Report Contents

1.0 Introduction

1.1 This report has been completed by John Harrison for Harrison Shortt Structural Engineers Ltd.

Anthony John Douglas Harrison (MIStructE (028362792), MEng, CEng).

1.2 Harrison Shortt Structural Engineers Ltd. (HSSE) have been appointed by the building owners to prepare the structural design of the alterations at 82 Fitzjohns Avenue.

1.3 We will be visiting site periodically thought the works to ensure the works are generally in accordance with the design and constructed in a safe and robust manor. Typically we will visit on a fortnightly basis reducing to monthly as the structural works are completed

1.4 This Report provides the Structural Drawings and Calculations for the proposed works.

1.5 The Basement Impact Assessment has been prepared by Geotechnical & Environment Associates Ltd. (GEA)

1.6a The report has been retitled "Structural Report – Supporting Documentation" as referenced int eh CampbellReith Audit

2.0 Existing Building, Site and Ground Conditions

2.1 The original part of the existing building was constructed between 1910 and 1920 and was extended over the 20th century to be the three storey residential house on the site today. The building is L-shaped on plan with the building extending along the Northern and Eastern Boundaries

2.2 The building is constructed with brickwork external and party walls. The internal walls are brickwork where loadbearing and hollow clay blocks for non-loadbearing partitions.

2.3 The floors are constructed with timber floor joists spanning perpendicular to the main facades.

2.4 The roof is a traditional cut rafter and purlined roof clad in clay tiles.

2.5 The building has been extended with:

- A single storey rear extension,
- A small "pool house to the north for the northern wing,
- The Norther Wing has been elongated,
- A second storey extension has been added to the southern part of the eastern wing,
- A new swimming pool.

2.6 The building is founded on corbelled brickwork on London Clay. The detailed geology can be found in the GEA report

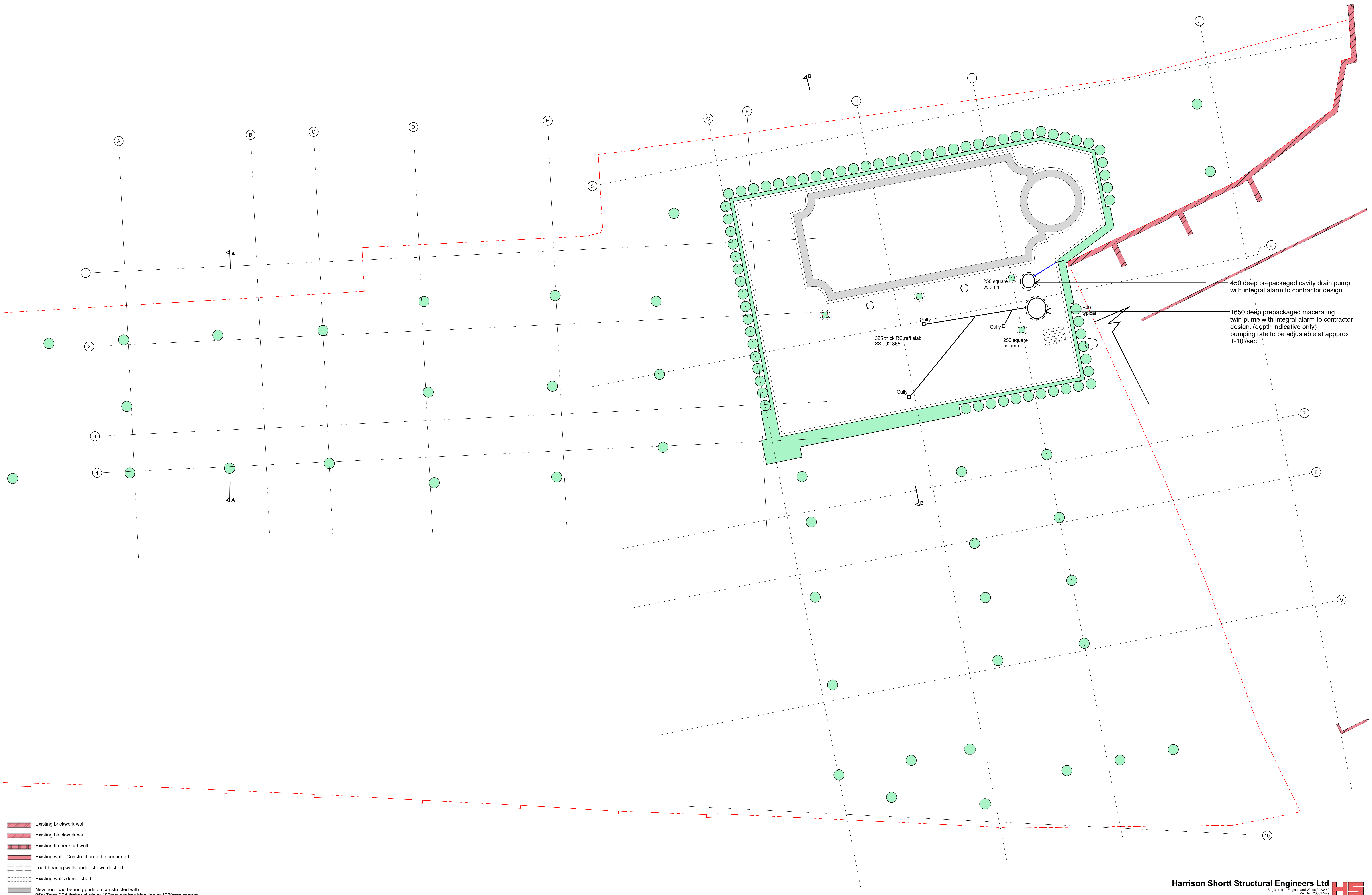
3.0 Proposed Works

3.1 Demolition of various parts of the building retaining parts of the main eastern wing and reconstruction of the remainder of the building on a piled raft with a new retaining wall to the northern boundary.

3.2 The swimming pool will be lowered to the existing ground floor level founded approximately 2m below with a new basement plant room.

3.3 The new super structure will be a traditional load bearing cavity construction with timber metal web service joists.

4.0 Drawings



- Existing brickwork wall.
- Existing blockwork wall.
- Existing timber stud wall.
- Existing wall. Construction to be confirmed.
- Load bearing walls under shown dashed
- Existing walls demolished
- New non-load bearing partition constructed with 95x47mm C24 timber studs at 400mm centres blocking at 1200mm centres.
- New brickwork wall
- New medium dense (min 14kN/m^3) blockwork wall and M12 mortar UNO.
- Loadbearing timber stud wall with 12mm cladding to one side fixed at 150 centers

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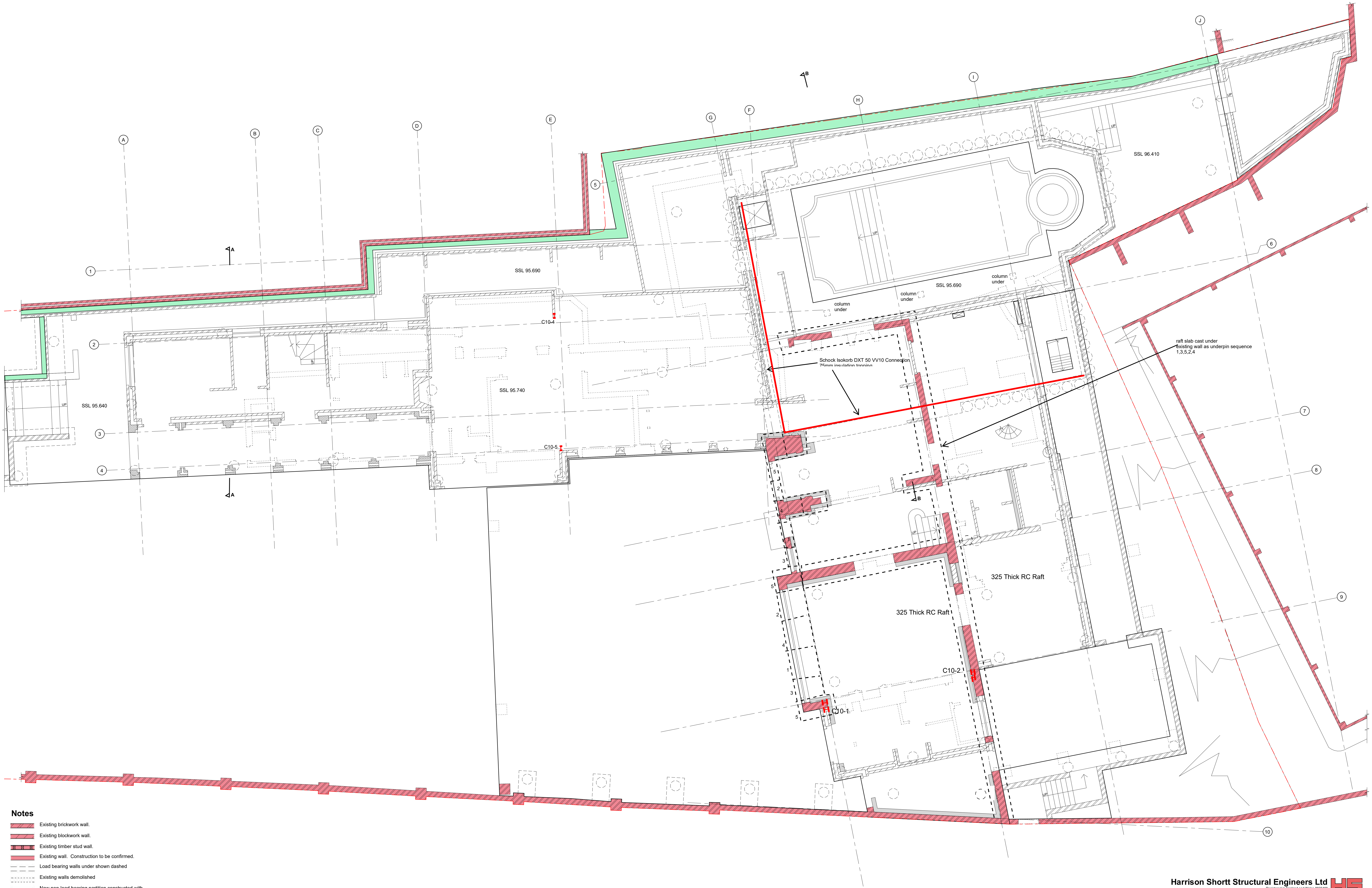
Proposed Basement Floor Plan 2020_06_25 1:100 (A2) 2092_P09_F



Notes

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Proposed Ground Floor Plan   2020_06_25   1:100 (A2)   2092_P10_L

Notes

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- Existing blockwork wall.
- Existing timber stud wall.
- Existing wall. Construction to be confirmed.
- Load bearing walls under shown dashed
- Existing walls demolished
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Proposed First Floor Plan 2020_06_25 NTS (A3) 2092_P11_J

Notes

- Existing brickwork wall.
- Existing blockwork wall.
- Existing timber stud wall.
- Existing wall. Construction to be confirmed.
- Load bearing walls under shown dashed
- Existing walls demolished
- New non-load bearing partition constructed with 95x47mm C24 timber studs at 400mm centres blocking at 1200mm centres.
- New brickwork wall
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0 1 2 5 1:100 at A2

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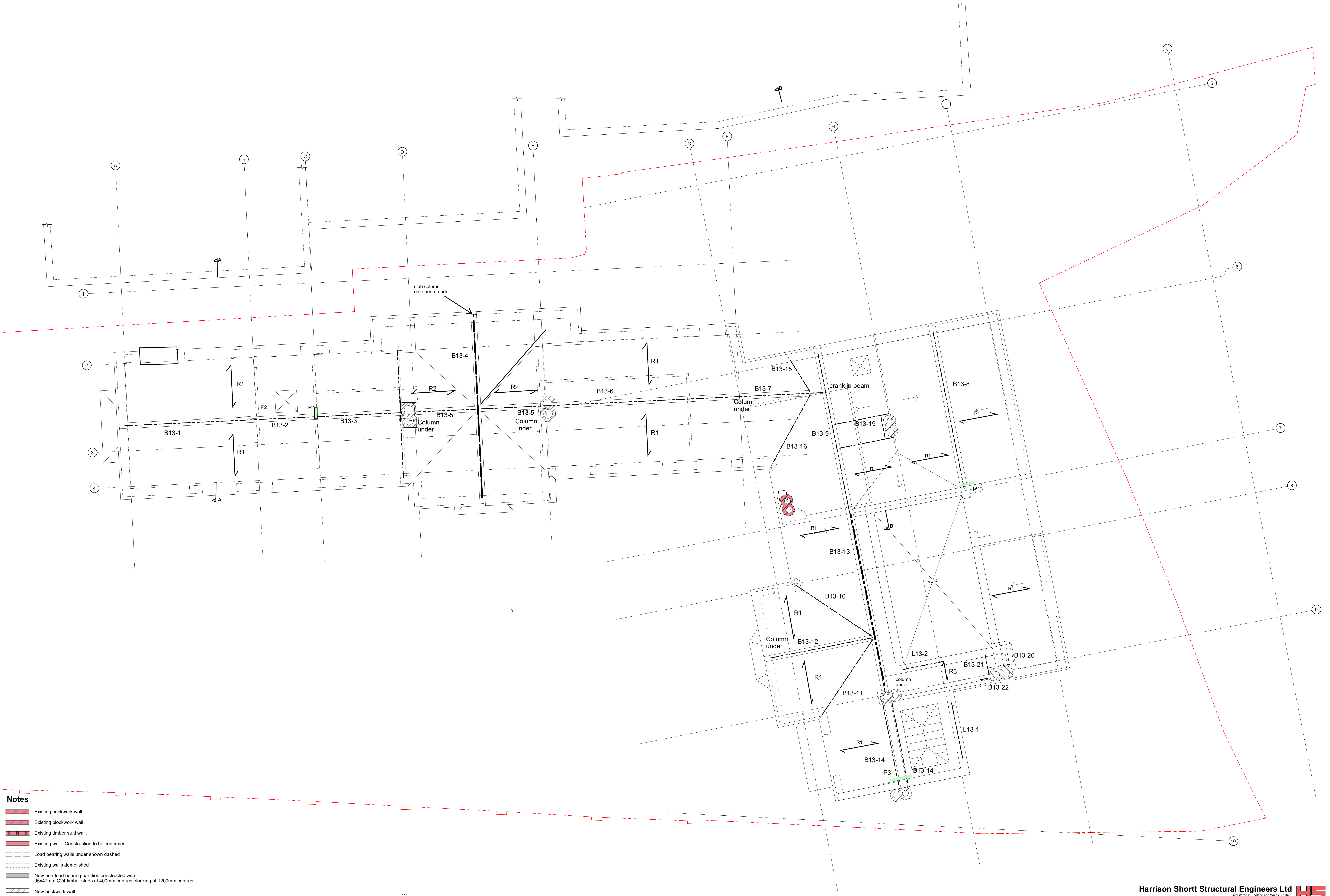
Proposed Second Floor Plan 2020_06_25 NTS (A3) 2092_P12_G



Notes

- Existing brickwork wall.
- Existing blockwork wall.
- Existing timber stud wall.
- Existing wall. Construction to be confirmed.
- Load bearing walls under shown dashed
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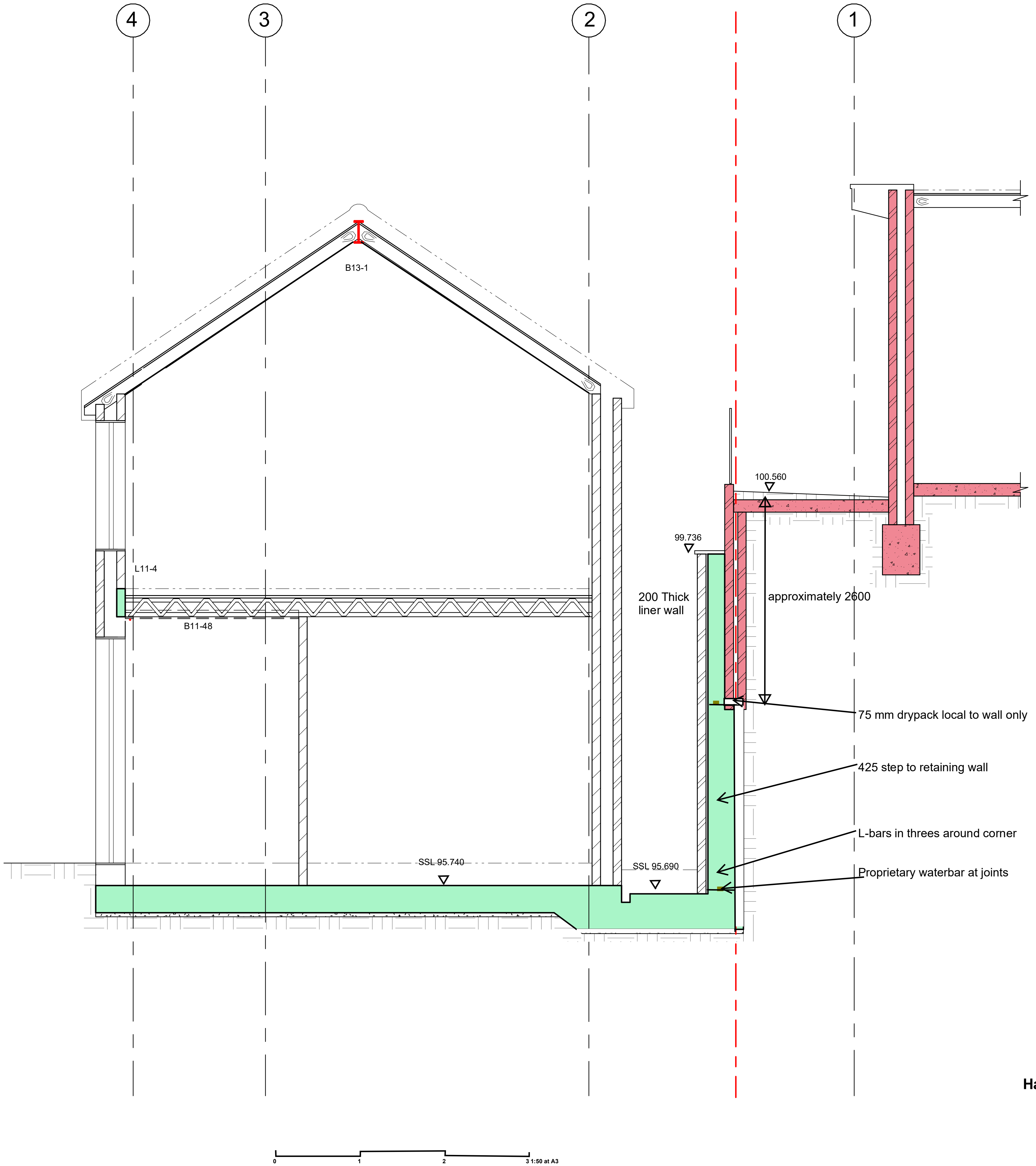
Proposed Roof Plan 2020_06_25 NTS (A3) 2092_P13_H



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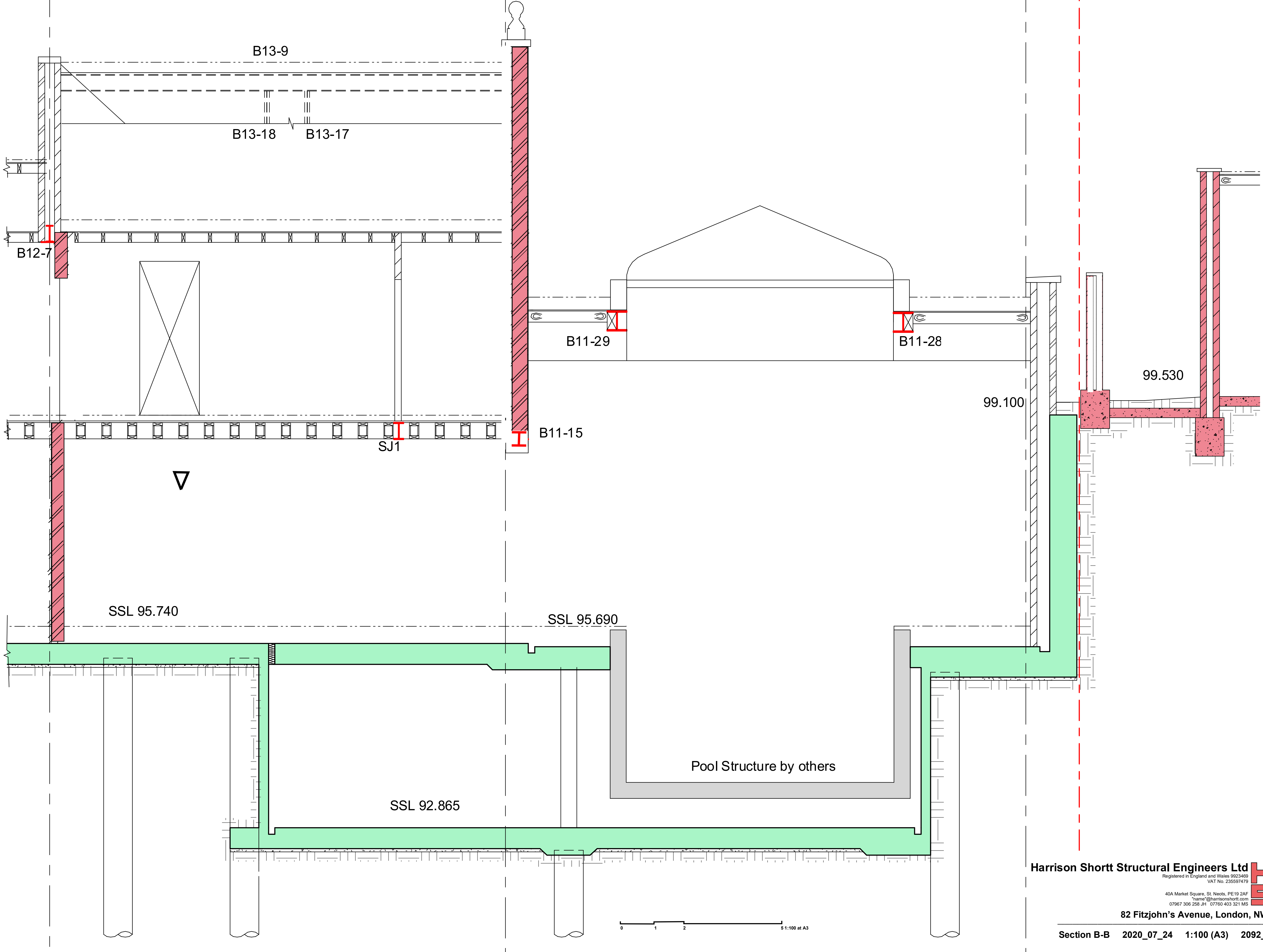
Section A-A 2020_07_24 1:50 (A3) 2092_P20_H



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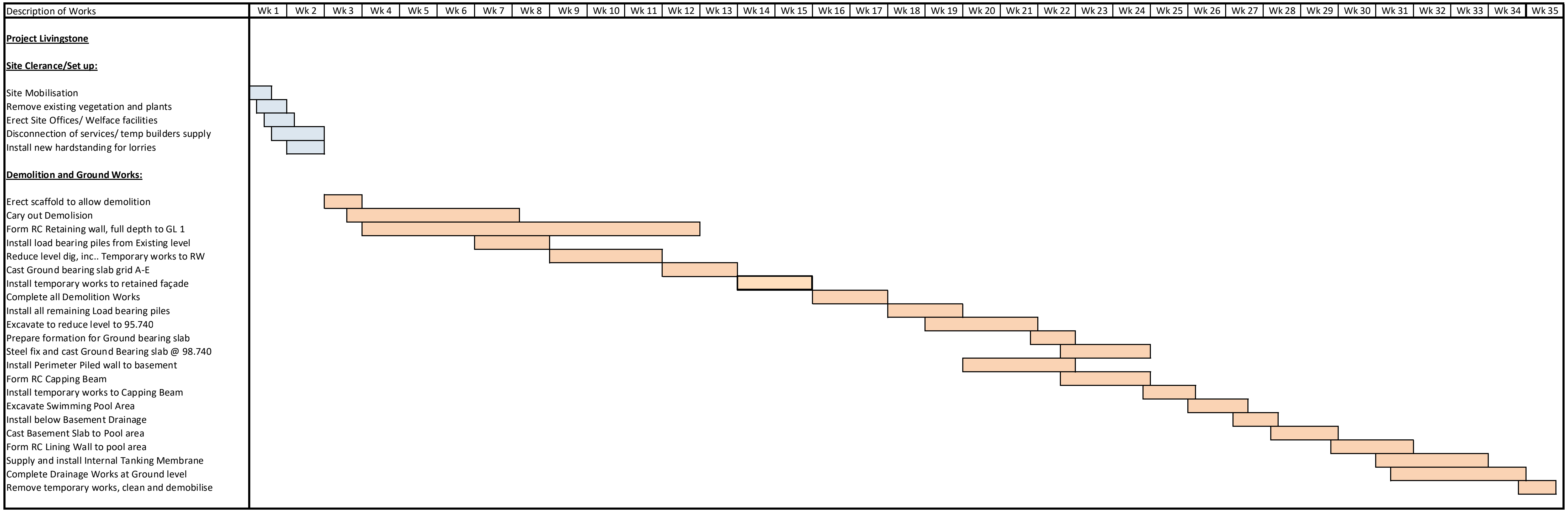
Section B-B 2020_07_24 1:100 (A3) 2092_P21_H

5.0 Program



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Indicative Program 2020_08_07 NTS (A3) 2092_Program 01_A

6.0 Movement Monitoring Regime

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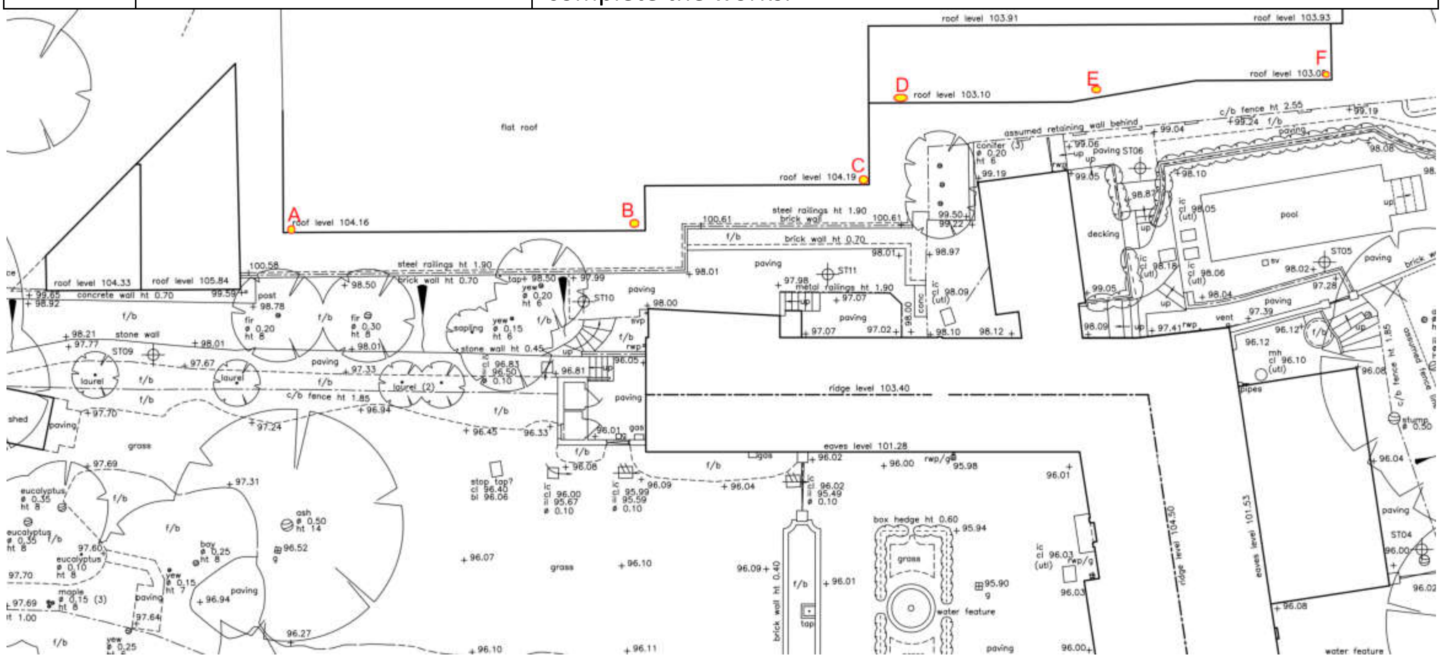
Method
Adhesive targets shall be fixed to the walls at just below eaves levels All results including initial base-line readings shall be issued within 48 hours of being recorded to the Two Surveyors and consultant and project engineers in graphical and tabular format.

Frequency
1 reading to be taken in addition to baseline prior to commencing works
1 month intervals.
Frequency shall increase subject to following trigger levels.
Post completion of retaining walls monthly thereafter for 3 months post completion, or until movement trends ceased.

Triggers and Actions

	Trigger	Action
Green	- Cumulative vertical or lateral movement of +/-2.5mm being measured.	Movement monitoring should increased in frequency to fortnightly
Amber	-Cumulative vertical or lateral movement of +/-5mm being measure.	- movement monitoring should increased in frequency to weekly. - General photographs of the site are to be issued to the surveyors and engineers for immediate review. - The project engineer and Surveyors are to be informed immediately and to meet on site within 10 working days to review the construction and agree further actions at the meeting with the contractor to immediately implement these as applicable.
Red	- Cumulative vertical or lateral movement of +/-10mm being measured.	- All works are to stop. - All open excavations are to back filled with 150mm layers granular material or foamed concrete. - General photographs of the site are to be issued to the surveyors and engineers for immediate review. - The project engineer and Surveyors are to be informed immediately and to meet on site ideally within 48 hours but no later than 6 working days to determine how to complete the basement structure - At this stage it may be necessary to employ a different contractor to complete the works.



Index

1.0 Introduction

1.1 Harrison Shortt Structural Engineers (HSSE) are acting as both the temporary and Permanent works engineer. The proposed method provides a detailed and safe method of works.

1.2 This document should be read in conjunction with all other contract documents.

1.3 The intention of this document is not to describe the number of operatives, timescales or exact method of working, but to set out the principles of the works and the details of the temporary structure.

1.4 The existing building has been soft stripped, prior to starting the structural works the building can be stripped back to the shell to allow for reclamation and recycling

1.5 This document provides the Temporary works and sequence up to the completion of the ground works.

2.0 Existing Building

2.1 The House is a Two storey detached house L-shaped on plan with the Northern wing set into the Hill, The original parts of the building were started in the first decade of the twentieth century.

2.2 The buildings are traditionally constructed with solid 9 inch brick walls supporting timber joists that generally span form front to back, the joists spanning front to back with a sarking board at mid-depth to support pugging

2.3 Internally the walls are hollow clay blocks built off the floor joists.

2.4 The building was extended in the middle of the twentieth century adding the two storey Northern wing constructed in solid masonry with timber floors.

2.5 There are two further single storey extensions to the East and the North on single are lightweight timber structures.

2.6 The building is founded on very shallow corbelled brickwork foundations. The underlying soil is Claygate members

3.0 Proposed Building

3.1 The proposed works involve retaining the southern block of the building and demolishing the modern extensions

3.2 The position of the building is in approximately the same position as the existing with the Northern wing extended in length, and constructed with a new pool and basement plant room.

3.3 The basement will be formed with contiguous bored piles with a concrete lining wall cast across the face of the piles and basement raft slab supported on internal piles.

3.4 The Northern boundary will be a Reinforced concrete retaining wall underpinning the majority of the existing boundary and supported on a thick reinforced concrete raft that will be supported on insitu bored concrete piles.

3.5 The super structure will be a traditional loadbearing masonry building supporting timber service joists and steel cellular beams as required.

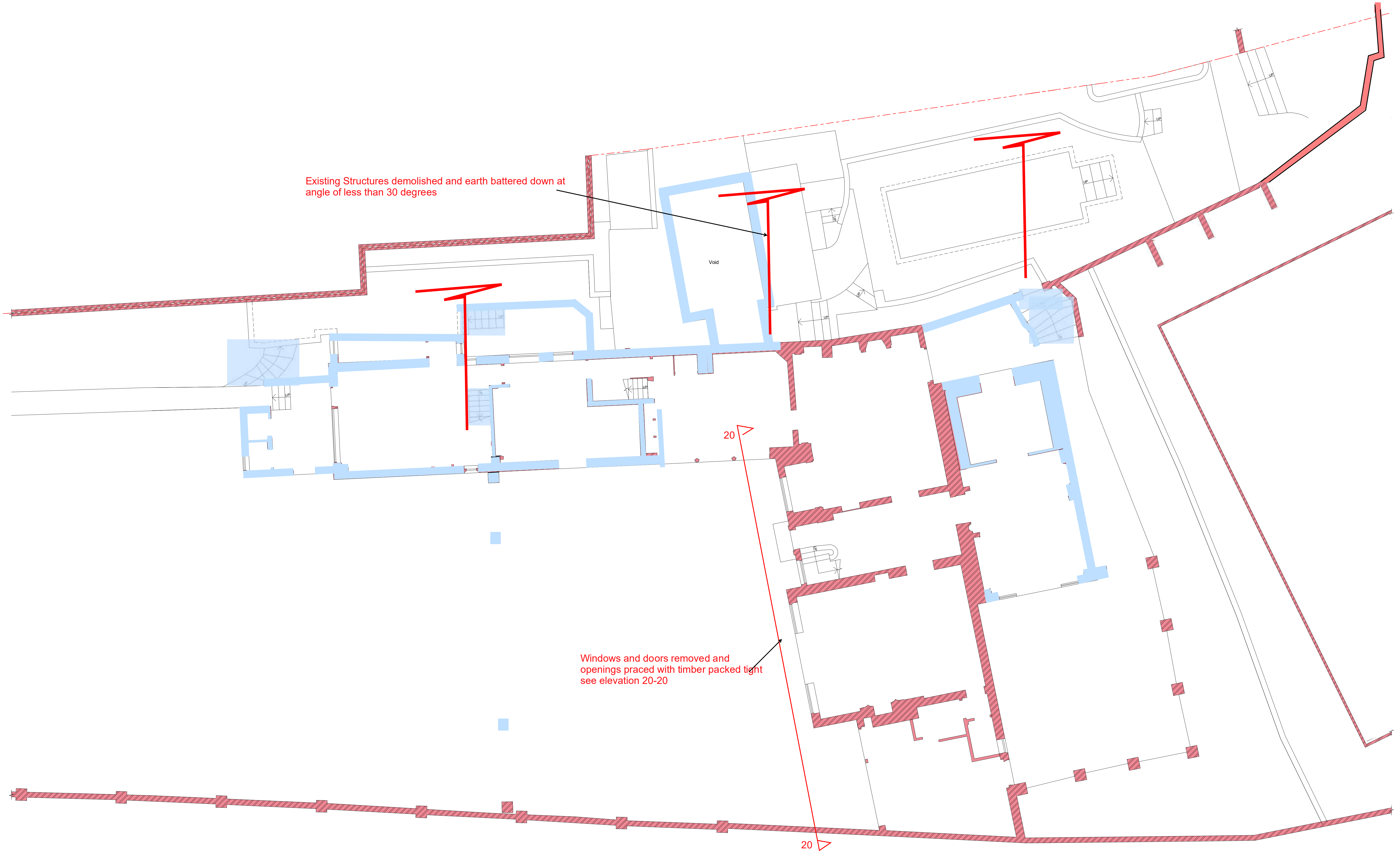
3.6 The roof will be a cut timber roof with steel ridge beam and steel posts onto the masonry walls below

4.0 Sequence of Construction / Temporary Works

Stage 1

1.1 Contractor to provide temporary cabins sited on the existing garden, Hoarding, alarms and site management to contractor's standard procedure.
1.2 Provide access platforms grid 4 B-C of existing façade and brace front façade See TW20
1.3 Install scaffold Gridline B-G 4-3 and internal crash deck
1.4 Strip roof finishes and demolish timbers
1.5 Diamond cut vertical slot between retained and demolished structure
1.6 Demolish walls highlighted in blue manually using breakers or using excavator with demolition jaw
1.7 Demolished material can be stockpiles for removal from site
1.8 Areas of hard paving broken up and waste removed.
1.9 Timber extension GL E/G5-6 demolished using excavator with demolition jaws and material removed for recycling
1.10 Rear extension H-I 6-9 single storey rear extension, existing pool and court yard demolished and spoil battered back towards northern boundary

NOTE no soil is to be removed from the base of retaining walls on the northern boundary.



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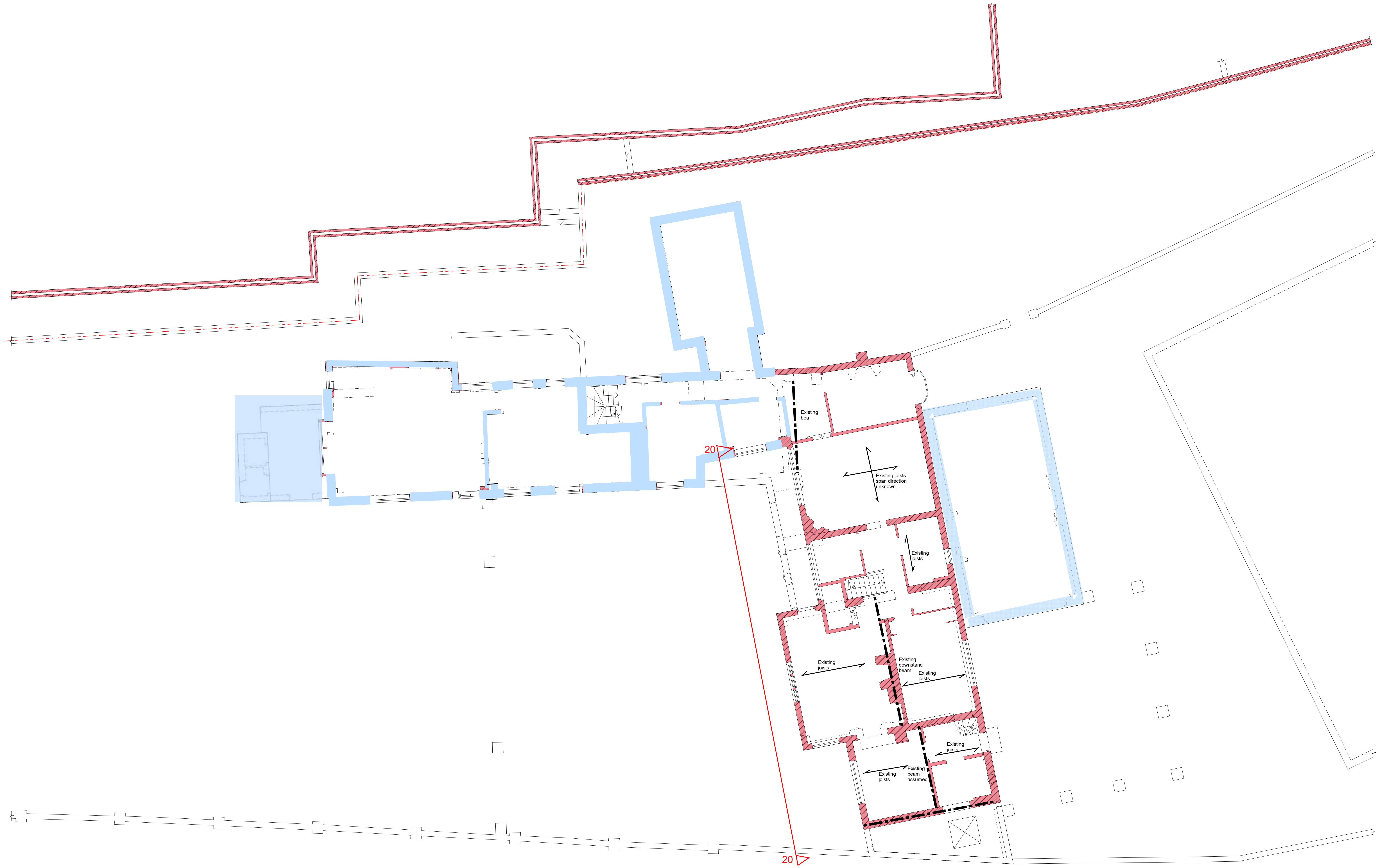
Construction Method Statement Ground Plan - Stage 1 2020_06_25 1:100 (A2) 2092_CMS-Stage 1-10_A



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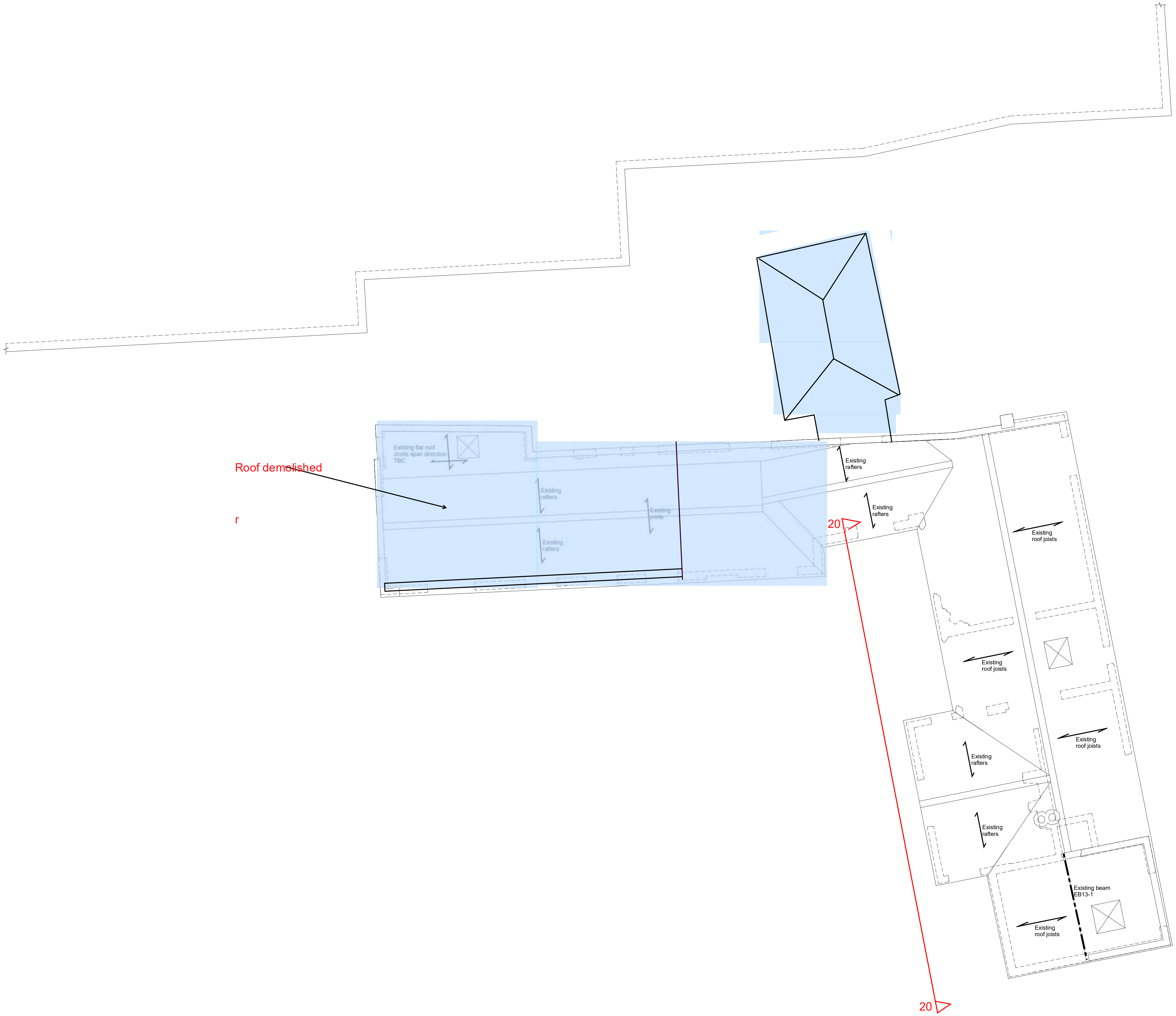
Construction Method Statement First Floor Plan - Stage 1 2020_06_25 1:100 (A2) 2092_CMS-Stage 1-11_A



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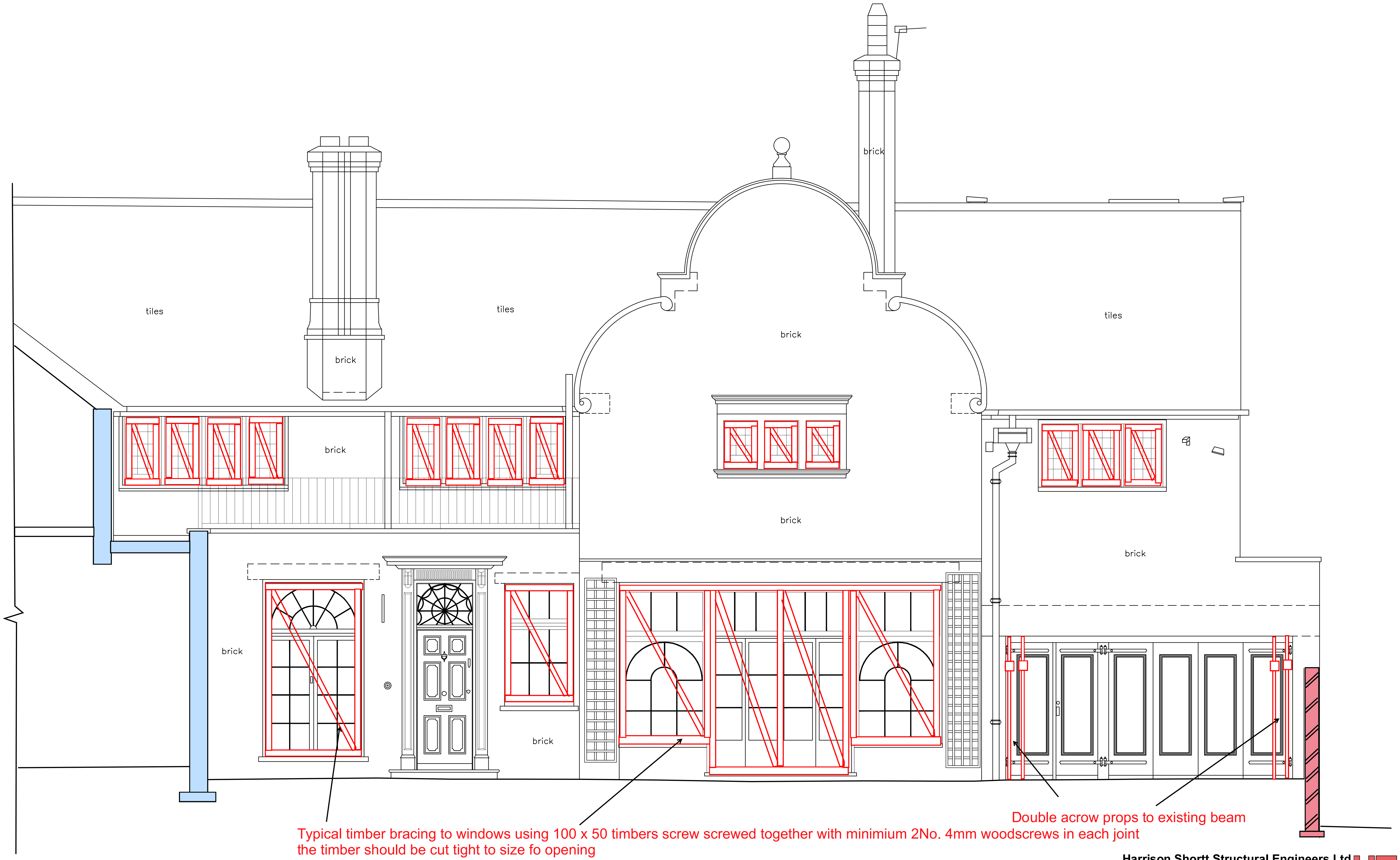
Construction Method Statement Roof Plan - Stage 1 2020_06_25 1:100 (A2) 2092_CMS-Stage 1-13_A



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Construction Method Statement- Front Facade Bracing 2020_08_07 NTS (A3) 2092_CMS20_A

Stage 2

2.1 The retaining wall can be excavated in a linear sequence:

- 2.1.1 Cut 1.2m strip into battered Compact ground providing steel trengh sheets to either side of cut braced with trnchprops and 200 x 50 timber whalers at 1m centres
- 2.1.2 Place steel reinforcement with bars in 3 extending into wall
- 2.1.3 Form drainage channels
- 2.1.4 Cast slab
- 2.1.5 Place waterbar and lace vertical reinforcement
- 2.1.6 Cast wall up to underside existing footings of boundary wall
- 2.1.7 Allow 24 to cure
- 2.1.8 Drypack gap to underside of clean footing
- 2.1.9 Place waterbar at joint and lace reinforcement to full height
- 2.1.10 Cast concrete to full height

2.2

- 2.2.1 Cut 1m strip into earth face placing spoil onto toe of previous step compacted with excavator bucket to angle of approximately 30 degrees
- 2.2.2 repeat steps 2.1.2-2.1.10

2.3 Repeat steps 2.2 for full sequence of underpinning

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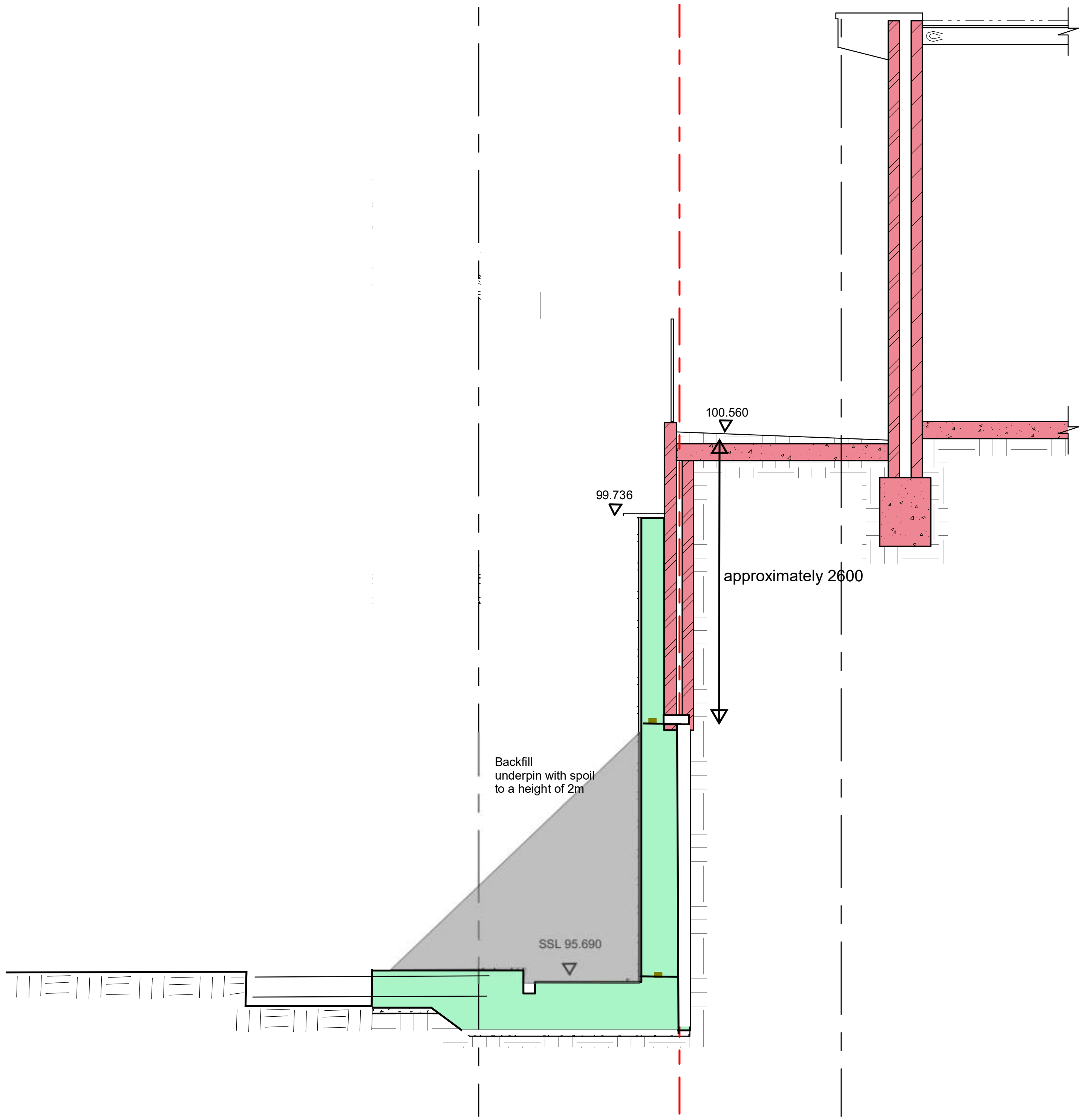
Construction Method Statement Ground Plan - Stage 2 2020_06_25 1:100 (A2) 2092_CMS-Stage 2-10_A



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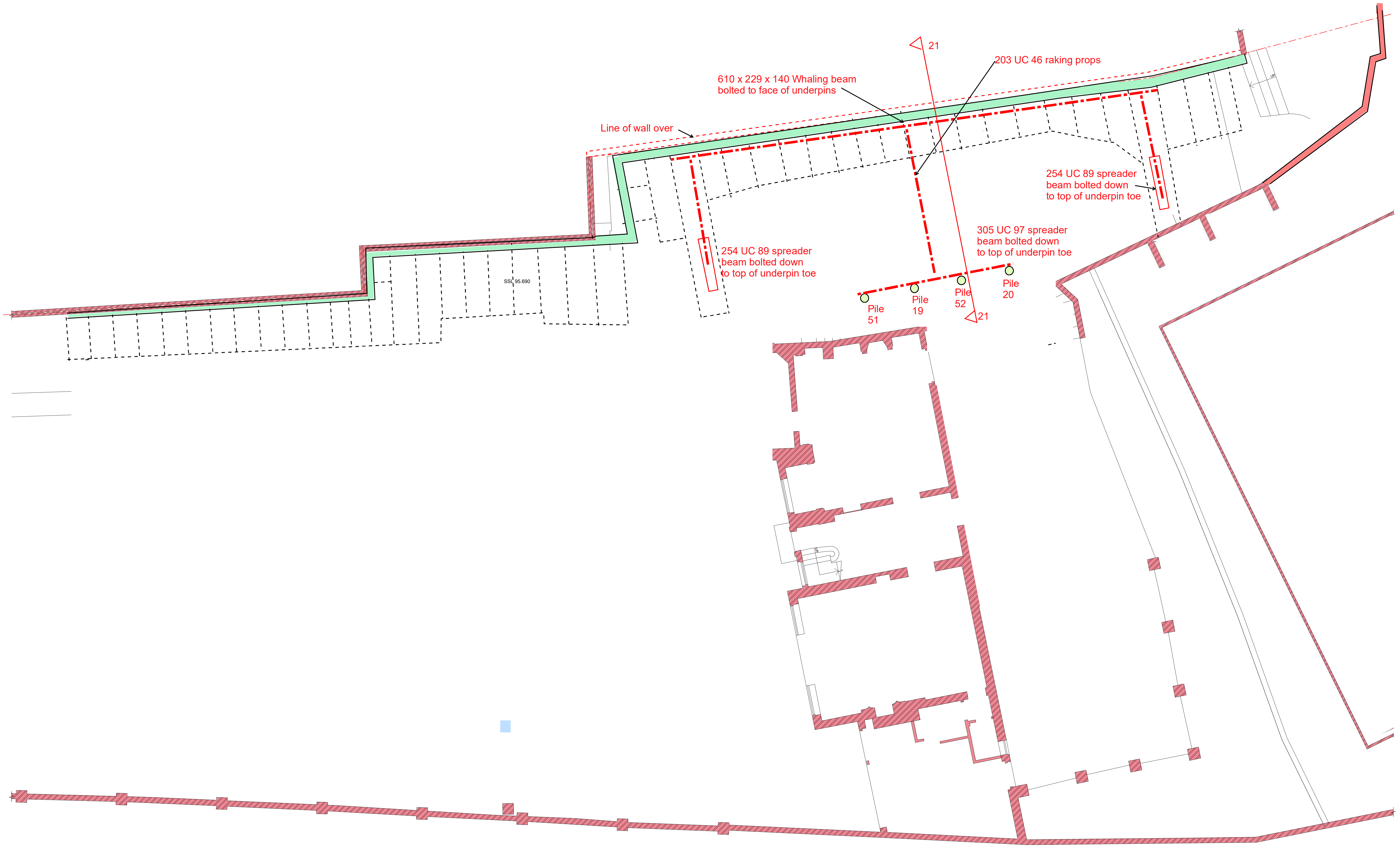
Construction Method Statement Ground Plan - Stage 2 2020_06_25 1:100 (A2) 2092_CMS-Stage 2-22_A

Stage 3

3.1 Install 4 number piles
3.2 place high level whaling beam across top of underpins adjacent to the pool
3.3 Install spreader beam across face of piles and bolt in place
3.4 Install racking beams to allow excavation of material LOCAL TO POOL ONLY EARTH MUST BE RETAINED ON EXISTING TOES OF ALL OTHER L-shaped UNDERPINS



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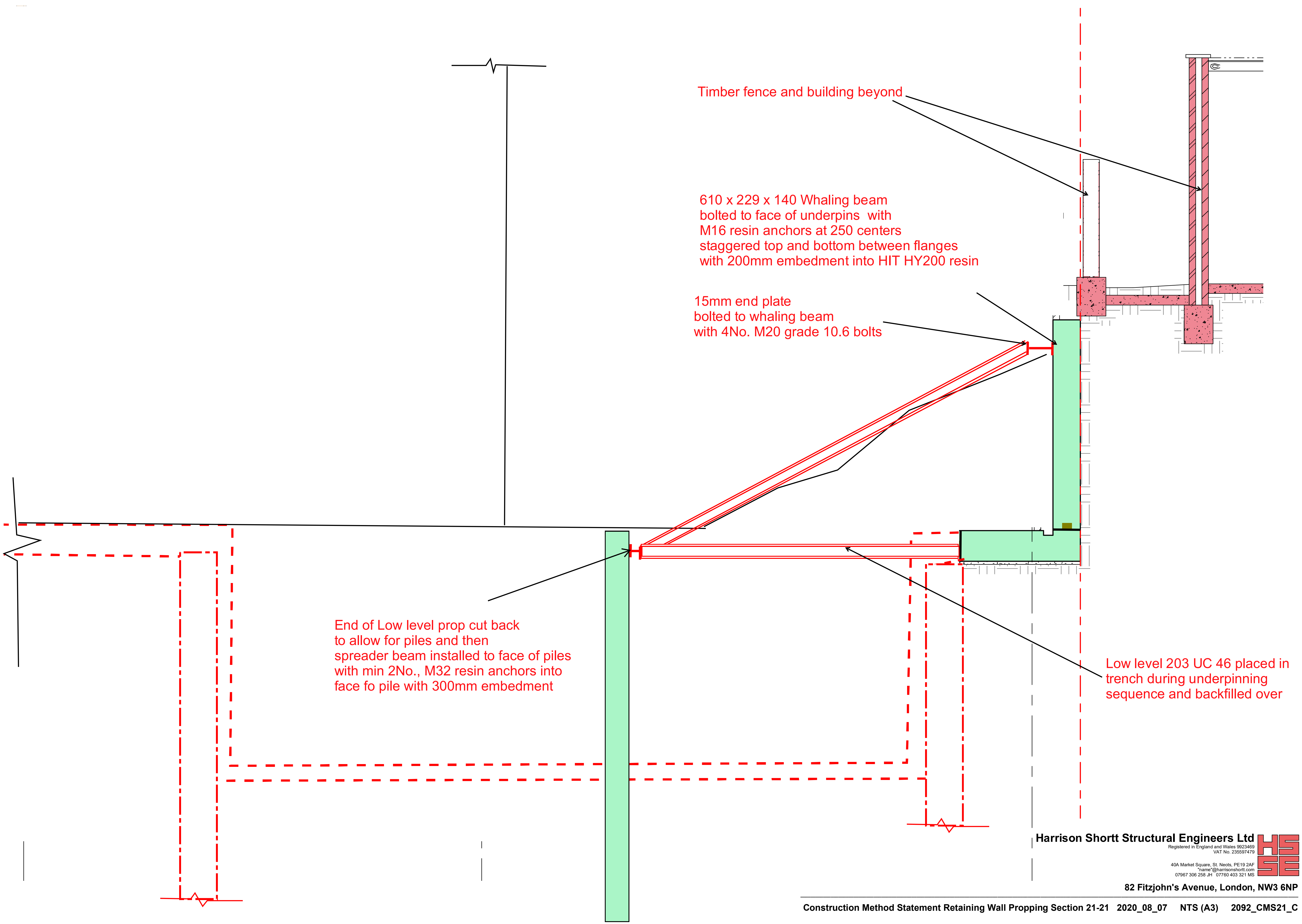
Construction Method Statement Ground Plan - Stage 3 2020_06_25 1:100 (A2) 2092_CMS-Stage 3-10_A



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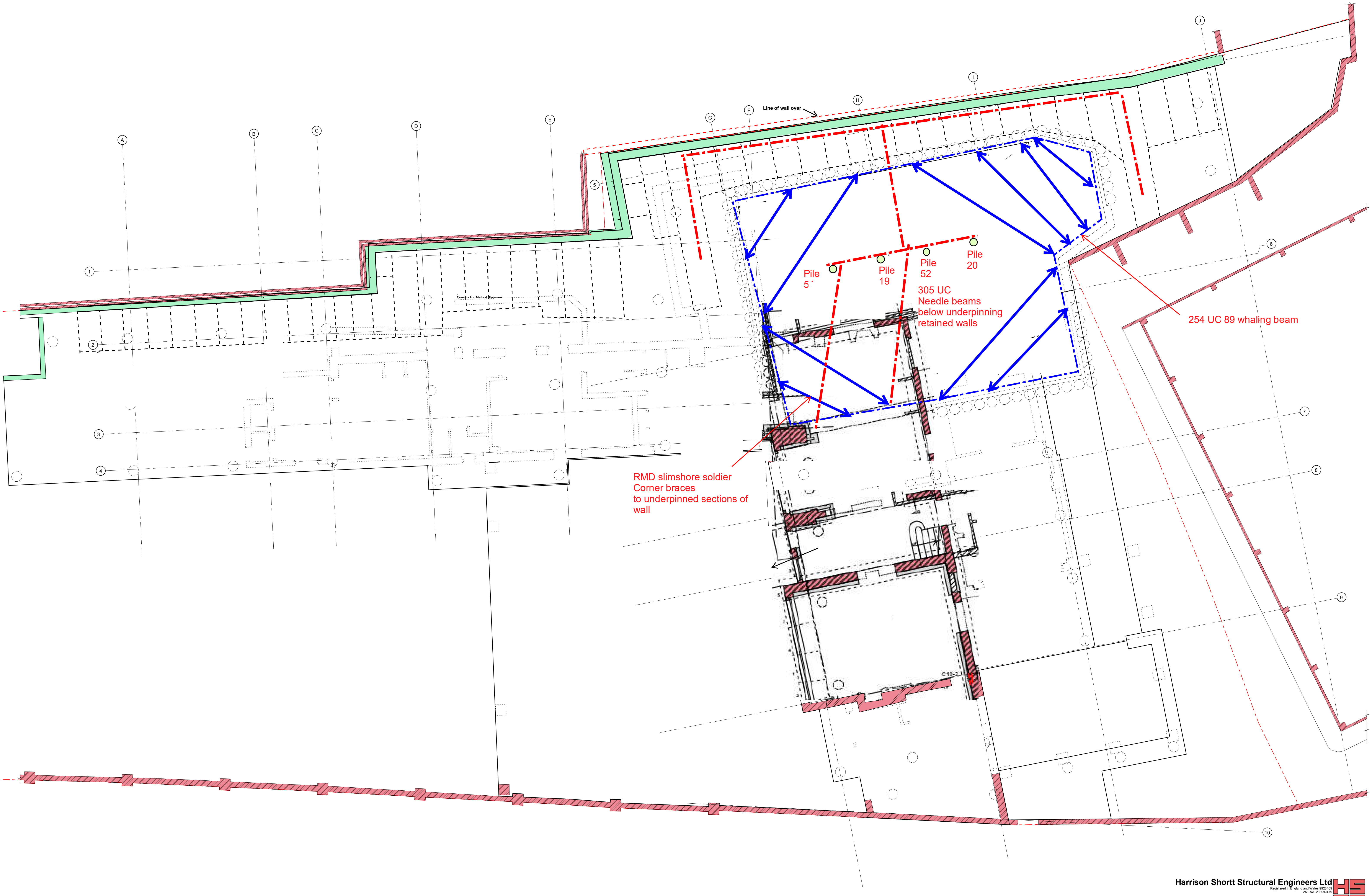
Construction Method Statement Retaining Wall Propping Section 21-21   2020_08_07   NTS (A3)   2092_CMS21_C

Stage 4

4.1 Underpin existing façades and spine walls - See specification for underpinning requirements including placing reinforcement with a full tension lap into slab.
4.3 Install internal waling frames to allow removal of timber floors to facilitate piling.
4.4 Local to pile position excavate 450 x 450 square trialpit to 1m below ground level to look for obstructions and then backfill
4.5 Install piling and contiguous piles to basement.
4.6 Install needle beam from temporary piles under retained existing walls and onto new underpins
4.7b Back prop underpinned section of basement piles to act in bending in temporary condition
Alternatively
Install high level knee braces to perimeter of basement to reduce reinforcement in piles.
4.8 Excavate basement to formation level.
4.9 Install Sumps
4.10 Cast basement slab
4.11 Cast liner walls
4.12 Cast ground floor slabs
4.13 Remove Propping to retaining walls



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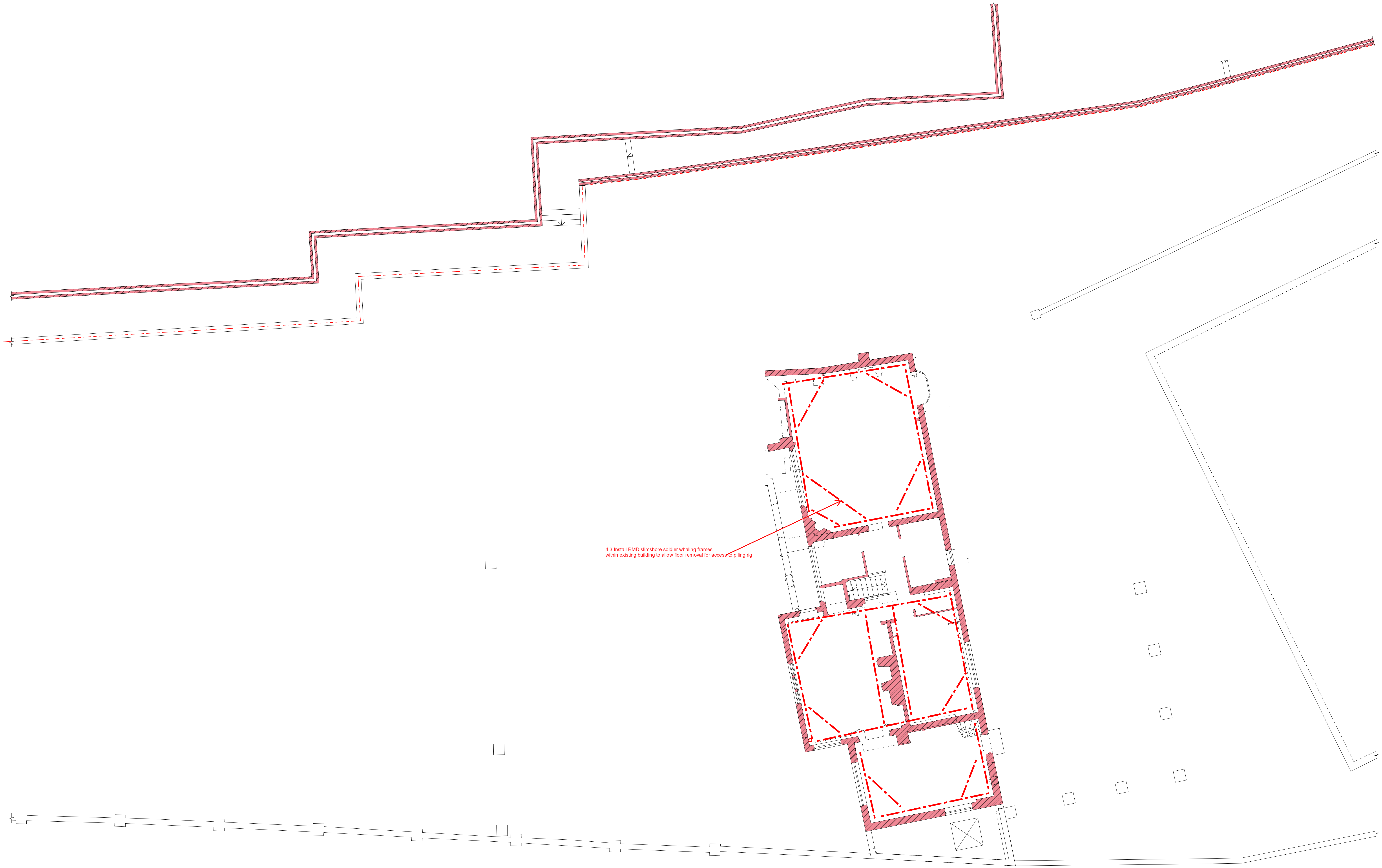
Construction Method Statement Ground Plan - Stage 4 2020_06_25 1:100 (A2) 2092_CMS-Stage 4-10_B



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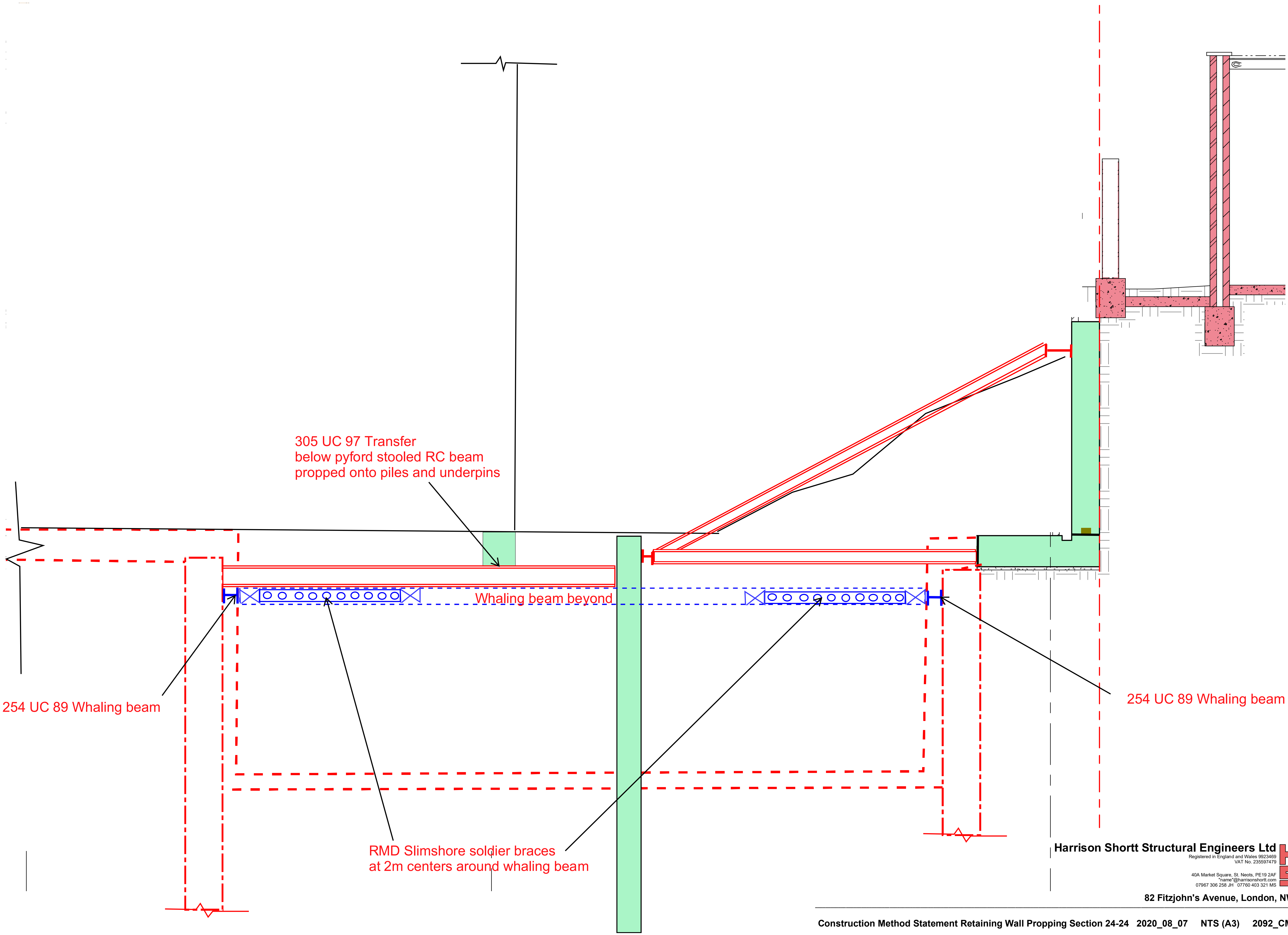
Construction Method Statement First Floor Plan - Stage 4 2020_06_25 1:100 (A2) 2092_CMS-Stage 4-10_A



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Construction Method Statement Retaining Wall Propping Section 24-24 2020_08_07 NTS (A3) 2092_CMS24_A

7.0 Construction Method Statement

7.1e In the following methodology a linear sequence of "underpinning/sequential retaining wall is proposed. Within a building a hit miss sequence is proposed because this aims to provide support evenly around the perimeter of the building so any vertical settlement is uniform across the building.

At this site there is no building over to experience vertical settlement and therefore the issue of uniform settlement is not a problem.

The advantage of this strategy is that the majority of earth remains undisturbed and there are not isolated 1m lumps of earth propped in the temporary case there is a single retained earth face that advances along the excavation maintaining the natural consolidated ground and better retaining the lateral forces

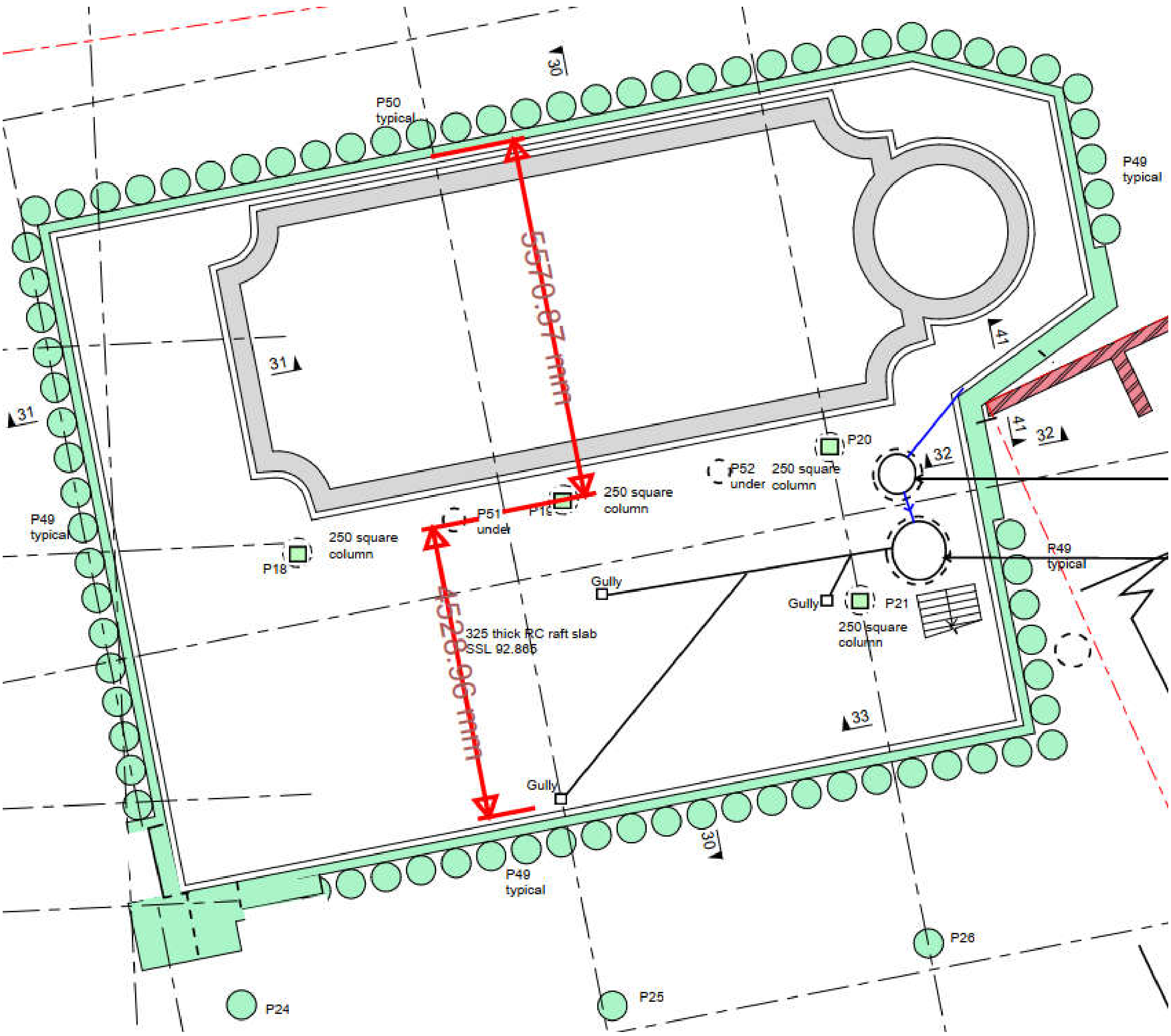
8.0 Calculations

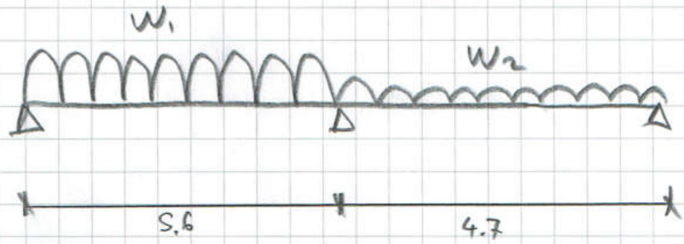
81 Loadings

		Dead Load	Imposed Load	SLS	(ULS)
A	Rafters	0.2			
Pitched Roof	Battens	0.1			
(boarded and clay	Boards	0.2			
tiles)	Tiles	0.32			
(slate roof lighter)	At 30 degrees	(load/cos30)			
	Imposed Load		0.60		
		0.95	**0.60**	**1.6 kN/m^2**	**(2.3) kN/m^2**
B	Waterproofing membrane	0.10			
Flat Roof	Insulation	0.02			
(general)	18mm plywood sheeting	0.11			
	225x50mm timber floor joists at 400mm c/c	0.17			
	12.5mm plasterboard ceiling	0.11			
	Finish (decking or similar)	0.30			
	Imposed Load		0.75		
		0.81	**0.75**	**1.6kN/m^2**	**(2.3) kN/m^2**
C	20mm timber floor finishes	0.11			
Internal Floor	225x50mm timber floor joists at 360mm c/c	0.19			
(typical)	19mm lath and plaster ceiling	0.38			
	Insulation	0.02			
	Imposed Load		1.5		
		0.7	**1.5**	**2.2 kN/m^2**	**(3.4) kN/m^2**
D	19mm chip board	0.1			
Loft Floor	100x50mm timber floor joists at #360mm	0.1			
Storage	c/c	0.38			
	Lathe and plaster ceiling		0.6		
	Imposed Load				
		0.58	**0.6**	**1.2 kN/m^2**	**(1.8) kN/m^2**
E	19mm plaster	0.38			
9" Brick Wall	9" (228.6mm) brickwork	4.11			
		4.5		**4.5 kN/m^2**	**(6.3) kN/m^2**
F	19mm plaster	0.38			
13 1/2" Brick Wall	9" (342.9mm) brickwork	6.20			
		6.6		**6.6 kN/m**	**(9.2) kN/m**
G	19mm lath and plaster	0.38			
4" Timber Stud Wall	100x50mm timber studs at 360mm c/c	0.08			
	100x50mm timber blocking at 1200mm c/c	0.03			
	19mm lath and plaster	0.38			
		0.87		**0.9 kN/m**	**(1.2) kN/m**
H	19mm lath and plaster	0.38			
4" Brick Nogged	100x50mm timber studs at 360mm c/c	0.08			
Timber Stud Wall	Brick Noggins 225 @ 360 c/c	1.13			
	19mm lath and plaster	0.38			
		1.97		**1.97 kN/m**	**(2.8) kN/m**
J	6mm slate cladding lapped	0.375			
4" Slate Clad Mansard	25x40mm battens at 150mm c/c	0.04			
Wall	18mm plywood sheeting	0.2			
	100x50mm timber studs at 400mm c/c	0.08			
	100x50mm timber blocking at 1200mm c/c	0.03			
	12.5mm plasterboard and Skim	0.28			
		1.01		**1.0 kN/m^2**	**(1.4) kN/m**
K	4" (101.6mm) brickwork	1.83			
Brick / Block Cavity	100mm Insulation	0.10			
Wall	100mm dense concrete blocks	2.40			
	19mm plaster	0.38			
		4.71		**4.7 kN/m^2**	**(6.6) kN/m^2**
L	3 Layers 10mm glass	0.87			
Flat Roof Light	2mm interlayer	0.01			
	Imposed Load		0.6		
		0.88	**0.6**	**1.5 kN/m^2**	**(2.2) kN/m^2**
M	3 Layers 10mm glass	0.87			
Glass Doors	2mm interlayer	0.01			
	Framing	0.2			
		1.08		**1.1 kN/m^2**	**(1.5) kN/m^2**
N	325mm concrete slab	**7.8**			
Raft slab	100mm screed and finish	**2.4**			
	Imposed Loading		**1.0 + 1.5**		
		10..2	**2.5**	**12.7 kN/m^2**	**(18.3) kN/m^2**

8.2 Basement

8.2.1 Basement Raft Slab





				DL.	L.L
W_1 =	BASE SLAB	= 0.325 x 24	=	7.8	
	Screed	= 0.075 x 22	=	1.65	
	Pool x 3.5m	= 3.5 x 10	=		35
				9.5 +	35 = 44.5 (69.3)

TOP moment

M = 174.5 k = 0.064

z = 0.922d = 0.239 USE H20 @ 200 c/c

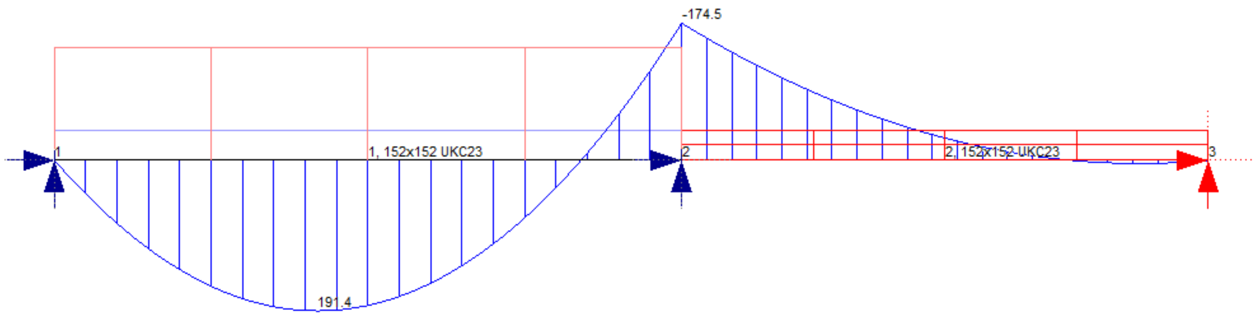
A_s = 1673

Bottom Moment

M = 191.4 k = 0.0707

z = 0.913 d = 0.237 USE H25 @ 200 c/c

A_s = 1852



Reactions per linear Meter:
Reaction 1 = 20.9 + 83.6
Reaction 2 = 61.5 + 141.4
Reaction 3 = 15.5 + 5.4

Piles at 2m centers, within beam strip allow distribution steel over column heads.

8.2.2 250 square columns to underside of ground floor

Project	Spreadsheets to BS 8110	REINFORCED CONCRETE COUNCIL	
Client	Advisory Group	Made by: RMW	Date: 03-Mar-21
Location	Ground floor columns at B1, B2 etc	Page: 96	Checked: chg
	SYMMETRICALLY REINFORCED RECTANGULAR COLUMN DESIGN, BENT ABOUT TWO AXES TO BS 8110:1997	Revision: -	Job No: R68
	Originated from RCC53.xls v1.3 © 2000 BCA for RCC		

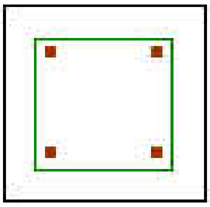
MATERIALS

fcu	25	N/mm²	γm, steel	1.05	Cover to link	30	mm
fy	250	N/mm²	γm, conc	1.5	h agg	20	mm

SECTION

h	250	mm
b	250	mm
with	2	bars per 250 face
and	2	bars per 250 face

ie. 250 x 250 columns with 4 bars

X  X

RESTRAINTS

	Lo (mm)	Top Condition	Btm Condition	Braced ?	β	Le (mm)	Slenderness	Status
X-AXIS	2800	F	f	Y	0.75	2100	Lex/h = 8.40	Column is
Y-AXIS	2800	F	f	Y	0.75	2100	Ley/b = 8.40	SHORT

LOADCASES

	AXIAL N (kN)	TOP MOMENTS (kNm) M ix	TOP MOMENTS (kNm) M iy	BTM MOMENTS (kNm) M ix	BTM MOMENTS (kNm) M iy
B1	312	10.0	10.0	10.0	10.0
B2	0	0.0	0.0	0.0	0.0
Loadcase 3	0	0.0	0.0	0.0	0.0
Loadcase 4	0	0.0	0.0	0.0	0.0
Loadcase 5	0	0.0	0.0	0.0	0.0
Loadcase 6	0	0.0	0.0	0.0	0.0

BAR ARRANGEMENTS

Bar Ø	Asc %	Link Ø	BAR CENTRES (mm) 250 Face	BAR CENTRES (mm) 250 Face	Nuz (kN)	Checks
R 40	8.04	10	130	130	0	Asc > 6 % (3.12.6.2)
R 32	5.15	8	142	142	1428	ok
R 25	3.14	8	149	149	1143	ok
R 20	2.01	6	158	158	983	ok
R 16	1.29	6	162	162	880	ok
R 12	0.72	6	166	166	801	ok

DESIGN MOMENTS

	K	X AXIS M add	X AXIS Mx	Y AXIS M add	Y AXIS My	COMBINED Axis	COMBINED M '	REBAR	max V *
B1	0.000	0.0	10.0	0.0	10.0	X	17.7	4 R12	28.3
B2	0.000	0.0	0.0	0.0	0.0	0.0	0.0	#N/A	#DIV/0!
Loadcase 3	0.000	0.0	0.0	0.0	0.0	0.0	0.0	#N/A	#DIV/0!
Loadcase 4	0.000	0.0	0.0	0.0	0.0	0.0	0.0	#N/A	#DIV/0!
Loadcase 5	0.000	0.0		0.0	0.0	0.0	0.0	#N/A	#DIV/0!
Loadcase 6	0.000	0.0	0.0	0.0	0.0	0.0	0.0	#N/A	#DIV/0!

SEE CHARTS ON NEXT SHEET

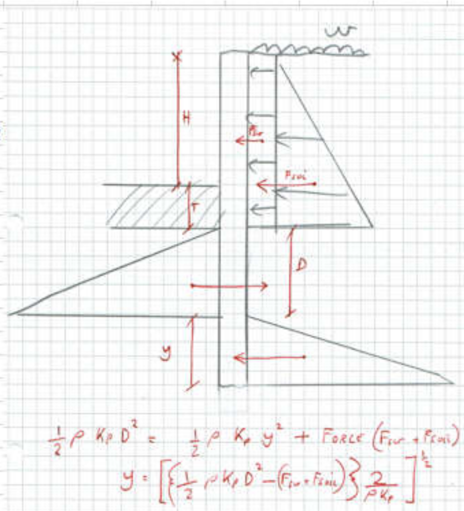
Therefore 4 H12 bars ok

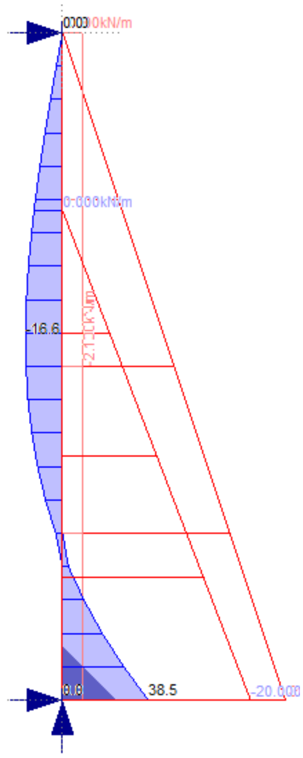
8.2.3d Contig piles to single level of basement P49

- Permanent case, piles effectively propped at head of wall
- Temporary Case full cantilever Cotig piles

Temporary case assuming planting depth assume 3.5m

Retained height	H	3	m							
top soil	T	0	m							
		3								
Resisting depth	D	3.5								
bottom planting	y	3.11152		6.61152						
Surcharge		5	kNm							
water		1	m							
		2								
Soil										
Typical Soil Density		19.5	kN/m^3							
Internal Angle of Friction		25	degrees							
Ko	1-sin φ	0.57738								
Ka	1- sin φ	0.40586								
	1+sin φ									
Kp	1/Ka	2.46391								
Factor	Ka	0.40586								
Stability	Pressure			Force			Moment			
Surcharge	Ka w	2.02929		P... H	6.08788		(H+T)/2+:	3.83333	F sur H/2	23.3369
Soil	ρKaH	23.7427		0.5 P soil H	35.6141		(H+T)/3+:	3.33333	F soil H/3	118.714
Water	ρ water h	20		0.5 P water h	20		(H+T)/3+:	0.66667	F water h/3	13.3333
Total					**61.702**					**155.384**
Restoring	Pressure						Restoring		FOS	**4.85121**
Top		168.162		294.284						
Planting		149.497		232.582			**753.8**			

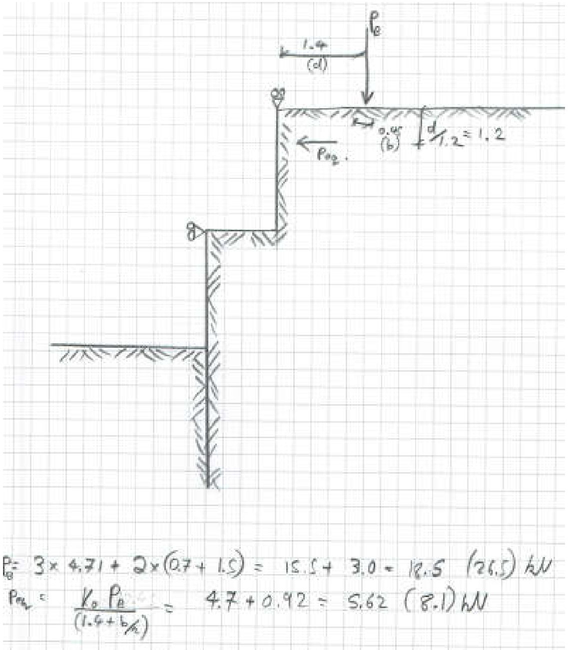


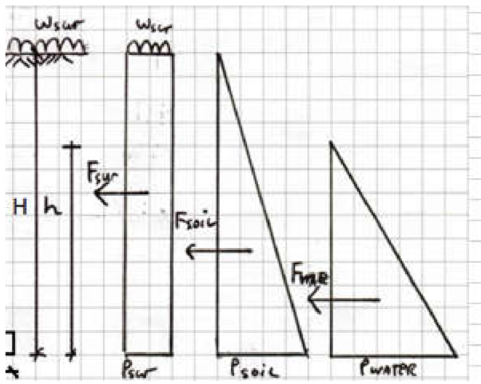


Permanent case head of wall restrained by ground floor slab
Moment per piles = 38.5kNm
2 piles per linear meter therefore Load into pile = 19.3 kNm ULS (13.8 SLS)

40A Market Square, St. Neots, PE19 2AF
"name"@harrisonshortt.com
07967 306 258 JH 07760 403 321 MS

8.2.4d Contig piles to Northern Boundary P50
Permanent case the slab restrains





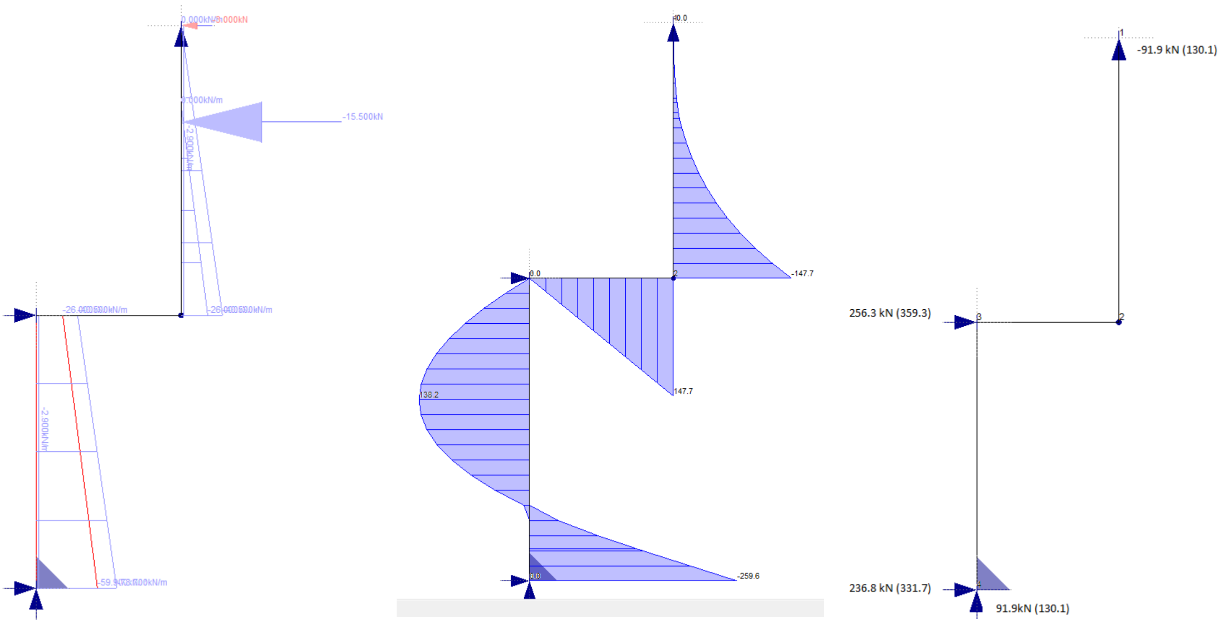
Ground floor level

Soil					Geometry		
Typical Soil Density		19.5	kN/m^3		H	3.6	m
Internal Angle of Friction		25	degrees		t	0.45	m
					d	0.35	m
Ko	1-sin φ	0.5774			L	0.45	m
					I	0	
Ka	1- sin φ	0.4059			Water BGL	1	m
	1+sin φ				h	2.6	
Kp	1/Ka	2.4639			Wsur	5	kN/m
Stability	Pressure			Force			
Surcharge	Ko w	2.8869		P... H	10.39287		
Soil	ρ Ko H	40.532		0.5 P...il H	72.95796		
Water	ρ...h	26		0.5 P...r h	33.8		
Total					**117.1508**		

40

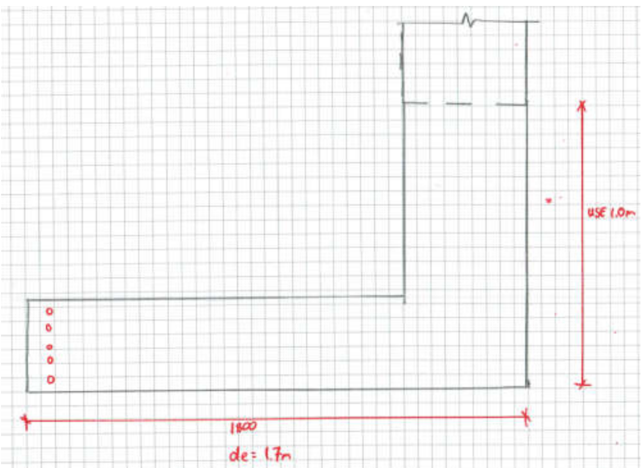
Basement level

Soil					Geometry		
Typical Soil Density		19.5	kN/m^3		H	6.99	m
Internal Angle of Friction		25	degrees		t	0.45	m
					d	0.35	m
Ko	1-sin φ	0.5774			L	0.45	m
					l	0	
Ka	1- sin φ	0.4059			Water BGL	1	m
	1+sin φ				h	5.99	
Kp	1/Ka	2.4639			Wsur	5	kN/m
Stability	Pressure			Force			
Surcharge	Ko w	2.8869		P... H	20.17949		
Soil	ρ Ko H	78.7		0.5 P... H	275.0566		
Water	ρ... h	59.9		0.5 P... h	179.4005		
Total					**474.6366**		



Span of beam = 10m
Moment = wl²/8 = 4487.5kNm

Wall and toe acting as flanged beam



de = 1.7m

$k = \frac{M}{bd^2 f_{cu}} = 0.038$

$z = d\left(0.5 + \sqrt{0.25 - \frac{k}{0.9}}\right)$

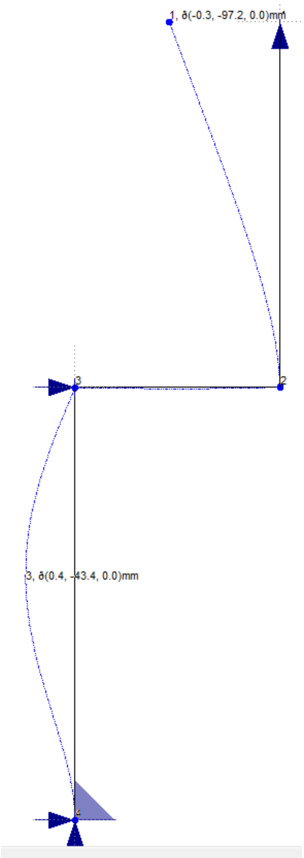
$= 0.95d$

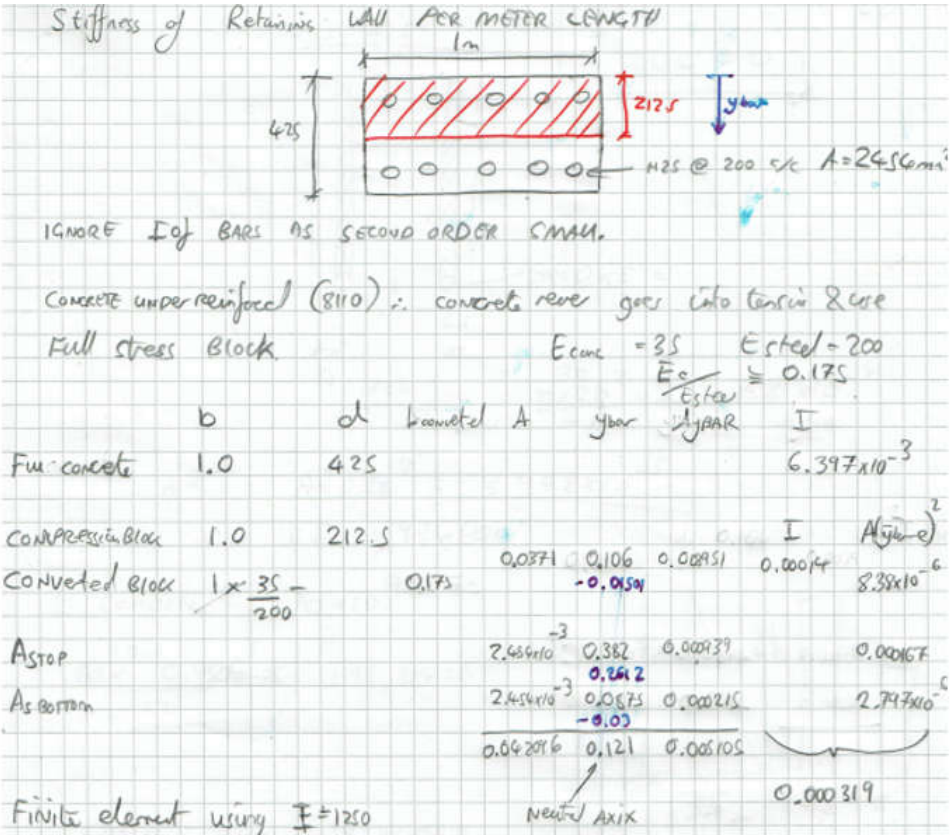
$= 1.615$

Neutral Axis WITHIN FLANGE ∴ OK

$A_s = \frac{M}{z\, 0.87\, f_y} = 6386\text{mm}^2$

Use 10 H32 bars = 8042 mm² within pile cap to form horizontal beam to provide restraint to wall and pile cap/
Retaining wall to have H16 bars at 200 centres





Analysis model based on Stiffness of 1250 in steel, the above is a cracked **I** value for the concrete section

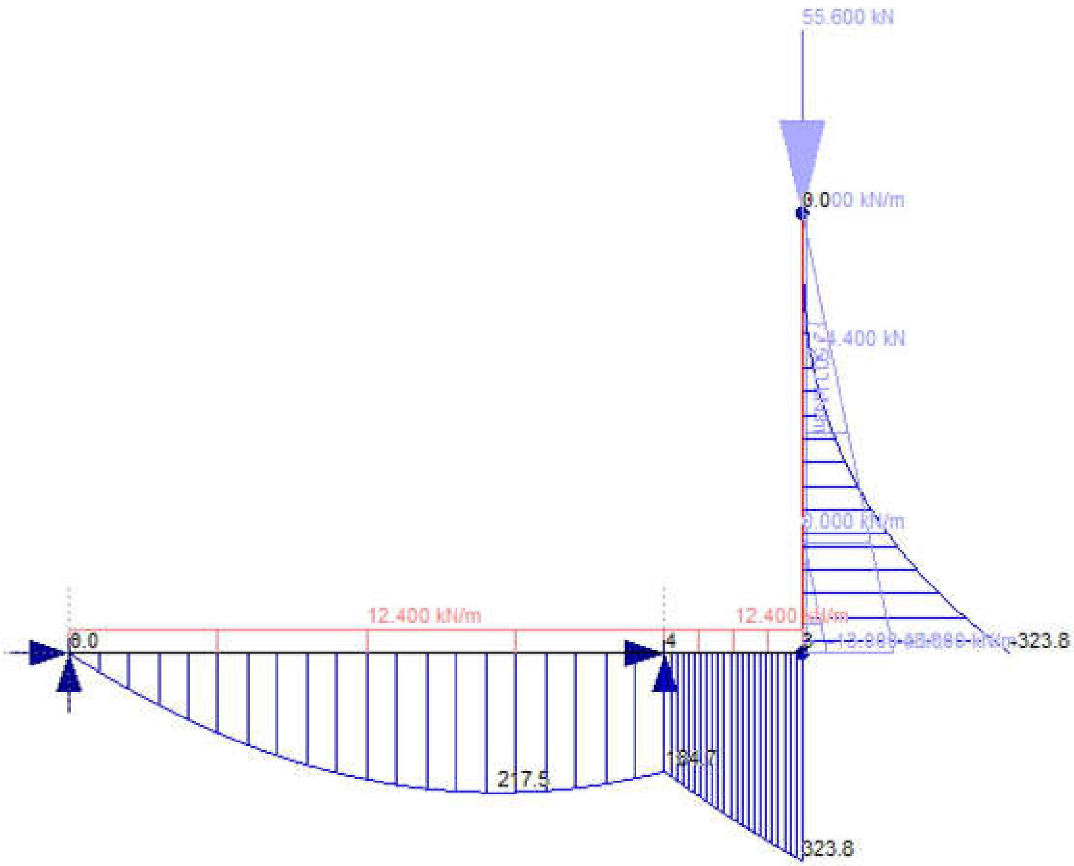
Deflection 97.2 x 1.250x-5 / 0.00039 =3.75

8.3 Ground Floor

8.3.1d Retaining Wall Gridline A-E

Top section of wall 2.5m high

Soil					Geometry						
Typical Soil Density		19.5	kN/m^3		H	2.5	m				
Internal Angle of Friction		25	degrees		t	0.2	m				
					d	0.2	m				
Ko	1-sin φ	0.577			L	0.2	m				
					l	0					
Ka	1- sin φ	0.406			Water BGL	1	m				
	1+sin φ				h	1.5					
Kp	1/Ka	2.464			Wsur	5	kN/m				
Stability	Pressure			Force				Moment			
Surcharge	Ko w	2.887		P. H	7.21727			H/2	1.25	F ...H/2	9.022
Soil	ρ Ko H	28.15		0.5 P. H	35.1842			H/3	0.833333	F ..H/3	29.32
Water	ρ...h	15		0.5 P...r h	11.25			h/3	0.5	F h/3	5.625
Total					**53.651**						**44**
Restoring											
	Load			Lever Arm							
Party Wall load	P	0	kN	L-t/2	0						
Weight of Stem	(H-d)*t*24	8.46	kN	L-t/2	0.846						
Weight of Slab	(D*L)*24	0.72		L/2	0.072						
Heel	(.d*l)*24	0		L+l/2	0						
Heel Soil	l*H*ρ	0		L+l/2	0						
Heel Surcharge	Wsur * l	0	5	L+l/2	0						
		9.18		M restore	**0.918**		FOS	M r / M	**0**		
X bar	Mr-Mo	-4.689		Middle Third	0.06667	0.1	FAIL				
	R										
e	(L+l)/2-xb:	4.789									
Bearing Pressures		6641	-6549								
Concrete Design											
Cantilever length		2.35									
Stability	Pressure			Force			Moment				
Surcharge	Ko w	2.887		P. H	6.78424		H/2	1.175	F ...H/2	7.971	
Soil	ρ Ko H	26.46		0.5 P. H	31.0888		H/3	0.783	F ..H/3	24.35	
Water	ρ...(H-h)	13.5		0.5 P...r (H-h)	9.1125		(H-h)/3	0.45	F .....(H-h)/:	4.101	
Total					**46.985**					**36.4**	
Factor of Safety	1.4										
ULS Moement	50.9949										
t		0.2									
cover		0.05									
main bar		0.02									
de		0.135									
b		1									
Fcu		40									
k	M/fcu/b/d	0.07									
Z	de(0.5+(.2!	0.128									
As		9E-04	m^2								
		914	mm^2								

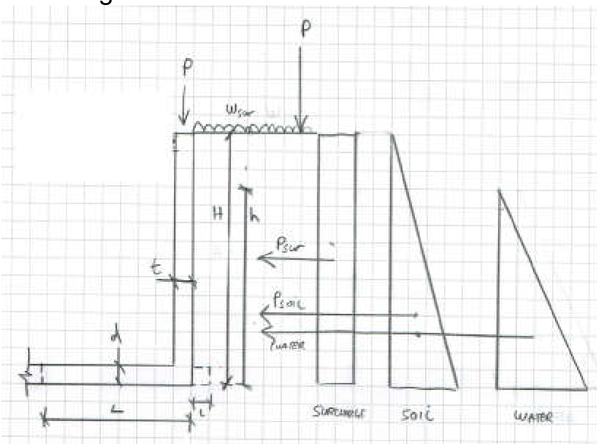


Concrete Design										
Cantilever length		4.3								
Stability	Pressure			Force			Moment			
Surcharge	Ko w	2.8869		P... H	12.41371		H/2	2.15	F ... H/2	26.689
Soil	ρ Ko H	48.413		0.5 P.. H	104.0889		H/3	1.4333	F ... H/3	149.19
Water	ρ... (H-h)	33		0.5 P... (H-h)	54.45		(H-h)/3	1.1	F ... (H-h)/3	59.895
Total					**170.95**					**235.8**
Factor of Safety	1.4									
ULS Moement	330.0901									
t		0.425								
cover		0.05								
main bar		0.02								
de		0.36								
b		1								
Fcu		40								
k	M/fcu/b/d^2	0.0637								
Z	de(0.5+(.25	0.342								
As		0.0022	m^2							
		2219	mm^2							

Soil					Geometry						
Typical Soil Density		19.5	kN/m^3		H	4.625	m				
Internal Angle of Friction		25	degrees		t	0.425	m				
					d	0.325	m				
Ko	1-sin φ	0.5774			L	7	m				
					l	0					
Ka	1- sin φ	0.4059			Water BGL	1	m				
	1+sin φ				h	3.625					
Kp	1/Ka	2.4639			Wsur	5	kN/m				
Stability	Pressure			Force				Moment			
Surcharge	Ko w	2.8869		P... H	13.35195			H/2	2.3125	F ... H/2	30.876
Soil	ρ Ko H	52.073		0.5 P.. H	120.4179			H/3	1.541667	F ... H/3	185.64
Water	ρ... h	36.25		0.5 P... h	65.70313			h/3	1.208333	F ... h/3	79.391
Total					**199.47**						**295.9**

What height does rebar need to1570 mm^2/m = 233.7kNm
Therefore use = 233 / 330 x 4.625 =3.3m retained height switch from 32 bars down to 20s

8.3.2d Retaining Wall Gridline E-J



$P_G = 3 \times 4.71 + 2 \times (0.7 + 1.5) = 15.5 + 3.0 = 18.5\ (26.5)\ kN$

$P_{RH} = \frac{K_o P_G}{(1.4 + b/h)} = 4.7 + 0.92 = 5.62\ (8.1)\ kN$

Soil					Geometry						
Typical Soil Density		19.5	kN/m^3		H	4	m				
Internal Angle of Friction		25	degrees		t	0.425	m				
					d	0.325	m				
Ko	1-sin ϕ	0.5774			L	7	m				
					l	0					
Ka	1- sin ϕ	0.4059			Water BGL	1	m				
	1+sin ϕ				h	3					
Kp	1/Ka	2.4639			Wsur	5	kN/m				
Stability	Pressure			Force				Moment			
Surcharge	Ko w	2.8869		P... H	11.54763			H/2	2	F ... H/2	23.095
Soil	ρ Ko H	45.036		0.5 P.. H	90.07155			H/3	1.333333	F ... H/3	120.1
Water	ρ... h	30		0.5 P...r h	45			h/3	1	F ... h/3	45
Total					**146.62**						**188.2**
Restoring											
	Load			Lever Arm							
Party Wall load	P	0	kN	L-t/2	0						
Weight of Stem	(H-d)*t*24	28.114	kN	L-t/2	190.8221						
Weight of Slab	(D*L)*24	54.6		L/2	191.1						
Heel	(.d*l)*24	0		L+l/2	0						
Heel Soil	l*H*ρ	0		L+l/2	0						
Heel Surcharge	Wsur * l	0	5	L+l/2	0						
		82.71		M restore	**381.92**		FOS	M r / M o	**2**		
X bar	Mr-Mo	2.3422		Middle Third	2.333333	4.6667	Load in Middle Third				
	R										
e	(L+l)/2-xba	1.1578									
Bearing Pressures		23.543	0.0897								
Concrete Design											
Cantilever length		3.675									
Stability	Pressure			Force			Moment				
Surcharge	Ko w	2.8869		P... H	10.60939		H/2	1.8375	F ... H/2	19.495	
Soil	ρ Ko H	41.377		0.5 P.. H	76.02954		H/3	1.225	F ... H/3	93.136	
Water	ρ... (H-h)	26.75		0.5 P...r (H-h)	35.77813		(H-h)/3	0.8917	F ... (H-h)/3	31.902	
Total					**122.42**					**144.5**	
Factor of Safety	1.4										
ULS Moement	202.3463										
t		0.425									
cover		0.05									
main bar		0.02									
de		0.36									
b		1									
Fcu		40									
k	M/fcu/b/d^2	0.039									
Z	de(0.5+(.2!	0.342									
As		0.0014	m^2								
		1360	mm^2								

8.3.3 Retaining Wall lateral North Gridline 1

Take pressure at base of wall sum of pressure = 75 kN/m
Span 2m

Moment ignoring fixity wl^2/8 = 37.5 kNm

			MOMENT			
span	2000	mm				
width	1000	mm				
depth	425	mm				
cover	50	mm				
bar depth	20	mm				
extra	5	mm				
deff	360	mm				
concrete grade	40	N/mm^2				
steel grade	500	N/mm^2				
spacing	200	mm				
span/ depth ratio	5.555556			simple	20	
Moment	37.5	kNm		cantilver	7	
Area of /m	1570.796	mm^2 / m		continous	27	
Max Calculated	2.34E+08					
Max cpacity	**233.7**	kNm	k-M/bd^2fcu	0.007233796		
			z/d=(0.5-(0.25-k/0.9)^(	0.991896786		
			but not less 0.95			
			z	0.342		
			As=M/0.87 fy z	0.000252067		
				252.066949		mm^2
				252.066949	**252**	mm^2/m

Use H12 at 200 centers bent down = 566 > 252 therefore Ok

8.3.4 Retaining wall Toe into raft slab

Gridlines A-E 8.3.1

Peak Moment per linear meter = 217.5 kNm

			MOMENT
span	6000	mm	
width	1000	mm	
depth	325	mm	
cover	30	mm	
bar depth	25	mm	
extra	5	mm	
deff	277.5	mm	
concrete grade	40	N/mm^2	
steel grade	500	N/mm^2	
spacing	200	mm	
span/ depth ratio	21.62162		
Moment	217.5	kNm	

k-M/bd^2fcu	0.070611152		
z/d=(0.5-(0.25-k/0.9)^(	0.914177697		
but not less 0.95			
z	0.253684311		
As=M/0.87 fy z	0.001970954		
	1970.953577		mm^2
	1970.953577	**1971**	mm^2/m

Use 25's at 200 centres over pile caps = 2454 mm^2/m
200's at 200 centres in middle strip= 1570

Average reinforcement = 2010 > 1971 mm^2/m

Gridlines E-J
Peak moment 184 kNm reduced from cantilevering action therefore

Therefore Use H20 at 200 centre

8.3.5 General raft slab

Slab grid							
6							
4							
	DL	IL	SLS	ULS			
Loading	10.2	2.5	12.7	18.28			
			DL	1.4			
			IL	1.6			
				Beam strip		Middle strip	
				Hogging	Sagging	Hogging	Sagging
Use Moment	Wl^2/8	8		75	55	25	45
	Long span	329.04		246.78	180.972	82.26	148.068
	Short span	219.36		164.52	120.648	54.84	98.712
Depth	325						
	Top cover	T1	T2	B2	B1	Bottom cover	
	30	16	16	16	16	50	
De		282	271	246	262		
concrete grade	40	N/mm^2					
steel grade	500	N/mm^2					
	Beam strip	Middlestrip					
Long span	2000	2000		282	262	282	262
k-M/bd^2fcu				0.03879	0.032955	0.01293	0.026963
z/d=(0.5-(0.25-k/0.9)^0.5				0.954862	0.961935	0.985421	0.969085
but not less 0.95							
z				0.2679	0.2489	0.2679	0.2489
As=M/0.87 fy z				0.002118	0.001671	0.000706	0.001368
				2117.62	1671.465	705.8733	1367.562
Use bars				12	16	12	16
Spacing				100	200	200	200
width				2000	2000	2000	2000
Area steel				2262	2011	1131	2011
Short span	2000	4000		271	246	271	246
				0.028002	0.024921	0.009334	0.02039
				0.967853	0.971498	0.989519	0.976807
				0.25745	0.2337	0.25745	0.2337
				0.001469	0.001187	0.00049	0.000971
				1469.05	1186.785	489.6833	971.0062
Use bars				16	12	12	12
Spacing				200	200	200	200
width				2000	2000	4000	4000
Area steel				2011	1131	2262	2262

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8.3.6 Beam strip below loadbearing spine;

GRIDLINE (H)

ADDITIONAL LOAD ON BEAM STRIP SPAN = 3.25

w = 0.225 x 18 * 5 + 6 (ⓒ + ⓒ)

= 28.7 + 30 = 58.7 (88.2) kN/m

SLAB = (10.2 + 2.5) x 6

= 61.2 + 15

TOTAL = 89.9 + 45 = 134.9 (197.9)

$M = \frac{wl^2}{8} = 261$ kNm

Beam strip = $\frac{3.25}{2}$ = 1.6m

k = 0.051 $\frac{z}{d}$ = 0.93 z = 0.264

As = 2265

USE 16's @ 100 c/c. = 3216 > 2265.

8.3.7 Raft slab long direction Gridline 8

W = 0.225 x 18 x 5 + 6(Ⓐ + Ⓒ) -

= 30.2 + 18.6 = 48.8

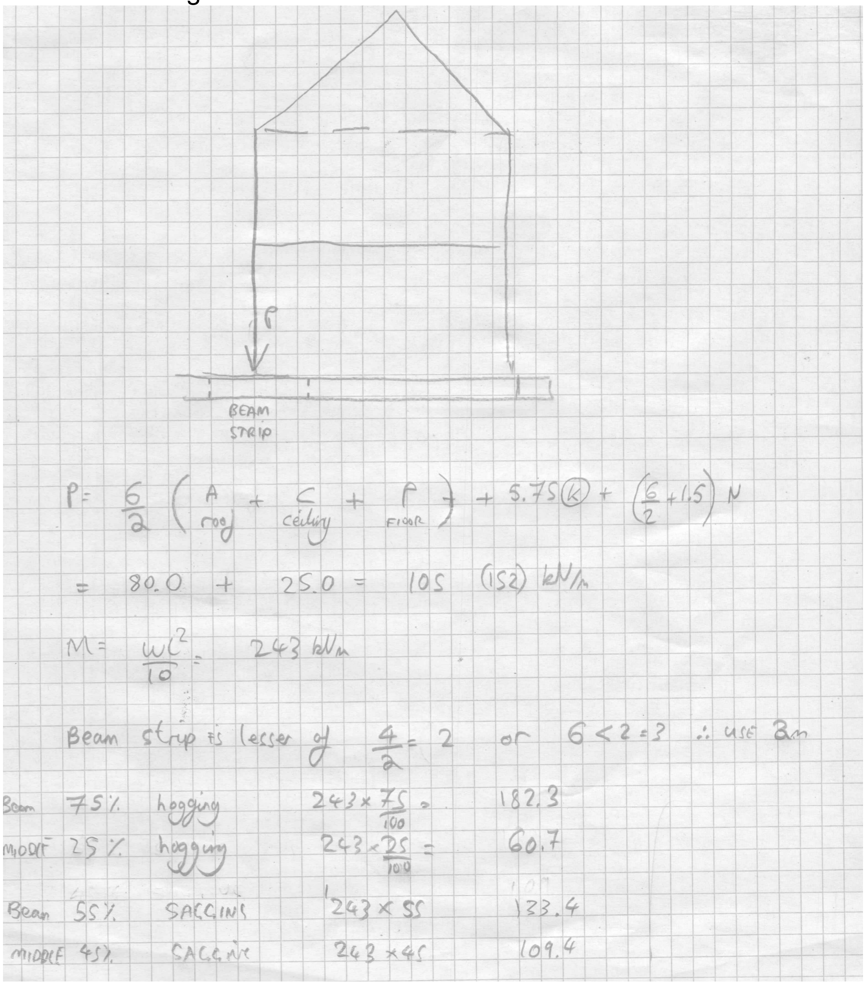
SLAB = 4 x SLAB) = 40.8 + 10

TOTAL LOAD = 71 + 28.6 = 99.6 (145.7)

$M = \frac{wL^2}{10} = 522$

			IL	1.6			
				Beam strip		Middle strip	
				Hogging	Sagging	Hogging	Sagging
Use Moment	Wl^2/8	8		75	55	25	45
	Long span	522		391.5	287.1	130.5	234.9
	Short span	219.36		164.52	120.648	54.84	98.712
Depth	325						
	Top cover	T1	T2	B2	B1	Bottom cover	
	30	16	16	16	16	50	
De		282	271	246	262		
concrete grade	40	N/mm^2					
steel grade	500	N/mm^2					
	Beam strip	Middlestrip					
Long span	2000	2000		282	262	282	262
k-M/bd^2fcu				0.061538026	0.052281	0.020513	0.042775
z/d=(0.5-(0.25-k/0.9)^0.5				0.926174161	0.938076	0.976664	0.949969
but not less 0.95							
z				0.261181113	0.245776	0.2679	0.248892
As=M/0.87 fy z				0.003445885	0.002685	0.00112	0.00217
				3445.884691	2685.373	1119.821	2169.617
Use bars				16	16	16	16
Spacing				100	100	200	100
width				2000	2000	2000	2000
Area steel				4021	4021	2011	4021
Short span	2000	4000		271	246	271	246
				0.02800207	0.024921	0.009334	0.02039
				0.967853171	0.971498	0.989519	0.976807
				0.25745	0.2337	0.25745	0.2337
				0.00146905	0.001187	0.00049	0.000971
				1469.049899	1186.785	489.6833	971.0062
Use bars				16	12	12	12
Spacing				200	200	200	200
width				2000	2000	4000	4000
Area steel				2011	1131	2262	2262

8.3.8 Raft slab loading Gridline 2

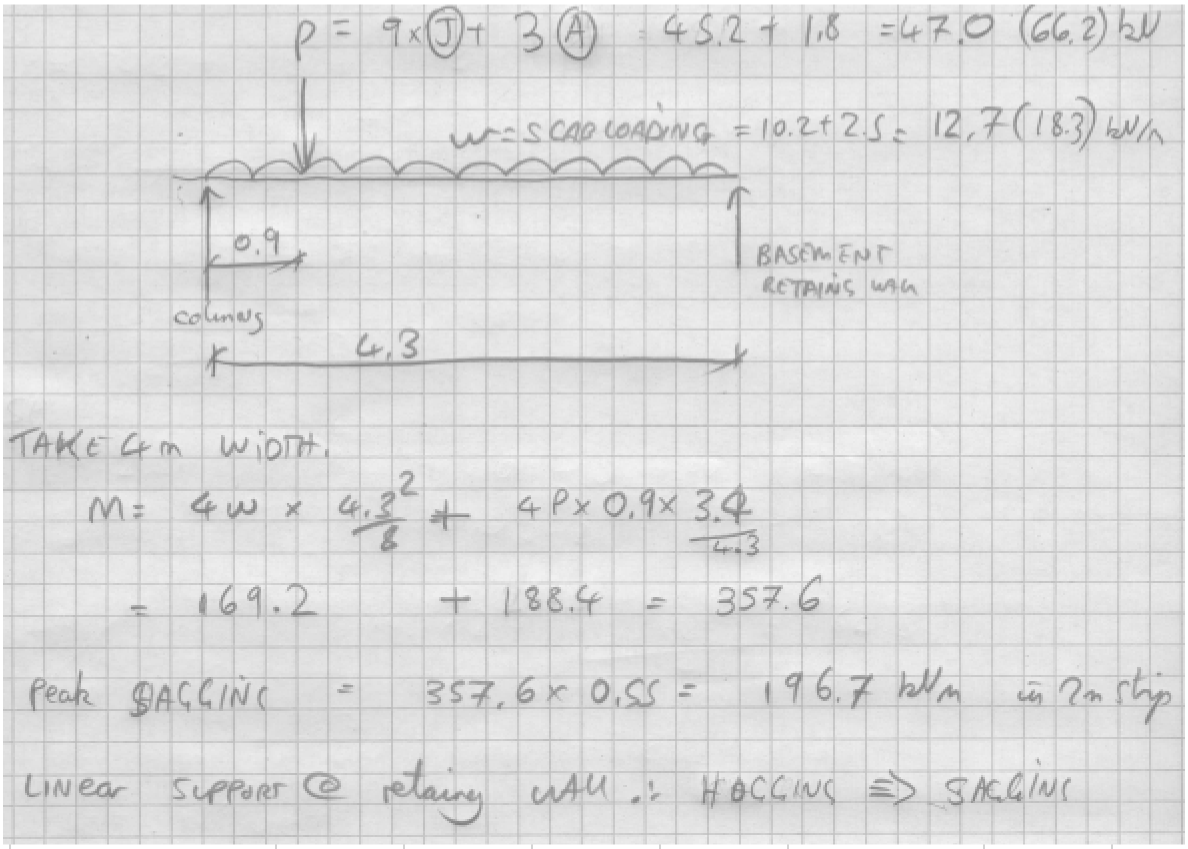


Span between piles 4m

span	4000	mm					
width	2000	mm			spacing	200	mm
depth	325	mm					
cover	30	mm			Area of /m	1005.31	mm^2 / m
bar depth	16	mm			Max Calculated	2.34E+08	
extra	5	mm			Max cpacity	**234.3**	kNm
deff	282	mm					
concrete grade	40	N/mm^2					
steel grade	500	N/mm^2					
span/ depth ratio	14.1844			simple	20		
Moment	183	kNm		cantilver	7		
				continous	27		
k-M/bd^2fcu	0.028765						
z/d=(0.5-(0.25-k/0.9)^0	0.966946						
but not less 0.95							
z	0.2679						
As=M/0.87 fy z	0.00157						
	1570.323	**1570**	mm^2				
Use bars	16		Area	201.0619			
Spacing	200	OR	Number	0			
Area steel	2010.619						

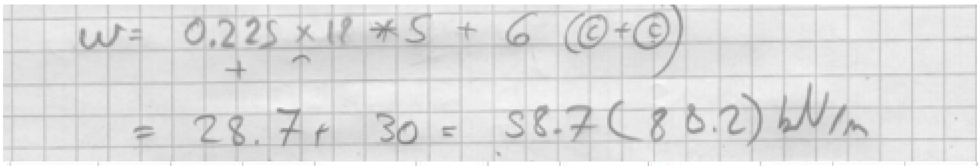
182.3	1570	H16 at 200	2010
60.7	520	H12 200 centres	1130
133.4	1141	H12 198 centres	1142
109.4	935	H12 200 centres	1130

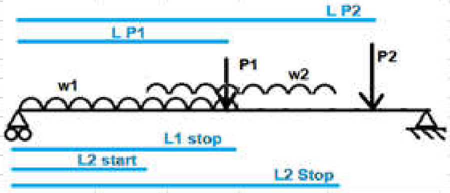
8.3.9 Transfer section of slab Gridline 6



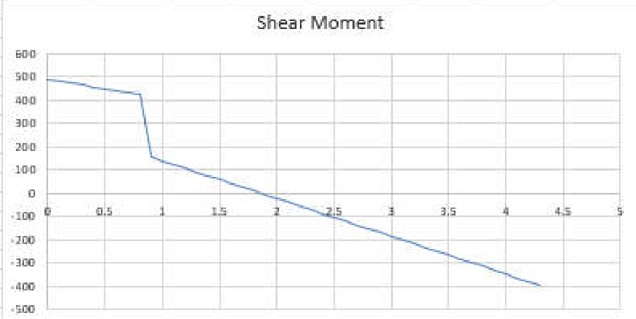
span	4300	mm					
width	2000	mm			spacing	200	mm
depth	325	mm					
cover	30	mm			Area of /m	1005.31	mm^2 / m
bar depth	16	mm			Max Calculated	2.25E+08	
extra	5	mm			Max cpacity	**225.2**	kNm
deff	271	mm					
concrete grade	40	N/mm^2					
steel grade	500	N/mm^2					
span/ depth ratio	15.86716			simple	20		
Moment	196.7	kNm		cantilver	7		
				continous	27		
k-M/bd^2fcu	0.033479						
z/d=(0.5-(0.25-k/0.9)^0	0.961303						
but not less 0.95							
z	0.25745						
As=M/0.87 fy z	0.001756						
	1756.395	**1756**	mm^2				
Use bars	16		Area	201.0619			
Spacing	200	OR	Number	0			
Area steel	2010.619						

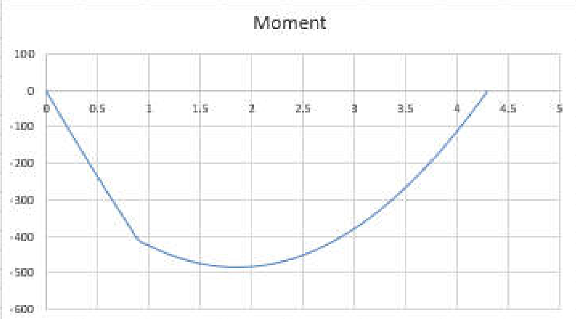
Local to loadbearing spine





	Span	4.3														
		UDL 1	UDL 2	UDL 3	UDL 4		Point 1	Point 2	Point 3	Point 4		Total				
	DL	**41.80**	**28.70**	**0.00**	**0.00**		**180.8**	**0**	**0**	**0**						
	IL	**10.00**	**30.00**	**0.00**	**0.00**		**7.2**	**0**	**0**	**0**						
	SLS	51.8	58.7	0	0		188	0	0	0						
	ULS	74.52	88.18	0	0		264.64	0	0	0						
Distance R1	start L1	**0**	**0.9**	**0**	**0**											
	stop L2	**4.3**	**4.3**	**0**	**0**											
	L3						**0.9**	**0**	**0**	**0**						
Total Load	DL	179.74	97.58	0	0		180.8	0	0	0						
	IL	43	102	0	0		7.2	0	0	0						
R1	DL	89.87	38.57814	0	0		142.95814	0	0	0		271.4063	67.5186	338.9249	487.9986	
	IL	21.5	40.32558	0	0		5.69302326	0	0	0		**271.4**	**67.5**	**338.9**	**488**	kN
R2	DL	89.87	59.00186	0	0		37.8418605	0	0	0		186.7137	84.6814	271.3951	396.8894	
	IL	21.5	61.67442	0	0		1.50697674	0	0	0		**186.7**	**84.7**	**271.4**	**396.9**	kN

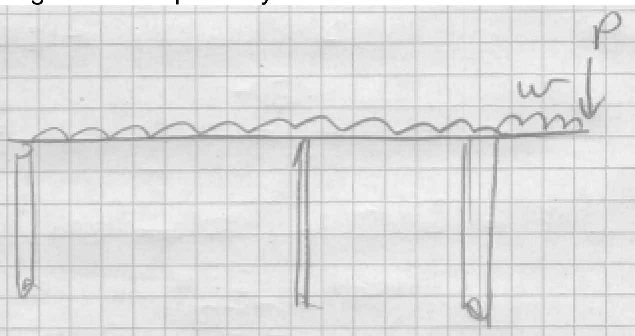




Shear Max at V= 0 at	1.9	m	Peak Moment	-484.0 kNm

span/ depth ratio	15.86716		simple	20
Moment	266.2	kNm	cantilver	7
			continous	27
k-M/bd^2fcu	0.045308			
z/d=(0.5-(0.25-k/0.9)^0	0.94683			
but not less 0.95				
z	0.256591			
As=M/0.87 fy z	0.002385			
	2384.94	**2385** mm^2		
Use bars	16		Area	201.0619
Spacing	100	OR	Number	0
Area steel	4021.239			

8.3.10 Cantilevering section of pathway



$P = 2.5 \times 0.225 \times 18 = 10.1 + 0 = 10.1\ (14.1)\ kN$

$w \qquad 10.2 + 2.5 = 12.7\ (18.3)$

$M/\text{meter run} = 14.1 \times 2 + \frac{18.3 \times 2^2}{2} = 64.8$

Beam strip 2m wide supporting 4m hogging

$M = 129.6\ kNm$

$d = 0.271$

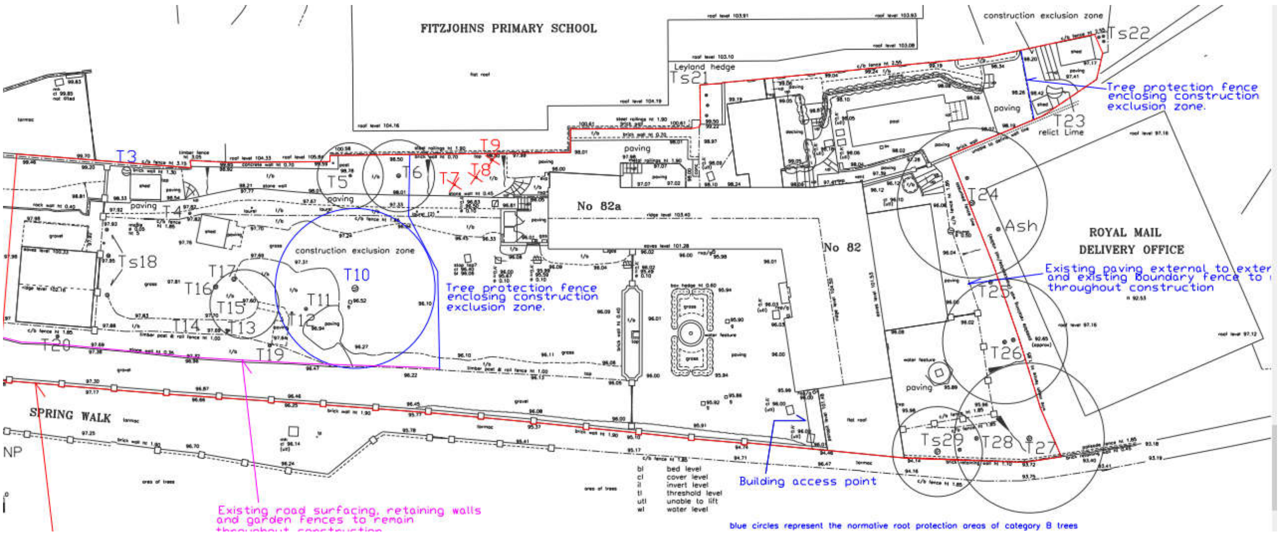
$k = 0.022$

$z = 0.95d = 0.257$

$A_s = \frac{129.6 \times 10^3}{0.257 \times 500 \times 10^6 \times 0.87} = 1159\ mm^2 = 579\ mm^2/m$

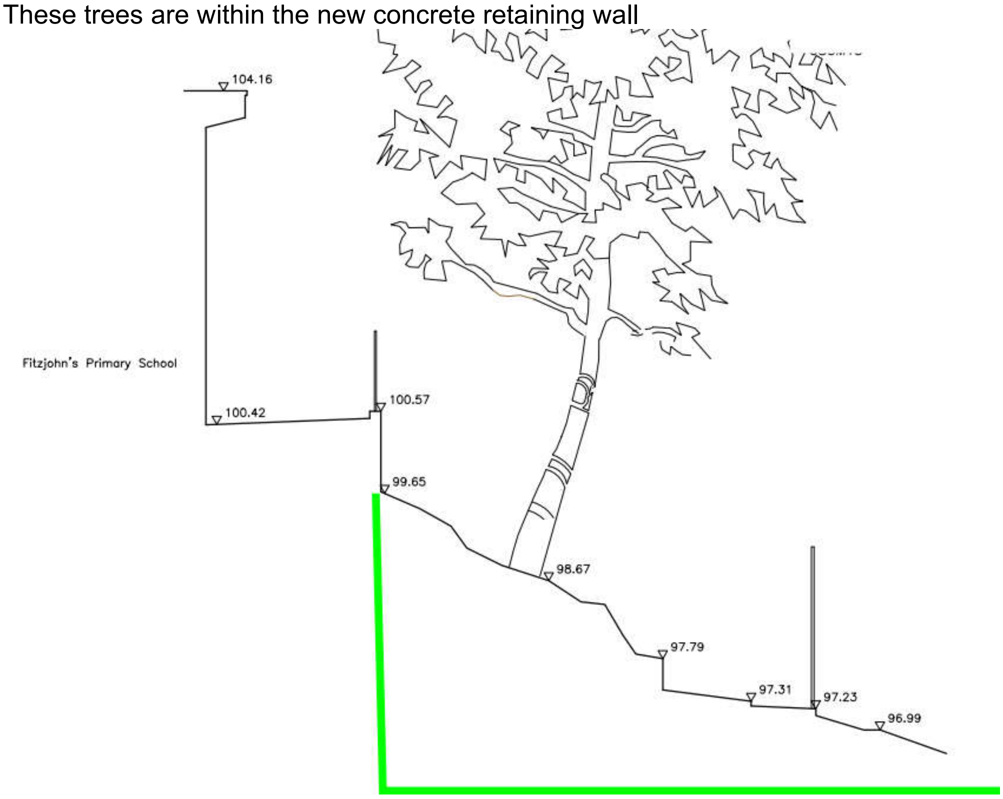
9.0d Effect of tree removal on shallow foundations

9.1d Arboriculture Plan



There are 2 Locations where groups of trees are being removed:
T7, T8 and T9 – located within the footprint of the new extension (9.2)
T24 T25 and T26 - Located too close to the new basement extension (9.3)

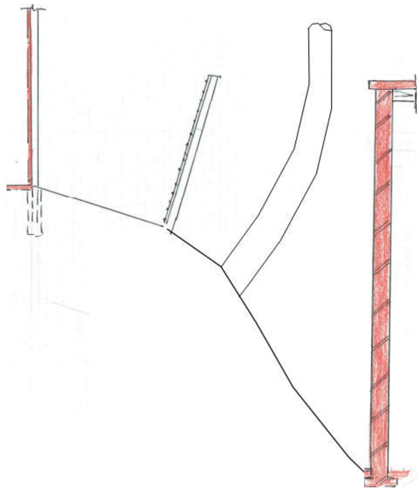
9.2d Tree removal T7, T8, T9
These trees are within the new concrete retaining wall



The new building will be founded on a piled raft and therefore designed to be resistant to the effects of these tree removals.

The single storey Fitzjohn's primary school building is approximately 1.8m below the level of the base of the tree any effect of heave is likely to be damped by the significant height difference,
The ground movement assessment is predicting settlement in this location and therefore any subsequent heave is likely to have a positive effect to reduce any movement within the building.

9.3d Tree Removal T24, T25, T26



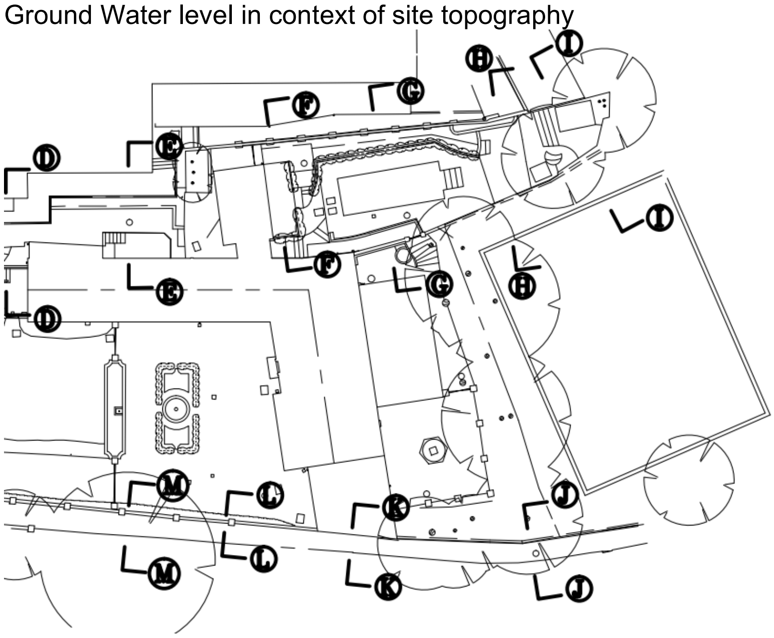
The new building and boundary wall will be founded on the piled raft and therefore the effect of heave form the tree removal will be resisted.

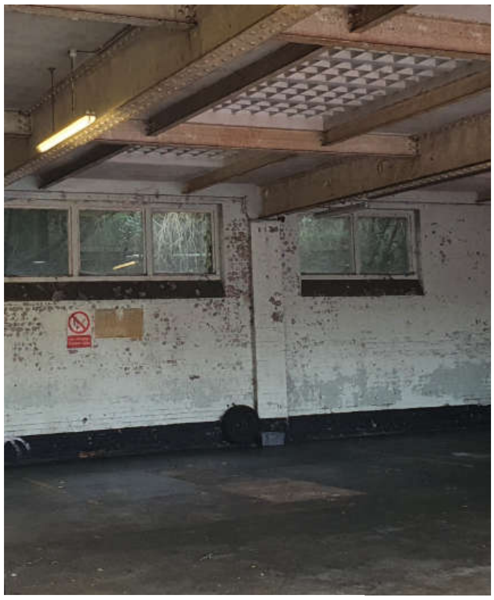
The localised section of the boundary wall is being underpinned to a depth of approximately 3.5m and therefore below the effects of the tree roots.

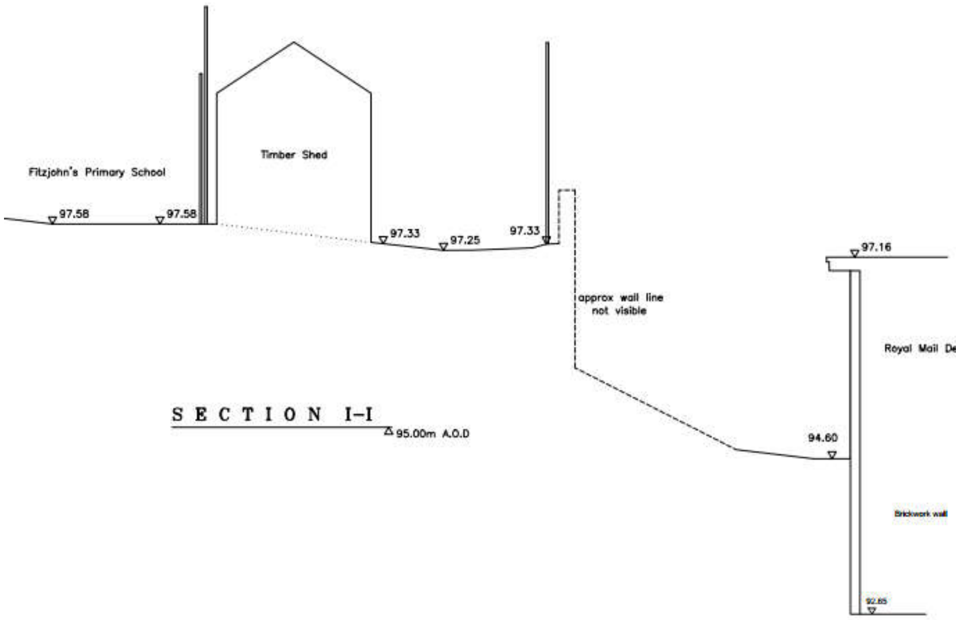
The post office building is a single storey building of masonry construction with likely shallow foundations but those foundations are approximately 2.5-3.0m below the level of the tree. The angle of the trunk and the steep banks suggests the water gathering roots extend away form the neighbours building. Any effects of heave on this building should be minor and the risk of long term settlement or damage from these trees collapsing as a result of high winds far more likely and catastrophic.

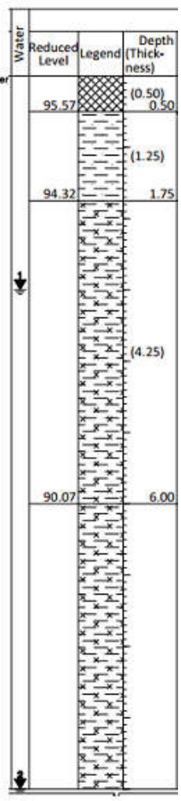
10.0e Ground Water Management

10.1e Ground Water level in context of site topography



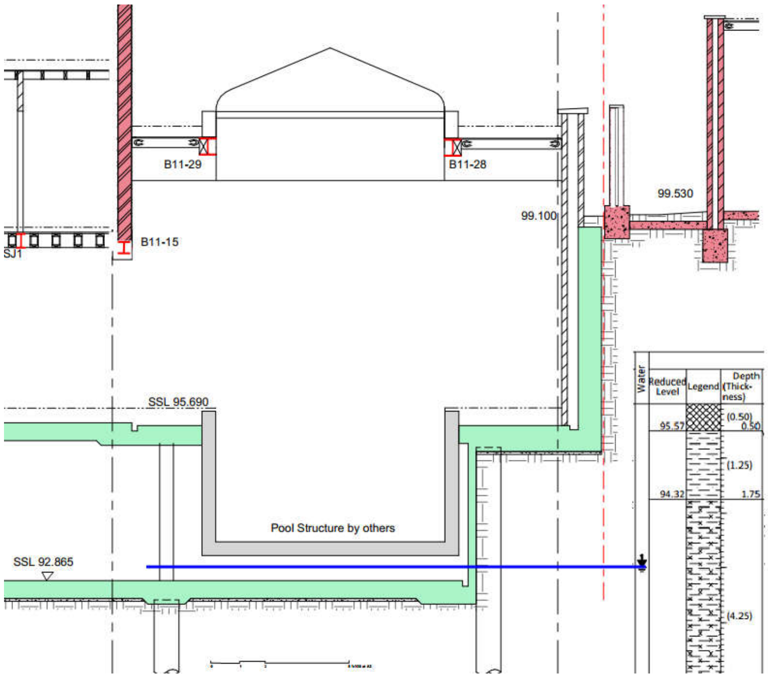






No evidence of water ingress through this brickworkwall.

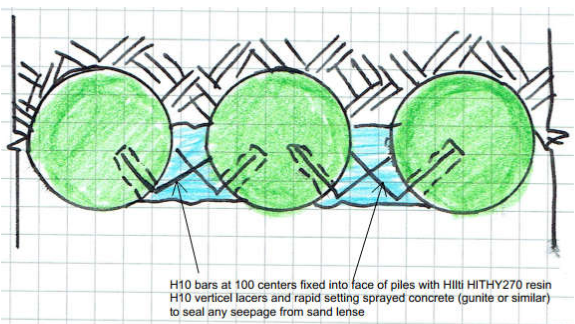
10.2e Ground water encountered at a depth of 3m at 93.070m
The formation level of the 92.490m



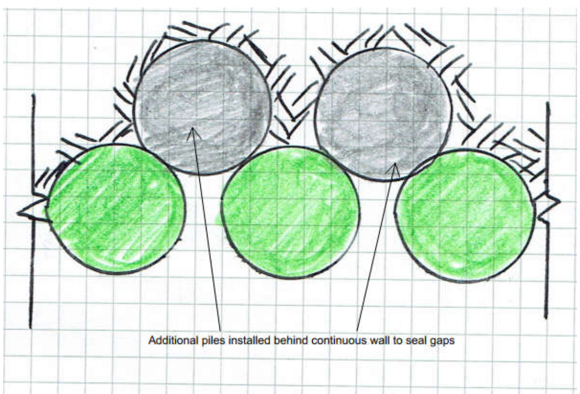
The ground water is likely to be seepage over 500mm this will be managed with local submersible electric pumps within an excavated sump.

10.3 Water Management Strategy.

Level	Ground Condition	Strategy	Risk	Loss Fines
1	Water encountered at the bottom of excavation as low seepage	Local sump within contiguous piled wall and electric pump.	High/likely	If fines are being washed out then the local face should be reinforced with sprayed concrete and reinforcing mesh as per level 2
2	Local sand lenses	Increased water flow Mesh to be installed across lens and sprayed concrete to plug he gap	Medium to Low	Low
3	Large inflows due to sand lenses	Allow for additional piles behind the contiguous wall to plug the soil from the retained side of the wall	Low	Minimal



Level 2 – localised sprayed concrete



Level 3 – Localised intermediate piles