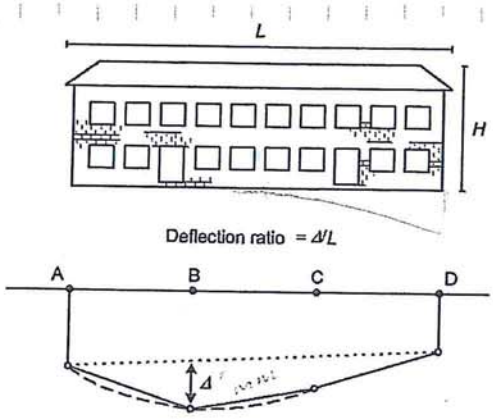
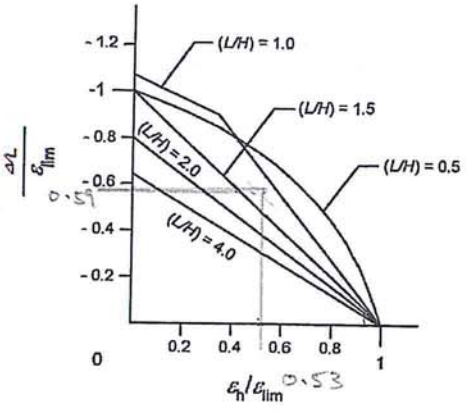


Figure 2.16 *Relationship between analysed lateral (propped) wall deflections and predicted ground surface settlements in stiff soil*

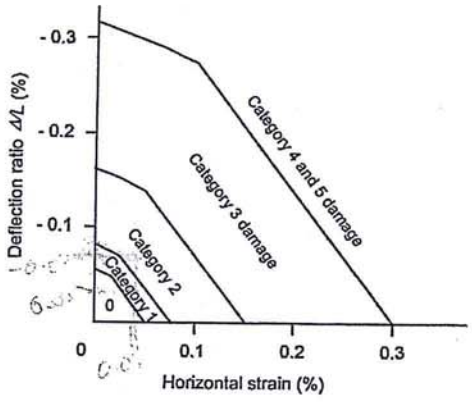
P61



(a) Definition of deflection ratio.



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



(c) Relationship between damage category and deflection ratio and horizontal tensile strain for hogging for (L/H) = 1.0 (after Burland, 2001)

FIGURE 2.18

CALCULATION SHEET

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Project: 51 CALTHORPE ST. LONDON BIA	Sheet no. of	Job No: P12-385
	Calc. no: P1.7	Checked by:
Subject: CLASSIFICATION OF VISIBLE DAMAGE ↳ HOLIDAY INN. GROUND MOVEMENT CALCS	Made by: PMO	Date: AUG. '16
	Date: 9/08/16	

ASSESSMENT OF POTENTIAL MOVEMENT AND CONSEQUENCES TO HOLIDAY INN

HOLIDAY INN ALSO HAS A BASEMENT WITH SIM. DEPTH AS WHAT IS PROPOSED TO 51 CALTHORPE ST.

∴ HOLIDAY INN MAY BE AFFECTED BY MOVEMENT DURING INSTALLATION OF SECANT PILES BUT NOT OF ANY LONG-TERM GROUND MOVEMENTS.

INSTALLATION MOVEMENTS

TABLE 2.2

HORIZ MOVEMENTS
↳ SECANT PILES - 0.05% = 4.56mm - N/A - ✓
DIST. TO MAX. MOVEMENT - N/A - METHODOLOGY ✓

VERT. MOVEMENT
0.05 % = 2.85mm

HOLIDAY INN
BUILDING: SIM L & B = 9 x 3 = 27m TALL

∴ $\frac{L}{H} = 1.9 \cong 2$

$\frac{\Delta}{L} = \frac{2.85}{51000} = 0.006\%$

↳ WELL BELOW 'VERY SLIGHT' CRITERIA

∴ **NEGLIGIBLE EXPECTED EFFECT ON HOLIDAY INN**

CALCULATION SHEET

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Project: 51 CALTHORPE ST. LONDON WC1A	Sheet no. of	Job No: 20-385
	Calc. no: P18.	Checked by: J.
Subject: CLASSIFICATION OF VISIBLE DAMAGE ↳ ROAD. GROUND MOVEMENT CALCULATIONS	Made by: AMO	Date: AUG 16
	Date: 9/08/16	

POTENTIAL MOVEMENT EFFECTS TO HIGHWAY

MIN. DISTANCE TO ROAD = AT S/E CORNER
= ~5m

FROM PREVIOUS PAGES:

DIST. TO NEG. MOVEMENT = 11.4m
DIST. TO MAX. MOVEMENT ≈ 2m = 5mm VERT
EXTRAPOLATING FOR 5m =

$$5 - \left[\frac{5}{(11.4-2)}\right] \times 3 = 3.4\text{mm}$$ VERT. DISP AT EDGE OF ROAD.

HORIZONTAL
- ONLY INSTALLATION MOVEMENTS DUE TO TOP-DOWN CONSTRUCTION:
= 4.56mm AT PILES

TABLE 2.2 DISTANCE TO NEG. MOVEMENT = 1.5 × 5.7 = 8.55.

∴ AT 5m, HORIZ. MOVEMENT =

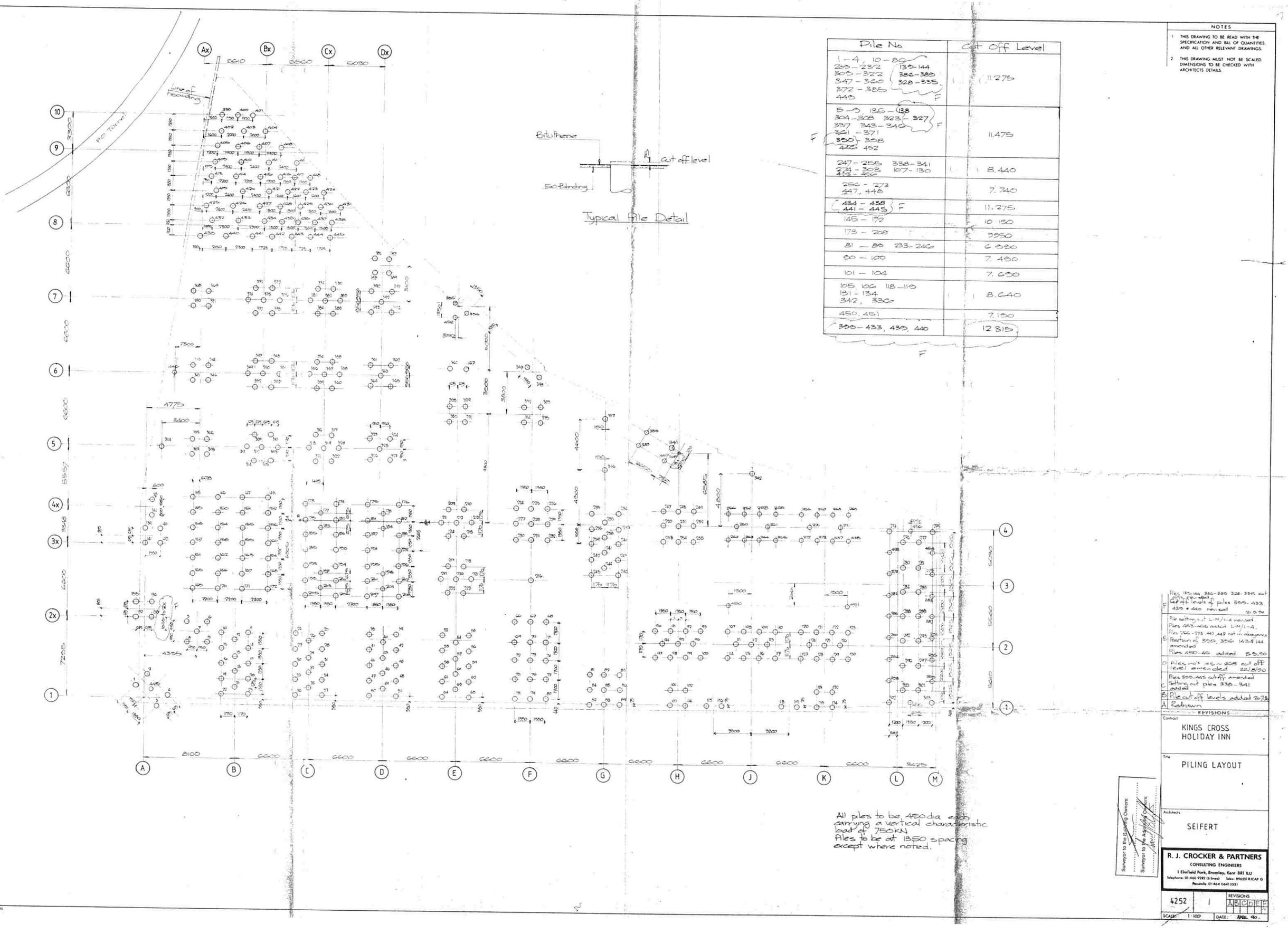
$$4.56 - \left[\frac{4.56}{8.55}\right] \times 5 = 1.9\text{ mm}$$

∴ PREDICTED SURFACE MOVEMENTS AT CLOSEST PART OF ROAD = 3.4mm VERT.
1.9 mm HORIZ.

CARRIAGEWAY AT GRADE, THESE VALUES OF MOVEMENT ARE WELL WITHIN WHAT CAN BE TOLERATED FOR A ROADWAY.

NEGLIGABLE EXPECTED EFFECT ON ROAD

APPENDIX Q



Typical Pile Detail

Pile No.	Cut Off Level
1 – 4, 10 – 80, 265 – 282, 303 – 322, 347 – 360, 372 – 385, 445 (135–144, 386–388, 328–335) F	11.275
5 – 9, 135 – 138, 304 – 308, 323 – 327, 337, 343 – 346, 361 – 371, 389 – 398, 446 – 452 F	11.475
247 – 255, 338 – 341, 274 – 303, 107 – 130, 453 – 456	8.440
256 – 273, 447, 448	7.740
434 – 438, 441 – 445 F	11.275
145 – 172	10.150
173 – 208	9.950
81 – 88, 233 – 246	6.890
90 – 100	7.490
101 – 104	7.690
105, 106, 118 – 119, 131 – 134, 342, 336	8.640
450, 451	7.150
399 – 433, 439, 440	12.315

F

NOTES

1 THIS DRAWING TO BE READ WITH THE SPECIFICATION AND BILL OF QUANTITIES AND ALL OTHER RELEVANT DRAWINGS.

2 THIS DRAWING MUST NOT BE SCALED. DIMENSIONS TO BE CHECKED WITH ARCHITECTS DETAILS.

All piles to be 450 dia each carrying a vertical characteristic load of 750KN
Piles to be at 1350 spacing except where noted.

Surveyor to this Building Owners:

Surveyor to the Adjoining Owners:

F	Piles 135-144, 386-388, 328-335 cut off level amended Cut off levels of piles 399-433, 439 & 440 revised 2.5.90
E	Pile setting out L-M/1-4 revised. Piles 453-456 added L-M/1-4. Piles 256-273, 447, 449 not in sequence. Position of 399, 336, 143 & 144 amended. Piles 450-452 added 5.5.90
D	Piles no's 145 to 208 cut off level amended 22.3.90
C	Piles 399-445 cut off amended Setting out piles 336-341 added
B	Pile cut off levels added 20.2.90
A	Redrawn

REVISIONS

Contract: KINGS CROSS HOLIDAY INN

Title: PILING LAYOUT

Architects: SEIFERT

R. J. CROCKER & PARTNERS
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4252 | 1 | REVISIONS A B C D E F

SCALE: 1:100 | DATE: APRIL 90.

GEOPRINT 1695