ENGINEER'S REPORT

For

Proposed Rear Basement

At:

23 Healey Street
London
NW1 8SR

Date: October 2017
Ref: 3356

CONTENTS

1.0 INTRODUCTION

This report has been prepared to confirm the extent and nature of structural engineering works necessary for the proposed rear basement extension and associated alterations to the existing domestic dwelling at 23 Healey Street London NW1 8SR.

This report should be read in conjunction with all relevant drawings showing details of the proposed scheme.

The proposed subterranean development comprises construction of a small rear basement at the rear of the main house to create a utility and gym area. The basement works will form part of a proposed rear superstructure extension as indicated on the drgs attached.

2.0 EXISTING PROPERTY

The existing property consists of a terraced three-storey house with a butterfly main roof construction estimated to be early 1900's construction.

Layout of existing building is shown on Drgs no's A1/3356/ 01-02 attached.

External and party walls to the property are generally 9-inch and 13-inch solid brickwork, internal partitions are generally brickwork or studwalls and the upper floors are of timber construction.

Main roof construction is of a butterfly type design formed of cut timber rafters and purlins with a slate finish.

3.0 THE PROPOSALS (refer to Addendum Appendices for details)

The proposals for the development of this property comprise the following:

- Construction of a small rear basement extension with rear ground and first floor extensions above. Internal alterations are also proposed and the full refurbishment of the house to fully upgrade the living accommodation.

Refer to proposed Drgs no's A1/3356/ 03-04 attached.

4.0 SITE GROUND CONDITIONS

Site investigations have been undertaken to determine the nature of the sub soils at the site together with a desk top study of record borehole logs in the close proximity. Trial holes have also been excavated to confirm the profile and depth of the existing foundations at the partywall junctions and on the rear wall where basement construction is proposed, details of which are indicated on the Trial Pit Logs attached.

These investigations have confirmed that the sub soil comprises of a well compacted fill material to a depth of approximately 1.23 metres below main ground floor level with London Clay below this level (refer to Trial Pit 1 investigation log attached).

The historical borehole logs attached, indicate similar sub soil conditions which indicate the clay layer extending to a depth in excess of 20 metres

No ground water was encountered within the excavations.

Based on this information it is proposed to design the new section of lower ground floor area in reinforced concrete, constructed in underpinning sections to remove any risk of damage to the adjacent house structures. It is proposed to utilise waterproof concrete in the construction and install an internal tanking system within the basement to prevent any potential damp issues that may arise. This system will be designed and installed by a reputable contractor who has experience of this work and include a 20 year insurance backed guarantee for the works

5.0 STRUCTURAL PROPOSALS

The rear basement extension will be formed as detailed above with existing partywalls and existing main rear wall of the house being underpinned as detailed on the attached structural Drg A1/3356/PW01.

Temporary supports will be required to the face of the excavated soils during the excavation of the proposed basement in the form of steel trench sheets which will require to be propped back to the existing solid ground using suitable horizontal / raking steel props and bracing accordingly.

The reinforced concrete base slab foundation can then be cast with a raised toe around the perimeter and the reinforced concrete walling cast directly against the excavated face of the soil with temporary propping either cast in with the wall or gradually removed as the concrete is poured to suit the particular site access conditions. Shuttering for the walling will be erected, propped and maintained to suit the curing of the poured concrete wall

Once the new retaining wall has been constructed and allowed to cure the props and shuttering can be removed and the ground level slab constructed over to restrain the top of the new walls.

Refer to temporary support sequence indicated on Drg No A1/3356/PW02 attached.

Waterproofing to the new basement structure will comprise of a drained cavity system in conjunction with suitable drainage sump as specified by the tanking specialist and as detailed on the drawings.

The structural design calculations for the proposed base and walls are attached for information purposes (refer to appendices).

All works will be designed in accordance with the latest British Standards, Codes of Practice and the Building Regulations.

6.0 Geotechnical Assessment for Ground Movement

Based on the limited depth of the proposed basement, presence of firm clay subsoils together with the sequenced nature of the construction in bays not exceeding 1.2 meters, previous experience suggests there will be very little ground movement in response to the proposed basement extension and any damage to the neighbouring property will be in the negligible to very slight category.

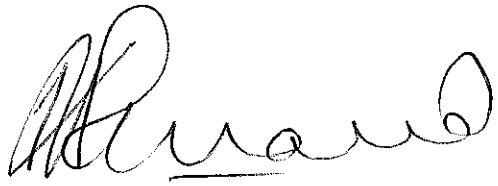
7.0 Flood Risk Assessment

The property is located within the Flood Risk Zone 1, as defined by the Environment agency which does not require a floor risk assessment for planning purposes.

See Flood risk table extract below:

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)

The design of the basement will include for any potential ground water up to within 1 meter of the ground level and as no ground water was encountered during the site investigations or noted on the historical borehole logs then it is unlikely that this situation will arise.



K P RENAUD BSc(Hons), MSc, MICE, C.Eng. MIHT

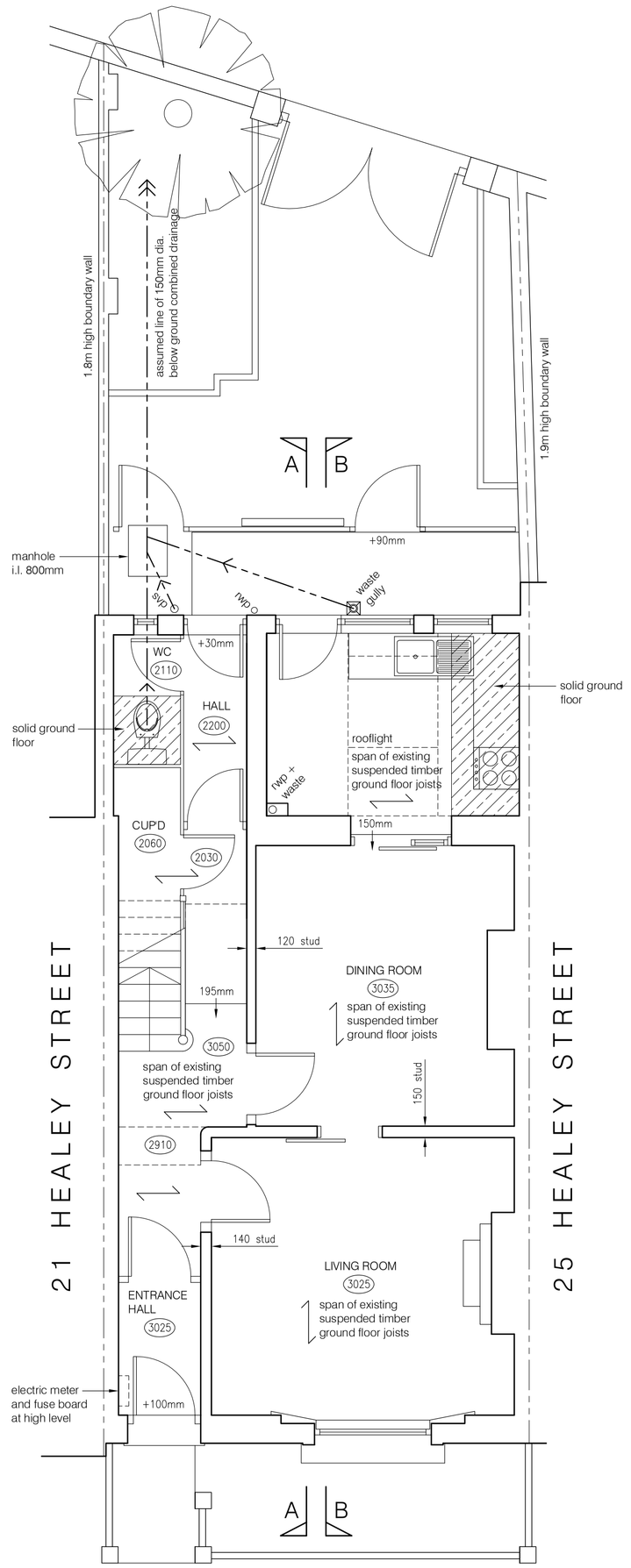
DATE: October 2017

8.0 APPENDICES

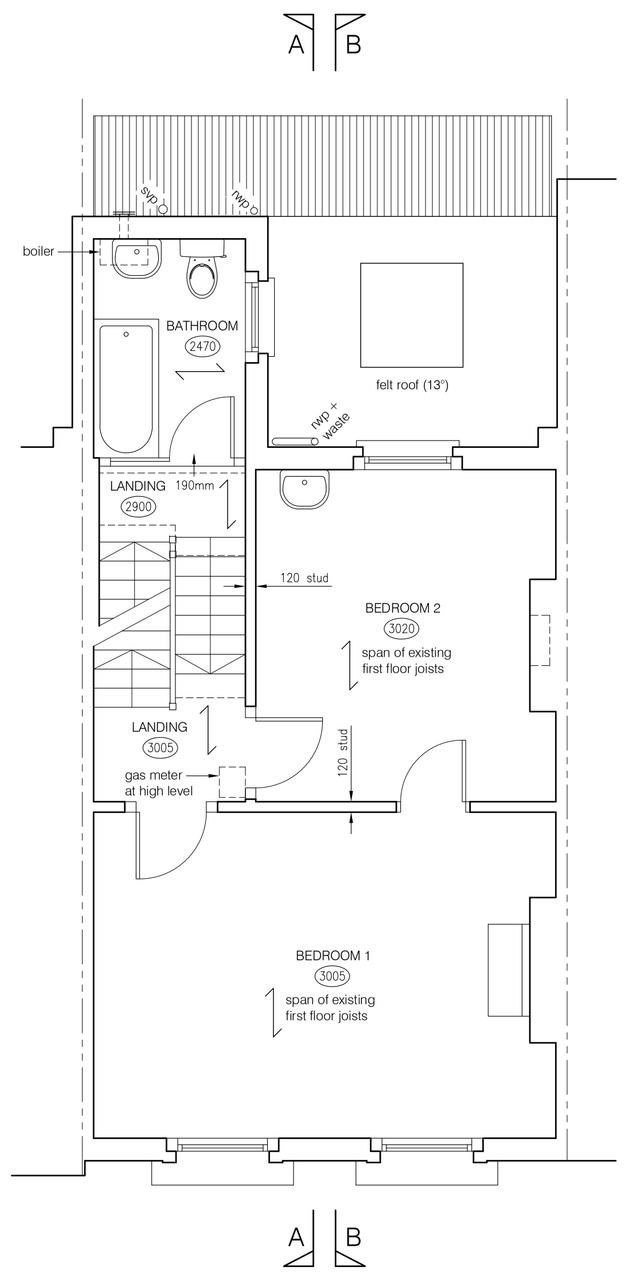
- PCDS Ltd.'s Existing and Proposed plans and sections Drg No's A1/3356/01-04.
- Trial Pit Logs 1-3 and location plan
- Historical Borehole Logs
- PCDS Ltd.'s Proposed basement plans sections and temporary works details Drg No's A1/3356/PW 01-02.
- Supporting Structural Calculations

APPENDIX

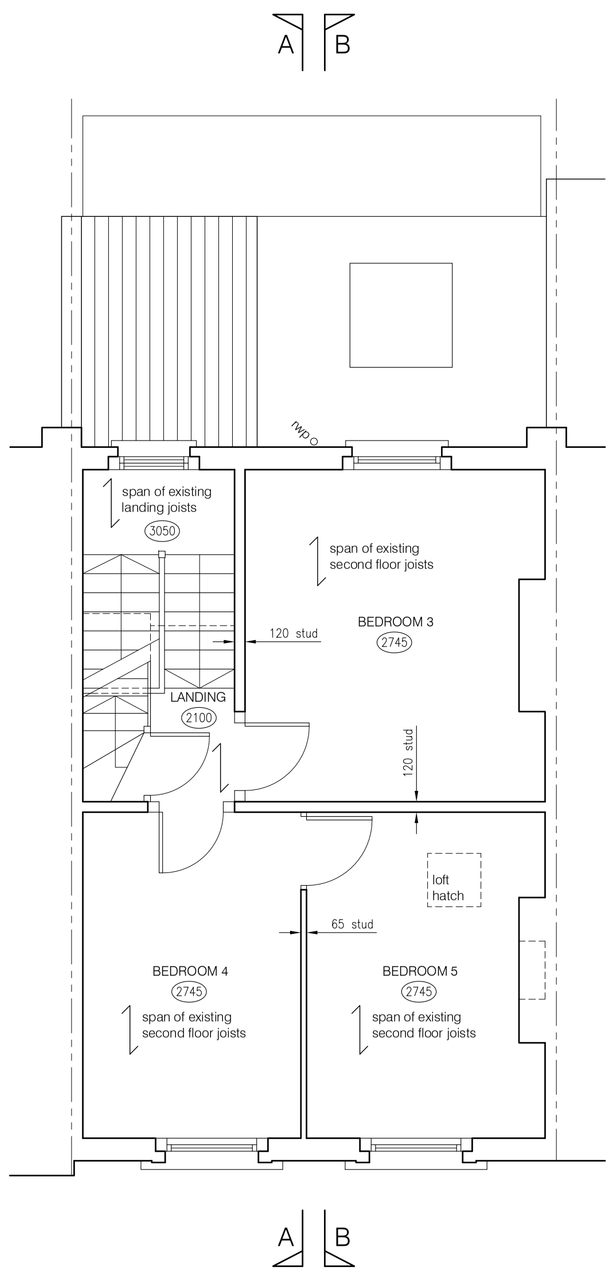
- **PCDS Ltd.'s Existing and Proposed plans and sections Drg No's A1/3356/01-04.**



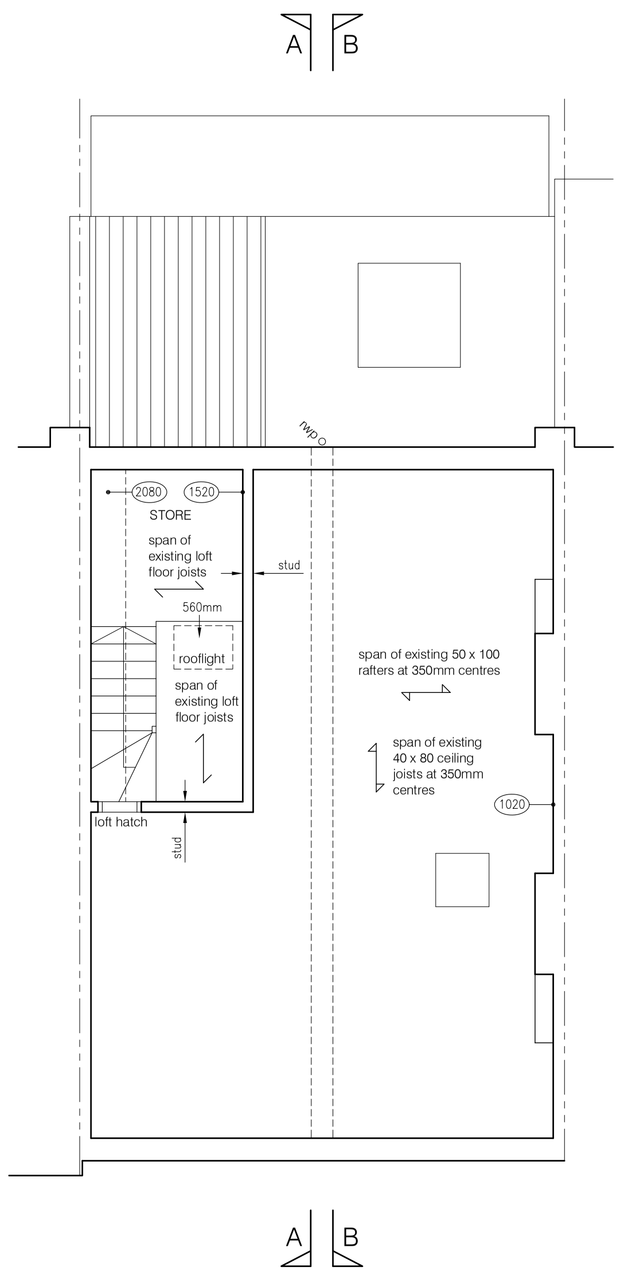
GROUND FLOOR PLAN
SCALE 1:50



FIRST FLOOR PLAN
SCALE 1:50



SECOND FLOOR PLAN
SCALE 1:50



LOFT PLAN
SCALE 1:50

1:50
0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5
(metres)

NOTES:

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Rev.	Date	Revisions

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Unit 2, The Mead Business Centre
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IStructE

Client
JOHANNA QUINN

Job Title
23 HEALEY STREET
LONDON
NW1 8SR

Drawing Title
DETAILS OF EXISTING
FLOOR PLANS

Scale 1:50 @ A1

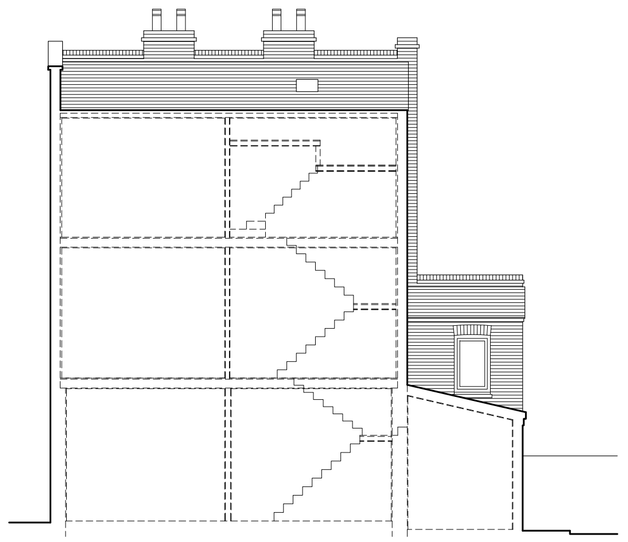
Date JUNE 17 | Drawn G.J.

Drawing No. A1/3356/01 | Rev.

Plot Date: 28 SEPTEMBER 2017

FRONT ELEVATION
SCALE 1:100

REAR ELEVATION
SCALE 1:100



SECTION A - A
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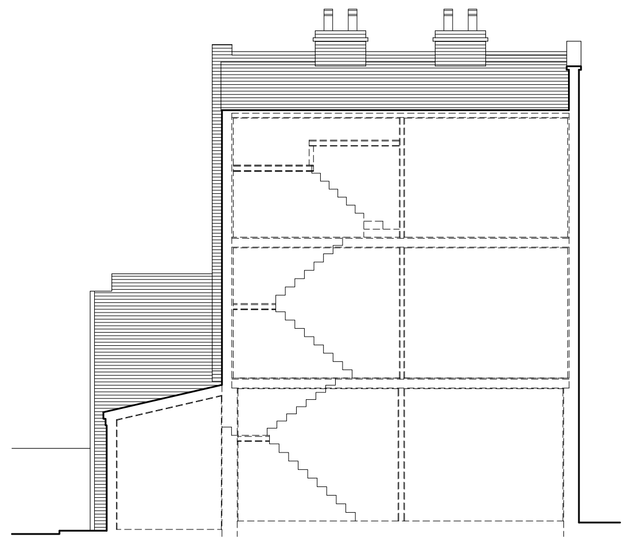

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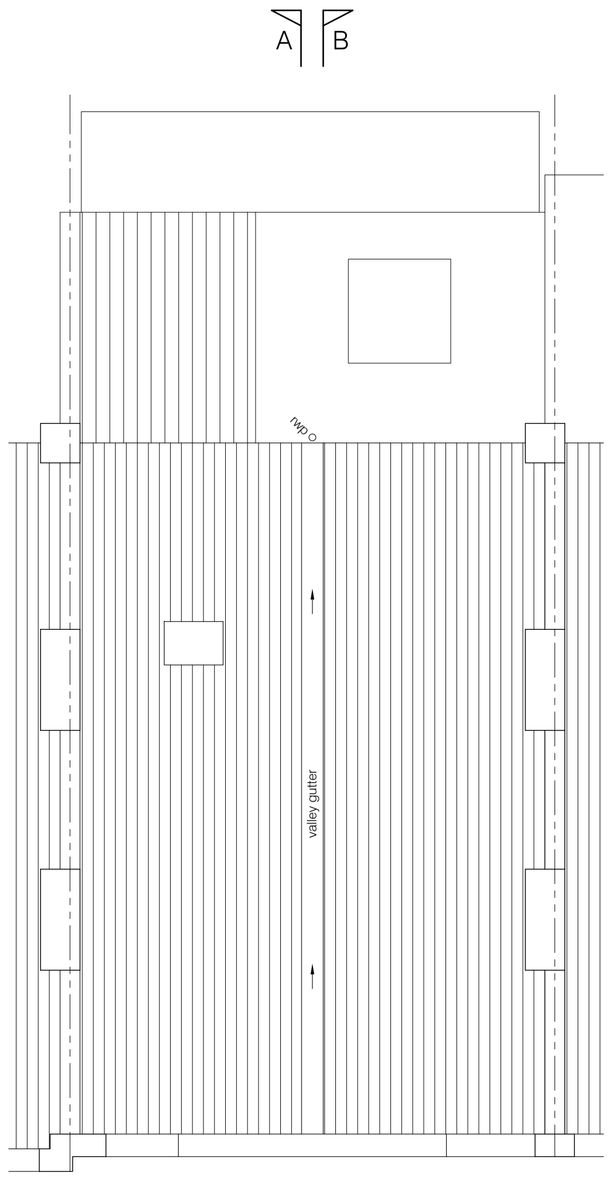

ROOF PLAN
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(metres)

1:100
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(metres)

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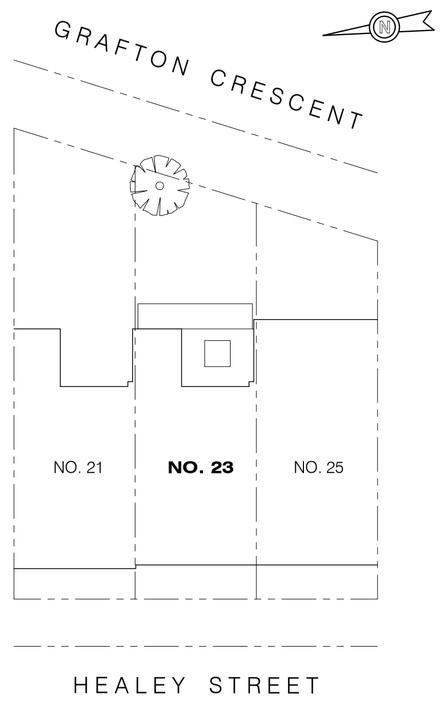
(metres)



SITE PLAN
SCALE 1:200

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Client
JOHANNA QUINN

Job Title
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NW1 8SR

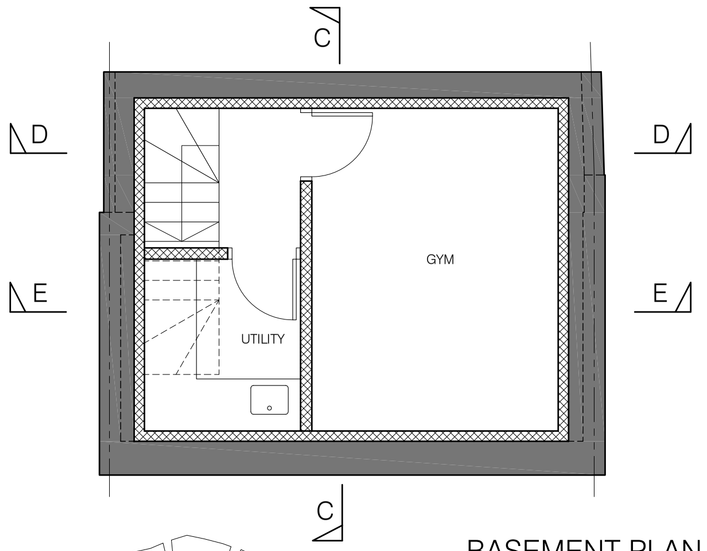
Drawing Title
DETAILS OF EXISTING
ELEVATIONS, SITE PLAN
AND ROOF PLAN

Scale 1:200, 1:100, 1:50 @ A1

Date JUNE 17 | Drawn G.J.

Drawing No. A1/3356/02 | Rev.

Plot Date: 28 SEPTEMBER 2017



BASEMENT PLAN
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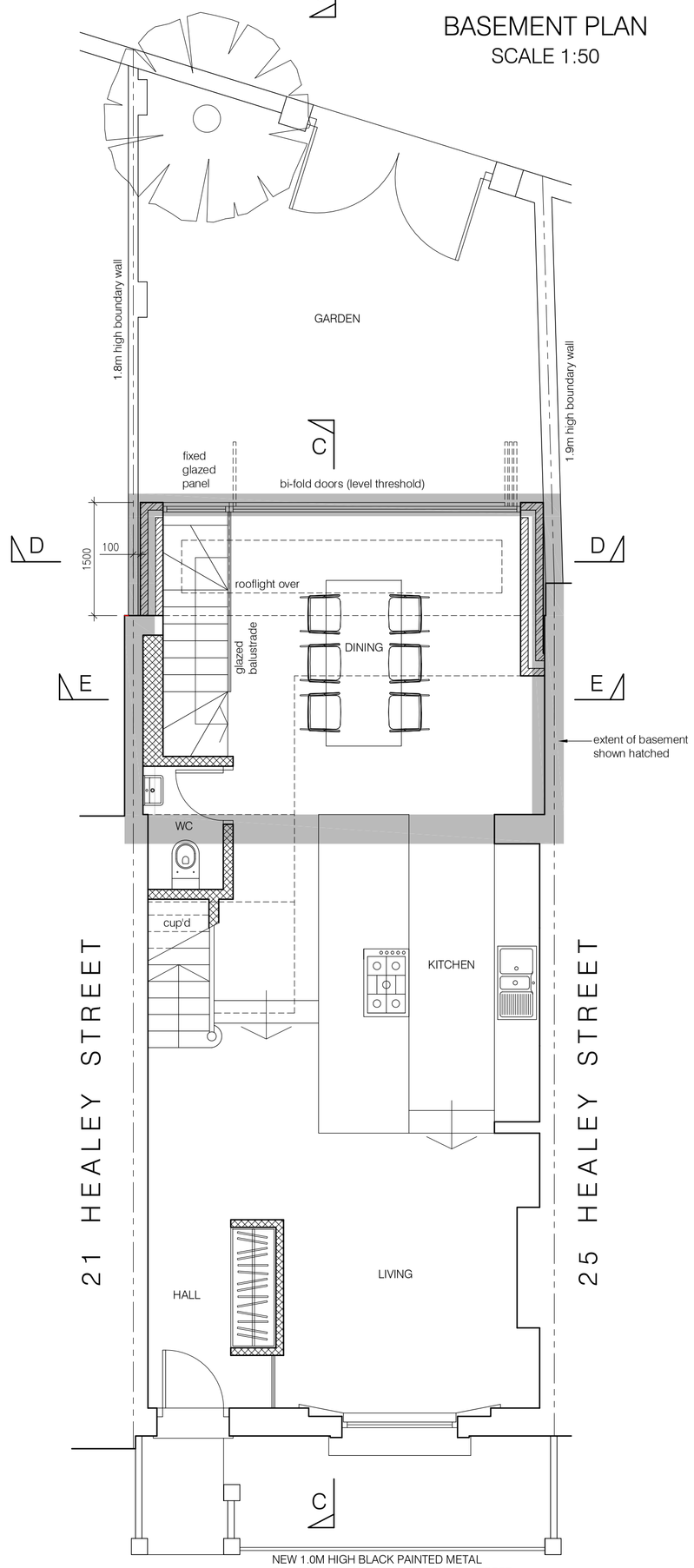

GROUND FLOOR PLAN
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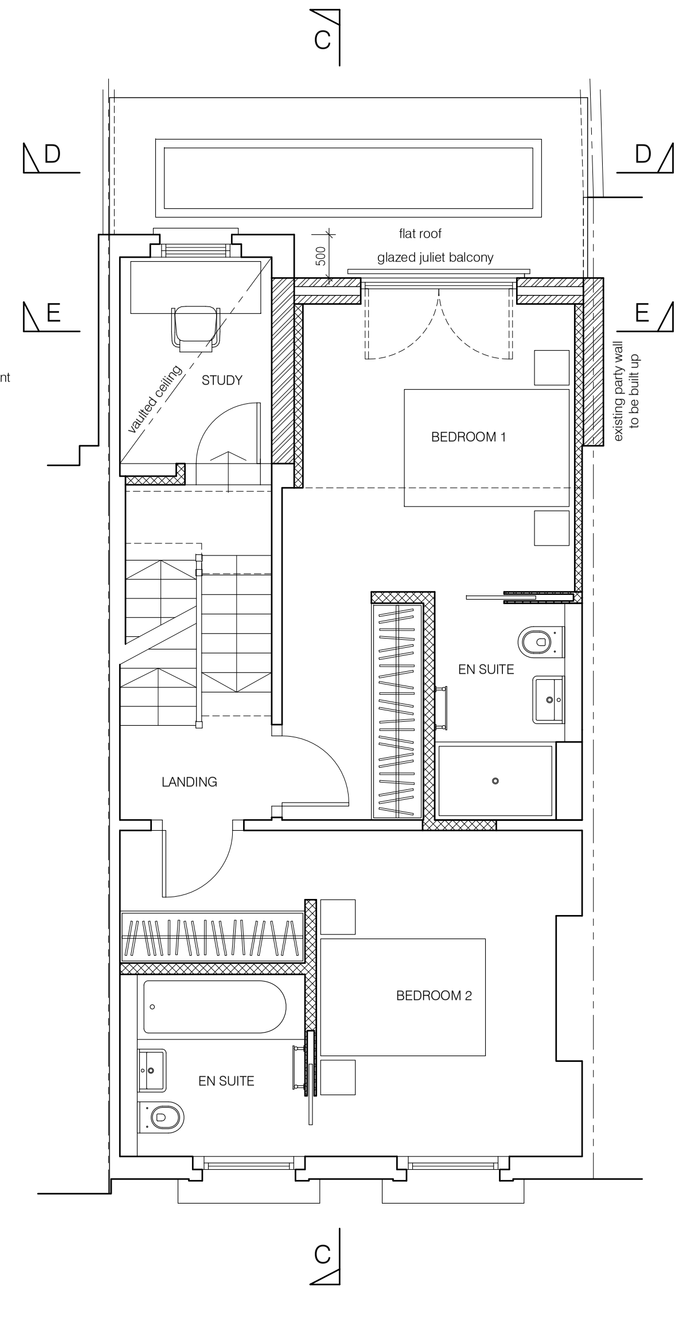

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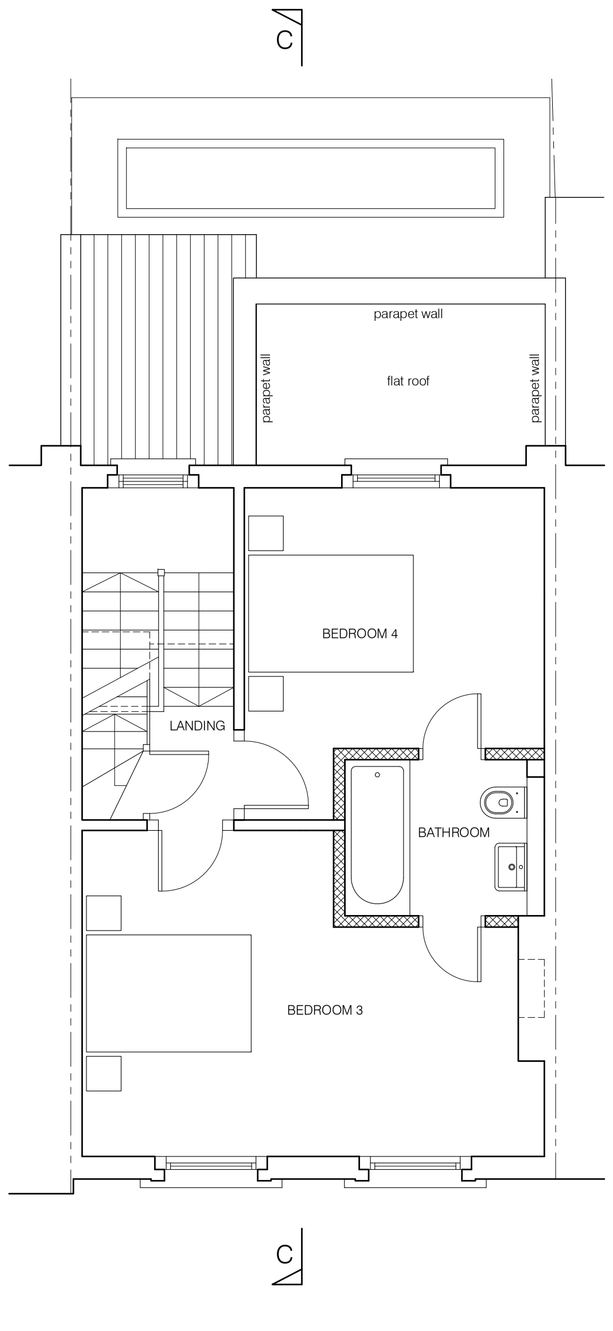
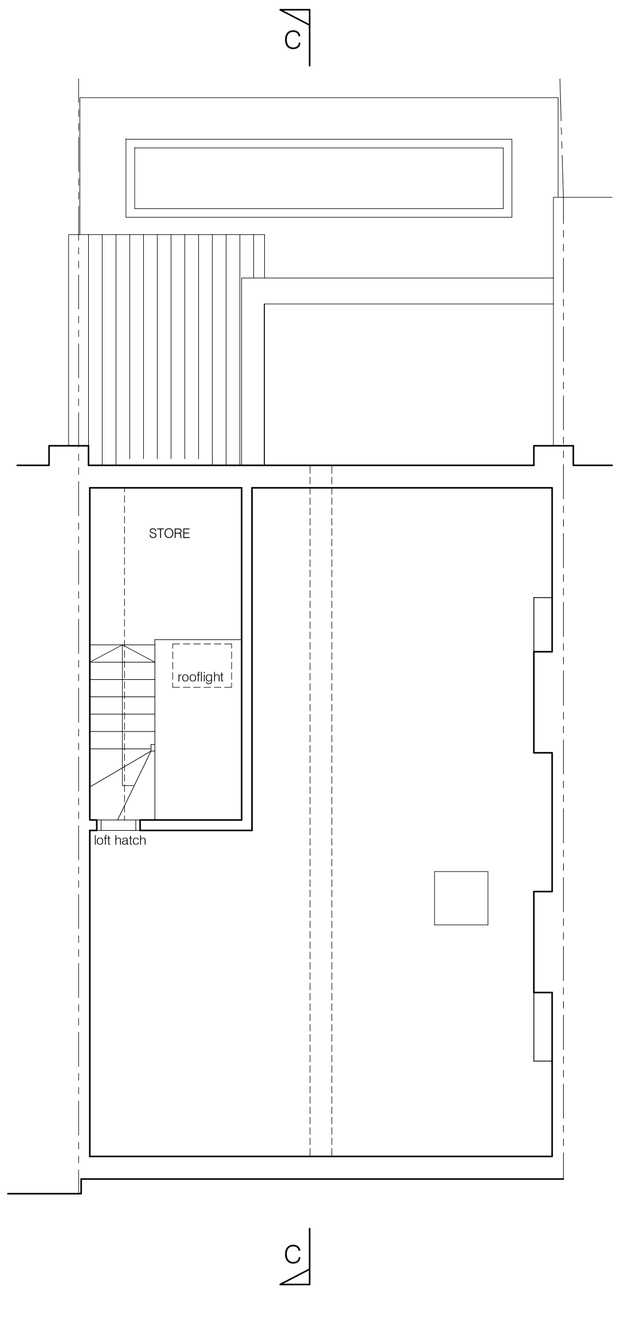


SECOND FLOOR PLAN
SCALE 1:50



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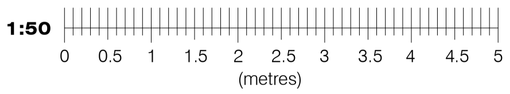

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Drawing Title
PROPOSED TWO STOREY REAR EXTENSION

FLOOR PLANS

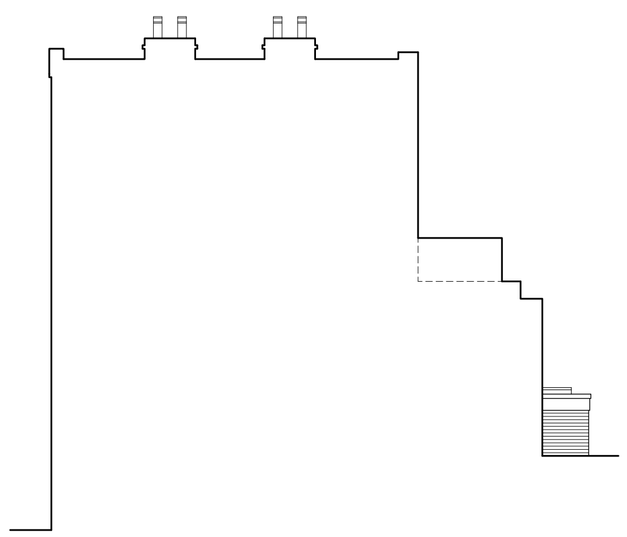
Scale 1:50 @ A1

Date JUNE 17 | Drawn G.J.

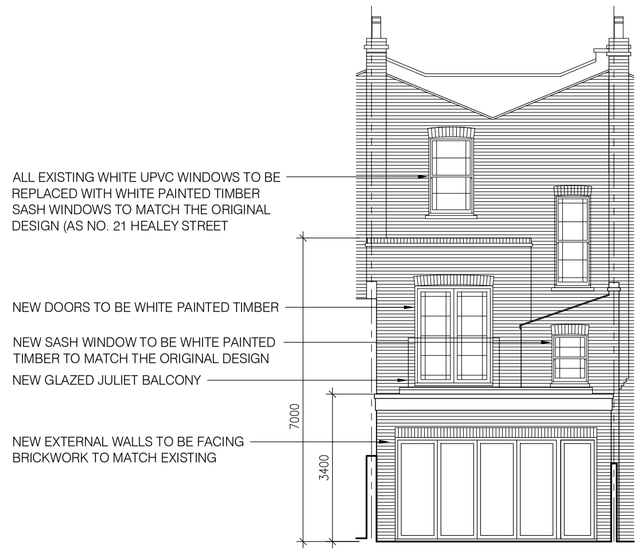
Drawing No. A1/3356/03 | Rev. A

Plot Date: 2 OCTOBER 2017

FRONT ELEVATION
SCALE 1:100



SIDE ELEVATION
SCALE 1:100



REAR ELEVATION
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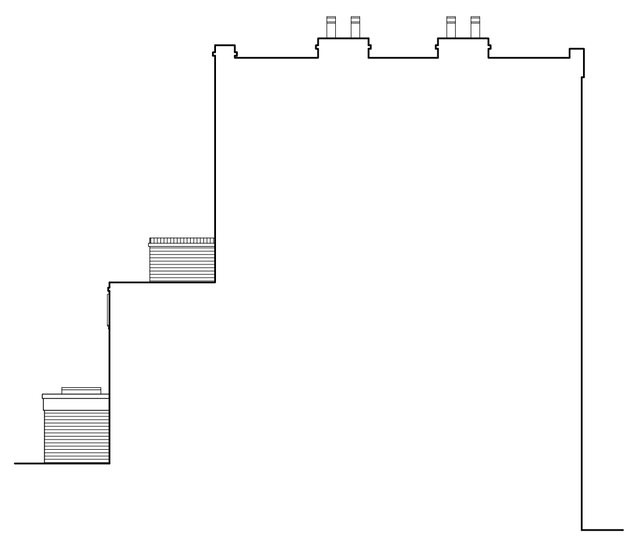
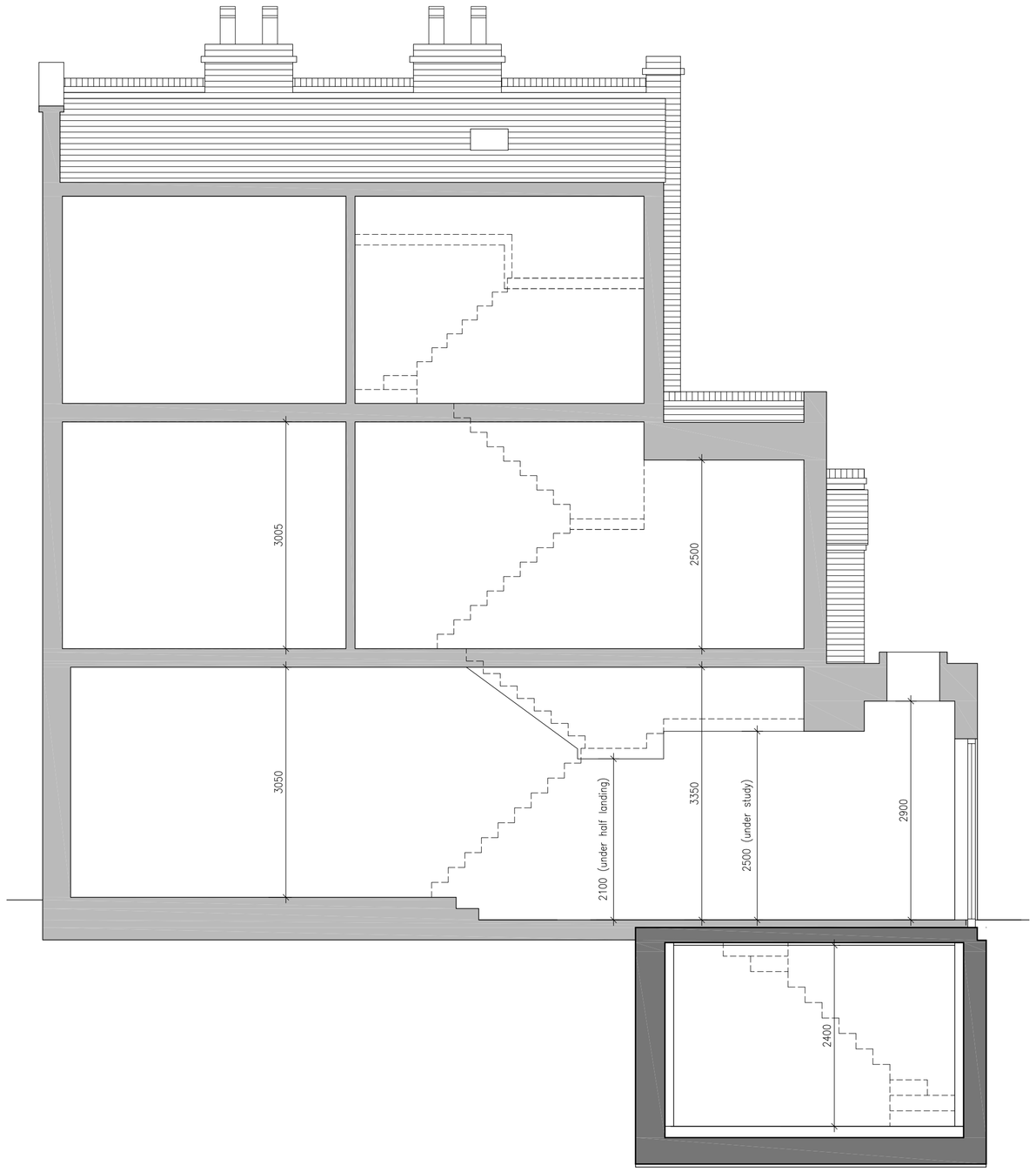


SIDE ELEVATION
SCALE 1:100



SECTION C - C
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(metres)

1:100
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(metres)

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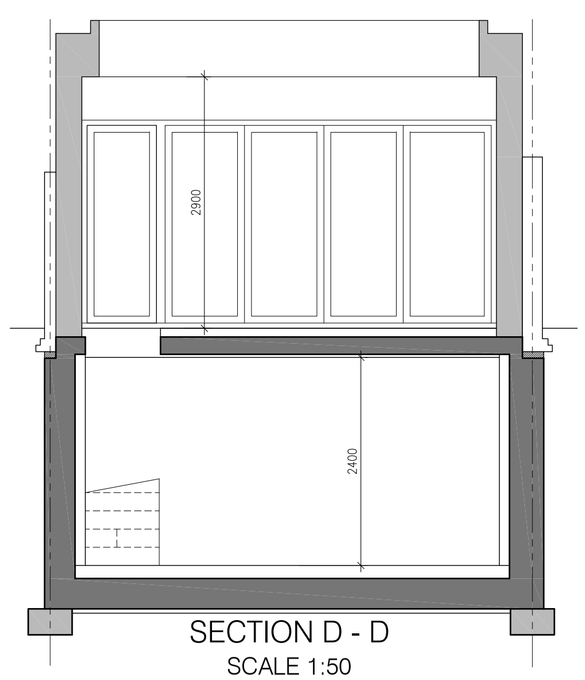
(metres)



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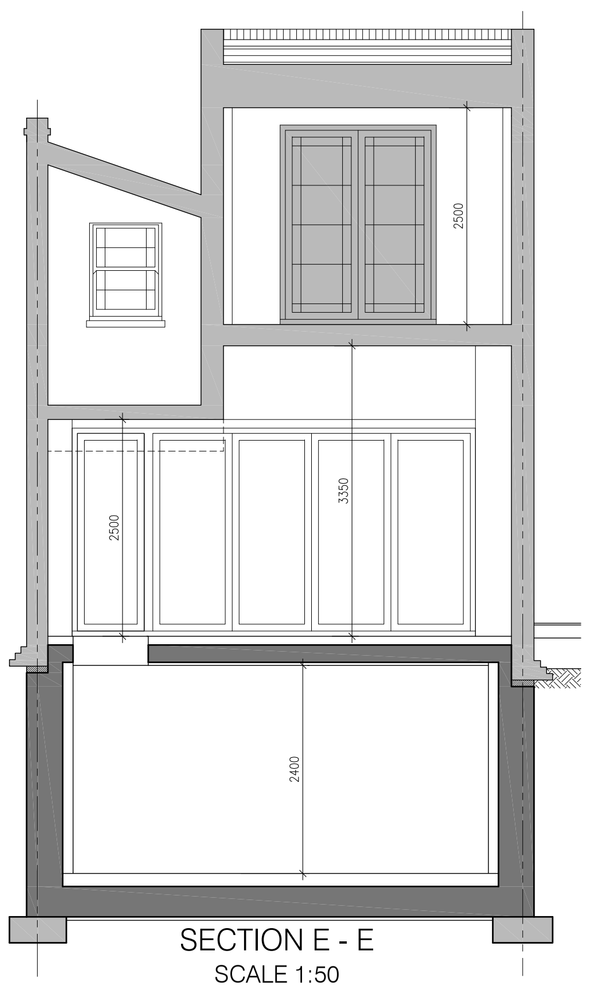

SECTION E - E
SCALE 1:50

SITE PLAN
SCALE 1:200

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PROPOSED TWO STOREY REAR EXTENSION
ELEVATIONS, SECTIONS AND SITE PLAN

Scale 1:200, 1:100, 1:50 @ A1

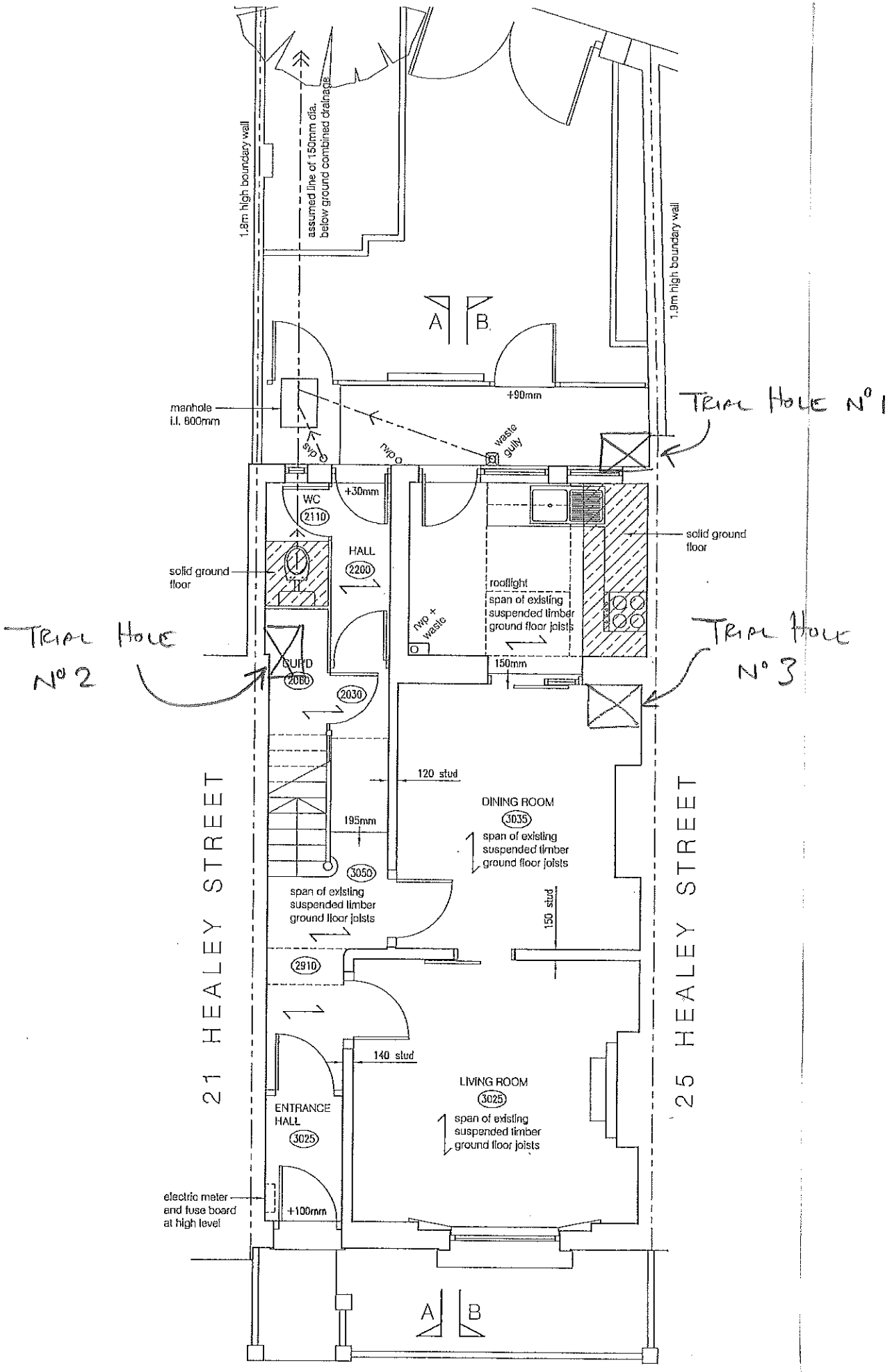
Date JUNE 17 | Drawn G.J.

Drawing No. A1/3356/04 | Rev. A

Plot Date: 6 OCTOBER 2017

APPENDIX

- **Trial Pit Logs 1-3 and location plan**



TRIAL HOLE LOCATION PLAN.

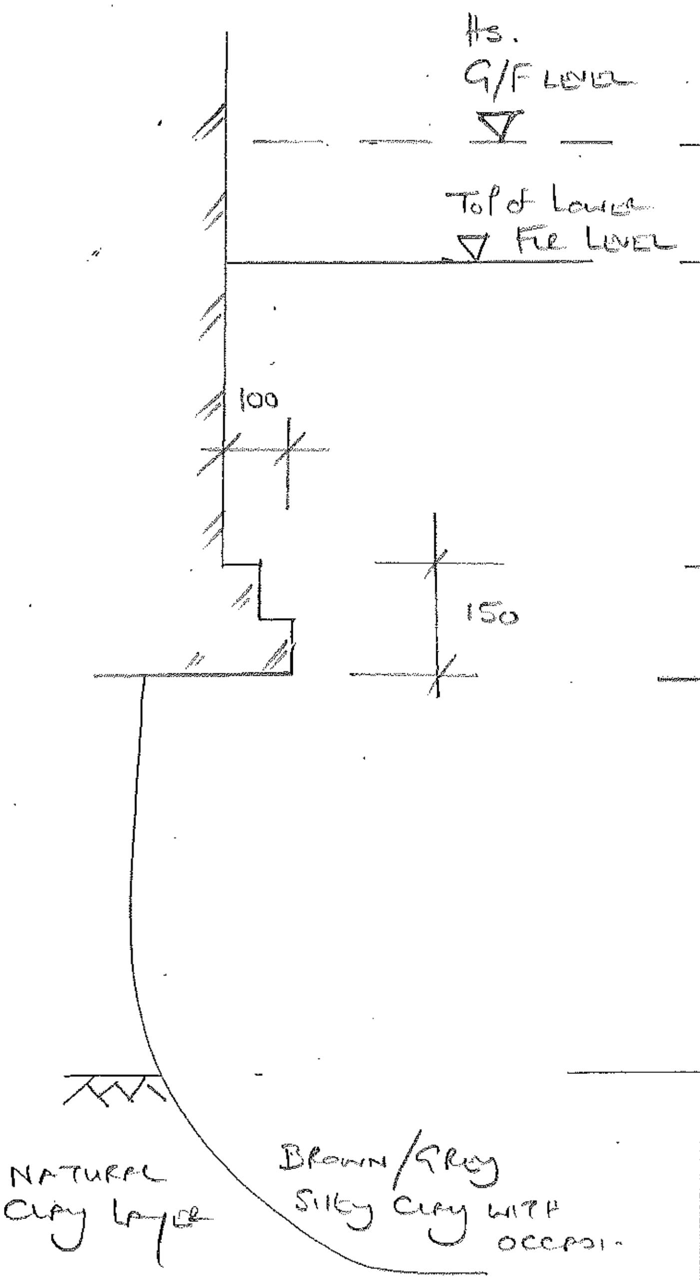
GROUND FLOOR PLAN

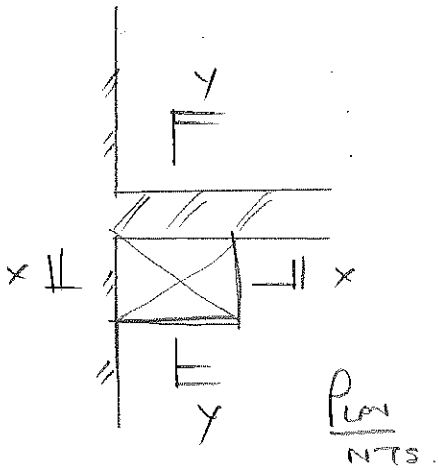
~~SCALE 1:50~~

LOCATION	JOB No.	TRIAL PIT No. 1
23 Harley ST. NW1	3356.	SHT 1 OF 1
		DATE Sept. 17.

CLIENT	METHOD OF EXCAVATION	BY
Quinn Const	Hand / Machine	JPM

SKETCH	DEPTH	SOIL DESCRIPTION
	0	
	.160	
	.560	
	.710	Fill (Clay with Gravel & Brick Fragments)
	1.230	Brown Grey Silty Clay with occasional Roots.

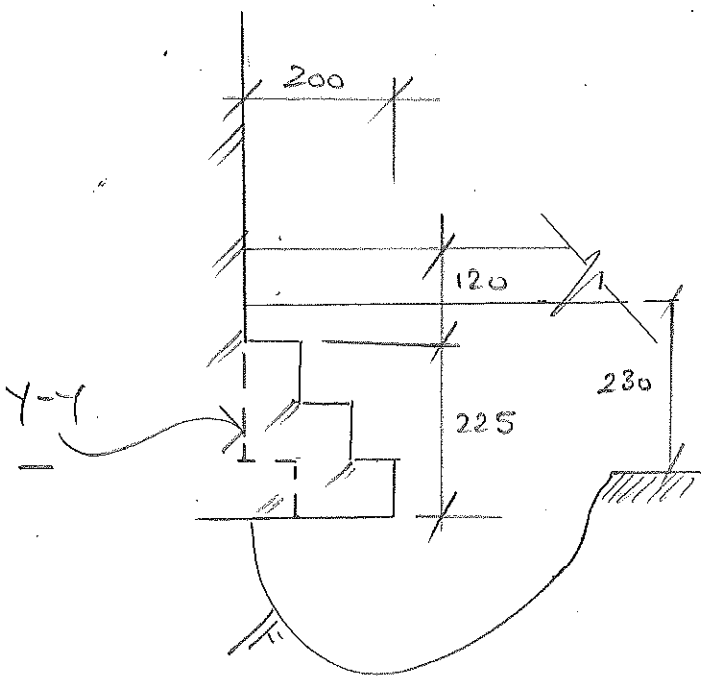




CHECK LIST	REMARKS
TREE ROOTS ✓	* Sections X-X & Y-Y Similar
GRD WATER ✗	
DRAIN RUNS ✗	

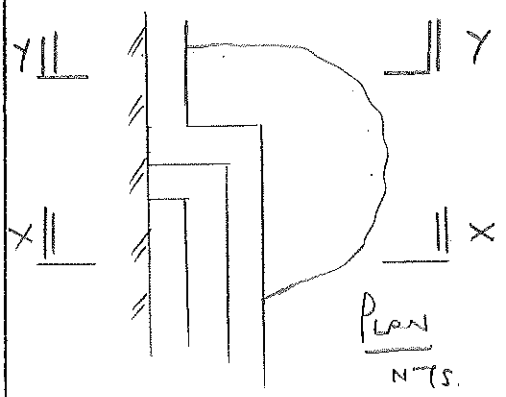
LOCATION	JOB No.	TRIAL PIT No. 2
23 Horley St. NW1	3356	SHT 1 OF 1
		DATE Sept. 17.
CLIENT	METHOD OF EXCAVATION	BY
Quinn Carey	Hand	

SKETCH	DEPTH	SOIL DESCRIPTION



X-Y

1:10



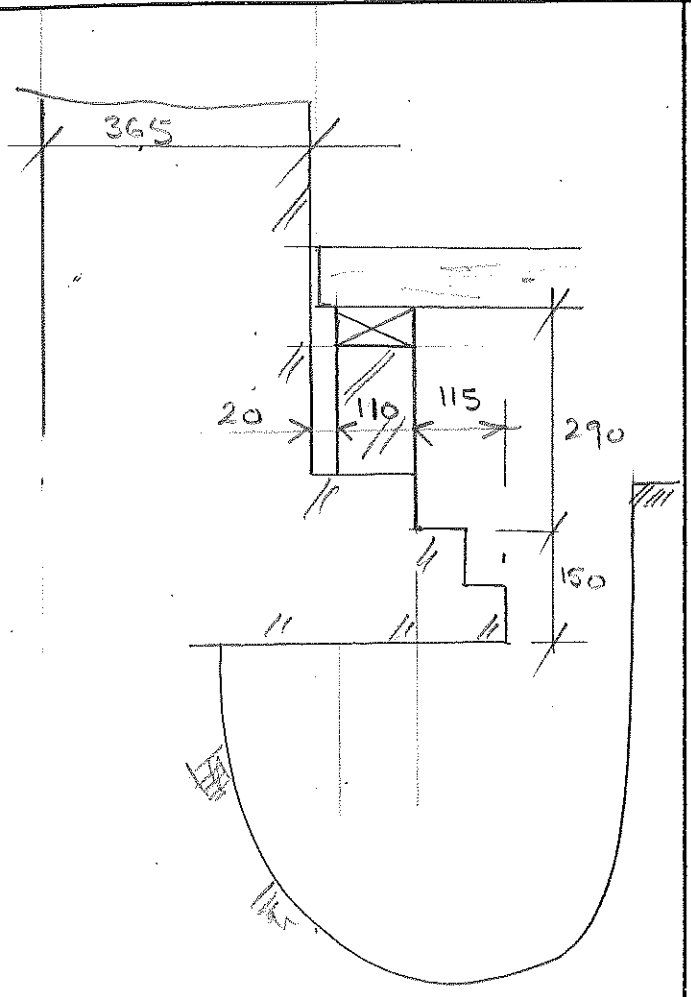
OVERSITE CONC.

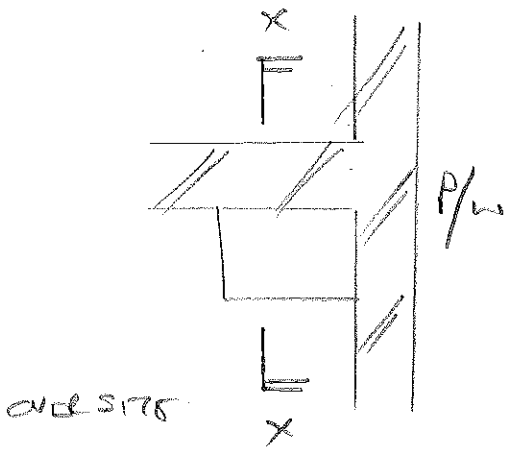
FILL (CLAY WITH GRAVEL & BRICK FRAGMENTS)

CHECK LIST	REMARKS
TREE ROOTS X GRD WATER X DRAIN RUNS X	

LOCATION	JOB No.	TRIAL PIT No. 3
23 Hervey St. N'th.	3356	SHT 1 OF 2
		DATE Sept. 17
CLIENT	METHOD OF EXCAVATION	BY JPh
Quinn Const	Hand	

SKETCH	DEPTH	SOIL DESCRIPTION





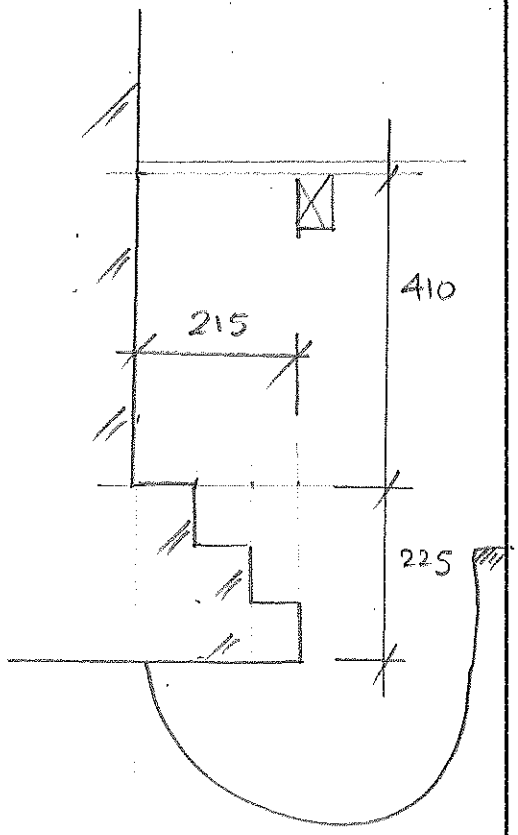
ONE SIDE

FILL (Clay with gravel & Brick Fragments)

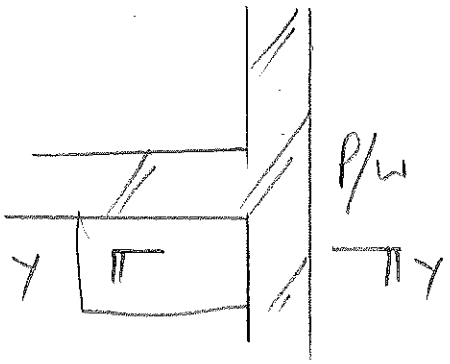
CHECK LIST	REMARKS
TREE ROOTS X GRD WATER X DRAIN RUNS X	

LOCATION	JOB No.	TRIAL PIT No. 3
23 Henry ST		SHT 2 OF 2
		DATE SEPT 17.
CLIENT	METHOD OF EXCAVATION	BY JPm
Quinn Const	Hand	

SKETCH	DEPTH	SOIL DESCRIPTION



Y-Y



ONSITE

FILL (CLAY WITH GRAVEL & BRICK FRAGMENTS.)

CHECK LIST	REMARKS
TREE ROOTS X GRD WATER X DRAIN RUNS X	

APPENDIX

- **Historical Borehole Logs**

TQ28SE/847 NGR 2859 3464

Boring method: Shell and Auger		Location	Record of BOREHOLE 3
Boring diameter (mm): 200			(sheet 1 of 2)
Casing diameter (mm): 200 to 1.50m		Orientation	Ground level (m.O.D.): 29.80
Boring equipment: Pilcon 20			Date commenced: 12.7.74

Samples and in situ tests		Casing Depth (m)	Water Depth (m)	Date and Depth (m)	DESCRIPTION OF STRATA	O.D. Level (m.O.D.)	Legend
Depth (m)	Type						
				0.15	FILL (Cobblestones)	29.65	
				0.80	FILL (Clay with gravel and brick fragments)	29.00	
0.90	U			1.20	Brown and grey mottled CLAY	28.60	
1.35	D						
1.90	D						
2.40	U	1.50					
2.85	D						
3.40	D		3.40*		Firm to stiff fissured brown sandy silty CLAY with grey staining in the fissures, some selenite crystals and small pockets of orange-brown fine sand.		
3.90	U						
4.35	D						
4.90	D						
5.20	W						
5.40	U						
5.85	D						
6.40	D			6.50		23.30	
6.90	U				Stiff to very stiff fissured grey-brown silty CLAY with partings of silty fine sand and some selenite crystals. A claystone was encountered at 10.80m depth.		
7.35	D						
7.90	D						
8.40	U						
8.85	D						
9.40	D						
9.90	U						

REMARKS

For explanation of symbols and abbreviations see Notes, pages (i) and (ii)

LAB Ref. No.		Fig.
S/10721	CAMDEN - HARMOOD STREET	3

WIMPEY LABORATORIES LIMITED

TQ28SE/~~85~~ 848 NGR 2859 3461

Boring method: Shell and Auger		Location	Record of BOREHOLE 4
Boring diameter (mm): 200			(sheet 1 of 2)
Casing diameter (mm): 200 to 1.50m		Orientation	Ground level (m.O.D.) 29.40
Boring equipment: Pilcon 20			Date commenced 10.7.74

Samples and in situ tests: Depth (m)	Type	Casing Depth (m)	Water Depth (m)	Date and Depth (m)	DESCRIPTION OF STRATA	O.D. Level (m.O.D.)	Legend
				0.15	FILL (Cobblestones)	29.25	
					FILL (Topsoil with gravel and brick fragments)		
1.00	U		DRY	1.10			
			DRY	11/7			
1.45	D			1.30		28.10	
2.00	D	1.50					
2.50	U				Firm to stiff fissured brown slightly sandy silty CLAY with grey staining in the fissures, small pockets of orange-brown sand and selenite crystals		
2.95	D						
3.50	D						
4.00	U						
4.45	D						
5.00	D						
5.50	U						
5.95	D			6.20		23.20	
6.50	D						
7.00	U				Stiff to very stiff fissured grey-brown silty CLAY with partings of silty fine sand and some selenite crystals. A claystone was encountered at 10.80m depth.		
7.45	D						
8.00	D						
8.50	U						
8.95	D						
9.50	D						
10.00	U						

REMARKS

For explanation of symbols and abbreviations see Notes, pages (i) and (ii)

LAB Ref. No. S/10721	CAMDEN – HAMWOOD STREET	Fig. 4

WIMPEY LABORATORIES LIMITED

TQ28SE/853 NGR 2802 8454

Boring method: Shell and Auger		Location	Record of BOREHOLE 9 (sheet 1 of 2)
Boring diameter (mm): 200			
Casing diameter (mm): 200 to 1.50m		Orientation	Ground level (m.O.D.): 28.70
Boring equipment: Pilcon 20			Date commenced: 5.7.74

Samples and in situ tests: Depth (m)	Type	Casing Depth (m)	Water Depth (m)	Date and Depth (m)	DESCRIPTION OF STRATA	O.D. Level (m.O.D.)	Legend
				0.15	FILL (Concrete)	28.55	
					FILL (Clay with gravel and brick fragments)		
0.90	U						
1.35	D						
				1.90		26.80	
1.90	D				Firm to stiff fissured brown slightly sandy silty CLAY with grey staining in the fissures, some small pockets of orange-brown fine sand and selenite crystals.		
2.40	U	1.50					
			DRY	2.90			
2.85	D						
			DRY	6/7			
3.40	D						
3.90	U						
4.35	D						
4.90	D						
5.40	U						
5.85	D			6.20		22.50	
6.40	D						
6.90	U				Stiff to very stiff fissured grey-brown silty CLAY with partings of silty fine sand and occasional small claystones below 9.70m depth.		
7.35	D						
7.90	D						
8.40	U						
8.85	D						
9.40	D						
9.90	U						

REMARKS

For explanation of symbols and abbreviations see Notes, pages (i) and (ii)

LAB Ref. No.		Fig.
S/10721	CAMDEN - HARMOOD STREET	9

GROUND LEVEL: 94·5 A.O.D. 28·80m
NOMINAL B.H. DIA.: 8" Casing to 20ft.
DATE OF BORING: 25 Feb. to 4 March '58

BOREHOLE No. 30

GROUNDWATER LEVEL	GROUNDWATER DATE	SAMPLE DEPTH	B.H. DEPTH	R.L.	DESCRIPTION OF STRATA
			0'		Tarmacadam
			0'-6" 0·15m	+94·0 +28·65m	Fill
			5'-0" 1·52m	+89·5 +27·28m	Stiff brown fissured clay
			22'-0" 6·71m	+72·5 +22·10m	Stiff grey-blue fissured clay
			46'-0"	+48·5	Mudstone boulder
			46'-6" 14·17m	+48·0 +14·63m	Stiff grey-blue fissured clay
		63'-6" to 65'-0"	21·49m	+7·32m	
			70'-6"	+24·0	Mudstone boulder
		71'-6" to 73'-0"	71'-0" 21·64m	+23·5 +7·16m	Stiff grey-blue fissured clay
		79'-6" to 81'-0"	24·84m	+3·96m	Contd.
			81'-6"	+13·0	

REMARKS: Some water observed in green sand layer at 116 ft. to 117 ft.

SAMPLES: ■ Undisturbed ● Disturbed

SCALE: 1/8" to 1'-0"

SOILS No. S/371

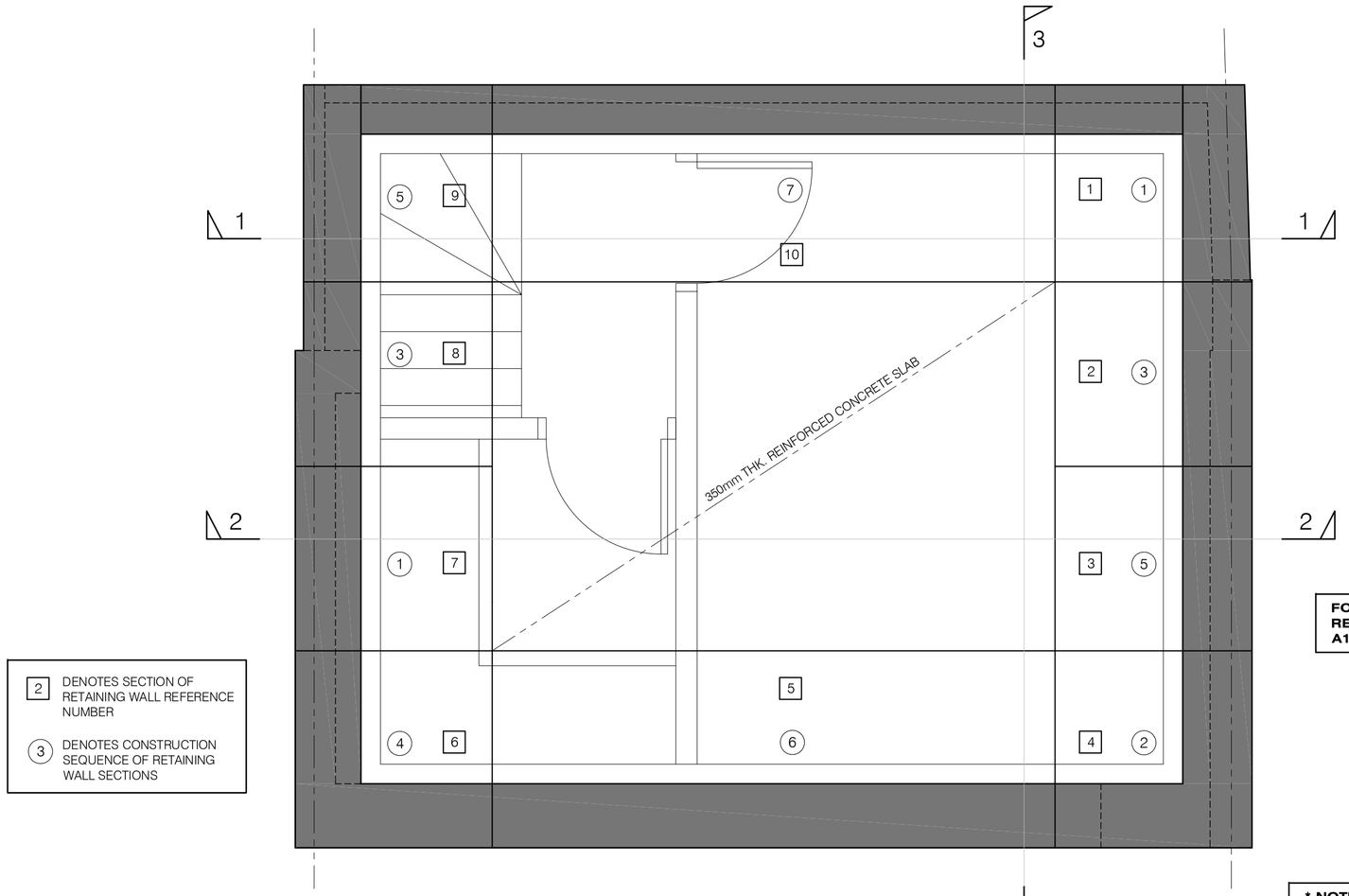
DRWG. No.

METROPOLITAN WATER BOARD

MAIN IN TUNNEL BETWEEN THAMES AND [illegible] VALLEYS

APPENDIX

- **PCDS Ltd.'s Proposed basement plans sections and temporary works details Drg No's A1/3356/PW 01-02.**



2 DENOTES SECTION OF RETAINING WALL REFERENCE NUMBER

3 DENOTES CONSTRUCTION SEQUENCE OF RETAINING WALL SECTIONS

LOWER GROUND FLOOR PLAN SHOWING NEW RETAINING WALL AND BASES

SCALE 1:25

FOR DETAILS OF SECTION 3 - 3 REFER TO DRAWING NO. A1/3356/PW02

*** NOTE:**
EXISTING FOOTINGS ARE ASSUMED AND SHOULD BE INVESTIGATED PRIOR TO ANY UNDERPINNING WORKS COMMENCING AND FINDINGS REPORTED TO PCDS LTD. SO THAT ADJUSTMENTS MAY BE MADE TO THE DESIGN IF REQUIRED

**** NOTE:**
EXISTING WALL THICKNESSES ARE ASSUMED AND SHOULD BE INVESTIGATED PRIOR TO ANY UNDERPINNING WORKS COMMENCING AND FINDINGS REPORTED TO PCDS LTD. SO THAT ADJUSTMENTS MAY BE MADE TO THE DESIGN IF REQUIRED

NOTES AND SPECIFICATION FOR SECTIONS OF RETAINING WALL

A. MATERIALS

THE RETAINING WALL STEM AND BASE IS TO BE FORMED IN REINFORCED CONCRETE OF GRADE RC35 U.N.O. CONTAINING A MINIMUM OF 275Kg/m³ OF SULPHATE-RESISTING PORTLAND CEMENT, AND USING 20mm MAXIMUM SIZE AGGREGATE. THE SEMI-DRY CONCRETE PACK IS TO BE IN A 1:1 ½:3 CEMENT:SHARP SAND:COARSE AGGREGATE MIX USING SULPHATE-RESISTING PORTLAND CEMENT AND 10mm MAXIMUM SIZE AGGREGATE.

B. CONSTRUCTION SEQUENCE

THE RETAINING WALL OPERATION SHALL BE EXECUTED IN A STRICTLY PREDETERMINED SEQUENCE INDICATED BY NUMBERS SHOWN THUS (5) ON THE PLAN SHOWN ON DRAWING NO. A1/3356/PW02. THE LENGTH OF EACH RETAINING WALL SECTION OPERATION IS NOT TO EXCEED 1200mm, EXCEPT FOR SECTION REFERENCE NO. 12, AND UNLESS OTHERWISE AGREED WITH 'PCDS'.

C. SECURITY DURING UNDERPINNING

DURING THE CONSTRUCTION OF RETAINING WALL SECTIONS THE STRUCTURE (E.G. WALL) SHALL BE SECURELY STRUTTED IF REQUIRED, AND IF NECESSARY, TEMPORARILY BRACED IN ACCORDANCE WITH THE ENGINEER'S INSTRUCTION.

D. EXCAVATIONS

EXCAVATIONS ARE TO BE ADEQUATELY SHORED AGAINST THE COLLAPSE OF THE SIDES AND SHALL HAVE UNDISTURBED GROUND AT THE FORMATION LEVEL. IF EXCAVATION IS BELOW WATER TABLE, IMMEDIATELY AFTER EXCAVATION TO THE CORRECT DEPTH THE BOTTOM IS TO BE BLINDED WITH 150mm OF CONCRETE TO PREVENT SOFTENING OF THE CLAY. ANY PLANKING WHICH HAS TO BE LEFT IN POSITION TO BE PRECAST CONCRETE OR STEEL.

E. STRUTTING

STRUTTING SHALL BE SO DESIGNED AS TO PERMIT RE-STRUTTING OF THE EXCAVATION DURING CONSTRUCTION OF THE UNDERPINNING. ALL STRUTTING SHALL BE FIXED IN POSITION USING HARDWOOD FOLDING WEDGES AND/OR JACKS CAPABLE OF TRANSFERRING TO EXPOSED SOIL FACES SUPPORT EQUAL TO THAT OFFERED BY GROUND REMOVED IN EXCAVATION.

F. PREPARATION OF EXISTING FOUNDATIONS

THE UNDERSIDE OF FOUNDATIONS ARE TO BE THOROUGHLY CLEANED, LOOSE AND DETERIORATED PARTS CUT AWAY PRIOR TO THE PINNING PROCESS.

G. CASTING OF CONCRETE

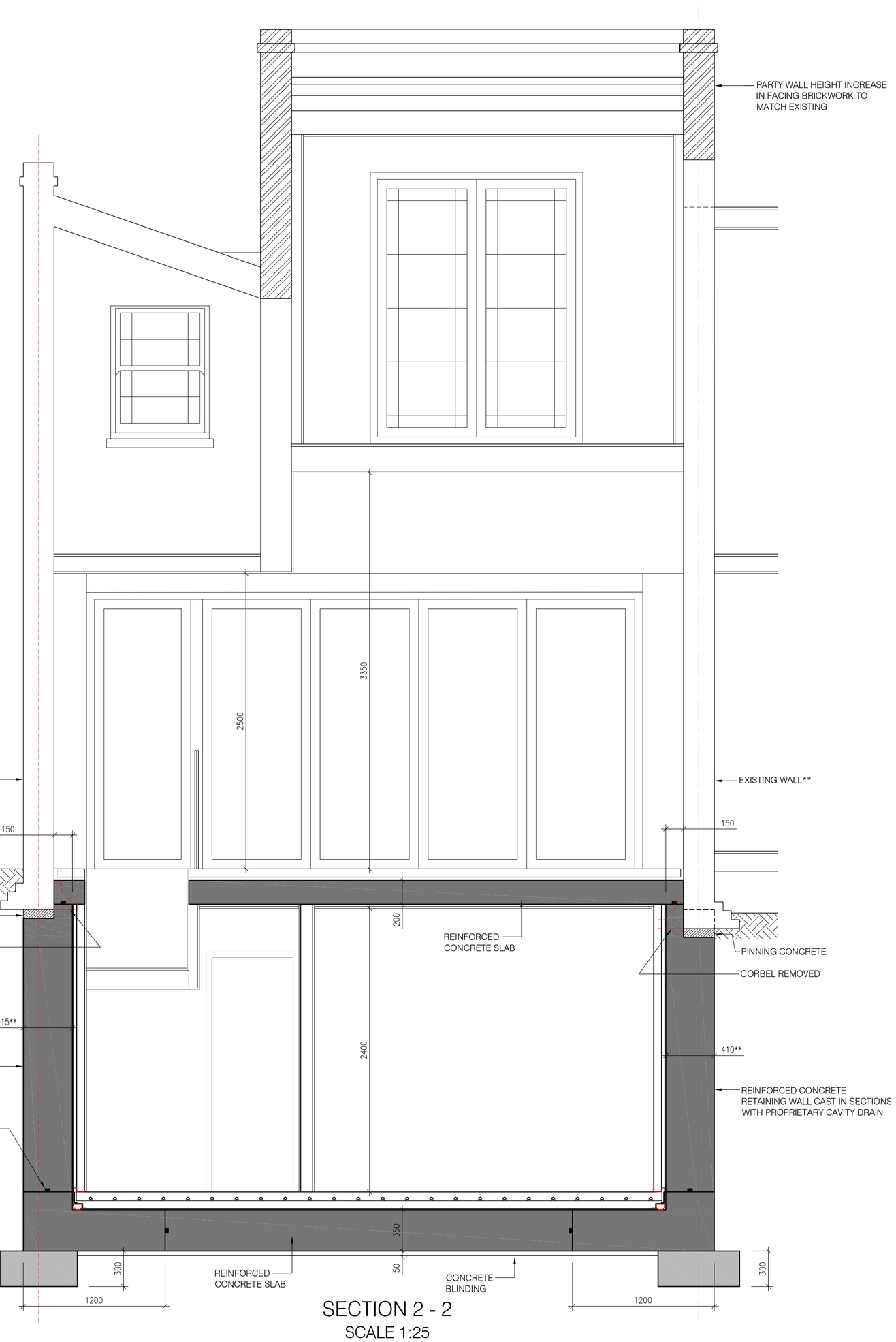
THE CONCRETE RETAINING WALL STEM AND BASE ARE TO BE CAST TO WITHIN 75mm OF THE UNDERSIDE OF THE EXISTING FOUNDATIONS, WHICH IS PREPARED AS DESCRIBED AT F. ABOVE.

H. COMPLETING THE UNDERPINNING

THE 75mm GAP BETWEEN EXISTING FOUNDATION AND NEW RETAINING WALL STEM IS TO BE PACKED BY RAMMING IN SEMI-DRY CONCRETE. THIS OPERATION TO START NOT EARLIER THAN TWO DAYS AFTER COMPLETION OF G. ABOVE, AND A FURTHER 24 HOURS TO ELAPSE BEFORE COMMENCING EXCAVATION OF AN ADJOINING SECTION. SHOULD THE SPACE BETWEEN NEW AND OLD CONCRETE VARY, IT MAY BE NECESSARY TO CHANGE THE SPECIFICATION OF SEMI-DRY CONCRETE AND THE ENGINEER'S INSTRUCTIONS SHOULD BE OBTAINED.

I. JOINTS BETWEEN RETAINING WALL SECTIONS

THE JOINTS ARE TO BE FORMED AT POSITIONS SHOWN ON THE PLAN. THE FACE OF THE PREVIOUSLY PLACED CONCRETE IS TO BE THOROUGHLY ROUGHENED, AND BRUSHED FREE OF ALL LOOSE MATERIAL AND DUST BEFORE CONCRETE IS PLACED. JOINTS TO BE DOWELLED USING H16 x 800mm LONG MILD STEEL BARS, WITH A CONCRETE COVER OF 150mm.



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Rev.	Date	Revisions

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Client

JOHANNA QUINN

Job Title

23 HEALEY STREET
LONDON
NW1 8SR

Drawing Title

PROPOSED TWO STOREY REAR EXTENSION

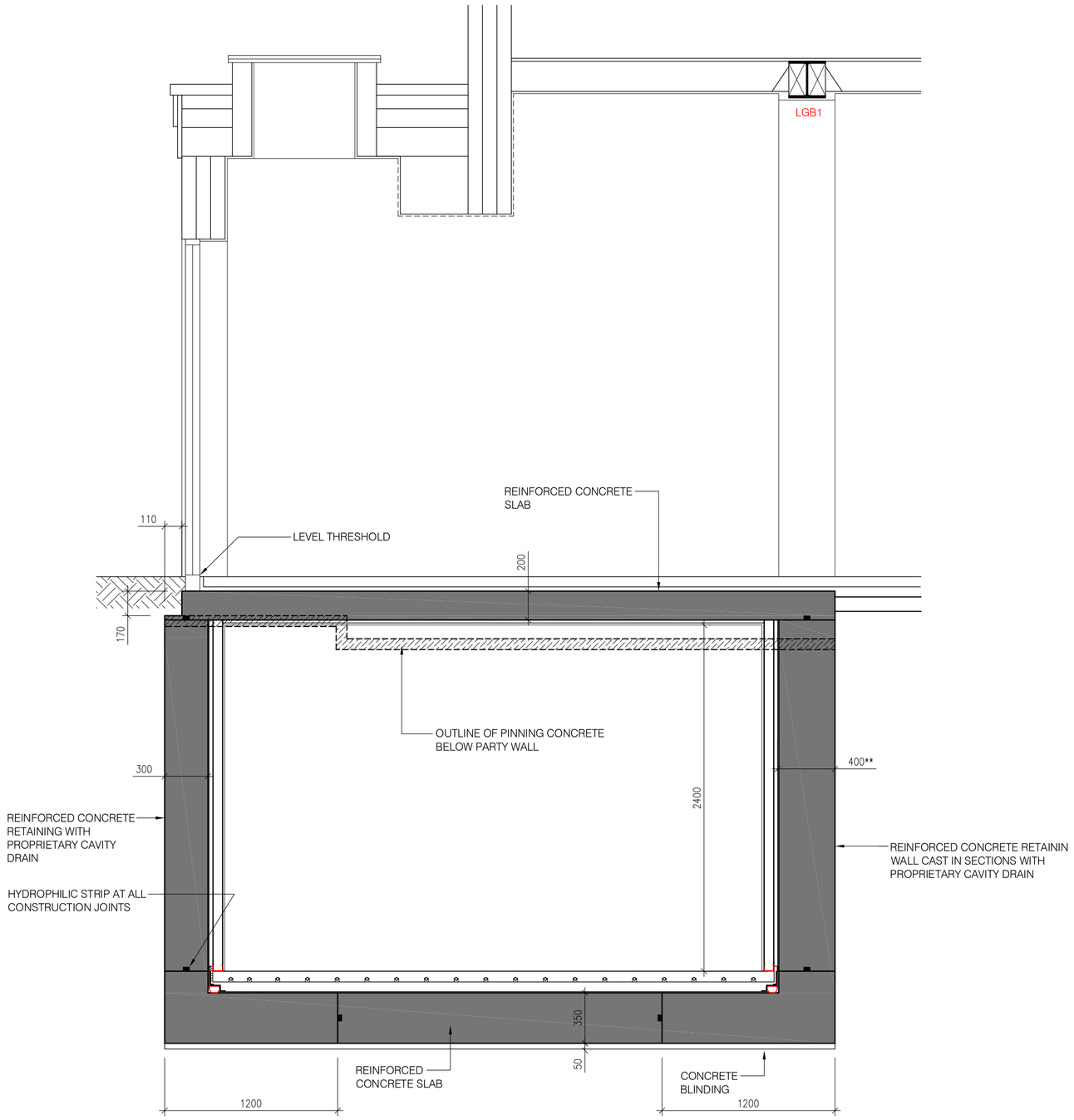
DETAILS FOR PARTY WALL AWARDS - SHEET 1 OF 2

Scale 1:25 @ A1

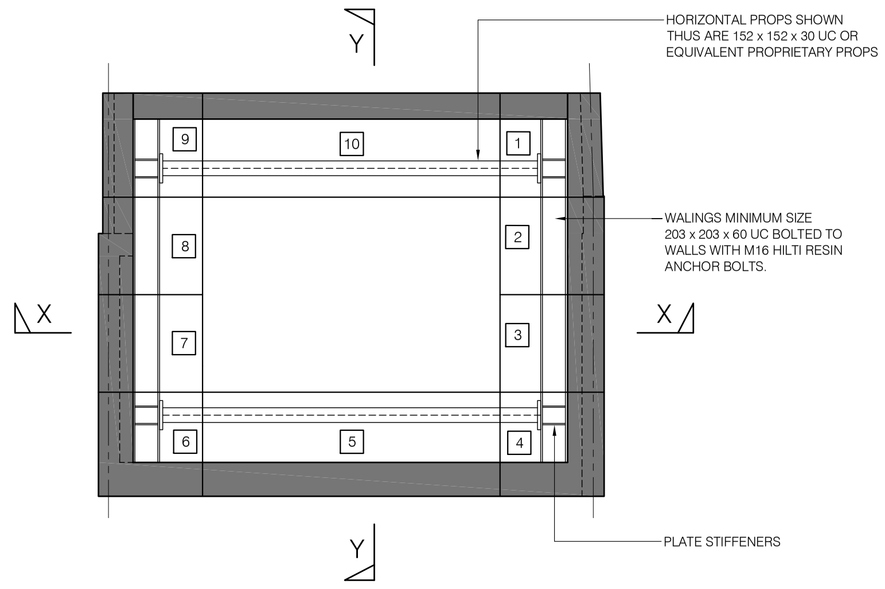
Date SEPT 17 | Drawn I.W.

Drawing No. A1/3356/PW01 | Rev.

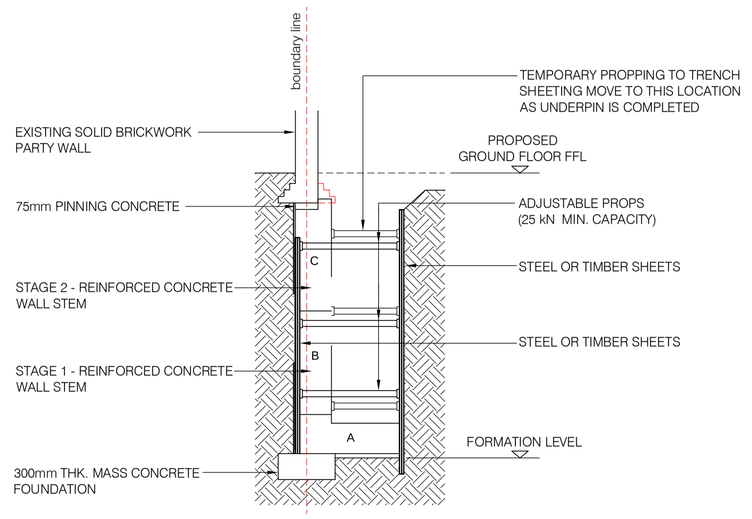
Plot Date: 28 SEPTEMBER 2017



SECTION 3 - 3
SCALE 1:25



BASEMENT PLAN
SHOWING PROPPING DETAILS



DETAIL 1: SECTION
SHOWING EXCAVATION AND TEMPORARY PROPPING FOR STAGE 1 UNDERPINNING.

NOTE ON SHORING:

STEELS TRENCH SHEETS OR 25mm PLYWOOD ARE TO BE USED GENERALLY FOR SHORING SIDES OF EXCAVATIONS DEEPER THAN 1200mm. STEEL SHEETING PROFILE AND THICKNESS DESIGNED SO AS NOT TO DEFLECT EXCESSIVELY UNDER LATERAL LOADS. DETAILS OF THESE WILL BE SUBMITTED FOR APPROVAL PRIOR TO COMMENCEMENT OF THE EXCAVATION WORKS. WHERE THE STEEL SHEETS ARE TO BE LEFT IN PLACE THE VOIDS BEHIND ARE TO BE FILLED IN WITH A WEAK SAND CEMENT GROUT. PLYWOOD SHEETING AND TIMBER PROPS, IF USED MUST NOT BE LEFT IN THE PERMANENT WORKS.

NOTE ON WALINGS AND PROPS:

WALINGS TO BE FABRICATED FROM MIN. SIZE STEEL SECTION OF 203 x 203 x 60 UC AND PROPS FROM 152 x 152 x 30 UC, WITH 12mm STIFFENERS TO WALINGS AS INDICATED. DETAILED DESIGN WILL BE COMPLETED PRIOR TO COMMENCEMENT ON SITE. JOINTS TO BE SITE WELDED OR BOLTED.

ALTERNATIVELY PROPPING TO BE 'MEGASHOR' PROPRIETARY ADJUSTABLE PROPS AND WALINGS SUPPLIED AND DESIGNED BY 'RMD KWIKFORM'.
COMPRESSION LOAD CAPACITY (UP TO 100kN). DESIGN TO BE CONFIRMED BY 'RMD KWIKFORM' AND SUBMITTED TO PCDS FOR APPROVAL PRIOR TO COMMENCEMENT OF THE WORK ON SITE.

SEQUENCE OF CONSTRUCTION FOR THE BASEMENT

1. CARRY OUT DEMOLITIONS OF ALL NON-LOAD BEARING INTERNAL WALLS AT GROUND FLOOR LEVEL.
2. INSTALL NEW BEAM LGB1 AND REMOVE SECTION OF EXISTING REAR WALL AS SHOWN ON STRUCTURAL PLANS
3. REMOVE THE TIMBER GROUND FLOOR STRUCTURE COMPLETE.
4. REDUCE INTERNAL GROUND LEVEL TO 150mm ABOVE FOOTING OF LOAD BEARING WALLS ENSURING NO UNDERMINING OF FOOTINGS.

IF ANY SERVICES FOUND THEY ARE TO BE RECORDED AND REPORTED IMMEDIATELY TO PCDS AND THE ARCHITECT.

5. CARRY OUT MASS CONCRETE FOUNDATION AND REINFORCED CONCRETE RETAINING WALL BASE AND STEM (REF NOS. 1 to 4 and 6 to 9 inc.) CONSTRUCTION BELOW PARTY WALLS AND REMAINING RETURNS OF EXISTING REAR WALL AS SHOWN ON DRAWING NOS. A1/3356/PW01.

6. PARTY WALL UNDERPINNING TO BE PROPPED AND CONSTRUCTED TO THE FOLLOWING SEQUENCE AND AS SHOWN ON DETAIL 1
a. EXCAVATE TO FORMATION LEVEL, SHORING AND PROPPING AT P1, P2 & P3 AS EXCAVATION PROGRESSES.
b. CONSOLIDATE FORMATION AND CONSTRUCT MASS CONCRETE BASE.
c. RAISE P3 UP OUT OF THE WAY AND CONSTRUCT BASE A WITH A 150 KICKER.
d. AT LEAST 24 HOURS LATER PROP BASE A HORIZONTALLY, RAISE P2 OUT OF THE WAY AND CONSTRUCT WALL SECTION B
f. 24 HOURS LATER REINSTATE PROPPING P2 & P3 BACK TO WALL SECTION B, REMOVE P1 AND CONSTRUCT WALL SECTION C
f. 24 HOURS LATER REINSTATE PROPPING P1 BACK TO WALL SECTION C.
DRY PACK IN ACCORDANCE WITH 'NOTES AND SPECIFICATION FOR SECTIONS OF RETAINING WALL' ON DRAWING NO. A1/3356/PW01
g. REARRANGE PROPS TO FRONT FACE OF WALL

CONTINUE THE PROCESS UNTIL ALL SECTIONS OF RETAINING WALL ARE COMPLETE (BELOW THE PARTY WALLS) AND ARE FULLY PROPPED. WHEN ALL RETAINING WALL SECTIONS HAVE BEEN COMPLETED, BULK EXCAVATION CAN COMMENCE.

9. REDUCE GROUND LEVEL AS NECESSARY IN ORDER TO INSTALL WALINGS AND PROPPING AT LEVEL P1 AS SHOWN ON THE BASEMENT PLAN ABOVE AND SECTION X - X. AT THE SAME TIME REMOVE THE SHORT PROPS AT LEVEL P1.

DURING BULK EXCAVATION BATTER BACK THE EXCAVATION (TO SUITABLE GRADIENT TO PREVENT EARTH COLLAPSE) TO THE FRONT AND REAR OF THE NEW BASEMENT AS SHOWN ON SECTION Y - Y

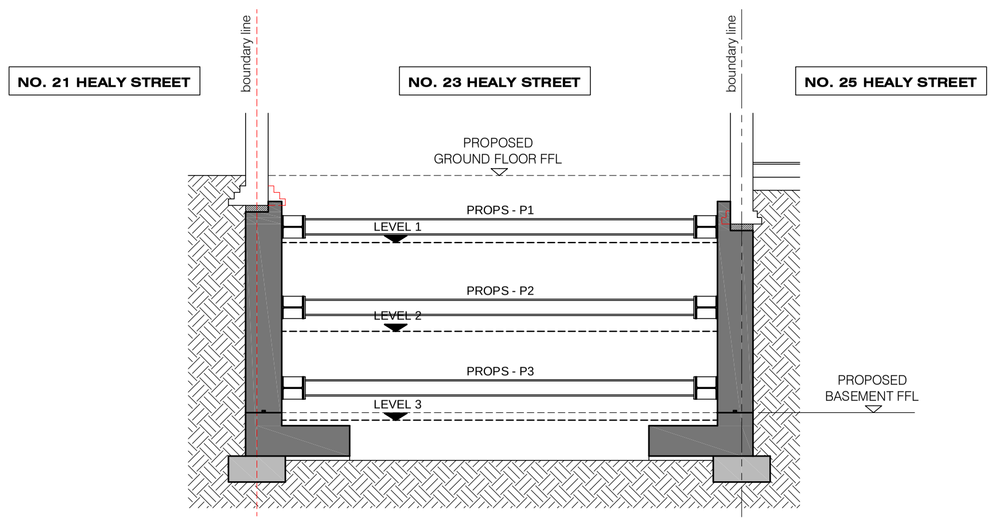
10. CONTINUE BULK EXCAVATIONS UNTIL ALL WALINGS HAVE BEEN INSTALLED AND ARE ADEQUATELY PROPPED.

11. COMPLETE THE EXCAVATION, COMPACT AND BLIND THE FORMATION.

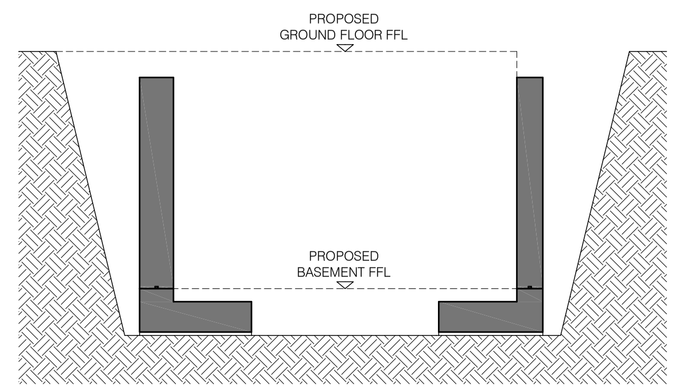
12. CONSTRUCT SECTIONS OF RETAINING WALL BASE AND STEM (REF. NO. 5 AND 10).

13. CONSTRUCT THE BASE SLAB. PROPPING TO BE REMOVE NOT EARLIER THAN 14 DAYS AFTER CONSTRUCTION OF THE BASE SLAB.

14. CONSTRUCT THE GROUND FLOOR SLAB



SECTION X - X
SECTION SHOWING LEVELS OF EXCAVATION AND PROPPING



SECTION Y - Y

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Rev.	Date	Revisions

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Client
JOHANNA QUINN

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NW1 8SR

Drawing Title
PROPOSED TWO STOREY REAR EXTENSION

DETAILS FOR PARTY WALL AWARDS - SHEET 1 OF 2

Scale 1:25, 1:50 @ A1

Date SEPT 17 | Drawn I.W.

Drawing No. A1/3356/PW02 | Rev.

Plot Date: 3 OCTOBER 2017

APPENDIX

- **Supporting Structural Calculations**

STRUCTURAL DESIGN CALCULATIONS

FOR NEW BASEMENT AND INTERNAL ALTERATIONS TO THE GROUND FLOOR OF A 3-STOREY MID TERRACE HOUSE.

PROPERTY
23 HEALY STREET
LONDON
NW1 8SR

CLIENT
JOHANNA QUINN
23 HEALY STREET
LONDON
NW1 8SR

PREPARED BY K. P. RENAUD B Sc(Hons), M Sc, C Eng, MICE, MCIHT

Date : October 2016
Project ref: 3356

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Project:			Project Reference:
23 HEALY STREET, LONDON NW1 8SR			**3356**
Refer to drawing:	Calculations by: **KPR**	Checked by:	Sheet Number: 1
Location: **Rear extension and basement.**			Date: Oct 17

Synopsis : These calculations are to be read in conjunction with PCDS structural drawings and architectural drawings and other sub consultants' drawings.

The scheme comprises the construction of a basement beneath the rear of an existing 3-storey terrace property.

Design in accordance with :

Building Regulations
BS 648 Weights of Building Materials
BS 6399: Part 1 Design Loading for Buildings
BS 5950 Use of Structural Steelwork in Buildings
BS 5268 Structural Use of Timber
BS 5628 Use of Masonry
BS 8110 Structural use of concrete
BS 8002 Retaining Structures
BS 8004 Foundations
BS 8500 Specifying Concrete

References : Steel Designers Manual
Steelwork Capacity Tables to BS 5950

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Project: 23 HEALY STREET, LONDON NW1 8SR			Project Reference: 3356
Refer to drawing:	Calculations by: KPR	Checked by:	Sheet Number: 2
Location: Rear extension and basement.			Date: Oct 17

LOADING DATA

Loadings shown are unfactored

Pitched Roof (30°)			
Weight of tiles	=	0.75	kN/m^2
Rafters, battens etc.	=	0.17	kN/m^2
Imposed roof load	=	0.75	kN/m^2
Total dead load	=	0.92	kN/m^2
Total imposed load	=	0.75	kN/m^2
Ceiling			
Self weight of ceiling	=	0.30	kN/m^2
Imposed ceiling load	=	0.25	kN/m^2
Flat Roofs			
Self weight of roof	=	0.80	kN/m^2
Imposed roof load	=	0.75	kN/m^2
Timber floors			
Self weight of timber floor	=	0.50	kN/m^2
Insulation, u/f heating, services etc.	=	0.05	kN/m^2
Imposed floor load	=	1.50	kN/m^2
Total dead load	=	0.55	kN/m^2
Total imposed load	=	1.50	kN/m^2
New 200 in-situ concrete floor at gound floor			
Self weight 200 floor	=	4.80	kN/m^2
Finishes	=	2.00	kN/m^2
Imposed floor load	=	1.50	kN/m^2
Total dead load	=	6.8	kN/m^2
Total imposed load	=	1.50	kN/m^2
Existing 330 party wall			
Self weight of 330 wall including plaster finish	=	7.1	kN/m^2
Existing 225 party wall			
Self weight of 225 wall including plaster finish	=	4.9	kN/m^2

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Project: 23 HEALY STREET, LONDON NW1 8SR			Project Reference: 3356
Refer to drawing:	Calculations by: KPR	Checked by:	Sheet Number: 3
Location: Rear extension and basement.			Date: Oct 17

Existing boundary wall		
Self weight of 215 wall	= 4.4	kN/m^2
Internal studwork partitions		
Self weight	= 0.40	kN/m^2
New External rendered cavity wall		
Outer leaf rendered blockwork	= 1.6	kN/m^2
100 Inner leaf blockwork and plaster	= 1.3	kN/m^2
New External brick block cavity wall		
Outer brickwork leaf	= 2.2	kN/m^2
100 Inner leaf blockwork and plaster	= 1.25	kN/m^2
New 100 Internal blockwork wall		
Self weight of 100 block wall, 2 faces plastered	= 1.90	kN/m^2
New Internal 215 blockwork wall		
Self weight of 215 blockwall, 2 faces plastered	= 3.60	kN/m^2

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Project: 23 HEALY STREET, LONDON NW1 8SR			Project Reference: 3356
Refer to drawing:	Calculations by: KPR	Checked by:	Sheet Number: 4
Location: Rear extension and basement.			Date: Oct 17

DESIGN OF BASEMENT RETAINING WALLS AND UNDERPINNING.

UNFACTORED WALL LOADS

Worst case loading is right hand party wall

Party Walls – Assume 330 thick throughout.

Dead Loads

330 brickwork with plaster, ground to roof	7.1 x 7.5	=	53.3	kN/m
Rear wall load over 4.5 metres	4.65 x 4.5 x 2.7 / 4.5	=	12.6	kN/m
Flat roof	0.8 x 1.7	=	1.36	kN/m
First and second floors	0.5 x 1.7 x 2	=	1.7	kN/m
Ground floor	6.8 x 2.5	=	17.0	kN/m
Total udl dead load		**=**	**85.96**	**kN/m**

Imposed Loads

Flat roof	0.75 x 1.7	=	1.3	kN/m
First and second floors	1.5 x 1.7 x 2	=	5.1	kN/m
Ground floor	1.5 x 2.5	=	3.8	kN/m
Total udl imposed load		**=**	**10.2**	**kN/m**

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Project: 23 HEALY STREET, LONDON NW1 8SR			Project Reference: 3356
Refer to drawing:	Calculations by: KPR	Checked by:	Sheet Number: 5
Location: Rear extension and basement.			Date: Oct 17

REINFORCED CONCRETE BASEMENT STRUCTURE DESIGN.

Preamble

The calculations for the reinforced concrete underpins have been carried out using Tekla's TEDDS program and the input and output calculations are appended with these calculations.

The underpin walls are designed as cantilevers propped at the base by temporary propping during construction. In the permanent condition it is checked for at rest pressures, propped at the top by the ground floor and at the base by the 350mm thick reinforced concrete basement floor slab.

Surcharge loads are taken as 10 kN/m^2
It is assumed water level may rise to 2.0 metres above base level.

Ground conditions will be checked by trial holes, but for this design they are assumed to be similar to borehole records in the vicinity, held by the BGS.

SOIL PROPERTIES BASED ON SITE BASED ON BGS BOREHOLES.

1. Retained Soil generally

Made ground and firm clay

Mobilisation factor	=	1.5
Moist density	=	19 kN/m^3
Saturated density	=	21 kN/m^3
Angle of wall friction	=	22.7°
Design shear strength	=	29.2°
Critical state angle of shear resistance	=	36°

2. Soil beneath base

Firm clayl.

Allowable bearing pressure	=	150 kN/m^2
Design shear strength	=	29.2°
Critical state angle of shear resistance	=	36°

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Project: 23 HEALY STREET, LONDON NW1 8SR			Project Reference: 3356
Refer to drawing:	Calculations by: KPR	Checked by:	Sheet Number: 6
Location: Rear extension and basement.			Date: Oct 17

TEDDS Design of underpin retaining walls.

1.Underpinning retaining walls side party walls. Top of wall unpropped

Retained height	=	3200 mm
Stem thickness	=	350 mm
Base thickness	=	350 mm
Surcharge load	=	10.0 kN/m^2

Refer to TEDDS calculation reference TEDDS – 01.

Use H20 at 200 vertically in rear face in wall
Use H20 at 200 bottom in base
Use H16 at 250 ,main bars elsewhere
Distribution minimum H12 at 250

2.Underpinning retaining walls side party walls. Top of wall propped

Retained height	=	3200 mm
Stem thickness	=	350 mm
Base thickness	=	350 mm
Surcharge load	=	10.0 kN/m^2

Refer to TEDDS calculation reference TEDDS – 02.

Use H20 at 200 vertically in rear face in wall
Use H20 at 200 bottom in base
Use H16 at 250 ,main bars elsewhere
Distribution minimum H12 at 250

3.Rear basement wall. Top of wall unpropped

Retained height	=	3200 mm
Stem thickness	=	300 mm
Base thickness	=	350 mm
Surcharge load	=	5.0 kN/m^2

Refer to TEDDS calculation reference TEDDS – 03.

Use H20 at 200 vertically in rear face in wall
Use H20 at 200 bottom in base
Use H16 at 250 ,main bars elsewhere
Distribution minimum H12 at 250

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Project: 23 HEALY STREET, LONDON NW1 8SR			Project Reference: 3356
Refer to drawing:	Calculations by: KPR	Checked by:	Sheet Number: 7
Location: Rear extension and basement.			Date: Oct 17

4.Rear basement wall. Top of wall propped

Retained height	=	3200 mm
Stem thickness	=	300 mm
Base thickness	=	350 mm
Surcharge load	=	10.0 kN/m^2

Refer to TEDDS calculation reference TEDDS – 04.

Use H20 at 200 vertically in rear face in wall
Use H20 at 200 bottom in base
Use H16 at 250 ,main bars elsewhere
Distribution minimum H12 at 250

5.Retaining wall to rear of existing house.

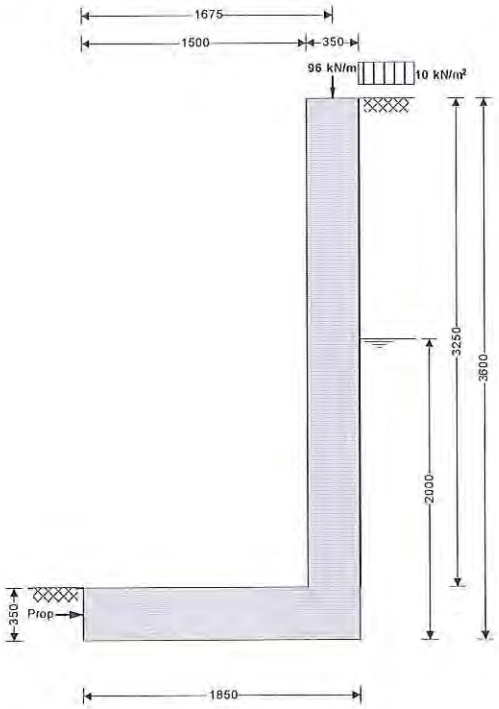
This to be similar to rear basement wall.

Use H20 at 200 vertically in rear face in wall
Use H20 at 200 bottom in base
Use H16 at 250 ,main bars elsewhere
Distribution minimum H12 at 250

Tekla Tedds	Project				Job Ref.	
PCDS ltd.	23 HEALY STREET, LONDON NW1 8SR				3356	
Unit 2, The Mead Business Centre	Section				Sheet no./rev.	
	UNDERPIN TO Pparty WALL - UNPROPPED				TEDDS- 01 / 1	
	Calc. by	Date	Chk'd by	Date	App'd by	Date
	KPR	05/10/2017				

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} = **3250** mm	Wall stem thickness	t_{wall} = **350** mm
Length of toe	l_{toe} = **1500** mm	Length of heel	l_{heel} = **0** mm
Overall length of base	l_{base} = **1850** mm	Base thickness	t_{base} = **350** mm
Height of retaining wall	h_{wall} = **3600** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **350** mm
Position of downstand	l_{ds} = **600** 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} = **2000** mm	Density of water	γ_{water} = 9.81 kN/m³
Density of wall construction	γ_{wall} = **23.6** kN/m³	Density of base construction	γ_{base} = **23.6** kN/m³
Angle of soil surface	β = **0.0** deg	Effective height at back of wall	h_{eff} = **3600** mm
Mobilisation factor	M = **1.5**		
Moist density	γ_m = **19.0** kN/m³	Saturated density	γ_s = **21.0** kN/m³
Design shear strength	ϕ' = **29.2** deg	Angle of wall friction	δ = **22.7** deg
Design shear strength	ϕ'_b = **29.2** deg	Design base friction	δ_b = **22.7** deg
Moist density	γ_{mb} = **19.0** kN/m³	Allowable bearing	$P_{bearing}$ = **150** kN/m²

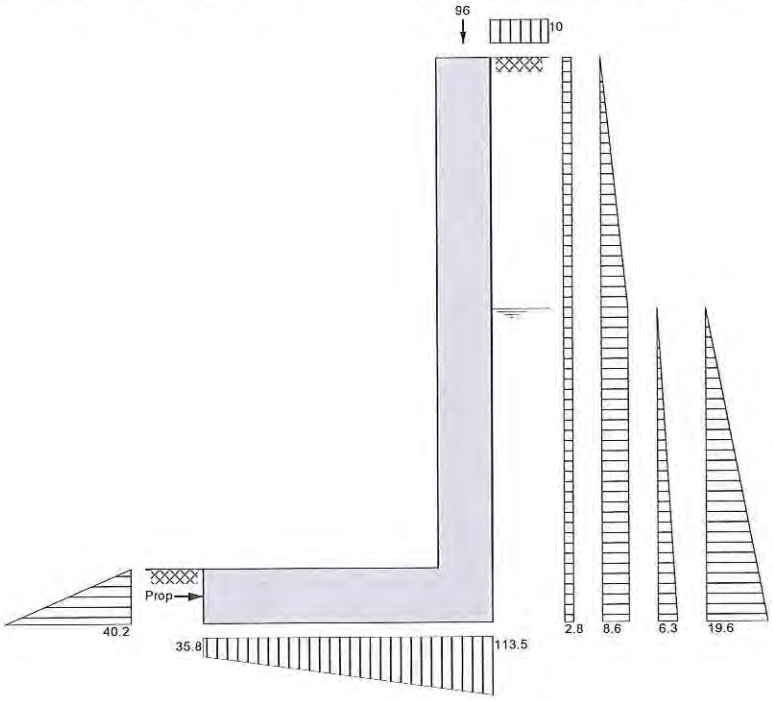
Using Coulomb theory

Active pressure	K_a =**0.305**	Passive pressure	K_p = **6.558**
At-rest pressure	K_0 = **0.512**		

Loading details

Surcharge load	Surcharge = **10.0** kN/m²		
Vertical dead load	W_{dead} = **86.0** kN/m	Vertical live load	W_{live} = **10.0** 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} = **1675** mm Height of horizontal load h_{load} = **0** mm



Loads shown in kN/m, pressures shown in kN/m²

Calculate propping force

Propping force F_{prop} = **0.0** kN/m

Check bearing pressure

Total vertical reaction R = **138.1** kN/m Distance to reaction x_{bar} = **1085** mm

Eccentricity of reaction e = **160** mm

Reaction acts within middle third of base

Bearing pressure at toe p_{toe} = **35.8** kN/m² Bearing pressure at heel p_{heel} = **113.5** 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 pressure factor γ_{f_e} = **1.4**

Calculate propping force

Propping force F_{prop} = **0.0** kN/m

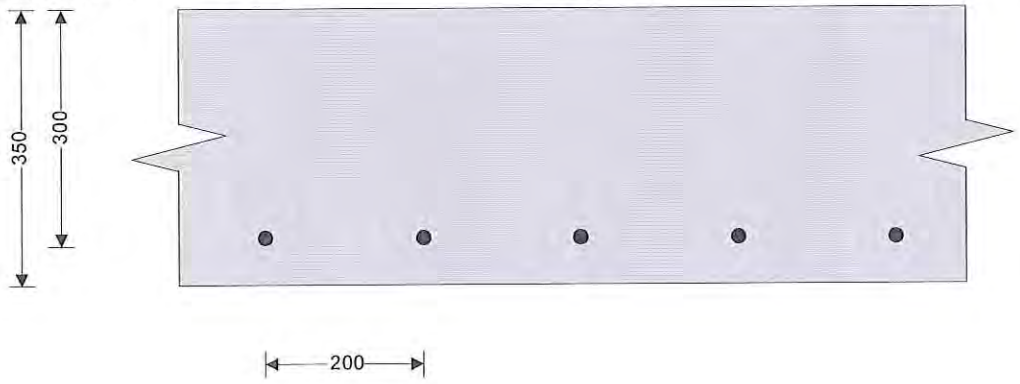
Design of reinforced concrete retaining wall toe (BS 8002:1994)

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 = **0.20** % Cover in toe c_{toe} = **40** mm



Design of retaining wall toe

Shear at heel V_{toe} = **126.7** kN/m Moment at heel M_{toe} = **103.8** kNm/m

Compression reinforcement is not required

Check toe in bending

Reinforcement provided **20 mm dia.bars @ 200 mm centres**

Area required $A_{s\_toe\_req}$ = **837.3** mm^2/m Area provided $A_{s\_toe\_prov}$ = **1571** mm^2/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress v_{toe} = **0.422** 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} = **0.612** N/mm^2

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

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

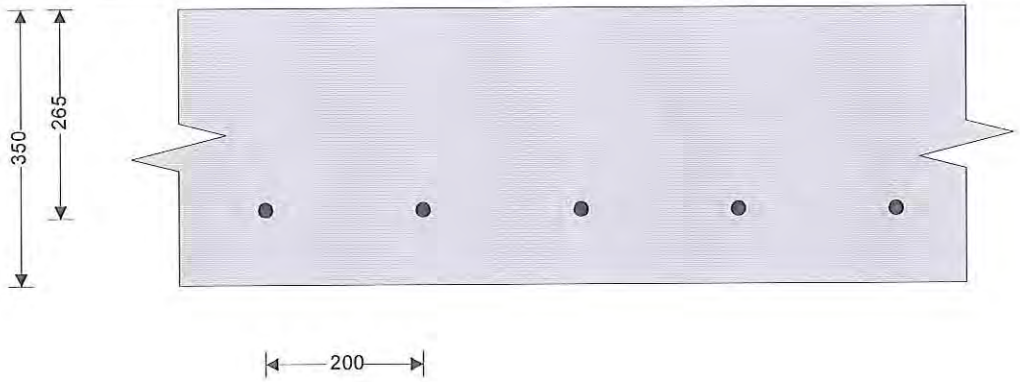
Material properties

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

Wall details

Minimum reinforcement k = **0.20** %

Cover in stem c_{stem} = **75** mm Cover in wall c_{wall} = **40** mm



Design of retaining wall stem

Shear at base of stem V_{stem} = **67.5** kN/m Moment at base of stem M_{stem} = **78.9** kNm/m

Compression reinforcement is not required

Check wall stem in bending

Reinforcement provided **20 mm dia.bars @ 200 mm centres**

Area required $A_{s\_stem\_req}$ = **720.1** mm²/m Area provided $A_{s\_stem\_prov}$ = **1571** mm²/m

PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress v_{stem} = **0.255** N/mm² Allowable shear stress v_{adm} = **4.733** N/mm²

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_stem} = **0.658** N/mm²

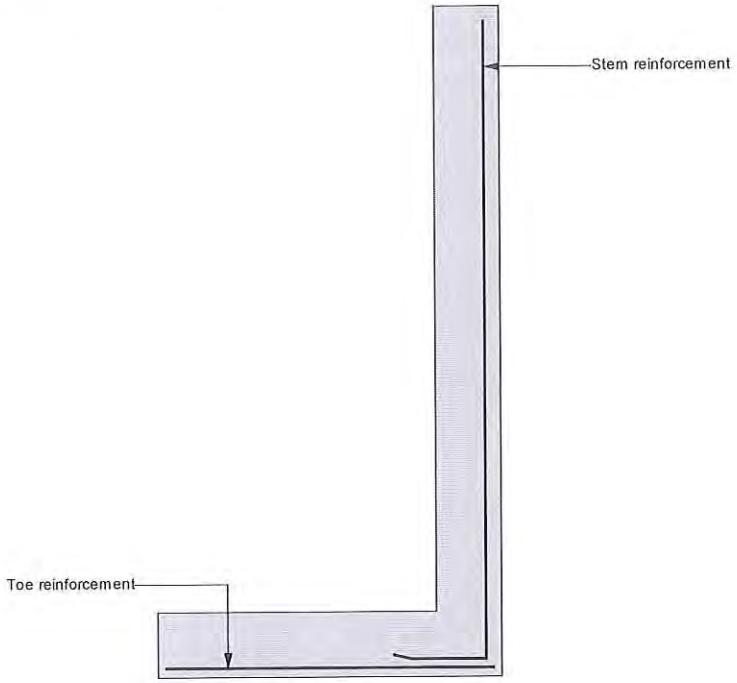
v_{stem} < v_{c_stem} - No shear reinforcement required

Check retaining wall deflection

Max span/depth ratio $ratio_{max}$ = **13.20** Actual span/depth ratio $ratio_{act}$ = **12.26**

PASS - Span to depth ratio is acceptable

Indicative retaining wall reinforcement diagram

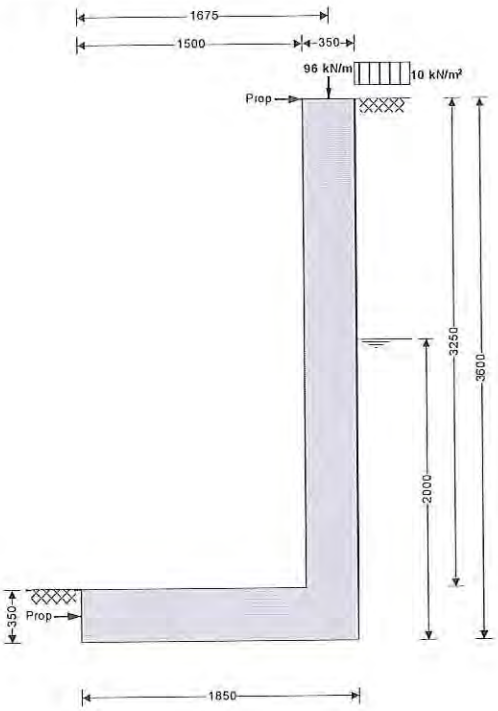


Toe bars - 20 mm dia.@ 200 mm centres - (1571 mm^2/m)
Stem bars - 20 mm dia.@ 200 mm centres - (1571 mm^2/m)

Tekla Tedds PCDS ltd. Unit 2, The Mead Business Centre	Project 23 HEALY STREET, LONDON NW1 8SR			Job Ref. 3356	
	Section UNDERPIN TO PARTY WALL - PROPPED			Sheet no./rev. TEDDS- 02 / 1	
	Calc. by KPR	Date 05/10/2017	Chk'd by	Date	App'd by	Date

RETAINING WALL ANALYSIS (BS 8002:1994)

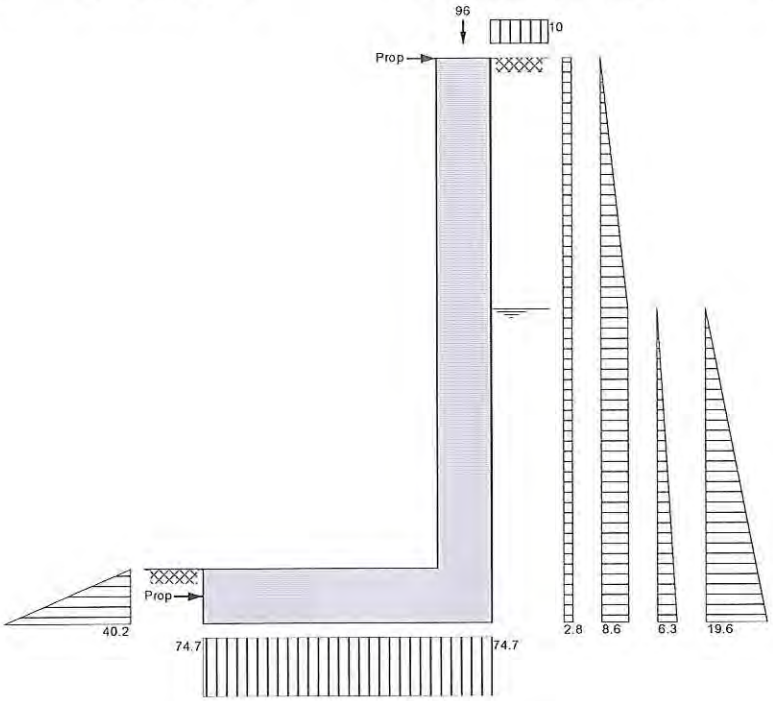
TEDDS calculation version 1.2.01.06



Wall details

Retaining wall type	**Cantilever**		
Height of wall stem	h_{stem} = **3250** mm	Wall stem thickness	t_{wall} = **350** mm
Length of toe	l_{toe} = **1500** mm	Length of heel	l_{heel} = **0** mm
Overall length of base	l_{base} = **1850** mm	Base thickness	t_{base} = **350** mm
Height of retaining wall	h_{wall} = **3600** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **350** mm
Position of downstand	l_{ds} = **600** 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} = **2000** 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} = **3600** mm
Mobilisation factor	M = **1.5**		
Moist density	γ_m = **19.0** kN/m^3	Saturated density	γ_s = **21.0** kN/m^3
Design shear strength	ϕ' = **29.2** deg	Angle of wall friction	δ = **22.7** deg
Design shear strength	ϕ'_b = **29.2** deg	Design base friction	δ_b = **22.7** deg
Moist density	γ_{mb} = **19.0** kN/m^3	Allowable bearing	$P_{bearing}$ = **150** kN/m^2
Using Coulomb theory			
Active pressure	K_a = **0.305**	Passive pressure	K_p = **6.558**
At-rest pressure	K_0 = **0.512**		
Loading details			
Surcharge load	Surcharge = **10.0** kN/m^2		
Vertical dead load	W_{dead} = **86.0** kN/m	Vertical live load	W_{live} = **10.0** 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} = **1675** 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} = **0.0** kN/m

Check bearing pressure

Total vertical reaction R = **138.1** kN/m Distance to reaction x_{bar} = **925** mm

Eccentricity of reaction e = **0** mm

Reaction acts within middle third of base

Bearing pressure at toe p_{toe} = **74.7** kN/m^2 Bearing pressure at heel p_{heel} = **74.7** kN/m^2

PASS - Maximum bearing pressure is less than allowable bearing pressure

Calculate propping forces to top and base of wall

Propping force to top of wall F_{prop_top} = **-1.574** kN/m Propping force to base of wall F_{prop_base} = **1.574** kN/m

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} = **0.0** kN/m

Calculate propping forces to top and base of wall

Propping force to top of wall $F_{prop\_top\_f}$ = **8.989** kN/m Propping force to base of wall $F_{prop\_base\_f}$ = **40.164** kN/m

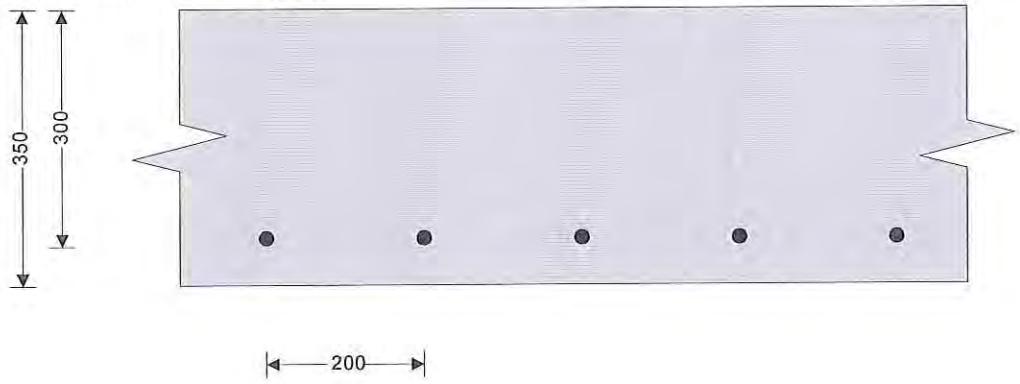
Design of reinforced concrete retaining wall toe (BS 8002:1994)

Material properties

Strength of concrete f_{cu} = **35** N/mm² Strength of reinforcement f_y = **500** N/mm²

Base details

Minimum reinforcement k = **0.20** % Cover in toe c_{toe} = **40** mm



Design of retaining wall toe

Shear at heel V_{toe} = **141.1** kN/m Moment at heel M_{toe} = **131.9** kNm/m

Compression reinforcement is not required

Check toe in bending

Reinforcement provided **20 mm dia.bars @ 200 mm centres**

Area required $A_{s\_toe\_req}$ = **1064.1** mm²/m Area provided $A_{s\_toe\_prov}$ = **1571** mm²/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress v_{toe} = **0.470** N/mm² Allowable shear stress v_{adm} = **4.733** N/mm²

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_toe} = **0.612** N/mm²

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

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

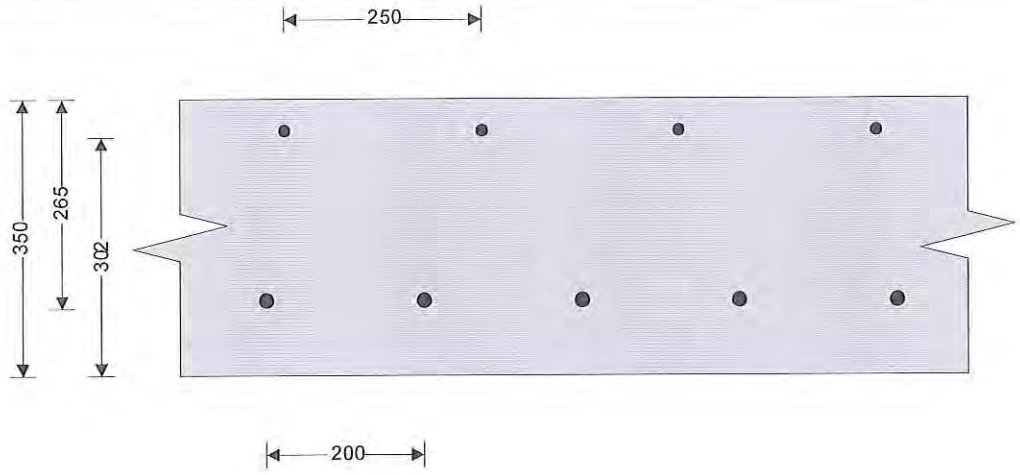
Material properties

Strength of concrete f_{cu} = **35** N/mm² Strength of reinforcement f_y = **500** N/mm²

Wall details

Minimum reinforcement k = **0.20** %

Cover in stem c_{stem} = **75** mm Cover in wall c_{wall} = **40** mm



Design of retaining wall stem

Shear at base of stem V_{stem} = **83.7** kN/m Moment at base of stem M_{stem} = **48.7** kNm/m

Compression reinforcement is not required

Check wall stem in bending

Reinforcement provided **20 mm dia.bars @ 200 mm centres**

Area required $A_{s\_stem\_req}$ = **700.0** mm²/m Area provided $A_{s\_stem\_prov}$ = **1571** mm²/m

PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress v_{stem} = **0.316** N/mm² Allowable shear stress v_{adm} = **4.733** N/mm²

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_stem} = **0.658** N/mm²

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

Design of retaining wall at mid height

Moment at mid height M_{wall} = **24.7** kNm/m

Compression reinforcement is not required

Reinforcement provided **16 mm dia.bars @ 250 mm centres**

Area required $A_{s\_wall\_req}$ = **700.0** mm²/m Area provided $A_{s\_wall\_prov}$ = **804** mm²/m

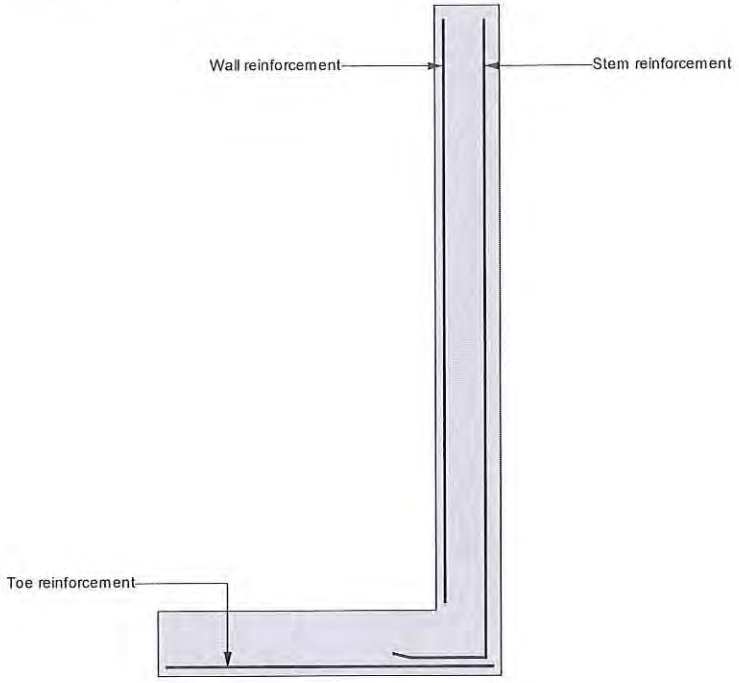
PASS - Reinforcement provided to the retaining wall at mid height is adequate

Check retaining wall deflection

Max span/depth ratio $ratio_{max}$ = **40.00** Actual span/depth ratio $ratio_{act}$ = **12.26**

PASS - Span to depth ratio is acceptable

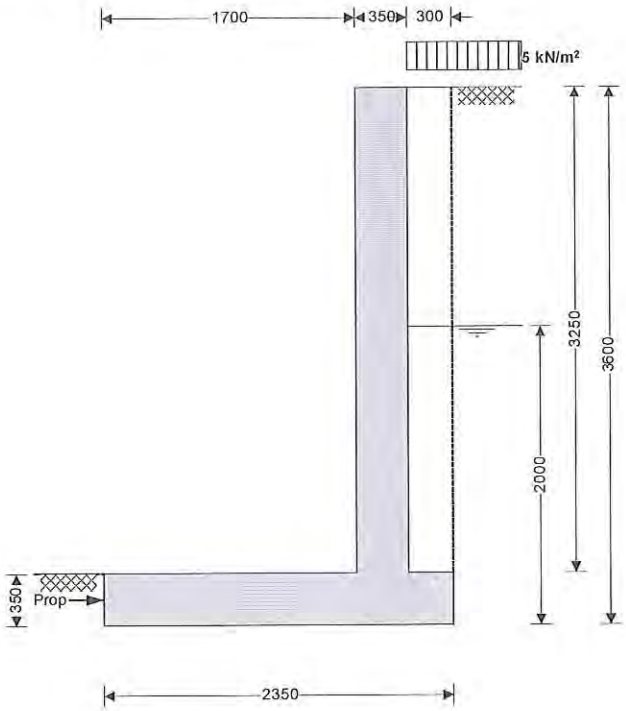
Indicative retaining wall reinforcement diagram



Toe bars - 20 mm dia.@ 200 mm centres - (1571 mm^2/m)
Wall bars - 16 mm dia.@ 250 mm centres - (804 mm^2/m)
Stem bars - 20 mm dia.@ 200 mm centres - (1571 mm^2/m)

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} = **3250** mm	Wall stem thickness	t_{wall} = **350** mm
Length of toe	l_{toe} = **1700** mm	Length of heel	l_{heel} = **300** mm
Overall length of base	l_{base} = **2350** mm	Base thickness	t_{base} = **350** mm
Height of retaining wall	h_{wall} = **3600** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **350** mm
Position of downstand	l_{ds} = **600** 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} = **2000** mm	Density of water	γ_{water} = 9.81 kN/m³
Density of wall construction	γ_{wall} = **23.6** kN/m³	Density of base construction	γ_{base} = **23.6** kN/m³
Angle of soil surface	β = **0.0** deg	Effective height at back of wall	h_{eff} = **3600** mm
Mobilisation factor	M = **1.5**		
Moist density	γ_m = **19.0** kN/m³	Saturated density	γ_s = **21.0** kN/m³
Design shear strength	ϕ' = **29.2** deg	Angle of wall friction	δ = **22.7** deg
Design shear strength	ϕ'_b = **29.2** deg	Design base friction	δ_b = **22.7** deg
Moist density	γ_{mb} = **19.0** kN/m³	Allowable bearing	$P_{bearing}$ = **150** kN/m²

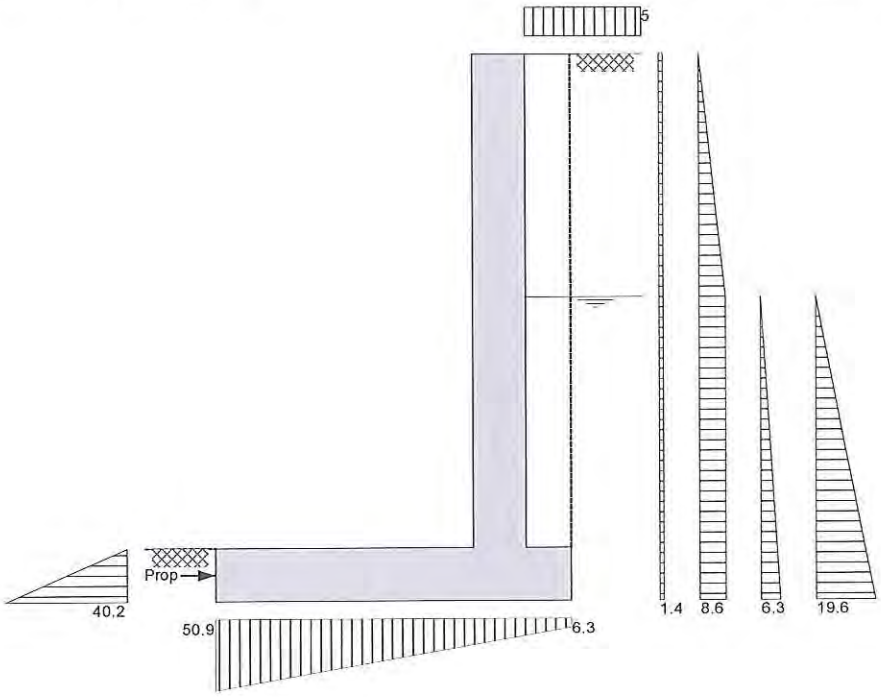
Using Coulomb theory

Active pressure	K_a =**0.305**	Passive pressure	K_p = **6.558**
At-rest pressure	K_0 = **0.512**		

Loading details

Surcharge load	Surcharge = **5.0** kN/m²		
Vertical dead load	W_{dead} = **0.0** 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} = **0** mm Height of horizontal load h_{load} = **0** mm



Loads shown in kN/m, pressures shown in kN/m²

Calculate propping force

Propping force F_{prop} = **20.4** kN/m

Check bearing pressure

Total vertical reaction R = **67.3** kN/m Distance to reaction x_{bar} = **870** mm

Eccentricity of reaction e = **305** mm

Reaction acts within middle third of base

Bearing pressure at toe p_{toe} = **50.9** kN/m² Bearing pressure at heel p_{heel} = **6.3** 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 pressure factor γ_{f_e} = **1.4**

Calculate propping force

Propping force F_{prop} = **20.4** kN/m

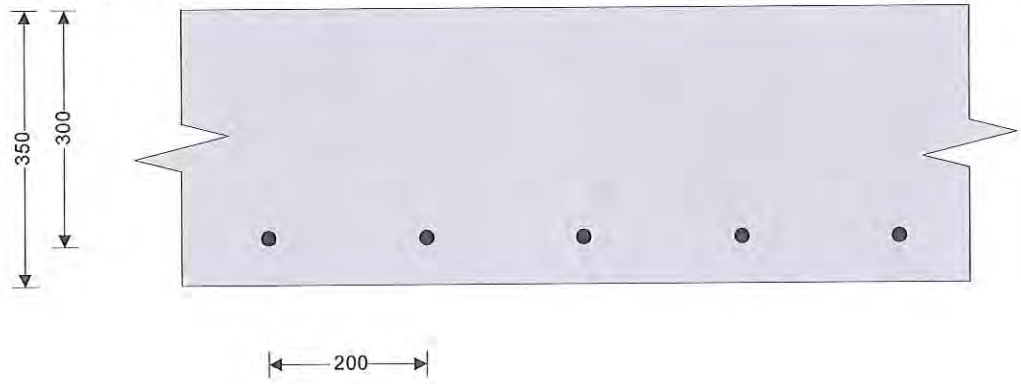
Design of reinforced concrete retaining wall toe (BS 8002:1994)

Material properties

Strength of concrete f_{cu} = **35** N/mm² — Strength of reinforcement f_y = **500** N/mm²

Base details

Minimum reinforcement k = **0.20** % — Cover in toe c_{toe} = **40** mm



Design of retaining wall toe

Shear at heel V_{toe} = **64.2** kN/m — Moment at heel M_{toe} = **77.4** kNm/m

Compression reinforcement is not required

Check toe in bending

Reinforcement provided **20 mm dia.bars @ 200 mm centres**

Area required $A_{s\_toe\_req}$ = **700.0** mm²/m — Area provided $A_{s\_toe\_prov}$ = **1571** mm²/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress v_{toe} = **0.214** N/mm² — Allowable shear stress v_{adm} = **4.733** N/mm²

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_toe} = **0.612** N/mm²

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

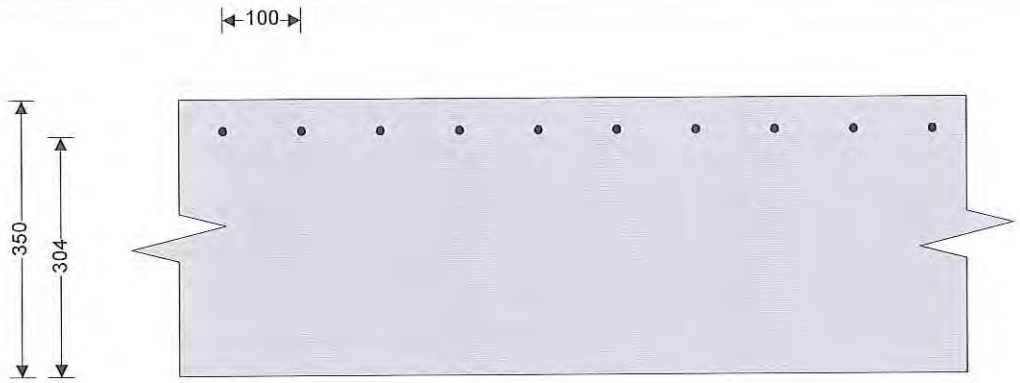
Design of reinforced concrete retaining wall heel (BS 8002:1994)

Material properties

Strength of concrete f_{cu} = **35** N/mm² — Strength of reinforcement f_y = **500** N/mm²

Base details

Minimum reinforcement k = **0.20** % — Cover in heel c_{heel} = **40** mm



Design of retaining wall heel

Shear at heel V_{heel} = **29.7** kN/m Moment at heel M_{heel} = **9.6** kNm/m

Compression reinforcement is not required

Check heel in bending

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

Area required $A_{s\_heel\_req}$ = **700.0** mm²/m Area provided $A_{s\_heel\_prov}$ = **1131** mm²/m

PASS - Reinforcement provided at the retaining wall heel is adequate

Check shear resistance at heel

Design shear stress v_{heel} = **0.098** N/mm² Allowable shear stress v_{adm} = **4.733** N/mm²

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_heel} = **0.545** N/mm²

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

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

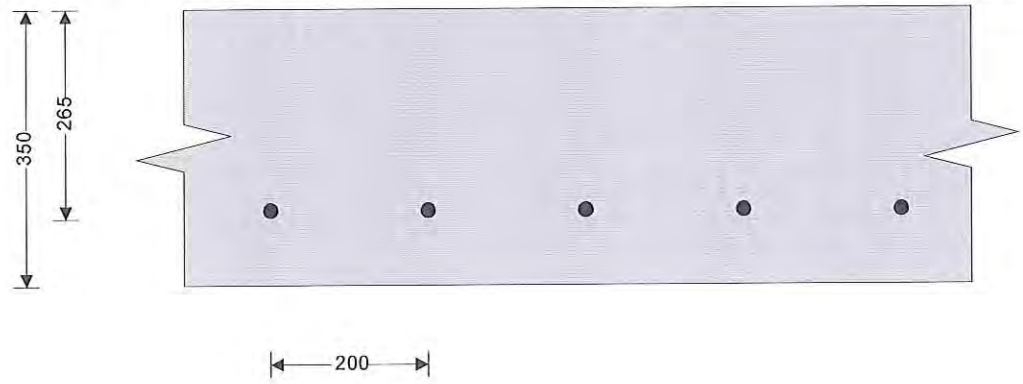
Material properties

Strength of concrete f_{cu} = **35** N/mm² Strength of reinforcement f_y = **500** N/mm²

Wall details

Minimum reinforcement k = **0.20** %

Cover in stem c_{stem} = **75** mm Cover in wall c_{wall} = **40** mm



Design of retaining wall stem

Shear at base of stem V_{stem} = **31.8** kN/m Moment at base of stem M_{stem} = **65.7** kNm/m

Compression reinforcement is not required

Check wall stem in bending

Reinforcement provided **20 mm dia.bars @ 200 mm centres**

Area required $A_{s\_stem\_req}$ = **700.0** mm²/m Area provided $A_{s\_stem\_prov}$ = **1571** mm²/m

PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress v_{stem} = **0.120** N/mm² Allowable shear stress v_{adm} = **4.733** N/mm²

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_stem} = **0.658** N/mm²

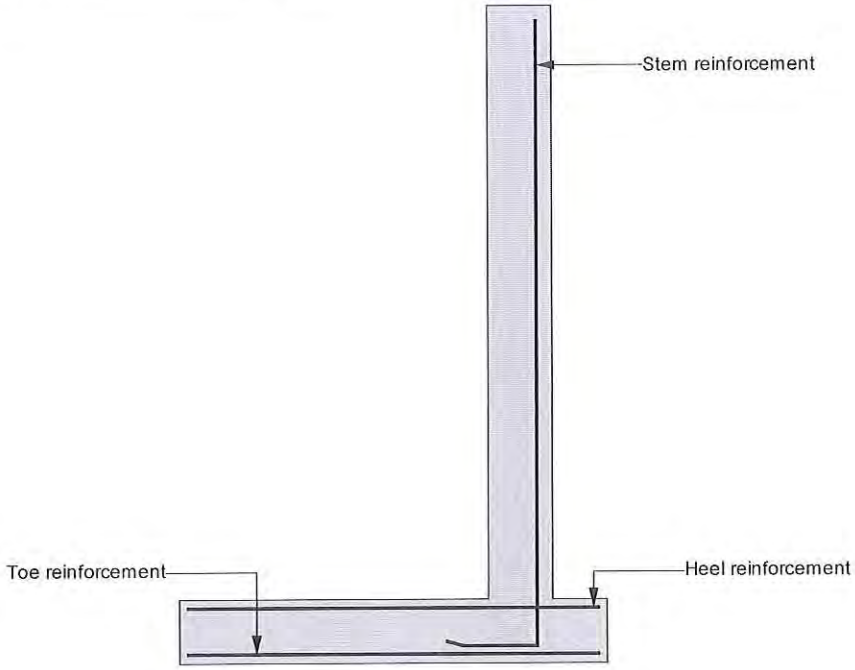
$v_{stem} < v_{c\_stem}$ - No shear reinforcement required

Check retaining wall deflection

Max span/depth ratio $ratio_{max}$ = **14.00** Actual span/depth ratio $ratio_{act}$ = **12.26**

PASS - Span to depth ratio is acceptable

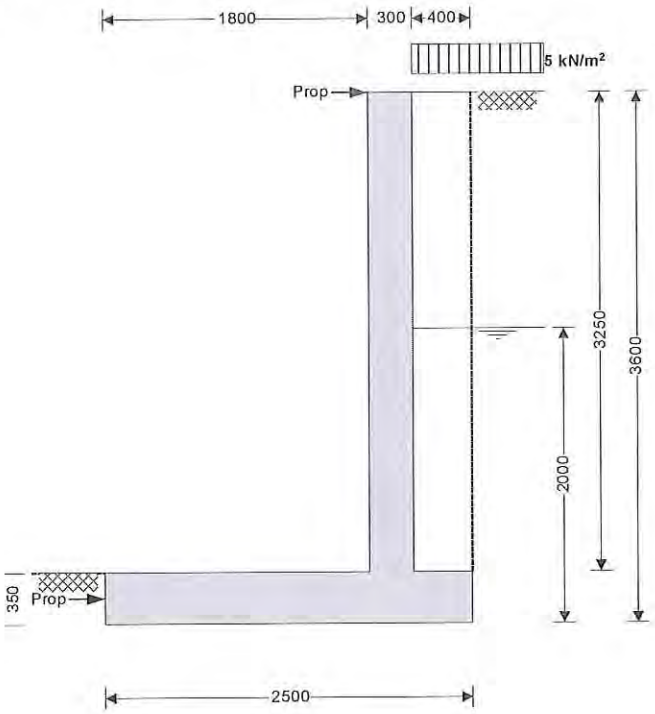
Indicative retaining wall reinforcement diagram



Toe bars - 20 mm dia.@ 200 mm centres - (1571 mm^2/m)
Heel bars - 12 mm dia.@ 100 mm centres - (1131 mm^2/m)
Stem bars - 20 mm dia.@ 200 mm centres - (1571 mm^2/m)

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} = **3250** mm	Wall stem thickness	t_{wall} = **300** mm
Length of toe	l_{toe} = **1800** mm	Length of heel	l_{heel} = **400** mm
Overall length of base	l_{base} = **2500** mm	Base thickness	t_{base} = **350** mm
Height of retaining wall	h_{wall} = **3600** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **350** mm
Position of downstand	l_{ds} = **600** 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} = **2000** mm	Density of water	γ_{water} = 9.81 kN/m³
Density of wall construction	γ_{wall} = **23.6** kN/m³	Density of base construction	γ_{base} = **23.6** kN/m³
Angle of soil surface	β = **0.0** deg	Effective height at back of wall	h_{eff} = **3600** mm
Mobilisation factor	M = **1.5**		
Moist density	γ_m = **19.0** kN/m³	Saturated density	γ_s = **21.0** kN/m³
Design shear strength	ϕ' = **29.2** deg	Angle of wall friction	δ = **22.7** deg
Design shear strength	ϕ'_b = **29.2** deg	Design base friction	δ_b = **22.7** deg
Moist density	γ_{mb} = **19.0** kN/m³	Allowable bearing	$P_{bearing}$ = **150** kN/m²

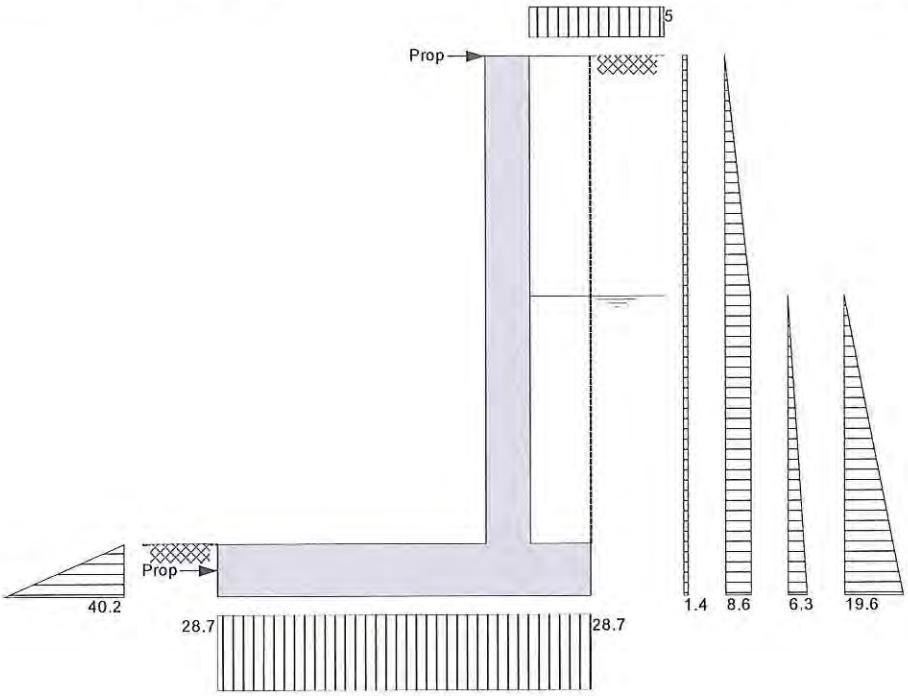
Using Coulomb theory

Active pressure	K_a =**0.305**	Passive pressure	K_p = **6.558**
At-rest pressure	K_0 = **0.512**		

Loading details

Surcharge load	Surcharge = **5.0** kN/m²		
Vertical dead load	W_{dead} = **0.0** 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} = **0** mm Height of horizontal load h_{load} = **0** mm



Loads shown in kN/m, pressures shown in kN/m²

Calculate propping force

Propping force F_{prop} = **18.8** kN/m

Check bearing pressure

Total vertical reaction R = **71.7** kN/m Distance to reaction x_{bar} = **1250** mm

Eccentricity of reaction e = **0** mm

Reaction acts within middle third of base

Bearing pressure at toe p_{toe} = **28.7** kN/m² Bearing pressure at heel p_{heel} = **28.7** kN/m²

PASS - Maximum bearing pressure is less than allowable bearing pressure

Calculate propping forces to top and base of wall

Propping force to top of wall F_{prop_top} = **4.863** kN/m Propping force to base of wall F_{prop_base} = **13.904** kN/m

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} = **18.8** kN/m

Calculate propping forces to top and base of wall

Propping force to top of wall $F_{prop\_top\_f}$ = **19.608** kN/m Propping force to base of wall $F_{prop\_base\_f}$ = **49.024** kN/m

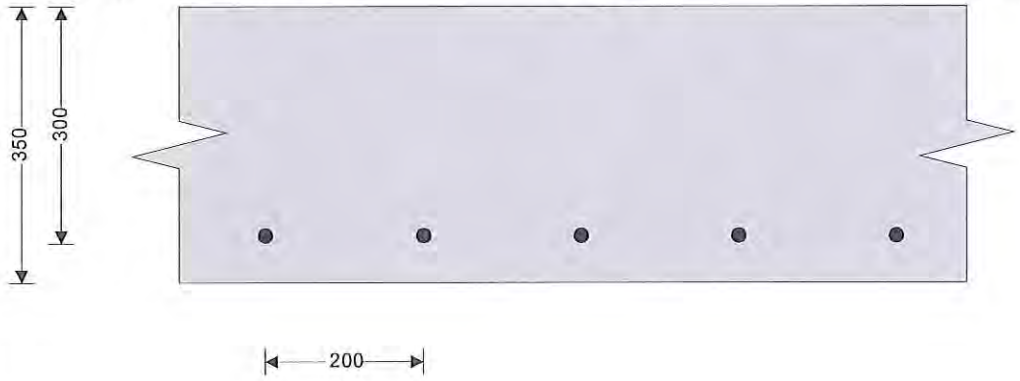
Design of reinforced concrete retaining wall toe (BS 8002:1994)

Material properties

Strength of concrete f_{cu} = **35** N/mm² Strength of reinforcement f_y = **500** N/mm²

Base details

Minimum reinforcement k = **0.20** % Cover in toe c_{toe} = **40** mm



Design of retaining wall toe

Shear at heel V_{toe} = **51.7** kN/m Moment at heel M_{toe} = **54.6** kNm/m

Compression reinforcement is not required

Check toe in bending

Reinforcement provided **20 mm dia.bars @ 200 mm centres**

Area required $A_{s\_toe\_req}$ = **700.0** mm²/m Area provided $A_{s\_toe\_prov}$ = **1571** mm²/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress v_{toe} = **0.172** N/mm² Allowable shear stress v_{adm} = **4.733** N/mm²

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_toe} = **0.612** N/mm²

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

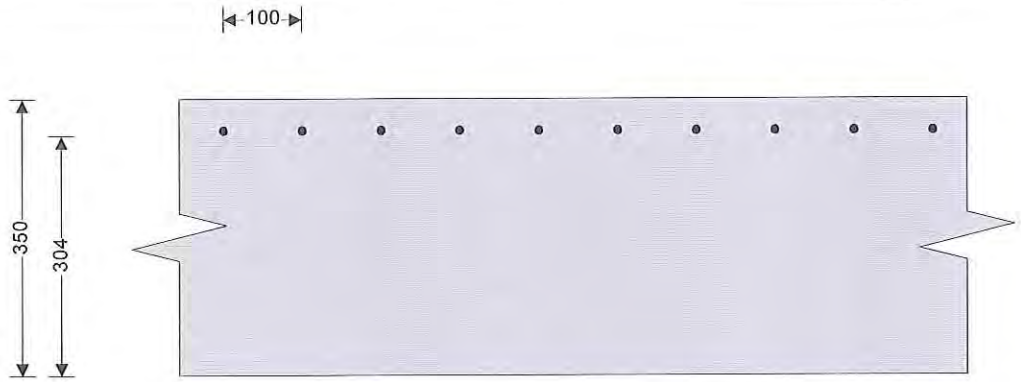
Design of reinforced concrete retaining wall heel (BS 8002:1994)

Material properties

Strength of concrete f_{cu} = **35** N/mm² Strength of reinforcement f_y = **500** N/mm²

Base details

Minimum reinforcement k = **0.20** % Cover in heel c_{heel} = **40** mm



Design of retaining wall heel

Shear at heel V_{heel} = **28.1** kN/m Moment at heel M_{heel} = **9.5** kNm/m

Compression reinforcement is not required

Check heel in bending

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

Area required $A_{s\_heel\_req}$ = **700.0** mm²/m Area provided $A_{s\_heel\_prov}$ = **1131** mm²/m

PASS - Reinforcement provided at the retaining wall heel is adequate

Check shear resistance at heel

Design shear stress v_{heel} = **0.093** N/mm² Allowable shear stress v_{adm} = **4.733** N/mm²

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_heel} = **0.545** N/mm²

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

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

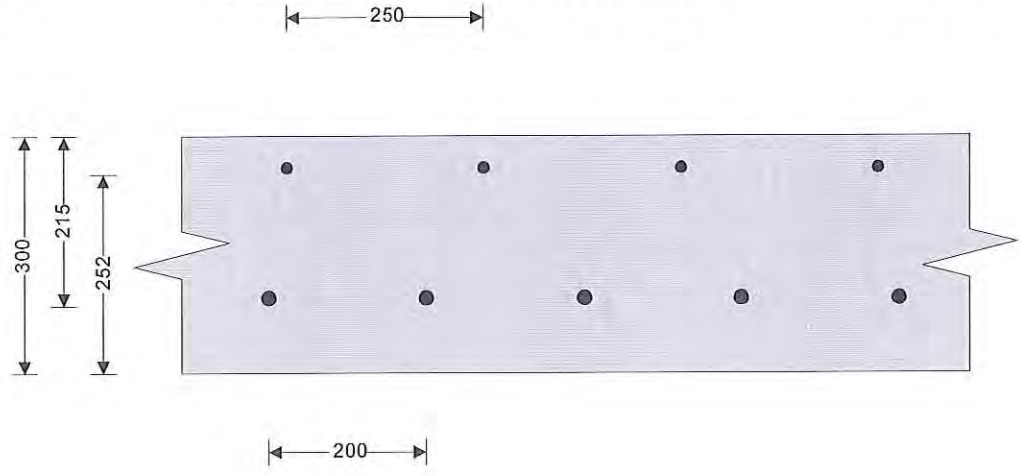
Material properties

Strength of concrete f_{cu} = **35** N/mm² Strength of reinforcement f_y = **500** N/mm²

Wall details

Minimum reinforcement k = **0.20** %

Cover in stem c_{stem} = **75** mm Cover in wall c_{wall} = **40** mm



Design of retaining wall stem

Shear at base of stem V_{stem} = **75.4** kN/m Moment at base of stem M_{stem} = **43.0** kNm/m

Compression reinforcement is not required

Check wall stem in bending

Reinforcement provided **20 mm dia.bars @ 200 mm centres**

Area required $A_{s\_stem\_req}$ = **600.0** mm²/m Area provided $A_{s\_stem\_prov}$ = **1571** mm²/m

PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress v_{stem} = **0.351** N/mm² Allowable shear stress v_{adm} = **4.733** N/mm²

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_stem} = **0.744** N/mm²

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

Design of retaining wall at mid height

Moment at mid height M_{wall} = **21.5** kNm/m

Compression reinforcement is not required

Reinforcement provided **16 mm dia.bars @ 250 mm centres**

Area required $A_{s\_wall\_req}$ = **600.0** mm²/m Area provided $A_{s\_wall\_prov}$ = **804** mm²/m

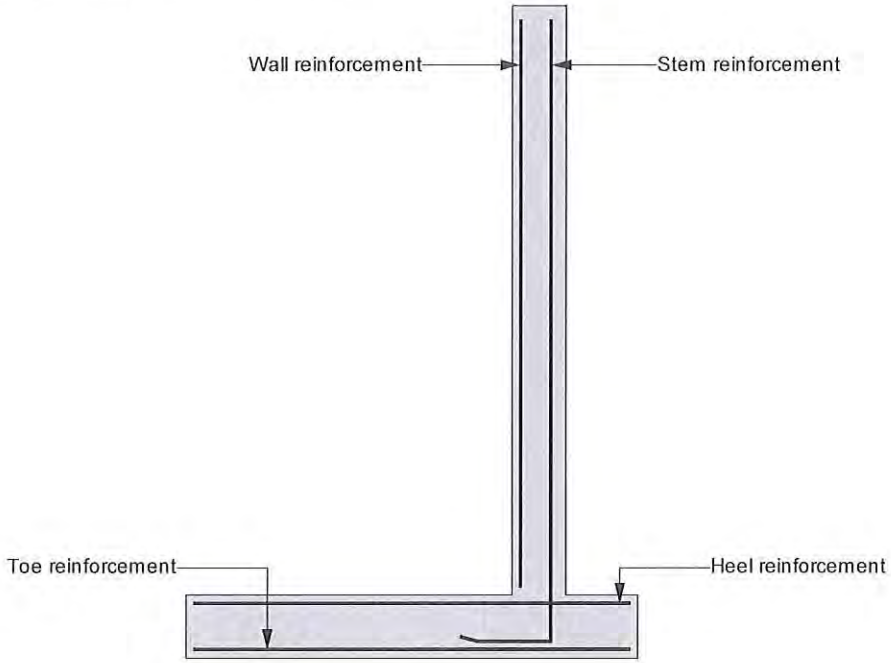
PASS - Reinforcement provided to the retaining wall at mid height is adequate

Check retaining wall deflection

Max span/depth ratio $ratio_{max}$ = **40.00** Actual span/depth ratio $ratio_{act}$ = **15.12**

PASS - Span to depth ratio is acceptable

Indicative retaining wall reinforcement diagram



Toe bars - 20 mm dia.@ 200 mm centres - (1571 mm^2/m)
Heel bars - 12 mm dia.@ 100 mm centres - (1131 mm^2/m)
Wall bars - 16 mm dia.@ 250 mm centres - (804 mm^2/m)
Stem bars - 20 mm dia.@ 200 mm centres - (1571 mm^2/m)